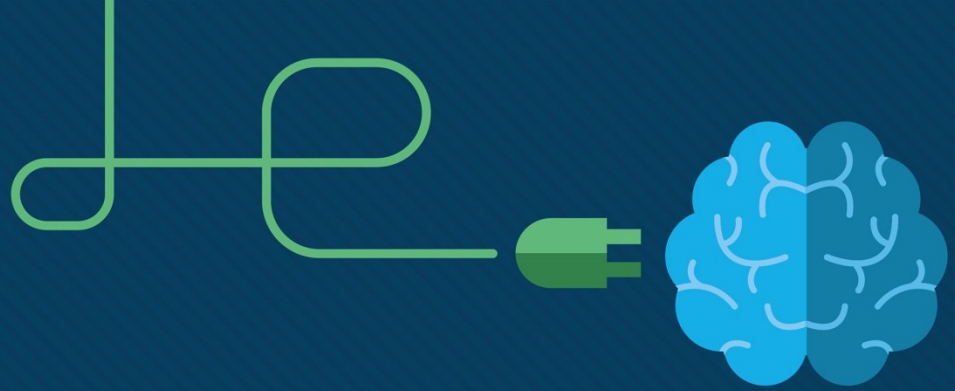

Chapter 4: Switched Networks

Instructor Materials

CCNA Routing and Switching

Routing and Switching Essentials v6.0

Chapter 4: Switched Networks

Introduction to Networks 6.0 Planning Guide

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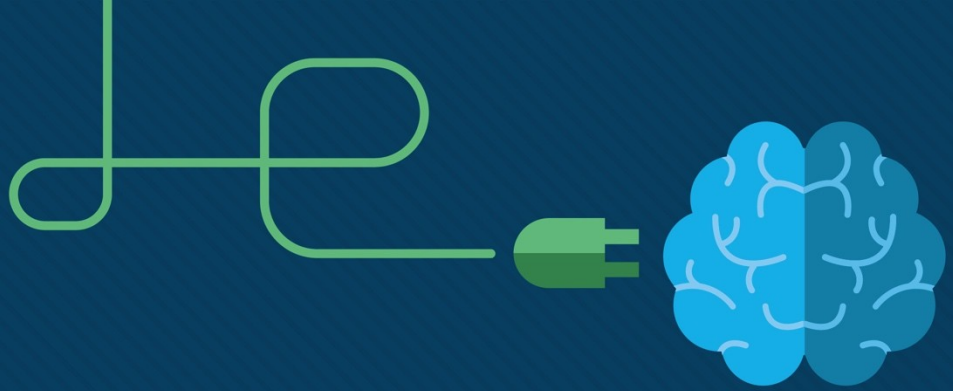

Chapter 4: Switched Networks

CCNA Routing and Switching

Routing and Switching Essentials v6.0

Chapter 4 - Sections & Objectives

- 4.1 LAN Design
  - Explain how switched networks support small to medium-sized businesses.
    - Explain how data, voice, and video are converged in a switched network.
    - Describe a switched network in a small to medium-sized business.
- 4.2 The Switched Environment
  - Explain how Layer 2 switches forward data in a small to medium-sized LAN.
    - Explain how frames are forwarded in a switched network.
    - Compare a collision domain to a broadcast domain.

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4.1 LAN Design

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Growing Complexity of Networks

- Next-generation networks need to be secure, reliable, and highly available.
- They must support a globalized workforce.
- They must be able to integrate legacy devices.

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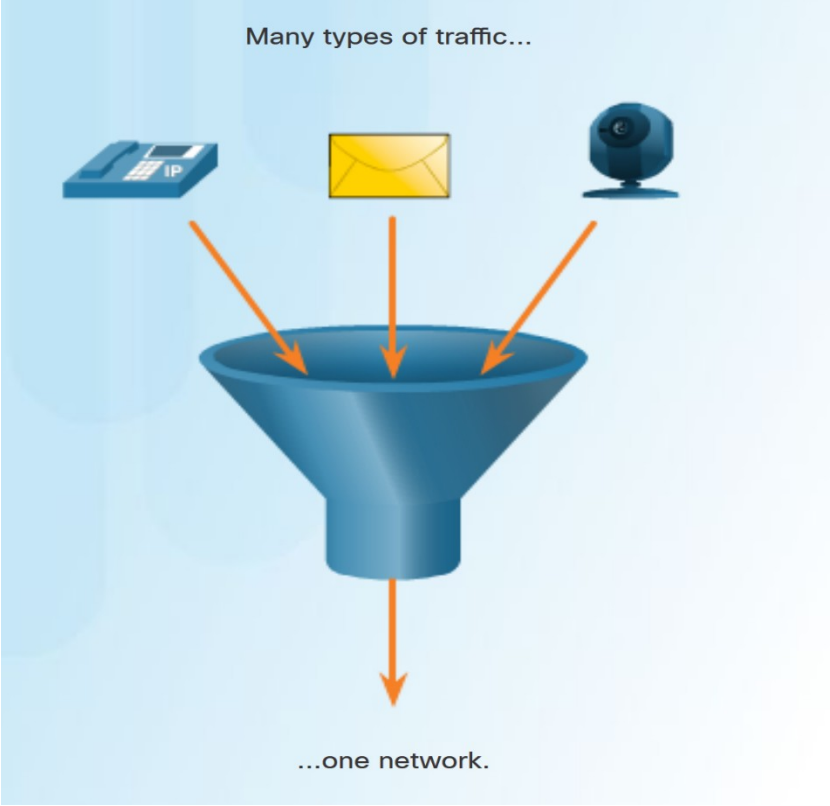
Elements of a Converged Network



- Converged network solutions integrate voice systems, IP phones, voice gateways, video support, and video conferencing.
- Primary benefit of the converged network - just one physical network to install and manage.

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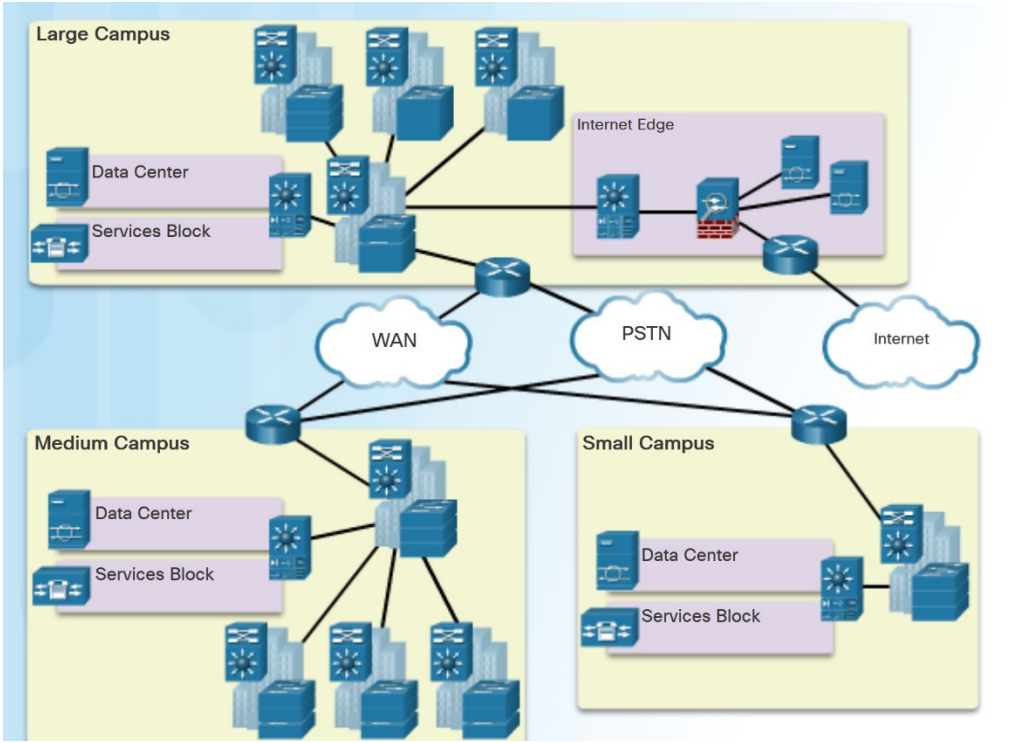
Cisco Borderless Networks

- The Cisco Borderless Network has the following features:
  - Allows organizations to connect anyone, anywhere, anytime, on any device; securely, reliably, and seamlessly.
  - Provides the framework to unify wired and wireless access, including policy, access control, and performance management across many different device types.
  - Provides network services, and user and endpoint services that are all managed by an integrated management solution.



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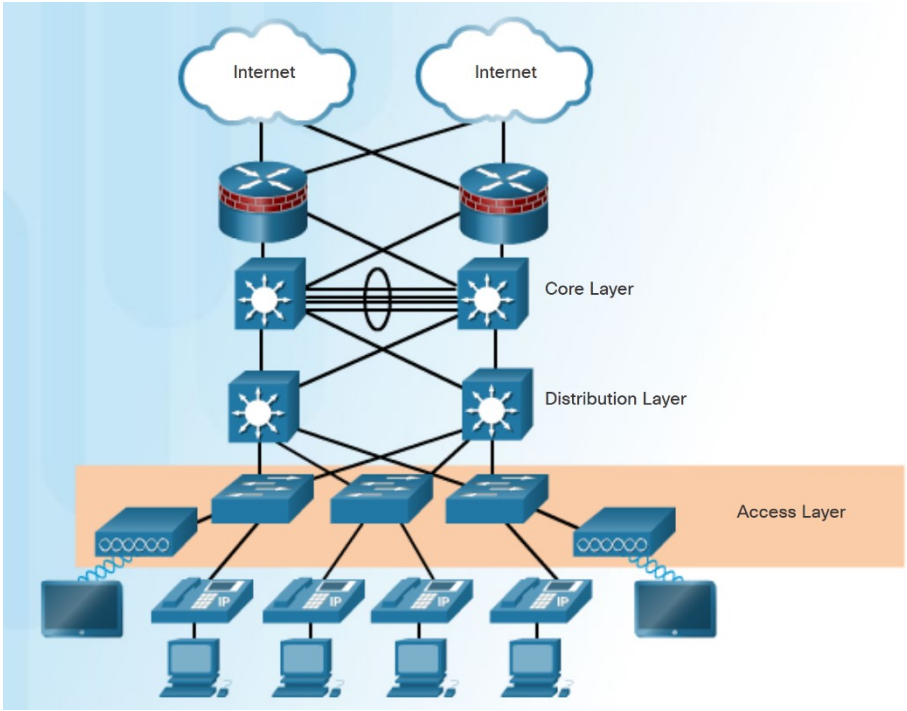
Hierarchy in the Borderless Switched Network



- Borderless switched network design guidelines are based on the following principles:
  - Hierarchical - Facilitates understanding the role of each device at every tier.
  - Modularity - Allows seamless network expansion and integrated services.
  - Resiliency – Provides an always available network.
  - Flexibility - Allows intelligent traffic load sharing.
- The three tiers of the hierarchical model are Access, Distribution and Core layers.

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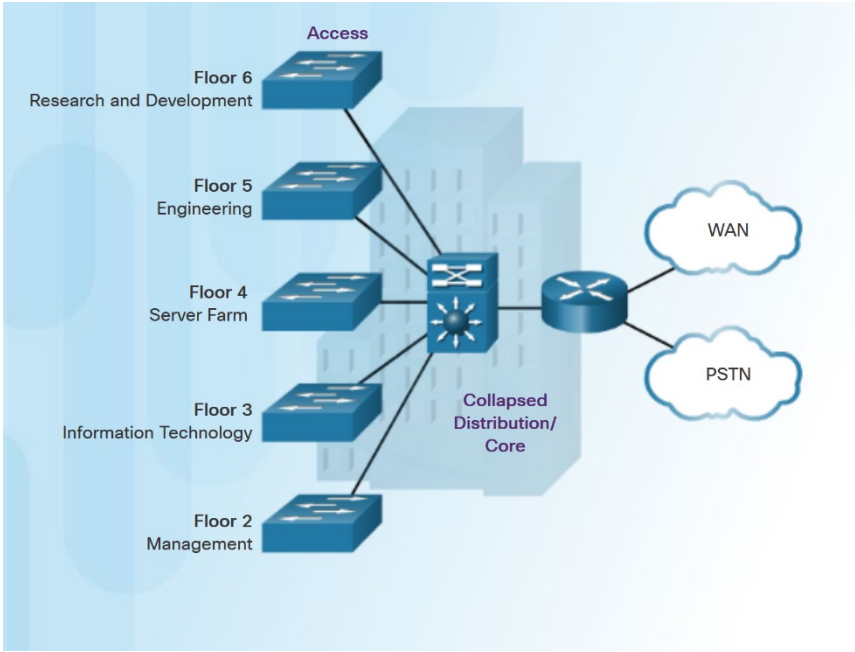
Access, Distribution, and Core Layers

- Access Layer – provides network access to the user.
- Distribution Layer - interfaces between the access layer and the core layer. Provides functions such as:
  - 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.
- Core Layer - is the network backbone. It provides fault isolation and high-speed backbone connectivity.



Smaller networks that do not need a separate distribution and core layer often use a two-tier campus or collapsed core network design.

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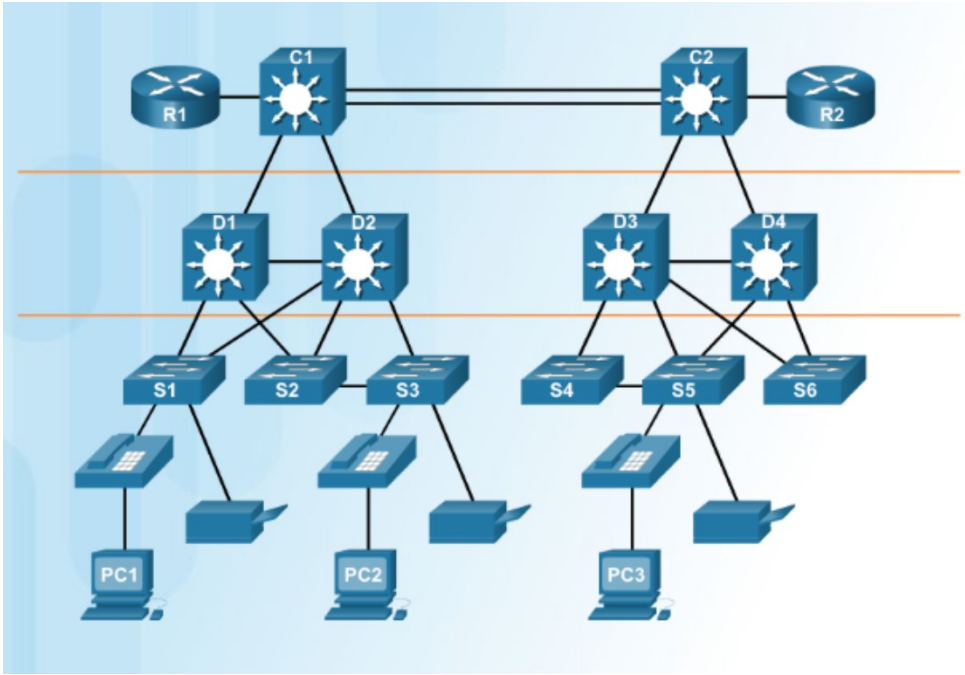
Role of Switched Networks



- A hierarchical switched LAN allows more flexibility, traffic management, and additional features:
  - Quality of service
  - Additional security
  - Support for wireless networking and connectivity
  - Support for new technologies.

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Form Factors

Fixed Configuration

Modular Configuration

Stackable Configuration

- Considerations when selecting switches:
  - Cost
  - Port Density
  - Power
  - Reliability
  - Port Speed
  - Frame buffers
  - Scalability

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4.2 The Switched Environment

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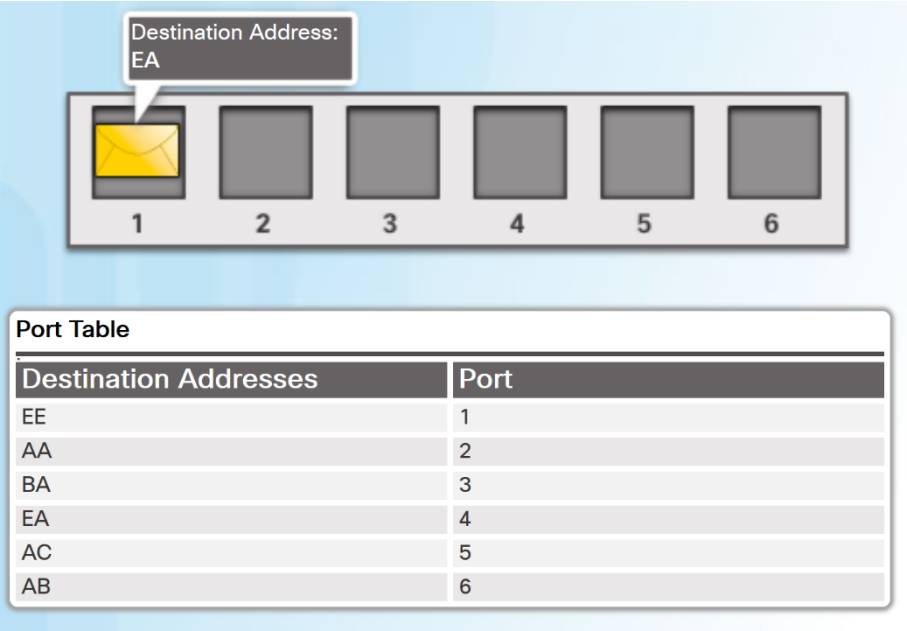
Switching as a General Concept in Networking and Telecommunications



Port Table

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

- A LAN switch makes decisions based on two criteria:
  - Ingress port - where a frame enters the device
  - Destination address
- A LAN switch maintains a table that it uses to determine how to forward traffic.
- In the diagram, If a message enters switch port 1 with a destination address of EA, then the switch forwards the traffic out port 4.
- Layer 2 Ethernet switches forward frames based on the destination MAC address.

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Video Demonstration - MAC Address Tables on Connected Switches

- The video explains how a switch builds its MAC address table by recording the MAC address of each device connected to each of its ports.

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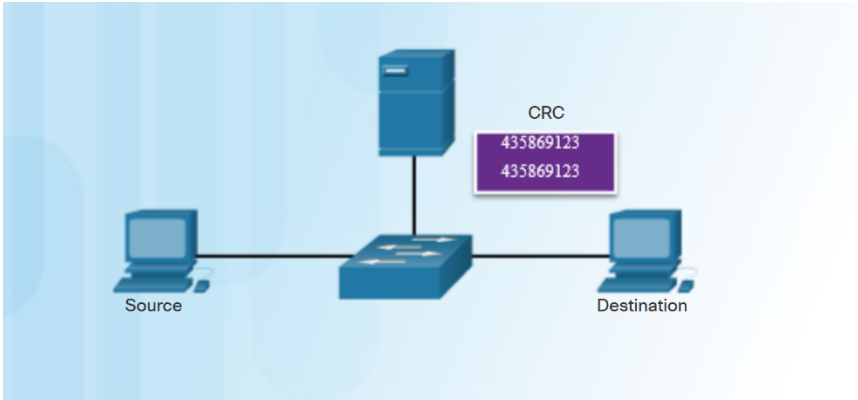
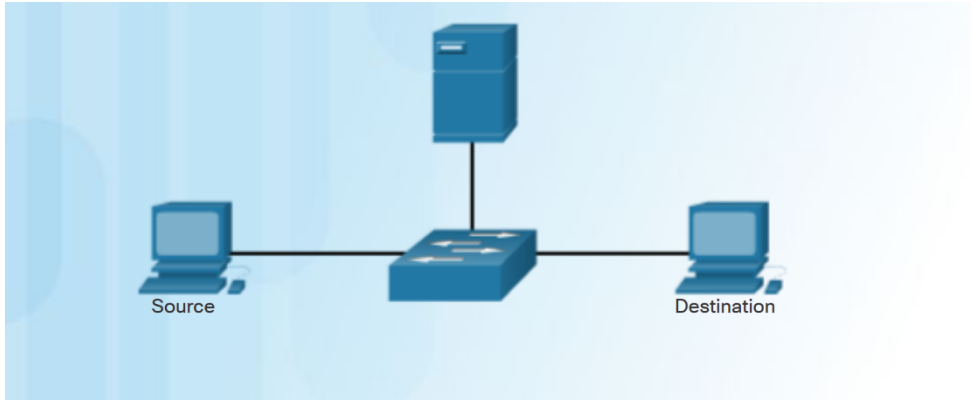
Switch Forwarding Methods



A store-and-forward switch receives the entire frame, and computes the CRC. If the CRC is valid, the switch looks up the destination address, which determines the outgoing interface. The frame is then forwarded out the correct port.



A cut-through switch forwards the frame before it is entirely received. At a minimum, the destination address of the frame must be read before the frame can be forwarded.

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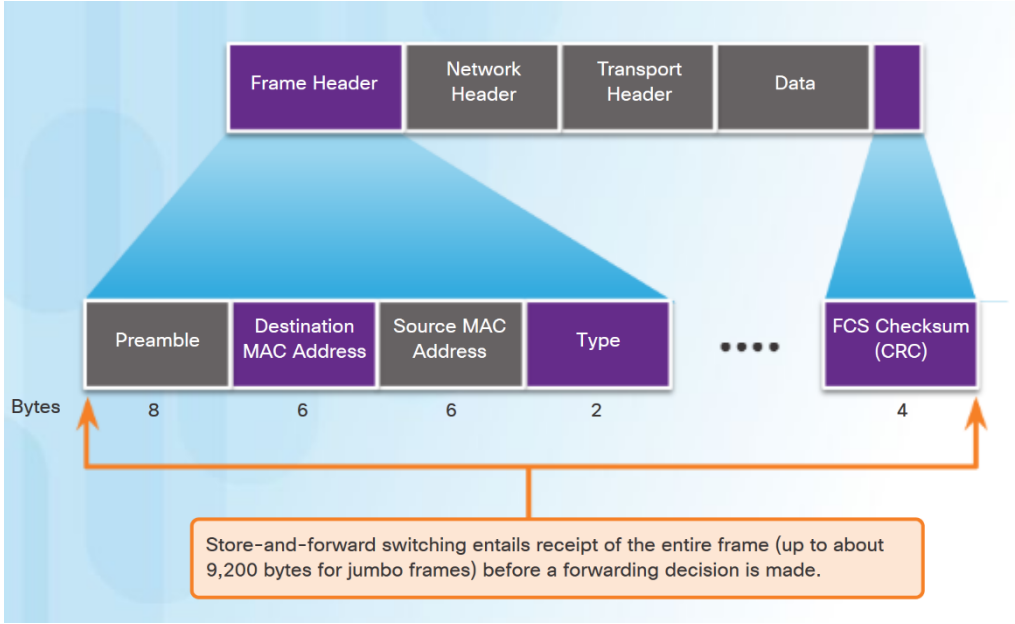
Store-and-Forward Switching



- Features of Store-and-Forward Switching:
  - **Error Checking–** After receiving the entire frame, the switch compares the frame-check-sequence (FCS) value in the last field against its own FCS calculations. Only error-free frames are forwarded
  - **Automatic Buffering–** ingress port buffering provides the flexibility to support any mix of Ethernet speeds.
- Store-and-Forward is Cisco's primary LAN switching method.

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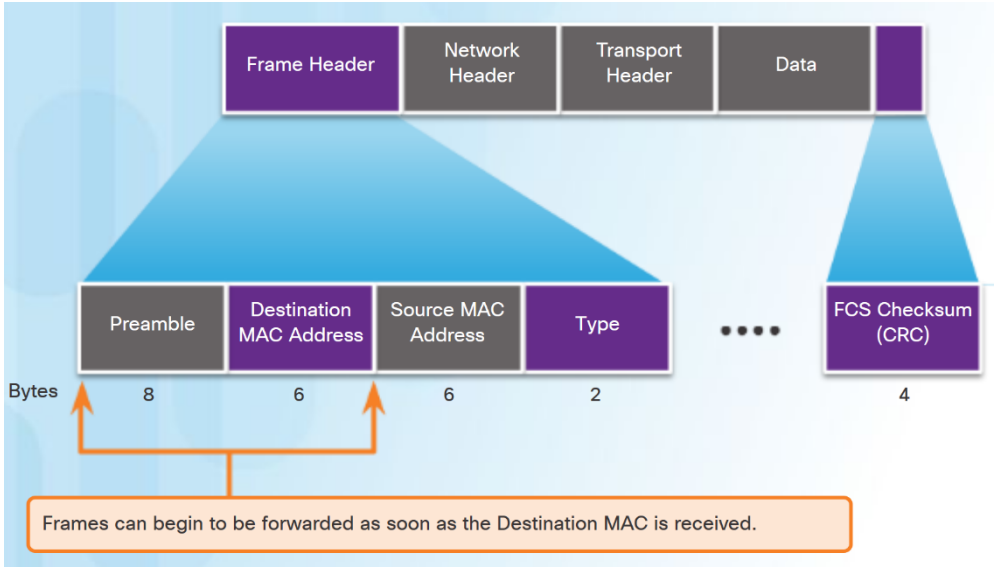
Cut-Through Switching



- Rapid Frame Forwarding - The switch can make a forwarding decision as soon as it has looked up the destination MAC address.
  - Frames with errors are forwarded.
- Fragment Free - modified form of cut-through switching. The switch waits for the collision window (64 bytes) to pass before forwarding the frame.
  - Provides better error checking than cut-through, with practically no increase in latency.

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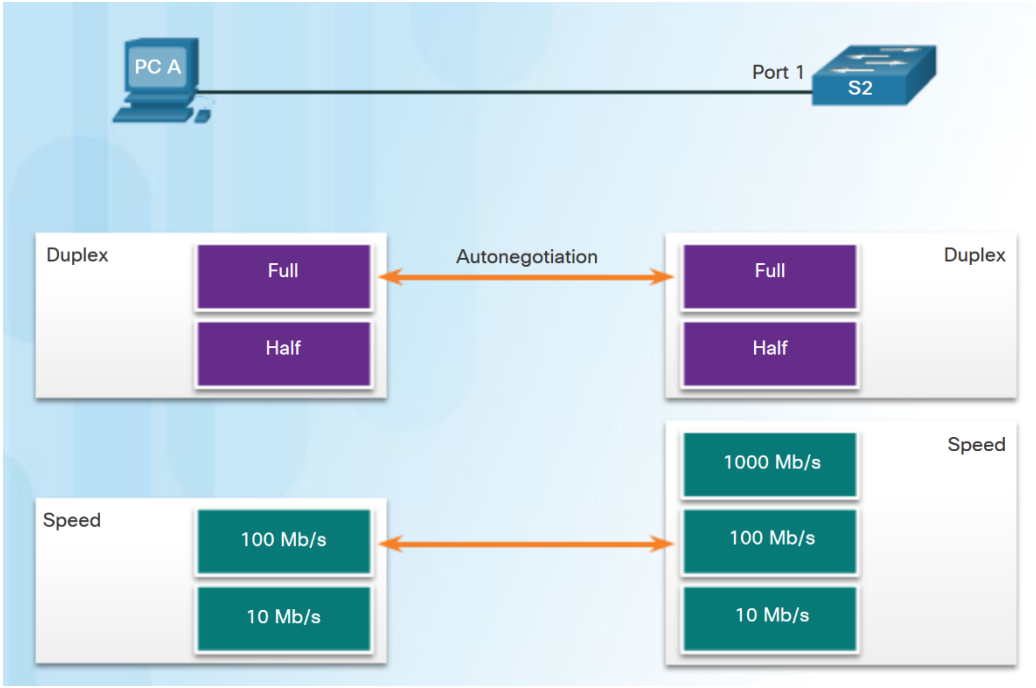
Collision Domains

- In hub-based Ethernet segments, network devices compete for the medium, therefore collisions will occur.
- Ethernet switch ports operating in full duplex eliminate collisions.
- Ethernet switch ports will autonegotiate full-duplex if connected to full-duplex device.
- If connected to a half-duplex device then the switch port will operate in half duplex and be part of a collision domain.



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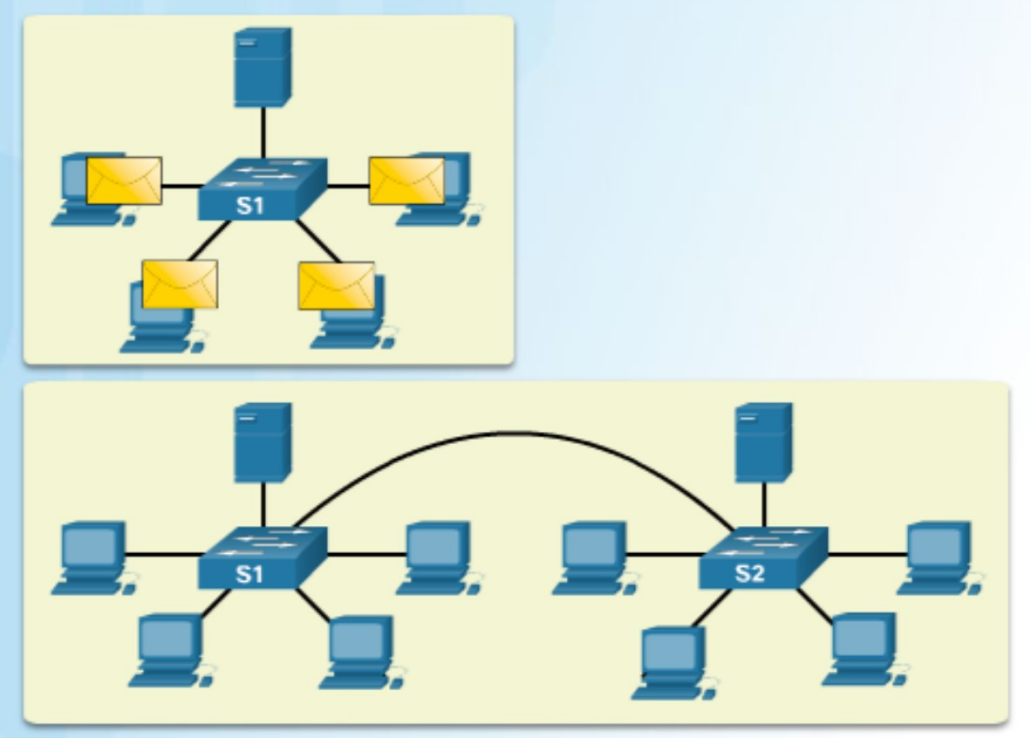
Broadcast Domains



- One switch or multiple interconnected switches form a single broadcast domain.
- When a switch receives a broadcast frame, it forwards the frame out each of its ports, except the ingress port where the broadcast frame was received.
- When two switches or more switches are connected together, the broadcast domain is increased because the broadcast is propagated from switch to switch.
- Too many broadcasts can cause network congestion.

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Alleviating Network Congestion

- The following characteristics of switches help alleviate congestion:
  - Establishing full-duplex links, therefore eliminating collisions.
  - High port density
  - Large frame buffers
  - Port speed
  - Fast internal switching
  - Low per-port cost

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4.3 Chapter Summary

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Conclusion

Chapter 4: Switched Networks

- Explain how switched networks support small to medium-sized businesses.
- Explain how Layer 2 switches forward data in a small to medium-sized LAN.

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