



TCP-IP
POP3
HTML
FTP
UDP
SMTP

IP over Ethernet – Michael Johnson

iReady Confidential

ISO Layers

The diagram illustrates the ISO 7-layer model. It consists of a grid with seven rows representing layers. The layers are labeled on the left: L7 Applications Layer, L6 Presentation Layer, L5 Session Layer, L4 Transport Layer, L3 Network Layer, L2 Link Layer, and L1 Physical Layer. Above the grid, 'Applications Programs' is written with two circles representing endpoints. A central box represents a network device, with lines connecting it to the endpoints. The L2 and L1 layers are highlighted in a light red color. Below the L1 layer, the word 'Cabling' is written.

Applications Programs

L7 Applications Layer

L6 Presentation Layer

L5 Session Layer

L4 Transport Layer

L3 Network Layer

L2 Link Layer

L1 Physical Layer

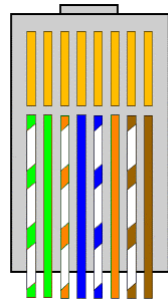
Cabling

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Slide 2

Layer 0 – Copper Cabling

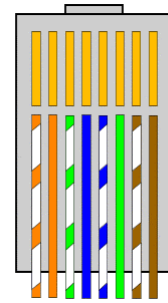
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Standard



- ❖ 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

Slide 3

Layer 1 - Physical Layer

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

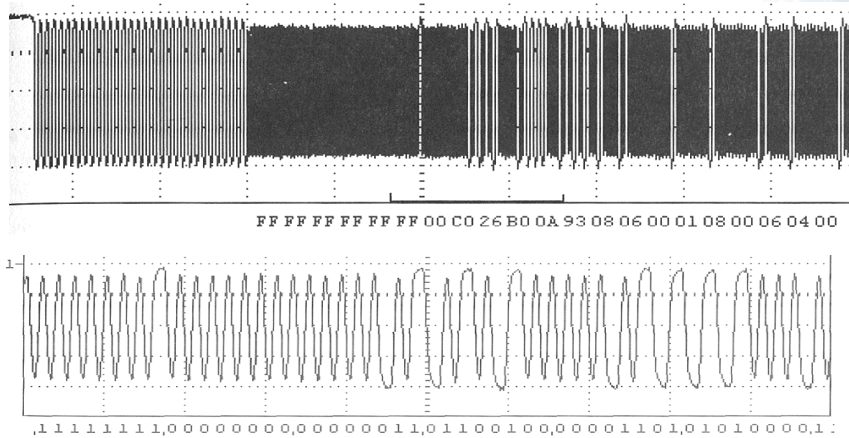
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10Mbps Ethernet

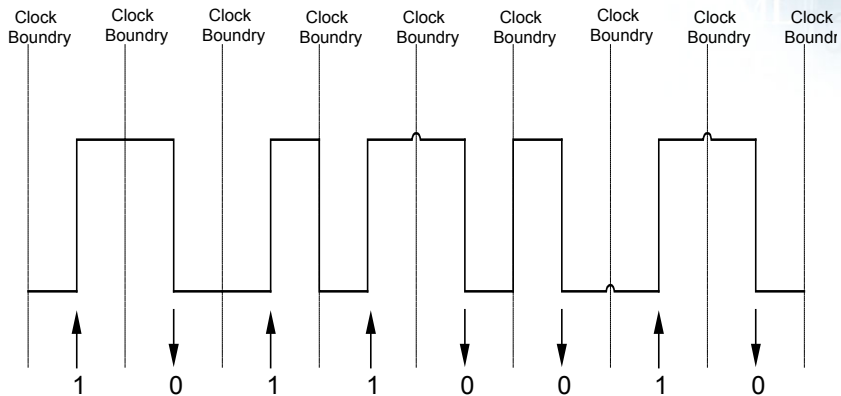


- ❖ CSMA/CD
 - Carrier Sense
 - Wait for quite time of interframe gap (IFG)
 - Collision detection
 - JAM signal
 - Random Backoff
- ❖ 2 Pairs, 1 for Tx, 1 for Rx

Layer 1 - 10BT Ethernet Signaling



10Mbps Ethernet – Manchester Encoding



Slide 7

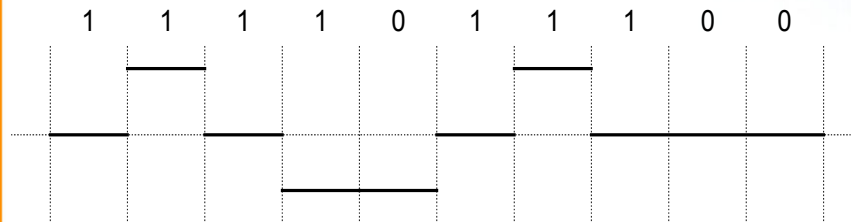
100Mbps Ethernet – Signaling



- ❖ 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.

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MLT-3 encoding



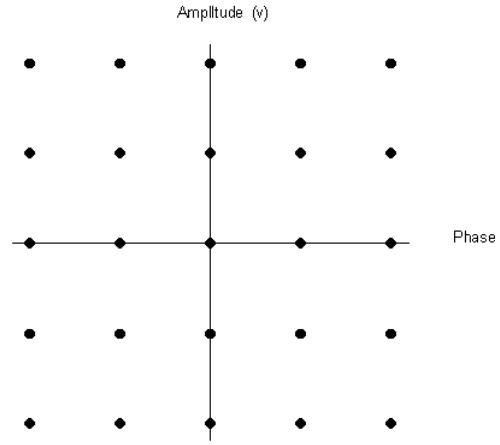
0x0E -> 4B5B = 0->11110, E -> 11100

Gigabit Ethernet

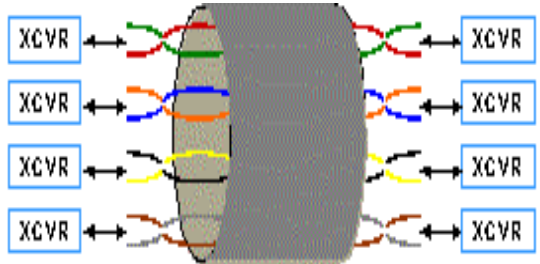


- ❖ Gigabit Ethernet uses CSMA/CD protocol in half duplex only. There is little industry support.
- ❖ In full-duplex mode, frame-based flow control as defined in the IEEE 802.3x standard is used.
- ❖ PAM-5 - Pulse Amplitude Modulation 5 levels.
- ❖ 4 Copper pairs, 250Mbps full-duplex per pair.

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

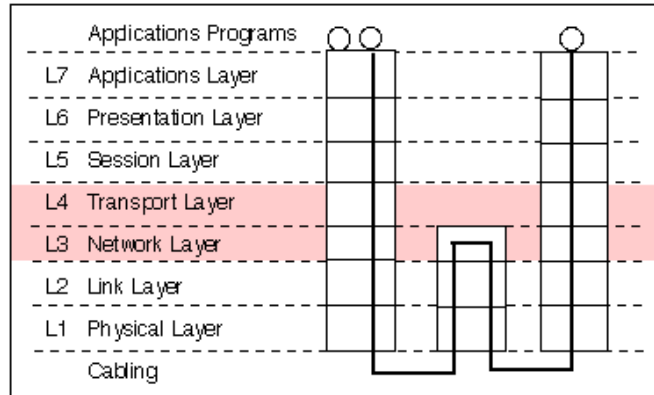
Destination Address	Source Address	VLAN type ID	Tag Control	Length/ Type	Data/Pad	FCS
6	6	2	2	4	46-1500	4

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

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ARP - Address Resolution Protocol

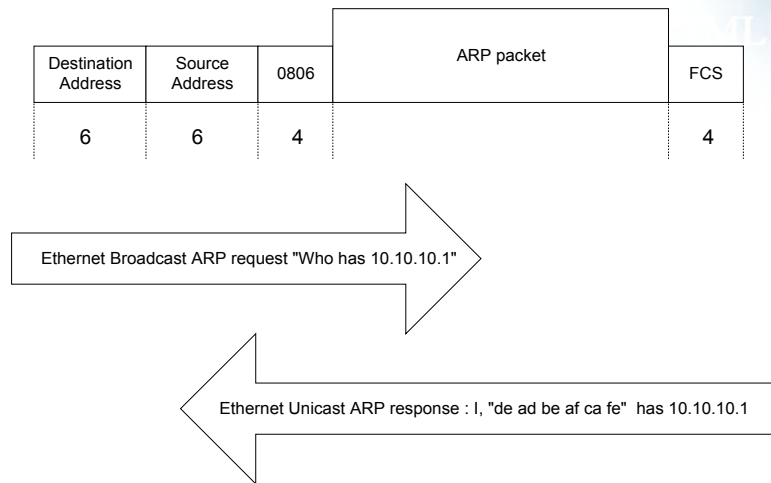
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- ❖ **Link to Network Layer Glue**
- ❖ **Maps Ethernet Physical Addresses to IP addresses.**
- ❖ **ARP requests**
- ❖ **ARP replies**
- ❖ **ARP cache**

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ARP request and response

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Slide 17

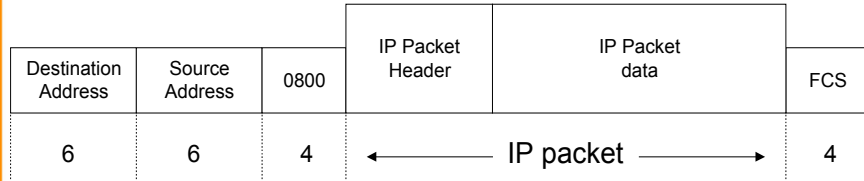
IP Protocol – Network Layer

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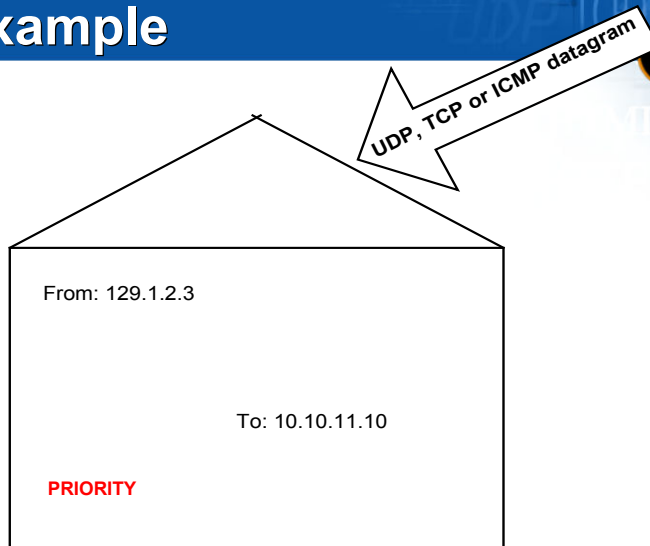
- ❖ IP provides a an envelope for a data packet that describes the destination and source address.
- ❖ Identifies Transport layer.
- ❖ Allows Fragmentation and Re-assembly.
- ❖ Finite Network Life.
- ❖ Routers work at this layer.

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IP Packet



IP example



Transport Layer



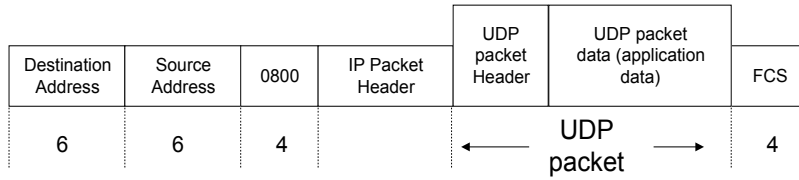
- ❖ **UDP - unreliable packet delivery**
- ❖ **TCP - reliable stream delivery**
- ❖ **ICMP - Control, Status and Error messages**

UDP - User Datagram Protocol

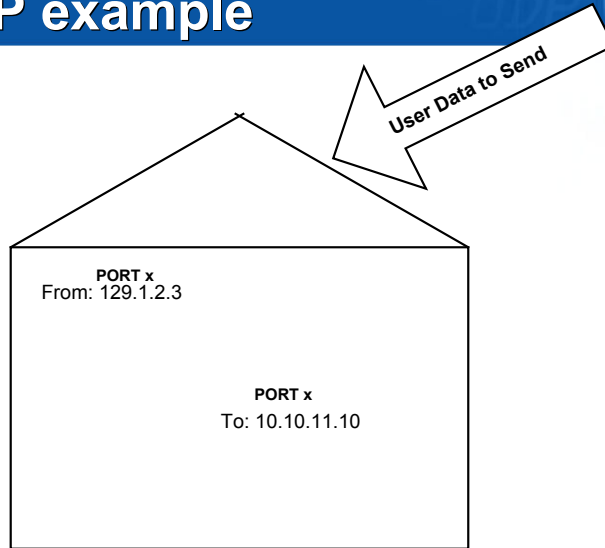


- ❖ **Destination Port**
- ❖ **Source Port**
- ❖ **Length of data**
- ❖ **Optional Checksum**

UDP - Packet



UDP example



TCP - Transmission Control Protocol



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

Questions?

