Campus Networking Workshop

Ethernet evolution

UNIVERSITY OF OREGON

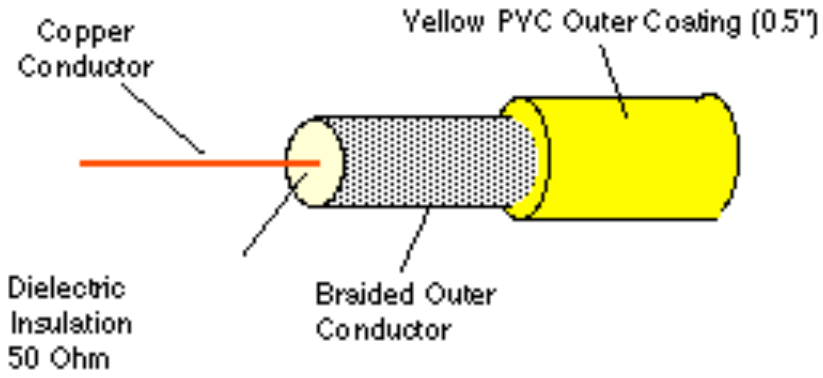
NSRC
Network Startup Resource Center

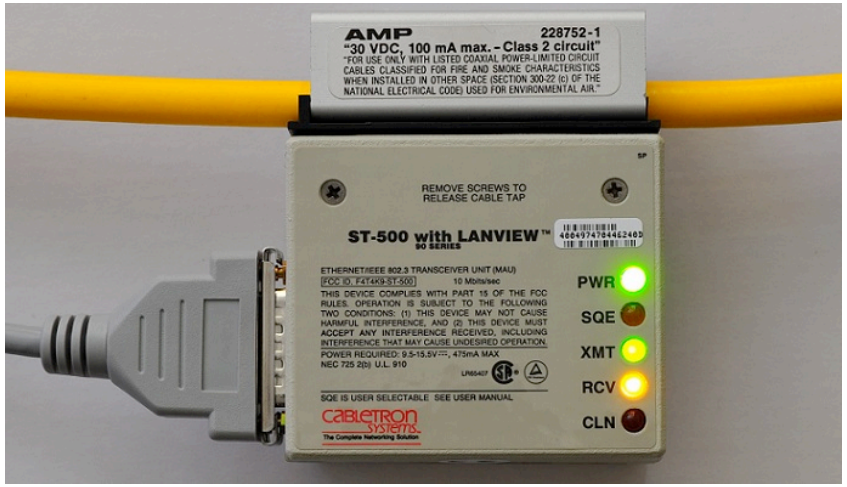
Layer 2 Concepts

- Layer 2 protocols basically control access to a shared medium (copper, fiber, electro-magnetic 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

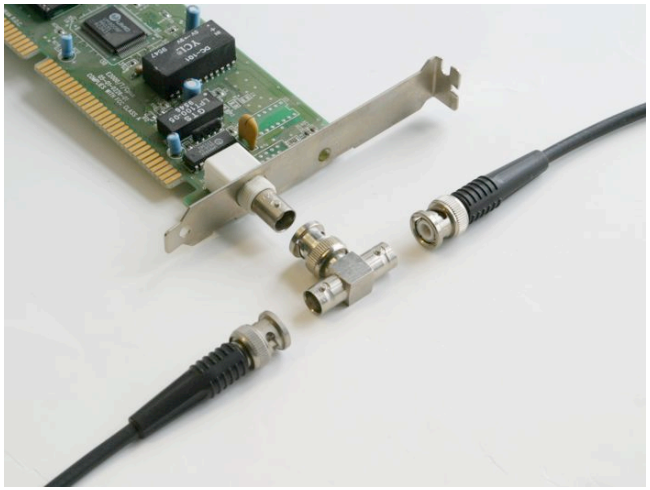




Source: wikipedia

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 CASMA-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

  - 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

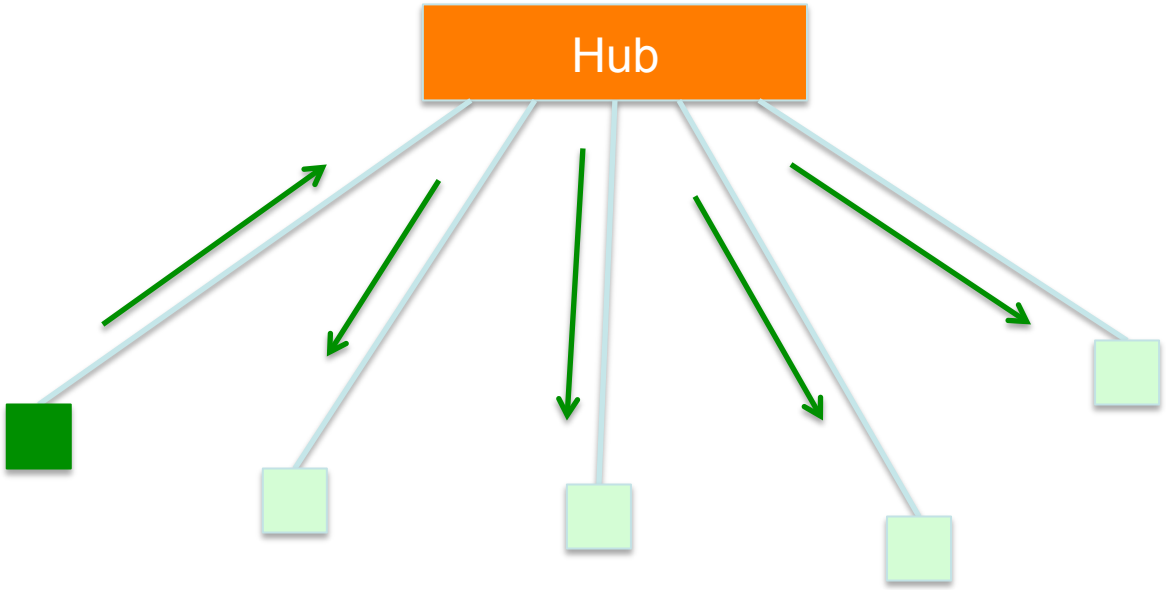
Switched Star Topology Benefits

- 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.

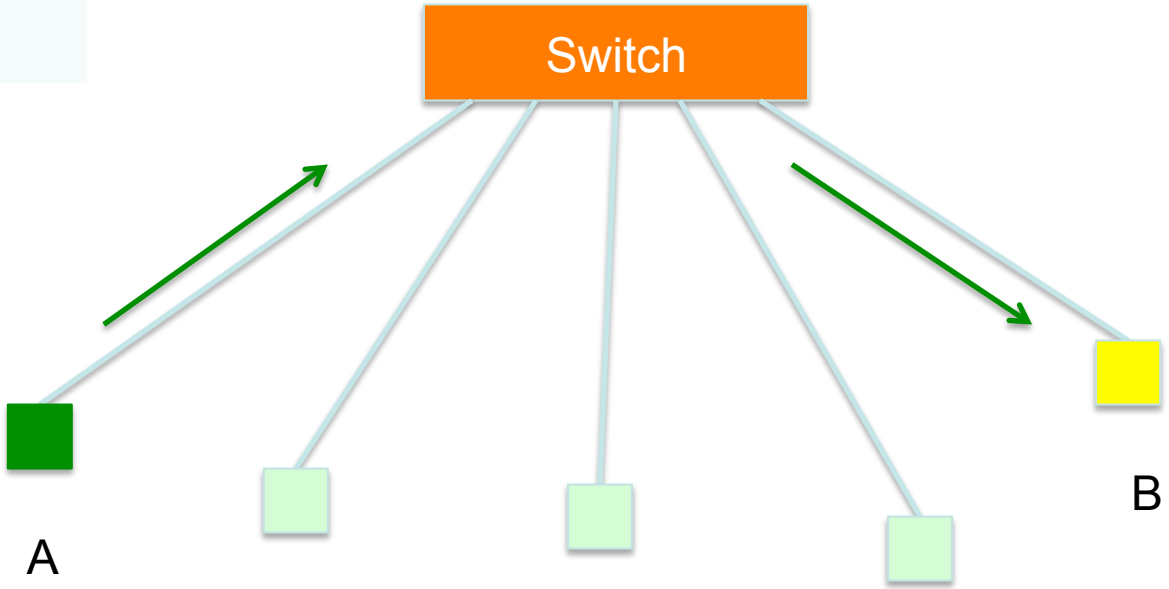
Switch

- ***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
AAAAAAAAAAAA	1
BBBBBBBBBBBB	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!

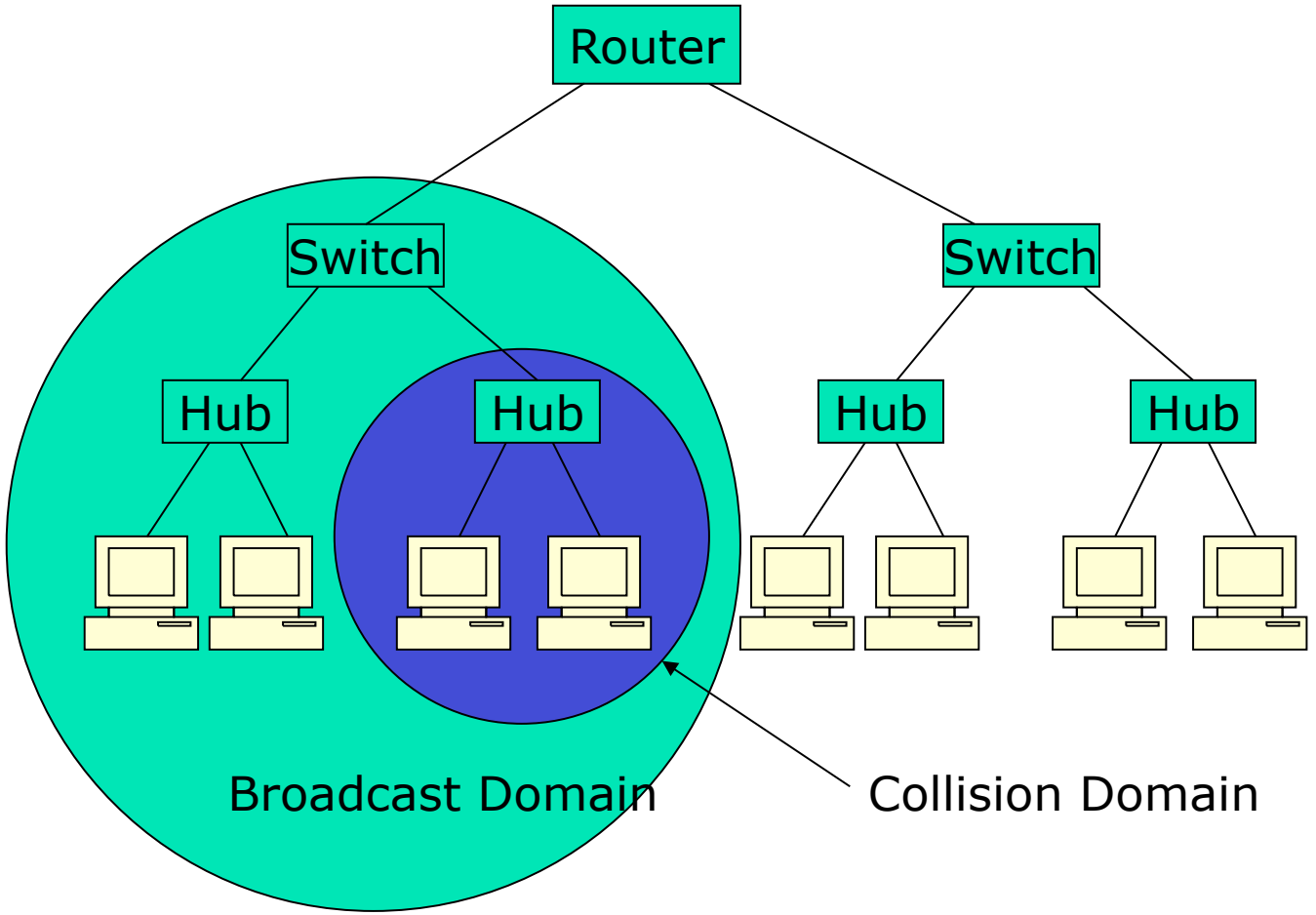
Switch vs. Router

- 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?