

Campus Networking Workshop

Ethernet evolution



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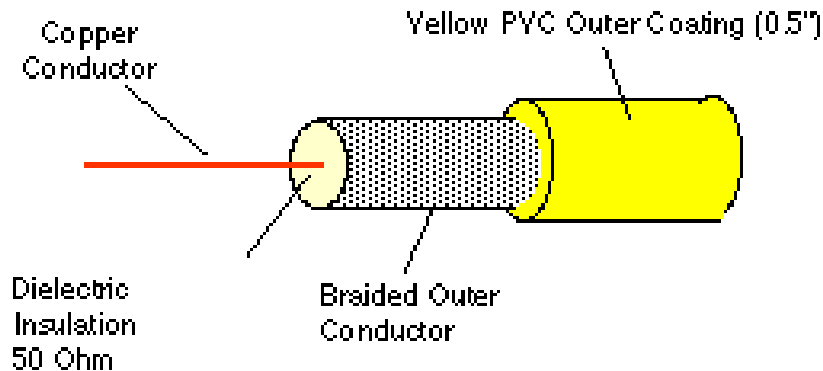


Layer 2 Concepts

- Layer 2 protocols basically control access to a shared medium (copper, fiber, electromagnetic waves)
- Ethernet is the *de-facto* standard today
 - Reasons:
 - Simple
 - Cheap
 - Manufacturers keep making it faster

Ethernet Evolution

- In the beginning:
 - “Thick Ethernet” – 10base5, IEEE802.3
 - Invented by DEC, IBM and Xerox in the 1970s

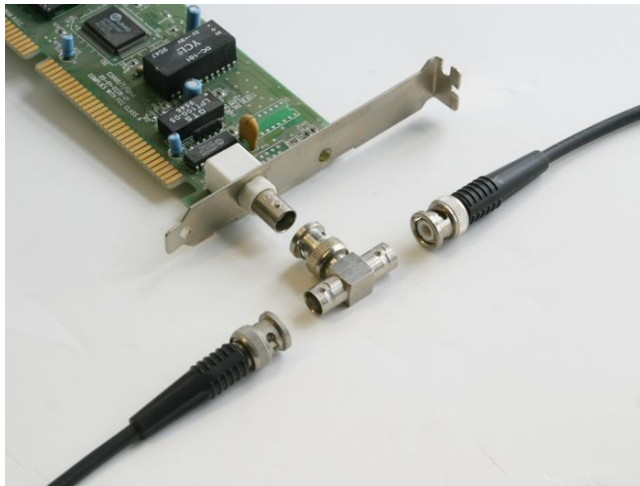


Source: wikipedia



Ethernet Evolution

- Things got a bit better:
 - “Thin Ethernet” – 10base2 – in the mid 1980s
 - Coax cable, sometimes proprietary “make-before-break” connectors to attach hosts



Ethernet Evolution

- And then the familiar unshielded twisted pair:
 - 10baseT – original Cat3 – 10Mbps Ethernet – standardised in 1990 (IEEE802.3i)
 - 100baseT – 100Mbps Ethernet and Cat5/Cat5e cabling in 1995 (IEEE802.3u)
- Ongoing evolution in 21st Century
 - 1Gbps Ethernet
 - 10Gbps Ethernet
 - 40Gbps Ethernet
 - 100Gbps Ethernet
 - 400Gbps Ethernet is proposed



Ethernet Functions

- Source and Destination identification
 - MAC addresses
- Detect and avoid frame collisions
 - Listen and wait for channel to be available
 - If collision occurs, wait a random period before retrying
 - This is called CSMA-CD: Carrier Sense Multiple Access with Collision Detection
 - 1Gbps links and above are always full duplex



Ethernet Frame

- Normal Ethernet Frame:

Preamble: 7	SFD: 1	DA: 6	SA: 6	Type/Length: 2	Data: 46 to 1500	CRC: 4
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- SFD = Start of Frame Delimiter
- DA = Destination Address
- SA = Source Address
- CRC = Cyclic Redundancy Check



Evolution of Ethernet Topologies

- Bus
 - Everybody on the same coaxial cable
- Star
 - One central device connects every other node
 - First with hubs (repeated traffic)
 - Later with switches (bridged traffic)
 - Structured cabling for star topologies standardized

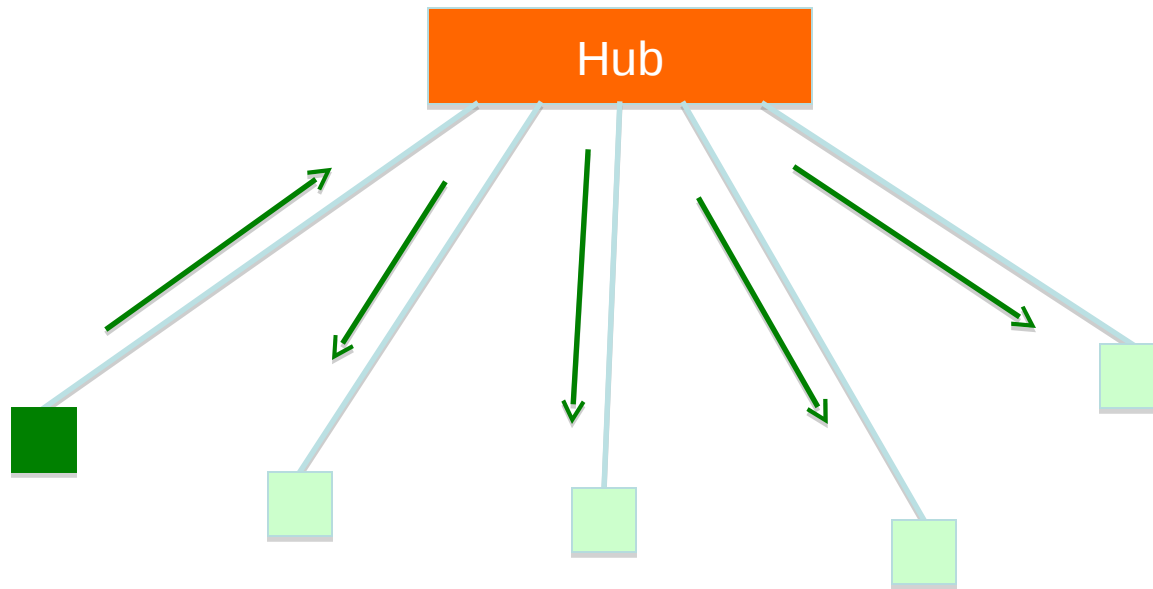
Switched Star Topology Benefits

- It is modular:
 - Independent wires for each end node
 - Independent traffic in each wire
 - A second layer of switches can be added to build a hierarchical network that extends the same two benefits above
 - ALWAYS DESIGN WITH MODULARITY IN MIND

Hub

- Receives a frame on one port and sends it out every other port, always.
- Collision domain spans the whole hub or chain of hubs
- Traffic ends up in places where it's not needed

Hub



A frame sent by one node is always sent to every other node. Hubs are also called “repeaters” because they just “repeat” what they hear.

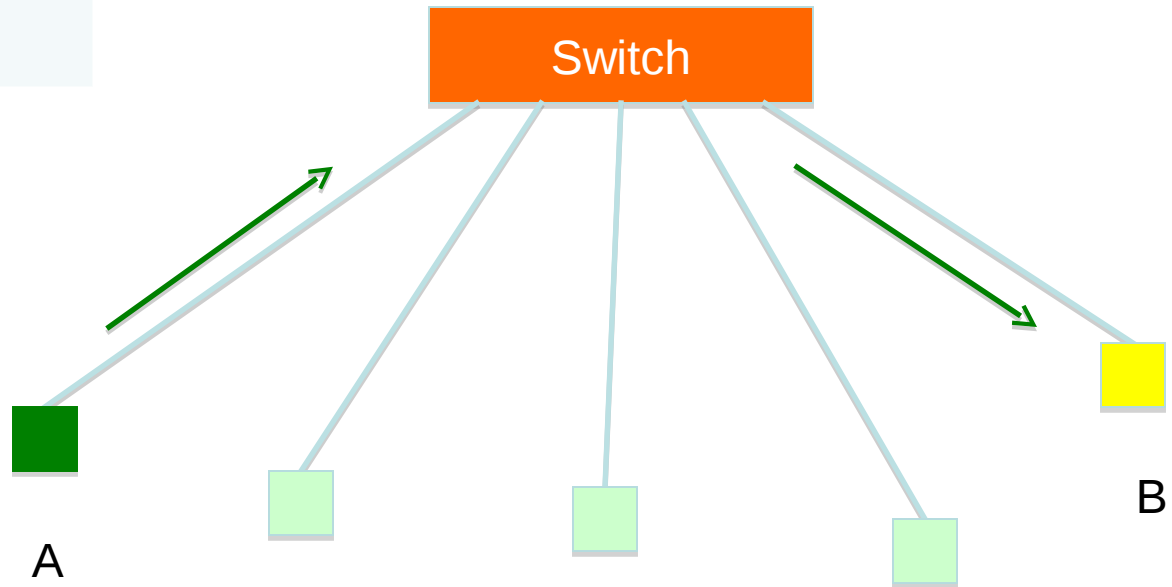
Switch

- ***Learns*** the location of each node by looking at the source address of each incoming frame, and builds a ***forwarding table***
- ***Forwards*** each incoming frame only to the port where the destination node is
 - Reduces the collision domain
 - Makes more efficient use of the wire
 - Nodes don't waste time checking frames not destined to them

Switch

Forwarding Table

Address	Port
AAAAAAAAAAAAA	1
BBBBBBBBBBBBB	5



Switches and Broadcast

- A switch broadcasts some frames:
 - When the destination address is not found in the table
 - When the frame is destined to the broadcast address (FF:FF:FF:FF:FF:FF)
 - When the frame is destined to a multicast ethernet address
- So, switches do not reduce the broadcast domain!

Switch vs. Router

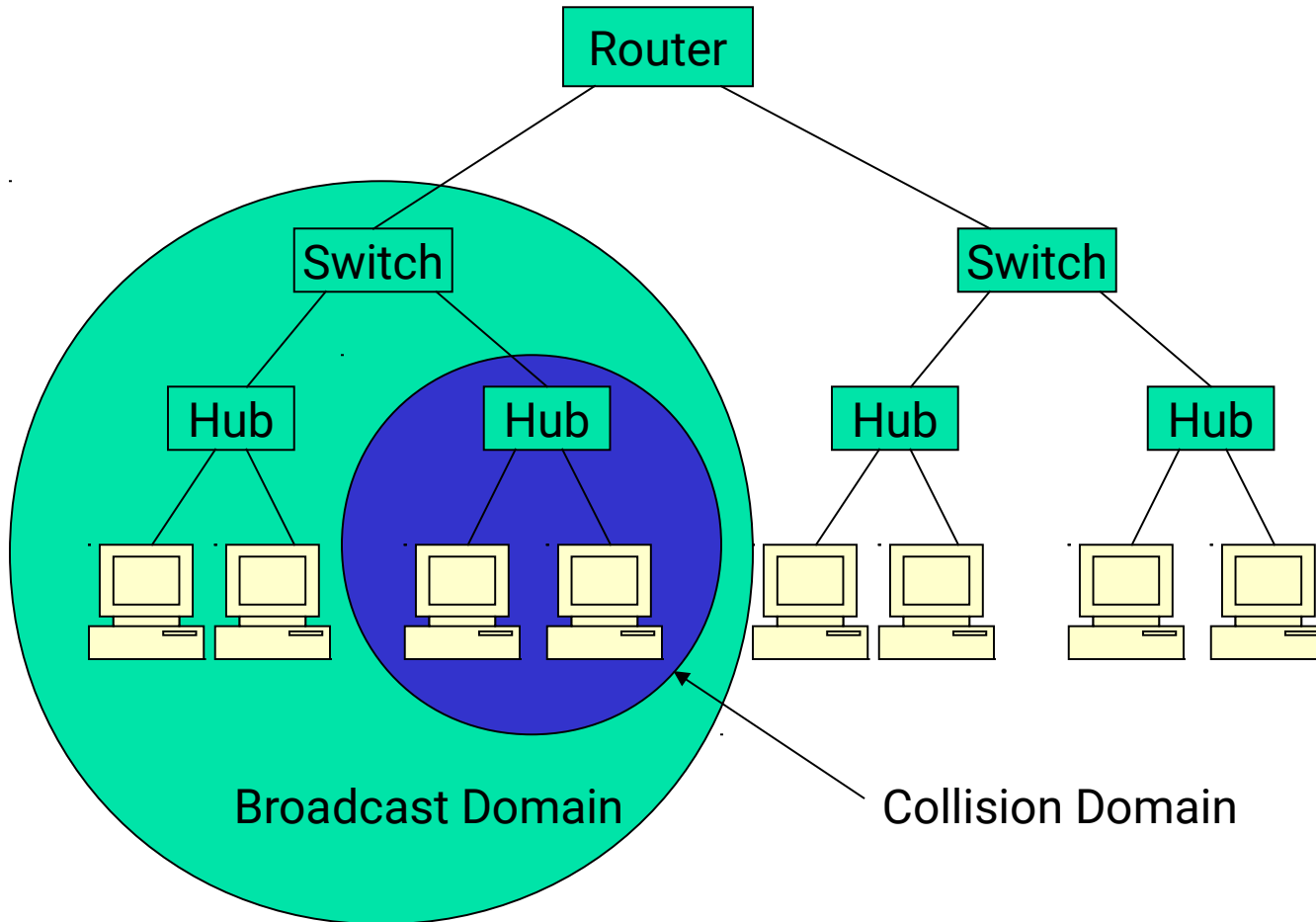
- Routers more or less do with IP packets what switches do with Ethernet frames
 - A router looks at the IP packet destination and checks its ***forwarding table*** to decide where to forward the packet
- Some differences:
 - IP packets travel inside ethernet frames
 - IP networks can be logically segmented into *subnets*
 - Switches do not usually know about IP, they only deal with Ethernet frames



Switch vs. Router

- Routers do not forward Ethernet broadcasts. So:
 - Switches reduce the collision domain
 - Routers reduce the broadcast domain
- This becomes ***really*** important when trying to design hierarchical, scalable networks that can grow sustainably

Traffic Domains



Traffic Domains

- Try to eliminate collision domains
 - Get rid of hubs!
- Try to keep your broadcast domain limited to no more than 250 simultaneously connected hosts
 - Segment your network using routers

Questions?



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