

# LAN Design and Switching

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# Objectives

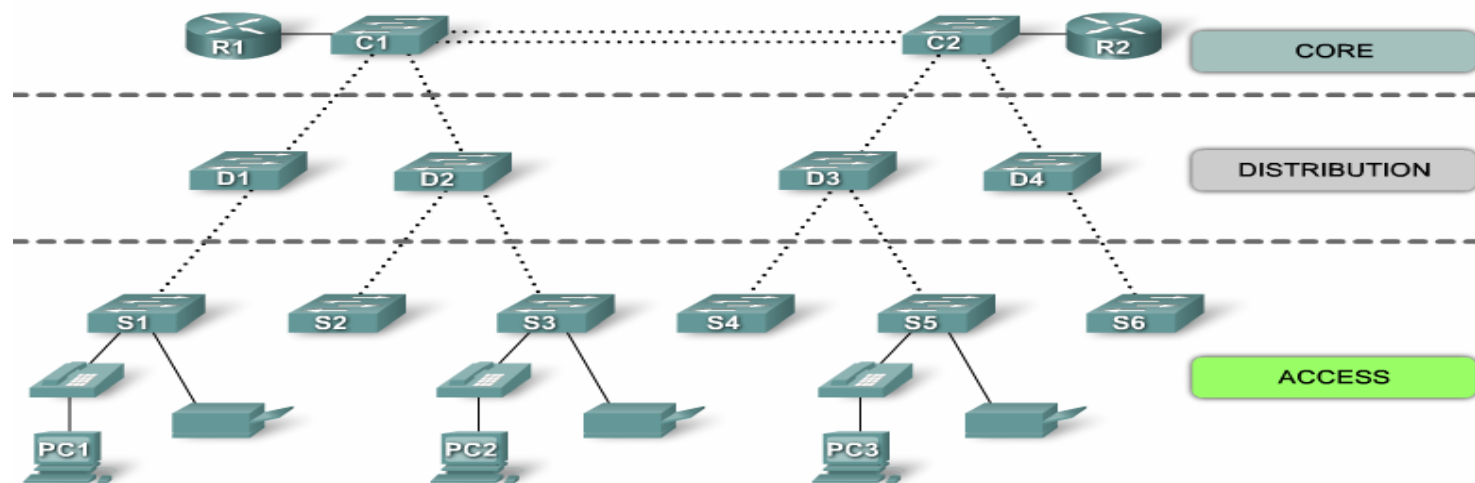


- **LAN Design**
- **Introduction to LAN switching**
- **Switch operation**
- **Switch configuration (laborations)**

# The Hierarchical Network Model

- Easier to manage and expand
- Each layer provides specific functions, which facilitates scalability and performance

The Hierarchical Network Model



# Hierarchical Design Model

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- **Access Layer**
  - Provides users in workgroups access to the network
- **Distribution Layer**
  - Provides policy-based connectivity
- **Core Layer (Backbone)**
  - Provides optimal transport between sites

# Access Layer



- **Interfaces with end devices**
  - PCs, printers, IP phones
- **Provides access to the network**
- **Controls which devices are allowed to communicate on the network**

# Distribution Layer

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- **Controls the flow of network traffic using policies**
- **High-performance devices that have high availability and redundancy to ensure reliability**

# Core Layer



- **The high-speed backbone of the internetwork**
- **Critical for interconnectivity between distribution layer devices**
  - **Highly available and redundant**
- **Forwards large amounts of data quickly**

# Benefits of Hierarchical Network Design

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- **Scalability**
- **Redundancy**
- **Performance**
- **Security**
- **Manageability**
- **Maintainability**



# Access Layer Switch Features

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- **Port security**
- **VLANs**
- **Fast Ethernet/Gigabit Ethernet**
- **Power over Ethernet (PoE)**
- **Link Aggregation**
- **Quality of Service (QoS)**

# Distribution Layer Switch Features

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- **Layer 3 support**
- **High forwarding rate**
- **Gigabit Ethernet/10 Gigabit Ethernet**
- **Redundant components**
- **Security policies/Access Control Lists**
- **Link Aggregation**
- **Quality of Service (QoS)**

# Core Layer Switch Features

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- **Layer 3 support**
- **Very high forwarding rate (dependent of number of devices)**
- **Gigabit Ethernet/10 Gigabit Ethernet**
- **Redundant components**
- **Link Aggregation**
- **Quality of Service (QoS)**

# Network Performance

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- **Network traffic (congestion)**
- **Multitasking desktops**
  - **Simultaneous network transactions**
- **Faster OS**
- **Increased number of applications**

# Ethernet/802.3 LAN

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- **Broadcast transmission technology**
- **Shared network medium**
- **CSMA/CD**
- **Best-effort delivery service**
- **Collisions**
  - **A major problem**

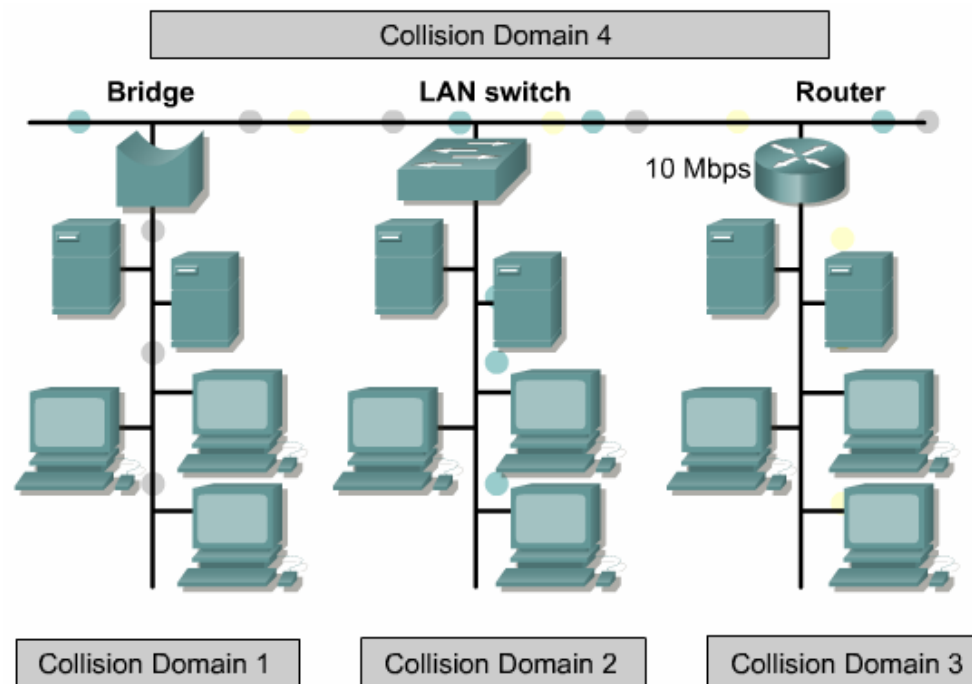
# Repeaters and Hubs

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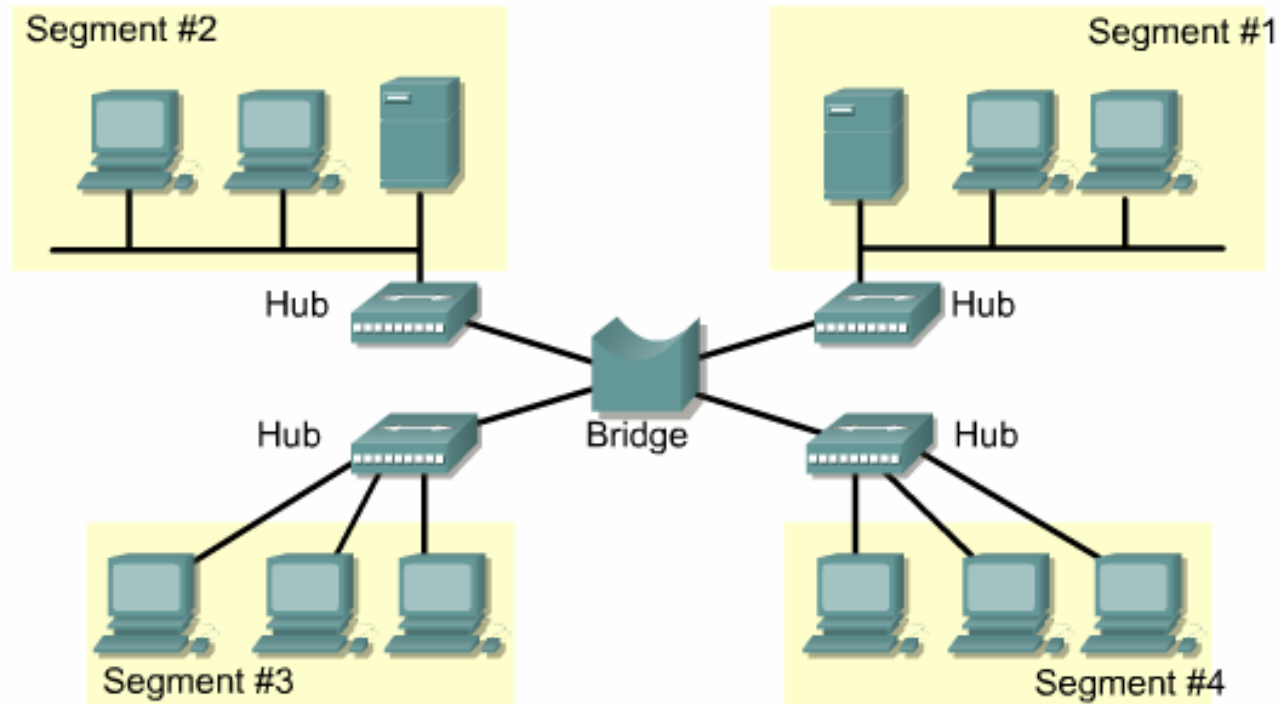
- **Limited distance of LAN**
- **Attenuation**
  - **Signal weakens, loss of signal strength**
- **Repeaters/hubs regenerates the signal**
- **Extends broadcast and collision domains**

# LAN Segmentation

- Allows network congestion to be significantly reduced within each segment
- Each segment is its own collision domain



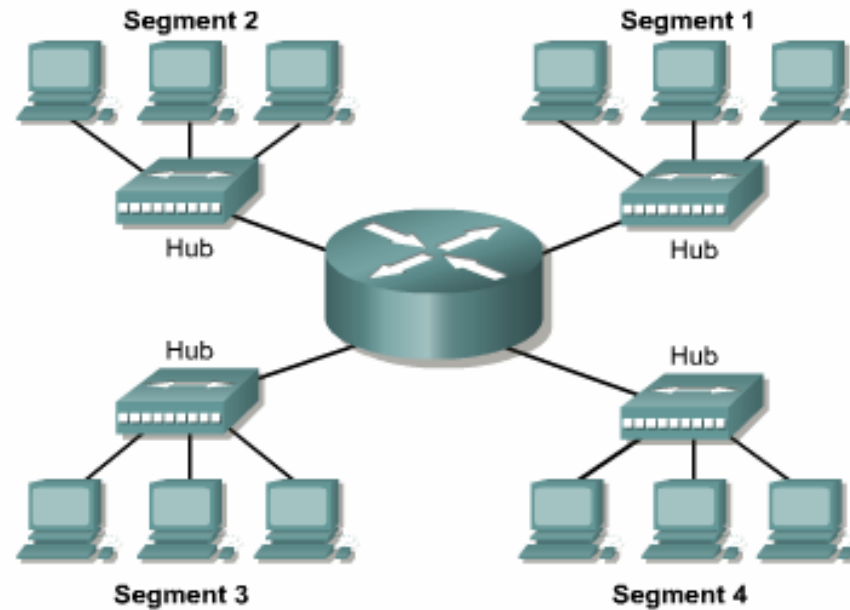
# Segmentation with Bridge/Switch



- Segmentation provides fewer users per segment
- Bridges store, then forward frames based on Layer 2 addresses
- Layer 3 Protocol-independent
- Increase latency on the network



# Segmentation with Router



- More manageable, greater functionality, multiple active paths
- Smaller broadcast domains
- Operates at Layer 3

# LAN Switch Operation

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- **Forward packets based on forwarding table**
  - **MAC addresses (layer 2)**
- **Operates at OSI layer 2**
- **Learns a stations location by examining source address**
  - **Sends out all ports when destination is broadcast, multicast, or unknown address**
  - **Forwards when destination is located on different interface**

# Ethernet Communications

**Unicast:**  
One sender and one receiver



**Broadcast:**  
One sender to all other addresses



**Multicast:**  
One sender to a group of addresses



# Ethernet Communications

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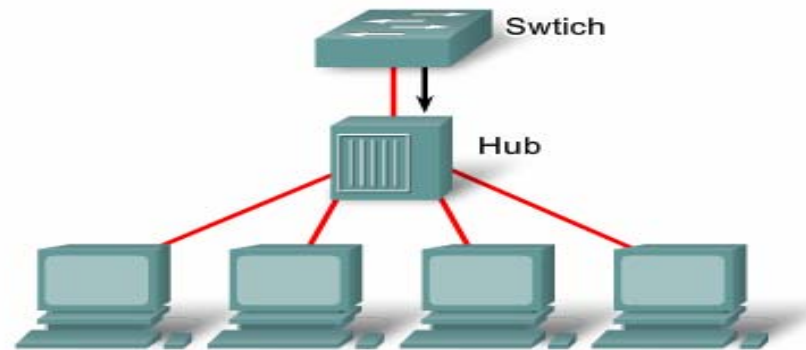
- **Unicast**
  - **Single destination MAC address**
- **Broadcast**
  - **Broadcast MAC address: FF-FF-FF-FF-FF-FF**
- **Multicast**
  - **Multicast MAC address: 01-00-5E-##-##-##**

# Duplex Settings

## Half Duplex (CSMA/CD)

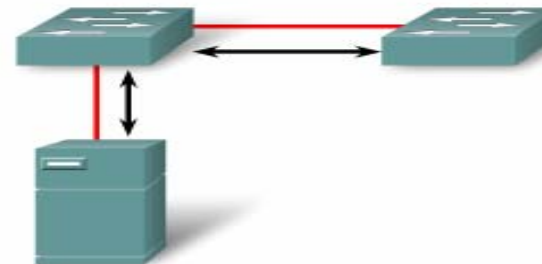
- Unidirectional data flow
- Higher potential for collision
- Hub connectivity

## Duplex Settings



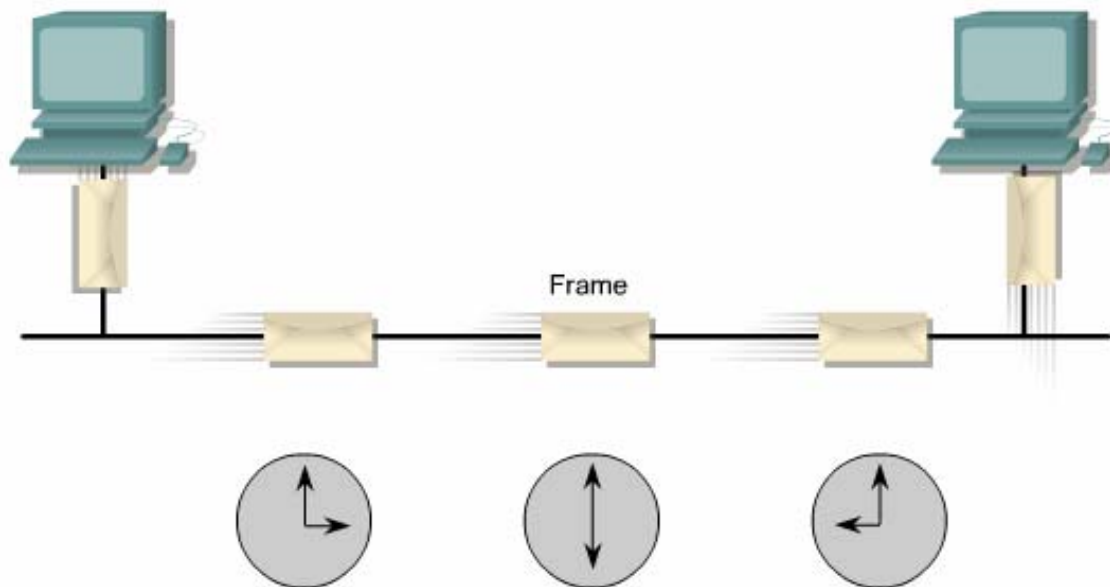
## Full Duplex

- Point-to-point only
- Attached to dedicated switched port
- Requires full-duplex support on both ends
- Collision-free
- Collision detect circuit disabled



# Network Latency

- **Latency (or delay) = the time a frame or a packet takes to travel from the source to the final destination**



# Transmission Time

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- **Bit time (or slot time) = basic unit of time in which 1 bit can be sent**
- **Transmission time = number of bits being sent times the bit time for a given technology**

# Switching Methods

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## Cut-through



Switch checks destination address and immediately begins forwarding frame

## Store-and-Forward



Complete frame is received before forwarding



# Memory Buffering

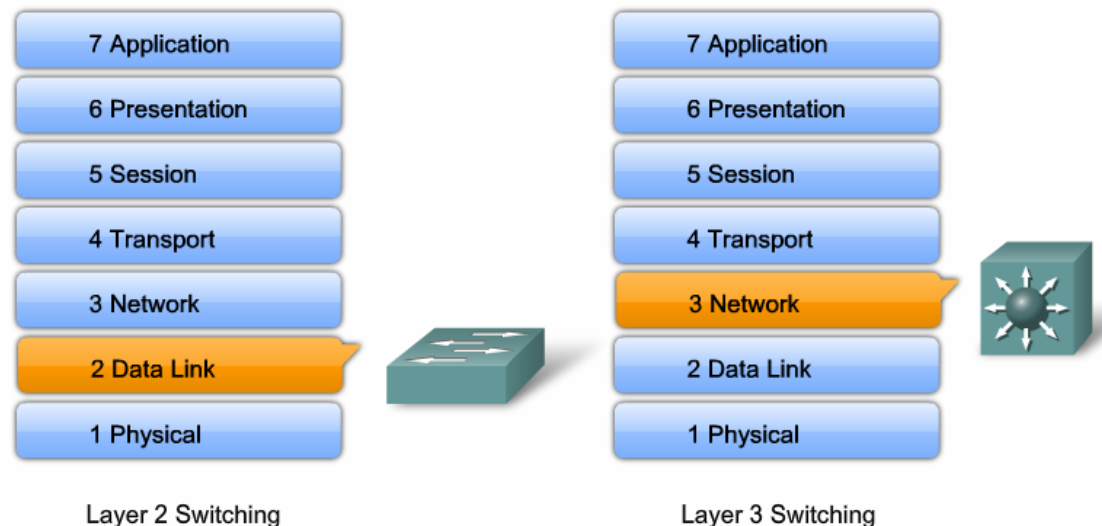
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- **Port-based memory buffering**
  - **Packets are stored in queues that are linked to specific incoming and outgoing ports**
  - **Possible for a single packet to block all other packets because its destination port is busy**
- **Shared memory buffering**
  - **All packets use a common memory buffer**
  - **Packets in the buffer are then linked dynamically to the appropriate destination port**
  - **Helps balance between 10- and 100-Mbps ports**

# Layer 2 and Layer 3 Switching

- **Layer 2:** based on MAC addresses, uses the MAC address table to make forwarding decisions
- **Layer 3:** can use IP addresses that are associated with the ports, and can perform routing functions

Layer 2 and Layer 3 Switching



# Configuring the Catalyst Switch

- To overwrite any existing configuration, follow these steps:
  - Remove any existing VLAN information by deleting the VLAN database file, **vlan.dat** from the Flash memory directory.
  - Erase the backup configuration file startup-config.
  - Reload the switch.

```
Switch#delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:vlan.dat? [confirm]
Switch#erase startup-config
<output omitted>
Switch#reload
```