I. Internet Control Message Protocol (ICMP)

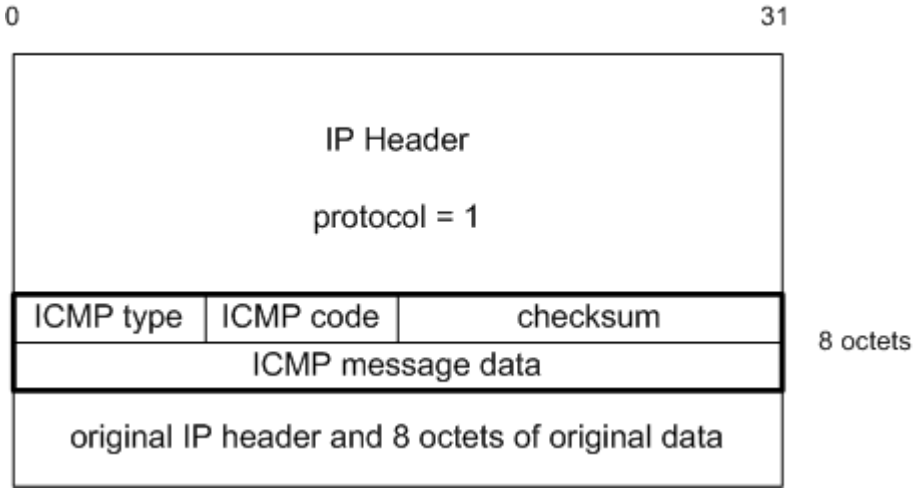
Week 11

- described in RFC 792
- helper protocol for IP, but more like a 3 ½ layer protocol (like ARP as a 2 ½ layer protocol)
- since a helper protocol for IP, uses IP datagrams to deliver ICMP packets
- any IP device can send/receive ICMP packets (i.e. nodes & routers)
- provides a mechanism for IP devices to exchange information about network problems
- purpose of ICMP control messages is to provide feedback about problems in the communication environment, not to make IP reliable
- even though IP is an ? (unreliable) protocol, it is valuable to know about **semi-permanent** errors

General ICMP types:

1. Network errors
    - network unreachable/unknown
    - host unreachable/unknown
    - protocol unreachable/unknown
    - port unreachable/unknown
2. Network congestion
    - *source quench* – sender sending too fast, message to slow down
3. Time exceeded
    - TTL becomes zero (see TraceRoute)
4. Network queries
    - echo request/reply (see ping)

General ICMP PDU format:



- why original header and 8 octets? (see pg. 197 & 204)
- some (not all) sample type values (see pg 196)

ICMP Type	Description	Family
0	echo reply	query
3	destination unreachable	error
4	source quench	error
8	echo request	query
9	router advertisement	query
11	time exceeded	error

- some (not all) sample code values for type 3 (see pg 206)

ICMP Code	Description
0	network unreachable
1	host unreachable
2	protocol unreachable
3	port unreachable
4	frag required but DF bit set
5	source route failed

- note that all ICMP type packets do not have all parts following the checksum, or some parts may be unused, or some parts may be subdivided, e.g.

  - echo request/reply packets **do not have** original IP header data
  - the echo request/reply message field is subdivided into an ID field and a sequence # field (ID field does not change but the seq # does for a single ping session)

II. Introduction to the Transport Layer

In general the transport layer is:

- layer 4 protocol (in TCP/IP model)
- connection oriented & reliable
- a provider of error detection / correction
- recall PDU called segments (aka TPDU)

- transport layer provides logical connection between end nodes application processes (where layer 3 provided connections between nodes)

- application identification based upon **ports,** numeric IDs which identify the sending/receiving application

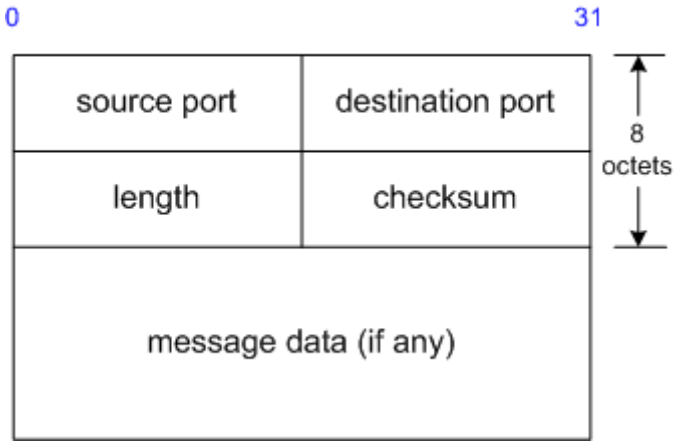
Name	Range	Description
well-known*	0-1023	basic core services
registered*	1024-49151	registered industry applications
dynamic or ephemeral	49152-65535	temporary ports

*well known or registered ports usually on server side, e.g. DNS:53, WWW:80, IM: 5190 – see **/etc/services**

- 2 main protocols
  - TCP – transport control protocol (IP protocol = 6)
  - UDP – user datagram protocol (IP protocol = 17)

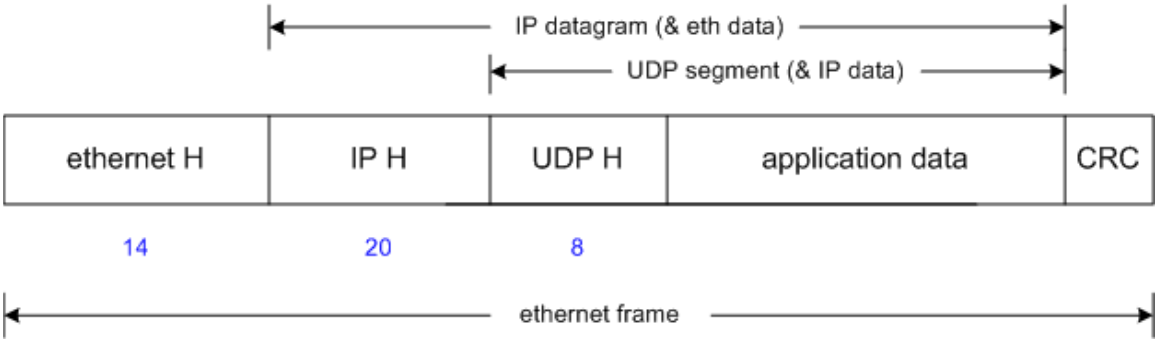
III. User Datagram Protocol (UDP)

- defined in RFC 768
- UDP provides none of the reliability (or connection) associated with the transport layer – so why use it?
  - offers low overhead and high performance
  - many applications cannot use TCP, e.g. streaming audio & video where error correction is a liability
  - most networking technologies today are fairly reliable, so an unreliable protocol is still fairly reliable
  - if errors do occur, these are most likely caught at the application layer
- UDP PDU – 8 octets (typically), pg 258



  - **source port**: identifies points at which upper-layer source processes send the UDP data
  - **destination port**: identifies points at which upper-layer destination processes receive the UDP data
  - **length**: length (in bytes) of the entire UDP message, including header & data
  - **checksum**: error check of entire message, including the header & data (recall IP only checksums its header)

- checksum also includes a “pseudo-header” which includes source & destination IP addresses, protocol id (UDP = 17) and the size of the UDP PDU
- optional for UDP (why?), required for TCP



- see /etc/services (on linux)
- search for etc on Win XP
- see http://www.iana.org/assignments/port-numbers