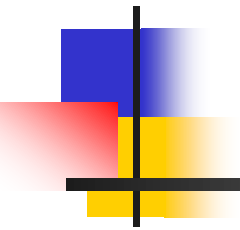
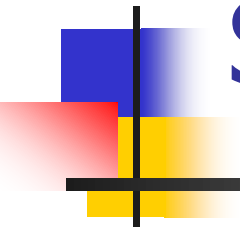


Understanding LAN Switching

Agenda

- Shared LAN Technology
- LAN Switching Basics
- 802.1d Spanning-Tree Protocol

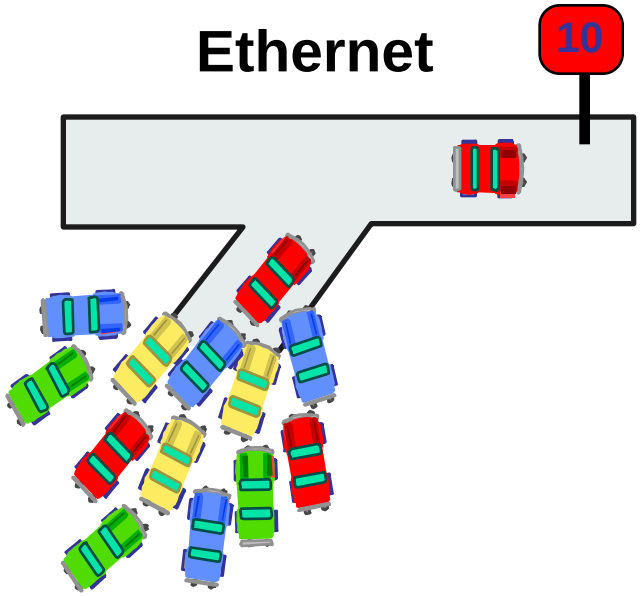


Shared LAN Technology

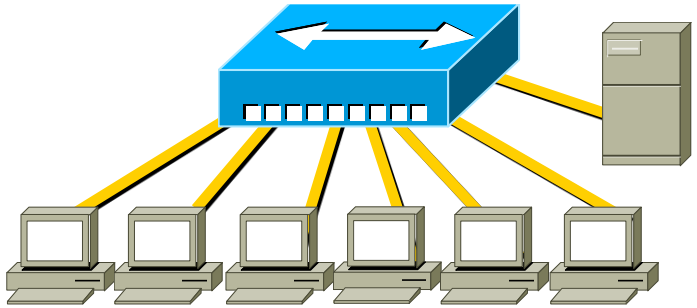
Early Local Area Networks

- Thick Ethernet
  - Limited to 500 meters before signal degradation
  - Required repeaters every 500 meters
  - Limitations on number and placement of stations
  - Expensive, large, and difficult to pull through buildings
  - Relatively simple to add new users
  - Provided 10-Mbps shared bandwidth
- Thin Ethernet
  - Less expensive and required less space than thick Ethernet
  - Still difficult to pull through buildings
  - Adding users required network interruptions

Hubs Addressed Many of These Problems



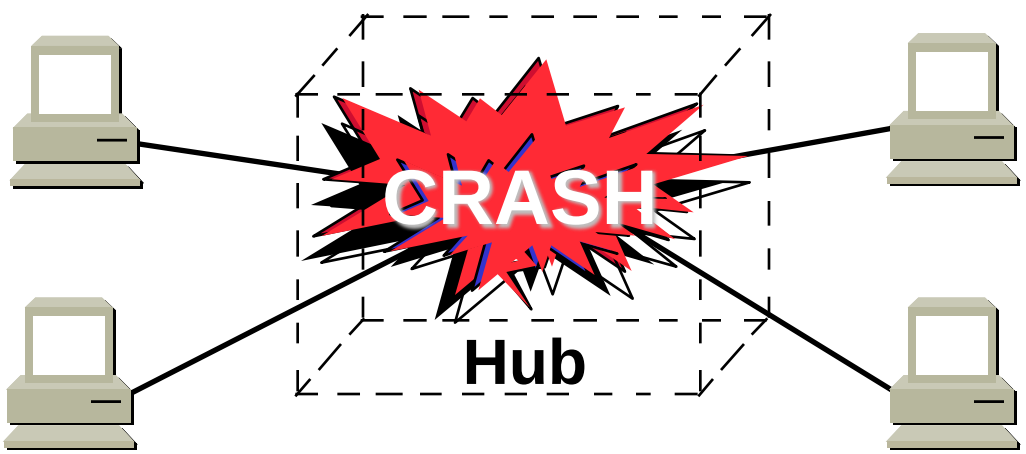
One device sending at a time



All nodes share 10 Mbps

- Ethernet concentrator
- "Self-contained" Ethernet LAN in a box
- Passive
- Works at physical layer 1

Collisions: Telltale Signs

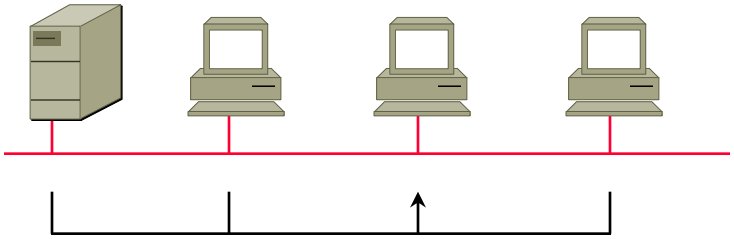


- "I could have walked to Finance by now."
- "I knew I should have stayed home."
- "File transfers take forever."
- "I'm waiting all the time."

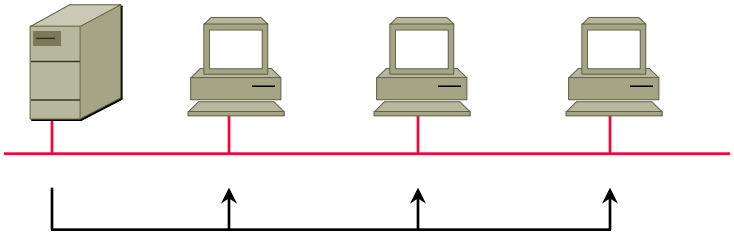
- Sluggish network response
- Increasing user complaints

Other Bandwidth Consumers

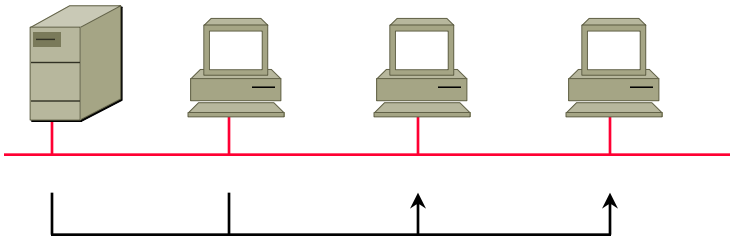
Unicast



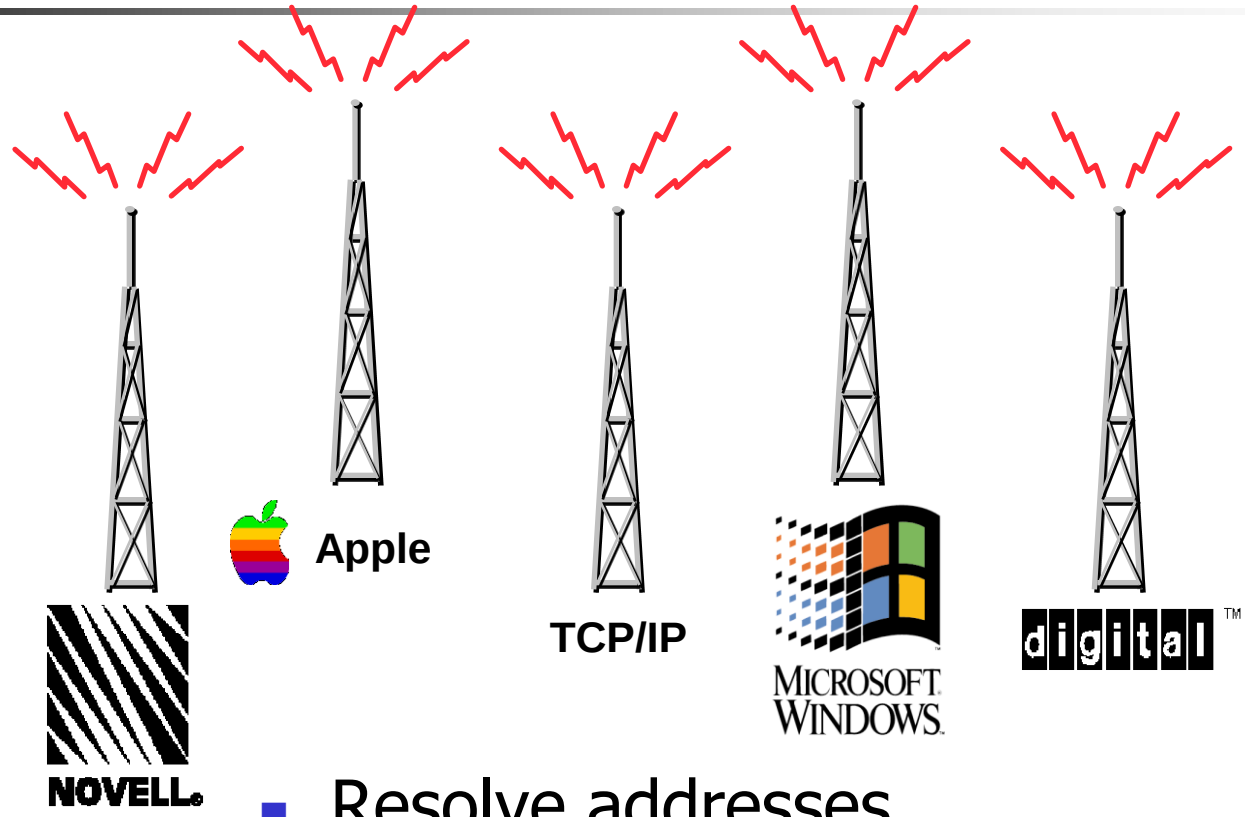
Broadcast



Multicast

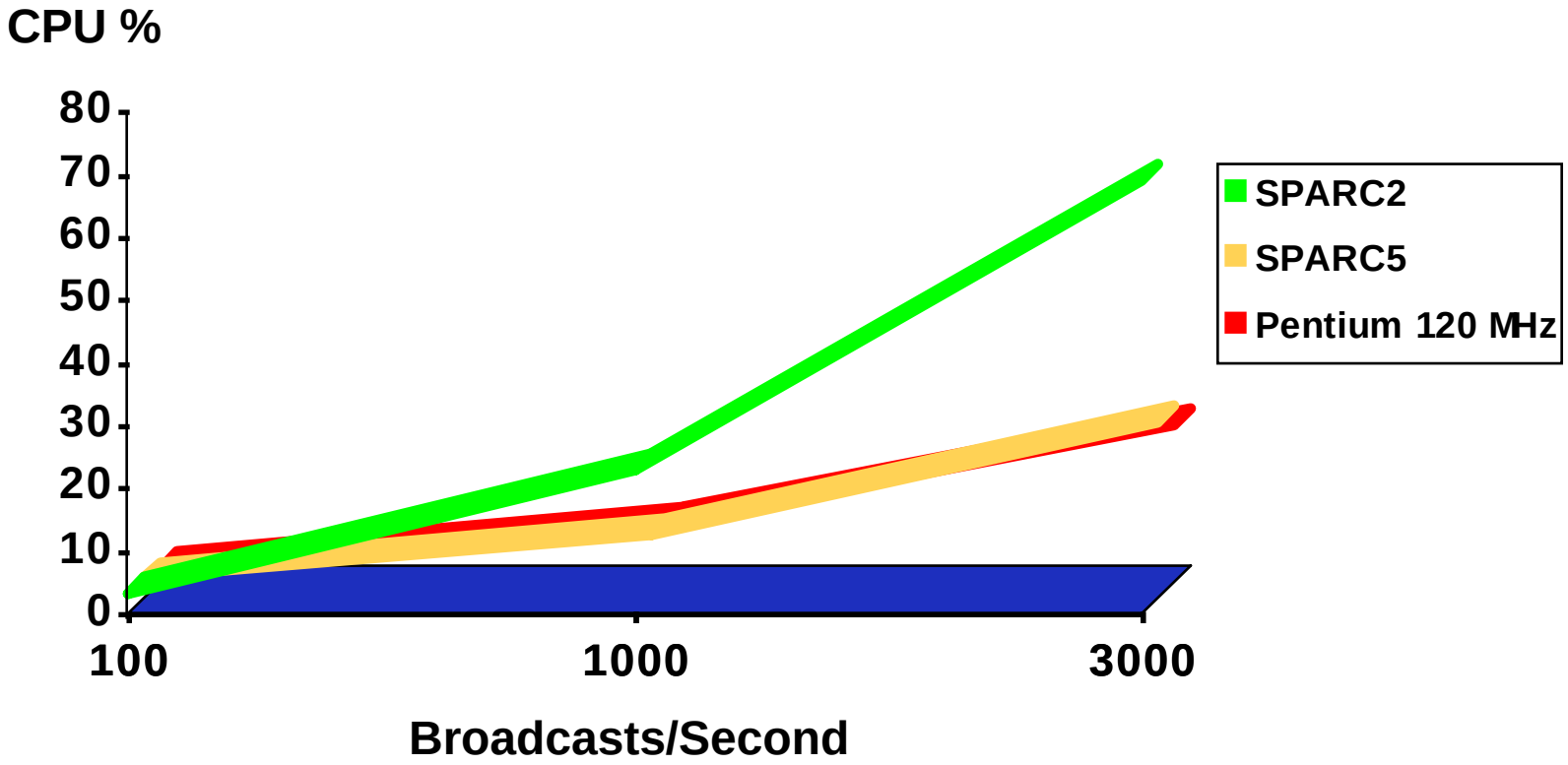


Broadcasts Consume Bandwidth



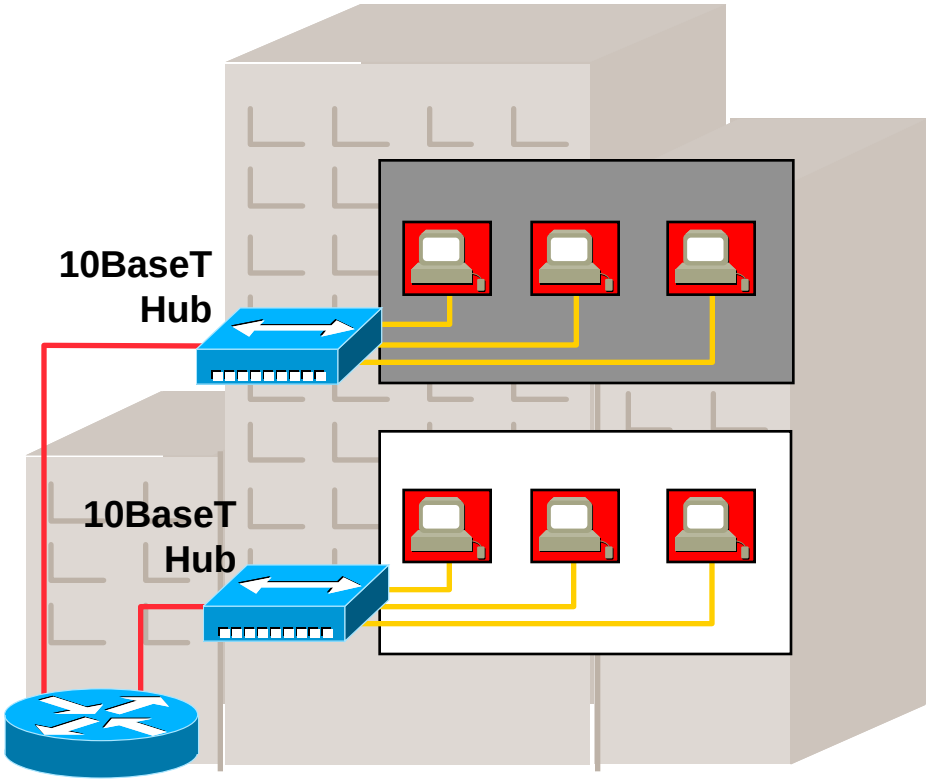
- Resolve addresses
- Distribute route information
- Find network services

Broadcasts Consume Processor Performance



- Broadcasts and multicasts interrupt all computers on the network

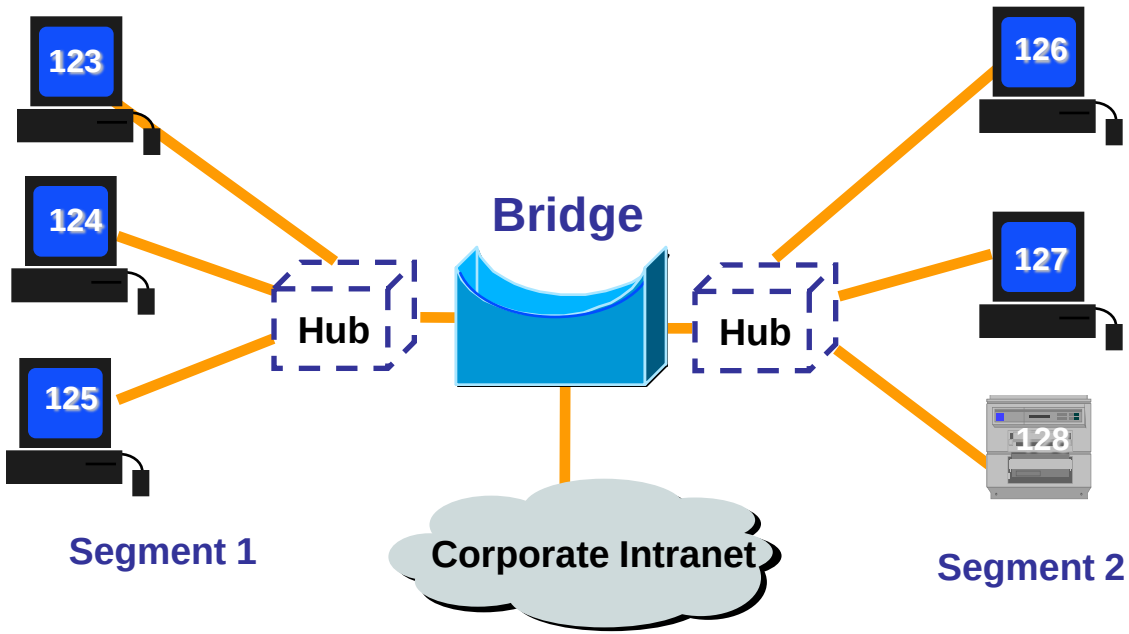
Hub-Based LANs



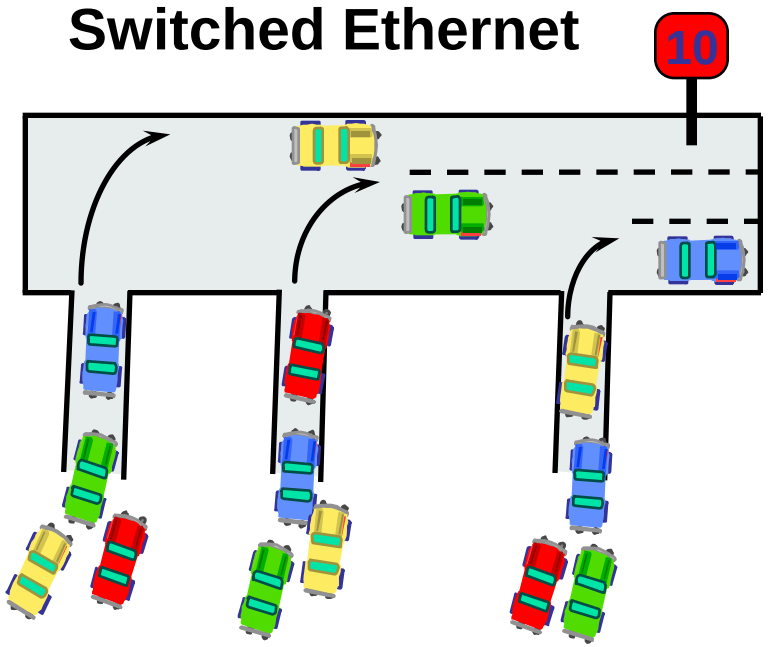
- Shared resources
- Desktop connections wired to centralized closets
- Poor security within shared segments
- Routers provide scalability
- Adds, moves, and changes are easier than without hubs, but still a hassle
- Groups of users determined by physical location

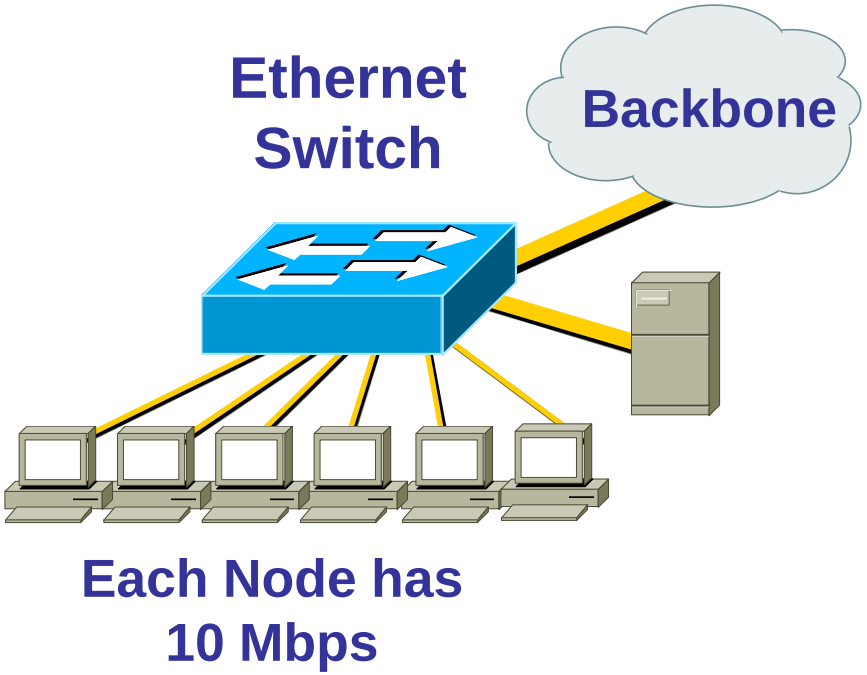
Bridges

- More intelligent than a hub
- "Eavesdrop" on conversations to learn and maintain address tables
- Collect and pass packets between two network segments
- Control traffic to the network



Switches—Layer 2

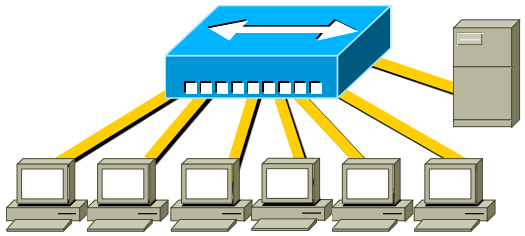




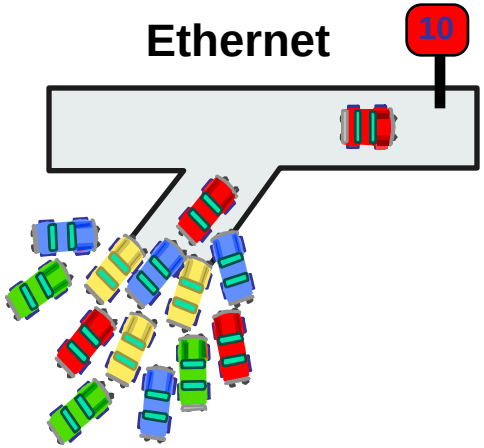
Multiple devices sending at the same time

Switches versus Hubs

Hub

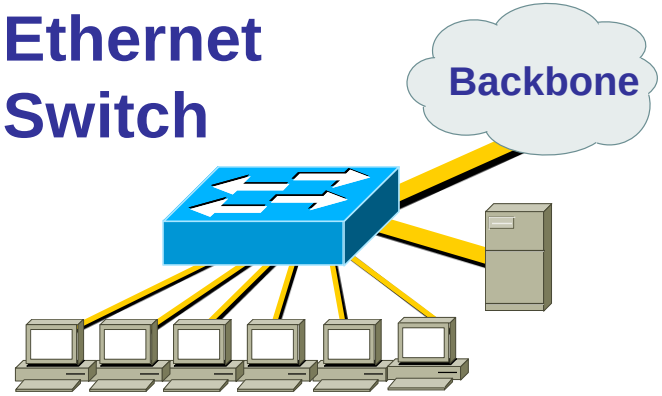


All nodes share 10 Mbps

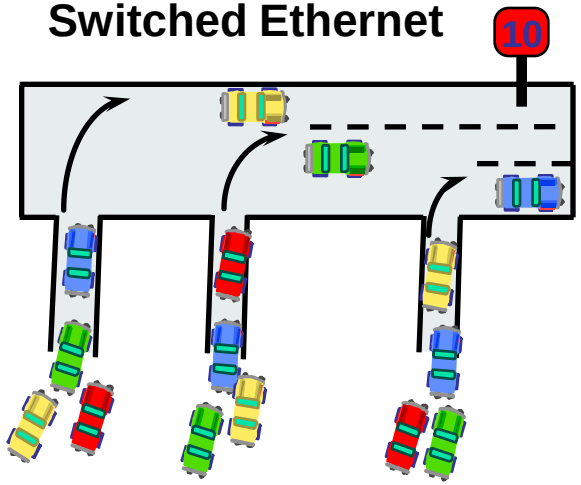


One device sending at a time

Ethernet Switch



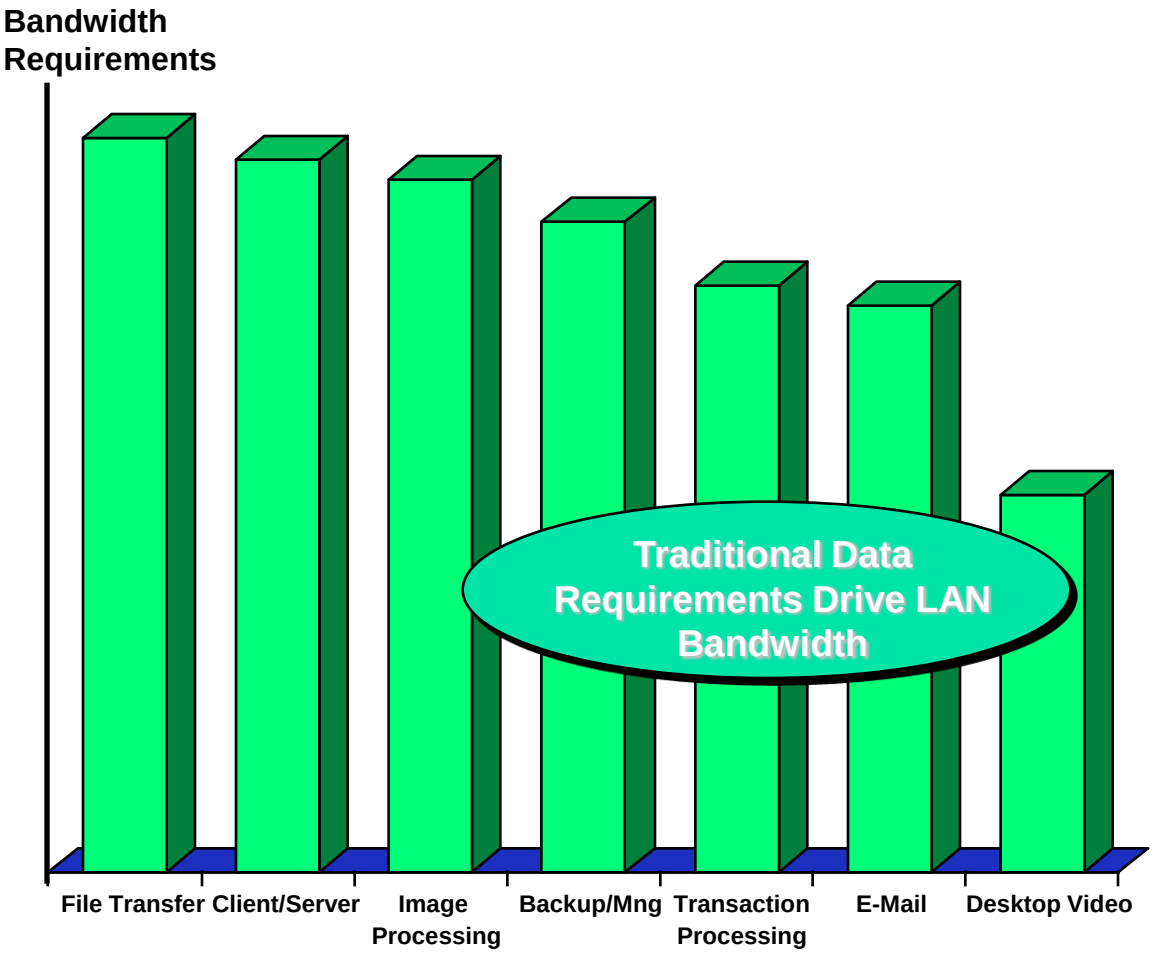
Each node has 10 Mbps



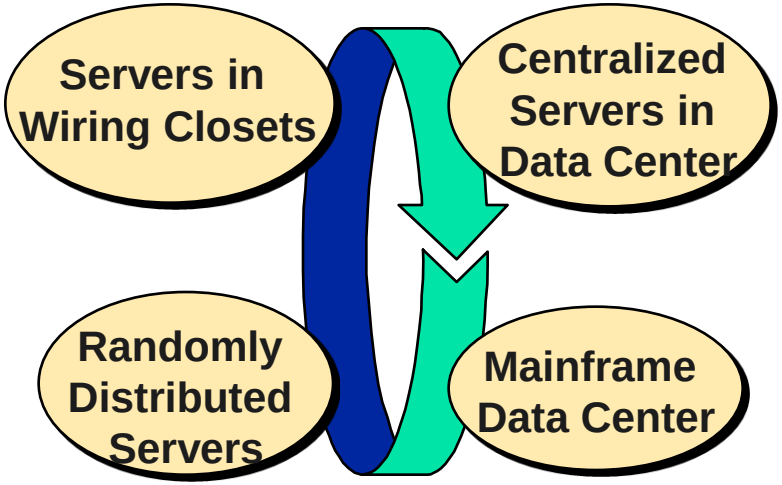
Multiple devices sending at the same time

Typical Causes of Network Congestion

- Too many users on a 10-Mbps segment
- Most users accessing one or two servers
- High-performance PCs such as EISA, PCI, and S-Bus
- Network-intensive applications such as color publishing, CAD/CAM, imaging, and relational databases

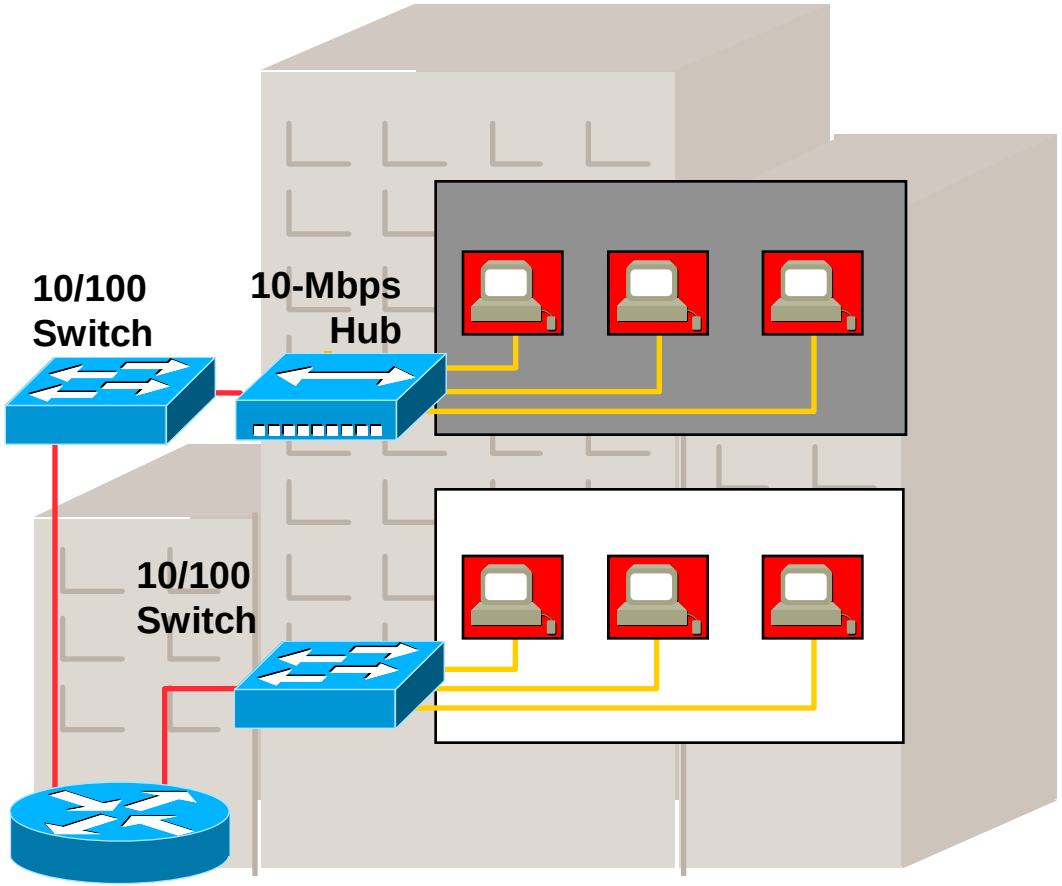


Network Traffic Impact from Centralization of Servers

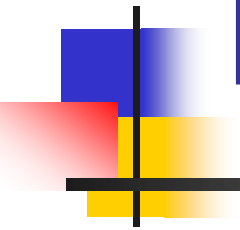


- Servers are gradually moving into a central area (data center) versus being located throughout the company to:
  - Ensure company data integrity
  - Maintain the network and ensure operability
  - Maintain security
  - Perform configuration and administrative functions
- More centralized servers increase the bandwidth demands on campus and workgroup backbones

Today's LANs



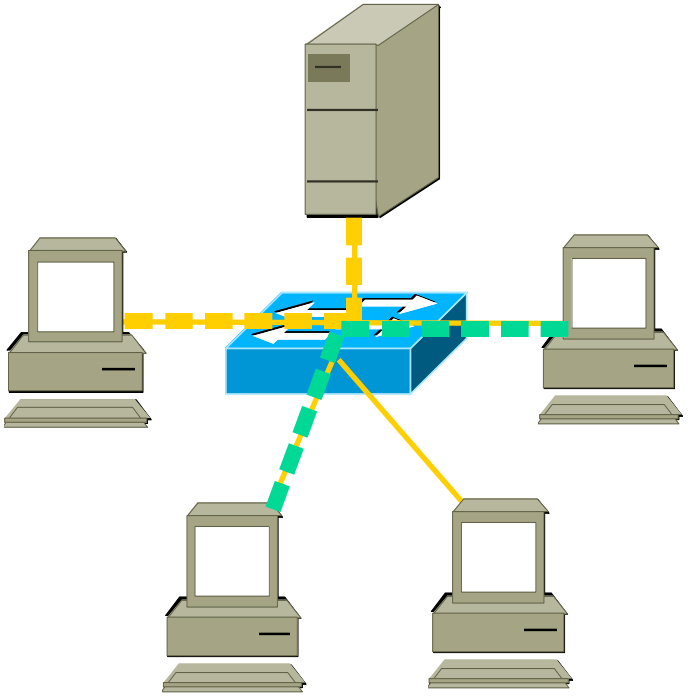
- Mostly switched resources; few shared
- Routers provide scalability
- Groups of users determined by physical location



LAN Switching Basics

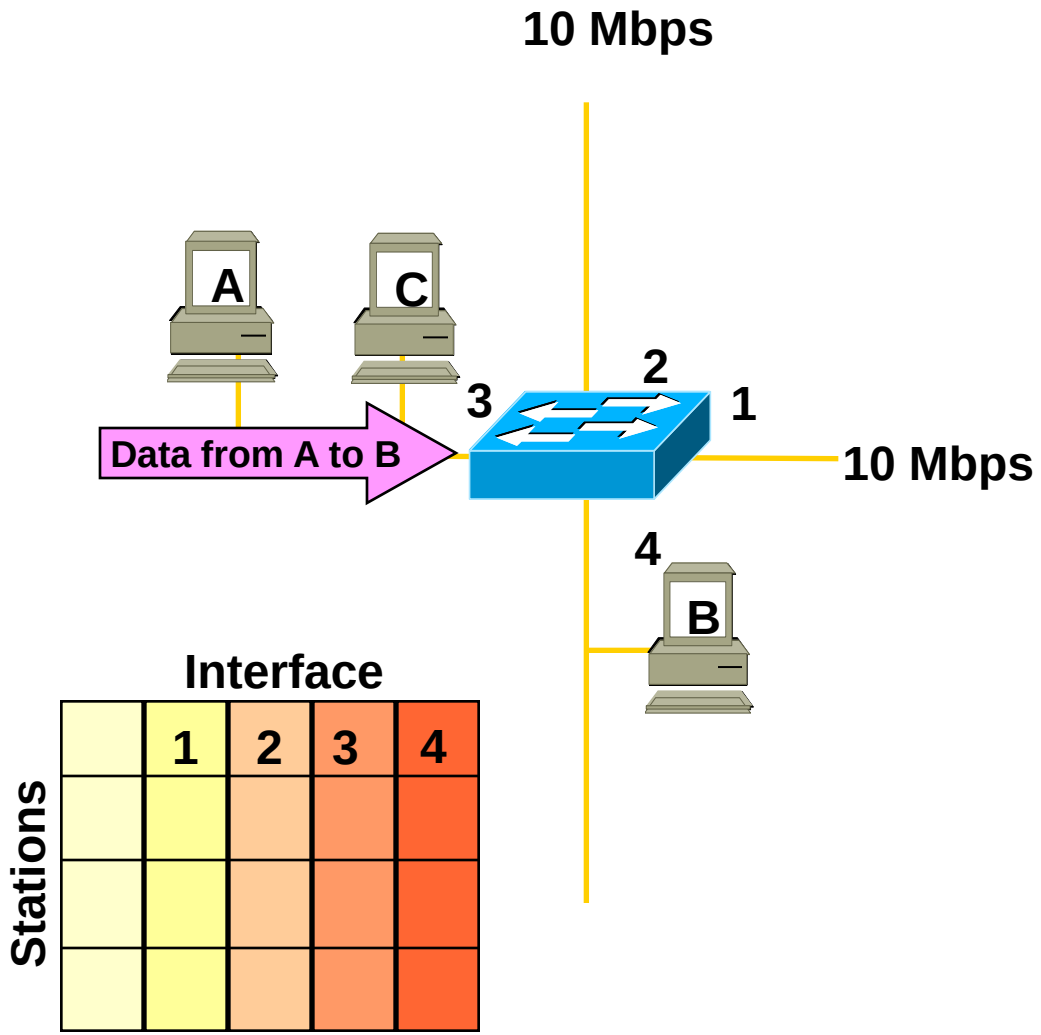
LAN Switching Basics

- Enables dedicated access
- Eliminates collisions and increases capacity
- Supports multiple conversations at the same time



LAN Switch Operation

- Forwards packets based on a forwarding table
  - Forwards based on the MAC (Layer 2) address
- Operates at OSI Layer 2
- Learns a station's location by examining source address
  - Sends out all ports when destination address is broadcast, multicast, or unknown address
  - Forwards when destination is located on different interface



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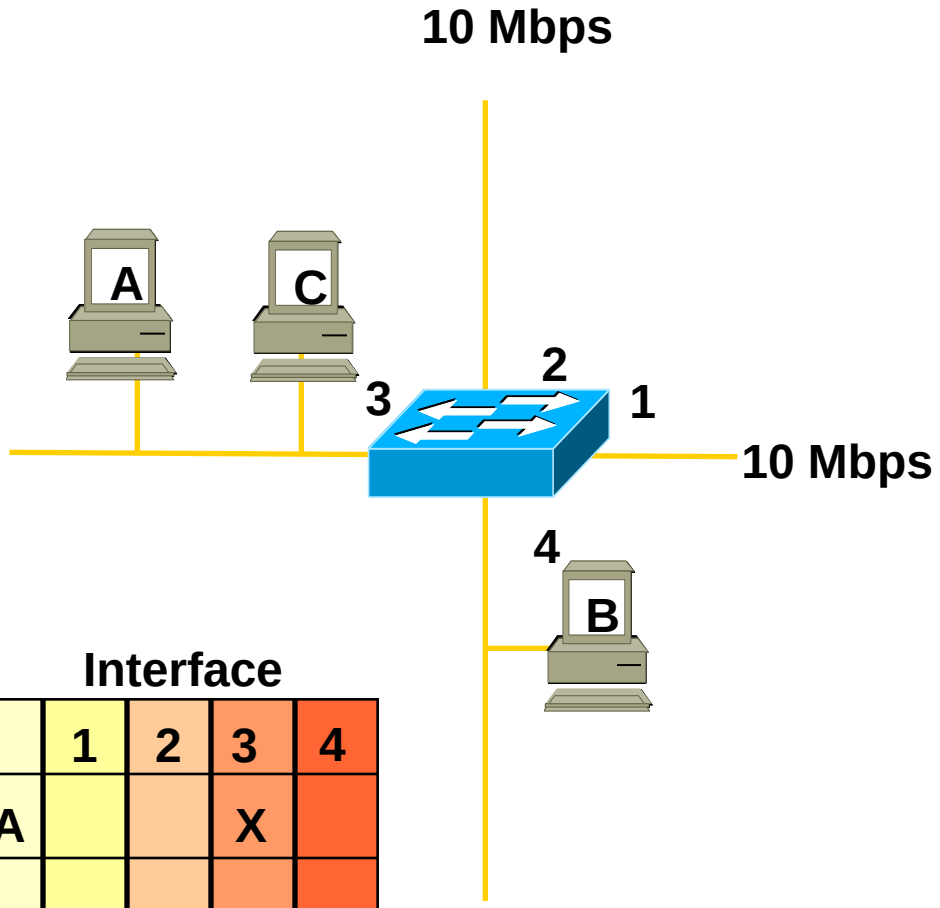

Interface

Stations	1	2	3	4
A			X	

LAN Switch Operation

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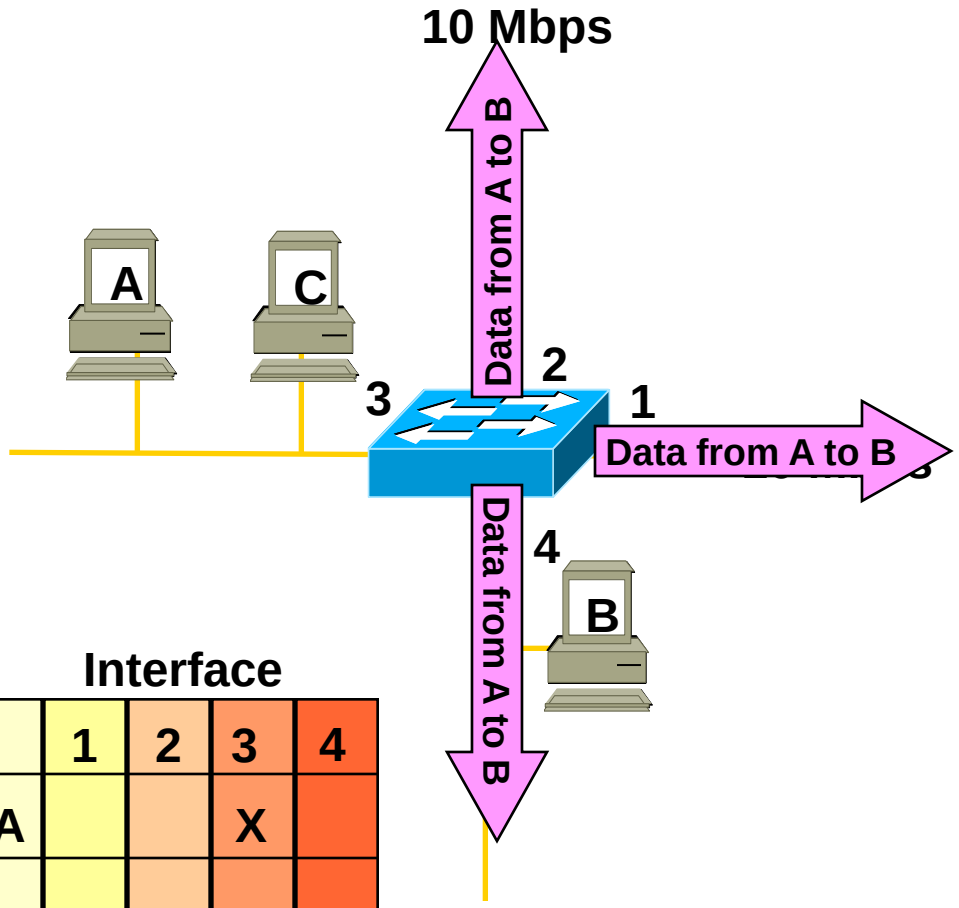

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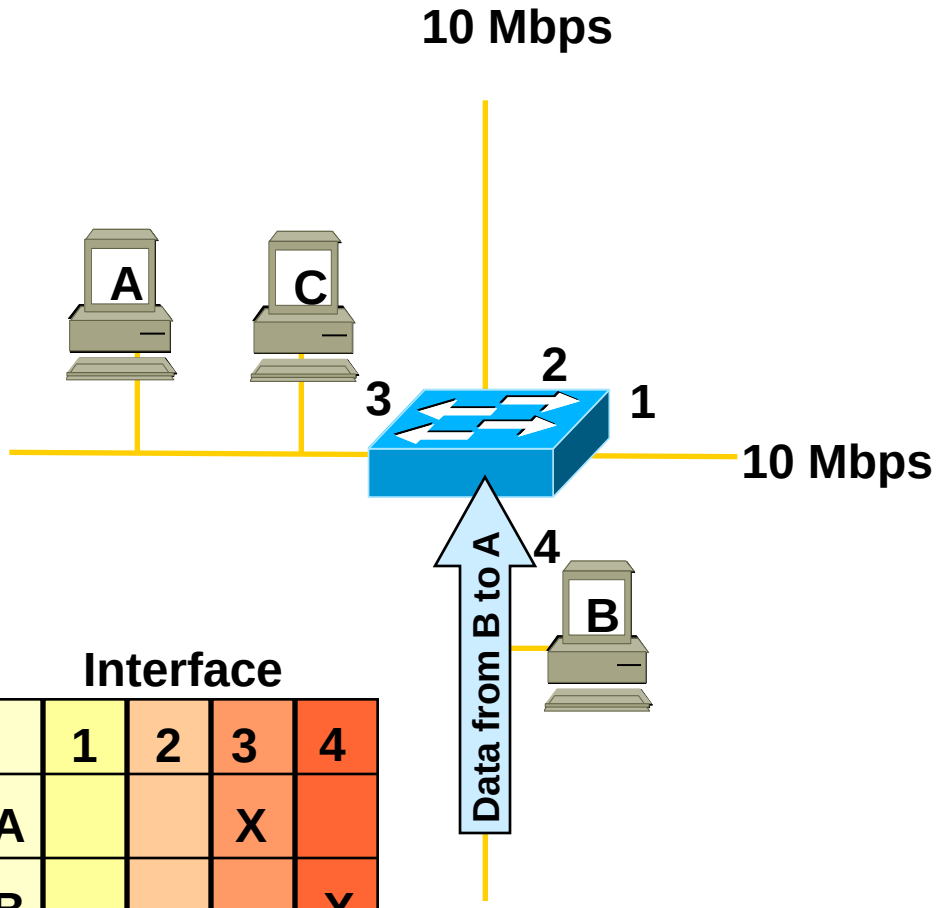

Stations	Interface 1	2	3	4
A			X	
B				X

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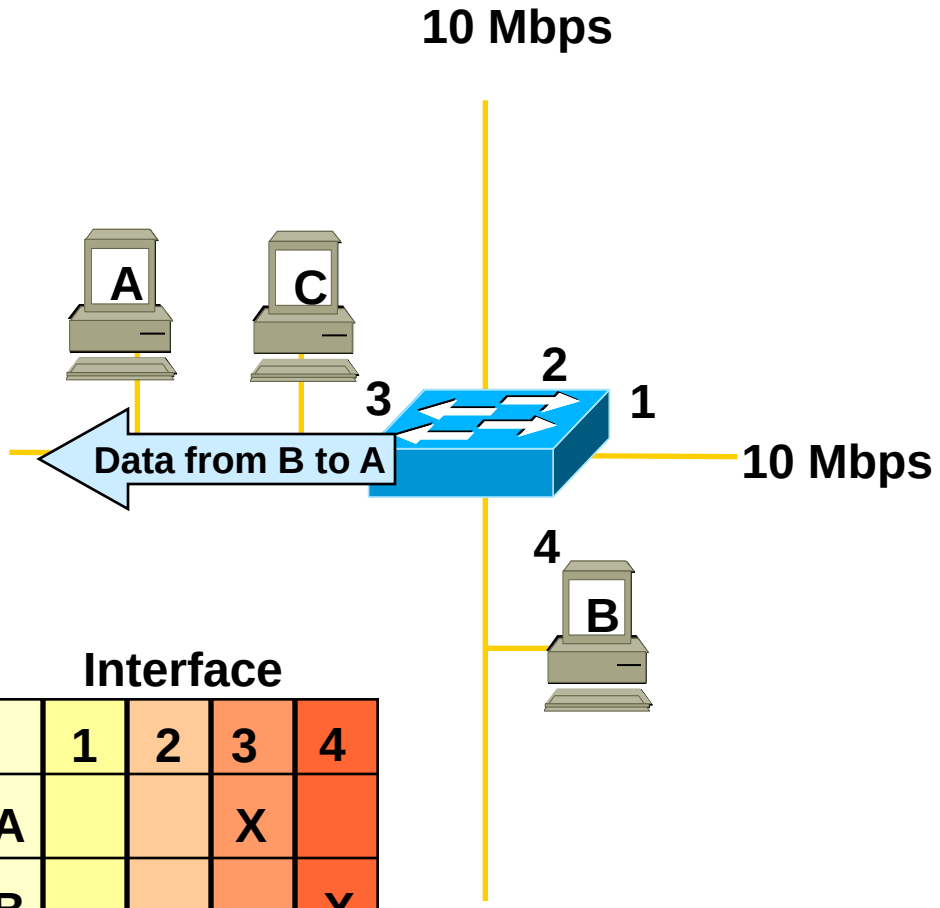
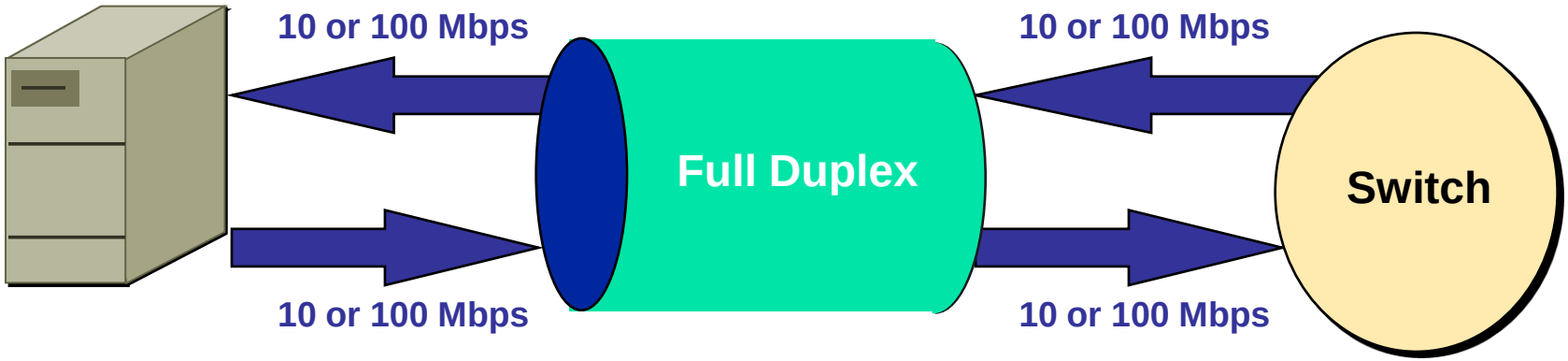


Stations	Interface 1	2	3	4
A			X	
B				X

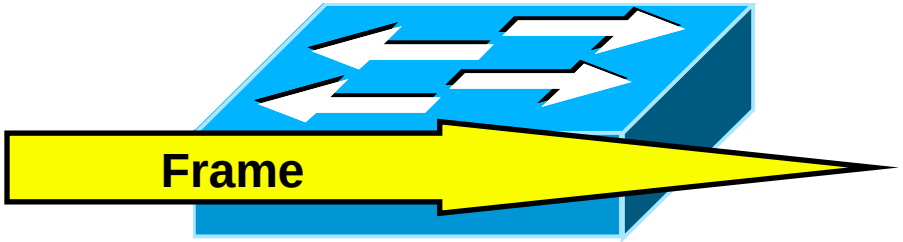
Switching Technology: Full Duplex

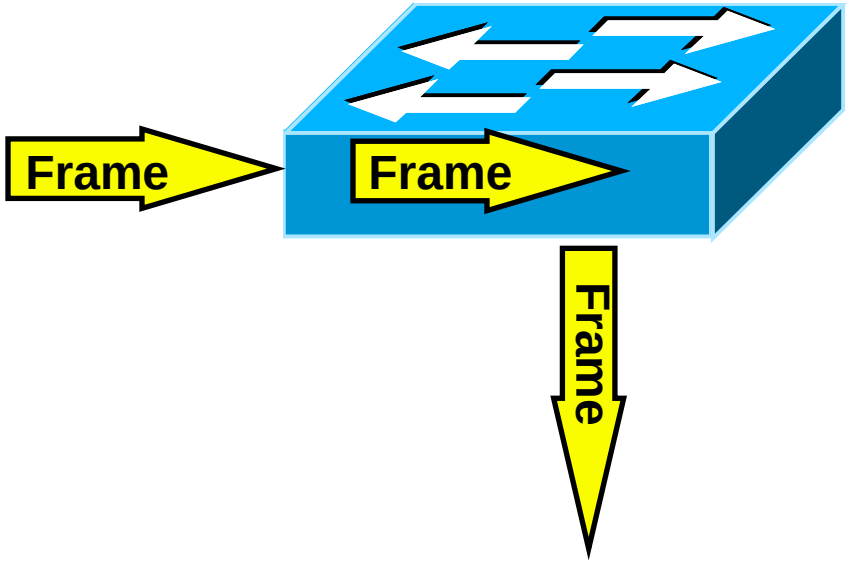
- Doubles bandwidth between nodes
  - e.g. switch and server
- Collision-free transmission
- Two 10- or 100-Mbps data paths

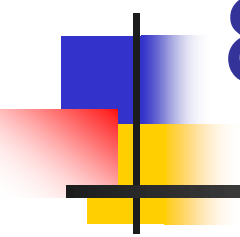


Switching Technology: Two Methods

- Cut-through
  - Switch checks DA and immediately begins forwarding frame
- Store-and-forward
  - Complete frame is received before forwarding



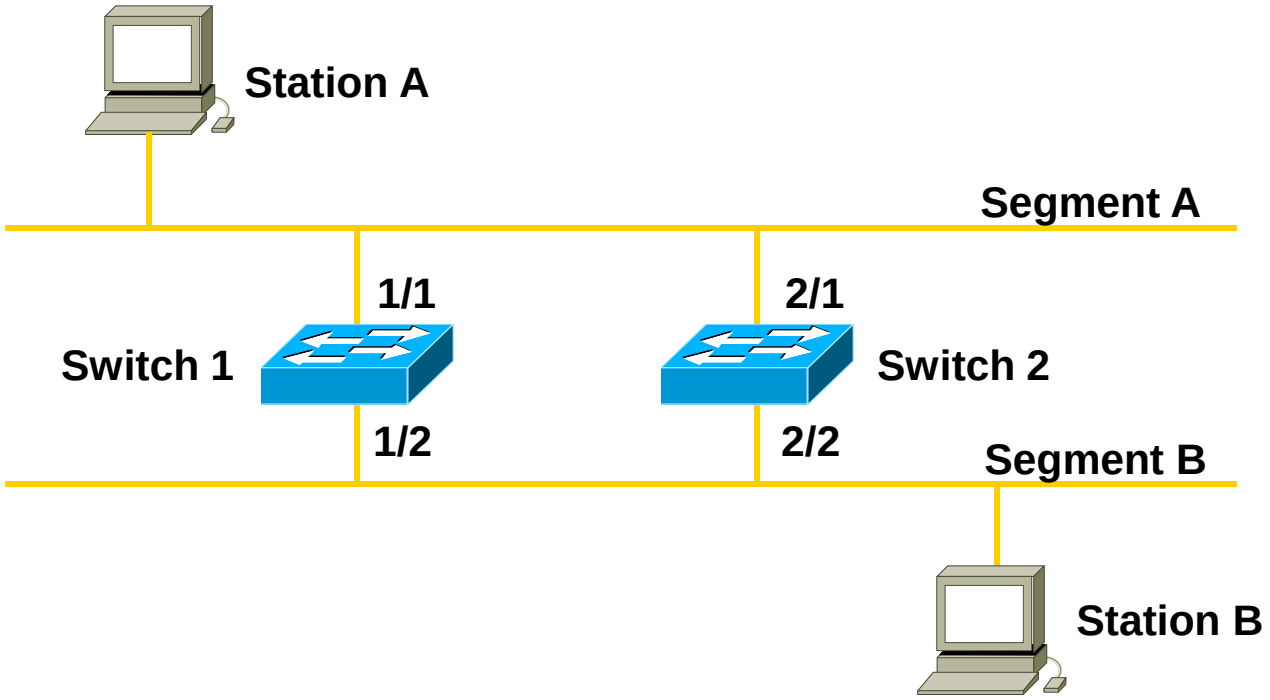




802.1d Spanning-Tree Protocol

The Need for Spanning Tree

- Problems with large switched networks
  - Local multicast, broadcast, and unknown single-destination event "storms" become global events



802.1d Spanning-Tree Protocol (STP)

- **Allows redundancy by using parallel links**
- **Shuts down redundant links to eliminate loops**
- **Switches communicate with each other using BPDUs (Bridge Protocol Data Units)**
- **Takes 30–60 seconds to converge**

Spanning Tree Terms (1)

- STP → bridge protocol that uses the STA to find redundant links dynamically and create a spanning-tree topology database.
- Bridge ID → combination of the bridge priority (32,768 by default on all Cisco switches) and base MAC address.
- BPDU → protocol that used by switches to exchange information.
- Root bridge → bridge with the best bridge ID.
- Nonroot bridge → all bridge that are not the root bridge.

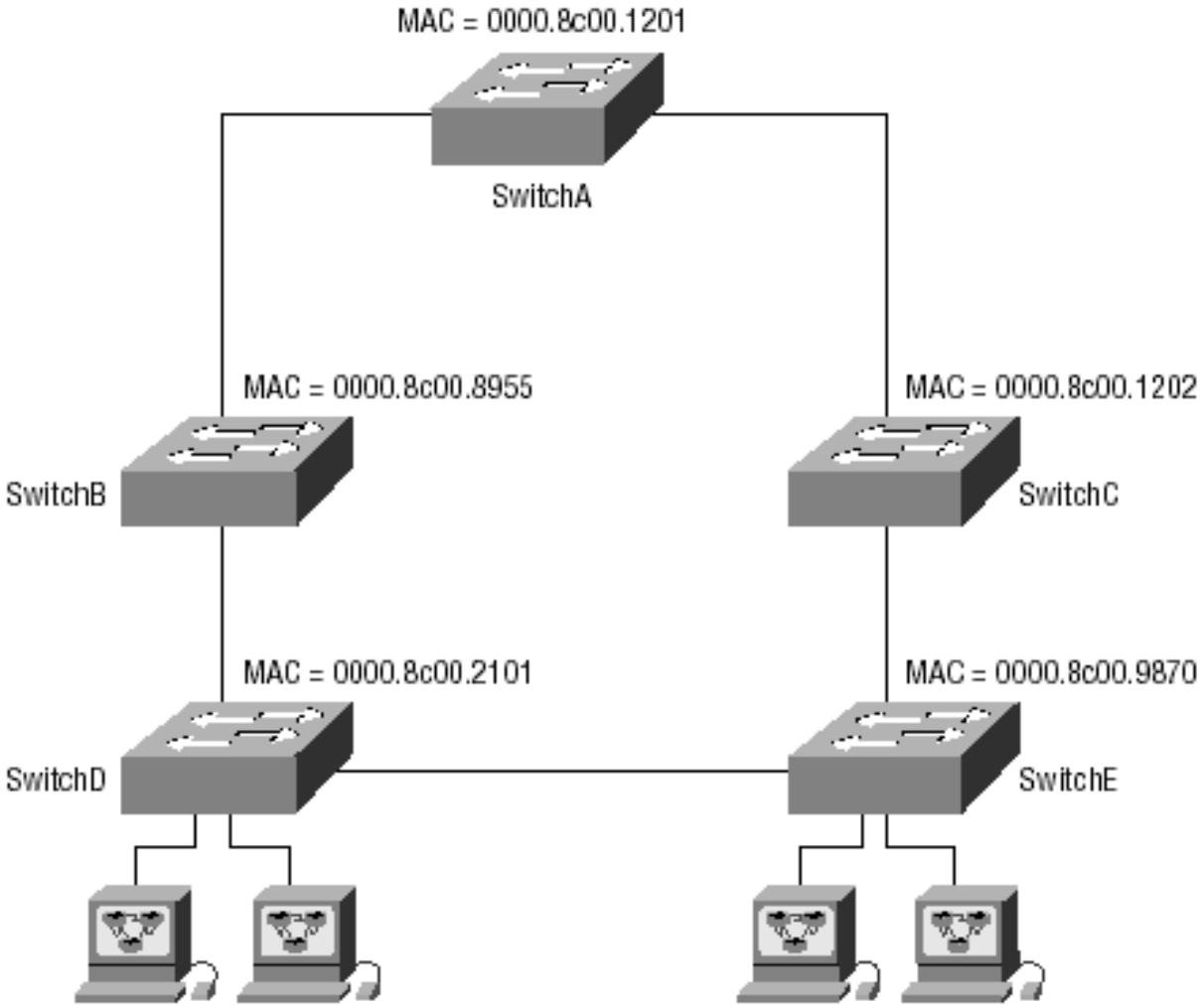
Spanning Tree Terms (2)

- Port cost → determined by the bandwidth of a link.
- Root port → shortest path to the root bridge.
- Forwarding port → a port that forwards frames.
- Blocked port → not forward frames → to prevent loops.
- Designated port → a port that has been determined as having the best (lowest) cost → forwarding port.
- Nondesignated port → port with a higher cost than the designated port → blocking port.

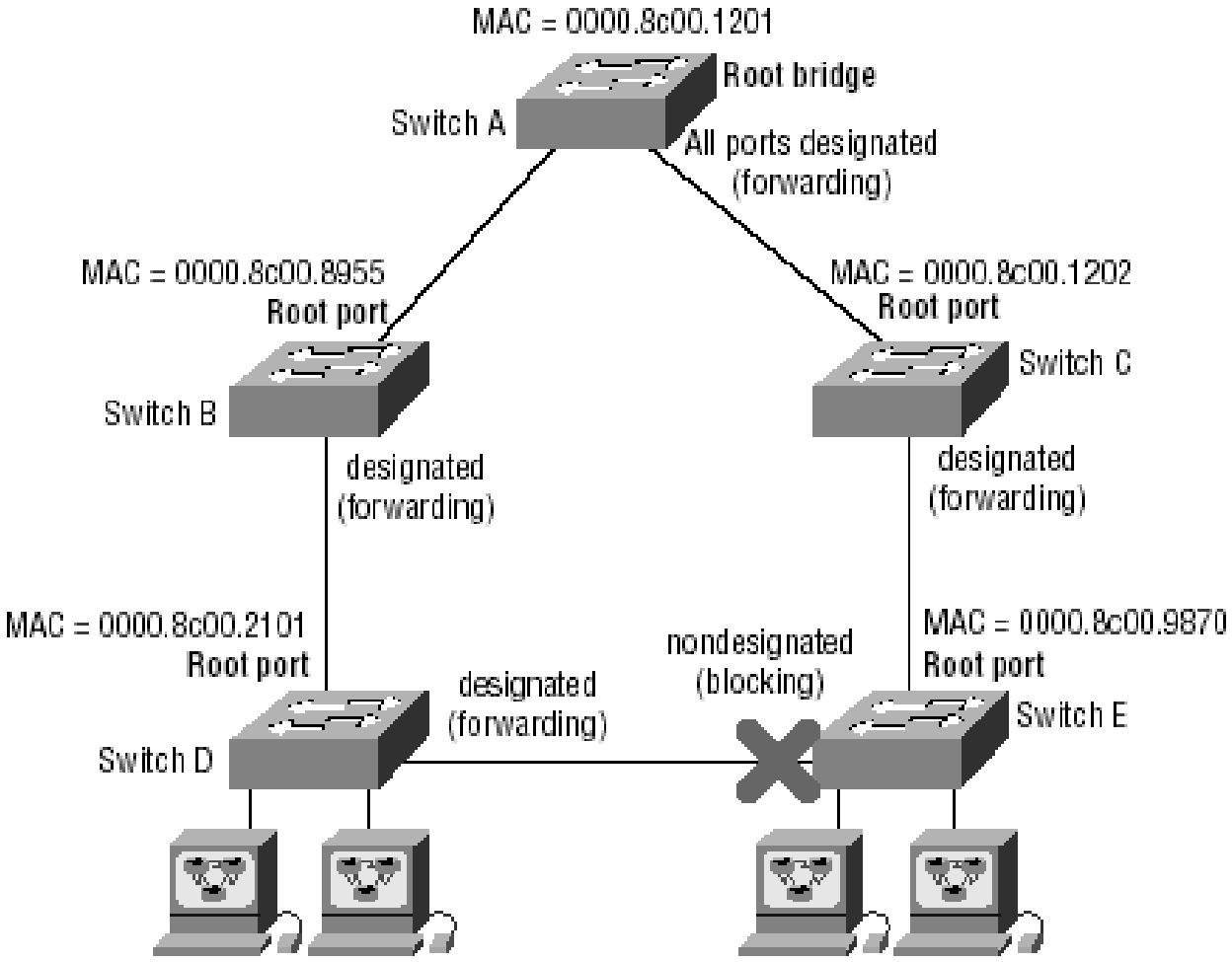
Spanning Tree Port States

- Disabled → administratively down.
- Blocking → it won't forward frames → it just listens to BPDUs.
- Listening → prepares to forward data frames without populating the MAC address table.
- Learning → populates the MAC address table but doesn't forward data frames.
- Forwarding → sends and receives all data frames.

Spanning Tree Example (1)



Spanning Tree Example (2)



1900 Series (1)

1 user(s) now active on Management Console.

User Interface Menu

[M] Menus
[K] Command Line
[I] IP Configuration
[P] Console Password

Enter Selection: K

CLI session with the switch is open.
To end the CLI session, enter [Exit].

>

1900 Series (2)

```
>enable
#conf t
Enter configuration commands, one per line.  End with CNTL/Z
(config)#enable password ?
  level  Set exec level password
(config)#enable password level ?
  <1-15>  Level number
(config)#enable password level 1 console
(config)#enable password level 15 cisco
(config)#enable secret c
(config)#
```

1900 Series (3)

(config)#hostname uniti_1900
uniti_1900(config)#
uniti_1900#sh ip
IP Address: 192.168.0.100
Subnet Mask: 255.255.255.0
Default Gateway: 0.0.0.0
Management VLAN: 1
Domain name: uniti.net
Name server 1: 0.0.0.0
Name server 2: 0.0.0.0
HTTP server : Enabled
HTTP port : 80
RIP : Enabled
uniti_1900#

1900 Series (4)

uniti_1900(config)#ip address 192.168.11.10 255.255.255.0
uniti_1900(config)#ip default-gateway 192.168.11.1
uniti_1900(config)#
uniti_1900(config)#int e0/1
uniti_1900(config-if)#description connect_to_building_1
uniti_1900(config-if)#
uniti_1900 #delete nvram

2950 Series (1)

Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

Switch>
00:32:52: %LINK-5-CHANGED: Interface Vlan1, changed state to administratively down
00:32:53: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
Switch>

2950 Series (2)

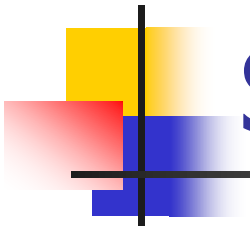
```
Switch(config)#line ?
  <0-16>    First Line number
  console   Primary terminal line
  vty       Virtual terminal

Switch(config)#line vty ?
  <0-15>   First Line number

Switch(config)#line vty 0 15
Switch(config-line)#login
Switch(config-line)#password telnet
Switch(config-line)#line console 0
Switch(config-line)#login
Switch(config-line)#password console
```

2950 Series (3)

Switch(config)#enable password cisco
Switch(config)#enable secret c
Switch(config)#hostname uniti_2950
uniti_2950(config)#int vlan 1
uniti_2950(config-if)#ip address 192.168.1.2 255.255.255.0
uniti_2950(config-if)#no shut
uniti_2950(config-if)#
00:41:40: %LINK-3-UPDOWN: Interface Vlan1, changed state to up
00:41:41: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
uniti_2950(config-if)#exit
uniti_2950(config)#ip default-gateway 192.168.1.1

2950 Series (4)

```
uniti_2950(config)#
uniti_2950(config)#int fastEthernet 0/1
uniti_2950(config-if)#description connect to pc1
uniti_2950(config-if)#int f0/2
uniti_2950(config-if)#description connect to pc2
uniti_2950(config-if)#^Z
uniti_2950 #copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
uniti_2950 #erase startup-config
Erasing the nvram filesystem will remove all configuration files!
    Continue? [confirm]
[OK]
```



Summary

- Switches provide dedicated access
- Switches eliminate collisions and increase capacity
- Switches support multiple conversations at the same time