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CSCI 5010 – Fundamentals of Data Communications

Lab

Static and Dynamic Routing

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# Summary

This lab is intended to be an overview of Cisco IOS configuration, and routing technologies, such as static routes, default routes, link failover, and dynamic routing protocols.

The questions in the lab are intentionally vague. The purpose of this is for you not only to research, investigate, and learn the technologies, but also become proficient at interpreting both non-technical and technical questions. Being able to research and discover answers on your own will be critical as you progress in your career.

* Learn how to perform basic router configuration & troubleshooting including:
  + Configure static routes and populate the routing tables
  + Apply administrative distance for automatic route failover
  + Designing and configuring a routing protocol to create dynamically learned routes
  + Routing protocol convergence and failover

# Part 1

# Objective 1: Network Design and Setup [16 points] Create the following network topology, enable all the appropriate ports, and configure the basic setup for the devices in the topology.

A diagram of a network

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1. Use /24 subnets for all LANs (Each host is in a different subnet) (private IPv4 addresses). Other than IP and subnet, nothing else is configured on the hosts.
2. Use /30 subnets for network connecting routers (private IPv4 addresses)
3. Add your addressing scheme to the network diagram (drawing) indicating the subnets for each network, as well as the interface/PC addresses used in your design [**10 points**]

Solution above.

1. Make sure there is IP connectivity from each PC to the local router (ping the LAN & WAN interfaces).
2. Can PC1 ping the WAN interface IP address of R1? Why or why not? [**2 points**]
   1. PC1 cannot ping the WAN interface IP address of R1 because that IP is out of its network.
3. Is PC1 able to ping R3? Why or why not? [**2 points**]
   1. PC1 is not able to ping R3 because the routers are not set up with any type of static or dynamic routes.
4. Explain one reason why PC1 could ping the LAN IP address of R1, but could not ping the WAN IP address of R1. [**2 points**]
   1. One reason for this would be that the LAN IP address is directly connected to the same network as PC1 but the WAN IP address is out of network and is the LAN interface is not correctly routed to the WAN interface.

# Objective 2: Static Routing [14 points]

1. Configure static routes in each router to ensure connectivity between all routers and PCs in the network.
   1. Show the static routes configured
      1. Show the routes in the route table of R1 and R2 [**2 points**]

A screenshot of a computer program

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* + 1. Show the routes in the running configuration of R3 [**2 points**]

A screenshot of a computer

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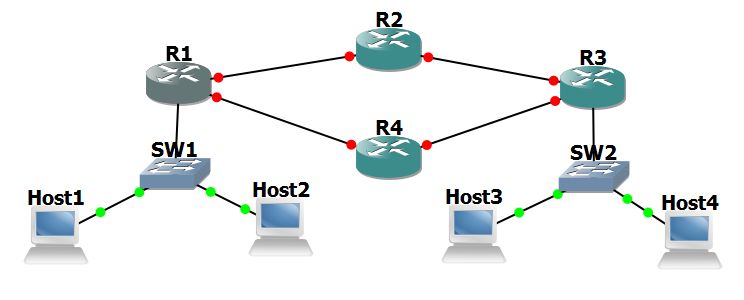
1. Configure Inter-VLAN routing, ensure and maintain 100% connectivity between all devices in the network.
   1. Provide the output from traceroutes from PC1 to PC2, 3, & 4 [**10 points**]

A screenshot of a computer program

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# Objective 3: Dynamic Routing (RIP or OSPF) [30 points]

Create the following network topology, enable all the appropriate ports, and configure the basic setup for the devices in the topology.



1. Remove the static routes from all router configurations.
2. Configure RIPv2 or OSPF on all router interfaces and networks.
   1. Provide commands used to implement, screenshot of the route table (from R2 & R4) indicating the network has converged [**20 points**]

Commands:

Conf t

Router ospf 1

Network [DG IP] [wildcard submask] area 0

Ex: network 192.168.1.1 0.0.0.255 area 0

(do that for each router and every network that is connected to that router

Router 2:

A screenshot of a computer program

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Router 4:

A computer screen shot of a computer

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* + 1. What does convergence mean, and why is it important? [**10 points**]

Convergence is the process of the routers updating their routing tables based on the changes in the network. Convergence is important because it ensures routers can adapt to the network. They adapt by updating their routing tables and allowing for users in the network to still talk to each other even when there is a change in the network topology.

Extra Credit: Implement RIPv2 as well as OSPF separately on the network and answer question for Objective 4. **[+5 points]**

# Objective 4: Routing Protocol Failover [17 points]

1. Demonstrate Failover
   1. Issue a traceroute from PC1 to PC3. Which path is it taking? [**2 points**]
      1. Is it taking the path: R1->R2->R3
   2. Issue a continuous ping from PC1 to PC3.
   3. Remove the router link/connection between the active path routers (discovered in above [1.a]). *For example, if the path was R1, R2, R3, then remove the connection to R2*. 
      1. Were any packets lost? If packets were lost, how long was the network down? Explain this, and indicate how the traffic failed over and the new traffic flow [**5 points**]
         1. Only 1 packet was lost. The network was down for only a couple seconds. When I disconnected the R1->R2 connection, the traffic failed over to the R1->R3. It realized that there wasn’t a route to PC3 anymore and OSPF determined that it must try to find another path, which it did.
   4. Do some critical thinking and research. Could failover be achieved with this network design using only static routes? Explain [**10 points**]
      1. Failover could not be achieved with this network design using only static routes. Static routes are configured to connect one path and one path only. There are no built in failover logic by just configuring a static route, extra configuration would be required to allow for failover.

**Report Questions**: [18 points]

* What are the advantages of using routing protocols?
  + Allows for automatic fail over
  + Simplifies router configurations
  + Allows for load balancing in the network
  + In some cases there are increased security by using routing protocols
* What is the difference between Distance Vector and Link State Routing protocols?
  + Distance Vector routing protocols learn by rumor, they add directly connected routes to their table. It uses broadcast and multicast for updates and is always listening for routing updates.
  + Link State routing protocols also add directly connected routes to their table but learns a complete map of the network. It uses Dijkstra’s algorithm to determine the best routes.
* What are the advantages of using static routing or when would static routing be preferred over dynamic routing?
  + Static routing is simple to configure.
  + Static routing consumes less resources while dynamic routing does much more calculation.
  + There can be increased security because some dynamic protocols ask for routing information of the whole network and that could be a possible security risk.
* Classify the below routing protocols as Distance Vector and Link State Routing protocols:

1. OSPF, BGP, RIP, IS-IS
2. OSPF – LS, BGP – DV, RIP – DV, IS-IS – LS

* Give:
* Scenario when distance vector routing protocol would be used in the network.
  + A small office or home network would be good for DV routing protocol. It uses less resources and would not change routes that much
* Scenario when link state routing protocol would be used in the network.
  + Large company / enterprise network would be good for LS routing protocol. These protocols rapidly adapt to network changes and would be better when it comes to redundancy and failover.
* What is an Administrative Distance (AD) for a routing protocol? Give AD for OSPF and RIP.
  + AD prioritizes different routing protocols and ranks them by number. Lower numbers are prioritized.
  + OSPF – 110
  + RIP – 120
  + If a network had OSPF and RIP, OSPF would be used because the AD number is lower.
* What is a metric in a routing protocol?
  + A metric in a routing protocol is a measurable value that is assigned by the routing protocol. There are different values that are used to calculated the usefulness to different routes.

# **Extra Credit Q1 - Understanding Routing Protocol [ 25 points ]**

E1.1 For the network given below in Figure. 1, give global distance-vector tables **WHEN:**

1. Each node knows only the distance of its immediate neighbors. **[4pt]**
2. Each node has reported the information it had in the preceding step to its immediate neighbors. **[4pt]**
3. Repeat step (b) one more time. **[4pt]**

5

8

4

2

2

2

4

Figure. 1

Refer the slides below for an example of how to do this question:



<https://www.youtube.com/watch?v=dmS1t2twFrI>

**E1.2 (7 points)**

Again for the network graph in Figure. 1. Show how the link-state algorithm builds the routing table for node D.

1. Show the detailed link-state algorithm. **[5pt]**
2. Show the final routing table of node D. **[2pt]**

Refer the slides below for an example of how to do this question:



**E1.3 (6 points)**

Consider this directional graph below in Figure 4. Use Dijkstra’s algorithm to find the shortest path from node v3 to v5. Write down the **steps**. Do you have any comments on the result (what if the link cost of v3-v1 was 1 instead of 5?)? [**6 pts]**

5

2

3

5

-2

3

2

5

6

Figure. 4

**Extra Credit Q2 [10 points]:**

A diagram of a network

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Consider the above network. RIP and OSPF both are simultaneously working on this network.

For H1 to reach H3, R1 gives a RIP path R1-R2-R3 and OSPF gives R1-R4-R5-R3. Which path would packets from H1 going to H3 via R1 take?

Explain why you think a particular path would be chosen.

I think the OSPF path would be chosen because of administrative distance. When the routers talk to each other, they ask which route would be best, and because OSPF has a lower AD than RIP, the routers will take the route of OSPF.

# Total Score = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_/135 (including 40 extra points)