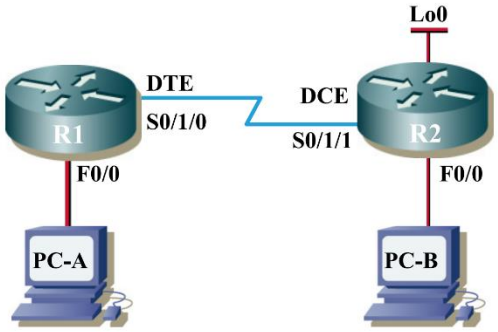
Kommunikationsnät
(Nätverkslabb 2)

Yasir Riyadh (KTH 2022)



Figur 1: Nätverkstopologin

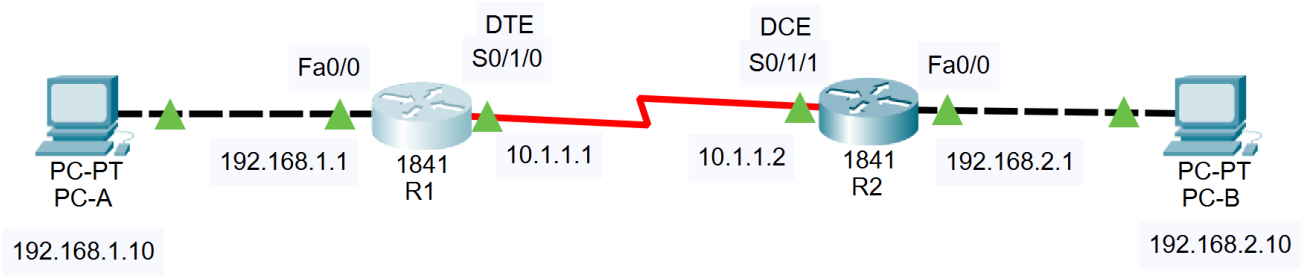
Tabell 1: Namn och nätverksadresser till de olika nätverksenheterna

Device	Interface	IP Address	Subnet Mask	Default
R1	F0/0	192.168.1.1	255.255.255.0	N/A
R1	S0/1/0	10.1.1.1	255.255.255.252	N/A
R2	F0/0	192.168.2.1	255.255.255.0	N/A
R2	S0/1/1	10.1.1.2	255.255.255.252	N/A
R2	Lo0	198.133.219.1	255.255.255.0	N/A
PC-A	NIC	192.168.1.10	255.255.255.0	192.168.1.1
PC-B	NIC	192.168.2.10	255.255.255.0	192.168.2.1

Part 1 - Connection and basic configuration of routers and computers

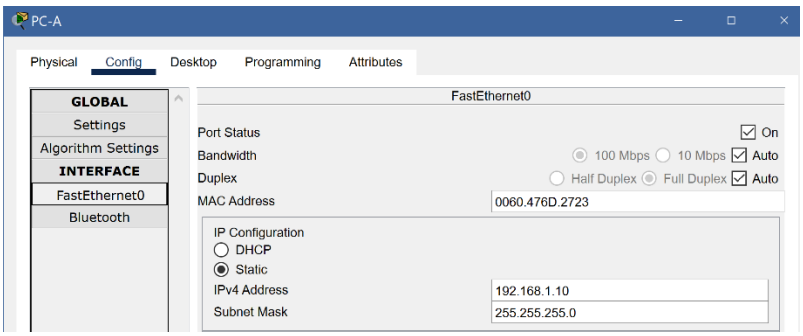
Step 1 - Connect all cables

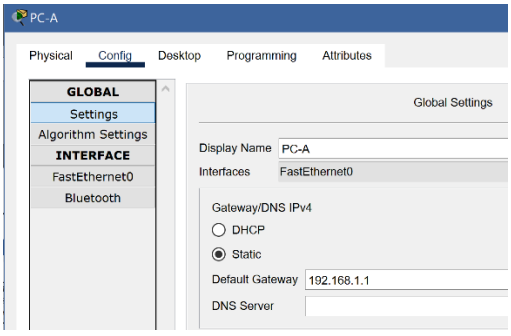
a) The first step would have been "Start by connecting all the cables according to the topology above and turn on the power of the router and the switch." but due to the ongoing pandemic, the teachers have connected all the cables in the cross-connection room. It is possible to look into the cross-connection room if it is vacant! Note that Lo0 is a virtual interface and will be used to simulate an IP address on the Internet.

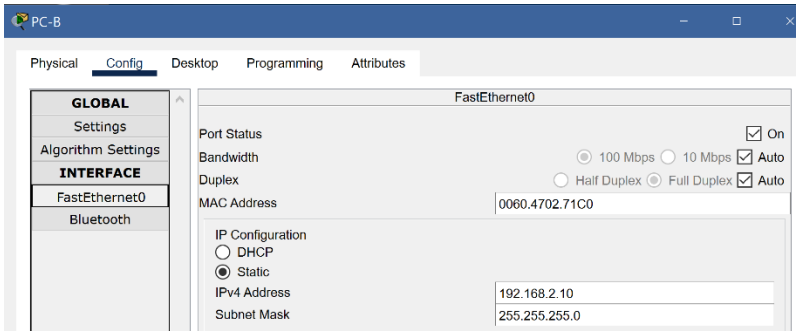


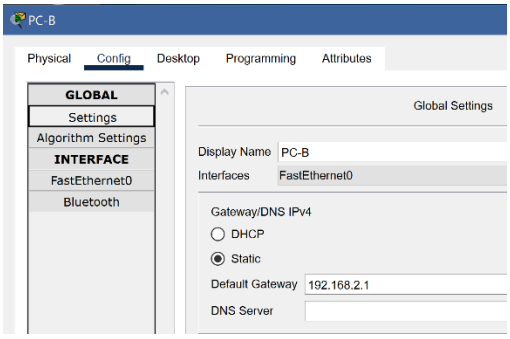
Step 2 - Configure the network settings on the computers

a) Configure the IP address, subnet mask and default gateway on the computers (PC-A and PC-B) according to Table 1.





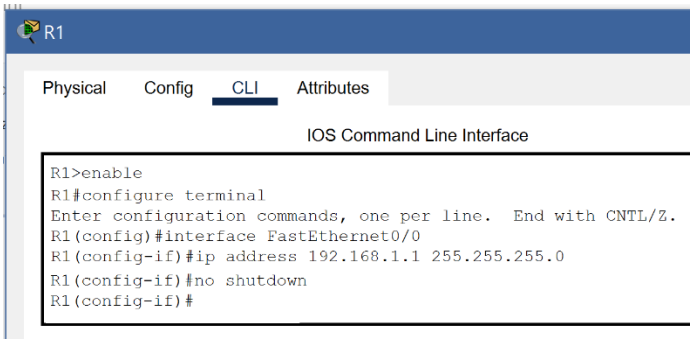


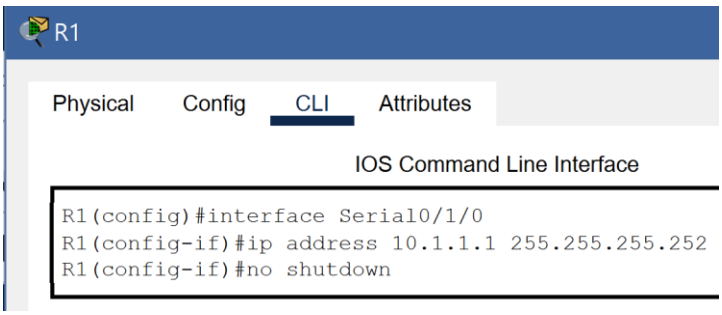


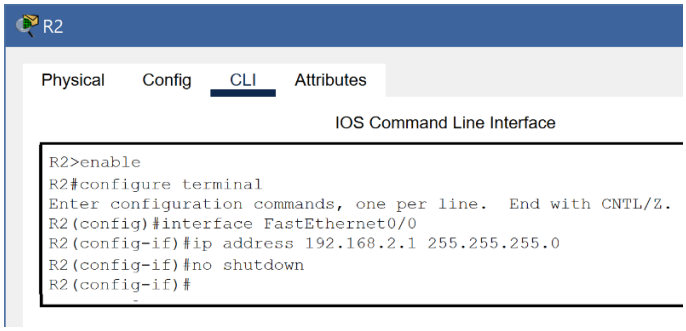
Step 3 - Configure the routers with IP addresses

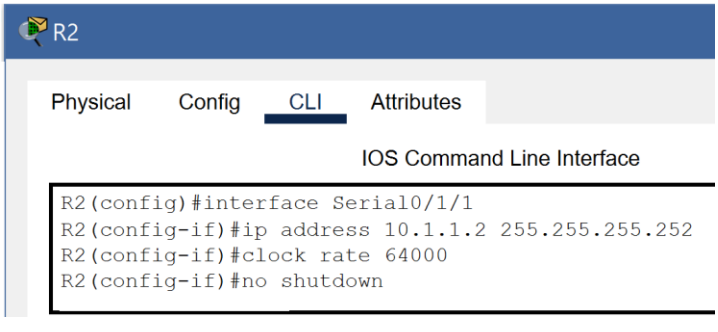
The routers also need IP addresses to be able to communicate with other devices. An IP address per interface.
To be able to configure the router, you need to use a terminal program. In our case TeraTerm which is pre-installed and on the computer desktop. If it is not already default, select Serial in Tera Terms and the port labeled USB-Serial CH340.
a) Start the program and after the routers have started, answer NO to the question "Would you like to enter the initial… ..." Sometimes the continuation question can come "Would you like to terminate auto install?" and there you answer YES. Then it's time to configure the network cards on the router called interface. The router has several interfaces with different name sets (fast ethernet, serial, loopback) and associated port numbering. An abbreviation of these names and the numbering can be found in the topology and table 1.
b) Configure the connected interfaces (2-3pcs per router: fast Ethernet, serial and loopback) on the router with IP address and subnet mask on the routers. See the last page for the designation of the interface
Note: DCE and the DTE end of the serial cable. It must be connected according to what is shown on the topology. The router that has the DCE end of the cable needs to enter the following command for the link to work: **clock rate 64000**
The command is entered when configuring the current serial interface

F1 What commands are used to put an IP address on an interface on a router?







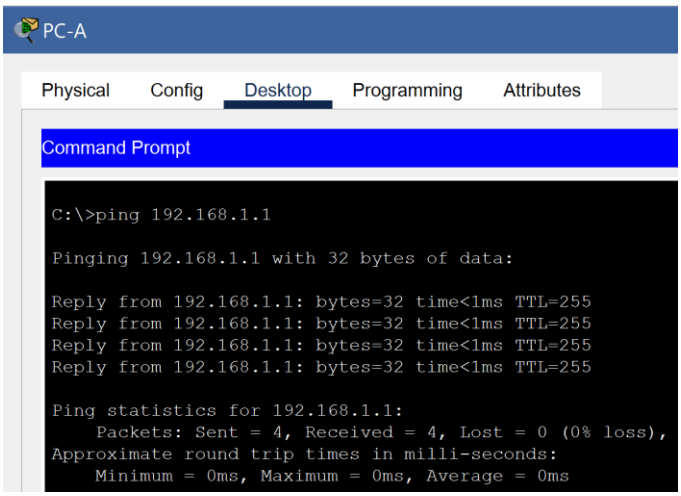


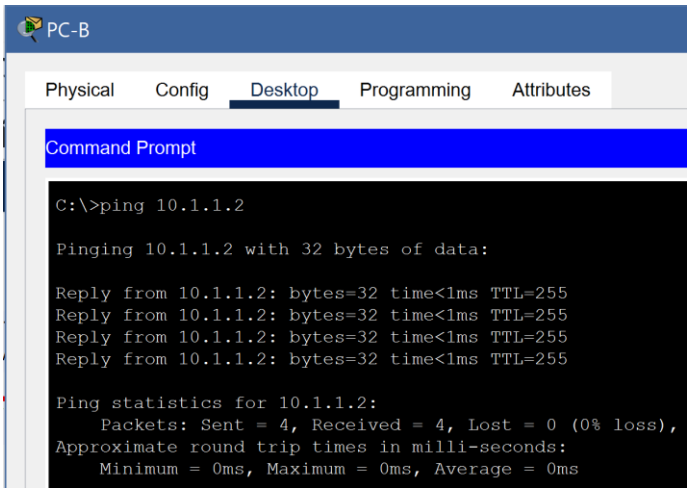
c) When the cable connection and the configuration of IP addresses on the computer and the router is complete, it is important to test so that the network basically works. Use the test tool ping in the command prompt.

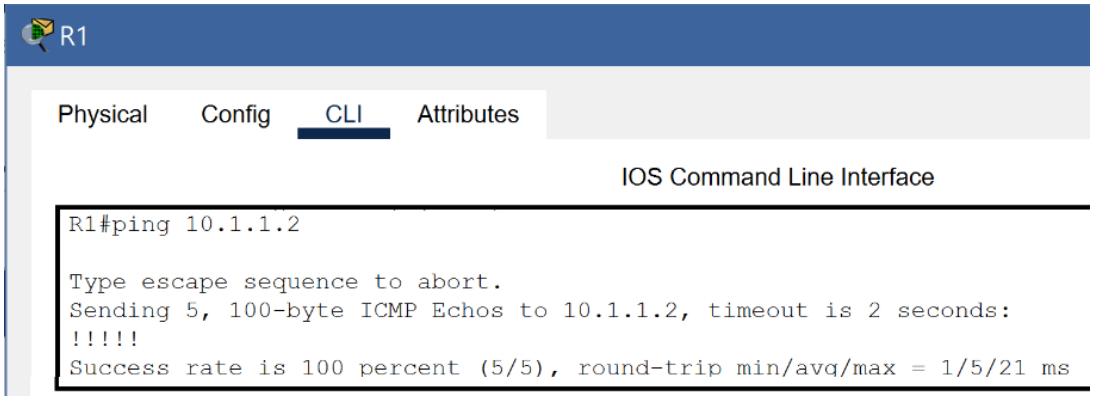
(a) Test that PC-A accesses R1's IP address on the fast ethernet.

(b) Test that PC-B accesses R2's IP address on the fast ethernet.

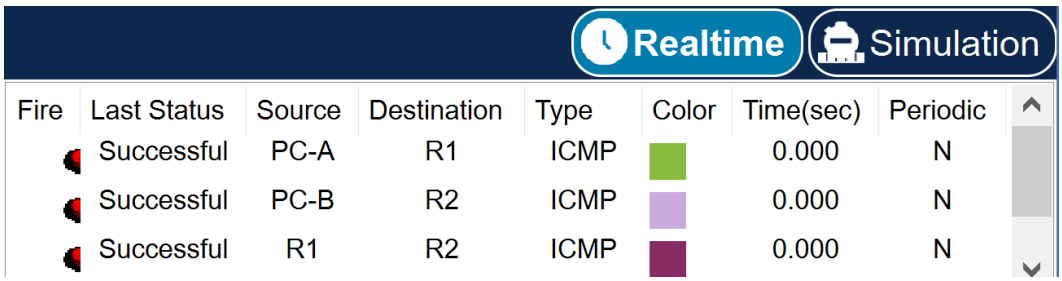
(c) Test that R1 accesses R2's IP address on the serial interface.







All this should work, do not do so, check the connection and configuration again. (No need to move on to the next step if this does not work.)



Step 4 - Traffic analysis of ping packets

a) Start Wireshark on PC-A and PC-B and check if the **Round Trip Time (RTT)** from the ping program in the command prompt matches the one you get from Wireshark.
[*RTT is the length time it takes for a data packet to be sent to a destination plus the time it takes for an acknowledgment of that packet to be received back*]

1) Start by selecting Capture-> Options in Wireshark.
2) Then select Ethernet and then start.
3) Test the link again by pinging (from the command prompt) R1 (192.168.1.1) from PC-A and R2 (192.168.2.1) from PC-B. The Ping program uses the ICMP protocol.

b) Select an ICMP request packet with subsequent ICMP Reply in Wireshark and calculate the time between these two packets. Does the time correspond to the time you get out of the ping program (step 4a)?
c) Stop Wireshark on both computers.

/// results from Wireshark in the Lab
/// from PC-A: ping 192.168.1.1
/// from PC-B: ping 192.168.2.1

Part 2 - Configuring static and default routes

In this part you will implement static and default route on routers R1 and R2 and verify and test the configuration.

Step 1 - Configure static routing

Right now, PC-A and PC-B cannot access each other, but feel free to test to confirm this. The computers only know about the network address to which it is directly connected and have no knowledge of any other network addresses. If the computer wants to reach other network addresses, it must send its packets to the router (default gateway address) so that the router can forward the packet to the correct network.

The router, which is usually connected to several networks, only knows the connected network addresses from the beginning. You will now first implement static route and default static route and thus introduce other network addresses to the routers so that these network addresses become accessible.

The implementation of static route is done by entering the destination network address, the subnet mask of the network you want to reach and the IP address of the next router. Static route uses the following syntax:

```
Router(config)# ip route network-address subnet-mask ip-address
```

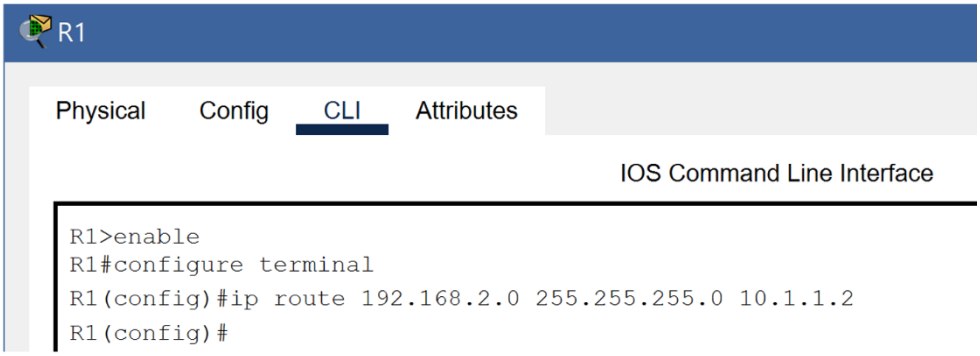
To configure the router R1 with a static route so that it knows how to reach the network 192.168.2.0 via the router 10.1.1.2, enter the following command

```
R1(config)# ip route 192.168.2.0 255.255.255.0 10.1.1.2
```

F2 Enter below the corresponding command to be used on R2 to make a static route to the network address where PC-A is located? (See the example above) It is important not to configure the router R2 yet with this command but it will happen a little later

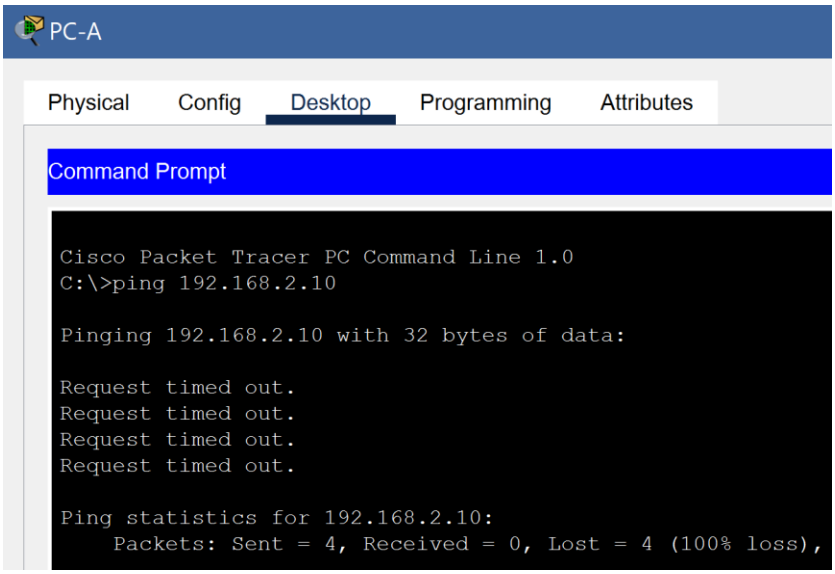
R2(config)# ip route 192.168.1.0 255.255.255.0 10.1.1.1

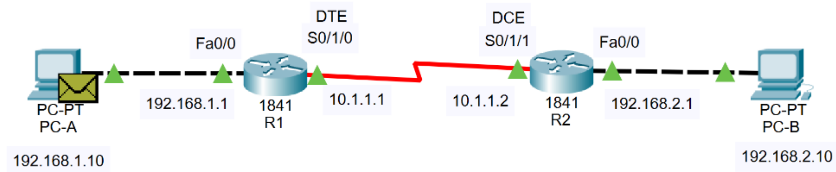
a) Configure R1 with the above command. Static route for R2 will be implemented later in the lab.

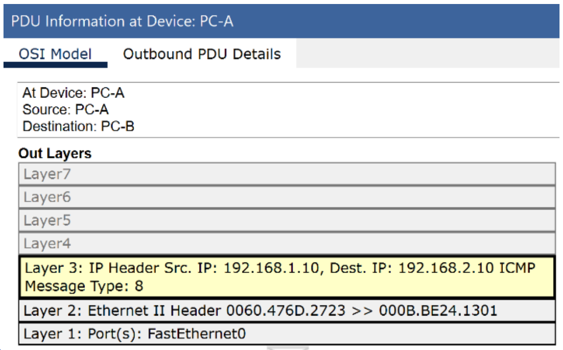


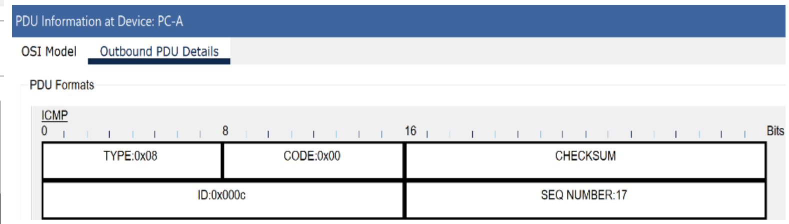
b) Launch Wireshark on PC-A and PC-B again, then ping from PC-A's Windows command prompt to PC-B.

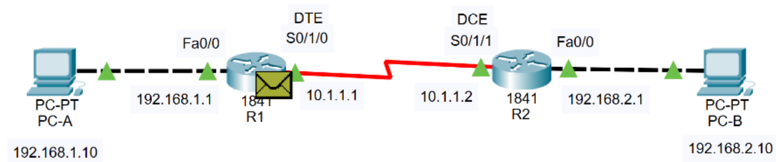
1) What will be the result in the Windows terminal in response to the ping packets?
2) What will be the results in Wireshark on PC-A? Specify the types of ICMP packets sent.
3) What does Wireshark look like on PC-B? Will the ping packets arrive and send PC-B answers back? If not, why not?
4) Does the result differ from the one that was on PC-A before in step part 1, step 4? If so, where for?

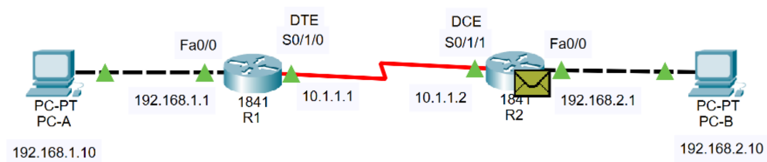


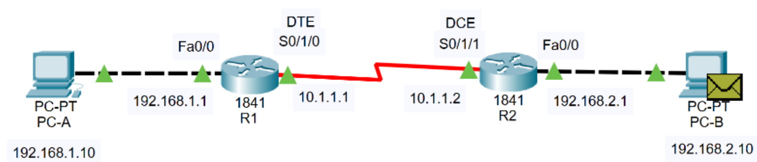


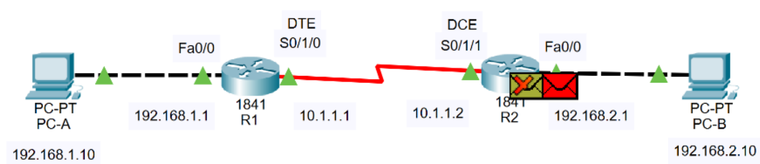












Simulation Panel

Event List

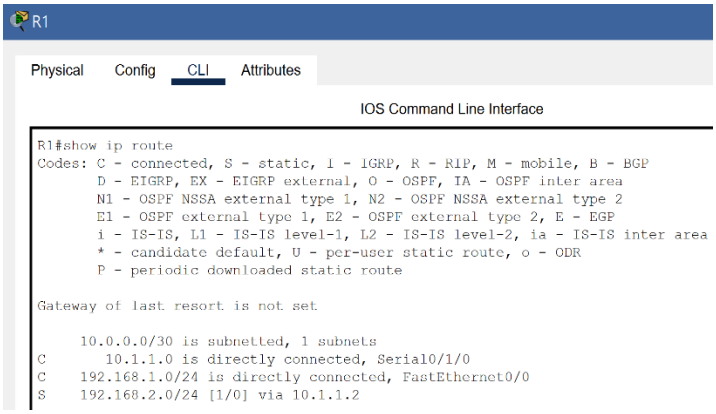
Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC-A	ICMP
	0.001	PC-A	R1	ICMP
	0.002	R1	R2	ICMP
	0.003	R2	PC-B	ICMP
	0.004	PC-B	R2	ICMP
	0.004	--	R2	ICMP
	0.005	R2	PC-B	ICMP
	4.961	--	R1	CDP

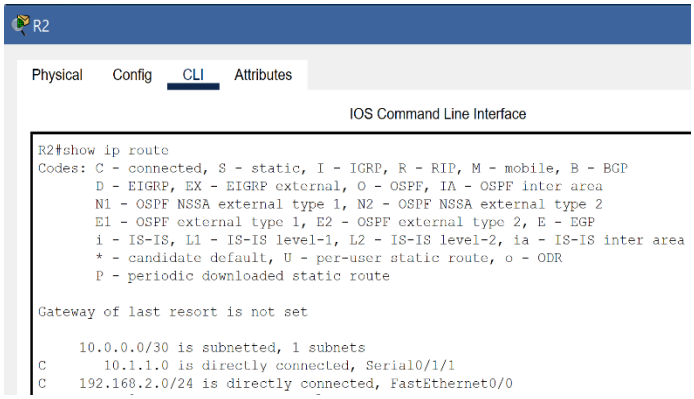
F3 What command is used in the router to display its routing table (the router's image of the network)?

Router# **show ip route**

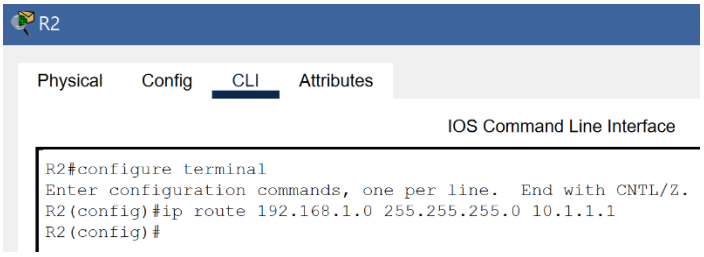
c) Show the routing table in R1 and R2. Is there a network address we are missing?

//Static route address for R2 is missing

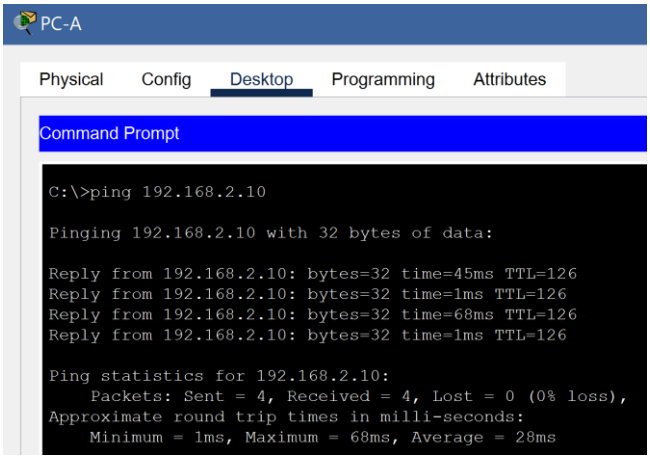


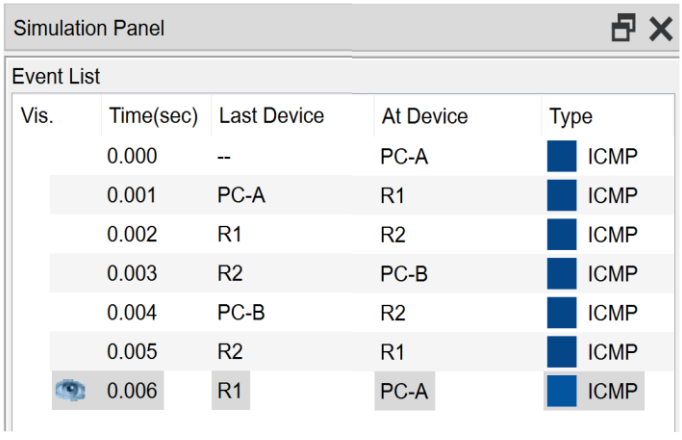


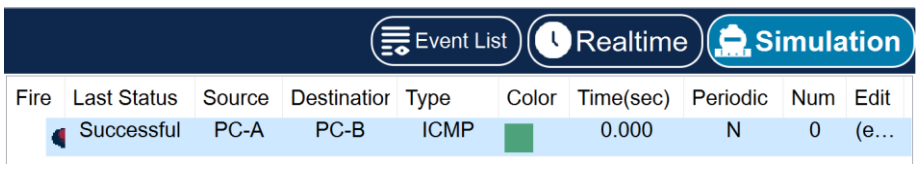
d) Now add a correct static route to R2. See the first preparation task in part 2 step 1.



e) Try to ping again from PC-A to PC-B and at the same time look at the result in the Windows terminal and in Wireshark. This should work.

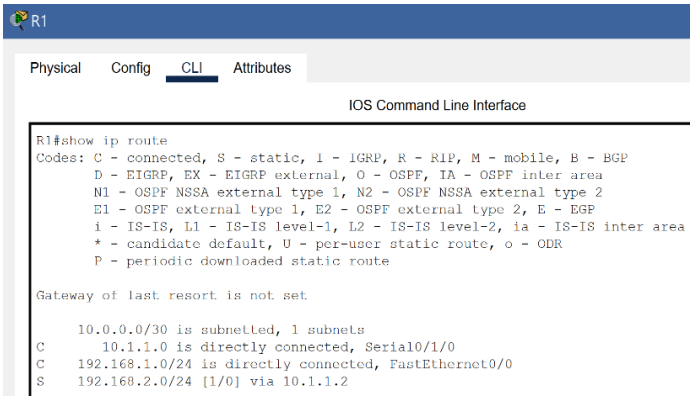


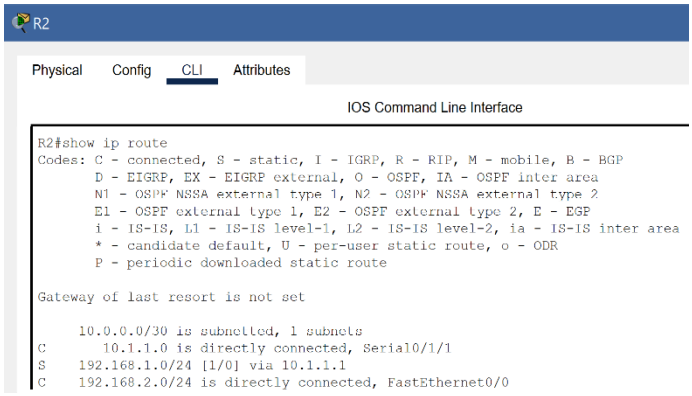




f) Show the routing table in R1 and R2 again. What has changed?

//Static route address for R2 now shown in the table.





Step 2 - Configure the default static route

In this step, a default static route should be implemented instead of a static route. A default static route determines to which router you should send your packets if the destination network address is not included in your routing table. Everyone with "unknown" destination addresses is forwarded to this router. Hopefully this router has information about the destination address, otherwise you are forwarded to the next router which is in your default static route.

F4 The command to remove the static route from R1:
R1(config)# ip route 192.168.2.0 255.255.255.0 10.1.1.2

R1(config)# no ip route 192.168.2.0 255.255.255.0 10.1.1.2

a. Remove the static route on R1. See the preparation question above.
b. Enter the default static route on R1 by entering

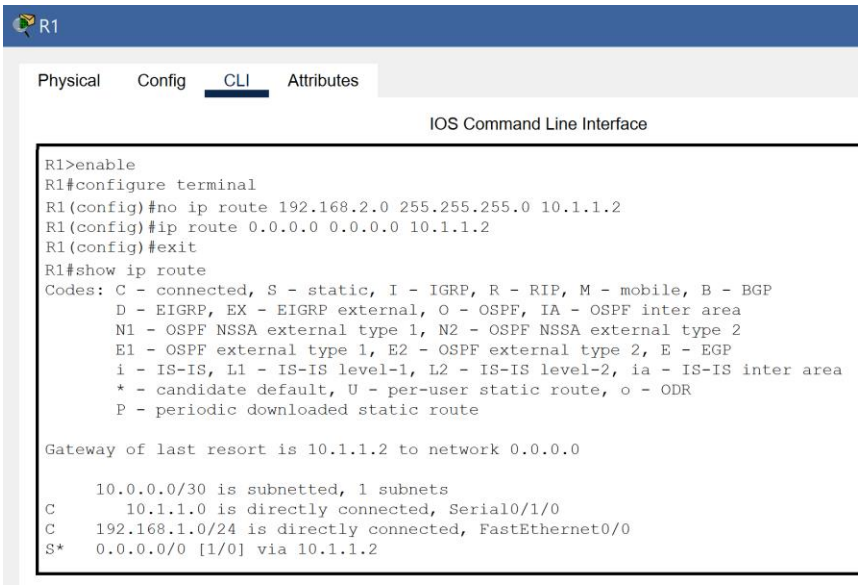
R1(config)# ip route 0.0.0.0 0.0.0.0 10.1.1.2

c. Display the routing table in R1. Use the show ip route command to display the routing table.

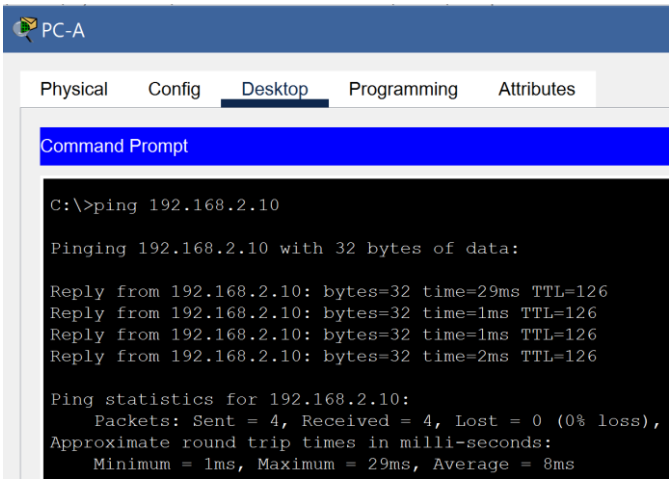
R1# show ip route

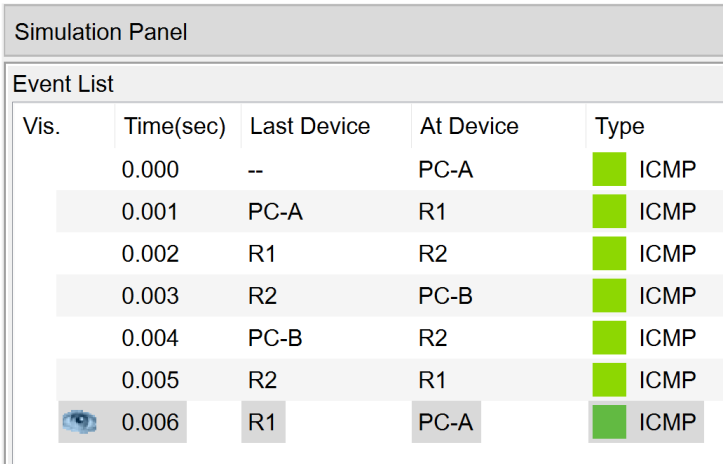
The static route should be gone and replaced with a default static route. How is the default static route displayed in the routing table?

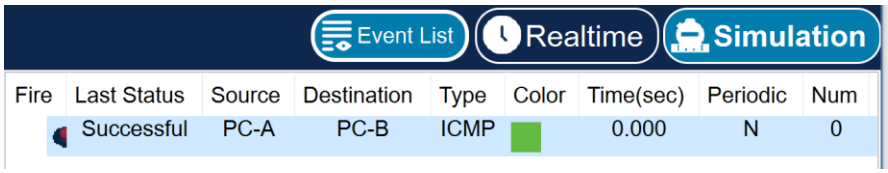
/// S* 0.0.0.0/0 [1/0] via 10.1.1.2



d. Try to ping again, from PC-A to PC-B and look at the result in the Windows terminal and in Wireshark. If everything works, we are done with this part of the laboratory.







e. Remove the default static route from R1 with the command

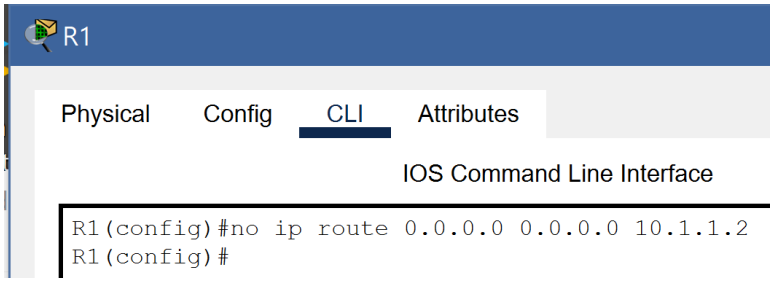
R1 (config) # no ip route 0.0.0.0 0.0.0.0 10.1.1.2

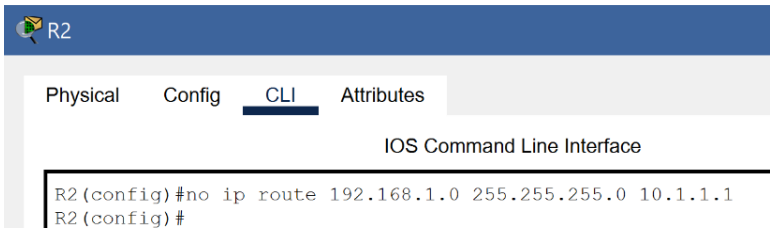
and static route from R2 with the command

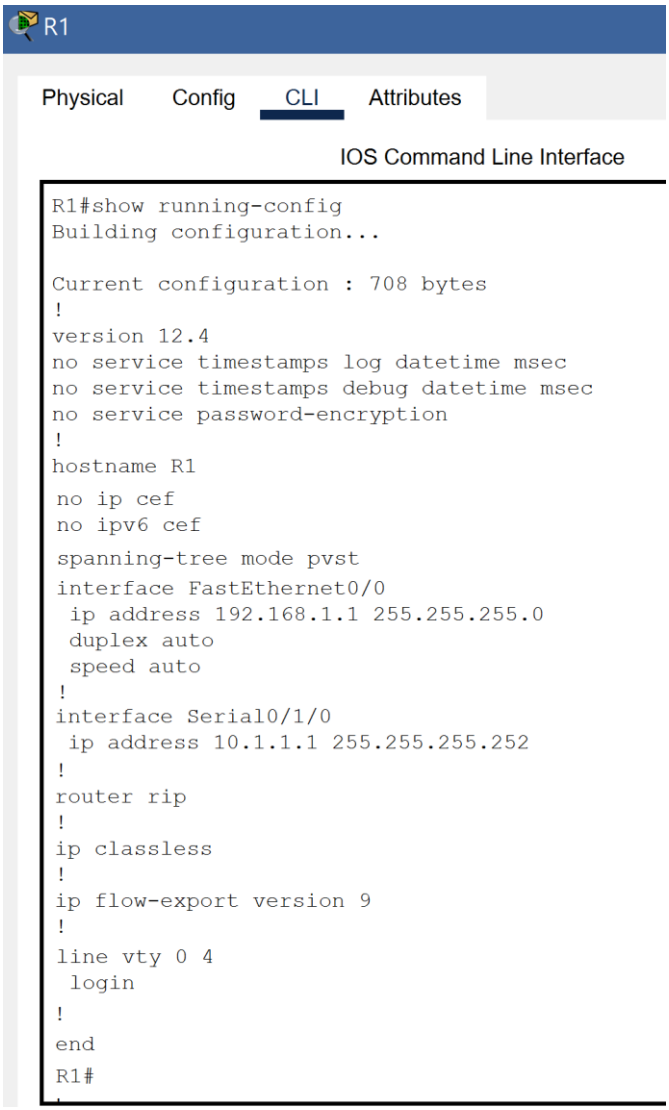
R2 (config) # no ip route 192.168.1.0 255.255.255.0 10.1.1.1

f. Check the routers with the show running command to verify that all static routing and default routes have been removed.

R1 # show running-config


R1
Physical
Config
CLI
Attributes
IOS Command Line Interface
R1(config)#no ip route 0.0.0.0 0.0.0.0 10.1.1.2
R1(config)#


R2
Physical
Config
CLI
Attributes
IOS Command Line Interface
R2(config)#no ip route 192.168.1.0 255.255.255.0 10.1.1.1
R2(config)#


R1
Physical
Config
CLI
Attributes
IOS Command Line Interface
R1#show running-config
Building configuration...
Current configuration : 708 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
no ip cef
no ipv6 cef
spanning-tree mode pvst
interface FastEthernet0/0
ip address 192.168.1.1 255.255.255.0
duplex auto
speed auto
!
interface Serial0/1/0
ip address 10.1.1.1 255.255.255.252
!
router rip
!
ip classless
!
ip flow-export version 9
!
line vty 0 4
login
!
end
R1#

Part 3 - Configuring RIPv2 authentication

In this part you will implement dynamic routing protocols RIPv2 on both routers and verify and test the configuration

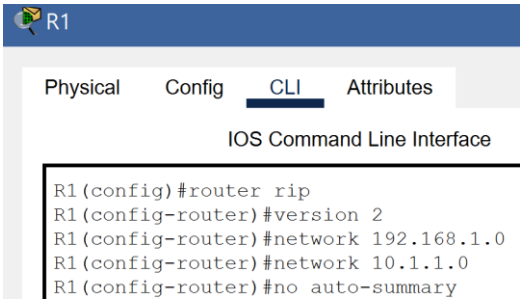
F5 What is a routing update and what information does it contain?

Depending on the routing protocol, the router periodically sends either any network it knows or only its own network to other routers on the network. Contains network address(s) with associated subnet mask and cost of reaching the network.

Step 1 - Configure the dynamic routing protocol RIPv2

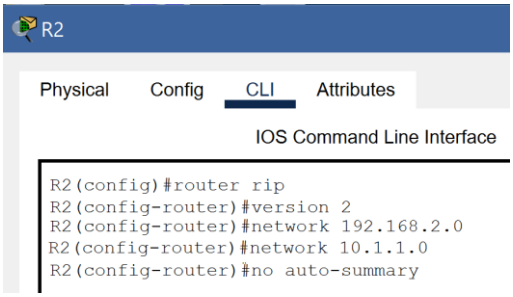
a. On R1, configure RIPv2 and advertise only the online networks. You only enter the networks you are directly connected to. These network addresses will then be announced via the RIP protocol to the other routers. Then the other routers know which network addresses can be reached via your router.

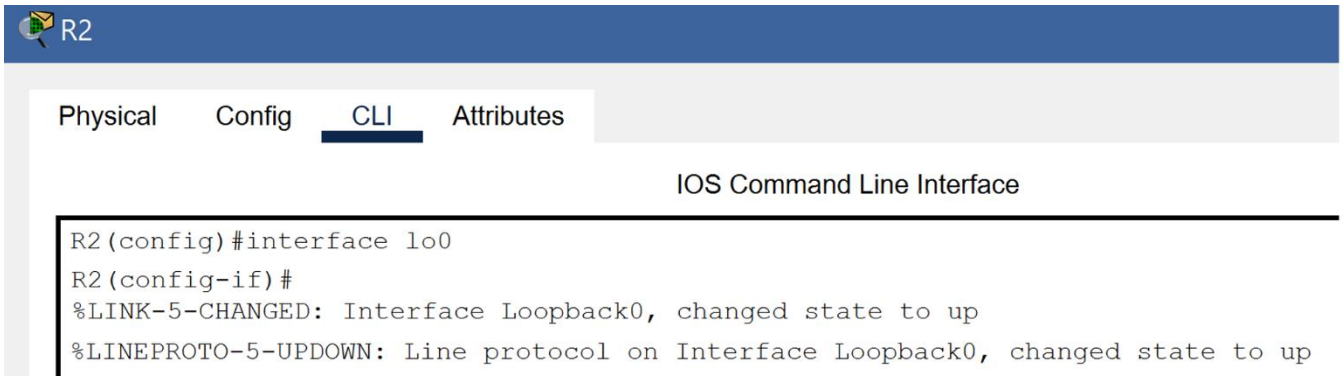
```
R1# config t
R1(config)# router rip
R1(config-router)# version 2
R1(config-router)# network 192.168.1.0
R1(config-router)# network 10.1.1.0
R1(config-router)# no auto-summary
```



b. Now configure RIPv2 on R2 and the appropriate network addresses for the online networks in addition to the Loopback 0 network address.

```
R2# config t
R2(config)# router rip
R2(config-router)# version 2
R2(config-router)# network 192.168.2.0
R2(config-router)# network 10.1.1.0
R2(config-router)# no auto-summary
```





Now review the routing table on both routers and verify that all network addresses (except Lo0 on R2) are visible in both R1 and R2's routing table.

R1

Physical Config CLI Attributes

IOS Command Line Interface

```
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial0/1/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
R    192.168.2.0/24 [120/1] via 10.1.1.2, 00:00:02, Serial0/1/0
```

R2

Physical Config CLI Attributes

IOS Command Line Interface

```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial0/1/1
R    192.168.1.0/24 [120/1] via 10.1.1.1, 00:00:06, Serial0/1/1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
```

Enter the cost (metric) and which outbound interface is used on R1 to send packets to the network 192.168.2.0?

/// [120/1] 120 means RIP and 1 is the cost (RIP makes a routing protocol decision based on the least number of hops)

/// outbound interface that is used on R1 is Serial 0/1/0

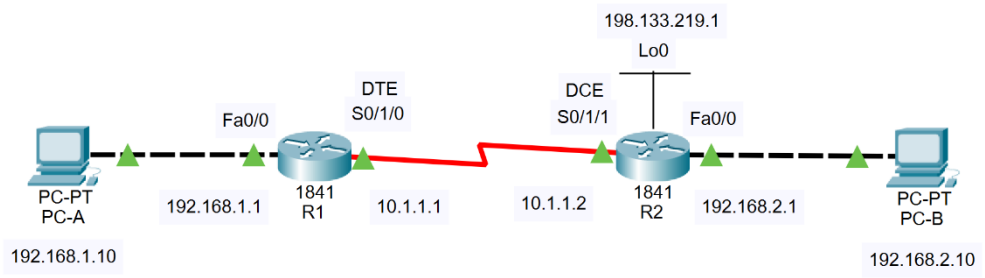
Routing Protocol	Value
Directly connected	0
Static route	1
Internal EIGRP	90
OSPF	110
RIP	120
External EIGRP	170
Unknown	255

c. Now start Wireshark on PC-A and wait until you see a RIPv2 package in the Wireshark program. In the RIPv2 package, examine the information you find in the “Routing Information Protocol” section that may be of interest and enter these below.

d. What could this information be used for? On "good" and / or "bad"?

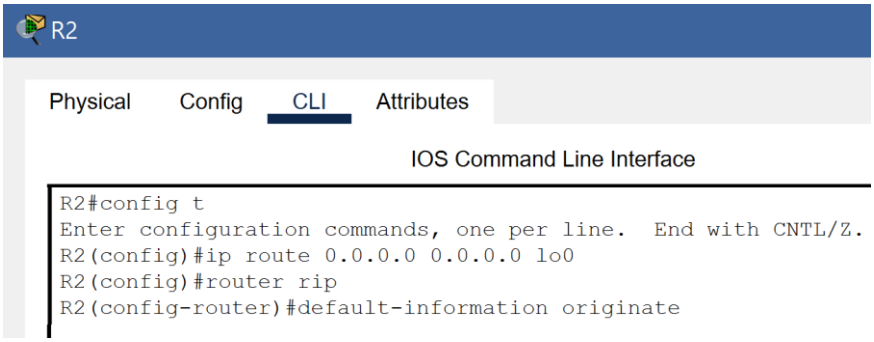
/// using Wireshark on PC-A in the Lab

Step 2 - Configure and deploy a default route for Internet access



a. On R2, a default static route choice to the Internet must be created by using the command ip route. Loopback 0 or the abbreviation lo0 will in our case simulate the way out to the Internet. Create the static default route to the Internet by entering the lines below.

R2(config)# ip route 0.0.0.0 0.0.0.0 lo0
R2(config)# router rip
R2(config-router)# default-information originate



F6 Explain in more detail what the commands "ip route 0.0.0.0 0.0.0.0 lo0" and "default-information originate" have for the task?

ip route 0.0.0.0 0.0.0.0 lo0 – tells the router that, if you want to reach a network that is not in your own routing table, the packets should be passed on to the next router (via interface lo0) which may have a path to the desired destination network. If it doesn't have a route, it in turn sends it to the next router. In this case, the next router is illustrated with the virtual interface lo0.

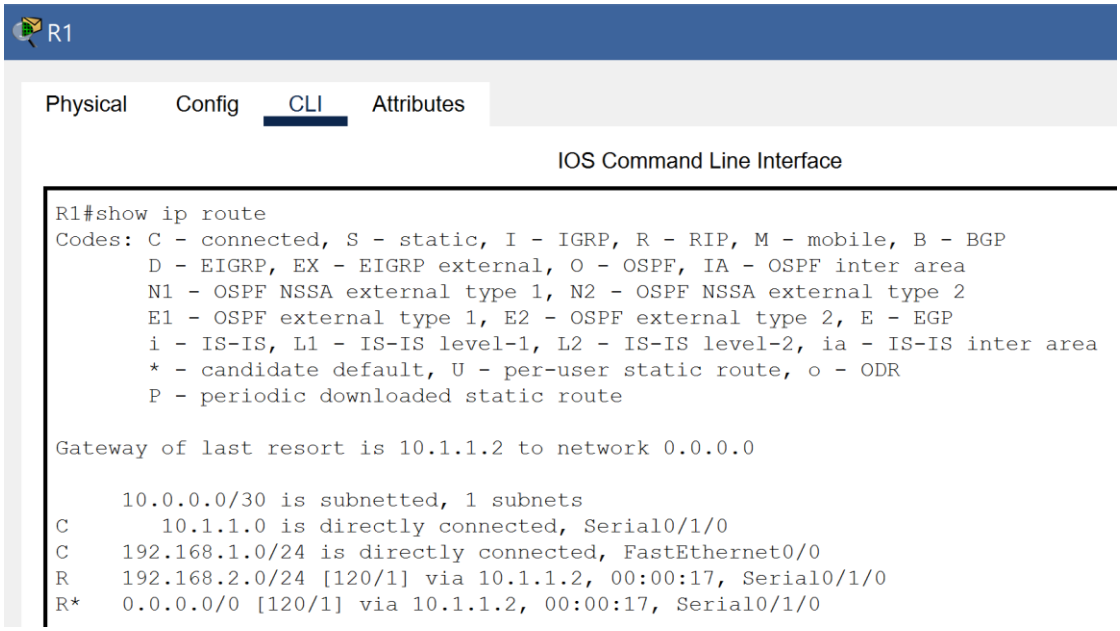
"default information originate" – the router advertises via the routing protocols to all other routers on the network that, if the network address you want to reach is not included in the routing table, send the packet to the advertising router.

b. Now verify that the dynamic default route path selection has been propagated to the router R1 m.h.a. RIPv2. Use the show ip route command to display the routing table

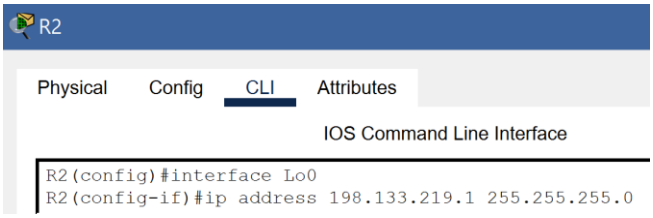
R1# show ip route

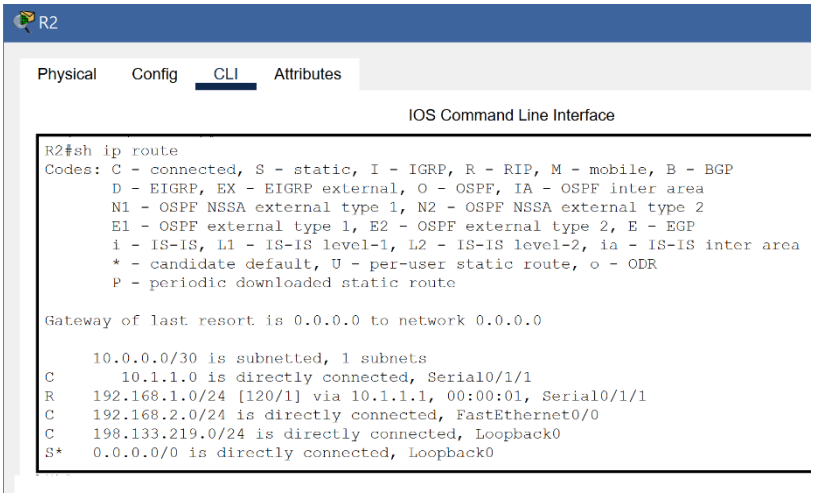
Terminalen skall följande

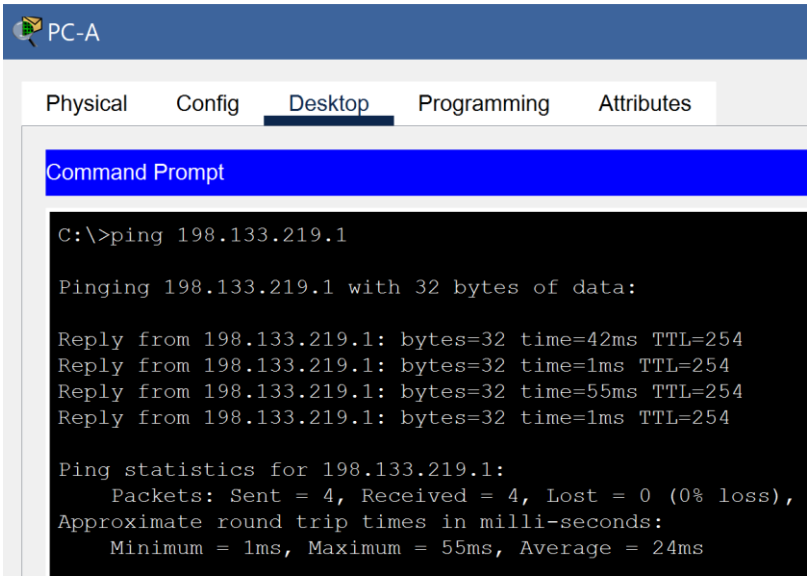
```
<Output omitted>
Gateway of last resort is 10.1.1.2 to network 0.0.0.0
     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial0/1/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
R    192.168.2.0/24 [120/1] via 10.1.1.2, 00:00:24, Serial0/1/0
     209.165.200.0/27 is subnetted, 1 subnets
R*   0.0.0.0/0 [120/1] via 10.1.1.2, 00:00:01, Serial0/1/0
```



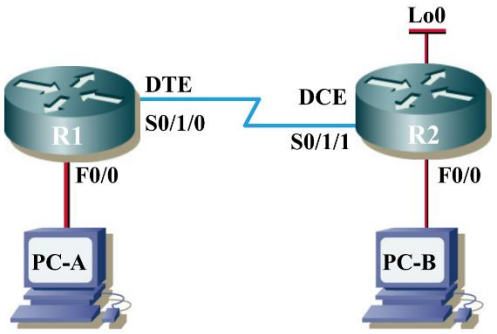
c. Now simulate the traffic to the Internet by pinging from PC-A to 198.133.219.1. This should work even if the network 198.133.219.0 is not included in R1's routing table. This is because we have a default static route that finds out about these packets that are not included in the routing table.







Part 4 - Configuring IPv6 Addresses and Dynamic IPv6 address assignment.



Figur 1: Nätverkstopologin

Tabell 2: Namn och nätverksadresser

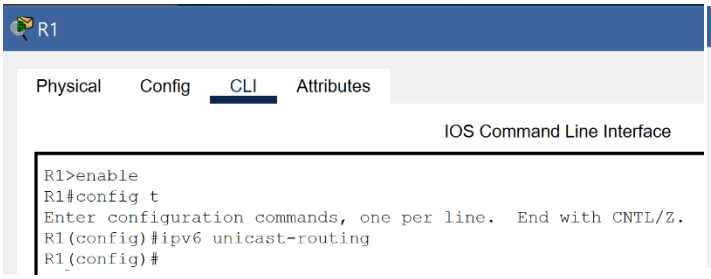
Device	Interface	IPv6 Address
R1	F0/0	2001:db8:acad:1::1/64
R1	S0/1/0	2001:db8:acad:2::1 /64
R2	S0/1/1	2001:db8:acad:2::2/64
R2	F0/0	2001:db8:acad:3::1 /64
PC-A	NIC	DHCPv6
PC-B	NIC	DHCPv6

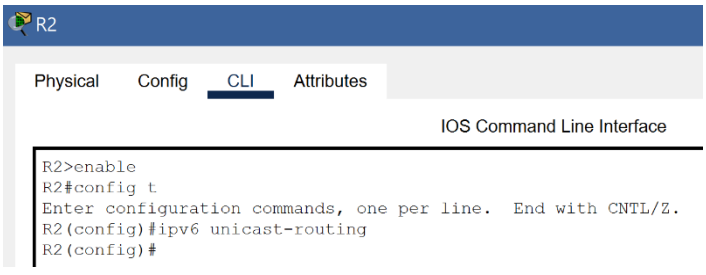
In this part of the lab, the network engineer has been instructed to configure so that there is support for IPv6 and that the computers are dynamically assigned IPv6 addresses to the computers. Your job is to configure the R1 and R2 routers so that you also have IPv6 addresses in parallel with IPv4 addresses and to get static routing for the IPv6 networks connected to the routers.

Step 1 - Turn on IPv6 routing support

Enable IPv6 routing support by entering the following commands in R1 and R2

Router(config)# ipv6 unicast-routing





Step 2 - Configure the routers with IPv6 addresses

Configure the interface on both routers with IPv6 addresses according to Table 2

R1

Physical Config CLI Attributes

IOS Command Line Interface

```
R1(config)#interface Fa0/0
R1(config-if)#ipv6 address 2001:db8:acad:1::1/64
R1(config-if)#exit
R1(config)#interface s0/1/0
R1(config-if)#ipv6 address 2001:db8:acad:2::1/64
R1(config-if)#
```

R2

Physical Config CLI Attributes

IOS Command Line Interface

```
R2(config)# interface Fa0/0
R2(config-if)#ipv6 address 2001:db8:acad:3::1/64
R2(config-if)#exit
R2(config)# interface S0/1/1
R2(config-if)#ipv6 address 2001:db8:acad:2::2/64
R2(config-if)#
```

a. Configure a static path selection on each router that points to the IP address of the serial interface on the other router using the following commands. (We do this so that a little later in the lab can reach the networks "behind" or router where PC-A or PC-B is connected. The first line below says that, if a packet comes in where you do not know where to go send it, then select the default route (**:: / 0**) in the routing table and forward that packet to R2 (**2001: db8: acad: 2 :: 2**). Same thing with R2 when a packet arrives with an unknown destination, sends it to R1.)

R1

Physical Config CLI Attributes

IOS Command Line Interface

```
R1(config)#ipv6 route ::/0 2001:db8:acad:2::2
R1(config)#
```

R2

Physical Config CLI Attributes

IOS Command Line Interface

```
R2(config)#ipv6 route ::/0 2001:db8:acad:2::1
R2(config)#
```

b. Verify that the static routing works by pinging R1's fast ethernet from R2 and R2's fast ethernet interface from R1, respectively.

R1

Physical Config CLI Attributes

IOS Command Line Interface

```
R1#ping 2001:db8:acad:3::1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:db8:acad:3::1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/5/25 ms
```

R2

Physical Config CLI Attributes

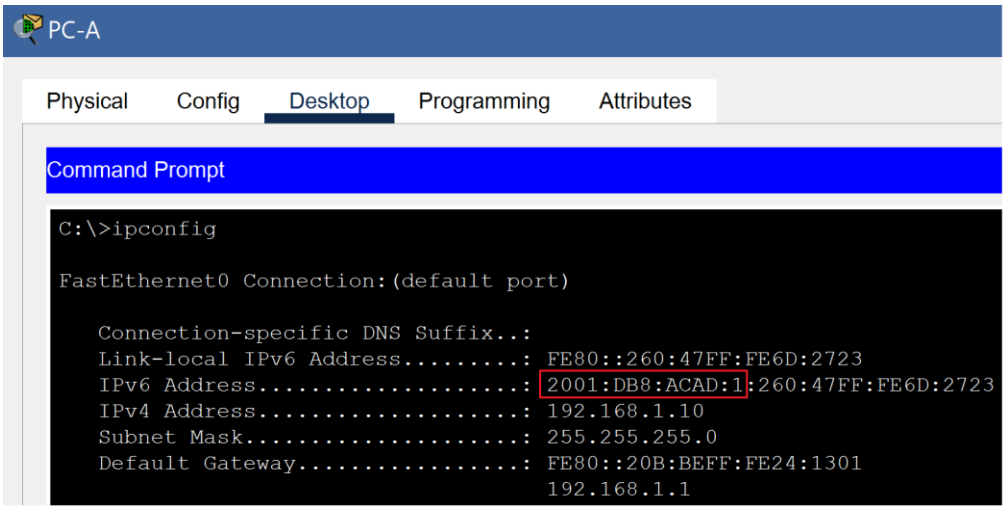
IOS Command Line Interface

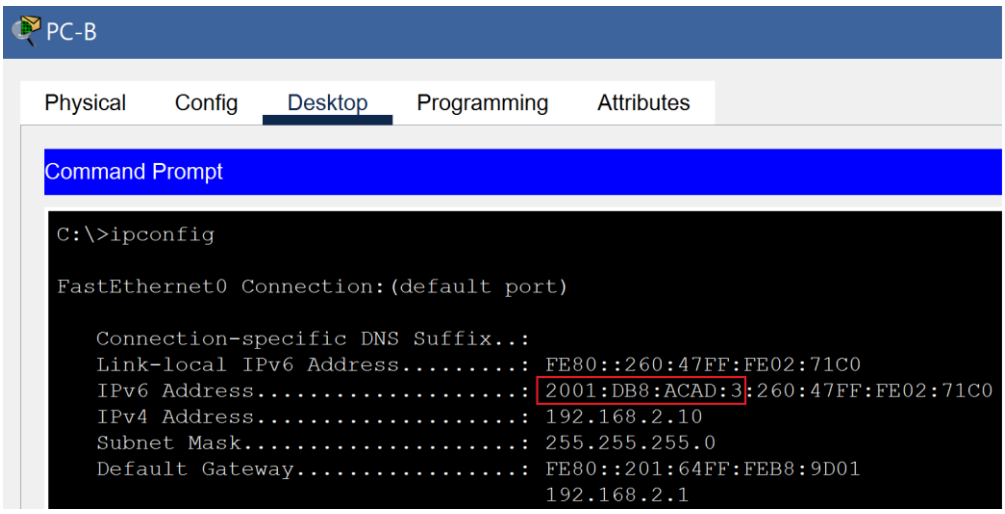
```
R2# ping 2001:db8:acad:1::1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:db8:acad:1::1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/11/36 ms
```

Step 3 - Verify dynamic assignment of IPv6 addresses

In this step, you must verify that PC-A or PC-B is assigned a dynamic IPv6 address by using the Stateless address autoconfiguration (SLAAC) service. The computer is set to receive automatic assignment of IPv6 addresses.

a. Enter the ipconfig command in the command prompt on the computer to verify that PC-A has received an IP address from the network address 2001: db8: acad: 1 :: / 64 and PC-B has received an IP address from the network 2001: db8: acad: 3 :: / 64





b. As a final step, verify that the IPv6 network is working by pinging the IPv6 address of the other PC in the command prompt from one PC.