

Appendix

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Virtual Machine Requirements

Cisco IOS XRv 9000 Router runs only on a virtual machine. This section describes the virtual machine requirements for the router.

Virtual Machine

A virtual machine (VM) is a software implementation of a computing environment in which an operating system (OS) or program can be installed and run. The VM typically emulates a physical computing environment, but requests for CPU, memory, hard disk, network, and other hardware resources. These are managed by a virtualization layer which translates these requests to the underlying physical hardware.

You can use an Open Virtualization Archive (OVA) file to deploy VM. The OVA file package simplifies the process of deploying a VM by providing a complete definition of the parameters and resource allocation requirements for the new VM.

An OVA file consists of a descriptor (.ovf) file, a storage (.vmdk) file and a manifest (.mf) file.

- ovf file—Descriptor file, an xml file with extension .ovf, which consists of all metadata about the package. It encodes all product details, virtual hardware requirements, and licensing.
- vmdk file—File format that encodes a single virtual disk from a VM.
- mf file—Optional file that stores the SHA key generated during packaging.

You can also install Cisco IOS XRv 9000 Router using an .iso file and manually create the VM in the hypervisor.

Hypervisor Support

A hypervisor enables multiple operating systems to share a single host machine. While each operating system appears to have the dedicated use of the host's processor, memory, and other resources, the hypervisor actually controls and allocates only needed resources to each operating system and ensures that the operating systems (VMs) do not disrupt each other.

Installation of Cisco IOS XRv 9000 Router is supported on selected Type 1 (native, bare metal) hypervisors. Installation is not supported on Type 2 (hosted) hypervisors, such as VMware Fusion, VMware Player, or Virtual Box. The following table lists hypervisor versions supported in the latest Cisco IOS XR Software Release.

Table 1: Support Matrix for Hypervisor Versions

Cisco IOS XR Version	VMWare ESXi	Kernel Based Virtual Machine (KVM)
Release 7.3.1	version 6.7 and newer	Linux KVM based on • Red Hat Enterprise Linux 7, 7.1, 7.2, 7.3 and 7.4 • Ubuntu 14.04.03 LTS • Ubuntu 16.04 LTS • CentOS 7, 7.1, 7.2, 7.3, 7.4 • Openstack 10
Release 24.4.1	Version 7	Linux KVM based on • Ubuntu 20.04 and 24.04

The features available in a hypervisor may differ depending on their type. Not all hypervisor features in a given version may be supported. The hypervisor versions listed are those officially tested and supported by Cisco IOS XRv 9000 Router. See the following sections for more information.

- VMware ESXi Support Information

Hypervisor NIC Requirements

The specific Cisco IOS XR Software Release determines the type and maximum number of NICs supported by hypervisor.

NIC Hot Add/Remove allows you to add and remove NICs without the need to power down the VM in some Cisco IOS XR software versions and hypervisors.

This table lists the supported NICs for each VM instance.

Cisco IOS XR Release	5.4	6.0.x, 6.1.x, 6.2.x, 6.3.x, 6.4.x, 6.5.x	24.1.x, 24.2.x, 24.3.x, 24.4.x
VMware ESXi			

NIC Types Supported	E1000	E1000, VMXNET Generation 3 (VMXNET3) for traffic interfaces only.	Physical NIC:E810 (SRIOV VF only), X710 Virtual NIC:E1000, VMXNet3 (for traffic interfaces only)
Maximum number of NICs per VM instance	11 (one for management, two are reserved, and eight for traffic)	11 (one for management, two are reserved, and eight for traffic)	11 (one for management, two are reserved, and eight for traffic)
NIC Hot Add/Remove Support	No	No	No
Single Root I/O virtualization (SR-IOV) Support	No	No	Yes
Physical OIR Support	No	No	You need to power down the VM, complete the OIR process, and power up the VM.
KVM			
NIC Types Supported	VirtIO, ixgbe/ixgbevf	VirtIO, ixgbe/ixgbevf	Physical NICs (traffic interfaces only):X710 Virtual NICs:e1000, VirtIO
Maximum number of NICs per VM instance	11 (one for management, two are reserved, and eight for traffic)	11 (one for management, two are reserved, and eight for traffic)	11 (one for management, two are reserved, and eight for traffic)
NIC Hot Add/Remove Support	No	No	No
Single Root I/O virtualization (SR-IOV) Support	No	No	No

See the section Installation Requirements for KVM for information on physical NICs supported by the Cisco IOS XRv 9000 Router in KVM environments.

Cisco IOS XRv 9000 Router and Hypervisor Limitations

Cisco IOS XRv 9000 Router limitations are:

- Cisco IOS XRv 9000 Router interface bandwidth defaults to 1GB for all virtualized interfaces, irrespective of the hypervisor's physical NIC bandwidth.
- When a Cisco IOS XRv 9000 Router is using virtualized interfaces or virtual functions (not physical pass-through), and that interface is directly connected to a physical router and the physical router's connecting interface goes down, the change is not reflected on Cisco IOS XRv 9000 Router. This is because the Cisco IOS XRv 9000 Router is actually connected to the hypervisor's vSwitch and the vSwitch uplink port is connected to the physical interface of the router. This is expected behavior.
- Cisco IOS XRv 9000 Router provides an MTU range of 64-9216 bytes but, Cisco advises you to use minimum MTU value of 68 bytes. However, VMWare ESXi vSwitches support maximum frame size of 9000 bytes.

Benefits of Virtualization Using Cisco IOS XRv 9000 Router

Cisco IOS XRv 9000 Router provides these virtualization benefits in a cloud environment.

Table 2: Virtualization Benefits

Benefits	Description
Hardware independence	Because Cisco IOS XRv 9000 Router runs on a virtual machine, it can be supported on any x86 hardware that the virtualization platform supports.
Resources sharing	The resources used by Cisco IOS XRv 9000 Router are managed by the hypervisor, and resources can be shared among VMs. The amount of hardware resources that the VM server allocates to a specific VM can be reallocated to another VM on the server.
Flexibility in deployment	You can easily move a VM from one server to another. Thus, you can move Cisco IOS XRv 9000 Router from a server in one physical location to a server in another physical location without moving any hardware resources.

Cisco IOS XRv 9000 Router Architecture-Differences from Hardware Platforms

Unlike traditional Cisco hardware router platforms, Cisco IOS XRv 9000 Router is a virtual router that runs independently on an x86 machine. As a result, Cisco IOS XRv 9000 Router architecture has unique attributes that differentiate it from hardware-based router platforms.

This table compares some key areas where Cisco IOS XRv 9000 Router differs from the Cisco ASR 9000 Series Router.

Table 3: Cisco IOS XRv 9000 Series Router architecture differences with Cisco ASR 9000 Series Router

Feature	Cisco ASR 9000 Series	Cisco IOS XRv 9000 Series
Distributed routing	Distributed routing system which consists of RP and LCs. LCs are inter-connected through fabric.	Centralized routing system which consists of a combination of RP and LC. Because it is a virtualized platform there are no LCs and no fabric.
Control plane and data plane separation	Control plane and data plane located in the same chassis	Architecturally supports control plane and data plane separation. Supports data plane OIR.
Interface naming	The line interface is hosted on LC. The name of line interface indicates the location of the interface in the chassis. For example, Tenge 0/0/0/0 is the first port of LC slot 0.	The line interface is hosted on RP. The name of the line interface represents the instance of certain type. For example, Tenge 0/0/0/0 is the first instance of the Tenge interface.
Cluster	Supports cluster of ASR9000 routers as one logical router.	Not supported
Satellite interface	Supports satellite interface.	Not supported
Control plane redundancy	Supports active and standby RP	Not supported
Dynamic resource allocation	The resources are fixed	Memory and CPU can be dynamically allocated during installation.
Physical resources	Managed by architecture of the hardware platform	Memory and CPU can be assigned during VM provisioning, but requires a reboot for changes to take effect.
Console types supported	Physical serial port	• VGA console • Serial port [default]
ROMMON	Supported	The Cisco IOS XRv 9000 does not include ROMMON, but uses GRUB to provide similar but more limited functionality.
ISSU	Supported	Not supported
Interface module	Supports installation of pluggable interface module	Not supported
Dynamic addition/deletion of ports	Supported	Supported, but requires VM reload. **Note** Power down the VM before adding or removing interfaces in VMware ESXi and KVM environment.

Support Information for Platforms and Cisco Software Images

Cisco software is packaged in feature sets consisting of software images that support specific platforms. The feature sets available for a specific platform depend on which Cisco software images are included in a release. To identify the set of software images available in a specific release or to find out if a feature is available in a given Cisco IOS XR software image, you can use Cisco Feature Navigator, the Software advisor, or the software release notes.

Cisco Feature Navigator

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS XR software images support a specific software release, feature set, or platform. An account on Cisco.com is not required to access Cisco Feature Navigator.

Software Advisor

To see if a feature is supported by a Cisco IOS XR release, to locate the software document for that feature, or to check the minimum Cisco IOS XR software requirements with your router, Cisco maintains the Software Advisor tool on Cisco.com. You must be a registered user on Cisco.com to access this tool.

Software Release Notes

Cisco IOS XR software release notes provide the following information:

- Platform support
- Memory recommendations
- New features
- Open and resolved severity 1 and 2 caveats

Release notes are intended to be release-specific for the most current release, and the information provided in these documents may not be cumulative in providing information about features that first appeared in previous releases. See Cisco Feature Navigator for cumulative feature information.

For more information, see the Cisco IOS XRv 9000 Router Release Notes page.

VMware ESXi Support Information

Cisco IOS XRv 9000 Router runs on the VMware ESXi hypervisor. You can use the single VMware ESXi hypervisor to run several VMs. Use the VMware vSphere client GUI to create and manage VMs.

The VMware vSphere Client is an application for creating, configuring, and managing VMs on the VMware vCenter Server. Cisco IOS XRv 9000 Router can boot from a virtual disk located on the data store. You can perform basic administration tasks such as start and shutdown Cisco IOS XRv 9000 Router using the VMware vSphere client.

VMware vCenter Server manages the vSphere environment and provides unified management of all the hosts and VMs in the data center from a single console.

This table lists the VMware virtual machine vendor tools supported for the Cisco IOS XRv 9000 Router.

Table 4: VMware Virtual Machine Requirements

Cisco IOS XRv 9000	Supported Tools and Requirements	Supported vSwitch
Release 7.3.1	PC running VMware vSphere Client 5.5, 6.0 Server running VMware ESXi 6.7 and newer version VMware vCenter installation tool	VMware standard and distributed switch
Release 25.2.1	PC running VMware vSphere Client 5.5, 6.0 Server running VMware ESXi 8 VMware vCenter installation tool	VMware standard and distributed switch

Supported VMware Features and Operations

VMware supports various features and operations that allow you to manage your virtual applications and perform operations such as cloning, migration, shutdown and resume.

Some of these operations cause the runtime state of the VM to be saved and then restored upon restarting. If the runtime state includes traffic-related state, then on resumption or replaying the runtime state, additional errors, statistics, or messages maybe displayed on the user console. If the saved state is just configuration driven, you can use these features and operations without a problem.

This table lists the VMware features and operations that are supported on Cisco IOS XRv 9000 Router in the latest Cisco IOS XR Software Releases. For more information about VMware features and operations, see the VMware Documentation.

Table 5: Supported VMware Features and Operations: Storage Options (for Both vCenter Server and vSphere Client)

Entities	Status	Description
Local Storage	Supported	Local storage is in the internal hard disks located inside your ESXi host. Local storage devices do not support sharing across multiple hosts. A datastore on a local storage device can be accessed by only one host.
External Storage Target	Supported	You can deploy Cisco IOS XRv 9000 Router on external storage, that is; a Storage Area Network (SAN).

Entities	Status	Description
Mount or Pass Through of USB Storage	Not supported	You can connect USB sticks to Cisco IOS XRv 9000 Router and use them as storage devices. In VMware ESXi, you need to add a USB controller and then assign the disk devices to Cisco IOS XRv 9000 Router.

The following table lists features that are supported or not-supported in the latest Cisco IOS XR Software Releases.

Table 6: Supported VMware Features and Operations: General Features (for vCenter Server Only)

Entities	Status	Description
Cloning	Supported	Enables cloning a virtual machine or template, or cloning a virtual machine to a template.
Migrating	Not supported	The entire state of the virtual machine as well as its configuration file, if necessary, is moved to the new host even while the data storage remains in the same location on shared storage.
vMotion	Not supported	Enables moving the VM from one physical server to another while the VM remains active.
Template	Supported	Uses templates to create new virtual machines by cloning the template as a virtual machine.

This table lists supported VMware features and operations for both vCenter Server and vSphere Client in the latest Cisco IOS XR Software Releases.

Table 7: Supported VMware Features and Operations: Operations (for Both vCenter Server and vSphere Client)

Entities	Status	Description
Power On	Supported	Powers on the virtual machine and boots the guest operating system if the guest operating system is installed.
Power Off	Supported	Stops the virtual machine until it is powered back. The power off option performs a “hard” power off, which is analogous to pulling the power cable on a physical machine and always works.
Shut Down	Not supported	Shut Down, or “soft” power off, leverages VMware Tools to perform a graceful shutdown of a guest operating system. In certain situations, such as when VMware Tools is not installed or the guest operating system is hung, shut down might not succeed and using the Power off option is necessary.
Suspend	Not supported	Suspends the virtual machine.

Entities	Status	Description
Reset/Restart	Supported	Stops the virtual machine and restarts (reboots) it.
OVF Creation	Supported	An OVF package captures the state of a virtual machine into a self-contained package. You can create the OVF file by exporting it to your local computer.
OVA Creation	Supported	Single file (OVA) to package the OVF template into a single .ova file. This enables distributing the OVF package as a single file, if it needs to be explicitly downloaded from a website or moved around using a USB key.

This table lists supported VMware features and operations: Networking Features in the latest Cisco IOS XR Software Releases

Table 8: Supported VMware Features and Operations: Networking Features

Entities	Status	Description
Custom MAC address	Supported	From both vCenter Server and vSphere Client. Allows you to set up the MAC address manually for a virtual network adapter.
Distributed vSwitch	Supported	From vCenter Server only. A vSphere distributed switch on a vCenter Server data center can handle networking traffic for all associated hosts on the data center.
Distributed Resources Scheduler	Not supported	Provides automatic load balancing across hosts.
NIC Load Balancing	Not supported	From both vCenter Server and vSphere Client. Load balancing and failover policies allow you to determine how network traffic is distributed between adapters and how to reroute traffic if an adapter fails.

Entities	Status	Description
NIC Teaming	Not supported	From both vCenter Server and vSphere Client. Allows you to set up an environment where each virtual switch connects to two uplink adapters that form a NIC team. The NIC teams can then either share the load of traffic between physical and virtual networks among some or all of its members, or provide passive failover in the event of a hardware failure or a network outage. **Note** NIC Teaming can cause a large number of ARP packets to flood Cisco IOS XRv 9000 Router and overload the CPU. To avoid this situation, reduce the number of ARP packets and implement NIC Teaming as Active-Standby rather than Active-Active.
vSwitch	Supported	From both vCenter Server and vSphere Client. A vSwitch is a virtualized version of a Layer 2 physical switch. A vSwitch can route traffic internally between virtual machines and link to external networks. You can use vSwitches to combine the bandwidth of multiple network adapters and balance communications traffic among them. You can also configure a vSwitch to handle a physical NIC failover.

This table lists not-supported VMware features and Operations: High Availability, in the latest Cisco IOS XR Software Releases.

Table 9: Not-supported VMware Features and Operations: High Availability

Entities	Status	Description
VM-Level High Availability	Not supported	To monitor operating system failures, VM-Level High Availability monitors heartbeat information in the VMware High Availability cluster. Failures are detected when no heartbeat is received from a given virtual machine within a user-specified time interval. VM-Level High Availability is enabled by creating a resource pool of VMs using VMware vCenter Server.
Host-Level High Availability	Not supported	To monitor physical servers, an agent on each server maintains a heartbeat with the other servers in the resource pool such that a loss of heartbeat automatically initiates the restart of all affected virtual machines on other servers in the resource pool. Host-Level High Availability is enabled by creating a resource pool of servers or hosts, and enabling high availability in vSphere.

Entities	Status	Description
Fault Tolerance	Not supported	Using high availability, fault tolerance is enabled on the ESXi host. When you enable fault tolerance on the VM running Cisco IOS XRv 9000 Router, a secondary VM on another host in the cluster is created. If the primary host goes down, then the VM on the secondary host will take over as the primary VM for Cisco IOS XRv 9000 Router.

Note The Cisco IOS XRv 9000 Router does not support Active/Standby control plane redundancy.

KVM Support on OpenStack

Cisco IOS XRv 9000 router supports installation of a KVM in the OpenStack environment. The OpenStack support requires the qcow2 installation file available on the Cisco.com download page.

For information on supported OpenStack and Red Hat Enterprise Linux versions, see latest Release Notes for Cisco IOS XRv 9000 Router for Cisco IOS XR Software .

Certificate management for M7

Cisco IOS XRv 9000 router supports these commands to facilitate certificate management for M7 setup.

- **show platform security variable customer dba location** *location*
- **show platform security variable customer dbx location** *location*
- **platform security variable customer [append|update] dba** *file_location* **location** *location*
- **platform security variable customer [append|update] dbx** *file_location* **location** *location*

Use the command **show platform security variable customer [dba|dbx] location** *location* to display the details of customer-provided certificates stored in the security database. You can replace *location* with either a specific node location to narrow down your query or use *all* to retrieve certificate information from all nodes.

Use the command **platform security variable customer [append|update] [dba|dbx]** *file_location* **location** *location* to append or update a customer-provided security variable or certificate from the specified file (*file_location*) to the security database.