

## Laboratory 6: Border Gateway Protocol (BGP)

*In this Lab not many hints are given. We want to see who can complete the task. You can decide your own way to implement the given network model.*

### Objective:

- To configure and analyze the performance of BGP
- To understand the routing table of each router created by BGP

### Introduction

BGP is Inter-domain path vector routing protocol. Within an autonomous system, one router works as a border router on behalf of the entire autonomous system. The border router creates a routing table and exchanges it using reliable TCP connection. The border router within an autonomous system advertises the path to its neighbor AS. Each border router gets a set of path in order to reach another AS. The organization can choose any path based on their policies.

In this Lab you have to create a project using BGP with only one scenario. In that scenario (**start**), you will configure the router and BGP parameters to analyze the performance of BGP.

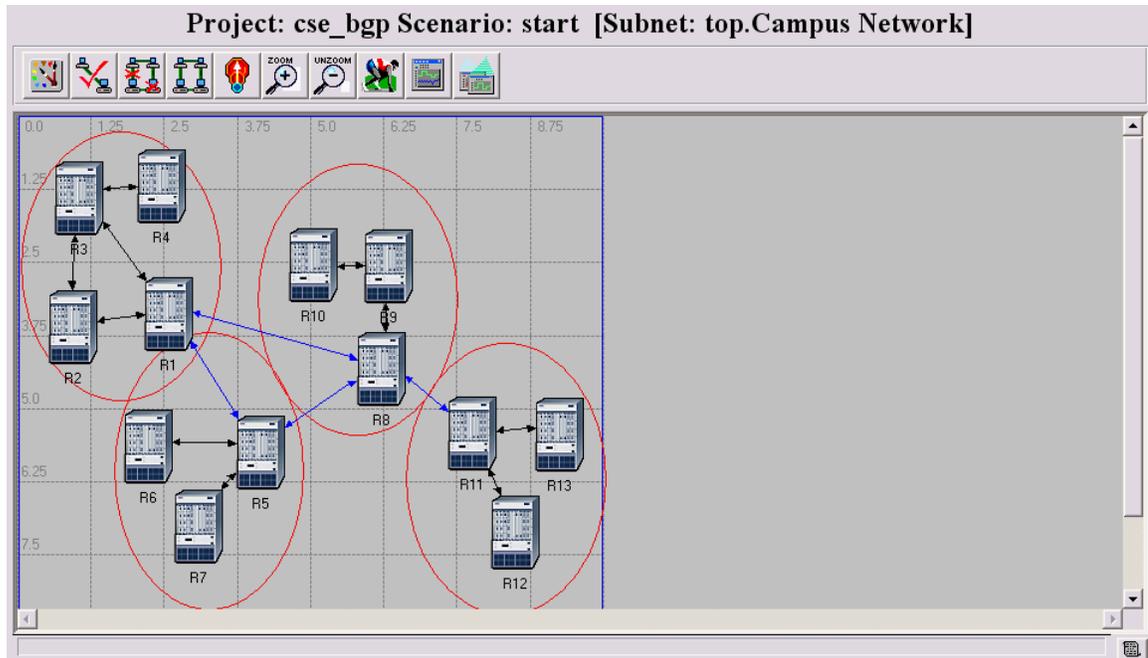
## Create a project

### First Scenario (start):

1. Create a project (cse\_bgp) 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, routers,**  
**advanced routers.**

Now you will see an empty workspace.

4. Click the object Palette and bring 13 slip8\_gtwy (one of the routers) or any advanced router object to workspace and change the name R1, R2,.....R13 and connect the router using PPP-DS3 link in the following way



## Assign the Autonomous System Number:

Assign autonomous system number,3000, for router R1-R4

Assign autonomous system number,1000, for router R5-R7

Assign autonomous system number,2000, for router R8-R10

Assign autonomous system number,4000, for router R11-R13

Out of 13 Routers, Router 1,5,8, and 11 will act as a border router.

### (R1) Attributes

Type: router

Attribute	Value
+ IP Processing Information	(...)
- IP Routing Parameters	(...)
Router ID	Auto Assigned
Autonomous System Number	3000
+ Interface Information	(...)
+ Loopback Interfaces	(...)
Default Route	Auto Assigned
+ Static Routing Table	None
Load Balancing Options	Destination-Based
+ Routing Table Export	Disabled
Multipath Routes Threshold	Unlimited
Administrative Weights	(...)
OS Version	Not Set
+ Extended ACL Configuration	None
+ Prefix Filter Configuration	None
+ Route Map Configuration	None
+ VRF Configuration	None
VRF Table Export	Disabled
Local Policy	None
+ IS-IS Parameters	(...)
- OSPF Parameters	(...)

Apply Changes to Selected Objects  Advanced

Find Next Cancel OK

## Collect all Interface address:

Run the simulation for 20 minutes and collect the router interface address which is allocated automatically.

11. Select **File/Model Files/Refresh Model Directories**.

12. Select **File/Open/Generic Data File**. Select a file named `cse_bgp_startip_addr` and you will see the following window:

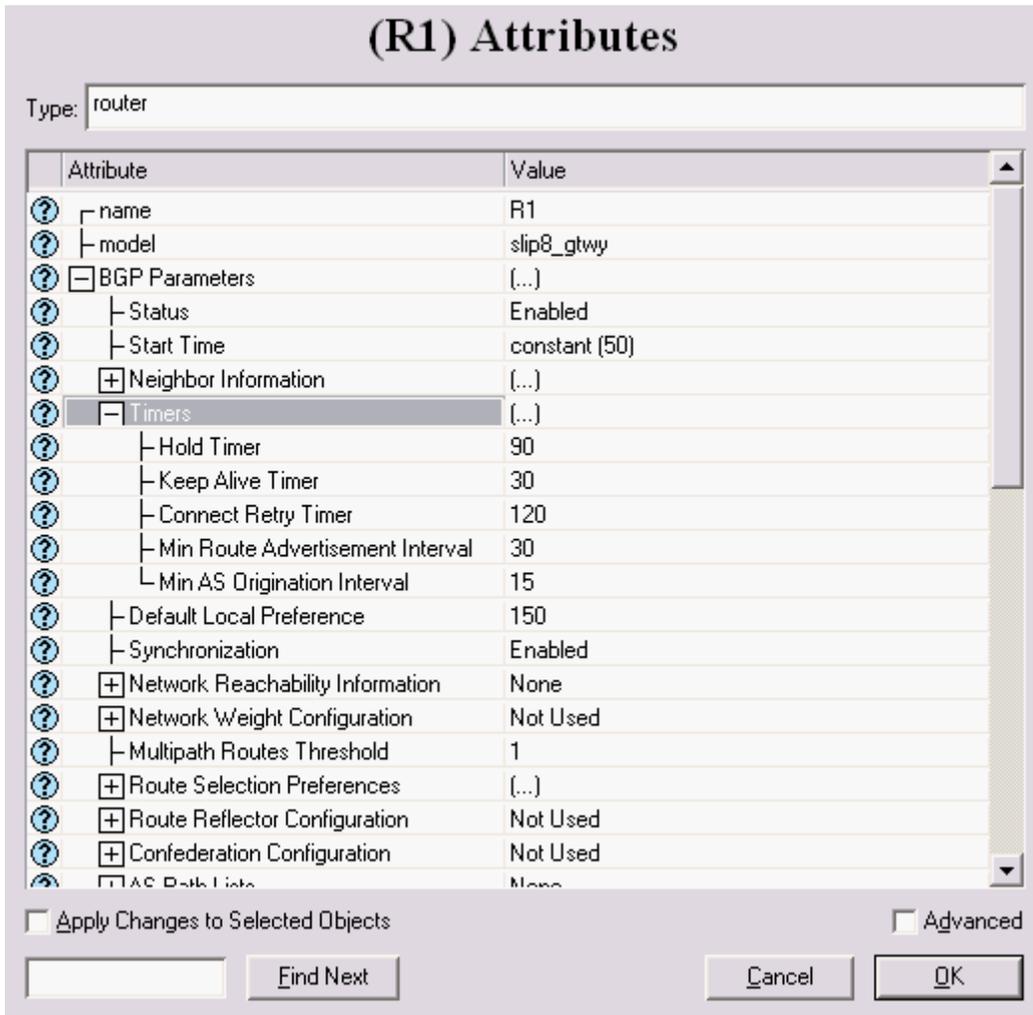
**Generic Data File: cse\_bgp-start-ip\_addresses**

#	Iface Name	Iface Index	IP Address	Subnet Mask	Connected Li	
16	#	-----	-----	-----	-----	
17	#	-----	-----	-----	-----	
18	IF0	0	192.0.5.2	255.255.255.0	Campus Ne	
19	IF1	1	192.0.6.1	255.255.255.0	Campus Ne	
20	IF2	2	192.0.6.4	255.255.255.0	Campus Ne	
21	IF3	3	192.0.0.1	255.255.255.0	Campus Ne	
22	Loopback	8	192.0.14.1	255.255.255.0	Not connec	
23						
24						
25	# Node Name: Campus Network.R5					
26	#	Iface Name	Iface Index	IP Address	Subnet Mask	Connected Li
27	#	-----	-----	-----	-----	-----
28	IF0	0	192.0.6.2	255.255.255.0	Campus Ne	
29	IF1	1	192.0.7.1	255.255.255.0	Campus Ne	
30	IF2	2	192.0.8.3	255.255.255.0	Campus Ne	
31	IF3	3	192.0.7.3	255.255.255.0	Campus Ne	
32	Loopback	8	192.0.15.1	255.255.255.0	Not connec	
33						
34						
35	# Node Name: Campus Network.R8					
36	#	Iface Name	Iface Index	IP Address	Subnet Mask	Connected Li
37	#	-----	-----	-----	-----	-----
38	IF0	0	192.0.7.2	255.255.255.0	Campus Ne	
39	IF1	1	192.0.11.1	255.255.255.0	Campus Ne	
40	IF2	2	192.0.12.1	255.255.255.0	Campus Ne	
41	IF3	3	192.0.0.2	255.255.255.0	Campus Ne	
42	Loopback	8	192.0.16.1	255.255.255.0	Not connec	
43						
44						
45	# Node Name: Campus Network.R3					
46	#	Iface Name	Iface Index	IP Address	Subnet Mask	Connected Li
47	#	-----	-----	-----	-----	-----
48	IF0	0	192.0.1.2	255.255.255.0	Campus Ne	
49	IF1	1	192.0.2.1	255.255.255.0	Campus Ne	
50	IF2	2	192.0.6.3	255.255.255.0	Campus Ne	
51	Loopback	8	192.0.17.1	255.255.255.0	Not connec	
52						
53						

Dialog bitmap image saved in [C:\Program Files\OPNET EDU\9.1.A\sys\pc\_intel\_win32\bin>window\_snap Line: 14

## Configure BGP Attribute:

5. Select one of the routers and **Edit Attribute/BGP Parameters**. You will see the following BGP parameters in a window:



The screenshot shows a window titled "(R1) Attributes" with a "Type:" field set to "router". Below is a table of attributes and their values:

Attribute	Value
name	R1
model	slip8_gtwy
BGP Parameters	[...]
Status	Enabled
Start Time	constant (50)
Neighbor Information	[...]
Timers	[...]
Hold Timer	90
Keep Alive Timer	30
Connect Retry Timer	120
Min Route Advertisement Interval	30
Min AS Origination Interval	15
Default Local Preference	150
Synchronization	Enabled
Network Reachability Information	None
Network Weight Configuration	Not Used
Multipath Routes Threshold	1
Route Selection Preferences	[...]
Route Reflector Configuration	Not Used
Confederation Configuration	Not Used
AS Path List	None

At the bottom of the window, there are checkboxes for "Apply Changes to Selected Objects" and "Advanced", and buttons for "Find Next", "Cancel", and "OK".

6. **Set Start Time:** The default start time is 70sec. You have to set the start time such a way so that it starts after creating the internal routing table within autonomous system.

- Set Neighbor Information:** BGP does not discover neighbor automatically. You have to explicitly configure the neighbor manually for each and every router. In order to set neighbor, you have to know all interface addresses of every router. One of the routers neighbor is set in the following way:

**(Neighbor Information) Table**

IP Address	Remote AS	EBGP Multihop Se...	Timers	Next Hop Self	Update Source	Prefix Limit	Weight	Send-Conn
192.0.13.1	3000	No EBGP Multihop	(...)	Default	Loopback	No Max Limit	100	Disabled
192.0.17.1	3000	No EBGP Multihop	(...)	Default	Loopback	No Max Limit	100	Disabled
192.0.6.2	1000	No EBGP Multihop	(...)	Default	Not Used	No Max Limit	100	Disabled
192.0.16.1	2000	No EBGP Multihop	(...)	Default	Not Used	No Max Limit	100	Disabled

4 Rows

You have to set each and every router neighbor.

## 8. Set the Timers:

You can set the following timer:

**Hold Timer**

**Keep Alive Timer**

**Connect Retry Timer**

**Min Route Advertisement Interval**

**Min As Origination Interval**

## ***EXPORT ROUTING TABLE:***

- Select Router1, Router5, Router8, and Router 11 and then select **Protocols/IP/Routing/Export Routing Table for Selected Routers.**

Now save your project

### ***Configure Simulation Parameters:***

11. Click on the **Configure and Run** button from the menu. Now select the **Global Attributes** and change the following:

\* **IP Dynamic Routing Protocol: BGP**

\* **IP Interface Addressing Mode: Auto Addressed/Export**

### ***Run the Simulation:***

12. Click the **RUN** button to run the simulation for **30 min** and collect statistics. Save the project

### ***Collect the results:***

13. Select **Results/Open Simulation Log** and expand it. Select **IP Routing Table**.

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

**14. Save** your project

**Task1:** Analyze the routing table of border routers and other routers.

**Task2:** Create another scenario (failure) where one of the routers or links fails after certain time. Analyze the new routing table.