

Layer 1 & 2 Physical and Datalink Technologies

Data-Link Layer Functions

Defines:

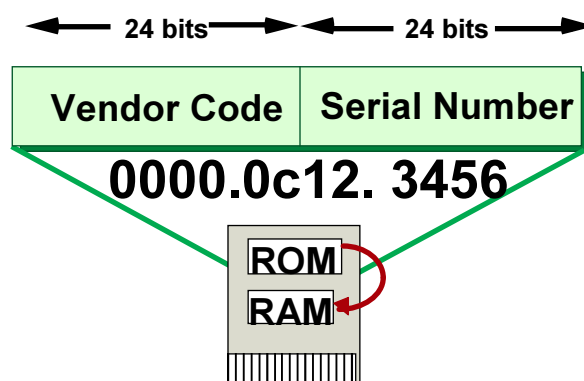
- Physical source and destination addresses
- Higher-layer protocol (service access point) associated with frame
- Network topology
- Frame sequencing
- Flow control
- Connection-oriented or connectionless

Data-Link	Ethernet	802.2	HDLC	Frame Relay
Physical		802.3	EIA/TIA-232 V.35	

Ethernet and IEEE 802.3

- Benefits and background
 - Ethernet is the most popular physical layer LAN technology because it strikes a good balance between speed, cost, and ease of installation
 - Supports virtually all network protocols
 - Xerox initiated, then joined by DEC & Intel in 1980
- Revisions of Ethernet specification
 - Fast Ethernet (IEEE 802.3u) raises speed from 10 Mbps to 100 Mbps
 - Gigabit Ethernet is an extension of IEEE 802.3 which increases speeds to 1000 Mbps, or 1 Gbps

MAC Address

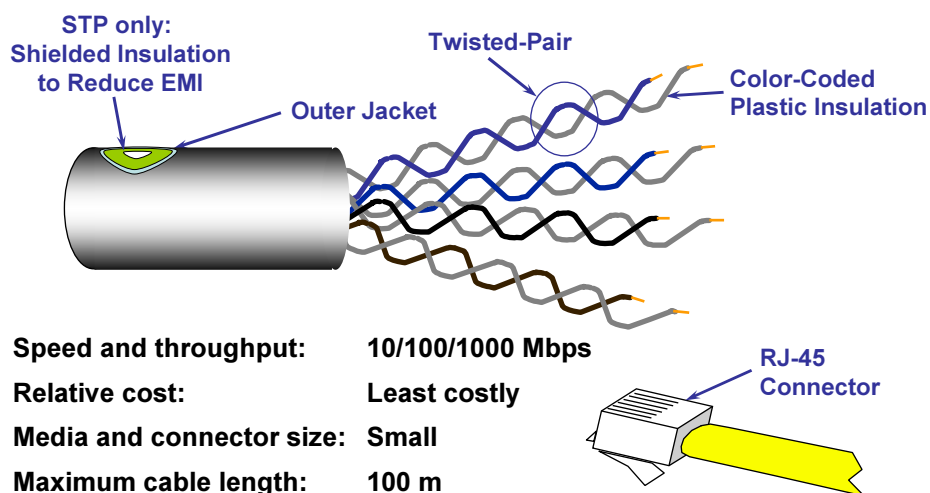


- MAC address is burned into ROM on a network interface card

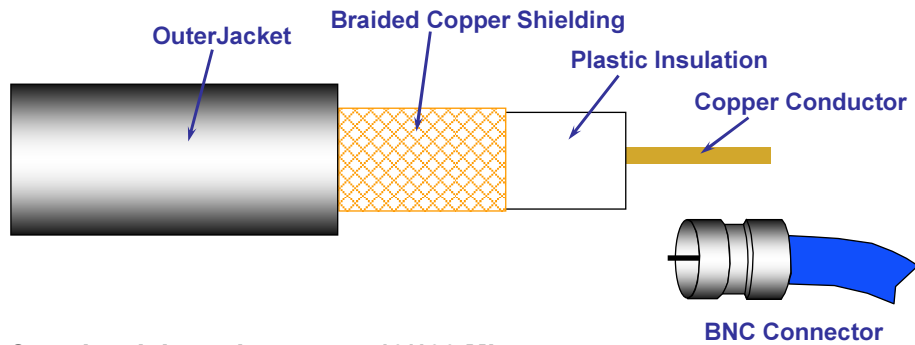
Network Cabling

- Media connecting network components
 - NIC cards take turns transmitting on the cable
 - LAN cables only carry one signal at a time
 - WAN cables can carry multiple signals simultaneously
- Three primary types of cabling
 - Twisted-pair (or copper)
 - Coaxial cable
 - Fiber-optic cable

Twisted-Pair (UTP and STP)

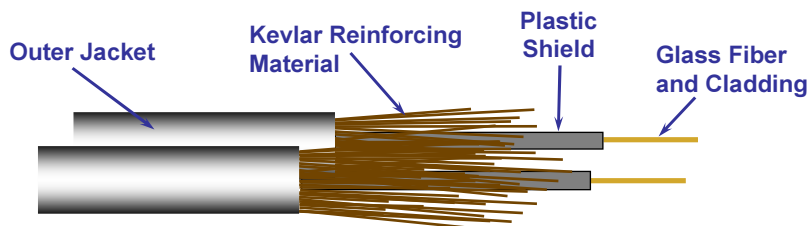


Coaxial Cable



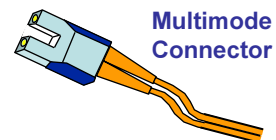
Speed and throughput:	10/100 Mbps
Relative cost:	More than UTP, but still low
Media and connector size:	Medium
Maximum cable length:	200/500 m

Fiber-Optic Cable

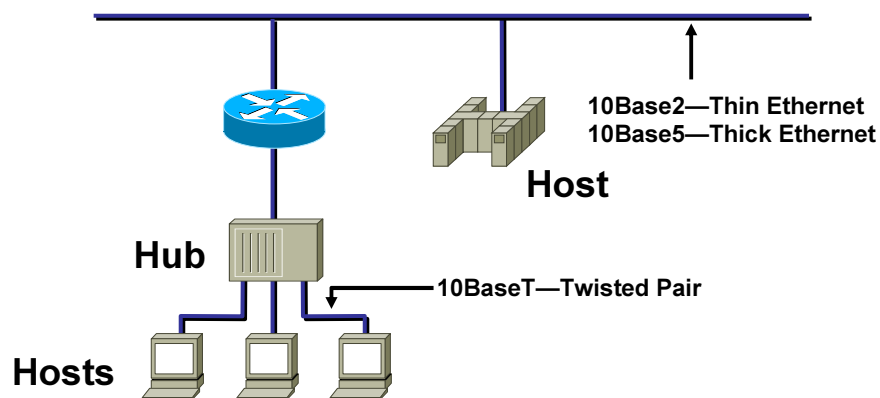


Single mode: One stream of laser-generated light (100 km)
Multimode: Multiple streams of LED-generated light (2 km)

Speed and throughput:	10/100/1000 Mbps
Average cost per node:	Most expensive
Media and connector size:	Small
Maximum cable length:	Up to 100 km

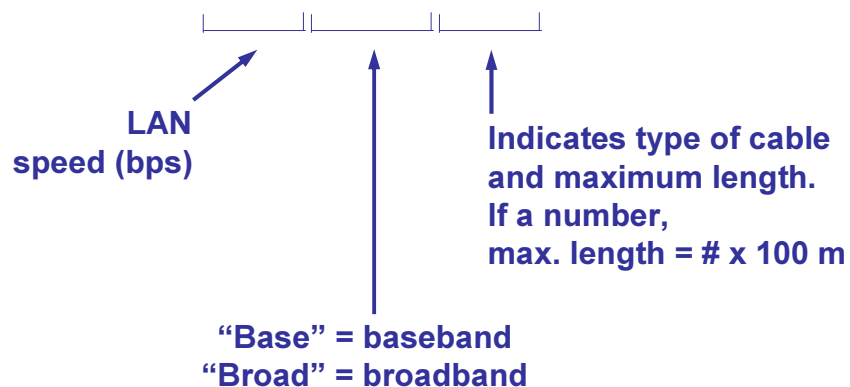


Physical Layer: Ethernet/802.3



Ethernet Protocol Names

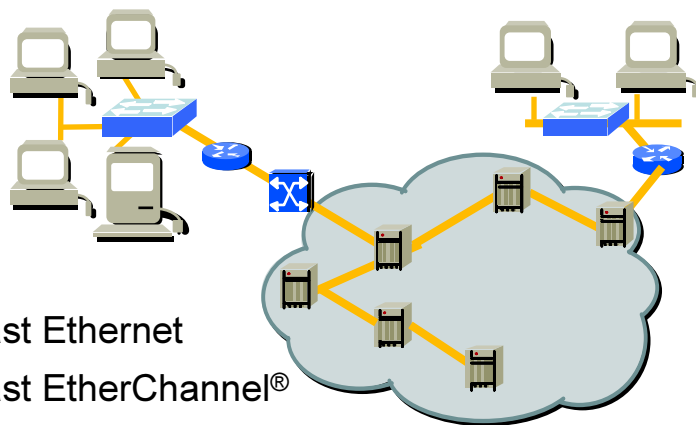
100BaseFX



Ethernet and Fast Ethernet

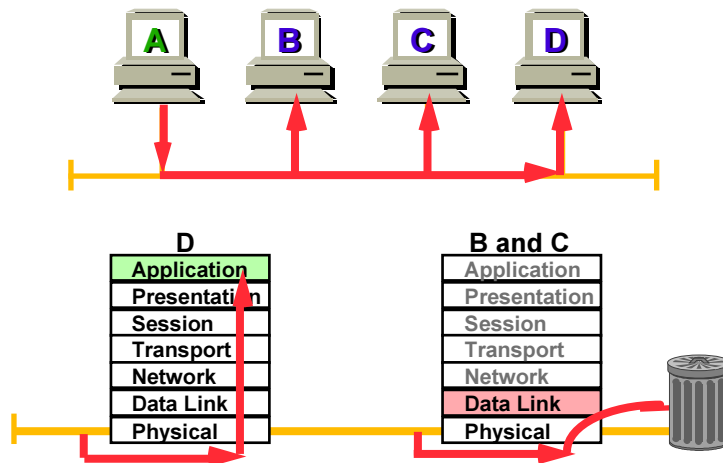
Protocol	Max. Segment Length (m)	Transmission Medium	Application
10Base2	185	50-ohm coaxial	A: Link user stations
10Base5	500	50-ohm coaxial	A: Link user stations
10BaseF	Refers to 10BaseFB, 10BaseFL, and 10Base FP		
10BaseFB	2000	Fiber-optic	A: Add segments
10BaseFL	1000–2000	Fiber-optic	A: Operate w/ FOIRL
10BaseFP	500	Fiber-optic	Star topo w/out repeaters
10BaseT	100	2-pairs TP	Sends link signals
10Broad36	3600	Broadband coax	A: Broadband
100BaseFX	400	2 strands of multimode fiber-optic cable	
100BaseT	100	UTP	10BaseT function + more
100BaseT4	100	4 prs Cat 3-5 UTP	-
100BaseTX	100	2 prs UTP or STP	-
100BaseX	Refers to 2 strand/pair 100BaseFX and 100BaseTX		

High-Speed Ethernet Options

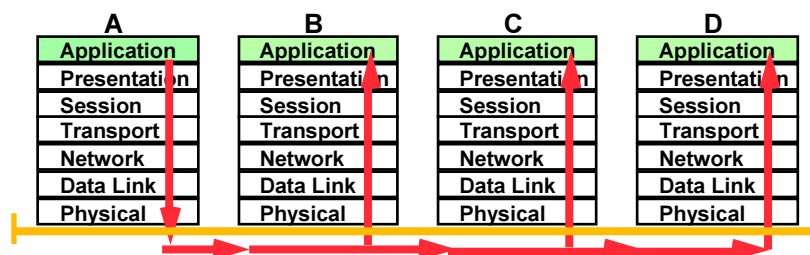


- Fast Ethernet
- Fast EtherChannel®
- Gigabit Ethernet
- Gigabit EtherChannel

Ethernet Operation



Ethernet Broadcast



Ethernet Reliability

Figure 1

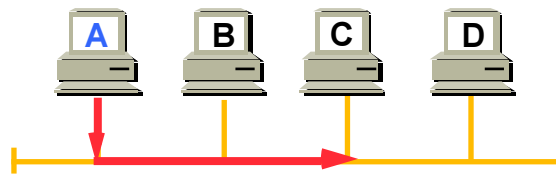
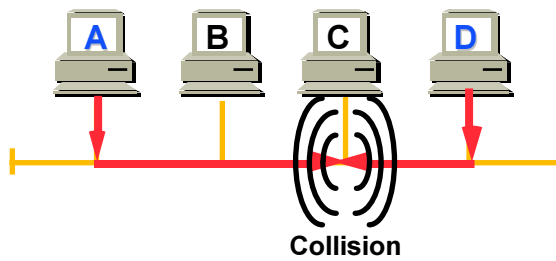
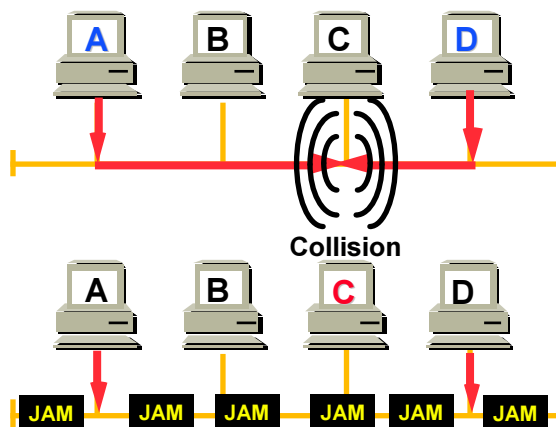


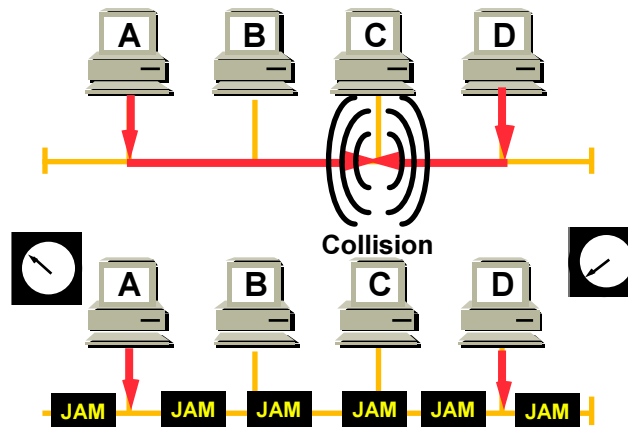
Figure 2



Ethernet Reliability



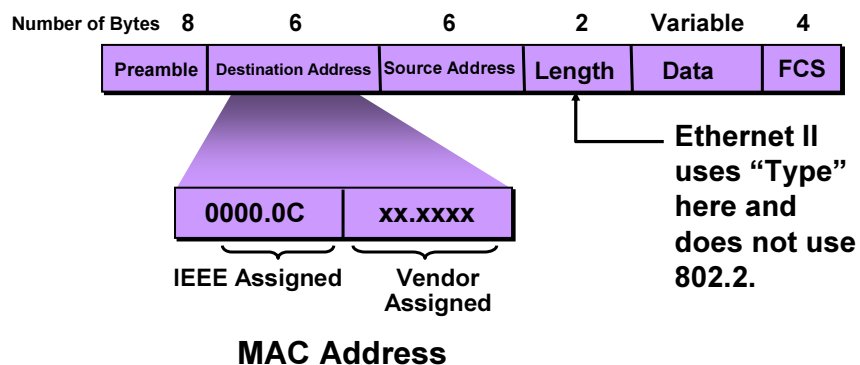
Ethernet Reliability



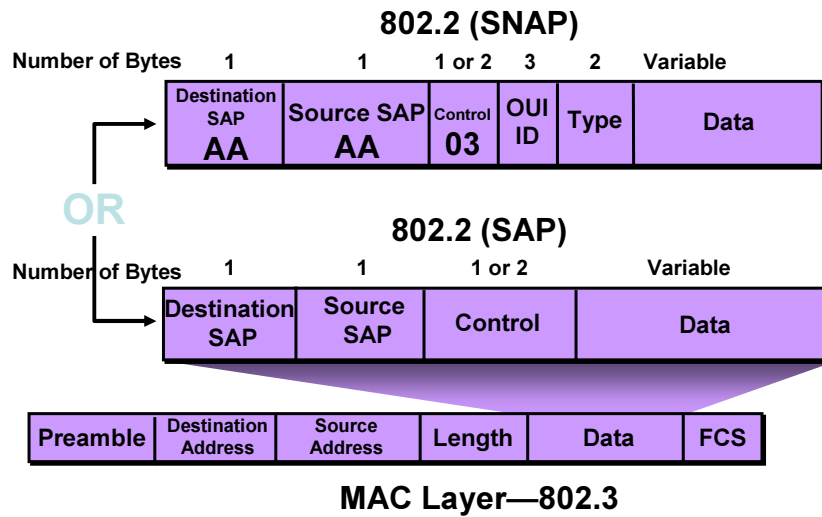
- Carrier sense multiple access with collision detection (CSMA/CD)

Data-Link Layer Functions (cont.)

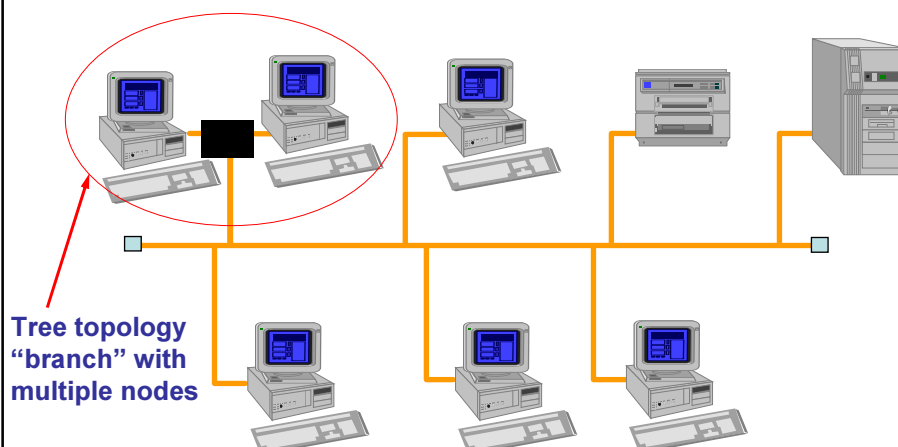
MAC Layer—802.3



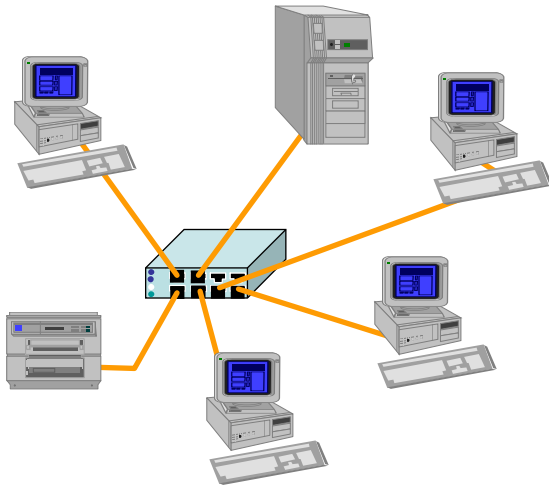
Data-Link Layer Functions (cont.)



Bus and Tree Topology



Star Topology (LAN)



- Center: hub, repeater, or concentrator
- Typically used in both Ethernet and Token Ring

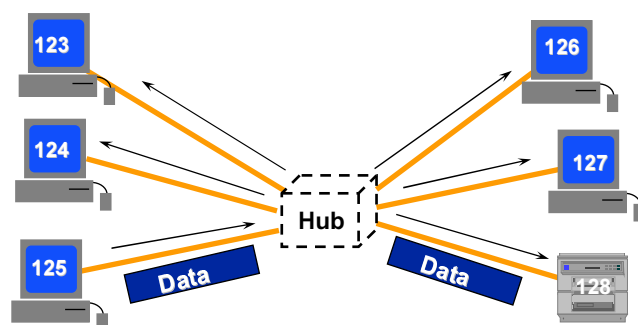
LAN/WAN Devices

- **Hubs**
- **Bridges**
- **Switches**
- **Routers**

Hub

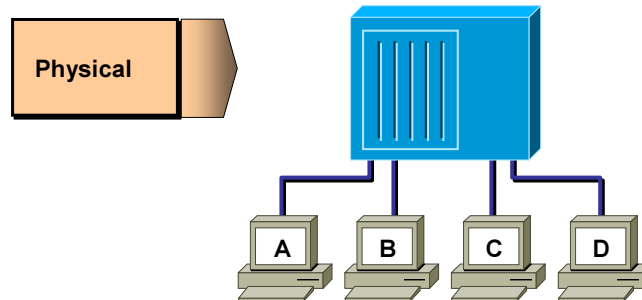
- Device that serves as the center of a star topology network, sometimes referred to as a *multiport repeater*, or in Ethernet, a *concentrator*; no forwarding intelligence

Hubs



- Amplifies signals
- Propagates signals through the network
- Does not filter data packets based on destination
- No path determination or switching
- Used as network concentration point

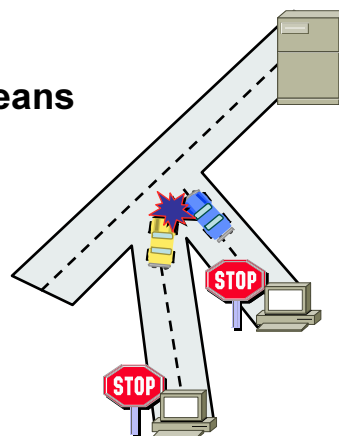
Hubs Operate at Physical Layer



- All devices are in the same collision domain.
- All devices are in the same broadcast domain.
- Devices share the same bandwidth.

Hubs: One Collision Domain

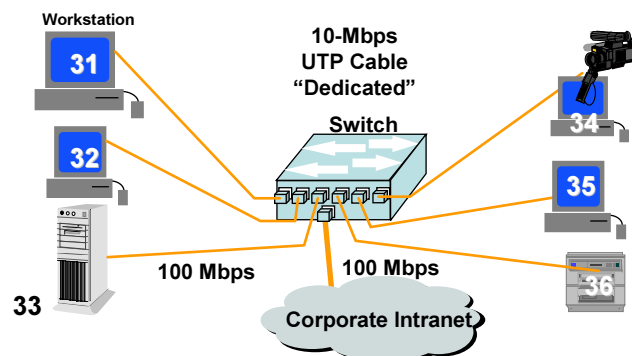
- More end stations means more collisions.
- CSMA/CD is used.



Switches

- Use bridging technology to forward traffic between ports.
- Provide full dedicated data transmission rate between two stations that are directly connected to the switch ports.
- Build and maintain address tables called content-addressable memory (CAM).

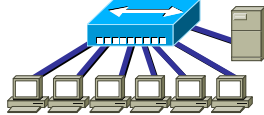
Switching—"Dedicated" Media



- Uses bridging technology to forward traffic (i.e. maintains address tables, and can filter)
- Provides full dedicated transmission rate between stations that are connected to switch ports
- Used in both local-area and in wide-area networking
- All types available—Ethernet, Token Ring, ATM

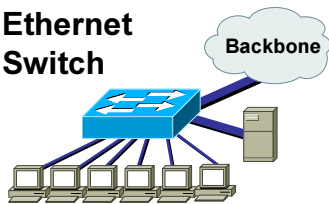
Switches versus Hubs

Hub



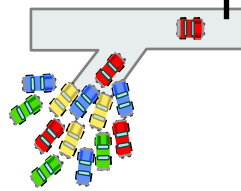
All nodes share 10 Mbps

Ethernet Switch



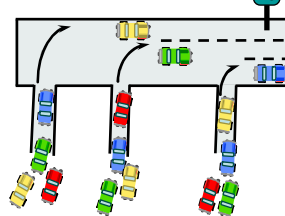
Each node has 10 Mbps

Ethernet



One device
sending at
a time

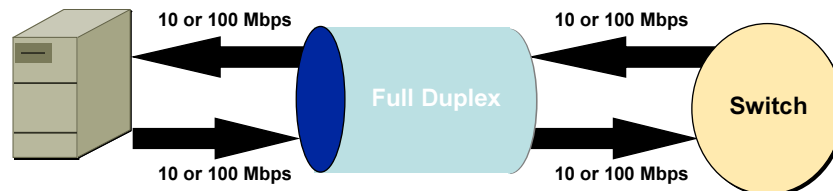
Switched Ethernet



Multiple
devices
sending at the
same time

Switching Technology: Full Duplex

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



Switching Modes

- Three selectable switching modes supported
 - FastForward (cut-through)
 - FragmentFree (modified cut-through)
 - Store-and-Forward

