

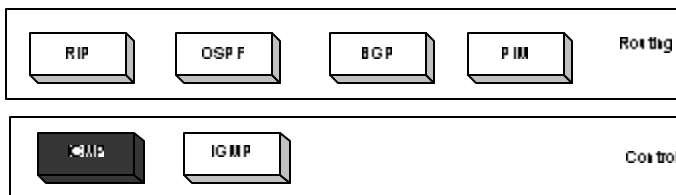
Internet Control Message Protocol (ICMP)

Relates to Lab 2:

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

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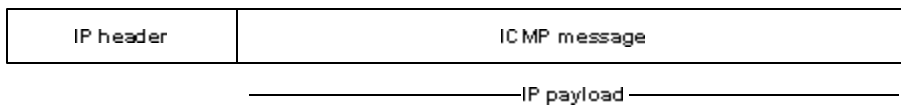
- The IP (Internet Protocol) relies on several other protocols to perform necessary control and routing functions:
 - Control functions (ICMP)
 - Multicast signaling (IGMP)
 - Setting up routing tables (RIP, OSPF, BGP, PIM, ...)



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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:



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ICMP message format

bit #	0	7	8	15	16	23	24	31
	type		code			checksum		
	additional information or 0x00000000							

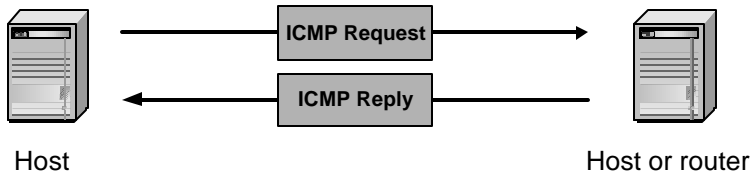
4 byte header:

- 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

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ICMP Query message



ICMP query:

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

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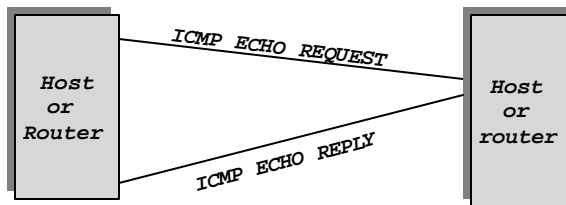
Example of ICMP Queries

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	

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Example of a Query: Echo Request and Reply

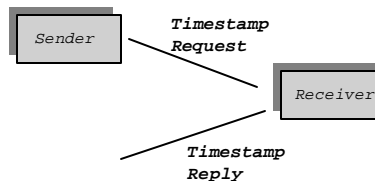
- Ping's are handled directly by the kernel
- Each Ping is translated into an ICMP Echo Request
- The Ping'ed host responds with an ICMP Echo Reply



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Example of a Query: ICMP Timestamp

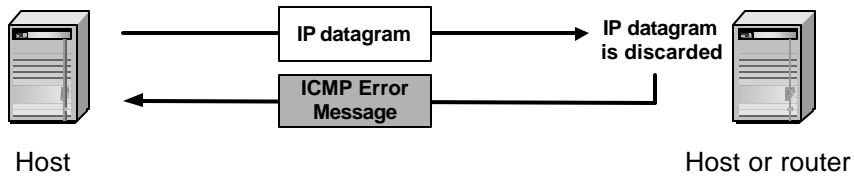
- A system (host or router) asks another system for the current time.
- Time is measured in milliseconds after midnight UTC (Universal Coordinated Time) of the current day
- Sender sends a request, receiver responds with reply



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

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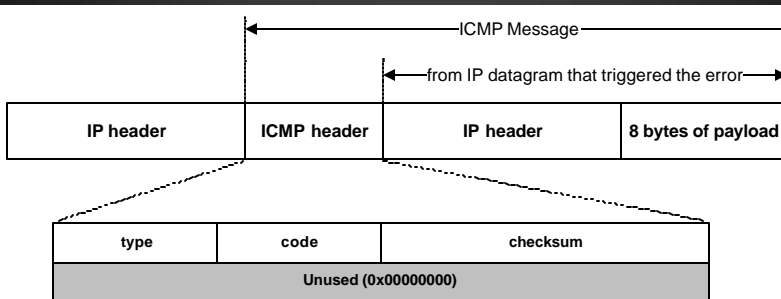
ICMP Error message



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

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ICMP Error message



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

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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)

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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.

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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:

