Task 3 **(35%) You are given the following initial IP block: 122.87.96.0/21. Divide it into 3 subnets, so that they fit the following number of hosts:**

- **13 hosts**
- **168 hosts**
- **75 hosts**

Subnet your network based on the information you were given and fill out the table appropriately (if something is not applicable, *leave the cell blank*). Make sure to show all calculation steps on your paper(s).

a. For each subnet, find the subnet mask, network ID, broadcast IP address and first and last host address.

a. Consider the following:

Within the *1st and 2nd subnet*:

- **The *first usable host address* is used for the router,**
- **The *last usable host* address is for the DHCP server.**
- **The *HTTP server* is located in the *1st subnet*, with the *second-to-last usable host address* assigned to it.**
- **The *DNS server* is located in the *2nd subnet*, with the *second-to-last usable host address* assigned to it.**
- **There are 3 PCs in each subnet.**

In the *3rd subnet*:

- **This subnet *connects* the routers of Subnets 1 and 2.**
- **The *first usable host address* is used for Router 1,**
- **The *last usable host* address is used for Router 2.**

Work:

Initial IP block: **122.87.96.0/21**.

Subnets:

- **13 hosts**
- **168 hosts**
- **75 hosts**

I) Sort the subnets in *descending* order (from largest to smallest), based on the **number of hosts**.

- **Subnet 1**: **168** hosts
- **Subnet 2**: **75** hosts

- **Subnet 3**: **13** hosts

II) Find the *default subnet mask*:

122.87.96.0/21 → 21 means that there are **21 network bits,** which means there are **11 host bits** (32 total bits - 21 = **11**).

- 21 ones
- 11 zeroes
- Turn it into an IP address

11111111 11111111 11111000 00000000

Default mask for the entire network: **255.255.248.0**

III) *Find custom subnet masks for each subnet*

Subnet 1:

2^h - 2 >= hosts

2^h - 2 >= 168

2^h >= 170

h = 8 → *8 hosts bits; 24 network bits* (32 - 8)

11111111 11111111 11111111 00000000

255.255.255.0 /24

Subnet 2:

2^h - 2 >= hosts

2^h - 2 >= 75

2^h >= 77

h = 7 → *7 host bits; 25 network bits (32 - 7)*

11111111 11111111 11111111 10000000

255.255.255.128 /25

Subnet 3:

2^h - 2 >= hosts

2^h - 2 >= 13

2^h >= 15

h = 4 → *4 host bits; 28 network bits (32 - 4)*

11111111 11111111 11111111 11110000

255.255.255.240 /28

IV) Find subnet ranges:

For each subnet, find the *network address*, *broadcast address*, *first and last usable host*.

broadcast = network + (2^h - 1)

Subnet 1:

- Network address: 122.87.96.0 N = first given IP
- Broadcast address: 122.87.96.255 B = N + (2^h - 1) = N + 2^8 -1 = N + 255
- First usable host: 122.87.96.1 F = N + 1
- Last usable host: 122.87.96.254 L = B - 1

Subnet 2:

- Network address: 122.87.**97**.0 N = last B + 1 (overflow)
- Broadcast address: 122.87.97.127 B = N + (2^h - 1) = N + 2^7 -1 = N + 127
- First usable host: 122.87.97.1 F = N + 1
- Last usable host: 122.87.97.126 L = B - 1

Subnet 3:

- Network address: 122.87.97.128 N = last B + 1
- Broadcast address: 122.87.97.143 B = N + (2^h - 1) = N + 2^4 -1 = N + 15
- First usable host: 122.87.97.129 F = N + 1
- Last usable host: 122.87.97.142 L = B - 1

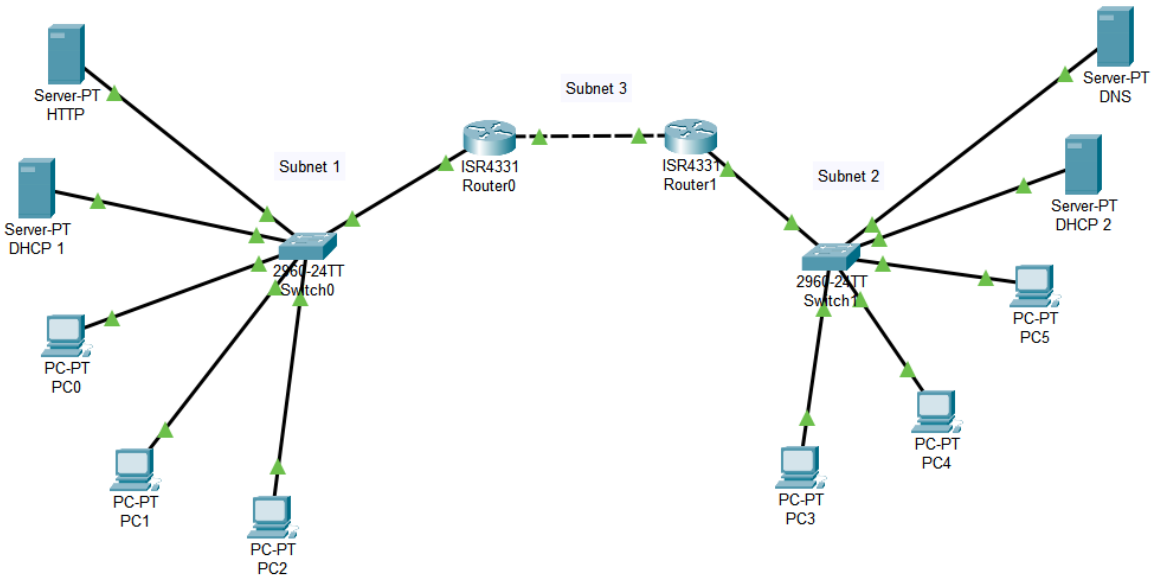
Network:	122.87.96.0/21		
Default subnet mask:	255.255.248.0		
Subnet 1			
Subnet mask:	255.255.255.0 /24	**Number of hosts:**	168
Network address:	122.87.96.0	Broadcast address:	122.87.96.255
First usable host:	122.87.96.1	Last usable host:	122.87.96.254
Default gateway:	122.87.96.1	DHCP server:	122.87.96.254
HTTP server:	122.87.96.253	DNS server:	/
Subnet 2			
Subnet mask:	255.255.255.128 /25	**Number of hosts:**	75
Network address:	122.87.97.0	Broadcast address:	122.87.97.127
First usable host:	122.87.97.1	Last usable host:	122.87.97.126
Default gateway:	122.87.97.1	DHCP server:	122.87.97.126
HTTP server:	/	DNS server:	122.87.97.125
Subnet 3			
Subnet mask:	255.255.255.240 /28	**Number of hosts:**	13
Network address:	122.87.97.128	Broadcast address:	122.87.97.143
First usable host:	122.87.97.129	Last usable host:	122.87.97.142
Router 1:	122.87.97.129	Router 2:	122.87.97.142

4. Task (30%) Set up the **network topology** in **Packet Tracer**. It should be possible to:

1. **ping** *between Subnets 1 and 2* (every end device from Subnet 1 should be able to ping Subnet 2, and vice versa).
2. **access** the *HTTP server* from *all PCs on Subnet 1 and 2* via the domain name: **lab-group-a.ba**

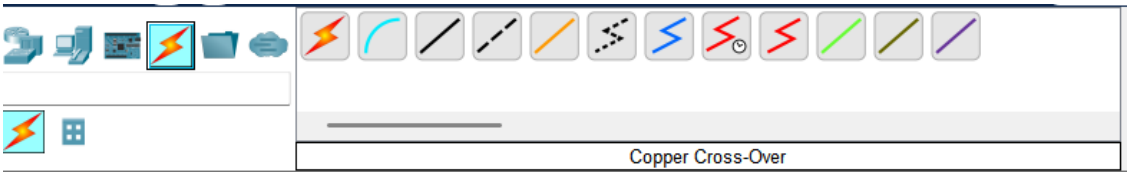
Work:

Your first step is to set up the topology as shown in the picture below. Don't worry if you don't see the green indicators on the connections right away because it's expected. The links only turn green once everything is correctly configured, so at this point just focus on placing the devices and connecting them with the right cables.



When it comes to cables, there are two types you'll need here. Copper Straight-Through is used for connecting different types of devices like router to switch, switch to PC, and switch to server. Copper Cross-Over is used for the direct connection between Router0 and Router1.

The difference comes down to something pretty simple. Every device has pins it uses to send data and pins it uses to receive data. When you connect two different types of devices, like a PC and a switch, one is naturally the sender and the other is the receiver so the pins line up and everything just works. But when you connect two routers to each other, both of them are trying to send on the same pins, which means neither one is actually listening. A cross-over cable fixes this by swapping the wires on one end, so what one router sends goes directly into the other router's receive pins and vice versa.



Configuration Process Steps

Step 1 - Router Interface Configuration

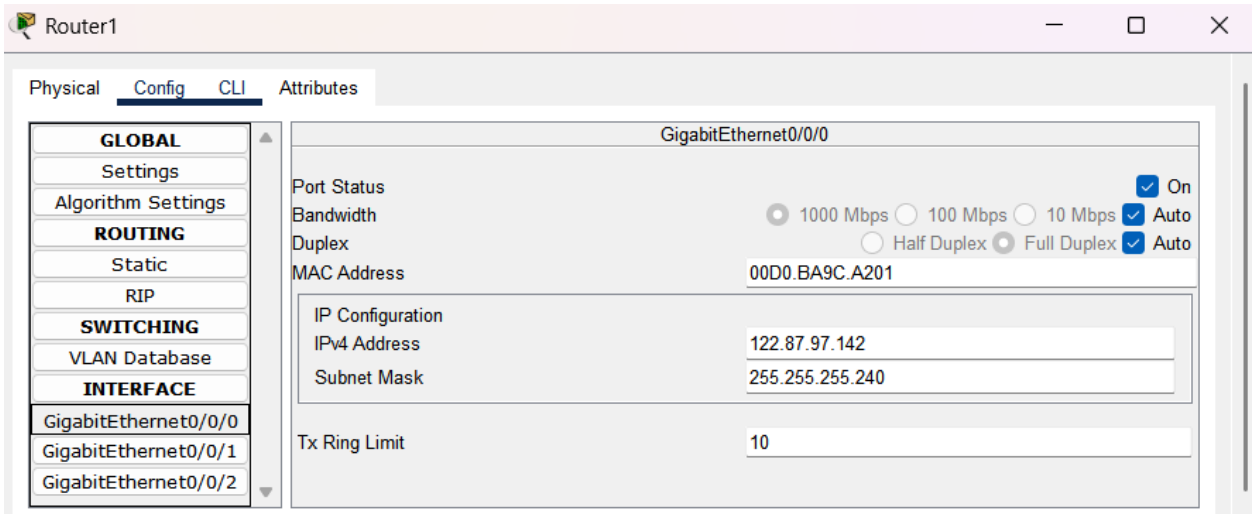
To get routing working between the subnets, each router interface had to be assigned its IP address and turned on. This is done under Config > Interface in Packet Tracer just select the interface, check Port Status to On, and enter the IP and subnet mask.

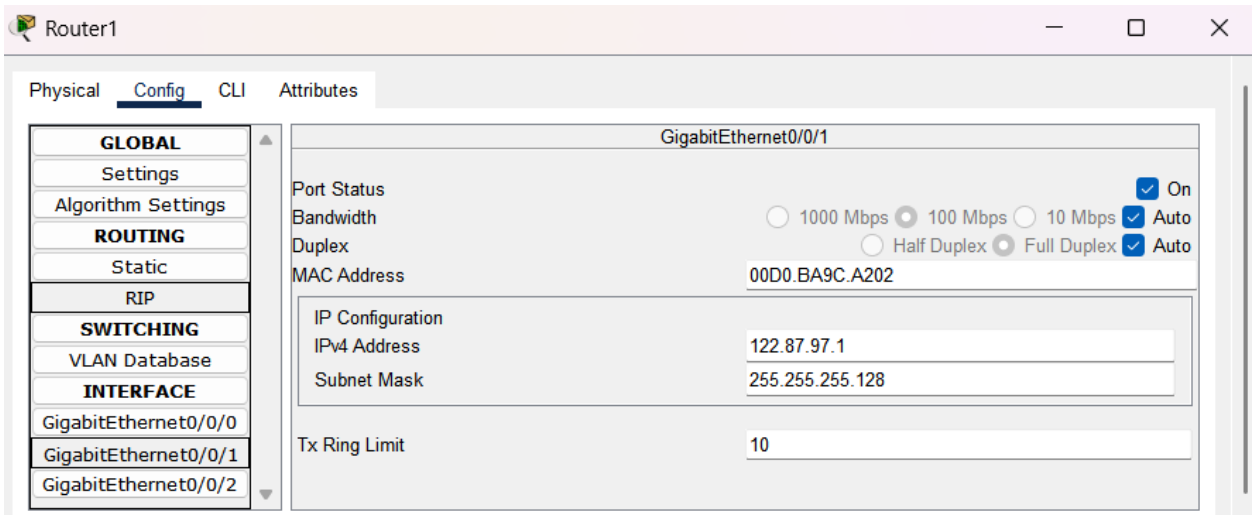
Router0:

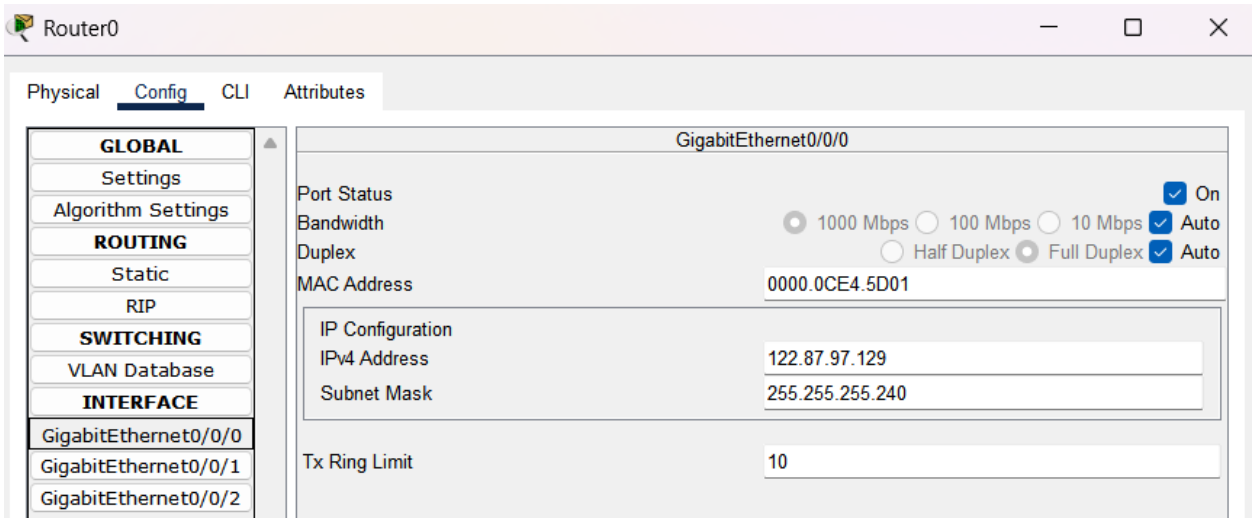
- GigabitEthernet0/0/0 => 122.87.97.129 / 255.255.255.240 (Subnet 3, to Router1)
- GigabitEthernet0/0/1 => 122.87.96.1 / 255.255.255.0 (Subnet 1)

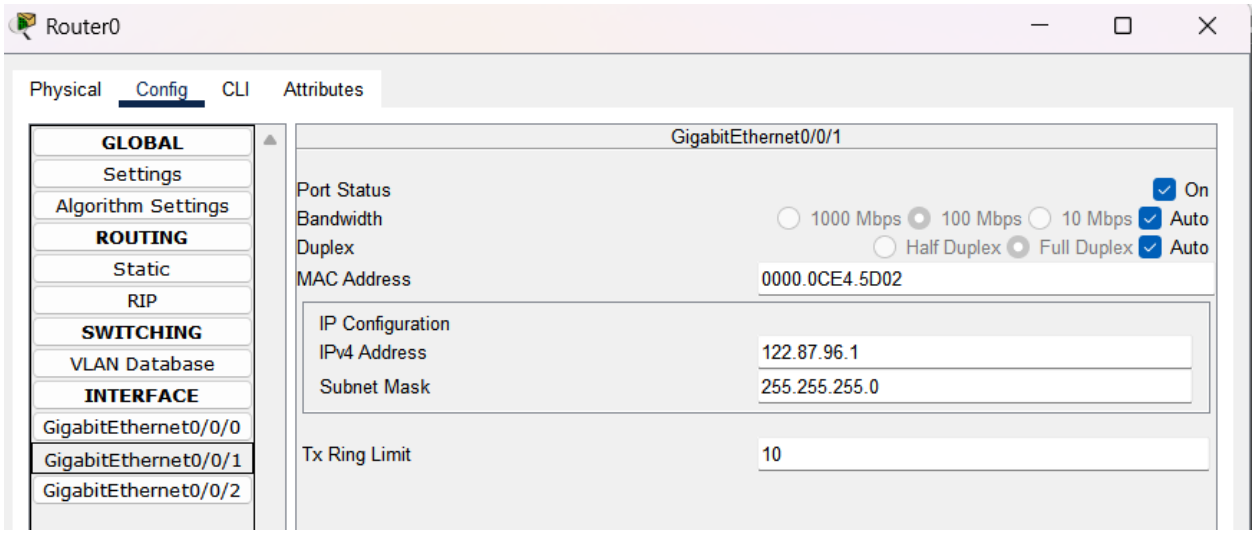
Router1:

- GigabitEthernet0/0/0 => 122.87.97.142 / 255.255.255.240 (Subnet 3, to Router0)
- GigabitEthernet0/0/1 =>122.87.97.1 / 255.255.255.128 (Subnet 2)









Step 2 - DHCP Configuration

Instead of manually configuring IPs on every PC, I set up two DHCP servers one per subnet. Each server is configured under Services > DHCP. The important thing here is that besides the IP pool, you also have to set the default gateway and DNS server in the pool, otherwise PCs won't know where to route traffic or where to send DNS queries.

DHCP 1 (Subnet 1):

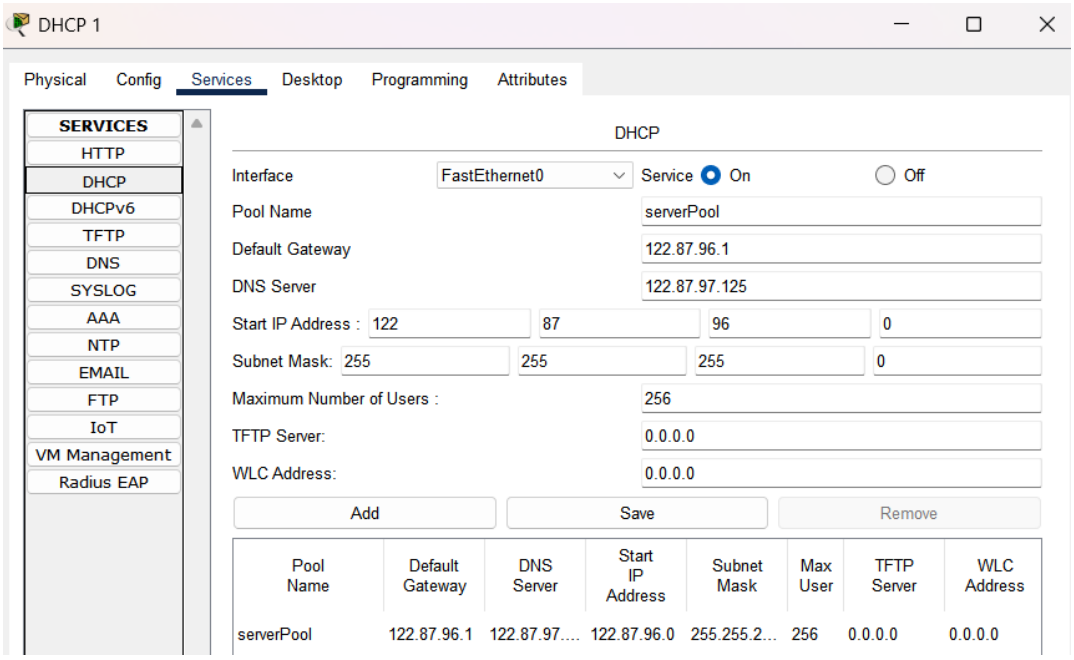
- Default Gateway: 122.87.96.1
- DNS Server: 122.87.97.125
- Start IP: 122.87.96.0 / Mask: 255.255.255.0 / Max Users: 256

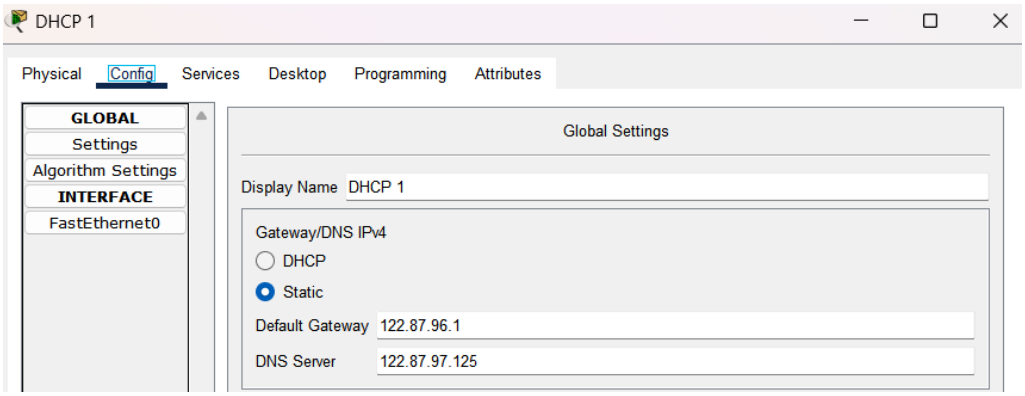
DHCP 2 (Subnet 2):

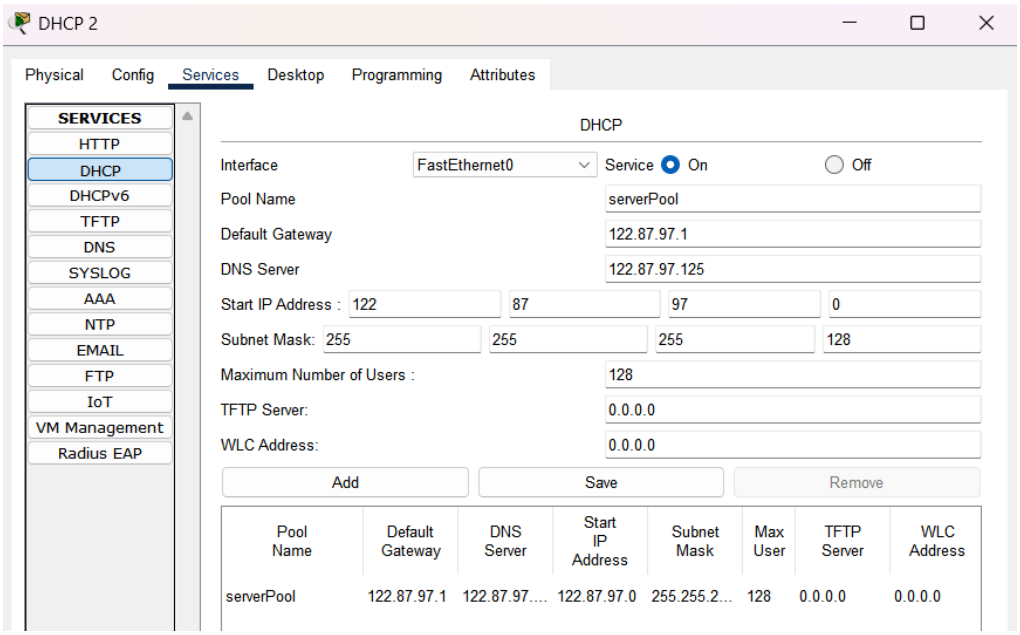
- Default Gateway: 122.87.97.1
- DNS Server: 122.87.97.125

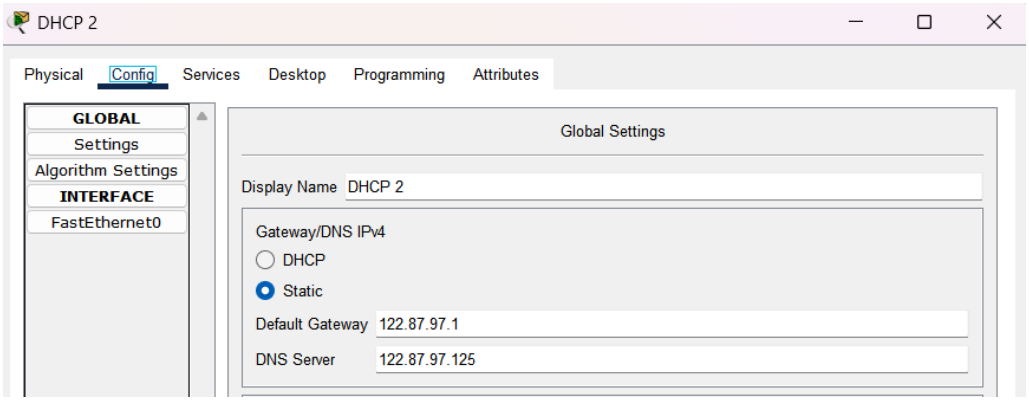
- Start IP: 122.87.97.0 / Mask: 255.255.255.128 / Max Users: 128

Both servers also had their own static gateway and DNS set under Config > Settings.







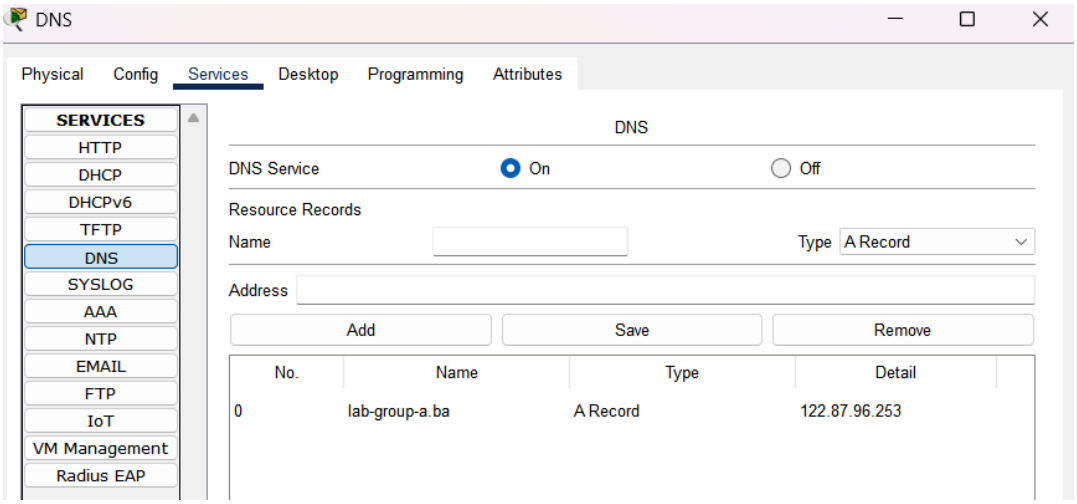


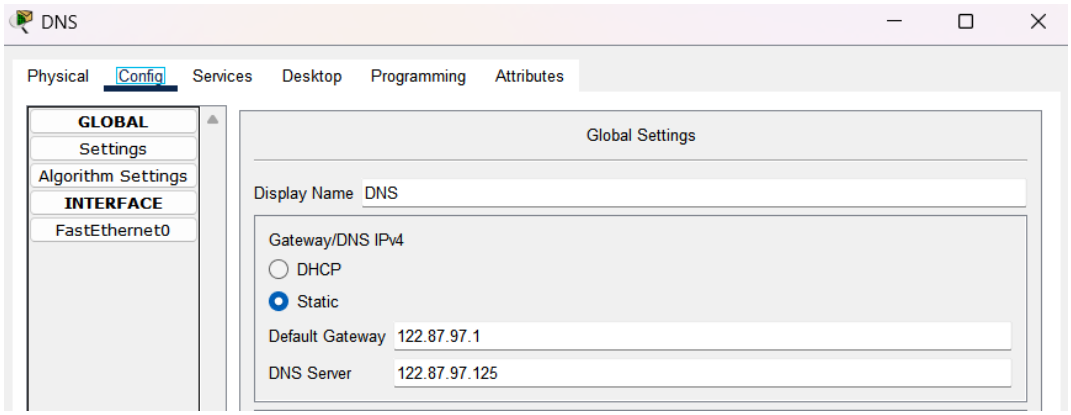
Step 3 - DNS Configuration

The DNS server is configured under Services > DNS, service set to On. One A Record was added:

- Name: lab-group-a.ba => Address: 122.87.96.253

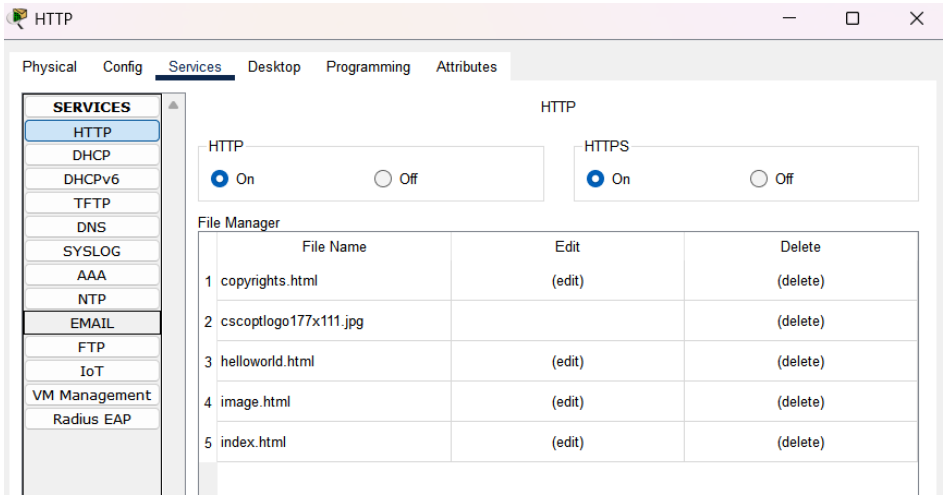
That's the HTTP server's IP. Without this record, typing the domain name in a browser would just fail because nothing would know what IP it maps to. The DNS server's own gateway and DNS were set under Config > Settings (gateway 122.87.97.1, DNS 122.87.97.125).





Step 4 - HTTP Configuration

The HTTP server just needed HTTP and HTTPS turned On under Services > HTTP. Packet Tracer already has default pages ready so nothing else needed to be changed there. Gateway and DNS were set to static under Config > Settings (gateway 122.87.96.1, DNS 122.87.97.125).



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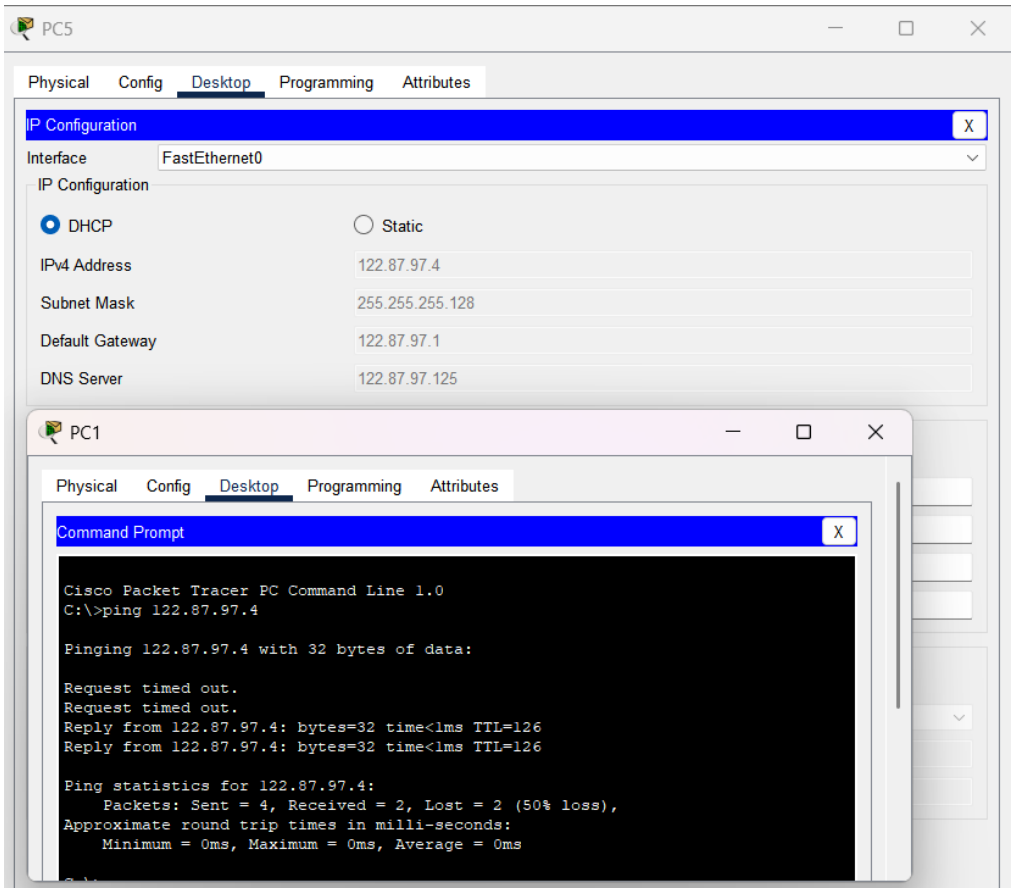
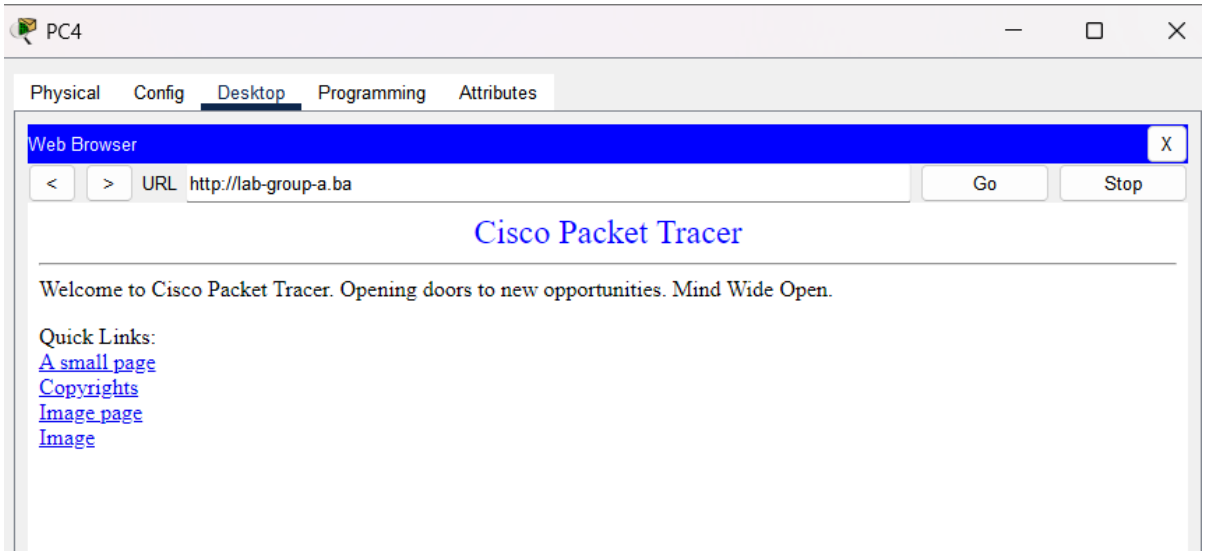
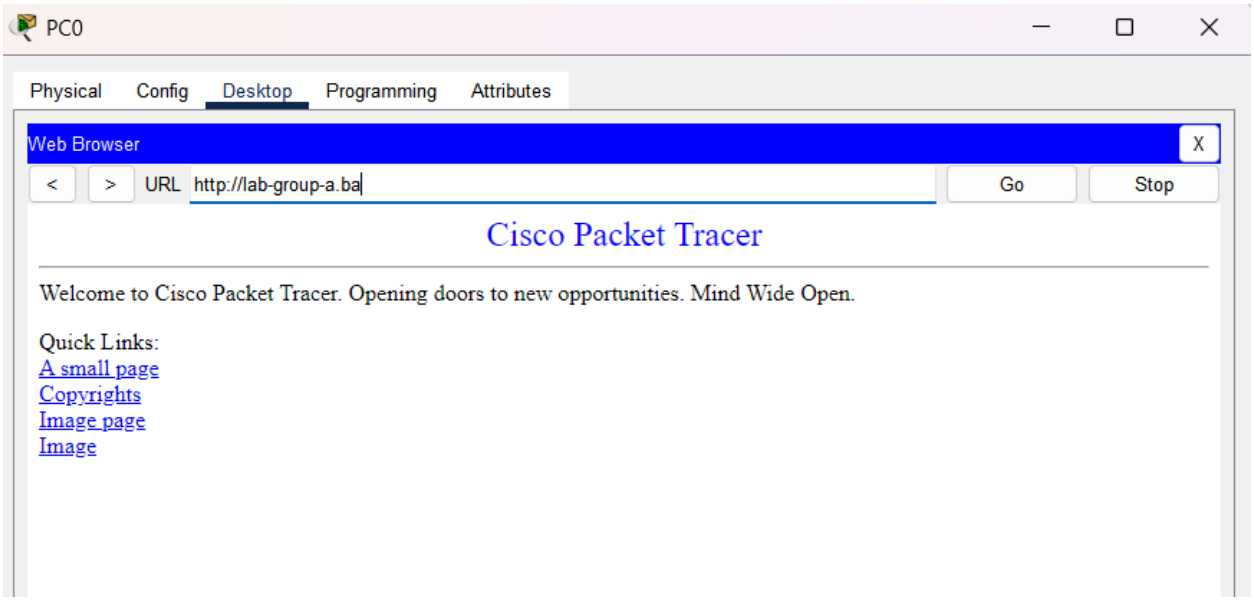

PC5
Physical
Config
Desktop
Programming
Attributes
IP Configuration
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
122.87.97.4
Subnet Mask
255.255.255.128
Default Gateway
122.87.97.1
DNS Server
122.87.97.125
PC1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 122.87.97.4
Pinging 122.87.97.4 with 32 bytes of data:
Request timed out.
Request timed out.
Reply from 122.87.97.4: bytes=32 time<1ms TTL=126
Reply from 122.87.97.4: bytes=32 time<1ms TTL=126
Ping statistics for 122.87.97.4:
Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

2)


PC4
Physical
Config
Desktop
Programming
Attributes
Web Browser
URL
http://lab-group-a.ba
Go
Stop
Cisco Packet Tracer
Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.
Quick Links:
A small page
Copyrights
Image page
Image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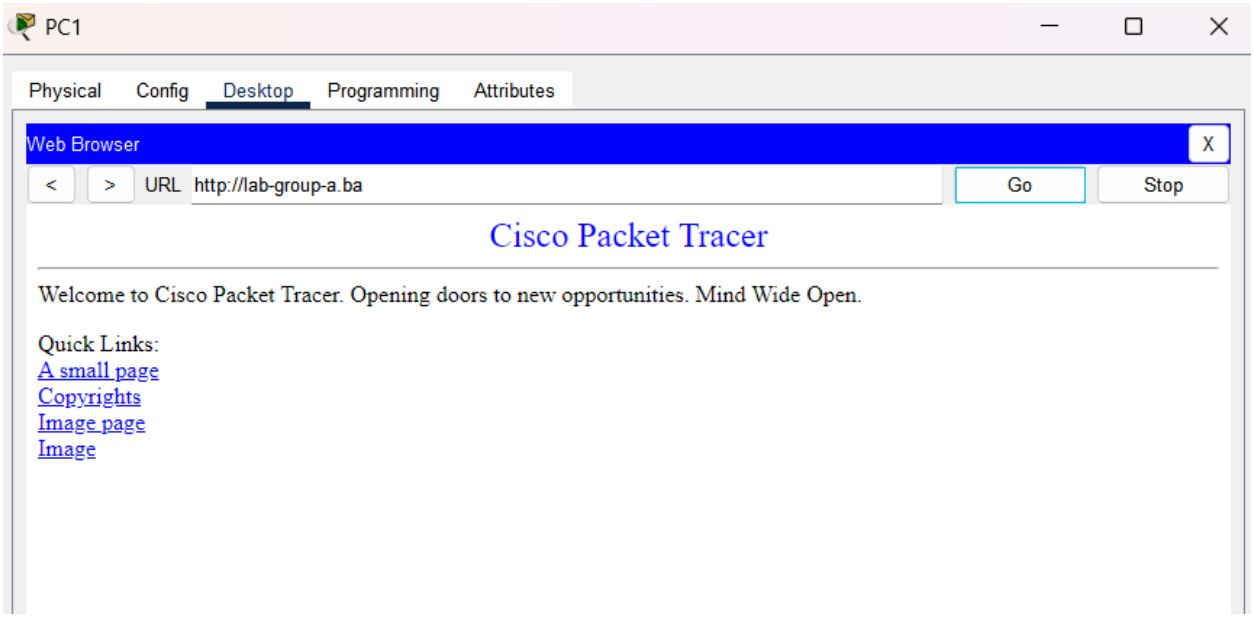
PC1
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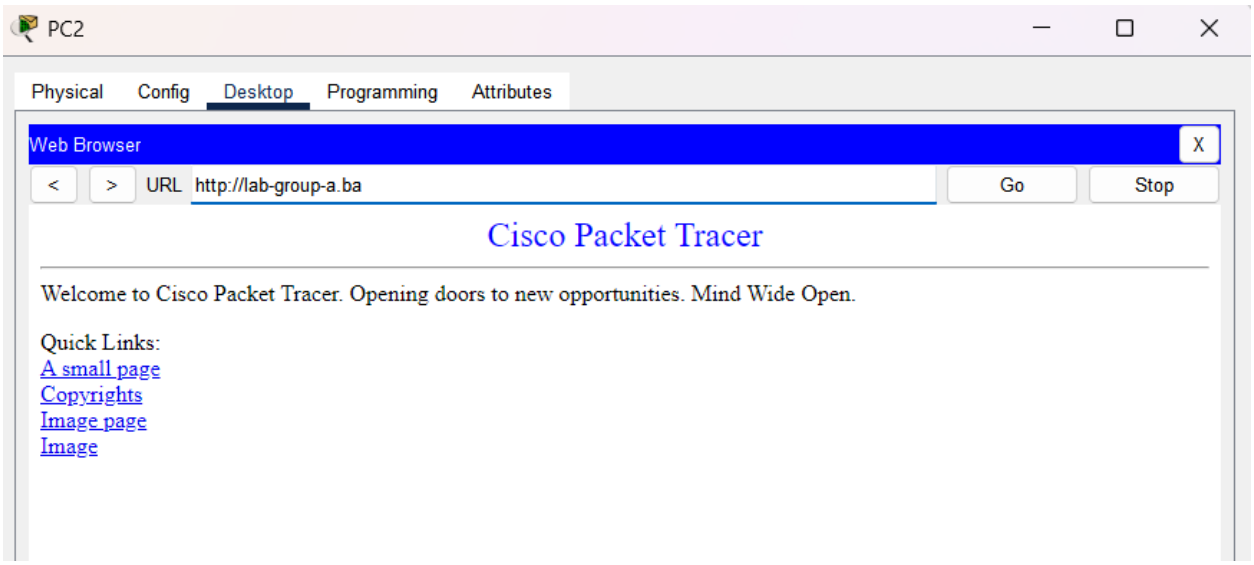
PC2
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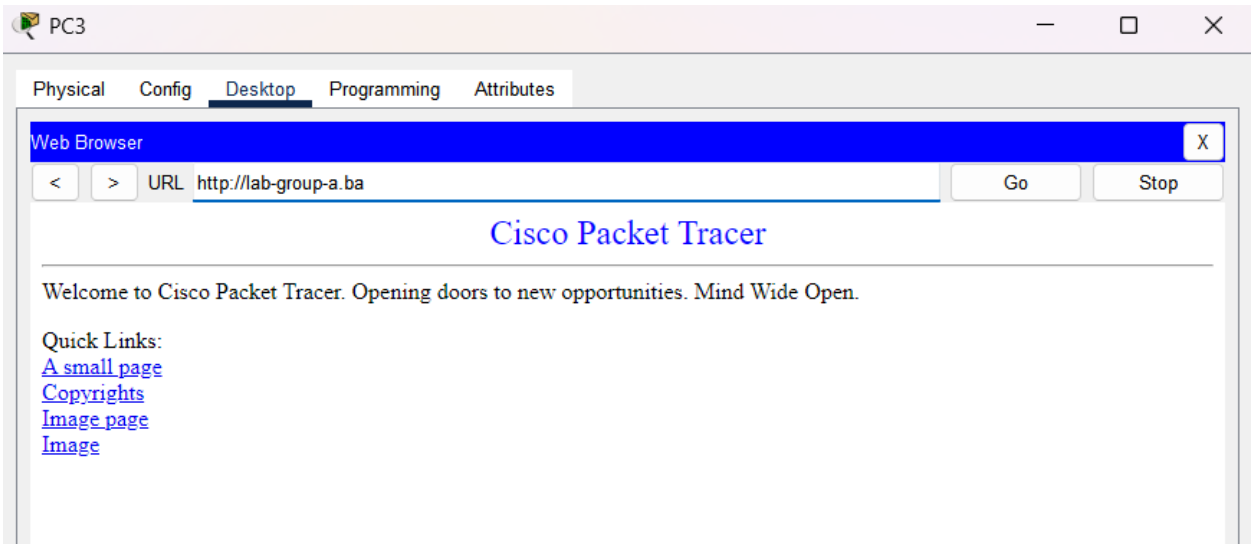
PC3
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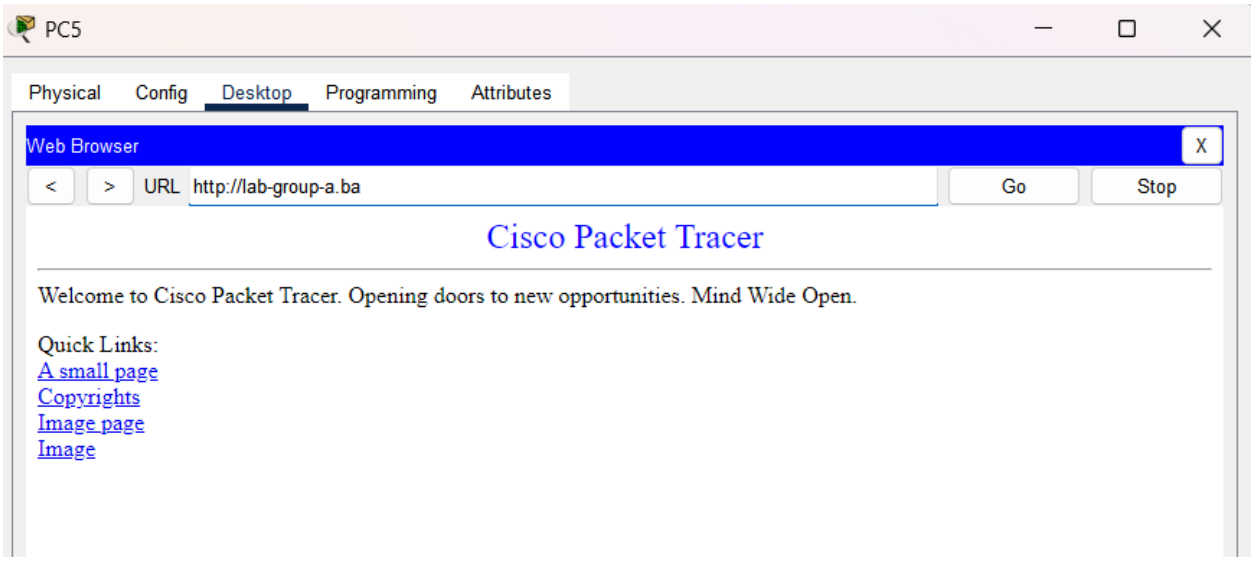
PC5
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Cisco Packet Tracer
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