AMC Lab 1 **Homework** **Deadline: 30.11.2020**

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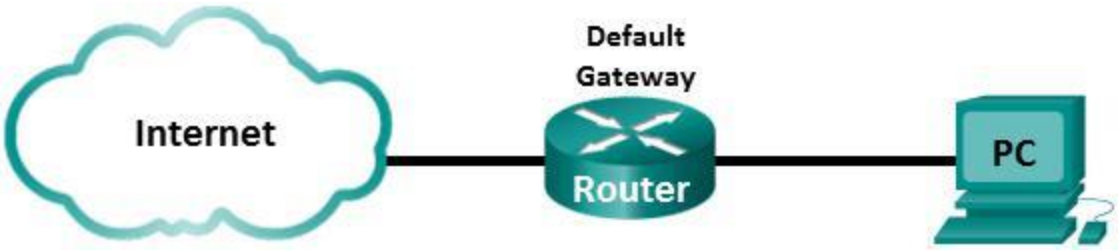
Simple Network
Internet Access Analysis
VoIP / Video Streaming Analysis



Tasks: **Ideas about some delays in networks**

IP addressing of a host computer

Wireshark packet capture

Examine ICMP Message Types

VoIP throughput calculation

Homework / Preparation

Ideas about some delays in networks

Read the extra slides m transmission time and propagation delay, and calculate the following delays.

a) Propagation delay

In our DN.Lab we have Cat5e twisted pair cabling (signal transmission speed c = 2/3 c_0) with 100BASE-Tx Ethernet technology using a data rate of R = 100 Mbps. Calculate the propagation delay t_{pd} of an Ethernet link with a length of 55m.

Answer: We know,
Propagation delay, t_{pd}= l / C
where l = length of the link =55m and
C= velocity of the signal through twisted pair cabling =2 / 3 c_0 = 2 / 3 × 300.000 km /s=200,000 km /s=2×10^8 m /s Therefore, t_{pd}= l / C = 55m / (2×10^8) m /s = 2.75×10^{-7} s=**275 ns**

Calculate the propagation delay t_{pd} of a similar link, which would run from TH Köln to Berlin (~ 600 km).

Answer: From TH Köln IWZ to Berlin (~ 600 km), fiber optic cable is used. Therefore, the C will be same as before.
C= velocity of the signal through fiber optic cabling =2 / 3 c_0 = 2 / 3 × 300.000 km /s=200,000 km /s=2×10^8 m /s l = length of the link =600 km (given)
We know,
Propagation delay, t_{pd}= l / C = (6×10^5 m) / (2×10^8) m /s = 3×10^{-3} s= **3ms**

b) Transmission time

Transmission time is the time for serial (Bit by Bit) transmission of a data frame to a connected medium. Calculate the transmission time t_t of a 100BASE-Tx NIC transmitting a minimum sized Ethernet frame with a length of 64 Bytes and a maximum sized Ethernet frame with a length of 1518 Bytes.

64 Byte Ethernet frame

Answer: **Transmission time, t_t= M/R**
where M = Size of the frame =64 bytes=64*8=512 bits and
R= Bit rate=100 Mbps=10^8 bit per second
Therefore, t_t= M / R= 512 bits / 10^8 bps = 5.12×10^{-6} s=**5.12 µs**

1518 Byte Ethernet frame
Transmission time, t_t= M/R
where M = Size of the frame =1518
bytes=1518*8=12144 bits and R= Bit rate=100
Mbps=10^8 bit per second
Therefore, t_t= M / R= 12144 bits / 10^8 bps = 1.2144×10^{-4} s=**121.44 µs**

IP addressing of a host computer and connectivity check

There are different ways to configure IP connectivity in Windows or Linux-based PCs from a shell / terminal window / console window.
Research how to configure IP connectivity in PCs.

a) Windows PC

Which command is used to set an IP address and subnet mask?
netsh "interface" static <ipv4 address name> <subnet mask> <gateway> = netsh "Wi-Fi" static 192.168.0.1 255.255.255.0 192.168.0.1

Which command displays all IP settings?
ipconfig /all

When you open the network configuration tab in your control panel GUI, which options must be configured or are available when configuring IPv4 of an Interface?
Control Panel>Network and Sharing Centre> Change adapter settings>Network connections window>Wi-Fi (or any other active options)>click Properties>click IPv4 version protocol
There we will get two options:

1. **IP settings:**
   a. **Static (which is done manually, called Static IP addressing)**
      -Here, we have to fill up IP address, subnet mask and default gateway on our own.
   b. **or Dynamic IP addressing (by DHCP)**
2. **DNS server settings: Static or Dynamic (by DHCP)**

c) Networking tools

Which simple command line tool checks, whether an IP address (no ports) is reachable or not?

ping

Which simple command line tool lists all routers in the path from your host to a destination?

tracert

Which simple command line tool displays all sockets used on your computer (Windows and Linux)?

netstat

Which simple command line tool displays the mapping a domain name to an IP address?

nslookup

Wireshark packet capture

a) Read the Wireshark manual and answer the following question

If you want to filter PING traffic in your capture, what must be done after you captured all packets, sent and received by your host?

- I will enter ***icmp*** message filter in filter section of Wireshark.

b) Review the Ethernet II header field descriptions and lengths.

Background / Scenario

When upper layer protocols communicate with each other, data flows down the Open Systems Interconnection (OSI) layers and is encapsulated into a Layer 2 frame. The frame composition is dependent on the media access type. For example, if the upper layer protocols are TCP and IP and the media access is Ethernet, then the Layer 2 frame encapsulation will be Ethernet II. This is typical for a LAN environment.

1. Looking at the Ethernet II frame format, answer the questions.

Preamble	Destination Address	Source Address	Frame Type	Data	FCS
(8 Bytes)	6 Bytes	6 Bytes	2 Bytes	46 – 1500 Bytes	4 Bytes

The preamble represents **no bits and provides no header information!!!** It is only used for physical signal transmission of Ethernet frames over LAN cables. Which function does the Ethernet preamble have?

Ethernet preamble is used to let know the receiver of upcoming arrival of a frame from source with the help of Start Frame Delimiter (SFD).

How many Bytes do we have in the Ethernet II header?

14 Bytes

How many Bytes do we have in the Ethernet II trailer?

4 Bytes

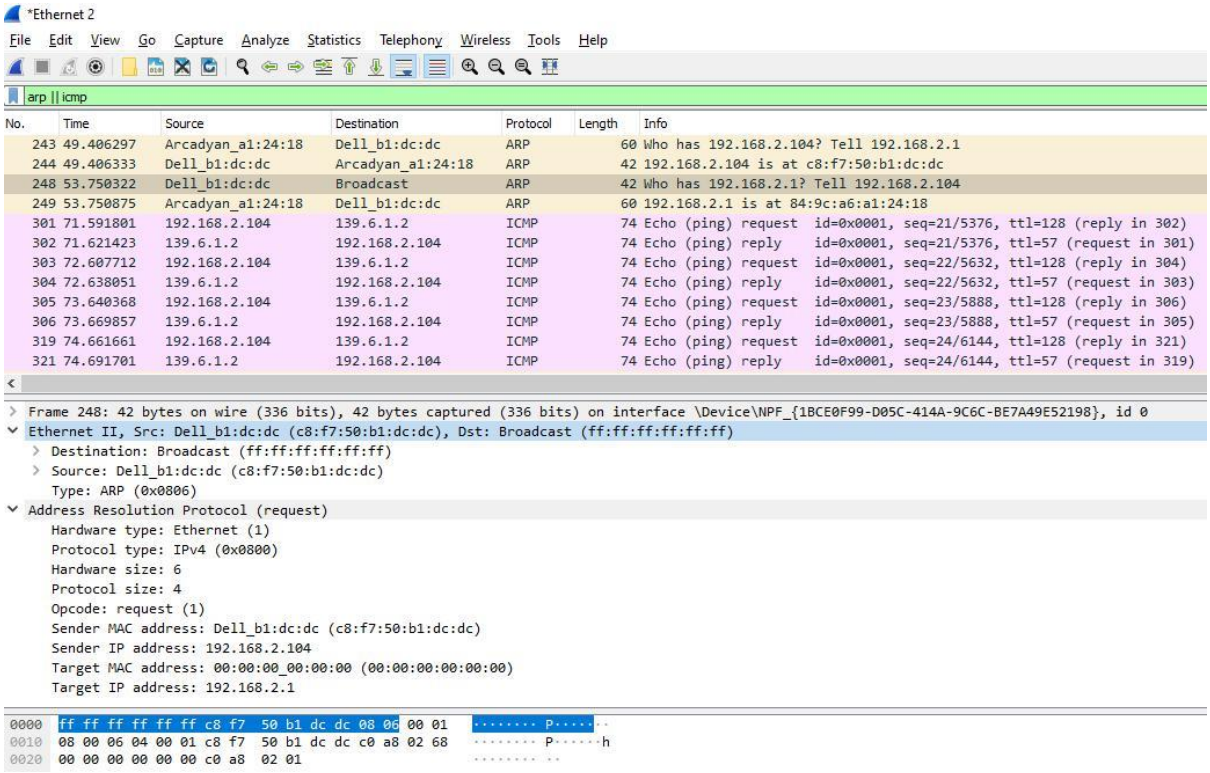
2. Examine Ethernet frames in a Wireshark capture. The

following information is known from a PC:

```
Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . : cisco.com
   Link-local IPv6 Address . . . . . : fe80::b875:731b:3c7b:c0b1%10
   IPv4 Address. . . . . . . . . . . : 10.20.164.22
   Subnet Mask . . . . . . . . . . . : 255.255.255.240
   Default Gateway . . . . . . . . . : 10.20.164.17
```

The Wireshark capture below shows the packets generated by a ping being issued from a PC host to its default gateway. A filter has been applied to Wireshark to view the ARP and ICMP protocols only. The session begins with an ARP query for the MAC address of the gateway router, followed by four ping requests and replies.



a) **Check frame #248.** In the shown hex dump at the bottom of the Wireshark window you see all bytes displayed by Wireshark. Is the Ethernet II trailer shown in the Wireshark capture?

Explain why yes or why no.

Answer: No. The Ethernet II trailer ***FCS*** is not shown in Wireshark capture. FCS stands for Frame check Sequence to detect errors in frames while transferring frames to the receiver. FCS is added to the frame at the end as a trailer containing 4 bytes in data link layer. **If there is no significant error captured or bad checksum found while transferring frame, there is not FCS shown in Wireshark capture.**

b) ARP – Address Resolution Protocol. **Check frames #248 and #249.**

b.1) Which IP source address is used in the **ARP request**?

Answer: There is no IP source address in ARP request. MAC address is the only source address as shown c8:f7:50:b1:dc:dc.

b.2) Which type (unicast, multicast, broadcast) of MAC address is used as the MAC destination address in the **ARP request**? - **Broadcast address ff: ff: ff: ff: ff: ff**

b.3.) The MAC address of which network device is given back by the ARP response? -**The network device containing 192.168.2.1 IP address.**

Why did the PC send a broadcast ARP prior to sending the first ping request?

Answer: Prior to sending the first ping request to a destination device, PC needs to know the MAC address of the default gateway. Then after knowing the MAC address of gateway, PC can finally send request to remote area. And the ARP request is sent as a broadcast request from PC because PC wants to get specific MAC address of a particular device such as of default gateway by sending only destination IP address in the local area network. Then the existing all devices start matching with the given IP address and finally when IP address get matched with router's, router (default gateway) sends out ARP response to the first host with its MAC address.

Examine ICMP Message Types

Check information about the ICMP protocol, e.g. using your materials from Bachelor classes or www.wikipedia.com. Which function is provided by the following ICMP message?

ICMP Type 8: **Echo request**

ICMP Type 0: **Echo reply**

ICMP Type 11: **Time exceeded (Time to live exceeded in transit)**

ICMP Type 3 Code 0: **Destination unreachable (Net Unreachable)**

ICMP Type 3 Code 1: **Destination unreachable (Host Unreachable)**

ICMP Type 3 Code 3: **Destination unreachable (Port Unreachable)**

ICMP Type 3 Code 4: **Fragment Needed or Don't Fragment was Set**

VoIP throughput calculation

We have a VoIP application using the MS Netmeeting Tool with G.723.1 MP-MLQ voice codec settings. Calculate the throughput of a VoIP call on Layer 2 with typical IP streaming encapsulation and without VLAN tagging.

Number of bytes per IP packet on application layer: **From sending side, there is no IP packet in application layer (Layer 7). In receiving side, from received frame, IP Packet will be: 40 (IP/UDP/RTP header) + 24(voice payload) =64 Bytes**

Name the sequence of all protocols from application to data link, which encapsulate the G.723.1 samples.

From Application layer- DNS, HTTP, RTP, SRTP, SIP
Transport layer-TCP, SRTCP, UDP, (or RTP, SRTP), STUN
Network layer- IPv4
To Data link layer- ARP

Number of bytes per Ethernet frame: **Ethernet header+ IP/UDP/RTP header+ Data payload= 18+40+24=82 Bytes**

Time interval of 2 consecutive IP packets on sender side: ***30ms***

Calculate the Ethernet throughput of G.723.1 VoIP call from sender to receiver.

Provide the formula before you calculate the result.

Answer:
We Know, **for G.723.1 MP-MLQ Codec** settings following parameters will be applicable.

Voice payload size= 24 Bytes
Packets per second=PPS= 33.3
Codec bit rate= 6.3 kbps

Ethernet Throughput formula:
Total frame size= (L2 Header of Ethernet) + (IP+UDP+RTP header) + (Voice Payload Size)
PPS= Packet Per second= (Codec bit rate)／(Voice Payload Size)
Bandwidth (theoretical)= Throughput= Total Packet size× PPS

Calculation:

Layer 2 Header for Ethernet= 18 Bytes without FCS
IP+UDP+RTP header = 40 Bytes

Total frame size(bytes)= (Ethernet Header of 18 Bytes) + ((IP+UDP+RTP) header of 40 Bytes) + (Voice payload of 24 bytes) = 18+40+24=82 Bytes

Total frame size(bits)= 82 bytes* 8 bits per second=656 bits

PPS= 6.3kbps/ (24*8) =32.8 pps= 33 pps or 33.3 pps (theoretically)

Ethernet Throughput per call= total voice frame size (656 bits) *33pps=21648 bps= 21.648 kbps or 656* 33.3=21.8 kbps (theoretically)