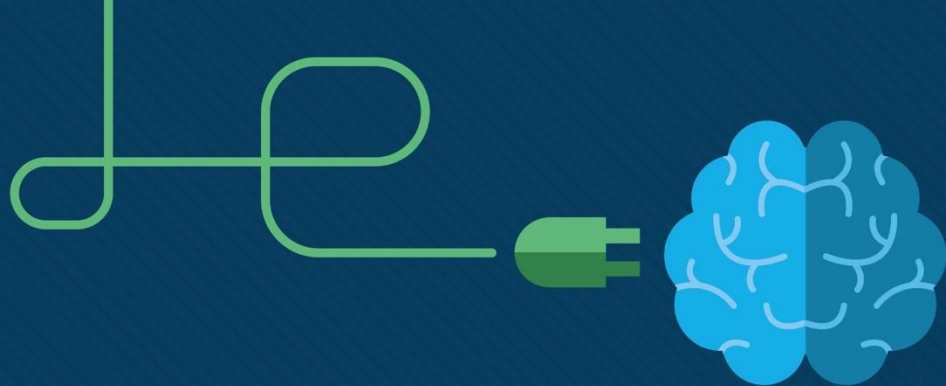# Module 2: Switching Concepts

Switching, Routing, and Wireless Essentials v7.0 (SRWE)

# Module Objectives

**Module Title:** Switching Concepts

**Module Objective:** Explain how Layer 2 switches forward data.

| Topic Title | Topic Objective |
|---|---|
| **Frame Forwarding** | Explain how frames are forwarded in a switched network. |
| **Switching Domains** | Compare a collision domain to a broadcast domain. |

# 2.1 Frame Forwarding

# Switching in Networking

Two terms are associated with frames entering or leaving an interface:

- **Ingress** – entering the interface
- **Egress** – exiting the interface

A switch forwards based on the ingress interface and the destination MAC address.

A switch uses its MAC address table to make forwarding decisions.

**Note**: A switch will never allow traffic to be forwarded out the interface it received the traffic.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
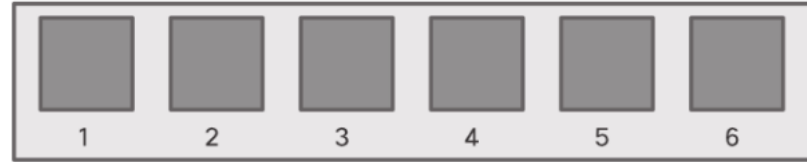
### Port Table

| Destination Addresses | Port |
|---|---|
| EE | 1 |
| AA | 2 |
| BA | 3 |
| EA | 4 |
| AC | 5 |
| AB | 6 |

# The Switch MAC Address Table

A switch will use the destination MAC address to <span style="color:red">determine the egress interface.</span>

Before a switch can make this decision it must learn what interface the destination is located.

A switch builds a MAC address table, also known as a <span style="color:red">Content Addressable Memory (CAM) table,</span> by recording the source MAC address into the table along with the port it was received.

# The Switch Learn and Forward Method

The switch uses a two step process:

**Step 1.** Learn – Examines Source Address

- Adds the source MAC if not in table
- Resets the time out setting back to 5 minutes if source is in the table

**Step 2.** Forward – Examines Destination Address

- If the destination MAC is in the MAC address table it is forwarded out the specified port.
- If a destination MAC is not in the table, it is flooded out all interfaces except the one it was received.

# Video – MAC Address Tables on Connected Switches
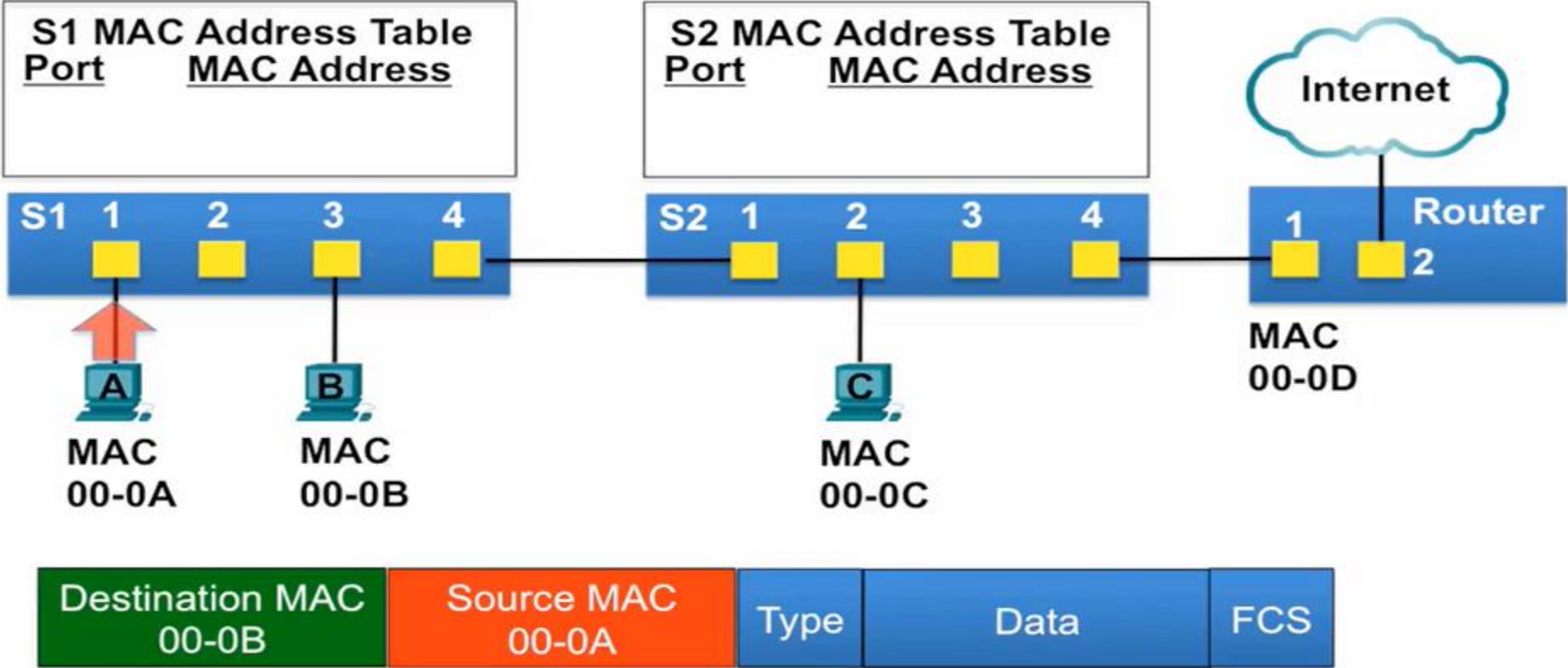
# Switch Forwarding Methods

Switches use software on application-specific-integrated circuits (ASICs) to make very quick decisions.
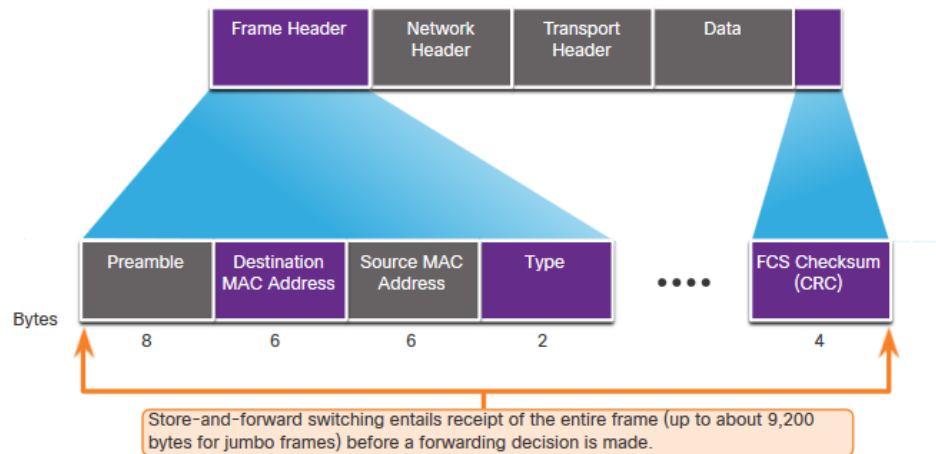
A switch will use one of two methods to make forwarding decisions after it receives a frame:

- **Store-and-forward switching** - Receives the entire frame and ensures the frame is valid. Store-and-forward switching is Cisco's preferred switching method.

- **Cut-through switching** – Forwards the frame immediately after determining the destination MAC address of an incoming frame and the egress port.
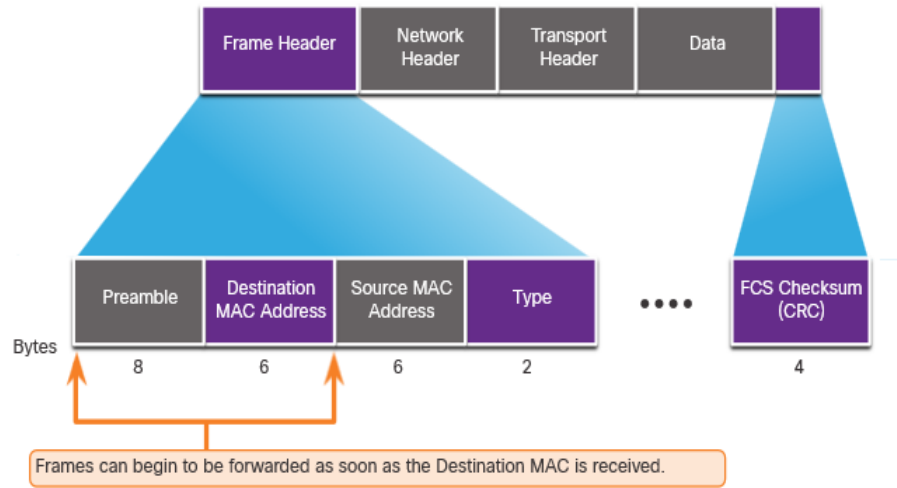
# Store-and-Forward Switching

Store-and-forward has two primary characteristics:

- **Error Checking** – The switch will check the Frame Check Sequence (FCS) for CRC errors. Bad frames will be discarded.

- **Buffering** – The ingress interface will buffer the frame while it checks the FCS. This also allows the switch to adjust to a potential difference in speeds between the ingress and egress ports.

| Frame Header | Network Header | Transport Header | Data | |
|---|---|---|---|---|

| Preamble | Destination MAC Address | Source MAC Address | Type | • • • • | FCS Checksum (CRC) |
|---|---|---|---|---|---|

Bytes

| 8 | 6 | 6 | 2 | | 4 |
|---|---|---|---|---|---|

Store-and-forward switching entails receipt of the entire frame (up to about 9,200 bytes for jumbo frames) before a forwarding decision is made.

## Frame Forwarding
# Cut-Through Switching



- **Cut-through** forwards the frame immediately after determining the destination MAC.

- **Fragment (Frag) Free** method will check the destination and ensure that the frame is at least 64 Bytes. This will eliminate runts.

Concepts of Cut-Through switching:

- Is appropriate for switches needing latency to be under 10 microseconds

- Does not check the FCS, so it can propagate errors

- May lead to bandwidth issues if the switch propagates too many errors

- Cannot support ports with differing speeds going from ingress to egress

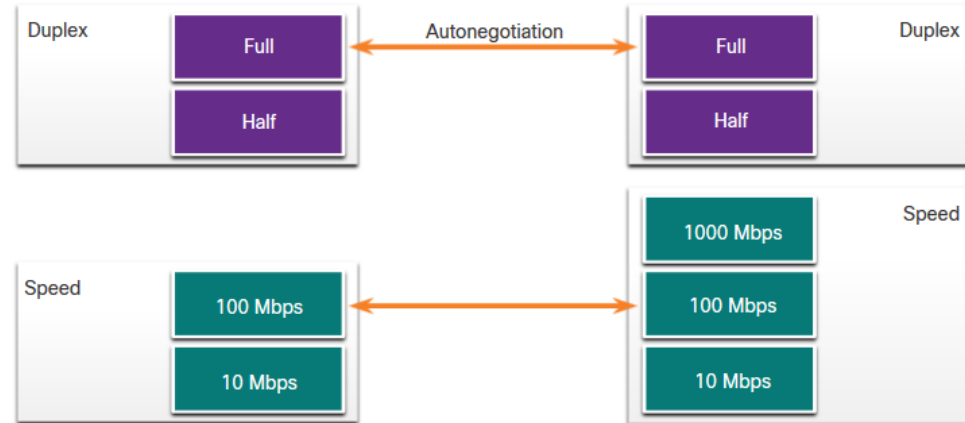# 2.2 Switching Domains

# Collision Domains

Switches eliminate collision domains and reduce congestion.

- When there is full duplex on the link the collision domains are eliminated.

- When there is one or more devices in half-duplex there will now be a collision domain.

  - There will now be contention for the bandwidth.

  - Collisions are now possible.

- Most devices, including Cisco and Microsoft use auto-negotiation as the default setting for duplex and speed.

# Broadcast Domains
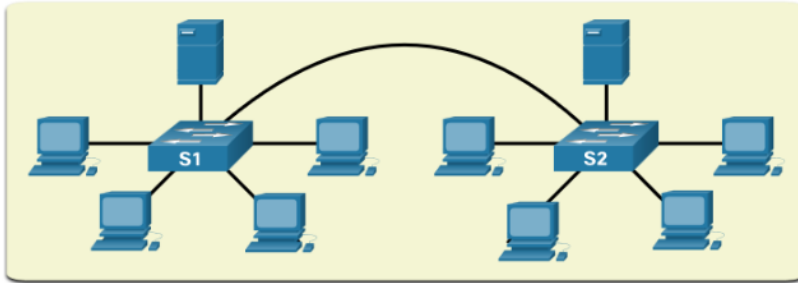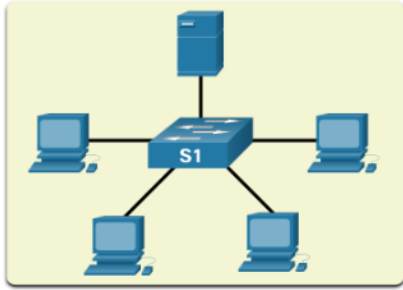


- A broadcast domain extends across all Layer 1 or Layer 2 devices on a LAN.

  - Only a layer 3 device (router) will break the broadcast domain, also called a MAC broadcast domain.

  - The broadcast domain consists of all devices on the LAN that receive the broadcast traffic.

- When the layer 2 switch receives the broadcast it will flood it out all interfaces except for the ingress interface.

- Too many broadcasts may cause congestion and poor network performance.

- Increasing devices at Layer 1 or layer 2 will cause the broadcast domain to expand.

# Alleviated Network Congestion

Switches use the MAC address table and full-duplex to  eliminate collisions and avoid congestion.

Features of the switch that alleviate congestion are as follows:

| Protocol | Function |
|---|---|
| **Fast Port Speeds** | Depending on the model, switches may have up to 100Gbps port speeds. |
| **Fast Internal Switching** | This uses fast internal bus(micro-segments) or shared memory to improve performance. |
| **Large Frame Buffers** | This allows for temporary storage while processing large quantities of frames. |

# 2.3 Module Practice and Quiz