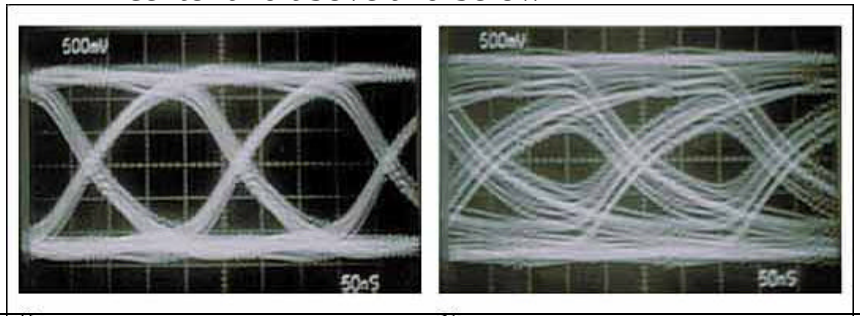
CSIS 625 Week 9

Overview

- Eye diagrams
- LAN technologies continued
  - Ethernet physical layer
  - Gigabit Ethernet
  - VLANs
  - Ethernet-in-First-Mile
  - Wireless Ethernet 802.11

Eye Diagrams

- A diagram that shows how well a digital signal is transported on a medium.
- Shows amplitude and timing noise
- Wide open eye is better than mostly closed one.
- Standards often have exclusion zones in the center and above and below



Ethernet Physical Layer

- 10BaseT Ethernet - 2 pair Cat 3
  - Uses Manchester encoding
    - This results in 10 to 20 million transitions per second on the line
    - Spectrum is in the 5-10Mhz range
- 100BaseFx Ethernet
  - Uses 4b5b-NRZI on fiber
    - This increases the bits sent to 125Mbps
- 100BaseT Ethernet - 2 pair Cat 5
  - Uses 4b5b MLT-3 on twisted pair

4b5b - Why

- 4b5b table in handout
  - only 16 of the 32 5b symbols needed for data.
    - Plus a few for control
  - Ensures that transitions still present on line for clock recovery
    - No more than 3 zeros in a row
  - More efficient than Manchester
- MLT-3 - Multi Level Transmit
  - Transition on a 1, no transition on a 0
  - Goes +1, 0, -1, 0, +1, 0, -1, 0, etc.
  - Reduces bandwidth to 31.25Mhz

Ethernet Physical Layer cont.

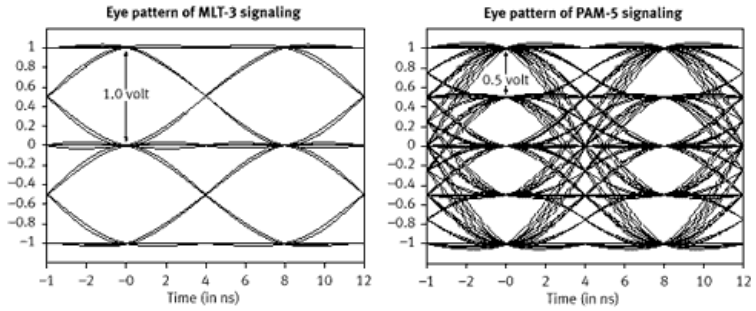
- 1000BaseX Ethernet -
  - Uses 8b10b NRZ @ 1.25Gbaud
  - 8b10b Ensures 50% ones density
- 1000BaseT Ethernet - 4 pair Cat 5
  - Uses PAM5 (Pulse Amplitude Modulation)
    - Provides 2 bits, plus extra symbol for FEC, special codes, transition density.
  - Each pair is used in both directions with echo cancellation
  - The use of PAM5 is a 6dB hit, but made up for with FEC.

Ethernet Physical layer

- 10G Ethernet
  - Use of PAM5 on Fiber?
  - Use of SONET framing?
  - Wait and see
- All 100Base & 1000Base
  - Send idle codes when line is not in use.
  - Keeps clocks in sync.
  - Lets connections know when cable is broken
- 10BaseX
  - Had link pulse to keep nodes aware of connection status, but that isn't used now that everything is point to point.

Ethernet MLT-3 & PAM-5

- Eye diagrams for MLT-3 from 100BaseT and PAM-5 from 1000BaseT
- 100Base-T2 also uses PAM5



Collision Domain

- 10BaseX
  - 512 bit times => about 2km
- 100BaseX
  - 512 bit times => about 200m
- 1000BaseX
  - 512 byte times => about 200m
  - Has to extend short frames to 512 byte times
    - Didn't want to expand minimum frame size because of mixed environments.
    - Some methods exist to send multiple frames so the bandwidth isn't wasted

More collision stuff

- With xBaseT standards, the hub sends the incoming signal to everyone but the sender.
  - The Sender knows a collision occurred if it receives anything while transmitting.
- With Switched Ethernet, the collision domain doesn't matter much.
- With full duplex collisions do not exist

Ethernet terminology (again)

- Switch = Bridge - works at L2 (data link) layer
  - Switch is newer name - faster & done in HW.
  - Bridges are older and often done in SW
  - Allows use of full-duplex links
- Hub = Repeater - works at physical layer
  - Regenerates signal
  - Must be a half-duplex link connected to these

VLANs

- VLAN - Virtual LAN
  - This is not the same as VPN – Virtual Private Network
- VLANs are a configuration on some switches that group multiple ports together as one LAN or broadcast domain.
- Different VLANs must be bridged using a router
  - Often this router functionality is in the same box.
- VLANs can span switches, by adding a field to the Ethernet frame that has a VLAN number in it.
  - All switches must be configured with the same set of numbers

Ethernet In First Mile

- A new IEEE group
- Looking at ways to use Ethernet to connect to your home.
- Currently unsure if this will be point to point, or using PON technology
  - PON – Passive Optical Network.
    - Use of optical splitter/combiners that don't require any electronics.
  - PON technology requires 2 "tricky" things
    - Ranging of nodes
    - Contention for the upstream bandwidth.

802.11 - Wireless Ethernet

- Started out as 1 or 2Mbps using RF or infra-red links.
- Recently added 5.5 and 11Mbps
- RF uses frequencies around 2.4GHz
  - This is the same range used by microwave ovens
  - Water absorbs this energy very well making hard to use for long distances.

802.11 – For last mile

- Since this is unlicensed spectrum, people have started to use this with directional antennas for Internet Access.
  - Unlicensed spectrum – RF bandwidth that you don't need to buy a license from the government to use
- To overcome the problems with water absorption, the link has to be carefully set up
  - Line of site links
  - No trees in the way
- Typically will run at less than peak rates

802.11

- Additional wireless links
  - http://www.wlana.com/
  - http://www.wirelessethernet.org/
  - http://www.midcoast.net/wirelessfaq.html

RPR - Resilient Packet Rings – 802.17

- Another new technology – just starting out in the IEEE
- Idea is to provide good protection that Sonet rings enjoy, using packet technology (most likely gig-Ethernet)
- Sonet Rings are circuit switch oriented, and reserve 50% of the bandwidth on the ring for protection purposes.
  - A Sonet protection switch occurs within 60ms
- Packet rings or meshs today rely on the routing protocols to converge when a failure occurs
  - This will often take minutes