IP Protocol

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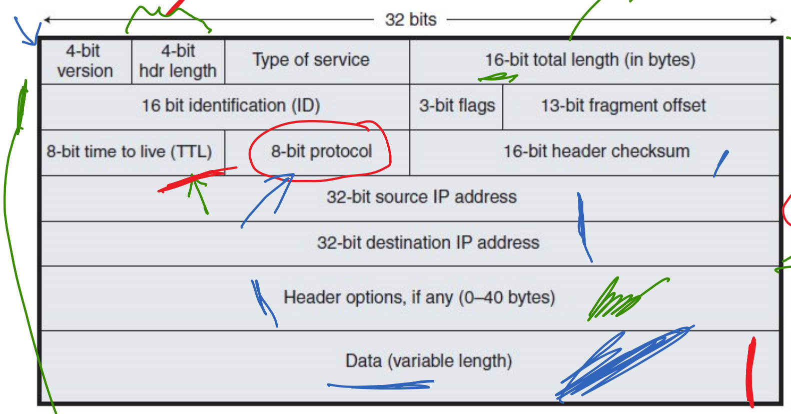
IP Header and Protocol

×4



32 bits

4-bit version	4-bit hdr length	Type of service	16-bit total length (in bytes)
16 bit identification (ID)		3-bit flags	13-bit fragment offset
8-bit time to live (TTL)	8-bit protocol	16-bit header checksum	
32-bit source IP address			
32-bit destination IP address			
Header options, if any (0–40 bytes)			
Data (variable length)			

header + payload $2^{16} = 65536$

IPV4

IPV6

$5 \times 4 = 20$

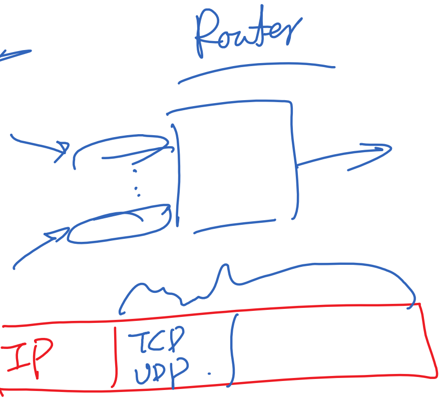
4 5

20 octets

byte

TOS

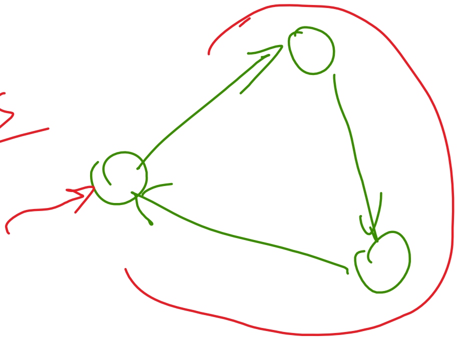
Router



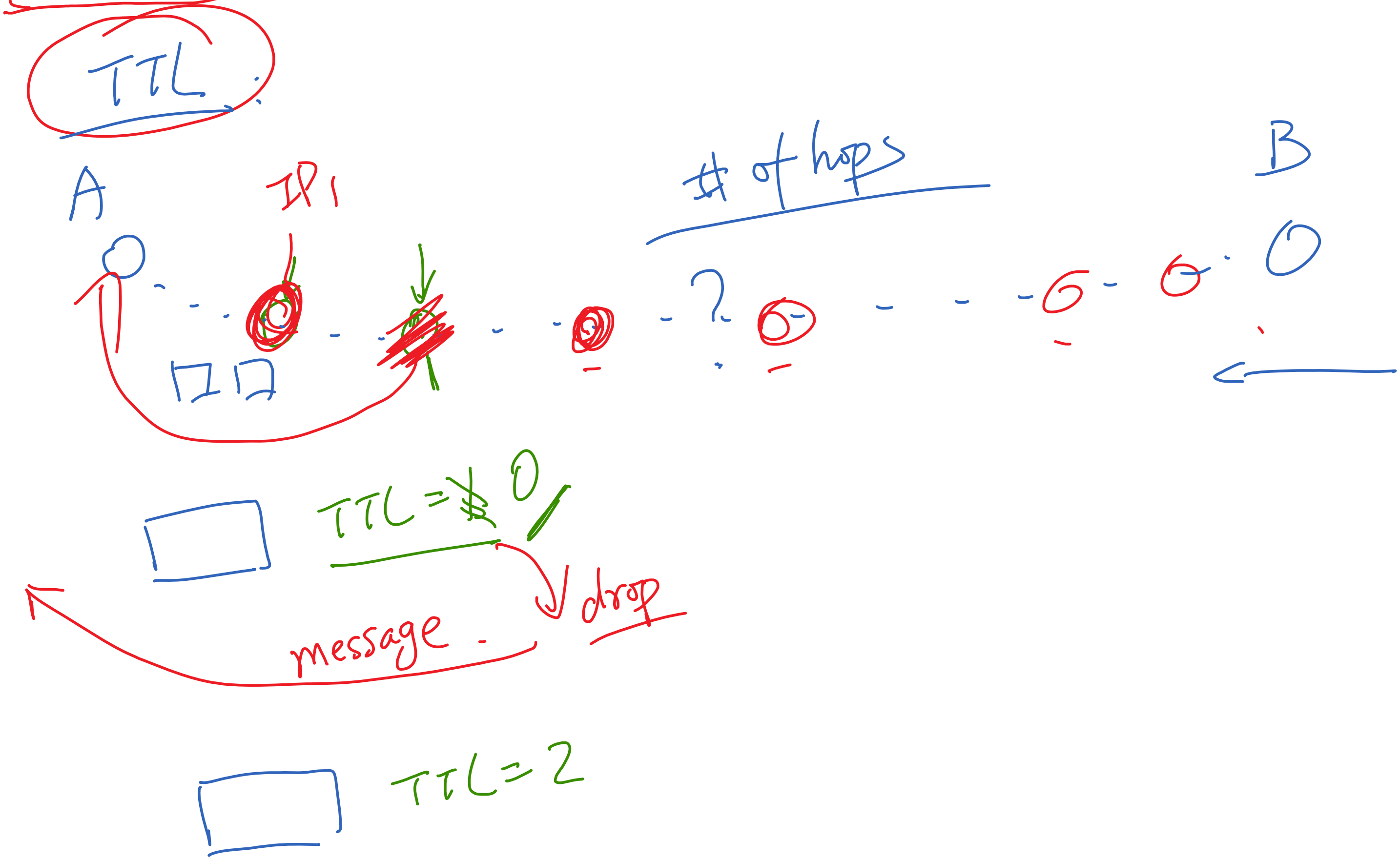
fragmentation

TTL ; # of hops

30



How Traceroute Works



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IP Fragmentation

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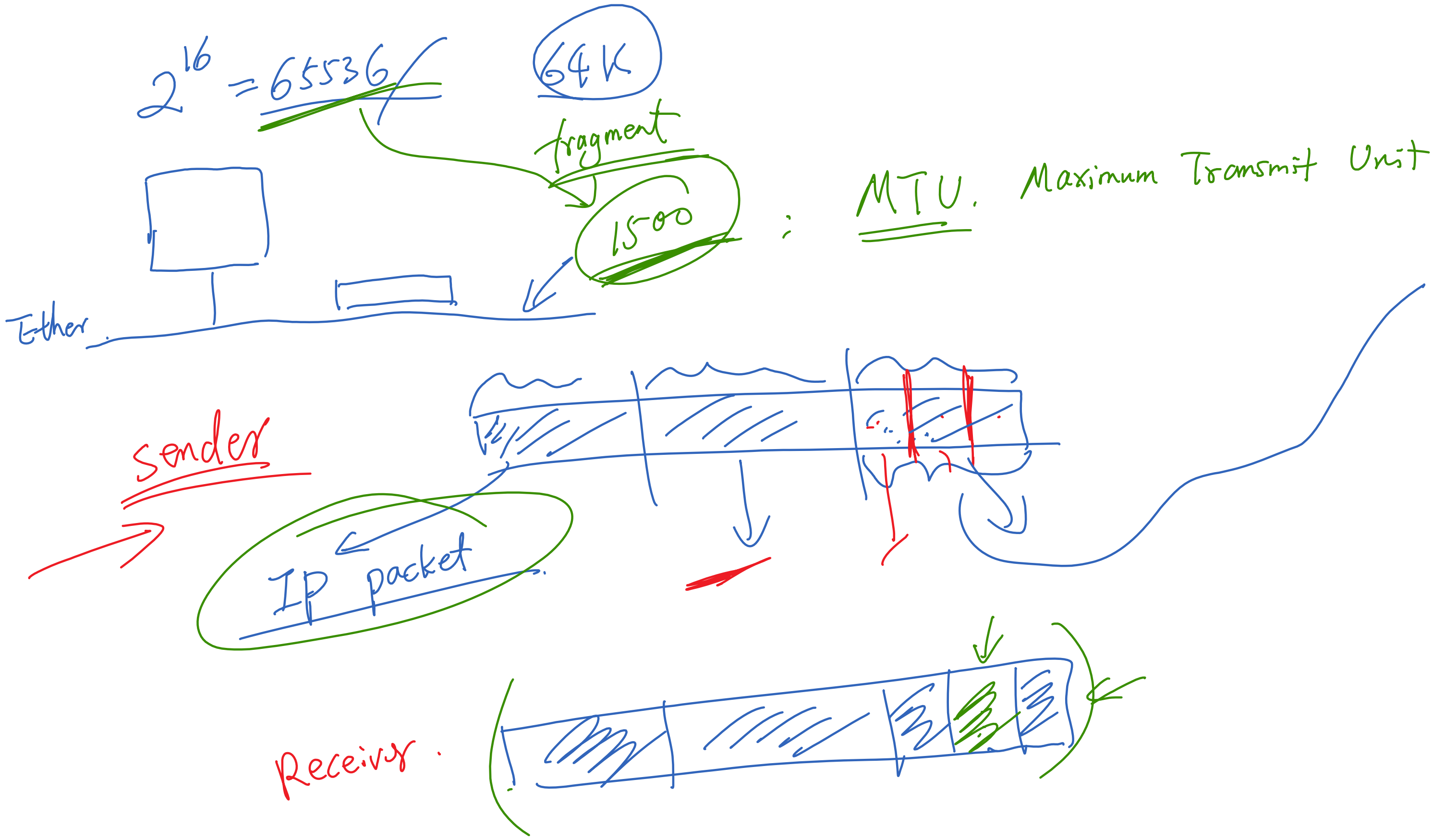
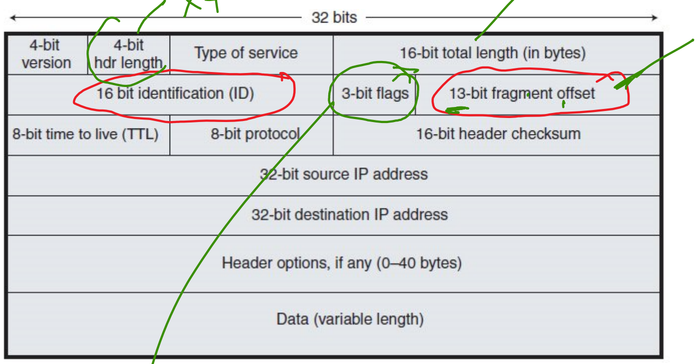
IP Fragmentation: Why



IP Fragmentation: How



4-bit version	4-bit hdr length	Type of service	16-bit total length (in bytes)
16 bit identification (ID)		3-bit flags	13-bit fragment offset
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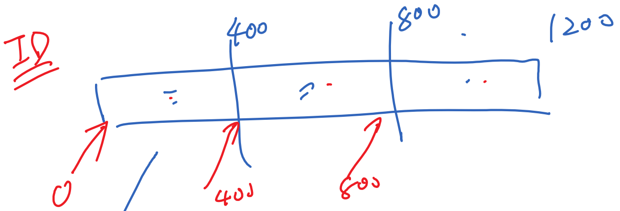
Header options, if any (0–40 bytes)			
Data (variable length)			



packet1 : ID, offset : 0 bit: 1

packet2 : ID, offset : $400/2^3 = 50$ bit: 1

packet3 : ID, offset : $800/2^3 = 100$ bit 2 : 0

3-bit flags:

0 : not used.

1 : Don't fragment

2 : more fragment.

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Attacks on IP Fragmentation

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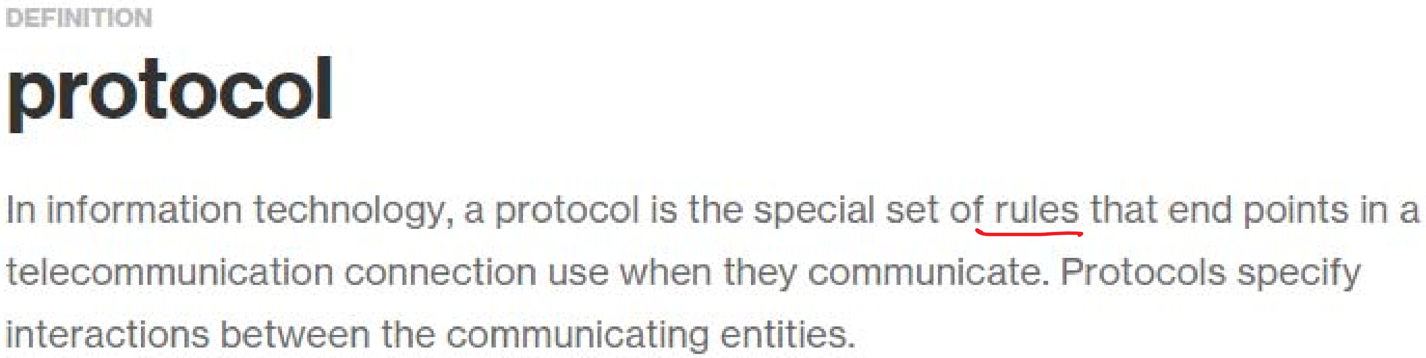
Attacks on IP Fragmentation



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.

Attacker's strategy:

- Do not follow the rule.
- Create unreal condition

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.

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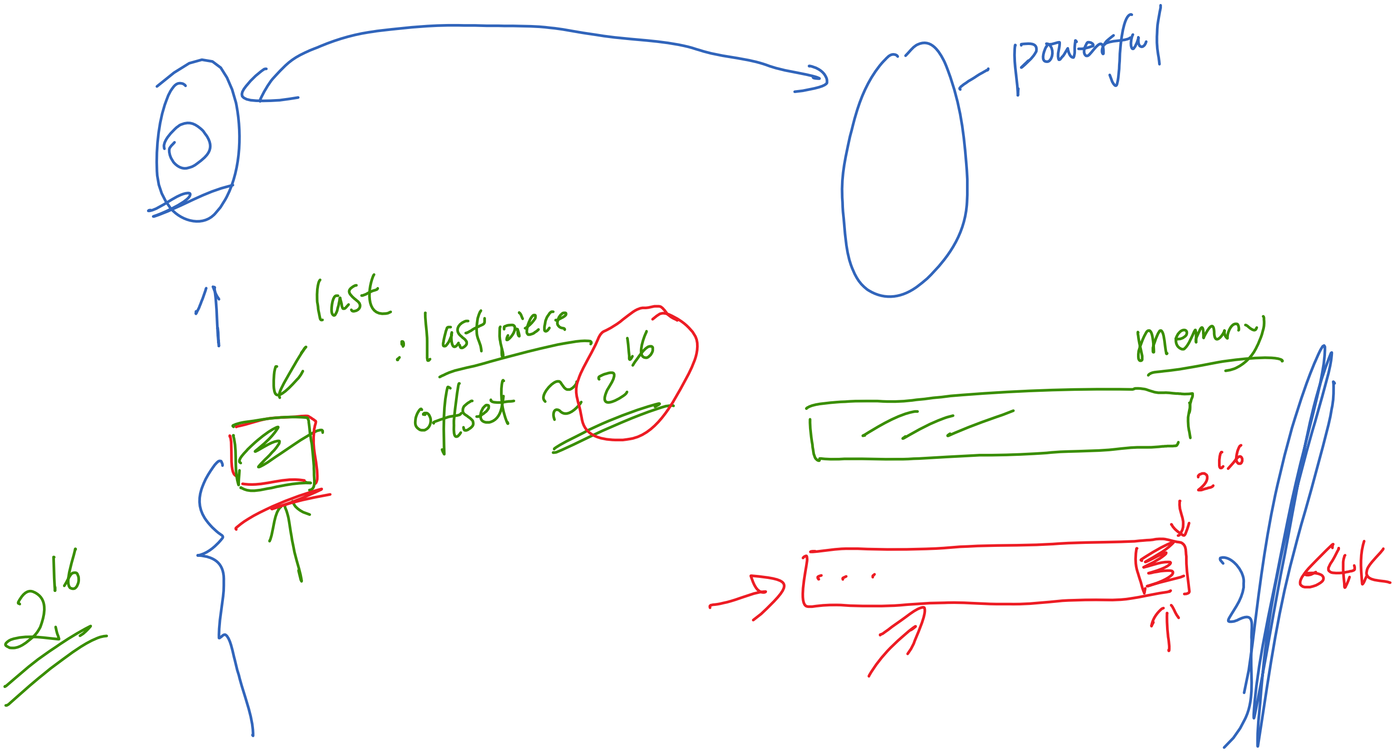
Attacks on IP Fragmentation: Answers to Questions

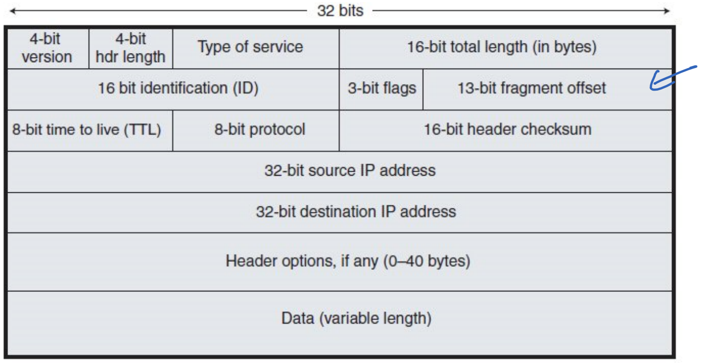
Attack 1: Tie Up Target's Resources

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?



← 32 bits →				
4-bit version	4-bit hdr length	Type of service	16-bit total length (in bytes)	
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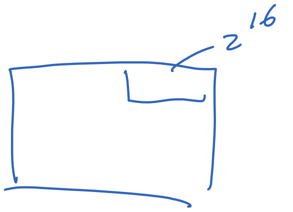
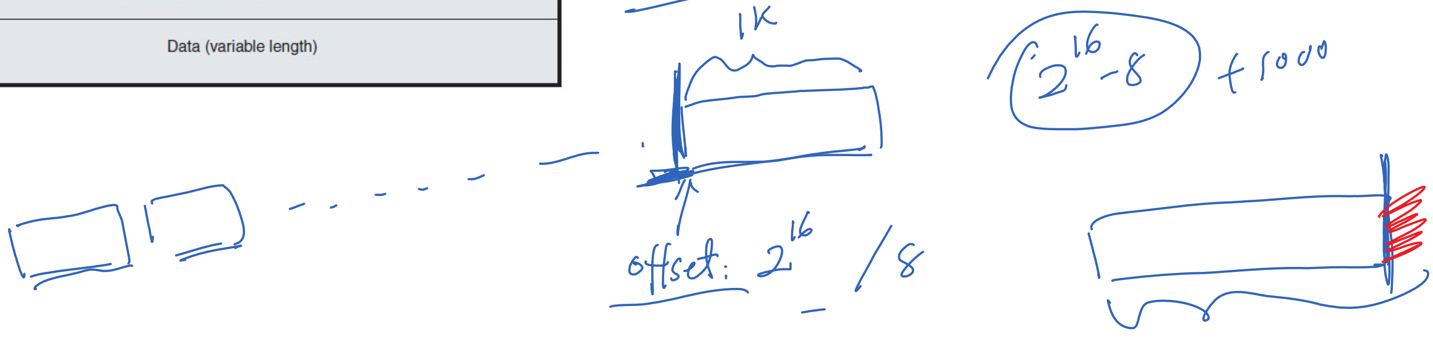
32-bit source IP address				
32-bit destination IP address				
Header options, if any (0–40 bytes)				
Data (variable length)				

$\geq 2^{16}$



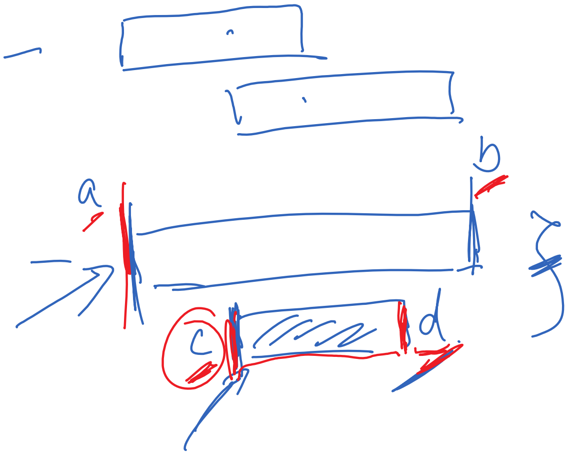
Last Piece

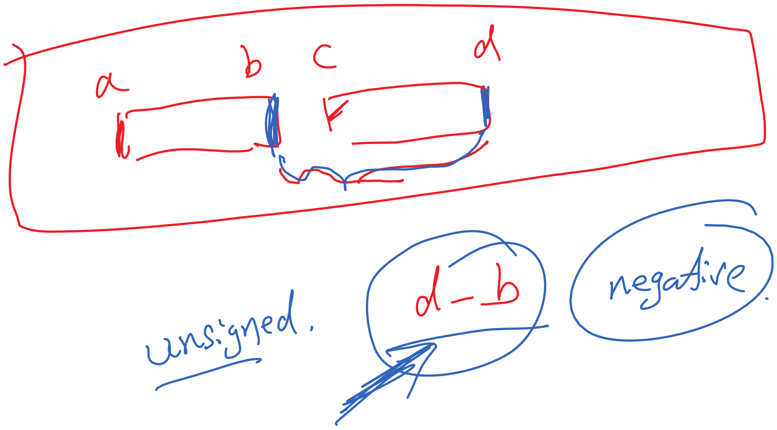


Attack 3: Create Abnormal Situation

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

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





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ICMP Protocol

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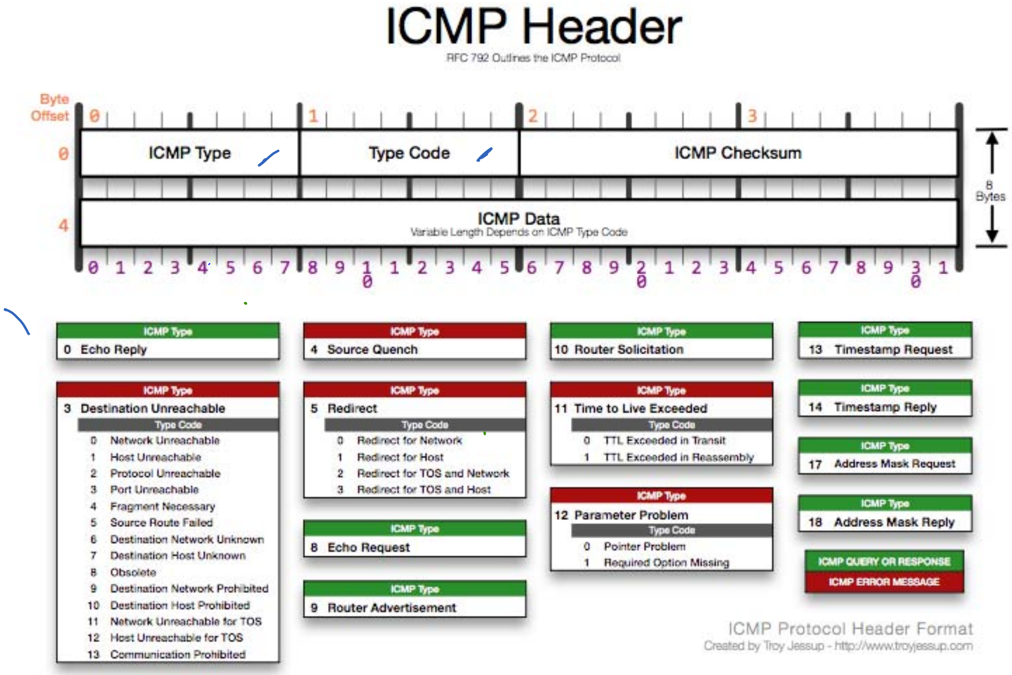
ICMP: Internet Control Message Protocol

purpose: – { Control message
Error message.

ICMP Header



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

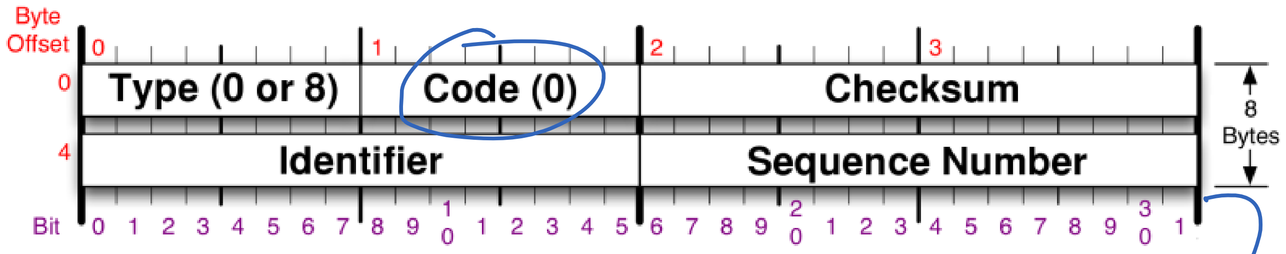
ICMP Type
18 Address Mask Reply

🟩 ICMP QUERY OR RESPONSE
🟥 ICMP ERROR MESSAGE

ICMP Protocol Header Format
Created by Troy Jessup - http://www.troyjessup.com

code: subtype

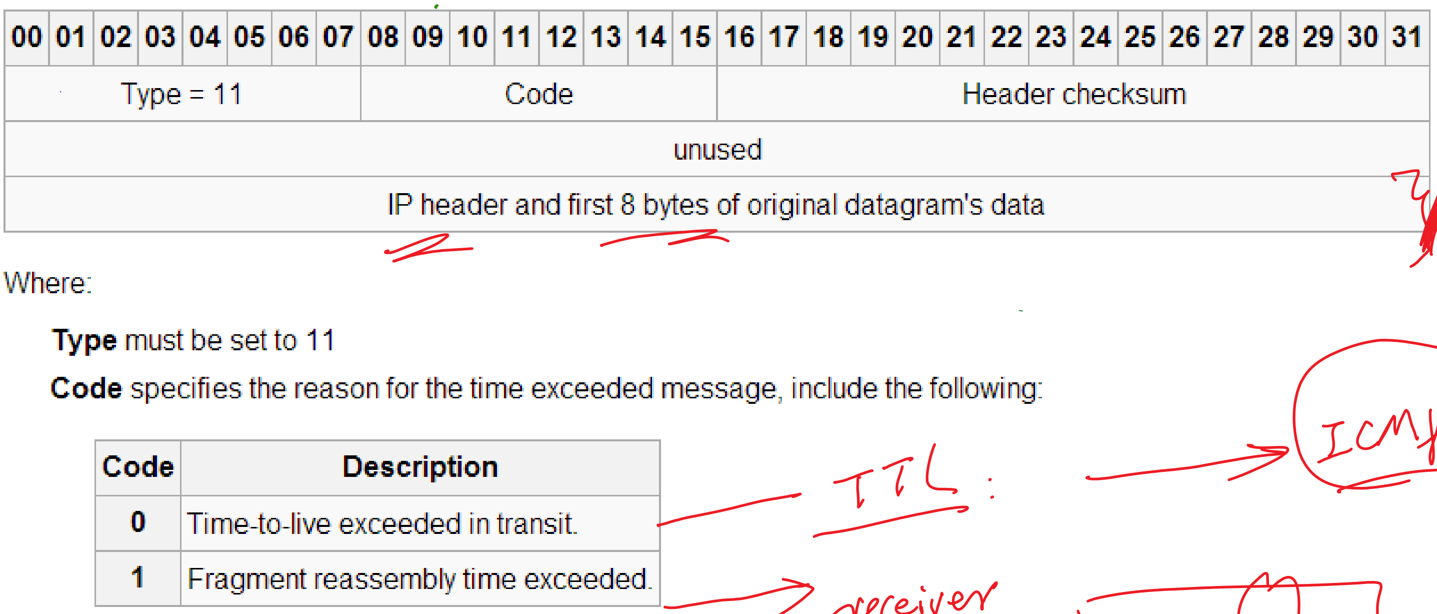
ICMP Echo Request/Reply



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

Data

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

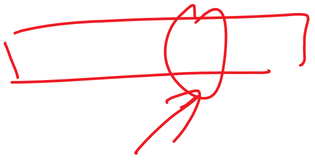
Code specifies the reason for the time exceeded message, include the following:

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

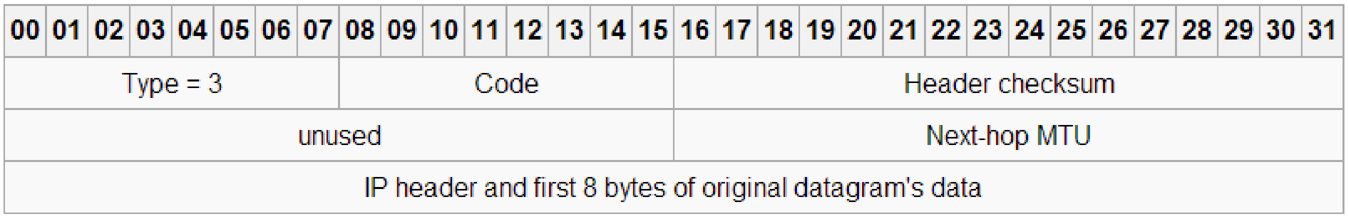
TTL :

ICMP

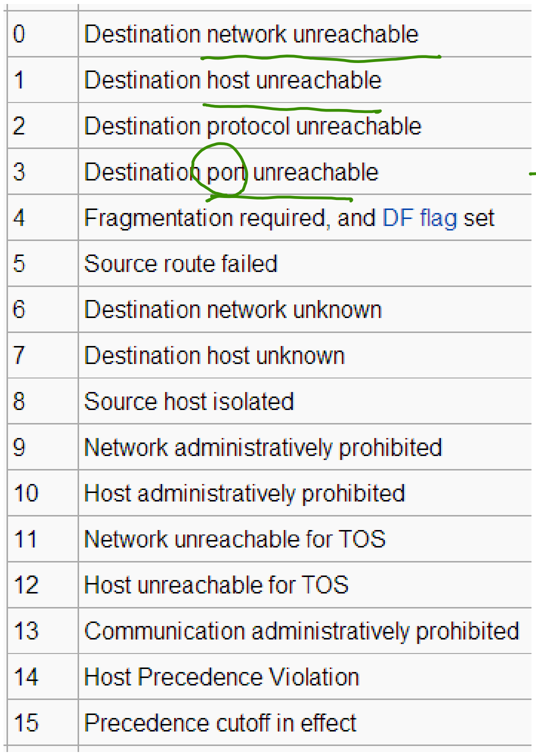
receiver



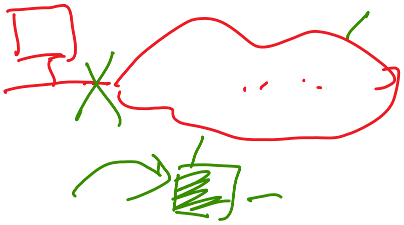
ICMP Destination Unreachable



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



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Attacks on ICMP

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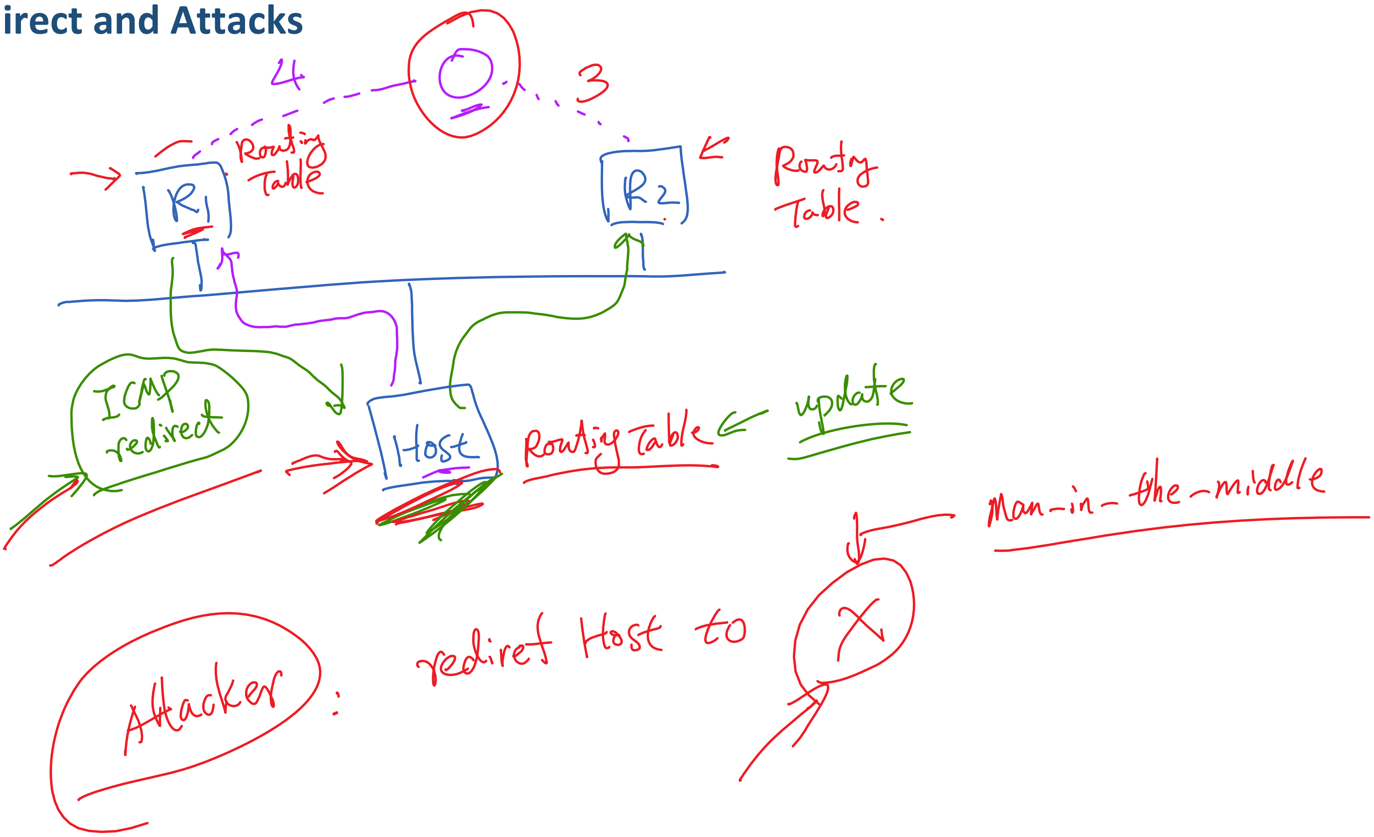
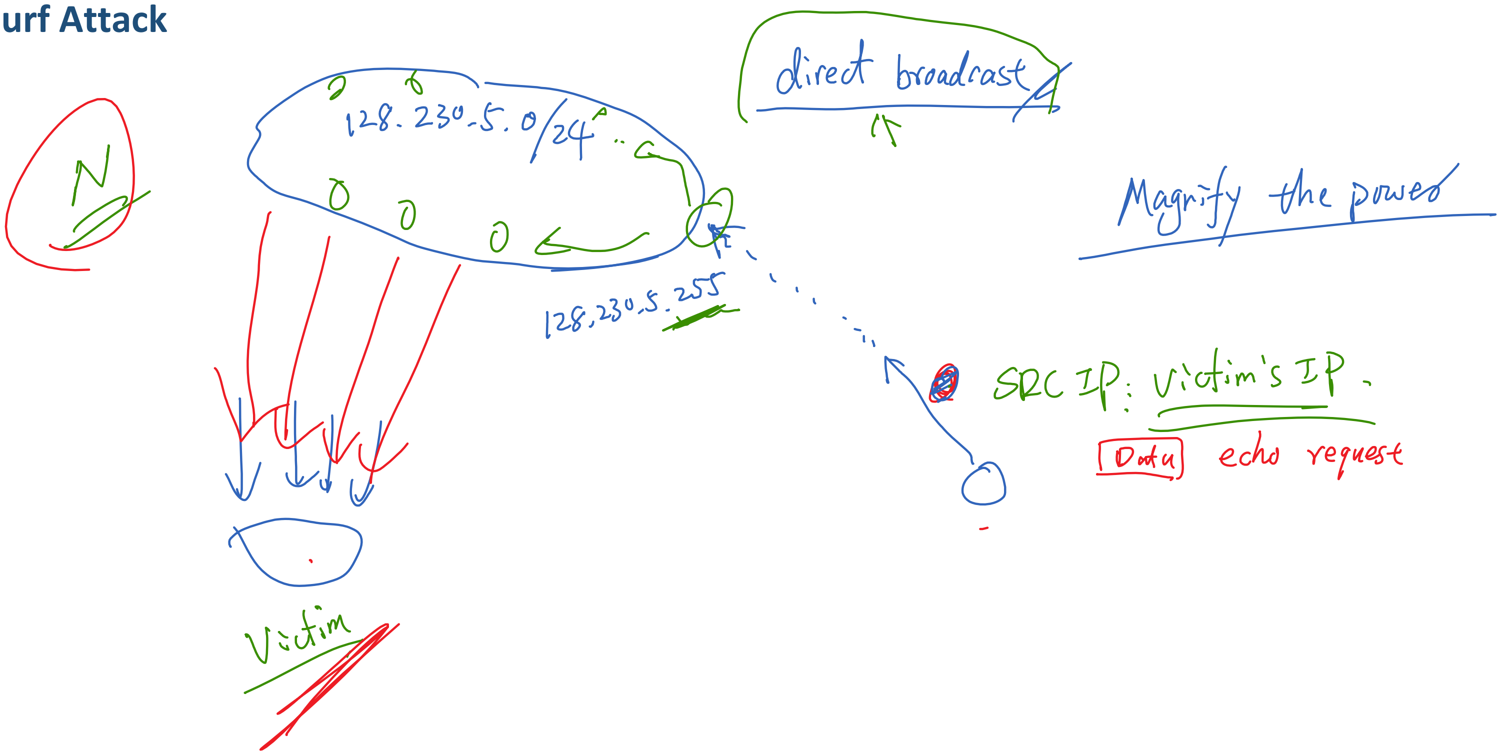
ICMP Redirect and Attacks



Smurf Attack



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Routing

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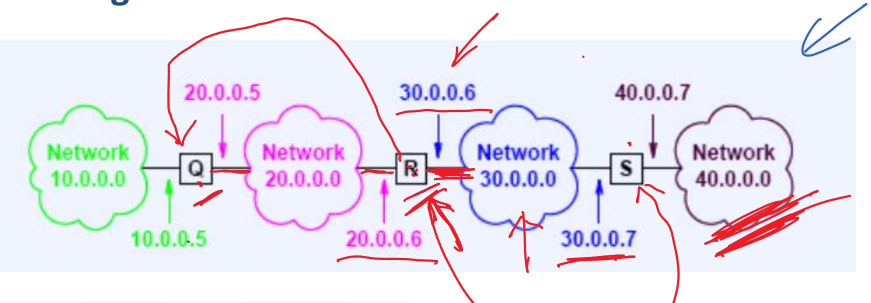
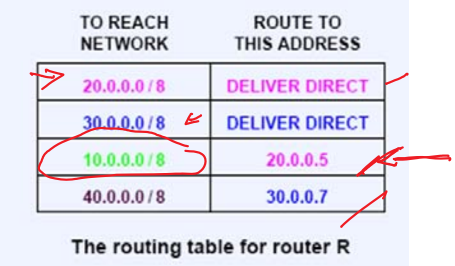
Routing





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: routing tables
routing decision.

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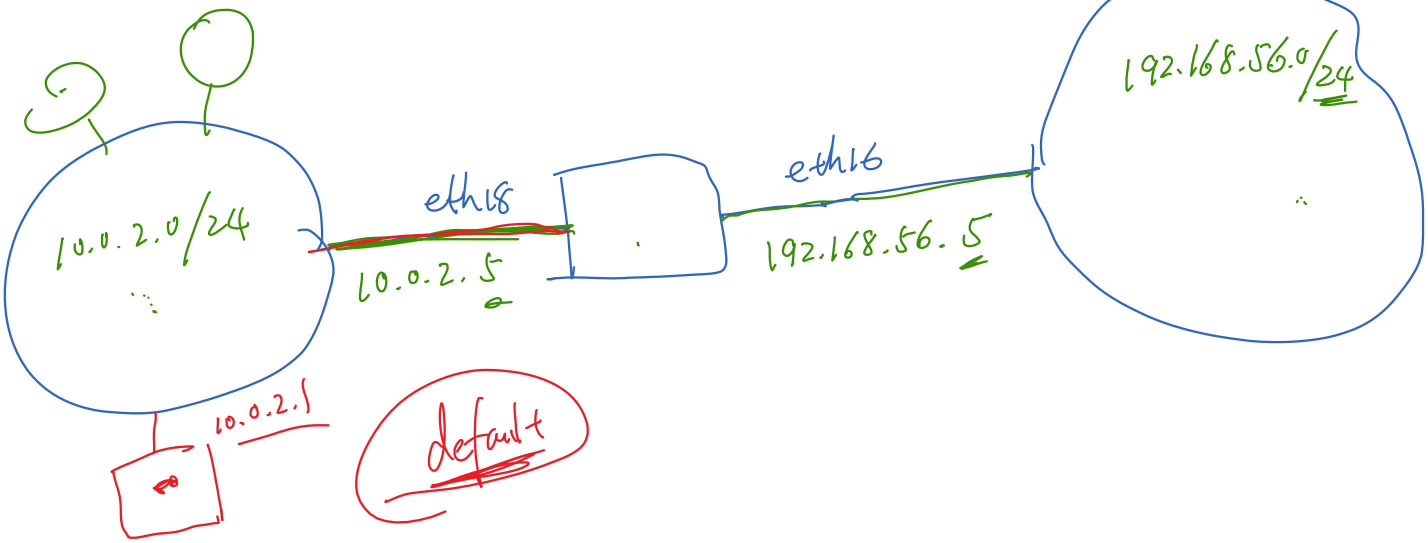
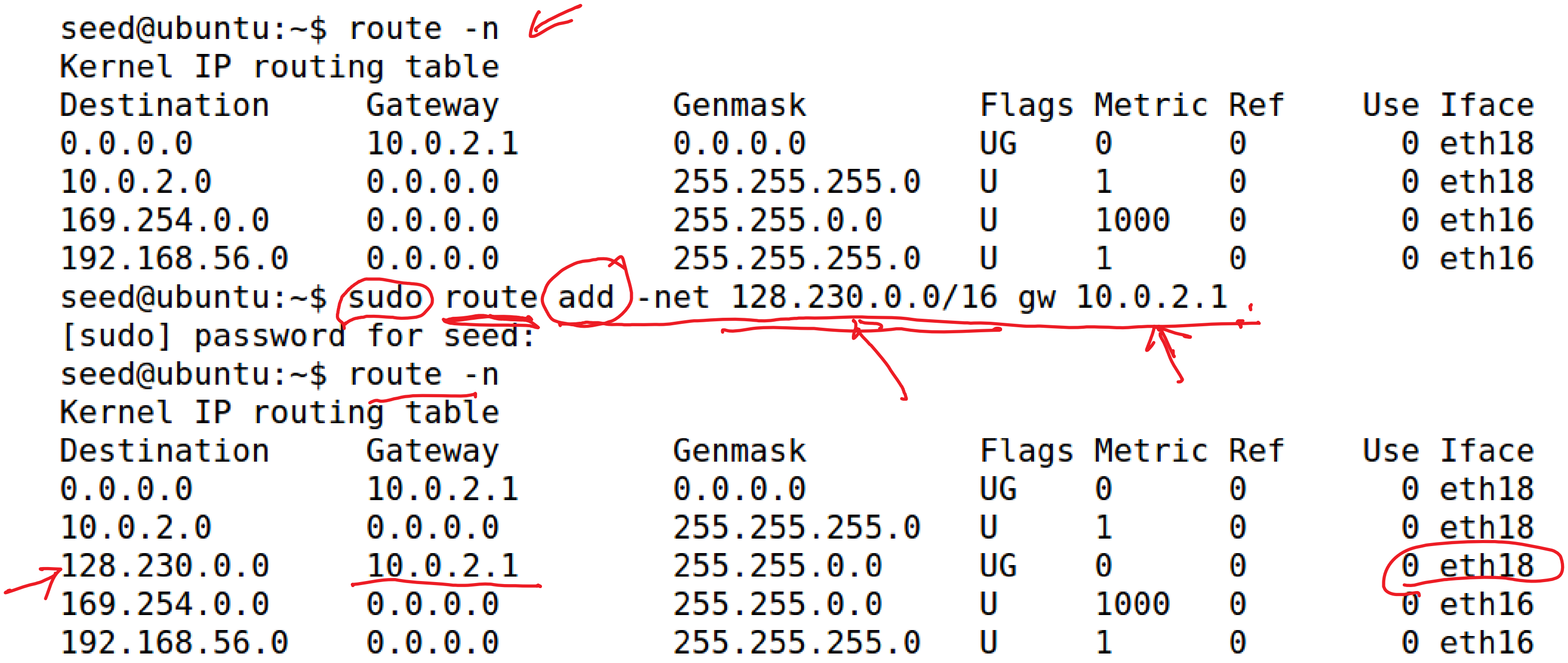
Routing Table

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       1 10.0.2.1        0.0.0.0         UG    0      0        0 eth18
10.0.2.0      2 0.0.0.0         255.255.255.0   U     1      0        0 eth18
169.254.0.0   3 0.0.0.0         255.255.0.0     U     1000   0        0 eth16
192.168.56.0  4 0.0.0.0         255.255.255.0   U     1      0        0 eth16
```

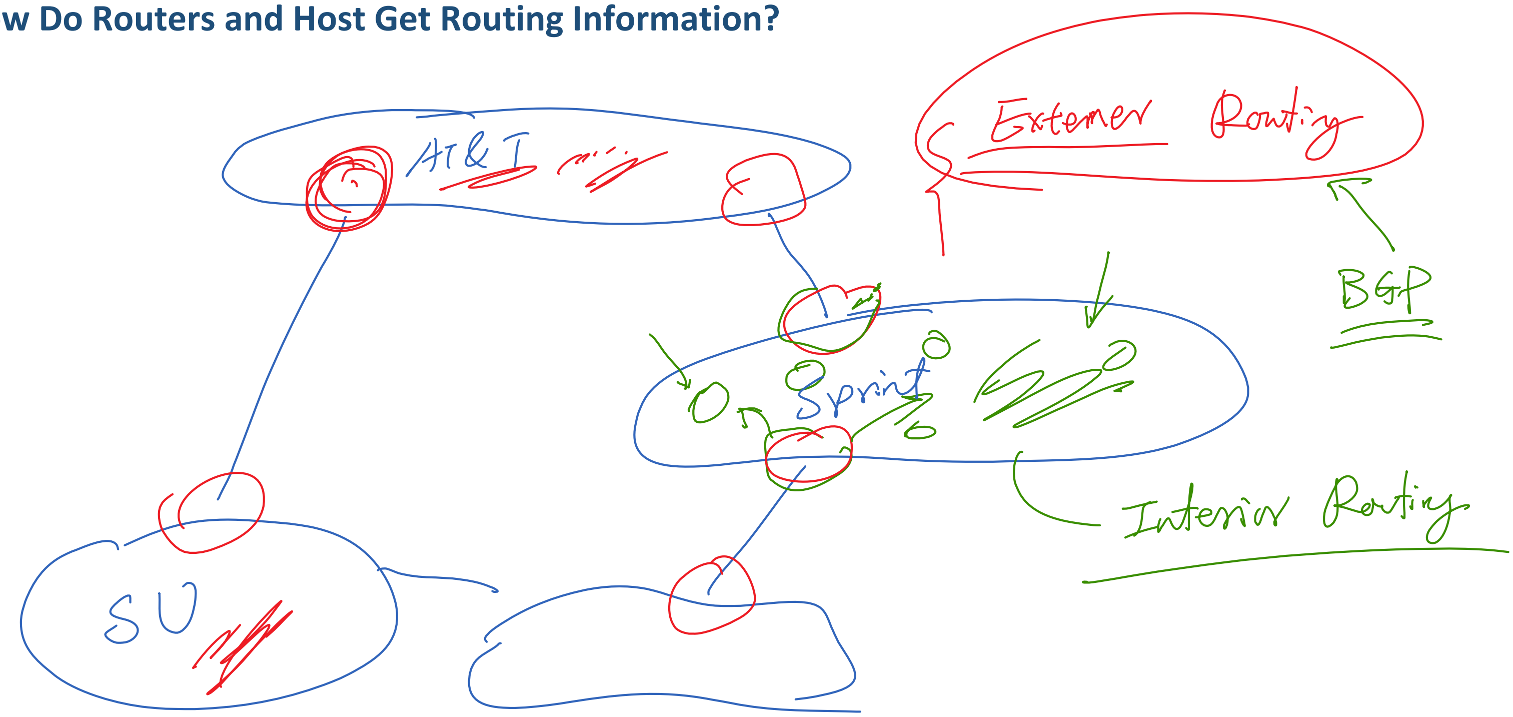


Change Routing Table



```
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?



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Summary

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Summary

- IP protocol
- IP fragmentation
- Attacks on IP fragmentation
- ICMP protocol
- Attacks on ICMP protocol
- Routing

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