

NET 363

Introduction to LANs

Ethernet Switches

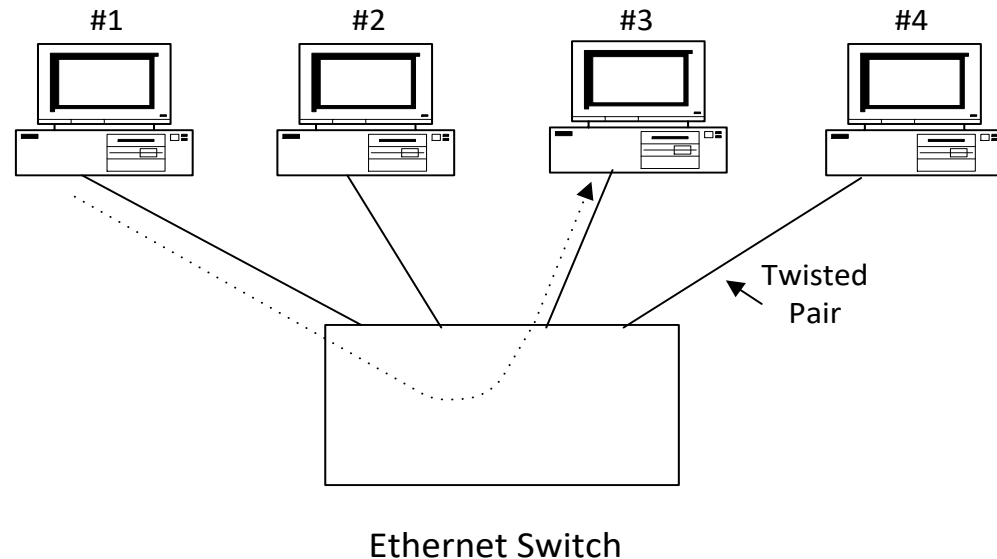
Greg Brewster
DePaul University

Ethernet Switches

- Ethernet Switch – Delivers data frame based on its MAC Destination address
 - Switch receives Ethernet frame
 - Switch looks up 6-byte Destination Address in a Forwarding Table
 - Forwarding Table also called Mac Address Table or CAM Table
 - Sends frame out ***only*** the port associated with the Destination Address
 - Old 2-port switches were called **bridges**.

Switched Ethernet

Data delivery via intelligent switch



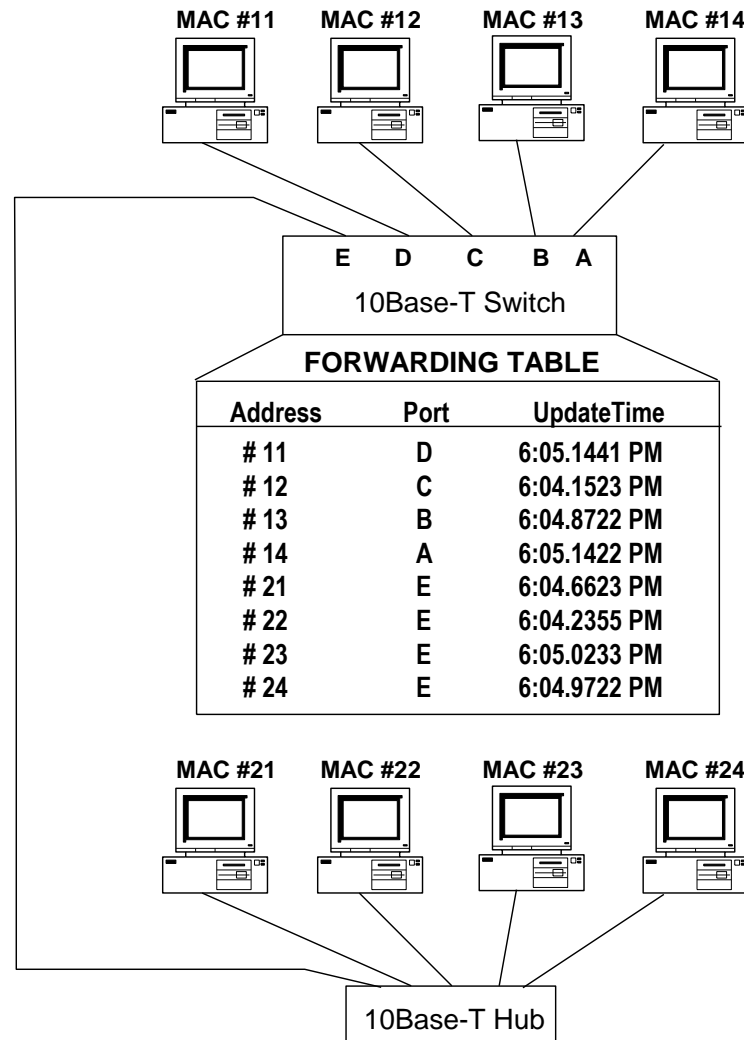
- Example: PC #1 puts MAC address “#2” into Destination Address field of Ethernet header and transmits data frame to Switch
- Switch checks its MAC Forwarding Table and ONLY transmits data frame to #2.

Switch Operations

Data frame arrives on switch interface (port) x :

- If destination address = FF:FF:FF:FF:FF:FF (broadcast) then the frame is re-transmitted out all ports except port x .
- Else Switch looks up destination address in Forwarding Table and finds associated port = y
 - If x not equal to y then send frame out port y
 - Else if $x = y$, drop the frame
 - If there is no entry for destination address in Forwarding Table, then forward frame out all ports except port x (that is, broadcast the frame).

Switch Forwarding Table

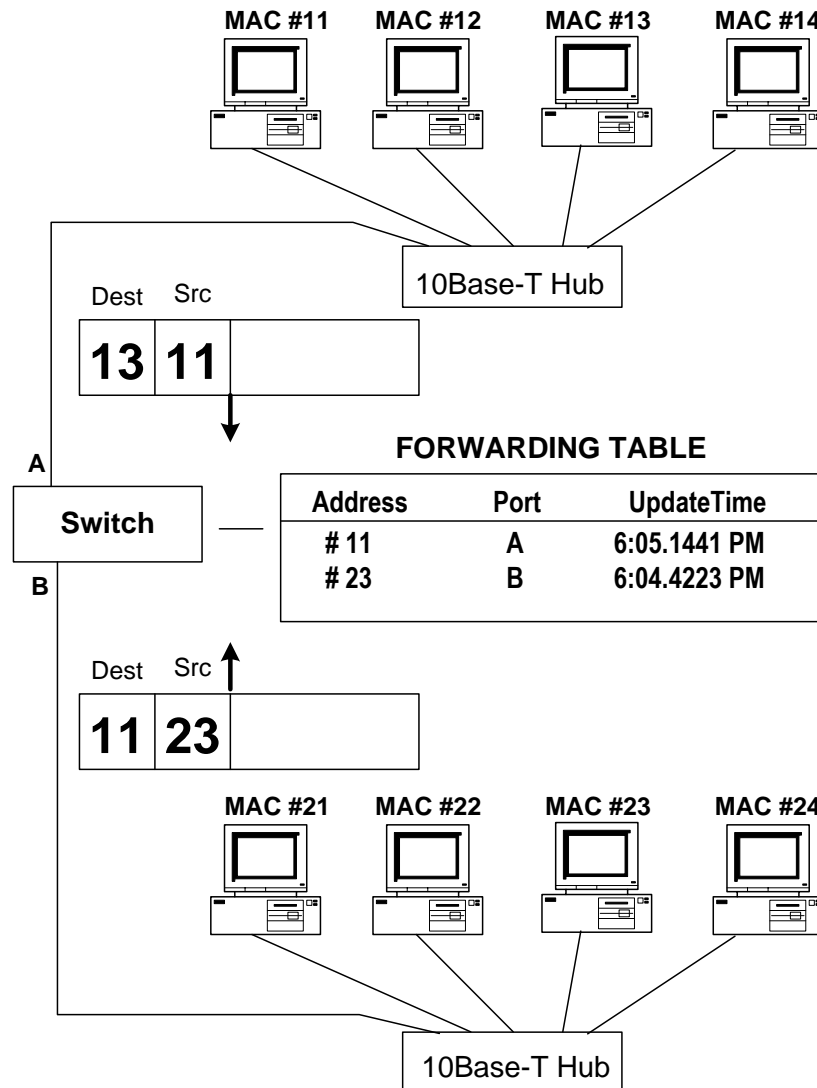


Building Forwarding Table

Bridge/Switch Learning:

- For each arriving data frame, switch examines source address and adds/updates entry in Forwarding Table containing
 - Source Address (6-byte format)
 - Port that this frame arrived on
 - Current Time

Switch Learning



Timing out Table entries

Table Entry Removal:

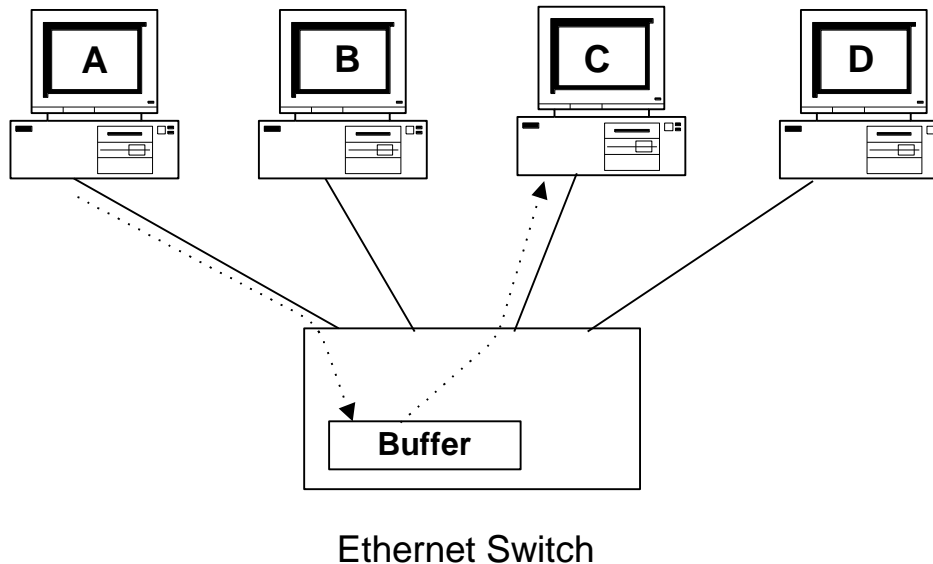
- If the source address of an arriving frame is already in the Forwarding Table, switch will simply update the ***Update Time*** to the current time.
- Any entry not updated within a specific timeout period (typically about 5 minutes) is erased from the Forwarding Table.

Switch Forwarding Modes

- ***Store-and-Forward:*** Switch waits to receive entire frame and check for errors before forwarding
 - Adv: No errored frames are forwarded
 - Disad: Extra delay to buffer the frame
- ***Cut-Through:*** Switch forwards data frame as soon as possible (after receiving Dest MAC address)
 - Adv: Minimizes delay through switch.
 - Disad: Switch may forward errored frames
 - ***Fragment-Free option:*** Waits until at least 64 bytes have been received before starting to forward frame

Switch Example

Cut-Through Mode

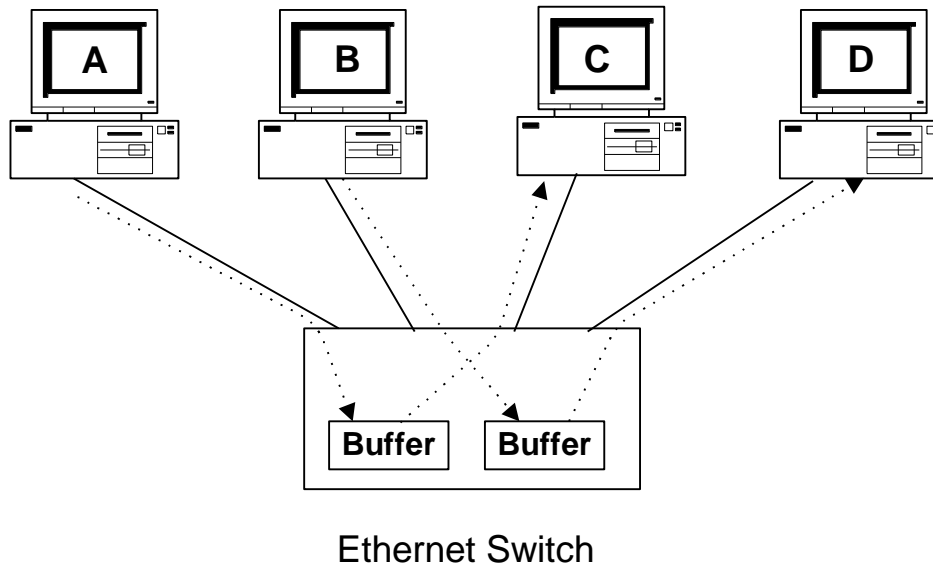


A transmits to C in Cut-Through Mode:

Data from A goes briefly into Switch Buffer (until switch can look up destination address) and is then immediately forwarded to C

Switch Example

Cut-Through Mode



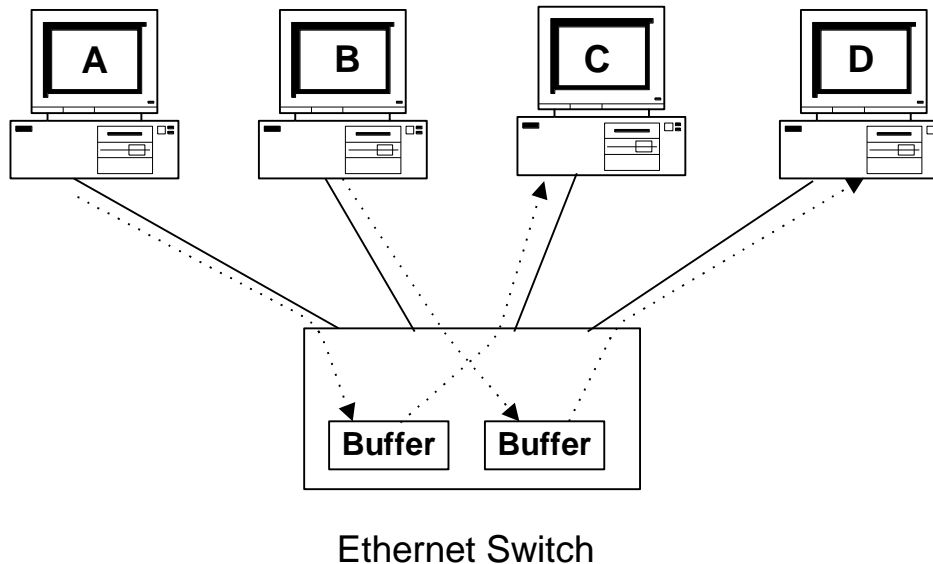
A transmits to C and B transmits to D in Cut-Through Mode:

Data from A goes briefly into Switch Buffer (until switch can look up destination address) and is then immediately forwarded to C. In the same way, data flows from B into another buffer and then on to D.

NOTE: Switch is giving double the bandwidth we could get from a hub.

Switch Example

Cut-Through Mode



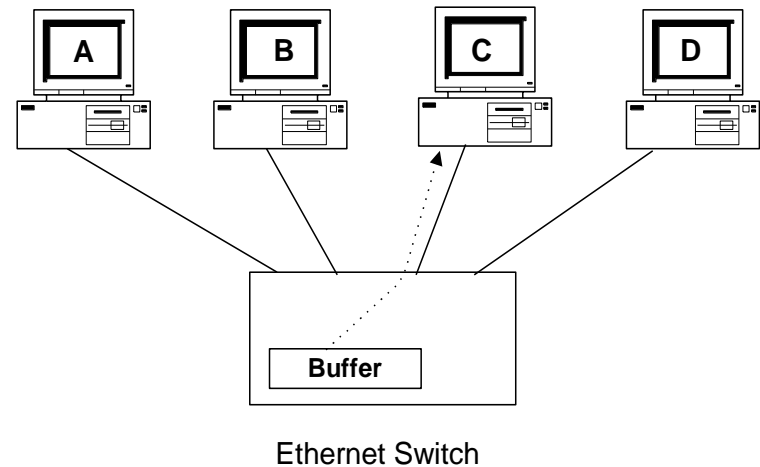
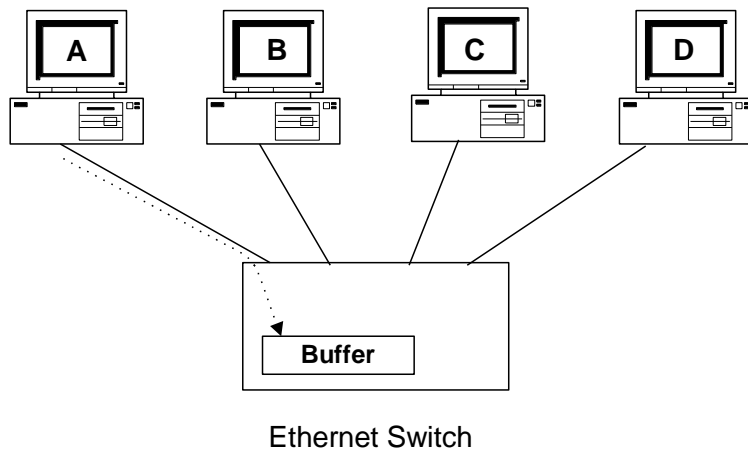
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Switch Example

Store-and-Forward Mode



A transmits to C in Store-and-Forward Mode:

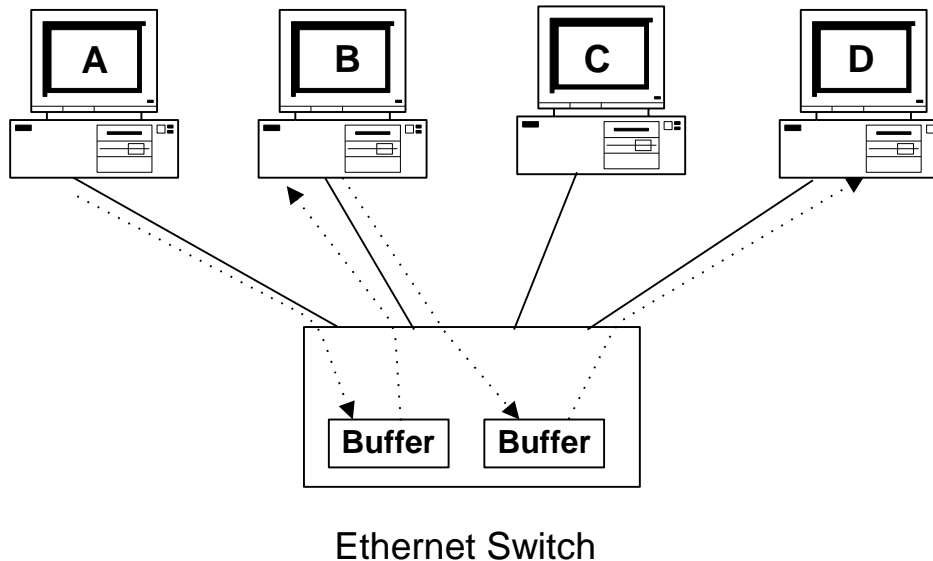
Data from A goes into Switch Buffer until complete data frame has been received and checked for errors. Then data frame is sent from buffer to C

Full-Duplex Ethernet

- Full-Duplex Ethernet allows a workstation to send and receive data simultaneously.
- Requirements
 - Must have a full-duplex Ethernet interface
 - Must be connected to Ethernet **switch**

Switch Example

Cut-Through Mode and Full-Duplex



A transmits to B and B transmits to D in Cut-Through Mode:

Data from A goes briefly into Switch Buffer (until switch can look up destination address) and is then immediately forwarded to B. Since B has a Full-Duplex NIC card, data can flow from B into the switch buffer at the same time.

PoE (Power over Ethernet)

- IEEE 802.3af standard
 - Supplying electrical power over Ethernet connections
- Two device types
 - PSE (power sourcing equipment)
 - PDs (powered devices)
- Requires Cat 5 or better copper cable
- Connectivity devices must support PoE
- Compatible with current 802.3 installations



Basic Switch Configuration

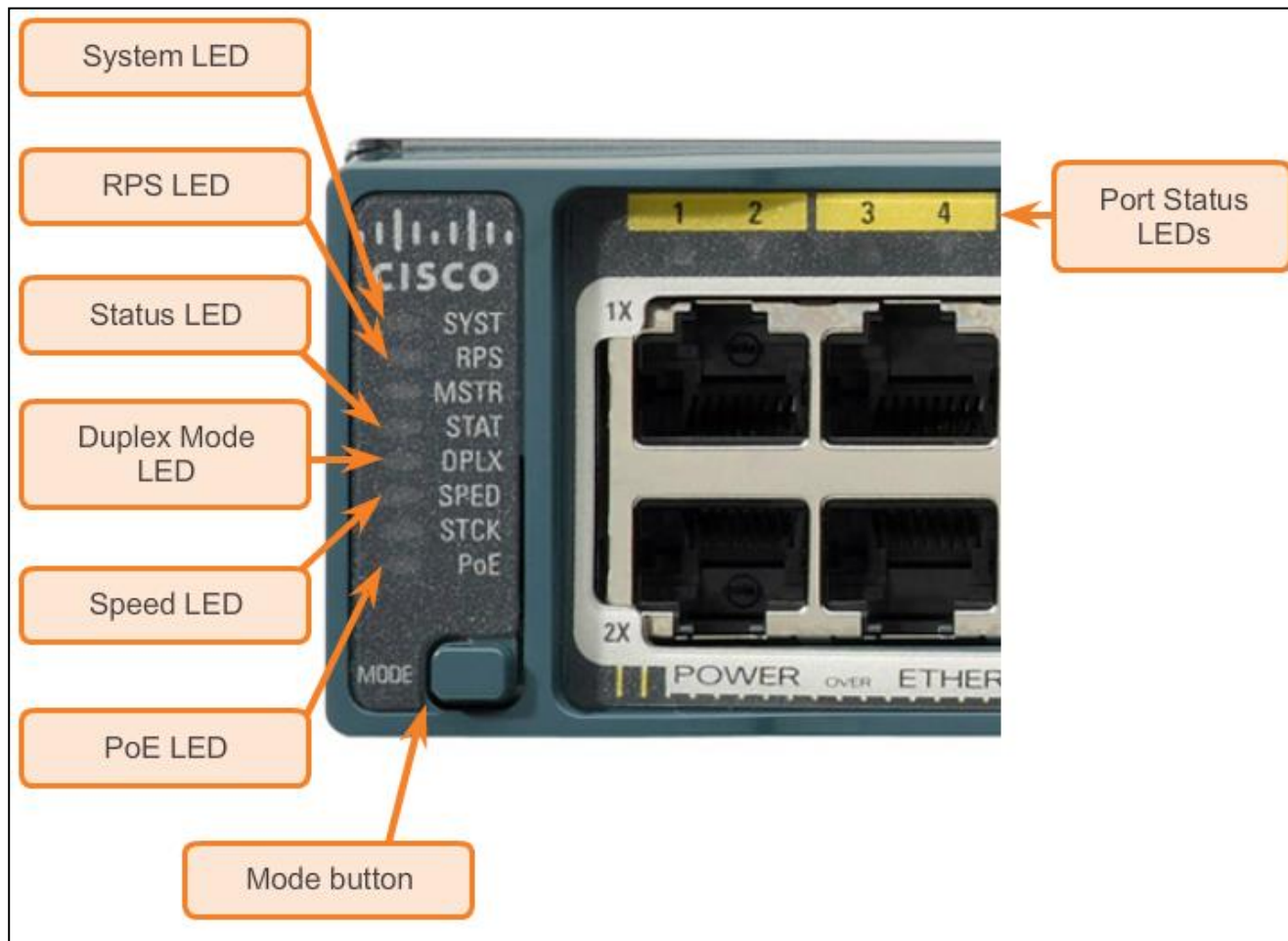
Switch LED Indicators

- Each port on Cisco Catalyst switches have status LED indicator lights.
- By default, these LED lights reflect port activity, but they can also provide other information about the switch through the **Mode** button.
- The following modes are available on Cisco Catalyst 2960 switches:
 - System LED
 - Redundant Power System (RPS) LED
 - Port Status LED
 - Port Duplex LED
 - Port Speed LED
 - Power over Ethernet (PoE) Mode LED



Basic Switch Configuration

Cisco Catalyst 2960 Switch Modes





Basic Switch Configuration

Preparing for Basic Switch Management

- To remotely manage a Cisco switch, it must be configured to access the network.
- An IP address and a subnet mask must be configured.
- If managing the switch from a remote network, a default gateway must also be configured.
- The IP information (address, subnet mask, gateway) is to be assigned to a switch switch virtual interface (SVI).
- Although these IP settings allow remote management and remote access to the switch, they do not allow the switch to route Layer 3 packets.



Basic Switch Configuration

Preparing for Basic Switch Management (cont.)

Cisco Switch IOS Commands

Enter global configuration mode.	S1# configure terminal
Enter interface configuration mode for the SVI.	S1(config)# interface vlan99
Configure the management interface IP address.	S1(config-if)# ip address 172.17.99.11
Enable the management interface.	S1(config-if)# no shutdown
Return to the privileged EXEC mode.	S1(config-if)# end
Save the running config to the startup config.	S1# copy running-config startup-config



Basic Switch Configuration

Preparing for Basic Switch Management (cont.)

Cisco Switch IOS Commands

Enter global configuration mode.

S1# **configure terminal**

Configure the default gateway for the switch.

S1(config)# **ip default-gateway 172.17.99.**

Return to the privileged EXEC mode.

S1(config-if)# **end**

Save the running config to the startup config.

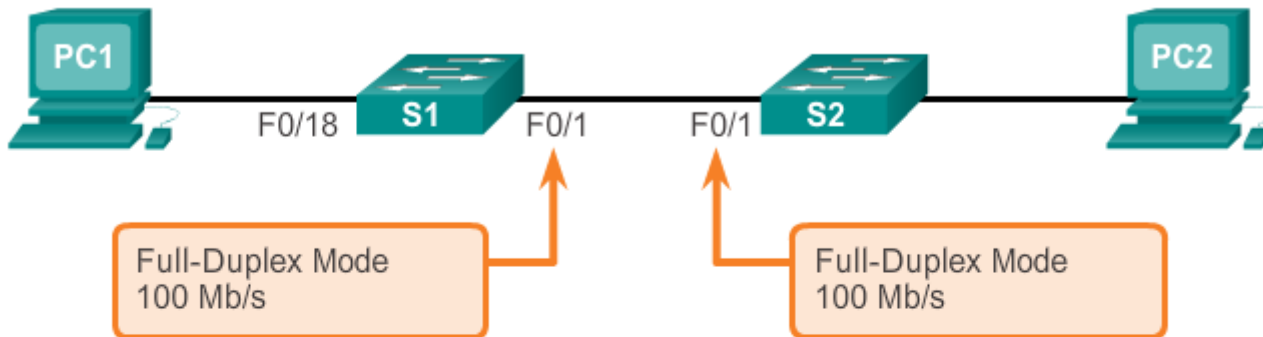
S1# **copy running-config startup-config**



Configuring Switch Ports

Configuring Switch Ports at the Physical Layer

Configure Duplex and Speed



Cisco Switch IOS Commands

Enter global configuration mode.	S1# configure terminal
Enter interface configuration mode.	S1 (config) # interface FastEthernet 0/1
Configure the interface duplex.	S1 (config-if) # duplex full
Configure the interface speed.	S1 (config-if) # speed 100
Return to the privileged EXEC mode.	S1 (config-if) # end
Save the running config to the startup config.	S1# copy running-config startup-config



Configuring Switch Ports

Auto-MDIX Feature

- Certain cable types (straight-through or crossover) were historically required when connecting devices.
- The automatic medium-dependent interface crossover (auto-MDIX) feature eliminates this problem.
- When auto-MDIX is enabled, the interface automatically detects and appropriately configures the connection.
- When using auto-MDIX on an interface, the interface speed and duplex must be set to **auto**.



Configuring Switch Ports

Auto-MDIX Feature (cont.)

Configure auto-MDIX



Cisco Switch IOS Commands

Enter global configuration mode.	S1# configure terminal
Enter interface configuration mode.	S1 (config)# interface fastethernet 0/1
Configure the interface to autonegotiate duplex with the connected device.	S1 (config-if)# duplex auto
Configure the interface to autonegotiate speed with the connected device.	S1 (config-if)# speed auto
Enable auto-MDIX on the interface.	S1 (config-if)# mdix auto
Return to the privileged EXEC mode.	S1 (config-if)# end
Save the running config to the startup config.	S1# copy running-config startup-config



Configuring Switch Ports

Verifying Switch Port Configuration

Verification Commands

Cisco Switch IOS Commands	
Display interface status and configuration.	S1# show interfaces [<i>interface-id</i>]
Display current startup configuration.	S1# show startup-config
Display current operating config.	S1# show running-config
Display information about flash file system.	S1# show flash
Display system hardware and software status.	S1# show version
Display history of commands entered.	S1# show history
Display IP information about an interface.	S1# show ip [<i>interface-id</i>]
Display the MAC address table.	S1# show mac-address-table OR S1# show mac address-table

Switching is Local and Transparent

- Ethernet switch learns MAC addresses on its own IP subnet only.
- MAC address is used for transmission within a single IP subnet (LAN) only.
- Ethernet switch forwards frames unchanged.
- Switches are invisible to host computers and routers.
 - There is no way for a host computer to determine whether it is connected to switch or hub.
 - There is no “traceroute for switches” – that is, there is no way for host computers or routers to know what switches or how many switches a packet passes through.