Digital Trolleys (Instructor Version)

Instructor Note: Red font color or Gray highlights indicate text that appears in the instructor copy only.

Objective

Use CLI commands to verify operational status of a multiarea OSPF network.

OSPF is configured in this activity both as a single-area topology and as a multiarea topology to review `show` commands from the chapter curriculum.

Scenario

Your city has an aging digital trolley system based on a one-area design. All communications within this one area are taking longer to process as trolleys are being added to routes serving the population of your growing city. Trolley departures and arrivals are also taking a little longer, because each trolley must check large routing tables to determine where to pick up and deliver residents from their source and destination streets.

A concerned citizen has come up with the idea of dividing the city into different areas for a more efficient way to determine trolley routing information. It is thought that if the trolley maps are smaller, the system might be improved because of faster and smaller updates to the routing tables.

Your city board approves and implements the new area-based, digital trolley system. But to ensure the new area routes are more efficient, the city board needs data to show the results at the next open board meeting.

Complete the activity directions as stated below.

Save your work and explain the differences between the old, single area and new, multiarea system to another group or the entire class.

Required Resources

- Packet Tracer software
- Word processing software

Directions

Step 1: Map the single-area city trolley routing topology.

a. Use Packet Tracer to map the old routing topology for the city. Cisco 1941 Integrated Services Routers (ISRs) are preferred.

b. Create a core area and place one of the routers in the core area.

c. Connect at least two routers to the core area router.

d. Choose to connect two more routers to the routers from Step 1c or create loopback addresses for the LAN interfaces on the routers from Step 1c.

e. Address the connected links or interfaces using IPv4 and VLSM.

f. Configure OSPF on each router for area 0 only.

g. Ping all routers to ensure full connectivity within the entire area.

Step 2:   Map the multiarea city trolley routing topology.

a.   Use your cursor to highlight all devices from Step 1, and copy and paste them to another area of the Packet Tracer desktop.

b.   Assign at least three areas to your topology. One must be the backbone (or core area) and the other two areas will be joined to the backbone area using current routers, which will now become area border routers.

c.   Configure the appropriate routers to their new area assignments. Remove old area configuration commands and assign new area commands to the appropriate interfaces.

d.   Save each router's changes as you make changes.

e.   When complete, you should have three areas represented on the topology and all routers should be able to ping each other throughout the network.

f.   Use the drawing tool and identify your areas by drawing circles or rectangles around the three areas.

g.   Save your work.

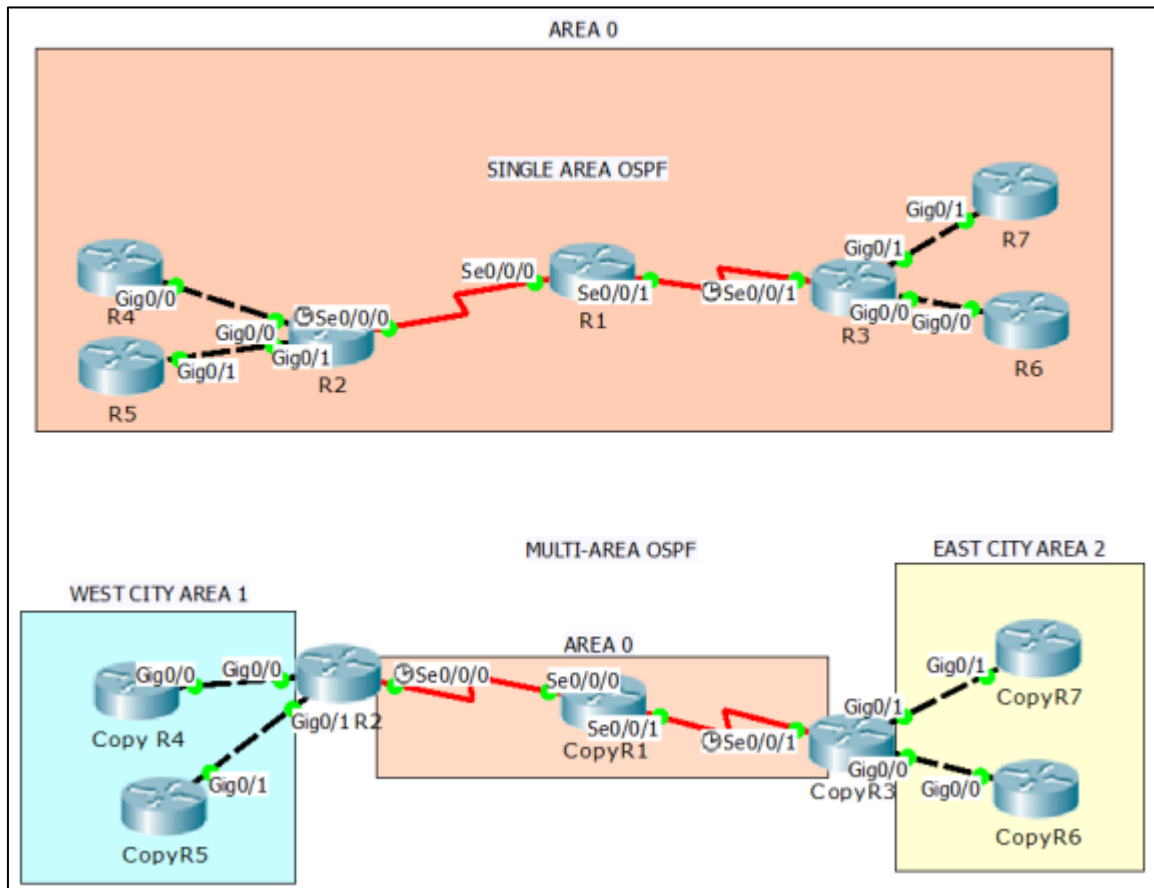## Step 3:   Verify the network for city council members.

a.   Use at least three commands learned (or used in this chapter) to help the city council prove that the new area, digital trolley routing topology works.

b.   Save a copy of topology graphics and verification commands comparisons in table format to a word processing file.

c.   Share your work with another group or the class. You may also want to add this activity and its files to a portfolio for this course.

Instructor Resource Example

Packet Tracer Single-area and Multiarea Topology Diagram Example

Single-Area OSPF City Design	Multiarea OSPF City Design
R1# **show ip protocols**	R1# **show ip protocols**
Routing Protocol is "ospf 1"	Routing Protocol is "ospf 1"
Outgoing update filter list for all interfaces is not set	Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set	Incoming update filter list for all interfaces is not set
Router ID 1.1.1.1	Router ID 1.1.1.1
Number of areas in this router is 1. 1 normal 0 stub 0 nssa	Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Maximum path: 4	Maximum path: 4
Routing for Networks:	Routing for Networks:
192.168.4.0 0.0.0.3 area 0	192.168.4.0 0.0.0.3 area 0
192.168.20.4 0.0.0.3 area 0	192.168.20.4 0.0.0.3 area 0
192.168.10.4 0.0.0.3 area 0	192.168.10.4 0.0.0.3 area 0
Routing Information Sources:	Routing Information Sources:
Gateway Distance Last Update	Gateway Distance Last Update
1.1.1.1 110 00:03:33	1.1.1.1 110 00:03:50
2.2.2.2 110 00:02:58	2.2.2.2 110 00:03:51
3.3.3.3 110 00:02:58	3.3.3.3 110 00:03:50
4.4.4.4 110 00:02:58	Distance: (default is 110)
5.5.5.5 110 00:02:58	
6.6.6.6 110 00:03:03	R1#
7.7.7.7 110 00:02:58	
Distance: (default is 110)	
R1#	

Single-Area OSPF City Design

R1# **show ip ospf database**

      OSPF Router with ID (1.1.1.1) (Process ID 1)

      Router Link States (Area 0)

Link ID count	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	728	0x80000005	0x001701	4
6.6.6.6	6.6.6.6	698	0x80000002	0x005ba8	1
3.3.3.3	3.3.3.3	693	0x80000007	0x00c181	4
7.7.7.7	7.7.7.7	693	0x80000002	0x0025d4	1
5.5.5.5	5.5.5.5	693	0x80000002	0x00917c	1
2.2.2.2	2.2.2.2	693	0x80000007	0x004e19	4
4.4.4.4	4.4.4.4	693	0x80000003	0x00c551	1

      Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.3.2	6.6.6.6	698	0x80000001	0x00a70b
10.1.4.2	7.7.7.7	693	0x80000001	0x00a442
10.1.2.2	5.5.5.5	693	0x80000001	0x009920
10.1.1.2	4.4.4.4	693	0x80000001	0x002479

R1#

Multiarea OSPF City Design

R1# **show ip ospf database**

      OSPF Router with ID (1.1.1.1) (Process ID 1)

      Router Link States (Area 0)

Link ID count	ADV Router	Age	Seq#	Checksum	Link count
2.2.2.2	2.2.2.2	716	0x80000003	0x0020a2	2
3.3.3.3	3.3.3.3	715	0x80000003	0x00297d	2
1.1.1.1	1.1.1.1	715	0x80000005	0x00d443	4

      Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.3.0	3.3.3.3	681	0x80000001	0x0089ba
10.1.4.0	3.3.3.3	681	0x80000002	0x007cc5
10.1.2.0	2.2.2.2	676	0x80000001	0x00b296
10.1.1.0	2.2.2.2	676	0x80000002	0x00bb8d

R1#

Single-Area OSPF City Design

R1# **show ip ospf 1**
 Routing Process "ospf 1" with ID 1.1.1.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 2
    Area has no authentication
    SPF algorithm executed 3 times
    Area ranges are
    Number of LSA 11. Checksum Sum 0x0507ca

Multiarea OSPF City Design

R1# **show ip ospf 1**
 Routing Process "ospf 1" with ID 1.1.1.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 2
    Area has no authentication
    SPF algorithm executed 3 times
    Area ranges are
    Number of LSA 7. Checksum Sum 0x039304

Number of opaque link LSA 0. Checksum Sum 0x000000 Number of DCbitless LSA 0 Number of indication LSA 0 Number of DoNotAge LSA 0 Flood list length 0 R1#	Number of opaque link LSA 0. Checksum Sum 0x000000 Number of DCbitless LSA 0 Number of indication LSA 0 Number of DoNotAge LSA 0 Flood list length 0 R1#

Identify elements of the model that map to IT-related content:

- Backbone router
- Border area router
- Core area
- OSPF verification commands
    - `show ip protocols`
    - `show ip ospf database`
    - `show ip ospf`