



# Configuring NTP

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This chapter describes how to configure the Network Time Protocol (NTP) on Cisco NX-OS devices.

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## About NTP

The Network Time Protocol (NTP) synchronizes the time of day among a set of distributed time servers and clients so that you can correlate events when you receive system logs and other time-specific events from multiple network devices. NTP uses the User Datagram Protocol (UDP) as its transport protocol. All NTP communications use Coordinated Universal Time (UTC).

An NTP server usually receives its time from an authoritative time source, such as a radio clock or an atomic clock attached to a time server, and then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two machines to within a millisecond of each other.

NTP uses a stratum to describe the distance between a network device and an authoritative time source:

- A stratum 1 time server is directly attached to an authoritative time source (such as a radio or atomic clock or a GPS time source).
- A stratum 2 NTP server receives its time through NTP from a stratum 1 time server.

Before synchronizing, NTP compares the time reported by several network devices and does not synchronize with one that is significantly different, even if it is a stratum 1. Because Cisco NX-OS cannot connect to a radio or atomic clock and act as a stratum 1 server, we recommend that you use the public NTP servers available on the Internet. If the network is isolated from the Internet, Cisco NX-OS allows you to configure the time as though it were synchronized through NTP, even though it was not.



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**Note** You can create NTP peer relationships to designate the time-serving hosts that you want your network device to consider synchronizing with and to keep accurate time if a server failure occurs.

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The time kept on a device is a critical resource, so we strongly recommend that you use the security features of NTP to avoid the accidental or malicious setting of incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

## NTP Associations

An NTP association can be one of the following:

- A peer association—The device can either synchronize to another device or allow another device to synchronize to it.
- A server association—The device synchronizes to a server.

You need to configure only one end of an association. The other device can automatically establish the association.

## NTP as a Time Server

The Cisco NX-OS device can use NTP to distribute time. Other devices can configure it as a time server. You can also configure the device to act as an authoritative NTP server, enabling it to distribute time even when it is not synchronized to an outside time source.

## Clock Manager

Clocks are resources that need to be shared across different processes. Multiple time synchronization protocols, such as NTP, might be running in the system.

The clock manager allows you to specify the protocol to control the various clocks in the system. Once you specify the protocol, the system clock starts updating. For information on configuring the clock manager, see the [Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide](#).

## High Availability

Stateless restarts are supported for NTP. After a reboot or a supervisor switchover, the running configuration is applied. For more information on high availability, see the [Cisco Nexus 9000 Series NX-OS High Availability and Redundancy Guide](#).

You can configure NTP peers to provide redundancy in case an NTP server fails.

## Virtualization Support

NTP recognizes virtual routing and forwarding (VRF) instances. NTP uses the default VRF if you do not configure a specific VRF for the NTP server and NTP peer. See the [Cisco Nexus 9000 Series NX-OS Unicast Routing Configuration Guide](#) for more information about VRFs.

## Prerequisites for NTP

NTP has the following prerequisites:

- To configure NTP, you must have connectivity to at least one server that is running NTP.

## Guidelines and Limitations for NTP

NTP has the following configuration guidelines and limitations:

- NTP server functionality is supported.
- You should have a peer association with another device only when you are sure that your clock is reliable (which means that you are a client of a reliable NTP server).
- A peer configured alone takes on the role of a server and should be used as a backup. If you have two servers, you can configure several devices to point to one server and the remaining devices to point to the other server. You can then configure a peer association between these two servers to create a more reliable NTP configuration.
- If you have only one server, you should configure all the devices as clients to that server.
- You can configure up to 64 NTP entities (servers and peers).
- If you configure NTP in a VRF, ensure that the NTP server and peers can reach each other through the configured VRFs.
- You must manually distribute NTP authentication keys on the NTP server and Cisco NX-OS devices across the network.
- If you are using the switch as an edge device and want to use NTP, Cisco recommends using the **ntp access-group** command and filtering NTP only to the required edge devices.
- If the system has been configured with the **ntp passive**, **ntp broadcast client**, or **ntp multicast client** commands, when NTP receives an incoming symmetric active, broadcast, or multicast packet, it can set up an ephemeral peer association in order to synchronize with the sender.
- If the **ntp authenticate** command is specified, when a symmetric active, broadcast, or multicast packet is received, the system does not synchronize to the peer unless the packet carries one of the authentication keys specified in the **ntp trusted-key** global configuration command.
- To prevent synchronization with unauthorized network hosts, the **ntp authenticate** command should be specified any time the **ntp passive**, **ntp broadcast client**, or **ntp multicast client** command has been specified unless other measures, such as the **ntp access-group** command, have been taken to prevent unauthorized hosts from communicating with the NTP service on the device.
- The **ntp authenticate** command does not authenticate peer associations configured via the **ntp server** and **ntp peer** configuration commands. To authenticate the **ntp server** and **ntp peer** associations, specify the **key** keyword.
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## Default Settings for NTP

The following table lists the default settings for NTP parameters.

Parameters	Default
NTP	Enabled
NTP authentication	Disabled
NTP access	Enabled
NTP logging	Disabled

## Configuring NTP



**Note** Be aware that the Cisco NX-OS commands for this feature may differ from those commands used in Cisco IOS.

## Enabling or Disabling NTP

You can enable or disable NTP. NTP is enabled by default.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] feature ntp</b>  <b>Example:</b> switch(config)# feature ntp	Enables or disables NTP.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Configuring the Device as an Authoritative NTP Server

You can configure the device to act as an authoritative NTP server, enabling it to distribute time even when it is not synchronized to an existing time server.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] ntp master [stratum]</b> <b>Example:</b> switch(config)# ntp master	Configures the device as an authoritative NTP server.  You can specify a different stratum level from which NTP clients get their time synchronized. The range is from 1 to 15.
<b>Step 3</b>	(Optional) <b>show running-config ntp</b> <b>Example:</b> switch(config)# show running-config ntp	Displays the NTP configuration.
<b>Step 4</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Configuring an NTP Server and Peer

You can configure an NTP server and peer.

**Before you begin**

Make sure you know the IP address or Domain Name System (DNS) names of your NTP server and its peers.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] ntp server {ip-address   ipv6-address   dns-name} [key key-id] [maxpoll max-poll] [minpoll min-poll] [prefer] [use-vrf vrf-name]</b> <b>Example:</b> switch(config)# ntp server 192.0.2.10	Forms an association with a server.  Use the <b>key</b> keyword to configure a key to be used while communicating with the NTP server. The range for the <i>key-id</i> argument is from 1 to 65535.  Use the <b>maxpoll</b> and <b>minpoll</b> keywords to configure the maximum and minimum intervals in which to poll a server. The range for the

	Command or Action	Purpose
		<p><i>max-poll</i> and <i>min-poll</i> arguments is from 4 to 16 (configured as powers of 2, so effectively 16 to 65536 seconds), and the default values are 6 and 4, respectively (<i>maxpoll</i> default = 64 seconds, <i>minpoll</i> default = 16 seconds).</p> <p>Use the <b>prefer</b> keyword to make this server the preferred NTP server for the device.</p> <p>Use the <b>use-vrf</b> keyword to configure the NTP server to communicate over the specified VRF. The <i>vrf-name</i> argument can be <b>default</b>, <b>management</b>, or any case-sensitive, alphanumeric string up to 32 characters.</p> <p><b>Note</b> If you configure a key to be used while communicating with the NTP server, make sure that the key exists as a trusted key on the device.</p>
<b>Step 3</b>	<p><b>[no] ntp peer</b> {<i>ip-address</i>   <i>ipv6-address</i>   <i>dns-name</i>} [<b>key</b> <i>key-id</i>] [<b>maxpoll</b> <i>max-poll</i>] [<b>minpoll</b> <i>min-poll</i>] [<b>prefer</b>] [<b>use-vrf</b> <i>vrf-name</i>]</p> <p><b>Example:</b></p> <pre>switch(config)# ntp peer 2001:0db8::4101</pre>	<p>Forms an association with a peer. You can specify multiple peer associations.</p> <p>Use the <b>key</b> keyword to configure a key to be used while communicating with the NTP peer. The range for the <i>key-id</i> argument is from 1 to 65535.</p> <p>Use the <b>maxpoll</b> and <b>minpoll</b> keywords to configure the maximum and minimum intervals in which to poll a server. The range for the <i>max-poll</i> and <i>min-poll</i> arguments is from 4 to 17 (configured as powers of 2, so effectively 16 to 131072 seconds), and the default values are 6 and 4, respectively (<i>maxpoll</i> default = 64 seconds, <i>minpoll</i> default = 16 seconds).</p> <p>Use the <b>prefer</b> keyword to make this peer the preferred NTP peer for the device.</p> <p>Use the <b>use-vrf</b> keyword to configure the NTP peer to communicate over the specified VRF. The <i>vrf-name</i> argument can be <b>default</b>, <b>management</b>, or any case-sensitive, alphanumeric string up to 32 characters.</p>
<b>Step 4</b>	<p>(Optional) <b>show ntp peers</b></p> <p><b>Example:</b></p>	<p>Displays the configured server and peers.</p>

	Command or Action	Purpose
	<code>switch(config)# show ntp peers</code>	<p><b>Note</b> A domain name is resolved only when you have a DNS server configured.</p> <p>When DNS/Name Server resolves both IPv4 and IPv6, IPv6 Address is preferred by NX-OS.</p>
<b>Step 5</b>	<p>(Optional) <b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>switch(config)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Configuring NTP Authentication

You can configure the device to authenticate the time sources to which the local clock is synchronized. When you enable NTP authentication, the device synchronizes to a time source only if the source carries one of the authentication keys specified by the **ntp trusted-key** command. The device drops any packets that fail the authentication check and prevents them from updating the local clock. NTP authentication is disabled by default.

### Before you begin

Make sure that you configured the NTP server with the authentication keys that you plan to specify in this procedure.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	<p><b>[no] ntp authentication-key <i>number md5 md5-string</i></b></p> <p><b>Example:</b></p> <pre>switch(config)# ntp authentication-key 42 md5 aNiceKey</pre>	<p>Defines the authentication keys. The device does not synchronize to a time source unless the source has one of these authentication keys and the key number is specified by the <b>ntp trusted-key <i>number</i></b> command.</p> <p>The range for authentication keys is from 1 to 65535. For the MD5 string, you can enter up to eight alphanumeric characters.</p>
<b>Step 3</b>	<p><b>ntp server <i>ip-address key key-id</i></b></p> <p><b>Example:</b></p>	<p>Forms an association with a server.</p> <p>Use the <b>key</b> keyword to configure a key to be used while communicating with the NTP server.</p>

	Command or Action	Purpose
	<code>switch(config)# ntp server 192.0.2.1 key 1001</code>	The range for the <i>key-id</i> argument is from 1 to 65535.  To require authentication, the <b>key</b> keyword must be used. Any <b>ntp server</b> or <b>ntp peer</b> commands that do not specify the <b>key</b> keyword will continue to operate without authentication.
<b>Step 4</b>	(Optional) <b>show ntp authentication-keys</b>  <b>Example:</b> <code>switch(config)# show ntp authentication-keys</code>	Displays the configured NTP authentication keys.
<b>Step 5</b>	<b>[no] ntp trusted-key number</b>  <b>Example:</b> <code>switch(config)# ntp trusted-key 42</code>	Specifies one or more keys (defined in Step 2) that an unconfigured remote symmetric, broadcast, and multicast time source must provide in its NTP packets in order for the device to synchronize to it. The range for trusted keys is from 1 to 65535.  This command provides protection against accidentally synchronizing the device to a time source that is not trusted.
<b>Step 6</b>	(Optional) <b>show ntp trusted-keys</b>  <b>Example:</b> <code>switch(config)# show ntp trusted-keys</code>	Displays the configured NTP trusted keys.
<b>Step 7</b>	<b>[no] ntp authenticate</b>  <b>Example:</b> <code>switch(config)# ntp authenticate</code>	Enables or disables authentication for ntp passive, ntp broadcast client, and ntp multicast. NTP authentication is disabled by default.
<b>Step 8</b>	(Optional) <b>show ntp authentication-status</b>  <b>Example:</b> <code>switch(config)# show ntp authentication-status</code>	Displays the status of NTP authentication.
<b>Step 9</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <code>switch(config)# copy running-config startup-config</code>	Copies the running configuration to the startup configuration.

## Configuring NTP Access Restrictions

You can control access to NTP services by using access groups. Specifically, you can specify the types of requests that the device allows and the servers from which it accepts responses.

If you do not configure any access groups, NTP access is granted to all devices. If you configure any access groups, NTP access is granted only to the remote device whose source IP address passes the access list criteria.

- Without the **match-all** keyword, the packet gets evaluated against the access groups (in the order mentioned below) until it finds a permit. If a permit is not found, the packet is dropped.
- With **match-all** keyword, the packet gets evaluated against all the access groups (in the order mentioned below) and the action is taken based on the last successful evaluation (the last access group where an ACL is configured).
- peer—process client, symmetric active, symmetric passive, serve, control, and private packets(all types)
- serve—process client, control, and private packets
- serve-only—process client packets only
- query-only—process control and private packets only

The access groups are evaluated in the following order:

1. peer (all packet types)
2. serve (client, control, and private packets)
3. serve-only (client packets) or query-only (control and private packets)

ACL processing of serve-only or query-only depends on the NTP packet type.

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	(Optional) <b>show ntp access-groups</b>  <b>Example:</b> <pre>switch(config)# show ntp access-groups</pre>	Displays the NTP access group configuration.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch(config)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Configuring the NTP Source IP Address

NTP sets the source IP address for all NTP packets based on the address of the interface through which the NTP packets are sent. You can configure NTP to use a specific source IP address.

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] ntp source <i>ip-address</i></b> <b>Example:</b> switch(config)# ntp source 192.0.2.1	Configures the source IP address for all NTP packets. The <i>ip-address</i> can be in IPv4 or IPv6 format.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Configuring the NTP Source Interface

You can configure NTP to use a specific interface.

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] ntp source-interface <i>interface</i></b> <b>Example:</b> switch(config)# ntp source-interface ethernet 2/1	Configures the source interface for all NTP packets. Use the ? keyword to display a list of supported interfaces.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Configuring NTP Logging

You can configure NTP logging in order to generate system logs with significant NTP events. NTP logging is disabled by default.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>[no] ntp logging</b> <b>Example:</b> switch(config)# ntp logging	Enables or disables system logs to be generated with significant NTP events. NTP logging is disabled by default.
<b>Step 3</b>	(Optional) <b>show ntp logging-status</b> <b>Example:</b> switch(config)# show ntp logging-status	Displays the NTP logging configuration status.
<b>Step 4</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Verifying the NTP Configuration

To display the NTP configuration, perform one of the following tasks:

<b>Command</b>	<b>Purpose</b>
<b>show ntp access-groups</b>	Displays the NTP access group configuration.
<b>show ntp authentication-keys</b>	Displays the configured NTP authentication keys.
<b>show ntp authentication-status</b>	Displays the status of NTP authentication.
<b>show ntp logging-status</b>	Displays the NTP logging status.
<b>show ntp peer-status</b>	Displays the status for all NTP servers and peers.
<b>show ntp peers</b>	Displays all the NTP peers.
<b>show ntp rts-update</b>	Displays the RTS update status.
<b>show ntp source</b>	Displays the configured NTP source IP address.
<b>show ntp source-interface</b>	Displays the configured NTP source interface.
<b>show ntp statistics {io   local   memory   peer {ipaddr {ipv4-addr   ipv6-addr}   name peer-name}}</b>	Displays the NTP statistics.
<b>show ntp trusted-keys</b>	Displays the configured NTP trusted keys.
<b>show running-config ntp</b>	Displays NTP information.

Use the **clear ntp session** command to clear the NTP sessions.

Use the **clear ntp statistics** command to clear the NTP statistics.

## Configuration Examples for NTP

This example shows how to configure the device to synchronize only to time sources that provide authentication key 42 in their NTP packets:

```
switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# ntp authentication-key 42 md5 aNiceKey
switch(config)# ntp server 192.0.2.105 key 42
switch(config)# ntp trusted-key 42
switch(config)# ntp authenticate
switch(config)# copy running-config startup-config
[#####] 100%
switch(config)#
```

This example shows an NTP access group configuration with the following restrictions:

- Peer restrictions are applied to IP addresses that pass the criteria of the access list named “peer-acl.”
- Serve restrictions are applied to IP addresses that pass the criteria of the access list named “serve-acl.”
- Serve-only restrictions are applied to IP addresses that pass the criteria of the access list named “serve-only-acl.”
- Query-only restrictions are applied to IP addresses that pass the criteria of the access list named “query-only-acl.”

```
switch# configure terminal
switch(config)# ntp peer 10.1.1.1
switch(config)# ntp peer 10.2.2.2
switch(config)# ntp peer 10.3.3.3
switch(config)# ntp peer 10.4.4.4
switch(config)# ntp peer 10.5.5.5
switch(config)# ntp peer 10.6.6.6
switch(config)# ntp peer 10.7.7.7
switch(config)# ntp peer 10.8.8.8
switch(config)# ntp access-group peer peer-acl
switch(config)# ntp access-group serve serve-acl
switch(config)# ntp access-group serve-only serve-only-acl
switch(config)# ntp access-group query-only query-only-acl
switch(config)# ip access-list peer-acl
switch(config-acl)# 10 permit ip host 10.1.1.1 any
switch(config-acl)# 20 permit ip host 10.8.8.8 any
switch(config)# ip access-list serve-acl
switch(config-acl)# 10 permit ip host 10.4.4.4 any
switch(config-acl)# 20 permit ip host 10.5.5.5 any
switch(config)# ip access-list serve-only-acl
switch(config-acl)# 10 permit ip host 10.6.6.6 any
switch(config-acl)# 20 permit ip host 10.7.7.7 any
switch(config)# ip access-list query-only-acl
switch(config-acl)# 10 permit ip host 10.2.2.2 any
switch(config-acl)# 20 permit ip host 10.3.3.3 any
```



**Note** When only a single ACL group is applied, then all the packets relevant for other ACL categories are denied and only packets relevant for the configured ACL group is processed, as mentioned in below scenarios:

- If serve ACL is configured, then only client, control, and private packets are processed and all the other packets are denied.
- If serve-only ACL is configured, then only client packets are processed and all the other packets are denied.

If more than a single ACL is configured, it follows the order of processing as mentioned in below scenario:

- If serve and serve-only both are configured for the same IP address without match-all configured, where the IP is permitted in serve-acl and denied in serve-only, the client, control, private packets are permitted for that IP.

## Additional References

### Related Documents

Related Topic	Document Title
Clock manager	<a href="#">Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide</a>

### MIBs

MIBs	MIBs Link
MIBs related to NTP	To locate and download supported MIBs, go to the following <a href="ftp://ftp.cisco.com/pub/mibs/supportlists/nexus9000/Nexus9000MIBSupportList.html">ftp://ftp.cisco.com/pub/mibs/supportlists/nexus9000/Nexus9000MIBSupportList.html</a>

