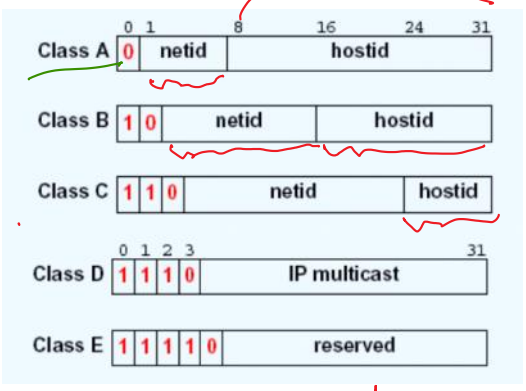
Internet Security

Network Layer
(IP and ICMP Protocols)

IP Address



reserved for private network

10.0.0.0/8

192.168.0.0/16

2^7

2^{16}

128.230.0.0

netid

hostid

149.—

ESF

128.230.0.0/16

128.230.0.0/18

10.0.0.0

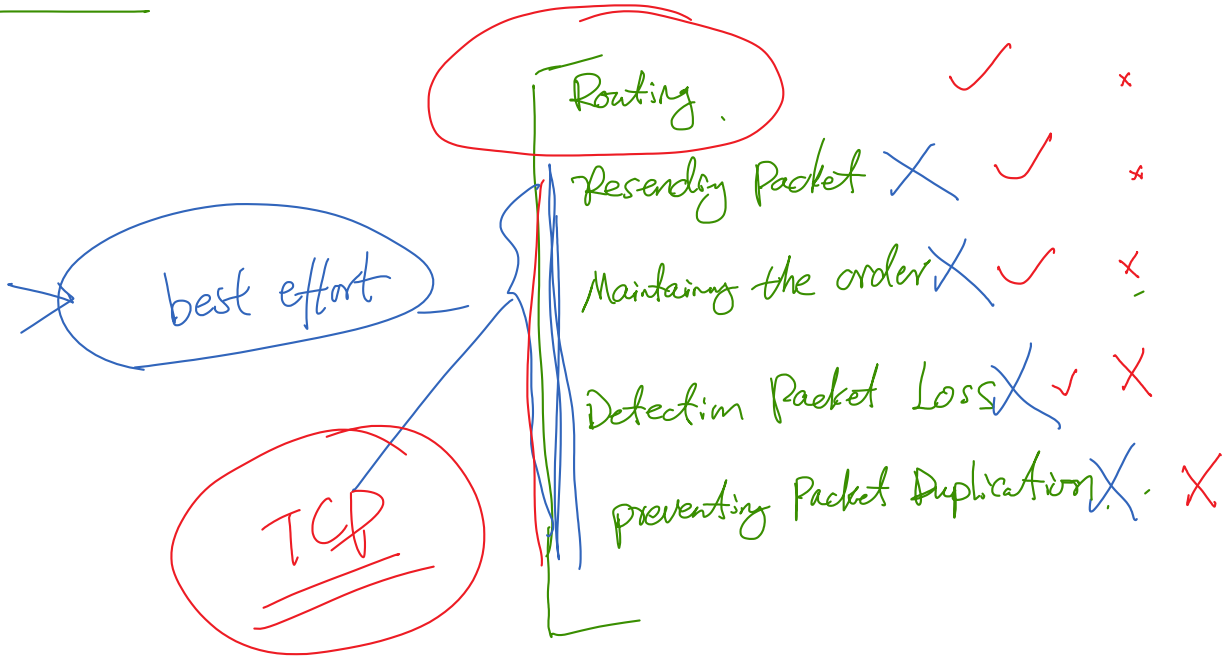
10.0.0.0/8

128.230.0.5

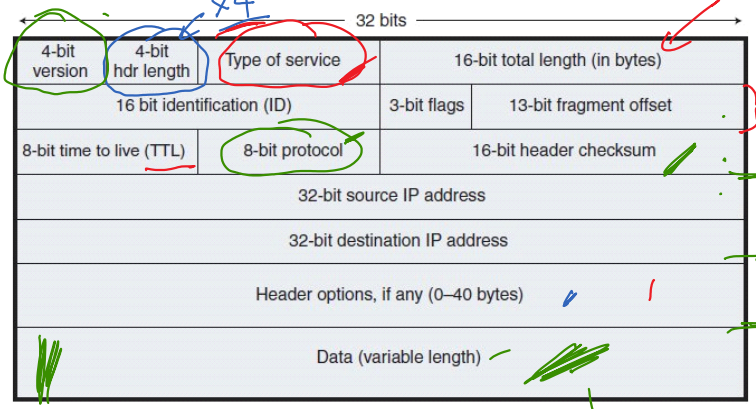
128.230.128.5

1000 0000

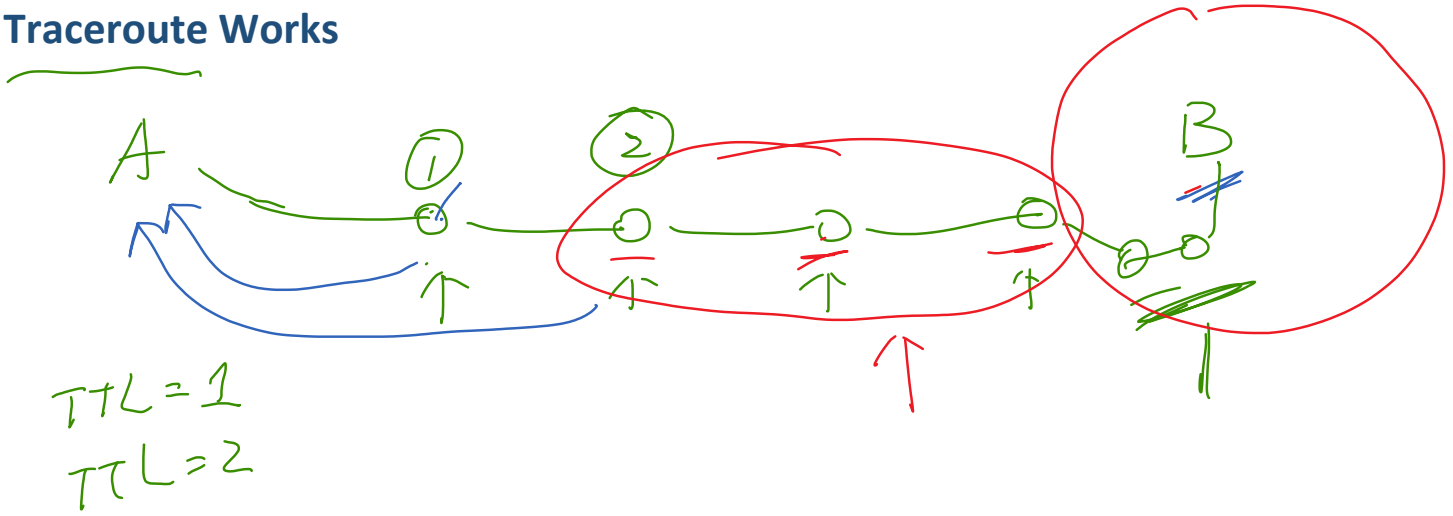
Responsibility of IP Layer



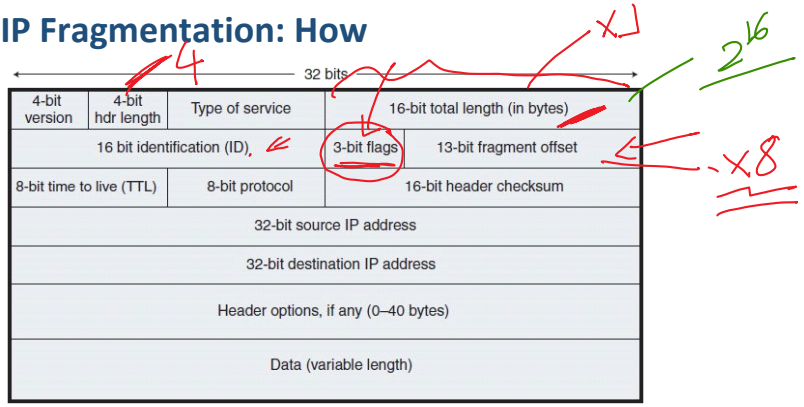
IP Header and Protocol

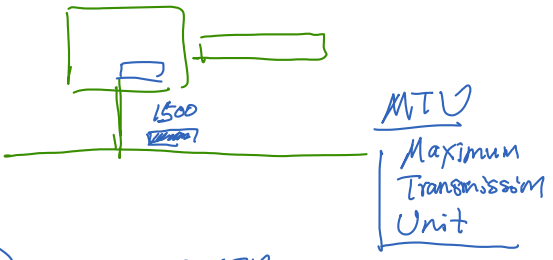


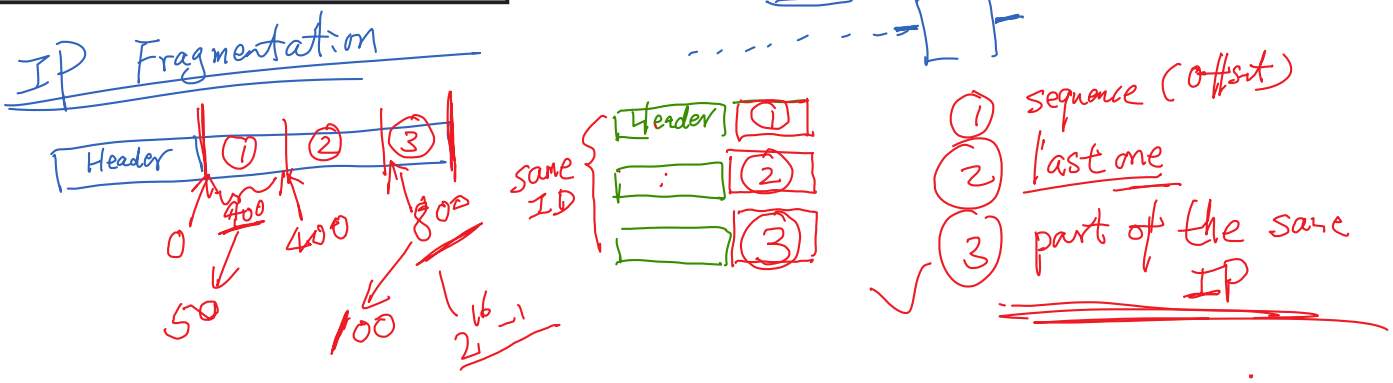
How Traceroute Works

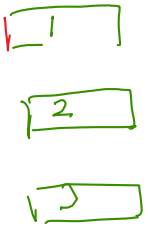


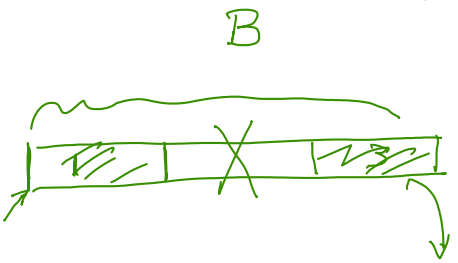
IP Fragmentation: How











Attacks on IP Fragmentation

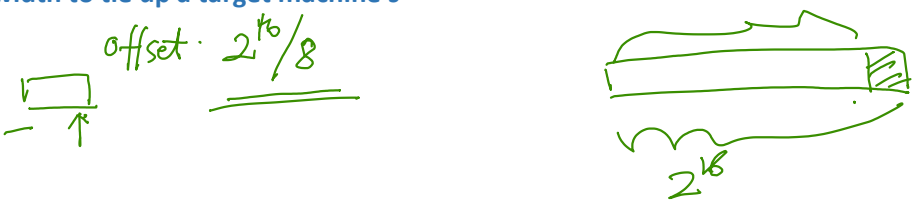
DEFINITION

protocol

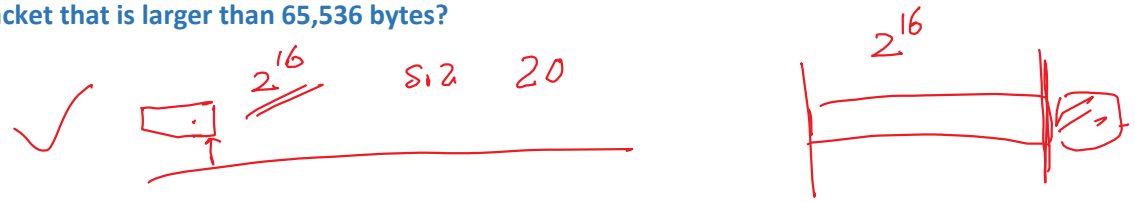
In information technology, a protocol is the special set of rules that end points in a telecommunication connection use when they communicate. Protocols specify interactions between the communicating entities.

Questions: Attacks Using Fragmentation

Q1: Can you use a small amount of bandwidth to tie up a target machine's significant amount of resources?

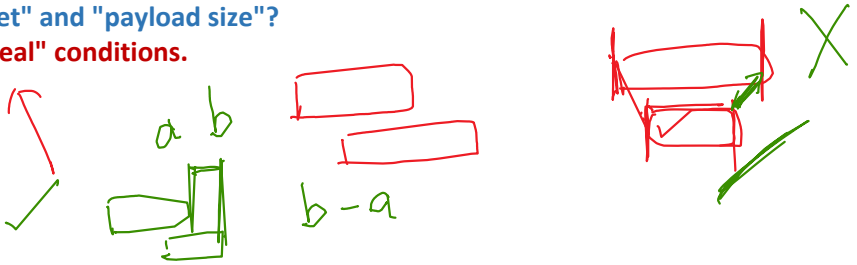


Q2: Can you create an IP packet that is larger than 65,536 bytes?



Q3: Can you create some abnormal conditions using "offset" and "payload size"?

Goal: Test whether a computer can handle these "unreal" conditions.

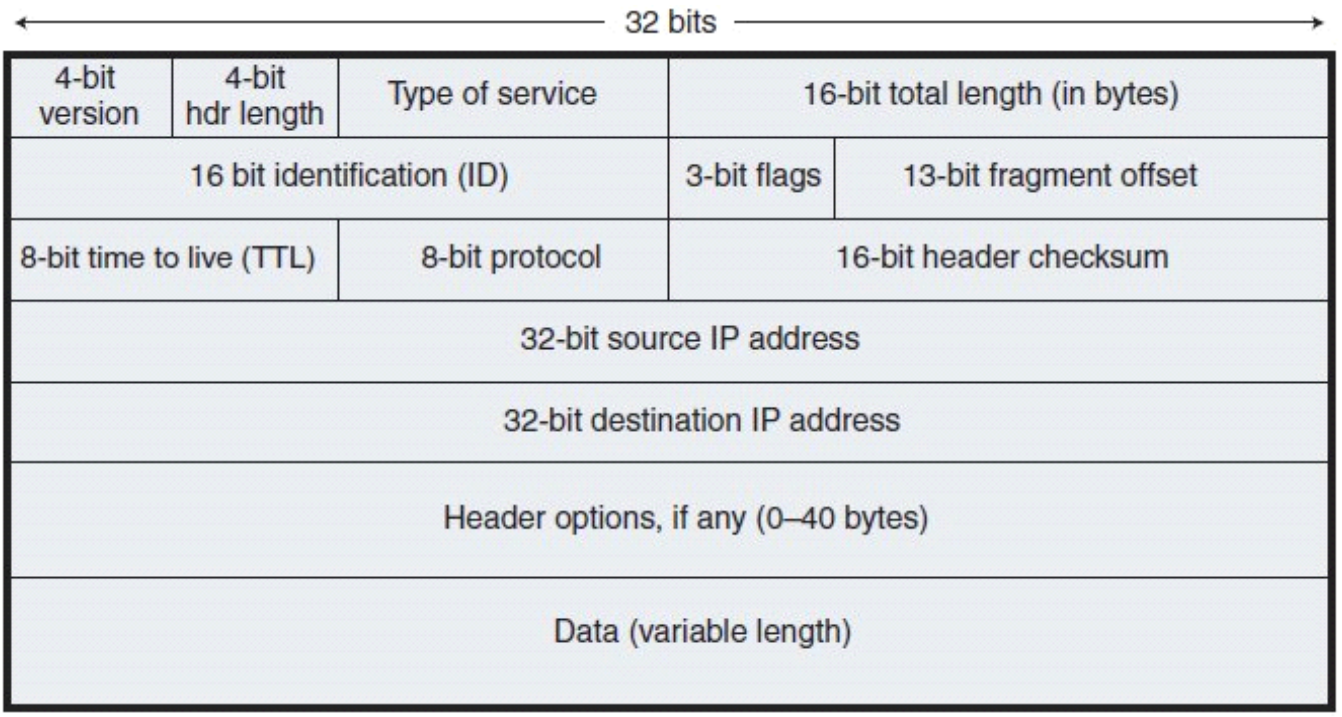


Attack 1: Tie Up Target's Resources

Can you use a small amount of bandwidth to tie up a target machine's significant amount of resources?

Attack 2: Create a Super-Large Packet

Can you create an IP packet that is larger than 65,536 bytes?



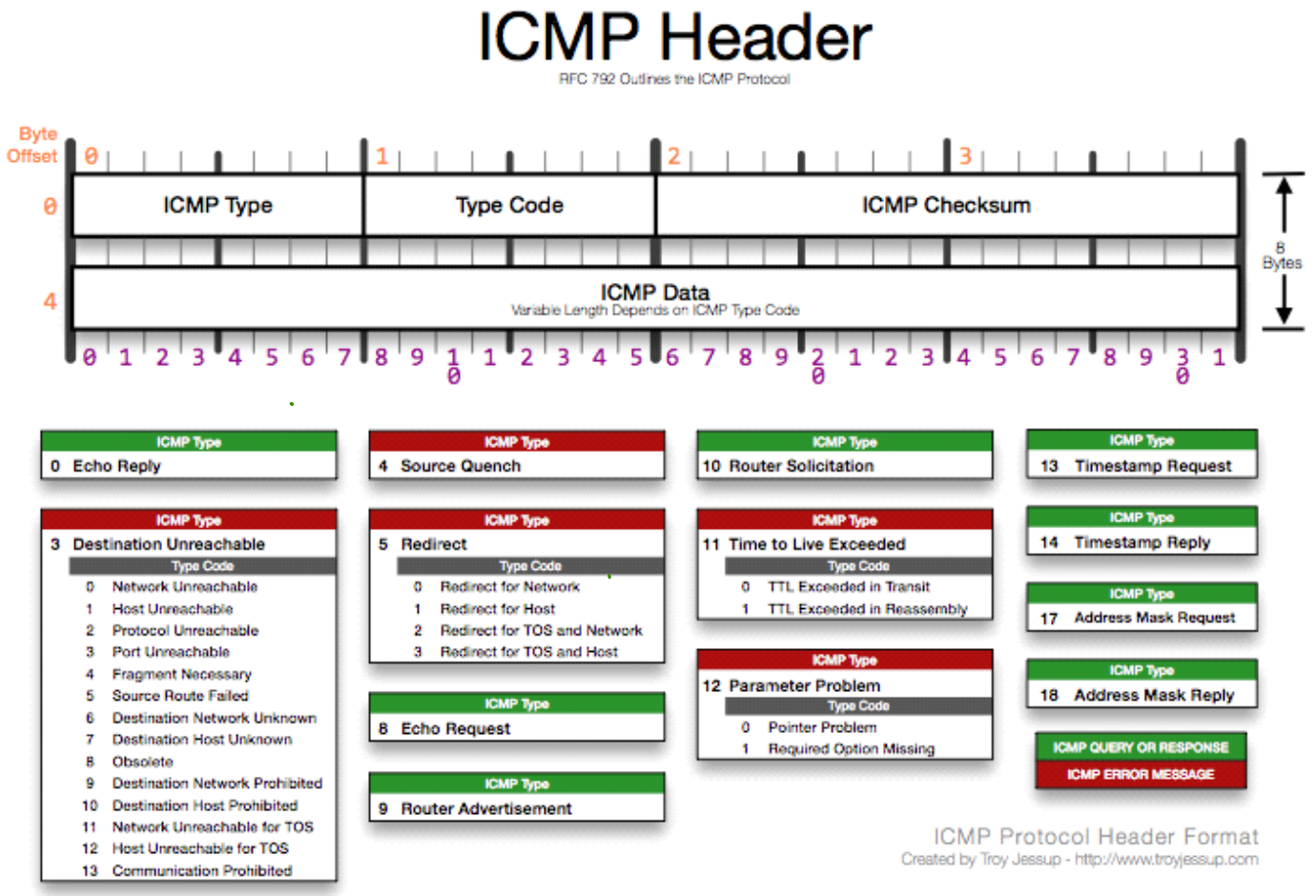
Attack 3: Create Abnormal Situation

Can you create some abnormal conditions using "offset" and "payload size"?

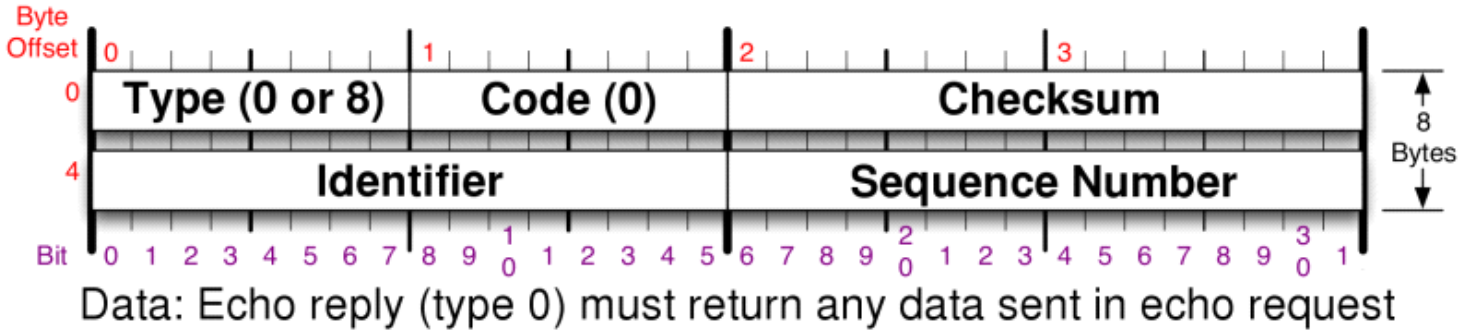
Test whether a computer can handle these "unreal" conditions.

ICMP: Internet Control Message Protocol

ICMP Header


ICMP Header
RFC 792 Outlines the ICMP Protocol
Byte Offset
0
4
ICMP Type
Type Code
ICMP Checksum
ICMP Data
Variable Length Depends on ICMP Type Code
8 Bytes
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
ICMP Type
0 Echo Reply
ICMP Type
3 Destination Unreachable
Type Code
0 Network Unreachable
1 Host Unreachable
2 Protocol Unreachable
3 Port Unreachable
4 Fragment Necessary
5 Source Route Failed
6 Destination Network Unknown
7 Destination Host Unknown
8 Obsolete
9 Destination Network Prohibited
10 Destination Host Prohibited
11 Network Unreachable for TOS
12 Host Unreachable for TOS
13 Communication Prohibited
ICMP Type
4 Source Quench
ICMP Type
5 Redirect
Type Code
0 Redirect for Network
1 Redirect for Host
2 Redirect for TOS and Network
3 Redirect for TOS and Host
ICMP Type
8 Echo Request
ICMP Type
9 Router Advertisement
ICMP Type
10 Router Solicitation
ICMP Type
11 Time to Live Exceeded
Type Code
0 TTL Exceeded in Transit
1 TTL Exceeded in Reassembly
ICMP Type
12 Parameter Problem
Type Code
0 Pointer Problem
1 Required Option Missing
ICMP Type
13 Timestamp Request
ICMP Type
14 Timestamp Reply
ICMP Type
17 Address Mask Request
ICMP Type
18 Address Mask Reply
ICMP QUERY OR RESPONSE
ICMP ERROR MESSAGE
ICMP Protocol Header Format
Created by Troy Jessup - http://www.troyjessup.com

ICMP Echo Request/Reply



Data: Echo reply (type 0) must return any data sent in echo request

ICMP Time Exceeded

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type = 11								Code								Header checksum															
unused																															
IP header and first 8 bytes of original datagram's data																															

Where:

Type must be set to 11

Code specifies the reason for the time exceeded message, include the following:

Code	Description
0	Time-to-live exceeded in transit.
1	Fragment reassembly time exceeded.

ICMP Destination Unreachable

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type = 3								Code								Header checksum															
unused																Next-hop MTU															
IP header and first 8 bytes of original datagram's data																															

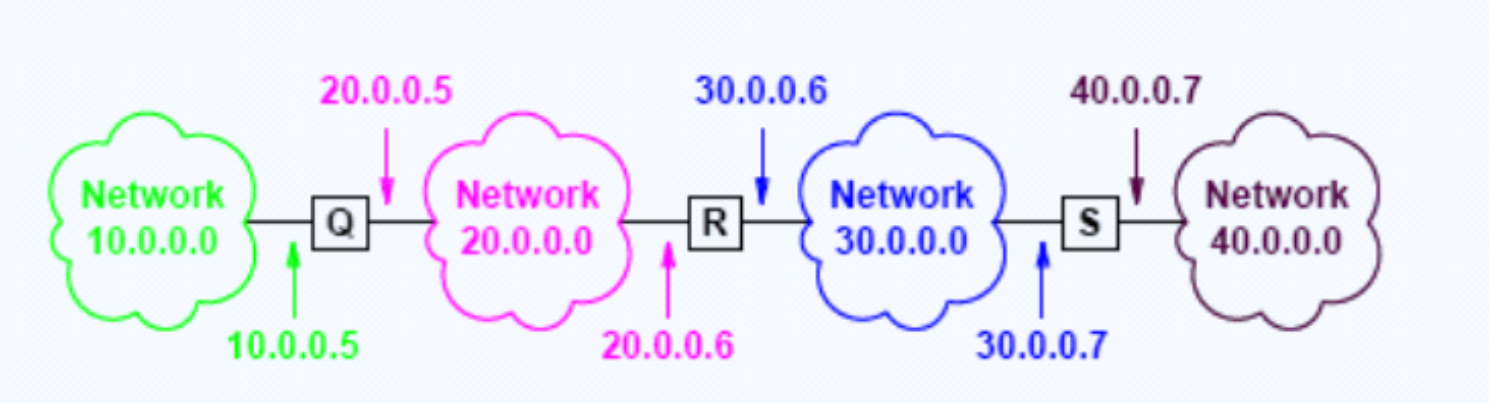
0	Destination network unreachable
1	Destination host unreachable
2	Destination protocol unreachable
3	Destination port unreachable
4	Fragmentation required, and DF flag set
5	Source route failed
6	Destination network unknown
7	Destination host unknown
8	Source host isolated
9	Network administratively prohibited
10	Host administratively prohibited
11	Network unreachable for TOS
12	Host unreachable for TOS
13	Communication administratively prohibited
14	Host Precedence Violation
15	Precedence cutoff in effect

ICMP Redirect and Attacks

Smurf Attack

Summary of Attack Strategies

Routing



TO REACH NETWORK	ROUTE TO THIS ADDRESS
20.0.0.0 / 8	DELIVER DIRECT
30.0.0.0 / 8	DELIVER DIRECT
10.0.0.0 / 8	20.0.0.5
40.0.0.0 / 8	30.0.0.7

The routing table for router R

Routing Table on a Host

```
seed@ubuntu:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.1        0.0.0.0         UG    0      0        0 eth18
10.0.2.0        0.0.0.0         255.255.255.0   U     1      0        0 eth18
169.254.0.0     0.0.0.0         255.255.0.0     U     1000   0        0 eth16
192.168.56.0    0.0.0.0         255.255.255.0   U     1      0        0 eth16
```

Change Routing Table

```
seed@ubuntu:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.1        0.0.0.0         UG    0      0        0 eth18
10.0.2.0        0.0.0.0         255.255.255.0   U     1      0        0 eth18
169.254.0.0     0.0.0.0         255.255.0.0     U     1000   0        0 eth16
192.168.56.0    0.0.0.0         255.255.255.0   U     1      0        0 eth16
seed@ubuntu:~$ sudo route add -net 128.230.0.0/16 gw 10.0.2.1
[sudo] password for seed:
seed@ubuntu:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.1        0.0.0.0         UG    0      0        0 eth18
10.0.2.0        0.0.0.0         255.255.255.0   U     1      0        0 eth18
128.230.0.0     10.0.2.1        255.255.0.0     UG    0      0        0 eth18
169.254.0.0     0.0.0.0         255.255.0.0     U     1000   0        0 eth16
192.168.56.0    0.0.0.0         255.255.255.0   U     1      0        0 eth16
```

How Do Routers and Host Get Routing Information?