

TCP/IP 通訊協定及應用

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<http://wmlab.csie.ncu.edu.tw/course/tcp>

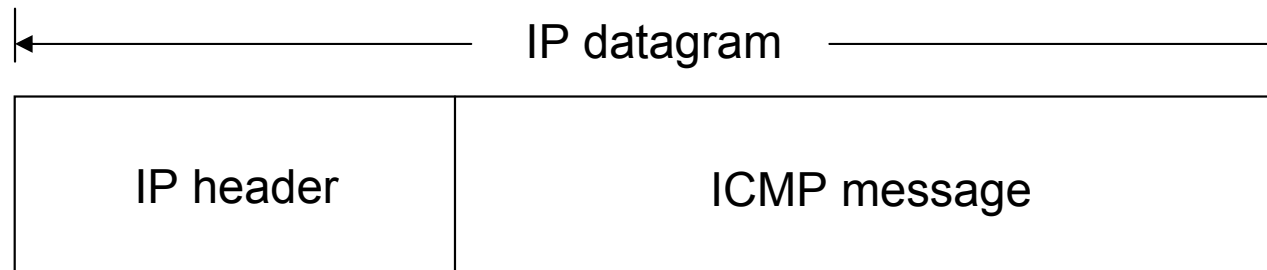
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Chapter 6

ICMP: Internet Control Message Protocol

Introduction

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

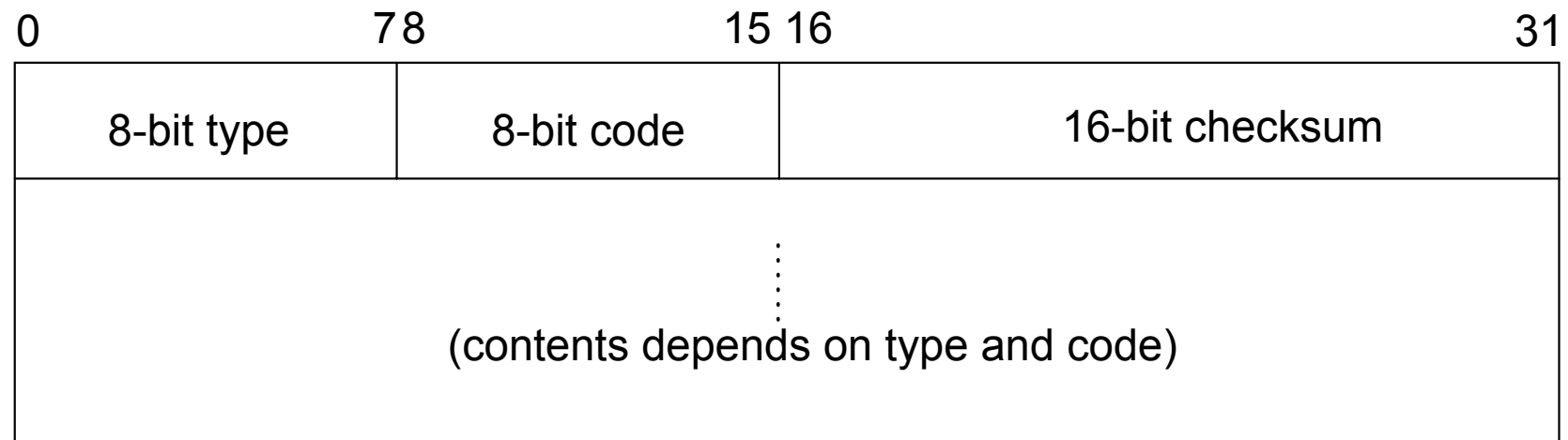


20 bytes

ICMP message encapsulated within an IP datagram

- ◆ It communicates error messages and other conditions that require attention.

◆ Format:



- There are 15 different values for the type field, which identify the particular ICMP message.
- Some types of ICMP messages then use different values 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		•

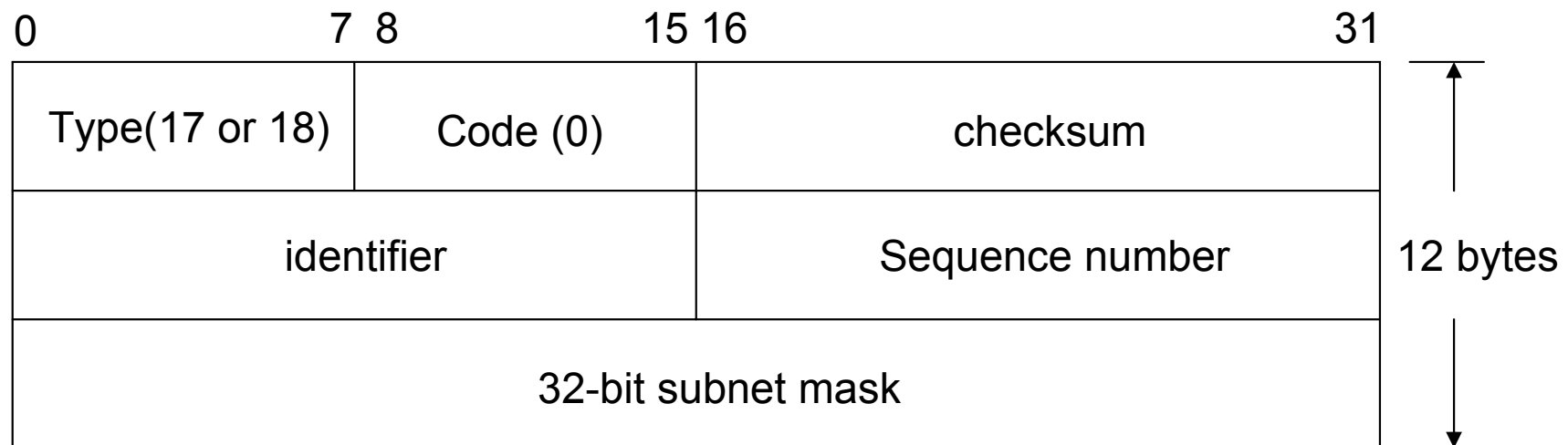
	12	Host unreachable for TOS		•
	13	Communication administratively prohibited by filtering		•
	14	Host precedence violation		•
	15	Precedence cutoff in effect		•
4	0	Source quench (elementary flow control)		•
5		Redirect		
	0	Redirect for network		•
	1	Redirect for host		•
	2	Redirect for type-of-service 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:		

	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	•	

- ◆ 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:

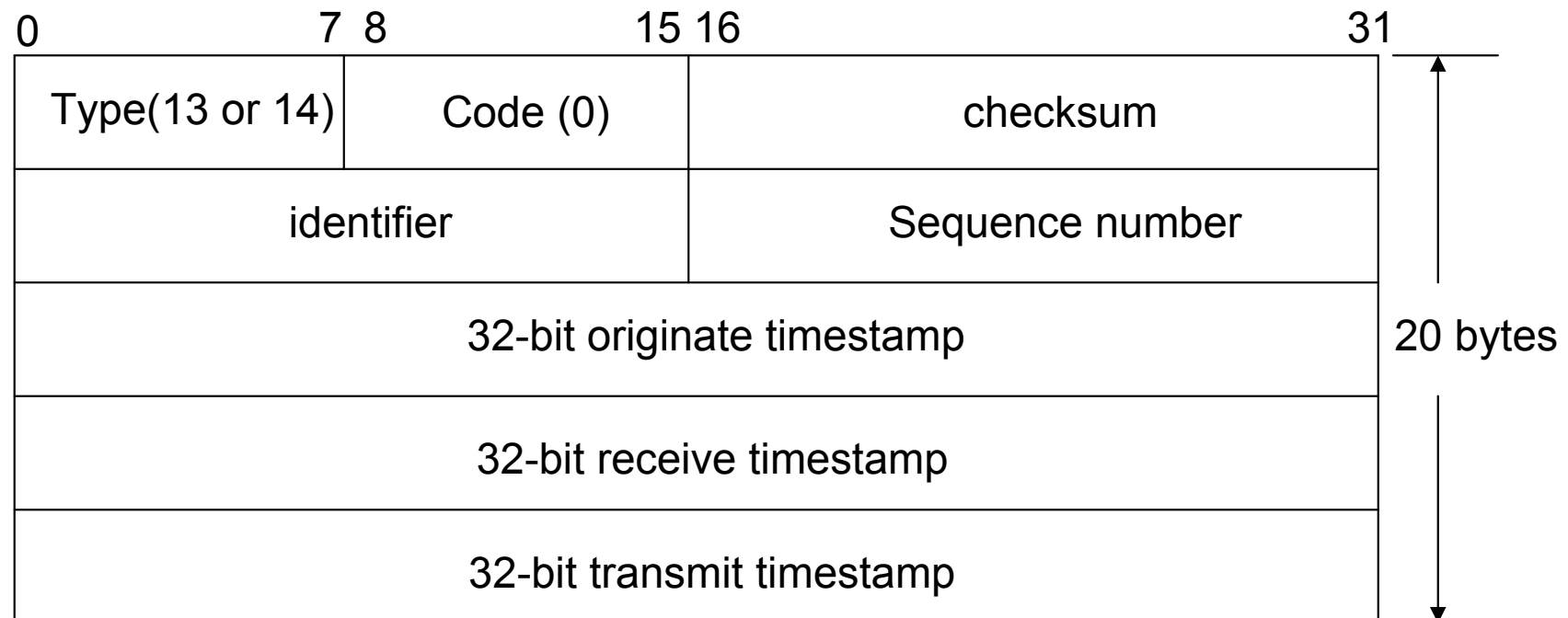


- The identifier and sequence number fields in the ICMP message can be set to anything the sender chooses, and these values are returned in the reply.

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 from some other means.

◆ 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

◆ Event:

- 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
```

◆ Output: use *tcpdump*

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

UDP

- ◆ Transport layer protocol
- ◆ No reliability
- ◆ TFTP: Trivial File Transfer Protocol
 - 和TCP一樣都是用來傳輸檔案的協定，不過TFTP協定適用於小檔案且不需要像FTP協定那樣複雜且功能太多的傳輸場合

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.