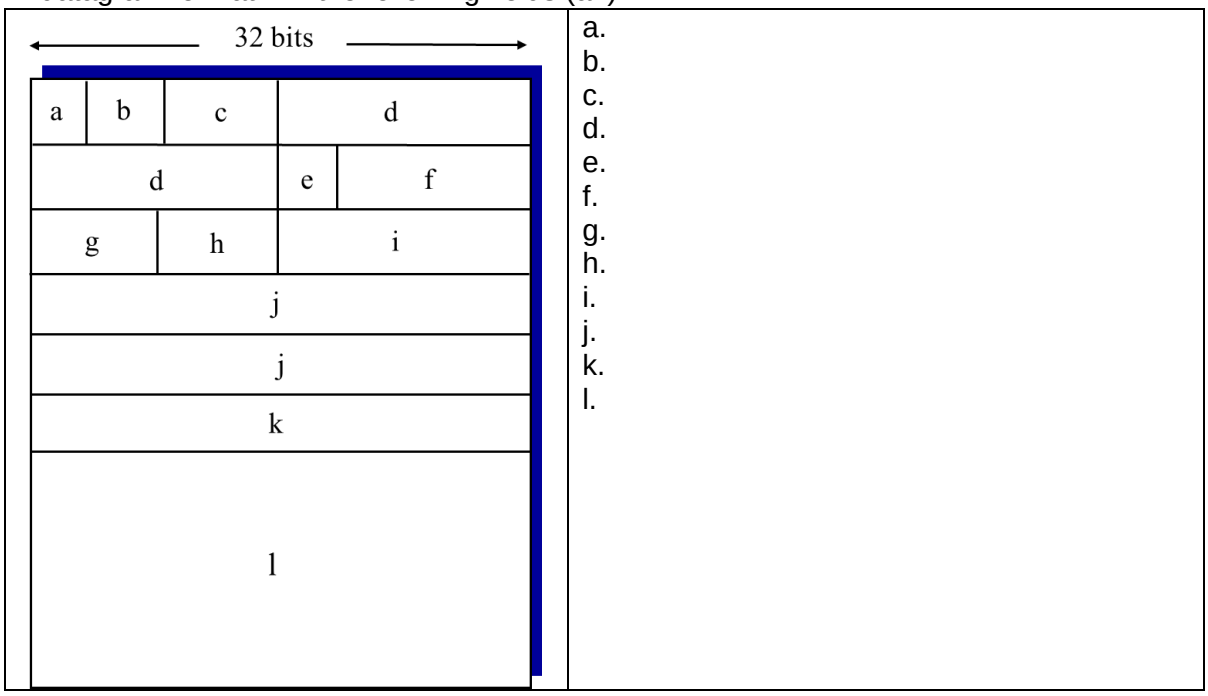
Tutorial questions for Chapter 4.

Expected time to complete: 1-2 weeks.

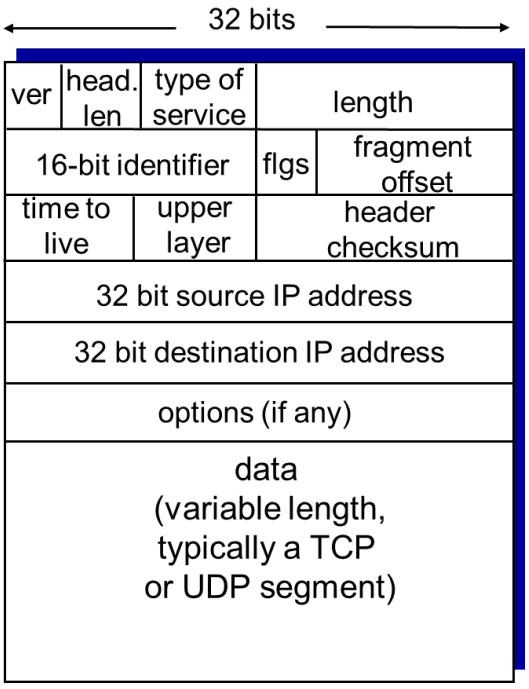
1. Briefly define/explain the following terms/concepts:
    a. Data plan
    b. Control plan
    c. Routing algorithm
    d. Forwarding table
    e. Link interface
    f. Routing protocol
    g. MTU
    h. CIDR
    i. DHCP
    j. NAT

2. IP datagram format. Fill the following fields (a-l).



a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.

Answer:



3. IP address classes of IPv4: Determine which class the following IP Address belongs to.

[Answers: class A, B, C, D, E, none, invalid IP address, For loopback or localhost only]

a. 172.16.1.20: class B
b. 192.168.1.1: belongs to class C of IPv4 addresses;
c. 0.0.0.0: none
d. 1.1.1.1: class A
e. 190.0.0.0: class B
f. 223.200.200.1: class C
g. 127.0.0.1: local host
h. 111.111.111.1: class A
i. 224.0.0.0: class D

Answers:

The IP address number 0.0.0.0 is a non-routable IPv4 address with several uses, primarily as a default or placeholder.

Ranges 127.x.x.x are reserved for the loopback or localhost, for example, 127.0.0.1 is the loopback address.

Class	Address range	Supports
Class A	1.0.0.1 to 126.255.255.254	Supports 16 million hosts on each of 127 networks.

Class B	128.1.0.1 to 191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.
Class C	192.0.1.1 to 223.255.254.254	Supports 254 hosts on each of 2 million networks.
Class D	224.0.0.0 to 239.255.255.255	Reserved for multicast groups.
Class E	240.0.0.0 to 254.255.255.254	Reserved for future use, or research and development purposes.

4. Subnet mask questions:

    a. What is the total number of usable hosts for IP address 224.1.1.1/24?

    b. What is the total number of usable hosts for IP address 224.1.1.1/27?

    c. Subnet the Address 160.30.0.0 into networks supporting 500 Hosts each. What is the New Subnet Mask and the IP Address Range of the first Network?

    d. Your company wants to utilize the private Class C IP Address of 192.168.1.0. You are tasked with Subnetting the Address to get the most networks with at least 30 Hosts per Subnet. How many Networks will be created after you subnet? What is the first usable IP Address in the Second Network range?

    e. Subnet the IP Address 210.30.12.0 so there are 60 Hosts in each network. What are the Broadcast Addresses of each Network?

Answers:

a. What is the total number of usable hosts for IP address 224.1.1.1/24?

IP address: 224.1.1.1

Network address: 224.1.1.0

Usable host IP range: 224.1.1.1 – 22.4.1.254

Broadcast address: 224.1.1.255

Number of hosts: 256

Number of usable hosts: 254

b. What is the total number of usable hosts for IP address 224.1.1.1/26?

https://www.calculator.net/ip-subnet-calculator.html?cclass=c&csubnet=26&cip=224.1.1.1&ctype=ipv4&printit=0&x=42&y=28

IP address: 224.1.1.1

Network address: 224.1.1.0

Usable host IP range: 224.1.1.1 – 22.4.1.62

Broadcast address: 224.1.1.63

Number of hosts: 64

Number of usable hosts: 62

All 4 of the Possible /26 Networks for 224.1.1.*

Network Address	Usable Host Range	Broadcast Address:
224.1.1.0	224.1.1.1 - 224.1.1.62	224.1.1.63
224.1.1.64	224.1.1.65 - 224.1.1.126	224.1.1.127
224.1.1.128	224.1.1.129 - 224.1.1.190	224.1.1.191
224.1.1.192	224.1.1.193 - 224.1.1.254	224.1.1.255

c. Subnet the Address 160.30.0.0 into networks supporting 500 Hosts each. What is the New Subnet Mask and the IP Address Range of the first Network?

https://www.calculator.net/ip-subnet-calculator.html?cclass=b&csubnet=23&cip=160.30.0.0&ctype=ipv4&printit=0&x=66&y=19

All 128 of the Possible /23 Networks for 160.30.*.*

Network Address	Usable Host Range	Broadcast Address:
160.30.0.0	160.30.0.1 - 160.30.1.254	160.30.1.255
160.30.2.0	160.30.2.1 - 160.30.3.254	160.30.3.255

d. Your company wants to utilize the private Class C IP Address of 192.168.1.0. You are tasked with Subnetting the Address to get the most networks with at least 30 Hosts per Subnet. How many Networks will be created after you subnet? What is the first usable IP Address in the Second Network range?

https://www.calculator.net/ip-subnet-calculator.html?cclass=c&csubnet=27&cip=192.168.1.0&ctype=ipv4&printit=0&x=87&y=25

All 8 of the Possible /27 Networks for 192.168.1.*

Network Address	Usable Host Range	Broadcast Address:
192.168.1.0	192.168.1.1 - 192.168.1.30	192.168.1.31
192.168.1.32	192.168.1.33 - 192.168.1.62	192.168.1.63
192.168.1.64	192.168.1.65 - 192.168.1.94	192.168.1.95
192.168.1.96	192.168.1.97 - 192.168.1.126	192.168.1.127
192.168.1.128	192.168.1.129 - 192.168.1.158	192.168.1.159
192.168.1.160	192.168.1.161 - 192.168.1.190	192.168.1.191
192.168.1.192	192.168.1.193 - 192.168.1.222	192.168.1.223
192.168.1.224	192.168.1.225 - 192.168.1.254	192.168.1.255

e. Subnet the IP Address 210.30.12.0 so there are 60 Hosts in each network. What are the Broadcast Addresses of each Network?

https://www.calculator.net/ip-subnet-calculator.html?cclass=any&csubnet=26&cip=210.30.12.0+&ctype=ipv4&printit=0&x=76&y=3

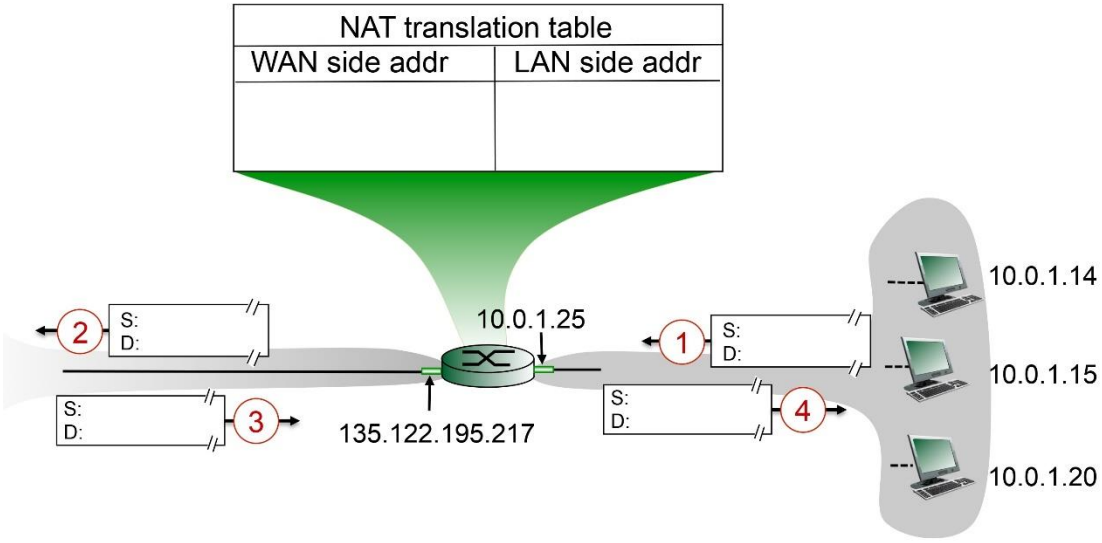
All 4 of the Possible /26 Networks for 210.30.12.*

Network Address	Usable Host Range	Broadcast Address:
210.30.12.0	210.30.12.1 - 210.30.12.62	210.30.12.63
210.30.12.64	210.30.12.65 - 210.30.12.126	210.30.12.127
210.30.12.128	210.30.12.129 - 210.30.12.190	210.30.12.191
210.30.12.192	210.30.12.193 - 210.30.12.254	210.30.12.255

5. NAT question.

Consider the scenario below in which three hosts, with private IP addresses 10.0.1.14, 10.0.1.15, 10.0.1.20 are in a local network behind a NATted router that sits between these three hosts and the larger Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.1.25, while the router's address on the Internet side has IP address 135.122.195.217.

Before doing this problem, you might want to reread the section on the NAT protocol in section 4.3.4 in the text.



Suppose that the host with IP address 10.0.1.14 sends an IP datagram destined to host 128.119.165.188. The source port is 3481, and the destination port is 80.

a. Consider the datagram at step 1, after it has been sent by the host but before it has reached the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

b. Now consider the datagram at step 2, after it has been transmitted by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram? Identify the differences in datagram's IP addresses and port numbers between step 1 and step 2. Specify the entry that has been made in the router's NAT table.

c. Now consider the datagram at step 3, just before it is received by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

d. Last, consider the datagram at step 4, after it has been transmitted by the NATted router but before it has been received by the host. What are the source and destination IP address for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram? Identify the differences in datagram's IP addresses and port numbers between step 3 and step 4. Has a new entry been made in the router's NAT table, or removed from the NAT table? Explain your answer.

Solution:

At Step 1:
source address of the IP datagram: 10.0.1.14
destination address of the IP datagram: 128.119.165.188
source port number for the TCP segment of the IP datagram: 3481
destination port number for the TCP segment of the IP datagram: 80

Host 10.0.0.14 has assigned an arbitrary source port number 3481 and sends the datagram to LAN. The datagram is received at the NAT router's right port.

At Step 2:
source address of the IP datagram: 135.122.195.217
destination address of the IP datagram: 128.119.165.188
source port number for the TCP segment of the IP datagram: 5116
destination port number for the TCP segment of the IP datagram:80

After receiving the datagram from host 10.0.0.14, the NAT router generates a new source port number 5116 (not already in use within the NAT table) for the datagram and replaces the original source port number 3481 with the new source port number 5116. The traffic leaving the home router for the larger internet has the source IP of the NAT router which is 135.122.195.217, and thus the datagram's source IP address now changes to 135.122.195.217. The destination address and the port number remain the same. The NAT table, after step 2, looks like (see Figure 4.25 in text):

WAN-side address	LAN-side address
135.122.195.217, 5116	10.0.1.14, 3481

At Step 3:
source address of the IP datagram: 128.119.165.188
destination address of the IP datagram: 135.122.195.217
source port number for the TCP segment in the IP datagram: 80
destination port number for the TCP segment in the IP datagram: 5116

This arriving datagram was sent by remote host 128.119.165.188 in response to the datagram sent by this NAT router in Step 2 above.

At Step 4:
source address of the IP datagram: 128.119.165.188
destination address of the IP datagram: 10.0.1.14
source port number for the TCP segment of the IP datagram: 80
destination port number for the TCP segment of the IP datagram: 3481

When this datagram arrived at NAT router's left port from the Internet, the router indexed the NAT translation table using the destination IP address and destination port number to obtain the appropriate IP address(10.0.1.14) and destination port (3481) for the destination host in the home network. The router then rewrites the datagram's destination address and destination port number, and forwards the datagram into the home network.