



# **ADVANCED COMPUTER NETWORKS**

eBGP and iBGP

Prepared by:

Yara Darabumukho 1211269

Haleema Hmaid 1210551

Instructor: Dr. Imad Tartir





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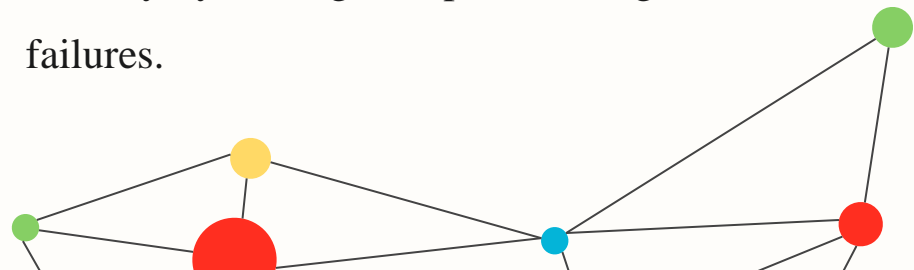


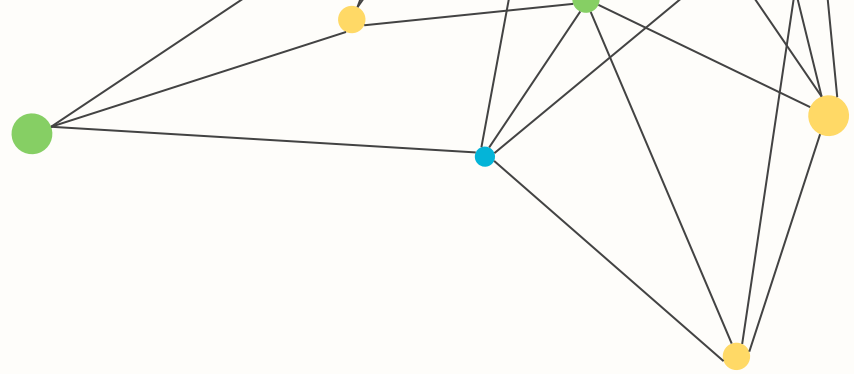
# Introduction

In this project multi routing protocols applies, OSPF over AS 100, 200, and 300, RIP over AS 400. eBGP protocol applies at the connections between the AS's. and the iBGP applies at the BGP routers inside each AS in a complete mesh. This project done using GNS3.

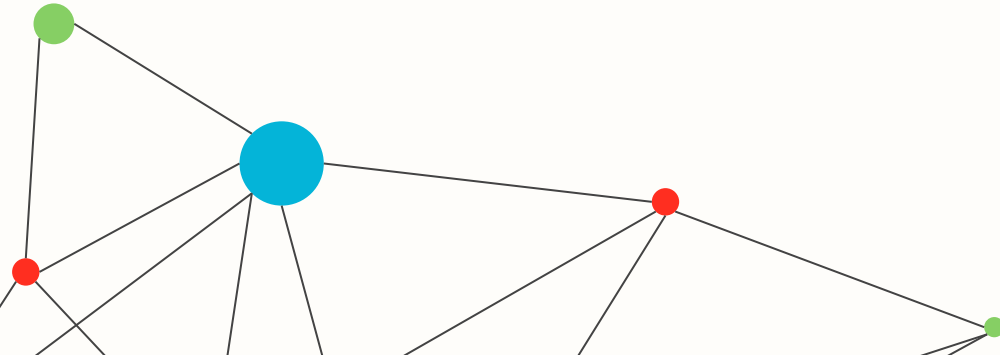


The aim of this project is to understand BGP protocols, how to apply each, and how its work in practical way. BGP manages how the packets routed globally, exchanging routing information among edge routers and ensuring network stability by finding new paths during route failures.





EBGP allows different networks to share the routing information, help efficient message delivery across the internet. OSPF and RIP are important protocols too, which used for routing within the autonomous systems “AS”.





# Topology

The topology contains four AS's each one  
them have multi network as shown:

## AS100:

26.19.10.0/24, 26.19.20.0/24, 26.19.30.0/24, 26.19.40.0/24,  
26.19.50.0/24, 26.19.60.0/24, 26.19.70.0/24.

## AS200:

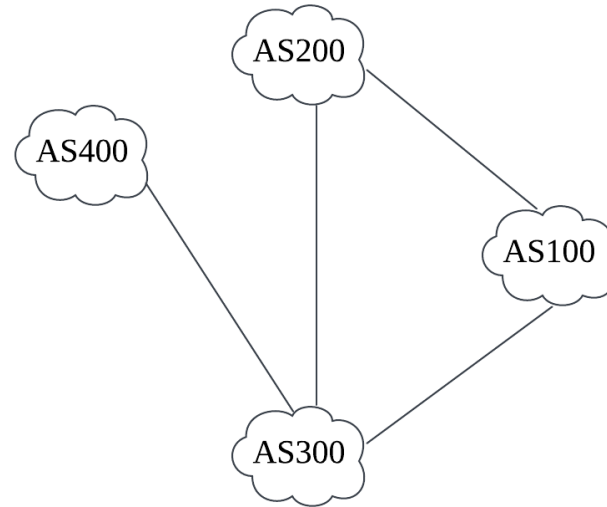
12.69.1.0/24, 12.69.2.0/24, 12.69.3.0/24.

## AS300:

69.12.10.0/24, 69.12.20.0/24, 69.12.30.0/24, 69.12.40.0/24.

## AS400:

112.69.40.0/24, 112.69.50.0/24, 112.69.60.0/24.





# Topology

Each router or device in the network has multi- interfaces, which can be

Fast-Ethernet or serial. The IP applies using same steps:

1. Enter the configuration terminal

**config t**

2. Enter the interface, for example:

**interface fastethernet 0/0 or interface serial2/0**

3. Add the IP address

**ip address 112.69.50.1 255.255.255.0**

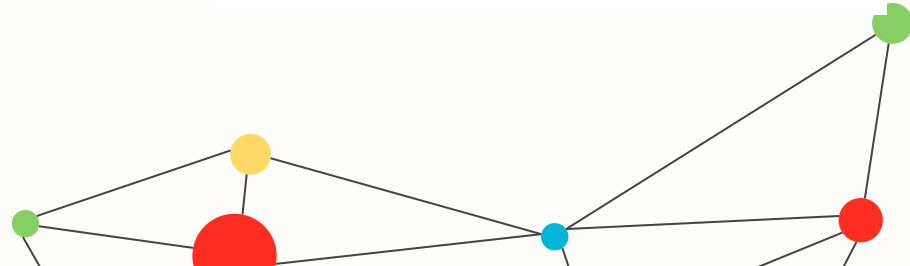
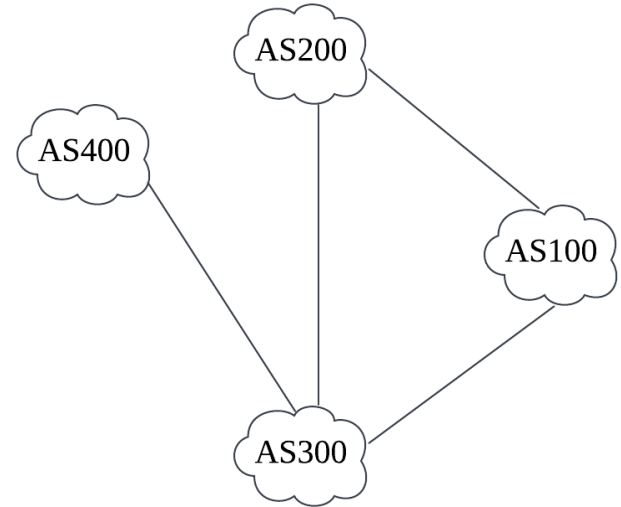
4. Exit the interface and the configuration mode:

**exit**

**exit**

4. Save the configurations in the memory

**write memory**





01

# Applying OSPF



# How to apply the OSPF protocol

**The following steps used for router 15 in AS 100:**

1. config t

2. router ospf 1

start the OSPF configuration, number 1 is the OSPF process ID. Which can be between 1 and 65535.

3. network 26.19.30.0 0.0.0.255 area 1

define the neighbour networks 26.19.30.0, the wildcard-mask 0.0.0.255, and the area id which equal to 1 for AS 100.

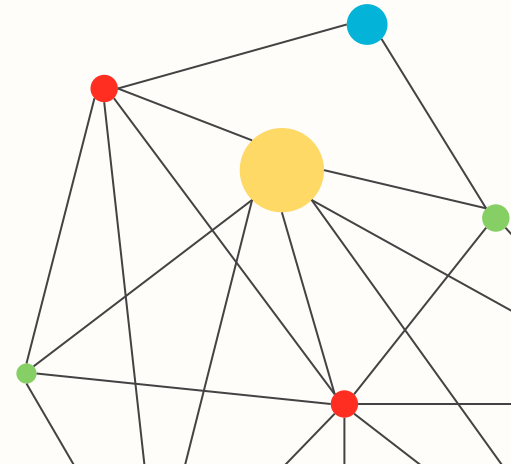
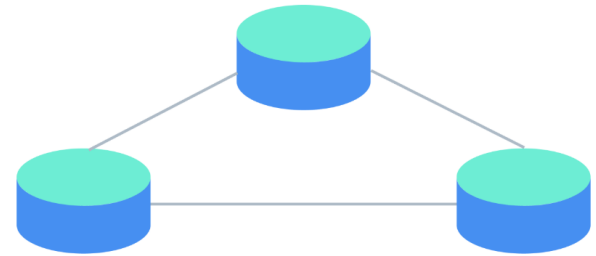
4. network 26.19.20.0 0.0.0.255 area 1

5. exit

exit router configuration

6. exit

7. write memory





# OSPF at router 15

The screenshot displays the GNS3 network simulator interface. On the left, a network topology diagram shows a central router labeled 'R1' connected to several other nodes. The main window is a terminal window titled 'R15' showing the configuration process for OSPF. The terminal output includes status messages about the line protocol on Serial2/1, 2, and 3, and the execution of the 'show ip route' command. The configuration commands entered are: 'router ospf 1', 'network 26.19.30.0 0.0.0.255 area 1', and 'network 26.19.20.0 0.0.0.255 area 1'. The terminal also shows the 'write' command being used to save the configuration. On the right side of the GNS3 interface, there are two summary panels: 'Topology Summary' and 'Servers Summary'. The 'Topology Summary' panel lists 11 nodes (PC1 through R11) with their respective console addresses. The 'Servers Summary' panel shows the system resources for the host: Halima, with CPU at 24.5% and RAM at 60.9%. The bottom of the screen shows the Windows taskbar with various application icons and the system clock indicating 6:28 PM on 1/9/2025.

```
changed state to down
*Mar 1 00:00:04.839: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/1,
changed state to down
*Mar 1 00:00:04.839: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/2,
changed state to down
*Mar 1 00:00:04.839: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/3,
changed state to down
R15#show ip route
Codes: C - connected, S - static, 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
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

26.0.0.0/24 is subnetted, 2 subnets
C    26.19.30.0 is directly connected, FastEthernet0/1
C    26.19.20.0 is directly connected, FastEthernet0/0
R15#config t
Enter configuration commands, one per line. End with CNTL/Z.
R15(config)#router ospf 1
R15(config-router)#network 26.19.30.0 0.0.0.255 area 1
R15(config-router)#network 26.19.20.0 0.0.0.255 area 1
*Mar 1 00:20:41.951: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.60.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
R15(config-router)#exit
R15(config)#exit
R15#
*Mar 1 00:20:59.287: %SYS-5-CONFIG_I: Configured from console by console
R15#writ
*Mar 1 00:21:01.595: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.50.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R15#write
Building configuration...
[OK]
R15#
```

Topology Summary

Node	Console
PC1	telnet localhost:5018
R1	telnet localhost:5000
R2	telnet localhost:5001
R3	telnet localhost:5002
R4	telnet localhost:5003
R5	telnet localhost:5004
R6	telnet localhost:5005
R7	telnet localhost:5006
R8	telnet localhost:5007
R9	telnet localhost:5008
R10	telnet localhost:5009
R11	telnet localhost:5010

Servers Summary

Server	CPU	RAM
Halima	24.5%	60.9%

Open project

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02

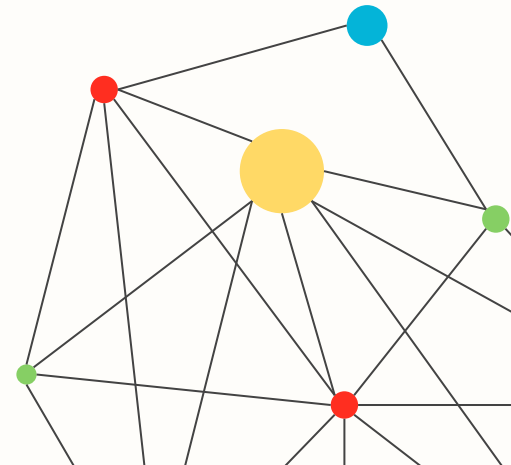
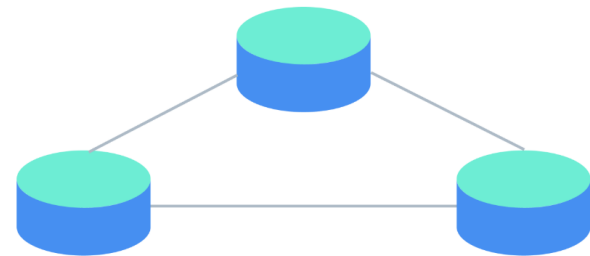
# Applying RIP



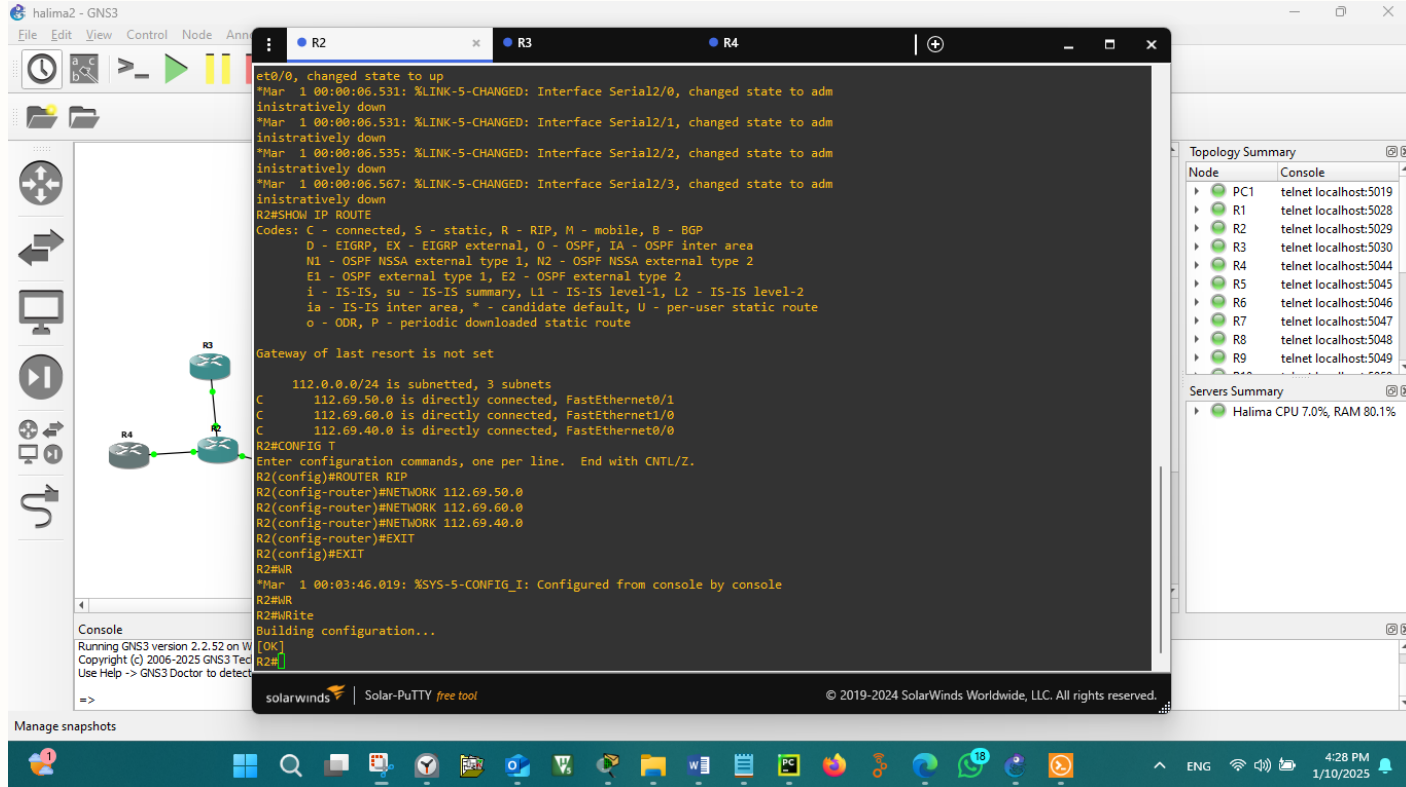
# How to apply the RIP protocol

**The following steps used for router 2 in AS 400:**

1. config t
2. router rip  
Enable RIP routing.
3. network 112.69.40.0  
  
define the neighbour networks.
4. network 112.69.50.0
5. network 112.69.60.0
6. exit  
exit router configuration
7. exit
8. write memory



# RIP at router 2



halima2 - GNS3

File Edit View Control Node Annotations

et0/0, changed state to up  
\*Mar 1 00:00:06.531: %LINK-5-CHANGED: Interface Serial2/0, changed state to administratively down  
\*Mar 1 00:00:06.531: %LINK-5-CHANGED: Interface Serial2/1, changed state to administratively down  
\*Mar 1 00:00:06.535: %LINK-5-CHANGED: Interface Serial2/2, changed state to administratively down  
\*Mar 1 00:00:06.567: %LINK-5-CHANGED: Interface Serial2/3, changed state to administratively down  
R2#SHOW IP ROUTE  
Codes: C - connected, S - static, 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  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route  
Gateway of last resort is not set  
112.0.0.0/24 is subnetted, 3 subnets  
C 112.69.50.0 is directly connected, FastEthernet0/1  
C 112.69.60.0 is directly connected, FastEthernet1/0  
C 112.69.40.0 is directly connected, FastEthernet0/0  
R2#CONFIG T  
Enter configuration commands, one per line. End with CNTL/Z.  
R2(config)#ROUTER RIP  
R2(config-router)#NETWORK 112.69.50.0  
R2(config-router)#NETWORK 112.69.60.0  
R2(config-router)#NETWORK 112.69.40.0  
R2(config-router)#EXIT  
R2(config)#EXIT  
R2#  
\*Mar 1 00:03:46.019: %SYS-5-CONFIG\_I: Configured from console by console  
R2#  
R2#Write  
Building configuration...  
[OK]  
R2#

Toplogy Summary

Node	Console
PC1	telnet localhost:5019
R1	telnet localhost:5028
R2	telnet localhost:5029
R3	telnet localhost:5030
R4	telnet localhost:5044
R5	telnet localhost:5045
R6	telnet localhost:5046
R7	telnet localhost:5047
R8	telnet localhost:5048
R9	telnet localhost:5049

Servers Summary

Server	CPU	RAM
Halima	7.0%	80.1%

Console  
Running GNS3 version 2.2.52 on W  
Copyright (c) 2006-2025 GNS3 Tec  
Use Help -> GNS3 Doctor to detect

solarwinds | Solar-PuTTY free tool

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Manage snapshots

4:28 PM  
1/10/2025



03

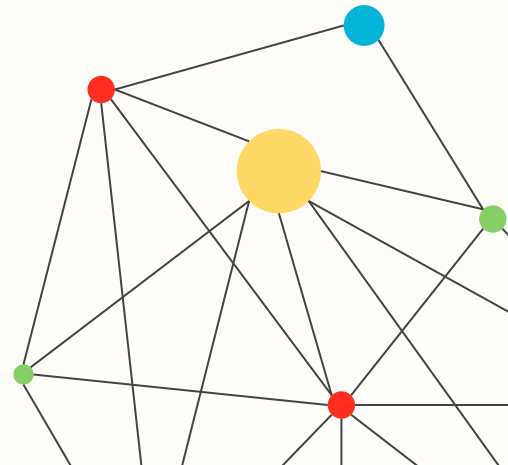
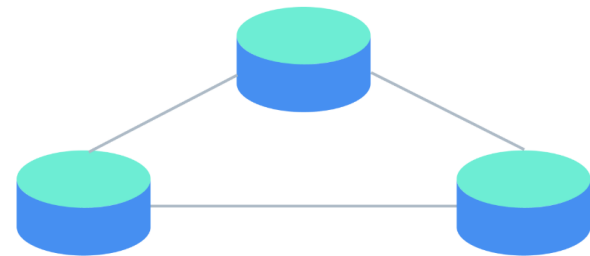
# Applying eBGP



# How to apply the eBGP protocol

**The following steps used for router 5:**

1. `config t`
2. `router bgp 200`  
Enable BGP configuration process for AS 200.
3. `neighbor 11.69.12.5 remote as 300`  
configures BGP neighbor, which has IP of 11.69.12.5 in AS 300.
4. `exit`  
exit the BGP configuration mode.
5. `exit`
6. write "same as write memory"







04

# Applying iBGP





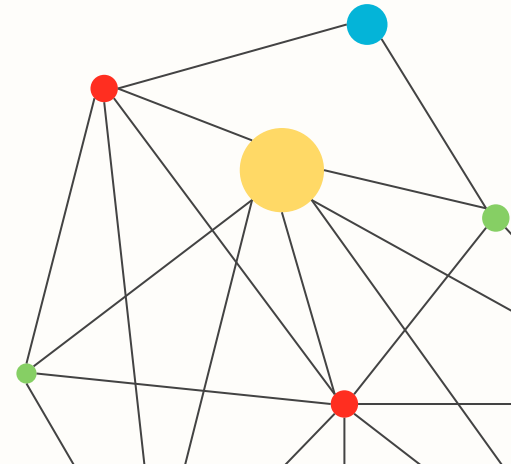
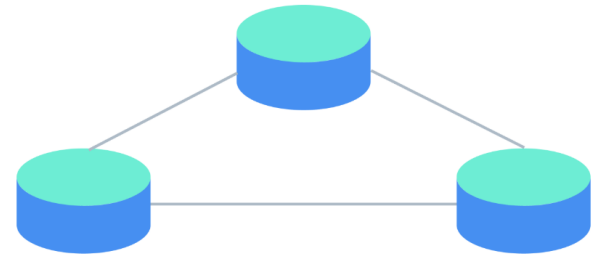
# How to apply the iBGP protocol

config t

for both routers to enter the configuration mode.

## - Router 5:

1. router bgp 200
2. neighbor 12.69.1.2 remote-as 200  
IP of the second BGP router.
3. network 12.69.1.0 mask 255.255.255.0  
IP of the connection network.



# How to apply the iBGP protocol

## - Router 6:

1. router bgp 200

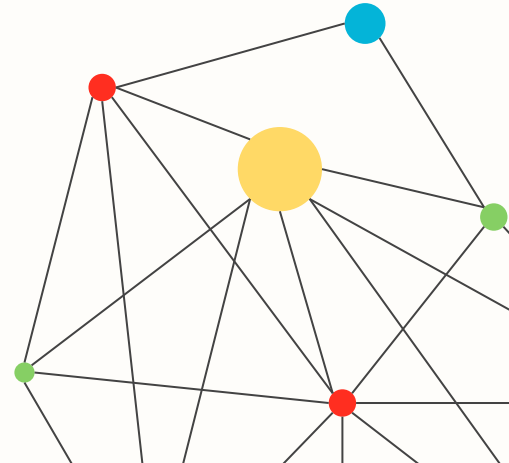
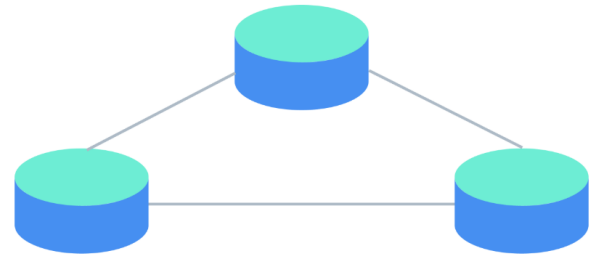
2. neighbor 12.69.1.1 remote-as 200

IP of the second BGP router.

3. network 12.69.1.0 mask 255.255.255.0

IP of the connection network.

**Exit and write memory for both routers.**



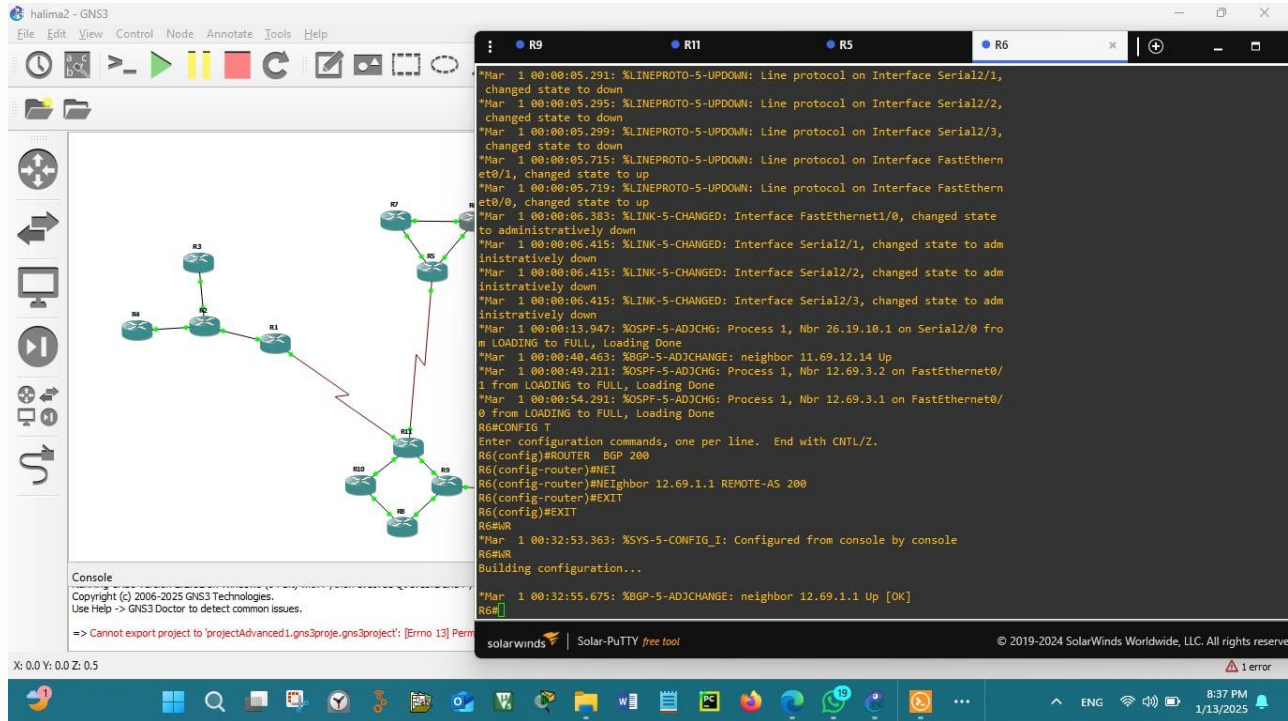
# iBGP at router 5

The screenshot displays the GNS3 (Graphical Network Simulator-3) interface. On the left, a network topology is visible with several routers (R3, R4, R5, R6, R7, R8, R9, R10, R11) connected in a mesh-like structure. The main window shows the configuration for router R5. The terminal output indicates that the router is in the process of loading the configuration and establishing BGP sessions. The configuration commands entered are:

```
R5#CONFIG
Translating "CONFIG"
% Unknown command or computer name, or unable to find computer address
R5#CONFIG T
Enter configuration commands, one per line. End with CNTL/Z.
R5(config)#ROUTER BGP 200
R5(config-router)#NEI
R5(config-router)#NEighbor 12.69.1.2 REMOTE-AS
% Incomplete command.
R5(config-router)#NEighbor 12.69.1.2 REMOTE-AS 200
R5(config-router)#EXIT
R5(config)#EXIT
R5#W
*Mar 1 00:28:34.135: %SYS-5-CONFIG_I: Configured from console by console
R5#WR
Building configuration...
[OK]
R5#
```

The bottom status bar shows the SolarWinds logo, Solar-PuTTY free tool, and copyright information: © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved. The system tray at the bottom indicates the time is 8:33 PM on 1/13/2025.

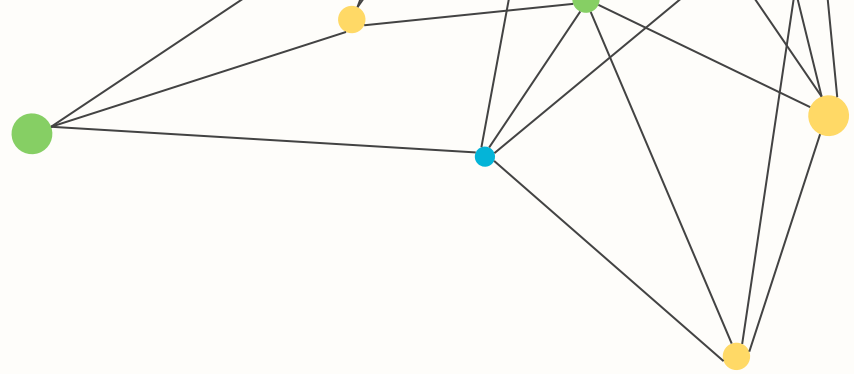
# iBGP at router 6



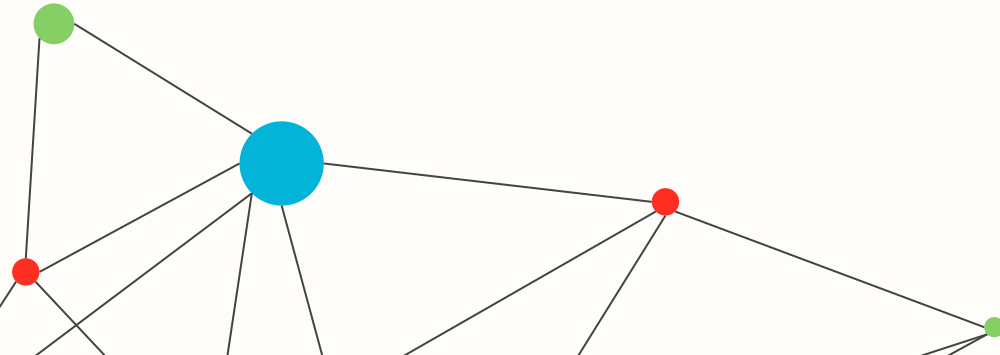
The screenshot displays the GNS3 (Graphical Network Simulator-3) interface. On the left, a network topology is visible with several routers (R1, R2, R3, R4, R5, R6) connected in a mesh-like structure. The main window shows the configuration for router R6. The terminal output indicates that the router is in configuration mode and has successfully configured iBGP on interface FastEthernet0/0. The configuration commands entered are:

```
R6#CONFIG T
Enter configuration commands, one per line. End with CNTL/Z.
R6(config)#ROUTER BGP 200
R6(config-router)#NE1
R6(config-router)#Neighbor 12.69.1.1 REMOTE-AS 200
R6(config-router)#EXIT
R6(config)#EXIT
R6#WR
*Mar 1 00:32:53.363: %SYS-5-CONFIG_I: Configured from console by console
R6#WR
Building configuration...
*Mar 1 00:32:55.675: %BGP-5-ADJCHANGE: neighbor 12.69.1.1 Up [OK]
R6#
```

The bottom status bar shows the SolarWinds Solar-PUTTY free tool and the copyright notice: © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.




The previous steps work when the routers have a physical connection between each other. When the routers don't have any physical connection, like AS 100, a logical connection should be established. Usually using loopback interfaces.



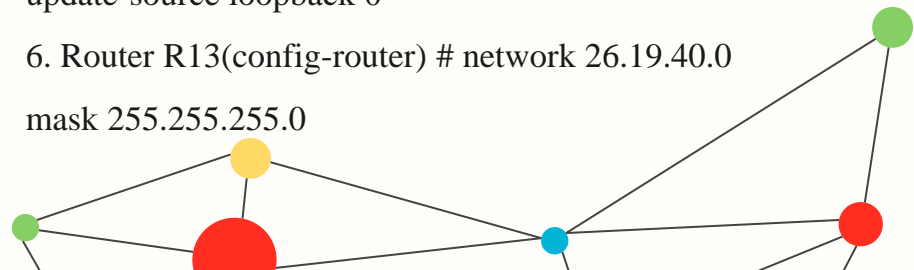


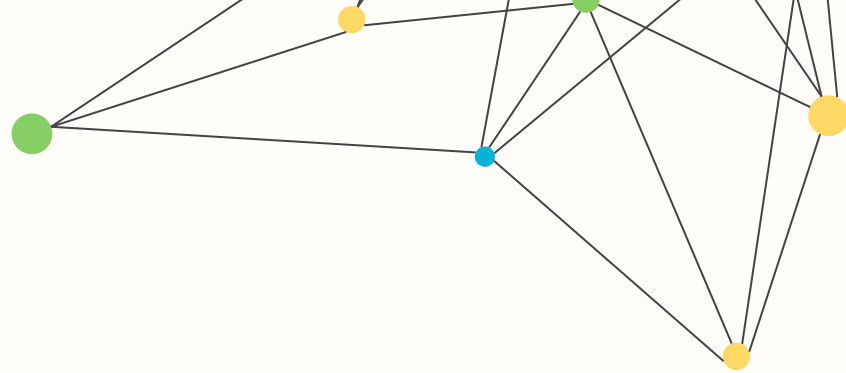
# How to apply the iBGP protocol

## Router 12

1. Router R12(config) # interface loopback 0
  2. Router R12(config-if) # ip address 5.5.5.5  
255.255.255.255
  3. Router R12(config) # router bgp 100
  4. Router R12(config-router) # neighbor 6.6.6.6  
remote-as 100
  5. Router R12(config-router) # neighbor 6.6.6.6  
update-source loopback 0
  6. Router R12(config-router) # network 26.19.10.0  
mask 255.255.255.0
- 

## Router 13

1. Router R13(config) # interface loopback 0
  2. Router R13(config-if) # ip address 6.6.6.6  
255.255.255.255
  3. Router R13(config) # router bgp 100
  4. Router R13(config-router) # neighbor 5.5.5.5  
remote-as 100
  5. Router R13(config-router) # neighbor 5.5.5.5  
update-source loopback 0
  6. Router R13(config-router) # network 26.19.40.0  
mask 255.255.255.0
- 



Note:

In the practical part of the iBGP the configuration just has these two steps for all routers:

1. router bgp AS
2. neighbor X remote-as AS when X equivalent to the neighbour BGP router at the same AS.

the configuration seems to be right; that's Maby happens because it's a small topology and there is no conflict between the AS's.

