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Junos OS

Junos Node Slicing User Guide

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junos

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The information in this document is current as of the date on the title page.

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About the Documentation

IN THIS SECTION

Use this guide to set up, configure and manage Junos Node Slicing. This guide contains procedures such as installing the required software packages, configuring the JDM and server interfaces, configuring the BSYS mode, creating GNFs, and configuring abstracted fabric interfaces. It also has the configuration statements and command summaries used for Junos Node Slicing.

Documentation and Release Notes

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Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

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

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

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

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

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

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

Documentation Conventions

Table 1 on page xii 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 xii 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`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*

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

Convention	Description	Examples
Italic text like this	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** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• 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*]**

Indention 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		

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

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• 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**.

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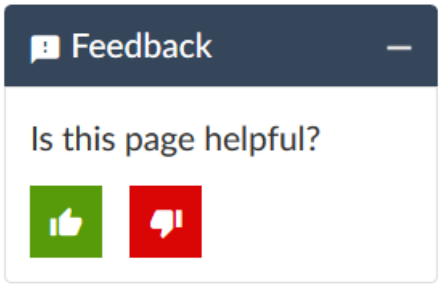

  - Click the thumbs-up icon if the information on the page was helpful to you.
  - Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.
- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

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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 https://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf.
- Product warranties—For product warranty information, visit https://www.juniper.net/support/warranty/.
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- Find product documentation: https://www.juniper.net/documentation/
- Find solutions and answer questions using our Knowledge Base: https://kb.juniper.net/
- Download the latest versions of software and review release notes: https://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://kb.juniper.net/InfoCenter/
- Join and participate in the Juniper Networks Community Forum: https://www.juniper.net/company/communities/
- Create a service request online: https://myjuniper.juniper.net

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

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You can create a service request with JTAC on the Web or by telephone.

- Visit https://myjuniper.juniper.net.
- 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 https://support.juniper.net/support/requesting-support/.

CHAPTER 1

Junos Node Slicing Overview

Understanding Junos Node Slicing

IN THIS SECTION

Junos Node Slicing Overview

Junos node slicing enables service providers and large enterprises to create a network infrastructure that consolidates multiple routing functions into a single physical device. It helps leverage the benefits of virtualization without compromising on performance. In particular, Junos node slicing enables the convergence of multiple services on a single physical infrastructure while avoiding the operational complexity involved. It provides operational, functional, and administrative separation of functions on a single physical infrastructure that enables the network to implement the same virtualization principles the compute industry has been using for years.

Using Junos node slicing, you can create multiple partitions in a single physical MX Series router. These partitions are referred to as guest network functions (GNFs). Each GNF behaves as an independent router, with its own dedicated control plane, data plane, and management plane. This enables you to run multiple services on a single converged MX Series router, while still maintaining operational isolation between them. You can leverage the same physical device to create parallel partitions that do not share the control plane or the forwarding plane, but only share the same chassis, space, and power.

You can also send traffic between GNFs through the switch fabric by using an Abstracted Fabric (**af**) interface, a pseudo interface that behaves as a first class Ethernet interface. An Abstracted Fabric interface facilitates routing control, data, and management traffic between GNFs.

Junos node slicing offers two models - an external server model and an in-chassis model. In the external server model, the GNFs are hosted on a pair of industry-standard x86 servers. For the in-chassis model, the GNFs are hosted on the Routing Engines of the MX Series router itself.

Junos node slicing supports multiversion software compatibility, thereby allowing the GNFs to be independently upgraded.

Benefits of Junos Node Slicing

- **Converged network**—With Junos node slicing, service providers can consolidate multiple network services, such as video edge and voice edge, into a single physical router, while still maintaining operational separation between them. You can achieve both horizontal and vertical convergence. Horizontal convergence consolidates router functions of the same layer to a single router, while vertical convergence collapses router functions of different layers into a single router.
- **Improved scalability**—Focusing on virtual routing partitions, instead of physical devices, improves the programmability and scalability of the network, enabling service providers and enterprises to respond to infrastructure requirements without having to buy additional hardware.
- **Easy risk management**—Though multiple network functions converge on a single chassis, all the functions run independently, benefiting from operational, functional, and administrative separation. Partitioning a physical system, such as Broadband Network Gateway (BNG), into multiple independent logical instances ensures that failures are isolated. The partitions do not share the control plane or the forwarding plane, but only share the same chassis, space, and power. This means failure in one partition does not cause any widespread service outage.
- **Reduced network costs**—Junos node slicing enables interconnection of GNFs through internal switching fabrics, which leverages Abstracted Fabric (**af**) interface, a pseudo interface that represents a first class Ethernet interface behavior. With **af** interface in place, companies no longer need to depend on physical interfaces to connect GNFs, resulting in significant savings.
- **Reduced time-to-market for new services and capabilities**—Each GNF can operate on a different Junos software version. This advantage enables companies to evolve each GNF at its own pace. If a new service or a feature needs to be deployed on a certain GNF, and it requires a new software release, only the GNF involved requires an update. Additionally, with the increased agility, Junos node slicing enables service providers and enterprises to introduce highly flexible Everything-as-a-service business model to rapidly respond to ever-changing market conditions.

Components of Junos Node Slicing

IN THIS SECTION

Junos node slicing allows a single MX Series router to be partitioned to appear as multiple, independent routers. Each partition has its own Junos OS control plane, which runs as a virtual machine (VM), and a dedicated set of line cards. Each partition is called a guest network function (GNF).

The MX Series router functions as the base system (BSYS). The BSYS owns all the physical components of the router, including the line cards and the switching fabric. The BSYS assigns line cards to GNFs.

The Juniper Device Manager (JDM) software orchestrates the GNF VMs. In JDM, a GNF VM is referred to as a virtual network function (VNF). A GNF thus comprises a VNF and a set of line cards.

Through configuration at the BSYS, you can assign line cards of the chassis to different GNFs.

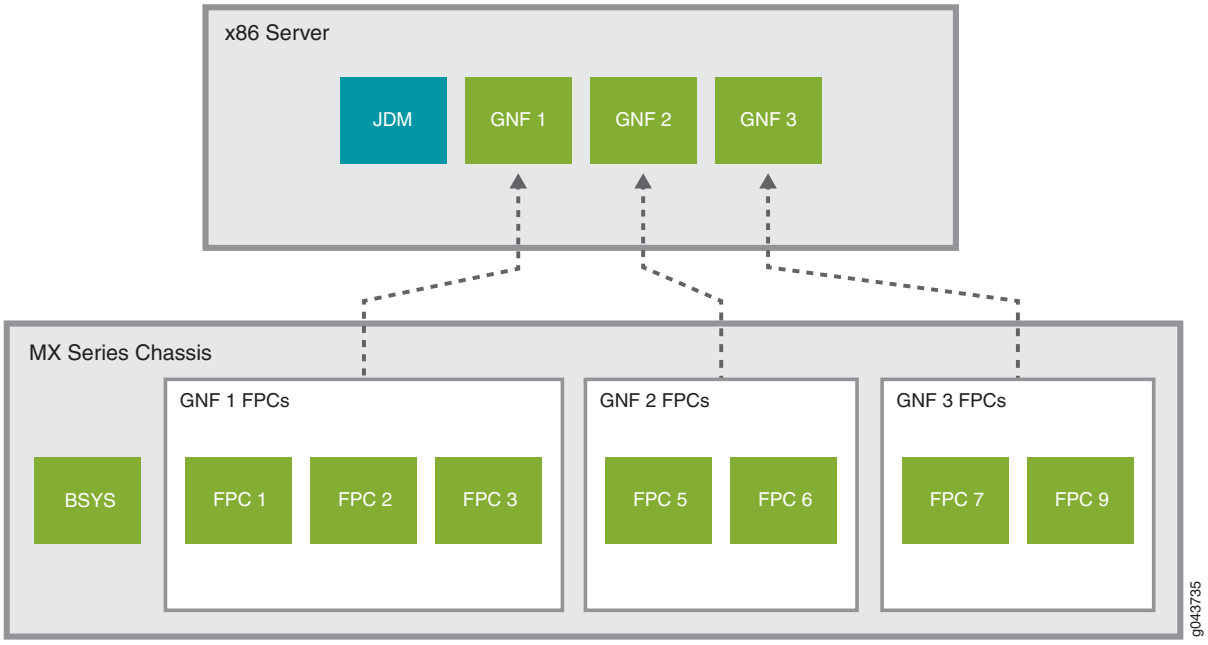
Junos node slicing supports two models:

- External server model
- In-chassis model

In the external server model, JDM and VNFs are hosted on a pair of external industry standard x86 servers.

Figure 1 on page 20 shows three GNFs with their dedicated line cards running on an external server.

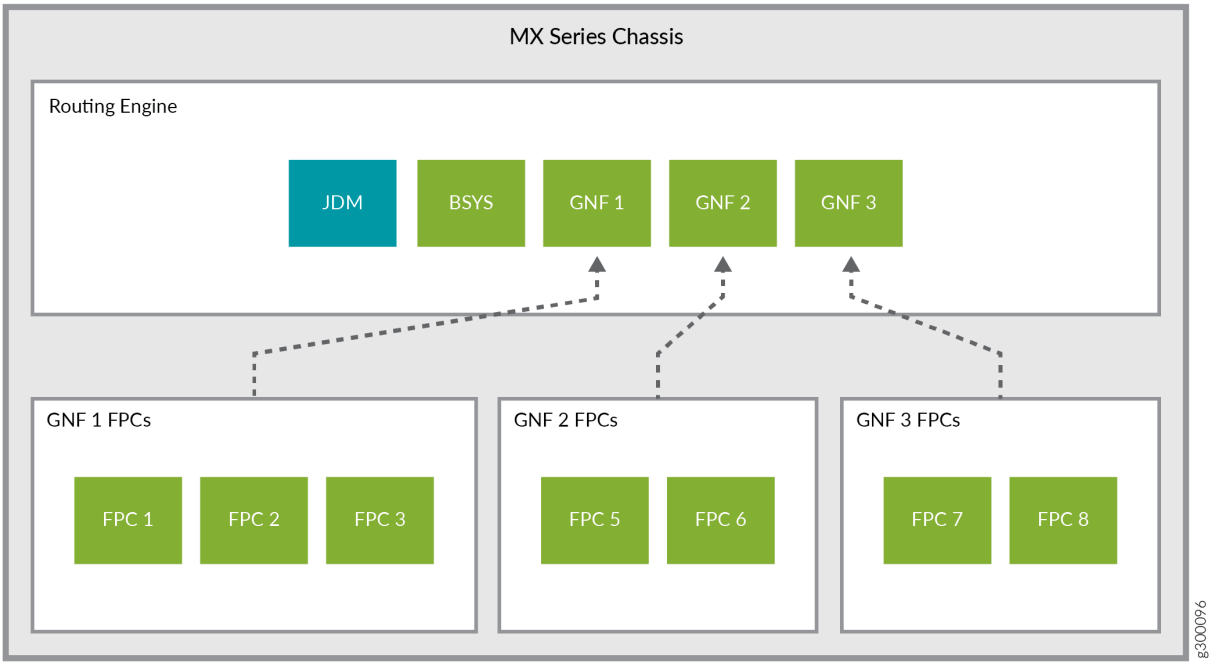
Figure 1: GNFs on External Server



See "Connecting the Servers and the Router" on page 38 for information about how to connect an MX Series router to a pair of external x86 servers.

In the in-chassis model, all components (JDM, BSYS, as well as GNFs) run within the Routing Engine of the MX Series router. See Figure 2 on page 21.

Figure 2: In-chassis Junos Node Slicing



Base System (BSYS)

In Junos node slicing, the MX Series router functions as the base system (BSYS). The BSYS owns all the physical components of the router, including all line cards and fabric. Through Junos OS configuration at the BSYS, you can assign line cards to GNFs and define Abstracted Fabric (**af**) interfaces between GNFs. The BSYS software runs on a pair of redundant Routing Engines of the MX Series router.

Guest Network Function (GNF)

A guest network function (GNF) logically owns the line cards assigned to it by the base system (BSYS), and maintains the forwarding state of the line cards. You can configure multiple GNFs on an MX Series router (see "Configuring Guest Network Functions" on page 68). The Junos OS control plane of each GNF runs as a virtual machine (VM). The Juniper Device Manager (JDM) software orchestrates the GNF VMs. In the JDM context, the GNFs are referred to as virtual network functions (VNF).

A GNF is equivalent to a standalone router. GNFs are configured and administered independently, and are operationally isolated from each other.

Creating a GNF requires two sets of configurations, one to be performed at the BSYS, and the other at the JDM.

A GNF is defined by an ID. This ID must be the same at the BSYS and JDM.

The BSYS part of the GNF configuration comprises giving it an ID and a set of line cards.

The JDM part of the GNF configuration comprises specifying the following attributes:

- A VNF name.
- A GNF ID. This ID must be the same as the GNF ID used at the BSYS.
- The MX Series platform type (for the external server model).
- A Junos OS image to be used for the VNF.
- The VNF server resource template.

The server resource template defines the number of dedicated (physical) CPU cores and the size of DRAM to be assigned to a GNF. For a list of predefined server resource templates available for GNFs, see the *Server Hardware Resource Requirements (Per GNF)* section in "Minimum Hardware and Software Requirements for Junos Node Slicing" on page 33.

After a GNF is configured, you can access it by connecting to the virtual console port of the GNF. Using the Junos OS CLI at the GNF, you can then configure the GNF system properties such as hostname and management IP address, and subsequently access it through its management port.

Juniper Device Manager (JDM)

The Juniper Device Manager (JDM), a virtualized Linux container, enables provisioning and management of the GNF VMs.

JDM supports Junos OS-like CLI, NETCONF for configuration and management and SNMP for monitoring.

> **NOTE:** In the in-chassis model, JDM does not support SNMP.

A JDM instance is hosted on each of the x86 servers in the external server model, and on each Routing Engine for the in-chassis model. The JDM instances are typically configured as peers that synchronize the GNF configurations: when a GNF VM is created on one server, its backup VM is automatically created on the other server or Routing Engine.

An IP address and an administrator account need to be configured on the JDM. After these are configured, you can directly log in to the JDM.

SEE ALSO

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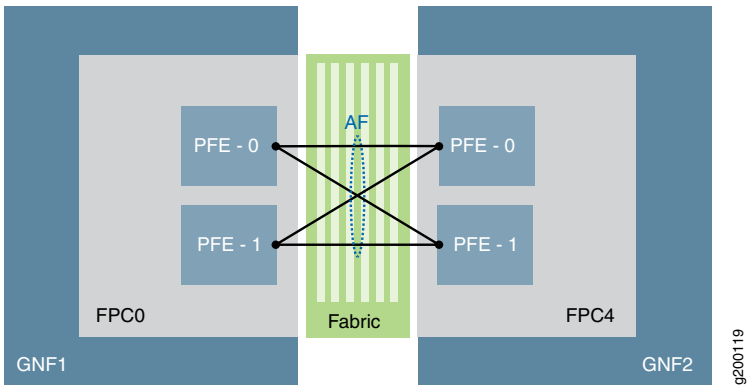
Mastership Behavior of BSYS and GNF | 28

Abstracted Fabric Interface

Abstracted Fabric (**af**) interface is a pseudo interface that represents a first class Ethernet interface behavior. An **af** interface facilitates routing control and management traffic between guest network functions (GNFs) through the switch fabric. An **af** interface is created on a GNF to communicate with its peer GNF when the two GNFs are configured to be connected to each other. Abstracted Fabric interfaces must be created at BSYS. The bandwidth of the **af** interfaces changes dynamically based on the insertion or reachability of the remote line card/MPC. Because the fabric is the communication medium between GNFs, **af** interfaces are considered to be the equivalent WAN interfaces. See Figure 3 on page 23.

Figure 3: Abstracted Fabric Interface



Understanding Abstracted Fabric Interface Bandwidth

An Abstracted Fabric (**af**) interface connects two GNFs through the fabric and aggregates all the Packet Forwarding Engines (PFEs) that connect the two GNFs. An **af** interface can leverage the sum of the bandwidth of each Packet Forwarding Engine belonging to the **af** interface.

For example, if GNF1 has one MPC8 (which has four Packet Forwarding Engines with 240 Gbps capacity each), and GNF1 is connected with GNF2 and GNF3 using **af** interfaces (af1 and af2), the maximum **af** interface capacity on GNF1 would be 4x240 Gbps = 960 Gbps.

GNF1—af1——GNF2

GNF1—af2——GNF3

Here, af1 and af2 share the 960 Gbps capacity.

For information on the bandwidth supported on each MPC, see Table 3 on page 25.

Features Supported on Abstracted Fabric Interfaces

Abstracted Fabric interfaces support the following features:

- Unified in-service software upgrade (ISSU).

  > **NOTE:** Abstracted Fabric interfaces do not support ISSU on MPC11E line cards.

- Hyper mode configuration at the BSYS level (starting in Junos OS Release 19.3R2). This feature is supported on MPC6E, MPC8E, MPC9E, and MPC11E line cards.

  > **NOTE:**
  > - You cannot have different hyper mode configurations for individual GNFs as they inherit the configuration from the BSYS.
  > - The MX2020 and MX2010 routers with SFB3 come up in hyper mode by default. If you require hyper mode to be disabled at any GNF, you must configure it at the BSYS, and it will apply to all GNFs of that chassis.

- Load balancing based on the remote GNF line cards present
- Class of service (CoS) support:
  - Inet-precedence classifier and rewrite
  - DSCP classifier and rewrite
  - MPLS EXP classifier and rewrite
  - DSCP v6 classifier and rewrite for IP v6 traffic
- Support for OSPF, IS-IS, BGP, OSPFv3 protocols, and L3VPN

  > **NOTE:** The non-**af** interfaces support all the protocols that work on Junos OS.

- Multicast forwarding
- Graceful Routing Engine switchover (GRES)
- MPLS applications where the **af** interface acts as a core interface (L3VPN, VPLS, L2VPN, L2CKT, EVPN, and IP over MPLS)
- The following protocol families are supported:

  - IPv4 Forwarding
  - IPv6 Forwarding
  - MPLS
  - ISO
  - CCC
- Junos Telemetry Interface (JTI) sensor support

  NOTE: The MPC11E line card does not support Abstracted Fabric interface fabric-stats sensor.

- Starting in Junos OS Release 19.1R1, guest network functions (GNFs) support Ethernet VPNs (EVPN) with Virtual Extensible LAN protocol (VXLAN) encapsulation. This support is available with non-**af** (that is, physical) interface and **af** interface as the core facing interface. This support is not available for the MPC11E line card.
- With the **af** interface configuration, GNFs support **af**-capable MPCs. Table 3 on page 25 lists the **af**-capable MPCs, the number of PFEs supported per MPC, and the bandwidth supported per MPC.

  Table 3: Supported Abstracted Fabric-capable MPCs

MPC	Initial Release	Number of PFEs	Total Bandwidth
MPC7E-MRATE	17.4R1	2	480G (240*2)
MPC7E-10G	17.4R1	2	480G (240*2)
MX2K-MPC8E	17.4R1	4	960G (240*4)
MX2K-MPC9E	17.4R1	4	1.6T (400*4)
MPC2E	19.1R1	2	80 (40*2)
MPC2E NG	17.4R1	1	80G
MPC2E NG Q	17.4R1	1	80G
MPC3E	19.1R1	1	130G
MPC3E NG	17.4R1	1	130G
MPC3E NG Q	17.4R1	1	130G

Table 3: Supported Abstracted Fabric-capable MPCs *(continued)*

MPC	Initial Release	Number of PFEs	Total Bandwidth
32x10GE MPC4E	19.1R1	2	260G (130*2)
2x100GE + 8x10GE MPC4E	19.1R1	2	260G (130*2)
MPC5E-40G10G	18.3R1	2	240G (120*2)
MPC5EQ-40G10G	18.3R1	2	240G (120*2)
MPC5E-40G100G	18.3R1	2	240G (120*2)
MPC5EQ-40G100G	18.3R1	2	240G (120*2)
MX2K-MPC6E	18.3R1	4	520G (130*4)
Multiservices MPC (MS-MPC)	19.1R1	1	120G
16x10GE MPC	19.1R1	4	160G (40*4)
MPC11E	19.3R2	8	4T (500G*8)

NOTE:

- A GNF that does not have the **af** interface configuration supports all the MPCs that are supported by a standalone MX Series router. For the list of supported MPCs, see MPCs Supported by MX Series Routers.
- We recommend that you set the MTU settings on the **af** interface to align to the maximum allowed value on the XE/GE interfaces. This ensures minimal or no fragmentation of packets over the **af** interface.

Abstracted Fabric Interface Restrictions

The following are the current restrictions of Abstracted Fabric interfaces:

- Configurations such as single endpoint **af** interface, **af** interface-to-GNF mapping mismatch or multiple **af** interfaces mapping to same remote GNF are not checked during commit on the BSYS. Ensure that you have the correct configurations.
- Bandwidth allocation is static, based on the MPC type.

- There can be minimal traffic drops (both transit and host) during the offline/restart of an MPC hosted on a remote GNF.
- Interoperability between MPCs that are **af**-capable and the MPCs that are not **af**-capable is not supported.

SEE ALSO

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | 71

Optimizing Fabric Path for Abstracted Fabric Interface

You can optimize the traffic flowing over the abstracted fabric (af) interfaces between two guest network functions (GNFs), by configuring a fabric path optimization mode. This feature reduces fabric bandwidth consumption by preventing any additional fabric hop (switching of traffic flows from one Packet Forwarding Engine to another) before the packets eventually reach the destination Packet Forwarding Engine. Fabric path optimization, supported on MX2008, MX2010, and MX2020 with MPC9E and MX2K-MPC11E, prevents only a single additional traffic hop that results from abstracted fabric interface load balancing.

You can configure one of the following fabric path optimization modes:

- **monitor**—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized traffic path. In this mode, the source GNF does not forward the traffic towards the desired Packet Forwarding Engine.
- **optimize**—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized traffic path. The source GNF then forwards the traffic towards the desired Packet Forwarding Engine.

To configure a fabric path optimization mode, use the following CLI commands at BSYS.

```
user@router# set chassis network-slices guest-network-functions gnf id collapsed-forward (monitor | optimize)

user@router# commit
```

After configuring fabric path optimization, you can use the command **show interfaces *af-interface-name*** in GNF to view the number of packets that are currently flowing on the optimal / non-optimal path.

SEE ALSO

collapsed-forward | 118

show interfaces (Abstracted Fabric) | 164

Choosing Between External Server Model and In-Chassis Model

The external server model allows you to configure more instances of GNFs with higher scale, since you can choose a server of sufficient capacity to match GNF requirements. With the in-chassis model, the number of GNFs that can be configured is a function of the scale requirements of the constituent GNFs and the overall capacity of the Routing Engine.

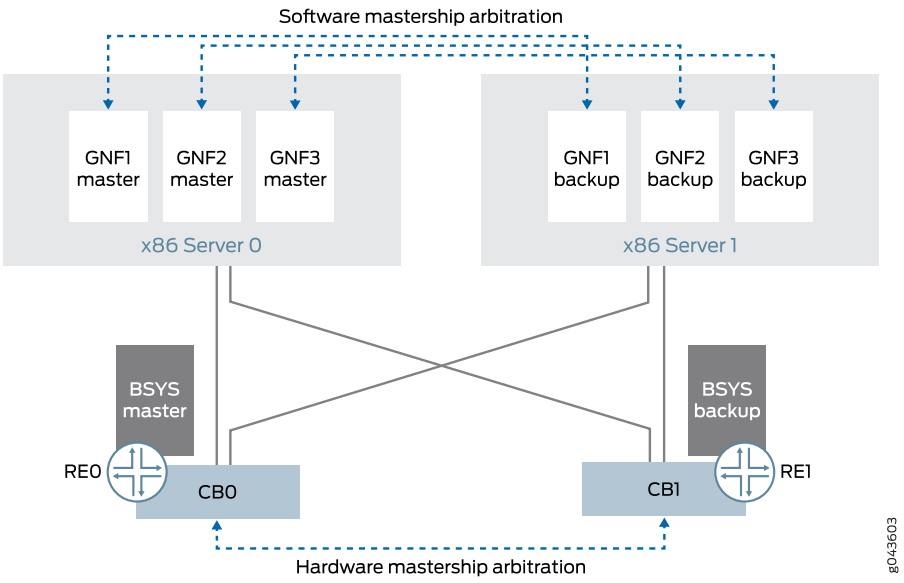
The external server and in-chassis models of Junos node slicing are mutually exclusive. An MX Series router can be configured to operate in only one of these models at one time.

Mastership Behavior of BSYS and GNF

The following sections address the mastership behavior of BSYS and GNF in the context of Routing Engine redundancy.

Figure 4 on page 28 shows the mastership behavior of GNF and BSYS with Routing Engine redundancy.

Figure 4: Mastership Behavior of GNF and BSYS (External Server Model)



BSYS Mastership

The BSYS Routing Engine mastership arbitration behavior is identical to that of Routing Engines on MX Series routers.

GNF Mastership

The GNF VM mastership arbitration behavior is similar to that of MX Series Routing Engines. Each GNF runs as a master-backup pair of VMs. A GNF VM that runs on **server0** (or **re0** for in-chassis) is equivalent to Routing Engine slot 0 of an MX Series router, and the GNF VM that runs on **server1** (or **re1** for in-chassis) is equivalent to Routing Engine slot 1 of an MX Series router.

The GNF mastership is independent of the BSYS mastership and that of other GNFs. The GNF mastership arbitration is done through Junos OS. Under connectivity failure conditions, GNF mastership is handled conservatively.

The GNF mastership model is the same for both external server and in-chassis models.

> **NOTE:** As with the MX Series Routing Engines, you must configure graceful Routing Engine switchover (GRES) at each GNF. This is a prerequisite for the backup GNF VM to automatically take over the mastership when the master GNF VM fails or is rebooted.

Junos Node Slicing Administrator Roles

The following administrator roles enable you to carry out the node slicing tasks:

- BSYS administrator—Responsible for the physical chassis, as well as for GNF provisioning (assignment of line cards to GNFs). Junos OS CLI commands are available for these tasks.
- GNF administrator—Responsible for configuration, operation, and management of Junos OS at the GNF. All regular Junos OS CLI commands are available to the GNF administrator for these tasks.
- JDM administrator—Responsible for the JDM server port configuration (for the external server model), and for the provisioning and life-cycle management of the GNF VMs (VNFs). JDM CLI commands are available for these tasks.

Multiversion Software Interoperability Overview

Starting from Junos OS Release 17.4R1, Junos node slicing supports multiversion software compatibility, enabling the BSYS to interoperate with a guest network function (GNF) which runs a Junos OS version that is higher than the software version of the BSYS. This feature supports a range of up to two versions between GNF and BSYS. That is, the GNF software can be two versions higher than the BSYS software. Both BSYS and GNF must meet a minimum version requirement of Junos OS Release 17.4R1.

> **NOTE:** The restrictions in multiversion support are also applicable to the unified ISSU upgrade process.

While JDM software versioning does not have a similar restriction with respect to the GNF or BSYS software versions, we recommend that you regularly update the JDM software. A JDM upgrade does not affect any of the running GNFs.

Next Gen Services for Junos node slicing

Guest network functions (GNFs) on MX480 and MX960 routers support Next Gen Services when the MX-SPC3 Services Processing Card is installed. You can enable Next Gen Services on a guest network function (GNF), by using the CLI **request system enable unified-services** at the GNF level.

The *MX-SPC3 Services Card* is a Services Processing Card (SPC) that provides additional processing power to run the Next Gen Services on the MX Series routers. In a Junos node slicing setup, you can use both MX-SPC3 and MS-MPC on the same chassis but on different GNF Routing Engines. However, the MX-SPC3 comes online only if you have enabled Next Gen Services at GNF. If you have not enabled Next Gen Services, only the MS-MPC comes online

The software installation/upgrade of an MX-SPC3 card happens along with its GNF Routing Engine software installation/upgrade.

Comparing Junos Node Slicing with Logical Systems

Junos node slicing is a layer below logical systems in Junos. Both technologies have some overlapping capabilities but differ in other aspects. With Junos node slicing, complete line cards, and therefore, physical interfaces, are assigned to a GNF, while with logical systems, a single physical interface itself can be shared across different logical systems, since multiple logical interfaces defined over a physical interface can all be assigned to separate logical systems. This means, logical systems allow finer granularity of sharing than Junos node slicing. But all logical systems share a single Junos kernel, thus necessarily running the same Junos version, besides having to share the Routing Engine and line card physical resources such as CPU, memory and storage. With Junos node slicing, each GNF gets its own equivalent of a pair of Routing Engines, as also line cards dedicated to that GNF, so the GNFs do not share most physical resources – they only share the chassis and switch fabric. GNFs, unlike logical systems, can be independently upgraded and administered like a MX standalone router.

Junos node slicing is a technology that complements, and even augments logical systems, since a GNF can itself have multiple logical systems within it. Where physical isolation, guaranteed resources and complete administrative isolation is paramount, Junos node slicing would be a better match. And where fine granularity of sharing, down to the logical interface level, is paramount, a logical system would be the better match.

Licensing for Junos Node Slicing

Operating Junos node slicing requires licenses for the GNFs and Abstracted Fabric interfaces to be installed at the BSYS. Running a GNF without a license installed at the BSYS will result in the following syslog message and minor alarm:

```
CHASSISD_LICENSE_EVENT: License Network-Slices: Failed to get valid license('216')
 'gnf-creation'
Minor alarm set, 1 Guest network functions creation for JUNOS requires a license.
```

Please contact Juniper Networks if you have queries pertaining to Junos node slicing licenses.

RELATED DOCUMENTATION

Junos Node Slicing Upgrade | 87

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | 71

CHAPTER 2

Setting Up Junos Node Slicing

Minimum Hardware and Software Requirements for Junos Node Slicing

To set up Junos node slicing using the external server model, you need an MX Series router and a pair of industry standard x86 servers. The x86 servers host the Juniper Device Manager (JDM) along with the GNF VMs.

To set up Junos node slicing using the in-chassis model, you need an MX Series router with MX Series Routing Engines that support x86 virtualization and have sufficient resources to host JDM and GNF VMs.

MX Series Router

The following routers support Junos node slicing:

- MX2010
- MX2020
- MX480
- MX960
- MX2008

NOTE:

- For the MX960 and MX480 routers, the Control Boards must be SCBE2; and the Routing Engines must be interoperable with SCBE2 (RE-S-1800X4-32G, RE-S-1800X4-16G, RE-S-X6-64G, RE-S-2X00x6-128G, RE-MX2X00x8-128G).
- To configure in-chassis Junos node slicing, the MX Series router must have one of the following types of Routing Engines installed:
  - RE-S-2X00x6-128 (used in MX480 and MX960 routers)
  - RE-MX200X8-128G (used in MX2010 and MX2020 routers)
  - REMX2008-X8-128G (used in MX2008 routers)

x86 Servers (External Server Model)

Ensure that both the servers have similar (preferably identical) hardware configuration.

The x86 server hardware resource requirements comprise:

- Per-GNF resource requirements (CPU, memory, and storage).
- Shared resource requirements (CPU, memory, storage and network ports).

The server hardware requirements are thus the sum of the requirements of the individual GNFs, and the shared resource requirements. The server hardware requirements are a function of how many GNFs you plan to use.

x86 CPU:

- Must be Intel Haswell-EP or newer.

  BIOS:

  - Must have hyperthreading disabled.
  - Must have performance mode enabled.

Storage:

- Must be local to the server.
- Must be solid-state drive (SSD)-based.

The storage space for GNFs is allocated from the following:

- /(root), which must have a minimum available storage space of 50 GB.
- /vm-primary, which must have a minimum available storage space of 350 GB.

> **NOTE:**
> We recommend that you:
>
> - use hardware RAID 1 configuration for storage resiliency.
> - set up /vm-primary as a Linux partition.
> - do not use software RAID.

Server Hardware Resource Requirements (Per GNF)

Each GNF must be associated with a resource template, which defines the number of dedicated CPU cores and the size of DRAM to be assigned for that GNF.

Table 4 on page 35 lists the GNF resource templates available for configuring Junos node slicing on external servers:

Table 4: GNF Resource Template (External Server Model)

Template	CPU cores	DRAM (GB)
2core-16g	2	16
4core-32g	4	32
6core-48g	6	48
8core-64g	8	64

NOTE: Each GNF requires a minimum of 64 GB storage.

Table 5 on page 35 lists the GNF resource templates available for configuring in-chassis Junos node slicing:

Table 5: GNF Resource Templates for In-Chassis Model

Template	CPU cores	DRAM (GiB)
1core-16g	1	16
1core-32g	1	32
1core-48g	1	48
2core-16g	2	16
2core-32g	2	32
2core-48g	2	48
4core-32g	4	32
4core-48g	4	48

Shared Server Hardware Resource Requirements (External Server Model)

Table 6 on page 36 lists the server hardware resources that are shared between all the guest network functions (GNFs) on a server:

NOTE: These requirements are in addition to the per-GNF requirements mentioned in the Server Hardware Resource Requirements (Per GNF) section.

Table 6: Shared Server Resources Requirements (External Server Model)

Component	Specification
CPU	• Four cores to be allocated for JDM and Linux host processing.
Memory	• Minimum of 32 GB DRAM for JDM and Linux host processing.
Storage	• Minimum of 64 GB storage for JDM and Linux host.

Network Ports	• Two 10-Gbps Ethernet interfaces for control plane connection between the server and the router.
	  ◦ Minimum—1 PCIe NIC card with Intel X710 dual port 10-Gbps Direct Attach, SFP+, Converged Network Adapter, PCIe 3.0, x8
	  ◦ Recommended—2 NIC cards of the above type. Use one port from each card to provide redundancy at the card level.
	• One Ethernet interface (1/10 Gbps) for Linux host management network.
	• One Ethernet interface (1/10 Gbps) for JDM management network.
	• One Ethernet interface (1/10 Gbps) for GNF management network. (This port is shared by all the GNFs on that server).
	• Serial port or an equivalent interface (iDRAC, IPMI) for server console access.

Server Software Requirements (External Server Model)

The x86 servers must have the following installed:

- Red Hat® Enterprise Linux® (RHEL) 7.3 or Ubuntu 16.04 LTS - with virtualization packages.

  To enable virtualization for RHEL, choose “Virtualization Host" for the Base Environment and "Virtualization Platform" as an Add-On from the Software Selection screen during installation.

  NOTE:
  - The hypervisor supported is KVM.

- Install additional packages required for Intel X710 NIC Driver and JDM. For more information, see the “Updating Intel X710 NIC Driver for x86 Servers” on page 44 and “Installing Additional Packages for JDM” on page 46 sections.

- Ensure that you have the latest X710 NIC driver (2.4.10 or later version) and firmware (18.5.17 or later version) installed. For more details, see "Updating Intel X710 NIC Driver for x86 Servers" on page 44.

The servers must also have the BIOS setup as described in "x86 Server CPU BIOS Settings" on page 41 and the Linux GRUB configuration as described in "x86 Server Linux GRUB Configuration" on page 42.

Ensure that the host OS is up to date.

NOTE:

- The x86 servers require internet connectivity for you to be able to perform host OS updates and install the additional packages.
- Ensure that you have the same host OS software version on both the servers.

NOTE: The following software packages are required to set up Junos node slicing:

- JDM package
- Junos OS image for GNFs
- Junos OS package for BSYS
- Junos OS vmhost package for REMX2K-X8-64G and RE-S-X6-64G Control Board-Routing Engine based BSYS

RELATED DOCUMENTATION

Components of Junos Node Slicing | 19

Connecting the Servers and the Router | 38

Preparing for Junos Node Slicing Setup

IN THIS SECTION

NOTE: Topics in this section apply only to Junos node slicing set up using the external server model. For the in-chassis Junos node slicing, proceed to "Configuring MX Series Router to Operate in In-Chassis Mode" on page 60.

Before setting up Junos node slicing (external server model), you need to perform a few preparatory steps, such as connecting the servers and the router, installing additional packages, configuring x86 server Linux GRUB, and setting up the BIOS of the x86 server CPUs.

Connecting the Servers and the Router

To set up Junos node slicing, you must directly connect a pair of external x86 servers to the MX Series router. Besides the management port for the Linux host, each server also requires two additional ports for providing management connectivity for the JDM and the GNF VMs, respectively, and two ports for connecting to the MX Series router.

NOTE:

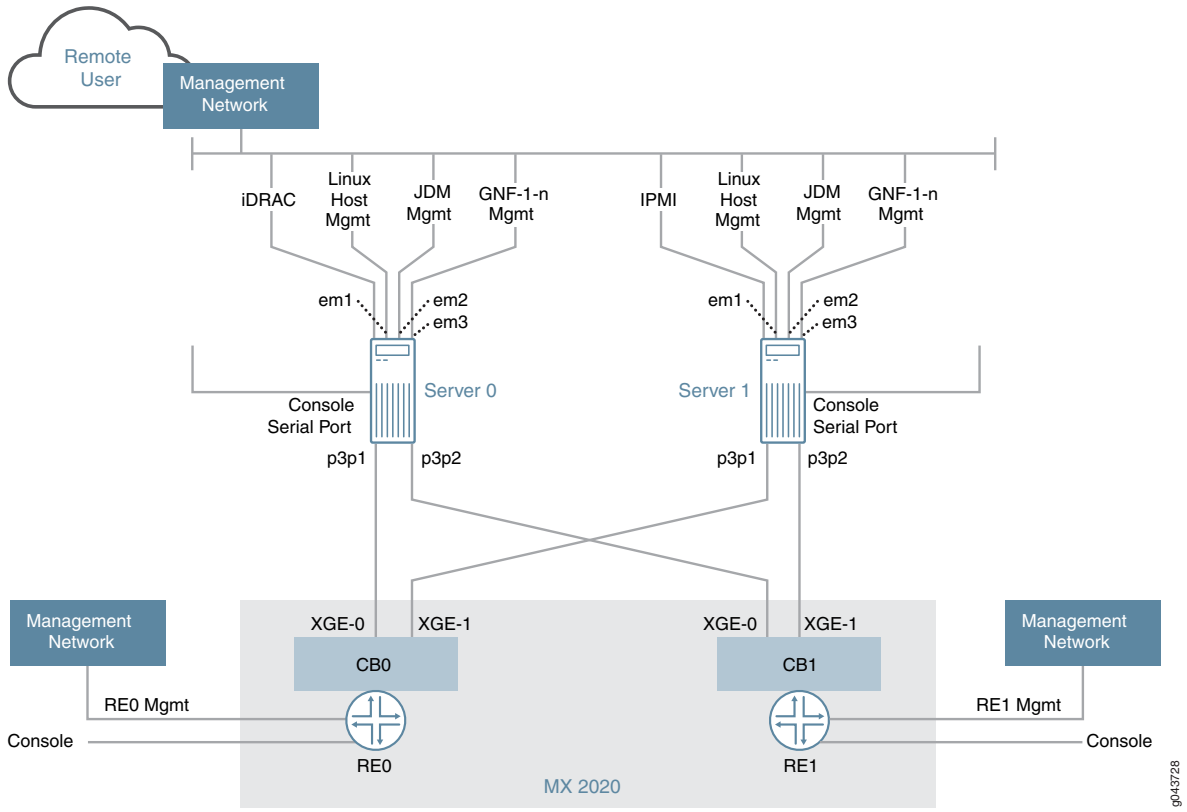
- Do not connect the loopback cable to external CB port when Junos node slicing is enabled on the MX series router. Also, ensure that the external CB port is not connected to the other CB's external port.
- To prevent the host server from any SSH brute force attack, we recommend that you add IPtables rules on the host server. The following is an example:

```
iptables -N SSH_CONNECTIONS_LIMIT
iptables -A INPUT -i jmgmt0 -p tcp -m tcp --dport 22 -m state --state
NEW -j SSH_CONNECTIONS_LIMIT iptables -A SSH_CONNECTIONS_LIMIT -m recent
 --set --name SSH --rsource iptables -A SSH_CONNECTIONS_LIMIT -m recent
 --update --seconds 120 --hitcount 10 --name SSH --rsource -j DROP
iptables -A SSH_CONNECTIONS_LIMIT -j ACCEPT
```

  The rule in the above example is used to rate-limit the incoming SSH connections. It allows you to block connections from the remote IP for a certain period of time when a particular number of SSH attempts are made. As per the example above, after 10 attempts, connections from remote IP will be blocked for 120 seconds.

Figure 5 on page 40 shows how an MX2020 router is connected to a pair of x86 external servers.

Figure 5: MX2020 Router—External x86 Server Connectivity



According to the example in Figure 5 on page 40, **em1**, **em2**, and **em3** on the x86 servers are the ports that are used for the management of the Linux host, the JDM and the GNFs, respectively. **p3p1** and **p3p2** on each server are the two 10-Gbps ports that are connected to the Control Boards of the MX Series router.

> **NOTE:** The names of interfaces on the server, such as **em1**, **p3p1** might vary according to the server hardware configuration.

For more information on the XGE ports of the MX Series router Control Board (CB) mentioned in Figure 5 on page 40, see:

- SCBE2-MX Description (for MX960 and MX480)
- REMX2K-X8-64G and REMX2K-X8-64G-LT CB-RE Description (for MX2010 and MX2020)

> **NOTE:** Use the **show chassis ethernet-switch** command to view these XGE ports. In the command output on MX960, refer to the port numbers **24** and **26** to view these ports on the SCBE2. In the command output on MX2010 and MX2020, refer to the port numbers **26** and **27** to view these ports on the Control Board-Routing Engine (CB-RE).

x86 Server CPU BIOS Settings

For Junos node slicing, the BIOS of the x86 server CPUs should be set up such that:

- Hyperthreading is disabled.
- The CPU cores always run at their rated frequency.
- The CPU cores are set to reduce jitter by limiting C-state use.

To find the rated frequency of the CPU cores on the server, run the Linux host command **lscpu**, and check the value for the field **Model name**. See the following example:

```
Linux server0:~# lscpu
```

```
..
Model name:         Intel(R) Xeon(R) CPU E5-2680 v3 @ 2.50GHz
..
```

To find the frequency at which the CPU cores are currently running, run the Linux host command **grep MHz /proc/cpuinfo** and check the value for each CPU core.

On a server that has the BIOS set to operate the CPU cores at their rated frequency, the observed values for the CPU cores will all match the rated frequency (or be very close to it), as shown in the following example.

```
Linux server0:~# grep MHz /proc/cpuinfo
```

```
…
cpu MHz  : 2499.902
cpu MHz  : 2500.000
cpu MHz  : 2500.000
```

```
cpu MHz  : 2499.902
…
```

On a server that does not have the BIOS set to operate the CPU cores at their rated frequency, the observed values for the CPU cores do not match the rated frequency, and the values could also vary with time (you can check this by rerunning the command).

`Linux server0:~#` **grep MHz /proc/cpuinfo**

```
…
cpu MHz  : 1200.562
cpu MHz  : 1245.468
cpu MHz  : 1217.625
cpu MHz  : 1214.156
```

To set the x86 server BIOS system profile to operate the CPU cores at their rated frequency, reduce jitter, and disable hyperthreading, consult the server manufacturer, because these settings vary with server model and BIOS versions.

Typical BIOS system profile settings to achieve this include:

- **Logical processor**: set to Disabled.
- **CPU power management**: set to Maximum performance.
- **Memory frequency**: set to Maximum performance.
- **Turbo boost**: set to Disabled.
- **C-states and C1E state**: set to Disabled.
- **Energy efficient policy**: set to Performance.
- **Monitor/Mwait**: set to Disabled.

A custom BIOS system profile might be required to set these values.

x86 Server Linux GRUB Configuration

In Junos node slicing, each GNF VM is assigned dedicated CPU cores. This assignment is managed by Juniper Device Manager (JDM). On each x86 server, JDM requires that all CPU cores other than CPU cores 0 and 1 be reserved for Junos node slicing – and in effect, that these cores be isolated from other applications. CPU cores 2 and 3 are dedicated for GNF virtual disk and network I/O. CPU cores 4 and

above are available for assignment to GNF VMs. To reserve these CPU cores, you must set the **isolcpus** parameter in the Linux GRUB configuration as described in the following procedure:

For x86 servers running Red Hat Enterprise Linux (RHEL) 7.3, perform the following steps:

1. Determine the number of CPU cores on the x86 server. Ensure that hyperthreading has already been disabled, as described in "x86 Server CPU BIOS Settings" on page 41. You can use the Linux command **lscpu** to find the total number of CPU cores, as shown in the following example:

   ```
   Linux server0:~# lscpu
   ```

   ```
   …
   Cores per socket: 12
   Sockets: 2
   …
   ```

   Here, there are 24 cores (12 x 2). The CPU cores are numbered as core 0 to core 23.

2. As per this example, the **isolcpus** parameter must be set to 'isolcpus=4-23' (isolate all CPU cores other than cores 0, 1, 2, and 3 for use by the GNF VMs). The **isolcpus** parameter is set to 'isolcpus=4-23' because of the following:

   - On each x86 server, JDM requires that all CPU cores other than CPU cores 0 and 1 be reserved for Junos node slicing.
   - CPU cores 2 and 3 are dedicated for GNF virtual disk and network I/O.

   > **NOTE:** Previously, the **isolcpus** parameter 'isolcpus=2-23' was used. This has now been updated to 'isolcpus=4-23'. For more information, see KB35301.

   To set the **isolcpus** parameter in the Linux GRUB configuration file, follow the procedure described in the section *Isolating CPUs from the process scheduler* in this Red Hat document. A summary of the section is as follows:

   a. Edit the Linux GRUB file **/etc/default/grub** to append the **isolcpus** parameter to the variable GRUB_CMDLINE_LINUX, as shown in the following example:

      ```
      GRUB_CMDLINE_LINUX=
      "crashkernel=auto rd.lvm.lv=rhel/root rd.lvm.lv=rhel/swap rhgb quiet
      isolcpus=4-23"
      ```

   b. Run the Linux shell command **grub2-mkconfig** to generate the updated GRUB file as shown below:

      If you are using legacy BIOS, issue the following command:

 # grub2-mkconfig -o /boot/grub2/grub.cfg

If you are using UEFI, issue the following command:

 # grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg

c. Reboot the x86 server.

d. Verify that the **isolcpus** parameter has now been set, by checking the output of the Linux command **cat /proc/cmdline**, as shown in the following example:

cat /proc/cmdline

```
BOOT_IMAGE=/vmlinuz-3.10.0-327.36.3.el7.x86_64 … quiet isolcpus=4-23
```

For x86 servers running Ubuntu 16.04, perform the following steps:

1. Determine the number of CPU cores on the x86 server. Ensure that hyperthreading has already been disabled, as described in x86 Server CPU BIOS Settings. You can use the Linux command **lscpu** to find the total number of CPU cores.

2. Edit the /etc/default/grub file to append the isolcpus parameter to the variable GRUB_CMDLINE_LINUX_DEFAULT, as shown in the following example:

```
GRUB_CMDLINE_LINUX_DEFAULT=
"intel_pstate=disable processor.ignore_ppc=1 isolcpus=4-23"
```

3. To update the changes, run **update-grub**.

4. Reboot the server.

5. Verify that the **isolcpus** parameter has now been set, by checking the output of the Linux command **cat /proc/cmdline**.

Updating Intel X710 NIC Driver for x86 Servers

If you are using Intel X710 NIC, ensure that you have the latest driver (2.4.10 or later) installed on the x86 servers, and that X710 NIC firmware version is 18.5.17 or later.

You need to first identify the X710 NIC interface on the servers. For example, this could be **p3p1**.

You can check the NIC driver version by running the Linux command **ethtool -i *interface***. See the following example:

```
root@Linux server0# ethtool -i p3p1
```

```
driver: i40e
version: 2.4.10
firmware-version: 5.05 0x80002899 18.5.17
...
```

Refer to the Intel support page for instructions on updating the driver.

> **NOTE:** Updating the host OS may replace the Intel X710 NIC driver. Therefore, ensure that the host OS is up to date prior to updating the Intel X710 NIC driver.

You need the following packages for building the driver:

- For RedHat:
  - kernel-devel
  - Development Tools
- For Ubuntu:
  - make
  - gcc

If you are using RedHat, run the following commands to install the packages:

```
root@Linux server0#yum install kernel-devel
```

```
root@Linux server0#yum group install "Development Tools"
```

If you are using Ubuntu, run the following commands to install the packages:

```
root@Linux server0# apt-get install make
```

```
root@Linux server0# apt-get install gcc
```

> **NOTE:** After updating the Intel X710 NIC driver, you might notice the following message in the host OS log:
>
> **"i40e: module verification failed: signature and/or required key missing - tainting kernel"**
>
> Ignore this message. It appears because the updated NIC driver module has superseded the base version of the driver that was packaged with the host OS.

SEE ALSO

Minimum Hardware and Software Requirements for Junos Node Slicing | 33

Installing Additional Packages for JDM

The x86 servers must have Red Hat Enterprise Linux (RHEL) 7.3 or Ubuntu 16.04 LTS installed.

> **NOTE:** The x86 Servers must have the virtualization packages installed.

For RHEL 7.3, install the following additional packages, which can be downloaded from the Red Hat Customer Portal.

- python-psutil-1.2.1-1.el7.x86_64.rpm
- net-snmp-5.7.2-24.el7.x86_64.rpm
- net-snmp-libs-5.7.2-24.el7.x86_64.rpm
- libvirt-snmp-0.0.3-5.el7.x86_64.rpm

Only for Junos OS Releases 17.4R1 and earlier, and for 18.1R1, if you are running RHEL 7.3, also install the following additional package:

- libstdc++-4.8.5-11.el7.i686.rpm

> **NOTE:**
> - The package version numbers shown are the minimum versions. Newer versions might be available in the latest RHEL 7.3 patches.
> - The libstdc++ package extension **.i686** indicates that it is a 32-bit package.
> - For RHEL, we recommend that you install the packages using the **yum** command.

For Ubuntu 16.04, install the following packages:

- python-psutil

Only for Junos OS Releases 17.4R1 and earlier, and for 18.1R1, if you are running Ubuntu, also install the following additional package:

- libstdc++6:i386

> **NOTE:**
> - For Ubuntu, you can use the **apt-get** command to install the latest version of these packages. For example, use:
>   - the command **apt-get install python-psutil** to install the latest version of the **python-psutil** package.
>   - the command **apt-get install libstdc++6:i386** to install the latest version of the **libstdc++6** package (the extension **:i386** indicates that the package being installed is a 32-bit version).

Completing the Connection Between the Servers and the Router

Complete the following steps before you start installing the JDM:

- Ensure that the MX Series router is connected to the x86 servers as described in "Connecting the Servers and the Router" on page 38.
- Power on the two x86 servers and both the Routing Engines on the MX Series router.
- Identify the Linux host management port on both the x86 servers. For example, **em1**.

- Identify the ports to be assigned for the JDM and the GNF management ports. For example, **em2** and **em3**.
- Identify the two 10-Gbps ports that are connected to the Control Boards on the MX Series router. For example, **p3p1** and **p3p2**.

SEE ALSO

Components of Junos Node Slicing | 19

Minimum Hardware and Software Requirements for Junos Node Slicing | 33

Connecting the Servers and the Router | 38

Sample Configuration for Junos Node Slicing | 77

RELATED DOCUMENTATION

Junos Node Slicing Overview | 17

Components of Junos Node Slicing | 19

Minimum Hardware and Software Requirements for Junos Node Slicing | 33

Setting Up Junos Node Slicing

IN THIS SECTION

Before proceeding to perform the Junos node slicing setup tasks, if you are using the external server model, you must have completed the procedures described in the chapter "Preparing for Junos Node Slicing Setup" on page 37.

Configuring an MX Series Router to Operate in BSYS Mode (External Server Model)

NOTE: Ensure that the MX Series router is connected to the x86 servers as described in "Connecting the Servers and the Router" on page 38.

Junos node slicing requires the MX Series router to function as the base system (BSYS).

Use the following steps to configure an MX Series router to operate in BSYS mode:

1. Install the Junos OS package for BSYS on both the Routing Engines of the MX Series router.

   To download the package:

   a. Go to the Juniper Support page.

   b. Click **Base System** > ***Junos OS version number*** > **Junos *version number* (64-bit High-End)**.

   c. On the **Software Download** page, select the **I Agree** option under End User License Agreement and then click **Proceed**.

2. On the MX Series router, run the **show chassis hardware** command and verify that the transceivers on both the Control Boards (CBs) are detected. The following text represents a sample output:

   ```
   root@router> show chassis hardware
   ```

```
…
CB 0             REV 23   750-040257   CABL4989          Control Board
  Xcvr 0         REV 01   740-031980   ANT00F9           SFP+-10G-SR
  Xcvr 1         REV 01   740-031980   APG0SC3           SFP+-10G-SR
CB 1             REV 24   750-040257   CABX8889          Control Board
  Xcvr 0         REV 01   740-031980   AP41BKS           SFP+-10G-SR
  Xcvr 1         REV 01   740-031980   ALN0PCM           SFP+-10G-SR
```

3. On the MX Series router, apply the following configuration statements:

```
root@router# set chassis network-slices guest-network-functions
root@router# set chassis redundancy graceful-switchover
root@router# set chassis network-services enhanced-ip
root@router# set routing-options nonstop-routing
root@router# set system commit synchronize
root@router# commit
```

> **NOTE:** On MX960 routers, you must configure the **network-services** mode as **enhanced-ip** or **enhanced-ethernet**. On MX2020 routers, the **enhanced-ip** configuration statement is already enabled by default .

The router now operates in BSYS mode.

> **NOTE:** A router in the BSYS mode is not expected to run features other than the ones required to run the basic management functionalities in Junos node slicing. For example, the BSYS is not expected to have interface configurations associated with the line cards installed in the system. Instead, guest network functions (GNFs) will have the full-fledged router configurations.

Installing JDM RPM Package on x86 Servers Running RHEL (External Server Model)

Before installing the JDM RPM package for x86 servers, ensure that you have installed the additional packages, as described in “Installing Additional Packages for JDM” on page 46.

Download and install the JDM RPM package for x86 servers running RHEL as follows:

To download the package:

a. Go to the Juniper Support page.

b. Click **JDM** > ***Junos OS version number*** > **Juniper Device Manager *version number* (for Redhat)**.

c. On the **Software Download** page, select the **I Agree** option under the End User License Agreement and then click **Proceed**.

To install the package on x86 servers running RHEL, perform the following steps on each of the servers:

1. Disable SELINUX and reboot the server. You can disable SELINUX by setting the value for **SELINUX** to **disabled** in the **/etc/selinux/config** file.

2. Install the JDM RPM package (indicated by the *.rpm* extension) by using the following command. An example of the JDM RPM package used is shown below:

   root@Linux Server0# **rpm -ivh jns-jdm-1.0-0-17.4R1.*13*.x86_64.rpm**

```
Preparing...                          ################################# [100%]
Detailed log of jdm setup saved in /var/log/jns-jdm-setup.log
Updating / installing...
   1:jns-jdm-1.0-0          ################################# [100%]
Setup host for jdm...
Launch libvirtd in listening mode
Done Setup host for jdm
Installing /juniper/.tmp-jdm-install/juniper_ubuntu_rootfs.tgz...
Configure /juniper/lxc/jdm/jdm1/rootfs...
Configure /juniper/lxc/jdm/jdm1/rootfs DONE
Created symlink from /etc/systemd/system/multi-user.target.wants/jdm.service to
 /usr/lib/systemd/system/jdm.service.
Done Setup jdm
Redirecting to /bin/systemctl restart  rsyslog.service
```

Repeat the steps for the second server.

Installing JDM Ubuntu Package on x86 Servers Running Ubuntu 16.04 (External Server Model)

Before installing the JDM Ubuntu package for x86 servers, ensure that you have installed the additional packages. For more details, see “Installing Additional Packages for JDM” on page 46.

Download and install the JDM Ubuntu package for x86 servers running Ubuntu 16.04 as follows:

To download the JDM Ubuntu package:

a. Go to the Juniper Support page.

b. Click **JDM** > ***Junos OS version number*** > **Juniper Device Manager *version number* (for Debian)**.

c. On the **Software Download** page, select the **I Agree** option under the End User License Agreement and then click **Proceed**.

To install the JDM package on the x86 servers running Ubuntu 16.04, perform the following steps on each of the servers:

1. Disable **apparmor** and reboot the server.

   root@Linux Server0# **systemctl stop apparmor**

   root@Linux Server0# **systemctl disable apparmor**

   root@Linux Server0# **reboot**

2. Install the JDM Ubuntu package (indicated by the *.deb* extension) by using the following command. An example of the JDM Ubuntu package used is shown below:

```
root@Linux Server0# dpkg -i jns-jdm-1.0-0-17.4R1.13.x86_64.deb
Selecting previously unselected package jns-jdm.
(Reading database ... 71846 files and directories currently installed.)
Preparing to unpack jns-jdm-1.0-0-17.4R1.13.x86_64.deb ...
Unpacking jns-jdm (1.0-0) ...
Setting up jns-jdm (1.0-0) ...
Installing /juniper/.tmp-jdm-install/juniper_ubuntu_latest.tgz...
Configure /juniper/lxc/jdm/jdm1/rootfs...
Configure /juniper/lxc/jdm/jdm1/rootfs DONE
Done Setup jdm
Processing triggers for ureadahead (0.100.0-19) ...
Processing triggers for systemd (225-1ubuntu9) ...
```

Repeat the steps for the second server.

Configuring JDM on the x86 Servers (External Server Model)

Use the following steps to configure JDM on each of the x86 servers.

1. At each server, start the JDM, and assign identities for the two servers as **server0** and **server1**, respectively, as follows:

   On one server, run the following command:

   root@Linux server0# **jdm start server=0**

   ```
   Starting JDM
   ```

   On the other server, run the following command:

   root@Linux server1# **jdm start server=1**

   ```
   Starting JDM
   ```

   > **NOTE:** The identities, once assigned, cannot be modified without uninstalling the JDM and then reinstalling it:

2. Enter the JDM console on each server by running the following command:

   root@Linux Server0# **jdm console**

   ```
   Connected to domain jdm
   Escape character is ^]
    * Starting Signal sysvinit that the rootfs is mounted [ OK ]
    * Starting Populate /dev filesystem                   [ OK ]
    * Starting Populate /var filesystem                   [ OK ]
    * Stopping Send an event to indicate plymouth is up   [ OK ]
    * Stopping Populate /var filesystem                   [ OK ]
    * Starting Clean /tmp directory                       [ OK ]
   …
    jdm login:
   ```

3. Log in as the **root** user.

4. Enter the JDM CLI by running the following command:

root@jdm% cli

> **NOTE:** The JDM CLI is similar to the Junos OS CLI.

5. Set the root password for the JDM.

   root@jdm# **set system root-authentication plain-text-password**

   ```
   New Password:
   ```

   > **NOTE:**
   > - The JDM root password must be the same on both the servers.
   > - Starting in Junos OS Release 18.3R1, you can create non-root users in JDM. For more information, see "Configuring Non-Root Users in JDM (Junos Node Slicing)" on page 55.
   > - JDM installation blocks libvirt port access from outside the host.

6. Commit the changes:

   root@jdm# **commit**

7. Enter **Ctrl-]** to exit from the JDM console.

8. From the Linux host, run the **ssh jdm** command to log in to the JDM shell.

Configuring Non-Root Users in JDM (Junos Node Slicing)

In the external server model, you can create non-root users on Juniper Device Manager (JDM) for Junos node slicing, starting in Junos OS Release 18.3R1. You need a root account to create a non-root user. The non-root users can log in to JDM by using the JDM console or through SSH. Each non-root user is provided a username and assigned a predefined login class.

The non-root users can perform the following functions:

- Interact with JDM.
- Orchestrate and manage Guest Network Functions (GNFs).
- Monitor the state of the JDM, the host server and the GNFs by using JDM CLI commands.

> **NOTE:** The non-root user accounts function only inside JDM, not on the host server.

To create non-root users in JDM:

1. Log in to JDM as a root user.

2. Define a user name and assign the user with a predefined login class.

   root@jdm# **set system login user *username* class *predefined-login-class***

3. Set the password for the user.

   root@jdm# **set system login user *username* authentication plain-text-password**

   ```
   New Password:
   ```

4. Commit the changes.

   root@jdm# **commit**

Table 7 on page 56 contains the predefined login classes that JDM supports for non-root users:

Table 7: Predefined Login Classes

Login Class	Permissions
super-user	• Create, delete, start and stop GNFs. • Start and stop daemons inside the JDM. • Execute all CLIs. • Access the shell.
operator	• Start and stop GNFs. • Restart daemons inside the JDM. • Execute all basic CLI operational commands (except the ones which modify the GNFs or JDM configuration).
read-only	Similar to operator class, except that the users cannot restart daemons inside JDM.
unauthorized	Ping and traceroute operations.

Configuring JDM interfaces (External Server Model)

In the JDM, you must configure:

- The two 10-Gbps server ports that are connected to the MX Series router.
- The server port to be used as the JDM management port.
- The server port to be used as the GNF management port.

Therefore, you need to identify the following on each server before starting the configuration of the ports:

- The server interfaces (for example, **p3p1** and **p3p2**) that are connected to **CB0** and **CB1** on the MX Series router.
- The server interfaces (for example, **em2** and **em3**) to be used for JDM management and GNF management.

For more information, see the figure “Connecting the Servers and the Router” on page 38.

NOTE:

- You need this information for both **server0** and **server1**.
- These interfaces are visible only on the Linux host.

To configure the x86 server interfaces in JDM, perform the following steps on both the servers:

1. On **server0**, apply the following configuration statements:

```
root@jdm# set groups server0 server interfaces cb0 p3p1
root@jdm# set groups server0 server interfaces cb1 p3p2
root@jdm# set groups server1 server interfaces cb0 p3p1
root@jdm# set groups server1 server interfaces cb1 p3p2
root@jdm# set apply-groups [ server0 server1 ]
root@jdm# commit

root@jdm# set groups server0 server interfaces jdm-management em2
root@jdm# set groups server0 server interfaces vnf-management em3
root@jdm# set groups server1 server interfaces jdm-management em2
root@jdm# set groups server1 server interfaces vnf-management em3
root@jdm# commit
```

2. Repeat the step 1 on **server1**.

> **NOTE:** Ensure that you apply the same configuration on both **server0** and **server1**.

3. Share the **ssh** identities between the two x86 servers.

   At both **server0** and **server1**, run the following JDM CLI command:

   root@jdm> **request server authenticate-peer-server**

> **NOTE:** The **request server authenticate-peer-server** command displays a CLI message requesting you to log in to the peer server using ssh to verify the operation. To log in to the peer server, you need to prefix **ip netns exec jdm_nv_ns** to **ssh root@jdm-server1**.
>
> For example, to log in to the peer server from **server0**, exit the JDM CLI, and use the following command from JDM shell:
>
> ```
> root@jdm:~# ip netns exec jdm_nv_ns ssh root@jdm-server1
> ```
>
> Similarly, to log in to the peer server from **server1**, use the following command:
>
> ```
> root@jdm:~# ip netns exec jdm_nv_ns ssh root@jdm-server0
> ```

4. Apply the configuration statements in the JDM CLI configuration mode to set the JDM management IP address, default route, and the JDM hostname for each JDM instance as shown in the following example.

   NOTE:
   - The management IP address and default route must be specific to your network.
   - JDM does not support IPv6, even though IPv6 addresses are themselves configurable.

```
root@jdm# set groups server0 interfaces jmgmt0 unit 0 family inet address 10.216.105.112/21
root@jdm# set groups server1 interfaces jmgmt0 unit 0 family inet address 10.216.105.113/21
root@jdm# set groups server0 routing-options static route 0.0.0.0/0 next-hop 10.216.111.254
root@jdm# set groups server1 routing-options static route 0.0.0.0/0 next-hop 10.216.111.254
root@jdm# set groups server0 system host-name test-jdm-server0
root@jdm# set groups server1 system host-name test-jdm-server1
root@jdm# commit
```

   NOTE:
   - **jmgmt0** stands for the JDM management port. This is different from the Linux host management port. Both JDM and the Linux host management ports are independently accessible from the management network.

5. Run the following JDM CLI command on each server and ensure that all the interfaces are up.

```
root@jdm> show server connections

                                Component               Interface
       Status  Comments
                                Host to JDM port        virbr0
       up
                                Physical CB0 port       p3p1
       up
                                Physical CB1 port       p3p2
       up
                                Physical JDM mgmt port  em2
       up
                                Physical VNF mgmt port  em3
       up
```

```
                                JDM-GNF bridge          bridge_jdm_vm
        up
                                CB0                     cb0
        up
                                CB1                     cb1
        up
                                JDM mgmt port           jmgmt0
        up
                                JDM to HOST port        bme1
        up
                                JDM to GNF port         bme2
        up
                                JDM to JDM link0*       cb0.4002
        up
                                JDM to JDM link1        cb1.4002
        up
```

NOTE: For sample JDM configurations, see "Sample Configuration for Junos Node Slicing" on page 77.

If you want to modify the server interfaces configured in the JDM, perform the following steps:

1. Stop all running GNFs.

   ```
   root@jdm> request virtual-network-functions gnf-name stop
   ```

2. From the configuration mode, deactivate the virtual network functions configuration, and then commit the change.

   ```
   root@jdm# deactivate virtual-network-functions
   root@jdm# commit
   ```

3. Configure and commit the new interfaces as described in the step 1 of the main procedure.

4. Reboot the JDM from the shell.

   ```
   root@jdm:~# reboot
   ```

5. From the configuration mode, activate the virtual network functions configuration, and then commit the change.

```
root@jdm# activate virtual-network-functions
root@jdm# commit
```

Starting in Junos OS Release 19.2R1, Junos node slicing supports the assignment of a globally unique MAC address range (supplied by Juniper Networks) for GNFs. To know more, see "Assigning MAC Addresses to GNF" on page 67.

Configuring MX Series Router to Operate in In-Chassis Mode

NOTE:

- To configure in-chassis Junos node slicing, the MX Series router must have one of the following types of Routing Engines installed:
  - RE-S-2X00x6-128 (used in MX480 and MX960 routers)
  - RE-MX200X8-128G (used in MX2010 and MX2020 routers)
  - REMX2008-X8-128G (used in MX2008 routers)

In in-chassis model, the base system (BSYS), Juniper Device Manager (JDM), and all guest network functions (GNFs) run within the Routing Engine of the MX Series router. BSYS and GNFs run on the host as virtual machines (VMs). You need to first reduce the resource footprint of the standalone MX Series router as follows:

1. Ensure that both the Routing Engines (re0 and re1) in the MX Series router have the required VM host package (example: **junos-vmhost-install-mx-x86-64-19.2R1.tgz**) installed. The VM host package should be of 19.1R1 or a later version.

2. Applying the following configuration and then reboot VM host on both the Routing Engines (re0 and re1).

   ```
   user@router# set vmhost resize vjunos compact
   user@router# set system commit synchronize
   user@router> request vmhost reboot (re0|re1)
   ```

   When this configuration is applied, and following the reboot, the Routing Engine resource footprint of the Junos VM on MX Series router shrinks in order to accommodate GNF VMs. A resized Junos VM, now operating as the base system (BSYS) on the MX Series Routing Engine has the following resources:

   - CPU Cores—1 (Physical)
   - DRAM—16GB

- Storage—14GB (/var)

> **NOTE:** All files in the **/var/** location, including the log files (**/var/log**) and core files (**/var/crash**), are deleted when you reboot VM host after configuring the **set vmhost resize vjunos compact** statement. You must save any files currently in **/var/log** or **/var/crash** before proceeding with the VM host resize configuration if you want to use them for reference.

Installing and Configuring JDM for In-Chassis Model

IN THIS SECTION

Steps listed in this topic apply only to in-chassis Junos node slicing configuration.

Installing JDM RPM Package on MX Series Router (In-Chassis Model)

Before installing the Juniper Device Manager (JDM) RPM package on an MX Series router, you must configure the MX Series router to operate in the in-chassis BSYS mode. For more information, see "Configuring MX Series Router to Operate in In-Chassis Mode" on page 60.

> **NOTE:** The RPM package **jns-jdm-vmhost** is meant for in-chassis Junos node slicing deployment, while the RPM package **jns-jdm** is used for external servers based Junos node slicing deployment.

1. Download the JDM RPM package from the Juniper Support page.

2. Install the JDM RPM package on both Routing Engines (re0 and re1), by using the command shown in the following example:

```
root@router> request vmhost jdm add jns-jdm-vmhost-18.3-20180930.0.x86_64.rpm
```

```
Starting to validate the Package
Finished validating the Package
Starting to validate the Environment
Finished validating the Environment
Starting to copy the RPM package from Admin Junos to vmhost
Finished Copying the RPM package from Admin Junos to vmhost
Starting to install the JDM RPM package
Preparing...                ##################################################
Detailed log of jdm setup saved in /var/log/jns-jdm-setup.log
jns-jdm-vmhost              ##################################################
Setup host for jdm...
Done Setup host for jdm
Installing
/vm/vm/iapps/jdm/install/juniper/.tmp-jdm-install/juniper_ubuntu_rootfs.tgz...
Configure /vm/vm/iapps/jdm/install/juniper/lxc/jdm/jdm1/rootfs...
Configure /vm/vm/iapps/jdm/install/juniper/lxc/jdm/jdm1/rootfs DONE
Setup Junos cgroups...Done
Done Setup jdm
stopping rsyslogd ... done
starting rsyslogd ... done
Finished installing the JDM RPM package
Installation Successful !
Starting to generate the host public keys at Admin Junos
Finished generating the host public keys at Admin Junos
Starting to copy the host public keys from Admin Junos to vmhost
Finished copying the host public keys from Admin Junos to vmhost
Starting to copy the public keys of Admin junos from vmhost to JDM
Finished copying the public keys of Admin junos from vmhost to JDM
Starting to cleanup the temporary file from Vmhost containing host keys of Admin
 Junos
Finished cleaning the temporary file from Vmhost containing host keys of Admin
 Junos
```

3. Run the **show vmhost status** command to see the **vJunos Resource Status** on both the Routing Engines.

   `user@router>` **show vmhost status re0**

```
bsys-re0:
--------------------------------------------------------------------------

Compute cluster: rainier-re-cc
  Compute Node: rainier-re-cn, Online
```

```
vJunos Resource Status: Compact
```

```
user@router> show vmhost status re1
```

```
bsys-re1:
--------------------------------------------------------------------------

Compute cluster: rainier-re-cc
  Compute Node: rainier-re-cn, Online

vJunos Resource Status: Compact
```

Configuring JDM (In-Chassis Model)

Use the following steps to configure JDM on both the Routing Engines of an MX Series router:

1. Apply the following command on both the Routing Engines to start JDM:

```
user@router> request vmhost jdm start
```

```
Starting JDM
Starting jdm: Domain jdm defined from
/vm/vm/iapps/jdm//install/juniper/lxc/jdm/current/config/jdm.xml

Domain jdm started
```

Starting in Junos OS 19.3R1, the JDM console does not display the message 'Domain JDM Started'. However, this message will be added to the system logs when the JDM is started.

> **NOTE:** If hyperthreading is disabled, a warning is displayed when you enter the command **request vmhost jdm start**, as shown in the following example:
>
> ```
> Warning: Hyperthreading is disabled! Cores: (6) Processors: (6) Expected:
>  (12)
> ```

2. Use the command **show vmhost jdm status** to check if the JDM is **running**.

```
user@router> show vmhost jdm status

JDM Information
---------------------------
Package    :  jns-jdm-vmhost-19.1-B2.x86_64
Status     :  Running
PID        :  3088
Free Space :  62967 (MiB)
```

3. After a few seconds, log in to JDM.

```
root@router> request vmhost jdm login

************************************************************************
* The Juniper Device Manager (JDM) must only be used for orchestrating the *
* Virtual Machines for Junos Node Slicing                                *
*                                                                        *
* Host Linux Distro: Wind River Linux                                    *
* JDM Version: jns-jdm-vmhost-19.1-20181003.dev.common.0.x86_64          *
* Free Disk Space on JDM's root-fs ("/"): 125081(MiB)                    *
************************************************************************
Last login: Thu Oct  4 15:26:30 2018 from 192.168.1.1
```

NOTE:

- You need to have root user privilege on the BSYS to log in to JDM.
- The in-chassis JDM root account password can be different from Junos root account password.
- It takes approximately 10 seconds for JDM to start. If you enter the **request vmhost jdm login** command before JDM starts, you might get the following message:

```
ssh_exchange_identification: read: Connection reset by peer
```

4. Enter the JDM CLI by running the following command:

```
root@jdm% cli
```

5. In configuration mode, apply the configurations shown in the following example:

> **NOTE:** The IP addresses shown in the following example are samples. Replace them with the actual IP addresses in your configuration.

```
root@jdm#  set groups server0 system host-name host-name
root@jdm#  set groups server0 interfaces jmgmt0 unit 0 family inet address 192.0.2.1/24
root@jdm#  set groups server0 routing-options static route 0.0.0.0/0 next-hop 192.0.2.2
root@jdm#  set groups server1 system host-name host-name
root@jdm#  set groups server1 interfaces jmgmt0 unit 0 family inet address 198.51.100.1/24
root@jdm#  set groups server1 routing-options static route 0.0.0.0/0 next-hop 198.51.100.2
```

6. In configuration mode, set the root password for the JDM on both the Routing Engines, and commit.

```
root@jdm#  set apply-groups [server0 server1]
root@jdm#  set system root-authentication plain-text-password
New password:

root@jdm#  commit
```

> **NOTE:**
> - The JDM supports root user administration account only.

7. In operation mode, enter the following command on both the Routing Engines to copy the ssh public key to the peer JDM.

```
root@jdm>  request server authenticate-peer-server

/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter
 out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted
 now it is to install the new keys
root@jdm-server1's password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'root@jdm-server1'"
and check to make sure that only the key(s) you wanted were added.
```

> **NOTE:** You need to enter the root password of the peer JDM when prompted.

8. In the configuration mode, apply the following commands:

```
root@jdm# set system commit synchronize
```

> **NOTE:**
> - In in-chassis Junos node slicing, you cannot ping or send traffic between the management interfaces of the same Routing Engine (for example, from the Routing Engine 0 of GNF1 to the Routing Engine 0 of GNF2 or from the Routing Engine 0 of GNF1 to JDM).
> - In in-chassis mode, you cannot perform an **scp** operation between the BSYS and the JDM management interfaces.

Starting in Junos OS Release 19.2R1, Junos node slicing supports the assignment of a globally unique MAC address range (supplied by Juniper Networks) for GNFs. To know more, see "Assigning MAC Addresses to GNF" on page 67.

Assigning MAC Addresses to GNF

Starting in Junos OS Release 19.2R1, Junos node slicing supports the assignment of a globally unique MAC address range (supplied by Juniper Networks) for GNFs.

To receive the globally unique MAC address range for the GNFs, contact your Juniper Networks representative and provide your GNF license SSRN (Software Support Reference Number), which will have been shipped to you electronically upon your purchase of the GNF license. To locate the SSRN in your GNF license, refer to the Juniper Networks Knowledge Base article KB11364.

For each GNF license, you will then be provided an 'augmented SSRN', which includes the globally unique MAC address range assigned by Juniper Networks for that GNF license. You must then configure this augmented SSRN at the JDM CLI as follows:

1. `root@jdm#` **set system vnf-license-supplement vnf-id *gnf-id* license-supplement-string *augmented-ssrn-string***
   `root@jdm#` **commit**

> **NOTE:**
> - An augmented SSRN must be used for only one GNF ID. In the JDM, the GNF VMs are referred to as virtual network functions (VNFs). GNF ID is one of its attributes. Attributes of a VNF are fully described in the follow-on section "Configuring Guest Network Functions" on page 68.
> - By default, the augmented SSRN will be validated. Should you ever need to skip this validation, you can use the no-validate attribute in the CLI as follows: Example: **set system vnf-license-supplement vnf-id *gnf-id* license-supplement-string *augmented-ssrn-string* [no-validate]**.

NOTE:

- You can configure the augmented SSRN for a GNF ID only when the GNF is not operational and has not yet been provisioned as well. You must first configure the augmented SSRN for a GNF ID before configuring the GNF.
- Ensure that the GNF ID for which the augmented SSRN is being configured has not already been provisioned. If the GNF ID is already provisioned, you must first delete the GNF for that GNF ID on both the servers (in case of the external server model) or on both the Routing Engines (in case of the in-chassis Junos node slicing model) before configuring the augmented SSRN.
- Analogously, you must first delete the GNF for a given GNF ID on both the servers (in case of the external server model) or on both the Routing Engines (in case of the in-chassis Junos node slicing model) before deleting the augmented SSRN for the GNF ID.
- You cannot apply an augmented SSRN to a GNF that is based on Junos OS 19.1R1 or older.
- To confirm that the assigned MAC address range for a GNF has been applied, when the GNF becomes operational, use the Junos CLI command **show chassis mac-addresses** - the output will match a substring of the augmented SSRN.

Configuring Guest Network Functions

Configuring a guest network function (GNF) comprises two tasks, one to be performed at the BSYS and the other at the JDM.

NOTE:

- Before attempting to create a GNF, you must ensure that the servers (or Routing Engines in the case of in-chassis model) have sufficient resources (CPU, memory, storage) for that GNF.
- You need to assign an ID to each GNF. This ID must be the same at the BSYS and the JDM.

At the BSYS, specify a GNF by assigning it an ID and a set of line cards by applying the configuration as shown in the following example:

user@router# **set chassis network-slices guest-network-functions gnf 1 fpcs 4**

user@router# **commit**

In the JDM, the GNF VMs are referred to as virtual network functions (VNFs). A VNF has the following attributes:

- A VNF name.
- A GNF ID. This ID must be the same as the GNF ID used at the BSYS.
- The MX Series platform type.
- A Junos OS image to be used for the GNF.
- The VNF server resource template.

At the JDM, to configure a VNF, perform the following steps:

1. Use the JDM shell command **scp** to retrieve the Junos OS Node Slicing image for GNF and place it in the JDM local directory **/var/jdm-usr/gnf-images** (repeat this step to retrieve the GNF configuration file).

   `root@jdm:~#` **scp *source-location-of-the-gnf-image* /var/jdm-usr/gnf-images**
   `root@jdm:~#` **scp *source-location-of-the-gnf-configuration-file* /var/jdm-usr/gnf-config**

2. Assign this image to a GNF by using the JDM CLI command as shown in the following example:

   `root@test-jdm-server0>` **request virtual-network-functions test-gnf add-image /var/jdm-usr/gnf-images/junos-install-ns-mx-x86-64-17.4R1.10.tgz all-servers**

   ```
   Server0:
   Added image: /vm-primary/test-gnf/test-gnf.img
   ```

   ```
   Server1:
   Added image: /vm-primary/test-gnf/test-gnf.img
   ```

3. Configure the VNF by applying the configuration statements as shown in the following example:

   ```
   
   ```

   root@test-jdm-server0# **set virtual-network-functions test-gnf id 1**

   root@test-jdm-server0# **set virtual-network-functions test-gnf chassis-type mx2020**

   root@test-jdm-server0# **set virtual-network-functions test-gnf resource-template 2core-16g**

   root@test-jdm-server0# **set system vnf-license-supplement vnf-id test-gnf license-supplement-string RTU00023003204-01-AABBCCDDEE00-1100-01-411C**

   For in-chassis model, do not configure the platform type (**set virtual-network-functions test-gnf chassis-type mx2020**). It will be detected automatically.

Starting in Junos OS Release 19.2R1, Junos node slicing supports the assignment of a globally unique MAC address range (supplied by Juniper Networks) for GNFs. To know more, see "Assigning MAC Addresses to GNF" on page 67.

To also specify a baseline or initial Junos OS configuration for a GNF, prepare the GNF configuration file (example: **/var/jdm-usr/gnf-config/test-gnf.conf**) on both the servers (server0 and server1) for external server model, and on both the Routing Engines (re0 and re1) for the in-chassis model, and specify the filename as the parameter in the **base-config** statement as shown below:

root@test-jdm-server0# **set virtual-network-functions test-gnf base-config /var/jdm-usr/gnf-config/test-gnf.conf**

root@test-jdm-server0# **commit synchronize**

NOTE: Ensure that:

- You use the same GNF ID as the one specified earlier in BSYS.
- The baseline configuration filename (with the path) is the same on both the servers / Routing Engines.
- The syntax of the baseline file contents is in the Junos OS configuration format.
- The GNF name used here is the same as the one assigned to the Junos OS image for GNF in the step 2.

4. To verify that the VNF is created, run the following JDM CLI command:

   root@test-jdm-server0> **show virtual-network-functions test-gnf**

5. Log in to the console of the VNF by issuing the following JDM CLI command:

   root@test-jdm-server0> **request virtual-network-functions test-gnf console**

6. Configure the VNF the same way as you configure an MX Series Routing Engine.

NOTE:

- The CLI prompt for in-chassis model is **root@jdm#** .
- For sample configurations, see "Sample Configuration for Junos Node Slicing" on page 77.
- In the case of the external server model, if you had previously brought down any physical x86 CB interfaces or the GNF management interface from Linux shell (by using the command **ifconfig *interface-name* down**), these will automatically be brought up when the GNF is started.

Chassis Configuration Hierarchy at BSYS and GNF

In Junos node slicing, the BSYS owns all the physical components of the router, including the line cards and fabric, while the GNFs maintain forwarding state on their respective line cards. In keeping with this split responsibility, Junos CLI configuration under the **chassis** hierarchy (if any), should be applied at the BSYS or at the GNF as follows:

- Physical-level parameters under the **chassis** configuration hierarchy should be applied at the BSYS. For example, the configuration for handling physical errors at an FPC is a physical-level parameter, and should therefore be applied at the BSYS.

  At BSYS Junos CLI:

  ```
  [edit]
  user@router# set chassis fpc fpc slot error major threshold threshold value action alarm
  ```

- Logical or feature-level parameters under the **chassis** configuration hierarchy should be applied at the GNF associated with the FPC. For example, the configuration for max-queues per line card is a logical-level parameter, and should therefore be applied at the GNF.

  At GNF Junos CLI:

  ```
  [edit]
  user@router# set chassis fpc fpc slot max-queues value
  ```

- As exceptions, the following two parameters under the **chassis** configuration hierarchy should be applied at both BSYS and GNF:

  At both BSYS and GNF CLI:

  ```
  [edit]
  user@router# set chassis network-services network services mode
  user@router# set chassis fpc fpc slot flexible-queueing-mode
  ```

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs

Creating an Abstracted Fabric (**af**) interface between two guest network functions (GNFs) involves configurations both at the base system (BSYS) and at the GNF. Abstracted Fabric interfaces are created on GNFs based on the BSYS configuration, which is then sent to those GNFs.

> **NOTE:** Only one **af** interface can be configured between a pair of GNFs.

To configure **af** interfaces between a pair of GNFs:

1. At the BSYS, apply the configuration as shown in the following example:

   ```
   user@router# set chassis network-slices guest-network-functions gnf 2 af4 peer-gnf id 4
   user@router# set chassis network-slices guest-network-functions gnf 2 af4 peer-gnf af2
   user@router# set chassis network-slices guest-network-functions gnf 4 af2 peer-gnf id 2
   user@router# set chassis network-slices guest-network-functions gnf 4 af2 peer-gnf af4
   ```

   In this example, **af2** is the Abstracted Fabric interface instance 2 and **af4** is the Abstracted Fabric interface instance 4.

   > **NOTE:** The allowed **af** interface values range from **af0** through **af9**.

   The GNF **af** interface will be visible and up. You can configure an **af** interface the way you configure any other interface.

2. At the GNF, apply the configuration as shown in the following example:

   ```
   user@router-gnf-b# set interfaces af4 unit 0 family inet address 10.10.10.1/24
   user@router-gnf-d# set interfaces af2 unit 0 family inet address 10.10.10.2/24
   ```

   > **NOTE:**
   > - If you want to apply MPLS family configurations on the **af** interfaces, you can apply the command **set interfaces *af-name* unit *logical-unit-number* family mpls** on both the GNFs between which the **af** interface is configured.
   > - For sample **af** configurations, see "Sample Configuration for Junos Node Slicing" on page 77.

Class of Service on Abstracted Fabric Interfaces

IN THIS SECTION

Class of service (CoS) packet classification assigns an incoming packet to an output queue based on the packet's forwarding class. See CoS Configuration Guide for more details.

The following sections explain the forwarding class- to-queue mapping, and the behavior aggregate (BA) classifiers and rewrites supported on the Abstracted Fabric (**af**) interfaces.

Forwarding Class-to-Queue Mapping

An **af** interface is a simulated WAN interface with most capabilities of any other interface except that the traffic designated to a remote Packet Forwarding Engine will still have to go over the two fabric queues (Low/High priority ones).

> **NOTE:** Presently, an **af** interface operates in 2-queue mode only. Hence, all queue-based features such as scheduling, policing, and shaping are not available on an **af** interface.

Packets on the **af** interface inherit the fabric queue that is determined by the fabric priority configured for the forwarding class to which that packet belongs. For example, see the following forwarding class to queue map configuration:

[edit]

`user@router#` **show class-of-service forwarding-classes**

```
class Economy queue-num 0 priority low; /* Low fabric priority */
class Stream queue-num 1;
class Business queue-num 2;
class Voice queue-num 3;
class NetControl queue-num 3;
class Business2 queue-num 4;
class Business3 queue-num 5;
class VoiceSig queue-num 6 priority high; /* High fabric priority */
class VoiceRTP queue-num 7;
```

As shown in the preceding example, when a packet gets classified to the forwarding class **VoiceSig**, the code in the forwarding path examines the fabric priority of that forwarding class and decides which fabric queue to choose for this packet. In this case, high-priority fabric queue is chosen.

BA Classifiers and Rewrites

The behavior aggregate (BA) classifier maps a class-of-service (CoS) value to a forwarding class and loss priority. The forwarding class and loss-priority combination determines the CoS treatment given to the packet in the router. The following BA classifiers and rewrites are supported:

- Inet-Precedence classifier and rewrite
- DSCP classifier and rewrite
- MPLS EXP classifier and rewrite

  You can also apply rewrites for IP packets entering the MPLS tunnel and do a rewrite of both EXP and IPv4 type of service (ToS) bits. This approach will work as it does on other normal interfaces.
- DSCP v6 classifier and rewrite for IP v6 traffic

> **NOTE:**
> The following are not supported:
>
> - IEEE 802.1 classification and rewrite
> - IEEE 802.1AD (QinQ) classification and rewrite

See CoS Configuration Guide for details on CoS BA classifiers.

Optimizing Fabric Path for Abstracted Fabric Interface

You can optimize the traffic flowing over the abstracted fabric (af) interfaces between two guest network functions (GNFs), by configuring a fabric path optimization mode. This feature reduces fabric bandwidth consumption by preventing any additional fabric hop (switching of traffic flows from one Packet Forwarding Engine to another) before the packets eventually reach the destination Packet Forwarding Engine. Fabric path optimization, supported on MX2008, MX2010, and MX2020 with MPC9E and MX2K-MPC11E, prevents only a single additional traffic hop that results from abstracted fabric interface load balancing.

You can configure one of the following fabric path optimization modes:

- **monitor**—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized traffic path. In this mode, the source GNF does not forward the traffic towards the desired Packet Forwarding Engine.
- **optimize**—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized traffic path. The source GNF then forwards the traffic towards the desired Packet Forwarding Engine.

To configure a fabric path optimization mode, use the following CLI commands at BSYS.

`user@router#` **set chassis network-slices guest-network-functions gnf *id* collapsed-forward (monitor | optimize)**

```
user@router# commit
```

After configuring fabric path optimization, you can use the command **show interfaces *af-interface-name*** in GNF to view the number of packets that are currently flowing on the optimal / non-optimal path.

SEE ALSO

collapsed-forward | **118**

show interfaces (Abstracted Fabric) | **164**

SNMP Trap Support: Configuring NMS Server (External Server Model)

The Juniper Device Manager (JDM) supports the following SNMP traps:

- LinkUp and linkDown traps for JDM interfaces.

  Standard linkUp/linkDown SNMP traps are generated. A default community string **jdm** is used.

- LinkUp/linkDown traps for host interfaces.

  Standard **linkUp/linkDown** SNMP traps are generated. A default community string **host** is used.

- JDM to JDM connectivity loss/regain traps.

  JDM to JDM connectivity loss/regain traps are sent using generic syslog traps (jnxSyslogTrap) through the host management interface.

  The JDM connectivity down trap **JDM_JDM_LINK_DOWN** is sent when the JDM is not able to communicate with the peer JDM on another server over **cb0** or **cb1** links. See the following example:

```
{ SNMPv2c C=host { V2Trap(296) R=1299287309
.1.3.6.1.2.1.1.3.0=42761992
.1.3.6.1.6.3.1.1.4.1.0=.1.3.6.1.4.1.2636.4.12.0.1
.1.3.6.1.4.1.2636.3.35.1.1.1.2.1="JDM_JDM_LINK_DOWN"
.1.3.6.1.4.1.2636.3.35.1.1.1.3.1=""
.1.3.6.1.4.1.2636.3.35.1.1.1.4.1=5
.1.3.6.1.4.1.2636.3.35.1.1.1.5.1=24
.1.3.6.1.4.1.2636.3.35.1.1.1.6.1=0
.1.3.6.1.4.1.2636.3.35.1.1.1.7.1="jdmmon"
.1.3.6.1.4.1.2636.3.35.1.1.1.8.1="JDM-HOST"
.1.3.6.1.4.1.2636.3.35.1.1.1.9.1="JDM to JDM Connection Lost"
.1.3.6.1.6.3.1.1.4.3.0.0=”” } }
```

The JDM to JDM Connectivity up trap **JDM_JDM_LINK_UP** is sent when either the **cb0** or **cb1** link comes up, and JDMs on both the servers are able to communicate again. See the following example:

```
{ SNMPv2c C=host { V2Trap(292) R=998879760
.1.3.6.1.2.1.1.3.0=42762230
.1.3.6.1.6.3.1.1.4.1.0=.1.3.6.1.4.1.2636.4.12.0.1
.1.3.6.1.4.1.2636.3.35.1.1.1.2.1="JDM_JDM_LINK_UP"
.1.3.6.1.4.1.2636.3.35.1.1.1.3.1=""
.1.3.6.1.4.1.2636.3.35.1.1.1.4.1=5
.1.3.6.1.4.1.2636.3.35.1.1.1.5.1=24
.1.3.6.1.4.1.2636.3.35.1.1.1.6.1=0
.1.3.6.1.4.1.2636.3.35.1.1.1.7.1="jdmmon"
.1.3.6.1.4.1.2636.3.35.1.1.1.8.1="JDM-HOST"
.1.3.6.1.4.1.2636.3.35.1.1.1.9.1="JDM to JDM Connection Up"
.1.3.6.1.6.3.1.1.4.3.0.0="" } }
```

- VM(GNF) up/down—**libvirtGuestNotif** notifications.

  For GNF start/shutdown events, the standard **libvirtGuestNotif** notifications are generated. For **libvirtMIB** notification details, see this web page. Also, see the following example:

```
HOST [UDP: [127.0.0.1]:53568->[127.0.0.1]]: Trap ,
DISMAN-EVENT-MIB::sysUpTimeInstance = Timeticks: (636682) 1:46:06.82,
SNMPv2-MIB::snmpTrapOID.0 = OID: LIBVIRT-MIB::libvirtGuestNotif,
LIBVIRT-MIB::libvirtGuestName.0 = STRING: "gnf1",
LIBVIRT-MIB::libvirtGuestUUID.1 = STRING: 7ad4bc2a-16db-d8c0-1f5a-6cb777e17cd8,
LIBVIRT-MIB::libvirtGuestState.2 = INTEGER: running(1),
LIBVIRT-MIB::libvirtGuestRowStatus.3 = INTEGER: active(1)
```

SNMP traps are sent to the target NMS server. To configure the target NMS server details in the JDM, see the following example:

[edit]

`root@jdm#` **show snmp | display set**

`root@jdm#` **set snmp name *name***

`root@jdm#` **set snmp description *description***

`root@jdm#` **set snmp location *location***

`root@jdm#` **set snmp contact *user's email***

```
root@jdm# set snmp trap-group tg-1 targets target ip address1
root@jdm# set snmp trap-group tg-1 targets target ip address2
```

Sample Configuration for Junos Node Slicing

This section provides sample configurations for Junos node slicing.

Sample JDM Configuration (External Server Model)

```
root@test-jdm-server0> show configuration
    groups {
    server0 {
        system {
            host-name test-jdm-server0;
        }
        server {
            interfaces {
                cb0 p3p1;
                cb1 p3p2;
                jdm-management em2;
                vnf-management em3;
            }
        }
        interfaces {
            jmgmt0 {
                unit 0 {
                    family inet {
                        address 10.216.105.112/21;
                    }
                }
            }
        }
        routing-options {
            static {
                route {
                    0.0.0.0/0 next-hop 10.216.111.254;
                }
            }
        }
    }
```

```
    server1 {
        system {
            host-name test-jdm-server1;
        }
        server {
            interfaces {
                cb0 p3p1;
                cb1 p3p2;
                jdm-management em2;
                vnf-management em3;
            }
        }
        interfaces {
            jmgmt0 {
                unit 0 {
                    family inet {
                        address 10.216.105.113/21;
                    }
                }
            }
            routing-options {
                static {
                    route {
                        0.0.0.0/0 next-hop 10.216.111.254;
                    }
                }
            }
        }
    }
}
apply-groups [ server0 server1 ];
system {
    root-authentication {
        encrypted-password "..."; ## SECRET-DATA
    }
    services {
        ssh;
        netconf {
            ssh;
            rfc-compliant;
        }
    }
}
virtual-network-functions {
```

```
    test-gnf {
        id 1;
        chassis-type mx2020;
        resource-template 2core-16g;
        base-config /var/jdm-usr/gnf-config/test-gnf.conf;
    }
}
```

Sample JDM Configuration (In-Chassis Model)

```
root@test-jdm-server0> show configuration
    groups {
    server0 {
        system {
            host-name test-jdm-server0;
        }
        interfaces {
            jmgmt0 {
                unit 0 {
                    family inet {
                        address 10.216.105.112/21;
                    }
                }
            }
        }
        routing-options {
            static {
                route {
                    0.0.0.0/0 next-hop 10.216.111.254;
                }
            }
        }
    }
    server1 {
        system {
            host-name test-jdm-server1;
        }
        interfaces {
            jmgmt0 {
                unit 0 {
                    family inet {
                        address 10.216.105.113/21;
                    }
```

```
            }
          }
          routing-options {
            static {
              route {
                0.0.0.0/0 next-hop 10.216.111.254;
              }
            }
          }
        }
    }
}
apply-groups [ server0 server1 ];
system {
    root-authentication {
        encrypted-password "..."; ## SECRET-DATA
    }
    services {
        ssh;
        netconf {
            ssh;
            rfc-compliant;
        }
    }
}
virtual-network-functions {
    test-gnf {
        id 1;
        resource-template 2core-16g;
        base-config /var/jdm-usr/gnf-config/test-gnf.conf;
    }
}
```

Sample BSYS Configuration with Abstracted Fabric Interface

```
user@router> show configuration chassis
    network-slices {
    guest-network-functions {
        gnf 1 {
            af2 {
                peer-gnf id 2 af1;
            }
            af4 {
```

```
            peer-gnf id 4 af1;
        }
        description gnf-a;
        fpcs [ 0 19];
    }
    gnf 2 {
        af1 {
            peer-gnf id 1 af2;
        }
        af4 {
            peer-gnf id 4 af2;
        }
        description gnf-b;
        fpcs [ 1 6 ];
    }
    gnf 4 {
        af1 {
            peer-gnf id 1 af4;
        }
        af2 {
            peer-gnf id 2 af4;
        }
        description gnf-d;
        fpcs [ 3 4 ];
    }
  }
}
```

Sample Abstracted Fabric Configuration at GNF with Class of Service

Assume that there is an Abstracted Fabric (**af**) interface between GNF1 and GNF2. The following sample configuration illustrates how to apply rewrites on the **af** interface at GNF1 and apply classifiers on the **af** interface on GNF2, in a scenario where traffic comes from GNF1 to GNF2:

GNF1 Configuration

```
interfaces {
  xe-4/0/0 {
    unit 0 {
      family inet {
        address 22.1.2.2/24;
      }
    }
```

```
    }
    af2 {
        unit 0 {
            family inet {
                address 32.1.2.1/24;
            }
        }
    }
}
class-of-service {
    classifiers {
        dscp testdscp {
            forwarding-class assured-forwarding {
                loss-priority low code-points [ 001001 000000 ];
            }
        }
    }
    interfaces {
        xe-4/0/0 {
            unit 0 {
                classifiers {
                    dscp testdscp;
                }
            }
            classifiers {
                dscp testdscp;
            }
        }
        af1 {
            unit 0 {
                rewrite-rules {
                    dscp testdscp; /*Rewrite rule applied on egress AF interface on GNF1.*/
                }
            }
        }
    }
    rewrite-rules {
        dscp testdscp {
            forwarding-class assured-forwarding {
                loss-priority low code-point 001001;
            }
        }
    }
}
```

GNF2 Configuration

```
interfaces {
    xe-3/0/0:0 {
        unit 0 {
            family inet {
                address 42.1.2.1/24;
            }
        }
    }
    af1 {
        unit 0 {
            family inet {
                address 32.1.2.2/24;
            }
        }
    }
}
class-of-service {
    classifiers {
        dscp testdscp {
            forwarding-class network-control {
                loss-priority low code-points 001001;
            }
        }
    }
    interfaces {
        af1 {
            unit 0 {
                classifiers {
                    dscp testdscp; /*Classifier applied on AF at ingress of GNF2*/
                }
            }
        }
    }
}
```

Sample Output for Abstracted Fabric Interface State at a GNF

`user@router-gnf-b>` **show interfaces af9**

```
Physical interface: af9, Enabled, Physical link is Up
  Interface index: 209, SNMP ifIndex: 527
```

```
 Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 370000mbps
 Device flags   : Present Running
 Interface flags: Internal: 0x4000
 Link type      : Full-Duplex
 Link flags     : None
 Current address: 00:90:69:2b:00:4c, Hardware address: 00:90:69:2b:00:4c
 Last flapped   : 2018-09-12 01:44:01 PDT (00:01:02 ago)
 Input rate     : 0 bps (0 pps)
 Output rate    : 0 bps (0 pps)
 Bandwidth      : 370 Gbps
 Peer GNF id    : 9
 Peer GNF Forwarding element(FE) view :
 FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
Bytes
      6:0                  130         Up                      0
      0
     12:0                  120         Up                      0
      0
     12:1                  120         Up                      0
      0

 Residual Transmit Statistics :
 Packets :                    0 Bytes :                   0

 Fabric Queue Statistics :
 FPC slot:FE num    High priority(pkts)        Low priority(pkts)
      6:0                            0                         0
     12:0                            0                         0
     12:1                            0                         0
 FPC slot:FE num    High priority(bytes)      Low priority(bytes)
      6:0                              0                        0
     12:0                              0                        0
     12:1                              0                        0
 Residual Queue Statistics :
     High priority(pkts)       Low priority(pkts)
                      0                        0
     High priority(bytes)      Low priority(bytes)
                       0                        0

 Logical interface af9.0 (Index 332) (SNMP ifIndex 528)
   Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
   Input packets : 0
   Output packets: 13
   Protocol inet, MTU: 1500
```

RELATED DOCUMENTATION

Minimum Hardware and Software Requirements for Junos Node Slicing | 33

Connecting the Servers and the Router | 38

Components of Junos Node Slicing | 19

3

CHAPTER

Upgrading and Managing Junos Node Slicing

Junos Node Slicing Upgrade

IN THIS SECTION

Junos node slicing upgrade involves upgrading Juniper Device Manager (JDM), guest network functions (GNFs), and the base system (BSYS).

Upgrading Junos Node Slicing

IN THIS SECTION

Junos node slicing comprises three types of software components:

- Juniper Device Manager (JDM) package
- Junos OS image for guest network function (GNFs)
- Junos OS package for base system (BSYS)

You can upgrade each of these components independently, as long as they are within the allowed range of software versions (see "Multiversion Software Interoperability Overview" on page 30 for more details). You can also upgrade all of them together.

> **NOTE:** Before starting the upgrade process, save the JDM, GNF VM, and BSYS configurations for reference.

Upgrading JDM for External Server Model

1. Upgrade the JDM by performing the following tasks on both the servers:
   a. Copy the new JDM package (RPM or Ubuntu) to a directory on the host (for example, **/var/tmp**).
   b. Stop the JDM by using the following command:

      ```
      root@Linux server0# jdm stop
      Stopping JDM
      ```

   c. Issue the upgrade command to upgrade the JDM package:

      If you are upgrading the JDM RHEL package, use the following command:

      ```
      root@Linux server0# rpm -U package_name.rpm --force
      ```

      If you are upgrading the JDM Ubuntu package, use the following command:

      ```
      root@Linux server0# dpkg -i deb package.deb
      ```

      NOTE:
      - A JDM upgrade does not affect any of the running GNFs.
      - Before upgrading JDM, ensure that both JDM deployments are in sync. This means:
        - Junos running on a given GNF should support the same SMBIOS version across both the servers.
        - Before upgrade, ensure that all GNFs exist on both the servers.
      - After upgrading both the JDM servers, you must run **commit synchronize** before configuring any new GNF. If you do not run **commit synchronize** and create new GNFs on server1, you will not be able to do **commit synchronize** later from server0 to server1.
      - You must upgrade both the JDMs.

      See also:

      - Installing JDM RPM Package on x86 Servers Running RHEL (External Server Model) on page 50
      - Installing JDM Ubuntu Package on x86 Servers Running Ubuntu 16.04 (External Server Model) on page 51

Upgrading JDM for In-Chassis Model

1. Upgrade the JDM by performing the following tasks on the BSYS instance of both the routing engines:
   a. Copy the new JDM RPM package to a directory (for example, **/var/tmp**).
   b. Stop the JDM by running the following command:

      ```
      root@router> request vmhost jdm stop
      ```

   c. Install the JDM RPM package for in-chassis Junos node slicing, by using the command shown in the following example:

      ```
      root@router> request vmhost jdm add jns-jdm-vmhost-18.3-20180930.0.x86_64.rpm
      ```

      NOTE: A JDM upgrade does not affect any of the running GNFs.

NOTE: In order to upgrade JDM for in-chassis model, you need not uninstall the existing JDM software. Uninstalling the existing JDM might impact the guest network functions (GNFs).

SEE ALSO

Installing and Configuring JDM for In-Chassis Model | 61

Upgrading GNF and BSYS

The GNF and BSYS packages can be upgraded in the same way as you would upgrade Junos OS on a standalone MX Series router.

Ensure that all GNFs are online when you perform an upgrade. This is because both GNF and BSYS upgrade processes trigger multiversion checks (covered later in this guide), and all GNFs are required to be online during the multiversion check phase, failing which the upgrade will be aborted. In case a GNF remains shut down, you must deactivate its configuration from BSYS CLI, which will result in skipping multiversion checks for that particular GNF.

> **NOTE:** A **force** option is also available, through which you can overwrite an existing GNF image with a new one by using the JDM CLI command **request virtual-network-functions *vnf-name* add-image *new-image-name* force**. This can be useful in a rare situation where the GNF image does not boot. You can also use the **force** option to perform a cleanup if, for example, you abruptly terminated an earlier **add-image** that was in progress, by pressing Ctrl-C (example: **request virtual-network-functions *vnf-name* delete-image *image-name* force**).

Upgrading JDM to Support WRL 9 based VM Host - In-Chassis Model

If the Routing Engine is to run Junos OS 19.3R1 or later, you must upgrade JDM to 19.3R1 or later.

> **NOTE:**
> Junos OS versions released prior to 19.3R1 use WRL6 version of the VM Host software. Junos OS 19.3R1 brings in WRL9 version of the VM Host software. To check the VM Host version, on the BSYS VM, use the Junos CLI command **show vmhost version**.

Use the following steps to upgrade the JDM.

1. At each of the GNFs, assign mastership to the backup GNFs running on Routing Engine1 (re1).

   ```
   root@router> request chassis routing-engine master switch no-confirm
   ```

2. On re0, first stop the GNFs from the JDM, and then stop the JDM itself from BSYS.

   ```
   root@jdm> request virtual-network-functions stop gnf-name
   root@router> request vmhost jdm stop
   ```

3. Ensure that re0 VM Host version is Junos OS 19.3R1 or later. To check the VM Host version, use the Junos CLI command **show vmhost version**.

   You can use the following Junos CLIs to upgrade VM Host software:

   ```
   root@router> request vmhost software add package-name
   root@router> request vmhost reboot
   ```

   For more information, see Installing, Upgrading, Backing Up, and Recovery of VM Host.

4. When re0 is back up after the reboot, copy the new JDM RPM package (19.3R1 or later) to a directory (for example, /var/tmp).

5. Install the new JDM RPM package on re0 and then start the JDM.

```
root@router> request vmhost jdm add package-name
root@router> request vmhost jdm start
```

The GNFs on re0 automatically start after this step.

6. Repeat the steps 1 to 5 on Routing Engine 1 (r1).

7. Run the **request server authenticate-peer-server** command at the JDM on both the Routing Engines.

```
user@jdm> request server authenticate-peer-server
```

8. Configure **set system commit synchronize** and then apply **commit** on re0 JDM.

```
user@jdm# set system commit synchronize
user@jdm# commit synchronize
```

NOTE: The JDM software version 19.3R1 is capable of running on Junos OS version 19.3R1 as well as on Junos OS versions prior to 19.3R1.

Downgrading JDM for External Server Model

NOTE: You cannot downgrade Juniper Device Manager (JDM) installed in a single-server based Junos node slicing setup.

Use the following steps to downgrade JDM:

1. Acquire mastership to the backup GNFs running on server1.

   ```
   user@gnf> request chassis routing-engine master acquire no-confirm
   ```

   ```
   Resolving mastership...
   Complete. The local routing engine becomes the master.
   ```

   ```
   user@gnf# commit synchronize
   ```

   ```
   re1:
   configuration check succeeds
   re0:
   commit complete
   re1:
   commit complete
   ```

2. On server0, stop all the GNFs and delete the **commit synchronize** configuration.

   ```
   user@jdm> request virtual-network-functions test-gnf stop
   ```

   ```
   test-gnf stopped
   ```

   ```
   user@jdm# delete system commit synchronize
   user@jdm# commit
   ```

   ```
   server0:
    configuration check succeeds
   server1:
    commit complete
   server0:
    commit complete
   ```

3. On server0, stop and uninstall JDM.

   ```
   [user@server0 ~]# jdm stop
   ```

   ```
   Stopping JDM
   ```

   ```
   [user@server0 ~]# rpm -e jns-jdm
   ```

```
Detailed log of jdm setup saved in /var/log/jns-jdm-setup.log
Cleanup jdm from host...
Cleaning up jdm rootfs and bridges..
Domain jdm has been undefined

Done Cleanup jdm from host
```

NOTE: If you are using Ubuntu, use the command **dpkg --purge jns-jdm** to uninstall JDM.

4. On server0, install the target version of JDM.

   `[user@server0]#` **rpm -ivh jns-jdm-18.3-20181207.0.x86_64.rpm**

```
Preparing...                          ################################# [100%]
Detailed log of jdm setup saved in /var/log/jns-jdm-setup.log

 Updating / installing...
    1:jns-jdm-18.3-20181207.0         ################################# [100%]
Setup host for jdm...
Launch libvirtd in listening mode
Done Setup host for jdm
Installing /juniper/.tmp-jdm-install/juniper_ubuntu_rootfs.tgz...
Configure /juniper/lxc/jdm/jdm1/rootfs...
Configure /juniper/lxc/jdm/jdm1/rootfs DONE
Created symlink from /etc/systemd/system/multi-user.target.wants/jdm.service to
 /usr/lib/systemd/system/jdm.service.
Done Setup jdm
Redirecting to /bin/systemctl restart  rsyslog.service
```

5. Configure JDM with root authentication or interfaces, and routing-options.

6. On server0 JDM, add a GNF image version that is compatible with the JDM version.

   `user@jdm>` **request virtual-network-functions add-image /var/tmp/junos-install-ns-mx-x86-64-18.3-R1.tgz gnf**

```
Added Image
```

   In case the GNF version is incompatible with the JDM version, the following error message is shown:

```
user@jdm> request virtual-network-functions test add-image
/var/jdm-usr/gnf-images/junos-install-ns-mx-x86-64-19.1-20181212_dev_common.0.tgz

 SMBIOS version of GNF(v2) is incompatible with JDM(v1)
```

7. Wait till the GNF comes up on server0 JDM.

8. Perform a commit synchronize from the Master RE (which is the GNF running on server1).

   `user@gnf#` **commit synchronize**

9. Assign mastership to the GNF which is running on server0 JDM.

10. On Server 1, repeat the steps 2 through 5.

11. Run the **request server authenticate-peer-server** command on both the servers.

    `user@jdm>` **request server authenticate-peer-server**

12. Apply **show server connections all-servers** and ensure that no issues are seen.

13. Configure **set system commit synchronize** and then apply **commit** on server0 JDM.

    `user@jdm#` **set system commit synchronize**
    `user@jdm#` **commit synchronize**

14. Use the command **show virtual-network-functions all-servers** to see if the GNFs are coming up.

Downgrading JDM for In-Chassis Model

NOTE: You cannot downgrade Juniper Device Manager (JDM) installed in a single Routing Engine-based Junos node slicing setup.

Use the following steps to downgrade JDM:

1. Assign mastership to the backup GNFs running on Routing Engine 1 (re1).

   ```
   user@gnf> request chassis routing-engine master switch no-confirm
   ```

2. On re0, stop all the GNFs and delete the **commit synchronize** configuration.

   ```
   user@jdm> request virtual-network-functions stop server0 gnf
   user@jdm# delete system commit synchronize
   user@jdm# commit
   ```

3. On re0, uninstall JDM (on BSYS master).

   ```
   user@bsys> request vmhost jdm delete
   ```

4. On re0, install the target version (example: 18.3R1) of JDM.

   ```
   user@bsys> request vmhost jdm add /var/tmp/jns-jdm-vmhost-18.3-R1.3.x86_64.rpm
   ```

5. On re0, deploy the same version of GNF which is running on server1.

   ```
   user@jdm> request virtual-network-functions add-image
   /var/tmp/junos-install-ns-mx-x86-64-19.1-20181115.1.tgz gnf
   ```

   In case the GNF version is incompatible with the JDM version, the following error message is shown:

   ```
   user@jdm> request virtual-network-functions test add-image
   /var/jdm-usr/gnf-images/junos-install-ns-mx-x86-64-19.1-20181212_dev_common.0.tgz

    SMBIOS version of GNF(v2) is incompatible with JDM(v1)
   ```

   You can use the following command to check the GNF version.

   ```
   user@gnf1> show version
   ```

   ```
   Hostname: gnf1
     Model: mx960
     Junos: 19.1-20181115.1
   ```

6. On re1, repeat the steps 1 through 5.

7. Run the **request server authenticate-peer-server** command on both the Routing Engines.

```
user@jdm> request server authenticate-peer-server
```

8. Perform a commit synchronize from the master Routing Engine (which is the GNF running on server1).

```
user@gnf# commit synchronize
```

9. Configure **set system commit synchronize** and then apply **commit** on re0 JDM.

```
user@jdm# set system commit synchronize
user@jdm# commit synchronize
```

Now, JDM is up with Junos OS version 18.3R1.

Unified ISSU Support

Junos node slicing also supports unified in-service software upgrade (ISSU), enabling you to upgrade between two different Junos OS versions with no disruption on the control plane and with minimal disruption of traffic. You can perform unified ISSU on BSYS and GNFs separately. Also, you can run unified ISSU on each GNF independently—without affecting other GNFs. See also Understanding the Unified ISSU Process.

> **NOTE:** The multiversion software support restrictions (such as version deviation limits) are applicable to unified ISSU upgrade as well.

Managing Multiversion Software Interoperability

IN THIS SECTION

Junos node slicing supports multiversion software interoperability. However, if there are any incompatibilities between software versions, alert messages appear during the software upgrade process or when a GNF

or a FRU comes online. When minor incompatibilities occur, you can choose to accept them and proceed. In case of a major incompatibility, you need to either abort the process or use the **force** option to accept the incompatibility and proceed.

> **NOTE:** In case of vmhost software upgrade, the **force** option is not available. Therefore, if a GNF is offline or is incompatible with the software being installed, and is causing multiversion checks to abort, you need to deactivate that GNF during the software upgrade and then reactivate it once the upgrade is over.

The following are sample messages that appear if incompatibilities are detected during software upgrade:

Sample alert message indicating a minor incompatibility:

`user@router>` **request system software add /var/tmp/junos-install-mx-x86-64-17.4-20170703_dev_common.0.tgz**

```
Starting Multiversion compatibility checks for package
/var/tmp/junos-install-mx-x86-64-17.4-20170703_dev_common.0.tgz
Starting compatibility checks...
--------------------------------------------------------------------------------
System Anomalies:
--------------------------------------------------------------------------------
Ano-ID  ACTION  MESSAGE
--------------------------------------------------------------------------------
   100    WARN  <sample system incompatibility 1>

Accept incompatibility? [yes,no] (no) yes

   103    WARN  <sample system incompatibility 2>

Accept incompatibility? [yes,no] (no) yes

--------------------------------------------------------------------------------
CFG Anomalies for: set snmp interface
--------------------------------------------------------------------------------
FRU-ID   Ano-ID  ACTION  MESSAGE
--------------------------------------------------------------------------------
NONE        102    WARN  <sample config incompatibility 1>

Accept incompatibility? [yes,no] (no) yes

NONE        105    WARN  <sample config incompatibility 2>
```

```
Accept incompatibility? [yes,no] (no) yes


--------------------------------------------------------------------------------
FRU Anomalies:
--------------------------------------------------------------------------------
FRU-ID   Ano-ID  ACTION  MESSAGE
--------------------------------------------------------------------------------
0xaa0b      100    WARN  <sample FRU incompatibility 1>

Accept incompatibility? [yes,no] (no) yes

0xbb0b      101    WARN  <sample FRU incompatibility 2>

Accept incompatibility? [yes,no] (no) yes

Compatibility Checks done... OK
NOTICE: Validating configuration against
junos-install-mx-x86-64-17.4-20170703_dev_common.0.tgz.
NOTICE: Use the 'no-validate' option to skip this if desired.
Verified junos-install-mx-x86-64-17.4-20170703_dev_common.0 signed by
PackageDevelopmentEc_2017 method ECDSA256+SHA256
```

Sample alert message indicating a major incompatibility:

`user@router>` **request system software add /var/tmp/junos-install-mx-x86-64-17.4I20170713_0718.tgz**

```
Starting Multiversion compatibility checks for package
/var/tmp/junos-install-mx-x86-64-17.4I20170713_0718.tgz
Starting compatibility checks...
--------------------------------------------------------------------------------
System Anomalies:
--------------------------------------------------------------------------------
Ano-ID  ACTION  MESSAGE
--------------------------------------------------------------------------------
1677721600   ABORT  <sample system incompatibility 1>

error: Junos-Node-Slicing multi-version checks returned abort for package
/var/tmp/junos-install-mx-x86-64-17.4I20170713_0718.tgz
```

Sample output showing how to use the 'force' option to proceed with an upgrade:

user@router> **request system software add /var/tmp/junos-install-mx-x86-64-17.4I20170713_0718.tgz force**

```
NOTICE: Validating configuration against
junos-install-mx-x86-64-17.4I20170713_0718.tgz.
NOTICE: Use the 'no-validate' option to skip this if desired.
Verified junos-install-mx-x86-64-17.4I20170713_0718 signed by
PackageDevelopmentEc_2017 method ECDSA256+SHA256
Verified manifest signed by PackageDevelopmentEc_2017 method ECDSA256+SHA256
Checking PIC combinations
Adding junos-x86-64-17.4I20170713_0718...
```

Viewing Software Incompatibility Alarms

After a software update of a GNF or BSYS, if software incompatibilities between the GNF and the BSYS exist, they will be raised as a chassis alarm. You can view the incompatibility alarm information by using the **show chassis alarms** command. You can further view the details of the incompatibilities by using the **show system anomalies** command. For more details, see "Viewing Incompatibilities Between Software Versions" on page 100.

The alarms appear only on GNFs even if the upgrade is performed on the BSYS. The following types of alarm can occur:

- System Incompatibility with BSYS—This is a major alarm. It appears when any incompatibilities between BSYS and GNF software versions cause the GNF to go offline.
- Feature Incompatibility with BSYS—This is a minor alarm. It indicates a minor incompatibility between BSYS and GNF software versions. This does not cause the GNF to go offline.

Viewing Incompatibilities Between Software Versions

To view software incompatibilities from the BSYS, use the CLI as shown in the following example:

user@router> **show system anomalies gnf-id *4* system**

To view software incompatibilities from a GNF, use the CLI as shown in the following example:

user@router> **show system anomalies system**

NOTE:

- As shown in the CLI, remember to specify the GNF ID while viewing the incompatibilities from BSYS.
- The preceding examples show system-level incompatibilities. Use the **fru** or **config** options to view FRU or feature-level incompatibilities.

Restarting External Servers

Server maintenance activities such as hardware or host OS upgrade and fault isolation might require you to restart the external servers used in Junos node slicing. Use the following procedure to restart the servers:

1. Stop all the GNFs.

   If you are restarting both the servers, choose the **all-servers** option while stopping each GNF as shown in the following example:

   `root@server1>` **request virtual-network-functions *gnf_name* stop all-servers**

   ```
   gnf_name stopped
   ```

   If you are restarting a particular server, stop the GNFs on that server by specifying the server-id as shown in the following example:

   `root@server1>` **request virtual-network-functions *gnf_name* stop *server0***

   ```
   gnf_name stopped
   ```

2. Verify that the GNFs have been stopped.

   `root@server1>` **show virtual-network-functions**

   ```
   ID       Name                                                State      Liveness
   ------------------------------------------------------------------------------
   1        mgb-gnf-b                                           Shutdown   down
   ```

> **NOTE:** If you want to view the status of GNFs on both the servers, choose the **all-servers** option. Example: **show virtual-network-functions all-servers**).

3. From the Linux host shell, stop the JDM by using the following command:

```
[root@HostLinux ~]# jdm stop
Stopping JDM
```

4. From the Linux host shell, verify that the JDM status shows as stopped.

```
[root@HostLinux ~]# jdm status
JDM is stopped
```

5. After rebooting, verify that the JDM status now shows as running.

```
[root@HostLinux ~]# jdm status
JDM (pid 2828) is running as server1
```

After a server reboot, the JDM and the configured GNFs will automatically start running.

If you are replacing the servers, ensure that the operating server pair continues to have similar or identical hardware configuration. If the server pair were to become temporarily dissimilar during the replacement (this could be the case when replacing the servers sequentially), it is recommended that you disable GRES and NSR for this period, and re-enable them only when both the servers are similar once again.

Updating Host OS on the External Servers

Before updating the host OS on an external server, you must first stop the GNFs and JDM on that server as described in “Restarting External Servers” on page 101.

Following the host OS update, if you are using Intel X710 NICs, ensure that the version of the X710 NIC driver in use continues to be the latest version as described in “Updating Intel X710 NIC Driver for x86 Servers” on page 44 .

Applying Security Updates to Host OS

The host OS requires security updates from time to time. This section highlights the steps involved in applying Security Updates to the host OS using Red Hat (RHEL) OS.

Junos node slicing supports RHEL 7.3.

Before doing any updates to the host OS, ensure that Red Hat Subscription Manager is set to version 7.3 and that Red Hat Subscription Service includes Extended Update Support (EUS).

You can use the command **subscription-manager release --show** to confirm that the release is set to 7.3. If it is not, you can use the command **subscription-manager release --set=7.3** to set the release to 7.3.

> **NOTE:** You must ensure that the Red Hat Subscription Manager is set to version 7.3. Otherwise, updates to the RHEL will attempt to upgrade to the latest minor release. For example, RHEL 7.3 could become RHEL 7.4 (or a later version) with a general **yum** update, or a **yum** security update can pull in a new kernel beyond RHEL 7.3.

Red Hat's extended update support allows for patches and security updates to be applied within the specified release. Allowed use of RHEL's Extended Update support is a function of the RHEL support contract and beyond the scope of this section. You can check to see if your RHEL subscription includes Extended Update Support (EUS), by using the command **subscription-manager repos --list | grep rhel-7-server-eus-rpms**. EUS support is not enabled by default. EUS can be enabled, by using the command **subscription-manager repos --enable rhel-7-server-eus-rpms**.

Steps to Apply Host OS Security Updates

Applying security updates to host OS will likely require you to reboot the external x86 servers. See the "Updating Host OS on the External Servers" on page 102 topic.

It is also possible that a host OS security update will bring in a new kernel version. Updating the host OS kernel could also overwrite the Intel i40e driver to bring in a version of it that does not meet the i40e driver minimum version requirements. If so, you must update the i40e driver to meet the minimum requirements. For more details, see "Updating Intel X710 NIC Driver for x86 Servers" on page 44.

Before rebooting the external x86 servers, you must stop all GNF VMs and JDM on that server. Since we have two external x86 servers, the host OS Security Updates can be done without disrupting GNF forwarding, by updating one server at a time. A GRES/NSR Master Routing Engine switch-over is required to move the Master Routing Engine away from the affected server.

We start with the default behavior of Routing Engine 1 (**re1**) as the Backup Routing Engine for each GNF where **re1** for each GNF is running on the external x86 server1.

1. Back up all configurations.

2. Gather view of host OS kernel and package versions on the external x86 servers before the host OS security update. Also confirm i40e driver and Intel X710 firmware meet minimum requirements (version: 2.4.10 and version: 18.5.17).

   ```
   user@server# cat /etc/redhat-release
   user@server# uname -r
   user@server# uname -a
   user@server# rpm -q kernel
   user@server# ethtool -i p3p1
   ```

3. Ensure that RedHat Subscription Manager is set to RHEL 7.3 and the EUS Repository is enabled.

   ```
   [user@server ~]# subscription-manager version
   [user@server ~]# subscription-manager repos --list | grep rhel-7-server-eus-rpms
   ```

4. Ensure all GNFs are using Master RE on **server0**. The backup Routing Engine is **re1** on **server1**. First perform host OS security updates on the server that contains the backup Routing Engines.

   ```
   user@router> show chassis routing-engine
   ```

   Run this command on all the GNFs to confirm that all the GNFs have their master Routing Engine on server0.

5. Stop all GNF VMs in JDM cli via request **stop** on **server1** only. **server1** contains the backup Routing Engines for all the GNFs. Do not use the **all-servers** option. Example:

   ```
   user@jdm> request virtual-network-functions gnf-a stop server 1
   user@jdm> request virtual-network-functions gnf-b stop server 1
   ```

6. Stop JDM on the affected server from the host OS.

   ```
   user@server# jdm status
   user@server# jdm stop
   ```

7. Do the **yum** security update and reboot the server.

   ```
   user@server# yum -y update -security
   root@server# shutdown -r now
   ```

8. Reload or compile the i40e Driver. See the Intel support page for instructions on updating the driver.

At this point, the host OS security update to **server1** is done. Note that the GNF VMs start up on server reboot.

9. After the security updates are completed, the server rebooted and the GNFs are back up, repeat on the other server.

Applying Security Patches for Ubuntu Container

The Ubuntu container, which Juniper Device Manager (JDM) is based on, needs to have security patches applied from time to time.

> **NOTE:** JDM must be able to reach the internet and must have **name-server** configured. Apply the following JDM CLI configuration statement to specify the **name-server**:
>
> **root@jdm# set system name-server *address***

Use the following steps to apply security updates to the Ubuntu container components of JDM:

1. If you are using the external server model, from host OS, use the JDM console to enter JDM as root.

   root@server# **jdm console**

   Or, from the JDM CLI, enter JDM shell by using the command:

   root@jdm> **start shell user root**

   If you are using the in-chassis Junos node slicing, use the following command on the BSYS VM to enter JDM:

   root@router> **request vmhost jdm login**

2. From the JDM shell, use the command **apt-get update** to download information about new packages or the latest versions of the currently installed packages.

   jdm-srv1:~# **sudo apt-get update**

3. From the JDM shell, use the command **apt-get upgrade**.

   jdm-srv1:~# **sudo apt-get upgrade**

   You are shown a list of upgrades, and prompted to continue. Answer **Y** for yes and press **Enter**.

4. From the JDM shell, use the command **apt-get dist-upgrade** to perform the upgrade.

jdm-srv1:~# **sudo apt-get dist-upgrade**

Answer **Y** when prompted to continue, and wait for the upgrades to finish.

5. If you are using the external server model, from the host OS, restart the JDM.

   user@server# **sudo jdm restart**

   If you are using the in-chassis Junos node slicing, use the following commands on the BSYS VM to restart the JDM:

   root@router> **request vmhost jdm stop**

   root@router> **request vmhost jdm start**

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Managing Junos Node Slicing

IN THIS SECTION

Deleting Guest Network Functions

This procedure involves shutting down a GNF and then deleting it. In JDM, GNF VMs are called VNFs. Use the following steps to delete a VNF:

1. Shut down a VNF by using the JDM CLI command **request virtual-network-functions *gnf-name* stop all-servers**. For example:

   root@test-jdm-server0> **request virtual-network-functions test-gnf stop all-servers**

```
server0:
--------------------------------------------------------------------------
test-gnf stopped

server1:
--------------------------------------------------------------------------
test-gnf stopped
```

2. Delete the VNF configuration by applying the JDM CLI configuration statement **delete virtual-network-functions *gnf-name***. See the following example:

   root@test-jdm-server0# **delete virtual-network-functions test-gnf**

   root@test-jdm-server0# **commit synchronize**

3. Delete the VNF image repository by using the JDM CLI command **request virtual-network-functions *gnf-name* delete-image all-servers**. For example:

   root@test-jdm-server0> **request virtual-network-functions test-gnf delete-image all-servers**

```
server0:
--------------------------------------------------------------------------
Deleted the image repository
server1:
--------------------------------------------------------------------------
Deleted the image repository
```

NOTE:

- To delete a VNF completely, you must perform all the three steps.
- If you want to delete a VNF management interface, you must stop and delete the VNF first.

Disabling Junos Node Slicing

To disable Junos node slicing, you must uninstall the following packages:

- JDM package
- Junos OS image for GNFs

NOTE: Save the JDM configuration if you want to use it for reference.

Use the following steps to disable Junos node slicing (external server model):

1. Delete the GNFs first by performing all the steps described in the section "Deleting Guest Network Functions" on page 106.

2. Stop the JDM on each server by running the following command at the host Linux shell:

   root@Linux server0# **jdm stop**

   Stopping jdm: Domain jdm destroyed

3. Uninstall the JDM on each server by running the following command at the host Linux shell.

   For the servers running RHEL, run the following command:

   ```
   root@Linux server0# rpm -e jns-jdm
   ```

   For the servers running Ubuntu, run the following command:

   ```
   root@Linux server0# dpkg --remove jns-jdm
   ```

4. To revert the MX Series router from BSYS mode to standalone mode, apply the following configuration statements on the MX Series router:

   ```
   root@router# delete chassis network-slices guest-network-functions
   root@router# commit
   ```

   The router now operates in standalone mode.

To disable in-chassis Junos node slicing, you must:

- Shut down and delete all GNFs. Also, delete the Junos OS image associated with the GNF.
- Shut down JDM and then delete the JDM software package.
- Delete the in-chassis BSYS mode configuration (**set vmhost resize vjunos**).
- Reboot the Routing Engine.

Use the following steps to disable in-chassis Junos node slicing:

1. Delete the GNFs first by performing all the steps described in the section "Deleting Guest Network Functions" on page 106.

2. Stop the JDM on each Routing Engine by running the following command:

   ```
   root@router> request vmhost jdm stop
   ```

3. Uninstall the JDM on each Routing Engine by running the following command.

   ```
   root@router> request vmhost jdm delete
   ```

4. To revert the MX Series router from BSYS mode to standalone mode, apply the following configuration statements on the MX Series router:

   ```
   root@router# delete vmhost resize vjunos
   root@router# commit
   ```

5. Reboot VM host.

   ```
   user@router> request vm host reboot (re0|re1)
   ```

   The router now operates in standalone mode.

> **NOTE:** All files in the **/var/** location, including the log files (**/var/log**) and core files (**/var/crash**), are deleted when you reboot VM host after deleting the **vmhost resize vjunos compact** configuration. You must save any files currently in **/var/log** or **/var/crash** before deleting the **vmhost resize vjunos compact** configuration if you want to use them for reference.

RELATED DOCUMENTATION

- Junos Node Slicing Overview | 17
- Components of Junos Node Slicing | 19
- Sample Configuration for Junos Node Slicing | 77

4

CHAPTER

Configuration Statements for BSYS

af-name

Syntax

```
af-name {
    peer-gnf {
        id peer-gnf-id;
        remote-af-name;
    }
    description af-description;
}
```

Hierarchy Level

[edit chassis network-slices guest-network-functions gnf id]

Release Information

Statement introduced in Junos OS Release 17.4R1.

Description

Configure Abstracted Fabric (**af**) interface between a pair of guest network functions (GNFs). Abstracted Fabric interface is a pseudo interface that represents a first class Ethernet interface behavior. An **af** interface is created on a GNF to communicate with the peer GNF when the two GNFs are connected to each other through the CLI.

NOTE: Only one **af** interface can be configured between a pair of GNFs.

Options

af-name—Name of the **af** interface being created on the GNF.

Range: **af0** through **af9**

id *peer-gnf -id*—Name of the GNF peer connected using the **af** interface.

Range: 1 through 10

remote-af-name—Name of the **af** interface on the peer GNF.

description *af-description*—A description for the **af** interface.

Required Privilege Level

system

RELATED DOCUMENTATION

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | 71

control-plane-bandwidth-percent (Node Slicing)

Syntax

```
control-plane-bandwidth-percent percent;
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions gnf]
```

Release Information
Statement introduced in Junos OS Release 17.2.

Description
Allocate a percentage of the bandwidth that exists on the control plane on the router to the specified guest network function (GNF). Allocating bandwidth prevents potential overutilization by one GNF over another.

Options
percent—Percentage of control plane bandwidth.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

network-slices | 116
guest-network-functions | 120
gnf | 117
description | 113
fpcs | 115

description (GNF)

Syntax

```
description description;
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions gnf]
```

Release Information
Statement introduced in Junos OS Release 17.2.

Description
Provide a description string for the specified guest network function (GNF).

Options
description—A description string for the specified guest network function (GNF).

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

- network-slices | 116
- guest-network-functions | 120
- gnf | 117
- control-plane-bandwidth-percent | 112
- fpcs | 115

description (Abstracted Fabric)

Syntax

```
description description;
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions gnf af-name]
```

Release Information
Statement introduced in Junos OS Release 17.4R1.

Description
Provide a description string for the specified Abstracted Fabric (**af**) interface.

Options
description—A description string for the specified Abstracted Fabric (**af**) interface.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

- Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | **71**
- gnf | **117**
- control-plane-bandwidth-percent | **112**
- fpcs | **115**

fpcs (Node Slicing)

Syntax

```
fpcs fpcs;
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions gnf]
```

Release Information

Statement introduced in Junos OS Release 17.2.

Description

Assign FPCs to a guest network function.

> **NOTE:** A given FPC cannot be assigned to more than one GNF.

Options

fpcs—The FPC to be assigned to a guest network function.

Range: 0–63

Required Privilege Level

view-level—To view this statement in the configuration.

control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

- network-slices | 116
- guest-network-functions | 120
- gnf | 117
- control-plane-bandwidth-percent | 112
- description | 113

network-slices

Syntax

```
network-slices {
   guest-network-functions{
      gnf  id {
         control-plane-bandwidth-percent percent;
         description description;
         fpcs fpcs;
         af-name
         collapsed-forward
      }
   }
}
```

Hierarchy Level

```
[edit chassis]
```

Release Information
Statement introduced in Junos OS Release 17.2.

Description
Configure Junos node slicing.

Junos node slicing enables a single MX Series router to be partitioned to appear as multiple, independent routers. Each partition has its own Junos control plane, which runs as a virtual machine (VM), and a dedicated set of line cards. Each partition is called a guest network function (GNF).

The remaining statements are explained separately.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

- Optimizing Fabric Path for Abstracted Fabric Interface | 27
- Configuring an MX Series Router to Operate in BSYS Mode (External Server Model) | 49
- Configuring Guest Network Functions | 68

gnf

Syntax

```
gnf id {
    control-plane-bandwidth-percent percent;
    description description;
    fpcs fpcs;
    af-name ;
    collapsed-forward
}
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions]
```

Release Information
Statement introduced in Junos OS Release 17.2.

Description
Define a GNF by assigning an ID to it.

Junos node slicing enables a single MX Series router to be partitioned to appear as multiple, independent routers. Each partition has its own Junos control plane, which runs as a virtual machine (VM), and a dedicated set of line cards. Each partition is called a guest network function (GNF).

Options
id—GNF ID

Range: 1–10

The remaining statements are explained separately.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

Configuring Guest Network Functions | 68
network-slices | 116
guest-network-functions | 120

collapsed-forward

Syntax

```
collapsed-forward (monitor | optimize);
```

Hierarchy Level

```
[edit chassis network-slices guest-network-functions gnf]
```

Release Information

Statement introduced in Junos OS Release 19.4R1.

Description

Configure a fabric path optimization mode to optimize the fabric path of the traffic flowing over Abstracted Fabric (af) interfaces between two guest network functions (GNFs). After configuring fabric path optimization, you can use the command **show interfaces *af-interface-name*** in GNF to view the number of packets that are currently flowing on the optimal / non-optimal path.

NOTE:

- You must configure the **collapsed-forward** statement on both the peer guest network functions (GNFs) on the Abstracted Fabric interface for the commit to be successful.
- The **collapsed-forward** statement is configured at the Abstracted Fabric interface level. All logical interfaces on the Abstracted Fabric interface inherit this configuration.
- We strongly recommend that you do not configure the **collapsed-forward** statement on GNFs that have a mix of supported and unsupported MPCs (MPCs that support fabric path optimization and MPCs that do not) to avoid any erratic behavior.

Options

monitor—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized path. However, the source GNF does not forward the traffic towards the desired Packet Forwarding Engine.

optimize—If you configure this mode, the peer GNF monitors the traffic flow and sends information to the source GNF about the Packet Forwarding Engine to which the traffic is being forwarded currently and the desired Packet Forwarding Engine that could provide an optimized path. The source GNF then forwards the traffic towards the desired Packet Forwarding Engine.

Required Privilege Level

view-level—To view this statement in the configuration.

control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

- Optimizing Fabric Path for Abstracted Fabric Interface | **27**
- network-slices | **116**
- guest-network-functions | **120**
- gnf | **117**
- control-plane-bandwidth-percent | **112**
- description | **113**

guest-network-functions

Syntax

```
guest-network-functions {
    gnf id {
        control-plane-bandwidth-percent percent;
        description description;
        fpcs fpcs;
        af-name
    }
}
```

Hierarchy Level

```
[edit chassis network-slices]
```

Release Information

Statement introduced in Junos OS Release 17.2.

Description

Configure a guest network function for Junos node slicing.

Junos node slicing enables a single MX Series router to be partitioned to appear as multiple, independent routers. Each partition has its own Junos control plane, which runs as a virtual machine (VM), and a dedicated set of line cards. Each partition is called a guest network function (GNF).

The remaining statements are explained separately.

Required Privilege Level

view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

RELATED DOCUMENTATION

Configuring Guest Network Functions | 68

network-slices | 116

peer-gnf

Syntax

```
peer-gnf {
    id peer-gnf-id;
    remote-af-name;
}
```

Hierarchy Level

[edit chassis network-slices guest-network-functions gnf id *af-name*]

Release Information

Statement introduced in Junos OS Release 17.4R1.

Description

Configure the details of the GNF peer connected using the Abstracted Fabric (**af**) interface.

Options

id*peer-gnf -id*—Name of the GNF peer connected using the Abstracted Fabric (**af**) interface.

Range: 1 through 10

remote-af-name—Name of the **af** interface on the peer GNF.

Required Privilege Level

system

RELATED DOCUMENTATION

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | 71

vmhost resize vjunos compact

Syntax

```
vmhost resize vjunos compact
```

Hierarchy Level

```
[edit]
```

Release Information
Statement introduced in Junos OS Release 19.1R1.

Description
Reduce the routing engine resource footprint on MX Series router to accommodate GNF VMs within the Routing Engine in in-chassis Junos node slicing. Configuring the **vmhost resize vjunos compact** statement enables hyperthreading in Routing Engine CPU. The in-chassis Junos node slicing requires that hyperthreading be enabled.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

5

CHAPTER

Operational Commands for BSYS

request vmhost jdm add (In-Chassis Model)

Syntax

request vmhost jdm add *package-name*

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Adds the Juniper Device Manager (JDM) software package. This command is applicable to in-chassis Junos node slicing.

Options

add *package-name*—Add the Juniper Device Manager (JDM) software package. You need to type the package name after the command **add**.

Required Privilege Level

maintenance

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | **200**
- show virtual-network-functions | **210**
- request server authenticate-peer-server | **206**

request vmhost jdm delete (In-Chassis Model)

Syntax

request vmhost jdm delete

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Uninstalls the Juniper Device Manager (JDM). This command is applicable to in-chassis Junos node slicing.

Required Privilege Level

maintenance

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- show virtual-network-functions | 210
- request server authenticate-peer-server | 206

request vmhost jdm start (In-Chassis Model)

Syntax

request vmhost jdm start

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Starts the Juniper Device Manager (JDM). This command is applicable to in-chassis Junos node slicing.

Required Privilege Level

maintenance

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- show virtual-network-functions | 210
- request server authenticate-peer-server | 206

Sample Output

request vmhost jdm start

```
user@router> request vmhost jdm start

Starting JDM
Starting jdm: Domain jdm defined from
/vm/vm/iapps/jdm//install/juniper/lxc/jdm/current/config/jdm.xml
Domain jdm started
```

request vmhost jdm login (In-Chassis Model)

Syntax

request vmhost jdm login

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Logs in to the Juniper Device Manager (JDM). This command is applicable to in-chassis Junos node slicing.

Required Privilege Level

maintenance

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- show virtual-network-functions | 210
- request server authenticate-peer-server | 206

Sample Output

request vmhost jdm login

```
root@router> request vmhost jdm login

**************************************************************************
* The Juniper Device Manager (JDM) must only be used for orchestrating the *
* Virtual Machines for Junos Node Slicing *
* *
* Host Linux Distro: Wind River Linux *
* JDM Version: jns-jdm-vmhost-19.1-20181003.dev.common.0.x86_64 *
* Free Disk Space on JDM's root-fs ("/"): 125081(MiB) *
**************************************************************************
Last login: Thu Oct 4 15:26:30 2018 from 192.168.1.1
```

request vmhost jdm stop (In-Chassis Model)

Syntax

request vmhost jdm stop

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Stops the Juniper Device Manager (JDM). This command is applicable to in-chassis Junos node slicing.

Required Privilege Level

maintenance

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- show virtual-network-functions | 210
- request server authenticate-peer-server | 206

show vmhost status (In-Chassis Model)

Syntax

```
show vmhost status (re0 | re1)
<routing-engine (backup | both | local | master | other)>
<invoke-on (all-routing-engines | other-routing-engine)>
```

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Displays the VM host status. This command is applicable to in-chassis Junos node slicing. When the router is operating in the in-chassis Junos node slicing mode, the **vJunos Resource Status** is shown as **Compact**. When the router is not operating in the in-chassis Junos node slicing mode, the **vJunos Resource Status** is shown as **Normal**.

Options

re0—Displays Routing Engine 0 (re0) VM host status.

re1—Displays Routing Engine 1 (re1) VM host status.

routing-engine—Displays the VM host status of a specific routing engine. You have the following sub-options:

- backup
- master
- both
- local
- other

invoke-on—Displays the VM host status of the remote Routing Engines or all Routing Engines. You have the following options:

- all-routing-engines
- other-routing-engine

Required Privilege Level

View

RELATED DOCUMENTATION

Generic Guidelines for Using JDM Server Commands | 200

show virtual-network-functions | 210

request server authenticate-peer-server | 206

Sample Output

show vmhost jdm status re0

```
user@router> show vmhost status re0


bsys-re0:
--------------------------------------------------------------------------

Compute cluster: rainier-re-cc
  Compute Node: rainier-re-cn, Online

vJunos Resource Status: Compact
```

show vmhost jdm status (In-Chassis Model)

Syntax

show vmhost jdm status

Release Information

Command introduced in Junos OS Release 19.1R1.

Description

Displays the Juniper Device Manager (JDM) status. This command is applicable to in-chassis Junos node slicing.

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- show virtual-network-functions | 210
- request server authenticate-peer-server | 206

Sample Output

show vmhost jdm status

```
user@router> show vmhost jdm status

JDM Information
--------------------------
Package    :  jns-jdm-vmhost-19.1-B2.x86_64
Status     :  Running
PID        :  3088
Free Space :  62967 (MiB)
```

show chassis network-slices

Syntax

```
show chassis network-slices
<gnf gnf-id>
```

Release Information

Command introduced in Junos OS Release 17.2R1.

Description

Display Junos node slicing information for the guest network functions (GNFs) configured on the base system (BSYS). The **gnf *gnf-id*** option displays the information about a particular GNF.

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis fpc pic-status (Node Slicing) | 136
- show chassis fpc (Node Slicing) | 138
- show chassis adc (Node Slicing) | 141
- show chassis network-slices fpcs | 143

List of Sample Output

Output Fields

Table 8 on page 132 lists the output fields for the **show chassis network-slices** command. Output fields are listed in the approximate order in which they appear.

Table 8: show chassis network-slices Output Fields

Field Name	Field Description
GNF	GNF identifier for each partition.
Description	Description of the guest network function.

Table 8: show chassis network-slices Output Fields *(continued)*

Field Name	Field Description
State	Status of the GNF. • **Online**—GNF online and running. • **Offline**—GNF is offline.
Uptime	Duration for which the GNFs have been up and running. In case of a GNF Routing Engine switchover, the uptime value is reset as the new master GNF Routing Engine establishes a fresh connection with the BSYS. This behavior is specific to GNFs and does not have any functional impact.
GNF ID	Shows the GNF ID.
GNF description	Shows the description of GNF.
FPCs assigned	Shows the FPC slot numbers assigned to the GNF.
FPCs online	Shows the FPCs that are online.
BSYS	Shows the name of the BSYS.
BSYS sw version	Shows the Junos software version used in the BSYS.
GNF sw version	Shows the Junos software version used in the GNF.
BSYS master RE	Master Routing Engine slot.
GNF uptime	Duration for which the GNF has been up and running. In case of a GNF Routing Engine switchover, the GNF uptime value is reset as the new master GNF Routing Engine establishes a fresh connection with the BSYS. This behavior is specific to GNFs and does not have any functional impact.
GNF Routing Engine Status:	Show the details of the Routing Engines in the slot 0 and 1. It includes the Current State, (master or backup), Routing Engine model, and GNF host name.

Sample Output

show chassis network-slices

user@router> show chassis network-slices

```
guest-network-functions:
GNF    Description    State          Uptime
 1     gnf-a          Online         12 hours, 46 minutes, 11 seconds
 2     gnf-b          Online         12 hours, 13 minutes, 57 seconds
 3     gnf-c          Online         12 hours, 3 minutes, 55 seconds
 4     gnf-d          Online         12 hours, 8 minutes, 20 seconds
 5     gnf-e          Online         12 hours, 2 minutes, 46 seconds
 6     gnf-f          Online         11 hours, 56 minutes, 29 seconds
```

show chassis network-slices gnf

user@router> show chassis network-slices gnf

```
GNF ID           1
GNF description  NA
GNF state        Online
FPCs assigned    7 8
FPCs online      7 8
BSYS             router(mx960)
BSYS sw version  18.2-20180321_0948_bsys
GNF  sw version  18.2-20180314_gnf
Chassis          mx960
BSYS master RE   0
GNF uptime       4 days, 23 hours, 55 minutes, 1 second
GNF Routing Engine Status:
Slot 0:
    Current state   Master
    Model           RE-GNF-2400x4
    GNF host name   gnf-host0
Slot 1:
    Current state   Backup
    Model           RE-GNF-2400x4
    GNF host name   gnf-host1
GNF ID           2
GNF description  NA
GNF state        Online
FPCs assigned    NA
FPCs online      NA
BSYS             router(mx960)
BSYS sw version  18.2-20180321_0948_bsys
GNF  sw version  18.2-20180216_gnf
Chassis          mx960
```

```
BSYS master RE   0
GNF uptime       4 days, 23 hours, 53 minutes, 54 seconds
GNF Routing Engine Status:
Slot 0:
    Current state   Master
    Model           RE-GNF-2400x4
    GNF host name   gnf-host2
Slot 1:
    Current state   Backup
    Model           RE-GNF-2400x4
    GNF host name   gnf-host3
```

show chassis network-slices gnf <gnf-id>

```
user@router> show chassis network-slices gnf 2
```

```
GNF ID           2
GNF description  NA
GNF state        Online
FPCs assigned    NA
FPCs online      NA
BSYS             router(mx960)
BSYS sw version  18.2-20180321_0948_bsys
GNF  sw version  18.2-20180216_gnf
Chassis          mx960
BSYS master RE   0
GNF uptime       4 days, 23 hours, 53 minutes, 54 seconds
GNF Routing Engine Status:
Slot 0:
    Current state   Master
    Model           RE-GNF-2400x4
    GNF host name   gnf-host2
Slot 1:
    Current state   Backup
    Model           RE-GNF-2400x4
    GNF host name   gnf-host3
```

show chassis fpc pic-status (Node Slicing)

Syntax

```
show chassis fpc pic-status
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.

Description

Display the status of the physical interface cards (PICs) of each Flexible PIC Concentrator (FPC) assigned to different guest network functions (GNFs).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis network-slices | 132
- show chassis fpc (Node Slicing) | 138
- show chassis adc (Node Slicing) | 141
- show chassis network-slices fpcs | 143

Sample Output

user@router> show chassis fpc pic-status

```
Slot 0   Online       MPC5E 3D 24XGE+6XLGE                        GNF 3
  PIC 0  Online       12X10GE SFPP OTN
  PIC 1  Offline      12X10GE SFPP OTN
  PIC 2  Offline      3X40GE QSFPP
  PIC 3  Online       3X40GE QSFPP
Slot 1   Online       MPC9E 3D                                    GNF 2
  PIC 1  Online       MRATE-12xQSFPP-XGE-XLGE-CGE
Slot 2   Online       MPC5E 3D Q 2CGE+4XGE                        GNF 3
  PIC 0  Online       2X10GE SFPP OTN
```

```
  PIC 1  Online       1X100GE CFP2 OTN
  PIC 2  Online       2X10GE SFPP OTN
  PIC 3  Online       1X100GE CFP2 OTN
Slot 3   Online       MPCE Type 2 3D EQ                              GNF 6
Slot 4   Online       MPC6E 3D                                       GNF 6
  PIC 0  Online       24X10GE SFPP
  PIC 1  Online       2X100GE CFP2 OTN
Slot 5   Online       MPC9E 3D                                       GNF 4
  PIC 0  Online       MRATE-12xQSFPP-XGE-XLGE-CGE
Slot 6   Online       MPC7E 3D MRATE-12xQSFPP-XGE-XLGE-CGE           GNF 1
  PIC 0  Online       MRATE-6xQSFPP-XGE-XLGE-CGE
  PIC 1  Online       MRATE-6xQSFPP-XGE-XLGE-CGE
Slot 7   Online       MPC5E 3D 2CGE+4XGE                             GNF 5
  PIC 0  Online       2X10GE SFPP OTN
  PIC 1  Online       1X100GE CFP2 OTN
  PIC 2  Online       2X10GE SFPP OTN
  PIC 3  Online       1X100GE CFP2 OTN
Slot 8   Online       MPC6E 3D                                       GNF 5
  PIC 0  Online       24X10GE SFPP OTN
Slot 9   Online       MPC6E 3D                                       GNF 5
  PIC 0  Online       24X10GE SFPP
  PIC 1  Online       4X100GE CXP
```

show chassis fpc (Node Slicing)

Syntax

show chassis fpc

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.

Description

Display information about Flexible PIC Concentrators (fpcs) assigned to different guest network functions (GNFs).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis network-slices | **132**
- show chassis fpc pic-status (Node Slicing) | **136**
- show chassis adc (Node Slicing) | **141**
- show chassis network-slices fpcs | **143**

Output Fields

Table 9 on page 139 lists the output fields for the **show chassis fpc** command. Output fields are listed in the approximate order in which they appear.

Table 9: show chassis fpc Output Fields

Field Name	Field Description
Slot or **Slot State**	Slot number and state. The state can be one of the following conditions: • **Dead**—Held in reset because of errors. • **Diag**—Slot is being ignored while the FPC is running diagnostics. • **Dormant**—Held in reset. • **Empty**—No FPC is present. • **Online**—FPC is online and running. • **Present**—FPC is detected by the chassis daemon but either is not supported by the current version of Junos OS or is inserted in the wrong slot. The output also states either **Hardware Not Supported** or **Hardware Not In Right Slot**. The FPC is coming up but not yet online. • **Probed**—Probe is complete; awaiting restart of the Packet Forwarding Engine. • **Probe-wait**—Waiting to be probed.
Temp (C) or Temperature	Temperature of the air passing by the FPC, in degrees Celsius or in both Celsius and Fahrenheit.
Total CPU Utilization (%)	Total percentage of CPU being used by the FPC's processor.
Interrupt CPU Utilization (%)	Of the total CPU being used by the FPC's processor, the percentage being used for interrupts.
1 min CPU Utilization (%)	Information about the Routing Engine's CPU utilization in the past 1 minute.
5 min CPU Utilization (%)	Information about the Routing Engine's CPU utilization in the past 5 minutes.
15 min CPU Utilization (%)	Information about the Routing Engine's CPU utilization in the past 15 minutes.
Memory DRAM (MB)	Total DRAM, in megabytes, available to the FPC's processor.

Table 9: show chassis fpc Output Fields *(continued)*

Field Name	Field Description
Heap Utilization (%)	Percentage of heap space (dynamic memory) being used by the FPC's processor. If this number exceeds 80 percent, there may be a software problem (memory leak). **NOTE:** On MX Series routers and EX Series switches in a broadband edge environment, heap utilization levels higher than 70 percent can affect unified ISSU, router stability, or scaling capability.
Buffer Utilization (%)	Percentage of buffer space being used by the FPC's processor for buffering internal messages.
GNF	GNF identifier associated with each FPC. (**pic-status** output only) GNF identifier associated with each PIC.

Sample Output

user@router> show chassis fpc

```
                    Temp  CPU                 CPU                     Memory
                          Utilization (%)     Utilization(%)          Utilization (%)
Slot State          (C)   Total  Interrupt    1min   5min   15min DRAM(MB) Heap  Buffer GNF
0  Online           45     12          0      12     12     12    3584      6      25   3
1  Online           57     22          0      20     20     20    3136     16      22   2
2  Online           50     19          0      17     17     16    3584      6      25   3
3  Online           28     10          0      11     11     11    2048     10      20   6
4  Online           42     20          0      20     19     19    3584      8      25   6
5  Online           58     22          0      21     20     20    3136     16      22   4
6  Online           49     17          0      15     16     16    3136     13      20   1
7  Online           44     11          0      10     10     10    3584      6      25   5
8  Online           40     19          0      18     18     18    3584      8      25   5
9  Online           44     19          0      20     20     20    3584      8      25   5
```

show chassis adc (Node Slicing)

Syntax

```
show chassis adc
```

Release Information

Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.
Command introduced in Junos OS Release 17.2 for MX2008 Universal Routing Platforms.

Description

Display chassis information about the adapter cards (ADCs).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis network-slices | 132
- show chassis fpc pic-status (Node Slicing) | 136
- show chassis fpc (Node Slicing) | 138
- show chassis network-slices fpcs | 143

List of Sample Output

show chassis adc (Node Slicing) on page 142

Output Fields

Table 10 on page 141 lists the output fields for the **show chassis adc** command. Output fields are listed in the approximate order in which they appear.

Table 10: show chassis adc Output Fields

Field Name	Field Description
Slot	Slot number.
State	Status of the adapter card. • **Online**—The adapter card is online and running. • **Offline**—Adapter card is powered down.

Table 10: show chassis adc Output Fields *(continued)*

Field Name	Field Description
Uptime	How long the Routing Engine has been connected to the adapter card and, therefore, how long the adapter card has been up and running.
GNF (Node slicing)	GNF identifier for each ADC.

Sample Output

show chassis adc (Node Slicing)

```
user@router> show chassis adc
```

```
Slot  State           Uptime                                      GNF
 0    Online           12 hours, 57 minutes, 46 seconds            3
 1    Empty       --- Native line card ---                         2
 2    Online           12 hours, 57 minutes, 18 seconds            3
 3    Online           11 minutes, 23 seconds                      6
 4    Empty       --- Native line card ---                         6
 5    Empty       --- Native line card ---                         4
 6    Online           13 hours, 38 minutes, 58 seconds            1
 7    Online           13 hours, 3 minutes, 40 seconds             5
 8    Empty       --- Native line card ---                         5
 9    Empty       --- Native line card ---                         5
```

show chassis network-slices fpcs

Syntax

```
show chassis network-slices fpcs
```

Release Information

Command introduced in Junos OS Release 17.2R1.

Description

Display information about the FPCs associated with different guest network functions (GNFs).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis network-slices | 132
- show chassis fpc pic-status (Node Slicing) | 136
- show chassis fpc (Node Slicing) | 138
- show chassis adc (Node Slicing) | 141

Output Fields

Table 11 on page 143 lists the output fields for the **show chassis network-slices fpcs** command. Output fields are listed in the approximate order in which they appear.

Table 11: show chassis network-slices fpcs Output Fields

Field Name	Field Description
GNF	GNF ID.
FPCs	Slot numbers of FPCs associated with the GNF ID.

Sample Output

```
user@router> show chassis network-slices fpcs
```

```
guest-network-functions:
GNF    FPCs
 1     6
 2     1
 3     0 2
 4     5
 5     7 8 9
 6     3 4
```

show system anomalies gnf-id (BSYS)

Syntax

show system anomalies gnf-id *id* (all-anomalies | config | fru | system)

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display incompatibilities between the software version running on the base system (BSYS) and the software running on a specific guest network function (GNF).

Options

gnf-id *id*—Specify the GNF ID for which you want to view the software incompatibilities.

all-anomalies—Display the multiversion software incompatibilities from all categories—system, configuration and FRU.

config—Display feature-level incompatibilities between software versions.

fru—Display the FRU-level incompatibilities between software versions. This can be an incompatibility pertaining to the support for a specific FRU.

system—Display the system-level incompatibilities between software versions. These include IPC incompatibility, CLI or SNMP incompatibility.

Required Privilege Level

View

RELATED DOCUMENTATION

- show system anomalies (GNF) | **186**
- Generic Guidelines for Using JDM Server Commands | **200**
- request virtual-network-functions | **208**
- request server authenticate-peer-server | **206**

Output Fields

Table 12 on page 146 lists the output fields for the **show system anomalies gnf-id** command. Output fields are listed in the approximate order in which they appear.

Table 12: show system anomalies gnf-id Output Fields

Field Name	Field Description
Anomaly Type	Shows the software incompatibility type. The following are the possible values: • SYS—Indicates system-specific incompatibilities. • FRU—Indicates FRU-specific incompatibilities. • CONFIG—Indicates feature-specific incompatibilities.
Anomaly ID	Shows the incompatibility ID.
Default Action	Shows the default actions associated with incompatibilities. The following are the possible values: • WARN—Indicates the presence of a minor incompatibility. It causes a warning. • ABORT—Indicates the presence of a major incompatibility. It causes an abort action.
Class	Indicates of the incompatibility is present in GNF, or BSYS, or both.
Message	Incompatibility description.
FRU ID	Field-replaceable unit (FRU) ID. Applicable in the case of FRU-specific incompatibilities.
Firmware	Firmware of the FRU.

Sample Output

`user@router>` **show system anomalies gnf-id 1**

```
Anomaly Type    Anomaly ID   Default Action     Class         Message
                   FRU ID    Firmware
-------------------------------------------------------------------------------------------------------------------------
SYS             100        WARN              GNF Present   system incompatibility
 1
SYS             103        WARN              BOTH Present  system incompatibility
 2
```

```
SYS             200         WARN             BSYS Present  system incompatibility
 3
```

CHAPTER 6

Operational Commands for GNF

show chassis gnf

Syntax

show chassis gnf

Release Information

Command introduced in Junos OS Release 18.2R1.

Description

Display information about the guest network function (GNF) you logged in.

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis hardware (GNF) | **155**
- show chassis fpc pic-status (GNF) | **161**
- show chassis adc (GNF) | **162**
- show chassis network-slices | **132**

List of Sample Output

show chassis gnf on page 150

Output Fields

Table 13 on page 149 lists the output fields for the **show chassis gnf** command. Output fields are listed in the approximate order in which they appear.

Table 13: show chassis gnf Output Fields

Field Name	Field Description
GNF ID	Shows the GNF ID.
GNF State	Status of the GNF. • **Online**—GNF online and running. • **Offline**—GNF is offline.
GNF description	Description of the guest network function.
FPCs assigned	The FPC slot numbers assigned to the GNF.

Table 13: show chassis gnf Output Fields *(continued)*

Field Name	Field Description
FPCs online	The FPCs that are online.
BSYS	Name of the BSYS.
BSYS sw version	The Junos software version used in the BSYS.
GNF sw version	The Junos software version used in the GNF.
BSYS master RE	Master Routing Engine slot.
GNF uptime	Duration for which the GNF has been up and running.
GNF Routing Engine Status:	The details of the Routing Engines in the slot 0 and 1. The details include the Current State, (master or backup), Routing Engine model, and GNF host name.

Sample Output

show chassis gnf

user@router> show chassis gnf

```
GNF ID           1
GNF description  NA
GNF state        Online
FPCs assigned    8 9
FPCs online      8 9
BSYS             router(mx960)
BSYS sw version  18.2-20180321_0948_bsys
GNF  sw version  18.2-20180314_1035_gnf
Chassis          mx960
BSYS master RE   0
GNF uptime       54 minutes, 37 seconds
GNF Routing Engine Status:
Slot 0:
    Current state   Master
    Model           RE-GNF-2100x4
    GNF host name   gnf-host0
Slot 1:
```

```
Current state   Backup
Model           RE-GNF-2100x4
GNF host name   gnf-host1
```

show chassis gnf

Syntax

show chassis gnf

Release Information

Command introduced in Junos OS Release 18.2R1.

Description

Display information about the guest network function (GNF) you logged in.

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis hardware (GNF) | **155**
- show chassis fpc pic-status (GNF) | **161**
- show chassis adc (GNF) | **162**
- show chassis network-slices | **132**

List of Sample Output

show chassis gnf on page 153

Output Fields

Table 13 on page 149 lists the output fields for the **show chassis gnf** command. Output fields are listed in the approximate order in which they appear.

Table 14: show chassis gnf Output Fields

Field Name	Field Description
GNF ID	Shows the GNF ID.
GNF State	Status of the GNF. • **Online**—GNF online and running. • **Offline**—GNF is offline.
GNF description	Description of the guest network function.
FPCs assigned	The FPC slot numbers assigned to the GNF.

Table 14: show chassis gnf Output Fields *(continued)*

Field Name	Field Description
FPCs online	The FPCs that are online.
BSYS	Name of the BSYS.
BSYS sw version	The Junos software version used in the BSYS.
GNF sw version	The Junos software version used in the GNF.
BSYS master RE	Master Routing Engine slot.
GNF uptime	Duration for which the GNF has been up and running.
GNF Routing Engine Status:	The details of the Routing Engines in the slot 0 and 1. The details include the Current State, (master or backup), Routing Engine model, and GNF host name.

Sample Output

show chassis gnf

user@router> show chassis gnf

```
GNF ID           1
GNF description  NA
GNF state        Online
FPCs assigned    8 9
FPCs online      8 9
BSYS             router(mx960)
BSYS sw version  18.2-20180321_0948_bsys
GNF  sw version  18.2-20180314_1035_gnf
Chassis          mx960
BSYS master RE   0
GNF uptime       54 minutes, 37 seconds
GNF Routing Engine Status:
Slot 0:
    Current state   Master
    Model           RE-GNF-2100x4
    GNF host name   gnf-host0
Slot 1:
```

```
    Current state   Backup
    Model           RE-GNF-2100x4
    GNF host name   gnf-host1
```

show chassis hardware (GNF)

Syntax

```
show chassis hardware
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.3 for MX2010 and MX2020 Universal Routing Platforms.

Description

Display a list of all hardware components of the chassis, including the hardware version level and serial number, the GNF Routing Engine details, and the FPCs assigned to the GNF.

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis fpc (GNF) | **158**
- show chassis fpc pic-status (GNF) | **161**
- show chassis adc (GNF) | **162**

Output Fields

Table 15 on page 155 lists the output fields for the **show chassis hardware** command. Output fields are listed in the approximate order in which they appear.

Table 15: show chassis hardware Output Fields

Field Name	Field Description
Item	Chassis component: • Information about the backplane, Routing Engine, Power Entry Modules (PEMs), and fan trays. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs), Modular Port Concentrators (MPCs) and associated Modular Interface Cards (MICs), or Dense Port Concentrators (DPCs).
Version	Revision level of the chassis component.
Part number	Part number of the chassis component.

Table 15: show chassis hardware Output Fields *(continued)*

Field Name	Field Description
Serial number	Serial number of the chassis component. The serial number of the backplane is also the serial number of the router chassis. Use this serial number when you need to contact Juniper Networks Customer Support about the router or switch chassis.
Description	Brief description of the hardware item.

Sample Output

`user@router>` **show chassis hardware**

```
bsys-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11C9CDDAFK      MX2010
Midplane         REV 35   750-044636   ABAB9184          Lower Backplane
Midplane 1       REV 02   711-044557   ABAB9048          Upper Backplane
PMP              REV 04   711-032426   ACAJ2622          Power Midplane
FPM Board        REV 09   760-044634   ABCF2618          Front Panel Display
PSM 0           REV 01   740-050037   1EDB3130084      DC 52V Power Supply Module
PSM 1           REV 01   740-050037   1EDB313001Z      DC 52V Power Supply Module
PSM 2           REV 01   740-050037   1EDB321018D      DC 52V Power Supply Module
PSM 3           REV 01   740-050037   1EDB32101AZ      DC 52V Power Supply Module
PSM 4           REV 01   740-050037   1EDB32202C2      DC 52V Power Supply Module
PSM 5           REV 01   740-050037   1EDB32100TC      DC 52V Power Supply Module
PSM 6           REV 01   740-050037   1EDB3210166      DC 52V Power Supply Module
PSM 7           REV 01   740-050037   1EDB3210165      DC 52V Power Supply Module
PSM 8           REV 01   740-050037   1EDB3210163      DC 52V Power Supply Module
PDM 0            REV 03   740-045234   1EGA3170177       DC Power Dist Module
Routing Engine 0 REV 08   750-055814   CAFV5537          RE-S-2X00x8
CB 0             REV 08   750-055087   CAFN3426          MX2K Enhanced SCB
  Xcvr 0         REV 01   740-031980   ALM0HC7           SFP+-10G-SR
  Xcvr 1         REV 01   740-031980   123363A00418      SFP+-10G-SR
CB 1             REV 08   750-055087   CAFN3423          MX2K Enhanced SCB
SPMB 0           REV 05   711-041855   CAEZ5998          PMB Board
SPMB 1           REV 05   711-041855   CAEZ5993          PMB Board
```

```
SFB 0           REV 06   711-044466   ABCD6742         Switch Fabric Board
SFB 1           REV 06   711-044466   ABCG5627         Switch Fabric Board
SFB 2           REV 06   711-044466   ABCG5659         Switch Fabric Board
SFB 3           REV 06   711-044466   ABCG5653         Switch Fabric Board
SFB 4           REV 06   711-044466   ABCG5611         Switch Fabric Board
SFB 5           REV 06   711-044466   ABCG5635         Switch Fabric Board
SFB 6           REV 06   711-044466   ABCG5638         Switch Fabric Board
SFB 7           REV 06   711-044466   ABCG3650         Switch Fabric Board
FPC 8           REV 68   750-044130   ABCY5967         MPC6E 3D
  CPU           REV 12   711-045719   ABCY9696         RMPC PMB
Fan Tray 0      REV 06   760-046960   ACAY0428         172mm FanTray - 6 Fans
Fan Tray 1      REV 06   760-046960   ACAY0800         172mm FanTray - 6 Fans
Fan Tray 2      REV 06   760-046960   ACAY0797         172mm FanTray - 6 Fans
Fan Tray 3      REV 06   760-046960   ACAY1047         172mm FanTray - 6 Fans

gnf2-re0:
--------------------------------------------------------------------------
Chassis                                 GN59081553B0      MX2010-GNF     <<<
Routing Engine 0                                          RE-GNF-1700x4
```

show chassis fpc (GNF)

Syntax

show chassis fpc

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.

Description

Display information about the Flexible PIC Concentrators (fpcs) assigned to the guest network function (GNF).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis hardware (GNF) | **155**
- show chassis fpc pic-status (GNF) | **161**
- show chassis adc (GNF) | **162**

Output Fields

Table 16 on page 159 lists the output fields for the **show chassis fpc** command. Output fields are listed in the approximate order in which they appear.

Table 16: show chassis fpc Output Fields

Field Name	Field Description
Slot or **Slot State**	Slot number and state. The state can be one of the following conditions: • **Dead**—Held in reset because of errors. • **Diag**—Slot is being ignored while the FPC is running diagnostics. • **Dormant**—Held in reset. • **Empty**—No FPC is present. • **Online**—FPC is online and running. • **Present**—FPC is detected by the chassis daemon but either is not supported by the current version of Junos OS or is inserted in the wrong slot. The output also states either **Hardware Not Supported** or **Hardware Not In Right Slot**. The FPC is coming up but not yet online. • **Probed**—Probe is complete; awaiting restart of the Packet Forwarding Engine. • **Probe-wait**—Waiting to be probed.
Temp (C) or Temperature	Temperature of the air passing by the FPC, in degrees Celsius or in both Celsius and Fahrenheit.
Total CPU Utilization (%)	Total percentage of CPU being used by the FPC's processor.
Interrupt CPU Utilization (%)	Of the total CPU being used by the FPC's processor, the percentage being used for interrupts.
1 min CPU utilization (%)	Information about the Routing Engine's CPU utilization in the past 1 minute.
5 min CPU utilization (%)	Information about the Routing Engine's CPU utilization in the past 5 minutes.
15 min CPU utilization (%)	Information about the Routing Engine's CPU utilization in the past 15 minutes.
Memory DRAM (MB)	Total DRAM, in megabytes, available to the FPC's processor.

Table 16: show chassis fpc Output Fields *(continued)*

Field Name	Field Description
Heap Utilization (%)	Percentage of heap space (dynamic memory) being used by the FPC's processor. If this number exceeds 80 percent, there might be a software problem (memory leak). **NOTE:** On MX Series routers and EX Series switches in a broadband edge environment, heap utilization levels higher than 70 percent can affect unified ISSU, router stability, or scaling capability.
Buffer Utilization (%)	Percentage of buffer space being used by the FPC's processor for buffering internal messages.
GNF	GNF identifier associated with each FPC. (**pic-status** output only) GNF identifier associated with each PIC.

Sample Output

```
user@router>show chassis fpc
```

```
                     Temp CPU Utilization(%) CPU Utilization(%) Memory Utilization(%)
Slot State  (C)  Total Interrupt    1min 5min  15min  DRAM(MB)  Heap  Buffer  GNF

  4  Online  42     20         0     19   19    19    3584        8     25     2
  6  Online  46     12         0     11   11    11    3136        8     19     2
```

show chassis fpc pic-status (GNF)

Syntax

```
show chassis fpc pic-status
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.

Description

Display the status of the physical interface cards (PICs) of each Flexible PIC Concentrator (FPC) assigned to the guest network function (GNF).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis hardware (GNF) | **155**
- show chassis fpc (GNF) | **158**
- show chassis adc (GNF) | **162**

Sample Output

`user@router>` **show chassis fpc pic-status**

```
Slot 4   Online       MPC6E 3D                                        GNF 2
  PIC 0  Online       24X10GE SFPP
  PIC 1  Online       4X100GE CXP
Slot 6   Online       MPC7E 3D MRATE-12xQSFPP-XGE-XLGE-CGE            GNF 2
  PIC 0  Online       MRATE-6xQSFPP-XGE-XLGE-CGE
  PIC 1  Online       MRATE-6xQSFPP-XGE-XLGE-CGE
```

show chassis adc (GNF)

Syntax

```
show chassis adc
```

Release Information

Command introduced in Junos OS Release 12.3 for MX2020 Universal Routing Platforms.
Command introduced in Junos OS Release 12.3 for MX2010 Universal Routing Platforms.
Command introduced in Junos OS Release 17.2 for MX2008 Universal Routing Platforms.

Description

Display chassis information about the adapter cards (ADCs) assigned to the guest network function (GNF).

Required Privilege Level

view

RELATED DOCUMENTATION

- show chassis hardware (GNF) | **155**
- show chassis fpc (GNF) | **158**
- show chassis fpc pic-status (GNF) | **161**

Output Fields

Table 17 on page 162 lists the output fields for the **show chassis adc** command. The output fields are listed in the approximate order in which they appear.

Table 17: show chassis adc Output Fields

Field Name	Field Description
Slot	Slot number.
State	Status of the adapter card. • **Online**—The adapter card is online and running. • **Offline**—Adapter card is powered down.
Uptime	How long the Routing Engine has been connected to the adapter card and, therefore, how long the adapter card has been up and running.
GNF (Node slicing)	GNF identifier for each ADC.

Sample Output

user@router> **show chassis adc**

```
Slot  State           Uptime                                        GNF
 4    Empty       --- Native line card ---                            2
 6    Online           50 minutes, 2 seconds                          2
```

show interfaces (Abstracted Fabric)

Syntax

```
show interfaces af-interface-name
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index snmp-index>
<statistics>
```

Release Information

Command introduced before Junos OS Release 17.4R1.

Description

Display status information for the specified Abstracted Fabric (**af**) interface.

> **NOTE:** Starting in Junos OS Release 18.3R1, the **show interfaces *af-interface-name*** output provides transmit statistics of each Packet Forwarding Engine peer list on a given **af** interface, in addition to the physical interface statistics.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level

view

RELATED DOCUMENTATION

Configuring Abstracted Fabric Interfaces Between a Pair of GNFs | 71

List of Sample Output

show interfaces af-interface-name on page 170

show interfaces af-interface-name brief on page 170
show interfaces af-interface-name extensive on page 171
show interfaces af-interface-name detail on page 173
show interfaces af-interface-name on page 174
show interfaces af-interface-name detail on page 175
show interfaces af-interface-name extensive on page 178
show interfaces af-interface-name statistics on page 181
show interfaces af2 (with collapsed forwarding configured) on page 183

Output Fields

Table 18 on page 165 describes the output fields for the **show interfaces** (Abstracted Fabric) command. Output fields are listed in the approximate order in which they appear.

Table 18: show interfaces (Abstracted Fabric) Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name and status of the physical interface.	All levels
Interface index	Index number of the physical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Type	Interface type.	
Link-level type	Encapsulation being used on the physical interface.	All levels
MTU	Maximum transmission unit size on the physical interface.	All levels
Speed	Speed at which the interface is running.	All levels
Device flags	Information about the physical device. Possible values are described in the “Device Flags” section under *Common Output Fields Description*.	All levels
Interface flags	Information about the interface. Possible values are described in the “Interface Flags” section under *Common Output Fields Description*.	All levels
Link type	Link type. For example, Full-Duplex.	All levels
Damping	Damping information.	**detail extensive**

Table 18: show interfaces (Abstracted Fabric) Output Fields *(continued)*

Field Name	Field Description	Level of Output
Alternate link address	Address of the alternative link.	**detail extensive**
Hold-times	Current interface hold-time up and hold-time down, in milliseconds (ms).	**detail extensive**
Current address	Configured MAC address.	**detail extensive** none
Hardware address	Hardware MAC address.	**detail extensive** none
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped: *year-month-day hour:minute:second:timezone* (*hour:minute:second* ago)**. For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).**	**detail extensive** none
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the interface if IPv6 statistics tracking is enabled.	**extensive**
Input errors	Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **Resource errors**—Sum of transmit drops.	**extensive**

Table 18: show interfaces (Abstracted Fabric) Output Fields *(continued)*

Field Name	Field Description	Level of Output
Output errors	Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue. NOTE: • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**extensive**
Bandwidth	Shows the interface bandwidth.	**detail extensive** none
Peer GNF id	The GNF peer connected using the Abstracted Fabric interface.	**detail extensive** none
Peer GNF Forwarding element(FE) view	Shows forwarding element (FE) number and the FPC slot, FE bandwidth, and FE status (up/down).	**detail extensive** none
Transmit Packets	Shows the packets transmitted.	
Transmit Bytes	Shows the bytes transmitted.	
Residual Transmit Statistics	Displays the historical transmit statistics for the peer **af** interface from the FPC events (FPC offline/online/removal/power off on the local or remote side).	
Fabric Queue Statistics	Displays the statistics of the transmit traffic on the fabric queues (high and low queues) for each peer PFE on the **af** interface.	
Residual Queue Statistics	Displays the historical fabric queue statistics for the peer **af** interface from the FPC events (FPC offline/online/removal/power off on the local or remote side).	

Table 18: show interfaces (Abstracted Fabric) Output Fields *(continued)*

Field Name	Field Description	Level of Output
Collapsed Forwarding Optimized Statistics	This section has the following subsections to display fabric optimization information. • Optimal Packets—shows the packets that are already forwarded to optimal Packet Forwarding Engine based on the Abstracted Fabric interface load balancing. • Non-optimal Packets—By default, these packets are forwarded to the non-optimal Packet Forwarding Engine by Abstracted Fabric interface. If you have configured the **optimize** mode using the command **set chassis network-slices guest-network-functions gnf *id* collapsed-forward optimize**, this section shows the packets that are optimized because of this configuration. If you have configured the **monitor** mode using the command **set chassis network-slices guest-network-functions gnf *id* collapsed-forward monitor**, this section shows non-optimal packets.	All levels
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Index number of the logical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP interface index number for the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under *Common Output Fields Description*.	All levels
Encapsulation	Encapsulation on the logical interface.	All levels
Protocol	Protocol family. Possible values are described in the “Protocol Field” section under *Common Output Fields Description*.	**detail extensive** none
MTU	Maximum transmission unit size on the logical interface.	**detail extensive** none

Table 18: show interfaces (Abstracted Fabric) Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Number and rate of bytes and packets received and transmitted on the specified interface set. • **Input bytes, Output bytes**—Number of bytes received and transmitted on the interface set. • **Input packets, Output packets**—Number of packets received and transmitted on the interface set.	**detail extensive**
Transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.	**extensive**
Local statistics	Number and rate of bytes and packets destined to the router.	**extensive**
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route Table	Route table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive** none
Flags	Information about protocol family flags. Possible values are described in the “Family Flags” section under *Common Output Fields Description*.	**detail extensive**
Addresses, Flags	Information about the address flags. Possible values are described in the “Addresses Flags” section under *Common Output Fields Description*.	**detail extensive** none
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
Flags	Information about the address flag. Possible values are described in the “Addresses Flags” section under *Common Output Fields Description*.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address of the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces af-interface-name

This output is applicable to Junos OS versions prior to 18.3R1.

user@router> **show interfaces af4**

```
Physical interface: af4, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 514
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Speed: 480000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Current address: 2c:6b:f5:55:eb:f6, Hardware address: 2c:6b:f5:55:eb:f6
  Last flapped   : 2017-10-18 19:40:00 EDT (02:47:02 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Bandwidth      : 480 Gbps
  Peer GNF id    : 4
  Peer GNF Forwarding element(FE) view :
         FPC slot:FE Num        FE Bandwidth(Gbps)     Status
             6:0                     240                 Up
             6:1                     240                 Up

  Logical interface af4.1 (Index 328) (SNMP ifIndex 593)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Input packets : 9
    Output packets: 9
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1,
    Curr new hold cnt: 0, NH drop cnt: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255
    Protocol multiservice, MTU: Unlimited
```

show interfaces af-interface-name brief

This output is applicable to Junos OS versions prior to 18.3R1.

user@router> **show interfaces af4 brief**

```
Physical interface: af4, Enabled, Physical link is Up
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Clocking: Unspecified,
Speed: 480000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000

  Logical interface af4.1
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    inet  1.1.1.1/24
    multiservice
```

show interfaces af-interface-name extensive

This output is applicable to Junos OS versions prior to 18.3R1.

`user@router>` **show interfaces af4 extensive**

```
Physical interface: af4, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 514, Generation: 142
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Clocking: Unspecified,
Speed: 480000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
state: unsuppressed
  Current address: 2c:6b:f5:55:eb:f6, Hardware address: 2c:6b:f5:55:eb:f6
  Alternate link address: Unspecified
  Last flapped   : 2017-10-18 19:40:00 EDT (02:50:04 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                4048                    0 bps
   Output bytes  :              144092                59440 bps
   Input  packets:                  88                    0 pps
   Output packets:                 186                    4 pps
   IPv6 transit statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
```

```
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
 0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0
  Bandwidth      : 480 Gbps
  Peer GNF id    : 4
  Peer GNF Forwarding element(FE) view :
         FPC slot:FE Num        FE Bandwidth(Gbps)     Status
             6:0                     240                 Up
             6:1                     240                 Up

  Logical interface af4.1 (Index 328) (SNMP ifIndex 593) (Generation 137)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                 414
     Output bytes  :              139906
     Input  packets:                   9
     Output packets:                 107
    Local statistics:
     Input  bytes  :                 414
     Output bytes  :                 598
     Input  packets:                   9
     Output packets:                  13
    Transit statistics:
     Input  bytes  :                   0                    0 bps
     Output bytes  :              139308                59240 bps
     Input  packets:                   0                    0 pps
     Output packets:                  94                    4 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 162, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Output Filters: f-basic-sr-tcm-ca
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255, Generation:
148
    Protocol multiservice, MTU: Unlimited, Generation: 163, Route table: 0
      Policer: Input: __default_arp_policer__
```

show interfaces af-interface-name detail

This output is applicable to Junos OS versions prior to 18.3R1.

`user@router>` **show interfaces af4 detail**

```
Physical interface: af4, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 514, Generation: 142
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Clocking: Unspecified,
Speed: 480000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
state: unsuppressed
  Current address: 2c:6b:f5:55:eb:f6, Hardware address: 2c:6b:f5:55:eb:f6
  Alternate link address: Unspecified
  Last flapped   : 2017-10-18 19:40:00 EDT (02:55:48 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :          77518216910           1944810944 bps
   Output bytes  :              3059154                68832 bps
   Input  packets:             52450649               164494 pps
   Output packets:                 4672                   20 pps
   IPv6 transit statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
  Bandwidth      : 480 Gbps
  Peer GNF id    : 4
  Peer GNF Forwarding element(FE) view :
         FPC slot:FE Num        FE Bandwidth(Gbps)     Status
             6:0                     240                 Up
             6:1                     240                 Up

  Logical interface af4.1 (Index 328) (SNMP ifIndex 593) (Generation 137)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :          77518213184
     Output bytes  :              3054342
     Input  packets:             52450568
     Output packets:                 4591
```

```
    Local statistics:
     Input  bytes  :                  460
     Output bytes  :                 4600
     Input  packets:                   10
     Output packets:                  100
    Transit statistics:
     Input  bytes  :          77518212724           1944810944 bps
     Output bytes  :              3049742                68632 bps
     Input  packets:             52450558               164494 pps
     Output packets:                 4491                   20 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 162, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Output Filters: f-basic-sr-tcm-ca
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255, Generation:
148
    Protocol multiservice, MTU: Unlimited, Generation: 163, Route table: 0
      Policer: Input: __default_arp_policer__
```

show interfaces af-interface-name

This output is applicable to Junos OS 18.3R1 and later releases.

`user@router>` **show interfaces af9**

```
Physical interface: af9, Enabled, Physical link is Up
  Interface index: 209, SNMP ifIndex: 527
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 370000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Link flags     : None
  Current address: 00:90:69:2b:00:4c, Hardware address: 00:90:69:2b:00:4c
  Last flapped   : 2018-09-12 01:44:01 PDT (00:01:02 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Bandwidth      : 370 Gbps
  Peer GNF id    : 9
  Peer GNF Forwarding element(FE) view :
  FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
 Bytes
```

```
      6:0                  130         Up                      0
      0
     12:0                  120         Up                      0
      0
     12:1                  120         Up                      0
      0

  Residual Transmit Statistics :
  Packets :                    0 Bytes :                    0

  Fabric Queue Statistics :
  FPC slot:FE num    High priority(pkts)        Low priority(pkts)
      6:0                            0                         0
     12:0                            0                         0
     12:1                            0                         0
  FPC slot:FE num    High priority(bytes)      Low priority(bytes)
      6:0                              0                       0
     12:0                              0                       0
     12:1                              0                       0
  Residual Queue Statistics :
     High priority(pkts)       Low priority(pkts)
                      0                        0
     High priority(bytes)      Low priority(bytes)
                       0                       0

  Logical interface af9.0 (Index 332) (SNMP ifIndex 528)
    Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
    Input packets : 0
    Output packets: 13
    Protocol inet, MTU: 1500
```

show interfaces af-interface-name detail

This output is applicable to Junos OS 18.3R1 and later releases.

`user@router>` **show interfaces af2 detail**

```
Physical interface: af2, Enabled, Physical link is Up
  Interface index: 167, SNMP ifIndex: 674, Generation: 349
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Clocking: Unspecified,
Speed: 130000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
```

```
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
state: unsuppressed
  Current address: 00:90:69:fd:85:a4, Hardware address: 00:90:69:fd:85:a4
  Alternate link address: Unspecified
  Last flapped   : 2018-11-01 20:44:26 PDT (6d 02:57 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :             23381827                 280 bps
   Output bytes  :            652664393                 416 bps
   Input  packets:               341618                   0 pps
   Output packets:              5986312                   0 pps
   IPv6 transit statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
  Bandwidth      : 130 Gbps
  Peer GNF id    : 2
  Peer GNF Forwarding element(FE) view :
  FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
 Bytes
       2:0                   130         Up                5656951
622264610

  Residual Transmit Statistics :
  Packets :                    0 Bytes :                   0

  Fabric Queue Statistics :
  FPC slot:FE num    High priority(pkts)        Low priority(pkts)
       2:0                       5656951                        0
  FPC slot:FE num    High priority(bytes)      Low priority(bytes)
       2:0                     622264610                        0
  Residual Queue Statistics :
      High priority(pkts)       Low priority(pkts)
                        0                        0
      High priority(bytes)      Low priority(bytes)
                         0                        0

  Logical interface af2.0 (Index 334) (SNMP ifIndex 647) (Generation 234)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
```

```
     Input  bytes  :             23382038
     Output bytes  :            650688227
     Input  packets:               341621
     Output packets:              5986312
    Local statistics:
     Input  bytes  :             23381827
     Output bytes  :             28423617
     Input  packets:               341618
     Output packets:               329361
    Transit statistics:
     Input  bytes  :                 211                   0 bps
     Output bytes  :           622264610                   0 bps
     Input  packets:                   3                   0 pps
     Output packets:              5656951                   0 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 314, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255,
Generation: 224
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 315, Route table: 0
      Flags: Is-Primary
    Protocol multiservice, MTU: Unlimited, Generation: 316, Route table: 0
      Flags: Is-Primary
      Policer: Input: __default_arp_policer__

  Logical interface af2.1 (Index 336) (SNMP ifIndex 649) (Generation 235)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                   0 bps
     Output bytes  :                   0                   0 bps
     Input  packets:                   0                   0 pps
```

```
     Output packets:                    0                    0 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 0, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 317, Route table: 0
      Flags: Sendbcast-pkt-to-re
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 318, Route table: 0
    Protocol multiservice, MTU: Unlimited, Generation: 319, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface af2.32767 (Index 337) (SNMP ifIndex 675) (Generation 236)
    Flags: Up SNMP-Traps 0x4004000 VLAN-Tag [ 0x0000.0 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                    0 bps
     Output bytes  :                   0                    0 bps
     Input  packets:                   0                    0 pps
     Output packets:                   0                    0 pps
    Protocol multiservice, MTU: Unlimited, Generation: 320, Route table: 0
      Flags: None
      Policer: Input: __default_arp_policer__
```

show interfaces af-interface-name extensive

This output is applicable to Junos OS 18.3R1 and later releases.

`user@router>` **show interfaces af2 extensive**

```
Physical interface: af2, Enabled, Physical link is Up
  Interface index: 167, SNMP ifIndex: 674, Generation: 349
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Clocking: Unspecified,
Speed: 130000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
```

```
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
state: unsuppressed
  Current address: 00:90:69:fd:85:a4, Hardware address: 00:90:69:fd:85:a4
  Alternate link address: Unspecified
  Last flapped   : 2018-11-01 20:44:26 PDT (6d 02:57 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :             23382976                   0 bps
   Output bytes  :            652665950                   0 bps
   Input  packets:               341635                   0 pps
   Output packets:              5986329                   0 pps
   IPv6 transit statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
 0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0
  Bandwidth      : 130 Gbps
  Peer GNF id    : 2
  Peer GNF Forwarding element(FE) view :
  FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
 Bytes
       2:0                   130         Up                5656951
622264610

  Residual Transmit Statistics :
  Packets :                    0 Bytes :                    0

  Fabric Queue Statistics :
  FPC slot:FE num    High priority(pkts)        Low priority(pkts)
       2:0                       5656951                         0
  FPC slot:FE num    High priority(bytes)      Low priority(bytes)
       2:0                       622264610                       0
  Residual Queue Statistics :
      High priority(pkts)       Low priority(pkts)
                        0                       0
```

```
      High priority(bytes)      Low priority(bytes)
                         0                        0

  Logical interface af2.0 (Index 334) (SNMP ifIndex 647) (Generation 234)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :             23383187
     Output bytes  :            650689682
     Input  packets:               341638
     Output packets:              5986329
    Local statistics:
     Input  bytes  :             23382976
     Output bytes  :             28425072
     Input  packets:               341635
     Output packets:               329378
    Transit statistics:
     Input  bytes  :                 211                    0 bps
     Output bytes  :           622264610                    0 bps
     Input  packets:                   3                    0 pps
     Output packets:             5656951                    0 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 314, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255,
Generation: 224
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 315, Route table: 0
      Flags: Is-Primary
    Protocol multiservice, MTU: Unlimited, Generation: 316, Route table: 0
      Flags: Is-Primary
      Policer: Input: __default_arp_policer__

  Logical interface af2.1 (Index 336) (SNMP ifIndex 649) (Generation 235)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
```

```
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 0, Curr new hold
cnt: 0, NH drop cnt: 0
    Generation: 317, Route table: 0
      Flags: Sendbcast-pkt-to-re
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 318, Route table: 0
    Protocol multiservice, MTU: Unlimited, Generation: 319, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface af2.32767 (Index 337) (SNMP ifIndex 675) (Generation 236)
    Flags: Up SNMP-Traps 0x4004000 VLAN-Tag [ 0x0000.0 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol multiservice, MTU: Unlimited, Generation: 320, Route table: 0
      Flags: None
      Policer: Input: __default_arp_policer__
```

show interfaces af-interface-name statistics

This output is applicable to Junos OS 18.3R1 and later releases.

`user@router>` **show interfaces af4 statistics**

```
Physical interface: af4, Enabled, Physical link is Up
  Interface index: 165, SNMP ifIndex: 958
  Type: Ethernet, Link-level type: Flexible-Ethernet, MTU: 1522, Speed: 240000mbps

  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Current address: 00:90:69:c7:31:62, Hardware address: 00:90:69:c7:31:62
  Last flapped   : 2018-08-07 21:47:10 PDT (00:58:48 ago)
  Statistics last cleared: Never
  Input rate     : 1523826080 bps (2976222 pps)
  Output rate    : 112168 bps (232 pps)
  Input errors: 0, Output errors: 0
  Bandwidth      : 240 Gbps
  Peer GNF id    : 4
  Peer GNF Forwarding element(FE) view :
  FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
 Bytes
      12:0                  120         Up                   2802
  168120
      12:1                  120         Up                   2848
  170880

  Residual Transmit Statistics :
  Packets :                    0 Bytes :                    0

  Fabric Queue Statistics :
  FPC slot:FE num    High priority(pkts)        Low priority(pkts)
      12:0                         2802                         0
      12:1                         2848                         0
  FPC slot:FE num    High priority(bytes)      Low priority(bytes)
      12:0                         168120                        0
      12:1                         170880                        0
  Residual Queue Statistics :
      High priority(pkts)       Low priority(pkts)
                       0                        0
      High priority(bytes)      Low priority(bytes)
                        0                       0

  Logical interface af4.1 (Index 335) (SNMP ifIndex 7354)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.100 ]  Encapsulation: ENET2
    Input packets : 71572652
    Output packets: 5740
```

```
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 20.0.0/24, Local: 20.0.0.1, Broadcast: 20.0.0.255
    Protocol mpls, MTU: 1488, Maximum labels: 3
    Protocol multiservice, MTU: Unlimited

  Logical interface af4.32767 (Index 336) (SNMP ifIndex 7355)
    Flags: Up SNMP-Traps 0x4004000 VLAN-Tag [ 0x0000.0 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
    Protocol multiservice, MTU: Unlimited
      Flags: None
```

show interfaces af2 (with collapsed forwarding configured)

`user@router>` **show interfaces af2**

```
Physical interface: af2, Enabled, Physical link is Up
  Interface index: 152, SNMP ifIndex: 626
  Type: Ethernet, Link-level type: Ethernet, MTU: 1518, Speed: 1600000mbps
  Device flags   : Present Running
  Interface flags: Internal: 0x4000
  Link type      : Full-Duplex
  Current address: 00:90:69:00:c0:4a, Hardware address: 00:90:69:00:c0:4a
  Last flapped   : 2019-10-01 06:19:50 PDT (2d 00:54 ago)
  Input rate     : 312 bps (0 pps)
  Output rate    : 144327758752 bps (18371659 pps)
  Bandwidth      : 1600 Gbps
  Peer GNF id    : 7
  Collapsed Forwarding : Optimized
  Peer GNF Forwarding element(FE) view :
  FPC slot:FE num  FE Bandwidth(Gbps) Status     Transmit Packets        Transmit
 Bytes
       1:0                  400         Up           111437126843
110991378335628
       1:1                  400         Up                     0
       0
       1:2                  400         Up                     0
       0
       1:3                  400         Up                     0
```

```
      0

  Residual Transmit Statistics :
  Packets :                    0 Bytes :                    0

  Fabric Queue Statistics :
  FPC slot:FE num    High priority(pkts)        Low priority(pkts)
       1:0                             0              111437126843
       1:1                             0                         0
       1:2                             0                         0
       1:3                             0                         0
  FPC slot:FE num    High priority(bytes)      Low priority(bytes)
       1:0                               0          110991378335628
       1:1                               0                         0
       1:2                               0                         0
       1:3                               0                         0
  Residual Queue Statistics :
      High priority(pkts)       Low priority(pkts)
                       0                         0
      High priority(bytes)      Low priority(bytes)
                         0                          0
  Collapsed Forwarding Optimized Statistics :
            Optimal Packets             Non-optimal Packets
                          0                    111437126843
            Optimal Bytes               Non-optimal Bytes
                         0                  110991378335628

  Logical interface af2.0 (Index 342) (SNMP ifIndex 689)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Input packets : 532
    Output packets: 41761133660
    Protocol inet, MTU: 1500
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 5.1.1/24, Local: 5.1.1.2, Broadcast: 5.1.1.255
    Protocol multiservice, MTU: Unlimited

  Logical interface af2.1 (Index 341) (SNMP ifIndex 690)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Input packets : 536
    Output packets: 41764698890
    Protocol inet, MTU: 1500
```

```
    Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 1, Curr new hold
cnt: 0, NH drop cnt: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 6.1.1/24, Local: 6.1.1.2, Broadcast: 6.1.1.255
    Protocol multiservice, MTU: Unlimited

  Logical interface af2.32767 (Index 343) (SNMP ifIndex 692)
    Flags: Up SNMP-Traps 0x4004000 VLAN-Tag [ 0x0000.0 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
    Protocol multiservice, MTU: Unlimited
      Flags: None
```

show system anomalies (GNF)

Syntax

show system anomalies (all-anomalies | config | fru | system)

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the incompatibilities between the software version running on the guest network function (GNF) and the version running on the base system (BSYS).

Options

all-anomalies—Display the multiversion software incompatibilities from all categories—system, configuration, and FRU.

config—Display the feature incompatibilities between software versions.

fru—Display the FRU-level incompatibilities between software versions. This can be an incompatibility pertaining to the support for a specific FRU.

system—Display the system-level incompatibilities between software versions. These include interprocess communication (IPC) message, CLI, or SNMP incompatibility.

Required Privilege Level

View

RELATED DOCUMENTATION

- show system anomalies gnf-id (BSYS) | **145**
- Generic Guidelines for Using JDM Server Commands | **200**
- request virtual-network-functions | **208**
- request server authenticate-peer-server | **206**

Output Fields

Table 19 on page 187 lists the output fields for the **show system anomalies** command. Output fields are listed in the approximate order in which they appear.

Table 19: show system anomalies gnf-id Output Fields

Field Name	Field Description
Anomaly Type	Shows the software incompatibility type. The following are the possible values: • SYS—Indicates system-specific incompatibilities. • FRU—Indicates FRU-specific incompatibilities. • CONFIG—Indicates feature-specific incompatibilities.
Anomaly ID	Shows the incompatibility ID.
Default Action	Shows the default actions associated with incompatibilities. The following are the possible values: • WARN—Indicates the presence of a minor incompatibility. It causes a warning. • ABORT—Indicates the presence of a major incompatibility. It causes an abort action.
Class	Indicates of the incompatibility is present in GNF, or BSYS, or both.
Message	Incompatibility description.
FRU ID	Field-replaceable unit (FRU) ID. Applicable in the case of FRU-specific incompatibilities.
Firmware	Firmware of the FRU.

Sample Output

```
user@router> show system anomalies
```

```
Anomaly Type    Anomaly ID   Default Action     Class         Message
                   FRU ID    Firmware
-------------------------------------------------------------------------------------------------------------------------
SYS             100          WARN               GNF Present   system incompatibility
 1
SYS             103          WARN               BOTH Present  system incompatibility
 2
```

```
SYS             200         WARN             BSYS Present  system incompatibility
 3
```

CHAPTER 7

Configuration Statements for JDM

virtual-network-functions

Syntax

```
virtual-network-functions vnf-name {
    base-config base-config ;
    chassis-type chassis-type;
    id id;
    resource-template resource-template;
}
```

Hierarchy Level

[edit]

Release Information

Statement introduced in Junos OS Release 17.2R1.

Description

Associate a GNF ID, base configuration, chassis type and resource template with the VNF.

The GNFs that are configured and committed will appear as auto-complete options in operational commands.

Options

vnf-name—Name of the VNF.

base-config *base- config*—Choose a base configuration for the VNF.

chassis-type *chassis-type*—Applicable only to Junos node slicing set up using external server model. Choose the type of the router chassis (for example, MX960) used as the base system (BSYS) in the node slicing setup.

id *id*—Assign a GNF ID.

Range: 1–10

Range: 1-4 (for in-chassis model)

resource-template *resource-template*—Assign a resource template to the VNF. The server resource template defines the number of dedicated CPU cores and the size of DRAM to be assigned to a VNF.

Required Privilege Level

root

RELATED DOCUMENTATION

server

Syntax

```
server {
    interfaces {
        cb0 cb0-interface;
        cb1 cb1-interface;
        jdm-management jdm-management-interface;
        vnf-management gnf-management-interface;
    }
}
```

Hierarchy Level

[edit]

Release Information

Statement introduced in Junos OS Release 17.2R1.

Description

Applicable only to Junos node slicing set up using external server model.

Configure the server interfaces for the JDM and GNFs. These include a JDM management interface, a GNF management interface, and two server interfaces that are connected to the MX Series router.

Options

cb0 ***cb0-interface***—The server interface that is connected to the control board 0 of the MX Series router.

cb1 ***cb1-interface***—The server interface that is connected to the control board 1 of the MX Series router.

jdm-management ***jdm-management-interface***—The server interface to be used as the JDM management interface.

vnf-management ***gnf-management-interface***—The server interface to be used as GNF management interface.

Required Privilege Level

root

RELATED DOCUMENTATION

virtual-network-functions | 190

interfaces (Junos Node Slicing)

Syntax

```
interfaces interface-name{
    unit unit {
        family (inet|inet6) {
            address address;
        }
    }
}
```

Hierarchy Level

[edit]

Release Information

Statement introduced in Junos OS Release 17.2.

Description

Configure an IP address for the JDM management interface.

Options

interface-name—Name of the interface.

unit *unit*—Interface unit number. This is a logical unit number. The only supported value is **0**.

family (inet|inet6)—Protocol family.

- inet—Indicates IPv4.
- inet6—Indicates IPv6.

address *address*—IP address of the interface.

Required Privilege Level

root

RELATED DOCUMENTATION

server | 192

virtual-network-functions | 190

routing-options (Junos Node Slicing)

Syntax

```
routing-options {
    static {
        route route {
            next-hop next-hop;
        }
    }
}
```

Hierarchy Level

[edit]

Release Information

Statement introduced in Junos OS Release 17.2.

Description

Configure static routes for JDM.

Options

route *route*—Static route destination.

next-hop *next-hop*—Specify the address of the next hop to destination.

Required Privilege Level

root

RELATED DOCUMENTATION

server | 192

virtual-network-functions | 190

system login (Junos Node Slicing)

Syntax

```
system login {
    user username ;
    class class-name;
}
```

Hierarchy Level

[root]

Release Information

Statement introduced in Junos OS Release 18.3 R1.

Description

Create a non-root user in JDM for Junos node slicing. The non-root user accounts function only inside JDM, not on the host server.

Options

user *username*—Username of the account.

class *class-name*—Predefined login classes that JDM supports for non-root users.

- super-user
- operator
- read-only
- unauthorized

Required Privilege Level

RELATED DOCUMENTATION

Configuring Non-Root Users in JDM (Junos Node Slicing) | 55

Configuring JDM on the x86 Servers (External Server Model) | 53

root-login (JDM)

Syntax

```
root-login (allow | deny );
```

Hierarchy Level

```
[edit system services ssh]
```

Release Information
Statement introduced in Junos OS Release 18.3.

Description
Control user access to the JDM through SSH.

Default
root-login allow is the default.

Options
allow—Allow users to log in to the JDM as root through SSH.

deny—Disable users from logging in to the JDM as root through SSH. This configuration option is applicable only to the JDM management interface (jmgmt0). Setting this configuration option does not block the internal JDM to JDM communication, which uses root account with password-less authentication method.

Required Privilege Level
admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

RELATED DOCUMENTATION

Configuring JDM on the x86 Servers (External Server Model) | 53

vnf-license-supplement

Syntax

```
vnf-license-supplement {
    vnf-id gnf-id
    license-supplement-string augmented-ssrn
}
```

Hierarchy Level

[edit system]

Release Information

Statement introduced in Junos OS Release 19.2R1.

Description

Allocate a MAC address to a licensed guest network function (GNF). For more details, see “Assigning MAC Addresses to GNF” on page 67.

Options

vnf-id *gnf-id*—Specify the GNF ID that will be assigned the licensed MAC address range. Each license can only be assigned to a single GNF.

license-supplement-string *augmented-ssrn*—Specify the augmented software support reference number (SSRN) string, which contains the MAC address details. Example: **RTU00023003204-01-AABBCCDDEEFF-1100-01-ABCD**.

8

CHAPTER

Operational Commands for JDM

Generic Guidelines for Using JDM Server Commands

The following are general guidelines on how to use the JDM server commands:

- Append **all-servers** to an operational command to take action on both the servers. Example: **request virtual-network-functions gnf1 restart all-servers**.
- Append **server0** or **server1** to an operational command to take action on server0 or server1. Example: **request virtual-network-functions gnf1 restart server0**.

  By default, the operational commands work only on the local JDM.
- Use the **commit synchronize** command to ensure that the configuration committed on one server is synchronized with the other server. The synchronization is bidirectional. A JDM configuration change at either of the servers is synchronized with the other server. When a virtual machine (VM) is instantiated, the GNF-re0 VM instance starts on server0 and the GNF-re1 VM instance starts on server1.

  NOTE: If you do not use the **commit synchronize** command, you must configure and manage the VMs on both the servers manually.

RELATED DOCUMENTATION

show virtual-network-functions | 210

request virtual-network-functions | 208

request server authenticate-peer-server | 206

clear log (JDM)

Syntax

clear log ***file-name***

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Clear the system log or trace files.

Required Privilege Level

View

RELATED DOCUMENTATION

monitor start (JDM) | **203**

List of Sample Output

clear log on page 201

Output Fields

This command produces no output.

Sample Output

clear log

```
user@jdm> clear log syslog
```

monitor list (JDM)

Syntax

monitor list

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Show status of monitored files.

Required Privilege Level

View

RELATED DOCUMENTATION

monitor start (JDM) | 203

List of Sample Output

monitor list on page 202

Sample Output

monitor list

```
user@jdm> monitor list
```

monitor start (JDM)

Syntax

monitor start *file-name*

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Start displaying the system log or trace file and additional entries being added to those files.

Additional Information

Log files are generated by the routing protocol process or by system logging.

Required Privilege Level

View

RELATED DOCUMENTATION

monitor stop (JDM) | **205**

List of Sample Output

monitor start on page 203

Output Fields

Table 20 on page 203 describes the output fields for the **monitor start** command. Output fields are listed in the approximate order in which they appear.

Table 20: monitor start Output Fields

Field Name	Field Description
****filename****	Name of the file from which entries are being displayed.
Date and time	Timestamp for the log entry.

Sample Output

monitor start

```
user@jdm> monitor start syslog
```

```
*** syslog ***
Oct 19 19:44:21 jdm mgd[4069]: UI_CMDLINE_READ_LINE: User 'root', command 'monit

      or start syslog '
Oct 19 19:44:29 jdm mgd[3268]: UI_CMDLINE_READ_LINE: User 'root', command 'delet

      e groups server0 server interfaces cb1 '
Oct 19 19:44:29 jdm mgd[3268]: UI_CFG_AUDIT_OTHER: User 'root' delete: [groups s

      erver0 server interfaces cb1]
Oct 19 19:44:35 jdm mgd[3268]: UI_CMDLINE_READ_LINE: User 'root', command 'delet

      e groups server1 server interfaces cb1 '
Oct 19 19:44:35 jdm mgd[3268]: UI_CFG_AUDIT_OTHER: User 'root' delete: [groups s

      erver1 server interfaces cb1]
Oct 19 19:44:36 jdm mgd[3268]: UI_CMDLINE_READ_LINE: User 'root', command 'commi

      t '
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT: User 'root' requested 'commit' operati

      on (comment: none)
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT_PROGRESS: Commit operation in progress:

       Obtaining lock for commit
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT_PROGRESS: Commit operation in progress:

       updating commit revision
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT_PROGRESS: Commit operation in progress:

       obtaining db lock on  server1
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT_PROGRESS: Commit operation in progress:

       UI extensions feature is not configured
Oct 19 19:44:36 jdm mgd[3268]: UI_COMMIT_PROGRESS: Commit operation in progress:

       Started running translation script
```

monitor stop (JDM)

Syntax

monitor stop *file-name*

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Stop displaying the system log or trace file.

Additional Information

Log files are generated by the routing protocol process or by system logging.

Required Privilege Level

View

RELATED DOCUMENTATION

monitor start (JDM) | 203

Output Fields

This command produces no output.

request server authenticate-peer-server

Syntax

request server authenticate-peer-server

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Copy the **ssh** public key to the peer JDM. This command is equivalent to **ssh-copy-id user@jdm-server<0/1>**.

> **NOTE:** If the JDM fails to establish SSH connection with its peer on either of the two CB links, you need to run the JDM CLI command **request server authenticate-peer-server**. You can use the JDM CLI command **show server connections** to view the status of the SSH connection between the JDM peers. Note that the command **request server authenticate-peer-server** will prompt for user confirmation twice - once per CB link.

Required Privilege Level

View

RELATED DOCUMENTATION

Generic Guidelines for Using JDM Server Commands | 200

show virtual-network-functions | 210

request virtual-network-functions | 208

Sample Output

```
user@jdm> request server authenticate-peer-server
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter
out anythat are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted
 now it is to install the new keys
user@jdm-server1's password:
```

```
Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'user@jdm-server1'"
and check to make sure that only the key(s) you wanted were added.
```

request virtual-network-functions

Syntax

request virtual-network-functions *vnf-name* (add-image | all-servers | delete-image | force | restart | server | start | stop)

Release Information

Command introduced in Junos OS Release 17.2R1.
The **force** option is available from Junos OS Release 17.4R1.

Description

Start, stop or restart the VNFs. Also, you can add or remove the base image.

> **NOTE:** You can issue these commands either on both the servers (server0 and server1) or on one specific server.

Options

vnf-name—Name of the VNF.

add-image—Add the base image to the VNF repository.

all-servers—Issue the command on both the servers.

delete-image—Delete the base image from the VNF repository.

force—Overwrite the image that was added earlier (example: **request virtual-network-functions *vnf-name* add-image *new-image-name* force**). The **force** option is also used with **delete-image** command to perform a cleanup in case, for example, you abruptly stopped an earlier **add-image** process by pressing Ctrl-C.

restart—Restart the VNF specified.

server—Issue the command on a specific server. Applicable value is **0** or **1**.

start—Start the VNF.

stop—Stop the VNF.

Required Privilege Level

View

RELATED DOCUMENTATION

show virtual-network-functions

Syntax

```
show virtual-network-functions (all-servers | server| slot)
<vnf-name>
<vnf-name detail>
<vnf-name vnf-xml-profile>
```

Release Information

Command introduced in Junos OS Release 17.2R1.

Description

Display the list of guest network functions (GNFs) along with their IDs, status and availability.

Options

all-servers—Display the details of the GNFs on both the servers.

server—Display the details of the GNFs on one specific server. Applicable value is **0** or **1**.

vnf-name—Display additional details of a particular GNF. You can use the **detail** option to view the detailed output. For example, **show virtual-network-functions gnf1 detail**.

vnf-xml-profile—Displays the xml profile of a GNF.

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Output Fields

Table 21 on page 210 lists the output fields for the **show virtual-network-functions** command.

Table 21: show virtual network functions Output Fields

Field Name	Field Description
ID	The ID associated with the VNF.

Table 21: show virtual network functions Output Fields *(continued)*

Field Name	Field Description
Name	Name of the VNF.
State	Status of the VNF. • **Running**—The VNF is online and running. • **Shut off**—The VNF is in the shut down state.
Liveness	Indicates the availability of VNF. • **Up** • **Down**
Name	Name of the VNF.
IP Address	IP address of the VNF.
Status	Status of a particular VNF. • **Running**—The VNF is online and running. • **Shut off**—The VNF is in the shut down state.
Cores	Number of cores in the VNF.
Memory	The VNF memory.
Resource Template	The resource template associated with a VNF.
Qemu Process id **VNF CPU Utilization and Allocation Information**	Qemu process ID. Shows the GNF CPU utilization details. See also: show system cpu (JDM).
VNF Memory Information	Displays the following memory information about the GNFs: • Name—GNF name. • Resident—The memory used by the GNFs. • Actual—Actual memory.

Table 21: show virtual network functions Output Fields *(continued)*

VNF Storage Information	Displays the following guest network function (GNF) storage information: • Directories—Names of the directories. • Size—Total storage size. • Used—Storage used.
VNF Interfaces Statistics	Shows the GNF interface statistics information. See also: show system network (JDM).
VNF Network Information	Shows the list of Physical Interfaces, Virtual Interfaces and MAC addresses.

Sample Output

show virtual-network-functions

```
user@jdm> show virtual-network-functions
```

```
ID       Name                                                State      Liveness
-------------------------------------------------------------------------------
1        bittern-gnf-a                                       Running    Up
2        bittern-gnf-b                                       Running    Up
3        bittern-gnf-c                                       Running    Up
4        bittern-gnf-d                                       Running    Up
5        bittern-gnf-e                                       Running    Up
```

Sample Output

show virtual-network-functions (for a specific VNF)

```
user@jdm> show virtual-network-functions gnf1
```

```
Virtual Machine Information
---------------------------
```

```
Name:               gnf1
IP Address:         192.168.2.1
Status:             Running
Liveness:           up
Cores:              4
Memory:             32GB
Resource Template:  4core-32g
Qemu Process id:    10891
```

Sample Output

show virtual-network-functions <vnf-name> detail

`user@jdm>` **show virtual-network-functions gnf1 detail**

```
VNF Information
---------------------------
ID                  1
Name:               gnf1
Status:             Running
Liveness:           up
IP Address:         192.168.2.1
Cores:              2
Memory:             16GB
Resource Template:  2core-16g
Qemu Process id:    20478
SMBIOS version:     v1

VNF Uptime: 206:09.58


VNF CPU Utilization and Allocation Information
--------------------------------------------------------------------------------
GNF                                     CPU-Id(s)               Usage  Qemu Pid
--------------------------------------- ----------------------- -----  --------
gnf1                                    10,11                   6.1%   20478


VNF Memory Information
----------------------------------------------------------------
```

```
Name                                                Actual Resident
--------------------------------------------------- ------ --------
gnf1                                                16.0G  15.5G


VNF Storage Information
-------------------------------------------------------------
Directory                                      Size   Used
-------------------------------------------- ------ ------
/vm-primary/gnf1                               50.2G  4.2G


VNF Interfaces Statistics
-----------------------------------------------------------------------------------------------------------------
Interface                  Rcvd Bytes    Rcvd packets Rcvd Error Rcvd Drop Trxd
bytes   Trxd Packets Trxd Error Trxd Drop
-------------------------- ------------  ------------ ---------- ---------
------------ ------------ ---------- ---------
macvtap0                  19077011      335687       0          0         261601960
    3545272      0          0
macvtap1                  99369778      689729       0          0         172763580
    2786344      0          0
vnet1                      24686         527          0          0          11620
       250          0          0
macvtap2                  428385        7405         0          0         861020752
    10813152     0          0


VNF Network Information
-------------------------------------------------------------------------------
Virtual Interface           Physical Interface    MAC
--------------------------  ------------------    ----------------------------
macvtap0                    ens3f0                00:85:49:54:cd:30
macvtap1                    ens3f1                00:85:49:54:cd:31
vnet1                       bridge_jdm_vm         00:85:49:54:cd:32
macvtap2                    enp3s0f2              00:85:49:54:cd:33
```

show virtual-network-functions <vnf-name> vnf-xml-profile

user@jdm> **show virtual-network-functions gnf1 vnf-xml-profile**

```
<domain type='kvm' id='1'>
```

```
  <name>gnf1</name>
  <uuid>a1c62c35-910f-4354-991c-7ad26c1b32e7</uuid>
  <memory unit='KiB'>33554432</memory>
  <currentMemory unit='KiB'>33554432</currentMemory>
  <vcpu placement='static'>4</vcpu>
  <cputune>
    <vcpupin vcpu='0' cpuset='4'/>
    <vcpupin vcpu='1' cpuset='5'/>
    <vcpupin vcpu='2' cpuset='6'/>
    <vcpupin vcpu='3' cpuset='7'/>
    <emulatorpin cpuset='2-3'/>
  </cputune>
  <resource>
    <partition>/machine</partition>
  </resource>
  <sysinfo type='smbios'>
    <system>
      <entry name='manufacturer'>JUNIPER</entry>
      <entry name='product'>RE-GNF</entry>
      <entry
name='version'>v2-mx480-gnf1-re0-vtnet0-vtnet1-vtnet3-vtnet2-external-0x009069136000:0x0800</entry>

    </system>
  </sysinfo>
  <os>
    <type arch='x86_64' machine='pc-i440fx-rhel7.0.0'>hvm</type>
    <boot dev='hd'/>
    <smbios mode='sysinfo'/>
  </os>
  <features>
    <acpi/>
    <apic/>
  </features>
  <clock offset='utc'/>
  <on_poweroff>destroy</on_poweroff>
  <on_reboot>restart</on_reboot>
  <on_crash>restart</on_crash>
  <devices>
    <emulator>/usr/libexec/qemu-kvm</emulator>
    <disk type='file' device='disk'>
      <driver name='qemu' type='raw' cache='directsync' io='native'/>
      <source file='/vm-primary/gnf1/gnf1.img'/>
      <backingStore/>
      <target dev='hda' bus='virtio'/>
```

```
    <alias name='virtio-disk0'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x07' function='0x0'/>

  </disk>
  <disk type='file' device='disk'>
    <driver name='qemu' type='raw' cache='directsync' io='native'/>
    <source file='/vm-primary/gnf1/var-config.img'/>
    <backingStore/>
    <target dev='vdb' bus='virtio'/>
    <alias name='virtio-disk1'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x08' function='0x0'/>

  </disk>
  <disk type='file' device='disk'>
    <driver name='qemu' type='raw' cache='directsync' discard='unmap'/>
    <source file='/vm-primary/gnf1/swap-disk.img'/>
    <backingStore/>
    <target dev='hdc' bus='virtio'/>
    <alias name='virtio-disk2'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x09' function='0x0'/>

  </disk>
  <disk type='file' device='disk'>
    <driver name='qemu' type='raw' cache='directsync' discard='unmap'/>
    <source file='/vm-primary/gnf1/aux-disk.img'/>
    <backingStore/>
    <target dev='hdb' bus='ide'/>
    <alias name='ide0-0-1'/>
    <address type='drive' controller='0' bus='0' target='0' unit='1'/>
  </disk>
  <disk type='file' device='disk'>
    <driver name='qemu' type='raw' cache='directsync'/>
    <source file='/vm-primary/gnf1/usb-disk.img'/>
    <backingStore/>
    <target dev='sda' bus='usb'/>
    <alias name='usb-disk0'/>
    <address type='usb' bus='0' port='1'/>
  </disk>
  <controller type='usb' index='0'>
    <alias name='usb'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x01' function='0x2'/>

  </controller>
  <controller type='pci' index='0' model='pci-root'>
```

```
    <alias name='pci.0'/>
  </controller>
  <controller type='ide' index='0'>
    <alias name='ide'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x01' function='0x1'/>

  </controller>
  <interface type='direct' trustGuestRxFilters='yes'>
    <mac address='52:54:00:09:ab:83'/>
    <source dev='ens2f0' mode='vepa'/>
    <target dev='macvtap0'/>
    <model type='virtio'/>
    <alias name='net0'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x03' function='0x0'/>

  </interface>
  <interface type='direct' trustGuestRxFilters='yes'>
    <mac address='52:54:00:45:e3:ba'/>
    <source dev='ens2f1' mode='vepa'/>
    <target dev='macvtap1'/>
    <model type='virtio'/>
    <alias name='net1'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x04' function='0x0'/>

  </interface>
  <interface type='bridge'>
    <mac address='52:54:00:ee:73:93'/>
    <source bridge='bridge_jdm_vm'/>
    <target dev='vnet1'/>
    <model type='virtio'/>
    <alias name='net2'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x05' function='0x0'/>

  </interface>
  <interface type='direct'>
    <mac address='00:90:69:13:7f:00'/>
    <source dev='eno2' mode='bridge'/>
    <bandwidth>
      <inbound average='125000' peak='125000' burst='256'/>
      <outbound average='125000' peak='125000' burst='256'/>
    </bandwidth>
    <target dev='macvtap2'/>
    <model type='virtio'/>
    <driver name='qemu'/>
```

```
      <alias name='net3'/>
      <address type='pci' domain='0x0000' bus='0x00' slot='0x06' function='0x0'/>

    </interface>
    <serial type='pty'>
      <source path='/dev/pts/6'/>
      <target port='0'/>
      <alias name='serial0'/>
    </serial>
    <console type='pty' tty='/dev/pts/6'>
      <source path='/dev/pts/6'/>
      <target type='serial' port='0'/>
      <alias name='serial0'/>
    </console>
    <input type='mouse' bus='ps2'>
      <alias name='input0'/>
    </input>
    <input type='keyboard' bus='ps2'>
      <alias name='input1'/>
    </input>
    <memballoon model='virtio'>
      <alias name='balloon0'/>
      <address type='pci' domain='0x0000' bus='0x00' slot='0x0a' function='0x0'/>

    </memballoon>
  </devices>
  <seclabel type='none' model='none'/>
  <seclabel type='dynamic' model='dac' relabel='yes'>
    <label>+107:+107</label>
    <imagelabel>+107:+107</imagelabel>
  </seclabel>
</domain>
```

show version vnf

Syntax

show version vnf *vnf-name*

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the hostname and version information about the specified guest network function (GNF).

Options

vnf-name—Name of the GNF for which you want to view the version details.

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Sample Output

Depending on the platform running Junos OS, you might see different installed sub-packages.

show version vnf

```
user@jdm> show version vnf gnf2

Hostname: gnf2
Model: mx960
Junos: 17.4X48-D10.3
JUNOS OS Kernel 64-bit  [20170913.201739_fbsd-builder_stable_11]
JUNOS OS libs [20170913.201739_fbsd-builder_stable_11]
JUNOS OS runtime [20170913.201739_fbsd-builder_stable_11]
JUNOS OS time zone information [20170913.201739_fbsd-builder_stable_11]
JUNOS network stack and utilities [20170926.111120_builder_junos_174_x48_d10]
```

```
JUNOS modules [20170926.111120_builder_junos_174_x48_d10]
JUNOS mx modules [20170926.111120_builder_junos_174_x48_d10]
JUNOS libs [20170926.111120_builder_junos_174_x48_d10]
JUNOS OS libs compat32 [20170913.201739_fbsd-builder_stable_11]
JUNOS OS 32-bit compatibility [20170913.201739_fbsd-builder_stable_11]
JUNOS libs compat32 [20170926.111120_builder_junos_174_x48_d10]
JUNOS runtime [20170926.111120_builder_junos_174_x48_d10]
Junos vmguest package [20170926.111120_builder_junos_174_x48_d10]
JUNOS py extensions [20170926.111120_builder_junos_174_x48_d10]
JUNOS py base [20170926.111120_builder_junos_174_x48_d10]
JUNOS OS vmguest [20170913.201739_fbsd-builder_stable_11]
JUNOS OS crypto [20170913.201739_fbsd-builder_stable_11]
JUNOS mx libs compat32 [20170926.111120_builder_junos_174_x48_d10]
JUNOS mx runtime [20170926.111120_builder_junos_174_x48_d10]
JUNOS common platform support [20170926.111120_builder_junos_174_x48_d10]
JUNOS mx libs [20170926.111120_builder_junos_174_x48_d10]
JUNOS mtx Data Plane Crypto Support [20170926.111120_builder_junos_174_x48_d10]
JUNOS daemons [20170926.111120_builder_junos_174_x48_d10]
JUNOS mx daemons [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services URL Filter package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services TLB Service PIC package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services SSL [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services SOFTWIRE [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Stateful Firewall [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services RPM [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services PTSP Container package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services PCEF package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services NAT [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Mobile Subscriber Service Container package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services MobileNext Software package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Logging Report Framework package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services LL-PDF Container package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Jflow Container package [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Deep Packet Inspection package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services IPSec [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services IDS [20170926.111120_builder_junos_174_x48_d10]
JUNOS IDP Services [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services HTTP Content Management package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Crypto [20170926.111120_builder_junos_174_x48_d10]
```

```
JUNOS Services Captive Portal and Content Delivery Container package
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services COS [20170926.111120_builder_junos_174_x48_d10]
JUNOS AppId Services [20170926.111120_builder_junos_174_x48_d10]
JUNOS Services Application Level Gateways
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Services AACL Container package [20170926.111120_builder_junos_174_x48_d10]
JUNOS SDN Software Suite [20170926.111120_builder_junos_174_x48_d10]
JUNOS Extension Toolkit [20170926.111120_builder_junos_174_x48_d10]
JUNOS Packet Forwarding Engine Support (wrlinux)
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Packet Forwarding Engine Support (MX/EX92XX Common)
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Packet Forwarding Engine Support (M/T Common)
[20170926.111120_builder_junos_174_x48_d10]
JUNOS Packet Forwarding Engine Support (MX Common)
[20170926.111120_builder_junos_174_x48_d10]
JUNOS jfirmware [20170926.111120_builder_junos_174_x48_d10]
JUNOS Online Documentation [20170926.111120_builder_junos_174_x48_d10]
```

show version (JDM)

Syntax

show version (all-servers | server | vnf | all-vnfs | detail | brief)

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the version information about the Juniper Device Manager (JDM).

Options

all-servers—Display the version details of the JDM instances on both the servers.

server—Display the version details of the JDM instance on one specific server.

Range: **0** through **1**

vnf —Display the version details for a particular guest network function (GNF). You need to mention the GNF name in the command. Example: **show version vnf *gnf2***.

all-vnfs—Display the version details for all the GNFs.

(detail | brief)—Display the specified level of output.

Required Privilege Level

View

RELATED DOCUMENTATION

Generic Guidelines for Using JDM Server Commands | 200

request virtual-network-functions | 208

request server authenticate-peer-server | 206

Sample Output

show version

```
user@jdm> show version
```

```
Hostname: mgb-dvaita-ixr1-jdm
```

```
Model: junos_node_slicing
Server slot : 1
JDM package version : 17.4-R1.7
Host Software [Red Hat Enterprise Linux]
JDM container Software [Ubuntu 14.04.1 LTS]
JDM daemon jdmd [Version: 17.4R1.7-secure]
JDM daemon jinventoryd [Version: 17.4R1.7-secure]
JDM daemon jdmmon [Version: 17.4R1.7-secure]
Host daemon jlinkmon [Version: 17.4R1.7-secure]
```

user@jdm> **show version brief**

```
Hostname: mgb-dvaita-ixr1-jdm
Model: junos_node_slicing
Server slot : 1
JDM package version : 17.4-R1.7
Host Software [Red Hat Enterprise Linux]
JDM container Software [Ubuntu 14.04.1 LTS]
JDM daemon jdmd [Version: 17.4R1.7-secure]
JDM daemon jinventoryd [Version: 17.4R1.7-secure]
JDM daemon jdmmon [Version: 17.4R1.7-secure]
Host daemon jlinkmon [Version: 17.4R1.7-secure]
```

user@jdm> **show version detail**

```
Hostname: mgb-dvaita-ixr1-jdm
Model: junos_node_slicing
Server slot : 1
JDM package version : 17.4-R1.7
Host Software [Red Hat Enterprise Linux]
JDM container Software [Ubuntu 14.04.1 LTS]
JDM daemon jdmd [Version: 17.4R1.7-secure]
JDM daemon jinventoryd [Version: 17.4R1.7-secure]
JDM daemon jdmmon [Version: 17.4R1.7-secure]
Host daemon jlinkmon [Version: 17.4R1.7-secure]
KERNEL 3.10.0-514.el7.x86_64
MGD release 17.4R1.7 built by builder on 2017-11-17 11:29:41 UTC
CLI release 17.4R1.7 built by builder on 2017-11-17 10:53:44 UTC
base-actions-dd release 17.4R1.7 built by builder on 2017-11-17 10:06:17 UTC
jdmd_common-actions-dd release 17.4R1.7 built by builder on 2017-11-17 10:06:09
UTC
```

```
jdmd_nv_jdm-actions-dd release 17.4R1.7 built by builder on 2017-11-17 10:06:09
UTC
```

show system cpu (JDM)

Syntax

show system cpu

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the CPUs and their usage status.

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Output Fields

Table 22 on page 225 describes the output fields for the **show system cpu** command. Output fields are listed in the approximate order in which they appear.

Table 22: show system cpu Output Fields

Field Name	Field Description
VNF	Name of the GNF.
State	GNF status. For example, “Running”.
CPU-Id(s)	List of CPU IDs.
Usage	CPU usage percentage.
Qemu Pid	Qemu process ID.

Sample Output

show system cpu

```
user@jdm> show system cpu
```

```
VNF CPU Utilization and Allocation Information
-------------------------------------------------------------------------------

      -------------
VNF                                     CPU-Id(s)               Usage  Qemu Pid

        State
---------------------------------------- ---------------------- ------ --------

        -----------
test                                    4,5,6,7,8,9,10,11       5.0%   32392

        Running

Free CPUs      : 12,13,14,15
Host Isolcpu(s): 2-15
Emulator Pins  : 2-3
```

show system mac-addresses (JDM)

Syntax

show system mac-addresses

Release Information

Command introduced in Junos OS Release 19.2R1.

Description

Display information related to the Juniper Device Manager (JDM) management interface MAC address and available MAC address range.

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Output Fields

Table 23 on page 227 describes the output fields for the **show system mac-addresses** command. Output fields are listed in the approximate order in which they appear.

Table 23: show system mac-addresses Output Fields

Field Name	Field Description
Management Interface MAC Addresses	
Domain	This could be a Juniper Device Manager (JDM) domain or guest network function (GNF) domain.
Interface	Interface name.
Management-MAC	The MAC address of the JDM or GNF.

Table 23: show system mac-addresses Output Fields *(continued)*

Field Name	Field Description
Donor-GNF-ID	Displays name of the GNF which is the donor for the JDM management interface (jmgmt0) MAC address. This field is marked as not applicable (NA) for the GNFs listed in the column 'Management Interface MAC Addresses'. **NOTE:** • If there are no licensed GNFs in the system, no donor will be available for the **jmgmt0** MAC address. In that case, a virtual license is used and this field is marked as '-'. • For in-chassis Junos node slicing, **jmgmt0** and **fxp0** MAC addresses come from Juniper's licensed address space available on BSYS, not from a licensed GNF.
VNF MAC Address Pool	
Base-Mac-Address	Starting address of the MAC pool.
Size	Size of the MAC address pool.
Licensed	Indicates if the GNF is licensed or not. The following are the possible options: • Y • N
Donor	Indicates if the GNF is donor for jmgmt0 MAC address. The following are the possible options: • Y • N

Sample Output

show system mac-addresses

```
user@jdm> show system mac-addresses
```

```
Management Interface MAC Addresses
```

```
-------------------------------------------------------------------------------------
Domain                                          Interface   Management-MAC
Donor-GNF-ID
-----------------------------------------   ---------   ------------------
------------
JDM                                             jmgmt0      7C:E2:CA:FF:36:73   NA
gnf1                                            fxp0        7C:E2:CA:FF:36:74   NA
gnf3                                            fxp0        7C:E2:CA:FF:36:75   NA

MAC Blocks
-------------------------------------------------
GNF-ID  Base-Mac-Address    Size   Licensed  Donor
------  ------------------  -----  --------  -----
1       aa:bb:cc:dd:ee:00   4096   Y         N
3       00:90:69:3a:40:00   4096   N         N
```

show system max-smbios-version (JDM)

Syntax

show system max-smbios-version

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the latest SMBIOS version supported by the Juniper Device Manager (JDM).

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Sample Output

show system max-smbios-version

```
user@jdm> show system max-smbios-version
```

```
Version : v2
```

show system memory (JDM)

Syntax

show system memory

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the memory usage information about the host server, Juniper Device Manager (JDM), and guest network functions (GNF).

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Output Fields

Table 24 on page 231 describes the output fields for the **show system memory** command. Output fields are listed in the approximate order in which they appear.

Table 24: show system memory Output Fields

Field Name	Field Description
Memory Usage Information	Displays the following memory usage information about host server and JDM: • Total—Total memory. • Used—Used memory. • Free—Available memory.
VNF Memory Information	Displays the following memory information about the GNFs: • Name—GNF name. • Resident—The memory used by the GNFs. • Actual—Actual memory.

Sample Output

show system memory

```
user@jdm> show system memory
```

```
Memory Usage Information
--------------------------
       Total  Used   Free
       ------ ------ ------
Host:  251G   14G    219G

JDM :  2.0G   2.0G   0

VNF Memory Information
-----------------------------------------------------------------
Name                                                Actual Resident
--------------------------------------------------- ------ --------
gnf1                                                16.0G  13.6G
gnf2                                                16.0G  11.6G
gnf3                                                16.0G  12.6G
gnf4                                                16.0G  12.0G
gnf5                                                16.0G  12.7G
```

show system network (JDM)

Syntax

show system network

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the statistics information for physical interface, JDM interface, and interfaces per guest network function (GNF).

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Output Fields

Table 25 on page 233 describes the output fields for the **show system network** command. Output fields are listed in the approximate order in which they appear.

Table 25: show system network Output Fields

Field Name	Field Description
Physical Interfaces	
Name	Name of the physical interface.
Index	Interface index.
MTU	The maximum transmission unit.
Hardware-address	The physical interface hardware address.
Rcvd Bytes	The number of bytes received.
Rcvd Packets	The number of packets received.

Table 25: show system network Output Fields *(continued)*

Field Name	Field Description
Rcvd Error	The packets received with error.
Rcvd Drop	The packets dropped during reception.
Trxd Bytes	The number of bytes transmitted.
Trxd Packets	The number of packets transmitted.
Trxd Error	The packets transmitted with error.
Trxd Drop	The packets dropped during transmission.
Flags	Interface flags.
Per VNF Interface Statistics	
Name	List of the interfaces for each GNF.
Source	Interface source.
MAC Address	The MAC address of the interface.
Rcvd Bytes	The number of bytes received.
Rcvd Packets	The number of packets received.
Rcvd Error	The packets received with error.
Rcvd Drop	The packets dropped during reception.
Trxd Bytes	The number of bytes transmitted.
Trxd Packets	The number of packets transmitted.
Trxd Error	The packets transmitted with error.
Trxd Drop	The packets dropped during transmission.
JDM Interface Statistics	
Name	Name of the JDM interface.

Table 25: show system network Output Fields *(continued)*

Field Name	Field Description
Index	Interface index.
MTU	The maximum transmission unit.
Hardware-address	The JDM interface hardware address.
Rcvd Bytes	The number of bytes received.
Rcvd Packets	The number of packets received.
Rcvd Error	The packets received with error.
Rcvd Drop	The packets dropped during reception.
Trxd Bytes	The number of bytes transmitted.
Trxd Packets	The number of packets transmitted.
Trxd Error	The packets transmitted with error.
Trxd Drop	The packets dropped during transmission.
Flags	Interface flags.
VNF MAC Address Pool	
Start MAC Address	MAC address start value.
Range	Available MAC address range.

Sample Output

show system network

```
user@jdm> show system network

Physical Interfaces
---------------------------------------------------------------------------------------------------------------------
```

```
Name     Index MTU     Hardware-address  Rcvd Bytes   Rcvd Packets Rcvd Error Rcvd
 Drop Trxd Bytes   Trxd Packets Trxd Error Trxd Drop Flags
-------- ----- ------- ----------------- ------------ ------------ ----------
--------- ------------ ------------ ---------- --------- ------
enp3s0f1 4     1500    00:25:90:b5:75:51 8787662837   51975964     0
538926    40009223     407379       0          0         BMPRU
ens3f1   7     1500    3c:fd:fe:08:87:02 1019880532   16723722     0
11243028  19265494115  31971968     0          0         BMPRU
ens3f0   3     1500    3c:fd:fe:08:87:00 5951717054   81330473     0
11226877  139135292735 124708008    0          0         BMPRU
enp3s0f2 5     1500    00:25:90:b5:75:52 3343179197   40806691     0
461955    3449064446   12191724     0          0         BMRU

Per VNF Interface Statistics
-------------------------------------------------------------------------------------------------------------------------------------------
Interface                   Source        MAC Address        Rcvd Bytes   Rcvd
packets Rcvd Error Rcvd Drop Trxd bytes   Trxd Packets Trxd Error Trxd Drop
--------------------------- ------------ -----------------  ------------
------------ ---------- --------- ------------ ------------ ---------- ---------
VNF name: test
macvtap0                    ens3f0        00:f1:60:3d:20:23  91526        1697
     0          0         1254382      16782        0          0
macvtap1                    ens3f1        00:f1:60:3d:20:24  561558       3727
     0          0         803396       12958        0          0
vnet1                       bridge_jdm_vm 00:f1:60:3d:20:25  2888         32
     0          0         2282         25           0          0
macvtap2                    enp3s0f2      00:f1:60:3d:20:26  152563       1080
     0          0         4472700      55664        0          0

JDM Interface Statistics
-------------------------------------------------------------------------------------------------------------------------------------------
Name     Index MTU   Hardware-address  Rcvd Bytes   Rcvd Packets Rcvd Error Rcvd
Drop Trxd Bytes   Trxd Packets Trxd Error Trxd Drop Flags
-------- ----- ----- ----------------- ------------ ------------ ----------
--------- ------------ ------------ ---------- --------- ------
bme1     1433  1500  52:54:00:21:20:2e 502730       4506         0          0
     477328       2619         0          0         BMRU
jmgmt0   1439  1500  00:f1:60:3d:20:22 4991675      66429        0          2862
     100548       891          0          0         BMRU
bme2     1435  1500  52:54:00:88:b5:dd 2930         33           0          0
     3466         39           0          0         ABMRU
cb0.4002 2     1500  00:f1:60:3d:20:20 12204921     209269       0          0
     3688591023   195579       0          0         ABMRU
cb1.4002 3     1500  00:f1:60:3d:20:21 161850       3026         0          0
```

```
     204784       3029         0          0         ABMRU

.....................
```

Starting in Junos OS Release 19.2R1, the **show system network** output does not display information related to MAC address pool. For MAC address information use the command **show system mac-addresses**.

show system max-smbios-version (JDM)

Syntax

show system max-smbios-version

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Display the latest SMBIOS version supported by the Juniper Device Manager (JDM).

Required Privilege Level

View

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | 200
- request virtual-network-functions | 208
- request server authenticate-peer-server | 206

Sample Output

show system max-smbios-version

```
user@jdm> show system max-smbios-version
```

```
Version : v2
```

restart (JDM)

Syntax

```
restart (gracefully | immediately | soft)
<jdmd>
<jdmmon>
<jinventoryd>
<jlinkmon>
```

Release Information

Command introduced in Junos OS Release 17.4R1.

Description

Restart daemons belonging to Juniper Device Manager (JDM).

CAUTION: Never restart a software process unless instructed to do so by a customer support engineer.

NOTE: Starting in Junos OS Release 19.2R1, JDM does not support the **jinventoryd** option in the **restart** command.

Options

gracefully—(Optional) Restart a specified module or component by sending the equivalent of a UNIX SIGTERM signal.

immediately—(Optional) Immediately restart a module or component by sending the equivalent of a UNIX SIGKILL signal.

soft—(Optional) Reread and reactivate the configuration without completely restarting a module or component. This option is the equivalent of a UNIX SIGHUP signal.

jdmd—Restart the JDM service process.

jdmmon—Restart the JDM link monitoring daemon.

jinventoryd—Restart the JDM inventory management daemon.

jlinkmon—Restart the JDM link monitor daemon, which runs on the Linux host.

NOTE: The options **gracefully**, **immediately**, and **soft** are not available for restarting the Juniper link monitor daemon.

RELATED DOCUMENTATION

- Generic Guidelines for Using JDM Server Commands | **200**
- request virtual-network-functions | **208**
- request server authenticate-peer-server | **206**

List of Sample Output

restart jdmd gracefully on page 240

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

restart jdmd gracefully

```
user@jdm> restart jdmd gracefully
```

```
Juniper Device Manager service process started, pid 12058
```