Empowerment Technologies – Networking Technologies Review Notes for Q3 Periodical Test

NOTE: This is supplementary material to delve into some topics that we may not have covered as deeply as we should have during class. You should still refer to you're the Mastery Test Review Notes, your lecture notes, and the Powerpoint slides, Module1.pptx to Module6.pptx, to prepare for the exam.

Discussion of Mastery Test Questions

IP NETWORKING

Consider the network and the devices below.

1. 1 Point. How many subnets are there in the network?
2. 3 Points. Write down the subnets and the device IP addresses in each subnet.
3. 2 Points. Write down the devices that can connect directly to the device 192.168.1.2
4. 1 Point. What network setting should be changed to put all the devices under one network, so that they can all communicate with each other?
5. 3 Points. Modify the IP address and subnet mask of all six devices to put them all on the same network.

Answers

First, determine the network address of each device.

192.168.1.1/24 (or 192.168.1.1/255.255.255.0) – network address: 192.168.1.0
192.168.1.2/24 (or 192.168.1.2/255.255.255.0) – network address: 192.168.1.0
192.168.2.1/24 (or 192.168.2.1/255.255.255.0) – network address: 192.168.2.0
192.168.2.2/24 (or 192.168.2.2/255.255.255.0) – network address: 192.168.2.0
192.168.3.1/24 (or 192.168.3.1/255.255.255.0) – network address: 192.168.3.0
192.168.3.2/24 (or 192.168.3.2/255.255.255.0) – network address: 192.168.3.0

Having done so, the answers are now straightforward.

1. *How many subnets are there in the network?*

   There are 3 subnets, with the following network addresses: 192.168.1.0, 192.168.2.0 and 192.168.3.0.

2. *Write down the subnets and the device IP addresses in each subnet.*

   192.168.1.0 network: 192.168.1.1, 192.168.1.2
   192.168.2.0 network: 192.168.2.1, 192.168.2.2
   192.168.3.0 network: 192.168.3.1, 192.168.3.2

3. *Write down the devices that can connect directly to the device 192.168.1.2*

   Devices in the 192.168.1.0 network can connect to 192.168.1.2. These are 192.168.1.1 and 192.168.1.2.

4. *What network setting should be changed to put all the devices under one network?*

   Changing the subnet mask of all devices to /16 will put all devices under one network. The answer to the next question explains further.

   Changing the IP addresses will also put the devices under one network.

5. *Modify the IP address and subnet mask of all devices to put them under the same network.*

   a) One approach is to change just the subnet mask:

      Change the subnet mask, from /24 (or 255.255.255.0) to /16 (or 255.255.0.0). With a 255.255.0.0 network mask, this will be the network addresses of each device:

      192.168.1.1 -> 192.168.0.0
      192.168.1.2 -> 192.168.0.0
      192.168.2.1 -> 192.168.0.0
      192.168.2.2 -> 192.168.0.0
      192.168.3.1 -> 192.168.0.0
      192.168.3.2 -> 192.168.0.0

      Because all network devices will be under one network, they can all communicate with each other.

      Change the subnet mask to /8, or 255.0.0.0 is also an acceptable answer.

      Exercise: What will be the network address of each device if the subnet mask is changed to 255.0.0.0?

b) Another approach is to change the IP addresses. For example, move them all under the 192.168.1.0 network:

192.168.1.1 -> 192.168.1.1
192.168.1.2 -> 192.168.1.2
192.168.2.1 -> 192.168.1.3
192.168.2.2 -> 192.168.1.4
192.168.3.1 -> 192.168.1.5
192.168.3.2 -> 192.168.1.6

THROUGHPUT CALCULATIONS

Always remember to convert bytes to bits when the throughput is given in bits per second (e.g. Kbps, Mbps, Gbps, etc.)

1. *Calculate how long it will take to download a 1GB file over a 1Gbps connection.*

   1GB = 1GB x 8 bits/byte = 8Gb

   download time = 8Gb/1Gbps = 8 seconds

2. *Calculate how long it will take to download a 500MB file over a 10Mbps connection.*

   500MB = 500MB x 8 bits/byte = 4000Mb
   download time = 4000Mb/10Mbps = 400 seconds

3. *In 1995, the fastest Internet connection over standard telephone lines is 14.4kbps. How long will it take to download a 1800KB file over a standard telephone line?*

   File size in kilobits = 1800KB x 8 bits/byte = 14400 Kb
   download time = 14400Kb/14.4kbps = 1000s

4. *You are preparing a second data center in Baguio City. You need to copy a 1000GB database backup from your Makati data center to the new data center in Baguio City. The two data centers are connected by a 50Mbps network connection. Which will be faster: copying the files through the network, or copying the file to a hard disk and driving the hard disk to Baguio City? Assume the drive takes 4 hours. Prove your answer with calculations.*

   There are two approaches. You can calculate the throughput and compare, or calculate the network transfer time and compare.

   a) Compare the throughputs

   Calculate the throughput of the Drive to Baguio operation:

   First, convert the units to Mbits and seconds:
   1000GB = 1000GB x 1024MB/GB x 8 bits/byte = 8192000 Mb
   4 hours = 3600 seconds/hour x 4 = 14400 s

   Now the throughput calculation is straightforward:
   throughput = 8192000 Mb/14400 s = 568 Mbps

   568Mbps > 50Mbps, therefore driving to Baguio is faster.

   b) Compare the transfer time

   1000GB = 8192000 Mb
   transfer time through the network = 8192000Mb / 50 Mbps = 163840 s

   Drive to Baguio time = 4 hours = 4hr x 3600s/hr = 14400 s

   14400 s < 163840 s, therefore driving to Baguio is faster

5. *In 1982, Lockheed Martin needed to get copies of graphic design projects from Sunnyvale, California, to Felton, California, 48 kilometers away. They captured the graphic designs in microfilm and used carrier pigeons to transport the microfilm. It takes a pigeon an average of 40 minutes to fly from Sunnyvale to Felton. Assuming the following:*
   - the system uses eight pigeons
   - each pigeon can carry 2 microfilms
   - each microfilm is worth 1MB of data
   Calculate the throughput, in MB per minute, of the Lockheed Martin pigeon network.

   First, gather the data and discard the ones that are not relevant to the question. The only relevant parts are:

   - there are eight pigeons
   - each pigeon can carry 2 x 1MB each
   - travel time is 40 minutes

   throughput = 8 pigeons x 2 MB/pigeon / 40 minutes
   = 16MB/40 minutes
   = 0.4 MB/minute

Network Troubleshooting Tools

ifconfig / ipconfig

This command returns information about the machine's network configuration:

- List of network interfaces (Ethernet card, Wifi adapter, etc.)
- IP configuration of each network device: IP address, netmask, default gateway

netstat

This command returns a list of the open network connections. This can be used to determine:

- if there an open connection from this device to a specific device
- if there is a process running on this device that is using a specific network service, e.g. http

Example:
C:\Users\RadamanthusBatnag>netstat

Active Connections

```
  Proto  Local Address          Foreign Address        State
  TCP    127.0.0.1:49703        DESKTOP-N1CR2G2:49704  ESTABLISHED
  TCP    127.0.0.1:49704        DESKTOP-N1CR2G2:49703  ESTABLISHED
  TCP    127.0.0.1:49705        DESKTOP-N1CR2G2:49706  ESTABLISHED
  TCP    127.0.0.1:49706        DESKTOP-N1CR2G2:49705  ESTABLISHED
  TCP    127.0.0.1:49707        DESKTOP-N1CR2G2:49708  ESTABLISHED
  TCP    127.0.0.1:49708        DESKTOP-N1CR2G2:49707  ESTABLISHED
  TCP    127.0.0.1:49971        DESKTOP-N1CR2G2:49972  ESTABLISHED
  TCP    127.0.0.1:49972        DESKTOP-N1CR2G2:49971  ESTABLISHED
  TCP    127.0.0.1:50024        DESKTOP-N1CR2G2:50025  ESTABLISHED
  TCP    127.0.0.1:50025        DESKTOP-N1CR2G2:50024  ESTABLISHED
  TCP    192.168.1.104:49672    52.230.3.194:https     ESTABLISHED
  TCP    192.168.1.104:49697    153.254.86.142:27020   ESTABLISHED
  TCP    192.168.1.104:50071    sc-in-f99:https        ESTABLISHED
  TCP    192.168.1.104:50072    ec2-52-26-56-183:https  TIME_WAIT
  TCP    192.168.1.104:50073    ti-in-f94:https        ESTABLISHED
  TCP    192.168.1.104:50074    114.108.207.152:http   ESTABLISHED
  TCP    192.168.1.104:50075    114.108.207.25:https   ESTABLISHED
```

host / nslookup

This returns the IP address of a hostname.

Example:
C:\Users\RadamanthusBatnag>nslookup portal.office.com
Server: google-public-dns-a.google.com
Address: 8.8.8.8

Non-authoritative answer:
Name: b-0004.b-msedge.net
Addresses: 2620:1ec:a92::156
          13.107.6.156
Aliases: portal.office.com
          geo.portal.office.akadns.net
          nonus_edge.portal.office.akadns.net
          portal-office365-com.b-0004.b-msedge.net

ping

This command is used to determine if another host is reachable, and returns the network connection speed to the other host.

Example:

C:\Users\RadamanthusBatnag>ping portal.office.com

Pinging b-0004.b-msedge.net [13.107.6.156] with 32 bytes of data:
Reply from 13.107.6.156: bytes=32 time=55ms TTL=117
Reply from 13.107.6.156: bytes=32 time=55ms TTL=117
Reply from 13.107.6.156: bytes=32 time=58ms TTL=117
Reply from 13.107.6.156: bytes=32 time=55ms TTL=117

Ping statistics for 13.107.6.156:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 55ms, Maximum = 58ms, Average = 55ms

traceroute / tracert

This command is used to analyze the network connection and identify bottlenecks to a specific host.

Example:

C:\Users\RadamanthusBatnag>tracert portal.office.com

Tracing route to b-0004.b-msedge.net [13.107.6.156]
over a maximum of 30 hops:

1	<1 ms	<1 ms	<1 ms	192.168.1.1
2	<1 ms	<1 ms	<1 ms	192.168.0.1
3	*	*	*	Request timed out.
4	9 ms	9 ms	10 ms	172.31.64.1
5	11 ms	10 ms	9 ms	130.105.0.18
6	40 ms	40 ms	57 ms	3257.sgw.equinix.com [27.111.228.217]
7	49 ms	39 ms	55 ms	xe-1-3-0.cr0-sin1.ip4.gtt.net [89.149.133.21]
8	55 ms	54 ms	54 ms	corero-gw.ip4.gtt.net [183.182.80.62]
9	53 ms	61 ms	53 ms	ae12-0.sg2-96cbe-1a.ntwk.msn.net [104.44.225.116]
10	*	*	*	Request timed out.
11	*	*	*	Request timed out.
12	56 ms	55 ms	55 ms	13.107.6.156

Comparing the ping output (55-58ms) and the tracert output, you can surmise that the bulk of the network delay to portal.office.com is in the hop between 130.105.0.18 and 27.111.228.217 (row 5 and 6). Hop 5 took only 11ms, but hop 6 took 40ms.