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Homework #5

ECE 545
Due Date: 4/9/2023

Problems to be submitted.
Review Questions: R#
Problem Questions: P#

R#3
- Centralized: In a centralized network, a single node obtains complete information regarding the network topology, traffic, and other nodes. This node then transmits the acquired information to the corresponding routers. The benefit of this approach is that only one node needs to store the information. However, the disadvantage is that if the central node fails, the entire network goes down, resulting in a single point of failure.
- Distributed: A node receives information from its neighboring nodes and decides which path to take to send the packet. The drawback of this approach is that if there is a change in information between the time a node receives information and when it sends the packet, it may cause a delay.

Link-State uses a centralized approach, while Distance Vector uses a decentralized approach.

R#7
- BGP is utilized for inter-Autonomous System (AS) protocols, while Router Information Protocol (RIP) and OpenShortest Path First (OSPF) protocol are used for intra-AS protocols.
- Inter-AS protocol involves controlled distribution of routing information, whereas policy issues play a less significant role in selecting routes for intra-AS protocols.
- Inter-AS protocol emphasizes quality and performance, while Intra-AS protocol focuses primarily on performance.

R#11
BGP is an inter-AS routing protocol that relies on two key attributes: AS-PATH and NEXT-HOP.
The AS-PATH attribute is included in the advertisement that

carries the prefix values and indicates the sequence of AS numbers involved.
NEXT-HOP denotes the router interface responsible for initiating the AS-PATH. Routers also utilize the AS-PATH attribute for multiple paths. When the first router is set up in the forward table, it employs the NEXT-HOP attributes.

R#15 In the SDN (Software Defined Networking) control Plane, routing protocol implementation occurs in the Network layer since routing algorithms determine the path for data packet transmission. The Networking layer is where we determine the path flow from the sender to the receiver. In addition to routing, SDN is responsible for access control and load balancing to maintain network state information by collaborating with network control applications.

R#17 There are two types of OpenFlow messages that a controlled device sends to the controller:

- Flow Removed: These messages inform the controller about the removal of a flow table entry. They may occur due to timed out flow table entries.
- Port Status: These messages inform about the changes in the status of a specified port.

There are also two types of OpenFlow messages that the controller sends to the controlled devices:

- Read State: These messages are used for collecting statistics and obtaining counter values from the switch's flow table & port.
- Modify State: These messages are used to set the properties of a switch port. They may involve changes to entries, such as adding or deleting them.

R#20 Traceroute displays the path that data takes from its sources to its destination on the internet. It is essential to know the names and addresses of the routers used in the transmission of data between the source and hosts. Therefore, the sending host may receive ICMP warning and Port unreachable messages. The two types of messages that may be received are:

- ICMP warning message (type 11 code 0).
- ICMP message indicating destination port unreachable (type 3 code 3).

P#3 Using the figure, the computation of shortest path from source x to all the nodes by using Dijkstra's algorithm:

S'	L(t), c(t)	L(u), c(u)	L(v), c(v)	L(w), c(w)	L(y), c(y)	L(z), c(z)
x	∞	∞	3, x	6, x	6, x	8, x
xv	7, v	6, v	3, x	6, x	6, x	8, x
xvu	7, v	6, v	3, x	6, x	6, x	8, x
xvuw	7, v	6, v	3, x	6, x	6, x	8, x
xvuwy	7, v	6, v	3, x	6, x	6, x	8, x
xvuwyt	7, v	6, v	3, x	6, x	6, x	8, x
xvuwytz	7, v	6, v	3, x	6, x	6, x	8, x

c(v) is the current path of node v & L(v) is least cost path of node v
S' is the subset of nodes.

∴ The following are shortest paths from x along with their cost:

t: xvt = 7;

u: xvu = 6;

v: xv = 3;

w: xw = 6;

y: xy = 6;

z: xz = 8.

P#8 The cost of the link:

c(x, y) = 3; c(y, z) = 6; c(z, x) = 4.

Construct the matrix as follows:

	x	y	z
x	0	3	4
y	3	0	6
z	4	6	0

Using to Distance Vector algorithm, any node m computes the distance vector using the following formulas:

$D_m(m) = 0$; $D_m(n) = min\{c(m,n) + D_n(n),\ c(m,n) + D_o(n)\}$

$D_m(o) = min\{c(m,n) + D_n(o),\ c(m,o) + D_o(o)\}$

Distance at node x after intialization:

	x	y	z
x	0	3	4
y	N/A	N/A	N/A
z	N/A	N/A	N/A

Distance at node y after intialization:

	x	y	z
x	N/A	N/A	N/A
y	3	0	6
z	N/A	N/A	N/A

Distance at node z after intialization:

	x	y	z
x	N/A	N/A	N/A
y	N/A	N/A	N/A
z	4	6	0

P# 14 External BGP operates between routers in distinct (AS)s, while Internal BGP runs between routers in the same AS.

The following are examples of how a router may learn about x using EBGP or IBGP:

a) EBGP Router3c learns about x from an EBGP connection.

b) IBGP: Router 3a learns about x from an IBGP connection.
c) EBGP: Router 1c learns about x from an EBGP connection
d) IBGP: Router 1d learns about x from an IBGP connection

P#16 To compel B to send all of its traffic to D on the east coast, C may choose to only broadcast its route to D through its east coast peering point with B.

P#22 It is more advantageous to transport SNMP messages using unreliable UDP datagrams:
The designers of SNMP opted for UDP as the preferred transport protocol instead of TCP. This decision was made because if SNMP ran over TCP and stopped sending messages, the control of TCP would back off to SNMP, preventing the network manager from sending SNMP messages.