I. Signal Issues

Week 3

- as an electrical signal travels through (along) a wire, the strength of the signal weakens, referred to as **attenuation**

- the longer the circuit, the greater the attenuation

- analog signals can be strengthened using **amplifiers,** but these also boost the amount of ? (noise)

- digital signals are strengthened using **repeaters**

II. Physical Layer & Media Specifications

Physical Layer Specifications: **<u>xxx</u>** **<u>yyy</u>** **<u>zzz</u>**

- xxx is speed in Mbps
- yyy is signaling method (baseband – a single signal or broadband – multiple mux-ed signals)
- zzz is max cable length (in 100 meters lengths) **or** medium type

<u>Copper</u>

1. coaxial

a. thick coax
- called "thick Ethernet"
- 10 base 5 (? Mbps, ?, ? meter max cable length)

b. thin coax
- called "thin Ethernet" or thinnet
- 10 base 2

2. twisted pair

- consists of (at least) 2 pairs of copper, 1 transmit, 1 receive
- twists cause noise to get out of phase, thus cancels itself out

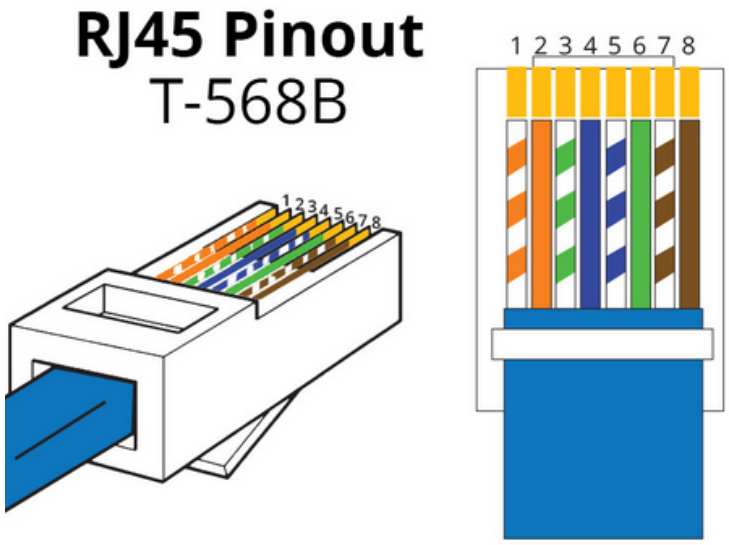
a. shielded twisted pair (STP)

- each pair enclosed in shielding
- expensive, used for specialty applications, e.g. hospitals

b. unshielded twisted pair (UTP)

- standards set by EIA/TIA (see www.tiaonline.org & spec 568)
- categories 1-5e & 6 are standards**,** 6e & 7 are proposed, but currently proprietary
- cat 3 supports 10 Mbps - 10BaseT (802.3i)
- cat 5 supports 100 Mbps - 100BaseTX (802.3u) aka Fast Ethernet
- cat 5 4 pair supports 1000 Mbps - 1000BaseT (802.3ab) aka Gigabit Ethernet
- UTP connectors are called 8-pin modular connectors, officially called 8 Position 8 Contact (8P8C), more commonly called RJ-45 (telco name, Registered Jack)
- pin 1 – TD+ pin 2 – TD- pin 3 – RD+ pin 6 – RD-
- cat 5 made up of 4 twisted pairs, colored
  orange / orange-white green / green-white
  blue / blue-white brown / brown-white
- **patch cables** connect computer to hub or switch, both ends (EIA 568B):

pin	1	2	3	4	5	6	7	8
wire	o-w	o	gr-w	bl	bl-w	g	br-w	br



- **<u>crossover cables</u>** connect computer to computer, one end above, one end below

pin	1	2	3	4	5	6	7	8
wire	gr-w	g	o-w	bl	bl-w	o	br-w	br

III. Physical Components, Cont'd.

1. Transceiver (Transmitter/Receiver)

- layer 1 devices used in Ethernet/802.3 to connect the node to the physical medium (i.e. wire)
- transmit & receive signals simultaneously as well as performs notification to the host if an error condition has occurred
- connect to/from host via an Attachment Unit Interface (AUI)
- transceivers/AUIs today are typically (almost always) incorporated into the NIC

2. Network Interface Cards (NICs)

- sometimes called LAN adapters, network adapters, network cards, etc.
- NICs can support different types of networks and media, e.g.
  - an Ethernet card is a NIC used in an Ethernet network
  - a token ring card is a NIC used in a Token Ring network
- NICs are considered as layer 2 devices, providing:
  - organization of data into frames
  - transfer of frames between end points of connection
  - link management
    - error control
    - initialization
    - termination control
    - flow control
- layer 2 functionality is implementation specific, e.g. Ethernet ≠ Token Ring

- NICs come hard-wired with addresses from the manufacturer (what kind of addresses? – Ethernet cards with Ethernet addresses, etc.)

- NICs also require a software device driver, specific to the hardware and OS

- NICs **also provide layer 1** functionality

  - converting bit values into electric signals using coding scheme
  - capturing data from the physical medium if addressed to that NIC

3. Hubs

- sometimes called a repeating hub (not a switching hub)

- device which connects 2 or more computer or network segments

- hubs are dumb, layer 1 devices

- takes incoming signal, regenerates it, and repeats signal on all outgoing ports (except incoming one), this is a broadcast model

- source of **propagation delay or latency**, that is the time for a signal to get from point A to point B

- see ch 17

4. Switches

- sometimes called switching hub

- establishes a link between sending and receiving nodes, via a virtual circuit model

- each switch port on an Ethernet switch supports a separate LAN segment, also called a **collision domain**

- layer 2 devices, examine ? addresses (MAC addresses, e.g. Ethernet)

- ports can accommodate different media types, e.g. 10baseT, 10baseF

- switches examine source and destination addresses and switch based upon pre-learned knowledge

- each port filters traffic sent across its segment, if destination is on same segment, frame is discarded; if traffic sent to another segment, frame is switched to that segment

IV. Collisions

- detection based upon media type, e.g.
  - coax: improper signal levels (e.g. 2x normal level)
  - TP: any data on receive wire during transmit

- collision domain: any network or segment where 2 or more nodes can experience a collision (see pg. 65)

V. Switching, cont'd.

- **goal:** break-up (segment) the collision domain

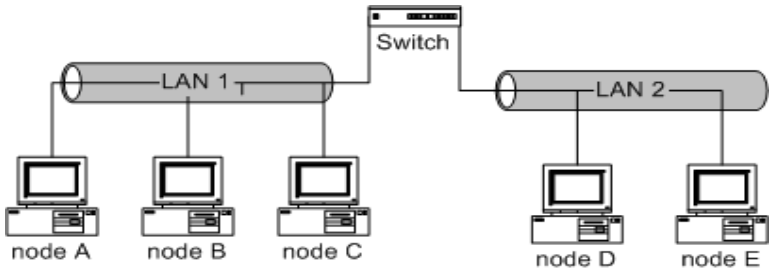
- each switch (sometimes called a bridge) port is a separate collision domain

- support multiple protocols, e.g. Ethernet, ATM

- typically operate in **promiscuous mode**, that is they capture every frame along wire

- self-learning, i.e. build table based upon **source** address of each frame keeping track of LAN/node pair

  1. if destination not in table, send out all ports on switch (flood)
  2. if destination in table, and on same LAN (or port) as source, drop (filter)
  3. if destination in table, and NOT on same LAN (or port), send (forward)



Node	LAN
A	1
E	2
B	1

A to D: flood
E to C: flood
B to C: flood
A to B: filter
A to E: forward

Switch Types

1. cut-through
    - only read and process the minimum number of bits in frame necessary to determine where to send it
    - no error checking
    - low latency
2. store & forward
    - accept entire frame before forwarding
    - provides error checking, if errors present, drop frame
    - higher latency, larger the frame, the larger the latency