LAN Design

Chapter 4 Switched Networks

The Switched Environment

Frame Forwarding

Switching as a General Concept in Networking and Telecommunications - The concept of switching and forwarding frames is universal in networking and telecommunications.

Various types of switches are used in LANs, WANs, and the public switched telephone network (**PSTN**).

The fundamental concept of switching refers to a device making a decision based on two criteria:

- Ingress port
- Destination address

The decision on how a switch forwards traffic is made in relation to the flow of that traffic.

The term **ingress** is used to describe where a frame enters the device on a port. The term **egress** is used to describe frames leaving the device from a particular port.

The only intelligence of the LAN switch is its ability to use its table to forward traffic based on the ingress port and the destination address of a message.

Layer 2 Ethernet switches forward Ethernet frames based on the destination MAC address of the frames.

With a LAN switch, there is only one master switching table that describes a strict association between addresses and ports

Dynamically Populating a Switch MAC Address Table - **For a switch to know which port to use to transmit a frame, it must first learn which devices exist on each port** and **content addressable memory (CAM)** table.

As the switch learns the relationship of ports to devices, it builds a table called a MAC address,

The following two-step process is performed on every Ethernet frame that enters a switch.

Step 1. Learn – Examining the Source MAC Address - Every frame that enters a switch is checked for new information to learn. It does this by examining the frame's source MAC address and port number where the frame entered the switch:

- If the source MAC address does not exist, it is added to the table along with the incoming port number.
- If the source MAC address does exist, the switch updates the refresh timer for that entry. By default, most Ethernet switches keep an entry in the table for five minutes.
- **If the source MAC address does exist in the table but on a different port, the switch treats this as a new entry. The entry is replaced using the same MAC address, but with the more current port number.**

Step 2. Forward – Examining the Destination MAC Address - If the destination MAC address is a unicast address, the switch will look for a match between the destination MAC address of the frame and an entry in its MAC address table:

- If the destination MAC address is in the table, it will forward the frame out the specified port.
- If the destination MAC address is not in the table, the switch will forward the frame out **all ports except the incoming port.** This is called an unknown unicast.

Switching Domains

Collision Domains - The network segments that share the same bandwidth between devices are known as collision domains.

- In hub-based Ethernet segments, network devices compete for the medium, because devices must take turns when transmitting.
- If an Ethernet switch port is operating in half duplex, each segment is in its own collision domain. However, **Ethernet switch ports operating in full duplex eliminate collisions; therefore, there is no collision domain.**

Broadcast Domains - **A collection of interconnected switches forms a single broadcast domain.** **Only a network layer device, such as a router, can divide a Layer 2 broadcast domain.**

Converged Networks

Elements of a Converged Network - To support collaboration, business networks employ converged solutions using voice systems, IP phones, voice gateways, video support, and video conferencing

Including data services, a converged network with collaboration support may include the following features:

- **Call control** - Telephone call processing, caller ID, call transfer, hold, and conference
- **Voice messaging** - Voicemail
- **Mobility** - Receive important calls wherever you are
- **Automated attendant** - Serve customers faster by routing calls directly to the right department or individual

Cisco Borderless Networks - The Cisco Borderless Network is a network architecture that combines innovation and design.

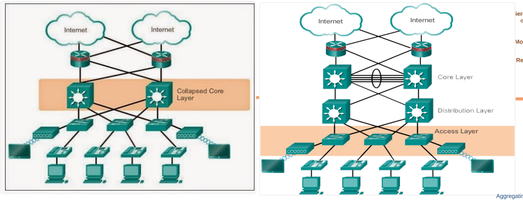
the Cisco Borderless Network provides two primary sets of services: **network services**, and **user and endpoint services** that are all managed by an integrated management solution.

Hierarchy in the Borderless Switched Network - Borderless switched network design guidelines are built upon the following principles:

- **Hierarchical** - Facilitates understanding the role of each device at every tier, simplifies deployment, operation, and management, and reduces fault domains at every tier
- **Modularity** - Allows seamless network expansion and integrated service enablement on an on-demand basis
- **Resiliency** - Satisfies user expectations for keeping the network always on
- **Flexibility** - Allows intelligent traffic load sharing by using all network resources

Two time-tested and proven hierarchical design frameworks for campus networks are the **three-tier layer** and the **two-tier layer models**

The three critical layers within these tiered designs are the **access, distribution, and core layers**



Access, Distribution, and Core Layers

Access Layer - Represents the network edge, where traffic enters or exits the campus network.

Provide network access to the user.

Distribution Layer - The distribution layer interfaces between the access layer and the core layer to provide many important functions

- Aggregating large-scale wiring closet networks
- Aggregating **Layer 2 broadcast domains** and **Layer 3 routing boundaries**
- Providing intelligent switching, routing, and **network access policy** functions to access the rest of the network
- Providing high availability through **redundant** distribution layer switches to the end-user and **equal cost paths** to the core
- Providing **differentiated services** to various classes of service applications at the edge of the network

Core Layer - The core layer is the network backbone. It connects several layers of the campus network

The primary purpose of the core layer is to provide **fault isolation** and **high-speed backbone connectivity.**

The core layer serves as the aggregator for all of the other campus blocks and ties the campus together with the rest of the network.

Switched Networks

Role of Switched Networks - A switched LAN allows more flexibility, traffic management, and additional features:

- Additional security
- Quality of service
- Support for wireless networking and connectivity
- Support for new technologies, such as IP telephony and mobility services

Form Factors - common business considerations when selecting switch equipment.

- the thickness of the switch, which is expressed in number of rack units.
- Cost, port density, power (PoE), reliability, port speed, frame buffers, scalability

When selecting the type of switch, the network designer must choose between a fixed configuration or a modular configuration, and stackable or non-stackable

Fixed Configuration Switches - Do not support features or options beyond those that originally came with the switch. The particular model determines the features and options available.

Modular Configuration Switches - Modular configuration switches typically come with different sized chassis that allow for the installation of different numbers of modular line cards.

Stackable Configuration Switches - Stackable configuration switches can be interconnected using a special cable that provides high-bandwidth throughput between the switches. **Cisco StackWise** technology allows the interconnection of up to nine switches. Switches can be stacked one on top of the other with cables connecting the switches in a daisy chain fashion. The stacked switches effectively operate as a single larger switch. Stackable switches are desirable where fault tolerance and bandwidth availability are critical and a modular switch is too costly to implement. By cross-connecting these stacked switches, the network can recover quickly if a single switch fails. Stackable switches use a special port for interconnections. Many Cisco stackable switches also support StackPower technology, which enables power sharing among stack members.