

Layer 2 Discovery Protocols (CDP and LLDP)

- **Exam Topic:** 2.3 (Configure and verify Layer 2 discovery protocols CDP and LLDP).
- **Lecture Overview:**
 - Brief overview of Layer 2 discovery protocols.
 - Cisco Discovery Protocol (CDP).
 - Link Layer Discovery Protocol (LLDP).
- **Comparison:** CDP and LLDP are very similar in function and configuration but have key differences.
- **Practice Resource:** Boson Software's ExSim for CCNA simulates real exam style and difficulty.

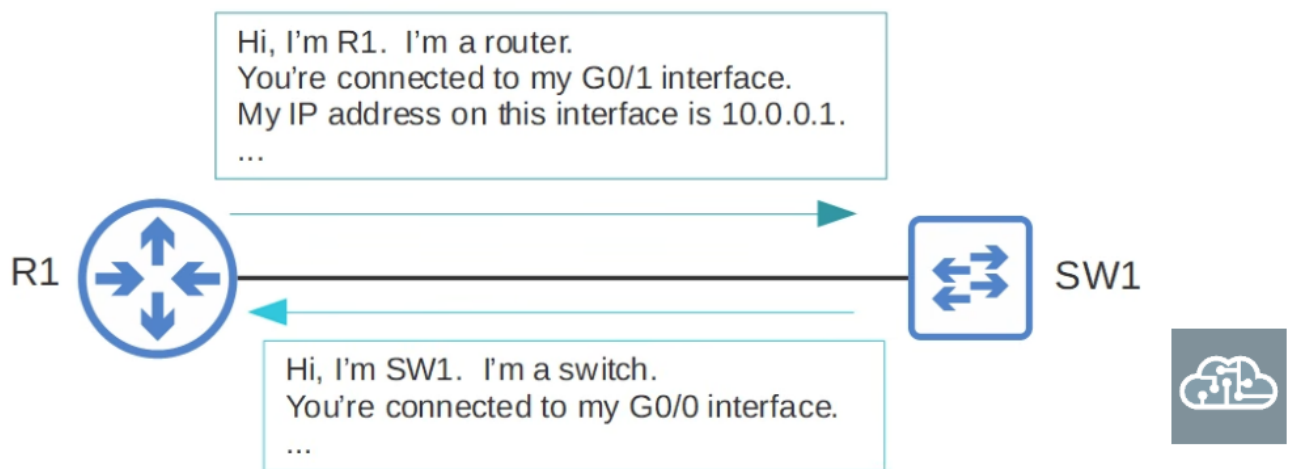
Overview of Layer 2 Discovery Protocols

- **Function:** Layer 2 discovery protocols such as CDP and LLDP share information with, and discover information about, neighboring (directly connected) devices.
- **Layer 2 Operation:** Operate at Layer 2 and do not use IP addresses.
 - Wireshark captures show no IP packets inside the frames sent by CDP and LLDP.
- **Shared Information:** Host name, IP address, device type, etc.
 - Although they are Layer 2 protocols, they can share Layer 3 information (e.g., IP addresses).
- **Protocols:**
 - **CDP:** Cisco proprietary protocol, developed by Cisco for Cisco devices.
 - **LLDP:** Industry standard protocol (IEEE 802.1AB).

- **Vendor Compatibility:**
 - Use CDP if the network uses only Cisco devices.
 - Use LLDP if there is a mix of vendors (e.g., Cisco routers, Juniper switches, Palo Alto firewalls).
- **Security Consideration:** These protocols can be a security risk because they share device information. Network engineers/admins must decide whether to use them.

Example: How the Protocols Work

- **Scenario:** Two devices, R1 and SW1, are directly connected.
- **Behavior:**



- R1 periodically sends frames to SW1, sharing information like hostname, device type, interface ID, IP address, etc.
- SW1 periodically sends frames to R1 with similar information.
- **Note:** SW1 does not include an IP address in its messages to R1 because it is a switch and its interface does not have an IP address.

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Cisco Discovery Protocol (CDP)

- **Nature:** Cisco proprietary protocol.

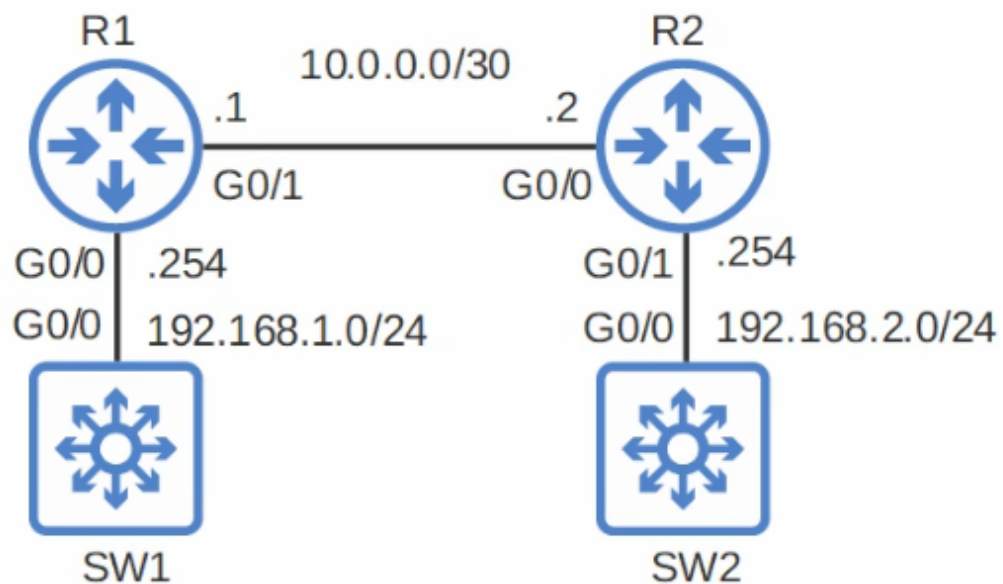
- **Default State:** Enabled on Cisco devices by default.
 - **Example:** Cisco routers, Cisco switches, Cisco firewalls, Cisco IP phones — all have CDP enabled by default.
- **Multicast Address:** CDP messages are periodically sent to multicast MAC address `0100.0CCC.CCCC`.
 - *Note:* This MAC address will be in the Anki flashcards.
 - MAC addresses used by different protocols (CDP, STP, PVST, HSRP, VRRP, etc.) are difficult to memorize. Use Anki flashcards with specific tags to review MAC address cards whenever you want.
- **Scope / Message Handling:**
 - Because CDP uses a multicast MAC address, you might think the message is forwarded to multiple devices — but it is not.
 - When a device receives a CDP message, it **processes and discards** the message. It does **not** forward it to other devices.
 - Therefore, only **directly connected neighbors** can become CDP neighbors.
- **Timers:**
 - **Message Frequency:** By default, CDP messages are sent once every **60 seconds**, out of all interfaces that are in an **up state**.
 - These messages contain information such as host name, IP address, etc.
 - **CDP Neighbor Table:** When a device receives CDP messages from a neighboring device, it adds an entry for that device in its **CDP neighbor table**.
 - **Holdtime:** Default is **180 seconds**. If a message is not received from a neighbor for 180 seconds, the neighbor is removed from the CDP neighbor table.
 - This ensures the CDP neighbor table does not contain entries from old neighbors that are no longer connected.

- **Version:**

- **Default:** CDP version 2 messages are sent by default.
- There are two versions of CDP — version 1 and version 2 — but version 2 is used by default.
- CDP version 1 is very old; you will probably never need to use it.
- You do not need to know the differences between version 1 and version 2, but basically version 2 provides a few more advanced features like the ability to **identify native VLAN mismatches**.

Cisco Discovery Protocol (CDP) CLI Commands

- **Lab Network Setup:**



- Used to demonstrate CDP and LLDP.
- Consists of two routers and two multilayer switches (Layer 3 functions on switches are not being used).

- **Basic CDP Show Commands:**

```
R1#show cdp
Global CDP information:
    Sending CDP packets every 60 seconds
    Sending a holdtime value of 180 seconds
    Sending CDPv2 advertisements is enabled

R1#
R1#show cdp traffic
CDP counters :
    Total packets output: 105, Input: 112
    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: 105, Input: 112

R1#
```

- `show cdp:`

- Displays global CDP information.
- Shows the CDP timer (60 seconds by default).
- Shows the CDP holdtime (180 seconds by default).
- Shows the CDP version in use (version 2 by default).

```
R1#show cdp
Global CDP information:
    Sending CDP packets every 60 seconds
    Sending a holdtime value of 180 seconds
    Sending CDPv2 advertisements is enabled

R1#
R1#show cdp traffic
CDP counters :
    Total packets output: 105, Input: 112
    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: 105, Input: 112

R1#
```

```
R1#show cdp
% CDP is not enabled
R1#
```

R1 R2

- *Note:* If CDP is not enabled, this command will output: "CDP is not enabled".

- `show cdp traffic:`

```
R1#show cdp traffic
CDP counters :
  Total packets output: 105, Input: 112
  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: 105, Input: 112
R1#
```

- Displays statistics on CDP packets sent and received.
- Shows the count of CDP advertisements sent and received.
- **Example:** R1 had sent 105 CDP messages and received 112 CDP messages, all of which were CDP version 2.

- `show cdp interface:`

```
R1#show cdp interface
GigabitEthernet0/0 is up, line protocol is up
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/1 is up, line protocol is up
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/2 is administratively down, line protocol is down
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
GigabitEthernet0/3 is administratively down, line protocol is down
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds

cdp enabled interfaces : 4
interfaces up          : 2
interfaces down        : 2
```

- Provides basic CDP information for each interface.
- Shows the CDP message timer and holdtime for the interface.
- Displays the encapsulation type (e.g., 'ARPA', which is also known as Ethernet 2).

```
cdp enabled interfaces : 4
interfaces up          : 2
interfaces down        : 2
```

- Displays a summary of CDP-enabled interfaces and their status (up or down).
- Can be used to view all interfaces or a specific interface.

CDP Neighbor Table (`show cdp neighbors`)

- Command: `show cdp neighbors`

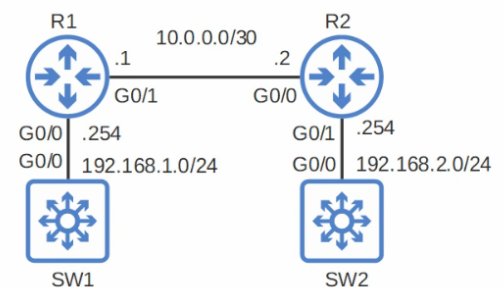
```
R1#show cdp neighbors
```

```
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 0/0	153	R S I		Gig 0/0
R2	Gig 0/1	146	R B		Gig 0/0

```
Total cdp entries displayed : 2
```

```
R1#
```



- Displays a table of directly connected CDP-enabled devices.

- **Fields/Columns:**

- **Device ID:**

```
R1#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 0/0        153        R S I              Gig 0/0
R2               Gig 0/1        146        R B              Gig 0/0

Total cdp entries displayed : 2
R1#
```

- Lists the hostname of the neighboring device.
 - *Example:* R1 has received CDP messages from SW1 and R2.

- **Local Interface:**

```
R1#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 0/0        153        R S I              Gig 0/0
R2               Gig 0/1        146        R B              Gig 0/0

Total cdp entries displayed : 2
R1#
```

- Identifies the interface on the **local device** (the device you are typing the command on) that connects to the neighbor.
 - *Example:* SW1 is connected to R1's G0/0 interface; R2 is connected to R1's G0/1 interface.
 - *Note:* Useful for mapping physical connections if a network diagram is unavailable.

- **Holdtime:**

```
R1#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 0/0        153        R S I           Gig 0/0
R2               Gig 0/1        146        R B             Gig 0/0

Total cdp entries displayed : 2
R1#
```

- The amount of time the local device will wait to receive a CDP message before dropping the neighbor.
- Resets to 180 seconds each time a message is received.
- *Behavior:* With default timers, it counts down (e.g., to 120 seconds), receives a message, resets to 180, and repeats. If it reaches 0, the neighbor is removed from the table.

- **Capability:**

```
R1#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 0/0        153        R S I        Gig 0/0
R2               Gig 0/1        146        R B          Gig 0/0

Total cdp entries displayed : 2
R1#
```

- Codes identifying the device type/function.
- **R:** Router
- **S:** Switch
- **I:** IGMP (Multicast—beyond CCNA scope).
- **B:** Source Route Bridge (beyond CCNA scope).
- *Example:* SW1 (a multilayer switch) lists R and S because it has both routing and switching capabilities.

- **Platform:**

```
R1#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 0/0        153        R S I
R2               Gig 0/1        146        R B

Total cdp entries displayed : 2
R1#
```

```
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone
Device ID         Local Intrfce   Holdtme    Capability   Platform   Port ID
R2               Gig 0/1        124        R           C2900      Gig 0/0
SW1             Gig 0/0        126        S           2960      Gig 0/1
```

- Displays the hardware model of the neighbor (e.g., Cisco 2900 series, Catalyst 2960).
- *Note:* Virtual environments like GNS3 may not display this information, whereas Packet Tracer usually does.

- **Port ID:**

```
R1#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 0/0        153        R S I
R2               Gig 0/1        146        R B

Total cdp entries displayed : 2
R1#
```

- Identifies the interface on the **neighboring device** that connects to the local device.
- *Example:* R1 connects to SW1's G0/0 and R2's G0/0.
- *Exam Tip:* Distinguish between **Local Interface** (my port) and **Port ID** (their port).

CDP Neighbor Details (show cdp neighbors detail and show

cdp entry)

- Command: `show cdp neighbors detail`

```
R1#show cdp neighbors detail
-----
Device ID: SW1
Entry address(es):
Platform: Cisco , Capabilities: Router Switch IGMP
Interface: GigabitEthernet0/0, Port ID (outgoing port): GigabitEthernet0/0
Holdtime : 174 sec

Version :
Cisco IOS Software, vios_12 Software (vios_12-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST ENGINEERING ESTG_WEEKLY BUILD, synced to END_OF_FLO_ISP
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compiled Tue 28-Jul-15 18:52 by sasyamal

advertisement version: 2
VTP Management Domain: ''
Native VLAN: 1
Duplex: full

-----
Device ID: R2
Entry address(es):
  IP address: 10.0.0.2
Platform: Cisco , Capabilities: Router Source-Route-Bridge
Interface: GigabitEthernet0/1, Port ID (outgoing port): GigabitEthernet0/0
Holdtime : 163 sec

Version :
Cisco IOS Software, IOSv Software (VIOS-ADVENTERPRISEK9-M), Version 15.6(2)T, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2016 by Cisco Systems, Inc.
Compiled Tue 22-Mar-16 16:19 by prod_rel_team

advertisement version: 2
Duplex: full
Management address(es):
  IP address: 10.0.0.2

Total cdp entries displayed : 2
```

- Displays detailed information for all CDP neighbors.

- **Additional Information (compared to `show cdp neighbors`):**

```

R1#show cdp neighbors detail
Device ID: SW1
Entry address(es):
Platform: Cisco , Capabilities: Router Switch IGMP
Interface: GigabitEthernet0/0, Port ID (outgoing port): GigabitEthernet0/0
Holdtime : 174 sec

Version :
Cisco IOS Software, vios_l2 Software (vios_l2-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST ENGINEERING ESTG_WEEKLY BUILD, synced to END_OF_FLO_ISP
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compiled Tue 28-Jul-15 18:52 by sasyamal

advertisement version: 2
VTP Management Domain: ''
Native VLAN: 1
Duplex: full

```

- **Software Version:** Shows the version of IOS running on the neighbor device.
- **VTP Information:** Because SW1 is a switch, you can see VTP information here.
 - *Note:* This is a capability unique to CDP; LLDP cannot do this because VTP is a Cisco proprietary protocol.
- **Native VLAN:** Displays the native VLAN of the neighbor's interface (currently the default of 1).
 - *Function:* Helps identify native VLAN mismatches.
- **Duplex:** Displays the duplex setting of the neighbor's interface.
 - *Function:* Helps identify interface duplex mismatches.
 - *Note:* If a mismatch is found, CDP will display messages on the device to alert the user.
- **IP Address:** Displays the IP address of the neighbor.

```

Device ID: R2
Entry address(es):
  IP address: 10.0.0.2
Platform: Cisco , Capabilities: Router Source-Route-Bridge
Interface: GigabitEthernet0/1, Port ID (outgoing port): GigabitEthernet0/0
Holdtime : 163 sec

Version :
Cisco IOS Software, IOSv Software (VIOS-ADVENTERPRISEK9-M), Version 15.6(2)T, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2016 by Cisco Systems, Inc.
Compiled Tue 22-Mar-16 16:19 by prod_rel_team

advertisement version: 2
Duplex: full
Management address(es):
  IP address: 10.0.0.2

```

- *Example:* R2's IP address (10.0.0.2) is visible here.
- *Note:* If the device (like SW1) does not have an IP address, none will be displayed.

- **Command:** `show cdp entry <neighbor_hostname>`

```
R1#show cdp entry R2
```

```
-----
Device ID: R2
Entry address(es):
  IP address: 10.0.0.2
Platform: Cisco , Capabilities: Router Source-Route-Bridge
Interface: GigabitEthernet0/1, Port ID (outgoing port): GigabitEthernet0/0
Holdtime : 178 sec

Version :
Cisco IOS Software, IOSv Software (VIOS-ADVENTERPRISEK9-M), Version 15.6(2)T, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2016 by Cisco Systems, Inc.
Compiled Tue 22-Mar-16 16:19 by prod_rel_team

advertisement version: 2
Duplex: full
Management address(es):
  IP address: 10.0.0.2
```

- **Function:** Views detailed information for a **single** neighbor rather than all neighbors.
- **Context:** Useful if the device has many CDP neighbors and the output of `show cdp neighbors detail` is too long.
- **Output:** The output is exactly the same as `show cdp neighbors detail`, but filtered for the specified device.
- **Example:**

```
R1# show cdp entry R2
```

Summary of CDP Show Commands

- R1# **show cdp**
→ shows basic information about CDP (timers, version)
- R1# **show cdp traffic**
→ displays how many CDP messages have been sent and received
- R1# **show cdp interface**
→ displays which interfaces CDP is enabled on
- R1# **show cdp neighbors**
→ lists CDP neighbors and some basic information about each neighbor
- R1# **show cdp neighbors detail**
→ lists each CDP neighbor with more detailed information
- R1# **show cdp entry name**
→ displays the same info as above, but for the specified neighbor only



- **Review:** The video presents a summary of the CDP show commands covered so far. Students are encouraged to pause and review them.
- **Default State:** Because CDP is **enabled by default**, no configuration is required to use it in a network of Cisco devices.
- **Usage:** You can immediately use the **show** commands to verify and view CDP information.

- **show cdp**
 - Displays basic CDP information (version and timers).

```
R1# show cdp
```

- **show cdp traffic**

- Shows CDP packets sent and received.

```
R1# show cdp traffic
```

- **show cdp interface**

- Shows which interfaces have CDP enabled.

```
R1# show cdp interface
```

- **show cdp neighbors**

- Lists directly connected Cisco neighbors.

```
R1# show cdp neighbors
```

- **show cdp neighbors detail**

- Displays detailed information about all neighbors (IP, IOS, platform, interfaces).

```
R1# show cdp neighbors detail
```

- `show cdp entry <device-name>`

- Displays detailed information for one specific neighbor.

```
R1# show cdp entry SW1
```

CDP Configuration Commands

- CDP is globally enabled by default.
- CDP is also enabled on each interface by default.
- To enable/disable CDP globally: `R1(config)# [no] cdp run`
- To enable/disable CDP on specific interfaces: `R1(config-if)# [no] cdp enable`
- Configure the CDP timer: `R1(config)# cdp timer seconds`
- Configure the CDP holdtime: `R1(config)# cdp holdtime seconds`
- Enable/disable CDPv2: `R1(config)# [no] cdp advertise-v2`

- **Global State:** CDP is globally enabled on Cisco devices by default.
- **Interface State:** CDP is enabled on each interface by default.

- **Global Configuration:**
 - `cdp run`: Enables CDP globally (default state).
 - `no cdp run`: Disables CDP globally.
 - `cdp timer <seconds>`: Sets how often CDP messages are sent.
 - `cdp holdtime <seconds>`: Sets the holdtime for CDP messages.
 - `cdp advertise-v2`: Enables CDP version 2 (default state).
 - `no cdp advertise-v2`: Disables version 2 and reverts to version 1.
- **Interface Configuration:**
 - `cdp enable`: Enables CDP on the specific interface (default state).
 - `no cdp enable`: Disables CDP on the specific interface.

Configuration Examples

- **Enable CDP globally (if previously disabled):**

```
R1(config)# cdp run
```

- **Disable CDP globally:**

```
R1(config)# no cdp run
```

- **Set CDP timer to 90 seconds:**

```
R1(config)# cdp timer 90
```

- **Set CDP holdtime to 240 seconds:**

```
R1(config)# cdp holdtime 240
```

- **Disable CDP on a specific interface:**

```
R1(config)# interface GigabitEthernet 0/0  
R1(config-if)# no cdp enable
```

Link Layer Discovery Protocol (LLDP)

- **Nature:** Industry standard protocol (IEEE 802.1AB), implemented by many different vendors.
- **History:** CDP was the original protocol; LLDP was later developed to provide an industry standard alternative.
- **Default State on Cisco Devices:** Usually **disabled** by default; must be manually enabled.
- **Coexistence:** A device can run CDP and LLDP simultaneously, so you do not have to choose between them, although usually you will just use one.
- **Multicast Address:** LLDP messages are periodically sent to multicast MAC address `0180.C200.000E`.
 - *Note:* Remember this address for the CCNA exam.
- **Scope / Message Handling:** When a device receives an LLDP message, it processes and discards the message. It does **not** forward it to other devices. Only directly connected devices can become LLDP neighbors.
- **Default Timers:**
 - **Message Frequency:** Messages are sent once every **30 seconds** (half the time of CDP's default 60 seconds).
 - **Holdtime:** Default is **120 seconds**.
 - **Reinitialization Delay:** Timer is **2 seconds** by default.
 - *Function:* When LLDP is enabled (globally or on an interface), this timer delays the actual initialization of LLDP to prevent issues with "flapping" (when LLDP is rapidly enabled or disabled).
 - *Note:* You probably don't need to know this timer for the CCNA, but it will appear in command output.

LLDP Configuration Commands

- LLDP is usually globally disabled by default.
- LLDP is also disabled on each interface by default.
- To enable LLDP globally: `R1(config)# lldp run`
- To enable LLDP on specific interfaces (tx): `R1(config-if)# lldp transmit`
- To enable LLDP on specific a interface (rx): `R1(config-if)# lldp receive`
- Configure the LLDP timer: `R1(config)# lldp timer seconds`
- Configure the LLDP holdtime: `R1(config)# lldp holdtime seconds`
- Configure the LLDP reinit timer: `R1(config)# lldp reinit seconds`

- **Global State:** LLDP is usually globally disabled by default.
- **Interface State:** LLDP is disabled on each interface by default.
- **Global Configuration:**
 - `lldp run`: Enables LLDP globally.
 - `no lldp run`: Disables LLDP globally.
 - `lldp timer <seconds>`: Sets how often LLDP messages are sent.
 - `lldp holdtime <seconds>`: Sets the holdtime for LLDP messages.
 - `lldp reinit <seconds>`: Sets the reinitialization delay timer.

- **Interface Configuration:**

- **lldp transmit**: Enables the interface to send LLDP messages.
- **lldp receive**: Enables the interface to receive LLDP messages.
- *Note:* Unlike CDP, which uses a single command (**cdp enable**), LLDP requires two separate commands (**lldp transmit** and **lldp receive**). Make sure to enable both unless a specific reason exists to only send or only receive.

Configuration Examples

- **Enable LLDP globally:**

```
R1(config)# lldp run
```

- **Disable LLDP globally:**

```
R1(config)# no lldp run
```

- **Set LLDP timer to 45 seconds:**

```
R1(config)# lldp timer 45
```

- **Set LLDP holdtime to 150 seconds:**

```
R1(config)# lldp holdtime 150
```

- **Enable LLDP transmit and receive on an interface:**

```
R1(config)# interface GigabitEthernet 0/0  
R1(config-if)# lldp transmit  
R1(config-if)# lldp receive
```

LLDP Verification Commands (Basic)

- **Lab Configuration Note:**

- In the demonstration, LLDP is enabled globally (`lldp run`) and configured with `lldp transmit` and `lldp receive` on all interfaces.
- The devices are running both CDP and LLDP simultaneously.

- **Command:** `show lldp`

```
R1#show lldp traffic

LLDP traffic statistics:
  Total frames out: 4
  Total entries aged: 0
  Total frames in: 3
  Total frames received in error: 0
  Total frames discarded: 0
  Total TLVs discarded: 0
  Total TLVs unrecognized: 0

R1#
R1#show lldp interface

GigabitEthernet0/0:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

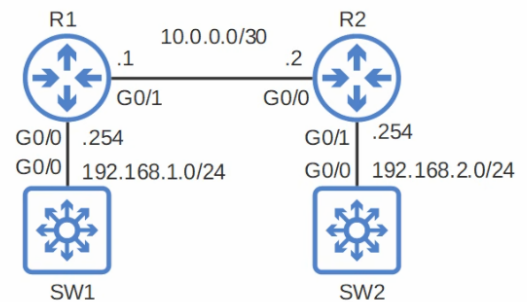
GigabitEthernet0/1:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

GigabitEthernet0/2:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER

GigabitEthernet0/3:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER
```

```
R1#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
```



- **Function:** Displays global LLDP status.
- **Details:** Shows that LLDP is enabled and lists the timers:
 - Timer: 30 seconds (default)
 - Holdtime: 120 seconds (default)
 - Re-initialization Delay: 2 seconds (default)

- **Command:** `show lldp traffic`

```
R1#show lldp traffic

LLDP traffic statistics:
  Total frames out: 4
  Total entries aged: 0
  Total frames in: 3
  Total frames received in error: 0
  Total frames discarded: 0
  Total TLVs discarded: 0
  Total TLVs unrecognized: 0
```

```
R1#
R1#show lldp interface

GigabitEthernet0/0:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

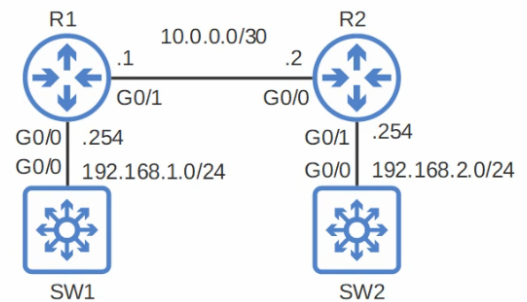
GigabitEthernet0/1:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

GigabitEthernet0/2:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER

GigabitEthernet0/3:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER
```

```
R1#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
```



- **Function:** Displays LLDP packet statistics.
- **Details:** Shows the number of LLDP frames sent and received (e.g., 4 sent, 3 received).

- **Command:** `show lldp interface`

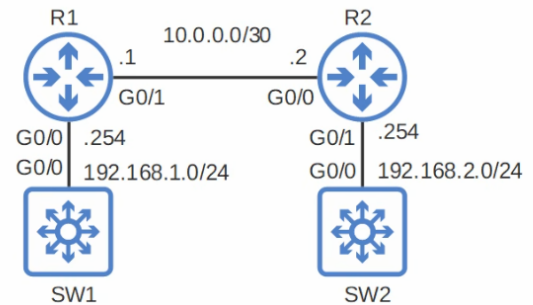
```
R1#show lldp interface

GigabitEthernet0/0:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

GigabitEthernet0/1:
  Tx: enabled
  Rx: enabled
  Tx state: IDLE
  Rx state: WAIT FOR FRAME

GigabitEthernet0/2:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER

GigabitEthernet0/3:
  Tx: enabled
  Rx: enabled
  Tx state: INIT
  Rx state: WAIT PORT OPER
```



- **Function:** Displays LLDP status on a per-interface basis.
- **Details:** Shows if transmit (Tx) and receive (Rx) are enabled.
- **State Information:**
 - **Tx State:** e.g., `IDLE` (waiting to send next frame).
 - **Rx State:** e.g., `WAIT FOR FRAME` (waiting to receive a frame).

LLDP Neighbor Table (`show lldp neighbors`)

- **Command:** `show lldp neighbors`
 - Displays a table of directly connected LLDP-enabled devices.

- **Fields/Columns:**

- **Device ID:**

```
R1#show lldp neighbors
```

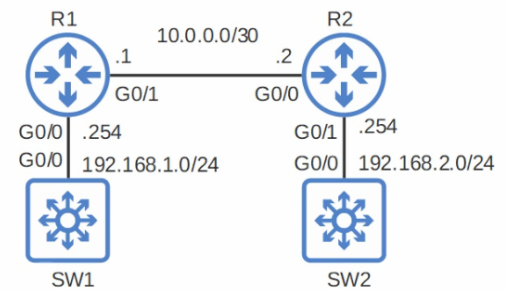
```
Capability codes:
```

```
(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
SW1	Gi0/0	120		Gi0/0
R2	Gi0/1	120	R	Gi0/0

```
Total entries displayed: 2
```



- Lists the hostname of the neighboring device.
- *Example:* R1 has received LLDP messages from SW1 and R2.

- **Local Interface:**

```
R1#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
SW1            Gi0/0        120          R             Gi0/0
R2            Gi0/1        120          R             Gi0/0

Total entries displayed: 2
```

- Identifies the interface on the **local device** (the device you are typing the command on) that connects to the neighbor.
- *Example:* SW1 is connected to R1's G0/0 interface; R2 is connected to R1's G0/1 interface.

- **Holdtime:**

```
R1#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
SW1            Gi0/0        120          R             Gi0/0
R2            Gi0/1        120          R             Gi0/0

Total entries displayed: 2
```

- *Difference from CDP:* Unlike `show cdp neighbors` which displays a countdown timer, `show lldp neighbors` simply displays the configured holdtime (default 120 seconds). It does not count down in this specific output.

- **Capability:**

```
R1#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
SW1                  Gi0/0       120                            Gi0/0
R2                   Gi0/1       120         R            Gi0/0

Total entries displayed: 2
```

- Codes identifying the device type/function.
- **R:** Router
- **B:** Bridge (This is the LLDP equivalent of "Switch" in CDP).
- *Note:* The output for capability might be limited in summary view compared to detailed view.

- **Port ID:**

```
R1#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
SW1                  Gi0/0       120         R            Gi0/0
R2                   Gi0/1       120         R            Gi0/0

Total entries displayed: 2
```

- Identifies the interface on the **neighboring device** that connects to the local device.
- *Example:* R1 connects to SW1's G0/0 and R2's G0/0.
- *Exam Tip:* Just like with CDP, distinguish between **Local Interface** (my port) and **Port ID** (their port).

LLDP Neighbor Details (show lldp neighbors detail and show lldp entry)

```
R1#show lldp neighbors detail
```

```
-----  
Local Intf: Gi0/0  
Chassis id: 0c04.41d2.1a00  
Port id: Gi0/0  
Port Description: GigabitEthernet0/0  
System Name: SW1  
  
System Description:  
Cisco IOS Software, vios_l2 Software (vios_l2-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST ENGINEERING ESTG_WEEKLY BUILD, synced to END_OF_FLO_ISP  
Technical Support: http://www.cisco.com/techsupport  
Copyright (c) 1986-2015 by Cisco Systems, Inc.  
Compi
```

```
Time remaining: 99 seconds
```

```
System Capabilities: B,R  
Enabled Capabilities - not advertised  
Management Addresses - not advertised  
Auto Negotiation - not supported  
Physical media capabilities - not advertised  
Media Attachment Unit type - not advertised  
Vlan ID: - not advertised
```

```
-----  
Local Intf: Gi0/1  
Chassis id: 0c04.418d.a400  
Port id: Gi0/0  
Port Description: GigabitEthernet0/0  
System Name: R2  
  
System Description:  
Cisco IOS Software, IOSv Software (VIOS-ADVENTERPRISEK9-M), Version 15.6(2)T, RELEASE SOFTWARE (fc2)  
Technical Support: http://www.cisco.com/techsupport  
Copyright (c) 1986-2016 by Cisco Systems, Inc.  
Compiled Tue 22-Mar-16 16:19 by prod_rel_team
```

```
Time remaining: 92 seconds  
System Capabilities: B,R  
Enabled Capabilities: R  
Management Addresses:  
IP: 10.0.0.2
```

- **Command:** `show lldp neighbors detail`

- **Function:** Displays detailed information for all LLDP neighbors.
- **Operating System:** Displays the software version running on the neighbor device.
- **Time Remaining:** Shows the actual countdown of the holdtime timer for each neighbor (unlike the summary view which shows the static configured value).
- **Capabilities Fields:**

```
Local Intf: Gi0/0
Chassis id: 0c04.41d2.1a00
Port id: Gi0/0
Port Description: GigabitEthernet0/0
System Name: SW1

System Description:
Cisco IOS Software, vios_l2 Software (vios_l2-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST ENGINEERING ESTG_WEEKLY BUILD, synced to END_OF_FLO_ISP
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compi

Time remaining: 99 seconds
System Capabilities: B,R
Enabled Capabilities - not advertised
Management Addresses - not advertised
Auto Negotiation - not supported
Physical media capabilities - not advertised
Media Attachment Unit type - not advertised
Vlan ID: - not advertised
```

- **System Capabilities:** Indicates what the device is capable of (e.g., Router, Bridge).
 - **B:** Bridge (equivalent to "Switch" in CDP).
 - **R:** Router.
- **Enabled Capabilities:** Indicates which of the system capabilities are actually turned on and active.
 - *Example:* If IP routing is disabled, the Router capability appears in System Capabilities but might appear as "not advertised" or absent in Enabled Capabilities.
- **Comparison to CDP:**
 - LLDP does **not** display VTP (VLAN Trunking Protocol) information because VTP is Cisco proprietary, whereas LLDP is an industry standard.

- **Command:** `show lldp entry <neighbor_hostname>`

```
R1#show lldp entry SW1
Capability codes:
  (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
  (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
-----
Local Intf: Gi0/0
Chassis id: 0c04.41d2.1a00
Port id: Gi0/0
Port Description: GigabitEthernet0/0
System Name: SW1

System Description:
Cisco IOS Software, vios_l2 Software (vios_l2-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST ENGINEERING ESTG_WEEKLY BUILD, synced to END_OF_FLO_ISP
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compi

Time remaining: 119 seconds
System Capabilities: B,R
Enabled Capabilities: R
Management Addresses - not advertised
Auto Negotiation - not supported
Physical media capabilities - not advertised
Media Attachment Unit type - not advertised
Vlan ID: - not advertised
```

- **Function:** Displays the exact same detailed output as `show lldp neighbors detail`, but only for a single specified neighbor.
- **Example:**

```
R1# show lldp entry SW1
```

Summary of LLDP Show Commands

- R1# **show lldp**
→ shows basic information about LLDP (timers, version)
 - R1# **show lldp traffic**
→ displays how many LLDP messages have been sent and received
 - R1# **show lldp interface**
→ displays which interfaces LLDP tx/rx is enabled on
 - R1# **show lldp neighbors**
→ lists LLDP neighbors and some basic information about each neighbor
 - R1# **show lldp neighbors detail**
→ lists each LLDP neighbor with more detailed information
 - R1# **show lldp entry *name***
→ displays the same info as above, but for the specified neighbor only
-
- **Comparison:** The commands are the same as CDP, just replace "CDP" with "LLDP".
 - **Output:** The output for these commands is similar to the output for CDP, but there are a few differences.
 - **Review:** Students are encouraged to pause the video here to review these commands.
 - **show lldp**
 - Displays basic LLDP information (version and timers).

```
R1# show lldp
```

- **show lldp traffic**

- Shows LLDP packets sent and received.

```
R1# show lldp traffic
```

- **show lldp interface**

- Shows which interfaces have LLDP enabled.

```
R1# show lldp interface
```

- **show lldp neighbors**

- Lists directly connected LLDP neighbors.

```
R1# show lldp neighbors
```

- **show lldp neighbors detail**

- Displays detailed information about all neighbors (IP, OS, platform, interfaces).

```
R1# show lldp neighbors detail
```

- `show lldp entry <neighbor_hostname>`

- Displays detailed information for one specific neighbor.

```
R1# show lldp entry SW1
```

Wireshark Capture: CDP Message

```
> Frame 12: 369 bytes on wire (2952 bits), 369 bytes captured (2952 bits) on interface -, id 0
▼ IEEE 802.3 Ethernet
  > Destination: CDP/VTP/DTP/PagP/UDLD (01:00:0c:cc:cc:cc)
  > Source: 0c:04:41:47:57:00 (0c:04:41:47:57:00)
  Length: 355
  > Logical-Link Control
  ▼ Cisco Discovery Protocol
    Version: 2
    TTL: 180 seconds
    Checksum: 0xee0f [correct]
    [Checksum Status: Good]
    > Device ID: R1
    > Software Version
    > Platform: Cisco
    > Addresses
    > Port ID: GigabitEthernet0/0
    ▼ Capabilities
      Type: Capabilities (0x0004)
      Length: 8
      ▼ Capabilities: 0x00000005
        ....1 = Router: Yes
        ...0. = Transparent Bridge: No
        ...1.. = Source Route Bridge: Yes
        ...0... = Switch: No
        ...0.... = Host: No
        ...0. .... = IGMP capable: No
        ...0.. .... = Repeater: No
        ...0... .... = VoIP Phone: No
        ...0..... = Remotely Managed Device: No
        ...0. .... = CVTA/STP Dispute Resolution/Cisco VT Camera: No
        ...0.. .... = Two Port Mac Relay: No
    > IP Prefixes: 1
    > Duplex: Full
    > Management Addresses
```

- **Scenario:** A CDP message sent from R1 to SW1.
- **Destination MAC Address:** `0100.0CCC.CCCC`.
 - *Note:* Wireshark describes this destination MAC as `CDP/VTP/DTP/PagP/UDLD` because this same multicast MAC address is used for multiple Cisco protocols, not just CDP.

- **CDP Information Fields:**

```

> Frame 12: 369 bytes on wire (2952 bits), 369 bytes captured (2952 bits) on interface -, id 0
▼ IEEE 802.3 Ethernet
  > Destination: CDP/VTP/DTP/PAgP/UDLD (01:00:0c:cc:cc:cc)
  > Source: 0c:04:41:47:57:00 (0c:04:41:47:57:00)
  Length: 355
> Logical-Link Control
▼ Cisco Discovery Protocol
  Version: 2
  TTL: 180 seconds
  Checksum: 0xee0f [correct]
  [Checksum Status: Good]
  > Device ID: R1
  > Software Version
  > Platform: Cisco
  > Addresses
  > Port ID: GigabitEthernet0/0
  ▼ Capabilities
    Type: Capabilities (0x0004)
    Length: 8
    ▼ Capabilities: 0x00000005
      ....1 = Router: Yes
      ...0. = Transparent Bridge: No
      ...1.. = Source Route Bridge: Yes
      ...0... = Switch: No
      ...0.... = Host: No
      ...0. .... = IGMP capable: No
      ...0.. .... = Repeater: No
      ...0... .... = VoIP Phone: No
      ...0.... .... = Remotely Managed Device: No
      ...0. .... = CVTA/STP Dispute Resolution/Cisco VT Camera: No
      ...0.. .... = Two Port Mac Relay: No
  > IP Prefixes: 1
  > Duplex: Full
  > Management Addresses

```

- **Version:** CDP version 2 is being used.
- **TTL (Time to Live):** This value is actually the CDP holdtime.

- **Other Fields:** Device ID (R1), version, platform, addresses, and port ID.

```

> Frame 12: 369 bytes on wire (2952 bits), 369 bytes captured (2952 bits) on interface -, id 0
  IEEE 802.3 Ethernet
    > Destination: CDP/VTP/DTP/PAgP/UDLD (01:00:0c:cc:cc:cc)
    > Source: 0c:04:41:47:57:00 (0c:04:41:47:57:00)
    Length: 355
  > Logical-Link Control
    Cisco Discovery Protocol
      Version: 2
      TTL: 180 seconds
      Checksum: 0xee0f [correct]
      [Checksum Status: Good]
      > Device ID: R1
      > Software Version
      > Platform: Cisco
      > Addresses
      > Port ID: GigabitEthernet0/0
      Capabilities
        Type: Capabilities (0x0004)
        Length: 8
        Capabilities: 0x00000005
          ....1 = Router: Yes
          ...0. = Transparent Bridge: No
          ...1.. = Source Route Bridge: Yes
          ...0... = Switch: No
          ...0.... = Host: No
          ...0. .... = IGMP capable: No
          ...0.. .... = Repeater: No
          ...0... .... = VoIP Phone: No
          ...0..... = Remotely Managed Device: No
          ...0. .... = CVTA/STP Dispute Resolution/Cisco VT Camera: No
          ...0.. .... = Two Port Mac Relay: No
      > IP Prefixes: 1
      > Duplex: Full
      > Management Addresses

```

- **Capabilities Field:**

- *Example:* R1 shows a '1' for 'Router' and 'Source Route Bridge'.

- **Layer 2 Operation Confirmation:** There is no IP packet inside the Ethernet frame. These Layer 2 discovery protocols use MAC addresses, not IP addresses.

Wireshark Capture: LLDP Message

```
> Frame 466: 325 bytes on wire (2600 bits), 325 bytes captured (2600 bits) on interface -. id 0
> Ethernet II, Src: 0c:04:41:d2:1a:00 (0c:04:41:d2:1a:00), Dst: LLDP_Multicast (01:80:c2:00:00:0e)
▼ Link Layer Discovery Protocol
  > Chassis Subtype = MAC address, Id: 0c:04:41:d2:1a:00
  > Port Subtype = Interface name, Id: Gi0/0
  > Time To Live = 120 sec
  > System Name = SW1
  > [truncated]System Description = Cisco IOS Software, vios_12 Software (vios_12-ADVENTERPRISEK9-M), Versio
  > Port Description = GigabitEthernet0/0
  ▼ Capabilities
    0000 111. .... = TLV Type: System Capabilities (7)
    .... ..0 0000 0100 = TLV Length: 4
    ▼ Capabilities: 0x0014
      .... ..0 = Other: Not capable
      .... ..0. = Repeater: Not capable
      .... ..1.. = Bridge: Capable
      .... ..0... = WLAN access point: Not capable
      .... ..1 .... = Router: Capable
      .... ..0. .... = Telephone: Not capable
      .... ..0.. .... = DOCSIS cable device: Not capable
      .... ..0... .... = Station only: Not capable
    ▼ Enabled Capabilities: 0x0010
      .... ..0 = Other: Not capable
      .... ..0. = Repeater: Not capable
      .... ..0.. = Bridge: Not capable
      .... ..0... = WLAN access point: Not capable
      .... ..1 .... = Router: Capable
      .... ..0. .... = Telephone: Not capable
      .... ..0.. .... = DOCSIS cable device: Not capable
      .... ..0... .... = Station only: Not capable
  > End of LLDPDU
```

- **Scenario:** An LLDP message sent from SW1 to R1.
- **Destination MAC Address:** 0180.C200.000E.

- **LLDP Information Fields:**

```
> Frame 466: 325 bytes on wire (2600 bits), 325 bytes captured (2600 bits) on interface -, id 0
> Ethernet II, Src: 0c:04:41:d2:1a:00 (0c:04:41:d2:1a:00), Dst: LLDP Multicast (01:80:c2:00:00:0e)
▼ Link Layer Discovery Protocol
  > Chassis Subtype = MAC address, Id: 0c:04:41:d2:1a:00
  > Port Subtype = Interface name, Id: Gi0/0
  > Time To Live = 120 sec
  > System Name = SW1
  > [truncated]System Description = Cisco IOS Software, vios_12 Software (vios_12-ADVENTERPRISEK9-M), Versio
  > Port Description = GigabitEthernet0/0
  ▼ Capabilities
    0000 111. .... = TLV Type: System Capabilities (7)
    .... 0000 0100 = TLV Length: 4
    ▼ Capabilities: 0x0014
      .... 0 = Other: Not capable
      .... 0 = Repeater: Not capable
      .... 1.. = Bridge: Capable
      .... 0... = WLAN access point: Not capable
      .... 1... = Router: Capable
      .... 0. .... = Telephone: Not capable
      .... 0.. .... = DOCSIS cable device: Not capable
      .... 0... .... = Station only: Not capable
    ▼ Enabled Capabilities: 0x0010
      .... 0 = Other: Not capable
      .... 0 = Repeater: Not capable
      .... 0.. = Bridge: Not capable
      .... 0... = WLAN access point: Not capable
      .... 1... = Router: Capable
      .... 0. .... = Telephone: Not capable
      .... 0.. .... = DOCSIS cable device: Not capable
      .... 0... .... = Station only: Not capable
  > End of LLDPDU
```

- **TTL (Time to Live):** This value is the LLDP holdtime (120 seconds).
- **System Name:** The hostname of the sending device (SW1).

- **Capabilities Field:**

```
> Frame 466: 325 bytes on wire (2600 bits), 325 bytes captured (2600 bits) on interface -, id 0
> Ethernet II, Src: 0c:04:41:d2:1a:00 (0c:04:41:d2:1a:00), Dst: LLDP Multicast (01:80:c2:00:00:0e)
▼ Link Layer Discovery Protocol
  > Chassis Subtype = MAC address, Id: 0c:04:41:d2:1a:00
  > Port Subtype = Interface name, Id: Gi0/0
  > Time To Live = 120 sec
  > System Name = SW1
  > [truncated]System Description = Cisco IOS Software, vios_12 Software (vios_12-ADVENTERPRISEK9-M), Versio
  > Port Description = GigabitEthernet0/0
  ▼ Capabilities
    0000 111. .... = TLV Type: System Capabilities (7)
    .... 0000 0100 = TLV Length: 4
    ▼ Capabilities: 0x0014
      .... 0 = Other: Not capable
      .... 0 = Repeater: Not capable
      .... 1 = Bridge: Capable
      .... 0 = WLAN access point: Not capable
      .... 1 = Router: Capable
      .... 0 = Telephone: Not capable
      .... 0 = DOCSIS cable device: Not capable
      .... 0 = Station only: Not capable
    ▼ Enabled Capabilities: 0x0010
      .... 0 = Other: Not capable
      .... 0 = Repeater: Not capable
      .... 0 = Bridge: Not capable
      .... 0 = WLAN access point: Not capable
      .... 1 = Router: Capable
      .... 0 = Telephone: Not capable
      .... 0 = DOCSIS cable device: Not capable
      .... 0 = Station only: Not capable
  > End of LLDPDU
```

- *Example:* SW1 lists **Bridge** and **Router** as system capabilities.
- *Note:* Only **Router** is listed as an enabled capability.

Review of Today's Lecture

- **Overview:** Brief introduction to Layer 2 discovery protocols and their purpose.
 - Enable directly connected neighbors to share information (host name, device type, IP address, software version, etc.).
 - Can be a security risk because of the information shared.
 - Many network admins choose to disable them.
- **CDP:** Introduced as Cisco's Layer 2 discovery protocol.

- **LLDP:** Introduced as the industry standard alternative, developed after CDP.
 - Supported by many vendors (Cisco, Juniper, Palo Alto, Fortinet, etc.).
 - Must use LLDP in a multi-vendor network if you want a Layer 2 discovery protocol.