CSET 2200 Lecture 14 - Summary Day!

Physical Layer

- ▶ PDU: Bit
- ▶ Electrical or Optical implementation that carries data
- ▶ Ethernet, Token Ring, Wifi, Bluetooth, etc

Data Link Layer

- PDU: Frame
- Handles local communication

Ethernet

- Has pieces of Layer 1 and Layer 2
- 802.3 is the IEEE working group
- Primary LAN technology

Ethernet PHY

- Layer 1 piece of Ethernet
- Defines Electical Format
  - 10Base2 - Thin Coax
  - 10Base5 - Thick Coax
  - 10BaseT - Twisted Pair
  - 100BaseT - 100mbps
  - 1000BaseT, 10GBaseT, etc - all Twisted Pair
  - XBaseFX/LX/SX/ZX - Ethernet over Fiber

Ethernet Layer 1

- Broadcast Medium
- Every frame is seen by everyone
- Various devices such as switches limit this

CSMA/CD

- ▶ Carrier Sense Multi Access with Collision Detect
- ▶ Listen before you transmit
- ▶ When gap transmit and listen
- ▶ If garbage, back off random time and try again

Collision Domain

- ▶ Hosts that all receive broadcasts electrically
- ▶ Switches limit broadcast domain

Full vs Half Duplex

- With half one transmitter at a time
- With full both can - only 2 stations possible

Layer 2 - Ethernet

- PDU: Frame
- Address - 6 byte MAC address
- Format:
  - 6 Byte Dest Mac
  - 6 Byte Src Mac
  - Optional 4 byte tag
  - 2 Byte type (Or size then type)
  - Pay load

Devices

- ▶ Repeater extends reach
- ▶ Hub just connects multiple twisted pair - dumb and half duplex
- ▶ Bridge joins two collision domains
- ▶ Switch is a multi port bridge
    - ▶ Each port collision domain
    - ▶ Usually full duplex

Layer 3

- ▶ PDU is packet
- ▶ Address - 4 byte IP address
- ▶ Dotted quad
- ▶ Each network has a network and a mask
- ▶ Mask decides if address is local

ARP

- ▶ Used to Map layer 3 to Layer 2
- ▶ Sent to broadcast asking who has an IP
- ▶ Response is Unicast with answer

IPv4

- ▶ Connectionless
- ▶ Best effort
- ▶ Addresses allocated by IANA

Classes

- A = 0-127 (128 networks, 2ˆ24 hosts)
- B = 128-191 (16384 netwirks, 2ˆ16 hosts)
- C = 193-223 (2ˆ21 networks, 256 hosts)
- D = 224-239 (Multicast)
- E = 240-255 (Experimental)
- Can be combined or split if classless

RFC1918 Space

- Private use
- 10.0.0.0/8
- 172.16.0.0/12
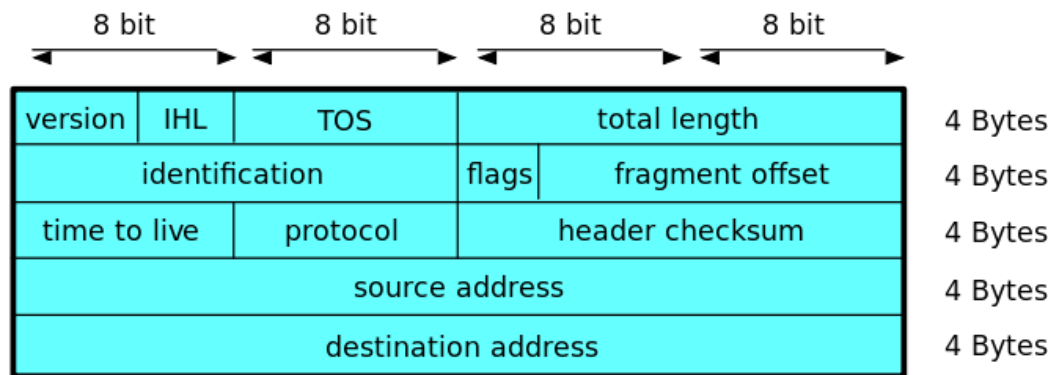- 192.168.0.0/16

IPV4 Header

Figure 1: IPV4 Header

Subnets

- ▶ Written as dotted quad or CIDR mask
- ▶ 1 is care bit or network address
- ▶ 0 is host addresses
- ▶ Binary AND to determine if local

CIDR

- Classless Inter-Domain Routing
- Uses VLSM
  - Variable Length Subnet Mask

VLSM

- Split network and host at any boundary
- We can combine adjacent networks or split big ones
- Use Tree method to split networks if needed

Layer 4

- TCP
- UDP
- ICMP

TCP

- Transport Control Protocol
- PDU: Segment
- Connection Oriented
- Stream Oriented
- Reliable
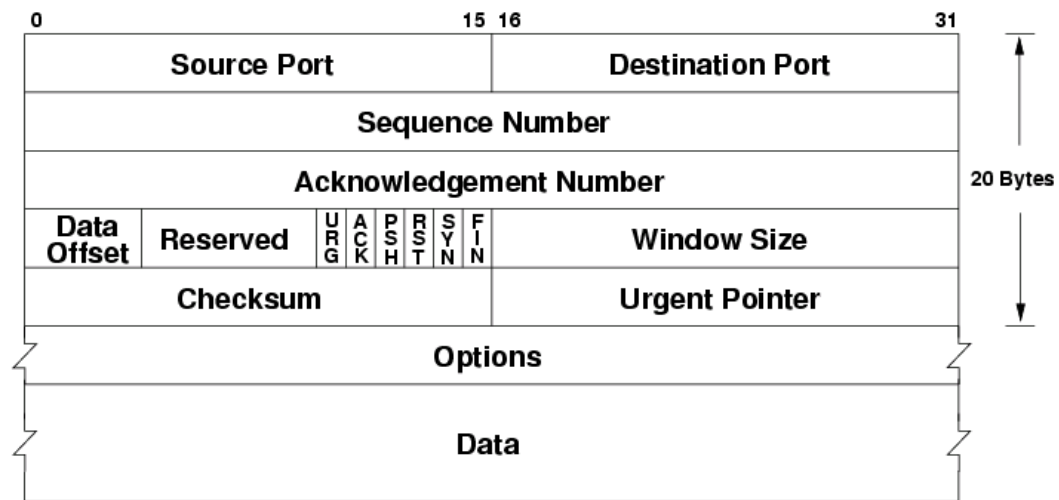 - In Order Deliery
  - Error Handling

TCP Header

Figure 2: TCP Header

TCP connections

- ▶ 3 way handshake to connect
- ▶ 4 way handshake to disconnect
- ▶ Each packet gets ACK
- ▶ Scaling controls ACK with no reply

UDP

- ▶ PDU: Datagram
- ▶ User Datagram Protocol
- ▶ Connectionless
- ▶ Unreliable
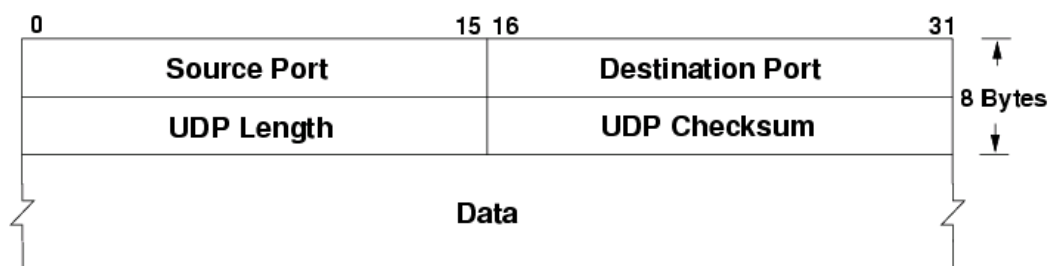- ▶ Used by services that need low latency

UDP Header

Figure 3: UDP Header

ICMP

- ▶ Intenret Control Message Protocol
- ▶ Error handling
- ▶ Also used for Ping/Traceroute

ICNP Header

ICMP Header Format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Type								Code								Checksum															
4	32	Rest of Header																															

Figure 4: ICMP Header

Layer 5 - Session

- ▶ Not much to talk about
- ▶ Handles Persistence
- ▶ Not present in TCP/IP Model

Layer 6 - Presentation

- ▶ Again boring
- ▶ Handles data conversion
- ▶ Also not in TCP/IP Model

Layer 7 - Application

- What we care about if not network people
- Carries user data
- Many Protocols

BOOTP

- Used to get IP address from ARP
- Opposite of ARP kinda
- Static mappings
- Simple request/reply

DHCP

- Extends BOOTP to add dynamic pools
- Supports passing other options
  - Discover
  - Offer
  - Request
  - Acknowledge

DNS

- Domain name system
- Maps hosts to IP and vice versa
- Many hosts to one IP
- One IP to one hostname
- Hierachal - also a tree

DNS (contd)

- A record = Answer - Hostname
- NS Record = Name Server - Delegation
- CNAME Record = Alias
- PTR record = Pointer - Reverse

Internetworks

- Link many local networks
- Internet large example
- Changing as time goes on

Router

- Links multiple layer 2 networks
- Moves packets at layer 3

Route table

- Contains destination network
- Mask
- Next Hop IP
- Metric

Routing

- ▶ Most specific match wins
- ▶ On tie metric breaks it
- ▶ Metric varies by protocol
- ▶ Default Gateway (0.0.0.0/0) = Where packets go if not known

Questions

Next Session

- Review game/session
  - Lucas will have exam so will likely give good review
- Exam 2 weeks from today