# Cisco CSR 1000v Series Cloud Services Router Overview


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# Introduction

### Virtual Routers

The Cisco CSR 1000v Cloud Services Router provides a cloud-based virtual router deployed on a virtual machine (VM) instance on x86 server hardware. It supports a subset of Cisco IOS XE software features and technologies, providing Cisco IOS XE security and switching features on a virtualization platform.

The Cisco Integrated Services Virtual Router (Cisco ISRv) is very similar to the Cisco CSR 1000v. It provides a virtual IOS XE operating system for routing and forwarding on the Enterprise Network Compute System (ENCS) platform.

When the Cisco CSR 1000v is deployed on a VM, the Cisco IOS XE software functions just as if it were deployed on a traditional Cisco hardware platform.

### Features

The Cisco CSR 1000v includes a virtual Route Processor and a virtual Forwarding Processor (FP) as part of its architecture. It supports a subset of Cisco IOS XE software features and technologies.

The Cisco CSR 1000v can provide secure connectivity from an enterprise location, such as a branch office or data center, to the public or private cloud.

The Cisco CSR 1000v is deployed as a virtual machine on a hypervisor. Optionally, you can use a virtual switch (vSwitch), depending on your deployment. You can use selected Cisco equipment for some components. The supported components will depend on your software release.

# Benefits of Virtualization Using the Cisco CSR 1000v Series Cloud Services Router

The Cisco CSR 1000v Series uses the benefits of virtualization in the cloud to provide the following:

- Hardware independence

  Because the Cisco CSR 1000v runs on a virtual machine, it can be supported on any x86 hardware that the virtualization platform supports.

- Sharing of resources

  The resources used by the Cisco CSR 1000v 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 the Cisco CSR 1000v from a server in one physical location to a server in another physical location without moving any hardware resources.

# Software Configuration and Management Using the Cisco IOS XE CLI

You can perform software configuration and management of the Cisco CSR 1000v using the following methods:

- Provision a serial port in the VM and connect to access the Cisco IOS XE CLI commands.
- Use the virtual VGA console or the console on the virtual serial port to access the Cisco IOS XE CLI commands.

**Note** A serial port can be used to manage a Cisco CSR 1000v VM only if the underlying hypervisor supports associating a serial port with a VM. For example, the Citrix XenServer environment does not support serial port association. See your hypervisor documentation for details.

- Use remote SSH/Telnet to access the Cisco IOS XE CLI commands.

The Cisco CSR 1000v also supports management and configuration using the following products:

- Cisco IOS XE REST API
- Cisco Prime Network Services Controller

For more information, see "Management Support", from Managing the Router Using Cisco Configuration Professional, on page 46 onwards.

# Router Interfaces

The Cisco CSR 1000v router interfaces perform the same functionality as those on hardware-based Cisco routers. The Cisco CSR 1000v interfaces function as follows:

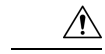
- Interfaces are logically named as the Gigabit Ethernet (GE) interfaces.
- The available interface numbering depends on the Cisco CSR 1000v version.

(Cisco IOS XE Release 3.11S and later, and Denali 16.2 and later) The interface numbering is as follows:

- - Interface port numbering is from 1 and up to the number of interfaces supported.
  - GigabitEthernet interface 0 is no longer supported beginning with this release.
  - You can designate any interface as the management interface. You can change the management interface when deploying the OVA template on first-time installation.

(Cisco IOS XE Release 3.10S and earlier) The interface numbering is as follows:

- - Interface port numbering is from 0 and up to the number of interfaces supported.
  - Gigabit Ethernet interface 0 is reserved for the management interface used for obtaining the licenses and upgrading software.
- At first boot, the Cisco CSR 1000v router interfaces are mapped to the vNIC interfaces on the VM based on the vNIC enumeration to the Cisco CSR 1000v; on subsequent boot, the Cisco CSR 1000v router interfaces are mapped to the vNIC MAC address



**Caution** If upgrading to Cisco IOS XE Release 3.11S from an earlier release, we recommend you update your configuration to remove the GigabitEthernet 0 management interface before upgrading. Because the GigabitEthernet 0 interface is no longer supported beginning with Cisco IOS XE Release 3.11S, you will receive system errors if the upgraded configuration includes this interface.

For more information, see the "Mapping Cisco CSR 1000v Network Interfaces to VM Network Interfaces" section on page 11-1 .

# Virtual Machine Requirements

The Cisco CSR 1000v runs only on a virtual machine. This section describes the virtual machine requirements for the router.

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- Hypervisor Support, on page 4
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## Virtual Machines

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 are managed by a virtualization layer which translates these requests to the underlying physical hardware.

You can deploy an Open Virtualization Archive (OVA) file. 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 which is an xml file with extension .ovf which consists of all the metadata about the package. It encodes all the 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 the Cisco CSR 1000v using an .iso file and manually create the VM in the hypervisor.

For more information, see the "Installation Overview" section on page 3-1 .

# Hypervisor Support

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

### Supported Hypervisor Types

Installation of the Cisco CSR 1000v 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.

### Amazon Cloud Marketplace

The Cisco CSR 1000v is available in the Amazon Cloud Marketplace. (For use with Cisco IOS XE Release 3.11S through 3.16.2S, and Cisco IOS XE Denali 16.3.1 and later.) For more information, see the Cisco CSR 1000V Series Cloud Services Router Deployment Guide for Amazon Web Services.

### Microsoft Azure Marketplace

The Cisco CSR 1000v is available in the Microsoft Azure Marketplace . For more information, see the Cisco CSR 1000V Series Cloud Services Router Deployment Guide for Microsoft Azure .

## Hypervisor Versions for Cisco IOS XE Denali 16.3.1 and Later

The following hypervisors/versions are supported by Cisco CSR 1000v on Cisco IOS XE Denali 16.3.1 and later. If you are using older versions of Cisco IOS XE, see Hypervisor Versions—Cisco IOS XE 3.x, on page 5.

### VMware ESXi

Server 6.0 update2 (instance running vm11)—recommended. F.ully tested and meets performance benchmarks

Server 5.5 update3 (instance running vm10)

Although 5.5 update 3 is supported for Cisco IOS XE Denali 16.3.1 and later, we recommend using VMware ESXi Server 6.0 update 2 instead.

### Kernel Based Virtual Machine (KVM)

RHEL 7.2—recommended

RHEL 7.1

Citrix XenServer

6.5—recommended

6.2

Microsoft Hyper-V

Windows Server 2012-R2, Hyper-V Mgr 6.3.9600.16384—recommended

### Amazon Web Services

C4 and T2 instance types—recommended

C3 instance types—supported (in Cisco IOS XE 3.11 to IOS XE 3.17)

See "Amazon Web Services" in Hypervisor Support, on page 4.

### Microsoft Azure

Standard D2 and Standard D3—recommended

Standard D4—supported

See "Microsoft Azure" in Hypervisor Support, on page 4.

## Hypervisor Versions—Cisco IOS XE 3.x

The following table lists the supported hypervisor versions for older software releases (Cisco IOS XE 3.x).

**Note** For recent hypervisor versions see the *Hypervisor Versions for Cisco IOS XE Denali 16.3.1 and Later* section.

***Table 1: Support Matrix for Hypervisor Versions***

| Cisco CSR 1000v IOS XE Release | VMwareESXi | Citrix XenServer | Kernel Based Virtual Machine (KVM) | Microsoft Hyper-V | Amazon Web Services |
|---|---|---|---|---|---|
| 3.9S | 5.0 | Not supported | Not supported | Not supported | Not supported |
| 3.10S | 5.05.1 | 6.0.2 | • Linux KVM based on Red Hat Enterprise Linux 6.3[1]<br>• Red Hat Enterprise Virtualization 3.1 | Not supported | Not supported |

| Cisco CSR 1000v IOS XE Release | VMwareESXi | Citrix XenServer | Kernel Based Virtual Machine (KVM) | Microsoft Hyper-V | Amazon Web Services |
|---|---|---|---|---|---|
| 3.11S | 5.05.1 | 6.02 | • Linux KVM based on Red Hat Enterprise Linux 6.31<br>• Red Hat Enterprise Virtualization 3.1<br>• Ubuntu 12.04.03 LTS Server 64 Bits[2] | Not supported | Supported |
| 3.12S | 5.05.15.5[3] | 6.1 | • Linux KVM based on Red Hat Enterprise Linux 6.31<br>• Ubuntu 12.04.03 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Supported |
| 3.13S | 5.05.15.5[4] | 6.2 | • Linux KVM based on Red Hat Enterprise Linux 6.31<br>• Ubuntu 12.04.03 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Supported |
| 3.14S | 5.05.15.5[5] | 6.2 | • Linux KVM based on Red Hat Enterprise Linux 6.5<br>• Ubuntu 14.04 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Supported |

| Cisco CSR 1000v IOS XE Release | VMwareESXi | Citrix XenServer | Kernel Based Virtual Machine (KVM) | Microsoft Hyper-V | Amazon Web Services |
|---|---|---|---|---|---|
| 3.15S | 5.05.15.5[6] | 6.2 | • Linux KVM based on Red Hat Enterprise Linux 6.6<br>• Ubuntu 14.04 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Supported |
| 3.16S | 5.05.15.5[7]6.0[8] | 6.2 | • Linux KVM based on Red Hat Enterprise Linux 6.6<br>• Ubuntu 14.04 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Supported until Cisco IOS XE 3.16.2 |
| 3.17S | 5.05.15.56.0 | 6.2 | • Linux KVM based on Red Hat Enterprise Linux 7.1[9]<br>• Ubuntu 14.04 LTS Server 64 Bits 2 | Windows Server 2012 R2 | Not supported |
| For later versions of Cisco IOS XE, see Hypervisor Versions for Cisco IOS XE Denali 16.3.1 and Later, on page 4 | | | | | |

[1] Requires Kernel version 2.6.3.2 and QEMU 0.12.
[2] Requires QEMU-x86_64 version 1.0 (qemu-kvm-1.0), Copyright (c) 2003-2008 Fabrice Bellard.
[3] VMware ESXi 5.5 update 3 is not supported on Cisco IOS XE 3.12S..
[4] VMware ESXi 5.5 update 3 is not supported on Cisco IOS XE 3.13S..
[5] VMware ESXi 5.5 update 3 is not supported on Cisco IOS XE 3.14S.
[6] VMware ESXi 5.5 update 3 is not supported on Cisco IOS XE 3.15S.
[7] VMware ESXi 5.5 update 3 is supported on Cisco IOS XE 3.16.1S and later.
[8] VMware ESXi 6.0 supported on Cisco IOS XE 3.16.1S and later (and 3.17S and later).
[9] Requires Kernel version 3.10.0 and QEMU 1.5.3.

Hypervisor features may differ depending on the hypervisor, and not all features in a given hypervisor version may be supported. The hypervisor versions listed are those officially tested and supported by the Cisco CSR 1000v. See the following sections for more information:

**Note** For information about deploying the Cisco CSR 1000v in an Amazon Web Services environment, see the

**Note** For information about deploying the Cisco CSR 1000v in a Microsoft Azure environment, see the Cisco CSR 1000v Deployment Guide for Microsoft Azure.

## Hypervisor vNIC Requirements

Depending on the Cisco CSR 1000v release version, each of the hypervisors supports different virtual network interface card (vNIC) types. The Cisco CSR 1000v also supports a different maximum number of vNICs depending on the hypervisor. Some versions and hypervisors also support the ability to add and remove vNICs without powering down the VM (for example, vNIC Hot Add/Remove).

The VMXNET3, VIF and Virtio NIC types listed in the table are para-virtualized NICs.

See also Supported I/O Modes and Drivers, on page 24.

Note: PCI Passthrough: enic is not supported in Cisco IOS XE Denali 16.3.1 and higher.

The following sections list the supported vNICs and the minimum and maximum number of vNICs supported for each VM instance. Choose a section, depending on the release of Cisco IOS XE which you are using.

### Hypervisor vNIC Requirements for Cisco IOS XE Gibraltar 17.1 Release

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver), ixgbevf, i40evf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Two-Step Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe, i40evf |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | Yes |
| vNIC Two-Step Hot Remove Support | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Gibraltar 16.10, 16.11 and 16.12 releases

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver), ixgbevf, i40evf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| vNIC Two-Step Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe, i40evf |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Fuji 16.9

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver), ixgbevf, i40evf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| vNIC Two-Step Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe, i40evf |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Fuji 16.8

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver), ixgbevf, i40evf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| vNIC Two-Step Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe, i40evf |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Fuji 16.7

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver), ixgbevf, i40evf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| vNIC Two-Step Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe, i40evf |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | Yes |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| vNIC Two-Step Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Everest 16.6

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver) ixgbevf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Everest 16.5

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver) ixgbevf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Everest 16.4

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe(Intel 10Gb PCI Express NIC Driver) ixgbevf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 4 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE Denali 16.3

| vNIC Requirements for VMware ESXi | Value |
|---|---|
| NIC Types Supported | VMXNET3 ixgbe (Intel 10Gb PCI Express NIC Driver) ixgbevf |
| Max. number of vNICs per VM instance | 10 |
| vNIC Hot Add Support (Intel 10Gb PCI Express NIC Driver) | Yes |
| vNIC Hot Remove Support (Intel 10Gb PCI Express NIC Driver) | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Citrix XenServer | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap) |
| Max. number of vNICs per VM instance | 7 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for KVM | Value |
|---|---|
| NIC Types Supported | Virtio, ixgbevf, ixgbe |
| Max. number of vNICs per VM instance | 26 |
| vNIC Hot Add Support | Yes |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | Yes |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 8 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |

| vNIC Requirements for Microsoft Hyper-V | Value |
|---|---|
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Microsoft Azure | Value |
|---|---|
| NIC Types Supported | NetVSC |
| Max. number of vNICs per VM instance | 4 |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

| vNIC Requirements for Amazon Web Services (AWS) | Value |
|---|---|
| NIC Types Supported | VIF-netfront(pmap), ixgbevf |
| Max. number of vNICs per VM instance | 8 (See http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI) |
| vNIC Hot Add Support | No |
| vNIC Hot Remove Support | No |
| Single Root I/O virtualization (SR-IOV) Support | No |

## Hypervisor vNIC Requirements for Cisco IOS XE 3S Releases

***Table 2: Cisco CSR 1000v vNIC Support for Cisco IOS XE 3S Releases***

| Cisco IOS XE Release: | 3.9S | 3.10S, 3.11S | 3.12S | 3.13S, 3.14S, 3.15S | 3.16S, 3.17S |
|---|---|---|---|---|---|
| VMware ESXi | | | | | |
| NIC Types Supported | VMXNET3 | VMXNET3 | VMXNET3 | VMXNET3 ixgbe (Intel 10Gb PCI Express NIC Driver) | VMXNET3 ixgbe (Intel 10Gb PCI Express NIC Driver) enic |
| Max. number of vNICs per VM instance | 10 | 10 | 10 | 10 | 10 |

| Cisco IOS XE Release: | 3.9S | 3.10S, 3.11S | 3.12S | 3.13S, 3.14S, 3.15S | 3.16S, 3.17S |
|---|---|---|---|---|---|
| vNIC Hot Add/Remove Support(Prior to release 3.15S, vNIC Hot Remove requires reloading the Cisco CSR 1000v. This is applicable only when using the VMXNET3 driver.) | No | Yes | Yes | Yes | Yes |
| Single Root I/O virtualization (SR-IOV) Support | — | — | No | No | No |
| Citrix XenServer | | | | | |
| NIC Types Supported | — | VIF | VIF | VIF ixgbevf<br>ixgbe (Intel 10Gb PCI Express NIC Driver) | VIF ixgbevf<br>ixgbe (Intel 10Gb PCI Express NIC Driver) |
| Max. number of vNICs per VM instance | — | 7 | 7 | 7 | 7 |
| vNIC Hot Add/Remove Support | — | No | No | No | No |
| Single Root I/O virtualization (SR-IOV) Support | — | — | Yes (from release 3.12.1S) | Yes | Yes |
| KVM | | | | | |
| NIC Types Supported | — | Virtio | Virtio | Virtio<br>ixgbevf<br>ixgbe (Intel 10Gb PCI Express NIC Driver) | Virtio<br>ixgbevf<br>ixgbe (Intel 10Gb PCI Express NIC Driver)enic |
| Max. number of vNICs per VM instance | — | 10 | 26 | 26 | 26 |

| Cisco IOS XE Release: | 3.9S | 3.10S, 3.11S | 3.12S | 3.13S, 3.14S, 3.15S | 3.16S, 3.17S |
|---|---|---|---|---|---|
| vNIC Hot Add/Remove Support<br>(Prior to release 3.15S, vNIC Hot Remove requires reloading the Cisco CSR 1000v. This is applicable only when using the Virtio driver) | — | Yes | Yes | Yes | Yes |
| Single Root I/O virtualization (SR-IOV) Support | — | — | Yes (from release 3.12.1S) | Yes (Requires the host hardware to support the Intel VT-d or AMD IOMMU specification. SR-IOV is not supported with Virtual LANs (VLANs)) | Yes(Requires the host hardware to support the Intel VT-d or AMD IOMMU specification. SR-IOV is not supported with Virtual LANs (VLANs)) |
| Microsoft Hyper-V | | | | | |
| NIC Types Supported | — | — | HV NetVSC | HV NetVSC | HV NetVSC |
| Max. number of vNICs per VM instance | — | — | 3 | 3 | 3 |
| vNIC Hot Add/Remove Support | — | — | No | No | No |
| Single Root I/O virtualization (SR-IOV) Support | — | — | No | No | No |
| Amazon Web Services | | | | | |
| NIC Types Supported | — | (For Cisco IOS XE 3.11 and later), aws-vif(pmap) | aws-vif(pmap) | aws-vif(pmap) | (Up until Cisco IOS XE 3.16.2) aws-vif(pmap), aws-ixgbevf(SRIOV) |

| Cisco IOS XE Release: | 3.9S | 3.10S, 3.11S | 3.12S | 3.13S, 3.14S, 3.15S | 3.16S, 3.17S |
|---|---|---|---|---|---|
| Max. number of vNICs per VM instance | — | (For Cisco IOS XE 3.11 to 3.16.2, number depends on instance type. For more information, see the AWS User Guide. | | | |
| vNIC Hot Add/Remove Support | — | No | No | No | No |
| Single Root I/O virtualization (SR-IOV) Support | No | No | Yes | Yes | Yes |
| The vNIC requirements for later versions of Cisco IOS XE are available in the respective sections in this guide. | | | | | |

## Supported I/O Modes and Drivers

The Cisco CSR 1000v operates within a virtualization environment. Data I/O involves communication between one or more vNICs of the guest OS in which the CSR is operating, and the physical NIC accessed by the host OS.

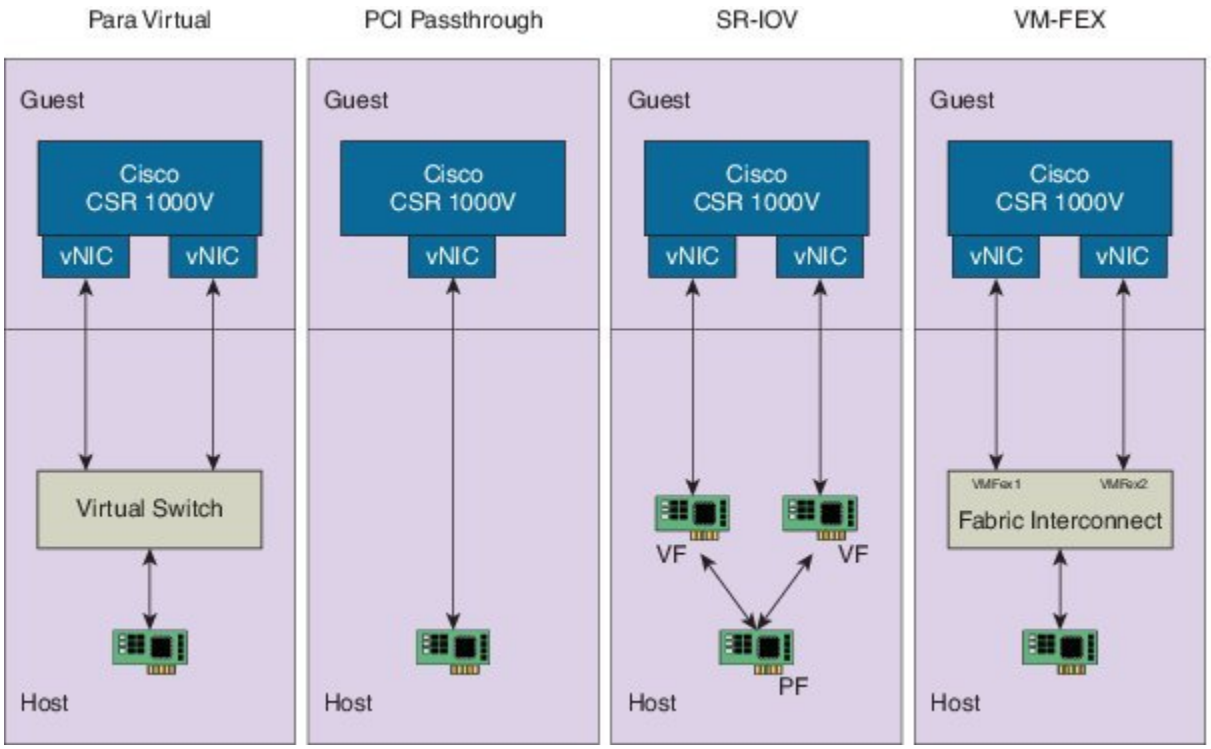
### Modes

Beginning with Cisco IOS XE 3.16S and also including Cisco IOS XE Denali 16.3.1 and later, the Cisco CSR 1000v supports several modes of communication between the vNICs and the physical hardware:

- Para Virtual
- PCI Passthrough
- Single Root I/O Virtualization (SR-IOV)
- Cisco Virtual Machine Fabric Extender (VM-FEX)

The figure below, "Cisco CSR 1000v I/O Routing Between vNIC of Guest OS and Hardware NIC of Host", shows the I/O routing options.

*Figure 1: Cisco CSR 1000v I/O Routing Between vNIC of Guest OS and Hardware NIC of Host*




### Drivers

The following table indicates the drivers required to support various I/O modes.

**Note** See the Hypervisor vNIC Requirements to determine the drivers supported for a particular release. PCI Passthrough: enic is not supported in Cisco IOS XE Denali 16.3.1 and higher.

*Table 3: Driver Support for I/O Modes*

| Mode | Cisco CSR1000v Drivers |
|---|---|
| Para Virtual | • VMXNET3 (ESXi)<br>• Virtio (KVM)<br>• VIF-netfront (Xen)<br>• NetVSC (Hyper-V) |
| PCI Passthrough | • ixgbe (for Intel 10 gig NIC)<br>• enic (for Cisco VIC) |

| Mode | Cisco CSR1000v Drivers |
|---|---|
| SR-IOV | • ixgbevf<br>• i40evf |
| VM-FEX | Only applicable to Cisco VIC<br>There are 2 modes:<br>• ESXi DirectPath IO: VMXNET3<br>• PCI Passthrough: enic |

**Note:** For releases Cisco IOS XE 3.16 or later, and Cisco IOS XE Denali 16.3 or later, the boot up process may take a long time (5 minutes) when using passthrough drivers. This is due to performing DHCP during a PXE boot. This issue can be resolved (as mentioned in resolved caveat CSCvd45286) by turning off rom bar for Ethernet PCI devices in the Cisco CSR 1000v xml file; for example:

```
<hostdev mode='subsystem' type='pci' managed='yes'>
     <source>
       <address domain='0x0000' bus='0x85' slot='0x00' function='0x0'/>
     </source>
     <rom bar='off'/>     <------ Add this line to xml file
     <address type='pci' domain='0x0000' bus='0x00' slot='0x07' function='0x0'/>
</hostdev>
```

### Limitations

**Note** See the Hypervisor vNIC Requirements to determine the drivers supported for a particular release.

The following table describes the limitations that apply to I/O modes.

**Note** PCI Passthrough: enic is not supported in Cisco IOS XE Denali 16.3.1 and higher.

*Table 4: I/O Mode Limitations*

| Mode/Driver | Limitations |
|---|---|
| PCI passthrough (enic) | • Interoperability with another NIC: If enic is connected to other NIC (for example, Intel NIC) and then that NIC is used for other CSR VM (Para virtual or Passthrough), traffic will not pass through if enic is configured with VLAN.<br>• If a VLAN is configured, the other NIC receives a VLAN packet with VLAN id of 0.<br>• Jumbo packet support: In this release, jumbo packet (MTU > 1518) is not supported.<br>• CDP is not supported.<br>• HSRP standby cannot ping the HSRP group address |

| Mode/Driver | Limitations |
|---|---|
| SR-IOV (ixgbevf) | • MTU change: (Intel limitation) First change the VF MTU on the host PF using the **ip link set** command. Then change the corresponding interface MTU on the VM. Otherwise, no traffic will pass. (Intel limitation)<br>• MAC address change: After changing the MAC address, it is necessary to change the MAC address of the VF on the host PF using the **ip link set** command. Otherwise, no traffic will pass. (Intel limitation.)<br>• Maximum VLANs: The maximum number of VLANs supported on PF is 64. Together, all VFs can have a total of 64 VLANs. (Intel limitation.)<br>• Maximum Multicast filtering: Intel VF supports registering a maximum of 30 multicast addresses. (Intel limitation.)<br>• Layer2 Learning: The Intel SR-IOV VF does not support promiscuous mode, so Layer 2 functionality, such as EVC, does not work. (Intel limitation.) |
| SR-IOV (i40evf) | • MTU change: (Intel limitation) First change the VF MTU on the host PF using the **ip link set** command. Then change the corresponding interface MTU on the VM. Otherwise, no traffic will pass. (Intel limitation.)<br>• MAC address change: After changing the MAC address, you must change the MAC address of the VF on the host PF using the **ip link set** command. Otherwise, no traffic will pass. (Intel limitation.)<br>• Maximum VLANs: The maximum number of VLANs supported on PF is 512. Together, all VFs can have a total of 512 VLANs. (Intel limitation.) Per-VF resources are managed by the PF (host) device driver.<br>• Maximum Multicast filtering: The maximum number of mac addresses supported on the PF is 1024. (Intel limitation.) Per-VF resources are managed by the PF (host) device driver.<br>• Layer2 Learning: The Intel SR-IOV VF does not support promiscuous mode, so Layer 2 functionality, such as EVC, does not work. (Intel limitation.)<br>This information about SR-IOV (i40evf) has partly been obtained from Table 7-132. "710 series Versus 82599 Virtualization Support" and Table 7-134. "VF resource allocation" in the Intel Ethernet Controller 710 Series Datasheet. |
| VM-FEX ESXi DirectPath IO (VMXNET3) | • VLAN is not supported in high-performance mode. |

## Cisco CSR 1000v and Hypervisor Limitations

This section describes performance limitations due to how the Cisco CSR 1000v integrates with supported hypervisors.

### Cisco CSR 1000v and Hypervisor Limitations for Cisco IOS XE Denali 16.3.1 and Later

In these releases, the Cisco CSR 1000v does not support the hot removal of interfaces and does not have the ability to modify vNIC MTU.

### Cisco CSR 1000v and Hypervisor Limitations for Cisco IOS XE Denali 16.2

**Note** Cisco IOS XE Denali 16.3.1 and later is recommended instead of Cisco IOS XE Denali 16.2.

### Cisco CSR 1000v and Hypervisor Limitations for Cisco IOS XE Release 3.12S

- When the Cisco CSR 1000v is installed on Microsoft Hyper-V, the interface numbers can change after Microsoft Hyper-V fails over to a new server, or restarts after a live migration.
  - If the server is set to perform ungraceful failover, there is no workaround.
  - If the server is set to perform graceful failover or restart, enter the **clear platform software vnic-if nvtable** command before executing the failover or restart.

This issue is not seen if the maximum number of interfaces is configured.

- When the Cisco CSR 1000v is installed on Microsoft Hyper-V, if you want to configure a VLAN, you must configure the VLAN interfaces on Microsoft Hyper-V using the Hyper-V Power Shell CLI.
- When the Cisco CSR 1000v is installed on Microsoft Hyper-V and an NSF-based virtual hard disk is used, if there is a network connectivity issue between the Cisco CSR 1000v and the NSF server, the Cisco CSR 1000v is unable to use the virtual hard disk even if the network connection is restored. You must reboot the Cisco CSR 1000v to restore access to the virtual hard disk.
- The Microsoft Hyper-V GUI only allows one VLAN to be specified for a Virtual Machine interface. This limits deployments where multiple VLANS for a Virtual Machine interface are used.
- When the MAC address of a Cisco CSR1000v interface is changed from the address assigned by the hypervisor, then traffic to and from external devices is unsuccessful. This occurs even when MAC address spoofing is enabled on the Microsoft Hyper-V vSwitch. Operation of protocols like FHRP, CLNS, and Etherchannel that use their own MAC address may be unsuccessful.
- In Microsoft Hyper-V environments, the following limitations apply when the Windows Power Shell CLI is used to configure VLANs:
  - The power shell CLI commands must be reapplied each time the Cisco CSR1000v is reloaded.
  - When a large AllowedVlanIdList is configured, only lower numbered VLANS may successfully pass traffic. For example, when the following Power Shell CLI command is used:

Set-VMNetworkAdapterVlan -VMName dr-vm-6-1 -Trunk -AllowedVlanIdList 1-2000 -NativeVlanId 0

Only VLANS lower than 300 may successfully pass traffic.

### Cisco CSR 1000v and Hypervisor Limitations for Cisco IOS XE Release 3.10S

- Configuring Network Based Application Recognition (NBAR), or Application Visibility and Control (AVC) support on the Cisco CSR 1000v requires a minimum of 4GB of DRAM on the VM, even when using the one vCPU configuration on the VM.
- On the Cisco CSR 1000v, all the NICs are logically named as the Gigabit Ethernet interface. The Cisco CSR 1000v does support the 10G IXGBE vNIC in passthrough mode; but that interface also is also logically named as a Gigabit Ethernet interface. Note that with emulated devices like VMXNET3/PV/VIRTIO from the hypervisor, the Cisco CSR 1000v is not aware of the underlying interfaces. The vSwitch may be connected to a 10-GB physical NIC or 1-GB physical NICs or multiple NICs (with NIC teaming on the hypervisor) as well.

- The Cisco CSR 1000v supports an MTU range from 1500 to 9216 bytes. However, the maximum MTU supported on your hypervisor version may be lower. The MTU value configured on the Cisco CSR 1000v should not exceed the maximum MTU value supported on the hypervisor.

### Cisco CSR 1000v and Hypervisor Limitations for Cisco IOS XE Release 3.9S

The following are the Cisco CSR 1000v and VMware ESXi limitations for Cisco IOS XE Release 3.9S:

- The Cisco CSR 1000v interface bandwidth defaults to 1 GB, irrespective of the hypervisor's physical NIC bandwidth. The routing protocols (OSPF, EIGRP) use the Cisco CSR 1000v interface bandwidth values for calculating the costs, not the physical NIC bandwidth.
- When a Cisco CSR 1000v interface is directly connected to a physical router, and that physical router's connecting interface goes down, the change is not reflected on the Cisco CSR 1000v. This is because the Cisco CSR 1000v is actually connected to the hypervisor's vSwitch and the vSwitch uplink port is connected to the physical interface of the router. This behavior is expected.
- The Cisco CSR 1000v provides an MTU range from 1500 to 9216 bytes. However, ESXi 5.0 supports only a maximum value of 9000 bytes.

## Server Requirements

The server and processor requirements are different depending on the Cisco CSR 1000v release.

***Table 5: Server Requirements***

| Cisco CSR 1000v Release | Intel | AMD |
|---|---|---|
| Cisco IOS XE Release 3.9S | Intel Nehalem and later generation processors | Not supported |
| Cisco IOS XE Release 3.10S and later | 64-bit processors with VT extensions | 64-bit processors with VT extensions |
| Cisco IOS XE Denali 16.3.1 and later | 64-bit Intel Core2 and later generation processors with VT extensions and support for Streaming SIMD instructions: SSE, SSE2, SSE3 and SSSE3. | The equivalent of 64-bit Intel Core2 and later generation processors with VT extensions and support for Streaming SIMD instructions: SSE, SSE2, SSE3 and SSSE3. |

For more information, see the release notes: http://www.cisco.com/c/en/us/support/routers/cloud-services-router-1000v-series/products-release-notes-list.html.

(For Cisco IOS XE Release 3.9S) the Cisco CSR 1000v uses instructions not supported on Intel pre-Nehalem generation processors. The existence of the required Nehalem or later processor instruction set is determined at boot time. If the required instructions are not present, the following message is displayed:

```
%IOSXEBOOT-4-BOOT_HALT: (rp/0): Halted boot due to missing CPU feature
requirement(s)
```

(For Cisco IOS XE Denali 16.3 and 16.4) the Cisco CSR 1000v uses instructions supported on Intel Core 2 and later generation processors including Streaming SIMD: SSE, SSE2, SSE3 and SSSE3. The existence of the required instruction set is not verified and the deployment of the Cisco CSR 1000v in an environment that does not meet these processor requirements may result in random system reloads.

(For Cisco IOS XE Everest 16.5 and later) the Cisco CSR 1000v uses instructions supported on Intel Core 2 and later generation processors including Streaming SIMD SSE, SSE2, SSE3 and SSSE3. The existence of

the required streaming SIMD instruction sets is determined at boot time. If the required instructions are not present, a message similar to following is displayed:

```
%CPPDRV-3-FATAL_CPU_FEATURE: F0: cpp_driver: CPP0: CPU lacks feature
(Supplemental Streaming SIMD Extensions 3 (SSSE3)). Packet forwarding disabled.
```

# Cisco Software Licensing (CSL)

The Cisco CSR 1000v supports two types of license: Cisco Software Licensing and Cisco Smart Licensing. This section summarizes Cisco Software Licensing. For more details of both licensing methods, see Activating Cisco CSR 1000v Licenses

The Cisco CSR 1000v supports the following types of Cisco Software License, depending on the software release:

- Perpetual and subscription term licenses for 1, 3, and 5 years based on the following attributes:
  - (Cisco IOS XE 3.13S and later, and Denali 16.3.1 and later) Technology packages: **IPBase**, **Security**, **AX** and **APPX** (supported by Cisco Smart Licensing beginning with Cisco IOS XE 3.15S)
  - Maximum supported throughput level for the **AX** package: 10, 25, 50, 100, 250, or 500 Mbps; 1, 2.5, or 5 Gbps
  - Maximum supported throughput level for the **Security** and **APPX** packages: 10, 25, 50, 100, 250, or 500 Mbps; 1, 2.5, or 5 Gbps
  - Maximum supported throughput level for the **IPBase** package: 10, 25, 50, 100, 250, or 500 Mbps; 1, 2.5, 5, or 10 Gbps
- Memory upgrade licenses (selected technology packages and throughput levels only)
- Evaluation licenses (see Evaluation Licenses for Cisco IOS XE 3.13S and Later and Cisco IOS XE Denali 16.3.1 and Later, on page 34).

**Note** Three legacy technology packages—**Standard**, **Advanced**, and **Premium**—were replaced in Cisco IOS XE Release 3.13 with the IPBase, Security, and AX technology packages.

The following table lists the available license types for your release.

***Table 6: Cisco CSR 1000v Software Licenses***

| Cisco CSR 1000v Version | License Type | License Term |
|---|---|---|
| Cisco IOS XE Release 3.9S | (Legacy)<br>Base subscription technology package licenses (**Standard**, **Advanced**, and **Premium**) for the following throughput maximums: 10 Mbps, 25 Mbps, 50 Mbps | • 1, 3, and 5 years<br>• 60-day evaluation license |

| Cisco CSR 1000v Version | License Type | License Term |
|---|---|---|
| Cisco IOS XE Releases 3.10S, 3.11S | (Legacy)<br>Base subscription **Standard** technology package licenses for the following throughput maximums: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps<br>Base subscription **Advanced** and **Premium** technology package licenses for the following throughput maximums: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps<br>Feature Add-on License:<br>• License to add 8 GB of memory with route reflector support.<br>This is available for the Premium or AX packages only. The additional memory is allocated to IOSD processes on the router only. The memory upgrade license does not add available memory on the VM.<br>**Note** Selected licenses are available through a Cisco service representative only. | • 1 and 3 years<br>• Perpetual<br>• 60-day evaluation license |
| Cisco IOS XE Release 3.12S | (Legacy)<br>Base subscription **Standard** technology package licenses for the following throughput maximums: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps, 2.5 Gbps, 5 Gbps<br>Base subscription **Advanced** and **Premium** technology package licenses for the following throughput maximums: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 1 Gbps<br>Feature Add-on License:<br>• License to add 8 GB of memory with route reflector support.<br>This is available for the Premium or AX packages only. The additional memory is allocated to IOSD processes on the router only. The memory upgrade license does not add available memory on the VM.<br>Selected licenses are only available through a Cisco service representative. | • 1 and 3 years<br>• Perpetual<br>• 60-day evaluation license |

| Cisco CSR 1000v Version | License Type | License Term |
|---|---|---|
| Cisco IOS XE Release 3.12.1S | New technology package licenses are supported:<br>• **IPBase** package license, with the same feature set as the Standard package<br>• **Security** package license, with the same feature set as the Advanced package<br>• **AX** package license, with the same feature set as the **Premium** package<br>We recommend using these technology packages for compatibility with future releases. All technology packages support the same throughput maximums as feature sets in earlier releases. | • 1 and 3 years<br>• Perpetual<br>• 60-day evaluation license |
| Cisco IOS XE Releases 3.13S, 3.14S, 3.15S, 3.16S, 3.17<br>Cisco IOS XE Denali 16.3.1 and later | Base subscription **IPBase** technology package licenses for the following maximum throughputs: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps, 2.5 Gbps, 5 Gbps, 10 Gbps.<br>(IPBase replaces the Standard package.)<br>Base subscription **Security** technology package licenses for the following maximum throughputs: 10, 25, 50, 100, 250, or 500 Mbps; 1, 2.5, or 5 Gbps<br>(**Security** replaces the Advanced package.)<br>Base subscription **AX** technology package licenses for the following maximum throughputs: 10, 25, 50, 100, 250, or 500 Mbps; 1 or 2.5 Gbps<br>(**AX** replaces the Premium package.)<br>Base subscription **Application Experience (APPX)** technology package licenses for the following maximum throughputs: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps, 2.5 Gbps, 5 Gbps | • 1 and 3 years<br>• Perpetual<br>• 60-day evaluation license available through Cisco licensing portal |

The supported performance indicates the maximum throughput supported by the Cisco CSR 1000v for the license. If the throughput exceeds the supported performance, the router may experience dropped packets and you will receive notification that the supported performance has been exceeded. The Cisco CSR 1000v uses a performance limiter to regulate the throughput level. For example this applies when using 10 Gbps throughput as part of the IPBase technology package licenses. For more information, see the Configuring an Interface for 10 Gbps Maximum Throughput.

If additional performance is required, an additional license for a separate Cisco CSR 1000v VM must be purchased. The Cisco CSR 1000v supports only one router instance per VM.

The Cisco CSR 1000v software licenses operate as follows:

- Each software license can be used for only one VM.
- You can install more than one license on a VM, but the multiple licenses can only apply to that VM.

- Similar to Cisco hardware products, the software license is node-locked to the unique device identifier (UDI) of that product. The Cisco CSR 1000v generates a Virtual UDI (vUDI) when first installed on the VM, and licenses are node-locked to that vUDI. One license per VM instance is required. Instances that are cloned from a repository must generate a new vUDI.

**Note** When you clone the Cisco CSR 1000v, you will automatically get a new vUDI, and all the licenses from the original VM should be removed.

- You must purchase and install a new technology package license if you want to upgrade or downgrade the technology level. For example, if you have a Premium technology package license and you want to downgrade to the Standard technology package, you must purchase a new Standard technology package license.
- In Cisco IOS XE Release 3.10S, the default license will not enable advanced IPsec features and MPLS.
- The Cisco CSR 1000v does not provide or support Right-to-Use performance licenses.
- You will receive warning notices that the subscription term license will expire beginning eight weeks before license expiration.

The licenses must be activated in order for the Cisco CSR 1000v network ports to provide the supported throughput.

When the Cisco CSR 1000v is first booted, the router operates in evaluation mode, and provides limited feature support and limited throughput. To obtain the full feature support and throughput provided by your license, you must install the license using the **license install** command. The configuration requirements depend on the release version:

- In Cisco IOS XE 3.12S and earlier, to access the features supported in your license, you must enter the **license boot level** command and set it to the level supported by your license. The Cisco CSR 1000v must be rebooted for the new license level to take effect and to have the new license applied.
- In Cisco IOS XE 3.13S and later, the Cisco CSR 1000v first boots up in the AX technology mode by default, so all features in this package are supported. Installing an AX technology license applies the AX license immediately, and the throughput is increased to the maximum throughput of the installed license. Rebooting the router is not required.

If you install a different technology license (IPBase, Security or APPX), the corresponding license boot level command setting is automatically added to the running configuration, but you must reboot the router for the new license technology level to take effect and to have the license applied.

The installed license technology package must match the router's current technology level (as shown with the **show version** command). If the license package does not match the current license level the throughput is limited to 100kbps. To apply a license belonging to a different technology package level, you must update the license level using the license boot level command and reboot the Cisco CSR 1000v for the new license level to take effect.

If the throughput license expires or becomes invalid, the maximum throughput of the router reverts to 2.5 Mbps (Cisco IOS XE 3.12S and earlier), or 100 Kbps (Cisco IOS XE 3.13S and later), upon reload.

The subscription term begins on the day the license is issued.

For more information about license activation, see the Activating Cisco CSR 1000v Licenses.

If you rehost the Cisco CSR 1000v to a VM on another server, the following rules apply:

- You must purchase a new rehost software license that lasts for the period remaining on the original license.
- If the original license was renewed, the rehosted software license will last for the period remaining on the renewed license.
- You have a 60-day grace period to remove the software license from the original server hardware and activate it on the rehosted server hardware.

The Cisco CSR 1000v also supports Cisco License Manager and Cisco License Call Home. For more information about the standard Cisco IOS XE software activation procedure, and information about Cisco License Manager and Cisco License Call Home, see the Software Activation Configuration Guide, Cisco IOS XE Release 3S .

# Evaluation Licenses for Cisco IOS XE 3.13S and Later and Cisco IOS XE Denali 16.3.1 and Later

Evaluation licenses are available to try out Cisco CSR 1000v features. Evaluation licenses are obtained differently depending on the Cisco IOS XE release version. This section describes versions Cisco IOS XE 3.13S or later and Cisco IOS XE Denali 16.3.1 or later.

### Default

Beginning with the Cisco IOS XE 3.13S release, the CSR 1000v boots by default with the following features:

- AX technology package features
- 100 Kbps maximum throughput

### Evaluation License Options

Evaluation licenses valid for 60 days are available at the Cisco licensing portal.

http:/www.cisco.com/go/license

The evaluation license options enable test driving additional technology packages and higher throughputs. (The throughputs available through evaluation licenses are the highest supported throughput levels for the package type.)

- IPBase Technology package, 10 Gbps
- SEC Technology package, 5 Gbps
- APP Technology package, 5 Gbps
- AX Technology package, 2.5 Gbps
- 1000 broadband sessions
- 12 GB memory upgrade

### Testing a Lower Maximum Throughput

To test a lower throughput license type not listed here, use the **platform hardware throughput level MB <throughput>** command to set the throughput to a supported level below that provided by the installed license.

This has the same effect as installing a license for that throughput level. For example, on a CSR 1000v with a 5 Gbps license installed, the following command sets the throughput level to 250 Mbps:

```
platform hardware throughput level MB 250
```

The supported throughput levels are: 10 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps, 2.5 Gbps, 5 Gbps, 10 Gbps

For any additional questions, contact your Cisco sales representative.

**Obtaining an Evaluation License from the Cisco Licensing Portal**

To obtain a 60-day evaluation license for the Cisco CSR 1000v, follow the instructions below.

When the 60-day evaluation license expires, the maximum throughput becomes limited to 100 Kbps upon reload. For more information, see Installing CSL Evaluation Licenses for Cisco IOS XE 3.13S and Later.

**Note** These instructions are subject to change.

**Before you begin**

**Step 1** Navigate to https://www.cisco.com/go/license and log in.

**Step 2** Navigate to the Product License Registration Portal.

**Step 3** On the Product License Registration page, select “Continue to Product License Registration.”

**Step 4** Click “Get Other Licenses” and select “Demo and Evaluation” from the dropdown menu.

**Step 5** In the Product Family section, select “Routers & Switches.” In the Product section, select “Cisco Cloud Services Router 1000v.” Click Next.

**Step 6** Select the desired license type. Enter the UDI Serial number, then click Next to generate the license. You can display the UDI Serial number on your router by entering the **show license udi** command.

# Evaluation Licenses for Cisco IOS XE 3.12S and Earlier

Evaluation licenses are available to try out Cisco CSR 1000v features. Evaluation licenses are obtained differently depending on the IOS XE release version. This section describes versions Cisco IOS XE 3.12S or earlier.

Prior to the Cisco IOS XE 3.13S release, the Cisco CSR 1000v came bundled with a 60-day evaluation license included with the software image, providing:

- Premium technology package features
- 50 Mbps maximum throughput

The license is activated by entering the **license boot level** command and rebooting the router.

When the 60-day evaluation license expires, the maximum throughput reverts to 2.5 Mbps and to the Standard feature set upon reload.

# Cisco Smart Licensing

The Cisco CSR 1000v supports two types of license: Cisco Software Licensing and Cisco Smart Licensing. This section summarizes Cisco Smart Licensing. For details, see Cisco Smart Licensing

Beginning with Cisco IOS XE Release 3.15S, the Cisco CSR 1000v supports activation using Cisco Smart Licensing (CSL). To use Cisco Smart Licensing, first configure the Call Home feature and obtain Cisco Smart Call Home Services. For details, see Cisco Smart Licensing.

The Cisco CSR 1000v supports the following license types (Cisco IOS XE 3.14S and later):

- IPBase
- Security
- AX
- APPX

# Differences Between Cisco CSR 1000v Series and ASR 1000 Series

Unlike traditional Cisco hardware router platforms, the Cisco CSR 1000V Series is a virtual router that runs independently on an x86 machine. As a result, the Cisco CSR 1000v Series architecture has unique attributes that differentiate it from hardware-based router platforms.

For example, the table below lists a comparison of some key areas where the Cisco CSR 1000v Series differs from the Cisco ASR 1000 series routers.

***Table 7: Cisco CSR 1000v Series Architecture Differences with Cisco ASR 1000 Series Routers***

| Feature | Cisco ASR 1000 Series | Cisco CSR 1000v Series |
|---|---|---|
| Hard Disk | Supported. | The Cisco CSR 1000v does not include a hard disk. The software image is stored on bootflash only (8 GB). |
| Physical resources | Managed by architecture of the hardware platform. | Managed by the hypervisor. Physical resources are shared among VMs. |
| Console types supported | Physical serial port. | • Virtual VGA console<br>• Virtual serial port network option (virtual terminal server)<br>• Named pipe option<br>• Physical serial port on the ESXi or KVM host |

| Feature | Cisco ASR 1000 Series | Cisco CSR 1000v Series |
|---|---|---|
| ROMMON | Supported. | The Cisco CSR 1000v does not include ROMMON, but uses GRUB to provide similar but more limited functionality. |
| Break Signal | Supported. | Not supported. |
| Port numbering | See the Cisco ASR1000 documentation . | Gigabit Ethernet x ports only. |
| ISSU | Supports In-Service Software Upgrades (ISSU). | Not supported. |
| Subpackage upgrades | Supports installation of subpackages for specific SPAs and SIP SPAs. | Subpackages not supported. The Cisco CSR 1000v does not support SPAs. |
| Diagnostic mode | Supported. | Not supported. |
| Dynamic addition/deletion of ports | Supported. | Supported. (Requires reload of the VM.) |

# Supported Cisco IOS XE Technologies

The Cisco CSR 1000v Series Cloud Services Router supports selected Cisco IOS XE technologies. The Cisco CSR 1000v supports a more limited set of functionality compared to other router platforms.

The table below lists the major Cisco IOS XE technologies the Cisco CSR 1000V supports. Technologies not listed are not currently supported on the Cisco CSR 1000v. Not all features in a given technology may be supported. To verify support for specific features, use the Cisco Feature Navigator.

The information listed in this table applies only if using the Cisco IOS XE CLI. Support for Cisco IOS XE technologies is more limited in the following scenarios:

- When you deploy Cisco CSR 1000v on Amazon Web Services (AWS). For more information, see Cisco CSR 1000V Series Cloud Services Router Deployment Guide for Amazon Web Services.

  See also the following white paper that includes information about the high availability solution: Deploying the Cisco Cloud Services Router 1000V Series in Amazon AWS: Design and Implementation Guide.

- When you deploy Cisco CSR 1000v on Microsoft Azure. For more information, see Cisco CSR 1000v Deployment Guide for Microsoft Azure.

- When using the Cisco IOS XE REST API to manage the Cisco CSR 1000v. For more information, see Enabling Management by REST API.

  For information about Cisco IOS XE technologies supported by the REST API, see the Cisco IOS XE REST API Management Reference Guide .

- When using Cisco Prime Network Services Controller (PNSC) to remotely manage the Cisco CSR 1000v. For more information on features supported, see Configuring Support for Remote Management by the Cisco Prime Network Services Controller.

**Note** The IPBase, Security, and AX license technology packages became available beginning with Cisco IOS XE 3.12.1.

*Table 8: Cisco IOS XE Technologies Supported on the Cisco CSR 1000v Cloud Services Router*

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| IP: | | | |
| • IPv4 Routing<br>• IPv4 Fragmentation and Reassembly<br>• IPv6 Forwarding | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Addressing Configuration Guide Library, Cisco IOS XE Release 3S<br>• Cisco IOS IP Addressing Services Command Reference |
| • IPv6 Routing | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IPv6 Configuration Guide Library, Cisco IOS XE Release 3S<br>• Cisco IOS IPv6 Command Reference |
| • Generic Routing Encapsulation (GRE) | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Interface and Hardware Component Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Interface and Hardware Component Command Reference |
| • LISP | • Premium | • AX<br>• APPX | • IP Routing: LISP Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Routing: LISP Command Reference |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| • Connectionless mode network service (CLNS) | — | • IPBase<br>• Security<br>• AX<br>• APPX | • ISO CLNS Configuration Guide, Cisco IOS XE Release 3S |
| Basic Routing: | | | |
| • BGP | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Routing: BGP Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Routing: BGP Command Reference |
| • EIGRP | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Routing: EIGRP Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Routing: EIGRP Command Reference |
| • ISIS | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Routing: ISIS Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Routing: ISIS Command Reference |
| • OSPF | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Routing: OSPF Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Routing: OSPF Command Reference |
| • Performance Routing | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Performance Routing Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Performance Routing Command Reference |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| IP Multicast: | | | |
| • IGMP | • Advanced<br>• Premium | • Security<br>• AX | • IP Multicast: IGMP Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Multicast Command Reference |
| • PIM | • Advanced<br>• Premium | • Security<br>• AX | • IP Multicast: PIM Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Multicast Command Reference |
| IP Switching: | | | |
| • Cisco Express Forwarding | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Switching Cisco Express Forwarding Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Switching Command Reference |
| Wide Area Networking: | | | |
| • OTV<br>(Supported beginning in Cisco IOS XE 3.10S.) | • Premium | • AX<br>• APPX | • Wide-Area Networking Configuration Guide: Overlay Transport Virtualization, Cisco IOS XE Release 3S<br>• Cisco IOS Wide-Area Networking Command Reference |
| • VxLAN<br>(Supported beginning in Cisco IOS XE 3.11S.) | • Premium | • AX<br>• APPX | • Cisco CSR 1000V VxLAN Support |
| • WCCPv2 | • Premium | • AX<br>• APPX | • IP Application Services Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Application Services Command Reference |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| VPN: | | | |
| • IPsec VPN | • Advanced<br>• Premium | • Security<br>• AX | • Secure Connectivity Configuration Guide Library, Cisco IOS XE Release 3S |
| • DMVPN | • Advanced<br>• Premium | • Security<br>• AX | • Dynamic Multipoint VPN Configuration Guide, Cisco IOS XE Release 3S |
| • Easy VPN | • Advanced<br>• Premium | • Security<br>• AX | • Easy VPN Configuration Guide, Cisco IOS XE Release 3S |
| • FlexVPN | • Advanced<br>• Premium | • Security<br>• AX | • FlexVPN and Internet Key Exchange Version 2 Configuration Guide, Cisco IOS XE Release 3S |
| • GETVPN<br><br>(Supported beginning in Cisco IOS XE Everest 16.6.1) | • Advanced<br>• Premium | • Security<br>• AX | • Cisco Group Encrypted Transport VPN Configuration Guide, Cisco IOS XE Release 3S |
| • SSL VPN<br><br>(Supported beginning in Cisco IOS XE 3.12.1S.) | • Advanced<br>• Premium | • Security<br>• AX | • SSL VPN Configuration Guide, Cisco IOS XE Release 3S |
| MPLS: | | | |
| • MPLS | • Premium | • APPX<br>• AX | See the Multiprotocol Label Switching (MPLS) guides in the CSR 1000v Configuration Guides. |
| • EoMPLS | • Premium | • APPX<br>• AX | • See the Multiprotocol Label Switching (MPLS) guides in the CSR 1000v Configuration Guides. |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| • VRF | • Advanced<br>• Premium | • IPBase | • MPLS: Layer 3 VPNs Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Multiprotocol Label Switching Command Reference |
| • VPLS<br>(Supported beginning in Cisco IOS XE 3.10S.) | • Premium | • APPX<br>• AX | • MPLS Layer 2 VPNs Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Multiprotocol Label Switching Command Reference |
| Network Management: | | | |
| • SNMP | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • SNMP Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Network Management Command Reference |
| • Flexible NetFlow | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Flexible NetFlow Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Flexible NetFlow Command Reference |
| • Secure Shell (SSH) | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Secure Shell Configuration Guide, Cisco IOS XE Release 3S |
| QoS: | | | |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| • QoS | • Standard (Cisco IOS XE 3.12S)<br>• Advanced(Cisco IOS XE 3.10S and later)<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Quality of Service Solutions Configuration Guide Library, Cisco IOS XE Release 3S<br>• Cisco IOS Quality of Service Solutions Command Reference |
| Services: | | | |
| • NAT | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • IP Addressing: NAT Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP Addressing Services Command Reference |
| Access Control: | | | |
| • AAA | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Authentication Authorization and Accounting Configuration Guide, Cisco IOS XE Release 3S |
| • Access Control Lists | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • Securing the Data Plane Configuration Guide Library, Cisco IOS XE Release 3S |
| • IP SLA | • Premium | • AX<br>• APPX | • IP SLAs Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS IP SLAs Command Reference |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| • RADIUS | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • RADIUS Configuration Guide Cisco IOS XE Release 3S |
| • TACACS+ | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • TACACS+ Configuration Guide Cisco IOS XE Release 3S |
| • Layer3 Firewall | • Advanced<br>• Premium | • Security<br>• AX | • MPLS: Layer 3 VPNs Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Multiprotocol Label Switching Command Reference |
| • Zone-Based Firewall | • Advanced<br>• Premium | • Security<br>• AX | • Security Configuration Guide: Zone-Based Policy Firewall, Cisco IOS XE Release 3S |
| • Zone-Based Firewall Multi-tenancy for Cloud Integrated Security Solution<br>(Supported starting with Cisco IOS XE Denali 16.4.1.) | • NA | • Advanced<br>• Premium | • Cloud Integrated Security Solution Guide |
| Application Services: | | | |
| • Application Visibility and Control (AVC) | • Premium | • AX<br>• APPX | • Application Visibility and Control Configuration Guide |

| Technologies Supported | Technology Package Licenses Supported in Cisco IOS XE Releases 3.12S and Earlier (Legacy) | Technology Package Licenses Supported in Cisco IOS XE Releases 3.13S and Later, and Denali 16.3.1 and Later | See the Following Documentation: |
|---|---|---|---|
| • NBAR2 | • Premium | • AX<br>• APPX | • NBAR Protocol Library, Cisco IOS XE Release 3S<br>• QoS: NBAR Configuration Guide, Cisco IOS XE Release 3S<br><br>Download the NBAR2 protocol pack for your release on the Cisco CSR 1000V software download page. For more information, see the NBAR2 Protocol Library. |
| Broadband: | | | |
| • Broadband Network Gateway<br><br>(Supported beginning in Cisco IOS XE 3.13S.) | NA | • APPX<br><br>(Requires broadband add-on feature license (L-CSR-BB-1K=). | • Broadband Access Aggregation and DSL Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Broadband Access Aggregation and DSL Command Reference |
| • Intelligent Services Gateway<br><br>(Supported beginning in Cisco IOS XE 3.13S.) | NA | • APPX<br><br>(Requires broadband add-on feature license (L-CSR-BB-1K=). | • Intelligent Services Gateway Configuration Guide, Cisco IOS XE Release 3S<br>• Cisco IOS Intelligent Services Gateway Command Reference |
| Redundancy: | | | |
| • HSRP | • Standard<br>• Advanced<br>• Premium | • IPBase<br>• Security<br>• AX<br>• APPX | • First Hop Redundancy Protocols Configuration Guide, Cisco IOS XE Release 3S |
| WAAS: | | | |
| • Integrated AppNav-XE | • Premium | • AX<br>• APPX | • Configuration Guide for AppNav-XE for Cisco Cloud Services Router 1000V Series |

# Management Support

## Managing the Router Using Cisco Configuration Professional

Beginning with Cisco IOS XE Release 3.12S, the Cisco CSR 1000v supports managing the router using Cisco Configuration Professional. The minimum version required is Cisco Configuration Professional 2.8. For more information, see the Cisco Configuration Professional documentation.

## Managing the Router Using the Cisco IOS XE REST API

Beginning with Cisco IOS XE Release 3.10S, and including Cisco IOS XE Denali 16.2, a REST API is available as an alternative method for managing the Cisco CSR 1000v router.

**Note** The Cisco CSR 1000v currently does not fully support IPv6 for the REST API.

The following requirements apply to the Cisco IOS XE REST API (formerly called the Cisco CSR 1000v REST API):

- The Cisco IOS XE REST API supports only selected features and technologies compared to the Cisco IOS XE command-line interface.
- The REST API is supported over HTTPS only.
- (Cisco IOS XE releases 3.13.2, 3.14.1, 3.15 and later, and Denali 16.3.1 and later) REST API (and PNSC) support is limited to TLS.
- The Cisco CSR 1000v Amazon Machine Image (AMI) does not support management of the router using the REST API.

For more information about configuring the router to support management using the REST API, see Enabling Management by REST API. For more information about using the Cisco IOS XE REST API, see the Cisco IOS XE REST API Management Reference Guide .

## Managing the Router Using Cisco Prime Network Services Controller

Beginning with Cisco IOS XE Release 3.11S, you can use the Cisco Prime Network Services Controller to provision, manage, and monitor the Cisco CSR 1000v. Cisco Prime Network Services Controller can be used to streamline configuration when you are provisioning and managing many Cisco CSR 1000v VMs.

If deploying the Cisco CSR 1000v on ESXi, support for remote management using PNSC can be configured while deploying the OVA template. If deploying the Cisco CSR 1000v on other hypervisors, or if launching the Cisco CSR 1000v on an AWS instance, the PNSC configuration settings are performed using the Cisco IOS CLI.

For more information about remote management using Cisco Prime Network Services Controller, see:

Configuring the Management Interface to Support Remote Management by the Cisco Prime Network Services Controller

Enabling Remote Management by the Cisco Prime Network Services Controller Host

Disabling Remote Management by the Cisco Prime Network Services Controller Host

For more information about configuring Cisco Prime Network Services Controller and using the GUI for remote management, see the following documentation:

- Cisco Prime Network Services Controller Quick Start Guide
- Cisco Prime Network Services Controller User Guide

The table below lists the Cisco Prime Network Services Controller versions that are compatible with the Cisco CSR 1000v.

***Table 9: Cisco CSR 1000v Compatibility with Cisco Prime Network Services Controller***

| Cisco IOS XE Release for Cisco CSR 1000V | Cisco Prime Network Services Controller Version | Hypervisors Supported for Implementation | Feature Support |
|---|---|---|---|
| Cisco IOS XE Release 3.11S | Version 3.2.1Version 3.2.2 | • VMware ESXi<br>• KVM | Baseline features:<br>• Hostname, DNS, User Credentials<br>• Interfaces: cloud-facing, external-facing<br>• Interface types: Gigabit Ethernet, loopback<br>• NAT, NTP<br>• ACL, Firewall<br>• Routing: BGP, OSPF, static routes<br>• Syslog |
| Cisco IOS XE Release 3.12S and later | Version 3.2.1<br>Version 3.2.2 | • VMware ESXi<br>• KVM | Features added in this release:<br>• Sub-interface<br>• IPSec VPN<br>• DHCP Server/Relay<br>• Routing: EIGRP<br>• SNMP<br>• NAT: Overload, PAT<br>• VPN Tunnel interface<br>• Site-to-Site VPN |

# Cisco Unified Computing System (UCS) Products

*Table 10: Cisco CSR 1000v Compatibility with Cisco UCS Servers*

| | |
|---|---|
| Cisco IOS XE Release 3.9S and later: | |
| Cisco Unified Computing System (UCS) Products | The Cisco UCS server requirements are:<br>• VMware-certified<br>• 4 or more cores configured<br>• 6 GB or more memory<br>• VMware vCenter or standalone VMware vSphere client installed to manage the ESXi server<br>See http://www.cisco.com/en/US/products/ps10477/prod_technical_reference_list.html to determine the UCS hardware and software that is compatible with the supported hypervisors. |

# Finding 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 XE software image, you can use Cisco Feature Navigator, the Software Advisor, or the Cisco CSR 1000v Release Notes.

## Using 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 XE software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

## Using the Software Advisor

To see if a feature is supported by a Cisco IOS XE release, to locate the software document for that feature, or to check the minimum Cisco IOS XE software requirements with your router, Cisco maintains the Software Advisor tool on Cisco.com at:

http://tools.cisco.com/Support/Fusion/FusionHome.do

You must be a registered user on Cisco.com to access this tool.

# Using the Software Release Notes

Cisco IOS XE 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 http://www.cisco.com/c/en/us/support/routers/cloud-services-router-1000v-series/products-release-notes-list.html.