NETWORK ARCHITECTURE-1

HOMEWORK-2

Submitted by:

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1. In CSMA/CD, after the fifth collision, what is the probability that a node chooses K=10? The result K=10 corresponds to a delay of how many seconds on a 10 Mbps Ethernet?

Solution:

Carrier sense multiple access with collision detection (CSMA/CD) is a media access control method used most notably in local area networking using early Ethernet technology.

In case of Ethernet CSMA/CD algorithm after aborting, Network Interface Card (NIC) enters binary exponential back off.

After m^{th} collisions, NIC chooses K at random from {0, 1, 2…, (2^(m))-1}. NIC waits K*512 bit times.

As it's after 5^{th} Collision, m=5. Hence 2^ (m)-1 = 2^ (5)-1 = 32-1 = 31

So, after the fifth collision the adapter will choose a value of K from {0,1,2…31}

Probability that the node chooses the value of K=10 from among 32 values is 1/32.

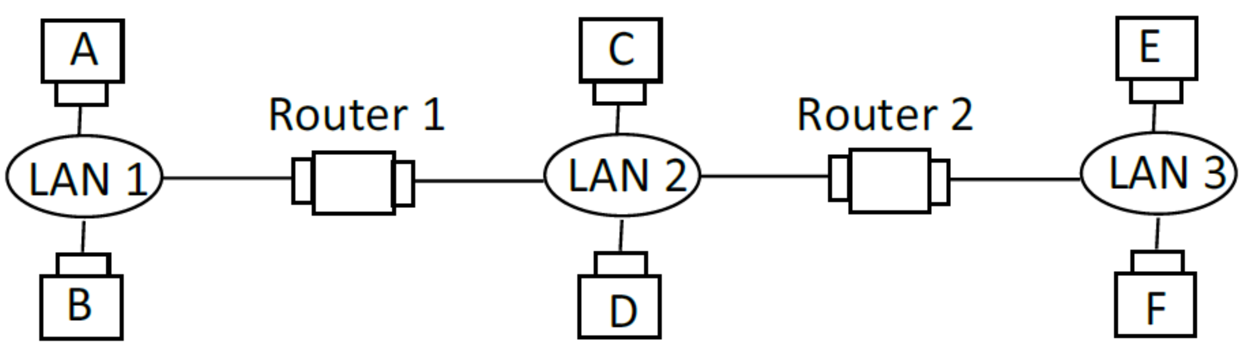
As K=10, NIC waiting time is 10*512 bit times.

On a 10 Mbps Ethernet, it will correspond to a delay of

= (10*512) / (10 * 1000 *1000)

= 512 micro seconds.

2. Consider three LANs interconnected by two routers, as shown in the diagram below.



(a) Assign IP addresses to all the interfaces. For subnet 1 use address of the form 111.111.111.xxx; for subnet 2 use address of the form 122.222.222.xxx; and for subnet 3 use addresses of the form 133.133.133.xxx.

Solution:

- For subnet 1 IP Addresses to all the interfaces are
  111.111.111.001, 111.111.111.002, 111.111.111.003

- For subnet 2 IP addresses to all the interfaces are
  122.222.222.001, 122.222.222.002, 122.222.222.003

- For subnet 3 IP addresses to all the interfaces are
  133.133.133.001, 133.133.133.002, 133.133.133.003

(b) (Randomly) Assign MAC addresses to all the adapters.

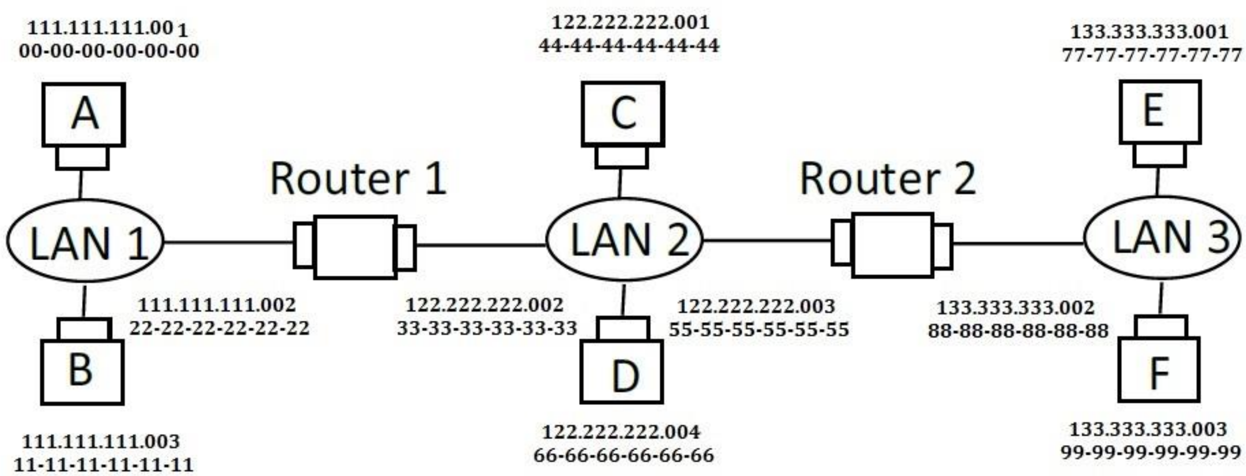
Solution:

MAC address of the adapter connecting

Host A to LAN is 00-00-00-00-00-00
Host B to LAN is 11-11-11-11-11-11
LAN to 1st Router is 22-22-22-22-22-22
1st Router to LAN is 33-33-33-33-33-33
Host C to LAN is 44-44-44-44-44-44
LAN to 2nd Router is 55-55-55-55-55-55
Host D to LAN is 66-66-66-66-66-66
Host E to LAN is 77-77-77-77-77-77
2nd Router to LAN is 88-88-88-88-88-88
Host F to LAN is 99-99-99-99-99-99

(c) Consider sending and IP datagram from Host A to Host F. Suppose all of the ARP tables are up to date. Enumerate all the steps as done for the single-router example.

Solution:



1. **Address resolution protocol (ARP)** table in A determines that the datagram should be sent to the interface 111.111.111.002.
2. Host A uses ARP to determine the LAN address for 111.111.111.002, which is 22-22-22-22-22-22.
3. The adapter in A sends an Ethernet packet with Ethernet destination address 22-22-22-22-22-22.
4. The 1st Router receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 122.222.222.003.
5. The 1st Router then uses ARP to obtain the associated Ethernet address, namely 55-55-55-55-55-55.
6. Now, the packet is forwarded to the 2nd Router having destination Ethernet address 55-55-55-55-55-55.
7. The 2nd Router receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 133.133.133.003.
8. The 2nd Router then uses ARP to obtain the associated Ethernet address, namely 99-99-99-99-99-99.
9. Now, the packet is sent to the final destination having Ethernet address 99-99-99-99-99-99 from second router.

(d) Repeat (c), now assuming that the ARP table in the sending host is empty (and the other tables are up to date).

- If the ARP table in the sending host is empty then ARP in A has to determine the MAC address of first router interface.
- **<u>The below are the Steps to find the LAN address:</u>**
  1. Host A sends out an ARP query packet within a broadcast Ethernet frame.
  2. The 1st Router receives the query packet and sends back an ARP response to packet A. This ARP response packet is carried by an Ethernet frame with destination address as ***00-00-00-00-00-00.***

Now, the ARP table of host A is updated with an entry of MAC address of the router. Then IP datagram is sent in the same sequence of steps as mentioned below.

1. Address resolution protocol ARP table in A determines that the datagram should be sent to the interface 111.111.111.002.
2. Host A uses ARP to determine the LAN address for 111.111.111.002, which is 22-22-22-22-22-22.
3. The adapter in A sends an Ethernet packet with Ethernet destination address 22-22-22-22-22-22.
4. The 1st Router receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 122.222.222.003.
5. The 1st Router then uses ARP to obtain the associated Ethernet ad dress, namely 55-55-55-55-55-55.
6. Now, the packet is forwarded to the 2nd Router having destination Ethernet address 55-55-55-55-55-55.
7. The 2nd Router receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 133.133.133.003.
8. The 2nd Router then uses ARP to obtain the associated Ethernet address, namely 99-99-99-99-99-99.
9. Now, the packet is sent to the final destination having Ethernet address 99-99-99-99-99-99 from second router.

3. Suppose a CSMA/CD network is running 100 mbps over a 1km cable with no repeaters. The signal speed in the cable is 200,000 km/sec.

a. Compute:

i. End to End propagation delay

= cable length/signal speed

=1km/200,000 km/sec = (1 / 200,000)

= 0.000005 seconds

ii. Worst-case collision detection time

= Round trip propagation time

= 0.000005 * 2 **= 0.00001 seconds**

iii. Minimum frame size

= 2*t*bandwidth

= 0.00001 * 100 * 1000 * 1000 bits

= 1000 bits

b. Suppose we increase the bandwidth from 100 Mbps to 1 Gbps, how does it affect the above three values?

Solution:

Given bandwidth increases from 100 Mbps to 1 Gbps.

End to end propagation delay and collision detection time does not change with the increase in bandwidth since they are independent of the change in bandwidth.

Minimum frame size changes which is as follows:

= worst case collision * Bandwidth

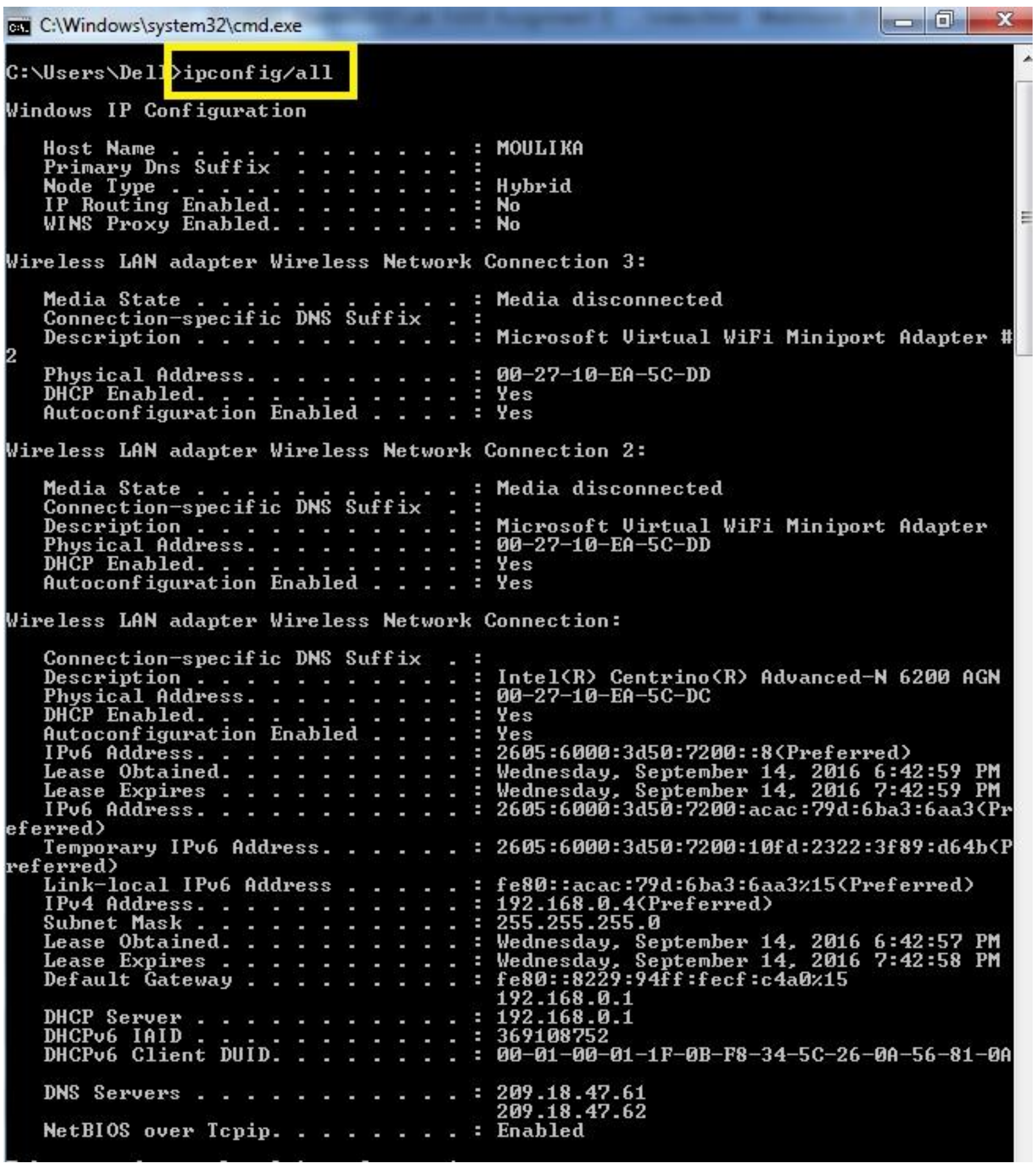
= 0.00001 * 10^9 bits

= 10,000 bits

Laboratory Homework Part 1: using ipconfig(Windows)

1. What are the Physical and IP addresses of the host?

- ipconfig/all gives all the current TCP/IP network configuration values.
- It also refreshes **Dynamic Host Configuration Portal (DHCP)** and **Domain Name System (DNS)** settings.



- From the above network Configurations

  Physical address of Wireless LAN adapter Network Connection is **00-27-10-EA-5C-DD**

  IP Address id **192.168.0.4**

2. How many bits are for the subnet mask? What is the subnet (not subnet mask) of the host?

Generally the subnet mask is of 32 bits

The subnet mask from above configurations is 255. 255. 255.0 or **24 bits**.

So, now the number of bits for subnet mask is 24 bits

IP address = 192.168.0.4

To get **subnet** of the host we use **AND** operation between IP address and subnet mask:

Initially the Converting IP address and subnet mask is changed to binary form,

IP address = 11000000.10101000.00000000.00000100

Subnet mask = 11111111.11111111.11111111.00000000

Subnet = **11000000.10101000.00000000.00000000**

Therefore, subnet = **192. 168. 0. 0**.

Laboratory Homework Part 2: Try 'arp' command

- The purpose of **Address Resolution Protocol (ARP)** is to find out the MAC address of a device in your Local Area Network (LAN), for the corresponding IPv4 address, which network application is trying to communicate.

- ARP is used for mapping a network address (e.g. an IPv4 address) to a physical address like an Ethernet address.

ARP Commands:

- **arp -a** command can be used to view the ARP cache.
- **arp -s** command is used to add a static entry for the host.
- **arp -d** to delete entries from the cache.

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a. Show the current ARP table of an interface of your host.

```
C:\Windows\system32>arp -a

Interface: 192.168.0.4 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           80-29-94-cf-c4-a0     dynamic
  192.168.0.2           80-29-94-cf-c4-a1     dynamic
  192.168.0.3           00-db-df-74-64-ef     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  224.0.0.253           01-00-5e-00-00-fd     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

b. Delete all current entries of the ARP table of an interface of your host.

```
C:\Windows\system32>arp -d * 192.168.0.4

C:\Windows\system32>arp -a

Interface: 192.168.0.4 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           80-29-94-cf-c4-a0     dynamic
  239.255.255.250       01-00-5e-7f-ff-fa     static
```

c. Show the ARP table again after a web browsing.

```
C:\Windows\system32>arp -a

Interface: 192.168.0.4 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           80-29-94-cf-c4-a0     dynamic
  192.168.0.2           80-29-94-cf-c4-a1     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  224.0.0.253           01-00-5e-00-00-fd     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
```

d. Show the ARP table again after a few minutes of no network activity.

```
C:\Windows\system32>arp -a

Interface: 192.168.0.4 --- 0xf
  Internet Address      Physical Address      Type
  192.168.0.1           80-29-94-cf-c4-a0     dynamic
  192.168.0.2           80-29-94-cf-c4-a1     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  224.0.0.253           01-00-5e-00-00-fd     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
```