

Junosphere

Junosphere Network Topology

Release

1.3

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Junosphere Topology Guide

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Terms of Use – Junosphere

THIS TERMS OF USE AGREEMENT (“**AGREEMENT**”) GOVERNS YOUR USE OF THE SERVICES. IF YOU PURCHASE OUR SERVICES, THIS AGREEMENT WILL ALSO GOVERN YOUR PURCHASE AND ONGOING USE OF THOSE SERVICES. BY ACCEPTING THIS AGREEMENT, EITHER BY CLICKING A BOX INDICATING YOUR ACCEPTANCE OR BY EXECUTING AN ORDER FORM THAT REFERENCES THIS AGREEMENT, YOU AGREE TO THE TERMS OF THIS AGREEMENT. IF YOU ARE ENTERING INTO THIS AGREEMENT ON BEHALF OF A COMPANY OR OTHER LEGAL ENTITY, YOU REPRESENT THAT YOU HAVE THE AUTHORITY TO BIND SUCH ENTITY AND ITS AFFILIATES TO THESE TERMS AND CONDITIONS, IN WHICH CASE THE TERMS “YOU” OR “YOUR” SHALL REFER TO SUCH ENTITY AND ITS AFFILIATES. IF YOU DO NOT HAVE SUCH AUTHORITY, OR IF YOU DO NOT AGREE WITH THESE TERMS AND CONDITIONS, YOU MUST NOT ACCEPT THIS AGREEMENT AND MAY NOT USE THE SERVICES.

You may not access the Services if you are our direct competitor, except with our prior written consent. In addition, You may not access the Services for purposes of monitoring their availability, performance or functionality, or for any other benchmarking or competitive purposes.

This Agreement is effective between You and Us as of the date of You accepting this Agreement.

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1. DEFINITIONS

“**Affiliate**” means any entity and its successors which directly or indirectly controls, is controlled by, or is under common control with the subject entity. “**Control**,” for purposes of this definition, means direct or indirect ownership or control of more than 50% of the voting interests of the subject entity. An entity shall be considered an Affiliate only so long as such entity continues to meet the foregoing definition.

“**Applications**” means the online applications that interoperate with the Services, located on Juniper designated websites.

“**Malicious Code**” means viruses, worms, time bombs, Trojan horses and other harmful or malicious code, files, scripts, agents or programs.

“**Order Form**” means the ordering documents for purchases hereunder, including addenda thereto, that are entered into between You and Us from time to time. Order Forms shall be deemed incorporated herein by reference.

“**Purchased Services**” means Services that You or Your Affiliates purchase under an Order Form, as distinguished from those provided pursuant to a free trial.

“**Services**” means the online, Web-based applications and platform provided by Juniper via Juniper designated websites (including as described in the User Guide), that are ordered by You as part of a free trial or Purchased Services, including associated offline components but excluding Third Party Applications.

“**Software**” means the program modules and features of any Juniper or Juniper-supplied software. “Software” also includes updates, upgrades and new releases of such software.

“**Third-Party Applications**” means online, Web-based applications and offline software products that are provided by third parties, interoperate with the Services, and are identified as third-party applications.

“**User Guide**” means the online user guide and data sheets for the Services, accessible via a Juniper designated website as updated from time to time. You acknowledge that You have had the opportunity to review the User Guide.

“**Users**” means individuals who are authorized by You to use the Services, for whom subscriptions to a Service have been purchased, and who have been supplied user identifications and passwords by You (or by Us at Your request). Users may include but are not limited to Your employees, consultants, contractors and agents; or third parties with which You transact business.

“**We**,” “**Us**,” “**Our**” or “**Juniper**” means the Juniper Networks (U.S.), Inc. 1194 North Mathilda Avenue Sunnyvale, CA 94089-1206 and its Affiliates.

“**You**” or “**Your**” means the company or other legal entity for which you are accepting this Agreement, and Affiliates of that company or entity.

“**Your Data**” means all electronic data or information submitted by You to the Purchased Services.

2. FREE TRIAL

We may make one or more Services available to You on a trial basis free of charge until the earlier of (a) the end of the free trial period for which you registered or are registering to use the applicable Service or (b) the start date of any Purchased Services ordered by You. Additional trial terms and conditions may appear on the trial registration web page. Any such additional terms and conditions are incorporated into this Agreement by reference and are legally binding.

ANY DATA YOU ENTER INTO THE SERVICES, AND ANY CUSTOMIZATIONS MADE TO THE SERVICES BY OR FOR YOU, DURING YOUR FREE TRIAL WILL BE PERMANENTLY LOST UNLESS YOU EXPORT AND SAVE THE DATA FROM JUNIPER’S DESIGNATED WEBSITE.

NOTWITHSTANDING SECTION 9 (WARRANTIES AND DISCLAIMERS), DURING THE FREE TRIAL THE SERVICES ARE PROVIDED “AS-IS” WITHOUT ANY WARRANTY.

Please review the User Guide during the trial period so that You become familiar with the features and functions of the Services before You make Your purchase.

3. PURCHASED SERVICES

3.1. Provision of Purchased Services. Provision of Purchased Services. We shall make the Purchased Services available to You pursuant to this Agreement and the relevant Order Forms during a subscription term. You agree that Your purchases hereunder are neither contingent on the delivery of any future functionality or features nor dependent on any oral or written public comments made by Us regarding future functionality or features.

3.2. User Subscriptions. Unless otherwise specified in the applicable Order Form, (i) Services are purchased as User subscriptions and may be accessed by no more than the specified number of Users, (ii) additional User subscriptions may be added during the subscription term at the same pricing as that for the pre-existing subscriptions, prorated for the remainder of the subscription term in effect at the time the additional User subscriptions are added, and (iii) the added User subscriptions shall terminate on the same date as the pre-existing subscriptions. User subscriptions are for designated Users and cannot be shared or used by more than one User but may be reassigned to new Users replacing former Users who no longer require ongoing use of the Services.

4. USE OF THE SERVICES

4.1 Our Responsibilities. We shall: (i) provide to You basic support for the Purchased Services at no additional charge, (ii) use commercially reasonable efforts to make the Purchased Services available 24 hours a day, 7 days a week, except for: (a) planned downtime of which We shall give at least 8 hours notice via the Purchased Services, or (b) any unavailability caused by circumstances beyond Our reasonable control, including without limitation, acts of God, acts of government, flood, fire, earthquakes, civil unrest, acts of terror, strikes or other labor problems (other than those involving Our employees), or Internet service provider failures or delays, and (iii) provide the Purchased Services only in accordance with applicable laws and government regulations.

4.2. Your Responsibilities. You shall (i) be responsible for Users' compliance with this Agreement, (ii) be solely responsible for the accuracy, quality, integrity and legality of Your Data and of the means by which You acquired Your Data, (iii) use commercially reasonable efforts to prevent unauthorized access to or use of the Services, and notify Us promptly of any such unauthorized access or use, and (iv) use the Services only in accordance with the User Guide, applicable data sheets and applicable laws and government regulations. You shall not (a) make the Services available to anyone other than Users, (b) sell, resell, rent or lease the Services, (c) use the Services to store or transmit infringing, libelous, or otherwise unlawful or tortious material, or to store or transmit material in violation of third-party privacy rights, (d) use the Services to store or transmit Malicious Code, (e) interfere with or disrupt the integrity or performance of the Services or third-party data contained therein, or (f) attempt to gain unauthorized access to the Services or their related systems or networks.

4.3. Usage Limitations. Junosphere permits customers to create virtual networks for, among other things, qualification and configuration testing. PLEASE NOTE: VIRTUAL NETWORKING DEVICES CREATED IN JUNOSPHERE WILL NOT HAVE THE SAME PERFORMANCE METRICS AS ACTUAL JUNIPER PRODUCTS DEPLOYED IN YOUR NETWORKS. Services may be subject to other limitations, such as, for example, limits on disk storage space. VIRTUAL NETWORKING DEVICES ARE NOT INTENDED TO BE USED IN "LIVE," PRODUCTION NETWORKS AND INSTEAD SHOULD ONLY BE USED IN CONJUNCTION WITH LAB NETWORKING ENVIRONMENTS.

5. THIRD-PARTY PROVIDERS

5.1. Acquisition of Third-Party Products and Services. We may offer Third-Party Applications for use in Junosphere. Any other acquisition by You of third-party products or services, including but not limited to Third-Party Applications and implementation, customization and other consulting services, and any exchange of data between You and any third-party provider, is solely between You and the applicable third-party provider. We do not warrant or support Third-Party Applications whether or not they are designated by Us as "certified" or otherwise. No purchase of third-party products or services is required to use the Services.

5.2. Disclaimer. Any Third-Party Applications provided on Junosphere are provided "as is," with no warranties, or telephone or other type of support.

6. FEES AND PAYMENT FOR PURCHASED SERVICES

6.1. User Fees. You shall pay all fees specified in all Order Forms hereunder. Except as otherwise specified herein or in an Order Form, (i) fees are quoted and payable in United States dollars (ii) fees are based on Services purchased and not actual usage, (iii) payment obligations are non-cancelable and fees paid are non-refundable, and (iv) the number of User Subscriptions purchased cannot be decreased during the relevant subscription term stated on the Order Form.

6.2. Invoicing and Payment. You will provide Us with a valid purchase order or alternative document reasonably acceptable to Us. We do not accept credit card payments at this time. We will invoice You in advance and otherwise in accordance with the relevant Order Form. Unless otherwise stated in the Order Form, invoiced charges are due net 30 days from the invoice date. You are responsible for maintaining complete and accurate billing and contact information in the Services.

6.3. Overdue Charges. If any invoiced charges are not received from You by the due date, then at Our discretion, (a) such charges may accrue late interest at the rate of 1.5% of the outstanding balance per month, or the maximum rate permitted by law, whichever is lower, from the date such payment was due until the date paid, and/or (b) We may condition future subscription renewals and Order Forms on payment terms shorter than those specified in Section 6.2 (Invoicing and Payment).

6.4. Suspension of Service and Acceleration. If any amount owing by You under this or any other agreement for Our services is 30 or more days overdue, We may, without limiting Our other rights and remedies, accelerate Your unpaid fee obligations under such agreements so that all such obligations become immediately due and payable, and suspend Our Services to You until such amounts are paid in full.

6.5. Payment Disputes. We shall not exercise Our rights under Section 6.3 (Overdue Charges) or 6.4 (Suspension of Service and Acceleration) if the applicable charges are under reasonable and good-faith dispute and You are cooperating diligently to resolve the dispute.

7. PROPRIETARY RIGHTS; SOFTWARE

7.1. Reservation of Rights. Subject to the limited rights expressly granted hereunder, We reserve all rights, title and interest in and to the Services, including all related intellectual property rights. No rights are granted to You hereunder other than as expressly set forth herein.

7.2. Restrictions. You shall not (i) permit any third party to access the Services except as permitted herein or in an Order Form, (ii) create derivative works based on the Services, (iii) copy, frame or mirror any part or content of the Services, other than copying or framing on Your own intranets or otherwise for Your own internal business purposes, (iv) reverse engineer the Services, or (v) access the Services in order to (a) build a competitive product or service, or (b) copy any features, functions or graphics of the Services.

7.3. Ownership of Your Data. As between Us and You, You exclusively own all rights, title and interest in and to all of Your Data.

7.4. Suggestions. We shall have a royalty-free, worldwide, transferable, sublicenseable, irrevocable, perpetual license to use or incorporate into the Services or Software any suggestions, enhancement requests, recommendations or other feedback provided by You, including Users, relating to the operation of the Services.

7.5. Federal Government End Use Provisions. We provide the Services, including related software and technology, for ultimate federal government end use solely in accordance with the following: Government technical data and software rights related to the Services include only those rights customarily provided to the public as defined in this Agreement. This customary commercial license is provided in accordance with FAR 12.211 (Technical Data) and FAR 12.212 (Software) and, for Department of Defense transactions, DFAR 252.227-7015 (Technical Data – Commercial Items) and DFAR 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation). If a government agency has a need for rights not conveyed under these terms, it must negotiate with Us to determine if there are acceptable terms for transferring such rights, and a mutually acceptable written addendum specifically conveying such rights must be included in any applicable contract or agreement.

7.6. Software downloads. You will be required to download Software to enable you to connect securely with Junosphere and use the Services. The terms and conditions governing Your right to use such Software are set forth in Schedule A.

8. CONFIDENTIALITY

8.1. Definition of Confidential Information. As used herein, "Confidential Information" means all confidential information disclosed by a party ("Disclosing Party") to the other party ("Receiving Party"), whether orally or in writing, that is designated as confidential or that reasonably should be understood to be confidential given the nature of the information and the circumstances of disclosure. Your Confidential Information shall include Your Data; Our Confidential Information shall include the Services and Software; and Confidential Information of each party shall include the terms and conditions of this Agreement and all Order Forms, as well as business and marketing plans, technology and technical information, product plans and designs, and business processes disclosed by such party. However, Confidential Information (other than Your Data) shall not include any information that (i) is or becomes generally known to the public without breach of any obligation owed to the Disclosing Party, (ii) was known to the Receiving Party prior to its disclosure by the Disclosing Party without breach of any obligation owed to the Disclosing Party, (iii) is received from a third party without breach of any obligation owed to the Disclosing Party, or (iv) was independently developed by the Receiving Party.

8.2. Protection of Confidential Information. Except as otherwise permitted in writing by the Disclosing Party, (i) the Receiving Party shall use the same degree of care that it uses to protect the confidentiality of its own confidential information of like kind (but in no event less than reasonable care) not to disclose or use any Confidential Information of the Disclosing Party for any purpose outside the scope of this Agreement, and (ii) the Receiving Party shall limit access to Confidential Information of the Disclosing Party to those of its employees, contractors and agents who need such access for purposes consistent with this Agreement and who have signed confidentiality agreements with the Receiving Party containing protections no less stringent than those herein.

8.3. Protection of Your Data. Without limiting the above, We shall maintain appropriate administrative, physical, and technical safeguards for protection of the security, confidentiality and integrity of Your Data. We shall not (a) modify Your Data, (b) disclose Your Data except as compelled by law in accordance with Section 8.4 (Compelled Disclosure) or as expressly permitted in writing by You, or (c) access Your Data except to provide the Services or prevent or address service or technical problems, or at Your request in connection with customer support matters.

8.4. Compelled Disclosure. The Receiving Party may disclose Confidential Information of the Disclosing Party if it is compelled by law to do so, provided the Receiving Party gives the Disclosing Party prior notice of such compelled disclosure (to the extent legally permitted) and reasonable assistance, at the Disclosing Party's cost, if the Disclosing Party wishes to contest the disclosure. If the Receiving Party is compelled by law to disclose the Disclosing Party's Confidential Information as part of a civil proceeding to which the Disclosing Party is a party, and the Disclosing Party is not contesting the disclosure, the Disclosing Party will reimburse the Receiving Party for its reasonable cost of compiling and providing secure access to such Confidential Information.

8.5. Injunctive Relief. In the event of a threatened or actual breach of this Section 8, the non-breaching party shall be entitled to seek immediate injunctive or other equitable relief, in addition to, and not in lieu of, any other available remedies.

9. WARRANTIES AND DISCLAIMERS

9.1. Our Warranties. We warrant that (i) the Services shall perform materially in accordance with the User Guide and applicable data sheets, and (ii) the functionality of the Services will not be materially decreased during a subscription term. For any breach of either such warranty, Your exclusive remedy shall be as provided in Section 12.3 (Termination for Cause) and Section 12.4 (Refund or Payment upon Termination) below.

9.2. Mutual Warranties. You represent and warrant that (i) You the legal power to enter into this Agreement, and (ii) You will not transmit to Us any Malicious Code.

9.3. Disclaimer. THIS SITE AND ALL INFORMATION, CONTENT, MATERIALS, PRODUCTS (INCLUDING SOFTWARE) AND SERVICES INCLUDED ON OR OTHERWISE MADE AVAILABLE TO YOU THROUGH THIS SITE ARE PROVIDED BY JUNIPER ON AN "AS IS" AND "AS AVAILABLE" BASIS, UNLESS OTHERWISE SPECIFIED IN WRITING. EXCEPT AS EXPRESSLY PROVIDED HEREIN, NEITHER PARTY MAKES ANY WARRANTIES OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, AND EACH PARTY SPECIFICALLY DISCLAIMS ALL IMPLIED WARRANTIES, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW.

9.4 YOUR DATA. ANY DATA YOU ENTER INTO THE SERVICES, AND ANY CUSTOMIZATIONS MADE TO THE SERVICES BY OR FOR YOU WILL BE PERMANENTLY LOST UNLESS YOU EXPORT AND SAVE THE DATA FROM JUNIPER'S DESIGNATED WEBSITE. WE DO NOT GUARANTEE THAT YOUR DATA WILL NOT BE SUBJECT TO MISAPPROPRIATION, LOSS OR DAMAGE AND WE WILL NOT BE LIABLE IF IT IS. YOU ARE RESPONSIBLE FOR MAINTAINING APPROPRIATE SECURITY, PROTECTION AND BACKUP OF YOUR DATA. The Services may provide Juniper with information relating to your use and performance of the Services, as well as information regarding the devices on which you download and use Services. For example, this information may include the device type, mobile network connectivity, location of the device, information about when the Service is launched, individual session lengths for use of the Service, or occurrences of technical errors. Any information we receive is subject to the Juniper privacy notice located at www.juniper.net/us/en/privacy-policy. You must ensure that you have all the necessary rights in Your Data that permit you to use the Service without infringing the rights of any copyright owners, violating any applicable laws or violating the terms of any license or agreement to which you are bound.

9.5 VIRTUAL NETWORK PERFORMANCE LIMITATIONS. VIRTUAL NETWORKING DEVICES CREATED IN JUNOSPHERE WILL NOT HAVE THE SAME PERFORMANCE METRICS AS ACTUAL JUNIPER PRODUCTS DEPLOYED IN YOUR NETWORKS.

10. INDEMNIFICATION

10.1. Indemnification by You. You shall defend Us against any Claim made or brought against Us by a third party alleging that Your Data, or Your use of the Services in violation of this Agreement, infringes or misappropriates the intellectual property rights of a third party or violates applicable law, and shall indemnify Us for any damages finally awarded against, and for reasonable attorney's fees incurred by, Us in connection with any such Claim; provided, that We (a) promptly give You written notice of the Claim; (b) give You sole control of the defense and settlement of the Claim (provided that You may not settle any Claim unless the settlement unconditionally release Us of all liability); and (c) provide to You all reasonable assistance, at Our expense.

10.2. Exclusive Remedy. This Section 10 (Indemnification) states the indemnifying party's sole liability to, and the indemnified party's exclusive remedy against, the other party for any type of Claim described in this Section.

11. LIMITATION OF LIABILITY

11.1. LIMITATION OF LIABILITY. EXCEPT FOR LIABILITY ARISING FROM YOUR UNAUTHORIZED USE OF THE NETWORK OR UNAUTHORIZED USE, DISTRIBUTION OR REMOVAL OF SOFTWARE, OR YOUR BREACHES OF SECTION 8, "CONFIDENTIALITY," IN NO EVENT SHALL EITHER PARTY'S AGGREGATE LIABILITY ARISING OUT OF OR RELATED TO THIS AGREEMENT, WHETHER IN CONTRACT, TORT OR UNDER ANY OTHER THEORY OF LIABILITY, EXCEED THE TOTAL AMOUNT PAID BY YOU HEREUNDER OR, WITH RESPECT TO ANY SINGLE INCIDENT, THE LESSER OF \$100,000 OR THE AMOUNT PAID BY YOU HEREUNDER IN THE 12 MONTHS PRECEDING THE INCIDENT. THE FOREGOING SHALL NOT LIMIT YOUR PAYMENT OBLIGATIONS UNDER SECTION 6 (FEES AND PAYMENT FOR PURCHASED SERVICES).

11.2. EXCLUSION OF CONSEQUENTIAL AND RELATED DAMAGES. IN NO EVENT SHALL EITHER PARTY HAVE ANY LIABILITY TO THE OTHER PARTY FOR ANY LOST PROFITS OR REVENUES OR FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, COVER OR PUNITIVE DAMAGES HOWEVER CAUSED, WHETHER IN CONTRACT, TORT OR UNDER ANY OTHER THEORY OF LIABILITY, AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE FOREGOING DISCLAIMER SHALL NOT APPLY TO THE EXTENT PROHIBITED BY APPLICABLE LAW.

12. TERM AND TERMINATION

12.1. Term of Agreement. This Agreement commences on the date You accept it and continues until all User Subscriptions granted in accordance with this Agreement have expired or been terminated. If You elect to use the Services for a free trial period and do not purchase a subscription before the end of that period, this Agreement will terminate at the end of the free trial period.

12.2. Term of Purchased User Subscriptions. User Subscriptions purchased by You commence on the start date specified in the applicable Order Form and continue for the subscription term specified therein.

12.3. Termination for Cause. A party may terminate this Agreement for cause: (i) upon 30 days written notice to the other party of a material breach if such breach remains uncured at the expiration of such period, or (ii) if the other party becomes the subject of a petition in bankruptcy or any other proceeding relating to insolvency, receivership, liquidation or assignment for the benefit of creditors.

12.4. Refund or Payment upon Termination. Upon any termination for cause by You, We shall refund You any prepaid fees covering the remainder of the term of all User Subscriptions after the effective date of termination. Upon any termination for cause by Us, You shall pay any unpaid fees covering the remainder of the term of all Order Forms after the effective date of termination. In no event shall any termination relieve You of the obligation to pay any fees payable to Us for the period prior to the effective date of termination.

12.5. Return of Your Data. You must download any and all of Your Data within 30 days after the effective date of termination of a Purchased Services subscription. After such 30-day period, We shall have no obligation to maintain or provide any of Your Data and shall thereafter, unless legally prohibited, delete all of Your Data in Our systems or otherwise in Our possession or under Our control. **ANY DATA YOU ENTER INTO THE PURCHASED SERVICES, AND ANY CUSTOMIZATIONS MADE TO THE SERVICES BY OR FOR YOU, WILL BE PERMANENTLY LOST UNLESS YOU EXPORT AND SAVE THE DATA FROM JUNIPER'S DESIGNATED WEBSITE.**

12.6. Surviving Provisions. Section 6 (Fees and Payment for Purchased Services), 7 (Proprietary Rights), 8 (Confidentiality), 9.3 (Disclaimer), 10 (Indemnification), 11 (Limitation of Liability), 12.4 (Refund or Payment upon Termination), 12.5 (Return of Your Data), 13 (General Provisions) shall survive any termination or expiration of this Agreement.

13. General Provisions

13.1 Privacy. This Agreement incorporates by reference the Juniper privacy notice posted at www.juniper.net/us/en/privacy-policy.

13.2 Taxes. All prices and license fees payable under this agreement are exclusive of tax. Customer shall be responsible for paying taxes arising from the purchase of the products, license, or importation or use of the Software. If applicable, valid exemption documentation for each taxing jurisdiction shall be provided to Juniper prior to invoicing, and Customer shall promptly notify Juniper if their exemption is revoked or modified. All payments made by Customer shall be net of any applicable withholding tax. Customer will provide reasonable assistance to Juniper in connection with such withholding taxes by promptly: providing Juniper with valid tax receipts and other required documentation showing Customer's payment of any withholding taxes; completing appropriate applications that would reduce the amount of withholding tax to be paid; and notifying and assisting Juniper in any audit or tax proceeding related to transactions hereunder. Customer shall comply with all applicable tax laws and regulations, and Customer will promptly pay or reimburse Juniper for all costs and damages related to any liability incurred by Juniper as a result of Customer's non-compliance or delay with its responsibilities herein. Neither party shall be liable for taxes or assessments on the other party's net income, gross income, capital, net worth, franchise, privilege, property, or any similar taxes or assessments. Customer's obligations under this Section shall survive termination or expiration of this Agreement.

13.3 Governing Law; Jurisdiction. This Agreement shall be interpreted and governed by the laws of the State of California without reference to its conflict of laws principles. The provisions of the United Nations Convention on the International Sale of Goods shall not apply to this Agreement. For any disputes arising out of this Agreement, the parties consent to the personal and exclusive jurisdiction of, and venue in, the state and federal courts within Santa Clara County, California.

13.4 Entire Agreement. The terms and conditions contained in this Agreement constitute the entire agreement between the parties and supersede all previous and/or contemporaneous agreements and understandings, whether oral or written, between the parties hereto with respect to the subject matter of this Agreement, including but not limited to any preprinted terms on purchase orders, invoices, advertising and sales literature.

13.5 Force Majeure. Except for Customer's payment obligations, neither party will be responsible for any failure to perform due to causes beyond its reasonable control.

13.6 Assignment. Customer may not assign or delegate or otherwise transfer its licenses, rights or duties under this Agreement except with prior written consent of Juniper Networks. Any prohibited assignment will be void. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the parties thereto and successors and assigns.

13.7 Notices. All notices and other communications pertaining to this Agreement shall be in writing and shall be deemed delivered upon personal delivery or three days after deposit in U.S. mail via certified mail, return receipt requested, postage prepaid. All notices of communications between Customer and Juniper Networks pertaining to this Agreement shall be directed to the address specified on the last page of this Agreement.

13.9 Amendment; Waiver. Neither modification to this Agreement, nor any waiver of any rights shall be effective unless assented to in writing by the party to be charged and the waiver of any other right hereunder or any subsequent breach or default.

13.10 Severability. If any portion of this Agreement is held invalid, the parties agree that such invalidity shall not affect the validity of the remaining portions of this Agreement, and the parties shall seek in good faith to agree to substitute for the invalid provision a valid provision that most closely approximates the economic effect and intent of the invalid provision.

13.11 Counterparts. This Agreement may be signed in counterparts each of which shall be deemed an original and together shall constitute one and the same agreement.

SCHEDULE A

END USER LICENSE AGREEMENT

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 - b. **“Concurrent Users”** means the number of Users that Customer is licensed to have concurrently accessing the Software. If a single User connects to Software using multiple concurrent log-ins or connections, each such active logical connection or log-in is counted toward the number of Concurrent Users.
 - c. **“Country-Specific Terms”** means those terms posted at <http://www.juniper.net/techpubs/software/software-license.html> and designated as replacing one or more terms of this End User License Agreement solely for Customers to the extent they use the Software in a particular country or group of countries (herein **“Geography”**). Any Country-Specific Terms applicable to Customers using the Software in a stated Geography shall take precedence over any inconsistent terms of this Agreement with respect to Customer’s use of the Software in such Geography.
 - d. **“Customer”** or **“You”** means the individual or other legal entity or other business, governmental or not-for-profit organization that (A) is the original end user purchaser of a license to the Software from Juniper or a Juniper-authorized reseller, (B) accepts the terms of this Agreement, and (C) is identified as Customer or end user in the applicable Entitlement or in the authorized reseller’s invoice for such license to the Software. If Software is lawfully received from Juniper or from an authorized reseller but there is no Entitlement, then “Customer” means the party that first so received the software from Juniper or its authorized reseller and accepts the terms of this Agreement. (See Section 2.k, below, with respect to license limitations where there is no Entitlement.)
 - e. **“Device”** means any device such as a computer, handset, tablet, laptop, server, switch or router. A Device may also be a physical or virtual machine, hardware partition or blade.
 - f. **“Embedded Software”** means a copy of operating system software delivered embedded in or loaded onto Juniper hardware equipment when such equipment is sold by Juniper; PROVIDED, however, that no Separately Licensable Feature incorporated in such Embedded Software shall itself be deemed licensed along with the Embedded Software unless an Entitlement expressly so provides. If the Customer has an Entitlement to an Update of such Embedded Software, then such Update is itself deemed “Embedded Software” to the extent such Update would be deemed Embedded Software without regard to this sentence had it been delivered installed on the Juniper equipment.
 - g. **“End-point”** means any Device that terminates a network connection.
 - h. **“Entitlement”** means the set of documents issued by (or under authority granted by) Juniper that specify (i) the Software licensed (by Juniper product number), (ii) the license term, (iii) the Licensed Units, (iv) the authorized use, if any, (v) the Customer, and (vi) the license fee charged, if any, and, if none is charged, the fact that the license was granted to Customer free-of-charge.
 - i. By way of illustration, “Entitlements” may be composed of, among other things, any of the following or combinations of the following, as long as together they meet the criteria of the preceding sentence: written agreement signed by Customer and Juniper, a product description in the Juniper price list, a Juniper invoice, a Juniper-issued e-certificate, a Juniper-issued email transmitting authorization codes, as to Updates, a Juniper website-posted Services Description Document, or an End User Services Agreement.
 - ii. In the event of inconsistency with respect to any two Entitlement documents or between this Agreement and any Entitlement document, the one most restrictive of the rights of the Customer shall take precedence.
 - i. **“Juniper”** means (a) Juniper Networks (Ireland) and/or its authorized service representative(s) if Customer has acquired its license rights to the Software for use in Europe, the Middle East or Africa; (b) Juniper Networks (Hong Kong) Ltd. and/or its authorized service representative(s) if Customer has acquired its license rights to the Software for use in the Asia Pacific Rim; or (c) Juniper Networks (U.S.), Inc. and/or its authorized service representative(s) if Customer has acquired its license rights to the Software for use in North America, Central America or South America
 - j. **“Licensed Unit”** means a unit of measure by which Customer’s licensed use of Software is limited, as specified in the Entitlement. Examples of Licensed Units include, but are not limited to, seats, users, sessions, calls, connections, subscribers, clusters, nodes, devices, links, ports, events or transactions. Licensed Units may also be based on throughput (such as gigabytes per second), performance, configuration, bandwidth, interfaces, processing, or geographic scope. Some Licensed Units are defined in this Section 1 and those definitions shall apply to all Entitlements except as otherwise expressly provided in such Entitlements. Such defined Licensed Units include: Authorized Users, Concurrent Users, Device, End-point, Managed Device, Subscriber, and User.
 - k. **“Managed Device”** is a Device that (1) is recognized by the Software as authorized to be configured, administered, managed, provisioned, monitored or otherwise acted upon by the Software or (2) has been configured, administered, managed, provisioned, monitored or otherwise acted upon by the Software.
 - l. **“Network”** means a set of networked Devices or other network elements of the Customer that are under the common management and operational control of Customer, and in the case of an internet service provider are located within a single country unless Customer’s Entitlement otherwise expressly provides.
 - m. **“Separately Licensable Feature”** means any module, feature, function, service, application, operation, or capability furnished in combination within other Software (herein, collectively, “feature”), which feature is separately licensable from Juniper or its authorized resellers for additional fee, whether such feature is ‘locked’ or key-restricted or even of the feature can be activated or used without a Juniper-issued product activation key.
 - n. **“Software”** means an instance of a program, module, feature, function, service, application, operation, or capability of the Juniper or Juniper-supplied software either (i) identified in an Entitlement as licensed to Customer or (ii) made available to Customer by Juniper or a Juniper-authorized reseller for Evaluation Use. **“Software”** may also consist of an instance either of a Separately Licensable Feature distributed in combination with other Software and/or of an Update of other Software.
 - o. **“Subscriber”** is a Device, individual, Customer billing record or other identity that is recognized by the Software as authorized (presently, in the past or in the future) to receive services, usage, access or content which were, are or could be provided, managed, distributed, provisioned, billed or otherwise enabled by the Software.
 - p. **“Subscription License”** means a license to Software with respect to which the Entitlement states a finite, fixed term of use for the Software and

either identifies the license as a “subscription” or expressly includes the right to Updates throughout the fixed term of use without need to purchase a separate Support Contract.

- q. **“Support Contract”** means a support services contract that includes rights to receive certain Updates of the Software, which contract is either (i) a Juniper-issued contract purchased by Customer either from Juniper or from a Juniper-authorized reseller, or (ii) a support services contract issued by a support services provider to Customer under authorization granted by Juniper.
 - r. **“Update”** means Software that is an update, upgrade, bug fix or other new releases of other Software. Updates are either **“Major Releases”** (meaning a revision of Software as determined by Juniper Networks to have significant additional functionality or improved performance) or **“Minor Releases”** (meaning a bug fix, maintenance release, service release or a revision of a software application as determined by Juniper Networks to be limited to minor additional functionality or corrections of errors). An Entitlement to Updates may for certain cases exclude Major Releases.
 - s. **“Usage Monitor”** means a network management appliance or application software furnished to Customer (or approved in writing) by Juniper for monitoring use of the Software.
 - t. **“User”** means Device, individual, Customer billing record or other identity usable to gain access to any Software functionality (whether or not such account is restricted to a particular Device). User may be an individual or another Device. In counting Users for purposes of measuring usage against the licensed number of “Authorized Users” or “Concurrent Users,” if a User can access the Software through another User each such User shall be counted separately.
2. **License Grant.** Subject to payment of the applicable fees and subject to the terms of this Agreement, Juniper grants to Customer a non-exclusive and non-transferable license, without right to sublicense, to use the Software, in executable form only, and only within the restrictions and subject to the conditions set forth in the Entitlement and those set forth in this Agreement. Unless otherwise expressly provided in the Entitlement:
- a. **Embedded Software.** Customer shall use Embedded Software solely for execution on the unit of Juniper equipment originally delivered to Customer with such Software installed. Any Update of such Embedded Software that Customer has licensed under a Support Contract may be loaded and executed only on the Juniper equipment on which the originally licensed Embedded Software is authorized to execute. Further, if Customer also licenses any Separately Licensable Feature combined with or incorporated in the Embedded Software (whether in dormant or active form), Customer may use such Separately Licensable Feature only for execution on the Juniper equipment on which the Embedded Software is authorized to execute. The license term for any such Separately Licensable Feature or Update shall be as specified in its own Entitlement. Notwithstanding any other provision of this Agreement, except as may otherwise be required by applicable law, no license is granted for installation or use of any Embedded Software or associated Update or Separately Licensable Feature on any Juniper equipment resold by anyone who is not an authorized reseller of such equipment.
 - b. **Single Instance/Single Device.** Except to the extent otherwise explicitly stated in the Entitlement (including, without limitation, where the Entitlement states that the license is a “Network License”) Customer shall use a single instance of the Software on a single Device and the quantity of all applicable Licensed Units shall be one (1).
 - c. **Non-transferability of Licensed Units.** Unless expressly permitted by the Entitlement, quantities of Licensed Units purchased separately are not allowed to be transferred or allocated between or among different licenses or instances of the Software.
 - d. **Separately Licensable Features and Updates.** Unless otherwise expressly stated in an Entitlement purchased by Customer, a license to a particular release of Software shall not entitle Customer to receive or use any Separately Licensable Feature delivered in combination with that Software or any Update of that Software. An Entitlement to a Separately Licensable Feature or to an Update may specify terms, conditions and restrictions, including different Licensed Units and different term of use, that are different than those of that underlying licensed Software; provided however, that in no event shall any such Entitlement be construed to expand implicitly any terms, conditions or restriction of use of the underlying licensed Software.
 - e. **Network License.** If the Entitlement specifies that it is a Network License, Customer may allocate the applicable Licensed Units across the licensed number of Software instances provided that (i) such instances are all running on the Customer Network specified in Customer’s Entitlement; (ii) the total number of Licensed Units does not exceed the number licensed under that Entitlement and (iii) a Usage Monitor is used to validate (i) and (ii) and to report such usage to Juniper. Customer shall not alter or disable the Usage Monitor at any time during the term of the network license and shall not disable, alter or destroy the Usage Monitor, its connection to Juniper or any data collected by such Usage Monitor. If the network license is granted as to a particular number of Licensed Units, then all licensed copies of the software in the Customer Network may not be used to support in the aggregate more than that number of Licensed Units.
 - f. **Updates.** Except as expressly provided below in Section 2.g, below, with respect to Subscription Licenses or as otherwise expressly provided in an Entitlement or Support Contract, Customer shall have no rights in any Update to Software, nor any rights to support services associated with such Software.
 - g. **Subscription License.** In case of a Subscription License of Software, Juniper Networks shall make available to Customer during the term of the Subscription License the Supported Updates (as defined below) solely for support of the Customer’s licensed copy(ies) of such Software during the term of the Subscription License, subject to the terms and conditions set forth below:
 - i. As used herein, **“Supported Updates”** as of any particular time during the term of the Subscription License means any Update of such Software then available generally to Customers who have purchased a Subscription License to such Software.
 - ii. **Rights in Supported Updates.** For each Supported Update, the Customer’s rights in such Update will be subject to the same terms, restrictions and conditions as apply to the Software (including without limitation the terms, restrictions or conditions on use set forth in this Agreement and in any “Entitlement” as it applies to the Software).
 - h. Specific license terms applicable to particular products:
 - i. **Junos Space Software.** If this license is granted in fulfillment of a Customer purchase order (or associated fulfillment documentation) placed with Juniper or any Juniper-authorized reseller or support services provider (including any Operate Specialist) for any package of Junos Space Software, then Customer is authorized to use Junos Space in a networked environment on the Customer Network identified in the Entitlement

solely to manage Devices in such Customer Network, but only to the extent of Licensed Units specified in the Entitlement. If, instead, Customer's license in a package of Junos Space Software is granted in fulfillment of a feature of a Support Contract, the scope of the license shall be as set forth in that Support Contract, an associated Service Description Document or another associated Entitlement.

- ii. *Steel-Belted Radius or Odyssey Access Client Software* -- Customer shall use such Software on a single computer containing a single physical random access memory space and containing any number of processors. Use of the Steel-Belted Radius or IMS AAA Software on multiple computers or virtual machines (e.g., Solaris zones) requires multiple licenses, regardless of whether such computers or virtualizations are physically contained on a single chassis.
 1. The Global Enterprise Edition of the Steel-Belted Radius Software may be used by Customer only to manage access to Customer's enterprise network. Specifically, service provider Customers are expressly prohibited from using the Global Enterprise Edition of the Steel-Belted Radius Software to support any commercial network access services.
 - i. If the Entitlement specifies "*Research and Development Use*", then Customer may only use the Software in Customer's own internal lab activities for research and development, excluding (A) research and development activities conducted as a paid contractor on behalf of a third party, and (B) any use of Software supporting, or installed or incorporated in whole or in part in, a product or service made commercially available or supporting live network traffic in the ordinary course of Customer's business.
 - j. If the Entitlement specifies "*Lab Use*", then Customer may only use the Software in Customer's own internal lab activities to evaluate and test network setup and configuration and feature testing, but excluding (A) lab testing or other activities conducted as a paid contractor on behalf of a third party, and (B) any use of Software supporting, or installed or incorporated in whole or in part in, a product or service made commercially available or supporting live network traffic in the ordinary course of Customer's business.
 - k. If there is no Entitlement, or if there is an Entitlement that specifies "*Evaluation*", "*Demonstration*" or "*Trial*" use then Customer may only use the Software for its internal evaluation or qualification of the Software (or the equipment in which it is embedded) and only in a development or test network environment in contemplation of potential future licensing for a commercial or other use.
 - l. Except to the extent otherwise required by applicable law or expressly provided in the Entitlement, this license is not sublicensable, transferable or assignable by Customer and any attempted sublicense, transfer or assignment shall be null and void.
3. **Use Prohibitions.** Notwithstanding the foregoing, this license does not permit the Customer to, and Customer agrees that it shall not, alone or through another party: (a) modify, unbundle, reverse engineer, or create derivative works based on the Software; (b) make copies of the Software (except as necessary for backup purposes and as otherwise expressly permitted in the Entitlement); (c) remove any proprietary notices, labels, or marks on or in the Software; (d) distribute any copy of the Software to any third party, including Embedded Software in Juniper equipment sold in any secondhand market; (e) use any feature, function, service, application, operation, or capability embedded within Software (herein, collectively, "feature") where such feature is 'locked,' key-restricted or otherwise identified as not licensed for use without paying a separate fee, unless Customer first purchases the applicable license(s) and obtains a valid authorization from Juniper supported by an Entitlement explicitly authorizing such feature; this prohibition applies even if the feature can be activated or used without a Juniper-issued product activation key; (f) distribute any product activation key for the Software provided by Juniper to any third party; (g) use the Software in any manner that extends or is broader than the uses purchased by Customer from Juniper or an authorized Juniper reseller; (h) use Embedded Software on non-Juniper equipment; (i) use Embedded Software (or make it available for use) on Juniper equipment that the Customer did not originally purchase from Juniper or an authorized Juniper reseller; (j) disclose the results of testing or benchmarking of the Software to any third party without the prior written consent of Juniper; (k) attempt to alter or deface any notice or marking on any copy of the Software or attempt to assign or transfer any rights (whether by contract, by operation of law or otherwise) under this Agreement or under any Entitlement; (l) use any Update to which Customer may otherwise be entitled if either (1) at the time of acquiring such Update, Customer does not already hold a valid license to the original Software or (2) Customer has not paid the applicable fee for the Update (or the Support Contract under which the Update is furnished); (m) deactivate or modify or impair the functioning of any Usage Monitor or any record, log or functionality designed to monitor, measure or limit use of the Software or compliance with the license terms of this Agreement; (n) unless otherwise expressly provided in the Entitlement, permit any other User to use its access to any Software features or functionality in support of any business activity in which such other User for a fee grants third parties access to such features or functionality; or (o) use the Software or permit any User or any other third party to use the Software in violation of any applicable law or regulation or to support any illegal activity.
4. **Audit.** Customer agrees to allow Juniper or its independent professionals the right, at any times during the term of any license to any Software licensed by Juniper to Customer hereunder and thereafter until three years after the latest termination or expiration date of any such license, to inspect and copy during normal business hours the Usage Monitor logs, other Software logs and other relevant Customer records to verify Customer's compliance with this Agreement and the Entitlement; provided that any such inspection and copying shall be conducted under reasonable and customary restrictions to protect against use or disclosure of confidential Customer information therein other than as appropriate to verify Customer's compliance with the terms of this Agreement and any Entitlement and to enforce Juniper's rights thereunder. In the event such inspection discloses non-compliance with this Agreement, Customer shall promptly pay to Juniper the appropriate license fees, plus the reasonable cost of conducting the audit.
5. **Recordkeeping.** Customer shall maintain accurate records as necessary to verify compliance with this Agreement. Upon request by Juniper, Customer shall furnish such records to Juniper and certify its compliance with this Agreement.
6. **Confidentiality.** The Parties agree that aspects of the Software and associated documentation are the confidential property of Juniper. As such, Customer shall maintain the Software and associated documentation in confidence, which at a minimum includes restricting access to the Software to Customer employees and contractors having a need to use the Software for Customer's internal business purposes.
7. **Ownership.** Juniper and Juniper's licensors, respectively, retain ownership of all right, title, and interest (including copyright) in and to the Software, associated documentation, and all copies of the Software. Nothing in this Agreement constitutes a sale or other transfer or conveyance of any right, title, or interest in the Software or associated documentation.
8. **Limited Warranty.** Except as may otherwise be provided in the warranty posted at <http://www.juniper.net/support/warranty/> applicable to the Software, and except for Software excluded from warranty coverage under subsection (f), below, Juniper warrants for the sole benefit of Customer that for a period of ninety (90) days from the Start Date, the media on which software is delivered, shall be free from defects in material and workmanship under normal authorized use consistent with the product instructions, subject to the following:

- a. In addition, with respect to Embedded Software embedded in Juniper security products, application acceleration products or certain other Hardware products, as more specifically set forth on <http://www.juniper.net/support>, for a period of fifteen (15) days from the date a Customer receives such Hardware product Juniper will provide the Customer that purchased such Hardware product access to one (1) download of the most recent commercially-available revision of Software that is embedded in such hardware product. Customer may download the Software by going to <http://www.juniper.net/support>. Such download shall be treated as though it were an Update for purposes of this Agreement. This right to download extends only to the Customer and not to any subsequent transferee of the Hardware product on which it is embedded;
- b. In any event, **THE SOLE AND EXCLUSIVE REMEDY OF THE CUSTOMER AND THE ENTIRE LIABILITY OF JUNIPER UNDER THIS LIMITED WARRANTY SHALL BE THE REPLACEMENT OF THE MEDIA CONTAINING THE SOFTWARE.**
- c. **Restrictions:** No warranty will apply if the Software (i) has been altered, except by Juniper Networks; (ii) has not been installed, operated, repaired, or maintained in accordance with instructions supplied by Juniper; (iii) has been subjected to unreasonable physical, thermal or electrical stress, misuse, negligence, or accident or (iv) has been licensed solely for Evaluation Use or demonstration use or is beta software or otherwise not commercially released. In addition, Software is not designed or intended for use in (i) the design, construction, operation or maintenance of any nuclear facility, (ii) navigating or operating aircraft; or (iii) operating life-support or life-critical medical equipment, and Juniper disclaims any express or implied warranty of fitness for such uses. Customer is solely responsible for backing up its programs and data to protect against loss or corruption. Juniper warranty obligations do not include installation, reinstallation or backup support.
- d. IN NO EVENT DOES JUNIPER WARRANT THAT THE SOFTWARE, OR ANY EQUIPMENT OR NETWORK RUNNING THE SOFTWARE, WILL OPERATE WITHOUT ERROR OR INTERRUPTION, OR WILL BE FREE OF VULNERABILITY TO INTRUSION OR ATTACK.
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9. **Exclusion of Certain Damages.** TO THE EXTENT PERMITTED BY LAW, NEITHER JUNIPER NOR ITS SUPPLIERS OR LICENSORS BE LIABLE FOR ANY LOST PROFITS, LOSS OF DATA, OR COSTS OR PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, OR FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS AGREEMENT OR RELATING TO THE SOFTWARE OR USE OF THE SOFTWARE. IN NO EVENT SHALL JUNIPER OR ITS SUPPLIERS OR LICENSORS BE LIABLE FOR DAMAGES ARISING FROM UNAUTHORIZED OR IMPROPER USE OF ANY JUNIPER OR JUNIPER-SUPPLIED SOFTWARE. BECAUSE SOME JURISDICTIONS DO NOT ALLOW LIMITATION OR EXCLUSION OF CONSEQUENTIAL OR INCIDENTAL DAMAGES, SOME OR ALL OF THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. Juniper has set its prices and entered into this Agreement in reliance upon the disclaimers of warranty and the limitations of liability set forth herein, that the same reflect an allocation of risk between the Parties (including the risk that a contract remedy may fail of its essential purpose and cause consequential loss), and that the same form an essential basis of the bargain between the Parties.
10. **Limitation of Damages.** IN NO EVENT SHALL JUNIPER'S OR ITS SUPPLIERS' OR LICENSORS' CUMULATIVE LIABILITY TO CUSTOMER FROM ALL CAUSES OF ACTION AND ALL THEORIES OF LIABILITY, EXCEED THE GREATER OF (I) ONE HUNDRED US DOLLARS (\$100.00) IN THE AGGREGATE OVER ALL COPIES OF ANY AND ALL SOFTWARE LICENSED TO CUSTOMER BY JUNIPER OR ITS DISTRIBUTORS OR RESELLERS; OR (II) THE PRICE PAID TO JUNIPER FOR LICENSED RIGHTS TO THE SOFTWARE THAT GAVE RISE TO THE CLAIM. BECAUSE SOME JURISDICTIONS DO NOT ALLOW LIMITATION OR EXCLUSION OF CONSEQUENTIAL OR INCIDENTAL DAMAGES, SOME OR ALL OF THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. Juniper has set its prices and entered into this Agreement in reliance upon the disclaimers of warranty and the limitations of liability set forth herein, that the same reflect an allocation of risk between the Parties, and that the same form an essential basis of the bargain between the Parties.
11. **No Liability to any Third Party.** TO THE EXTENT PERMITTED BY LAW, JUNIPER DISCLAIMS ANY AND ALL LIABILITIES OR OBLIGATIONS WHATSOEVER RELATED TO THE SOFTWARE OR ITS LICENSING TO OR USE BY ANYONE OTHER THAN CUSTOMER. Customer shall defend, indemnify and hold Juniper harmless from and against any liability, damages, loss or cost (including attorneys' fees) arising out of or relating to any dispute, lawsuit, administrative hearing, arbitration or settlement based on any claim by a party other than Customer relating to the Software originally licensed to Customer (or relating to a service offered by Customer involving use of the Software).
12. **Term and Termination.**
- a. This License is granted for the license term specified in the Entitlement, if any.
- b. If no license term is specified in the Entitlement, then
- i. As to any Embedded Software, unless the license is for Lab Use, Research and Development Use, Evaluation Use, Demonstration Use or Trial Use, the license shall be terminable only for non-payment or other breach under Section 12.c, below.
- ii. If Software is licensed under a Subscription License, or under annual Support Contract or other time-limited basis, all rights to use such Software cease upon the expiration of the applicable subscription period or of the applicable Support Contract, subject to any renewal rights explicitly set forth in the Entitlement to the extent properly exercised by the Customer.

- iii. As to any other Software, if the Customer has lawfully received the Software without any Entitlement, then the license term shall be thirty (30) days from date of delivery to Customer of the first copy of the Software; provided that Customer may not perform multiple downloads of Software (or otherwise take delivery of multiple successive copies of the Software) to circumvent such term limitation.
 - c. Any breach of this Agreement (including any Entitlement) or failure by Customer to pay any applicable fees due shall result in termination of the license granted herein ten days after failure by Customer to cure any curable breach.
 - d. Upon any expiration or other termination of any license to Software, Customer's right to use the Software shall terminate and Customer shall promptly destroy or return to Juniper all copies of the Software and related documentation in Customer's possession or control.
13. **Taxes.** All license fees payable under this agreement are exclusive of tax. Customer shall be responsible for paying taxes arising from the purchase of the license, or importation or use of the Software. If applicable, valid exemption documentation for each taxing jurisdiction shall be provided to Juniper prior to invoicing, and Customer shall promptly notify Juniper if their exemption is revoked or modified. All payments made by Customer shall be net of any applicable withholding tax. Customer will provide reasonable assistance to Juniper in connection with such withholding taxes by promptly: providing Juniper with valid tax receipts and other required documentation showing Customer's payment of any withholding taxes; completing appropriate applications that would reduce the amount of withholding tax to be paid; and notifying and assisting Juniper in any audit or tax proceeding related to transactions hereunder. Customer shall comply with all applicable tax laws and regulations, and Customer will promptly pay or reimburse Juniper for all costs and damages related to any liability incurred by Juniper as a result of Customer's non-compliance or delay with its responsibilities herein. Customer's obligations under this Section shall survive termination or expiration of this Agreement.
14. **Export.** Customer agrees to comply in its use of the Software with all applicable export laws and restrictions and regulations of the United States and any applicable foreign agency or authority, and not to export or re-export the Software or any direct product thereof in violation of any such restrictions, laws or regulations, or without all necessary approvals. Customer shall be solely liable for any such violations.
15. **Commercial Computer Software.** The Software is a "commercial item" as defined at Federal Acquisition Regulation (48 C.F.R.) ("FAR") section 2.101 comprised of "commercial computer software" and "commercial computer software documentation" as such terms are used in FAR 12.212. Consequently, regardless of whether the Customer is the US Government or a department or agency thereof, the Customer shall acquire only such rights with respect to the Software as are set forth in this Agreement and the Entitlement.
16. **Interface Information.** To the extent required by applicable law, and at Customer's written request, Juniper shall provide Customer with the interface information needed to achieve interoperability between the Software and another independently created program, on payment of applicable fee, if any. Customer shall observe strict obligations of confidentiality with respect to such information and shall use such information in compliance with any applicable terms and conditions upon which Juniper makes such information available.
17. **Third Party Software.** Any licensor of Juniper whose software is embedded in the Software and any supplier of Juniper whose products or technology are embedded in (or services are accessed by) the Software shall be a third party beneficiary with respect to this Agreement, and such licensor or vendor shall have the right to enforce this Agreement in its own name as if it were Juniper. In addition, certain third party software may be provided with the Software and is subject to the accompanying license(s), if any, of its respective owner(s). To the extent portions of the Software are distributed under and subject to open source licenses obligating Juniper to make the source code for such portions publicly available (such as the GNU General Public License ("GPL") or the GNU Library General Public License ("LGPL")), Juniper will make such source code portions (including Juniper modifications, as appropriate) available upon request for a period of up to three years from the date of distribution. You may obtain a copy of the GPL at <http://www.gnu.org/licenses/gpl.html>, and a copy of the LGPL at <http://www.gnu.org/licenses/lgpl.html>. Open source information and information on contacting Juniper can be found at <http://www.juniper.net/support/products/> as applicable.
18. **Governing Law and Localized Versions of this Agreement.** This Agreement shall be governed by the laws of the State of California (without reference to its conflicts of laws principles). The provisions of the U.N. Convention for the International Sale of Goods shall not apply to this Agreement. For any disputes arising under this Agreement, the Parties hereby consent to the personal and exclusive jurisdiction of, and venue in the courts of the state of California (and the US District Court for the district of Northern California).
19. **Miscellaneous.** This Agreement constitutes the entire and sole agreement between Juniper and the Customer with respect to the Software, and supersedes all prior and contemporaneous agreements relating to the Software, whether oral or written (including any inconsistent terms contained in a purchase order), except that the terms of a separate written agreement executed by an authorized Juniper representative and Customer shall govern to the extent such terms are inconsistent or conflict with terms contained herein. Neither any modification to this Agreement nor any waiver of any rights hereunder shall be effective unless expressly assented to in writing by the party to be charged. If any portion of this Agreement is held invalid, the Parties agree that such invalidity shall not affect the validity of the remainder of this Agreement. This Agreement and associated documentation has been written in the English language, and the Parties agree that the English version will govern unless otherwise expressly stated in applicable Country-Specific Terms.

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ABOUT THIS GUIDE

Junosphere Documentation and Release Notes

For a list of related Junosphere documentation, see http://www.juniper.net/techpubs/en_US/junosphere/information-products/pathway-pages/junosphere1.0/index.html.

If the information in the latest release notes differs from the information in the documentation, follow the *Junosphere Release Notes*. To obtain the most current version of all Juniper Networks technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

Juniper Networks supports a technical book program to publish books by Juniper Networks engineers and subject matter experts with book publishers around the world.

These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration using the Junos OS and Juniper Networks devices. In addition, the Juniper Networks Technical Library, published in conjunction with O'Reilly Media, explores improving network security, reliability, and availability using Junos OS configuration techniques. All the books are for sale at technical bookstores and book outlets around the world. The current list can be viewed at <http://www.juniper.net/books>.

Objectives

This guide provides an overview of the Junosphere features supported in this release and describes how to configure the features to provide solutions to setting up a virtual network.



NOTE: For additional information about the Junos OS—either corrections to or information that might have been omitted from this guide—see the software release notes at http://www.juniper.net/techpubs/en_US/release-independent/junosphere/information-products/pathway-pages/junosphere/product/index.html

Audience

This guide is designed for network administrators who are configuring and monitoring the Junosphere virtual network.

To use this guide, you need a broad understanding of networks in general, networking principles, network configuration and Junos OS configuration.

Personnel operating the equipment must be trained and competent and must abide by the instructions provided by the documentation.

Using the Indexes

This reference contains a standard index with topic entries.

Documentation Conventions

Table 1 on page xx defines the notice icon used in this guide.

Table 1: Notice Icon


ICON	MEANING	DESCRIPTION
	Informational note	Indicates important features or instructions.

Table 2:Text and Syntax Conventions defines the text and syntax conventions used in this guide.

Table 2:Text and Syntax Conventions

CONVENTION	DESCRIPTION
Bold text like this	Represents text that you type.
Fixed-width text like this	Represents output that appears on a terminal screen.
<i>Italic text like this</i>	<ul style="list-style-type: none">• Introduces important new terms.• Identifies book names.• Identifies RFC and Internet drafts.
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands of configuration statements.
Text like this	Represents names of configuration statements, commands, files, and directory interface names; configuration hierarchy levels; or labels on routing platform components.
< > (angle brackets)	Enclose optional keywords or variables.
(pipe symbol)	Indicates a choice between keywords or variables on either side of the symbol. The set of choices are enclosed in parentheses for clarity.
# (pound sign)	Indicates a comment specified on the line as the configuration statement to which it applies.
[] (square brackets)	Enclose a variable for which you substitute one or more values.
{ } (indents and braces)	Identify a level in the configuration hierarchy.

; (semicolon)

Identifies a leaf statement at a configuration hierarchy level.

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- Document or topic name
- URL or page number
- Software release version (if applicable)

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- Download the latest versions of software and review release notes: <http://www.juniper.net/customers/csc/software/>
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- Join and participate in the Juniper Networks Community Forum: <http://www.juniper.net/company/communities/>
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USING JUNOSPHERE NETWORK TOPOLOGIES

Overview

This document describes the language, procedure, and the method for creating network configurations that are required for creating virtual networks on Junosphere.

About Virtual Machine Manager

Junosphere is a virtualization environment where multiple virtual machines representing network devices can be connected and configured to create network topologies.

A network configuration is defined by a topology file set, which consists of:

- *topology.vmm* - This is a configuration file that defines the virtual devices, such as routers, virtual distributed Ethernet (VDEs), and related connections within a single topology.
- Configuration for each Junos OS virtual machine that is defined in the *topology.vmm* file. For the VJX1000 virtual machines, these would be the Junos OS configuration (*.conf*) files.

The topology file set is used by the Junosphere user interface to create the virtual network.

Creating a Virtual Network

The following are the main steps in creating a virtual network:

1. Design the network. Understand the requirements, purpose, and goals of the virtual network.
2. Create the topology file set to describe this virtual network with the following steps:
 - a. Create the *topology.vmm* file using the Virtual Machine Manager (VMM) language syntax by defining the following in a file:
 - i. The devices
 - ii. The interfaces
 - iii. Their interconnections
 - b. Define a configuration file for each Junos OS virtual machine:
 - c. Build the topology file set, as documented in Building a Topology File Set on page 14.
3. Test and debug your network topology:
 - a. Schedule time on Junosphere.
 - b. Test and debug your *.vmm* script file.
 - c. Load and activate your virtual network topology.
 - d. Use your virtual network to meet your objectives.

Creating the Topology .vmm File

After understanding the customer's requirements, purpose, and goals with the network, you define the virtual network topology using Virtual Machine Manager (VMM) language syntax.

To create a virtual network using the VMM syntax, you need to define the following:

- For each virtual machine:
 - The virtual machine name, such as *vrouter#*, where *#* is a number.
 - The virtual image to boot with that virtual machine.
 - The network interfaces to map.
 - A link to a configuration file.
- The connections between your interfaces.
 - To connect interfaces between two virtual machines, define them to be on the same bridge.

NOTE: While you are able to use your existing host names and IP addresses in the Junosphere topology models, and while Junosphere is architected based on secure VPN paradigms, we recommend for additional security that you use alternative names and addresses in your topology files.

.vmm File Syntax

The .vmm configuration file syntax is similar to the syntax of a Junos OS configuration file. It follows the same basic nesting structure, with *{}* braces to encapsulate properties belonging to objects. It differs in syntax because it is dealing with different types of objects.

The syntax is a list of statements beginning with a keyword and ending with a semicolon. Some of the statements are simple property definitions; others are more complex compound object definitions. Compound definitions are a list of statements encapsulated within *{ }* braces.

Take care when editing the configuration and ensure that you have the correct sets of braces. If a configuration file contains syntactic errors, the configuration will not be processed.

Consider the following beginning lines of an example *topology.vmm* file:

```
1 // description - bind global definitions
2 #include "/vmm/bin/common.defs"
3 config "config" {
4   display "NULL";
5
6   vm "vrouter001" {
7     // description - hostname of configuration set for VM
8     hostname "vrouter001";
9     // description - Operating system image to load -
10
11     VJX1000_LATEST
12     // description - ge 0/0/0 interface to the outside world
13     interface "em0" { EXTERNAL; };
14     // description - ge 0/0/1 link
15     interface "em1" { bridge "private0"; };
16     // description - configuration file to load on the router
17     install "ENV(HOME)/active/configset/vrouter001.conf" "/root/junos.conf";
18   };
19 }
```

The keyword *config* is an object that is given a filename. The keyword is defined by a compound statement. One of those statements is the definition of a virtual machine object, also given a filename, *vrouter001*. Another statement is the definition of the VJX1000_LATEST image, which reflects the hostname.

Other objects are defined within context:

- Virtual machines and bridges can only be defined within the *config* object.
- Interfaces can only be defined within a virtual machine.

Table 3 on page 3 shows the formal .vmm file syntax definition.

Virtual Machine Description

The .vmm configuration file consists of sections within braces {} that describe each virtual machine. Each virtual machine section consists of the following parts:

- The virtual machine image to boot
Junosphere provides a range of virtual machine images that can be defined in the .vmm file (see “Virtual Machine Images” on page 4). The VMM system will create a new unique copy of the virtual machine image when the virtual machine is started.
- A description of each of the interfaces
Each virtual machine image defines the number of interfaces it can support. The user needs to define any of the options of the interface
- The configuration file to be passed to the virtual machine when it boots
Each virtual machine representing a network device also has a configuration file. The virtual machine configuration files for the VJX1000 series of networking devices are the same as the Junos OS configuration files for physical network devices such as routers. The virtual machine configuration file must be defined in the following way:

```
install "ENV(HOME)/active/configset/vrouter001.conf" "/root/vjx.conf";
```

The configuration file will be applied as part of the virtual machine's boot-up process.

Table 3: .vmm File Syntax

CONFIGURATION	CONFIGURATION VALUE
config_statement	<i>config_property vm_definition bridge_definition</i>
vm_definition	vm <i>name_value</i> { <i>vm_statement</i> + };
config_property	display <i>string_value</i> ;
bridge_definition	bridge <i>name_value</i> { };
vm_statement	basedisk <i>string_value</i> ;
vm_statement	bootdisk <i>string_value</i> ;
vm_statement	script <i>string_value</i> ;
vm_statement	install <i>string_value</i> <i>string_value</i> ;
vm_statement	interface <i>definition</i> ;
interface_definition	interface <i>name_value</i> { <i>interface_statement</i> + };

interface_statement	bridge <i>name_value</i> ;
interface_statement	macaddr <i>string_value</i> ;
interface_statement	ipaddr <i>string_value</i> ;
interface_statement	netmask <i>string_value</i> ;
interface_statement	gateway <i>string_value</i> ;
name_value	<i>string_value</i>

Virtual Machine Images

Junosphere provides a range of virtual machine image files, depending on the permissions. Table 4 on page 5 lists the generic definition of the images. See the Release Notes for a release-specific table of images. See the virtual machine image descriptions in the online help for information about installing the images.

Table 4: Virtual Machine Images

Disk Name	Description	Technical Support Provider
VJX1000_ <i>release_number</i>	This is a Junos OS release for VJX1000. Example: VJX1000_10_3R1_0	Juniper Technical Assistance Center (JTAC)
VJX1000_LATEST	Latest qualified VJX1000 image	JTAC
VJX1000_ <i>release_number</i> _EXP	Unqualified VJX1000 experimental images	NA
BGP_SERVICE	Latest qualified BGP image	JTAC
SPACE_ <i>release_number</i>	This is a Junos OS release for Space Example: SPACE_11_1R1_8	JTAC
SPACE_LATEST	Latest qualified Space image	JTAC
CENTOS_ <i>release_number</i>	Centos 32-bit image Example: Centos_5_3	NA

CENTOS64_ <i>release_number</i>	Centos 64-bit image Example: Centos64_5_4.xe <i>"image:Centos"</i>
---------------------------------	--

RIM_LATEST	Latest qualified Virtual Route Insight Manager image	Packet Design
------------	--	---------------

SPIRENT_LATEST	Latest qualified Spirent image	Spirent
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Virtual Machine Interfaces

This section describes:

- Defining the number of interfaces
- Connecting the interfaces
- Defining additional bridges
- Assigning an IP address to an interface using the **ipaddr** interface option

Defining the number of interfaces

You can define the number of interfaces that a virtual machine would have using the following .vmm file syntax:

interface emx;

Where $x = 0 \dots N$

For example:

```
vm "space01" {
    hostname "space";
    SPACE_11_1R1_8

    interface "em0" { EXTERNAL };
    interface "em1" { bridge "connect1"; };
}
```

Connecting the Interfaces

To connect interfaces between two virtual machines, use *bridge* syntax to create a virtual distributed Ethernet (VDE) switch between them.

Interfaces on different virtual machines connect to each other when defined with the same bridge. For example, configuring two interfaces with the bridge Connect1 establishes a common virtual distributed Ethernet switch between them.

The bridge EXTERNAL has a special meaning as it is a bridge connecting interface em0 to the management LAN.

The following is an example:

```
...
vm "space01" {
    hostname "space";
    SPACE_11_1R1_8
}
```

```

        interface "em0" { EXTERNAL };
        interface "em1" { bridge "connect1"; };
    };

vm "centos01" {
    hostname "vrouter001" ;
    CENTOS64_5.4
    interface "em0" { EXTERNAL; };
    interface "em1" { bridge "connect3"; };
    interface "em2" { bridge "connect1"; };
}
...

```

The example indicates:

- EXTERNAL is a keyword defining that the em0 interface is connected to the management LAN via the external bridge.
- Interface em1 of virtual machine space01 is connected to interface em2 of virtual machine centos01 via the common bridge connect1.

Defining Additional Bridges

You can use predefined bridges private0 to private123 within your topology file. However, you can define your own bridges, by creating a # define and defining each bridge using the following statement:

```
bridge "<name of bridge>" { };
```

NOTE: When defining bridges, the last line should not end with a “\.”

In order to use these bridge names in your topology you will also have to call out this # define name within the body of the config section.

In the example below, we are creating a # define called LOCAL_BRIDGE, then defining bridges private 124 to private 156. We also call out the # define LOCAL_BRIDGE within the body of the config section.

```

#define LOCAL BRIDGES \
    bridge "private124" { }; \
    bridge "private125" { }; \
    bridge "private126" { }; \
    bridge "private127" { }; \
    bridge "private128" { }; \
    bridge "private129" { }; \
    bridge "private130" { }; \
    bridge "private131" { }; \
    bridge "private132" { }; \
    bridge "private133" { }; \
    bridge "private134" { }; \
    bridge "private135" { }; \
    bridge "private136" { }; \
    bridge "private137" { }; \
    bridge "private138" { }; \
    bridge "private139" { }; \
    bridge "private140" { }; \
    bridge "private141" { }; \
    bridge "private142" { }; \
    bridge "private143" { }; \
    bridge "private144" { }; \

```

```

bridge "private145" {}; \
bridge "private146" {}; \
bridge "private147" {}; \
bridge "private148" {}; \
bridge "private149" {}; \
bridge "private150" {}; \
bridge "private151" {}; \
bridge "private152" {}; \
bridge "private153" {}; \
bridge "private154" {}; \
bridge "private155" {}; \
bridge "private156" {};

config "config" {
    display "NULL";

    vm "node1" {
        hostname "node1";
        VJX1000_LATEST
        interface "em0" { EXTERNAL; };
        // Interface node1 -> node2
        interface "em1" { bridge "private120"; };

        // Interface node1 -> node3
        interface "em2" { bridge "private92"; };

        // Interface node1 -> node4
        interface "em3" { bridge "private146"; };

        // Interface node1 -> node5
        interface "em4" { bridge "private91"; };

        install "ENV(HOME)/active/configset/node1.conf"
    }
}
PRIVATE_BRIDGES

LOCAL_BRIDGES

};

```

Assigning an IP Address to an Interface Using the ipaddr Interface Option

You can use the ipaddr option to assign an IP address to an interface from the topology.vmm file. Use this option with care. The following example shows the ipaddr option.interface:

```
interface "emx" { bridge "<private#>"; ipaddr "aaa.bbb.ccc.ddd"; };
```

- The ipaddr function should *not* be used if a full router configuration is being loaded from the library.
 - A VMM ipaddr-assigned address will override an IP address contained in a Junos OS router configuration.
- The ipaddr function in VMM can be used for the quick creation of configured and addressed interfaces.
- By default a /20 subnet mask will be applied to the interface; this cannot be changed.

- Take care to ensure that the assigned address of interface X is not in the same subnet as an address assigned to interface Y, otherwise the configuration will be rejected when the VJX virtual machine boots up. In the example below, R0 has two interfaces that are being configured with family inet addresses. The addresses (192.85.1.1 and 192.86.2.1) do not reside in the same subnet when the /20 subnet mask is applied.

In the example below, R0 has two interfaces that are being configured with family inet addresses:

```
vm "vrouter001" {
    hostname "vrouter001" ;
    VJX1000_LATEST
    interface "em0" { EXTERNAL; };
    interface "em1" { bridge "private0"; ipaddr "192.85.1.1"; };
    interface "em2" { bridge "private2"; ipaddr "192.86.2.1"; };
}
```

VJX Virtual Machines Interface Options

VMM interfaces for VJX virtual machines are mapped as follows:

- VMM *'em0'* = VJX *'ge-0/0/0'*
- VMM *'em1'* = VJX *'ge-0/0/1'*
- VMM *'em2'* = VJX *'ge-0/0/2'*
- ...
- VMM *'em15'* = VJX *'ge-0/0/15'*

The following lists the options to consider when defining interfaces in a .vmm file:

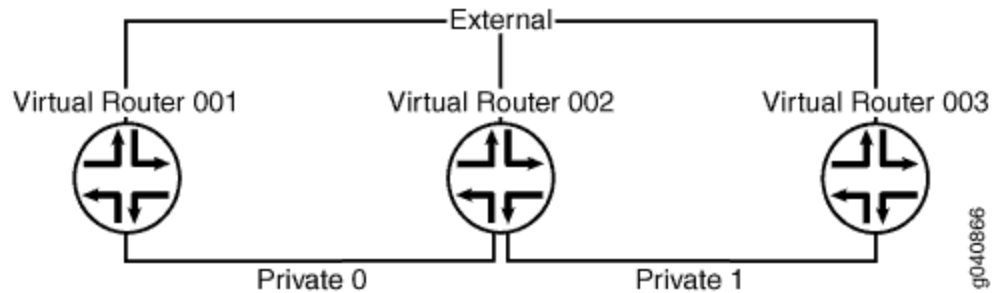
- The *em0 / ge-0/0/0* interface is reserved for out-of-band (OOB) management access. You cannot configure an IP address, features, or routing protocols against this interface.
- Additional interfaces can be configured with VLANs via the Junos OS router configuration file to create more logical interfaces.
- Interfaces must be listed sequentially, without gaps.
- Virtual machines must share a common segment (bridge) to communicate with each other.

```
interface "<vrouter00#>" { bridge "private0"; };
```

- *EXTERNAL* indicates a bridge to the management LAN outside the cloud. The *EXTERNAL* segment is special in that it is created by the Junosphere environment as the LAN to which both the user (via the Secure Access service) and the management Ethernet port of every virtual machine in the user's topology can be connected.
- Only IPv4 addresses are currently supported in the Virtual Machine Manager configuration syntax. Other address families must be configured within the virtual machine.
- Refer to the Release Notes for the current number of supported interfaces.

Topology Configuration Example

The example below defines a simple topology.vmm configuration:



The network devices *vrouter001*, *vrouter002*, and *vrouter003* are virtual machines representing virtual routers. Private0 and Private1 are bridges associated with network segments connecting *vrouter001* to *vrouter002*, and *vrouter002* to *vrouter003*, respectively. In order for the virtual machines to be able to communicate with each other, they must share a common bridge.

The following shows the .vmm configuration file with line numbers so that each line can be described in Table 5 on page 10. For an example without line numbers, see Sample .vmm Configuration File on page 15.

```

1 // description - global definitions.
2 #include "/vmm/bin/common.defs"
3 config "config" {
4     display "NULL";
5
6     vm "vrouter001" {
7         // description - hostname of set on VM
8         hostname "vrouter001";
9         // description Operating system image to load
10
11         VJX1000_LATEST
12         // description - ge 0/0/0 management interface
13         interface "em0" { EXTERNAL; };
14         // description - ge 0/0/1 link between vrouter001 and vrouter002
15         interface "em1" { bridge "private0"; };
16         // description - configuration file to load on the router
17         install "ENV(HOME)/active/configset/vrouter001.conf" "/root/junos.conf";
18     };
19
20     vm "vrouter002" {
21         hostname "vrouter002" ;
22         VJX1000_LATEST
23         interface "em0" { EXTERNAL; };
24         // description - link between vrouter002 and vrouter001
25         interface "em1" { bridge "private0"; };
26         // description - link between vrouter002 and vrouter003
27         interface "em2" { bridge "private1"; };
28         // description - configuration file to load on the router
29         install "ENV(HOME)/active/configset/vrouter002.conf" "/root/junos.conf";
30     };
31
32     vm "vrouter003" {
33         hostname "vrouter003" ;
34         VJX1000_LATEST
35         interface "em0" { EXTERNAL; };
36         // description - link between vrouter003 and vrouter002
37         interface "em1" { bridge "private1"; };

```

```

38 // description - configuration file to load on the router
39 install "ENV(HOME)/active/configset/vrouter003.conf" "/root/junos.conf";
40 };
41 PRIVATE_BRIDGES
42};

```

Table 5 - .vmm Configuration File Example on page 10 explains each line in the .vmm configuration file.

Table 5 - .vmm Configuration File Example

Code	Description
1 // description - bind global definitions	Comment placeholder.
2 #include "/vmm/bin/common.defs"	Pulls in global variables defined in <i>common.defs</i> .
3 config "config" {	Opens the Junosphere configuration container. Only one configuration container is allowed per configuration file.
4 display "NULL";	Display must be <i>NULL</i> .
5	
6 vm "vrouter001" {	Starts the definition for virtual machine <i>vrouter001</i> .
7 // description - hostname of set on VM	Comment placeholder.
8 hostname "vrouter001";	The hostname is the name applied to the Junos OS configuration set for this virtual machine. The hostname does <i>not</i> have to match the virtual machine name.
9 // description - Operating system image to load -	Comment placeholder.
10	
11 VJX1000_LATEST	Defines the Junos OS image that the virtual machine will boot. Setting the value to <i>VJX1000_LATEST</i> will make the virtual machine boot the system default image.
12 // description - ge 0/0/0 interface to the outside world	Comment placeholder.

13 interface "em0" { EXTERNAL;};

Maps interface *ge-0/0/0* to the external bridge for network management. The virtual machine must have a connection to the external bridge. Operational access to each device using methods such as ssh is via the external bridge.

14 // description - ge 0/0/1 link between vrouter001 and vrouter002

Comment placeholder.

15 interface "em1";

Defines the first data interface and maps it to the network bridge *private0*. { bridge "private0"; }

16 // description - configuration file to load on the router

Comment placeholder.

17 install "ENV(HOME)/active/configset/vrouter001.conf"
"/root/junos.conf";

Points to the Junos OS configuration file that will be loaded from its library location to the virtual machine once it boots. Be sure to make the *<name>.conf* equal to the *hostname*.

18};

Closes the definition for virtual machine *vrouter001*.

19

20 vm "vrouter002" {

Starts the definition for virtual machine *vrouter002*.

21 hostname "vrouter002";

The hostname is the name applied to the Junos OS configuration for this virtual machine. The hostname does *not* have to match the virtual machine name.

22 VJX1000_LATEST

Defines the Junos OS image that the virtual machine will boot. Setting the value to *VJX1000_LATEST* will make the virtual machine boot the system default image.

23 interface "em0" { EXTERNAL;};

Maps interface *ge-0/0/0* to the external bridge for network management. The virtual machine must have a connection to the external bridge. Operational access to each device using methods such as ssh is via the external bridge.

24 // description - link between vrouter002 and vrouter001

Comment placeholder.

25 interface "em1" { bridge "private0";};

Defines the first data interface and maps it to the network bridge *private0*.

26 // description - link between vrouter002 and vrouter003	Comment placeholder.
27 interface "em2" { bridge "private1"; };	Defines the second data interface and maps it to the network bridge <i>private1</i> .
28 // description - configuration file to load on the router	Comment placeholder.
29 install "ENV(HOME)/active/configset/vrouter002.conf" "/root/junos.conf";	Points to the Junos OS configuration file that will be loaded from its library location to the virtual machine once it boots. Be sure to make the <i><name>.conf</i> equal to the <i>hostname</i> .
30 };	Closes the definition for virtual machine <i>vrouter002</i> .
31	
32 vm "vrouter003" {	Starts the definition for virtual machine <i>vrouter003</i> .
33 hostname "vrouter003";	The hostname is the name applied to the Junos OS configuration for this virtual machine. The hostname does NOT have to match the virtual machine name.
34 VJX1000_LATEST	Defines the Junos OS image that the virtual machine will boot. Setting the value to <i>VJX1000_LATEST</i> will make the virtual machine boot the system default image.
35 interface "em0" { EXTERNAL;};	Maps interface <i>ge 0/0/0</i> to the external bridge for network management. The virtual machine must have a connection to the external bridge. Operational access to each device using methods such as ssh is via the external bridge.
36 // description - link between vrouter003 and vrouter002	Comment placeholder.
37 interface "em1" { bridge "private1"; };	Defines the first data interface and maps it to the network bridge <i>private0</i> .
38 // description - configuration file to load on the router	Comment placeholder.
39 install "ENV(HOME)/active/configset/vrouter003.conf" "/root/junos.conf";	Points to the Junos OS configuration file that will be loaded from its library location to the virtual machine once it boots. Be sure to make the <i><name>.conf</i> equal to the <i>hostname</i> .

40};	Closes the definition for virtual machine <i>vrouter003</i> .
41 PRIVATE_BRIDGES	Mandatory line to enable Ethernet bridge segments 0 to 123. You can define additional bridges.
42};	Closes the Junosphere configuration container.

Creating the Virtual Machine Configuration

To configure the virtual machines:

- For Junos OS network devices such as the *VJX1000*, write, build, and edit the Junos OS configurations.
- For other virtual machines, configure and boot those virtual machines.

Configuring Junos OS Network Devices

To configure a Junos OS network device:

- Manually compose a new Junos OS configuration file, or edit an existing one for each virtual machine using a text editor.
- Submit the virtual machine configuration files with the *topology.vmm* file as part of the topology file set, as listed in Building a Topology File Set on page 14.

Subsequent to the initial submission, log in to the network devices and use the CLI to update the configurations, as discussed in Connecting to the Network Topology on page 14.

Rules for Junos OS Configuration Files

The following rules apply to the Junos OS configuration files:

- The *topology.vmm* file must be coded to install each virtual machine configuration file from its library location, as noted in the following coding example:

```
install "ENV(HOME)/active/configset/vrouter001.conf" "/root/junos.conf";
```

The *install* command defines the active configuration. As part of the virtual machine's boot-up process, the configuration file will be applied.

- Junosphere applies a default configuration to each Junos OS network device.
 - A default configuration file is prepended to the configuration file you supply.
 - Your configuration takes precedence over the default file.
 - The default configuration will set up a *root* name and password, as well as basic services such as *telnet* and *ssh*.
 - The default configuration is found in Default Configuration File on page 16.
- Interface *ge-0/0/0* gets an assigned management IP address.
 - Do not otherwise configure this management interface.
 - Do not enable the interior gateway protocol (IGP) on this interface.

Configuring Other Virtual Machines

For other virtual machines, such as Centos servers and Junos Space, configure and boot those virtual machines. Refer to the device user documentation.

Building and Testing your Network Topology

After you have completed the configuration of your virtual network, you need to:

- Build a topology file set.
- Test the topology file set.
- Connect to the network topology.

Building a Topology File Set

To build a topology file set, perform the following in exact order:

1. Create the directory structure specified below:
 - `<home>/active/`
 - `<home>/active/configset/`
2. Add topology.vmm, the VMM configuration file defining the topology, to the *active* directory.
3. Add the Junos OS configuration files for each network device referenced by topology.vmm to the `/active/configset/` directory.
4. Create a topology file set, suitable for submission, by doing the following:
 - a. Change to the */active* directory.
cd active
 - b. Tar the files.
tar -cvf mytopology.tar
 - c. Zip the files.
gzip mytopology.tar

This creates the *mytopology.tar.gz* file.

Testing the Topology File Set

1. Log in to the Junosphere User Interface.
2. Load the topology file set into Junosphere using the user interface.
You do not need a timeslot to login and load a topology.
3. Schedule a time slot on Junosphere.
4. Activate and start the topology.
5. Connect to the network topology.

Connecting to the Network Topology

To connect to the virtual devices in the network topology to verify that they are working or to make changes:

1. On the Topology Page of the Junosphere User Interface, view the IP address and connection information for the Console Port or management Ethernet of the virtual device.
2. With a topology active, on the Library page click **Connect** to go to the Junosphere Access Portal page.
3. Enter your username and password and click **Sign In**.
The Network Connect page appears.

4. Click the Network Connect **Start** button.

Network Connect establishes a Secure Access SSL VPN to the internal management Ethernet of the topology. Traffic will be directed only to the local management Ethernet over that tunnel.

5. Connect to a virtual device using an appropriate communications programs such as telnet, SSH, or vnc.
6. Log in to the Junos virtual device using the default username and password. The default root password is Clouds.
7. If you are connecting to a Junos OS network device, enter **cli** to start using the Junos OS environment.

Just as with a physical Junos OS device, configuration changes are made in edit mode and then committed to implement the changes on the router. To save your changes to the library, click **Save** on the user interface Library menu.

Sample .vmm Configuration File

The following is an example of a .vmm configuration file that you can copy and paste to use a starting configuration. To use this as code, copy and paste the text into an ASCII text editor such as Notepad and recopy it to eliminate any extra, non-ASCII characters.

```
// description - global definitions.
//
#include "/vmm/bin/common.defs"
config "config" {
    display "NULL";

    vm "vrouter001" {
        // description - hostname of set on VM
        hostname "vrouter001";

        // description Operating system image to load
        VJX1000_LATEST

        // description - ge 0/0/0 management interface
        interface "em0" { EXTERNAL; };

        // description - ge 0/0/1 link between vrouter001 and vrouter002
        interface "em1" { bridge "private0"; };

        // description - configuration file to load on the router
        install "ENV(HOME)/active/configset/vrouter001.conf" "/root/junos.conf";
    };

    vm "vrouter002" {
        hostname "vrouter002" ;

        VJX1000_LATEST

        interface "em0" { EXTERNAL; };

        // description - link between vrouter002 and vrouter001
        interface "em1" { bridge "private0"; };

        // description - link between vrouter002 and vrouter003
        interface "em2" { bridge "private1"; };
    };
}
```

```

// description - configuration file to load on the router
install "ENV(HOME)/active/configset/vrouter002.conf" "/root/junos.conf";
};

vm "vrouter003" {
  hostname "vrouter003" ;

  VJX1000_LATEST

  interface "em0" { EXTERNAL;};

  // description - link between vrouter003 and vrouter002
  interface "em1" { bridge "private1"; };

  // description - configuration file to load on the router
  install "ENV(HOME)/active/configset/vrouter003.conf" "/root/junos.conf";
};

PRIVATE_BRIDGES
};

```

Default Configuration File

The following is the default Junos OS configuration file that is prepended to the configuration files that you submit.

```

groups {
  member0 {
    system {
      host-name XXXhostnameXXX;
    }
  }
}
global {
  system {
    root-authentication {
      encrypted-password "$1$SGUyJfYE$r5hly2IU4IamO1ye3u70v0"; ## SECRET-DATA
    }
    login {
      message "Welcome to the cloud\npassword is Clouds\n";
    }
    time-zone America/Los_Angeles;
    debugger-on-panic;
    debugger-on-break;
    dump-on-panic;
    name-server {
      8.8.8.8;
    }
    services {
      finger;
      ftp;
      rlogin;
      rsh;
      ssh;
      telnet;
      xnm-clear-text;
    }
    security {
      forwarding-options {

```

```

family {
    inet6 {
        mode packet-based;
    }
    mpls {
        mode packet-based;
    }
    iso {
        mode packet-based;
    }
}
}
}
syslog {
    host log {
        kernel info;
        any notice;
        pfe info;
        interactive-commands any;
    }
    file messages {
        kernel info;
        any notice;
        authorization info;
        pfe info;
        archive world-readable;
    }
    file security {
        interactive-commands any;
        archive world-readable;
    }
}
}
processes {
    routing enable;
    management enable;
    watchdog enable;
    snmp enable;
    inet-process enable;
    mib-process enable;
}
}
chassis {
    dump-on-panic;
}
}
}
apply-groups [ global member0 ];
system {
    archival {
        configuration {
            transfer-on-commit;
            archive-sites {
                "ftp://tftp:tftp@XXXgatewayXXX/active/configset";
            }
        }
    }
}
}
}
}

```


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