COMP90007 Internet Technologies
Week 6 Workshop

Semester 2, 2018

Suggested solutions

Question 1

If there are n independent paths between two nodes in a network, and the probability that an individual path is working is p, what is the probability of these two nodes being connected? Assume path failures are independent.

Hint: first try to calculate what is the probability that all paths have failed

Answer:

Pr(nodes connected)
= 1 − Pr(no connection)
= 1 − Pr(all paths failed)
= 1 − Pr(individual path failure)^n *(assuming independent events)*
= 1 − [1 − Pr(individual path working)]^n
= $1 - (1 - p)^n$

Question 2

Give two example computer applications for which connection-oriented service is appropriate, and two examples for which connectionless service is best.

Answer:
File transfer (FTP), remote login (SSH/telnet), web surfing (HTTP) and email (SMTP/IMAP/POP) need *connection-oriented* service. Lost packets are unacceptable.

On the other hand, point-of-sale terminals and many forms of remote database access are inherently *connectionless*, with a query going one way and a reply and coming back the other way. Other examples include P2P, VPN, video/audio streaming and some online games, where we don't care too much about lost packets.

Question 3

Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?

Answer:
Yes. A large noise burst could garble a packet badly. With a k-bit checksum, there is a probability of 2^{-k} that the error is undetected. If the destination field, or equivalently, virtual circuit number is changed, the packet will be delivered to the wrong destination and accepted as genuine. Put in other words, an occasional noise burst could change a perfectly legal packet for one destination into a perfectly legal packet for another destination.

Question 4

Is fragmentation needed in concatenated virtual-circuit internet or only in datagram systems?

Answer:
It is needed in both. Even in a concatenated virtual circuit network, some networks along the path might accept 1024-byte packets, and others might only accept 48-byte packets. Fragmentation is still needed.

Question 5

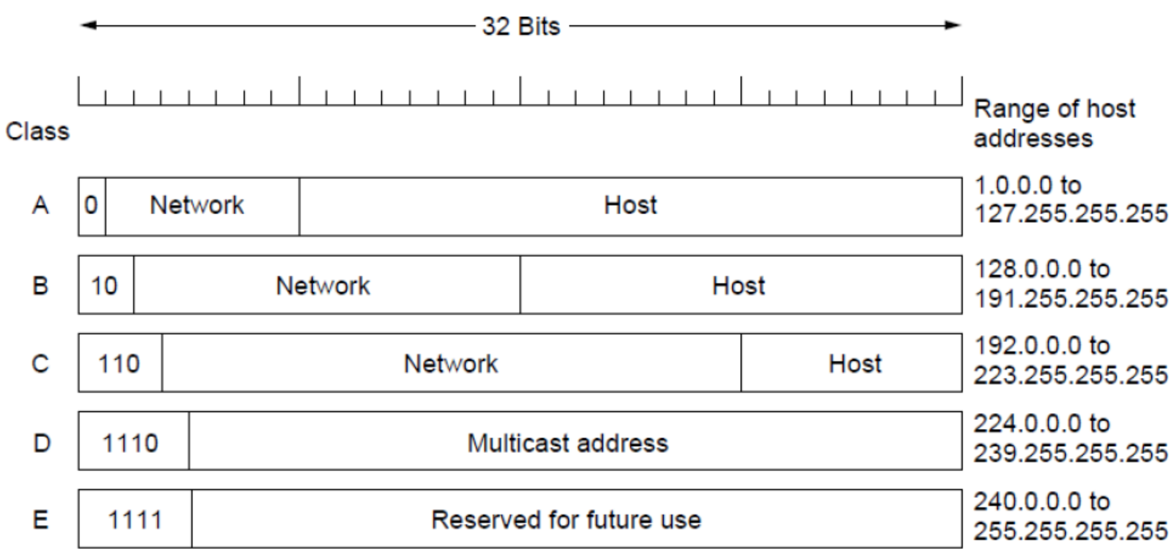
A router blasting out IP packets whose total length (header plus data) is 1024 bytes. Assuming that packets live for 10 sec, what is the maximum line speed the router can operate at without danger of cycling through the IP datagram ID number space (*identification* field – 16 bits)?

Answer:
If the bit rate of the line is b, the number of packets/sec that the router can emit is b/(1024×8), so the number of seconds that it takes to emit a packet is 8192/b = 2^{13}/b.

To put out 65,536 packets takes (2^{16}×2^{13})/b sec.
Equating this to the maximum packet lifetime, we get 2^{29}/b = 10. Then b is about 53,687,091 bps.

Question 6

Suppose that instead of using 16 bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been?



Answer:

With a 2-bit prefix, there would have been 18 bits left over to indicate the network. Consequently, the number of networks would have been 2^{18} or 262,144.

However, all 0s and all 1s are special, so only 262,142 are available.

(This is an old way of doing things and now it is generally not used anymore.)

Question 7

Convert the IP address 11000001, 01010010, 11010010, 00001111 to dotted decimal notation.

Ans. 193.82.210.15

Question 8

Convert the IP address 240.68.10.10 to binary format

Use the following key:

10000000	2^7	128
01000000	2^6	64
00100000	2^5	32
00010000	2^4	16
00001000	2^3	8
00000100	2^2	4
00000010	2^1	2
00000001	2^0	1

Ans. 1111 0000 . 0100 0100 . 0000 1010 . 0000 1010

Question 9

A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts that it can handle?

Answer:
255.255.240.0 in binary is 11111111 11111111 11111111 11110000 0000000

The mask is 20 bits long, so the network part is 20 bits. The remaining 12 bits are for the host, so 4096 host addresses exist.

Question 10

A router has just received the following IP addresses: 57.6.96.0/21, 57.6.104.0/21, 57.6.112.0/21 and 57.6.120.0/21. If all of them use the same outgoing line, can they be aggregated? If so, to what? If not, why not?

Answer:

They can be aggregated to 57.6.96.0/19

Question 11

A router has the following (CIDR) entries in its routing table:

Address/mask	Next hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
135.46.0.0/16	Router 0
192.53.40.0/23	Router 1
default	Router 2

For each of the following IP addresses, what does the router do if a packet with that address arrives?

a) 135.46.63.10 b) 135.46.57.14 c) 135.46.52.2
d) 192.53.40.7 e) 192.53.56.7 f) 135.46.22.35

Answer:

The packets are routed as follows:

a) Interface 1 b) Interface 0
c) Router 0 d) Router 1
e) Router 2 f) Router 0

Question 12

IPv6 uses 16 bytes addresses. If a block of 1 million addresses is allocated every picosecond, how long will the addresses last?

Answer:

With 16 bytes there are 2^{128} or addresses. If we allocate them at a rate of $10^6 / 10^{-12} = 10^{18}$ addresses per second. Therefore it will take 3.4×10^{20} seconds to run out of IP addresses, which is about 10^{13} years.

This number is 1000 times the age of the universe. Of course, the address space is not flat, so they are not allocated linearly, but this calculation shows that even with an allocation scheme that has an efficiency of 1/1000 (0.1 percent), one will never run out.

Additional Questions

Question 1

A router an entry in its table that can be represented with mask as 135.46.56.0/21. What is the maximum number of hosts that this network can represent?

Ans. 21 bits means network has 21 bits reserved, and remaining 11 bits are for hosts.

Hence maximum number of hosts is 2^11 = 2048

Question 2

A router has the following (CIDR) entries in its routing table:

Address/mask	Next hop
151.46.184.0/22	Interface 0
151.46.188.0/22	Interface 1
151.53.40.0/23	Router 1
default	Router 2

For each of the following IP addresses, what does the router do If a packet with that address arrives?

(a) 151.46.191.10

⇒ Interface 1

(b) 151.46.187.2

⇒ Interface 0

(c) 192.53.40.7

⇒ Router 2