



vMX

Getting Started Guide for AWS

Release

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Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, California 94089
USA
408-745-2000
www.juniper.net

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Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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About the Documentation

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Documentation and 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/>.

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

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

Documentation Conventions

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

Table 1: Notice Icons







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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies guide names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS CLI User Guide</i> RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>

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

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. The console port is labeled CONSOLE.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric metric>;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (string1 string2 string3)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Encloses a variable for which you can substitute one or more values.	community name members [community-ids]
Indentation and braces ({ })	Identifies a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop address; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> In the Logical Interfaces box, select All Interfaces. To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

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

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <http://www.juniper.net/techpubs/feedback/>.

- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

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

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

Self-Help Online Tools and Resources

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

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

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

Opening a Case with JTAC

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

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

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

CHAPTER 1

Overview

- [vMX and AWS on page 13](#)
- [vMX Licenses on page 14](#)

vMX and AWS

vMX can be deployed in a virtual private cloud (VPC) in the Amazon Web Services (AWS) cloud. You can launch vMX as an Amazon Elastic Compute Cloud (EC2) instance in an Amazon VPC dedicated to a specific user account. vMX Amazon Machine Image (AMI) uses hardware virtual machine (HVM) virtualization.

vMX instances can be used to route between subnets in a VPC or to act as a gateway between a VPC and other VPCs or private networks outside of the AWS environment.

When deploying vMX as a VPC gateway, you might set up your vMX instance as follows:

- Management interface (fxp0) on one subnet
- Each WAN interface (ge-0/0/x) on independent subnets

These interfaces use an Elastic IP address to provide external connectivity by mapping a private IP address to a public IP address. vMX instances use private IP addresses for configuration. AWS transparently handles the mapping between private and public IP addresses using NAT.

vMX Limitations on AWS

vMX has the following limitations on AWS:

- Maximum number of interfaces for supported instance types is 8.
- Minimum of 4 vCPUs is required and 15 GB memory for lite mode.
- Minimum of 8 vCPUs is required and 15 GB memory for performance mode.

vMX does not support these features on AWS:

- Layer 2 features, and any features or protocols dependent on Layer 2 features
- Attachment or detachment of interfaces while a vMX instance is running

- VLAN tagging
- Jumbo frames (MTU greater than 1500)

vMX Models

vMX can be deployed using one of these models on AWS:

- Bring Your Own License (BYOL)—Licenses are required to use vMX features with this model. You must order licenses from Juniper Networks and add the license key.
- Pay As You Go (PAYG)—No licenses are required. You can use all vMX features for the available capacity. The selected EC2 instance type determines the available bandwidth.

vMX Licenses

Licenses are required to use vMX features in the Amazon Bring Your Own License (BYOL) model on AWS. When you order licenses, this information is bound to a customer ID. If you did not order the licenses, contact your account team or Juniper Networks Customer Care for assistance.

The vMX licenses are based on application packages and processing capacity. [Table 3 on page 14](#) describes the features available with application packages.

Table 3: Application Packages for Licenses

Application Package	Features
BASE	IP routing with up to 256,000 routes in the forwarding table Basic Layer 2 functionality, Layer 2 bridging and switching
ADVANCE	Features in the BASE application package, plus: IP routing with up to 2,000,000 routes in the forwarding table IP and MPLS switching for unicast and multicast applications Layer 2 features—Layer 2 VPN, VPLS, EVPN, and Layer 2 Circuit
PREMIUM	Features in the BASE and ADVANCE application packages, plus: IP routing with up to 4,000,000 routes in the forwarding table Layer 3 VPN for IP and multicast IPsec

An application package is associated with a bandwidth license. Bandwidth licenses that are not associated with a specific application package apply to all application packages. Bandwidth licenses are additive. For example, if you add a 500 Mbps license and a 1 Gbps license, you are entitled to use 1.5 Gbps of capacity.

vMX Evaluation License

Juniper Networks provides a 60-day evaluation license for vMX. On AWS, you can try one instance for 60 days with the BYOL model without incurring hourly software charges for this instance but AWS infrastructure charges still apply.

For information about the 60-day evaluation license for vMX, see <https://www.juniper.net/us/en/dm/free-vmx-trial/>.

vMX License Model Numbers

The Juniper Networks licenses are based on SKUs, which represent lists of features that the license enables.

The following SKUs are supported for vMX Bring Your Own License (BYOL):

- VMX-100M-1YR
- VMX-250M-1YR
- VMX-500M-1YR
- VMX-PRM-1G-1YR
- VMX-PRM-5G-1YR
- VMX-PRM-10G-1YR

Related Documentation

- [Managing vMX Licenses on page 25](#)

CHAPTER 2

Installing vMX in an AWS VPC

- [Installing vMX in an AWS VPC on page 17](#)
- [Logging In to vMX on AWS on page 20](#)
- [Changing the Interface Type to SR-IOV on page 21](#)

Installing vMX in an AWS VPC

This procedure requires you to have an AWS account. Sign in to your AWS account to perform these tasks to install vMX in an AWS VPC.

- [Creating an SSH Key Pair on page 17](#)
- [Creating a VPC on page 18](#)
- [Creating Network Interfaces on page 18](#)
- [Creating the vMX Instance on page 19](#)
- [Attaching Network Interfaces for WAN Ports on page 20](#)

Creating an SSH Key Pair

An SSH key pair is required to remotely access a vMX instance in AWS. You can create a new key pair in the EC2 Management Console or import a key pair created by another tool.

To create an SSH key pair:

1. In the AWS Management Console, click **EC2** under Compute to display the EC2 Management Console.
2. In the left navigation pane, click **Key Pairs**. Verify that the region name shown in the toolbar is the same as the region where you created the VPC.
3. Click **Create Key Pair**, specify a key pair name, and click **Create**.
4. Download the private key, where the filename is based on the key pair name you specified (*key-pair-name.pem*), and save it to a secure location.
5. To use an SSH client on a Mac or Linux computer to connect to the vMX instance, use the following command to set the permissions of the private key file so that only you can read it:

```
chmod 400 key-pair-name.pem
```

Creating a VPC



NOTE: You do not have to create a VPC. You can use an existing VPC that is in the same region as your EC2 instance.

To create a VPC, you configure private IP addresses for the network and private IP addresses for the subnet in the VPC, attach an Internet gateway to the VPC, and configure a route table to connect the subnet to the Internet gateway.

To configure the VPC on AWS:

1. In the AWS Management Console, click **VPC** under Networking to display the VPC Management Console.
2. In the left navigation pane, click **Your VPCs** to list configured VPCs. A default VPC that is automatically created is listed.
3. Click **Create VPC**, specify a name and CIDR block of private IP addresses for a new VPC, and click **Yes, Create**.
4. In the left navigation pane, click **Subnets** to list configured subnets.
5. Click **Create Subnet**, specify a name for the subnet, select the VPC, specify the subnet CIDR block within the VPC CIDR, and click **Yes, Create**.

One subnet is created for the management port (fxp0) and a subnet is created for each WAN port on the vMX. These values must be customized depending on your deployment scenario.

6. In the left navigation pane, click **Internet Gateways** to list configured gateways. The Internet gateway routes traffic between the VPC and the Internet. The gateway is required for communications outside of the AWS network.
7. Click **Create Internet Gateway**, specify a name for the gateway, and click **Yes, Create**.
8. Select the gateway, click **Attach to VPC**, select the VPC from the drop-down list to associate the gateway with the VPC, and click **Yes, Attach**.
9. In the left navigation pane, click **Route Tables** to list configured route tables. Select the route table associated with the VPC.
10. Select the **Routes** tab in the bottom section and click **Edit** to add a default route pointing to the Internet gateway. Specify **0.0.0.0/0** as the destination, select the Internet gateway as the target, and click **Save**.

Creating Network Interfaces



NOTE: Make sure the VPC and EC2 instance are in the same region.

To configure the EC2 instance on AWS:

1. In the AWS Management Console, click **EC2** under Compute to display the EC2 Management Console.
2. In the left navigation pane, click **Network Interfaces** to list configured network interfaces.
3. Click **Create Network Interface**, specify a description (used as the Name field), select a subnet, provide an IP address (optional), select a security group to be associated with the network interface, and click **Yes, Create**.

Create one network interface for the management port and one network interface for each WAN port. Copy the description into the Name field for ease of use.



NOTE: You can only associate two interfaces when creating the EC2 instance using the Web interface. You must have at least one WAN interface.

4. For each network interface associated with a WAN port, disable the source and destination check.

Select the network interface, click **Actions**, click **Change Source/Dest. Check**, select **Disabled**, and click **Save**.



NOTE: You must disable the source and destination check for each network interface associated with a WAN port.

5. For each network interface connected to vMX, create Elastic IP addresses for external access from the Internet.

In the left navigation pane, click **Elastic IPs**, and click **Allocate New Address**. Select the Elastic IP address, click **Actions > Associate Address**, select the network interface in the Associate Address dialog box, and click **Associate**.

Creating the vMX Instance

To configure the vMX instance on AWS:

1. In the AWS Management Console, click **EC2** under Compute to display the EC2 Management Console.
2. In the left navigation pane, click **AMIs** to list available AMIs.
3. Select the vMX AMI and click **Launch**.
4. Choose the instance type and click **Next: Configure Instance Details**.

For example, you might choose m4.xlarge for lite mode or c4.2xlarge for performance mode.

5. Configure the instance.
 - a. Select the VPC for the Network field, select the management subnet in the Subnet field, and enable Auto-assign Public IP.
 - b. In the Network Interfaces section, select the management interface for the eth0 device as the network interface. Click **Add Device** to add the eth1 device and select the WAN interface as the network interface.

You can configure the instances for the WAN interfaces later.
 - c. Click **Next: Add Storage**.
6. You do not need to change any values. Click **Next: Tag Instance**.
7. Specify the vMX instance name as the value for the Name key and then click **Next: Configure Security Group**.
8. Configure the security group with a rule to allow all required protocol traffic to reach the instance. You can create a new security group or select an existing security group.
9. Click **Review and Launch** to review the instance settings, and click **Launch**.
10. Select the SSH key pair you created, select the acknowledgment check box, and click **Launch Instance**.
11. In the left navigation pane, click **Instances** to list the instances.



NOTE: The initial boot after installation might take up to 25 minutes. Subsequent boot times might take several minutes.

Attaching Network Interfaces for WAN Ports

To attach the network interfaces for WAN ports on AWS:

1. In the AWS Management Console, click **EC2** under Compute to display the EC2 Management Console.
2. In the left navigation pane, click **Instances** to list available instances.
3. Select the vMX instance, click **Actions**, select **Networking > Attach Network Interfaces**, and select the network interface to be attached.

For each network interface associated with a WAN port, repeat this step to attach to the vMX instance.
4. To use the attached interfaces, restart the vMX instance.

Logging In to vMX on AWS

To log in to vMX or the VCP on AWS, use the SSH protocol to log in to the management interface (fxp0) with username **root** and SSH key pair. The SSH key pair is the same key used when creating the vMX instance. You must set a root password for Junos OS configuration; otherwise, the **commit check** command fails for configuration.

At a minimum, you must perform these initial Junos OS configuration tasks after logging in to vMX:

1. Start the CLI.

```
root# cli
```

2. Enter configuration mode.

```
root> configure
[edit]
root#
```

3. Configure the root password.

```
[edit]
root# set system root-authentication plain-text-password
New password: password
Retype new password: password
```

4. Configure the WAN interfaces with the same private IP address associated with the AWS network interface.

```
[edit]
root# set interfaces interface-name unit 0 family inet address address
```

For example:

```
[edit]
root# set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.10/24
```

5. Commit the configuration.

```
[edit]
root# commit
```

Changing the Interface Type to SR-IOV

For instance types that support Enhanced Networking, you can change the interface type from Xen-PV to SR-IOV. The interface type applies to all interfaces for this instance.



NOTE: After you set the interface type to SR-IOV, you cannot change the instance back to the Xen-PV interface type.

To change the interface type, you use CLI tools installed on a separate host. The CLI tools cannot be on the same host as the instance being modified.

To change the interface type to SR-IOV:

1. Shut down the instance being modified.
2. Execute the following commands on a Ubuntu host.

```
$ sudo apt-get install ec2-api-tools
$ export AWS_ACCESS_KEY=access-key
$ export AWS_SECRET_KEY=secret-key
$ export EC2_URL=ec2-url
$ ec2-describe-instance-attribute instance-id --sriov
$ ec2-modify-instance-attribute instance-id --sriov simple
```

For example:

```
$ sudo apt-get install ec2-api-tools
$ export AWS_ACCESS_KEY=ABC123EXAMPLE
$ export AWS_SECRET_KEY=abc123EXAMPLEKEY
$ export EC2_URL=https://ec2.us-west-1.amazonaws.com
$ ec2-describe-instance-attribute i-0abc9cde12f345 --sriov
sriovNetSupport i-0abc9cde12f345
$ ec2-modify-instance-attribute i-0abc9cde12f345 --sriov simple
sriovNetSupport i-abc9cde12f345 simple
```

3. Start the instance with SR-IOV network interfaces.

CHAPTER 3

Configuring vMX Chassis-Level Features

- [Configuring the Number of Active Ports on vMX on page 23](#)
- [Naming the Interfaces on page 23](#)
- [Configuring the Media MTU on page 24](#)
- [Enabling Performance Mode or Lite Mode on page 24](#)
- [Tuning Performance Mode on page 25](#)
- [Managing vMX Licenses on page 25](#)

Configuring the Number of Active Ports on vMX

You can specify the number of active ports for vMX. The default number of ports is 10, but you can specify any value in the range of 1 through 23. You can change this number if you want to limit the number of Ethernet interfaces in the VCP VM to match the number of NICs added to the VFP VM.

To specify the number of active ports, configure the number of ports at the **[edit chassis fpc 0 pic 0]** hierarchy level.

```
[edit]
user@vmx# set chassis fpc 0 pic 0 number-of-ports
```

Naming the Interfaces

vMX supports the following interface types:

- Gigabit Ethernet (ge)
- 10-Gigabit Ethernet (xe)
- 100-Gigabit Ethernet (et)

By default, the interfaces come up as ge interfaces with 1 Gbps bandwidth in the Junos OS configuration. The default port speed values for the interface types are 1 Gbps (ge), 10 Gbps (xe), and 100 Gbps (et). If you do not enable schedulers, the speed is only for display purposes and is not enforced. If you enable schedulers, the transmit rate of the port is limited to the speed unless it is overridden by the shaping rate in the CoS configuration.

To specify the interface types, configure the interface type at the **[edit chassis fpc 0 pic 0]** hierarchy level.

```
[edit]
user@vmx# set chassis fpc 0 pic 0 interface-type (ge | xe | et)
```

Configuring the Media MTU

For vMX, you can configure the media MTU in the range 256 through 9500.



NOTE: For AWS, the maximum value is 1514.



NOTE: For VMware, the maximum value is 9000.

You configure the MTU by including the **mtu** statement at the **[edit interface interface-name]** hierarchy level.

```
[edit]
user@vmx# set interface ge-0/0/0 mtu bytes
```

Enabling Performance Mode or Lite Mode

vMX can be configured to run in two modes depending on the use case.

- Lite mode—Needs fewer resources in terms of CPU and memory to run at lower bandwidth.
- Performance mode—Needs higher resources in terms of CPU and memory to run at higher bandwidth.



NOTE: Performance mode is enabled implicitly by default.

When you enable performance mode, make sure you have configured the proper number of vCPUs and memory for your VMs based on your use case.

To calculate the minimum number of vCPUs needed by VFP for performance mode: $(4 * \text{number-of-ports}) + 4$.

You can explicitly enable performance mode by including the **performance-mode** statement at the **[edit chassis fpc 0]** hierarchy level.

```
[edit]
user@vmx# set chassis fpc 0 performance-mode
```

If you are using paravirtualized network interfaces such as virtio (for KVM) or VMXNET3 (for VMware) for lab simulation use cases, you can disable performance mode by including the **lite-mode** statement at the **[edit chassis fpc 0]** hierarchy level.

```
[edit]
user@vmx# set chassis fpc 0 lite-mode
```


Related Documentation • [Tuning Performance Mode on page 25](#)

Tuning Performance Mode

To tune performance mode for unicast traffic, you can specify the number of Workers dedicated to processing multicast and control traffic. You can specify any value in the range of 0 through 15. The default of 0 specifies that all available Workers are used to process all traffic.

The number of dedicated Workers specified in relation to the number of available Workers results in the following behavior:

- If the number of dedicated Workers is greater than or equal to the number of available Workers, then all available Workers are used to process all traffic.
- If the number of dedicated Workers is less than the number of available Workers, then the first set of available Workers (equal to the specified number of dedicated Workers) is used to process multicast and control traffic while the remaining available Workers are used to process flow cache traffic.

To specify the number of dedicated Workers for processing multicast and control traffic, configure the number of Workers at the `[edit chassis fpc 0 performance-mode]` hierarchy level.

```
[edit]
user@vmx# set chassis fpc 0 performance-mode number-of-ucode-workers number-workers
```



NOTE: Changing the number of Workers reboots the FPC.

Managing vMX Licenses

You must add a license to use vMX features. The licensed features are enforced based on the license you purchased.



NOTE: For AWS, you must add a license if you are using vMX in the Bring Your Own License (BYOL) model.

If you upgrade from a BASE package license to an ADVANCE or PREMIUM package license or if you downgrade from an ADVANCE or PREMIUM package license to a BASE package license, you must restart the routing protocol process (**restart routing**). If your configuration has logical systems, you must restart the routing protocol process for all logical systems (**restart routing logical-system *logical-system-name***).

If you need to move your vMX installation to another host, you must remove vMX from the current host before installing vMX and adding the license on the new host.

- [Adding a License on page 26](#)
- [Deleting a License on page 27](#)

Adding a License

To add a license key to the vMX:

1. Copy the license activation key file to the VCP and add the license key by specifying the filename.

```
user@vmx> request system license add filename
```

Or, you can copy and paste the license activation key directly to add the license key. For example:

```
user@vmx> request system license add terminal
E408408918 aeaqib qcsbja okbuqe rcmxnq vjocwf uxfsta
z5ufjb kdrmt6 57bimv 2f3ddp qttdcn 627q4a
jx4s5x hiri
```

2. Verify that the license is installed. VMX-BANDWIDTH indicates the licensed bandwidth (in Mbps) and VMX-SCALE indicates the application package. (VMX-SCALE 1 is the BASE package, VMX-SCALE 2 is the ADVANCE package, and VMX-SCALE 3 is the PREMIUM package.) This information is also listed as Features in the Licenses installed section. For example, this output indicates that the 40G perpetual license for the PREMIUM application package is installed:

```
user@vmx> show system license
```

License usage:

Feature name	Licenses used	Licenses installed	Licenses needed	Expiry
scale-subscriber	0	1000	0	permanent
scale-12tp	0	1000	0	permanent
scale-mobile-ip	0	1000	0	permanent
VMX-BANDWIDTH	40000	40000	0	permanent
VMX-SCALE	3	3	0	permanent

Licenses installed:

License identifier: JUNOS640113

License version: 4

Software Serial Number: 1012620150123J

Customer ID: vMX-Juniper

Features:

vmx-bandwidth-40g - vmx-bandwidth-40g
permanent

vmx-feature-premium - vmx-feature-premium
permanent

3. Verify the configured bandwidth for PFE traffic matches the licensed bandwidth (VMX-BANDWIDTH). The current and average bandwidth are also displayed.

```
user@vmx> show pfe statistics traffic bandwidth
```

```
Configured Bandwidth : 40000000000 bps
Bandwidth             : 0 bps
Average Bandwidth     : 0 bps
```

Deleting a License

To delete a vMX license:

1. Display the installed licenses.

```
user@vmx> show system license installed
License identifier: JUNOS640113
License version: 4
Features:
  vmx-bandwidth-40g - vmx-bandwidth-40g
    permanent
  vmx-feature-premium - vmx-feature-premium
    permanent
```

2. Delete the license.

```
user@vmx> request system license delete license-identifier
```

For example:

```
user@vmx> request system license delete JUNOS640113
```

3. Verify that the license is deleted.

```
user@vmx> show system license
License usage:
```

Feature name	Licenses used	Licenses installed	Licenses needed	Expiry
scale-subscriber	0	1000	0	permanent
scale-l2tp	0	1000	0	permanent
scale-mobile-ip	0	1000	0	permanent

```
Licenses installed: none
```

