

# Ethernet Switching - Module 7 Key Concepts

## 1. Ethernet Frames

- **Encapsulation:** Operates in the Data Link Layer (Layer 2) and Physical Layer (Layer 1). Defined by IEEE 802.3 standards.
- **Data Link Sublayers:**
  - **LLC (Logical Link Control):** Identifies the network layer protocol in the frame.
  - **MAC (Media Access Control):** Handles data encapsulation and media access.
- **Frame Fields:** Includes source/destination MAC addresses, EtherType, data, and Frame Check Sequence (FCS).
  - Minimum frame size: 64 bytes; Maximum frame size: 1518 bytes.

## 2. Ethernet MAC Addresses

- **Structure:** A 48-bit binary address (12 hexadecimal digits).
- **Purpose:** Identifies devices at the Data Link Layer.
- **Types:**
  - **Unicast:** One-to-one communication.
  - **Broadcast:** Sent to all devices on the LAN (FF-FF-FF-FF-FF-FF).
  - **Multicast:** Sent to a group of devices using specific reserved addresses.
- **Address Resolution Protocol (ARP):** Resolves IPv4 to MAC addresses. Neighbor Discovery (ND) resolves IPv6.

## 3. MAC Address Table

- **Switch Fundamentals:**
  - Uses MAC addresses for forwarding decisions.
  - Dynamically builds a MAC address table by examining the source MAC of incoming frames.
- **Learning and Forwarding:**
  - Learns the source MAC and port.
  - Forwards frames based on destination MAC or floods the frame if the MAC is unknown.
- **Filtering Frames:** Allows precise forwarding when the destination MAC is known.

## 4. Switch Speeds and Forwarding Methods

- **Frame Forwarding Methods:**
  - **Store-and-Forward:** Validates frame integrity before forwarding.
  - **Cut-Through:** Forwards the frame immediately after reading the destination MAC.
    - Variants: Fast-Forward and Fragment-Free.
- **Memory Buffering:**
  - **Port-Based Memory:** Allocates frames to specific ports.
  - **Shared Memory:** Uses a common buffer for all ports.
- **Duplex Settings:**
  - **Full-Duplex:** Simultaneous send/receive.
  - **Half-Duplex:** Only one action at a time (send or receive).
- Autonegotiation ensures optimal settings for connected devices.

## 5. Advanced Features

- **\*\*Auto-MDIX:\*\*** Automatically configures ports to match the cable type (crossover or straight-through).
- **\*\*Collision Avoidance:\*\*** Modern switches use full-duplex communication, eliminating the need for collision detection (CSMA/CD).

## Practice and Labs

- **\*\*Using Wireshark:\*\*** Analyze Ethernet frames to understand header fields and traffic patterns.
- **\*\*MAC Address Table Exploration:\*\*** Configure switches and examine MAC address behavior.