Network Architecture HW-1

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Network Architecture

Home Work -1

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1. **(a) (10 points) Consider a packet of length 2,500 bytes begins its journey from end system A and travels over four links connected by three routers to a destination end system B. The queueing delay in each router is 3 msec and there is no processing delay in these routers. Suppose the propagation speed on all four links is $3.7X10^6$ m/s, the transmission rates of all three links are 1.5 Mbps, the packet switch processing delay at A and B are 3 and 4 msec respectively, the length of links are 5,000 km, 4,000 km, 3000 km and 2,000 km. For these values, calculate the end-to-end delay.**

End system A End system B

Solution:

(a) Length of packet = 2500bytes = 2500 * 8 = 20,000bits

Queueing delay in each router = 3msec

Total Queueing delay in all routers = 3*3 = 9msec

Processing delay = 0

Propagation speed on all four links: S = 3.7 * 10^6 m/s

Transmission rate of each link: = 1.5Mbps

Packet switch processing delay at A: Ta = 3msec

Packet switch processing delay at B: Tb = 4msec

Lengths of links: D1 = 5000km
D2 = 4000km
D3 = 3000km
D4 = 2000km

Total End To End delay = Transmission delay + Propagation delay + packet switching delay + Queueing delay

Transmission delay = L/R
L = 20000bits
R = 1.5Mbps = 1.5 * 10^6 bits/sec

Transmission delay per one link: Ttrans = L/R = 2 * (10^4) / 1.5 * (10^6)
Ttrans = 0.013msec

Total Transmission delay for four links = Ttrans * 4
= 0.013msec * 4
Total Transmission delay in all links: **= 0.053msec**

Propagation delay = D/S
Propagation delay in link 1 = Pd1 = D1/S
= 5000 * 10^3 / 3.7 * 10^6
= 1.35sec

Propagation delay in link 2 = Pd2 = D2/S
= 4000 * 10^3/3.7 * 10^6
=1.08sec

Propagation delay in link 3 = Pd3 = D3/S
= 3000 * 10^3/3.7 * 10^6
=0.81sec

Propagation delay in link 4 = Pd4 = D4/S
= 2000 * 10^3/3.7 * 10^6
=0.54sec

Total propagation delay: Tprop = Pd1 + Pd2 + Pd3 + Pd4
= 1.35 + 1.08 + 0.81 + 0.54
Tprop = 3.78sec

Packet switching delay at A: Ta = 3ms = 0.003s (We only consider 'Ta' we don't need packet switching delay at end system 'B'(Tb) because the switching time in end system B doesn't come under end to end delay.)
Packet switching delay at B: Tb = 4ms = 0.004s

Total End To End delay = Transmission delay + Propagation delay + packet switching delay + Queueing delay
= 0.053 + 3.78 + 0.003 + 0.009
= 3.845sec

End to End delay = 3.845sec

(b) (10 points) Now, for the above scenario consider that the end system B sends an acknowledgement packet of length 2 bytes after receiving the packet successfully. After how long, A will receive the acknowledgement after sending the main packet? Consider that there is no queueing and processing delay while sending the acknowledgement packet in both routers and end systems.

Solution:
(b)

Acknowledgement packet length = 2bytes = 2 * 8 = 16bits
Processing delay = 0sec
Queuing delay = 0sec
Transmission delay = L/R
L = 16bits
R = 1.5 * 10^6 bits/sec

Transmission delay = L/R = 16/1.5 * (10^6)
= 0.0000106sec

Total Transmission delay in all four links = 4 * 0.0000106
= 0.0000424sec

Propagation delay from above problem: Tprop = 3.78sec

The acknowledgement packet at A will be received after the time:

= Transmission delay + Propagation delay
= 3.78 + 0.0000424
= 3.78sec

Total time for receiving acknowledgement packet at A from B after sending the main packet to B is:

= End to End delay from above problem + Time taken for acknowledgement packet to receive at system A
= 3.845 + 3.78
= 7.625sec.

Total time for receiving acknowledgement packet at A from B after sending the main packet to B is: 7.625sec

2. (20points) Read articles on two Internet pioneers from http://www.ibiblio.org/pioneers/index.html and write 1~2 paragraph(s) of your personal perspective (why you chose the person, what part of the story strikes/interests you, or what you learned from the story, etc.) on each person's story (thus 2~4 paragraphs total).

Solution:

Vannevar Bush:

I was extremely propelled by the narrative of Vannevar Bush. Even though he isn't specifically required with the creation and improvement of the Internet He is the principle purpose behind the present headway of web. Since his childhood Bush interested in inventing things. His first invention was land surveying device he called as profile tracer. He also made a proposal to FBI to build a machine that could review 1000 finger prints but they turned him down**.**

His inventive thought for computerizing human memory was essential part in the development digital age. The hypothetical machine he called "memex", which was to upgrade human memory by enabling the client to store and recover records connected by affiliations. His concept of "memex" was base for the present "Hypertext". Many others who did pioneering work with hypertext credited Bush as their main influence. His work to make a connection between the administration and the logical foundation amid WWII changed the way logical research is conveyed in the US. After this it prompted development of web. Bush proposed the arrangement of National Defense Research Committee to president Roosevelt and he consented to it and NDFC was built up later NDFC was subsumed into OSRD and Bush was made director to it.

Tim Berners-Lee:

Another person that inspired me was Tim Berners-Lee the one who invented World Wide Web. He also founded and directs the World Wide Consortium (W3) the forum for technical development of the web.

Tim Berners-Lee invented the web while at CERN, the European particle physics laboratory. Lee started work as Software Consultant at CERN. Where he developed a program called “Enquire” later which helped him to get a permanent position at CERN. He wrote HTTP (Hyper Text Transfer Protocol) the language computers would use to communicate hypertext documents over internet and designed a scheme to give documents addresses on the internet and called this address URI (Unified Resource Identifier). He also developed a client program (browser). He also developed HTML and first web server. This says he is the creator of entire web. Vannevar Bush theoretical concepts were the basis for these inventions.

3.(10 points) Briefly explain your understanding about IETF and RFC. What is the bandwidth-delay product?

Solution:

Internet Engineering Task Force(IETF): IETF is a large open worldwide community of network engineers, operators and researchers. The primary mission of IETF is to make internet work better. It intends to make the internet work better from an engineering point of view they are also concerned with the evolution of internet architecture

Request for Comments(RFC): RFC is a formal document from the Internet Engineering Task Force and Internet Society that is the result of committee drafting and subsequent review by interested parties. It is submitted for peer review or to convey new concepts, information. Some of the proposals published by RFC's are taken as Internet standards by IETF.

Bandwidth-Delay product: It is the product of bandwidth and the latency. Bandwidth delay product is very crucial concept in window-based protocols such as TCP. The important role of BDP is in the high-speed networks like broadband connections. It is used for tuning systems by tweaking TCP.

BDP = TotalAvailbleBandwidth(bits/sec) * RoundTripTime(Sec)

4.(20 points) Discuss on computer virus, worm, spyware, malware, and botnet. (maximum 5 sentences each).

Virus: A computer virus is a type of malicious program written to change the way a computer operates and that is designed to spread from one computer to another and can replicate itself. A virus operates by inserting or attaching itself to a legitimate program or document that supports macros to execute its code. In the process a virus has the potential to cause unexpected or damaging effects, such as harming the system software by corrupting or destroying data.

Worm: A computer worm is a self-replicating malware that gets passively executed by itself i.e. it can spread copies of itself form one computer to other without being activated by users. For example, worms can spread themselves to everyone in an email address book and then to everyone in their email address book thereby spreading to millions of computers.

Spyware: Spyware are the programs that secretly record what we do on our machine. They mainly capture keystrokes so if we type passwords, give bank details and credit card details in our machine they will automatically record at the hacker's end.

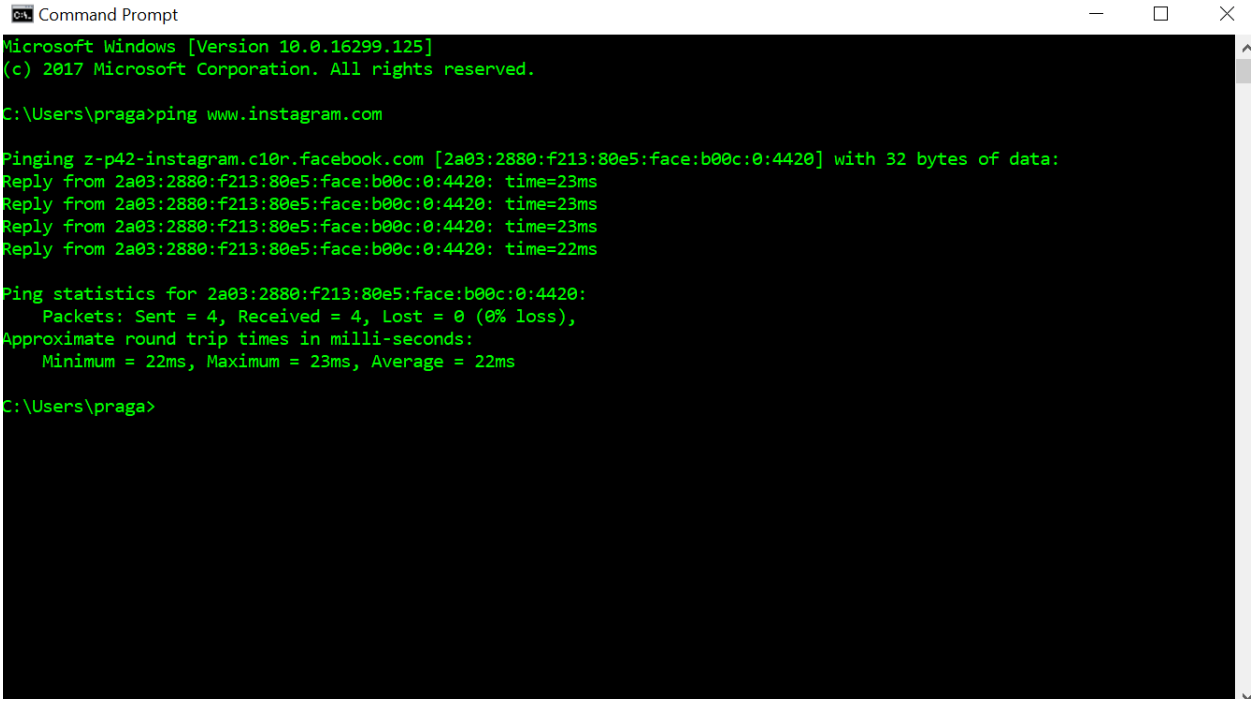
Malware: Malware means malicious software's, or the programs designed to damage and infiltrate computers or machines without user's consent. Malware covers all the security threats that occur to a computer or a machine. There are so many software in market to protect computers form these malwares.
Examples of malwares: Virus, Worms, Trojans

Botnet: Botnet is a type of malware that is made up of remote-controlled computers or bots. These bots are infected with malware that allows them to be controlled remotely. This allows hacker to control large number of computers for malicious purpose.

5. **(10 points) Run 'ping' and 'traceroute' at your favorite website. Record the commands and their output. Explain your observation from the output.**

Solution:
Ping:

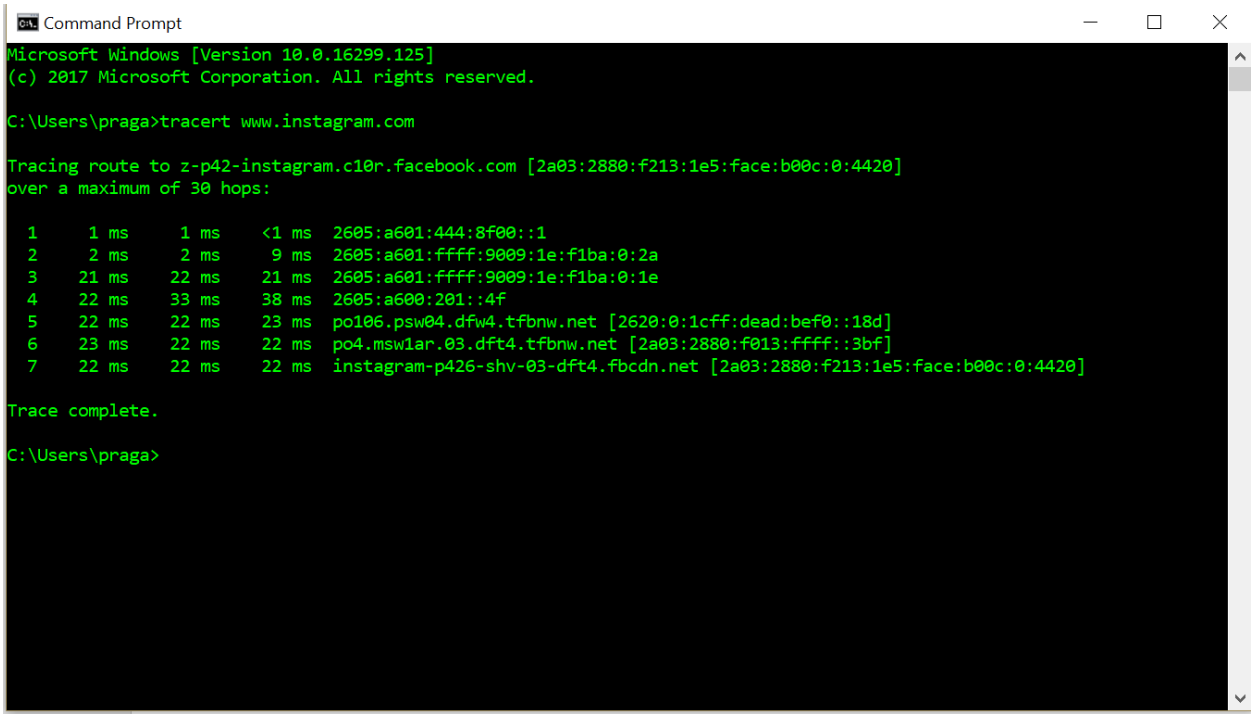
The ping command is used to test the ability of the source computer to reach a destination computer. It is a simple to verify that a computer can communicate over the network with another computer on network device. The ping command operates by sending Internet Control Message Protocol (ICMP) Echo Request messages to the destination computer and waits for a response. In the above example I pinged www.instagram.com and it sends a ICMP Echo request to destination computer i.e instagram.com and it replies the ping statistics to the source computer



The source computer sent 4 packets to the destination and the 4 packets are received at destination there is no loss. The approximate round trip time is: Minimum time taken =22ms, Maximum time taken =23ms, Average time taken is: 22ms

Traceroute:

The tracert command is used to show several details about the path the packet takes from the computer or device that requests the tracert request to the destination we specify and it also includes a time limit value with the packet called TTL(Time To Live) In the above example we requested tracert to show us the path from the local computer all the way to the network device with the hostname *www.instagram.com*

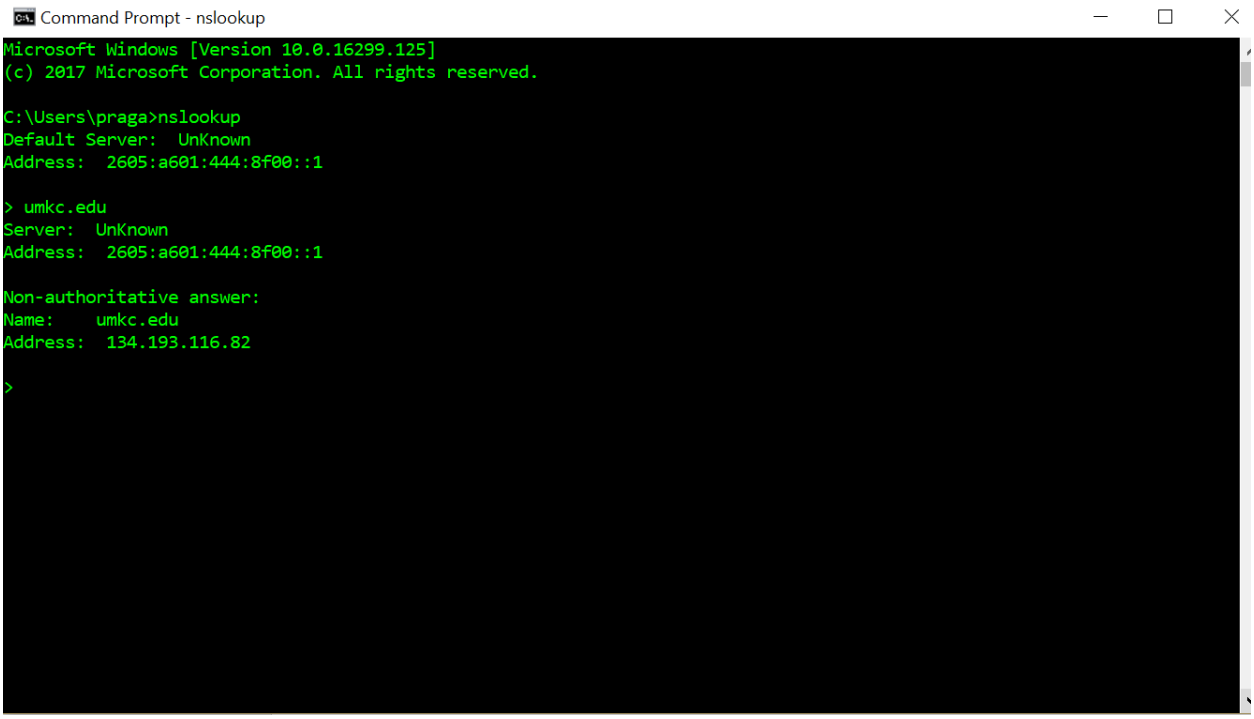


The tracert identified 7 network devices including our router 2605:a601:444:8f00::1 and all the way through to the destination www.instagram.com which has the public ip address 2a03:2880:f213:1e5:face:b00c:0:4420. The ping will be blocked sometimes for security reasons resulting in “request timed out” messages

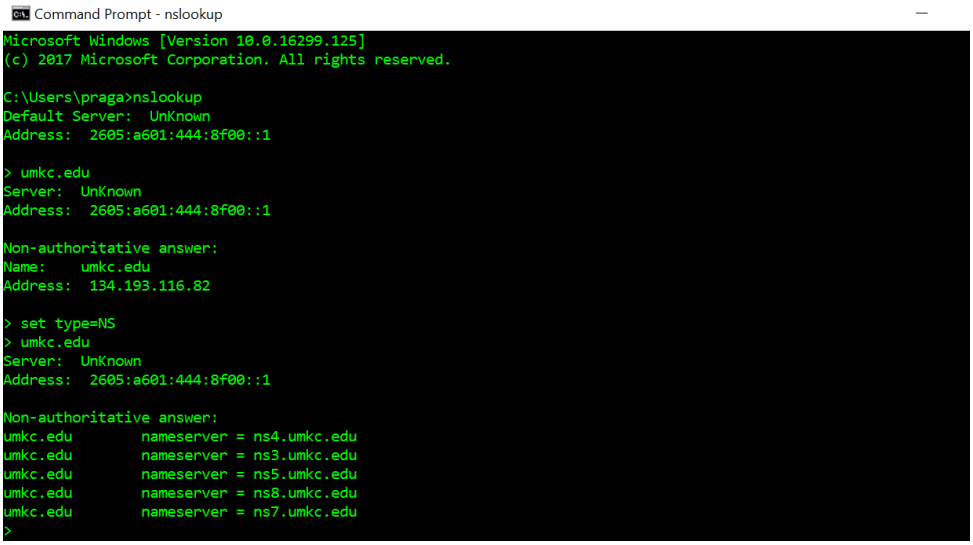
6. (20 points) Using 'nslookup' command from your command prompt/terminal find out the ip address(es) of www.umkc.edu, the name servers and their IP addresses of umkc.edu domain, the email servers and their IP addresses of umkc.edu domain.

Solution:

Nslookup for umkc.edu



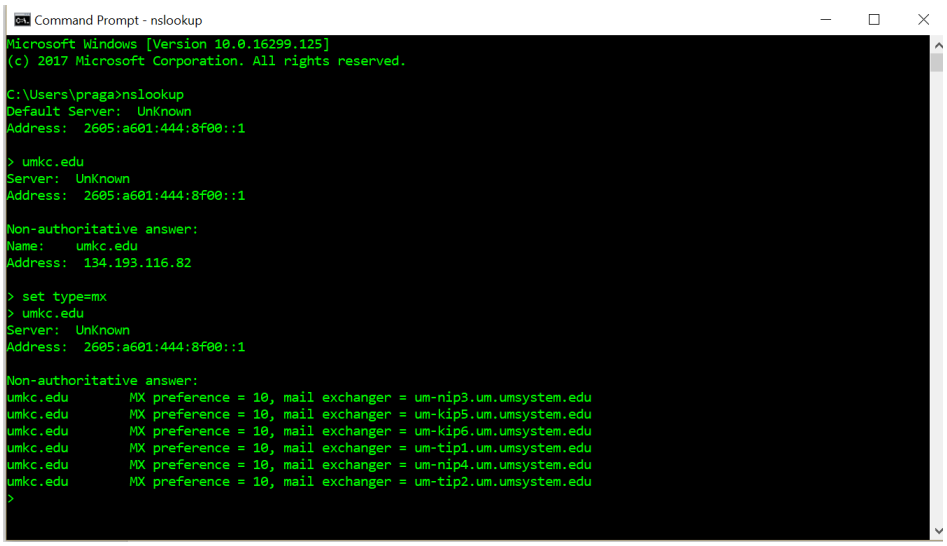
Name servers and their Ip Addresses of umkc.edu :



Command Prompt - nslookup

```
Default Server:  UnKnown
Address:  2605:a601:444:8f00::1

> umkc.edu
Server:  UnKnown
Address:  2605:a601:444:8f00::1

Non-authoritative answer:
Name:    umkc.edu
Address:  134.193.116.82

> set type=NS
> umkc.edu
Server:  UnKnown
Address:  2605:a601:444:8f00::1

Non-authoritative answer:
umkc.edu        nameserver = ns7.umkc.edu
umkc.edu        nameserver = ns8.umkc.edu
umkc.edu        nameserver = ns5.umkc.edu
umkc.edu        nameserver = ns3.umkc.edu
umkc.edu        nameserver = ns4.umkc.edu
> nslookup  ns7.umkc.edu
Server:  ns7.umkc.edu
Address:  198.209.56.232

*** ns7.umkc.edu can't find nslookup: Query refused
> nslookup ns8.umkc.edu
Server:  ns8.umkc.edu
Address:  131.151.249.33

*** ns8.umkc.edu can't find nslookup: Query refused
> nslookup ns5.umkc.edu
Server:  ns5.umkc.edu
Addresses:  2610:e0:a040:6401::3
          134.193.126.161

*** ns5.umkc.edu can't find nslookup: Query refused
> nslookup ns3.umkc.edu
Server:  ns3.umkc.edu
Addresses:  2610:e0:a040:640a::2
          134.193.86.1

*** ns3.umkc.edu can't find nslookup: Query refused
> nslookup ns4.umkc.edu
Server:  ns4.umkc.edu
Addresses:  2610:e0:a040:64fc::3
          134.193.126.153

*** ns4.umkc.edu can't find nslookup: Query refused
>
```

Mail servers and their Ip Addresses:



Corresponding IP addresses