

## 1. Sub-CLO 5, Weight (12%)

a. Describe at least two network routing protocols that can be used to exchange information from one router to other routers within a single autonomous systems (AS) number. The following properties should be included in the description: default settings, max number of supported routers/hops, routing metrics, type of routing algorithm, routing table sharing and updating mechanism, routing error prevention mechanism (if any)!

### 1. Open Shortest Path First (OSPF)

OSPF uses a link state or the shortest path first algorithm. OSPF's most significant advantage compared to RIP is the reduced time needed to converge after a network change. However, it is also the most complicated to configure than RIP and would best not to be used by small networks.

Default settings :

Parameter	Default Settings
OSPF	Disabled
Interval at which Hello packets are sent	10 seconds on P2P and broadcast interfaces; 30 seconds on P2MP and NBMA interfaces
Dead interval after which OSPF neighbor relationships expire	40 seconds on P2P and broadcast interfaces; 120 seconds on P2MP and NBMA interfaces
Period during which a device acts as a stub router	500 seconds
Bandwidth reference value used to calculate a link cost	100 Mbit/s

Max number of supported router/hops : No Limitations

Routing Metrics : OSPF used the sum of the metric used for all outgoing interfaces in the route.

Type of routing algorithm : Shortest path first

Routing Table Sharing : Each OSPF router passes along information about the routes and costs they've heard about to all of their adjacent OSPF routers called the neighbors. After that OSPF rely mostly on the cost to compute the shortest path through the network between themselves and a remote router or network destination

Updating Mechanism : When an OSPF router first discovers a new neighbor, it will send the full update to all known link-state information routers within the OSPF area. Then All the router within the area will identify and synchronized link-state information to the database. If a change occurs on a network that becomes unavailable, an OSPF router sends only a partial update. It is done by the updated

state giving info to all the neighbor but gets ignored and only DR accepts the info and relay back the info to the other neighbor. DR are based on the highest preference on OSPF.

Routing Error Prevention : OSPF's backbone area is used for exchanging inter-area routes between all other areas. Based on that info, OSPF later than used the distance-vector principles to prevent routing loops.

## 2. Routing Information Protocol (RIP)

RIP uses a distance vector algorithm that is used to calculate the most efficient path to a destination **based on the number of hops** in the path.

Default settings :

Parameter	Default Setting
Maximum number of equal-cost routes	By default, the maximum number of equal-cost routes on the S5720I-SI, S5735-S, S5735S-S, S5735-S-I, S5735S-H, S5736-S, and S6720S-S, S6720S-S is 8, and the maximum number of equal-cost routes on the S5731-H, S5731-S, S5731S-H, S5731S-S, S5732-H, S6720-EI, S6720S-EI, S6730-H, S6730S-H, S6730-S, and S6730S-S is 16.
RIP function	Disabled
Split horizon	Enabled

Max number of supported router/hops : 15 hops

Routing Metrics : RIP uses hop count as the metric to rate the value of the different routes. The hop count is the number of devices that could be traversed in a routed and A directly connected network has a metric of zero; an unreachable network has a metric of 16

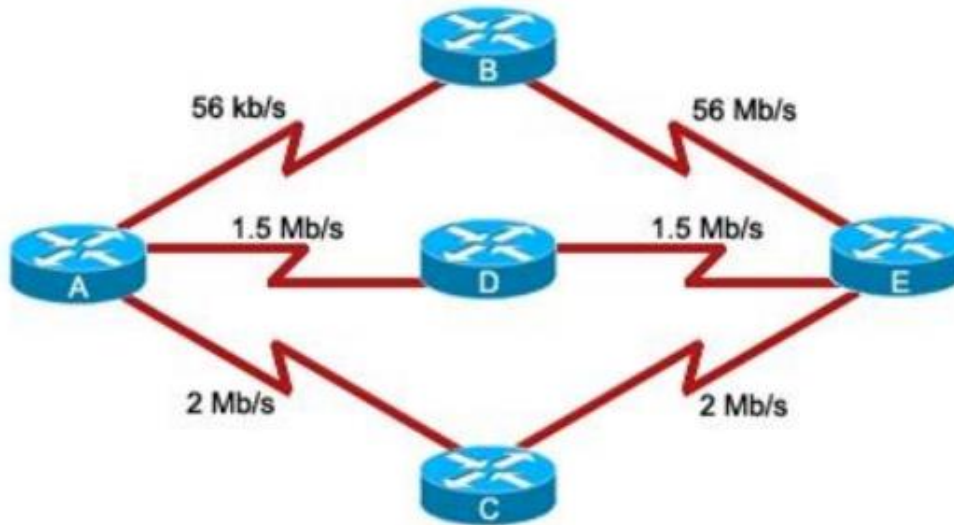
Type of routing algorithm : Distance vector

Routing Table Sharing : RIP uses a distance vector algorithm to decide which path to put a packet on/get to destination. Each RIP router maintains a routing table, which is a list of all the destinations the router knows how to reach.

Updating Mechanism : Each router then broadcasts the information to the entire routing table to its closest neighbors for every 30 seconds.

Routing Error Prevention : RIP has a feature called “route poisoning” which prevents routing loops by setting the hop count to 16. This hop count makes the route unreachable.

b. Refer to the following figure. Show the selected routing path when router A is forwarding data to router E if the routers are properly configured using following routing protocol with default settings and the network is fully converged.



- Using RIP protocol

On this example, there will be 3 routes

$A \rightarrow B \rightarrow E = 2$  Hops

$A \rightarrow D \rightarrow E = 2$  Hops

$A \rightarrow C \rightarrow E = 2$  Hops

Dari 3 routes ini, artinya dari state A ke E memiliki Load balancing.

- Using OSPF protocol

On this example, there will be 3 state that will be calculated

State B =  $0.056 + 56 = 56.056$

State D =  $1.5 + 1.5 = 3$

State C =  $2 + 2 = 4$

From the 3 state, OSPF then will decide the shortest path is  $A \rightarrow C \rightarrow E$

## 2. Sub-CLO 6, Weight (15%)

a. In UMN, K VLAN will be created to support teaching and learning activities in each department. The campus purchased N switches to build this system. How many ports are used to build K VLANs and connect N switches with this trucking method? Please also justify your answer clearly!

Because each switch needs two trunking ports. One is for the input and one is for the output port. The first switch and last switch only have 1 number of ports. Then the remaining N-2 Switches other than the last switches use 2 ports each. Therefore the number of ports all these switches uses is  $2 \times (N-2)$  ports. So the total number of N switches is  $2 + 2 \times (N - 2) = (2 \times N) - 2$  ports. Then,  **$(2 \times N) - 2$**  ports is needed to connect the switches.

b. A CSMA/CD protocol is used in a communication system. This CSMA/CD has a speed of 200 Mbps. The maximum time required to perform a one-way propagation delay from one host to another is  $200.10^{-6}$  sec. What is the minimum size of the transmitted frame if the transmitting node needs to detect a collision before completing the transmission of the frame?

Speed = 200 Mbps

Maximum time =  $200.10^{-6}$  sec

Minimum size of frame?

Minimum size of frame =  $2 \times 200.10^{-6} \times 2.10^8$  Mbps.

$$= 400 \times 200$$

$$= 80000 \text{ bits/8}$$

$$= 10000 \text{ bytes}$$

### 3. Sub-CLO 6, Weight (13%)

a. An office has two subnets that are interconnected by a router, as shown in the following figure. The figure above shows that the office uses two ARP modules. Each ARP module has its own ARP table. A computer with a MAC address wants to join this network connection. Is it allowed for this MAC address to appear in both ARP tables? Explain your answer!

Yes. Mac Address is possible to be appear in both ARP Tables, this is due to the fact that ARP modules are designed to handle communication between devices in the same network and maintaining packet sending P2P. Every single IP's and MAC Address will be located and connected, and when a new MAC Address is connected into the network it will send/receive packets from any device. ARP Table will be needed it's MAC address so the package will be transferred successfully. MAC Address will then expire in the ARP Modules within an 2 hour → 4 hours. ARP Module will then broadcast all of the connected device on the network if there is no more IP available.

b. What are the similarities between CSMA/CD and CSMA/CA? Which one is more efficient?

The similarity between CSMA/CD and CSMA/CA is the network protocol for their transmission, which operates at the media access control layer. Both uses it to handle data collisions, and belong to the IEEE standard (CSMA/CD uses higher versions). Also both are on a network, and is upgraded versions of CSMA with improved performance.

Although both use are beneficial, CSMA/CD is more efficient than CSMA/CA, since it is used to minimize the possibility of a collision and to recover a collision if it happens. For example, if a collision happens when a packet is sent over a wifi connection. The wireless devices will then check if another device is sending it before sending the packet. In contrast, if the channel is used, the device will wait for the channel to be free. Still, two devices can send at the same time and cause a conflict. In this case, both devices will detect the interference and stop sending.

When a retransmission, both will wait a random amount of time. CSMA/CD works very well on a traffic on the channel that increases, the packets will collide more frequently and the bandwidth gradually decreases. When the channel reaches about 80% of its capacity, the number of retransmissions increases rapidly and the channel collapses.

#### 4. Sub-CLO 7, Weight (15%)

a. If we want to build a wireless network infrastructure, what kind of hardware element do we need?

Elements We Need:

1. Wireless Host  
Wireless Host is needed because it contains hardware which is connected to the network such as Laptops, IP Phone, PDA.Hosts
2. Base Station  
Base stations is needed because it is a fixed transceiver that is the main communication point for one or more wireless mobile client devices.
3. Wireless Link  
Wireless link is needed because a link to connect mobile to base station.
4. Infrastructure Mode  
Infrastructure mode is needed because it is the wireless network framework.
5. Ad Hoc Mode  
Ad Hoc mode is needed because it can transmit each other nodes within a link coverage, and the node organize themselves into a working network or a route among the nodes.

Hardware used to create a Wireless Connection

1. Wireless Network Adapter  
Wireless Network Adapter is used due to the fact that it usually connect a device such as laptops and computer and allow the device to connect via wireless network. But due to modern technology, some of this device have already integrated wifi connection.
2. Wireless Routers or Access Points  
Wireless Router or Access Points is used due to the fact that this is the base of the network that works as a transmitter that spread the connection around. This works with the ethernet connect to the wireless router or the access points.
3. Wireless Antenas  
Wireless Antenas is used due to the fact that each router has an antenna to increase the signal range and speed of the internet.
4. Wireless Repeaters  
Wireless Repeaters is also necessary because it acts as an extension to wireless network.

b. In a bookstore, WiFi access is provided by two different Internet Service Providers (ISP). Each ISP operates its own Access Point (AP). Besides, they also have different IP address blocks. What will happen if both APs run on different channels? And what will happen if both APs operate on the same channel?

1. Running in a different channel

If the 2 access points are running in different channel, it is surely the best option. Not only that, both could be used as an extensions of a different internet provider or different ISP. Everything about that network and Access Points is also different like address blocks, and each access point reference a different ISP so it will have no problem on having its own channel.

2. Running in a same channel

Running 2 access points with different ISP and address block can cause an interference problems or an wireless network overlapping problem. However routers often try to automatically choose the best WiFi Channel for the least interference. Then, 2 separate access points with different ISP should run at its own channel to avoid network issues.

## 5. Sub-CLO 8, Weight (15%)

a. True or false:

- If stored video is streamed directly from a Web server to a media player, then the application is using UDP as the underlying transport protocol. → **FALSE**
- if an RTP session has a separate audio and video stream for each sender, then the audio and video streams use the different SSRC. → **TRUE**
- Suppose Alice wants to establish an SIP session with Bob. In her INVITE message she includes the line: m=audio 48753 RTP/AVP 3 (AVP 3 denotes GSM audio). Alice has therefore indicated in this message that she wishes to receive GSM audio. → **TRUE**

b. Describe two types of redundancy in video and discuss how they can be exploited for efficient compression!

### 1. Spatial Redundancy

Spatial redundancy within a particular image, intuitively images that are mostly blank are highly redundant and can be compressed efficiently without significantly degrade its image quality.

### 2. Temporal Redundancy

Temporal redundancy reflects repetition from image to subsequent image. When the subsequent images are most similar, then their encoding can be avoided. It can also achieve an indication that the subsequent image is similar, rather than re-encoding it.

Image and the subsequent image are exactly the same, there is no reason to re-encode the subsequent image. In contrast, it is more efficient to simply indicate during encoding process. If the two images are very similar it is not recommended to indicate how the two image are similar/not. Instead, it is best to re-encode the second image.

c. What is the difference between end-to-end delay and packet jitter? What are the causes of packet jitter?

### 1. Delay

Delay is the amount of time data(signal) takes to reach the destination. A higher delay generally means congestion of some sort of breaking of the communication link.

### 2. Jitter

Jitter is the variation of delay time, it happens when a system is not deterministic state eg. Video Streaming suffers from jitter a lot because the size of data transferred is quite large and hence there is no way determining the time needed to transfer.



