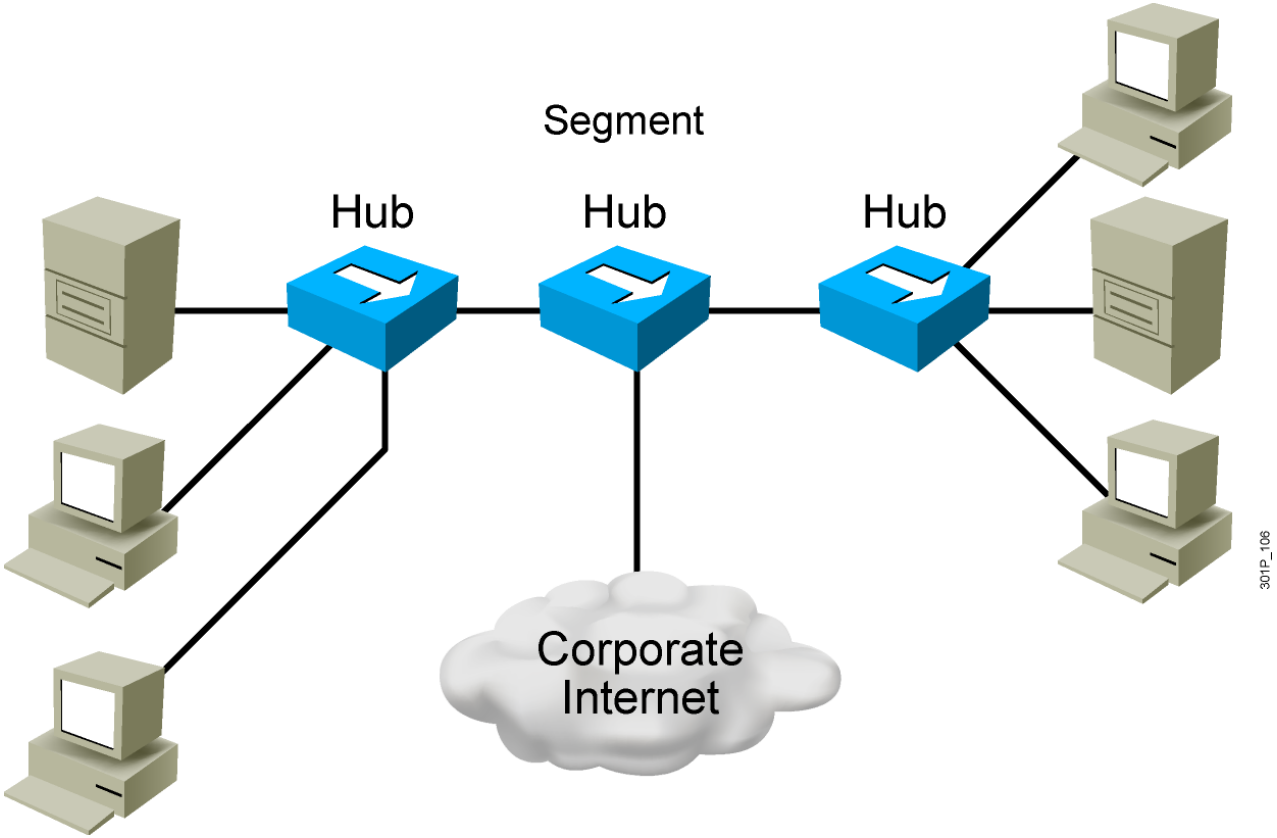
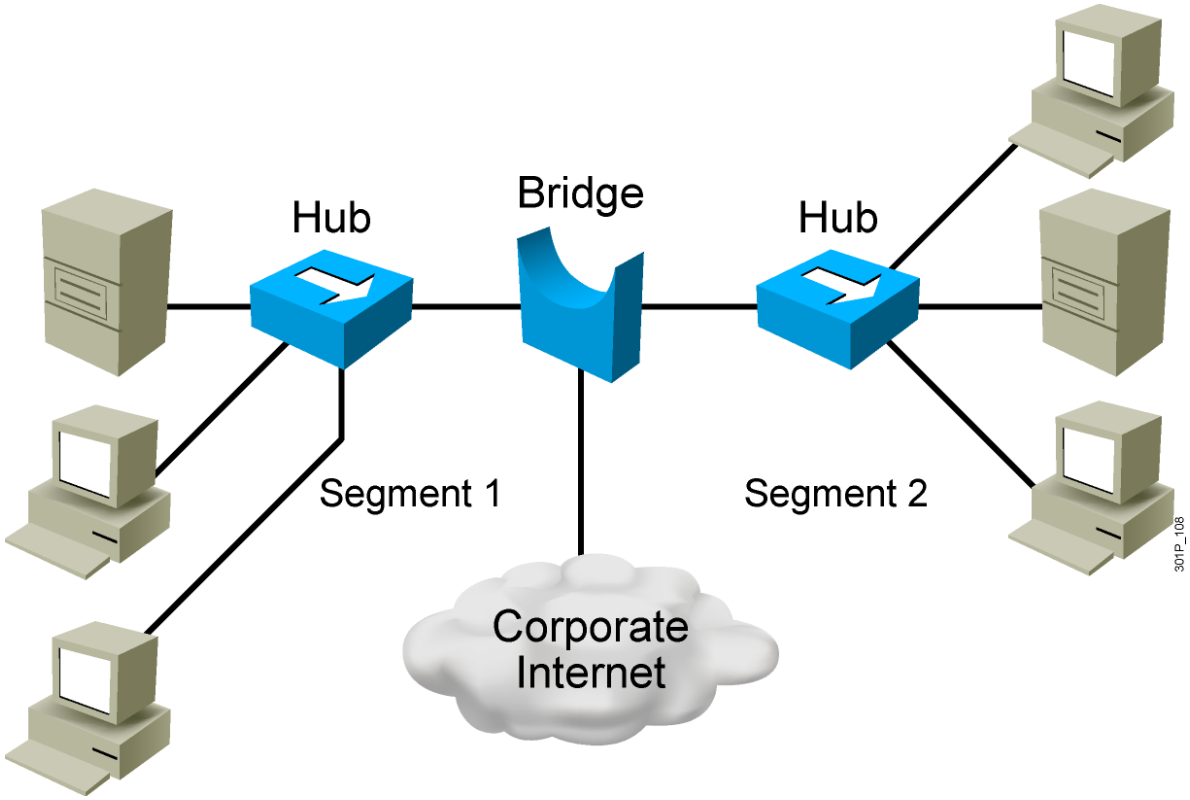
Ethernet Switch

Network Congestion



- High-performance PCs
- More networked data
- Bandwidth-intensive applications

Bridges

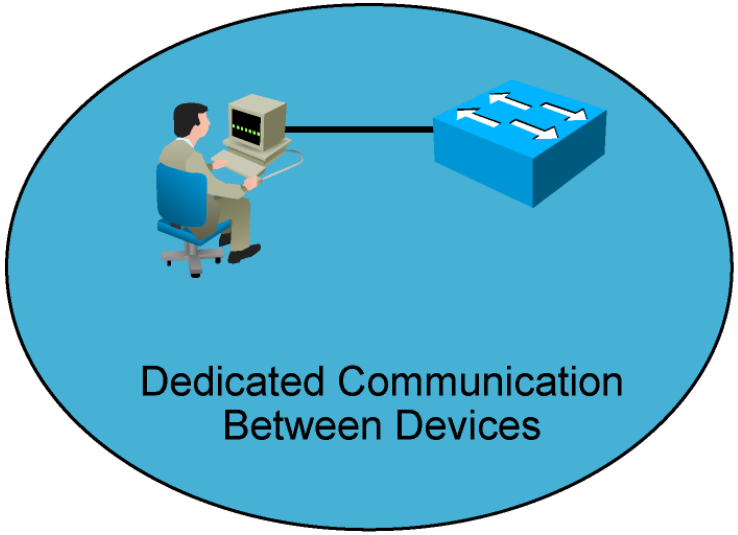


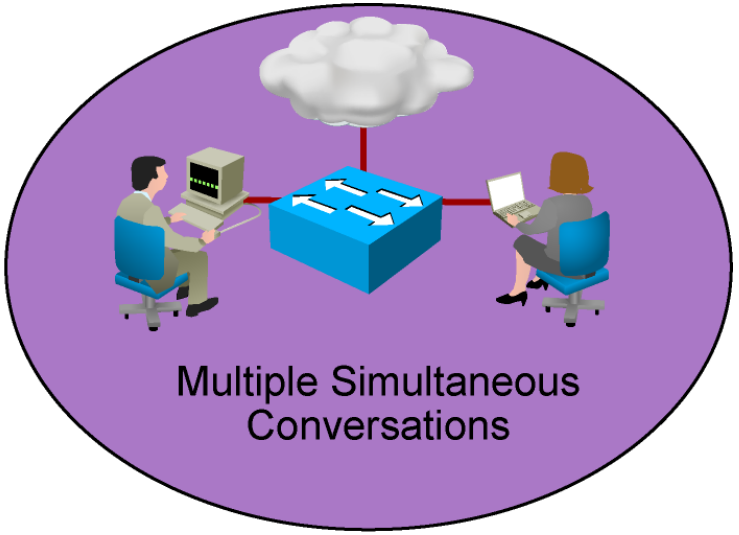
- Operate at Layer 2 of the OSI model
- Forward, filter, or flood frames
- Have few ports
- Are slow

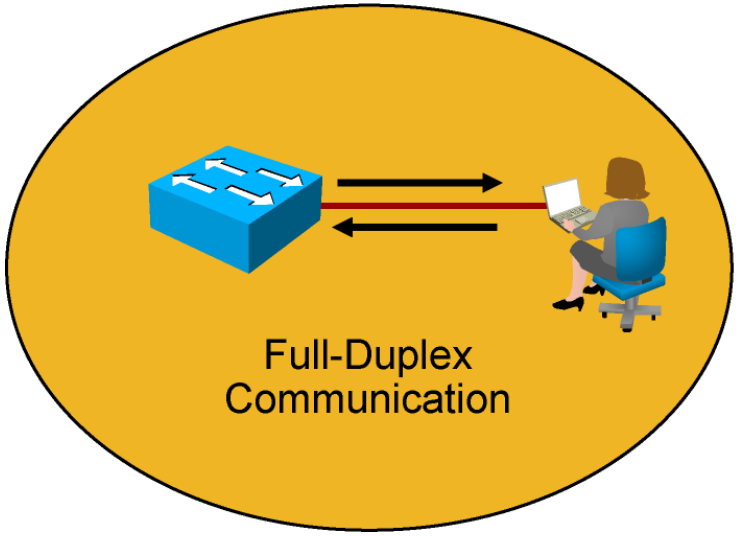
LAN Switch

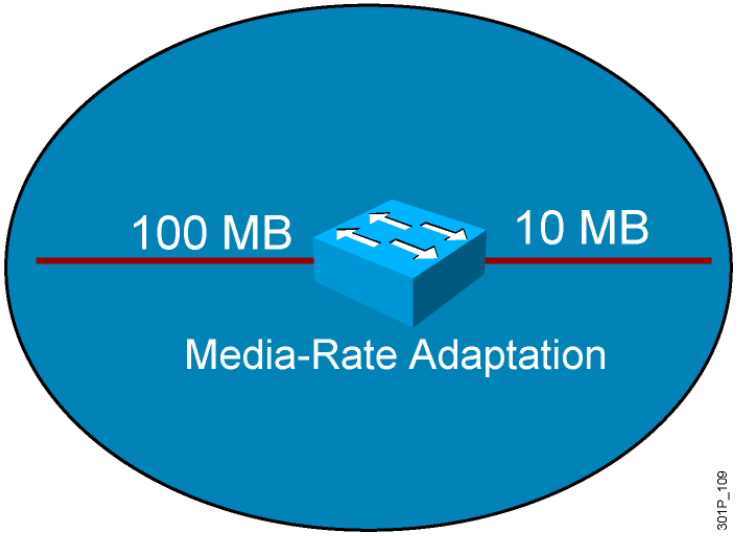
- High port density
- Large frame buffers
- Mixture of port speeds
- Fast internal switching
- Switching modes:
  - Cut-through
  - Store-and-forward
  - Fragment-free

LAN Switch Features

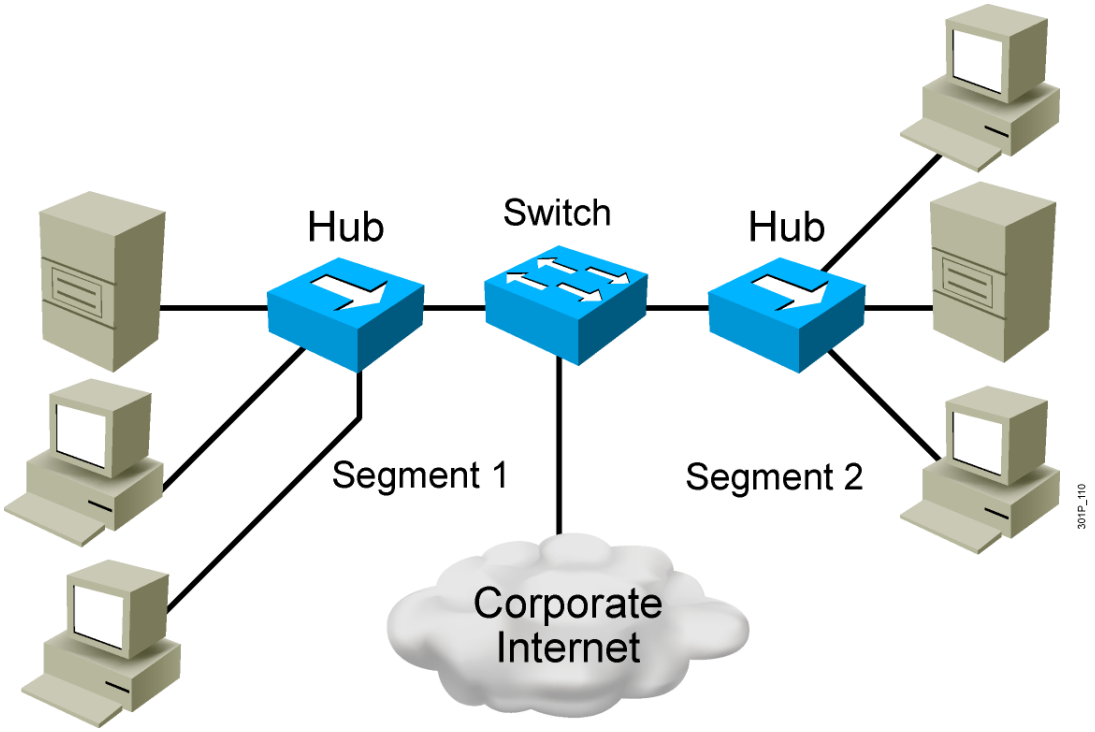






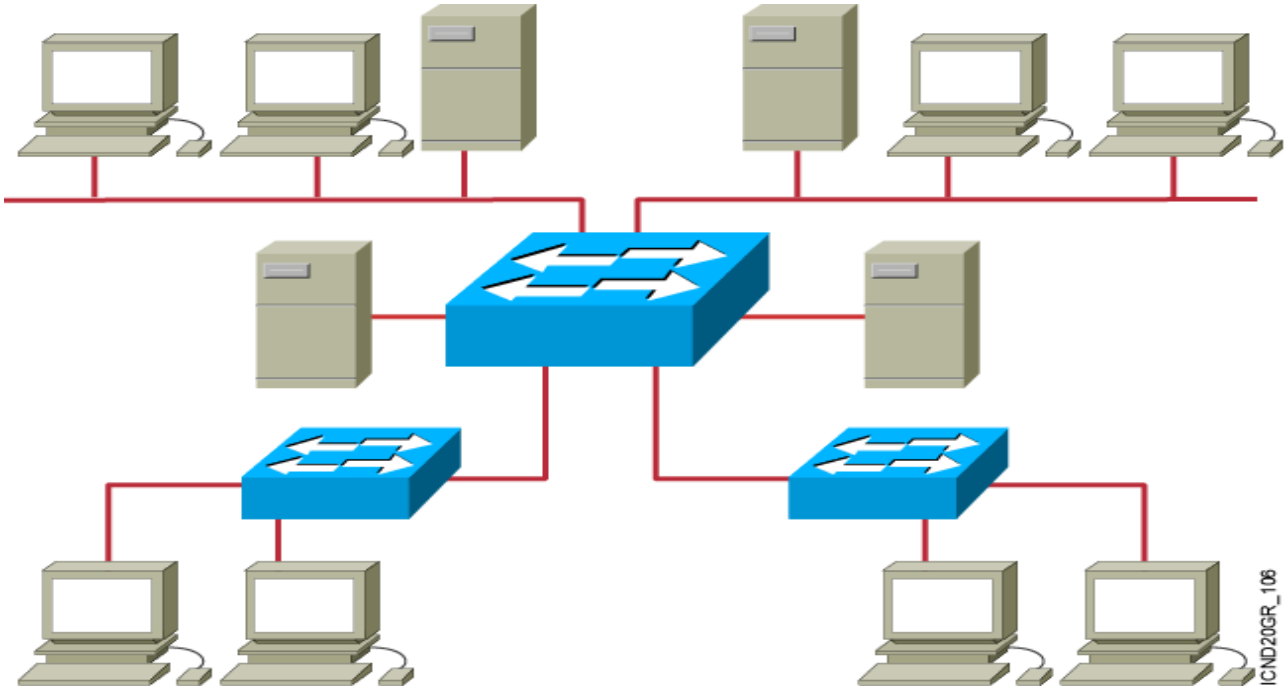


Switches Supersede Bridges



- Operate at Layer 2 of the OSI model
- Forward, filter, or flood frames
- Have many ports
- Are fast

Ethernet Switches and Bridges

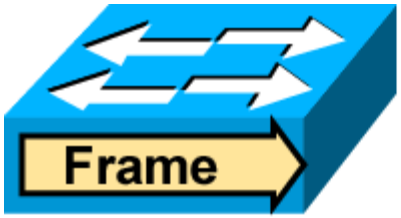


- Address learning
- Forward/filter decision
- Loop avoidance

Transmitting Frames

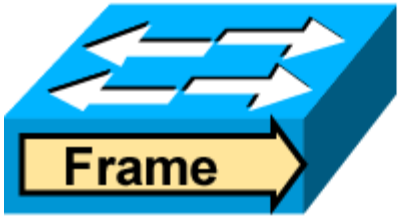
Cut-Through

- Switch checks destination address and immediately begins forwarding frame.



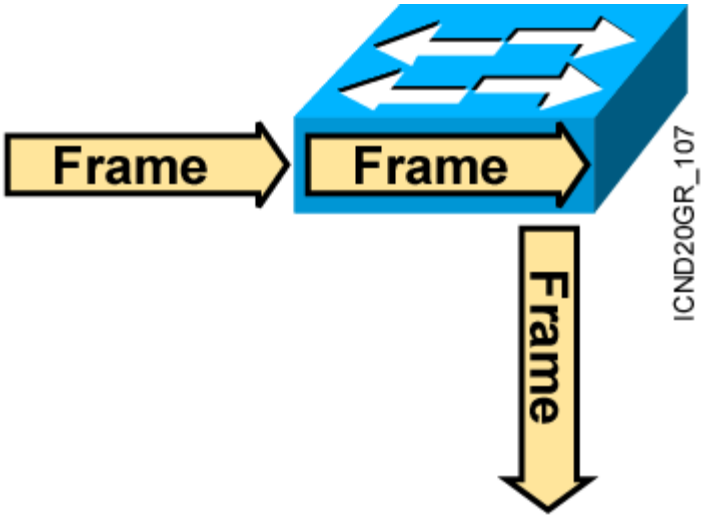
Fragment-Free

- Switch checks the first 64 bytes, then immediately begins forwarding frame.

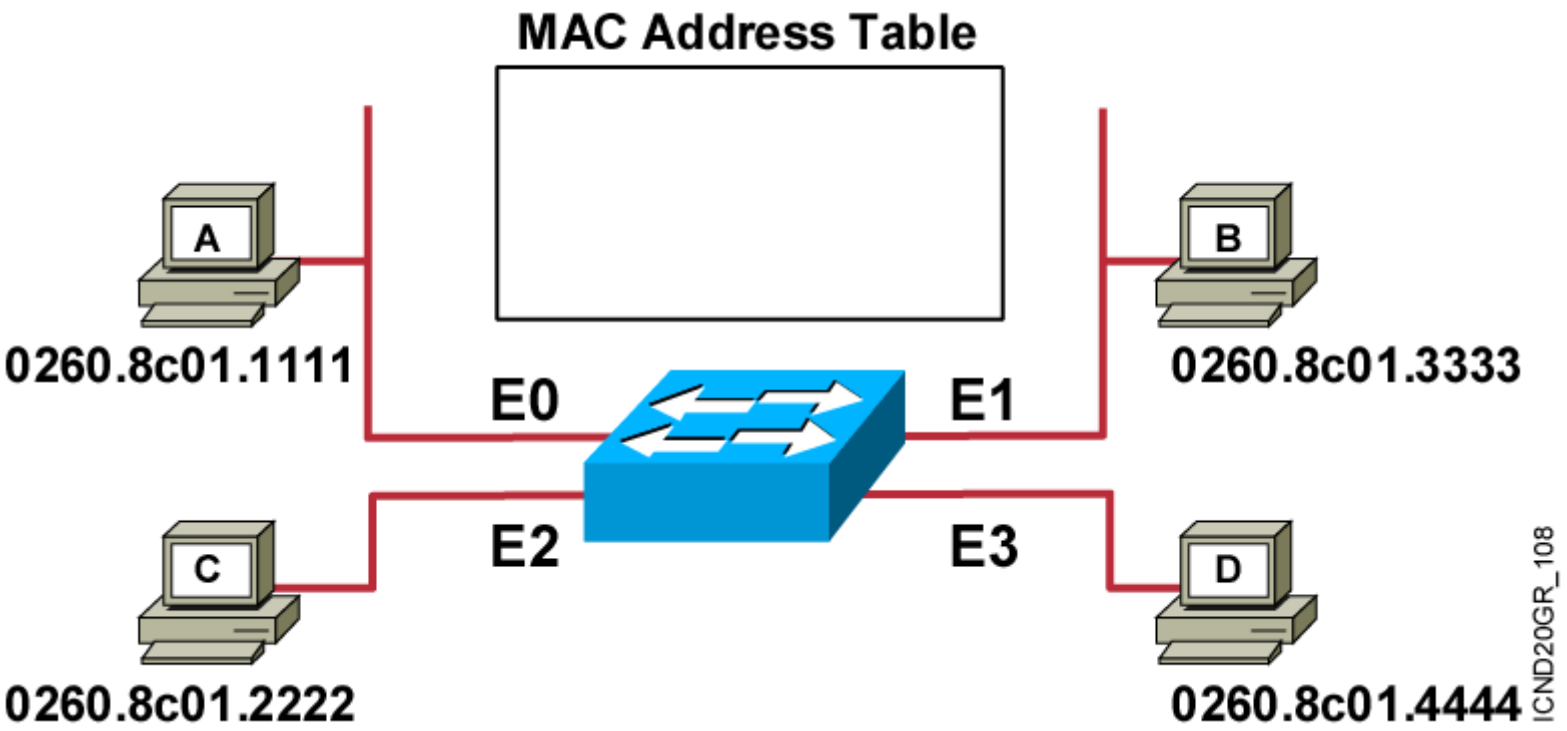


Store and Forward

Complete frame is received and checked before forwarding.

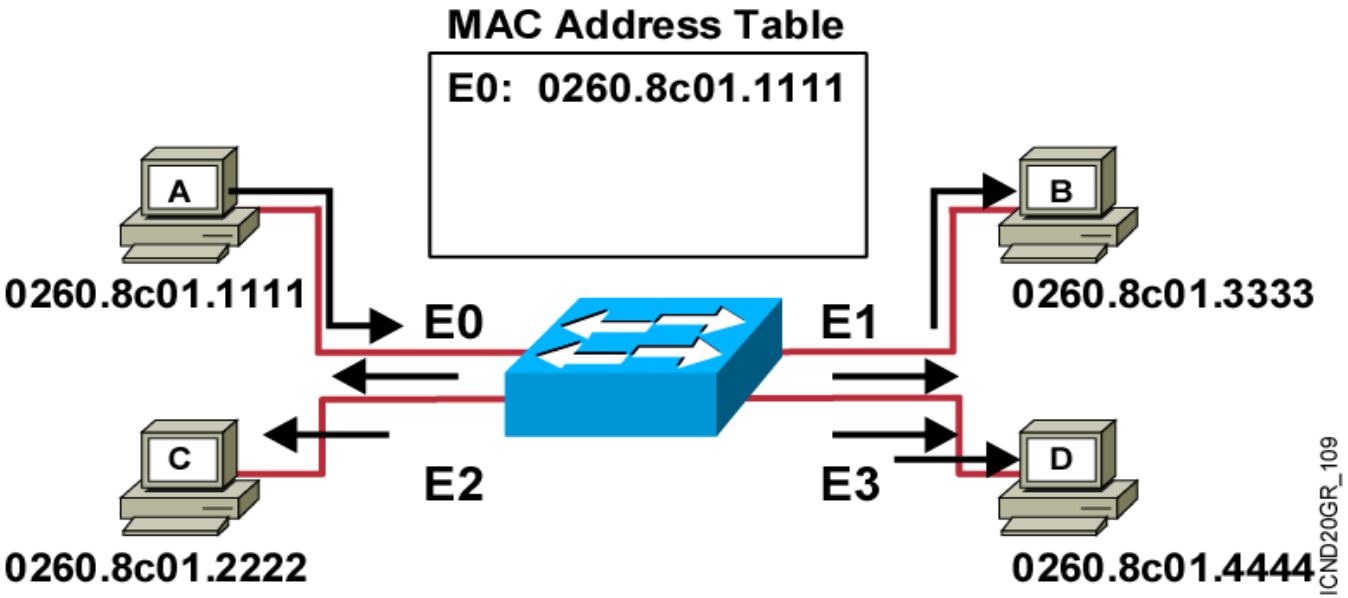


MAC Address Table



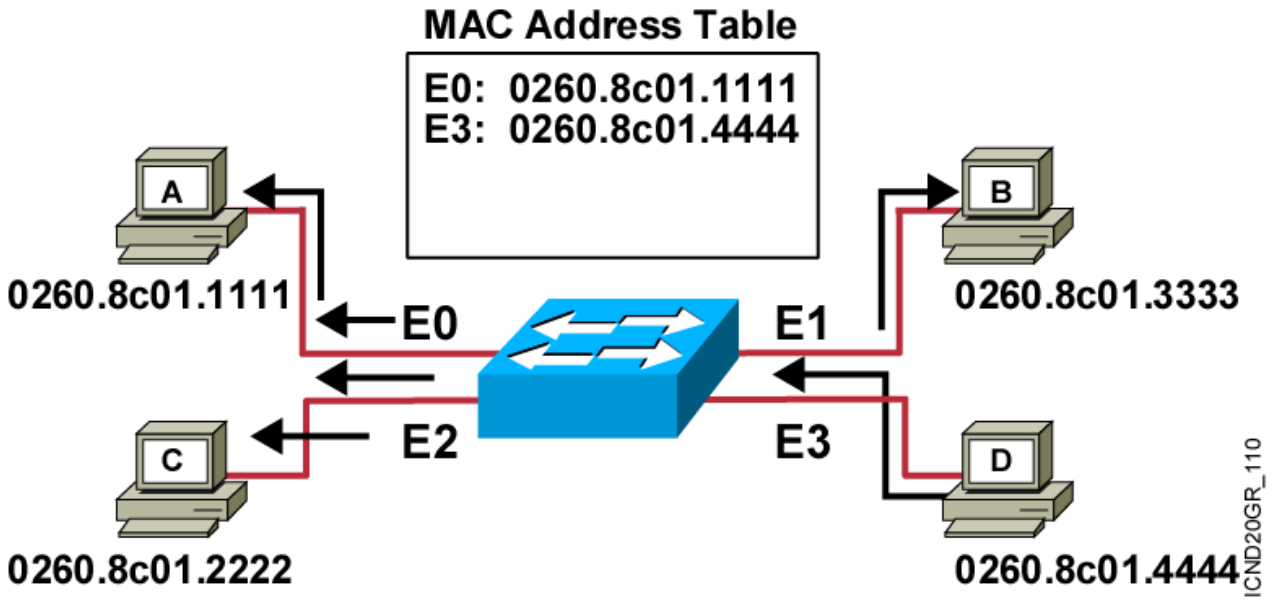
- Initial MAC address table is empty.

Learning Addresses



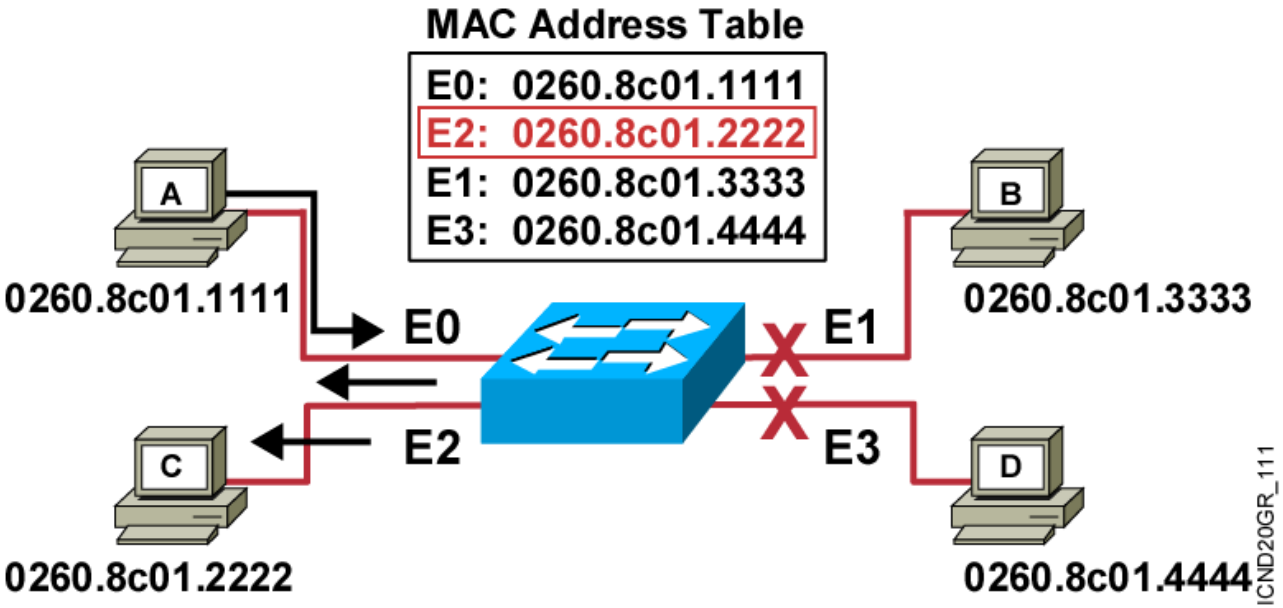
- Station A sends a frame to station C.
- Switch caches the MAC address of station A to port E0 by **learning the source address of data frames**.
- The frame from station A to station C is flooded out to all ports except port E0 (unknown unicasts are flooded).

Learning Addresses (Cont.)



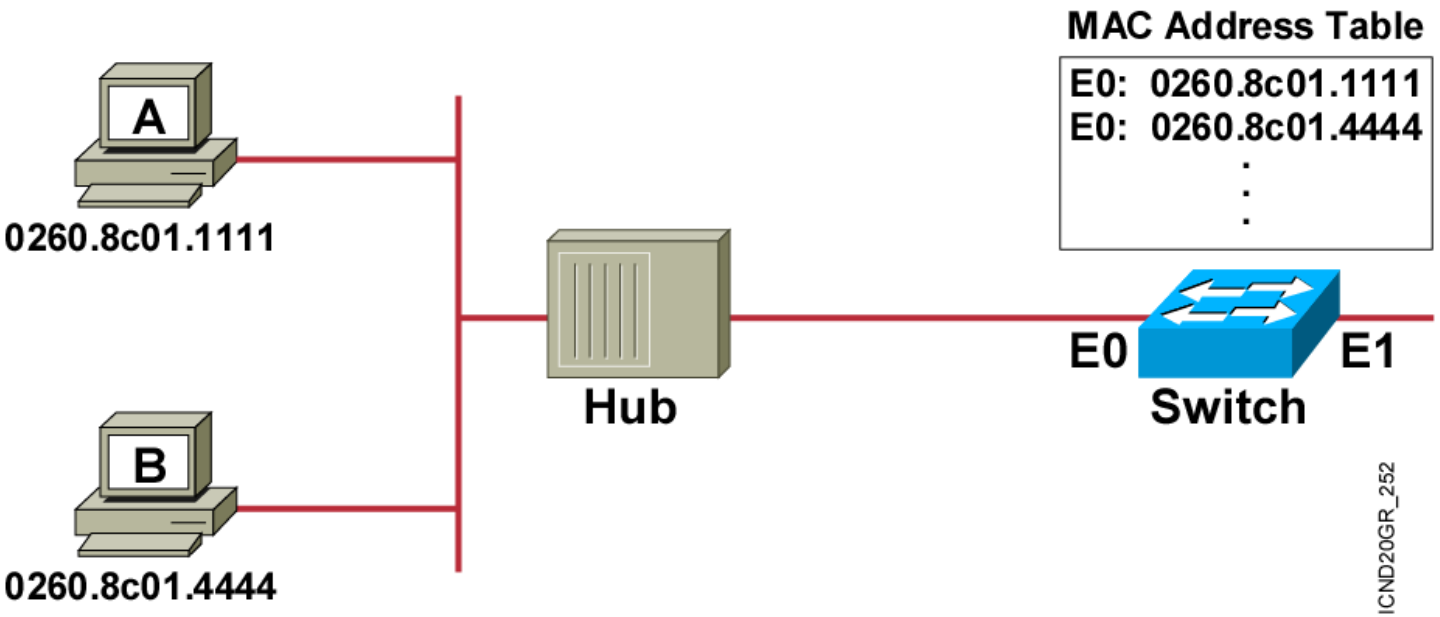
- Station D sends a frame to station C.
- Switch caches the MAC address of station D to port E3 by learning the source address of data frames.
- The frame from station D to station C is flooded out to all ports except port E3 (unknown unicasts are flooded).

Forward Frames



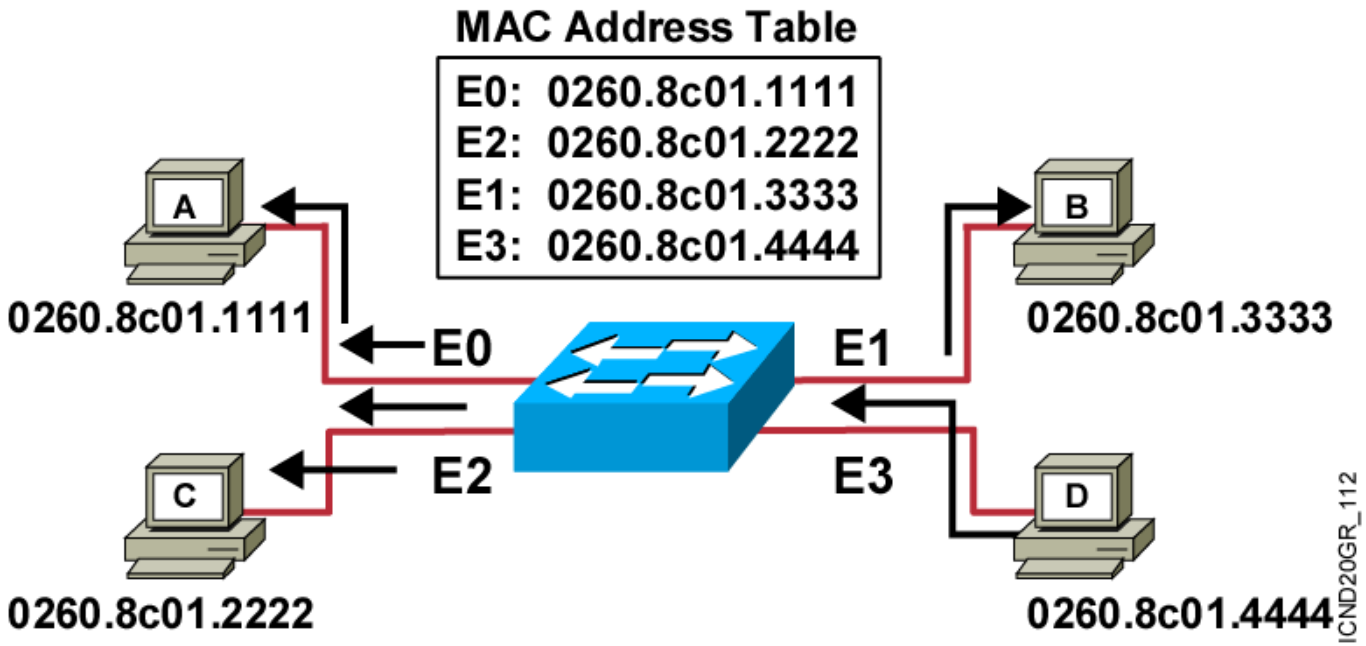
- Station A sends a frame to station C.
- Destination is known; frame is not flooded.

Filtering Frames



- Station A sends a frame to station B.
- The switch has the address for station B in the MAC address table.

Broadcast and Multicast Frames



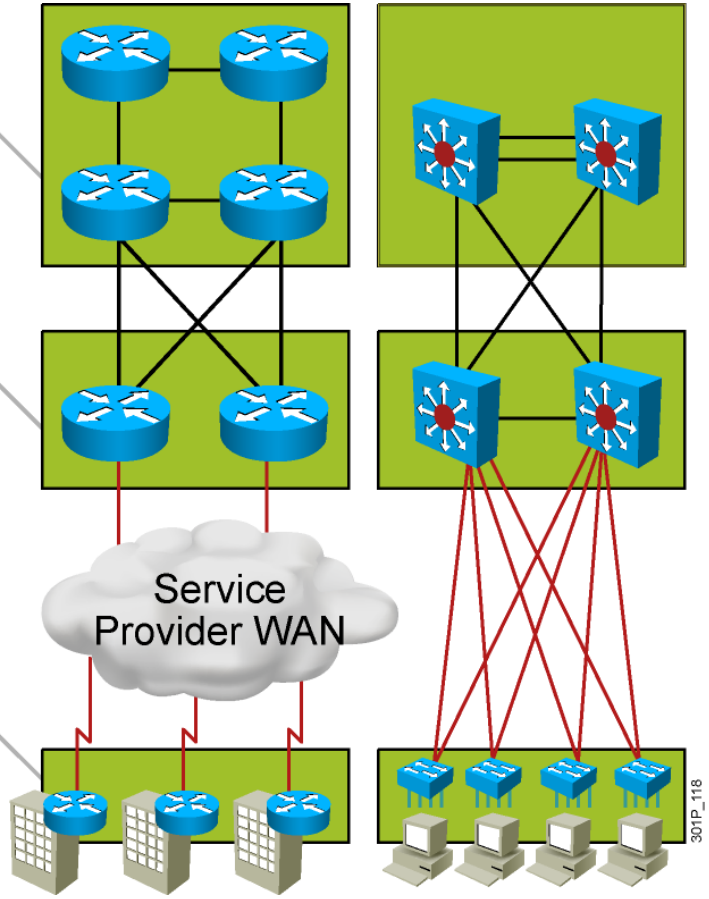
- Station D sends a broadcast or multicast frame.
- Broadcast and multicast frames are flooded to all ports other than the originating port.

The Hierarchy of Connectivity

Core layer: Provides optimal transport between core routers and distribution sites

Distribution layer: Provides policy-based connectivity, ? peer reduction, and aggregation

Access layer: Provides common group access to the internetworking environment



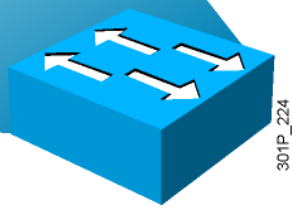
Ethernet LANs

Starting a Switch

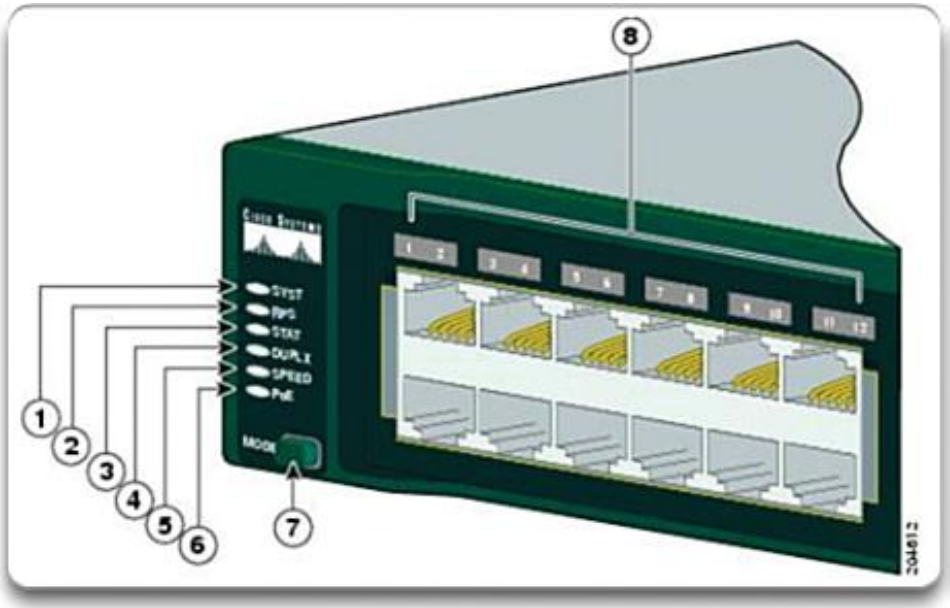
Initial Startup of the Catalyst Switch

- **System startup routines initiate switch software.**
- **Initial startup uses default configuration parameters.**

1. Before you start the switch, verify the cabling and console connection.
2. Attach the power cable plug to the switch power supply socket.
3. Observe the boot sequence:
   - LEDs on the switch chassis
   - Cisco IOS software output text



Catalyst 2960 Switch LED Indicators



Catalyst 2960 Switch LEDs			
1	The system LED	5	The port speed LED
2	The RPS LED (if RPS is supported on the switch)	6	The PoE status LED (if PoE is supported on the switch)
3	The port status LED (This is the default mode.)	7	The Mode button
4	The port duplex mode LED	8	The port LEDs

Initial Bootup Output from the Catalyst 2960 Switch

```
Base ethernet MAC Address: 00:19:30:38:bd:00
Xmodem file system is available.
The password-recovery mechanism is enabled.
Initializing Flash...
flashfs[0]: 598 files, 19 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 32514048
flashfs[0]: Bytes used: 8210432
flashfs[0]: Bytes available: 24303616
flashfs[0]: flashfs fsck took 9 seconds.
...done Initializing Flash.
Boot Sector Filesystem (bs) installed, fsid: 3
done.
Loading "flash:c2960-lanbasek9-mz.122-25.SEE2/c2960-lanbasek9
-mz.122-25.SEE2.bin"...@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
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@@@@@@@@@@@@@@@@
File "flash:c2960-lanbasek9-mz.122-25.SEE2/c2960-lanbasek9-mz.
122-25.SEE2.bin" uncompressed and installed, entry point: 0x3000
executing...

!Rest of startup text omitted
```
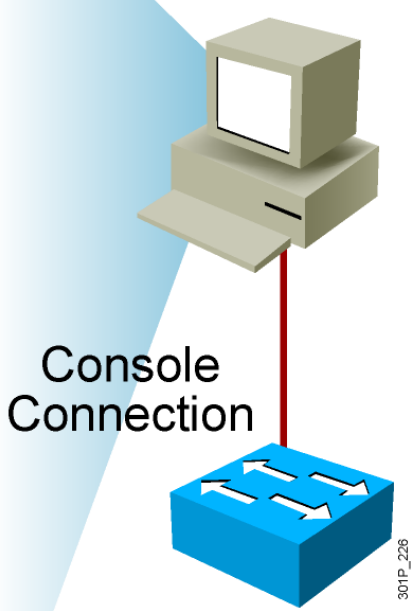
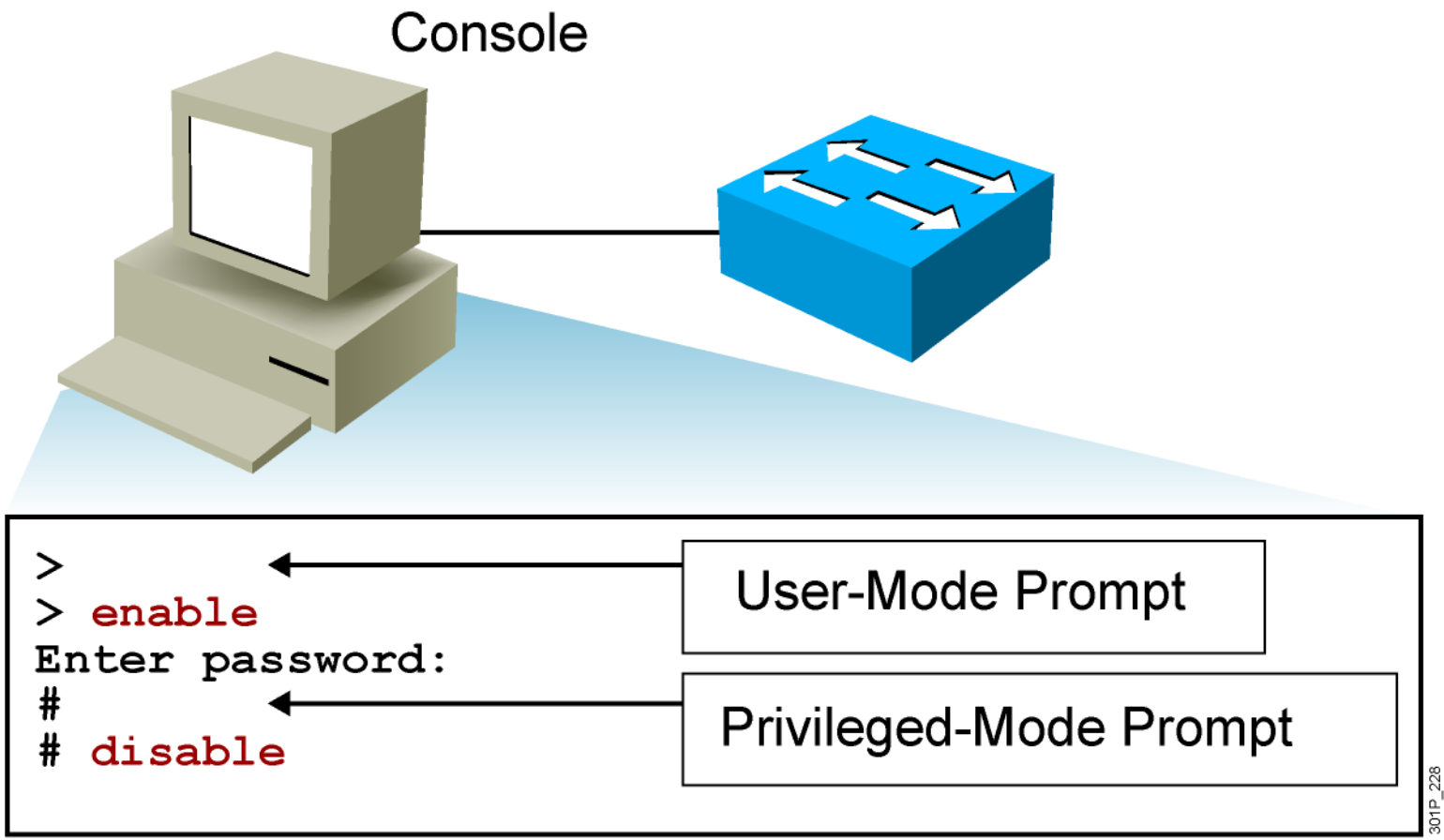



Initial Configuration of the Catalyst 2960 Switch Using Setup

```
--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]:
y

At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.

Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system
Would you like to enter basic management setup? [yes/no]: no
First, would you like to see the current interface summary? [yes]:
no
Configuring global parameters:
..
..text omitted ..
..
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]:
Building configuration...
[OK]
Use the enabled mode 'configure' command to modify this
configuration.
```

Logging In to the Switch and Entering the Privileged EXEC Mode



Configuring the Switch

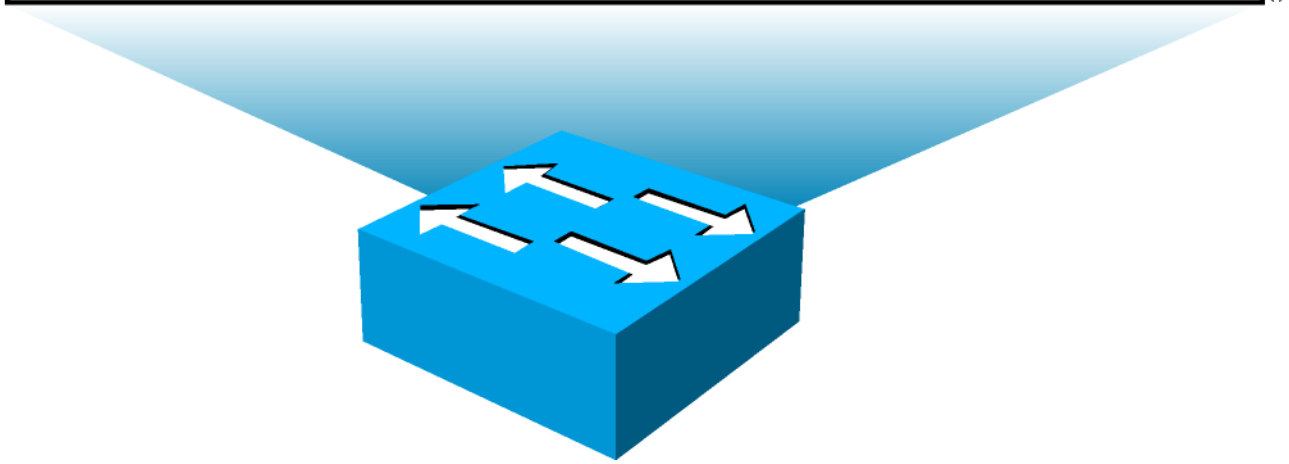
Configuration modes:

- Global configuration mode
  - **`SwitchX#configure terminal`**
  - **`SwitchX(config)#`**
- Interface configuration mode
  - **`SwitchX(config)#interface fa0/1`**
  - **`SwitchX(config-if)#`**

Configuring Switch Identification

Switch Name

```
(config) #hostname SwitchX
SwitchX(config)#
```



Sets the local identity for the switch

Configuring the Switch IP Address

```
SwitchX(config)#interface vlan 1
SwitchX(config-if)#ip address {ip address} {mask}
```

Example:

```
SwitchX(config)#interface vlan 1
SwitchX(config-if)#ip address 10.5.5.11 255.255.255.0
SwitchX(config-if)#no shutdown
```

Note: It is necessary to use the **no shutdown** command to make the interface operational.

Configuring the Switch Default Gateway


```
SwitchX(config)#ip default-gateway {ip address}
```

Example:

```
SwitchX(config)#ip default-gateway 172.20.137.1
```

Saving Configurations

```
SwitchX
SwitchX copy running-config startup-config
Destination filename [startup-config]?
Building configuration…

SwitchX
```

Copies the current configuration to NVRAM

Showing Switch Initial Startup Status

```
SwitchX#show version
```

- Displays the configuration of the system hardware, software version, names and sources of configuration files, and boot images

```
SwitchX#show running-config
```

- Displays the current active configuration file of the switch

```
SwitchX#show interfaces
```

- Displays statistics for all interfaces configured on the switch

Switch show version Command

```
Switch#show version
Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 12.2(25)SEE2, RELEASE
SOFTWARE (fc1)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 28-Jul-06 11:57 by yenanh
Image text-base: 0x00003000, data-base: 0x00BB7944

ROM: Bootstrap program is C2960 boot loader
BOOTLDR: C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)SEE1, RELEASE SOFTWARE (fc1)

Switch uptime is 24 minutes
System returned to ROM by power-on
System image file is "flash:c2960-lanbasek9-mz.122-25.SEE2/c2960-lanbasek9-mz.122-
25.SEE2.bin"
cisco WS-C2960-24TT-L (PowerPC405) processor (revision B0) with 61440K/4088K bytes of memory.

Processor board ID FOC1052W3XC
Last reset from power-on
1 Virtual Ethernet interface
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

! Text omitted

Switch#
```

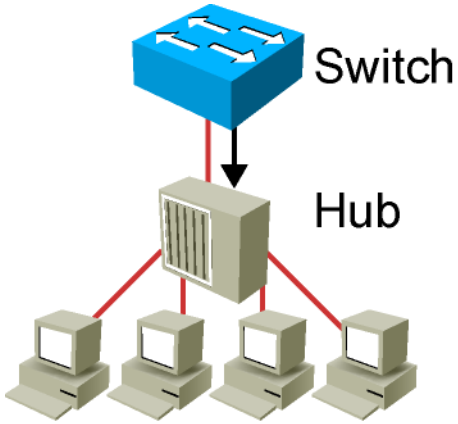
Switch show interfaces Command

```
SwitchX#show interfaces FastEthernet0/2
FastEthernet0/2 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 0008.a445.ce82 (bia 0008.a445.ce82)
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Half-duplex, 10Mb/s
  input flow-control is unsupported output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 4w6d, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     182979 packets input, 16802150 bytes, 0 no buffer
     Received 49954 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors 0 CRC,   0 frame, 0 overrun, 8 ignored
     0 watchdog, 20115 multicast, 0 pause input
     0 input packets with dribble condition detected
     3747473 packets output, 353656347 bytes, 0 underruns
 --More--
```

Full Duplex And Half Duplex

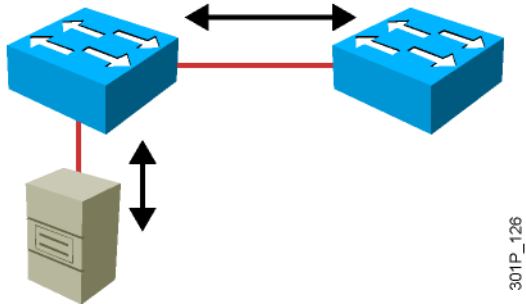
Half Duplex (CSMA/CD)

- Unidirectional data flow
- Higher potential for collision
- Hub connectivity



Full Duplex

- Point-to-point only
- Attached to dedicated switched port
- Requires full-duplex support on both ends
- Collision-free
- Collision detect circuit disabled



Full Duplex And Half Duplex

Cisco Catalyst 2960 Series

```
SwitchX(config)#interface fa0/1
SwitchX(config-if)#duplex {auto | full | half}
```

Cisco Catalyst 2960 Series

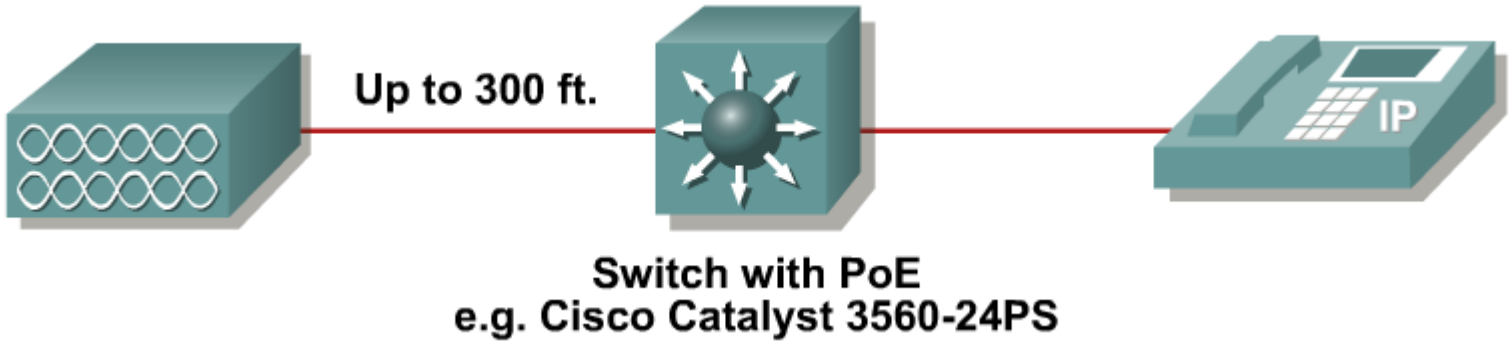
```
SwitchX(config)#interface fa0/1
SwitchX(config-if)#speed {10 | 100 | 1000 | auto}
```

Managing the MAC Address Table

Catalyst 2960 Series

```
SwitchX#show mac-address-table
          Mac Address Table
-------------------------------------------
Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 All    0008.a445.9b40    STATIC      CPU
 All    0100.0ccc.cccc    STATIC      CPU
 All    0100.0ccc.cccd    STATIC      CPU
 All    0100.0cdd.dddd    STATIC      CPU
   1    0008.e3e8.0440    DYNAMIC     Fa0/2
Total Mac Addresses for this criterion: 5
SwitchX#
```

Power over Ethernet (PoE)



Sending operating power over Category 5 Ethernet cable

Power Sourcing Equipment (PSE)

- **Switches, power injector**

Powered devices (PD)

- **Access points, IP phones**

Up to 15.4W power per port

Distances up to 100 meters

Alternative: AC power adapter

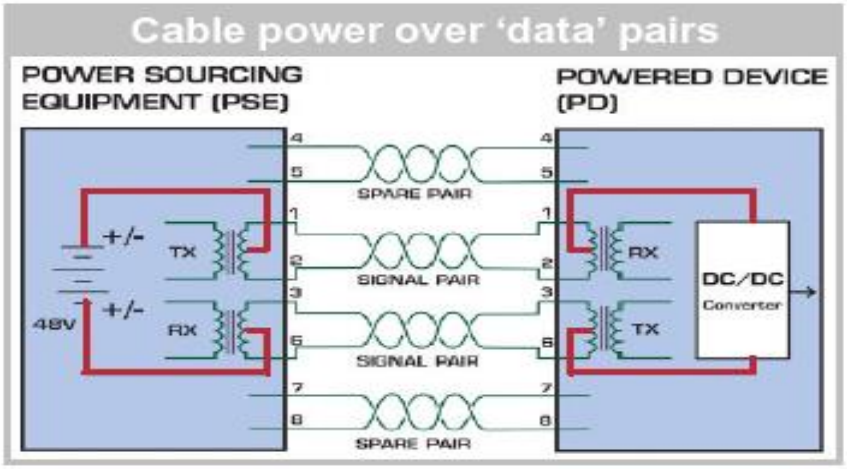
PoE Delivery

Detection of power requirements

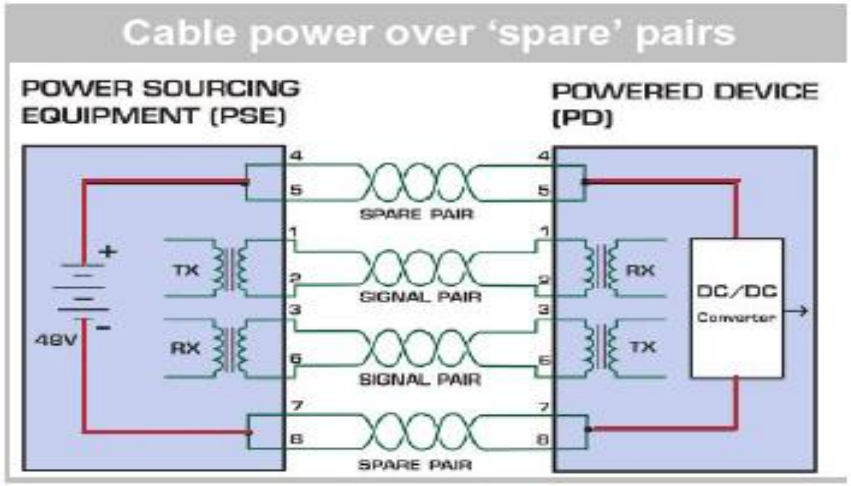
IEEE 802.3af

Cisco proprietary inline power

Two approved methods for “inserting” power into Ethernet cable:



Pair 1,2 & 3,6



Pair 4,5 & 7,8

MidSpan Power Injection

Uses pairs 4,5 & 7,8

Requires 8-wire cabling

Does not extend 100-m total length limit

Not possible for 1000TX

Power Sourcing Equipment

Power injector

- AIR-PWRINJ3/AIR-PWRINJ-FIB

Powering switch

- Cisco Catalyst 3560-PS/3750-PS
- Cisco Express CE500-LC/CE500-PC
- Cisco Catalyst 4500/6500 switch with inline power line cards
- Router module NM-16ESW-PWR
- Router card HWIC-4ESW-POE
- Router with PoE support

PoE Switch

- **PoE interface configuration**

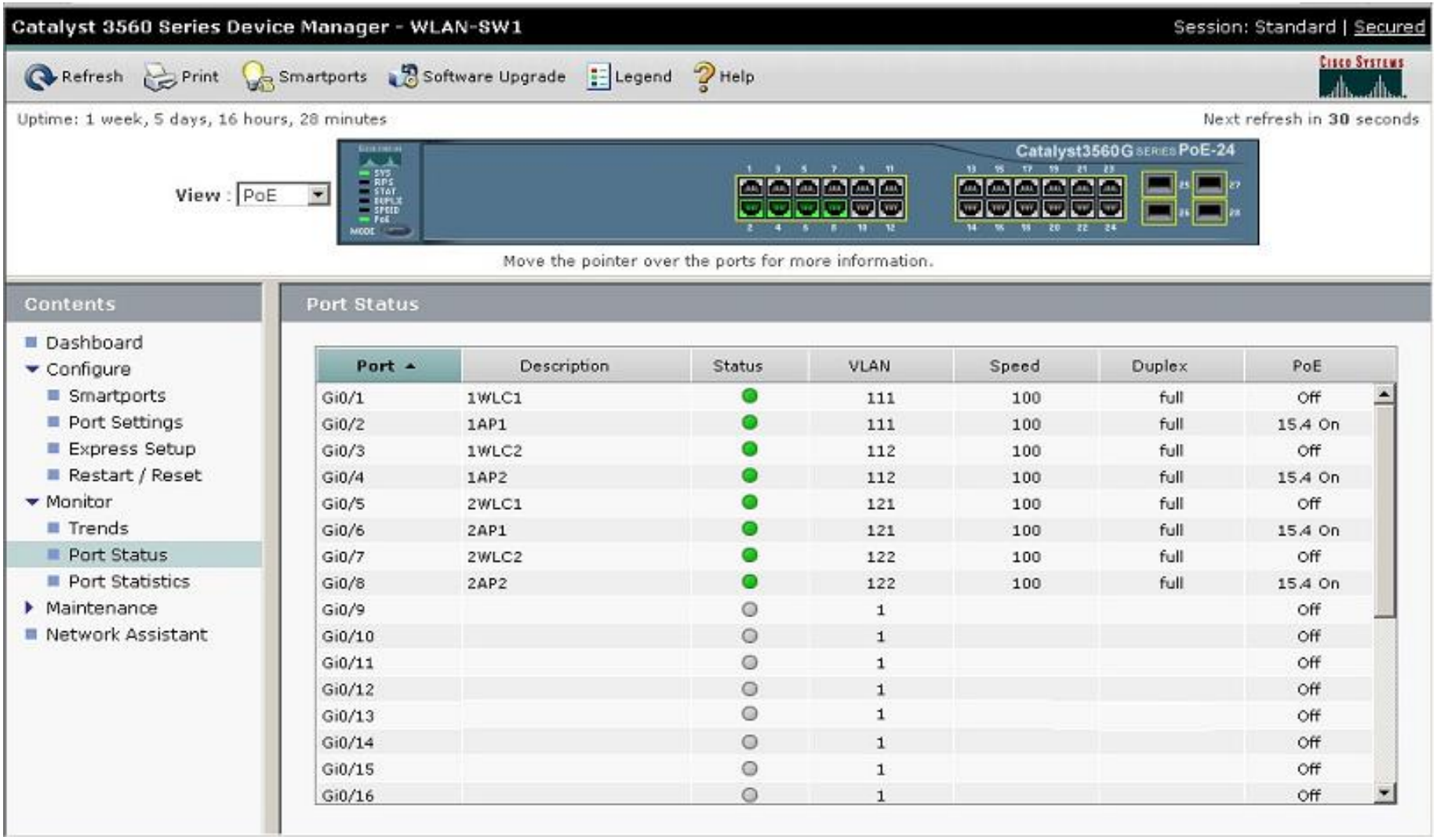
```
switch(config-if)# power inline {auto | never}
```

- **Display PoE statistics**

```
switch# show power inline [interface]
```

```
switch# show power inline
Available:370.0(w)  Used:61.6(w)  Remaining:308.4(w)
Interface Admin  Oper   Power   Device      Class Max
                        (Watts)
--------- ------ ------ ------- ---------- ----- ----
Gi0/1     auto   off    0.0     n/a         n/a   15.4
Gi0/2     auto   on     15.4    Ieee PD     3     15.4
Gi0/3     auto   off    0.0     n/a         n/a   15.4
Gi0/4     auto   on     15.4    Ieee PD     3     15.4
Gi0/5     auto   off    0.0     n/a         n/a   15.4
```

PoE Switch Port Status



PoE Standards

IEEE Extension	Type	Power Budget per Device
IEEE 802.3af	Type 1	15.4W
IEEE 802.3at / PoE+	Type 2	30.8W
IEEE 802.3bt / UPoE	Type 3	60W
IEEE 802.3bt	Type 4	90-95W


CISCO