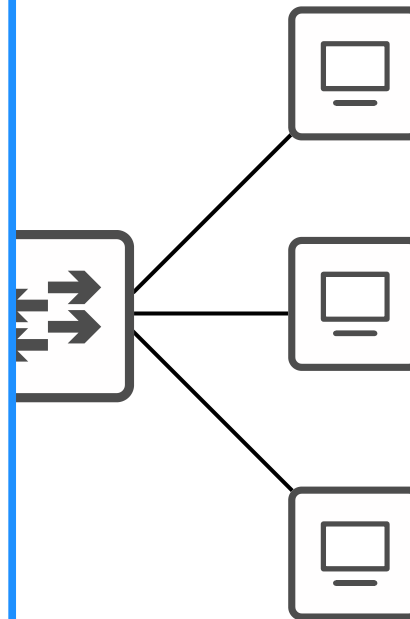


CCNA Day 37

Network Time Protocol



1.0 Network Fundamentals	20%	▼
2.0 Network Access	20%	▼
3.0 IP Connectivity	25%	▼
4.0 IP Services	10%	▲
4.1 Configure and verify inside source NAT using static and pools		
4.2 Configure and verify NTP operating in a client and server mode		
4.3 Explain the role of DHCP and DNS within the network		
4.4 Explain the function of SNMP in network operations		
4.5 Describe the use of syslog features including facilities and levels		
4.6 Configure and verify DHCP client and relay		
4.7 Explain the forwarding per-hop behavior (PHB) for QoS such as classification, marking, queuing, congestion, policing, shaping		
4.8 Configure network devices for remote access using SSH		
4.9 Describe the capabilities and function of TFTP/FTP in the network		
5.0 Security Fundamentals	15%	▼
6.0 Automation and Programmability	10%	▼



Things we'll cover

- Why is time important for network devices?
- Manual time configuration
- NTP basics
- NTP configuration

The importance of time

- All devices have an internal clock (routers, switches, your PC, etc)
- In Cisco IOS, you can view the time with the **show clock** command.

```
R1#show clock
*00:16:00.857 UTC Sat Dec 26 2020
```

The default time zone is UTC
(Coordinated Universal Time).

- If you use the **show clock detail** command, you can see the time source.

```
R1#show clock detail
*00:19:49.411 UTC Sat Dec 26 2020
Time source is hardware calendar
```

* = time is not considered authoritative

The hardware calendar is the default
time source.

- The internal hardware clock of a device will drift over time, so it is not the ideal time source.
- From a CCNA perspective, the most important reason to have accurate time on a device is to have accurate logs for troubleshooting.
- **Syslog**, the protocol used to keep device logs, will be covered in a later video.

show logging

```
R2#show logging
```

```
!output abbreviated!
```

```
*Dec 27 00:50:20.005: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.122.192 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
*Dec 27 01:06:38.653: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.6 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
*Dec 27 01:07:07.311: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.6 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
*Dec 27 01:08:29.924: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.6 on GigabitEthernet0/1 from FULL to DOWN, Neighbor Down: Dead timer expired
*Dec 27 01:09:10.714: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.6 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
```

```
R2#show clock
```

```
*01:17:06.706 UTC Sun Dec 27 2020
```

```
R3#show logging
```

```
!output abbreviated!
```

```
May 23 16:24:17.320: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.5 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
May 23 16:25:08.758: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.5 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
May 23 16:25:10.714: %LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to down
May 23 16:25:11.716: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to down
May 23 16:26:14.976: %LINK-3-UPDOWN: Interface GigabitEthernet0/0, changed state to up
May 23 16:26:15.977: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
May 23 16:26:20.618: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.5 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

```
R3#show clock
```

```
16:30:37.020 UTC Fri May 23 2008
```

Manual Time Configuration

- You can manually configure the time on the device with the **clock set** command.

```
R2#clock set ?  
hh:mm:ss Current Time
```

```
R2#clock set 14:30:00 ?  
<1-31> Day of the month  
MONTH Month of the year
```

```
R2#clock set 14:30:00 27 ?  
MONTH Month of the year
```

```
R2#clock set 14:30:00 27 Dec ?  
<1993-2035> Year
```

```
R2#clock set 14:30:00 27 Dec 2020 ?  
<cr>
```

```
R2#clock set 14:30:00 27 Dec 2020
```

```
R2#show clock detail
```

```
14:30:05.887 UTC Sun Dec 27 2020  
Time source is user configuration
```

- Although the hardware calendar (built-in clock) is the default time-source, the hardware clock and software clock are separate and can be configured separately.

Hardware Clock (Calendar) Configuration

- You can manually configure the hardware clock with the **calendar set** command.

```
R2#calendar set 14:35:00 ?  
<1-31> Day of the month  
MONTH Month of the year
```

```
R2#calendar set 14:35:00 27 ?  
MONTH Month of the year
```

```
R2#calendar set 14:35:00 27 Dec ?  
<1993-2035> Year
```

```
R2#calendar set 14:35:00 27 Dec 2020 ?  
<cr>
```

```
R2#calendar set 14:35:00 27 Dec 2020
```

```
R2#show calendar  
14:35:07 UTC Sun Dec 27 2020
```

- Typically you will want to synchronize the 'clock' and 'calendar'.
- Use the command **clock update-calendar** to sync the calendar to the clock's time.
- Use the command **clock read-calendar** to sync the clock to the calendar's time.

Hardware Clock (Calendar) Configuration

```
R2#show clock
14:38:14.301 UTC Sun Dec 27 2020
R2#show calendar
00:00:03 UTC Sun Dec 27 2020
R2#clock update-calendar
R2#show clock
14:38:22.181 UTC Sun Dec 27 2020
R2#show calendar
14:38:23 UTC Sun Dec 27 2020
```

```
R2#show clock
00:00:15.788 UTC Mon Sep 6 1993
R2#show calendar
14:55:07 UTC Sun Dec 27 2020
R2#clock read-calendar
R2#show clock
14:55:12.522 UTC Sun Dec 27 2020
R2#show calendar
14:55:15 UTC Sun Dec 27 2020
```

Configuring the Time Zone

- You can configure the time zone with the **clock timezone** command.

```
R2(config)#do show clock  
15:13:33.985 UTC Sun Dec 27 2020
```

```
R2(config)#clock timezone ?  
WORD name of time zone
```

```
R2(config)#clock timezone JST ?  
<-23 - 23> Hours offset from UTC
```

```
R2(config)#clock timezone JST 9 ?  
<0-59> Minutes offset from UTC  
<cr>
```

```
R2(config)#clock timezone JST 9
```

```
R2(config)#do show clock  
00:13:45.414 JST Mon Dec 28 2020
```

```
R2(config)#do clock set 15:15:00 Dec 27 2020
```


```
R2(config)#do show clock  
15:15:02.129 JST Sun Dec 27 2020
```

Daylight Saving Time (Summer Time)

```
R2(config)#clock summer-time ?  
WORD name of time zone in summer  
R2(config)#clock summer-time EDT ?  
date Configure absolute summer time  
recurring Configure recurring summer time  
R2(config)#clock summer-time EDT recurring ?  
<1-4> Week number to start  
first First week of the month  
last Last week of the month  
<cr>  
R2(config)#clock summer-time EDT recurring 2 ?  
DAY Weekday to start  
R2(config)#clock summer-time EDT recurring 2 Sunday ?  
MONTH Month to start  
R2(config)#clock summer-time EDT recurring 2 Sunday March ?  
hh:mm Time to start (hh:mm)  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 ?  
<1-4> Week number to end  
first First week of the month  
last Last week of the month  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 ?  
DAY Weekday to end  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday ?  
MONTH Month to end  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November ?  
hh:mm Time to end (hh:mm)  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November 02:00 ?  
<1-1440> Offset to add in minutes  
<cr>  
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November 02:00
```

Daylight Saving Time (Summer Time)

```
R2(config)#clock summer-time ?
WORD name of time zone in summer
R2(config)#clock summer-time EDT ?
date Configure absolute summer time
recurring Configure recurring summer time
R2(config)#clock summer-time EDT recurring ?
<1-4> Week number to start
first First week of the month
last Last week of the month
<cr>
```

 Canada	Northern America	Northern	Second Sunday March at 02:00 local standard time (for most of Canada)	First Sunday November at 02:00 local daylight saving time (for most of Canada)
--	------------------	----------	---	--

```
R1(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November 02:00
```

```
MONTH Month to start
R2(config)#clock summer-time EDT recurring 2 Sunday March ?
hh:mm Time to start (hh:mm)
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 ?
<1-4> Week number to end
first First week of the month
last Last week of the month
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1
DAY Weekday to end
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday ?
MONTH Month to end
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November ?
hh:mm Time to end (hh:mm)
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November 02:00 ?
<1-1440> Offset to add in minutes
<cr>
R2(config)#clock summer-time EDT recurring 2 Sunday March 02:00 1 Sunday November 02:00
```

Start of DST

End of DST

Manual Time Configuration

```
R1# show clock
```

```
R1# show clock detail
```

```
R1# clock set hh:mm:ss {day|month} {month|day} year
```

```
R1# show calendar
```

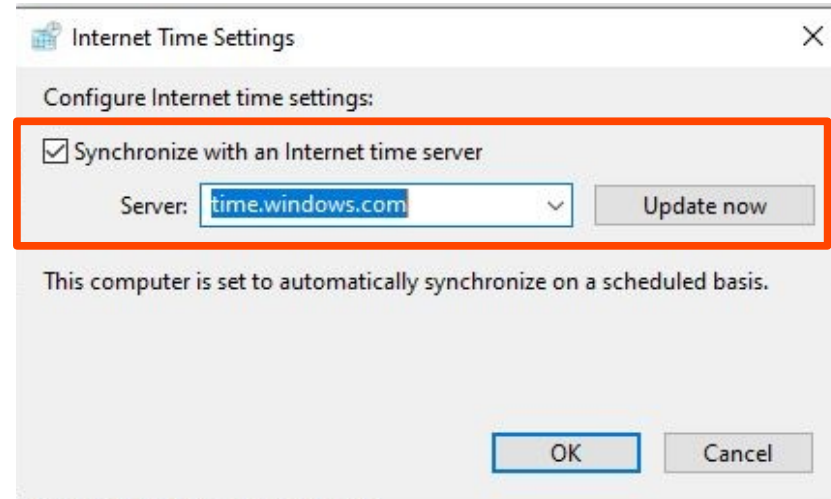
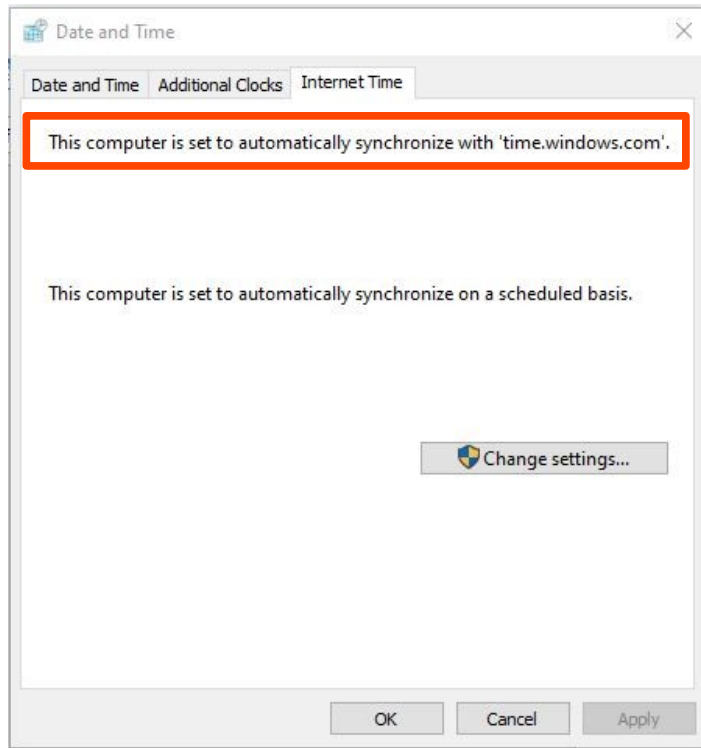
```
R1# calendar set hh:mm:ss {day|month} {month|day} year
```

```
R1(config)# clock timezone name hours-offset [minutes-offset]
```

```
R1(config)# clock summer-time recurring name start end [offset]
```

Network Time Protocol

- Manually configuring the time on devices is not scalable.
- The manually configured clocks will drift, resulting in inaccurate time.
- NTP (Network Time Protocol) allows automatic syncing of time over a network.



Network Time Protocol

```
C:\Users\user>nslookup time.windows.com
```

```
Server:  dns.google
```

```
Address:  8.8.8.8
```

```
Non-authoritative answer:
```

```
Name:     time.microsoft.akadns.net
```

```
Address:  20.43.94.199
```

```
Aliases:  time.windows.com
```

```
C:\Users\user>nslookup time.google.com
```

```
Server:  dns.google
```

```
Address:  8.8.8.8
```

```
Non-authoritative answer:
```

```
Name:     time.google.com
```

```
Addresses: 2001:4860:4806::
```

```
           2001:4860:4806:c::
```

```
           2001:4860:4806:8::
```

```
           2001:4860:4806:4::
```

```
           216.239.35.12
```

```
           216.239.35.8
```

```
           216.239.35.4
```

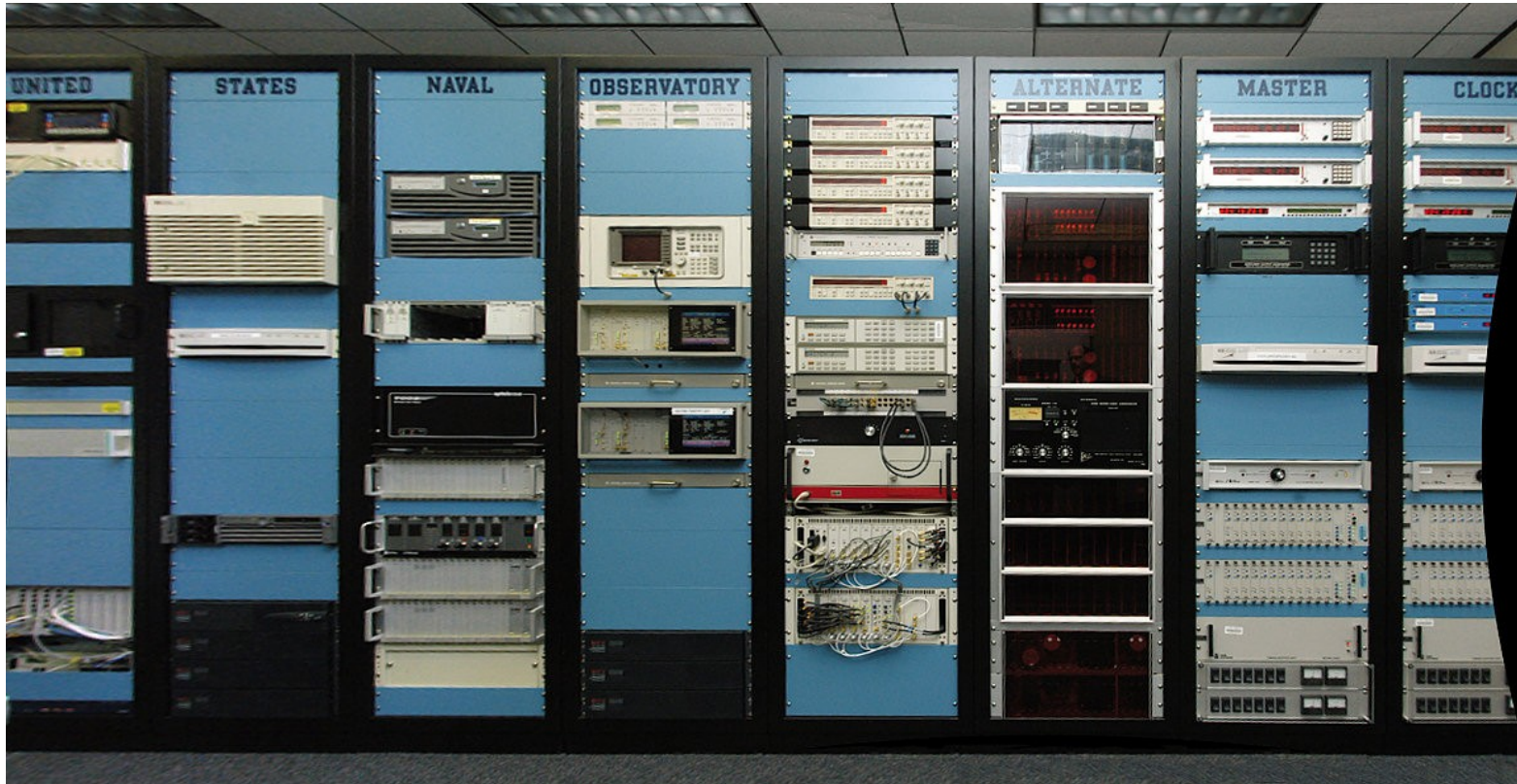
```
           216.239.35.0
```

Network Time Protocol

- Manually configuring the time on devices is not scalable.
- The manually configured clocks will drift, resulting in inaccurate time.
- NTP (Network Time Protocol) allows automatic syncing of time over a network.
- NTP clients request the time from NTP servers.
- A device can be an NTP server and an NTP client at the same time.
- NTP allows accuracy of time within ~1 millisecond if the NTP server is in the same LAN, or within ~50 milliseconds if connecting to the NTP server over a WAN/the Internet.
- Some NTP servers are 'better' than others. The 'distance' of an NTP server from the original **reference clock** is called **stratum**.
- NTP uses UDP port 123 to communicate.

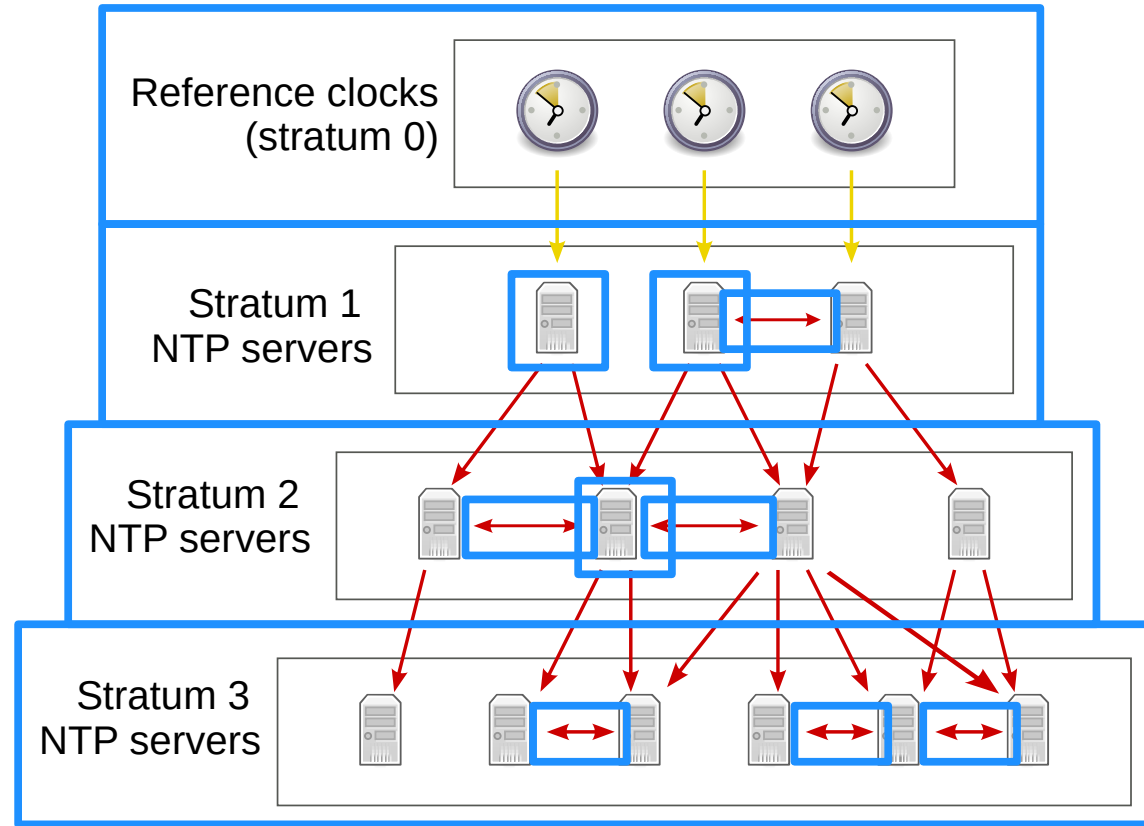
Reference Clocks

- A reference clock is usually a very accurate time device like an atomic clock or a GPS clock.
- Reference clocks are **stratum 0** within the NTP hierarchy.
- NTP servers directly connected to reference clocks are **stratum 1**.



NTP Hierarchy

- Reference clocks are **stratum 0**.
- Stratum 1** NTP servers get their time from reference clocks.
- Stratum 2** NTP servers get their time from stratum 1 NTP servers.
- Stratum 3** NTP servers get their time from stratum 2 NTP servers.
- Stratum 15** is the maximum. Anything above that is considered unreliable.
- Devices can also 'peer' with devices at the same stratum to provide more accurate time.
- An NTP client can sync to multiple NTP servers.

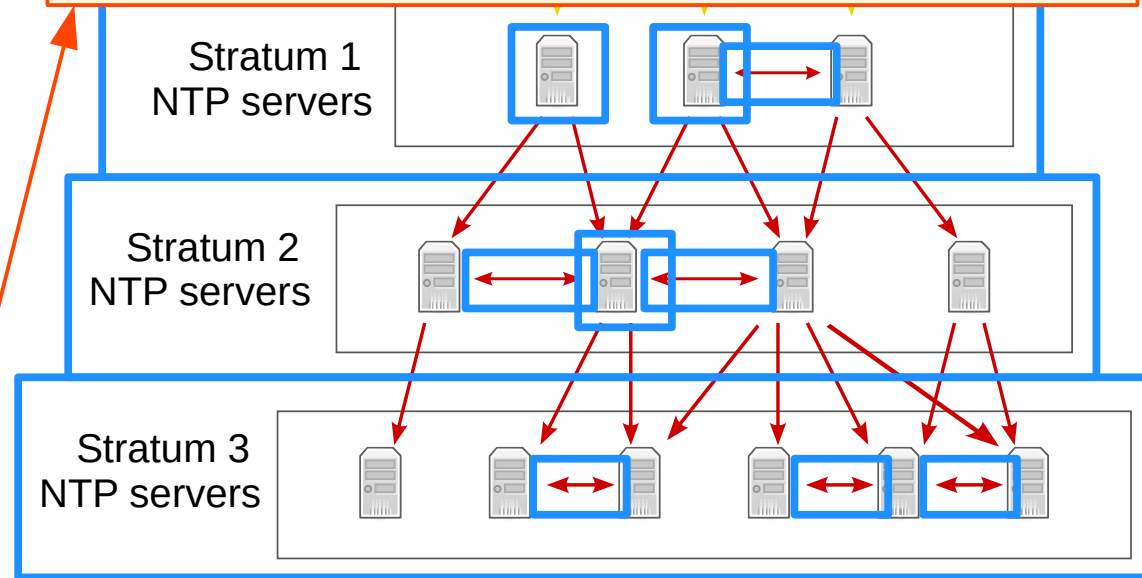


NTP Hierarchy

- Reference clocks are **stratum 0**.
- Stratum 1** NTP servers get their time from reference clocks.
- Stratum 2** NTP servers get their time from stratum 1 NTP servers.
- Stratum 3** NTP servers get their time from stratum 2 NTP servers.
- Stratum 15** is the maximum. Anything above that is considered unreliable.
- Devices can also 'peer' with devices at the same stratum to provide more accurate time.
- An NTP client can sync to multiple NTP servers.

This is called 'symmetric active' mode.
Cisco devices can operate in three NTP modes:

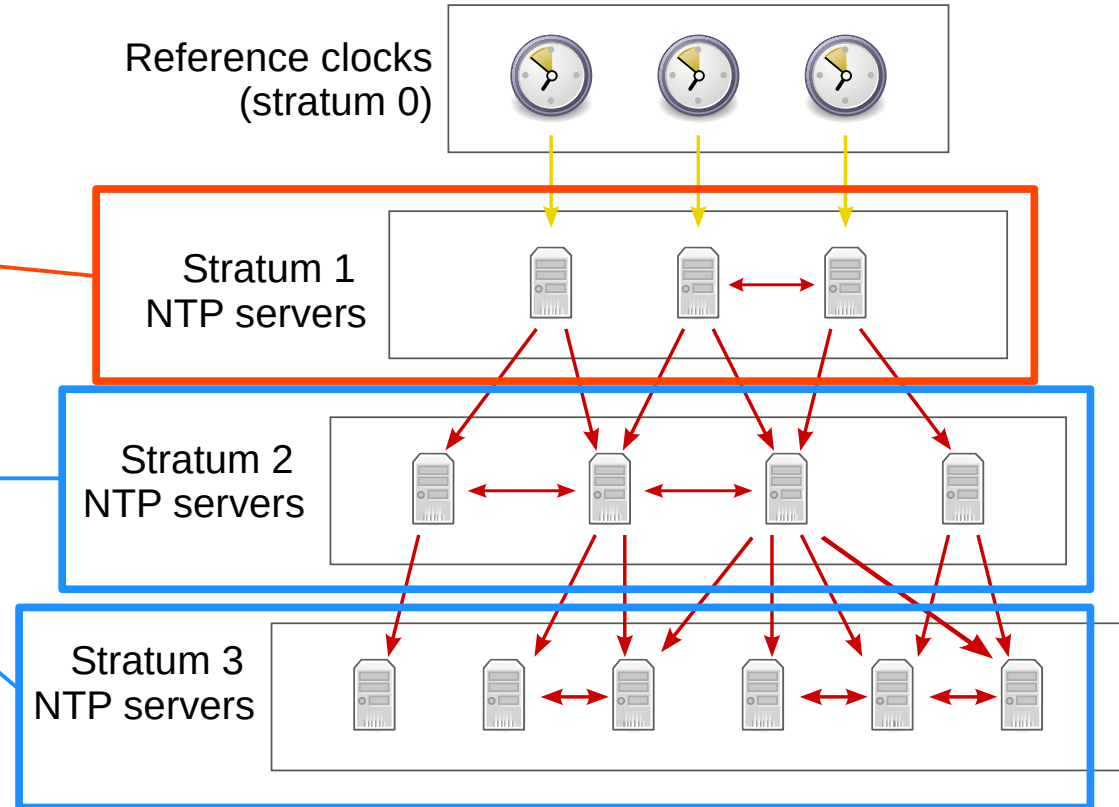
- Server mode
- Client mode
- Symmetric active mode



NTP Hierarchy

NTP servers which get their time directly from reference clocks are also called **primary servers**.

NTP servers which get their time from other NTP servers are called **secondary servers**. They operate in server mode and client mode at the same time.



NTP Configuration

NT - GNS3

File Edit View Control Node Annotate Tools Help

Topology Summary

Node	Console
INT---	none
R1	telnet 192.168.83.128:5000
R2	telnet 192.168.83.128:5002
R3	telnet 192.168.83.128:5004

Servers Summary

GNS3 VM (GNS3 VM)	CPU 11.4%, RAM 13.6%
PC CPU	13.2%, RAM 52.3%

Console

GNS3 management console.
Running GNS3 version 2.2.16 on Windows (64-bit) with Python 3.6.8 Qt 5.12.1 and PyQt 5.12.
Copyright (c) 2006-2020 GNS3 Technologies.
Use Help -> GNS3 Doctor to detect common issues.
=>

```

graph LR
    Internet((INTERNET)) ---|.192.168.122.0/24|.1|.192|.G0/0| R1((R1))
    R1 ---|.10.0.0.0/30|.2|.G0/0| R2((R2))
    R1 ---|.10.0.0.4/30|.5|.G0/0| R3((R3))
    R2 ---|.10.0.0.8/30|.9|.G0/1| R3
  
```

10.0.0.0/30 .2 G0/0 G0/1 .9

INTERNET 192.168.122.0/24 .1 .192 G0/0

R1 .1 G0/1 .5 G0/2

10.0.0.4/30 .6 G0/0 G0/1 .10

R2 R3

10.0.0.8/30

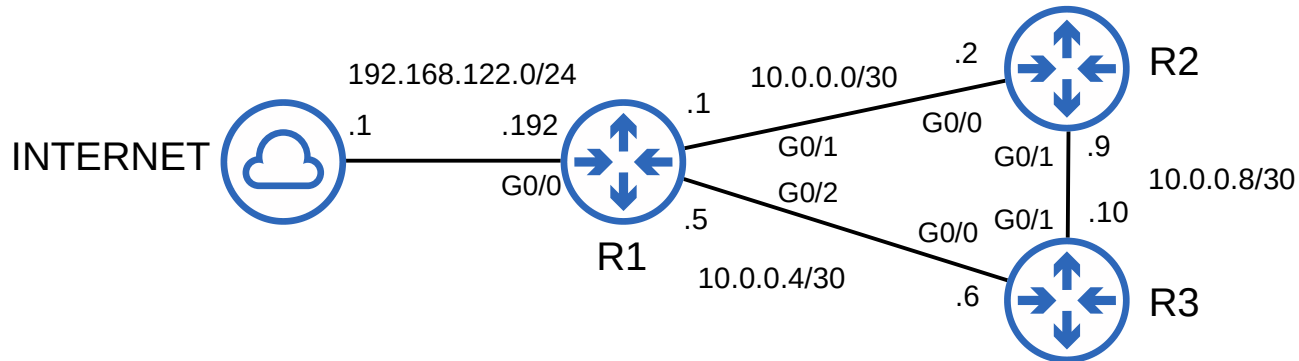
Windows taskbar: 1:42 PM 12/28/2020

NTP Configuration

```
C:\Users\user>nslookup time.google.com
Server:  dns.google
Address:  8.8.8.8
```

```
Non-authoritative answer:
Name:     time.google.com
Addresses: 2001:4860:4806::
           2001:4860:4806:c::
           2001:4860:4806:8::
           2001:4860:4806:4::
           216.239.35.12
           216.239.35.8
           216.239.35.4
           216.239.35.0
```

```
R1(config)#ntp server 216.239.35.0 prefer
R1(config)#ntp server 216.239.35.4
R1(config)#ntp server 216.239.35.8
R1(config)#ntp server 216.239.35.12
```

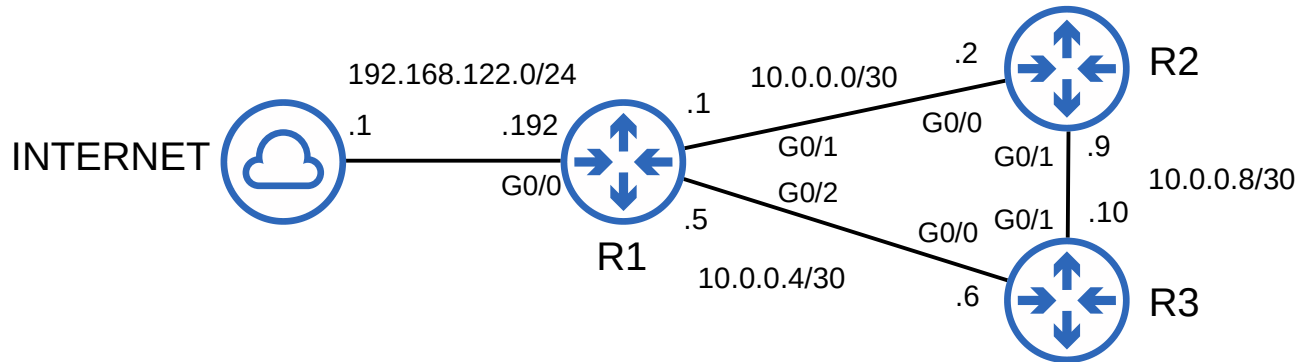


NTP Configuration

R1#show ntp associations

address	ref clock	st	when	poll	reach	delay	offset	disp
*~216.239.35.0	.GOOG.	1	43	64	17	62.007	1401.54	0.918
+~216.239.35.8	.GOOG.	1	43	64	17	64.220	1416.65	0.939
+~216.239.35.4	.GOOG.	1	47	64	17	57.669	1402.11	0.916
+~216.239.35.12	.GOOG.	1	39	64	17	62.229	1409.03	0.960

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

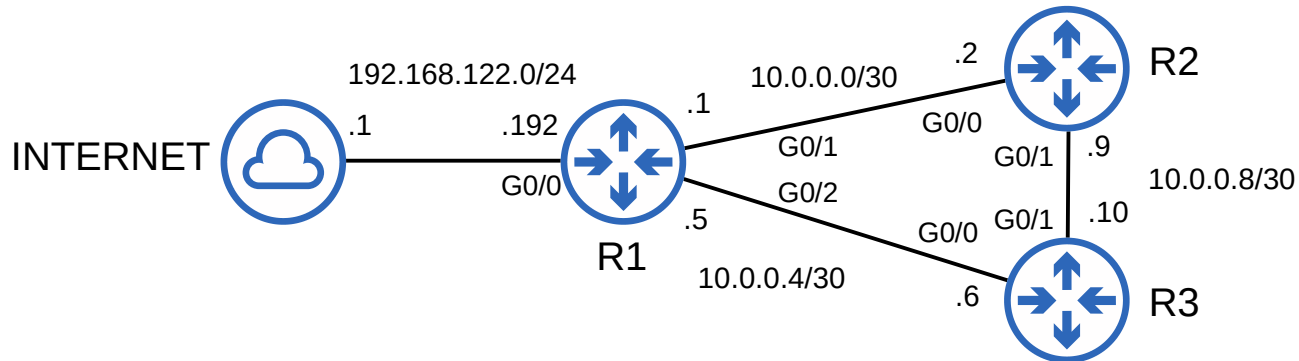


NTP Configuration

```
R1#show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
~216.239.35.0	.GOOG.	1	22	64	1	50.637	1.087	939.58
~216.239.35.8	.GOOG.	1	19	64	1	60.279	-4.402	939.83
*~216.239.35.4	.GOOG.	1	20	64	1	63.205	1351.20	938.52
~216.239.35.12	.GOOG.	1	20	64	1	49.130	1343.72	938.34

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

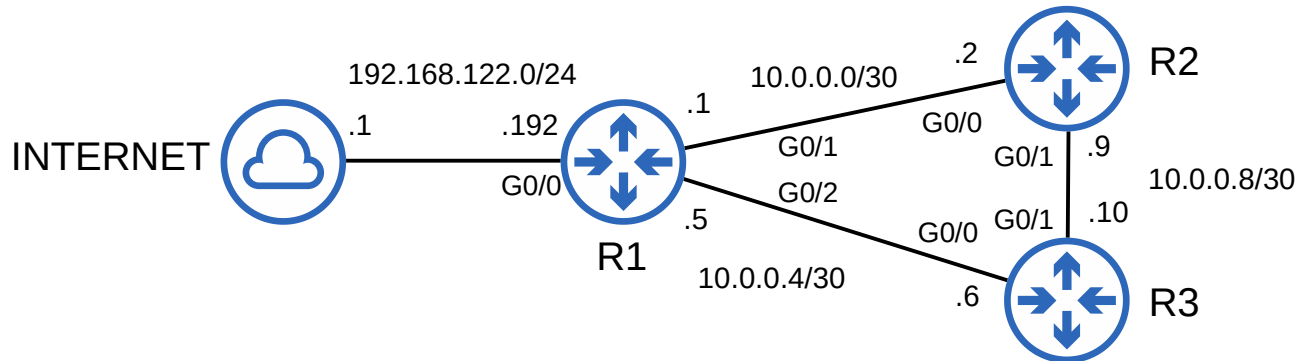


NTP Configuration

```
R1#show ntp status
```

```
Clock is synchronized, stratum 2, reference is 216.239.35.12
nominal freq is 1000.0003 Hz, actual freq is 999.5003 Hz, precision is 2**14
ntp uptime is 295800 (1/100 of seconds), resolution is 1001
reference time is E393F0A9.1F758C5B (05:50:33.122 UTC Mon Dec 28 2020)
clock offset is 1343.7280 msec, root delay is 49.13 msec
root dispersion is 2275.31 msec, peer dispersion is 3.44 msec
loopfilter state is 'SPIK' (Spike), drift is 0.000499999 s/s
system poll interval is 64, last update was 173 sec ago.
```

Because R1 is synchronizing its time to Google's NTP servers, it automatically becomes an NTP server itself (stratum level 1 higher than Google's NTP servers). Now other devices can synchronize their time to R1.



NTP Configuration

```
R1(config)#do show clock detail
06:56:32.315 UTC Mon Dec 28 2020
Time source is NTP
```

```
R1(config)#do show calendar
05:23:06 UTC Mon Dec 28 2020
```

```
R1(config)#clock timezone JST 9
```

```
R1(config)#ntp update-calendar
```

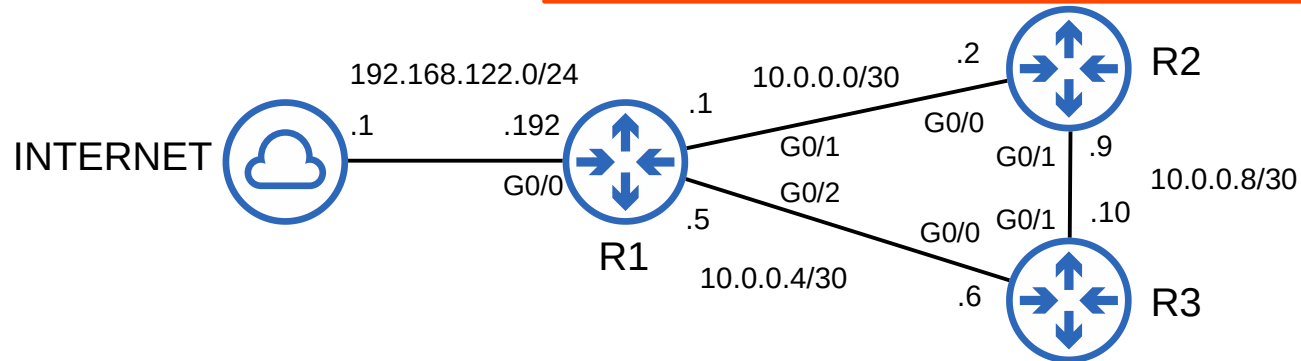
```
R1(config)#do show clock detail
15:57:33.078 JST Mon Dec 28 2020
Time source is NTP
```

```
R1(config)#do show calendar
15:57:36 JST Mon Dec 28 2020
```

NTP uses only the UTC time zone. You must configure the appropriate time zone on each device.

Configures the router to update the hardware clock (calendar) with the time learned via NTP.

The hardware clock tracks the date and time on the device even if it restarts, power is lost, etc. When the system is restarted, the hardware clock is used to initialize the software clock.



NTP Configuration

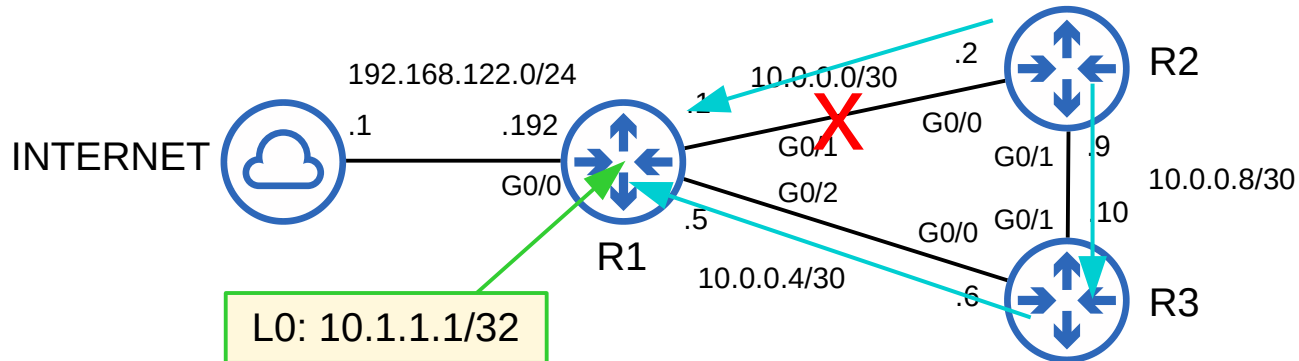
```
R1(config)#interface loopback0
R1(config-if)#ip address 10.1.1.1 255.255.255.255
R1(config-if)#exit
R1(config)#ntp source loopback0
```

```
R2(config)#ntp server 10.1.1.1
R2(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.1.1.1	216.239.35.12	2	0	64	1	7.038	-13.128	3937.5

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

```
R2(config)#do show ntp status
Clock is synchronized, stratum 3, reference is 10.1.1.1
...
```



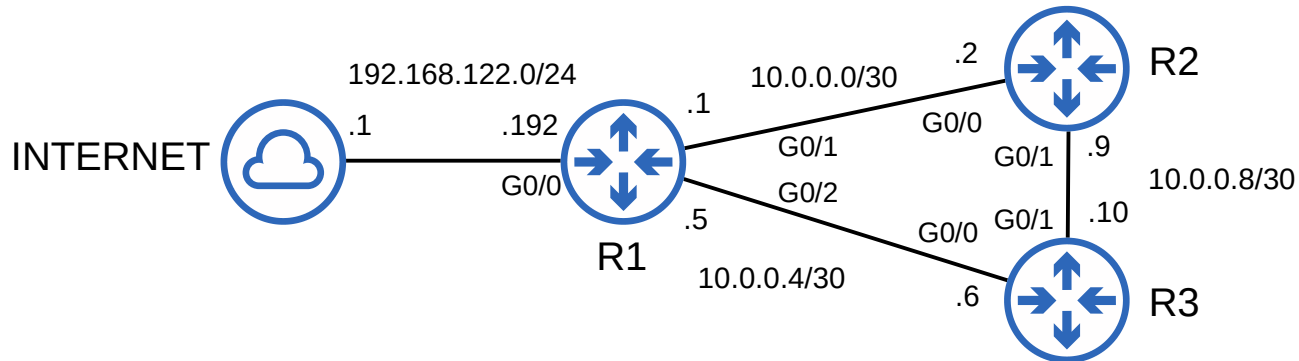
NTP Configuration

```
R3(config)#ntp server 10.1.1.1
R3(config)#ntp server 10.2.2.2
R3(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.1.1.1	216.239.35.0	2	1	64	0	0.000	0.000	15937.
~10.2.2.2	10.1.1.1	3	1	64	0	0.000	0.000	15937.

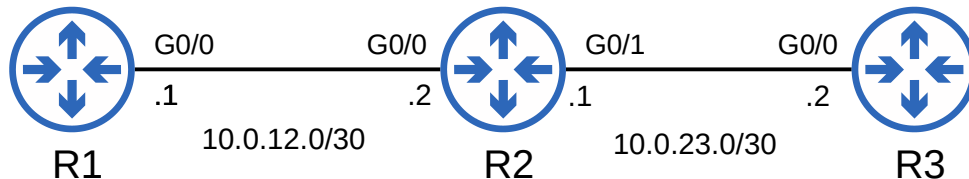
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

Servers with lower stratum levels are preferred.



Configuring NTP server mode

```
R1(config)#ntp ?
access-group      Control NTP access
allow             Allow processing of packets
authenticate      Authenticate time sources
authentication-key Authentication key for trusted time sources
broadcastdelay    Estimated round-trip delay
clock-period      Length of hardware clock tick
logging           Enable NTP message logging
master            Act as NTP master clock
max-associations  Set maximum number of associations
maxdistance       Maximum Distance for synchronization
mindistance       Minimum distance to consider for clockhop
orphan            Threshold Stratum for orphan mode
panic             Reject time updates > panic threshold (default 1000Sec)
passive           NTP passive mode
peer             Configure NTP peer
server            Configure NTP server
source            Configure interface for source address
trusted-key       Key numbers for trusted time sources
update-calendar   Periodically update calendar with NTP time
```



Configuring NTP server mode

```
R1(config)#ntp master ?
```

```
<1-15> Stratum number  
<cr>
```

```
R1(config)#ntp master
```

```
R1(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~127.127.1.1	.LOCL.	7	2	16	377	0.000	0.000	0.292

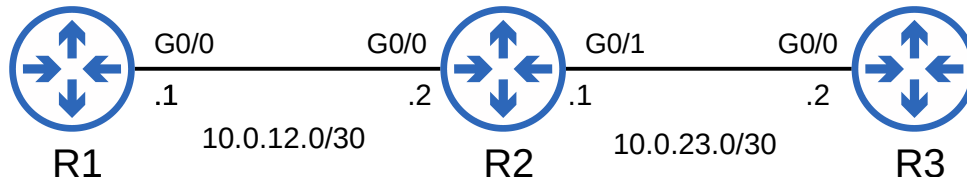
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

```
R1(config)#do show ntp status
```

```
Clock is synchronized, stratum 8, reference is 127.127.1.1
```

```
...
```

The default stratum of the **ntp master** command is 8.



Configuring NTP server mode

```
R2(config)#ntp server 10.0.12.1
```

```
R2(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.0.12.1	127.127.1.1	8	2	64	1	5.263	62.494	187.64

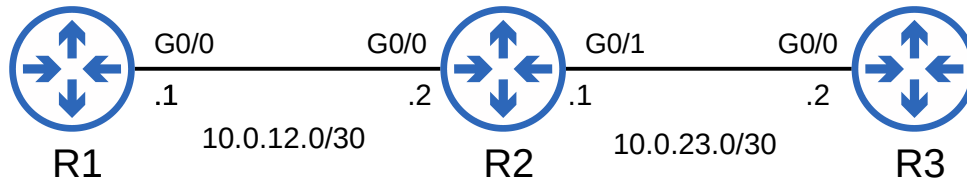
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

```
R3(config)#ntp server 10.0.12.1
```

```
R3(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.0.12.1	127.127.1.1	8	45	64	17	21.534	-21.440	0.976

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured



Configuring NTP symmetric active mode

```
R2(config)#ntp peer 10.0.23.2
```

```
R2(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.0.12.1	127.127.1.1	8	60	64	17	24.040	206.682	0.987
~10.0.23.2	10.0.12.1	9	33	64	0	0.000	0.000	15937.

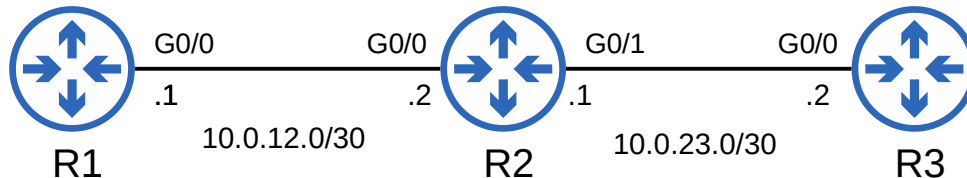
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

```
R3(config)#ntp peer 10.0.23.1
```

```
R3(config)#do show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~10.0.12.1	127.127.1.1	8	11	64	37	12.605	-7.406	63.575
~10.0.23.1	10.0.12.1	9	1	64	0	0.000	0.000	15937.

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured



Configuring NTP Authentication

- NTP authentication can be configured, although it is optional.
- It allows NTP clients to ensure they only sync to the intended servers.

- To configure NTP authentication:

Enable NTP authentication

`ntp authenticate`

`ntp authentication-key key-number md5 key`

Create the NTP authentication key(s)

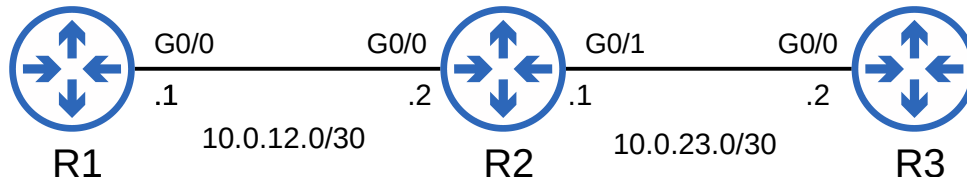
`ntp trusted-key key-number`

Specify the trusted key(s)

`ntp server ip-address key key-number`

Specify which key to use for the server

This command isn't needed on the server (R1).

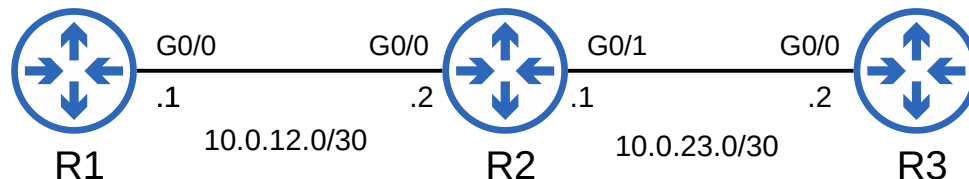


Configuring NTP Authentication

```
R1(config)#ntp authenticate
R1(config)#ntp authentication-key 1 md5 jeremysitlab
R1(config)#ntp trusted-key 1
```

```
R2(config)#ntp authenticate
R2(config)#ntp authentication-key 1 md5 jeremysitlab
R2(config)#ntp trusted-key 1
R2(config)#ntp server 10.0.12.1 key 1
R2(config)#ntp peer 10.0.23.2 key 1
```

```
R3(config)#ntp authenticate
R3(config)#ntp authentication-key 1 md5 jeremysitlab
R3(config)#ntp trusted-key 1
R3(config)#ntp server 10.0.12.1 key 1
R2(config)#ntp peer 10.0.23.1 key 1
```



NTP Command Review

!Basic Configuration Commands

```
R1(config)# ntp server ip-address [prefer]
R1(config)# ntp peer ip-address
R1(config)# ntp update-calendar
R1(config)# ntp master [stratum]
R1(config)# ntp source interface
```

!Basic Show Commands

```
R1# show ntp associations
R1# show ntp status
```

!Basic Authentication Commands

```
R1(config)# ntp authenticate
R1(config)# ntp authentication-key key-number md5 key
R1(config)# ntp trusted-key key-number
R1(config)# ntp server ip-address key key-number
R1(config)# ntp peer ip-address key key-number
```

Things we covered

- Why is time important for network devices?
- Manual time configuration
- NTP basics
- NTP configuration

Which of the following commands will cause the router to adjust its software clock to match the hardware clock?

- a) R1#**calendar update-clock**
- b) R1#**calendar read-clock**
- c) R1#**clock read-calendar**
- d) R1#**clock update-calendar**

Quiz 2

Which of the following commands can be used to configure the time zone of the device?

- a) R1#**clock set** *hh:mm:ss day month year time-zone*
- b) R1#**clock timezone** *name offset*
- c) R1(config)#**clock set** *hh:mm:ss day month year time-zone*
- d) R1(config)#**clock timezone** *name offset*

Quiz 3

Examine the output below. Which of the following commands was configured on R1?

```
R1#show ntp associations
```

address	ref clock	st	when	poll	reach	delay	offset	disp
*~127.127.1.1	.LOCL.	8	2	16	377	0.000	0.000	0.292

* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured

- a) R1(config)#ntp master 9
- b) R1(config)#ntp server 127.127.1.1
- c) R1(config)#ntp master
- d) R1(config)#ntp master 8

Which of the following commands configures the router to operate in NTP client mode?

- a) `R1(config)#ntp peer 10.0.12.2`
- b) `R1(config)#ntp master`
- c) `R1(config)#ntp server 216.239.35.0`
- d) `R1(config)#ntp client 216.239.35.4`

Quiz 5

Which of the following commands must be configured on an NTP client to enable NTP authentication? (select all that apply)

- a) `R1(config)#ntp authentication`
- b) `R1(config)#ntp master`
- c) `R1(config)#ntp authenticate`
- d) `R1(config)#ntp authentication-key key-number md5 key`
- e) `R1(config)#ntp key key-number trust`
- f) `R1(config)#ntp trusted-key key-number`
- g) `R1(config)#ntp server ip-address key key-number`