



Stateful Firewall for JSF



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PART 1

Overview

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CHAPTER 1

Stateful Firewall

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Stateful Firewall Overview for JSF

Routers use firewalls to track and control the flow of traffic. Adaptive Services and MultiServices PICs employ a type of firewall called a *stateful firewall*. Contrasted with a *stateless* firewall that inspects packets in isolation, a stateful firewall provides an extra layer of security by using state information derived from past communications and other applications to make dynamic control decisions for new communication attempts.

Stateful Firewall (SFW) is supported on the Junos Services Framework (JSF). JSF is a unified framework for the integration of services on Junos-based platforms.

Stateful firewalls group relevant *flows* into *conversations*. A flow is identified by the following five properties:

- Source address
- Source port
- Destination address
- Destination port
- Protocol



NOTE: The protocols that are not supported on top of TCP/UDP can have the source port and destination port mapped to other fields.

A typical Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) conversation consists of two flows: the initiation flow and the responder flow. However, some conversations, such as an FTP conversation, might consist of two control flows and many data flows.

Firewall rules govern whether the conversation is allowed to be established. If a conversation is allowed, all flows within the conversation are permitted, including flows that are created during the life cycle of the conversation.

You configure stateful firewalls using a powerful rule-driven conversation handling path. A *rule* consists of direction, source address, source port, destination address, destination port, IP protocol value, and application protocol or service. In addition to the specific values you configure, you can assign the value **any** to rule objects, addresses, or ports, which allows them to match any input value. Finally, you can optionally negate the rule objects, which negates the result of the type-specific match.

Firewall rules are directional. For each new conversation, the router software checks the initiation flow matching the direction specified by the rule.

Firewall rules are ordered. The software checks the rules in the order in which you include them in the configuration. The first time the firewall discovers a match, the router implements the action specified by that rule. Rules still unchecked are ignored.

For more information, see *Configuring Stateful Firewall Rules*.

Stateful Firewall Support for Application Protocols

By inspecting the application protocol data, the AS or MultiServices PIC firewall can intelligently enforce security policies and allow only the minimal required packet traffic to flow through the firewall.

The firewall rules are configured in relation to an interface. By default, the stateful firewall allows all sessions initiated from the hosts behind the interface to pass through the router.

PART 2

Configuration

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CHAPTER 2

Configuration Tasks

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- Configuring Stateful Firewall Rule Sets for JSF on page 10
- Configuring Juniper Service Framework – Stateful Firewall, Rules, and Services Set on page 10

Configuring Stateful Firewall Rules for JSF

To configure a stateful firewall rule, include the **rule *rule-name*** statement at the **[edit services stateful-firewall]** hierarchy level:

```
[edit services stateful-firewall]
rule rule-name {
  match-direction (input | output | input-output);
  term term-name {
    from {
      application-sets set-name;
      applications [ application-names ];
      destination-address address <except>;
      destination-address-range low minimum-value high maximum-value <except>;
      destination-prefix-list list-name <except>;
      source-address address <except>;
      source-address-range low minimum-value high maximum-value <except>;
      source-prefix-list list-name <except>;
    }
    then {
      (accept | discard | reject);
      allow-ip-options [ values ];
      syslog;
    }
  }
}
```

Each stateful firewall rule consists of a set of terms, similar to a filter configured at the **[edit firewall]** hierarchy level. A term consists of the following:

- **from** statement—Specifies the match conditions and applications that are included and excluded. The **from** statement is optional in stateful firewall rules.
- **then** statement—Specifies the actions and action modifiers to be performed by the router software. The **then** statement is mandatory in stateful firewall rules.

The following sections explain how to configure the components of stateful firewall rules:

- Configuring Match Direction for Stateful Firewall Rules on page 8
- Configuring Match Conditions in Stateful Firewall Rules on page 8
- Configuring Actions in Stateful Firewall Rules on page 9

Configuring Match Direction for Stateful Firewall Rules

Each rule must include a **match-direction** statement that specifies the direction in which the rule match is applied. To configure where the match is applied, include the **match-direction** statement at the **[edit services stateful-firewall rule *rule-name*]** hierarchy level:

```
[edit services stateful-firewall rule rule-name]  
  match-direction (input | output | input-output);
```

If you configure **match-direction input-output**, sessions initiated from both directions might match this rule.

The match direction is used with respect to the traffic flow through the AS or Multiservices PIC. When a packet is sent to the PIC, direction information is carried along with it.

With an interface service set, packet direction is determined by whether a packet is entering or leaving the interface on which the service set is applied.

With a next-hop service set, packet direction is determined by the interface used to route the packet to the AS or Multiservices PIC. If the inside interface is used to route the packet, the packet direction is input. If the outside interface is used to direct the packet to the PIC, the packet direction is output. For more information on inside and outside interfaces, see Configuring Service Sets to be Applied to Services Interfaces.

On the PIC, a flow lookup is performed. If no flow is found, rule processing is performed. Rules in this service set are considered in sequence until a match is found. During rule processing, the packet direction is compared against rule directions. Only rules with direction information that matches the packet direction are considered. Most packets result in the creation of bidirectional flows.

Configuring Match Conditions in Stateful Firewall Rules

To configure stateful firewall match conditions, include the **from** statement at the **[edit services stateful-firewall rule *rule-name* term *term-name*]** hierarchy level:

```
[edit services stateful-firewall rule rule-name term term-name]  
  from {  
    application-sets set-name;  
    applications [ application-names ];  
    destination-address (address | any-unicast) <except>;  
    destination-address-range low minimum-value high maximum-value <except>;  
    destination-prefix-list list-name <except>;  
    source-address (address | any-unicast) <except>;  
    source-address-range low minimum-value high maximum-value <except>;  
    source-prefix-list list-name <except>;  
  }
```

The source address and destination address can be either IPv4 or IPv6. You can use either the source address or the destination address as a match condition, in the same way that you would configure a firewall filter; for more information, see the *Junos OS Policy Framework Configuration Guide*. You can use the wildcard value **any-unicast**, which denotes matching all unicast addresses.

Alternatively, you can specify a list of source or destination prefixes by configuring the **prefix-list** statement at the **[edit policy-options]** hierarchy level and then including either the **destination-prefix-list** or the **source-prefix-list** statement in the stateful firewall rule. For an example, see Examples: Configuring Stateful Firewall Rules.

If you omit the **from** term, the stateful firewall accepts all traffic and the default protocol handlers take effect:

- User Datagram Protocol (UDP), Transmission Control Protocol (TCP), and Internet Control Message Protocol (ICMP) create a bidirectional flow with a predicted reverse flow.

You can also include application protocol definitions you have configured at the **[edit applications]** hierarchy level; for more information, see Configuring Application Protocol Properties.

- To apply one or more specific application protocol definitions, include the **applications** statement at the **[edit services stateful-firewall rule rule-name term term-name from]** hierarchy level.
- To apply one or more sets of application protocol definitions you have defined, include the **application-sets** statement at the **[edit services stateful-firewall rule rule-name term term-name from]** hierarchy level.



NOTE: If you include one of the statements that specifies application protocols, the router derives port and protocol information from the corresponding configuration at the **[edit applications]** hierarchy level; you cannot specify these properties as match conditions.

Configuring Actions in Stateful Firewall Rules

To configure stateful firewall actions, include the **then** statement at the **[edit services stateful-firewall rule rule-name term term-name]** hierarchy level:

```
[edit services stateful-firewall rule rule-name term term-name]
then {
  (accept | discard | reject);
  syslog;
}
```

You must include one of the following three possible actions:

- **accept**—The packet is accepted and sent on to its destination.
- **discard**—The packet is not accepted and is not processed further.

- **reject**—The packet is not accepted and a rejection message is returned; UDP sends an ICMP unreachable code and TCP sends RST. Rejected packets can be logged or sampled.

You can optionally configure the firewall to record information in the system logging facility by including the **syslog** statement at the **[edit services stateful-firewall rule rule-name term term-name then]** hierarchy level. This statement overrides any **syslog** setting included in the service set or interface default configuration.

Configuring Stateful Firewall Rule Sets for JSF

The **rule-set** statement defines a collection of stateful firewall rules that determine what actions the router software performs on packets in the data stream. You define each rule by specifying a rule name and configuring terms. Then, you specify the order of the rules by including the **rule-set** statement at the **[edit services stateful-firewall]** hierarchy level with a **rule** statement for each rule:

```
[edit services stateful-firewall]
rule-set rule-set-name {
  rule rule-name;
}
```

The router software processes the rules in the order in which you specify them in the configuration. If a term in a rule matches the packet, the router performs the corresponding action and the rule processing stops. If no term in a rule matches the packet, processing continues to the next rule in the rule set. If none of the rules matches the packet, the packet is dropped by default.

Configuring Juniper Service Framework – Stateful Firewall, Rules, and Services Set

Routers use firewalls to track and control the flow of traffic. Adaptive Services and Multiservices PICs employ a type of firewall called a stateful firewall. To use JSF to run Stateful Firewall, you must configure the `jservices-sfw` package at the hierarchy level. In addition, you must configure SFW rules and a services set with a Multiservice interface. This section includes the following tasks:

1. Configuring the JSF Stateful Firewall Package on page 10
2. Configuring the Stateful Firewall Rule on page 12
3. Configuring the Services Set for Stateful Firewall on page 13

Configuring the JSF Stateful Firewall Package

To configure the JSF services:

1. In configuration mode, go to the following hierarchy level:

```
user@host# edit chassis
```

2. In the hierarchy level, configure the FPC and PIC.

```
[edit chassis]
user@host# edit fpc slot pic slot
```

In this example, the FPC is in slot 1 and the PIC is in slot 0:

```
[edit chassis]
user@host# edit fpc 1 pic 0
```

3. Configure the number of cores dedicated to run control functionality.

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider control-cores
control-cores
```

In this example, the number of control cores is 1.

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider control-cores
1
```

4. Configure the number of processing cores dedicated to data.

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider data-cores
data-cores
```

In this example, the number of data cores is 7.

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider data-cores 7
```

5. Configure the size of the object cache in MB. Only values in increments of 128 MB are allowed and the maximum value of object cache can be 1280 MB. To configure the size of the cache:

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider
object-cache-size object-cache-size
```

In this example, the size of the object cache is 1280 MB.

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider
object-cache-size 1280
```

6. Configure the size of the policy database in MB.

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider policy-db-size
policy-db-size
```

In this example, the size of the policy database is 64 MB.

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider policy-db-size
64
```

7. Configure the package.

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider package
package
```

In this example, the package is **jservices-nat**.

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider package
jservices-nat
```

8. Configure the extension provider system log, to enable PIC system logging to record or view system log messages:

```
[edit chassis fpc slot pic slot]
user@host# set adaptive-services service-package extension-provider syslog syslog
```

In this example **syslog** is set to **daemon any** and **external any**:

```
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider syslog daemon
any
[edit chassis fpc 1 pic 0]
user@host# set adaptive-services service-package extension-provider syslog external
any
```

9. Verify the configuration.

```
[edit chassis]
user@host# show chassis
fpc 1 {
  pic 0 {
    adaptive-services {
      service-package {
        extension-provider {
          control-cores 1;
          data-cores 7;
          object-cache-size 1280;
          policy-db-size 64;
          package jservices-nat;
          syslog {
            daemon any;
            external any;
          }
        }
      }
    }
  }
}
```

Configuring the Stateful Firewall Rule

To configure the stateful firewall rule:

1. In configuration mode, go to the following hierarchy level:

```
user@host# edit services
```

2. Configure the Stateful Firewall rule.

```
[edit services]
user@host# set stateful-firewall rule rule
```

In this example, the SFW rule is **rule1 match-direction input-output**.

```
[edit services]
```

```
user@host# set stateful-firewall rule rule1 match-direction input-output
```

3. Configure the rule input conditions for a rule to define the stateful firewall term.

```
[edit services]
user@host# set stateful-firewall rule rule
```

In this example, the rule input conditions are **rule1 term term1 from applications junos-tftp** and **rule1 term term1 from applications junos-rsh**

```
[edit services]
user@host# set stateful-firewall rule rule1 term term1 from applications junos-tftp
user@host# set stateful-firewall rule rule1 term term1 from applications junos-rsh
```

4. Configure the rule for the stateful firewall term actions.

```
[edit services]
user@host# set stateful-firewall rule rule
```

In this example, the rule is **rule1 term term1 then accept**.

```
[edit services]
user@host# set stateful-firewall rule rule1 term term1 then accept
```

5. Verify the configuration.

```
[edit services]
stateful-firewall {
  rule rule1 {
    match-direction input-output;
    term term1 {
      from {
        applications [ junos-tftp junos-rsh ];
      }
      then {
        accept;
      }
    }
  }
}
```

Configuring the Services Set for Stateful Firewall

To configure the services set for stateful firewall:

1. In configuration mode, go to the following hierarchy level:

```
user@host# edit services
```

2. Configure the services set.

```
[edit services]
user@host# edit service-set service-set
```

In this example, the services set with a rule is **sfw-ss**.

```
[edit services]
user@host# edit service-set sfw-ss
```

3. Configure the services set message rate limit.

```
[edit services service-set sfw-ss]
```

```
user@host# edit syslog syslog
```

In this example, the service set message rate limit is set to **syslog**, which is the maximum number of system log messages per second allowed from this interface.

```
[edit services service-set sfw-ss]
user@host# edit syslog
```

4. Configure the host attributes.

```
[edit services service-set sfw-ss syslog]
user@host# edit host host
```

In this example, the host is **host-local**.

```
[edit services service-set sfw-ss syslog]
user@host# edit host host-local
```

5. Configure the services with services attributes.

```
[edit services service-set sfw-ss syslog host host-local]
user@host# set services services
```

In this example, the services attribute is **any**.

```
[edit services service-set sfw-ss syslog host host-local]
user@host# set services any
```

6. Configure the services set with SFW rules.

```
[edit services service-set sfw-ss]
user@host# edit stateful-firewall-rules stateful-firewall-rules
```

In this example, the SFW rule is **rule1**.

```
[edit services service-set sfw-ss]
user@host# edit stateful-firewall-rules rule1
```

7. Configure the interface.

```
[edit services service-set sfw-ss]
user@host# edit interface interface
```

In this example, the interface is **interface-service**.

```
[edit services service-set sfw-ss]
user@host# edit interface interface-service
```

8. Configure the service interface.

```
[edit services service-set sfw-ss interface-service]
user@host# set service-interface service-interface
```

In this example, the interface is **ms-1/0/0**.

```
[edit services service-set sfw-ss interface-service]
user@host# set service-interface ms-1/0/0
```

9. Verify the configuration.

```
[edit services]
user@host# show services
service-set sfw-ss {
    syslog {
```



```
        host local {  
            services any;  
        }  
    }  
    stateful-firewall-rules rule1;  
    interface-service {  
        service-interface ms-1/0/0;  
    }  
}
```


CHAPTER 3

Example

- Examples: Configuring Stateful Firewall Rules for JSF on page 17

Examples: Configuring Stateful Firewall Rules for JSF

The following example show a stateful firewall configuration containing two rules, one for input matching on a specified application set and the other for output matching on a specified source address:

```
[edit services]
stateful-firewall {
  rule Rule1 {
    match-direction input;
    term 1 {
      from {
        application-sets Applications;
      }
      then {
        accept;
      }
    }
    term accept {
      then {
        accept;
      }
    }
  }
}
rule Rule2 {
  match-direction output;
  term Local {
    from {
      source-address {
        10.1.3.2/32;
      }
    }
    then {
      accept;
    }
  }
}
```

The following example has a single rule with two terms. The first term rejects all traffic in **my-application-group** that originates from the specified source address, and provides a detailed system log record of the rejected packets. The second term accepts Hypertext Transfer Protocol (HTTP) traffic from anyone to the specified destination address.

```
[edit services stateful-firewall]
rule my-firewall-rule {
  match-direction input-output;
  term term1 {
    from {
      source-address 10.1.3.2/32;
      application-sets my-application-group;
    }
    then {
      reject;
      syslog;
    }
  }
  term term2 {
    from {
      destination-address 10.2.3.2/32;
      applications http;
    }
    then {
      accept;
    }
  }
}
```

The following example shows use of source and destination prefix lists. This requires two separate configuration items.

You configure the prefix list at the **[edit policy-options]** hierarchy level:

```
[edit]
policy-options {
  prefix-list p1 {
    1.1.1.1/32;
    2.2.2.0/24;
  }
  prefix-list p2 {
    3.3.3.3/32;
    4.4.4.0/24;
  }
}
```

You reference the configured prefix list in the stateful firewall rule:

```
[edit]
services {
  stateful-firewall {
    rule r1 {
      match-direction input;
      term t1 {
        from {
          source-prefix-list {
```

```

        p1;
    }
    destination-prefix-list {
        p2;
    }
}
then {
    accept;
}
}
}
}
}
}
}

```

This is equivalent to the following configuration:

```

[edit]
services {
    stateful-firewall {
        rule r1 {
            match-direction input;
            term t1 {
                from {
                    source-address {
                        1.1.1.1/32;
                        2.2.2.0/24;
                    }
                    destination-address {
                        3.3.3.3/32;
                        4.4.4.0/24;
                    }
                }
                then {
                    accept;
                }
            }
        }
    }
}
}

```

You can use the **except** qualifier with the prefix lists, as in the following example. In this case, the **except** qualifier applies to all prefixes included in prefix list **p2**.

```

[edit]
services {
    stateful-firewall {
        rule r1 {
            match-direction input;
            term t1 {
                from {
                    source-prefix-list {
                        p1;
                    }
                    destination-prefix-list {
                        p2 except;
                    }
                }
            }
        }
    }
}

```

```
    }  
    then {  
        accept;  
    }  
}  
}  
}
```

For additional examples that combine stateful firewall configuration with other services and with virtual private network (VPN) routing and forwarding (VRF) tables, see the configuration examples.

**Related
Documentation**

- Example: BOOTP and Broadcast Addresses
- Example: NAT Between VRFs Configuration
- Example: Dynamic Source NAT as a Next-Hop Service
- Example: VPN Routing and Forwarding (VRF) and Service Configuration
- Example: Service Interfaces Configuration

CHAPTER 4

Configuration Statements

application-sets

Syntax	<code>applications-sets <i>set-name</i>;</code>
Hierarchy Level	[<code>edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from</code>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Define one or more target application sets.
Options	<i>set-name</i> —Name of the target application set.
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

applications

Syntax	<code>applications [<i>application-names</i>];</code>
Hierarchy Level	[<code>edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from</code>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Define one or more applications to which the stateful firewall services apply.
Options	<i>application-name</i> —Name of the target application.
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

destination-address

Syntax	<code>destination-address (<i>address</i> any-unicast) <except>;</code>
Hierarchy Level	[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]
Release Information	Statement introduced before Junos OS Release 7.4. any-unicast and except options introduced in Junos OS Release 7.6. address option enhanced to support IPv4 and IPv6 addresses in Junos OS Release 8.5.
Description	Specify the destination address for rule matching.
Options	address —Destination IPv4 or IPv6 address or prefix value. any-unicast —Match all unicast packets. except —(Optional) Exclude the specified address, prefix, or unicast packets from rule matching.
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

destination-address-range

Syntax	<code>destination-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>;</code>
Hierarchy Level	[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]
Release Information	Statement introduced in Junos OS Release 7.6. minimum-value and maximum-value options enhanced to support IPv4 and IPv6 addresses in Junos OS Release 8.5.
Description	Specify the destination address range for rule matching.
Options	minimum-value —Lower boundary for the IPv4 or IPv6 address range. maximum-value —Upper boundary for the IPv4 or IPv6 address range. except —(Optional) Exclude the specified address range from rule matching.
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

destination-prefix-list

Syntax	<code>destination-prefix-list <i>list-name</i> <except>;</code>
Hierarchy Level	<code>[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]</code>
Release Information	Statement introduced in Junos OS Release 8.2.
Description	Specify the destination prefix list for rule matching. You configure the prefix list by including the prefix-list statement at the [edit policy-options] hierarchy level.
Options	<p><i>list-name</i>—Destination prefix list.</p> <p>except—(Optional) Exclude the specified prefix list from rule matching.</p>
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none">• <i>Junos OS Policy Framework Configuration Guide</i>

from

Syntax	<pre>from { application-sets <i>set-name</i>; applications [<i>application-names</i>]; destination-address (<i>address</i> any-unicast) <except>; destination-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>; destination-prefix-list <i>list-name</i> <except>; source-address (<i>address</i> any-unicast) <except>; source-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>; source-prefix-list <i>list-name</i> <except>; }</pre>
Hierarchy Level	[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Specify input conditions for a stateful firewall term.
Options	<p>For information on match conditions, see the description of firewall filter match conditions in the <i>Junos OS Policy Framework Configuration Guide</i>.</p> <p>The remaining statements are explained separately.</p>
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

match-direction

Syntax	<pre>match-direction (input output input-output);</pre>
Hierarchy Level	[edit services stateful-firewall rule <i>rule-name</i>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Specify the direction in which the rule match is applied.
Options	<p>input—Apply the rule match on the input side of the interface.</p> <p>output—Apply the rule match on the output side of the interface.</p> <p>input-output—Apply the rule match bidirectionally.</p>
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

rule

Syntax	<pre> rule <i>rule-name</i> { match-direction (input output input-output); term <i>term-name</i> { from { application-sets <i>set-name</i>; applications [<i>application-names</i>]; destination-address (<i>address</i> any-unicast) <except>; destination-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>; destination-prefix-list <i>list-name</i> <except>; source-address (<i>address</i> any-unicast) <except>; source-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>; source-prefix-list <i>list-name</i> <except>; } then { (accept discard reject); syslog; } } } </pre>
Hierarchy Level	<pre> [edit services stateful-firewall], [edit services stateful-firewall rule-set <i>rule-set-name</i>] </pre>
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Specify the rule the router uses when applying this service.
Options	<p><i>rule-name</i>—Identifier for the collection of terms that constitute this rule.</p> <p>The remaining statements are explained separately.</p>
Usage Guidelines	See Configuring Stateful Firewall Rules.
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>

rule-set

Syntax	<code>rule-set <i>rule-set-name</i> { [rule <i>rule-names</i>]; }</code>
Hierarchy Level	[edit services stateful-firewall]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Specify the rule set the router uses when applying this service.
Options	<i>rule-set-name</i> —Identifier for the collection of rules that constitute this rule set.
Usage Guidelines	See Configuring Stateful Firewall Rule Sets for JSF.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

services

Syntax	<code>services stateful-firewall { ... }</code>
Hierarchy Level	[edit]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Define the service rules to be applied to traffic.
Options	<i>stateful-firewall</i> —Identifies the stateful firewall set of rules statements.
Usage Guidelines	See Stateful Firewall.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

source-address

Syntax	<code>source-address (<i>address</i> any-unicast) <except>;</code>
Hierarchy Level	<code>[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]</code>
Release Information	Statement introduced before Junos OS Release 7.4. any-unicast and except options introduced in Junos OS Release 7.6. address option enhanced to support IPv4 and IPv6 addresses in Junos OS Release 8.5.
Description	Source address for rule matching.
Options	address —Source IPv4 or IPv6 address or prefix value. any-unicast —Any unicast packet. except —(Optional) Exclude the specified address, prefix, or unicast packets from rule matching.
Usage Guidelines	See Configuring Match Conditions in Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

source-address-range

Syntax	<code>source-address-range low <i>minimum-value</i> high <i>maximum-value</i> <except>;</code>
Hierarchy Level	<code>[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]</code>
Release Information	Statement introduced in Junos OS Release 7.6. minimum-value and maximum-value options enhanced to support IPv4 and IPv6 addresses in Junos OS Release 8.5.
Description	Source address range for rule matching.
Options	minimum-value —Lower boundary for the IPv4 or IPv6 address range. maximum-value —Upper boundary for the IPv4 or IPv6 address range. except —(Optional) Exclude the specified address, prefix, or unicast packets from rule matching.
Usage Guidelines	See Configuring Match Conditions in Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

source-prefix-list

Syntax	<code>source-prefix-list <i>list-name</i> <except>;</code>
Hierarchy Level	<code>[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> from]</code>
Release Information	Statement introduced in Junos OS Release 8.2.
Description	Specify the source prefix list for rule matching. You configure the prefix list by including the prefix-list statement at the <code>[edit policy-options]</code> hierarchy level.
Options	<i>list-name</i> —Destination prefix list. except —(Optional) Exclude the specified prefix list from rule matching.
Usage Guidelines	See Configuring Match Conditions in Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• <i>Junos OS Policy Framework Configuration Guide</i>

syslog

Syntax	<code>syslog;</code>
Hierarchy Level	<code>[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i> then]</code>
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Enable system logging. The system log information from the Adaptive Services or Multiservices PIC is passed to the kernel for logging in the <code>/var/log</code> directory. This setting overrides any syslog statement setting included in the service set or interface default configuration.
Usage Guidelines	See Configuring Actions in Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

term

Syntax `term term-name {`
 `from {`
 `application-sets set-name;`
 `applications [application-names];`
 `destination-address (address | any-unicast) <except>;`
 `destination-address-range low minimum-value high maximum-value <except>;`
 `destination-prefix-list list-name <except>;`
 `source-address (address | any-unicast) <except>;`
 `source-address-range low minimum-value high maximum-value <except>;`
 `source-prefix-list list-name <except>;`
 `}`
 `then {`
 `(accept | discard | reject);`
 `syslog;`
 `}`
 `}`

Hierarchy Level [edit services stateful-firewall rule *rule-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Define the stateful firewall term properties.

Options *term-name*—Identifier for the term.

The remaining statements are explained separately.

Usage Guidelines See Configuring Stateful Firewall Rules.

Required Privilege interface—To view this statement in the configuration.

Level interface-control—To add this statement to the configuration.

then

Syntax	<pre>then { (accept discard reject); syslog; }</pre>
Hierarchy Level	[edit services stateful-firewall rule <i>rule-name</i> term <i>term-name</i>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Define the stateful firewall term actions. You can configure the router to accept, discard, or reject the targeted traffic. The other actions are optional.
Options	<p>accept—Accept the traffic and send it on to its destination.</p> <p>discard—Do not accept traffic or process it further.</p> <p>reject—Do not accept the traffic and return a rejection message. Rejected traffic can be logged or sampled.</p> <p>The remaining statement is explained separately.</p>
Usage Guidelines	See Configuring Actions in Stateful Firewall Rules.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• <i>Junos OS Policy Framework Configuration Guide</i>

PART 3

Administration

- [Stateful Firewall Operational Mode Commands on page 33](#)

CHAPTER 5

Stateful Firewall Operational Mode Commands

clear services stateful-firewall flows

Syntax clear services stateful-firewall flows
<application-protocol *protocol*>
<destination-port *destination-port*>
<destination-prefix *destination-prefix*>
<interface *interface-name*>
<protocol *protocol*>
<service-set *service-set*>
<source-port *source-port*>
<source-prefix *source-prefix*>

Release Information Command introduced before Junos OS Release 7.4.

Description Clear stateful firewall flows.

Options none—Clear all stateful firewall flows.

destination-port *destination-port*—(Optional) Clear stateful firewall flows for a particular destination port. The range of values is 0 to 65535.

destination-prefix *destination-prefix*—(Optional) Clear stateful firewall flows for a particular destination prefix.

interface *interface-name*—(Optional) Clear stateful firewall flows for a particular interface. On M Series and T Series routers, the *interface-name* can be *sp-fpc/pic/port* or *rspnumber*. On J Series routers, the *interface-name* is *sp-pim/0/port*.

protocol—(Optional) Clear stateful firewall flows for one of the following IP types:

- *number*—Numeric protocol value from 0 to 255.
- *ah*—IPsec Authentication Header protocol
- *egp*—An exterior gateway protocol
- *esp*—IPsec Encapsulating Security Payload protocol
- *gre*—A generic routing encapsulation protocol
- *icmp*—Internet Control Message Protocol
- *igmp*—Internet Group Management Protocol
- *ipip*—IP-over-IP Encapsulation Protocol
- *ospf*—Open Shortest Path First protocol
- *pim*—Protocol Independent Multicast protocol
- *rsvp*—Resource Reservation Protocol
- *sctp*—Stream Control Protocol
- *tcp*—Transmission Control Protocol
- *udp*—User Datagram Protocol

`service-set service-set`—(Optional) Clear stateful firewall flows for a particular service set.

`source-port source-port`—(Optional) Clear stateful firewall flows for a particular source port. The range of values is from 0 through 65535.

`source-prefix source-prefix`—(Optional) Clear stateful firewall flows for a particular source prefix.

Required Privilege Level

view

Related Documentation

- [show services stateful-firewall flows on page 37](#)

List of Sample Output

[clear services stateful-firewall flows on page 35](#)

Output Fields

Table 1 on page 35 lists the output fields for the **clear services stateful-firewall flows** command. Output fields are listed in the approximate order in which they appear.

Table 1: clear services stateful-firewall flows Output Fields

Field Name	Field Description
Interface	Name of an adaptive services interface.
Service set	Name of the service set from which flows are being cleared.
Conv removed	Number of conversations removed.

clear services stateful-firewall flows

```

user@host> clear services stateful-firewall flows
Interface  Service set      Conv removed
sp-0/3/0   svc_set_trust     0
sp-0/3/0   svc_set_untrust   0

```

clear services stateful-firewall statistics

Syntax	clear services stateful-firewall statistics <interface <i>interface-name</i> > <service-set <i>service-set</i> >
Release Information	Command introduced before Junos OS Release 7.4.
Description	Clear stateful firewall statistics.
Options	<p>none—Clear stateful firewall statistics for all interfaces and all service sets.</p> <p>interface <i>interface-name</i>—(Optional) Clear stateful firewall statistics for the specified interface. On M Series and T Series routers, the <i>interface-name</i> can be <i>sp-fpc/pic/port</i> or <i>rspnumber</i>. On J Series routers, the <i>interface-name</i> is <i>sp-pim/0/port</i>.</p> <p>service-set <i>service-set</i>—(Optional) Clear stateful firewall statistics for the specified service set.</p>
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none">• show services stateful-firewall statistics on page 41
List of Sample Output	clear services stateful-firewall statistics on page 36
Output Fields	When you enter this command, you are provided feedback on the status of your request.
clear services stateful-firewall statistics	user@host> clear services stateful-firewall statistics

show services stateful-firewall flows

Syntax	<pre>show services stateful-firewall flows <brief extensive summary terse> <application-protocol <i>protocol</i>> <count> <destination-port <i>destination-port</i>> <destination-prefix <i>destination-prefix</i>> <interface <i>interface-name</i>> <limit <i>number</i>> <protocol <i>protocol</i>> <service-set <i>service-set</i>> <source-port <i>source-port</i>> <source-prefix <i>source-prefix</i>></pre>
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>pgcp option introduced in Junos OS Release 8.4.</p>
Description	Display stateful firewall flow table entries.
Options	<p>none—Display standard information about all stateful firewall flows.</p> <p>brief extensive summary terse—(Optional) Display the specified level of output.</p> <p>count—(Optional) Display a count of the matching entries.</p> <p>destination-port <i>destination-port</i>—(Optional) Display information for a particular destination port. The range of values is from 0 to 65535.</p> <p>destination-prefix <i>destination-prefix</i>—(Optional) Display information for a particular destination prefix.</p> <p>interface <i>interface-name</i>—(Optional) Display information about a particular interface. On M Series and T Series routers, <i>interface-name</i> can be sp-fpc/pic/port or rspnumber. On J Series routers, <i>interface-name</i> is sp-pim/O/port.</p> <p>limit <i>number</i>—(Optional) Maximum number of entries to display.</p> <p>protocol <i>protocol</i>—(Optional) Display information about one of the following IP types:</p> <ul style="list-style-type: none"> <i>number</i>—Numeric protocol value from 0 to 255 ah—IPsec Authentication Header protocol egp—An exterior gateway protocol esp—IPsec Encapsulating Security Payload protocol gre—A generic routing encapsulation protocol icmp—Internet Control Message Protocol igmp—Internet Group Management Protocol ipip—IP-within-IP Encapsulation Protocol

- **ospf**—Open Shortest Path First protocol
- **pim**—Protocol Independent Multicast protocol
- **rsvp**—Resource Reservation Protocol
- **sctp**—Stream Control Protocol
- **tcp**—Transmission Control Protocol
- **udp**—User Datagram Protocol

service-set *service-set*—(Optional) Display information for a particular service set.

source-port *source-port*—(Optional) Display information for a particular source port. The range of values is from 0 to 65535.

source-prefix *source-prefix*—(Optional) Display information for a particular source prefix.

Required Privilege Level view

Related Documentation • [clear services stateful-firewall flows on page 34](#)

List of Sample Output [show services stateful-firewall flows on page 39](#)
[show services stateful-firewall flows brief on page 39](#)
[show services stateful-firewall flows extensive on page 39](#)
[show services stateful-firewall flows count on page 39](#)
[show services stateful-firewall flows destination port on page 40](#)
[show services stateful-firewall flows source port on page 40](#)
[show services stateful-firewall flows \(Twice NAT\) on page 40](#)

Output Fields Table 2 on page 38 lists the output fields for the **show services stateful-firewall flows** command. Output fields are listed in the approximate order in which they appear.

Table 2: show services stateful-firewall flows Output Fields

Field Name	Field Description
Interface	Name of the interface.
Service set	Name of a service set. Individual empty service sets are not displayed. If no service set has any flows, a flow table header is displayed for each service set.
Flow Count	Number of flows in a session.
Flow or Flow Prot	Protocol used for this flow.
Source	Source prefix of the flow in the format <i>source-prefix:port</i> . For ICMP flows, port information is not displayed.
Dest	Destination prefix of the flow. For ICMP flows, port information is not displayed.

Table 2: show services stateful-firewall flows Output Fields (*continued*)

Field Name	Field Description
State	Status of the flow: <ul style="list-style-type: none"> • Drop—Drop all packets in the flow without response. • Forward—Forward the packet in the flow without looking at it. • Reject—Drop all packets in the flow with response. • Watch—Inspect packets in the flow.
Dir	Direction of the flow: input (I) or output (O).
Frm count	Number of frames in the flow.

show services stateful-firewall flows	<pre> user@host> show services stateful-firewall flows Interface: sp-1/3/0, Service set: green Flow Prot Source Dest State Dir Frm count TCP 10.58.255.178:23 -> 10.59.16.100:4000 Forward O TCP 10.58.255.50:33005-> 10.58.255.178:23 Forward I 1 Source NAT 10.58.255.50:33005-> 10.59.16.100:4000 Destin NAT 10.58.255.178:23 -> 0.0.0.0:4000 </pre>
show services stateful-firewall flows brief	The output for the show services stateful-firewall flows brief command is identical to that for the show services stateful-firewall flows command. For sample output, see show services stateful-firewall flows .
show services stateful-firewall flows extensive	<pre> user@host> show services stateful-firewall flows extensive Interface: sp-0/3/0, Service set: ss_nat Flow count State Dir Frm TCP 16.1.0.1:2330 -> 16.49.0.1:21 Forward I 8 NAT source 16.1.0.1:2330 -> 16.41.0.1:2330 NAT dest 16.49.0.1:21 -> 16.99.0.1:21 Byte count: 455, TCP established, TCP window size: 57344 TCP acknowledge: 3251737524, TCP tickle enabled, tcp_tickle: 0 Flow role: Master, Timeout: 720 TCP 16.99.0.1:21 -> 16.41.0.1:2330 Forward O 5 NAT source 16.99.0.1:21 -> 16.49.0.1:21 NAT dest 16.41.0.1:2330 -> 16.1.0.1:2330 Byte count: 480, TCP established, TCP window size: 57344 TCP acknowledge: 463128048, TCP tickle enabled, tcp_tickle: 0 Flow role: Responder, Timeout: 720 </pre>
show services stateful-firewall flows count	<pre> user@host> show services stateful-firewall flows count Interface Service set Flow Count sp-1/3/0 green 2 </pre>

```
show services user@router> show services stateful-firewall flows destination-port 21
stateful-firewall flows Interface: sp-0/3/0, Service set: svc_set_trust
destination port Flow
State Dir Frm count
Interface: sp-0/3/0, Service set: svc_set_untrust
Flow State Dir Frm count
TCP 10.50.10.2:2143 -> 10.50.20.2:21 Watch 0 0

show services user@router> show services stateful-firewall flows source-port 2143
stateful-firewall flows Interface: sp-0/3/0, Service set: svc_set_trust
source port Flow
State Dir Frm count
Interface: sp-0/3/0, Service set: svc_set_untrust
Flow State Dir Frm count
TCP 10.50.10.2:2143 -> 10.50.20.2:21 Watch 0 0

show services user@router> show services stateful-firewall flows
stateful-firewall flows Flow State Dir Frm count
(Twice NAT) UDP 40.0.0.8:23439 -> 80.0.0.1:16485 Watch I 20
NAT source 40.0.0.8:23439 -> 172.16.1.10:1028
NAT dest 80.0.0.1:16485 -> 192.16.1.10:22415
UDP 192.16.1.10:22415 -> 172.16.1.10:1028 Watch 0 20
NAT source 192.16.1.10:22415 -> 80.0.0.1:16485
NAT dest 172.16.1.10:1028 -> 40.0.0.8:23439
```

show services stateful-firewall statistics

Syntax	show services stateful-firewall statistics <application-protocol <i>protocol</i> > <brief detail extensive summary> <interface <i>interface-name</i> > <service-set <i>service-set</i> >
Release Information	Command introduced before Junos OS Release 7.4.
Description	Display stateful firewall statistics.
Options	<p>none—Display standard information about all stateful firewall statistics.</p> <p>brief detail extensive summary—(Optional) Display the specified level of output.</p> <p>interface <i>interface-name</i>—(Optional) Display information about a particular interface. On M Series and T Series routers, the <i>interface-name</i> can be <i>sp-fpc/pic/port</i> or <i>rspnumber</i>. On J Series routers, the <i>interface-name</i> is <i>sp-pim/0/port</i>.</p> <p>service-set <i>service-set</i>—(Optional) Display information about a particular service set.</p>
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> clear services stateful-firewall statistics on page 36
List of Sample Output	show services stateful-firewall statistics extensive on page 44
Output Fields	Table 3 on page 41 lists the output fields for the show services stateful-firewall statistics command. Output fields are listed in the approximate order in which they appear.

Table 3: show services stateful-firewall statistics Output Fields

Field Name	Field Description
Interface	Name of an adaptive services interface.
Service set	Name of a service set.
New flows	Rule match counters for new flows: <ul style="list-style-type: none"> Accept—New flows accepted. Discard—New flows discarded. Reject—New flows rejected.
Existing flows	Rule match counters for existing flows: <ul style="list-style-type: none"> Accept—Match existing forward or watch flow. Discard—Match existing discard flow. Reject—Match existing reject flow.

Table 3: show services stateful-firewall statistics Output Fields (*continued*)

Field Name	Field Description
Drops	<p>Drop counters:</p> <ul style="list-style-type: none"> • TCP SYN defense—Packets dropped by SYN defender. • NAT ports exhausted—Hide mode. The router has no available Network Address Translation (NAT) ports for a given address or pool.
Errors	<p>Total errors, categorized by protocol:</p> <ul style="list-style-type: none"> • IP—Total IP version 4 errors. • TCP—Total Transmission Control Protocol (TCP) errors. • UDP—Total User Datagram Protocol (UDP) errors. • ICMP—Total Internet Control Message Protocol (ICMP) errors. • Non-IP—Total non-IPv4 errors.
IP Errors	<p>IPv4 errors:</p> <ul style="list-style-type: none"> • IP packet length inconsistencies—IP packet length does not match the Layer 2 reported length. • Minimum IP header length check failures—Minimum IP header length is 20 bytes. The received packet contains less than 20 bytes. • Reassembled packet exceeds maximum IP length—After fragment reassembly, the reassembled IP packet length exceeds 65,535. • Illegal source address 0—Source address is not a valid address. Invalid addresses are, loopback, broadcast, multicast, and reserved addresses. Source address 0, however, is allowed to support BOOTP and the destination address 0xffffffff. • Illegal destination address 0—Destination address is not a valid address. The address is reserved. • TTL zero errors—Received packet had a time-to-live (TTL) value of 0. • IP protocol number 0 or 255—IP protocol is 0 or 255. • Land attack—IP source address is the same as the destination address. • Smurf attack—Echo request is sent to a directed broadcast address. • Non-IP packets—Packet did not conform to the IP standard. • IP option—Packet dropped because of a nonallowed IP option. • Non-IPv4 packets—Packet was not IPv4. (Only IPv4 is supported.) • Bad checksum—Packet had an invalid IP checksum. • Illegal IP fragment length—Illegal fragment length. All fragments (other than the last fragment) must have a length that is a multiple of 8 bytes. • IP fragment overlap—Fragments have overlapping fragment offsets. • IP fragment reassembly timeout—Some of the fragments for an IP packet were not received in time, and the reassembly handler dropped partial fragments.

Table 3: show services stateful-firewall statistics Output Fields (*continued*)

Field Name	Field Description
TCP Errors	<p>TCP protocol errors:</p> <ul style="list-style-type: none"> • TCP header length inconsistencies—Minimum TCP header length is 20 bytes, and the IP packet received does not contain at least 20 bytes. • Source or destination port number is zero—TCP source or destination port is zero. • Illegal sequence number, flags combination—Dropped because of TCP errors, such as an illegal sequence number, which causes an illogical combination of flags to be set. • SYN attack (multiple SYN messages seen for the same flow)—Multiple SYN packets received for the same flow are treated as a SYN attack. The packets might be retransmitted SYN packets and therefore valid, but a large number is cause for concern. • First packet not SYN—First packets for a connection are not SYN packets. These packets might originate from previous connections or from someone performing an ACK/FIN scan. • TCP port scan (Handshake, RST seen from server for SYN)—In the case of a SYN defender, if an RST (reset) packet is received instead of a SYN/ACK message, someone is probably trying to scan the server. This behavior can result in false alarms if the RST packet is not combined with an intrusion detection service (IDS). • Bad SYN cookie response—SYN cookie generates a SYN/ACK message for all incoming SYN packets. If the ACK received for the SYN/ACK message does not match, this counter is incremented.
UDP Errors	<p>UDP protocol errors:</p> <ul style="list-style-type: none"> • IP data length less than minimum UDP header length (8 bytes)—Minimum UDP header length is 8 bytes. The received IP packets contain less than 8 bytes. • Source or destination port is zero—UDP source or destination port is 0. • UDP port scan (ICMP error seen for UDP flow)—ICMP error is received for a UDP flow. This could be a genuine UDP flow, but it is counted as an error.
ICMP Errors	<p>ICMP protocol errors:</p> <ul style="list-style-type: none"> • IP data length less than minimum ICMP header length (8 bytes)—ICMP header length is 8 bytes. This counter is incremented when received IP packets contain less than 8 bytes. • ICMP error length inconsistencies—Minimum length of an ICMP error packet is 48 bytes, and the maximum length is 576 bytes. This counter is incremented when the received ICMP error falls outside this range. • Ping duplicate sequence number—Received ping packet has a duplicate sequence number. • Ping mismatched sequence number—Received ping packet has a mismatched sequence number.

**show services
stateful-firewall
statistics extensive**

```
user@host> show services stateful-firewall statistics extensive
Interface: sp-1/3/0
Service set: interface-svc-set
New flows:
  Accept: 907, Discard: 0, Reject: 0
Existing flows:
  Accept: 3535, Discard: 0, Reject: 0
Drops:
  IP option: 0, TCP SYN defense: 0
  NAT ports exhausted: 0
Errors:
  IP: 0, TCP: 0
  UDP: 0, ICMP: 0
  Non-IP packets: 0, ALG: 0
IP errors:
  IP packet length inconsistencies: 0
  Minimum IP header length check failures: 0
  Reassembled packet exceeds maximum IP length: 0
  Illegal source address: 0
  Illegal destination address: 0
  TTL zero errors: 0, IP protocol number 0 or 255: 0
  Land attack: 0, Smurf attack: 0
  Non IP packets: 0, IP option: 0
  Non-IPv4 packets: 0, Bad checksum: 0
  Illegal IP fragment length: 0
  IP fragment overlap: 0
  IP fragment reassembly timeout: 0
TCP errors:
  TCP header length inconsistencies: 0
  Source or destination port number is zero: 0
  Illegal sequence number, flags combination: 0
  SYN attack (multiple SYNs seen for the same flow): 0
  First packet not SYN: 0
  TCP port scan (Handshake, RST seen from server for SYN): 0
  Bad SYN cookie response: 0
UDP errors:
  IP data length less than minimum UDP header length (8 bytes): 0
  Source or destination port is zero: 0
  UDP port scan (ICMP error seen for UDP flow): 0
ICMP errors:
  IP data length less than minimum ICMP header length (8 bytes): 0
  ICMP error length inconsistencies: 0
  Ping duplicate sequence number: 0
  Ping mismatched sequence number: 0
ALG drops:
  BOOTP: 0, DCE-RPC: 0, DCE-RPC portmap: 0
  DNS: 0, Exec: 0, FTP: 0
  H323: 0, ICMP: 0, IIOP: 0
  Login: 0, Netbios: 0, Netshow: 0
  Realaudio: 0, RPC: 0, RPC portmap: 0
  RTSP: 0, Shell: 0
  SNMP: 0, Sqlnet: 0, TFTP: 0
  Traceroute: 0
```

PART 4

Troubleshooting

- Knowledge Base on page 47

CHAPTER 6

Knowledge Base

PART 5

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