

Lab 3

Static Routing, RIP, OSPF

Summer 2014

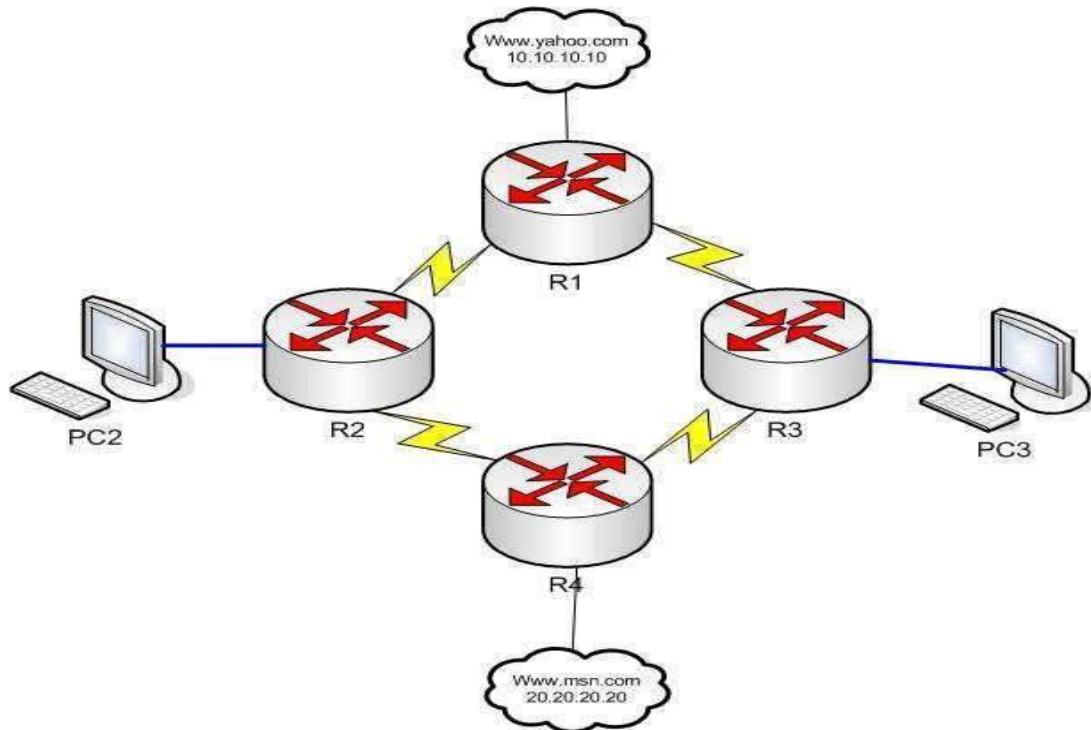


OBJECTIVES

- 1. Learn how to configure static routes and populate a routing table using static routing.**
- 2. Learn the operation and limitations of RIP version 2.**
- 3. Learn the application of default routes in a simple network environment.**
- 4. Learn how to configure OSPF Routing in a Single Area.**
- 5. Learn how to configure OSPF across Multiple Areas.**
- 6. Learn the application and configuration of Virtual Links.**
- 7. Learn Route Summarization within OSPF.**

1. Static Routing

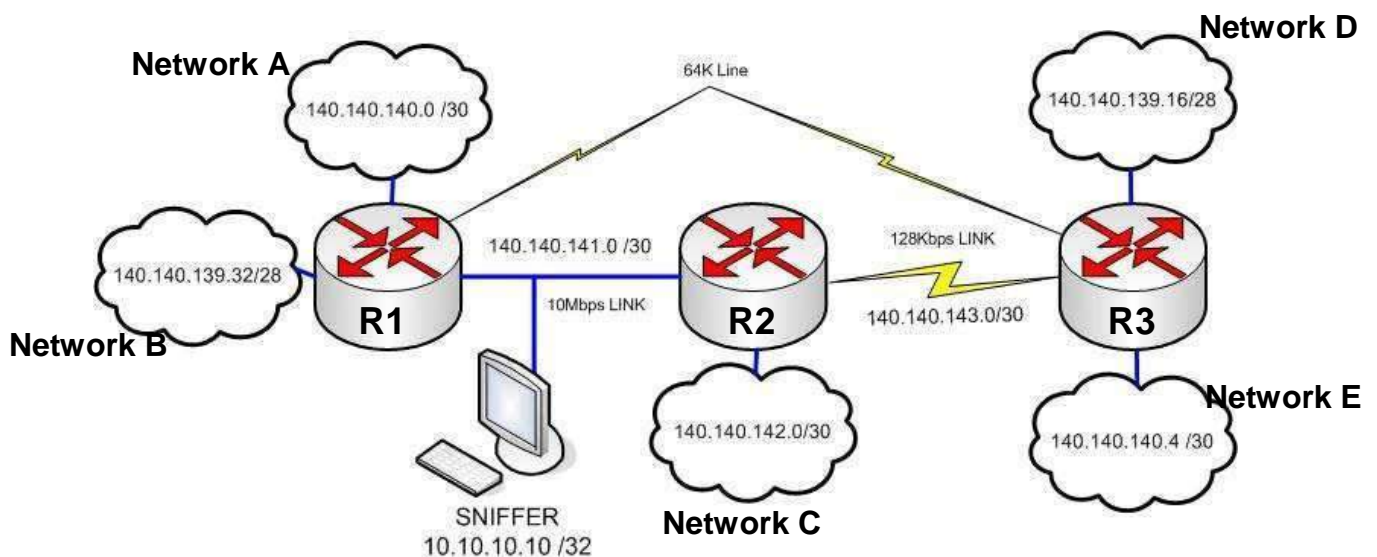
Create the following network configuration:



- Use static routes to achieve endpoint connectivity.
- Use **extended pings** at R1 and R4 to ensure reachability to the websites.
- Manipulate static routes to achieve the following:
 - ☐ When PC2 pings PC3, Echo request follows path R2-R4-R3; Echo Reply R3-R1-R2. Remember ping makes roundtrip from source to destination, so you can configure different routes for outgoing and incoming ping packets.
 - ☐ When PC3 pings www.msn.com Echo request follows R3-R4; Echo Reply R4-R2-R1-R3. Apply the same logic as above.

2. RIPv2

- Enable RIP version 2 on all the 3 Routers.
- Using **show ip route**, document propagation of network advertisements.
- Use SNIFFER station to capture routing information exchanged by RIP. Document your findings. Remember lab0, you would need a switch between R1 and R2 to do so
- Document as well any information you find related to: Auto-summarization, VLSM support, and Network Reachability.
- Do you need Static Routes to support RIPv2?
- Enable appropriate debug command to monitor RIP events, report what all information you could see in the debug output.
- Add a link between routers as shown:



- ☐ Use IP values of your preference to configure this new link and include this new subnet on your routing protocol.
- ☐ Document your routing table after network reconvergence.
- ☐ What is the fastest way from 139.16 to 139.32 networks? Does this match your routing table? Why or why not? Explain your results

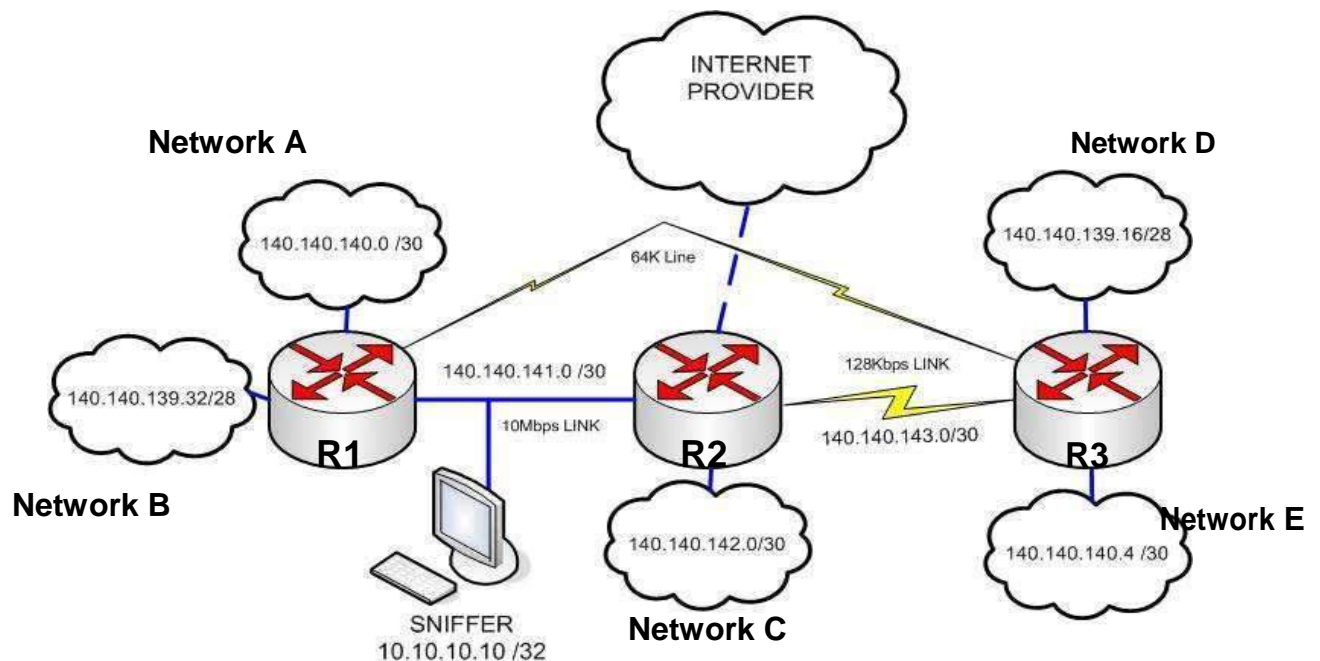
Extra Credit:

- Use appropriate configuration to make the router to allow 140.140.139.32/28 to ping 140.140.140.4/30 via 10Mbps – 128Kbps link and not the 64 Kbps link. ?
- ? Hint: Select the more appropriate option between offset list or route maps.

4. Default Route

Your small corporate network needs to go online and it is your task to connect one of your routers to your Internet provider (see diagram). In order to be able to reach any other site on the Internet you will need:

- a. A routing table entry for each network connected to the Internet on your router. Try it with static routes.
- b. A default route to your provider (recall function of default gateway on a local subnet)

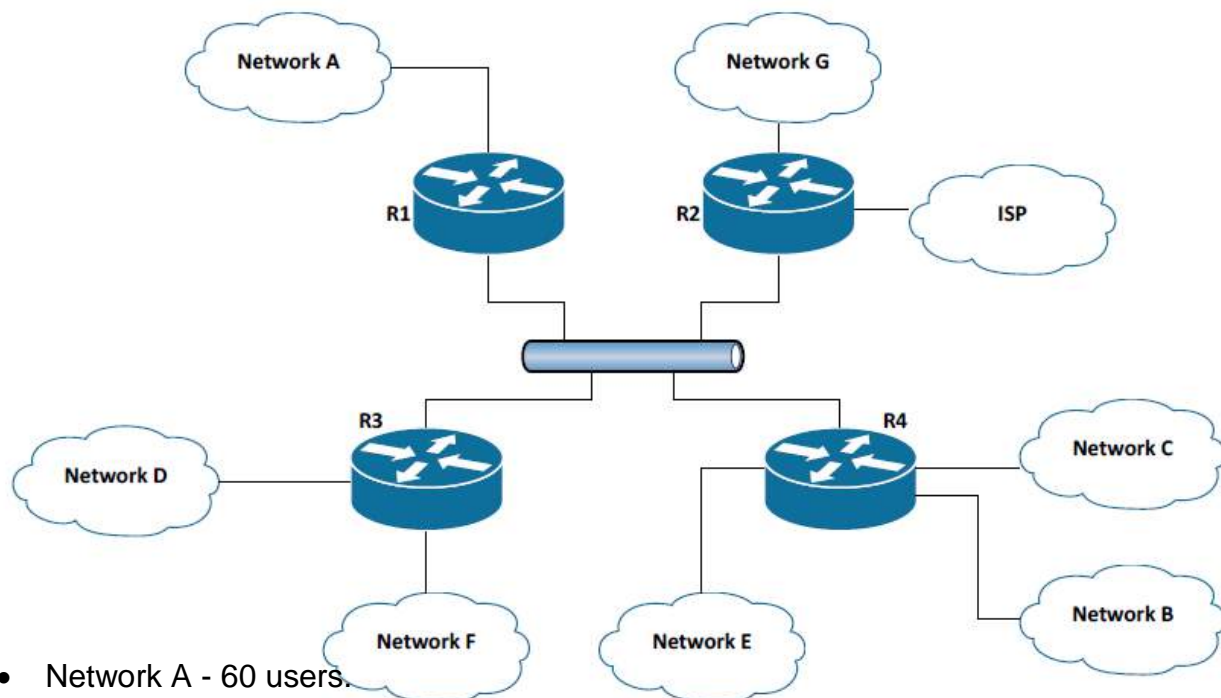


- c. Configure default routes on appropriate sites in order to support any “other” route. Include in your report a copy of the configuration file of the routers after goal completion.

5. OSPF Single Area

Before you start configuring OSPF let's get comfortable with subnetting. Also, make transition to the network diagram below with minimum no of link changes

Use a single class C to design the following network:



- Network A - 60 users.
- Networks B, E & F - 20 users each.
- Networks C, D, G & ISP - 10 users each.
- IP block allocation should be in the following order: A, F, C, ISP, B, E, D, G, and serial/fast Ethernet Links. **Use optimal subnetting**

Note: First do your IP addressing on a piece of paper and get it checked from your TA before proceeding.

- b. Create a monitor session on the switch and sniff the ospf traffic. Describe the different stages and the order by which OSPF neighbors are established. Create a flowchart of that. Use appropriate OSPF commands to achieve network connectivity between all the clouds. R1, R2, R3, and R4 should be a part of Area 0. Make R1 as DR and R2 as BDR. R3 *must not* participate in election.(<http://packetlife.net/blog/2011/jun/2/ospf-designated-router-election/>) Include each OSPF configuration on your report. Show the neighbor relationships from all the routers.

- c. Identify ABR and ASBRs (if any present) in your network.
- d. Identify which routers are fully adjacent. Paste the appropriate 'show' command.
- e. Report the routing advertisements being propagated by each router to each other ('show ip route').
- f. Analyze a single OSPF route entry; explain each parameter listed.
- g. Report result of the following commands on Router 3 & 4:
 - show ip ospf
 - show ip ospf database (Describe the type of LSAs you observe)
 - show ip ospf neighbor detail
 - show ip protocols

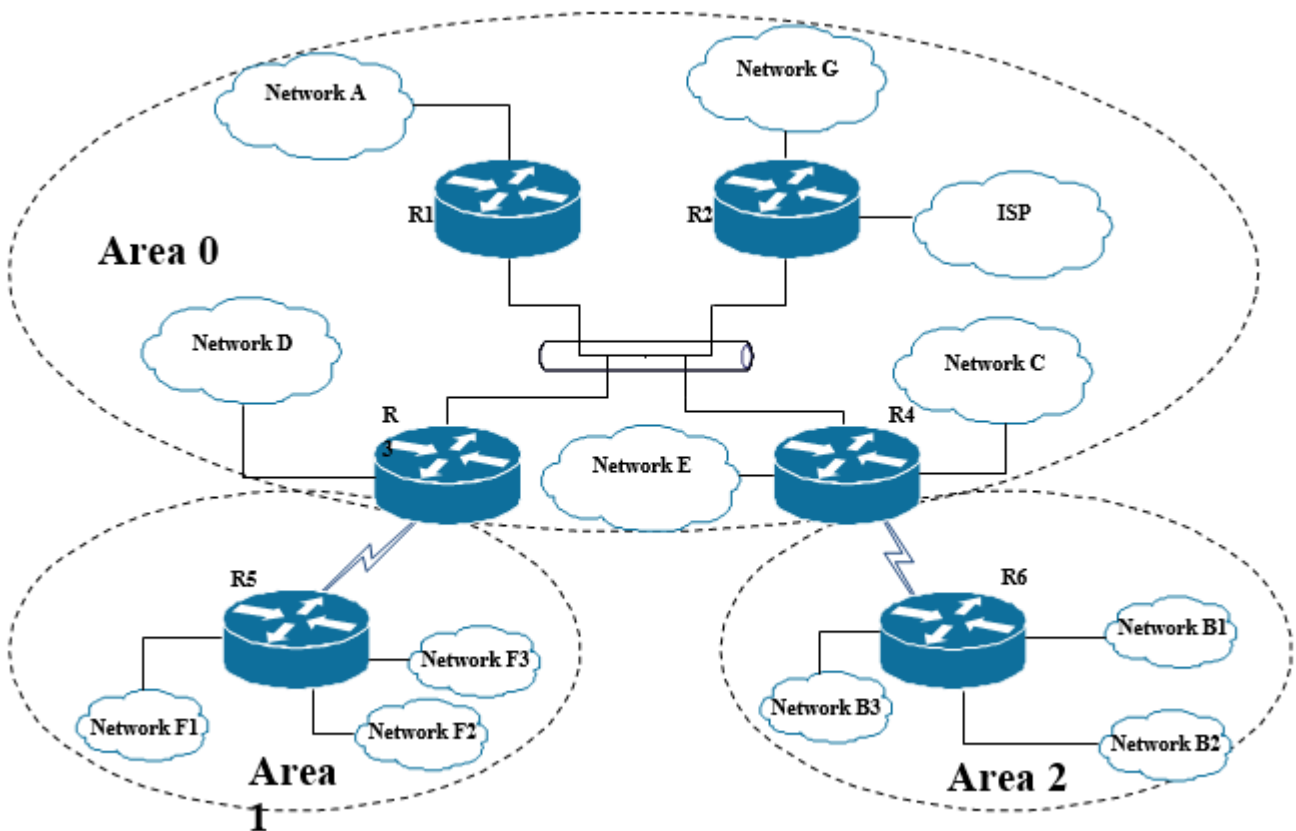
Also explain output of "debug ip ospf pkt/adj/hello" in brief

6. OSPF Multi Area

- a. Users on network B and F decide to split their networks in 3 different broadcast domains, they require a router (each) to be added to their network.
- b. You should make their routers parts of the OSPF domain, however you don't want them as a part of area 0.
- c. Make their routers part of an independent area each, and use R3 and R4 as ABR
- d. Adjust your OSPF configuration to achieve end to end connectivity.
- e. Report OSPF configuration from R3, R4, R5 & R6.
- f. Report any variations on the ABRs for the command **show ip ospf database** (from previous section)
- g. How are the routes internal to an area being propagated to other areas?

(How are B routes visible at R3 and R5?) & (How are F routes visible at R4 and R6?)

h. Do you have a route to each network? Do you see any route summary?



7. OSPF Virtual Link

All areas in an Open Shortest Path First (OSPF) autonomous system must be physically connected to the backbone area (Area 0). In some cases, where this is not possible, you can use a virtual link to connect to the backbone through a non-backbone area. You can also use virtual links to connect two parts of a partitioned backbone through a non-backbone area. The area through which you configure

the virtual link, known as a *transit area*, must have full routing information. The transit area cannot be a stub area.

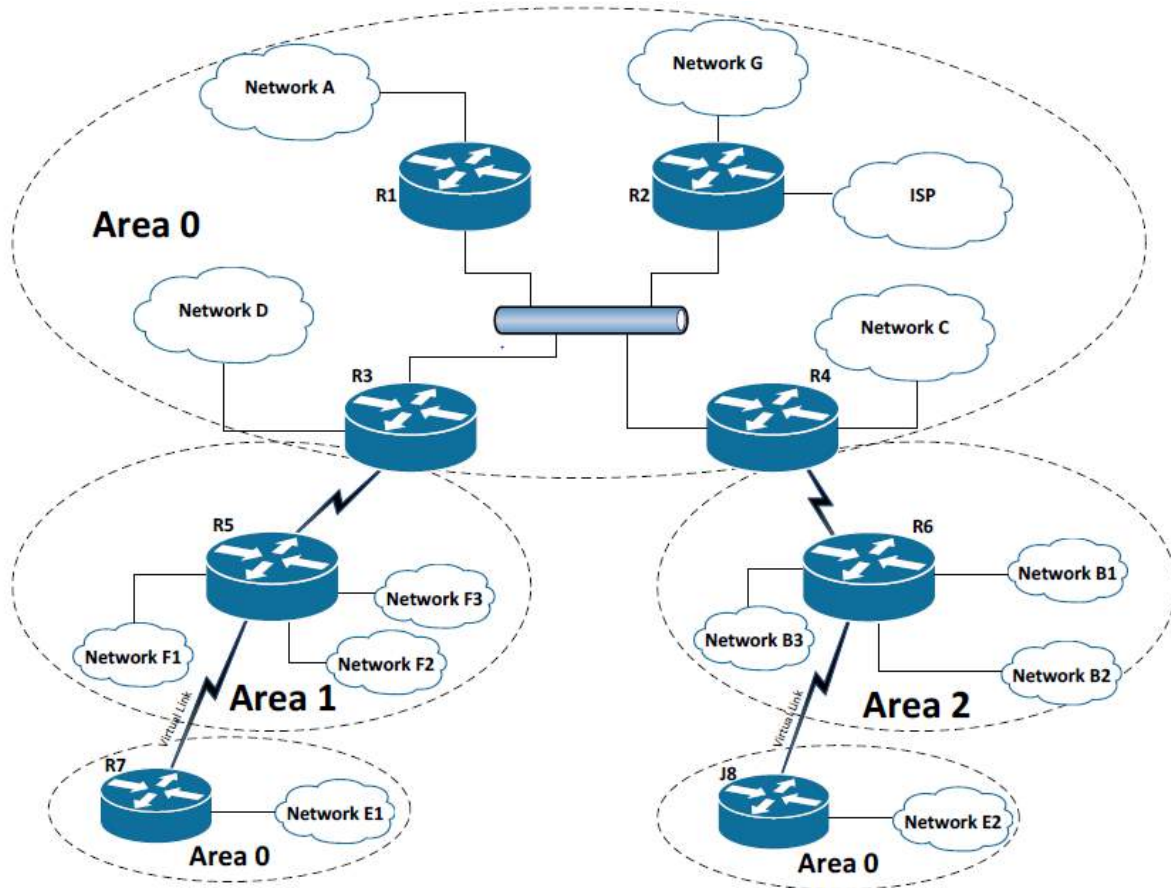
- a. Network E is now split into two parts and Network E1 and E2 is now part of an important segment of your company and now require connectivity to area 0 with minimal impact on the current network design (but remotely connected using virtual links).
- b. Your job is to create virtual links (one from R7 to area 0, and one from a “Juniper Router” J8 to area 0), so these routers can exchange routing information directly with other ABRs.
- c. R1, R2, R3, R4, R7 and J8 should be part of area 0, R5 and R6 of their respective non-zero areas.
- d. Analyze the results of the command **show ip ospf neighbor detail** on routers R7 and J8. Do you see any interesting information? Explain.
- e. What about your results for the **show ip route** command on same routers? **(use appropriate command on Juniper routers)**
- f. Based on routing tables, manually trace a ping from network E1 to network E2, and vice versa.

Cisco Virtual Link Reference:

http://www.cisco.com/en/US/tech/tk365/technologies_configuration_example09186a00801ec9ee.shtml

Juniper Virtual Link Reference:

http://www.juniper.net/techpubs/en_US/junos11.4/topics/example/ospf-virtual-links-configuring.html



8. OSPF Route Summarization

Route summarization is the process of summarizing subnets into a larger subnet to be advertised to upstream routers for ease of management/troubleshooting and resource conservation. However when working with OSPF you can only summarize at an ABR or ASBR.

- Optimize your LSA advertisements to minimize size of Routing Tables.
- Make use of the commands available under **area range** to do so (If needed, use appropriate commands on Juniper routers). Report each router's OSPF configuration after summarization. Report routing table after

summarization for each router.

- c. Compare your results with the ones you got from OSPF Multi-area.
Report your observations.

Route Summarization Reference:

<https://supportforums.cisco.com/docs/DOC-27672>

Extra Credit:

Do question Q3.1 to Q 3.10

[Q3.1] Using the information below, what sort of information is being conveyed and

what is the purpose of the message within OSPF?

4d20h: OSPF: Rcv hello from 172.16.1.1 area 0 from Serial1 172.16.4.13

4d20h: OSPF: End of hello processing

4d20h: OSPF: Rcv hello from 172.16.2.1 area 0 from Serial0 172.16.4.10

4d20h: OSPF: End of hello processing

[Q3.2] Use the output below to answer the following questions. What is the process-id

for OSPF? What networks are routable? On the router, what commands would you

use to verify the router was properly configured to route to the networks below?

R2#sh ip protocol

Routing Protocol is "ospf 100"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: ospf 100

Routing for Networks:

172.16.2.1/32
172.16.4.5/32
172.16.4.10/32

[Q3.3] Using the *sh ip ospf int* command one receives the following information (below).

Please use the information that has been provided for you to answer the following questions.

Ethernet0 is up, line protocol is down

Internet Address 172.16.1.1/24, Area 0

Process ID 100, Router ID 172.16.1.1, Network Type BROADCAST, Cost: 10

Transmit Delay is 1 sec, State DOWN, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Serial0 is up, line protocol is up

Internet Address 172.16.4.13/30, Area 0

Process ID 100, Router ID 172.16.1.1, Network Type POINT_TO_POINT,
Cost: 64

Transmit Delay is 1 sec, State POINT_TO_POINT,

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:03

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 172.16.3.1

Suppress hello for 0 neighbor(s)

Serial1 is up, line protocol is up

Internet Address 172.16.4.6/30, Area 0

Process ID 100, Router ID 172.16.1.1, Network Type POINT_TO_POINT,
Cost: 64

Transmit Delay is 1 sec, State POINT_TO_POINT,

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:00

Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 172.16.2.1

Suppress hello for 0 neighbor(s)

[Q3.4] Which interfaces are configured correctly to support the OSPF protocol (be sure to include proof to support your answer)?

[Q3.5] What is a designated router and what is its function? Is there a designated router for each configured network?

[Q3.6] How often are the HELLO packets initiated?

[Q3.7] What is the cost for the Ethernet0 and serial links? How is the cost of a link determined (please show calculations)?

[Q3.8] Using the *sh ip route* command one receives the following information. Please use the information that has been provided for you to answer the following questions.

R2#sh ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
U - per-user static route, o - ODR

Gateway of last resort is not set

172.16.0.0/30 is subnetted, 3 subnets

C 172.16.4.8 is directly connected, Serial1

O 172.16.4.12 [110/128] via 172.16.4.9, 00:09:55, Serial1
[110/128] via 172.16.4.6, 00:09:55, Serial0

C 172.16.4.4 is directly connected, Serial0

[Q3.9] How many routes were discovered by the OSPF process?

[Q3.10] What does [110/128] mean, please be very specific?

Study Questions:

1. What is meant by administrative distance and how is this important when one does a show ip route?
2. Why do routing protocols use metrics?
3. What is convergence time?
4. What is a distance vector routing protocol?
5. Name several problems associated with distance vector protocols?
6. What is the difference between a routed and routing protocol? Give 2 examples.
7. What does a routing protocol communicate?
8. With whom does a routing protocol communicate?
9. What does convergence mean?
10. What is meant by default route?
11. What is meant by load sharing?
12. What are the differences between RIPv1 and RIPv2 update packets?
13. In a RIP routing table, how do you determine which networks are discovered by the routing protocol?
14. What information does the show ip route summary command convey?
15. List the different ways as to how RIP avoid loops?

16. List five major difference between RIPv1 and RIPv2
17. What are the benefits of hierarchical routing and of flat routing?
18. What is VLSM? Does OSPF support VLSM? If so, how? If not, why should it?
19. Does route summarization occur automatically in OSPF? If so, how? If not, should it?
20. In what situations would using a virtual link be preferable to physically connecting an OSPF area to the backbone area?
21. What is the purpose of a loopback interface?
22. What types of routers may be seen in an OSPF network?