Virtualized 7250 IXR, 7750 SR, and 7950 XRS Simulator (vSIM)

Release 26.7.R1

vSIM Installation and Setup Guide

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Nokia is committed to diversity and inclusion. We are continuously reviewing our customer documentation and consulting with standards bodies to ensure that terminology is inclusive and aligned with the industry. Our future customer documentation will be updated accordingly.

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1 Getting started

1.1 About this guide

This guide describes how to install and set up the Virtualized 7750 SR and 7950 XRS Simulator (vSIM).

Note: Unless otherwise indicated, CLI commands, contexts, and configuration examples in this guide apply for both the MD-CLI and the classic CLI.

This guide is organized into functional chapters and includes:

- a functional overview of the vSIM
- a description of the vSIM system architecture
- requirements for the NFV infrastructure (NFVI) supporting the vSIM system
- initial commissioning procedures to bring up a vSIM for first-time use

Command outputs shown in this guide are examples only; actual displays may differ depending on supported functionality and user configuration.

Note: This guide generically covers Release 26.*x*.R*x* content and may contain some content that will be released in later maintenance loads. See the *SR OS R26.x.Rx Software Release Notes*, part number 3HE 29176 000*x* TQZZA, for information about features supported in each load of the Release 26.*x*.R*x* software.

1.1.1 Audience

This guide is intended for anyone who is creating vSIMs in a qualified lab environment. It is assumed that the reader has an understanding of the following:

- x86 hardware architecture
- Linux system installation, configuration, and administration methods
- basic XML syntax
- 7750 SR and 7950 XRS chassis components
- SR OS CLI
- networking principles and configurations, including virtualized I/O techniques

1.1.2 List of technical publications

After the installation process of the vSIM is completed, see the SR OS documents, as listed in the *7450 ESS, 7750 SR, and 7950 XRS Guide to Documentation*. These documents contain information about the software configuration and the command line interface (CLI) that is used to configure network parameters and services.

1.1.3 Conventions

This section describes the general conventions used in this guide.

1.1.3.1 Precautionary and information messages

The following information symbols are used in the documentation.

DANGER: Danger warns that the described activity or situation may result in serious personal injury or death. An electric shock hazard could exist. Before you begin work on this equipment, be aware of hazards involving electrical circuitry, be familiar with networking environments, and implement accident prevention procedures.

WARNING: Warning indicates that the described activity or situation may, or will, cause equipment damage, serious performance problems, or loss of data.

Caution: Caution indicates that the described activity or situation may reduce your component or system performance.

Note: Note provides additional operational information.

Tip: Tip provides suggestions for use or best practices.

1.1.3.2 Options or substeps in procedures and sequential workflows

Options in a procedure or a sequential workflow are indicated by a bulleted list. In the following example, at step 1, the user must perform the described action. At step 2, the user must perform one of the listed options to complete the step.

Example: Options in a procedure

1. User must perform this step.
2. This step offers three options. User must perform one option to complete this step.
   - This is one option.
   - This is another option.
   - This is yet another option.

Substeps in a procedure or a sequential workflow are indicated by letters. In the following example, at step 1, the user must perform the described action. At step 2, the user must perform two substeps (a. and b.) to complete the step.

Example: Substeps in a procedure

1. User must perform this step.
2. User must perform all substeps to complete this action.
   a. This is one substep.
   b. This is another substep.

Nested substeps within a procedure or a sequential workflow are indicated by roman numerals. In the following example, at step 1, the user must perform the described action. At step 2, the user must perform two substeps (a. and b.) to complete the step. At substep b, the user must perform two additional substeps (i. and ii.) to complete the step.

Example: Nested substeps in a procedure

1. User must perform this step.
2. User must perform all substeps to complete this action.
   a. This is one substep.
   b. User must perform all nested substeps to complete this action.
      i. This is a nested substep.
      ii. This is another nested substep.

1.2 vSIM installation and setup process

This guide is presented in an overall logical configuration flow. Each section describes the tasks for a functional area.

Table 1: vSIM installation and configuration workflow lists the general tasks and procedures necessary to install and setup a vSIM, in the recommended order of execution.

Table 1: vSIM installation and configuration workflow

Task	Description	See
Installing the host machine	Set up and install the host machine, including the host operating system.	Host OS and hypervisor
Installing the virtualization packages	Install the necessary virtualization packages on the host machine.	Linux KVM hypervisor Virtual switch
Configuring host networking	Configure host networking (NICs, network interfaces, vSwitch).	vSIM networking Virtual switch Network interfaces Guest vNIC mapping in vSIM VMs
Downloading the software image	Download the SR OS software image.	vSIM software packaging
Obtaining the license keys	Obtain the software license keys from Nokia.	vSIM software licensing
VM resource requirements	Determine resource requirements for the virtual machine (VM).	Memory vCPU
Creating configuration files	If required, create configuration files for the VM. The exact format of the configuration files depends on the method of installation.	Creating and starting a vSIM VM on a Linux KVM host

Task	Description	See
		Creating and starting a vSIM VM on a VMware ESXi host
Launching the VM	Launch the vSIM VM.	Creating and starting a vSIM VM on a Linux KVM host Creating and starting a vSIM VM on a VMware ESXi host
Verifying the installation	Verify the vSIM VM installation.	Verifying the vSIM installation

2 vSIM overview

2.1 vSIM overview

The Nokia Virtualized 7750 SR and 7950 XRS Simulator (vSIM) is a Virtualized Network Function (VNF) that simulates the control, management, and forwarding functions of a 7750 SR or 7950 XRS router.

The vSIM runs the same Service Router Operating System (SR OS) as 7750 SR and 7950 XRS hardware-based routers and, therefore, has the same feature set and operational behavior as those platforms. Configuration of interfaces, network protocols, and services on the vSIM are performed the same way as they are on physical 7750 SR and 7950 XRS systems. vSIM software is designed to run on x86 virtual machines (VMs) deployed on industry-standard Intel servers. In this document, vSIM refers to the guest software running on a VM and to the set of those VMs that comprise a network element.

The vSIM is suitable for labs, training and education, network simulation, or to emulate a device under test (DUT) in preparation for deployment into a production network. It is not intended for deployment in an actual production network.

NFV enables network functions that previously depended on custom hardware to be deployed on commodity hardware using standard IT virtualization technologies. For network operators, the benefits of NFV include:

- reduced CAPEX by using industry-standard hardware that is potentially easier to upgrade
- reduced OPEX (space, power, cooling) by consolidation of multiple functions on fewer physical platforms
- faster and simpler testing and rollout of new services
- more flexibility to scale capacity up or down, as needed
- ability to move or add network functions to a location without necessarily needing new equipment

2.1.1 vSIM concept

The vSIM software is designed for a standard virtualization environment in which the hypervisor software running on a host machine creates and manages one or more VMs that consume a subset of the host machine resources. Each VM is an abstraction of a physical machine with its own CPU, memory, storage, and interconnect devices. Each vSIM can be viewed as a Virtual Network Function (VNF) made up of one or more VNF components (VNF-C) spanning one or more compute servers. For a vSIM, each VNF-C is a VM that emulates one card slot of a physical router, or a complete physical router in the case of one integrated model.

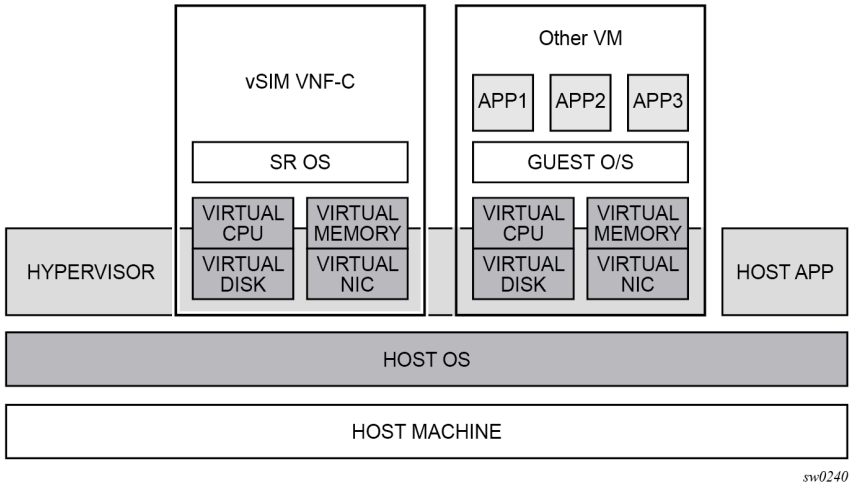
The SR OS is the guest operating system of each VNF-C VM. vSIM VMs can be deployed in combination with other VMs on the same server, including VMs that run guest operating systems other than the SR OS.

Note: Care must be taken not to over-subscribe host resources; vSIM VMs must have dedicated CPU cores and dedicated vRAM memory to ensure stability. In addition, combining vSIM VMs with other VMs that have intensive memory access requirements on the same CPU socket should

be generally avoided for stability reasons. See Creating and starting a vSIM VM on a Linux KVM host for more information about this topic.

Figure 1: vSIM concept shows the general concept of a vSIM.

Figure 1: vSIM concept



The host machine supporting a vSIM VM must be a qualified x86 machine that may range from a laptop to a dedicated server.

The host machine must run a hypervisor that is compatible with the vSIM software. QEMU-KVM and VMware are the only supported hypervisors.

See Host machine requirements for more information about the minimum requirements of the host server and the supported hypervisors for the vSIM.

2.2 vSIM deployment models

The vSIM can be deployed as one of two models: integrated or distributed. The deployment model depends entirely on the configured chassis type of the vSIM system.

2.2.1 Integrated model

The integrated vSIM model uses a single VM to emulate the physical router. All functions and processing tasks of the emulated router, including control, management and data plane, are performed by the resources of the single VM.

An integrated vSIM is created when the configured chassis type is SR-1, SR-1s, IXR-R6, IXR-ec, IXR-e2, IXR-e2c, or IXR-e2sc. All other chassis types require a distributed model of deployment.

Note: SR-1 and SR-1s do not refer to the following chassis types:

- 7750 SR-1x-48D
- 7750 SR-1-24D

- 7750 SR-1-48D
- 7750 SR-1-92S
- 7750 SR-1-46S
- 7750 SR-1x-92S
- 7750 SR-1se

All FP5 small fixed platforms require a distributed model of deployment.

While SR-1, SR-1s, IXR-ec, IXR-e2, IXR-e2c, and IXR-e2sc chassis types are single VM combined systems without redundancy support, the IXR-R6 chassis type can have two combined VMs to allow for redundancy. The IXR-R6 otherwise behaves as an integrated model, as both VMs have combined CPM/IOM components.

2.2.2 Distributed model

The distributed vSIM model uses two or more VMs (VNFCs) connected to a common internal network to emulate a single physical router (VNF).

In a distributed system (vSIM), each VM is specialized, supporting either control plane processing (CPM) or datapath functions (IOM or XCM).

A distributed vSIM supports one CPM or two hot-redundant CPMs in the same active/standby model as the emulated physical router so that if the active CPM fails, the standby can take over immediately, with minimal or no impact to packet forwarding, services, or control plane sessions. These can be placed on different hosts to provide hardware and software resiliency.

A distributed vSIM is created when the configured chassis type is anything other than SR-1, SR-1s, IXR-R6, IXR-ec, IXR-e2, IXR-e2c, or IXR-e2sc.

The VMs of a distributed vSIM must be able to communicate privately over an internal network dedicated to the router being emulated. The internal network behaves similar to the switch fabric of a physical router.

Each CPM and IOM/XCM of a specific vSIM instance must be connected to the fabric network of that instance. The fabric network is a Layer 2 broadcast domain over which the VMs of the vSIM send messages to each other for purposes of discovery, inter-card communication and synchronization, inter-IOM data traffic, and so on. The MTU of network interfaces associated with vSIM internal fabric interfaces must be set to 9000 bytes. Packets sent over the fabric by each IOM/XCM or CPM are Ethernet encapsulated (without 802.1Q VLAN tags) and frames with a multicast/broadcast destination MAC address must be delivered to all the VMs of the vSIM instance.

2.3 Supported vSIM configurations

For a vSIM to properly simulate a particular 7750 SR or 7950 XRS router configuration, the SR OS software running on each of its component VMs must read the SMBIOS information (see Sysinfo for information about SMBIOS parameters), which must have the following configured:

- chassis type of the emulated router

  The chassis type must be set identically for all VMs that make up one chassis or system.
- slot number corresponding to each VM
- card type represented by each VM

- equipped MDAs/XMAs in each VM emulating an IOM or XCM card
- SFM (switch fabric module) that virtually connects the slot to the rest of the system

  The SFM must be set identically for all VMs that make up one chassis or system.
- chassis topology of the system

  When this value is set to *XRS-40*, the slot is part of an extended 7950 XRS chassis. This must be set identically for all VMs that make up one 7950 XRS-40 system.

Note: Before the Release 16.0, the chassis-topology attribute was not supported and VMs emulating a 7950 XRS-20 or 7950 XRS-20e card would automatically boot as being part of an extended 7950 XRS-40 system. With Release 16.0 and later software, a VM emulating a 7950 XRS-20 or 7950 XRS-20e card automatically boots as being part of a standalone XRS-20 system.

vSIM software can only simulate valid 7750 SR and 7950 XRS router configurations. For example, with real physical hardware, you cannot install a 7950 XRS CPM-X20 in an SR-12 chassis or pass data traffic through a 7950 XRS chassis with only one CPM-X20 and no XCMs installed. The same rules apply to vSIMs.

vSIM configuration should always start with a decision about the chassis type to be emulated. vSIM supports the following chassis types:

- 7750 SR-7
- 7750 SR-12
- 7750 SR-12e
- 7750 SR-a4
- 7750 SR-a8
- 7750 SR-1e
- 7750 SR-2e
- 7750 SR-3e
- 7750 SR-1
- 7750 SR-1s
- 7750 SR-2s
- 7750 SR-7s
- 7750 SR-14s
- 7750 SR-1x-48D
- 7750 SR-1-24D
- 7750 SR-1-48D
- 7750 SR-1-92S
- 7750 SR-1-46S
- 7750 SR-1x-92S
- 7750 SR-1se
- 7750 SR-2se

- 7750 DMS-1-24D
- 7950 XRS-20
- 7950 XRS-20e
- 7250 IXR-6
- 7250 IXR-10
- 7250 IXR-R4
- 7250 IXR-R6
- 7250 IXR-s
- 7250 IXR-e
- 7250 IXR-X
- 7250 IXR-X3
- 7250 IXR-ec
- 7250 IXR-e2
- 7250 IXR-e2c
- 7250 IXR-e2sc
- 7250 IXR-R6d
- 7250 IXR-R6dl

The chassis, sfm, and chassis-topology SMBIOS parameters determine the total number of card slots available, the eligible card types in each slot position and the minimum configuration of cards to create a functional system.

If a VM of a vSIM emulates a physical card with I/O ports (for example, an IOM or XCM) then specific MDAs compatible with that card can be virtually equipped. I/O ports on these MDAs map to VM vNIC interfaces as described later in this document. The MDA types that are compatible with a card adhere to physical hardware rules.

Appendix A: vSIM supported hardware summarizes all currently supported valid combinations of chassis type, SFM type, card type, XIOM type and MDA type that may be represented by one single vSIM VM.

2.4 vSIM networking

A vSIM VM can have one or more virtual NIC ports. Depending on the hypervisor, each vNIC port presented to a vSIM VM can be one of the following types:

- VirtIO (KVM)
- E1000 (KVM and VMware)

For each of the above options, the virtual NIC port that is presented to the guest is internally connected to a logical interface within the host. The logical host interface may map directly to a physical NIC port/VLAN or it may connect to a vSwitch within the host. If a vNIC port is connected to a vSwitch, a physical NIC port/VLAN must be added as a bridge port of the vSwitch to enable traffic to reach other external hosts.

Note: SR-IOV and PCI pass-through are not supported technologies for vSIM VMs.

Each vSIM VM supports up to 20 virtual NIC ports. Depending on the card-type emulated by the VM, this may be more or less than the actual number of I/O ports supported by the card-type. Additional ports may be configured on the vSIM, but they will have no external connectivity and will remain in the down state.

Note: Throughput on vSIM ports is limited to no more than 250 pps.

2.5 vSIM software packaging

The vSIM software is part of the VSR software package that is available for download from the Nokia Support Portal as a ZIP file in one of the following formats, depending on the machine on which the VSR is installed:

- **vSIM-KVM ZIP archive file**

  The vSIM-KVM ZIP archive filename uses the format `Nokia-vSIM-KVM-yy.m.Rx.zip` (release specific version). For example, `Nokia-vSIM-KVM-21.2.R1.zip`.

  The vSIM-KVM ZIP archive file contains the following:

  – a QCOW2 disk image file. The sros-vsim.qcow2 disk image should be used when creating VSR-I VMs on Linux KVM machines using libvirt or OpenStack.

  – a MIBs directory containing MIB files

  – a support directory containing YANG files

  – MD5 and SHA256 checksums for files in the zip

- **vSIM-VMware ZIP archive file**

  The vSIM-VMware ZIP archive filename uses the format `Nokia-vSIM-VMware-yy.m.Rx.zip` (release specific version). For example, `Nokia-vSIM-VMware-21.2.R1.zip`.

  The vSIM-KVM ZIP archive file contains the following:

  – an OVA file. The sros-vsim.ova archive file is used for onboarding a VSR-I VM into a VMware environment. This OVA contains an OVF descriptor file and a VMDK disk image containing the VSR software. The OVA file can be used to instantiate a VSR-I VM using either vCloud Director or the vSphere Web Client interacting with a vCenter Server.

  – a MIBs directory containing MIB files

  – a support directory containing YANG files

  – MD5 and SHA256 checksums for files in the zip

Note: Do not use the files contained in the Nokia-VSR-VMware or Nokia-VSR-KVM ZIP files. These files should only be used for VSR deployments. See the *VSR VNF Installation and Setup Guide* for more information.

Note: TIMOS content is created under the `cf3:/TIMOS` directory. This location cannot be edited.

3 Host machine requirements

3.1 Overview

This section describes the requirements that must be fulfilled by a host machine to support vSIM virtual machines (VMs).

The host machine for vSIM VMs is usually a dedicated server or PC in a lab environment. vSIM VMs may also be deployed in a fully orchestrated data center, but this topic is out of scope of this guide.

3.2 Host machine hardware requirements

This section describes the host machine hardware requirements.

3.2.1 vCPU requirements

The minimum number of vCPUs that you can allocate to a vSIM VM is two. See vCPU for more information.

The 7250 IXR family has the following minimum requirements:

- four vCPUs for cpiom-ixr-r6
- a minimum of four vCPUs for imm36-100g-qsfp28; however, eight vCPUs are recommended

3.2.2 CPU and DRAM memory

vSIM VMs can be deployed on any PC or server with an Intel CPU that is Sandy Bridge or later in terms of micro-architecture.

The PC or server should be equipped with sufficient DRAM memory to meet the memory requirement of the host, and have adequate resources to back the memory of each vSIM VM without oversubscription.

The minimum amount of memory for each vSIM VM depends on emulated card type, as listed in Table 2: VM memory requirements by card type.

Table 2: VM memory requirements by card type

Emulated card type	Minimum required memory (GB)
cpiom-ixr-r6	6
imm36-100g-qsfp28	6
cpm-ixr-x/imm36-qsfpdd	6

Emulated card type	Minimum required memory (GB)
xcm2-x20	6
xcm-1s	6
xcm-2s	6
xcm-2se	8
xcmc-2se	8
xcm-7s	6
xcm-7s-b	6
xcm2-7s	8
xcm-14s	8
xcm-14s-b	8
xcm2-14s	12
cpm-1se/imm36-800g-qsfpdd	6
all other card types	4

Note: vSIM deployment is not supported on PCs or servers powered by AMD or ARM CPUs.

3.2.3 Storage

Each vSIM VM needs only a moderate amount of persistent storage space; 5 to 10 Gbytes is sufficient in most cases.

The currently supported method for attaching a storage device to a vSIM VM is to attach a disk image that appears as an IDE hard drive to the guest. The vSIM VM disk images can either be stored on the host server hard drive, or stored remotely.

3.2.4 NICs

vSIM VMs are supported with any type of NIC, as long as it is supported by the hypervisor.

3.3 Host machine software requirements

This section describes the requirements for host OS and virtualization software requirements for vSIM VMs.

3.3.1 Host OS and hypervisor

The supported host OS depends on the hypervisor selected to run the vSIM VMs. Integrated model vSIM VMs (SR-1, SR-1s, IXR-R6, IXR-ec) are supported with the following hypervisors:

- Linux KVM, as provided by one of the host OSs listed below
- VMware ESXi 6.0, 6.5, 6.7, or 7.0

Distributed model vSIM VMs are only supported with the Linux KVM hypervisor, using one of the following host OSs:

- CentOS 7.0-1406 with 3.10.0-123 kernel
- CentOS 7.2-1511 with 3.10.0-327 kernel
- CentOS 7.4-1708 with 3.10.0-693 kernel
- Centos 7.5-1804 with 3.10.0-862 kernel
- Red Hat Enterprise Linux 7.1 with 3.10.0-229 kernel
- Red Hat Enterprise Linux 7.2 with 3.10.0-327 kernel
- Red Hat Enterprise Linux 7.4 with 3.10.0-693 kernel
- Red Hat Enterprise Linux 7.5 with 3.10.0-862 kernel
- Ubuntu 14.04 LTS with 3.13 kernel
- Ubuntu 16.04 LTS with 4.4

3.3.1.1 Linux KVM hypervisor

vSIM VMs can be created and managed using the open-source Kernel-based VM (KVM) hypervisor.

Nokia recommends the use of the Libvirt software package to manage the deployment of VMs in a Linux KVM environment. Libvirt is open source software that provides a set of APIs for creating and managing VMs on a host machine, independent of the hypervisor. Libvirt uses XML files to define the properties of VMs and virtual networks. It also provides a convenient **virsh** command line tool.

The vSIM VM examples shown in this guide assume that VM parameters in a domain XML file are read and acted upon by the **virsh** program.

3.3.1.2 VMware hypervisor

You can install integrated model vSIM (SR-1, SR-1s, IXR-R6, IXR-ec) VMs on hosts running the VMware ESXi hypervisor. Only ESXi versions 6.0, 6.5, 6.7, and 7.0 are supported with the vSIM.

Note: Distributed model vSIMs are not supported on VMware managed hosts.

Nokia recommends deployment of the vSphere vCenter server and use of the vSphere Web Client GUI for managing the virtual machines in a VMware environment.

The following VMware features are supported with vSIM VMs:

- e1000 vNIC interfaces

- vNIC association with a vSphere standard switch
- vNIC association with a vSphere distributed switch
- vMotion
- High Availability

Non-supported features include VMXNET3 device adapter support, SR-IOV, PCI pass-through, DRS, fault tolerance, and Storage vMotion.

3.3.2 Virtual switch

A virtual switch (vSwitch) is a software implementation of a Layer 2 bridge or Layer 2-3 switch in the host OS software stack. When the host has one or more VMs, the vNIC interfaces (or some subset) can be logically connected to a vSwitch to enable the following:

- vNIC-to-vNIC communication within the same host without relying on the NIC or other switching equipment
- multiple vNICs to share the same physical NIC port

The Linux bridge vSwitch implementation option is available on Linux hosts.

The standard switch and distributed switch vSwitch implementation options are available on VMware ESXi hosts.

3.3.2.1 Linux bridge

The Linux bridge is a software implementation of an IEEE 802.1D bridge that forwards Ethernet frames based on learned MACs. It is part of the `bridge-utils` package. The Linux bridge datapath is implemented in the kernel (specifically, the **bridge** kernel module), and it is controlled by the `brctl` userspace program.

On Centos and RHEL hosts, a Linux bridge can be created by adding the **ifcfg-brN** (where *N* is a number) file in the `/etc/sysconfig/network-scripts/` directory. The contents of this file contain the following directives:

- **DEVICE=brN** (with *N* correctly substituted)
- **TYPE=Bridge** (*Bridge* is case-sensitive)

The following shows an example `ifcfg` file:

```
TYPE=Bridge
DEVICE=br0
IPADDR=192.0.2.1
PREFIX=24
GATEWAY=192.0.2.254
DNS1=8.8.8.8
BOOTPROTO=static
ONBOOT=yes
NM_CONTROLLED=no
DELAY=0
```

To add another interface as a bridge port of **brN**, add the **BRIDGE=brN** directive to the `ifcfg` network-script file for that other interface.

On Ubuntu hosts, a Linux bridge is created by adding an **auto brN** stanza followed by an **iface brN** stanza to the `/etc/network/interfaces` file. The **iface brN** stanza can include several attributes, including the **bridge_ports** attribute, which lists the other interfaces that are ports of the Linux bridge.

The following example shows an `/etc/network/interfaces` file that creates a **bridge br0** with *eth0* as a bridge port.

```
auto lo
     iface lo inet loopback
auto br0
     iface br0 inet dhcp
          bridge_ports eth0
          bridge_stp off
          bridge_fd 0
          bridge_maxwait 0
```

By default, the Linux bridge is VLAN unaware and it does not look at VLAN tags, nor does it modify them when forwarding the frames.

If the bridge is configured to have VLAN sub-interfaces, frames without a matching VID are dropped or filtered.

If a VLAN sub-interface of a port is added as a bridge port, then frames with the matching VID are presented to the bridge with the VLAN tag stripped. When the bridge forwards an untagged frame to this bridge port, a VLAN tag with a matching VID is automatically added.

4 vSIM software licensing

4.1 vSIM licensing overview

This section describes how software licensing applies to vSIMs. For a vSIM to be fully functional, the system must load a valid license file at bootup. The license file encodes the allowed capabilities and features of the vSIM system. Contact your Nokia account representative to obtain license files associated with a purchase order or trial request.

4.2 Using vSIM license keys

When you purchase software licenses for one or more vSIMs, your Nokia account representative provides you with corresponding vSIM license key files, which could be one license file for all the vSIMs or a separate license file for each one.

Each vSIM requires its own license tied to the specific UUID of the individual vSIM VM, but more than one license may be included in a single license file. The virtual machines acting as the CPMs of each vSIM must have their UUIDs manually set to the specified values. See Domain name and UUID for more information about UUIDs.

4.3 Using an SR-SIM subscription license

When you purchase an SR-SIM subscription license, you can use this same license file with an unlimited number of vSIM instances without the requirement to have a license per vSIM instance.

The user does not need to set the UUID to match the license file when using the SR-SIM subscription license.

4.4 Deploying and configuring license keys

The **license-file** boot-option parameter of each vSIM indicates the location of the license file, which can be a local disk location or an FTP server location. The **license-file** parameter can be specified by editing the BOF file (before or after bootup), or by including it in the SMBIOS information provided to each CPM virtual machine of the vSIM. See Sysinfo for more information about the SMBIOS parameters.

Note: Both CPMs in a redundant vSIM system should have the same BOF setting for the **license-file** parameter. Also, if the **license-file** is stored on the local disk (CF3) of the active

CPM, it should also be stored on the local disk (CF3) of the standby CPM. Use the following command to synchronize the BOF settings:

- **MD-CLI**

```
admin redundancy synchronize boot-environment
```

- **classic CLI**

```
admin redundancy synchronize boot-env
```

After synchronizing the BOF settings, copy the `license-file` to the standby CPM, if it is stored locally.

When the vSIM software starts booting and determines that it should serve the function of a CPM in a vSIM system, it attempts to read and parse the referenced license file.

If the CPM cannot find a valid license key and it is the only CPM of the vSIM, the system is allowed to complete its bootup procedures. Only a limited number of non-configuration-related commands are available in this state, and the system is forced to reboot after 60 minutes.

If the CPM cannot find a valid license key (with matching UUID, major software version, valid date range, or valid SR-SIM subscription license), and the vSIM has another CPM with a valid license key, only the CPM without a license will be rebooted after 60 minutes. In the meantime, the system is fully functional. However, if either CPM of a vSIM system has a corrupt license file or a license file for the wrong type of product, the entire chassis will be forced to reboot after 60 minutes.

Note: The IOMs of a vSIM system do not need their own license keys; they inherit the license state of the system, as determined by the CPMs. The IOMs reboot immediately if no CPM has a valid license.

4.5 Checking the license status

After the vSIM is operational, use the following command to check the license status of the system.

```
show system license
```

Output example: vSIM emulating a 7750 SR-7 chassis with a valid license

```
===============================================================================
System License
===============================================================================
License status : monitoring, valid license record
Time remaining : 99 days 4 hours
-------------------------------------------------------------------------------
License name   : name@organization.com
License uuid   : 00000000-0000-0000-0000-000000000000
Machine uuid   : a8812f3e-a90d-4de3-8a5e-6e44001e35f6
License desc   : 7xxx vm-training-sim
License prod   : Virtual-SIM
License sros   : TiMOS-[BC]-16.0.*
Current date   : WED OCT 24 20:52:37 UTC 2018
Issue   date   : THU AUG 02 17:40:35 UTC 2018
Start   date   : WED AUG 01 00:00:00 UTC 2018
End     date   : FRI FEB 01 00:00:00 UTC 2019
```

```
================================================================================
```

5 Creating and starting a vSIM VM on a Linux KVM host

5.1 Introduction

This section describes how to create and start up vSIM virtual machines (VMs) on host machines using the Linux KVM hypervisor.

Several methods are available for creating a Linux KVM VM based on a specific set of parameters or constraints. These methods include:

- specifying the VM parameters in a domain XML file read by **virsh**, the **libvirt** command shell
- using the **virt-manager** GUI application available as part of the `libvirt` package
- using the **qemu-kvm** (RedHat/Centos) or **qemu-system-x86_64** (Ubuntu) commands

The Linux `libvirt` package provides the Virtual Shell (**virsh**) command-line application to facilitate the administration of VMs. The **virsh** application provides commands to create and start a VM using the information contained in a domain XML file. It also provides commands to shut down a VM, list all the VMs running on a host, and output specific information about the host or a VM.

This section describes how to define and manage your vSIM VM using the **virsh** tool.

5.2 VM configuration process overview

The `libvirt` domain XML file for a vSIM VM defines the important properties of the VM. You can use any text editor to create the domain XML file; pass the filename as a parameter of the **virsh create** command to start up the vSIM VM. For example, `virsh create domain1.xml`.

You can run **virsh** commands to display information about the VM or change specific properties. Table 3: Basic virsh commands lists the basic virsh commands, where *VM_name* is the value that you configured for the **name** element in the XML configuration file. See https://libvirt.org/sources/virshcmdref/html/ for more information.

Table 3: Basic virsh commands

Command	Example	Result
capabilities | grep cpu	`virsh capabilities | grep cpu ↵`	Displays the number of cores on the physical machine, the vendor, and the model
console	`virsh console` *VM_name* `↵`	Connects the serial console of the VM if using the serial PTY port
define	`virsh define` *VM_name*`.xml ↵`	Reads the XML configuration file and creates a domain. This is useful to provide persistence of the domain across reboots

Command	Example	Result
destroy	`virsh destroy` *`VM_name`* ↵	Stop and power off a VM (domain). The terminated VM is still available on the host and can be started again. The system status is "shut off"
dumpxml	`virsh dumpxml` *`VM_name`* ↵	Displays the XML configuration information for the specified VM, including properties added automatically by `libvirt`
list	`virsh list [ --all | --inactive] ↵`	The "--all" argument displays all active and inactive VMs that have been configured and their state The "--inactive" argument displays all VMs that are defined but inactive
nodeinfo	`virsh nodeinfo ↵`	Displays the memory and CPU information, including the number of CPU cores on the physical machine
start	`virsh start` *`VM_name`* ↵	Starts the VM domain
undefine	`virsh undefine` *`VM_name`* ↵	Deletes a specified VM from the system
vcpuinfo	`virsh vcpuinfo` *`VM_name`* ↵	Displays information about each vCPU of the VM

Note: The **virsh shutdown** and **virsh reboot** commands do not affect vSIM VMs because the vSIM software does not respond to ACPI signals.

Some VM property changes made from the **virsh** command line do not take immediate effect because the vSIM does not recognize and apply these changes until the VM is destroyed and restarted. Examples of these changes include:

- modifying the vCPU allocation with the **virsh setvcpus** command
- modifying the vRAM allocation with the **virsh setmem** command
- adding or removing a disk with the **virsh attach-disk**, **virsh attach-device**, **virsh detach-disk,** or **virsh detach-device** commands
- adding or removing a vNIC with the **virsh attach-interface**, **virsh attach-device**, **virsh detach-interface**, or **virsh detach-device** commands

5.3 Libvirt domain XML structure

The `libvirt` domain XML file describes the configuration of a vSIM VM. The file begins with a <**domain type='kvm'**> line and ends with a <**/domain**> line. In XML syntax, **domain** is an *element* and **type='kvm'** is an *attribute* of the **domain** element. vSIM VMs must have the **type='kvm'** attribute because KVM acceleration is mandatory. Other domain types, including **type='qemu'**, are not valid.

The `libvirt` domain XML file structure can conceptually be interpreted as a tree, where the **domain** element is the root element and contains all the sub-elements (child elements) in the file. All sub-elements can contain their own child elements, and so on. The following **domain** child elements should be configured to for vSIM VMs:

- name, see Domain name and UUID
- uuid, see Domain name and UUID
- memory, see Memory
- vcpu, see vCPU
- cpu, see CPU
- sysinfo, see Sysinfo
- os, see OS
- clock, see Clock
- devices, see Devices
- seclabel, see Seclabel

5.3.1 Domain name and UUID

Use the <**name**> element to assign each VM a meaningful name. The name should be composed of alphanumeric characters (spaces should be avoided) and must be unique within the scope of the host machine. Use the **virsh list** command to display the VM name. The following is an example of a <name> element:

```
<name>v-sim-01-control</name>
```

Each VM has a globally unique UUID identifier. The UUID format is described in RFC 4122. If you do not include a < **uuid**> element in the domain XML file, `libvirt` auto generates a value that you can display (after the VM is created) using the **virsh dumpxml** command. Setting the UUID value explicitly ensures that it matches the UUID specified in the software license. See vSIM software licensing for information about vSIM software licenses. The following is an example of a <**uuid**> element, using the correct RFC 4122 syntax:

```
<uuid>ab9711d2-f725-4e27-8a52-ffe1873c102f</uuid>
```

Note: Do not use the UUID in this example. A unique UUID must be used. You can use the **uuidgen** command on a Linux/UNIX machine or use an external UUID generation website – the recommended one is http://uuidgenerator.net; select Version 4 instead of Version 1.

5.3.2 Memory

The maximum memory (vRAM) allocated to a VM at boot time is defined in the <**memory**> element. The '**unit**' attribute is used to specify the unit to count the vRAM size.

Note: The unit value is specified in kibibytes (2^10 bytes) by default. However, all memory recommendations in this document are expressed in units of gigabytes (2^30 bytes), unless otherwise stated.

To express a memory requirement in gigabytes, include a **unit='G'** (or **unit='GiB'**) attribute, as shown in the following example:

```
<memory unit='G'>6</memory>
```

The amount of vRAM needed for a vSIM VM depends on the vSIM system type, vSIM card type, and the MDAs installed in the system or card. See CPU and DRAM memory for more information.

5.3.3 vCPU

The <**vcpu**> element defines the number of vCPU cores allocated to a VM. The minimum number of vCPUs that you can allocate to a vSIM VM is two.

The <**vcpu**> element contains the following attributes:

- **cpuset**

  The **cpuset** attribute provides a comma-separated list of physical CPU numbers or ranges, where "^" indicates exclusion. Any vCPU or vhost-net thread associated with the VM that is not explicitly assigned by the <**cputune**> configuration is assigned to one of the physical CPUs allowed by the **cpuset** attribute.

- **current**

  The **current** attribute allows fewer than the maximum vCPUs to be allocated to the VM at boot up. This attribute is not required for vSIM VMs because in-service changes to the vCPU allocation are not allowed.

- **placement**

  The **placement** attribute accepts a value of either '*static*' or '*auto*'. You should use '*static*' when specifying a **cpuset**. When '*auto*' is used, `libvirt` ignores the **cpuset** attribute and maps vCPUs to physical CPUs in a NUMA-optimized manner based on input from the **numad** process. The **placement** attribute defaults to the placement mode of <**numatune**>, or to *static* if a **cpuset** is specified.

The following example <**vcpu**> configuration for a vSIM VM allocates four vCPUs.

```
<vcpu>4</vcpu>
```

5.3.4 CPU

The <**cpu**> element specifies CPU capabilities and topology presented to the guest, and applies to the model of the CPU. The **mode** attribute of <**cpu**> supports the following values:

- **custom**

  In the **custom** mode, you must specify all the capabilities of the CPU that are presented to the guest.

- **host-model**

  In the **host-model** mode, the model and features of the host CPU are read by `libvirt` just before the VM is started and the guest is presented with almost identical CPU and features.

  If the exact host model cannot be supported by the hypervisor, `libvirt` falls back to the next closest supported model that has the same CPU features. This fallback is permitted by the <**model fallback='allow'/**> element.)

- **host-passthrough**

  In the **host-passthrough** mode, the guest CPU is represented as exactly the same as the host CPU, even for features that `libvirt` does not understand.

The <**topology**> child element specifies three values for the guest CPU topology: the number of CPU sockets, the number of CPU cores per socket, and the number of threads per CPU core.

The <**numa**> child element in the <**cpu**> element creates specific guest NUMA topology. However, this is not applicable to the vSIM because the vSIM software is not NUMA-aware.

The following is the recommended configuration of the <**cpu**> element for vSIM VMs:

```
<cpu mode="custom" match="minimum">
        <model>SandyBridge</model>
        <vendor>Intel</vendor>
</cpu>
```

5.3.5 Sysinfo

The <**sysinfo**> element presents SMBIOS information to the guest. SMBIOS is divided into three blocks of information (blocks 0 to 2); each block consists of multiple entries. SMBIOS **system** block 1 is most important for the vSIM. The SMBIOS **system** block contains entries for the manufacturer, product, version, serial number, UUID, SKU number, and family.

SMBIOS provides a necessary way to pass vSIM-specific configuration information from the host to the guest so that it is available to vSIM software when it boots. When a vSIM VM is started, the vSIM software reads the product entry of the SMBIOS system block. If the product entry begins with '**TIMOS**: ' (without the quotes and case insensitive), the software recognizes the string that follows as containing important initialization information. The string following the '**TIMOS**: ' characters contains one or more attribute-value pairs formatted as follows:

`attribute1=value1 attribute2=value2 attribute3=value3`

This pattern continues until all attributes have been specified.

The supported attribute-value pairs and their uses are summarized in Table 4: vSIM boot parameters in SMBIOS product entry.

Table 4: vSIM boot parameters in SMBIOS product entry

Attribute name	Valid values	Description
address	For a vSIM VM acting as CPM: <ip-prefix>/<ip-prefix-length>@active <ip-prefix>/<ip-prefix-length>@standby For a vSIM VM acting as IOM: n/a Where: <ip-prefix>: an IPv4 or IPv6 prefix <ip-prefix-length>: 1-128	Sets a management IP address. In a vSIM with two CPMs, the SMBIOS product entry for each CPM should include two address attributes: one for the active CPM (ending with **@active**) and one for the standby CPM (ending with **@standby**). The active and standby management IP addresses must be different addresses in the same IP subnet.
static-route	For a vSIM VM acting as CPM: <ip-prefix>/<ip-prefix-length>@<next-hop-ip> For a vSIM VM acting as IOM:	Adds a static route for management connectivity. Static default routes (0/0) are not supported.

Attribute name	Valid values	Description
	n/a Where: <ip-prefix>: an IPv4 or IPv6 prefix <next-hop-ip>: an IPv4 or IPv6 address	
license-file	For a vSIM VM acting as CPM: <file-url> For a vSIM VM acting as IOM: n/a Where: <file-url>: <cflash-id/><file-path> or ftp://<login>:<password>@<remote-host/><file-path> or tftp://<login>:<password>@<remote-host/><file-path> <cflash-id>: cf1: | cf1-A: | cf1-B: | cf2: | cf2-A: | cf2-B: | cf3: | cf3-A: | cf3-B:	Specifies the local disk or remote FTP/TFTP location of the license file.
primary-config	For a vSIM VM acting as CPM: <file-url> For a vSIM VM acting as IOM: n/a Where: <file-url>: <cflash-id/><file-path> or ftp://<login>:<password>@<remote-host/><file-path> or tftp://<login>:<password>@<remote-host/><file-path> <cflash-id>: cf1: | cf1-A: | cf1-B: | cf2: | cf2-A: | cf2-B: | cf3: | cf3-A: | cf3-B:	Specifies the local disk or remote FTP/TFTP location of the primary configuration file.
chassis	One of the chassis names (excluding the product number) listed in Appendix A: vSIM supported hardware. For example, the chassis string for the 7750 SR-1se is **chassis=SR-1se**. This parameter must be set to the same value for all CPM and IOM VMs that make up one system.	Specifies the emulated chassis type.
chassis-topology	For 7950 XRS-20/XRS-20e CPM and IOM VMs: XRS-40	Specifies that the 7950 XRS-20 or 7950 XRS-20e CPM or IOM VM should

Attribute name	Valid values	Description
	This parameter must be set to the same value for all CPM and IOM VMs that make up one system.	boot up as belonging to an extended 7950 XRS-40 system.
sfm	One of the SFM names from Appendix A. The SFM type must be valid for the chassis type and must be set to the same value for all CPM and IOM VMs that make up one system.	Specifies the switch fabric module to be emulated.
slot	For a vSIM VM acting as CPM: A,B,C,D For a vSIM VM acting as IOM: 1 to 20 (chassis dependent)	Specifies the slot number in the emulated chassis.
card	One of the card names from Appendix A: vSIM supported hardware. The card type must be valid for the chassis type, SFM type, and the slot number. For some chassis types, notably the IXR-e and IXR-X, the required value of this parameter, for both the VM of slot=A and the VM of slot=1, is a CPM name followed by an IOM name, with a single forward slash character separating them. See Appendix A: vSIM supported hardware for more details.	Specifies the emulated card type.
xiom/m m=x1, x2	One of the XIOM names from Appendix A: vSIM supported hardware. The XIOM type must be valid for the card type.	Specifies the emulated XIOM types that are logically equipped in the indicated card.
mda/n n=1, 2, 3, 4, 5, 6 mda/m/n m=x1, x2 and n=1, 2	One of the MDA names from Appendix A: vSIM supported hardware. The MDA type must be valid for the card type and XIOM type (if applicable).	Specifies the emulated MDA types that are logically equipped in the indicated card. The mda/m/n only applies to XIOM MDAs.
es-secret	12 to 128 character string	Specifies the emulated system secret. This is a top-level secret used for local encryption functions. Some examples include encryption of confidential system files on the local filesystem and protection of the primary secret, which is used for hash3 configuration shared secrets. See "Configuration secrets" in the *7450 ESS, 7750 SR, 7950 XRS, and*

Attribute name	Valid values	Description
		VSR System Management Guide for more information about primary secret and hash3. **Note:** It is highly recommended to commission each system with a unique es-secret generated from a high-entropy source. The es-secret is a string with the following constraints: • It must be a printable ASCII string 12 to 128 characters in length. • No whitespace characters (TAB, space, etc.) are permitted. • The string is restricted to the following characters: a-z, A-Z, 0-9, !@#$%^&* (that is, besides letters and numbers, shift 1 through 8 on a standard USA keyboard). The comma character (,) is not accepted. **WARNING:** The ampersand character (&) must be escaped in the XML-based SMBOIS product string as '&'.
system-base-mac	For a vSIM VM acting as CPM: hh:hh:hh:hh:hh:hh For a vSIM VM acting as IOM: n/a	Specifies the first MAC address in a range of 1024 contiguous values to use as chassis MACs. The default is the same for all vSIMs and should be changed so that each

Attribute name	Valid values	Description
		vSIM has a unique, non-overlapping range. The two CPMs of a vSIM node must specify the same **system-base-mac** value.

The following <**sysinfo**> example personalizes a vSIM VM to emulate an iom4-e card installed in slot 1 of an SR-12 chassis equipped with an m-sfm5-12 switch fabric module The card is virtually equipped with one me10-10gb-sfp MDA and one me40-1gb-csfp MDA. Replace the attribute values in the SMBIOS **product** entry string with values appropriate for your deployment.

```
<sysinfo mode=smbios’>
   <system>
      <entry name='product'>TIMOS:slot=1 chassis=SR-12 sfm=m-sfm5-12 card=iom4-e mda/1=me10-
10gb-sfp+ mda/2=me40-1gb-csfp es-secret=abcdef123456</entry>
   </system>
</sysinfo>
```

The following <**sysinfo**> example personalizes a vSIM VM to emulate a xcm-14s card installed in slot 1 of an SR-14s chassis. This chassis has the sfm-s switch fabric module. The following example simulates 2 XIOMs where the first one has two MDAs and the second one has one MDA. Replace the attribute values in the SMBIOS **product** entry string with values appropriate for your deployment.

```
<sysinfo mode=smbios'>
   <system>
      <entry name='product'>TIMOS:slot=1 chassis=SR-14s sfm=sfm-s card=xcm-14s xiom/x1=iom-
s-3.0t mda/x1/1=ms18-100gb-qsfp28 mda/x1/2=ms4-400gb-qsfpdd+4-100gb-qsfp28 xiom/x2=iom-s-3.0t
 mda/x2/1=ms6-200gb-cfp2-dco es-secret=abcdef123456</entry>
   </system>
</sysinfo>
```

The following <**sysinfo**> example personalizes a vSIM VM to emulate a cpm5 card installed in slot A of an SR-12 chassis. This chassis has the m-sfm5-12 switch fabric module. Replace the attribute values in the SMBIOS **product** entry string with values appropriate for your deployment.

```
<sysinfo mode=smbios'>
   <system>
     <entry name='product'>TIMOS:slot=A chassis=SR-12 sfm=m-sfm5-12 card=cpm5 \
      es-secret=abcdef123456 system-base-mac=de:ad:be:ef:00:01 \
      address=192.0.2.124@active address=192.0.2.2/24@standby \
      primary-config=ftp://user01:pass@10.0.0.1/home/user01/SR-12/config.cfg \
      license-file=ftp://user01:pass@10.0.0.1/home/user01/license.txt</
      entry>
   </system>
</sysinfo>
```

5.3.6 OS

The <**os**> element provides information about the guest OS to the hypervisor. It contains a <**type**> element that specifies the guest operating system type. For vSIM VMs, the <**type**> element must specify **hvm**, which means that the guest OS is designed to run on bare metal and requires full virtualization.

The **arch** attribute of the <**type**> element specifies the CPU architecture that is presented to the guest. For vSIM VMs, you must specify **arch=x86_64** to allow the vSIM software to take advantage of 64-bit instructions and addressing.

The **machine** attribute of the <**type**> element specifies how QEMU should model the motherboard chipset in the guest system. For vSIM VMs, you should specify **machine='pc'**, which is an alias for the latest I440FX/PIIX4 architecture supported by the hypervisor when the VM is created. The I440FX is a (1996 era) motherboard chipset that combines both Northbridge (memory controller) and Southbridge (IO devices) functionality.

QEMU-KVM can also emulate a Q35 chipset, if you specify **machine='q35'**. Q35 is a relatively modern (2009 era) chipset design; it separates the Northbridge controller (MCH) from the Southbridge controller (ICH9) and provides the guest with advanced capabilities such as IOMMU and PCI-E.

Although the I440FX emulation is the older machine type, it is the more mature and hardened option and is recommended by Nokia.

The <**os**> element also contains the <**smbios**> child element that you must include in the configuration of vSIM VMs. Set the **mode** attribute to **"sysinfo"**, which allows you to pass the information specified in the <sysinfo> element (including the **product** entry) to the vSIM guest.

The <**os**> element can also include one or more <**boot**> child elements. The **dev** attribute of each <**boot**> element specifies a device such as 'hd' (hard drive), 'fd' (disk), 'cdrom', or 'network', which indicates that the guest should load its OS from this device. The order of multiple <**boot**> elements determines the boot order. For vSIM VMs, you should always boot from the '**hd**' device that vSIM translates to its CF3 disk.

The following <**os**> example shows element configuration suitable for vSIM VMs of all types.

```
<os>
    <type arch='x86_64' machine='pc'>hvm</type>
    <boot dev='hd'/>
    <smbios mode='sysinfo'/>
</os>
```

5.3.7 Clock

The <**clock**> element controls specific aspects of timekeeping within the guest. Each guest must initialize its clock to the correct time-of-day when booting and update its clock accurately as time passes.

The **offset** attribute of <**clock**> controls how the of the time-of-day clock of the guest is initialized at bootup. For vSIM VMs, the **offset** attribute value should be set to **utc**, which enable the host and guest to belong to different timezones, if required.

The vSIM and other guests update the time-of-day clock by counting ticks of virtual timer devices. The hypervisor injects ticks to the guest in a manner that emulates traditional hardware devices, for example, the Programmable Interrupt Timer (PIT), CMOS Real Time Clock (RTC), or High Precision Event Timer (HPET). Each virtual timer presented to the guest is defined by a <**timer**> sub-element of <**clock**>. The **name** attribute of <**timer**> specifies the device name (for example, 'pit', 'rtc' or 'hpet'), the **present** attribute indicates whether the particular timer should be made available to the guest, and the **tickpolicy** attribute controls the action taken when the hypervisor (QEMU) discovers that it has missed a deadline for injecting a tick to the guest. A **tickpolicy** value set to 'delay' means the hypervisor should continue to delay ticks at the normal rate, with a resulting slip in guest time relative to host time. A **tickpolicy** value set to 'catchup' means the hypervisor should deliver ticks at a higher rate to compensate for the missed tick.

The following <**clock**> example shows element configuration suitable for vSIM VMs.

```
<clock offset='utc'>
    <timer name='pit' tickpolicy='delay'/>
    <timer name='rtc' tickpolicy='catchup'/>
    <time name='hpet' present='no'/>
</clock>
```

5.3.8 Devices

Use the <**devices**> element to add various devices to the VM, including hard drives, network interfaces, and serial console ports.

The <**devices**> element requires that the file path of the program used to emulate the devices must be specified in the <**emulator**> child element. On Centos and Red Hat hosts the emulator is a binary called **qemu-kvm**; on Ubuntu hosts, the emulator is called **qemu-system-x86_64**.

The device types are as follows:

- Disk devices
- Network interfaces
- Console and serial ports

5.3.8.1 Disk devices

The <**disk**> child element of the <**devices**> element allows you to add up to three disks to a vSIM VM.

The **type** attribute of the <**disk**> element specifies the underlying source for each disk. The only supported value for vSIM VMs is **type='file'**, which indicates that the disk is a file residing on the host machine.

The **device** attribute of the <**disk**> element configures the representation of the disk to the guest OS. The supported value for vSIM VMs is **device='disk'**. When **device='disk'** is specified, QEMU-KVM attaches a hard drive to the guest VM and vSIM interprets this as a Compact Flash (CF) storage device.

The optional <**driver**> child element of the <**disk**> element provides additional details about the back-end driver. For vSIM VMs, set the **name** attribute to *'qemu'* and the **type** attribute to *'qcow2'*. These two attributes specify that the disk image has the QCOW2 format.

When you download the vSIM software, the zip file contains a QCOW2 disk image, which is a file that represents the vSIM software on a hard disk; you can boot any vSIM VM from this disk image. QCOW2 is a disk image format for QEMU-KVM VMs that uses thin provisioning (that is, the file size starts small and increases in size only as more data is written to disk). It supports snapshots, compression, encryption, and other features.

The optional **cache** attribute of the <**driver**> element controls the caching mechanism of the hypervisor. A value set to 'writeback' offers high performance but risks data loss (for example, if the host crashes but the guest believes the data was written). For vSIM VMs, it is recommended to set **cache='none'** (no caching) or **cache='writethrough'** (writing to cache and to the permanent storage at the same time).

The mandatory <**source**> child element of the <**disk**> element indicates the path (for disks where **type='file'**) to the QCOW2 file used to represent the disk.

Note: The recommended storage location for QCOW2 disk image files is the `/var/lib/libvirt/images` directory; storing disk images in other locations may cause permission issues.

The mandatory <**target**> child element of the <**disk**> element controls how the disk appears to the guest in terms of bus and device. The **dev** attribute should be set to a value of '*hda*', '*hdb*' or '*hdc*'. A value of '*hda*' is the first IDE hard drive; it maps to CF3 on vSIM VMs. A value of '*hdb*' is the second IDE hard drive; it maps to CF1 on vSIM VMs acting as CPMs. A value of '*hdc*' is the third IDE hard drive; it maps to CF2 on vSIM VMs acting as CPMs. The **bus** attribute of the <**target**> element should be set to '*virtio*' for vSIM virtual disks.

Each vSIM VM, including the ones acting as IOMs, must be provided with a "hda" hard disk that contains the vSIM software images. You cannot write to the "hda" disk associated with an IOM or browse its file system using SR OS file commands. Each virtual disk of each vSIM VM should have be provided with its own, independent QCOW2 file.

The following <**disk**> element configuration example provides a vSIM CPM with a CF3 device.

```
<disk type='file' device='disk'>
      <driver name='qemu' type='qcow2' cache='none'/>
      <source file='/var/lib/libvirt/images/SR-12-cpm.qcow2'/>
      <target dev='hda' bus='virtio'/>
</disk>
```

5.3.8.2 Network interfaces

The <**interface**> sub-element of the <**devices**> element allows you to add up to 20 virtual NIC ports to a vSIM VM. The **type** attribute of <**interface**> can be configured to one of the following values:

- type='direct'
- type='bridge'

The following child elements of <**interface**> are common to most interface types:

- **<mac>**

  This element contains an **address** attribute that indicates the MAC address of the guest vNIC port.

- **<model>**

  This element contains a **type** attribute that indicates the NIC model presented to the guest.

  The default value for **type** is '*virtio*', which indicates that the guest should use its VirtIO driver for the network interface.

- **<driver>**

  This element contains several attributes corresponding to tunable driver settings.

  The **queues** attribute, when used in conjunction with the <**model type='virtio'/**> element, enables multiqueue VirtIO in the guest.

  Note: The vSIM does not support multiqueue VirtIO.

- **<address>**

  This element specifies the guest PCI address of the vNIC interface when the **type='pci'** attribute is included.

The other attributes required to specify a PCI address are: **domain** (0x0000), **bus** (0x00-0xff), **slot** (0x00-0x1f), and **function** (0x0-0x7).

If the <**address**> element is not included, the hypervisor assigns an address automatically as follows: the first interface defined in the `libvirt` domain XML has the lowest PCI address, the next one has the next-lowest PCI address, and so on.

The vSIM maps vNIC interfaces to its own set of interfaces based on the order of the vNIC interfaces, from lowest to highest PCI address; this should be considered when you change the PCI address of a vNIC interface. See Guest vNIC mapping in vSIM VMs for information about how the vSIM maps vNIC interfaces.

- **<target>**

  This element specifies the name of the target device representing the vNIC interface in the host.

  Note: You do not need to configure this element with vSIM VMs.

5.3.8.2.1 type='direct'

The <**interface**> element with **type='direct'** allows you to create a direct connection between the guest vNIC port and a host physical NIC port. The interconnection uses a MACVTAP driver in the Linux host.

To connect a guest vNIC port to a physical NIC port using the MACVTAP driver, include a <**source**> sub-element with the **dev** attribute that indicates the interface name of the host interface and **mode='passthrough'**. The following example shows a configuration where 'enp133s0' is the host interface name.

Note: type=direct should not be confused with PCI pass-through, which is not supported for vSIM VMs.

```
<interface type='direct'>
      <source dev='enp133s0' mode='passthrough'/>
      <model type='virtio'>
</interface>
```

5.3.8.2.2 type='bridge'

The <**interface**> element with **type='bridge'** specifies that the guest vNIC port should be connected to a vSwitch or Linux bridge in the host. The interconnection uses the Vhost-Net back end driver when the <**model type='virtio'/**> element is included.

To use a Linux bridge named brX, include a <**source**> sub-element with a **bridge='brX'** attribute, as shown in the following configuration example.

```
<interface type='bridge'>
         <source bridge='br0'/>
         <model type='virtio'>
</interface>
```

To use an OpenvSwitch bridge named brX, include a **<source>** sub-element with a bridge='brX' attribute. In addition, include a **<virtualport type='openvswitch'/>** element, as shown in the following configuration example.

```
<interface type='bridge'>
       <source bridge='br1'/>
       <virtualport type='openvswitch'/>
       <model type='virtio'>
</interface>
```

5.3.8.3 Guest vNIC mapping in vSIM VMs

This section describes the relationship between a network interface defined in the `libvirt` XML for a vSIM VM and its use by the vSIM software.

In the current release, each vSIM VM supports a maximum of 20 vNIC interfaces. The vSIM software puts the defined interfaces in ascending order of (guest) PCI address.

The order of the defined interfaces and the vSIM VM type determines the use of each interface by the vSIM software. The vSIM interface mapping information is summarized in the following tables:

- Table 5: 7750 SR-1, 7750 SR-1s, 7250 IXR-R6, 7250 IXR-ec vSIM interface mapping
- Table 6: vSIM CPM interface mapping
- Table 7: vSIM IOM interface mapping

Table 5: 7750 SR-1, 7750 SR-1s, 7250 IXR-R6, 7250 IXR-ec vSIM interface mapping

Order (by guest PCI address)	vSIM software use	Supported interface types
First	Management port (A/1)	**type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
Second	Fabric port [1]	**type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **< model type='virtio'/>**
Third	MDA port (1/1/1)	See Network interfaces for more information about the following interface types: **type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **< model type='virtio'/>**

[1] For 7750 SR-1 and 7750 SR-1s, the fabric port is not defined and the second vNIC interface (by PCI device order) is the first MDA port.

Order (by guest PCI address)	vSIM software use	Supported interface types
Fourth	MDA port (1/1/2)	See Network interfaces for more information about the following interface types: **type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **<modeltype='virtio'/>**
...	—	—
Eighth	MDA port (1/1/6)	See Network interfaces for more information about the following interface types: **type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **< model type='virtio'/>**
...	—	—
Twentieth	MDA port (1/1/18)	See Network interfaces for more information about the following interface types: **type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **< model type='virtio'/>**

Table 6: vSIM CPM interface mapping

Order (by guest PCI address)	vSIM software use	Supported interface types
First	Management port (A/1)	**type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
Second	Fabric port	**type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>

Table 7: vSIM IOM interface mapping

Order (by guest PCI address)	vSIM software use	Supported interface types
First	Management port (not used)	**type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
Second	Fabric port	**type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
Third	MDA port (1/1/1)	See Network interfaces for more information about the following interface types: **type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
...	—	—
Eighth	MDA port (1/1/6)	See Network interfaces for more information about the following interface types: **type='direct'** with <**model type='virtio'**/> **type='bridge'** with <**model type='virtio'**/>
...	—	—
Twentieth	MDA port (1/1/18)	See Network interfaces for more information about the following interface types: **type='direct'** with **<modeltype='virtio'/>** **type='bridge'** with **< model type='virtio'/>**

If a vSIM is emulating an MDA with connectors (which is only supported by specific chassis), then only the first breakout port of each connector can be associated with a VM vNIC interface and pass traffic. For example, if an MDA has connectors 1/1/c1, 1/1/c2, 1/1/c3, and so on, then only ports 1/1/c1/1, 1/1/c2/1, 1/1/c3/1, and so on can become operationally up.

5.3.8.4 Console and serial ports

The <**console**> sub-element in the <**devices**> element allows you to add a console port to a vSIM VM. As it does on physical routers, the console port on a vSIM VM provides interactive access to CLI.

There are several methods for creating and accessing a vSIM console port. The first method is to bind the console port to a TCP socket opened by the host. To access the console, you must establish a Telnet session with the host, using the port number of the TCP socket. The following example shows a configuration for this method:

```
<console type='tcp'>
      <source mode='bind' host='0.0.0.0' service='4000'/>
      <protocol type='telnet'/>
      <target type='virtio' port='0'/>
</console>
```

The second method is to bind the console port to an emulated serial port. In this case, the **virsh console <domain-name>** command is used to access the console. The following example shows a configuration for this method:

```
<serial type='pty'>
      <source path='/dev/pts/1'/>
      <target port='0'/>
      <alias name='serial0'/>
</serial>
<console type='pty' tty='/dev/pts/1'>
      <source path='/dev/pts/1'/>
      <target type='serial' port='0'/>
      <alias name='serial0'/>
</console>
```

5.3.9 Seclabel

The <**seclabel**> element controls the generation of security labels required by security drivers such as SELinux or AppArmor. These are not supported with vSIM VMs and therefore you must specify <seclabel type='none'> in the domain XML.

5.4 Example Libvirt domain XML

The following example shows a Libvirt domain XML configuration for a vSIM VM emulating one CPM of a 7750 SR-12. Substitute the correct values for your configuration.

```
<domain type="kvm">
    <name>CPM.A</name>
    <uuid>cb0ba837-07db-4ebb-88ea-694271754675</uuid>
    <description>SR-12 CPMA VM</description>
    <memory>4194304</memory>
    <currentMemory>4194304</currentMemory>
    <cpu mode="custom" match="minimum">
        <model>SandyBridge</model>
        <vendor>Intel</vendor>
    </cpu>
    <vcpu current="2">2</vcpu>
```

```
    <sysinfo type="smbios">
        <system>
            <entry name="product">TiMOS: slot=A chassis=SR-12 sfm=m-sfm5-12 card=cpm5
                primary-config=ftp://user:pass@[135.121.120.218]/./dut-a.cfg
                license-file=ftp://user:pass@[135.121.120.218]/./license.txt
                address=135.121.123.4/21@active
                address=135.121.123.8/21@standby
                address=3000::135.121.123.4/117@active
                address=3000::135.121.123.8/117@standby
                static-route=128.251.10.0/24@135.121.120.1
                static-route=135.0.0.0/8@135.121.120.1
                static-route=138.0.0.0/8@135.121.120.1
                static-route=172.20.0.0/14@135.121.120.1
                static-route=172.31.0.0/16@135.121.120.1
                static-route=192.168.120.218/32@135.121.120.218
                es-secret=abcdef123456
                system-base-mac=fa:ac:ff:ff:10:00
            </entry>
        </system>
    </sysinfo>
    <os>
        <type arch="x86_64" machine="pc">hvm</type>
        <smbios mode="sysinfo"/>
    </os>
    <clock offset="utc">
        <timer name="pit" tickpolicy="delay"/>
        <timer name="rtc" tickpolicy="delay"/>
    </clock>
    <devices>
        <emulator>/usr/libexec/qemu-kvm</emulator>
        <disk type="file" device="disk">
            <driver name="qemu" type="qcow2" cache="none"/>
            <source file="/var/lib/libvirt/images/cf3.qcow2"/>
            <target dev="hda" bus="virtio"/>
        </disk>
        <disk type="file" device="disk">
            <driver name="qemu" type="qcow2" cache="none"/>
            <source file="/var/lib/libvirt/images/cf1.qcow2"/>
            <target dev="hdb" bus="virtio"/>
        </disk>
        <interface type="bridge">
            <mac address="FA:AC:C0:04:06:00"/>
            <source bridge="breth0"/>
            <model type="virtio"/>
        </interface>
        <interface type="bridge">
            <mac address="FA:AC:C0:04:06:01"/>
            <source bridge="breth1"/>
            <model type="virtio"/>
        </interface>
        <console type="tcp">
            <source mode="bind" host="0.0.0.0" service="2500"/>
            <protocol type="telnet"/>
            <target type="virtio" port="0"/>
        </console>
    </devices>
    <seclabel type="none"/>
</domain>
```

6 Creating and starting a vSIM VM on a VMware ESXi host

6.1 Creating and starting an integrated model vSIM VM on a VMware host

Prerequisites

This chapter provides instructions on deploying integrated model vSIM VMs on VMware ESXi hosts using the vSphere Web Client only. Techniques for deploying VMs on ESXi hosts using other options (for example, vSphere Windows client, direct ESXi shell access) are beyond the scope of this guide.

Note: This procedure assumes that you have already installed the vCenter Server and added the ESXi host to the data center group.

Note: Distributed model vSIM VMs are not supported on VMware hosts.

Note: The figures that follow in this section show EXSi host 6.0. However, ESXi versions 6.0, 6.5, 6.7, and 7.0 are supported with the vSIM.

Procedure

Step 1. Connect to the vCenter Server over HTTP and log in from the **VMware vCenter Single Sign-On** window, as shown in Figure 2: VMware vCenter Single Sign-On, by doing the following:

a. Enter the username.

b. Enter the password you set during installation.

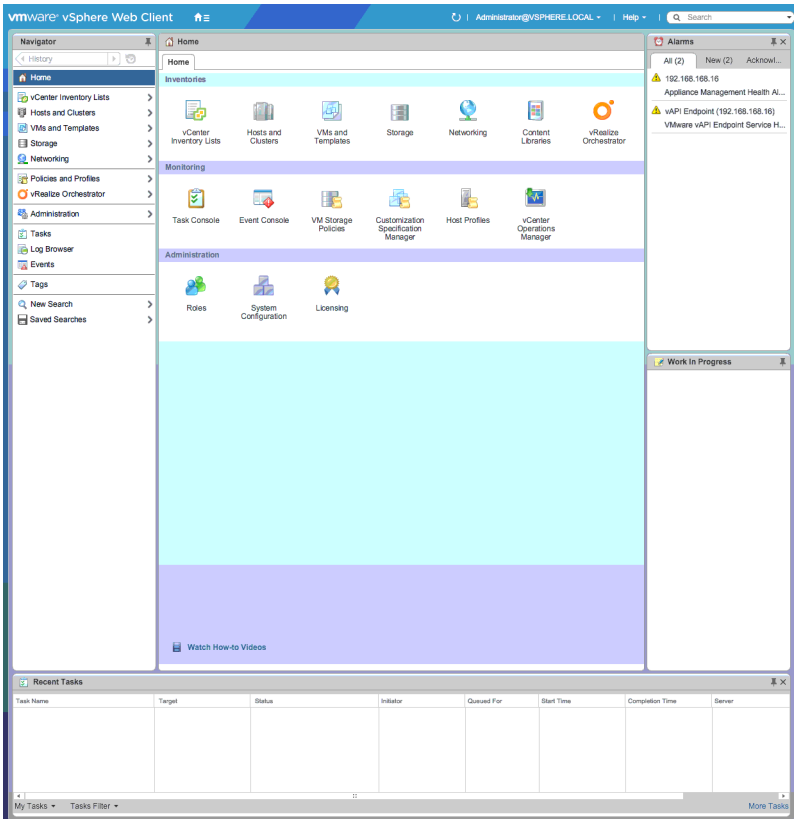
Figure 2: VMware vCenter Single Sign-On

Step 2. Click **Login**.

Expected outcome

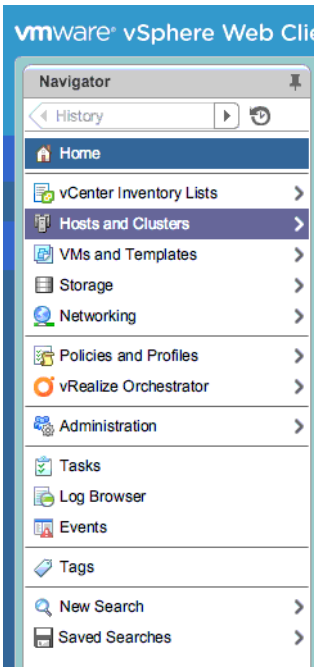
The **vSphere Web Client** dashboard is displayed, as shown in the following figure.

Figure 3: vSphere Web Client dashboard



Step 3. From the **Navigator** panel, choose **Home→Hosts and Clusters**, as shown in the following figure.

Figure 4: Home menu



Step 4. Select and deploy your OVF template, using the following steps:

a. Browse to the source location of your data center.

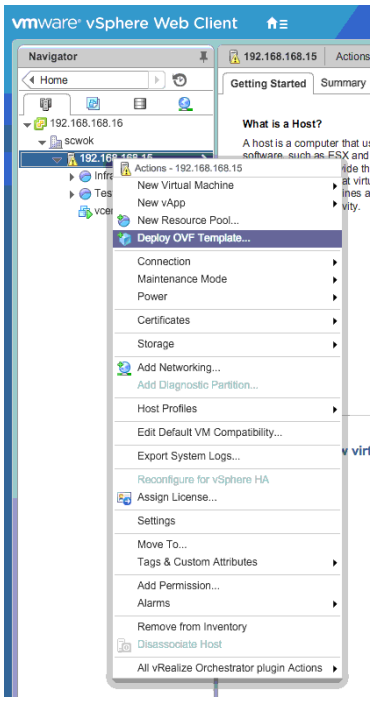
b. Right-click the ESXi host on which to deploy the vSIM VM.

Expected outcome

The **Actions** menu opens.

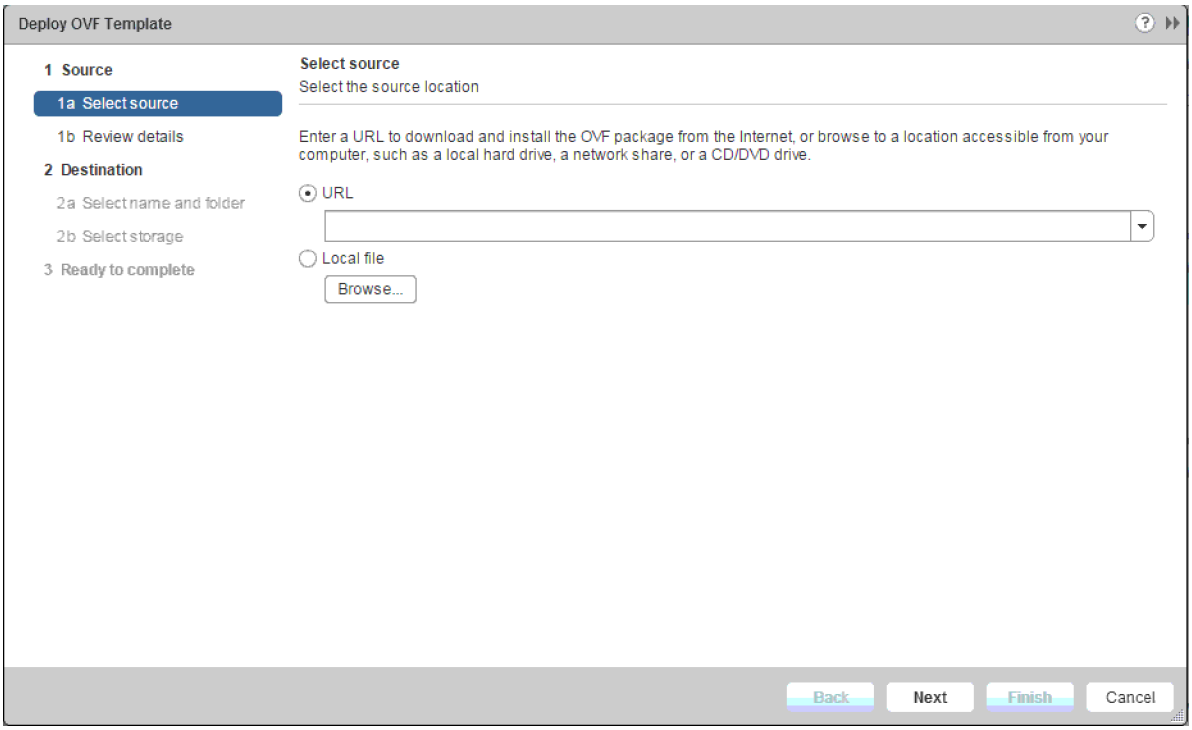
c. Select the **Deploy OVF Template** option, as shown in the following figure.

Figure 5: Actions menu



Step 5. The **Deploy OVF Template** window is displayed with the **Select source** option selected, as shown in the following figure.

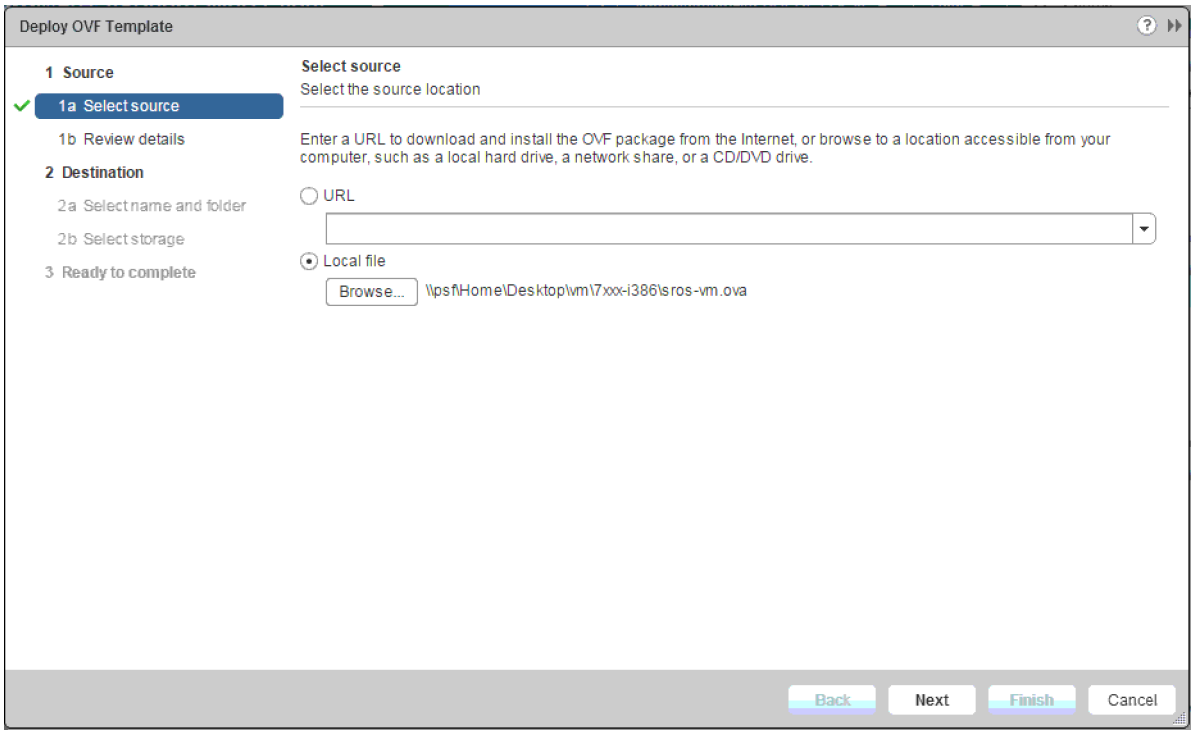
Figure 6: Deploy OVF Template



Step 6. Specify the location of the vSIM OVA archive file (sros-vm.ova), using the following steps:

a. Select the **Local file** option button to browse for and retrieve a local file.
The following figure shows an example selection using the **Local file** option.

Figure 7: Select the local file

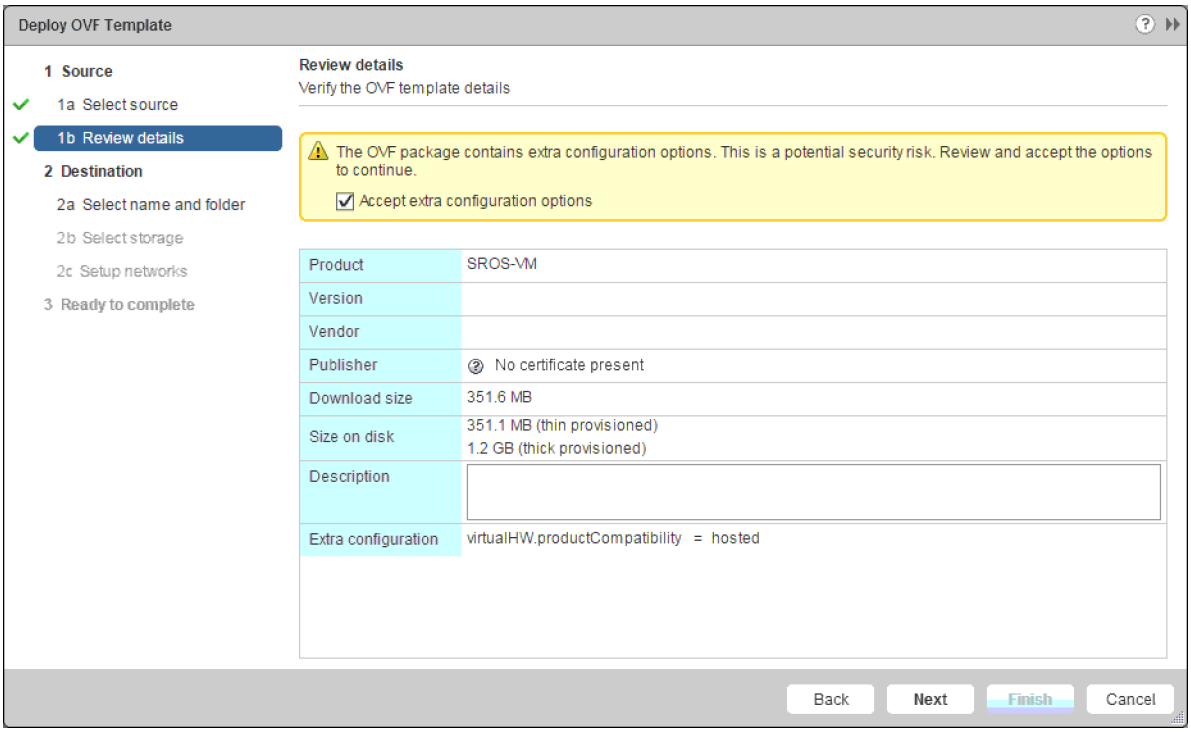


b. Click **Next** to advance to the **Review details** panel.

Step 7. From the **Review details** panel, select the **Accept extra configuration options** check box, as shown in Figure 8: Review details.

Note: This selection allows you to accept the additional configuration options in the vSIM OVA archive file that are not available in the standard VMware OVA templates.

Figure 8: Review details



Step 8. Click **Next** to advance to the **Select name and folder** option.

Step 9. From the **Select name and folder** panel, use the following steps to specify a name and location for the deployed OVF template:

a. Name the deployed OVF template as the vSIM VM.

The name can be up to 80 characters and must be unique within the vCenter Server VM folder.

b. Select the data center where the vSIM VM is deployed.

c. Click **Next** to advance to the **Select storage** option.

Step 10. From the **Select storage** panel, select the storage location for the deployed template, as shown in Figure 9: Select the storage location, using the following steps:

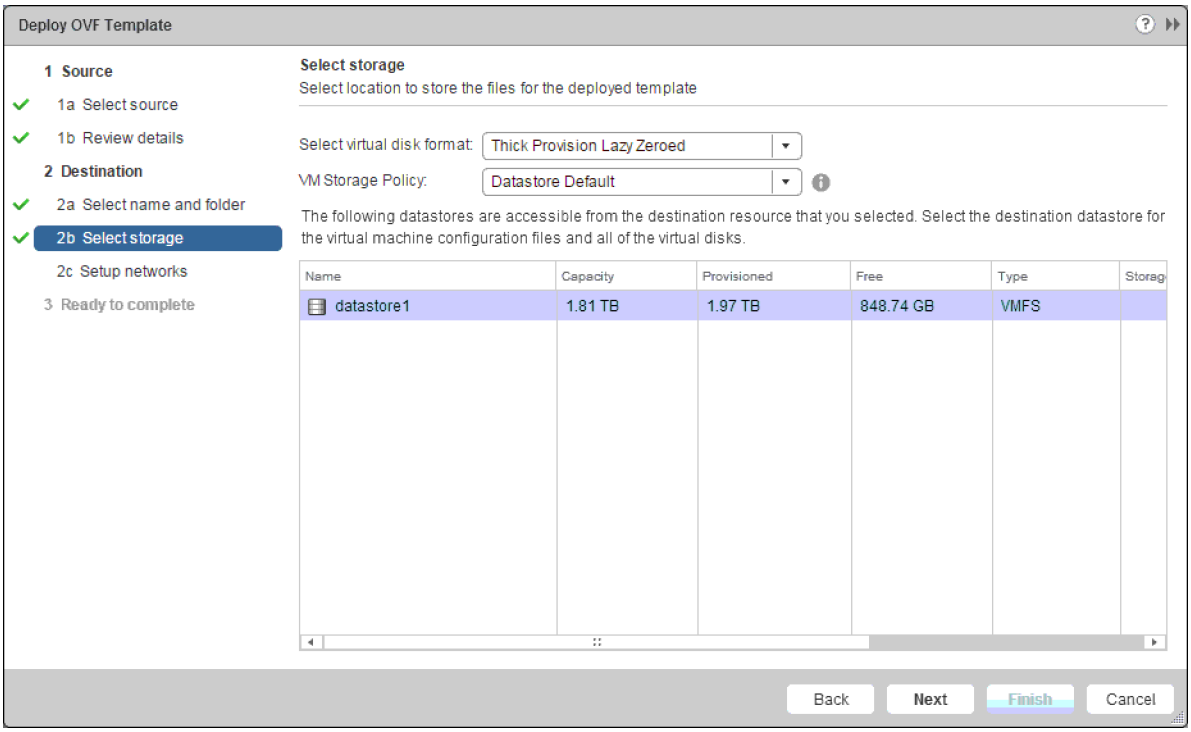
a. Select a virtual disk format.

b. Select a VM storage policy.

c. Click **Next** to advance to the **Setup networks** option.

For more information about the virtual disk format for your configuration, go to www.vmware.com.

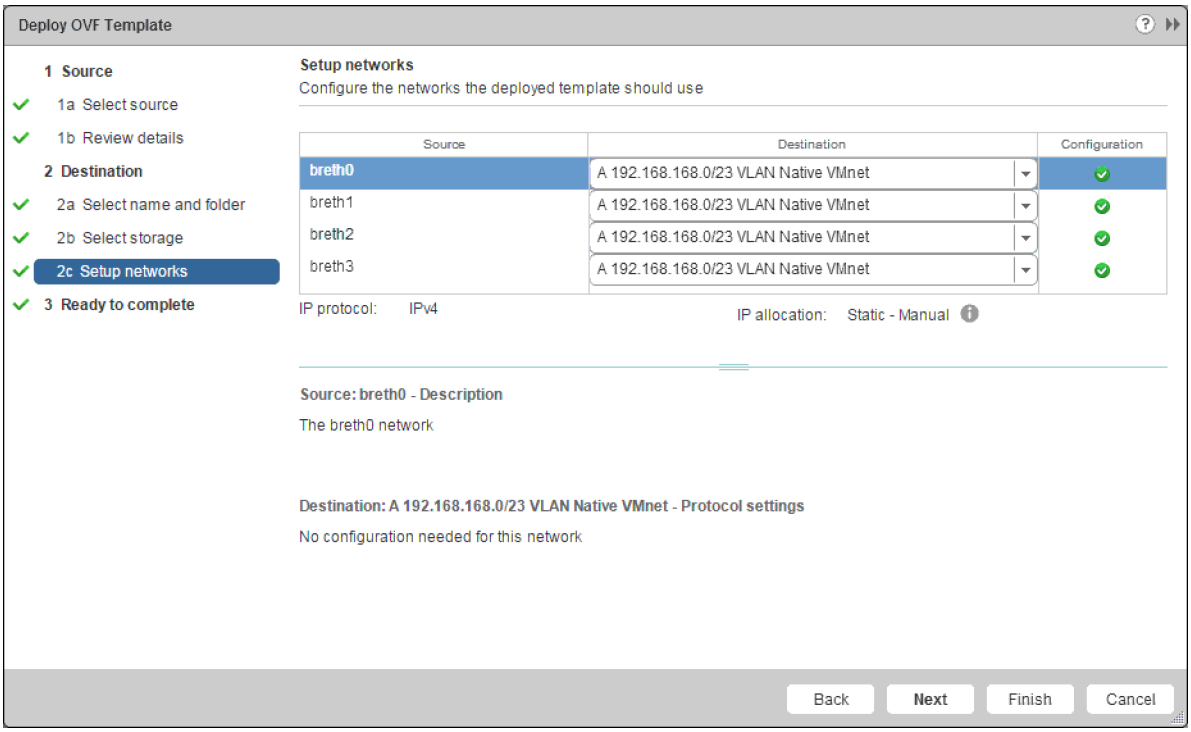
Figure 9: Select the storage location



Step 11. From the **Setup networks** panel, configure the network interfaces for the vSIM VM, as shown in the example in Figure 10: Configure the network interfaces.

By default, the vSIM created from the supplied OVF template is deployed with four network interfaces: breth0, breth1, breth2, and breth3. For example, breth0 is the first guest interface and maps to the A/1 management port of CPM A, and so on. See Table 5: 7750 SR-1, 7750 SR-1s, 7250 IXR-R6, 7250 IXR-ec vSIM interface mapping and Guest vNIC mapping in vSIM VMs for the mapping of the vNIC interfaces to SR OS interfaces, which is performed independently of the hypervisor.

Figure 10: Configure the network interfaces



Step 12. Click **Next** to advance to the **Ready to complete** option.

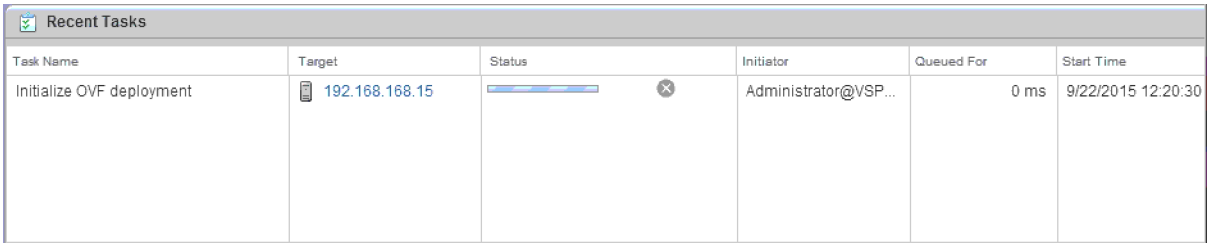
Step 13. Review the vSIM VM settings.

Note: Ensure that the **Power on after deployment** check box is not selected.

Step 14. Click **Finish** to deploy the vSIM VM.

The **Recent Tasks** panel on the dashboard displays the status of the vSIM deployment, as shown in the following figure.

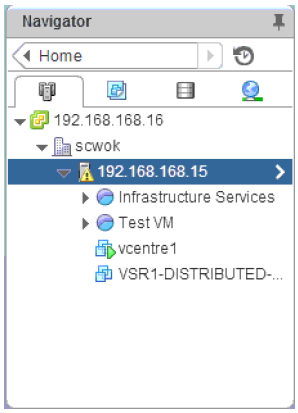
Figure 11: vSIM VM deployment status



Step 15. Configure the memory and resource allocation for the vSIM VM, using the following steps:

a. In the **Navigator** panel, locate the newly deployed vSIM, as shown in the following figure.

Figure 12: Navigator



b. Right-click the vSIM name and select **Edit Settings**.

Expected outcome

The **Edit Settings** window is displayed with the **Virtual Hardware** tab selected.

c. Select the number of vCPU and vMemory to allocate to the vSIM VM.

Step 16. Configure a serial port to obtain console connectivity to the vSIM, using the following steps:

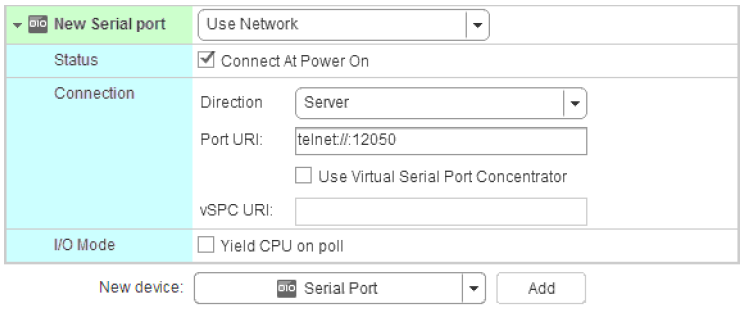
a. Click the **New Device** drop-down menu located toward the bottom of the **Edit Settings** window.

b. Select a **Serial Port** from the drop-down menu.

c. Configure the serial port, as required.

The example configuration shown in Figure 13: Serial port configuration enables console access to the vSIM via Telnet by routing TCP port 12050 on the ESXi host to the serial port on the vSIM. Other methods are available but are not documented here.

Figure 13: Serial port configuration



d. Click **Add** to implement the new serial port configuration.

Step 17. Add and modify the vSIM configuration parameters, using the following steps:

a. From the **Edit Settings** window, select the **VM Options** tab.

b. Click the arrow to expand the **Advanced Settings** option.

c. Click the **Edit Configuration** button to display the **Configuration Parameters**.

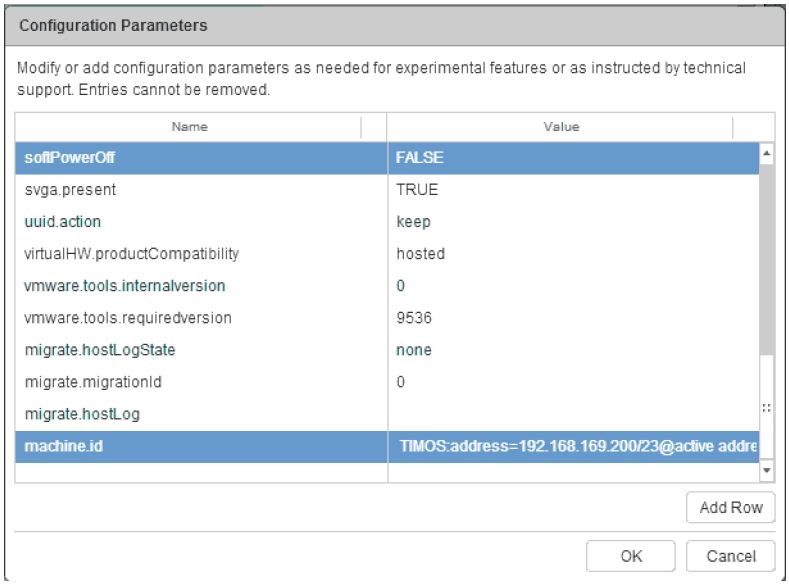
d. Click the **Add Row** button to add a machine.id setting.

Add a machine.id setting and set its value to the SMBIOS text string appropriate for the VM. See Sysinfo for more information.

Figure 14: Example machine.id setting shows an example vSIM in an integrated model deployment emulating a 7750 SR-1s chassis. The example machine.id setting is as follows:

```
TIMOS:address=192.168.169.200/23@active address=
192.168.169.201@standby license-file=ftp://
user:password@192.168.169.110/license.txt slot=A chassis=SR-1s card=
cpm-1s mda/1=s36-100gb-qsfp28 es-secret=abcdef123456
```

Figure 14: Example machine.id setting



e. Click **OK** to return to the **Edit Settings** window.

Step 18. From the **Edit Settings** window, click **OK** to finish the vSIM VM configuration.

Step 19. From the **Recent Tasks** panel, check the status of the vSIM VM reconfiguration.

Step 20. Start the vSIM, using the following steps:

a. Locate the vSIM in the **Navigator** panel and right-click it.

Expected outcome

The **Actions** menu opens.

b. Select the **Actions→Power→Power On** action.

Expected outcome

The vSIM starts the boot process.

Step 21. Optionally connect to the console by using Telnet to connect to the ESXi host (in this example, 192.168.168.15) on the TCP port number you defined earlier (in this example, 12050).

Expected outcome

The TIMOS login screen is displayed when the vSIM is up and running successfully.

Step 22. Log in using the following credentials:

- login – admin
- password – admin

Expected outcome

SR OS commands can now be issued as normal.

7 Verifying the vSIM installation

7.1 Overview

This section describes the basic procedures for verifying your vSIM virtual machine (VM) installation. Common problems that you may encounter are highlighted and possible solutions to resolve these issues are provided.

Note: This section provides instructions on verifying and troubleshooting VMs deployed on Linux hosts using the QEMU-KVM hypervisor. Similar techniques can also be applied to VMs deployed in a VMware environment.

7.2 Verifying host details

Successful installation of a vSIM VM requires the host machine to be set up properly. Use the commands described in this section to display host information for Linux systems (running Centos, Red Hat).

7.2.1 General system information

To display the Linux kernel version, enter the following:

```
uname -a ↵
```

To verify that your Linux kernel is 64-bit, enter the following:

```
uname -m ↵
```

The command output should be x86_64.

7.2.2 Linux distribution type

To display the type of Linux distribution and version, enter the following:

```
lsb_release -a ↵
```

Note: Depending on your Linux distribution, you may have to install a package such as **redhat-lsb-core** to run this command.

7.2.3 PCI devices

To view all PCI devices, enter the following:

```
lspci ↵
```

A partial example output of the command is as follows:

```
[user@host ~]# lspci
04:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
05:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
06:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
07:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
```

The first entry indicates that there is a PCI device attached to bus 04, with device ID 00 and function 0 (04:00.0) and that it is an 82574L Gigabit Ethernet controller made by Intel Corporation.

To view PCI device details, including capabilities such as the maximum bus speed and the number of lanes (for example x4), enter the following:

```
lspci -vvv ↵
```

7.2.4 CPU processor information

To view details about all the CPU processors available to the host, enter the following:

```
cat /proc/cpuinfo ↵
```

When hyper-threading is enabled on Intel CPUs, every hyper-thread appears as a separate processor, as shown in the following partial example output:

```
[user@host ~]# cat /proc/cpuinfo
processor       : 0
vendor_id       : GenuineIntel
cpu family      : 6
model           : 62
model name      : Intel(R) Xeon(R) CPU E5-2630 v2 @ 2.60GHz
stepping        : 4
cpu MHz         : 2593.614
cache size      : 15360 KB
physical id     : 0
siblings        : 12
core id         : 0
cpu cores       : 6
apicid          : 0
initial apicid  : 0
fpu             : yes
fpu_exception   : yes
cpuid level     : 13
wp              : yes
flags           : fpu vme de pse tsc msr pae mce cx8 apic mtrr pge mca cmov pat pse36 clflush
 dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc arch_perfmon
 pebs bts rep_good xtopology nonstop_tsc aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx
 est tm2 ssse3 cx16 xtpr pdcm dca sse4_1 sse4_2 x2apic popcnt aes xsave avx f16c rdrand lahf_lm
 ida arat epb xsaveopt pln pts dts tpr_shadow vnmi flexpriority ept vpid fsgsbase smep erms
bogomips        : 5187.22
clflush size    : 64
cache_alignment : 64
address sizes   : 46 bits physical, 48 bits virtual
power management:
```

To run vSIM VMs, the **cpu family** value must be 6 (Intel) and the **model** should be greater than or equal to 42 (in most cases). In addition, several CPU flags are critical for the vSIM and must be passed through to the guest. These include:

x2apic

support for an advanced interrupt controller introduced with Intel Nehalem processors. Support for the x2apic is mandatory; the flag must not be emulated.

lm

long mode, indicating a 64-bit CPU, which is necessary to support 64-bit guests

vmx

support for Intel virtualization technologies such as VT-d/VT-x

7.2.5 Host memory

To view details about the host memory, enter the following:

```
cat /proc/meminfo ↵
```

The following is a partial example output of this command:

```
[user@host ~]# cat /proc/meminfo
MemTotal:       16406144 kB
MemFree:         9442676 kB
MemAvailable:   11272708 kB
Buffers:          648220 kB
Cached:          1352744 kB
SwapCached:            0 kB
Active:          4898888 kB
Inactive:        1723664 kB
```

The **MemFree** value must be at least 4194304 kB if you want to create another vSIM VM on this host.

7.2.6 Host capability

To show summary information about the host and its virtualization capabilities, enter the following:

```
virsh capabilities ↵
```

Note: The `libvirt` package must be installed to run this command on the host.

The command output must confirm that the system is capable of supporting guests with the x86_64 architecture (64-bit guests).

7.2.7 QEMU and libvirt information

To show `libvirt` and QEMU version information, enter the following:

```
virsh version ↵
```

Note: The `libvirt` package must be installed to run this command on the host.

7.2.8 Loaded modules

To list all the kernel modules installed on the host, enter the following:

`lsmod ↵`

Some key modules are: **bridge**, **kvm**, **kvm_intel**, **vhost_net**, **tun**, **macvtap** and **openvswitch**.

7.2.9 Host virtualization setup

To check that dependencies for virtualization are installed correctly on the host, enter the following:

`virt-host-validate ↵`

The following is an example output of the command:

```
[user@host ~]# virt-host-validate
  QEMU: Checking for hardware virtualization                                 : PASS
  QEMU: Checking for device /dev/kvm                                         : PASS
  QEMU: Checking for device /dev/vhost-net                                   : PASS
  QEMU: Checking for device /dev/net/tun                                     : PASS
   LXC: Checking for Linux >= 2.6.26                                         : PASS
[user@host ~]#
```

7.3 Verifying the creation of VMs

Before attempting to log in to a vSIM and to check for successful boot of its VMs, ensure that the VMs have been created as expected on all the host machines.

If you are using `libvirt`, you can view the list of VMs on a specific host by entering the following command:

`virsh list ↵`

The following is an example output of this command:

```
[user@host ~]# virsh list --all
 Id    Name                           State
----------------------------------------------------
 1     CPMA                           running
 2     CPMB                           running
 3     IOM1                           running
```

Because each QEMU-KVM VM is a process with two or more threads, you can also use a sequence of commands, such as the following, to get more details about a running VM:

```
[user@host ~]# ps -ef | grep CPMA
qemu      6304     1  5 Sep10 ?        05:03:50 /usr/libexec/qemu-kvm.real
name CPMA -S -machine rhel6.0.0, accel=kvm, usb=off
cpu SandyBridge, +erms, +smep, +fsgsbase, +rdrand, +f16c, +osxsave, +pcid, +pdcm, +
tpr, +tm2, +est, +smx, +vmx, +ds_cpl, +monitor, +dtes64, +pbe, +tm, +ht, +ss, + acp
, + ds, +vme -m 6144 -realtime mlock=off -smp 2, sockets=2, cores=1, threads=1
uuid nnnnnnnn-nnnn-nnnn-nnnn-nnnnnnnnnnnn -nographic -no-user-config -nodefaults
chardev socket, id=charmonitor, path=/var/lib/libvirt/qemu
CPMA.monitor, server, nowait -mon chardev=charmonitor, id=monitor, mode=control
```

```
rtc base=utc -no-kvm-pit-reinjection -no-shutdown -no-acpi -boot strict=on
device piix3-usb-uhci, id=usb, bus=pci.0, addr=0x1.0x2 -device virtio-serial
pci, id=virtio-serial0, bus=pci.0, addr=0x7 -drive file=/path
disk1.qcow2, if=none, id=drive-virtio-disk0, format=qcow2, cache=none
device virtio-blk-pci, scsi=off, bus=pci.0, addr=0x8, drive=drive-virtio
disk0, id=virtio-disk0 -netdev tap, fd=23, id=hostnet0, vhost=on, vhostfd=24
device virtio-net
pci, netdev=hostnet0, id=net0, mac=nn:nn:nn:nn:nn:nn, bus=pci.0, addr=0x3, bootinde
=1 -netdev tap, fd=25, id=hostnet1, vhost=on, vhostfd=26 -device virtio-net
pci, netdev=hostnet1, id=net1, mac=nn:nn:nn:nn:nn:nn, bus=pci.0, addr=0x4
chardev socket, id=charconsole0, host=0.0.0.0, port=2500, telnet, server, nowait
device virtconsole, chardev=charconsole0, id=console0 -device virtio-balloon
pci, id=balloon0, bus=pci.0, addr=0x6
```

```
[user@host ~]# ps -T 6304
root@bksim4204 6304]# ps -T 6304
  PID  SPID TTY      STAT   TIME COMMAND
 6304  6304 ?        Sl     0:19 /usr/libexec/qemu-kvm.real -name CPMA -S -machine
 rhel6.0.0,accel=k
 6304  6310 ?        Sl   169:47 /usr/libexec/qemu-kvm.real -name CPMA -S -machine
 rhel6.0.0,accel=k
 6304  6311 ?        Sl   134:52 /usr/libexec/qemu-kvm.real -name CPMA -S -machine
 rhel6.0.0,accel=k
```

These example command outputs indicate that the VM called CPMA is running as process ID 6304 in the host machine. There are three threads associated with this process.

You can obtain a real-time view of the host system impact of all running VMs by entering the following commands:

`top ↵`

`htop ↵`

The following is an example output of the command:

```
[root@bksim4204 bin]# top
top - 14:00:10 up 5 days,  4:44,  2 users,  load average: 4.09, 4.08, 4.09
Tasks: 184 total,   2 running, 182 sleeping,   0 stopped,   0 zombie
%Cpu(s): 51.2 us,  0.1 sy,  0.0 ni, 48.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  16406144 total,  6970448 used,  9435696 free,   649488 buffers
KiB Swap:        0 total,        0 used,        0 free.  1328612 cached Mem

  PID USER    PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND

 6349 qemu    20  0  4860828 2.445g   5912 S 402.1 15.6   24522:22 qemu-kvm.real

 6304 qemu    20  0  6736452 0.981g   5916 S   4.7  6.3  305:44.16 qemu-kvm.real

 6321 qemu    20  0  6736424 0.980g   5916 S   4.3  6.3  280:32.31 qemu-kvm.real

 6308 root    20  0        0      0      0 S   0.3  0.0    4:45.88 vhost-6304

 6324 root    20  0        0      0      0 S   0.3  0.0    1:23.12 vhost-6321
```

7.4 Verifying host networking

You can use different methods to provide network connectivity between the vSIM VMs and external destinations.

Table 8: Host network troubleshooting lists some useful commands that can help you troubleshoot networking at the host level.

Table 8: Host network troubleshooting

Command syntax	Description
ip -d link show	Shows details of all host network interfaces, including physical NIC ports and logical interfaces, such as vNIC interface constructs on the host
ip link set dev <interface-name> **mtu** <value>	Explicitly sets the MTU (Maximum Transmit Unit) of a host interface You are required to set the MTU of network interfaces associated with vSIM internal fabric interfaces to 9000 bytes
ip addr show	Displays the IP addresses associated with host network interfaces **Note:** In a virtualization environment, many interfaces do not have any IP addresses assigned to them.
ip route show	Displays the IP routing table of the host
tcpdump -i <interface name>	Captures packets on the selected interface and outputs them for analysis
brctl show	Displays all the Linux bridges
ovs-vsctl show	Displays all the Open vSwitch bridges
ethtool -S <interface name>	Displays statistics collected by the physical NIC for a selected interface

7.5 Verifying vSIM software

After you have verified that the vSIM VMs have been created successfully on the respective hosts, check the SR OS operating system to verify that it has booted up properly on each VM and that the vSIM is functional. You will typically need console access to the vSIM to perform these checks. This is the main reason for adding a serial console port to vSIM VMs. With console access, you can log in to each vSIM and perform the checks that are described in this section.

7.5.1 Check the status of the system BOF

The output of this command depends on the SMBIOS text string used for the VM and the saved BOF configuration.

MD-CLI

Use the following command to check the status of the system BOF.

```
admin show configuration bof
```

Output example: Status of the system BOF

```
# TiMOS-C-22.10.B1-25 cpm/x86_64 Nokia 7750 SR Copyright (c) 2000-2022 Nokia.
# All rights reserved. All use subject to applicable license agreements.
# Built on Fri Dec 2 18:20:32 PST 2022 by builder in /builds/c/2210B/B1-25/panos/main/sros
# Configuration format version 22.10 revision 0

# Generated MON DEC 05 20:38:08 2022 UTC

bof {
    configuration {
        primary-location "ftp://*:*@[192.168.193.192]/./dut-a.cfg"
    }
    console {
        speed 115200
    }
    image {
        primary-location "cf3:\timos\"
    }
    li {
        local-save false
        separate false
    }
    license {
        primary-location "ftp://*:*@[192.168.193.192]/./license.txt"
    }
    router "management" {
        interface "management" {
            cpm active {
                ipv4 {
                    ip-address 192.168.231.86
                    prefix-length 18
                }
                ipv6 {
                    ipv6-address 3000::c0a8:e756
                    prefix-length 114
                }
            }
            cpm standby {
                ipv4 {
                    ip-address 192.168.231.87
                    prefix-length 18
                }
                ipv6 {
                    ipv6-address 3000::c0a8:e757
                    prefix-length 114
                }
            }
        }
        static-routes {
            route 135.0.0.0/8 {
                next-hop 192.168.193.191
            }
            route 138.0.0.0/8 {
                next-hop 192.168.193.191
            }
        }
```

```
    }
    system {
        base-mac-address fa:ac:ff:ff:10:00
        fips-140 false
        persistent-indices false
    }
}

# Finished MON DEC 05 20:38:08 2022 UTC
```

Classic CLI

Use the following command to check the status of the system BOF.

```
show bof
```

Output example: Status of the system BOF

```
===============================================================================
BOF (Memory)
===============================================================================
    primary-image    cf3:\timos\
    primary-config   ftp://*:*@[192.168.193.192]/./dut-a.cfg
    license-file     ftp://*:*@[192.168.193.192]/./license.txt
    address          192.168.231.86/18 active
    address          192.168.231.87/18 standby
    address          3000::c0a8:e756/114 active
    address          3000::c0a8:e757/114 standby
    static-route     135.0.0.0/8 next-hop 192.168.193.191
    static-route     138.0.0.0/8 next-hop 192.168.193.191
    autonegotiate
    duplex           full
    speed            100
    wait             3
    persist          off
    no li-local-save
    no li-separate
    no fips-140
    console-speed    115200
    system-base-mac  fa:ac:ff:ff:10:00
===============================================================================
```

7.5.2 Check the chassis type

Verify that the vSIM VM chassis type is set correctly. If the chassis type does not match the one encoded in the SMBIOS text string, there is likely an error in the SMBIOS text string. Use the following command to show the chassis information.

```
show chassis
```

Output example: Chassis information

```
===============================================================================
System Information
===============================================================================
  Name                            : Dut-A
  Type                            : 7750 SR-12
```

```
  Chassis Topology                  : Standalone
  Location                          : (Not Specified)
  Coordinates                       : (Not Specified)
  CLLI code                         :
  Number of slots                   : 12
  Oper number of slots              : 12
  Num of faceplate ports/connectors : 148
  Num of physical ports             : 128
  Critical LED state                : Off
  Major LED state                   : Off
  Minor LED state                   : Off
  Over Temperature state            : OK
  Base MAC address                  : fa:ac:ff:ff:10:00
  Admin chassis mode                : d
  Oper chassis mode                 : d
  Fabric Speed                      : S4
  FP Generations                    : FP3 FP4
  System Profile                    : none

===============================================================================
Chassis Summary
===============================================================================
Chassis   Role               Status
-------------------------------------------------------------------------------
1         Standalone         up
===============================================================================
```

7.5.3 Check the card types equipped in the system

Verify that correct (virtualized) card types are equipped in the system. If a card type does not match the one encoded in the SMBIOS text string of the corresponding VM, there is likely an error in that SMBIOS text string. Use the following command to show the card information.

```
show card
```

Output example: Card information

```
===============================================================================
Card Summary
===============================================================================
Slot      Provisioned Type                        Admin Operational   Comments
              Equipped Type (if different)        State State
-------------------------------------------------------------------------------
1         iom5-e:he1200g+                         up    up
2         iom5-e:he1200g+                         up    up
3         iom4-e-b                                up    up
4         iom4-e-hs                               up    up
5         imm48-1gb-sfp-c                         up    up
6         iom4-e                                  up    up
7         imm-2pac-fp3                            up    up
8         iom4-e                                  up    up
9         iom4-e                                  up    up
10        imm-2pac-fp3                            up    up
A         cpm5                                    up    up/active
B         cpm5                                    up    up/standby
===============================================================================
```

7.5.4 Check the vSIM system licenses

Verify that the vSIM has valid licenses. Use the following command to show the system license information.

```
show system license
```

Output example: System license information

```
===============================================================================
System  License
===============================================================================
License status : monitoring, valid license record
Time remaining : 141 days 10 hours
===============================================================================
===============================================================================
Active  License [CPM A]
===============================================================================
License status : monitoring, valid license record
Time remaining : 141 days 10 hours
-------------------------------------------------------------------------------
License name   : name@organization.com
License uuid   : cb0ba837-07db-4ebb-88ea-694271754675
Machine uuid   : cb0ba837-07db-4ebb-88ea-694271754675
License desc   : vSIM license1a
License prod   : Virtual-SIM
License sros   : TiMOS-[BC]-15.0.*
Current date   : WED JUL 12 14:21:52 UTC 2017
Issue   date   : THU JUN 01 22:57:48 UTC 2017
Start   date   : THU JUN 01 00:00:00 UTC 2017
End     date   : FRI DEC 01 00:00:00 UTC 2017
===============================================================================
===============================================================================
Standby License [CPM B]
===============================================================================
License status : monitoring, valid license record
Time remaining : 141 days 10 hours
-------------------------------------------------------------------------------
License name   : name@organization.com
License uuid   : 60ca42cf-d45a-4124-afd0-81057f167bf4
Machine uuid   : 60ca42cf-d45a-4124-afd0-81057f167bf4
License desc   : vSIM license1b
License prod   : Virtual-SIM
License sros   : TiMOS-[BC]-15.0.*
Current date   : WED JUL 12 14:21:52 UTC 2017
Issue   date   : THU JUN 01 22:57:48 UTC 2017
Start   date   : THU JUN 01 00:00:00 UTC 2017
End     date   : FRI DEC 01 00:00:00 UTC 2017
===============================================================================
```

Appendixes

Appendix A: vSIM supported hardware

This appendix provides tables that list supported hardware for the following chassis types:

7250 IXR

The following tables list the supported hardware for the 7250 IXR chassis type.

Table 9: 7250 IXR-6 supported hardware

7250 IXR-6			
Chassis	**SFM**	**Card**	**MDA**
IXR-6	sfm-ixr-6	cpm-ixr	—
		imm36-100g-qsfp28	m36-100g-qsfp28
		imm48-sfp+2-qsfp28	m48-sfp+2-qsfp28

Table 10: 7250 IXR-10 supported hardware

7250 IXR-10			
Chassis	**SFM**	**Card**	**MDA**
IXR-10	sfm-ixr-10	cpm-ixr	—
		imm36-100g-qsfp28	m36-100g-qsfp28
		imm48-sfp+2-qsfp28	m48-sfp+2-qsfp28

Table 11: 7250 IXR-e supported hardware

7250 IXR-e		
Chassis	**Card**	**MDA**
IXR-e	cpm-ixr-e/imm24-sfp++8-sfp28+2-qsfp28 cpm-ixr-e-gnss/imm24-sfp++8-sfp28+2-qsfp28	m24-sfp++8-sfp28+2-qsfp28 [2]
	cpm-ixr-e/imm14-10g-sfp++4-1g-tx cpm-ixr-e-gnss/imm14-10g-sfp++4-1g-tx	m14-10g-sfp++4-1g-tx [2]

Table 12: 7250 IXR-R4 supported hardware

7250 IXR-R4		
Chassis	**Card**	**MDA**
IXR-R4	cpm-ixr-r4	—
	iom-ixr-r4	m6-10g-sfp++1-100g-qsfp28
		m20-1g-csfp [3]
		m10-10g-sfp+
		m4-10g-sfp++1-100g-cfp2
		m6-10g-sfp++4-25g-sfp28
		m10-1g-sfp+2-10g-sfp+ [4]

Table 13: 7250 IXR-R6 supported hardware

7250 IXR-R6		
Chassis	**Card**	**MDA**
IXR-R6	cpiom-ixr-r6	a32-chds1v2 [5]
		m4-10g-sfp++1-100g-cfp2
		m6-10g-sfp++1-100g-qsfp28
		m6-10g-sfp++4-25g-sfp28

2 The MDA entry is not required on the CPM VM in slot A.

3 This MDA must use slots 1, 2, or 3.

4 The integrated MDA must be specified as mda/5.

5 This MDA has slot restrictions for slot 5 or 6.

7250 IXR-R6		
Chassis	**Card**	**MDA**
		m10-10g-sfp+
		m20-1g-csfp [6]

Table 14: 7250 IXR-s supported hardware

7250 IXR-s		
Chassis	**Card**	**MDA**
IXR-s	cpm-ixr-s/imm48-sfp++6-qsfp28	m48-sfp++6-qsfp28 [2]

Table 15: 7250 IXR-X1 supported hardware

7250 IXR-X1		
Chassis	**Card**	**MDA**
IXR-X	cpm-ixr-x/imm32-qsfp28+4-qsfpdd	m32-qsfp28+4-qsfpdd [2]

Table 16: 7250 IXR-Xs supported hardware

7250 IXR-Xs		
Chassis	**Card**	**MDA**
IXR-X	cpm-ixr-x/imm6-qsfpdd+48-sfp56	m6-qsfpdd+48-sfp56 [2]

Table 17: 7250 IXR-ec supported hardware

7250 IXR-ec		
Chassis	**Card**	**MDA**
IXR-ec	cpm-ixr-ec/imm4-1g-tx+20-1g-sfp +6-10g-sfp+	m4-1g-tx+20-1g-sfp+6-10g-sfp+

Table 18: 7250 IXR-e2 supported hardware

7250 IXR-e2		
Chassis	**Card**	**MDA**
IXR-e2	cpm-ixr-e2/imm2-qsfpdd+2-qsfp28+24-sfp28	m2-qsfpdd+2-qsfp28+24-sfp28

[6] This MDA must use either slot 3 or 4.

Table 19: 7250 IXR-e2c supported hardware

7250 IXR-e2c		
Chassis	**Card**	**MDA**
IXR-e2c	cpm-ixr-e2c/imm12-sfp28+2-qsfp28	m12-sfp28+2-qsfp28

Table 20: 7250 IXR-e2sc supported hardware

7250 IXR-e2sc		
Chassis	**Card**	**MDA**
IXR-e2sc	cpm-ixr-e2sc/imm16-sfp++4-sfp28	m16-sfp++4-sfp28

Table 21: 7250 IXR-X3 supported hardware

7250 IXR-X3		
Chassis	**Card**	**MDA**
IXR-X3	cpm-ixr-x/imm36-qsfpdd	m36-qsfpdd [2]

Table 22: 7250 IXR-R6d supported hardware

7250 IXR-R6d		
Chassis	**Card**	**MDA**
IXR-R6d	cpiom-ixr-r6d/iom-ixr-r6d	m1-400g-qsfpdd+1-100g-qsfp28 [2] m5-100g-qsfp28 [2] m18-25g-sfp28[2] m2-cfp2[2] m20-10g-sfp+[2] m10-50g-sfp56[2] m32-1g-csfp[2] m2-100g-qsfp28+16-10g-sfp+[2]

Table 23: 7250 IXR-R6dl supported hardware

7250 IXR-R6dl		
Chassis	**Card**	**MDA**
IXR-R6dl	cpiom-ixr-r6d/iom-ixr-r6d	m1-400g-qsfpdd+1-100g-qsfp28 [2]

7250 IXR-R6dl		
Chassis	**Card**	**MDA**
		m5-100g-qsfp28 [2] m18-25g-sfp28[2] m2-cfp2[2] m20-10g-sfp+[2] m10-50g-sfp56[2] m46-10g-sfp+[2] m32-1g-csfp[2] m80-1g-csfp[2] m2-100g-qsfp28+16-10g-sfp+[2]

7750 SR

The following tables list the supported hardware for the 7750 SR chassis type.

Table 24: 7750 SR-7 supported hardware

7750 SR-7			
Chassis	**SFM**	**Card**	**MDA**
SR-7	m-sfm5-7 or m-sfm6-7/12	cpm5	—
	m-sfm5-7 or m-sfm6-7/12	imm-2pac-fp3	isa2-aa
			isa2-bb
			isa2-tunnel
			p10-10g-sfp
			p1-100g-cfp
			p6-10g-sfp
			p20-1gb-sfp
	m-sfm5-7 or m-sfm6-7/12	imm48-1gb-sfp-c	imm24-1gb-xp-sfp
	m-sfm5-7 or m-sfm6-7/12	iom4-e	isa2-aa
			isa2-bb

7750 SR-7			
Chassis	**SFM**	**Card**	**MDA**
			isa2-tunnel
			me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-7 or m-sfm6-7/12	iom4-e-b	isa2-aa
			isa2-bb
			isa2-tunnel
			me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-12 or m-sfm6-7/12	iom4-e-hs	me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28

7750 SR-7			
Chassis	**SFM**	**Card**	**MDA**
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm6-7/12	iom5-e	me3-200gb-cfp2-dco
			me6-100gb-qsfp28
			me16-25gb-sfp28+2-100gb-qsfp28
			me3-400gb-qsfpdd
			me16-25gb-sfp28+2-100gb-qsfp-b

Table 25: 7750 SR-12 supported hardware

7750 SR-12			
Chassis	**SFM**	**Card**	**MDA**
SR-12	m-sfm5-12 or m-sfm6-7/12	cpm5	—
	m-sfm5-12 or m-sfm6-7/12	imm-2pac-fp3	isa2-aa
			isa2-bb
			isa2-tunnel
			p10-10g-sfp
			p1-100g-cfp
			p6-10g-sfp
			p20-1gb-sfp
	m-sfm5-12 or m-sfm6-7/12	imm48-1gb-sfp-c	imm24-1gb-xp-sfp
	m-sfm5-12 or m-sfm6-7/12	iom4-e	isa2-aa
			isa2-bb
			isa2-tunnel
			me10-10gb-sfp+

7750 SR-12			
Chassis	**SFM**	**Card**	**MDA**
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-12 or m-sfm6-7/12	iom4-e-b	isa2-aa
			isa2-bb
			isa2-tunnel
			me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-12 or m-sfm6-7/12	iom4-e-hs	me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp

7750 SR-12			
Chassis	**SFM**	**Card**	**MDA**
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm6-7/12	iom5-e	me3-200gb-cfp2-dco
			me6-100gb-qsfp28
			me16-25gb-sfp28+2-100gb-qsfp28
			me3-400gb-qsfpdd
			me16-25gb-sfp28+2-100gb-qsfp-b

Table 26: 7750 SR-12e supported hardware

7750 SR-12e			
Chassis	**SFM**	**Card**	**MDA**
SR-12e	m-sfm5-12e or m-sfm6-12e	cpm5	—
	m-sfm5-12e or m-sfm6-12e	imm-2pac-fp3	isa2-aa
			isa2-bb
			isa2-tunnel
			p10-10g-sfp
			p1-100g-cfp
			p6-10g-sfp
			p20-1gb-sfp
	m-sfm5-12e or m-sfm6-12e	imm40-10gb-sfp	m40-10g-sfp
	m-sfm5-12e or m-sfm6-12e	imm4-100gb-cfp4	m4-100g-cfp4
	m-sfm5-12e or m-sfm6-12e	iom4-e	isa2-aa
			isa2-bb
			isa2-tunnel
			me10-10gb-sfp+
			me1-100gb-cfp2

7750 SR-12e			
Chassis	**SFM**	**Card**	**MDA**
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-12e or m-sfm6-12e	iom4-e-b	isa2-aa
			isa2-bb
			isa2-tunnel
			me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+
			me8-10/25gb-sfp28
	m-sfm5-12e or m-sfm6-12e	iom4-e-hs	me10-10gb-sfp+
			me1-100gb-cfp2
			me12-10/1gb-sfp+
			me2-100gb-cfp4
			me2-100gb-ms-qsfp28
			me2-100gb-qsfp28
			me40-1gb-csfp
			me6-10gb-sfp+

7750 SR-12e			
Chassis	**SFM**	**Card**	**MDA**
			me8-10/25gb-sfp28
	m-sfm6-12e	iom5-e	me12-100gb-qsfp28
			me3-200gb-cfp2-dco
			me6-100gb-qsfp28
			me6-400gb-qsfpdd
			me16-25gb-sfp28+2-100gb-qsfp28
			me3-400gb-qsfpdd
			me16-25gb-sfp28+2-100gb-qsfp-b
			m5e2-100g-qsfp28+2-800g-qdd
			m5e8-100g-sfp112+2-800g-qdd
			m5e10-100g-qsfp28
			m5e16-100g-sfp112

Table 27: 7750 SR-a4/a8 supported hardware

7750 SR-a4/a8		
Chassis	**Card**	**MDA**
SR-a4	cpm-a	—
SR-a8	iom-a	ma20-1gb-tx
		ma2-10gb-sfp+12-1gb-sfp
		ma4-10gb-sfp+
		ma44-1gb-csfp
		maxp10-10/1gb-msec-sfp+
		maxp10-10gb-sfp+
		maxp1-100gb-cfp
		maxp1-100gb-cfp2
		maxp1-100gb-cfp4
		maxp6-10gb-sfp+1-40gb-qsfp+

Table 28: 7750 SR-1e/2e/3e supported hardware

7750 SR-1e/2e/3e		
Chassis	**Card**	**MDA**
SR-1e SR-2e SR-3e	cpm-e	—
	iom-e	isa2-aa
		isa2-bb
		isa2-tunnel
		me10-10gb-sfp+
		me1-100gb-cfp2
		me12-10/1gb-sfp+
		me2-100gb-cfp4
		me2-100gb-ms-qsfp28
		me2-100gb-qsfp28
		me40-1gb-csfp
		me6-10gb-sfp+
		me8-10/25gb-sfp28

Table 29: 7750 SR-1 supported hardware

7750 SR-1		
Chassis	**Card**	**MDA**
SR-1	cpm-1	me12-100gb-qsfp28
		me3-200gb-cfp2-dco
		me6-100gb-qsfp28
		me6-400gb-qsfpdd
		me16-25gb-sfp28+2-100gb-qsfp28
		me3-400gb-qsfpdd
		me16-25gb-sfp28+2-100gb-qsfp-b
		m5e2-100g-qsfp28+2-800g-qdd
		m5e8-100g-sfp112+2-800g-qdd

7750 SR-1		
Chassis	**Card**	**MDA**
		m5e10-100g-qsfp28
		m5e16-100g-sfp112

Table 30: 7750 SR-1s supported hardware

7750 SR-1s			
Chassis	**Card**	**XIOM**	**MDA**
SR-1s	cpm-1s	—	s18-100gb-qsfp28
			s36-100gb-qsfp28
			s36-400gb-qsfpdd
			s36-100gb-qsfp28-3.6t
		iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
			ms2-100g-qsfp28+2-800g-qsfpdd
			ms3-200gb-cfp2-dco
			ms4-400gb-qsfpdd+4-100gb-qsfp28
			ms6-300gb-cfp2-dco
			ms6-200gb-cfp2-dco
			ms8-100gb-sfpdd+2-100gb-qsfp28
			ms8-100g-sfp112+2-800g-qsfpdd
			ms18-100gb-qsfp28
			ms16-100gb-sfpdd+4-100gb-qsfp28
			ms24-10/100gb-sfpdd
			ms24-100g-sfp112
			ms16-sdd+4-qsfp28-b
			ms8-sdd+2-qsfp28-b

Table 31: 7750 SR-2s supported hardware

7750 SR-2s				
	SFM	**Card**	**XIOM**	**MDA**
SR-2s	sfm-2s	cpm-2s	—	—
		xcm-2s	—	s18-100gb-qsfp28
				s36-100gb-qsfp28
				s36-400gb-qsfpdd
				s36-100gb-qsfp28-3.6t
			iom-s-1.5t iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
				ms2-100g-qsfp28+2-800g-qsfpdd
				ms3-200gb-cfp2-dco
				ms4-400gb-qsfpdd+4-100gb-qsfp28
				ms6-300gb-cfp2-dco
				ms6-200gb-cfp2-dco
				ms8-100gb-sfpdd+2-100gb-qsfp28
				ms8-100g-sfp112+2-800g-qsfpdd
				ms16-100gb-sfpdd+4-100gb-qsfp28
				ms18-100gb-qsfp28
				ms24-10/100gb-sfpdd
				ms24-100g-sfp112
				ms16-sdd+4-qsfp28-b
				ms8-sdd+2-qsfp28-b

Table 32: 7750 SR-7s supported hardware

7750 SR-7s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
SR-7s	sfm-s	cpm-s cpm2-s	—	—
		xcm-7s	—	s18-100gb-qsfp28

7750 SR-7s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
				s36-100gb-qsfp28
				s36-400gb-qsfpdd
				s36-100gb-qsfp28-3.6t
			iom-s-1.5t iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
				ms2-100g-qsfp28+2-800g-qsfpdd
				ms3-200gb-cfp2-dco
				ms4-400gb-qsfpdd+4-100gb-qsfp28
				ms6-300gb-cfp2-dco
				ms6-200gb-cfp2-dco
				ms8-100gb-sfpdd+2-100gb-qsfp28
				ms8-100g-sfp112+2-800g-qsfpdd
				ms16-100gb-sfpdd+4-100gb-qsfp28
				ms18-100gb-qsfp28
				ms24-10/100gb-sfpdd
				ms24-100g-sfp112
				ms16-sdd+4-qsfp28-b
				ms8-sdd+2-qsfp28-b
	sfm2-s	cpm2-s	—	—
		xcm2-7s	—	x2-s36-800g-qsfpdd-18.0t
				x2-s36-800g-qsfpdd-12.0t
			iom2-se-3.0t iom2-se-6.0t	mse24-200g-sfpdd
				mse14-800g+4-400g
				mse6-800g-qsfpdd
				mse6-800g-cfp2-dco
			x2-s36-800g-qsfpdd-6.0t	m36-800g-qsfpdd

7750 SR-7s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
			x2-s36-400g-qsfp112-3.0t	m36-400g-qsfp112
		xcm-7s-b	—	s18-100gb-qsfp28
				s36-100gb-qsfp28
				s36-400gb-qsfpdd
				s36-100gb-qsfp28-3.6t
			iom-s-1.5t iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
				ms2-100g-qsfp28+2-800g-qsfpdd
				ms3-200gb-cfp2-dco
				ms4-400gb-qsfpdd+4-100gb-qsfp28
				ms6-300gb-cfp2-dco
				ms6-200gb-cfp2-dco
				ms8-100gb-sfpdd+2-100gb-qsfp28
				ms8-100g-sfp112+2-800g-qsfpdd
				ms16-100gb-sfpdd+4-100gb-qsfp28
				ms18-100gb-qsfp28
				ms24-10/100gb-sfpdd
				ms24-100g-sfp112
				ms16-sdd+4-qsfp28-b
				ms8-sdd+2-qsfp28-b

Table 33: 7750 SR-14s supported hardware

7750 SR-14s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
SR-14s	sfm-s	cpm-s cpm2-s	—	—
		xcm-14s	—	s18-100gb-qsfp28
				s36-100gb-qsfp28

7750 SR-14s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
				s36-400gb-qsfpdd
				s36-100gb-qsfp28-3.6t
			iom-s-1.5t iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
				ms2-100g-qsfp28+2-800g-qsfpdd
				ms3-200gb-cfp2-dco
				ms4-400gb-qsfpdd+4-100gb-qsfp28
				ms6-300gb-cfp2-dco
				ms6-200gb-cfp2-dco
				ms8-100gb-sfpdd+2-100gb-qsfp28
				ms8-100g-sfp112+2-800g-qsfpdd
				ms16-100gb-sfpdd+4-100gb-qsfp28
				ms18-100gb-qsfp28
				ms24-10/100gb-sfpdd
				ms24-100g-sfp112
				ms16-sdd+4-qsfp28-b
				ms8-sdd+2-qsfp28-b
	sfm2-s	cpm2-s	—	—
		xcm2-14s	—	x2-s36-800g-qsfpdd-18.0t
				x2-s36-800g-qsfpdd-12.0t
			iom2-se-3.0t iom2-se-6.0t	mse24-200g-sfpdd
				mse14-800g+4-400g
				mse6-800g-qsfpdd
				mse6-800g-cfp2-dco
			x2-s36-800g-qsfpdd-6.0t	m36-800g-qsfpdd
			x2-s36-400g-qsfp112-3.0t	m36-400g-qsfp112

7750 SR-14s				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
		xcm-14s-b	—	s18-100gb-qsfp28
				s36-100gb-qsfp28
				s36-400gb-qsfpdd
				s36-100gb-qsfp28-3.6t
			iom-s-1.5t iom-s-3.0t	ms2-400gb-qsfpdd+2-100gb-qsfp28
				ms2-100g-qsfp28+2-800g-qsfpdd
				ms3-200gb-cfp2-dco
				ms4-400gb-qsfpdd+4-100gb-qsfp28
				ms6-300gb-cfp2-dco
				ms6-200gb-cfp2-dco
				ms8-100gb-sfpdd+2-100gb-qsfp28
				ms8-100g-sfp112+2-800g-qsfpdd
				ms16-100gb-sfpdd+4-100gb-qsfp28
				ms18-100gb-qsfp28
				ms24-10/100gb-sfpdd
				ms24-100g-sfp112
				ms16-sdd+4-qsfp28-b
				ms8-sdd+2-qsfp28-b

Table 34: 7750 SR-1x-48D supported hardware

7750 SR-1x-48D		
Chassis	**Card**	**MDA**
SR-1x-48D	cpm-1x/i48-800g-qsfpdd-1x	m48-800g-qsfpdd-1x[2]

Table 35: 7750 SR-1-24D supported hardware

7750 SR-1-24D		
Chassis	**Card**	**MDA**
SR-1-24D	cpm-1x/i24-800g-qsfpdd-1	m24-800g-qsfpdd-1[2]

Table 36: 7750 SR-1-48D supported hardware

7750 SR-1-48D		
Chassis	**Card**	**MDA**
SR-1-48D	cpm-1x/i48-400g-qsfpdd-1	m48-400g-qsfpdd-1[2]

Table 37: 7750 SR-1-92S supported hardware

7750 SR-1-92S		
Chassis	**Card**	**MDA**
SR-1-92S	cpm-1x/i80-200g-sfpdd+12-400g-qsfpdd-1	m80-200g-sfpdd+12-400g-qsfpdd-1[2]

Table 38: 7750 SR-1-46S supported hardware

7750 SR-1-46S		
Chassis	**Card**	**MDA**
SR-1-46S	cpm-1x/i40-200g-sfpdd+6-800g-qsfpdd-1	m40-200g-sfpdd+6-800g-qsfpdd-1[2]

Table 39: 7750 SR-1x-92S supported hardware

7750 SR-1x-92S		
Chassis	**Card**	**MDA**
SR-1x-92S	cpm-1x/i80-200g-sfpdd+12-800g-qsfpdd-1x	m80-200g-sfpdd+12-800g-qsfpdd-1x[2]

Table 40: 7750 SR-1se supported hardware

7750 SR-1se		
Chassis	**Card**	**MDA**
SR-1se	cpm-1se/imm36-800g-qsfpdd	ms36-800g-qsfpdd[2]

Table 41: 7750 SR-2se supported hardware

7750 SR-2se				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
SR-2se	sfm-2se	cpm-2se	—	—
		xcm-2se	—	x2-s36-800g-qsfpdd-18.0t
				x2-s36-800g-qsfpdd-12.0t

7750 SR-2se				
Chassis	**SFM**	**Card**	**XIOM**	**MDA**
			iom2-se-3.0t iom2-se-6.0t	mse24-200g-sfpdd
				mse14-800g+4-400g
				mse6-800g-qsfpdd
				mse6-800g-cfp2-dco
			x2-s36-800g-qsfpdd-6.0t	m36-800g-qsfpdd
			x2-s36-400g-qsfp112-3.0t	m36-400g-qsfp112
		xcmc-2se	iom2-se-3.0t iom2-se-6.0t	mse24-200g-sfpdd
				mse14-800g+4-400g
				mse6-800g-qsfpdd
				mse6-800g-cfp2-dco
			x2-s36-800g-qsfpdd-6.0t	m36-800g-qsfpdd
			x2-s36-400g-qsfp112-3.0t	m36-400g-qsfp112

Table 42: 7750 DMS-1-24D supported hardware

7750 DMS-1-24D		
Chassis	**Card**	**MDA**
DMS-1-24D	cpm-1x/dms24-800g-qsfpdd-1	d24-800g-qsfpdd-1[2]

7950 XRS

The following tables list the supported hardware for the 7950 XRS chassis type.

Table 43: 7950 XRS-20/20e supported hardware

7950 XRS-20/20e			
Chassis	**SFM**	**Card**	**MDA**
XRS-20 XRS-20e	sfm-x20 or sfm-x20-b or sfm-x20s-b	cpm-x20	—

7950 XRS-20/20e			
Chassis	**SFM**	**Card**	**MDA**
	sfm2-x20s	cpm-x20 cpm2-x20	—
	sfm-x20	xcm-x20	x2-100g-tun
	sfm-x20-b or sfm-x20s-b or sfm2-x20s	xcm-x20	x2-100g-tun
			x40-10g-sfp
			x4-100g-cfp2
	sfm2-x20s	xcm2-x20	x12-400g-qsfpdd
			x24-100g-qsfp28
			x6-200g-cfp2-dco
			x6-400g-cfp8

Appendix B: Known limitations

The following are known limitations with respect to supported vSIM hardware configurations:

- Only one ISA MDA is supported per IOM.
- The imm-1pac-fp3 IOM is not supported.
- The isa-tms is not supported.
- The isa-video is not supported.
- Export-restricted ISA types are not supported.
- The imm40-10gb-sfp-ptp, m40-10gb-sfp-ptp and x40-10g-sfp-ptp are not supported.
- With the 7250 IXR-R4 chassis, the integrated MDA should be defined in slot 5; mda/5=m10-1g-sfp +2-10g-sfp+. It is automatically provisioned.

Appendix C: vSIM glossary of key terms

Table 44: C

Term	Definition
CentOS	An open source Linux distribution that reuses source code from Red Hat Enterprise Linux.

Term	Definition
CPU Pinning	A configuration constraint (often expressed as an affinity map), which specifies to the scheduler the (logical) cores that can be used to run a task or set of tasks.

Table 45: D

Term	Definition
Distributed Model	vSIM instance that uses two or more VMs, connected to a common internal network, to implement a single network element.

Table 46: H

Term	Definition
Haswell	Intel CPU micro-architecture introduced in 2013 that uses 22-nm process.
Huge pages	A large block (2MB or 1GB) of physically contiguous virtual memory that has a mapping (in the page table) to physical memory.
Hyper-threading	Intel technology that presents one physical CPU core as two logical processors to the OS.
Hypervisor	Software running on a host machine that creates and manages VMs, and provides the guest O/S in each VM with an abstraction of the physical machine. See also VMM.

Table 47: I

Term	Definition
Integrated model	A vSIM instance that uses a single VM to support all the functions of one network element.
Intel VT-d	Intel Virtualization Technology for Directed I/O Intel CPU MMU feature that provides hardware assist for mapping a guest virtual address (GVA) to a guest physical address (GPA) to a host physical address (HPA). Avoids the need for VMM to maintain a shadow page table per guest.
Intel VT-x	Intel Virtualization Technology for x86 processors Hardware virtualization support in Intel CPUs that allows guest OS to run natively on x86. Introduces two new CPU modes: VMX root (intended for host/VMM execution) and VMX non-root (intended for guest).

Table 48: K

Term	Definition
Kernel Space	A block of virtual memory strictly reserved for the OS kernel, kernel extensions and device drivers.
KVM	Kernel-based Virtual Machine Linux kernel module that allows a user space program, such as QEMU, to access the hardware virtualization features of the CPU.

Table 49: L

Term	Definition
L3 Cache	Fast on-chip memory of the CPU that stores frequently accessed data, saving time to access main memory. It is shared by all cores of the CPU.
Libvirt	Open source Linux package that provides a common set of APIs for creating and managing the VMs on one host, independent of hypervisor. Libvirt uses XML files to define the properties of VM instances, networks, and other devices; the **virsh** command line toolset is provided.
Linux Bridge	Software implementation of a bridge that forwards Ethernet frames based on destination MAC address; bridging is performed by a kernel module controlled by the **brctl** userspace program installed with the `bridge-utils` package. A Linux bridge is supported by various Linux OS.

Table 50: M

Term	Definition
MANO	Management and Orchestration A reference architecture defined by ETSI NFV study group that gives generic names to the functional components of a complete NFV solution.

Table 51: N

Term	Definition
NUMA	Non-Uniform Memory Access An optimization for multi-CPU systems where each processor has its own memory.

Table 52: O

Term	Definition
OpenStack	An open source cloud orchestration platform (VIM) managed by the non-profit OpenStack Foundation, it includes various components such as Nova (compute), Neutron (networking), Glance (image service), Cinder (block storage), and Dashboard (GUI).
OVA	Open Virtual Application A tar archive of an OVF package.
OVF	Open Virtualization Format A DMTF standard format for packaging software to be run in VMs. An OVF package contains an XML-based OVF descriptor file (.ovf), one or more disk images, and other auxiliary files. The OVF descriptor file specifies HW requirements and lists references to other files in the OVF package.
OVS	Open Virtual Switch Open-source software implementation of a multilayer switch, it supports standard bridging protocols, monitoring protocols (s Flow, Netflow), and programmatic extensions (OVSDB). Main OVS components are: userspace daemon (ovs-vswitchd), database daemon (ovsdb-server), and kernel module. The kernel module implements 'fast path' using a flow cache table populated by ovs-vswitchd. The first packet of a flow goes to ovs-switchd for slow-path processing. ovs-vswitchd communicates with the kernel using the netlink protocol, and with ovsdb-server using the OVSDB protocol. Release is 2.3.1 is the latest stable OVS release.

Table 53: P

Term	Definition
Paravirtualization	Technique where the guest and hypervisor coordinate to optimize performance in a virtualized environment.

Table 54: Q

Term	Definition
QCOW2	A virtual disk image format supported by QEMU.
QEMU	Quick Emulator

Term	Definition
	Open source hypervisor typically used with KVM that emulates a broad range of devices including CPUs, disks, PCIe chipsets, USB devices, and serial ports.

Table 55: R

Term	Definition
RHEL	Red Hat Enterprise Linux
RSS	Receive Side Scaling A feature supported by some NICs to classify incoming packets into different receive queues based on 5-tuple flow. Each queue has its own interrupt handled by its own core, which may improve receive throughput.

Table 56: S

Term	Definition
SMBIOS	System Management BIOS Data structures and access methods for storing and reading BIOS information.
SR-IOV	A PCI-SIG standard that allows a PCIe device to appear as multiple separate PCIe devices, allowing multiple VM vNIC interfaces to share the same physical NIC port for communications.

Table 57: U

Term	Definition
Ubuntu	A Debian-based common Linux distribution.
User Space	A block of virtual memory where application software and some drivers execute.

Table 58: V

Term	Definition
VIM	Virtualized Infrastructure Manager A MANO component responsible for managing the NFV infrastructure including compute, storage, and network resources. OpenStack and CloudStack are typical VIMs.

Term	Definition
VirtIO	A paravirtualized I/O framework where buffers are transferred between the guest-side VirtIO driver and the host-side VirtIO driver.
VHost-net	A device driver that runs in the host kernel and performs the virtqueue operations of the host-side VirtIO driver. It delivers higher performance than complete emulation of the host-side VirtIO driver in QEMU (avoids system calls from userspace, supports zero-copy TX operation).
VM	Virtual Machine
VMDK	Virtual Machine Disk The virtual disk image format used by VMware VMs.
VMware vSphere	A virtualization product suite sold by VMware, it includes ESXi hypervisor, vCenter server, vSphere Web client, and advanced feature add-ons including vMotion, High Availability, Fault Tolerance, Distributed Switch, Distributed Resource Scheduler.
VNFM	VNF Manager The MANO component responsible for lifecycle management of VNF instances. Coordinates with EMS/NMS. This role is provided by Cloudband CBAM for vSIM instances.
VXLAN	Virtual eXtensible Local Area Network A method of encapsulating Ethernet frames inside IP/UDP packets to create a tenant-specific overlay network within a data center.

Table 59: X

Term	Definition
x2APIC	Intel programmable interrupt controller.

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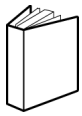

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