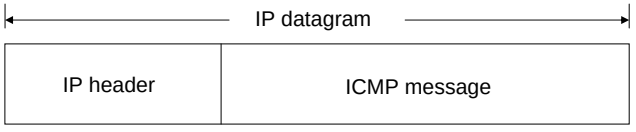
Chapter 6
ICMP: Internet Control Message Protocol

Introduction

- **ICMP is often considered part of the IP layer.**

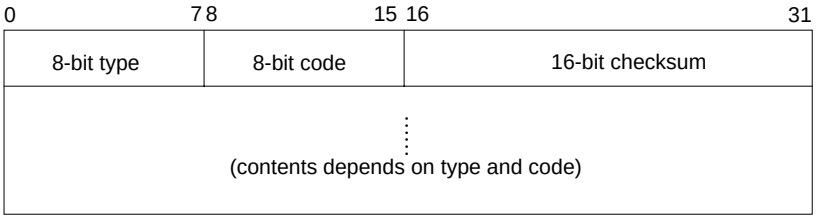


ICMP message encapsulated within an IP datagram

- **It communicates error messages and other conditions that require attention.**
- **ICMP messages are transmitted within IP datagram.**

ICMP Format

- **Format:**



- The are 15 different values for the *type* field, which identify the particular ICMP message.
- Some types of ICMP messages then use different vales of the *code* field to further specify the condition.
- The checksum field covers the entire ICMP message.

ICMP Message Types

Type	Code	Description	Query	Error
0	**0**	**Echo reply (Ping reply)**	•	
3		**Destination unreachable:**		
	0	Network unreachable		•
	1	Host unreachable		•
	2	Protocol unreachable		•
	3	Port unreachable		•
	4	Fragmentation needed but don't-fragment bit set		•
	5	Source route failed		•
	6	Destination network unknown		•
	7	Destination host unknown		•
	8	Source host isolated		•
	9	Destination network administratively prohibited		•
	10	Destination host administratively prohibited		•
	11	Network unreachable for TOS		•

ICMP Message Types (Cont.)

	12	Host unreachable for TOS		•
	13	Communication administratively prohibited by filtering		•
	14	Host precedence violation		•
	15	Precedence cutoff in effect		•
4	0	**Source quench (elementary flow control)**		•
5		**Redirect**		
	0	Redirect for network		•
	1	Redirect for host		•
	2	Redirect for type-of-service and network		•
	3	Redirect for type-of-service and host		•
8	0	**Echo request (Ping request)**	•	
9	0	**Router advertisement**	•	
10	0	**Router solicitation**	•	
11		**Time exceeded:**		

ICMP Message Types (Cont.)

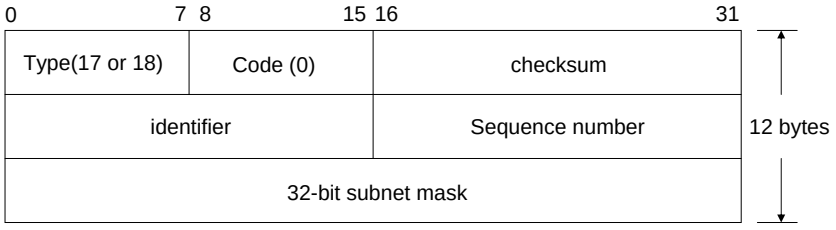
	0	Time-to-live equals 0 during transit (Traceroute)		•
	1	Time-to-live equals 0 during reassembly		•
12		**Parameter problem:**		
	0	IP header bad (catchall error)		•
	1	Required option missing		•
13	0	**Timestamp request**	•	
14	0	**Timestamp reply**	•	
15	0	**Information request (obsolete)**	•	
16	0	**Information reply (obsolete)**	•	
17	0	**Address mask request**	•	
18	0	**Address mask reply**	•	

ICMP Message Types (Cont.)

- **An ICMP error message is never generated in response to**
  - An ICMP error message.
  - A datagram destined to an IP broadcast address or an IP multicast address (a class D address).
  - A datagram sent as a link-layer broadcast.
  - A fragment other than the first.
  - A datagram whose source address does not define a single host.

ICMP Address Mask Request and Reply

- **The ICMP address mask request is intended for a diskless system to obtain its subnet mask at bootstrap time.**
- **The requesting system broadcasts its ICMP request.**
- **Format:**



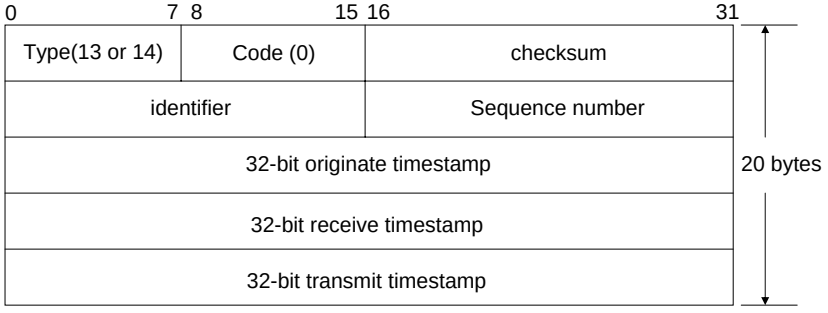
  - The identifier and sequence number fields in the ICMP message can be set to anything the sender chooses, and these values are returned in the reply.

ICMP Timestamp Request and Reply

- The ICMP timestamp request allows a system to query another for the current time.
- The recommended value to be returned is the number of milliseconds since midnight, Coordinated Universal Time (UTC).
- The drawback is that only the time since midnight is returned – the caller must know the date form some other means.

ICMP Timestamp Request and Reply (Cont.)

- **Format:**



- The requestor fills in the originate timestamp and sends the request.
- The replying system fills in the receive timestamp when it receives the request, and the transmit timestamp when it sends the reply.

ICMP Port Unreachable Error

- We use UDP to examine an ICMP error message, the port unreachable message.
- We can force a port unreachable using the TFTP client.
- The well-known UDP port for the TFTP server to be reading from is 69. But most TFTP client programs allow us to specify a port using the connect command.

```
bsdi % tftp
tftp> connect svr4 8888
tftp> get temp.foo
Transfer timed out.
tftp> quit
```

ICMP Port Unreachable Error (Cont.)

- Output: use *tcpdump*

0.0	arp who-has svr4 tell bsdi
0.002050 (0.2220)	arp reply svr4 is-at 0:0:c0:c2:9b:26
0.002723 (0.0007)	bsdi.2924>svr4.8888: udp 20
0.006399 (0.0037)	svr4>bsdi:icmp:svr4 udp port 8888 unreachable
5.000776 (4.9944)	bsdi.2924>svr4.8888: udp 20
5.004304 (0.0035)	svr4>bsdi:icmp:svr4 udp port 8888 unreachable
10.000887(4.9966)	bsdi.2924>svr4.8888: udp 20
10.004416(0.0037)	svr4>bsdi:icmp:svr4 udp port 8888 unreachable
15.001014(439966)	bsdi.2924>svr4.8888: udp 20
15.004574(0.0036)	svr4>bsdi:icmp:svr4 udp port 8888 unreachable
20.001177(4.9966)	bsdi.2924>svr4.8888: udp 20
20.004759 (0.0036)	svr4>bsdi:icmp:svr4 udp port 8888 unreachable

4.4BSD Processing of ICMP Message

Type	Code	Description	Handled by
0	0	Echo reply (Ping reply)	User process
3		Destination unreachable:	
	0	Network unreachable	"No route to host"
	1	Host unreachable	"No route to host"
	2	Protocol unreachable	"connection refused"
	3	Port unreachable	"connection refused"
	4	Fragmentation needed but don't-fragment bit set	"Message too long"
	5	Source route failed	"No route to host"
	6	Destination network unknown	"No route to host"
	7	Destination host unknown	"No route to host"
	8	Source host isolated	"No route to host"
	9	Destination network administratively prohibited	"No route to host"
	10	Destination host administratively prohibited	"No route to host"
	11	Network unreachable for TOS	"No route to host"

	12	Host unreachable for TOS	"No route to host"
	13	Communication administratively prohibited by filtering	(ignored)
	14	Host precedence violation	(ignored)
	15	Precedence cutoff in effect	(ignored)
4	0	Source quench (elementary flow control)	Kernel for TCP,ignored by UDP
5		Redirect	
	0	Redirect for network	Kernel updates routing table
	1	Redirect for host	Kernel updates routing table
	2	Redirect for type-of-service and network	Kernel updates routing table
	3	Redirect for type-of-service and host	Kernel updates routing table
8	0	Echo request (Ping request)	Kernel generates reply
9	0	Router advertisement	User process
10	0	Router solicitation	User process
11		Time exceeded:	

	0	Time-to-live equals 0 during transit (Traceroute)	**User process**
	1	Time-to-live equals 0 during reassembly	**User process**
12		**Parameter problem:**	
	0	IP header bad (catchall error)	**"Protocol not available"**
	1	Required option missing	**"Protocol not available"**
13	0	**Timestamp request**	**Kernel generates reply**
14	0	**Timestamp reply**	**User process**
15	0	**Information request (obsolete)**	**(ignored)**
16	0	**Information reply (obsolete)**	**User process**
17	0	**Address mask request**	**Kernel generates reply**
18	0	**Address mask reply**	**User process**

Summary

- **This chapter has been a look at the Internet Control Message Protocol, a required part of every implementation.**
- **We looked at the ICMP address mask request and reply and the timestamp request and reply in detail.**
- **We also saw the ICMP port unreachable error, a common ICMP error.**