FIT1047 Applied Session Week 8

NETWORKS: PHYSICAL, DATA LINK, NETWORK AND TRANSPORT LAYERS

OBJECTIVES

- The purpose of this applied session is getting to know (i) Digital data transmission using analog signals, (ii) IPv4 Addresses and subnets (iii) Transport layer protocols and (iv) Address resolution.

INSTRUCTIONS

- For some of the questions, you may have to refer to the pre-class video and associated slides available in the Moodle.
- You may work in a small group.

Activity 1: Transmission of Digital Data Using Analog Signals

Symbol	Frequency	Amplitude	Phase
00	1Hz	1.5	0
01	1Hz	1.5	180
10	1Hz	1	0
11	1Hz	1	180

Figure 1: Encoding Table

Digital data can be transmitted using analog signals employing modulation and demodulation techniques. Using the encoding rules in Figure 1, decode or demodulate the message i.e. analog signal shown in Figure 2. Here, (i) the phase values are in degrees, (ii) the amplitudes are in volts and (ii) one symbol corresponds to one time unit (one unit on the X axis, since the frequency is 1 Hz).

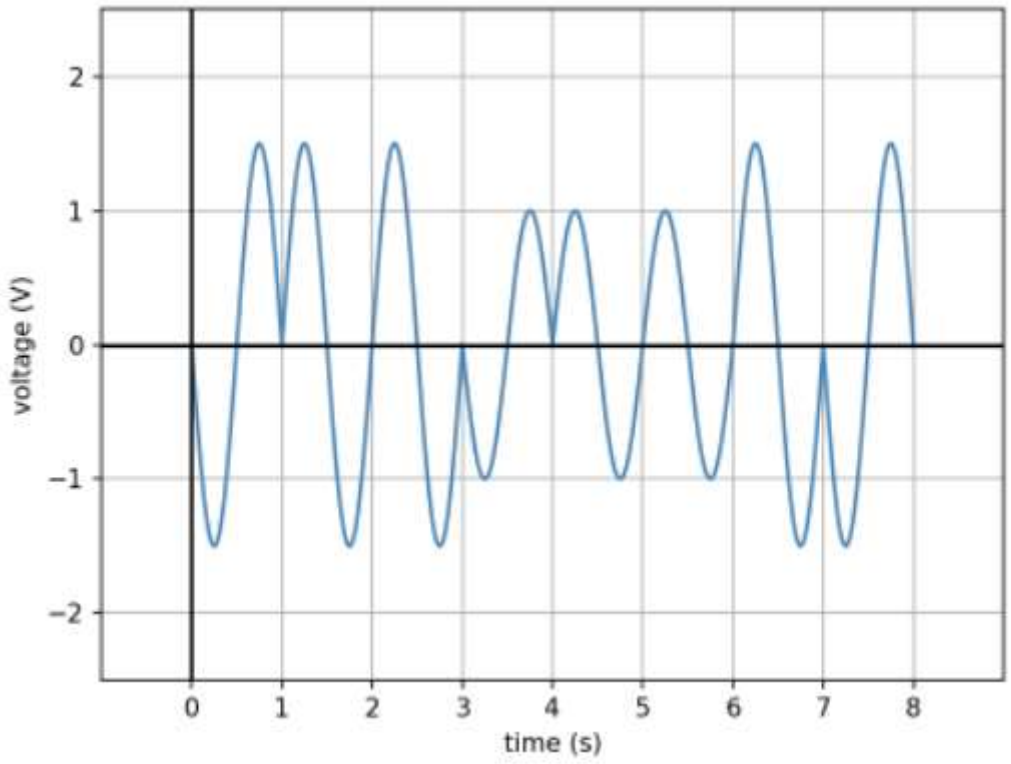

Figure 2: Modulated Message

Sample Solution:

Decoded or Demodulated Data bits: 01 00 00 11 10 10 00 01

Time	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
Data	01	00	00	11	10	10	00	01

MONASH University

Activity 2: IPv4 Addresses, Subnets and Masks

(i) Each IP address identifies one particular device (or more precisely, one network interface of one device). But IP addresses have structure: a certain number of bits are used to identify thesubnet that the device belongs to, and the remaining bits identify the concrete device in that subnet.

We use notation such as 130.196.13.5/24 to denote that the first 24 bits identify the subnet. In this case, it means any device whose IP address also starts with 130.196.13. belongs to the same subnet. This is important: Let's say 130.196.13.5 wants to send a message to 130.196.13.32; it can just look at the IP address to know that the destination is in the same subnet, which means that it can send the message directly. But if the destination is, e.g., 130.196.42.3, the IP address tells us that it's in a different subnet, so we have to send the message to our router.

We call /24 the subnet mask. An alternative notation, called "dotted-decimal", is 255.255.255.0, which when written in binary is simply a sequence of 24 ones, followed by 8 zeroes:

11111111.11111111.11111111.00000000

1st Octet	2nd Octet	3rd Octet	4th Octet
1111 1111.	1111 1111.	1111 1111.	0000 0000

The subnet address (which identifies the subnet) can be obtained by replacing the host part of an IP address with zero bits. e.g. the subnet address of 130.196.13.5/24 is 130.196.13.0/24.

(a) Write the subnet mask /22 using "dotted-decimal" notation.
(b) Write the subnet mask 255.255.0.0 using "slash" notation.

(ii) You are required to provide a detailed IP addressing plan for a company using the network address 202.169.63.0/24. How many IP addresses are available in this network? The networking team has decided to create three subnets for a varying number of hosts in each.

- Subnet A – 202.169.63.0/25
- Subnet B – 202.169.63.128/26
- Subnet C – 202.169.63.192/27

To complete the IP addressing plan, you are required to provide the following details for each subnet:

a) Usable IP address range
b) Broadcast IP address
c) Subnet address

Sample Solution:

Subnet A:

The first address in this block is 202.169.63.0/25.

The last address is 202.169.63.127/25.
Usable IP address range 202.169.63.1/25 - 202.169.63.126/25.
Broadcast IP Address 202.169.63.127/25.
Subnet address 202.169.63.0/25.

Subnet B:

The first address in this block is 202.169.63.128/26
The last address is 202.169.63.191/26.
Usable IP address range 202.169.63.129/26 - 202.169.63.190/26.
Broadcast IP Address 202.169.63.191/26.
Subnet address 202.169.63.128/26.

Subnet C:

The first address in this block is 202.169.63.192/27.
The last address is 202.169.63.223/27.
Usable IP address range 202.169.63.193/27 - 202.169.63.222/27
Broadcast IP Address 202.169.63.223/27.
Subnet address 202.169.63.192/27.

MONASH University

Activity 3: Transport Layer Protocols

In this activity, we will analyse sequences of packets captured in three different simulated neworks. You can download the log files that Wireshark produced from the FIT1047 Moodle site (week 8).

(a) Open the file "FIT1047-2022-Applied-W8-Q3a.pcapng" and answer the following questions.

(i) Inspect frames number 4 or 6 to name the application layer protocol used.
(ii) What is the name of the transport layer protocol used?
(iii) Inspect the frame number 4 and find the Destination and Source Port Numbers.
(iv) Inspect the frame number 6 and find the Destination and Source Port Numbers.

(b) Open the file "FIT1047-2022-Applied-W8-Q3b.pcapng" and answer the following questions.

(i) Inspect frames number 4 or 6 to name the application layer protocol used.
(ii) What is the name of the transport layer protocol used?
(iii) Inspect the frame number 4 and find the Destination and Source Port Numbers.
(iv) Inspect the frame number 6 and find the Destination and Source Port Numbers.

(c) Open the file "FIT1047-2022-Applied-W8-Q3c.pcapng" and answer the following questions.

(i) Name the application layer protocol used.
(ii) What is the name of the transport layer protocol used?
(iii) Inspect the frame number 1 and find the Destination and Source Port Numbers.
(iv) Inspect the frame number 2 and find the Destination and Source Port Numbers.

Sample Solution:

(a) Open the file "FIT1047-2022-Applied-W8-Q3a.pcapng", and answer the following questions.

(i) Inspect frames number 4 or 6 to name the application layer protocol used.
Application layer protocol used is HTTP (Hypertext Transfer Protocol).
(ii) What is the transport layer protocol used?
TCP, Transmission Control Protocol.
(iii) Inspect the frame number 4 to find the Destination and Source Port Numbers
Destination port: 80, Source port: 44168
(iv) Inspect the frame number 6 to find the Destination and Source Port Numbers
Destination port: 44168, Source port: 80

(b) Open the file "FIT1047-2022-Applied-W8-Q3b.pcapng", and answer the following questions.

(i) Inspect frames number 4 or 6 to name the application layer protocol used.
Application layer protocol used is SMTP (Simple Mail Transfer Protocol).
(ii) What is the transport layer protocol used?
TCP, Transmission Control Protocol.
(iii) Inspect the frame number 4 to find the Destination and Source Port Numbers
Destination port: 48604, Source port: 25
(iv) Inspect the frame number 6 to find the Destination and Source Port Numbers
Destination port: 25, Source port: 48604

(c) Open the file "FIT1047-2022-Applied-W8-Q3c.pcapng", and answer the following questions.

(i) Name the application layer protocol used.

Application layer protocol used is DNS (Domain Name System). It is used to map domain names to their corresponding IP address.

(ii) What is the transport layer protocol used?

UDP (User Datagram Protocol)

(iii) Inspect the frame number 1 to find the Destination and Source Port Numbers

Destination port: 53, Source port: 44565

(iv) Inspect the frame number 2 to find the Destination and Source Port Numbers

Destination port: 44565, Source port: 53

Activity 4: Address Resolution

(i) In this activity, we will analyze packets captured in a simulated network (Figure 3) with multiple users, a few switches and a router. We used Wireshark to capture packet movement in the network while we executed the "ping 10.0.0.11" command at node n4 to communicate with node n2. Ping uses ICMP protocol to send and receive information from participating nodes. The file "FIT1047-2022-Applied-W8-Q4.pcapng" contains the packets captured.

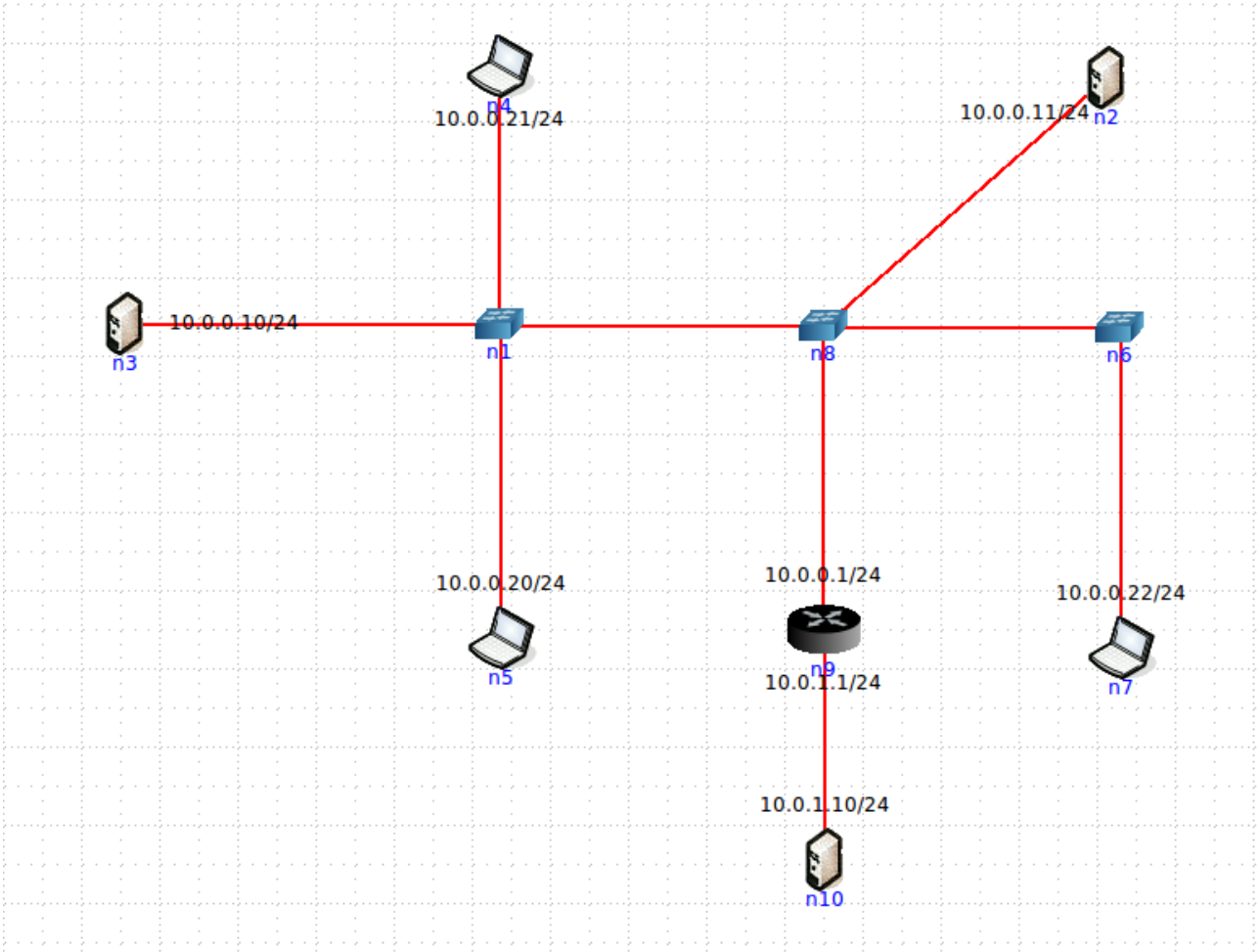

Figure 3: A Network

Frame movement between the participating nodes within a LAN is not possible without knowing the MAC addresses of the sender and the receiver. Any host will know its own MAC address after a successful booting and network configuration process. Node n4 MAC

Address: 00:00:00:aa:00:02, and node n2 MAC Address: 00:00:00:aa:00:03. Can you find out how the node n4 finds the MAC address of its communicating partner node n2 (server) during execution of the ping command? You may investigate the Wireshark capture to find your answer.

(ii) In this activity, we will analyze the file “FIT1047-2022-Applied-W8-Q4.pcapng” to investigate the DNS protocol used in the communication. DNS servers translate requests (from end users) for domain names into IP addresses. Analyze the packets and identify the IP addresses of the end user (client seeking DNS services) and the server.

Sample Solution:

(i) Click on frame 1 and 2 to find the use of ARP protocol. Note the destination MAC address in frame no 1, which is a broadcast address.
(ii) DNS Client IP Address: 51.128.215.10, DNS Server IP Address: 51.128.224.10