République Algérienne Démocratique et Populaire

École Polytechnique

Rapport de TP 1

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2022

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1 Introduction

IP multicast is a selective broadcast mode that allows a source to send a single copy of its traffic to multiple receivers. This mode allows for efficient multipoint-to-multipoint communications, especially for multimedia content delivery services.

Part I

2 Goals

- Subscribe Interfaces to Multicast Groups with IGMP.
- Configure dense-mode multicast on all routers.
- Configure OSPF on all routers, achieve full connectivity.
- Configure router Utrecht to join the multicast group 224.4.4.4 on it's *Fastethernet* 1/0 interface.
- Ping this multicast group address 224.4.4.4 from router Amsterdam to test your multicast configuration.

Topology

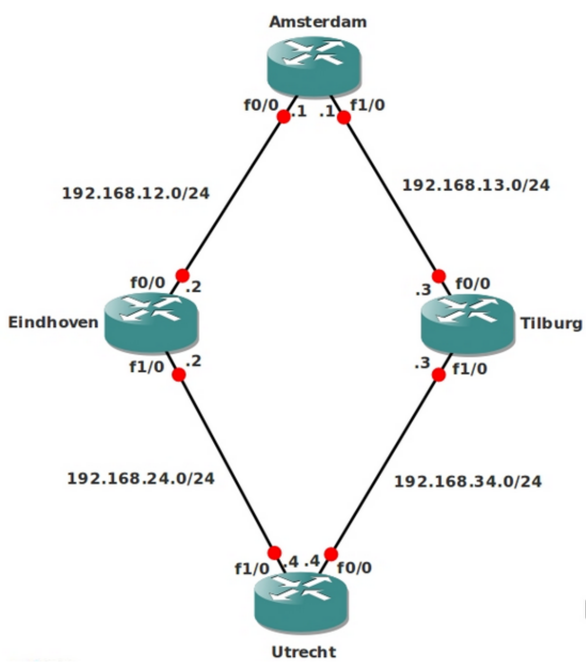

Figure 1: Topology

3 Step 1: Subscribe Interfaces to Multicast Groups

3.1

In IP multicast, hosts use the Internet Group Management Protocol (IGMP) to join and leave groups and to respond to membership queries. Debug IP IGMP and all IP packets on all routers. This allows you to see any IGMP messages sent or received by any of the routers. Commands: **debug ip igmp debug ip packet**.

3.2

The result of the commande : **ip igmp join-groupe 224.4.4.4** issue on router Amsterdam is showing in Figure 2.

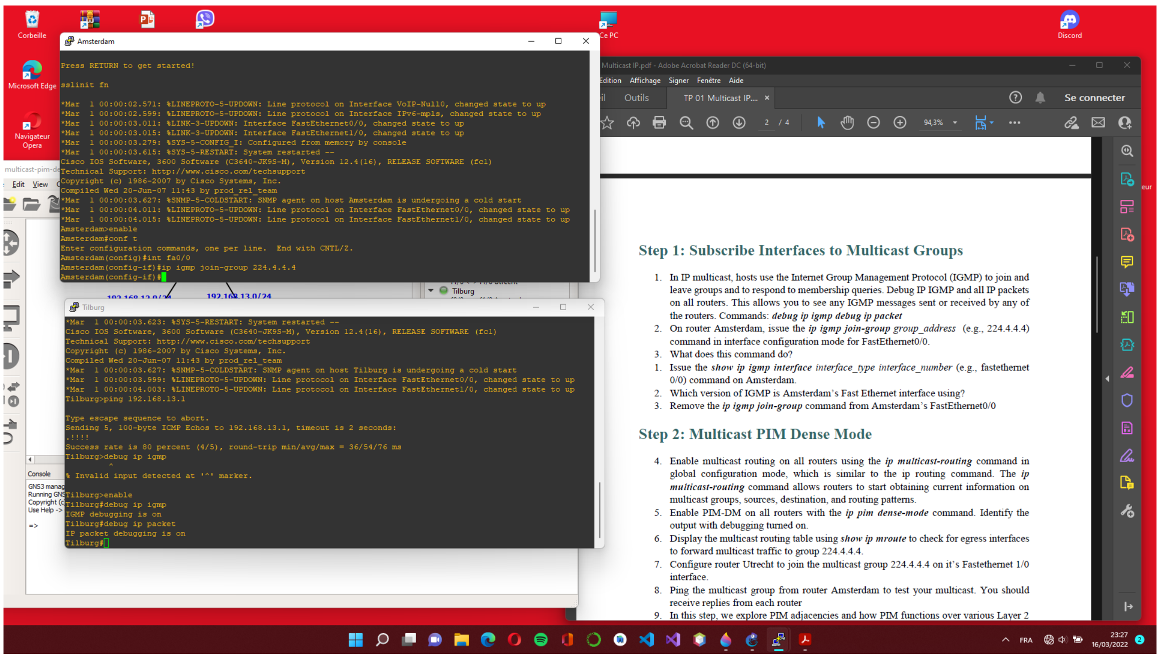

Figure 2: IGMP join

3.3

The command make Amsterdam router join a group wich have an adress 224.4.4.4 in *FastEthernet0/0* interface.

3.4

show ip igmp interface *interface_ type interface_ number*, Displays IGMP information for interface selected on which you enabled IGMP, the result for executing it in Amsterdam router shown in Figure 3. The current IGMP version running in Amsterdam's *Fast Ethernet* interface is *IGMPv2*.

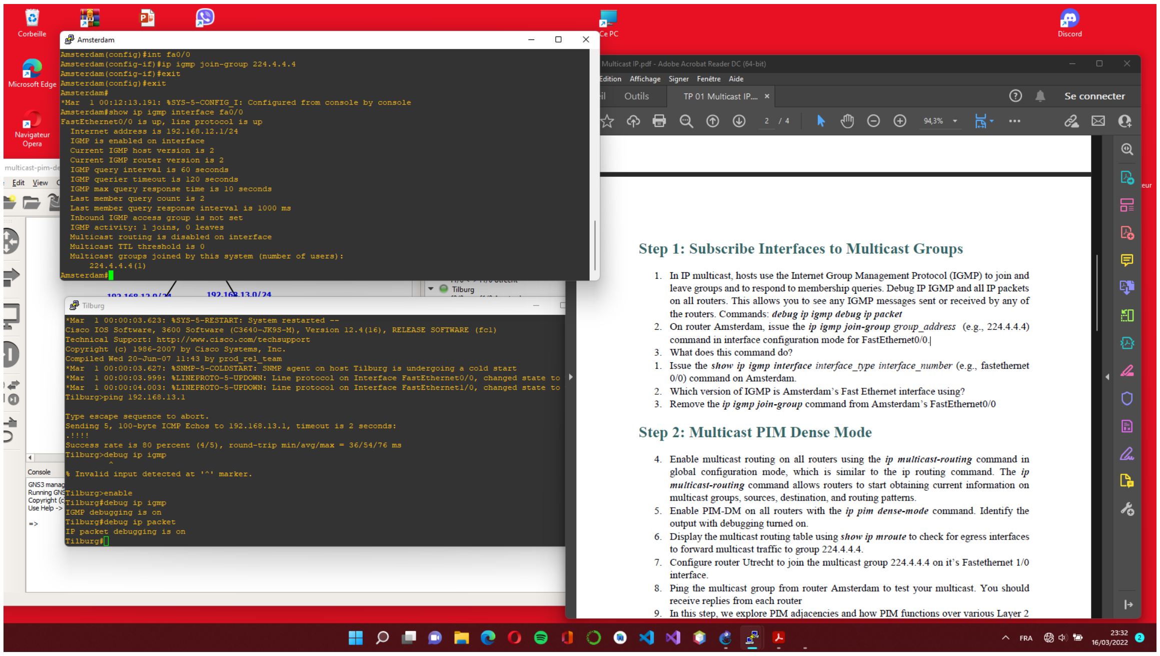

Figure 3: Display IGMP information

3.5

To remove Amsterdam router from the multicast group, we should run **no ip igmp join-group 224.4.4.4** in interface configuration mode, this command make the router out of group 224.4.4.4 (see Figure 4).

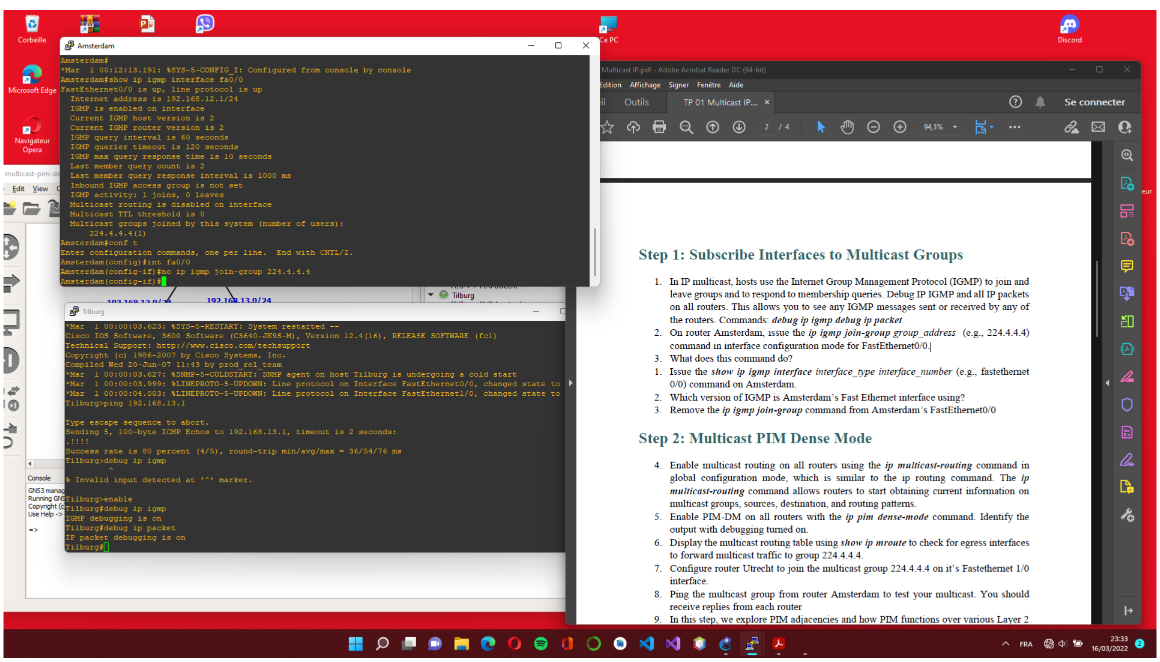

Figure 4: Remove group

4 Step 2: Multicast PIM Dense Mode

The **ip multicast-routing** command in global configuration mode, which is similar to the ip routing command. The ip multicast-routing command allows routers to start obtaining current information on multicast groups, sources, destination, and routing patterns.

4.1

To Enable PIM-DM on all routers we use **ip pim dense-mode** command in each interface, we can identify the output with debugging turned on, **debug ip pim** command ensure that, Figure 5 and 6 shown the result.

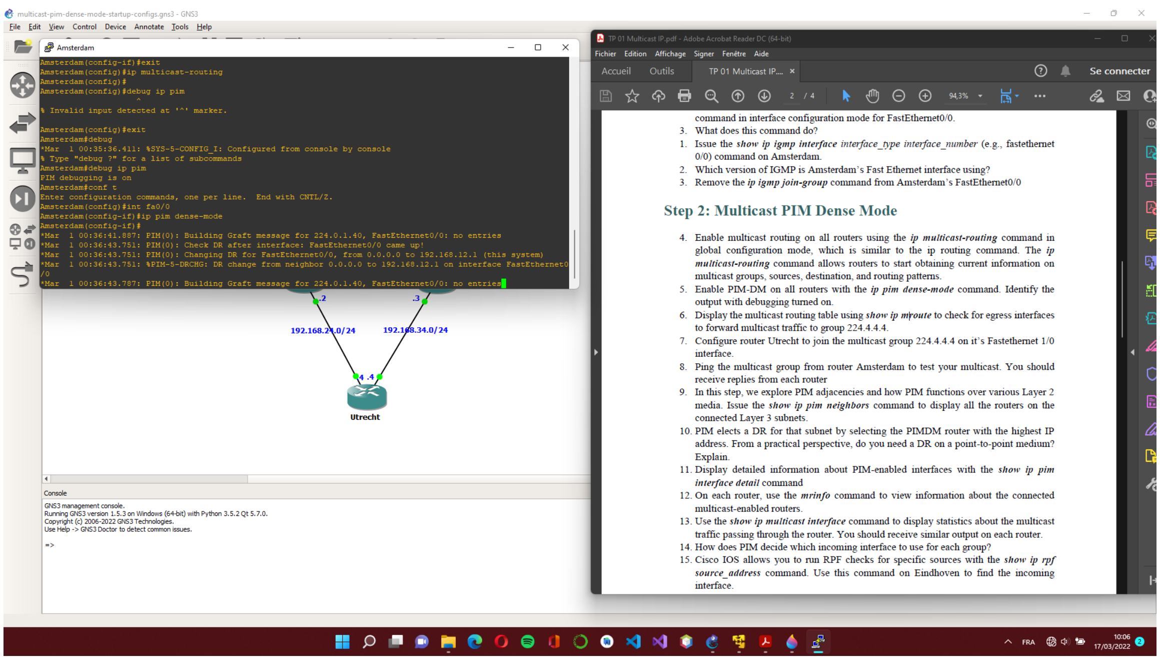

Figure 5: Enable PIM-DM in Amsterdam router

4.2

The **show ip mroute** command to display the multicast routing table in the router, we make as checking for egress interfaces to forward multicast traffic as shown on Figure 7.

4.3

To make Utrecht router to join the multicast group 224.4.4.4 on it's Fastethernet 1/0 interface, we should select the interface by **int Fa1/0** command and run **ip igmp join-group 224.4.4.4** (see Figure 8)

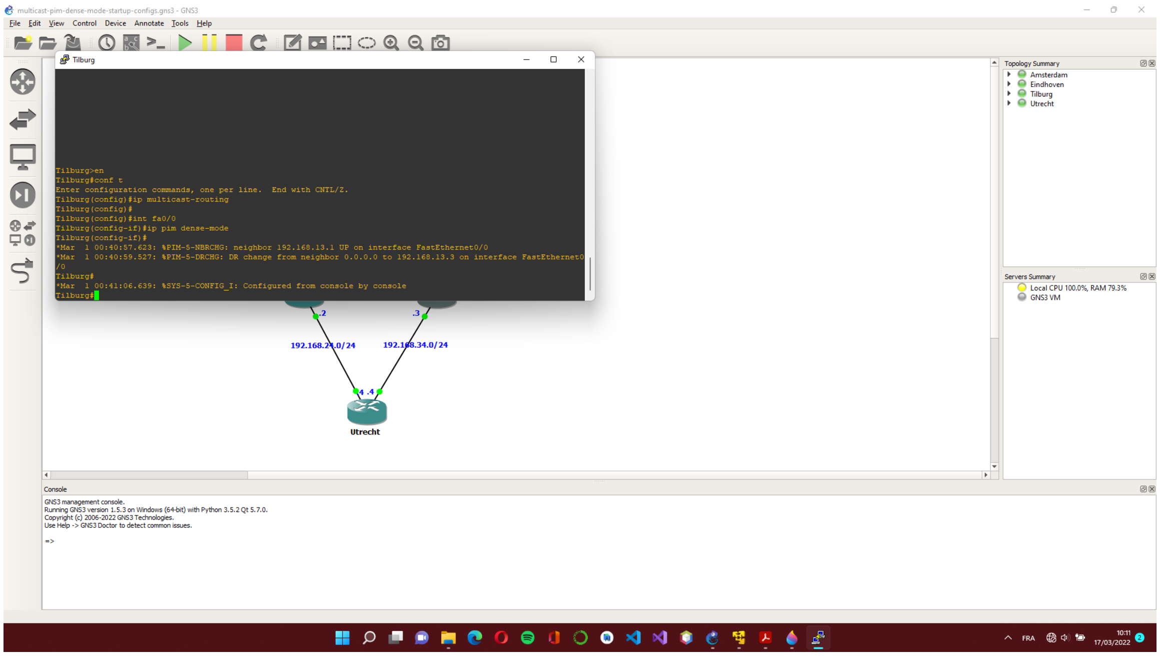

Figure 6: Enable PIM-DM in Tilburg router

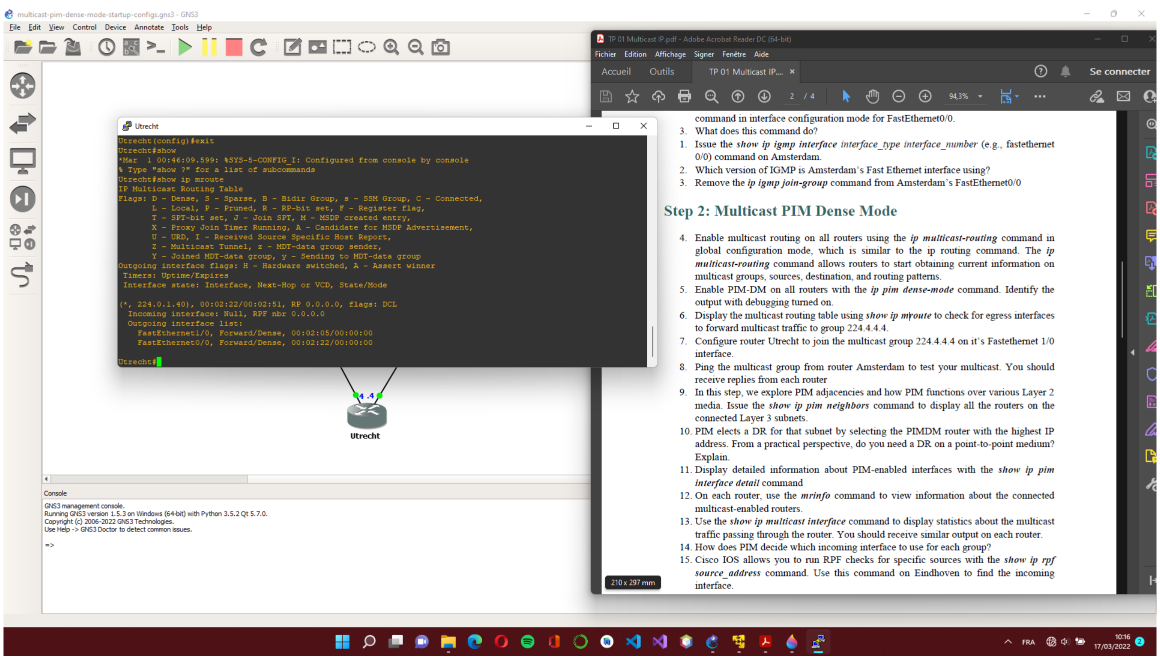

Figure 7: Displaying the multicast routing table

4.4

The **ping 224.4.4.4** command send 1 packet to the multicast group, the replay to request was receiving from the two Utrecht interfaces **192.168.24.4** and **192.168.34.4**, we can see the result in Figure 9

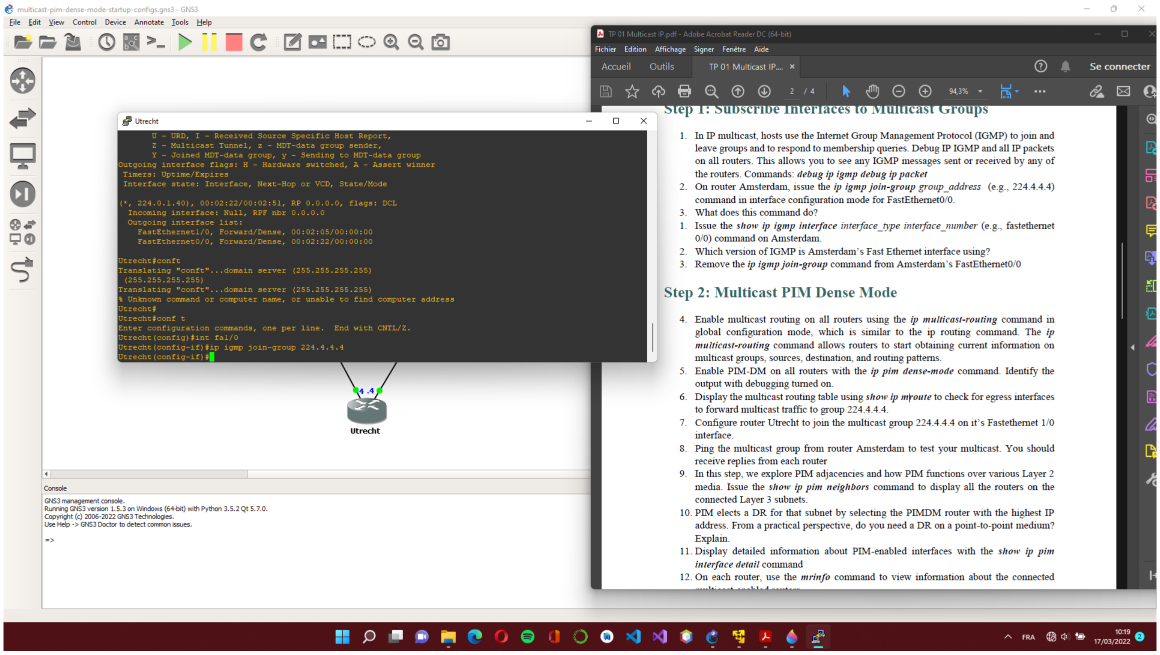

Figure 8: Join a group

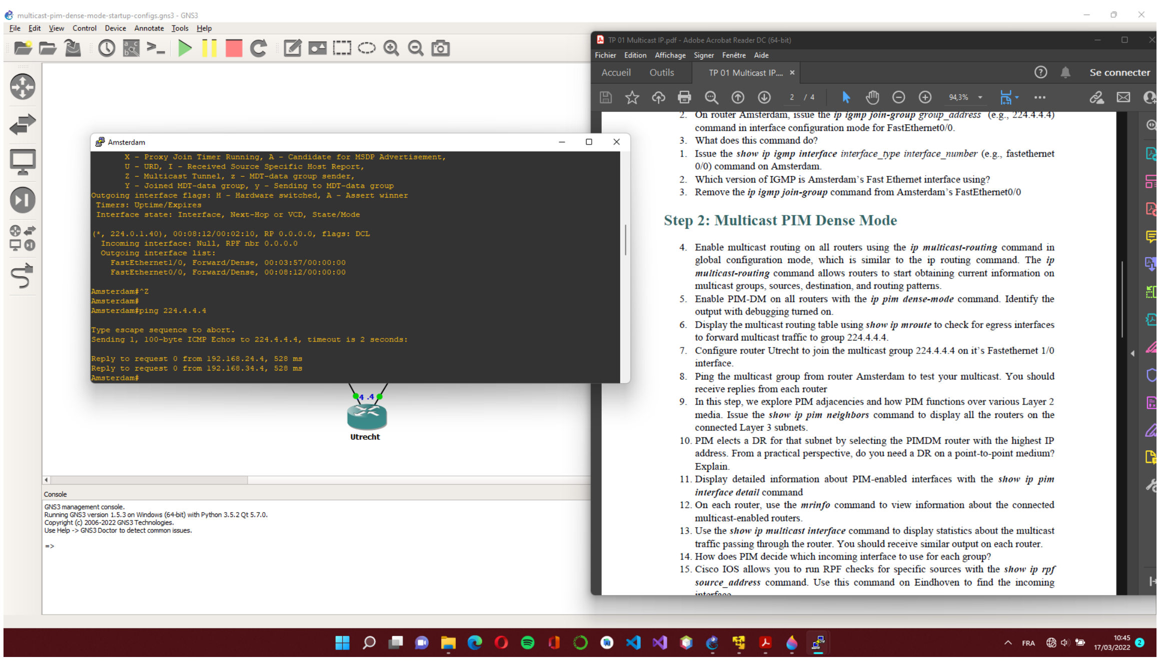

Figure 9: Ping a multicast adress

4.5

We explore PIM adjacencies and how PIM functions over various Layer 3 media with the **show ip pim neighbor** command to display all the routers on the connected Layer, as shown in Figure 10 Utrchet router have 2 PIM neighbor **192.168.34.3** which is the Fastethernet 1/0 interface of Tilburg and **192.168.24.2** of Eindhoven.

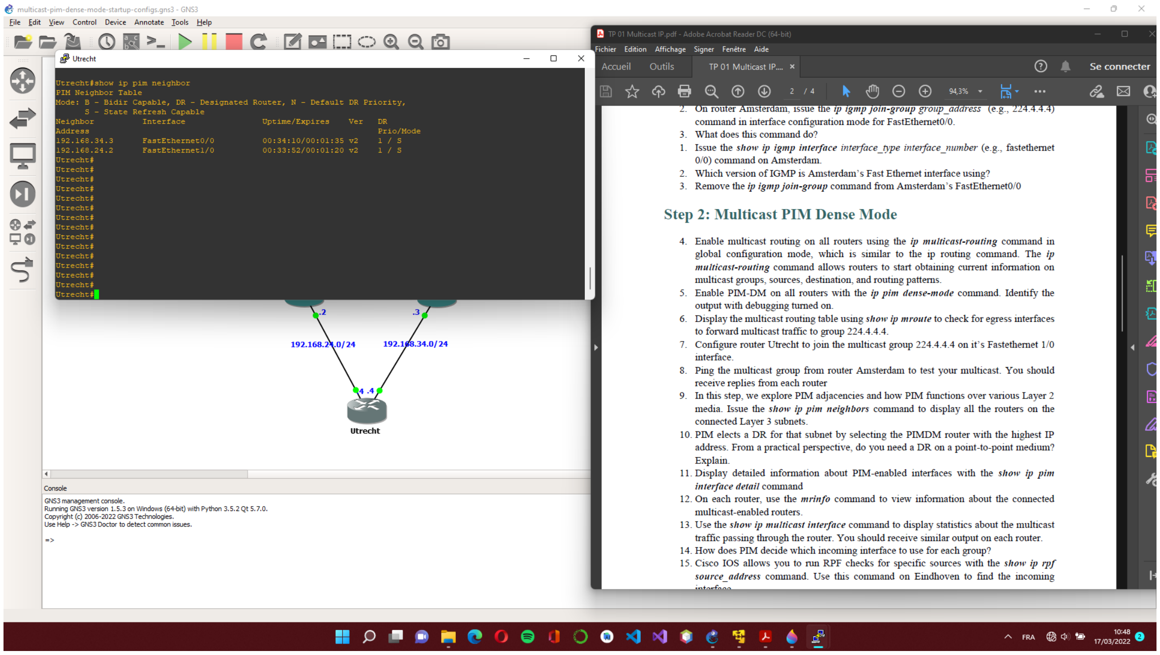

Figure 10: Explore PIM adjacencies

4.6

Point-to-point media do not require a DR because control traffic that needs to be sent from one router to another will be increased, not alleviated, by creating a DR.

4.7

To display detailed information about PIM-enabled interfaces, we use the **show ip pim interface detail** command, it can show ad DR address in the subnet. PIM elects a DR for that subnet by selecting the PIMDM router with the highest IP address (see Figure 11).

4.8

The **mrinfo** command display information about the connected multicast-enabled routers, for instance as shown in Figure 12 the Amsterdam router have two connected multicast-enabled routers at 1 hop which are **192.168.12.2** and **192.168.13.3**.

4.9

We use the **show ip multicast interface** command to display statistics about the multicast traffic passing through the router, we should receive similar output on each router, Figure 13 shown the result.

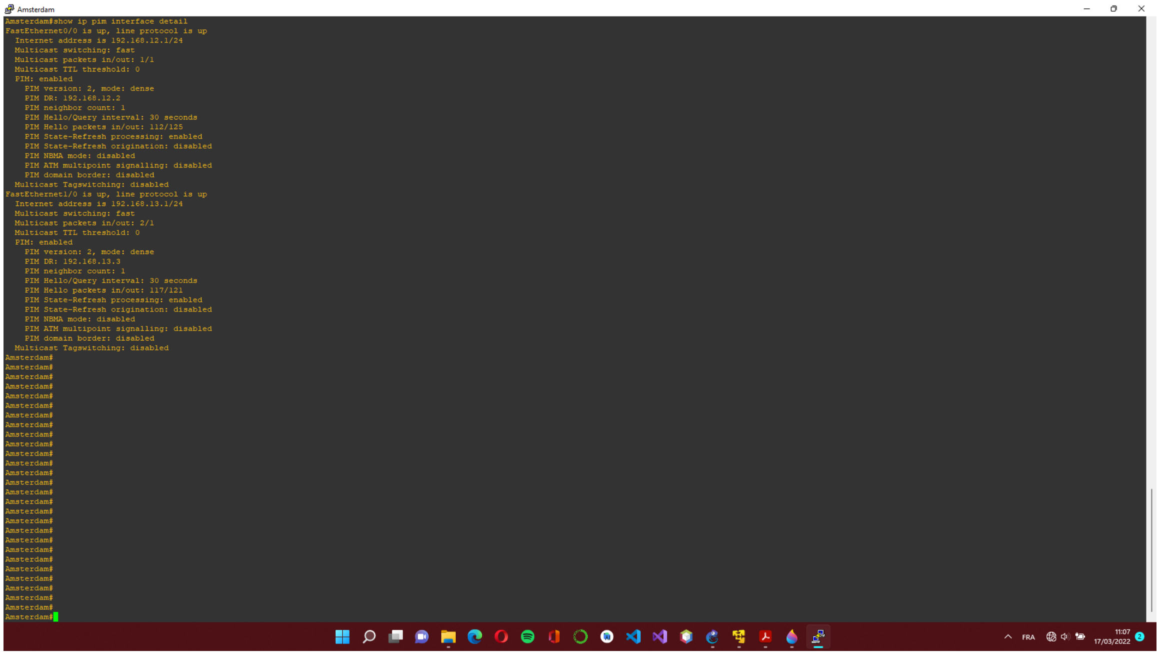

Figure 11: Display detailed information about PIM-interfaces

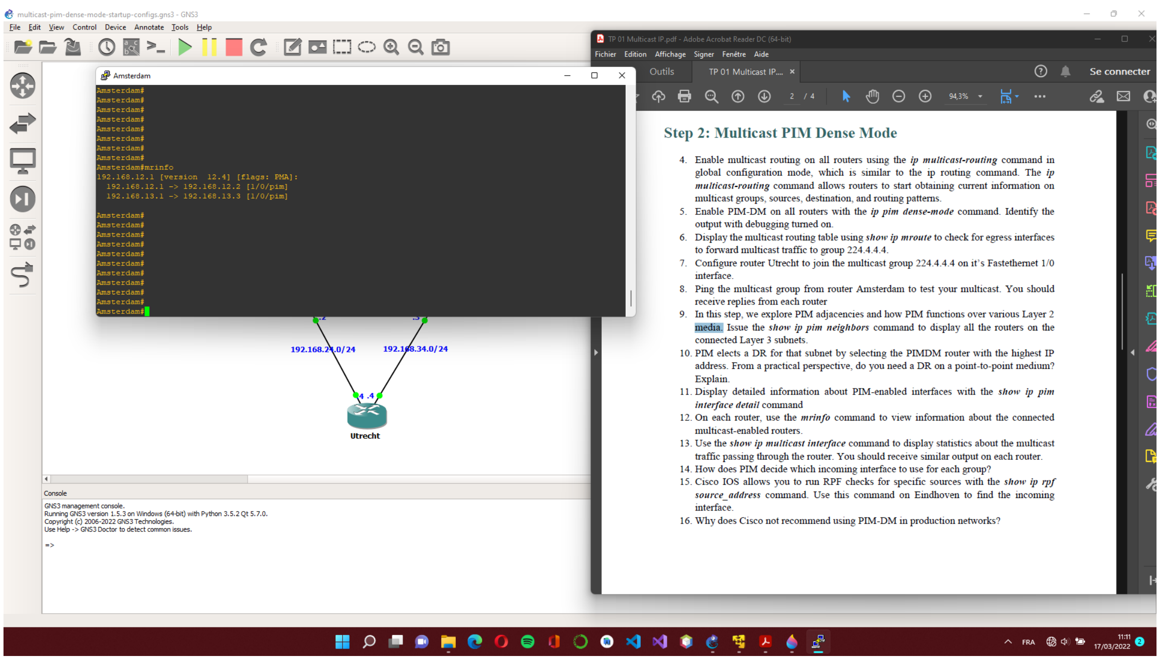

Figure 12: Display information about the connected multicast-enabled routers

4.10

PIM decide which incoming interface to use for each group by checking its unicast routing table, and RPF interface.

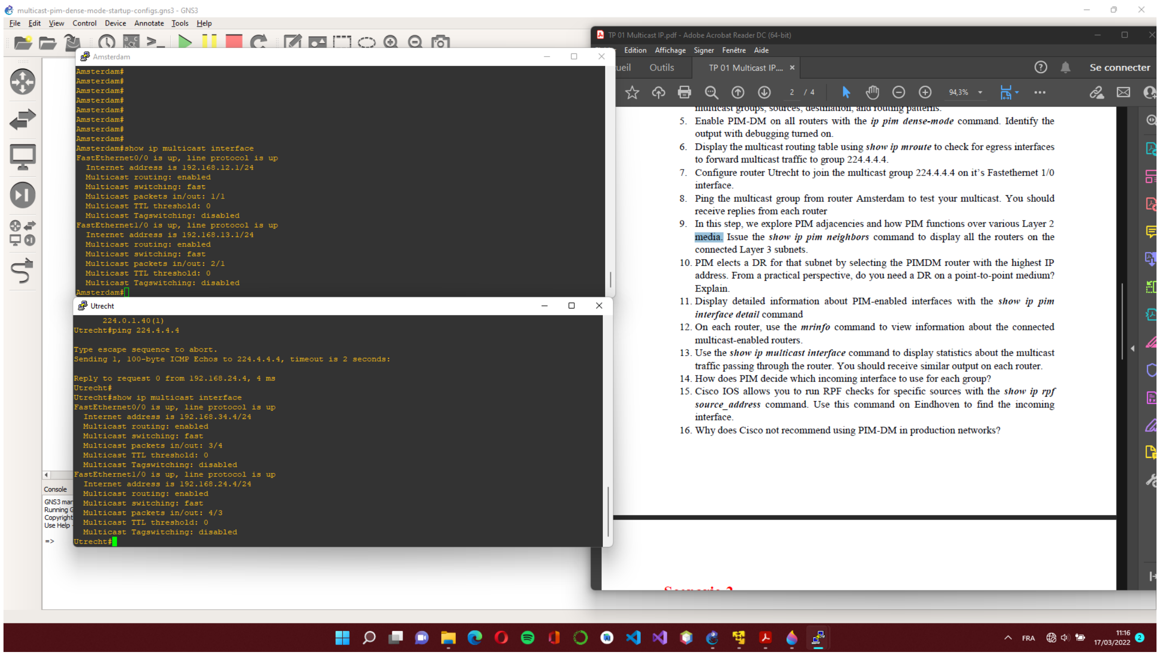

Figure 13: Display statistics about the multicast traffic

4.11

Cisco IOS allows you to run RPF checks for specific sources with the **show ip rpf source_address** command, we run this command in Eindhoven to find the incoming interface, the Figure 14 can display the RPF neighbor of Eindhoven router which have address 192.168.24.4.

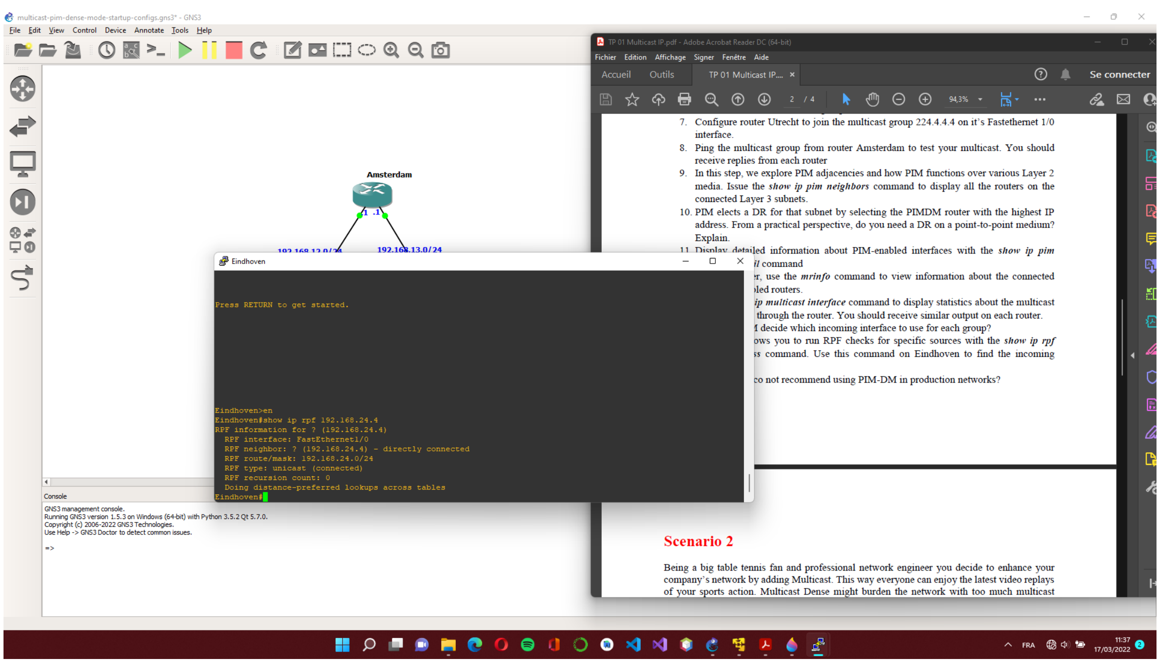

Figure 14: Run RPF checks

4.12

Deploying IP multicast with PIM Dense Mode is not scalable enough for the production networks due to inherent features of the dense mode multicast protocols. Instead, the PIM Sparse Mode is used in production IP multicast enabled networks.

This protocol is scalable and very appropriate for implementation in modern networks. Most current networks, whether enterprise or service provider networks, build their multicast solution on a sparse model of IP multicast.

4.13 The advantages of PIM-DM

- It is an efficient protocol when the receivers genuinely are densely distributed throughout.
- Like all PIM protocols, it is protocol-independent.
- It does not use RPs, which makes it simpler than PIM-SM to implement and deploy the network.

4.14 The disadvantages of PIM-DM

- All routers need to store per-source state for every source in the domain.
- It does not scale well in domains where most receivers do not wish to receive data, such as the Internet, so it is mostly used for individual small domains.

Part II

5 Goals

- Configure OSPF on all routers, advertise all networks. Complete full connectivity.
- Configure sparse-mode multicast on all routers.
- Configure all routers manually so that router Pong is the Rendezvous Point (RP).
- Configure router VideoReceiver to join the multicast group 224.4.4.4 on it's FastEthernet interface.
- Make sure you can ping the 224.4.4.4 group address from router VideoServer.

6 Topology

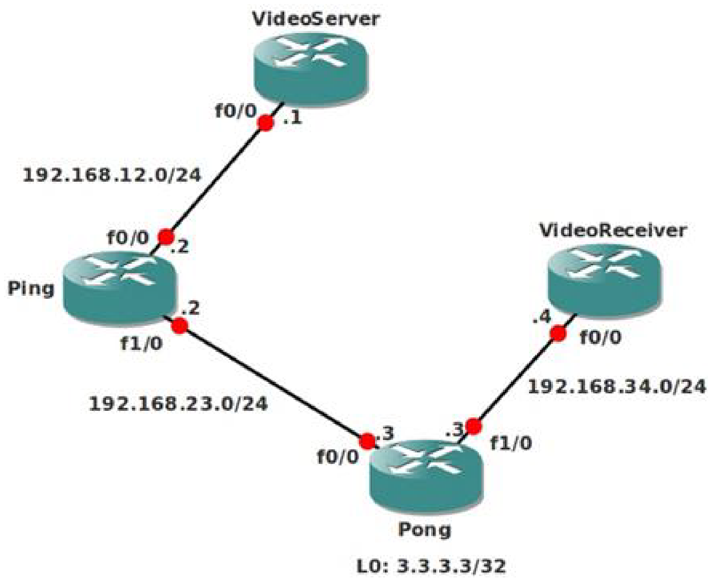

Figure 15: Topology

7 Step 3: Multicast PIM Sparse Mode

7.1 What is the purpose of the RP in PIM-SM?

PIM Sparse Mode connects the flow source or multicast tree to the router close to the want to be receiver using a special router called a Rendezvous Point (RP). As we'll see shortly, the RP is usually only used for a short period of time. Various *RPs* can be used for different multicast groups, which is one way to distribute the load.

7.2

The Figure 15 is the topology that we'll use. All routers are in OSPF Area 0, so we run **router ospf 1** command and **network 0.0.0.0 255.255.255.255 area 0** command in all routers to make OSPF running in all networks, The Figure 16 show the result of those commands.

When configuring multicast, the First step is enable multicast routing by **ip multicast-routing** command (see Figure 17).

7.3

Next step is to enable PIM with **ip pim sparse-mode** on required layer 3 interfaces as shown in Figure 18.

To display all adjacent PIM routers and also to check the expiration timer and mode to ensure successful PIM neighbor establishment, and look for any possible connectivity and

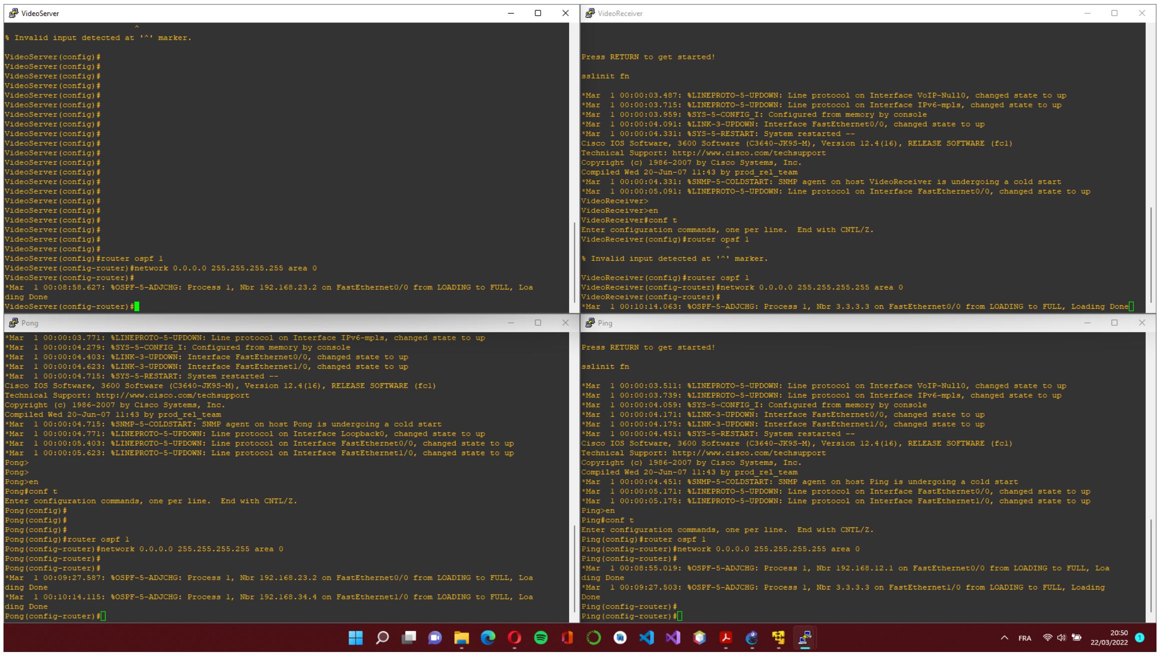

Figure 16: Configure OSPF

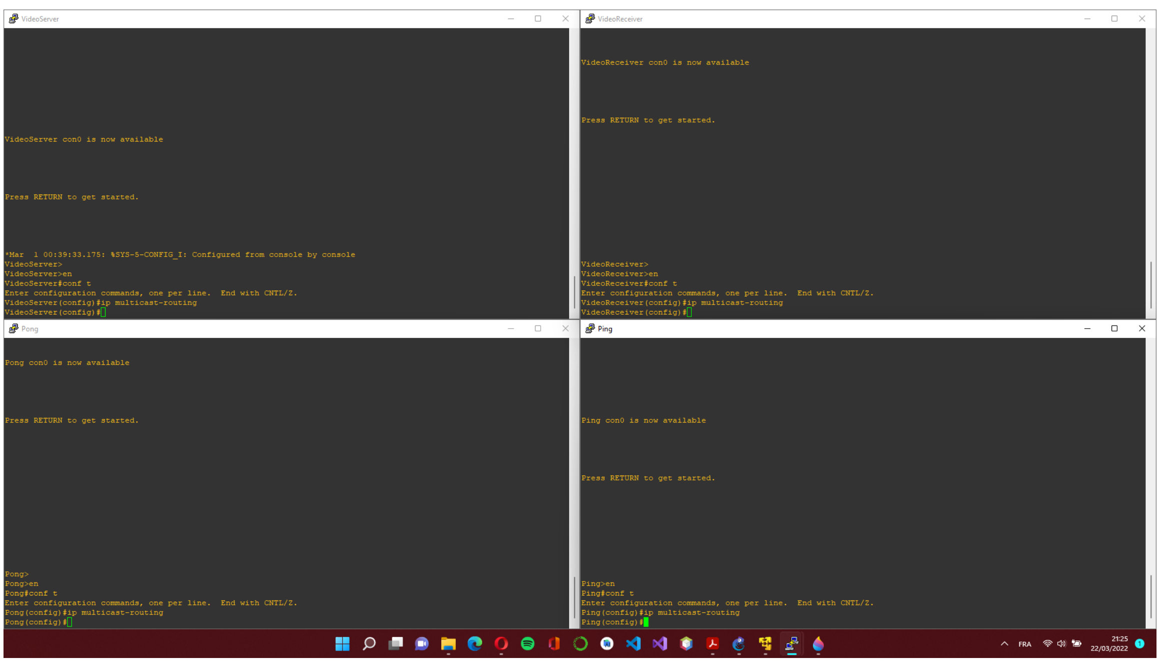

Figure 17: Enable multicast routing

timer issues that might inhibit the establishment of PIM neighbors, we can run **ip pim neighbor** command, as shown in Figure 19.

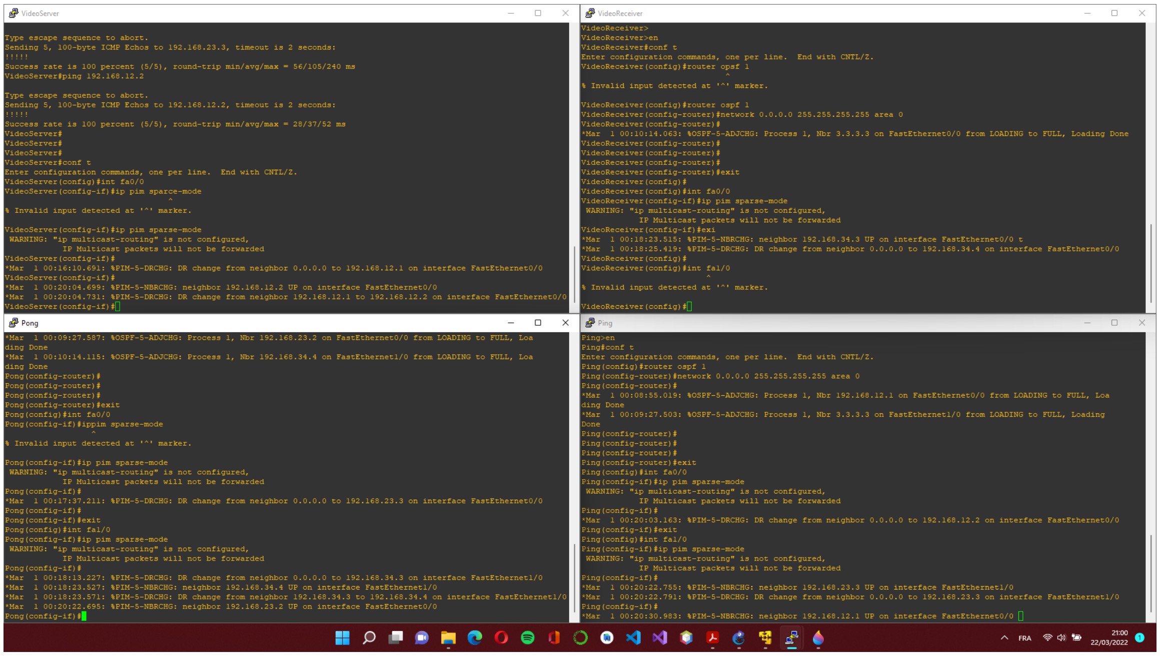

Figure 18: Enable PIM-SM

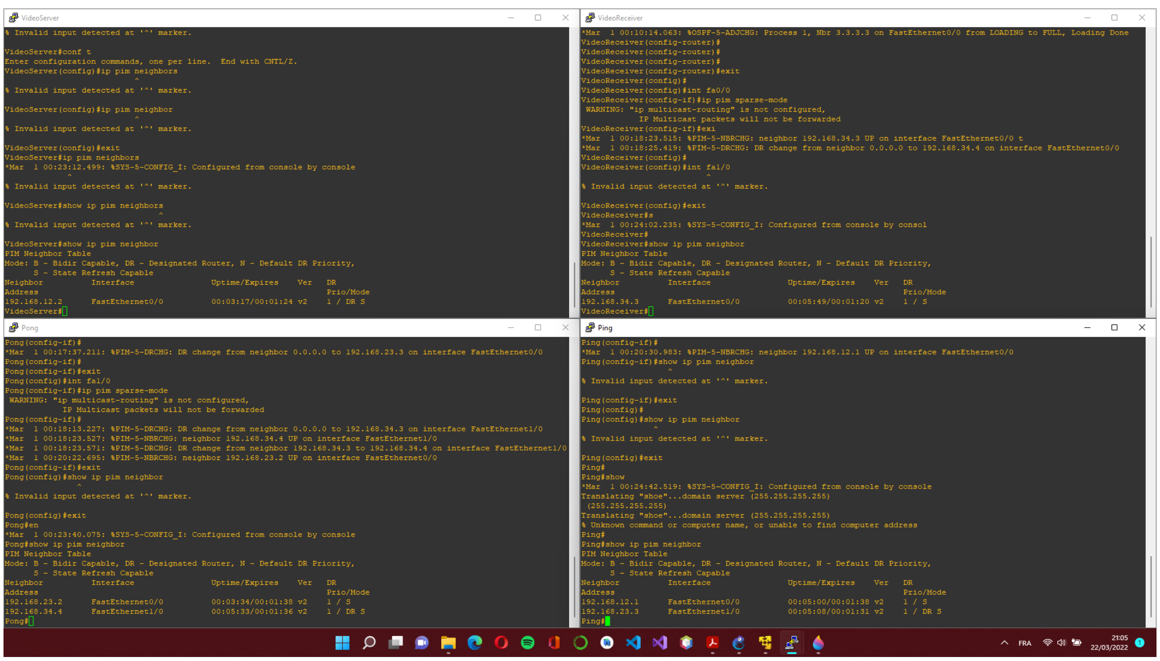

Figure 19: Display adjacent PIM routers

7.4

The final step is to configure RP in order to receivers to find multicast source in the network. In Static-RP configuration, you need to configure **ip pim rp-address x.x.x.x** command on every multicast enable router in your network, including RP itself, the RP in our network is Pong router which have **3.3.3.3** address Loopback, we can see the result in the Figure 20.

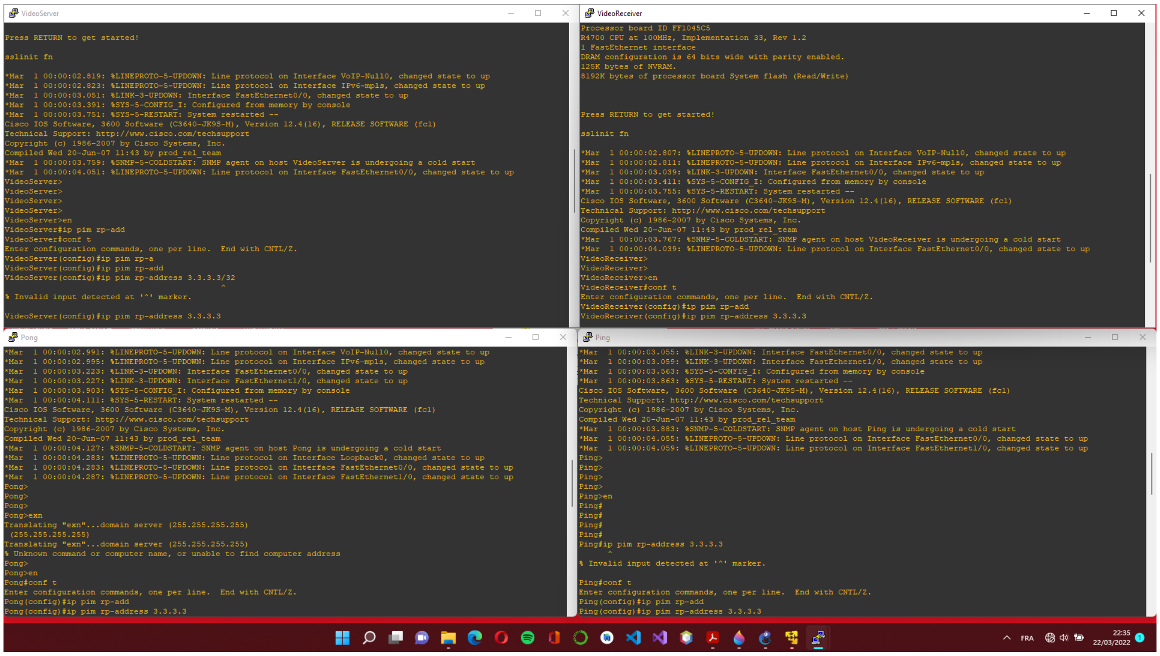

Figure 20: Configure RP

7.5

You can simulate a client join to a multicast group by configuring **ip igmp join-group x.x.x.x** command on a layer 3 interfaces. In this case will configure this on VideoReceiver router int fa0/0 as that's where our multicast receiver going to be, in our case the group address is **224.4.4.4** as shown in Figure 21.

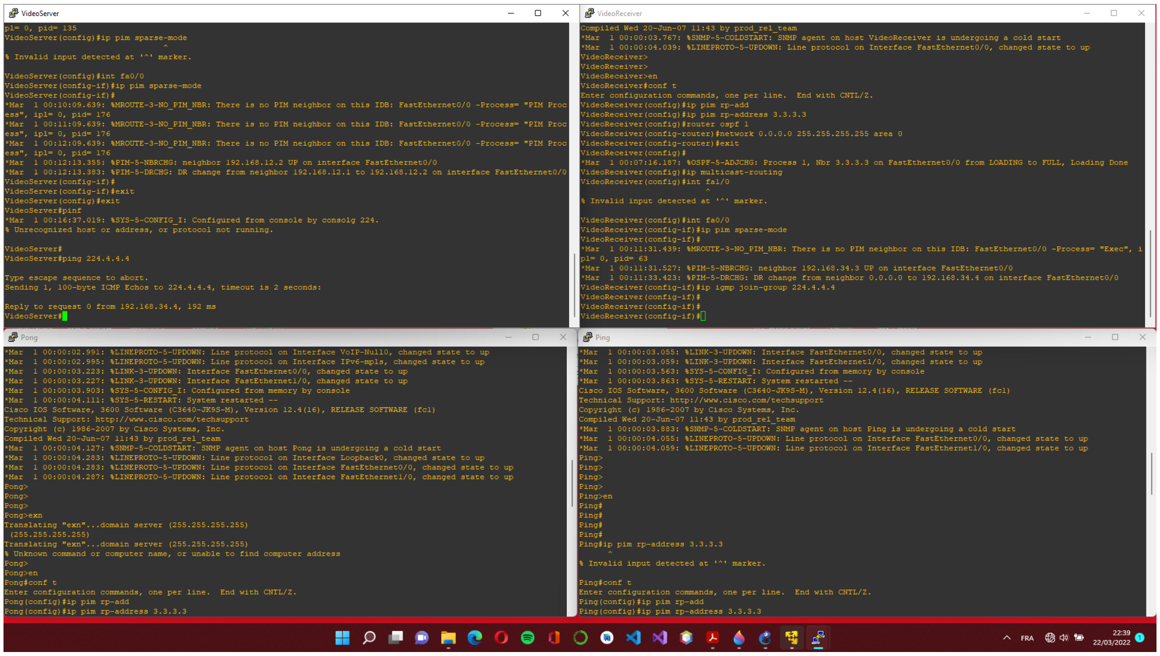

Figure 21: Join a group

7.6

Next is to simulate multicast source traffic to a group by simply ping a multicast group address with the source interface where you need to put your multicast source, so we can ping the **224.4.4.4** group address from router VideoServer (see Figure 22).

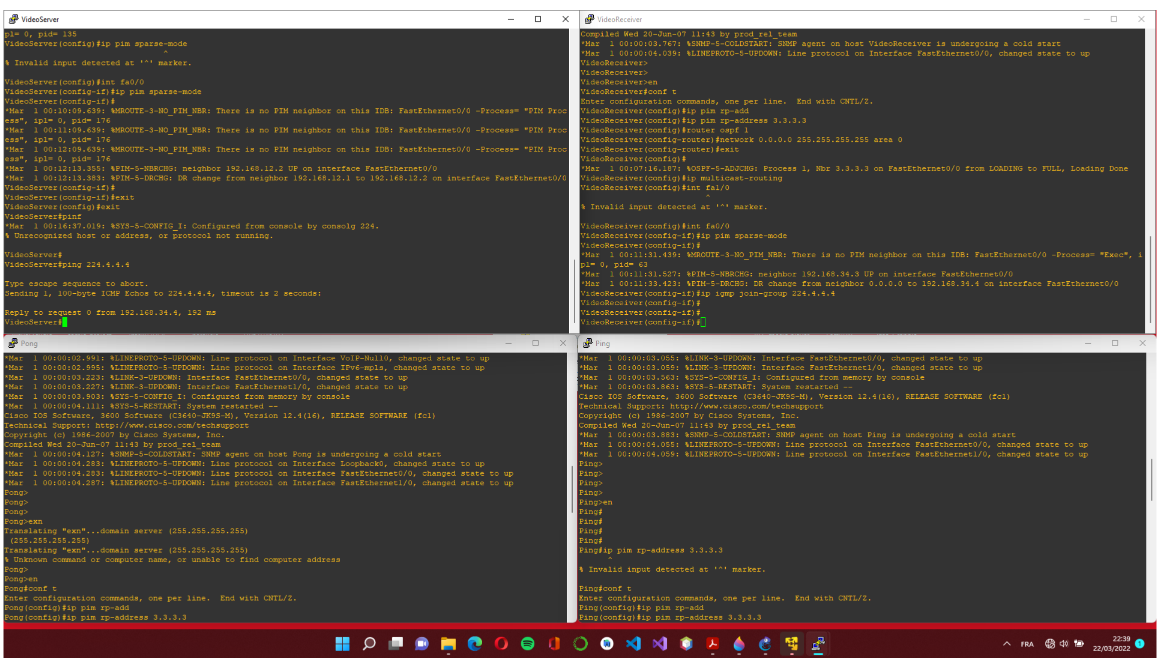

Figure 22: Ping a group

7.7

To display information about PIM-enabled interfaces, we can use **show ip pim interface detail** command, we can also use the **mrinfo** command to view information about the connected multicast-enabled routers as shown in Figure 23.

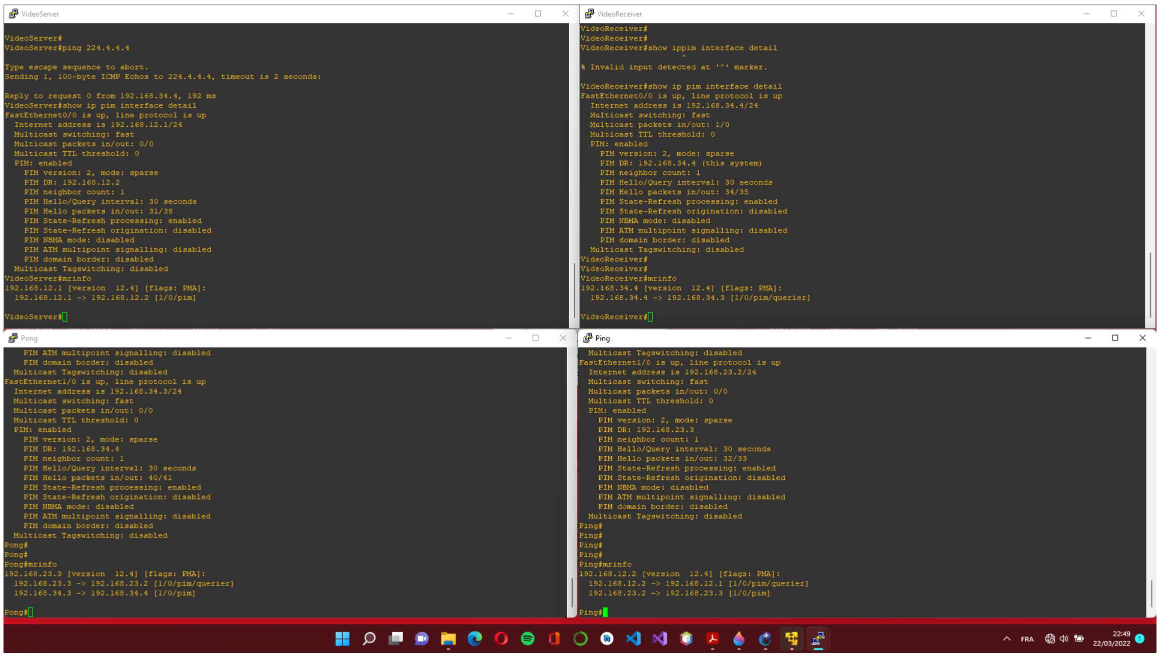

Figure 23: Display information about PIM

7.8

Now we verified both source to RP and receiver to RP multicast in working properly. The test is to simulate multicast traffic between source to receiver. It is simple, we can do the extended ping to multicast group address by **ping 224.4.4.4 repeat 100** from VideoServer router as shown in Figure 24

7.9

On each of the routers, we can see that PIM and IGMP have communicated to install the **224.4.4.4** multicast group in the multicast routing table, we verify this with the **show ip mroute** command on each router as shown in Figure 25

7.10

When the RP receives the encapsulated data packets, it decapsulates them and forwards them out down each branch of the RPT. Each router on the RPT receives the data from its upstream neighbor and forwards it on, In this way the data is sent to all interested receivers, following the opposite path to the PIM Join messages.

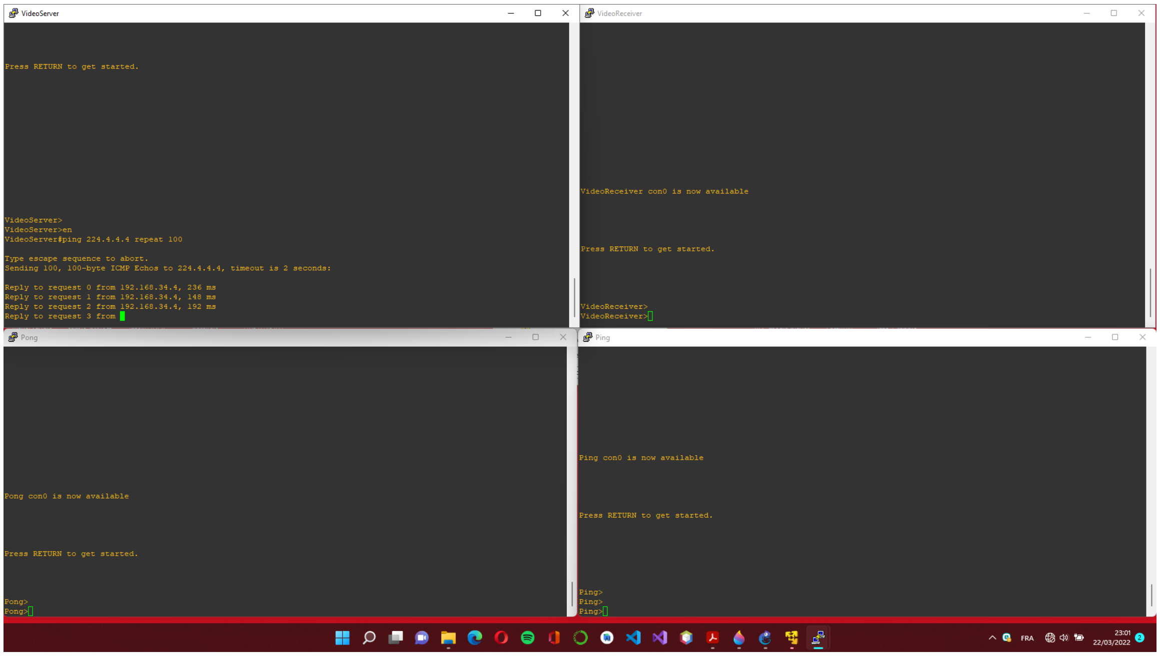

Figure 24: Ping a multicast group address

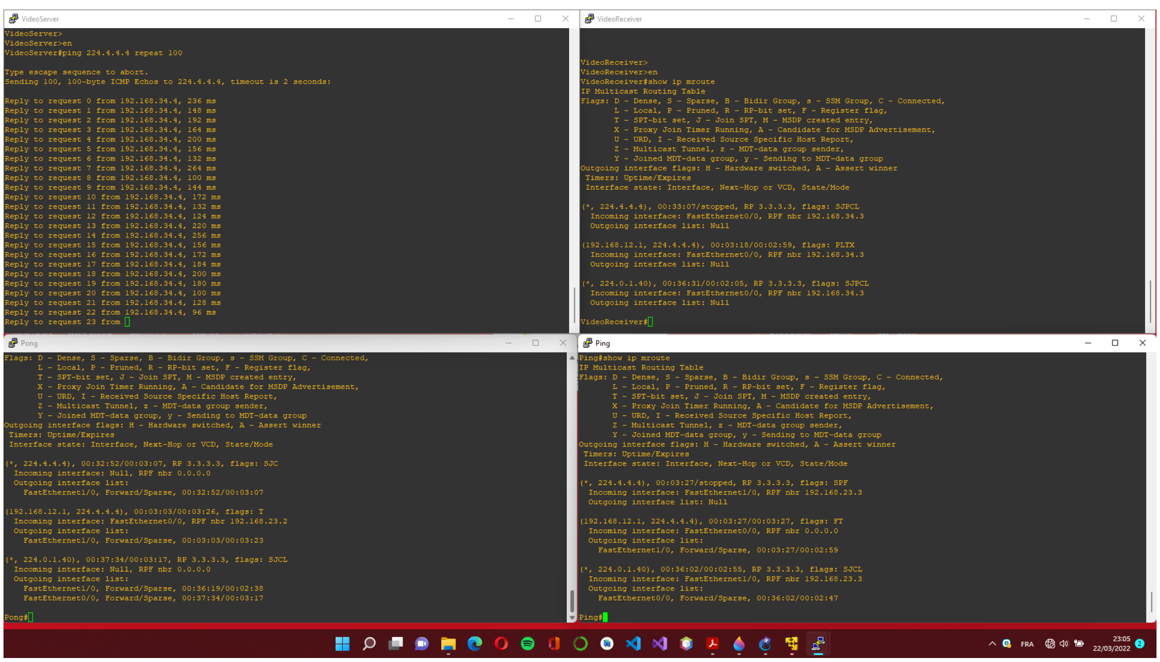

Figure 25: Routing table

7.11

PIM-SM defaults to shared trees and implements source-based trees for performance, assuming that no hosts require multicast traffic until they explicitly request it. It establishes a shared distribution tree based on a predetermined meeting location (RP)

7.12 The advantages of PIM-SM

- It scales well across large networks.
- Sparse mode means that information only needs to be held at those routers in the network that are part of a distribution tree.
- It can use MSDP, SSM or Embedded RP for an inter-domain solution.

7.13 The disadvantages of PIM-SM

- In shared trees, register-encapsulation and decapsulation between the source and RP can be inefficient.
- Many interactions with the data plane are required, which can affect the overall efficiency of routers.

8 Some Answers

How does PIM decide which incoming interface to use for each group? (1)

PIM does an RPF (reverse-path forwarding) check in the unicast routing table for the ip addres to find the 'upstream' incoming interface.

Why does Cisco not recommend using PIM-DM in production networks? (2)

PIM-DM sends traffic down the source tree to every subnet in the network using the flood-and-prune behavior. Flood and prune behavior basically acts as a network broadcast that is sent even to subnets that aren't interested in the traffic. PIM-DM additionally necessitates that each multicast router in the network has complete awareness of all multicast sources that are actively transmitting traffic. When compared to PIM-SM, which accomplishes all of the requirements of multicast without the same bandwidth and memory overhead, this is a considerable amount of memory overhead that is unnecessary.