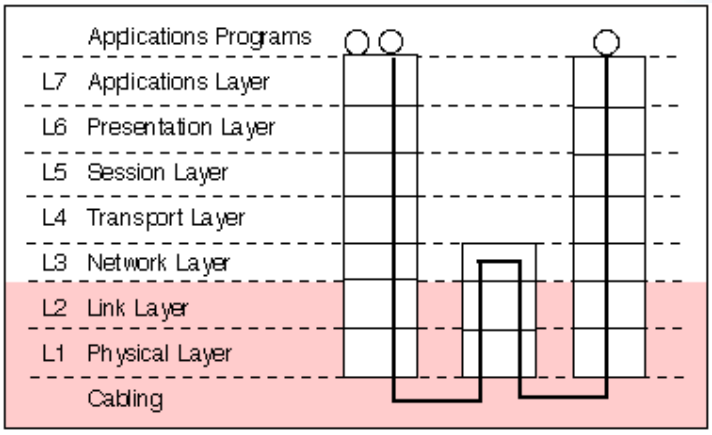
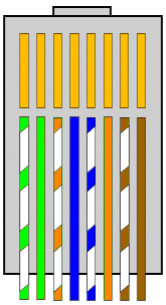
iReady®

IP over Ethernet – Michael Johnson

ISO Layers

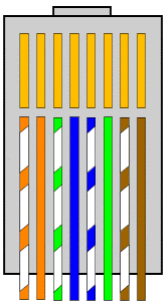


Layer 0 – Copper Cabling



Standard

- Cat3/Cat5 for 10Mbps Ethernet
- Cat5 for 100 and 1000Mbps Ethernet
- Standard to Standard end for regular cable.
- Standard to Crossover for Crossover cable.
- 1 Gigabit Ethernet auto configures cable.



Crossover

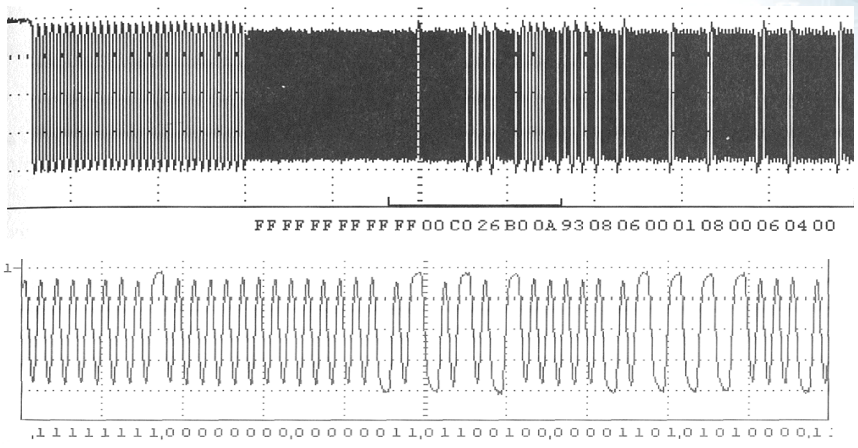
Layer 1 - Physical Layer

- The physical layer defines:
  - The electrical signaling
  - Symbols
  - line states
  - clocking requirements
  - encoding of the data
- Repeaters and Hubs work at this layer.

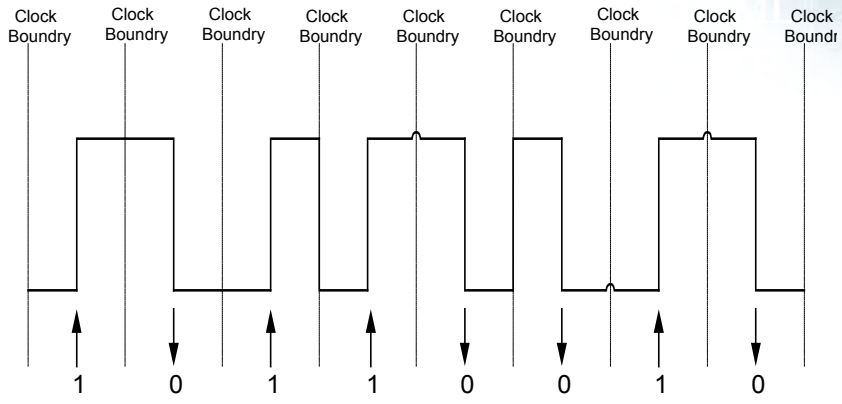
10Mbps Ethernet

- CSMA/CD
  - Carrier Sense
  - Wait for quite time of interframe gap (IFG)
  - Collision detection
  - JAM signal
  - Random Backoff
- 2 Pairs, 1 for Tx, 1 for Rx

Layer 1 - 10BT Ethernet Signaling



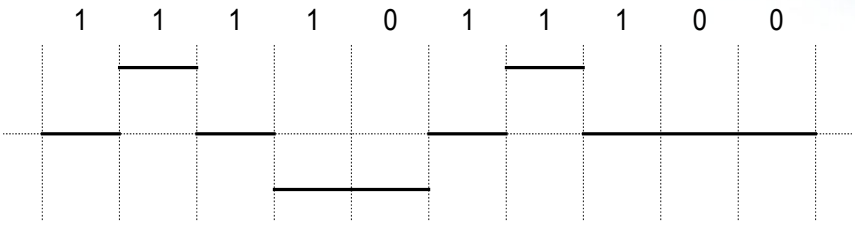
10Mbps Ethernet – Manchester Encoding



100Mbps Ethernet – Signaling

- CSMA/CD - Same as 10Mbps Ethernet.
- 4B5B instead of Manchester encoding.
  - 125Mhz Clock Requirement.
  - Replace every for bits of data with a 5 bit code.
- MLT-3 - Multiple Level Transition, 3 levels.
  - “Stop and Go” Sine Wave, 0 stop, 1 go
  - Reduces 125Mhz bit rate to 31.25Mhz by encoding 4 bits per cycle.

MLT-3 encoding

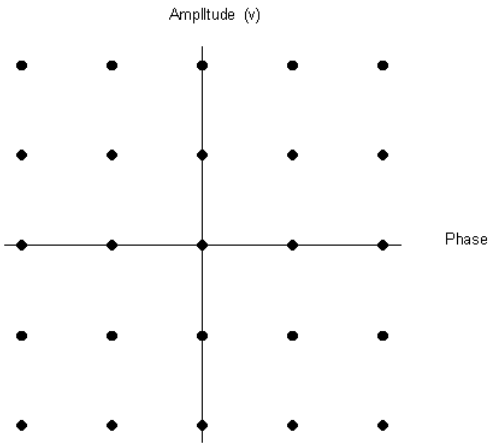


0x0E ->4B5B = 0->11110, E -> 11100

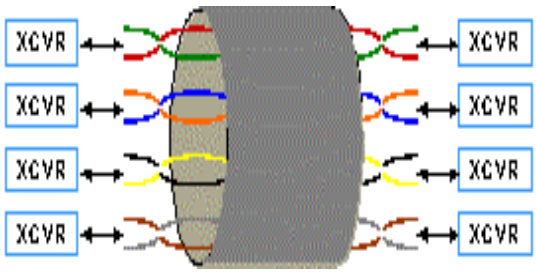
Gigabit Ethernet

- Gigabit Ethernet uses CSMA/CD protocol in half duplex only. There is little industry support.
- In full-duplex mode, frame-based flow control as defined in the IEEE 802.3x standard is used.
- PAM-5 - Pulse Amplitude Modulation 5 levels.
- 4 Copper pairs, 250Mbps full-duplex per pair.

PAM-5 - Pulse Amplitude Modulation 5 levels



Gigabit Ethernet 4 Pairs



250 Mbits/sec on each pair in each direction

2 bits/symbol -> 125 Msymbols/sec

Layer 2 - Link Layer

- Media Access Control (MAC)
  - Ensures reliable transfer across the link.
  - Synchronizes data transmissions.
  - Recognizes errors.
  - Controls the flow of data.
- DIX Format (DEC, Intel, Xerox)
- IEEE 802.3
- VLAN
- Switches/Bridges operate on the layer.

Link Layer Frames

Destination Address	Source Address	Length/ Type	Data/Pad	FCS
6	6	4	46-1500	4

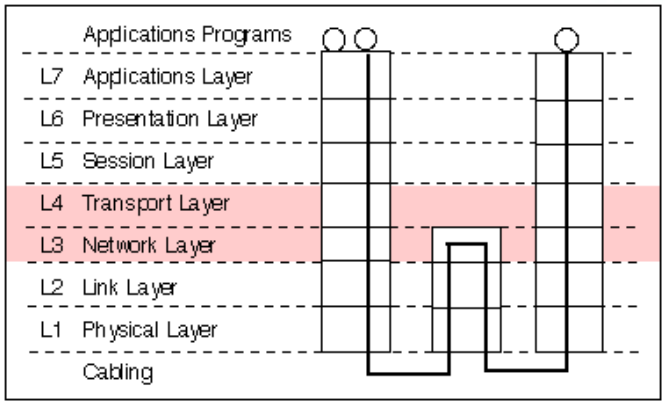
Inserted VLAN header

Destination Address	Source Address	VLAN type ID	Tag Control	Length/ Type	Data/Pad	FCS
6	6	2	2	4	46-1500	4

802.2 SNAP

Destination Address	Source Address	Length	DSAP	SSAP	Control	OUI	Proto Type	Data/Pad	FCS
6	6	4	1	1	1	1	2	46-1492	4

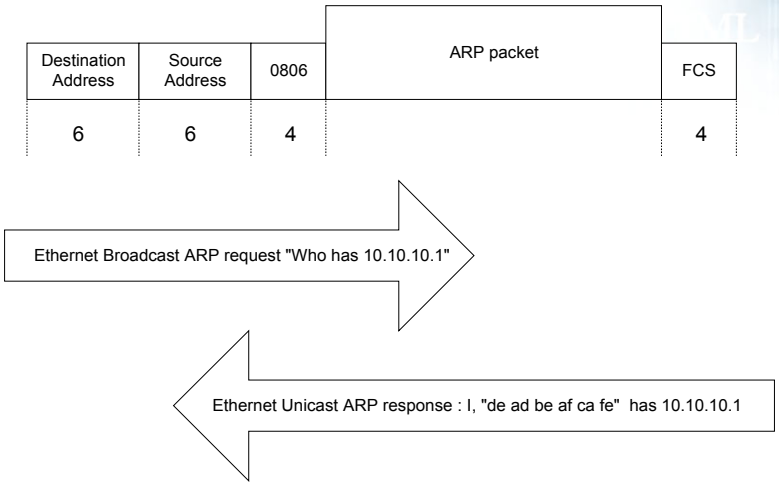
Moving above Ethernet



ARP - Address Resolution Protocol

- Link to Network Layer Glue
- Maps Ethernet Physical Addresses to IP addresses.
- ARP requests
- ARP replies
- ARP cache

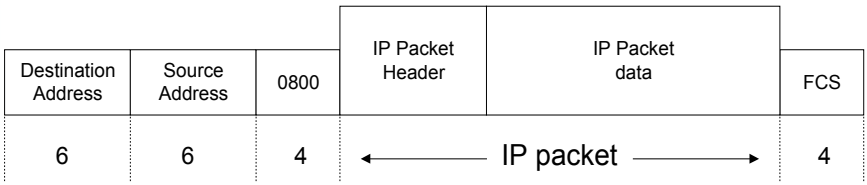
ARP request and response



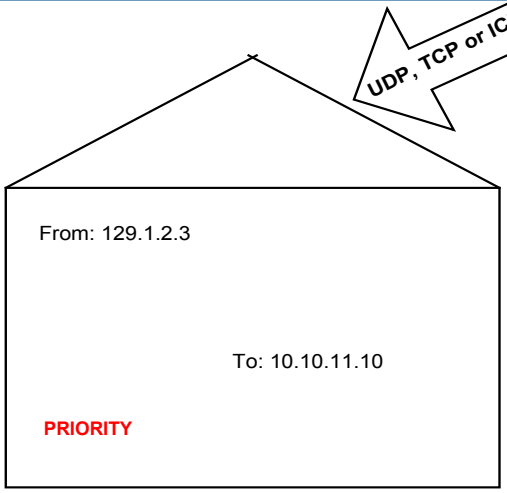
IP Protocol – Network Layer

- IP provides a an envelope for a data packet that describes the destination and source address.
- Identifies Transport layer.
- Allows Fragmentation and Re-assembly.
- Finite Network Life.
- Routers work at this layer.

IP Packet



IP example



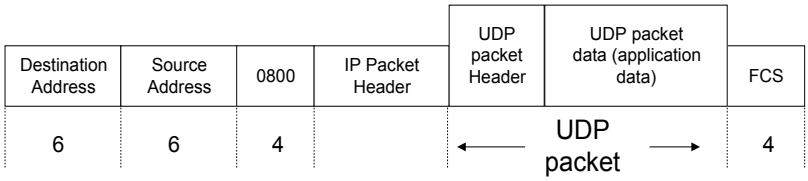
Transport Layer

- UDP - unreliable packet delivery
- TCP - reliable stream delivery
- ICMP - Control, Status and Error messages

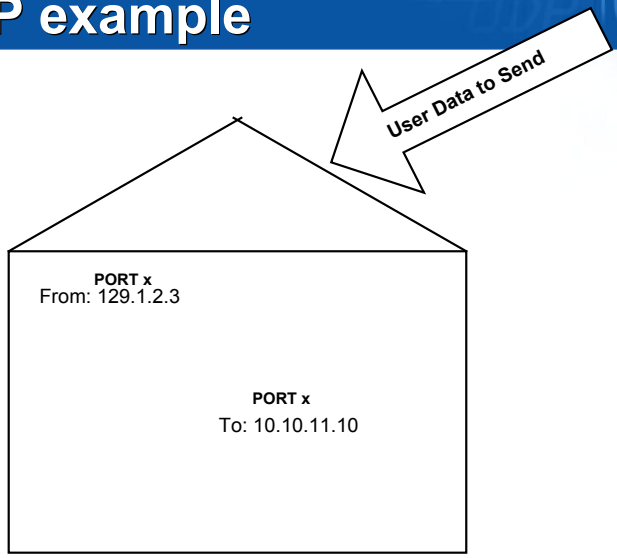
UDP - User Datagram Protocol

- Destination Port
- Source Port
- Length of data
- Optional Checksum

UDP - Packet



UDP example



TCP - Transmission Control Protocol

- I will present TCP next week as it is a whole presentation by itself.

Questions?