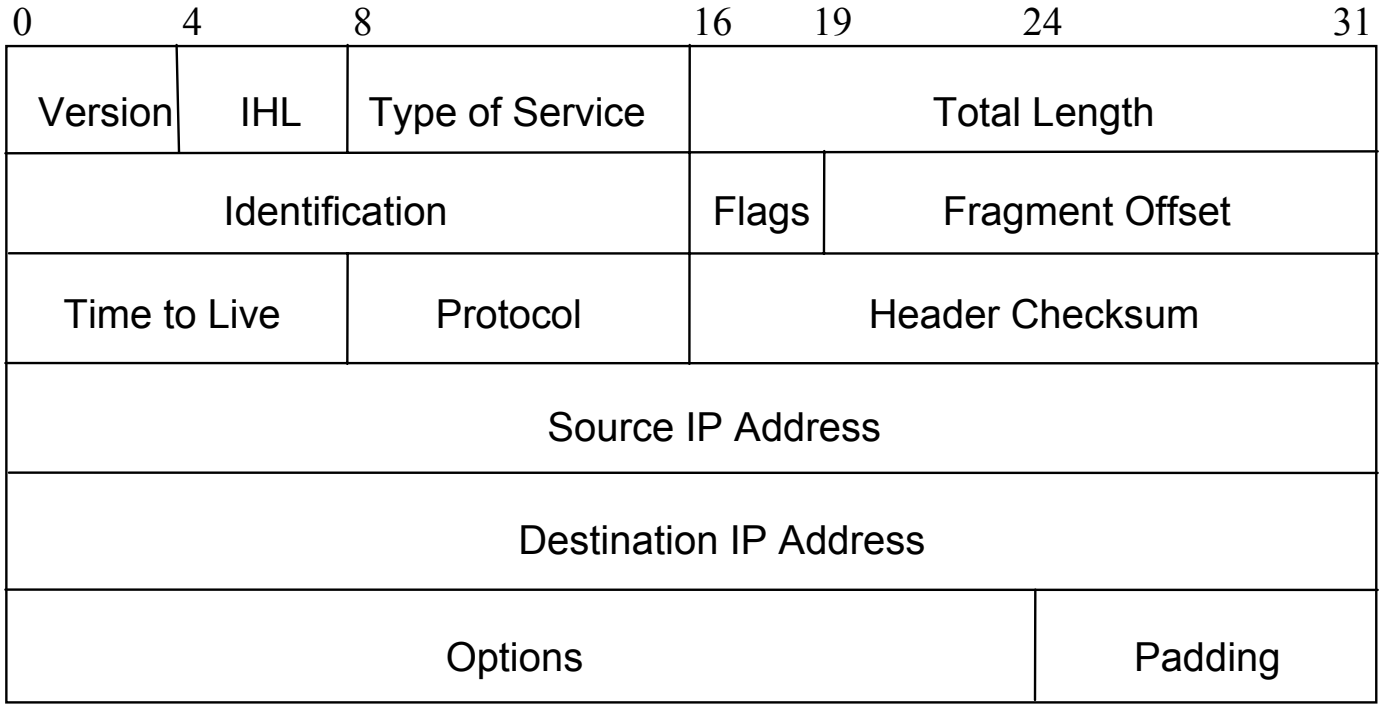
IP Packet Header



Protocol: specifies upper-layer protocol that is to receive IP data at the destination. Examples include TCP (protocol = 6), UDP (protocol = 17), and ICMP (protocol = 1).

Header checksum: verifies the integrity of the IP header.

Source IP address and **destination IP address:** contain the addresses of the source and destination hosts.

ICMP: Internet Control Message Protocol

- IP and ICMP can not be separated
- network-layer protocol:
  - ICMP msgs carried in IP datagrams
- ICMP message: type, code plus first 8 bytes of IP datagram causing error
- used by hosts, routers, gateways to communication network-level information
  - Error reporting: unreachable host, network, port, protocol
  - Query: echo request/reply (used by ping)

(Error reporting messages)

Type	Code	description
0	0	echo reply (ping)
3	0	dest. network unreachable
3	1	dest host unreachable
3	2	dest protocol unreachable
3	3	dest port unreachable
3	6	dest network unknown
3	7	dest host unknown
4	0	source quench (congestion control - not used)

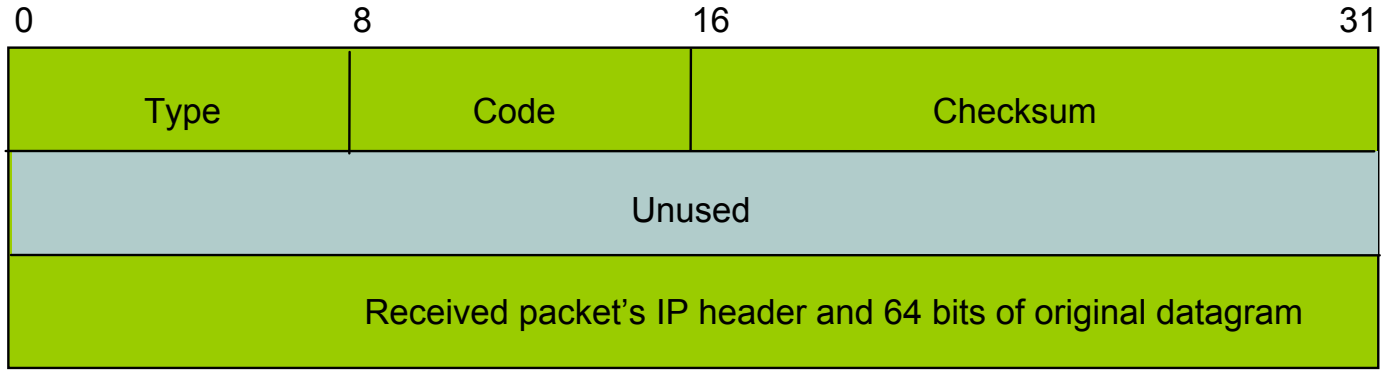
(Query messages)

8	0	echo request (ping)
9	0	route advertisement
10	0	router discovery
11	0	TTL expired
12	0	bad IP header

Internet Control Message Protocol (ICMP)

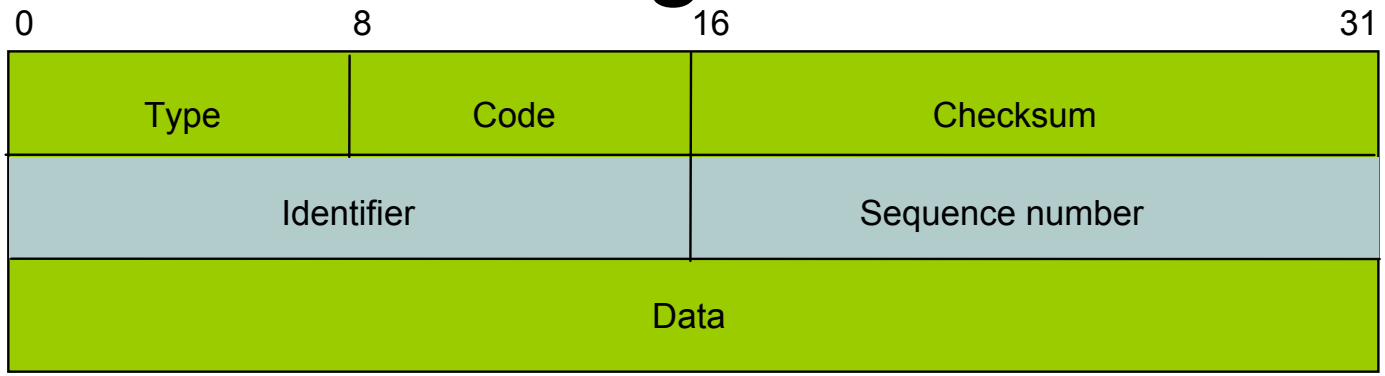
- RFC 792; Encapsulated in IP packet (protocl type = 1)
- Handles error and control messages
- If router cannot deliver or forward a packet, it sends an ICMP “host unreachable” message to the source
- If router receives packet that should have been sent to another router, it sends an ICMP “redirect” message to the sender; Sender modifies its routing table
- ICMP “router discovery” messages allow host to learn about routers in its network and to initialize and update its routing tables

ICMP Basic Error Message Format



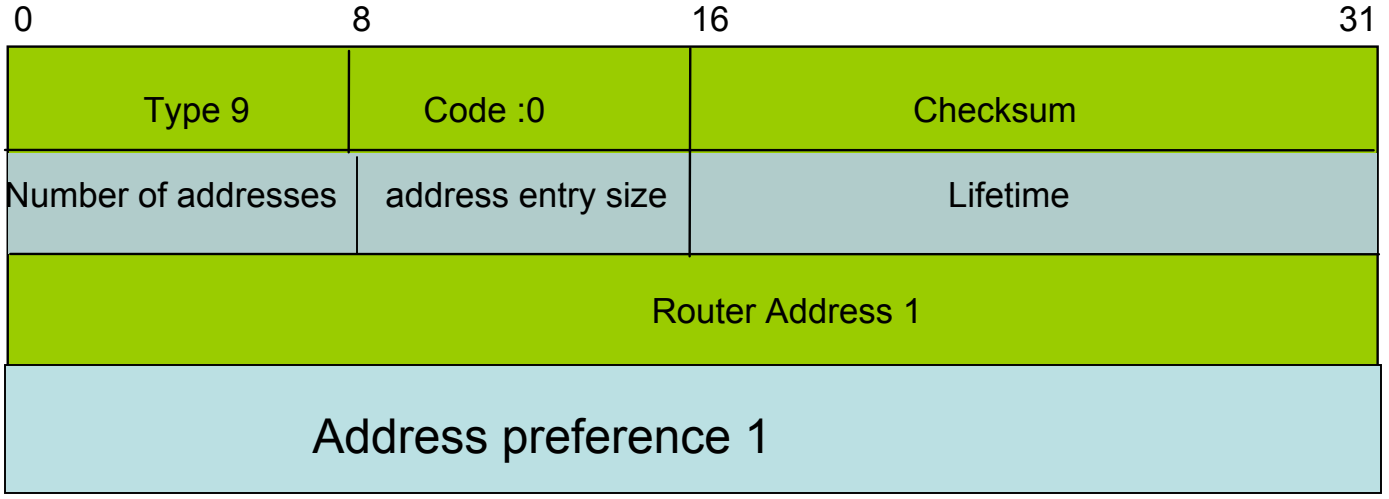
- IP header & 64 bits of original datagram
  - To match ICMP message with original data in IP packet

Echo Request & Echo Reply Message Format



- Echo request: type=8; Echo reply: type=0
  - Destination replies with echo reply by copying data in request onto reply message
- Sequence number to match reply to request
- ID to distinguish between different sessions using echo services
- Used in PING

Router solicitation and Advertisement (used by mobile IP)



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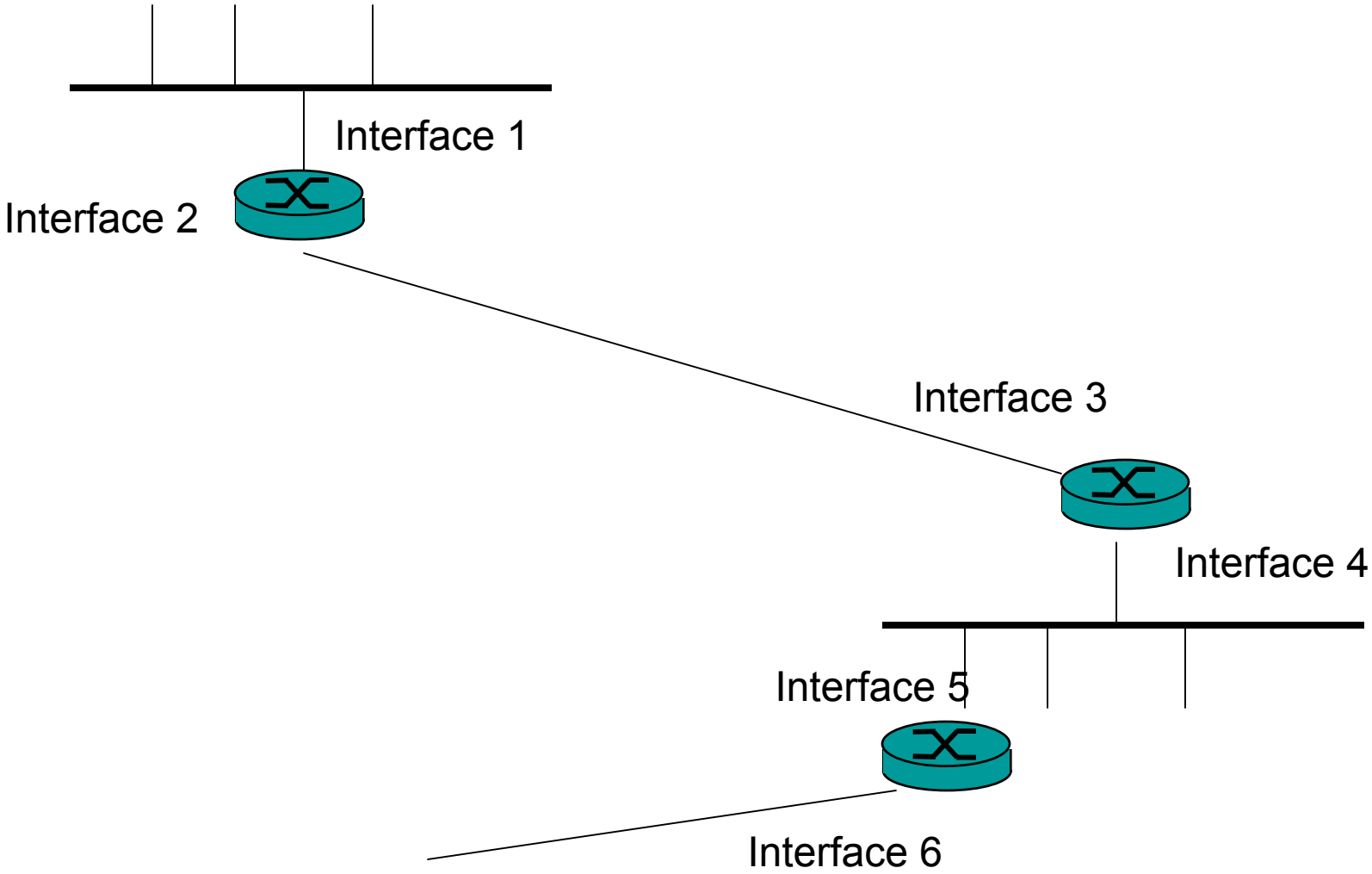
Traceroute

- When a packet dies, most routers return a notice using one of their interface addresses. Traceroute records these addresses

- Traceroute can be used to find the topology of a network

- For the Internet, this is done by randomly selecting (source, destination) pair from the prefixes stored in the BGP routing table.


Interface 1
Interface 2
Interface 3
Interface 4
Interface 5
Interface 6