



Faculty of Engineering and Technology

Electrical and Computer Engineering Department

ADVANCED COMPUTER NETWORKS ENCS5321

Course Project

BGP

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Abstract

In this experiment the main aim is to understand the Border Gateway Protocol BGP which is a routing protocol, how its work and how it applies. This project done using GNS3 tool.

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Acronyms and Abbreviations

- ⇒ IP: Internet Protocol
- ⇒ MAC: Media Access Control
- ⇒ BGP: Border Gateway Protocol
- ⇒ OSPF: Open Shortest Path First
- ⇒ RIP: Routing Information Protocol
- ⇒ AS: Autonomous System

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Introduction

I. Routing protocols

“Routing is the process of path selection in any network. A computer network is made of many machines, called *nodes*, and paths or links that connect those nodes. Communication between two nodes in an interconnected network can take place through many different paths. Routing is the process of selecting the best path using some predetermined rules.

Data moves along any network in the form of data packets. Each data packet has a header that contains information about the packet’s intended destination. As a packet travels to its destination, several routers might route it multiple times. Routers perform this process millions of times each second with millions of packets.

When a data packet arrives, the router first looks up its address in a routing table. This is like a passenger consulting a bus timetable to find the best bus route to their destination. Then the router forwards or moves the packet onward to the next point in the network.” [1]

II. Types of routing

II.I Static routing

“Static routing is also called as “non-adaptive routing”. In this, routing configuration is done manually by the network administrator. Let’s say for example, we have 5 different routes to transmit data from one node to another, so the network administrator will have to manually enter the routing information by assessing all the routes.” [2]

II.II Default routing

“This is the method where the router is configured to send all packets toward a single router (next hop). It doesn’t matter to which network the packet belongs, it is forwarded out to the router which is configured for default routing. It is generally used with stub routers. A stub router is a router that has only one route to reach all other networks.” [2]

II.III Dynamic routing

“Dynamic routing makes automatic adjustments of the routes according to the current state of the route in the routing table. Dynamic routing uses protocols to discover network destinations and the routes to reach them. RIP and OSPF are the best examples of dynamic routing protocols.” [2]

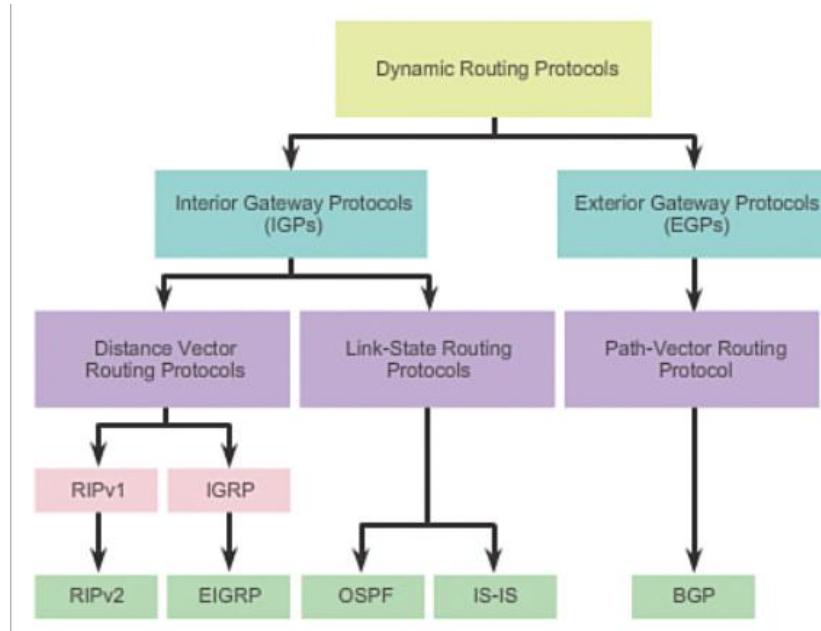


Figure 1: Dynamic routing protocols. [3]

III. BGP

“BGP (Border Gateway Protocol) is the protocol that enables the global routing system of the internet. It manages how packets get routed from network to network by exchanging routing and reachability information among edge routers. BGP enables peering to send packets between autonomous systems (ASes), which are networks managed by a single enterprise or service provider. Together, these ASes make up the public internet.

BGP creates network stability by guaranteeing that routers can adapt to route failures. When one path goes down, BGP quickly finds a new path. BGP makes routing decisions based on paths, defined by rules or network policies set by network administrators.” [4]

III.I IBGP

“IBGP is a way for computers in the same network to talk to each other about the best paths to send messages. It helps all the computers in a network know about all the paths they can use. This is important because it makes sure all the computers in the network have the same information about how the network is set up. When all the computers know the same things, they can make good choices about how to send messages inside the network. This helps the network work well and send messages quickly.” [5]

III.II EBGP

“EBGP is a way for different computer networks to talk to each other on the internet. It helps networks share information about how to send messages to other places outside their own network. EBGP is very important because it helps messages get where they need to go quickly and easily. To make EBGP work right people who take care of networks need to set it up correctly. This means putting in the right information like the addresses of other networks they want to talk to and special numbers that identify each network.” [5]

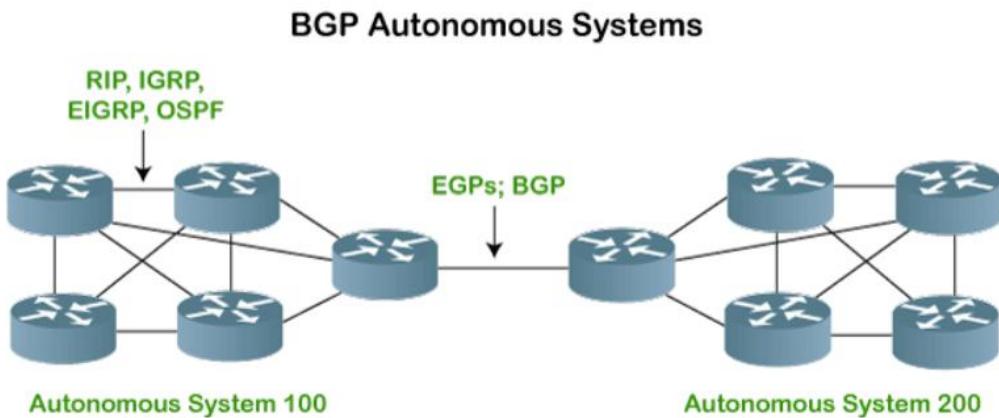


Figure 2: BGP Autonomous Systems. [8]

IV. OSPF

“OSPF is an interior gateway protocol (IGP) that routes packets within a single autonomous system (AS). OSPF uses link-state information to make routing decisions, making route calculations using the shortest-path-first (SPF) algorithm (also referred to as the Dijkstra algorithm). Each router running OSPF floods link-state advertisements throughout the AS or area that contain information about that router’s attached interfaces and routing metrics. Each router uses the information in these link-state advertisements to calculate the least cost path to each network and create a routing table for the protocol.” [6]

V. RIP

“The Routing Information Protocol is a distance vector routing protocol that helps routers determine the best path to transfer data packets across the network. RIP works on the Network layer of the OSI model. It uses **hop count** as its metric for determining the best path, but the maximum hop count allowed in the RIP is 15. Routing Information Protocol is mostly used in small to medium-sized networks.” [7]

Procedure

Topology

First, the topology should be created. Using GNS3 there is no routers. So, the router image added as a new template. Cisco 3725 router used.

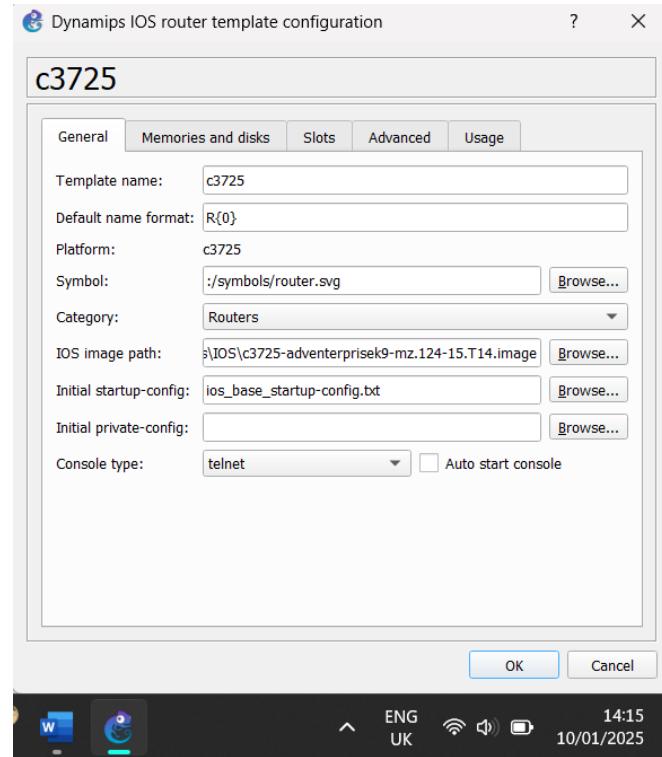


Figure 3: Cisco 3725 router.

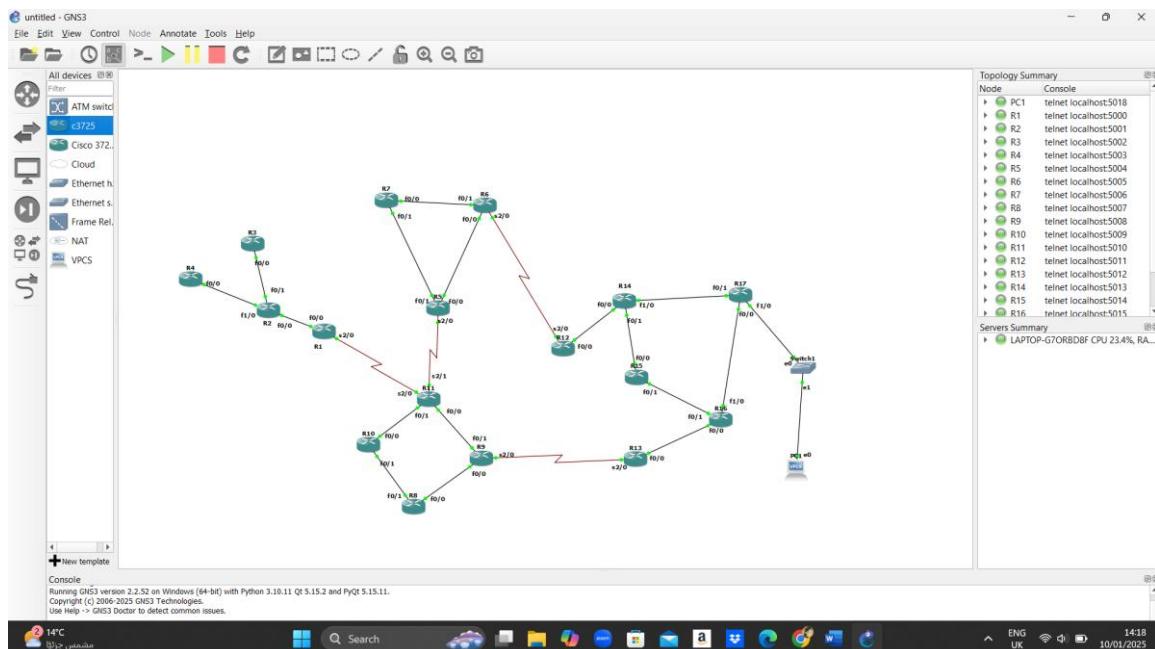


Figure 4: Topology.

This topology contains four autonomous systems distributed in the next way:

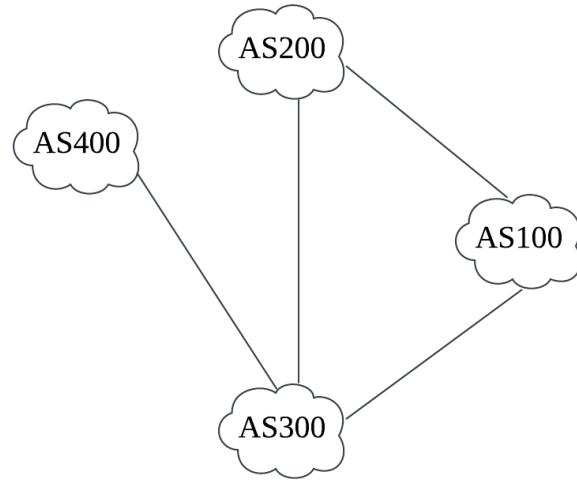


Figure 5: Autonomous systems.

- ⇒ Autonomous system 100 and autonomous system 400 are a client network.
- ⇒ Autonomous system 300 is as ISP network.

“An Internet service provider (ISP) is an organization that provides myriad services related to accessing, using, managing, or participating in the Internet. ISPs can be organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.” [9]

- ⇒ Autonomous system 200 is an IX network.

“Internet exchange points (IXes or IXP)s are common grounds of IP networking, allowing participant Internet service providers (ISPs) to exchange data destined for their respective networks. IXPs are generally located at places with preexisting connections to multiple distinct networks, and operate physical infrastructure (switches) to connect their participants. Organizationally, most IXPs are each independent not-for-profit associations of their constituent participating networks (that is, the set of ISPs that participate in that IXP). The primary alternative to IXPs is private peering, where ISPs directly connect their networks.” [10]

After building the topology, the IP addresses assigned to the ASs as follow:

Yara's university ID is equal to 1211269

So, For AS 400 the IP address become in this format:

12112**69**

112.**69**.X.0/24, when X equal to 40, 50, and 60.

For AS 200 the IP address become in this format:

12112**69**

12.**69**.X.0/24, when X equal to 1, 2, and 3.

For AS 300 the IP address become in this format:

12112**69**

69.12.X.0/24, when X equal to 10, 20, 30, and 40.

For AS 100 the IP address become in this format:

12112**69**

26.**19**.X.0/24, when X equal to 10, 20, 30, 40, 50, 60, and 70.

For the External connections:

12112**69**

11.**69**.12.0/30. For the connection between AS 300 and AS 400.

11.**69**.12.4/30. For the connection between AS 200 and AS 300.

11.**69**.12.8/30. For the connection between AS 100 and AS 300.

11.**69**.12.12/30. For the connection between AS 100 and AS 200.

The following table is the networks IPs table:

AS	Network	Device	Interface	IP	Subnet Mask
AS 400	112.69.40.0/24	R1	Fe0/0	112.69.40.1	255.255.255.0
		R2	Fe0/0	112.69.40.2	255.255.255.0
	112.69.50.0/24	R2	Fe0/1	112.69.50.2	255.255.255.0
		R3	Fe0/0	112.69.50.1	255.255.255.0
	112.69.60.0/24	R2	Fe1/0	112.69.60.2	255.255.255.0
		R4	Fe0/0	112.69.60.1	255.255.255.0
AS 200	12.69.1.0/24	R5	Fe0/0	12.69.1.1	255.255.255.0
		R6	Fe0/0	12.69.1.2	255.255.255.0
	12.69.2.0/24	R6	Fe0/1	12.69.2.1	255.255.255.0
		R7	Fe0/0	12.69.2.2	255.255.255.0
	12.69.3.0/24	R5	Fe0/1	12.69.3.1	255.255.255.0
		R7	Fe0/1	12.69.3.2	255.255.255.0
AS 300	69.12.10.0/24	R8	Fe0/0	69.12.10.1	255.255.255.0
		R9	Fe0/0	69.12.10.2	255.255.255.0
	69.12.20.0/24	R8	Fe0/1	69.12.20.1	255.255.255.0
		R10	Fe0/1	69.12.20.2	255.255.255.0
	69.12.30.0/24	R9	Fe0/1	69.12.30.1	255.255.255.0
		R11	Fe0/0	69.12.30.2	255.255.255.0
	69.12.40.0/24	R10	Fe0/0	69.12.40.2	255.255.255.0
		R11	Fe0/1	69.12.40.1	255.255.255.0
AS 100	26.19.10.0/24	R12	Fe0/0	26.19.10.1	255.255.255.0
		R14	Fe0/0	26.19.10.2	255.255.255.0
	26.19.20.0/24	R14	Fe0/1	26.19.20.1	255.255.255.0
		R15	Fe0/0	26.19.20.2	255.255.255.0
	26.19.30.0/24	R15	Fe0/1	26.19.30.1	255.255.255.0
		R16	Fe0/1	26.19.30.2	255.255.255.0
	26.19.40.0/24	R13	Fe0/0	26.19.40.1	255.255.255.0
		R16	Fe0/0	26.19.40.2	255.255.255.0
	26.19.50.0/24	R14	Fe1/0	26.19.50.1	255.255.255.0
		R17	Fe0/1	26.19.50.2	255.255.255.0

	26.19.60.0/24	R16	Fe1/0	26.19.60.1	255.255.255.0
		R17	Fe0/0	26.19.60.2	255.255.255.0
	26.19.70.0/24	R17	Fe1/0	26.19.70.1	255.255.255.0
		PC1	E0	26.19.70.2	255.255.255.0

Table 1: IP Address.

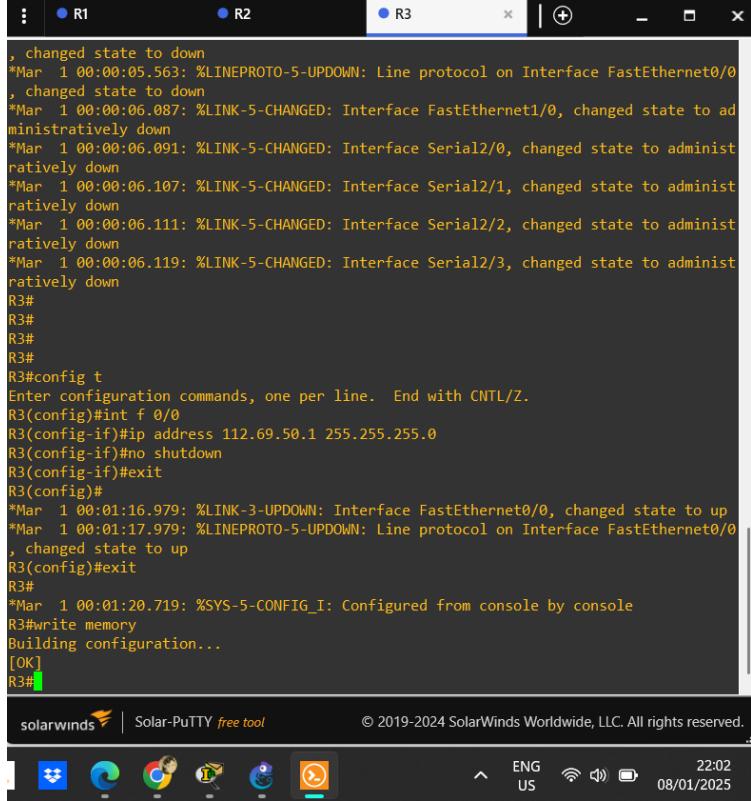
The following table is the external network table:

Network	Device	Interface	IP	Subnet Mask
11.69.12.0/30	R1	Se2/0	11.69.12.1	255.255.255.252
	R11	Se2/0	11.69.12.2	255.255.255.252
11.69.12.4/30	R5	Se2/0	11.69.12.6	255.255.255.252
	R11	Se2/1	11.69.12.5	255.255.255.252
11.69.12.8/30	R9	Se2/0	11.69.12.9	255.255.255.252
	R13	Se2/0	11.69.12.10	255.255.255.252
11.69.12.12/30	R6	Se2/0	11.69.12.13	255.255.255.252
	R12	Se2/0	11.69.12.14	255.255.255.252

Table 2: External network.

Networks IPs added using multi steps. The following steps for router 3 for example:

- ⇒ config t
let the user to enter the global configuration mode, where he can change the router configurations.
- ⇒ int f 0/0
select FastEthernet 0/0 interface.
- ⇒ ip address 112.69.50.1 255.255.255.0
assign the IP address 112.69.50.1 and the subnet mask 255.255.255.0 to the interface.
- ⇒ no shutdown
enable the interface which down by default.
- ⇒ exit
exit interface configuration mode.
- ⇒ exit
exit the global configuration mode.
- ⇒ write memory
saves the configuration changes made in RAM.



```

R1 R2 R3
, changed state to down
*Mar 1 00:00:05.563: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0
, changed state to down
*Mar 1 00:00:06.087: %LINK-5-CHANGED: Interface FastEthernet1/0, changed state to ad
ministratively down
*Mar 1 00:00:06.091: %LINK-5-CHANGED: Interface Serial2/0, changed state to administ
ratively down
*Mar 1 00:00:06.107: %LINK-5-CHANGED: Interface Serial2/1, changed state to administ
ratively down
*Mar 1 00:00:06.111: %LINK-5-CHANGED: Interface Serial2/2, changed state to administ
ratively down
*Mar 1 00:00:06.119: %LINK-5-CHANGED: Interface Serial2/3, changed state to administ
ratively down
R3#
R3#
R3#
R3#
R3#config t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#int f 0/0
R3(config-if)#ip address 112.69.50.1 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#exit
R3(config)#
*Mar 1 00:01:16.979: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:01:17.979: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0
, changed state to up
R3(config)#exit
R3#
*Mar 1 00:01:20.719: %SYS-5-CONFIG_I: Configured from console by console
R3#write memory
Building configuration...
[OK]
R3#

```

The screenshot shows a SolarWinds PuTTY window titled "R3". The terminal session displays configuration commands for Router 3, including setting the IP address to 112.69.50.1 and enabling the interface. The SolarWinds logo and copyright information are visible at the bottom.

Figure 6: Router 3 configurations commands.

The following figure show AS 400 configurations.

Router configurations shown using the following command:

⇒ show run

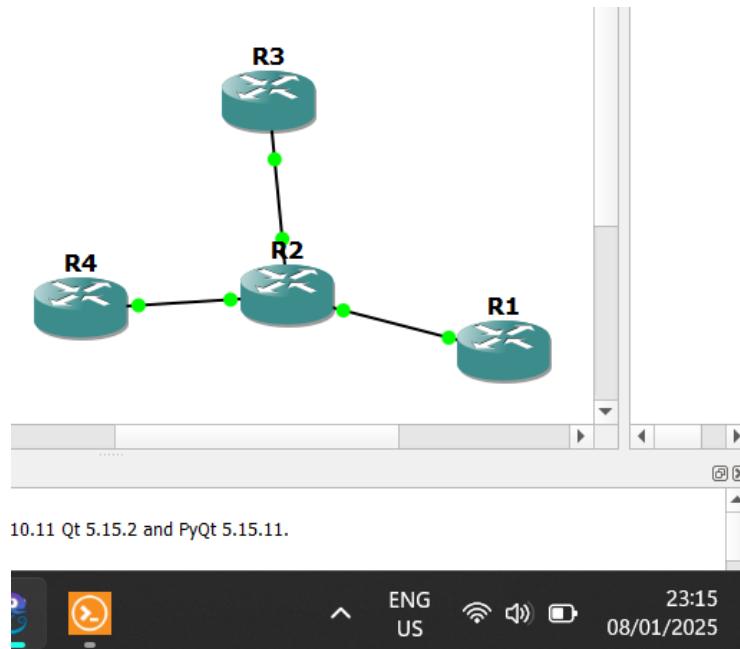


Figure 7: AS 400.

The screenshot shows a Solar-PuTTY window titled 'R1'. The configuration command entered is:

```
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 112.69.40.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
!
```

The Solar-PuTTY interface includes a toolbar with icons for file operations, a status bar at the bottom showing 'solarwinds' logo, 'Solar-PuTTY free tool', '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', and system status like ENG US, 22:03, and 08/01/2025.

Figure 8: Router 1 configuration.

The screenshot shows a Solar-PuTTY window titled 'R2'. The configuration command entered is:

```
!
!
!
!
interface FastEthernet0/0
 ip address 112.69.40.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 112.69.50.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 112.69.60.2 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/1
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/2
 no ip address
 shutdown
 serial restart-delay 0
```

The Solar-PuTTY interface includes a toolbar with icons for file operations, a status bar at the bottom showing 'solarwinds' logo, 'Solar-PuTTY free tool', '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', and system status like ENG US, 22:03, and 08/01/2025.

Figure 9: Router 2 configuration.

The screenshot shows a SolarPuTTY window titled 'R3'. The terminal session displays the configuration of Router 3. The configuration includes setting the TCP synwait-time to 5, defining three FastEthernet interfaces (FastEthernet0/0, FastEthernet0/1, FastEthernet1/0) with auto-duplex and auto-speed, and one Serial2/0 interface with no IP address. The SolarPuTTY status bar at the bottom indicates the tool is free, the copyright year is 2019-2024, the language is English (ENG), the country is United States (US), the date is 08/01/2025, and the time is 22:03.

```
ip tcp synwait-time 5

interface FastEthernet0/0
ip address 112.69.50.1 255.255.255.0
duplex auto
speed auto

interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto

interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto

interface Serial2/0
no ip address
--More--
```

Figure 10: Router 3 configuration.

The screenshot shows a SolarPuTTY window titled 'R4'. The terminal session displays the configuration of Router 4. The configuration is identical to Router 3, including setting the TCP synwait-time to 5, defining three FastEthernet interfaces (FastEthernet0/0, FastEthernet0/1, FastEthernet1/0) with auto-duplex and auto-speed, and one Serial2/0 interface with no IP address. The SolarPuTTY status bar at the bottom indicates the tool is free, the copyright year is 2019-2024, the language is English (ENG), the country is United States (US), the date is 11/01/2025, and the time is 14:35.

```
ip tcp synwait-time 5

interface FastEthernet0/0
ip address 112.69.60.1 255.255.255.0
duplex auto
speed auto

interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto

interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto

interface Serial2/0
no ip address
--More--
```

Figure 11: Router 4 configuration.

The following figure show AS 200 configurations.

Router configurations shown using the following command:

⇒ show run

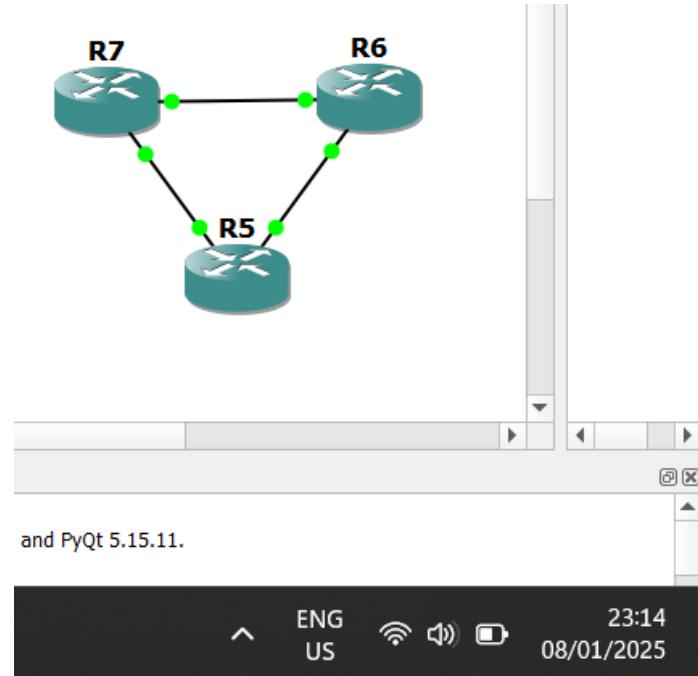


Figure 12: AS 200.

```
ip tcp synwait-time 5

interface FastEthernet0/0
ip address 12.69.1.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 12.69.3.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
no ip address
shutdown
--More--
```

solarwinds Solar-PuTTY free tool © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.

22:31
08/01/2025

Figure 13: Router 5 configuration.

The screenshot shows a Solar-PuTTY window titled 'R6' displaying the configuration of Router 6. The configuration includes:

```
!
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 12.69.1.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 12.69.2.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--
```

The Solar-PuTTY interface at the bottom shows the following status: solarwinds logo, Solar-PuTTY free tool, © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved, ENG US, 22:31, 08/01/2025.

Figure 14: Router 6 configuration.

The screenshot shows a Solar-PuTTY window titled 'R7' displaying the configuration of Router 7. The configuration is identical to Router 6, with minor differences in IP addresses:

```
!
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 12.69.2.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 12.69.3.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--
```

The Solar-PuTTY interface at the bottom shows the following status: solarwinds logo, Solar-PuTTY free tool, © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved, ENG US, 22:32, 08/01/2025.

Figure 15: Router 7 configuration.

The following figure show AS 300 configurations.

Router configurations shown using the following command:

⇒ show run

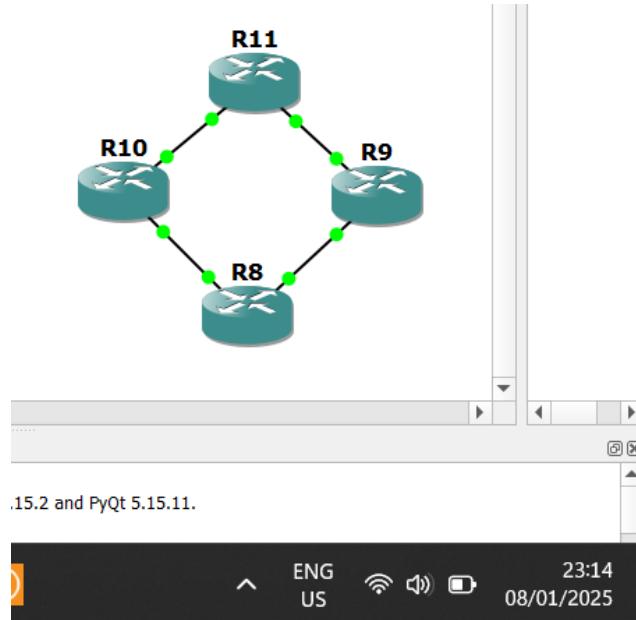


Figure 16: AS 300.

```
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
ip address 69.12.10.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 69.12.20.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
no ip address
shutdown
--More-- █
```

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23:12 08/01/2025 ENG US

Figure 17: Router 8 configuration.

The screenshot shows a Solar-PuTTY window titled 'R9'. The configuration text is as follows:

```
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 69.12.10.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 69.12.30.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--
```

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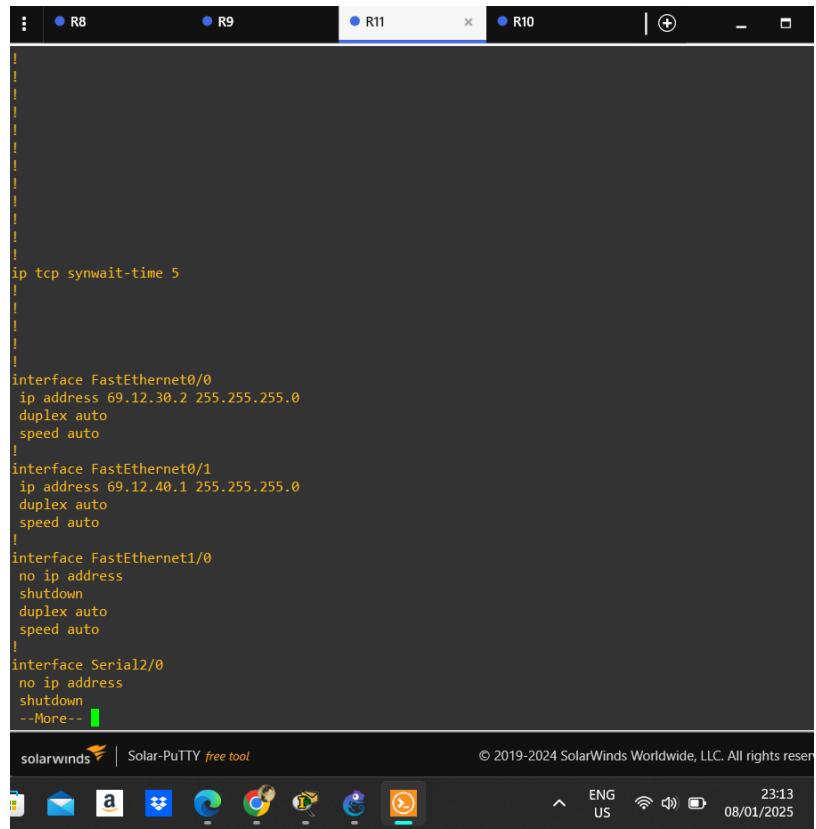
Figure 18: Router 9 configuration.

The screenshot shows a Solar-PuTTY window titled 'R10'. The configuration text is as follows:

```
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 69.12.40.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 69.12.20.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--
```

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Figure 19: Router 10 configuration.



```

!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 69.12.30.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 69.12.40.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--

```

The screenshot shows a SolarWinds PuTTY window titled "R11". The configuration command "show run" has been entered, displaying the router's running configuration. The configuration includes interface definitions for FastEthernet0/0, FastEthernet0/1, and FastEthernet1/0, all set to auto-duplex and auto-speed. The Serial2/0 interface is also defined but has no IP address and is shutdown.

Figure 20: Router 11 configuration.

The following figure show AS 100 configurations.

Router configurations shown using the following command:

⇒ show run

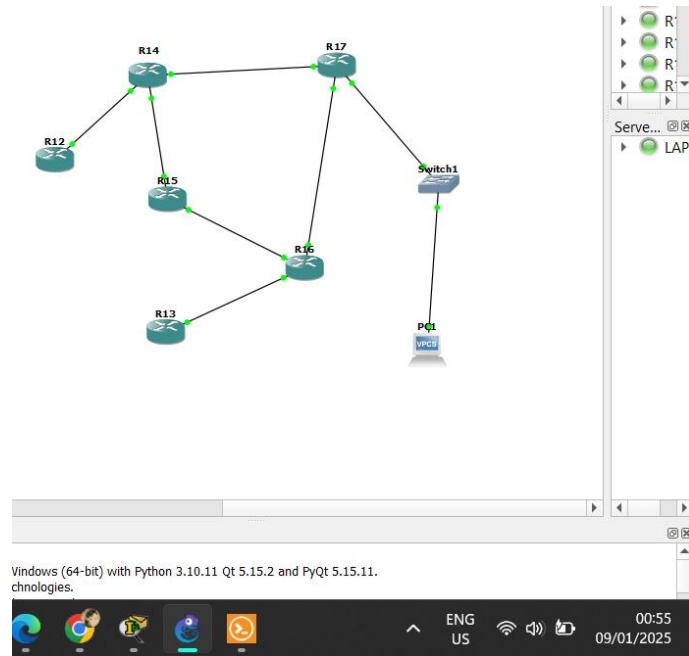


Figure 21: AS 100.

The screenshot shows a Solar-PuTTY terminal window titled 'R12'. The configuration command entered is:

```
ip tcp synwait-time 5
!
!
!
!
!
interface FastEthernet0/0
 ip address 26.19.10.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
--More--
```

The Solar-PuTTY interface includes tabs for R12, R14, R15, R13, R16, R17, and PC1. The status bar at the bottom shows the SolarWinds logo, the tool name 'Solar-PuTTY free tool', the copyright notice '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', the language 'ENG', the region 'US', the time '00:55', and the date '09/01/2025'.

Figure 22: Router 12 configuration.

The screenshot shows a Solar-PuTTY terminal window titled 'R13'. The configuration command entered is:

```
ip tcp synwait-time 5
!
!
!
!
!
interface FastEthernet0/0
 ip address 26.19.40.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
--More--
```

The Solar-PuTTY interface includes tabs for R12, R14, R15, R13, R16, R17, and PC1. The status bar at the bottom shows the SolarWinds logo, the tool name 'Solar-PuTTY free tool', the copyright notice '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', the language 'ENG', the region 'US', the time '00:56', and the date '09/01/2025'.

Figure 23: Router 13 configuration.

The screenshot shows a SolarPuTTY window titled 'R14'. The configuration command entered is:

```
ip tcp synwait-time 5

!
!
!
interface FastEthernet0/0
 ip address 26.19.10.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 26.19.20.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 26.19.50.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
```

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Figure 24: Router 14 configuration.

The screenshot shows a SolarPuTTY window titled 'R15'. The configuration command entered is:

```
ip tcp synwait-time 5

!
!
!
interface FastEthernet0/0
 ip address 26.19.20.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 26.19.30.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
--More--
```

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Figure 25: Router 15 configuration.

The screenshot shows a SolarWinds SolarPuTTY terminal window titled 'R16'. The configuration script for Router 16 is displayed, starting with 'ip tcp synwait-time 5' and listing interfaces FastEthernet0/0, FastEthernet0/1, FastEthernet1/0, and Serial2/0 with their respective IP addresses and auto configurations. The SolarWinds interface bar at the bottom includes icons for email, browser, file manager, and system status.

```
!
!
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 26.19.40.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 26.19.30.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 26.19.60.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
--More--
```

Figure 26: Router 16 configuration.

The screenshot shows a SolarWinds SolarPuTTY terminal window titled 'R17'. The configuration script for Router 17 is identical to Router 16, starting with 'ip tcp synwait-time 5' and listing the same four interfaces with their respective IP addresses and auto configurations. The SolarWinds interface bar at the bottom includes icons for email, browser, file manager, and system status.

```
!
!
!
!
!
!
ip tcp synwait-time 5
!
!
!
!
interface FastEthernet0/0
 ip address 26.19.60.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 26.19.50.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 26.19.70.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
--More--
```

Figure 27: Router 17 configuration.

AS 100 contain PC1 which an end device. PC configuration done in different way than the router that explained previously. PC configuration done using the following steps:

- ⇒ ip 26.19.70.2 255.255.255.0 26.19.70.1
 - assign PC IP address 26.19.70.2, the subnet mask 255.255.255.0, and the gateway 26.19.70.1
- ⇒ save
 - save the configuration.

When the PC used next time, the following command used to restore saved configurations:

- ⇒ lode

As shown in the next figure **ping** command used to test the PC configuration, by trying to send packets to the gateway router.:

- ⇒ ping 26.19.70.1

The screenshot shows a Solar-PuTTY terminal window with the title bar 'PC1'. The window displays the following text:

```
Copyright (c) 2007-2014, Paul Meng (mirnshi@gmail.com)
All rights reserved.

VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file

Checking for duplicate address...
PC1 : 26.19.70.2 255.255.255.0 gateway 26.19.70.1

PC1> lode
Bad command: "lode". Use ? for help.

PC1> sh ip

NAME      : PC1[1]
IP/MASK   : 26.19.70.2/24
GATEWAY   : 26.19.70.1
DNS       :
MAC       : 00:50:79:66:68:00
LPORT     : 10126
RHOST:PORT: 127.0.0.1:10127
MTU:      : 1500

PC1> ping 26.19.70.1
26.19.70.1 icmp_seq=1 timeout
84 bytes from 26.19.70.1 icmp_seq=2 ttl=255 time=17.366 ms
84 bytes from 26.19.70.1 icmp_seq=3 ttl=255 time=16.725 ms
84 bytes from 26.19.70.1 icmp_seq=4 ttl=255 time=15.875 ms
84 bytes from 26.19.70.1 icmp_seq=5 ttl=255 time=16.107 ms

PC1>
```

The status bar at the bottom of the terminal window shows the Solar-PuTTY logo, the text 'Solar-PuTTY free tool', and the copyright notice '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.'. It also shows system icons for battery, signal, and network, along with the text 'ENG US' and the date '11/01/2025'.

Figure 28: PC configuration and test ping.

For the external networks, the IP address assigned to the serial interfaces. The following steps assigned the IP address to Router 11 for example:

- ⇒ config t
- ⇒ int s 2/0
 - select serial 2/0 interface.
- ⇒ ip address 11.69.12.2 255.255.255.252
 - assign the IP address 11.69.12.2 and the subnet mask 255.255.255.252 to the interface.
- ⇒ no shutdown
 - enable the interface which down by default.
- ⇒ exit
 - exit interface configuration mode.
- ⇒ int s 2/1
 - select serial 2/1 interface.
- ⇒ ip address 11.69.12.5 255.255.255.252
- ⇒ no shutdown
- ⇒ exit
- ⇒ exit
 - exit the global configuration mode.
- ⇒ write memory
 - saves the configuration changes made in RAM.

Note:

Note that in the external networks the subnet mask equal to 255.255.255.252 “/30” while its equal to 255.255.255.0 “/24” in the AS’s networks “internal networks”. Which means that the external networks just have 2 hosts for each when the internal networks have 254 host for each.

```

!
interface FastEthernet0/0
ip address 112.69.40.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial1/0
ip address 11.69.12.1 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
```

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10:37
ENG US 09/01/2025

Figure 29: Router 1 External configuration.

```

!
interface FastEthernet0/0
ip address 69.12.30.2 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 69.12.40.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial1/0
ip address 11.69.12.2 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
ip address 11.69.12.5 255.255.255.252
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
```

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10:38
ENG US 09/01/2025

Figure 30: Router 11 External configuration.

The screenshot shows a Solar-PuTTY terminal window titled 'R5'. The configuration text is as follows:

```
speed auto
!
interface FastEthernet0/1
ip address 12.69.3.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
ip address 11.69.12.6 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
--More--
```

The Solar-PuTTY interface includes a toolbar with icons for R1, R11, Fx, R9, R13, R6, R12, and a plus sign. The status bar at the bottom shows 'solarwinds' logo, 'Solar-PuTTY free tool', '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', '10:38', 'ENG US', and '09/01/2025'.

Figure 31: Router 5 External configuration.

The screenshot shows a Solar-PuTTY terminal window titled 'R9'. The configuration text is as follows:

```
speed auto
!
interface FastEthernet0/1
ip address 69.12.30.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
ip address 11.69.12.9 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
--More--
```

The Solar-PuTTY interface includes a toolbar with icons for R1, R11, R5, Fx, R12, R6, R12, and a plus sign. The status bar at the bottom shows 'solarwinds' logo, 'Solar-PuTTY free tool', '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', '10:39', 'ENG US', and '09/01/2025'.

Figure 32: Router 9 External configuration.

```
speed auto
!
interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
ip address 11.69.12.10 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
--More--
```

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10:40 09/01/2025

Figure 33: Router 13 External configuration.

```
speed auto
!
interface FastEthernet0/1
ip address 12.69.2.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
ip address 11.69.12.13 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
```

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10:40 09/01/2025

Figure 34: Router 6 External configuration.

```

speed auto
!
interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
shutdown
duplex auto
speed auto
!
interface Serial2/0
ip address 11.69.12.14 255.255.255.252
serial restart-delay 0
!
interface Serial2/1
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/2
no ip address
shutdown
serial restart-delay 0
!
interface Serial2/3
no ip address
shutdown
serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
--More-- 

```

Figure 35: Router 6 External configuration.

Next the routing protocols should be assigned inside the AS's:

- ⇒ AS 100: OSPF
- ⇒ AS 200: OSPF
- ⇒ AS 300: OSPF
- ⇒ AS 400: RIP

OSPF

First, the OSPF applies to AS's 100, 200, and 300. For example, the following steps used for router 15 in AS 100:

- ⇒ config t
- ⇒ router ospf 1
- start the OSPF configuration, number 1 is the OSPF process ID. Which can be between 1 and 65535.
- ⇒ 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.

- ⇒ network 26.19.20.0 0.0.0.255 area 1
- ⇒ exit
- exit router configuration
- ⇒ exit
- ⇒ write

OSPF for AS 100

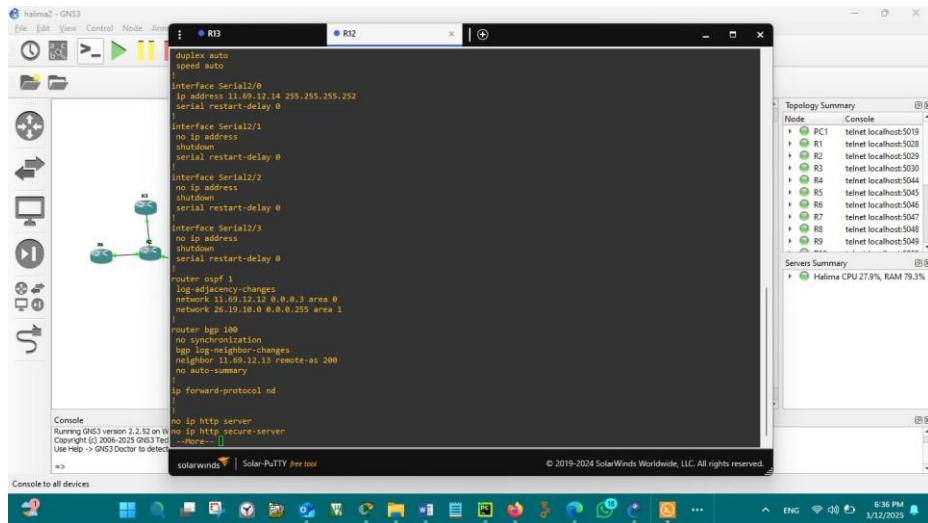


Figure 36: OSPF at router 12.

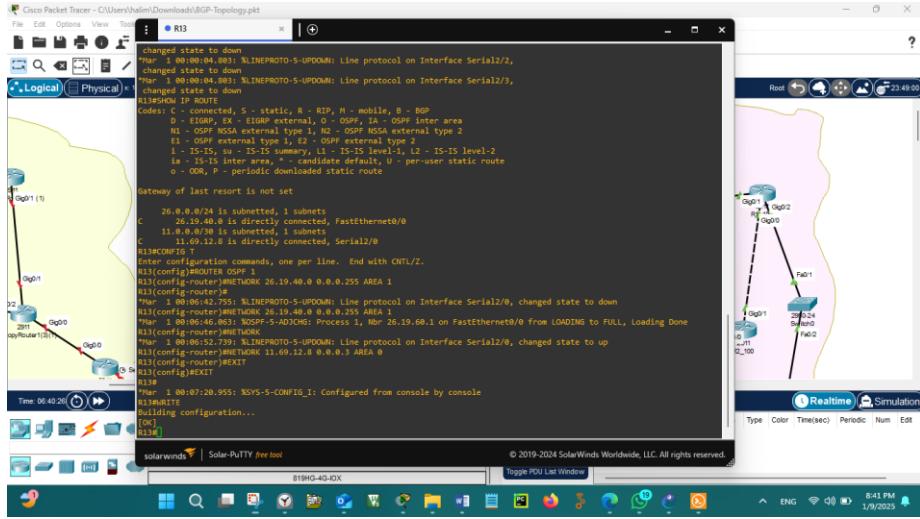


Figure 37: OSPF at router 13.

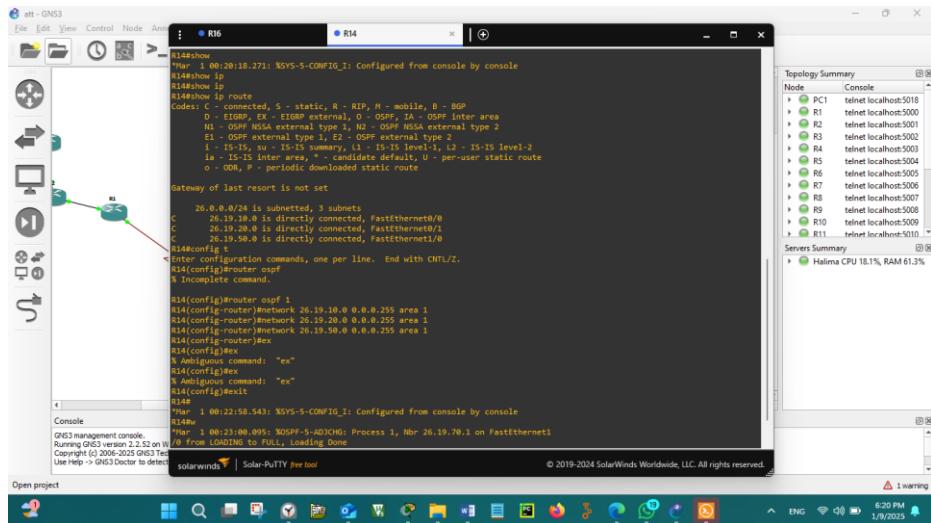


Figure 38: OSPF at router 14.

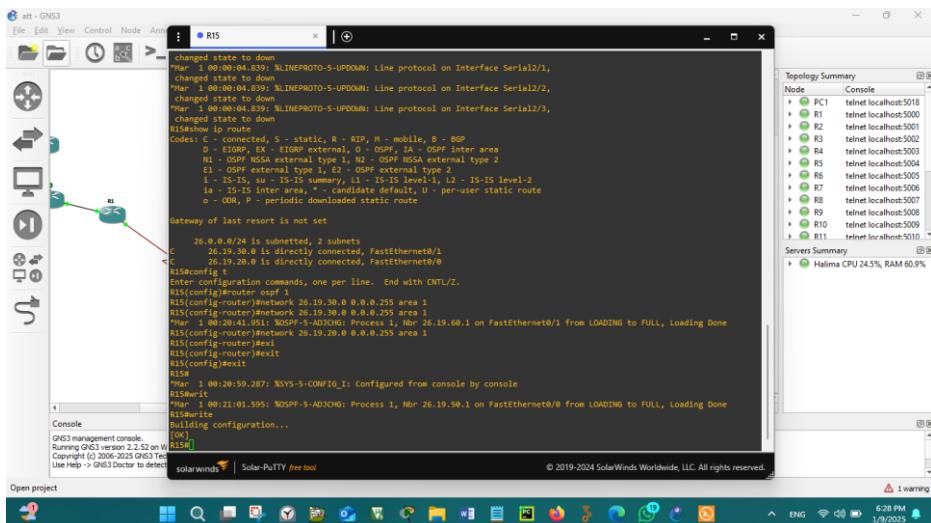


Figure 39: OSPF at router 15.

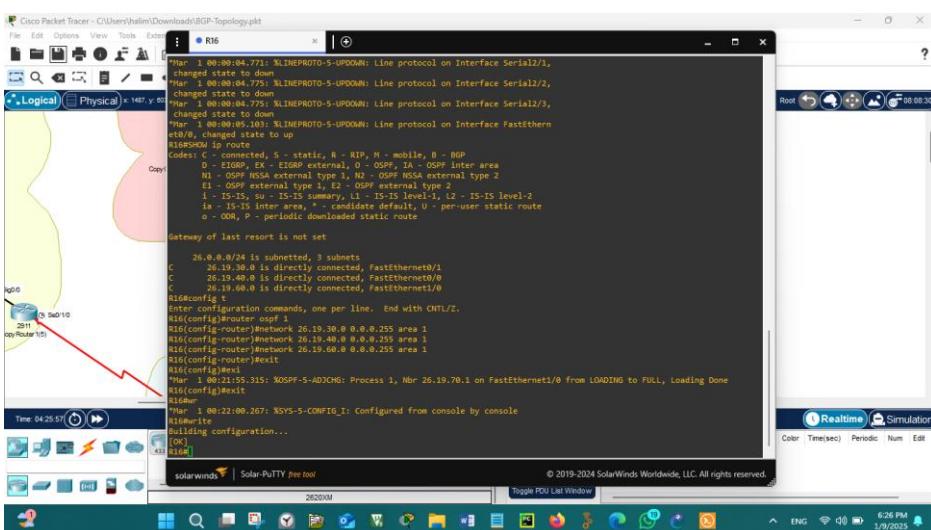


Figure 40: OSPF at router 16.

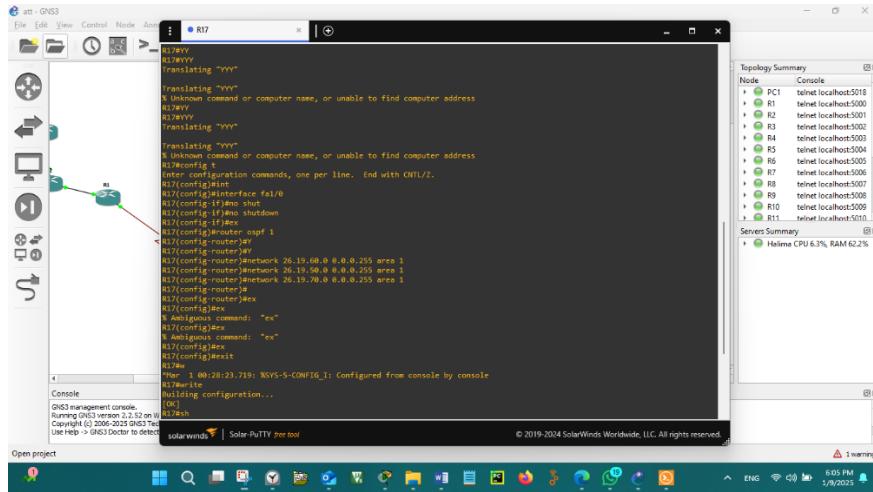


Figure 41: OSPF at router 17.

Test OSPF for AS 100

Ping command used for testing. The OSPF tested between router 13 and 14, and between router 15 and 17, by trying to send packets between two remote routers.

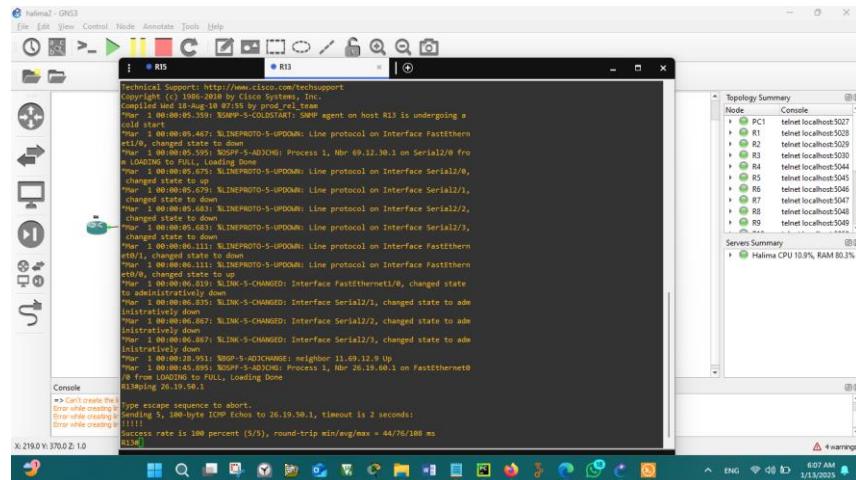


Figure 42: Testing between router 13 and 14.

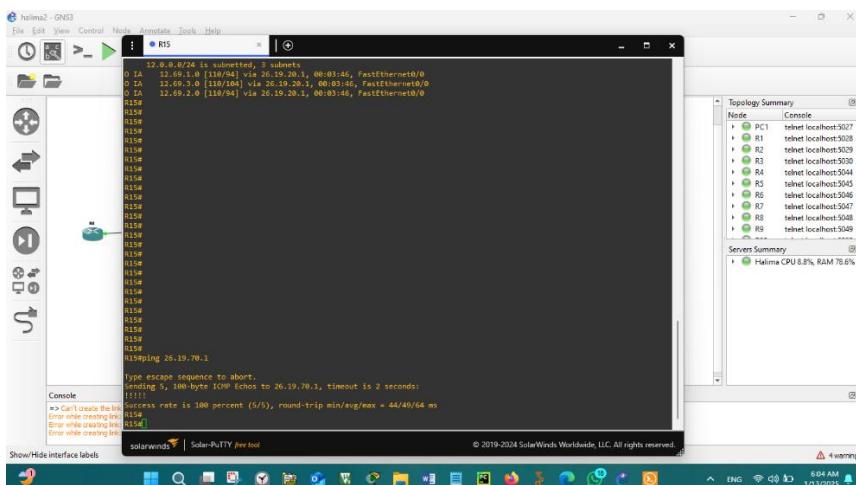


Figure 43: Testing between router 15 and 17.

OSPF for AS 200

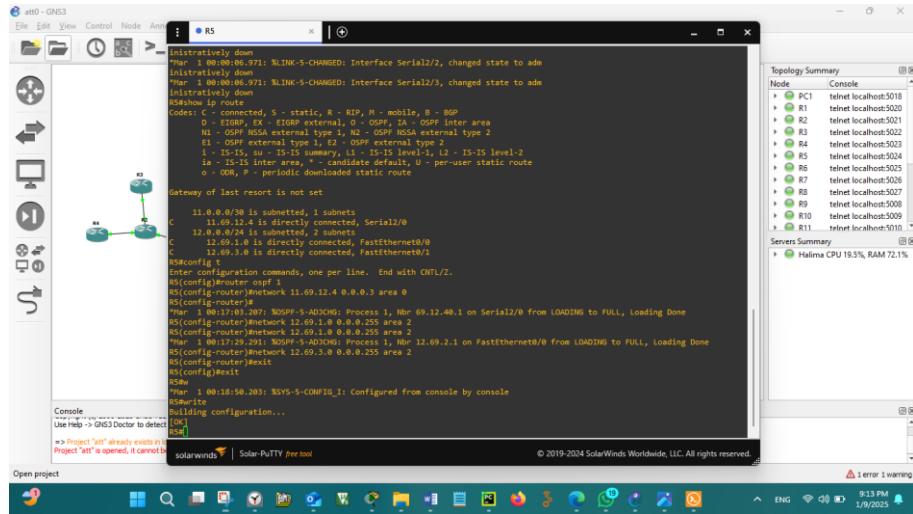


Figure 44: OSPF at router 5.

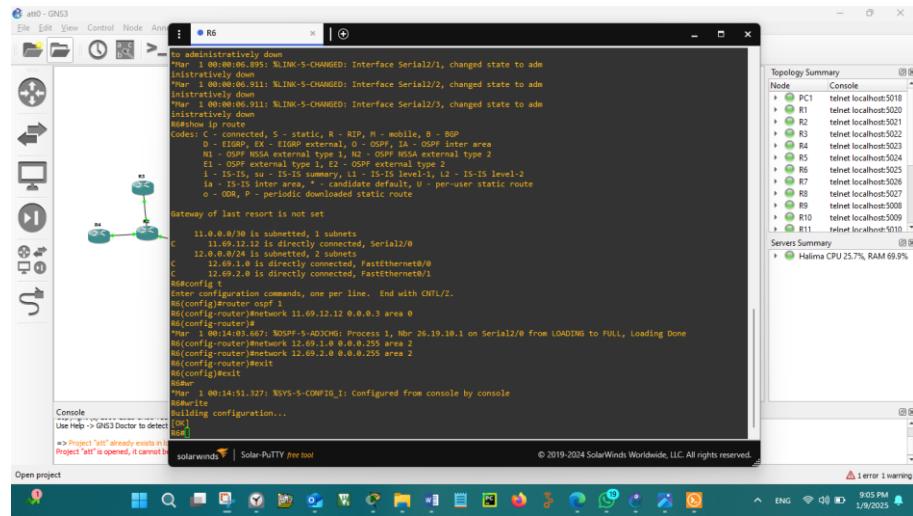


Figure 45: OSPF at router 6.

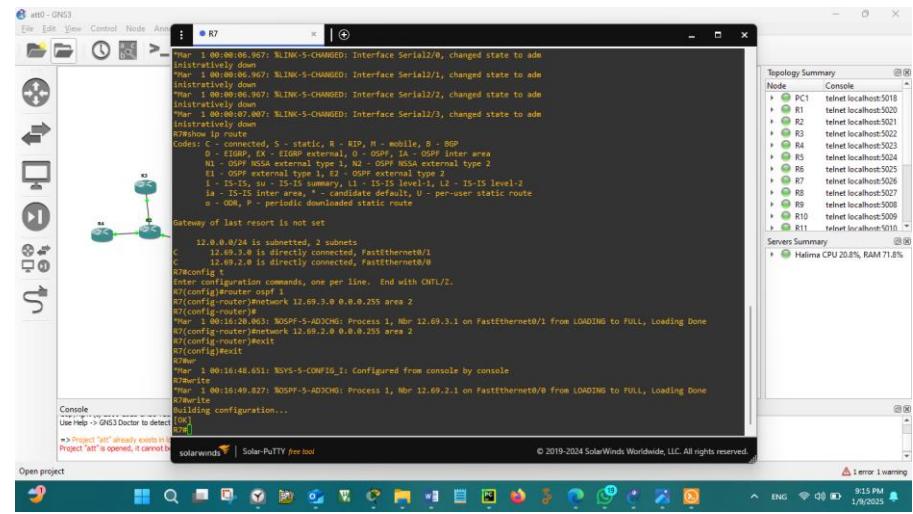


Figure 46: OSPF at router 7.

Test OSPF for AS 200

Ping command used for testing. The OSPF tested between router 5 and 7, by trying to send packets between two routers.

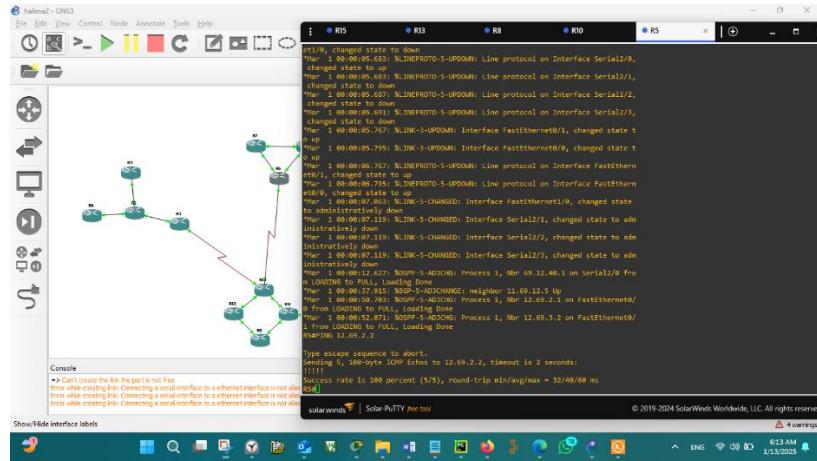


Figure 47: Testing between router 5 and 7.

OSPF for AS 300

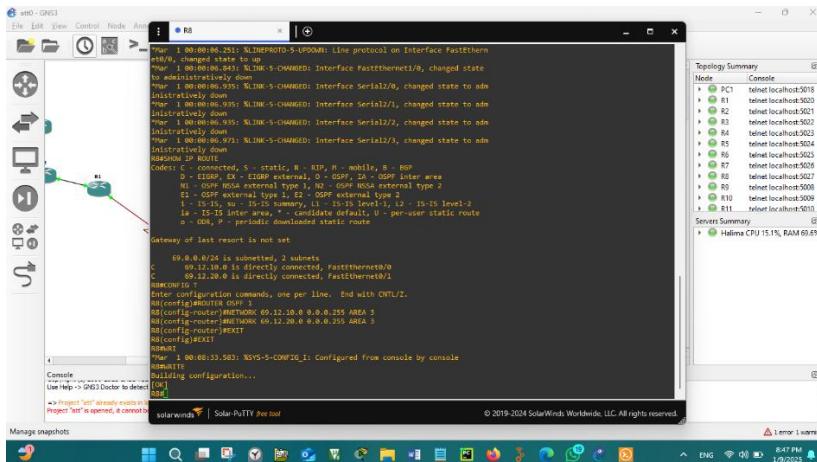


Figure 48: OSPF at router 8.

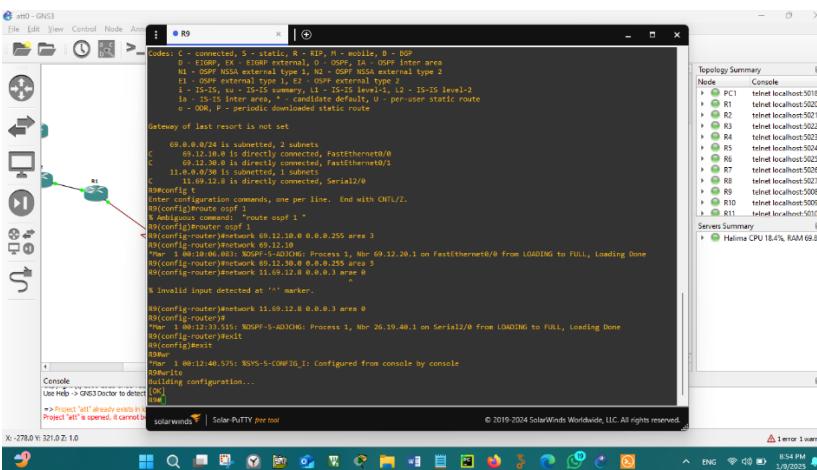


Figure 49: OSPF at router 9.

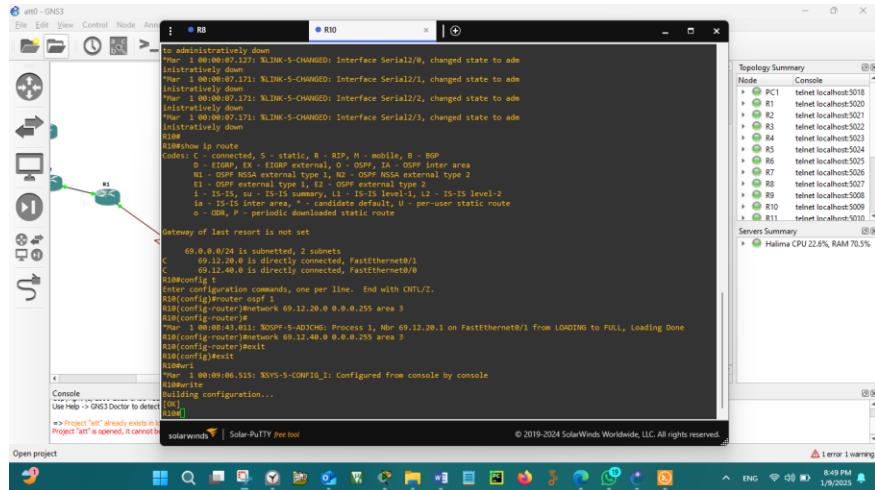


Figure 50: OSPF at router 10.

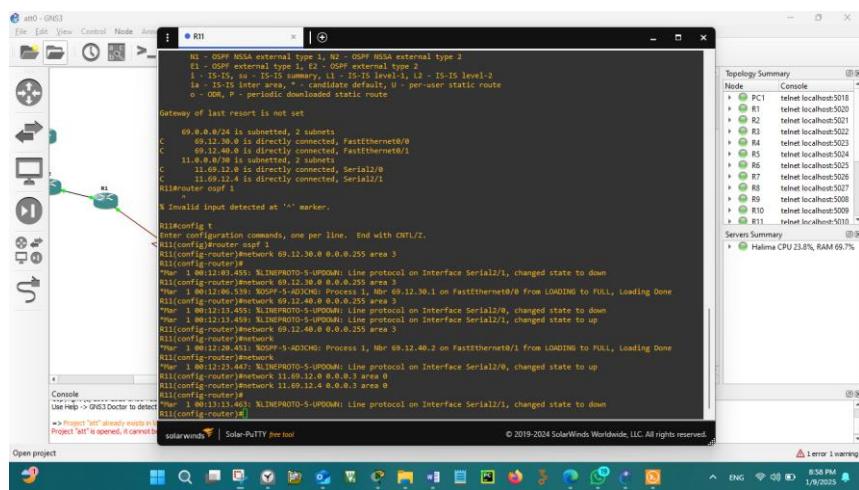


Figure 51: OSPF at router 11.

Test OSPF for AS 300

Ping command used for testing. The OSPF tested between router 8 and 11, and between router 9 and 10, by trying to send packets between two routers.

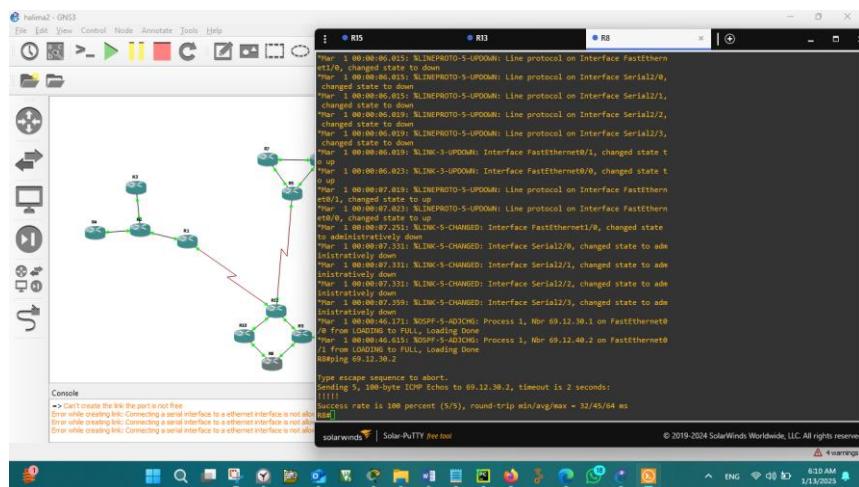


Figure 52: Testing between router 8 and 11.

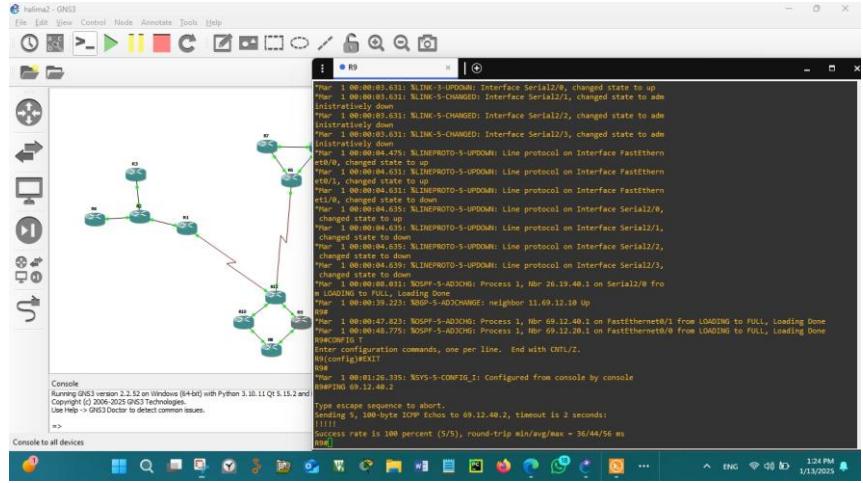


Figure 53: Testing between router 9 and 10.

RIP

Then, the RIP applies to AS's 400. For example, the following steps used for router 2 for example:

- ⇒ config t
- ⇒ router rip
- enable RIP routing
- ⇒ network 112.69.40.0
- define the neighbour networks 112.69.40.0
- ⇒ network 112.69.50.0
- ⇒ network 112.69.60.0
- ⇒ exit
- ⇒ exit
- ⇒ write memory

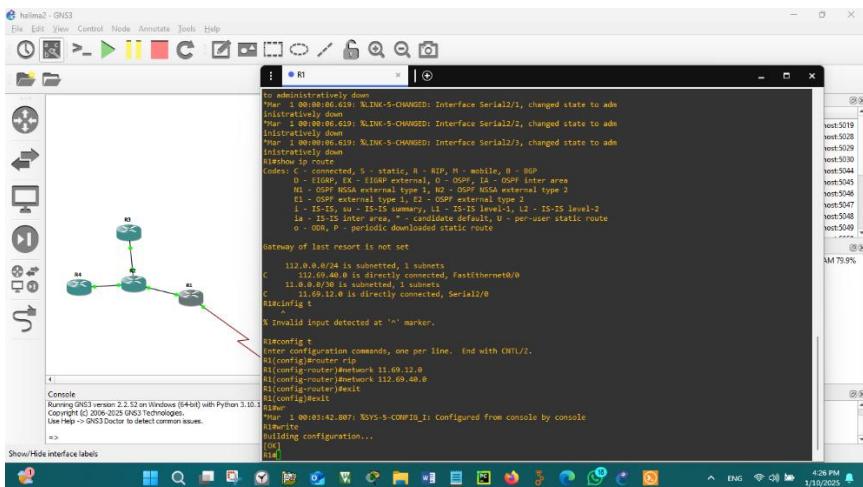


Figure 54: RIP at router 1.

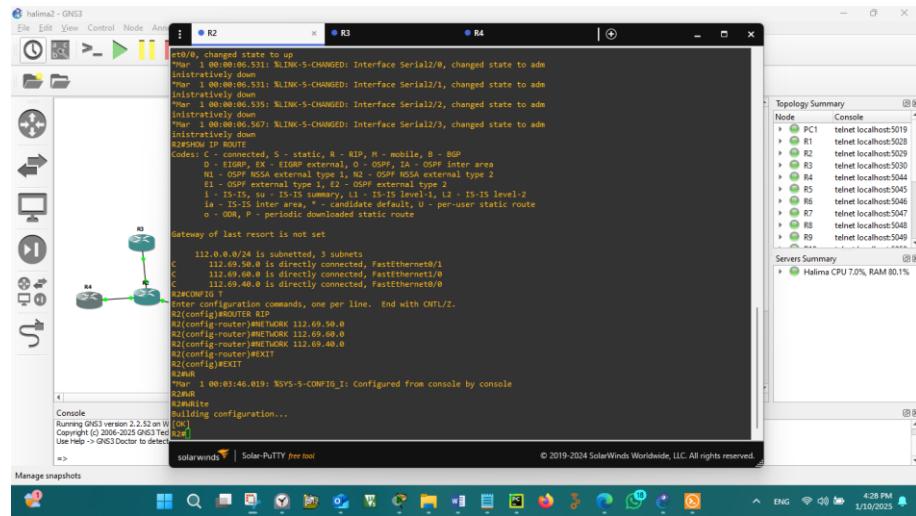


Figure 55: RIP at router 2.

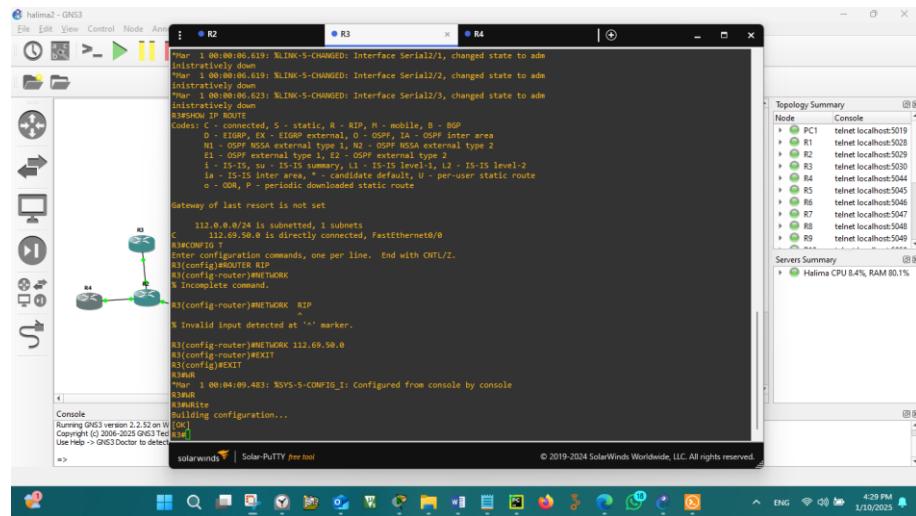


Figure 56: RIP at router 3.

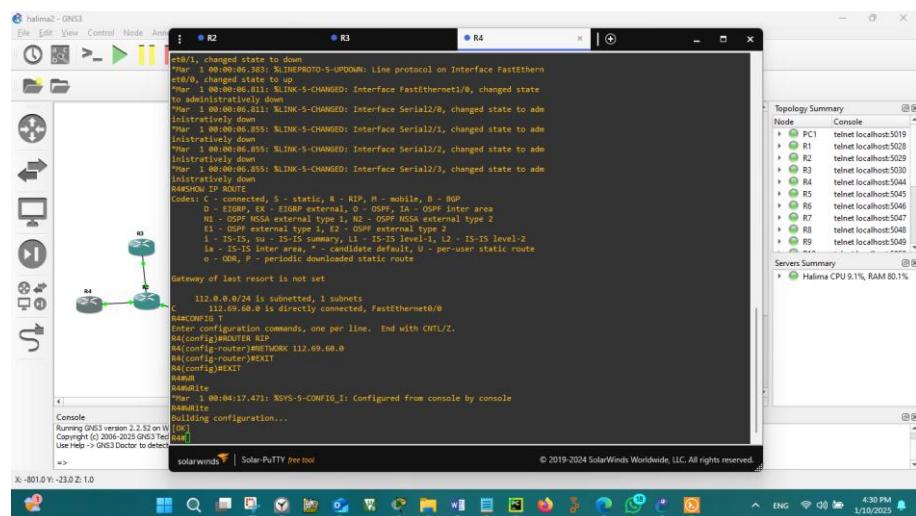


Figure 57: RIP at router 4.

Test RIP for AS 400

Ping command used for testing. The RIP tested between router 1 and 4, and between router 3 and 4, by trying to send packets between two routers.

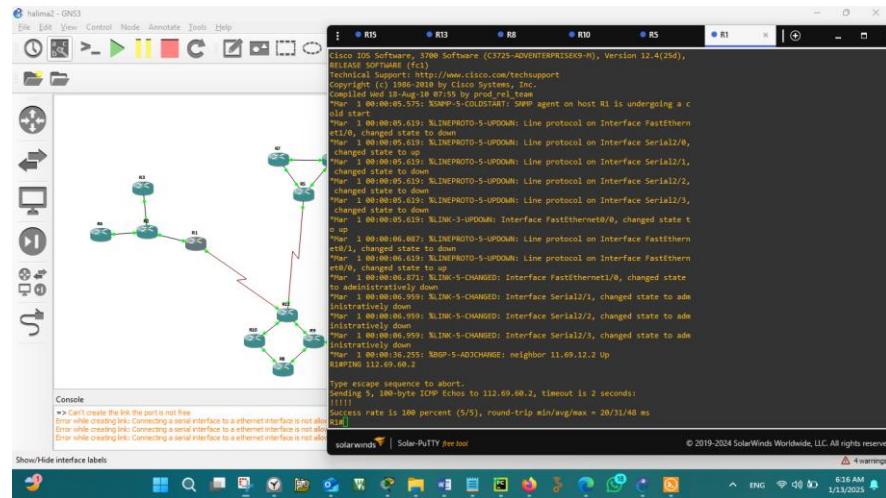


Figure 58: Testing between router 1 and 4.

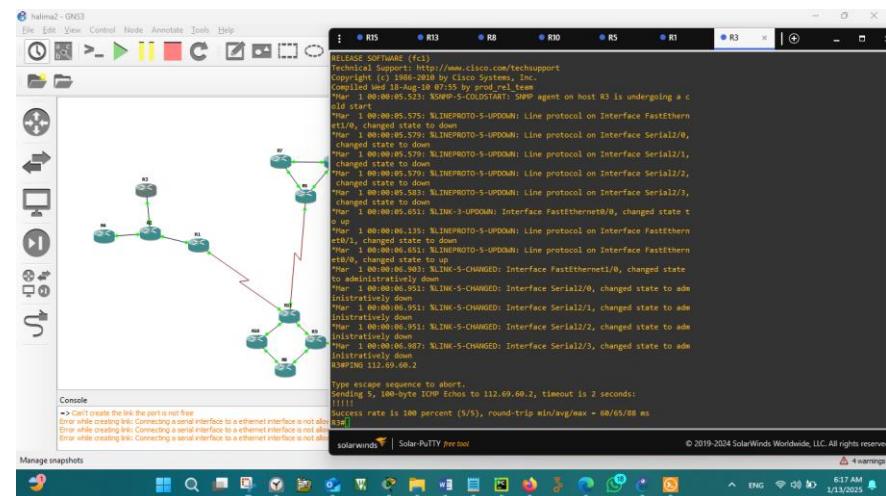


Figure 59: Testing between router 3 and 4.

eBGP

After that, the BGP should define between the AS's. First the eBGP applies at the edge routers to be the used routing protocol between the AS's. and the iBGP should defined between the BGP routers in each AS, and it should be a complete mesh for sure.

As shown in the next figure, the edge routers are R1, R5, R6, R9, R11, R12, and R14.

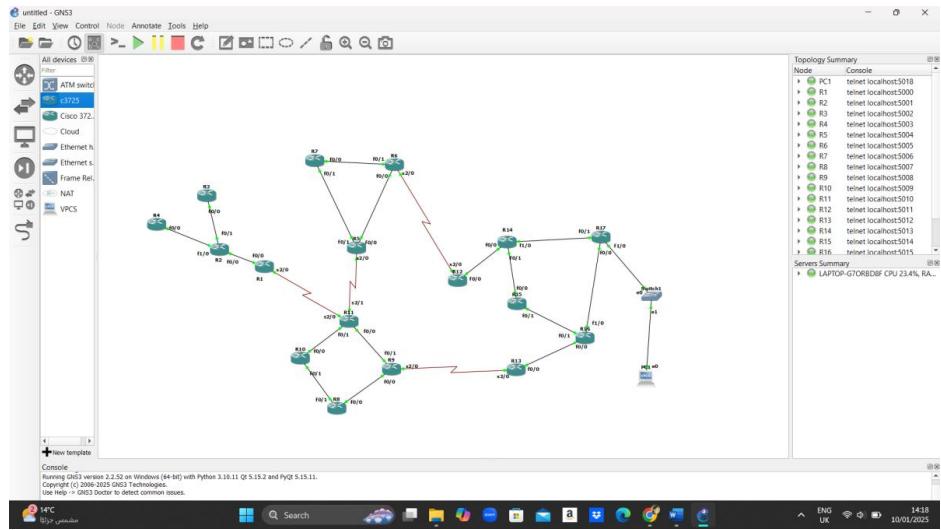


Figure 60: Topology for BGP.

The eBGP will applies to the previous routers using the same steps methodology, the following steps for router 5 for example:

- ⇒ config t
- ⇒ router bgp 200
 - starts the BGP configuration process for AS 200.
- ⇒ neighbor 11.69.12.5 remote as 300
 - configures BGP neighbor, which has IP of 11.69.12.5 in AS 300.
- ⇒ exit
 - exit the BGP configuration mode.
- ⇒ exit
- ⇒ write “same as write memory”

eBGP for router 1

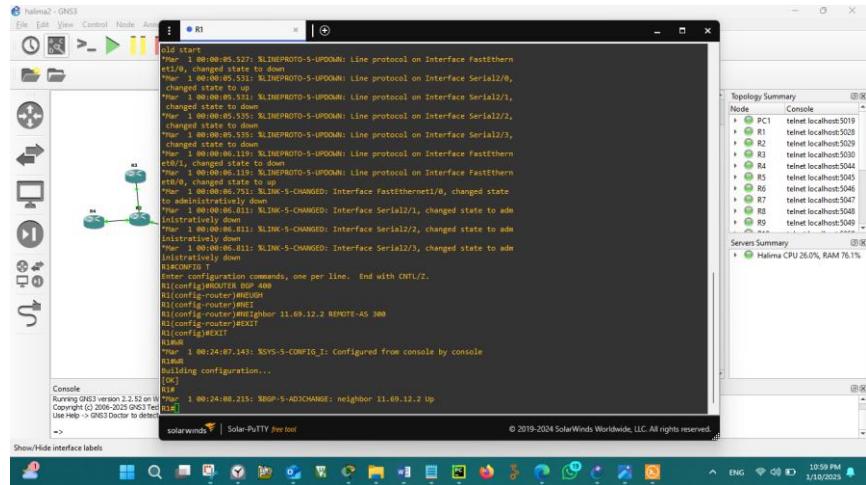


Figure 61: eBGP for router 1.

eBGP for router 5

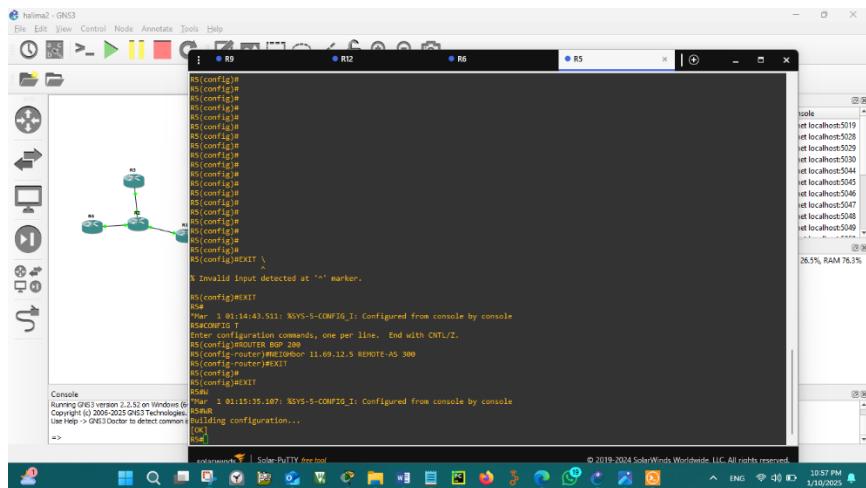


Figure 62: eBGP for router 5.

eBGP for router 6

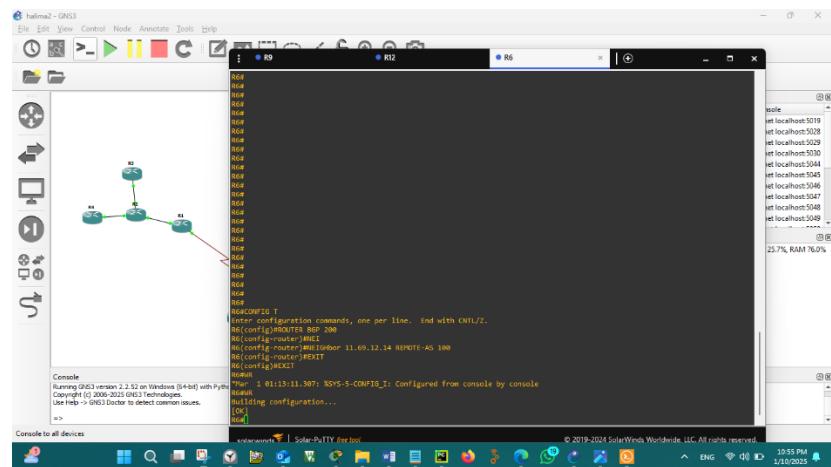


Figure 63: eBGP for router 6.

eBGP for router 9

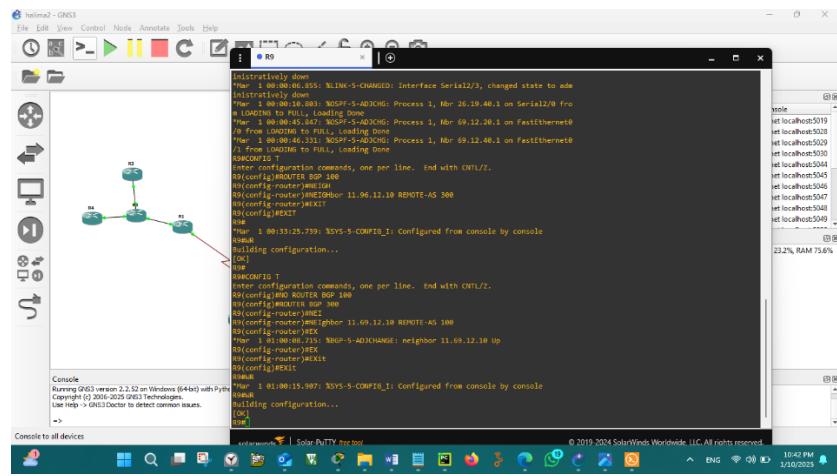


Figure 64: eBGP for router 9.

eBGP for router 11

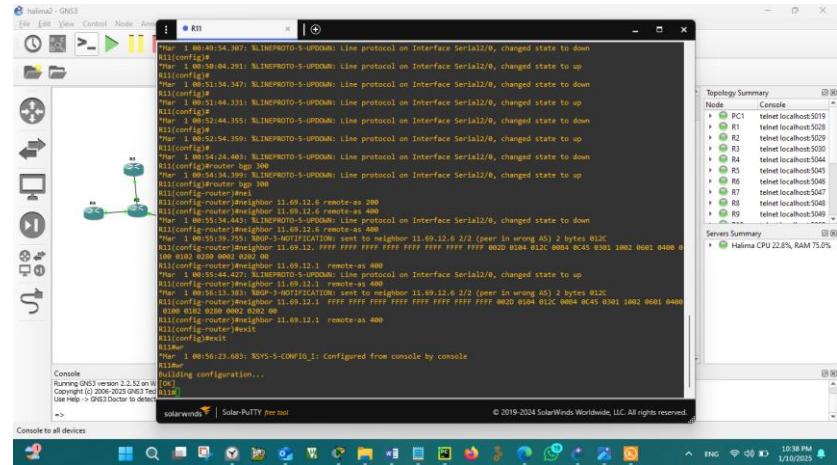


Figure 65: eBGP for router 11.

eBGP for router 12

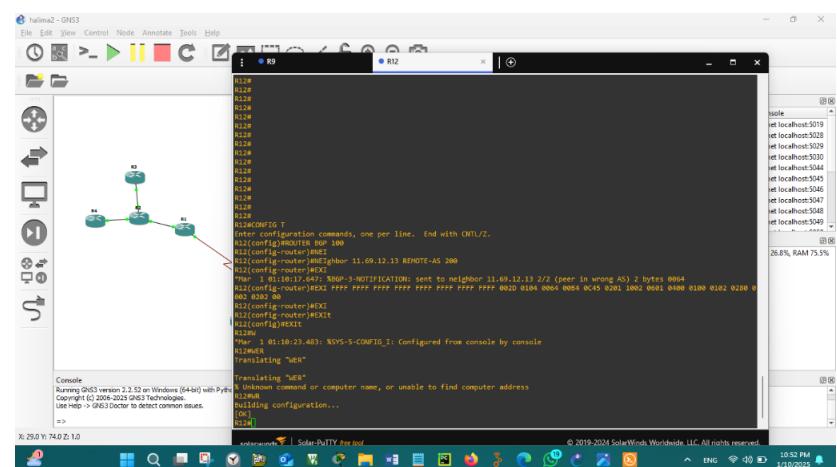


Figure 66: eBGP for router 12.

eBGP for router 13

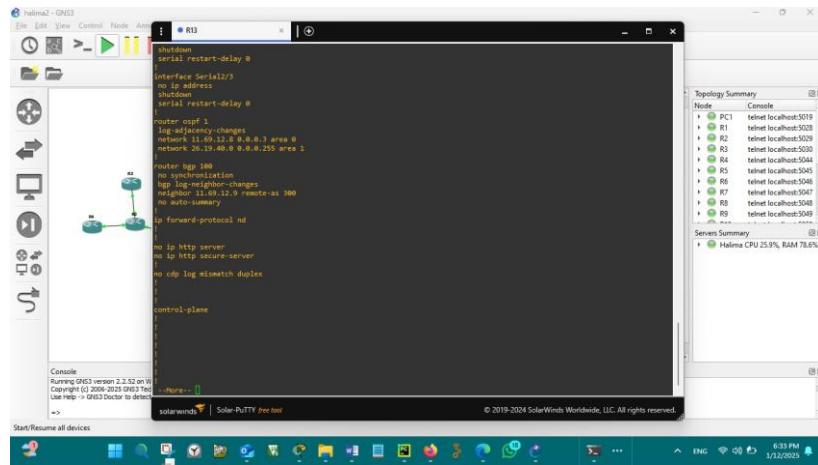


Figure 67: eBGP for router 13.

eBGP redistribution

At each router of the edge routers the BGP should defined over the OSPF and the OSPF should defined over the BGP. For example, the following steps for router 5:

- ⇒ router ospf 1
 - configure the OSPF process on the router.
- ⇒ redistribute bgp 200 subnets
 - define the BGP Over the OSPF.
- ⇒ exit
 - exit OSPF configuration.
- ⇒ Router bgp 200
 - configure the BGP process on the router.
- ⇒ redistribute ospf 1
 - define the OSPF Over the BGP.
- ⇒ exit
 - exit BGP configuration.
- ⇒ exit
 - exit the configuration mode.
- ⇒ write memory “WR”

For AS 400 the BGP should defined over the RIP and the RIP should defined over the BGP. the same steps will use almost:

- ⇒ Router bgp 400
- ⇒ redistribute rip
 - define the RIP Over the BGP.
- ⇒ exit
- ⇒ router rip
 - configure the RIP process on the router.
- ⇒ redistribute bgp 400
 - define the BGP Over the RIP.
- ⇒ exit
- exit RIP configuration.
- ⇒ exit
- ⇒ write memory “WR”

eBGP redistribution router 1

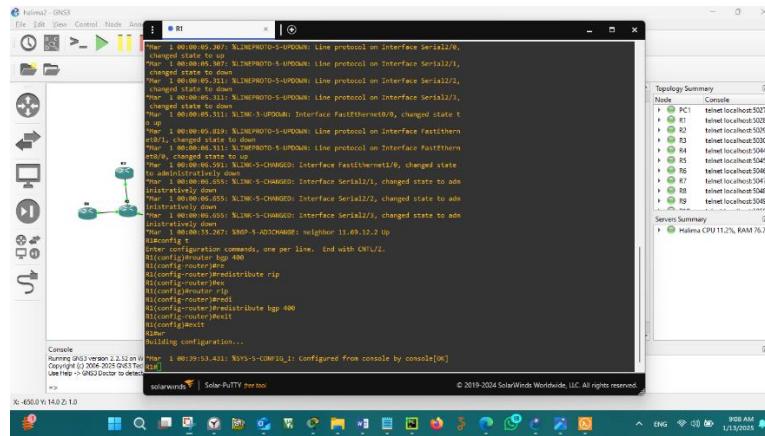


Figure 68: eBGP redistribution router 1.

eBGP redistribution router 5

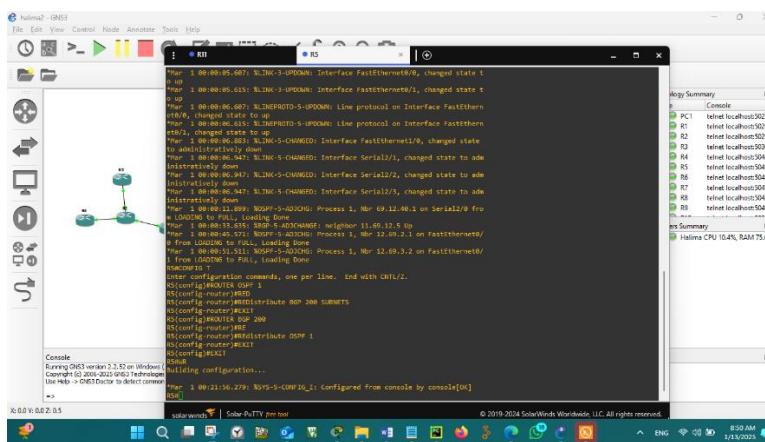


Figure 69: eBGP redistribution router 5.

eBGP redistribution router 6

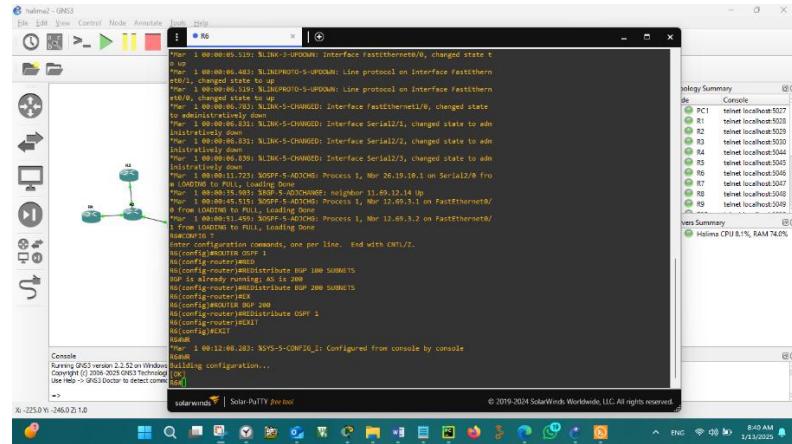


Figure 70: eBGP redistribution router 6.

eBGP redistribution router 9

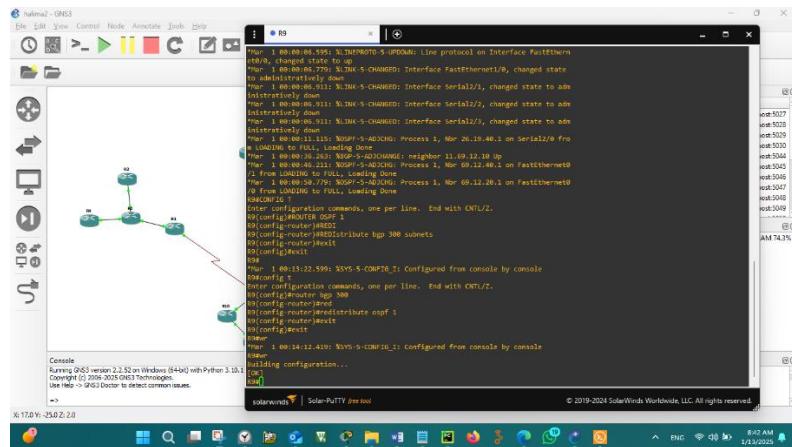


Figure 71: eBGP redistribution router 9.

eBGP redistribution router 11

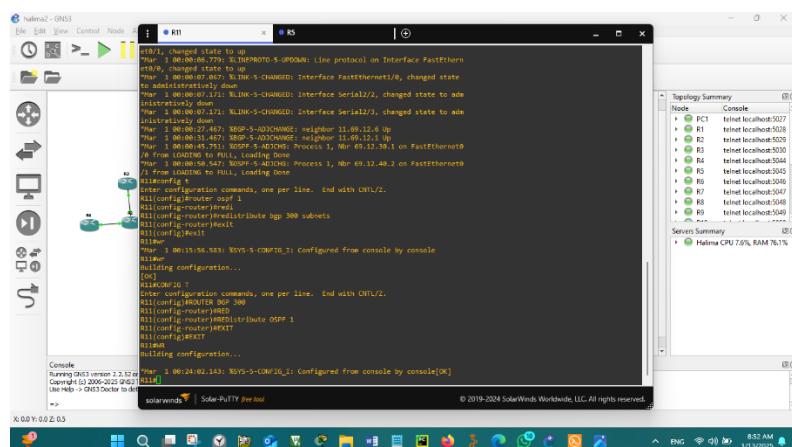


Figure 72: eBGP redistribution router 11.

eBGP redistribution router 12

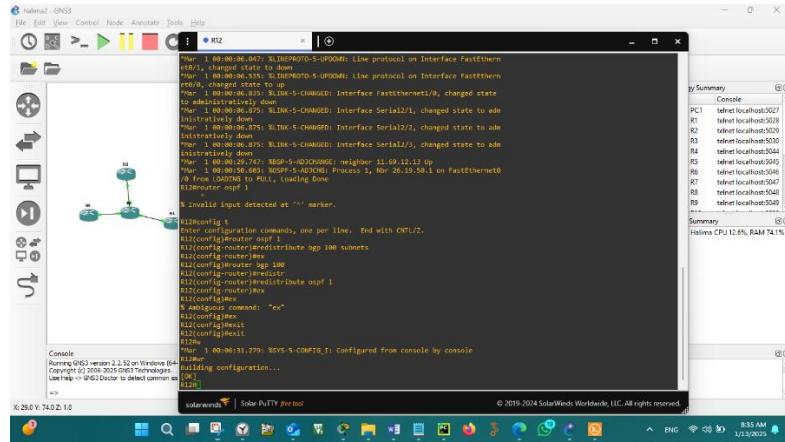


Figure 73: eBGP redistribution router 12.

eBGP redistribution router 13

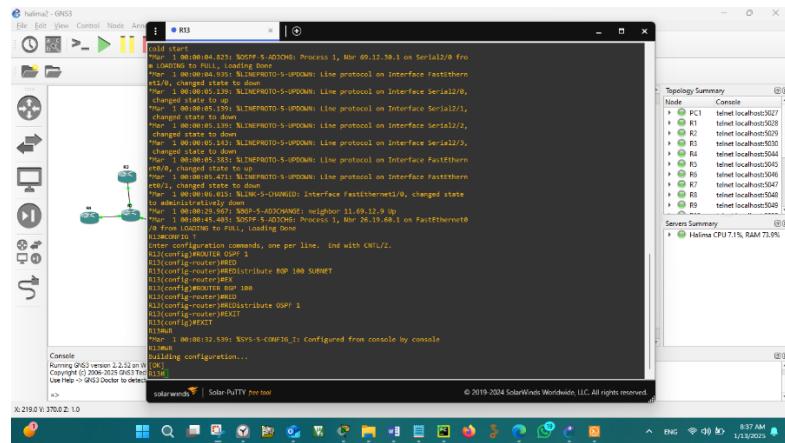


Figure 74: eBGP redistribution router 13.

iBGP

The iBGP should applies between the BGP routers inside the same AS to share the BGP received data. So, as shown in the next figure, the BGP in each AS listed as follow:

AS 100:

Router 12 and Router 13

AS 200:

Router 5 and Router 6

AS 300-

Router 9 and Router 11

AS 400:

Router 1. So, no need to apply the iBGP in this AS.

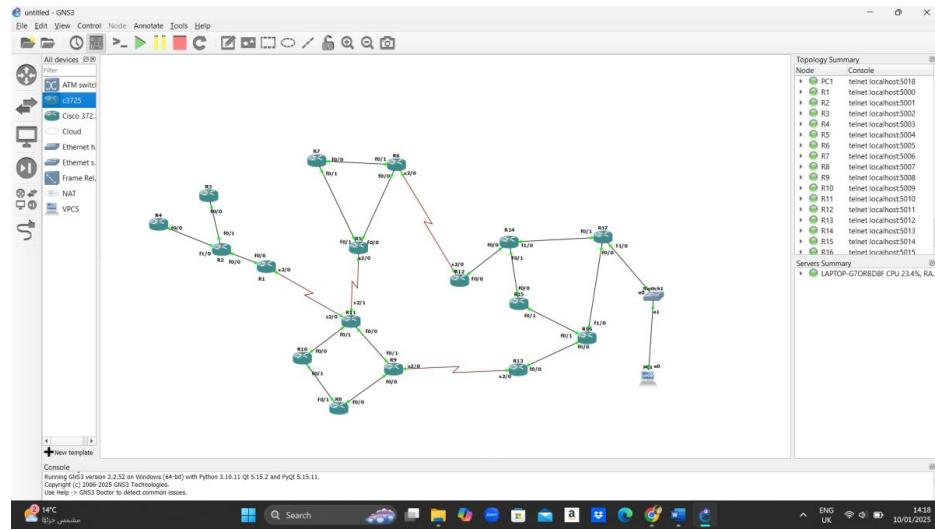


Figure 75: Topology for iBGP.

The iBGP will applies to the previous routers using the same steps methodology, the following steps for router 5 and router 6 for example in AS 200:

⇒ config t
for both routers to enter the configuration mode.

Router 5:

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

Router 6:

⇒ router bgp 200
⇒ neighbor 12.69.1.1 remote-as 200
IP of the second BGP router.
⇒ network 12.69.1.0 mask 255.255.255.0
IP of the connection network.

exit and write memory for sure.

The previous steps works 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.

First, the loopback defined as follow:

```
⇒ Router R12(config) # interface loopback 0
Router R12(config-if) # ip address 5.5.5.5 255.255.255.255
⇒ Router R13(config) # interface loopback 0
Router R13(config-if) # ip address 6.6.6.6 255.255.255.255
```

Then, the iBGP established using the loopback as follows:

```
⇒ Router R12(config) # router bgp 100
Router R12(config-router) # neighbor 6.6.6.6 remote-as 100
Router R12(config-router) # neighbor 6.6.6.6 update-source loopback 0
Router R12(config-router) # network 26.19.10.0 mask 255.255.255.0
                           network advertised
⇒ Router R13(config) # router bgp 100
Router R13(config-router) # neighbor 5.5.5.5 remote-as 100
Router R13(config-router) # neighbor 5.5.5.5 update-source loopback 0
Router R13(config-router) # network 26.19.40.0 mask 255.255.255.0
                           network advertised
```

iBGP for router 5

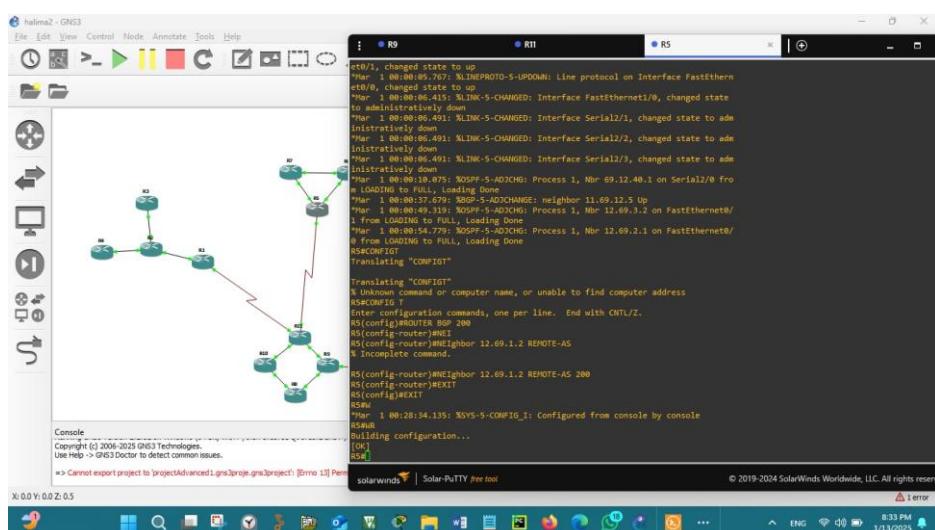


Figure 76: iBGP for router 5.

iBGP for router 6

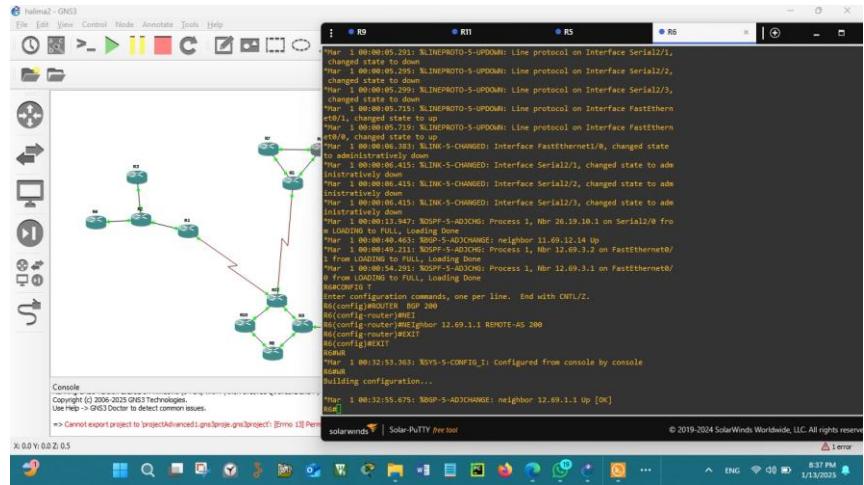


Figure 77: iBGP for router 6.

iBGP for router 9

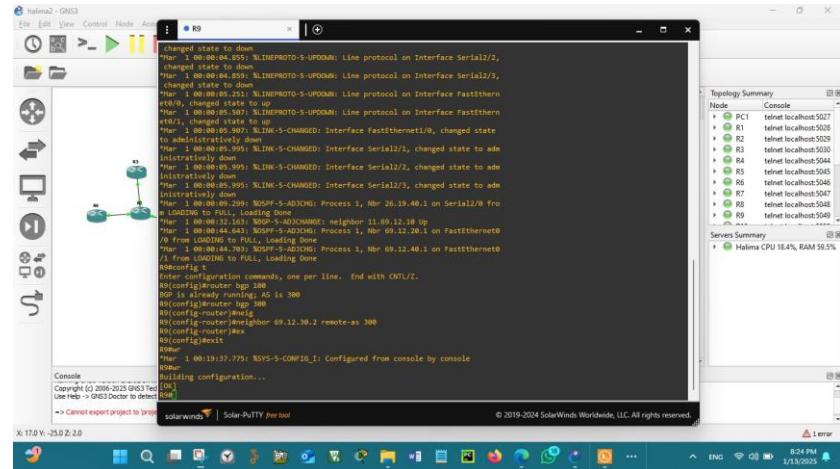


Figure 78: iBGP for router 9.

iBGP for router 11

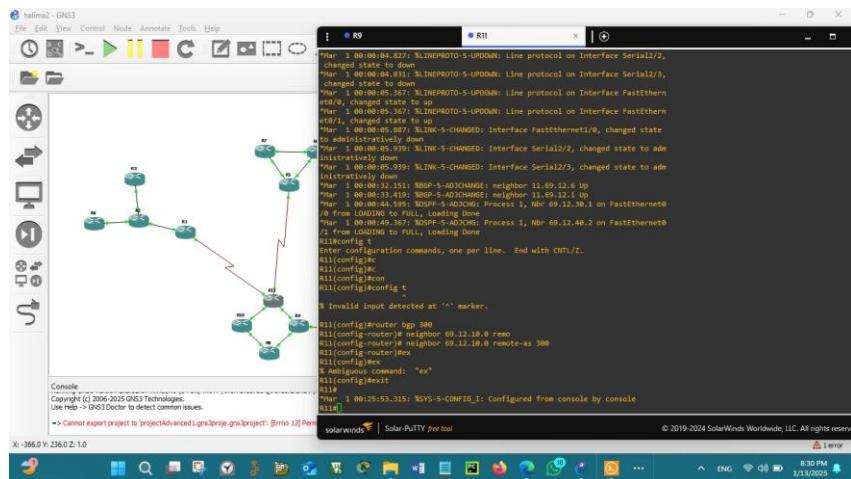
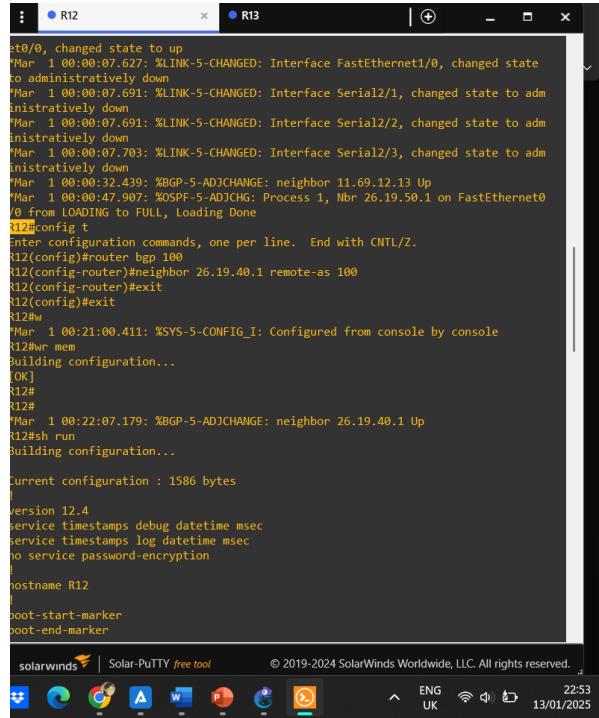


Figure 79: iBGP for router 11.

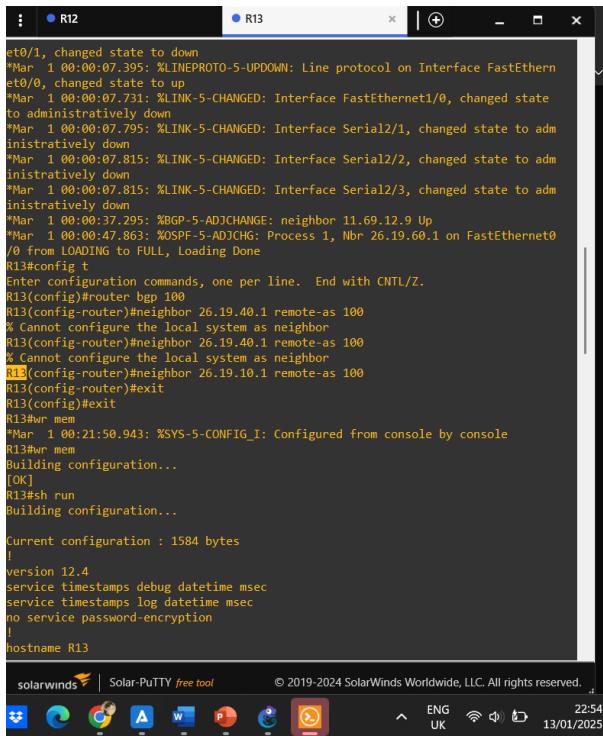
iBGP for router 12



```
et0/0, changed state to up
*Mar 1 00:00:07.627: %LINK-5-CHANGED: Interface FastEthernet1/0, changed state to administratively down
*Mar 1 00:00:07.691: %LINK-5-CHANGED: Interface Serial2/1, changed state to admin inistratively down
*Mar 1 00:00:07.691: %LINK-5-CHANGED: Interface Serial2/2, changed state to adm inistratively down
*Mar 1 00:00:07.703: %LINK-5-CHANGED: Interface Serial2/3, changed state to adm inistratively down
*Mar 1 00:00:32.439: %BGP-5-ADJCHANGE: neighbor 11.69.12.13 Up
*Mar 1 00:00:47.907: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.50.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R12#config t
Enter configuration commands, one per line. End with CNTL/Z.
R12(config)#router bgp 100
R12(config-router)#neighbor 26.19.40.1 remote-as 100
R12(config-router)#exit
R12(config)#exit
R12#
*Mar 1 00:21:00.411: %SYS-5-CONFIG_I: Configured from console by console
R12#wr mem
Building configuration...
[OK]
R12#
*Mar 1 00:22:07.179: %BGP-5-ADJCHANGE: neighbor 26.19.40.1 Up
R12#sh run
Building configuration...
Current configuration : 1586 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R12
!
boot-start-marker
boot-end-marker
solarwinds | Solar-PuTTY free tool   © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.
ENG UK 22:53 13/01/2025
```

Figure 80: iBGP for router 12.

iBGP for router 13



```
et0/1, changed state to down
*Mar 1 00:00:07.395: %LINKPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:07.731: %LINK-5-CHANGED: Interface FastEthernet1/0, changed state to administratively down
*Mar 1 00:00:07.795: %LINK-5-CHANGED: Interface Serial2/1, changed state to admin inistratively down
*Mar 1 00:00:07.815: %LINK-5-CHANGED: Interface Serial2/2, changed state to adm inistratively down
*Mar 1 00:00:07.815: %LINK-5-CHANGED: Interface Serial2/3, changed state to adm inistratively down
*Mar 1 00:00:37.295: %BGP-5-ADJCHANGE: neighbor 11.69.12.9 Up
*Mar 1 00:00:47.863: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.60.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R13#config t
Enter configuration commands, one per line. End with CNTL/Z.
R13(config)#router bgp 100
R13(config-router)#neighbor 26.19.40.1 remote-as 100
% Cannot configure the local system as neighbor
R13(config-router)#neighbor 26.19.40.1 remote-as 100
% Cannot configure the local system as neighbor
R13(config-router)#neighbor 26.19.10.1 remote-as 100
R13(config-router)#exit
R13(config)#exit
R13#wr mem
*Mar 1 00:21:50.943: %SYS-5-CONFIG_I: Configured from console by console
R13#wr mem
Building configuration...
[OK]
R13#sh run
Building configuration...
Current configuration : 1584 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R13
solarwinds | Solar-PuTTY free tool   © 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.
ENG UK 22:54 13/01/2025
```

Figure 81: iBGP for router 13.

Note:

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

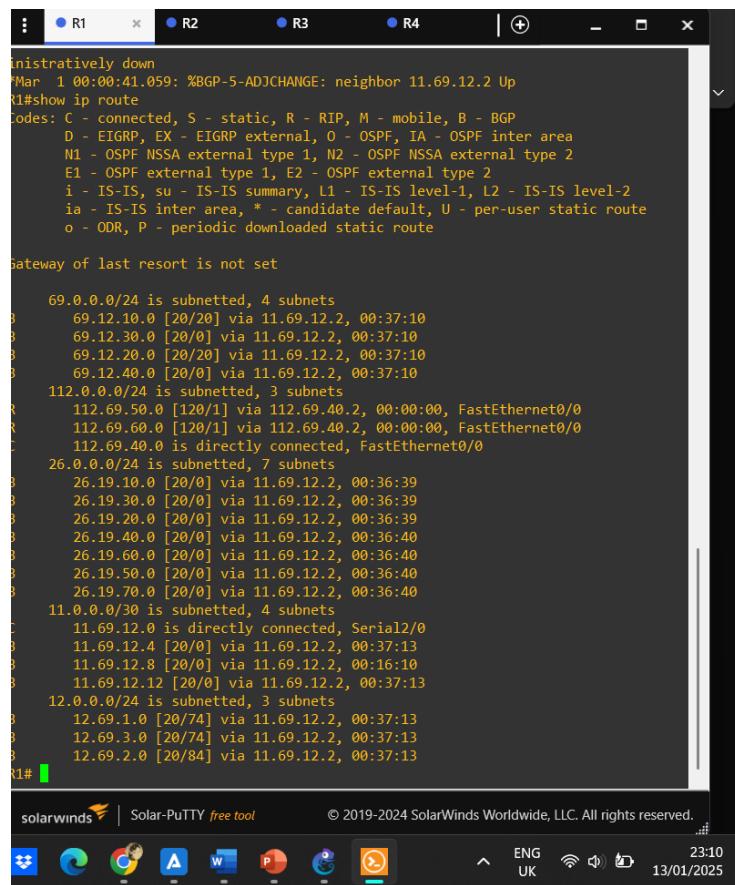
- ⇒ router bgp AS
- ⇒ neighbor X remote-as AS when X equivalent to the neighbour BGP router at the same AS.

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.

Routing tables

The routing tables shown using the following command:

- ⇒ show ip route



The screenshot shows a terminal window titled 'R1' displaying the output of the 'show ip route' command. The output lists various network routes with their subnet masks, next-hop addresses, and interface information. The terminal window is part of the SolarWinds Solar-Putty free tool, which includes a menu bar with 'File', 'Edit', 'View', 'Tools', 'Help', and 'About'. The status bar at the bottom shows the SolarWinds logo, the text 'SolarWinds Solar-Putty free tool', the copyright notice '© 2019-2024 SolarWinds Worldwide, LLC. All rights reserved.', and the system status including language ('ENG'), country ('UK'), battery level, signal strength, and the date/time '13/01/2025 23:10'.

```
Administratively down
*Mar 1 00:00:41.059: %BGP-5-ADJCHANGE: neighbor 11.69.12.2 Up
R1#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

69.0.0.0/24 is subnetted, 4 subnets
  69.12.10.0 [20/20] via 11.69.12.2, 00:37:10
  69.12.30.0 [20/0] via 11.69.12.2, 00:37:10
  69.12.20.0 [20/20] via 11.69.12.2, 00:37:10
  69.12.40.0 [20/0] via 11.69.12.2, 00:37:10

112.0.0.0/24 is subnetted, 3 subnets
  112.69.50.0 [120/1] via 112.69.40.2, 00:00:00, FastEthernet0/0
  112.69.60.0 [120/1] via 112.69.40.2, 00:00:00, FastEthernet0/0
  112.69.40.0 is directly connected, FastEthernet0/0

26.0.0.0/24 is subnetted, 7 subnets
  26.19.10.0 [20/0] via 11.69.12.2, 00:36:39
  26.19.30.0 [20/0] via 11.69.12.2, 00:36:39
  26.19.20.0 [20/0] via 11.69.12.2, 00:36:39
  26.19.40.0 [20/0] via 11.69.12.2, 00:36:40
  26.19.60.0 [20/0] via 11.69.12.2, 00:36:40
  26.19.50.0 [20/0] via 11.69.12.2, 00:36:40
  26.19.70.0 [20/0] via 11.69.12.2, 00:36:40

11.0.0.0/30 is subnetted, 4 subnets
  11.69.12.0 is directly connected, Serial2/0
  11.69.12.4 [20/0] via 11.69.12.2, 00:37:13
  11.69.12.8 [20/0] via 11.69.12.2, 00:16:10
  11.69.12.12 [20/0] via 11.69.12.2, 00:37:13

12.0.0.0/24 is subnetted, 3 subnets
  12.69.1.0 [20/74] via 11.69.12.2, 00:37:13
  12.69.3.0 [20/74] via 11.69.12.2, 00:37:13
  12.69.2.0 [20/84] via 11.69.12.2, 00:37:13

R1#
```

Figure 82: Routing table for router 1.

```

Compiled Wed 18-Aug-10 07:55 by prod_rel_team
*Mar 1 00:00:07.211: %SNMP-5-COLDSTART: SNMP agent on host R2 is undergoing a cold start
*Mar 1 00:00:07.367: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:07.371: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:08.367: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:08.371: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:08.571: %LINK-5-CHANGED: Interface Serial2/0, changed state to administratively down
*Mar 1 00:00:08.595: %LINK-5-CHANGED: Interface Serial2/1, changed state to administratively down
*Mar 1 00:00:08.611: %LINK-5-CHANGED: Interface Serial2/2, changed state to administratively down
*Mar 1 00:00:08.611: %LINK-5-CHANGED: Interface Serial2/3, changed state to administratively down
R2#show ip route
^
% Invalid input detected at '^' marker.

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, FastEthernet0/0
      C       112.69.40.0 is directly connected, FastEthernet0/0
R      11.0.0.0/8 [120/1] via 112.69.40.1, 00:00:12, FastEthernet0/0
R2#

```

The screenshot shows a SolarWinds Putty window titled 'R2'. It displays the output of the 'show ip route' command. The routing table includes entries for 112.0.0.0/24 with three direct connections to FastEthernet interfaces, and a default route to 11.0.0.0/8 via 112.69.40.1.

Figure 83: Routing table for router 2.

```

*Mar 1 00:00:06.807: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/1, changed state to down
*Mar 1 00:00:06.807: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/2, changed state to down
*Mar 1 00:00:06.807: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/3, changed state to down
*Mar 1 00:00:06.811: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:07.139: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
*Mar 1 00:00:07.811: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:07.955: %LINK-5-CHANGED: Interface FastEthernet1/0, changed state to administratively down
*Mar 1 00:00:07.999: %LINK-5-CHANGED: Interface Serial2/0, changed state to administratively down
*Mar 1 00:00:08.031: %LINK-5-CHANGED: Interface Serial2/1, changed state to administratively down
*Mar 1 00:00:08.063: %LINK-5-CHANGED: Interface Serial2/2, changed state to administratively down
*Mar 1 00:00:08.063: %LINK-5-CHANGED: Interface Serial2/3, changed state to administratively down
R3#
R3#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, FastEthernet0/0
      R      112.69.60.0 [120/1] via 112.69.50.2, 00:00:10, FastEthernet0/0
      R      112.69.40.0 [120/1] via 112.69.50.2, 00:00:10, FastEthernet0/0
      R      11.0.0.0/8 [120/2] via 112.69.50.2, 00:00:10, FastEthernet0/0
R3#

```

The screenshot shows a SolarWinds Putty window titled 'R3'. It displays the output of the 'show ip route' command. The routing table includes entries for 112.0.0.0/24 with three routes via 112.69.50.2 (via FastEthernet0/0) and 112.69.40.0 (via FastEthernet0/0), and a default route to 11.0.0.0/8 via 112.69.50.2.

Figure 84: Routing table for router 3.

```

Cisco IOS Software, 3700 Software (C3725-ADVENTERPRISEK9-M), Version 12.4(25d),
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
copyright (c) 1986-2010 by Cisco Systems, Inc.
Compiled Wed 18-Aug-10 07:55 by prod_rel_team
*Mar 1 00:00:06.531: %SNMP-5-COLDSTART: SNMP agent on host R4 is undergoing a cold start
*Mar 1 00:00:06.595: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:06.943: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
*Mar 1 00:00:07.595: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
*Mar 1 00:00:07.807: %LINK-5-CHANGED: Interface FastEthernet1/0, changed state to administratively down
*Mar 1 00:00:07.843: %LINK-5-CHANGED: Interface Serial2/0, changed state to administratively down
*Mar 1 00:00:07.871: %LINK-5-CHANGED: Interface Serial2/1, changed state to administratively down
*Mar 1 00:00:07.871: %LINK-5-CHANGED: Interface Serial2/2, changed state to administratively down
*Mar 1 00:00:07.871: %LINK-5-CHANGED: Interface Serial2/3, changed state to administratively down
R4#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
R        112.69.50.0 [120/1] via 112.69.60.2, 00:00:06, FastEthernet0/0
C        112.69.60.0 is directly connected, FastEthernet0/0
R        112.69.40.0 [120/1] via 112.69.60.2, 00:00:06, FastEthernet0/0
R        11.0.0.8 [120/2] via 112.69.60.2, 00:00:06, FastEthernet0/0
R4#

```

Figure 85: Routing table for router 4.

```

Success rate is 0 percent (0/5)
R5#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

      69.0.0.0/24 is subnetted, 4 subnets
O  IA   69.12.10.0 [110/84] via 11.69.12.5, 00:41:50, Serial2/0
O  IA   69.12.30.0 [110/74] via 11.69.12.5, 00:41:54, Serial2/0
O  IA   69.12.20.0 [110/84] via 11.69.12.5, 00:41:50, Serial2/0
O  IA   69.12.40.0 [110/74] via 11.69.12.5, 00:41:54, Serial2/0
      112.0.0.0/24 is subnetted, 3 subnets
B    112.69.50.0 [20/0] via 11.69.12.5, 00:41:04
B    112.69.60.0 [20/0] via 11.69.12.5, 00:41:04
B    112.69.40.0 [20/0] via 11.69.12.5, 00:41:04
      26.0.0.0/24 is subnetted, 7 subnets
O  E2   26.19.10.0 [110/1] via 11.69.12.5, 00:41:07, Serial2/0
O  E2   26.19.30.0 [110/1] via 11.69.12.5, 00:41:07, Serial2/0
O  E2   26.19.20.0 [110/1] via 11.69.12.5, 00:41:07, Serial2/0
O  E2   26.19.40.0 [110/1] via 11.69.12.5, 00:41:08, Serial2/0
O  E2   26.19.60.0 [110/1] via 11.69.12.5, 00:41:08, Serial2/0
O  E2   26.19.50.0 [110/1] via 11.69.12.5, 00:41:08, Serial2/0
O  E2   26.19.70.0 [110/1] via 11.69.12.5, 00:41:08, Serial2/0
      11.0.0.0/30 is subnetted, 4 subnets
O    11.69.12.0 [110/128] via 11.69.12.5, 00:42:21, Serial2/0
C    11.69.12.4 is directly connected, Serial2/0
O  E2   11.69.12.8 [110/1] via 12.69.1.2, 00:20:37, FastEthernet0/0
O  E2   11.69.12.12 [110/1] via 11.69.12.5, 00:20:37, Serial2/0
      12.0.0.0/24 is subnetted, 3 subnets
C    12.69.1.0 is directly connected, FastEthernet0/0
C    12.69.3.0 is directly connected, FastEthernet0/1
O    12.69.2.0 [110/20] via 12.69.3.2, 00:41:58, FastEthernet0/1
                           [110/20] via 12.69.1.2, 00:41:58, FastEthernet0/0
R5#

```

Figure 86: Routing table for router 5.

```

to administratively down
*Mar 1 00:00:09.235: %LINK-5-CHANGED: Interface Serial2/1, changed state to adm
inistratively down
*Mar 1 00:00:09.235: %LINK-5-CHANGED: Interface Serial2/2, changed state to adm
inistratively down
*Mar 1 00:00:09.235: %LINK-5-CHANGED: Interface Serial2/3, changed state to adm
inistratively down
*Mar 1 00:00:13.387: %OSPF-5-ADJCHG: Process 1, Nbr 12.69.3.1 on FastEthernet0/
0 from LOADING to FULL, Loading Done
*Mar 1 00:00:13.727: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.10.1 on Serial2/0 fro
m LOADING to FULL, Loading Done
*Mar 1 00:00:20.307: %BGP-5-ADJCHANGE: neighbor 12.69.1.1 Up
*Mar 1 00:00:39.399: %BGP-5-ADJCHANGE: neighbor 11.69.12.14 Up
*Mar 1 00:00:48.763: %OSPF-5-ADJCHG: Process 1, Nbr 12.69.3.2 on FastEthernet0/
1 from LOADING to FULL, Loading Done
R6#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

      69.0.0.0/24 is subnetted, 4 subnets
O   69.12.10.0 [200/84] via 11.69.12.5, 00:20:56
O   69.12.30.0 [200/74] via 11.69.12.5, 00:20:56
O   69.12.20.0 [200/84] via 11.69.12.5, 00:20:56
O   69.12.40.0 [200/74] via 11.69.12.5, 00:20:56
      112.0.0.0/24 is subnetted, 3 subnets
O E2  112.69.50.0 [110/1] via 12.69.1.1, 00:41:05, FastEthernet0/0
O E2  112.69.60.0 [110/1] via 12.69.1.1, 00:41:05, FastEthernet0/0
O E2  112.69.40.0 [110/1] via 12.69.1.1, 00:41:05, FastEthernet0/0
      26.0.0.0/24 is subnetted, 7 subnets
O IA  26.19.10.0 [110/74] via 11.69.12.14, 00:42:24, Serial2/0
O IA  26.19.30.0 [110/94] via 11.69.12.14, 00:42:08, Serial2/0
O IA  26.19.20.0 [110/84] via 11.69.12.14, 00:42:08, Serial2/0
--More-- [q]
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ENG UK 23:14 13/01/2025

```

Figure 87: Routing table for router 6.

```

O from LOADING to FULL, Loading Done
R7#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

      69.0.0.0/24 is subnetted, 4 subnets
O IA  69.12.10.0 [110/94] via 12.69.3.1, 00:42:24, FastEthernet0/1
O IA  69.12.30.0 [110/84] via 12.69.3.1, 00:42:29, FastEthernet0/1
O IA  69.12.20.0 [110/94] via 12.69.3.1, 00:42:24, FastEthernet0/1
O IA  69.12.40.0 [110/84] via 12.69.3.1, 00:42:29, FastEthernet0/1
      112.0.0.0/24 is subnetted, 3 subnets
O E2  112.69.50.0 [110/1] via 12.69.3.1, 00:41:13, FastEthernet0/1
O E2  112.69.60.0 [110/1] via 12.69.3.1, 00:41:13, FastEthernet0/1
O E2  112.69.40.0 [110/1] via 12.69.3.1, 00:41:15, FastEthernet0/1
      26.0.0.0/24 is subnetted, 7 subnets
O IA  26.19.10.0 [110/84] via 12.69.2.1, 00:42:31, FastEthernet0/0
O IA  26.19.30.0 [110/104] via 12.69.2.1, 00:42:15, FastEthernet0/0
O IA  26.19.20.0 [110/94] via 12.69.2.1, 00:42:15, FastEthernet0/0
O IA  26.19.40.0 [110/105] via 12.69.2.1, 00:42:45, FastEthernet0/0
O IA  26.19.60.0 [110/95] via 12.69.2.1, 00:42:45, FastEthernet0/0
O IA  26.19.50.0 [110/85] via 12.69.2.1, 00:42:55, FastEthernet0/0
O IA  26.19.70.0 [110/86] via 12.69.2.1, 00:42:45, FastEthernet0/0
      11.0.0.0/30 is subnetted, 4 subnets
O IA  11.69.12.0 [110/138] via 12.69.3.1, 00:43:01, FastEthernet0/1
O IA  11.69.12.4 [110/74] via 12.69.3.1, 00:43:01, FastEthernet0/1
O E2  11.69.12.8 [110/1] via 12.69.2.1, 00:21:49, FastEthernet0/0
O IA  11.69.12.12 [110/74] via 12.69.2.1, 00:43:01, FastEthernet0/0
      12.0.0.0/24 is subnetted, 3 subnets
O   12.69.1.0 [110/20] via 12.69.3.1, 00:43:01, FastEthernet0/1
                  [110/20] via 12.69.2.1, 00:43:01, FastEthernet0/0
C   12.69.3.0 is directly connected, FastEthernet0/1
C   12.69.2.0 is directly connected, FastEthernet0/0
R7#
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ENG UK 23:14 13/01/2025

```

Figure 88: Routing table for router 7.

```

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

   69.0.0.0/24 is subnetted, 4 subnets
      69.12.10.0 is directly connected, FastEthernet0/0
      69.12.30.0 [110/20] via 69.12.10.2, 00:45:16, FastEthernet0/0
      69.12.20.0 is directly connected, FastEthernet0/1
      69.12.40.0 [110/20] via 69.12.20.2, 00:45:16, FastEthernet0/1
   112.0.0.0/24 is subnetted, 3 subnets
O E2   112.69.50.0 [110/1] via 69.12.20.2, 00:44:09, FastEthernet0/1
      [110/1] via 69.12.10.2, 00:44:09, FastEthernet0/0
E2    112.69.60.0 [110/1] via 69.12.20.2, 00:44:11, FastEthernet0/1
      [110/1] via 69.12.10.2, 00:44:11, FastEthernet0/0
E2    112.69.40.0 [110/1] via 69.12.20.2, 00:44:11, FastEthernet0/1
      [110/1] via 69.12.10.2, 00:44:11, FastEthernet0/0
   26.0.0.0/24 is subnetted, 7 subnets
O IA   26.19.10.0 [110/105] via 69.12.10.2, 00:45:25, FastEthernet0/0
IA    26.19.30.0 [110/94] via 69.12.10.2, 00:45:31, FastEthernet0/0
IA    26.19.20.0 [110/104] via 69.12.10.2, 00:45:26, FastEthernet0/0
IA    26.19.40.0 [110/84] via 69.12.10.2, 00:45:31, FastEthernet0/0
IA    26.19.60.0 [110/85] via 69.12.10.2, 00:45:31, FastEthernet0/0
IA    26.19.50.0 [110/95] via 69.12.10.2, 00:45:26, FastEthernet0/0
IA    26.19.70.0 [110/86] via 69.12.10.2, 00:45:26, FastEthernet0/0
   11.0.0.0/30 is subnetted, 4 subnets
O IA   11.69.12.0 [110/84] via 69.12.20.2, 00:45:31, FastEthernet0/1
      [110/84] via 69.12.10.2, 00:45:31, FastEthernet0/0
O IA   11.69.12.4 [110/84] via 69.12.20.2, 00:45:31, FastEthernet0/1
      [110/84] via 69.12.10.2, 00:45:31, FastEthernet0/0
O IA   11.69.12.8 [110/74] via 69.12.10.2, 00:45:31, FastEthernet0/0
E2   11.69.12.12 [110/1] via 69.12.10.2, 00:24:29, FastEthernet0/0
   12.0.0.0/24 is subnetted, 3 subnets
O IA   12.69.1.0 [110/94] via 69.12.20.2, 00:45:31, FastEthernet0/1
      [110/94] via 69.12.10.2, 00:45:33, FastEthernet0/0
O IA   12.69.3.0 [110/94] via 69.12.20.2, 00:45:33, FastEthernet0/1
      [110/94] via 69.12.10.2, 00:45:33, FastEthernet0/0
O IA   12.69.2.0 [110/104] via 69.12.20.2, 00:45:33, FastEthernet0/1
      [110/104] via 69.12.10.2, 00:45:33, FastEthernet0/0
R8#

```

Figure 89: Routing table for router 8.

```

*Mar 1 00:00:53.163: %OSPF-5-ADJCHG: Process 1, Nbr 69.12.40.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
R9#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

   69.0.0.0/24 is subnetted, 4 subnets
C     69.12.10.0 is directly connected, FastEthernet0/0
C     69.12.30.0 is directly connected, FastEthernet0/1
O     69.12.20.0 [110/20] via 69.12.10.1, 00:45:28, FastEthernet0/0
O     69.12.40.0 [110/20] via 69.12.30.2, 00:45:28, FastEthernet0/1
   112.0.0.0/24 is subnetted, 3 subnets
O E2   112.69.50.0 [110/1] via 69.12.30.2, 00:44:21, FastEthernet0/1
O E2   112.69.60.0 [110/1] via 69.12.30.2, 00:44:21, FastEthernet0/1
O E2   112.69.40.0 [110/1] via 69.12.30.2, 00:44:23, FastEthernet0/1
   26.0.0.0/24 is subnetted, 7 subnets
O IA   26.19.10.0 [110/95] via 11.69.12.10, 00:45:25, Serial2/0
O IA   26.19.30.0 [110/84] via 11.69.12.10, 00:45:30, Serial2/0
O IA   26.19.20.0 [110/94] via 11.69.12.10, 00:45:25, Serial2/0
O IA   26.19.40.0 [110/74] via 11.69.12.10, 00:45:36, Serial2/0
O IA   26.19.60.0 [110/75] via 11.69.12.10, 00:45:36, Serial2/0
O IA   26.19.50.0 [110/85] via 11.69.12.10, 00:45:31, Serial2/0
O IA   26.19.70.0 [110/76] via 11.69.12.10, 00:45:31, Serial2/0
   11.0.0.0/30 is subnetted, 4 subnets
B     11.69.12.0 [20/0] via 11.69.12.10, 00:23:55
B     11.69.12.4 [20/0] via 11.69.12.10, 00:23:55
C     11.69.12.8 is directly connected, Serial2/0
B     11.69.12.12 [20/0] via 11.69.12.10, 00:24:25
   12.0.0.0/24 is subnetted, 3 subnets
B     12.69.1.0 [20/0] via 11.69.12.10, 00:24:25
B     12.69.3.0 [20/0] via 11.69.12.10, 00:24:25
B     12.69.2.0 [20/0] via 11.69.12.10, 00:24:25
R9#

```

Figure 90: Routing table for router 9.

```

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

99.0.0.0/24 is subnetted, 4 subnets
   69.12.10.0 [110/20] via 69.12.20.1, 00:45:59, FastEthernet0/1
   69.12.30.0 [110/20] via 69.12.40.1, 00:45:59, FastEthernet0/0
   69.12.20.0 is directly connected, FastEthernet0/1
   69.12.40.0 is directly connected, FastEthernet0/0

112.0.0.0/24 is subnetted, 3 subnets
   E2 112.69.50.0 [110/1] via 69.12.40.1, 00:44:53, FastEthernet0/0
   E2 112.69.60.0 [110/1] via 69.12.40.1, 00:44:53, FastEthernet0/0
   E2 112.69.40.0 [110/1] via 69.12.40.1, 00:44:56, FastEthernet0/0

26.0.0.0/24 is subnetted, 7 subnets
   IA 26.19.10.0 [110/115] via 69.12.40.1, 00:45:57, FastEthernet0/0
      [110/115] via 69.12.20.1, 00:45:57, FastEthernet0/1
   IA 26.19.30.0 [110/104] via 69.12.40.1, 00:46:01, FastEthernet0/0
      [110/104] via 69.12.20.1, 00:46:01, FastEthernet0/1
   IA 26.19.20.0 [110/114] via 69.12.40.1, 00:46:02, FastEthernet0/0
      [110/114] via 69.12.20.1, 00:46:02, FastEthernet0/1
   IA 26.19.40.0 [110/94] via 69.12.40.1, 00:46:06, FastEthernet0/0
      [110/94] via 69.12.20.1, 00:46:06, FastEthernet0/1
   IA 26.19.60.0 [110/95] via 69.12.40.1, 00:46:06, FastEthernet0/0
      [110/95] via 69.12.20.1, 00:46:06, FastEthernet0/1
   IA 26.19.50.0 [110/105] via 69.12.40.1, 00:46:02, FastEthernet0/0
      [110/105] via 69.12.20.1, 00:46:02, FastEthernet0/1
   IA 26.19.70.0 [110/96] via 69.12.40.1, 00:46:02, FastEthernet0/0
      [110/96] via 69.12.20.1, 00:46:02, FastEthernet0/1

11.0.0.0/30 is subnetted, 4 subnets
   IA 11.69.12.0 [110/74] via 69.12.40.1, 00:46:06, FastEthernet0/0
   IA 11.69.12.4 [110/74] via 69.12.40.1, 00:46:06, FastEthernet0/0
   IA 11.69.12.8 [110/84] via 69.12.40.1, 00:46:08, FastEthernet0/0
      [110/84] via 69.12.20.1, 00:46:08, FastEthernet0/1
   E2 11.69.12.12 [110/1] via 69.12.40.1, 00:25:06, FastEthernet0/0

12.0.0.0/24 is subnetted, 3 subnets
   IA 12.69.1.0 [110/84] via 69.12.40.1, 00:46:08, FastEthernet0/0
   IA 12.69.3.0 [110/84] via 69.12.40.1, 00:46:08, FastEthernet0/0
   IA 12.69.2.0 [110/94] via 69.12.40.1, 00:46:08, FastEthernet0/0
10#

```

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Figure 91: Routing table for router 10.

```

*Mar 1 00:00:47.151: %OSPF-5-ADJCHG: Process 1, Nbr 69.12.40.2 on FastEthernet0/1 from LOADING to FULL, Loading Done
111#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

99.0.0.0/24 is subnetted, 4 subnets
   69.12.10.0 [110/20] via 69.12.30.1, 00:45:59, FastEthernet0/0
   69.12.30.0 is directly connected, FastEthernet0/0
   69.12.20.0 [110/20] via 69.12.40.2, 00:45:59, FastEthernet0/1
   69.12.40.0 is directly connected, FastEthernet0/1

112.0.0.0/24 is subnetted, 3 subnets
   112.69.50.0 [20/1] via 11.69.12.1, 00:45:43
   112.69.60.0 [20/1] via 11.69.12.1, 00:45:43
   112.69.40.0 [20/0] via 11.69.12.1, 00:45:43

26.0.0.0/24 is subnetted, 7 subnets
   26.19.10.0 [20/0] via 11.69.12.6, 00:45:16
   26.19.30.0 [20/0] via 11.69.12.6, 00:45:16
   26.19.20.0 [20/0] via 11.69.12.6, 00:45:16
   26.19.40.0 [20/0] via 11.69.12.6, 00:45:23
   26.19.60.0 [20/0] via 11.69.12.6, 00:45:23
   26.19.50.0 [20/0] via 11.69.12.6, 00:45:23
   26.19.70.0 [20/0] via 11.69.12.6, 00:45:23

11.0.0.0/30 is subnetted, 4 subnets
   11.69.12.0 is directly connected, Serial2/0
   11.69.12.4 is directly connected, Serial2/1
   11.69.12.8 [20/0] via 11.69.12.6, 00:24:52
   11.69.12.12 [20/0] via 11.69.12.6, 00:45:53

12.0.0.0/24 is subnetted, 3 subnets
   IA 12.69.1.0 [110/74] via 11.69.12.6, 00:46:08, Serial2/1
   IA 12.69.3.0 [110/74] via 11.69.12.6, 00:46:08, Serial2/1
   IA 12.69.2.0 [110/84] via 11.69.12.6, 00:46:08, Serial2/1
111#

```

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Figure 92: Routing table for router 11.

```
% Invalid input detected at '^' marker.

R12#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

       69.0.0.0/24 is subnetted, 4 subnets
B        69.12.10.0 [200/74] via 11.69.12.9, 00:28:40
B        69.12.30.0 [200/74] via 11.69.12.9, 00:28:40
B        69.12.20.0 [200/84] via 11.69.12.9, 00:28:40
B        69.12.40.0 [200/84] via 11.69.12.9, 00:28:40
          112.0.0.0/24 is subnetted, 3 subnets
B          112.69.50.0 [20/0] via 11.69.12.13, 00:48:49
B          112.69.60.0 [20/0] via 11.69.12.13, 00:48:49
B          112.69.40.0 [20/0] via 11.69.12.13, 00:48:49
          26.0.0.0/24 is subnetted, 7 subnets
C          26.19.10.0 is directly connected, FastEthernet0/0
D          26.19.30.0 [110/30] via 26.19.10.2, 00:49:51, FastEthernet0/0
D          26.19.20.0 [110/20] via 26.19.10.2, 00:49:51, FastEthernet0/0
D          26.19.40.0 [110/31] via 26.19.10.2, 00:49:55, FastEthernet0/0
D          26.19.50.0 [110/21] via 26.19.10.2, 00:49:55, FastEthernet0/0
D          26.19.50.0 [110/11] via 26.19.10.2, 00:49:55, FastEthernet0/0
D          26.19.70.0 [110/12] via 26.19.10.2, 00:49:55, FastEthernet0/0
          11.0.0.0/30 is subnetted, 4 subnets
B          11.69.12.0 [20/0] via 11.69.12.13, 00:49:25
B          11.69.12.4 [20/0] via 11.69.12.13, 00:49:25
D E2          11.69.12.8 [110/1] via 11.69.12.13, 00:28:50, Serial2/0
C          11.69.12.12 is directly connected, Serial2/0
          12.0.0.0/24 is subnetted, 3 subnets
O IA          12.69.1.0 [110/74] via 11.69.12.13, 00:49:55, Serial2/0
O IA          12.69.3.0 [110/84] via 11.69.12.13, 00:49:55, Serial2/0
O IA          12.69.2.0 [110/74] via 11.69.12.13, 00:49:55, Serial2/0
R12#
```

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Figure 93: Routing table for router 12.

```
R13#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

       69.0.0.0/24 is subnetted, 4 subnets
O IA        69.12.10.0 [110/74] via 11.69.12.9, 00:14:45, Serial2/0
O E2        12.69.3.0 [110/1] via 11.69.12.9, 00:14:45, Serial2/0
R13#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

       69.0.0.0/24 is subnetted, 4 subnets
O IA        69.12.10.0 [110/74] via 11.69.12.9, 00:50:36, Serial2/0
O IA        69.12.30.0 [110/74] via 11.69.12.9, 00:50:36, Serial2/0
O IA        69.12.20.0 [110/84] via 11.69.12.9, 00:50:36, Serial2/0
O IA        69.12.40.0 [110/84] via 11.69.12.9, 00:50:36, Serial2/0
          112.0.0.0/24 is subnetted, 3 subnets
O E2        112.69.50.0 [110/1] via 26.19.40.2, 00:49:34, FastEthernet0/0
O E2        112.69.60.0 [110/1] via 26.19.40.2, 00:49:34, FastEthernet0/0
O E2        112.69.40.0 [110/1] via 26.19.40.2, 00:49:36, FastEthernet0/0
          26.0.0.0/24 is subnetted, 7 subnets
O          26.19.10.0 [110/31] via 26.19.40.2, 00:50:38, FastEthernet0/0
O          26.19.30.0 [110/20] via 26.19.40.2, 00:50:38, FastEthernet0/0
O          26.19.20.0 [110/30] via 26.19.40.2, 00:50:38, FastEthernet0/0
C          26.19.40.0 is directly connected, FastEthernet0/0
O          26.19.60.0 [110/11] via 26.19.40.2, 00:50:38, FastEthernet0/0
O          26.19.50.0 [110/21] via 26.19.40.2, 00:50:38, FastEthernet0/0
O          26.19.70.0 [110/12] via 26.19.40.2, 00:50:38, FastEthernet0/0
          11.0.0.0/30 is subnetted, 4 subnets
O E2        11.69.12.0 [110/1] via 26.19.40.2, 00:29:02, FastEthernet0/0
O E2        11.69.12.4 [110/1] via 26.19.40.2, 00:29:02, FastEthernet0/0
C          11.69.12.8 is directly connected, Serial2/0
O E2        11.69.12.12 [110/1] via 11.69.12.9, 00:29:33, Serial2/0
          12.0.0.0/24 is subnetted, 3 subnets
O E2        12.69.1.0 [110/1] via 11.69.12.9, 00:29:34, Serial2/0
O E2        12.69.3.0 [110/1] via 11.69.12.9, 00:29:34, Serial2/0
O E2        12.69.2.0 [110/1] via 11.69.12.9, 00:29:34, Serial2/0
R13#
```

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Figure 94: Routing table for router 13.

```

*Mar 1 00:00:51.315: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.30.1 on FastEthernet0/0
/1 from LOADING to FULL, Loading Done
R14#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

69.0.0.0/24 is subnetted, 4 subnets
 0 IA 69.12.10.0 [110/95] via 26.19.50.2, 00:50:19, FastEthernet1/0
 0 IA 69.12.30.0 [110/95] via 26.19.50.2, 00:50:19, FastEthernet1/0
 0 IA 69.12.20.0 [110/105] via 26.19.50.2, 00:50:19, FastEthernet1/0
 0 IA 69.12.40.0 [110/105] via 26.19.50.2, 00:50:19, FastEthernet1/0
112.0.0.0/24 is subnetted, 3 subnets
 0 E2 112.69.50.0 [110/1] via 26.19.10.1, 00:49:19, FastEthernet0/0
 0 E2 112.69.60.0 [110/1] via 26.19.10.1, 00:49:19, FastEthernet0/0
 0 E2 112.69.40.0 [110/1] via 26.19.10.1, 00:49:21, FastEthernet0/0
26.0.0.0/24 is subnetted, 7 subnets
 0 C 26.19.10.0 is directly connected, FastEthernet0/0
 0 C 26.19.30.0 [110/20] via 26.19.20.2, 00:50:22, FastEthernet0/1
 0 C 26.19.20.0 is directly connected, FastEthernet0/1
 0 C 26.19.40.0 [110/21] via 26.19.50.2, 00:50:22, FastEthernet1/0
 0 C 26.19.60.0 [110/11] via 26.19.50.2, 00:50:22, FastEthernet1/0
 0 C 26.19.50.0 is directly connected, FastEthernet1/0
 0 C 26.19.70.0 [110/2] via 26.19.50.2, 00:50:22, FastEthernet1/0
11.0.0.0/30 is subnetted, 4 subnets
 0 E2 11.69.12.0 [110/1] via 26.19.10.1, 00:28:49, FastEthernet0/0
 0 E2 11.69.12.4 [110/1] via 26.19.10.1, 00:28:49, FastEthernet0/0
 0 IA 11.69.12.8 [110/85] via 26.19.50.2, 00:50:22, FastEthernet1/0
 0 IA 11.69.12.12 [110/74] via 26.19.10.1, 00:50:22, FastEthernet0/0
12.0.0.0/24 is subnetted, 3 subnets
 0 IA 12.69.1.0 [110/84] via 26.19.10.1, 00:50:24, FastEthernet0/0
 0 IA 12.69.3.0 [110/94] via 26.19.10.1, 00:50:24, FastEthernet0/0
 0 IA 12.69.2.0 [110/84] via 26.19.10.1, 00:50:24, FastEthernet0/0
R14#

```

Figure 95: Routing table for router 14.

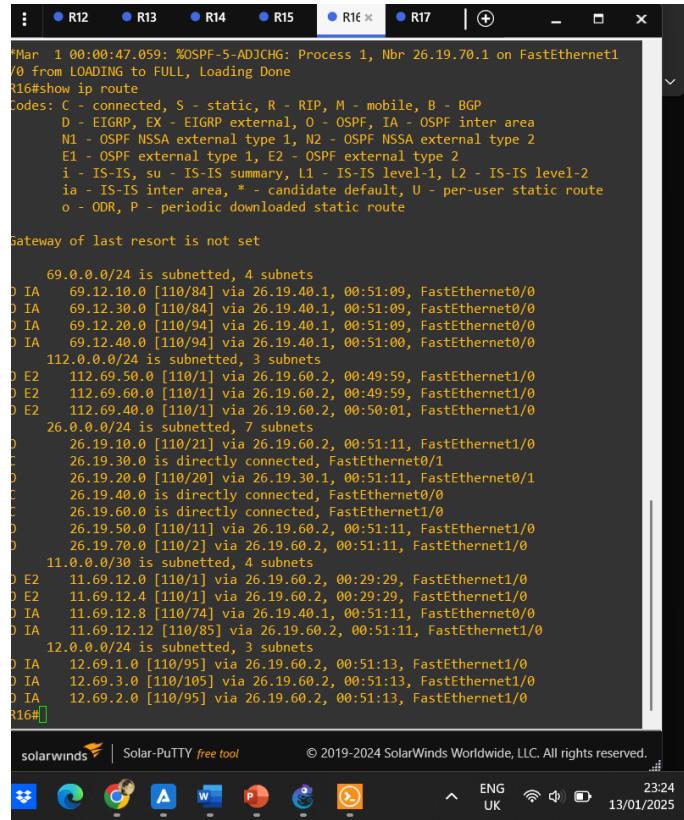
```

*Mar 1 00:00:51.315: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.30.1 on FastEthernet0/0
/1 from LOADING to FULL, Loading Done
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

69.0.0.0/24 is subnetted, 4 subnets
 0 IA 69.12.10.0 [110/94] via 26.19.30.2, 00:51:10, FastEthernet0/1
 0 IA 69.12.30.0 [110/94] via 26.19.30.2, 00:51:10, FastEthernet0/1
 0 IA 69.12.20.0 [110/104] via 26.19.30.2, 00:51:10, FastEthernet0/1
 0 IA 69.12.40.0 [110/104] via 26.19.30.2, 00:51:10, FastEthernet0/1
112.0.0.0/24 is subnetted, 3 subnets
 0 E2 112.69.50.0 [110/1] via 26.19.20.1, 00:50:10, FastEthernet0/0
 0 E2 112.69.60.0 [110/1] via 26.19.20.1, 00:50:10, FastEthernet0/0
 0 E2 112.69.40.0 [110/1] via 26.19.20.1, 00:50:13, FastEthernet0/0
26.0.0.0/24 is subnetted, 7 subnets
 0 C 26.19.10.0 [110/20] via 26.19.20.1, 00:51:13, FastEthernet0/0
 0 C 26.19.30.0 is directly connected, FastEthernet0/1
 0 C 26.19.20.0 is directly connected, FastEthernet0/0
 0 C 26.19.40.0 [110/20] via 26.19.30.2, 00:51:13, FastEthernet0/1
 0 C 26.19.60.0 [110/11] via 26.19.30.2, 00:51:13, FastEthernet0/1
 0 C 26.19.50.0 [110/11] via 26.19.20.1, 00:51:13, FastEthernet0/0
 0 C 26.19.70.0 [110/12] via 26.19.30.2, 00:51:13, FastEthernet0/1
 0 C 26.19.20.0 [110/12] via 26.19.20.1, 00:51:13, FastEthernet0/0
11.0.0.0/30 is subnetted, 4 subnets
 0 E2 11.69.12.0 [110/1] via 26.19.20.1, 00:29:45, FastEthernet0/0
 0 E2 11.69.12.4 [110/1] via 26.19.20.1, 00:29:45, FastEthernet0/0
 0 IA 11.69.12.8 [110/84] via 26.19.30.2, 00:51:13, FastEthernet0/1
 0 IA 11.69.12.12 [110/84] via 26.19.20.1, 00:51:13, FastEthernet0/0
12.0.0.0/24 is subnetted, 3 subnets
 0 IA 12.69.1.0 [110/94] via 26.19.20.1, 00:51:15, FastEthernet0/0
 0 IA 12.69.3.0 [110/104] via 26.19.20.1, 00:51:15, FastEthernet0/0
 0 IA 12.69.2.0 [110/94] via 26.19.20.1, 00:51:15, FastEthernet0/0
R15#

```

Figure 96: Routing table for router 15.



```

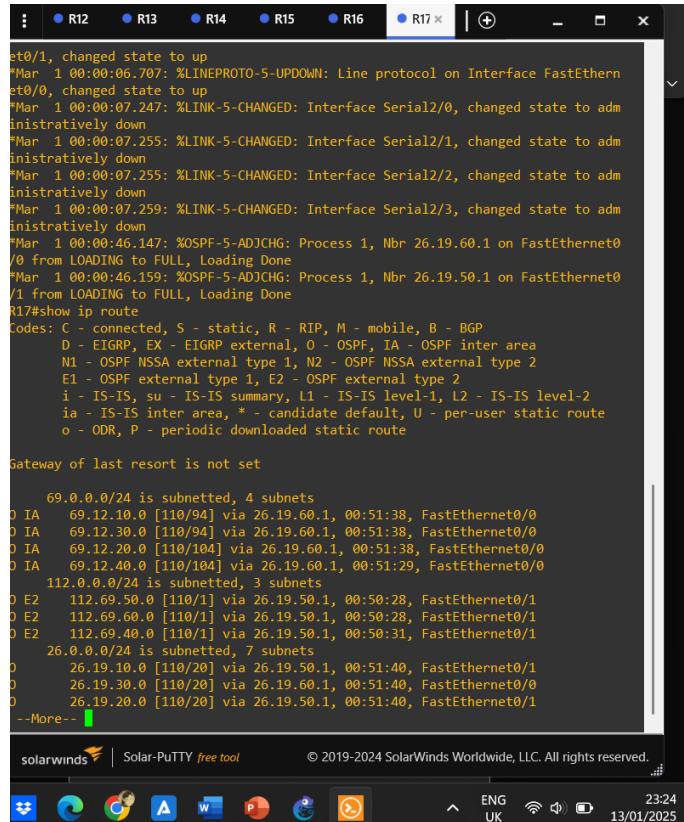
*Mar 1 00:00:47.059: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.70.1 on FastEthernet1/0 from LOADING to FULL, Loading Done
R16#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 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

       69.0.0.0/24 is subnetted, 4 subnets
O  IA   69.12.10.0 [110/84] via 26.19.40.1, 00:51:09, FastEthernet0/0
O  IA   69.12.30.0 [110/84] via 26.19.40.1, 00:51:09, FastEthernet0/0
O  IA   69.12.20.0 [110/94] via 26.19.40.1, 00:51:09, FastEthernet0/0
O  IA   69.12.40.0 [110/94] via 26.19.40.1, 00:51:09, FastEthernet0/0
      112.0.0.0/24 is subnetted, 3 subnets
O  E2   112.69.50.0 [110/1] via 26.19.60.2, 00:49:59, FastEthernet1/0
O  E2   112.69.60.0 [110/1] via 26.19.60.2, 00:49:59, FastEthernet1/0
O  E2   112.69.40.0 [110/1] via 26.19.60.2, 00:50:01, FastEthernet1/0
      26.0.0.0/24 is subnetted, 7 subnets
O  IA   26.19.10.0 [110/21] via 26.19.60.2, 00:51:11, FastEthernet1/0
O  IA   26.19.30.0 is directly connected, FastEthernet0/1
O  IA   26.19.20.0 [110/20] via 26.19.30.1, 00:51:11, FastEthernet0/1
O  IA   26.19.40.0 is directly connected, FastEthernet0/0
O  IA   26.19.60.0 is directly connected, FastEthernet1/0
O  IA   26.19.50.0 [110/11] via 26.19.60.2, 00:51:11, FastEthernet1/0
O  IA   26.19.70.0 [110/2] via 26.19.60.2, 00:51:11, FastEthernet1/0
      11.0.0.0/30 is subnetted, 4 subnets
O  E2   11.69.12.0 [110/1] via 26.19.60.2, 00:29:29, FastEthernet1/0
O  E2   11.69.12.4 [110/1] via 26.19.60.2, 00:29:29, FastEthernet1/0
O  IA   11.69.12.8 [110/74] via 26.19.40.1, 00:51:11, FastEthernet0/0
O  IA   11.69.12.12 [110/85] via 26.19.60.2, 00:51:11, FastEthernet1/0
      12.0.0.0/24 is subnetted, 3 subnets
O  IA   12.69.1.0 [110/95] via 26.19.60.2, 00:51:13, FastEthernet1/0
O  IA   12.69.3.0 [110/105] via 26.19.60.2, 00:51:13, FastEthernet1/0
O  IA   12.69.2.0 [110/95] via 26.19.60.2, 00:51:13, FastEthernet1/0
R16#[

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```

Figure 97: Routing table for router 16.



```

et0/1, changed state to up
*Mar 1 00:00:06.707: %LINK-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:07.247: %LINK-5-CHANGED: Interface Serial2/0, changed state to administratively down
*Mar 1 00:00:07.255: %LINK-5-CHANGED: Interface Serial2/1, changed state to administratively down
*Mar 1 00:00:07.255: %LINK-5-CHANGED: Interface Serial2/2, changed state to administratively down
*Mar 1 00:00:07.259: %LINK-5-CHANGED: Interface Serial2/3, changed state to administratively down
*Mar 1 00:00:46.147: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.60.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
*Mar 1 00:00:46.159: %OSPF-5-ADJCHG: Process 1, Nbr 26.19.50.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
R17#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

       69.0.0.0/24 is subnetted, 4 subnets
O  IA   69.12.10.0 [110/94] via 26.19.60.1, 00:51:38, FastEthernet0/0
O  IA   69.12.30.0 [110/94] via 26.19.60.1, 00:51:38, FastEthernet0/0
O  IA   69.12.20.0 [110/104] via 26.19.60.1, 00:51:38, FastEthernet0/0
O  IA   69.12.40.0 [110/104] via 26.19.60.1, 00:51:29, FastEthernet0/0
      112.0.0.0/24 is subnetted, 3 subnets
O  E2   112.69.50.0 [110/1] via 26.19.50.1, 00:50:28, FastEthernet0/1
O  E2   112.69.60.0 [110/1] via 26.19.50.1, 00:50:28, FastEthernet0/1
O  E2   112.69.40.0 [110/1] via 26.19.50.1, 00:50:31, FastEthernet0/1
      26.0.0.0/24 is subnetted, 7 subnets
O  IA   26.19.10.0 [110/20] via 26.19.50.1, 00:51:40, FastEthernet0/1
O  IA   26.19.30.0 [110/20] via 26.19.60.1, 00:51:40, FastEthernet0/0
O  IA   26.19.20.0 [110/20] via 26.19.50.1, 00:51:40, FastEthernet0/1
--More--[

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```

Figure 98: Routing table for router 17.

Conclusion

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”.

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