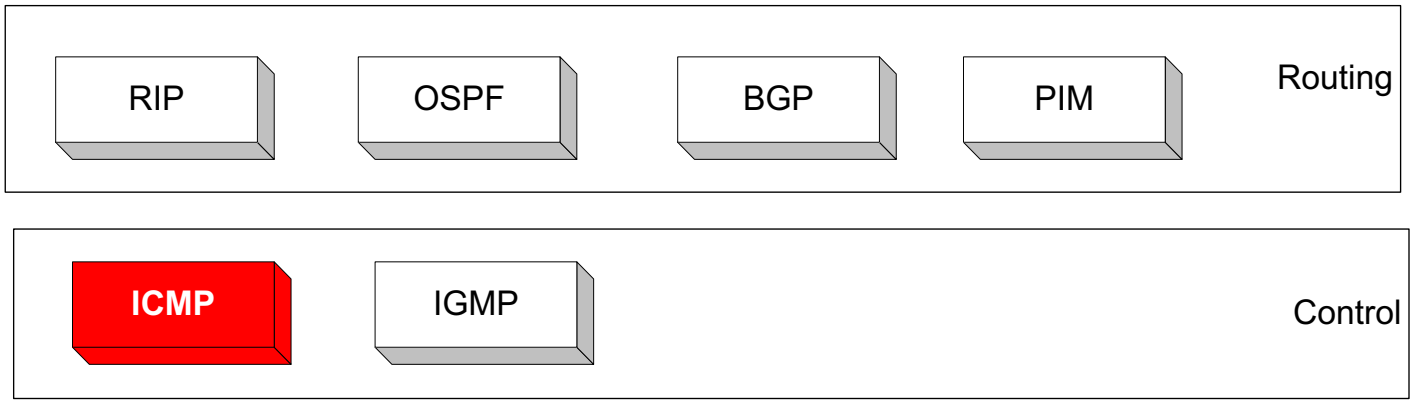
Internet Control Message Protocol (ICMP)

A short module on the Internet Control Message Protocol (ICMP).

Overview

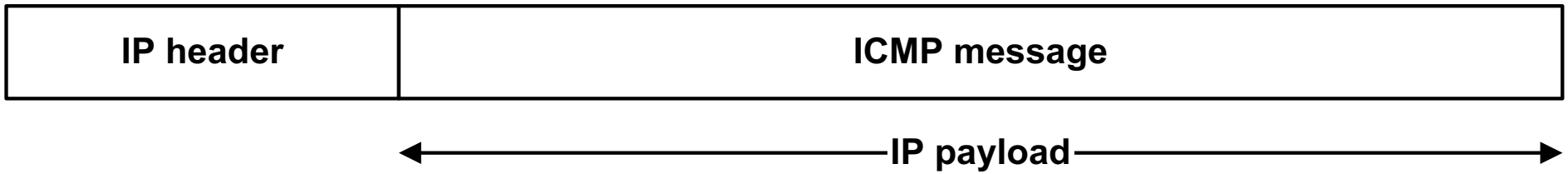
- The IP (Internet Protocol) relies on several other protocols to perform necessary control and routing functions:
  - Control functions (ICMP)
  - Multicast signaling (IGMP)
  - Setting up routing tables (RIP, OSPF, BGP, PIM, …)



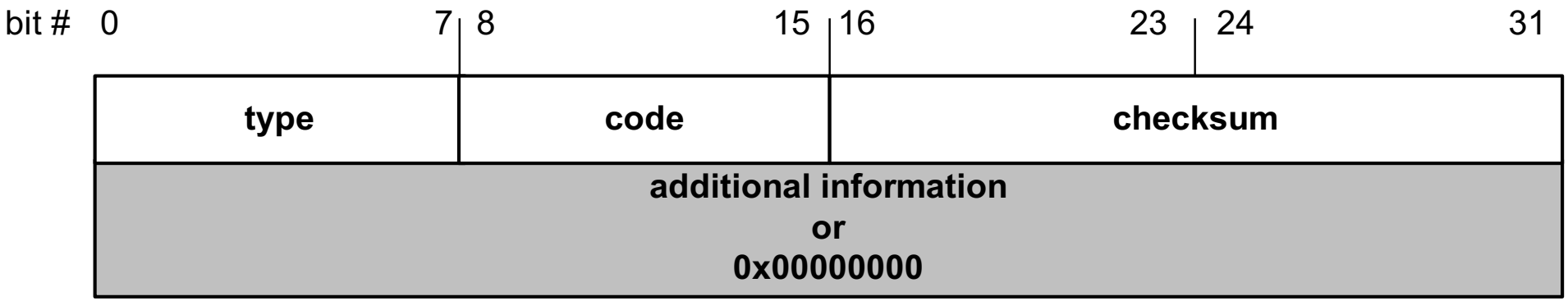
Overview

- The **Internet Control Message Protocol (ICMP)** is a helper protocol that supports IP with facility for
  - Error reporting
  - Simple queries

- ICMP messages are encapsulated as IP datagrams:



ICMP message format

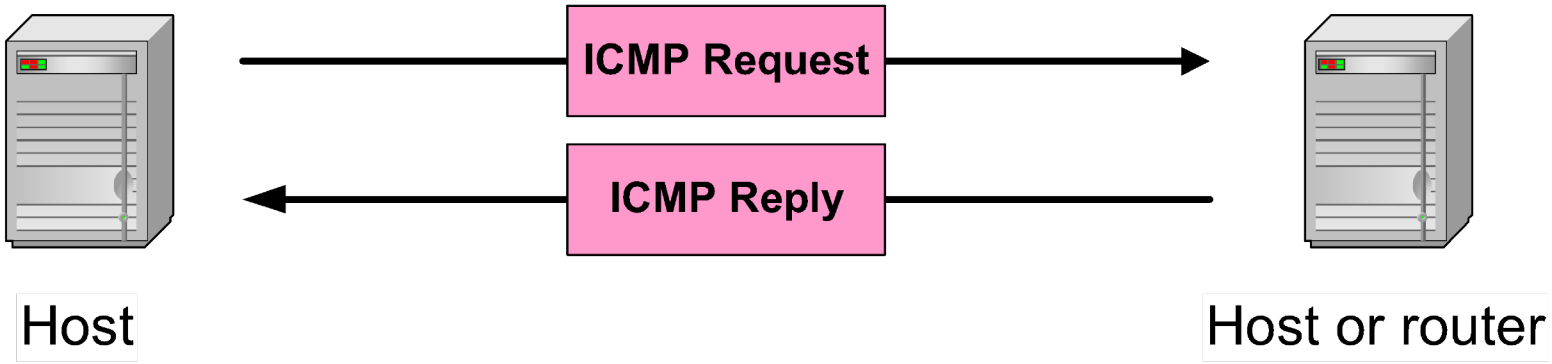


4 byte header:

- Type (1 byte): type of ICMP message
- Code (1 byte): subtype of ICMP message
- Checksum (2 bytes): similar to IP header checksum. Checksum is calculated over entire ICMP message

If there is no additional data, there are 4 bytes set to zero.
→ each ICMP messages is at least 8 bytes long

ICMP Query message



ICMP query:

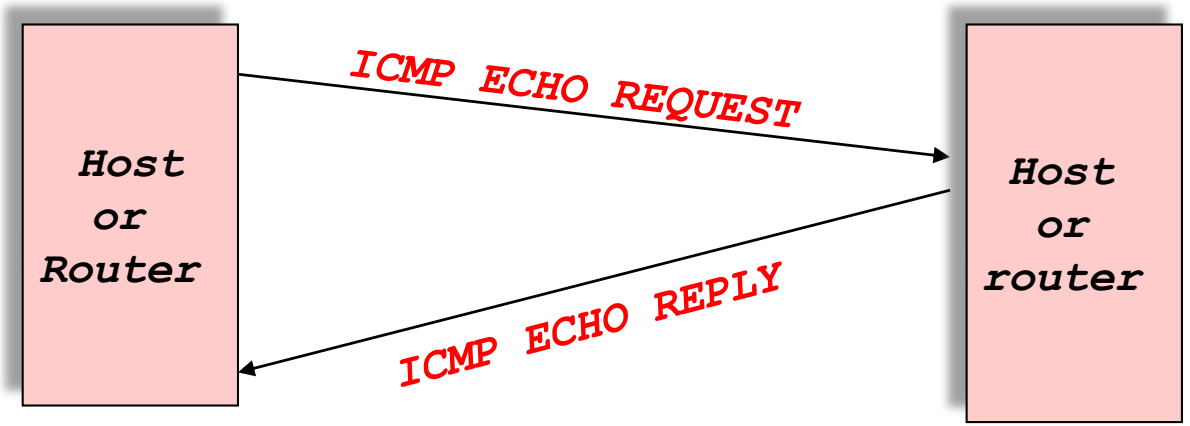
- Request sent by host to a router or host
- Reply sent back to querying host

Example of ICMP Queries

Type/Code:	Description	
8/0	Echo Request	The ping command uses Echo Request/ Echo Reply
0/0	Echo Reply	
13/0	Timestamp Request	
14/0	Timestamp Reply	
10/0	Router Solicitation	
9/0	Router Advertisement	

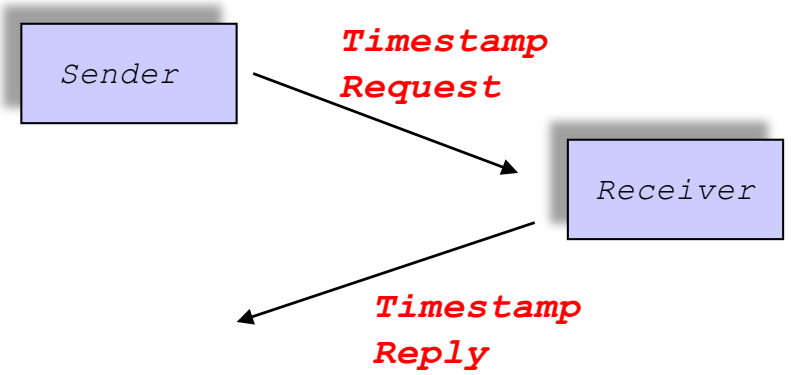
Example of a Query: Echo Request and Reply

- Ping's are handled directly by the kernel
- Each Ping is translated into an ICMP Echo Request
- The Ping'ed host responds with an ICMP Echo Reply



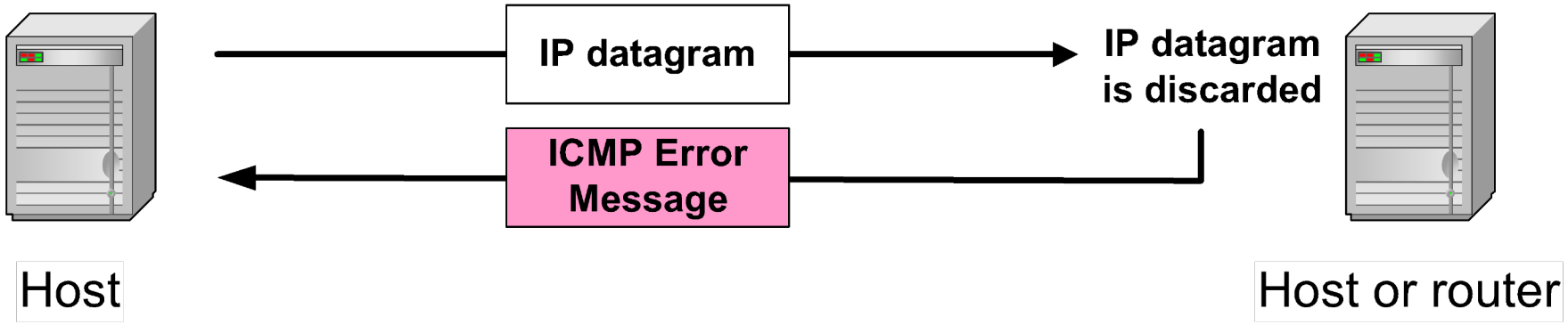
Example of a Query: ICMP Timestamp

- A system (host or router) asks another system for the current time.
- Time is measured in milliseconds after midnight UTC (Universal Coordinated Time) of the current day
- Sender sends a request, receiver responds with reply



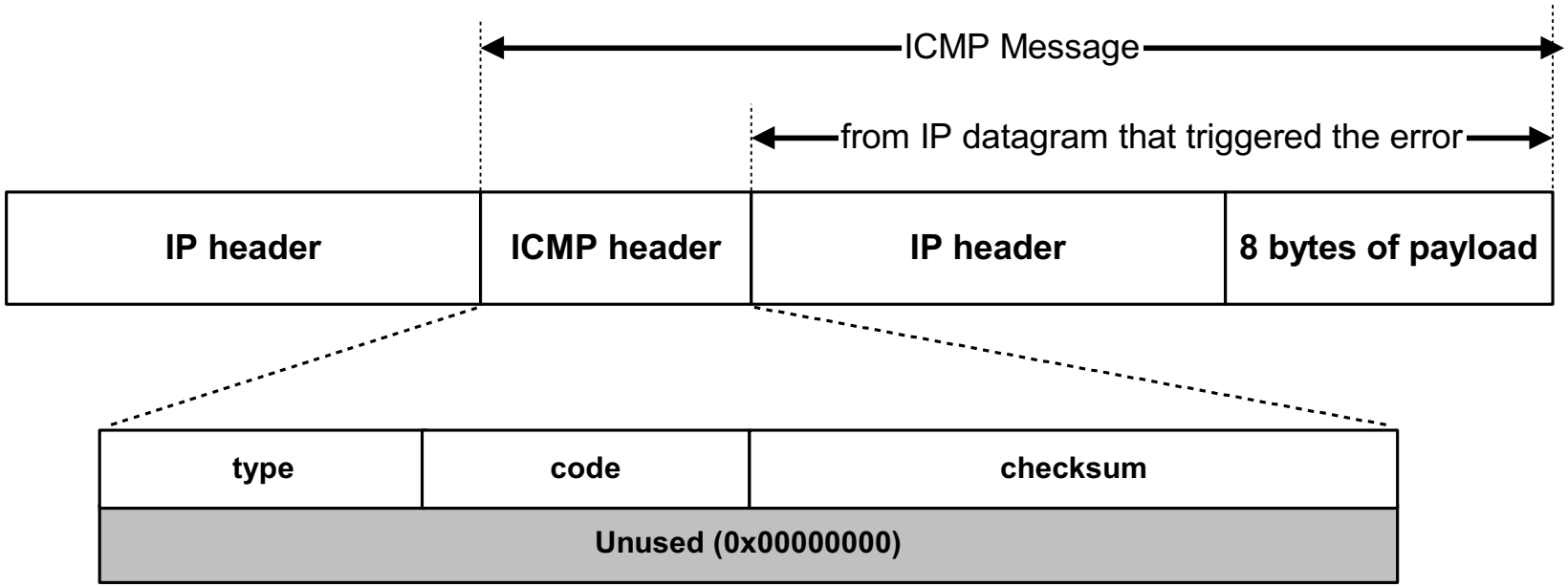
Type (= 17 or 18)	Code (=0)	Checksum
identifier		sequence number
32-bit sender timestamp		
32-bit receive timestamp		
32-bit transmit timestamp		

ICMP Error message



- **ICMP error messages report error conditions**
- **Typically sent when a datagram is discarded**
- **Error message is often passed from ICMP to the application program**

ICMP Error message



- ICMP error messages include the complete IP header and the first 8 bytes of the payload (typically: UDP, TCP)

Frequent ICMP Error message

Type	Code	Description	
3	0–15	Destination unreachable	Notification that an IP datagram could not be forwarded and was dropped. The code field contains an explanation.
5	0–3	Redirect	Informs about an alternative route for the datagram and should result in a routing table update. The code field explains the reason for the route change.
11	0, 1	Time exceeded	Sent when the TTL field has reached zero (Code 0) or when there is a timeout for the reassembly of segments (Code 1)
12	0, 1	Parameter problem	Sent when the IP header is invalid (Code 0) or when an IP header option is missing (Code 1)

Some subtypes of the “Destination Unreachable”

Code	Description	Reason for Sending
0	Network Unreachable	No routing table entry is available for the destination network.
1	Host Unreachable	Destination host should be directly reachable, but does not respond to ARP Requests.
2	Protocol Unreachable	The protocol in the protocol field of the IP header is not supported at the destination.
3	Port Unreachable	The transport protocol at the destination host cannot pass the datagram to an application.
4	Fragmentation Needed and DF Bit Set	IP datagram must be fragmented, but the DF bit in the IP header is set.

Example: ICMP Port Unreachable

- RFC 792: If, in the destination host, the IP module cannot deliver the datagram because the indicated protocol module or process port is not active, the destination host may send a destination unreachable message to the source host.
- Scenario: