Installation Requirements

This section provides general guidelines and minimum requirements for individual components installed on a single server, unless otherwise specified.

This section contains the following topics:

Virtual Machine (VM) Requirements

You can deploy Cisco Crosswork Optimization Engine as a VM on a host that meets the following minimum requirements.

Table 1:

Requirement	Description
Hypervisor and vCenter	• VMware ESXi 6.5 Update 2d or later. • VMware vCenter Server 6.5 Update 2d or later.
Memory	96 GB
Storage	1 TB, but see the volume requirements displayed in the VMware GUI when configuring disk space, as shown in Install Cisco Crosswork Optimization Engine. Thin provisioning is recommended, but the provisioning choice will not affect solution performance. Solid state drives are preferred over hard disk drives. If using HDD, minimum speed should be 10,000 RPM.

Requirement	Description
vCPU	16 vCPUs
Interfaces	Dual virtual interfaces in the VM: • One virtual interface for management network traffic, including SSH and GUI access to the VM. The DNS and NTP servers, and the default gateway, must be reachable via this interface. • One virtual interface for data traffic. Managed devices and providers must be reachable via this interface (routable). The installation can also be performed using a single virtual interface. Both management and data traffic will flow though this single interface. Cisco recommends dual interfaces. If there are two interfaces, telemetry configuration will use the data interface IP to configure on devices.
IP Addresses	Two IPv4 addresses: One public IP for the management network virtual interface and one public or private IP for the data network virtual interface. The DNS and NTP servers, and the default gateway, must be reachable via the management network IP address. The data network IP address must be able to reach managed devices, and be reachable by the servers of the providers you plan to use. You will only need one IPv4 address if you plan to use a single virtual interface, which Cisco does not recommend.
NTP Servers	The IPv4 addresses or host names of the NTP servers you plan to use. If you want to enter multiple NTP servers, separate them with spaces. These should be the same NTP servers you use to synchronize devices, clients, and servers across your network.
DNS Servers	The IPv4 addresses of the DNS servers you plan to use. These should be the same DNS servers you use to resolve host names across your network. Confirm that the DNS servers are reachable from Cisco Crosswork Optimization Engine after configuration or installation will fail.
DNS Search Domain	The search domain you want to use with the DNS servers (for example, `cisco.com`). You can only have one search domain.

Requirement	Description
Private Key	This is a 32-byte Unicode text string, used to encrypt the critical inventory database. For example: **CrossworkEncryptInventory123456!**. Make sure it is a key you can remember.
Disclaimer	The text of the legal disclaimer displayed to clients accessing the VM via the command line. Consult your organization's IT or legal department for the content of this text.

Important Notes

- The VM runs Ubuntu Server 18.04.1 (ubuntu-18.04.1-server).

- Kubernetes runs within the Cisco Crosswork Optimization Engine VM and uses Docker for containerization. The number of containers varies as applications are added or deleted.

Cisco IOS XR Software Version Support

Cisco Crosswork Optimization Engine supports the following Cisco IOS XR software versions.

Table 2: Cisco IOS XR Software Versions

Platform	PCC/Headend Software Version	SR-PCE Software Version	Telemetry
Cisco ASR 9000	• 6.5.3 + SMU (CSCvp83001) • 6.6.2 + SMU (CSCvq82324)	6.6.2 + SMU (CSCvq82324)	• Encoding—KVGPB • Transport—TCP
Cisco XRv 9000[1]	• 6.5.3 + SMU (CSCvp83001) • 6.6.2 + SMU (CSCvq82324)		
Cisco NCS 5500 series[2]	6.6.25 + SMU (CSCvq82324)		

[1] Segment Routing Traffic Matrix (SRTM) not supported
[2] SRTM not supported

Note Software Maintenance Updates (SMUs) are required for both PCC/Headend and SR-PCE versions indicated in the table. To download the Cisco IOS XR versions and updates, see the IOS XR Software Maintenance Updates (SMUs) document. The correct SMUs to download will have the associated bug ID number appended to the filename. For example: **asr9k-x64-6.6.2.CSCvq82324.tar**.

Cisco NSO and NED Requirements

Software/Driver	Version
Cisco Network Services Orchestrator (Cisco NSO)	4.4.5.3
Cisco IOS XR Network Element Driver (NED)	6.6.1
Cisco IOS Network Element Driver	5.9.2

Device and SR Policy Scale Support

The following number of devices and SR policies are supported.

Table 3: Device and SR Policy Scale Support

Feature	Devices	SR Policies
SR Policy Visualization and Provisioning	1,000 nodes 10,000 interfaces	2,000 SR policies **Note** This encompasses *all* SR policies (including those created by Function Packs).
Topology Visualization	5,000 nodes	Not applicable

IGP and Inter-AS Support

The following table captures the IGP and inter-AS features that Cisco Crosswork Optimization Engine supports.

Table 4: IGP and Inter-AS Support

Feature	OSPF	IS-IS	Inter-AS
Topology Visualization (including SR Policies)	Supported	Supported	Egress Peer Engineering (EPE) is limited to EPE adjacency segment IDs (SIDs)
SR Policy Creation, Modification, and Deletion	Supported	Supported	EPE is limited to EPE adjacency SIDs
Bandwidth on Demand Function Pack	Supported	Supported	Not Supported
Bandwidth Optimization Function Pack	Only single area is supported	Only single level is supported	Not Supported

Supported Web Browsers

This version of Cisco Crosswork Optimization Engine supports the web browsers shown in the table below.

Recommended display resolution: 1600 x 900 pixels or higher (minimum: 1366 x 768).

Browser	Version
Google Chrome (recommended)	75 or later
Mozilla Firefox	60 or later

Ports Used

As a general policy, any ports that are not needed should be disabled. You need to know which ports are enabled, and then decide which of those ports may be safely disabled without disrupting the normal functioning of Cisco Crosswork Optimization Engine. You can decide by listing the ports that are open and comparing it with the list of ports that are needed for Cisco Crosswork Optimization Engine. To view a list of all open listening ports, log in as a Linux CLI admin user and run the **netstat -aln** command.

In addition to the ports listed in the following tables: All client desktops accessing geographical map information in the Cisco Crosswork Optimization Engine topology maps must be able to reach the mapbox.com map data URL directly, via the standard HTTPS port 443. Similar guidance may apply if you choose a different map data provider, as explained in "Configure Geographical Map Settings" in the *Cisco Crosswork Optimization Engine User Guide* .

The following table lists the external ports that are open on the Cisco Crosswork Optimization Engine VM.

Table 5: External Ports That Are Open on the VM

Port	Protocol	Usage
22	TCP	Remote SSH traffic
323	UDP	Network Time Protocol (NTP) listener
30162	UDP	SNMP trap port to receive trap notifications
30603	TCP	User interface (NGINX server listens for secure connections on port 443)
31500:31502	TCP, UDP	MDT collector

The following table lists the destination ports on external devices that may be protected by a firewall. Cisco Crosswork Optimization Engine uses these ports to connect to network devices. You must open the required ports to allow Cisco Crosswork Optimization Engine to connect to these devices.

Table 6: Destination Ports Used by Cisco Crosswork Network Automation

Port	Protocol	Usage
7	TCP/UDP	Discover endpoints using ICMP
22	TCP	Initiate SSH connections with managed devices
23	TCP	Communicate with managed devices using Telnet
53	TCP/UDP	Connect to DNS
123	UDP	Network Time Protocol (NTP)
161	UDP	Poll using SNMP
830	TCP	Initiate NETCONF

Collection Modes

You may choose one of the following modes for device management collection during installation.

Single Collection Mode

In single collection mode, only one MDT collector is used for devices. Consider the following information when choosing single collection mode:

- The maximum number of MDT capable devices that can be managed is 500.

- If you do not plan to use Cisco NSO, choose single collection mode. Devices cannot be mapped to Cisco NSO.

- Telemetry configuration will not be automatically pushed by Cisco Crosswork Optimization Engine to devices. You must push the telemetry configuration to devices. See the "Prerequisites for Device Telemetry" topic in the *Cisco Crosswork Optimization Engine User Guide*.

- The default MDT collector port is 31500.

- Changing from single to multiple collection mode requires help from a Cisco representative.

Multiple Collection Mode

In multiple collection mode, multiple MDT collectors are enabled depending on the number of MDT devices that are added. For the first 500 devices, default 31500 ports will be configured to reach the first MDT collector. The next 500 devices, 31503 ports will be configured to reach the second collector, and so on.

Note If devices are deleted and then added to Cisco Crosswork Optimization Engine again, then original port assignments will change.

Consider the following information when choosing multiple collection mode:

- More than 500 MDT capable devices can be managed.

• You must add a Cisco NSO provider and map devices to it.

Collection Modes