

NETWORK ARCHITECTURE – I

HOMEWORK #1

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1. (a)

Transmission rate $R=1.5$ Mbps

Length of Packet $L=2500$ bytes

Queueing delay for each router $=3$ ms

Processing delay $= 0$

Propagation speed $=3.7 \times 10^6$ m/s

Packet switch processing delay at A and B $= 3$ and 4 msec

End-end delay, $D = N(L/R)$

$D = L/R_1 + L/R_2 + L/R_3 + L/R_4 + d_1/s + d_2/s + d_3/s + d_4/s + \text{queueing delay in each router} + \text{packet switch processing delay}$

$$= 4(2500/1.5) + ((5000 + 4000 + 3000 + 2000) \times 10^3)/(3.7 \times 10^6) + (9 \times 10^{-3}) + (7 \times 10^{-3})$$

$$= 3.852 \text{ s}$$

Therefore, the End- to End delay is 3.852 s

(b)

Length of acknowledgement packet= 2 bytes.

Propagation speed= 3.7×10^6 m/s

Length of the links are 5000km, 4000km, 3000km and 2000km respectively

Transmission time = $4 \times ((2 \times 8) / (1.5 \times (10^6))) = 0.0004s$

Total time = $3.852 + 0.0004 = 3.8524s$

Total time after packet transmission = $3.852 + 3.8524 = 7.7044s$

Therefore, total response time taken for the router A to receive acknowledgement of 2 bytes from B = 7.7044s

2. VINT CERF

Vint Cerf is the '**Father of the Internet**'. On reading the introduction of the ten pioneers, I was intrigued by the fact that he was one of the persons to write the protocol, **TCP** (Transmission Control Protocol). He was involved with the early designing of **ARPANET**.

Vint Cerf grew up in Los Angeles and as a child he developed an interest in computers. He graduated from UCLA and began pursuing his Ph.D. I was fascinated by the thesis he worked on, **Snupper Computer**. Snupper Computer is a computer which was designed to remotely observe the execution of programs on another computer. As crafty as this sounds, it is an interesting project which could help to do some good. We can monitor terrorist or other illegal activities. I learnt on further research about this that the Crime intelligence Agency used some similar technique to spy on suspects.

Cerf grew an interest in the field of Networking. He was involved in the designing of ARPANET. He met frequently with a group to discuss the new network and problems related to its development. This group, they called themselves the Network Working Group. They implemented a layered

approach to build a protocol which means they create several simple blocks which in future could be joined to create communication. By 1970, the NWG released the protocol for basic host-to-host communication called the Network Control Protocol (NCP). Apart from this they also created Telnet, which works on top of NCP and allows remote logins.

VANNEVAR BUSH

Vannevar Bush was involved with the creation and development of Internet. Hence was self-motivated to learn a little more about this personality and his accomplishments, Vannevar Bush. He grew up in Massachusetts and graduated from Tufts. In less than a year he completed his doctorate in MIT.

Bush's contribution during **World War I**, was to improve submarine detection was a notable contribution. He along with other scientists, formed a Military Service National Research Council to help during the World War I. He came up with an idea which uses magnetic field to detect submarines. His idea was appreciated and approved by the director of the Council. He convinced them that he could handle the research individually without any support. Unfortunately, his device was successful during the testing but failed during deployment. Despite this failure he continued his research to help during World War II.

During World war II , he was the chairman of NDRC (National Defense Research Committee) which brought together military and scientific leaders to coordinate military research. He also worked for OSRD and became the director . He proved that technology was most important in winning the war. His work did help the government and also created a new respect for Scientists.

3. IETF

IETF stands for **Internet Engineering Task Force**. They are overlooked by the Internet Society, Internet Architecture Board. They target to make the Internet work better by producing quality documents which helps in designing and managing Internet easier. All IETF documents are public documents freely available over the Internet and can be reproduce. They design the Internet Standard Protocols such as TCP/IP. Standards of IETF are expressed in the form of RFC (Requests for Comments).

IETF standards are developed in an open, all-inclusive process in which any interested individual can participate. The process the IETF follows a motto '**rough consensus and running code**'. There is no fixed percentage support of any proposal must achieve, but most proposals that have more than 90% support can be approved and those with less than 80% can often be rejected.

RFC

RFC stands for **Request for Comments**. It is a formal document which contains the result of IETF committee drafting and subsequent review by interested parties. Many concepts of computer network are covered in the document such as protocols, procedures, events and programs. RFCs tend to be quite technical and detailed. They define standards for TCP/IP, HTTP and SMTP. RFCs are assessed where some are informational in nature, while those that are intended to become Internet standards, the final version of the RFC document becomes the standard and no more changes are allowed. However, changes can be made through subsequent RFCs.

BANDWIDTH-DELAY PRODUCT

It is the product of bandwidth and latency, or Round Trip Time. In general, it is the amount of available data that can be in transit in a network.

BDP tells how TCP works and amount of data can be transmitted into a single stream of TCP. A high bandwidth-delay product is an important concept in the design of protocols such as TCP in considering TCP tuning. The TCP

protocol can only achieve certain optimum throughput if a sender sends a huge amount of data before being required to stop and wait until an acknowledgement is received from the receiver. If the quantity of data sent is insufficient compared with the bandwidth-delay product, then the link is not being kept busy and the protocol is operating below peak efficiency for the link.

The formula for BDP in bits or bytes is the product of total available bandwidth and round trip time.

4. COMPUTER VIRUS

A program or a piece of code that is loaded into a computer without the user's knowledge. It is easy to produce and can make copies of itself. Viruses can be produced by downloading files or any document by visiting an infected web site, by opening spam email or an email attachment, downloading free software or games. It can cause damage by corrupting or deleting the files without user's knowledge. They can have a hazardous effect. It can alter the way computer operates after affected by virus or can even stop it from working.

WORM

Computer worms are the programs which spreads malicious computer program. They are often confused with computer virus, but they are different in terms of the way they spread. They self-replicate in nature and spreads across the network. It can spread copies of itself from one computer to another without being activated by users. They can be connected to the computer network through attachments, files and links to infected websites. They exploit vulnerabilities, it is vital to stay on top of security updates by installing software as additional precaution of firewall.

SPYWARE

It is a Spying software. It is a software installed on the computer without user's knowledge. It runs on the background while it collects information and can give remote access to its attackers. This violates the end user's privacy and has potential to be abused. They are often difficult to be detected and they reduce the speed of processor and internet connections are one of the assumptions of spyware.

MALWARE

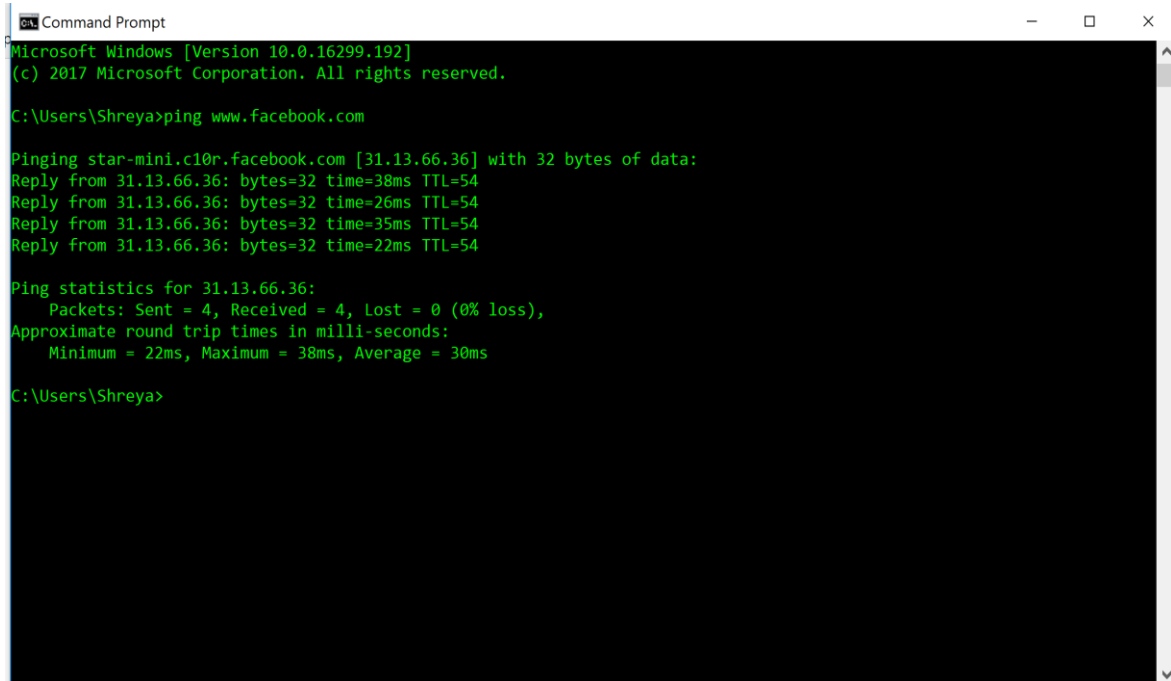
Malware stands for malicious software. It is designed to gain access to the computer without user's knowledge. There are various types of malware like viruses , worms and spyware. They perform variety of functions like deleting code, encrypting data, filtering data without user's permission. The best protection from malware could being careful about email attachments, web surfing on suspicious websites and install updated antivirus.

BOTNET

Botnet is a special type of malware. It is a collection of remote controlled computers and is derived from the words – Robot and Network. It affects the entire network. It can be defined as a bad piece of software or a type of malware in the network which is being controlled remotely along with many other in any network. By this the attacker takes control over many computers in a network for malicious purpose.

5. PING

PING stand for **Packet Internet Groper**. It is used to test connectivity between two nodes. It uses **Internet Control Message Protocol**.



```
Command Prompt
Microsoft Windows [Version 10.0.16299.192]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\Shreya>ping www.facebook.com

Pinging star-mini.c10r.facebook.com [31.13.66.36] with 32 bytes of data:
Reply from 31.13.66.36: bytes=32 time=38ms TTL=54
Reply from 31.13.66.36: bytes=32 time=26ms TTL=54
Reply from 31.13.66.36: bytes=32 time=35ms TTL=54
Reply from 31.13.66.36: bytes=32 time=22ms TTL=54

Ping statistics for 31.13.66.36:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 22ms, Maximum = 38ms, Average = 30ms

C:\Users\Shreya>
```

In this figure, it shows the demo of ping command run on Windows for www.facebook.com . The IP address of www.facebook.com is 31.13.66.36. It sends 32 bytes of data where 4 packets are sent and received. It shows that there is no packet loss. The ICMP is shown by the TTL (Time to leave) which is 54.

TRACEROUTE

Traceroute display the route and measures the transit delay along the path it traces.

```
Command Prompt
C:\Users\Shreya>tracert www.facebook.com
'traceroute' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\Shreya>tracert www.facebook.com

Tracing route to star-mini.c10r.facebook.com [157.240.3.35]
over a maximum of 30 hops:

  1   3 ms    1 ms    1 ms  192.168.1.1
  2  25 ms   59 ms   14 ms  cpe-76-92-192-1.kc.res.rr.com [76.92.192.1]
  3 104 ms   41 ms   26 ms  ae63.stwks0401h.kc.rr.com [98.156.45.209]
  4  17 ms   20 ms   12 ms  agg37.ksczmogn01r.kc.rr.com [98.156.43.120]
  5  54 ms   32 ms   26 ms  agg36.dlatx1301r.kc.rr.com [98.156.42.126]
  6  35 ms   42 ms   31 ms  bu-ether14.dllstx976iw-bcr00.tbone.rr.com [66.109.6.88]
  7  26 ms   32 ms   37 ms  unk-426d0579.adelphiacom.net [66.109.5.121]
  8  30 ms   36 ms   26 ms  ae33.pr05.dfw1.tfbnw.net [157.240.66.114]
  9  33 ms   40 ms   25 ms  po105.psw03.dfw4.tfbnw.net [157.240.32.147]
 10  28 ms   32 ms   28 ms  173.252.67.109
 11  53 ms    *      26 ms  edge-star-mini-shv-01-dft4.facebook.com [157.240.3.35]

Trace complete.

C:\Users\Shreya>
```

In the figure, it shows a demo of tracert command on Windows for www.facebook.com. Here the facebook uses a IP address of 157.240.3.35. A maximum of 30 hops is allowed . It traces the route from my router and all the way upto www.facebook.com . Here it takes 11 hops to connect to facebook.

6. NSLOOKUP

Nslookup stand for Name server lookup. It is used to obtain information about the internet servers. It finds the name servers for the domains by querying the Domain Name System.

(a) IP address of www.umkc.edu

```
Command Prompt
Microsoft Windows [Version 10.0.16299.192]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\Shreya>nslookup www.umkc.edu
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
Name:    www.umkc.edu
Addresses: 2610:e0:a040:64a2::52
           134.193.116.82

C:\Users\Shreya>
```

Here the server name is www.umkc.edu and their IPV6 address is 2610:e0:a040:64a2::52 and IPV4 address is 134.193.116.82

(b) Name servers of umkc.edu domain

```
Command Prompt
Microsoft Windows [Version 10.0.16299.192]
(c) 2017 Microsoft Corporation. All rights reserved.

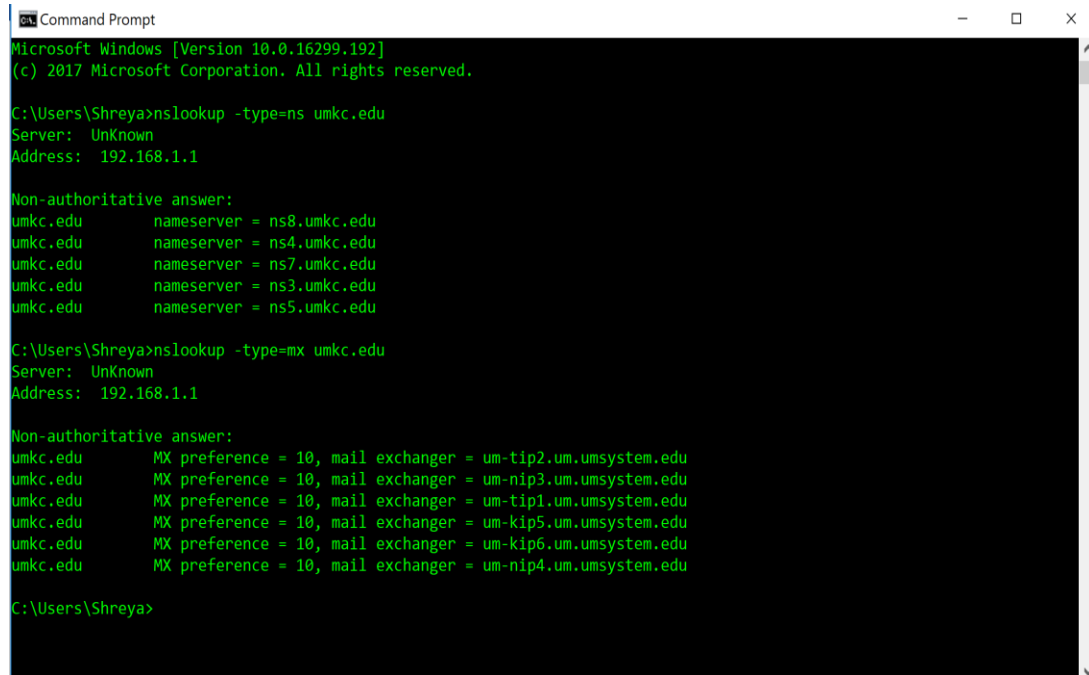
C:\Users\Shreya>nslookup -type=ns umkc.edu
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
umkc.edu      nameserver = ns8.umkc.edu
umkc.edu      nameserver = ns4.umkc.edu
umkc.edu      nameserver = ns7.umkc.edu
umkc.edu      nameserver = ns3.umkc.edu
umkc.edu      nameserver = ns5.umkc.edu

C:\Users\Shreya>
```

The output shows that there are 5 name servers for umkc.edu domain.

(c) Email servers of umkc.edu domain



```
Command Prompt
Microsoft Windows [Version 10.0.16299.192]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\Shreya>nslookup -type=ns umkc.edu
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
umkc.edu      nameserver = ns8.umkc.edu
umkc.edu      nameserver = ns4.umkc.edu
umkc.edu      nameserver = ns7.umkc.edu
umkc.edu      nameserver = ns3.umkc.edu
umkc.edu      nameserver = ns5.umkc.edu

C:\Users\Shreya>nslookup -type=mx umkc.edu
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
umkc.edu      MX preference = 10, mail exchanger = um-tip2.um.umsystem.edu
umkc.edu      MX preference = 10, mail exchanger = um-nip3.um.umsystem.edu
umkc.edu      MX preference = 10, mail exchanger = um-tip1.um.umsystem.edu
umkc.edu      MX preference = 10, mail exchanger = um-kip5.um.umsystem.edu
umkc.edu      MX preference = 10, mail exchanger = um-kip6.um.umsystem.edu
umkc.edu      MX preference = 10, mail exchanger = um-nip4.um.umsystem.edu

C:\Users\Shreya>
```

The output shows that there are 6 Email servers for umkc.edu domain.