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Junos<sup>®</sup> OS

# Security Services Administration Guide for Routing Devices

Release

14.1



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Juniper Networks, Inc.  
1194 North Mathilda Avenue  
Sunnyvale, California 94089  
USA  
408-745-2000  
[www.juniper.net](http://www.juniper.net)

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*Junos<sup>®</sup> OS Security Services Administration Guide for Routing Devices*

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# Table of Contents

|                  |   |           |
|------------------|---|-----------|
|                  | About the Documentation . . . . .   | xvii      |
|                  | Documentation and Release Notes . . . . .   | xvii      |
|                  | Supported Platforms . . . . .   | xvii      |
|                  | Using the Examples in This Manual . . . . .   | xvii      |
|                  | Merging a Full Example . . . . .  | xviii     |
|                  | Merging a Snippet . . . . .   | xviii     |
|                  | Documentation Conventions . . . . .   | xix       |
|                  | Documentation Feedback . . . . .  | xxi       |
|                  | Requesting Technical Support . . . . .  | xxi       |
|                  | Self-Help Online Tools and Resources . . . . .  | xxi       |
|                  | Opening a Case with JTAC . . . . .  | xxii      |
| <b>Part 1</b>    | <b>SSH and SSL</b>  |           |
| <b>Chapter 1</b> | <b>Configuring SSH and SSL for Secure Access to the Router . . . . .</b>                      | <b>3</b>  |
|                  | Configuring SSH Host Keys for Secure Copying of Data . . . . .                                | 3         |
|                  | Configuring SSH Known Hosts . . . . .   | 3         |
|                  | Configuring Support for SCP File Transfer . . . . .   | 4         |
|                  | Updating SSH Host Key Information . . . . .   | 4         |
|                  | Retrieving Host Key Information Manually . . . . .  | 5         |
|                  | Importing Host Key Information from a File . . . . .  | 5         |
|                  | Importing SSL Certificates for Junos XML Protocol Support . . . . .                           | 5         |
| <b>Part 2</b>    | <b>Digital Certificates</b>   |           |
| <b>Chapter 2</b> | <b>Understanding How Digital Certificates Can Be Used to Authenticate Users . . . . .</b>     | <b>9</b>  |
|                  | Digital Certificates Overview . . . . .   | 9         |
| <b>Chapter 3</b> | <b>Configuring Digital Certificates . . . . .</b>   | <b>11</b> |
|                  | Configuration Statements for Setting Up Digital Certificates for an ES PIC . . . . .          | 11        |
|                  | Obtaining a Certificate from a Certificate Authority for an ES PIC . . . . .                  | 12        |
|                  | Requesting a CA Digital Certificate for an ES PIC on an M Series or T Series Router . . . . . | 13        |
|                  | Example: Requesting a CA Digital Certificate . . . . .  | 13        |
|                  | Generating a Private and Public Key Pair for Digital Certificates for an ES PIC . . . . .     | 13        |
|                  | Obtaining a Signed Certificate from the CA for an ES PIC . . . . .                            | 14        |
|                  | Configuring Digital Certificates for an ES PIC . . . . .                                      | 15        |
|                  | Configuring the Certificate Authority Properties for an ES PIC . . . . .                      | 16        |
|                  | Specifying the Certificate Authority Name . . . . .   | 16        |
|                  | Configuring the Certificate Revocation List . . . . .   | 16        |
|                  | Configuring the Type of Encoding Your CA Supports . . . . .                                   | 17        |

|   |    |
|---|----|
| Specifying an Enrollment URL . . . . .  | 17 |
| Specifying a File to Read the Digital Certificate . . . . .   | 17 |
| Specifying an LDAP URL . . . . .  | 17 |
| Configuring the Cache Size . . . . .  | 18 |
| Configuring the Negative Cache . . . . .  | 18 |
| Configuring the Number of Enrollment Retries . . . . .  | 18 |
| Configuring the Maximum Number of Peer Certificates . . . . .   | 19 |
| Configuring the Path Length for the Certificate Hierarchy . . . . .   | 19 |
| Configuring an IKE Policy for Digital Certificates for an ES PIC . . . . .  | 19 |
| Configuring the Type of Encoding Your CA Supports . . . . .   | 20 |
| Configuring the Identity to Define the Remote Certificate Name . . . . .  | 20 |
| Specifying the Certificate Filename . . . . .   | 20 |
| Specifying the Private and Public Key File . . . . .  | 20 |
| Associating the Configured Security Association with a Logical Interface . . . . .  | 21 |
| Configuring Digital Certificates for Adaptive Services Interfaces . . . . .   | 21 |
| Configuring the Certificate Authority Properties . . . . .  | 23 |
| Specifying the CA Profile Name . . . . .  | 23 |
| Specifying an Enrollment URL . . . . .  | 23 |
| Specifying the Enrollment Properties . . . . .  | 24 |
| Configuring the Certificate Revocation List . . . . .   | 24 |
| Specifying an LDAP URL . . . . .  | 24 |
| Configuring the Interval Between CRL Updates . . . . .  | 25 |
| Overriding Certificate Verification if CRL Download Fails . . . . .   | 25 |
| Managing Digital Certificates . . . . .   | 25 |
| Requesting a CA Digital Certificate for AS and Multiservices PICs<br>installed on M Series and T Series Routers . . . . . | 26 |
| Generating a Public/Private Key Pair . . . . .  | 26 |
| Generating and Enrolling a Local Digital Certificate . . . . .  | 26 |
| Configuring the Auto-Reenrollment Properties for Automatic Renewal of<br>the Router Certificate from the CA . . . . .     | 27 |
| Specify the Certificate ID . . . . .  | 29 |
| Specify the CA Profile . . . . .  | 29 |
| Specify the Challenge Password . . . . .  | 29 |
| Specify the Reenroll Trigger Time . . . . .   | 29 |
| Specify the Regenerate Key Pair . . . . .   | 29 |
| Specify the Validity Period . . . . .   | 30 |
| Configuring the Auto-Reenrollment Properties for Automatic Renewal of the<br>Router Certificate from the CA . . . . .     | 30 |
| Specify the Certificate ID . . . . .  | 31 |
| Specify the CA Profile . . . . .  | 31 |
| Specify the Challenge Password . . . . .  | 32 |
| Specify the Reenroll Trigger Time . . . . .   | 32 |
| Specify the Regenerate Key Pair . . . . .   | 32 |
| Specify the Validity Period . . . . .   | 32 |

|                  |   |           |
|------------------|---|-----------|
| <b>Part 3</b>    | <b>Distributed Denial-of-Service (DDoS) Protection</b>                                    |           |
| <b>Chapter 4</b> | <b>DDoS Overview</b>  | <b>35</b> |
|                  | Distributed Denial-of-Service (DDoS) Protection Overview                                  | 35        |
|                  | Policer Types and Packet Priorities   | 36        |
|                  | Example of Policer Priority Behavior  | 36        |
|                  | Policer Hierarchy   | 37        |
|                  | Example of Policer Bandwidth Limit Behavior   | 39        |
| <b>Chapter 5</b> | <b>Configuring DDoS Protection</b>  | <b>41</b> |
|                  | Configuring Protection Against DDoS Attacks   | 41        |
|                  | Example: Configuring DDoS Protection  | 42        |
|                  | Configuring DDoS Protection Policers for Individual Packet Types                          | 51        |
|                  | Disabling DDoS Protection Policers and Logging Globally                                   | 55        |
|                  | Tracing DDoS Protection Operations  | 56        |
|                  | Configuring the DDoS Protection Trace Log Filename  | 57        |
|                  | Configuring the Number and Size of DDoS Protection Log Files                              | 57        |
|                  | Configuring Access to the DDoS Protection Log File  | 58        |
|                  | Configuring a Regular Expression for DDoS Protection Messages to Be<br>Logged             | 58        |
|                  | Configuring the DDoS Protection Tracing Flags   | 59        |
|                  | Configuring the Severity Level to Filter Which DDoS Protection Messages Are<br>Logged     | 59        |
|                  | Verifying and Managing DDoS Protection  | 59        |
| <b>Chapter 6</b> | <b>Configuring Flow Detection for DDoS Protection</b>                                     | <b>61</b> |
|                  | DDoS Protection Flow Detection Overview   | 62        |
|                  | Flow Detection and Control  | 62        |
|                  | Flow Tracking   | 63        |
|                  | Notifications   | 63        |
|                  | Configuring Flow Detection for DDoS Protection  | 65        |
|                  | Enabling Flow Detection for All Protocol Groups and Packet Types                          | 66        |
|                  | Configuring the Culprit Flow Reporting Rate for All Protocol Groups and Packet<br>Types   | 66        |
|                  | Configuring the Violation Reporting Rate for All Protocol Groups and Packet<br>Types      | 67        |
|                  | Configuring the Detection Period for Suspicious Flows                                     | 67        |
|                  | Configuring the Recovery Period for a Culprit Flow  | 68        |
|                  | Configuring the Timeout Period for a Culprit Flow   | 68        |
|                  | Configuring Flow Detection for Individual Protocol Groups or Packets                      | 69        |
|                  | Configuring How Flow Detection Operates at Each Flow Aggregation Level                    | 69        |
|                  | Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level                     | 71        |
|                  | Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation<br>Level | 71        |
|                  | Disabling Automatic Logging of Culprit Flow Events for a Packet Type                      | 73        |
|                  | Verifying and Managing Flow Detection   | 73        |

|                   |  |           |
|-------------------|--|-----------|
| <b>Part 4</b>     | <b>IPsec</b>   |           |
| <b>Chapter 7</b>  | <b>Understanding How IPsec Secures Network Traffic</b>                 | <b>77</b> |
|                   | IPsec Overview   | 77        |
|                   | Authentication Algorithms  | 78        |
|                   | Encryption Algorithms  | 79        |
|                   | IPsec Protocols  | 80        |
|                   | IPsec Security Associations  | 82        |
|                   | IPsec Modes  | 83        |
|                   | IKE Key Management Protocol Overview                                   | 84        |
|                   | Digital Certificates   | 85        |
|                   | Service Sets for IPsec Tunnels   | 86        |
|                   | IPsec Terms and Acronyms   | 87        |
| <b>Chapter 8</b>  | <b>IPsec System Requirements</b>                                       | <b>91</b> |
|                   | IPsec System Requirements  | 91        |
|                   | IPsec System Requirements for Junos-FIPS                               | 92        |
|                   | IPsec-Enabled Line Cards   | 92        |
| <b>Chapter 9</b>  | <b>IPsec Configuration Guidelines</b>                                  | <b>95</b> |
|                   | Considering General IPsec Issues                                       | 95        |
| <b>Chapter 10</b> | <b>Configuring IPsec Security Associations</b>                         | <b>99</b> |
|                   | Configuring Security Associations                                      | 99        |
|                   | Configuring Manual SAs   | 99        |
|                   | Example: AS PIC Manual SA Configuration                                | 101       |
|                   | Verifying Your Work  | 106       |
|                   | Router 1   | 107       |
|                   | Router 2   | 107       |
|                   | Router 3   | 108       |
|                   | Example: ES PIC Manual SA Configuration                                | 109       |
|                   | Verifying Your Work  | 115       |
|                   | Router 1   | 115       |
|                   | Router 2   | 115       |
|                   | Router 3   | 116       |
|                   | Router 4   | 117       |
|                   | Configuring IKE Dynamic SAs  | 117       |
|                   | Example: AS PIC IKE Dynamic SA Configuration                           | 121       |
|                   | Verifying Your Work  | 126       |
|                   | Router 1   | 127       |
|                   | Router 2   | 127       |
|                   | Router 3   | 128       |
|                   | Router 4   | 129       |
|                   | Example: AS PIC IKE Dynamic SA with Digital Certificates Configuration | 129       |
|                   | Verifying Your Work  | 139       |
|                   | Router 1   | 139       |
|                   | Router 2   | 140       |
|                   | Router 3   | 143       |
|                   | Router 4   | 146       |

|                   |   |            |
|-------------------|---|------------|
|                   | Example: ES PIC IKE Dynamic SA Configuration . . . . .                          | 147        |
|                   | Verifying Your Work . . . . .   | 154        |
|                   | Router 1 . . . . .  | 154        |
|                   | Router 2 . . . . .  | 155        |
|                   | Router 3 . . . . .  | 156        |
|                   | Router 4 . . . . .  | 157        |
|                   | Example: IKE Dynamic SA Between an AS PIC and an ES PIC Configuration . . .     | 158        |
|                   | Verifying Your Work . . . . .   | 164        |
|                   | Router 1 . . . . .  | 165        |
|                   | Router 2 . . . . .  | 165        |
|                   | Router 3 . . . . .  | 167        |
|                   | Router 4 . . . . .  | 168        |
|                   | Configuring Multiple Routed Tunnels in a Single Next-Hop Service Set . . . . .  | 168        |
| <b>Chapter 11</b> | <b>Configuring IPsec on an ES PIC . . . . .</b>                                 | <b>171</b> |
|                   | IPsec Configuration for an ES PIC Overview . . . . .                            | 171        |
|                   | Configuring Minimum Manual Security Associations for IPsec on an ES PIC . . .   | 172        |
|                   | Configuring Minimum IKE Requirements for IPsec on an ES PIC . . . . .           | 172        |
|                   | Configuring Minimum Digital Certificate Requirements for IKE on an ES PIC . . . | 172        |
|                   | Configuring Security Associations for IPsec on an ES PIC . . . . .              | 173        |
|                   | Configuring the Description for an SA . . . . .                                 | 174        |
|                   | Configuring IPsec Transport Mode . . . . .                                      | 174        |
|                   | Configuring IPsec Tunnel Mode . . . . .   | 175        |
|                   | Configuring Manual IPsec Security Associations for an ES PIC . . . . .          | 175        |
|                   | Configuring the Processing Direction . . . . .                                  | 176        |
|                   | Configuring the Protocol for a Manual SA . . . . .                              | 177        |
|                   | Configuring the Security Parameter Index . . . . .                              | 177        |
|                   | Configuring the Auxiliary Security Parameter Index . . . . .                    | 178        |
|                   | Configuring the Authentication Algorithm and Key . . . . .                      | 178        |
|                   | Configuring the Encryption Algorithm and Key . . . . .                          | 179        |
|                   | Configuring Dynamic IPsec Security Associations . . . . .                       | 179        |
|                   | Enabling Dynamic IPsec Security Associations . . . . .                          | 180        |
|                   | Configuring Manual IPsec Security Associations for an ES PIC . . . . .          | 180        |
|                   | Configuring the Processing Direction . . . . .                                  | 181        |
|                   | Configuring the Protocol for a Manual SA . . . . .                              | 182        |
|                   | Configuring the Security Parameter Index . . . . .                              | 182        |
|                   | Configuring the Auxiliary Security Parameter Index . . . . .                    | 182        |
|                   | Configuring the Authentication Algorithm and Key . . . . .                      | 183        |
|                   | Configuring the Encryption Algorithm and Key . . . . .                          | 183        |
|                   | Configuring Dynamic IPsec Security Associations . . . . .                       | 184        |
|                   | Configuring an IKE Proposal for Dynamic SAs . . . . .                           | 185        |
|                   | Configuring the Authentication Algorithm for an IKE Proposal . . . . .          | 185        |
|                   | Configuring the Authentication Method for an IKE Proposal . . . . .             | 185        |
|                   | Configuring the Description for an IKE Proposal . . . . .                       | 186        |
|                   | Configuring the Diffie-Hellman Group for an IKE Proposal . . . . .              | 186        |
|                   | Configuring the Encryption Algorithm for an IKE Proposal . . . . .              | 186        |
|                   | Configuring the Lifetime for an IKE SA . . . . .                                | 187        |
|                   | Example: Configuring an IKE Proposal . . . . .                                  | 187        |

|                   |   |            |
|-------------------|---|------------|
|                   | Configuring an IKE Policy for Preshared Keys . . . . .  | 187        |
|                   | Configuring the Description for an IKE Policy . . . . .   | 188        |
|                   | Configuring the Mode for an IKE Policy . . . . .  | 188        |
|                   | Configuring the Preshared Key for an IKE Policy . . . . .                                       | 188        |
|                   | Associating Proposals with an IKE Policy . . . . .  | 189        |
|                   | Example: Configuring an IKE Policy . . . . .  | 189        |
|                   | Configuring an IPsec Proposal for an ES PIC . . . . .   | 190        |
|                   | Configuring the Authentication Algorithm for an IPsec Proposal . . . . .                        | 190        |
|                   | Configuring the Description for an IPsec Proposal . . . . .                                     | 191        |
|                   | Configuring the Encryption Algorithm for an IPsec Proposal . . . . .                            | 191        |
|                   | Configuring the Lifetime for an IPsec SA . . . . .  | 191        |
|                   | Configuring the Protocol for a Dynamic IPsec SA . . . . .                                       | 192        |
|                   | Configuring the IPsec Policy for an ES PIC . . . . .  | 192        |
|                   | Configuring Perfect Forward Secrecy . . . . .   | 193        |
|                   | Example: Configuring an IPsec Policy . . . . .  | 193        |
|                   | Configuring Internal IPsec for Junos-FIPS . . . . .   | 194        |
|                   | Configuring the SA Direction . . . . .  | 195        |
|                   | Configuring the IPsec SPI . . . . .   | 195        |
|                   | Configuring the IPsec Key . . . . .   | 196        |
|                   | Example: Configuring Internal IPsec . . . . .   | 196        |
| <b>Chapter 12</b> | <b>Configuring Traffic Filters to Direct Traffic Through the Desired IPsec Tunnel . . . . .</b> | <b>197</b> |
|                   | IPsec Tunnel Traffic Configuration Overview . . . . .   | 197        |
|                   | Using a Filter to Select Traffic to Be Secured . . . . .  | 199        |
|                   | Applying the Filter or Service Set to the Interface Receiving Traffic to Be Secured . . . . .   | 201        |
|                   | Using Filter-Based Forwarding to Select Traffic to Be Secured . . . . .                         | 201        |
|                   | Example: Configuring an Outbound Traffic Filter . . . . .                                       | 202        |
|                   | Example: Applying an Outbound Traffic Filter . . . . .  | 203        |
|                   | Example: Configuring an Inbound Traffic Filter for a Policy Check . . . . .                     | 204        |
|                   | Example: Applying an Inbound Traffic Filter to an ES PIC for a Policy Check . . . . .           | 204        |
| <b>Chapter 13</b> | <b>Configuring IPsec Dynamic Endpoints . . . . .</b>  | <b>207</b> |
|                   | Configuring IPsec Dynamic Endpoints . . . . .   | 207        |
|                   | IPsec Dynamic Endpoint Tunnel Architecture . . . . .  | 208        |
|                   | Authentication Process . . . . .  | 208        |
|                   | Dynamic Implicit Rules . . . . .  | 209        |
|                   | Reverse Route Insertion . . . . .   | 209        |
|                   | Configuring an IKE Access Profile for IPsec Dynamic Endpoint Tunnels . . . . .                  | 210        |
|                   | Configuring the Service Set for IPsec Dynamic Endpoint Tunnels . . . . .                        | 211        |
|                   | Configuring the Interface Identifier for IPsec Dynamic Endpoint Tunnels . . . . .               | 211        |
|                   | Example: Configuring IPsec Dynamic Endpoint Tunneling . . . . .                                 | 212        |
|                   | Verifying Your Work . . . . .   | 213        |
| <b>Chapter 14</b> | <b>Configuring Digital Certificates for IPsec . . . . .</b>                                     | <b>215</b> |
|                   | Using Digital Certificates for IPsec . . . . .  | 215        |
|                   | Configuring a CA Profile . . . . .  | 216        |
|                   | Configuring a Certificate Revocation List . . . . .   | 216        |
|                   | Requesting a CA Digital Certificate . . . . .   | 217        |



|                   |  |            |
|-------------------|--|------------|
|                   | Generating a Private/Public Key Pair . . . . .                                   | 217        |
|                   | Generating and Enrolling a Local Digital Certificate . . . . .                   | 218        |
|                   | Applying the Local Digital Certificate to an IPsec Configuration . . . . .       | 218        |
|                   | Configuring Automatic Reenrollment of Digital Certificates . . . . .             | 218        |
|                   | Monitoring Digital Certificates . . . . .  | 219        |
|                   | Clearing Digital Certificates . . . . .  | 219        |
| <b>Chapter 15</b> | <b>Securing Layer 3 Protocol Traffic with IPsec Transport Mode . . . . .</b>     | <b>221</b> |
|                   | Securing BGP Sessions with IPsec Transport Mode . . . . .                        | 221        |
|                   | Securing OSPFv2 Networks with IPsec Transport Mode . . . . .                     | 221        |
|                   | Securing OSPFv3 Networks with IPsec Transport Mode . . . . .                     | 223        |
| <b>Chapter 16</b> | <b>Using IPsec with a Layer 3 VPN . . . . .</b>                                  | <b>225</b> |
|                   | Using IPsec with a Layer 3 VPN . . . . .   | 225        |
|                   | ES Tunnel Interface Configuration for a Layer 3 VPN . . . . .                    | 227        |
| <b>Part 5</b>     | <b>Monitoring and Troubleshooting Information</b>                                |            |
| <b>Chapter 17</b> | <b>Tracing Security Services Operations for Troubleshooting Purposes . . . .</b> | <b>231</b> |
|                   | Configuring Tracing Operations for Security Services . . . . .                   | 231        |
|                   | Configuring Tracing Operations for IPsec Events for Adaptive Services PICs . . . | 232        |
| <b>Chapter 18</b> | <b>Monitoring IPsec Traffic . . . . .</b>  | <b>233</b> |
|                   | Monitoring IPsec by Using SNMP . . . . .   | 233        |
| <b>Part 6</b>     | <b>Configuration Statements and Operational Commands</b>                         |            |
| <b>Chapter 19</b> | <b>Configuration Statements: DDoS . . . . .</b>                                  | <b>237</b> |
|                   | [edit system ddos-protection] Hierarchy Level . . . . .                          | 238        |
|                   | bandwidth (DDoS) . . . . .   | 239        |
|                   | bandwidth-scale (DDoS) . . . . .   | 240        |
|                   | burst (DDoS) . . . . .   | 240        |
|                   | burst-scale (DDoS) . . . . .   | 241        |
|                   | bypass-aggregate (DDoS) . . . . .  | 241        |
|                   | ddos-protection (DDoS) . . . . .   | 242        |
|                   | disable-fpc (DDoS) . . . . .   | 243        |
|                   | disable-logging (DDoS) . . . . .   | 244        |
|                   | disable-routing-engine (DDoS) . . . . .  | 244        |
|                   | flow-detection (DDoS Flow Detection) . . . . .                                   | 245        |
|                   | flow-detection (DDoS Packet Level) . . . . .                                     | 246        |
|                   | flow-detection-mode (DDoS Flow Detection) . . . . .                              | 247        |
|                   | flow-detect-time (DDoS Flow Detection) . . . . .                                 | 248        |
|                   | flow-level-bandwidth (DDoS Flow Detection) . . . . .                             | 249        |
|                   | flow-level-control (DDoS Flow Detection) . . . . .                               | 249        |
|                   | flow-level-detection (DDoS Flow Detection) . . . . .                             | 250        |
|                   | flow-recover-time (DDoS Flow Detection) . . . . .                                | 251        |
|                   | flow-report-rate (DDoS Flow Detection) . . . . .                                 | 251        |
|                   | flow-timeout-time (DDoS Flow Detection) . . . . .                                | 252        |
|                   | fpc (DDoS) . . . . .   | 252        |
|                   | global (DDoS) . . . . .  | 253        |
|                   | logical-interface (DDoS Flow Detection) . . . . .                                | 254        |

|                   |   |            |
|-------------------|---|------------|
|                   | no-flow-logging (DDoS Flow Detection) . . . . .                           | 255        |
|                   | physical-interface (DDoS Flow Detection) . . . . .                        | 256        |
|                   | priority (DDoS) . . . . .   | 257        |
|                   | protocols (DDoS) . . . . .  | 258        |
|                   | recover-time (DDoS) . . . . .   | 267        |
|                   | subscriber (DDoS Flow Detection) . . . . .                                | 268        |
|                   | timeout-active-flows (DDoS Flow Detection) . . . . .                      | 269        |
|                   | traceoptions (DDoS) . . . . .   | 270        |
|                   | violation-report-rate (DDoS Flow Detection) . . . . .                     | 272        |
| <b>Chapter 20</b> | <b>Configuration Statements: IPsec and Digital Certificates . . . . .</b> | <b>273</b> |
|                   | Security Services Configuration Statements . . . . .                      | 275        |
|                   | algorithm (Authentication Keychain) . . . . .                             | 279        |
|                   | algorithm (Junos FIPS) . . . . .  | 279        |
|                   | authentication (Security IPsec) . . . . .                                 | 280        |
|                   | authentication-algorithm (Security IKE) . . . . .                         | 281        |
|                   | authentication-algorithm (Security IPsec) . . . . .                       | 281        |
|                   | authentication-key-chains . . . . .                                       | 282        |
|                   | authentication-method . . . . .   | 283        |
|                   | auto-re-enrollment . . . . .  | 284        |
|                   | auxiliary-spi (Security IPsec) . . . . .                                  | 285        |
|                   | ca-identity . . . . .   | 285        |
|                   | ca-name . . . . .   | 286        |
|                   | ca-profile . . . . .  | 287        |
|                   | cache-size . . . . .  | 288        |
|                   | cache-timeout-negative . . . . .  | 289        |
|                   | certificate-id . . . . .  | 290        |
|                   | certificates . . . . .  | 291        |
|                   | certification-authority . . . . .   | 292        |
|                   | challenge-password . . . . .  | 292        |
|                   | crl (Adaptive Services Interface) . . . . .                               | 293        |
|                   | crl (Encryption Interface) . . . . .                                      | 294        |
|                   | description (Authentication Keychain) . . . . .                           | 294        |
|                   | description (IKE policy) . . . . .  | 295        |
|                   | dh-group . . . . .  | 295        |
|                   | direction (Junos OS) . . . . .  | 296        |
|                   | direction (Junos-FIPS Software) . . . . .                                 | 297        |
|                   | dynamic . . . . .   | 298        |
|                   | encoding . . . . .  | 299        |
|                   | encryption (Junos OS) . . . . .   | 300        |
|                   | encryption (Junos-FIPS Software) . . . . .                                | 301        |
|                   | encryption-algorithm (Security) . . . . .                                 | 301        |
|                   | enrollment . . . . .  | 302        |
|                   | enrollment-retry . . . . .  | 303        |
|                   | enrollment-url . . . . .  | 303        |
|                   | file . . . . .  | 304        |
|                   | identity . . . . .  | 304        |
|                   | ike (Security) . . . . .  | 305        |
|                   | internal . . . . .  | 306        |

|                   |  |            |
|-------------------|--|------------|
|                   | ipsec (Security) . . . . .                             | 307        |
|                   | key (Authentication Keychain) . . . . .                | 309        |
|                   | key (Junos FIPS) . . . . .                             | 310        |
|                   | key-chain (Security) . . . . .                         | 311        |
|                   | ldap-url . . . . .                                     | 312        |
|                   | lifetime-seconds (Security) . . . . .                  | 312        |
|                   | local . . . . .  | 313        |
|                   | local-certificate (Security) . . . . .                 | 314        |
|                   | local-key-pair . . . . .                               | 314        |
|                   | manual (Junos OS) . . . . .                            | 315        |
|                   | manual (Junos-FIPS Software) . . . . .                 | 316        |
|                   | maximum-certificates . . . . .                         | 317        |
|                   | mode (IKE) . . . . .                                   | 318        |
|                   | mode (IPsec) . . . . .                                 | 319        |
|                   | options (Security) . . . . .                           | 320        |
|                   | path-length . . . . .                                  | 321        |
|                   | perfect-forward-secrecy (Security) . . . . .           | 321        |
|                   | pki . . . . .  | 322        |
|                   | policy (Security IKE) . . . . .                        | 323        |
|                   | policy (Security IPsec) . . . . .                      | 324        |
|                   | pre-shared-key (Security) . . . . .                    | 324        |
|                   | proposal (Security IKE) . . . . .                      | 325        |
|                   | proposal (Security IPsec) . . . . .                    | 325        |
|                   | proposals . . . . .                                    | 326        |
|                   | protocol (Junos OS) . . . . .                          | 327        |
|                   | protocol (Junos-FIPS Software) . . . . .               | 328        |
|                   | re-enroll-trigger-time-percentage . . . . .            | 328        |
|                   | re-generate-keypair . . . . .                          | 329        |
|                   | refresh-interval . . . . .                             | 329        |
|                   | retry (Adaptive Services Interface) . . . . .          | 330        |
|                   | retry-interval . . . . .                               | 330        |
|                   | revocation-check . . . . .                             | 331        |
|                   | secret . . . . .                                       | 332        |
|                   | security-association (Junos OS) . . . . .              | 333        |
|                   | security-association (Junos-FIPS Software) . . . . .   | 334        |
|                   | spi (Junos OS) . . . . .                               | 335        |
|                   | spi (Junos-FIPS Software) . . . . .                    | 335        |
|                   | ssh-known-hosts . . . . .                              | 336        |
|                   | start-time (Authentication Key Transmission) . . . . . | 337        |
|                   | tolerance . . . . .                                    | 338        |
|                   | traceoptions . . . . .                                 | 339        |
|                   | url (Security) . . . . .                               | 341        |
|                   | validity-period . . . . .                              | 341        |
|                   | Security Services Configuration Statements . . . . .   | 342        |
| <b>Chapter 21</b> | <b>Operational Commands: DDoS . . . . .</b>            | <b>345</b> |
|                   | clear ddos-protection protocols . . . . .              | 346        |
|                   | show ddos-protection protocols . . . . .               | 347        |
|                   | show ddos-protection protocols culprit-flows . . . . . | 363        |

|                   |   |            |
|-------------------|---|------------|
|                   | show ddos-protection protocols flow-detection . . . . .               | 366        |
|                   | show ddos-protection protocols parameters . . . . .                   | 370        |
|                   | show ddos-protection protocols statistics . . . . .                   | 377        |
|                   | show ddos-protection protocols violations . . . . .                   | 387        |
|                   | show ddos-protection statistics . . . . .                             | 389        |
|                   | show ddos-protection version . . . . .                                | 390        |
| <b>Chapter 22</b> | <b>Operational Commands: IPsec and Digital Certificates . . . . .</b> | <b>391</b> |
|                   | clear security pki ca-certificate . . . . .                           | 393        |
|                   | clear security pki certificate-request . . . . .                      | 394        |
|                   | clear security pki crl . . . . .                                      | 395        |
|                   | clear security pki key-pair . . . . .                                 | 396        |
|                   | clear security pki local-certificate . . . . .                        | 397        |
|                   | clear services ipsec-vpn certificates . . . . .                       | 398        |
|                   | clear services ipsec-vpn ipsec statistics . . . . .                   | 399        |
|                   | clear services ipsec-vpn ike security-associations . . . . .          | 400        |
|                   | clear services ipsec-vpn ipsec security-associations . . . . .        | 401        |
|                   | request security certificate (signed) . . . . .                       | 402        |
|                   | request security certificate (unsigned) . . . . .                     | 404        |
|                   | request security key-pair . . . . .                                   | 405        |
|                   | request security pki ca-certificate enroll . . . . .                  | 406        |
|                   | request security pki ca-certificate load . . . . .                    | 407        |
|                   | request security pki ca-certificate verify . . . . .                  | 408        |
|                   | request security pki crl load . . . . .                               | 409        |
|                   | request security pki generate-certificate-request . . . . .           | 410        |
|                   | request security pki generate-key-pair . . . . .                      | 412        |
|                   | request security pki local-certificate enroll . . . . .               | 413        |
|                   | request security pki local-certificate generate-self-signed . . . . . | 415        |
|                   | request security pki local-certificate load . . . . .                 | 416        |
|                   | request security pki local-certificate verify . . . . .               | 417        |
|                   | request system certificate add . . . . .                              | 418        |
|                   | show ike security-associations . . . . .                              | 419        |
|                   | show ipsec certificates . . . . .                                     | 423        |
|                   | show ipsec security-associations . . . . .                            | 426        |
|                   | show security keychain . . . . .                                      | 429        |
|                   | show security pki ca-certificate . . . . .                            | 432        |
|                   | show security pki certificate-request . . . . .                       | 436        |
|                   | show security pki crl . . . . .                                       | 438        |
|                   | show security pki local-certificate . . . . .                         | 440        |
|                   | show services ipsec-vpn certificates . . . . .                        | 443        |
|                   | show services ipsec-vpn ike security-associations . . . . .           | 446        |
|                   | show services ipsec-vpn ipsec security-associations . . . . .         | 450        |
|                   | show services ipsec-vpn ipsec statistics . . . . .                    | 454        |
|                   | show system certificate . . . . .                                     | 457        |
| <b>Part 7</b>     | <b>Index . . . . .</b>  | <b>461</b> |

# List of Figures

|                   |   |            |
|-------------------|---|------------|
| <b>Part 3</b>     | <b>Distributed Denial-of-Service (DDoS) Protection</b>                                |            |
| <b>Chapter 4</b>  | <b>DDoS Overview</b>  | <b>35</b>  |
|                   | Figure 1: Policer Hierarchy for PPPoE Packets   | 37         |
|                   | Figure 2: Policer Hierarchy for DHCPv4 Packets  | 38         |
| <b>Part 4</b>     | <b>IPsec</b>  |            |
| <b>Chapter 7</b>  | <b>Understanding How IPsec Secures Network Traffic</b>                                | <b>77</b>  |
|                   | Figure 3: AH Protocol   | 80         |
|                   | Figure 4: ESP Protocol  | 81         |
| <b>Chapter 10</b> | <b>Configuring IPsec Security Associations</b>  | <b>99</b>  |
|                   | Figure 5: AS PIC Manual SA Topology Diagram   | 101        |
|                   | Figure 6: ES PIC Manual SA Topology Diagram   | 109        |
|                   | Figure 7: AS PIC IKE Dynamic SA Topology Diagram                                      | 121        |
|                   | Figure 8: AS PIC IKE Dynamic SA Topology Diagram                                      | 129        |
|                   | Figure 9: ES PIC IKE Dynamic SA Topology Diagram                                      | 147        |
|                   | Figure 10: AS PIC to ES PIC IKE Dynamic SA Topology Diagram                           | 158        |
| <b>Chapter 12</b> | <b>Configuring Traffic Filters to Direct Traffic Through the Desired IPsec Tunnel</b> | <b>197</b> |
|                   | Figure 11: Example: IPsec Tunnel Connecting Security Gateways                         | 198        |
| <b>Chapter 13</b> | <b>Configuring IPsec Dynamic Endpoints</b>  | <b>207</b> |
|                   | Figure 12: IPSec Dynamic Endpoint Tunneling Topology Diagram                          | 212        |



# List of Tables

|                   |   |             |
|-------------------|---|-------------|
|                   | <b>About the Documentation</b> . . . . .  | <b>xvii</b> |
|                   | Table 1: Notice Icons . . . . .   | xix         |
|                   | Table 2: Text and Syntax Conventions . . . . .  | xx          |
| <b>Part 3</b>     | <b>Distributed Denial-of-Service (DDoS) Protection</b>  |             |
| <b>Chapter 6</b>  | <b>Configuring Flow Detection for DDoS Protection</b> . . . . .   | <b>61</b>   |
|                   | Table 3: Triggering Event for Flow Detection Reports . . . . .  | 64          |
|                   | Table 4: Triggering Event for Bandwidth Violation Reports . . . . .   | 64          |
| <b>Part 4</b>     | <b>IPsec</b>  |             |
| <b>Chapter 9</b>  | <b>IPsec Configuration Guidelines</b> . . . . .   | <b>95</b>   |
|                   | Table 5: Comparison of IPsec Configuration Statements and Operational Mode<br>Commands for the AS and MultiServices PICs and ES PIC . . . . . | 95          |
|                   | Table 6: Authentication and Encryption Key Lengths . . . . .  | 97          |
|                   | Table 7: Weak and Semiweak Keys . . . . .   | 97          |
| <b>Chapter 10</b> | <b>Configuring IPsec Security Associations</b> . . . . .  | <b>99</b>   |
|                   | Table 8: IKE and IPsec Proposal and Policy Default Values for the AS and<br>MultiServices PICs . . . . .                                      | 119         |
| <b>Chapter 13</b> | <b>Configuring IPsec Dynamic Endpoints</b> . . . . .  | <b>207</b>  |
|                   | Table 9: Default IKE and IPsec Proposals for Dynamic SA Negotiations . . . . .  | 208         |
| <b>Part 6</b>     | <b>Configuration Statements and Operational Commands</b>  |             |
| <b>Chapter 20</b> | <b>Configuration Statements: IPsec and Digital Certificates</b> . . . . .   | <b>273</b>  |
|                   | Table 10: Security Services Configuration Statements . . . . .  | 342         |
| <b>Chapter 21</b> | <b>Operational Commands: DDoS</b> . . . . .   | <b>345</b>  |
|                   | Table 11: show ddos-protection protocols Output Fields . . . . .  | 354         |
|                   | Table 12: show ddos-protection protocols culprit-flows Output Fields . . . . .  | 363         |
|                   | Table 13: show ddos-protection protocols flow-detection Output Fields . . . . .   | 366         |
|                   | Table 14: show ddos-protection protocols parameters Output Fields . . . . .   | 371         |
|                   | Table 15: show ddos-protection protocols statistics Output Fields . . . . .   | 378         |
|                   | Table 16: show ddos-protection protocols violations Output Fields . . . . .   | 387         |
|                   | Table 17: show ddos-protection statistics Output Fields . . . . .   | 389         |
|                   | Table 18: show ddos-protection version Output Fields . . . . .  | 390         |
| <b>Chapter 22</b> | <b>Operational Commands: IPsec and Digital Certificates</b> . . . . .   | <b>391</b>  |
|                   | Table 19: show ike security-associations Output Fields . . . . .  | 419         |
|                   | Table 20: show ipsec certificates Output Fields . . . . .   | 423         |

|   |     |
|---|-----|
| Table 21: show ipsec security-associations Output Fields . . . . .                | 426 |
| Table 22: show security keychain Output Fields . . . . .                          | 429 |
| Table 23: show security pki ca-certificate Output Fields . . . . .                | 432 |
| Table 24: show security pki certificate-request Output Fields . . . . .           | 436 |
| Table 25: show security pki crl Output Fields . . . . .                           | 438 |
| Table 26: show security pki local-certificate Output Fields . . . . .             | 440 |
| Table 27: show services ipsec-vpn certificates Output Fields . . . . .            | 443 |
| Table 28: show services ipsec-vpn ike security-associations Output Fields . . . . | 446 |
| Table 29: show services ipsec-vpn ipsec security-associations Output Fields . .   | 450 |
| Table 30: show services ipsec-vpn ipsec statistics Output Fields . . . . .        | 454 |
| Table 31: show system certificate Output Fields . . . . .                         | 457 |



# About the Documentation

- [Documentation and Release Notes on page xvii](#)
- [Supported Platforms on page xvii](#)
- [Using the Examples in This Manual on page xvii](#)
- [Documentation Conventions on page xix](#)
- [Documentation Feedback on page xxi](#)
- [Requesting Technical Support on page xxi](#)

## Documentation and Release Notes

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To obtain the most current version of all Juniper Networks<sup>®</sup> technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <http://www.juniper.net/books>.

## Supported Platforms

---

For the features described in this document, the following platforms are supported:

- [M Series](#)
- [MX Series](#)
- [T Series](#)
- [T4000](#)
- [J Series](#)

## Using the Examples in This Manual

---

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming

configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

## Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

```
system {
  scripts {
    commit {
      file ex-script.xsl;
    }
  }
}
interfaces {
  fxp0 {
    disable;
    unit 0 {
      family inet {
        address 10.0.0.1/24;
      }
    }
  }
}
```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

```
[edit]
user@host# load merge /var/tmp/ex-script.conf
load complete
```

## Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

```
commit {
  file ex-script-snippet.xml; }
```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see the *CLI User Guide*.

## Documentation Conventions

Table 1 on page xix defines notice icons used in this guide.

Table 1: Notice Icons







| Icon  | Meaning            | Description   |
|---|--------------------|---|
|  | Informational note | Indicates important features or instructions.                               |
|  | Caution            | Indicates a situation that might result in loss of data or hardware damage. |
|  | Warning            | Alerts you to the risk of personal injury or death.                         |
|  | Laser warning      | Alerts you to the risk of personal injury from a laser.                     |
|  | Tip                | Indicates helpful information.  |
|  | Best practice      | Alerts you to a recommended use or implementation.                          |

Table 2 on page xx defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

| Convention                     | Description   | Examples   |
|--------------------------------|---|--|
| <b>Bold text like this</b>     | Represents text that you type.  | To enter configuration mode, type the <b>configure</b> command:<br><br>user@host> <b>configure</b>   |
| Fixed-width text like this     | Represents output that appears on the terminal screen.  | user@host> <b>show chassis alarms</b><br><br>No alarms currently active  |
| <i>Italic text like this</i>   | <ul style="list-style-type: none"> <li>Introduces or emphasizes important new terms.</li> <li>Identifies guide names.</li> <li>Identifies RFC and Internet draft titles.</li> </ul> | <ul style="list-style-type: none"> <li>A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li><i>Junos OS CLI User Guide</i></li> <li>RFC 1997, <i>BGP Communities Attribute</i></li> </ul>   |
| <i>Italic text like this</i>   | Represents variables (options for which you substitute a value) in commands or configuration statements.  | Configure the machine's domain name:<br><br>[edit]<br>root@# <b>set system domain-name</b> <i>domain-name</i>  |
| Text like this                 | Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.                           | <ul style="list-style-type: none"> <li>To configure a stub area, include the <b>stub</b> statement at the [edit protocols <b>ospf area area-id</b>] hierarchy level.</li> <li>The console port is labeled <b>CONSOLE</b>.</li> </ul> |
| < > (angle brackets)           | Encloses optional keywords or variables.  | <b>stub</b> <default-metric <i>metric</i> >;   |
| (pipe symbol)                  | Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.              | <b>broadcast</b>   <b>multicast</b><br><br>( <i>string1</i>   <i>string2</i>   <i>string3</i> )  |
| # (pound sign)                 | Indicates a comment specified on the same line as the configuration statement to which it applies.  | <b>rsvp { # Required for dynamic MPLS only</b>   |
| [ ] (square brackets)          | Encloses a variable for which you can substitute one or more values.  | <b>community name members</b> [ <i>community-ids</i> ]   |
| Indentation and braces ( { } ) | Identifies a level in the configuration hierarchy.  | [edit]<br>routing-options {<br>static {<br>route default {<br>nexthop <i>address</i> ;<br>retain;<br>}<br>}<br>}   |
| ;(semicolon)                   | Identifies a leaf statement at a configuration hierarchy level.   |  |

---

#### GUI Conventions

---

Table 2: Text and Syntax Conventions (*continued*)

| Convention                             | Description  | Examples  |
|--|--|---|
| <b>Bold text like this</b>             | Represents graphical user interface (GUI) items you click or select. | <ul style="list-style-type: none"> <li>In the Logical Interfaces box, select <b>All Interfaces</b>.</li> <li>To cancel the configuration, click <b>Cancel</b>.</li> </ul> |
| <b>&gt;</b> (bold right angle bracket) | Separates levels in a hierarchy of menu selections.                  | In the configuration editor hierarchy, select <b>Protocols&gt;Ospf</b> .  |

## Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page at the Juniper Networks Technical Documentation site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <https://www.juniper.net/cgi-bin/docbugreport/>.
- E-mail—Send your comments to [techpubs-comments@juniper.net](mailto:techpubs-comments@juniper.net). Include the document or topic name, URL or page number, and software version (if applicable).

## Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

## Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <http://www.juniper.net/customers/support/>
- Search for known bugs: <http://www2.juniper.net/kb/>
- Find product documentation: <http://www.juniper.net/techpubs/>
- Find solutions and answer questions using our Knowledge Base: <http://kb.juniper.net/>
- Download the latest versions of software and review release notes:  
<http://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications:  
<http://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum:  
<http://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <http://www.juniper.net/cm/>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://tools.juniper.net/SerialNumberEntitlementSearch/>

## Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at <http://www.juniper.net/cm/>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <http://www.juniper.net/support/requesting-support.html>.

## PART 1

# SSH and SSL

- [Configuring SSH and SSL for Secure Access to the Router on page 3](#)





## CHAPTER 1

# Configuring SSH and SSL for Secure Access to the Router

- [Configuring SSH Host Keys for Secure Copying of Data on page 3](#)
- [Importing SSL Certificates for Junos XML Protocol Support on page 5](#)

## Configuring SSH Host Keys for Secure Copying of Data

---

Secure Shell (SSH) uses encryption algorithms to generate a host, server, and session key system that ensures secure data transfer. You can configure SSH host keys to support secure copy (SCP) as an alternative to FTP for the background transfer of data such as configuration archives and event logs. To configure SSH support for SCP, you must complete the following tasks:

- Specify SSH known hosts by including hostnames and host key information in the Routing Engine configuration hierarchy.
- Set an SCP URL to specify the host from which to receive data. Setting this attribute automatically retrieves SSH host key information from the SCP server.
- Verify that the host key is authentic.
- Accept the secure connection. Accepting this connection automatically stores host key information in the local host key database. Storing host key information in the configuration hierarchy automates the secure handshake and allows background data transfer using SCP.

Tasks to configure SSH host keys for secure copying of data are:

1. [Configuring SSH Known Hosts on page 3](#)
2. [Configuring Support for SCP File Transfer on page 4](#)
3. [Updating SSH Host Key Information on page 4](#)

## Configuring SSH Known Hosts

To configure SSH known hosts, include the **host** statement, and specify hostname and host key options for trusted servers at the **[edit security ssh-known-hosts]** hierarchy level:

```
[edit security ssh-known-hosts]
host corporate-archive-server, ip-address {
```

```
    dsa-key key;
  }
  host archive-server-url {
    rsa-key key;
  }
  host server-with-ssh-version-1, ip-address {
    rsa1-key key;
  }
```

Host keys are one of the following:

- **dsa-key**—Base64 encoded Digital Signature Algorithm (DSA) key.
- **rsa-key**—Base64 encoded RSA public key algorithm, which supports encryption and digital signatures.
- **rsa1-key**—Base64 encoded RSA public key algorithm, which supports encryption and digital signatures for SSH version 1 and SSH version 2.

## Configuring Support for SCP File Transfer

To configure a known host to support background SCP file transfers, include the **archive-sites** statement at the **[edit system archival configuration]** hierarchy level.

```
[edit system archival configuration]
archive-sites {
  scp://username<:password>@host<:port>/url-path;
}
```



**NOTE:** When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks ( " ") and enclose the IPv6 host address in brackets ( [ ] ). For example, "scp://username<:password>@[host]<:port>/url-path";

Setting the **archive-sites** statement to point to an SCP URL triggers automatic host key retrieval. At this point, Junos OS connects to the SCP host to fetch the SSH public key, displays the host key message digest or fingerprint as output to the console, and terminates the connection to the server.

```
user@switch# set system archival configuration archive-sites "<scp-url-path>"
The authenticity of host <my-archive-server (<server-ip-address>)> can't be established.
RSA key fingerprint is <ascii-text key>. Are you sure you want to continue connecting
(yes/no)?
```

To verify that the host key is authentic, compare this fingerprint with a fingerprint that you obtain from the same host using a trusted source. If the fingerprints are identical, accept the host key by entering **yes** at the prompt. The host key information is then stored in the Routing Engine configuration and supports background data transfers using SCP.

## Updating SSH Host Key Information

Typically, SSH host key information is automatically retrieved when you set a URL attribute for SCP using the **archival configuration archive-sites** statement at the **[edit system]**

hierarchy level. However, if you need to manually update the host key database, use one of the following methods.

1. [Retrieving Host Key Information Manually on page 5](#)
2. [Importing Host Key Information from a File on page 5](#)

### Retrieving Host Key Information Manually

To manually retrieve SSH public host key information, use the **fetch-from-server** option with the **set security ssh-known-hosts** command. You must include a hostname attribute with the **set security ssh-known-hosts fetch-from-server** command to specify the host from which to retrieve the SSH public key.

```
user@switch# set security ssh-known-hosts fetch-from-server <hostname>
```

### Importing Host Key Information from a File

To manually import SSH host key information from the known-hosts file located at **/var/tmp/known-hosts** on the server, include the **load-key-file** option with the **set security ssh-known-hosts** command. You must include the path to the **known-hosts** file with the **set security ssh-known-hosts load-key-file** command to specify the location from which to import host key information.

```
user@switch# set security ssh-known-hosts load-key-file /var/tmp/known-hosts
```

## Importing SSL Certificates for Junos XML Protocol Support

A Junos XML protocol client application can use one of four protocols to connect to the Junos XML protocol server on a router or switch: clear-text (a Junos XML protocol-specific protocol for sending unencrypted text over a TCP connection), SSH, SSL, or Telnet. For clients to use the SSL protocol, you must copy an X.509 authentication certificate onto the router or switch, as described in this topic. You must also include the **xnm-ssl** statement at the **[edit system services]** hierarchy level.



**NOTE:** The **xnm-ssl** statement does not apply to standard IPsec services.

After obtaining an X.509 authentication certificate and private key, copy it to the router or switch by including the **local** statement at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
local certificate-name {
  load-key-file (filename | url);
}
```

**certificate-name** is a name you choose to identify the certificate uniquely (for example, **Junos XML protocol-ssl-client-hostname**, where **hostname** is the computer where the client application runs).

**filename** is the pathname of the file on the local disk that contains the paired certificate and private key (assuming you have already used another method to copy them to the router's or switch's local disk).

*url* is the URL to the file that contains a paired certificate and private key (for instance, on the computer where the Junos XML protocol client application runs).



**NOTE:** The CLI expects the private key in the *URL-or-path* file to be unencrypted. If the key is encrypted, the CLI prompts you for the passphrase associated with it, decrypts it, and stores the unencrypted version.

The `load-key-file` statement acts as a directive that copies the contents of the certificate file into the configuration. When you view the configuration, the CLI displays the string of characters that constitute the private key and certificate, marking them as `SECRET-DATA`. The `load-key-file` keyword is not recorded in the configuration.

**Related  
Documentation**

- [Configuring SSH Host Keys for Secure Copying of Data on page 3](#)
- [Configuring clear-text or SSL Service for Junos XML Protocol Client Applications](#)

## PART 2

# Digital Certificates

- [Understanding How Digital Certificates Can Be Used to Authenticate Users on page 9](#)
- [Configuring Digital Certificates on page 11](#)



## CHAPTER 2

# Understanding How Digital Certificates Can Be Used to Authenticate Users

- [Digital Certificates Overview on page 9](#)

## Digital Certificates Overview

---

A digital certificate provides a way of authenticating users through a trusted third-party called a certificate authority (CA). The CA validates the identity of a certificate holder and “signs” the certificate to attest that it has not been forged or altered.

A certificate includes the following information:

- The distinguished name (DN) of the owner. A DN is a unique identifier and consists of a fully qualified name including the common name (CN) of the owner, the owner's organization, and other distinguishing information.
- The public key of the owner.
- The date on which the certificate was issued.
- The date on which the certificate expires.
- The distinguished name of the issuing CA.
- The digital signature of the issuing CA.

The additional information in a certificate allows recipients to decide whether to accept the certificate. The recipient can determine if the certificate is still valid based on the expiration date. The recipient can check whether the CA is trusted by the site based on the issuing CA.

With a certificate, a CA takes the owner's public key, signs that public key with its own private key, and returns this to the owner as a certificate. The recipient can extract the certificate (containing the CA's signature) with the owner's public key. By using the CA's public key and the CA's signature on the extracted certificate, the recipient can validate the CA's signature and owner of the certificate.

When you use digital certificates, your first step is to send in a request to obtain a certificate from your CA. You then configure digital certificates and a digital certificate IKE policy. Finally, you obtain a digitally signed certificate from a CA.



NOTE: Certificates without an alternate subject name are not appropriate for IPsec services.

**Related  
Documentation**

- [Configuration Statements for Configuring Digital Certificates for an ES PIC on page 11](#)
- [Obtaining a Certificate from a Certificate Authority for an ES PIC on page 12](#)
- [Requesting a CA Digital Certificate for an ES PIC on an M Series or T Series Router on page 13](#)
- [Generating a Private and Public Key Pair for Digital Certificates for an ES PIC on page 13](#)
- [Configuring Digital Certificates for an ES PIC on page 15](#)
- [Configuring an IKE Policy for Digital Certificates for an ES PIC on page 19](#)
- [Associating the Configured Security Association with a Logical Interface on page 21](#)



## CHAPTER 3

# Configuring Digital Certificates

- [Configuration Statements for Setting Up Digital Certificates for an ES PIC on page 11](#)
- [Obtaining a Certificate from a Certificate Authority for an ES PIC on page 12](#)
- [Requesting a CA Digital Certificate for an ES PIC on an M Series or T Series Router on page 13](#)
- [Example: Requesting a CA Digital Certificate on page 13](#)
- [Generating a Private and Public Key Pair for Digital Certificates for an ES PIC on page 13](#)
- [Obtaining a Signed Certificate from the CA for an ES PIC on page 14](#)
- [Configuring Digital Certificates for an ES PIC on page 15](#)
- [Configuring an IKE Policy for Digital Certificates for an ES PIC on page 19](#)
- [Associating the Configured Security Association with a Logical Interface on page 21](#)
- [Configuring Digital Certificates for Adaptive Services Interfaces on page 21](#)
- [Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 30](#)

## Configuration Statements for Setting Up Digital Certificates for an ES PIC

---

To define the digital certificate configuration for an encryption service interface, include the following statements at the **[edit security certificates]** and **[edit security ike]** hierarchy levels:

```
[edit security]
certificates {
  cache-size bytes;
  cache-timeout-negative seconds;
  certification-authority ca-profile-name {
    ca-name ca-identity;
    crl filename;
    encoding (binary | pem);
    enrollment-url url-name;
    file certificate-filename;
    ldap-url url-name;
  }
  enrollment-retry attempts;
  local certificate-filename {
    certificate-key-string;
    load-key-file URL key-file-name;
```

```
    }  
    maximum-certificates number;  
    path-length certificate-path-length;  
  }  
  ike {  
    policy ike-peer-address {  
      description policy;  
      encoding (binary | pem);  
      identity identity-name;  
      local-certificate certificate-filename;  
      local-key-pair private-public-key-file;  
      mode (aggressive | main);  
      pre-shared-key (ascii-text key | hexadecimal key);  
      proposals [ proposal-names ];  
    }  
  }  
}
```

The statements for configuring digital certificates differ for the AS and MultiServices PICs and the ES PIC.

For information about how to configure the **description** and **mode** statements, see [“Configuring the Description for an IKE Policy” on page 188](#). For information about how to configure the IKE proposal, see [“Associating Proposals with an IKE Policy” on page 189](#)



**NOTE:** For digital certificates, the Junos OS supports only VeriSign CAs for the ES PIC.

---

**Related Documentation**

- [Digital Certificates Overview on page 9](#)

---

## Obtaining a Certificate from a Certificate Authority for an ES PIC

---

Certificate authorities (CAs) manage certificate requests and issue certificates to participating IPsec network devices. When you create a certificate request, you need to provide the information about the owner of the certificate. The required information and its format vary across certificate authorities.

Certificates use names in the X.500 format, a directory access protocol that provides both read and update access. The entire name is called a DN (distinguished name). It consists of a set of components, which often includes a CN (common name), an organization (O), an organization unit (OU), a country (C), a locality (L), and so on.



**NOTE:** For the dynamic registration of digital certificates, the Junos OS supports only the Simple Certificate Enrollment Protocol (SCEP).

---

**Related Documentation**

- [Digital Certificates Overview on page 9](#)

## Requesting a CA Digital Certificate for an ES PIC on an M Series or T Series Router

For an encryption interface on an M Series or T Series router, issue the following command to obtain a public key certificate from a CA. The results are saved in the specified file in the `/var/etc/ikecert` directory. The CA public key verifies certificates from remote peers.

```
user@host> request security certificate enroll filename filename ca-name ca-name
parameters parameters
```

- Related Documentation**
- [Example: Requesting a CA Digital Certificate on page 13](#)
  - [Digital Certificates Overview on page 9](#)

## Example: Requesting a CA Digital Certificate

Specify a URL to the SCEP server and the name of the certification authority whose certificate you want: **mycompany.com**. **filename 1** is name of the file that stores the result. The output, "Received CA certificate:" provides the signature for the certificate, which allows you to verify (offline) that the certificate is genuine.

```
user@host> request security certificate enroll filename ca_verisign ca-file verisign ca-name
xyzcompany url
http://hostname/path/filename
URL: http://hostname/path/filename name: juniper.net CA file: verisign Encoding: binary
Certificate enrollment has started. To see the certificate enrollment status, check the key
management process (kmd) log file at /var/log/kmd. <-----
```



**NOTE:** Each router is initially manually enrolled with a certificate authority.

- Related Documentation**
- [Requesting a CA Digital Certificate for an ES PIC on an M Series or T Series Router on page 13](#)

## Generating a Private and Public Key Pair for Digital Certificates for an ES PIC

To generate a private and public key, issue the following command:

```
user@host> request security key-pair name size key-size type ( rsa | dsa )
```

**name** specifies the filename in which to store the public and private keys.

**key-size** can be 512, 1024, 1596, or 2048 bytes. The default key size is 1024 bytes.

**type** can be **rsa** or **dsa**. The default is RSA.



**NOTE:** When you use SCEP, the Junos OS only supports RSA.

The following example shows how to generate a private and public key pair:

```
user@host> request security key-pair batt
Generated key pair, key size 1024, file batt Algorithm RSA
```

**Related Documentation**

- [Digital Certificates Overview on page 9](#)

---

## Obtaining a Signed Certificate from the CA for an ES PIC

---

To obtain a signed certificate from the CA, issue the following command:

```
user@host> request security certificate enroll filename filename subject c=us,o=x
alternative-subject certificate-ip-address certification-authority certificate-authority
key-file key-file-name domain-name domain-name
```

The results are saved in a specified file to the `/var/etc/ikecert` directory.

The following example shows how to obtain a CA signed certificate by referencing the configured `certification-authority` statement `local`. This statement is referenced by the `request security certificate enroll filename m subject c=us,O=x alternative subject 1.1.1.1 certification-authority` command.

```
[edit]
security {
  certificates {
    certification-authority local {
      ca-name xyz.company.com;
      file l;
      enrollment-url "http://www.xyzcompany.com";
    }
  }
}
```

To obtain a signed certificate from the CA, issue the following command:

```
user@host> request security certificate enroll filename l subject c=uk,o=london
alternative-subject 10.50.1.4 certification-authority verisign key-file host-l.prv
domain-name host.xyzcompany.com
CA name: xyz.company.com CA file: ca_verisign
local pub/private key pair: host.prv
subject: c=uk,o=london domain name: host.juniper.net
alternative subject: 10.50.1.4
Encoding: binary
Certificate enrollment has started. To see the certificate enrollment status, check the key
management process (kmd) log file at /var/log/kmd. <-----
```

For information about how to use the operational mode commands to obtain a signed certificate, see the [CLI Explorer](#).

Another way to obtain a signed certificate from the CA is to reference the configured statements such as the URL, CA name, and CA certificate file by means of the `certification-authority` statement:

```
user@host> request security certificate enroll filename m subject c=us,o=x
alternative-subject 1.1.1.1 certification-authority local key-file y domain-name
abc.company.com
```

**Related Documentation**

- [Digital Certificates Overview on page 9](#)

## Configuring Digital Certificates for an ES PIC

Digital certificates provide a way of authenticating users through a trusted third party called a certificate authority (CA). The CA validates the identity of a certificate holder and “signs” the certificate to attest that it has not been forged or altered.

To define the digital certificate configuration for an encryption service interface, include the following statements at the **[edit security certificates]** and **[edit security ike]** hierarchy levels:

```
[edit security]
certificates {
  cache-size bytes;
  cache-timeout-negative seconds;
  certification-authority ca-profile-name {
    ca-name ca-identity;
    crl filename;
    encoding (binary | pem);
    enrollment-url url-name;
    file certificate-filename;
    ldap-url url-name;
  }
  enrollment-retry attempts;
  local certificate-filename {
    certificate-key-string;
    load-key-file URL key-file-name;
  }
  maximum-certificates number;
  path-length certificate-path-length;
}
ike {
  policy ike-peer-address {
    description policy;
    encoding (binary | pem);
    identity identity-name;
    local-certificate certificate-filename;
    local-key-pair private-public-key-file;
    mode (aggressive | main);
    pre-shared-key (ascii-text key | hexadecimal key);
    proposals [ proposal-names ];
  }
}
```

Tasks to configure digital certificates for ES PICs are:

- [Configuring the Certificate Authority Properties for an ES PIC on page 16](#)
- [Configuring the Cache Size on page 18](#)
- [Configuring the Negative Cache on page 18](#)
- [Configuring the Number of Enrollment Retries on page 18](#)

- [Configuring the Maximum Number of Peer Certificates on page 19](#)
- [Configuring the Path Length for the Certificate Hierarchy on page 19](#)

## Configuring the Certificate Authority Properties for an ES PIC

A CA is a trusted third-party organization that creates, enrolls, validates, and revokes digital certificates.

To configure a certificate authority and its properties for an ES PIC, include the following statements at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
certification-authority ca-profile-name {
  ca-name ca-identity;
  crl filename;
  encoding (binary | pem);
  enrollment-url url-name;
  file certificate-filename;
  ldap-url url-name;
}
```

***ca-profile-name*** is the CA profile name.

Tasks for configuring the CA properties are:

1. [Specifying the Certificate Authority Name on page 16](#)
2. [Configuring the Certificate Revocation List on page 16](#)
3. [Configuring the Type of Encoding Your CA Supports on page 17](#)
4. [Specifying an Enrollment URL on page 17](#)
5. [Specifying a File to Read the Digital Certificate on page 17](#)
6. [Specifying an LDAP URL on page 17](#)

---

### Specifying the Certificate Authority Name

If you are enrolling with a CA using simple certificate enrollment protocols (SCEP), you need to specify the CA name (CA identity) that is used in the certificate request, in addition to the URL for the SCEP server.

To specify the name of the CA identity, include the **ca-name** statement at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]
ca-name ca-identity;
```

***ca-identity*** specifies the CA identity to use in the certificate request. It is typically the CA domain name.

---

### Configuring the Certificate Revocation List

A certificate revocation list (CRL) contains a list of digital certificates that have been canceled before their expiration date. When a participating peer uses a digital certificate, it checks the certificate signature and validity. It also acquires the most recently issued CRL and checks that the certificate serial number is not on that CRL.

To configure the CA certificate revocation list, include the **crl** statement and specify the file from which to read the CRL at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]  
  crl filename;
```

---

### Configuring the Type of Encoding Your CA Supports

By default, encoding is set to binary. Encoding specifies the file format used for the **local-certificate** and **local-key-pair** statements. By default, the binary (distinguished encoding rules) format is enabled. Privacy-enhanced mail (PEM) is an ASCII base 64 encoded format. Check with your CA to determine which file formats it supports.

To configure the file format that your CA supports, include the **encoding** statement and specify a binary or PEM format at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]  
  encoding (binary | pem);
```

---

### Specifying an Enrollment URL

You specify the CA location where your router or switch sends SCEP-based certificate enrollment requests. To specify the CA location by naming the CA URL, include the **enrollment-url** statement at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]  
  enrollment-url url-name;
```

***url-name*** is the CA location. The format is **http://*ca-name***, where ***ca-name*** is the CA host DNS name or IP address.

---

### Specifying a File to Read the Digital Certificate

To specify the file from which to read the digital certificate, include the **file** statement and specify the certificate filename at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]  
  file certificate-filename;
```

---

### Specifying an LDAP URL

If your CA stores its current CRL at its Lightweight Directory Access Protocol (LDAP) server, you can optionally check your CA CRL list before using a digital certificate. If the digital certificate appears on the CA CRL, your router or switch cannot use it. To access your CA CRL, include the **ldap-url** statement at the **[edit security certificates certification-authority *ca-profile-name*]** hierarchy level:

```
[edit security certificates certification-authority ca-profile-name]  
  ldap-url url-name;
```

**url-name** is the certification authority LDAP server name. The format is **ldap://server-name**, where **server-name** is the CA host DNS name or IP address.

## Configuring the Cache Size

By default, the cache size is 2 megabytes (MB). To configure total cache size for digital certificates, include the **cache-size** statement at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
cache-size bytes;
```

**bytes** is the cache size for digital certificates. The range can be from 64 through 4,294,967,295 bytes.



**NOTE:** We recommend that you limit your cache size to 4 MB.

## Configuring the Negative Cache

Negative caching stores negative results and reduces the response time for negative answers. It also reduces the number of messages that are sent to the remote server. Maintaining a negative cache state allows the system to quickly return a failure condition when a lookup attempt is retried. Without a negative cache state, a retry would require waiting for the remote server to fail to respond, even though the system already “knows” that remote server is not responding.

By default, the negative cache is 20 seconds. To configure the negative cache, include the **cache-timeout-negative** statement at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
cache-timeout-negative seconds;
```

**seconds** is the amount of time for which a failed CA or router certificate is present in the negative cache. While searching for certificates with a matching CA identity (domain name for certificates or CA domain name and serial for CRLs), the negative cache is searched first. If an entry is found in the negative cache, the search fails immediately.



**NOTE:** Configuring a large negative cache value can make you susceptible to a denial-of-service (DoS) attack.

## Configuring the Number of Enrollment Retries

By default, the number of enrollment retries is set to 0, an infinite number of retries. To specify how many times a router or switch will resend a certificate request, include the **enrollment-retry** statement at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
enrollment-retry attempts;
```

**attempts** is the number of enrollment retries (0 through 100).



## Configuring the Maximum Number of Peer Certificates

By default, the maximum number of peer certificates to be cached is 1024. To configure the maximum number of peer certificates to be cached, include the **maximum-certificates** statement at the **[edit security certificates]** hierarchy statement level:

```
[edit security certificates]
maximum-certificates number;
```

**number** is the maximum number of peer certificates to be cached. The range is from 64 through 4,294,967,295 peer certificates.

## Configuring the Path Length for the Certificate Hierarchy

Certification authorities can issue certificates to other CAs. This creates a tree-like certification hierarchy. The highest trusted CA in the hierarchy is called the *trust anchor*. Sometimes the trust anchor is the root CA, which is usually signed by itself. In the hierarchy, every certificate is signed by the CA immediately above it. An exception is the root CA certificate, which is usually signed by the root CA itself. In general, a chain of multiple certificates may be needed, comprising a certificate of the public key owner (the end entity) signed by one CA, and zero or more additional certificates of CAs signed by other CAs. Such chains, called certification paths, are required because a public key user is only initialized with a limited number of assured CA public keys.

Path length refers to a path of certificates from one certificate to another certificate, based on the relationship of a CA and its “children.” When you configure the **path-length** statement, you specify the maximum depth of the hierarchy to validate a certificate from the trusted root CA certificate to the certificate in question. For more information about the certificate hierarchy, see RFC 3280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile*.

By default, the maximum certificate path length is set to 15. The root anchor is 1.

To configure path length, include the **path-length** statement at the **[edit security certificates]** hierarchy level:

```
[edit security certificates]
path-length certificate-path-length;
```

**certificate-path-length** is the maximum number certificates for the certificate path length. The range is from 2 through 15 certificates.

## Configuring an IKE Policy for Digital Certificates for an ES PIC

---

An IKE policy for digital certificates defines a combination of security parameters (IKE proposals) to be used during IKE negotiation. It defines a peer address and the proposals needed for that connection. During the IKE negotiation, IKE looks for an IKE policy that is the same on both peers. The peer that initiates the negotiation sends all its policies to the remote peer, and the remote peer tries to find a match.

To configure an IKE policy for digital certificates for an ES PIC, include the following statements at the **[edit security ike policy ike-peer-address]** hierarchy level:

```
[edit security ike]
policy ike-peer-address{
  encoding (binary | pem);
  identity identity-name;
  local-certificate certificate-filename;
  local-key-pair private-public-key-file;
}
```

Tasks for configuring an IKE policy for digital certificates are:

1. [Configuring the Type of Encoding Your CA Supports on page 20](#)
2. [Configuring the Identity to Define the Remote Certificate Name on page 20](#)
3. [Specifying the Certificate Filename on page 20](#)
4. [Specifying the Private and Public Key File on page 20](#)

## Configuring the Type of Encoding Your CA Supports

By default, the encoding is set to binary. Encoding specifies the file format used for the **local-certificate** and **local-key-pair** statements. By default, the binary (distinguished encoding rules) format is enabled. PEM is an ASCII base 64 encoded format. Check with your CA to determine which file formats it supports.

To configure the file format that your CA supports, include the **encoding** statement and specify a binary or PEM format at the **[edit security ike policy *ike-peer-address*]** hierarchy level:

```
[edit security ike policy ike-peer-address ]
encoding (binary | pem);
```

## Configuring the Identity to Define the Remote Certificate Name

To define the remote certificate name, include the **identity** statement at the **[edit security ike policy *ike-peer-address*]** hierarchy level:

```
[edit security ike policy ike-peer-address]
identity identity-name;
```

***identity-name*** defines the identity of the remote certificate name if the identity cannot be learned through IKE (ID payload or IP address).

## Specifying the Certificate Filename

To configure the certificate filename from which to read the local certificate, include the **local-certificate** statement at the **[edit security ike policy *ike-peer-address*]** hierarchy level:

```
[edit security ike policy ike-peer-address]
local-certificate certificate-filename;
```

***certificate-filename*** specifies the file from which to read the local certificate.

## Specifying the Private and Public Key File

To specify the filename from which to read the public and private key, include the **local-key-pair** statement at the **[edit security ike policy *ike-peer-address*]** hierarchy level:

```
[edit security ike policy ike-peer-address ]
local-key-pair private-public-key-file;
```

*private-public-key-file* specifies the file from which to read the pair key.

## Associating the Configured Security Association with a Logical Interface

Configuring the ES PIC associates the configured SA with a logical interface. This configuration defines the tunnel itself (logical subunit, tunnel addresses, maximum transmission unit [MTU], optional interface addresses, and the name of the SA to apply to traffic).

The addresses configured as the tunnel source and destination are the addresses in the outer IP header of the tunnel.



**NOTE:** The tunnel source address must be configured locally on the router, and the tunnel destination address must be a valid address for the security gateway terminating the tunnel.

The M5, M10, M20, and M40 routers support the ES PIC.

The SA must be a valid tunnel-mode SA. The interface address and destination address listed are optional. The destination address allows the user to configure a static route to encrypt traffic. If a static route uses that destination address as the next hop, traffic is forwarded through the portion of the tunnel in which encryption occurs.

The following example shows how to configure an IPsec tunnel as a logical interface on the ES PIC. The logical interface specifies the tunnel through which the encrypted traffic travels. The **ipsec-sa** statement associates the security profile with the interface.

```
[edit interfaces]
es-0/0/0 {
  unit 0 {
    tunnel {
      source tunnel 10.5.5.5; # tunnel source address
      destination 10.6.6.6; # tunnel destination address
    }
    family inet {
      ipsec-sa ipsec-sa; # name of security association to apply to packet
      address 10.1.1.8/32 { # local interface address inside local VPN
        destination 10.2.2.254; # destination address inside remote VPN
      }
    }
  }
}
```

**Related  
Documentation**

- [Configuring Security Associations for IPsec on an ES PIC on page 173](#)

## Configuring Digital Certificates for Adaptive Services Interfaces

A digital certificate implementation uses the public key infrastructure (PKI), which requires that you generate a key pair consisting of a public key and a private key. The keys are

created with a random number generator and are used to encrypt and decrypt data. In networks that do not use digital certificates, an IPsec-enabled device encrypts data with the private key and IPsec peers decrypt the data with the public key.

With digital certificates, the key sharing process requires an additional level of complexity. First, you and your IPsec peers request that a certificate authority (CA) send you a CA certificate that contains the public key of the CA. Next you request the CA to assign you a local digital certificate that contains the public key and some additional information. When the CA processes your request, it signs your local certificate with the private key of the CA. Then you install the CA certificate and the local certificate in your router and load the CA in remote devices before you can establish IPsec tunnels with your peers.



**NOTE:** For digital certificates, the Junos OS supports VeriSign, Entrust, Cisco Systems, and Microsoft Windows CAs for the Adaptive Services (AS) and Multiservices PICs.

To define digital certificates configuration for J Series Services Routers and AS and Multiservices PICs installed on M Series and T Series routers, include the following statements at the **[edit security pki]** hierarchy level:

```
[edit security]
pki {
  ca-profile ca-profile-name {
    ca-identity ca-identity;
    enrollment {
      url-name;
      retry number-of-enrollment-attempts;
      retry-interval seconds;
    }
    revocation-check {
      disable;
      crl {
        disable on-download-failure;
        refresh-interval number-of-hours;
        url {
          url-name;
          password;
        }
      }
    }
  }
}
```

The following tasks enable you to implement digital certificates on J Series Services Routers and AS and Multiservices PICs installed on M Series and T Series routers:

1. [Configuring the Certificate Authority Properties on page 23](#)
2. [Configuring the Certificate Revocation List on page 24](#)
3. [Managing Digital Certificates on page 25](#)
4. [Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27](#)

## Configuring the Certificate Authority Properties

A CA is a trusted third-party organization that creates, enrolls, validates, and revokes digital certificates.

To configure a certificate authority and its properties for the AS and Multiservices PICs, include the following statements at the **[edit security pki]** hierarchy level:

```
[edit security pki]
ca-profile ca-profile-name {
  ca-identity ca-identity;
  enrollment {
    url url-name;
    retry number-of-attempts;
    retry-interval seconds;
  }
}
```

Tasks for configuring the Certificate Authority properties are:

1. [Specifying the CA Profile Name on page 23](#)
2. [Specifying an Enrollment URL on page 23](#)
3. [Specifying the Enrollment Properties on page 24](#)

### Specifying the CA Profile Name

The CA profile contains the name and URL of the CA or RA, as well as some retry-timer settings. CA certificates issued by Entrust, VeriSign, Cisco Systems, and Microsoft are compatible with the J Series Services Routers and AS and Multiservices PICs installed in the M Series and T Series routers.

To specify the CA profile name, include the **ca-profile statement** at the **[edit security pki]** security level:

```
[edit security pki]
ca-profile ca-profile-name;
```

You also need to specify the name of the CA identity used in the certificate request. This name is typically the domain name. To specify the name of the CA identity, include the **ca-identity statement** at the **[edit security pki ca-profile ca-profile-name]** level:

```
[edit security pki ca-profile ca-profile-name]
ca-identity ca-identity;
```

### Specifying an Enrollment URL

You specify the CA location where your router should send the SCEP-based certificate enrollment requests. To specify the CA location by naming the CA URL, include the **url statement** at the **[edit security pki enrollment]** hierarchy level:

```
[edit security pki ca-profile ca-profile-name enrollment]
url url-name;
```

**url-name** is the CA location. The format is **http://CA\_name**, where **CA\_name** is the CA host DNS name or IP address.

### Specifying the Enrollment Properties

---

You can specify the number of times a router will resend a certificate request and the amount of time, in seconds, the router should wait between enrollment attempts.

By default, the number of enrollment retries is set to 0, an infinite number of retries. To specify how many times a router will resend a certificate request, include the **retry number-of-attempts** statement at the **[edit security pki ca-profile ca-profile-name enrollment]** hierarchy level:

```
[edit security pki ca-profile ca-profile-name enrollment]
  retry number-of-attempts;
```

The range for **number-of-attempts** is from 0 through 100.

To specify the amount of time, in seconds, that a router should wait between enrollment attempts, include the **retry-interval seconds** statement at the **[edit security pki ca-profile ca-profile-name enrollment]** hierarchy level:

```
[edit security pki ca-profile ca-profile-name enrollment]
  retry-interval seconds;
```

The range for **seconds** is from 0 through 3600.

## Configuring the Certificate Revocation List

Tasks to configure the certificate revocation list are:

1. [Specifying an LDAP URL on page 24](#)
2. [Configuring the Interval Between CRL Updates on page 25](#)
3. [Overriding Certificate Verification if CRL Download Fails on page 25](#)

### Specifying an LDAP URL

---

You can specify the URL for the Lightweight Directory Access Protocol (LDAP) server where your CA stores its current CRL. If the CA includes the Certificate Distribution Point (CDP) in the digital certificate, you do not need to specify a URL for the LDAP server. The CDP is a field within the certificate that contains information about how to retrieve the CRL for the certificate. The router uses this information to download the CRL automatically.

Configure an LDAP URL if you want to use a different CDP from the one specified in the certificate. Any LDAP URL you configure takes precedence over the CDP included in the certificate.

You can configure up to three URLs for each CA profile.

If the LDAP server requires a password to access the CRL, you need to include the **password** statement.

To configure the router to retrieve the CRL from the LDAP server, include the **url** statement and specify the URL name at the **[edit security pki ca-profile ca-profile-name revocation-check crl]** hierarchy level:

```
[edit security pki ca-profile ca-profile-name revocation-check crl]
url {
  url-name;
}
```

**url-name** is the certificate authority LDAP server name. The format is `ldap://server-name`, where **server-name** is the CA host DNS name or IP address.

To specify to use a password to access the CRL, include the **password** statement at the `[edit security pki ca-profile ca-profile-name revocation-check crl url]` hierarchy level:

```
[edit security pki ca-profile ca-profile-name revocation-check crl url]
password password;
```

**password** is the secret password that the LDAP server requires for access.

### Configuring the Interval Between CRL Updates

By default, the time interval between CRL updates is 24 hours. To configure the amount of time between CRL updates, include the **refresh-interval** statement at the `[edit security pki ca-profile ca-profile-name revocation-check crl]` hierarchy level:

```
[edit security pki ca-profile ca-profile-name revocation-check crl]
refresh-interval number-of-hours;
```

The range for number of hours is from 0 through 8784.

### Overriding Certificate Verification if CRL Download Fails

By default, if the router either cannot access the LDAP URL or retrieve a valid certificate revocation list, certificate verification fails and the IPsec tunnel is not established. To override this behavior and permit the authentication of the IPsec peer when the CRL is not downloaded, include the **disable on-download-failure** statement at the `[edit security pki ca-profile ca-profile-name revocation-check crl]` hierarchy level:

```
[edit security pki ca-profile ca-profile-name revocation-check crl]
disable on-download-failure;
```

## Managing Digital Certificates

After you configure the CA profile, you can request a CA certificate from the trusted CA. Next, you must generate a public/private key pair. When the key pair is available, you can generate a local certificate either online or manually.

Tasks to manage digital certificates are:

1. [Requesting a CA Digital Certificate for AS and Multiservices PICs installed on M Series and T Series Routers on page 26](#)
2. [Generating a Public/Private Key Pair on page 26](#)
3. [Generating and Enrolling a Local Digital Certificate on page 26](#)

## Requesting a CA Digital Certificate for AS and Multiservices PICs installed on M Series and T Series Routers

---

For J Series Services Routers and AS and Multiservices PICs installed on M Series and T Series routers, issue the following command to obtain a digital certificate from a CA. Specify a configured **ca-profile-name** to request a CA certificate from the trusted CA.

```
user@host>request security pki ca-certificate enroll ca-profile ca-profile-name
```

For information about how to configure a CA profile, see [“Configuring the Certificate Authority Properties” on page 23](#).

In this example, the certificate is enrolled online and installed into the router automatically.

```
user@host> request security pki ca-certificate enroll ca-profile entrust
```

Received following certificates:

Certificate: C=us, O=juniper

Fingerprint:00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10

Certificate: C=us, O=juniper, CN=First Officer

Fingerprint:bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17

Certificate: C=us, O=juniper, CN=First Officer

Fingerprint:46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f

Do you want to load the above CA certificate ? [yes,no] (no) yes



**NOTE:** If you obtain the CA certificate directly from the CA (for example, as an e-mail attachment or Web site download), you can install it with the **request security pki ca-certificate load** command. For more information, see the [CLI Explorer](#).

---

## Generating a Public/Private Key Pair

---

After obtaining a certificate for an AS PIC or Multiservices PIC, you must generate a public-private key before you can generate a local certificate. The public key is included in the local digital certificate and the private key is used to decrypt data received from peers. To generate a public-private key pair, issue the **request security pki generate-key-pair certificate-id certificate-id-name** command.

The following example shows how to generate a public-private key for an AS PIC or Multiservices PIC:

```
user@host>request security pki generate-key-pair certificate-id local-entrust2
Generated key pair local-entrust2, key size 1024 bits
```

## Generating and Enrolling a Local Digital Certificate

---

You can generate and enroll local digital certificates either online or manually. To generate and enroll a local certificate online by using the Simple Certificate Enrollment Protocol (SCEP) for an AS PIC or Multiservices PIC, issue the **request security pki local-certificate enroll** command. To generate a local certificate request manually in the PKCS-10 format, issue the **request security pki generate-certificate-request** command.



If you create the local certificate request manually, you must also load the certificate manually. To manually install a certificate in your router, issue the **request security pki local-certificate load** command.

The following example shows how to generate a local certificate request manually and send it to the CA for processing:

```
user@host> request security pki generate-certificate-request certificate-id local-entrust2
domain-name router2.juniper.net filename entrust-req2
subject cn=router2.juniper.net

Generated certificate request
-----BEGIN CERTIFICATE REQUEST-----
MIIBoTCCAQoCAQAwGjEYMBYGA1UEAxMPdHxLmp1bm1wZXIubmV0MIGfMAOGCSqG
SIb3DQEBAQUAA4GNADCBiQKBgQCiUFk1Qws1Ud+AqN5DDxRs2kVyKEhh9qoVFnz+
Hz4c9vsy3B8E1wTJ1kmIt2cB3yi fB6zePd+6WYpf57Crwre7YqPkIXM31F6z3YjX
H+1BPNbCxNWYvyrnSyVYDbFj8o0Xyqog8ACDFVL2JBWrPNBYy7imq/K9soDBbAs6
5hZqqwIDAQABoEcwRQYJKoZIhvcNAQkOMTgwNjA0BgNVHQ8BAf8EBAMCB4AwJAYD
VR0RAQH/BBowGIIWdHxLmVuZ2xhYi5qdW5pcGVyLm5ldDANBgkqhkiG9w0BAQQF
AA0BgQBc2rq1v5S0QXH7LCb/FdqAL8ZM6GoaNs5d6cGwq4bB6a7UQFgtoH406gQ3G
3iH0Zfz4xMIBpJYuGd1dkqgvcDoH3AgTsLkfn7Wi3x5H2qeQVs9bvL4P5nvEZLND
EIMUHwteo1ZCiZ70f09Fer9cXWHSQs1UtXtgPqQJy2xIeImLgw==
-----END CERTIFICATE REQUEST-----
Fingerprint:
0d:90:b8:d2:56:74:fc:84:59:62:b9:78:71:9c:e4:9c:54:ba:16:97 (sha1)
1b:08:d4:f7:90:f1:c4:39:08:c9:de:76:00:86:62:b8 (md5)
```

The trusted CA digitally signs the local certificate and returns it to you. Copy the certificate file into the router and load the certificate:

```
user@host> request security pki local-certificate load filename /tmp/router2-cert
certificate-id local-entrust2
Local certificate local-entrust2 loaded successfully
```



**NOTE:** The name of the file sent to you by the CA might not match the name of the certificate identifier. However, the **certificate-id** name must always match the name of the key pair you generated for the router.

After the local and CA certificates have been loaded, you can reference them in your IPsec configuration. Using default values in the AS and Multiservices PICs, you do not need to configure an IPsec proposal or an IPsec policy. However, you must configure an IKE proposal that specifies the use of digital certificates, reference the IKE proposal and locate the certificate in an IKE policy, and apply the CA profile to the service set.

## Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA

Use the **auto-re-enrollment** statement to configure automatic reenrollment of a specified existing router certificate before its existing expiration date. This function automatically reenrolls the router certificate. The reenrollment process requests the certificate authority (CA) to issue a new router certificate with a new expiration date. The date of auto-reenrollment is determined by the following parameters:

- **re-enroll-trigger-time**—The percentage of the difference between the router certificate start date/time (when the certificate was generated) and the validity period; used to specify how long auto-reenrollment should be initiated before expiration.
- **validity-period**—The number of days after issuance when the router certificate will expire, as set when a certificate is generated.



**NOTE:** By default, this feature is not enabled unless configured explicitly. This means that a certificate that does not have auto-reenrollment configured will expire on its normal expiration date.

The **ca-profile** statement specifies which CA will be contacted to reenroll the expiring certificate. This is the CA that issued the original router certificate.

The **challenge-password** statement provides the issuing CA with the router certificate's password, as set by the administrator and normally obtained from the SCEP enrollment Web page of the CA. The password is 16 characters in length.

Optionally, the router certificate key pair can be regenerated by using the **re-generate-keypair** statement.

To configure automatic reenrollment properties, include the following statements at the **[edit security pki]** hierarchy level:

```
[edit security pki]
auto-re-enrollment {
  certificate-id {
    ca-profile ca-profile-name;
    challenge-password password;
    re-enroll-trigger-time-percentage percentage;
    re-generate-keypair;
    validity-period days;
  }
}
```

**percentage** is the percentage for the reenroll trigger time. The range can be from 1 through 99 percent.

**days** is the number of days for the validity period. The range can be from 1 through 4095.

Tasks to configure automatic reenrollment of certificates are:

1. [Specify the Certificate ID on page 29](#)
2. [Specify the CA Profile on page 29](#)
3. [Specify the Challenge Password on page 29](#)
4. [Specify the Reenroll Trigger Time on page 29](#)
5. [Specify the Regenerate Key Pair on page 29](#)
6. [Specify the Validity Period on page 30](#)

### Specify the Certificate ID

Use the **certificate-id** statement to specify the name of the router certificate to configure for auto-reenrollment. To specify the certificate ID, include the statement at the **[edit security pki auto-re-enrollment]** hierarchy level:

```
[edit security pki auto-re-enrollment]
certificate-id certificate-name;
```

### Specify the CA Profile

Use the **ca-profile** statement to specify the name of the CA profile from the router certificate previously specified by certificate ID. To specify the CA profile, include the statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]
ca-profile ca-profile-name;
```



**NOTE:** The referenced **ca-profile** must have an enrollment URL configured at the **[edit security pki ca-profile *ca-profile-name* enrollment url]** hierarchy level.

### Specify the Challenge Password

The challenge password is used by the CA specified by the PKI certificate ID for reenrollment and revocation. To specify the challenge password, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]
challenge-password password;
```

### Specify the Reenroll Trigger Time

Use the **re-enroll-trigger-time** statement to set the percentage of the validity period before expiration at which reenrollment occurs. To specify the reenroll trigger time, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]
re-enroll-trigger-time percentage;
```

**percentage** is the percentage for the reenroll trigger time. The range can be from 1 through 99 percent.

### Specify the Regenerate Key Pair

When a regenerate key pair is configured, a new key pair is generated during reenrollment. On successful reenrollment, a new key pair and new certificate replace the old certificate and key pair. To generate a new key pair, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
re-generate-keypair;
```

### Specify the Validity Period

---

The **validity-period** statement specifies the router certificate validity period, in number of days, that the specified router certificate remains valid. To specify the validity period, include the statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
validity-period days;
```

**days** is the number of days for the validity period. The range can be from 1 through 4095.

- Related Documentation**
- [Digital Certificates Overview on page 9](#)
  - [Configuring Digital Certificates for an ES PIC on page 15](#)

## Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA

---

Use the **auto-re-enrollment** statement to configure automatic reenrollment of a specified existing router certificate before its existing expiration date. This function automatically reenrolls the router certificate. The reenrollment process requests the certificate authority (CA) to issue a new router certificate with a new expiration date. The date of auto-reenrollment is determined by the following parameters:

- **re-enroll-trigger-time**—The percentage of the difference between the router certificate start date/time (when the certificate was generated) and the validity period; used to specify how long auto-reenrollment should be initiated before expiration.
- **validity-period**—The number of days after issuance when the router certificate will expire, as set when a certificate is generated.



**NOTE:** By default, this feature is not enabled unless configured explicitly. This means that a certificate that does not have auto-reenrollment configured will expire on its normal expiration date.

The **ca-profile** statement specifies which CA will be contacted to reenroll the expiring certificate. This is the CA that issued the original router certificate.

The **challenge-password** statement provides the issuing CA with the router certificate's password, as set by the administrator and normally obtained from the SCEP enrollment Web page of the CA. The password is 16 characters in length.

Optionally, the router certificate key pair can be regenerated by using the **re-generate-keypair** statement.

To configure automatic reenrollment properties, include the following statements at the **[edit security pki]** hierarchy level:

```
[edit security pki]
auto-re-enrollment {
  certificate-id {
    ca-profile ca-profile-name;
    challenge-password password;
    re-enroll-trigger-time-percentage percentage;
    re-generate-keypair;
    validity-period days;
  }
}
```

***percentage*** is the percentage for the reenroll trigger time. The range can be from 1 through 99 percent.

***days*** is the number of days for the validity period. The range can be from 1 through 4095.

Tasks to configure automatic reenrollment of certificates are:

1. [Specify the Certificate ID on page 31](#)
2. [Specify the CA Profile on page 31](#)
3. [Specify the Challenge Password on page 32](#)
4. [Specify the Reenroll Trigger Time on page 32](#)
5. [Specify the Regenerate Key Pair on page 32](#)
6. [Specify the Validity Period on page 32](#)

## Specify the Certificate ID

Use the **certificate-id** statement to specify the name of the router certificate to configure for auto-reenrollment. To specify the certificate ID, include the statement at the **[edit security pki auto-re-enrollment]** hierarchy level:

```
[edit security pki auto-re-enrollment]
certificate-id certificate-name;
```

## Specify the CA Profile

Use the **ca-profile** statement to specify the name of the CA profile from the router certificate previously specified by certificate ID. To specify the CA profile, include the statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]
ca-profile ca-profile-name;
```



**NOTE:** The referenced *ca-profile* must have an enrollment URL configured at the **[edit security pki ca-profile *ca-profile-name* enrollment url]** hierarchy level.

## Specify the Challenge Password

The challenge password is used by the CA specified by the PKI certificate ID for reenrollment and revocation. To specify the challenge password, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
challenge-password password;
```

## Specify the Reenroll Trigger Time

Use the **re-enroll-trigger-time** statement to set the percentage of the validity period before expiration at which reenrollment occurs. To specify the reenroll trigger time, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
re-enroll-trigger-time percentage;
```

***percentage*** is the percentage for the reenroll trigger time. The range can be from 1 through 99 percent.

## Specify the Regenerate Key Pair

When a regenerate key pair is configured, a new key pair is generated during reenrollment. On successful reenrollment, a new key pair and new certificate replace the old certificate and key pair. To generate a new key pair, include the following statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
re-generate-keypair;
```

## Specify the Validity Period

The **validity-period** statement specifies the router certificate validity period, in number of days, that the specified router certificate remains valid. To specify the validity period, include the statement at the **[edit security pki auto-re-enrollment certificate-id *certificate-name*]** hierarchy level:

```
[edit security pki auto-re-enrollment certificate-id certificate-name]  
validity-period days;
```

***days*** is the number of days for the validity period. The range can be from 1 through 4095.

## PART 3

# Distributed Denial-of-Service (DDoS) Protection

- [DDoS Overview on page 35](#)
- [Configuring DDoS Protection on page 41](#)
- [Configuring Flow Detection for DDoS Protection on page 61](#)





## CHAPTER 4

# DDoS Overview

- [Distributed Denial-of-Service \(DDoS\) Protection Overview on page 35](#)

### Distributed Denial-of-Service (DDoS) Protection Overview

---

A denial-of-service attack is any attempt to deny valid users access to network or server resources by using up all the resources of the network element or server. Distributed denial-of-service attacks involve an attack from multiple sources, enabling a much greater amount of traffic to attack the network. The attacks typically use network protocol control packets to trigger a large number of exceptions to the router's control plane. This results in an excessive processing load that disrupts normal network operations.

Junos OS DDoS protection enables the router to continue functioning while under an attack. It identifies and suppresses malicious control packets while enabling legitimate control traffic to be processed. A single point of DDoS protection management enables network administrators to customize profiles for their network control traffic. Protection and monitoring persists across graceful Routing Engine switchover (GRES) and unified in-service-software-upgrade (ISSU) switchovers. Protection is not diminished as the number of subscribers increases.

To protect against DDoS attacks, you can configure policers for host-bound exception traffic. The policers specify rate limits for individual types of protocol control packets or for all control packet types for a protocol. You can monitor policer actions for packet types and protocol groups at the level of the router, Routing Engine, and line cards. You can also control logging of policer events.

The policers at the MPC or FPC5 are the first line of protection. Control traffic is dropped when it exceeds any configured policer values or, for unconfigured policers, the default policer values. Each violation generates a notification to alert operators about a possible attack. The violation is counted, the time that the violation starts is noted, and the time of the last observed violation is noted. When the traffic rate drops below the bandwidth violation threshold, a recovery timer determines when the traffic flow is considered to have returned to normal. If no further violation occurs before the timer expires, the violation state is cleared and a notification is generated.

Policer states and statistics from each line card are relayed to the Routing Engine and aggregated. The policer states are maintained during a switchover. Although line card statistics and violation counts are preserved during a switchover, Routing Engine policer statistics are not.



**NOTE:** DDoS protection is supported only on MX Series routers that have only MPCs installed and T4000 routers that have only FPC5s installed. If the router has other line cards in addition to MPCs or FPC5s, respectively, the CLI accepts the configuration but the other line cards are not protected and so the router is not protected.

---

## Policer Types and Packet Priorities

DDoS protection includes two types of policers:

- An *aggregate policer* is applied to the complete set of packet types that belong to a protocol group. For example, you can configure an aggregate policer that applies to all PPPoE control packet types or to all DHCPv4 control packet types. You can specify bandwidth and burst limits, scale the bandwidth and burst limits, and set a traffic priority for aggregate policers. An aggregate policer is available for all protocol groups. Aggregate policers are supported by all protocol groups.
- An *individual policer*, also referred to as a *packet-type policer*, is allocated for each control packet type within a protocol group. For example, you can configure a policer for one or more types of PPPoE control packets. You can specify bandwidth and burst limits, scale the bandwidth and burst limits, and set a traffic priority for packet-type policers. Individual policers are not available for all protocol groups. See [protocols](#) for a list of protocol groups that have individual policers.

A control packet is policed first by its individual policer (if supported) and then by its aggregate policer. A packet dropped by the individual policer never reaches the aggregate policer. A packet that passes the individual policer can subsequently be dropped by the aggregate policer.

Each packet type within a protocol group has a default, configurable priority: low, medium, or high. Each control packet competes with other packets for the bandwidth within the limit imposed by its aggregate policer based on the priority configured for each packet type in the protocol group.

The priority mechanism is absolute. High-priority traffic gets bandwidth in preference to medium- and low-priority traffic. Medium-priority traffic gets bandwidth in preference to low-priority traffic. Low-priority traffic can use only the bandwidth left by high- and medium-priority traffic. If higher-priority traffic takes all of the bandwidth, then all the lower-priority traffic is dropped.

## Example of Policer Priority Behavior

For example, consider how you might configure packet types within the PPPoE protocol group. Ignoring other PPPoE packet types for this example, suppose you configure individual policers for PADI and PADT packets, as well as a PPPoE aggregate policer for all those packets. PADT packets are more important than PADI packets, because PADT packets enable the PPPoE application to release resources to accept new connections. Therefore, you might assign high priority to the PADT packets and low priority to the PADI packets.

The aggregate policer imposes a total bandwidth limit for the protocol group. PADT packets passed by their individual policer have access to that bandwidth before PADI packets passed by their individual policer, because the PADT packets have a higher priority. If so many PADT packets are passed that they use all the available bandwidth, then all the PADI packets are dropped, because there is no bandwidth remaining at the aggregate policer.

## Policer Hierarchy

DDoS policers are organized to match the hierarchical flow of protocol control traffic. Control traffic arriving from all ports of a line card converges on the card's Packet Forwarding Engine. Control traffic from all line cards on the router converges on the Routing Engine. Similarly, the DDoS policers are placed hierarchically along the control paths so that excess packets are dropped as early as possible on the path. This design preserves system resources by removing excess, malicious traffic so that the Routing Engine receives only the amount of traffic that it can process. To implement this design, five DDoS policers are present: One at the chipset, two at the line card, and two at the Routing Engine. [Figure 1 on page 37](#) shows the policer process for PPPoE traffic. [Figure 2 on page 38](#) shows the policer process for DHCPv4 traffic. (The same process applies to DHCPv6 traffic.)

**Figure 1: Policer Hierarchy for PPPoE Packets**

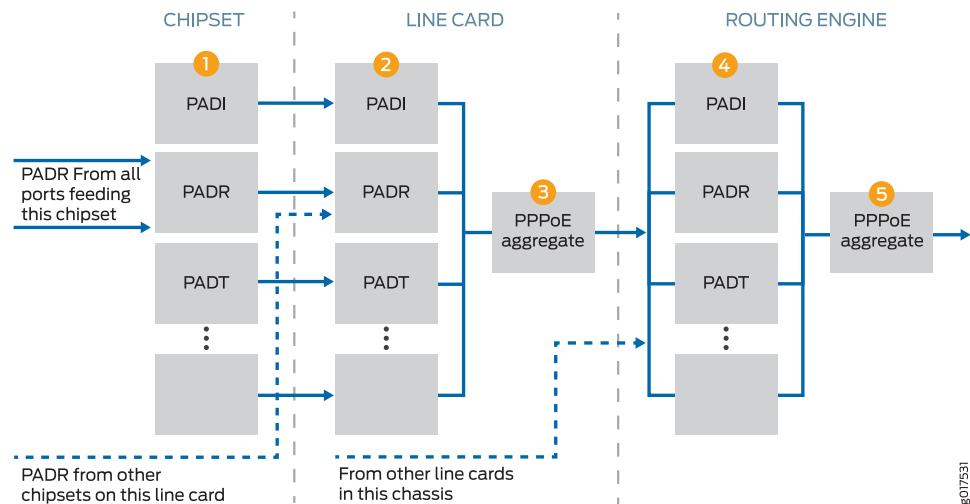
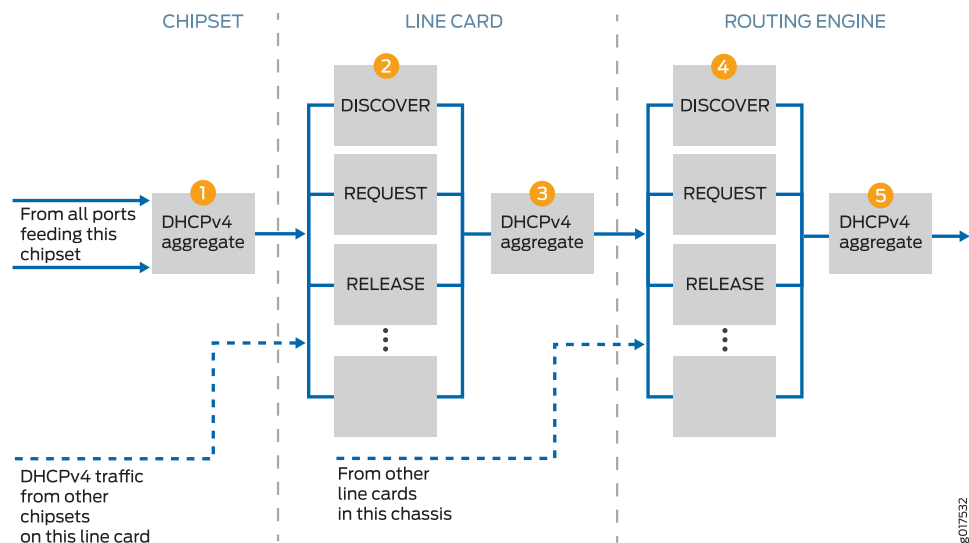


Figure 2: Policer Hierarchy for DHCPv4 Packets



Control packets arrive at the chipset on the MPC or FPC5 for processing and forwarding. The first policer (1) is either an individual policer ([Figure 1 on page 37](#)) or an aggregate policer ([Figure 2 on page 38](#)).

- The first policer is an individual policer for protocol groups that support individual policers, with two exceptions. For DHCPv4 and DHCPv6 traffic, the first policer is an aggregate policer.
- The first policer is an aggregate policer for protocol groups that support only aggregate policers.

Traffic that passes the first policer is monitored by one or both of the line card policers. If the card has more than one chipset, traffic from all chipsets converges on the line card policers.

- When the traffic belongs to a protocol group that supports individual policers, it passes through the line card individual policer (2) and then the line card aggregate policer (3). Traffic that passes the individual policer can be dropped by the aggregate policer. Although DHCPv4 and DHCPv6 traffic was monitored by an aggregate policer at the chipset, at the line card it is handled like other protocols that support individual policers.
- When the traffic belongs to a protocol group that supports only aggregate policers, only the line card aggregate policer monitors the traffic.

Traffic that passes the line card policers is monitored by one or both of the Routing Engine policers. Traffic from all MPCs or FPC5s converges on the Routing Engine policers.

- When the traffic belongs to a protocol group that supports individual policers, it passes through the Routing Engine individual policer (4) and then the Routing Engine aggregate policer (5). Traffic that passes the individual policer can be dropped by the aggregate

policer. As it was at the line card level, DHCPv4 and DHCPv6 traffic at the Routing Engine is handled like other protocols that support individual policers.

- When the traffic belongs to a protocol group that supports only aggregate policers, only the aggregate policer monitors the traffic.

The result of this design is that traffic for protocol groups that support only aggregate policers is evaluated by three policers. Among other groups, this includes ANCP, dynamic VLAN, FTP, and IGMP traffic. Traffic for protocol groups that support both aggregate and individual policers is evaluated by all five policers. Among other groups, this includes DHCPv4, MLP, PPP, PPPoE, and virtual chassis traffic.

Figure 1 on page 37 shows how DDoS protection polices PPPoE control packets:

1. PADR packets, for example, are evaluated at the first policer on the chipset to determine whether they are within the bandwidth limits. PADR packets that exceed the limit are dropped.
2. All PADR packets that pass the policer on all chipsets on the MPC or FPC5 are next evaluated by the line card individual policer. PADR packets that exceed the limit are dropped.
3. All PADR packets that pass the line card individual policer proceed to the line card aggregate policer. PADR packets that exceed the limit are dropped.
4. All PADR packets that are passed by the line card aggregate policers on all MPCs or FPC5s on the router proceed to the Routing Engine individual policer. PADR packets that exceed the limit are dropped.
5. Finally, all PADR packets that are passed by the Routing Engine individual policer proceed to the Routing Engine aggregate policer. PADR packets that exceed the limit are dropped. PADR packets that are not dropped here are passed along as safe, normal traffic.

By default, all three individual policers (chipset, line card, and Routing Engine) have the same bandwidth limit for a given packet type. This design enables all the control traffic from a chipset and line card to reach the Routing engine, as long as there is no competing traffic of the same type from other chipsets or line cards. When competing traffic is present, excess packets are dropped at the convergence points. That is, they are dropped at the line card for all competing chipsets and at the Routing Engine for all competing line cards.

### Example of Policer Bandwidth Limit Behavior

For example, suppose you set the policer bandwidth for PADI packets to 1000 packets per second. This value applies to the individual PADI policers at the chipset, the line card, and the Routing Engine. If only the card in slot 5 is receiving PADI packets, then up to 1000 PADI pps can reach the Routing Engine (if the PPPoE aggregate policer is not exceeded). However, suppose the card in slot 9 is also receiving PADI packets at 1000 pps and that its PPPoE aggregate policer is not exceeded. The traffic passes the individual and aggregate policers at both line cards and proceeds to the Routing Engine. At the Routing Engine, the combined bandwidth is 2000 pps. Because the PADI policer at the

Routing Engine allows only 1000 PADI pps to pass, it drops the excess 1000 packets. It continues to drop the excess packets for as long as the bandwidth is exceeded.

You can apply a scaling factor for both the bandwidth limit and the burst limit at the line card. This enables you to fine-tune the traffic limits for each slot. For example, suppose the individual policer sets the PADI packet bandwidth to 1000 pps and the burst size to 50,000 packets. You can reduce the traffic limit for PADI packets on any line card by specifying the slot number and scaling factor. A bandwidth scaling factor of 20 for slot 5 reduces the traffic in this example to 20 percent of 1000 pps, or 200 pps for the line card in that slot. Similarly, a burst scaling factor of 50 for that slot reduces the burst size by 50 percent to 25,000 packets. By default, scaling factors are set to 100 so traffic can pass through at 100 percent of the rate limit.

**Related  
Documentation**

- [Configuring Protection Against DDoS Attacks on page 41](#)
- [DDoS Protection Flow Detection Overview on page 62](#)

## CHAPTER 5

# Configuring DDoS Protection

- [Configuring Protection Against DDoS Attacks on page 41](#)
- [Example: Configuring DDoS Protection on page 42](#)
- [Configuring DDoS Protection Policers for Individual Packet Types on page 51](#)
- [Disabling DDoS Protection Policers and Logging Globally on page 55](#)
- [Tracing DDoS Protection Operations on page 56](#)
- [Configuring the DDoS Protection Trace Log Filename on page 57](#)
- [Configuring the Number and Size of DDoS Protection Log Files on page 57](#)
- [Configuring Access to the DDoS Protection Log File on page 58](#)
- [Configuring a Regular Expression for DDoS Protection Messages to Be Logged on page 58](#)
- [Configuring the DDoS Protection Tracing Flags on page 59](#)
- [Configuring the Severity Level to Filter Which DDoS Protection Messages Are Logged on page 59](#)
- [Verifying and Managing DDoS Protection on page 59](#)

## Configuring Protection Against DDoS Attacks

---

DDoS protection is enabled by default for all supported protocol groups and packet types. Default values are present for bandwidth, bandwidth scale, burst, burst scale, priority, and recover time. You can change the DDoS configuration for individual packet types within a protocol group or for the aggregate policer for the protocol group. DDoS logging is enabled by default, but you can disable it globally for all DDoS events or for individual packet types within a protocol group. You can also fine-tune monitoring of DDoS events by configuring tracing operations.

You can disable DDoS protection at the Routing Engine and for all line cards either globally or for individual packet types within a protocol group.



**NOTE:** DDoS protection is supported only on MX Series routers that have only MPCs installed and T4000 routers that have only FPC5s installed. If the router has other line cards in addition to MPCs or FPC5s, respectively, the CLI accepts the configuration but the other line cards are not protected and so the router is not protected.

To configure DDoS protection:

1. (Optional) Configure global DDoS settings.  
See [“Disabling DDoS Protection Policers and Logging Globally” on page 55.](#)
2. (Optional) Configure DDoS settings for individual packet types.  
See [“Configuring DDoS Protection Policers for Individual Packet Types” on page 51.](#)
3. (Optional) Configure tracing for DDoS operations.  
See [“Tracing DDoS Protection Operations” on page 56.](#)

**Related Documentation**

- [Distributed Denial-of-Service \(DDoS\) Protection Overview on page 35](#)
- [Example: Configuring DDoS Protection on page 42](#)

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## Example: Configuring DDoS Protection

This example shows how to configure DDoS protection that enables the router to quickly identify an attack and prevent a flood of malicious control packets from exhausting system resources.

- [Requirements on page 42](#)
- [Overview on page 43](#)
- [Configuration on page 43](#)
- [Verification on page 45](#)

## Requirements

DDoS protection requires the following hardware and software:

- MX Series 3D Universal Edge Routers that have only MPCs installed or T4000 Core Routers that have only FPC5s installed.



**NOTE:** If the router has other cards in addition to MPCs or FPC5s, the CLI accepts the configuration but the other cards are not protected and therefore the router is not protected.

- Junos OS Release 11.2 or later



No special configuration beyond device initialization is required before you can configure this feature.

## Overview

Distributed denial-of-service attacks use multiple sources to flood a network or router with protocol control packets. This malicious traffic triggers a large number of exceptions in the network and attempts exhaust the system resources to deny valid users access to the network or server.

This example describes how to configure rate-limiting policers that identify excess control traffic and drop the packets before the router is adversely affected. Sample tasks include configuring policers for particular control packet types within a protocol group, configuring an aggregate policer for a protocol group and bypassing that policer for a particular control packet type, and specifying trace options for DDoS operations.

This example does not show all possible configuration choices.

## Configuration

**CLI Quick Configuration** To quickly configure DDoS protection for protocol groups and particular control packet types, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

```
[edit]
edit system
set ddos-protection protocols dhcpv4 aggregate bandwidth 669
set ddos-protection protocols dhcpv4 aggregate burst 6000
set ddos-protection protocols dhcpv4 discover bandwidth 100
set ddos-protection protocols dhcpv4 discover recover-time 200
set ddos-protection protocols dhcpv4 discover burst 300
set ddos-protection protocols dhcpv4 offer priority medium
set ddos-protection protocols dhcpv4 offer bypass-aggregate
set ddos-protection protocols dhcpv4 offer fpc 1 bandwidth-scale 80
set ddos-protection protocols dhcpv4 offer fpc 1 burst-scale 75
set ddos-protection protocols pppoe aggregate bandwidth 800
set ddos-protection traceoptions file ddos-trace size 10m
set ddos-protection traceoptions flag all
top
```

**Step-by-Step Procedure** The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode*.

To configure DDoS protection:

1. Specify a protocol group.

```
[edit system ddos-protection protocols]
user@host# edit dhcpv4
```

2. Configure the maximum traffic rate for the DHCPv4 aggregate policer; that is, for the combination of all DHCPv4 packets.

```
[edit system ddos-protection protocols dhcpv4]
user@host# set aggregate bandwidth 669
```

3. Configure the maximum burst rate for the DHCPv4 aggregate policer.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set aggregate burst 6000
```
4. Configure the maximum traffic rate for the DHCPv4 policer for discover packets.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set discover bandwidth 100
```
5. Decrease the recover time for violations of the DHCPv4 discover policer.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set discover recover-time 200
```
6. Configure the maximum burst rate for the DHCPv4 discover policer.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set discover burst 300
```
7. Increase the priority for DHCPv4 offer packets.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set offer priority medium
```
8. Prevent offer packets from being included in the aggregate bandwidth; that is, offer packets do not contribute towards the combined DHCPv4 traffic to determine whether the aggregate bandwidth is exceeded. However, the offer packets are still included in traffic rate statistics.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set offer bypass-aggregate
```
9. Reduce the bandwidth and burst size allowed before violation is declared for the DHCPv4 offer policer on the MPC or FPC5 in slot 1.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# set offer fpc 1 bandwidth-scale 80
user@host# set offer fpc 1 burst-scale 75
```
10. Configure the maximum traffic rate for the PPPoE aggregate policer, that is, for the combination of all PPPoE packets.  

```
[edit system ddos-protection protocols dhcpv4]
user@host# up
[edit system ddos-protection protocols]
user@host# set pppoe aggregate bandwidth 800
```
11. Configure tracing for all DDoS protocol processing events.  

```
[edit system ddos-protection traceoptions]
user@host# set file ddos-log
user@host# set file size 10m
user@host# set flag all
```

**Results** From configuration mode, confirm your configuration by entering the **show ddos-protection** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit system]
user@host# show ddos-protection
```

```

traceoptions {
  file ddos-trace size 10m;
  flag all;
}
protocols {
  pppoe {
    aggregate {
      bandwidth 800;
    }
  }
  dhcpv4 {
    aggregate {
      bandwidth 669;
      burst 6000;
    }
    discover {
      bandwidth 100;
      burst 300;
      recover-time 200;
    }
    offer {
      priority medium;
      fpc 1 {
        bandwidth-scale 80;
        burst-scale 75;
      }
      bypass-aggregate;
    }
  }
}

```

If you are done configuring the device, enter **commit** from configuration mode.

## Verification

To confirm that the DDoS protection configuration is working properly, perform these tasks:

- [Verifying the DHCPv4 DDoS Protection Configuration and Operation on page 45](#)
- [Verifying the PPPoE DDoS Configuration on page 48](#)

### Verifying the DHCPv4 DDoS Protection Configuration and Operation

**Purpose** Verify that the DHCPv4 aggregate and protocol policer values have changed from the default. With DHCPv4 and PPPoE traffic flowing, verify that the policers are working correctly. You can enter commands to display the individual policers you are interested in, as shown here, or you can enter the **show ddos-protection protocols dhcpv4** command to display this information for all DHCPv4 packet types.

**Action** From operational mode, enter the **show ddos-protection protocols dhcpv4 aggregate** command.

```
user@host> show ddos-protection protocols dhcpv4 aggregate
```

## Protocol Group: DHCPv4

Packet type: aggregate (aggregate for all DHCPv4 traffic)

## Aggregate policer configuration:

Bandwidth: 669 pps  
 Burst: 6000 packets  
 Priority: medium  
 Recover time: 300 seconds  
 Enabled: Yes

## System-wide information:

Aggregate bandwidth is no longer being violated  
 No. of FPCs currently receiving excess traffic: 0  
 No. of FPCs that have received excess traffic: 1  
 Violation first detected at: 2011-03-10 06:27:47 PST  
 Violation last seen at: 2011-03-10 06:28:57 PST  
 Duration of violation: 00:01:10 Number of violations: 1  
 Received: 71064 Arrival rate: 0 pps  
 Dropped: 23115 Max arrival rate: 1000 pps

## Routing Engine information:

Bandwidth: 669 pps, Burst: 6000 packets, enabled  
 Aggregate policer is never violated  
 Received: 36130 Arrival rate: 0 pps  
 Dropped: 0 Max arrival rate: 671 pps  
 Dropped by aggregate policer: 0

## FPC slot 1 information:

Bandwidth: 100% (669 pps), Burst: 100% (5000 packets), enabled  
 Aggregate policer is no longer being violated  
 Violation first detected at: 2011-03-10 06:27:48 PST  
 Violation last seen at: 2011-03-10 06:28:58 PST  
 Duration of violation: 00:01:10 Number of violations: 1  
 Received: 71064 Arrival rate: 0 pps  
 Dropped: 34934 Max arrival rate: 1000 pps  
 Dropped by individual policers: 11819  
 Dropped by aggregate policer: 23115

From operational mode, enter the **show ddos-protection protocols dhcpv4 discover** command.

```
user@host> show ddos-protection protocols dhcpv4 discover
```

## Protocol Group: DHCPv4

Packet type: discover (DHCPv4 DHCPDISCOVER)

## Individual policer configuration:

Bandwidth: 100 pps  
 Burst: 300 packets  
 Priority: low  
 Recover time: 200 seconds  
 Enabled: Yes  
 Bypass aggregate: No

## System-wide information:

Bandwidth is no longer being violated  
 No. of FPCs currently receiving excess traffic: 0  
 No. of FPCs that have received excess traffic: 1  
 Violation first detected at: 2011-03-10 06:28:34 PST  
 Violation last seen at: 2011-03-10 06:28:55 PST  
 Duration of violation: 00:00:21 Number of violations: 1  
 Received: 47949 Arrival rate: 0 pps  
 Dropped: 11819 Max arrival rate: 671 pps

## Routing Engine information:

Bandwidth: 100 pps, Burst: 300 packets, enabled  
 Policer is never violated

```

Received: 36130           Arrival rate: 0 pps
Dropped: 0               Max arrival rate: 0 pps
Dropped by aggregate policer: 0
FPC slot 1 information:
Bandwidth: 100% (100 pps), Burst: 100% (300 packets), enabled
Policer is no longer being violated
Violation first detected at: 2011-03-10 06:28:35 PST
Violation last seen at: 2011-03-10 06:28:55 PST
Duration of violation: 00:00:20 Number of violations: 1
Received: 47949           Arrival rate: 0 pps
Dropped: 11819           Max arrival rate: 671 pps
Dropped by this policer: 11819
Dropped by aggregate policer: 0

```

From operational mode, enter the **show ddos-protection protocols dhcpv4 offer** command.

```

user@host> show ddos-protection protocols dhcpv4 offer
Protocol Group: DHCPv4

```

```

Packet type: offer (DHCPv4 DHCP OFFER)
Individual policer configuration:
Bandwidth: 1000 pps
Burst: 1000 packets
Priority: medium
Recover time: 300 seconds
Enabled: Yes
Bypass aggregate: Yes
System-wide information:
Bandwidth is never violated
Received: 0           Arrival rate: 0 pps
Dropped: 0           Max arrival rate: 0 pps
Routing Engine information:
Policer is never violated
Received: 0           Arrival rate: 0 pps
Dropped: 0           Max arrival rate: 0 pps
Dropped by aggregate policer: 0
FPC slot 1 information:
Bandwidth: 80% (800 pps), Burst: 75% (750 packets), enabled
Policer is never violated
Received: 0           Arrival rate: 0 pps
Dropped: 0           Max arrival rate: 0 pps
Dropped by aggregate policer: 0

```

**Meaning** The output of these commands lists the policer configuration and traffic statistics for the DHCPv4 aggregate, discover, and offer policers respectively.

The **Aggregate policer configuration** section in the first output example and **Individual policer configuration** sections in the second and third output examples list the configured values for bandwidth, burst, priority, recover time, and bypass-aggregate.

The **System-wide information** section shows the total of all DHCPv4 traffic statistics and violations for the policer recorded across all line cards and at the Routing Engine. The **Routing engine information** section shows the traffic statistics and violations for the policer recorded at the Routing Engine. The **FPC slot 1 information** section shows the traffic statistics and violations for the policer recorded only at the line card in slot 1.

The output for the aggregate policer in this example shows the following information:

- The **System-wide information** section shows that 71,064 DHCPv4 packets of all types were received across all line cards and the Routing Engine. The section shows a single violation with a time stamp and that the aggregate policer at a line card dropped 23,115 of these packets.
- The **FPC slot 1 information** section shows that this line card received all 71,064 DHCPv4 packets, but its aggregate policer experienced a violation and dropped the 23,115 packets shown in the other section. The line card individual policers dropped an additional 11,819 packets.
- The **Routing Engine information** section shows that the remaining 36,130 packets all reached the Routing Engine and that its aggregate policer dropped no additional packets.

The difference between the number of DHCPv4 packets received and dropped at the line card  $[71,064 - (23,115 + 11,819)]$  matches the number received at the Routing Engine. That might not always be the case, because packets can be received and dropped at more than one line card. In this example, only the line card in slot 1 received any DHCPv4 packets.

The output for the DHCPv4 discover packet policer in this example shows the following information:

- The **System-wide information** section shows that 47,949 DHCPv4 discover packets were received across all line cards and the Routing Engine. The section shows a single violation with a time stamp and that the aggregate policer at a line card dropped 11,819 of these packets.
- The **FPC slot 1 information** section shows that this line card received all 47,949 DHCPv4 discover packets, but its individual policer experienced a violation and dropped the 11,819 packets shown in the other section.
- The **Routing Engine information** section shows that only 36,130 DHCPv4 discover packets reached the Routing Engine and that it dropped no additional packets.

The difference between the number of DHCPv4 discover packets received and dropped at the line card  $(47,949 - 11,819)$  matches the number received at the Routing Engine. That might not always be the case, because packets can be received and dropped at more than one line card. In this example, only the line card in slot 1 received any DHCPv4 discover packets.

The output for the DHCPv4 offer packet policer in this example shows the following information:

- This individual policer has never been violated at any location.
- No DHCPv4 offer packets have been received at any location.

---

### Verifying the PPPoE DDoS Configuration

**Purpose** Verify that the PPPoE policer values have changed from the default.

**Action** From operational mode, enter the **show ddos-protection protocols pppoe parameters brief** command.

```
user@host> show ddos-protection protocols pppoe parameters brief
Number of policers modified: 1
Protocol  Packet      Bandwidth Burst  Priority Recover  Policer Bypass FPC
group    type          (pps)    (pkts)                time(sec) enabled aggr.  mod
pppoe    aggregate    800*     2000  medium  300      yes    --    no
pppoe    padi         500      500   low     300      yes    no    no
pppoe    pado         0        0     low     300      yes    no    no
pppoe    padr         500      500   medium  300      yes    no    no
pppoe    pads         0        0     low     300      yes    no    no
pppoe    padt         1000     1000  high    300      yes    no    no
pppoe    padm         0        0     low     300      yes    no    no
pppoe    padn         0        0     low     300      yes    no    no
```

From operational mode, enter the **show ddos-protection protocols pppoe padi** command, and enter the command for **padr** as well.

```
user@host> show ddos-protection protocols pppoe padi
Protocol Group: PPPoE
```

```
Packet type: padi (PPPoE PADI)
Individual policer configuration:
  Bandwidth:      500 pps
  Burst:          500 packets
  Priority:        low
  Recover time:   300 seconds
  Enabled:        Yes
  Bypass aggregate: No
System-wide information:
  Bandwidth for this packet type is being violated!
  Number of slots currently receiving excess traffic: 1
  Number of slots that have received excess traffic: 1
  Violation first detected at: 2011-03-09 11:26:33 PST
  Violation last seen at:    2011-03-10 12:03:44 PST
  Duration of violation: 1d 00:37 Number of violations: 1
  Received: 704832908          Arrival rate: 8000 pps
  Dropped: 660788548          Max arrival rate: 8008 pps
Routing Engine information:
  Bandwidth: 500 pps, Burst: 500 packets, enabled
  Policer is never violated
  Received: 39950330          Arrival rate: 298 pps
  Dropped: 0                  Max arrival rate: 503 pps
  Dropped by aggregate policer: 0
FPC slot 3 information:
  Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled
  Policer is currently being violated!
  Violation first detected at: 2011-03-09 11:26:35 PST
  Violation last seen at:    2011-03-10 12:03:44 PST
  Duration of violation: 1d 00:37 Number of violations: 1
  Received: 704832908          Arrival rate: 8000 pps
  Dropped: 664882578          Max arrival rate: 8008 pps
  Dropped by this policer: 660788548
  Dropped by aggregate policer: 4094030
```

```
user@host> show ddos-protection protocols pppoe padr
Protocol Group: PPPoE
```

```
Packet type: padr (PPPoE PADR)
Individual policer configuration:
```

```

Bandwidth:      500 pps
Burst:          500 packets
Priority:        medium
Recover time:   300 seconds
Enabled:         Yes
Bypass aggregate: No
System-wide information:
Bandwidth for this packet type is being violated!
  Number of slots currently receiving excess traffic: 1
  Number of slots that have received excess traffic: 1
  Violation first detected at: 2011-03-10 06:21:17 PST
  Violation last seen at:      2011-03-10 12:04:14 PST
  Duration of violation: 05:42:57 Number of violations: 1
Received: 494663595      Arrival rate: 24038 pps
Dropped:  484375900      Max arrival rate: 24062 pps
Routing Engine information:
Bandwidth: 500 pps, Burst: 500 packets, enabled
Policer is never violated
Received: 10287695      Arrival rate: 500 pps
Dropped:  0             Max arrival rate: 502 pps
Dropped by aggregate policer: 0
FPC slot 1 information:
Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled
Policer is currently being violated!
  Violation first detected at: 2011-03-10 06:21:18 PST
  Violation last seen at:      2011-03-10 12:04:14 PST
  Duration of violation: 05:42:56 Number of violations: 1
Received: 494663595      Arrival rate: 24038 pps
Dropped:  484375900      Max arrival rate: 24062 pps
Dropped by this policer: 484375900
Dropped by aggregate policer: 0

```

**Meaning** The output from the **show ddos-protection protocols pppoe parameters brief** command lists the current configuration for each of the individual PPPoE packet policers and the PPPoE aggregate policer. A change from a default value is indicated by an asterisk next to the modified value. The only change made to PPPoE policers in the configuration steps was to the aggregate policer bandwidth; this change is confirmed in the output. Besides the configuration values, the command output also reports whether a policer has been disabled, whether it bypasses the aggregate policer (meaning that the traffic for that packet type is not included for evaluation by the aggregate policer), and whether the policer has been modified for one or more line cards.

The output of the **show ddos-protection protocols pppoe padi** command in this example shows the following information:

- The **System-wide information** section shows that 704,832,908 PPPoE PADI packets were received across all line cards and the Routing Engine. The section shows a single violation on a line card that is still in progress, and that the aggregate policer at the line card dropped 660,788,548 of the PADI packets.
- The **FPC slot 3 information** section shows that this line card received all 704,832,908 PADI packets. Its individual policer dropped 660,788,548 of those packets and its aggregate policer dropped the other 4,094,030 packets. The violation is ongoing and has lasted more than a day.
- The **Routing Engine information** section shows that only 39,950,330 PADI packets reached the Routing Engine and that it dropped no additional packets.



The difference between the number of PADI packets received and dropped at the line card  $[704,832,908 - (660,788,548 + 4,094,030)]$  matches the number received at the Routing Engine. That might not always be the case, because packets can be received and dropped at more than one line card. In this example, only the line card in slot 3 received any PADI packets.

The output of the **show ddos-protection protocols pppoe padr** command in this example shows the following information:

- The **System-wide information** section shows that 494,663,595 PPPoE PADR packets were received across all line cards and the Routing Engine. The section shows a single violation on a line card that is still in progress, and that the policer at the line card dropped 484,375,900 of the PADR packets.
- The **FPC slot 1 information** section shows that this line card received all 494,663,595 PADR packets. Its individual policer dropped 484,375,900 of those packets. The violation is ongoing and has lasted more than five hours.
- The **Routing Engine information** section shows that only 10,287,695 PADR packets reached the Routing Engine and that it dropped no additional packets.

The difference between the number of PADR packets received and dropped at the line card  $(494,663,595 - 484,375,900)$  matches the number received at the Routing Engine. That might not always be the case, because packets can be received and dropped at more than one line card. In this example, only the line card in slot 1 received any PADR packets.



**NOTE:** This scenario is unrealistic in showing all PADI packets received on one line card and all PADR packets on a different line card. The intent of the scenario is to illustrate how policer violations are reported for individual line cards.

#### Related Documentation

- [Distributed Denial-of-Service \(DDoS\) Protection Overview on page 35](#)
- [Configuring Protection Against DDoS Attacks on page 41](#)

## Configuring DDoS Protection Policers for Individual Packet Types

DDoS policers are applied to control packet traffic. You configure the maximum allowed traffic rate, maximum burst size, traffic priority, and how much time must pass since the last violation before the traffic flow is considered to have recovered from the attack. You can also scale the bandwidth and burst values for individual line cards so that the policers at this level trigger at lower thresholds than the overall protocol or packet thresholds.

You can configure an aggregate policer for any protocol group. The aggregate policer applies to the combination of all types of control packet traffic for that group. When you configure an aggregate policer for certain protocol groups, you can optionally bypass that policer for one or more particular packet types in that group. For those same groups,

you can configure policers for individual packet types instead of configuring an aggregate policer.

DDoS protection is enabled by default. Although all policers have default parameter values, these values might not accurately reflect the control traffic pattern of your network.



**BEST PRACTICE:** We recommend that you model your network to determine the best values for your situation. Before you configure policers for your network, you can quickly view the default values for all packet types from operational mode by issuing the `show ddos-protection protocols parameters brief` command. You can also use the command to specify a single protocol group of interest; for example, issue the `show ddos-protection protocols dhcpv4 parameters brief` command.

You can disable a packet type's policer at either the Routing Engine, at a specified line card, or for all line cards. You can also disable logging of all DDoS events for individual packet types within a protocol group.

To configure individual, packet-level DDoS settings:

1. Specify the protocol group.

```
[edit system ddos-protection protocols]
user@host# edit protocol-group
```

For example, to specify the DHCPv4 protocol group:

```
[edit system ddos-protection protocols]
user@host# edit dhcpv4
```

2. Specify the packet type or the combination of all packet types in the group.

```
[edit system ddos-protection protocols protocol-group]
user@host# set packet-type
```

or

```
[edit system ddos-protection protocols protocol-group]
user@host# set aggregate
```

For example, to specify the DHCPv4 release packets:

```
[edit system ddos-protection protocols dhcpv4]
user@host# edit release
```

3. (Optional) Configure the maximum traffic rate the policer allows for the packet type.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set bandwidth packets-per-second
```

For example, to set a bandwidth of 600 packets per second for DHCPv4 release packets:

```
[edit system ddos-protection protocols dhcpv4 release]
user@host# set bandwidth 600
```

4. (Optional) Configure the maximum number of packets of the packet type that the policer allows in a burst of traffic.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set burst size
```

For example, to set a maximum of 5000 DHCPv4 release packets:

```
[edit system ddos-protection protocols dhcpv4 release]
user@host# set burst 5000
```

5. (Optional) Set the traffic priority.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set priority level
```

For example, to specify a medium priority for DHCPv4 release packets:

```
[edit system ddos-protection protocols dhcpv4 release]
user@host# set priority medium
```

6. (Optional) Configure how much time must pass since the last violation before the traffic flow is considered to have recovered from the attack.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set recover-time seconds
```

For example, to specify that 600 seconds must have passed since the last violation of the DHCPv4 release packet policer:

```
[edit system ddos-protection protocols dhcpv4 release]
user@host# set recover-time 600
```

7. (Optional) Bypass the aggregate policer configuration. This is relevant only when an aggregate policer is configured for the protocol group.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set bypass-aggregate
```

For example, to bypass the aggregate policer for DHCPv4 renew packets:

```
[edit system ddos-protection protocols dhcpv4 renew]
user@host# set bypass-aggregate
```

8. (Optional) Disable line card policers for the packet type on all line cards.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set disable-fpc
```



**NOTE:** When you disable line card policers globally at the [edit system ddos-protection global] hierarchy level, the global setting overrides the per-packet type setting shown in this step. If you subsequently remove the global configuration, then the per-packet type configuration takes effect.

For example, to disable the line card policer for DHCPv4 bootp packets:

```
[edit system ddos-protection protocols dhcpv4 bootp]
user@host# set disable-fpc
```

9. (Optional) Disable DDoS event logging for only this packet type.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# set disable-logging
```



**NOTE:** Events disabled for the packet are associated with policer violations; logging of flow detection culprit flow events is not affected by this statement.



**NOTE:** When you disable DDoS event logging globally at the [edit system ddos-protection global] hierarchy level, the global setting overrides the per-packet type setting shown in this step. If you subsequently remove the global configuration, then the per-packet type configuration takes effect.

For example, to disable DDoS event logging line card policer for DHCPv4 discover packets:

```
[edit system ddos-protection protocols dhcpv4 discover]  
user@host# set disable-logging
```

10. (Optional) Disable the Routing Engine policer for only this packet type.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# set disable-routing-engine
```



**NOTE:** When you disable the Routing Engine policer globally at the [edit system ddos-protection global] hierarchy level, the global setting overrides the per-packet type setting shown in this step. If you subsequently remove the global configuration, then the per-packet type configuration takes effect.

For example, to disable the Routing Engine policer for DHCPv4 discover packets:

```
[edit system ddos-protection protocols dhcpv4 discover]  
user@host# set disable-routing-engine
```

11. (Optional) Configure packet-level settings for the packet type on a single line card.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# edit fpc slot-number
```

For example, to access DHCPv4 discover packet settings on the line card in slot 3:

```
[edit system ddos-protection protocols dhcpv4 discover]  
user@host# edit fpc 3
```

12. (Optional) Scale the policer bandwidth for the packet type on the line card.

```
[edit system ddos-protection protocols protocol-group packet-type fpc slot-number]  
user@host# set bandwidth-scale percentage
```

For example, to scale the bandwidth to 80 percent of the all-line-card setting configured for DHCPv4 discover packets on the line card in slot 3:

```
[edit system ddos-protection protocols dhcpv4 discover fpc 3]
user@host# edit bandwidth-scale 80
```

13. (Optional) Scale the policer burst size for the packet type on the line card.

```
[edit system ddos-protection protocols protocol-group packet-type fpc slot-number]
user@host# set burst-scale percentage
```

For example, to scale the maximum bandwidth to 75 percent of the all-line-card setting configured for DHCPv4 discover packets on the line card in slot 3:

```
[edit system ddos-protection protocols dhcpv4 discover fpc 3]
user@host# edit burst-scale 75
```

14. (Optional) Disable the line card policer for the packet type on a particular line card.

```
[edit system ddos-protection protocols protocol-group packet-type fpc slot-number]
user@host# set disable-fpc
```

For example, to disable the line card policer for DHCPv4 discover packets on the line card in slot 3:

```
[edit system ddos-protection protocols dhcpv4 discover fpc 3]
user@host# edit disable-fpc
```

#### Related Documentation

- [Configuring Protection Against DDoS Attacks on page 41](#)
- For a list of supported protocol groups and packet types, see [protocols on page 258](#).
- [Example: Configuring DDoS Protection on page 42](#)

## Disabling DDoS Protection Policers and Logging Globally

DDoS policers are enabled by default for all supported protocol groups and packet types. Policers are established at the level of the individual line card and the Routing Engine. You can disable the line card policers globally for all MPCs or FPC5s. You can also disable the Routing Engine policer. When you disable either of these policers, the policers at that level for all protocol groups and packet types are disabled.

DDoS logging is also enabled by default. You can disable all DDoS event logging (including flow detection event logging) for all protocol groups and packet types across the router.



**NOTE:** The global configuration for disabling policers and logging overrides any local configuration for packet types.

To configure global DDoS settings:

1. (Optional) Disable line card policers.

```
[edit system ddos-protection global]
user@host# set disable-fpc
```

- 
2. (Optional) Disable Routing Engine policers.

```
[edit system ddos-protection global]  
user@host# set disable-routing-engine
```

- 
- 
3. (Optional) Disable event logging.

```
[edit system ddos-protection global]  
user@host# set disable-logging
```

**Related  
Documentation**

- [Configuring Protection Against DDoS Attacks on page 41](#)

---

## Tracing DDoS Protection Operations

The Junos OS trace feature tracks DDoS protection operations and records events in a log file. The error descriptions captured in the log file provide detailed information to help you solve problems.

By default, nothing is traced. When you enable the tracing operation, the default tracing behavior is as follows:

1. Important events are logged in a file located in the `/var/log` directory. By default, the router uses the filename `ddosd`. You can specify a different filename, but you cannot change the directory in which trace files are located.
2. When the trace log file *filename* reaches 128 kilobytes (KB), it is compressed and renamed *filename.0.gz*. Subsequent events are logged in a new file called *filename*, until it reaches capacity again. At this point, *filename.0.gz* is renamed *filename.1.gz* and *filename* is compressed and renamed *filename.0.gz*. This process repeats until the number of archived files reaches the maximum file number. Then the oldest trace file—the one with the highest number—is overwritten.

You can optionally specify the number of trace files to be from 2 through 1000. You can also configure the maximum file size to be from 10 KB through 1 gigabyte (GB). (For more information about how log files are created, see the *Junos OS System Log Messages Reference*.)

By default, only the user who configures the tracing operation can access log files. You can optionally configure read-only access for all users.

To configure all aspects of DDoS tracing operations:

1. (Optional) Configure a trace log filename.

See “[Configuring the DDoS Protection Trace Log Filename](#)” on page 57.

- 
2. (Optional) Configure the number and size of trace logs.

See “[Configuring the Number and Size of DDoS Protection Log Files](#)” on page 57.

- 
- 
3. (Optional) Configure user access to trace logs.

See “[Configuring Access to the DDoS Protection Log File](#)” on page 58.

4. (Optional) Configure a regular expression to filter the information to be included in the trace log.  
See [“Configuring a Regular Expression for DDoS Protection Messages to Be Logged” on page 58.](#)
5. (Optional) Configure flags to specify which events are logged.  
See [“Configuring the DDoS Protection Tracing Flags” on page 59.](#)
6. (Optional) Configure a severity level for messages to specify which event messages are logged.  
See [“Configuring the Severity Level to Filter Which DDoS Protection Messages Are Logged” on page 59.](#)

**Related Documentation** • [Example: Configuring DDoS Protection on page 42](#)

## Configuring the DDoS Protection Trace Log Filename

By default, the name of the file that records trace output for DDoS protection is **ddosd**. You can specify a different name with the **file** option.

To configure the filename for subscriber management database tracing operations:

- Specify the name of the file used for the trace output.

```
[edit system ddos-protection traceoptions]
user@host# set file ddos_logfile_1
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)

## Configuring the Number and Size of DDoS Protection Log Files

You can optionally specify the number of compressed, archived trace log files to be from 2 through 1000. You can also configure the maximum file size to be from 10 KB through 1 gigabyte (GB); the default size is 128 kilobytes (KB).

The archived files are differentiated by a suffix in the format **.number.gz**. The newest archived file is **.0.gz** and the oldest archived file is **.(maximum number)-1.gz**. When the current trace log file reaches the maximum size, it is compressed and renamed, and any existing archived files are renamed. This process repeats until the maximum number of archived files is reached, at which point the oldest file is overwritten.

For example, you can set the maximum file size to 2 MB, and the maximum number of files to 20. When the file that receives the output of the tracing operation, **filename**, reaches 2 MB, **filename** is compressed and renamed **filename.0.gz**, and a new file called **filename** is created. When the new **filename** reaches 2 MB, **filename.0.gz** is renamed **filename.1.gz** and **filename** is compressed and renamed **filename.0.gz**. This process repeats until there are 20 trace files. Then the oldest file, **filename.19.gz**, is simply overwritten when the next oldest file, **filename.18.gz** is compressed and renamed to **filename.19.gz**.

To configure the number and size of trace files:

- Specify the name, number, and size of the file used for the trace output.

```
[edit system ddos-protection traceoptions]  
user@host# set file ddos_1_logfile_1 files 20 size 2097152
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)

---

## Configuring Access to the DDoS Protection Log File

By default, only the user who configures the tracing operation can access the log files. You can enable all users to read the log file and you can explicitly set the default behavior of the log file.

To specify that all users can read the log file:

- Configure the log file to be world-readable.

```
[edit system ddos-protection traceoptions]  
user@host# set file ddos_1_logfile_1 world-readable
```

To explicitly set the default behavior, only the user who configured tracing can read the log file:

- Configure the log file to be no-world-readable.

```
[edit system ddos-protection traceoptions]  
user@host# set file ddos_1_logfile_1 no-world-readable
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)

---

## Configuring a Regular Expression for DDoS Protection Messages to Be Logged

By default, the trace operation output includes all messages relevant to the logged events.

You can refine the output by including regular expressions to be matched.

To configure regular expressions to be matched:

- Configure the regular expression.

```
[edit system ddos-protection traceoptions]  
user@host# set file ddos_1_logfile_1 match regex
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)



## Configuring the DDoS Protection Tracing Flags

By default, only important events are logged. You can specify which events and operations are logged by specifying one or more tracing flags.

To configure the flags for the events to be logged:

- Configure the flags.

```
[edit system ddos-protection traceoptions]
user@host# set flag flag
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)

## Configuring the Severity Level to Filter Which DDoS Protection Messages Are Logged

The messages associated with a logged event are categorized according to severity level. You can use the severity level to determine which messages are logged for the event type. The severity level that you configure depends on the issue that you are trying to resolve. In some cases you might be interested in seeing all messages relevant to the logged event, so you specify **all** or **verbose**. Either choice generates a large amount of output. You can specify a more restrictive severity level, such as **notice** or **info** to filter the messages. By default, the trace operation output includes only messages with a severity level of **error**.

To configure the type of messages to be logged:

- Configure the message severity level.

```
[edit system ddos-protection traceoptions]
user@host# set level severity
```

**Related Documentation** • [Tracing DDoS Protection Operations on page 56](#)

## Verifying and Managing DDoS Protection

**Purpose** View or clear information about DDoS configurations, states, and statistics.

**Action** • To display the DDoS policer configuration, violation state, and statistics for all packet types in all protocol groups:

```
user@host> show ddos-protection protocols
```

If you issue the command before you make any configuration changes, the default policer values are displayed.

- To display the DDoS policer configuration, violation state, and statistics for a particular packet type in a particular protocol group:

```
user@host> show ddos-protection protocols protocol-group packet-type
```

- To display only the number of DDoS policer violations for all protocol groups:  
user@host> **show ddos-protection protocols violations**
- To display a table of the DDoS configuration for all packet types in all protocol groups:  
user@host> **show ddos-protection protocols parameters brief**
- To display a complete list of packet statistics and DDoS violation statistics for all packet types in all protocol groups:  
user@host> **show ddos-protection protocols statistics detail**
- To display global DDoS violation statistics:  
user@host> **show ddos-protection statistics**
- To display the DDoS version number:  
user@host> **show ddos-protection version**
- To clear DDoS statistics for all packet types in all protocol groups:  
user@host> **clear ddos-protection protocols statistics**
- To clear DDoS statistics for all packet types in a particular protocol group:  
user@host> **clear ddos-protection protocols *protocol-group* statistics**
- To clear DDoS statistics for a particular packet type in a particular protocol group:  
user@host> **clear ddos-protection protocols *protocol-group* statistics *packet-type***
- To clear DDoS violation states for all packet types in all protocol groups:  
user@host> **clear ddos-protection protocols states**
- To clear DDoS violation states for all packet types in a particular protocol group:  
user@host> **clear ddos-protection protocols *protocol-group* states**
- To clear DDoS violation states for a particular packet type in a particular protocol group:  
user@host> **clear ddos-protection protocols *protocol-group* states *packet-type***

**Related  
Documentation**

- [Verifying and Managing Flow Detection on page 73](#)

## CHAPTER 6

# Configuring Flow Detection for DDoS Protection

- [DDoS Protection Flow Detection Overview on page 62](#)
- [Configuring Flow Detection for DDoS Protection on page 65](#)
- [Enabling Flow Detection for All Protocol Groups and Packet Types on page 66](#)
- [Configuring the Culprit Flow Reporting Rate for All Protocol Groups and Packet Types on page 66](#)
- [Configuring the Violation Reporting Rate for All Protocol Groups and Packet Types on page 67](#)
- [Configuring the Detection Period for Suspicious Flows on page 67](#)
- [Configuring the Recovery Period for a Culprit Flow on page 68](#)
- [Configuring the Timeout Period for a Culprit Flow on page 68](#)
- [Configuring Flow Detection for Individual Protocol Groups or Packets on page 69](#)
- [Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69](#)
- [Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level on page 71](#)
- [Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level on page 71](#)
- [Disabling Automatic Logging of Culprit Flow Events for a Packet Type on page 73](#)
- [Verifying and Managing Flow Detection on page 73](#)

## DDoS Protection Flow Detection Overview

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Flow detection is an enhancement to DDoS protection that supplements the DDoS policer hierarchies; it is part of a complete DDOS protection solution. Flow detection uses a limited amount of hardware resources to monitor the arrival rate of host-bound flows of control traffic. Flow detection is much more scalable than a solution based on filter policers. Filter policers track all flows, which consumes a considerable amount of resources. In contrast, flow detection only tracks flows it identifies as suspicious, using far fewer resources to do so.

The flow detection application has two interrelated components, detection and tracking. Detection is the process where flows suspected of being improper are identified and subsequently controlled. Tracking is the process where flows are tracked to determine whether they are truly hostile and when these flows recover to within acceptable limits.

- [Flow Detection and Control on page 62](#)
- [Flow Tracking on page 63](#)
- [Notifications on page 63](#)

### Flow Detection and Control

Flow detection is disabled by default. When you enable it at the **[edit system ddos-protection global]** hierarchy level, the application begins monitoring control traffic flows when a DDoS protection policer is violated for all protocol groups and packet types. Other than event report rates, all other characteristics of flow detection are configurable only at the level of individual packet types.

Control flows are aggregated at three levels. The *subscriber level* is the finest grained of the three and consists of flows for individual subscriber sessions. The *logical interface level* aggregates multiple subscriber flows, so it is coarser grained and does not provide discrimination into individual subscriber flows. The *physical interface level* aggregates multiple logical interface flows, so it provides the coarsest view of traffic flows.

You can turn flow detection off or on at any of these levels. You can also configure whether it is automatically triggered by the violation of a DDoS protection policer or is always on—meaning that it always monitors flows, even when no policer is being violated. Flow detection begins at the finest-grained level that has detection configured to **on** or **automatic**.

When a flow arrives, flow detection checks whether the flow is already listed in a table of *suspicious* flows. A suspicious flow is one that exceeds the bandwidth allowed by default or configuration. If the flow is not in the table and the aggregation level flow detection mode is **on**, then flow detection lists the flow in the table. If the flow is not in the table and the flow detection mode is **automatic**, flow detection checks whether this flow is suspicious.

If the flow is suspicious, then it goes in the flow table. If the flow is not suspicious, then it is processed the same way at the next coarser aggregation level that has flow detection

set to **on**. If none of the higher levels have detection on, then the flow continues to the DDoS protection packet policer for action, where it can be passed or dropped.

When the initial check finds the flow in the table, then the flow is dropped, policed, or kept, depending on the control mode setting for that aggregation level. All packets in dropped flows are dropped. In policed flows, packets are dropped until the flow is within the acceptable bandwidth for the aggregation level. Kept flows are passed along to the next aggregation level for processing.

## Flow Tracking

The flow detection application tracks flows that have been listed in the suspicious flow table. It periodically checks each entry in the table to determine whether the listed flow is still suspicious (violating the bandwidth). If a suspicious flow has continuously violated the bandwidth since it was inserted in the table for a period greater than the configurable flow detection period, then it is considered to be a *culprit* flow rather than merely suspicious. However, if the bandwidth has been violated for less than the detection period, the violation is treated as a false positive. Flow detection considers the flow to be safe and stops tracking it (deletes it from the table).

You can enable a timeout feature that suppresses culprit flows for a configurable timeout period, during which the flow is kept in the flow table. (Suppression is the default behavior, but the flow detection action can be changed by the flow level control configuration.) If the check of listed flows finds one for which the timeout is enabled and the timeout period has expired, then the flow has timed out and it is removed from the flow table.

If the timeout has not yet expired or if the timeout feature is not enabled, then the application performs a recovery check. If the time since the flow last violated the bandwidth is longer than the configurable recovery period, the flow has recovered and is removed from the flow table. If the time since last violation is less than the recovery period, the flow is kept in the flow table.

## Notifications

By default, flow detection automatically generates system logs for a variety of events that occur during flow detection. The logs are referred to as *reports* in the flow detection CLI. All protocol groups and packet types are covered by default, but you can disable automatic logging for individual packet types. You can also configure the rate at which reports are sent, but this applies globally to all packet types.

Each report belongs to one of the following two types:

- Flow reports—These reports are generated by events associated with the identification and tracking of culprit flows. Each report includes identifying information for the flow that experienced the event. This information is used to accurately maintain the flow table; flows are deleted or retained in the table based on the information in the report. [Table 3 on page 64](#) describes the event that triggers each flow report.

**Table 3: Triggering Event for Flow Detection Reports**

| Name                         | Description  |
|------------------------------|--|
| DDOS_SCFD_FLOW_FOUND         | A suspicious flow is detected.   |
| DDOS_SCFD_FLOW_TIMEOUT       | The timeout period expires for a culprit flow. Flow detection stops suppressing (or monitoring) the flow.  |
| DDOS_SCFD_FLOW_RETURN_NORMAL | A culprit flow returns to within the bandwidth limit.  |
| DDOS_SCFD_FLOW_CLEARED       | A culprit flow is cleared manually with a <b>clear</b> command or automatically as the result of suspicious flow monitoring shifting to a different aggregation level.   |
| DDOS_SCFD_FLOW_AGGREGATED    | Control flows are aggregated to a coarser level. This event happens when the flow table nears capacity or when the flow cannot be found at a particular flow level and the next coarser level has to be searched.  |
| DDOS_SCFD_FLOW_DEAGGREGATED  | Control flows are deaggregated to a finer level. This event happens when the flow table is not very full or when flow control is effective and the total arrival rate for the flow at the policer for the packet type is below its bandwidth for a fixed, internal period. |

- Bandwidth violation reports—These reports are generated by events associated with the discovery of suspicious flows. Each report includes identifying information for the flow that experienced the event. This information is used to track the suspicious flow and identify flows that are placed in the flow table. [Table 4 on page 64](#) describes the event that triggers each violation report.

**Table 4: Triggering Event for Bandwidth Violation Reports**

| Name                          | Description  |
|-------------------------------|--|
| DDOS_PROTOCOL_VIOLATION_SET   | The incoming traffic for a violated control protocol returned to normal.       |
| DDOS_PROTOCOL_VIOLATION_CLEAR | The incoming traffic for a control protocol exceeded the configured bandwidth. |

A report is sent only when triggered by an event; that is, there are no null or empty reports. Because the reports are made periodically, the only events of interest are ones that occur during the interval since the last report.

**Related Documentation**

- [Configuring Flow Detection for DDoS Protection on page 65](#)

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## Configuring Flow Detection for DDoS Protection

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Flow detection monitors the flows of control traffic for violation of the bandwidth allowed for each flow and manages traffic identified as a culprit flow. Suppression of the traffic is the default management option. Flow detection is typically implemented as part of an overall DDoS protection strategy, but it is also useful for troubleshooting and understanding traffic flow in new configurations. Flow detection is disabled by default.

Before you begin, ensure you have configured DDoS protection appropriately for your network. See [“Configuring Protection Against DDoS Attacks” on page 41](#) for detailed information about DDoS protection.

To configure flow detection:

1. Enable flow detection globally for all protocol groups and packet types.  
See [“Enabling Flow Detection for All Protocol Groups and Packet Types” on page 66](#).
2. (Optional) Set the rate at which culprit flow events are reported for all line cards, protocol groups, and packet types.  
See [“Configuring the Culprit Flow Reporting Rate for All Protocol Groups and Packet Types” on page 66](#).
3. Set the rate at which bandwidth violations are reported for all line cards, protocol groups, and packet types.  
See [“Configuring the Violation Reporting Rate for All Protocol Groups and Packet Types” on page 67](#).
4. (Optional) Configure how long a suspicious flow must be in violation of flow bandwidth before being declared a culprit flow.  
See [“Configuring the Detection Period for Suspicious Flows” on page 67](#).
5. (Optional) Configure how long a culprit flow must drop to within its allowed bandwidth before being declared normal.  
See [“Configuring the Recovery Period for a Culprit Flow” on page 68](#).
6. (Optional) Enable and configure how long a culprit flow is suppressed or monitored.  
See [“Configuring the Timeout Period for a Culprit Flow” on page 68](#).
7. (Optional) Configure when flow detection monitors flows.  
See [“Configuring Flow Detection for Individual Protocol Groups or Packets” on page 69](#).
8. (Optional) Configure when flow detection operates at each flow aggregation level (subscriber, logical interface, and physical interface).  
See [“Configuring How Flow Detection Operates at Each Flow Aggregation Level” on page 69](#).
9. Configure the maximum bandwidth for packet flows at each flow aggregation level (subscriber, logical interface, and physical interface).

See [“Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level”](#) on page 71.

10. (Optional) Configure how traffic is controlled at each flow aggregation level (subscriber, logical interface, and physical interface) for flows that violate their bandwidth.

See [“Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level”](#) on page 71.

11. (Optional) Disable automatic logging of suspicious flows.

See [“Disabling Automatic Logging of Culprit Flow Events for a Packet Type”](#) on page 73.

**Related  
Documentation**

- [Distributed Denial-of-Service \(DDoS\) Protection Overview](#) on page 35
- [DDoS Protection Flow Detection Overview](#) on page 62

---

## Enabling Flow Detection for All Protocol Groups and Packet Types

By default, flow detection is disabled for all protocol groups and packet types. You must enable flow detection globally by including the **flow-detection** statement. If you subsequently disable flow detection for individual packet types, you cannot use this global statement to override all such individual configurations; you must re-enable detection at the packet configuration level.

To enable flow detection globally:

- Set flow detection.

```
[edit system ddos-protection global]  
user@host# set flow-detection
```

**Related  
Documentation**

- [Configuring Flow Detection for DDoS Protection](#) on page 65
- [Configuring Protection Against DDoS Attacks](#) on page 41

---

## Configuring the Culprit Flow Reporting Rate for All Protocol Groups and Packet Types

When flow detection confirms that a suspicious flow it is tracking on a line card is indeed a culprit flow, it sends a report to the Routing Engine. Flow detection also reports each culprit flow that subsequently recovers to within the allowed bandwidth or is cleared. You can include the **flow-report-rate** statement to limit how many flows per second on each line card can be reported. Culprit flow events are reported for all protocol groups and packet types by default. When too many flows are reported, congestion can occur on the host path to the Routing Engine flow.

To globally configure the maximum report rate for culprit flows:

- Set the reporting rate.

```
[edit system ddos-protection global]  
user@host# set flow-report-rate rate
```



- Related Documentation**
- [Configuring Flow Detection for DDoS Protection on page 65](#)
  - [Disabling Automatic Logging of Culprit Flow Events for a Packet Type on page 73](#)

## Configuring the Violation Reporting Rate for All Protocol Groups and Packet Types

By default, flow detection reports to the Routing Engine all violations of bandwidth at the FPC for all protocol groups and packet types. You can include the **violation-report-rate** statement to limit how many violations per second flow detection reports from the line cards, thus reducing the load on the router. We recommend that you configure a report rate that is suitable for your network rather than rely on the default value.

To globally configure the maximum bandwidth violation reporting rate:

- Set the reporting rate.

```
[edit system ddos-protection global]
user@host# set violation-report-rate rate
```

- Related Documentation**
- [Configuring Flow Detection for DDoS Protection on page 65](#)

## Configuring the Detection Period for Suspicious Flows

DDoS protection flow detection considers a monitored flow to be a suspicious flow whenever the flow exceeds its allowed bandwidth, based on a crude test that eliminates obviously good flows from consideration. A closer examination of a suspicious flow requires the flow to remain in violation of the bandwidth for a period of time before flow detection considers it to be a culprit flow against which it must take action. You can include the **flow-detect-time** statement to configure the duration of this detection period or you can rely on the default period of three seconds.



**BEST PRACTICE:** We recommend that you use the default value for the detection period.

To specify how long a flow must be in violation before flow detection declares it to be a culprit flow:

- Set the detection period.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set flow-detect-time seconds
```

For example, include the following statement to require the DHCPv4 discover packet flow to be in violation of its allowed bandwidth for 30 seconds before it is considered to be a culprit flow:

```
[edit system ddos-protection protocols dhcpv4 discover]
user@host# set flow-detect-time 30
```

- Related Documentation**
- [Configuring Flow Detection for DDoS Protection on page 65](#)

---

## Configuring the Recovery Period for a Culprit Flow

After DDoS protection flow detection has identified a suspicious flow as a culprit flow, it has to determine when that flow no longer represents a threat to the router. When the traffic flow rate drops back to within the allowed bandwidth, the rate must remain within the bandwidth for a recovery period. Only then does flow detection consider the flow to be normal and stop the traffic handling action enacted against the culprit flow. You can include the **flow-recover-time** statement to configure the duration of this recovery period or you can rely on the default period of 60 seconds.

To specify how long a flow must be within its allowed bandwidth after a violation before flow detection declares it to be a normal flow:

- Set the recovery period.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# set flow-recover-time seconds
```

For example, include the following statement to require the DHCPv4 discover packet flow to be in recovery for five minutes (300 seconds):

```
[edit system ddos-protection protocols dhcpv4 discover]  
user@host# set flow-recover-time 300
```

- Related Documentation**
- [Configuring Flow Detection for DDoS Protection on page 65](#)

---

## Configuring the Timeout Period for a Culprit Flow

When DDoS protection flow detection identifies a suspicious flow as a culprit flow, by default it suppresses traffic for that flow for as long as the traffic flow exceeds the bandwidth limit. Suppression stops and the flow is removed from the flow table when the time since the last violation by the flow is greater than the recovery period.

Alternatively, you can include the **timeout-active-flows** statement to enable flow detection to suppress a culprit flow for a configurable timeout period. When the timeout period expires, suppression stops and the flow is removed from the flow table. You can either include the **flow-timeout-time** statement to configure the duration of the timeout period or rely on the default timeout of 300 seconds.

To enable flow detection to suppress a culprit flow for a timeout period:

1. Enable the timeout.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# set timeout-active-flows
```

2. Specify the timeout period.

```
[edit system ddos-protection protocols protocol-group packet-type]  
user@host# set flow-timeout-time seconds
```

For example, include the following statements to suppress the DHCPv4 discover packet flow for 10 minutes (600 seconds):

```
[edit system ddos-protection protocols dhcpv4 discover]
user@host# set timeout-active-flows
user@host# set flow-timeout-time 600
```

**Related Documentation**

- [Configuring Flow Detection for DDoS Protection on page 65](#)

## Configuring Flow Detection for Individual Protocol Groups or Packets

By default, flow detection is disabled for all protocol groups and packet types. After you have turned on flow detection globally, you can include the **flow-detection-mode** statement to configure flow detection to operate differently for individual packet types. By default, flow detection operates in automatic mode for all packet types, meaning that it monitors control traffic for suspicious flows only after a DDoS policer has been violated. You can also configure flow detection either to never monitor flows or to always monitor flows.



**NOTE:** The flow detection mode at the packet level must be either **automatic** or **on** for flow detection to operate at individual flow aggregation levels.

To configure how flow detection operates:

- Disable suspicious flow detection for a packet type.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set flow-detection-mode off
```

- Set flow detection to operate automatically when a policer is violated.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set flow-detection-mode automatic
```

- Specify that flow detection is always on for a packet type.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set flow-detection-mode on
```

**Related Documentation**

- [Configuring Flow Detection for DDoS Protection on page 65](#)
- [Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69](#)

## Configuring How Flow Detection Operates at Each Flow Aggregation Level

When flow detection is turned on, traffic flows are monitored by default for all protocol groups and packet types. When a policer violation occurs, each suspicious flow is examined to determine whether it is the culprit flow that caused the violation. You can include the **flow-level-detection** statement to configure how flow detection works at

each flow aggregation level for a packet type: subscriber, logical interface, or physical interface.



**NOTE:** The flow detection mode at the packet level must be either **automatic** or **on** for flow detection to operate at individual flow aggregation levels.

Like flow detection at the protocol group and packet level, flow detection at the flow aggregation level supports three modes:

- **automatic**—When a DDoS protection policer is violated, traffic flows at this flow aggregation level are monitored for suspicious behavior only until flow detection determines that the suspect flow is not at this aggregation level and instead must be at a coarser level of aggregation. Flows at this level are subsequently not searched again until the policer is no longer violated at the coarser level.
- **off**—Traffic flows are never monitored at this flow aggregation level.
- **on**—Traffic flows at this flow aggregation level are monitored for suspicious flows even when no DDoS protection policer is currently being violated, if flow detection at the packet level is configured to **on**. Monitoring continues at this level regardless of whether a suspect flow is identified at this level. However, if the packet level mode is **automatic**, then the policer must be in violation for traffic flows to be checked at this level.

Flows are examined first at the finest-grained (lowest bandwidth) flow aggregation level, subscriber. If the suspect flow is not found at the subscriber level, then flows are checked at the logical interface level. Finally, if the suspect is not found there, then flows are checked at the physical interface level; barring some misconfiguration, the culprit flow must be found at this level.

To configure how flow detection operates at each flow aggregation level:

1. (Optional) Specify the detection mode at the subscriber level.

```
[edit system ddos-protection protocols protocol-group packet-type flow-level-detection]  
user@host# set subscriber flow-detection-mode
```

2. (Optional) Specify the detection mode at the logical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type flow-level-detection]  
user@host# set logical-interface flow-detection-mode
```

3. (Optional) Specify the detection mode at the physical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type flow-level-detection]  
user@host# set physical-interface flow-detection-mode
```

For example, include the following statements to configure flow detection to check for suspicious flows at the subscriber level only when the policer is being violated, to never check at the logical interface level, and to always check at the physical interface level:

```
[edit system ddos-protection protocols dhcpv4 discover]  
user@host# edit flow-level-detection  
user@host# set subscriber automatic  
user@host# set logical-interface off
```

```
user@host# set physical-interface on
```

**Related  
Documentation**

- [Configuring Flow Detection for DDoS Protection on page 65](#)
- [Configuring Flow Detection for Individual Protocol Groups or Packets on page 69](#)

## Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level

You can include the **flow-level-bandwidth** statement to configure the maximum acceptable bandwidth for traffic flows for individual packet types. You have to specify the bandwidth behavior at a particular flow aggregation level: subscriber, logical interface, or physical interface. We recommend that you tune the bandwidth values for your network rather than rely on the defaults.

To configure the maximum bandwidth for traffic flows each flow aggregation level:

1. (Optional) Configure the bandwidth for flows at the subscriber level.

```
[edit system ddos-protection protocols protocol-group packet-type
flow-level-bandwidth]
user@host# set subscriber flow-bandwidth
```

2. (Optional) Configure the bandwidth for flows at the logical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type
flow-level-bandwidth]
user@host# set logical-interface flow-bandwidth
```

3. (Optional) Configure the bandwidth for flows at the physical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type
flow-level-bandwidth]
user@host# set physical-interface flow-bandwidth
```

For example, to configure the flow bandwidth to 1000 pps at the subscriber level, 5000 pps at the logical interface level, and 30,000 at the physical interface level:

```
[edit system ddos-protection protocols dhcpv4 discover]
user@host# edit flow-level-bandwidth
user@host# set subscriber 10
user@host# set logical-interface 100
user@host# set physical-interface 1000
```

**Related  
Documentation**

- [Configuring Flow Detection for DDoS Protection on page 65](#)

## Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level

When flow detection is enabled, all traffic in a culprit flow is dropped by default for all protocol groups and packet types and at all flow aggregation levels. You can include the **flow-level-control** statement to configure flow detection to control traffic differently for individual packet types. You have to specify the control behavior at a particular flow aggregation level: subscriber, logical interface, or physical interface.

You can configure flow detection flow control to employ one of the following modes for a packet type:

- Drop all traffic—Configure flow control to drop all traffic when you think the flow that is violating a bandwidth limit is malicious. This behavior is the default at all flow aggregation levels.
- Police traffic—Configure flow control to police a flow that is violating bandwidth, forcing the rate below the bandwidth limit. Flow control acts as a simple policer in this case.
- Keep all traffic—Configure flow control to keep all traffic whether the flow is in violation or below the bandwidth limit. This mode is helpful when you need to debug traffic flow for your network.

Flow control mode enables great flexibility in how you manage control traffic in your network. For example, if you only want to ensure that control flows for a packet type at all aggregation levels are within their limits, you can configure flow control to police the traffic at each level. Or if you want to detect culprit flows and suppress them at one level but only restrain traffic to the allowed bandwidth at another level, you can configure one level to drop all traffic and the other to police traffic.

To configure how flow detection controls traffic in a culprit flow:

1. (Optional) Specify the control mode at the subscriber level.

```
[edit system ddos-protection protocols protocol-group packet-type scfd
  flow-level-control]
user@host# set subscriber flow-control-mode
```

2. (Optional) Specify the control mode at the logical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type scfd
  flow-level-control]
user@host# set logical-interface flow-control-mode
```

3. (Optional) Specify the control mode at the physical interface level.

```
[edit system ddos-protection protocols protocol-group packet-type scfd
  flow-level-control]
user@host# set physical-interface flow-control-mode
```

For example, to configure flow detection to keep all traffic for a physical interface under the configured bandwidth, but detect and suppress culprit flows at the subscriber level:

```
[edit system ddos-protection protocols dhcpv4 discover]
user@host# edit flow-level-control
user@host# set subscriber drop
user@host# set physical-interface police
user@host# edit flow-level-detection
user@host# set logical-interface off
```

In this example, you do not care about the logical interface, so flow detection is turned off for that level. Because flow detection is disabled, the state of flow control for that level does not matter.

#### Related Documentation

- [Configuring Flow Detection for DDoS Protection on page 65](#)

## Disabling Automatic Logging of Culprit Flow Events for a Packet Type

By default, flow detection automatically logs policer violation events associated with suspicious flows (violation reports) and culprit flow events (flow reports) for all protocol groups and packet types. You can include the **no-flow-logging** statement to prevent automatic logging of culprit flow events for individual packet types. Automatic logging of suspicious flow violation events is disabled with the **disable-logging** statement at the **[edit system ddos-protection global]** hierarchy level.

To disable automatic culprit flow event logging for a packet type:

- Disable logging.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set no-flow-logging
```

To disable automatic suspicious flow violation event logging for a packet type:

- Disable logging.

```
[edit system ddos-protection protocols protocol-group packet-type]
user@host# set disable-logging
```

For example, include the following statement to disable automatic logging for DHCPv4 DISCOVER packet flows:

```
[edit system ddos-protection protocols dhcpv4 discover]
user@host# set no-flow-logging
```

### Related Documentation

- [Configuring Flow Detection for DDoS Protection on page 65](#)
- [Configuring DDoS Protection Policers for Individual Packet Types on page 51](#)

## Verifying and Managing Flow Detection

**Purpose** View or clear information about flow detection as part of a DDoS protection configuration.

- Action**
- To display configuration information for flow detection:
 

```
user@host> show ddos-protection protocols flow-detection
```
  - To display information about culprit flows identified by flow detection, including number of flows detected and tracked, source address of the flow, arriving interface, and rates:
 

```
user@host> show ddos-protection protocols culprit-flows
```
  - To clear culprit flows for all packet types in all protocol groups:
 

```
user@host> clear ddos-protection protocols culprit-flows
```
  - To clear culprit flows for all packet types in a particular protocol group:
 

```
user@host> clear ddos-protection protocols protocol-group culprit-flows
```

**Related Documentation** • [Verifying and Managing DDoS Protection on page 59](#)



## PART 4

# IPsec

- [Understanding How IPsec Secures Network Traffic on page 77](#)
- [IPsec System Requirements on page 91](#)
- [IPsec Configuration Guidelines on page 95](#)
- [Configuring IPsec Security Associations on page 99](#)
- [Configuring IPsec on an ES PIC on page 171](#)
- [Configuring Traffic Filters to Direct Traffic Through the Desired IPsec Tunnel on page 197](#)
- [Configuring IPsec Dynamic Endpoints on page 207](#)
- [Configuring Digital Certificates for IPsec on page 215](#)
- [Securing Layer 3 Protocol Traffic with IPsec Transport Mode on page 221](#)
- [Using IPsec with a Layer 3 VPN on page 225](#)



## CHAPTER 7

# Understanding How IPsec Secures Network Traffic

- [IPsec Overview on page 77](#)
- [Authentication Algorithms on page 78](#)
- [Encryption Algorithms on page 79](#)
- [IPsec Protocols on page 80](#)
- [IPsec Security Associations on page 82](#)
- [IPsec Modes on page 83](#)
- [IKE Key Management Protocol Overview on page 84](#)
- [Digital Certificates on page 85](#)
- [Service Sets for IPsec Tunnels on page 86](#)
- [IPsec Terms and Acronyms on page 87](#)

### IPsec Overview

---

IP Security (IPsec) provides a secure way to authenticate senders and encrypt IP version 4 (IPv4) and version 6 (IPv6) traffic between network devices, such as routers and hosts. IPsec offers network administrators and their users the benefits of data confidentiality, data integrity, sender authentication, and anti-replay services.

IPsec provides security services at the network layer of the Open Systems Interconnection (OSI) model by enabling a system to select required security protocols, determine the algorithms to use for the security services, and implement any cryptographic keys required to provide the requested services. You can use IPsec to protect one or more paths between a pair of hosts, between a pair of security gateways (such as routers), or between a security gateway and a host.

In addition to IPsec, the Junos operating system (Junos OS) supports the Internet Key Exchange (IKE), which defines mechanisms for key generation and exchange, and manages security associations (SAs).

IPsec also defines a security association and key management framework that can be used with any network layer protocol. The SA specifies what protection policy to apply to traffic between two IP-layer entities. IPsec provides secure tunnels between two peers.

The terminology and components of IPsec can be intimidating to first-time users. However, if you learn a few key concepts, you can quickly master and deploy IPsec in your network. The main concepts you need to understand are as follows:

- [Authentication Algorithms on page 78](#)
- [Encryption Algorithms on page 79](#)
- [IPsec Protocols on page 80](#)
- [IPsec Security Associations](#)
- [IPsec Modes on page 83](#)
- [Digital Certificates on page 85](#)
- [Service Sets for IPsec Tunnels on page 86](#)
- [IPsec-Enabled Line Cards on page 92](#)

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## Authentication Algorithms

Authentication is the process of verifying the identity of the sender. Authentication algorithms use a shared key to verify the authenticity of the IPsec devices. The Junos OS uses the following authentication algorithms:

- Message Digest 5 (MD5) uses a one-way hash function to convert a message of arbitrary length to a fixed-length message digest of 128 bits. Because of the conversion process, it is mathematically infeasible to calculate the original message by computing it backwards from the resulting message digest. Likewise, a change to a single character in the message will cause it to generate a very different message digest number.

To verify that the message has not been tampered with, the Junos OS compares the calculated message digest against a message digest that is decrypted with a shared key. The Junos OS uses the MD5 hashed message authentication code (HMAC) variant that provides an additional level of hashing. MD5 can be used with authentication header (AH), Encapsulating Security Payload (ESP), and Internet Key Exchange (IKE).

- Secure Hash Algorithm 1 (SHA-1) uses a stronger algorithm than MD5. SHA-1 takes a message of less than 264 bits in length and produces a 160-bit message digest. The large message digest ensures that the data has not been changed and that it originates from the correct source. The Junos OS uses the SHA-1 HMAC variant that provides an additional level of hashing. SHA-1 can be used with AH, ESP, and IKE.
- SHA-256, SHA-384, and SHA-512 (sometimes grouped under the name SHA-2) are variants of SHA-1 and use longer message digests. The Junos OS supports the SHA-256 version of SHA-2, which can process all versions of Advanced Encryption Standard (AES), Data Encryption Standard (DES), and Triple DES (3DES) encryption.

### Related Documentation

- [Understanding Junos VPN Site Secure](#)
- [Encryption Algorithms on page 79](#)

## Encryption Algorithms

---

Encryption encodes data into a secure format so that it cannot be deciphered by unauthorized users. Like authentication algorithms, a shared key is used with encryption algorithms to verify the authenticity of the IPsec devices. The Junos OS uses the following encryption algorithms:

- Data Encryption Standard cipher-block chaining (DES-CBC) is a symmetric secret-key block algorithm. DES uses a key size of 64 bits, where 8 bits are used for error detection and the remaining 56 bits provide encryption. DES performs a series of simple logical operations on the shared key, including permutations and substitutions. CBC takes the first block of 64 bits of output from DES, combines this block with the second block, feeds this back into the DES algorithm, and repeats this process for all subsequent blocks.
- Triple DES-CBC (3DES-CBC) is an encryption algorithm that is similar to DES-CBC, but provides a much stronger encryption result because it uses three keys for 168-bit (3 x 56-bit) encryption. 3DES works by using the first key to encrypt the blocks, the second key to decrypt the blocks, and the third key to re-encrypt the blocks.
- Advanced Encryption Standard (AES) is a next-generation encryption method based on the Rijndael algorithm developed by Belgian cryptographers Dr. Joan Daemen and Dr. Vincent Rijmen. It uses a 128-bit block and three different key sizes (128, 192, and 256 bits). Depending on the key size, the algorithm performs a series of computations (10, 12, or 14 rounds) that include byte substitution, column mixing, row shifting, and key addition. The use of AES in conjunction with IPsec is defined in RFC 3602, *The AES-CBC Cipher Algorithm and Its Use with IPsec*.

### Related Documentation

- *Understanding Junos VPN Site Secure*
- *Configuring IKE Proposals*
- *Configuring IPsec Proposals*
- *encryption*

## IPsec Protocols

IPsec protocols determine the type of authentication and encryption applied to packets that are secured by the router. The Junos OS supports the following IPsec protocols:

- **AH**—Defined in RFC 2402, AH provides connectionless integrity and data origin authentication for IPv4 and IPv6 packets. It also provides protection against replays. AH authenticates as much of the IP header as possible, as well as the upper-level protocol data. However, some IP header fields might change in transit. Because the value of these fields might not be predictable by the sender, they cannot be protected by AH. In an IP header, AH can be identified with a value of **51** in the **Protocol** field of an IPv4 packet and the **Next Header** field of an IPv6 packet. An example of the IPsec protection offered by AH is shown in [Figure 3 on page 80](#).



**NOTE:** AH is not supported on the T Series, M120, and M320 routers.

**Figure 3: AH Protocol**

Header format

|                                 |                |          |        |
|---------------------------------|----------------|----------|--------|
| Byte 0                          | Byte 1         | Byte 2   | Byte 3 |
| Next header                     | Payload length | Reserved |        |
| Security Parameters Index (SPI) |                |          |        |
| Sequence number                 |                |          |        |
| Authentication data (variable)  |                |          |        |

Original IPv4 packet before AH is applied

|                    |            |      |
|--------------------|------------|------|
| Original IP header | TCP header | Data |
|--------------------|------------|------|

IPv4 packet after AH transport mode is applied

|                    |           |            |      |
|--------------------|-----------|------------|------|
| Original IP header | AH header | TCP header | Data |
| Authenticating     |           |            |      |

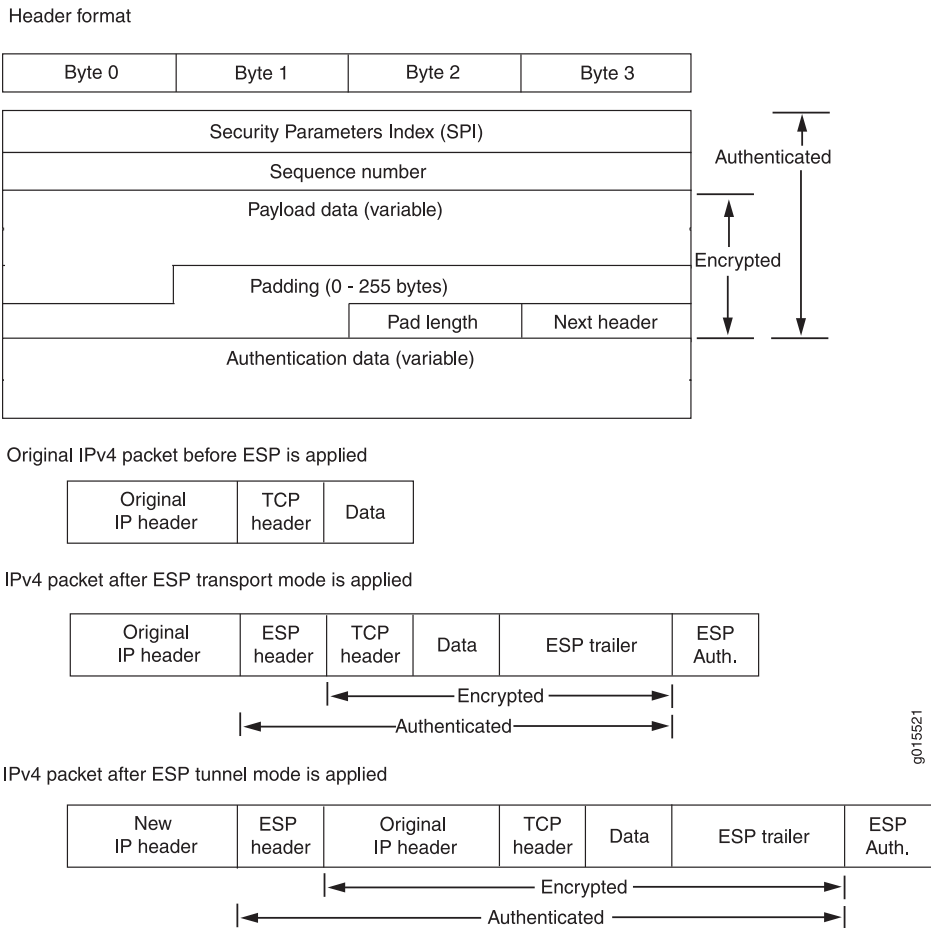
IPv4 packet after AH tunnel mode is applied

|                |           |                    |            |      |
|----------------|-----------|--------------------|------------|------|
| New IP header  | AH header | Original IP header | TCP header | Data |
| Authenticating |           |                    |            |      |

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- ESP—Defined in RFC 2406, ESP can provide encryption and limited traffic flow confidentiality, or connectionless integrity, data origin authentication, and an anti-replay service. In an IP header, ESP can be identified a value of **50** in the **Protocol** field of an IPv4 packet and the **Next Header** field of an IPv6 packet. An example of the IPsec protection offered by ESP is shown in [Figure 4 on page 81](#).

Figure 4: ESP Protocol



- Bundle—When you compare AH with ESP, there are some benefits and shortcomings in both protocols. ESP provides a decent level of authentication and encryption, but does so only for part of the IP packet. Conversely, although AH does not provide encryption, it does provide authentication for the entire IP packet. Because of this, the Junos OS offers a third form of IPsec protocol called a protocol bundle. The bundle option offers a hybrid combination of AH authentication with ESP encryption.

- Related Documentation**
- *Understanding Junos VPN Site Secure*
  - *Configuring IPsec Proposals*
  - *Configuring Security Associations*
  - *protocol (IPsec)*

## IPsec Security Associations

---

Another IPsec consideration is the type of security association (SA) that you wish to implement.

IPsec provides security to IP flows through the use of authentication and encryption:

- Authentication verifies that data is not altered during transmission and ensures that users are communicating with the individual or organization that they believe they are communicating with.
- Encryption makes data confidential by making it unreadable to everyone except the sender and intended recipient.

The Junos OS implementation of IPsec supports two modes of security (transport mode and tunnel mode):

- Transport mode: IPsec mode of operation in which the data payload is encrypted, but the original IP header is left untouched. The IP addresses of the source or destination can be modified if the packet is intercepted. Because of its construction, transport mode can be used only when the communication endpoint and cryptographic endpoint are the same. VPN gateways that provide encryption and decryption services for protected hosts cannot use transport mode for protected VPN communications.
- Tunnel mode: IPsec mode of operation in which the entire IP packet, including the header, is encrypted and authenticated and a new VPN header is added, protecting the entire original packet. This mode can be used by both VPN clients and VPN gateways, and protects communications that come from or go to non-IPsec systems.

A security association (SA) is set of security parameters that dictates how IPsec processes a packet. The SA defines what rules to use for authentication and encryption algorithms, key exchange mechanisms, and secure communications between two parties. A single secure tunnel uses multiple SAs. SA is a simplex connection that allows two hosts to communicate with each other securely by means of IPsec. You can configure two types of SAs:

- Manual—Requires no negotiation; all values, including the keys, are static and specified in the configuration. Manual SAs statically define the Security Parameter Index (SPI) values, algorithms, and keys to be used, and require matching configurations on both ends of the tunnel. As a result, each peer must have the same configured options for communication to take place.

In IPsec, SPI is a numeric identifier, which is used with the destination address and security protocol to identify an SA. When IKE is used to establish an SA, the SPI is randomly derived. When manual configuration is used for an SA, the SPI must be entered as a parameter.

- Dynamic—Specifies proposals to be negotiated with the tunnel peer. The keys are generated as part of the negotiation and therefore do not need to be specified in the configuration. Dynamic SAs require additional configuration. The dynamic SA includes one or more **proposal** statements, which allow you to prioritize a list of protocols and



algorithms to be negotiated with the peer. With dynamic SAs, you configure Internet Exchange Key (IKE) first and then the SA. IKE is a part of IPsec that provides ways to exchange keys for encryption and authentication securely over an unsecured medium such as the Internet.

IKE employs Diffie-Hellman methods and is optional in IPsec (the shared keys can be entered manually at the endpoints). IKE creates dynamic security associations; it negotiates SAs for IPsec. The IKE configuration defines the algorithms and keys used to establish the secure IKE connection with the peer security gateway. This connection is then used to dynamically agree upon keys and other data used by the dynamic IPsec SA. The IKE SA is negotiated first and then used to protect the negotiations that determine the dynamic IPsec SAs. IKE enables a pair of security gateways to:

- Dynamically establish a secure tunnel over which security gateways can exchange tunnel and key information.
- Set up user-level tunnels or SAs, including tunnel attribute negotiations and key management. These tunnels can also be refreshed and terminated on top of the same secure channel.

**Related Documentation**

- [IKE Key Management Protocol Overview on page 84](#)
- [IPsec System Requirements for Junos-FIPS on page 92](#)
- [Security Services Configuration Statements on page 275](#)

## IPsec Modes

When configuring IPsec, the last major consideration is the type of IPsec mode you wish to implement in your network. The Junos OS supports the following IPsec modes:

- Tunnel mode is supported for both authentication header (AH) and Encapsulating Security Payload (ESP) in Junos OS and is the usual choice for a router. In tunnel mode, the SA and associated protocols are applied to tunneled IPv4 or IPv6 packets. For a tunnel mode security association (SA), an outer IP header specifies the IPsec processing destination, and an inner IP header specifies the ultimate destination for the packet. The security protocol header appears after the outer IP header, and before the inner IP header. In addition, there are slight differences for tunnel mode when you implement it with AH and ESP:
  - For AH, portions of the outer IP header are protected, as well as the entire tunneled IP packet.
  - For ESP, only the tunneled packet is protected, not the outer header.

When one side of a security association is a security gateway (such as a router), the SA must use tunnel mode. However, when traffic (for example, SNMP commands or BGP sessions) is destined for a router, the system acts as a host. Transport mode is allowed in this case because the system does not act as a security gateway and does not send or receive transit traffic.

- Transport mode provides a security association between two hosts. In transport mode, the protocols provide protection primarily for upper layer protocols. For IPv4 and IPv6 packets, a transport mode security protocol header appears immediately after the IP header and any options, and before any higher layer protocols (for example, TCP or UDP). There are slight differences for transport mode when you implement it with AH and ESP:
  - For AH, selected portions of the IP header are protected, as well as selected portions of the extension headers and selected options within the IPv4 header.
  - For ESP, only the higher layer protocols are protected, not the IP header or any extension headers preceding the ESP header.



**NOTE:** Support for IPsec transport mode is primarily limited to routing authentication and to certain configurations only application when Junos FIPs code is used.

**Related  
Documentation**

- [IPsec Overview on page 77](#)
- [Configuring Security Associations on page 99](#)
- [Understanding OSPFv3 Authentication](#)
- [Example: Configuring IPsec Authentication for an OSPF Interface](#)

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## IKE Key Management Protocol Overview

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IKE is a key management protocol that creates dynamic SAs; it negotiates SAs for IPsec. An IKE configuration defines the algorithms and keys used to establish a secure connection with a peer security gateway.

IKE does the following:

- Negotiates and manages IKE and IPsec parameters
- Authenticates secure key exchange
- Provides mutual peer authentication by means of shared secrets (not passwords) and public keys
- Provides identity protection (in main mode)

IKE occurs over two phases. In the first phase, it negotiates security attributes and establishes shared secrets to form the bidirectional IKE SA. In the second phase, inbound and outbound IPsec SAs are established. The IKE SA secures the exchanges in the second phase. IKE also generates keying material, provides Perfect Forward Secrecy, and exchanges identities.

**Related  
Documentation**

- [IPsec Security Associations on page 82](#)
- [IPsec System Requirements for Junos-FIPS on page 92](#)

- [Security Services Configuration Statements on page 275](#)

## Digital Certificates

For small networks, the use of preshared keys in an IPsec configuration is often sufficient. However, as a network grows, it can become a challenge to add new preshared keys on the local router and all new and existing IPsec peers. One solution for scaling an IPsec network is to use digital certificates.

A digital certificate implementation uses the public key infrastructure (PKI), which requires you to generate a key pair consisting of a public key and a private key. The keys are created with a random number generator and are used to encrypt and decrypt data. In networks that do not use digital certificates, an IPsec-enabled device encrypts data with the private key and IPsec peers decrypt the data with the public key.

With digital certificates, the key sharing process requires an additional level of complexity. First, you and your IPsec peers request a certificate authority (CA) to send you a CA certificate that contains the public key of the CA. Next, you request the CA to enroll a local digital certificate that contains your public key and some additional information. When the CA processes your request, it signs your local certificate with the private key of the CA. Then you install the CA certificate and the local certificate in your local router and load the CA certificate in the remote devices before you can establish IPsec tunnels with your peers.

When you request a peering relationship with an IPsec peer, the peer receives a copy of your local certificate. Because the peer already has the CA certificate loaded, it can use the CA's public key contained in the CA certificate to decrypt your local certificate that has been signed by the CA's private key. As a result, the peer now has a copy of your public key. The peer encrypts data with your public key before sending it to you. When your local router receives the data, it decrypts the data with your private key.

In the Junos OS, you must implement the following steps to be able to initially use digital certificates:

- Configure a CA profile to request CA and local digital certificates—The profile contains the name and URL of the CA or registration authority (RA), as well as some retry timer settings.
- Configure certificate revocation list support—A certificate revocation list (CRL) contains a list of certificates canceled before their expiration date. When a participating peer uses a CRL, the CA acquires the most recently issued CRL and checks the signature and validity of a peer's digital certificate. You can request and load CRLs manually, configure an LDAP server to handle CRL processing automatically, or disable CRL processing that is enabled by default.
- Request a digital certificate from the CA—The request can be made either online or manually. Online CA digital certificate requests use the Simple Certificate Enrollment Protocol (SCEP) format. If you request the CA certificate manually, you must also load the certificate manually.

- Generate a private/public key pair—The public key is included in the local digital certificate and the private key is used to decrypt data received from peers.
- Generate and enroll a local digital certificate—The local certificate can be processed online using SCEP or generated manually in the Public-Key Cryptography Standards #10 (PKCS-10) format. If you create the local certificate request manually, you must also load the certificate manually.
- Apply the digital certificate to an IPSec configuration—To activate a local digital certificate, you configure the IKE proposal to use digital certificates instead of preshared keys, reference the local certificate in the IKE policy, and identify the CA in the service set.

Optionally, you can do the following:

- Configure the digital certificate to automatically reenroll—Starting in Junos OS Release 8.5, you can configure automatic reenrollment for digital certificates.
- Monitor digital certificate events and delete certificates and requests—You can issue operational mode commands to monitor IPSec tunnels established using digital certificates and delete certificates or requests.

For more details on managing digital certificates, configuring them in an IPSec service set, and monitoring and clearing them, see [“Using Digital Certificates for IPSec” on page 215](#) and [“Example: AS PIC IKE Dynamic SA with Digital Certificates Configuration” on page 129](#).

## Service Sets for IPSec Tunnels

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The Adaptive Services PIC supports two types of service sets when you configure IPSec tunnels. Because they are used for different purposes, it is important to know the differences between these service set types.

- Next-hop service set—Supports multicast and multicast-style dynamic routing protocols (such as OSPF) over IPSec. Next-hop service sets allow you to use *inside* and *outside* logical interfaces on the Adaptive Services PIC to connect with multiple routing instances. They also allow the use of Network Address Translation (NAT) and stateful firewall capabilities. However, next-hop service sets do not monitor Routing Engine traffic by default and require configuration of multiple service sets to support traffic from multiple interfaces.
- Interface service set—Applied to a physical interface and similar to a stateless firewall filter. They are easy to configure, can support traffic from multiple interfaces, and can monitor Routing Engine traffic by default. However, they cannot support dynamic routing protocols or multicast traffic over the IPSec tunnel.

In general, we recommend that you use next-hop service sets because they support routing protocols and multicast over the IPSec tunnel, they are easier to understand, and the routing table makes forwarding decisions without administrative intervention.

### Related Documentation

- *Understanding Junos VPN Site Secure*
- *Configuring Junos VPN Site Secure Using Junos OS Extension Provider Package*

## IPsec Terms and Acronyms

### A

|   |   |
|---|---|
| <b>Adaptive Services PIC</b>              | A next-generation Physical Interface Card (PIC) that provides IPsec services and other services, such as Network Address Translation (NAT) and stateful firewall, on M Series and T Series platforms.                                   |
| <b>Advanced Encryption Standard (AES)</b> | A next-generation encryption method that is based on the Rijndael algorithm and uses a 128-bit block, three different key sizes (128, 192, and 256 bits), and multiple rounds of processing to encrypt data.                            |
| <b>authentication header (AH)</b>         | A component of the IPsec protocol used to verify that the contents of a packet have not changed (data integrity), and to validate the identity of the sender (data source authentication). For more information about AH, see RFC 2402. |

### C

|  |  |
|--|--|
| <b>certificate authority (CA)</b>        | A trusted third-party organization that generates, enrolls, validates, and revokes digital certificates. The CA guarantees the identity of a user and issues public and private keys for message encryption and decryption.  |
| <b>certificate revocation list (CRL)</b> | A list of digital certificates that have been invalidated before their expiration date, including the reasons for their revocation and the names of the entities that have issued them. A CRL prevents usage of digital certificates and signatures that have been compromised.  |
| <b>cipher block chaining (CBC)</b>       | A cryptographic method that encrypts blocks of ciphertext by using the encryption result of one block to encrypt the next block. Upon decryption, the validity of each block of ciphertext depends on the validity of all the preceding ciphertext blocks. For more information on how to use CBC with DES and ESP to provide confidentiality, see RFC 2405. |

### D

|                                       |   |
|---------------------------------------|---|
| <b>Data Encryption Standard (DES)</b> | An encryption algorithm that encrypts and decrypts packet data by processing the data with a single shared key. DES operates in increments of 64-bit blocks and provides 56-bit encryption. |
| <b>digital certificate</b>            | Electronic file that uses private and public key technology to verify the identity of a certificate creator and distribute keys to peers.   |

### E

|   |  |
|---|--|
| <b>Encapsulating Security Payload (ESP)</b> | A component of the IPsec protocol used to encrypt data in an IPv4 or IPv6 packet, provide data integrity, and ensure data source authentication. For more information about ESP, see RFC 2406. |
| <b>ES PIC</b>                               | A PIC that provides first-generation encryption services and software support for IPsec on M Series and T Series platforms.  |

**H**

|  |  |
|--|--|
| <b>Hashed Message Authentication Code (HMAC)</b> | A mechanism for message authentication using cryptographic hash functions. HMAC can be used with any iterative cryptographic hash function, such as MD5 or SHA-1, in combination with a secret shared key. For more information on HMAC, see RFC 2104. |
|--|--|

**I**

|                                    |   |
|------------------------------------|---|
| <b>Internet Key Exchange (IKE)</b> | Establishes shared security parameters for any hosts or routers using IPSec. IKE establishes the SAs for IPSec. For more information about IKE, see RFC 2407. |
|------------------------------------|---|

**M**

|                               |  |
|-------------------------------|--|
| <b>Message Digest 5 (MD5)</b> | An authentication algorithm that takes a data message of arbitrary length and produces a 128-bit message digest. For more information, see RFC 1321. |
|-------------------------------|--|

**P**

|                                      |  |
|--------------------------------------|--|
| <b>Perfect Forward Secrecy (PFS)</b> | Provides additional security by means of a Diffie-Hellman shared secret value. With PFS, if one key is compromised, previous and subsequent keys are secure because they are not derived from previous keys. |
|--------------------------------------|--|

|  |   |
|--|---|
| <b>public key infrastructure (PKI)</b> | A trust hierarchy that enables users of a public network to securely and privately exchange data through the use of public and private cryptographic key pairs that are obtained and shared with peers through a trusted authority. |
|--|---|

**R**

|                                    |   |
|------------------------------------|---|
| <b>registration authority (RA)</b> | A trusted third-party organization that acts on behalf of a CA to guarantee the identity of a user. |
|------------------------------------|---|

|                       |  |
|-----------------------|--|
| <b>Routing Engine</b> | A PCI-based architectural portion of a Junos OS-based router that handles the routing protocol process, the interface process, some of the chassis components, system management, and user access. |
|-----------------------|--|

**S**

|  |   |
|--|---|
| <b>Secure Hash Algorithm 1 (SHA-1)</b> | An authentication algorithm that takes a data message of less than 264 bits in length and produces a 160-bit message digest. For more information on SHA-1, see RFC 3174. |
|--|---|

|  |  |
|--|--|
| <b>Secure Hash Algorithm 2 (SHA-2)</b> | A successor to the SHA-1 authentication algorithm that includes a group of SHA-1 variants (SHA-224, SHA-256, SHA-384, and SHA-512). SHA-2 algorithms use larger hash sizes and are designed to work with enhanced encryption algorithms such as AES. |
|--|--|

|                                  |  |
|----------------------------------|--|
| <b>security association (SA)</b> | Specifications that must be agreed upon between two network devices before IKE or IPSec are allowed to function. SAs primarily specify protocol, authentication, and encryption options. |
|----------------------------------|--|

|   |   |
|---|---|
| <b>Security Association Database (SADB)</b> | A database where all SAs are stored, monitored, and processed by IPSec. |
|---|---|

|                                       |  |
|---------------------------------------|--|
| <b>Security Parameter Index (SPI)</b> | An identifier that is used to uniquely identify an SA at a network host or router. |
|---------------------------------------|--|

**Security Policy Database (SPD)** A database that works with the SADB to ensure maximum packet security. For inbound packets, IPsec checks the SPD to verify if the incoming packet matches the security configured for a particular policy. For outbound packets, IPsec checks the SPD to see if the packet needs to be secured.

**Simple Certificate Enrollment Protocol (SCEP)** A protocol that supports CA and registration authority (RA) public key distribution, certificate enrollment, certificate revocation, certificate queries, and certificate revocation list (CRL) queries.

## T

**Triple Data Encryption Standard (3DES)** An enhanced DES algorithm that provides 168-bit encryption by processing data three times with three different keys.





## CHAPTER 8

# IPsec System Requirements

- [IPsec System Requirements on page 91](#)
- [IPsec System Requirements for Junos-FIPS on page 92](#)
- [IPsec-Enabled Line Cards on page 92](#)

## IPsec System Requirements

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To implement IPsec, your system must meet these minimum requirements:

- Junos OS Release 8.5 or later for automatic reenrollment of digital certificates.
- Junos OS Release 8.3 or later for IPsec support on OSPF version 2
- Junos OS Release 8.2 or later for support on M120 routers
- Junos OS Release 8.1 or later for IPsec IKE support in routing instances, and certificate revocation list support on AS and MultiServices PICs installed on M Series and T Series routers
- Junos OS Release 7.6 or later for AES encryption and SHA-256 authentication support on AS PICs installed in M Series routers, and IPv6-based IPsec for AS PICs installed in M Series and T Series routers
- Junos OS Release 7.5 or later for digital certificate support on AS PICs installed in M Series and T Series routers, and support of the IPsec Monitoring Management Information Base (MIB)
- Junos OS Release 7.4 or later for dynamic endpoint tunneling support and configuring multiple routed tunnels in a single next-hop service set
- Junos OS Release 7.2 or later for transport mode IPsec on Routing Engines running OSPF version 3 and support for the AS II FIPS PIC
- Junos OS Release 7.1 or later for IPsec on the ES PIC for T Series and M320 routers
- Junos OS Release 6.4 or later for IPsec on the AS PIC for T Series and M320 routers
- Junos OS Release 6.2 or later for IPsec on the AS PIC for M Series routers
- Junos OS Release 5.7 or later for multicast over IPsec tunnels on M Series routers
- Junos OS Release 5.2 or later for IPsec on the ES PIC for M Series routers

- Two Juniper Networks M Series or T Series routers
- Two ES PICs or AS PICs for M Series and T Series routers

## IPsec System Requirements for Junos-FIPS

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In a Junos-FIPS environment, hardware configurations with two Routing Engines must be configured to use IPsec and a private routing instance for all communications between the Routing Engines. IPsec communication between the Routing Engines and AS II FIPS PICs is also required.

### Related Documentation

- [IPsec Security Associations on page 82](#)
- [IKE Key Management Protocol Overview on page 84](#)
- [Security Services Configuration Statements on page 275](#)

## IPsec-Enabled Line Cards

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The first choice you need to make when implementing IPsec on a Junos OS-based router is the type of line card you wish to use. The term line card includes Physical Interface Cards (PICs), Modular Interface Cards (MICs), Dense Port Concentrators (DPCs), and Modular Port Concentrators (MPCs). The following line cards support IPsec implementation.



**NOTE:** See the specific hardware documentation for your router to determine if the line cards on that router support IPsec.

The following line cards support IPsec:

- The Encryption Services (ES) PIC provides encryption services and software support for IPsec.
- The Adaptive Services (AS) PIC and the Adaptive Services (AS) II PIC provide IPsec services and other services, such as Network Address Translation (NAT) and stateful firewall.
- The AS II Federal Information Processing Standards (FIPS) PIC is a special version of the AS PIC that communicates securely with the Routing Engine by using internal IPsec. You must configure IPsec on the AS II FIPS PIC when you enable FIPS mode on the router. For more information about implementing IPsec on an AS II FIPS PIC installed in a router configured in FIPS mode, see the *Secure Configuration Guide for Common Criteria and Junos-FIPS*.
- The Multiservices PICs supply hardware acceleration for an array of packet processing-intensive services. These services include IPsec services and other services, such as stateful firewall, NAT, IPsec, anomaly detection, and tunnel services.
- The Multiservices Dense Port Concentrators (DPCs) provide IPsec services.

- The Multiservices Modular Port Concentrators (MS-MPCs) support IPsec services.
- The Multiservices Modular Interface Cards (MS-MICs) support IPsec services.



**NOTE:** Junos OS extension-provider packages, including the IPsec service package, come preinstalled and preconfigured on MS-MPCs and MS-MICs.

**Related  
Documentation**

- [IPsec Overview on page 77](#)
- [Considering General IPsec Issues on page 95](#)
- *Understanding Services PICs*
- *Enabling Service Packages*
- *Introducing Multiservices MIC and Multiservices MPC (MS-MIC and MS-MPC)*



# IPsec Configuration Guidelines

- [Considering General IPsec Issues on page 95](#)

## Considering General IPsec Issues

Before you configure IPsec, it is helpful to understand some general guidelines.

- IPv4 and IPv6 traffic and tunnels—You can configure IPsec tunnels to carry traffic in the following ways: IPv4 traffic traveling over IPv4 IPsec tunnels, IPv6 traffic traveling over IPv4 IPsec tunnels, IPv4 traffic traveling over IPv6 IPsec tunnels, and IPv6 traffic traveling over IPv6 IPsec tunnels.
- Configuration syntax differences between the AS and MultiServices PICs and the ES PIC—There are slight differences in the configuration statements and operational mode commands that are used with the PICs that support IPsec. As a result, the syntax for the AS and MultiServices PICs cannot be used interchangeably with the syntax for the ES PIC. However, the syntax for one type of PIC can be converted to its equivalent syntax on the other PIC for interoperability. The syntax differences are highlighted in [Table 5 on page 95](#).
- Configuring keys for authentication and encryption—When preshared keys are required for authentication or encryption, you must use the guidelines shown in [Table 6 on page 97](#) to implement the correct key size.
- Rejection of weak and semiweak keys—The DES and 3DES encryption algorithms will reject weak and semiweak keys. As a result, do not create and use keys that contain the patterns listed in [Table 7 on page 97](#).

**Table 5: Comparison of IPsec Configuration Statements and Operational Mode Commands for the AS and MultiServices PICs and ES PIC**

| AS and MultiServices PICs Statements and Commands | ES PIC Statements and Commands |
|---|--------------------------------|
| Configuration Mode Statements                     |                                |
| <code>[edit service-set <i>name</i> ]</code>      | —                              |

**Table 5: Comparison of IPSec Configuration Statements and Operational Mode Commands for the AS and MultiServices PICs and ES PIC (continued)**

| AS and MultiServices PICs Statements and Commands   | ES PIC Statements and Commands  |
|---|---|
| <code>[edit services ipsec-vpn ike]</code><br><ul style="list-style-type: none"> <li>• <code>policy {...}</code></li> <li>• <code>proposal {...}</code></li> </ul>  | <code>[edit security ike]</code><br><ul style="list-style-type: none"> <li>• <code>policy {...}</code></li> <li>• <code>proposal {...}</code></li> </ul>  |
| <code>[edit services ipsec-vpn ipsec]</code><br><ul style="list-style-type: none"> <li>• <code>policy {...}</code></li> <li>• <code>proposal {...}</code></li> </ul>  | <code>[edit security ipsec]</code><br><ul style="list-style-type: none"> <li>• <code>policy {...}</code></li> <li>• <code>proposal {...}</code></li> </ul>  |
| <code>[edit services ipsec-vpn rule rule-name ]</code><br><ul style="list-style-type: none"> <li>• <code>remote-gateway address</code></li> </ul>   | <code>[edit interface es- fpc / pic /port ]</code><br><ul style="list-style-type: none"> <li>• <code>tunnel destination address</code></li> </ul>   |
| <code>[edit services ipsec-vpn rule rule-name term term-name]</code><br><ul style="list-style-type: none"> <li>• <code>from match-conditions {...}</code><br/>  <code>then dynamic {...}</code></li> <li>• <code>from match-conditions {...}</code><br/>  <code>then manual {...}</code></li> </ul> | <code>[edit security ipsec]</code><br><ul style="list-style-type: none"> <li>• <code>security-association name dynamic {...}</code></li> <li>• <code>security-association name manual {...}</code></li> </ul> |
| <code>[edit services ipsec-vpn rule-set]</code>   | —   |
| <code>[edit services service-set ipsec-vpn]</code><br><ul style="list-style-type: none"> <li>• <code>local-gateway address</code></li> </ul>  | <code>[edit interface es- fpc / pic /port ]</code><br><ul style="list-style-type: none"> <li>• <code>tunnel source address</code></li> </ul>  |
| <b>Operational Mode Commands</b>  |   |
| <code>clear security pki ca-certificate</code>  | —   |
| <code>clear security pki certificate-request</code>   | —   |
| <code>clear security pki local-certificate</code>   | —   |
| <code>clear services ipsec-vpn certificates</code>  | —   |
| <code>request security pki ca-certificate enroll</code>   | <code>request security certificate (unsigned)</code>  |
| <code>request security pki ca-certificate load</code>   | <code>request system certificate add</code>   |
| <code>request security pki generate-certificate-request</code>  | —   |
| <code>request security pki generate-key-pair</code>   | <code>request security key-pair</code>  |
| <code>request security pki local-certificate enroll</code>  | <code>request security certificate (signed)</code>  |

**Table 5: Comparison of IPSec Configuration Statements and Operational Mode Commands for the AS and MultiServices PICs and ES PIC (continued)**

| AS and MultiServices PICs Statements and Commands                | ES PIC Statements and Commands                |
|--|---|
| <code>request security pki local-certificate load</code>         | <code>request system certificate add</code>   |
| <code>show security pki ca-certificate</code>                    | <code>show system certificate</code>          |
| <code>show security pki certificate-request</code>               | —   |
| <code>show security pki crt</code>                               | —   |
| <code>show security pki local-certificate</code>                 | <code>show system certificate</code>          |
| <code>show services ipsec-vpn certificates</code>                | <code>show ipsec certificates</code>          |
| <code>show services ipsec-vpn ike security-associations</code>   | <code>show ike security-associations</code>   |
| <code>show services ipsec-vpn ipsec security-associations</code> | <code>show ipsec security-associations</code> |

**Table 6: Authentication and Encryption Key Lengths**

|                | Number of Hexadecimal Characters | Number of ASCII Characters |
|----------------|----------------------------------|----------------------------|
| Authentication |                                  |                            |
| HMAC-MD5-96    | 32                               | 16                         |
| HMAC-SHA1-96   | 40                               | 20                         |
| Encryption     |                                  |                            |
| AES-128-CBC    | 16                               | 32                         |
| AES-192-CBC    | 24                               | 48                         |
| AES-256-CBC    | 32                               | 64                         |
| DES-CBC        | 16                               | 8                          |
| 3DES-CBC       | 48                               | 24                         |

**Table 7: Weak and Semiweak Keys**

| Weak Keys |      |      |      |
|-----------|------|------|------|
| 0101      | 0101 | 0101 | 0101 |

Table 7: Weak and Semiweak Keys (*continued*)

| Weak Keys     |      |      |      |
|---------------|------|------|------|
| 1F1F          | 1F1F | 1F1F | 1F1F |
| E0E0          | E0E0 | E0E0 | E0E0 |
| FEFE          | FEFE | FEFE | FEFE |
| Semiweak Keys |      |      |      |
| 01FE          | 01FE | 01FE | 01FE |
| 1FE0          | 1FE0 | 0EF1 | 0EF1 |
| 01E0          | 01E0 | 01F1 | 01F1 |
| 1FFE          | 1FFE | 0EFE | 0EFE |
| 011F          | 011F | 010E | 010E |
| E0FE          | E0FE | F1FE | F1FE |
| FE01          | FE01 | FE01 | FE01 |
| E01F          | E01F | F10E | F10E |
| E001          | E001 | F101 | F101 |
| FEF1          | FEF1 | FE0E | FE0E |
| 1F01          | 1F01 | 0E01 | 0E01 |
| FEE0          | FEE0 | FEF1 | FEF1 |

Keep in mind the following limitations of IPSec services on the AS PIC:

- The AS PIC does not transport packets containing IPv4 options across IPSec tunnels. If you try to send packets containing IP options across an IPSec tunnel, the packets are dropped. Also, if you issue a **ping** command with the **record-route** option across an IPSec tunnel, the **ping** command fails.
- The AS PIC does not transport packets containing the following IPv6 options across IPSec tunnels: hop-by-hop, destination (Type 1 and 2), and routing. If you try to send packets containing these IPv6 options across an IPSec tunnel, the packets are dropped.
- Destination class usage is not supported with IPSec services on the AS PIC.



## CHAPTER 10

# Configuring IPsec Security Associations

- [Configuring Security Associations on page 99](#)
- [Configuring Manual SAs on page 99](#)
- [Example: AS PIC Manual SA Configuration on page 101](#)
- [Example: ES PIC Manual SA Configuration on page 109](#)
- [Configuring IKE Dynamic SAs on page 117](#)
- [Example: AS PIC IKE Dynamic SA Configuration on page 121](#)
- [Example: AS PIC IKE Dynamic SA with Digital Certificates Configuration on page 129](#)
- [Example: ES PIC IKE Dynamic SA Configuration on page 147](#)
- [Example: IKE Dynamic SA Between an AS PIC and an ES PIC Configuration on page 158](#)
- [Configuring Multiple Routed Tunnels in a Single Next-Hop Service Set on page 168](#)

## Configuring Security Associations

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The first IPSec configuration step is to select a type of security association (SA) for your IPSec connection. You must statically configure all specifications for manual SAs, but you can rely on some defaults when you configure an IKE dynamic SA. To configure a security association, see the following sections.

## Configuring Manual SAs

---

On the ES PIC, you configure a manual security association at the **[edit security ipsec security-association *name*]** hierarchy level. Include your choices for authentication, encryption, direction, mode, protocol, and SPI. Be sure that these choices are configured exactly the same way on the remote IPSec gateway.

```
[edit security]
ipsec {
  security-association sa-name {
    description description;
    manual {
      direction (inbound | outbound | bidirectional) {
        authentication {
          algorithm (hmac-md5-96 | hmac-sha1-96);
          key (ascii-text key | hexadecimal key);
        }
      }
    }
  }
}
```

```

        auxiliary-spi auxiliary-spi;
        encryption {
            algorithm (des-cbc | 3des-cbc);
            key (ascii-text key | hexadecimal key);
        }
        protocol (ah | esp | bundle);
        spi spi-value;
    }
}
mode (tunnel | transport);
}
}

```

On the AS and MultiServices PICs, you configure a manual security association at the **[edit services ipsec-vpn rule *rule-name*]** hierarchy level. Include your choices for authentication, encryption, direction, protocol, and SPI. Be sure that these choices are configured exactly the same way on the remote IPSec gateway.

```

[edit services ipsec-vpn]
rule rule-name {
    match-direction (input | output);
    term term-name {
        from {
            destination-address address;
            source-address address;
        }
        then {
            backup-remote-gateway address;
            clear-dont-fragment-bit;
            manual {
                direction (inbound | outbound | bidirectional) {
                    authentication {
                        algorithm (hmac-md5-96 | hmac-sha1-96);
                        key (ascii-text key | hexadecimal key);
                    }
                    auxiliary-spi spi-value;
                    encryption {
                        algorithm algorithm; # This can be aes-128-cbc, aes-192-cbc,
                        # aes-256-cbc, des-cbc, or 3des-cbc.
                        key (ascii-text key | hexadecimal key);
                    }
                    protocol (ah | bundle | esp);
                    spi spi-value;
                }
            }
            no-anti-replay;
            remote-gateway address;
            syslog;
        }
    }
}
rule-set rule-set-name {
    [ rule rule-names ];
}

```

## Example: AS PIC Manual SA Configuration

Figure 5: AS PIC Manual SA Topology Diagram

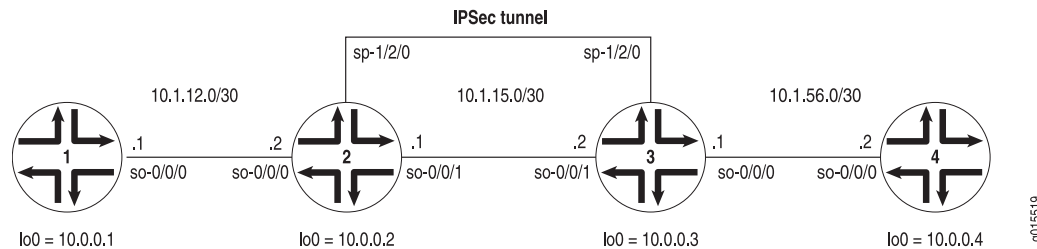


Figure 5 on page 101 shows a similar IPsec topology to the one used in the ES PIC manual SA example. The difference is that Routers 2 and 3 establish an IPsec tunnel using an AS PIC and use slightly modified manual SA settings. Routers 1 and 4 again provide basic connectivity and are used to verify that the IPsec tunnel is operational.

On Router 1, provide basic OSPF connectivity to Router 2.

```
Router 1 [edit]
interfaces {
  so-0/0/0 {
    description "To R2 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.1/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.1;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}
```

On Router 2, enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional manual SA in a rule called rule-manual-SA-BiEspshades at the **[edit ipsec-vpn rule]** hierarchy level. Reference this rule in a service set called service-set-manual-BiEspshades at the **[edit services service-set]** hierarchy level.

Configure all specifications for your manual SA. Use ESP for the protocol, **261** for the SPI, HMAC-SHA1-96 for authentication, DES-CBC for encryption, a 20-bit ASCII authentication key for the SHA-1 authentication key, and an 8-bit ASCII encryption key for the DES-CBC authentication key. (For more information about key lengths, see [Table 6 on page 97](#).)

To direct traffic into the AS PIC and the IPSec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPSec inside interface into the OSPF configuration.

```
Router 2  [edit]
          interfaces {
            so-0/0/0 {
              description "To R1 so-0/0/0";
              unit 0 {
                family inet {
                  address 10.1.12.1/30;
                }
              }
            }
            so-0/0/1 {
              description "To R3 so-0/0/1";
              unit 0 {
                family inet {
                  address 10.1.15.1/30;
                }
              }
            }
            sp-1/2/0 {
              services-options {
                syslog {
                  host local {
                    services info;
                  }
                }
              }
              unit 0 {
                family inet {
                }
              }
              unit 1 { # sp-1/2/0.1 is the IPSec inside interface.
                family inet;
                service-domain inside;
              }
              unit 2 { # sp-1/2/0.2 is the IPSec outside interface.
                family inet;
                service-domain outside;
              }
            }
            lo0 {
              unit 0 {
                family inet {
                  address 10.0.0.2/32;
                }
              }
            }
          }
```

```

routing-options {
    router-id 10.0.0.2;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
            interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
        }
    }
}
services {
    service-set service-set-manual-BiEspshades { # Define your service set here.
        next-hop-service { # Required for dynamic routing protocols such as OSPF.
            inside-service-interface sp-1/2/0.1;
            outside-service-interface sp-1/2/0.2;
        }
        ipsec-vpn-options {
            local-gateway 10.1.15.1; # Specify the local IP address of the IPsec tunnel.
        }
        ipsec-vpn-rules rule-manual-SA-BiEspshades; # Reference the IPsec rule here.
    }
    ipsec-vpn {
        rule rule-manual-SA-BiEspshades { # Define your IPsec VPN rule here.
            term term-manual-SA-BiEspshades {
                then {
                    remote-gateway 10.1.15.2; # The remote IP address of the IPsec tunnel.
                    manual { # Define the manual SA specifications here.
                        direction bidirectional {
                            protocol esp;
                            spi 261;
                            authentication {
                                algorithm hmac-sha1-96;
                                key ascii-text "$9$v.s8xd24Zk.5bs.5QFAtM8XNVYJGifT3goT369
                                OBxNdW2ajHmFnCZUnCtuEH";
                                ## The unencrypted key is juniperjuniperjunipe (20 characters for
                                HMAC-SHA-1-96).
                            }
                            encryption {
                                algorithm des-cbc;
                                key ascii-text "$9$3LJW/A0EcLLxdBlxdsJZn/CpOR";
                                ## The unencrypted key is juniperj (8 characters for DES-CBC).
                            }
                        }
                    }
                }
            }
            match-direction input; # Correct match direction for next-hop service sets.
        }
    }
}
security {
    pki {
        auto-re-enrollment {

```

```

certificate-id certificate-name {
    ca-profile ca-profile-name;
    challenge-password password;
    re-enroll-trigger-time-percentage percentage; #Percentage of validity-period
        # (specified in certificate) when automatic
        # reenrollment should be initiated.
    re-generate-keypair;
    validity-period number-of-days;
}
}
}

```

On Router 3, enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional manual SA in a rule called rule-manual-SA-BiEspshades at the **[edit ipsec-vpn rule]** hierarchy level. Reference this rule in a service set called service-set-manual-BiEspshades at the **[edit services service-set]** hierarchy level.

Configure the same specifications for your manual SA that you specified on Router 2. Use ESP for the protocol, **261** for the SPI, HMAC-SHA1-96 for authentication, DES-CBC for encryption, a 20-bit ASCII authentication key for the SHA-1 authentication key, and an 8-bit ASCII encryption key for the DES-CBC authentication key. (For more information about key lengths, see [Table 6 on page 97](#).)

To direct traffic into the AS PIC and the IPsec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPsec inside interface into the OSPF configuration.

```

Router 3 [edit]
interfaces {
    so-0/0/0 {
        description "To R4 so-0/0/0";
        unit 0 {
            family inet {
                address 10.1.56.1/30;
            }
        }
    }
    so-0/0/1 {
        description "To R2 so-0/0/1";
        unit 0 {
            family inet {
                address 10.1.15.2/30;
            }
        }
    }
    sp-1/2/0 {
        services-options {
            syslog {
                host local {
                    services info;
                }
            }
        }
        unit 0 {
            family inet {

```

```

    }
    unit 1 { # sp-1/2/0.1 is the IPsec inside interface.
        family inet;
        service-domain inside;
    }
    unit 2 { # sp-1/2/0.2 is the IPsec outside interface.
        family inet;
        service-domain outside;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.3/32;
        }
    }
}
}
routing-options {
    router-id 10.0.0.3;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
            interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
        }
    }
}
}
services {
    service-set service-set-manual-BiEspshades { # Define your service set here.
        next-hop-service { # Required for dynamic routing protocols such as OSPF.
            inside-service-interface sp-1/2/0.1;
            outside-service-interface sp-1/2/0.2;
        }
        ipsec-vpn-options {
            local-gateway 10.1.15.2; # Specify the local IP address of the IPsec tunnel.
        }
        ipsec-vpn-rules rule-manual-SA-BiEspshades; # Reference the IPsec rule here.
    }
    ipsec-vpn {
        rule rule-manual-SA-BiEspshades { # Define your IPsec VPN rule here.
            term term-manual-SA-BiEspshades {
                then {
                    remote-gateway 10.1.15.1; # The remote IP address of the IPsec tunnel.
                    manual { # Define the manual SA specifications here.
                        direction bidirectional {
                            protocol esp;
                            spi 261;
                            authentication {
                                algorithm hmac-sha1-96;
                                key ascii-text "$9$v.s8xd24Zk.5bs.5QFAtM8XNVYJGifT3goT369
                                OBxNdw2ajHmFnCZUnCtuEH";
                                ## The unencrypted key is juniperjuniperjunipe (20 characters for
                                HMAC-SHA-1-96).

```

```
    }
    encryption {
        algorithm des-cbc;
        key ascii-text "$9$3LJW/A0EcLLxdBlxdfsJZn/CpOR";
        ## The unencrypted key is juniperj (8 characters for DES-CBC).
    }
}
}
}
}
}
match-direction input; # Specify in which direction the rule should match.
}
}
}
}
```

On Router 4, provide basic OSPF connectivity to Router 3.

```
Router 4 [edit]
interfaces {
    so-0/0/0 {
        description "To R3 so-0/0/0";
        unit 0 {
            family inet {
                address 10.1.56.2/30;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.4/32;
            }
        }
    }
}
routing-options {
    router-id 10.0.0.4;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
        }
    }
}
```

## Verifying Your Work

To verify proper operation of a manual IPSec SA on the AS PIC, use the following commands:

- **ping**
- **show services ipsec-vpn ipsec security-associations (detail)**



- **show services ipsec-vpn ipsec statistics**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 107](#)
- [Router 2 on page 107](#)
- [Router 3 on page 108](#)

### Router 1

On Router 1, issue a **ping** command to the **lo0** interface on Router 4 to send traffic across the IPsec tunnel.

```
user@R1> ping 10.0.0.4
PING 10.0.0.4 (10.0.0.4): 56 data bytes
64 bytes from 10.0.0.4: icmp_seq=0 ttl=254 time=1.375 ms
64 bytes from 10.0.0.4: icmp_seq=1 ttl=254 time=18.375 ms
64 bytes from 10.0.0.4: icmp_seq=2 ttl=254 time=1.120 ms
^C
--- 10.0.0.4 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.120/6.957/18.375/8.075 ms
```

### Router 2

To verify that the IPsec security association is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. Notice that the SA contains the settings you specified, such as ESP for the protocol and HMAC-SHA1-96 for the authentication algorithm.

```
user@R2> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-manual-BiEspshades
Rule: rule-manual-SA-BiEspshades, Term: term-manual-SA-BiEspshades,
Tunnel index: 1
Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
Local identity: ipv4_subnet(any:0,[0..7]=10.0.0.0/8)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)

Direction: inbound, SPI: 261, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: des-cbc
Anti-replay service: Disabled

Direction: outbound, SPI: 261, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: des-cbc
Anti-replay service: Disabled
```

To verify that traffic is traveling over the bidirectional IPsec tunnel, issue the **show services ipsec-vpn statistics** command:

```
user@R2> show services ipsec-vpn ipsec statistics

PIC: sp-1/2/0, Service set: service-set-manual-BiEspshades

ESP Statistics:
  Encrypted bytes:          1616
```

```
Decrypted bytes:          1560
Encrypted packets:       20
Decrypted packets:       19
AH Statistics:
  Input bytes:           0
  Output bytes:          0
  Input packets:         0
  Output packets:        0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0
```

---

### Router 3

To verify that the IPSec security association is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. To be successful, the SA on Router 3 must contain the same settings you specified on Router 2.

```
user@R3> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-manual-BiEspshades
Rule: rule-manual-SA-BiEspshades, Term: term-manual-SA-BiEspshades,
Tunnel index: 1
Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
Local identity: ipv4_subnet(any:0,[0..7]=10.0.0.0/8)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)

Direction: inbound, SPI: 261, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: des-cbc
Anti-replay service: Disabled

Direction: outbound, SPI: 261, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: des-cbc
Anti-replay service: Disabled
```

To verify that traffic is traveling over the bidirectional IPSec tunnel, issue the **show services ipsec-vpn statistics** command:

```
user@R3> show services ipsec-vpn ipsec statistics
PIC: sp-1/2/0, Service set: service-set-manual-BiEspshades
ESP Statistics:
  Encrypted bytes:       1560
  Decrypted bytes:       1616
  Encrypted packets:     19
  Decrypted packets:     20
AH Statistics:
  Input bytes:           0
  Output bytes:          0
  Input packets:         0
  Output packets:        0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0
```

## Example: ES PIC Manual SA Configuration

Figure 6: ES PIC Manual SA Topology Diagram

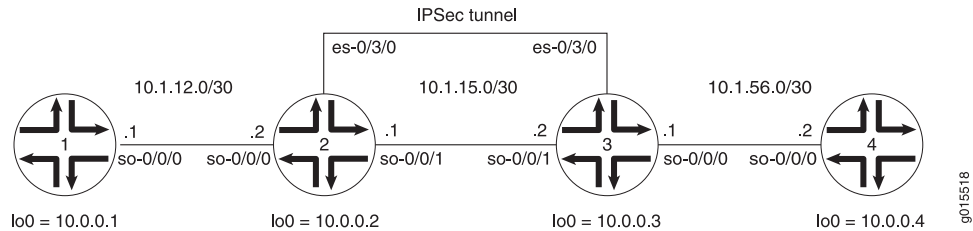


Figure 6 on page 109 shows an IPsec topology containing a group of four routers. Routers 2 and 3 establish an IPsec tunnel using an ES PIC and manual SA settings. Routers 1 and 4 provide basic connectivity and are used to verify that the IPsec tunnel is operational.

On Router 1, provide basic OSPF connectivity to Router 2.

```
Router 1 [edit]
interfaces {
  so-0/0/0 {
    description "To R2 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.1/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.1;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}
```

On Router 2, enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional manual SA called **sa-manual** at the **[edit security ipsec security-association]** hierarchy level. Use AH for the protocol, **400** for the SPI, HMAC-MD5-96 for authentication, and a 32-bit hexadecimal authentication key for the MD5 authentication key. (For more information about key length, see Table 6 on page 97.) Because you are using AH, there is no need to configure encryption.

To direct traffic into the ES PIC and the IPSec tunnel, create two firewall filters. The **es-traffic** filter matches inbound traffic from Router 1 destined for Router 4, whereas the **es-return** filter matches the return path from Router 4 to Router 1. Apply the **es-traffic** filter to the **so-0/0/0** interface; then apply both the **es-return** filter and the **sa-manual** SA to the **es-0/3/0** interface.

```
Router 2 [edit]
interfaces {
  so-0/0/0 {
    description "To R1 so-0/0/0";
    unit 0 {
      family inet {
        filter {
          input es-traffic; # Apply a filter that sends traffic to the IPSec tunnel here.
        }
        address 10.1.12.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R3 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.1/30;
      }
    }
  }
}
es-0/3/0 {
  unit 0 {
    tunnel { # Specify the IPSec tunnel endpoints here.
      source 10.1.15.1;
      destination 10.1.15.2;
    }
    family inet {
      ipsec-sa sa-manual; # Apply the manual SA here.
      filter {
        input es-return; # Apply the filter that matches return IPSec traffic here.
      }
    }
  }
}
lo0 {
  unit 0 {
    family inet {
      address 10.0.0.2/32;
    }
  }
}
}
routing-options {
  router-id 10.0.0.2;
}
protocols {
  ospf {
    area 0.0.0.0 {
```

```

    interface so-0/0/0.0;
    interface so-0/0/1.0;
    interface lo0.0;
  }
}
security {
  ipsec {
    security-association sa-manual { # Define the manual SA specifications here.
      mode tunnel;
      manual {
        direction bidirectional {
          protocol ah;
          spi 400;
          authentication {
            algorithm hmac-md5-96;
            key hexadecimal "$9$ro/eK8x7VY2ahSvL7-2gfTQF9Apu1EhrmfF/Ctl
              RlKMW7-VwYg4ZhSeW8XbwoJGjHmP5QF69wY4Zjif5369ApBSyKv8XRE";
          }
        }
      }
    }
  }
}

# The 32-bit unencrypted hexadecimal key is abcdef01abcdef01abcdef01abcdef01.
firewall {
  filter es-traffic { # Define a filter that sends traffic to the IPSec tunnel here.
    term to-es {
      from {
        source-address {
          10.1.12.0/24;
        }
        destination-address {
          10.1.56.0/24;
        }
      }
      then {
        count ipsec-tunnel;
        ipsec-sa sa-manual;
      }
    }
    term other {
      then accept;
    }
  }
  filter es-return { # Define a filter that matches return IPSec traffic here.
    term return {
      from {
        source-address {
          10.1.56.0/24;
        }
        destination-address {
          10.1.12.0/24;
        }
      }
    }
  }
}

```

```

        then accept;
    }
}

```

On Router 3, enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional manual SA called **sa-manual** at the **[edit security ipsec security-association]** hierarchy level. Use the exact same specifications that you used for the SA on Router 2: AH for the protocol, 400 for the SPI, HMAC-MD5-96 for authentication, and a 32-bit hexadecimal authentication key of **abcdef01abcdef01abcdef01abcdef01** for the MD5 authentication key. (For more information about authentication key length, see [Table 6 on page 97](#).) Because you are using AH, there is no need to configure an encryption algorithm.

To direct traffic into the ES PIC and the IPSec tunnel, create two firewall filters. The **es-traffic** filter matches inbound traffic from Router 4 destined for Router 1, whereas the **es-return** filter matches the return path from Router 1 to Router 4. Apply the **es-traffic** filter to the **so-0/0/0** interface; then apply both the **es-return** filter and the **sa-manual** SA to the **es-0/3/0** interface.

```

Router 3 [edit]
interfaces {
  so-0/0/0 {
    description "To R4 so-0/0/0";
    unit 0 {
      family inet {
        filter {
          input es-traffic; # Apply a filter that sends traffic to the IPSec tunnel here.
        }
        address 10.1.56.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R2 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.2/30;
      }
    }
  }
  es-0/3/0 {
    unit 0 {
      tunnel { # Specify the IPSec tunnel endpoints here.
        source 10.1.15.2;
        destination 10.1.15.1;
      }
      family inet {
        ipsec-sa sa-manual; # Apply the manual SA here.
        filter {
          input es-return; # Apply the filter that matches return IPSec traffic here.
        }
      }
    }
  }
}

```

```

lo0 {
  unit 0 {
    family inet {
      address 10.0.0.3/32;
    }
  }
}
routing-options {
  router-id 10.0.0.3;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface so-0/0/1.0;
      interface lo0.0;
    }
  }
}
security {
  ipsec {
    security-association sa-manual { # Define the manual SA specifications here.
      mode tunnel;
      manual {
        direction bidirectional {
          protocol ah;
          spi 400;
          authentication {
            algorithm hmac-md5-96;
            key hexadecimal "$9$KMfMWx-ds4oGyl87dboaQF36tuOBESyK5Q6
              Ap0hcvWLXdbS24aJDylMXxNY2ZUjk.5Tz36Ct24JDkqQz/CtuORleW8xNcS";
          }
        }
      }
    }
  }
}

```

## The 32-bit unencrypted hexadecimal key is abcdef01abcdef01abcdef01abcdef01.

```

firewall {
  filter es-traffic { # Define a filter that sends traffic to the IPSec tunnel here.
    term to-es {
      from {
        source-address {
          10.1.56.0/24;
        }
        destination-address {
          10.1.12.0/24;
        }
      }
      then {
        count ipsec-tunnel;
        ipsec-sa sa-manual;
      }
    }
  }
}

```

```
    }  
  }  
  term other {  
    then accept;  
  }  
}  
filter es-return { # Define a filter that matches return IPSec traffic here.  
  term return {  
    from {  
      source-address {  
        10.1.12.0/24;  
      }  
      destination-address {  
        10.1.56.0/24;  
      }  
    }  
    then accept;  
  }  
}
```

On Router 4, provide basic OSPF connectivity to Router 3.

```
Router 4 [edit]  
interfaces {  
  so-0/0/0 {  
    description "To R3 so-0/0/0";  
    unit 0 {  
      family inet {  
        address 10.1.56.2/30;  
      }  
    }  
  }  
  lo0 {  
    unit 0 {  
      family inet {  
        address 10.0.0.4/32;  
      }  
    }  
  }  
}  
routing-options {  
  router-id 10.0.0.4;  
}  
protocols {  
  ospf {  
    area 0.0.0.0 {  
      interface so-0/0/0.0;  
      interface lo0.ping  
    }  
  }  
}
```



## Verifying Your Work

To verify proper operation of a manual IPsec SA on the ES PIC, use the following commands:

- **ping**
- **show ipsec security-associations (detail)**
- **traceroute**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 115](#)
- [Router 2 on page 115](#)
- [Router 3 on page 116](#)
- [Router 4 on page 117](#)

### Router 1

On Router 1, issue a **ping** command to the **so-0/0/0** interface of Router 4 to send traffic across the IPsec tunnel.

```
user@R1> ping 10.1.56.2
PING 10.1.56.2 (10.1.56.2): 56 data bytes
64 bytes from 10.1.56.2: icmp_seq=0 ttl=253 time=0.939 ms
64 bytes from 10.1.56.2: icmp_seq=1 ttl=253 time=0.886 ms
64 bytes from 10.1.56.2: icmp_seq=2 ttl=253 time=0.826 ms
^C
--- 10.1.56.2 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.826/0.884/0.939/0.046 ms
```

You can also issue the **traceroute** command to verify that traffic to **10.1.56.2** travels over the IPsec tunnel between Router 2 and Router 3. Notice that the second hop does not reference **10.1.15.2**—the physical interface on Router 3. Instead, the loopback address of **10.0.0.3** on Router 3 appears as the second hop. This indicates that the IPsec tunnel is operating correctly.

```
user@R1> traceroute 10.1.56.2
traceroute to 10.1.56.2 (10.1.56.2), 30 hops max, 40 byte packets
 1 10.1.12.1 (10.1.12.1) 0.655 ms 0.549 ms 0.508 ms
 2 10.0.0.3 (10.0.0.3) 0.833 ms 0.786 ms 0.757 ms
 3 10.1.56.2 (10.1.56.2) 0.808 ms 0.741 ms 0.716 ms
```

### Router 2

Another way to verify that matched traffic is being diverted to the bidirectional IPsec tunnel is to view the firewall filter counter. After you issue the **ping** command from Router 1 (three packets), the **es-traffic** firewall filter counter looks like this:

```
user@R2> show firewall filter es-traffic
Filter: es-traffic
Counters:
```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 252   | 3       |

After you issue the **ping** command from both Router 1 (three packets) and Router 4 (two packets), the **es-traffic** firewall filter counter looks like this:

```
user@R2> show firewall filter es-traffic
```

```
Filter: es-traffic
```

```
Counters:
```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 420   | 5       |

To verify that the IPSec security association is active, issue the **show ipsec security-associations detail** command. Notice that the SA contains the settings you specified, such as AH for the protocol and HMAC-MD5-96 for the authentication algorithm.

```
user@R2> show ipsec security-associations detail
```

```
Security association: sa-manual, Interface family: Up
```

```
Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
```

```
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
```

```
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
```

```
Direction: inbound, SPI: 400, AUX-SPI: 0
```

```
Mode: tunnel, Type: manual, State: Installed
```

```
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
```

```
Anti-replay service: Disabled
```

```
Direction: outbound, SPI: 400, AUX-SPI: 0
```

```
Mode: tunnel, Type: manual, State: Installed
```

```
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
```

```
Anti-replay service: Disabled
```

### Router 3

View the firewall filter counter to continue verifying that matched traffic is being diverted to the bidirectional IPSec tunnel. After you issue the **ping** command from Router 1 (three packets), the **es-traffic** firewall filter counter looks like this:

```
user@R3> show firewall filter es-traffic
```

```
Filter: es-traffic
```

```
Counters:
```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 252   | 3       |

After you issue the **ping** command from both Router 1 (three packets) and Router 4 (two packets), the **es-traffic** firewall filter counter looks like this:

```
user@R3> show firewall filter es-traffic
```

```
Filter: es-traffic
```

```
Counters:
```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 420   | 5       |

To verify that the IPSec security association is active, issue the **show ipsec security-associations detail** command. Notice that the SA on Router 3 contains the same settings you specified on Router 2.

```
user@R3> show ipsec security-associations detail
```

```

Security association: sa-manual, Interface family: Up

Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)

Direction: inbound, SPI: 400, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
Anti-replay service: Disabled

Direction: outbound, SPI: 400, AUX-SPI: 0
Mode: tunnel, Type: manual, State: Installed
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
Anti-replay service: Disabled

```

#### Router 4

On Router 4, issue a **ping** command to the **so-0/0/0** interface of Router 1 to send traffic across the IPsec tunnel.

```

user@R4> ping 10.1.12.2
PING 10.1.12.2 (10.1.12.2): 56 data bytes
64 bytes from 10.1.12.2: icmp_seq=0 ttl=253 time=0.937 ms
64 bytes from 10.1.12.2: icmp_seq=1 ttl=253 time=0.872 ms
^C
--- 10.1.12.2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.872/0.905/0.937/0.032 ms

```

You can also issue the **traceroute** command to verify that traffic to **10.1.12.2** travels over the IPsec tunnel between Router 3 and Router 2. Notice that the second hop does not reference **10.1.15.1**—the physical interface on Router 2. Instead, the loopback address of **10.0.0.2** on Router 2 appears as the second hop. This indicates that the IPsec tunnel is operating correctly.

```

user@R4> traceroute 10.1.12.2
traceroute to 10.1.12.2 (10.1.12.2), 30 hops max, 40 byte packets
 1 10.1.56.1 (10.1.56.1) 0.670 ms 0.589 ms 0.548 ms
 2 10.0.0.2 (10.0.0.2) 0.815 ms 0.791 ms 0.763 ms
 3 10.1.12.2 (10.1.12.2) 0.798 ms 0.741 ms 0.714 ms

```

## Configuring IKE Dynamic SAs

On the ES PIC, you configure an IKE dynamic SA at the **[edit security ike]** and **[edit security ipsec]** hierarchy levels. Include your choices for IKE policies and proposals, which include options for authentication algorithms, authentication methods, Diffie-Hellman groups, encryption, IKE modes, and preshared keys. The IKE policy must use the IP address of the remote end of the IPsec tunnel as the policy name. Also, include your choices for IPsec policies and proposals, which include options for authentication, encryption, protocols, Perfect Forward Secrecy (PFS), and IPsec modes. Be sure that these choices are configured exactly the same way on the remote IPsec gateway.

```

[edit security]
ike {
    proposal ike-proposal-name {

```

```

    authentication-algorithm (md5 | sha1 | sha-256 | sha-384);
    authentication-method (dsa-signatures | pre-shared-keys | rsa-signatures);
    description description;
    dh-group (group1 | group2);
    encryption-algorithm (3des-cbc | aes-128-cbc | aes-192-cbc | aes-256-cbc | des-cbc);
    lifetime-seconds seconds;
}
policy ike-peer-address {
    description description;
    encoding (binary | pem);
    identity identity-name;
    local-certificate certificate-filename;
    local-key-pair private-public-key-file;
    mode (aggressive | main);
    pre-shared-key (ascii-text key | hexadecimal key);
    proposals [ proposal-names ];
}
}
ipsec {
    proposal ipsec-proposal-name {
        authentication-algorithm (hmac-md5-96 | hmac-sha1-96 | hmac-sha-256-128);
        description description;
        encryption-algorithm (3des-cbc | aes-128-cbc | aes-192-cbc | aes-256-cbc | des-cbc);
        lifetime-seconds seconds;
        protocol (ah | esp | bundle);
    }
    policy ipsec-policy-name {
        description description;
        perfect-forward-secrecy {
            keys (group1 | group2);
        }
        proposals [ proposal-names ];
    }
    security-association sa-name {
        description description;
        dynamic {
            ipsec-policy policy-name;
            replay-window-size (32 | 64);
        }
        mode (tunnel | transport);
    }
}
}

```

On the AS and MultiServices PICs, you configure an IKE dynamic security association at the `[edit services ipsec-vpn ike]`, `[edit services ipsec-vpn ipsec]`, and `[edit services ipsec-vpn rule rule-name]` hierarchy levels. Include your choices for IKE policies and proposals, which include options for authentication algorithms, authentication methods, Diffie-Hellman groups, encryption, IKE modes, and preshared keys. Also, include your choices for IPSec policies and proposals, which include options for authentication, encryption, protocols, PFS, and IPSec modes. Be sure that these choices are configured exactly the same way on the remote IPSec gateway.

If you choose not to explicitly configure IKE and IPSec policies and proposals on the AS and MultiServices PICs, your configuration can default to some preset values. These default values are shown in [Table 8 on page 119](#).

Table 8: IKE and IPsec Proposal and Policy Default Values for the AS and MultiServices PICs

| IKE Policy Statement         | Default Value   |
|------------------------------|-----------------|
| mode                         | main            |
| proposals                    | default         |
| IKE Proposal Statement       | Default Value   |
| authentication-algorithm     | sha1            |
| authentication-method        | pre-shared-keys |
| dh-group                     | group2          |
| encryption-algorithm         | 3des-cbc        |
| lifetime-seconds             | 3600 (seconds)  |
| IPsec Policy Statement       | Default Value   |
| perfect-forward-secrecy keys | group2          |
| proposals                    | default         |
| IPsec Proposal Statement     | Default Value   |
| authentication-algorithm     | hmac-sha1-96    |
| encryption-algorithm         | 3des-cbc        |
| lifetime-seconds             | 28800 (seconds) |
| protocol                     | esp             |



**NOTE:** If you use the default IKE and IPsec policy and proposal values preset within the AS and MultiServices PICs, you must explicitly configure an IKE policy and include a preshared key. This is because the `pre-shared-keys` authentication method is one of the preset values in the default IKE proposal.

If you decide to configure values manually, the following information shows the complete statement hierarchy and options for dynamic IKE SAs on the AS and MultiServices PICs:

```
[edit services ipsec-vpn]
ike {
  proposal proposal-name {
    authentication-algorithm (md5 | sha1 | sha256);
```

```

    authentication-method (pre-shared-keys | rsa-signatures);
    description description;
    dh-group (group1 | group2);
    encryption-algorithm algorithm; # This can be aes-128-cbc, aes-192-cbc,
    # aes-256-cbc, des-cbc, or 3des-cbc.
    lifetime-seconds seconds;
  }
  policy policy-name {
    description description;
    local-id {
      ipv4_addr [ values ];
      key_id [ values ];
    }
    local-certificate certificate-id-name;
    mode (aggressive | main);
    pre-shared-key (ascii-text key | hexadecimal key);
    proposals [ proposal-names ];
    remote-id {
      ipv4_addr [ values ];
      key_id [ values ];
    }
  }
}
ipsec {
  proposal proposal-name {
    authentication-algorithm (hmac-md5-96 | hmac-sha1-96);
    description description;
    encryption-algorithm algorithm; # This can be aes-128-cbc, aes-192-cbc,
    # aes-256-cbc, des-cbc, or 3des-cbc.
    lifetime-seconds seconds;
    protocol (ah | esp | bundle);
  }
  policy policy-name {
    description description;
    perfect-forward-secrecy {
      keys (group1 | group2);
    }
    proposals [ proposal-names ];
  }
}
rule rule-name {
  match-direction (input | output);
  term term-name {
    from {
      destination-address address;
      source-address address;
    }
    then {
      backup-remote-gateway address;
      clear-dont-fragment-bit;
      dynamic {
        ike-policy policy-name;
        ipsec-policy policy-name;
      }
      no-anti-replay;
      remote-gateway address;
    }
  }
}

```

```

        syslog;
    }
}
}
rule-set rule-set-name {
    [ rule rule-names ];
}

```

## Example: AS PIC IKE Dynamic SA Configuration

Figure 7: AS PIC IKE Dynamic SA Topology Diagram

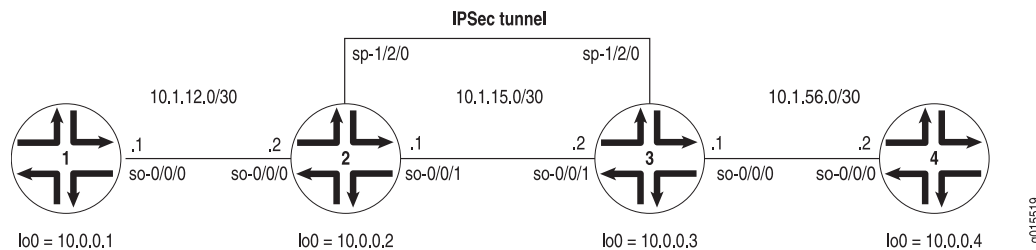


Figure 7 on page 121 shows the same IPsec topology as seen in the AS PIC manual SA example. However, this configuration requires Routers 2 and 3 to establish an IPsec tunnel using an IKE dynamic SA, enhanced authentication, and stronger encryption. Routers 1 and 4 continue to provide basic connectivity and are used to verify that the IPsec tunnel is operational.



**NOTE:** When you do not specify an IKE proposal, an IPsec proposal, and an IPsec policy on an AS PIC, the Junos OS defaults to the highest level of encryption and authentication. As a result, the default authentication protocol is ESP, the default authentication mode is HMAC-SHA1-96, and the default encryption mode is 3DES-CBC. For more information about default IKE and IPsec policies and proposals on the AS PIC, see [Table 8 on page 119](#).

On Router 1, provide basic OSPF connectivity to Router 2.

```

Router 1 [edit]
interfaces {
    so-0/0/0 {
        description "To R2 so-0/0/0";
        unit 0 {
            family inet {
                address 10.1.12.2/30;
            }
        }
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.1/32;
        }
    }
}

```

```

}
routing-options {
  router-id 10.0.0.1;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}

```

On Router 2, enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional IKE dynamic SA in a rule called **rule-ike** at the **[edit ipsec-vpn rule]** hierarchy level. Reference this rule in a service set called **service-set-dynamic-BiEspsha3des** at the **[edit services service-set]** hierarchy level.

Using default values in the AS PIC, you do not need to specify an IPSec proposal, IPSec policy, or IKE proposal. However, you do need to configure a preshared key in an IKE policy with the **pre-shared-key** statement at the **[edit services ipsec-vpn ike policy *policy-name*]** hierarchy level. (For more information about default IKE and IPSec policies and proposals on the AS PIC, see [Table 8 on page 119](#).)

To direct traffic into the AS PIC and the IPSec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPSec inside interface into the OSPF configuration.

```

Router 2 [edit]
interfaces {
  so-0/0/0 {
    description "To R1 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R3 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.1/30;
      }
    }
  }
  sp-1/2/0 {
    services-options {
      syslog {
        host local {
          services info;
        }
      }
    }
    unit 0 {

```



```

family inet {
}
unit 1 { # sp-1/2/0.1 is the IPsec inside interface.
    family inet;
    service-domain inside;
}
unit 2 { # sp-1/2/0.2 is the IPsec outside interface.
    family inet;
    service-domain outside;
}
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.2/32;
        }
    }
}
}
routing-options {
    router-id 10.0.0.2;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
            interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
        }
    }
}
}
services {
    service-set service-set-dynamic-BiEspsha3des { # Define your service set here.
        next-hop-service { # Required for dynamic routing protocols such as OSPF.
            inside-service-interface sp-1/2/0.1;
            outside-service-interface sp-1/2/0.2;
        }
        ipsec-vpn-options {
            local-gateway 10.1.15.1; # Specify the local IP address of the IPsec tunnel.
        }
        ipsec-vpn-rules rule-ike; # Reference your IPsec VPN rule here.
    }
    ipsec-vpn {
        rule rule-ike { # Define your IPsec VPN rule here.
            term term-ike {
                then {
                    remote-gateway 10.1.15.2; # The remote IP address of the IPsec tunnel.
                    dynamic { # This creates a dynamic SA.
                        ike-policy ike-policy-preshared; # Reference your IKE policy here.
                    }
                }
            }
            match-direction input; # Specify in which direction the rule should match.
        }
    }
    ike {
        policy ike-policy-preshared { # Define your IKE policy specifications here.

```

```

        pre-shared-key ascii-text "$9$KtKWX-YgJHqfVwqfTzCAvWL";
        ## The unencrypted preshared key for this example is juniper.
    }
}
}
}
}

```

On Router 3, enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional IKE dynamic SA in a rule called **rule-ike** at the **[edit ipsec-vpn rule]** hierarchy level. Reference this rule in a service set called **service-set-dynamic-BiEspsha3des** at the **[edit services service-set]** hierarchy level.

Again, use the same default policies and proposals that you used on Router 2. However, remember to configure a preshared key in an IKE policy with the **pre-shared-key** statement at the **[edit services ipsec-vpn ike policy *policy-name*]** hierarchy level. The key must match the one you specified on Router 2. (For more information about default IKE and IPSec policies and proposals on the AS PIC, see [Table 8 on page 119](#).)

To direct traffic into the AS PIC and the IPSec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPSec inside interface into the OSPF configuration.

```

Router 3 [edit]
interfaces {
  so-0/0/0 {
    description "To R4 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.56.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R2 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.2/30;
      }
    }
  }
  sp-1/2/0 {
    services-options {
      syslog {
        host local {
          services info;
        }
      }
    }
    unit 0 {
      family inet {
      }
    }
    unit 1 { # sp-1/2/0.1 is the IPSec inside interface.
      family inet;
      service-domain inside;
    }
  }
}

```

```

    }
    unit 2 { # sp-1/2/0.2 is the IPsec outside interface.
        family inet;
        service-domain outside;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.3/32;
        }
    }
}
routing-options {
    router-id 10.0.0.3;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
            interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
        }
    }
}
services {
    service-set service-set-dynamic-BiEspsha3des { # Define your service set here.
        next-hop-service { # Required for dynamic routing protocols such as OSPF.
            inside-service-interface sp-1/2/0.1;
            outside-service-interface sp-1/2/0.2;
        }
        ipsec-vpn-options {
            local-gateway 10.1.15.2; # Specify the local IP address of the IPsec tunnel.
        }
        ipsec-vpn-rules rule-ike; # Reference your IPsec VPN rule here.
    }
    ipsec-vpn {
        rule rule-ike { # Define your IPsec VPN rule here.
            term term-ike {
                then {
                    remote-gateway 10.1.15.1; # The remote IP address of the IPsec tunnel.
                    dynamic { # This creates a dynamic SA.
                        ike-policy ike-policy-preshared; # Reference your IKE policy here.
                    }
                }
            }
            match-direction input; # Specify in which direction the rule should match.
        }
        ike {
            policy ike-policy-preshared { # Define your IKE policy specifications here.
                pre-shared-key ascii-text "$9$KtKWx-YgJHqfVwqfTzCAvWL";
                ## The unencrypted preshared key for this example is juniper.
            }
        }
    }
}

```

```
}  
}
```

On Router 4, provide basic OSPF connectivity to Router 3.

```
Router 4 [edit]  
interfaces {  
  so-0/0/0 {  
    description "To R3 so-0/0/0";  
    unit 0 {  
      family inet {  
        address 10.1.56.2/30;  
      }  
    }  
  }  
  lo0 {  
    unit 0 {  
      family inet {  
        address 10.0.0.4/32;  
      }  
    }  
  }  
}  
routing-options {  
  router-id 10.0.0.4;  
}  
protocols {  
  ospf {  
    area 0.0.0.0 {  
      interface so-0/0/0.0;  
      interface lo0.0;  
    }  
  }  
}
```

## Verifying Your Work

To verify proper operation of an IKE-based dynamic SA on the AS PIC, use the following commands:

- **ping**
- **show services ipsec-vpn ike security-associations (detail)**
- **show services ipsec-vpn ipsec security-associations (detail)**
- **show services ipsec-vpn ipsec statistics**
- **traceroute**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 127](#)
- [Router 2 on page 127](#)

- [Router 3 on page 128](#)
- [Router 4 on page 129](#)

### Router 1

On Router 1, issue a **ping** command to the **so-0/0/0** interface on Router 4 to send traffic across the IPsec tunnel.

```
user@R1> ping 10.1.56.2
PING 10.1.56.2 (10.1.56.2): 56 data bytes
64 bytes from 10.1.56.2: icmp_seq=0 ttl=254 time=1.351 ms
64 bytes from 10.1.56.2: icmp_seq=1 ttl=254 time=1.187 ms
64 bytes from 10.1.56.2: icmp_seq=2 ttl=254 time=1.172 ms
64 bytes from 10.1.56.2: icmp_seq=3 ttl=254 time=1.154 ms
64 bytes from 10.1.56.2: icmp_seq=4 ttl=254 time=1.156 ms
^C
--- 10.1.56.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.154/1.204/1.351/0.074 ms
```

### Router 2

To verify that the IKE SA negotiation is successful, issue the **show services ipsec-vpn ike security-associations** command.

```
user@R2> show services ipsec-vpn ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
10.1.15.2       Matured      03075bd3a0000003  4bff26a5c7000003  Main
```

To verify that the IPsec security association is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. Notice that the SA contains the default settings inherent in the AS PIC, such as ESP for the protocol and HMAC-SHA1-96 for the authentication algorithm.

```
user@R2> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-dynamic-BiEspsha3des
Rule: rule-ike, Term: term-ike, Tunnel index: 1
Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
Local identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
Remote identity: ipv4_subnet(any:0,[0..7]=10.1.56.0/24)
Direction: inbound, SPI: 2666326758, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26863 seconds
Hard lifetime: Expires in 26998 seconds
Anti-replay service: Enabled, Replay window size: 64
Direction: outbound, SPI: 684772754, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26863 seconds
Hard lifetime: Expires in 26998 seconds
Anti-replay service: Enabled, Replay window size: 64
```

To verify that traffic is traveling over the bidirectional IPsec tunnel, issue the **show services ipsec-vpn statistics** command:

```
user@R2> show services ipsec-vpn ipsec statistics
PIC: sp-1/2/0, Service set: service-set-dynamic-BiEspsha3des
ESP Statistics:
```

```
Encrypted bytes:          2248
Decrypted bytes:          2120
Encrypted packets:        27
Decrypted packets:        25
AH Statistics:
  Input bytes:             0
  Output bytes:            0
  Input packets:           0
  Output packets:          0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0
```

Bad headers: 0, Bad trailers: 0

### Router 3

To verify that the IKE SA negotiation is successful, issue the **show services ipsec-vpn ike security-associations** command. To be successful, the SA on Router 3 must contain the same settings you specified on Router 2.

```
user@R3> show services ipsec-vpn ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
10.1.15.1       Matured             03075bd3a0000003  4bff26a5c7000003  Main
```

To verify that the IPSec SA is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. To be successful, the SA on Router 3 must contain the same settings you specified on Router 2.

```
user@R3> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-dynamic-BiEspsha3des
Rule: rule-ike, Term: term-ike, Tunnel index: 1
Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
Local identity: ipv4_subnet(any:0,[0..7]=10.1.56.0/24)
Remote identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
Direction: inbound, SPI: 684772754, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26598 seconds
Hard lifetime: Expires in 26688 seconds
Anti-replay service: Enabled, Replay window size: 64
Direction: outbound, SPI: 2666326758, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26598 seconds
Hard lifetime: Expires in 26688 seconds
Anti-replay service: Enabled, Replay window size: 64
```

To verify that traffic is traveling over the bidirectional IPSec tunnel, issue the **show services ipsec-vpn statistics** command:

```
user@R3> show services ipsec-vpn ipsec statistics
PIC: sp-1/2/0, Service set: service-set-dynamic-BiEspsha3des
ESP Statistics:
  Encrypted bytes:          2120
  Decrypted bytes:          2248
  Encrypted packets:        25
  Decrypted packets:        27
AH Statistics:
  Input bytes:             0
  Output bytes:            0
```

```

Input packets:          0
Output packets:         0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0

```

Bad headers: 0, Bad trailers: 0

#### Router 4

On Router 4, issue a **ping** command to the **so-0/0/0** interface on Router 1 to send traffic across the IPsec tunnel.

```

user@R4> ping 10.1.12.2
PING 10.1.12.2 (10.1.12.2): 56 data bytes
64 bytes from 10.1.12.2: icmp_seq=0 ttl=254 time=1.350 ms
64 bytes from 10.1.12.2: icmp_seq=1 ttl=254 time=1.161 ms
64 bytes from 10.1.12.2: icmp_seq=2 ttl=254 time=1.124 ms
64 bytes from 10.1.12.2: icmp_seq=3 ttl=254 time=1.142 ms
64 bytes from 10.1.12.2: icmp_seq=4 ttl=254 time=1.139 ms
64 bytes from 10.1.12.2: icmp_seq=5 ttl=254 time=1.116 ms
^C
--- 10.1.12.2 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.116/1.172/1.350/0.081 ms

```

The final way you can confirm that traffic travels over the IPsec tunnel is by issuing the **traceroute** command to the **so-0/0/0** interface on Router 1. Notice that the physical interface between Routers 2 and 3 is not referenced in the path; traffic enters the IPsec tunnel through the adaptive services IPsec inside interface on Router 3, passes through the loopback interface on Router 2, and ends at the **so-0/0/0** interface on Router 1.

```

user@R4> traceroute 10.1.12.2
traceroute to 10.1.12.2 (10.1.12.2), 30 hops max, 40 byte packets
 1  10.1.15.2 (10.1.15.2)  0.987 ms  0.630 ms  0.563 ms
 2  10.0.0.2 (10.0.0.2)  1.194 ms  1.058 ms  1.033 ms
 3  10.1.12.2 (10.1.12.2)  1.073 ms  0.949 ms  0.932 ms

```

### Example: AS PIC IKE Dynamic SA with Digital Certificates Configuration

Figure 8: AS PIC IKE Dynamic SA Topology Diagram

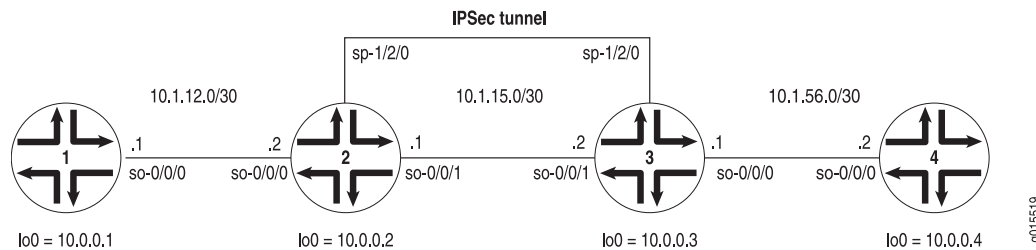


Figure 8 on page 129 shows the same IPsec topology as the AS PIC dynamic SA example on “Example: AS PIC IKE Dynamic SA Configuration” on page 121. However, this configuration requires Routers 2 and 3 to establish an IKE-based IPsec tunnel by using digital certificates in place of preshared keys. Routers 1 and 4 continue to provide basic connectivity and are used to verify that the IPsec tunnel is operational.

On Router 1, provide basic OSPF connectivity to Router 2.

```
Router 1 [edit]
interfaces {
  so-0/0/0 {
    description "To R2 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.1/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.1;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}
```

On Router 2, you must request a CA certificate, create a local certificate, and load these digital certificates into the router before you can reference them in your IPsec configuration. To begin, configure an IPsec profile by specifying the trusted CA and URL of the CA server that handles CA certificate processing:

```
[edit]
security {
  pki {
    ca-profile entrust {
      ca-identity entrust;
      enrollment {
        url http://ca-1.jnpr.net/cgi-bin/pkiclient.exe;
      }
    }
  }
}
```

Certificate revocation list (CRL) verification is enabled by default. You can optionally specify the Lightweight Access Directory (LDAP) server where the CA stores the CRL. The certificate typically includes a certificate distribution point (CDP), which contains information about how to retrieve the CRL for the certificate. The router uses this information to download the CRL automatically. In this example, the LDAP URL is specified, which overrides the location provided in the certificate:



```
[edit]
security pki ca-profile entrust {
  revocation-check {
    crl {
      url ldap://10.157.90.185/o=juniper,c=uscertificateRevocationListbase;
    }
  }
}
```

After you configure the CA profile, you can request a CA certificate from the trusted CA. In this example, the certificate is enrolled online and installed into the router automatically.

```
user@R2> request security pki ca-certificate enroll ca-profile entrust
Received following certificates:
Certificate: C=us, O=juniper
Fingerprint: 00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: 46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f
Do you want to load the above CA certificate ? [yes,no] (no) yes
```



**NOTE:** If you obtain the CA certificate directly from the CA (for example, as an e-mail attachment or website download), you can install it with the `request security pki ca-certificate load` command.

Next, you must generate a private/public key pair before you can create a local certificate.

```
user@R2> request security pki generate-key-pair certificate-id local-entrust2
Generated key pair local-entrust2, key size 1024 bits
```

When the key pair is available, generate a local certificate request and send it to the CA for processing.

```
user@R2> request security pki generate-certificate-request
certificate-id local-entrust2 domain-name router2.juniper.net
filename entrust-req2 subject cn=router2.juniper.net
Generated certificate request
-----BEGIN CERTIFICATE REQUEST-----
MIIBoTCCAQoCAQAwGjEYMBYGA1UEAxMPdHAXLmp1bm1wZXIubmVOMIGfMAOGCSqG
SIb3DQEBAQUAA4GNADCBiQKBgQCiUFk1Qws1Ud+AqN5DDxRs2kVyKEhh9qoVFnz+
Hz4c9vsy3B8E1wTJlkmIt2cB3yi fB6zePd+6WYpf57Crwre7YqPkiXM31F6z3YjX
H+1BPNbCxNWYvyrnSyVYDbFj8o0Xyqog8ACDFVL2JBWrPNBYy7imq/K9soDBbAs6
5hZqqwIDAQABoEcwRQYJKoZIhvcNAQkOMTgwNjA0BGNVHQ8BAf8EBAMCB4AwJAYD
VR0RAQH/BBowGIIwDHAXLmVuZ2xhYi5qdW5pcGVyLm51dDANBgkqhkiG9w0BAQQF
AAOBgQBc2rq1v5SOQXH7LCb/FdqAL8ZM6GoaN5d6cGwq4bB6a7UQFgtH406gQ3G
3iH0Zfz4xMIBpJYuGd1dkqgvcDoH3AgTsLkfn7Wi3x5H2qeQVs9bvL4P5nvEZLND
EIMUHwteo1ZCiZ70f09Fer9cXWHSQs1UtXtgPqQJy2xIeImLgw==
-----END CERTIFICATE REQUEST-----
Fingerprint:
0d:90:b8:d2:56:74:fc:84:59:62:b9:78:71:9c:e4:9c:54:ba:16:97 (sha1)
1b:08:d4:f7:90:f1:c4:39:08:c9:de:76:00:86:62:b8 (md5)
```



**NOTE:** You can request the creation and installation of a local certificate online with the `request security pki local-certificate enroll` command. For more information, see [“Generating and Enrolling a Local Digital Certificate” on page 218](#) or the *Junos System Basics and Services Command Reference*.

The trusted CA digitally signs the local certificate and returns it to you. Copy the certificate file into the router and load the certificate.

```
user@R2> request security pki local-certificate load filename /tmp/router2-cert certificate-id
local-entrust2
Local certificate local-entrust2 loaded successfully
```



**NOTE:** The name of the file sent to you by the CA might not match the name of the certificate identifier. However, the `certificate-id` name must always match the name of the key pair you generated for the router.

After the local and CA certificates have been loaded, you can reference them in your IPsec configuration.

Using default values in the AS PIC, you do not need to configure an IPsec proposal or IPsec policy. However, you must configure an IKE proposal that specifies the use of digital certificates, reference the IKE proposal and local certificate in an IKE policy, and apply the CA profile to the service set. To enable an IKE proposal for digital certificates, include the `rsa-signatures` statement at the `[edit services ipsec-vpn ike proposal proposal-name authentication-method]` hierarchy level. To reference the local certificate in the IKE policy, include the `local-certificate` statement at the `[edit services ipsec-vpn ike policy policy-name]` hierarchy level. To identify the CA or RA in the service set, include the `trusted-ca` statement at the `[edit services service-set service-set-name ipsec-vpn-options]` hierarchy level.



**NOTE:** For more information about default IKE and IPsec policies and proposals on the AS PIC, see [Table 8 on page 119](#).

Optionally, you can configure automatic reenrollment of the certificate with the `auto-re-enrollment` statement at the `[edit security pki]` hierarchy level.

The remaining configuration components of your IKE-based IPsec tunnel are the same as when you use preshared keys. Enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional IKE dynamic SA in a rule called `rule-ike` at the `[edit ipsec-vpn rule]` hierarchy level. Reference this rule in a service set called `service-set-dynamic-BIEspsha3des` at the `[edit services service-set]` hierarchy level.

To direct traffic into the AS PIC and the IPsec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPsec inside interface into the OSPF configuration.

```
Router 2    [edit]
            interfaces {
```

```

so-0/0/0 {
  description "To R1 so-0/0/0";
  unit 0 {
    family inet {
      address 10.1.12.1/30;
    }
  }
}
so-0/0/1 {
  description "To R3 so-0/0/1";
  unit 0 {
    family inet {
      address 10.1.15.1/30;
    }
  }
}
sp-1/2/0 {
  unit 0 {
    family inet;
  }
  unit 1 { # sp-1/2/0.1 is the IPsec inside interface.
    family inet;
    service-domain inside;
  }
  unit 2 { # sp-1/2/0.2 is the IPsec outside interface.
    family inet;
    service-domain outside;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 10.0.0.2/32;
    }
  }
}
routing-options {
  router-id 10.0.0.2;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
      interface lo0.0;
    }
  }
}
security { # Configure CA profiles here, including the URLs used to reach the CAs.
  pki {
    ca-profile entrust {
      ca-identity entrust;
      enrollment {
        url http://ca-1.jnpr.net/cgi-bin/pkiclient.exe;
      }
    }
  }
}

```

```

    revocation-check {
        crl {
            url ldap://10.157.90.185/o=juniper,c=uscertificateRevocationListbase;
            # Specify the URL of the LDAP server where the CA stores the CRL.
        }
    }
}
ca-profile microsoft {
    ca-identity microsoft;
    enrollment {
        url http://192.168.11.78:80/certsrv/mscep/mscep.dll;
    }
}
ca-profile verisign {
    ca-identity verisign;
    enrollment {
        url http://pilotonsiteipsec.verisign.com/cgi-bin/pkiclient.exe;
    }
}
}
}
services {
    service-set service-set-dynamic-BiEspsha3des { # Define your service set here.
        next-hop-service { # Required for dynamic routing protocols such as OSPF.
            inside-service-interface sp-1/2/0.1;
            outside-service-interface sp-1/2/0.2;
        }
        ipsec-vpn-options {
            trusted-ca entrust; # Reference the CA profile here.
            local-gateway 10.1.15.1; # Specify the local IP address of the IPSec tunnel.
        }
        ipsec-vpn-rules rule-ike; # Reference your IPSec VPN rule here.
    }
    ipsec-vpn {
        rule rule-ike { # Define your IPSec VPN rule here.
            term term-ike {
                then {
                    remote-gateway 10.1.15.2; # The remote IP address of the IPSec tunnel.
                    dynamic { # This creates a dynamic SA.
                        ike-policy ike-digital-certificates; # Reference your IKE policy here.
                    }
                }
            }
            match-direction input; # Specify in which direction the rule should match.
        }
        ike {
            proposal ike-proposal {
                authentication-method rsa-signatures; # Uses digital certificates
            }
            policy ike-digital-certificates {
                proposals ike-proposal; # Apply the IKE proposal here.
                local-id fqdn router2.juniper.net; # Provide an identifier for the local router.
                local-certificate local-entrust2; # Reference the local certificate here.
                remote-id fqdn router3.juniper.net; # Provide an ID for the remote router.
            }
        }
    }
}

```

```

    establish-tunnels immediately;
  }
}

```

On Router 3, you must repeat the digital certificate procedures you performed on Router 2. If the IPsec peers do not have a symmetrical configuration containing all the necessary components, they cannot establish a peering relationship.

You need to request a CA certificate, create a local certificate, load these digital certificates into the router, and reference them in your IPsec configuration. Begin by configuring an IPsec CA profile. Include the **ca-profile** statement at the **[edit security pki]** hierarchy level and specify the trusted CA and URL of the CA server that handles CA certificate processing. Include the CRL statements found on Router 2 to complete your CA profile on Router 3.

After you configure the CA profile, request a CA certificate from the trusted CA. In this example, the certificate is enrolled online and installed into the router automatically.

```

user@R3> request security pki ca-certificate enroll ca-profile entrust
Received following certificates:
Certificate: C=us, O=juniper
Fingerprint: 00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: 46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f
Do you want to load the above CA certificate ? [yes,no] (no) yes

```



**NOTE:** If you obtain the CA certificate directly from the CA (for example, as an e-mail attachment or website download), you can install it with the **request security pki ca-certificate load** command.

Next, generate a private/public key pair.

```

user@R3> request security pki generate-key-pair certificate-id local-entrust3
Generated key pair local-entrust3, key size 1024 bits

```

When the key pair is available, you can generate a local certificate request and send it to the CA for processing.

```

user@R3> request security pki generate-certificate-request
certificate-id local-entrust3 domain-name router3.juniper.net
filename entrust-req3 subject cn=router3.juniper.net
Generated certificate request
-----BEGIN CERTIFICATE REQUEST-----
MIIB8jCCAVsCAQAwZTEYMBYGA1UEAxMPdHA1Lmp1bm1wZXIubmV0MRQwEgYDVQQL
EwtFbmdpbmV1cm1uZzEQMA4GA1UEChMHSnVuaXB1c2EjETMBEGA1UECBMKQ2FsaWZv
cm5pYTEEMMAoGA1UEBhMDVVBmIGFMAOGCSqGSIb3DQEBAQUAA4GNADCBiQKBgQCg
Wjo50w8jrnphs0sRFvqQMwC6P1Ya65thrJ8nHZ2qgYgRbSr08hd0DhvU6/5VuD2/
zBtgV5ZSA01yV6DXqlbVj/2Xi rQAJMRCr1eYu6DhYRBMNq/UaQv4Z8Sse1EJv+uR
HTNbD7xlpw2zwz1tRuGFtFr/FrGB0hF7IE+Xm5e2wIDAQABoE0wSwYJKoZIhvcN
AQkOMT4wPDA0BgNVHQ8BAF8EBAMCB4AwKgYDVORQAQh/BCAwHocEwKhGk4IwdHA1
LmVuZ2xhYi5qdW5pcGVyLm51dDANBgkqhkiG9w0BAQQFAA0BgQBbiJ+ZCeQ59/eY
4Rd6awIpJFTz0svRZLxxjFWogusVTmaD2dsqFBqftS1eJBdeiueRcYMF9vOn0GKm
FNfoue gwei5+vzdNmNo55eIb3rs4pP62q0W5CUgmbHrjtp3lyJsvu0XTTCPNY8zw
b6GyM2Hdkk3Vh2ReX11tQUSqYujTjw==

```

```
-----END CERTIFICATE REQUEST-----
```

```
Fingerprint:
```

```
7c:e8:f9:45:93:8d:a3:92:7f:18:29:02:f1:c8:e2:85:3d:ad:df:1f (sha1)
```

```
00:4e:df:a0:6b:ad:8c:50:da:7c:a1:cf:5d:37:b0:ea (md5)
```

The trusted CA digitally signs the local certificate and returns it to you. Copy the certificate file into the router and load the certificate.

```
user@R3> request security pki local-certificate load filename /tmp/router3-cert certificate-id
local-entrust3
```

```
Local certificate local-entrust3 loaded successfully
```

After the local and CA certificates have been loaded, you can reference them in your IPsec configuration. Using default values in the AS PIC, you do not need to configure an IPsec proposal or IPsec policy. However, you must configure an IKE proposal that uses digital certificates, reference the IKE proposal and local certificate in an IKE policy, and apply the CA profile to the service set. To enable the IKE proposal for digital certificates, include the **rsa-signatures** statement at the **[edit services ipsec-vpn ike proposal proposal-name authentication-method]** hierarchy level. To reference the local certificate in the IKE policy, include the **local-certificate** statement at the **[edit services ipsec-vpn ike policy policy-name]** hierarchy level. To identify the CA or RA in the service set, include the **trusted-ca** statement at the **[edit services service-set service-set-name ipsec-vpn-options]** hierarchy level.

The remaining configuration components of your IKE-based IPsec tunnel are the same as when you use preshared keys. Enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional IKE dynamic SA in a rule called **rule-ike** at the **[edit ipsec-vpn rule]** hierarchy level. Reference this rule in a service set called **service-set-dynamic-BiEspsha3des** at the **[edit services service-set]** hierarchy level.

To direct traffic into the AS PIC and the IPsec tunnel, configure a next-hop style service set and add the adaptive services logical interface used as the IPsec inside interface into the OSPF configuration.

```
Router 3 [edit]
          interfaces {
            so-0/0/0 {
              description "To R4 so-0/0/0";
              unit 0 {
                family inet {
                  address 10.1.56.1/30;
                }
              }
            }
            so-0/0/1 {
              description "To R2 so-0/0/1";
              unit 0 {
                family inet {
                  address 10.1.15.2/30;
                }
              }
            }
            sp-1/2/0 {
              unit 0 {
                family inet;
              }
            }
          }
```

```

    }
    unit 1 { # sp-1/2/0.1 is the IPsec inside interface.
        family inet;
        service-domain inside;
    }
    unit 2 { # sp-1/2/0.2 is the IPsec outside interface.
        family inet;
        service-domain outside;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.3/32;
        }
    }
}
}
routing-options {
    router-id 10.0.0.3;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface sp-1/2/0.1; # This sends OSPF traffic over the IPsec tunnel.
            interface lo0.0;
        }
    }
}
}
security { # Configure CA profiles here, including the URLs used to reach the CAs.
    pki {
        ca-profile entrust {
            ca-identity entrust;
            enrollment {
                url http://ca-1.jnpr.net/cgi-bin/pkiclient.exe;
            }
            revocation-check {
                crl {
                    url ldap://10.157.90.185/o=juniper,c=uscertificateRevocationListbase;
                    # Specify the URL of the LDAP server where the CA stores the CRL.
                }
            }
        }
        ca-profile microsoft {
            ca-identity microsoft;
            enrollment {
                url http://192.168.11.78:80/certsrv/mscep/mscep.dll;
            }
        }
        ca-profile verisign {
            ca-identity verisign;
            enrollment {
                url http://pilotonsiteipsec.verisign.com/cgi-bin/pkiclient.exe;
            }
        }
    }
}

```

```

    }
  }
  services {
    service-set service-set-dynamic-BiEspsha3des { # Define your service set here.
      next-hop-service { # Required for dynamic routing protocols such as OSPF.
        inside-service-interface sp-1/2/0.1;
        outside-service-interface sp-1/2/0.2;
      }
      ipsec-vpn-options {
        trusted-ca entrust; # Reference the CA profile here.
        local-gateway 10.1.15.2; # Specify the local IP address of the IPsec tunnel.
      }
      ipsec-vpn-rules rule-ike; # Reference your IPsec VPN rule here.
    }
    ipsec-vpn {
      rule rule-ike { # Define your IPsec VPN rule here.
        term term-ike {
          then {
            remote-gateway 10.1.15.1; # The remote IP address of the IPsec tunnel.
            dynamic { # This creates a dynamic SA.
              ike-policy ike-digital-certificates; # Reference your IKE policy here.
            }
          }
        }
        match-direction input; # Specify in which direction the rule should match.
      }
      ike {
        proposal ike-proposal {
          authentication-method rsa-signatures; # Uses digital certificates
        }
        policy ike-digital-certificates {
          proposals ike-proposal; # Apply the IKE proposal here.
          local-id fqdn router3.juniper.net; # Provide an identifier for the local router.
          local-certificate local-entrust3; # Reference the local certificate here.
          remote-id fqdn router2.juniper.net; # Provide an ID for the remote router.
        }
        establish-tunnels immediately;
      }
    }
  }
}

```

On Router 4, provide basic OSPF connectivity to Router 3.

```

Router 4 [edit]
interfaces {
  so-0/0/0 {
    description "To R3 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.56.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {

```



```

        address 10.0.0.4/32;
    }
}
}
routing-options {
    router-id 10.0.0.4;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
        }
    }
}
}

```

## Verifying Your Work

To verify proper operation of an IKE-based dynamic SA on the AS PIC, use the following commands:

- **ping**
- **show services ipsec-vpn certificates (detail)**
- **show services ipsec-vpn ike security-associations (detail)**
- **show services ipsec-vpn ipsec security-associations (detail)**
- **show services ipsec-vpn ipsec statistics**
- **traceroute**

To verify and manage digital certificates in your router, use the following commands:

- **show security pki ca-certificate (detail)**
- **show security pki certificate-request (detail)**
- **show security pki local-certificate (detail)**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 139](#)
- [Router 2 on page 140](#)
- [Router 3 on page 143](#)
- [Router 4 on page 146](#)

### Router 1

On Router 1, issue a **ping** command to the **so-0/0/0** interface on Router 4 to send traffic across the IPSec tunnel.

```
user@R1> ping 10.1.56.2
```

```

PING 10.1.56.2 (10.1.56.2): 56 data bytes
64 bytes from 10.1.56.2: icmp_seq=0 ttl=254 time=1.351 ms
64 bytes from 10.1.56.2: icmp_seq=1 ttl=254 time=1.187 ms
64 bytes from 10.1.56.2: icmp_seq=2 ttl=254 time=1.172 ms
64 bytes from 10.1.56.2: icmp_seq=3 ttl=254 time=1.154 ms
64 bytes from 10.1.56.2: icmp_seq=4 ttl=254 time=1.156 ms
^C
--- 10.1.56.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.154/1.204/1.351/0.074 ms

```

If you ping the loopback address of Router 4, the operation succeeds because the address is part of the OSPF network configured on Router 4.

```

user@R1> ping 10.0.0.4
PING 10.0.0.4 (10.0.0.4): 56 data bytes
64 bytes from 10.0.0.4: icmp_seq=0 ttl=62 time=1.318 ms
64 bytes from 10.0.0.4: icmp_seq=1 ttl=62 time=1.084 ms
64 bytes from 10.0.0.4: icmp_seq=2 ttl=62 time=3.260 ms
^C
--- 10.0.0.4 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.084/1.887/3.260/0.975 ms

```

## Router 2

To verify that matched traffic is being diverted to the bidirectional IPsec tunnel, view the IPsec statistics:

```

user@R2> show services ipsec-vpn ipsec statistics

PIC: sp-1/2/0, Service set: service-set-dynamic-BiEspsha3des

ESP Statistics:
  Encrypted bytes:      162056
  Decrypted bytes:      161896
  Encrypted packets:    2215
  Decrypted packets:    2216
AH Statistics:
  Input bytes:          0
  Output bytes:         0
  Input packets:        0
  Output packets:       0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0

```

To verify that the IKE SA negotiation is successful, issue the **show services ipsec-vpn ike security-associations** command:

```

user@R2> show services ipsec-vpn ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
10.1.15.2       Matured    d82610c59114fd37 ec4391f76783ef28  Main

```

To verify that the IPsec security association is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. Notice that the SA contains the default

settings inherent in the AS PIC, such as ESP for the protocol and HMAC-SHA1-96 for the authentication algorithm.

```
user@R2> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-dynamic-BiEspsha3des
```

```
Rule: rule-ike, Term: term-ike, Tunnel index: 1
Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
IPSec inside interface: sp-1/2/0.1
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)

Direction: inbound, SPI: 857451461, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 9052 seconds
Hard lifetime: Expires in 9187 seconds
Anti-replay service: Enabled, Replay window size: 64

Direction: outbound, SPI: 1272330309, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 9052 seconds
Hard lifetime: Expires in 9187 seconds
Anti-replay service: Enabled, Replay window size: 64
```

To display the digital certificates that are used to establish the IPsec tunnel, issue the **show services ipsec-vpn certificates** command:

```
user@R2> show services ipsec-vpn certificates
Service set: service-set-dynamic-BiEspsha3des, Total entries: 3
Certificate cache entry: 3
  Flags: Non-root Trusted
  Issued to: router3.juniper.net, Issued by: juniper
  Alternate subject: router3.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:33:58 GMT
    Not after: 2008 Nov 22nd, 00:03:58 GMT

Certificate cache entry: 2
  Flags: Non-root Trusted
  Issued to: router2.juniper.net, Issued by: juniper
  Alternate subject: router2.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:28:22 GMT
    Not after: 2008 Nov 21st, 23:58:22 GMT

Certificate cache entry: 1
  Flags: Root Trusted
  Issued to: juniper, Issued by: juniper
  Validity:
    Not before: 2005 Oct 18th, 23:54:22 GMT
    Not after: 2025 Oct 19th, 00:24:22 GMT
```

To display the CA certificate, issue the **show security pki ca-certificate detail** command. Notice that there are three separate certificates: one for certificate signing, one for key encipherment, and one for the CA's digital signature.

```
user@R2> show security pki ca-certificate detail
Certificate identifier: entrust
Certificate version: 3
```

Serial number: 4355 9235  
Issuer:  
  Organization: juniper, Country: us  
Subject:  
  Organization: juniper, Country: us  
Validity:  
  Not before: 2005 Oct 18th, 23:54:22 GMT  
  Not after: 2025 Oct 19th, 00:24:22 GMT  
Public key algorithm: rsaEncryption(1024 bits)  
  cb:9e:2d:c0:70:f8:ea:3c:f2:b5:f0:02:48:87:dc:68:99:a3:57:4f  
  0e:b9:98:0b:95:47:0d:1f:97:7c:53:17:dd:1a:f8:da:e5:08:d1:1c  
  78:68:1f:2f:72:9f:a2:cf:81:e3:ce:c5:56:89:ce:f0:97:93:fa:36  
  19:3e:18:7d:8c:9d:21:fe:1f:c3:87:8d:b3:5d:f3:03:66:9d:16:a7  
  bf:18:3f:f0:7a:80:f0:62:50:43:83:4f:0e:d7:c6:42:48:c0:8a:b2  
  c7:46:30:38:df:9b:dc:bc:b5:08:7a:f3:cd:64:db:2b:71:67:fe:d8  
  04:47:08:07:de:17:23:13  
Signature algorithm: sha1WithRSAEncryption  
Fingerprint:  
  00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10 (sha1)  
  71:6f:6a:76:17:9b:d6:2a:e7:5a:72:97:82:6d:26:86 (md5)  
Distribution CRL:  
  C=us, O=juniper, CN=CRL1  
  [http://CA-1/CRL/juniper\\_us\\_crlfile.crl](http://CA-1/CRL/juniper_us_crlfile.crl)  
Use for key: CRL signing, Certificate signing

Certificate identifier: entrust  
Certificate version: 3  
Serial number: 4355 925c  
Issuer:  
  Organization: juniper, Country: us  
Subject:  
  Organization: juniper, Country: us, Common name: First Officer  
Validity:  
  Not before: 2005 Oct 18th, 23:55:59 GMT  
  Not after: 2008 Oct 19th, 00:25:59 GMT  
Public key algorithm: rsaEncryption(1024 bits)  
  c0:a4:21:32:95:0a:cd:ec:12:03:d1:a2:89:71:8e:ce:4e:a6:f9:2f  
  1a:9a:13:8c:f6:a0:3d:c9:bd:9d:c2:a0:41:77:99:1b:1e:ed:5b:80  
  34:46:f8:5b:28:34:38:2e:91:7d:4e:ad:14:86:78:67:e7:02:1d:2e  
  19:11:b7:fa:0d:ba:64:20:e1:28:4e:3e:bb:6e:64:dc:cd:b1:b4:7a  
  ca:8f:47:dd:40:69:c2:35:95:ce:b8:85:56:d7:0f:2d:04:4d:5d:d8  
  42:e1:4f:6b:bf:38:c0:45:1e:9e:f0:b4:7f:74:6f:e9:70:fd:4a:78  
  da:eb:10:27:bd:46:34:33  
Signature algorithm: sha1WithRSAEncryption  
Fingerprint:  
  bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17 (sha1)  
  23:79:40:c9:6d:a6:f0:ca:e0:13:30:d4:29:6f:86:79 (md5)  
Distribution CRL:  
  C=us, O=juniper, CN=CRL1  
  [http://CA-1/CRL/juniper\\_us\\_crlfile.crl](http://CA-1/CRL/juniper_us_crlfile.crl)  
Use for key: Key encipherment

Certificate identifier: entrust  
Certificate version: 3  
Serial number: 4355 925b  
Issuer:  
  Organization: juniper, Country: us  
Subject:  
  Organization: juniper, Country: us, Common name: First Officer  
Validity:  
  Not before: 2005 Oct 18th, 23:55:59 GMT  
  Not after: 2008 Oct 19th, 00:25:59 GMT

```

Public key algorithm: rsaEncryption(1024 bits)
ea:75:c4:f3:58:08:ea:65:5c:7e:b3:de:63:0a:cf:cf:ec:9a:82:e2
d7:e8:b9:2f:bd:4b:cd:86:2f:f1:dd:d8:a2:95:af:ab:51:a5:49:4e
00:10:c6:25:ff:b5:49:6a:99:64:74:69:e5:8c:23:5b:b4:70:62:8e
e4:f9:a2:28:d4:54:e2:0b:1f:50:a2:92:cf:6c:8f:ae:10:d4:69:3c
90:e2:1f:04:ea:ac:05:9b:3a:93:74:d0:59:24:e9:d2:9d:c2:ef:22
b9:32:c7:2c:29:4f:91:cb:5a:26:fe:1d:c0:36:dc:f4:9c:8b:f5:26
af:44:bf:53:aa:d4:5f:67
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f (sha1)
ee:cc:c7:f4:5d:ac:65:33:0a:55:db:59:72:2c:dd:16 (md5)
Distribution CRL:
C=us, O=juniper, CN=CRL1
http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: Digital signature

```

To display the local certificate request, issue the **show security pki certificate-request** command:

```

user@R2> show security pki certificate-request
Certificate identifier: local-entrust2
Issued to: router2.juniper.net
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed

```

To display the local certificate, issue the **show security pki local-certificate** command:

```

user@R2> show security pki local-certificate
Certificate identifier: local-entrust2
Issued to: router2.juniper.net, Issued by: juniper
Validity:
Not before: 2005 Nov 21st, 23:28:22 GMT
Not after: 2008 Nov 21st, 23:58:22 GMT
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed

```

### Router 3

To verify that matched traffic is being diverted to the bidirectional IPsec tunnel, view the IPsec statistics:

```

user@R3> show services ipsec-vpn ipsec statistics

PIC: sp-1/2/0, Service set: service-set-dynamic-BiEspsha3des

ESP Statistics:
  Encrypted bytes:      161896
  Decrypted bytes:      162056
  Encrypted packets:    2216
  Decrypted packets:    2215
AH Statistics:
  Input bytes:          0
  Output bytes:         0
  Input packets:        0
  Output packets:       0
Errors:
  AH authentication failures: 0, Replay errors: 0
  ESP authentication failures: 0, ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0

```

To verify that the IKE SA negotiation is successful, issue the **show services ipsec-vpn ike security-associations** command. To be successful, the SA on Router 3 must contain the same settings you specified on Router 2.

```
user@R3> show services ipsec-vpn ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
10.1.15.1       Matured          d82610c59114fd37 ec4391f76783ef28  Main
```

To verify that the IPSec SA is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. To be successful, the SA on Router 3 must contain the same settings you specified on Router 2.

```
user@R3> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-dynamic-BiEspsha3des

Rule: rule-ike, Term: term-ike, Tunnel index: 1
Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
IPSec inside interface: sp-1/2/0.1
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)

Direction: inbound, SPI: 1272330309, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 7219 seconds
Hard lifetime: Expires in 7309 seconds
Anti-replay service: Enabled, Replay window size: 64

Direction: outbound, SPI: 857451461, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 7219 seconds
Hard lifetime: Expires in 7309 seconds
Anti-replay service: Enabled, Replay window size: 64
```

To display the digital certificates that are used to establish the IPSec tunnel, issue the **show services ipsec-vpn certificates** command:

```
user@R3> show services ipsec-vpn certificates
Service set: service-set-dynamic-BiEspsha3des, Total entries: 3
Certificate cache entry: 3
  Flags: Non-root Trusted
  Issued to: router3.juniper.net, Issued by: juniper
  Alternate subject: router3.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:33:58 GMT
    Not after: 2008 Nov 22nd, 00:03:58 GMT

Certificate cache entry: 2
  Flags: Non-root Trusted
  Issued to: router2.juniper.net, Issued by: juniper
  Alternate subject: router2.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:28:22 GMT
    Not after: 2008 Nov 21st, 23:58:22 GMT

Certificate cache entry: 1
  Flags: Root Trusted
  Issued to: juniper, Issued by: juniper
  Validity:
```

Not before: 2005 Oct 18th, 23:54:22 GMT  
 Not after: 2025 Oct 19th, 00:24:22 GMT

To display the CA certificate, issue the **show security pki ca-certificate detail** command. Notice that there are three separate certificates: one for certificate signing, one for key encipherment, and one for the CA's digital signature.

```

user@R3> show security pki ca-certificate detail
Certificate identifier: entrust
Certificate version: 3
Serial number: 4355 9235
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us
Validity:
  Not before: 2005 Oct 18th, 23:54:22 GMT
  Not after: 2025 Oct 19th, 00:24:22 GMT
Public key algorithm: rsaEncryption(1024 bits)
cb:9e:2d:c0:70:f8:ea:3c:f2:b5:f0:02:48:87:dc:68:99:a3:57:4f
0e:b9:98:0b:95:47:0d:1f:97:7c:53:17:dd:1a:f8:da:e5:08:d1:1c
78:68:1f:2f:72:9f:a2:cf:81:e3:ce:c5:56:89:ce:f0:97:93:fa:36
19:3e:18:7d:8c:9d:21:fe:1f:c3:87:8d:b3:5d:f3:03:66:9d:16:a7
bf:18:3f:f0:7a:80:f0:62:50:43:83:4f:0e:d7:c6:42:48:c0:8a:b2
c7:46:30:38:df:9b:dc:bc:b5:08:7a:f3:cd:64:db:2b:71:67:fe:d8
04:47:08:07:de:17:23:13
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10 (sha1)
  71:6f:6a:76:17:9b:d6:2a:e7:5a:72:97:82:6d:26:86 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: CRL signing, Certificate signing
Certificate identifier: entrust
Certificate version: 3
Serial number: 4355 925c
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us, Common name: First Officer
Validity:
  Not before: 2005 Oct 18th, 23:55:59 GMT
  Not after: 2008 Oct 19th, 00:25:59 GMT
Public key algorithm: rsaEncryption(1024 bits)
c0:a4:21:32:95:0a:cd:ec:12:03:d1:a2:89:71:8e:ce:4e:a6:f9:2f
1a:9a:13:8c:f6:a0:3d:c9:bd:9d:c2:a0:41:77:99:1b:1e:ed:5b:80
34:46:f8:5b:28:34:38:2e:91:7d:4e:ad:14:86:78:67:e7:02:1d:2e
19:11:b7:fa:0d:ba:64:20:e1:28:4e:3e:bb:6e:64:dc:cd:b1:b4:7a
ca:8f:47:dd:40:69:c2:35:95:ce:b8:85:56:d7:0f:2d:04:4d:5d:d8
42:e1:4f:6b:bf:38:c0:45:1e:9e:f0:b4:7f:74:6f:e9:70:fd:4a:78
da:eb:10:27:bd:46:34:33
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17 (sha1)
  23:79:40:c9:6d:a6:f0:ca:e0:13:30:d4:29:6f:86:79 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: Key encipherment
Certificate identifier: entrust

```

```

Certificate version: 3
Serial number: 4355 925b
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us, Common name: First Officer
Validity:
  Not before: 2005 Oct 18th, 23:55:59 GMT
  Not after: 2008 Oct 19th, 00:25:59 GMT
Public key algorithm: rsaEncryption(1024 bits)
  ea:75:c4:f3:58:08:ea:65:5c:7e:b3:de:63:0a:cf:cf:ec:9a:82:e2
  d7:e8:b9:2f:bd:4b:cd:86:2f:f1:dd:d8:a2:95:af:ab:51:a5:49:4e
  00:10:c6:25:ff:b5:49:6a:99:64:74:69:e5:8c:23:5b:b4:70:62:8e
  e4:f9:a2:28:d4:54:e2:0b:1f:50:a2:92:cf:6c:8f:ae:10:d4:69:3c
  90:e2:1f:04:ea:ac:05:9b:3a:93:74:d0:59:24:e9:d2:9d:c2:ef:22
  b9:32:c7:2c:29:4f:91:cb:5a:26:fe:1d:c0:36:dc:f4:9c:8b:f5:26
  af:44:bf:53:aa:d4:5f:67
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f (sha1)
  ee:cc:c7:f4:5d:ac:65:33:0a:55:db:59:72:2c:dd:16 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: Digital signature

```

To display the local certificate request, issue the **show security pki certificate-request** command:

```

user@R3> show security pki certificate-request
Certificate identifier: local-entrust3
  Issued to: router3.juniper.net
  Public key algorithm: rsaEncryption(1024 bits)
  Public key verification status: Passed

```

To display the local certificate, issue the **show security pki local-certificate** command:

```

user@R3> show security pki local-certificate
Certificate identifier: local-entrust3
  Issued to: router3.juniper.net, Issued by: juniper
  Validity:
    Not before: 2005 Nov 21st, 23:33:58 GMT
    Not after: 2008 Nov 22nd, 00:03:58 GMT
  Public key algorithm: rsaEncryption(1024 bits)
  Public key verification status: Passed

```

## Router 4

On Router 4, issue a **ping** command to the **so-0/0/0** interface on Router 1 to send traffic across the IPSec tunnel.

```

user@R4> ping 10.1.12.2
PING 10.1.12.2 (10.1.12.2): 56 data bytes
64 bytes from 10.1.12.2: icmp_seq=0 ttl=254 time=1.350 ms
64 bytes from 10.1.12.2: icmp_seq=1 ttl=254 time=1.161 ms
64 bytes from 10.1.12.2: icmp_seq=2 ttl=254 time=1.124 ms
64 bytes from 10.1.12.2: icmp_seq=5 ttl=254 time=1.116 ms
^C
--- 10.1.12.2 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.116/1.172/1.350/0.081 ms

```



The final way you can confirm that traffic travels over the IPsec tunnel is by issuing the **traceroute** command to the **so-0/0/0** interface on Router 1. Notice that the physical interface between Routers 2 and 3 is not referenced in the path; traffic enters the IPsec tunnel through the adaptive services IPsec inside interface on Router 3, passes through the loopback interface on Router 2, and ends at the **so-0/0/0** interface on Router 1.

```
user@R4> traceroute 10.1.12.2
traceroute to 10.1.12.2 (10.1.12.2), 30 hops max, 40 byte packets
 1  10.1.15.2 (10.1.15.2)  0.987 ms  0.630 ms  0.563 ms
 2  10.0.0.2 (10.0.0.2)  1.194 ms  1.058 ms  1.033 ms
 3  10.1.12.2 (10.1.12.2)  1.073 ms  0.949 ms  0.932 ms
```

For additional information on using digital certificates, see the *Junos Services Interfaces Configuration Guide* and the *Junos System Basics and Services Command Reference*.

## Example: ES PIC IKE Dynamic SA Configuration

Figure 9: ES PIC IKE Dynamic SA Topology Diagram

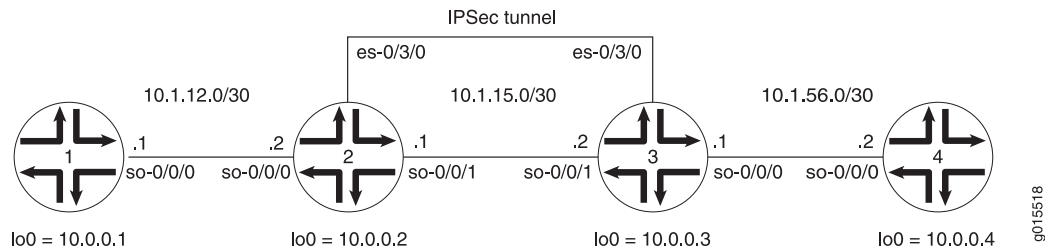


Figure 9 on page 147 shows the same IPsec topology as seen in the ES PIC manual SA example. However, this time the configuration requires Routers 2 and 3 to establish an IPsec tunnel using an IKE dynamic SA, enhanced authentication, and stronger encryption. Routers 1 and 4 continue to provide basic connectivity and are used to verify that the IPsec tunnel is operational.

On Router 1, provide basic OSPF connectivity to Router 2.

```
Router 1 [edit]
interfaces {
  so-0/0/0 {
    description "To R2 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.1/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.1;
```

```

}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}

```

On Router 2, enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional IKE dynamic SA called **sa-dynamic** at the **[edit security ipsec security-association]** hierarchy level. For your IKE policy and proposal, use preshared keys for the authentication method, SHA-1 for the authentication algorithm, 3DES-CBC for encryption, group 2 for the Diffie-Hellman group, main mode, 3600 seconds for the lifetime, and a preshared key of **juniper** for the initial IKE negotiation. For your IPSec policy and proposal, use ESP for the protocol, HMAC-SHA1-96 for authentication, 3DES-CBC for encryption, 28800 seconds for the lifetime, and group 2 for the PFS group.

To direct traffic into the ES PIC and the IPSec tunnel, create two firewall filters. The **es-traffic** filter matches inbound traffic from Router 1 destined for Router 4, whereas the **es-return** filter matches the return path from Router 4 to Router 1. Apply the **es-traffic** filter to the **so-0/0/0** interface, and then apply both the **es-return** filter and the **sa-dynamic** SA to the **es-0/3/0** interface.

```

Router 2 [edit]
interfaces {
  so-0/0/0 {
    description "To R1 so-0/0/0";
    unit 0 {
      family inet {
        filter {
          input es-traffic; # Apply a filter that sends traffic to the IPSec tunnel here.
        }
        address 10.1.12.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R3 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.1/30;
      }
    }
  }
  es-0/3/0 {
    unit 0 {
      tunnel { # Specify the IPSec tunnel endpoints here.
        source 10.1.15.1;
        destination 10.1.15.2;
      }
      family inet {
        ipsec-sa sa-dynamic; # Apply the dynamic SA here.
        filter {

```

```

        input es-return; # Apply the filter that matches return IPsec traffic here.
    }
}
}
lo0 {
    unit 0 {
        family inet {
            address 10.0.0.2/32;
        }
    }
}
routing-options {
    router-id 10.0.0.2;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface so-0/0/1.0;
            interface lo0.0;
        }
    }
}
security {
    ipsec {
        proposal es-ipsec-proposal { # Define your IPsec proposal specifications here.
            protocol esp;
            authentication-algorithm hmac-sha1-96;
            encryption-algorithm 3des-cbc;
            lifetime-seconds 28800;
        }
        policy es-ipsec-policy { # Define your IPsec policy specifications here.
            perfect-forward-secrecy {
                keys group2;
            }
            proposals es-ipsec-proposal; # Reference the IPsec proposal here.
        }
        security-association sa-dynamic { # Define your dynamic SA here.
            mode tunnel;
            dynamic {
                ipsec-policy es-ipsec-policy; # Reference the IPsec policy here.
            }
        }
    }
}
ike {
    proposal es-ike-proposal { # Define your IKE proposal specifications here.
        authentication-method pre-shared-keys;
        dh-group group2;
        authentication-algorithm sha1;
        encryption-algorithm 3des-cbc;
        lifetime-seconds 3600;
    }
    policy 10.1.15.2 { # Define your IKE policy specifications here.
        mode main;
    }
}

```

```

        proposals es-ike-proposal; # Reference the IKE proposal here.
        pre-shared-key ascii-text "$9$TF6ABlcvWxp0WxNdG4QFn";
        ## The unencrypted preshared key for this example is juniper.
    }
}
}
firewall {
    filter es-traffic { # Define a filter that sends traffic to the IPSec tunnel here.
        term to-es {
            from {
                source-address {
                    10.1.12.0/24;
                }
                destination-address {
                    10.1.56.0/24;
                }
            }
            then {
                count ipsec-tunnel;
                ipsec-sa sa-dynamic;
            }
        }
        term other {
            then accept;
        }
    }
    filter es-return { # Define a filter that matches return IPSec traffic here.
        term return {
            from {
                source-address {
                    10.1.56.0/24;
                }
                destination-address {
                    10.1.12.0/24;
                }
            }
            then accept;
        }
    }
}
}

```

On Router 3, enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional IKE dynamic SA called **sa-dynamic** at the **[edit security ipsec security-association]** hierarchy level. Use the same policies and proposals that you used on Router 2.

For your IKE policy and proposal, use preshared keys for the authentication method, SHA-1 for the authentication algorithm, 3DES-CBC for encryption, group 2 for the Diffie-Hellman group, main mode, 3600 seconds for the lifetime, and a preshared key of **juniper** for the initial IKE negotiation. For your IPSec policy and proposal, use ESP for the protocol, HMAC-SHA1-96 for authentication, 3DES-CBC for encryption, 28800 seconds for the lifetime, and group 2 for the PFS group.

To direct traffic into the ES PIC and the IPSec tunnel, create two firewall filters. The **es-traffic** filter matches inbound traffic from Router 4 destined for Router 1, whereas the

**es-return** filter matches the return path from Router 1 to Router 4. Apply the **es-traffic** filter to the **so-0/0/0** interface; then apply both the **es-return** filter and the **sa-dynamic** SA to the **es-0/3/0** interface.

```
Router 3 [edit]
interfaces {
  so-0/0/0 {
    description "To R4 so-0/0/0";
    unit 0 {
      family inet {
        filter {
          input es-traffic; # Apply a filter that sends traffic to the IPsec tunnel here.
        }
        address 10.1.56.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R2 so-0/0/1";
    unit 0 {
      family inet {
        address 10.1.15.2/30;
      }
    }
  }
  es-0/3/0 {
    unit 0 {
      tunnel { # Specify the IPsec tunnel endpoints here.
        source 10.1.15.2;
        destination 10.1.15.1;
      }
      family inet {
        ipsec-sa sa-dynamic; # Apply the dynamic SA here.
        filter {
          input es-return; # Apply the filter that matches return IPsec traffic here.
        }
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.3/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.3;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface so-0/0/1.0;
      interface lo0.0;
    }
  }
}
```

```
    }
  }
}
security {
  ipsec {
    proposal es-ipsec-proposal { # Define your IPSec proposal specifications here.
      protocol esp;
      authentication-algorithm hmac-sha1-96;
      encryption-algorithm 3des-cbc;
      lifetime-seconds 28800;
    }
    policy es-ipsec-policy { # Define your IPSec policy specifications here.
      perfect-forward-secrecy {
        keys group2;
      }
      proposals es-ipsec-proposal; # Reference the IPSec proposal here.
    }
    security-association sa-dynamic { # Define your dynamic SA here.
      mode tunnel;
      dynamic {
        ipsec-policy es-ipsec-policy; # Reference the IPSec policy here.
      }
    }
  }
}
ike {
  proposal es-ike-proposal { # Define your IKE proposal specifications here.
    authentication-method pre-shared-keys;
    dh-group group2;
    authentication-algorithm sha1;
    encryption-algorithm 3des-cbc;
    lifetime-seconds 3600;
  }
  policy 10.1.15.1 { # Define your IKE policy specifications here.
    mode main;
    proposals es-ike-proposal; # Reference the IKE proposal here.
    pre-shared-key ascii-text "$9$TF6ABlcWxpOWxNdG4QFn";
    ## The unencrypted preshared key for this example is juniper.
  }
}
}
firewall {
  filter es-traffic { # Define a filter that sends traffic to the IPSec tunnel here.
    term to-es {
      from {
        source-address {
          10.1.56.0/24;
        }
        destination-address {
          10.1.12.0/24;
        }
      }
      then {
        count ipsec-tunnel;
        ipsec-sa sa-dynamic;
      }
    }
  }
}
```

```

    term other {
        then accept;
    }
}
filter es-return { # Define a filter that matches return IPsec traffic here.
    term return {
        from {
            source-address {
                10.1.12.0/24;
            }
            destination-address {
                10.1.56.0/24;
            }
        }
        then accept;
    }
}
}

```

On Router 4, provide basic OSPF connectivity to Router 3.

```

Router 4 [edit]
interfaces {
    so-0/0/0 {
        description "To R3 so-0/0/0";
        unit 0 {
            family inet {
                address 10.1.56.2/30;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.4/32;
            }
        }
    }
}
routing-options {
    router-id 10.0.0.4;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface lo0.0;
        }
    }
}

```

## Verifying Your Work

To verify proper operation of an IKE-based dynamic SA on the ES PIC, use the following commands:

- **ping**
- **show ike security-associations (detail)**
- **show ipsec security-associations (detail)**
- **traceroute**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 154](#)
- [Router 2 on page 155](#)
- [Router 3 on page 156](#)
- [Router 4 on page 157](#)

---

### Router 1

On Router 1, issue a **ping** command to the **so-0/0/0** interface of Router 4 to send traffic across the IPsec tunnel.

```
user@R1> ping 10.1.56.2
PING 10.1.56.2 (10.1.56.2): 56 data bytes
64 bytes from 10.1.56.2: icmp_seq=0 ttl=253 time=0.917 ms
64 bytes from 10.1.56.2: icmp_seq=1 ttl=253 time=0.881 ms
64 bytes from 10.1.56.2: icmp_seq=2 ttl=253 time=0.897 ms
64 bytes from 10.1.56.2: icmp_seq=3 ttl=253 time=0.871 ms
64 bytes from 10.1.56.2: icmp_seq=4 ttl=253 time=0.890 ms
64 bytes from 10.1.56.2: icmp_seq=5 ttl=253 time=0.858 ms
64 bytes from 10.1.56.2: icmp_seq=6 ttl=253 time=0.904 ms
^C
--- 10.1.56.2 ping statistics ---
7 packets transmitted, 7 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.858/0.888/0.917/0.019 ms
```

You can also issue the **traceroute** command to verify that traffic to **10.1.56.2** travels over the IPsec tunnel between Router 2 and Router 3. Notice that the second hop does not reference **10.1.15.2**—the physical interface on Router 3. Instead, the loopback address of **10.0.0.3** on Router 3 appears as the second hop. This indicates that the IPsec tunnel is operating correctly.

```
user@R1> traceroute 10.1.56.2
traceroute to 10.1.56.2 (10.1.56.2), 30 hops max, 40 byte packets
 1  10.1.12.1 (10.1.12.1)  0.655 ms  0.549 ms  0.508 ms
 2  10.0.0.3 (10.0.0.3)  0.833 ms  0.786 ms  0.757 ms

3 10.1.56.2 (10.1.56.2) 0.808 ms 0.741 ms 0.716 ms
```



## Router 2

Another way to verify that matched traffic is being diverted to the bidirectional IPsec tunnel is to view the firewall filter counter. After you issue the **ping** command from Router 1 (seven packets), the **es-traffic** firewall filter counter looks like this:

```
user@R2> show firewall filter es-traffic
Filter: es-traffic
Counters:
Name                               Bytes      Packets
ipsec-tunnel                       588        7
```

After you issue the **ping** command from both Router 1 (seven packets) and Router 4 (five packets), the **es-traffic** firewall filter counter looks like this:

```
user@R2> show firewall filter es-traffic
Filter: es-traffic
Counters:
Name                               Bytes      Packets
ipsec-tunnel                       1008       12
```

To verify that the IKE SA negotiation between Routers 2 and 3 is successful, issue the **show ike security-associations detail** command. Notice that the SA contains the settings you specified, such as SHA-1 for the authentication algorithm and 3DES-CBC for the encryption algorithm.

```
user@R2> show ike security-associations detail
IKE peer 10.1.15.2
  Role: Initiator, State: Matured
  Initiator cookie: b5dbdfe2f9000000, Responder cookie: a24c868410000041
  Exchange type: Main, Authentication method: Pre-shared-keys
  Local: 10.1.15.1:500, Remote: 10.1.15.2:500
  Lifetime: Expires in 401 seconds
  Algorithms:
    Authentication      : sha1
    Encryption          : 3des-cbc
    Pseudo random function: hmac-sha1
  Traffic statistics:
    Input bytes :          1736
    Output bytes :          2652
    Input packets:           9
    Output packets:         15
  Flags: Caller notification sent
  IPsec security associations: 3 created, 0 deleted
  Phase 2 negotiations in progress: 0
```

To verify that the IPsec security association is active, issue the **show ipsec security-associations detail** command. Notice that the SA contains the settings you specified, such as ESP for the protocol, HMAC-SHA1-96 for the authentication algorithm, and 3DES-CBC for the encryption algorithm.

```
user@R2> show ipsec security-associations detail
Security association: sa-dynamic, Interface family: Up
  Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
  Local identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
  Remote identity: ipv4_subnet(any:0,[0..7]=10.1.15.0/24)
  Direction: inbound, SPI: 2133029543, AUX-SPI: 0
  Mode: tunnel, Type: dynamic, State: Installed
  Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
```

```

Soft lifetime: Expires in 26212 seconds
Hard lifetime: Expires in 26347 seconds
Anti-replay service: Disabled
Direction: outbound, SPI: 1759450863, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26212 seconds
Hard lifetime: Expires in 26347 seconds
Anti-replay service: Disabled

```

### Router 3

View the firewall filter counter to continue verifying that matched traffic is being diverted to the bidirectional IPSec tunnel. After you issue the **ping** command from Router 1 (seven packets), the **es-traffic** firewall filter counter looks like this:

```

user@R3> show firewall filter es-traffic
Filter: es-traffic
Counters:

```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 588   | 7       |

After you issue the **ping** command from both Router 1 (seven packets) and Router 4 (five packets), the **es-traffic** firewall filter counter looks like this:

```

user@R3> show firewall filter es-traffic
Filter: es-traffic
Counters:

```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 1008  | 12      |

To verify the success of the IKE security association, issue the **show ike security-associations detail** command. Notice that the SA on Router 3 contains the same settings you specified on Router 2.

```

user@R3> show ike security-associations detail
IKE peer 10.1.15.1
Role: Responder, State: Matured
Initiator cookie: b5dbdfe2f9000000, Responder cookie: a24c868410000041
Exchange type: Main, Authentication method: Pre-shared-keys
Local: 10.1.15.2:500, Remote: 10.1.15.1:500
Lifetime: Expires in 564 seconds
Algorithms:
Authentication      : sha1
Encryption          : 3des-cbc
Pseudo random function: hmac-sha1
Traffic statistics:
Input bytes  :          2652
Output bytes :          1856
Input packets:           15
Output packets:          10
Flags: Caller notification sent
IPSec security associations: 3 created, 4 deleted
Phase 2 negotiations in progress: 0

```

To verify that the IPSec security association is active, issue the **show ipsec security-associations detail** command. Notice that the SA on Router 3 contains the same settings you specified on Router 2.

```

user@R3> show ipsec security-associations detail

```

```

Security association: sa-dynamic, Interface family: Up
Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
Local identity: ipv4_subnet(any:0,[0..7]=10.1.56.0/24)
Remote identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
Direction: inbound, SPI: 1759450863, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26427 seconds
Hard lifetime: Expires in 26517 seconds
Anti-replay service: Disabled
Direction: outbound, SPI: 2133029543, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 26427 seconds
Hard lifetime: Expires in 26517 seconds
Anti-replay service: Disabled

```

#### Router 4

On Router 4, issue a **ping** command to the **so-0/0/0** interface of Router 1 to send traffic across the IPsec tunnel.

```

user@R4> ping 10.1.12.2
user@R4> ping 10.1.12.2
PING 10.1.12.2 (10.1.12.2): 56 data bytes
64 bytes from 10.1.12.2: icmp_seq=0 ttl=253 time=13.528 ms
64 bytes from 10.1.12.2: icmp_seq=1 ttl=253 time=0.873 ms
64 bytes from 10.1.12.2: icmp_seq=2 ttl=253 time=32.145 ms
64 bytes from 10.1.12.2: icmp_seq=3 ttl=253 time=0.921 ms
64 bytes from 10.1.12.2: icmp_seq=4 ttl=253 time=0.899 ms
^C
--- 10.1.12.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.873/9.673/32.145/12.255 ms

```

You can also issue the **traceroute** command to verify that traffic to **10.1.12.2** travels over the IPsec tunnel between Router 3 and Router 2. Notice that the second hop does not reference **10.1.15.1**—the physical interface on Router 2. Instead, the loopback address of **10.0.0.2** on Router 2 appears as the second hop. This indicates that the IPsec tunnel is operating correctly.

```

user@R4> traceroute 10.1.12.2
traceroute to 10.1.12.2 (10.1.12.2), 30 hops max, 40 byte packets
 1  10.1.56.1 (10.1.56.1)  0.681 ms  0.624 ms  0.547 ms
 2  10.0.0.2 (10.0.0.2)  0.800 ms  0.770 ms  0.737 ms
 3  10.1.12.2 (10.1.12.2)  0.793 ms  0.742 ms  0.716 ms

```

## Example: IKE Dynamic SA Between an AS PIC and an ES PIC Configuration

Figure 10: AS PIC to ES PIC IKE Dynamic SA Topology Diagram

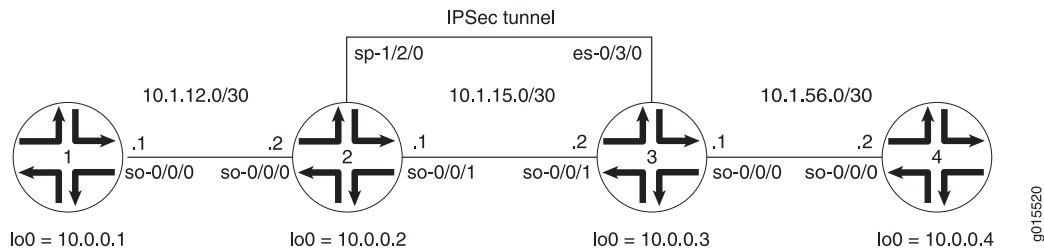


Figure 10 on page 158 shows a hybrid configuration that allows you to create an IPSec tunnel between the AS PIC and the ES PIC. Router 2 contains an AS PIC at **sp-1/2/0** and Router 3 has an ES PIC at **es-0/3/0**. To establish an IPSec tunnel using an IKE dynamic SA, the key is to learn the default IKE SA and IPSec SA settings built into the AS PIC and configure them explicitly on the ES PIC. Routers 1 and 4 again provide basic connectivity and are used to verify that the IPSec tunnel is operational.

On Router 1, provide basic OSPF connectivity to Router 2.

```
Router 1 [edit]
interfaces {
  so-0/0/0 {
    description "To R2 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.2/30;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.1/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.1;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}
```

On Router 2, enable OSPF as the underlying routing protocol to connect to Routers 1 and 3. Configure a bidirectional IKE dynamic SA in a rule called **rule-ike** at the **[edit ipsec-vpn**

**rule]** hierarchy level. Reference this rule in a service set called **service-set-dynamic-BiEspsha3des** at the **[edit services service-set]** hierarchy level.

Using default values in the AS PIC, you do not need to specify an IPsec proposal, IPsec policy, or IKE proposal. However, you do need to configure a preshared key in an IKE policy with the **pre-shared-key** statement at the **[edit services ipsec-vpn ike policy *policy-name*]** hierarchy level. (For more information about default IKE and IPsec policies and proposals on the AS PIC, see [Table 8 on page 119](#).)

To direct traffic into the AS PIC and the IPsec tunnel, include match conditions in the **rule-ike** IPsec VPN rule to match inbound traffic from Router 1 that is destined for Router 4. Because the rule is already referenced by the service set, apply the service set to the **so-0/0/1** interface. To count the amount of traffic that enters the IPsec tunnel, configure a firewall filter called **ipsec-tunnel** and apply it to the **sp-1/2/0** interface.

```
Router 2 [edit]
interfaces {
  so-0/0/0 {
    description "To R1 so-0/0/0";
    unit 0 {
      family inet {
        address 10.1.12.1/30;
      }
    }
  }
  so-0/0/1 {
    description "To R3 so-0/0/1";
    unit 0 {
      family inet {
        service { # Apply the service set here.
          input {
            service-set service-set-dynamic-BiEspsha3des;
          }
          output {
            service-set service-set-dynamic-BiEspsha3des;
          }
        }
        address 10.1.15.1/30;
      }
    }
  }
  sp-1/2/0 {
    services-options {
      syslog {
        host local {
          services info;
        }
      }
    }
    unit 0 {
      family inet {
        filter {
          input ipsec-tunnel; # Apply the firewall filter with the counter here.
        }
      }
    }
  }
}
```

```

    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.2/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.2;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface so-0/0/1.0;
      interface lo0.0;
    }
  }
}
firewall {
  filter ipsec-tunnel { # Configure a firewall filter to count IPSec traffic here.
    term 1 {
      then {
        count ipsec-tunnel;
        accept;
      }
    }
  }
}
services {
  service-set service-set-dynamic-BiEspsha3des { # Define your service set here.
    interface-service {
      service-interface sp-1/2/0; # Specify an interface to process IPSec.
    }
    ipsec-vpn-options {
      local-gateway 10.1.15.1; # Specify the local IP address of the IPSec tunnel.
    }
    ipsec-vpn-rules rule-ike; # Reference your IPSec VPN rule here.
  }
  ipsec-vpn {
    rule rule-ike { # Define your IPSec VPN rule here.
      term term-ike {
        from {
          source-address {
            10.1.12.0/24;
          }
          destination-address {
            10.1.56.0/24;
          }
        }
        then {
          remote-gateway 10.1.15.2; # The remote IP address of the IPSec tunnel.
          dynamic { # This creates a dynamic SA.

```

```

        ike-policy ike-policy-preshared; # Reference your IKE proposal here.
    }
}
match-direction output; # Specify in which direction the rule should match.
}
ike {
    policy ike-policy-preshared { # Define your IKE policy specifications here.
        pre-shared-key ascii-text "$9$KtKWx-YgJHqfVwqfTzCAvWL";
        ## The unencrypted preshared key for this example is juniper.
    }
}
}
}

```

On Router 3, enable OSPF as the underlying routing protocol to connect to Routers 2 and 4. Configure a bidirectional IKE dynamic SA called **sa-dynamic** at the **[edit security ipsec security-association]** hierarchy level. To allow the ES PIC to communicate with the IKE dynamic SA established on Router 2, you must explicitly configure the same policies and proposals on the ES PIC that are available by default on the AS PIC. (For more information about default IKE and IPSec policies and proposals on the AS PIC, see [Table 8 on page 119](#).)

For your IKE policy and proposal, use preshared keys for the authentication method, SHA-1 for the authentication algorithm, 3DES-CBC for encryption, group 2 for the Diffie-Hellman group, main mode, 3600 seconds for the lifetime, and a preshared key of **juniper** for the initial IKE negotiation. For your IPSec policy and proposal, use ESP for the protocol, HMAC-SHA1-96 for authentication, 3DES-CBC for encryption, 28800 seconds for the lifetime, and group 2 for the PFS group.

To direct traffic into the ES PIC and the IPSec tunnel, create two firewall filters. The **es-traffic** filter matches inbound traffic from Router 4 destined for Router 1, whereas the **es-return** filter matches the return path from Router 1 to Router 4. Apply the **es-traffic** filter to the **so-0/0/0** interface; then apply both the **es-return** filter and the **sa-dynamic SA** to the **es-0/3/0** interface.

```

Router 3 [edit]
interfaces {
    so-0/0/0 {
        description "To R4 so-0/0/0";
        unit 0 {
            family inet {
                filter {
                    input es-traffic; # Apply a filter that sends traffic to the IPSec tunnel here.
                }
                address 10.1.56.1/30;
            }
        }
    }
    so-0/0/1 {
        description "To R2 so-0/0/1";
        unit 0 {
            family inet {
                address 10.1.15.2/30;
            }
        }
    }
}

```

```
    }
  }
  es-0/3/0 {
    unit 0 {
      tunnel { # Specify the IPSec tunnel endpoints here.
        source 10.1.15.2;
        destination 10.1.15.1;
      }
      family inet {
        ipsec-sa sa-dynamic; # Apply the dynamic SA here.
        filter {
          input es-return; # Apply the filter that matches return IPSec traffic here.
        }
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.0.0.3/32;
      }
    }
  }
}
routing-options {
  router-id 10.0.0.3;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface so-0/0/1.0;
      interface lo0.0;
    }
  }
}
security {
  ipsec {
    proposal es-ipsec-proposal { # Define your IPSec proposal specifications here.
      protocol esp;
      authentication-algorithm hmac-sha1-96;
      encryption-algorithm 3des-cbc;
      lifetime-seconds 28800;
    }
    policy es-ipsec-policy { # Define your IPSec policy specifications here.
      perfect-forward-secrecy {
        keys group2;
      }
      proposals es-ipsec-proposal; # Reference the IPSec proposal here.
    }
    security-association sa-dynamic { # Define your dynamic SA here.
      mode tunnel;
      dynamic {
        ipsec-policy es-ipsec-policy; # Reference the IPSec policy here.
      }
    }
  }
}
```



```

}
ike {
  proposal es-ike-proposal { # Define your IKE proposal specifications here.
    authentication-method pre-shared-keys;
    dh-group group2;
    authentication-algorithm sha1;
    encryption-algorithm 3des-cbc;
    lifetime-seconds 3600;
  }
  policy 10.1.15.1 { # Define your IKE policy specifications here.
    mode main;
    proposals es-ike-proposal; # Reference the IKE proposal here.
    pre-shared-key ascii-text "$9$TF6ABlcvWxpOWxNdG4QFn";
    ## The unencrypted preshared key for this example is juniper.
  }
}
}
firewall {
  filter es-traffic { # Define a filter that sends traffic to the IPsec tunnel here.
    term to-es {
      from {
        source-address {
          10.1.56.0/24;
        }
        destination-address {
          10.1.12.0/24;
        }
      }
      then {
        count ipsec-tunnel;
        ipsec-sa sa-dynamic;
      }
    }
    term other {
      then accept;
    }
  }
  filter es-return { # Define a filter that matches return IPsec traffic here.
    term return {
      from {
        source-address {
          10.1.12.0/24;
        }
        destination-address {
          10.1.56.0/24;
        }
      }
      then accept;
    }
  }
}
}

```

On Router 4, provide basic OSPF connectivity to Router 3.

Router 4    [edit]  
 interfaces {

```
so-0/0/0 {
  description "To R3 so-0/0/0";
  unit 0 {
    family inet {
      address 10.1.56.2/30;
    }
  }
}
lo0 {
  unit 0 {
    family inet {
      address 10.0.0.4/32;
    }
  }
}
}
routing-options {
  router-id 10.0.0.4;
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0.0;
      interface lo0.0;
    }
  }
}
}
```

## Verifying Your Work

To verify proper operation of an IKE-based dynamic SA on the AS PIC, use the following commands:

- **ping**
- **show services ipsec-vpn ike security-associations (detail)**
- **show services ipsec-vpn ipsec security-associations (detail)**
- **traceroute**

To verify proper operation of an IKE-based dynamic SA on the ES PIC, use the following commands:

- **ping**
- **show ike security-associations (detail)**
- **show ipsec security-associations (detail)**
- **traceroute**

The following sections show the output of these commands used with the configuration example:

- [Router 1 on page 165](#)
- [Router 2 on page 165](#)
- [Router 3 on page 167](#)
- [Router 4 on page 168](#)

### Router 1

On Router 1, issue a **ping** command to the **so-0/0/0** interface of Router 4 to send traffic across the IPsec tunnel.

```
user@R1> ping 10.1.56.2
PING 10.1.56.2 (10.1.56.2): 56 data bytes
64 bytes from 10.1.56.2: icmp_seq=0 ttl=253 time=1.172 ms
64 bytes from 10.1.56.2: icmp_seq=1 ttl=253 time=1.020 ms
64 bytes from 10.1.56.2: icmp_seq=2 ttl=253 time=0.998 ms
64 bytes from 10.1.56.2: icmp_seq=3 ttl=253 time=1.037 ms
^C
--- 10.1.56.2 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.998/1.057/1.172/0.068 ms
```

You can also issue the **tracert** command to verify that traffic to **10.1.56.2** travels over the IPsec tunnel between Router 2 and Router 3. Notice that the traced path does not reference **10.1.15.2**—the physical interface on Router 3. Instead, traffic arriving at Router 2 is immediately filtered into the IPsec tunnel and the path is listed as unknown with the **\*\*\*** notation. This indicates that the IPsec tunnel is operating correctly.

```
user@R1> traceroute 10.1.56.2
traceroute to 10.1.56.2 (10.1.56.2), 30 hops max, 40 byte packets
 1 * * *
 2 10.1.56.2 (10.1.56.2) 1.045 ms 0.915 ms 0.850 ms
```

### Router 2

One way to verify that matched traffic is being diverted to the bidirectional IPsec tunnel is to view the firewall filter counter. Before any traffic flows, the **ipsec-tunnel** firewall filter counter looks like this:

```
user@R2> show firewall filter ipsec-tunnel
Filter: ipsec-tunnel
Counters:
Name                               Bytes          Packets
ipsec-tunnel                        0              0
```

After you issue the **ping** command from Router 1 (four packets) to **10.1.56.2**, the **ipsec-tunnel** firewall filter counter looks like this:

```
user@R2> show firewall filter ipsec-tunnel
Filter: ipsec-tunnel
Counters:
Name                               Bytes          Packets
ipsec-tunnel                       336            4
```

After you issue the **ping** command from both Router 1 to **10.1.56.2** (four packets) and from Router 4 to **10.1.12.2** (six packets), the **ipsec-tunnel** firewall filter counter looks like this:

```
user@R2> show firewall filter ipsec-tunnel
Filter: es-traffic
Counters:

```

| Name         | Bytes | Packets |
|--------------|-------|---------|
| ipsec-tunnel | 840   | 10      |

To verify that the IKE SA negotiation is successful, issue the **show services ipsec-vpn ike security-associations detail** command. Notice that the SA contains the default IKE settings inherent in the AS PIC, such as SHA-1 for the authentication algorithm and 3DES-CBC for the encryption algorithm.

```
user@R2> show services ipsec-vpn ike security-associations detail
IKE peer 10.1.15.2
  Role: Responder, State: Matured
  Initiator cookie: c8e1e4c0da000040, Responder cookie: 4fbaa5184e000044
  Exchange type: Main, Authentication method: Pre-shared-keys
  Local: 10.1.15.1:500, Remote: 10.1.15.2:500
  Lifetime: Expires in 3535 seconds
  Algorithms:
    Authentication      : sha1
    Encryption          : 3des-cbc
    Pseudo random function: hmac-sha1
  Traffic statistics:
    Input bytes :      840
    Output bytes :     756
    Input packets:       5
    Output packets:      4
  Flags: Caller notification sent
  IPSec security associations: 1 created, 0 deleted
  Phase 2 negotiations in progress: 0
```

To verify that the IPSec security association is active, issue the **show services ipsec-vpn ipsec security-associations detail** command. Notice that the SA contains the default settings inherent in the AS PIC, such as ESP for the protocol and HMAC-SHA1-96 for the authentication algorithm.

```
user@R2> show services ipsec-vpn ipsec security-associations detail
Service set: service-set-dynamic-BiEspsha3des
  Rule: rule-ike, Term: term-ike, Tunnel index: 1
  Local gateway: 10.1.15.1, Remote gateway: 10.1.15.2
  Local identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
  Remote identity: ipv4_subnet(any:0,[0..7]=10.1.56.0/24)
  Direction: inbound, SPI: 407204513, AUX-SPI: 0
  Mode: tunnel, Type: dynamic, State: Installed
  Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
  Soft lifetime: Expires in 24546 seconds
  Hard lifetime: Expires in 24636 seconds
  Anti-replay service: Disabled
  Direction: outbound, SPI: 2957235894, AUX-SPI: 0
  Mode: tunnel, Type: dynamic, State: Installed
  Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
  Soft lifetime: Expires in 24546 seconds
  Hard lifetime: Expires in 24636 seconds
  Anti-replay service: Disabled
```

### Router 3

View the firewall filter counter to continue verifying that matched traffic is being diverted to the bidirectional IPsec tunnel. After you issue the **ping** command from Router 1 (four packets), the **es-traffic** firewall filter counter looks like this:

```
user@R3> show firewall filter es-traffic
Filter: es-traffic
Counters:
Name                               Bytes      Packets
ipsec-tunnel                        336         4
```

After you issue the **ping** command from both Router 1 (four packets) and Router 4 (six packets), the **es-traffic** firewall filter counter looks like this:

```
user@R3> show firewall filter es-traffic
Filter: es-traffic
Counters:
Name                               Bytes      Packets
ipsec-tunnel                        840        10
```

To verify the success of the IKE security association on the ES PIC, issue the **show ike security-associations detail** command. Notice that the IKE SA on Router 3 contains the same settings you specified on Router 2.

```
user@R3> show ike security-associations detail
IKE peer 10.1.15.1
Role: Initiator, State: Matured
Initiator cookie: c8e1e4c0da000040, Responder cookie: 4fbaa5184e000044
Exchange type: Main, Authentication method: Pre-shared-keys
Local: 10.1.15.2:500, Remote: 10.1.15.1:500
Lifetime: Expires in 3441 seconds
Algorithms:
Authentication      : sha1
Encryption          : 3des-cbc
Pseudo random function: hmac-sha1
Traffic statistics:
Input bytes :          756
Output bytes :          840
Input packets:           4
Output packets:          5
Flags: Caller notification sent
IPsec security associations: 1 created, 0 deleted
Phase 2 negotiations in progress: 0
```

To verify that the IPsec security association is active, issue the **show ipsec security-associations detail** command. Notice that the IPsec SA on Router 3 contains the same settings you specified on Router 2.

```
user@R3> show ipsec security-associations detail
Security association: sa-dynamic, Interface family: Up
Local gateway: 10.1.15.2, Remote gateway: 10.1.15.1
Local identity: ipv4_subnet(any:0,[0..7]=10.1.56.0/24)
Remote identity: ipv4_subnet(any:0,[0..7]=10.1.12.0/24)
Direction: inbound, SPI: 2957235894, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 28555 seconds
Hard lifetime: Expires in 28690 seconds
Anti-replay service: Disabled
```

```

Direction: outbound, SPI: 407204513, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 28555 seconds
Hard lifetime: Expires in 28690 seconds
Anti-replay service: Disabled

```

## Router 4

On Router 4, issue a **ping** command to the **so-0/0/0** interface on Router 1 to send traffic across the IPsec tunnel.

```

user@R4> ping 10.1.12.2
PING 10.1.12.2 (10.1.12.2): 56 data bytes
64 bytes from 10.1.12.2: icmp_seq=0 ttl=254 time=1.350 ms
64 bytes from 10.1.12.2: icmp_seq=1 ttl=254 time=1.161 ms
64 bytes from 10.1.12.2: icmp_seq=2 ttl=254 time=1.124 ms
64 bytes from 10.1.12.2: icmp_seq=3 ttl=254 time=1.142 ms
64 bytes from 10.1.12.2: icmp_seq=4 ttl=254 time=1.139 ms
64 bytes from 10.1.12.2: icmp_seq=5 ttl=254 time=1.116 ms
^C
--- 10.1.12.2 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.116/1.172/1.350/0.081 ms

```

Again, the **traceroute** command verifies that traffic to **10.1.12.2** travels over the IPsec tunnel between Router 3 and Router 2. Notice that the second hop does not reference **10.1.15.1**—the physical interface on Router 2. Instead, the second hop is listed as unknown with the **\*\*\*** notation. This indicates that the IPsec tunnel is operating correctly.

```

user@R4> traceroute 10.1.12.2
traceroute to 10.1.12.2 (10.1.12.2), 30 hops max, 40 byte packets
 1  10.1.56.1 (10.1.56.1)  3.561 ms  0.613 ms  0.558 ms
 2  * * *
 3  10.1.12.2 (10.1.12.2)  1.073 ms  0.862 ms  0.818 ms

```

## Configuring Multiple Routed Tunnels in a Single Next-Hop Service Set

To save you time and simplify your configurations, an enhancement to the Junos OS enables you to configure several routed IPsec tunnels within a single next-hop service set. To configure, establish multiple services interfaces as inside interfaces by including the **service-domain inside** statement at the **[edit interfaces sp-fpc/pic/port unit logical-unit-number]** hierarchy level. Then, include the **ipsec-inside-interface** statement at the **[edit services ipsec-vpn rule rule-name term term-name from]** hierarchy level.



**NOTE:** The full IPsec and IKE proposals and policies are not shown in the following example for the sake of brevity. For more information on proposals and policies, see [“Configuring IKE Dynamic SAs” on page 117](#).

```

[edit]
interfaces {
  sp-3/3/0 {
    unit 3 {
      family inet;

```

```

        service-domain inside;
    }
    unit 4 {
        family inet;
        service-domain outside;
    }
    unit 5 {
        family inet;
        service-domain inside;
    }
}
}
services {
    service-set link_type_ss_1 {
        next-hop-service {
            inside-service-interface sp-3/3/0.3;
            outside-service-interface sp-3/3/0.4;
        }
        ipsec-vpn-options {
            local-gateway 10.8.7.2;
        }
        ipsec-vpn-rules link_rule_1;
    }
    ipsec-vpn {
        rule link_rule_1 {
            term 1 {
                from {
                    ipsec-inside-interface sp-3/3/0.3;
                }
                then {
                    remote-gateway 10.10.7.3;
                    backup-remote-gateway 10.8.7.1;
                    dynamic {
                        ike-policy main_mode_ike_policy;
                        ipsec-policy dynamic_ipsec_policy;
                    }
                }
            }
            term 2 {
                from {
                    ipsec-inside-interface sp-3/3/0.5;
                }
                then {
                    remote-gateway 10.12.7.5;
                    dynamic {
                        ike-policy main_mode_ike_policy;
                        ipsec-policy dynamic_ipsec_policy;
                    }
                }
            }
        }
        match-direction input;
    }
}
}

```

To confirm that your configuration is working, issue the **show services ipsec-vpn ipsec security-associations** command. Notice that each IPSec inside interface that you assigned to each IPSec tunnel is included in the output of this command.

```
user@router> show services ipsec-vpn ipsec security-associations
Service set: link_type_ss_1
```

```
Rule: link_rule_1, Term: 1, Tunnel index: 1
```

```
Local gateway: 10.8.7.2, Remote gateway: 10.8.7.1
```

```
IPSec inside interface: sp-3/3/0.3
```

| Direction | SPI        | AUX-SPI | Mode   | Type    | Protocol |
|-----------|------------|---------|--------|---------|----------|
| inbound   | 3216392497 | 0       | tunnel | dynamic | ESP      |
| outbound  | 398917249  | 0       | tunnel | dynamic | ESP      |

```
Rule: link_rule_1, Term: 2, Tunnel index: 2
```

```
Local gateway: 10.8.7.2, Remote gateway: 10.12.7.5
```

```
IPSec inside interface: sp-3/3/0.5
```

| Direction | SPI       | AUX-SPI | Mode   | Type    | Protocol |
|-----------|-----------|---------|--------|---------|----------|
| inbound   | 762146783 | 0       | tunnel | dynamic | ESP      |
| outbound  | 319191515 | 0       | tunnel | dynamic | ESP      |



## CHAPTER 11

# Configuring IPsec on an ES PIC

- [IPsec Configuration for an ES PIC Overview on page 171](#)
- [Configuring Minimum Manual Security Associations for IPsec on an ES PIC on page 172](#)
- [Configuring Minimum IKE Requirements for IPsec on an ES PIC on page 172](#)
- [Configuring Minimum Digital Certificate Requirements for IKE on an ES PIC on page 172](#)
- [Configuring Security Associations for IPsec on an ES PIC on page 173](#)
- [Configuring Manual IPsec Security Associations for an ES PIC on page 180](#)
- [Configuring Dynamic IPsec Security Associations on page 184](#)
- [Configuring an IKE Proposal for Dynamic SAs on page 185](#)
- [Example: Configuring an IKE Proposal on page 187](#)
- [Configuring an IKE Policy for Preshared Keys on page 187](#)
- [Example: Configuring an IKE Policy on page 189](#)
- [Configuring an IPsec Proposal for an ES PIC on page 190](#)
- [Configuring the IPsec Policy for an ES PIC on page 192](#)
- [Example: Configuring an IPsec Policy on page 193](#)
- [Configuring Internal IPsec for Junos-FIPS on page 194](#)
- [Example: Configuring Internal IPsec on page 196](#)

## IPsec Configuration for an ES PIC Overview

---

IP Security (IPsec) provides a secure way to authenticate senders and encrypt IPv4 and IPv6 traffic between network devices, such as routers and hosts. The following sections show how to configure IPsec for an ES PIC.

The key management process (kmd) provides IPsec authentication services for ES PICs. The key management process starts only when IPsec is configured on the router.

### Related Documentation

- [Configuring Minimum Manual Security Associations for IPsec on an ES PIC on page 172](#)
- [Configuring Minimum Digital Certificate Requirements for IKE on an ES PIC on page 172](#)
- [Configuring Security Associations for IPsec on an ES PIC on page 173](#)
- [Configuring an IKE Proposal for Dynamic SAs on page 185](#)

- [Example: Configuring an IKE Proposal on page 187](#)

## Configuring Minimum Manual Security Associations for IPsec on an ES PIC

---

To define a manual security association (SA) configuration for an ES PIC, include at least the following statements at the **[edit security ipsec]** hierarchy level:

```
[edit security ipsec]
security-association sa-name {
  manual {
    direction (inbound | outbound | bidirectional) {
      authentication {
        algorithm (hmac-md5-96 | hmac-sha1-96);
        key (ascii-text key | hexadecimal key);
      }
      encryption {
        algorithm (des-cbc | 3des-cbc);
        key (ascii-text key | hexadecimal key);
      }
      protocol (ah | esp | bundle);
      spi spi-value;
    }
  }
}
```

**Related Documentation** • [IPsec Configuration for an ES PIC Overview on page 171](#)

## Configuring Minimum IKE Requirements for IPsec on an ES PIC

---

To define an IKE configuration for an ES PIC, include at least the following statements at the **[edit security]** hierarchy level:

```
[edit security ike]
proposal ike-proposal-name {
  authentication-method (dsa-signatures | pre-shared-keys | rsa-signatures);
  dh-group (group1 | group2);
  encryption-algorithm (3des-cbd | des-cbc | aes-128-cbc | aes-192-cbc | aes-256-cbc);
}
policy ike-peer-address {
  proposals [ ike-proposal-names ];
  pre-shared-key (ascii-text key | hexadecimal key);
}
```

**Related Documentation** • [IPsec Configuration for an ES PIC Overview on page 171](#)

## Configuring Minimum Digital Certificate Requirements for IKE on an ES PIC

---

To define a digital certificate configuration for IKE for an encryption interface on M Series and T Series routers, include at least the following statements at the **[edit security certificates]** and **[edit security ike]** hierarchy levels:

```

[edit security]
certificates {
  certification-authority ca-profile-name {
    ca-name ca-identity;
    crl filename;
    enrollment-url url-name;
    file certificate-filename;
    ldap-url url-name;
  }
}
ike {
  policy ike-peer-address {
    local-certificate certificate-filename;
    local-key-pair private-public-key-file;
    proposal [ ike-proposal-names ];
  }
  proposal ike-proposal-name {
    authentication-method rsa-signatures;
  }
}

```

**Related Documentation**

- [IPsec Configuration for an ES PIC Overview on page 171](#)

## Configuring Security Associations for IPsec on an ES PIC

To use IPsec security services, you create an SA between hosts. An SA is a simplex connection that allows two hosts to communicate with each other securely by means of IPsec. You can configure two types of SAs:

- **Manual**—Requires no negotiation; all values, including the keys, are static and specified in the configuration. As a result, each peer must have the same configured options for communication to take place. For information about how to configure a manual SA, see [“Configuring Manual IPsec Security Associations for an ES PIC” on page 175](#).
- **Dynamic**—Specify proposals to be negotiated with the tunnel peer. The keys are generated as part of the negotiation and therefore do not need to be specified in the configuration. The dynamic SA includes one or more **proposal** statements, which allow you to prioritize a list of protocols and algorithms to be negotiated with the peer. For information about how to configure a dynamic SA, see [“Associating the Configured Security Association with a Logical Interface” on page 21](#).



**NOTE:** The Junos OS does not perform a commit check when an SA name referenced in the Border Gateway Protocol (BGP) protocol section is not configured at the `[edit security ipsec]` hierarchy level.

We recommend that you configure no more than 512 dynamic security associations per ES Physical Interface Card (PIC).

To configure an SA for IPsec for an ES PIC, include the **security-association** statement at the `[edit security ipsec]` hierarchy level:

```
[edit security ipsec]  
security-association sa-name;
```



**NOTE:** You configure a dynamic SA for the AS and MultiServices PICs at the [edit services ipsec-vpn rule *rule-name* term *term-name* then dynamic], [edit services ipsec-vpn ike], and [edit services ipsec-vpn ipsec] hierarchy levels.

For more information, see the “IPsec” chapter of the *Junos OS, Release 14.1* and the “IPsec Services Configuration Guidelines” chapter of the *Junos OS Services Interfaces Library for Routing Devices*.

Tasks to configure SAs for IPsec for an ES PIC are:

1. [Configuring the Description for an SA on page 174](#)
2. [Configuring IPsec Transport Mode on page 174](#)
3. [Configuring IPsec Tunnel Mode on page 175](#)
4. [Configuring Manual IPsec Security Associations for an ES PIC on page 175](#)
5. [Configuring Dynamic IPsec Security Associations on page 179](#)
6. [Enabling Dynamic IPsec Security Associations on page 180](#)

## Configuring the Description for an SA

To specify a description for an IPsec SA, include the **description** statement at the **edit security ipsec security-association sa-name** hierarchy level:

```
[edit security ipsec security-association sa-name]  
description description;
```

## Configuring IPsec Transport Mode

In transport mode, the data portion of the IP packet is encrypted, but the IP header is not. Transport mode can be used only when the communication endpoint and cryptographic endpoint are the same. Virtual private network (VPN) gateways that provide encryption and decryption services for protected hosts cannot use transport mode for protected VPN communications. You configure manual SAs, and you must configure static values on both ends of the SA.



**NOTE:** When you use transport mode, the Junos OS supports both BGP and OSPFv3 for manual SAs.

To configure IPsec security for transport mode, include the **mode** statement with the **transport** option at the **edit security ipsec security-association sa-name** hierarchy level:

```
[edit security ipsec security-association sa-name]  
mode transport;
```

To apply tunnel mode, you configure manual SAs in transport mode and then reference the SA by name at the `[edit protocols bgp]` hierarchy level to protect a session with a given peer.



**NOTE:** You can configure BGP to establish a peer relationship over encrypted tunnels.

## Configuring IPsec Tunnel Mode

You use tunnel mode when you use preshared keys with IKE to authenticate peers, or digital certificates with IKE to authenticate peers.

When you use preshared keys, you manually configure a preshared key, which must match that of its peer. With digital certificates, each router is dynamically or manually enrolled with a certificate authority (CA). When a tunnel is established, the public keys used for IPsec are dynamically obtained through IKE and validated against the CA certificate. This avoids the manual configuration of keys on routers within the topology. Adding a new router to the topology does not require any security configuration changes to existing routers.

To configure the IPsec in tunnel mode, include the **mode** statement with the **tunnel** option at the `edit security ipsec security-association sa-name` hierarchy level:

```
[edit security ipsec security-association sa-name]
mode tunnel;
```



**NOTE:** The Junos OS supports both BGP and OSPFv3 in transport mode.

To enable tunnel mode, follow the steps in these sections:

- [Configuring an IKE Proposal for Dynamic SAs on page 185](#)
- [Associating the Configured Security Association with a Logical Interface on page 21](#)
- [IPsec Tunnel Traffic Configuration Overview on page 197](#)

## Configuring Manual IPsec Security Associations for an ES PIC

To use IPsec security services, you create security associations (SAs) between hosts. An SA is a simplex connection that allows two hosts to communicate with each other securely by means of IPsec. There are two types of SAs: manual and dynamic.

Manual SAs require no negotiation; all values, including the keys, are static and specified in the configuration. As a result, peers can communicate only when they all share the same configured options.

To configure the manual IPsec SA for an ES PIC, include the **manual** statement at the `edit security ipsec security-association sa-name` hierarchy level:

```
[edit security ipsec security-association sa-name]
```

```
manual {  
  direction (inbound | outbound | bi-directional) {  
    authentication {  
      algorithm (hmac-md5-96 | hmac-sha1-96);  
      key (ascii-text key | hexadecimal key);  
    }  
    auxiliary-spi auxiliary-spi-value;  
    encryption {  
      algorithm (des-cbc | 3des-cbc);  
      key (ascii-text key | hexadecimal key);  
    }  
    protocol (ah | esp | bundle);  
    spi spi-value;  
  }  
}
```

Tasks to configure a manual SA are:

1. [Configuring the Processing Direction on page 176](#)
2. [Configuring the Protocol for a Manual SA on page 177](#)
3. [Configuring the Security Parameter Index on page 177](#)
4. [Configuring the Auxiliary Security Parameter Index on page 178](#)
5. [Configuring the Authentication Algorithm and Key on page 178](#)
6. [Configuring the Encryption Algorithm and Key on page 179](#)

---

### Configuring the Processing Direction

The **direction** statement sets inbound and outbound IPsec processing. If you want to define different algorithms, keys, or security parameter index (SPI) values for each direction, you configure the **inbound** and **outbound** options. If you want the same attributes in both directions, use the **bidirectional** option.

To configure the direction of IPsec processing, include the **direction** statement and specify the direction at the **[edit security ipsec security-association *sa-name* manual]** hierarchy level:

```
[edit security ipsec security-association sa-name manual]  
direction (inbound | outbound | bidirectional);
```

The following example shows how to define different algorithms, keys, and security parameter index values for inbound and outbound processing directions:

```
[edit security ipsec security-association sa-name]  
manual {  
  direction inbound {  
    encryption {  
      algorithm 3des-cbc;  
      key ascii-text 23456789012345678901234;  
    }  
    protocol esp;  
    spi 16384;  
  }  
  direction outbound {  
    encryption {
```

```

        algorithm 3des-cbc;
        key ascii-text 12345678901234567890abcd;
    }
    protocol esp;
    spi 24576;
}

```

The following example shows how to define the same algorithms, keys, and security parameter index values for bidirectional processing:

```

[edit security ipsec security-association sa-name manual]
direction bidirectional {
    authentication {
        algorithm hmac-md5-96;
        key ascii-text 123456789012abcd;
    }
    protocol ah;
    spi 20001;
}

```

### Configuring the Protocol for a Manual SA

IPsec uses two protocols to protect IP traffic: Encapsulating Security Payload (ESP) and authentication header (AH). For transport mode SAs, both ESP and AH are supported. The AH protocol is used for strong authentication. The **bundle** option uses AH authentication and ESP encryption; it does not use ESP authentication because AH provides stronger authentication of IP packets.



**NOTE:** The AH protocol is supported only on M Series routers.

To configure the IPsec protocol on an ES PIC, include the **protocol** statement at the **edit security ipsec security-association *sa-name* manual direction (inbound | outbound | bidirectional)]** hierarchy level and specify the **ah**, **bundle**, or **esp** option:

```

[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bi-directional)]
protocol (ah | bundle | esp);

```

### Configuring the Security Parameter Index

An SPI is an arbitrary value that uniquely identifies which SA to use at the receiving host. The sending host uses the SPI to identify and select which SA to use to secure every packet. The receiving host uses the SPI to identify and select the encryption algorithm and key used to decrypt packets.



**NOTE:** Each manual SA must have a unique SPI and protocol combination.

Use the auxiliary SPI when you configure the protocol statement to use the **bundle** option.

To configure the SPI on an ES PIC, include the **spi** statement and specify a value (256 through 16,639) at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```
[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bidirectional)]
spi spi-value;
```

### Configuring the Auxiliary Security Parameter Index

When you configure the protocol statement to use the bundle option, the Junos OS uses the auxiliary SPI for the ESP and the SPI for the AH.



**NOTE:** Each manual SA must have a unique SPI and protocol combination.

To configure the auxiliary SPI, include the **auxiliary-spi** statement at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level and set the value to an integer between 256 and 16,639:

```
[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bidirectional)]
auxiliary-spi auxiliary-spi-value;
```

### Configuring the Authentication Algorithm and Key

To configure an authentication algorithm and key, include the **authentication** statement at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```
[edit security ipsec security-association sa-name manual direction (inbound | outbound |
bidirectional)]
authentication {
  algorithm (hmac-md5-96 | hmac-sha1-96);
  key (ascii-text key | hexadecimal key);
}
```

The algorithm can be one of the following:

- **hmac-md5-96**—Hash algorithm that authenticates packet data. It produces a 128-bit authenticator value and 96-bit digest.
- **hmac-sha1-96**—Hash algorithm that authenticates packet data. It produces a 160-bit authenticator value and a 96-bit digest.

The key can be one of the following:

- **ascii-text key**—ASCII text key. With the **hmac-md5-96** option, the key contains 16 ASCII characters. With the **hmac-sha1-96** option, the key contains 20 ASCII characters.
- **hexadecimal key**—Hexadecimal key. With the **hmac-md5-96** option, the key contains 32 hexadecimal characters. With the **hmac-sha1-96** option, the key contains 40 hexadecimal characters.



### Configuring the Encryption Algorithm and Key

To configure IPsec encryption, include the **encryption** statement and specify an algorithm and key at the **[edit security ipsec security-association *sa-name* manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```
[edit security ipsec security-association sa-name manual direction (inbound | outbound |
bi-directional)]
encryption {
  algorithm (des-cbc | 3des-cbc);
  key (ascii-text key | hexadecimal key);
}
```

The algorithm can be one of the following:

- **des-cbc**—Encryption algorithm that has a block size of 8 bytes; its key size is 64 bits long.
- **3des-cbc**—Encryption algorithm that has a block size of 24 bytes; its key size is 192 bits long.



**NOTE:** For a list of Data Encryption Standard (DES) encryption algorithm weak and semiweak keys, see RFC 2409. For **3des-cbc**, we recommend that the first 8 bytes not be the same as the second 8 bytes, and that the second 8 bytes be the same as the third 8 bytes.

The key can be one of the following:

- **ascii-text**—ASCII text key. With the **des-cbc** option, the key contains 8 ASCII characters. With the **3des-cbc** option, the key contains 24 ASCII characters.
- **hexadecimal**—Hexadecimal key. With the **des-cbc** option, the key contains 16 hexadecimal characters. With the **3des-cbc** option, the key contains 48 hexadecimal characters.



**NOTE:** You cannot configure encryption when you use the AH protocol.

### Configuring Dynamic IPsec Security Associations

You configure dynamic SAs with a set of proposals that are negotiated by the security gateways. The keys are generated as part of the negotiation and do not need to be specified in the configuration. The dynamic SA includes one or more proposals, which allow you to prioritize a list of protocols and algorithms to be negotiated with the peer.

To configure a dynamic SA, include the **dynamic** statement at the **[edit security ipsec security-association *sa-name*]** hierarchy level. Specify an IPsec policy name, and optionally, a 32-packet or 64-packet replay window size.

```
[edit security ipsec security-association sa-name]
```

```
dynamic {  
    ipsec-policy policy-name;  
    replay-window-size (32 | 64);  
}
```

## Enabling Dynamic IPsec Security Associations

To enable a dynamic SA, follow these steps:

1. Configure IKE proposals and IKE policies associated with these proposals.
2. Configure IPsec proposals and an IPsec policy associated with these proposals.
3. Associate an SA with an IPsec policy.



**NOTE:** Dynamic tunnel SAs require an ES PIC. If you want to establish a dynamic SA, the attributes in at least one configured IPsec and IKE proposal must match those of its peer.

The replay window is not used with manual SAs.

---

## Configuring Manual IPsec Security Associations for an ES PIC

To use IPsec security services, you create security associations (SAs) between hosts. An SA is a simplex connection that allows two hosts to communicate with each other securely by means of IPsec. There are two types of SAs: manual and dynamic.

Manual SAs require no negotiation; all values, including the keys, are static and specified in the configuration. As a result, peers can communicate only when they all share the same configured options.

To configure the manual IPsec SA for an ES PIC, include the **manual** statement at the **edit security ipsec security-association *sa-name*** hierarchy level:

```
[edit security ipsec security-association sa-name]  
manual {  
    direction (inbound | outbound | bi-directional) {  
        authentication {  
            algorithm (hmac-md5-96 | hmac-sha1-96);  
            key (ascii-text key | hexadecimal key);  
        }  
        auxiliary-spi auxiliary-spi-value;  
    }  
    encryption {  
        algorithm (des-cbc | 3des-cbc);  
        key (ascii-text key | hexadecimal key);  
    }  
    protocol (ah | esp | bundle);  
    spi spi-value;  
}
```

```
}
```

Tasks to configure a manual SA are:

1. [Configuring the Processing Direction on page 181](#)
2. [Configuring the Protocol for a Manual SA on page 182](#)
3. [Configuring the Security Parameter Index on page 182](#)
4. [Configuring the Auxiliary Security Parameter Index on page 182](#)
5. [Configuring the Authentication Algorithm and Key on page 183](#)
6. [Configuring the Encryption Algorithm and Key on page 183](#)

## Configuring the Processing Direction

The **direction** statement sets inbound and outbound IPsec processing. If you want to define different algorithms, keys, or security parameter index (SPI) values for each direction, you configure the **inbound** and **outbound** options. If you want the same attributes in both directions, use the **bidirectional** option.

To configure the direction of IPsec processing, include the **direction** statement and specify the direction at the **[edit security ipsec security-association sa-name manual]** hierarchy level:

```
[edit security ipsec security-association sa-name manual]
direction (inbound | outbound | bidirectional);
```

The following example shows how to define different algorithms, keys, and security parameter index values for inbound and outbound processing directions:

```
[edit security ipsec security-association sa-name]
manual {
  direction inbound {
    encryption {
      algorithm 3des-cbc;
      key ascii-text 23456789012345678901234;
    }
    protocol esp;
    spi 16384;
  }
  direction outbound {
    encryption {
      algorithm 3des-cbc;
      key ascii-text 12345678901234567890abcd;
    }
    protocol esp;
    spi 24576;
  }
}
```

The following example shows how to define the same algorithms, keys, and security parameter index values for bidirectional processing:

```
[edit security ipsec security-association sa-name manual]
direction bidirectional {
  authentication {
```

```

    algorithm hmac-md5-96;
    key ascii-text 123456789012abcd;
  }
  protocol ah;
  spi 20001;
}

```

## Configuring the Protocol for a Manual SA

IPsec uses two protocols to protect IP traffic: Encapsulating Security Payload (ESP) and authentication header (AH). For transport mode SAs, both ESP and AH are supported. The AH protocol is used for strong authentication. The **bundle** option uses AH authentication and ESP encryption; it does not use ESP authentication because AH provides stronger authentication of IP packets.



**NOTE:** The AH protocol is supported only on M Series routers.

To configure the IPsec protocol on an ES PIC, include the **protocol** statement at the **edit security ipsec security-association sa-name manual direction (inbound | outbound | bidirectional)]** hierarchy level and specify the **ah**, **bundle**, or **esp** option:

```

[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bi-directional)]
  protocol (ah | bundle | esp);

```

## Configuring the Security Parameter Index

An SPI is an arbitrary value that uniquely identifies which SA to use at the receiving host. The sending host uses the SPI to identify and select which SA to use to secure every packet. The receiving host uses the SPI to identify and select the encryption algorithm and key used to decrypt packets.



**NOTE:** Each manual SA must have a unique SPI and protocol combination.

Use the auxiliary SPI when you configure the protocol statement to use the **bundle** option.

To configure the SPI on an ES PIC, include the **spi** statement and specify a value (256 through 16,639) at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```

[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bidirectional)]
  spi spi-value;

```

## Configuring the Auxiliary Security Parameter Index

When you configure the protocol statement to use the bundle option, the Junos OS uses the auxiliary SPI for the ESP and the SPI for the AH.



**NOTE:** Each manual SA must have a unique SPI and protocol combination.

To configure the auxiliary SPI, include the **auxiliary-spi** statement at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level and set the value to an integer between 256 and 16,639:

```
[edit security ipsec security-association sa-name manual direction (inbound |
outbound | bidirectional)]
auxiliary-spi auxiliary-spi-value;
```

## Configuring the Authentication Algorithm and Key

To configure an authentication algorithm and key, include the **authentication** statement at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```
[edit security ipsec security-association sa-name manual direction (inbound | outbound |
bidirectional)]
authentication {
  algorithm (hmac-md5-96 | hmac-sha1-96);
  key (ascii-text key | hexadecimal key);
}
```

The algorithm can be one of the following:

- **hmac-md5-96**—Hash algorithm that authenticates packet data. It produces a 128-bit authenticator value and 96-bit digest.
- **hmac-sha1-96**—Hash algorithm that authenticates packet data. It produces a 160-bit authenticator value and a 96-bit digest.

The key can be one of the following:

- **ascii-text key**—ASCII text key. With the **hmac-md5-96** option, the key contains 16 ASCII characters. With the **hmac-sha1-96** option, the key contains 20 ASCII characters.
- **hexadecimal key**—Hexadecimal key. With the **hmac-md5-96** option, the key contains 32 hexadecimal characters. With the **hmac-sha1-96** option, the key contains 40 hexadecimal characters.

## Configuring the Encryption Algorithm and Key

To configure IPsec encryption, include the **encryption** statement and specify an algorithm and key at the **[edit security ipsec security-association sa-name manual direction (inbound | outbound | bi-directional)]** hierarchy level:

```
[edit security ipsec security-association sa-name manual direction (inbound | outbound |
bi-directional)]
encryption {
  algorithm (des-cbc | 3des-cbc);
  key (ascii-text key | hexadecimal key);
}
```

The algorithm can be one of the following:

- **des-cbc**—Encryption algorithm that has a block size of 8 bytes; its key size is 64 bits long.
- **3des-cbc**—Encryption algorithm that has a block size of 24 bytes; its key size is 192 bits long.



**NOTE:** For a list of Data Encryption Standard (DES) encryption algorithm weak and semiweak keys, see RFC 2409. For **3des-cbc**, we recommend that the first 8 bytes not be the same as the second 8 bytes, and that the second 8 bytes be the same as the third 8 bytes.

The key can be one of the following:

- **ascii-text**—ASCII text key. With the **des-cbc** option, the key contains 8 ASCII characters. With the **3des-cbc** option, the key contains 24 ASCII characters.
- **hexadecimal**—Hexadecimal key. With the **des-cbc** option, the key contains 16 hexadecimal characters. With the **3des-cbc** option, the key contains 48 hexadecimal characters.



**NOTE:** You cannot configure encryption when you use the AH protocol.

---

## Configuring Dynamic IPsec Security Associations

---

You configure dynamic SAs with a set of proposals that are negotiated by the security gateways. The keys are generated as part of the negotiation and do not need to be specified in the configuration. The dynamic SA includes one or more proposals, which allow you to prioritize a list of protocols and algorithms to be negotiated with the peer.

To configure a dynamic SA, include the **dynamic** statement at the **[edit security ipsec security-association sa-name]** hierarchy level. Specify an IPsec policy name, and optionally, a 32-packet or 64-packet replay window size.

```
[edit security ipsec security-association sa-name]
dynamic {
    ipsec-policy policy-name;
    replay-window-size (32 | 64);
}
```

### Related Documentation

- [Configuring Manual IPsec Security Associations for an ES PIC on page 175](#)

## Configuring an IKE Proposal for Dynamic SAs

Dynamic Security Associations (SAs) require IKE configuration. The IKE configuration defines the algorithms and keys used to establish the secure IKE connection with the peer security gateway.

You can configure one or more IKE proposals. Each proposal is a list of IKE attributes to protect the IKE connection between the IKE host and its peer.

To configure an IKE proposal and define its properties, include the following statements at the **[edit security ike]** hierarchy level:

```
[edit security ike]
proposal ike-proposal-name {
  authentication-algorithm (md5 | sha1);
  authentication-method (dsa-signatures | pre-shared-keys | rsa-signatures);
  description description;
  dh-group (group1 | group2);
  encryption-algorithm (3des-cbc | des-cbc | aes-128-cbc | aes-192-cbc | aes-256-cbc);
  lifetime-seconds seconds;
}
```

For information about associating an IKE proposal with an IKE policy, see [“Configuring an IKE Policy for Preshared Keys” on page 187](#).

Tasks for configuring the IKE proposal are:

1. [Configuring the Authentication Algorithm for an IKE Proposal on page 185](#)
2. [Configuring the Authentication Method for an IKE Proposal on page 185](#)
3. [Configuring the Description for an IKE Proposal on page 186](#)
4. [Configuring the Diffie-Hellman Group for an IKE Proposal on page 186](#)
5. [Configuring the Encryption Algorithm for an IKE Proposal on page 186](#)
6. [Configuring the Lifetime for an IKE SA on page 187](#)

### Configuring the Authentication Algorithm for an IKE Proposal

To configure an IKE authentication algorithm, include the **authentication-algorithm** statement at the **[edit security ike proposal *ike-proposal-name*]** hierarchy level:

```
[edit security ike proposal ike-proposal-name]
authentication-algorithm (md5 | sha1);
```

The authentication algorithm can be one of the following:

- **md5**—Produces a 128-bit digest.
- **sha1**—Produces a 160-bit digest.

### Configuring the Authentication Method for an IKE Proposal

To configure an IKE authentication method, include the **authentication-method** statement at the **[edit security ike proposal *ike-proposal-name*]** hierarchy level:

```
[edit security ike proposal ike-proposal-name]  
authentication-method (dsa-signatures | pre-shared-keys | rsa-signatures);
```

The authentication method can be one of the following:

- **dsa-signatures**—Digital Signature Algorithm (DSA)
- **pre-shared-keys**—Preshared keys; a key derived from an out-of-band mechanism is used to authenticate an exchange
- **rsa-signatures**—Public key algorithm that supports encryption and digital signatures

## Configuring the Description for an IKE Proposal

To specify a description for an IKE proposal, include the **description** statement at the [edit security ike proposal *ike-proposal-name*] hierarchy level:

```
[edit security ike proposal ike-proposal-name]  
description description;
```

## Configuring the Diffie-Hellman Group for an IKE Proposal

The Diffie-Hellman key exchange is a public-key cryptography scheme that allows two parties to establish a shared secret over an insecure communications channel. It is also used within IKE to establish session keys.

To configure an IKE Diffie-Hellman group, include the **dh-group** statement at the [edit security ike proposal *ike-proposal-name*] hierarchy level:

```
[edit security ike proposal ike-proposal-name ]  
dh-group (group1 | group2);
```

The group can be one of the following:

- **group1**—Specify that IKE use the 768-bit Diffie-Hellman prime modulus group when performing the new Diffie-Hellman exchange.
- **group2**—Specify that IKE use the 1024-bit Diffie-Hellman prime modulus group when performing the new Diffie-Hellman exchange.

**group2** provides more security but requires more processing time.

## Configuring the Encryption Algorithm for an IKE Proposal

To configure an IKE encryption algorithm, include the **encryption-algorithm** statement at the [edit security ike proposal *ike-proposal-name*] hierarchy level:

```
[edit security ike proposal ike-proposal-name ]  
encryption-algorithm (3des-cbc | des-cbc);
```

The encryption algorithm can be one of the following:

- **3des-cbc**—Encryption algorithm that has a key size of 24 bytes; its key size is 192 bits long.
- **des-cbc**—Encryption algorithm that has a key size of 8 bytes; its key size is 56 bits long.



- **aes-128-cbc**—Advanced encryption algorithm that has a key size of 16 bytes; its key size is 128 bits long.
- **aes-192-cbc**—Advanced encryption algorithm that has a key size of 24 bytes; its key size is 192 bits long.
- **aes-256-cbc**—Advanced encryption algorithm that has a key size of 32 bytes; its key size is 256 bits long.

## Configuring the Lifetime for an IKE SA

The IKE lifetime sets the lifetime of an IKE SA. When the IKE SA expires, it is replaced by a new SA (and SPI) or is terminated. The default value IKE lifetime is 3600 seconds.

To configure the IKE lifetime, include the **lifetime-seconds** statement and specify the number of seconds (180 through 86,400) at the **[edit security ike proposal *ike-proposal-name*]** hierarchy level:

```
[edit security ike proposal ike-proposal-name ]
lifetime-seconds seconds;
```

---

## Example: Configuring an IKE Proposal

The following example shows how to configure an IKE proposal:

```
[edit security ike]
proposal ike-proposal {
  authentication-method pre-shared-keys;
  dh-group group1;
  authentication-algorithm sha1;
  encryption-algorithm 3des-cbc;
}
```

### Related Documentation

- [Configuring an IKE Proposal for Dynamic SAs on page 185](#)

---

## Configuring an IKE Policy for Preshared Keys

An IKE policy defines a combination of security parameters (IKE proposals) to be used during IKE negotiation. It defines a peer address, the preshared key for the given peer, and the proposals needed for that connection. During the IKE negotiation, IKE looks for an IKE policy that is the same on both peers. The peer that initiates the negotiation sends all its policies to the remote peer, and the remote peer tries to find a match.

A match is made when both policies from the two peers have a proposal that contains the same configured attributes. If the lifetimes are not identical, the shorter lifetime between the two policies (from the host and peer) is used. The configured preshared key must also match its peer.

You can create multiple, prioritized proposals at each peer to ensure that at least one proposal will match a remote peer's proposal.

First, you configure one or more IKE proposals; then you associate these proposals with an IKE policy. You can also prioritize a list of proposals used by IKE in the **policy** statement by listing the proposals you want to use, from first to last.

To configure an IKE policy, include the **policy** statement at the **[edit security ike]** hierarchy level and specify a peer address:

```
[edit security ike]  
policy ike-peer-address;
```



**NOTE:** The IKE policy peer address must be an IPsec tunnel destination address.

Tasks for configuring an IKE policy are:

1. [Configuring the Description for an IKE Policy on page 188](#)
2. [Configuring the Mode for an IKE Policy on page 188](#)
3. [Configuring the Preshared Key for an IKE Policy on page 188](#)
4. [Associating Proposals with an IKE Policy on page 189](#)

## Configuring the Description for an IKE Policy

To specify a description for an IKE policy, include the **description** statement at the **[edit security ike policy ike-peer-address]** hierarchy level:

```
[edit security ike policy ike-peer-address]  
description description;
```

## Configuring the Mode for an IKE Policy

IKE policy has two modes: aggressive and main. By default, main mode is enabled. Main mode uses six messages, in three exchanges, to establish the IKE SA. (These three steps are IKE SA negotiation, a Diffie-Hellman key exchange, and authentication of the peer.) Main mode also allows a peer to hide its identity.

Aggressive mode also establishes an authenticated IKE SA and keys. However, aggressive mode uses half the number of messages, has less negotiation power, and does not provide identity protection. The peer can use the aggressive or main mode to start IKE negotiation; the remote peer accepts the mode sent by the peer.

To configure IKE policy mode, include the **mode** statement and specify **aggressive** or **main** at the **[edit security ike policy ike-peer-address]** hierarchy level:

```
[edit security ike policy ike-peer-address ]  
mode (aggressive | main);
```

## Configuring the Preshared Key for an IKE Policy

IKE policy preshared keys authenticate peers. You must manually configure a preshared key, which must match that of its peer. The preshared key can be an ASCII text (alphanumeric) key or a hexadecimal key.

A local certificate is an alternative to the preshared key. A commit operation fails if either a preshared key or a local certificate is not configured.

To configure an IKE policy preshared key, include the **pre-shared-key** statement at the **[edit security ike policy *ike-peer-address*]** hierarchy level:

```
[edit security ike policy ike-peer-address]
pre-shared-key (ascii-text key | hexadecimal key);
```

## Associating Proposals with an IKE Policy

The IKE policy proposal is a list of one or more proposals associated with an IKE policy.

To configure an IKE policy proposal, include the **proposals** statement at the **[edit security ike policy *ike-peer-address*]** hierarchy level and specify one or more proposal names:

```
[edit security ike policy ike-peer-address]
proposals [ proposal-names ];
```

**Related Documentation**

- [Example: Configuring an IKE Policy on page 189](#)

## Example: Configuring an IKE Policy

Define two IKE policies: policy 10.1.1.2 and policy 10.1.1.1. Each policy is associated with **proposal-1** and **proposal-2**.

```
[edit security]
ike {
  proposal proposal-1 {
    authentication-method pre-shared-keys;
    dh-group group1;
    authentication-algorithm sha1;
    encryption-algorithm 3des-cbc;
    lifetime-seconds 1000;
  }
  proposal proposal-2 {
    authentication-method pre-shared-keys;
    dh-group group2;
    authentication-algorithm md5;
    encryption-algorithm des-cbc;
    lifetime-seconds 10000;
  }
  proposal proposal-3 {
    authentication-method rsa-signatures;
    dh-group group2;
    authentication-algorithm md5;
    encryption-algorithm des-cbc;
    lifetime-seconds 10000;
  }
  policy 10.1.1.2 {
    mode main;
    proposals [ proposal-1 proposal-2 ];
    pre-shared-key ascii-text example-pre-shared-key;
  }
}
```

```

policy 10.1.1.1 {
  local-certificate certificate-filename;
  local-key-pair private-public-key-file;
  mode aggressive;
  proposals [ proposal-2 proposal-3 ]
  pre-shared-key hexadecimal 0102030abbcdd;
}

```



**NOTE:** Updates to the current IKE proposal and policy configuration are not applied to the current IKE SA; updates are applied to new IKE SAs.

If you want the new updates to take immediate effect, you must clear the existing IKE security associations so that they will be reestablished with the changed configuration. For information about how to clear the current IKE security association, see the [CLI Explorer](#).

**Related Documentation**

- [Configuring an IKE Policy for Preshared Keys on page 187](#)

## Configuring an IPsec Proposal for an ES PIC

An IPsec proposal lists protocols and algorithms (security services) to be negotiated with the remote IPsec peer.

To configure an IPsec proposal and define its properties, include the following statements at the `[edit security ipsec]` hierarchy level:

```

[edit security ipsec]
proposal ipsec-proposal-name {
  authentication-algorithm (hmac-md5-96 | hmac-sha1-96);
  description description ;
  encryption-algorithm (3des-cbc | des-cbc);
  lifetime-seconds seconds;
  protocol (ah | esp | bundle);
}

```

Tasks to configure an IPsec proposal for an ES PIC include:

- [Configuring the Authentication Algorithm for an IPsec Proposal on page 190](#)
- [Configuring the Description for an IPsec Proposal on page 191](#)
- [Configuring the Encryption Algorithm for an IPsec Proposal on page 191](#)
- [Configuring the Lifetime for an IPsec SA on page 191](#)
- [Configuring the Protocol for a Dynamic IPsec SA on page 192](#)

## Configuring the Authentication Algorithm for an IPsec Proposal

To configure an IPsec authentication algorithm, include the `authentication-algorithm` statement at the `[edit security ipsec proposal ipsec-proposal-name]` hierarchy level:

```

[edit security ipsec proposal ipsec-proposal-name]

```

```
authentication-algorithm (hmac-md5-96 | hmac-sha1-96);
```

The authentication algorithm can be one of the following:

- **hmac-md5-96**—Hash algorithm that authenticates packet data. It produces a 128-bit digest. Only 96 bits are used for authentication.
- **hmac-sha1-96**—Hash algorithm that authenticates packet data. It produces a 160-bit digest. Only 96 bits are used for authentication.

## Configuring the Description for an IPsec Proposal

To specify a description for an IPsec proposal, include the **description** statement at the **[edit security ipsec proposal *ipsec-proposal-name*]** hierarchy level:

```
[edit security ike policy ipsec-proposal-name]  
description description;
```

## Configuring the Encryption Algorithm for an IPsec Proposal

To configure the IPsec encryption algorithm, include the **encryption-algorithm** statement at the **[edit security ipsec proposal *ipsec-proposal-name*]** hierarchy level:

```
[edit security ipsec proposal ipsec-proposal-name ]  
encryption-algorithm (3des-cbc | des-cbc);
```

The encryption algorithm can be one of the following:

- **3des-cbc**—Encryption algorithm that has a block size of 24 bytes; its key size is 192 bits long.
- **des-cbc**—Encryption algorithm that has a block size of 8 bytes; its key size is 48 bits long.



**NOTE:** We recommend that you use the triple DES cipher block chaining (3DES-CBC) encryption algorithm.

## Configuring the Lifetime for an IPsec SA

The IPsec lifetime option sets the lifetime of an IPsec SA. When the IPsec SA expires, it is replaced by a new SA (and SPI) or is terminated. A new SA has new authentication and encryption keys, and SPI; however, the algorithms may remain the same if the proposal is not changed. If you do not configure a lifetime and a lifetime is not sent by a responder, the lifetime is 28,800 seconds.

To configure the IPsec lifetime, include the **lifetime-seconds** statement and specify the number of seconds (180 through 86,400) at the **[edit security ipsec proposal *ipsec-proposal-name*]** hierarchy level:

```
[edit security ipsec proposal ipsec-proposal-name]  
lifetime-seconds seconds;
```



**NOTE:** When a dynamic SA is created, two types of lifetimes are used: hard and soft. The hard lifetime specifies the lifetime of the SA. The soft lifetime, which is derived from the hard lifetime, informs the IPsec key management system that the SA is about to expire. This allows the key management system to negotiate a new SA before the hard lifetime expires. When you specify the lifetime, you specify a hard lifetime.

---

## Configuring the Protocol for a Dynamic IPsec SA

The **protocol** statement sets the protocol for a dynamic SA. The ESP protocol can support authentication, encryption, or both. The AH protocol is used for strong authentication. AH also authenticates the IP packet. The **bundle** option uses AH authentication and ESP encryption; it does not use ESP authentication because AH provides stronger authentication of IP packets.

To configure the protocol for a dynamic SA, include the **protocol** statement at the **[edit security ipsec proposal *ipsec-proposal-name*]** hierarchy level:

```
[edit security ipsec proposal ipsec-proposal-name ] protocol (ah | esp | bundle);
```

---

## Configuring the IPsec Policy for an ES PIC

An IPsec policy defines a combination of security parameters (IPsec proposals) used during IPsec negotiation. It defines Perfect Forward Secrecy (PFS) and the proposals needed for the connection. During the IPsec negotiation, IPsec looks for an IPsec proposal that is the same on both peers. The peer that initiates the negotiation sends all its policies to the remote peer, and the remote peer tries to find a match.

A match is made when both policies from the two peers have a proposal that contains the same configured attributes. If the lifetimes are not identical, the shorter lifetime between the two policies (from the host and peer) is used.

You can create multiple, prioritized IPsec proposals at each peer to ensure that at least one proposal will match a remote peer's proposal.

First, you configure one or more IPsec proposals; then you associate these proposals with an IPsec policy. You can prioritize the proposals in the list by listing them in the order in which the IPsec policy uses them (first to last).

To configure an IPsec policy, include the **policy** statement at the **[edit security ipsec]** hierarchy level, specifying the policy name and one or more proposals you want to associate with this policy:

```
[edit security ipsec]  
policy ipsec-policy-name {  
  proposals [ proposal-names ];
```

```
}
```

## Configuring Perfect Forward Secrecy

PFS provides additional security by means of a Diffie-Hellman key exchange shared secret value. With PFS, if one key is compromised, previous and subsequent keys are secure because they are not derived from previous keys. This statement is optional.

To configure PFS, include the **perfect-forward-secrecy** statement and specify a Diffie-Hellman group at the **[edit security ipsec policy *ipsec-policy-name*]** hierarchy level:

```
[edit security ipsec policy ipsec-policy-name]
perfect-forward-secrecy {
  keys (group1 | group2);
}
```

The key can be one of the following:

- **group1**—Specify that IKE use the 768-bit Diffie-Hellman prime modulus group when performing the new Diffie-Hellman exchange.
- **group2**—Specify that IKE use the 1024-bit Diffie-Hellman prime modulus group when performing the new Diffie-Hellman exchange.

**group2** provides more security than **group1**, but requires more processing time.

### Related Documentation

- [Example: Configuring an IPsec Policy on page 193](#)
- [IPsec Configuration for an ES PIC Overview on page 171](#)

## Example: Configuring an IPsec Policy

The following example shows how to configure an IPsec policy:

```
[edit security ipsec]
proposal dynamic-1 {
  protocol esp;
  authentication-algorithm hmac-md5-96;
  encryption-algorithm 3des-cbc;
  lifetime-seconds 6000;
}
proposal dynamic-2 {
  protocol esp;
  authentication-algorithm hmac-sha1-96;
  encryption-algorithm 3des-cbc;
  lifetime-seconds 6000;
}
policy dynamic-policy-1 {
  perfect-forward-secrecy {
    keys group1;
  }
  proposals [ dynamic-1 dynamic-2 ];
}
security-association dynamic-sa1 {
  dynamic {
```

```

    replay-window-size 64;
    ipsec-policy dynamic-policy-1;
  }
}

```



**NOTE:** Updates to the current IPsec proposal and policy configuration are not applied to the current IPsec SA; updates are applied to new IPsec SAs.

If you want the new updates to take immediate effect, you must clear the existing IPsec security associations so that they will be reestablished with the changed configuration. For information about how to clear the current IPsec security association, see the [CLI Explorer](#).

**Related  
Documentation**

- [Configuring the IPsec Policy for an ES PIC on page 192](#)
- [IPsec Configuration for an ES PIC Overview on page 171](#)

## Configuring Internal IPsec for Junos-FIPS

In a Junos-FIPS environment, routers with two Routing Engines must use IPsec for internal communication between the Routing Engines. You configure internal IPsec after you install Junos-FIPS. You must be a Crypto Officer to configure internal IPsec.

To configure internal IPsec, include the **security-association** statement at the **[edit security]** hierarchy level:

```

[edit security]
ipsec {
  internal {
    security-association {
      manual {
        direction (bidirectional | inbound | outbound) {
          protocol esp;
          spi spi-value;
          encryption {
            algorithm 3des-cbc;
            key ascii-text ascii-text-string;
          }
        }
      }
    }
  }
}

```

Tasks for configuring internal IPsec for Junos-FIPS are:

1. [Configuring the SA Direction on page 195](#)
2. [Configuring the IPsec SPI on page 195](#)
3. [Configuring the IPsec Key on page 196](#)



## Configuring the SA Direction

To configure the IPsec SA direction, include the **direction** statement at the **[edit security ipsec internal security-association manual]** hierarchy level:

**direction** (bidirectional | inbound | outbound);

The value can be one of the following:

- **bidirectional**—Apply the same SA values in both directions between Routing Engines.
- **inbound**—Apply these SA properties only to the inbound IPsec tunnel.
- **outbound**—Apply these SA properties only to the outbound IPsec tunnel.

If you do not configure the SA to be bidirectional, you must configure SA parameters for IPsec tunnels in both directions. The following example uses an inbound and outbound IPsec tunnel:

```
[edit security]
ipsec {
  internal {
    security-association {
      manual {
        direction inbound {
          protocol esp;
          spi 512;
          encryption {
            algorithm 3des-cbc;
            key ascii-text "$.KL3rngIH7,theOPcn87lxfpe9GJKdme";
          }
        }
        direction outbound {
          protocol esp;
          spi 513;
          encryption {
            algorithm 3des-cbc;
            key ascii-text ".n87lngIH7,thxefpe9GJKdme.KL3rOPc";
          }
        }
      }
    }
  }
}
```

## Configuring the IPsec SPI

A security parameter index (SPI) is a 32-bit index identifying a security context between a pair of Routing Engines. To configure the IPsec Security Parameter Index (SPI) value, include the **spi** statement at the **[edit security ipsec internal security-association manual direction]** hierarchy level:

**spi** *value*;

The value must be from 256 through 16639.

## Configuring the IPsec Key

To configure the ASCII text key, include the **key** statement at the **[edit security ipsec internal security-association manual direction encryption]** hierarchy level:

```
key ascii-text ascii-text-string;
```

The value must be from 256 through 16639. You must enter the key ASCII value twice and the strings entered must match, or the key will not be set. The ASCII text key is never displayed in plain text.

**Related Documentation**

- [Example: Configuring Internal IPsec on page 196](#)

---

## Example: Configuring Internal IPsec

Configure a bidirectional IPsec SA with an SPI value of 512 and a key value conforming to the FIPS 140-2 rules:

```
[edit security]
ipsec {
  internal {
    security-association {
      manual {
        direction bidirectional {
          protocol esp;
          spi 512;
          encryption {
            algorithm 3des-cbc;
            key ascii-text "$9$90j.COlek8X7VevbYgoji1rh";
          }
        }
      }
    }
  }
}
```

**Related Documentation**

- [Configuring Internal IPsec for Junos-FIPS on page 194](#)

# Configuring Traffic Filters to Direct Traffic Through the Desired IPsec Tunnel

- [IPsec Tunnel Traffic Configuration Overview on page 197](#)
- [Using a Filter to Select Traffic to Be Secured on page 199](#)
- [Applying the Filter or Service Set to the Interface Receiving Traffic to Be Secured on page 201](#)
- [Using Filter-Based Forwarding to Select Traffic to Be Secured on page 201](#)
- [Example: Configuring an Outbound Traffic Filter on page 202](#)
- [Example: Applying an Outbound Traffic Filter on page 203](#)
- [Example: Configuring an Inbound Traffic Filter for a Policy Check on page 204](#)
- [Example: Applying an Inbound Traffic Filter to an ES PIC for a Policy Check on page 204](#)

## IPsec Tunnel Traffic Configuration Overview

---

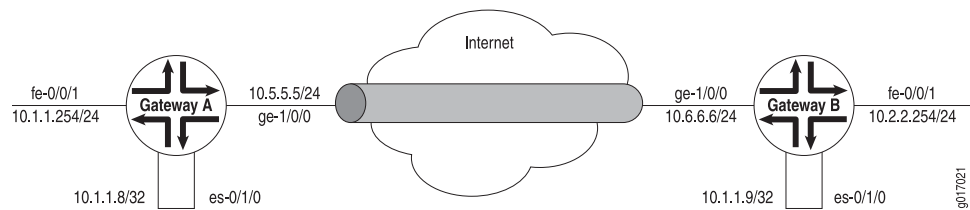
Traffic configuration defines the traffic that must flow through the IPsec tunnel. You configure outbound and inbound firewall filters, which identify and direct traffic to be encrypted and confirm that decrypted traffic parameters match those defined for the given tunnel. The outbound filter is applied to the LAN or WAN interface for the incoming traffic you want to encrypt off of that LAN or WAN. The inbound filter is applied to the ES PIC to check the policy for traffic coming in from the remote host. Because of the complexity of configuring a router to forward packets, no automatic checking is done to ensure that the configuration is correct. Make sure that you configure the router very carefully.



**NOTE:** The valid firewall filters statements for IPsec are **destination-port**, **source-port**, **protocol**, **destination-address**, and **source-address**.

In [Figure 11 on page 198](#), Gateway A protects the network 10.1.1.0/24, and Gateway B protects the network 10.2.2.0/24. The gateways are connected by an IPsec tunnel.

Figure 11: Example: IPsec Tunnel Connecting Security Gateways



The SA and ES interfaces for Gateway A are configured as follows:

```
[edit security ipsec]
security-association manual-sa1 {
  manual {
    direction bidirectional {
      protocol esp;
      spi 2312;
      authentication {
        algorithm hmac-md5-96;
        key ascii-text 1234123412341234;
      }
      encryption {
        algorithm 3des-cbc;
        key ascii-text 123456789009876543211234;
      }
    }
  }
}
[edit interfaces es-0/1/0]
unit 0 {
  tunnel {
    source 10.5.5.5;
    destination 10.6.6.6;
  }
  family inet {
    ipsec-sa manual-sa1;
    address 10.1.1.8/32 {
      destination 10.1.1.9;
    }
  }
}
```

The SA and ES interfaces for Gateway B are configured as follows:

```
[edit security ipsec]
security-association manual-sa1 {
  manual {
    direction bidirectional {
      protocol esp;
      spi 2312;
      authentication {
        algorithm hmac-md5-96;
        key ascii-text 1234123412341234;
      }
      encryption {
        algorithm 3des-cbc;
      }
    }
  }
}
```

```

        key ascii-text 123456789009876543211234;
    }
}
}
[edit interfaces es-0/1/0]
unit 0 {
    tunnel {
        source 10.6.6.6;
        destination 10.5.5.5;
    }
    family inet {
        ipsec-sa manual-sa1;
        address 10.1.1.9/32; {
            destination 10.1.1.8;
        }
    }
}
}

```

#### Related Documentation

- [Example: Configuring an Outbound Traffic Filter on page 202](#)
- [Example: Applying an Outbound Traffic Filter on page 203](#)
- [Example: Configuring an Inbound Traffic Filter for a Policy Check on page 204](#)
- [ES Tunnel Interface Configuration for a Layer 3 VPN on page 227](#)

## Using a Filter to Select Traffic to Be Secured

For the ES PIC, you need to configure a firewall filter to direct traffic into the IPsec tunnel. To apply a security association to traffic that matches a firewall filter, include the **ipsec-sa sa-name** statement at the **[edit firewall filter *filter-name* term *term-name* then]** hierarchy level.

```

[edit firewall filter filter-name]
term term-name {
    from {
        source-address {
            ip-address;
        }
        destination-address {
            ip-address;
        }
    }
    then {
        count counter-name;
        ipsec-sa sa-name;
    }
}
term other {
    then accept;
}

```

For the AS and MultiServices PICs, you do not need to configure a separate firewall filter. A filter is already built into the IPsec VPN **rule** statement at the **[edit services ipsec-vpn]**

hierarchy level. To apply a security association to traffic that matches the IPsec VPN rule, include the **dynamic** or **manual** statement at the **[edit services rule *rule-name* term *term-name* then]** hierarchy level. To specify whether the rule should match input or output traffic, include the **match-direction** statement at the **[edit services rule *rule-name*]** hierarchy level.

After defining the rules for your IPsec VPNs, you must apply the rules to a service set. To do this, include the **ipsec-vpn-rules *rule-name*** statement at the **[edit services service-set *service-set-name*]** hierarchy level. Include an IPv4 or IPv6 IPsec gateway with the **local-gateway *local-ip-address*** statement at the **[edit services service-set *service-set-name*]** hierarchy level.

Also, you must select either a single interface or a pair of interfaces that participate in IPsec. To select a single interface, include the interface-service ***interface-name*** statement at the **[edit services service-set *service-set-name*]** hierarchy level. To select a pair of interfaces and a next hop, include the **next-hop-service** statement at the **[edit services service-set *service-set-name*]** hierarchy level and specify an inside interface and an outside interface. Only next-hop service sets support IPsec within Layer 3 VPNs and use of routing protocols over the IPsec tunnel.

```
[edit services]
service-set service-set-name {
  interface-service {
    service-interface interface-name;
  }
  next-hop-service {
    inside-service-interface interface-name;
    outside-service-interface interface-name;
  }
  ipsec-vpn-options {
    local-gateway local-ip-address <routing-instance instance-name>;
    trusted-ca ca-profile-name;
  }
  ipsec-vpn-rules rule-name;
}
ipsec-vpn {
  rule rule-name {
    term term-name {
      from {
        source-address {
          ip-address;
        }
        destination-address {
          ip-address;
        }
      }
      then {
        remote-gateway remote-ip-address;
        (dynamic | manual);
      }
    }
  }
  match-direction output;
}
}
```

## Applying the Filter or Service Set to the Interface Receiving Traffic to Be Secured

For the ES PIC, apply your firewall filter on the input interface receiving the traffic that you wish to send to the IPsec tunnel. To do this, include the **filter** statement at the **[edit interfaces *interface-name* unit *unit-number* family inet]** hierarchy level.

```
[edit interfaces interface-name unit unit-number family inet]
filter {
  input filter-name;
}
```

For the AS and MultiServices PICs, apply your IPsec-based interface service set to the input interface receiving the traffic that you wish to send to the IPsec tunnel. To do this, include the **service-set *service-set-name*** statement at the **[edit interfaces *interface-name* unit *unit-number* family inet service (input | output)]** hierarchy level.

```
[edit interfaces interface-name unit unit-number family inet]
service {
  input {
    service-set service-set-name;
  }
  output {
    service-set service-set-name;
  }
}
```

To configure a next-hop-based service set on the AS and MultiServices PICs, include the **service-domain** statement at the **[edit interfaces *interface-name* unit *unit-number*]** hierarchy level and specify one logical interface on the AS PIC as an inside interface and a second logical interface on the AS PIC as an outside interface.

```
[edit interfaces sp-fpc/pic/port]
unit 0 {
  family inet {
    address ip-address;
  }
}
unit 1 {
  family inet;
  service-domain inside;
}
unit 2 {
  family inet;
  service-domain outside;
}
```

## Using Filter-Based Forwarding to Select Traffic to Be Secured

Instead of using a firewall filter, you can also forward traffic into an IPsec security association by using a filter-based forwarding instance. First, configure the filter-based forwarding instance. Then, configure a routing table group to advertise the routes from the filter-based forwarding instance. Next, create a firewall filter for the ES PIC and

reference the filter-based forwarding instance. Lastly, apply the filter and IPsec security association to the ES PIC.

```
[edit]
routing-instances {
  forwarding {
    instance-type forwarding;
    routing-options {
      static {
        route 10.10.10.0/24 next-hop 192.168.0.5;
      }
    }
  }
}
routing-options {
  rib-groups {
    group-name {
      import-rib [ inet.0 forwarding.inet.0 ];
    }
  }
}
firewall {
  family inet {
    filter filter-name {
      term term-name {
        then routing-instance instance-name;
      }
    }
  }
}
[edit]
interfaces {
  es-0/0/0 {
    unit 0 {
      tunnel {
        source source-ip-address;
        destination destination-ip-address;
      }
      family inet {
        ipsec-sa sa-name;
        filter {
          input filter-name;
        }
        address ip-address;
      }
    }
  }
}
```

---

## Example: Configuring an Outbound Traffic Filter

Firewall filters for outbound traffic direct the traffic through the desired IPsec tunnel and ensure that the tunneled traffic goes out the appropriate interface (see [Figure 11 on page 198](#)). Here, an outbound firewall filter is created on security Gateway A; it identifies



the traffic to be encrypted and adds it to the input side of the interface that carries the internal VPN traffic:

```
[edit firewall]
filter ipsec-encrypt-policy-filter {
  term term1 {
    from {
      source-address { # local network
        10.1.1.0/24;
      }
      destination-address { # remote network
        10.2.2.0/24;
      }
    }
  }
  then ipsec-sa manual-sa1; # apply SA name to packet
  term default {
    then accept;
  }
}
```



**NOTE:** The source address, port, and protocol on the outbound traffic filter must match the destination address, port, and protocol on the inbound traffic filter. The destination address, port, and protocol on the outbound traffic filter must match the source address, port, and protocol on the inbound traffic filter.

**Related  
Documentation**

- [Example: Applying an Outbound Traffic Filter on page 203](#)
- [IPsec Tunnel Traffic Configuration Overview on page 197](#)

## Example: Applying an Outbound Traffic Filter

After you have configured the outbound firewall filter, you apply it:

```
[edit interfaces]
fe-0/0/1 {
  unit 0 {
    family inet {
      filter {
        input ipsec-encrypt-policy-filter;
      }
      address 10.1.1.254/24;
    }
  }
}
```

The outbound filter is applied on the Fast Ethernet interface at the **[edit interfaces fe-0/0/1 unit 0 family inet]** hierarchy level. Any packet matching the IPsec action term (**term 1**) on the input filter (**ipsec-encrypt-policy-filter**), configured on the Fast Ethernet interface, is directed to the ES PIC interface at the **[edit interfaces es-0/1/0 unit 0 family inet]** hierarchy level. If a packet arrives from the source address 10.1.1.0/24 and goes to the destination address 10.2.2.0/24, the Packet Forwarding Engine directs the packet to the ES PIC

interface, which is configured with the **manual-sa1** SA. The ES PIC receives the packet, applies the **manual-sa1** SA, and sends the packet through the tunnel.

The router must have a route to the tunnel endpoint; add a static route if necessary.

**Related Documentation**

- [IPsec Tunnel Traffic Configuration Overview on page 197](#)

---

## Example: Configuring an Inbound Traffic Filter for a Policy Check

Here, an inbound firewall filter, which performs the final IPsec policy check, is created on security Gateway A. This check ensures that only packets that match the traffic configured for this tunnel are accepted.

```
filter ipsec-decrypt-policy-filter {
  term term1 { # perform policy check
    from {
      source-address { # remote network
        10.2.2.0/24;
      }
      destination-address { # local network
        10.1.1.0/24;
      }
    }
    then accept;
  }
}
```

**Related Documentation**

- [IPsec Tunnel Traffic Configuration Overview on page 197](#)

---

## Example: Applying an Inbound Traffic Filter to an ES PIC for a Policy Check

After you create the inbound firewall filter, apply it to the ES PIC. Here, the inbound firewall filter (**ipsec-decrypt-policy-filter**) is applied on the decrypted packet to perform the final policy check. The IPsec **manual-sa1** SA is referenced at the **[edit interfaces es-1/2/0 unit 0 family inet]** hierarchy level and decrypts the incoming packet.

```
[edit interfaces]
es-1/2/0 {
  unit 0 {
    tunnel {
      source 10.5.5.5; # tunnel source address
      destination 10.6.6.6; # tunnel destination address
    }
    family inet {
      filter {
        input ipsec-decrypt-policy-filter;
      }
      ipsec-sa manual-sa1; # SA name applied to packet
      address 10.1.1.8/32 { # local interface address inside local VPN
        destination 10.2.2.254; # destination address inside remote VPN
      }
    }
  }
}
```

The Packet Forwarding Engine directs IPsec packets to the ES PIC. It uses the packet's SPI, protocol, and destination address to look up the SA configured on one of the ES interfaces. The IPsec **manual-sa1** SA is referenced at the **[edit interfaces es-1/2/0 unit 0 family inet]** hierarchy level and is used to decrypt the incoming packet. When the packets are processed (decrypted, authenticated, or both), the input firewall filter (**ipsec-decrypt-policy-filter**) is applied on the decrypted packet to perform the final policy check. Term1 defines the decrypted (and verified) traffic and performs the required policy check.



**NOTE:** The inbound traffic filter is applied after the ES PIC has processed the packet, so the decrypted traffic is defined as any traffic that the remote gateway is encrypting and sending to this router. IKE uses this filter to determine the policy required for a tunnel. This policy is used during the negotiation with the remote gateway to find the matching SA configuration.

**Related  
Documentation**

- [IPsec Tunnel Traffic Configuration Overview on page 197](#)



# Configuring IPsec Dynamic Endpoints

- [Configuring IPsec Dynamic Endpoints on page 207](#)
- [IPsec Dynamic Endpoint Tunnel Architecture on page 208](#)
- [Authentication Process on page 208](#)
- [Dynamic Implicit Rules on page 209](#)
- [Reverse Route Insertion on page 209](#)
- [Configuring an IKE Access Profile for IPsec Dynamic Endpoint Tunnels on page 210](#)
- [Configuring the Service Set for IPsec Dynamic Endpoint Tunnels on page 211](#)
- [Configuring the Interface Identifier for IPsec Dynamic Endpoint Tunnels on page 211](#)
- [Example: Configuring IPsec Dynamic Endpoint Tunneling on page 212](#)

## Configuring IPsec Dynamic Endpoints

---

IPSec tunnels can also be established using *dynamic peer* security gateways, in which the remote end of the tunnels do not have a statically assigned IPv4 or IPv6 address. Since the remote address is not known and is assigned from an address pool each time the remote host reboots, establishment of the tunnel relies on using IKE main mode with preshared global keys. Both policy-based and link-type tunnels are supported as follows:

- Policy-based tunnels use shared mode.
- Link-type or routed tunnels use dedicated mode. Each tunnel allocates a service interface from a pool of interfaces configured for the dynamic peers. Routing protocols can be configured to run on these service interfaces to learn routes over the IPSec tunnel that is used as a link.

This section includes the following topics:

- [IPsec Dynamic Endpoint Tunnel Architecture on page 208](#)
- [Configuring an IKE Access Profile for IPsec Dynamic Endpoint Tunnels on page 210](#)
- [Configuring the Service Set for IPsec Dynamic Endpoint Tunnels on page 211](#)
- [Configuring the Interface Identifier for IPsec Dynamic Endpoint Tunnels on page 211](#)

## IPsec Dynamic Endpoint Tunnel Architecture

When you configure dynamic endpoint tunnels, the following components are used:

- [Authentication Process on page 208](#)
- [Dynamic Implicit Rules on page 209](#)
- [Reverse Route Insertion on page 209](#)

## Authentication Process

The remote dynamic peer initiates IKE and IPsec negotiations with the local (Juniper Networks) router. The local router uses a default set of authentication and encryption values to match the IPsec and IKE proposals sent by the remote peer to establish the SA. If any of the values match, the tunnel establishment process continues. The default values are shown in [Table 9 on page 208](#).

**Table 9: Default IKE and IPsec Proposals for Dynamic SA Negotiations**

| Statement Name                  | Values                    |
|---------------------------------|---------------------------|
| <b>Implicit IKE Proposal</b>    |                           |
| <b>authentication-method</b>    | preshared keys            |
| <b>dh-group</b>                 | group1, group2            |
| <b>authentication-algorithm</b> | sha1, md5                 |
| <b>encryption-algorithm</b>     | 3des-cbc, des-cbc         |
| <b>lifetime-seconds</b>         | 3600 seconds              |
| <b>Implicit IPsec Proposal</b>  |                           |
| <b>protocol</b>                 | esp, ah, bundle           |
| <b>authentication-algorithm</b> | hmac-sha1-96, hmac-md5-96 |
| <b>encryption-algorithm</b>     | 3des-cbc, des-cbc         |
| <b>lifetime-seconds</b>         | 28,800 seconds (8 hours)  |

Phase 2 of the authentication process matches the *proxy identities* of the protected hosts and networks sent by the peer against a list of configured proxy identities. The accepted proxy identity is used to create the dynamic rules for encrypting the traffic. You can configure proxy identities by including the **allowed-proxy-pair** statement in an IKE access profile at the **[edit access profile *profile-name* client \* ike]** hierarchy level. If no configured entry matches, the negotiation is rejected.

However, if you do not configure the **allowed-proxy-pair** statement, the default value **ANY(0.0.0.0/0)-ANY** is applied, and the local router accepts any proxy identities sent by the peer.

Once the phase 2 negotiation has been successfully completed, the router builds dynamic rules and inserts the reverse route into the routing table using the accepted proxy identity.

## Dynamic Implicit Rules

After successful negotiation with the dynamic peer, the key management process (kmd) creates a dynamic rule for the accepted phase 2 proxy and applies it on the local AS or MultiServices PIC. The source and destination addresses are specified by the accepted proxy. This rule is used to encrypt traffic directed to one of the end hosts in the phase 2 proxy identity.



**NOTE:** You do not configure this rule; it is created by the key management process (kmd).

The **ipsec-inside-interface** value is the interface name assigned to the dynamic tunnel. The **source-address** and **destination-address** values are accepted from the proxy ID. The **match-direction** value is **input** for next-hop-style service sets.

Rule lookup for static tunnels is unaffected by the presence of a dynamic rule; it is performed in the order configured. When a packet is received for a service-set, static rules are always matched first. Dynamic rules are matched only after the rule match for static rules has failed.

## Reverse Route Insertion

Static routes are automatically inserted into the route table for those networks and hosts protected by a remote tunnel endpoint. These protected hosts and networks are known as remote proxy identities.

Each route is created based on the remote proxy network and prefix length sent by the peer and is inserted in the relevant route table after successful phase 1 and phase 2 negotiations.

The route preference for each of these static reverse routes is 1. This value is necessary to avoid conflict with similar routes that might be added by the routing protocol process (rpd).

No routes are added if the accepted remote proxy address is the default (**0.0.0.0/0**). In this case, you can run routing protocols over the IPSec tunnel to learn routes and add static routes for the traffic you want to be protected over this tunnel.

For next-hop style service sets, the reverse routes include next hops pointing to the locations specified by the **inside-service-interface** statements.

The selection of the routing table in which these routes are inserted depends on where you configure the **inside-service-interface** statement. If these interfaces are present in a

VRF routing instance, then routes are added to the corresponding VRF routing table; otherwise, the routes are added to **inet.0**.



**NOTE:** Reverse route insertion takes place only for tunnels to dynamic peers. These routes are added only for next-hop style service sets.

## Configuring an IKE Access Profile for IPsec Dynamic Endpoint Tunnels

You can configure only one tunnel profile per service set for all dynamic peers. The configured preshared key in the profile is used for IKE authentication of all dynamic peers terminating in that service set.

The IKE tunnel profile specifies all the information needed to complete the IKE negotiation. For more information on access profiles, see the *Junos System Basics Configuration Guide*.

```
[edit access]
profile profile-name {
  client * {
    ike {
      allowed-proxy-pair {
        remote remote-proxy-address local local-proxy-address;
      }
      pre-shared-key ([ ascii-text key-string ] | [ hexadecimal key-string ]);
      interface-id string-value;
      ipsec-policy ipsec-policy;
    }
  }
}
```



**NOTE:** For dynamic peers, the Junos OS supports only IKE main mode with the preshared key method of authentication. In this mode, an IPv4 or IPv6 address is used to identify a tunnel peer to get the preshared key information. The client value \* (wildcard) means that the configuration within this profile is valid for all dynamic peers terminating within the service set accessing this profile.

The following statements are the parts of the IKE profile:

- **allowed-proxy-pair**—During phase 2 IKE negotiation, the remote peer supplies its network address (**remote**) and its peer's network address (**local**). Since multiple dynamic tunnels are authenticated through the same mechanism, this statement must include the list of possible combinations. If the dynamic peer does not present a valid combination, the phase 2 IKE negotiation fails.

By default, remote 0.0.0.0/0 local 0.0.0.0/0 is used if no values are configured.

- **pre-shared-key**—Mandatory key used to authenticate the dynamic peer during IKE phase 1 negotiation. This key must be configured on both ends of the tunnel and



distributed through an out-of-band secure mechanism. You can configure the key value either in **hexadecimal** or **ascii-text** format.

- **interface-id**—Interface identifier, a mandatory attribute used to derive the logical service interface information for the session.
- **ipsec-policy**—Name of the IPsec policy that defines the IPsec policy information for the session. You define the IPsec policy at the **[edit services ipsec-vpn ipsec policy policy-name]** hierarchy level. If no policy is set, any policy proposed by the dynamic peer is accepted.

## Configuring the Service Set for IPsec Dynamic Endpoint Tunnels

To complete a dynamic endpoint tunnel configuration, you need to reference the IKE access profile configured at the **[edit access]** hierarchy level in the service set. To do this, include the **ike-access-profile** statement at the **[edit services service-set name ipsec-vpn-options]** hierarchy level:

```
[edit services]
service-set name {
  next-hop-service {
    inside-service-interface interface-name;
    outside-service-interface interface-name;
  }
  ipsec-vpn-options {
    local-gateway address;
    ike-access-profile profile-name;
  }
}
```

You can reference only one access profile in each service set. This profile is used to negotiate IKE and IPSec security associations with dynamic peers only.



**NOTE:** If you configure an IKE access profile in a service set, no other service set can share the same **local-gateway** address.

## Configuring the Interface Identifier for IPsec Dynamic Endpoint Tunnels

You can configure an interface identifier for a group of dynamic peers, which specifies which adaptive services logical interface(s) take part in the dynamic IPSec negotiation. By assigning the same interface identifier to multiple logical interfaces, you can create a pool of interfaces for this purpose. To configure, include the **ipsec-interface-id** statement at the **[edit interfaces interface-name]** hierarchy level:

```
[edit interfaces sp-fpc/pic/port]
unit logical-unit-number {
  dial-options {
    ipsec-interface-id identifier;
    (shared | dedicated);
  }
}
```

Specifying the interface identifier in the **dial-options** statement makes this logical interface part of the pool identified by the IPSec interface identifier.



**NOTE:** Only one interface identifier can be specified at a time. You can include the **ipsec-interface-id** statement or the **l2tp-interface-id** statement, but not both simultaneously.

The **shared** statement enables one logical interface to be shared across multiple tunnels. The **dedicated** statement specifies that the logical interface is associated with a single tunnel, which is necessary when you are configuring an IPSec link-type tunnel. You must include the **dedicated** statement when you specify an **ipsec-interface-id** value.

## Example: Configuring IPSec Dynamic Endpoint Tunneling

Figure 12: IPSec Dynamic Endpoint Tunneling Topology Diagram

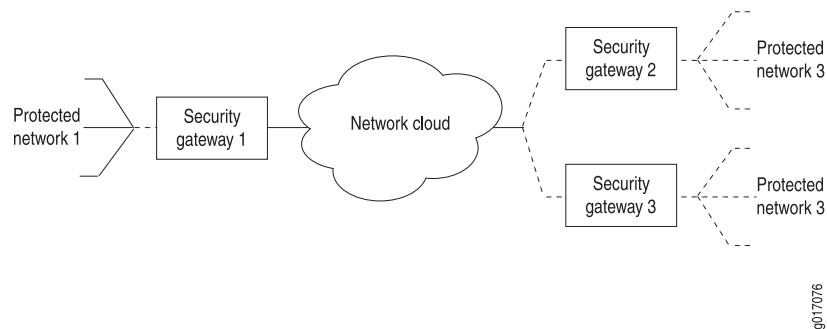


Figure 12 on page 212 shows a local network N-1 located behind security gateway SG-1. SG-1 is a Juniper Networks router terminating dynamic peer endpoints. The tunnel termination address on SG-1 is 10.7.7.2 and the local network address is 172.16.1.0/24.

A remote peer router obtains addresses from an ISP pool and runs RFC-compliant IKE. Remote network N-2 has address 172.16.2.0/24 and is located behind security gateway SG-2 with tunnel termination address 10.7.7.1.

On Router SG-1, configure an IKE access profile to accept proposals from SG-2. Apply the interface identifier from the access profile to the inside services interface and apply the IKE access profile itself to the IPSec next-hop style service set.

```
Router SG-1 [edit]
access {
  profile ike_access {
    client * { # Accepts proposals from specified peers that use the preshared key.
      ike {
        allowed-proxy-pair local 10.255.14.63/32 remote 10.255.14.64/32;
        pre-shared-key ascii-text "$9$1hoESeLxdgoGvWoGDif5IEc"; # SECRET-DATA
        interface-id test_id; # Apply this ID to the inside services interfaces.
      }
    }
  }
}
interfaces {
```

```

fe-0/0/0 {
  description "Connection to the local network";
  unit 0 {
    family inet {
      address 172.16.1.1/24;
    }
  }
}
so-1/0/0 {
  description "Connection to SG-2";
  no-keepalives;
  encapsulation cisco-hdlc;
  unit 0 {
    family inet {
      address 10.7.7.2/30;
    }
  }
}
sp-3/3/0 {
  unit 0 {
    family inet;
  }
  unit 3 {
    dial-options {
      ipsec-interface-id test_id; # Accepts dynamic endpoint tunnels.
      shared;
    }
    service-domain inside;
  }
  unit 4 {
    family inet;
    service-domain outside;
  }
}
}
services {
  service-set dynamic_nh_ss { # Create a next-hop service set
    next-hop-service { # for the dynamic endpoint tunnels.
      inside-service-interface sp-3/3/0.3;
      outside-service-interface sp-3/3/0.4;
    }
    ipsec-vpn-options {
      local-gateway 10.7.7.2;
      ike-access-profile ike_access; # Apply the IKE access profile here.
    }
  }
}
}

```

## Verifying Your Work

To verify proper operation of a dynamic endpoint tunnel configured on the AS PIC, use the following command:

```
show services ipsec-vpn ipsec security-associations (detail)
```

The following section shows output from this command used with the configuration example. The dynamically created rule `_junos_` appears in the output, as well as the establishment of the inbound and outbound dynamically created tunnels.

```
user@router> show services ipsec-vpn ipsec security-associations detail
Service set: dynamic_nh_ss
```

```
Rule: _junos_ , Term: tunnel4, Tunnel index: 4
Local gateway: 10.7.7.2, Remote gateway: 10.7.7.1
Local identity: ipv4(any:0,[0..3]=10.255.14.63)
Remote identity: ipv4(any:0,[0..3]=10.255.14.64)
```

```
Direction: inbound , SPI: 428111023, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 27660 seconds
Hard lifetime: Expires in 27750 seconds
Anti-replay service: Enabled, Replay window size: 64
```

```
Direction: outbound , SPI: 4035429231, AUX-SPI: 0
Mode: tunnel, Type: dynamic, State: Installed
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Soft lifetime: Expires in 27660 seconds
Hard lifetime: Expires in 27750 seconds
Anti-replay service: Enabled, Replay window size: 64
```

## CHAPTER 14

# Configuring Digital Certificates for IPsec

- [Using Digital Certificates for IPsec on page 215](#)
- [Configuring a CA Profile on page 216](#)
- [Configuring a Certificate Revocation List on page 216](#)
- [Requesting a CA Digital Certificate on page 217](#)
- [Generating a Private/Public Key Pair on page 217](#)
- [Generating and Enrolling a Local Digital Certificate on page 218](#)
- [Applying the Local Digital Certificate to an IPsec Configuration on page 218](#)
- [Configuring Automatic Reenrollment of Digital Certificates on page 218](#)
- [Monitoring Digital Certificates on page 219](#)
- [Clearing Digital Certificates on page 219](#)

## Using Digital Certificates for IPsec

---

A popular way for network administrators to scale an IPSec network is to use digital certificates instead of preshared keys. To enable digital certificates in your network, you need to use a combination of operational mode commands and configuration statements. The following tasks enable you to implement digital certificates on AS and MultiServices PICs installed in M Series and T Series routers:

- [Configuring a CA Profile on page 216](#)
- [Configuring a Certificate Revocation List on page 216](#)
- [Requesting a CA Digital Certificate on page 217](#)
- [Generating a Private/Public Key Pair on page 217](#)
- [Generating and Enrolling a Local Digital Certificate on page 218](#)
- [Applying the Local Digital Certificate to an IPsec Configuration on page 218](#)
- [Configuring Automatic Reenrollment of Digital Certificates on page 218](#)
- [Monitoring Digital Certificates on page 219](#)
- [Clearing Digital Certificates on page 219](#)

Related • [Digital Certificates on page 85](#)  
Documentation

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## Configuring a CA Profile

The CA profile contains the name and URL of the CA or RA, as well as some retry timer settings. CA certificates issued by Entrust, VeriSign, and Microsoft are all compatible with M Series, and T Series routers. To configure the domain name of the CA or RA, include the **ca-identity** statement at the **[edit security pki ca-profile *ca-profile-name*]** hierarchy level. To configure the URL of the CA, include the **url** statement at the **[edit security pki ca-profile *ca-profile-name* enrollment]** hierarchy level. To configure the number of enrollment attempts the router should perform, include the **retry** statement at the **[edit security pki ca-profile *ca-profile-name* enrollment]** hierarchy level. To configure the amount of time the router should wait between enrollment attempts, include the **retry-interval** statement at the **[edit security pki ca-profile *ca-profile-name* enrollment]** hierarchy level.

```
[edit security pki]
ca-profile ca-profile-name {
  ca-identity ca-identity;
  enrollment {
    url url-name;
    retry number-of-enrollment-attempts; # The range is 0 though 100 attempts.
    retry-interval seconds; # The range is 0 though 3600 seconds.
  }
}
```

---

## Configuring a Certificate Revocation List

A certificate revocation list (CRL) contains a list of digital certificates that have been canceled before their expiration date. When a participating peer uses a digital certificate, it checks the certificate signature and validity. It also acquires the most recently issued CRL and checks that the certificate serial number is not on that CRL. By default, CRL verification is enabled on any CA profile running on Junos OS Release 8.1 or later. To disable CRL verification, include the **disable** statement at the **[edit security pki ca-profile *ca-profile-name* revocation-check]** hierarchy level.

To specify the URL for the Lightweight Directory Access Protocol (LDAP) server where your CA stores its current CRL, include the **url** statement at the **[edit security pki ca-profile *ca-profile-name* revocation-check *crl*]** hierarchy level. If the LDAP server requires a password to access the CRL, include the **password** statement at the **[edit security pki ca-profile *ca-profile-name* revocation-check *crl* url]** hierarchy level.



**NOTE:** You do not need to specify a URL for the LDAP server if the certificate includes a certificate distribution point (CDP). The CDP is a field within the certificate that contains information about how to retrieve the CRL for the certificate. The router uses this information to download the CRL automatically. Any LDAP URL you configure takes precedence over the CDP included in the certificate.

If you manually downloaded the CRL, you must manually install it on the router. To manually install the CRL, issue the **request security pki crl load ca-profile *ca-profile-name* filename *path/filename*** command.

To configure the time interval between CRL updates, include the **refresh-interval** statement at the **[edit security ca-profile *ca-profile-name* revocation-check crl]** hierarchy level.

To override the default behavior and permit IPsec peer authentication to continue when the CRL fails to download, include the **disable on-download-failure** statement at the **[edit security ca-profile *ca-profile-name* revocation-check crl]** hierarchy level.

```
[edit security pki ca-profile ca-profile-name]
revocation-check {
  disable;
  crl {
    disable on-download-failure;
    refresh-interval number-of-hours { # The range is 0 through 8784 hours.
      url {
        url-name;
        password;
      }
    }
  }
}
```

## Requesting a CA Digital Certificate

You can request a CA digital certificate either online or manually. To request a digital certificate from a CA or RA online by using SCEP, issue the **request security pki ca-certificate enroll ca-profile *ca-profile-name*** command.

If you obtained the CA digital certificate manually through e-mail or other out-of-band mechanism, you must load it manually. To manually install a certificate in your router, issue the **request security pki local-certificate load** command.

## Generating a Private/Public Key Pair

A key pair is a critical element of a digital certificate implementation. The public key is included in the local digital certificate and the private key is used to decrypt data received from peers. To generate a private/public key pair, issue the **request security pki generate-key-pair certificate-id *certificate-id-name*** command.

## Generating and Enrolling a Local Digital Certificate

---

You can generate and enroll a local digital certificate either online or manually. To generate and enroll a local certificate online by using SCEP, issue the **request security pki local-certificate enroll** command. To generate a local certificate request manually in the PKCS-10 format, issue the **request security pki generate-certificate-request** command.

If you create the local certificate request manually, you must also load the certificate manually. To manually install a certificate in your router, issue the **request security pki local-certificate load** command.

## Applying the Local Digital Certificate to an IPsec Configuration

---

To activate a local digital certificate, you configure the IKE proposal to use digital certificates instead of preshared keys, reference the local certificate in the IKE policy, and identify the CA or RA in the service set. To enable the IKE proposal for digital certificates, include the **rsa-signatures** statement at the **[edit services ipsec-vpn ike proposal *proposal-name* authentication-method]** hierarchy level. To reference the local certificate in the IKE policy, include the **local-certificate** statement at the **[edit services ipsec-vpn ike policy *policy-name*]** hierarchy level. To identify the CA or RA in the service set, include the **trusted-ca** statement at the **[edit services service-set *service-set-name* ipsec-vpn-options]** hierarchy level.

```
[edit services]
service-set service-set-name {
  .....
  ipsec-vpn-options {
    trusted-ca ca-profile-name;
  }
}
ipsec-vpn {
  ike {
    proposal proposal-name {
      .....
      authentication-method [pre-shared-keys | rsa-signatures];
    }
    policy policy-name {
      .....
      local-certificate certificate-id-name;
    }
  }
}
```

## Configuring Automatic Reenrollment of Digital Certificates

---

You can configure automatic reenrollment for digital certificates. This feature is by default not enabled. To configure automatic reenrollment for digital certificates, include the **auto-re-enrollment** statement at the **[edit security pki]** hierarchy level:

```
[edit]
security {
```



```

pki {
  auto-re-enrollment {
    certificate-id certificate-name {
      ca-profile ca-profile-name;
      challenge-password password;
      re-enroll-trigger-time-percentage percentage; # Percentage of validity-period
        # (specified in certificate) when automatic
        # reenrollment should be initiated.
      re-generate-keypair;
      validity-period number-of-days;
    }
  }
}

```

## Monitoring Digital Certificates

- Purpose** You can issue various forms of the **show security pki** command to view digital certificates and certificate requests and certificate revocation lists:
- Action**
- To display the CA digital certificate, issue the **show security pki ca-certificate ca-profile *ca-profile-name*** command.
  - To display the local digital certificate and the public key used to enroll the certificate, issue the **show security pki local-certificate certificate-id *certificate-id-name*** command.
  - To display the local certificate request in PKCS-10 format, issue the **show security pki certificate-request certificate-id *certificate-id-name*** command.
  - You can also view which digital certificates are used in IKE negotiations to establish IPsec tunnels by issuing the **show services ipsec-vpn certificates** command.
  - To display the certificate revocation list, issue the **show security pki crl ca-profile *ca-profile-name*** command.
  - To determine if a certificate is enabled for automatic-reenrollment, issue the **show security pki** command.

## Clearing Digital Certificates

- Purpose** Variations of the **clear security pki** command enable you to delete certificates or requests and certificate revocation lists:
- Action**
- To delete the CA digital certificate, issue the **clear security pki ca-certificate ca-profile *ca-profile-name*** command.
  - To delete the local digital certificate and the associated private/public key pair, issue the **clear security pki local-certificate certificate-id *certificate-id-name*** command.
  - To delete the local certificate request, issue the **clear security pki certificate-request certificate-id *certificate-id-name*** command.

- To clear the digital certificates that were used in IKE negotiations to establish IPSec tunnels, issue the **clear services ipsec-vpn certificates** command.
- To delete the certificate revocation list, issue the **clear security pki crl ca-profile *ca-profile-name*** command.

**Related  
Documentation**

- [Example: AS PIC IKE Dynamic SA with Digital Certificates Configuration on page 129](#)
- *Security Services Administration Guide for Routing Devices*
- *Junos VPN Site Secure*

## CHAPTER 15

# Securing Layer 3 Protocol Traffic with IPsec Transport Mode

- [Securing BGP Sessions with IPsec Transport Mode on page 221](#)
- [Securing OSPFv2 Networks with IPsec Transport Mode on page 221](#)
- [Securing OSPFv3 Networks with IPsec Transport Mode on page 223](#)

## Securing BGP Sessions with IPsec Transport Mode

---

For the ES PIC, you can use IPsec to secure BGP sessions between Routing Engines in M Series and T Series platforms. To configure, create a transport mode security association and apply the SA to the BGP configuration by including the **ipsec-sa** statement at the **[edit protocols bgp group group-name]** hierarchy level.

```
[edit]
protocols {
  bgp {
    group group-name {
      local-address ip-address;
      export export-policy;
      peer-as as-number;
      ipsec-sa sa-name;
      neighbor peer-ip-address;
    }
  }
}
```

**Related Documentation** • [IPsec Modes on page 83](#)

## Securing OSPFv2 Networks with IPsec Transport Mode

---

By default, you can configure MD5 or simple text password-based authentication over OSPFv2 links. In addition to these basic authentications, the Junos OS supports OSPFv2 with a security authentication header (AH), Encapsulating Security Payload (ESP), or an IPsec protocol bundle that supports both AH and ESP. You can configure IPsec over OSPFv2 using transport mode security associations on physical, sham, or virtual links.

Because the Junos OS supports only bidirectional security associations over OSPFv2, OSPFv2 peers must be configured with the same IPsec security association. Configuring OSPFv2 peers with different security associations or with dynamic IKE will prevent adjacencies from being established. In addition, you must configure identical security associations for sham links with the same remote endpoint address, for virtual links with the same remote endpoint address, for all neighbors on OSPF nonbroadcast multiaccess (NBMA) or point-to-multipoint links, and for every subnet that is part of a broadcast link.

To create a manual bidirectional security association, include the **security-association** *security-association-name* statement at the **[edit security ipsec]** hierarchy level:

```
[edit]
security {
  ipsec {
    security-association security-association name {
      mode transport;
      manual {
        direction bidirectional {
          protocol (ah | esp | bundle);
          spi spi--value;
          authentication {
            algorithm (hmac-md5-96 | hmac-sha1-96);
            key (ascii-text key | hexadecimal key);
          }
        }
      }
    }
  }
}
```

To configure IPsec on an OSPFv2 interface, create a transport mode security association and include the **ipsec-sa name** statement at the **[edit protocols ospf area area-id]** hierarchy level:

```
[edit]
protocols {
  ospf {
    area area-id {
      interface interface-name {
        ipsec-sa sa-name;
      }
      virtual-link neighbor-id a.b.c.d transit-area x.x.x.x {
        ipsec-sa sa-name;
      }
      sham-link-remote {
        ipsec-sa sa-name;
      }
    }
  }
}
```

To verify your configuration, enter the **show ospf interface detail** command. This command gives detailed information about the **ospfv2** interface and displays the interface's security

association at the bottom of the output. In the example below, the security association configured on this router is **sa1**.

```
user@router> show ospf interface detail
Interface          State      Area      DR ID      BDR ID Nbrs
fe-0/0/1.0         BDR       0.0.0.0    192.168.37.12  10.255.245.215  1
Type LAN, address 192.168.37.11, Mask 255.255.255.248, MTU 4460, Cost 40
DR addr 192.168.37.12, BDR addr 192.168.37.11, Adj count 1, Priority 128
Hello 10, Dead 40, ReXmit 5, Not Stub
t1-0/2/1.0         PtToPt    0.0.0.0    0.0.0.0      0.0.0.0  0
Type P2P, Address 0.0.0.0, Mask 0.0.0.0, MTU 1500, Cost 2604
Adj count 0
Hello 10, Dead 40, ReXmit 5, Not Stub
Auth type: MD5, Active key ID 3, Start time 2002 Nov 19 10:00:00 PST
IPsec SA Name: sa1
```

**Related Documentation**

- [IPsec Modes on page 83](#)

## Securing OSPFv3 Networks with IPsec Transport Mode

OSPF version 3 (OSPFv3), unlike OSPF version 2, does not have a built-in authentication method and relies on IPsec to provide this functionality. Using the ES PIC syntax, you can use IPsec to secure OSPFv3 between Routing Engines in M Series and T Series platforms. You can secure specific OSPFv3 interfaces and protect OSPFv3 virtual links. To configure, create a transport mode security association and apply the SA to the OSPFv3 configuration by including the **ipsec-sa** statement at the **[edit protocols ospf3 area *area-number* interface *interface-name*]** or **[edit protocols ospf3 area *area-number* virtual-link neighbor-id *neighbor-ip-address* transit-area *area-number*]** hierarchy level.

```
[edit]
protocols {
  ospf3 {
    area area-number {
      interface interface-name {
        ipsec-sa sa-name;
      }
      virtual-link neighbor-id neighbor-ip-address transit-area area-number {
        ipsec-sa sa-name;
      }
    }
  }
}
```

**Related Documentation**

- [IPsec Modes on page 83](#)



# Using IPsec with a Layer 3 VPN

- [Using IPsec with a Layer 3 VPN on page 225](#)
- [ES Tunnel Interface Configuration for a Layer 3 VPN on page 227](#)

## Using IPsec with a Layer 3 VPN

---

Some key concepts to keep in mind when configuring IPsec within a VPN include the following:

- Add the outside services interface for a next-hop style service set into the routing instance by including the **interface sp-fpc/pic/port** statement at the **[edit routing-instances instance-name]** hierarchy level.
- For interface style service sets, add the interface on which you apply the service set and the services interface by including both interfaces at the **[edit routing-instances instance-name]** hierarchy level.
- To define a routing instance for the local gateway within the service set, include the **routing-instance instance-name** option at the **[edit services service-set service-set-name ipsec-vpn-options local-gateway address]** hierarchy level.

The following configuration for an AS PIC on a provider edge (PE) router demonstrates the use of next-hop service sets with an IKE dynamic SA in a VPN routing and forwarding (VRF) routing instance.

```
[edit]
interfaces {
  so-0/0/0 {
    description "Interface connected to the customer edge (CE) router";
    unit 0 {
      family inet {
        address 10.6.6.6/32;
      }
    }
  }
  so-2/2/0 {
    description "Source IPsec tunnel interface to the network core";
    unit 0 {
      family inet {
        address 10.10.1.1/30;
      }
    }
  }
}
```

```

    }
  }
  sp-3/1/0 {
    description "AS PIC interface";
    unit 0 {
      family inet {
        address 10.7.7.7/32;
      }
    }
    unit 1 {
      family inet;
      service-domain inside;
    }
    unit 2 {
      family inet;
      service-domain outside;
    }
  }
}
policy-options {
  policy-statement vpn-export-policy {
    then {
      community add community-name;
      accept;
    }
  }
  policy-statement vpn-import-policy {
    term term-name {
      from community community-name;
      then accept;
    }
  }
  community community-name members target:100:20;
}
routing-instances {
  vrf {
    instance-type vrf;
    interface sp-3/1/0.1; # Inside sp interface.
    interface so-0/0/0.0; # Interface that connects to the CE router.
    route-distinguisher route-distinguisher;
    vrf-import vpn-import-policy;
    vrf-export vpn-export-policy;
    routing-options {
      static {
        route ip-address/prefix next-hop so-0/0/0.0; # Routes for the CE router.
        route ip-address/prefix next-hop sp-3/1/0.1; # Routes for IPSec.
      }
    }
  }
}
services {
  service-set service-set-name {
    next-hop-service {
      inside-service-interface sp-3/1/0.1;
      outside-service-interface sp-3/1/0.2;
    }
  }
}

```



```

    ipsec-vpn-options {
        local-gateway 10.10.1.1;
    }
    ipsec-vpn-rules rule-name;
}
ipsec-vpn {
    rule rule-name {
        term term-name {
            from {
                source-address {
                    source-ip-address;
                }
            }
            then {
                remote-gateway 10.10.1.2;
                dynamic {
                    ike-policy ike-policy-name;
                }
            }
        }
        match-direction direction;
    }
    ike {
        policy ike-policy-name {
            pre-shared-key ascii-text preshared-key;
        }
    }
}
}

```

For more information on VRF routing instances, see the *Junos VPNs Configuration Guide*.  
 For more information on next-hop service sets, see the *Junos Services Interfaces Configuration Guide*.

## ES Tunnel Interface Configuration for a Layer 3 VPN

To configure an ES tunnel interface for a Layer 3 VPN, you need to configure an ES tunnel interface on the provider edge (PE) router and on the customer edge (CE) router. You also need to configure IPsec on the PE and CE routers.

- Related Documentation**
- [IPsec Tunnel Traffic Configuration Overview on page 197](#)



## PART 5

# Monitoring and Troubleshooting Information

- [Tracing Security Services Operations for Troubleshooting Purposes on page 231](#)
- [Monitoring IPsec Traffic on page 233](#)



# Tracing Security Services Operations for Troubleshooting Purposes

- [Configuring Tracing Operations for Security Services on page 231](#)
- [Configuring Tracing Operations for IPsec Events for Adaptive Services PICs on page 232](#)

## Configuring Tracing Operations for Security Services

---

To configure trace options for security services, specify flags using the **traceoptions** statement:

```
[edit security]
traceoptions {
  file filename <files number> <size size>;
  flag all;
  flag database;
  flag general;
  flag ike;
  flag parse;
  flag policy-manager;
  flag routing-socket;
  flag timer;
}
```

You can include these statements at the following hierarchy levels:

- **[edit security]**
- **[edit services ipsec-vpn]**

You can specify one or more of the following security tracing flags:

- **all**—Trace all security events
- **database**—Trace database events
- **general**—Trace general events
- **ike**—Trace IKE module processing
- **parse**—Trace configuration processing
- **policy-manager**—Trace policy manager processing

- **routing-socket**—Trace routing socket messages
- **timer**—Trace internal timer events

**Related  
Documentation**

- [Configuring Tracing Operations for IPsec Events for Adaptive Services PICs on page 232](#)
- [IPsec Security Associations on page 82](#)

---

## Configuring Tracing Operations for IPsec Events for Adaptive Services PICs

---

To configure trace options to trace IPsec events for Adaptive Services PICs, include the following statements at the **[edit services ipsec-vpn]** hierarchy level:

```
[edit services ipsec-vpn]
traceoptions {
  file filename <files number> <size size>;
  flag all;
  flag database;
  flag general;
  flag ike;
  flag parse;
  flag policy-manager;
  flag routing-socket;
  flag timer;
}
```

Trace option output is recorded in the `/var/log/kmd` file.

You can specify one or more of the following security tracing flags:

- **all**—Trace all security events
- **database**—Trace database events
- **general**—Trace general events
- **ike**—Trace IKE module processing
- **parse**—Trace configuration processing
- **policy-manager**—Trace policy manager processing
- **routing-socket**—Trace routing socket messages
- **timer**—Trace internal timer events

**Related  
Documentation**

- [Configuring Tracing Operations for Security Services on page 231](#)

## CHAPTER 18

# Monitoring IPsec Traffic

- [Monitoring IPsec by Using SNMP on page 233](#)

### Monitoring IPsec by Using SNMP

---

In Junos OS Release 7.5 and later, the IPsec Monitoring MIB provides a way to monitor IPsec information on AS PICs installed in M Series and T Series routers by using the Simple Network Management Protocol (SNMP). The MIB provides an IKE tunnel table to monitor IKE security associations and view related statistics, an IPsec tunnel table to view IPsec tunnel statistics, and an IPsec security associations table to view all IPsec SAs. For more information, see the *Junos Network Management Configuration Guide*.





## PART 6

# Configuration Statements and Operational Commands

- [Configuration Statements: DDoS on page 237](#)
- [Configuration Statements: IPsec and Digital Certificates on page 273](#)
- [Operational Commands: DDoS on page 345](#)
- [Operational Commands: IPsec and Digital Certificates on page 391](#)



# Configuration Statements: DDoS

- [\[edit system ddos-protection\] Hierarchy Level](#) on page 238
- [bandwidth \(DDoS\)](#) on page 239
- [bandwidth-scale \(DDoS\)](#) on page 240
- [burst \(DDoS\)](#) on page 240
- [burst-scale \(DDoS\)](#) on page 241
- [bypass-aggregate \(DDoS\)](#) on page 241
- [ddos-protection \(DDoS\)](#) on page 242
- [disable-fpc \(DDoS\)](#) on page 243
- [disable-logging \(DDoS\)](#) on page 244
- [disable-routing-engine \(DDoS\)](#) on page 244
- [flow-detection \(DDoS Flow Detection\)](#) on page 245
- [flow-detection \(DDoS Packet Level\)](#) on page 246
- [flow-detection-mode \(DDoS Flow Detection\)](#) on page 247
- [flow-detect-time \(DDoS Flow Detection\)](#) on page 248
- [flow-level-bandwidth \(DDoS Flow Detection\)](#) on page 249
- [flow-level-control \(DDoS Flow Detection\)](#) on page 249
- [flow-level-detection \(DDoS Flow Detection\)](#) on page 250
- [flow-recover-time \(DDoS Flow Detection\)](#) on page 251
- [flow-report-rate \(DDoS Flow Detection\)](#) on page 251
- [flow-timeout-time \(DDoS Flow Detection\)](#) on page 252
- [fpc \(DDoS\)](#) on page 252
- [global \(DDoS\)](#) on page 253
- [logical-interface \(DDoS Flow Detection\)](#) on page 254
- [no-flow-logging \(DDoS Flow Detection\)](#) on page 255
- [physical-interface \(DDoS Flow Detection\)](#) on page 256
- [priority \(DDoS\)](#) on page 257
- [protocols \(DDoS\)](#) on page 258
- [recover-time \(DDoS\)](#) on page 267

- [subscriber \(DDoS Flow Detection\)](#) on page 268
- [timeout-active-flows \(DDoS Flow Detection\)](#) on page 269
- [traceoptions \(DDoS\)](#) on page 270
- [violation-report-rate \(DDoS Flow Detection\)](#) on page 272

---

## [edit system ddos-protection] Hierarchy Level

---

```
system {
  ddos-protection {
    global {
      disable-fpc;
      disable-logging;
      disable-routing-engine;
      flow-detection;
      flow-report-rate;
      violation-report-rate;
    }
    protocols protocol-group (aggregate | packet-type) {
      bandwidth packets-per-second;
      burst size;
      bypass-aggregate;
      disable-fpc;
      disable-logging;
      disable-routing-engine;
      flow-detection-mode (automatic | off | on);
      flow-detect-time seconds;
      flow-level-bandwidth {
        logical-interface flow-bandwidth;
        physical-interface flow-bandwidth;
        subscriber flow-bandwidth;
      }
      flow-level-control {
        logical-interface flow-control-mode;
        physical-interface flow-control-mode;
        subscriber flow-control-mode;
      }
      flow-level-detection {
        logical-interface flow-operation-mode;
        physical-interface flow-operation-mode;
        subscriber flow-operation-mode;
      }
      flow-recover-time seconds;
      flow-timeout-time seconds;
      fpc slot-number {
        bandwidth-scale percentage;
        burst-scale percentage;
        disable-fpc;
      }
      no-flow-logging
      priority level;
      recover-time seconds;
      timeout-active-flows;
    }
  }
  traceoptions{
```

```

file filename <files number> <match regular-expression > <size maximum-file-size>
    <world-readable | no-world-readable>;
flag flag;
level (all | error | info | notice | verbose | warning);
no-remote-trace;
    }
}
}

```

- Related Documentation**
- [Configuring Protection Against DDoS Attacks on page 41](#)
  - [Configuring Flow Detection for DDoS Protection on page 65](#)

## bandwidth (DDoS)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>bandwidth <i>packets-per-second</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">protocols</a> <i>protocol-group</i> (aggregate   <i>packet-type</i> )]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure the DDoS bandwidth rate limit; the maximum traffic rate (packets per second) allowed for the packet type. When the value is exceeded, a violation is declared. |
| <b>Options</b>                  | <i>packets-per-second</i> —Number of packets per second that are allowed for the packet type.<br><b>Range:</b> 1 through 100,000 packets per second   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li> </ul>   |

## bandwidth-scale (DDoS)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>bandwidth-scale <i>percentage</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> ) <b>fpc</b> <i>slot-number</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure the percentage by which the DDoS bandwidth rate limit is scaled down for the packet type on the card in the specified slot.    |
| <b>Options</b>                  | <b><i>percentage</i></b> —Percentage multiplied by the bandwidth rate limit to reduce the number of packets per second allowed for the packet type.<br><b>Range:</b> 1 through 100 percent<br><b>Default:</b> 100 |
| <b>Required Privilege Level</b> | <b>admin</b> —To view this statement in the configuration.<br><b>admin-control</b> —To add this statement to the configuration.   |

## burst (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>burst <i>size</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <b>protocols</b> <i>protocol-group</i> (aggregate   <i>packet-type</i> )]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure the DDoS burst limit; the maximum number of packets of the packet type that is allowed in a burst of traffic. When this value is exceeded, a violation is declared.   |
| <b>Options</b>                  | <b><i>size</i></b> —Number of packets that are allowed in a burst for the packet type.<br><b>Range:</b> 1 through 100,000 packets<br><b>Default:</b> The default burst value varies by packet type. You can view the default values for all packet types on an unconfigured router by entering the <b>show ddos-protection protocols parameters brief</b> command from operational mode. |
| <b>Required Privilege Level</b> | <b>admin</b> —To view this statement in the configuration.<br><b>admin-control</b> —To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li></ul>  |

## burst-scale (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>burst-scale <i>percentage</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> ) <b>fpc</b> <i>slot-number</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure the percentage by which the DDoS burst limit is scaled down for the packet type on the specified card.                |
| <b>Options</b>                  | <b><i>percentage</i></b> —Percentage multiplied by the burst limit to reduce the number of packets allowed in a burst for the packet type.<br><b>Range:</b> 1 through 100 percent<br><b>Default:</b> 100 |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li></ul>  |

## bypass-aggregate (DDoS)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>bypass-aggregate;</code>  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <b>protocols</b> <i>protocol-group</i> <i>packet-type</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Prevent this packet type from being considered by the DDoS aggregate policer. Traffic for the packet type is still included in traffic statistics. |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li></ul>   |

## ddos-protection (DDoS)

```
Syntax ddos-protection
      global {
        disable-fpc;
        disable-logging;
        disable-routing-engine;
        flow-detection;
        flow-report-rate;
        violation-report-rate;
      }
      protocols protocol-group (aggregate | packet-type) {
        bandwidth packets-per-second;
        burst size;
        bypass-aggregate;
        disable-fpc;
        disable-logging;
        disable-routing-engine;
        flow-detection-mode (automatic | off | on);
        flow-detect-time seconds;
        flow-level-bandwidth {
          logical-interface flow-bandwidth;
          physical-interface flow-bandwidth;
          subscriber flow-bandwidth;
        }
        flow-level-control {
          logical-interface flow-control-mode;
          physical-interface flow-control-mode;
          subscriber flow-control-mode;
        }
        flow-level-detection {
          logical-interface flow-detection-mode;
          physical-interface flow-detection-mode;
          subscriber flow-detection-mode;
        }
        flow-recover-time seconds;
        flow-timeout-time seconds;
        fpc slot-number {
          bandwidth-scale percentage;
          burst-scale percentage;
          disable-fpc;
        }
        no-flow-logging
        priority level;
        recover-time seconds;
        timeout-active-flows;
      }
      traceoptions{
        file filename <files number> <match regular-expression> <size maximum-file-size>
          <world-readable | no-world-readable>;
        flag flag;
        level (all | error | info | notice | verbose | warning);
        no-remote-trace;
      }
```



}

|                                 |   |
|---------------------------------|---|
| <b>Hierarchy Level</b>          | [edit system]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | Configure DDoS policers.<br><br>The remaining statements are explained separately.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Protection Against DDoS Attacks on page 41</a></li> <li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li> </ul> |

## disable-fpc (DDoS)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | disable-fpc;  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ],<br>[edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> )],<br>[edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> ) <a href="#">fpc slot-number</a> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.<br>Support at the [edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> )] hierarchy level introduced in Junos OS Release 12.1.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Disable DDoS policers for debugging purposes on the card in the specified slot for a particular packet type within a protocol group, on all cards for a particular packet type within a protocol group, or globally on all cards and for all packet types in all protocols. This statement does not affect the state of the Routing Engine policers. |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Disabling DDoS Protection Policers and Logging Globally on page 55</a></li> <li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li> </ul>   |

## disable-logging (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | disable-logging;   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ],<br>[edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> )]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.<br>Support at the [edit system ddos-protection protocols <i>protocol-group</i> (aggregate   <i>packet-type</i> )] hierarchy level introduced in Junos OS Release 12.1.  |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Disable router-wide logging of all DDoS violation and flow detection events globally. Disable only logging of events other than flow detection culprit flow events for a particular packet type within a protocol group. Typically used for debugging purposes.             |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Disabling DDoS Protection Policers and Logging Globally on page 55</a></li><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li><li>• <a href="#">Disabling Automatic Logging of Culprit Flow Events for a Packet Type on page 73</a></li></ul> |

## disable-routing-engine (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | disable-routing-engine;  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ],<br>[edit system ddos-protection <a href="#">protocols</a> <i>protocol-group</i> (aggregate   <i>packet-type</i> )]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Disable DDoS Routing Engine policers for debugging purposes for a particular packet type within a protocol group or globally for all packet types in all protocols. This statement does not affect the state of the line card policers. |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Disabling DDoS Protection Policers and Logging Globally on page 55</a></li></ul>   |

## flow-detection (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | flow-detection;   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Enable flow detection globally for all protocol groups and packet types.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Enabling Flow Detection for All Protocol Groups and Packet Types on page 66</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

## flow-detection (DDoS Packet Level)

---

**Syntax**    `flow-detection {  
          flow-detect-time detect-period;  
          no-flow-logging;  
          timeout-active-flows enable-period;  
          flow-level-bandwidth {  
            logical-interface flow-bandwidth;  
            physical-interface flow-bandwidth;  
            subscriber flow-bandwidth;  
          }  
          flow-level-control {  
            logical-interface flow-control-mode;  
            physical-interface flow-control-mode;  
            subscriber flow-control-mode;  
          }  
          flow-level-detection {  
            logical-interface operation-mode;  
            physical-interface operation-mode;  
            subscriber operation-mode;  
          }  
          flow-detection-mode (automatic | off | on);  
          flow-recover-time recover-period;  
          flow-timeout-time timeout-period;  
          }  
}`

**Hierarchy Level**    [edit system ddos-protection [protocols](#) *protocol-group packet-type* ]

**Release Information**    Statement introduced in Junos OS Release 12.3.

**Description**    (MX Series routers with MPCs only) Configure DDoS protection suspicious control flow detection for a packet type.

The remaining statements are explained separately.

**Required Privilege Level**    admin—To view this statement in the configuration.  
                                  admin-control—To add this statement to the configuration.

**Related Documentation**    • [Configuring Flow Detection for DDoS Protection on page 65](#)


## flow-detection-mode (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | flow-detection-mode (automatic   off   on)  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Configure the mode of operation for flow detection for the packet type. The operation mode is effective only when flow detection is enabled.   |
| <b>Default</b>                  | The default mode for all protocol groups and packet types is <b>automatic</b> .   |
| <b>Options</b>                  | <b>automatic</b> —Detect flows only when the policer is being violated.<br><br><b>off</b> —Disable flow detection.<br><br><b>on</b> —Always monitor and detect flows, even when the policer is not being violated.                    |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Flow Detection for Individual Protocol Groups or Packets on page 69</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

## flow-detect-time (DDoS Flow Detection)

---

|  |  |
|--|--|
| <b>Syntax</b>  | <code>flow-detect-time seconds;</code>   |
| <b>Hierarchy Level</b>   | [edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-detection</a> ]  |
| <b>Release Information</b>   | Statement introduced in Junos OS Release 12.3.   |
| <b>Description</b>   | (MX Series routers with MPCs only) Configure how much time must pass before a suspicious flow that has exceeded the bandwidth allowed for the packet type is confirmed to be a culprit flow.                           |
| <div> <b>BEST PRACTICE:</b> We recommend that you use the default value for the detection period.</div> |  |
| <b>Options</b>   | <b>seconds</b> —Period of excessive bandwidth required for flow to be a culprit flow.<br><b>Range:</b> 1 through 60 seconds<br><b>Default:</b> Three seconds   |
| <b>Required Privilege Level</b>  | <b>admin</b> —To view this statement in the configuration.<br><b>admin-control</b> —To add this statement to the configuration.  |
| <b>Related Documentation</b>   | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Detection Period for Suspicious Flows on page 67</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

## flow-level-bandwidth (DDoS Flow Detection)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>flow-level-bandwidth {   logical-interface flow-bandwidth;   physical-interface flow-bandwidth;   subscriber flow-bandwidth; }</pre>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | <p>(MX Series routers with MPCs only) Configure allowed flow bandwidth for the packet type at each flow aggregation level.</p> <p>The remaining statements are explained separately.</p>  |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level on page 71</a></li> <li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li> </ul> |

## flow-level-control (DDoS Flow Detection)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>flow-level-control {   logical-interface flow-control-mode;   physical-interface flow-control-mode;   subscriber flow-control-mode; }</pre>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.   |
| <b>Description</b>              | <p>(MX Series routers with MPCs only) Specify how traffic in the detected flow is handled for the packet type at each flow aggregation level.</p> <p>The remaining statements are explained separately.</p>  |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level on page 71</a></li> <li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li> </ul> |

## flow-level-detection (DDoS Flow Detection)

---

**Syntax**    flow-level-detection {  
              logical-interface *flow-detection-mode*;  
              physical-interface *flow-detection-mode*;  
              subscriber *flow-detection-mode*;  
              }

**Hierarchy Level**    [edit system ddos-protection protocols *protocol-group packet-type*]

**Release Information**    Statement introduced in Junos OS Release 12.3.

**Description**    (MX Series routers with MPCs only) Configure the mode of operation for flow detection for the packet type at each flow aggregation level.

The remaining statements are explained separately.



**NOTE:** Flow detection operates for individual flow aggregation levels only when the flow detection mode at the packet level is configured to either **automatic** or **on**.

---

**Required Privilege Level**    admin—To view this statement in the configuration.  
                                  admin-control—To add this statement to the configuration.

**Related Documentation**    • [Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69](#)  
                                  • [Configuring Flow Detection for DDoS Protection on page 65](#)



## flow-recover-time (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>flow-recover-time <i>seconds</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Configure how much time must pass before a culprit flow for the packet type is considered to have returned to normal. The period starts when the flow drops below the threshold that triggered the last violation. |
| <b>Options</b>                  | <b><i>seconds</i></b> —Period required for the traffic to recover.<br><b>Range:</b> 1 through 3600 seconds<br><b>Default:</b> 60 seconds  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Recovery Period for a Culprit Flow on page 68</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul>                                   |

## flow-report-rate (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>flow-report-rate <i>report-rate</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Set the rate at which culprit flow events are reported by system log messages, for all protocol groups and packet types on all line cards.   |
| <b>Options</b>                  | <b><i>report-rate</i></b> —Number of flows per second.<br><b>Range:</b> 1 through 50,000<br><b>Default:</b> 10  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Culprit Flow Reporting Rate for All Protocol Groups and Packet Types on page 66</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

## flow-timeout-time (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>flow-timeout-time seconds;</code>   |
| <b>Hierarchy Level</b>          | <code>[edit system ddos-protection protocols <i>protocol-group packet-type</i>]</code>  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Configure the period of time that a culprit flow is suppressed for the packet type. The timeout period is effective only when timing out has been enabled with the <a href="#">timeout-active-flows</a> statement. |
| <b>Options</b>                  | <b>seconds</b> —Period that the traffic is suppressed.<br><b>Range:</b> 1 through 7200 seconds<br><b>Default:</b> 300 seconds   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Timeout Period for a Culprit Flow on page 68</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul>                                    |

## fpc (DDoS)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>fpc slot-number;<br/>    bandwidth-scale percentage;<br/>    burst-scale percentage;<br/>    disable-fpc;<br/>}</code>                        |
| <b>Hierarchy Level</b>          | <code>[edit system ddos-protection <a href="#">protocols</a> <i>protocol-group</i> (aggregate   <i>packet-type</i>)]</code>                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Modify the DDoS policer for the packet type on the specified card.         |
| <b>Options</b>                  | <b>slot-number</b> —Slot number of the card.<br><b>Range:</b> Depends on the router model<br><br>The remaining statements are explained separately. |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li></ul>       |

## global (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>global {<br/>  disable-fpc;<br/>  disable-logging;<br/>  disable-routing-engine;<br/>  flow-detection;<br/>  flow-report-rate;<br/>  violation-report-rate;<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit system <a href="#">ddos-protection</a> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | <p>Modify DDoS policers, event logging, and flow detection globally for all protocols.</p> <p>The remaining statements are explained separately.</p>                         |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Disabling DDoS Protection Policers and Logging Globally on page 55</a></li></ul>   |

## logical-interface (DDoS Flow Detection)

---

|                     |  |
|---------------------|--|
| Syntax              | logical-interface ( <i>flow-bandwidth</i>   <i>flow-control-mode</i>   <i>flow-detection-mode</i> )  |
| Hierarchy Level     | [edit system ddos-protection protocols <i>protocol-group packet-type flow-level-bandwidth</i> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type flow-level-control</i> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type flow-level-detection</i> ]  |
| Release Information | Statement introduced in Junos OS Release 12.3.   |
| Description         | (MX Series routers with MPCs only) Configure flow bandwidth, flow control mode, or flow detection mode for flow detection at the logical interface flow aggregation level for the packet type.   |
| Options             | <p><b><i>flow-bandwidth</i></b>—Bandwidth for the flow at the logical interface level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type flow-level-bandwidth</i>] hierarchy level.</p> <p><b>Default:</b> 200 packets per second</p> <p><b>Range:</b> 1 through 30,000 packets per second</p> <p><b><i>flow-control-mode</i></b>—Mode for how traffic in the detected flow is controlled at the logical interface level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type flow-level-control</i>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>drop</b>—Drop all traffic in flow.</li><li>• <b>keep</b>—Keep all traffic in flow.</li><li>• <b>police</b>—Police the traffic to within its allowed bandwidth.</li></ul> <p><b>Default:</b> drop</p> <p><b><i>flow-detection-mode</i></b>—Mode for how flow detection operates at the logical interface level when a policer has been violated. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type flow-level-detection</i>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>automatic</b>—Search flows at the logical interface level only when a DDoS policer is being violated and only when the flow causing the policer violation is not discovered at the finer flow aggregation level, subscriber. When the suspicious flow is not found at this level, then the search moves to a coarser level of flow aggregation (physical interface). Flows at the logical interface level are subsequently not searched again until the policer is no longer violated at the coarser level, and a subsequent violation occurs that cannot be found at the subscriber level.</li><li>• <b>off</b>—Disable flow detection at the logical interface level so that flows are never searched at this level.</li><li>• <b>on</b>—Search flows at the logical interface level, even when no DDoS protection policer is currently being violated. Monitoring continues at this level regardless of whether a suspect flow is identified at this level.</li></ul> <p><b>Default:</b> automatic</p> |

|                                 |   |
|---------------------------------|---|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level on page 71</a></li> <li>• <a href="#">Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level on page 71</a></li> <li>• <a href="#">Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69</a></li> <li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li> </ul> |

## no-flow-logging (DDoS Flow Detection)

|                            |  |
|----------------------------|--|
| <b>Syntax</b>              | no-flow-logging;   |
| <b>Hierarchy Level</b>     | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]   |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.3.   |
| <b>Description</b>         | (MX Series routers with MPCs only) Disable automatic logging of flow detection culprit flow events (flow reports) for the packet type. |



**NOTE:** You can disable logging of suspicious flow events (violation reports) with the `disable-logging` statement at the [edit system ddos-protection global hierarchy level].

|                                 |  |
|---------------------------------|--|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Disabling Automatic Logging of Culprit Flow Events for a Packet Type on page 73</a></li> <li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li> </ul> |

## physical-interface (DDoS Flow Detection)

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|                     |  |
|---------------------|--|
| Syntax              | <code>physical-interface (flow-bandwidth   flow-control-mode   flow-detection-mode)</code>   |
| Hierarchy Level     | [edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-bandwidth</b> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-control</b> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-detection</b> ]   |
| Release Information | Statement introduced in Junos OS Release 12.3.   |
| Description         | (MX Series routers with MPCs only) Configure flow bandwidth, flow control mode, or flow detection mode at the physical interface flow aggregation level for the packet type.   |
| Options             | <p><b>flow-bandwidth</b>—Bandwidth for the flow at the physical interface level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-bandwidth</b>] hierarchy level.</p> <p><b>Default:</b> 20,000 packets per second</p> <p><b>Range:</b> 1 through 50,000 packets per second</p> <p><b>flow-control-mode</b>—Mode for how traffic in the detected flow is controlled at the physical interface level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-control</b>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>drop</b>—Drop all traffic in flow.</li><li>• <b>keep</b>—Keep all traffic in flow.</li><li>• <b>police</b>—Police the traffic to within its allowed bandwidth.</li></ul> <p><b>Default:</b> drop</p> <p><b>flow-detection-mode</b>—Mode for how flow detection operates at the physical interface level when a policer has been violated. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <b>flow-level-detection</b>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>automatic</b>—Search flows at the physical interface level only when a DDoS policer is being violated and only when the policer violation is not discovered at the finer aggregation levels, logical interface or subscriber. Flows at the physical interface level are subsequently not searched again until a subsequent violation occurs that cannot be found at the subscriber or logical interface levels.</li><li>• <b>off</b>—Disable flow detection at the physical interface level so that flows are never searched at this level.</li><li>• <b>on</b>—Search flows at the physical interface level, even when no DDoS protection policer is currently being violated. Monitoring continues at this level regardless of whether a suspect flow is identified at this level.</li></ul> <p><b>Default:</b> automatic</p> |

|                                 |  |
|---------------------------------|--|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level on page 71</a></li><li>• <a href="#">Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level on page 71</a></li><li>• <a href="#">Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

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## priority (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>priority level;</code>   |
| <b>Hierarchy Level</b>          | <code>[edit system ddos-protection <a href="#">protocols</a> protocol-group packet-type)]</code>   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure the priority for the packet type within the parent protocol group. In the event of downstream traffic congestion, high priority packets are provided bandwidth before medium priority packets. In turn, medium priority packets are provided bandwidth before low priority packets. Packets are dropped when there is insufficient available bandwidth. |
| <b>Options</b>                  | <i>level</i> —Priority of the packet type, low, medium, or high.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a></li></ul>  |

## protocols (DDoS)

```
Syntax protocols protocol-group (aggregate | packet-type) {
    bandwidth packets-per-second;
    burst size;
    bypass-aggregate;
    disable-fpc;
    disable-logging;
    disable-routing-engine;
    flow-detection-mode (automatic | off | on);
    flow-detect-time seconds;
    flow-level-bandwidth {
        logical-interface flow-bandwidth;
        physical-interface flow-bandwidth;
        subscriber flow-bandwidth;
    }
    flow-level-control {
        logical-interface flow-control-mode;
        physical-interface flow-control-mode;
        subscriber flow-control-mode;
    }
    flow-level-detection {
        logical-interface flow-operation-mode;
        physical-interface flow-operation-mode;
        subscriber flow-operation-mode;
    }
    flow-recover-time seconds;
    flow-timeout-time seconds;
    fpc slot-number {
        bandwidth-scale percentage;
        burst-scale percentage;
        disable-fpc;
    }
    no-flow-logging
    priority level;
    recover-time seconds;
    timeout-active-flows;
}
```

**Hierarchy Level** [edit system [ddos-protection](#)]

**Release Information** Statement introduced in Junos OS Release 11.2.

**Description** Configure DDoS policers for all packet types within a protocol group or for a particular packet type within a protocol group.

**Options** **aggregate**—Configure the policer to monitor all control packets within the protocol group. You can configure an aggregate policer for any protocol group.

**packet-type**—(Optional) Name of the control packet type to be policed. You can configure a specific policer for only the following packet types and protocol groups:

- **dhcpv4**—The following packet types are available for DHCPv4 traffic:



- **ack**—DHCPACK packets.
- **bad-packets**—DHCPv4 packets with bad formats.
- **bootp**—DHCPBOOTP packets.
- **decline**—DHCPDECLINE packets.
- **discover**—DHCPDISCOVER packets.
- **force-renew**—DHCPFORCERENEW packets.
- **inform**—DHCPINFORM packets.
- **lease-active**—DHCPLEASEACTIVE packets.
- **lease-query**—DHCPLEASEQUERY packets.
- **lease-unassigned**—DHCPLEASEUNASSIGNED packets.
- **lease-unknown**—DHCPLEASEUNKNOWN packets.
- **nak**—DHCPNAK packets.
- **no-message-type**—DHCP packets that are missing the message type.
- **offer**—DHCPOFFER packets.
- **release**—DHCPRELEASE packets.
- **renew**—DHCPRENEW packets.
- **request**—DHCPREQUEST packets.
- **unclassified**—All unclassified packets in the protocol group.

- **dhcpv6**—The following packet types are available for DHCPv6 traffic:
  - **advertise**—ADVERTISE packets.
  - **confirm**—CONFIRM packets.
  - **decline**—DECLINE packets.
  - **information-request**—INFORMATION-REQUEST packets.
  - **leasequery**—LEASEQUERY packets.
  - **leasequery-data**—LEASEQUERY-DATA packets.
  - **leasequery-done**—LEASEQUERY-DONE packets.
  - **leasequery-reply**—LEASEQUERY-REPLY packets.
  - **rebind**—REBIND packets.
  - **reconfigure**—RECONFIGURE packets.
  - **relay-forward**—RELAY-FORWARD packets.
  - **relay-reply**—RELAY-REPLY packets.
  - **release**—RELEASE packets.
  - **renew**—RENEW packets.
  - **reply**—REPLY packets.
  - **request**—REQUEST packets.
  - **solicit**—SOLICIT packets.
  - **unclassified**—All unclassified packets in the protocol group.
- **filter-action**—The following packet types are available for unclassified firewall filter action packets, sent to the host because of reject terms in firewall filters:
  - **filter-v4**—Unclassified IPv4 filter action packets.
  - **filter-v6**—Unclassified IPv6 filter action packets.
  - **other**—All other unclassified filter action packets that are not IPv4 or IPv6.
- **frame-relay**—The following packet types are available for Frame Relay traffic:
  - **frf15**—Multilink frame relay FRF.15 packets.
  - **frf16**—Multilink frame relay FRF.16 packets.
- **ip-fragments**—The following packet types are available for IP fragments:
  - **first-fragment**—First IP fragment.
  - **trail-fragment**—Last IP fragment.

- **ip-options**—The following packet types are available for IP option traffic:
  - **non-v4v6**—Options packets other than IPv4/v6.
  - **router-alert**—Router alert options packets.
  - **unclassified**— All unclassified packets in the protocol group.
- **mcast-snoop**—Control traffic for multicast snooping.
  - **igmp**—Snooped IGMP traffic.
  - **pim**—Snooped PIM control traffic.
- **mlp**—The following MLP packet types are available:
  - **aging-exception**—MLP aging exception packets.
  - **packets**—MLP packets.
  - **unclassified**—All unclassified packets in the protocol group.
- **ppp**—The following PPP packet types are available:
  - **authentication**—PPP authentication protocol packets.
  - **echo-rep**
  - **echo-req**—LCP echo request packets.
  - **ipcp**—IP Control Protocol packets.
  - **ipv6cp**—IPv6 Control Protocol packets.
  - **isis**—IS-IS packets.
  - **lcp**—Link Control Protocol packets.
  - **mlppp-lcp**—MLPPP LCP packets.
  - **mplscp**—MPLS Control Protocol packets.
  - **unclassified**—All unclassified packets in the protocol group.
- **pppoe**—The following PPPoE packet types are available:
  - **padi**—PADI packets.
  - **padm**—PADM packets.
  - **padn**—PADN packets.
  - **pado**—PADO packets.
  - **padr**—PADR packets.
  - **pads**—PADS packets.
  - **padt**—PADT packets.

- **radius**—The following RADIUS packet types are available:
  - **accounting**—RADIUS accounting packets.
  - **authorization**—RADIUS authorization packets.
  - **server**—RADIUS server traffic.
  - **unclassified**—All unclassified packets in the protocol group.
- **resolve**—The following packet types are available for unclassified resolve packets, which are sent to the host because of a traffic request resolve action:
  - **mcast-v4**—Unclassified IPv4 multicast resolve packets.
  - **mcast-v6**—Unclassified IPv6 multicast resolve packets.
  - **ucast-v4**—Unclassified IPv4 unicast resolve packets.
  - **ucast-v6**—Unclassified IPv6 unicast resolve packets.
  - **other**—All other unclassified resolve packets.
- **sample**—The following sample packet types are available:
  - **host**—Host packets.
  - **pfe**—Packet Forwarding Engine packets.
  - **syslog**—System log message packets.
  - **tap**—TAP packets.
- **tcp-flags**—The following TCP-flagged packet types are available:
  - **established**—TCP ACK and RST connection packets.
  - **initial**—TCP SYN and NAK packets.

- **unclassified**—The following unclassified packet types are available:
  - **control-layer2**—Unclassified layer 2 control packets.
  - **control-v4**—Unclassified IPv4 control packets.
  - **control-v6**—Unclassified IPv6 control packets.
  - **fw-host**—Unclassified send-to-host firewall packets.
  - **host-route-v4**—Unclassified IPv4 routing protocol and host packets in traffic sent to the router local interface address for broadcast and multicast.
  - **host-route-v6**—Unclassified IPv6 routing protocol and host packets in traffic sent to the router local interface address for broadcast and multicast.
  - **mcast-copy**—Unclassified host copy (due to multicast routing) packets.
  - **other**—All unclassified packets that do not belong to another type.
- **virtual-chassis**—The following packet types are available for virtual chassis packets:
  - **control-low**—Low-priority control packets.
  - **control-high**—High-priority control packets.
  - **unclassified**—All unclassified packets in the protocol group.
  - **vc-packets**—All exception packets on the virtual chassis link.
  - **vc-ttl-errors**—Virtual chassis TTL error packets.

***protocol-group***—Name of the protocol group for which traffic is policed. You can configure a policer for any of the following protocol groups:

- **amtv4**—IPv4 AMT traffic.
- **amtv6**—IPv6 AMT traffic.
- **ancp**—ANCP traffic.
- **ancpv6**—ANCPv6 traffic.
- **arp**—ARP traffic.
- **atm**—ATM traffic.
- **bfd**—BFD traffic.
- **bfdv6**—BFDv6 traffic.
- **bgp**—BGP traffic.
- **bgpv6**—BGPv6 traffic.
- **control**—Control traffic.
- **demux-autosense**—Demux autosensing traffic.
- **dhcpv4**—DHCPv4 traffic.
- **dhcpv6**—DHCPv6 traffic.
- **diameter**—Diameter and Gx-Plus traffic.
- **dns**—DNS traffic.
- **dtcp**—DTCP traffic.
- **dynamic-vlan**—Dynamic VLAN exception traffic.
- **egpv6**—EGPv6 traffic.
- **eoam**—EOAM traffic.
- **esmc**—ESMC traffic.
- **fab-probe**—Fab out probe packets.
- **filter-action**—IPv4 and IPv6 firewall filter action packets sent to the host because of reject terms in firewall filters
- **firewall-host**—Firewall send-to-host traffic.
- **frame-relay**—Frame relay traffic.
- **ftp**—FTP traffic.
- **ftpv6**—FTPv6 traffic.
- **gre**—GRE traffic.
- **icmp**—ICMP traffic.
- **igmp**—IGMP traffic
- **igmpv4v6**—IGMP v4/v6 traffic.

- **igmpv6**—IGMPv6 traffic.
- **inline-ka**—Inline service interfaces keepalive traffic.
- **inline-svcs**—Inline services traffic.
- **ip-fragments**—IP fragments traffic.
- **ip-options**—IP traffic with IP packet header options.
- **isis**—IS-IS traffic.
- **jfm**—JFM traffic.
- **keepalive**—Keepalive traffic.
- **l2pt**—Layer 2 protocol tunneling traffic.
- **l2tp**—L2TP traffic.
- **lACP**—LACP traffic.
- **ldp**—LDP traffic.
- **ldpv6**—LDPv6 traffic.
- **lldp**—LLDP traffic.
- **lmp**—LMP traffic.
- **lmpv6**—LMPv6 traffic.
- **mac-host**—Layer 2 MAC send-to-host traffic.
- **mcast-snoop**—Control traffic for multicast snooping.
- **mlp**—MLP traffic.
- **msdp**—MSDP traffic.
- **msdpv6**—MSDPv6 traffic.
- **multicast-copy**—Host copy traffic due to multicast routing.
- **mvrp**—MVRP traffic.
- **ndpv6**—NDPv6 traffic.
- **ntp**—NTP traffic.
- **oam-lfm**—OAM-LFM traffic.
- **ospf**—OSPF traffic.
- **ospfv3v6**—OSPFv3/IPv6 traffic.
- **pfe-alive**—Packet Forwarding Engine keepalive traffic.
- **pim**—PIM traffic.
- **pimv6**—PIMv6 traffic.
- **pmvrp**—PMVRP traffic.
- **pos**—POS traffic.

- **ppp**—PPP traffic.
- **pppoe**—PPPoE traffic.
- **ptp**—PTP traffic.
- **pvstp**—PVSTP traffic.
- **radius**—RADIUS traffic.
- **redirect**—Traffic that triggers ICMP redirects.
- **reject**—Packets rejected by a next-hop forwarding decision.
- **rejectv6**—V6 packets rejected by a next-hop forwarding decision.
- **resolve**—Unclassified IPv4 and IPv6 resolve packets sent to the host because of a traffic request resolve action.
- **rip**—RIP traffic.
- **ripv6**—RIPv6 traffic.
- **rsvp**—RSVP traffic.
- **rsvpv6**—RSVPv6 traffic.
- **services**—Service traffic.
- **snmp**—SNMP traffic.
- **snmpv6**—SNMPv6 traffic.
- **ssh**—SSH traffic.
- **sshv6**—SSHv6 traffic.
- **stp**—STP traffic.
- **tacacs**—TACACS traffic.
- **tcp-flags**—Traffic with TCP flags.
- **telnet**—TELNET traffic.
- **telnetv6**—TELNETv6 traffic.
- **ttl**—TTL traffic.
- **tunnel-fragment**—Tunnel fragments traffic.
- **unclassified**—Unclassified traffic.
- **virtual-chassis**—Virtual chassis traffic.
- **vrrp**—VRRP traffic.
- **vrrpv6**—VRRPv6 traffic.

The remaining statements are explained separately.

|                                 |   |
|---------------------------------|---|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.        |
|                                 | admin-control—To add this statement to the configuration. |



**Related Documentation** • [Configuring DDoS Protection Policers for Individual Packet Types on page 51](#)

---

## recover-time (DDoS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>recover-time seconds;</code>   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">protocols</a> <i>protocol-group</i> (aggregate   <i>packet-type</i> )]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | (MX Series routers with only MPCs or T4000 Core Routers with only FPC5s) Configure how much time must pass since the last detected DDoS violation before the traffic is considered to have recovered from the attack and returned to normal. |
| <b>Options</b>                  | <b>seconds</b> —Period required for the traffic to recover.<br><b>Range:</b> 1 through 3600 seconds<br><b>Default:</b> 300   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | • <a href="#">Configuring DDoS Protection Policers for Individual Packet Types on page 51</a>  |

## subscriber (DDoS Flow Detection)

---

|                     |  |
|---------------------|--|
| Syntax              | <code>subscriber (flow-bandwidth   flow-control-mode   flow-detection-mode)</code>   |
| Hierarchy Level     | [edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-bandwidth</a> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-control</a> ],<br>[edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-detection</a> ]  |
| Release Information | Statement introduced in Junos OS Release 12.3.   |
| Description         | (MX Series routers with MPCs only) Configure flow bandwidth, flow control mode, or flow detection mode at the subscriber flow aggregation level for the packet type.   |
| Options             | <p><b>flow-bandwidth</b>—Specify the bandwidth for the flow at the subscriber level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-bandwidth</a>] hierarchy level.</p> <p><b>Default:</b> 100 packets per second</p> <p><b>Range:</b> 1 through 10,000 packets per second</p> <p><b>flow-control-mode</b>—Specify how traffic in the detected flow is controlled at the subscriber level. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-control</a>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>drop</b>—Drop all traffic in flow.</li><li>• <b>keep</b>—Keep all traffic in flow.</li><li>• <b>police</b>—Police the traffic to within its allowed bandwidth.</li></ul> <p><b>Default:</b> drop</p> <p><b>flow-detection-mode</b>—Specify how flow detection operates at the subscriber level when a DDoS protection policer has been violated. Available only at the [edit system ddos-protection protocols <i>protocol-group packet-type</i> <a href="#">flow-level-detection</a>] hierarchy level.</p> <ul style="list-style-type: none"><li>• <b>automatic</b>—Search flows at the subscriber level only when a DDoS policer is being violated and only until it is established that the flow causing the violation is not at this level. When the suspicious flow is not at this level, then the search moves to a coarser level of flow aggregation (logical interface). Flows at the subscriber level are subsequently not searched again until the policer is no longer violated at the coarser level.</li><li>• <b>off</b>—Disable flow detection at the subscriber level so that flows are never searched at this level.</li><li>• <b>on</b>—Search flows at the subscriber level, even when no DDoS protection policer is currently being violated. Monitoring continues at this level regardless of whether a suspect flow is identified at this level.</li></ul> <p><b>Default:</b> automatic</p> |

|                                 |  |
|---------------------------------|--|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Maximum Flow Bandwidth at Each Flow Aggregation Level on page 71</a></li><li>• <a href="#">Configuring How Traffic in a Culprit Flow Is Controlled at Each Flow Aggregation Level on page 71</a></li><li>• <a href="#">Configuring How Flow Detection Operates at Each Flow Aggregation Level on page 69</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

---

### timeout-active-flows (DDoS Flow Detection)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | timeout-active-flows;   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection protocols <i>protocol-group packet-type</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.  |
| <b>Description</b>              | (MX Series routers with MPCs only) Enable culprit flows for the packet type to time out according to the timeout period. The culprit flow is suppressed for the duration of the timeout period. When the period expires, the flow times out and is released from suppression. |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Timeout Period for a Culprit Flow on page 68</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul>  |

## traceoptions (DDoS)

---

|                            |  |
|----------------------------|--|
| <b>Syntax</b>              | <pre>traceoptions {<br/>    file <i>filename</i> &lt;files <i>number</i>&gt; &lt;match <i>regular-expression</i> &gt; &lt;size <i>maximum-file-size</i>&gt;<br/>    &lt;world-readable   no-world-readable&gt;;<br/>    flag <i>flag</i>;<br/>    level (all   error   info   notice   verbose   warning);<br/>    no-remote-trace;<br/>}</pre>  |
| <b>Hierarchy Level</b>     | [edit system <a href="#">ddos-protection</a> ]   |
| <b>Release Information</b> | Statement introduced in Junos OS Release 11.2.   |
| <b>Description</b>         | Define tracing operations for DDoS protection processes.   |
| <b>Options</b>             | <p><b>file <i>filename</i></b>—Name of the file to receive the output of the tracing operation. Enclose the filename within quotation marks. All files are placed in the directory <code>/var/log</code>.</p> <p><b>files <i>number</i></b>—(Optional) Maximum number of trace files to create before overwriting the oldest one. If you specify a maximum number of files, you also must specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 3 files</p> <p><b>flag <i>flag</i></b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements. You can include the following flags:</p> <ul style="list-style-type: none"><li>• <b>all</b>—Trace all operations.</li><li>• <b>config</b>—Trace processing of the DDoS configuration at an extensive level.</li><li>• <b>events</b>—Trace jddosd event processing; currently only exit events are traced.</li><li>• <b>gres</b>—Trace messages exchanged with the kernel and jddosd process that could affect.</li><li>• <b>init</b>—Trace jddosd initialization.</li><li>• <b>memory</b>—Trace memory management code. This flag is not currently supported.</li><li>• <b>protocol</b>—Trace DDoS protocol state processing. Only the violation state is currently traced.</li><li>• <b>rtsock</b>—Trace messages exchanged with the kernel and jddosd process.</li><li>• <b>signal</b>—Trace system signals that are passed to jddosd, such as SIGTERM.</li><li>• <b>state</b>—Trace state machine events. This flag is not currently supported.</li><li>• <b>timer</b>—Trace jddosd timer events.</li><li>• <b>ui</b>—Trace user interface processing. This flag is not currently supported.</li></ul> <p><b>level</b>—Level of tracing to perform. You can specify any of the following levels:</p> <ul style="list-style-type: none"><li>• <b>all</b>—Match all levels.</li></ul> |

- **error**—Match error conditions.
- **info**—Match informational messages.
- **notice**—Match notice messages about conditions requiring special handling.
- **verbose**—Match verbose messages.
- **warning**—Match warning messages.

**match *regular-expression***—(Optional) Refine the output to include lines that contain the regular expression.

**no-remote-trace**—Disable remote tracing.

**no-world-readable**—(Optional) Disable unrestricted file access.

**size *maximum-file-size***—(Optional) Maximum size of each trace file. By default, the number entered is treated as bytes. Alternatively, you can include a suffix to the number to indicate kilobytes (KB), megabytes (MB), or gigabytes (GB). If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

**Syntax:** *sizek* to specify KB, *sizem* to specify MB, or *sizeg* to specify GB

**Range:** 10,240 through 1,073,741,824

**world-readable**—(Optional) Enable unrestricted file access.

|                                 |   |
|---------------------------------|---|
| <b>Required Privilege Level</b> | trace—To view this statement in the configuration.  |
|                                 | trace-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Tracing DDoS Protection Operations on page 56</a></li></ul> |

## violation-report-rate (DDoS Flow Detection)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | violation-report-rate <i>report-rate</i> ;   |
| <b>Hierarchy Level</b>          | [edit system ddos-protection <a href="#">global</a> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.   |
| <b>Description</b>              | (MX Series routers with MPCs only) Limit the rate at which bandwidth violations (violation reports) are reported from an FPC to the Routing Engine, for all protocol groups and packet types on all line cards.                                    |
| <b>Options</b>                  | <b>report-rate</b> —Number of violations per second.<br><b>Range:</b> 1 through 50,000<br><b>Default:</b> 100  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Violation Reporting Rate for All Protocol Groups and Packet Types on page 67</a></li><li>• <a href="#">Configuring Flow Detection for DDoS Protection on page 65</a></li></ul> |

## CHAPTER 20

# Configuration Statements: IPsec and Digital Certificates

- [Security Services Configuration Statements on page 275](#)
- [algorithm \(Authentication Keychain\) on page 279](#)
- [algorithm \(Junos FIPS\) on page 279](#)
- [authentication \(Security IPsec\) on page 280](#)
- [authentication-algorithm \(Security IKE\) on page 281](#)
- [authentication-algorithm \(Security IPsec\) on page 281](#)
- [authentication-key-chains on page 282](#)
- [authentication-method on page 283](#)
- [auto-re-enrollment on page 284](#)
- [auxiliary-spi \(Security IPsec\) on page 285](#)
- [ca-identity on page 285](#)
- [ca-name on page 286](#)
- [ca-profile on page 287](#)
- [cache-size on page 288](#)
- [cache-timeout-negative on page 289](#)
- [certificate-id on page 290](#)
- [certificates on page 291](#)
- [certification-authority on page 292](#)
- [challenge-password on page 292](#)
- [crl \(Adaptive Services Interface\) on page 293](#)
- [crl \(Encryption Interface\) on page 294](#)
- [description \(Authentication Keychain\) on page 294](#)
- [description \(IKE policy\) on page 295](#)
- [dh-group on page 295](#)
- [direction \(Junos OS\) on page 296](#)
- [direction \(Junos-FIPS Software\) on page 297](#)

- [dynamic](#) on page 298
- [encoding](#) on page 299
- [encryption \(Junos OS\)](#) on page 300
- [encryption \(Junos-FIPS Software\)](#) on page 301
- [encryption-algorithm \(Security\)](#) on page 301
- [enrollment](#) on page 302
- [enrollment-retry](#) on page 303
- [enrollment-url](#) on page 303
- [file](#) on page 304
- [identity](#) on page 304
- [ike \(Security\)](#) on page 305
- [internal](#) on page 306
- [ipsec \(Security\)](#) on page 307
- [key \(Authentication Keychain\)](#) on page 309
- [key \(Junos FIPS\)](#) on page 310
- [key-chain \(Security\)](#) on page 311
- [ldap-url](#) on page 312
- [lifetime-seconds \(Security\)](#) on page 312
- [local](#) on page 313
- [local-certificate \(Security\)](#) on page 314
- [local-key-pair](#) on page 314
- [manual \(Junos OS\)](#) on page 315
- [manual \(Junos-FIPS Software\)](#) on page 316
- [maximum-certificates](#) on page 317
- [mode \(IKE\)](#) on page 318
- [mode \(IPsec\)](#) on page 319
- [options \(Security\)](#) on page 320
- [path-length](#) on page 321
- [perfect-forward-secrecy \(Security\)](#) on page 321
- [pki](#) on page 322
- [policy \(Security IKE\)](#) on page 323
- [policy \(Security IPsec\)](#) on page 324
- [pre-shared-key \(Security\)](#) on page 324
- [proposal \(Security IKE\)](#) on page 325
- [proposal \(Security IPsec\)](#) on page 325
- [proposals](#) on page 326
- [protocol \(Junos OS\)](#) on page 327



- [protocol \(Junos-FIPS Software\)](#) on page 328
- [re-enroll-trigger-time-percentage](#) on page 328
- [re-generate-keypair](#) on page 329
- [refresh-interval](#) on page 329
- [retry \(Adaptive Services Interface\)](#) on page 330
- [retry-interval](#) on page 330
- [revocation-check](#) on page 331
- [secret](#) on page 332
- [security-association \(Junos OS\)](#) on page 333
- [security-association \(Junos-FIPS Software\)](#) on page 334
- [spi \(Junos OS\)](#) on page 335
- [spi \(Junos-FIPS Software\)](#) on page 335
- [ssh-known-hosts](#) on page 336
- [start-time \(Authentication Key Transmission\)](#) on page 337
- [tolerance](#) on page 338
- [traceoptions](#) on page 339
- [url \(Security\)](#) on page 341
- [validity-period](#) on page 341
- [Security Services Configuration Statements](#) on page 342

---

## Security Services Configuration Statements

To configure security services, you can include the following configuration statements at the `[edit security]` hierarchy level:

```
[edit security]
authentication-key-chains {
  key-chain key-chain-name {
    key key {
      secret secret-data;
      start-time yyyy-mm-dd.hh:mm:ss;
    }
  }
}
certificates {
  cache-size bytes;
  cache-timeout-negative seconds;
  certification-authority ca-profile-name {
    ca-name ca-identity;
    crl file-name;
    encoding (binary | pem);
    enrollment-url url-name;
    file certificate-filename;
    ldap-url url-name;
  }
  enrollment-retry attempts;
```

```

local certificate-filename {
    certificate-key-string;
    load-key-file URL key-filename;
}
maximum-certificates number;
path-length certificate-path-length;
}
ike {
    proposal ike-proposal-name {
        authentication-algorithm (md5 | sha1);
        authentication-method (dsa-signatures | pre-shared-keys | rsa-signatures);
        description description;
        dh-group (group1 | group2);
        encryption-algorithm (3des-cbc | des-cbc | aes-128-cbc | aes-192-cbc | aes-256-cbc);
        lifetime-seconds seconds;
    }
    policy ike-peer-address {
        description description;
        encoding (binary | pem);
        identity identity-name;
        local-certificate certificate-filename;
        local-key-pair private-public-key-file;
        mode (aggressive | main);
        pre-shared-key (ascii-text key | hexadecimal key);
        proposals [ proposal-names ];
    }
}
ipsec {
    security-association {
        manual {
            direction (bidirectional | inbound | outbound) {
                protocol esp;
                spi spi-value;
                encryption {
                    algorithm 3des-cbc;
                    key ascii-text ascii-text-string;
                }
            }
        }
    }
}
proposal ipsec-proposal-name {
    authentication-algorithm (hmac-md5-96 | hmac-sha1-96);
    description description;
    encryption-algorithm (3des-cbc | des-cbc);
    lifetime-seconds seconds;
    protocol (ah | esp | bundle);
}
policy ipsec-policy-name {
    description description;
    perfect-forward-secrecy {
        keys (group1 | group2);
    }
    proposals [ proposal-names ];
}
security-association sa-name {
    description description;
}

```

```

dynamic {
    ipsec-policy policy-name;
    replay-window-size (32 | 64);
}
manual {
    direction (inbound | outbound | bidirectional) {
        authentication {
            algorithm (hmac-md5-96 | hmac-sha1-96);
            key (ascii-text key | hexadecimal key);
        }
        auxiliary-spi auxiliary-spi;
        encryption {
            algorithm (des-cbc | 3des-cbc);
            key (ascii-text key | hexadecimal key);
        }
        protocol (ah | esp | bundle);
        spi spi-value;
    }
}
mode (tunnel | transport);
}
}
pki {
    auto-re-enrollment {
        certificate-id {
            ca-profile ca-profile-name;
            challenge-password password;
            re-enroll-trigger-time-percentage percentage;
            re-generate-keypair;
            validity-period days;
        }
    }
    ca-profile ca-profile-name {
        ca-identity ca-identity;
        enrollment {
            url url-name;
            retry number-of-attempts;
            retry-interval seconds;
        }
        revocation-check {
            disable;
            crl {
                disable on-download-failure;
                refresh-interval number-of-hours;
                url {
                    url-name;
                    password;
                }
            }
        }
    }
}
traceoptions {
    file filename <files number> <match regular-expression> <size maximum-file-size>
    <world-readable | no-world-readable>;
    flag flag;
}

```

```
}
ssh-known-hosts {
  host {
    dsa-key key;
    rsa-key key;
    rsa1-key key;
  }
}
traceoptions {
  file filename <files number> < size size>;
  flag all;
  flag database;
  flag general;
  flag ike;
  flag parse;
  flag policy-manager;
  flag routing-socket;
  flag timer;
}
```



**NOTE:** Most of the configuration statements do not have default values. If you do not specify an identifier for a statement that does not have a default value, you cannot commit the configuration.

For information about IP Security (IPsec) monitoring and troubleshooting, see the [CLI Explorer](#).

---

**Related  
Documentation**

- [Security Services Configuration Statements on page 342](#)

## algorithm (Authentication Keychain)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | algorithm (hmac-sha-1   md5);   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> key <i>key</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.<br>Statement introduced in Junos OS Release 11.3 for the QFX Series.   |
| <b>Description</b>              | Configure the authentication algorithm for IS-IS.   |
| <b>Options</b>                  | <b>hmac-sha-1</b> —96-bit hash-based message authentication code (SHA-1).<br><b>md5</b> —Message digest 5.<br><b>Default:</b> md5   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li> <li>• <i>Understanding Hitless Authentication Key Rollover for IS-IS</i></li> </ul> |

## algorithm (Junos FIPS)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | algorithm 3des-cbc;   |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual direction encryption]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Select the encryption algorithm for the internal Routing-Engine-to-Routing-Engine IPsec security association (SA) configuration.  |
| <b>Options</b>                  | Only 3des-cbc is supported.   |
| <b>Required Privilege Level</b> | Crypto Officer—To add and view this statement in the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li> <li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li> </ul> |

## authentication (Security IPsec)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>authentication {<br/>  algorithm (hmac-md5-96   hmac-sha1-96);<br/>  key (ascii-text key   hexadecimal key);<br/>}</pre>   |
| <b>Hierarchy Level</b>          | [edit security ipsec security-association <i>sa-name</i> manual direction (inbound   outbound   bi-directional)]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Configure IP Security (IPsec) authentication parameters for manual security association (SA).   |
| <b>Options</b>                  | <p><b>algorithm</b>—Hash algorithm that authenticates packet data. It can be one of the following:</p> <ul style="list-style-type: none"><li>• <b>hmac-md5-96</b>—Produces a 128-bit digest.</li><li>• <b>hmac-sha1-96</b>—Produces a 160-bit digest.</li></ul> <p><b>key</b>—Type of authentication key. It can be one of the following:</p> <ul style="list-style-type: none"><li>• <b>ascii-text key</b>—ASCII text key. For <b>hmac-md5-96</b>, the key is 16 ASCII characters; for <b>hmac-sha1-96</b>, the key is 20 ASCII characters.</li><li>• <b>hexadecimal key</b>—Hexadecimal key. For <b>hmac-md5-96</b>, the key is 32 hexadecimal characters; for <b>hmac-sha1-96</b>, the key is 40 hexadecimal characters.</li></ul> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li></ul>  |

## authentication-algorithm (Security IKE)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | authentication-algorithm (md5   sha1);   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">proposal</a> <i>ike-proposal-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure the Internet Key Exchange (IKE) authentication algorithm.  |
| <b>Options</b>                  | <p><b>authentication-algorithm</b>—Hash algorithm that authenticates packet data. It can be one of two algorithms:</p> <ul style="list-style-type: none"> <li>• <b>md5</b>—Produces a 128-bit digest.</li> <li>• <b>sha1</b>—Produces a 160-bit digest.</li> </ul> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Authentication Algorithm for an IKE Proposal on page 185</a></li> </ul>   |

## authentication-algorithm (Security IPsec)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | authentication-algorithm (hmac-md5-96   hmac-sha1-96);   |
| <b>Hierarchy Level</b>          | [edit security ipsec proposal <i>ipsec-proposal-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure the IPsec authentication algorithm.  |
| <b>Options</b>                  | <p><b>authentication-algorithm</b>—Hash algorithm that authenticates packet data. It can be one of two algorithms:</p> <ul style="list-style-type: none"> <li>• <b>hmac-md5-96</b>—Produces a 128-bit digest.</li> <li>• <b>hmac-sha1-96</b>—Produces a 160-bit digest.</li> </ul> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Authentication Algorithm for an IPsec Proposal on page 190</a></li> </ul>   |

## authentication-key-chains

---

|                          |   |
|--------------------------|---|
| Syntax                   | <pre>authentication-key-chains {<br/>  key-chain key-chain-name {<br/>    description text-string;<br/>    key key {<br/>      algorithm (md5   hmac-sha-1);<br/>      options (basic   isis-enhanced);<br/>      secret secret-data;<br/>      start-time yyyy-mm-dd.hh:mm:ss;<br/>    }<br/>    tolerance seconds;<br/>  }<br/>}</pre>  |
| Hierarchy Level          | [edit security]   |
| Release Information      | <p>Statement introduced in Junos OS Release 7.6.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.</p> <p>Support for IS-IS introduced in JUNOS OS Release 11.2.</p> <p>Statement introduced in Junos OS Release 11.3 for the QFX Series.</p>  |
| Description              | <p>Configure authentication key updates for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol. When the <b>authentication-key-chains</b> statement is configured at the <b>[edit security]</b> hierarchy level, and is associated with the BGP, LDP, or IS-IS protocols at the <b>[edit protocols]</b> hierarchy level or with the BFD protocol using the <b>bfd-liveness-detection</b> statement, authentication key updates can occur without interrupting routing and signaling protocols such as Open Shortest Path First (OSPF) and Resource Reservation Setup Protocol (RSVP).</p> <p>The remaining statements are explained separately.</p> |
| Required Privilege Level | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| Related Documentation    | <ul style="list-style-type: none"><li>• <i>Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</i></li><li>• <i>Example: Configuring BFD Authentication for Static Routes</i></li><li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li></ul>   |



## authentication-method

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | authentication-method (dsa-signatures   pre-shared-keys   rsa-signatures);   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">proposal</a> <i>ike-proposal-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure the IKE authentication method.   |
| <b>Options</b>                  | <p><b>dsa-signatures</b>—Digital Signature Algorithm (DSA)</p> <p><b>rsa-signatures</b>—A public key algorithm, which supports encryption and digital signatures</p> <p><b>pre-shared-keys</b>—A key derived from an out-of-band mechanism; the key authenticates the exchange</p> |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li></ul>   |

## auto-re-enrollment

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>auto-re-enrollment {<br/>  certificate-id {<br/>    ca-profile <i>ca-profile-name</i>;<br/>    challenge-password <i>password</i>;<br/>    re-enroll-trigger-time-percentage <i>percentage</i>;<br/>    re-generate-keypair;<br/>    validity-period <i>days</i>;<br/>  }<br/>}</pre>   |
| <b>Hierarchy Level</b>          | [edit security pki]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.  |
| <b>Description</b>              | Specify auto-reenrollment parameters for a certificate authority (CA) issued router certificate. Auto-reenrollment requests that the issuing CA replace a router certificate before its specified expiration date.   |
| <b>Options</b>                  | The remaining statements are explained separately.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li><li>• <a href="#">Configuring Digital Certificates for Adaptive Services Interfaces on page 21</a></li></ul> |

## auxiliary-spi (Security IPsec)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>auxiliary-spi <i>auxiliary-spi-value</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security ipsec security-association <i>sa-name</i> manual <b>direction</b> (inbound   outbound   bi-directional)]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure the auxiliary Security Parameter Index (SPI) for a manual SA. Use the auxiliary SPI when you configure the <b>protocol</b> statement to use the <b>bundle</b> option.                          |
| <b>Options</b>                  | <p><b><i>auxiliary-spi-value</i></b>—Arbitrary value that uniquely identifies which SA to use at the receiving host (the destination address in the packet).</p> <p><b>Range:</b> 256 through 16,639</p> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li> <li>• <a href="#">spi on page 335</a></li> </ul>                  |

## ca-identity

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>ca-identity <i>ca-identity</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit security <b>pki</b> <b>ca-profile</b> <i>ca-profile-name</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | Specify the certificate authority (CA) identity to use in requesting digital certificates for J Series Services Routers and Adaptive Services (AS) and MultiServices PICs installed in M Series and T Series routers. |
| <b>Options</b>                  | <b><i>ca-identity</i></b> —The name of the CA identity. This name is typically the domain name of the CA.   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying the CA Profile Name on page 23</a></li> </ul>   |

## ca-name

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>ca-name <i>ca-identity</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security certificates <a href="#">certification-authority</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Specify the certificate authority (CA) identity to use in the certificate request.                      |
| <b>Options</b>                  | <i>ca-identity</i> —CA identity to use in the certificate request.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Certificate Authority Name on page 16</a></li></ul>   |

## ca-profile

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> ca-profile <i>ca-profile-name</i> {   <i>ca-identity</i> <i>ca-identity</i>;   enrollment {     url <i>url-name</i>;     retry <i>number-of-enrollment-attempts</i>;     retry-interval <i>seconds</i>;   }   revocation-check {     disable:     <i>crl</i> {       disable on-download-failure;       refresh-interval <i>number-of-hours</i>;       url {         url-name;         password;       }     }   } } </pre> |
| <b>Hierarchy Level</b>          | [edit security <b>pki</b> ]   |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 7.5.</p> <p><b>revocation-check</b> and <b>crl</b> statements added in Junos OS Release 8.1.</p>  |
| <b>Description</b>              | <p>Specify the name of the certificate authority (CA) profile for J Series Services Routers and Adaptive Services (AS) and MultiServices PICs installed on M Series and T Series routers.</p> <p>The remaining statements are explained separately.</p>   |
| <b>Options</b>                  | <b>ca-profile-name</b> —Name of the trusted CA.   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Specifying the CA Profile Name on page 23</a></li> </ul>   |

## cache-size

---

|                            |  |
|----------------------------|--|
| <b>Syntax</b>              | cache-size <i>bytes</i> ;  |
| <b>Hierarchy Level</b>     | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>         | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure the cache size for digital certificates.  |
| <b>Options</b>             | <b>bytes</b> —Cache size for digital certificates.<br><b>Range:</b> 64 through 4,294,967,295<br><b>Default:</b> 2 megabytes (MB)   |




**NOTE:** We recommend that you limit your cache size to 4 MB.

---

|                                 |  |
|---------------------------------|--|
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Cache Size on page 18</a></li></ul>        |

## cache-timeout-negative

|  |  |
|--|--|
| <b>Syntax</b>  | cache-timeout-negative <i>seconds</i> ;  |
| <b>Hierarchy Level</b>   | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>   | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>   | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure a negative cache for digital certificates.  |
| <b>Options</b>   | <b>seconds</b> —Negative time to cache digital certificates, in seconds.<br><b>Range:</b> 10 through 4,294,967,295<br><b>Default:</b> 20   |
| <div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p><b>CAUTION:</b> Configuring a large negative cache value can lead to a denial-of-service attack.</p> </div> </div> |  |
| <b>Required Privilege Level</b>  | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration   |
| <b>Related Documentation</b>   | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Negative Cache on page 18</a></li> </ul>  |

## certificate-id

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>certificate-id {<br/>  <a href="#">ca-profile</a> <i>ca-profile-name</i>;<br/>  <a href="#">challenge-password</a> <i>password</i>;<br/>  <a href="#">re-enroll-trigger-time-percentage</a> <i>percentage</i>;<br/>  <a href="#">re-generate-keypair</a>;<br/>  <a href="#">validity-period</a> <i>days</i>;<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit security <a href="#">auto-re-enrollment</a> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.   |
| <b>Description</b>              | Specify a router certificate for auto-reenrollment. The ID is the same as that used to get the end entity's certificate from the issuing certificate authority.   |
| <b>Options</b>                  | The remaining statements are explained separately.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li><li>• <a href="#">auto-re-enrollment on page 284</a></li></ul>  |



## certificates

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> certificates {   cache-size bytes;   cache-timeout-negative seconds;   certification-authority ca-profile-name {     ca-name ca-identity;     crt file-name;     encoding (binary   pem);     enrollment-url url-name;     file certificate-filename;     ldap-url url-name;   }   enrollment-retry attempts;   local certificate-name {     certificate-key-string;     load-key-file URL filename;   }   maximum-certificates number;   path-length certificate-path-length; } </pre> |
| <b>Hierarchy Level</b>          | [edit security]   |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p>   |
| <b>Description</b>              | <p>(Encryption interface on M Series and T Series routers and EX Series switches only)</p> <p>Configure the digital certificates for IPsec.</p> <p>The remaining statements are explained separately.</p>   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Digital Certificates for an ES PIC on page 15</a></li> </ul>   |

## certification-authority

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>certification-authority <i>ca-profile-name</i> {<br/>    <i>ca-name</i> <i>ca-identity</i>;<br/>    <i>crl</i> <i>file-name</i>;<br/>    <i>encoding</i> (binary   pem);<br/>    <i>enrollment-url</i> <i>url-name</i>;<br/>    <i>file</i> <i>certificate-filename</i>;<br/>    <i>ldap-url</i> <i>url-name</i>;<br/>}</code> |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.   |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure a certificate authority profile name.<br><br>The remaining statements are explained separately.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Certificate Authority Properties for an ES PIC on page 16</a></li></ul>  |

## challenge-password

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>challenge-password <i>password</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security pki auto-re-enrollment certificate-id]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.  |
| <b>Description</b>              | Specify the challenge password used by the certificate authority (CA) for router certificate enrollment and revocation. This challenge password must be the same used when the router certificate was originally configured.                   |
| <b>Options</b>                  | <i>password</i> —The password required by the CA.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li><li>• <a href="#">auto-re-enrollment on page 284</a></li></ul> |

## crl (Adaptive Services Interface)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> crl {   disable on-download-failure;   refresh-interval <i>number-of-hours</i>;   url {     <i>url-name</i>;     password;   } } </pre>   |
| <b>Hierarchy Level</b>          | [edit security <b>pki</b> <i>ca-profile</i> <i>ca-profile-name</i> revocation-check]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.   |
| <b>Description</b>              | Configure the certificate revocation list (CRL). A CRL is a time-stamped list identifying revoked certificates, which is signed by a CA and made available to the participating IPsec peers on a regular periodic basis.  |
| <b>Options</b>                  | <p><b>disable on-download-failure</b>—Permit the authentication of the IPsec peer when the CRL is not downloaded.</p> <p><b>password</b>—Password to access the URLs.</p> <p><b>refresh-interval <i>number-of-hours</i></b>—Time interval, in hours, between CRL updates.<br/> <b>Range:</b> 0 through 8784<br/> <b>Default:</b> 24</p> <p><b>url <i>url-name</i></b>—Location from which to retrieve the CRL through the Lightweight Directory Access Protocol (LDAP). You can configure as many as three URLs for each configured CA profile.</p> |
| <b>Required Privilege Level</b> | <p><b>admin</b>—To view this statement in the configuration.</p> <p><b>admin-control</b>—To add this statement to the configuration</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Certificate Revocation List on page 24</a></li> </ul>  |

## crl (Encryption Interface)

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>crl <i>file-name</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure the certificate revocation list (CRL). A CRL is a time-stamped list identifying revoked certificates, which is signed by a CA and made available to the participating IPsec peers on a regular periodic basis. |
| <b>Options</b>                  | <i>file-name</i> —Specify the file from which to read the CRL.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Certificate Authority Properties for an ES PIC on page 16</a></li></ul>   |

## description (Authentication Keychain)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>description <i>text-string</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.6.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Support for the BFD protocol introduced in Junos OS Release 9.6.<br>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.<br>Support for IS-IS introduced in JUNOS OS Release 11.2. |
| <b>Description</b>              | Configure a description for an authentication key-chain.   |
| <b>Options</b>                  | <i>text-string</i> —A text string describing the <b>authentication-key-chain</b> . Put the text string in quotes ("text description").   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</a></li><li>• <a href="#">Example: Configuring BFD Authentication for Static Routes</a></li><li>• <a href="#">Example: Configuring Hitless Authentication Key Rollover for IS-IS</a></li></ul>       |

## description (IKE policy)

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>description <i>description</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit security ike <b>policy</b> <i>ike-peer-address</i> ],<br>[edit security ike <b>proposal</b> <i>ike-proposal-name</i> ],<br>[edit security ipsec <b>policy</b> <i>ipsec-policy-name</i> ],<br>[edit security ipsec <b>proposal</b> <i>ipsec-proposal-name</i> ],<br>[edit security ipsec <b>security-association</b> <i>sa-name</i> ]  |
| <b>Description</b>              | Specify a text description for an IKE proposal or policy, or an IPsec proposal, policy, or SA.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Security Associations for IPsec on an ES PIC on page 173</a></li> <li>• <a href="#">Configuring the Description for an IKE Proposal on page 186</a></li> <li>• <a href="#">Configuring the Description for an IKE Policy on page 188</a></li> <li>• <a href="#">Configuring an IPsec Proposal for an ES PIC on page 190</a></li> <li>• <a href="#">Configuring the IPsec Policy for an ES PIC on page 192</a></li> </ul> |

## dh-group

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>dh-group (group1   group2);</code>  |
| <b>Hierarchy Level</b>          | [edit security ike <b>proposal</b> <i>ike-proposal-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Configure the IKE Diffie-Hellman group.   |
| <b>Options</b>                  | <b>dh-group</b> —Type of Diffie-Hellman prime modulus group when performing the new Diffie-Hellman exchange. It can be one of the following: <ul style="list-style-type: none"> <li>• <b>group1</b>—768-bit.</li> <li>• <b>group2</b>—1024-bit.</li> <li>• <b>group5</b>—1536-bit.</li> <li>• <b>group14</b>—2048-bit.</li> </ul> |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Diffie-Hellman Group for an IKE Proposal on page 186</a></li> </ul>  |

## direction (Junos OS)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>direction (inbound   outbound   bidirectional) {<br/>  authentication {<br/>    algorithm (hmac-md5-96   hmac-sha1-96);<br/>    key (ascii-text key   hexadecimal key);<br/>  }<br/>  auxiliary-spi auxiliary-spi-value;<br/>  encryption {<br/>    algorithm (des-cbc   3des-cbc);<br/>    key (ascii-text key   hexadecimal key);<br/>  }<br/>  protocol (ah   esp   bundle);<br/>  spi spi-value;<br/>}</pre>  |
| <b>Hierarchy Level</b>          | [edit security ipsec security-association <i>sa-name</i> <a href="#">manual</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define the direction of IPsec processing.  |
| <b>Options</b>                  | <p><b>inbound</b>—Inbound SA—Define algorithms, keys, or security parameter index (SPI) values to decrypt and authenticate incoming traffic coming from the peer.</p> <p><b>outbound</b>—Outbound SA—Define algorithms, keys, or SPI values to decrypt and authenticate outbound traffic to the peer.</p> <p><b>bidirectional</b>—Bidirectional SA—Decrypt and authenticate the incoming and outgoing traffic using the same algorithm, keys, or SPI in both directions, unlike inbound and outbound SAs that use different attributes in both directions.</p> <p>The remaining statements are explained separately.</p> |
| <b>Required Privilege Level</b> | <p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li><li>• <i>Example: Using IPsec to Protect BGP Traffic</i></li></ul>  |

## direction (Junos-FIPS Software)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre> direction (bidirectional   inbound   outbound) {   protocol esp;   spi spi-value;   encryption {     algorithm 3des-cbc;     key ascii-text <i>ascii-text-string</i>;   } }</pre>  |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual],<br>[edit security trusted-channel ipsec security-association manual]   |
| <b>Description</b>              | Establish a manual security association (SA) for internal Routing-Engine-to-Routing-Engine communication.  |
| <b>Options</b>                  | <p><b>bidirectional</b>—Apply the same SA values in both directions between Routing Engines.</p> <p><b>inbound</b>—Apply these SA properties only to the inbound IPsec tunnel.</p> <p><b>outbound</b>—Apply these SA properties only to the outbound IPsec tunnel.</p> <p>The remaining statements are explained separately.</p> |
| <b>Required Privilege Level</b> | Crypto Officer—To view and add this statement in the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li> <li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li> </ul>  |

## dynamic

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>dynamic {<br/>  ipsec-policy <i>ipsec-policy-name</i>;<br/>  replay-window-size (32   64);<br/>}</pre>  |
| <b>Hierarchy Level</b>          | [edit security ipsec <a href="#">security-association name</a> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define a dynamic IPsec SA.   |
| <b>Options</b>                  | <p><b>ipsec-policy <i>ipsec-policy-name</i></b>—Name of the IPsec policy.</p> <p><b>replay-window-size</b>—(Optional) Antireplay window size. It can be one of the following values:</p> <ul style="list-style-type: none"><li>• <b>32</b>—32-packet window size.</li><li>• <b>64</b>—64-packet window size.</li></ul> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Dynamic IPsec Security Associations on page 179</a></li><li>• <a href="#">Associating the Configured Security Association with a Logical Interface on page 21</a></li></ul>  |




## encoding

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | encoding (binary   pem);   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">policy ike-peer-address</a> ],<br>[edit security certificates <a href="#">certification-authority ca-profile-name</a> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.                           |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Specify the file format used for the <b>local-certificate</b> and <b>local-key-pair</b> statements.                               |
| <b>Options</b>                  | <b>binary</b> —Binary file format.<br><br><b>pem</b> —Privacy-enhanced mail (PEM), an ASCII base 64 encoded format.<br><b>Default:</b> binary  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Type of Encoding Your CA Supports on page 17</a></li> <li>• <a href="#">Configuring the Type of Encoding Your CA Supports on page 20</a></li> </ul> |

## encryption (Junos OS)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre> encryption {   algorithm (des-cbc   3des-cbc);   key (ascii-text key   hexadecimal key); } </pre>  |
| <b>Hierarchy Level</b>          | [edit security ipsec security-association <i>sa-name</i> manual <b>direction</b> (inbound   outbound   bidirectional)]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure an encryption algorithm and key for manual SA.   |
| <b>Options</b>                  | <p><b>algorithm</b>—Type of encryption algorithm. It can be one of the following:</p> <ul style="list-style-type: none"> <li><b>des-cbc</b>—Has a block size of 8 bytes (64 bits); its key size is 48 bits long.</li> <li><b>3des-cbc</b>—Has block size of 8 bytes (64 bits); its key size is 192 bits long.</li> </ul>   |
|                                 | <p> <b>NOTE:</b> For <b>3des-cbc</b>, we recommend that the first 8 bytes be different from the second 8 bytes, and the second 8 bytes be the same as the third 8 bytes.</p>   |
|                                 | <p><b>key</b>—Type of encryption key. It can be one of the following:</p> <ul style="list-style-type: none"> <li><b>ascii-text</b>—ASCII text key. For the <b>des-cbc</b> option, the key contains 8 ASCII characters; for <b>3des-cbc</b>, the key contains 24 ASCII characters.</li> <li><b>hexadecimal</b>—Hexadecimal key. For the <b>des-cbc</b> option, the key contains 16 hexadecimal characters; for the <b>3des-cbc</b> option, the key contains 48 hexadecimal characters.</li> </ul> |
| <b>Required Privilege Level</b> | <p><b>system</b>—To view this statement in the configuration.</p> <p><b>system-control</b>—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><i>Example: Using IPsec to Protect BGP Traffic</i></li> <li><a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li> </ul>   |

## encryption (Junos-FIPS Software)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> encryption {   algorithm 3des-cbc;   key ascii-text <i>ascii-text-string</i>; } </pre>  |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual direction]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Define the encryption parameters for internal Routing-Engine-to-Routing-Engine communication. The remaining statements are explained separately.  |
| <b>Required Privilege Level</b> | Crypto Officer—To view and add this statement in the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li> <li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li> </ul> |

## encryption-algorithm (Security)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | encryption-algorithm (3des-cbc   des-cbc   aes-128-cbc   aes-192-cbc   aes-256-cbc);   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">proposal</a> <i>ike-proposal-name</i> ],<br>[edit security ipsec <a href="#">proposal</a> <i>ipsec-proposal-name</i> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure an IKE or IPsec encryption algorithm.  |
| <b>Options</b>                  | <p><b>3des-cbc</b>—Encryption algorithm with key size of 24 bytes; its key size is 192 bits long.</p> <p><b>des-cbc</b>—Encryption algorithm with key size of 8 bytes; its key size is 48 bits long.</p> <p><b>aes-128-cbc</b>—Advanced encryption algorithm that has a key size of 16 bytes; its key size is 128 bits long.</p> <p><b>aes-192-cbc</b>—Advanced encryption algorithm that has a key size of 24 bytes; its key size is 192 bits long.</p> <p><b>aes-256-cbc</b>—Advanced encryption algorithm that has a key size of 32 bytes; its key size is 256 bits long.</p> |
| <b>Required Privilege Level</b> | <p>security—To view this statement in the configuration.</p> <p>security-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an IKE Proposal for Dynamic SAs on page 185</a></li> <li>• <a href="#">Configuring an IPsec Proposal for an ES PIC on page 190</a></li> </ul>   |

## enrollment

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>enrollment {<br/>  url <i>url-name</i>;<br/>  retry <i>number-of-enrollment-attempts</i>;<br/>  retry-interval <i>seconds</i>;<br/>}</pre>  |
| <b>Hierarchy Level</b>          | [edit security <b>pki</b> <b>ca-profile</b> <i>ca-profile-name</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Specify the URL and enrollment parameters of the certificate authority (CA) for J Series Services Routers and Adaptive Services (AS) and MultiServices PICs installed on M Series and T Series routers.  |
| <b>Options</b>                  | <p><b>url</b> <i>url-name</i>—Location of the CA to which the router sends the Simple Certificate Enrollment Protocol-based (SCEP-based) certificate enrollment requests for the configured CA profile. Use the CA host DNS name or IP address.</p> <p><b>retry</b> <i>number-of-enrollment-attempts</i>—Number of enrollment retries.<br/><b>Range:</b> 0 through 100<br/><b>Default:</b> 0</p> <p><b>retry-interval</b> <i>seconds</i>—Length of time, in seconds, that a router should wait between enrollment attempts.<br/><b>Range:</b> 0 through 3600<br/><b>Default:</b> 0</p> |
| <b>Required Privilege Level</b> | <p><b>admin</b>—To view this statement in the configuration.</p> <p><b>admin-control</b>—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying an Enrollment URL on page 23</a></li><li>• <a href="#">Specifying the Enrollment Properties on page 24</a></li></ul>  |

## enrollment-retry

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>enrollment-retry <i>attempts</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Specify how many times a router or switch can resend a digital certificate request. |
| <b>Options</b>                  | <i>attempts</i> —Number of enrollment retries.<br><b>Range:</b> 0 through 100<br><b>Default:</b> 0   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Number of Enrollment Retries on page 18</a></li> </ul>  |

## enrollment-url

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>enrollment-url <i>url-name</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit security certificates <a href="#">certification-authority</a> <i>ca-profile-name</i> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Specify where your router or switch sends Simple Certificate Enrollment Protocol-based (SCEP-based) certificate enrollment requests (certificate authority URL). |
| <b>Options</b>                  | <i>url-name</i> —Certificate authority URL.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Enrollment URL on page 17</a></li> </ul>   |

## file

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>file <i>certificate-filename</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security certificates <a href="#">certification-authority</a> <i>ca-profile-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Specify the file from which to read the digital certificate.  |
| <b>Options</b>                  | <i>certificate-filename</i> —File from which to read the digital certificate.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying a File to Read the Digital Certificate on page 17</a></li></ul>   |

## identity

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>identity <i>identity-name</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security <a href="#">ike</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Define the identity of the remote certificate name if the identity cannot be learned through IKE (ID payload or IP address).                |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Identity to Define the Remote Certificate Name on page 20</a></li></ul> |

## ike (Security)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre> ike {     policy <i>ike-peer-address</i> {         description <i>policy-description</i>;         encoding (binary   pem);         identity <i>identity-name</i>;         local-certificate <i>certificate-filename</i>;         local-key-pair <i>private-public-key-file</i>;         mode (aggressive   main);         pre-shared-key (ascii-text <i>key</i>   hexadecimal <i>key</i>);         proposals [ <i>proposal-names</i> ];     }     proposal <i>ike-proposal-name</i> {         authentication-algorithm (md5   sha1);         authentication-method (dsa-signatures   pre-shared-keys   rsa-signatures);         dh-group (group1   group2);         encryption-algorithm (3des-cbc   des-cbc);         lifetime-seconds <i>seconds</i>;     } } </pre> |
| <b>Hierarchy Level</b>          | [edit security]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers only) Configure IKE.  |
| <b>Options</b>                  | The remaining statements are explained separately.   |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an IKE Proposal for Dynamic SAs on page 185</a></li> <li>• <a href="#">Configuring an IKE Policy for Preshared Keys on page 187</a></li> </ul>  |

## internal

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**Syntax**

```
internal {
  security-association {
    manual {
      direction (bidirectional | inbound | outbound) {
        protocol esp;
        spi spi-value;
        encryption {
          algorithm 3des-cbc;
          key ascii-text ascii-text-string;
        }
      }
    }
  }
}
```

**Hierarchy Level** [edit security ipsec]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description** (Junos-FIPS only) Define an internal security association (SA) for internal Routing-Engine-to-Routing-Engine communication.

**Options** The remaining statements are explained separately.

**Required Privilege Level** Crypto Officer—To view and add this statement in the configuration.

**Related Documentation**

- [Configuring Internal IPsec for Junos-FIPS on page 194](#)
- *Secure Configuration Guide for Common Criteria and Junos-FIPS*



## ipsec (Security)

```
Syntax  ipsec {
    security-association {
        manual {
            direction (bidirectional | inbound | outbound) {
                protocol esp;
                spi spi-value;
                encryption {
                    algorithm 3des-cbc;
                    key ascii-text ascii-text-string;
                }
            }
        }
    }
    policy ipsec-policy-name {
        perfect-forward-secrecy {
            keys (group1 | group2);
        }
        proposals [ proposal-names ];
    }
    proposal ipsec-proposal-name {
        authentication-algorithm (hmac-md5-96 | hmac-sha1-96);
        encryption-algorithm (3des-cbc | des-cbc);
        lifetime-seconds seconds;
        protocol (ah | esp | bundle);
    }
    security-association name {
        dynamic {
            ipsec-policy policy-name;
            replay-window-size (32 | 64);
        }
        manual {
            direction (inbound | outbound | bi-directional) {
                authentication {
                    algorithm (hmac-md5-96 | hmac-sha1-96);
                    key (ascii-text key | hexadecimal key);
                }
                auxiliary-spi auxiliary-spi-value;
                encryption {
                    algorithm (des-cbc | 3des-cbc);
                    key (ascii-text key | hexadecimal key);
                }
                protocol (ah | esp | bundle);
                spi spi-value;
            }
        }
        mode (tunnel | transport);
    }
    traceoptions {
        file <files number> < size size>;
        flag all;
        flag database;
        flag general;
    }
}
```

```
    flag ike;  
    flag parse;  
    flag policy-manager;  
    flag routing-socket;  
    flag timer;  
  }  
}
```

|                                 |  |
|---------------------------------|--|
| <b>Hierarchy Level</b>          | [edit security]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers only) Configure IPsec.  |
| <b>Options</b>                  | The remaining statements are explained separately.   |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Security Associations for IPsec on an ES PIC on page 173</a></li></ul> |

## key (Authentication Keychain)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>key key {   algorithm (md5   hmac-sha-1);   options (basic   isis-enhanced);   secret secret-data;   start-time yyyy-mm-dd.hh:mm:ss; }</pre>   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> ]  |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 7.6.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.</p> <p>Support for IS-IS introduced in JUNOS OS Release 11.2.</p> <p>Statement introduced in Junos OS Release 11.3 for QFX Series switches.</p> |
| <b>Description</b>              | Configure the authentication element.   |
| <b>Options</b>                  | <p><b>key</b>—Each key within a keychain is identified by a unique integer value.</p> <p><b>Range:</b> 0 through 63</p> <p>The remaining statements are explained separately.</p>   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</i></li> <li>• <i>Example: Configuring BFD Authentication for Static Routes</i></li> <li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li> </ul>   |

## key (Junos FIPS)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>key ascii-text <i>ascii-text-string</i>;</code>  |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual direction encryption]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | The key used for the internal Routing-Engine-to-Routing-Engine IPsec security association (SA) configuration.  |
| <b>Options</b>                  | Only ascii-text is supported.<br><br><i>ascii-text-string</i> —The encrypted ASCII text key.   |
| <b>Required Privilege Level</b> | Crypto Officer—To add and view this statement in the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li><li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li></ul> |

## key-chain (Security)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>keychain <i>key-chain-name</i> {   <b>description</b> <i>text-string</i>;   <b>key</b> <i>key</i> {     <b>algorithm</b> (md5   hmac-sha-1);     <b>options</b> (basic   isis-enhanced);     <b>secret</b> <i>secret-data</i>;     <b>start-time</b> <i>yyyy-mm-dd.hh:mm:ss</i>;   }   <b>tolerance</b> <i>seconds</i>; }</pre>   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains]  |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 7.6.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.</p> <p>Support for IS-IS introduced in Junos OS Release 11.2.</p> <p>Statement introduced in Junos OS Release 11.3 for the QFX Series.</p> |
| <b>Description</b>              | Create the key-chain configuration for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol.   |
| <b>Options</b>                  | <b>key-chain-name</b> —Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (" ").   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">authentication-key-chains on page 282</a></li> <li>• <i>Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</i></li> <li>• <i>Example: Configuring BFD Authentication for Static Routes</i></li> <li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li> </ul>   |

## ldap-url

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <ldap-url <i>url-name</i> >;   |
| <b>Hierarchy Level</b>          | [edit security certificates <a href="#">certification-authority</a> <i>ca-profile-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>(Optional) Specify the Lightweight Directory Access Protocol (LDAP) URL for digital certificates.       |
| <b>Options</b>                  | <i>url-name</i> —Name of the LDAP URL.   |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying an LDAP URL on page 17</a></li></ul>  |

## lifetime-seconds (Security)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <lifetime-seconds <i>seconds</i> >;   |
| <b>Hierarchy Level</b>          | [edit security ike proposal <i>ike-proposal-name</i> ],<br>[edit security ipsec proposal <i>ipsec-proposal-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | (Optional) Configure the lifetime of IKE or IPsec SA. When the SA expires, it is replaced by a new SA (and SPI) or terminated.  |
| <b>Options</b>                  | <i>seconds</i> —Lifetime, in seconds.<br><b>Range:</b> 180 through 86,400   |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Lifetime for an IKE SA on page 187</a></li><li>• <a href="#">Configuring the Lifetime for an IPsec SA on page 191</a></li></ul> |

## local

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>local <i>certificate-name</i> {     <i>certificate-key-string</i>;     load-key-file <i>URL filename</i>; }</pre>   |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p>  |
| <b>Description</b>              | Import a paired X.509 private key and authentication certificate, to enable Junos XML protocol client applications to establish Secure Sockets Layer (SSL) connections to the router or switch.  |
| <b>Options</b>                  | <p><b><i>certificate-name</i><i>certificate-key-string</i></b>—String of alphanumeric characters that constitute the private key and certificate.</p> <p><b><i>certificate-name</i></b>—Name that uniquely identifies the certificate.</p> <p><b><i>load-key-file URL filename</i></b>—File that contains the private key and certificate. It can be one of two types of values:</p> <ul style="list-style-type: none"> <li>• Pathname of a file on the local disk (assuming you have already used another method to copy the certificate file to the router's or switch's local disk)</li> <li>• URL to the certificate file location (for instance, on the computer where the Junos XML protocol client application runs)</li> </ul> |
| <b>Required Privilege Level</b> | <p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Importing SSL Certificates for Junos XML Protocol Support on page 5</a></li> </ul>  |

## local-certificate (Security)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>local-certificate <i>certificate-filename</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">policy</a> <i>ike-peer-address</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Configure the certificate filename from which to read the local certificate.                                      |
| <b>Options</b>                  | <b><i>certificate-filename</i></b> —File from which to read the local certificate.                                |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Certificate Filename on page 20</a></li></ul>  |

## local-key-pair

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>local-key-pair <i>private-public-key-file</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">policy</a> <i>ike-peer-address</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos 7.4.  |
| <b>Description</b>              | Specify private and public keys.  |
| <b>Options</b>                  | <b><i>private-public-key-file</i></b> —Specify the file from which to read the private and public key pair.             |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Private and Public Key File on page 20</a></li></ul> |



## manual (Junos OS)

---

```
Syntax  manual {
        direction (inbound | outbound | bi-directional) {
            authentication {
                algorithm (hmac-md5-96 | hmac-sha1-96);
                key (ascii-text key | hexadecimal key);
            }
            auxiliary-spi auxiliary-spi-value;
            encryption {
                algorithm (des-cbc | 3des-cbc);
                key (ascii-text key | hexadecimal key);
            }
            protocol (ah | esp | bundle);
            spi spi-value;
        }
    }
```

**Hierarchy Level** [edit security ipsec [security-association](#)]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description** Define a manual IPsec SA.

**Options** The remaining statements are explained separately.

**Required Privilege Level** admin—To view this statement in the configuration.  
admin-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring Manual IPsec Security Associations for an ES PIC on page 175](#)

## manual (Junos-FIPS Software)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>manual {<br/>  direction (bidirectional   inbound   outbound) {<br/>    protocol esp;<br/>    spi spi-value;<br/>    encryption {<br/>      algorithm 3des-cbc;<br/>      key ascii-text ascii-text-string;<br/>    }<br/>  }<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define a manual security association (SA) for internal Routing Engine-to-Routing Engine communication.   |
| <b>Options</b>                  | The remaining statements are explained separately.   |
| <b>Required Privilege Level</b> | Crypto Officer—To view and add this statement in the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li><li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li></ul>   |


## maximum-certificates

---


|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>maximum-certificates <i>number</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure the maximum number of peer digital certificates to be cached.                                 |
| <b>Options</b>                  | <b><i>number</i></b> —Maximum number of peer digital certificates to be cached.<br><b>Range:</b> 64 through 4,294,967,295 peer certificates<br><b>Default:</b> 1024 peer certificates          |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Maximum Number of Peer Certificates on page 19</a></li></ul>   |

## mode (IKE)

---

|   |  |
|---|--|
| <b>Syntax</b>   | mode (aggressive   main);  |
| <b>Hierarchy Level</b>  | [edit security ike <a href="#">policy</a> <i>ike-peer-address</i> ]  |
| <b>Release Information</b>  | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>  | Define the IKE policy mode.  |
| <div> <b>NOTE:</b> IKEv2 protocol does not negotiate using mode configuration.</div> |  |
| <b>Default</b>  | main   |
| <b>Options</b>  | <p><b>aggressive</b>—Take half the number of messages of main mode, has less negotiation power, and does not provide identity protection.</p> <p><b>main</b>—Use six messages, in three peer-to-peer exchanges, to establish the IKE SA. These three steps include the IKE SA negotiation, a Diffie-Hellman exchange, and authentication of the peer. Also provides identity protection.</p> |
| <b>Required Privilege Level</b>   | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>  | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Mode for an IKE Policy on page 188</a></li></ul>   |

## mode (IPsec)

|   |  |
|---|--|
| <b>Syntax</b>   | mode (transport   tunnel);   |
| <b>Hierarchy Level</b>  | [edit security ipsec <a href="#">security-association name</a> ]   |
| <b>Release Information</b>  | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>  | Define the mode for the IPsec security association.  |
| <b>Default</b>  | tunnel   |
| <b>Options</b>  | <p><b>transport</b>—Protect traffic when the communication endpoint and cryptographic endpoint are the same. The data portion of the IP packet is encrypted, but the IP header is not. Virtual Private Network (VPN) gateways that provide encryption and decryption services for protected hosts cannot use transport mode for protected VPN communications.</p> <p><b>tunnel</b>—Protect traffic using preshared keys with IKE to authenticate peers or digital certificates with IKE to authenticate peers.</p> |
| <div>  <p><b>NOTE:</b> The Junos OS supports only encapsulating security payload (ESP) when you use tunnel mode.</p> <p>In transport mode, the Junos OS does not support authentication header (AH) and ESP header bundles.</p> <p>In transport mode, the Junos OS supports only Border Gateway Protocol (BGP).</p> </div> |  |
| <b>Required Privilege Level</b>   | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>  | <ul style="list-style-type: none"> <li>• <i>Example: Using IPsec to Protect BGP Traffic</i></li> <li>• <a href="#">Configuring IPsec Tunnel Mode on page 175</a></li> </ul>  |

## options (Security)

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | options (basic   isis-enhanced);  |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> key <i>key</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2.<br>Statement introduced in Junos OS Release 11.3 for the QFX Series.   |
| <b>Description</b>              | <p>For IS-IS only, configure the protocol transmission encoding format for encoding the message authentication code in routing protocol packets.</p> <p>Because this setting is for IS-IS only, the TCP and the BFD protocol ignore the encoding option configured in the key.</p>  |
| <b>Options</b>                  | <p><b>basic</b>—RFC 5304 based encoding. Junos OS sends and receives RFC 5304-encoded routing protocols packets, and drops 5310-encoded routing protocol packets that are received from other devices.</p> <p><b>isis-enhanced</b>—RFC 5310 based encoding. Junos OS sends RFC 5310-encoded routing protocol packets and accepts both RFC 5304-encoded and RFC 5310-encoded routing protocol packets that are received from other devices.</p> <p><b>Default:</b> basic</p> |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li><li>• <i>Understanding Hitless Authentication Key Rollover for IS-IS</i></li></ul>  |

## path-length

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>path-length <i>certificate-path-length</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security <a href="#">certificates</a> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series. |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Configure the digital certificate path length.  |
| <b>Options</b>                  | <b><i>certificate-path-length</i></b> —Digital certificate path length.<br><b>Range:</b> 2 through 15 certificates<br><b>Default:</b> 15 certificates  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Path Length for the Certificate Hierarchy on page 19</a></li> </ul>   |

## perfect-forward-secrecy (Security)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>perfect-forward-secrecy {<br/>    keys (group1   group2);<br/>}</code>   |
| <b>Hierarchy Level</b>          | [edit security ipsec <a href="#">policy</a> <i>ipsec-policy-name</i> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define the Perfect Forward Secrecy (PFS) protocol. Create single-use keys.   |
| <b>Options</b>                  | <b>keys</b> —Type of Diffie-Hellman prime modulus group that IKE uses when performing the new Diffie-Hellman exchange.<br><br>The key can be one of the following: <ul style="list-style-type: none"> <li>• <b>group1</b>—768-bit.</li> <li>• <b>group2</b>—1024-bit.</li> </ul> |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Perfect Forward Secrecy on page 193</a></li> </ul>  |

## pki

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> pki {   auto-re-enrollment {     certificate-id {       ca-profile <i>ca-profile-name</i>;       challenge-password <i>password</i>;       re-enroll-trigger-time-percentage <i>percentage</i>;       re-generate-keypair;       validity-period <i>days</i>;     }   }   ca-profile <i>ca-profile-name</i> {     ca-identity <i>ca-identity</i>;     enrollment {       url <i>url-name</i>;       retry <i>number-of-enrollment-attempts</i>;       retry-interval <i>seconds</i>;     }     revocation-check {       disable;       crl {         disable on-download-failure;         refresh-interval <i>hours</i>;         url {           url-name;           password;         }       }     }   }   traceoptions {     file <i>filename</i> &lt;files <i>number</i>&gt; &lt;match <i>regular-expression</i>&gt; &lt;size <i>maximum-file-size</i>&gt;     &lt;world-readable   no-world-readable&gt;;     flag <i>flag</i>;   } } </pre> |
| <b>Hierarchy Level</b>          | [edit security]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.<br><b>revocation-check</b> and <b>crl</b> statements added in Junos OS Release 8.1.   |
| <b>Description</b>              | Configure an IPsec profile to request digital certificates for J Series Services Routers and Adaptive Services (AS) and MultiServices PICs installed in M Series and T Series routers.  |
| <b>Options</b>                  | The remaining statements are explained separately.  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Configuring Digital Certificates for Adaptive Services Interfaces on page 21</a></li> </ul>  |



- [Junos OS, Release 14.1](#)
- [CLI Explorer](#)

## policy (Security IKE)

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|                          |  |
|--------------------------|--|
| Syntax                   | <pre>policy <i>ike-peer-address</i> {<br/>  <b>description</b> <i>policy-description</i>;<br/>  <b>encoding</b> (binary   pem);<br/>  <b>identity</b> <i>identity-name</i>;<br/>  <b>local-certificate</b> <i>certificate-filename</i>;<br/>  <b>local-key-pair</b> <i>private-public-key-file</i>;<br/>  <b>mode</b> (aggressive   main);<br/>  <b>pre-shared-key</b> (ascii-text <i>key</i>   hexadecimal <i>key</i>);<br/>  <b>proposals</b> [ <i>proposal-names</i> ];<br/>}</pre> |
| Hierarchy Level          | [edit security <a href="#">ike</a> ]   |
| Release Information      | Statement introduced before Junos OS Release 7.4.  |
| Description              | Define an IKE policy.  |
| Options                  | <p><b><i>ike-peer-address</i></b>—A tunnel address configured at the [edit interfaces <a href="#">es</a>] hierarchy level.</p> <p>The remaining statements are explained separately.</p>   |
| Required Privilege Level | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an IKE Policy for Preshared Keys on page 187</a></li><li>• <a href="#">Configuring an IKE Policy for Digital Certificates for an ES PIC on page 19</a></li></ul>   |

## policy (Security IPsec)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>policy <i>ipsec-policy-name</i> {<br/>  description <i>description</i>;<br/>    perfect-forward-secrecy {<br/>      keys (group1   group 14   group2   group 5);<br/>    }<br/>  proposals [ <i>proposal-names</i> ];<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit security <a href="#">ipsec</a> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define an IPsec policy.  |
| <b>Options</b>                  | <p><i>ipsec-policy-name</i>—Specify an IPsec policy name.</p> <p>The remaining statements are explained separately.</p>  |
| <b>Required Privilege Level</b> | <p>security—To view this statement in the configuration.</p> <p>security-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the IPsec Policy for an ES PIC on page 192</a></li></ul>   |

## pre-shared-key (Security)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>pre-shared-key (ascii-text <i>key</i>   hexadecimal <i>key</i>);</pre>  |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">policy</a> <i>ike-peer-address</i> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure the key used to authenticate a dynamic peer during IKE phase 1 negotiation. Specify the key in either ASCII or hexadecimal format. |
| <b>Options</b>                  | <p><i>ascii-text key</i>—Authentication key in ASCII format.</p> <p><i>hexadecimal key</i>—Authentication key in hexadecimal format.</p>     |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Preshared Key for an IKE Policy on page 188</a></li></ul>                |

## proposal (Security IKE)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>proposal <i>ike-proposal-name</i> {     authentication-algorithm (md5   sha1   sha-256);     authentication-method (dsa-signatures   pre-shared-keys   rsa-signatures);     description <i>description</i>;     dh-group (group1   group2   group 5   group14);     encryption-algorithm <i>algorithm</i>;     lifetime-seconds <i>seconds</i>; }</pre> |
| <b>Hierarchy Level</b>          | [edit security <a href="#">ike</a> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Define an IKE proposal for a dynamic SA.   |
| <b>Options</b>                  | <p><i>ike-proposal-name</i>—Specify an IKE proposal name.</p> <p>The remaining statements are explained separately.</p>  |
| <b>Required Privilege Level</b> | <p>security—To view this statement in the configuration.</p> <p>security-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an IKE Proposal for Dynamic SAs on page 185</a></li> </ul>  |

## proposal (Security IPsec)

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>proposal <i>ipsec-proposal-name</i> {     authentication-algorithm (hmac-md5-96   hmac-sha1-96);     encryption-algorithm <i>algorithm</i>;     lifetime-seconds <i>seconds</i>;     protocol (ah   bundle   esp); }</pre> |
| <b>Hierarchy Level</b>          | [edit security ipsec]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Define an IPsec proposal for a dynamic SA.  |
| <b>Options</b>                  | <p><i>ipsec-proposal-name</i>—Specify an IPsec proposal name.</p> <p>The remaining statements are explained separately.</p>   |
| <b>Required Privilege Level</b> | <p>security—To view this statement in the configuration.</p> <p>security-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an IPsec Proposal for an ES PIC on page 190</a></li> </ul>   |

## proposals

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>proposals [ <i>proposal-names</i> ];</code>   |
| <b>Hierarchy Level</b>          | [edit security ike <a href="#">policy</a> <i>ike-peer-address</i> ],<br>[edit security ipsec <a href="#">policy</a> <i>ipsec-policy-name</i> ]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Associate one or more proposals with an IKE or IPsec policy.  |
| <b>Options</b>                  | <i>proposal-names</i> —Name of one or more proposals.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Associating Proposals with an IKE Policy on page 189</a></li><li>• <a href="#">Configuring the IPsec Policy for an ES PIC on page 192</a></li></ul> |

## protocol (Junos OS)

|                            |   |
|----------------------------|---|
| <b>Syntax</b>              | <code>protocol (ah   esp   bundle);</code>  |
| <b>Hierarchy Level</b>     | [ <code>edit security ipsec <a href="#">proposal</a> <i>ipsec-proposal-name</i></code> ],<br>[ <code>edit security ipsec security-association <i>sa-name</i> manual <a href="#">direction</a> (inbound   outbound   bidirectional)</code> ] |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>         | Define the IPsec protocol for a manual or dynamic SA.   |



**NOTE:** The Junos OS supports only encapsulating security payload (ESP) when you use tunnel mode.

In transport mode, the Junos OS does not support authentication header (AH) and ESP header bundles.

In transport mode, the Junos OS supports only Border Gateway Protocol (BGP).

|                                 |  |
|---------------------------------|--|
| <b>Options</b>                  | <p><b>ah</b>—Authentication Header protocol</p> <p><b>bundle</b>—AH and ESP protocols</p> <p><b>esp</b>—ESP protocol (the <b>tunnel</b> statement must be included at the [<code>edit security ipsec security-association <i>sa-name</i> mode</code> hierarchy level])</p>                                 |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Example: Using IPsec to Protect BGP Traffic</a></li> <li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li> <li>• <a href="#">Configuring the Protocol for a Dynamic IPsec SA on page 192</a></li> </ul> |

## protocol (Junos-FIPS Software)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | protocol esp;  |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual direction]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | The protocol used for the internal Routing-Engine-to-Routing-Engine IPsec security association (SA) configuration.   |
| <b>Options</b>                  | Only <b>esp</b> is supported.  |
| <b>Required Privilege Level</b> | Crypto Officer—To add and view this statement in the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li><li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li></ul> |

## re-enroll-trigger-time-percentage

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | re-enroll-trigger-time-percentage <i>percentage</i> ;  |
| <b>Hierarchy Level</b>          | [edit security <b>pki auto-re-enrollment certificate-id</b> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.  |
| <b>Description</b>              | Percentage of the router certificate <b>validity-period</b> statement value, in days, when auto-reenrollment should start before expiration.   |
| <b>Options</b>                  | <b>percentage</b> —Percentage for the reenroll trigger time.<br><b>Range:</b> 1 through 99   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li><li>• <a href="#">auto-re-enrollment on page 284</a></li></ul> |

## re-generate-keypair

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <re-generate-keypair>;  |
| <b>Hierarchy Level</b>          | [edit security pki auto-re-enrollment certificate-id]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.   |
| <b>Description</b>              | (Optional) Automatically generate a new key pair when auto-reenrolling a router certificate. If this statement is not configured, the current key pair is used.   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li> <li>• <a href="#">auto-re-enrollment on page 284</a></li> </ul> |

## refresh-interval

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | refresh-interval <i>hours</i> ;   |
| <b>Hierarchy Level</b>          | [edit security pki ca-profile <i>ca-profile-name</i> revocation-check <i>crl</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.   |
| <b>Description</b>              | (Adaptive services interfaces only) Specify the amount of time between certificate revocation list (CRL) updates.   |
| <b>Options</b>                  | <p><i>number-of-hours</i>—Time interval, in hours, between CRL updates.</p> <p><b>Range:</b> 0 through 8784</p> <p><b>Default:</b> 24</p>                             |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Certificate Revocation List on page 24</a></li> <li>• <a href="#">crl on page 293</a></li> </ul> |

## retry (Adaptive Services Interface)

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>retry number-of-attempts;</code>   |
| <b>Hierarchy Level</b>          | [edit security pki ca-profile <i>ca-profile-name</i> enrollment]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | (Adaptive services interfaces only) Specify how many times a router can resend a digital certificate request.  |
| <b>Options</b>                  | <i>number-of-attempts</i> —Number of enrollment retries.<br><b>Range:</b> 0 through 100<br><b>Default:</b> 0   |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Enrollment Properties on page 24</a></li><li>• <a href="#">enrollment on page 302</a></li></ul> |

## retry-interval

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>retry-interval seconds;</code>   |
| <b>Hierarchy Level</b>          | [edit security pki ca-profile <i>ca-profile-name</i> enrollment]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | (Adaptive services interfaces only) Specify the amount of time the router should wait between enrollment retries.  |
| <b>Options</b>                  | <i>seconds</i> —Time interval, in seconds, between enrollment retries.<br><b>Range:</b> 0 through 3600<br><b>Default:</b> 0  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Enrollment Properties on page 24</a></li><li>• <a href="#">enrollment on page 302</a></li></ul> |



## revocation-check

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre> revocation-check {   disable;   <b>crl</b> {     refresh-interval <i>number-of-hours</i>;     url {       <i>url-name</i>;     }   } } </pre>   |
| <b>Hierarchy Level</b>          | [edit security pki ca-profile <i>ca-profile-name</i> ]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.   |
| <b>Description</b>              | Specify the method to verify revocation status of digital certificates for J Series Services Routers and Adaptive Services (AS) and MultiServices PICs installed in M Series and T Series routers.  |
| <b>Options</b>                  | <p><b>disable</b>—Disable verification of status of digital certificates.</p> <p><b>crl</b>—Only certificate revocation list (CRL) is supported. A CRL is a time-stamped list identifying revoked certificates, which is signed by a CA and made available to the participating IPsec peers on a regular periodic basis. By default, <b>crl</b> is enabled.</p> <p>The remaining statements are explained separately.</p> |
| <b>Required Privilege Level</b> | <p><b>admin</b>—To view this statement in the configuration.</p> <p><b>admin-control</b>—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Certificate Revocation List on page 24</a></li> </ul>  |

## secret

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>secret <i>secret-data</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> key <i>key</i> ]   |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 7.6.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.</p> <p>Support for IS-IS introduced in JUNOS OS Release 11.2.</p> <p>Statement introduced in Junos OS Release 11.3 for QFX Series switches.</p> |
| <b>Description</b>              | Specify a password in encrypted text or plain text format. The secret password always appears in encrypted format.  |
| <b>Options</b>                  | <b><i>secret-data</i></b> —Password to use; it can include spaces if the character string is enclosed in quotation marks.   |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</i></li><li>• <i>Example: Configuring BFD Authentication for Static Routes</i></li><li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li></ul>   |

## security-association (Junos OS)


|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre> security-association <i>sa-name</i> {   dynamic {     ipsec-policy <i>policy-name</i>;     replay-window-size (32   64);   }   manual {     direction (inbound   outbound   bi-directional) {       authentication {         algorithm (hmac-md5-96   hmac-sha1-96);         key (ascii-text <i>key</i>   hexadecimal <i>key</i>);       }       auxiliary-spi <i>auxiliary-spi-value</i>;       encryption {         algorithm (des-cbc   3des-cbc);         key (ascii-text <i>key</i>   hexadecimal <i>key</i>);       }       protocol ( ah   esp   bundle);       spi <i>spi-value</i>;     }     mode (tunnel   transport);   } } </pre> |
| <b>Hierarchy Level</b>          | [edit security ipsec]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Configure an IPsec security association.   |
| <b>Options</b>                  | <p><b><i>sa-name</i></b>—Name of the security association.</p> <p>The remaining statements are explained separately.</p>   |
| <b>Required Privilege Level</b> | <p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Security Associations for IPsec on an ES PIC on page 173</a></li> </ul>   |

## security-association (Junos-FIPS Software)

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|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <pre>security-association {<br/>  manual {<br/>    direction (bidirectional   inbound   outbound) {<br/>      protocol esp;<br/>      spi spi-value;<br/>      encryption {<br/>        algorithm 3des-cbc;<br/>        key ascii-text ascii-text-string;<br/>      }<br/>    }<br/>  }<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit security ipsec internal]  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | Define a security association (SA) for internal Routing-Engine-to-Routing-Engine communication.   |
| <b>Options</b>                  | The remaining statements are explained separately.  |
| <b>Required Privilege Level</b> | Crypto Officer—To view and add this statement in the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li><li>• <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i></li></ul>  |

## spi (Junos OS)

|   |   |
|---|---|
| <b>Syntax</b>   | <code>spi spi-value;</code>   |
| <b>Hierarchy Level</b>  | [edit security ipsec security-association <i>sa-name</i> manual <b>direction</b> (inbound   outbound   bi-directional)]   |
| <b>Release Information</b>  | Statement introduced before Junos OS Release 7.4.   |
| <b>Description</b>  | Configure the security parameter index (SPI) for a security association (SA).   |
| <b>Options</b>  | <p><b>spi-value</b>—An arbitrary value that uniquely identifies which SA to use at the receiving host (the destination address in the packet).</p> <p><b>Range:</b> 256 through 16639</p>                           |
| <div>  <b>NOTE:</b> Use the auxiliary SPI when you configure the protocol statement to use the bundle option. </div> |   |
| <b>Required Privilege Level</b>   | <p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>  |
| <b>Related Documentation</b>  | <ul style="list-style-type: none"> <li>• <a href="#">Example: Using IPsec to Protect BGP Traffic</a></li> <li>• <a href="#">Configuring Manual IPsec Security Associations for an ES PIC on page 175</a></li> </ul> |

## spi (Junos-FIPS Software)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>spi spi-value;</code>  |
| <b>Hierarchy Level</b>          | [edit security ipsec internal security-association manual <b>direction</b> ]   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | The security parameter index (SPI) value used for the internal Routing Engine-to-Routing Engine IPsec security association (SA) configuration.   |
| <b>Options</b>                  | <p><b>spi-value</b>—Integer to use for this SPI.</p> <p><b>Range:</b> 256 through 16639</p>  |
| <b>Required Privilege Level</b> | Crypto Officer—To add and view this statement in the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Internal IPsec for Junos-FIPS on page 194</a></li> <li>• <a href="#">Secure Configuration Guide for Common Criteria and Junos-FIPS</a></li> </ul> |

## ssh-known-hosts

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|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <pre>ssh-known-hosts {<br/>  host <i>host-name</i> {<br/>    dsa-key <i>key</i>;<br/>    fetch-from-server <i>hostname</i>;<br/>    load-key-file <i>URL filename</i>;<br/>    rsa-key <i>key</i>;<br/>    rsa1-key <i>key</i>;<br/>  }<br/>}</pre>  |
| <b>Hierarchy Level</b>          | [edit security ssh-known-hosts]  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Configure SSH support for known hosts and for administering SSH host key updates.  |
| <b>Options</b>                  | <p><b>host <i>host-name</i></b>—Hostname of the SSH known host entry. This option has the following suboptions:</p> <ul style="list-style-type: none"><li>• <b>dsa-key <i>key</i></b>—Base64 encoded Digital Signature Algorithm (DSA) key for SSH version 2.</li><li>• <b>fetch-from-server <i>host-name</i></b>—Retrieve SSH public host key information from a specified server.</li><li>• <b>load-key-file <i>filename</i></b>—Import SSH host key information from the <code>/var/tmp/ssh-known-hosts</code> file.</li><li>• <b>rsa-key <i>key</i></b>—Base64 encoded public key algorithm that supports encryption and digital signatures for SSH version 1 and SSH version 2.</li><li>• <b>rsa1-key <i>key</i></b>—Base64 encoded RSA public key algorithm, which supports encryption and digital signatures for SSH version 1.</li></ul> |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring SSH Host Keys for Secure Copying of Data on page 3</a></li></ul>   |

## start-time (Authentication Key Transmission)

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>start-time (now   yyyy-mm-dd.hh:mm:ss);</code>   |
| <b>Hierarchy Level</b>          | [edit security authentication-key-chains key-chain <i>key-chain-name</i> key <i>key</i> ]  |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 7.6.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6.</p> <p>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.</p> <p>Support for IS-IS introduced in JUNOS OS Release 11.2.</p> <p>Statement introduced in Junos OS Release 11.3 for QFX Series switches.</p>  |
| <b>Description</b>              | <p>Specify a start time for key transmission. You do not need to specify an end time for the key. If a new key is present with a new start time, the keychain rolls over to the new one. The start time must be unique within the keychain.</p>  |
| <b>Options</b>                  | <p><b>now</b>—Start time as the current year, month, day, hour, minute, and second.</p> <p><b>daydays</b>—Start time as the specified number of days after the current day. For example, if the current day is the 12th and you configure <b>start-time 2day</b>, the start time will be on the 14th, exactly two days after the configuration is entered.</p> <p><b>hourhours</b>—Start time as the specified number of hours after the current hour. For example, if the current hour is 9:00 and you configure <b>start-time 3hour</b>, the start time will be in 12:00, exactly three hours after the configuration is entered.</p> <p><b>minuteminutes</b>—Start time as the specified number of minutes after the current minute. For example, if the current minute is 27 minutes after the hour and you configure <b>start-time 5min</b>, the start time will be in 32 minutes after the hour, exactly five minutes after the configuration is entered.</p> <p><b>monthmonths</b>—Start time as the specified number of months after the current month. For example, if the current month is March and you configure <b>start-time 4month</b>, the start time will be in July, exactly four months after the configuration is entered.</p> <p><b>secondseconds</b>—Start time as the specified number of seconds after the current second. For example, if the current second is 10:20:40 and you configure <b>start-time 10seconds</b>, the start time will be 10:20:50, exactly 10 seconds after the configuration is entered.</p> <p><b>yearyears</b>—Start time as the specified number of years after the current year. For example, if the current year is 2011 and you configure <b>start-time 1year</b>, the start time will be in 2012, exactly one year after the configuration is entered.</p> <p><b>yyyy-mm-dd.hh:mm:ss</b>—Start time in UTC (Coordinated Universal Time). The start time must be unique within the keychain.</p> |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>   |

- Related Documentation**
- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
  - *Example: Configuring BFD Authentication for Static Routes*
  - *Example: Configuring BFD Authentication for Static Routes*
  - *Example: Configuring Hitless Authentication Key Rollover for IS-IS*

---


## tolerance

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>tolerance seconds;</code>  |
| <b>Hierarchy Level</b>          | <code>[edit security authentication-key-chains key-chain key-chain-name]</code>  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.6.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Support for the BFD protocol introduced in Junos OS Release 9.6.<br>Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.<br>Support for IS-IS introduced in JUNOS OS Release 11.2. |
| <b>Description</b>              | Configure the clock-skew tolerance for accepting keys for a key chain.   |
| <b>Options</b>                  | <b>seconds</b> —Number of seconds to accept for clock-skew.<br><b>Default:</b> 0 seconds<br><b>Range:</b> 0 through 999,999,999  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols</i></li><li>• <i>Example: Configuring BFD Authentication for Static Routes</i></li><li>• <i>Example: Configuring Hitless Authentication Key Rollover for IS-IS</i></li></ul>                                  |



## traceoptions

|   |  |
|---|--|
| <b>Syntax</b>   | <pre> traceoptions {     file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>size</i>&gt;;     flag all;     flag certificates;     flag database;     flag general;     flag ike;     flag parse;     flag policy-manager;     flag routing-socket;     flag timer;     level     no-remote-trace } </pre>   |
| <b>Hierarchy Level</b>  | <p>[edit security],<br/>[edit services ipsec-vpn]</p> <p>Trace options can be configured at either the [edit security] or the [edit services ipsec-vpn] hierarchy level, but not at both levels.</p>   |
| <b>Release Information</b>  | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p>  |
| <b>Description</b>  | <p>Configure security trace options.</p> <p>To specify more than one trace option, include multiple <b>flag</b> statements. Trace option output is recorded in the <code>/var/log/kmd</code> file.</p>   |
| <div style="display: flex; align-items: center;">  <p><b>NOTE:</b> The <code>traceoptions</code> statement is not supported on QFabric systems.</p> </div> |  |
| <b>Options</b>  | <p><b>files <i>number</i></b>—(Optional) Maximum number of trace files. When a trace file (for example, <b>kmd</b>) reaches its maximum size, it is renamed <b>kmd.0</b>, then <b>kmd.1</b>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p>If you specify a maximum number of files, you must also specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000 files</p> <p><b>Default:</b> 0 files</p> <p><b>size <i>size</i></b>—(Optional) Maximum size of each trace file, in kilobytes (KB). When a trace file (for example, <b>kmd</b>) reaches this size, it is renamed, <b>kmd.0</b>, then <b>kmd.1</b> and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p><b>Default:</b> 1024 KB</p> |

**flag *flag***—Trace operation to perform. To specify more than one trace operation, include multiple **flag** statements.

- **all**—Trace all security events.
- **certificates**—Trace certificate events.
- **database**—Trace database events.
- **general**—Trace general events.
- **ike**—Trace IKE module processing.
- **parse**—Trace configuration processing.
- **policy-manager**—Trace policy manager processing.
- **routing-socket**—Trace routing socket messages.
- **timer**—Trace internal timer events.

**level *level***—(Optional) Set traceoptions level.

- **all**—match all levels.
- **error**—Match error conditions.
- **info**—Match informational messages.
- **notice**—Match conditions that should be handled specially.
- **verbose**—Match verbose messages.
- **warning**—Match warning messages.

**no-remote-trace**—(Optional) Disable remote tracing

|                           |   |
|---------------------------|---|
| <b>Required Privilege</b> | admin—To view the configuration.                          |
| <b>Level</b>              | admin-control—To add this statement to the configuration. |

|                              |  |
|------------------------------|--|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <a href="#">Configuring Tracing Operations for Security Services on page 231</a></li></ul> |
|------------------------------|--|

## url (Security)

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>url <i>url-name</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security pki ca-profile <i>ca-profile-name</i> enrollment],<br>[edit security pki ca-profile <i>ca-profile-name</i> revocation-check <i>crl</i> ]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | (Adaptive services interfaces only) Specify the certificate authority (CA) URL to use in requesting digital certificates or the URL for the Lightweight Access Directory Protocol (LDAP) location from which retrieve the certificate revocation list (CRL).          |
| <b>Options</b>                  | <i>url-name</i> —URL of CA or URL of LDAP location of CRL.  |
| <b>Required Privilege Level</b> | admin—To view the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Enrollment URL on page 23</a></li> <li>• <a href="#">Specifying an LDAP URL on page 24</a></li> <li>• <a href="#">crl on page 293</a></li> <li>• <a href="#">enrollment on page 302</a></li> </ul> |

## validity-period

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>validity-period <i>days</i>;</code>   |
| <b>Hierarchy Level</b>          | [edit security pki auto-re-enrollment certificate-id]   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.   |
| <b>Description</b>              | Certificate validity period, in days, from the enrollment start date. If not specified, the issuing certificate authority (CA) sets this time as per its own policy. The start time is when auto-reenrollment is initiated.                       |
| <b>Options</b>                  | <i>days</i> —Number of days that the certificate is valid.<br><b>Range:</b> 1 through 4095 days<br><b>Default:</b> Per CA policy  |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Auto-Reenrollment Properties for Automatic Renewal of the Router Certificate from the CA on page 27</a></li> <li>• <a href="#">auto-re-enrollment on page 284</a></li> </ul> |

## Security Services Configuration Statements

The following table lists the security services configuration statements available at the **[edit security]** hierarchy level:

**Table 10: Security Services Configuration Statements**

| A-C                                       | D-G                                   | H-M                           | N-R                                 | S-Z  |
|---|---------------------------------------|-------------------------------|-------------------------------------|--|
| algorithm (Authentication Keychain)       | description (Authentication Keychain) | identity                      | options (Security)                  | secret                                       |
| algorithm (Junos FIPS)                    | description (IKE policy)              | ike                           | path-length                         | security-association (Junos OS)              |
| authentication (Security IPsec)           | dh-group                              | internal                      | perfect-forward-secrecy (Security)  | security-association (Junos-FIPS Software)   |
| authentication-algorithm (Security IKE)   | direction (Junos OS)                  | ipsec (Security)              | pki                                 | spi (Junos OS)                               |
| authentication-algorithm (Security IPsec) | direction (Junos-FIPS Software)       | key (Authentication Keychain) | policy (Security IKE)               | spi (Junos-FIPS Software)                    |
| authentication-key-chains                 | dynamic                               | key (Junos FIPS)              | policy (Security IPsec)             | ssh-known-hosts                              |
| authentication-method                     | encoding                              | key-chain (Security)          | pre-shared-key (Security)           | start-time (Authentication Key Transmission) |
| auto-re-enrollment                        | encryption (Junos OS)                 | ldap-url                      | proposal (Security IKE)             | tolerance                                    |
| auxiliary-spi                             | encryption (Junos-FIPS Software)      | lifetime-seconds (Security)   | proposal (Security IPsec)           | traceoptions                                 |
| ca-identity                               | encryption-algorithm                  | local                         | proposals                           | url  |
| ca-name                                   | enrollment                            | local-certificate (Security)  | protocol (Junos OS)                 | validity-period                              |
| ca-profile                                | enrollment-retry                      | local-key-pair                | protocol (Junos-FIPS Software)      |  |
| cache-size                                | enrollment-url                        | manual (Junos OS)             | re-enroll-trigger-time-percentage   |  |
| cache-timeout-negative                    | file                                  | manual (Junos-FIPS Software)  | re-generate-keypair                 |  |
| certificate-id                            |                                       | maximum-certificates          | refresh-interval                    |  |
| certificates                              |                                       | mode (IKE)                    | retry (Adaptive Services Interface) |  |

Table 10: Security Services Configuration Statements *(continued)*

| A-C                               | D-G | H-M          | N-R              | S-Z |
|-----------------------------------|-----|--------------|------------------|-----|
| certification-authority           |     | mode (IPsec) | retry-interval   |     |
| challenge-password                |     |              | revocation-check |     |
| crl (Adaptive Services Interface) |     |              |                  |     |
| crl (Encryption Interface)        |     |              |                  |     |

**Related Documentation** • [Security Services Configuration Statements on page 275](#)



## CHAPTER 21

# Operational Commands: DDoS

- `clear ddos-protection protocols`
- `show ddos-protection protocols`
- `show ddos-protection protocols culprit-flows`
- `show ddos-protection protocols flow-detection`
- `show ddos-protection protocols parameters`
- `show ddos-protection protocols statistics`
- `show ddos-protection protocols violations`
- `show ddos-protection statistics`
- `show ddos-protection version`

## clear ddos-protection protocols

---

|                          |   |
|--------------------------|---|
| Syntax                   | <code>clear ddos-protection protocols</code><br><code>&lt;protocol-group &lt;packet-type&gt;&gt; (culprit-flows   states   statistics)</code>   |
| Release Information      | Command introduced in Junos OS Release 11.2.<br>Option <b>culprit-flows</b> introduced in Junos OS Release 12.3.  |
| Description              | Clear current DDoS protection statistics, violation states, or culprit flows for all packet types in all protocol groups, for all packet types in a particular protocol group, or for a particular packet type in a particular protocol group.  |
| Options                  | <p><b>protocol-group</b>—(Optional) Protocol group that is cleared. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p> <p><b>packet-type</b>—(Optional) Packet type in a particular protocol group that is cleared. See <a href="#">show ddos-protection protocols</a> for a list of available packet types.</p> <p><b>culprit-flows</b>—Clear culprit flows for a packet type, for a protocol group, or for all protocol groups.</p> <p><b>states</b>—Clear DDoS protection violation states for a packet type, for a protocol group, or for all protocol groups.</p> <p><b>statistics</b>—Clear DDoS protection statistics such as packet counts and rates for a packet type, for a protocol group, or for all protocol groups.</p> |
| Required Privilege Level | clear   |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">show ddos-protection protocols on page 347</a></li><li>• <a href="#">show ddos-protection statistics on page 389</a></li><li>• <a href="#">show ddos-protection version on page 390</a></li></ul>   |
| List of Sample Output    | <a href="#">clear ddos-protection protocols on page 346</a>   |
| Output Fields            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

### clear ddos-protection protocols

```
user@host> clear ddos-protection protocols dhcpv4 bootp states
```



## show ddos-protection protocols

|                            |  |
|----------------------------|--|
| <b>Syntax</b>              | <code>show ddos-protection protocols &lt;protocol-group (aggregate   packet-type)&gt;</code>   |
| <b>Release Information</b> | Command introduced in Junos OS Release 11.2.   |
| <b>Description</b>         | Display DDoS protection configuration and statistics for protocol groups or individual packet types.   |
| <b>Options</b>             | <p><b>none</b>—Display information for all packet types in all protocol groups.</p> <p><b>aggregate</b>—(Optional) Display DDoS protection information for the aggregate policer. The <b>aggregate</b> option is available for all protocol groups.</p> <p><b>packet-type</b>—(Optional) Display DDoS protection information for the specified packet type in the protocol group. The available packet types vary by protocol group. Only an aggregate policer is available for protocol groups that are not in the following list:</p> <ul style="list-style-type: none"> <li>• <b>dhcpv4</b>—The following packet types are available for DHCPv4 traffic: <ul style="list-style-type: none"> <li>• <b>ack</b>—DHCPACK packets.</li> <li>• <b>bad-packets</b>—DHCPv4 packets with bad formats.</li> <li>• <b>bootp</b>—DHCPBOOTP packets.</li> <li>• <b>decline</b>—DHCPDECLINE packets.</li> <li>• <b>discover</b>—DHCDISCOVER packets.</li> <li>• <b>force-renew</b>—DHCPFORCERENEW packets.</li> <li>• <b>inform</b>—DHCPINFORM packets.</li> <li>• <b>lease-active</b>—DHCPLEASEACTIVE packets.</li> <li>• <b>lease-query</b>—DHCPLEASEQUERY packets.</li> <li>• <b>lease-unassigned</b>—DHCPLEASEUNASSIGNED packets.</li> <li>• <b>lease-unknown</b>—DHCPLEASEUNKNOWN packets.</li> <li>• <b>nak</b>—DHCPNAK packets.</li> <li>• <b>no-message-type</b>—DHCP packets that are missing the message type..</li> <li>• <b>offer</b>—DHCOFFER packets.</li> <li>• <b>release</b>—DHCPACK packets.</li> <li>• <b>renew</b>—DHCPRENEW packets.</li> <li>• <b>request</b>—DHCPREQUEST packets.</li> <li>• <b>unclassified</b>— All unclassified packets in the protocol group.</li> </ul> </li> <li>• <b>dhcpv6</b>—The following packet types are available for DHCPv6 traffic:</li> </ul> |

- **advertise**—ADVERTISE packets.
- **confirm**—CONFIRM packets.
- **decline**—DECLINE packets.
- **information-request**—INFORMATION-REQUEST packets.
- **leasequery**—LEASEQUERY packets.
- **leasequery-data**—LEASEQUERY-DATA packets.
- **leasequery-done**—LEASEQUERY-DONE packets.
- **leasequery-reply**—LEASEQUERY-REPLY packets.
- **rebind**—REBIND packets.
- **reconfigure**—RECONFIGURE packets.
- **relay-forward**—RELAY-FORWARD packets.
- **relay-reply**—RELAY-REPLY packets.
- **release**—RELEASE packets.
- **renew**—RENEW packets.
- **reply**—REPLY packets.
- **request**—REQUEST packets.
- **solicit**—SOLICIT packets.
- **unclassified**— All unclassified packets in the protocol group.
- **filter-action**—The following packet types are available for unclassified firewall filter action packets, sent to the host because of reject terms in firewall filters:
  - **filter-v4**—Unclassified IPv4 filter action packets.
  - **filter-v6**—Unclassified IPv6 filter action packets.
  - **other**—All other unclassified filter action packets that are not IPv4 or IPv6.
- **frame-relay**—The following packet types are available for Frame Relay traffic:
  - **frf15**—Multilink frame relay FRF.15 packets.
  - **frf16**—Multilink frame relay FRF.16 packets.
- **ip-fragments**—The following packet types are available for IP fragments:
  - **first-fragment**—First IP fragment.
  - **trail-fragment**—Last IP fragment.
- **ip-options**—The following packet types are available for IP option traffic:
  - **non-v4v6**—Options packets other than IPv4/v6.
  - **router-alert**—Router alert options packets.
  - **unclassified**— All unclassified packets in the protocol group.

- **mcast-snoop**—Control traffic for multicast snooping.
  - **igmp**—Snooped IGMP traffic.
  - **pim**—Snooped PIM control traffic.
- **mlp**—The following MLP packet types are available:
  - **aging-exception**—MLP aging exception packets.
  - **packets**—MLP packets.
  - **unclassified**— All unclassified packets in the protocol group.
- **ppp**—The following PPP packet types are available:
  - **authentication**—PPP authentication protocol packets.
  - **echo-rep**—LCP echo reply packets.
  - **echo-req**—LCP echo request packets.
  - **ipcp**—IP Control Protocol packets.
  - **ipv6cp**—IPv6 Control Protocol packets.
  - **isis**—IS-IS packets.
  - **lcp**—Link Control Protocol packets.
  - **mlppp-lcp**—MLPPP LCP packets.
  - **mplscp**—MPLS Control Protocol packets.
  - **unclassified**— All unclassified packets in the protocol group.
- **pppoe**—The following PPPoE packet types are available:
  - **padi**—PADI packets.
  - **padm**—PADM packets.
  - **padn**—PADN packets.
  - **pado**—PADO packets.
  - **padr**—PADR packets.
  - **pads**—PADS packets.
  - **padt**—PADT packets.
- **radius**—The following RADIUS packet types are available:
  - **accounting**—RADIUS accounting packets.
  - **authorization**—RADIUS authorization packets.
  - **server**—RADIUS server traffic.
  - **unclassified**— All unclassified packets in the protocol group.

- **resolve**—The following packet types are available for unclassified resolve packets, which are sent to the host because of a traffic request resolve action:
  - **mcast-v4**—Unclassified IPv4 multicast resolve packets.
  - **mcast-v6**—Unclassified IPv6 multicast resolve packets.
  - **ucast-v4**—Unclassified IPv4 unicast resolve packets.
  - **ucast-v6**—Unclassified IPv6 unicast resolve packets.
  - **other**—All other unclassified resolve packets.
- **sample**—The following sample packet types are available:
  - **host**—Host packets.
  - **pfe**—Packet Forwarding Engine packets.
  - **syslog**—System log message packets.
  - **tap**—TAP packets.
- **tcp-flags**—The following TCP-flagged packet types are available:
  - **established**—TCP ACK and RST connection packets.
  - **initial**—TCP SYN and SYN ACK packets.
- **unclassified**—The following unclassified packet types are available:
  - **control-layer2**—Unclassified layer 2 control packets.
  - **control-v4**—Unclassified IPv4 control packets.
  - **control-v6**—Unclassified IPv6 control packets.
  - **fw-host**—Unclassified send-to-host firewall packets.
  - **host-route-v4**—Unclassified IPv4 routing protocol and host packets in traffic sent to the router local interface address for broadcast and multicast.
  - **host-route-v6**—Unclassified IPv6 routing protocol and host packets in traffic sent to the router local interface address for broadcast and multicast.
  - **mcast-copy**—Unclassified host copy (due to multicast routing) packets.
  - **other**—All unclassified packets that do not belong to another type.
- **virtual-chassis**—The following packet types are available for virtual chassis packets:
  - **control-low**—Low-priority control packets.
  - **control-high**—High-priority control packets.
  - **unclassified**—All unclassified packets in the protocol group.
  - **vc-packets**—All exception packets on the virtual chassis link.
  - **vc-ttl-errors**—Virtual chassis TTL error packets.

***protocol-group***—(Optional) Display DDoS protection information for one of the following protocol groups:

- **amtv4**—IPv4 AMT traffic.
- **amtv6**—IPv6 AMT traffic.
- **ancp**—ANCP traffic.
- **ancpv6**—ANCPv6 traffic.
- **arp**—ARP traffic.
- **atm**—ATM traffic.
- **bfd**—BFD traffic.
- **bfdv6**—BFDv6 traffic.
- **bgp**—BGP traffic.
- **bgpv6**—BGPv6 traffic.
- **control**—Control traffic.
- **demux-autosense**—Demux autosensing traffic.
- **dhcipv4**—DHCPv4 traffic.
- **dhcipv6**—DHCPv6 traffic.
- **diameter**—Diameter and Gx-Plus traffic.
- **dns**—DNS traffic.
- **dtcp**—DTCP traffic.
- **dynamic-vlan**—Dynamic VLAN exception traffic.
- **egpv6**—EGPv6 traffic.
- **eoam**—EOAM traffic.
- **esmc**—ESMC traffic.
- **fab-probe**—Fab out probe packets.
- **filter-action**—IPv4 and IPv6 firewall filter action packets sent to the host because of reject terms in firewall filters
- **firewall-host**—Firewall send-to-host traffic.
- **frame-relay**—Frame relay traffic.
- **ftp**—FTP traffic.
- **ftpv6**—FTPv6 traffic.
- **gre**—GRE traffic.
- **icmp**—ICMP traffic.
- **igmp**—IGMP traffic
- **igmpv4v6**—IGMP v4/v6 traffic.

- **igmpv6**—IGMPv6 traffic.
- **inline-ka**—Inline service interfaces keepalive traffic.
- **inline-svcs**—Inline services traffic.
- **ip-fragments**—IP fragments traffic.
- **ip-options**—IP traffic with IP packet header options.
- **isis**—IS-IS traffic.
- **jfm**—JFM traffic.
- **keepalive**—Keepalive traffic.
- **l2pt**—Layer 2 protocol tunneling traffic.
- **l2tp**—L2TP traffic.
- **lACP**—LACP traffic.
- **ldp**—LDP traffic.
- **ldpv6**—LDPv6 traffic.
- **lldp**—LLDP traffic.
- **lmp**—LMP traffic.
- **lmpv6**—LMPv6 traffic.
- **mac-host**—Layer 2 MAC send-to-host traffic.
- **mcast-snoop**—Control traffic for multicast snooping.
- **mlp**—MLP traffic.
- **msdp**—MSDP traffic.
- **msdpv6**—MSDPv6 traffic.
- **multicast-copy**—Host copy traffic due to multicast routing.
- **mvrp**—MVRP traffic.
- **ndpv6**—NDPv6 traffic.
- **ntp**—NTP traffic.
- **oam-lfm**—OAM-LFM traffic.
- **ospf**—OSPF traffic.
- **ospfv3v6**—OSPFv3/IPv6 traffic.
- **pfe-alive**—Packet Forwarding Engine keepalive traffic.
- **pim**—PIM traffic.
- **pimv6**—PIMv6 traffic.
- **pmvrp**—PMVRP traffic.
- **pos**—POS traffic.

- **ppp**—PPP traffic.
- **pppoe**—PPPoE traffic.
- **ptp**—PTP traffic.
- **pvstp**—PVSTP traffic.
- **radius**—RADIUS traffic.
- **redirect**—Traffic that triggers ICMP redirects.
- **reject**—Packets rejected by a next-hop forwarding decision.
- **rejectv6**—V6 packets rejected by a next-hop forwarding decision.
- **resolve**—Unclassified IPv4 and IPv6 resolve packets sent to the host because of a traffic request resolve action.
- **rip**—RIP traffic.
- **ripv6**—RIPv6 traffic.
- **rsvp**—RSVP traffic.
- **rsvpv6**—RSVPv6 traffic.
- **services**—Service traffic.
- **snmp**—SNMP traffic.
- **snmpv6**—SNMPv6 traffic.
- **ssh**—SSH traffic.
- **sshv6**—SSHv6 traffic.
- **stp**—STP traffic.
- **tacacs**—TACACS traffic.
- **tcp-flags**—Traffic with TCP flags.
- **telnet**—TELNET traffic.
- **telnetv6**—TELNETv6 traffic.
- **ttl**—TTL traffic.
- **tunnel-fragment**—Tunnel fragments traffic.
- **unclassified**—Unclassified traffic.
- **virtual-chassis**—Virtual chassis traffic.
- **vrrp**—VRRP traffic.
- **vrrpv6**—VRRPv6 traffic.

**Required Privilege**    [view](#)  
**Level**

- Related Documentation**
- [clear ddos-protection protocols on page 346](#)
  - [show ddos-protection protocols culprit-flows on page 363](#)
  - [show ddos-protection protocols flow-detection on page 366](#)
  - [show ddos-protection protocols parameters on page 370](#)
  - [show ddos-protection protocols statistics on page 377](#)
  - [show ddos-protection protocols violations on page 387](#)

- List of Sample Output**
- [show ddos-protection protocols on page 358](#)
  - [show ddos-protection protocols \(Specific Packet Type with Flow Detection Disabled\) on page 360](#)
  - [show ddos-protection protocols \(Specific Packet Type with Flow Detection Enabled and Automatic\) on page 360](#)
  - [show ddos-protection protocols \(Specific Packet Type with Bandwidth Violation\) on page 361](#)

- Output Fields** [Table 11 on page 354](#) lists the output fields for the **show ddos-protection protocols** command. Output fields are listed in the approximate order in which they appear.

**Table 11: show ddos-protection protocols Output Fields**

| Field Name                     | Field Description   |
|--------------------------------|---|
| <b>Packet types</b>            | Number of packet types  |
| <b>Modified</b>                | Number of packets for which policer values have been modified from the default.                               |
| <b>Received traffic</b>        | Number of traffic flows received.   |
| <b>Currently violated</b>      | Number of flows that are currently violating the flow bandwidth limit.  |
| <b>Currently tracked flows</b> | Number of active flows that are being tracked as culprit flows by flow detection.                             |
| <b>Total detected flows</b>    | Total number of culprit flows that have been detected, including those that have recovered or timed out.      |
| <b>Protocol Group</b>          | Name of protocol group.   |
| <b>Packet type</b>             | Name of packet type in protocol group.  |
| <b>Bandwidth</b>               | Bandwidth policer value; number of packets per second that is allowed before a violation is declared.         |
| <b>Burst</b>                   | Burst policer value; the maximum number of packets that is allowed in a burst before a violation is declared. |



Table 11: show ddos-protection protocols Output Fields (*continued*)

| Field Name                   | Field Description  |
|------------------------------|--|
| Priority                     | Priority of the packet type for individual packet policers that enables more important traffic to pass through in the event of traffic congestion: <b>low</b> , <b>medium</b> , or <b>high</b> . Lower priority packets can be dropped when insufficient bandwidth is available.   |
| Recover time                 | Time that must pass since the last violation before the traffic flow is considered to have recovered from the attack. A notification is generated when the timer expires.  |
| Enabled                      | State of the policer, enabled ( <b>Yes</b> ), disabled ( <b>No</b> ), or partially disabled ( <b>Partial</b> ); <b>Partial</b> indicates that only some of the policer instances are disabled for the policer.   |
| Bypass aggregate             | State of the bypass aggregate configuration: <ul style="list-style-type: none"> <li>• Yes—The aggregate policer is bypassed.</li> <li>• No—The aggregate policer is enforced.</li> </ul> This field appears only for individual policers.  |
| Flow detection configuration | State of flow detection configured on the router: <ul style="list-style-type: none"> <li>• Detection mode—Mode of operation for suspicious flow detection: automatic, off, or on.</li> <li>• Log flows—State of automatic logging of suspicious traffic flows: on (<b>Yes</b>) or off (<b>No</b>).</li> <li>• Timeout flows—State of culprit flow timeout behavior: flow is suppressed for a configured timeout period (<b>Yes</b>) or flow is suppressed until it is no longer in violation (<b>No</b>).</li> <li>• Detect time—Time in seconds that must pass before a suspicious flow that has exceeded the bandwidth allowed for the packet type is considered to be a culprit flow.</li> <li>• Recover time—Time in seconds that must pass before a culprit flow is considered to have returned to normal. The period starts when the flow drops below the threshold that triggered the last violation.</li> <li>• Timeout time—Time in seconds that a culprit flow is suppressed, if timeouts have been enabled.</li> <li>• Flow aggregation level configuration—Flow detection mode, flow control mode, and flow bandwidth for traffic at each of the traffic flow aggregation levels: subscriber, logical interface, and physical interface. <ul style="list-style-type: none"> <li>• Detection mode—State of flow detection: automatic, off, or on.</li> <li>• Control mode—Mode of controlling culprit traffic: dropped, kept, or policed back to within the allowed bandwidth.</li> <li>• Flow rate—Bandwidth allowed for the control traffic in packets per second.</li> </ul> </li> </ul> |

Table 11: show ddos-protection protocols Output Fields (*continued*)

| Field Name                        | Field Description  |
|-----------------------------------|--|
| <b>System-wide information</b>    | <p>The following information collected for the router:</p> <ul style="list-style-type: none"> <li>• A message indicates whether the policer has been violated.</li> <li>• No. of FPCs currently receiving excess traffic—Number of cards that are currently in violation of a policer.</li> <li>• No. of FPCs that have received excess traffic—Number of cards that have at some point been in violation of a policer.</li> <li>• Violation first detected at—Timestamp of the first violation.</li> <li>• Violation last seen at—Timestamp of the last observed violation.</li> <li>• Duration of violation—Length of the violation.</li> <li>• Number of violations—Number of times the violation has occurred.</li> <li>• Received—Number of packets received at all card slots and the Routing Engine.</li> <li>• Dropped—Number of packets dropped regardless of where they were dropped.</li> <li>• Arrival rate—Current traffic rate for packets arriving from all cards and at the Routing Engine.</li> <li>• Max arrival rate—Highest traffic rate for packets arriving from all cards and at the Routing Engine.</li> </ul>   |
| <b>Routing Engine information</b> | <p>The following information collected for the Routing Engine:</p> <ul style="list-style-type: none"> <li>• Bandwidth—Maximum number of packets per second that is allowed.</li> <li>• Burst—Maximum number of packets that is allowed in a burst.</li> <li>• A message indicates the State of the policer, enabled (<b>Yes</b>) or disabled (<b>No</b>).</li> <li>• A message indicates whether the policer has been violated; the policer might be passed at the individual cards, but the combined rate of packets arriving at the Routing Engine can exceed the configured policer value.</li> <li>• Violation first detected at—Timestamp of the first violation.</li> <li>• Violation last seen at—Timestamp of the last observed violation.</li> <li>• Duration of violation—Length of the violation.</li> <li>• Number of violations—Number of times the violation has occurred.</li> <li>• Received—Number of packets received at the Routing Engine from all cards.</li> <li>• Dropped—Number of packets dropped at the Routing Engine; includes packets dropped by the aggregate policer and by individual protocol policers.</li> <li>• Arrival rate—Current traffic rate for packets arriving at the Routing Engine from all cards.</li> <li>• Max arrival rate—Highest traffic rate for packets arriving at the Routing Engine from all cards.</li> <li>• Dropped by aggregate policer—Number of packets dropped by the aggregate policer.</li> <li>• Dropped by individual policers—Number of packets dropped by individual policer.</li> </ul> |

Table 11: show ddos-protection protocols Output Fields (*continued*)

| Field Name                               | Field Description   |
|--|---|
| <b>FPC slot information</b>              | <p>The following information collected for the card in the indicated slot:</p> <ul style="list-style-type: none"> <li>• Bandwidth—Bandwidth scaling percentage and the number of packets per second that is allowed before a violation is declared.</li> <li>• Burst—Burst scaling percentage and the maximum number of packets that is allowed in a burst before a violation is declared.</li> <li>• A message indicates whether the policer has been violated.</li> <li>• Violation first detected at—Timestamp of the first violation.</li> <li>• Violation last seen at—Timestamp of the last observed violation.</li> <li>• Duration of violation—Length of the violation.</li> <li>• Number of violations—Number of times the violation has occurred.</li> <li>• Received—Number of packets received on the line card.</li> <li>• Dropped—Number of packets dropped at the line card; includes packets dropped by the aggregate policer and by individual protocol policers.</li> <li>• Arrival rate—Current traffic rate for packets arriving at the line card.</li> <li>• Max arrival rate—Highest traffic rate for packets arriving at the line card.</li> <li>• Dropped by this policer—Number of packets dropped by the individual policer.</li> <li>• Dropped by aggregate policer—Number of packets dropped by the aggregate policer.</li> </ul> |
| <b>Bypass aggr.</b>                      | <p>State of the bypass aggregate configuration:</p> <ul style="list-style-type: none"> <li>• Yes—The aggregate policer configuration is bypassed.</li> <li>• No—The aggregate policer configuration is enforced.</li> </ul> <p>Dashes indicate that the bypass aggregate configuration is not available; this is possible only for aggregate policers.</p>  |
| <b>FPC Mod</b>                           | <p>Indicates whether configuration has changed from the default for any line cards.</p> <ul style="list-style-type: none"> <li>• No—The default configuration has not changed from the default for the packet type.</li> <li>• Yes—The default configuration has changed from the default for the packet type</li> </ul>  |
| <b>Op mode</b>                           | Mode of operation for suspicious flow detection for the packet type: always-on ( <b>on</b> ), ( <b>auto</b> ), or disabled ( <b>off</b> ).  |
| <b>Policer BW (pps)</b>                  | Bandwidth policer value; number of packets per second that is allowed before a violation is declared.   |
| <b>Aggr level<br/>Op:Fc:Bwidth (pps)</b> | Flow operation mode, flow control mode, and flow bandwidth for traffic of the packet type at each traffic flow aggregation level: subscriber ( <b>sub</b> ), logical interface ( <b>ifl</b> ), and physical interface ( <b>ifd</b> ).   |
| <b>Log flow</b>                          | State of automatic logging of suspicious traffic flows for the packet type: on ( <b>Yes</b> ) or off ( <b>No</b> ).   |

Table 11: show ddos-protection protocols Output Fields (*continued*)

| Field Name | Field Description   |
|------------|---|
| Time out   | State of culprit flow timeout behavior for the packet type: flow is suppressed or monitored for a configured timeout period ( <b>Yes</b> ) or flow is suppressed or monitored until it is no longer in violation ( <b>No</b> ). |

## Sample Output

### show ddos-protection protocols

```
user@host> show ddos-protection protocols
```

```
Packet types: 190, Modified: 0, Received traffic: 12, Currently violated: 3
Currently tracked flows: 0, Total detected flows: 0
* = User configured value
```

```
Protocol Group: IPv4-Unclassified
```

```
Packet type: aggregate (Aggregate for unclassified host-bound IPv4 traff)
```

```
Aggregate policer configuration:
```

```
Bandwidth:      2000 pps
Burst:          10000 packets
Recover time:   300 seconds
Enabled:        Yes
```

```
Flow detection configuration:
```

```
Detection mode: Automatic Detect time: 3 seconds
Log flows:      No          Recover time: 60 seconds
Timeout flows: No          Timeout time: 300 seconds
```

```
Flow aggregation level configuration:
```

| Aggregation level  | Detection mode | Control mode | Flow rate |
|--------------------|----------------|--------------|-----------|
| Subscriber         | Automatic      | Drop         | 10 pps    |
| Logical interface  | Automatic      | Drop         | 10 pps    |
| Physical interface | Automatic      | Drop         | 2000 pps  |

```
System-wide information:
```

```
Aggregate bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
```

```
Routing Engine information:
```

```
Bandwidth: 2000 pps, Burst: 10000 packets, enabled
Aggregate policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Dropped by individual policers: 0
```

```
FPC slot 1 information:
```

```
Bandwidth: 100% (2000 pps), Burst: 100% (10000 packets), enabled
Aggregate policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Dropped by individual policers: 0
Dropped by flow suppression: 0
```

```
...
```

```
Protocol Group: PPPoE
```

```
Packet type: aggregate (Aggregate for all PPPoE control traffic)
```

```
Aggregate policer configuration:
```

```

Bandwidth:      2000 pps
Burst:          2000 packets
Recover time:   300 seconds
Enabled:        Yes
Flow detection configuration:
Detection mode: Automatic Detect time: 3 seconds
Log flows:      No          Recover time: 60 seconds
Timeout flows: No          Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
  Subscriber         Automatic      Drop          10 pps
  Logical interface  Automatic      Drop          10 pps
  Physical interface Automatic      Drop          2000 pps
System-wide information:
Aggregate bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Routing Engine information:
Bandwidth: 2000 pps, Burst: 2000 packets, enabled
Aggregate policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by individual policers: 0
FPC slot 1 information:
Bandwidth: 100% (2000 pps), Burst: 100% (2000 packets), enabled
Aggregate policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by individual policers: 0
  Dropped by flow suppression: 0

Packet type: padi (PPPoE PADI)
Individual policer configuration:
Bandwidth:      500 pps
Burst:          500 packets
Priority:        Low
Recover time:   300 seconds
Enabled:        Yes
Bypass aggregate: No
Flow detection configuration:
Detection mode: Automatic Detect time: 3 seconds
Log flows:      No          Recover time: 60 seconds
Timeout flows: No          Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
  Subscriber         Automatic      Drop          10 pps
  Logical interface  Automatic      Drop          10 pps
  Physical interface Automatic      Drop          500 pps
System-wide information:
Bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Routing Engine information:
Bandwidth: 500 pps, Burst: 500 packets, enabled
Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled
Policer is never violated

```

```

Received: 0                      Arrival rate: 0 pps
Dropped: 0                      Max arrival rate: 0 pps
Dropped by aggregate policer: 0
Dropped by flow suppression: 0
...

```

### show ddos-protection protocols (Specific Packet Type with Flow Detection Disabled)

```

user@host> show ddos-protection protocols pppoe padi
Currently tracked flows: 0, Total detected flows: 0
* = User configured value

Protocol Group: PPPoE

Packet type: padi (PPPoE PADI)
Individual policer configuration:
  Bandwidth: 500 pps
  Burst: 500 packets
  Priority: Low
  Recover time: 300 seconds
  Enabled: Yes
  Bypass aggregate: No
Flow detection configuration:
  Detection mode: Off* Detect time: 3 seconds
  Log flows: No Recover time: 60 seconds
  Timeout flows: No Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level Detection mode Control mode Flow rate
  Subscriber Automatic Drop 10 pps
  Logical interface Automatic Drop 10 pps
  Physical interface Automatic Drop 500 pps
System-wide information:
  Bandwidth is never violated
  Received: 0 Arrival rate: 0 pps
  Dropped: 0 Max arrival rate: 0 pps
Routing Engine information:
  Bandwidth: 500 pps, Burst: 500 packets, enabled
  Policer is never violated
  Received: 0 Arrival rate: 0 pps
  Dropped: 0 Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled
  Policer is never violated
  Received: 0 Arrival rate: 0 pps
  Dropped: 0 Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
  Dropped by flow suppression: 0

```

### show ddos-protection protocols (Specific Packet Type with Flow Detection Enabled and Automatic)

```

user@host> show ddos-protection protocols pppoe padi
Currently tracked flows: 0, Total detected flows: 0
* = User configured value

Protocol Group: PPPoE

```

```

Packet type: padi (PPPoE PADI)
Individual policer configuration:
  Bandwidth: 500 pps
  Burst: 500 packets

```

```

Priority:          Low
Recover time:     300 seconds
Enabled:          Yes
Bypass aggregate: No
Flow detection configuration:
  Detection mode: Automatic Detect time: 3 seconds
Log flows:        No        Recover time: 60 seconds
Timeout flows:    No        Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
Subscriber          Automatic      Drop          10 pps
Logical interface    Automatic      Drop          10 pps
Physical interface   Automatic      Drop          500 pps
System-wide information:
Bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Routing Engine information:
Bandwidth: 500 pps, Burst: 500 packets, enabled
Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Dropped by aggregate policer: 0
FPC slot 1 information:
Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled
Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Dropped by aggregate policer: 0
Dropped by flow suppression: 0

```

### show ddos-protection protocols (Specific Packet Type with Bandwidth Violation)

```

user@host> show ddos-protection protocols bfd
Packet types: 1, Modified: 0, Received traffic: 1, Currently violated: 1
Currently tracked flows: 1, Total detected flows: 1
* = User configured value

```

Protocol Group: BFD

```

Packet type: aggregate (Aggregate for all bfd traffic)
Aggregate policer configuration:
Bandwidth:          20000 pps
Burst:              20000 packets
Recover time:       300 seconds
Enabled:            Yes
Flow detection configuration:
  Detection mode: Automatic Detect time: 3 seconds
Log flows:        No        Recover time: 60 seconds
Timeout flows:    No        Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
Subscriber          Automatic      Drop          10 pps
Logical interface    Automatic      Drop          10 pps
Physical interface   Automatic      Drop          20000 pps
System-wide information:
Aggregate bandwidth is being violated!
No. of FPCs currently receiving excess traffic: 1
No. of FPCs that have received excess traffic: 1
Violation first detected at: 2012-10-24 23:40:20 EDT
Violation last seen at:     2012-10-25 10:25:48 EDT

```

Duration of violation: 10:45:28 Number of violations: 1  
Received: 1173471731 Arrival rate: 30304 pps  
Dropped: 399135607 Max arrival rate: 30331 pps  
Flow counts:  
Aggregation level Current Total detected  
Subscriber 1 1  
Total 1 1

Routing Engine information:  
Bandwidth: 20000 pps, Burst: 20000 packets, enabled  
Aggregate policer is never violated  
Received: 366831604 Arrival rate: 0 pps  
Dropped: 0 Max arrival rate: 9522 pps  
Dropped by individual policers: 0

**FPC slot 1 information:**  
**Bandwidth: 100% (20000 pps), Burst: 100% (20000 packets), enabled**  
**Aggregate policer is currently being violated!**  
Violation first detected at: 2012-10-24 23:40:21 EDT  
Violation last seen at: 2012-10-25 10:25:48 EDT  
Duration of violation: 10:45:27 Number of violations: 1  
Received: 1173471731 Arrival rate: 30304 pps  
Dropped: 399135607 Max arrival rate: 30331 pps  
Dropped by individual policers: 0  
Dropped by aggregate policer: 398854530  
Dropped by flow suppression: 281077

Flow counts:  
Aggregation level Current Total detected State  
Subscriber 1 1 Active  
Logical-interface 0 0 Active  
Physical-interface 0 0 Active  
Total 1 1



## show ddos-protection protocols culprit-flows

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>show ddos-protection protocols &lt;protocol-group (aggregate   packet-type)&gt; culprit-flows</code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 12.3.   |
| <b>Description</b>              | Display culprit flow information for protocol groups or individual packet types.   |
| <b>Options</b>                  | <p><b>none</b>—Display information for all protocol groups and packet types.</p> <p><b>aggregate</b>—(Optional) Display DDoS protection information for the aggregate policer. The <b>aggregate</b> option is available for all protocol groups.</p> <p><b>packet-type</b>—(Optional) Display information for the specified packet type in the protocol group. The available packet types vary by protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available packet types.</p> <p><b>protocol-group</b>—(Optional) Display information for a particular protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection protocols flow-detection on page 366</a></li> <li>• <a href="#">show ddos-protection protocols parameters on page 370</a></li> <li>• <a href="#">show ddos-protection protocols statistics on page 377</a></li> <li>• <a href="#">show ddos-protection protocols violations on page 387</a></li> </ul>  |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection protocols culprit-flows on page 364</a><br><a href="#">show ddos-protection protocols culprit-flows (Specific Protocol Group) on page 364</a>   |
| <b>Output Fields</b>            | Table 12 on page 363 lists the output fields for the <b>show ddos-protection protocols culprit-flows</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 12: show ddos-protection protocols culprit-flows Output Fields

| Field Name              | Field Description  | Level of Output |
|-------------------------|--|-----------------|
| Currently tracked flows | Number of active flows that are being tracked as culprit flows by flow detection.                        | none            |
| Total detected flows    | Total number of culprit flows that have been detected, including those that have recovered or timed out. | none            |
| Protocol Group          | Name of protocol group.  | none            |

Table 12: show ddos-protection protocols culprit-flows Output Fields (*continued*)

| Field Name                          | Field Description  | Level of Output |
|-------------------------------------|--|-----------------|
| <b>Packet type</b>                  | Name of packet type in protocol group.   | none            |
| <b>Arriving Interface</b>           | Logical interface on which the traffic flow arrived.   | none            |
| <b>Source Address<br/>MAC or IP</b> | Source address of the traffic flow, either a MAC address or an IP address.   | none            |
| <b>pps</b>                          | Rate of the traffic flow in packets per second.  | none            |
| <b>pkts</b>                         | Number of packets in the traffic flow.   | none            |
| <b>Additional<br/>information</b>   | Flow ID numbers automatically assigned to flow, with embedded slot ID. The flow ID is prefixed by <b>sub</b> , <b>ifl</b> , or <b>ifd</b> , which indicate the subscriber, logical interface, and physical interface flow aggregation levels.<br><br>Timestamp that identifies when the flow arrived on the interface. | none            |

## Sample Output

### show ddos-protection protocols culprit-flows

```

user@host> show ddos-protection protocols culprit-flows
Currently tracked flows: 3, Total detected flows: 3

Protocol   Packet   Arriving   Source Address
group      type     Interface  MAC or IP
dhcpcv4    aggregate ge-1/2/0.1073741824 192.85.1.2

    sub:0001000000000000 2012-10-25 10:25:39 EDT pps:0    pkts:0
bfd        aggregate ge-1/2/0.1073741824 192.85.1.2

    sub:0001000000000001 2012-10-25 10:25:39 EDT pps:30000 pkts:322137
reject     aggregate ge-1/2/0.1073741824 00:10:94:00:00:02

    sub:0001000000000002 2012-10-25 10:25:39 EDT pps:0    pkts:0

root@abc> show ddos-protection protocols bfd culprit-flows
Currently tracked flows: 1, Total detected flows: 1

Protocol   Packet   Arriving   Source Address
group      type     Interface  MAC or IP
bfd        aggregate ge-1/2/0.1073741824 192.85.1.2

    sub:0001000000000001 2012-10-25 10:25:39 EDT pps:30000 pkts:2872642

```

### show ddos-protection protocols culprit-flows (Specific Protocol Group)

```

user@host> show ddos-protection protocols bfd culprit-flows
Currently tracked flows: 1, Total detected flows: 1

Protocol   Packet   Arriving   Source Address
group      type     Interface  MAC or IP

```

```
bfd          aggregate    ge-1/2/0.1073741824 192.85.1.2
sub:00010000000000001 2012-10-25 10:25:39 EDT pps:30000 pkts:2872642
```

## show ddos-protection protocols flow-detection

|                                 |   |  |
|---------------------------------|---|--|
| <b>Syntax</b>                   | <b>show ddos-protection protocols &lt;protocol-group&gt; flow-detection &lt;brief   detail   terse&gt;</b>  |  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 12.3.  |  |
| <b>Description</b>              | Display flow detection information for all protocol groups or for a particular protocol group.  |  |
| <b>Options</b>                  | <p><b>none</b>—Display information for all protocol groups.</p> <p><b>brief   detail   terse</b>—(Optional) Display the specified level of output.</p> <ul style="list-style-type: none"> <li>• <b>brief</b>—Display basic function information.</li> <li>• <b>detail</b>—Add information to the <b>brief</b> output; it is identical to the output displayed when you choose no option. The <b>brief</b> and <b>detail</b> options display information for all protocol groups, which can be a long list.</li> <li>• <b>terse</b>—Display the same level of information as the <b>brief</b> option but only for active protocol groups.</li> </ul> <p><b>protocol-group</b>—(Optional) Display information for a particular protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p> |  |
| <b>Required Privilege Level</b> | view  |  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection protocols culprit-flows on page 363</a></li> <li>• <a href="#">show ddos-protection protocols parameters on page 370</a></li> <li>• <a href="#">show ddos-protection protocols statistics on page 377</a></li> <li>• <a href="#">show ddos-protection protocols violations on page 387</a></li> </ul>  |  |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection protocols flow-detection on page 368</a><br><a href="#">show ddos-protection protocols flow-detection brief (Parameters for a Specific Protocol) on page 368</a>   |  |
| <b>Output Fields</b>            | Table 13 on page 366 lists the output fields for the <b>show ddos-protection protocols flow-detection</b> command. Output fields are listed in the approximate order in which they appear.  |  |

Table 13: show ddos-protection protocols flow-detection Output Fields

| Field Name   | Field Description       | Level of Output |
|--------------|-------------------------|-----------------|
| Packet types | Number of packet types. | All levels      |

Table 13: show ddos-protection protocols flow-detection Output Fields (*continued*)

| Field Name                                  | Field Description  | Level of Output    |
|---|--|--------------------|
| <b>Modified</b>                             | Number of packets for which policer values have been modified from the default.  | All levels         |
| <b>Protocol Group</b>                       | Name of protocol group.  | All levels         |
| <b>Packet type</b>                          | Name of packet type in protocol group.   | All levels         |
| <b>Flow detection configuration</b>         | Configuration of flow detection at the packet level.   | <b>detail none</b> |
| <b>Detection mode or Op mode</b>            | Mode of operation for flow detection at the packet level: <ul style="list-style-type: none"> <li>• <b>Automatic</b> or <b>a</b>—Search flows only when a policer is being violated.</li> <li>• <b>Off</b> or <b>x</b>—Never search flows even when a policer is being violated.</li> <li>• <b>On</b> or <b>o</b>—Search flows even when no policer is being violated.</li> </ul> | All levels         |
| <b>Policer BW (pps)</b>                     | Bandwidth allowed at the packet level.   | <b>brief terse</b> |
| <b>Detect time</b>                          | Time in seconds that a suspicious flow that has exceeded the bandwidth allowed for the packet type must remain in violation to be confirmed as a culprit flow.   | <b>detail none</b> |
| <b>Log flows or Log flow</b>                | State of automatic logging of suspicious traffic flows for the packet type: on ( <b>Yes</b> ) or off ( <b>No</b> ).  | All levels         |
| <b>Recover time</b>                         | Time in seconds that must pass before a culprit flow for the packet type is considered to have returned to normal. The period starts when the flow drops below the threshold that triggered the last violation.  | <b>detail none</b> |
| <b>Timeout flows or Time out</b>            | State of timeout enabling for culprit flows: <ul style="list-style-type: none"> <li>• <b>Yes</b>—Enabled; flows can time out (released from suppression) when a timeout period expires, regardless of whether flow is still in violation.</li> <li>• <b>No</b>—Disabled; flows are not allowed to time out.</li> </ul>   | All levels         |
| <b>Timeout time</b>                         | Time in seconds that a culprit flow is suppressed. On expiration, the flow times out even if it is still violating the bandwidth limit.  | <b>detail none</b> |
| <b>Flow aggregation level configuration</b> | Configuration of flow detection for each flow aggregation level.   | <b>detail none</b> |
| <b>Aggregation level or Agg level</b>       | One of three levels of flow aggregation <ul style="list-style-type: none"> <li>• <b>Subscriber</b> or <b>sub</b></li> <li>• <b>Logical interface</b> or <b>ifl</b></li> <li>• <b>Physical interface</b> or <b>ifd</b></li> </ul>   | All levels         |
| <b>Detection mode or Op</b>                 | Mode of operation for flow detection at the flow aggregation level: <ul style="list-style-type: none"> <li>• <b>Automatic</b>—Search flows only when a policer is being violated.</li> <li>• <b>Off</b>—Never search flows even when a policer is being violated.</li> <li>• <b>On</b>—Search flows even when no policer is being violated.</li> </ul>                           | All levels         |

Table 13: show ddos-protection protocols flow-detection Output Fields (*continued*)

| Field Name                       | Field Description  | Level of Output    |
|----------------------------------|--|--------------------|
| <b>Control mode or Fc</b>        | Mode by which traffic in a culprit flow is handled.<br><br><ul style="list-style-type: none"> <li>• <b>drop</b>—Drop all traffic in flow.</li> <li>• <b>keep</b>—Keep all traffic in flow.</li> <li>• <b>police</b>—Police the traffic to within its allowed bandwidth.</li> </ul> | All levels         |
| <b>Flow rate or BWidth (pps)</b> | Bandwidth allowed at the flow aggregation level.   | <b>brief terse</b> |

## Sample Output

### show ddos-protection protocols flow-detection

```

user@host> show ddos-protection protocols flow-detection
Packet types: 190, Modified: 2
* = User configured value

Protocol Group: IPv4-Unclassified

Packet type: aggregate
Flow detection configuration:
  Detection mode: Automatic Detect time: 3 seconds
  Log flows:      No        Recover time: 60 seconds
  Timeout flows: No        Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
  Subscriber         Automatic      Drop          10 pps
  Logical interface  Automatic      Drop          10 pps
  Physical interface Automatic      Drop          2000 pps

Protocol Group: IPv6-Unclassified

Packet type: aggregate
Flow detection configuration:
  Detection mode: Automatic Detect time: 3 seconds
  Log flows:      No        Recover time: 60 seconds
  Timeout flows: No        Timeout time: 300 seconds
Flow aggregation level configuration:
  Aggregation level  Detection mode  Control mode  Flow rate
  Subscriber         Automatic      Drop          10 pps
  Logical interface  Automatic      Drop          10 pps
  Physical interface Automatic      Drop          2000 pps

...

```

### show ddos-protection protocols flow-detection brief (Parameters for a Specific Protocol)

```

user@host> show ddos-protection protocols dhcpv4 flow-detection brief
Packet types: 19, Modified: 1
* = User configured value

Detection mode(Op): a = automatic   Flow control mode(Fc): d = drop
                   o = on           k = keep
                   x = off          p = police

```

| Protocol<br>group | Packet<br>type | Op<br>mode | Policer<br>BW(pps) | Aggr level<br>sub | Op:Fc:BWwidth(pps)<br>ifl ifd | Log<br>flow | Time<br>out |
|-------------------|----------------|------------|--------------------|-------------------|-------------------------------|-------------|-------------|
| dhcpv4            | aggregate      | auto       | 5000               | a:d:10            | a:d:10 a:d:5000               | No          | No          |
| dhcpv4            | unclass..      | auto       | 300                | a:d:10            | a:d:10 a:d:300                | No          | No          |
| dhcpv4            | discover       | auto       | 777*               | a:d:10            | a:d:10 a:d:500                | No          | No          |
| dhcpv4            | offer          | auto       | 1000               | a:d:10            | a:d:10 a:d:1000               | No          | No          |
| dhcpv4            | request        | auto       | 1000               | a:d:10            | a:d:10 a:d:1000               | No          | No          |
| dhcpv4            | decline        | auto       | 500                | a:d:10            | a:d:10 a:d:500                | No          | No          |
| dhcpv4            | ack            | auto       | 500                | a:d:10            | a:d:10 a:d:500                | No          | No          |
| dhcpv4            | nak            | auto       | 500                | a:d:10            | a:d:10 a:d:500                | No          | No          |
| dhcpv4            | release        | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | inform         | auto       | 500                | a:d:10            | a:d:10 a:d:500                | No          | No          |
| dhcpv4            | renew          | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | forcerenew     | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | leasequery     | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | leaseuna..     | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | leaseunk..     | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | leaseact..     | auto       | 2000               | a:d:10            | a:d:10 a:d:2000               | No          | No          |
| dhcpv4            | bootp          | auto       | 300                | a:d:10            | a:d:10 a:d:300                | No          | No          |
| dhcpv4            | no-msgtype     | auto       | 0                  | a:d:10            | a:d:10 a:d:0                  | No          | No          |
| dhcpv4            | bad-pack..     | auto       | 0                  | a:d:10            | a:d:10 a:d:0                  | No          | No          |

## show ddos-protection protocols parameters

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <b>show ddos-protection protocols</b> <protocol-group> parameters<br><brief   detail   terse>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | Display DDoS protection configuration information for all protocol groups or for a particular protocol group.  |
| <b>Options</b>                  | <p><b>none</b>—Display information for all protocol groups.</p> <p><b>brief   detail   terse</b>—(Optional) Display the specified level of output.</p> <ul style="list-style-type: none"><li>• <b>brief</b>—Display basic function information.</li><li>• <b>detail</b>—Add information to the <b>brief</b> output; it is identical to the output displayed when you choose no option. The <b>brief</b> and <b>detail</b> options display information for all protocol groups, which can be a long list.</li><li>• <b>terse</b>—Display the same level of information as the <b>brief</b> option but only for active protocol groups—groups that show traffic in the <b>Received (packets)</b> column.</li></ul> <p><b>protocol-group</b>—(Optional) Display information for a particular protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear ddos-protection protocols on page 346</a></li><li>• <a href="#">show ddos-protection protocols on page 347</a></li><li>• <a href="#">show ddos-protection protocols culprit-flows on page 363</a></li><li>• <a href="#">show ddos-protection protocols flow-detection on page 366</a></li><li>• <a href="#">show ddos-protection protocols statistics on page 377</a></li><li>• <a href="#">show ddos-protection protocols violations on page 387</a></li></ul>  |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection protocols parameters on page 372</a><br><a href="#">show ddos-protection protocols parameters brief on page 373</a><br><a href="#">show ddos-protection protocols dhcpv4 parameters brief on page 374</a><br><a href="#">show ddos-protection protocols dhcpv4 parameters terse on page 375</a><br><a href="#">show ddos-protection protocols dhcpv4 parameters on page 375</a>   |
| <b>Output Fields</b>            | <a href="#">Table 14 on page 371</a> lists the output fields for the <b>show ddos-protection protocols parameters</b> command. Output fields are listed in the approximate order in which they appear.   |



Table 14: show ddos-protection protocols parameters Output Fields

| Field Name                         | Field Description   | Level of Output    |
|------------------------------------|---|--------------------|
| <b>Protocol Group</b>              | Name of protocol group.   | All levels         |
| <b>Packet type</b>                 | Name of packet type in protocol group.  | All levels         |
| <b>Bandwidth</b>                   | Bandwidth policer value; number of packets per second that is allowed before a violation is declared.<br><br>In the <b>brief</b> output, an asterisk indicates the value has been modified from the default.  | All levels         |
| <b>Burst</b>                       | Burst policer value; the maximum number of packets that is allowed in a burst before a violation is declared.<br><br>In the <b>brief</b> output, an asterisk indicates the value has been modified from the default.  | All levels         |
| <b>Priority</b>                    | Priority of the packet type in the event of traffic congestion: <b>low</b> , <b>medium</b> , or <b>high</b> . Lower priority packets can be dropped when insufficient bandwidth is available.<br><br>In the <b>brief</b> output, an asterisk indicates the value has been modified from the default.  | All levels         |
| <b>Recover time</b>                | Time that must pass since the last violation before the traffic flow is considered to have recovered from the attack. A notification is generated when the timer expires.<br><br>In the <b>brief</b> output, an asterisk indicates the value has been modified from the default.  | All levels         |
| <b>Enabled</b>                     | State of the policer, enabled ( <b>Yes</b> ) or disabled ( <b>No</b> ).   | <b>detail none</b> |
| <b>Bypass aggregate</b>            | State of the bypass aggregate configuration:<br><ul style="list-style-type: none"><li>• Yes—The aggregate policer is bypassed.</li><li>• No—The aggregate policer is enforced.</li></ul> This field appears only for individual policers.   | <b>detail none</b> |
| <b>FPC slot information</b>        | The following configuration information for the card in the indicated slot:<br><ul style="list-style-type: none"><li>• Bandwidth—Bandwidth scale and the number of packets per second that is allowed before a violation is declared</li><li>• Burst—Burst scale and the maximum number of packets that is allowed in a burst before a violation is declared</li><li>• <b>enabled</b> or <b>disabled</b>—State of the line card policer</li></ul> | <b>detail none</b> |
| <b>Number of policers modified</b> | Number of policers that have been changed from the default configuration.<br><br>An asterisk by a particular value indicates that value has been modified.  | <b>brief terse</b> |
| <b>Policer Enabled</b>             | State of the policer, enabled ( <b>Yes</b> ), disabled ( <b>No</b> ), or partially disabled ( <b>part.</b> ); <b>part.</b> indicates that only some of the policer instances are disabled for the policer.  | <b>brief terse</b> |

Table 14: show ddos-protection protocols parameters Output Fields (*continued*)

| Field Name          | Field Description  | Level of Output    |
|---------------------|--|--------------------|
| <b>Bypass aggr.</b> | <p>State of the bypass aggregate configuration:</p> <ul style="list-style-type: none"> <li>• Yes—The aggregate policer is bypassed.</li> <li>• No—The aggregate policer is enforced.</li> </ul> <p>Dashes indicate that the bypass aggregate configuration is not available; this is possible only for aggregate policers.</p> | <b>brief terse</b> |
| <b>FPC Mod</b>      | <p>Indicates whether configuration has changed from the default for any line cards.</p> <ul style="list-style-type: none"> <li>• No—The default configuration has not changed from the default for the packet type.</li> <li>• Yes—The default configuration has changed from the default for the packet type</li> </ul>       | <b>brief terse</b> |

## Sample Output

### show ddos-protection protocols parameters

```

user@host> show ddos-protection protocols parameters
Protocol Group: IPv4-Unclassified

Packet type: aggregate (Aggregate for unclassified host-bound IPv4 traffic)
Aggregate policer configuration:
  Bandwidth:      20000 pps
  Burst:          20000 packets
  Priority:        medium
  Recover time:    300 seconds
  Enabled:         Yes
FPC slot 1 information:
  Bandwidth: 100% (20000 pps), Burst: 100% (20000 packets), enabled

Protocol Group: IPv6-Unclassified

Packet type: aggregate (Aggregate for unclassified host-bound IPv6 traffic)
Aggregate policer configuration:
  Bandwidth:      20000 pps
  Burst:          20000 packets
  Priority:        medium
  Recover time:    300 seconds
  Enabled:         Yes
FPC slot 1 information:
  Bandwidth: 100% (20000 pps), Burst: 100% (20000 packets), enabled

...

Protocol Group: PPPoE

Packet type: aggregate (Aggregate for all PPPoE control traffic)
Aggregate policer configuration:
  Bandwidth:      800 pps
  Burst:          2000 packets
  Priority:        medium
  Recover time:    300 seconds
  Enabled:         Yes

```

FPC slot 1 information:

Bandwidth: 100% (800 pps), Burst: 100% (2000 packets), enabled

Packet type: padi (PPPoE PADI)

Individual policer configuration:

Bandwidth: 500 pps  
Burst: 500 packets  
Priority: low  
Recover time: 300 seconds  
Enabled: Yes  
Bypass aggregate: No

FPC slot 1 information:

Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled

Packet type: pado (PPPoE PADO)

Individual policer configuration:

Bandwidth: 0 pps  
Burst: 0 packets  
Priority: low  
Recover time: 300 seconds  
Enabled: Yes  
Bypass aggregate: No

FPC slot 1 information:

Bandwidth: 100% (0 pps), Burst: 100% (0 packets), enabled

Packet type: padr (PPPoE PADR)

Individual policer configuration:

Bandwidth: 500 pps  
Burst: 500 packets  
Priority: medium  
Recover time: 300 seconds  
Enabled: Yes  
Bypass aggregate: No

FPC slot 1 information:

Bandwidth: 100% (500 pps), Burst: 100% (500 packets), enabled

### show ddos-protection protocols parameters brief

user@host> show ddos-protection protocols parameters brief

Number of policers modified: 3

| Protocol group | Packet type | Bandwidth (pps) | Burst (pkts) | Priority | Recover time(sec) | Policer enabled | Bypass aggr. | FPC mod |
|----------------|-------------|-----------------|--------------|----------|-------------------|-----------------|--------------|---------|
| ipv4-uncls     | aggregate   | 20000           | 20000        | medium   | 300               | yes             | --           | no      |
| ipv6-uncls     | aggregate   | 20000           | 20000        | medium   | 300               | yes             | --           | no      |
| dynvlan        | aggregate   | 1000            | 500          | low      | 300               | yes             | --           | no      |
| ppp            | aggregate   | 16000           | 16000        | medium   | 300               | yes             | --           | no      |
| ppp            | unclass     | 1000            | 500          | low      | 300               | yes             | no           | no      |
| ppp            | lcp         | 12000           | 12000        | low      | 300               | yes             | no           | no      |
| ppp            | auth        | 2000            | 2000         | medium   | 300               | yes             | no           | no      |
| ppp            | ipcp        | 2000            | 2000         | high     | 300               | yes             | no           | no      |
| ppp            | ipv6cp      | 2000            | 2000         | high     | 300               | yes             | no           | no      |
| ppp            | mplscp      | 2000            | 2000         | high     | 300               | yes             | no           | no      |
| ppp            | isis        | 2000            | 2000         | high     | 300               | yes             | no           | no      |
| pppoe          | aggregate   | 800*            | 2000         | medium   | 300               | part.*          | --           | no      |
| pppoe          | padi        | 500             | 500          | low      | 300               | part.           | no           | no      |
| pppoe          | pado        | 0               | 0            | low      | 300               | part.           | no           | no      |
| pppoe          | padr        | 500             | 500          | medium   | 300               | part.           | no           | no      |
| pppoe          | pads        | 0               | 0            | low      | 300               | part.           | no           | no      |
| pppoe          | padt        | 1000            | 1000         | high     | 300               | part.           | no           | no      |
| pppoe          | padm        | 0               | 0            | low      | 300               | part.           | no           | no      |
| pppoe          | padn        | 0               | 0            | low      | 300               | part.           | no           | no      |

|        |            |       |       |        |     |     |    |    |
|--------|------------|-------|-------|--------|-----|-----|----|----|
| dhcpv4 | aggregate  | 669*  | 5000  | medium | 300 | yes | -- | no |
| dhcpv4 | unclass..  | 300   | 150   | low    | 300 | yes | no | no |
| dhcpv4 | discover   | 100*  | 500   | low    | 300 | yes | no | no |
| dhcpv4 | offer      | 1000  | 1000  | low    | 300 | yes | no | no |
| dhcpv4 | request    | 1000  | 1000  | medium | 300 | yes | no | no |
| dhcpv4 | decline    | 500   | 500   | low    | 300 | yes | no | no |
| dhcpv4 | ack        | 500   | 500   | medium | 300 | yes | no | no |
| dhcpv4 | nak        | 500   | 500   | low    | 300 | yes | no | no |
| dhcpv4 | release    | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | inform     | 500   | 500   | low    | 300 | yes | no | no |
| dhcpv4 | renew      | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | forcerenew | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | leasequery | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | leaseuna.. | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | leaseunk.. | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | leaseact.. | 2000  | 2000  | high   | 300 | yes | no | no |
| dhcpv4 | bootp      | 300   | 300   | low    | 300 | yes | no | no |
| dhcpv4 | no-msgtype | 0     | 0     | low    | 300 | yes | no | no |
| dhcpv4 | bad-pack.. | 0     | 0     | low    | 300 | yes | no | no |
| ...    |            |       |       |        |     |     |    |    |
| icmp   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| igmp   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| ospf   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| rsvp   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| pim    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| rip    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| ptp    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| bfd    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| lmp    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| ldp    | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| msdp   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| bgp    | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| vrrp   | aggregate  | 20000 | 20000 | high   | 300 | yes | -- | no |
| telnet | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| ftp    | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| ssh    | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| snmp   | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| ancp   | aggregate  | 20000 | 20000 | low    | 300 | yes | -- | no |
| ...    |            |       |       |        |     |     |    |    |

### show ddos-protection protocols dhcpv4 parameters brief

```
user@host> show ddos-protection protocols dhcpv4 parameters brief
```

```
Number of policers modified: 2
```

| Protocol | Packet     | Bandwidth | Burst  | Priority | Recover   | Policer | Bypass | FPC |
|----------|------------|-----------|--------|----------|-----------|---------|--------|-----|
| group    | type       | (pps)     | (pkts) |          | time(sec) | enabled | aggr.  | mod |
| dhcpv4   | aggregate  | 669*      | 5000   | medium   | 300       | yes     | --     | no  |
| dhcpv4   | unclass..  | 300       | 150    | low      | 300       | yes     | no     | no  |
| dhcpv4   | discover   | 100*      | 500    | low      | 300       | yes     | no     | no  |
| dhcpv4   | offer      | 1000      | 1000   | low      | 300       | yes     | no     | no  |
| dhcpv4   | request    | 1000      | 1000   | medium   | 300       | yes     | no     | no  |
| dhcpv4   | decline    | 500       | 500    | low      | 300       | yes     | no     | no  |
| dhcpv4   | ack        | 500       | 500    | medium   | 300       | yes     | no     | no  |
| dhcpv4   | nak        | 500       | 500    | low      | 300       | yes     | no     | no  |
| dhcpv4   | release    | 2000      | 2000   | high     | 300       | yes     | no     | no  |
| dhcpv4   | inform     | 500       | 500    | low      | 300       | yes     | no     | no  |
| dhcpv4   | renew      | 2000      | 2000   | high     | 300       | yes     | no     | no  |
| dhcpv4   | forcerenew | 2000      | 2000   | high     | 300       | yes     | no     | no  |

|        |            |      |      |      |     |     |    |    |
|--------|------------|------|------|------|-----|-----|----|----|
| dhcpv4 | leasequery | 2000 | 2000 | high | 300 | yes | no | no |
| dhcpv4 | leaseuna.. | 2000 | 2000 | high | 300 | yes | no | no |
| dhcpv4 | leaseunk.. | 2000 | 2000 | high | 300 | yes | no | no |
| dhcpv4 | leaseact.. | 2000 | 2000 | high | 300 | yes | no | no |
| dhcpv4 | bootp      | 300  | 300  | low  | 300 | yes | no | no |
| dhcpv4 | no-msgtype | 0    | 0    | low  | 300 | yes | no | no |
| dhcpv4 | bad-pack.. | 0    | 0    | low  | 300 | yes | no | no |

### show ddos-protection protocols dhcpv4 parameters terse

```
user@host> show ddos-protection protocols dhcpv4 parameters terse
```

Number of policers modified: 2

| Protocol group | Packet type | Bandwidth (pps) | Burst (pkts) | Priority | Recover time(sec) | Policer enabled | Bypass aggr. | FPC mod |
|----------------|-------------|-----------------|--------------|----------|-------------------|-----------------|--------------|---------|
| dhcpv4         | aggregate   | 669*            | 5000         | medium   | 300               | yes             | --           | no      |
| dhcpv4         | discover    | 100*            | 500          | low      | 300               | yes             | no           | no      |

### show ddos-protection protocols dhcpv4 parameters

```
user@host> show ddos-protection protocols dhcpv4 parameters
```

Protocol Group: DHCPv4

Packet type: aggregate (aggregate for all DHCPv4 traffic)

Aggregate policer configuration:

Bandwidth: 669 pps  
 Burst: 5000 packets  
 Priority: medium  
 Recover time: 300 seconds  
 Enabled: Yes

FPC slot 1 information:

Bandwidth: 100% (669 pps), Burst: 100% (5000 packets), enabled

Packet type: unclassified (Unclassified DHCPv4 traffic)

Individual policer configuration:

Bandwidth: 300 pps  
 Burst: 150 packets  
 Priority: low  
 Recover time: 300 seconds  
 Enabled: Yes  
 Bypass aggregate: No

FPC slot 1 information:

Bandwidth: 100% (300 pps), Burst: 100% (150 packets), enabled

Packet type: discover (DHCPv4 DHCPDISCOVER)

Individual policer configuration:

Bandwidth: 100 pps  
 Burst: 500 packets  
 Priority: low  
 Recover time: 300 seconds  
 Enabled: Yes  
 Bypass aggregate: No

FPC slot 1 information:

Bandwidth: 100% (100 pps), Burst: 100% (500 packets), enabled

Packet type: offer (DHCPv4 DHCPOFFER)

Individual policer configuration:

Bandwidth: 1000 pps  
 Burst: 1000 packets  
 Priority: low  
 Recover time: 300 seconds  
 Enabled: Yes

```
    Bypass aggregate: No
FPC slot 1 information:
    Bandwidth: 100% (1000 pps), Burst: 100% (1000 packets), enabled

Packet type: request (DHCPv4 DHCPREQUEST)
Individual policer configuration:
    Bandwidth:      1000 pps
    Burst:          1000 packets
    Priority:        medium
    Recover time:    300 seconds
    Enabled:         Yes
    Bypass aggregate: No
FPC slot 1 information:
    Bandwidth: 100% (1000 pps), Burst: 100% (1000 packets), enabled

...
```

## show ddos-protection protocols statistics

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>show ddos-protection protocols &lt;protocol-group&gt; statistics</code><br><code>&lt;brief   detail   terse&gt;</code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | Display traffic statistics and DDoS policer violation statistics for all protocol groups or for a particular protocol group.   |
| <b>Options</b>                  | <p><b>none</b>—Display information for all protocol groups.</p> <p><b>brief   detail   terse</b>—(Optional) Display the specified level of output.</p> <ul style="list-style-type: none"> <li><b>brief</b>—Display basic function information.</li> <li><b>detail</b>—Add information to the <b>brief</b> output; it is identical to the output displayed when you choose no option. The <b>brief</b> and <b>detail</b> options display information for all protocol groups, which can be a long list.</li> <li><b>terse</b>—Display the same level of information as the <b>brief</b> option but only for active protocol groups—groups that show traffic in the <b>Received (packets)</b> column.</li> </ul> <p><b>protocol-group</b>—(Optional) Display information for a particular protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection protocols culprit-flows on page 363</a></li> <li>• <a href="#">show ddos-protection protocols flow-detection on page 366</a></li> <li>• <a href="#">show ddos-protection protocols parameters on page 370</a></li> <li>• <a href="#">show ddos-protection protocols violations on page 387</a></li> </ul>   |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection protocols statistics on page 379</a><br><a href="#">show ddos-protection protocols statistics brief on page 382</a><br><a href="#">show ddos-protection protocols statistics terse on page 383</a><br><a href="#">show ddos-protection protocols pppoe statistics on page 384</a><br><a href="#">show ddos-protection protocols pppoe statistics brief on page 386</a>  |
| <b>Output Fields</b>            | <a href="#">Table 15 on page 378</a> lists the output fields for the <b>show ddos-protection protocols statistics</b> command. Output fields are listed in the approximate order in which they appear.   |

Table 15: show ddos-protection protocols statistics Output Fields

| Field Name                        | Field Description   | Level of Output |
|-----------------------------------|---|-----------------|
| <b>Protocol Group</b>             | Name of protocol group.   | All levels      |
| <b>Packet type</b>                | Name of packet type in protocol group.  | All levels      |
| <b>System-wide information</b>    | <p>The following information collected for the router:</p> <ul style="list-style-type: none"> <li>• A message indicates whether the policer has been violated.</li> <li>• No. of FPCs currently receiving excess traffic—Number of cards that are currently in violation of a policer.</li> <li>• No. of FPCs that have received excess traffic—Number of cards that have at some point been in violation of a policer.</li> <li>• Violation first detected at—Timestamp of the first violation.</li> <li>• Violation last seen at—Timestamp of the last observed violation.</li> <li>• Duration of violation—Length of the violation.</li> <li>• Number of violations—Number of times the violation has occurred.</li> <li>• Received—Number of packets received at all card slots and the Routing Engine.</li> <li>• Dropped—Number of packets dropped regardless of where they were dropped.</li> <li>• Arrival rate—Current traffic rate for packets arriving from all cards and at the Routing Engine.</li> <li>• Max arrival rate—Highest traffic rate for packets arriving from all cards and at the Routing Engine.</li> </ul>  | detail none     |
| <b>Routing Engine information</b> | <p>The following information collected for the Routing Engine:</p> <ul style="list-style-type: none"> <li>• A message indicates whether the policer has been violated; the policer might be passed at the individual cards, but the combined rate of packets arriving at the Routing Engine can exceed the configured policer value.</li> <li>• Violation first detected at—Timestamp of the first violation.</li> <li>• Violation last seen at—Timestamp of the last observed violation.</li> <li>• Duration of violation—Length of the violation.</li> <li>• Number of violations—Number of times the violation has occurred.</li> <li>• Received—Number of packets received at the Routing Engine from all cards.</li> <li>• Dropped—Number of packets dropped at the Routing Engine; includes packets dropped by the aggregate policer and by individual protocol policers.</li> <li>• Arrival rate—Current traffic rate for packets arriving at the Routing Engine from all cards.</li> <li>• Max arrival rate—Highest traffic rate for packets arriving at the Routing Engine from all cards.</li> <li>• Dropped by aggregate policer—Number of packets dropped by the aggregate policer.</li> <li>• Dropped by individual policers—Number of packets dropped by individual policer.</li> </ul> | detail none     |



Table 15: show ddos-protection protocols statistics Output Fields (*continued*)

| Field Name                  | Field Description  | Level of Output    |
|-----------------------------|--|--------------------|
| <b>FPC slot information</b> | <p>The following information collected for the card in the indicated slot:</p> <ul style="list-style-type: none"> <li>• A message indicates whether the policer has been violated</li> <li>• Violation first detected at—Timestamp of the first violation</li> <li>• Violation last seen at—Timestamp of the last observed violation</li> <li>• Duration of violation—Length of the violation</li> <li>• Number of violations—Number of times the violation has occurred</li> <li>• Received—Number of packets received on the line card</li> <li>• Dropped—Number of packets dropped at the line card; includes packets dropped by the aggregate policer and by individual protocol policers</li> <li>• Arrival rate—Current traffic rate for packets arriving at the line card</li> <li>• Max arrival rate—Highest traffic rate for packets arriving at the line card</li> <li>• Dropped by this policer—Number of packets dropped by the individual policer</li> <li>• Dropped by aggregate policer—Number of packets dropped by the aggregate policer</li> </ul> | <b>detail none</b> |
| <b>Received (packets)</b>   | Number of packets of this packet type or protocol group received at all cards and the Routing Engine.  | <b>brief terse</b> |
| <b>Dropped (packets)</b>    | Number of packets dropped for this packet type or protocol group, regardless of where the packets were dropped.  | <b>brief terse</b> |
| <b>Rate (pps)</b>           | Highest observed traffic rate for this packet type or protocol group.  | <b>brief terse</b> |
| <b>Violation counts</b>     | Number of violations of the policer bandwidth.   | <b>brief terse</b> |
| <b>State</b>                | <p>Violation state of the packet type:</p> <ul style="list-style-type: none"> <li>• <b>ok</b>—Policer has not been violated for this packet type</li> <li>• <b>viol</b>—Policer has been violated for this packet type</li> </ul>  | <b>brief terse</b> |

## Sample Output

### show ddos-protection protocols statistics

```

user@host> show ddos-protection protocols statistics
Protocol Group: IPv4-Unclassified

Packet type: aggregate
System-wide information:
  Aggregate bandwidth is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
Routing Engine information:
  Aggregate policer is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
  Dropped by individual policers: 0
FPC slot 1 information:
  Aggregate policer is never violated
  Received: 0                      Arrival rate: 0 pps

```

Dropped: 0 Max arrival rate: 0 pps  
Dropped by individual policers: 0

Protocol Group: IPv6-Unclassified

Packet type: aggregate

System-wide information:

Aggregate bandwidth is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Routing Engine information:

Aggregate policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by individual policers: 0

FPC slot 1 information:

Aggregate policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by individual policers: 0

Protocol Group: PPPoE

Packet type: aggregate

System-wide information:

Aggregate bandwidth is never violated

Received: 61961244 Arrival rate: 4000 pps

Dropped: 0 Max arrival rate: 4002 pps

Routing Engine information:

Aggregate policer is never violated

Received: 15488871 Arrival rate: 1001 pps

Dropped: 0 Max arrival rate: 1011 pps

Dropped by individual policers: 0

FPC slot 1 information:

Aggregate policer is never violated

Received: 61961244 Arrival rate: 4000 pps

Dropped: 46473017 Max arrival rate: 4002 pps

Dropped by individual policers: 46473017

Packet type: padi

System-wide information:

Bandwidth is being violated!

No. of FPCs currently receiving excess traffic: 1

No. of FPCs that have received excess traffic: 1

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:41:23 PDT

Duration of violation: 04:18:06 Number of violations: 1

Received: 30980622 Arrival rate: 2000 pps

Dropped: 23236505 Max arrival rate: 2001 pps

Routing Engine information:

Policer is never violated

Received: 7744433 Arrival rate: 500 pps

Dropped: 0 Max arrival rate: 505 pps

Dropped by aggregate policer: 0

FPC slot 1 information:

Policer is currently being violated!

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:41:23 PDT

Duration of violation: 04:18:06 Number of violations: 1

Received: 30980622 Arrival rate: 2000 pps

Dropped: 23236505 Max arrival rate: 2001 pps  
 Dropped by this policer: 23236505  
 Dropped by aggregate policer: 0

Packet type: pado

System-wide information:

Bandwidth is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Routing Engine information:

Policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by aggregate policer: 0

FPC slot 1 information:

Policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by aggregate policer: 0

Packet type: padr

System-wide information:

Bandwidth is being violated!

No. of FPCs currently receiving excess traffic: 1

No. of FPCs that have received excess traffic: 1

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:43:23 PDT

Duration of violation: 04:20:06 Number of violations: 1

Received: 31220846 Arrival rate: 2000 pps

Dropped: 23416690 Max arrival rate: 2001 pps

Routing Engine information:

Policer is never violated

Received: 7806417 Arrival rate: 499 pps

Dropped: 0 Max arrival rate: 506 pps

Dropped by aggregate policer: 0

FPC slot 1 information:

Policer is currently being violated!

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:43:23 PDT

Duration of violation: 04:20:06 Number of violations: 1

Received: 31220846 Arrival rate: 2000 pps

Dropped: 23416690 Max arrival rate: 2001 pps

Dropped by this policer: 23416690

Dropped by aggregate policer: 0

Packet type: pads

System-wide information:

Bandwidth is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Routing Engine information:

Policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by aggregate policer: 0

FPC slot 1 information:

Policer is never violated

Received: 0 Arrival rate: 0 pps

Dropped: 0 Max arrival rate: 0 pps

Dropped by aggregate policer: 0

```

Packet type: padt
System-wide information:
  Bandwidth is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

```

```

Packet type: padm
System-wide information:
  Bandwidth is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

```

```

Packet type: padn
System-wide information:
  Bandwidth is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
  Received: 0           Arrival rate: 0 pps
  Dropped: 0           Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

```

...

### show ddos-protection protocols statistics brief

```
user@host> show ddos-protection protocols statistics brief
```

| Protocol group | Packet type | Received (packets) | Dropped (packets) | Rate (pps) | Violation counts | State |
|----------------|-------------|--------------------|-------------------|------------|------------------|-------|
| ipv4-unclass   | aggregate   | 0                  | 0                 | 0          | 0                | ok    |
| ipv6-unclass   | aggregate   | 0                  | 0                 | 0          | 0                | ok    |
| dynvlan        | aggregate   | 0                  | 0                 | 0          | 0                | ok    |
| ppp            | aggregate   | 0                  | 0                 | 0          | 0                | ok    |
| ppp            | unclass     | 0                  | 0                 | 0          | 0                | ok    |

```

ppp      lcp      0          0          0          0          ok
ppp      auth     0          0          0          0          ok
ppp      ipcp     0          0          0          0          ok
ppp      ipv6cp   0          0          0          0          ok
ppp      mplsdp   0          0          0          0          ok
ppp      isis     0          0          0          0          ok
pppoe    aggregate 61561238    0          4000       0          ok
pppoe    padi     30780619    23086506   2000       1          viol
pppoe    pado     0          0          0          0          ok
pppoe    padr     30780619    23086499   2000       1          viol
pppoe    pads     0          0          0          0          ok
pppoe    padt     0          0          0          0          ok
pppoe    padm     0          0          0          0          ok
pppoe    padn     0          0          0          0          ok
dhcipv4  aggregate 0          0          0          0          ok
dhcipv4  unclass.. 0          0          0          0          ok
dhcipv4  discover 0          0          0          0          ok
dhcipv4  offer    0          0          0          0          ok
dhcipv4  request  0          0          0          0          ok
dhcipv4  decline  0          0          0          0          ok
dhcipv4  ack      0          0          0          0          ok
dhcipv4  nak      0          0          0          0          ok
dhcipv4  release  0          0          0          0          ok
dhcipv4  inform   0          0          0          0          ok
dhcipv4  renew    0          0          0          0          ok
dhcipv4  forcerenew 0          0          0          0          ok
dhcipv4  leasequery 0          0          0          0          ok
dhcipv4  leaseuna.. 0          0          0          0          ok
dhcipv4  leaseunk.. 0          0          0          0          ok
dhcipv4  leaseact.. 0          0          0          0          ok
dhcipv4  bootp    0          0          0          0          ok
dhcipv4  no-msgtype 0          0          0          0          ok
dhcipv4  bad-pack.. 0          0          0          0          ok

```

...

```

icmp     aggregate 0          0          0          0          ok
igmp     aggregate 0          0          0          0          ok
ospf     aggregate 0          0          0          0          ok
rsvp     aggregate 0          0          0          0          ok
pim      aggregate 0          0          0          0          ok
rip      aggregate 0          0          0          0          ok
ptp      aggregate 0          0          0          0          ok
bfd      aggregate 0          0          0          0          ok
lmp      aggregate 0          0          0          0          ok
ldp      aggregate 0          0          0          0          ok
msdp     aggregate 0          0          0          0          ok
bgp      aggregate 0          0          0          0          ok
vrrp     aggregate 0          0          0          0          ok
telnet   aggregate 0          0          0          0          ok

```

...

#### show ddos-protection protocols statistics terse

```

user@host> show ddos-protection protocols statistics terse
Protocol  Packet  Received  Dropped  Rate  Violation  State
group     type   (packets) (packets) (pps)   counts
ipv4-uncls aggregate 241      0         0        0        ok
icmp      aggregate 20       0         0        0        ok

```

|            |           |         |        |   |   |    |
|------------|-----------|---------|--------|---|---|----|
| igmp       | aggregate | 55      | 0      | 0 | 0 | ok |
| ospf       | aggregate | 956     | 0      | 0 | 0 | ok |
| rsvp       | aggregate | 784     | 0      | 0 | 0 | ok |
| ldp        | aggregate | 2984    | 0      | 0 | 0 | ok |
| bgp        | aggregate | 312     | 0      | 0 | 0 | ok |
| lACP       | aggregate | 1744    | 0      | 0 | 0 | ok |
| stp        | aggregate | 9791    | 0      | 0 | 0 | ok |
| arp        | aggregate | 19      | 0      | 0 | 0 | ok |
| pvstp      | aggregate | 393     | 0      | 0 | 0 | ok |
| m1p        | aggregate | 624774  | 0      | 0 | 0 | ok |
| m1p        | packets   | 1714371 | 223937 | 0 | 3 | ok |
| mcast-copy | aggregate | 3018038 | 0      | 0 | 0 | ok |
| igmp-snoop | aggregate | 43      | 0      | 0 | 0 | ok |
| fw-host    | aggregate | 95547   | 0      | 0 | 0 | ok |
| unc1s      | aggregate | 10000   | 0      | 0 | 0 | ok |

### show ddos-protection protocols pppoe statistics

```
user@host> show ddos-protection protocols pppoe statistics
Protocol Group: PPPoE
```

Packet type: aggregate

System-wide information:

Aggregate bandwidth is never violated

Received: 60381200 Arrival rate: 4000 pps

Dropped: 0 Max arrival rate: 4002 pps

Routing Engine information:

Aggregate policer is never violated

Received: 15095242 Arrival rate: 1001 pps

Dropped: 0 Max arrival rate: 1011 pps

Dropped by individual policers: 0

FPC slot 1 information:

Aggregate policer is never violated

Received: 60381200 Arrival rate: 4000 pps

Dropped: 45287921 Max arrival rate: 4002 pps

Dropped by individual policers: 45287921

Packet type: padi

System-wide information:

Bandwidth is being violated!

No. of FPCs currently receiving excess traffic: 1

No. of FPCs that have received excess traffic: 1

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:34:48 PDT

Duration of violation: 04:11:31 Number of violations: 1

Received: 30190600 Arrival rate: 2000 pps

Dropped: 22643960 Max arrival rate: 2001 pps

Routing Engine information:

Policer is never violated

Received: 7547621 Arrival rate: 499 pps

Dropped: 0 Max arrival rate: 505 pps

Dropped by aggregate policer: 0

FPC slot 1 information:

Policer is currently being violated!

Violation first detected at: 2011-04-19 08:23:17 PDT

Violation last seen at: 2011-04-19 12:34:48 PDT

Duration of violation: 04:11:31 Number of violations: 1

Received: 30190600 Arrival rate: 2000 pps

Dropped: 22643960 Max arrival rate: 2001 pps

Dropped by this policer: 22643960

Dropped by aggregate policer: 0

```

Packet type: pado
System-wide information:
  Bandwidth is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

Packet type: padr
System-wide information:
  Bandwidth is being violated!
  No. of FPCs currently receiving excess traffic: 1
  No. of FPCs that have received excess traffic: 1
  Violation first detected at: 2011-04-19 08:23:17 PDT
  Violation last seen at: 2011-04-19 12:34:48 PDT
  Duration of violation: 04:11:31 Number of violations: 1
  Received: 30190600              Arrival rate: 2000 pps
  Dropped: 22643961              Max arrival rate: 2001 pps
Routing Engine information:
  Policer is never violated
  Received: 7547621              Arrival rate: 501 pps
  Dropped: 0                    Max arrival rate: 506 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is currently being violated!
  Violation first detected at: 2011-04-19 08:23:17 PDT
  Violation last seen at: 2011-04-19 12:34:48 PDT
  Duration of violation: 04:11:31 Number of violations: 1
  Received: 30190600              Arrival rate: 2000 pps
  Dropped: 22643961              Max arrival rate: 2001 pps
  Dropped by this policer: 22643961
  Dropped by aggregate policer: 0

Packet type: pads
System-wide information:
  Bandwidth is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
  Received: 0                      Arrival rate: 0 pps
  Dropped: 0                      Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

Packet type: padt
System-wide information:
  Bandwidth is never violated

```

```

Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
Routing Engine information:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

Packet type: padm
System-wide information:
  Bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

Packet type: padn
System-wide information:
  Bandwidth is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0
FPC slot 1 information:
  Policer is never violated
Received: 0          Arrival rate: 0 pps
Dropped: 0          Max arrival rate: 0 pps
  Dropped by aggregate policer: 0

```

#### show ddos-protection protocols pppoe statistics brief

```

user@host> show ddos-protection protocols pppoe statistics brief

```

| Protocol | Packet    | Received  | Dropped   | Rate  | Violation | State |
|----------|-----------|-----------|-----------|-------|-----------|-------|
| group    | type      | (packets) | (packets) | (pps) | counts    |       |
| pppoe    | aggregate | 60901227  | 0         | 4000  | 0         | ok    |
| pppoe    | padi      | 30450613  | 22838981  | 2000  | 1         | viol  |
| pppoe    | pado      | 0         | 0         | 0     | 0         | ok    |
| pppoe    | padr      | 30450614  | 22838977  | 2000  | 1         | viol  |
| pppoe    | pads      | 0         | 0         | 0     | 0         | ok    |
| pppoe    | padt      | 0         | 0         | 0     | 0         | ok    |
| pppoe    | padm      | 0         | 0         | 0     | 0         | ok    |
| pppoe    | padn      | 0         | 0         | 0     | 0         | ok    |



## show ddos-protection protocols violations

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>show ddos-protection protocols &lt;protocol-group&gt; violations</code>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | Display information about DDoS policer violations for all protocol groups or for a particular protocol group.  |
| <b>Options</b>                  | <p><b>none</b>—Display information for all protocol groups.</p> <p><b>protocol-group</b>—(Optional) Name of a particular protocol group. See <a href="#">show ddos-protection protocols</a> for a list of available groups.</p>  |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection protocols culprit-flows on page 363</a></li> <li>• <a href="#">show ddos-protection protocols flow-detection on page 366</a></li> <li>• <a href="#">show ddos-protection protocols parameters on page 370</a></li> <li>• <a href="#">show ddos-protection protocols statistics on page 377</a></li> </ul> |
| <b>List of Sample Output</b>    | <p><a href="#">show ddos-protection protocols violations on page 388</a></p> <p><a href="#">show ddos-protection protocols dhcpv4 violations on page 388</a></p> <p><a href="#">show ddos-protection protocols pppoe violations on page 388</a></p>  |
| <b>Output Fields</b>            | <a href="#">Table 16 on page 387</a> lists the output fields for the <b>show ddos-protection protocols violations</b> command. Output fields are listed in the approximate order in which they appear.   |

**Table 16: show ddos-protection protocols violations Output Fields**

| Field Name                                     | Field Description  |
|--|--|
| Number of packet types that are being violated | Number of individual policers and aggregate policers that are currently being violated |
| Protocol Group                                 | Name of protocol group   |
| Packet type                                    | Name of packet type in protocol group  |
| Bandwidth (pps)                                | Policer bandwidth  |
| Arrival rate (pps)                             | Current traffic rate for packets arriving from all cards and at the Routing Engine     |
| Peak rate (pps)                                | Highest traffic rate for packets arriving from all cards and at the Routing Engine     |

Table 16: show ddos-protection protocols violations Output Fields (*continued*)

| Field Name                              | Field Description   |
|---|---|
| Policer bandwidth violation detected at | Timestamp of the policer violation                          |
| Detected on                             | Slot number of the card on which the violation was detected |

## Sample Output

### show ddos-protection protocols violations

```

user@host> show ddos-protection protocols violations
Number of packet types that are being violated: 2
Protocol  Packet      Bandwidth  Arrival  Peak  Policer bandwidth
group    type        (pps)      rate(pps) rate(pps) violation detected at
pppoe    padi        500        2000     2001  2011-04-19 08:23:17 PDT
          Detected on: FPC-1
pppoe    padr        500        1999     2001  2011-04-19 08:23:17 PDT
          Detected on: FPC-1

```

### show ddos-protection protocols dhcpv4 violations

```

user@host> show ddos-protection protocols dhcpv4 violations
Number of packet types that are being violated: 0

```

### show ddos-protection protocols pppoe violations

```

user@host> show ddos-protection protocols pppoe violations
Number of packet types that are being violated: 2
Protocol  Packet      Bandwidth  Arrival  Peak  Policer bandwidth
group    type        (pps)      rate(pps) rate(pps) violation detected at
pppoe    padi        500        2000     2001  2011-04-19 08:23:17 PDT
          Detected on: FPC-1
pppoe    padr        500        1999     2001  2011-04-19 08:23:17 PDT
          Detected on: FPC-1

```

## show ddos-protection statistics

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <b>show ddos-protection statistics</b>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.  |
| <b>Description</b>              | Display DDoS protection global statistics for bandwidth violations.   |
| <b>Options</b>                  | This command has no options.  |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection version on page 390</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection statistics on page 389</a>   |
| <b>Output Fields</b>            | <a href="#">Table 17 on page 389</a> lists the output fields for the <b>show ddos-protection statistics</b> command. Output fields are listed in the approximate order in which they appear.  |

**Table 17: show ddos-protection statistics Output Fields**

| Field Name                               | Field Description   |
|--|---|
| <b>Currently violated packet types</b>   | Number of packet types currently experiencing a bandwidth violation.                              |
| <b>Packet types have seen violations</b> | Number of packet types that have experienced a bandwidth violation since statistics were cleared. |
| <b>Total violation counts</b>            | Total number of bandwidth violations.   |

## Sample Output

### show ddos-protection statistics

```

user@host> show ddos-protection statistics
DDOS protection global statistics:
  Currently violated packet types:    2
  Packet types have seen violations:  2
  Total violation counts:             2

```

## show ddos-protection version

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <b>show ddos-protection version</b>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.   |
| <b>Description</b>              | Display the DDoS protection version and the total numbers of protocol groups and packet types that this version can be configured in this version.   |
| <b>Options</b>                  | This command has no options.   |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ddos-protection protocols on page 346</a></li> <li>• <a href="#">show ddos-protection protocols on page 347</a></li> <li>• <a href="#">show ddos-protection statistics on page 389</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show ddos-protection version on page 390</a>   |
| <b>Output Fields</b>            | Table 18 on page 390 lists the output fields for the <b>show ddos-protection version</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 18: show ddos-protection version Output Fields

| Field Name                        | Field Description  |
|-----------------------------------|--|
| <b>Version</b>                    | Version number of the DDoS protection code.                      |
| <b>Total protocol groups</b>      | Number of protocol groups configured with DDoS protection.       |
| <b>Total tracked packet types</b> | Number of protocol packet types configured with DDoS protection. |

## Sample Output

### show ddos-protection version

```

user@host> show ddos-protection version
DDoS protection, Version 1.0
  Total protocol groups      = 83
  Total tracked packet types = 154

```

## CHAPTER 22

# Operational Commands: IPsec and Digital Certificates

- clear security pki ca-certificate
- clear security pki certificate-request
- clear security pki crl
- clear security pki key-pair
- clear security pki local-certificate
- clear services ipsec-vpn certificates
- clear services ipsec-vpn ipsec statistics
- clear services ipsec-vpn ike security-associations
- clear services ipsec-vpn ipsec security-associations
- request security certificate (signed)
- request security certificate (unsigned)
- request security key-pair
- request security pki ca-certificate enroll
- request security pki ca-certificate load
- request security pki ca-certificate verify
- request security pki crl load
- request security pki generate-certificate-request
- request security pki generate-key-pair
- request security pki local-certificate enroll
- request security pki local-certificate generate-self-signed
- request security pki local-certificate load
- request security pki local-certificate verify
- request system certificate add
- show ike security-associations
- show ipsec certificates
- show ipsec security-associations

- `show security keychain`
- `show security pki ca-certificate`
- `show security pki certificate-request`
- `show security pki crt`
- `show security pki local-certificate`
- `show services ipsec-vpn certificates`
- `show services ipsec-vpn ike security-associations`
- `show services ipsec-vpn ipsec security-associations`
- `show services ipsec-vpn ipsec statistics`
- `show system certificate`

## clear security pki ca-certificate

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear security pki ca-certificate (all   ca-profile <i>ca-profile-name</i> )   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Delete certificate authority (CA) digital certificates from the router.  |
| <b>Options</b>                  | <b>all</b> —Delete all CA digital certificates from the router.<br><b>ca-profile <i>ca-profile-name</i></b> —Delete the specified CA profile.  |
| <b>Required Privilege Level</b> | clear  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">request security pki ca-certificate enroll on page 406</a></li><li>• <a href="#">request security pki ca-certificate load on page 407</a></li><li>• <a href="#">show security pki ca-certificate on page 432</a></li></ul> |
| <b>List of Sample Output</b>    | <a href="#">clear security pki ca-certificate all on page 393</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

### Sample Output

clear security pki ca-certificate all

```
user@host> clear security pki ca-certificate all
```

## clear security pki certificate-request

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear security pki certificate-request (all   certificate-id <i>certificate-id-name</i> )  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Delete manually generated local digital certificate requests from the router.  |
| <b>Options</b>                  | <p><b>all</b>—Delete all local digital certificate requests from the router.</p> <p><b>certificate-id <i>certificate-id-name</i></b>—Delete the specified local digital certificate and corresponding public/private key pair.</p> |
| <b>Required Privilege Level</b> | clear  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show security pki certificate-request on page 436</a></li></ul>  |
| <b>List of Sample Output</b>    | <a href="#">clear security pki certificate-request all on page 394</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

### Sample Output

#### clear security pki certificate-request all

```
user@host> clear security pki certificate-request all
```



## clear security pki crt

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | clear security pki crt (all   ca-profile <i>ca-profile-name</i> )   |
| <b>Release Information</b>      | Command introduced in Junos 8.1   |
| <b>Description</b>              | Delete certificate revocation lists (CRLs) from the router.   |
| <b>Options</b>                  | <b>all</b> —Delete all CRLs from the router.<br><br><b>ca-profile <i>ca-profile-name</i></b> —Delete CRLs associated with the specified CA profile. |
| <b>Required Privilege Level</b> | clear   |
| <b>List of Sample Output</b>    | <a href="#">clear security pki crt ca-profile all on page 395</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

### clear security pki crt ca-profile all

```
user@host> clear security pki crt ca-profile all
```

## clear security pki key-pair

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear security pki key-pair (all   certificate-id <i>certificate-id-name</i> )   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.  |
| <b>Description</b>              | Clear public key infrastructure (PKI) key pair information for local digital certificates from the router.   |
| <b>Options</b>                  | <p><b>all</b>—Delete all local digital certificates, certificate requests, and the corresponding public and private key pairs from the router.</p> <p><b>certificate-id <i>certificate-id-name</i></b>—Delete the specified local digital certificate and corresponding public/private key pair.</p> |
| <b>Required Privilege Level</b> | clear  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">request security pki local-certificate enroll on page 413</a></li><li>• <a href="#">show security pki local-certificate on page 440</a></li></ul>  |
| <b>Output Fields</b>            | This command produces no output.   |

## Sample Output

```
user@host> clear security pki key pair
```

## clear security pki local-certificate

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear security pki local-certificate<br><all   certificate-id <i>certificate-id-name</i>   system-generated>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Delete local digital certificates, certificate requests, and the corresponding public/private key pairs from the router.   |
| <b>Options</b>                  | <p><b>all</b>—(Optional) Delete all local digital certificates, certificate requests, and the corresponding public and private key pairs from the router.</p> <p><b>certificate-id <i>certificate-id-name</i></b>—(Optional) Delete the specified local digital certificate and corresponding public and private key pair.</p> <p><b>system-generated</b>—(Optional) Auto-generated self-signed certificate.</p> |
| <b>Required Privilege Level</b> | clear  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">request security pki local-certificate enroll on page 413</a></li> <li>• <a href="#">show security pki local-certificate on page 440</a></li> </ul>   |
| <b>List of Sample Output</b>    | <a href="#">clear security pki local-certificate all on page 397</a>   |
| <b>Output Fields</b>            | This command produces no output.   |

### Sample Output

clear security pki local-certificate all

```
user@host> clear security pki local-certificate all
```

## clear services ipsec-vpn certificates

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | clear services ipsec-vpn certificates (all   service-set <i>service-set</i> )<br><certificate-cache-entry <i>number</i> >   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | (Adaptive services interfaces only) Delete digital certificates from the IPsec configuration memory cache. Issuing this command also clears the certificate revocation list (CRL) from the cache along with the certificates. |
| <b>Options</b>                  | <b>all</b> —Delete digital certificates for all service sets.<br><br><b>service-set <i>service-set</i></b> —Delete digital certificates for the specified service set.  |
| <b>Required Privilege Level</b> | clear   |
| <b>List of Sample Output</b>    | <a href="#">clear services ipsec-vpn certificates all on page 398</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

### Sample Output

#### clear services ipsec-vpn certificates all

```
user@host> clear services ipsec-vpn certificates all
```

## clear services ipsec-vpn ipsec statistics

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear services ipsec-vpn ipsec statistics<br><remote-gateway <i>address</i> ><br><service-set <i>service-set-name</i> >  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.1.  |
| <b>Description</b>              | (Adaptive services interface only) Clear IP Security (IPsec) statistics.   |
| <b>Options</b>                  | <b>remote-gateway <i>address</i></b> —(Optional) Clear statistics for the specified remote system.<br><br><b>service-set <i>service-set-name</i></b> —(Optional) Clear statistics for the specified service set. |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show services ipsec-vpn ipsec statistics on page 454</a></li></ul>   |
| <b>List of Sample Output</b>    | <a href="#">clear services ipsec-vpn ipsec statistics on page 399</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

## Sample Output

### clear services ipsec-vpn ipsec statistics

```
user@host> clear services ipsec-vpn ipsec statistics
```

## clear services ipsec-vpn ike security-associations

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | clear services ipsec-vpn ike security-associations<br><peer-address-name><br><service-set service-set-name>   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>service-set option added in Junos OS Release 8.5.  |
| <b>Description</b>              | (Adaptive services interfaces only) Clear Internet Key Exchange (IKE) security associations.  |
| <b>Options</b>                  | <b>peer-address-name</b> —(Optional) Clear only the security association specified by the peer address.<br><br><b>service-set service-set-name</b> —(Optional) Clear only the security association specified by the service-set name. |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show services ipsec-vpn ike security-associations on page 446</a></li></ul>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

### Sample Output

#### clear services ipsec-vpn ike security-associations

```
user@host> clear services ipsec-vpn ike security-associations
```

## clear services ipsec-vpn ipsec security-associations

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | clear services ipsec-vpn security-associations<br><peer-address-name><br><remote-gateway remote-gateway-address><br><service-set-name><br><tunnel-index tunnel-index-number>   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br><b>remote-gateway</b> , <b>service-set-name</b> , and <b>tunnel-index</b> options added in Junos OS Release 8.4.  |
| <b>Description</b>              | (Adaptive services interfaces only) Clear IP Security (IPsec) security associations. You can combine the options for greater specificity.  |
| <b>Options</b>                  | <p><b>peer-address-name</b>—(Optional) Clear only the security association specified by the peer address.</p> <p><b>remote-gateway remote-gateway-address</b>—(Optional) Clear only the security association specified by the remote gateway address.</p> <p><b>service-set-name</b>—(Optional) Clear only the security association specified by the service-set name.</p> <p><b>tunnel-index tunnel-index-number</b>—(Optional) Clear only the security association specified by the tunnel index number.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show services ipsec-vpn ipsec security-associations on page 450</a></li> </ul>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

## Sample Output

### clear services ipsec-vpn ipsec security-associations

```
user@host> clear services ipsec-vpn ipsec security-associations
```

## request security certificate (signed)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>request security certificate enroll filename <i>filename</i> subject <i>subject</i><br/>alternative-subject <i>alternative-subject</i> certification-authority <i>certification-authority</i> encoding<br/>(binary   pem) key-file <i>key-file</i> domain-name <i>domain-name</i></code>   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 9.0 for EX Series switches.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Obtain a signed certificate from a certificate authority (CA). The signed certificate validates the CA and the owner of the certificate. The results are saved in a specified file to the <code>/var/etc/ikecert</code> directory.  |
| <b>Options</b>                  | <p><b>filename <i>filename</i></b>—File that stores the certificate.</p> <p><b>subject <i>subject</i></b>—Distinguished name (<b>dn</b>), which consists of a set of components—for example, an organization (<b>o</b>), an organization unit (<b>ou</b>), a country (<b>c</b>), and a locality (<b>l</b>).</p> <p><b>alternative-subject <i>alternative-subject</i></b>—Tunnel source address.</p> <p><b>certification-authority <i>certification-authority</i></b>—Name of the certificate authority profile in the configuration.</p> <p><b>encoding (binary   pem)</b>—File format used for the certificate. The format can be a binary file or privacy-enhanced mail (PEM), an ASCII base64-encoded format. The default format is binary.</p> <p><b>key-file <i>key-file</i></b>—File containing a local private key.</p> <p><b>domain-name <i>domain-name</i></b>—Fully qualified domain name.</p> |
| <b>Required Privilege Level</b> | maintenance  |
| <b>List of Sample Output</b>    | <a href="#">request security certificate (signed) on page 402</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

## Sample Output

### request security certificate (signed)

```
user@host> request security certificate enroll filename host.crt subject c=uk,o=london  
alternative-subject 10.50.1.4 certification-authority verisign key-file host-1.prv domain-name  
host.juniper.net  
CA name: juniper.net CA file: ca_verisign  
local pub/private key pair: host.prv  
subject: c=uk,o=london domain name: host.juniper.net  
alternative subject: 10.50.1.4  
Encoding: binary  
Certificate enrollment has started. To view the status of your enrollment, check  
the key management process (kmd) log file at /var/log/kmd. <-----
```





## request security certificate (unsigned)

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>request security certificate enroll filename <i>filename</i> ca-file <i>ca-file</i> ca-name <i>ca-name</i> encoding (binary   perm) url <i>url</i></code>  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 9.0 for EX Series switches.  |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Obtain a certificate from a certificate authority (CA). The results are saved in a specified file to the <code>/var/etc/ikecert</code> directory.   |
| <b>Options</b>                  | <p><code>filename <i>filename</i></code>—File that stores the public key certificate.</p> <p><code>ca-file <i>ca-file</i></code>—Name of the certificate authority profile in the configuration.</p> <p><code>ca-name <i>ca-name</i></code>—Name of the certificate authority.</p> <p><code>encoding (binary   pem)</code>—File format used for the certificate. The format can be a binary file or privacy-enhanced mail (PEM), an ASCII base64-encoded format. The default value is <b>binary</b>.</p> <p><code>url <i>url</i></code>—Certificate authority URL.</p> |
| <b>Required Privilege Level</b> | maintenance  |
| <b>List of Sample Output</b>    | <a href="#">request security certificate (unsigned) on page 404</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

## Sample Output

### request security certificate (unsigned)

```
user@host> request security certificate enroll filename ca_verisign ca-file verisign ca-name
juniper.net urlxyzcompany URL
http://<verisign ca-name xyzcompany url>/cgi-bin/pkiclient.exe CA name: juniper.net
CA file: verisign Encoding: binary
Certificate enrollment has started. To view the status of your enrollment, check
the key management process (kmd) log file at /var/log/kmd. <-----
```

## request security key-pair

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security key-pair <i>filename</i></code><br><code>&lt;size <i>key-size</i>&gt;</code><br><code>&lt;type (rsa   dsa)&gt;</code>  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 9.0 for EX Series switches.   |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers and EX Series switches only)<br>Generate a public and private key pair for a digital certificate.  |
| <b>Options</b>                  | <b><i>filename</i></b> —Name of a file in which to store the key pair.<br><br><b><i>size key-size</i></b> —(Optional) Key size, in bits. The key size can be <b>512</b> , <b>1024</b> , or <b>2048</b> . The default value is <b>1024</b> .<br><br><b><i>type</i></b> —(Optional) Algorithm used to encrypt the key: <ul style="list-style-type: none"> <li>• <b>rsa</b>—RSA algorithm. This is the default.</li> <li>• <b>dsa</b>—Digital signature algorithm with Secure Hash Algorithm (SHA).</li> </ul> |
| <b>Required Privilege Level</b> | maintenance   |
| <b>List of Sample Output</b>    | <a href="#">request security key-pair on page 405</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

### request security key-pair

```
user@host> request security key-pair security-key-file
```

## request security pki ca-certificate enroll

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>request security pki ca-certificate enroll ca-profile <i>ca-profile-name</i></code>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Request a digital certificate from a certificate authority (CA) online by using the Simple Certificate Enrollment Protocol (SCEP).   |
| <b>Options</b>                  | <code>ca-profile <i>ca-profile-name</i></code> —CA profile name.   |
| <b>Required Privilege Level</b> | maintenance  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear security pki ca-certificate on page 393</a></li><li>• <a href="#">show security pki ca-certificate on page 432</a></li></ul> |
| <b>List of Sample Output</b>    | <a href="#">request security pki ca-certificate enroll on page 406</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

### Sample Output

#### request security pki ca-certificate enroll

```
user@host> request security pki ca-certificate enroll ca-profile entrust
Received following certificates:
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: 46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f
Certificate: C=us, O=juniper, CN=First Officer
Fingerprint: bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17
Certificate: C=us, O=juniper
Fingerprint: 00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10
Do you want to load the above CA certificate ? [yes,no] (no) yes
```

## request security pki ca-certificate load

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki ca-certificate load ca-profile <i>ca-profile-name</i> filename <i>path/filename</i></code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | Manually load a certificate authority (CA) digital certificate from a specified location.   |
| <b>Options</b>                  | <p><b>ca-profile <i>ca-profile-name</i></b>—Load the specified CA profile.</p> <p><b>filename <i>path/filename</i></b>—Directory location and filename of the CA digital certificate.</p> |
| <b>Required Privilege Level</b> | maintenance   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear security pki ca-certificate on page 393</a></li> <li>• <a href="#">show security pki ca-certificate on page 432</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">request security pki ca-certificate load on page 407</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

### request security pki ca-certificate load

```
user@host> request security pki ca-certificate load ca-profile ca-private filename pki-file
```

## request security pki ca-certificate verify

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki ca-certificate verify ca-profile <i>ca-profile-name</i></code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.   |
| <b>Description</b>              | Verify the digital certificate installed for the specified certificate authority (CA).      |
| <b>Options</b>                  | <b>ca-profile <i>ca-profile-name</i></b> —Name of the local digital certificate identifier. |
| <b>Required Privilege Level</b> | maintenance   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.       |

### Sample Output

You receive the following response before the certificate revocation list (CRL) is downloaded:

```
request security pki ca-certificate verify ca-profile ca1 (CRL not downloaded)
user@host> request security pki ca-certificate verify ca-profile ca1
```

```
CA certificate ca1: CRL verification in progress. Please check the PKId debug
logs for completion status
```

## request security pki crt load

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki crt load ca-profile <i>ca-profile-name</i> filename <i>path/filename</i></code>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.1.   |
| <b>Description</b>              | Manually install a certificate revocation list (CRL) on the router from a specified location.   |
| <b>Options</b>                  | <code>ca-profile <i>ca-profile-name</i></code> —Load the specified certificate authority (CA) profile.<br><code>filename <i>path/filename</i></code> —Directory location and filename of the CRL. |
| <b>Required Privilege Level</b> | maintenance   |
| <b>List of Sample Output</b>    | <a href="#">request security pki crt load on page 409</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

### request security pki crt load

```
user@host> request security pki crt load ca-profile ca-private filename pki-file
```

## request security pki generate-certificate-request

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>request security pki generate-certificate-request certificate-id <i>certificate-id-name</i><br/>domain-name <i>domain-name</i> subject <i>subject-distinguished-name</i><br/>&lt;email <i>email-address</i>&gt;<br/>&lt;filename (<i>path</i>   <i>terminal</i>)&gt;<br/>&lt;ip-address <i>ip-address</i>&gt;</code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Manually generate a local digital certificate request in the Public-Key Cryptography Standards #10 (PKCS-10) format.   |
| <b>Options</b>                  | <p><b>certificate-id <i>certificate-id-name</i></b>—Name of the local digital certificate and the public/private key pair.</p> <p><b>domain-name <i>domain-name</i></b>—Fully qualified domain name (FQDN). The FQDN provides the identity of the certificate owner for Internet Key Exchange (IKE) negotiations and provides an alternative to the subject name.</p> <p><b>subject <i>subject-distinguished-name</i></b>—Distinguished name format that contains the common name, department, company name, state, and country:</p> <ul style="list-style-type: none"><li>• <b>CN</b>—Common name</li><li>• <b>OU</b>—Organizational unit name</li><li>• <b>O</b>—Organization name</li><li>• <b>ST</b>—State</li><li>• <b>C</b>—Country</li></ul> <p><b>email <i>email-address</i></b>—(Optional) E-mail address of the certificate holder.</p> <p><b>filename (<i>path</i>   <i>terminal</i>)</b>—(Optional) Location where the local digital certificate request should be placed or the login terminal.</p> <p><b>ip-address <i>ip-address</i></b>—(Optional) IP address of the router.</p> |
| <b>Required Privilege Level</b> | maintenance  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear security pki certificate-request on page 394</a></li><li>• <a href="#">show security pki certificate-request on page 436</a></li></ul>   |
| <b>List of Sample Output</b>    | <a href="#">request security pki generate-certificate-request on page 411</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |



## Sample Output

### request security pki generate-certificate-request

```
user@host> request security pki generate-certificate-request certificate-id local-entrust2
domain-name router2.juniper.net filename entrust-req2 subject cn=router2.juniper.net
```

Generated certificate request

-----BEGIN CERTIFICATE REQUEST-----

```
MIIBOTCCAQoCAQAwGjEYMBYGA1UEAxMPdHxLmp1bm1wZXIubmV0MIGfMA0GCSqG
SIb3DQEBAQUAA4GNADCBiQKBgQCiUFk1Qws1Ud+AqN5DDxRs2kVyKEhh9qoVFnz+
Hz4c9vsy3B8E1wTJ1kmIt2cB3yi fB6zePd+6WYpf57Crwre7YqPk iXM31F6z3YjX
H+1BPNbCxNWYvyrnSyVYDbFj8o0Xyqog8ACDFVL2JBWrPNBYy7imq/K9soDBbAs6
5hZqqwIDAQABoEcwRQYJKoZIhvcNAQkOMTgwNjA0BGNVHQ8BAf8EBAMCB4AwJAYD
VR0RAQH/BBowGIIWdHxLmVuZ2xhYi5qdW5pcGVyLm5ldDANBgkqhkiG9w0BAQQF
AAOBgQBc2rq1v5S0QXH7LCb/FdqAL8ZM6GoaN5d6cGwq4bB6a7UQFgtH406gQ3G
3iH0Zfz4xMIBpJYuGd1dkqgvcDoH3AgTsLkfn7Wi3x5H2qeQVs9bvL4P5nvEZLND
EIMUHwteo1ZCiZ70f09Fer9cXWHSQs1UtXtgPqQJy2xIeImLgw==
```

-----END CERTIFICATE REQUEST-----

Fingerprint:

```
0d:90:b8:d2:56:74:fc:84:59:62:b9:78:71:9c:e4:9c:54:ba:16:97 (sha1)
1b:08:d4:f7:90:f1:c4:39:08:c9:de:76:00:86:62:b8 (md5)
```

## request security pki generate-key-pair

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki generate-key-pair certificate-id <i>certificate-id-name</i> &lt;size (512   1024   2048)&gt;</code>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | Generate a Public Key Infrastructure (PKI) public and private key pair for a local digital certificate.   |
| <b>Options</b>                  | <b>certificate-id <i>certificate-id-name</i></b> —Name of the local digital certificate and the public/private key pair.<br><br><b>size</b> —(Optional) Key pair size. The key pair size can be <b>512</b> , <b>1024</b> , or <b>2048</b> bits. |
| <b>Required Privilege Level</b> | maintenance   |
| <b>List of Sample Output</b>    | <a href="#">request security pki generate-key-pair on page 412</a>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

### Sample Output

#### request security pki generate-key-pair

```
user@host> request security pki generate-key-pair certificate-id billy size 2048
Generated key pair billy, key size 2048 bits
```

## request security pki local-certificate enroll

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | request security pki local-certificate enroll <i>ca-profile ca-profile-name</i><br><i>certificate-id certificate-id-name</i> challenge-password <i>password</i> domain-name<br><i>domain-name</i> subject <i>subject-distinguished-name</i><br><email <i>email-address</i> ><br><ip-address <i>ip-address</i> >  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Request that a certificate authority (CA) enroll and install a local digital certificate online by using the Simple Certificate Enrollment Protocol (SCEP).  |
| <b>Options</b>                  | <p><b>ca-profile</b> <i>ca-profile-name</i>—CA profile name.</p> <p><b>certificate-id</b> <i>certificate-id-name</i>—Name of the local digital certificate and the public/private key pair.</p> <p><b>challenge-password</b> <i>password</i>—Password set by the administrator and normally obtained from the SCEP enrollment webpage of the CA. The password is 16 characters in length.</p> <p><b>domain-name</b> <i>domain-name</i>—Fully qualified domain name (FQDN). The FQDN provides the identity of the certificate owner for Internet Key Exchange (IKE) negotiations and provides an alternative to the subject name.</p> <p><b>subject</b> <i>subject-distinguished-name</i>—Distinguished name format that contains the common name, department, company name, state, and country:</p> <ul style="list-style-type: none"> <li>• <b>CN</b>—Common name</li> <li>• <b>OU</b>—Organizational unit name</li> <li>• <b>O</b>—Organization name</li> <li>• <b>ST</b>—State</li> <li>• <b>C</b>—Country</li> </ul> <p><b>email</b> <i>email-address</i>—(Optional) E-mail address of the certificate holder.</p> <p><b>ip-address</b> <i>ip-address</i>—(Optional) IP address of the router.</p> |
| <b>Required Privilege Level</b> | maintenance  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show security pki local-certificate on page 440</a></li> </ul>  |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

## Sample Output

```
user@host> request security pki local-certificate enroll certificate-id r3-entrust-scep ca-profile  
entrust domain-name router3.juniper.net subject "CN=router3,OU=Engineering,O=juniper,C=US"  
challenge-password 123
```

Certificate enrollment has started. To view the status of your enrollment, check the public key infrastructure log (pkid) log file at /var/log/pkid. Please save the challenge-password for revoking this certificate in future. Note that this password is not stored on the router.

## request security pki local-certificate generate-self-signed

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki local-certificate generate-self-signed certificate-id <i>certificate-id-name</i><br/>domain-name <i>domain-name</i> ip-address <i>ip-address</i> email <i>email-address</i><br/>subject <i>subject-distinguished-name</i></code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.1.   |
| <b>Description</b>              | Manually generate a self-signed certificate for the given distinguished name.   |
| <b>Options</b>                  | <p><b>certificate-id <i>certificate-id-name</i></b>—Name of the local digital certificate and the public/private key pair.</p> <p><b>domain-name <i>domain-name</i></b>—Fully qualified domain name (FQDN). The FQDN provides the identity of the certificate owner for Internet Key Exchange (IKE) negotiations and provides an alternative to the subject name.</p> <p><b>email <i>email-address</i></b>—E-mail address of the certificate holder.</p> <p><b>ip-address <i>ip-address</i></b>—IP address of the router.</p> <p><b>subject <i>subject-distinguished-name</i></b>—Distinguished name format that contains the common name, department, company name, state, and country:</p> <ul style="list-style-type: none"> <li>• <b>CN</b>—Common name</li> <li>• <b>OU</b>—Organizational unit name</li> <li>• <b>O</b>—Organization name</li> <li>• <b>ST</b>—State</li> <li>• <b>C</b>—Country</li> </ul> |
| <b>Required Privilege Level</b> | maintenance<br>security   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show security pki local-certificate on page 440</a></li> </ul>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

## Sample Output

```
user@host> request security pki local-certificate generate-self-signed certificate-id self-cert
subject cn=abc domain-name juniper.net email mholmes@juniper.net
Self-signed certificate generated and loaded successfully
```

## request security pki local-certificate load

---

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki local-certificate load certificate-id <i>certificate-id-name</i> filename <i>path</i></code>   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | Manually load a local digital certificate from a specified location.  |
| <b>Options</b>                  | <p><b>certificate-id <i>certificate-id-name</i></b>—Name of the public/private key pair mapped to the local digital certificate.</p> <p><b>filename <i>path/filename</i></b>—Directory location and filename of the local digital certificate provided by the CA.</p> |
| <b>Required Privilege Level</b> | maintenance   |
| <b>List of Sample Output</b>    | <a href="#">request security pki local-certificate load on page 416</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.   |

### Sample Output

#### request security pki local-certificate load

```
user@host> request security pki local-certificate load filename /tmp/router2-cert certificate-id
local-entrust2
Local certificate local-entrust2 loaded successfully
```

## request security pki local-certificate verify

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>request security pki local-certificate verify certificate-id <i>certificate-id-name</i></code>                |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.   |
| <b>Description</b>              | Verify the validity of the local digital certificate identifier.  |
| <b>Options</b>                  | <code>certificate-id <i>certificate-id-name</i></code> —Display the specified certificate identifier name.          |
| <b>Required Privilege Level</b> | maintenance   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show security pki local-certificate on page 440</a></li> </ul> |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                               |

## Sample Output

You receive the following response before the certificate revocation list (CRL) is downloaded:

```
request security pki local-certificate verify certificate-id bme1 (not downloaded)
user@host> request security pki local-certificate verify certificate-id bme1
```

```
Local certificate bme1: CRL verification in progress. Please check the PKId debug
logs for completion status
```

You receive the following response after the certificate revocation list (CRL) is downloaded:

```
request security pki local-certificate verify certificate bme1 (downloaded)
user@host> request security pki local-certificate verify certificate-id bme1
Local certificate bme1 verification success
```

## request system certificate add

---

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | <code>request system certificate add (<i>filename</i>   terminal)</code>   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 11.1 for the QFX Series.   |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers, PTX Series, and QFX Series switches only) Add a certificate provided by the Juniper Networks certificate authority (CA). |
| <b>Options</b>                  | <b><i>filename</i></b> —Filename (URL, local, or remote).<br><b><i>terminal</i></b> —Use login terminal.   |
| <b>Required Privilege Level</b> | maintenance  |
| <b>List of Sample Output</b>    | <a href="#">request system certificate add on page 418</a>   |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.  |

### Sample Output

#### request system certificate add

```
user@host> request system certificate add terminal
```



## show ike security-associations

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show ike security-associations<br><brief   detail><br><peer-address>  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers only) Display information about Internet Key Exchange (IKE) security associations.   |
| <b>Options</b>                  | <p><b>none</b>—Display standard information about all IKE security associations.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>peer-address</b>—(Optional) Display IKE security associations for the specified peer address.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear ike security-associations</a></li> </ul>   |
| <b>List of Sample Output</b>    | <a href="#">show ike security-associations on page 422</a><br><a href="#">show ike security-associations detail on page 422</a>   |
| <b>Output Fields</b>            | <p><a href="#">Table 19 on page 419</a> lists the output fields for the <b>show ike security-associations</b> command. Output fields are listed in the approximate order in which they appear.</p>  |

**Table 19: show ike security-associations Output Fields**

| Field Name              | Field Description   | Level of Output |
|-------------------------|---|-----------------|
| <b>IKE peer</b>         | Remote end of the IKE negotiation.  | <b>detail</b>   |
| <b>Role</b>             | Part played in the IKE session. The router triggering the IKE negotiation is the initiator, and the router accepting the first IKE exchange packets is the responder.   | <b>detail</b>   |
| <b>Remote Address</b>   | Responder's address.  | none specified  |
| <b>State</b>            | State of the IKE security association: <ul style="list-style-type: none"> <li>• <b>Matured</b>—The IKE security association is established.</li> <li>• <b>Not matured</b>—The IKE security association is in the process of negotiation.</li> </ul> | none specified  |
| <b>Initiator cookie</b> | When the IKE negotiation is triggered, a random number is sent to the remote node.  | All levels      |

Table 19: show ike security-associations Output Fields (*continued*)

| Field Name                   | Field Description   | Level of Output |
|------------------------------|---|-----------------|
| <b>Responder cookie</b>      | <p>The remote node generates its own random number and sends it back to the initiator as a verification that the packets were received.</p> <p>Of the numerous security services available, protection against denial of service (DoS) is one of the most difficult to address. A “cookie” or anticlogging token (ACT) is aimed at protecting the computing resources from attack without spending excessive CPU resources to determine the cookie's authenticity. An exchange prior to CPU-intensive public key operations can thwart some DoS attempts (such as simple flooding with invalid IP source addresses).</p>  | All levels      |
| <b>Exchange type</b>         | <p>Specifies the number of messages in an IKE exchange, and the payload types that are contained in each message. Each exchange type provides a particular set of security services, such as anonymity of the participants, perfect forward secrecy of the keying material, and authentication of the participants. Junos OS supports two types of exchanges:</p> <ul style="list-style-type: none"> <li>• <b>Main</b>—The exchange is done with six messages. <b>Main</b> encrypts the payload, protecting the identity of the neighbor.</li> <li>• <b>Aggressive</b>—The exchange is done with three messages. <b>Aggressive</b> does not encrypt the payload, leaving the identity of the neighbor unprotected.</li> </ul> | All Levels      |
| <b>Authentication method</b> | Type of authentication determines which payloads are exchanged and when they are exchanged. The Junos OS supports only <b>pre-shared keys</b> .   | <b>detail</b>   |
| <b>Local</b>                 | Prefix and port number of the local end.  | <b>detail</b>   |
| <b>Remote</b>                | Prefix and port number of the remote end.   | <b>detail</b>   |
| <b>Lifetime</b>              | Number of seconds remaining until the IKE security association expires.   | <b>detail</b>   |
| <b>Algorithms</b>            | <p>Header for the IKE algorithms output.</p> <ul style="list-style-type: none"> <li>• <b>Authentication</b>—Type of authentication algorithm used: <b>md5</b> or <b>sha1</b>.</li> <li>• <b>Encryption</b>—Type of encryption algorithm used: <b>des-cbc</b>, <b>3des-cbc</b>, or <b>None</b>.</li> <li>• <b>Pseudo random function</b>—Function that generates highly unpredictable random numbers: <b>hmac-md5</b> or <b>hmac-sha1</b>.</li> </ul>  | <b>detail</b>   |
| <b>Traffic statistics</b>    | <p>Number of bytes and packets received and transmitted on the IKE security association.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the IKE security association.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the IKE security association.</li> </ul>   | <b>detail</b>   |

Table 19: show ike security-associations Output Fields (*continued*)

| Field Name                              | Field Description   | Level of Output |
|---|---|-----------------|
| <b>Flags</b>                            | Notification to the key management process of the status of the IKE negotiation: <ul style="list-style-type: none"> <li>• <b>caller notification sent</b>—Caller program notified about the completion of the IKE negotiation.</li> <li>• <b>waiting for done</b>—Negotiation is done. The library is waiting for the remote end retransmission timers to expire.</li> <li>• <b>waiting for remove</b>—Negotiation has failed. The library is waiting for the remote end retransmission timers to expire before removing this negotiation.</li> <li>• <b>waiting for policy manager</b>—Negotiation is waiting for a response from the policy manager.</li> </ul>   | <b>detail</b>   |
| <b>IPsec security associates</b>        | Number of IPsec security associations created and deleted with this IKE security association.   | <b>detail</b>   |
| <b>Phase 2 negotiations in progress</b> | Number of phase 2 IKE negotiations in progress and status information: <ul style="list-style-type: none"> <li>• <b>Negotiation type</b>—Type of phase 2 negotiation. The Junos OS currently supports <b>quick mode</b>.</li> <li>• <b>Message ID</b>—Unique identifier for a phase 2 negotiation.</li> <li>• <b>Local identity</b>—Identity of the local phase 2 negotiation. The format is <i>id-type-name (proto-name:port-number,[O..id-data-len] = iddata-presentation)</i></li> <li>• <b>Remote identity</b>—Identity of the remote phase 2 negotiation. The format is <i>id-type-name (proto-name:port-number,[O..id-data-len] = iddata-presentation)</i></li> <li>• <b>Flags</b>—Notification to the key management process of the status of the IKE negotiation: <ul style="list-style-type: none"> <li>• <b>caller notification sent</b>—Caller program notified about the completion of the IKE negotiation.</li> <li>• <b>waiting for done</b>—Negotiation is done. The library is waiting for the remote end retransmission timers to expire.</li> <li>• <b>waiting for remove</b>—Negotiation has failed. The library is waiting for the remote end retransmission timers to expire before removing this negotiation.</li> <li>• <b>waiting for policy manager</b>—Negotiation is waiting for a response from the policy manager.</li> </ul> </li> </ul> | <b>detail</b>   |

## Sample Output

### show ike security-associations

```
user@host> show ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
4.4.4.4         Matured          93870456fa000011 723a20713700003e Main
```

### show ike security-associations detail

```
user@host> show ike security-associations detail
IKE peer 4.4.4.4
  Role: Initiator, State: Matured
  Initiator cookie: cf22bd81a7000001, Responder cookie: fe83795c2800002e
  Exchange type: Main, Authentication method: Pre-shared-keys
  Local: 4.4.4.5:500, Remote: 4.4.4.4:500
  Lifetime: Expires in 187 seconds
  Algorithms:
    Authentication      : md5
    Encryption          : 3des-cbc
    Pseudo random function: hmac-md5
  Traffic statistics:
    Input bytes  :          1000
    Output bytes :          1280
    Input packets:           5
    Output packets:          9
  Flags: Caller notification sent
  IPsec security associations: 2 created, 0 deleted
  Phase 2 negotiations in progress: 1

Negotiation type: Quick mode, Role: Initiator, Message ID: 3582889153
  Local: 4.4.4.5:500, Remote: 4.4.4.4:500
  Local identity: ipv4_subnet(tcp:80,[0..7]=10.1.1.0/24)
  Remote identity: ipv4_subnet(tcp:100,[0..7]=10.1.2.0/24)
  Flags: Caller notification sent, Waiting for done
```

## show ipsec certificates

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show ipsec certificates<br><brief   detail><br><crl <i>crl-name</i>   <i>serial-number</i> >  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | (Encryption interface on M Series and T Series routers only) Display information about the IPsec certificate database.  |
| <b>Options</b>                  | <p><b>none</b>—Display standard information about all of the entries in the IPsec certificate database.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>crl <i>crl-name</i>   <i>serial-number</i></b>—(Optional) Display information about the entries on the certificate revocation list (CRL) or for the specified serial number. A CRL is a timestamped list identifying revoked certificates. The CRL is signed by a certificate authority (CA) or CRL issuer and made freely available in a public repository. Each revoked certificate is identified in a CRL by its certificate serial number.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>clear ipsec security-associations</i></li> </ul>  |
| <b>List of Sample Output</b>    | <a href="#">show ipsec certificates detail on page 424</a>  |
| <b>Output Fields</b>            | Table 20 on page 423 lists the output fields for the <b>show ipsec certificates</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 20: show ipsec certificates Output Fields

| Field Name      | Field Description   | Level of Output |
|-----------------|---|-----------------|
| <b>Database</b> | Display information about the IPsec certificate database. <ul style="list-style-type: none"> <li>• <b>Total entries</b>—Number of database entries, including entries that are not trusted or that are in the process of being deleted.</li> <li>• <b>Active entries</b>—Number of database entries, excluding entries that are marked as deleted.</li> <li>• <b>Locked entries</b>—Number of statically configured database entries that cannot expire, such as CA certificates that are root or trusted.</li> </ul> | All levels      |
| <b>Subject</b>  | Distinguished name for the certificate for <b>C, O, CN</b> , as described in RFC 3280, <i>Internet x.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile</i> .  | All levels      |
| <b>ID</b>       | Identification number of the database entry. <b>ID</b> is generated by the internal certificate database.   | All levels      |

Table 20: show ipsec certificates Output Fields (*continued*)

| Field Name                          | Field Description   | Level of Output |
|-------------------------------------|---|-----------------|
| <b>References</b>                   | Reference number the certificate manager has for the particular entry.  | <b>detail</b>   |
| <b>Serial</b>                       | Unique serial number assigned to each certificate by the CA.  | All levels      |
| <b>Flags</b>                        | State of the certificate. <ul style="list-style-type: none"> <li>• <b>Trusted</b>—Passed validity checks.</li> <li>• <b>Not trusted</b>—Failed validity checks.</li> <li>• <b>Root</b>—Entry is locked and may have been learned through IKE or a locally configured CA certificate.</li> <li>• <b>Non-root</b>—Entry is not locked.</li> <li>• <b>Crl-issuer</b>—Entity issues CRLs.</li> <li>• <b>Non-crl-issuer</b>—Entity does not issue CRLs.</li> </ul> | <b>detail</b>   |
| <b>Validity period starts</b>       | Start time that the certificate is valid, in the format <i>yyyy mon dd, hh:mm:ss GMT</i> .  | <b>detail</b>   |
| <b>Validity period ends</b>         | End time that the certificate is valid, in the format <i>yyyy mon dd, hh:mm:ss GMT</i> .  | <b>detail</b>   |
| <b>Alternative name information</b> | Auxiliary identity for the certificate: <i>dns-name</i> , <i>email-address</i> , <i>ip-address</i> , or <i>uri</i> (uniform resource identifier).   | <b>detail</b>   |
| <b>Issuer</b>                       | Information about the entity that has signed and issued the CRL as described in RFC 2459, <i>Internet X.509 Public Key Infrastructure Certificate and CRL Profile</i> .   | <b>detail</b>   |

## Sample Output

### show ipsec certificates detail

```

user@host> show ipsec certificates detail
Database: Total entries: 3 Active entries: 4 Locked entries: 1
Subject: C=us, O=x
  ID: 5, References: 0, Serial: 22314868
  Flags: Trusted Non-root Crl-issuer
  Validity period starts: 2003 Mar 1st, 01:20:42 GMT
  Validity period ends: 2003 Mar 31st, 01:50:42 GMT
  Alternative name information:
    IP address: 10.20.210.1
  Issuer: C=FI, O=Company-ABC, CN=Company ABC class 2

Subject: C=us, O=x
  ID: 4, References: 0, Serial: 22315496
  Flags: Trusted Non-root Crl-issuer
  Validity period starts: 2003 Mar 1st, 01:21:45 GMT
  Validity period ends: 2003 Mar 31st, 01:51:45 GMT
  Alternative name information:
    IP address: 10.20.210.20
  Issuer: C=FI, O=Company-ABC, CN=Company ABC class 2

Subject: C=FI, O=SSH Company-ABC, CN=Company ABC class 2
  ID: 1, References: 1, Serial: 1538512
  Flags: Trusted Root Non-crl-issuer

```

Validity period starts: 2001 Aug 1st, 07:08:32 GMT  
Validity period ends: 2004 Aug 1st, 07:08:32 GMT  
Alternative name information:  
Email address: certifier-support@ssh.com  
Issuer: C=FI, O=Company-ABC, CN=Company ABC class 2

## show ipsec security-associations

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | show ipsec security-associations<br><brief   detail><br><sa-name>  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.  |
| <b>Description</b>              | Display information about the IPsec security associations applied to the local or transit traffic stream.  |
| <b>Options</b>                  | <p><b>none</b>—Display standard information about all IPsec security associations.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>sa-name</b>—(Optional) Display the specified IPsec security association.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>List of Sample Output</b>    | <a href="#">show ipsec security-associations sa-name on page 428</a><br><a href="#">show ipsec security-associations sa-name detail on page 428</a>  |
| <b>Output Fields</b>            | Table 21 on page 426 lists the output fields for the <b>show ipsec security-associations</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 21: show ipsec security-associations Output Fields

| Field Name                  | Field Description  | Level of Output |
|-----------------------------|--|-----------------|
| <b>Security association</b> | Name of the security association.  | All levels      |
| <b>Interface family</b>     | <p>Status of the interface family of the security association. If the interface family field is absent, it is a transport mode security association. The interface family can have one of three options:</p> <ul style="list-style-type: none"> <li>• <b>Up</b>—The security association is referenced in the interface family and the interface family is up.</li> <li>• <b>Down</b>—The security association is referenced in the interface family and the interface family is down.</li> <li>• <b>No reference</b>—The security association is not referenced in the interface family.</li> </ul> | All levels      |
| <b>Local gateway</b>        | Gateway address of the local system.   | All levels      |
| <b>Remote gateway</b>       | Gateway address of the remote system.  | All levels      |
| <b>Local identity</b>       | Prefix and port number of the local end  | All levels      |
| <b>Remote identity</b>      | Prefix and port number of the remote end.  | All levels      |
| <b>Direction</b>            | Direction of the security association: <b>inbound</b> or <b>outbound</b> .   | All levels      |
| <b>SPI</b>                  | Value of the security parameter index.   | All levels      |



Table 21: show ipsec security-associations Output Fields (*continued*)

| Field Name                                   | Field Description  | Level of Output |
|--|--|-----------------|
| <b>AUX-SPI</b>                               | Value of the auxiliary security parameter index. <ul style="list-style-type: none"> <li>When the value is <b>AH</b> or <b>ESP</b>, <b>AUX-SPI</b> is always <b>0</b>.</li> <li>When the value is <b>AH+ESP</b>, <b>AUX-SPI</b> is always a positive integer.</li> </ul>  | All levels      |
| <b>State</b>                                 | Status of the security association: <ul style="list-style-type: none"> <li><b>Installed</b>—The security association is installed in the security association database. (For transport mode security associations, the value of <b>State</b> must always be <b>Installed</b>.)</li> <li><b>Not installed</b>—The security association is not installed in the security association database.</li> </ul>  | <b>detail</b>   |
| <b>Mode</b>                                  | Mode of the security association: <ul style="list-style-type: none"> <li><b>transport</b>—Protects single host-to-host protections.</li> <li><b>tunnel</b>—Protects connections between security gateways.</li> </ul>  | All levels      |
| <b>Type</b>                                  | Type of security association: <ul style="list-style-type: none"> <li><b>manual</b>—Security parameters require no negotiation. They are static, and are configured by the user.</li> <li><b>dynamic</b>—Security parameters are negotiated by the IKE protocol. Dynamic security associations are not supported in transport mode.</li> </ul>  | All levels      |
| <b>Protocol</b>                              | Protocol supported: <ul style="list-style-type: none"> <li><b>transport mode</b>—Supports Encapsulation Security Protocol (<b>ESP</b>) or Authentication Header (<b>AH</b>).</li> <li><b>tunnel mode</b>—Supports <b>ESP</b> or <b>AH+ESP</b>.</li> </ul>  | All levels      |
| <b>Authentication</b>                        | Type of authentication used: <b>hmac-md5-96</b> , <b>hmac-sha1-96</b> , or <b>None</b> .   | <b>detail</b>   |
| <b>Encryption</b>                            | Type of encryption used: <b>des-cbc</b> , <b>3des-csc</b> , or <b>None</b> .   | <b>detail</b>   |
| <b>Soft lifetime</b><br><b>Hard lifetime</b> | ( <b>dynamic</b> output only) Each lifetime of a security association has two display options, hard and soft, one of which must be present for a dynamic security association. The <b>hard lifetime</b> specifies the lifetime of the SA. The <b>soft lifetime</b> , which is derived from the hard lifetime, informs the IPsec key management system that the SA is about to expire. This allows the key management system to negotiate a new SA before the hard lifetime expires. <ul style="list-style-type: none"> <li><b>Expires in seconds seconds</b>—Number of seconds left until the security association expires.</li> <li><b>Expires in kilobytes kilobytes</b>—Number of kilobytes left until the security association expires.</li> </ul> | <b>detail</b>   |
| <b>Anti-replay service</b>                   | State of the service that prevents packets from being replayed: <b>Enabled</b> or <b>Disabled</b> .  | <b>detail</b>   |

Table 21: show ipsec security-associations Output Fields (*continued*)

| Field Name         | Field Description   | Level of Output |
|--------------------|---|-----------------|
| Replay window size | Configured size, in packets, of the antireplay service window: 32 or 64. The antireplay window size protects the receiver against replay attacks by rejecting old or duplicate packets. If the replay window size is 0, the antireplay service is disabled. | detail          |

## Sample Output

### show ipsec security-associations sa-name

```

user@host> show ipsec security-associations sa-cosmic brief
Security association: sa-cosmic, Interface family: Up
Local gateway: 21.21.1.1, Remote gateway: 21.21.2.1
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Direction SPI      AUX-SPI    Mode      Type      Protocol
inbound  2908734119  0          tunnel    dynamic   AH
outbound 3494029335  0          tunnel    dynamic   AH

```

### show ipsec security-associations sa-name detail

```

user@host> show ipsec security-associations sa-cosmic detail
Security association: sa-cosmic, Interface family: Up

Local gateway: 21.21.1.1, Remote gateway: 21.21.2.1
Local identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
Direction: inbound, SPI: 2908734119, AUX-SPI: 0, State: Installed
Mode: tunnel, Type: dynamic
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
Soft lifetime: Expired
Hard lifetime: Expires in 120 seconds
Anti-replay service: Disabled

Direction: outbound, SPI: 3494029335, AUX-SPI: 0, State: Installed
Mode: tunnel, Type: dynamic
Protocol: AH, Authentication: hmac-md5-96, Encryption: None
Soft lifetime: Expired
Hard lifetime: Expires in 120 seconds
Anti-replay service: Disabled

```

## show security keychain

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show security keychain<br><brief   detail>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.2.<br>Statement introduced in Junos OS Release 12.3X50 for the QFX Series.  |
| <b>Description</b>              | Display information about authentication keychains configured for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol. |
| <b>Options</b>                  | <b>none</b> —Display information about authentication keychains.<br><br><b>brief   detail</b> —(Optional) Display the specified level of output.  |
| <b>Required Privilege Level</b> | view  |
| <b>List of Sample Output</b>    | <a href="#">show security keychain brief on page 431</a><br><a href="#">show security keychain detail on page 431</a>   |
| <b>Output Fields</b>            | <a href="#">Table 22 on page 429</a> describes the output fields for the <b>show security keychain</b> command. Output fields are listed in the approximate order in which they appear.   |

**Table 22: show security keychain Output Fields**

| Field Name               | Field Description  | Level of Output |
|--------------------------|--|-----------------|
| <b>keychain</b>          | The name of the keychain in operation.   | All levels      |
| <b>Active-ID Send</b>    | Number of routing protocols packets sent with the active key.                            | All levels      |
| <b>Active-ID Receive</b> | Number of routing protocols packets received with the active key.                        | All levels      |
| <b>Next-ID Send</b>      | Number of routing protocols packets sent with the next key.                              | All levels      |
| <b>Next-ID Receive</b>   | Number of routing protocols packets received with the next key.                          | All levels      |
| <b>Transition</b>        | Amount of time until the current key will be replaced with the next key in the keychain. | All levels      |
| <b>Tolerance</b>         | Configured clock-skew tolerance, in seconds, for accepting keys for a key chain.         | All levels      |

Table 22: show security keychain Output Fields (*continued*)

| Field Name        | Field Description   | Level of Output |
|-------------------|---|-----------------|
| <b>Id</b>         | Identification number configured for the current key.   | <b>detail</b>   |
| <b>Algorithm</b>  | Authentication algorithm configured for the current key.  | <b>detail</b>   |
| <b>State</b>      | <p>State of the current key.</p> <p>The value can be:</p> <ul style="list-style-type: none"> <li>• <b>receive</b></li> <li>• <b>send</b></li> <li>• <b>send-receive</b></li> </ul> <p>For the active key, the <b>State</b> can be <b>send-receive</b>, <b>send</b>, or <b>receive</b>. For keys that have a future start time, the <b>State</b> is <b>inactive</b>. Compare the <b>State</b> field to the <b>Mode</b> field.</p>  | <b>detail</b>   |
| <b>Option</b>     | <p>For IS-IS only, the option determines how Junos OS encodes the message authentication code in routing protocol packets.</p> <p>The values can be:</p> <ul style="list-style-type: none"> <li>• <b>basic</b>—Based on RFC 5304.</li> <li>• <b>isis-enhanced</b>—Based on RFC 5310.</li> </ul> <p>The default value is <b>basic</b>. When you configure the <b>isis-enhanced</b> option, Junos OS sends RFC 5310-encoded routing protocol packets and accepts both RFC 5304-encoded and RFC 5310-encoded routing protocol packets that are received from other devices.</p> <p>When you configure <b>basic</b> (or do not include the <b>options</b> statement in the key configuration) Junos OS sends and receives RFC 5304-encoded routing protocols packets, and drops 5310-encoded routing protocol packets that are received from other devices.</p> <p>Because this setting is for IS-IS only, the TCP and the BFD protocol ignore the encoding option configured in the key.</p> | <b>detail</b>   |
| <b>Start-time</b> | Time that the current key became active.  | <b>detail</b>   |

Table 22: show security keychain Output Fields (*continued*)

| Field Name  | Field Description  | Level of Output |
|-------------|--|-----------------|
| <b>Mode</b> | <p>Mode of each key (Informational only.)</p> <p>The value can be</p> <ul style="list-style-type: none"> <li>• <b>receive</b></li> <li>• <b>send</b></li> <li>• <b>send-receive</b></li> </ul> <p>The mode of the key is based on the configuration. Suppose you configure two keys, one with a start-time of today and the other with a start-time of next week. For both keys, the <b>Mode</b> can be <b>send-receive</b>, <b>send</b>, or <b>receive</b>, regardless of the configured start-time. Compare the <b>Mode</b> field to the <b>State</b> field.</p> | <b>detail</b>   |

## Sample Output

### show security keychain brief

```

user@host> show security keychain brief
keychain          Active-ID      Next-ID      Transition  Tolerance
                  Send  Receive    Send  Receive
hakr              3     3           1     1         1d 23:58    3600

```

### show security keychain detail

```

user@host> show security keychain detail
keychain          Active-ID      Next-ID      Transition  Tolerance
                  Send  Receive    Send  Receive
hakr              3     3           1     1         1d 23:58    3600
Id 3, Algorithm hmac-md5, State send-receive, Option basic
Start-time Wed Aug 11 16:28:00 2010, Mode send-receive
Id 1, Algorithm hmac-md5, State inactive, Option basic
Start-time Fri Aug 20 11:30:57 2010, Mode send-receive

```

## show security pki ca-certificate

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | show security pki ca-certificate<br><brief   detail><br><ca-profile <i>ca-profile-name</i> >   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Display information about certificate authority (CA) digital certificates installed in the router.   |
| <b>Options</b>                  | <p><b>none</b>—(Same as brief) Display information about all CA digital certificates.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>ca-profile <i>ca-profile-name</i></b>—(Optional) Display information about only the specified CA profile.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>List of Sample Output</b>    | <a href="#">show security pki ca-certificate on page 433</a><br><a href="#">show security pki ca-certificate detail on page 434</a>  |
| <b>Output Fields</b>            | Table 23 on page 432 lists the output fields for the <b>show security pki ca-certificate</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 23: show security pki ca-certificate Output Fields

| Field Name                    | Field Description   | Level of Output   |
|-------------------------------|---|-------------------|
| <b>Certificate identifier</b> | Name of the digital certificate.  | All levels        |
| <b>Certificate version</b>    | Revision number of the digital certificate.   | <b>detail</b>     |
| <b>Serial number</b>          | Unique serial number of the digital certificate.  | <b>detail</b>     |
| <b>Issued by</b>              | Authority that issued the digital certificate.  | <b>none brief</b> |
| <b>Issued to</b>              | Device that was issued the digital certificate.   | <b>none brief</b> |
| <b>Issuer</b>                 | <p>Authority that issued the digital certificate, including details of the authority organized using the distinguished name format. Possible subfields are:</p> <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the authority.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul> | <b>detail</b>     |

Table 23: show security pki ca-certificate Output Fields (*continued*)

| Field Name                  | Field Description  | Level of Output |
|-----------------------------|--|-----------------|
| <b>Subject</b>              | Details of the digital certificate holder organized using the distinguished name format. Possible subfields are: <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the requestor.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul> | <b>detail</b>   |
| <b>Validity</b>             | Time period when the digital certificate is valid. Values are: <ul style="list-style-type: none"> <li>• <b>Not before</b>—Start time when the digital certificate becomes valid.</li> <li>• <b>Not after</b>—End time when the digital certificate becomes invalid.</li> </ul>   | All levels      |
| <b>Public key algorithm</b> | Encryption algorithm used with the private key, such as <b>rsaEncryption(1024 bits)</b> .  | All levels      |
| <b>Signature algorithm</b>  | Encryption algorithm that the CA used to sign the digital certificate, such as <b>sha1WithRSAEncryption</b> .  | <b>detail</b>   |
| <b>Fingerprint</b>          | Secure Hash Algorithm (SHA1) and Message Digest 5 (MD5) hashes used to identify the digital certificate.   | <b>detail</b>   |
| <b>Distribution CRL</b>     | Distinguished name information and the URL for the certificate revocation list (CRL) server.   | <b>detail</b>   |
| <b>Use for key</b>          | Use of the public key, such as <b>Certificate signing</b> , <b>CRL signing</b> , <b>Digital signature</b> , or <b>Key encipherment</b> .   | <b>detail</b>   |

## Sample Output

### show security pki ca-certificate

```

user@host> show security pki ca-certificate
Certificate identifier: entrust
  Issued to: juniper, Issued by: juniper
  Validity:
    Not before: 2005 Oct 18th, 23:54:22 GMT
    Not after: 2025 Oct 19th, 00:24:22 GMT
  Public key algorithm: rsaEncryption(1024 bits)

Certificate identifier: entrust
  Issued to: First Officer, Issued by: juniper
  Validity:
    Not before: 2005 Oct 18th, 23:55:59 GMT
    Not after: 2008 Oct 19th, 00:25:59 GMT
  Public key algorithm: rsaEncryption(1024 bits)

Certificate identifier: entrust
  Issued to: First Officer, Issued by: juniper
  Validity:
    Not before: 2005 Oct 18th, 23:55:59 GMT

```

Not after: 2008 Oct 19th, 00:25:59 GMT  
Public key algorithm: rsaEncryption(1024 bits)

### show security pki ca-certificate detail

```

user@host> show security pki ca-certificate detail
Certificate identifier: entrust
Certificate version: 3
Serial number: 4355 9235
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us
Validity:
  Not before: 2005 Oct 18th, 23:54:22 GMT
  Not after: 2025 Oct 19th, 00:24:22 GMT
Public key algorithm: rsaEncryption(1024 bits)
cb:9e:2d:c0:70:f8:ea:3c:f2:b5:f0:02:48:87:dc:68:99:a3:57:4f
0e:b9:98:0b:95:47:0d:1f:97:7c:53:17:dd:1a:f8:da:e5:08:d1:1c
78:68:1f:2f:72:9f:a2:cf:81:e3:ce:c5:56:89:ce:f0:97:93:fa:36
19:3e:18:7d:8c:9d:21:fe:1f:c3:87:8d:b3:5d:f3:03:66:9d:16:a7
bf:18:3f:f0:7a:80:f0:62:50:43:83:4f:0e:d7:c6:42:48:c0:8a:b2
c7:46:30:38:df:9b:dc:bc:b5:08:7a:f3:cd:64:db:2b:71:67:fe:d8
04:47:08:07:de:17:23:13
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10 (sha1)
  71:6f:6a:76:17:9b:d6:2a:e7:5a:72:97:82:6d:26:86 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: CRL signing, Certificate signing
Certificate identifier: entrust
Certificate version: 3
Serial number: 4355 925c
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us, Common name: First Officer
Validity:
  Not before: 2005 Oct 18th, 23:55:59 GMT
  Not after: 2008 Oct 19th, 00:25:59 GMT
Public key algorithm: rsaEncryption(1024 bits)
c0:a4:21:32:95:0a:cd:ec:12:03:d1:a2:89:71:8e:ce:4e:a6:f9:2f
1a:9a:13:8c:f6:a0:3d:c9:bd:9d:c2:a0:41:77:99:1b:1e:ed:5b:80
34:46:f8:5b:28:34:38:2e:91:7d:4e:ad:14:86:78:67:e7:02:1d:2e
19:11:b7:fa:0d:ba:64:20:e1:28:4e:3e:bb:6e:64:dc:cd:b1:b4:7a
ca:8f:47:dd:40:69:c2:35:95:ce:b8:85:56:d7:0f:2d:04:4d:5d:d8
42:e1:4f:6b:bf:38:c0:45:1e:9e:f0:b4:7f:74:6f:e9:70:fd:4a:78
da:eb:10:27:bd:46:34:33
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  bc:78:87:9b:a7:91:13:20:71:db:ac:b5:56:71:42:ad:1a:b6:46:17 (sha1)
  23:79:40:c9:6d:a6:f0:ca:e0:13:30:d4:29:6f:86:79 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: Key encipherment
Certificate identifier: entrust
Certificate version: 3
Serial number: 4355 925b

```



Issuer:  
  Organization: juniper, Country: us  
Subject:  
  Organization: juniper, Country: us, Common name: First Officer  
Validity:  
  Not before: 2005 Oct 18th, 23:55:59 GMT  
  Not after: 2008 Oct 19th, 00:25:59 GMT  
Public key algorithm: rsaEncryption(1024 bits)  
  ea:75:c4:f3:58:08:ea:65:5c:7e:b3:de:63:0a:cf:cf:ec:9a:82:e2  
  d7:e8:b9:2f:bd:4b:cd:86:2f:f1:dd:d8:a2:95:af:ab:51:a5:49:4e  
  00:10:c6:25:ff:b5:49:6a:99:64:74:69:e5:8c:23:5b:b4:70:62:8e  
  e4:f9:a2:28:d4:54:e2:0b:1f:50:a2:92:cf:6c:8f:ae:10:d4:69:3c  
  90:e2:1f:04:ea:ac:05:9b:3a:93:74:d0:59:24:e9:d2:9d:c2:ef:22  
  b9:32:c7:2c:29:4f:91:cb:5a:26:fe:1d:c0:36:dc:f4:9c:8b:f5:26  
  af:44:bf:53:aa:d4:5f:67  
Signature algorithm: sha1WithRSAEncryption  
Fingerprint:  
  46:71:15:34:f0:a6:41:76:65:81:33:4f:68:47:c4:df:78:b8:e3:3f (sha1)  
  ee:cc:c7:f4:5d:ac:65:33:0a:55:db:59:72:2c:dd:16 (md5)  
Distribution CRL:  
  C=us, O=juniper, CN=CRL1  
  http://CA-1/CRL/juniper\_us\_crlfile.crl  
Use for key: Digital signature

## show security pki certificate-request

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show security pki certificate-request<br><brief   detail><br><certificate-id <i>certificate-id-name</i> >   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | Display information about manually generated local digital certificate requests that are stored in the router.  |
| <b>Options</b>                  | <p><b>none</b>—(same as brief) Display information about all local digital certificate requests.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>certificate-id <i>certificate-id-name</i></b>—(Optional) Display information about only the specified local digital certificate request</p> |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear security pki certificate-request on page 394</a></li> </ul>  |
| <b>List of Sample Output</b>    | <a href="#">show security pki certificate-request on page 437</a><br><a href="#">show security pki certificate-request detail on page 437</a>   |
| <b>Output Fields</b>            | <a href="#">Table 24 on page 436</a> lists the output fields for the <b>show security pki certificate-request</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 24: show security pki certificate-request Output Fields

| Field Name                    | Field Description   | Level of Output   |
|-------------------------------|---|-------------------|
| <b>Certificate identifier</b> | Name of the digital certificate.  | All levels        |
| <b>Certificate version</b>    | Revision number of the digital certificate.   | <b>detail</b>     |
| <b>Issued to</b>              | Device that was issued the digital certificate.   | <b>none brief</b> |
| <b>Subject</b>                | <p>Details of the digital certificate holder organized using the distinguished name format. Possible subfields are:</p> <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the authority.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul> | <b>detail</b>     |
| <b>Alternate subject</b>      | Domain name or IP address of the device related to the digital certificate.   | <b>detail</b>     |

Table 24: show security pki certificate-request Output Fields (*continued*)

| Field Name                     | Field Description  | Level of Output |
|--------------------------------|--|-----------------|
| Validity                       | Time period when the digital certificate is valid. Values are: <ul style="list-style-type: none"> <li>• <b>Not before</b>—Time when the digital certificate becomes valid.</li> <li>• <b>Not after</b>—End time when the digital certificate becomes invalid.</li> </ul> | All levels      |
| Public key algorithm           | Encryption algorithm used with the private key, such as <b>rsaEncryption(1024 bits)</b> .  | All levels      |
| Public key verification status | Public key verification status: <b>Failed</b> or <b>Passed</b> . The <b>detail</b> output also provides the verification hash.   | All levels      |
| Fingerprint                    | Secure Hash Algorithm (SHA1) and Message Digest 5 (MD5) hashes used to identify the digital certificate.   | <b>detail</b>   |
| Use for key                    | Use of the public key, such as <b>Certificate signing</b> , <b>CRL signing</b> , <b>Digital signature</b> , or <b>Key encipherment</b> .   | <b>detail</b>   |

## Sample Output

### show security pki certificate-request

```

user@host> show security pki certificate-request
Certificate identifier: local-microsoft-2
Issued to: router2.juniper.net
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed

```

### show security pki certificate-request detail

```

user@host> show security pki certificate-request detail
Certificate identifier: local-entrust3
Certificate version: 3
Subject:
  Common name: router3.juniper.net
Alternate subject: router3.juniper.net
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed
  fb:79:df:d4:a9:03:0f:d3:69:7e:c1:e4:27:35:9c:d9:b1:a2:47:78
  d2:6d:f3:e5:f4:68:4f:b3:04:45:88:57:99:82:39:a6:51:9e:5f:42
  23:3f:d7:6e:3d:a5:54:a9:b1:2d:6e:90:dd:12:8a:bf:ef:2b:20:50
  ba:f0:da:d9:0c:ad:5e:d6:c6:98:3a:ae:3f:90:dd:94:78:c1:ea:2e
  7c:f0:2d:d4:79:d4:cd:f0:52:df:5e:72:f2:e7:ae:66:f7:61:f4:bc
  72:57:3e:6c:6d:d3:24:58:8b:f4:ef:da:2a:6a:fa:eb:98:f8:34:84
  79:54:da:4f:d3:6f:52:1f
Fingerprint:
  7c:e8:f9:45:93:8d:a3:92:7f:18:29:02:f1:c8:e2:85:3d:ad:df:1f (sha1)
  00:4e:df:a0:6b:ad:8c:50:da:7c:a1:cf:5d:37:b0:ea (md5)
Use for key: Digital signature

```

## show security pki crt

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show security pki crt<br><brief   detail><br><ca-profile <i>ca-profile-name</i> >   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.1.   |
| <b>Description</b>              | Display information about the certificate revocation lists (CRLs) that are stored in the router.  |
| <b>Options</b>                  | <p><b>none</b>—(same as brief) Display information about all CRLs.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>ca-profile <i>ca-profile-name</i></b>—(Optional) Display CRL information about only the specified CA profile.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear security pki crt on page 395</a></li> </ul>  |
| <b>List of Sample Output</b>    | <a href="#">show security pki crt on page 439</a><br><a href="#">show security pki crt detail on page 439</a>   |
| <b>Output Fields</b>            | Table 25 on page 438 shows the output fields for the <b>show security pki crt</b> command. Output fields are listed in the approximate order in which they appear.  |

Table 25: show security pki crt Output Fields

| Field Name     | Field Description   | Level of Output |
|----------------|---|-----------------|
| CA profile     | Name of the configured CA profile.  | All levels      |
| CRL version    | Revision number of the certificate revocation list.   | All levels      |
| CRL number     | Number of the certificate revocation list   | All levels      |
| CRL issuer     | Device that was issued the certificate revocation list.   | All levels      |
| Issuer         | <p>Details of the digital certificate holder organized using the distinguished name format. Possible subfields are:</p> <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the authority.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul> | <b>detail</b>   |
| Effective date | Date and time the certificate revocation list becomes valid.  | All levels      |

Table 25: show security pki crl Output Fields (*continued*)

| Field Name             | Field Description   | Level of Output |
|------------------------|---|-----------------|
| <b>Next update</b>     | Date and time the router will download the latest version of the certificate revocation list.   | All levels      |
| <b>Revocation List</b> | <p>List of digital certificates that have been revoked before their expiration date. Values are:</p> <ul style="list-style-type: none"> <li>• <b>Serial number</b>—Unique serial number of the digital certificate</li> <li>• <b>Revocation date</b>—Date and time that the digital certificate was revoked.</li> </ul> | <b>detail</b>   |

## Sample Output

### show security pki crl

```
CA profile entrust
CRL version: V2
CRL number: 24
CRL issuer: C=CA, O=juniper
Effective date: 2006 May 31st, 05:35:25 GMT
Next update: 2006 Jun 1st, 06:35:25 GMT
```

### show security pki crl detail

```
CA profile: entrust
CRL version: V2
CRL number: 24
Issuer:
  Organization: juniper, Country: ca
Validity:
  Effective date: 2006 May 31st, 05:35:25 GMT
  Next update: 2006 Jun 1st, 06:35:25 GMT
Revocation List:
  Serial number      Revocation date
  4451aca3 2006      May 25th, 09:13:38 GMT
  4451aca4 2006      May 25th, 10:11:33 GMT
  4451acb4 2006      May 29th, 11:28:54 GMT
  4451aceb 2006      May 29th, 11:29:01 GMT
  4451acfe 2006      May 29th, 11:29:17 GMT
  4451acff 2006      May 31st, 05:29:55 GMT
```

## show security pki local-certificate

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | show security pki local-certificate<br><brief   detail><br><certificate-id <i>certificate-id-name</i> ><br><system-generated>  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.  |
| <b>Description</b>              | Display information about the local digital certificates and the corresponding public keys installed in the router.  |
| <b>Options</b>                  | <p><b>none</b>—(same as brief) Display information about all local digital certificates and corresponding public keys.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>certificate-id <i>certificate-id-name</i></b>—(Optional) Display information about only the specified the local digital certificate and corresponding public keys.</p> <p><b>system-generated</b>—(Optional) Auto-generated self-signed certificate.</p> |
| <b>Required Privilege Level</b> | view   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear security pki local-certificate on page 397</a></li> </ul>   |
| <b>List of Sample Output</b>    | <a href="#">show security pki local-certificate on page 441</a><br><a href="#">show security pki local-certificate detail on page 442</a>  |
| <b>Output Fields</b>            | Table 26 on page 440 lists the output fields for the <b>show security pki local-certificate</b> command. Output fields are listed in the approximate order in which they appear.   |

**Table 26: show security pki local-certificate Output Fields**

| Field Name                    | Field Description                                | Level of Output   |
|-------------------------------|--|-------------------|
| <b>Certificate identifier</b> | Name of the digital certificate.                 | All levels        |
| <b>Certificate version</b>    | Revision number of the digital certificate.      | <b>detail</b>     |
| <b>Serial number</b>          | Unique serial number of the digital certificate. | <b>detail</b>     |
| <b>Issued by</b>              | Authority that issued the digital certificate.   | <b>none brief</b> |
| <b>Issued to</b>              | Device that was issued the digital certificate.  | <b>none brief</b> |

Table 26: show security pki local-certificate Output Fields (*continued*)

| Field Name                            | Field Description  | Level of Output |
|---------------------------------------|--|-----------------|
| <b>Issuer</b>                         | Authority that issued the digital certificate, including details of the authority organized using the distinguished name format. Possible subfields are: <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the authority.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul> | <b>detail</b>   |
| <b>Subject</b>                        | Details of the digital certificate holder organized using the distinguished name format. Possible subfields are: <ul style="list-style-type: none"> <li>• <b>Common name</b>—Name of the authority.</li> <li>• <b>Organization</b>—Organization of origin.</li> <li>• <b>Organizational unit</b>—Department within an organization.</li> <li>• <b>State</b>—State of origin.</li> <li>• <b>Country</b>—Country of origin.</li> </ul>   | <b>detail</b>   |
| <b>Alternate subject</b>              | Domain name or IP address of the device related to the digital certificate.  | <b>detail</b>   |
| <b>Validity</b>                       | Time period when the digital certificate is valid. Values are: <ul style="list-style-type: none"> <li>• <b>Not before</b>—Start time when the digital certificate becomes valid.</li> <li>• <b>Not after</b>—End time when the digital certificate becomes invalid.</li> </ul>   | All levels      |
| <b>Public key algorithm</b>           | Encryption algorithm used with the private key, such as <b>rsaEncryption (1024 bits)</b> .   | All levels      |
| <b>Public key verification status</b> | Public key verification status: <b>Failed</b> or <b>Passed</b> . The <b>detail</b> output also provides the verification hash.   | All levels      |
| <b>Signature algorithm</b>            | Encryption algorithm that the CA used to sign the digital certificate, such as <b>sha1WithRSAEncryption</b> .  | <b>detail</b>   |
| <b>Fingerprint</b>                    | Secure Hash Algorithm (SHA1) and Message Digest 5 (MD5) hashes used to identify the digital certificate.   | <b>detail</b>   |
| <b>Distribution CRL</b>               | Distinguished name information and URL for the certificate revocation list (CRL) server.   | <b>detail</b>   |
| <b>Use for key</b>                    | Use of the public key, such as <b>Certificate signing</b> , <b>CRL signing</b> , <b>Digital signature</b> , or <b>Key encipherment</b> .   | <b>detail</b>   |

## Sample Output

### show security pki local-certificate

```

user@host> show security pki local-certificate
Certificate identifier: local-entrust2
Issued to: router2.juniper.net, Issued by: juniper

```

```
Validity:
  Not before: 2005 Nov 21st, 23:28:22 GMT
  Not after: 2008 Nov 21st, 23:58:22 GMT
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed
```

#### show security pki local-certificate detail

```
user@host> show security pki local-certificate detail
Certificate identifier: local-entrust3
Certificate version: 3
Serial number: 4355 94f9
Issuer:
  Organization: juniper, Country: us
Subject:
  Organization: juniper, Country: us, Common name: router3.juniper.net
Alternate subject: router3.juniper.net
Validity:
  Not before: 2005 Nov 21st, 23:33:58 GMT
  Not after: 2008 Nov 22nd, 00:03:58 GMT
Public key algorithm: rsaEncryption(1024 bits)
Public key verification status: Passed
fb:79:df:d4:a9:03:0f:d3:69:7e:c1:e4:27:35:9c:d9:b1:a2:47:78
d2:6d:f3:e5:f4:68:4f:b3:04:45:88:57:99:82:39:a6:51:9e:5f:42
23:3f:d7:6e:3d:a5:54:a9:b1:2d:6e:90:dd:12:8a:bf:ef:2b:20:50
ba:f0:da:d9:0c:ad:5e:d6:c6:98:3a:ae:3f:90:dd:94:78:c1:ea:2e
7c:f0:2d:d4:79:d4:cd:f0:52:df:5e:72:f2:e7:ae:66:f7:61:f4:bc
72:57:3e:6c:6d:d3:24:58:8b:f4:ef:da:2a:6a:fa:eb:98:f8:34:84
79:54:da:4f:d3:6f:52:1f
Signature algorithm: sha1WithRSAEncryption
Fingerprint:
  61:3a:d0:b4:7a:16:9b:39:ba:81:3f:9d:ab:34:e5:c8:be:3b:a1:6d (sha1)
  60:a0:ff:58:05:4a:65:73:9d:74:3a:e1:83:6f:1b:c8 (md5)
Distribution CRL:
  C=us, O=juniper, CN=CRL1
  http://CA-1/CRL/juniper_us_crlfile.crl
Use for key: Digital signature
```



## show services ipsec-vpn certificates

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show services ipsec-vpn certificates<br><brief   detail><br><service-set <i>service-set</i> >   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 7.5.   |
| <b>Description</b>              | (Adaptive services interfaces only) Display local and remote certificates installed in the IPsec configuration memory cache that are used for the IKE negotiation.  |
| <b>Options</b>                  | <p><b>none</b>—(same as brief) Display information about local and remote certificates associated with all service sets.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>service-set <i>service-set</i></b>—(Optional) Display information about local and remote certificates associated with only the specified service set.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>List of Sample Output</b>    | <a href="#">show security ipsec-vpn certificates on page 444</a><br><a href="#">show security ipsec-vpn certificates detail on page 444</a>   |
| <b>Output Fields</b>            | Table 27 on page 443 lists the output fields for the <b>show services ipsec-vpn certificates</b> command. Output fields are listed in the approximate order in which they appear.   |

Table 27: show services ipsec-vpn certificates Output Fields

| Field Name                     | Field Description   | Level of Output   |
|--------------------------------|---|-------------------|
| <b>Service set</b>             | Name of the IPsec service set.  | All levels        |
| <b>Total entries</b>           | Number of certificate cache entries.  | All levels        |
| <b>Certificate cache entry</b> | Identification number of the certificate cache entry.   | All levels        |
| <b>Flags</b>                   | Information about the digital certificate, including whether the certificate is a root certificate and trusted. | none <b>brief</b> |
| <b>Issued to</b>               | Device that was issued the digital certificate.   | none <b>brief</b> |
| <b>Issued by</b>               | Authority that issued the digital certificate.  | none <b>brief</b> |
| <b>Certificate version</b>     | Revision number of the digital certificate.   | <b>detail</b>     |
| <b>Serial number</b>           | Unique serial number of the digital certificate.  | <b>detail</b>     |
| <b>Alternate subject</b>       | Domain name or IP address of the device related to the digital certificate.                                     | All levels        |

Table 27: show services ipsec-vpn certificates Output Fields (*continued*)

| Field Name           | Field Description  | Level of Output   |
|----------------------|--|-------------------|
| Validity             | Time period when the digital certificate is valid. Values are: <ul style="list-style-type: none"> <li>• <b>Not before</b>—Start time when the digital certificate becomes valid.</li> <li>• <b>Not after</b>—End time when the digital certificate becomes invalid.</li> </ul> | none <b>brief</b> |
| Public key algorithm | Specifies the encryption algorithm used with the private key, such as <b>rsaEncryption (1024 bits)</b> .   | <b>detail</b>     |
| Signature algorithm  | Encryption algorithm that the CA used to sign the digital certificate, such as <b>sha1WithRSAEncryption</b> .  | <b>detail</b>     |
| Fingerprint          | Secure Hash Algorithm (SHA1) and Message Digest 5 (MD5) hashes used to identify the digital certificate.   | <b>detail</b>     |
| Distribution CRL     | Distinguished name information and the URL for the certificate revocation list (CRL) server.   | <b>detail</b>     |
| Use for key          | Use of the public key, such as <b>Certificate signing</b> , <b>CRL signing</b> , <b>Digital signature</b> , or <b>Key encipherment</b> .   | <b>detail</b>     |

## Sample Output

### show security ipsec-vpn certificates

```

user@host> show services ipsec-vpn certificates
Service set: serviceset-dynamic-BiEspsha3des, Total entries: 3
Certificate cache entry: 3
  Flags: Non-root Trusted
  Issued to: router3.juniper.net, Issued by: juniper
  Alternate subject: router3.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:33:58 GMT
    Not after: 2008 Nov 22nd, 00:03:58 GMT

Certificate cache entry: 2
  Flags: Non-root Trusted
  Issued to: router2.juniper.net, Issued by: juniper
  Alternate subject: router2.juniper.net
  Validity:
    Not before: 2005 Nov 21st, 23:28:22 GMT
    Not after: 2008 Nov 21st, 23:58:22 GMT

Certificate cache entry: 1
  Flags: Root Trusted
  Issued to: juniper, Issued by: juniper
  Validity:
    Not before: 2005 Oct 18th, 23:54:22 GMT
    Not after: 2025 Oct 19th, 00:24:22 GMT

```

### show security ipsec-vpn certificates detail

```

user@host> show services ipsec-vpn certificates detail

```

```
Service set: serviceset-dynamic-BiEspsha3des, Total entries: 3
Certificate cache entry: 3
  Certificate version: 3
  Serial number: 4355 94f9
  Alternate subject: router3.juniper.net
  Public key algorithm: rsaEncryption
  Signature algorithm: sha1WithRSAEncryption
  Fingerprint:
    61:3a:d0:b4:7a:16:9b:39:ba:81:3f:9d:ab:34:e5:c8:be:3b:a1:6d (sha1)
    60:a0:ff:58:05:4a:65:73:9d:74:3a:e1:83:6f:1b:c8 (md5)
  Distribution CRL:
    C=us, O=juniper, CN=CRL1
    http://CA-1/CRL/juniper_us_crlfile.crl
  Use for key: Digital signature

Certificate cache entry: 2
  Certificate version: 3
  Serial number: 4355 94f8
  Alternate subject: router2.juniper.net
  Public key algorithm: rsaEncryption
  Signature algorithm: sha1WithRSAEncryption
  Fingerprint:
    30:c3:a4:04:da:33:9d:60:23:5a:48:75:48:2c:f0:c6:96:6c:31:fa (sha1)
    9a:a2:ce:ef:7e:10:80:a0:c8:4d:2f:e7:e1:d3:69:9d (md5)
  Distribution CRL:
    C=us, O=juniper, CN=CRL1
    http://CA-1/CRL/juniper_us_crlfile.crl
  Use for key: Digital signature

Certificate cache entry: 1
  Certificate version: 3
  Flags: Root
  Serial number: 4355 9235
  Public key algorithm: rsaEncryption
  Signature algorithm: sha1WithRSAEncryption
  Fingerprint:
    00:8e:6f:58:dd:68:bf:25:0a:e3:f9:17:70:d6:61:f3:53:a7:79:10 (sha1)
    71:6f:6a:76:17:9b:d6:2a:e7:5a:72:97:82:6d:26:86 (md5)
  Distribution CRL:
    C=us, O=juniper, CN=CRL1
    http://CA-1/CRL/juniper_us_crlfile.crl
  Use for key: CRL signing, Certificate signing
```

## show services ipsec-vpn ike security-associations

|                                 |  |
|---------------------------------|--|
| <b>Syntax</b>                   | show services ipsec-vpn ike security-associations<br><brief   detail><br><peer-address>  |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Statistics for Internet Key Exchange (IKE) security associations for each services PIC introduced in Junos OS Release 12.1.   |
| <b>Description</b>              | (Adaptive services interface only) Display information for Internet Key Exchange (IKE) security associations. If no security association is specified, the information for all security associations is displayed.   |
| <b>Options</b>                  | <b>none</b> —(same as brief) Display standard information for all IPsec security associations.<br><br><b>brief   detail</b> —(Optional) Display the specified level of output.<br><br><b>peer-address</b> —(Optional) Display information about a particular security association address. |
| <b>Required Privilege Level</b> | view   |
| <b>List of Sample Output</b>    | <a href="#">show services ipsec-vpn ike security-associations on page 448</a><br><a href="#">show services ipsec-vpn ike security-associations detail on page 449</a>  |
| <b>Output Fields</b>            | <a href="#">Table 28 on page 446</a> lists the output fields for the <b>show services ipsec-vpn ike security-associations</b> command. Output fields are listed in the approximate order in which they appear.   |

**Table 28: show services ipsec-vpn ike security-associations Output Fields**

| Field Name              | Field Description   | Level of Output |
|-------------------------|---|-----------------|
| <b>IKE peer</b>         | Remote end of the IKE negotiation.  | <b>detail</b>   |
| <b>Role</b>             | Part played in the IKE session. The router triggering the IKE negotiation is the initiator, and the router accepting the first IKE exchange packets is the responder.   | <b>detail</b>   |
| <b>Remote Address</b>   | Responder's address.  | none specified  |
| <b>State</b>            | State of the IKE security association: <ul style="list-style-type: none"> <li>• <b>Matured</b>—IKE security association is established.</li> <li>• <b>Not matured</b>—The IKE security association is in the process of negotiation.</li> </ul> | none specified  |
| <b>Initiator cookie</b> | When the IKE negotiation is triggered, a random number is sent to the remote node.  | All levels      |

Table 28: show services ipsec-vpn ike security-associations Output Fields (*continued*)

| Field Name                   | Field Description   | Level of Output |
|------------------------------|---|-----------------|
| <b>Responder cookie</b>      | <p>The remote node generates its own random number and sends it back to the initiator as a verification that the packets were received.</p> <p>Of the numerous security services available, protection against denial of service (DoS) is one of the most difficult to address. A “cookie” or anticlogging token (ACT) is aimed at protecting the computing resources from attack without spending excessive CPU resources to determine the cookie’s authenticity. An exchange prior to CPU-intensive public key operations can thwart some DoS attempts (such as simple flooding with invalid IP source addresses).</p>  | All levels      |
| <b>Exchange type</b>         | <p>Specifies the number of messages in an IKE exchange, and the payload types that are contained in each message. Each exchange type provides a particular set of security services, such as anonymity of the participants, perfect forward secrecy of the keying material, and authentication of the participants. Junos OS supports two types of exchanges:</p> <ul style="list-style-type: none"> <li>• <b>Main</b>—The exchange is done with six messages. <b>Main</b> encrypts the payload, protecting the identity of the neighbor.</li> <li>• <b>Aggressive</b>—The exchange is done with three messages. <b>Aggressive</b> does not encrypt the payload, leaving the identity of the neighbor unprotected.</li> <li>• <b>IKEv2</b>—The exchange is negotiated using IKE version 2.</li> </ul> | All levels      |
| <b>PIC</b>                   | The services PIC for which the IKE security associations are displayed.   | All levels      |
| <b>Authentication method</b> | Type of authentication determines which payloads are exchanged and when they are exchanged. The Junos OS supports only <b>pre-shared keys</b> .   | <b>detail</b>   |
| <b>Local</b>                 | Prefix and port number of the local end.  | <b>detail</b>   |
| <b>Remote</b>                | Prefix and port number of the remote end.   | <b>detail</b>   |
| <b>Lifetime</b>              | Number of seconds remaining until the IKE security association expires.   | <b>detail</b>   |
| <b>Algorithms</b>            | <p>Header for the IKE algorithms output.</p> <ul style="list-style-type: none"> <li>• <b>Authentication</b>—(<b>detail</b> output only) Type of authentication algorithm used: <b>md5</b> or <b>sha1</b></li> <li>• <b>Encryption</b>—(<b>detail</b> output only) Type of encryption algorithm used: <b>des-cbc</b>, <b>3des-cbc</b>, or <b>None</b>.</li> <li>• <b>Pseudo random function</b>—Function that generates highly unpredictable random numbers: <b>hmac-md5</b> or <b>hmac-sha1</b>.</li> </ul>   | <b>detail</b>   |
| <b>Traffic statistics</b>    | <p>Number of bytes and packets received and transmitted on the IKE security association.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the IKE security association.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the IKE security association.</li> </ul>   | <b>detail</b>   |

Table 28: show services ipsec-vpn ike security-associations Output Fields (*continued*)

| Field Name                              | Field Description  | Level of Output |
|---|--|-----------------|
| <b>Flags</b>                            | Notification to the key management process of the status of the IKE negotiation: <ul style="list-style-type: none"> <li><b>caller notification sent</b>—Caller program notified about the completion of the IKE negotiation.</li> <li><b>waiting for done</b>—Negotiation is done. The library is waiting for the remote end retransmission timers to expire.</li> <li><b>waiting for remove</b>—Negotiation has failed. The library is waiting for the remote end retransmission timers to expire before removing this negotiation.</li> <li><b>waiting for policy manager</b>—Negotiation is waiting for a response from the policy manager.</li> </ul>  | <b>detail</b>   |
| <b>IPsec security associates</b>        | Number of IPsec security associations created and deleted with this IKE security association.  | <b>detail</b>   |
| <b>Phase 2 negotiations in progress</b> | Number of phase 2 negotiations in progress and status information: <ul style="list-style-type: none"> <li>Negotiation type—Type of phase 2 negotiation. The Junos OS currently supports <b>quick mode</b>.</li> <li>Message ID—Unique identifier for a phase 2 negotiation.</li> <li>Local identity—Identity of the local phase 2 negotiation. The format is <i>id-type-name (proto-name:port-number,[0..id-data-len] = iddata-presentation)</i>.</li> <li>Remote identity—Identity of the remote phase 2 negotiation. The format is <i>id-type-name (proto-name:port-number,[0..id-data-len] = iddata-presentation)</i>.</li> <li>Flags—Notification to the key management process of the status of the IKE negotiation: <ul style="list-style-type: none"> <li><b>caller notification sent</b>—Caller program notified about the completion of the IKE negotiation.</li> <li><b>waiting for done</b>—Negotiation is done. The library is waiting for the remote end retransmission timers to expire.</li> <li><b>waiting for remove</b>—Negotiation has failed. The library is waiting for the remote end retransmission timers to expire before removing this negotiation.</li> <li><b>waiting for policy manager</b>—Negotiation is waiting for a response from the policy manager.</li> </ul> </li> </ul> | <b>detail</b>   |

## Sample Output

### show services ipsec-vpn ike security-associations

```

user@host> show services ipsec-vpn ike security-associations
Remote Address  State      Initiator cookie  Responder cookie  Exchange type
-----
6.6.6.1         Matured    062d291d21275fc7  82ef00e3d1f1c981  Main
6.6.6.2         Matured    cd6d581d7bb1664d  88a707779f3ad8d1  Main
6.6.6.3         Matured    86621051e3e78360  6bc5cc83fd67baa4  IKEv2
PIC: sp-0/3/0
6.6.6.7         Matured    565e2813075e6fdb  67886757a74edcd6  IKEv2

```

**show services ipsec-vpn ike security-associations detail**

```

user@host> show services ipsec-vpn ike security-associations detail
IKE peer 3.1.0.2
  Role: Responder, State: Matured
  Initiator cookie: d91c9f20f78e1d4e, Responder cookie: 727a04ed8d5021a1
  Exchange type: IKEv2, Authentication method: Pre-shared-keys
  Local: 4.1.0.2:500, Remote: 3.1.0.2:500
  Lifetime: Expires in 1357 seconds
  Algorithms:
    Authentication      : sha1
    Encryption          : 3des-cbc
    Pseudo random function: hmac-sha1
  Traffic statistics:
    Input bytes  :          22244
    Output bytes :          22236
    Input packets:           263
    Output packets:          263
  Flags: Caller notification sent
  IPsec security associations: 0 created, 0 deleted
  Phase 2 negotiations in progress: 0

IKE peer 4.4.4.4
  Role: Initiator, State: Matured
  Initiator cookie: cf22bd81a7000001, Responder cookie: fe83795c2800002e
  Exchange type: Main, Authentication method: Pre-shared-keys
  Local: 4.4.4.5:500, Remote: 4.4.4.4:500
  Lifetime: Expires in 187 seconds
  Algorithms:
    Authentication      : md5
    Encryption          : 3des-cbc
    Pseudo random function: hmac-md5
  Traffic statistics:
    Input bytes  :          1000
    Output bytes :          1280
    Input packets:           5
    Output packets:           9
  Flags: Caller notification sent
  IPsec security associations: 2 created, 0 deleted
  Phase 2 negotiations in progress: 1

Negotiation type: Quick mode, Role: Initiator, Message ID: 3582889153
  Local: 4.4.4.5:500, Remote: 4.4.4.4:500
  Local identity: ipv4_subnet(tcp:80,[0..7]=10.1.1.0/24)
  Remote identity: ipv4_subnet(tcp:100,[0..7]=10.1.2.0/24)
  Flags: Caller notification sent, Waiting for done

```

## show services ipsec-vpn ipsec security-associations

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show services ipsec-vpn ipsec security-associations<br><brief   detail   extensive><br><service-set <i>service-set-name</i> >   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.   |
| <b>Description</b>              | (Adaptive services interface only) Display IPsec security associations for the specified service set. If no service set is specified, the security associations for all service sets are displayed.   |
| <b>Options</b>                  | <p><b>none</b>—Display standard information about IPsec security associations for all service sets.</p> <p><b>brief   detail   extensive</b>—(Optional) Display the specified level of output.</p> <p><b>service-set <i>service-set-name</i></b>—(Optional) Display information about a particular service set.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>List of Sample Output</b>    | <a href="#">show services ipsec-vpn ipsec security associations extensive on page 453</a>   |
| <b>Output Fields</b>            | <a href="#">Table 29 on page 450</a> lists the output fields for the <b>show services ipsec-vpn ipsec security-associations</b> command. Output fields are listed in the approximate order in which they appear.  |

**Table 29: show services ipsec-vpn ipsec security-associations Output Fields**

| Field Name                    | Field Description   | Level of Output         |
|-------------------------------|---|-------------------------|
| <b>Service set</b>            | Name of the service set for which the IPsec security associations are defined. If appropriate, includes the outside service interface VRF name. | All levels              |
| <b>Rule</b>                   | Name of the rule set applied to the security association.   | <b>detail extensive</b> |
| <b>Term</b>                   | Name of the IPsec term applied to the security association.   | <b>detail extensive</b> |
| <b>Tunnel index</b>           | Numeric identifier of the specific IPsec tunnel for the security association.   | <b>detail extensive</b> |
| <b>Local gateway</b>          | Gateway address of the local system.  | All levels              |
| <b>Remote gateway</b>         | Gateway address of the remote system.   | All levels              |
| <b>IPsec inside interface</b> | Name of the logical interface hosting the IPsec tunnels.  | All levels              |
| <b>Tunnel MTU</b>             | MTU of the IPsec tunnel.  | All levels              |



Table 29: show services ipsec-vpn ipsec security-associations Output Fields (*continued*)

| Field Name                    | Field Description  | Level of Output |
|-------------------------------|--|-----------------|
| <b>Local identity</b>         | <p>Protocol, address or prefix, and port number of the local entity of the IPsec association. The format is <b>id-type-name (proto-name:port-number,[0..id-data-len] = iddata-presentation)</b>. The protocol is always displayed as any because it is not user-configurable in the IPsec rule. Similarly, the port number field in the output is always displayed as 0 because it is not user-configurable in the IPsec rule. The value of the <b>id-data-len</b> parameter can be one of the following, depending on the address configured in the IPsec rule:</p> <ul style="list-style-type: none"> <li>For an IPv4 address, the length is 4 and the value displayed is 3.</li> <li>For a subnet mask of an IPv4 address, the length is 8 and the value displayed is 7.</li> <li>For a range of IPv4 addresses, the length is 8 and the value displayed is 7.</li> <li>For an IPv6 address prefix, the length is 16 and the value displayed is 15.</li> <li>For a subnet mask of an IPv6 address prefix, the length is 32 and the value displayed is 31.</li> <li>For a range of IPv6 address prefixes, the length is 32 and the value displayed is 31.</li> </ul> <p>The value of the <b>id-data-presentation</b> field denotes the IPv4 address or IPv6 prefix details. If the fully qualified domain name (FQDN) is specified instead of the address for the local peer of the IPsec association, it is displayed instead of the address details.</p>   | All levels      |
| <b>Remote identity</b>        | <p>Protocol, address or prefix, and port number of the remote entity of the IPsec association. The format is <b>id-type-name (proto-name:port-number,[0..id-data-len] = iddata-presentation)</b>. The protocol is always displayed as any because it is not user-configurable in the IPsec rule. Similarly, the port number field in the output is always displayed as 0 because it is not user-configurable in the IPsec rule. The value of the <b>id-data-len</b> parameter can be one of the following, depending on the address configured in the IPsec rule:</p> <ul style="list-style-type: none"> <li>For an IPv4 address, the length is 4 and the value displayed is 3.</li> <li>For a subnet mask of an IPv4 address, the length is 8 and the value displayed is 7.</li> <li>For a range of IPv4 addresses, the length is 8 and the value displayed is 7.</li> <li>For an IPv6 address prefix, the length is 16 and the value displayed is 15.</li> <li>For a subnet mask of an IPv6 address prefix, the length is 32 and the value displayed is 31.</li> <li>For a range of IPv6 address prefixes, the length is 32 and the value displayed is 31.</li> </ul> <p>The value of the <b>id-data-presentation</b> field denotes the IPv4 address or IPv6 prefix details. If the fully qualified domain name (FQDN) is specified instead of the address for the remote peer of the IPsec association, it is displayed instead of the address details.</p> | All levels      |
| <b>Primary remote gateway</b> | IP address of the configured primary remote peer.  | All levels      |
| <b>Backup remote gateway</b>  | IP address of the configured backup remote peer.   | All levels      |

Table 29: show services ipsec-vpn ipsec security-associations Output Fields (*continued*)

| Field Name              | Field Description   | Level of Output         |
|-------------------------|---|-------------------------|
| <b>State</b>            | State of the primary or backup interface: <b>Active</b> , <b>Offline</b> , or <b>Standby</b> . Both ES PICs are initialized to <b>Offline</b> . For primary and backup peers, <b>State</b> can be <b>Active</b> or <b>Standby</b> . If both peers are in a state of <b>Standby</b> , no connection exists yet between the two peers.  | All levels              |
| <b>Failover counter</b> | Number of times a PIC switched between primary and backup interfaces, or the number of times the tunnel switched between the primary and remote peers since the software has been activated.  | All levels              |
| <b>Direction</b>        | Direction of the security association: <b>inbound</b> or <b>outbound</b> .  | All levels              |
| <b>SPI</b>              | Value of the security parameter index.  | All levels              |
| <b>AUX-SPI</b>          | Value of the auxiliary security parameter index. <ul style="list-style-type: none"> <li>When the value of <b>Protocol</b> is <b>AH</b> or <b>ESP</b>, <b>AUX-SPI</b> is always 0.</li> <li>When the value of <b>Protocol</b> is <b>AH+ESP</b>, <b>AUX-SPI</b> is always a positive integer.</li> </ul>  | All levels              |
| <b>Mode</b>             | Mode of the security association: <ul style="list-style-type: none"> <li><b>transport</b>—Protects single host-to-host protections.</li> <li><b>tunnel</b>—Protects connections between security gateways.</li> </ul>   | <b>detail extensive</b> |
| <b>Type</b>             | Type of security association: <ul style="list-style-type: none"> <li><b>manual</b>—Security parameters require no negotiation. They are static, and are configured by the user.</li> <li><b>dynamic</b>—Security parameters are negotiated by the IKE protocol. Dynamic security associations are not supported in transport mode.</li> </ul>   | <b>detail extensive</b> |
| <b>State</b>            | Status of the security association: <ul style="list-style-type: none"> <li><b>Installed</b>—The security association is installed in the security association database. (For transport mode security associations, the value of State must always be Installed.)</li> <li><b>Not installed</b>—The security association is not installed in the security association database.</li> </ul> | <b>detail extensive</b> |
| <b>Protocol</b>         | Protocol supported: <ul style="list-style-type: none"> <li><b>transport</b> mode supports Encapsulation Security Protocol (<b>ESP</b>) or Authentication Header (<b>AH</b>).</li> <li><b>tunnel</b> mode supports <b>ESP</b> or <b>AH+ESP</b>.</li> </ul>   | All levels              |
| <b>Authentication</b>   | Type of authentication used: <b>hmac-md5-96</b> , <b>hmac-sha1-96</b> , or <b>none</b> .  | <b>detail extensive</b> |
| <b>Encryption</b>       | Type of encryption algorithm used: <b>aes-cbc (128 bits)</b> , <b>aes-cbc (192 bits)</b> , <b>aes-cbc (256 bits)</b> , <b>des-cbc</b> , <b>3des-cbc</b> , or <b>None</b> .  | <b>detail</b>           |

Table 29: show services ipsec-vpn ipsec security-associations Output Fields (*continued*)

| Field Name                     | Field Description   | Level of Output  |
|--------------------------------|---|------------------|
| Soft lifetime<br>Hard lifetime | Each lifetime of a security association has two display options, hard and soft, one of which must be present for a dynamic security association. The hard lifetime specifies the lifetime of the SA. The soft lifetime, which is derived from the hard lifetime, informs the IPsec key management system that the SA is about to expire. This information allows the key management system to negotiate a new SA before the hard lifetime expires. <ul style="list-style-type: none"> <li>Expires in <i>seconds</i> <b>seconds</b>—Number of seconds left until the security association expires.</li> <li>Expires in <i>kilobytes</i> <b>kilobytes</b>—Number of kilobytes left until the security association expires.</li> </ul> | detail extensive |
| Anti-replay service            | State of the service that prevents packets from being replayed: <b>Enabled</b> or <b>Disabled</b> .   | detail extensive |
| Replay window size             | Configured size, in packets, of the antireplay service window: <b>32</b> or <b>64</b> . The antireplay window size protects the receiver against replay attacks by rejecting old or duplicate packets. If the replay window size is <b>0</b> , antireplay service is disabled.  | detail           |

## Sample Output

### show services ipsec-vpn ipsec security associations extensive

```

user@host> show services ipsec-vpn ipsec security-associations extensive
Service set: service-set-1
  Rule: _junos_, Term: term-1, Tunnel index: 1
  Local gateway: 101.101.101.2, Remote gateway: 14.14.14.4
  IPSec inside interface: sp-2/0/0.1 Local identity:
  ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
  Remote identity: ipv4_subnet(any:0,[0..7]=0.0.0.0/0)
  Primary remote gateway: 101.101.101.1, State: Standby
  Backup remote gateway: 14.14.14.4, State: Active
  Failover counter: 1

  Direction: inbound, SPI: 3743521590, AUX-SPI: 0
  Mode: tunnel, Type: dynamic, State: Installed
  Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
  Soft lifetime: Expires in 23043 seconds
  Hard lifetime: Expires in 23178 seconds
  Anti-replay service: Enabled, Replay window size: 64

  Direction: outbound, SPI: 2551045240, AUX-SPI: 0
  Mode: tunnel, Type: dynamic, State: Installed
  Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
  Soft lifetime: Expires in 23043 seconds
  Hard lifetime: Expires in 23178 seconds
  Anti-replay service: Enabled, Replay window size: 64

```

## show services ipsec-vpn ipsec statistics

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | show services ipsec-vpn ipsec statistics<br><brief   detail><br><remote-gw <i>remote-peer-address</i> ><br><service-set <i>service-set-name</i> >   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>New fields added in Junos OS Release 10.0.   |
| <b>Description</b>              | (Adaptive services interface only) Display IPsec statistics for the specified service set. If no service set is specified, the statistics for all service sets are displayed.   |
| <b>Options</b>                  | <p><b>none</b>—Display standard IPsec statistics for all service sets.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>remote-gw <i>remote-peer-address</i></b>—(Optional) Display IPsec statistics for an individual IPsec tunnel and an individual remote host.</p> <p><b>service-set <i>service-set-name</i></b>—(Optional) Display information about a particular service set.</p> |
| <b>Required Privilege Level</b> | view  |
| <b>List of Sample Output</b>    | <a href="#">show services ipsec-vpn ipsec statistics detail on page 456</a><br><a href="#">show services ipsec-vpn ipsec statistics remote-gw on page 456</a>   |
| <b>Output Fields</b>            | <a href="#">Table 30 on page 454</a> lists the output fields for the <b>show services ipsec-vpn ipsec statistics</b> command. Output fields are listed in the approximate order in which they appear.   |

**Table 30: show services ipsec-vpn ipsec statistics Output Fields**

| Field Name            | Field Description   | Level of Output |
|-----------------------|---|-----------------|
| <b>PIC</b>            | The physical interface on which the IPsec tunnel is configured.               | All levels      |
| <b>Service set</b>    | Name of the service set for which the IPsec tunnel is defined.                | All levels      |
| <b>Local gateway</b>  | Gateway address of the local system.  | All levels      |
| <b>Remote gateway</b> | Gateway address of the remote system.   | All levels      |
| <b>Tunnel index</b>   | Numeric identifier of the specific IPsec tunnel for the security association. | All levels      |

Table 30: show services ipsec-vpn ipsec statistics Output Fields (*continued*)

| Field Name            | Field Description   | Level of Output |
|-----------------------|---|-----------------|
| <b>ESP statistics</b> | Encapsulation Security Payload (ESP) statistics: <ul style="list-style-type: none"> <li>• <b>Encrypted bytes</b>—Total number of bytes encrypted by the local system across the IPsec tunnel.</li> <li>• <b>Decrypted bytes</b>—Total number of bytes decrypted by the local system across the IPsec tunnel.</li> <li>• <b>Encrypted packets</b>—Total number of packets encrypted by the local system across the IPsec tunnel.</li> <li>• <b>Decrypted packets</b>—Total number of packets decrypted by the local system across the IPsec tunnel.</li> </ul>   | All levels      |
| <b>AH Statistics</b>  | Authentication Header statistics: <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Total number of bytes received by the local system across the IPsec tunnel.</li> <li>• <b>Output bytes</b>—Total number of bytes transmitted by the local system across the IPsec tunnel.</li> <li>• <b>Input packets</b>—Total number of packets received by the local system across the IPsec tunnel.</li> <li>• <b>Output packets</b>—Total number of packets transmitted by the local system across the IPsec tunnel.</li> </ul>  | All levels      |
| <b>Errors</b>         | <ul style="list-style-type: none"> <li>• <b>AH authentication failures</b>—Number of authentication header (AH) failures. An AH failure occurs when there is a mismatch of the authentication header in a packet transmitted across an IPsec tunnel.</li> <li>• <b>ESP authentication failures</b>—Number of Encapsulation Security Payload (ESP) failures. An ESP failure occurs when there is an authentication mismatch in ESP packets.</li> <li>• <b>ESP Decryption failures</b>—Number of ESP decryption failures.</li> <li>• <b>Bad headers</b>—Number of invalid headers detected.</li> <li>• <b>Bad trailers</b>—Number of invalid trailers detected.</li> <li>• <b>Replay before window drops</b>—Number of replay errors. A replay error is generated when a duplicate packet is received within the replay window.</li> <li>• <b>Replayed pkts</b>—Number of packets replayed.</li> <li>• <b>IP integrity errors</b>—Number of IP integrity errors.</li> <li>• <b>Exceeds tunnel MTU</b>—Number of times the tunnel maximum transmission unit (MTU) value was exceeded.</li> <li>• <b>Rule lookup failures</b>—Number of rule lookup failures.</li> <li>• <b>No SA errors</b>—Number of errors resulting from a missing security association (SA).</li> <li>• <b>Flow errors</b>—Number of flow errors.</li> <li>• <b>Misc errors</b>—Number of miscellaneous errors.</li> </ul> | All levels      |

## Sample Output

### show services ipsec-vpn ipsec statistics detail

```
user@host> show services ipsec-vpn ipsec statistics
PIC: sp-0/2/0, Service set: ss0

ESP Statistics:
  Encrypted bytes:          0
  Decrypted bytes:         0
  Encrypted packets:       0
  Decrypted packets:       0
AH Statistics:
  Input bytes:             168
  Output bytes:            168
  Input packets:           2
  Output packets:          2
Errors:
  AH authentication failures: 0
  ESP authentication failures: 0
  ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0
  Replay before window drops: 0, Replayed pkts: 0
  IP integrity errors: 0, Exceeds tunnel MTU: 0
  Rule lookup failures: 0, No SA errors: 0
  Flow errors: 0, Misc errors: 0
```

### show services ipsec-vpn ipsec statistics remote-gw

```
user@host> show services ipsec-vpn ipsec statistics remote-gw 22.22.2.1
PIC: sp-3/1/0, Service set: service-set-2
Local gateway: 22.22.1.1, Remote gateway: 22.22.2.1, Tunnel index: 2
ESP Statistics:
  Encrypted bytes:          0
  Decrypted bytes:         0
  Encrypted packets:       0
  Decrypted packets:       0
AH Statistics:
  Input bytes:             0
  Output bytes:            0
  Input packets:           0
  Output packets:          0
Errors:
  AH authentication failures: 0
  ESP authentication failures: 0
  ESP decryption failures: 0
  Bad headers: 0, Bad trailers: 0
  Replay before window drops: 0, Replayed pkts: 0
  IP integrity errors: 0, Exceeds tunnel MTU: 0
  Rule lookup failures: 0, No SA errors: 0
  Flow errors: 0, Misc errors: 0
```

## show system certificate

|                                 |   |
|---------------------------------|---|
| <b>Syntax</b>                   | <code>show system certificate</code><br><code>&lt;certificate-id&gt;</code>   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 11.1 for the QFX Series.  |
| <b>Description</b>              | (Encryption interface on M Series, T Series routers, and QFX Series switches only) Display installed certificates signed by the Juniper Networks certificate authority.                     |
| <b>Options</b>                  | <b>none</b> —Display all installed certificates signed by the Juniper Networks certificate authority.<br><b>certificate-id</b> —(Optional) Display the details of a particular certificate. |
| <b>Required Privilege Level</b> | maintenance   |
| <b>List of Sample Output</b>    | <a href="#">show system certificate on page 458</a><br><a href="#">show system certificate (QFX Series) on page 458</a>   |
| <b>Output Fields</b>            | <a href="#">Table 31 on page 457</a> lists the output fields for the <b>show system certificate</b> command. Output fields are listed in the approximate order in which they appear.        |

**Table 31: show system certificate Output Fields**

| Field Name                      | Field Description   |
|---------------------------------|---|
| <b>Certificate identifier</b>   | Unique identifier associated with a certificate. The certificate identifier is the common name of the subject.  |
| <b>Issuer</b><br><b>Subject</b> | Information about the certificate issuer and the distinguished name (DN) of the issuer, respectively: <ul style="list-style-type: none"> <li>• <b>Organization</b>—Name of the owner's organization.</li> <li>• <b>Organizational unit</b>—Name of the owner's department.</li> <li>• <b>Country</b>—Two-character country code in which the owner's system is located.</li> <li>• <b>State</b>—State in the USA in which the owner is using the certificate.</li> <li>• <b>Locality</b>—City in which the owner's system is located.</li> <li>• <b>Common name</b>—Name of the owner of the certificate.</li> <li>• <b>E-mail address</b>—E-mail address of the owner of the certificate.</li> </ul> |
| <b>Validity</b>                 | When a certificate is valid.  |
| <b>Signature algorithm</b>      | Encryption algorithm applied to the installed certificate.  |
| <b>Public key algorithm</b>     | Encryption algorithm applied to the public key.   |

## Sample Output

### show system certificate

```
user@host> show system certificate
Certificate identifier: Dallas-v3
Issuer:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas CA,
E-mail address:ca@juniper.net
Subject:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas-v3,
E-mail address:ca@juniper.net
Validity:
Not before: Mar 13 03:23:25 2004 GMT
Not after: Mar 24 03:23:25 2014 GMT
Signature algorithm: sha1WithRSAEncryption
Public key algorithm: dsaEncryption
```

### show system certificate (QFX Series)

```
user@host> show system certificate
Certificate identifier: Dallas-v3
Issuer:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas CA,
E-mail address:ca@juniper.net
Subject:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas-v3,
E-mail address:ca@juniper.net
Validity:
Not before: Mar 13 03:23:25 2004 GMT
Not after: Mar 24 03:23:25 2014 GMT
Signature algorithm: sha1WithRSAEncryption
Public key algorithm: dsaEncryption
```



## PART 7

# Index

- [Index on page 461](#)



# Index

## Symbols

|  |    |
|--|----|
| #, comments in configuration statements..... | xx |
| ( ), in syntax descriptions.....             | xx |
| < >, in syntax descriptions.....             | xx |
| [ ], in configuration statements.....        | xx |
| { }, in configuration statements.....        | xx |
| (pipe), in syntax descriptions.....          | xx |

## A

|  |          |
|--|----------|
| algorithm statement.....                 | 279      |
| IPsec.....                               | 280      |
| Junos-FIPS software.....                 | 279      |
| usage guidelines.....                    | 194      |
| associations, clearing.....              | 401      |
| authentication statement                 |          |
| IPsec.....                               | 280      |
| usage guidelines.....                    | 178, 183 |
| authentication-algorithm statement       |          |
| IKE.....                                 | 281      |
| usage guidelines.....                    | 185      |
| IPsec.....                               | 281      |
| usage guidelines.....                    | 190      |
| authentication-key-chains statement..... | 282      |
| authentication-method statement          |          |
| IKE.....                                 | 283      |
| usage guidelines.....                    | 185      |
| auto-re-enrollment statement.....        | 284      |
| auxiliary-spi statement.....             | 285      |
| usage guidelines.....                    | 178, 182 |

## B

|  |     |
|--|-----|
| bandwidth statement                      |     |
| DDoS protection.....                     | 239 |
| bandwidth-scale statement                |     |
| DDoS protection.....                     | 240 |
| braces, in configuration statements..... | xx  |
| brackets                                 |     |
| angle, in syntax descriptions.....       | xx  |
| square, in configuration statements..... | xx  |
| burst statement                          |     |
| DDoS protection.....                     | 240 |

|                            |     |
|----------------------------|-----|
| burst-scale statement      |     |
| DDoS protection.....       | 241 |
| bypass-aggregate statement |     |
| DDoS protection.....       | 241 |

## C

|   |          |
|---|----------|
| ca-identity statement.....                  | 285      |
| usage guidelines.....                       | 23       |
| ca-name statement.....                      | 286      |
| usage guidelines.....                       | 16       |
| ca-profile statement.....                   | 287      |
| usage guidelines.....                       | 23       |
| cache-size statement.....                   | 288      |
| usage guidelines.....                       | 18       |
| cache-timeout-negative statement.....       | 289      |
| usage guidelines.....                       | 18       |
| certificate revocation list See CRL         |          |
| certificate-id statement.....               | 290      |
| certificates                                |          |
| for IKE negotiation, displaying.....        | 443      |
| installed, displaying.....                  | 457      |
| key pairs, generating.....                  | 405      |
| PKI   |          |
| CA certificates, clearing.....              | 393      |
| CA certificates, displaying.....            | 432      |
| CA certificates, loading manually.....      | 407      |
| certificate revocation lists, clearing..... | 395      |
| certificate revocation lists,               |          |
| displaying.....                             | 438      |
| certificate revocation lists, loading       |          |
| manually.....                               | 409      |
| key pair, generating.....                   | 412      |
| local certificates, clearing.....           | 396, 397 |
| local certificates, displaying.....         | 440      |
| local certificates, loading manually.....   | 416      |
| local certificates, requesting              |          |
| manually.....                               | 410, 415 |
| local certificates, requesting online.....  | 406      |
| local certificates, requesting that CA      |          |
| install.....                                | 413      |
| local certificates, requests, clearing..... | 394      |
| local certificates, requests,               |          |
| displaying.....                             | 436      |
| provided by Juniper Networks, adding.....   | 418      |
| signed certificate, obtaining.....          | 402      |
| unsigned certificate, obtaining.....        | 404      |
| certificates statement.....                 | 291      |
| usage guidelines.....                       | 5        |

|  |     |
|--|-----|
| certification-authority statement.....                               | 292 |
| usage guidelines.....  | 16  |
| challenge-password statement.....                                    | 292 |
| clear ddos-protection protocols command.....                         | 346 |
| clear security pki ca-certificate command.....                       | 393 |
| clear security pki certificate-request<br>command.....               | 394 |
| clear security pki crl command.....                                  | 395 |
| clear security pki key-pair.....                                     | 396 |
| clear security pki local-certificate command.....                    | 397 |
| clear services ipsec-vpn certificates<br>command.....                | 398 |
| clear services ipsec-vpn ike security-associations<br>command.....   | 400 |
| clear services ipsec-vpn ipsec security-associations<br>command..... | 401 |
| clear services ipsec-vpn ipsec statistics<br>command.....            | 399 |
| comments, in configuration statements.....                           | xx  |
| conventions  |     |
| text and syntax.....   | xix |
| CRL.....   | 216 |
| crl statement  |     |
| AS and MultiServices PICs.....                                       | 293 |
| ES PIC.....  | 294 |
| usage guidelines (AS and Multiservices<br>PICs).....                 | 24  |
| usage guidelines (ES PIC).....                                       | 16  |
| curly braces, in configuration statements.....                       | xx  |
| customer support.....  | xxi |
| contacting JTAC.....   | xxi |

## D

### DDoS protection

|  |     |
|--|-----|
| clearing statistics and violations.....                | 346 |
| configuration example.....                             | 42  |
| configuration overview.....                            | 41  |
| culprit flow information, displaying.....              | 363 |
| disabling policers and logging globally.....           | 55  |
| flags for tracing operations.....                      | 59  |
| flow-detection information, displaying.....            | 366 |
| log file access for tracing operations.....            | 58  |
| log file size and number.....                          | 57  |
| log filenames.....                                     | 57  |
| logging  |     |
| disabling globally.....                                | 55  |
| message severity levels for tracing<br>operations..... | 59  |
| overview.....  | 35  |

|  |          |
|--|----------|
| packet-level configuration.....                            | 51       |
| policers   |          |
| aggregate.....   | 36       |
| disabling globally.....                                    | 55       |
| disabling individual.....                                  | 51       |
| hierarchy.....   | 37       |
| packet-level configuration.....                            | 51       |
| protocol.....  | 36       |
| scaling.....   | 37       |
| protocol information, displaying.....                      | 347      |
| protocol policer information, displaying.....              | 370      |
| protocol policer violation information,<br>displaying..... | 387      |
| protocol statistics information, displaying.....           | 377      |
| regular expressions for tracing operations.....            | 58       |
| statistics, displaying.....                                | 389      |
| suspicious control flow detection.....                     | 62       |
| tracing operations.....                                    | 56       |
| traffic priority   |          |
| aggregate.....   | 36       |
| verifying configuration.....                               | 59       |
| version, displaying.....                                   | 390      |
| DDoS protection flow detection                             |          |
| configuration overview.....                                | 65       |
| DDoS protection statements                                 |          |
| bandwidth.....   | 239      |
| bandwidth-scale.....                                       | 240      |
| burst.....   | 240      |
| burst-scale.....   | 241      |
| bypass-aggregate.....                                      | 241      |
| ddos-protection.....                                       | 242      |
| disable-fpc.....   | 243      |
| disable-logging.....                                       | 244      |
| disable-routing-engine.....                                | 244      |
| flow-detect-time.....                                      | 248      |
| flow-detection.....  | 245, 246 |
| flow-detection-mode.....                                   | 247      |
| flow-level-bandwidth.....                                  | 249      |
| flow-level-control.....                                    | 249      |
| flow-level-detection.....                                  | 250      |
| flow-recover-time.....                                     | 251      |
| flow-report-rate.....                                      | 251      |
| flow-timeout-time.....                                     | 252      |
| fpc.....   | 252      |
| global.....  | 253      |
| logical-interface.....                                     | 254      |
| no-flow-logging.....                                       | 255      |
| physical-interface.....                                    | 256      |
| priority.....  | 257      |

|   |               |   |               |
|---|---------------|---|---------------|
| protocols.....                                    | 258           | dynamic statement.....                          | 298           |
| recover-time.....                                 | 267           | usage guidelines.....                           | 179, 184      |
| subscriber.....                                   | 268           | <b>E</b>  |               |
| timeout-active-flows.....                         | 269           | enable-timeout-active statement                 |               |
| traceoptions.....                                 | 270           | DDoS protection flow detection.....             | 269           |
| violation-report-rate.....                        | 272           | encoding statement.....                         | 299           |
| ddos-protection statement                         |               | usage guidelines                                |               |
| DDoS protection.....                              | 242           | certificate authority.....                      | 17            |
| denial-of-service attacks                         |               | IKE policy.....                                 | 20            |
| protecting against See DDoS Protection            |               | encryption statement                            |               |
| DEP   |               | Junos OS.....                                   | 300           |
| configuration procedure.....                      | 207           | Junos-FIPS software.....                        | 301           |
| example configuration.....                        | 212           | usage guidelines.....                           | 179, 183, 194 |
| operational mode commands.....                    | 213           | encryption-algorithm statement.....             | 301           |
| overview.....                                     | 207           | usage guidelines                                |               |
| description statement.....                        | 294           | IKE.....  | 186           |
| IKE policy.....                                   | 295           | IPsec.....                                      | 191           |
| usage guidelines.....                             | 188           | encryption-algorithm statement (IKE)            |               |
| IKE proposal.....                                 | 295           | usage guidelines.....                           | 186           |
| usage guidelines.....                             | 186           | enrollment statement.....                       | 302           |
| IPsec policy.....                                 | 295           | usage guidelines.....                           | 23            |
| usage guidelines.....                             | 192           | enrollment-retry statement.....                 | 303           |
| IPsec proposal.....                               | 295           | usage guidelines.....                           | 18            |
| usage guidelines.....                             | 191           | enrollment-url statement.....                   | 303           |
| IPsec SA.....                                     | 295           | usage guidelines.....                           | 17            |
| usage guidelines.....                             | 174           | ES PIC.....                                     | 21            |
| usage guidelines.....                             | 174, 186, 191 | <b>F</b>  |               |
| dh-group statement.....                           | 295           | file statement                                  |               |
| usage guidelines.....                             | 186           | security  |               |
| digital certificates See certificates             |               | usage guidelines.....                           | 17            |
| IPSec.....  | 215           | security certificate.....                       | 304           |
| direction statement                               |               | flow detection See overview                     |               |
| Junos OS.....                                     | 296           | flow detection, DDoS protection                 |               |
| Junos-FIPS software.....                          | 297           | configuration overview.....                     | 65            |
| usage guidelines.....                             | 176, 181, 195 | configuring the detection period.....           | 67            |
| direction, IPsec.....                             | 195           | configuring the flow aggregation level          |               |
| disable-fpc statement                             |               | mode.....                                       | 69            |
| DDoS protection.....                              | 243           | configuring the flow bandwidth.....             | 71            |
| disable-logging statement                         |               | configuring the flow control mode.....          | 71            |
| DDoS protection.....                              | 244           | configuring the operation mode.....             | 69            |
| disable-routing-engine statement                  |               | configuring the recovery period.....            | 68            |
| DDoS protection.....                              | 244           | configuring the timeout period.....             | 68            |
| distributed denial-of-service See DDoS protection |               | disabling automatic logging for packet          |               |
| documentation                                     |               | types.....                                      | 73            |
| comments on.....                                  | xxi           | enabling flow detection globally.....           | 66            |
| dynamic endpoint tunneling See DEP                |               | global rate for reporting suspicious flows..... | 66            |
| dynamic security associations.....                | 185           |   |               |
| dynamic security associations                     |               |   |               |
| (IPsec).....                                      | 179, 180, 184 |   |               |

|  |          |   |                    |
|--|----------|---|--------------------|
| global rate for reporting violations.....  | 67       | IKE.....  | 84, 185            |
| verifying configuration.....               | 73       | adaptive services interfaces                    |                    |
| flow detection, DDoS protection statements |          | security associations, clearing.....            | 400                |
| flow-detect-time.....                      | 248      | security associations, displaying.....          | 446                |
| flow-detection.....                        | 245, 246 | statistics, clearing.....                       | 399                |
| flow-detection-mode.....                   | 247      | authentication algorithm.....                   | 185                |
| flow-level-bandwidth.....                  | 249      | authentication method.....                      | 185                |
| flow-level-control.....                    | 249      | Diffie-Hellman group.....                       | 186                |
| flow-level-detection.....                  | 250      | dynamic SAs.....                                | 185                |
| flow-recover-time.....                     | 251      | encryption algorithm.....                       | 186                |
| flow-report-rate.....                      | 251      | encryption services interfaces                  |                    |
| flow-timeout-time.....                     | 252      | security associations, displaying.....          | 419                |
| logical-interface.....                     | 254      | encryption-algorithm statement                  |                    |
| no-flow-logging.....                       | 255      | usage guidelines.....                           | 186                |
| physical-interface.....                    | 256      | lifetime statement                              |                    |
| subscriber.....                            | 268      | usage guidelines.....                           | 187                |
| timeout-active-flows.....                  | 269      | policy configuration, example.....              | 189                |
| violation-report-rate.....                 | 272      | policy description.....                         | 188                |
| flow-detect-time statement                 |          | policy mode.....                                | 188                |
| DDoS protection flow detection.....        | 248      | policy statement                                |                    |
| flow-detection statement                   |          | usage guidelines.....                           | 187                |
| DDoS protection flow detection.....        | 245, 246 | preshared key.....                              | 188                |
| flow-detection-mode statement              |          | proposal description.....                       | 186                |
| DDoS protection flow detection.....        | 247      | proposals associated with policy.....           | 189                |
| flow-level-bandwidth statement             |          | SA lifetime.....                                | 187                |
| DDoS protection flow detection.....        | 249      | ike statement.....                              | 305                |
| flow-level-control statement               |          | usage guidelines .....                          | 185                |
| DDoS protection flow detection.....        | 249      | internal statement.....                         | 306                |
| flow-level-detection statement             |          | usage guidelines.....                           | 194                |
| DDoS protection flow detection.....        | 250      | IPsec   |                    |
| flow-recover-time statement                |          | algorithm.....                                  | 280                |
| DDoS protection flow detection.....        | 251      | authentication.....                             | 178, 183           |
| flow-report-rate statement                 |          | authentication algorithm.....                   | 190                |
| DDoS protection flow detection.....        | 251      | auxiliary security parameter index.....         | 178, 182           |
| flow-timeout-time statement                |          | configuring internal.....                       | 194                |
| DDoS protection flow detection.....        | 252      | digital certificates, configuring (AS and       |                    |
| font conventions.....                      | xix      | Multiservices PICs).....                        | 21                 |
| fpc statement                              |          | digital certificates, configuring (ES PIC)..... | 15                 |
| DDoS protection.....                       | 252      | direction.....                                  | 176, 181, 194      |
| <b>G</b>                                   |          | direction of processing.....                    | 176, 181           |
| global statement                           |          | dynamic security associations.....              | 179, 180, 184      |
| DDoS protection.....                       | 253      | encryption.....                                 | 179, 183, 194, 301 |
| <b>I</b>                                   |          | encryption algorithm.....                       | 191, 194           |
| identity statement.....                    | 304      | ES PIC.....                                     | 21                 |
| usage guidelines.....                      | 20       | example.....                                    | 196                |
|  |          | inbound traffic filter, applying.....           | 204                |
|  |          | inbound traffic filter, configuring.....        | 204                |
|  |          | outbound traffic filter, applying.....          | 203                |
|  |          | outbound traffic filter, configuring.....       | 202                |

|   |               |
|---|---------------|
| example configuration                             |               |
| outbound traffic.....                             | 202           |
| IKE.....  | 84            |
| internal.....                                     | 194           |
| key.....  | 196           |
| lifetime of SA.....                               | 191           |
| manual.....                                       | 175, 180, 194 |
| minimum configurations                            |               |
| dynamic SA .....                                  | 172           |
| manual SA .....                                   | 172           |
| overview.....                                     | 77            |
| Perfect Forward Secrecy.....                      | 193           |
| policy.....                                       | 192           |
| proposal.....                                     | 190           |
| proposal description.....                         | 191           |
| SA description.....                               | 174           |
| security associations.....                        | 82            |
| security parameter index.....                     | 177, 182      |
| SPI.....  | 195           |
| statements.....                                   | 334           |
| IPSec   |               |
| example configuration                             |               |
| AS PIC IKE SAs .....                              | 121           |
| AS PIC IKE SAs with digital                       |               |
| certificates.....                                 | 129           |
| AS PIC manual SAs .....                           | 101           |
| AS PIC to ES PIC IKE SAs .....                    | 158           |
| DEP.....  | 212           |
| ES PIC IKE SAs .....                              | 147           |
| ES PIC manual SAs .....                           | 109           |
| operational mode commands                         |               |
| AS PIC IKE SAs.....                               | 126           |
| AS PIC IKE SAs with digital                       |               |
| certificates.....                                 | 139           |
| AS PIC manual SAs.....                            | 106           |
| AS PIC to ES PIC IKE SAs.....                     | 164           |
| DEP.....  | 213           |
| ES PIC IKE SAs.....                               | 154           |
| ES PIC manual SAs.....                            | 115           |
| options   |               |
| configuring multiple routed tunnels in a          |               |
| single next-hop service set.....                  | 168           |
| CRL.....  | 216           |
| DEP.....  | 207           |
| digital certificates.....                         | 215           |
| filter-based forwarding.....                      | 201           |
| Layer 3 VPNs.....                                 | 225           |
| monitoring with SNMP.....                         | 233           |
| securing BGP sessions.....                        | 221           |
| securing OSPFv2 networks.....                     | 221           |
| securing OSPFv3 networks.....                     | 223           |
| system requirements.....                          | 91            |
| IPsec services                                    |               |
| adaptive services interfaces                      |               |
| IKE security associations, clearing.....          | 400           |
| IKE security associations, displaying.....        | 446           |
| IPSec security associations, clearing.....        | 401           |
| IPSec security associations,                      |               |
| displaying.....                                   | 450           |
| IPSec statistics, clearing.....                   | 399           |
| IPSec statistics, displaying.....                 | 454           |
| encryption services interfaces                    |               |
| certificate database, displaying.....             | 423           |
| IKE security associations, displaying.....        | 419           |
| IPSec security associations,                      |               |
| displaying.....                                   | 426           |
| ipsec statement.....                              | 307           |
| usage guidelines.....                             | 173           |
| ipsec-policy statement.....                       | 298           |
| usage guidelines.....                             | 179, 184      |
| IS-IS   |               |
| authentication, displaying.....                   | 429           |
| <b>J</b>  |               |
| Junos XML protocol xnm-ssl service.....           | 5             |
| Junos-FIPS  |               |
| IPsec requirements.....                           | 92            |
| <b>K</b>  |               |
| key pair for digital certificate, generating..... | 405           |
| key statement.....                                | 309, 310      |
| usage guidelines.....                             | 196           |
| key, IPsec.....                                   | 196           |
| key-chain statement.....                          | 311           |
| <b>L</b>  |               |
| Layer 3 VPNs                                      |               |
| IPSec.....  | 225           |
| ldap-url statement.....                           | 312           |
| usage guidelines.....                             | 17            |
| lifetime-seconds statement.....                   | 312           |
| usage guidelines                                  |               |
| IKE.....  | 187           |
| IPsec.....  | 191           |
| local statement.....                              | 313           |
| usage guidelines.....                             | 5             |
| local-certificate statement.....                  | 314           |
| usage guidelines.....                             | 20            |

|                                     |     |
|-------------------------------------|-----|
| local-key-pair statement.....       | 314 |
| usage guidelines.....               | 20  |
| log files                           |     |
| filenames for DDoS protection.....  | 57  |
| number of DDoS protection.....      | 57  |
| size of DDoS protection.....        | 57  |
| logical-interface statement         |     |
| DDoS protection flow detection..... | 254 |

## M

|                                     |               |
|-------------------------------------|---------------|
| manual security association.....    | 175, 180      |
| manual statement                    |               |
| Junos OS.....                       | 315           |
| Junos-FIPS software.....            | 316           |
| usage guidelines.....               | 175, 180, 194 |
| manuals                             |               |
| comments on.....                    | xxi           |
| maximum-certificates statement..... | 317           |
| usage guidelines.....               | 19            |
| mode statement                      |               |
| IKE.....                            | 318           |
| usage guidelines.....               | 188           |
| IPsec.....                          | 319           |

## N

|                                     |     |
|-------------------------------------|-----|
| no-flow-logging statement           |     |
| DDoS protection flow detection..... | 255 |

## O

|                        |     |
|------------------------|-----|
| options statement..... | 320 |
|------------------------|-----|

## P

|  |     |
|--|-----|
| parentheses, in syntax descriptions.....   | xx  |
| path-length statement.....                 | 321 |
| usage guidelines.....                      | 19  |
| perfect-forward-secrecy statement.....     | 321 |
| usage guidelines.....                      | 193 |
| physical-interface statement               |     |
| DDoS protection flow detection.....        | 256 |
| PKI See certificates, PKI                  |     |
| pki statement.....                         | 322 |
| policy statement                           |     |
| IKE.....                                   | 323 |
| usage guidelines, digital certificates (ES |     |
| PIC).....                                  | 19  |
| usage guidelines, preshared keys.....      | 187 |
| IPsec.....                                 | 324 |
| usage guidelines.....                      | 192 |

|                               |          |
|-------------------------------|----------|
| pre-shared-key statement..... | 324      |
| usage guidelines.....         | 188      |
| priority statement            |          |
| DDoS protection.....          | 257      |
| proposal statement            |          |
| IKE.....                      | 325      |
| usage guidelines.....         | 185      |
| IPsec.....                    | 325      |
| usage guidelines.....         | 190      |
| proposals statement.....      | 326      |
| usage guidelines              |          |
| IKE.....                      | 189      |
| IPsec.....                    | 192      |
| protocol                      |          |
| for dynamic SA.....           | 192      |
| for internal SA.....          | 194, 328 |
| for manual SA.....            | 177, 182 |
| protocol statement            |          |
| Junos OS.....                 | 327      |
| Junos-FIPS software.....      | 328      |
| usage guidelines              |          |
| dynamic SA.....               | 192      |
| internal SA.....              | 194      |
| manual SA.....                | 177, 182 |
| protocols statement           |          |
| DDoS protection.....          | 258      |

## R

|  |          |
|--|----------|
| re-enroll-trigger-time-percentage statement..... | 328      |
| re-generate-keypair statement.....               | 329      |
| recover-time statement                           |          |
| DDoS protection.....                             | 267      |
| refresh-interval statement.....                  | 329      |
| usage guidelines.....                            | 25       |
| replay-window-size statement.....                | 298      |
| usage guidelines.....                            | 179, 184 |
| request security certificate (signed)            |          |
| command.....                                     | 402      |
| request security certificate (unsigned)          |          |
| command.....                                     | 404      |
| request security certificate command.....        | 13       |
| usage guidelines.....                            | 13       |
| request security key-pair                        |          |
| usage guidelines.....                            | 13       |
| request security key-pair command.....           | 405      |
| request security pki ca-certificate enroll       |          |
| command.....                                     | 406      |
| request security pki ca-certificate load         |          |
| command.....                                     | 407      |



|  |     |
|--|-----|
| request security pki ca-certificate verify command.....                  | 408 |
| request security pki crt load command.....                               | 409 |
| request security pki generate-certificate-request command.....           | 410 |
| request security pki generate-key-pair command.....                      | 412 |
| request security pki local-certificate enroll command.....               | 413 |
| request security pki local-certificate generate-self-signed command..... | 415 |
| request security pki local-certificate load command.....                 | 416 |
| request security pki local-certificate verify command.....               | 417 |
| request system certificate add command.....                              | 418 |
| retry statement.....   | 330 |
| usage guidelines.....  | 24  |
| retry-interval statement.....  | 330 |
| usage guidelines.....  | 24  |
| revocation-check statement.....  | 331 |

## S

|  |               |
|--|---------------|
| SCP.....   | 3             |
| secret statement.....                                | 332           |
| secure copy See SCP                                  |               |
| security   |               |
| tracing operations.....                              | 231           |
| security association statement                       |               |
| usage guidelines.....                                | 194           |
| security certificate See certificates                |               |
| security services configuration guidelines.....      | 275           |
| security-association statement                       |               |
| Junos OS.....  | 333           |
| Junos-FIPS software.....                             | 334           |
| usage guidelines.....                                | 173           |
| show ddos-protection protocols                       |               |
| command.....   | 347, 366      |
| show ddos-protection protocols culprit-flows         |               |
| command.....   | 363           |
| show ddos-protection protocols parameters            |               |
| command.....   | 370           |
| show ddos-protection protocols statistics            |               |
| command.....   | 377           |
| show ddos-protection protocols violations            |               |
| command.....   | 387           |
| show ddos-protection statistics command.....         | 389           |
| show ddos-protection version command.....            | 390           |
| show ike security-associations command.....          | 419           |
| show ipsec certificates command.....                 | 423           |
| show ipsec security-associations command.....        | 426           |
| show security keychain command.....                  | 429           |
| show security pki ca-certificate command.....        | 432           |
| show security pki certificate-request command.....   | 436           |
| show security pki crt command.....                   | 438           |
| show security pki local-certificate command.....     | 440           |
| show services ipsec-vpn certificates                 |               |
| command.....   | 443           |
| show services ipsec-vpn ike security-associations    |               |
| command.....   | 446           |
| show services ipsec-vpn ipsec security-associations  |               |
| command.....   | 450           |
| show services ipsec-vpn ipsec statistics             |               |
| command.....   | 454           |
| show system certificate command.....                 | 457           |
| show system statistics command.....                  | 418           |
| SPI  |               |
| IPsec.....   | 195           |
| spi statement  |               |
| Junos OS.....  | 335           |
| Junos-FIPS software.....                             | 335           |
| usage guidelines .....                               | 177, 182, 195 |
| ssh-known-hosts statement.....                       | 336           |
| usage guidelines.....                                | 3             |
| start-time statement.....                            | 337           |
| subscriber statement                                 |               |
| DDoS protection flow detection.....                  | 268           |
| support, technical See technical support             |               |
| suspicious control flow detection See flow detection |               |
| suspicious flows                                     |               |
| detection period for culprit flows.....              | 67            |
| disabling automatic logging for packet               |               |
| types.....   | 73            |
| enabling detection globally.....                     | 66            |
| flow bandwidth.....                                  | 71            |
| flow control mode .....                              | 71            |
| flow detection mode .....                            | 69            |
| global reporting rate.....                           | 66            |
| global reporting rate for violations.....            | 67            |
| operation mode .....                                 | 69            |
| recovery period for culprit flows.....               | 68            |
| timeout period for culprit flows.....                | 68            |
| syntax conventions.....                              | xix           |
| system requirements                                  |               |
| IPSec.....   | 91            |

**T**

|                                       |     |
|---------------------------------------|-----|
| technical support                     |     |
| contacting JTAC.....                  | xxi |
| tolerance statement.....              | 338 |
| traceoptions statement                |     |
| DDoS protection.....                  | 270 |
| security.....                         | 339 |
| usage guidelines.....                 | 231 |
| tracing operations                    |     |
| DDoS protection.....                  | 56  |
| security.....                         | 231 |
| traffic                               |     |
| inbound (application of filter).....  | 204 |
| inbound (decryption).....             | 204 |
| outbound (application of filter)..... | 203 |
| outbound (encryption).....            | 202 |

**U**

|                    |     |
|--------------------|-----|
| url statement..... | 341 |
|--------------------|-----|

**V**

|                                     |     |
|-------------------------------------|-----|
| validity-period statement.....      | 341 |
| violation-report-rate statement     |     |
| DDoS protection flow detection..... | 272 |