CCNA 200-301, Volume 2

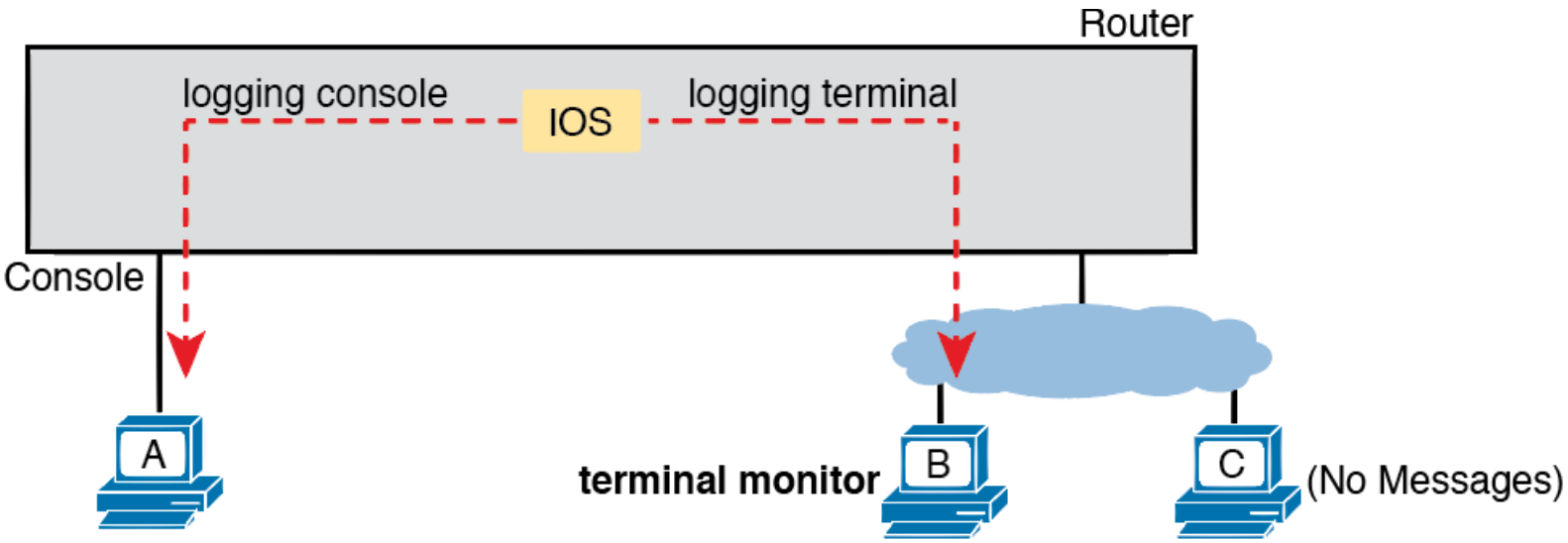
Chapter 9

Device Management Protocols

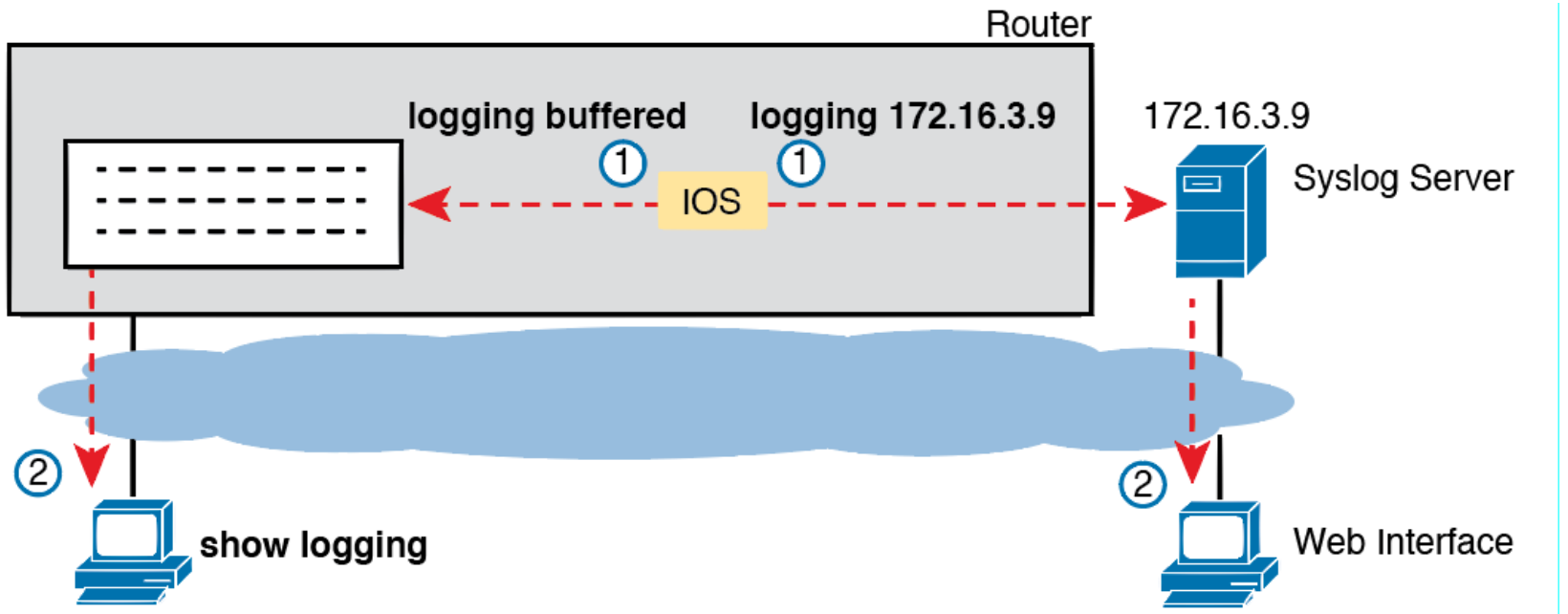
Objectives

- Configure and verify Layer 2 discovery protocols (Cisco Discovery Protocol and LLDP)
- Configure and verify NTP operating in a client and server mode
- Describe the use of syslog features including facilities and levels

IOS Processing for Log Messages to Current Users



IOS Storing Log Messages for Later View: Buffered and Syslog Server



Disabling Timestamps and Enabling Sequence Numbers in Log Messages

```
R1(config)# no service timestamps
R1(config)# service sequence-numbers
R1(config)# end
R1#
000011: %SYS-5-CONFIG_I: Configured from console by console
```

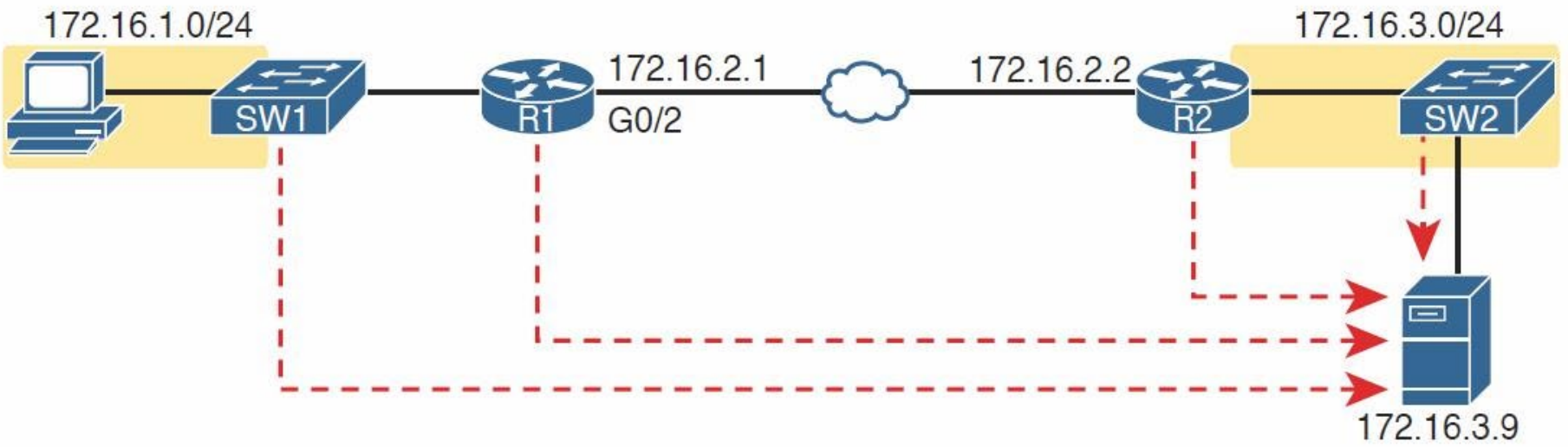
Syslog Message Severity Levels by Keyword and Numeral

Keyword	Numeral	Description	
Alert	0	Immediate action required	Severe
Emergency	1	System unusable	
Critical	2	Critical Event (Highest of 3)	Impactful
Error	3	Error Event (Middle of 3)	
Warning	4	Warning Event (Lowest of 3)	
Notification	5	Normal, More Important	Normal
Informational	6	Normal, Less Important	
Debug	7	Requested by User Debug	Debug

How to Configure Logging Message Levels for Each Log Service

Service	To Enable Logging	To Set Message Levels
Console	logging console	logging console *level-name*|*level-number*
Monitor	logging monitor	logging monitor *level-name*|*level-number*
Buffered	logging buffered	logging buffered *level-name*|*level-number*
Syslog	logging host *address*|*hostname*	logging trap *level-name*|*level-number*

Sample Network Used in Logging Examples



Syslog Configuration on R1

```
logging console 7
logging monitor debug
logging buffered 4
logging host 172.16.3.9
logging trap warning
```

Viewing the Configured Log Settings of the Earlier Example

```
R1# show logging
Syslog logging: enabled (0 messages dropped, 3 messages rate-limited, 0 flushes, 0
overruns, xml disabled, filtering disabled)

No Active Message Discriminator.

No Inactive Message Discriminator.

    Console logging: level debugging, 45 messages logged, xml disabled,
                     filtering disabled
    Monitor logging: level debugging, 0 messages logged, xml disabled,
                     filtering disabled
    Buffer logging: level warnings, 0 messages logged, xml disabled,
                    filtering disabled
```

Viewing the Configured Log Settings of the Earlier Example (continued)

```
    Exception Logging: size (8192 bytes)
    Count and timestamp logging messages: disabled
    Persistent logging: disabled

No active filter modules.

    Trap logging: level warnings, 0 message lines logged
       Logging to 172.16.3.9 (udp port 514, audit disabled,
            link up),
            0 message lines logged,
            0 message lines rate-limited,
            0 message lines dropped-by-MD,
           xml disabled, sequence number disabled
           filtering disabled
       Logging Source-Interface: VRF Name:

Log Buffer (8192 bytes):
```

Seeing Severity 3 and 5 Messages at the Console, and Severity 3 Only in the Buffer

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# interface g0/1
R1(config-if)# shutdown
R1(config-if)#
*Oct 21 20:07:07.244: %LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to
administratively down
*Oct 21 20:07:08.244: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEther-
```

Seeing Severity 3 and 5 Messages at the Console, and Severity 3 Only in the Buffer (continued)

```
net0/1, changed state to down
R1(config-if)# no shutdown
R1(config-if)#
*Oct 21 20:07:24.312: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to
up
*Oct 21 20:07:25.312: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEther-
net0/1, changed state to up
R1(config-if)# ^Z
R1#
*Oct 21 20:07:36.546: %SYS-5-CONFIG_I: Configured from console by console
R1# show logging
! Skipping about 20 lines, the same lines in Example 9-3, until the last few lines

Log Buffer (8192 bytes):

*Oct 21 20:07:24.312: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to
up
```

Using **debug ip ospf hello** from R1's Console

```
R1# debug ip ospf hello
OSPF hello debugging is on
R1#
*Aug 10 13:38:19.863: OSPF-1 HELLO Gi0/1: Send hello to 224.0.0.5 area 0 from
172.16.1.1
*Aug 10 13:38:21.199: OSPF-1 HELLO Gi0/2: Rcv hello from 2.2.2.2 area 0 172.16.2.2
*Aug 10 13:38:22.843: OSPF-1 HELLO Gi0/2: Send hello to 224.0.0.5 area 0 from
172.16.2.1
R1#
```

Log Messages from Routers R1 and R2, Compared

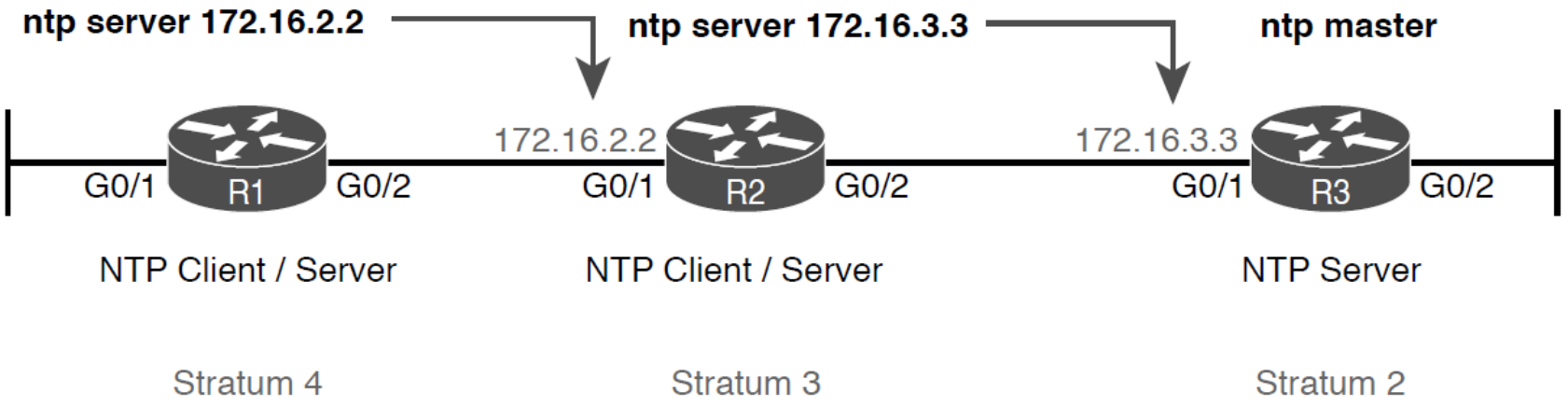
```
*Oct 19 13:38:37.568: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial0/0/0 from FULL
to DOWN, Neighbor Down: Interface down or detached

*Oct 19 13:38:40.568: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to down
```

```
! These messages happened on router R2

Oct 19 09:44:09.027: %LINK-3-UPDOWN: Interface Serial0/0/1, changed state to down

Oct 19 09:44:09.027: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial0/0/1 from FULL
to DOWN, Neighbor Down: Interface down or detached
```

Setting the Date/Time with **clock set**, Plus Timezone/DST

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# clock timezone EST -5
R1(config)# clock summer-time EDT recurring
R1(config)# ^Z
R1#
R1# clock set 20:52:49 21 October 2015
*Oct 21 20:52:49.000: %SYS-6-CLOCKUPDATE: System clock has been updated from 00:36:38
UTC Thu Oct 22 2015 to 20:52:49 UTC Wed Oct 21 2015, configured from console by
console.
R1# show clock
20:52:55.051 EDT Wed Oct 21 2015
```

R1 as NTP Client, R2 as Client/Server, R3 as Server



NTP Client/Server Configuration

```
! Configuration on R1:
ntp server 172.16.2.2
```

```
! Configuration on R2:
ntp server 172.16.3.3
```

```
! Configuration on R3:
ntp master 2
```

Verifying NTP Client Status on R1

```
R1# show ntp status
Clock is synchronized, stratum 4, reference is 172.16.2.2
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**21
ntp uptime is 1553800 (1/100 of seconds), resolution is 4000
reference time is DA5E7147.56CADEA7 (19:54:31.339 EST Thu Feb 4 2016)
clock offset is 0.0986 msec, root delay is 2.46 msec
root dispersion is 22.19 msec, peer dispersion is 5.33 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000000009 s/s
system poll interval is 64, last update was 530 sec ago.
```

Verifying NTP Client Status on R1 and R2

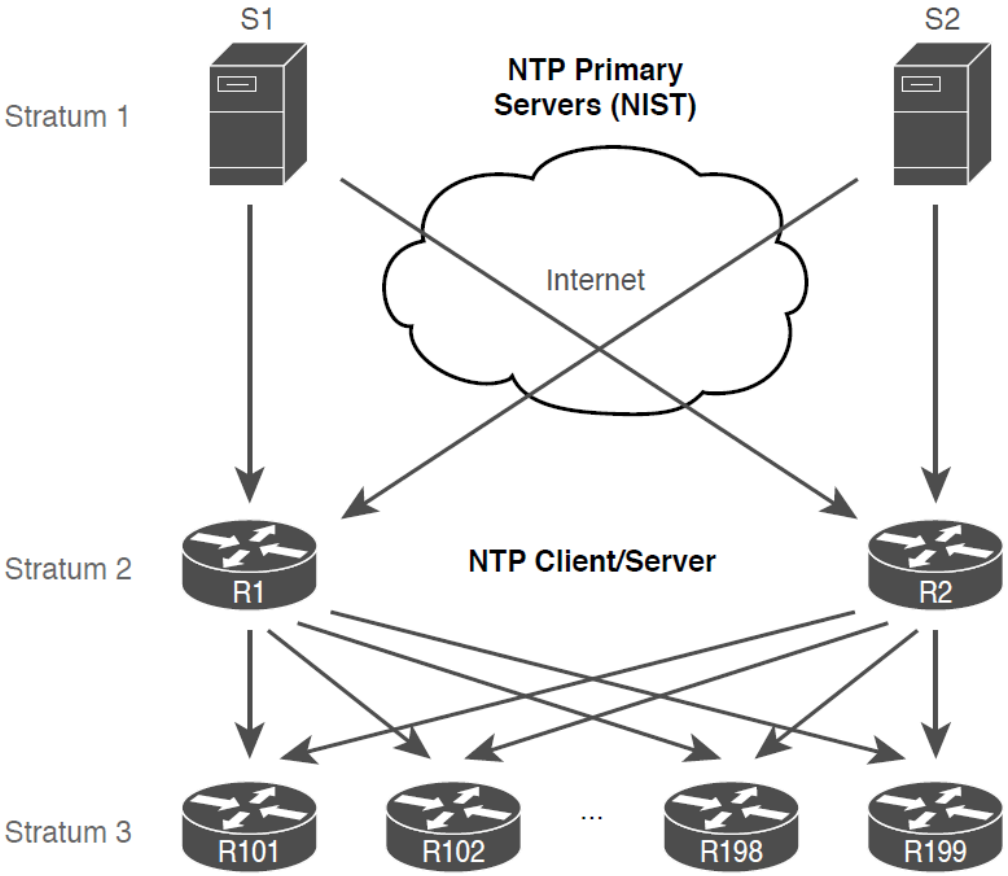
```
R1# show ntp associations
! This output is taken from router R1, acting in client/server mode
   address    ref clock      st  when poll  reach  delay  offset  disp
*~172.16.2.2  172.16.3.3     3   50    64   377    1.223  0.090   4.469
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
R2# show ntp associations
! This output is taken from router R2, acting in client/server mode
 address       ref clock     st  when poll  reach  delay  offset  disp
*~172.16.3.3   127.127.1.1   2   49    64   377    1.220  -7.758  3.695
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

Examining NTP Server, Reference Clock, and Stratum Data

```
R3# show ntp status
Clock is synchronized, stratum 2, reference is 127.127.1.1
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**20
ntp uptime is 595300 (1/100 of seconds), resolution is 4000
reference time is E0F9174C.87277EBB (16:13:32.527 daylight Sat Aug 10 2019)
clock offset is 0.0000 msec, root delay is 0.00 msec
root dispersion is 0.33 msec, peer dispersion is 0.23 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000000000 s/s
system poll interval is 16, last update was 8 sec ago.

R3# show ntp associations
  address         ref clock       st   when   poll reach  delay  offset   disp
*~127.127.1.1     .LOCL.           1     15     16   377  0.000   0.000  0.232
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

Stratum Levels When Using an Internet-based Stratum 1 NTP Server



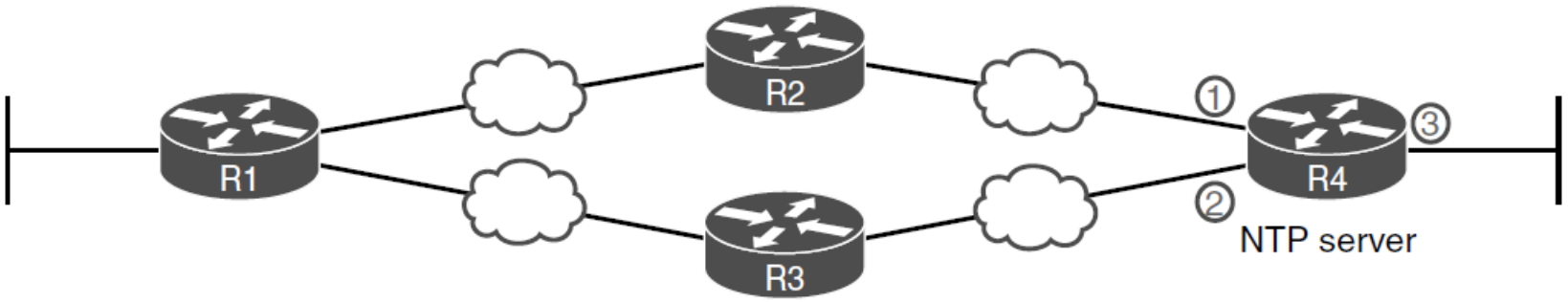
NTP Configuration on R1, R2 per Graphic on Previous Slide

```
ntp server time-a-b-nist.gov
ntp server time-a-g.nist.gov
```

NTP Configuration on R1 and R2 to Protect Against Internet Failures

```
ntp server time-a-b-nist.gov
ntp server time-a-g.nist.gov
ntp master 7
```

The Availability Issue of Referencing an NTP Server's Physical Interface IP Address



NTP Client/Server Configuration on R1 and R2 Using a Loopback Interface

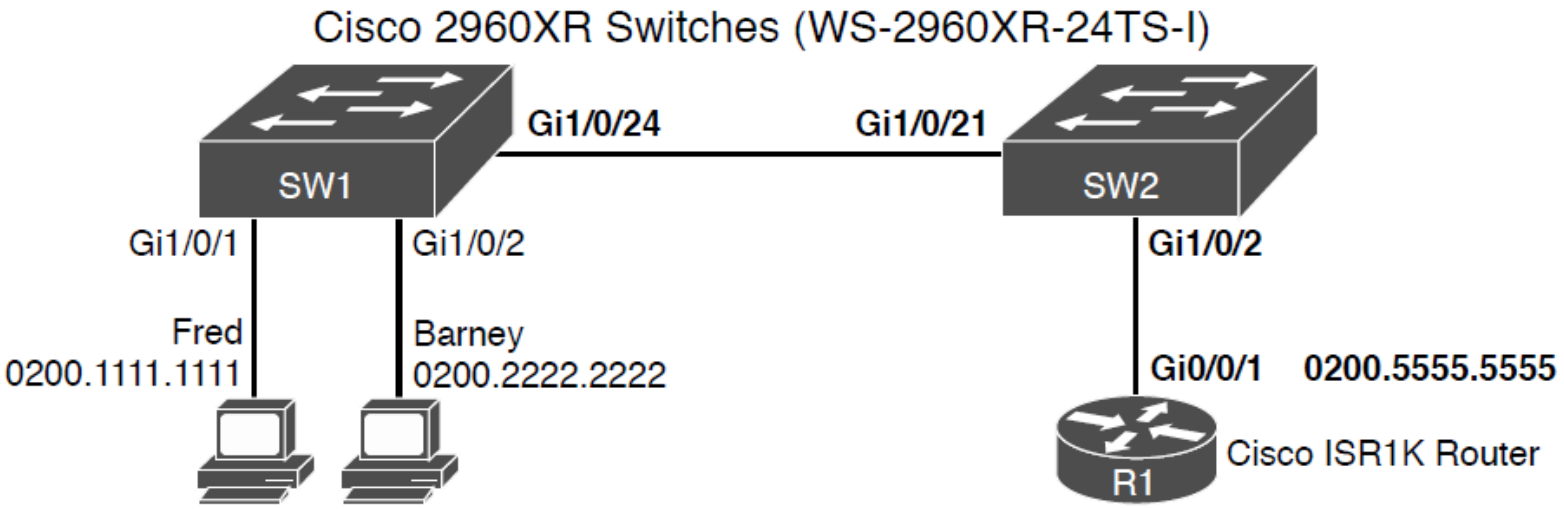
```
! Configuration on R1, a client
ntp server 172.16.9.9
```

```
! Configuration on R2 for its server function
interface loopback 0
   ip address 172.16.9.9 255.255.255.0
!
ntp master 4
ntp source loopback 0
! Verification on router R2
R2# show interfaces loopback 0
Loopback0 is up, line protocol is up
   Hardware is Loopback
   Internet address is 172.16.9.9/24
! lines omitted for brevity
```

show cdp Commands That List Information About Neighbors

Command	Description
show cdp neighbors *[type number]*	Lists one summary line of information about each neighbor, or just the neighbor found on a specific interface if an interface was listed.
show cdp neighbors detail	Lists one large set (approximately 15 lines) of information, one set for every neighbor.
show cdp entry *name*	Lists the same information as the **show cdp neighbors detail** command, but only for the named neighbor (case sensitive).

Small Network Used in CDP Examples



show cdp neighbors Command Examples: SW2

```
SW2# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
SW1              Gig 1/0/21        155              S I   WS-C2960X Gig 1/0/24
R1               Gig 1/0/2         131            R S I   C1111-8P  Gig 0/0/1

Total cdp entries displayed : 2
```

show cdp neighbors detail Command on SW2

```
SW2# show cdp neighbors detail
-------------------------
Device ID: SW1
Entry address(es):
  IP address: 1.1.1.1
Platform: cisco WS-C2960XR-24TS-I,  Capabilities: Switch IGMP
Interface: GigabitEthernet1/0/21,  Port ID (outgoing port): GigabitEthernet1/0/24
Holdtime : 144 sec

Version :
Cisco IOS Software, C2960X Software (C2960X-UNIVERSALK9-M), Version 15.2(6)E2, RELEASE
SOFTWARE (fc4)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Thu 13-Sep-18 03:43 by prod_rel_team

advertisement version: 2
Protocol Hello:  OUI=0x00000C, Protocol ID=0x0112; payload len=27, value=00000000FFFFF
FFF010225010000000000000BCC4938BA180FF0000
VTP Management Domain: 'fred'
Native VLAN: 1
Duplex: full
Management address(es):
  IP address: 1.1.1.1
```

show cdp neighbors detail Command on SW2 (continued)

```
Device ID: R1
Entry address(es):
  IP address: 10.12.25.5
Platform: cisco C1111-8P,  Capabilities: Router Switch IGMP
Interface: GigabitEthernet1/0/2,  Port ID (outgoing port): GigabitEthernet0/0/1
Holdtime : 151 sec

Version :
Cisco IOS Software [Fuji], ISR Software (ARMV8EB_LINUX_IOSD-UNIVERSALK9_IAS-M), Ver-
sion 16.8.1, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Tue 27-Mar-18 10:56 by mcpre

advertisement version: 2
```

show cdp neighbors detail Command on SW2 (continued)

```
VTP Management Domain: ''
Duplex: full
Management address(es):
  IP address: 10.12.25.5

Total cdp entries displayed : 2
```

Commands Used to Verify CDP Operations

Command	Description
show cdp	States whether CDP is enabled globally, and lists the default update and holdtime timers.
show cdp interface [type number]	States whether CDP is enabled on each interface, or a single interface if the interface is listed, and states update and holdtime timers on those interfaces.
show cdp traffic	Lists global statistics for the number of CDP advertisements sent and received.

show cdp Commands That Show CDP Status

```
SW2# show cdp
Global CDP information:
        Sending CDP packets every 60 seconds
        Sending a holdtime value of 180 seconds
        Sending CDPv2 advertisements is enabled

SW2# show cdp interface GigabitEthernet1/0/2
GigabitEthernet1/0/2 is up, line protocol is up
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds

SW2# show cdp traffic
CDP counters :
        Total packets output: 304, Input: 305
        Hdr syntax: 0, Chksum error: 0, Encaps failed: 0
        No memory: 0, Invalid packet: 0,
        CDP version 1 advertisements output: 0, Input: 0
        CDP version 2 advertisements output: 304, Input: 305
```

show lldp neighbors on SW2 with Similarities to CDP Highlighted

```
SW2# show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID           Local Intf     Hold-time  Capability      Port ID
R1                  Gi1/0/2        120        R               Gi0/0/1
SW1                 Gi1/0/21       120        B               Gi1/0/24

Total entries displayed: 2

SW2# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
SW1              Gig 1/0/21        155              S I   WS-C2960X Gig 1/0/24
R1               Gig 1/0/2         131             R S I  C1111-8P  Gig 0/0/1
Total entries displayed: 2
```

show lldp entry r2 Command on SW2

```
SW2# show lldp entry R1

Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
------------------------------------------------
Local Intf: Gi1/0/2
Chassis id: 70ea.1a9a.d300
Port id: Gi0/0/1
Port Description: GigabitEthernet0/0/1
System Name: R1

System Description:
Cisco IOS Software [Fuji], ISR Software (ARMV8EB_LINUX_IOSD-UNIVERSALK9_IAS-M),
Version 16.8.1, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Tue 27-Mar-18 10:56 by mcpre
Time remaining: 100 seconds
System Capabilities: B,R
Enabled Capabilities: R
Management Addresses:
    IP: 10.12.25.5
Auto Negotiation - not supported
Physical media capabilities - not advertised
Media Attachment Unit type - not advertised
Vlan ID: - not advertised


Total entries displayed: 1
```

Enabling LLDP on All Ports, Disabling on a Few Ports

```
lldp run
!
interface gigabitEthernet1/0/17
 no lldp transmit
 no lldp receive
!
interface gigabitEthernet1/0/18
 no lldp receive
```

Enabling LLDP on Limited Ports, Leaving Disabled on Most

```
interface gigabitEthernet1/0/19
 lldp transmit
 lldp receive
!
interface gigabitEthernet1/0/20
 lldp receive
```

show lldp Commands That Show LLDP Status

```
SW2# show lldp
Global LLDP Information:
    Status: ACTIVE
    LLDP advertisements are sent every 30 seconds
    LLDP hold time advertised is 120 seconds
    LLDP interface reinitialisation delay is 2 seconds

SW2# show lldp interface g1/0/2

GigabitEthernet1/0/2:
    Tx: enabled
    Rx: enabled
    Tx state: IDLE
    Rx state: WAIT FOR FRAME

SW2# show lldp traffic

LLDP traffic statistics:
    Total frames out: 259
    Total entries aged: 0
    Total frames in: 257
    Total frames received in error: 0
    Total frames discarded: 0
    Total TLVs discarded: 0
    Total TLVs unrecognized: 0
```