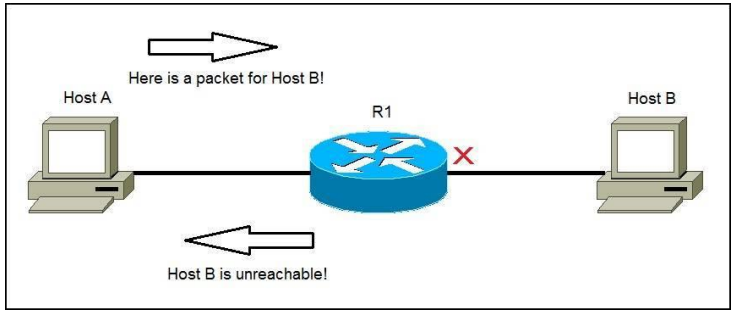

Computer Networks II

Internet Control Message Protocol (ICMP)

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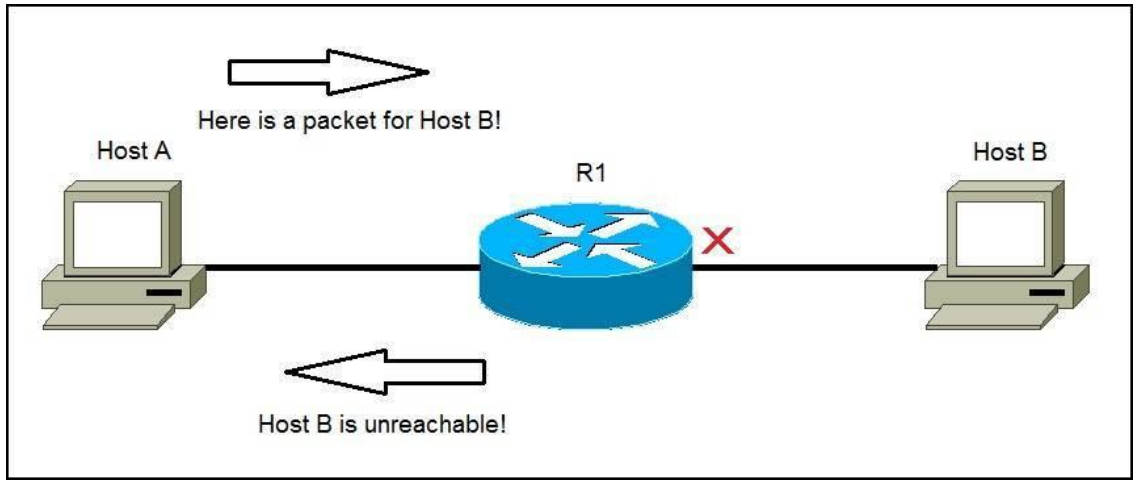
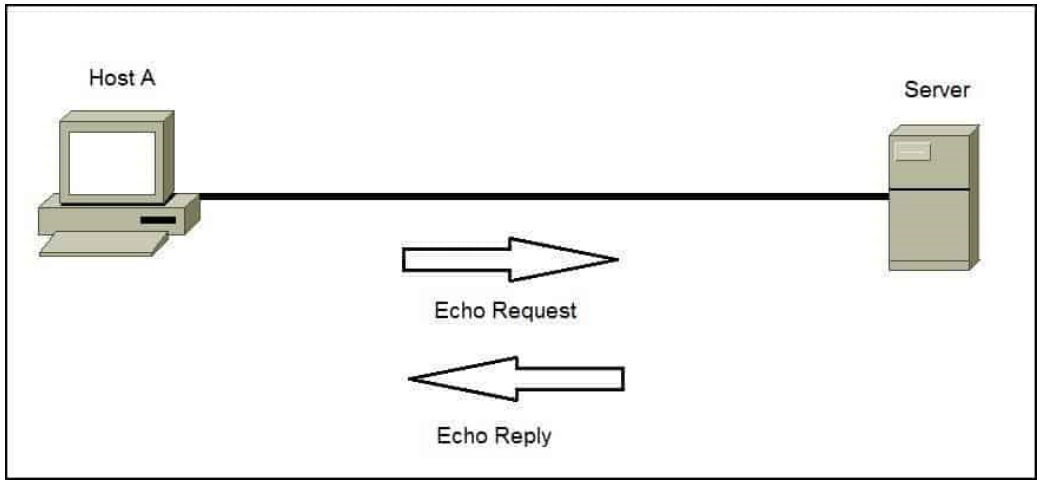
ICMP: Internet Control Message Protocol

- Used by hosts and routers to communicate network-level information
  - Error reporting: unreachable host, network, port, protocol
  - Diagnostic purposes: echo request/reply (used by ping)





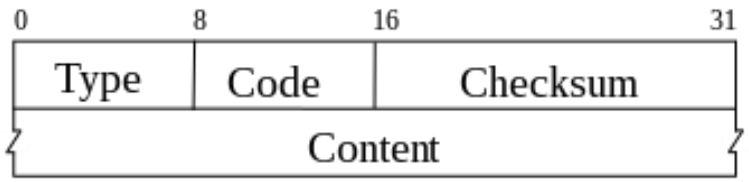
Src: https://study-ccna.com/icmp-internet-control-message-protocol/

Functionality:

Error Reporting: ICMP is utilized to report errors encountered during packet transmission, such as unreachable hosts, networks, ports, or protocols. This helps in diagnosing and troubleshooting network issues.
Diagnostic Purposes: ICMP facilitates diagnostic tasks like the echo request/reply mechanism, commonly used in tools like Ping. This allows for verifying connectivity between devices and measuring network latency.

ICMP: Internet Control Message Protocol

- ICMP message: Type, code, checksum
  - In case of error message it also contains the IP header + first 8 bytes of IP datagram causing error
    - Sender of the IP datagram can infer the problem

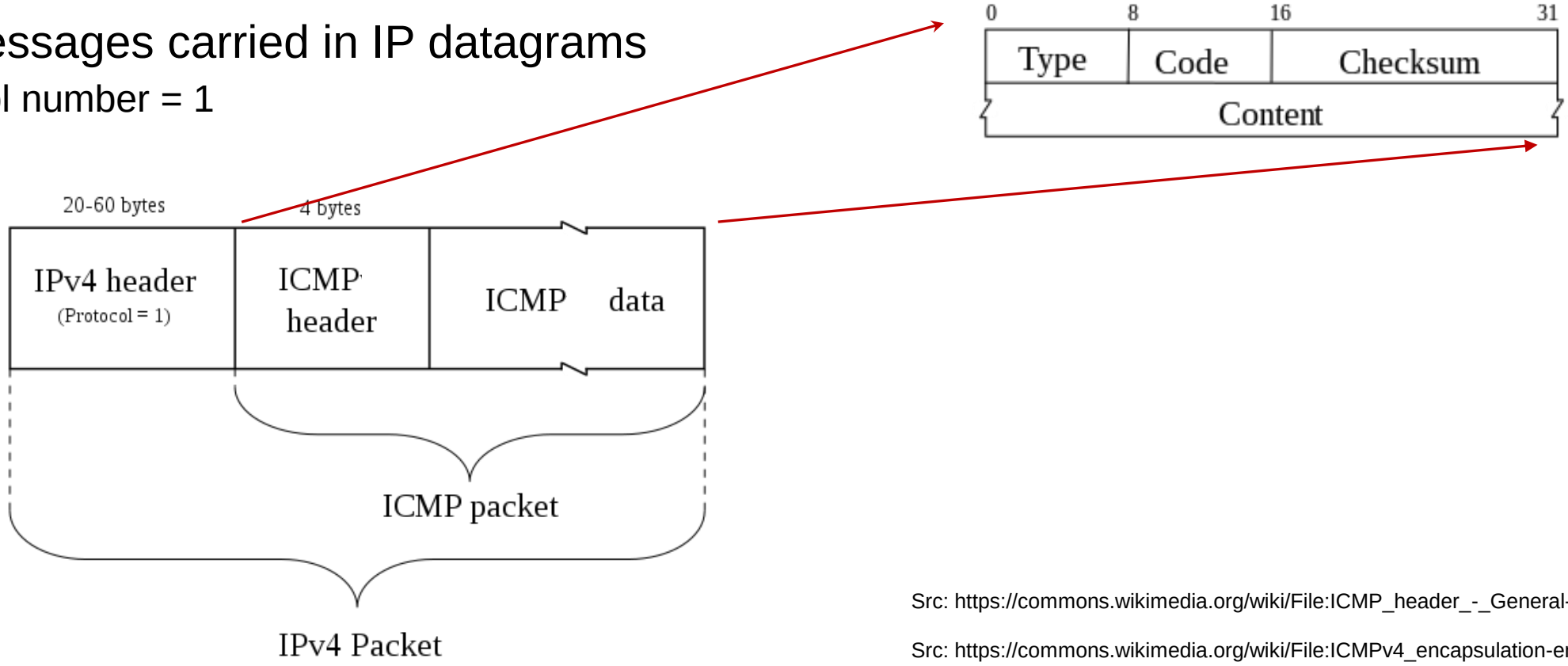


Src: https://commons.wikimedia.org/wiki/File:ICMP_header_-_General-en.svg

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	4	fragmentation required, DF set
3	6	dest network unknown
3	7	dest host unknown
4	0	source quench (congestion control - not used)
8	0	echo request (ping)
9	0	route advertisement
10	0	router discovery
11	0	TTL expired
12	0	bad IP header

ICMP: Internet Control Message Protocol

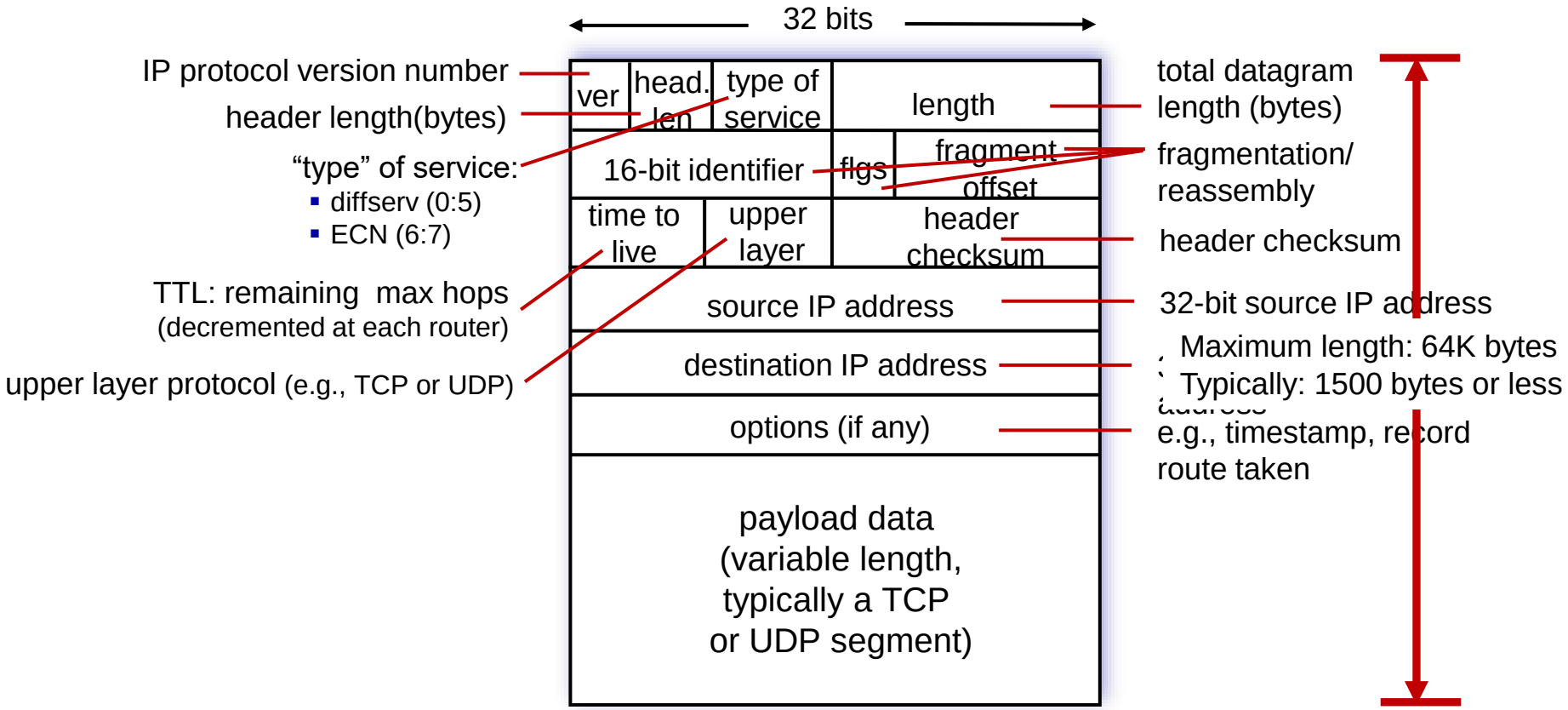
- ICMP messages carried in IP datagrams
  - Protocol number = 1



Src: https://commons.wikimedia.org/wiki/File:ICMP_header_-_General-en.svg

Src: https://commons.wikimedia.org/wiki/File:ICMPv4_encapsulation-en.svg

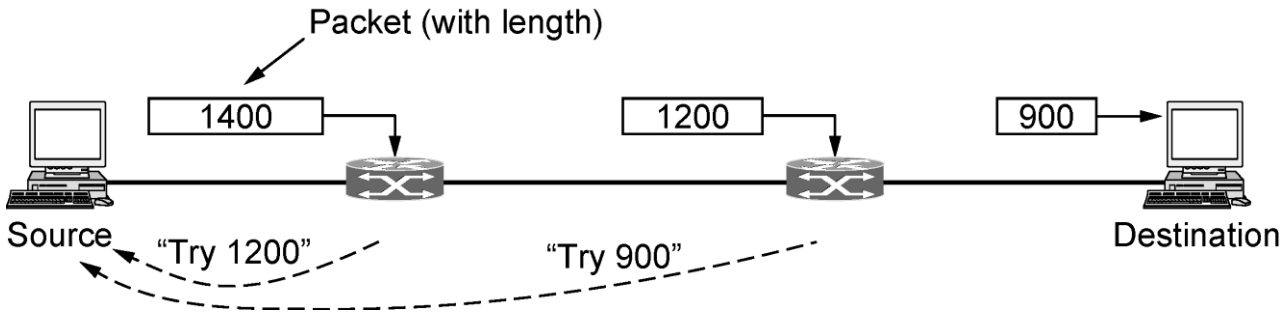
IP Datagram Format

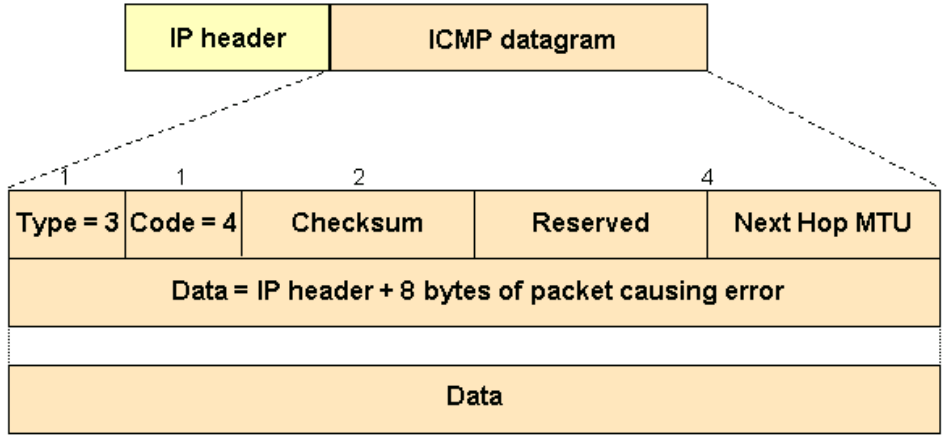


MTU Discovery and ICMP

Fragmentation is often undesirable

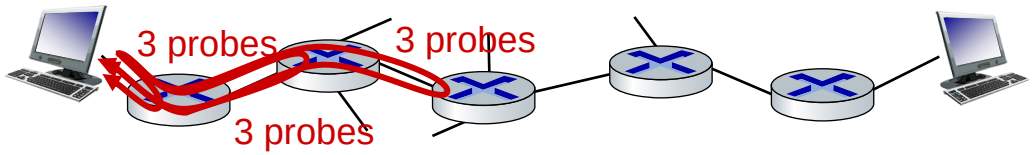
- More overhead for the routers
- Solution: discover the MTU that will fit for all the links
  - Implemented using ICMP (type 3, code 4) → DF bit is set to 1





Src: https://www.cisco.com/c/en/us/support/docs/ip/generic-routing-encapsulation-gre/25885-pmtud-ipfrag.html

Traceroute and ICMP



- Source sends sets of UDP segments to destination
  - 1st set has TTL =1, 2nd set has TTL=2, etc.
  - Destination port is set to an unlikely number
- Datagram in n-th set arrives to n-th router:
  - Router discards datagram and sends source ICMP message (type 11, code 0)
  - ICMP message possibly includes name of router & IP address
- When ICMP message arrives at source: record RTTs

Stopping criteria:

- UDP segment eventually arrives at destination host
- Destination returns ICMP "port unreachable" message (type 3, code 3)
- Source stops

Summary

- Internet Control Message Protocol:
  - ICMP message format
  - MTU discovery and ICMP
  - Traceroute and ICMP