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**Welcome
To
Network for you
NTP & PTP**



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NTP (Network time protocol):

- NTP stand for Network Time Protocol.
- NTP is use to provide time.
- NTP is used to allow network devices to synchronize clocks with central source clock.
- NTP is very important for network devices like routers, switches, server and firewalls.
- NTP make sure logging information and timestamps have the accurate time and date.
- NTP is runs over User Datagram Protocol (UDP).
- NTP is a protocol used on networks to maintain clock time.
- NTP uses a hierarchical system of time sources.
- NTP used client server architecture to work.
- NTP uses UDP port number 123.
- NTP have two version NTP Version 3 and Version 4.
- NTP Server is also called as NTP Master.
- CISCO Router and Switch can be configured in three modes Server, Client and Server/Client Mode.
- By default router works in NTP Server/Client mode.
- Stratum defines the reliability and accuracy of NTP source.
- NTP uses of stratum 0 to Stratum 15 for NTP Sources.
- One (1) is the most reliable and 15 are the worst NTP sources.
- Stratum 0 represents Atomic Clock and not used in CISCO Router or Switch.
- Stratum 1 to 15 are valid levels and used in CISCO Router and Switches.
- Stratum 16 represents NTP is not synchronized.
- Default stratum level of CISCO Router or Switches internal clock is 8.
- Syslog messages timestamp using the Network Time Protocol (NTP).

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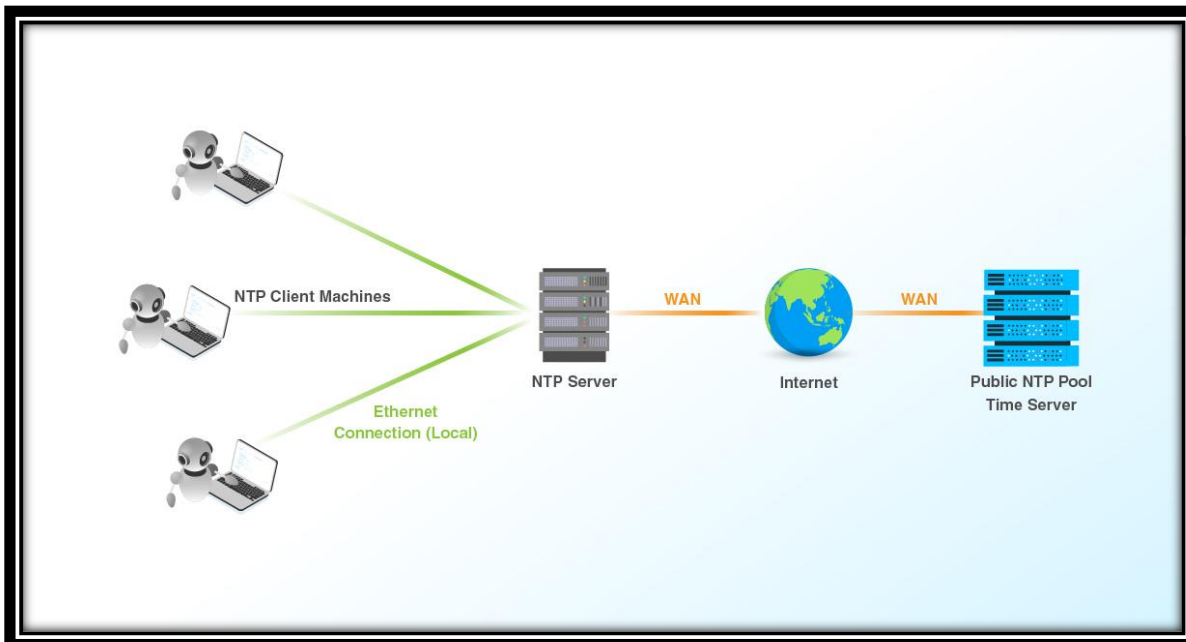
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NTP Stratum:

- NTP Stratum levels define the distance from the reference clock.
- A Stratum-0 device that is assumed to be most accurate and it has no delay.
- NTP Stratum-0 servers cannot be used on the network.

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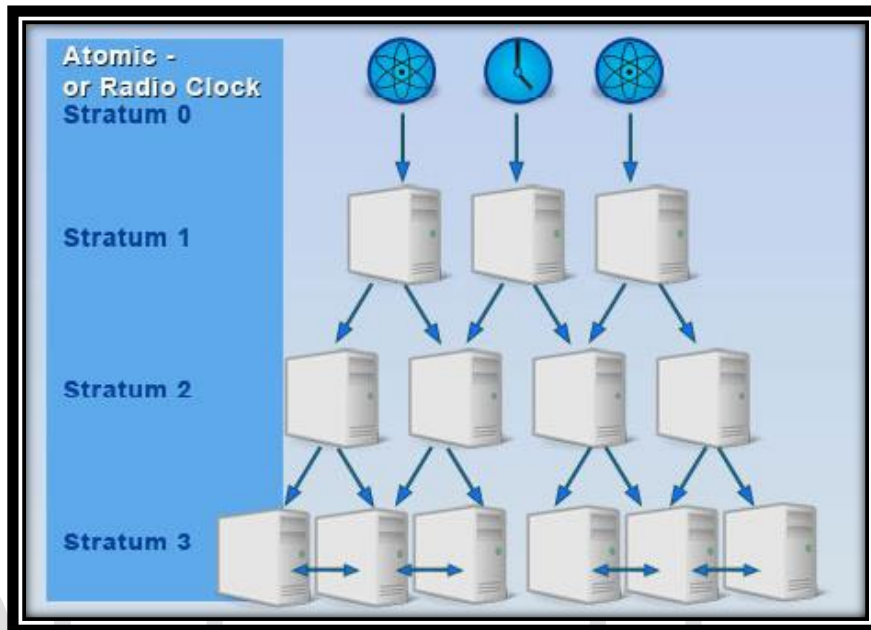
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NTP Architecture:

- NTP uses stratum 1 to 16 to define clock accuracy.
- A lower NTP stratum value represents higher accuracy.
- Clocks at NTP stratum 1 through 15 are in synchronized state.
- Clocks at Network Time Protocol stratum 16 are not synchronized.

NTP Modes:

- CISCO Router and Switches can use four different NTP modes.
 1. NTP Server,
 2. NTP Client,
 3. NTP Server/Client
 4. NTP Peer

NTP Server Mode:

- NTP Server is a network device, which running NTP service.
- NTP Server is configured to provide Time information to NTP Clients.
- NTP Server never accept time synchronization information from other devices.

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- NTP Server mode router reads time from NTP source or uses its own clock as NTP source.

NTP Client Mode:

- NTP Clients mode Only receives NTP updates.
- NTP Clients does not advertise received updates.
- NTP Clients uses them to synchronize its own clock.

NTP Server/Clients Mode:

- NTP Server/Clients, Router receives updates from NTP Server.
- NTP Server/Clients also advertises them from its own interfaces.
- CISCO Router and Switch play both role NTP Server and Clients.
- As NTP Clients, it received NTP updates and as NTP Server, it advertises NTP updates.

NTP Peer Mode:

- In NTP peer modes each device can provide time synchronization to other.
- So, one can synchronize the other in case of failures.

NTP Master:

- When we make NTP master then internal devices can synchronize use NTP master command.
- NTP Master command tells router that it is an NTP Server.
- NTP Server is also referred to as an NTP Master.

NTP Versions:

- We have two NTP version that is version 3 and version 4.
- Version 4 supports IPV6 and it backwards compatible with NTP version 3.
- NTP Version 4 also adds DNS support for IPV6.
- NTPv3 use broadcast messages where as NTPV4 use Multicast.
- NTPV4 is more secure compare to NTP V3.

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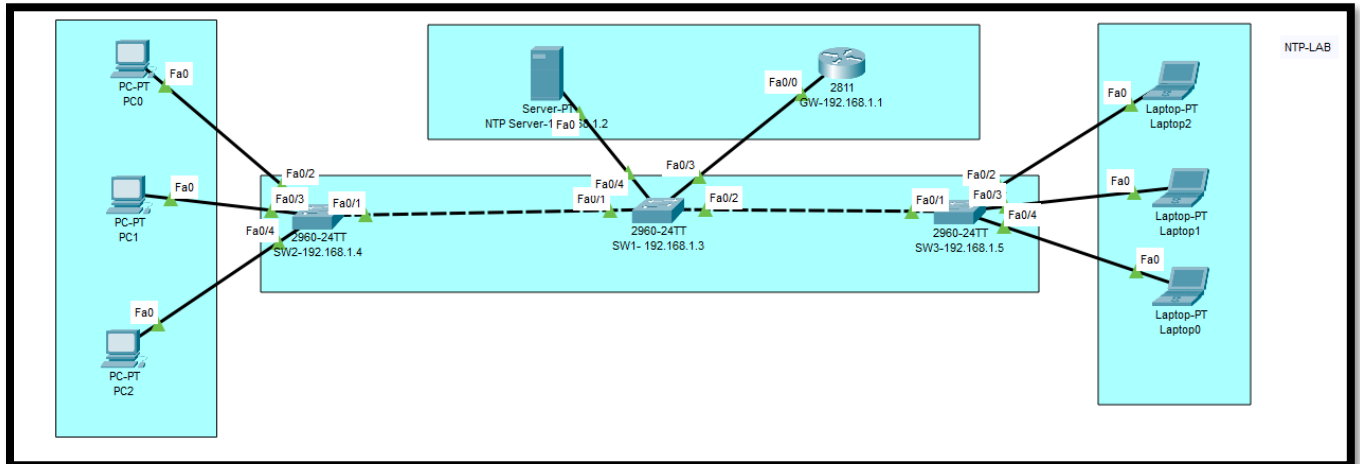
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NTP Security and Authentication:

- NTP can be secured by authentication mechanism that uses MD5 algorithm.
- All NTP packets that can update the clock have to be authenticated.
- The packets will be authenticated using HMAC MD5 which carries a key number.

NTP Lab in Packet Tracer:



R1 Configuration:	SW1 Configuration:
<pre>en config t hostname R1 int f0/0 ip add 192.168.1.1 255.255.255.0 no sh ntp server 192.168.1.2</pre>	<pre>en config t hostname SW1 int vlan 1 ip add 192.168.1.3 255.255.255.0 no sh</pre>

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	<pre>ip default-gateway 192.168.1.1 ntp server 192.168.1.2</pre>
SW2 Configuration:	SW3 Configuration:
<pre>en config t hostname SW2 int vlan 1 ip add 192.168.1.4 255.255.255.0 no sh ip default-gateway 192.168.1.1 ntp server 192.168.1.2</pre>	<pre>en config t hostname SW3 int vlan 1 ip add 192.168.1.5 255.255.255.0 no sh ip default-gateway 192.168.1.1 ntp server 192.168.1.2</pre>
Output: Sh ntp status Sh clock	<pre>R1#sh clock 12:18:16.312 UTC Sun Jan 17 2021 R1#sh ntp status Clock is synchronized, stratum 16, reference is 192.168.1.2 nominal freq is 250.0000 Hz, actual freq is 249.9990 Hz, precision is 2**24 reference time is 17EB4FF2.000002C1 (21:58:10.705 UTC Sat Dec 5 2048) clock offset is 0.00 msec, root delay is 0.00 msec root dispersion is 10.00 msec, peer dispersion is 0.12 msec. loopfilter state is 'CTRL' (Normal Controlled Loop), drift is - 0.000001193 s/s system poll interval is 4, last update was 11 sec ago.</pre>

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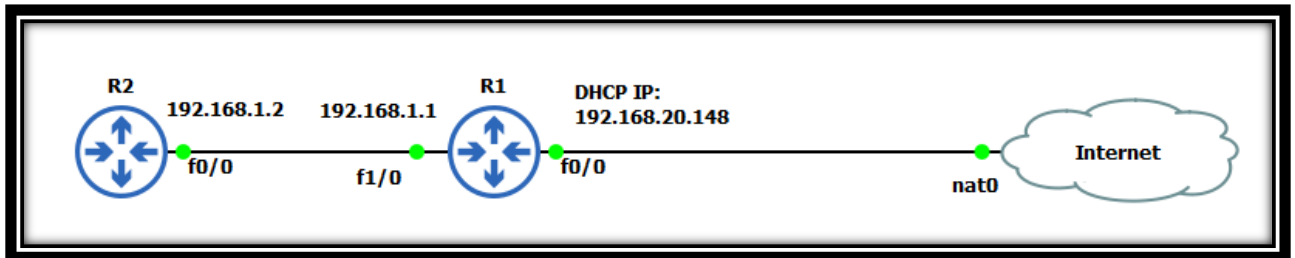
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Lab Time:



R1 Configuration	R2 Configuration
<pre>en config t hostname R1 int f0/0 ip add dhcp no sh exit ip name-server 8.8.8.8 ip domain-lookup int f1/0 ip add 192.168.1.1 255.255.255.0 no sh ip domain-lookup</pre>	<pre>en config t hostname R2 int f0/0 ip add 192.168.1.2 255.255.255.0 no sh</pre>
Adjust Router Clock (R1)	
<pre>Sh clock Sh clock detail Clock set 22:36:00 Oct 20 2020 Config t: Clock timezone UTC+3 Show clock Config t: ntp server sa.pool.ntp.org Sh ntp status Sh ntp associations</pre>	

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Interpret network time protocol configurations such as NTP and PTP:

- Network Time Protocol (NTP) is a protocol used to synchronize the clocks of computer systems over packet-switched, variable-latency data networks. It is used in a wide variety of applications, including synchronizing computer clocks, controlling industrial processes, and providing timestamping for data.
- NTP is a client-server protocol. A client computer sends a request to a server computer, which responds with the current time. The client then adjusts its clock to match the server's clock.
- NTP is a very reliable protocol. It can achieve accuracies of a **few milliseconds** over short distances and a few seconds over long distances.
- NTP is a valuable tool for ensuring that computer clocks are synchronized. It is used in a wide variety of applications, and there are many different implementations available.
- **PTP is the abbreviation of Precision Time Protocol. It is a standard based network protocol defined as IEEE-1588 standard. PTP (Precision Time Protocol) is basically used for the clock synchronization throughout a computer network.**
- **Precision Time Protocol (PTP)** is a more accurate and precise version of NTP. It is used in applications where high-accuracy time synchronization is required, such as telecommunications and power grids.
- **PTP clock accuracy is in the sub-microsecond range. This is a very good clock quality. PTP accuracy is higher than NTP (Network Time Protocol) accuracy. Because NTP provides only millisecond accuracy.** This accuracy let Precision Time Protocol used in critical systems like financial transactions, aircraft monitoring.
- PTP works by using a hierarchical structure of clocks. The clocks at the top of the hierarchy are called **primary reference clocks (PRCs)**. The clocks at the bottom of the hierarchy are called **ordinary clocks (OCs)**.
- **OCs synchronize their clocks with the PRCs using a process called time stamping.** Time stamping is the process of assigning a timestamp to a packet of data. The timestamp indicates the time at which the packet was generated.
- The OCs use the timestamps to calculate the time difference between their clocks and the PRCs. They then adjust their clocks accordingly.
- **PTP is a very accurate and precise protocol.** It can achieve accuracies of a few microseconds over short distances and a few milliseconds over long distances.
- PTP is a valuable tool for ensuring that clocks are synchronized in applications where high-accuracy time synchronization is required. It is used in a wide variety of applications, including telecommunications and power grids.

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Here are some of the benefits of using PTP:

- It is more accurate and precise than NTP.
- It can be used in applications where high-accuracy time synchronization is required.
- It is supported by a wide range of devices.

Here are some of the drawbacks of using PTP:

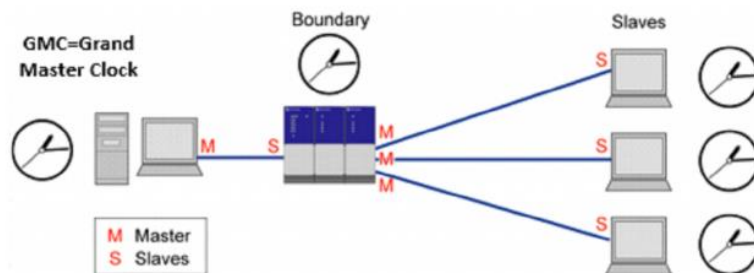
- It is more complex to configure and use than NTP.
- It is not as widely used as NTP.
- It can be more expensive than NTP.

NTP	PTP
Millisecond accuracy	Sub-Microsecond accuracy
WAN Networks and Public Networks	LAN and WAN
Security with hash codes	Security with cryptography
Used in home automation, Industrial automation etc.	Used in financial transactions, aircraft monitoring.

Overall, PTP is a valuable tool for ensuring that clocks are synchronized in applications where high-accuracy time synchronization is required. It is more accurate and precise than NTP, and it is supported by a wide range of devices. However, it is important to be aware of the complexity and cost of PTP before using it

PTP Clock Types:

The types of clocks available are as follows:



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- Grand Master Clock (GMC): the reference time source derived from an accurate clock.
- Boundary Clock (BC): A network device that acts as slave to its master and as master to its slaves.
- Ordinary Clock (OC): A clock that operates either as a Master or a Slave. In the case of a slave, the end point whose clock is been synced (normally a host/server).
- Master Clock (MC): A clock that operates as a Master and derives its timing capabilities from the clock chain up to the GMC. It typically serves as a port on a BC connected to a host running as a slave.

Cisco PTP Configuration:

If we want to enable PTP on CISCO device then we should enable it globally on that router with command “ptp”

```
Router# configure terminal
Router(config)# ptp
Router(config-ptp)# commit
Router(config-ptp)# end
```

To check the clock provided by PTP, we use, “show ptp advertised-clock” command

Configuring PTP Master:

To configure PTP Master, we use “ptp” command under interface. When we enable ptp under an interface, by default, it becomes PTP Master.

```
Router# configure terminal
Router(config)# interfaceGigabitEthernet 0/0/0
Router(config-if)# ptp
Router(config-ptp-if)# commit
Router(config-ptp)# end
```

To check PTP Master state of an interface, we will use **“show ptp interface interface”** command for this interface.



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Configuring PTP Slave:

To configure PTP Slave, we specify master with “master { ipv4 | ethernet }” command after “ptp” command.

```
Router #configure terminal
Router(config)# interface GigabitEthernet 0/0/1
Router(config-if)# ptp
Router(config-if-ptp)# master { ipv4 | ethernet }
Router(config-if-ptp-master)# commit
```

PTP Verification:

To verify PTP configuration, we can use “show ptp interfaces” command. With this command, we can see details of PTP configuration and Master table.

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