

Laboratory 4: Open Shortest Path First (OSPF-1)

Objective:

- To configure and analyze the performance of OSPF
- To understand the routing table of each router created by OSPF (with area and without area)

Introduction

OSPF is one of the Intra-domain link state routing protocol. Each router knows the neighbor information (name and cost). The router distributes the routing table information to all other routers. In this way, they create a routing table to reach to any router.

In this Lab you have to create a project using OSPF with four scenarios. In first scenario (**start**), you will configure the router and OSPF parameter (cost and others) without any area and analyze the performance of OSPF. In second scenario (**area**), you will divide routers into different areas and observe the routing table in order from one router to another router. In third scenario (**failure**), find new path and the convergence time when one of the links is broken. Finally, in fourth scenario (**load_balance**) you have to create another scenario to test the load balance.

Create a project

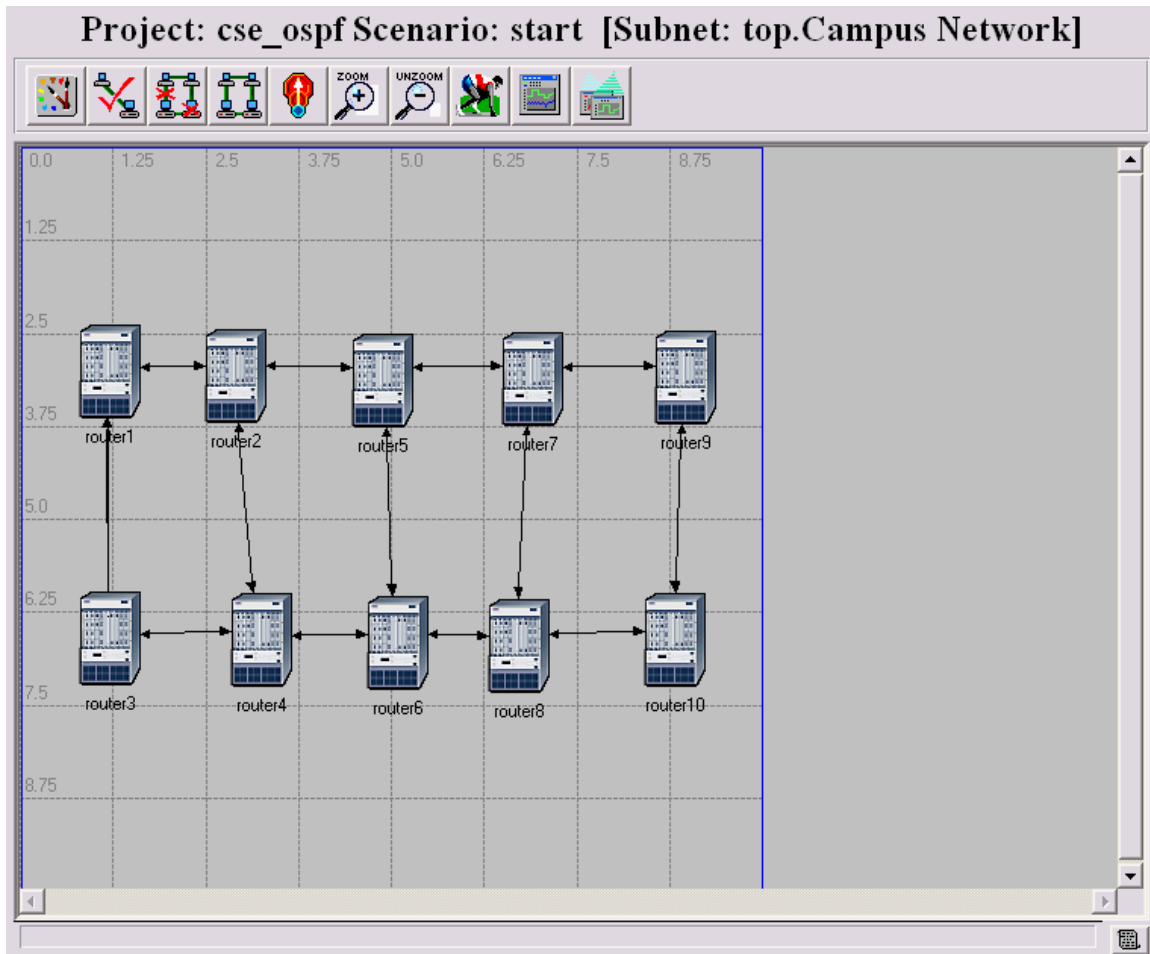
First Scenario (start):

1. Create a project (cse_ospf) and first scenario (**start**).
2. Select **create empty scenario** and click next

3. Select **Network Scale: Campus**
Network Size: 10 mi x 10 mi
Model family: internet_toolbox and routers

Now you will see an empty workspace.

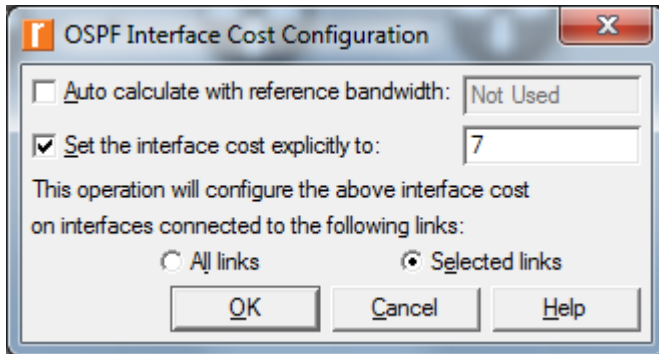
4. Click the object Palette and bring ethernet4_slip8_gtwy (one of the routers) object to workspace and change the name router1. Now make 9 copies of router1 and give router name router2.....router10. Connect the router using PPP_DS3 link in the following way



Configure Link Cost:

6. Now select the link between router1 and router2, router1 and router3, router3 and router4, router2 and router4. We want to set cost of **7** in the above links.

Select **Protocols/OSPF/Configure Interface Cost**. You will see the following window



Chose Selected links, and set the interface cost as 7.

Similarly, set the link cost of 1 between router (2 to 5, 4 to 6, 5 to 6, 5 to 7, 6 to 8).

Finally, set the link cost of 3 between router (7 to 8, 7 to 9, 8 to 10, 9 to 10).

7. Right click on one of the routers and **select similar nodes**. Go to **Protocols/IP/Interfaces/Create Loopback Interface**. Check **All Routers** and **Configure Routing Protocols**, press OK and choose OSPF only in next dialog box.

Configure OSPF Traffic Demand:

8. Select router 1 and router 4. Then Go to **Traffic/Create Traffic Flow/IP Unicast...** You will see the following window:

Create IP Unicast Traffic Flows

Node selection

☐ Full mesh between all nodes

☒ To all other nodes from:

☐ From all other nodes to:

Intensity

Packets/sec:

Bits/sec:

Duration (secs):

Characteristics

Description:

Color:

☐ Set start time

☐ Characterize demands

Socket information

Destination IP address:

Source port:

Type of service:

Destination port:

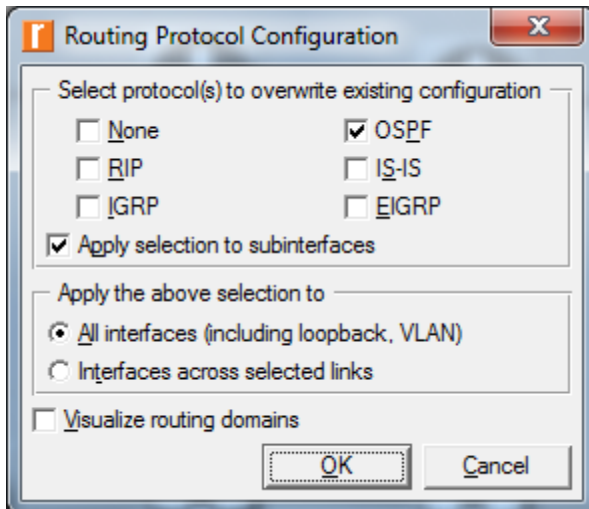
Protocol:

Select From Router1 and set the color green.

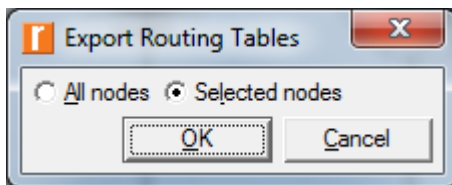
Similarly, select router4 and router10 and set the traffic demand from router4 and color red.

Finally, Select router 7 and 8 and set the traffic demand from router7 and color sky blue.

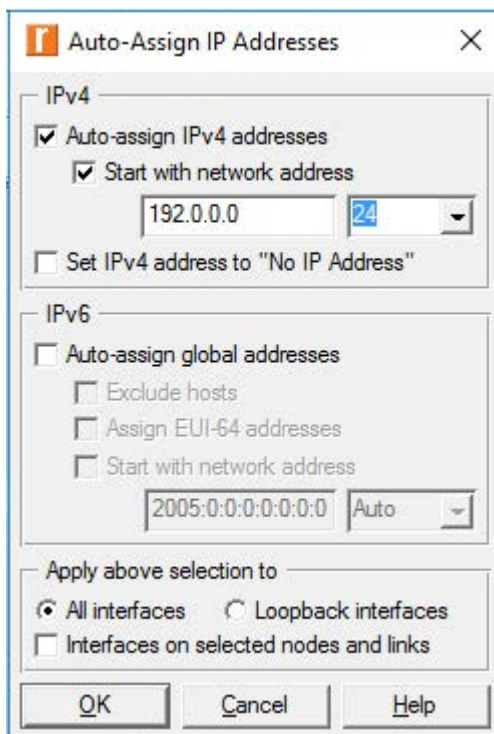
9. Select **Protocols/IP/Routing/Configure Routing Protocols and set the routing protocol OSPF as follow:**



10. Select Router1, Router4, and Router7 and then select **Protocols/IP/Routing/Export Routing Table for Selected Routers.**



11. Select **Protocols/IP/Addressing/Auto Assign IP Address**



The IP address will be assigned automatically.

Now save your project

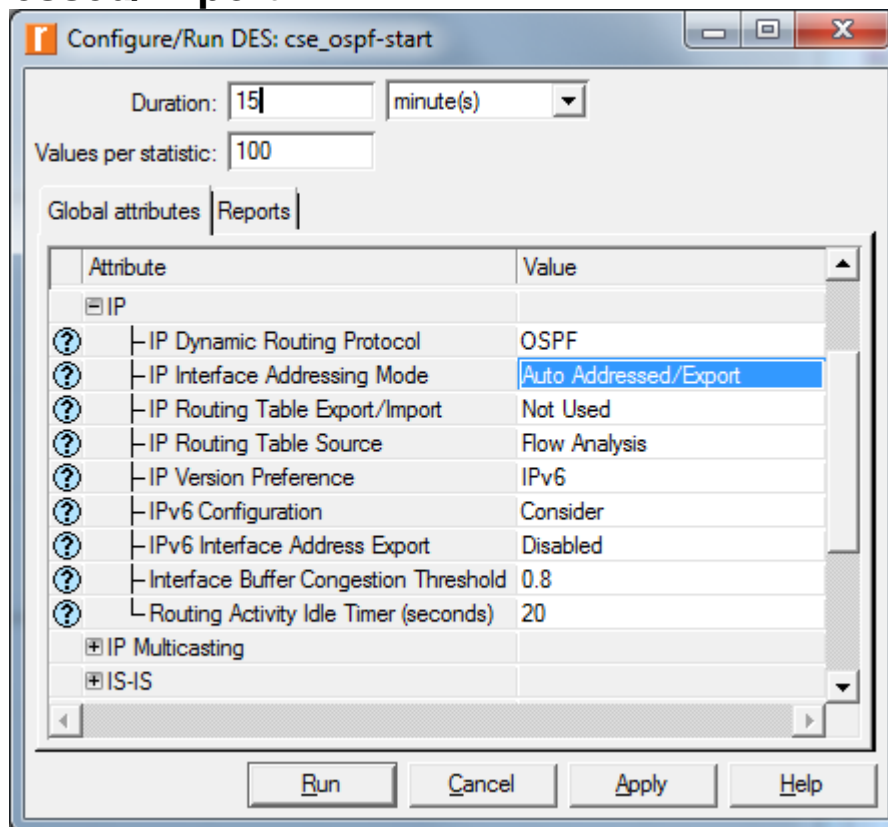
Configure Simulation Parameters:

12. Click on the **Configure and Run** button from the menu.
Set Duration as 15 minutes

Now select the **Global Attributes** and change the following:

- * **IP Dynamic Routing Protocol: OSPF**
- * **IP Interface Addressing Mode: Auto Addressed/Export**

Addressed/Export



Run the Simulation:

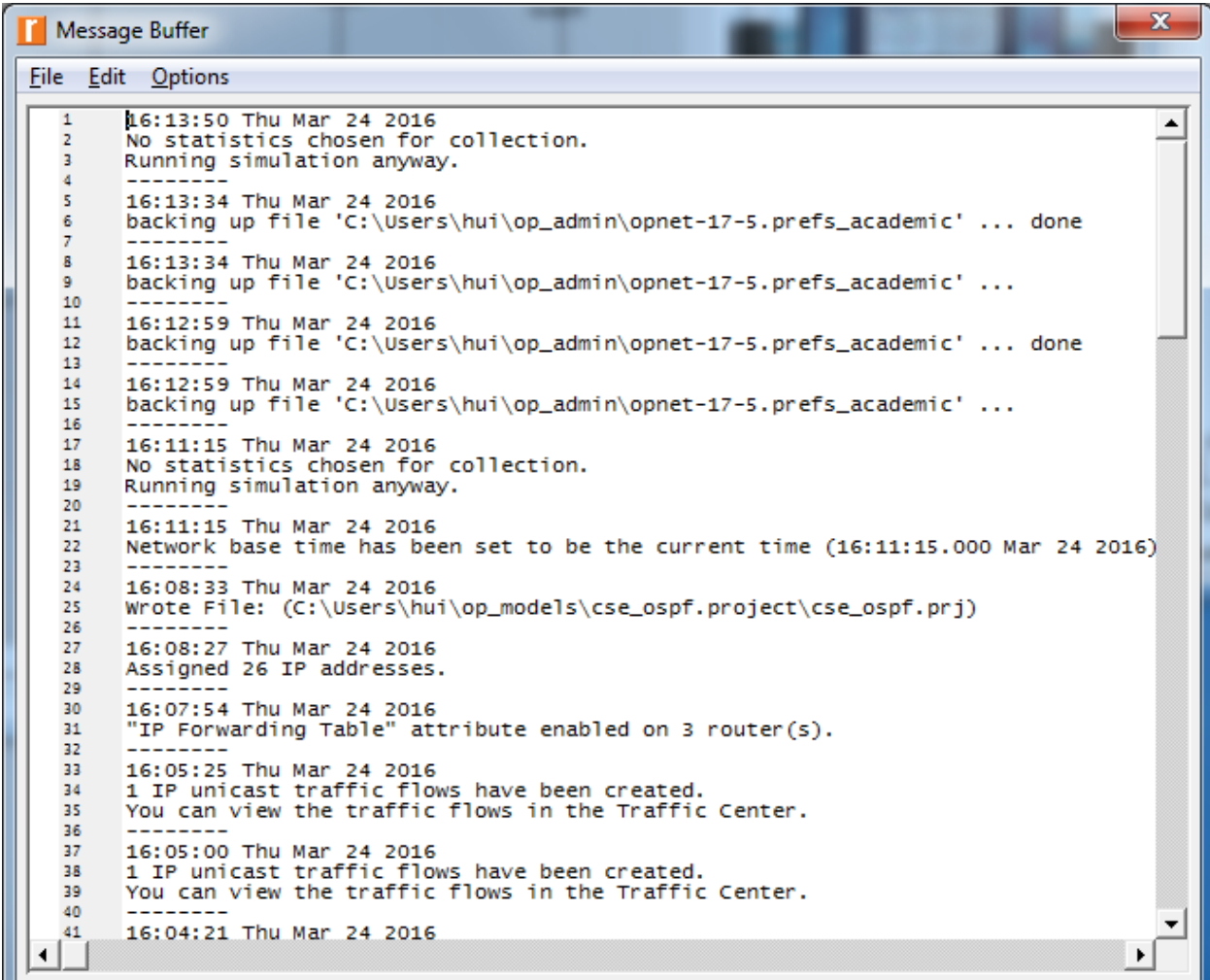
13. Click the **RUN** button to run the simulation for **15 min** and collect statistics. Save the project

Collect the results:

Now we want to collect the router interface address which is allocated automatically.

14. Select **File/Manage Model Files/Refresh Model Directories**.

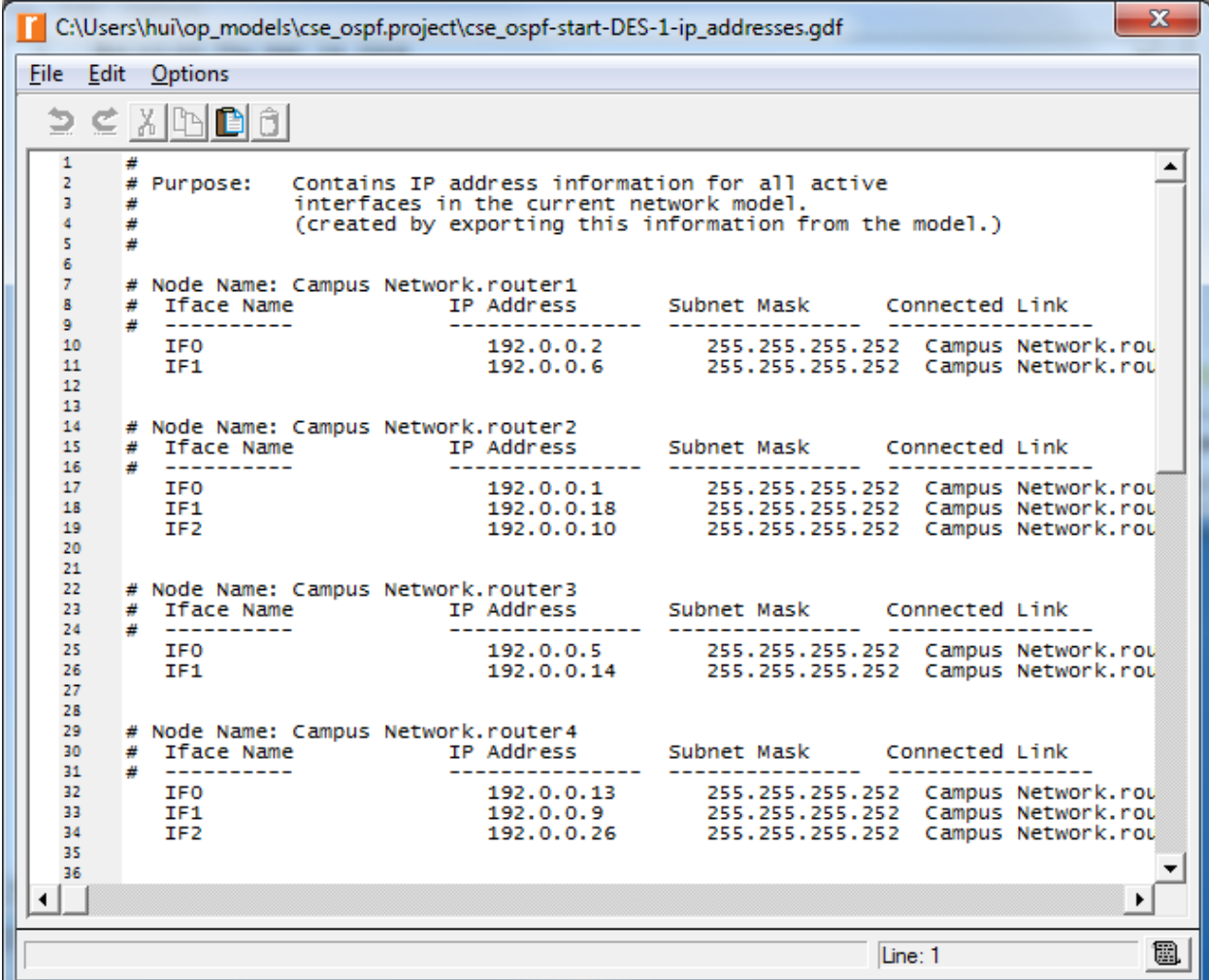
15. Click the button on the right-bottom corner, open message buffer window



The screenshot shows a 'Message Buffer' window with a menu bar (File, Edit, Options) and a text area containing simulation logs. The logs are timestamped and include messages about statistics collection, file backups, network base time setting, file writing, IP address assignment, and traffic flow creation.

```
1 16:13:50 Thu Mar 24 2016
2 No statistics chosen for collection.
3 Running simulation anyway.
4 -----
5 16:13:34 Thu Mar 24 2016
6 backing up file 'C:\Users\hui\op_admin\opnet-17-5.prefs_academic' ... done
7 -----
8 16:13:34 Thu Mar 24 2016
9 backing up file 'C:\Users\hui\op_admin\opnet-17-5.prefs_academic' ...
10 -----
11 16:12:59 Thu Mar 24 2016
12 backing up file 'C:\Users\hui\op_admin\opnet-17-5.prefs_academic' ... done
13 -----
14 16:12:59 Thu Mar 24 2016
15 backing up file 'C:\Users\hui\op_admin\opnet-17-5.prefs_academic' ...
16 -----
17 16:11:15 Thu Mar 24 2016
18 No statistics chosen for collection.
19 Running simulation anyway.
20 -----
21 16:11:15 Thu Mar 24 2016
22 Network base time has been set to be the current time (16:11:15.000 Mar 24 2016)
23 -----
24 16:08:33 Thu Mar 24 2016
25 Wrote File: (C:\Users\hui\op_models\cse_ospf.project\cse_ospf.prj)
26 -----
27 16:08:27 Thu Mar 24 2016
28 Assigned 26 IP addresses.
29 -----
30 16:07:54 Thu Mar 24 2016
31 "IP Forwarding Table" attribute enabled on 3 router(s).
32 -----
33 16:05:25 Thu Mar 24 2016
34 1 IP unicast traffic flows have been created.
35 You can view the traffic flows in the Traffic Center.
36 -----
37 16:05:00 Thu Mar 24 2016
38 1 IP unicast traffic flows have been created.
39 You can view the traffic flows in the Traffic Center.
40 -----
41 16:04:21 Thu Mar 24 2016
```

Select **File/Open** Select a file named `cse_ospf_startip_addr` in your project directory and you will see the following window:



The screenshot shows a text editor window titled "C:\Users\hui\op_models\cse_ospf.project\cse_ospf-start-DES-1-ip_addresses.gdf". The window contains a text file with the following content:

```
1  #
2  # Purpose:  Contains IP address information for all active
3  #           interfaces in the current network model.
4  #           (created by exporting this information from the model.)
5  #
6  #
7  # Node Name: Campus Network.router1
8  # Iface Name      IP Address      Subnet Mask      Connected Link
9  # -----
10 IF0                192.0.0.2        255.255.255.252  Campus Network.rou
11 IF1                192.0.0.6        255.255.255.252  Campus Network.rou
12
13
14 # Node Name: Campus Network.router2
15 # Iface Name      IP Address      Subnet Mask      Connected Link
16 # -----
17 IF0                192.0.0.1        255.255.255.252  Campus Network.rou
18 IF1                192.0.0.18       255.255.255.252  Campus Network.rou
19 IF2                192.0.0.10       255.255.255.252  Campus Network.rou
20
21
22 # Node Name: Campus Network.router3
23 # Iface Name      IP Address      Subnet Mask      Connected Link
24 # -----
25 IF0                192.0.0.5        255.255.255.252  Campus Network.rou
26 IF1                192.0.0.14       255.255.255.252  Campus Network.rou
27
28
29 # Node Name: Campus Network.router4
30 # Iface Name      IP Address      Subnet Mask      Connected Link
31 # -----
32 IF0                192.0.0.13       255.255.255.252  Campus Network.rou
33 IF1                192.0.0.9        255.255.255.252  Campus Network.rou
34 IF2                192.0.0.26       255.255.255.252  Campus Network.rou
35
36
```

The status bar at the bottom right indicates "Line: 1".

Task1:

Write down all the router interface address and link cost.

16. Select **DES/Results/View Results**

Results Browser

DES Graphs | DES Parametric Studies | DES Run (1) Tables | Flow Analysis Graphs

Object Tables

- Campus Network
 - router1
 - Performance
 - IP Forwarding Table at End of Si
 - router4
 - router7

Preview

	Destination	Source Protocol	Route Preference	Metric	Next Hop Address	Next Hop Node
1	192.0.0.0/30	Direct	0	0	192.0.0.2	Campus Network.rou
2	192.0.0.4/30	Direct	0	0	192.0.0.6	Campus Network.rou
3	192.0.0.8/30	OSPF 1	110	14	192.0.0.1	Campus Network.rou
4	192.0.0.12/30	OSPF 1	110	14	192.0.0.5	Campus Network.rou
5	192.0.0.16/30	OSPF 1	110	8	192.0.0.1	Campus Network.rou
6	192.0.0.20/30	OSPF 1	110	9	192.0.0.1	Campus Network.rou
7	192.0.0.24/30	OSPF 1	110	10	192.0.0.1	Campus Network.rou
8	192.0.0.28/30	OSPF 1	110	9	192.0.0.1	Campus Network.rou
9	192.0.0.32/30	OSPF 1	110	12	192.0.0.1	Campus Network.rou
10	192.0.0.36/30	OSPF 1	110	10	192.0.0.1	Campus Network.rou
11	192.0.0.40/30	OSPF 1	110	12	192.0.0.1	Campus Network.rou
12	192.0.0.44/30	OSPF 1	110	15	192.0.0.1	Campus Network.rou
13	192.0.0.48/30	OSPF 1	110	13	192.0.0.1	Campus Network.rou
14						
15	Gateway of last resort is not set					
16						

Results Generated: 16:13:51 Mar 24 2016

Generate Web Report... Add to Report Showcase Show

Observe all routers routing table and try to understand all information.

14. Go to **Protocols/IP/Demands/Display Routes for...** and explore the IP traffic flows you have created before and set the **Display** to yes. Try to explain the flows' path. You can discuss with tutor.

Save this project in order to complete Lab5 tasks.