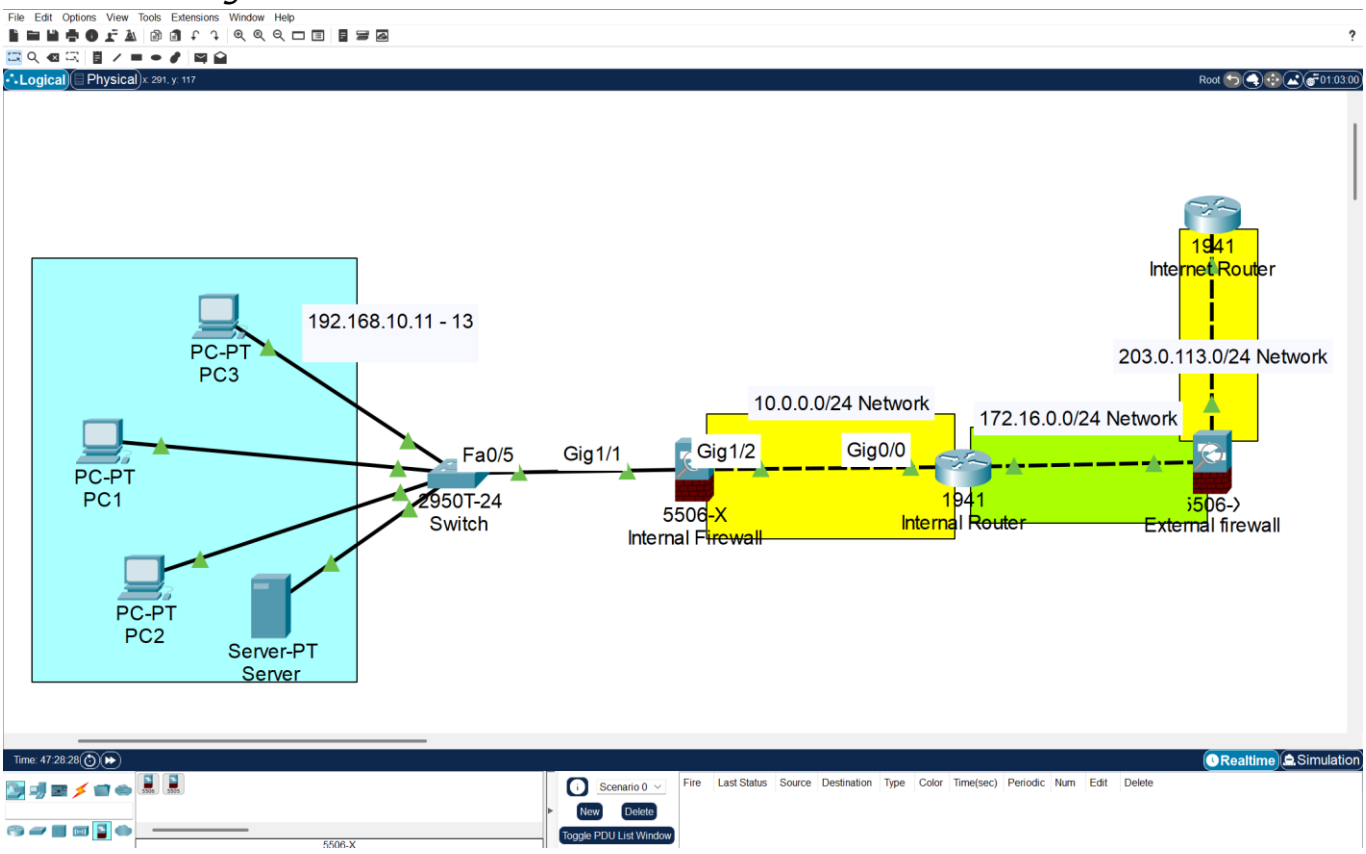
SIMULATION AND ANALYSIS IN CISCO PACKET TRACER

Here, I simulated a network topology using 3 PCs, switch, router, 2 firewalls (internal & external) and a Cloud/internet gateway. I have also included the commands and configurations used in this document.

This network is simple but at the same time, has some loose endings which I will be explaining at the end of this document.

Here is the design



Here is a link to the Cisco Packet tracer file

Here is the network configurations for each device used.

Device	Interface	IP Address
PC1–PC3	Fa0	192.168.10.11–13
DB Server	Fa0	192.168.10.100
Internal Firewall	Inside (Gig 1/1)	192.168.10.1
Internal Firewall	Outside (Gig 1/2)	10.0.0.1
Router0	Gig0/0	10.0.0.2
Router0	Gig0/1	172.16.0.1
External Firewall	Inside (Gig 1/1)	172.16.0.2
External Firewall	Outside (Gig 1/2)	203.0.113.2
Internet Router	Gig 0/0	203.0.113.1
Default gateway for PCs and sever		192.168.1.1

SUMMARY & EXPLANANTION OF COMMANDS USED

Command	Explanantion
interface GigabitEthernet1/1	This selects the physical interface G1/1 on the device. It can either FastEthernet or GigabitEthernet interface.
nameif inside	Names the interface "inside". This is the trusted/internal side of the network. (inside of the firewall)
security-level 100	Sets the highest security level (100). ASA uses this to define trust levels — 100 = fully trusted, 0 = untrusted (like the internet).
ip address 10.0.0.1 255.255.255.0	Assigns IP address 10.0.0.1 and subnet mask 255.255.255.0 to a particular interface
no shutdown	Enables (brings up) the interface.
	NAT CONFIGURATIONS
object network obj_any	Enables (brings up) the interface.

subnet 192.168.10.0 255.255.255.0	Defines the subnet that the object represents (192.168.10.0/24 in this case).
nat (inside,outside) dynamic interface	This configures dynamic NAT on the firewall to translate internal IP addresses to the IP address of the outside interface of the firewall when accessing external networks. This essentially uses dynamic NAT (PAT) and substitutes the source IP with the outside interface's IP.
	ROUTING CONFIGURATIONS
route outside 0.0.0.0 0.0.0.0 203.0.113.1	This is a default route: all unknown traffic from the outside interface will go to the next-hop gateway at 203.0.113.1 (This was our Internet router)
route inside 10.0.0.0 255.255.255.0 172.16.0.1 route inside 192.168.10.0 255.255.255.0 172.16.0.1	This means that traffic destined for 10.0.0.0/24 and 192.168.10.0/24 should be sent to 172.16.0.1 via the inside interface
route outside 192.168.10.0 255.255.255.0 203.0.113.1	This means to route traffic from 192.168.10.0/24 via the outside interface to 203.0.113.1.
	ACCESS CONTROL LISTS (ACLs)
access-list OUTSIDE-IN extended permit icmp any any	Allow all ICMP (e.g., ping) traffic from any source to any destination inbound from the outside.
access-list INSIDE-OUT extended permit ip any any	Allow all protocols from inside to any destination (very permissive). Often used in basic setups, but not secure long-term.
access-list INSIDE-OUT extended permit icmp any any	Allow users inside to ping any device (even public internet). This is okay for diagnostic purposes.

The PC IP CONFIGURATIONS

For the PC configurations, I used a static IP configuration of 192.168.10.0/24 network using the IP address of the Gig 1/1 of the internal firewall as default gateway. For all the PCs. The subnet mask is 255.255.255.0

The network is 192.168.10.0 /24.

Image configuration for PC2

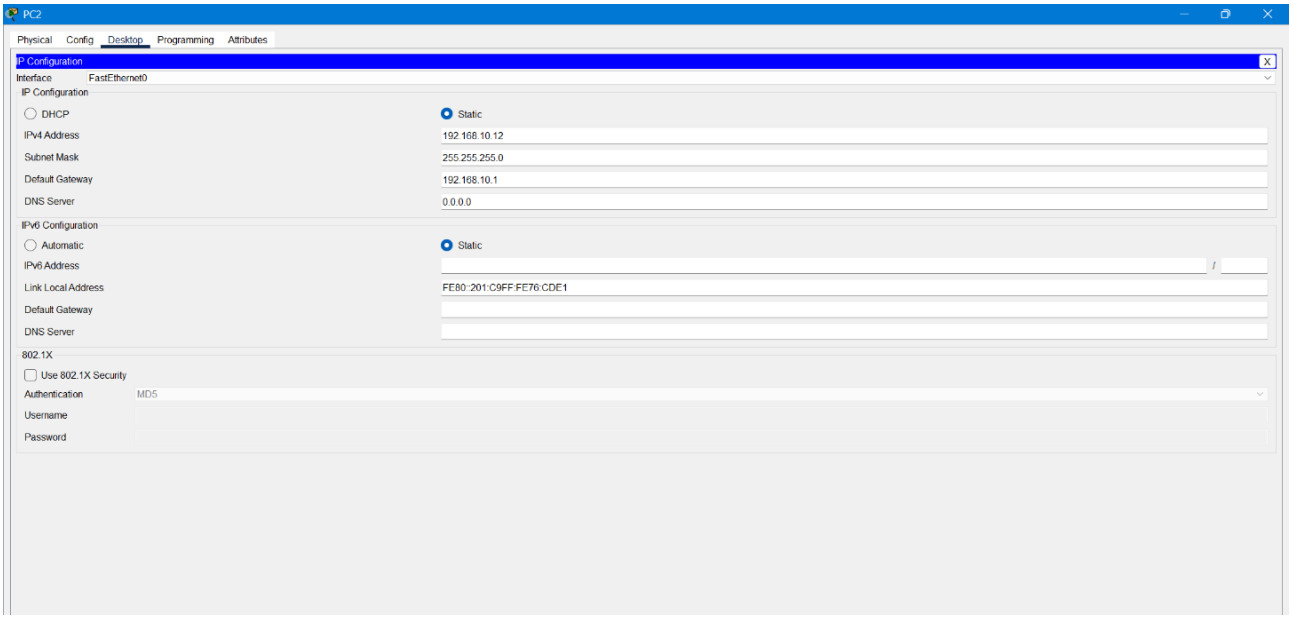


Image configuration for PC1

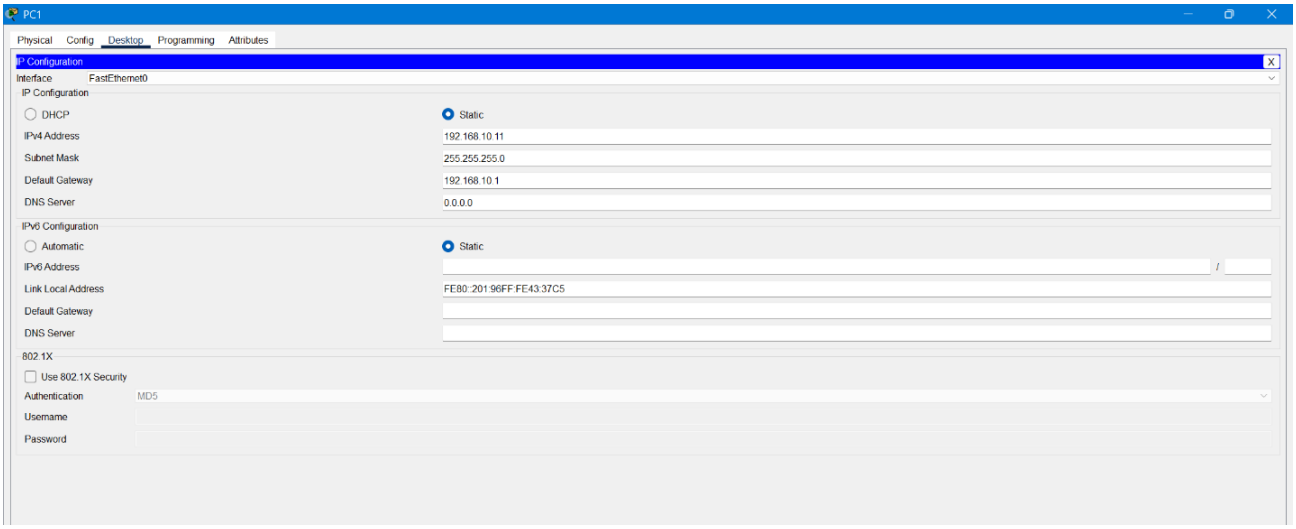
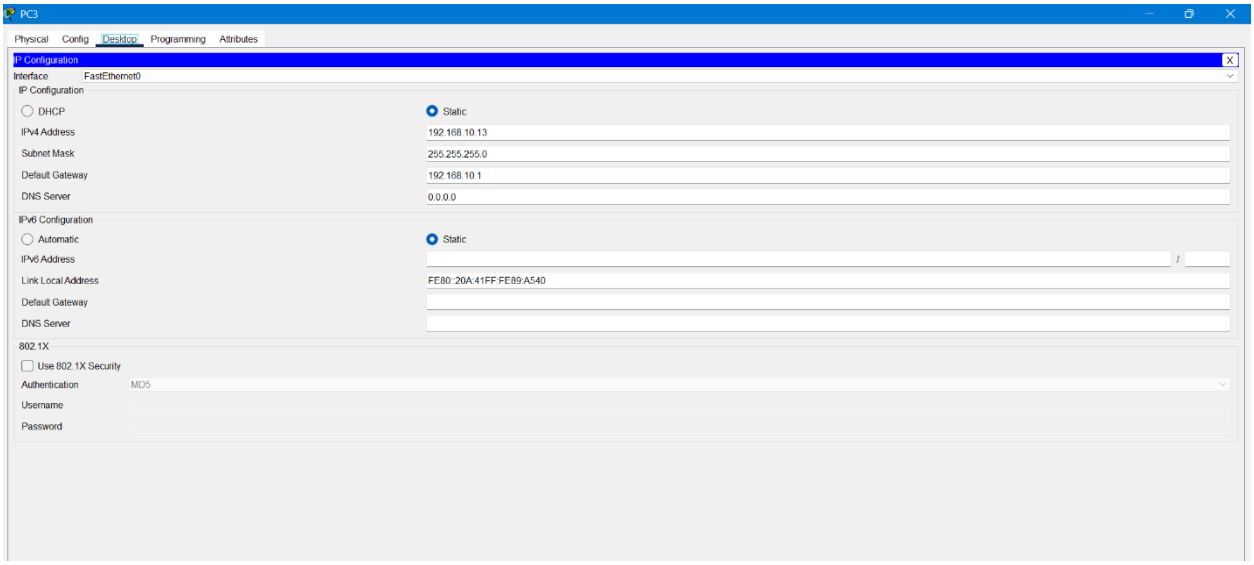


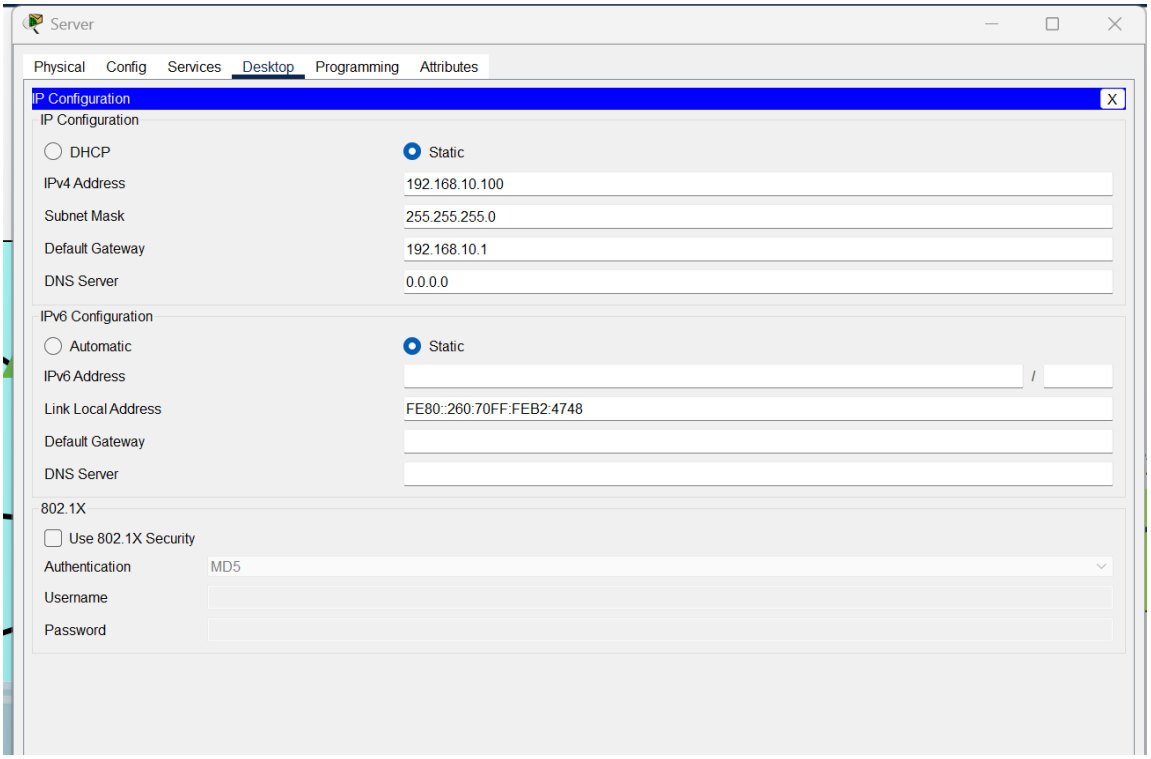
Image configuration for PC3



DB SERVER CONFIGURATION

The DB server is configured with an IP address 192.168.10.100 belonging to the same network as the three PCs using the GUI (Graphic User Interface) of the Server. The default gateway is 192.168.10.1 (IP address of the internal firewall - inside).

Image configuration for the Database Server



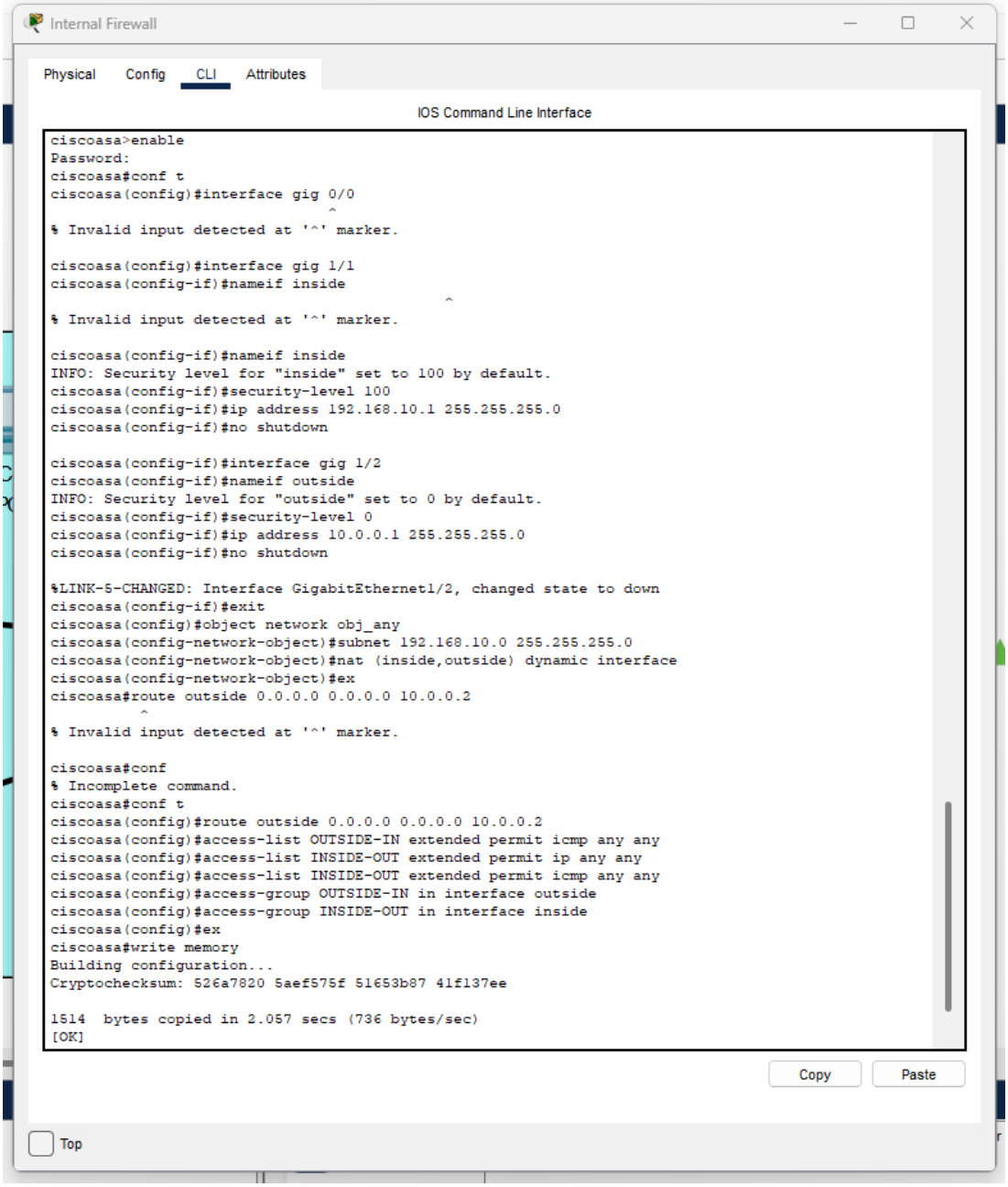
INTERNAL FIREWALL CONFIGURATION

The internal firewall was configured with IP address belonging to the same network of the 3 PCs to allow traffic to move outside from the PC to the firewall, then finally to reach the cloud. There are 2 interfaces; the inside security level was set to 100. While, for the external interface, the security level is set to 0.

The commands used:

```
interface GigabitEthernet1/1
nameif inside
security-level 100
ip address 10.0.0.1 255.255.255.0
no shutdown

interface GigabitEthernet1/2
nameif outside
security-level 0
ip address 192.168.10.1 255.255.255.0
no shutdown
object network obj_any
subnet 192.168.10.0 255.255.255.0
nat (inside,outside) dynamic interface

route outside 0.0.0.0 0.0.0.0 10.0.0.2
access-list OUTSIDE-IN extended permit icmp any any
access-list INSIDE-OUT extended permit ip any any
access-list INSIDE-OUT extended permit icmp any any
access-group OUTSIDE-IN in interface outside
access-group INSIDE-OUT in interface inside
```

Image showing the internal firewall configuration



ROUTER CONFIGURATION

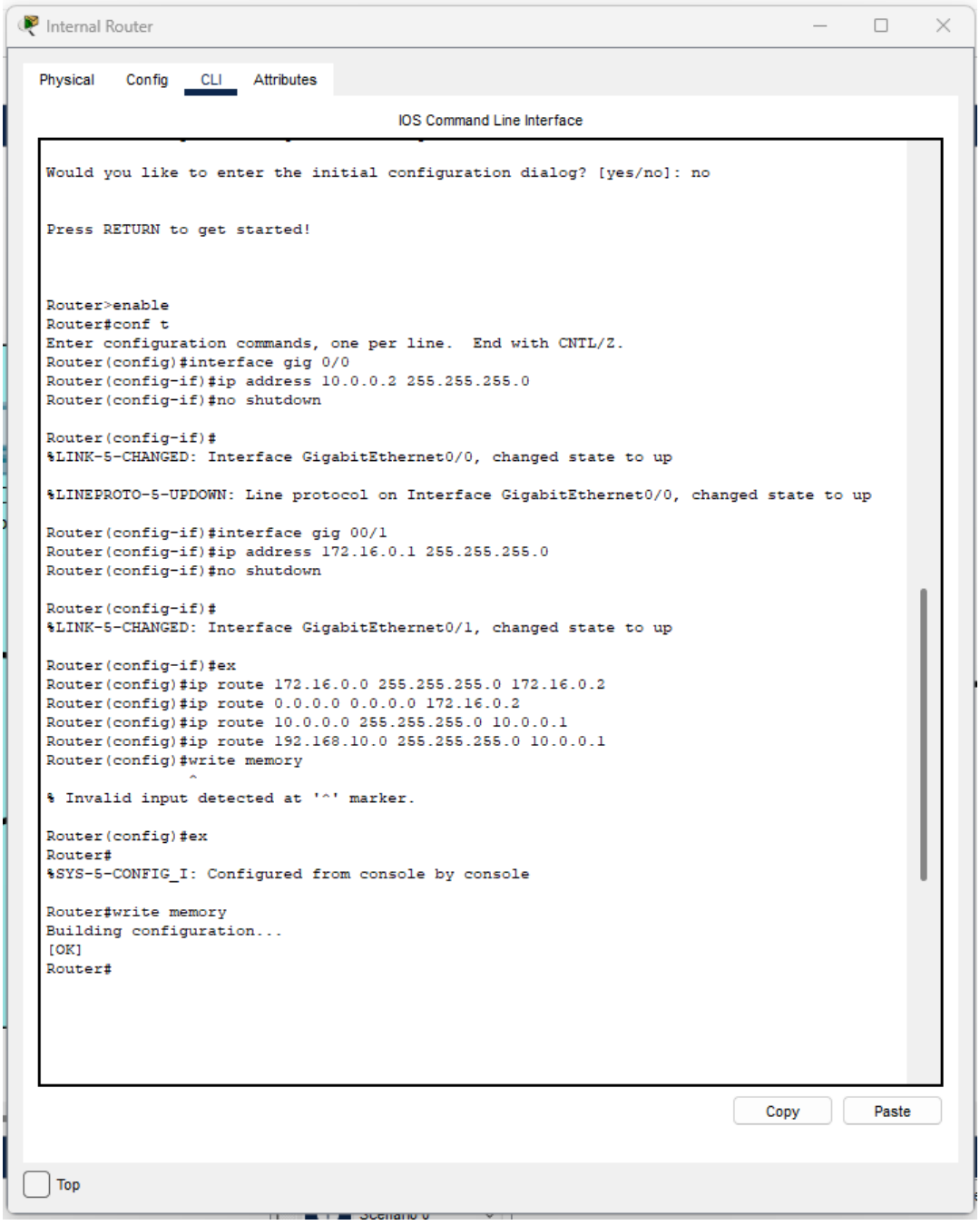
The router is located between the two firewalls. The Gig 0/0 interface is configured with the IP address belonging to the same network of outside interface of the internal firewall. The Gig 0/1 interface is configured with the Ip address belonging to the same network portion of the external firewall (internal interface).

After each configuration, no shutdown command was used to power the router. The configurations are shown in the screenshot below.

Commands used:

```
interface GigabitEthernet 0/0
ip address 10.0.0.2 255.255.255.0
no shutdown

interface GigabitEthernet0/0/1
ip address 172.16.0.1 255.255.255.0
no shutdown
```

Image showing the external router configuration



EXTERNAL FIREWALL CONFIGURATION

The external firewall was configured with IP address belonging to the same network as the router Gig 0/1 interface, because the firewall is located between the router and the

cloud. There are 2 interfaces; the inside security level was set to 100. While, for the external interface, the security level is set to 0.

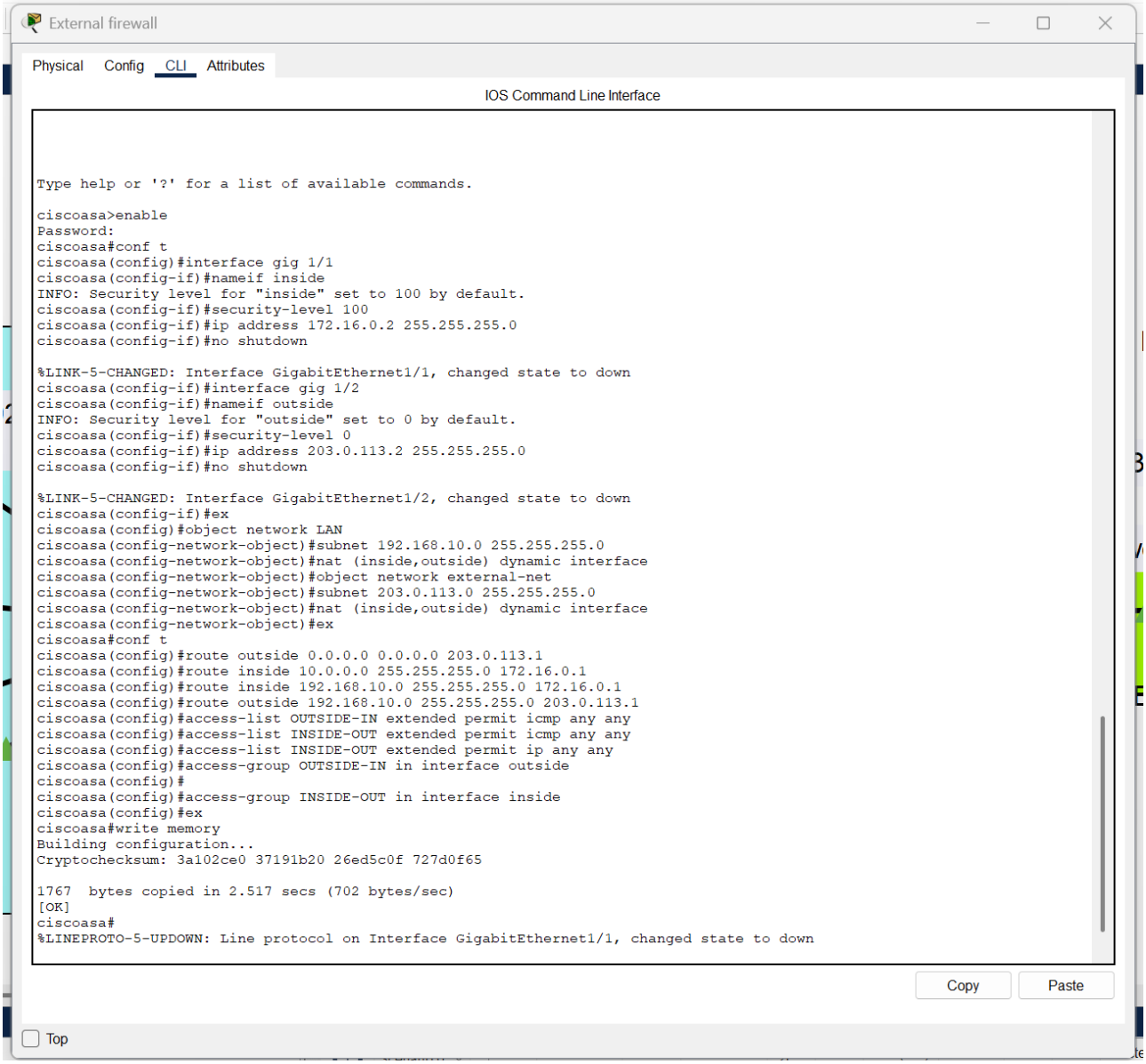
Commands used:

```
interface GigabitEthernet1/1
nameif inside
security-level 100
ip address 203.0.113.2 255.255.255.0
no shutdown

interface GigabitEthernet1/2
nameif outside
security-level 0
ip address 172.16.0.2 255.255.255.0
no shutdown

object network LAN
subnet 192.168.10.0 255.255.255.0
nat (inside,outside) dynamic interface
object network external-net
subnet 203.0.113.0 255.255.255.0
nat (inside,outside) dynamic interface

route outside 0.0.0.0 0.0.0.0 203.0.113.1
route inside 10.0.0.0 255.255.255.0 172.16.0.1
route inside 192.168.10.0 255.255.255.0 172.16.0.1
route outside 192.168.10.0 255.255.255.0 203.0.113.1

access-list OUTSIDE-IN extended permit icmp any any
access-list INSIDE-OUT extended permit icmp any any
access-list INSIDE-OUT extended permit ip any any
```

access-group OUTSIDE-IN in interface outside

access-group INSIDE-OUT in interface inside

Image showing the external firewall configuration



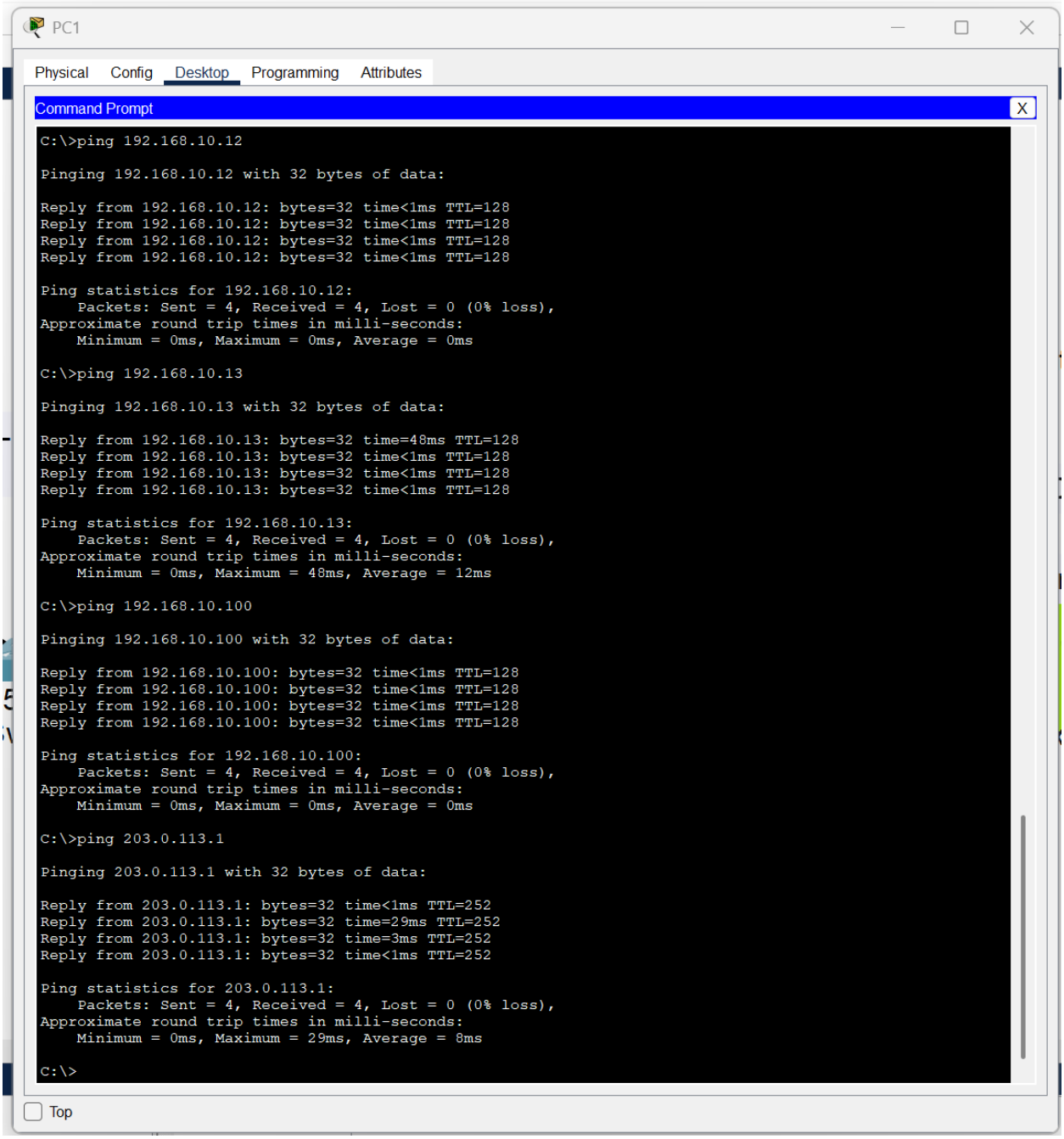
TESTING NETWORK CONNECTIVITY

a) Testing the PC connectivity to other PCs
b) Testing the connectivity of the device to the server located inside the internal network
c) Testing the connectivity to the Internet router by pinging its IP address

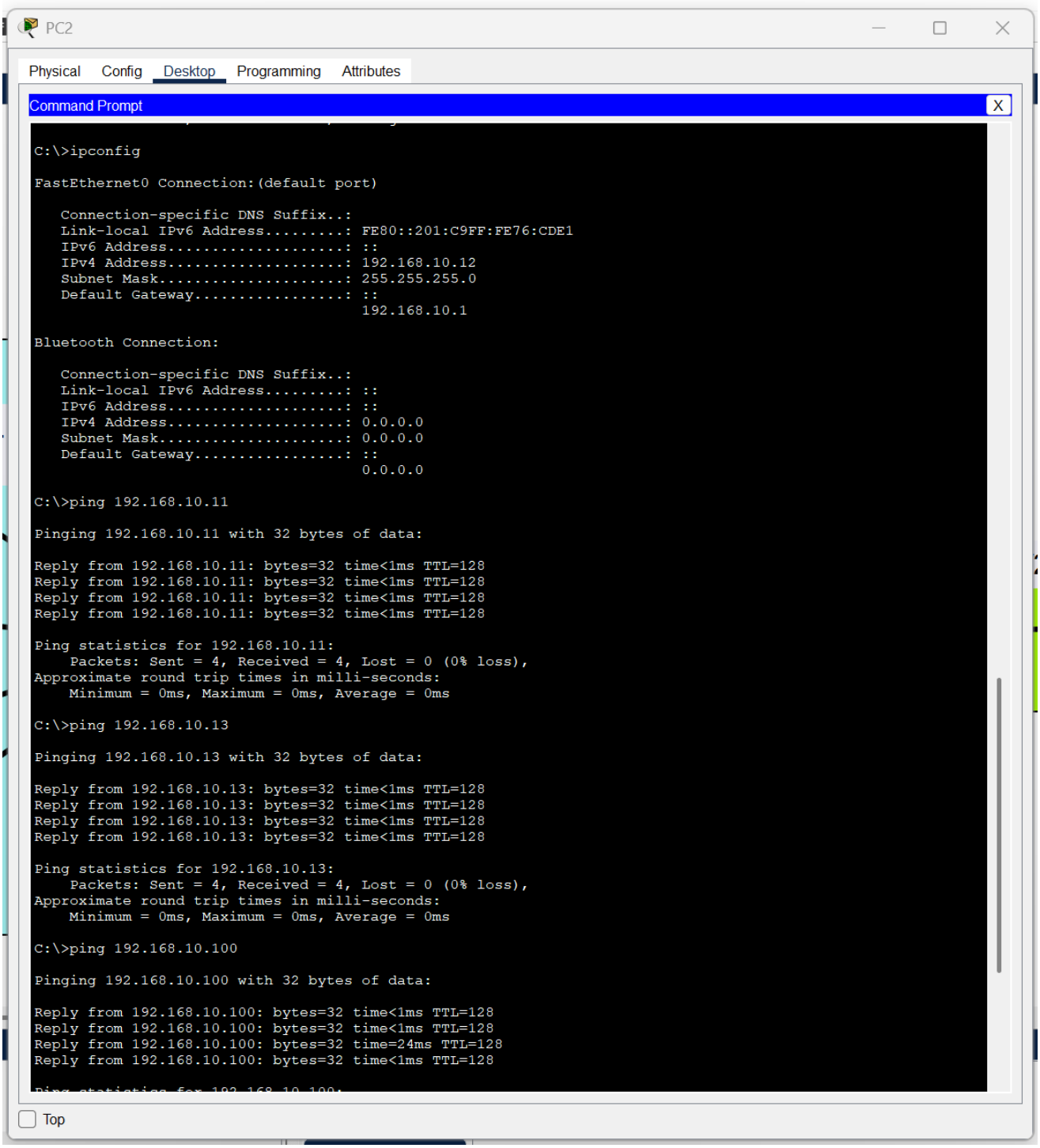
The commands used are:

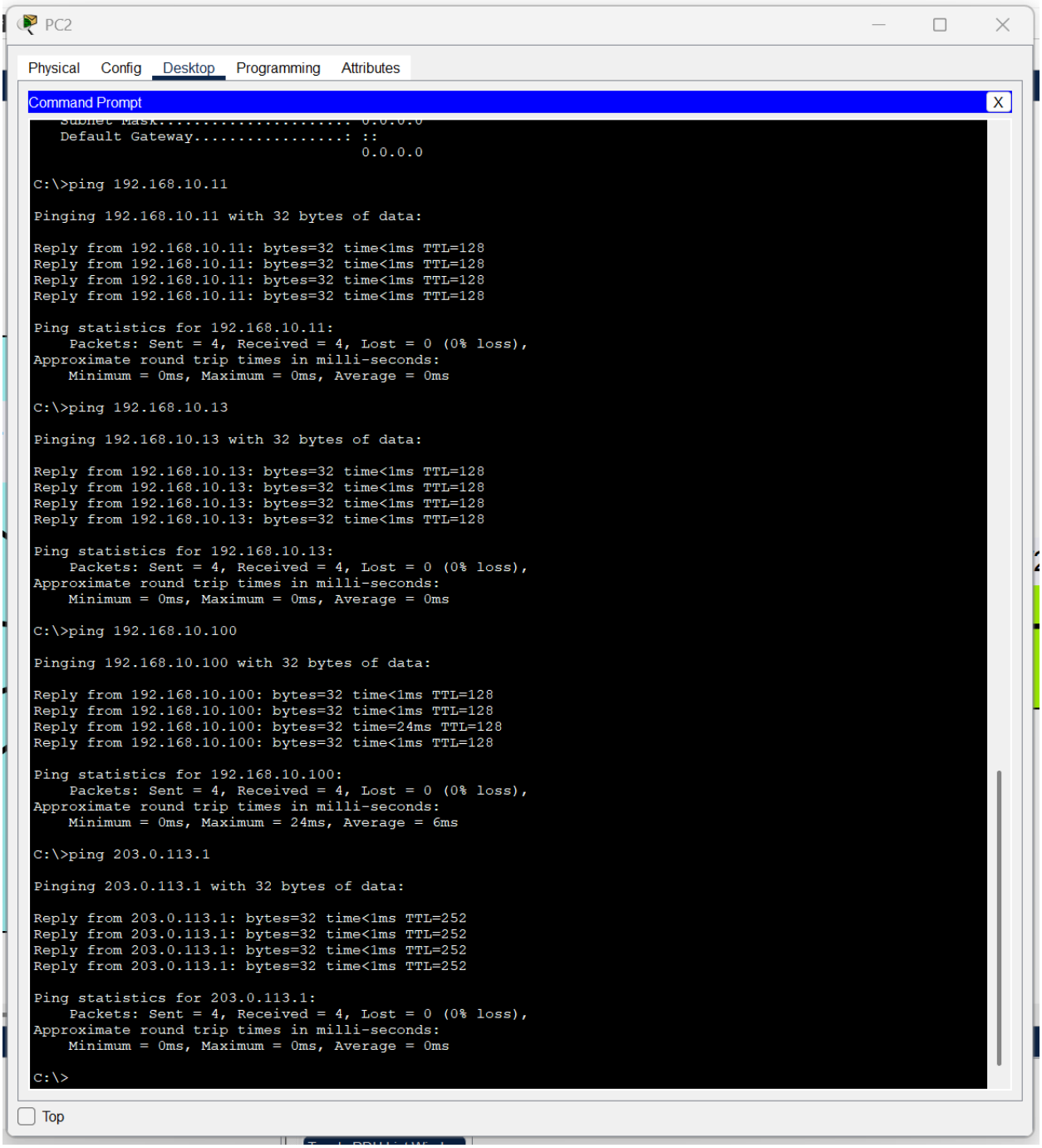
Ping 192.168.10.10 -13 – for PC1 to PC3
Ping 192.168.10.100 – for the server
Ping 203.0.113.1 – for the internet router

Here is a successful ping from PC1 to PC2, PC3, Server and Internet router

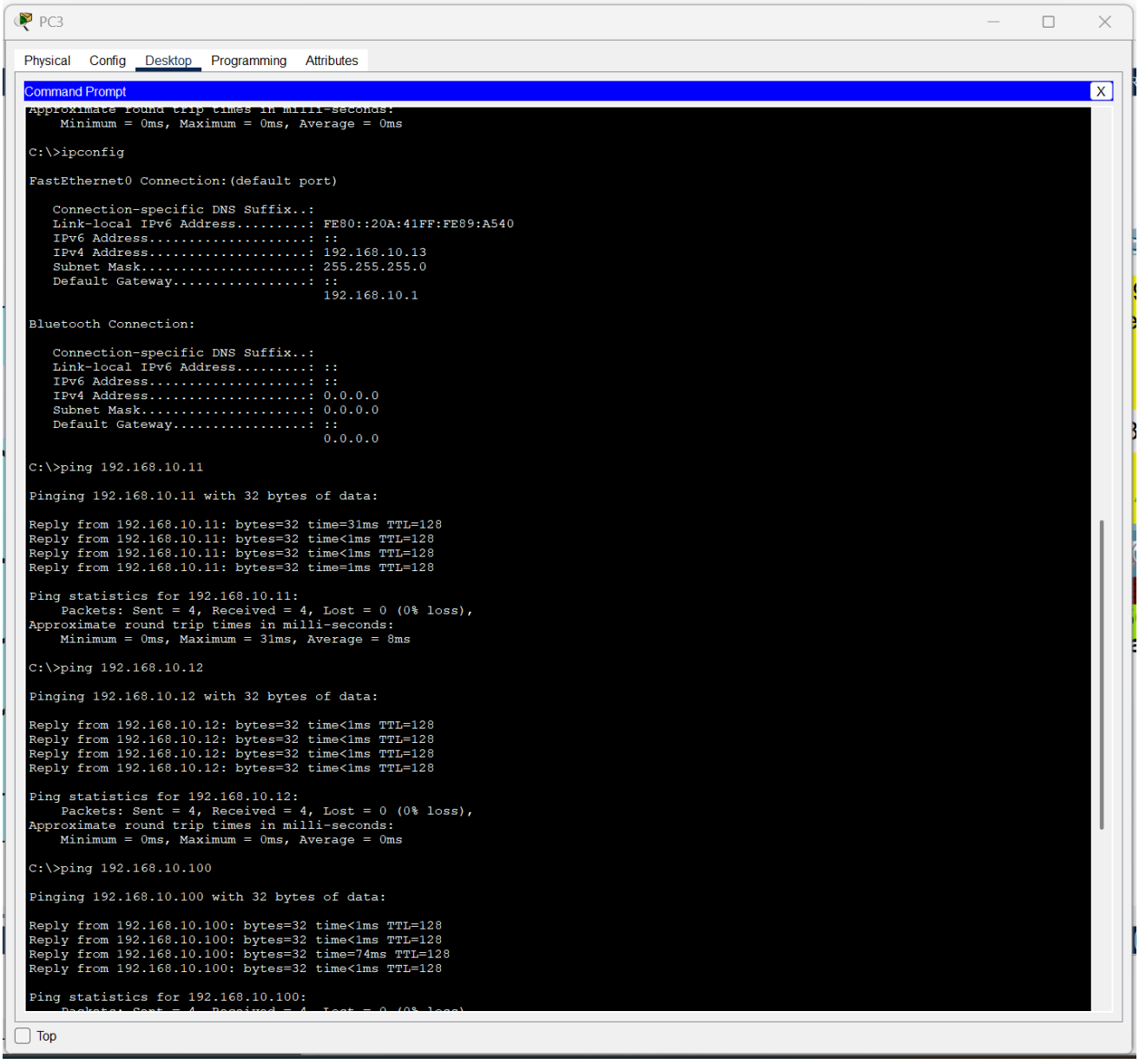


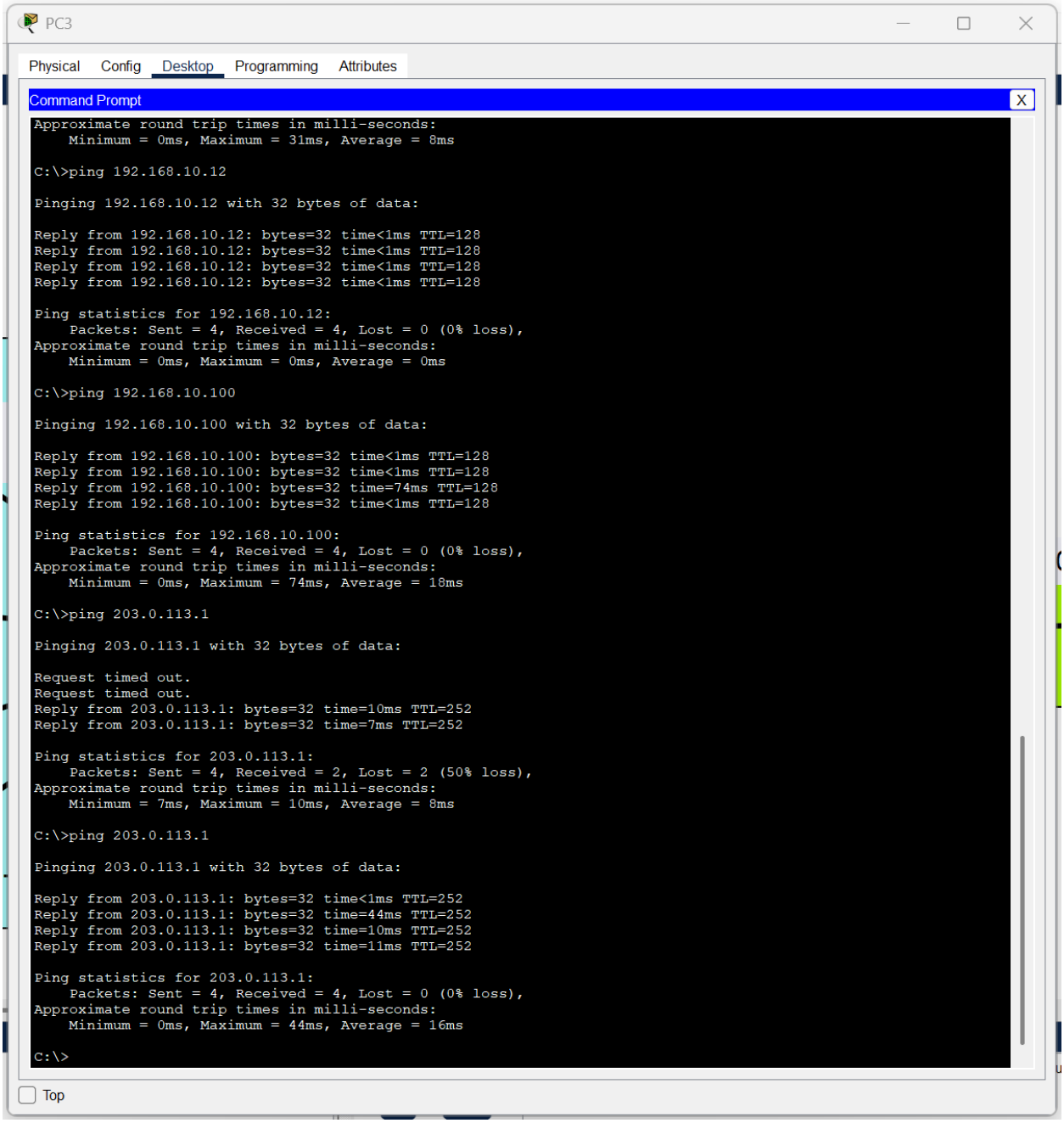
Here is also a successful ping from PC2 to PC1, PC3, Server and Internet router



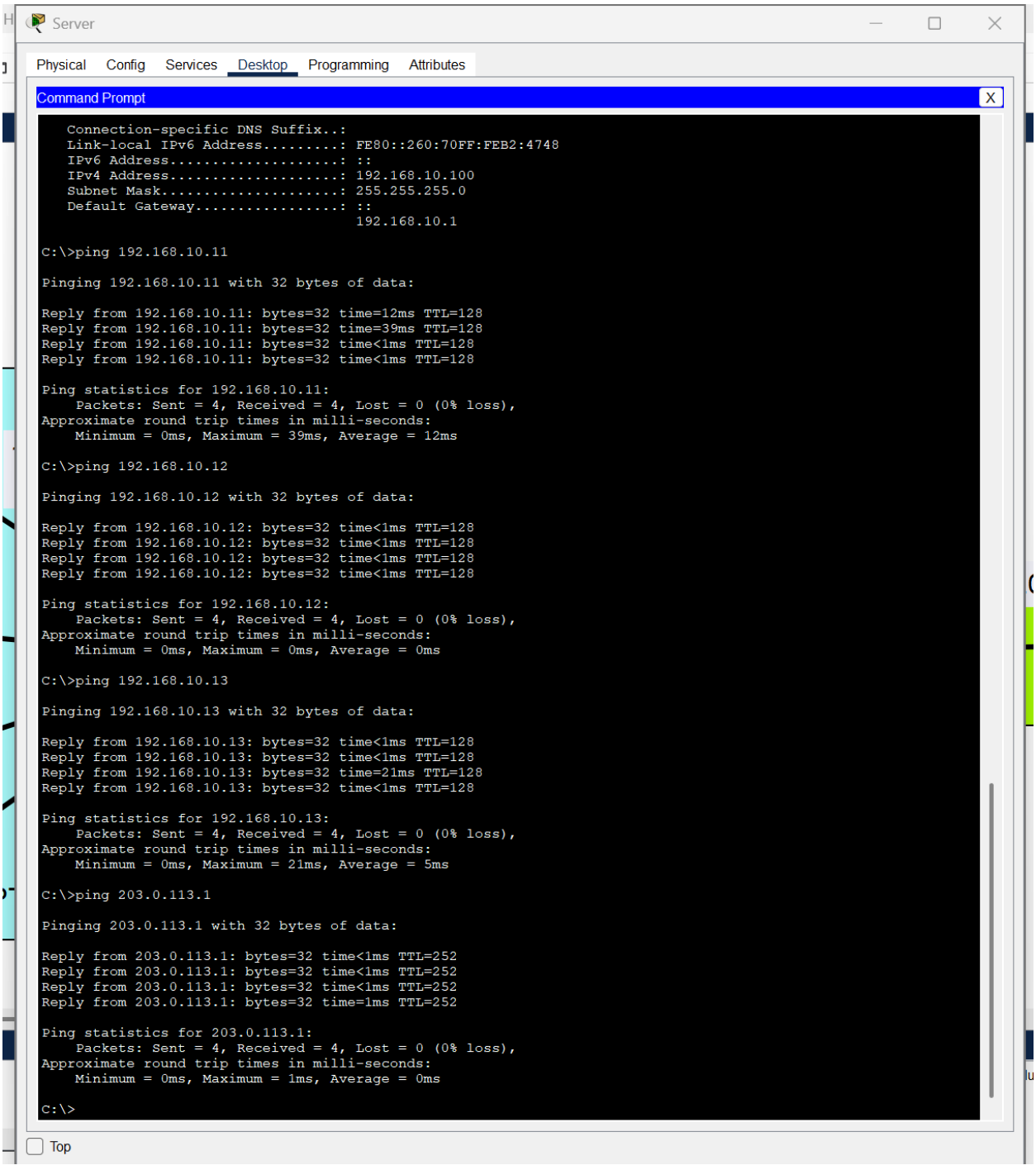

PC2
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Default Gateway.....: ::
0.0.0.0
C:\>ping 192.168.10.11
Pinging 192.168.10.11 with 32 bytes of data:
Reply from 192.168.10.11: bytes=32 time<1ms TTL=128
Reply from 192.168.10.11: bytes=32 time<1ms TTL=128
Reply from 192.168.10.11: bytes=32 time<1ms TTL=128
Reply from 192.168.10.11: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.10.11:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.10.13
Pinging 192.168.10.13 with 32 bytes of data:
Reply from 192.168.10.13: bytes=32 time<1ms TTL=128
Reply from 192.168.10.13: bytes=32 time<1ms TTL=128
Reply from 192.168.10.13: bytes=32 time<1ms TTL=128
Reply from 192.168.10.13: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.10.13:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.10.100
Pinging 192.168.10.100 with 32 bytes of data:
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Reply from 192.168.10.100: bytes=32 time=24ms TTL=128
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.10.100:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 24ms, Average = 6ms
C:\>ping 203.0.113.1
Pinging 203.0.113.1 with 32 bytes of data:
Reply from 203.0.113.1: bytes=32 time<1ms TTL=252
Reply from 203.0.113.1: bytes=32 time<1ms TTL=252
Reply from 203.0.113.1: bytes=32 time<1ms TTL=252
Reply from 203.0.113.1: bytes=32 time<1ms TTL=252
Ping statistics for 203.0.113.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
Top

Here is also a successful ping from PC 3 to PC2, PC1, Server and Internet router




PC3
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 31ms, Average = 8ms
C:\>ping 192.168.10.12
Pinging 192.168.10.12 with 32 bytes of data:
Reply from 192.168.10.12: bytes=32 time<1ms TTL=128
Reply from 192.168.10.12: bytes=32 time<1ms TTL=128
Reply from 192.168.10.12: bytes=32 time<1ms TTL=128
Reply from 192.168.10.12: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.10.12:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.10.100
Pinging 192.168.10.100 with 32 bytes of data:
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Reply from 192.168.10.100: bytes=32 time=74ms TTL=128
Reply from 192.168.10.100: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.10.100:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 74ms, Average = 18ms
C:\>ping 203.0.113.1
Pinging 203.0.113.1 with 32 bytes of data:
Request timed out.
Request timed out.
Reply from 203.0.113.1: bytes=32 time=10ms TTL=252
Reply from 203.0.113.1: bytes=32 time=7ms TTL=252
Ping statistics for 203.0.113.1:
Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
Minimum = 7ms, Maximum = 10ms, Average = 8ms
C:\>ping 203.0.113.1
Pinging 203.0.113.1 with 32 bytes of data:
Reply from 203.0.113.1: bytes=32 time<1ms TTL=252
Reply from 203.0.113.1: bytes=32 time=44ms TTL=252
Reply from 203.0.113.1: bytes=32 time=10ms TTL=252
Reply from 203.0.113.1: bytes=32 time=11ms TTL=252
Ping statistics for 203.0.113.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 44ms, Average = 16ms
C:\>
Top

Here is also a successful ping from the server to all the PCs and internet router.



NETWORK SECURITY CONCERNS & RECOMMENDATIONS

Here are the potential weaknesses and actionable improvements to enhance security, segmentation, monitoring, and redundancy:

1. Lack of Proper Segmentation: If devices (e.g., servers, IoT, workstations) share the same subnet, lateral movement by attackers becomes easier.
2. Insufficient Monitoring & Logging
3. No HA (High Availability) for Core Devices: A single router/firewall failure could disrupt the entire network.
4. No Zero Trust Policies: Excessive trust between internal devices increases insider threat risks.
5. Allowing all ICMP (e.g., ping) traffic from any source to any destination inbound from the outside is risky in production. It opens your firewall to ping scans and diagnostics from the public internet.

Recommended actions to improve security

1. Enhance Segmentation
2. Implement VLANs: Separate traffic by department
3. Micro-Segmentation: Use firewalls or SDN to restrict east-west traffic (e.g., only allow DB servers to talk to app servers).
4. Improve Redundancy
5. Dual ISP Connections: Ensure up time if one ISP fails.
6. Adopt Zero Trust: Require MFA and least privilege access for all users/devices.
7. Replace access-list OUTSIDE-IN extended permit icmp any any with a more restrictive one. E.g. access-list OUTSIDE-IN extended permit icmp any host 192.168.10.1 echo