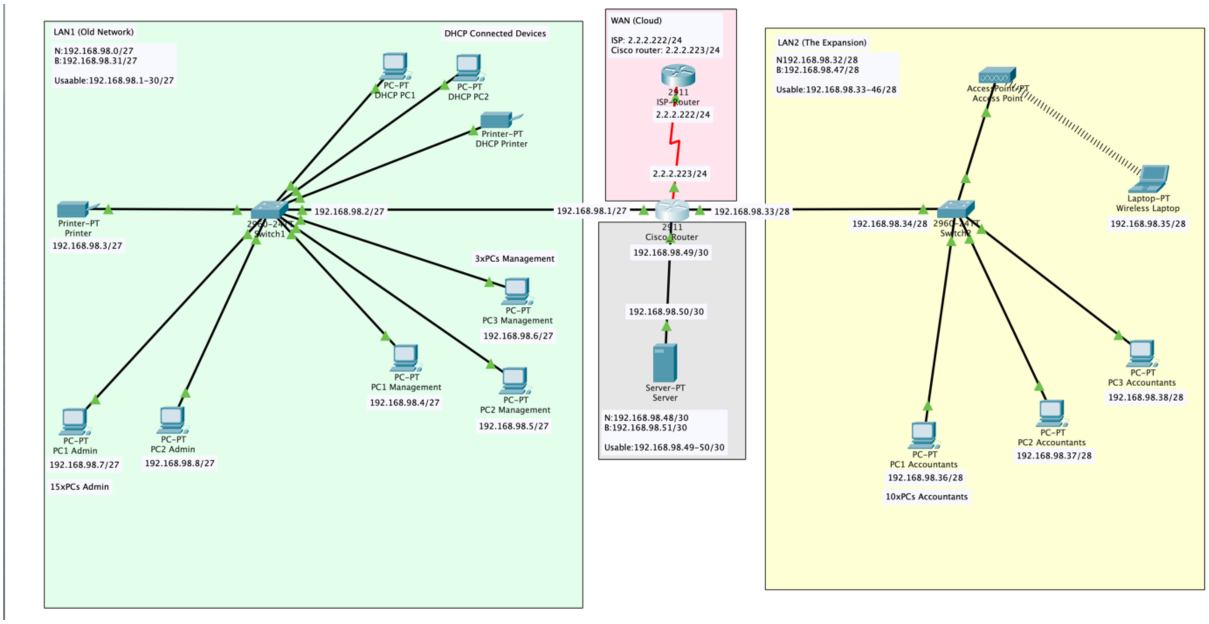
Network Protocols and Architectures Assignment.

Task 1:

Physical topology using Packet Tracer:



Correct IPv4 addresses for the network using subnetting:

Subnetwork 1:

Network Address: 192.168.98.0/27

Broadcast Address: 192.168.98.31/27

Usable address's: 192.168.98.1/27 – 192.168.98.30/27 - G0/0

Subnetwork 2:

Network Address: 192.168.98.32/28

Broadcast Address: 192.168.98.47/28

Usable address's: 192.168.98.33/28 – 192.168.98.46/28 - G0/1

Subnetwork 3:

Network Address: 192.168.98.48/30
Broadcast Address: 192.168.98.51/30

Usable address's: 192.168.98.49/30 & 192.168.98.50/30 - G0/2

Spare Sub Networks:

192.168.98.52/30
192.168.98.56/30
192.168.98.60/30

The range of these spare subnetworks can be used at a later date if for example the network scales or expands further.

Passwords for my configurations:

Console password: class
Enable password: cisco
VTY password: class

The IP address for the calculation of the subnets is 192.168.X.0 /24 where X will be the last two digits of my student ID: 19011398

<u>Table for all the IP addresses allocated</u>: LAN 1, ISP, SERVER. (Old Network)

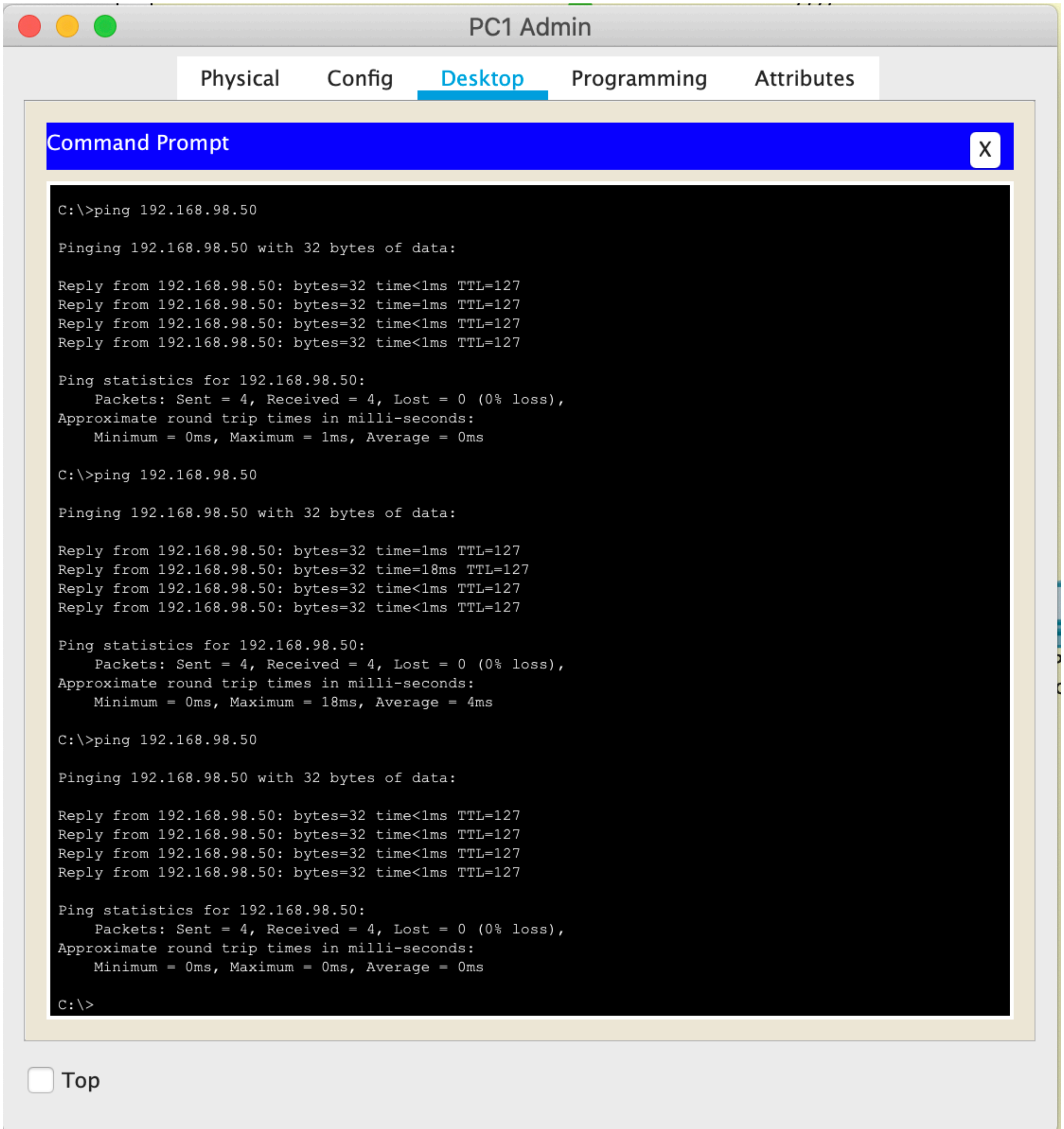
Device	Interface	IP Address or Network	Default Gateway
Cisco_Router	G0/0	192.168.98.1/27	N/A
	G0/1	192.168.98.33/28	N/A
	G0/2	192.168.98.49/30	N/A
	S0/3/0	2.2.2.223/24	N/A
ISP-Router	S/0/3/0	2.2.2.222/24	N/A
Server	NIC	192.168.98.50/30	192.168.98.49/30
Switch1	VLAN1	192.168.98.2/27	192.168.98.1/27
Printer	NIC	192.168.98.3/27	192.168.98.1/27
PC1 Management	NIC	192.168.98.4/27	192.168.98.1/27
PC2 Management	NIC	192.168.98.5/27	192.168.98.1/27
PC3 Management	NIC	192.168.98.6/27	192.168.98.1/27
PC1 Admin	NIC	192.168.98.7/27	192.168.98.1/27
PC2 Admin	NIC	192.168.98.8/27	192.168.98.1/27
PC3 Admin	NIC	192.168.98.9/27	192.168.98.1/27
PC4 Admin	NIC	192.168.98.10/27	192.168.98.1/27
PC5 Admin	NIC	192.168.98.11/27	192.168.98.1/27
PC6 Admin	NIC	192.168.98.12/27	192.168.98.1/27
PC7 Admin	NIC	192.168.98.13/27	192.168.98.1/27
PC8 Admin	NIC	192.168.98.14/27	192.168.98.1/27
PC9 Admin	NIC	192.168.98.15/27	192.168.98.1/27
PC10 Admin	NIC	192.168.98.16/27	192.168.98.1/27
PC11 Admin	NIC	192.168.98.17/27	192.168.98.1/27
PC12 Admin	NIC	192.168.98.18/27	192.168.98.1/27
PC13 Admin	NIC	192.168.98.19/27	192.168.98.1/27
PC14 Admin	NIC	192.168.98.20/27	192.168.98.1/27
PC15 Admin	NIC	192.168.98.21/27	192.168.98.1/27

<u>Table for all the IP addresses allocated</u>: LAN 2 (The Expansion)

Device	Interface	IP Address or Network	Default Gateway
Switch2	VLAN1	192.168.98.34/28	192.168.98.33/28
Wireless Laptop	WLAN	192.168.98.35/28	192.168.98.33/28
PC Accountant 1	NIC	192.168.98.36/28	192.168.98.33/28
PC Accountant 2	NIC	192.168.98.37/28	192.168.98.33/28
PC Accountant 3	NIC	192.168.98.38/28	192.168.98.33/28
PC Accountant 4	NIC	192.168.98.39/28	192.168.98.33/28
PC Accountant 5	NIC	192.168.98.40/28	192.168.98.33/28
PC Accountant 6	NIC	192.168.98.41/28	192.168.98.33/28
PC Accountant 7	NIC	192.168.98.42/28	192.168.98.33/28
PC Accountant 8	NIC	192.168.98.43/28	192.168.98.33/28
PC Accountant 9	NIC	192.168.98.44/28	192.168.98.33/28
PC Accountant 10	NIC	192.168.98.45/28	192.168.98.33/28

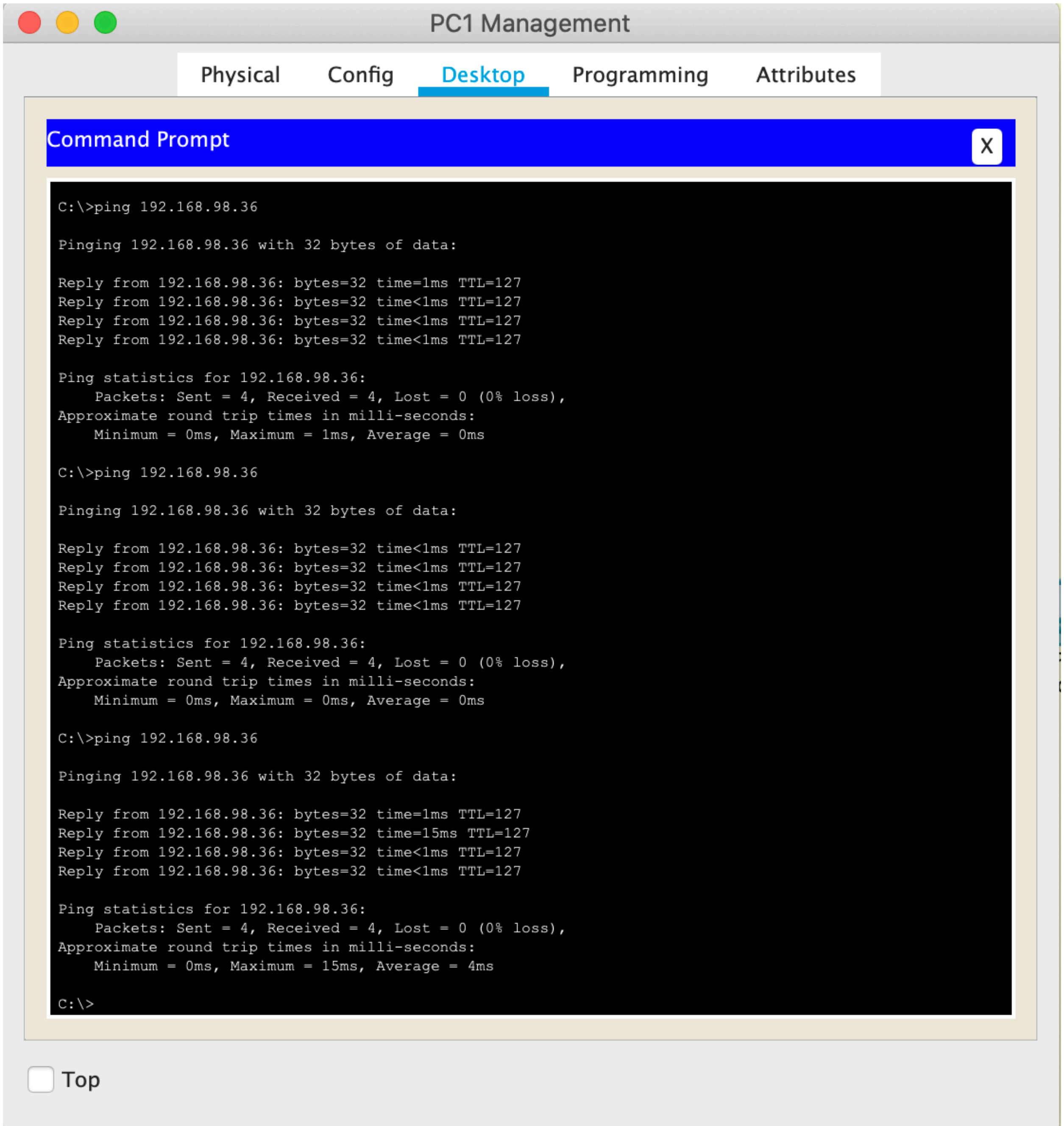
<u>Screenshots of ping results</u>:

1 - Admin computer to the Server:



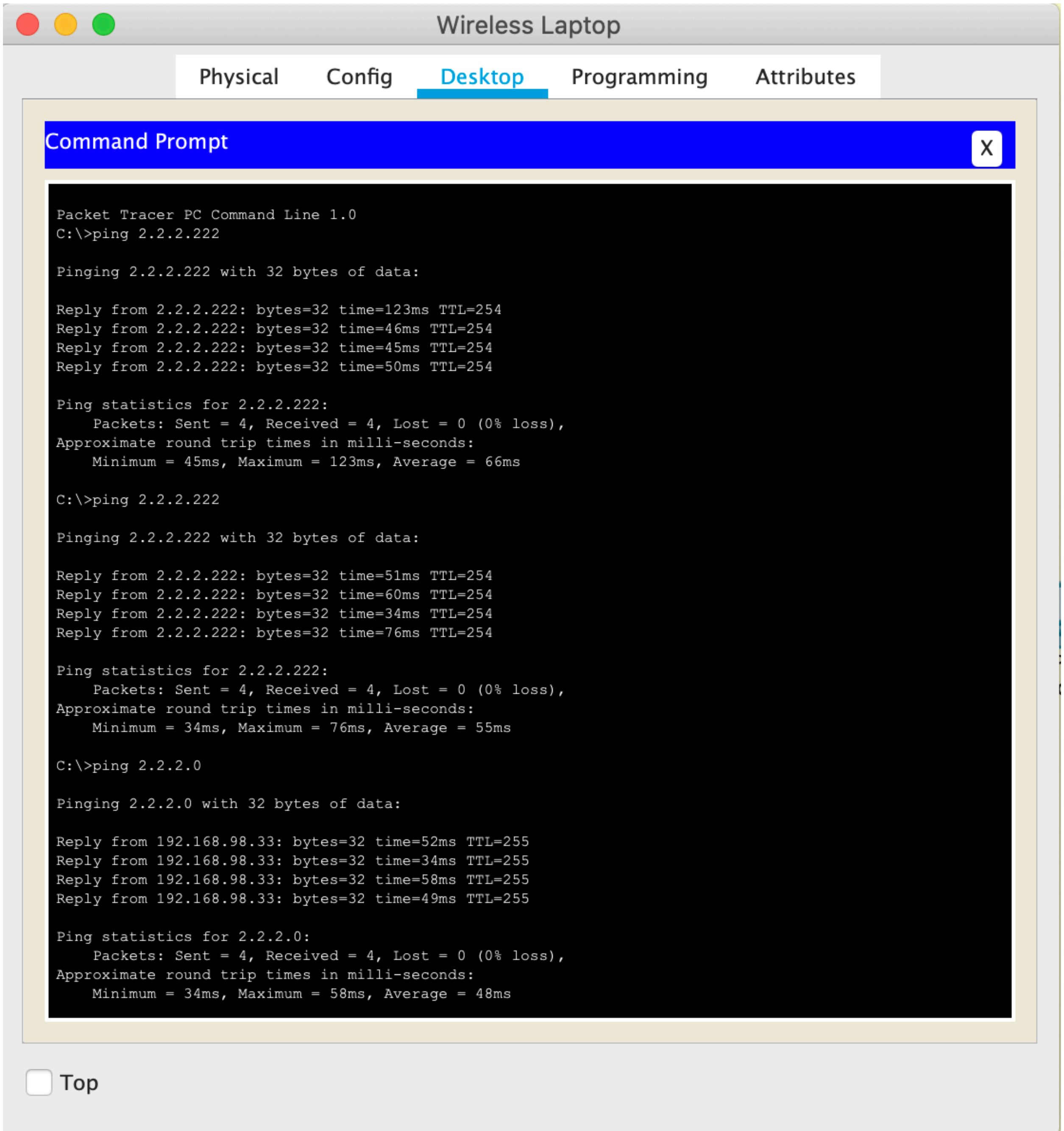
Explanation: This test aimed to make sure that the admin computers have been IP addressed correctly as should the ISP-Router and therefore able to ping each other. You can see in the image above that 4 packets were sent to the server from the admin computer and 4 packets received from the server with nothing lost.

2 - Management to accountant:



Explanation: This test aimed to make sure the expansion was carried out correctly and therefore the management computer should be able to ping the accountants as shown above. 4 Packets sent from Management and 4 packets received from the Accountant.

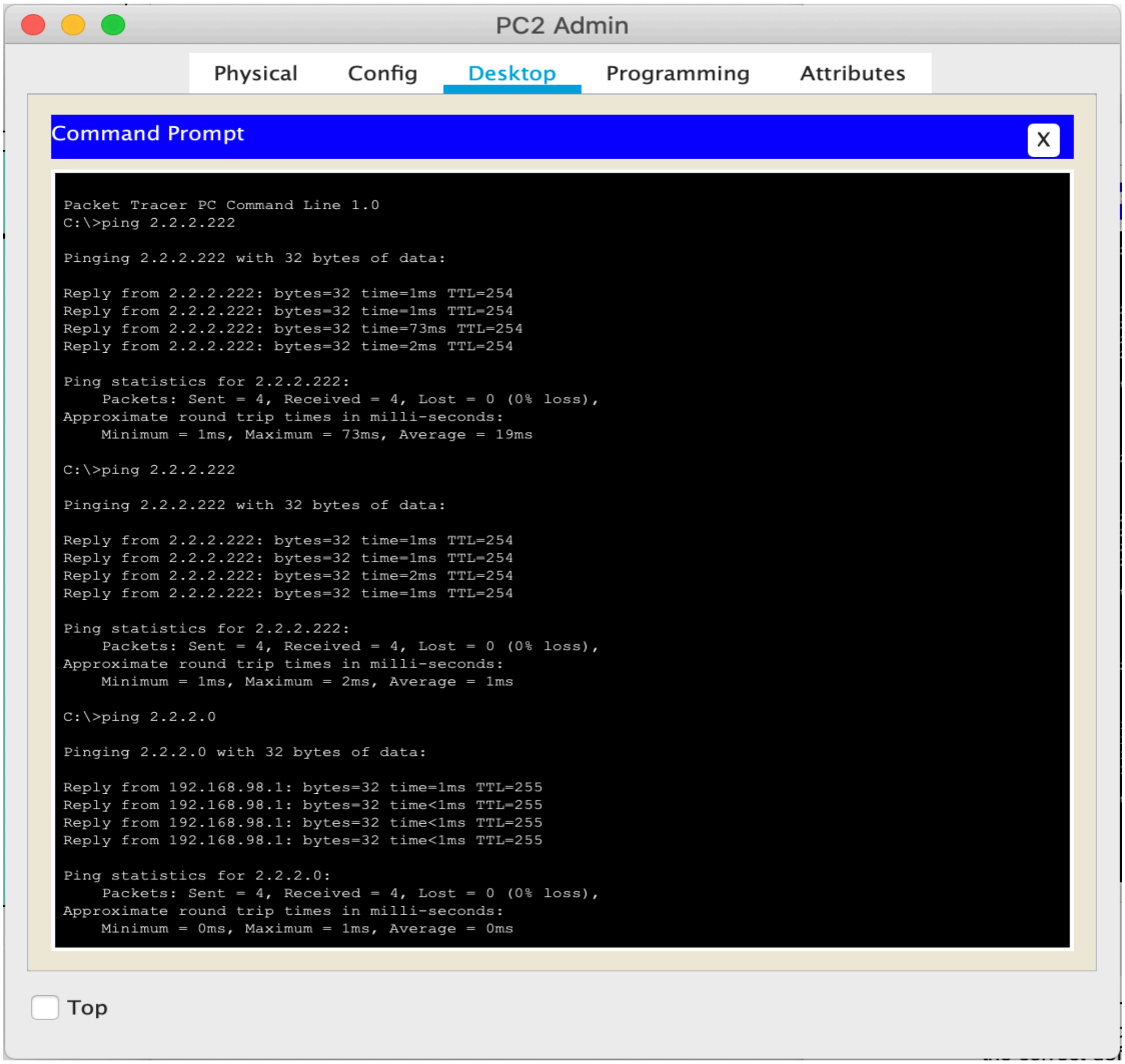
3 - Wireless laptop to ISP:




```
Packet Tracer PC Command Line 1.0
C:\>ping 2.2.2.222

Pinging 2.2.2.222 with 32 bytes of data:

Reply from 2.2.2.222: bytes=32 time=123ms TTL=254
Reply from 2.2.2.222: bytes=32 time=46ms TTL=254
Reply from 2.2.2.222: bytes=32 time=45ms TTL=254
Reply from 2.2.2.222: bytes=32 time=50ms TTL=254

Ping statistics for 2.2.2.222:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 45ms, Maximum = 123ms, Average = 66ms

C:\>ping 2.2.2.222

Pinging 2.2.2.222 with 32 bytes of data:

Reply from 2.2.2.222: bytes=32 time=51ms TTL=254
Reply from 2.2.2.222: bytes=32 time=60ms TTL=254
Reply from 2.2.2.222: bytes=32 time=34ms TTL=254
Reply from 2.2.2.222: bytes=32 time=76ms TTL=254

Ping statistics for 2.2.2.222:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 34ms, Maximum = 76ms, Average = 55ms

C:\>ping 2.2.2.0

Pinging 2.2.2.0 with 32 bytes of data:

Reply from 192.168.98.33: bytes=32 time=52ms TTL=255
Reply from 192.168.98.33: bytes=32 time=34ms TTL=255
Reply from 192.168.98.33: bytes=32 time=58ms TTL=255
Reply from 192.168.98.33: bytes=32 time=49ms TTL=255

Ping statistics for 2.2.2.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 34ms, Maximum = 58ms, Average = 48ms
```

Explanation: This test aims to show that the access point has been configured correctly and that the wireless laptops module has been changed to one that provides a 2.4GHZ wireless interface that is suitable for wireless connections and therefore able to connect to the network wirelessly and be able to ping the ISP-Router that has been configured with dynamic routing protocol.

4 - Admin to ISP:



Explanation: This test aims to show that the ISP-Router has been configured with a RIP (Dynamic Routing Protocol) and the admin computers have all been IP addressed correctly with the correct default gateways to the network in order for the admin to ping/communicate with the internet service provider.

Task 2: Report

Default gateway: The role of a default gateway.

In Internet lingo, a default gateway is a hardware node or point that offers outgoing data packet access to a destination on another discrete network.
The term "default" essentially refers to the fact that this gateway is used by default. The default server does not even have to be a router; it could simply be a multilayer switch or a device with two network adapters, one attached to the local subnet and the other to the internet. (What is a Default Gateway? - Definition from Techopedia, 2021)
(Advantages of Using DHCP - Oracle Solaris Administration: IP Services, 2021)

The router is essentially just a piece of hardware that sends data. The router isn't branded as "the gateway" by default; but, because of the way the device is set up, it serves as the default gateway. Some think that that the default gateway is the router, it is in some cases and not in others.

Simply, a default gateway is a node that allows one device to communicate with another device on a separate network seamlessly. (Walker, 2021)

Generally, and most common, the IP address specified is the router Interface IP address, then the router acts like a “gateway” that links your host to distant or remote network segments and is the last thing a packet would be sent to while trying to route. (Walker, 2021)

For example, in task 1 the default gateway for devices in Lan 1 would be the cisco routers G0/0 (Gigabit ethernet port 0) interfaces IP address, it’s where all of that network's packets that have destinations outside of its network leave from. Since it is the first and default route taken it is considered a "default" gateway, until another option is explicitly requested.

The default gateway is most widely used to obtain access to a webpage, where the message or packets are filtered through the gateway before being sent to the internet. Another major aspect as I have explained is connecting devices on one subnet to devices on another, using the default gateway as an intermediary. In my topology I have demonstrated this by connecting all end devices on Lan1 to all devices in the expansion Lan2 with full connectivity, this was only achieved by using ‘Default Gateways’, without them at most you may be able to connect or ping devices only in their network.

After configuring the Cisco routers g0/0 interface with an IP address of 191.168.98.1 this became my default gateway for all my devices in Lan1.

Now let’s say my admin pc sends some IPv4 packet. If the range is in its network, i.e., 192.168.98.1/27 – 192.168.98.31/27 the routing table contains the information that the packet could directly be sent to the requested destination.

If the destination is now in another network, i.e., in the range 192.168.98.33/28 or 192.168.98.49/30, the routing table contains information about the router “gateway” to be used. Either “A” or “B”. By checking the subnet mask.

Default gateways are routing methods that make sure that the request being processed is transmitted to the correct destination, even though the sender and recipient might be on separate network protocols.

The originating system is the one that makes the request, and as part of its procedure, it sends out an access request via a routing table. This decides the most effective and efficient path for sending the request, as well as what the router should be. Any request that does not have a specific router assigned to it is routed through the default gateway, guaranteeing data flow.

When you have a small network, as those most people have at home the main router is usually their default gateway. However, as networks scale and expand in size as I have shown in task 1, or where many networks are running at the same time, a system of subnets can be used in combination with a particular default gateway.

The use and benefits of Dynamic Host Configuration Protocol:

DHCP is an application layer protocol that distributes and assigns different network configuration parameters to devices on a TCP/IP network, it is fast to set up and makes sure devices are configured correctly and can join networks. Parameters that are configured automatically are IP addresses, subnet masks, default gateways, DNS servers, and other pertinent configurations.

A DHCP client is designed to request network parameters from a DHCP server on the network, using a client-server interface, The DHCP server responds by supplying IP configuration information previously defined by the network administrator. This includes a specific IP address as well as a period during which the allocation is valid (also known as a lease). (Gorman, 2021)

A DHCP server, therefore, maintains a pool of valid IP addresses and assigns one to each DHCP client on that network automatically.

A DHCP server can be of great benefit as it sends the appropriate network parameters to clients so that they can interact effectively on that network. Without one, the network administrator has to manually configure each client who joins the network, which can be time-consuming, particularly in large networks like the one from task 1 that required an expansion.

The primary explanation for DHCP's existence is to make network IP address management easier. There can't be two hosts with the same IP address, and manually configuring them would almost certainly result in errors. Manually assigning IP addresses, even on small networks, can be confusing, particularly for mobile devices that need IP addresses temporarily. Furthermore, the majority of users aren't technically savvy enough to find and allocate IP addresses and other parameters on a device. Therefore, using DHCP is an automated method to make things simpler for both users and network administrators. (Dynamic Host Configuration Protocol (DHCP), 2021)

Here are some of the main advantages of using DHCP:

- Manual configuration not necessary – As standard parameters are sent by the service to each device automatically.
- Less time wasted on network management.
- Manual configuration time of IP addresses is reduced.
- Reliable IP address configuration. Manual IP address configuration errors, such as typographical errors or address conflicts triggered by assigning an IP address to more than one device at the same time, are minimized by DHCP.
- There are no extra costs associated with the implementation.
- Invalid or repeated assignment of the same IP addresses is prevented.
- Allows the administrator to set lease times, even on manually allocated IP addresses.

(Advantages of Using DHCP - Oracle Solaris Administration: IP Services, 2021)

(Benefits of Using DHCP - University IT, 2021)

Appendix:

Here I have demonstrated how I managed to implement DHCP in my topology and how a DHCP server can be configured on a Cisco router.
As I did not want to create and submit another packet tracer file, I implemented DHCP separately inside Lan1 of my original topology and submitted one file.

In my topology, I have shown that DHCP has been configured correctly, showing that 3 devices 2 PC'S and a printer have been assigned parameters i.e., IP addresses, etc automatically inside of Lan1 via DHCP.

For this assignment, I have excluded the statically assigned IP addresses for my assignment-based end devices in Lan1 from the DHCP configuration, as I did not want to mess up or change the configuration of my assignment.

However, I understand that in a real-life situation all end devices should be assigned parameters automatically by DHCP except maybe your switches and printers.

The measures I used for configuring my DHCP are as follows:

1. I Excluded IP addresses from being assigned by DHCP by using the: **ip dhcp excluded-address FIRST_IP ADDRESS LAST_IP ADDRESS** command.

2. I created a new DHCP pool with the**: ip dhcp pool NAME** command.

3. I then defined a subnet that will be used to assign IP addresses to hosts with the: **network SUBNET SUBNET_MASK** command.

4. Forth I defined the default gateway with the: **default-router IP ADDRESS** command.

5. Fifth I defined the DNS server which was optional for me at this point as the DNS server is usually used to resolve hostnames into IP addresses, DNS then makes it easier for us humans to access websites by using domain names that we can remember rather than IP addresses in a number format.
to assign a DNS server I used the: **dns-server IP ADDRESS** command.

6. (Optional) You could define the DNS domain name by using the: **ip domain-name NAME** command.

7. (Optional) You could also define the lease duration by using the: **lease DAYS HOURS MINUTES** command. Otherwise, the default lease time of 24 hours will be used.

Example of my DHCP configuration:

(config)#ip dhcp excluded-address 192.168.98.1 192.168.98.21

(config)#ip dhcp pool Lan1

(dhcp-config)#network 192.168.98.0 255.255.255.224

(dhcp-config)#default-router 192.168.98.1

(dhcp-config)#dns-server 192.168.98.1

In the example above, you can see that I've set the following parameters for the DHCP server:

- The range of IP addresses from 192.168.98.1 – 192.168.98.21 will not be assigned to hosts as I have already configured them manually in my topology for my assignment in task 1.

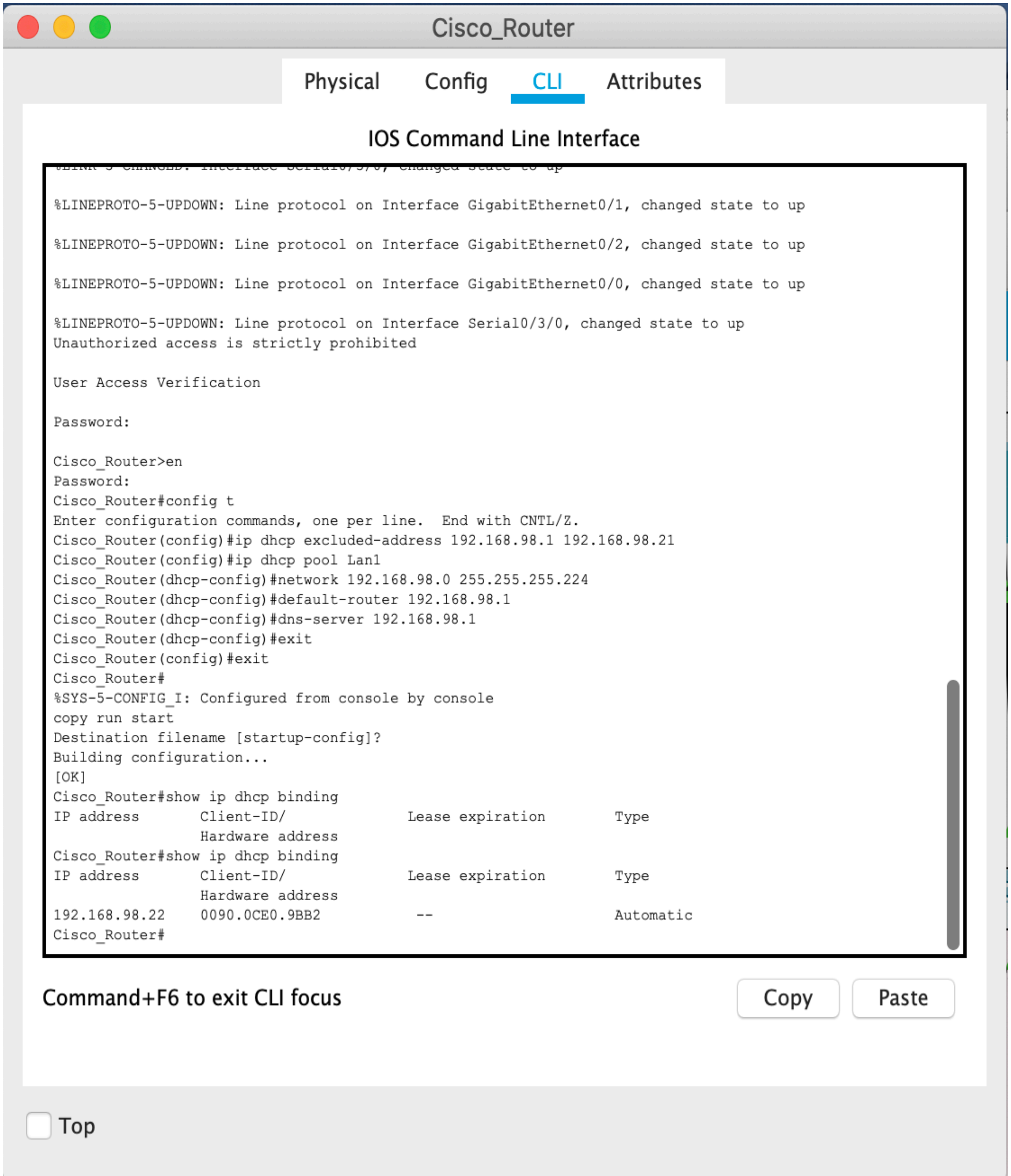
- The DHCP pool was created and named Lan1.

- IP addresses that will be assigned to hosts will be from the 192.168.98.0/27 range.

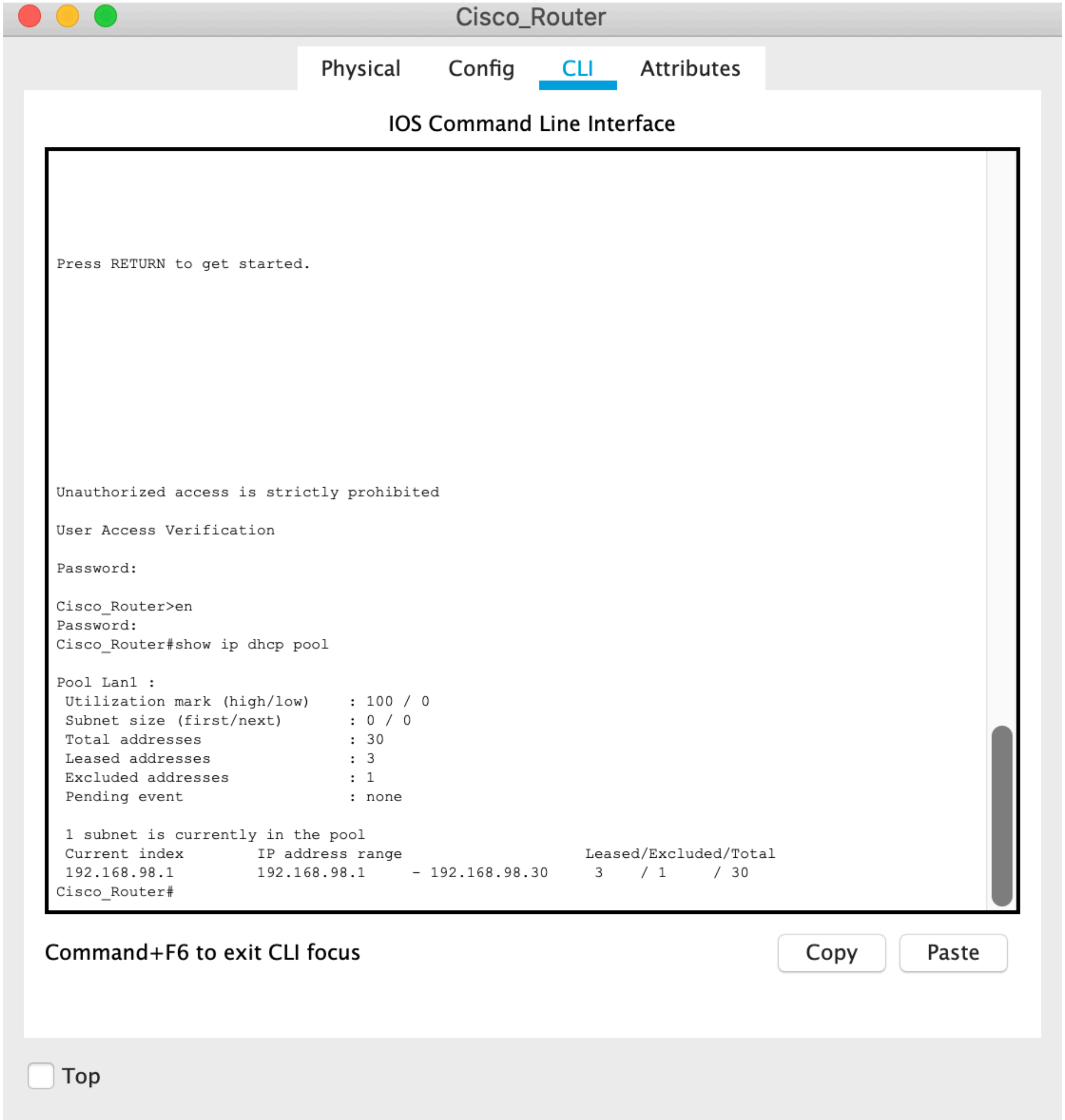
- The default-gateway IP address is 192.168.98.1

- The DNS servers IP address is 192.168.98.1

If you want to view information about the currently leased address run the command: #show ip dhcp binding.

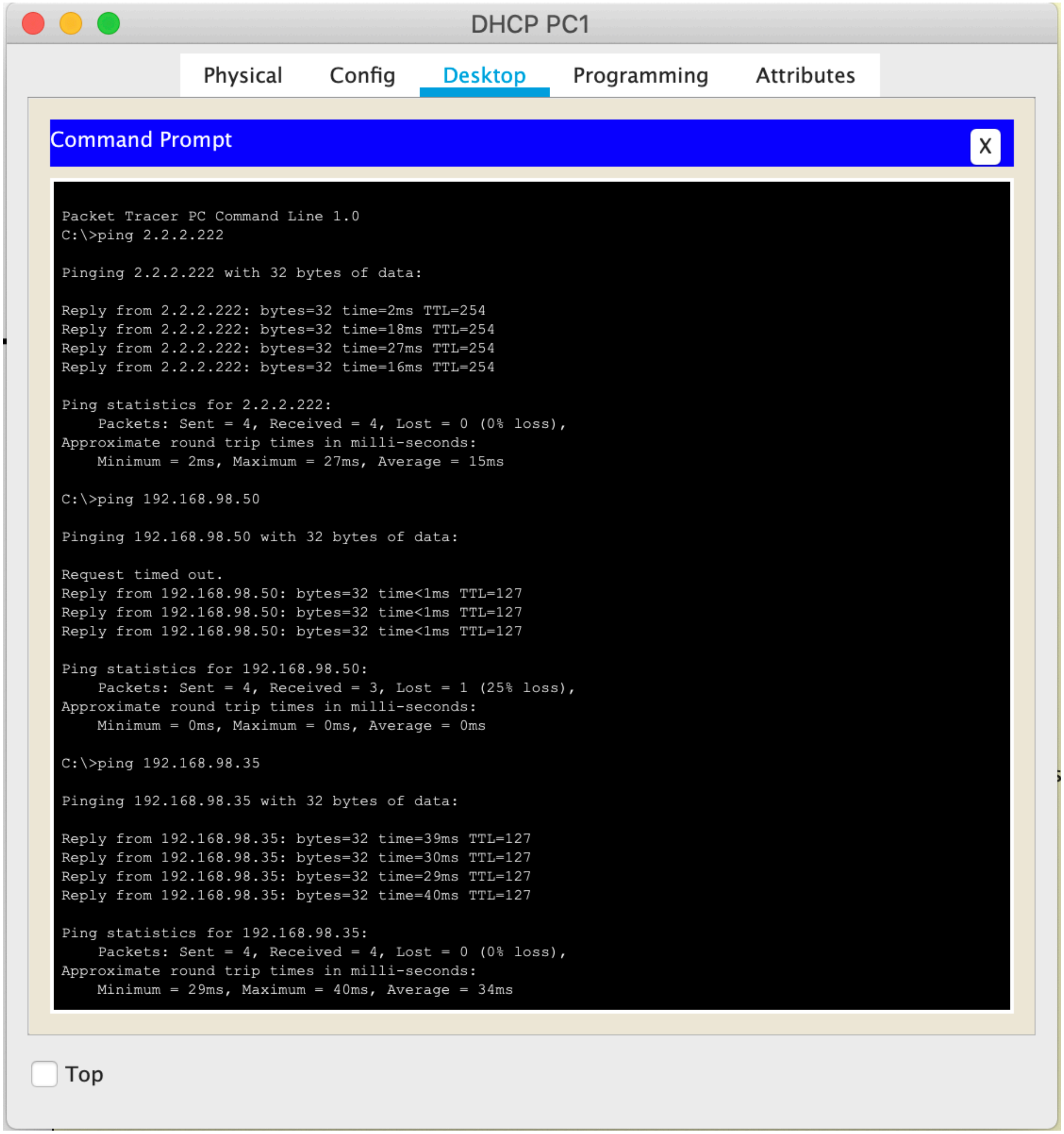


To display information about the configured DHCP pool run the command:
#show ip dhcp pool



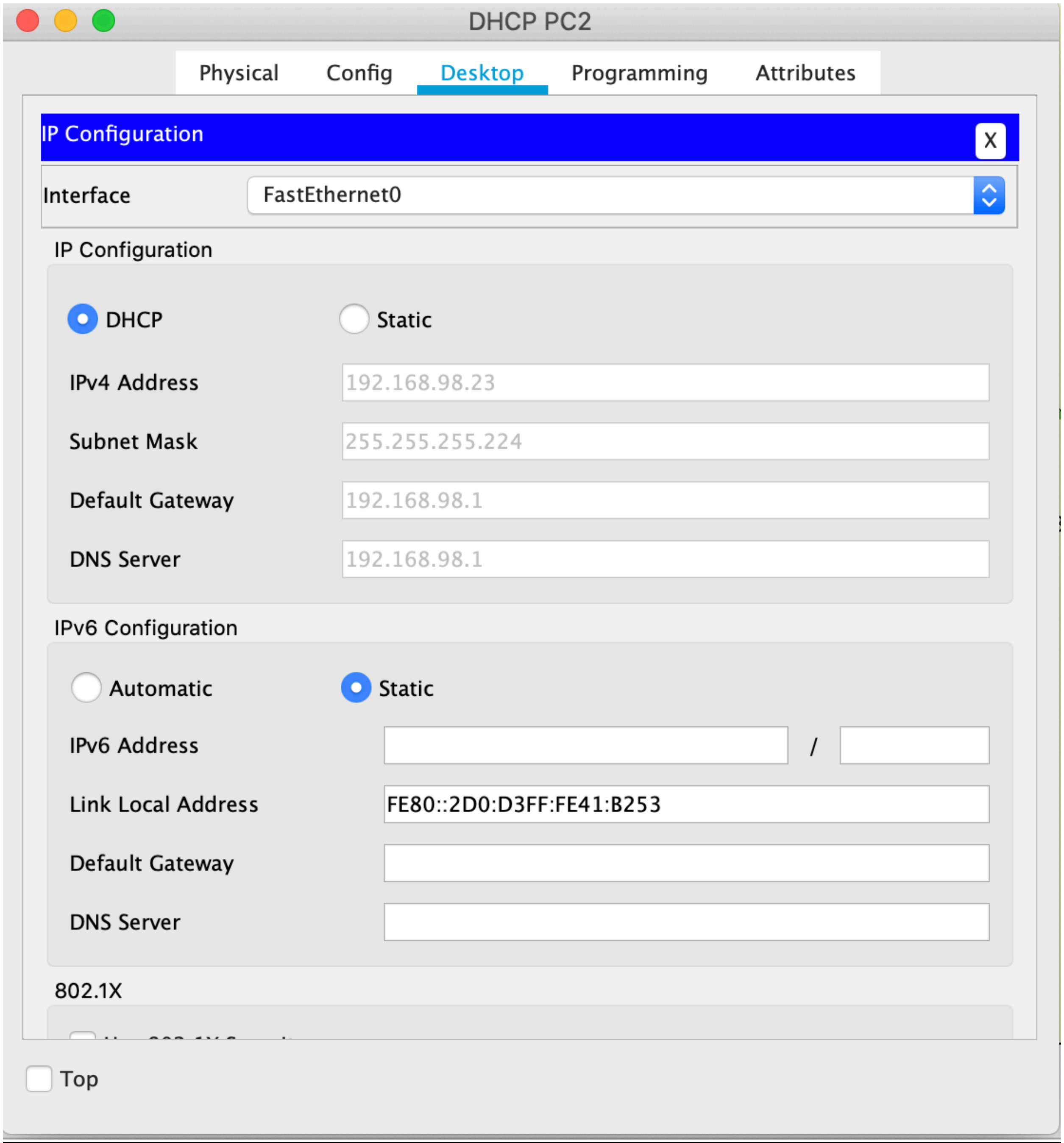
The pool name, the total number of IP addresses, number of leased and excluded addresses, subnet's IP range, and other relevant information about the DHCP pool(s) configured on the system is shown by this instruction.

DHCP PC1 pings to ISP, Server, and Wireless Laptop.



The aim of this test was to show that the DHCP configured end-devices were all configured and working correctly therefore able to connect and communicate with other devices outside its network.
Here you can see the pings have been sent successfully.

DHCP PC2 IP configuration.



As you can see the DHCP configuration is now checked and assigning IP addresses automatically.

References:

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