

## Chapter 34

# Network Time Protocol (NTP)

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## Introduction

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This chapter describes the Network Time Protocol (NTP) service provided by the switch, and how to configure and monitor NTP on the switch.

NTP is a protocol for synchronising the time clocks on a collection of network devices using a distributed client/server mechanism. NTP uses UDP (User Datagram Protocol) as the transport mechanism. NTP evolved from the Time Protocol (RFC 868) and the ICMP Timestamp message (RFC 792).

NTP provides protocol mechanisms to specify the precision and estimated error of the local clock and the characteristics of the reference clock to which it may be synchronized.

## Overview

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NTP uses a subnetwork with primary reference clocks, gateways, secondary reference clocks, and local hosts. These are organised into a hierarchy with the more accurate clocks near the top and less accurate ones near the bottom ([Figure 34-1 on page 34-3](#)).

A number of primary reference clocks, synchronised to national standards, are connected to widely accessible resources (such as backbone gateways or switches) operating as primary time servers. The primary time servers use NTP between them to crosscheck clocks, to mitigate errors due to equipment or propagation failures, and to distribute time information to local secondary time servers. The secondary time servers redistribute the time information to the remaining local hosts.

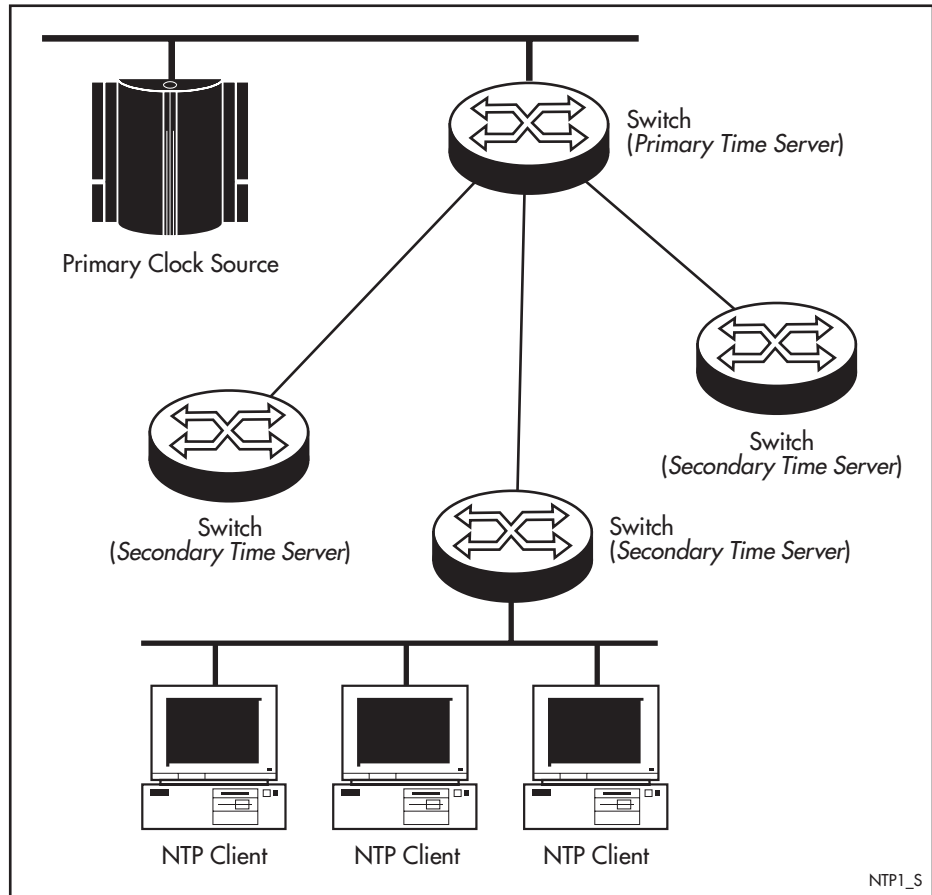
The hierarchical organisation and distribution of time information reduces the protocol overhead, and allows selected hosts to be equipped with cheaper but less accurate clocks. NTP provides information which organizes this hierarchy on the basis of precision or estimated error.

An NTP entity may be in one of the following operating modes; however, the switch's implementation of NTP supports two modes: client and server.

- An NTP entity operating in a *client* mode sends periodic messages to its peers, requesting synchronisation by its peers.
- An NTP entity enters the *server* mode temporarily when it receives a client request message from one of its peers, and remains in server mode until the reply to the request has been transmitted.
- An NTP entity operating in *symmetric active* mode sends messages announcing its willingness to synchronise and be synchronised by its peers.
- An NTP entity enters *symmetric passive* mode in response to a message from a peer operating in Symmetric Active mode. An NTP entity operating in this mode announces its willingness to synchronise and be synchronised by its peers.
- An NTP entity operating in *broadcast* mode periodically sends messages announcing its willingness to synchronise all of its peers but not to be synchronised by any of them.

NTP messages are generally sent regardless of the reachability state or stratum (rank) of the peers.

Figure 34-1: Network Model for the Network Time Protocol



The same message format is used for both requests and replies. When a request is received, the server interchanges addresses and ports, fills in or overwrites certain fields in the message, recalculates the checksum, and returns it immediately. The information included in the NTP message allows each client/server peer to determine the timekeeping characteristics of its peers, including the expected accuracies of their clocks. Each peer uses this information and selects the best time from possibly several other clocks, updates the local clock, and estimates its accuracy.

There is no provision in NTP for peer discovery, acquisition, or authentication. Data integrity is provided by the IP and UDP checksums. No reachability, circuit-management, duplicate-detection, or retransmission facilities are provided or necessary.

By its very nature clock synchronization requires long periods of time (hours or days) and multiple comparisons in order to maintain accurate timekeeping. The more comparisons performed, the greater the accuracy of the timekeeping.

## NTP on the Switch

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The implementation of NTP on the switch is based on the following RFCs:

- RFC 958, *Network Time Protocol (NTP)*
- RFC 1305, *Network Time Protocol (Version 3) Specification, Implementation and Analysis*
- RFC 1510, *The Kerberos Network Authentication Service (V5)*

Two modes of operation are supported: client and server. The switch is in client mode most of the time where it polls the configured peer at least once every preconfigured minimum time period.

The peer that the switch refers to must be a more accurate clock source than the switch itself or another switch directly connected to a more accurate clock source. The switch operates as a secondary time server. It cannot operate as a primary time server unless the primary clock source is operating in server mode. A primary clock source usually operates in broadcast mode, which is not supported by the switch's implementation of NTP. There is no support for clock selection or filtering. When the switch receives a valid reply from the peer, it synchronises its own internal clock according to the information from the reply.

If the switch receives a synchronisation request from an NTP client, it temporarily changes to server mode. It replies to the request with the current time from the switch's internal clock along with other information useful for synchronisation. The switch's internal clock is accurate to  $\pm 0.005$  seconds.

## Configuration Example

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NTP requires the IP module to be enabled and configured correctly. See [Chapter 13, Internet Protocol \(IP\)](#) for detailed descriptions of the commands required to enable and configure IP.

The switch's implementation of NTP supports two modes: client and server mode. When a synchronisation request is received from a client (e.g. a PC on a LAN), the switch enters server mode and responds with time information derived from the switch's own internal clock. Periodically the switch enters client mode, sending synchronisation requests to a predefined peer to synchronise its own internal clock. The peer is assumed to be a primary clock source or another switch connected directly to a primary clock source.

This example illustrates how to configure two switches, one at a Head Office and one at a Regional Office, to provide a network time service ([Figure 34-2 on page 34-5](#), [Table 34-1 on page 34-6](#)). The Head Office switch is connected to a primary time server and provides the most accurate time information. The switch at the Regional Office uses the Head Office switch as its peer to avoid the cost of an additional WAN connection but provides slightly less accurate time information.

To configure NTP on the switch, the NTP module must be enabled and an NTP peer must be defined. NTP transfers time information in UTC format. For the switch to correctly display the local time, set its UTC offset. There are two options:

- **set ntp utcoffset**
- **set timezone**

To set the switch to automatically change the time when summer time starts and ends, enable a summer time offset setting. Summer time is set using the **set summertime** command on page 4-27 of Chapter 4, *Configuring and Monitoring the System*.

For more information about defining the UTC offset, see “UTC offset” on page 4-6 of Chapter 4, *Configuring and Monitoring the System*.

For more information about setting and enabling summer time, see “Timezone and UTC Offset” on page 4-5 of Chapter 4, *Configuring and Monitoring the System*.

Figure 34-2: Network configuration for a network time service

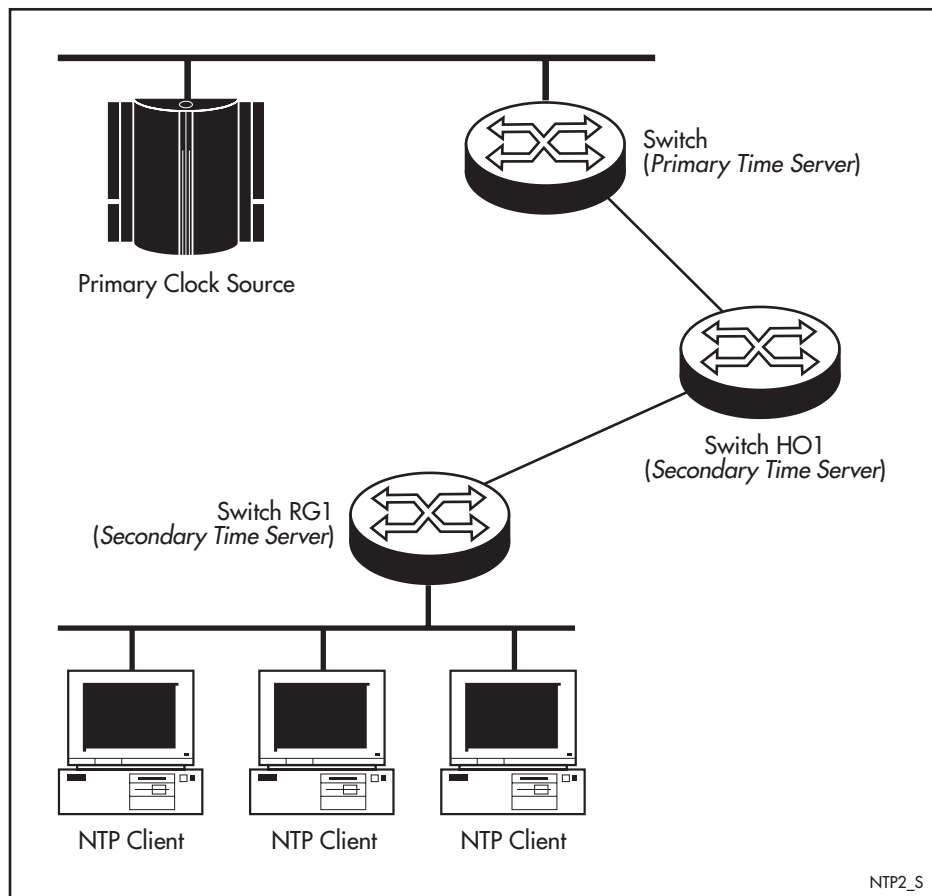


Table 34-1: Example configuration parameters for a network time service

Site	Regional Office	Head Office
Switch Name	RG1	HO1
IP Address of Switch	192.168.35.114	192.168.35.113
IP Address of Peer	192.168.35.113	192.168.13.3

### 1. Enable NTP and define the NTP peer.

The NTP feature must be enabled on all switches that are to provide a network time service. Each switch must have a peer defined where the switch synchronises its own internal clock. Enable NTP on the Head Office switch and specify a primary time server as the peer by using the commands:

```
enable ntp
add ntp peer=192.168.13.3
```

Enable NTP on the Regional Office switch and specify the Head Office switch as the peer by using the commands:

```
enable ntp
add ntp peer=192.168.35.113
```

### 2. Configure the NTP parameters.

On each switch, the offset of local time from UTC time must be specified. In this example, both switches are in the same time zone, which is 13 hours ahead of UTC time. Use the following commands on both switches:

```
set ntp utcoffset=+13:00:00
reset ntp
```

### 3. Check the NTP configuration.

Check the NTP configuration on each switch by using the command:

```
show ntp
```

This command displays the following information on the Head Office switch.

```
NTP Module Configurations
-----
Status           : ENABLED
Host Address      : 192.168.35.113
UTC offset        : +13:00:00
Last Updated      : 15:21:37 on 14-Feb-95
Last Delta        : +00.28

Configured Peer
-----
192.168.13.3

Counters
-----
Packets Sent      : 0000000011
Packets Received   : 0000000010
Packets w/ head error : 0000000000
Packets w/ data error : 0000000006
```

## Troubleshooting

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**Problem** The switch is not assigning the time to devices on the LAN.

- Solutions**
- Check NTP is enabled. To use the GUI to do this, select Configuration > System > Time.
  - Check that the NTP peer's IP address is entered correctly.
  - Check that the NTP peer can reach the switch, by pinging the switch from the NTP peer.
  - Check that the switch's link to the LAN is functioning.

**Problem** The switch's clock does not synchronise with the NTP peer.

- Solution**
- The switch's clock can synchronise with the NTP peer only when its initial time is similar to the NTP peer's time (after setting the UTC offset). Manually set the switch's time so that it is approximately correct, and enable NTP again.
  - Check that the UTC offset is correct.

**Problem** The switch's time is incorrect, even though it assigns the correct time to devices on the LAN.

**Solution** The UTC offset is probably incorrect, or needs to be adjusted for the beginning or end of summer time. To use the GUI to correct this, select Configuration > System > Time and enter the correct offset.

To set the switch to automatically adjust its time when summer time starts and ends, see [set summertime](#) in [Chapter 4, Configuring and Monitoring the System](#).

## Command Reference

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This section describes the commands available on the switch to configure and manage the Network Time Protocol (NTP) on the switch.

NTP requires the IP module to be enabled and configured correctly. See [Chapter 13, Internet Protocol \(IP\)](#) for detailed descriptions of the commands required to enable and configure IP.

The shortest valid command is denoted by capital letters in the Syntax section. See “[Conventions](#)” on page xxxviii of [About this Software Reference](#) in the front of this manual for details of the conventions used to describe command syntax. See [Appendix A, Messages](#) for a complete list of messages and their meanings.

### add ntp peer

---

**Syntax** ADD NTP PEer=*ipadd*

where *ipadd* is the IP address of the NTP peer, in dotted decimal notation

**Description** This command specifies the NTP peer for this switch. Only one peer may be defined and must not already be defined.

**Examples** To add the switch with IP address 172.16.8.1 as a peer, use the command:

```
add ntp pe=172.16.8.1
```

**Related Commands** [delete ntp peer](#)

### delete ntp peer

---

**Syntax** DElete NTP PEer=*ipadd*

where *ipadd* is the IP address of the NTP peer, in dotted decimal notation

**Description** This command deletes the specified NTP peer for this switch. The peer must already be defined.

**Examples** To remove the switch with IP address 172.16.8.1 as a peer, use the command:

```
del ntp pe=172.16.8.1
```

**Related Commands** [add ntp peer](#)



## disable ntp

---

**Syntax**    DISable NTP

**Description**    This command disables the NTP module. The NTP module must not already be disabled.

**Examples**    To disable the NTP module, use the command:

```
dis ntp
```

**Related Commands**    [enable ntp](#)  
[purge ntp](#)  
[reset ntp](#)

## enable ntp

---

**Syntax**    ENable NTP

**Description**    This command enables the NTP module. The NTP module must not already be enabled.

**Examples**    To enable the NTP module, use the command:

```
ena ntp
```

**Related Commands**    [disable ntp](#)  
[purge ntp](#)  
[reset ntp](#)

## purge ntp

---

**Syntax**    PURge NTP

**Description**    This command purges all NTP configurations and returns the NTP module to its initialised state.

**Examples**    To purge the current configuration of the NTP module, use the command:

```
pur ntp
```

**Related Commands**    [disable ntp](#)  
[enable ntp](#)  
[reset ntp](#)

## reset ntp

---

**Syntax** RESET NTP

**Description** This command resets the NTP module. All dynamic configuration information is cleared and then reloaded from non-volatile storage, and requests are transmitted.

**Examples** To restart the NTP module, use the command:

```
reset ntp
```

**Related Commands** [disable ntp](#)  
[enable ntp](#)  
[purge ntp](#)

## set ntp utcoffset

---

**Syntax** SET NTP UTCOffset=-23:59:59..+23:59:59

**Description** This command sets the offset of local time from UTC time. All time information managed by NTP is in UTC time.

If a timezone has been currently set up on the system using the [set timezone](#) in Chapter 4, Configuring and Monitoring the System command, the **set ntp utcoffset** command is invalid.

The UTC offset value that the system uses is dependent on the switch's configuration. For information about how the UTC offset is derived, see "UTC offset" on page 4-6 of Chapter 4, Configuring and Monitoring the System.

**Examples** To set the UTC offset to +4:00 hours, use the command:

```
set ntp utc=4:00
```

**Related Commands** [clear timezone](#) in Chapter 4, Configuring and Monitoring the System  
[disable summertime](#) in Chapter 4, Configuring and Monitoring the System  
[enable summertime](#) in Chapter 4, Configuring and Monitoring the System  
[set summertime](#) in Chapter 4, Configuring and Monitoring the System  
[set timezone](#) in Chapter 4, Configuring and Monitoring the System  
[show ntp](#)  
[show summertime](#) in Chapter 4, Configuring and Monitoring the System  
[show timezone](#) in Chapter 4, Configuring and Monitoring the System

## show ntp

**Syntax** SHow NTP

**Description** This command displays configuration information for the NTP module (Figure 34-3, Table 34-2).

Figure 34-3: Example output from the **show ntp** command

```
NTP Module Configurations
-----
Status           : ENABLED
Host Address      : 192.168.35.149
UTC offset        : +13:00:00
Last Updated      : 15:21:37 on 14-Feb-1995
Last Delta        : +00.28

Configured Peer
-----
192.168.46.33

Counters
-----
Packets Sent      : 0000000011
Packets Received   : 0000000010
Packets w/ head error : 0000000000
Packets w/ data error : 0000000006
```

Table 34-2: Parameters in output of the **show ntp** command

Parameter	Meaning
Status	Whether the NTP module is enabled.
Host Address	IP address of this NTP module.
UTC offset	Offset of local time from UTC time. The UTC offset value that is displayed is dependent on the switch's configuration. For information about how the UTC offset is derived, see <a href="#">"UTC offset" on page 4-6 of Chapter 4, Configuring and Monitoring the System</a> .
Last Updated	Time and date that NTP last updated the switch's clock.
Last Delta	Change in the switch's clock at the last update.
Configured Peer	IP address of the NTP peer.
Packets Sent	Number of NTP protocol packets this switch has transmitted.
Packets Received	Number of NTP protocol packets this switch has received.
Packets w/ head error	Number of NTP protocol packets with errors in the header that this switch received.
Packets w/ data error	Number of NTP protocol packets with errors in the data portion that this switch received.

**Examples** To display the current NTP configuration, use the command:

```
sh ntp
```

**Related Commands**

- `add ntp peer`
- `clear timezone` in Chapter 4, Configuring and Monitoring the System
- `disable summertime` in Chapter 4, Configuring and Monitoring the System
- `enable summertime` in Chapter 4, Configuring and Monitoring the System
- `set ntp utcoffset`
- `set summertime` in Chapter 4, Configuring and Monitoring the System
- `set timezone` in Chapter 4, Configuring and Monitoring the System
- `show summertime` in Chapter 4, Configuring and Monitoring the System
- `show timezone` in Chapter 4, Configuring and Monitoring the System