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* ARP
  + Hardware type
  + Protocol type
  + Hardware length
  + Protocol length
  + Operation
  + Sender Physical
  + Sender Logical
  + Target Physical
  + Target Logical
* ICMP
  + Internet control message protocol
  + Fills in all the holes of our ip protocol
  + HOW USED IN TRACEROUTE AND PING
  + 8 bytes
  + Type - 1 byte
  + Code - 1 byte
  + Checksum - 2 bytes
  + Rest - 4 bytes
* Error
  + Destination Unreachable
  + Parameter Problem
  + Source Quench
  + Timer Exceeded
  + Redirection
* Query
  + Echo request/Response
  + Timestamp requested response
* Round Trip Time
  + st - 35
  + rt - 41
  + sbt - 43
  + ft - 47
  + rtt = rt - st + ft - sbt
    - 41-35 + 47-43
      * 6 + 4
        + 10
* UDP
  + Transport Layer protocol
  + Anytime we have a single short message with a single short response
    - Good fit for UDP
  + Built in AWK with how it works
  + 8 bytes
  + source port 2 bytes
  + dest port 2 bytes
  + length 2 bytes
  + checksum 2 bytes
    - optional, but will always have 0’s
* TCP
  + 20-60 bytes
  + Source port - 2 bytes
  + Destination port - 2 bytes
  + Sequence Number
  + Acknowledge Number
  + Header length - 4 bits (4 byte increments)
  + Flags - 6 bits
    - SYN
      * Where we are starting our sequence number
    - SYN + ACK
      * Sent from receivers
    - ACK
      * Which byte we are expecting next
    - FIN
      * Close a connection
        + Either side can send it first
      * Half-open half-closed
    - RST
      * Refuse a connection
    - URG
      * Urgent pointer
      * Marks different data
    - PSH
      * Sends immediately
      * PSH is optional
      * It may or may not work
  + Window size
  + Checksum
  + Urgent Pointer
* 4 Theoretical Protocols
  + Simple Protocol (UDP)
    - Just send the data
    - Nothing with awk or window size
  + Stop - n - wait (UDP could work in a simple situation with our own awk)
    - Send window size 1. Receive window size 1.
    - Each time we sent, before we sent another, we had to stop and wait for the awk that said the package had been received
  + Go-back-N (TCP)
    - s = 2^n -1
    - n = size of sequence number
  + Selective Repeat (TCP)
    - Send window of 2 ^ (n-1)
    - r = 2^(n-1)
    - n is the size of sequence
* ATMARP
  + Why?
    - ATM does not support broadcasting.
      * Broadcasting is important to ARP because it sends the broadcast out to see where everyone is.
  + Servers simulate broadcast
* RIP OSPF BGP
  + Routing Protocols
    - Build our routing tables dynamically
  + RIP and OSPF
    - Intradomain
  + BGP
    - Interdomain
  + RIP
    - Count to infinity
      * Redefine Infinity
      * Infinity = 16
      * Split Horizon
        + Leave out info in the routing table
      * Reverse position
        + Include the info, but set the distance to infinity.
* Port Numbers
  + What they are
  + Addresses for transport layer
  + How to identify the process of receiving or sending
  + 0-65535
  + 0-1024
    - Well - Known
    - Treated Special
    - If you want to use this, you need special permissions
  + 1024-49151
    - Registered
  + 49152-65535
    - Dynamic/private
    - Potentially an Ephemeral port
* Time Difference
  + Receive timestamp - (original timestamp + one way duration )
* SCTP
  + Message oriented
  + Reliable
  + Connection - oriented
* TCP Timer
  + Retransmission Timeout (RTT)
    - RTT\_SA
    - RTT\_SD
    - RTT\_M
    - RTO
  + Keep Alive Timer
    - When we want to know if the connection has died or not
  + Time Wait
    - How long we wait before closing the connection
  + Persistence Timer - RWND = 0
* Silly Window Syndrome
* TCP Properties
  + Connection - oriented
  + Reliable
  + Byte-oriented
  + Stream-oriented
  + Flow Control
    - Rwnd
  + Error Control
    - Checksum
    - Ack and Retransmission
  + Congestion control
    - CWND = 1 max size
* IGMP
  + Under our multicast header
  + Used as part of multicasting
  + Internet group management protocol