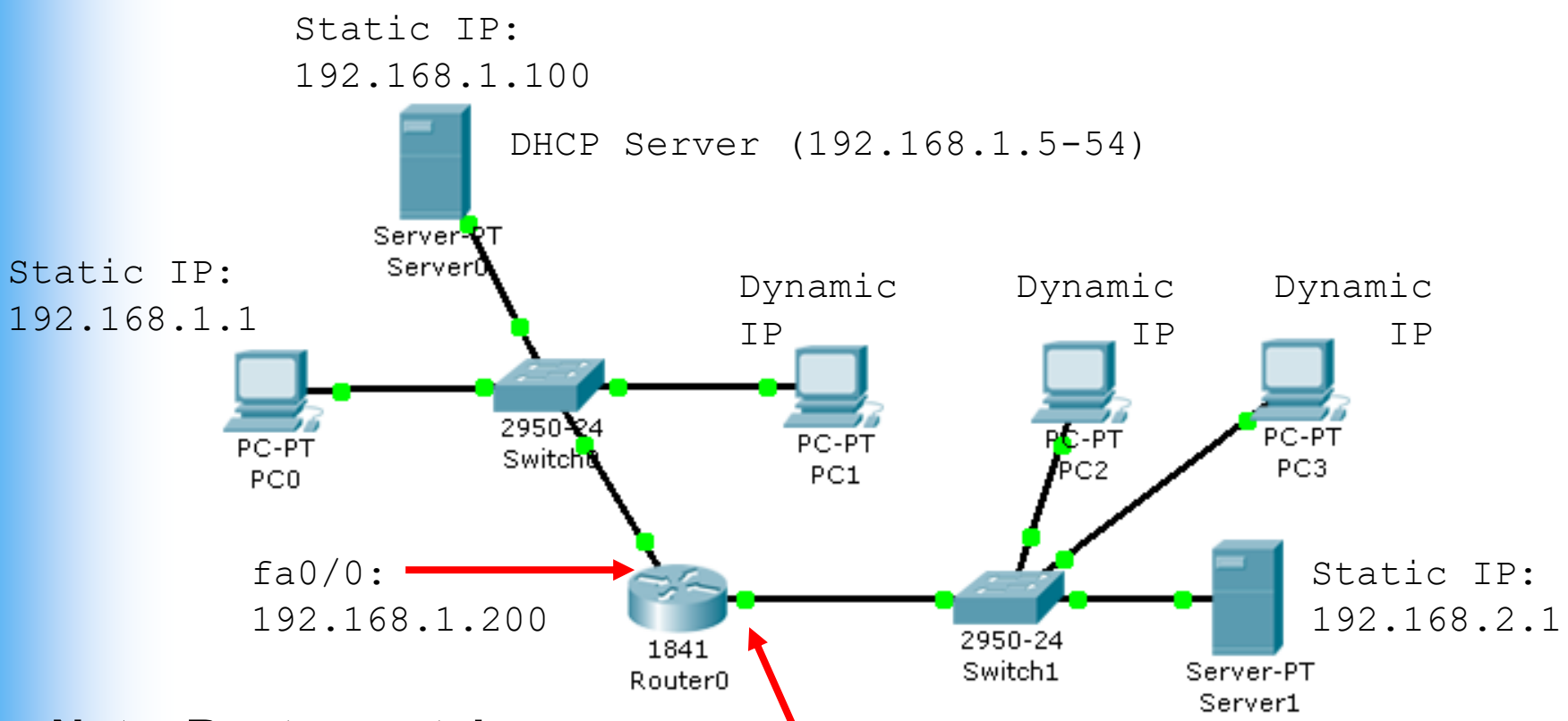
UEEN2013/UEEN2423

TCP/IP Network Fundamentals

(Topic 02)

Managing an Internetwork

IP Address Design Plan



Note: Router ports' IP have to static IP (ALWAYS)

Building your first LAN in Packet Tracer

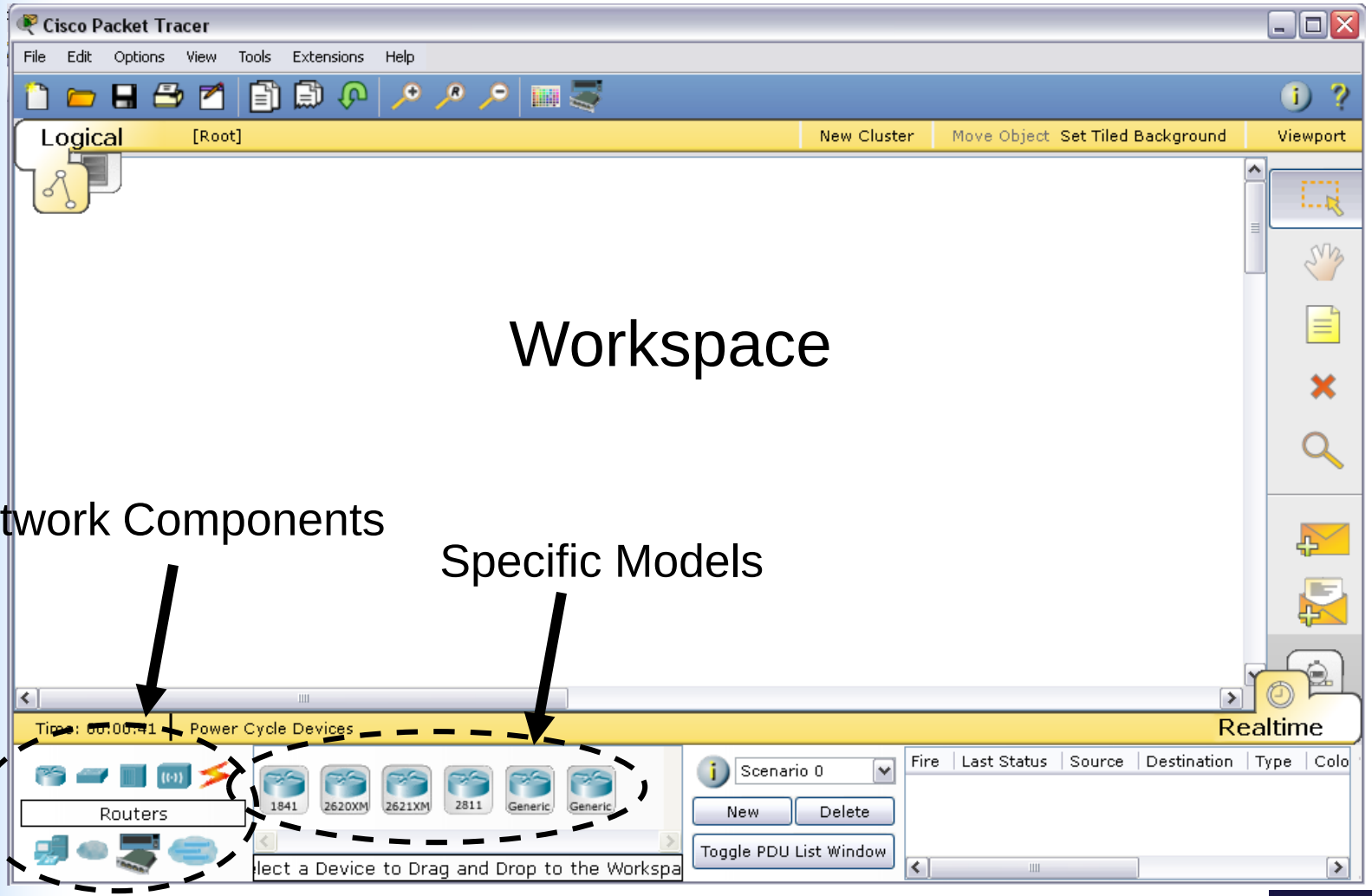
Your first guide on Packet Tracer

Forming a simple LAN

step by step

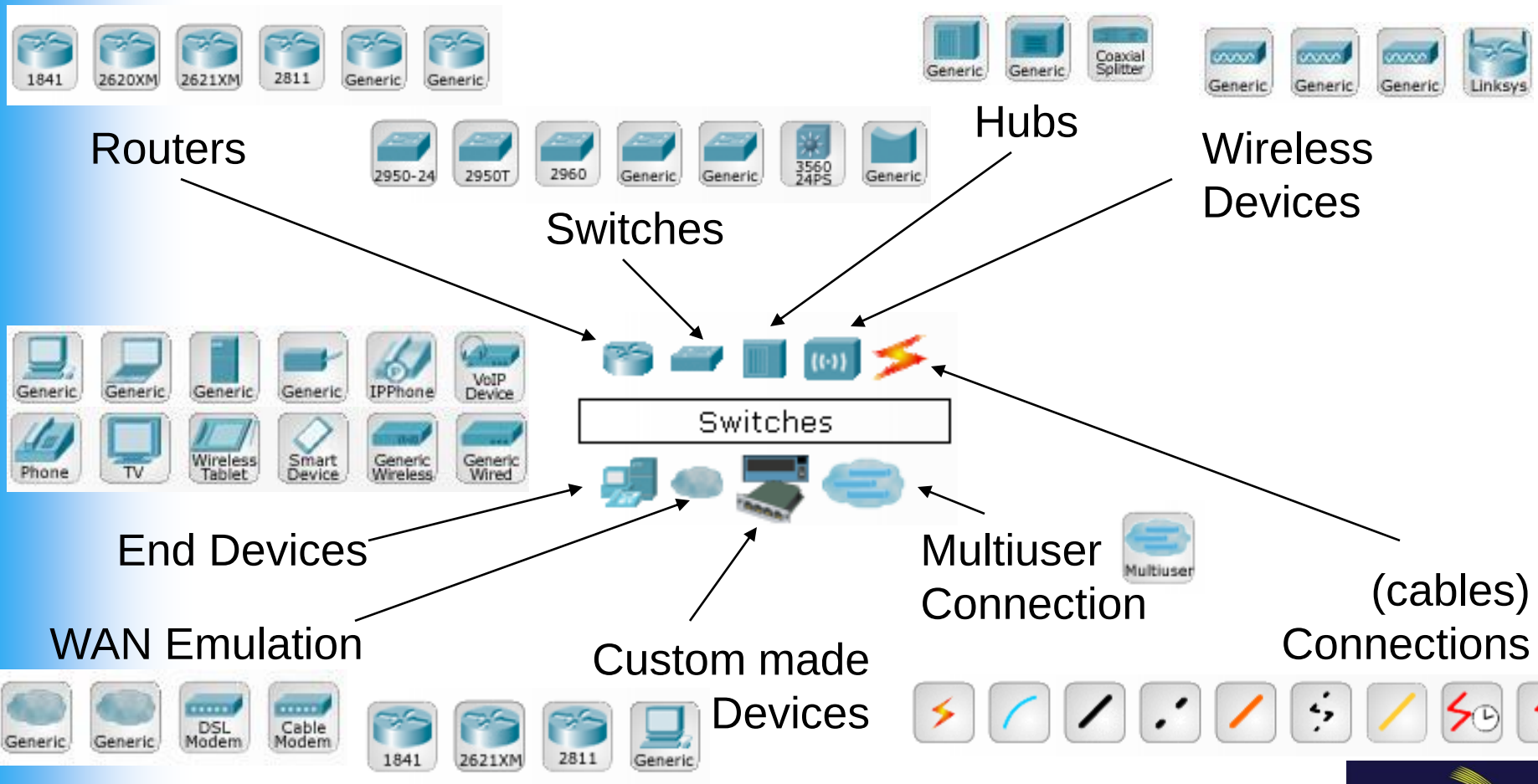
UTAR
UNIVERSITI TUNKU ABDUL RAHMAN

When you Open Your Packet Tracer

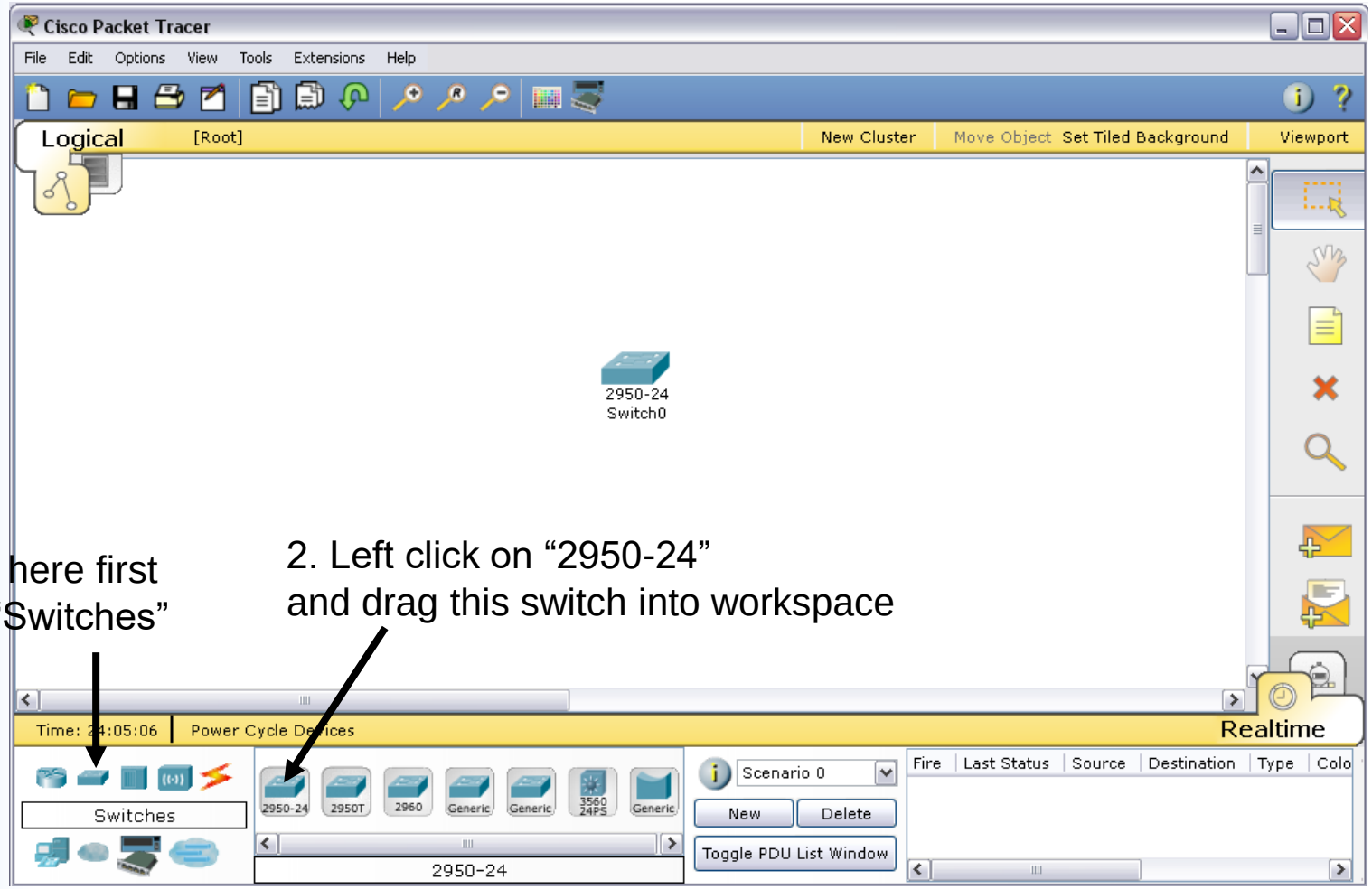


Network Components

- Network components in Packet Tracer 5.3



Switch



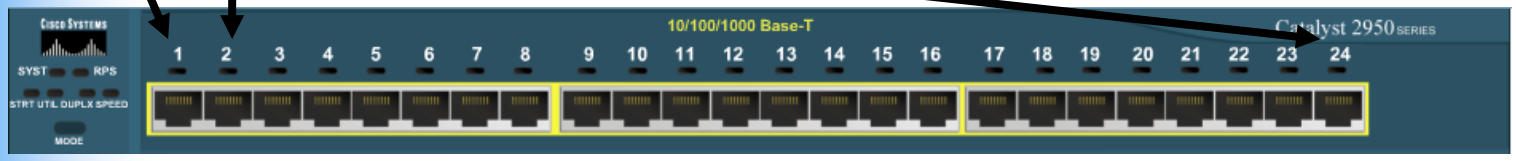
1.Click here first to get “Switches”

2. Left click on “2950-24” and drag this switch into workspace

2950-24 Switch

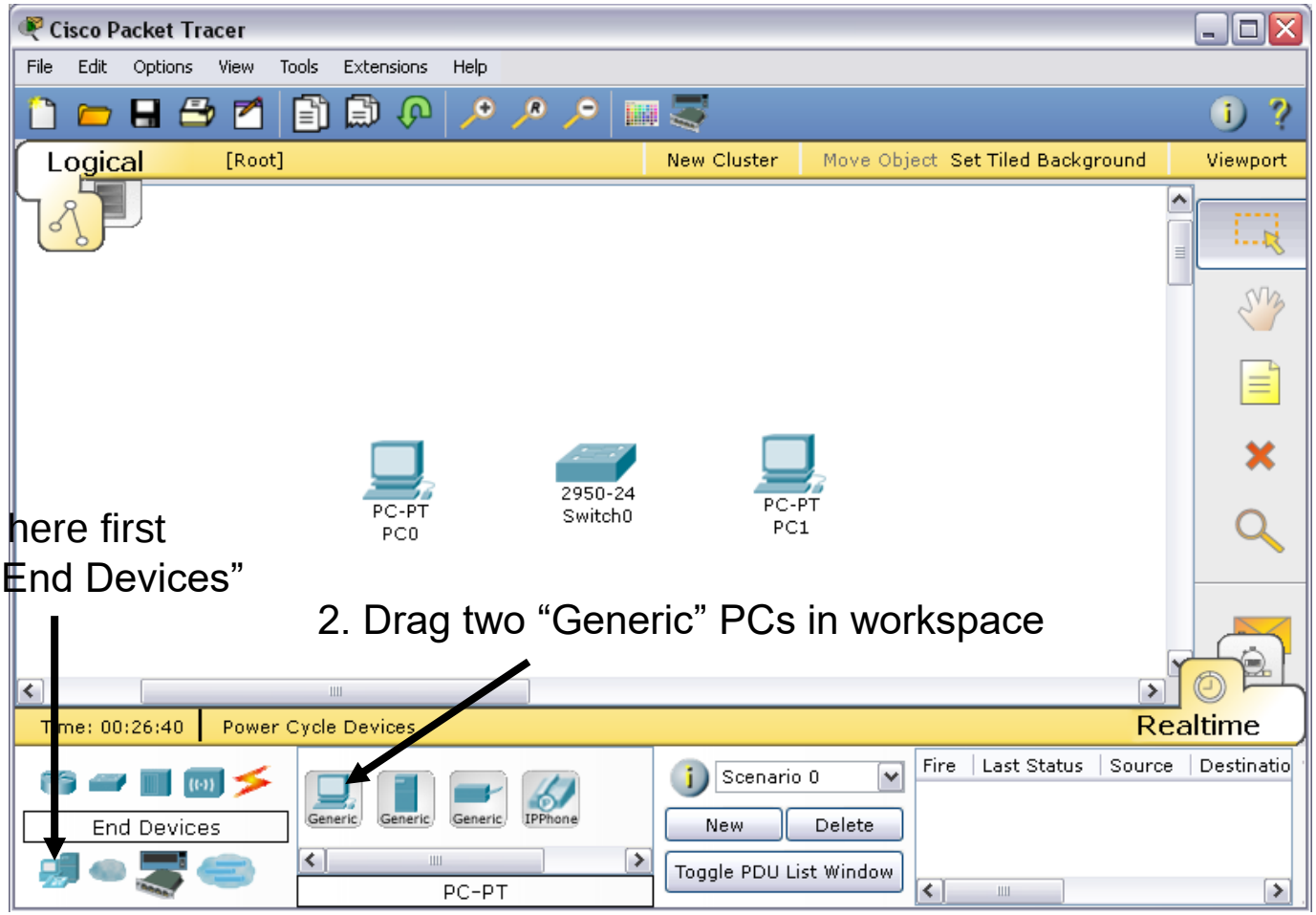
- Network Switches are used to form a simple local area network (LAN)
- Cisco Catalyst 2950-24
  - have 24 10M/100M ports
    - The port here (hardware) is different from “port number” (software)
    - 10M = 10Mbps, 100M = 100 Mega bits per second (Mbps)
    - 100M is what we call “Fast Ethernet”
    - 10M is what we call “Ethernet”

Each of the switch ports is named as fa0/1, fa0/2,….fa0/24



switch ports

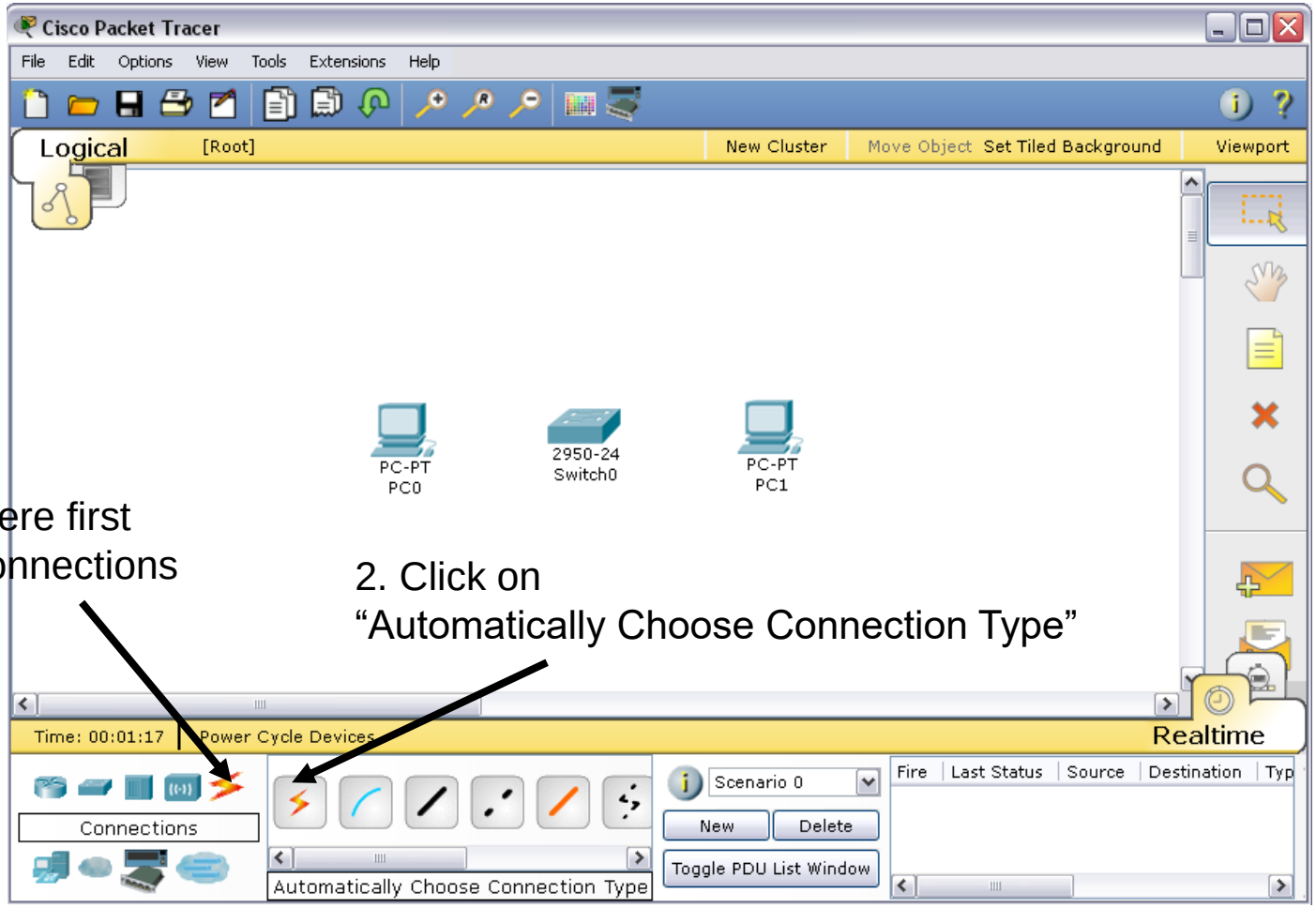
PC



1.Click here first to get “End Devices”

2. Drag two “Generic” PCs in workspace

Connection - 1

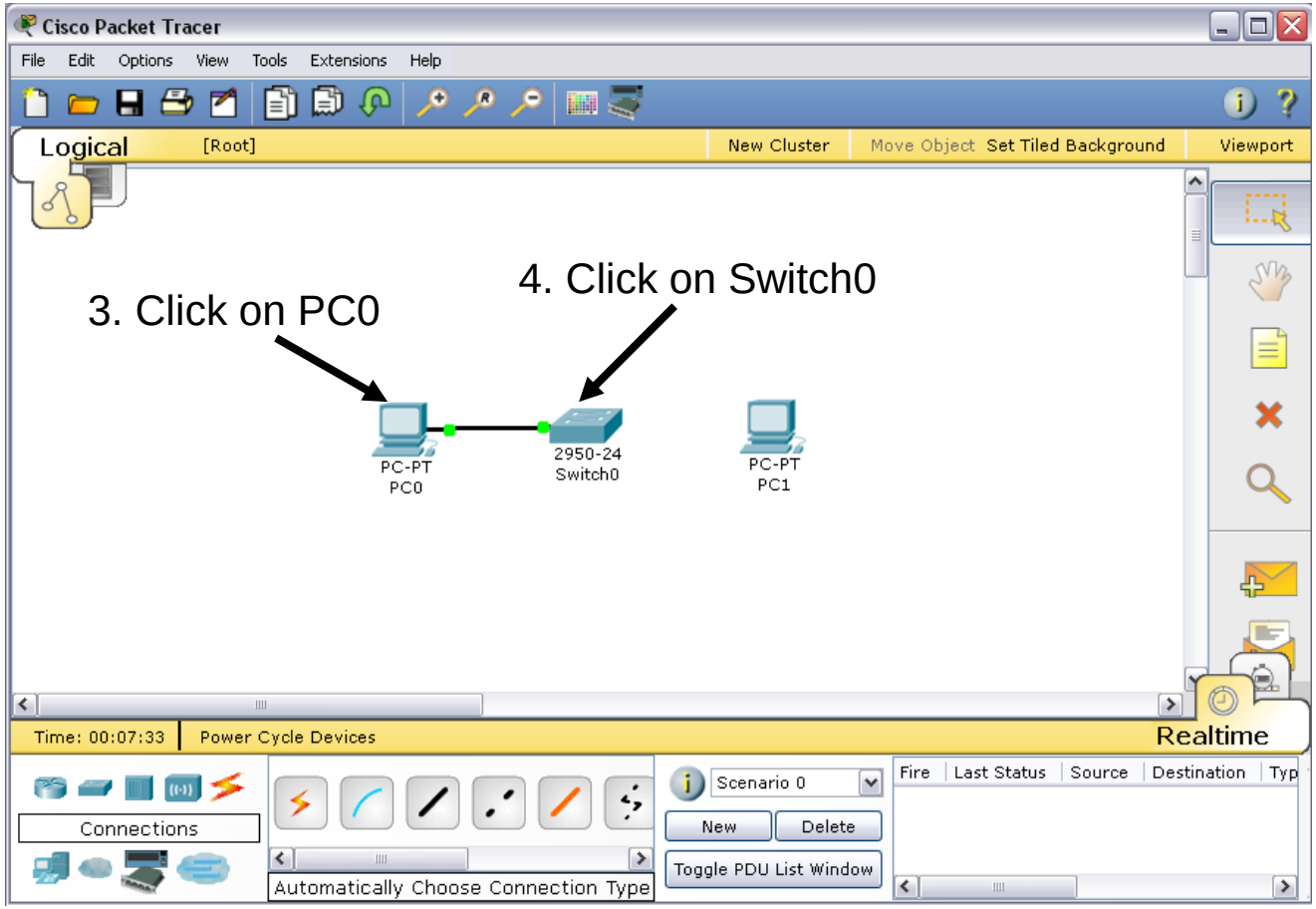


1.Click here first to get Connections

2. Click on "Automatically Choose Connection Type"

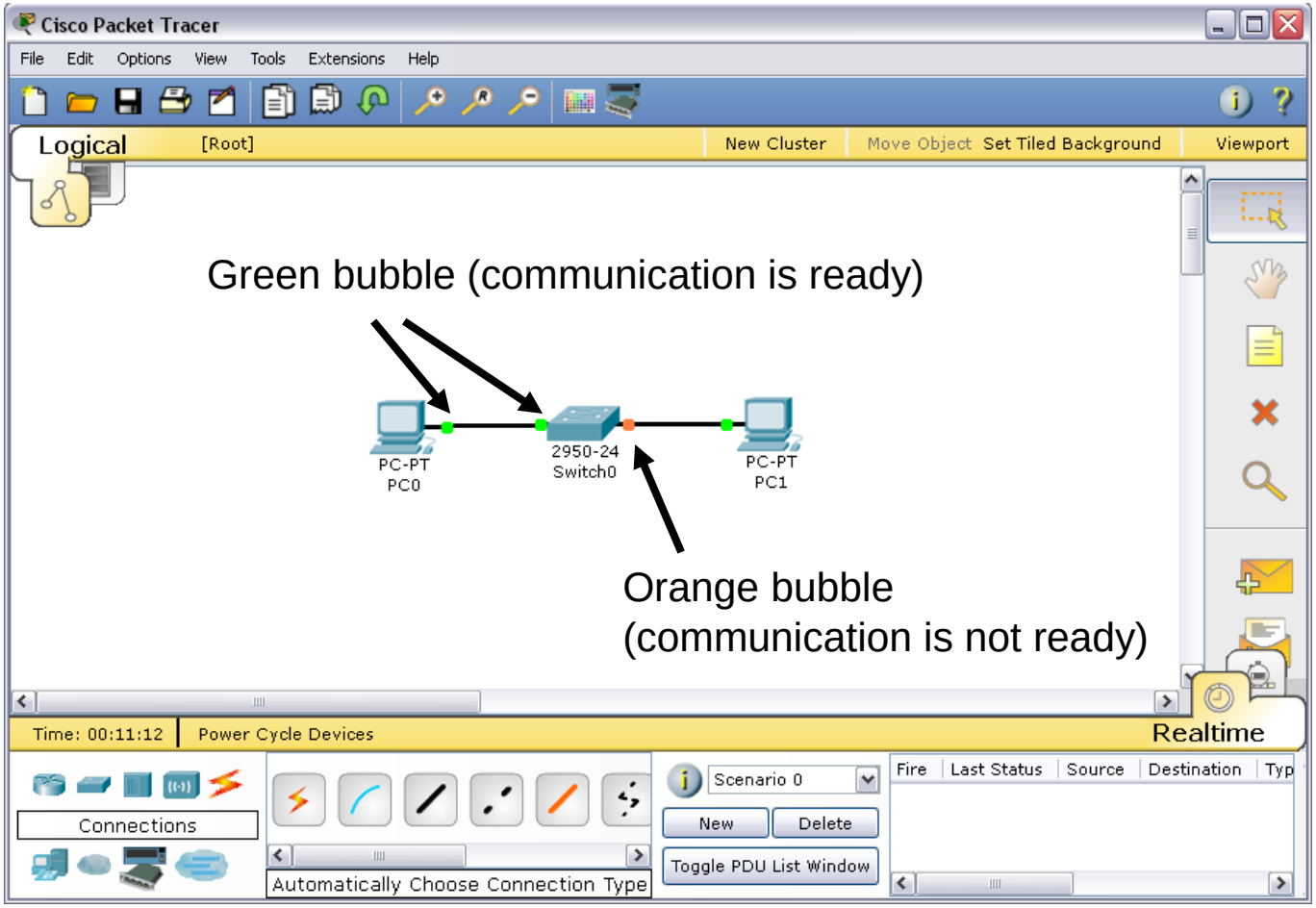
Connection - 2

- Click on both PC0 and Switch0 to form a connection.
- Do the same to connect a cable for PC1 and Switch0



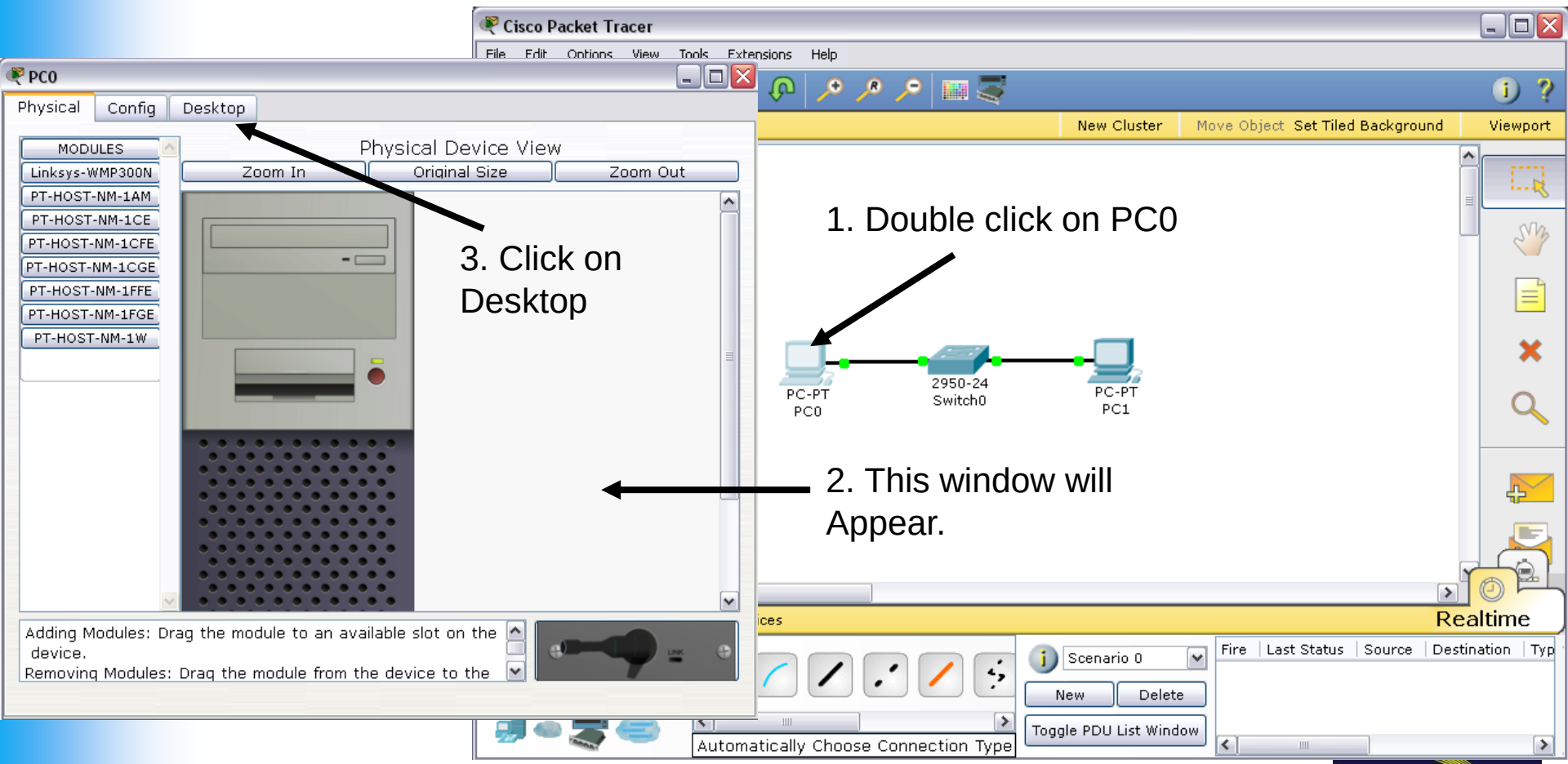
Connection - 3

- Wait for the little orange bubble to turn green.



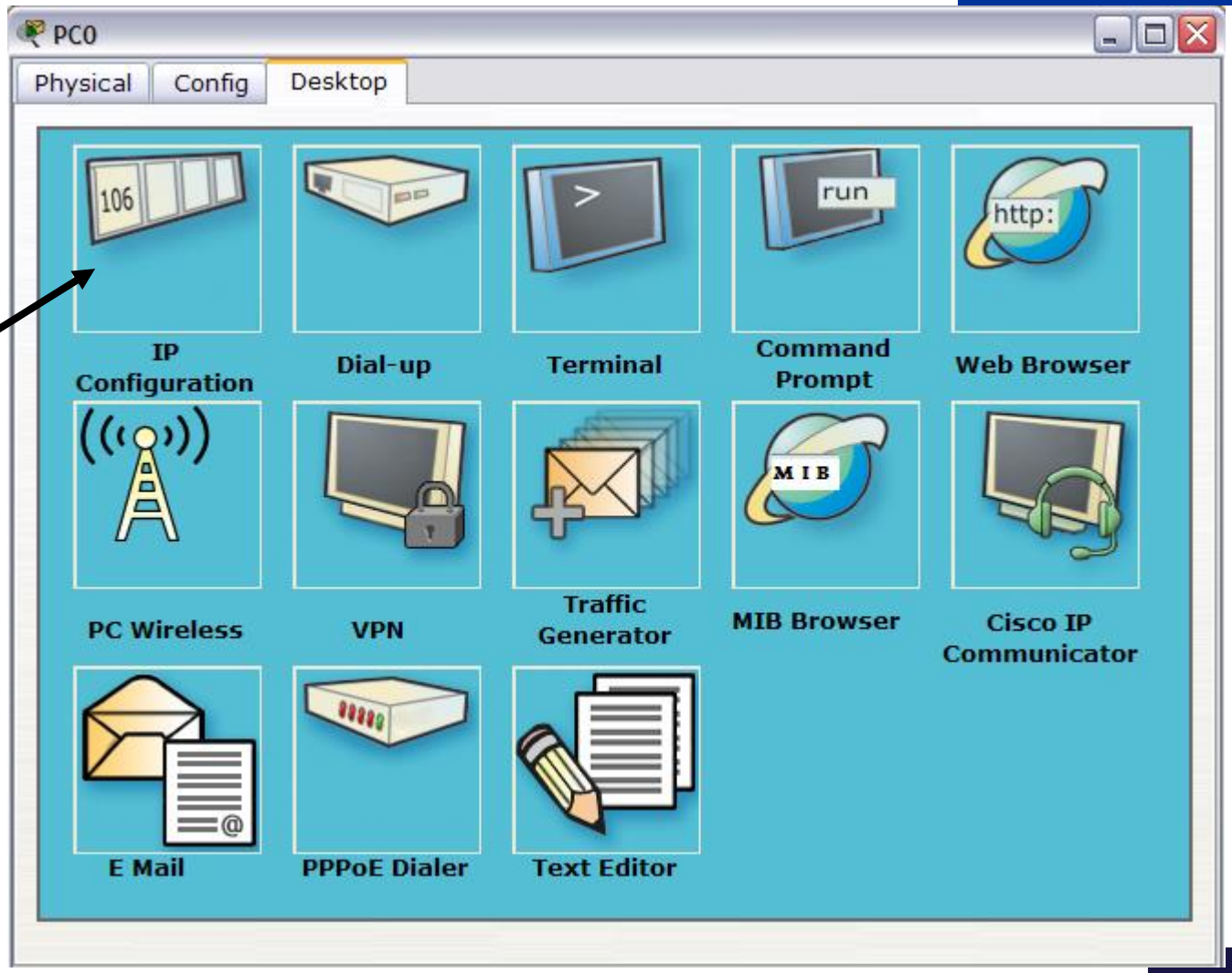
Configuring the PC - 1

- Double click on PC0 to call out the PC0 window

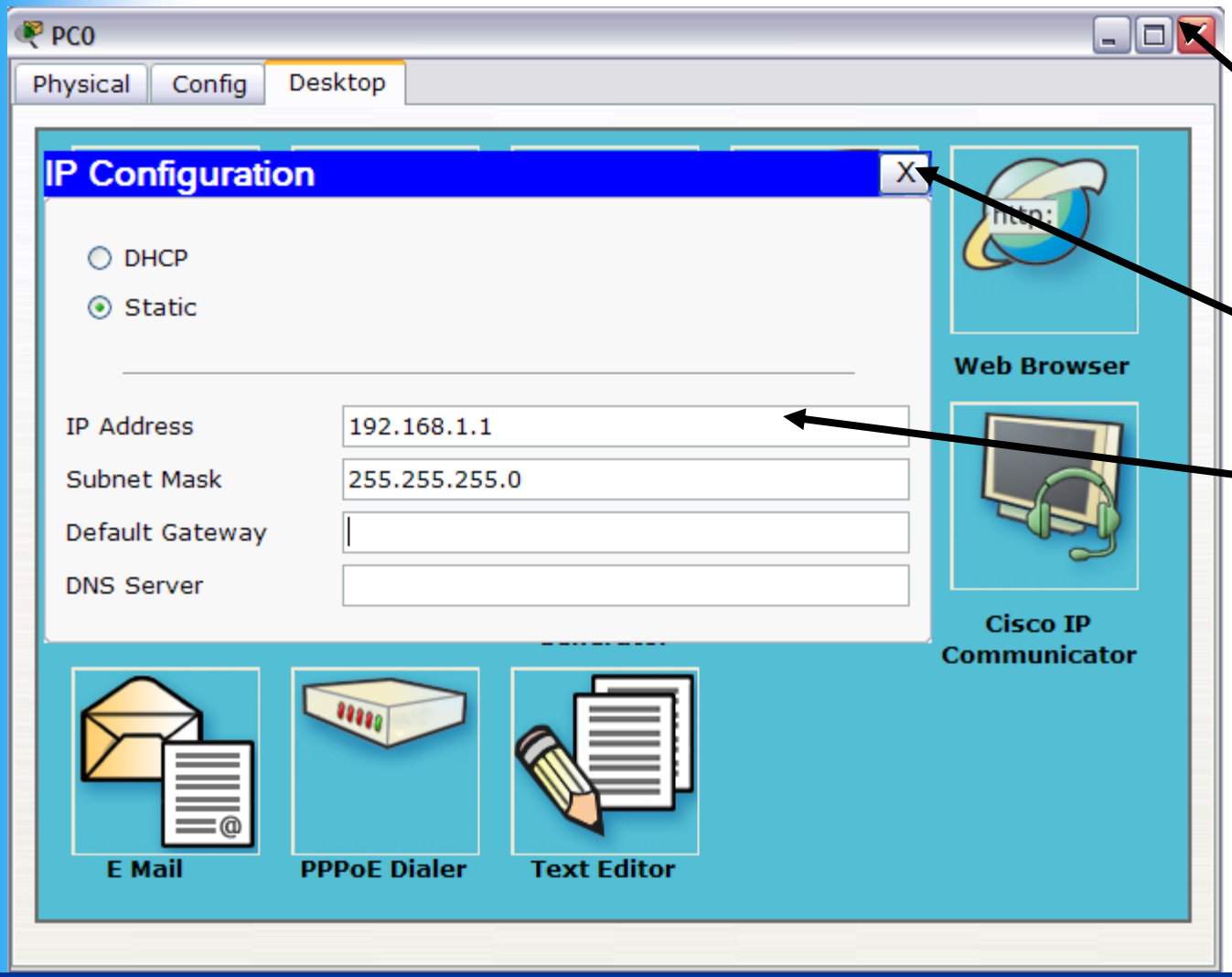


Configuring the PC - 2

4. Click on
IP Configuration



Configuring the PC - 3



9. Press this to close the PC0 window

8. Press this to close the IP Configuration window

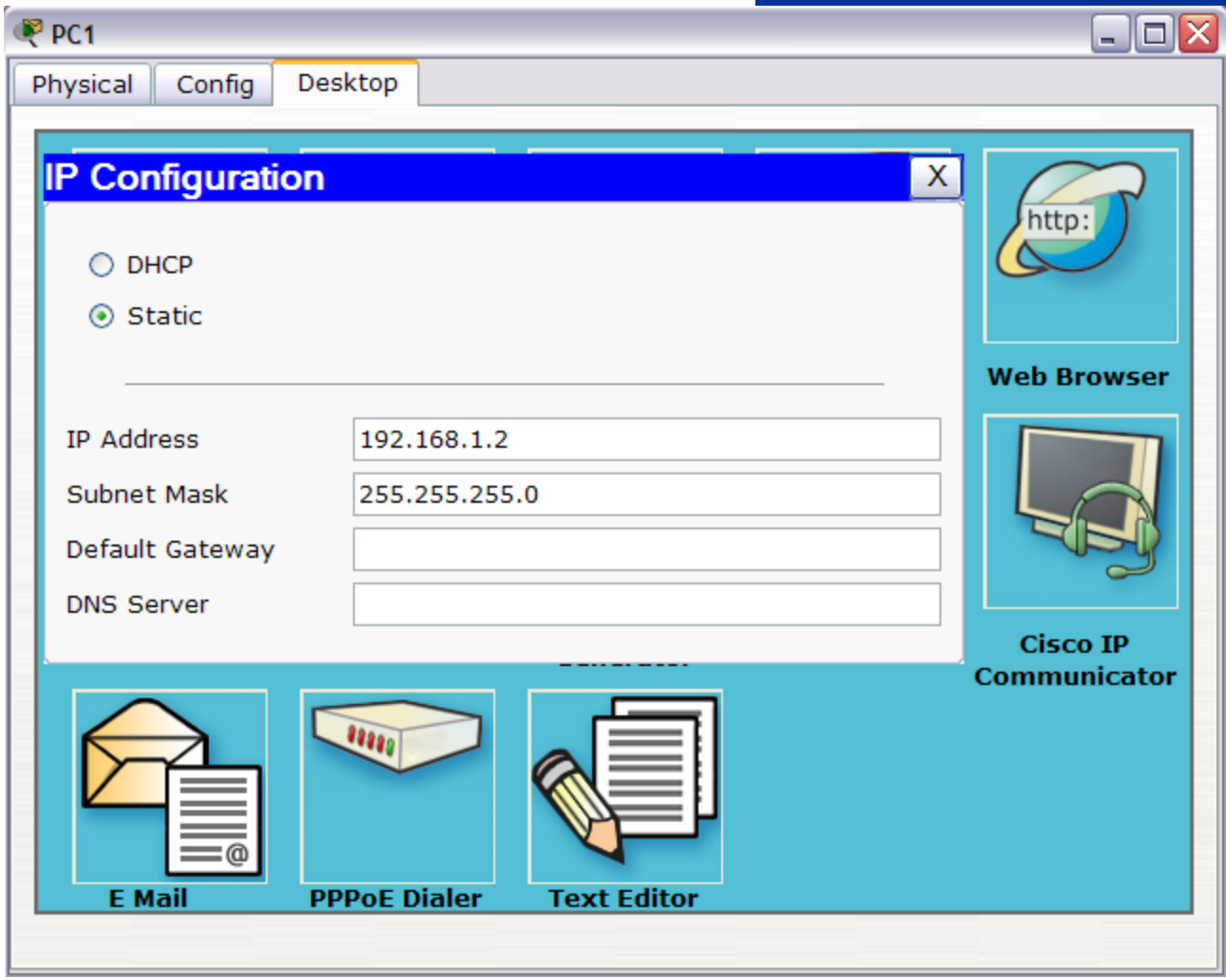
5. Enter 192.168.1.1

6. Press Tab key

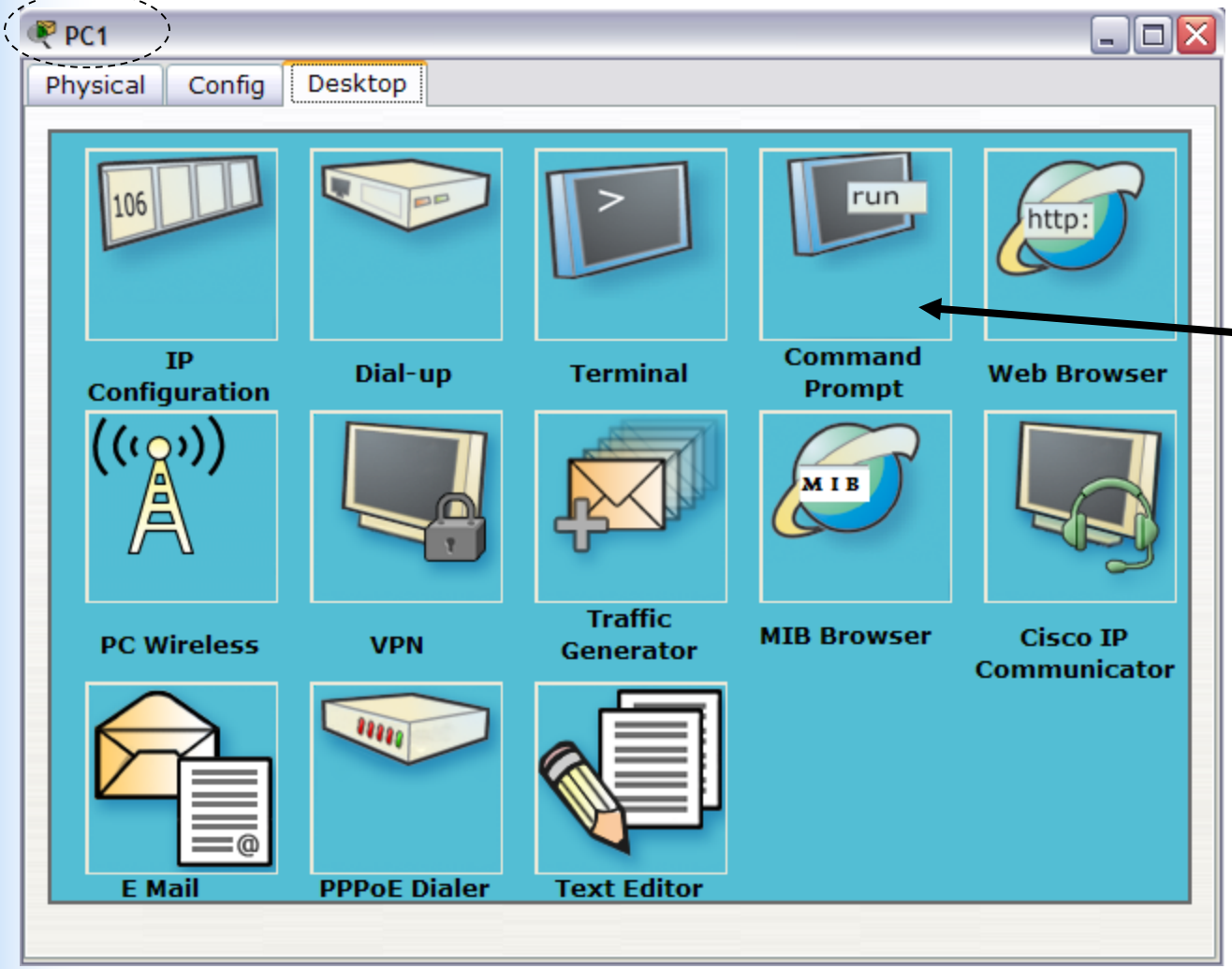
7. 255.255.255.0 will automatically appear

Configuring the PC - 4

- Repeat the same procedure for PC1.
- Enter 192.168.1.2 for PC1
- Close the IP Configuration window but not the PC1 window

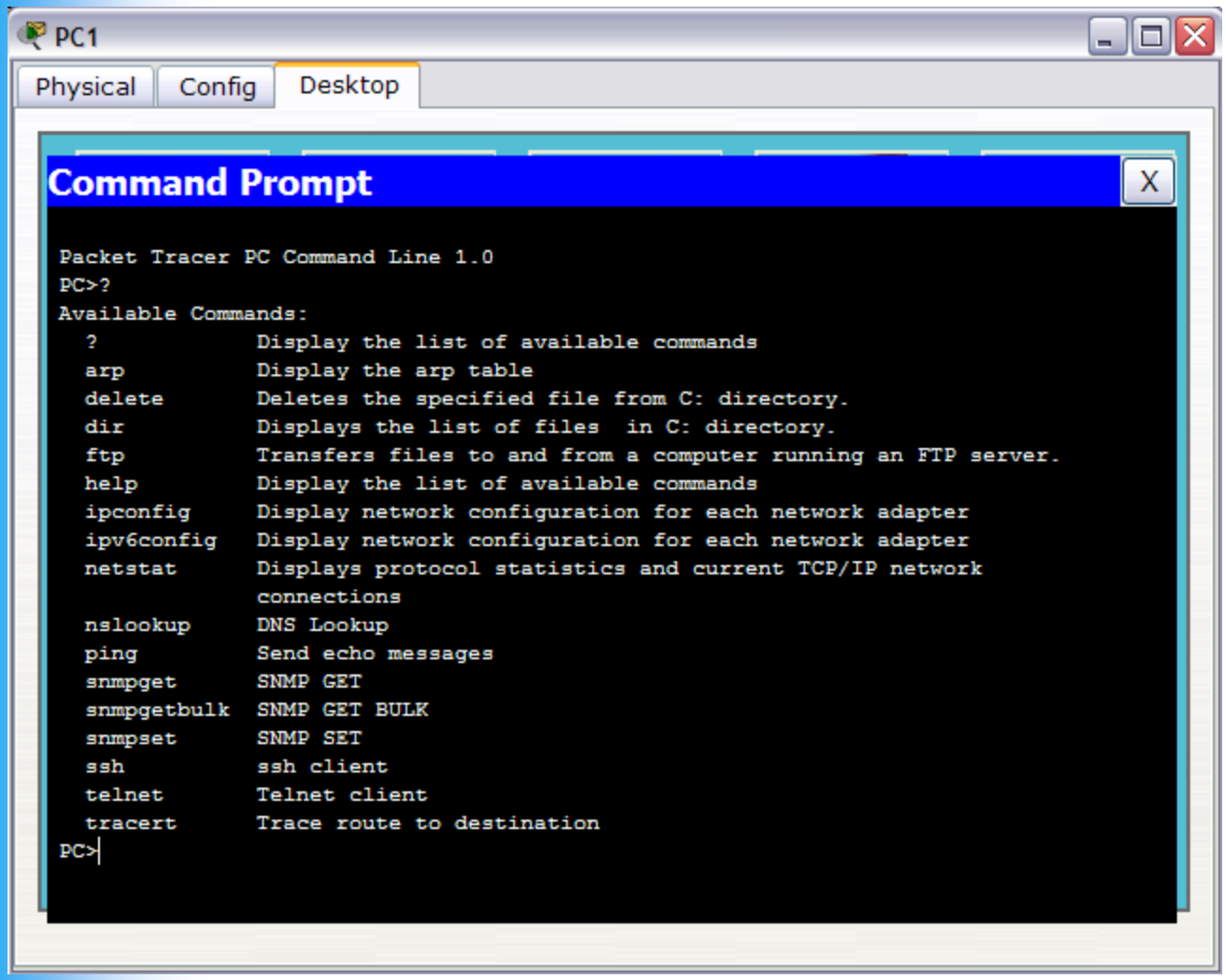


Testing connectivity - 1



1. Click on Command Prompt

Available Commands in PC



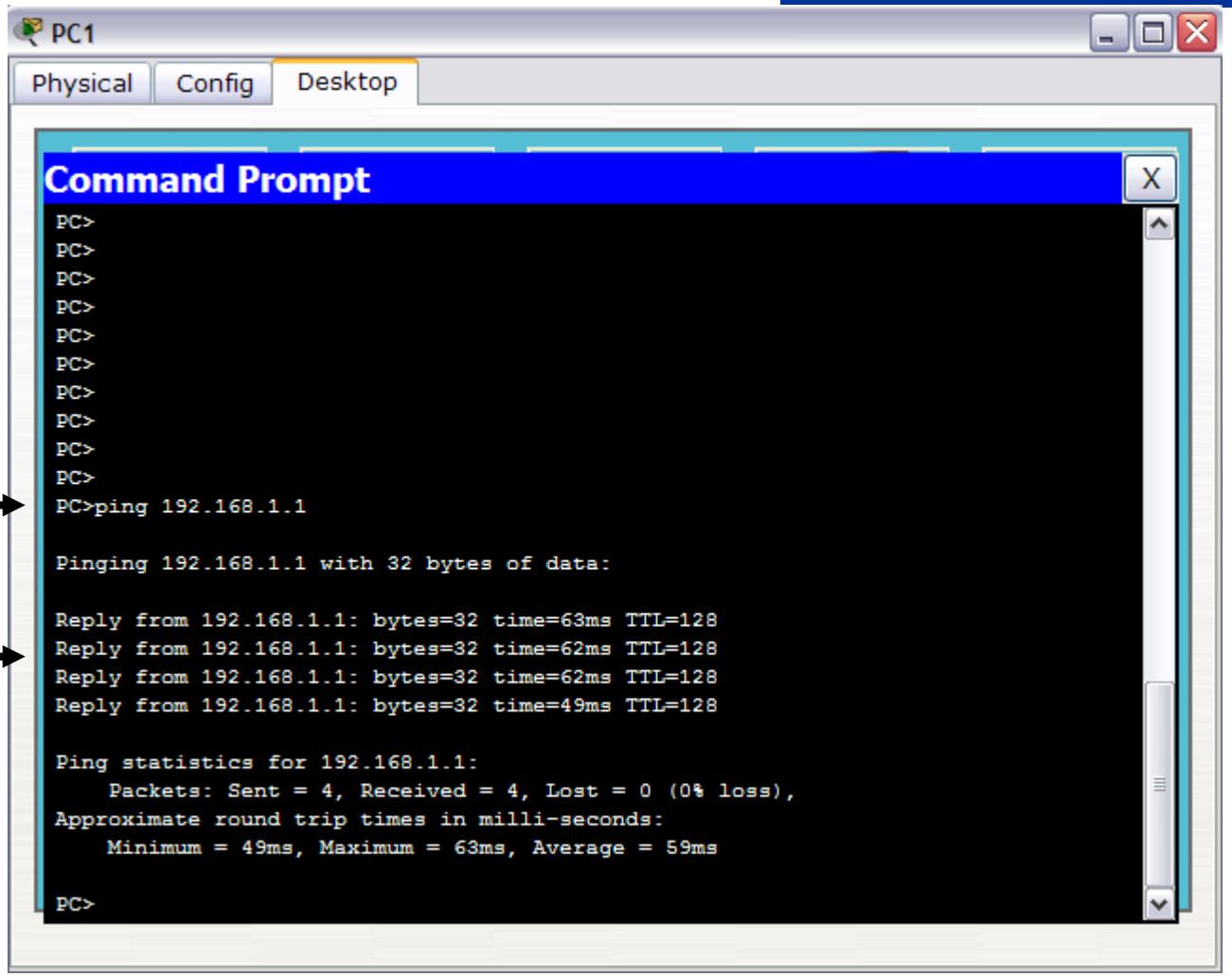
- Command prompt in PC of Packet tracer resembles the real life but with limited sets of commands.

Testing connectivity with ping

1. ping PC0 (ip = 192.168.1.1)

Successful ping !!

Note: ping is a to and fro process. You don't need to ping from the other side once this side is ok.

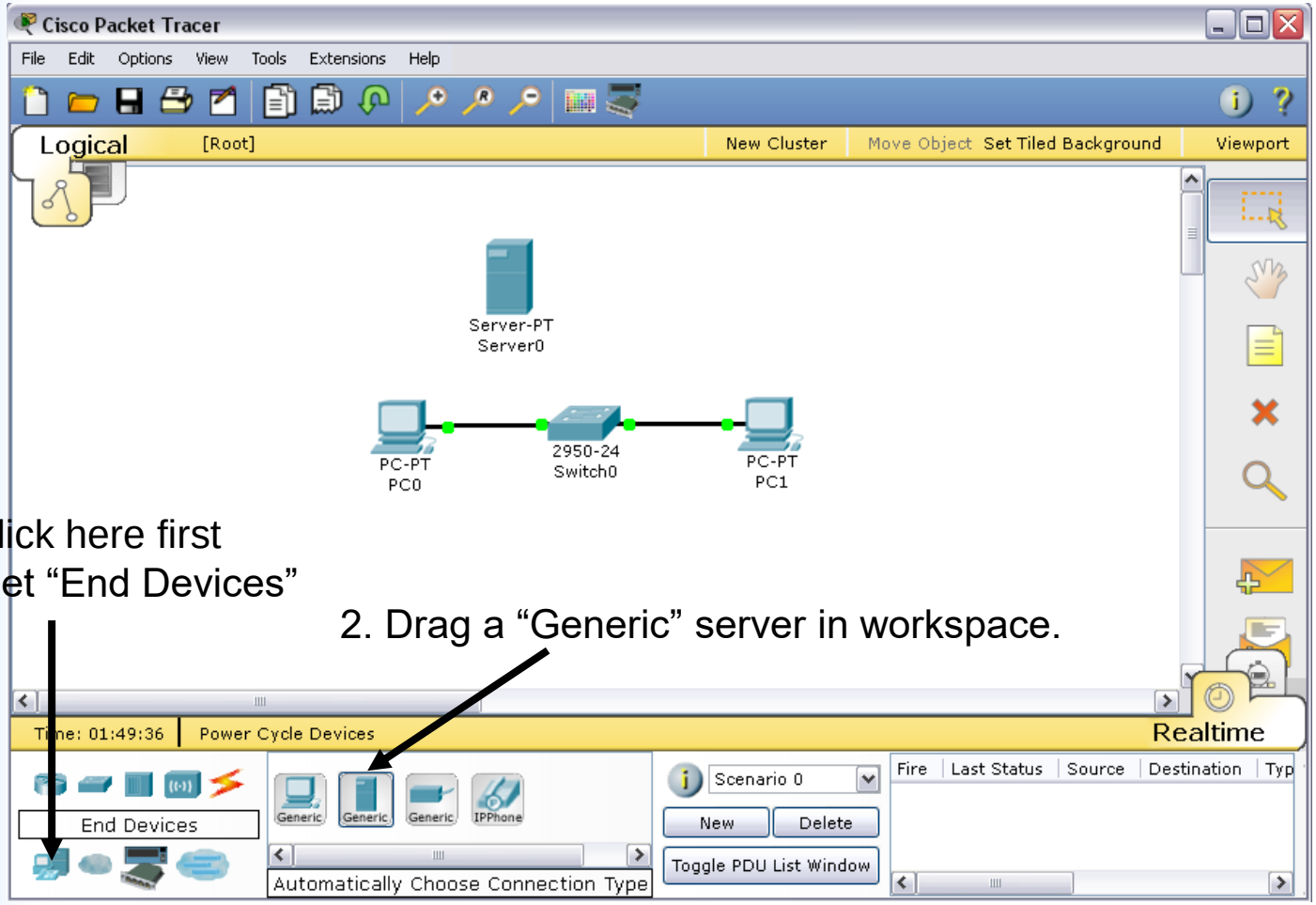


DHCP Server in Your LAN

Adding a DHCP server to your LAN step by step

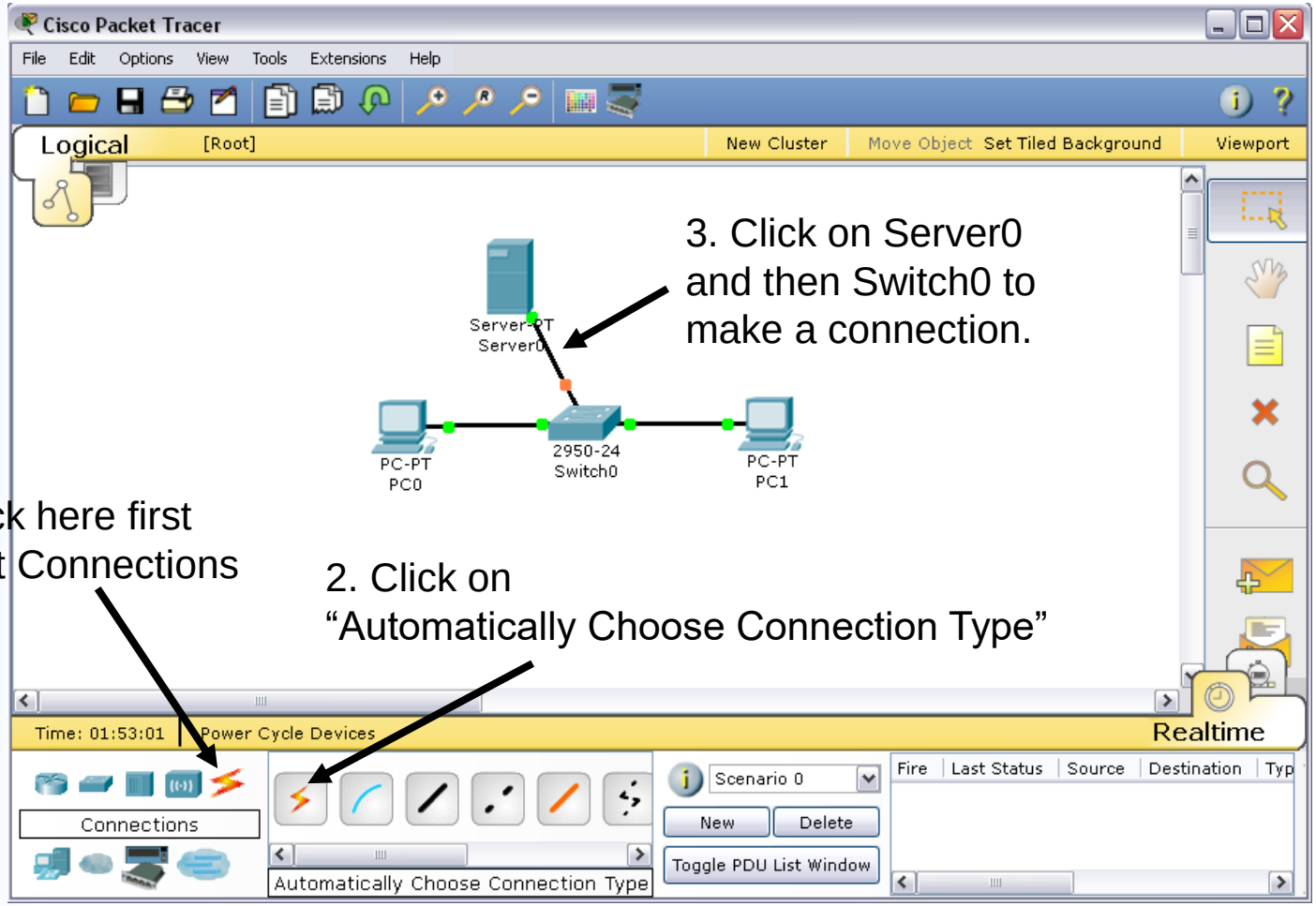
Server

- Drag a server in your “existing” LAN



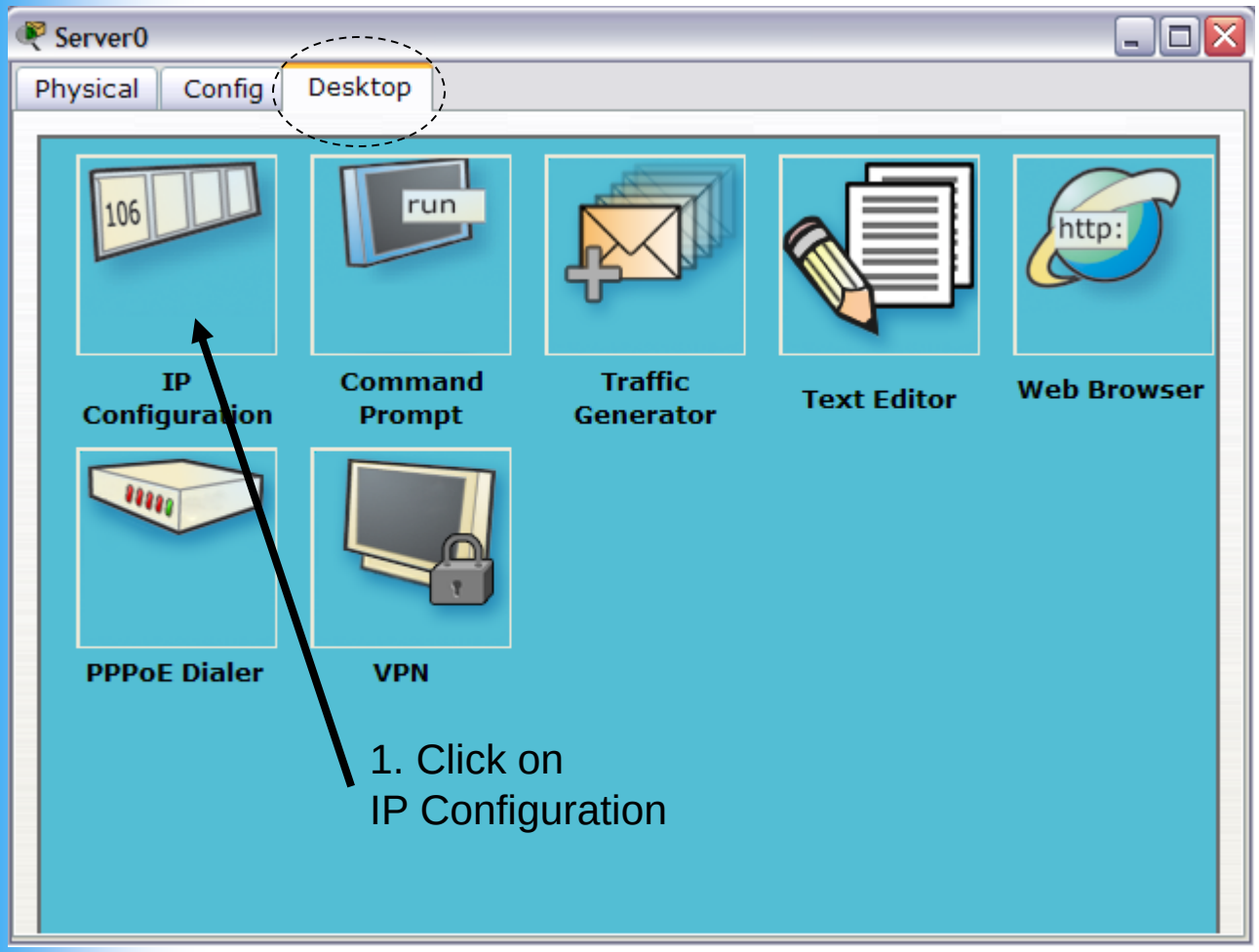
Make Connection

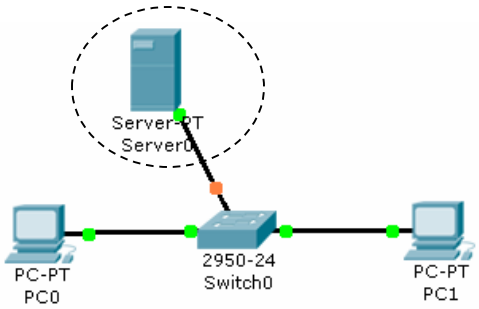
- Connect Server0 to Switch0.



Configuring IP for Server - 1

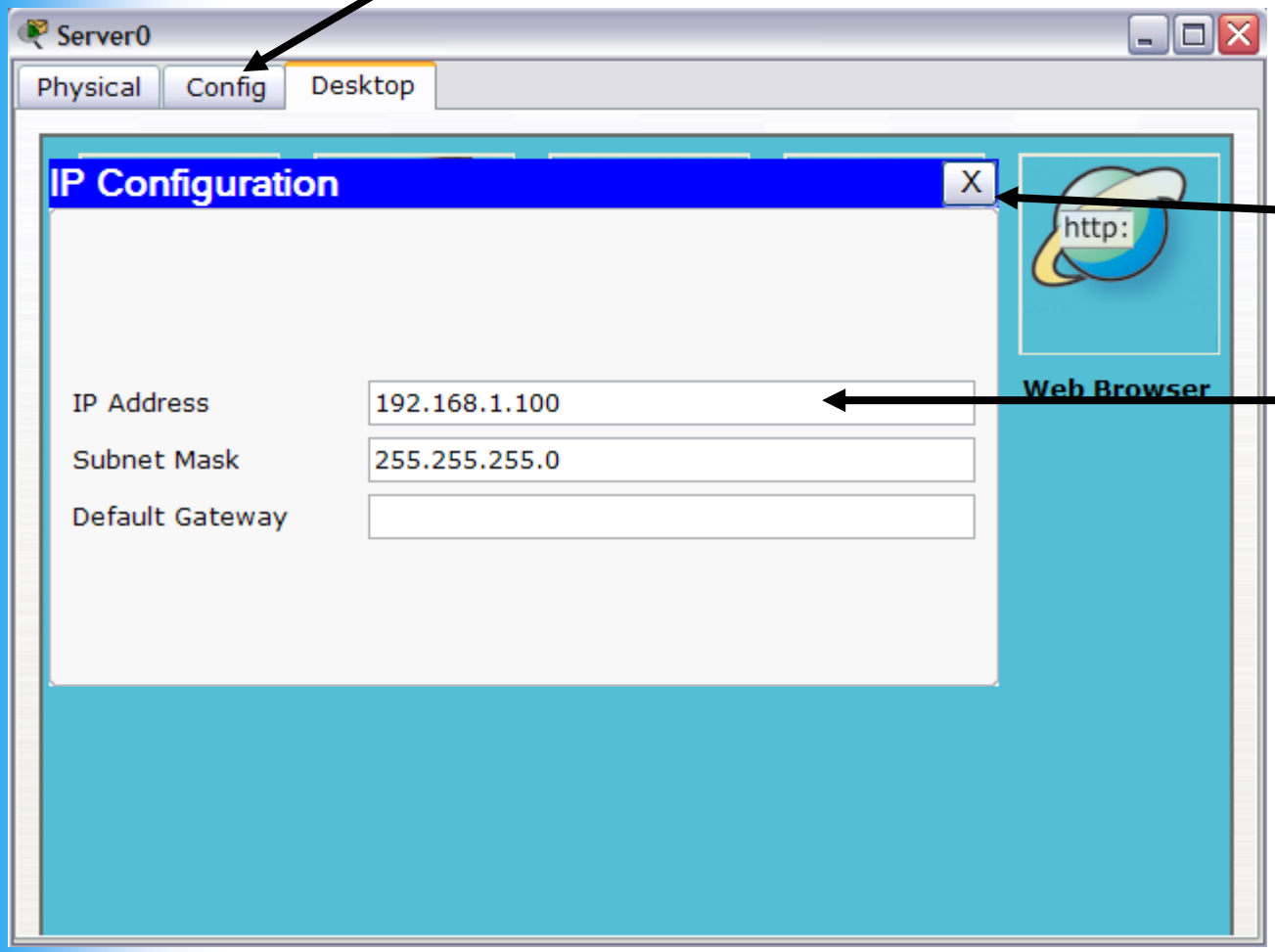
- Double click on Server0, a Server0 window will appear.





Configuring IP for Server - 2

6. Then click on Config



5. Press this to close the IP Configuration window

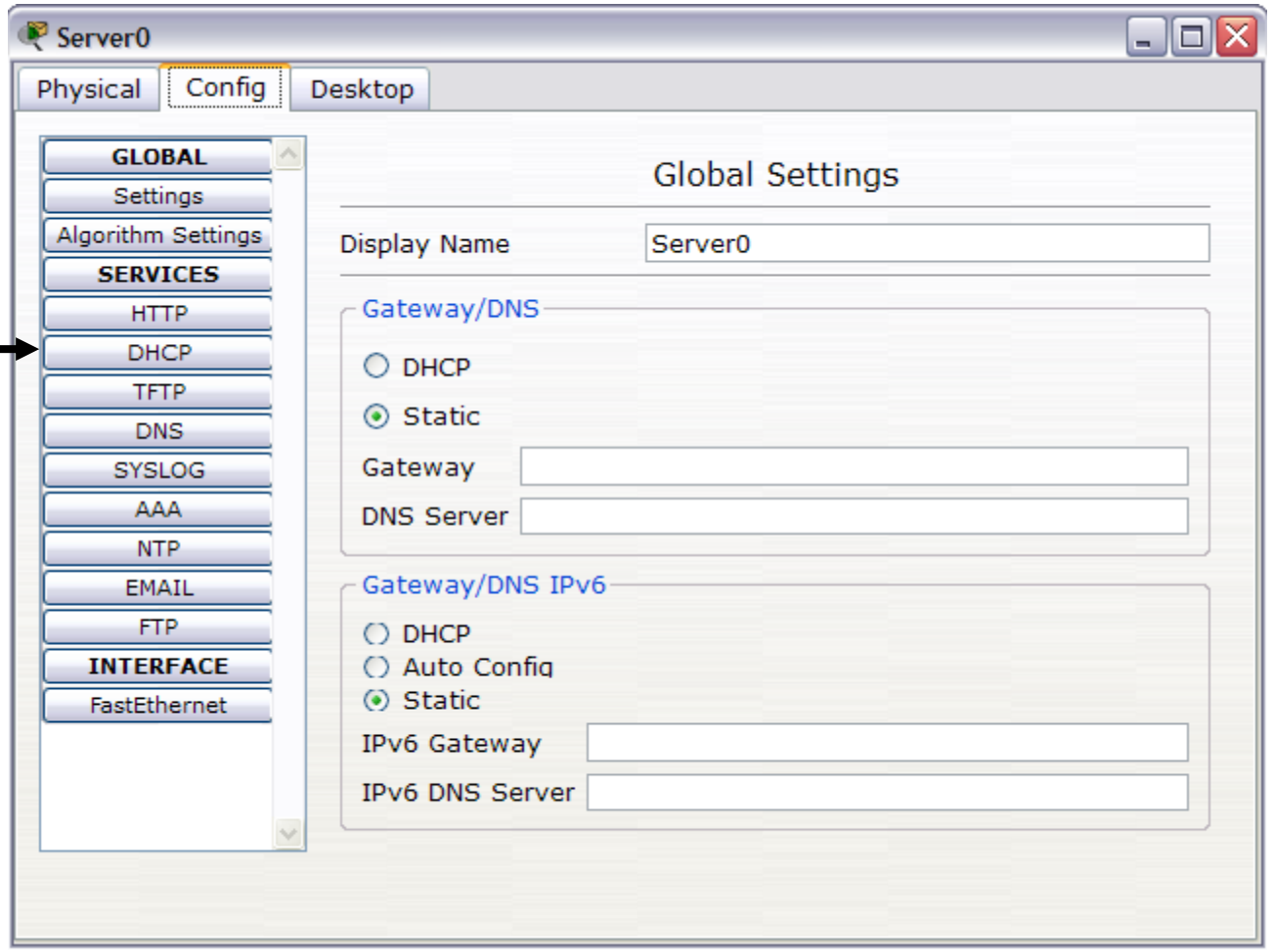
2. Enter 192.168.1.100

3. Press Tab key

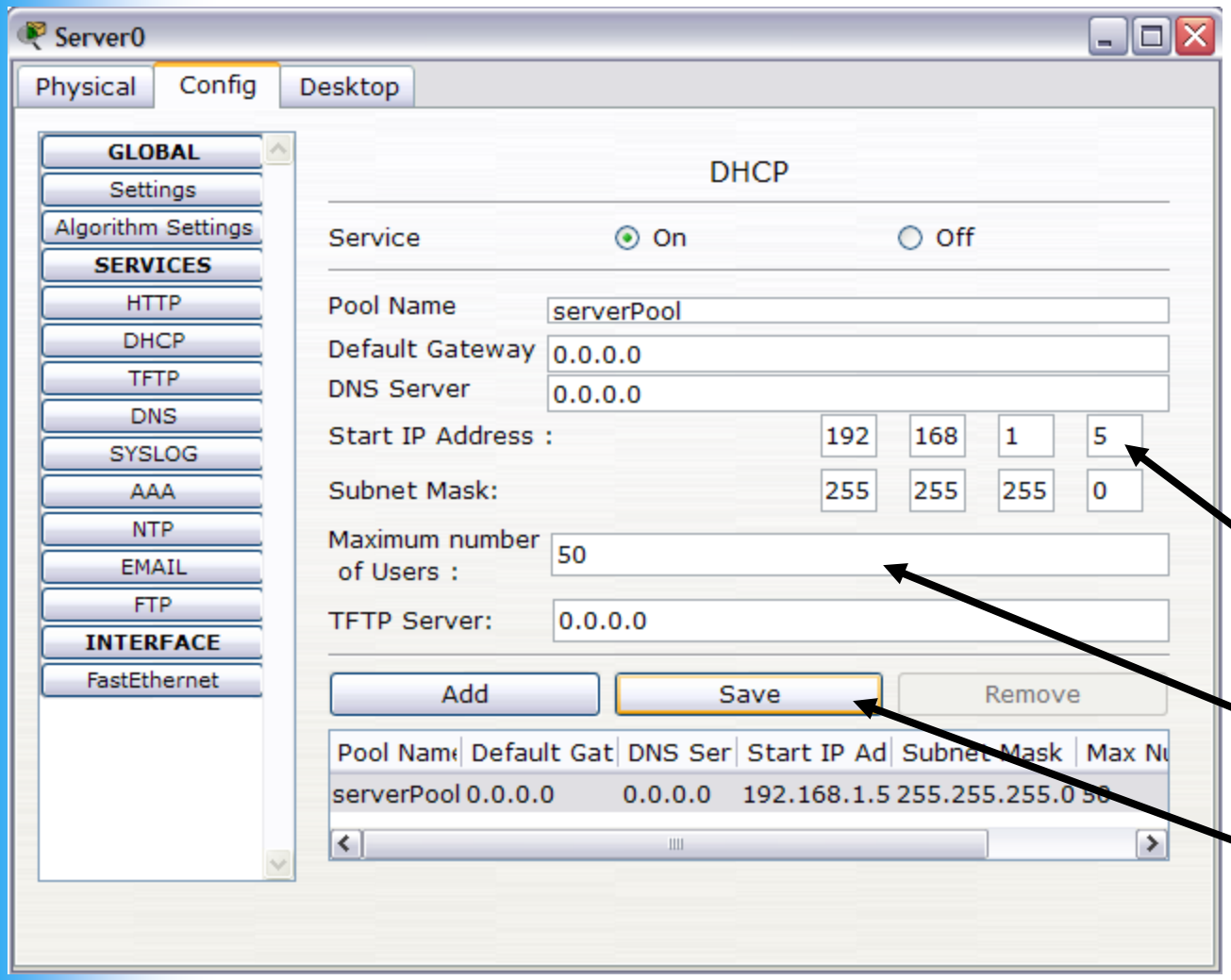
4. 255.255.255.0 will automatically appear

Setting DHCP service - 1

1. Click on DHCP



Setting DHCP service - 2



- Setting the DHCP IP range from 192.168.1.5 to 192.168.1.54
- If there are 52 PCs in the network, DHCP is not able to provide the remaining two PCs.

2. Change Start IP address to 192.168.1.5

3. Change to 50

4. Press “Save”

Testing DHCP Service

6. You may test the PC1 with a ping to/from PC0

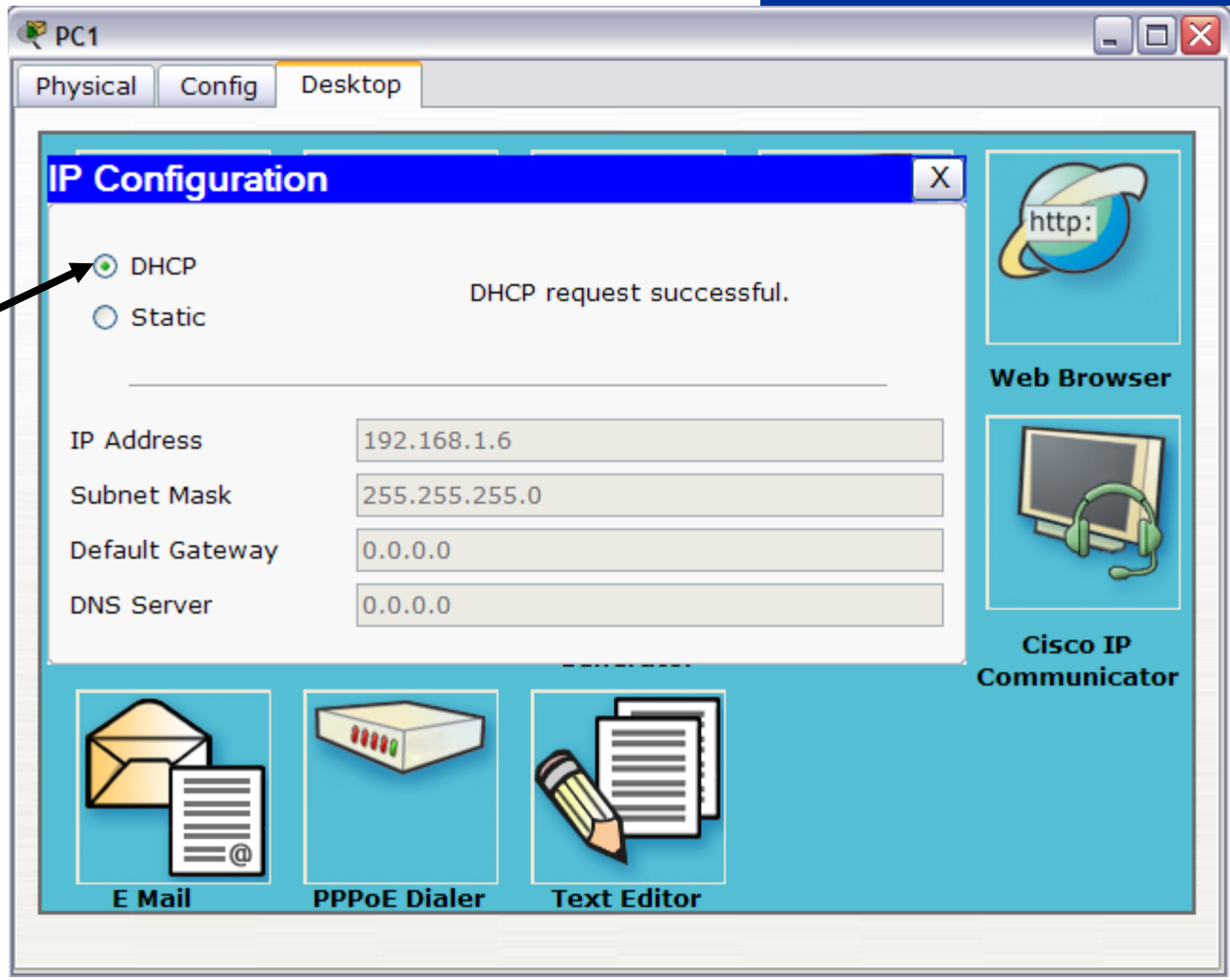
5. If your DHCP is set correctly, you will obtain a dynamic IP

4. Click on DHCP

3. Click on IP Configuration

2. PC1 windows pop up, click Desktop tab.

1. Double click on PC1

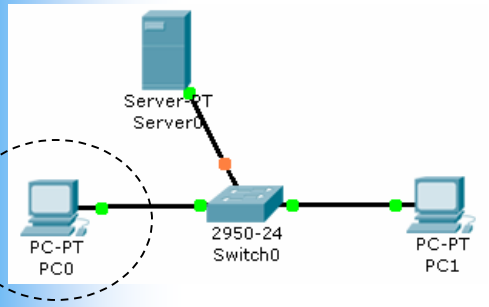


Testing PC1 from PC0

1. Go to command prompt of PC0

2. Type “ipconfig” to check the IP of PC0

3. Ping PC1



PC0

Physical | Config | Desktop

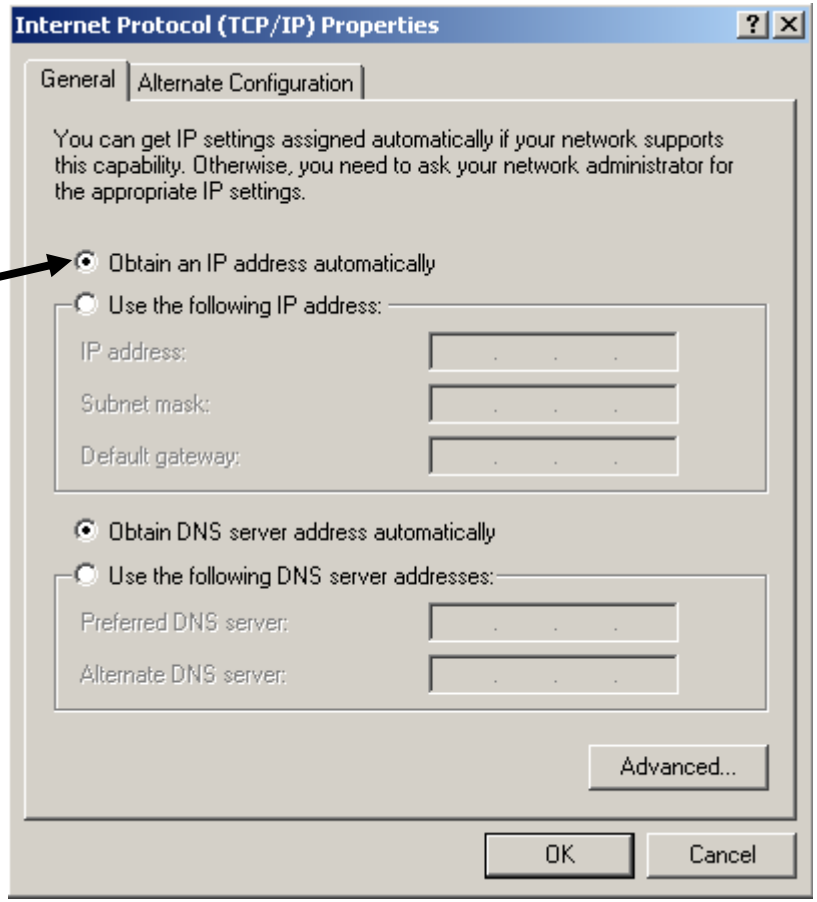
Command Prompt

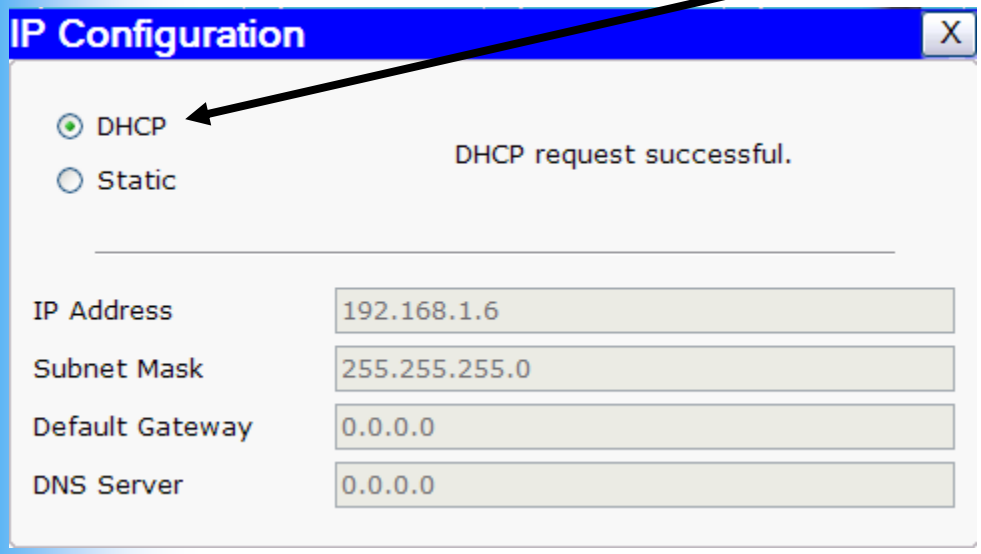
```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address.....................: 192.168.1.1
Subnet Mask....................: 255.255.255.0
Default Gateway................: 0.0.0.0

PC>ping 192.168.1.6

Pinging 192.168.1.6 with 32 bytes of data:

Reply from 192.168.1.6: bytes=32 time=63ms TTL=128
Reply from 192.168.1.6: bytes=32 time=63ms TTL=128
Reply from 192.168.1.6: bytes=32 time=62ms TTL=128
Reply from 192.168.1.6: bytes=32 time=62ms TTL=128

Ping statistics for 192.168.1.6:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 62ms, Maximum = 63ms, Average = 62ms

PC>
```

DHCP: Packet Tracer & Real Life

- The “DHCP” option is equivalent to “Obtain an IP address automatically” under Windows XP.

Real Life





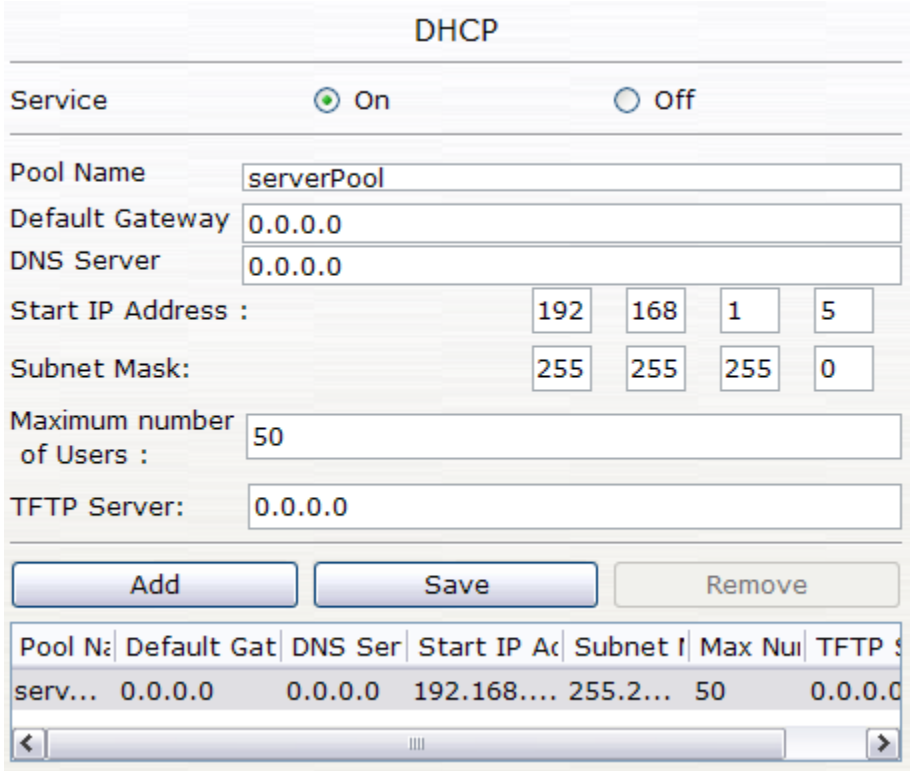
Packet Tracer

Review: Static IP and Dynamic IP

- As you've known, IP address in your PC is assigned one of two ways:
  - The IP is set manually (Static IP)
  - The IP is set by DHCP services (Dynamic IP)
- Comments on Static IP
  - Normally used for servers, printers, and routers.
  - Not advisable for large network due to maintenance.
    - Need to keep track.
    - Easily set duplicate IP due to negligence (human error).
- Comments on Dynamic IP
  - Used in normal PCs of large networks where it is relatively easier to maintain.
  - Used in wireless network where the computers/laptops are mobile (in and out all the time).

Packet Tracer DHCP Service

- A typical DHCP service configuration consists of:
  - IP address range
  - 1 Subnet mask
  - 1 Default Gateway
  - 2-4 DNS server IP
- The IP address range is configured with:
  - Starting IP Address
  - Maximum # of users.
- TFTP Server IP is NOT a typical DHCP configuration.

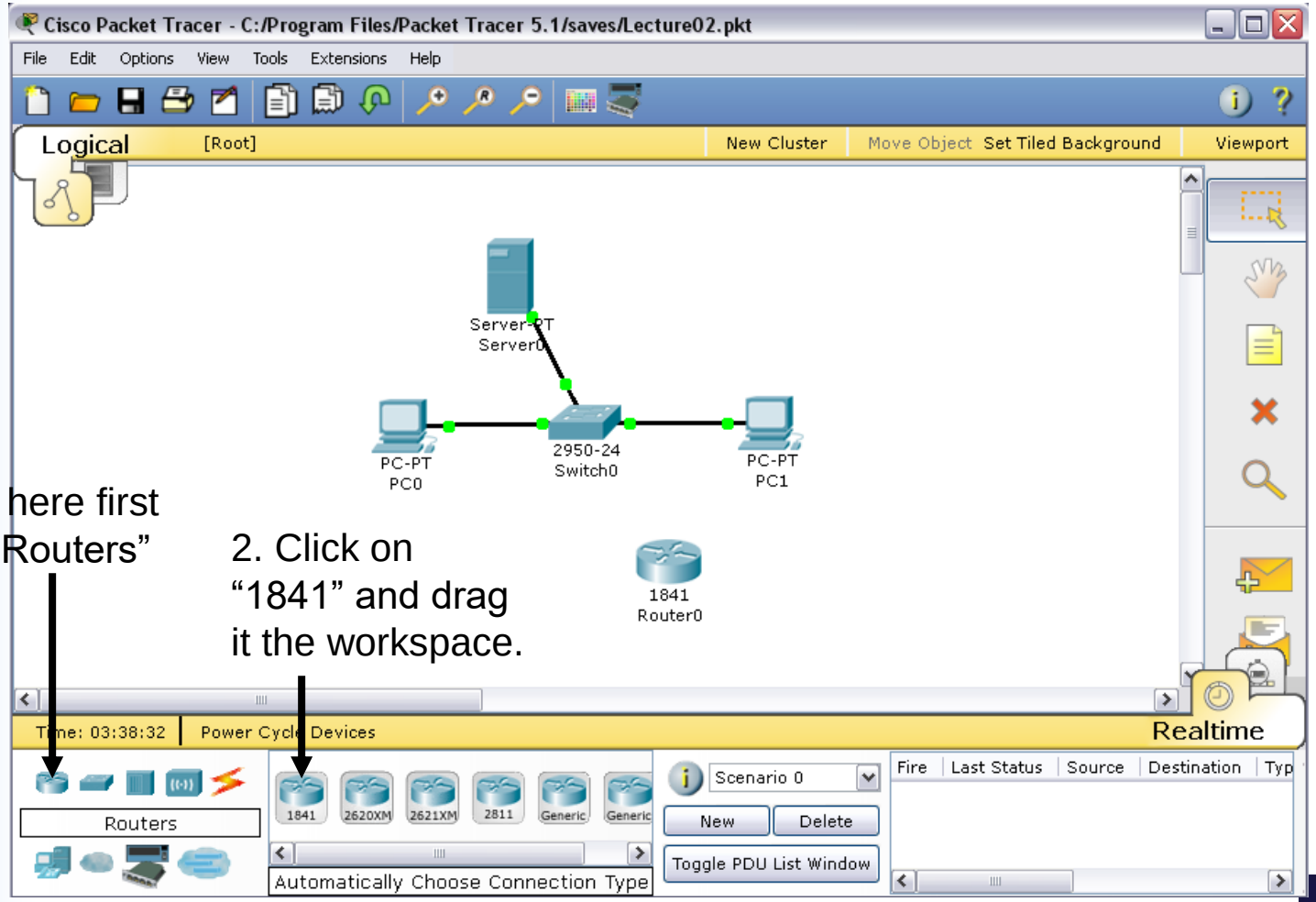


Router in Your LAN

Adding a Router to your LAN step by step

Router

- Drag a 1841 router into the workspace.



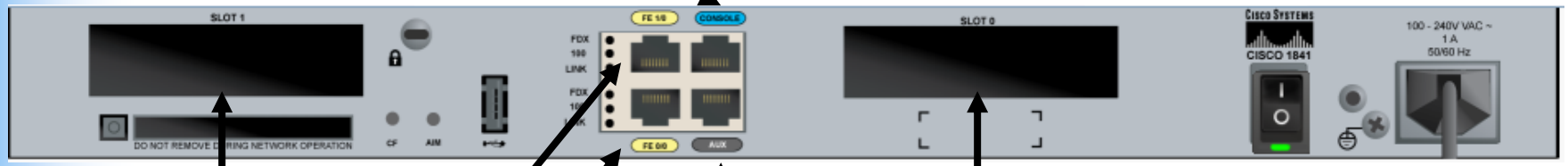
1.Click here first to get “Routers”

2. Click on “1841” and drag it the workspace.

Cisco 1841 router

Console port

Rear View



Slot for module (will discuss later)

Fast Ethernet ports (fa0/0 and fa0/1)

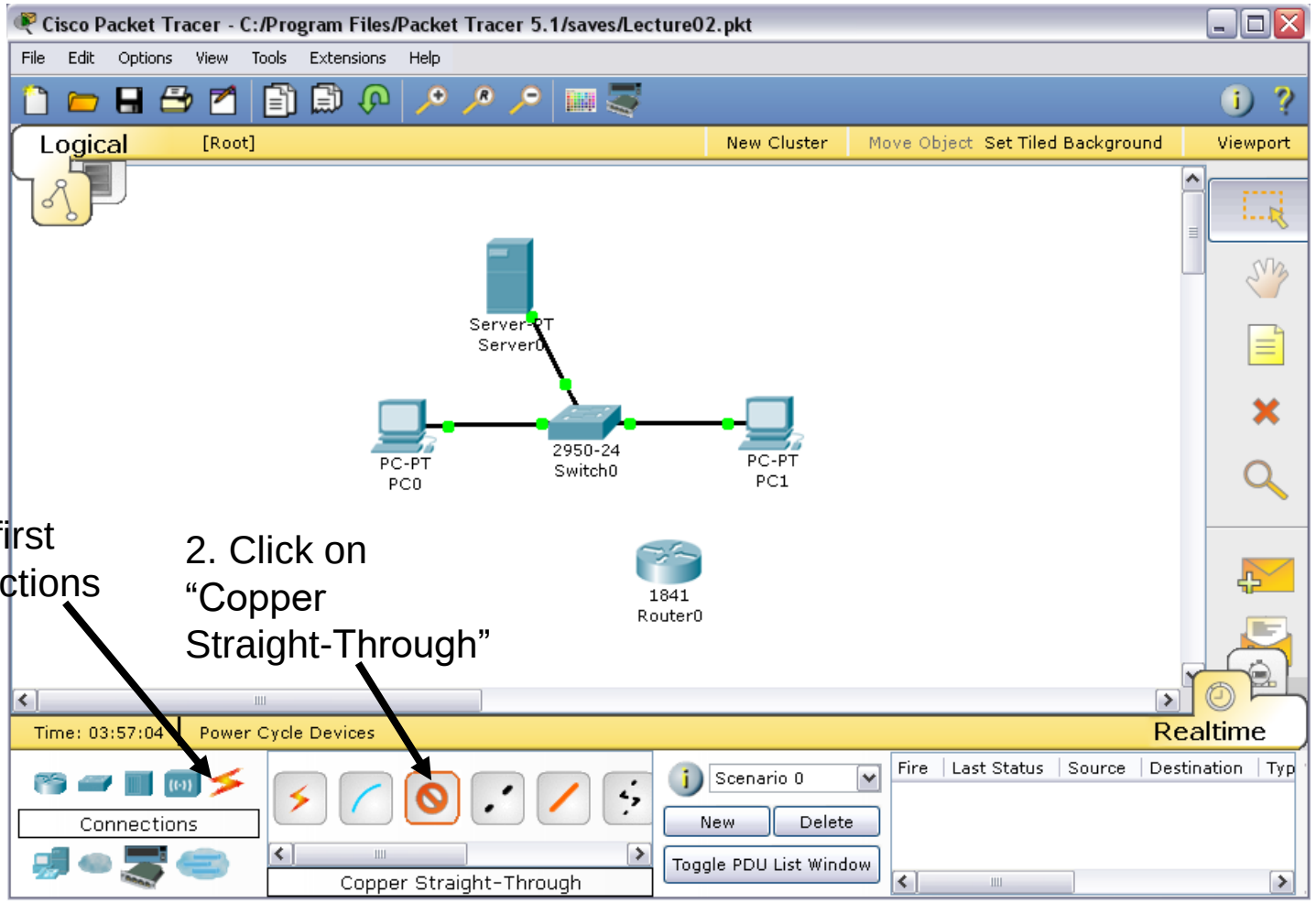
Aux port

Slot for module (will discuss later)

On/off switch

Front View

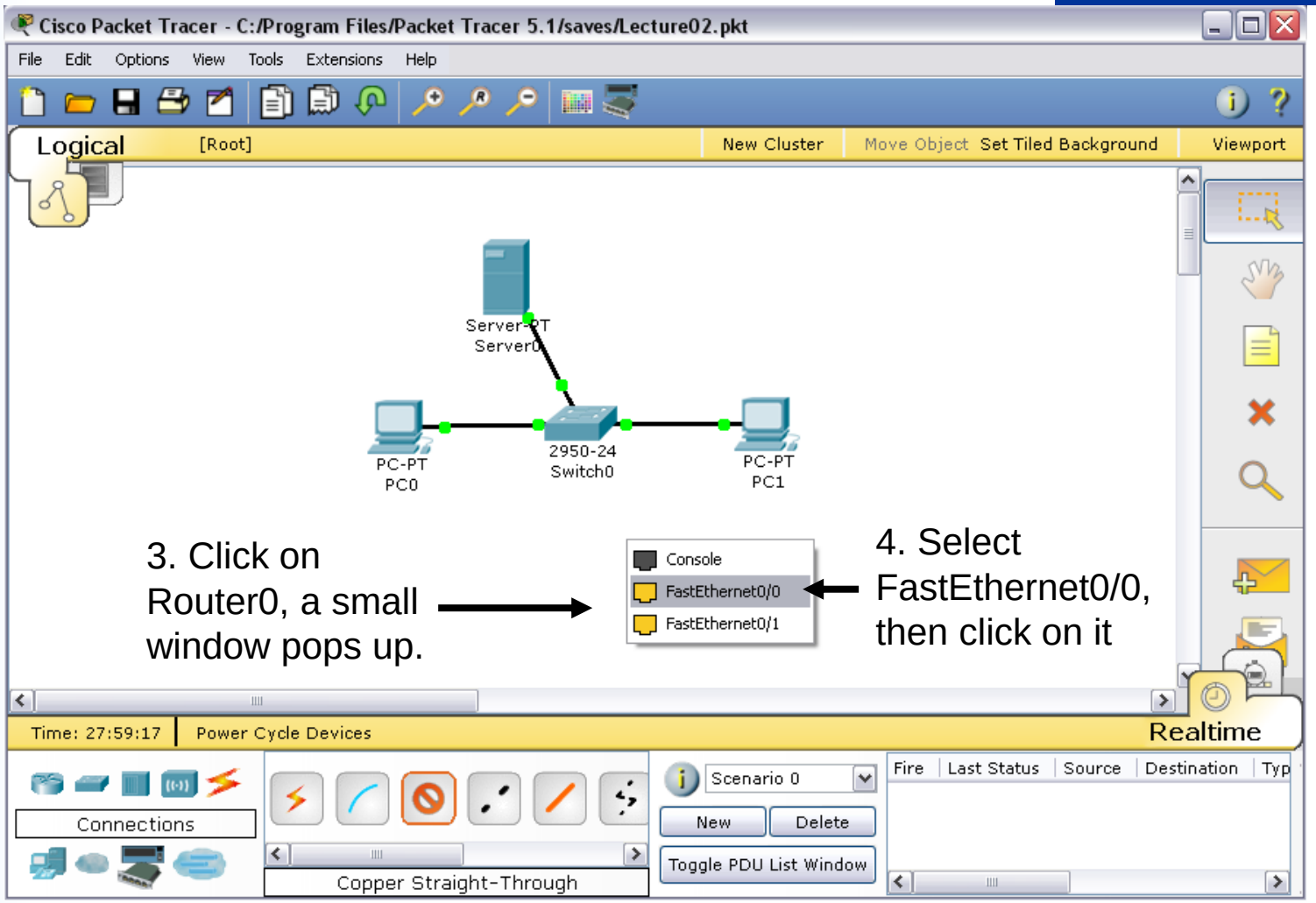
Connecting Router to Switch - 1



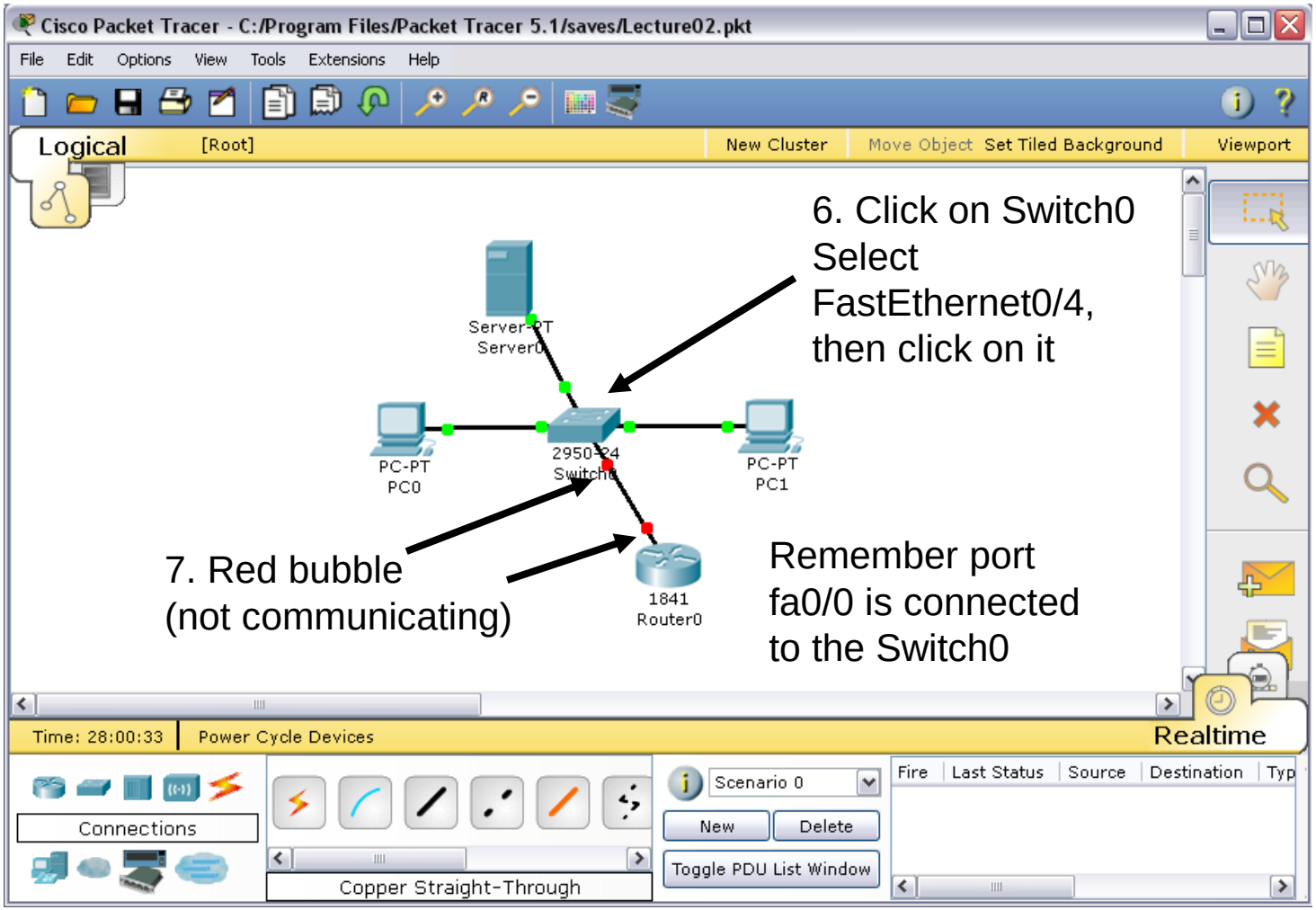
1.Click here first to get Connections

2. Click on "Copper Straight-Through"

Connecting Router to Switch - 2

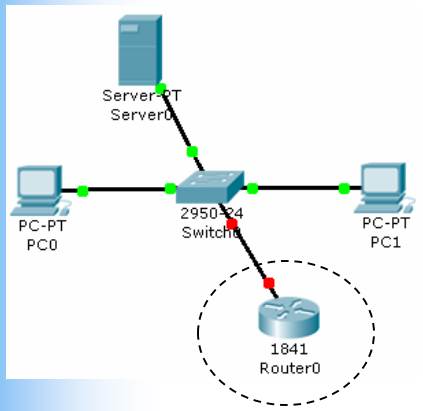


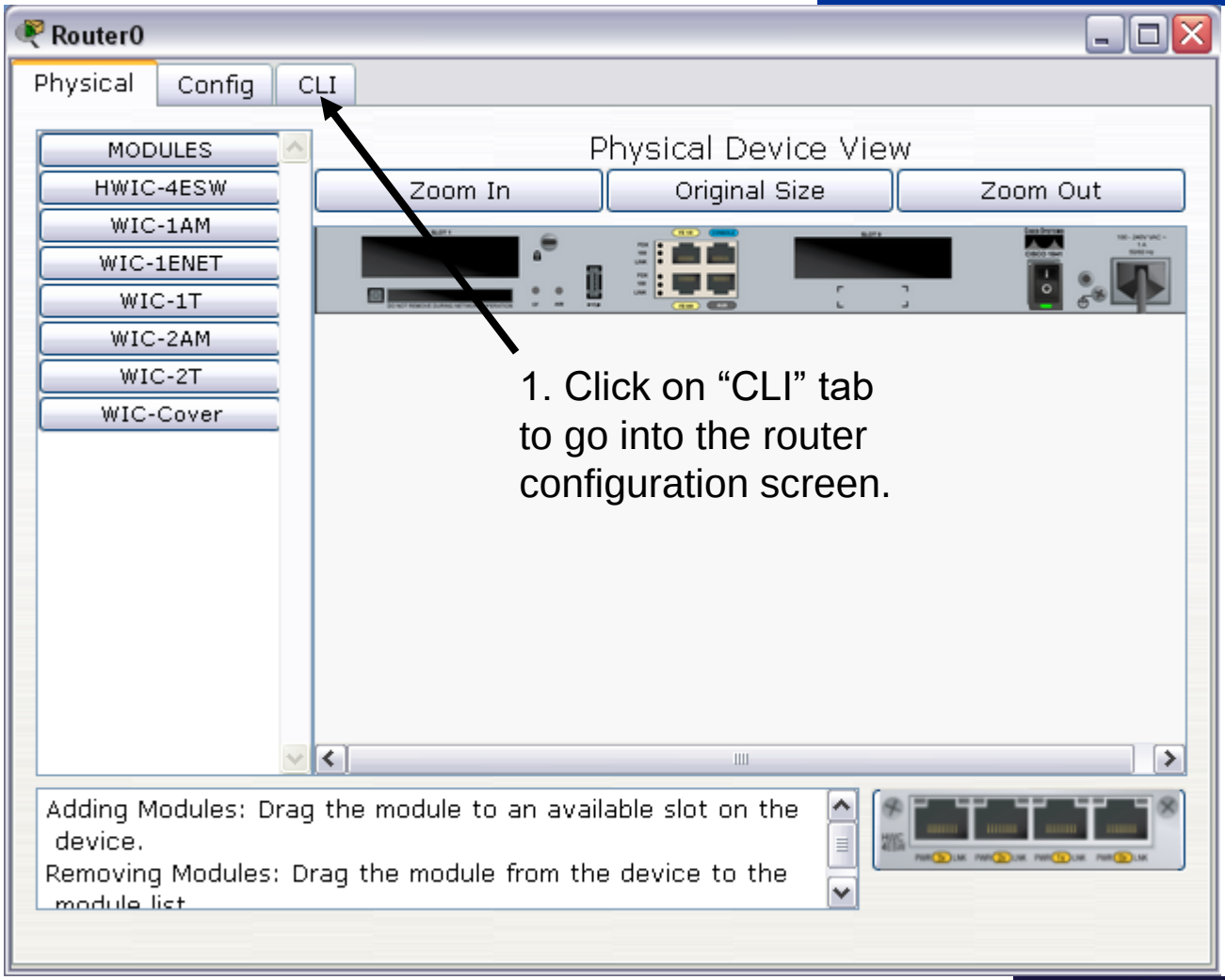
Connecting Router to Switch - 3



Configuring IP in Router - 1

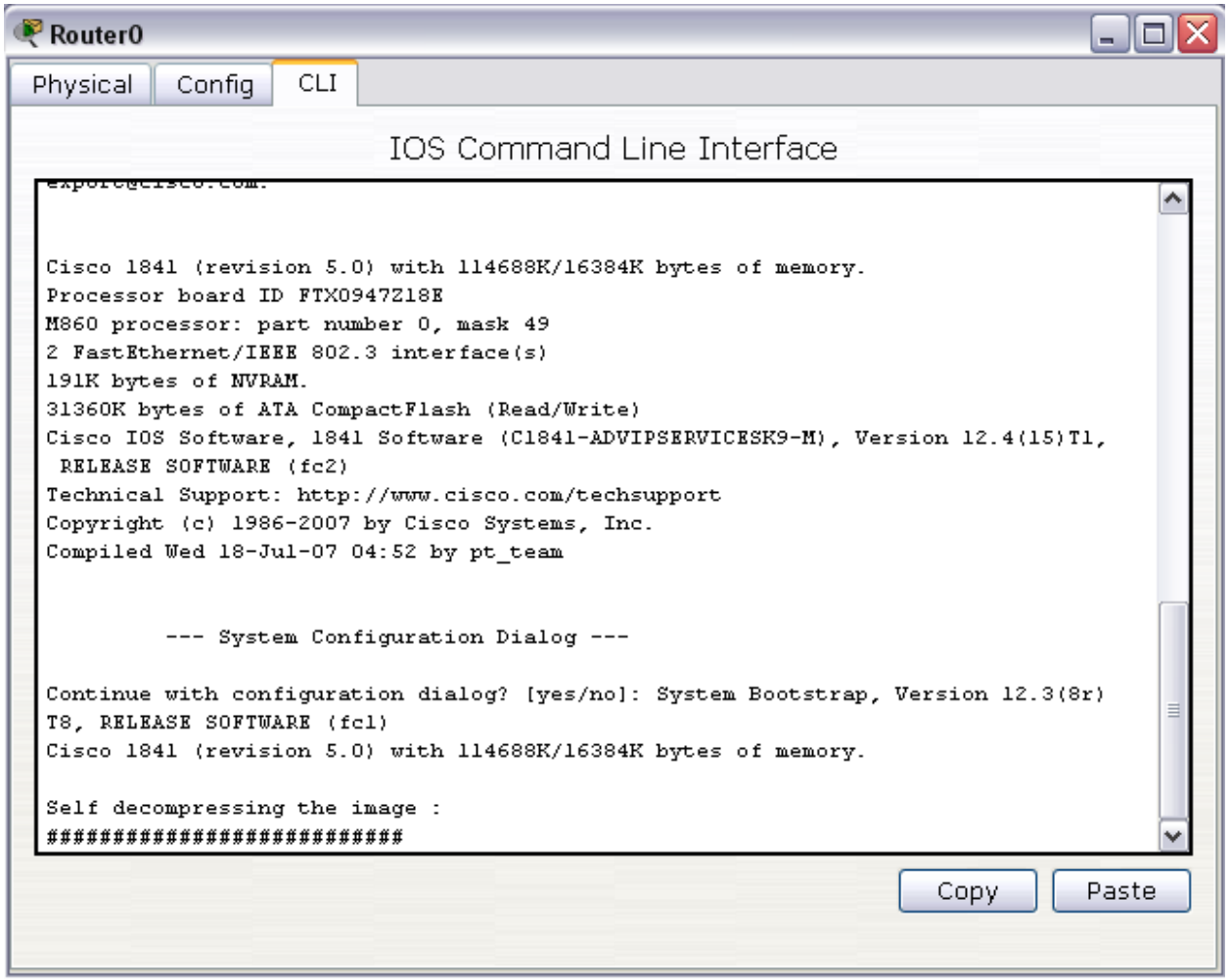
- Double click on Router0 so that this window can pop up.





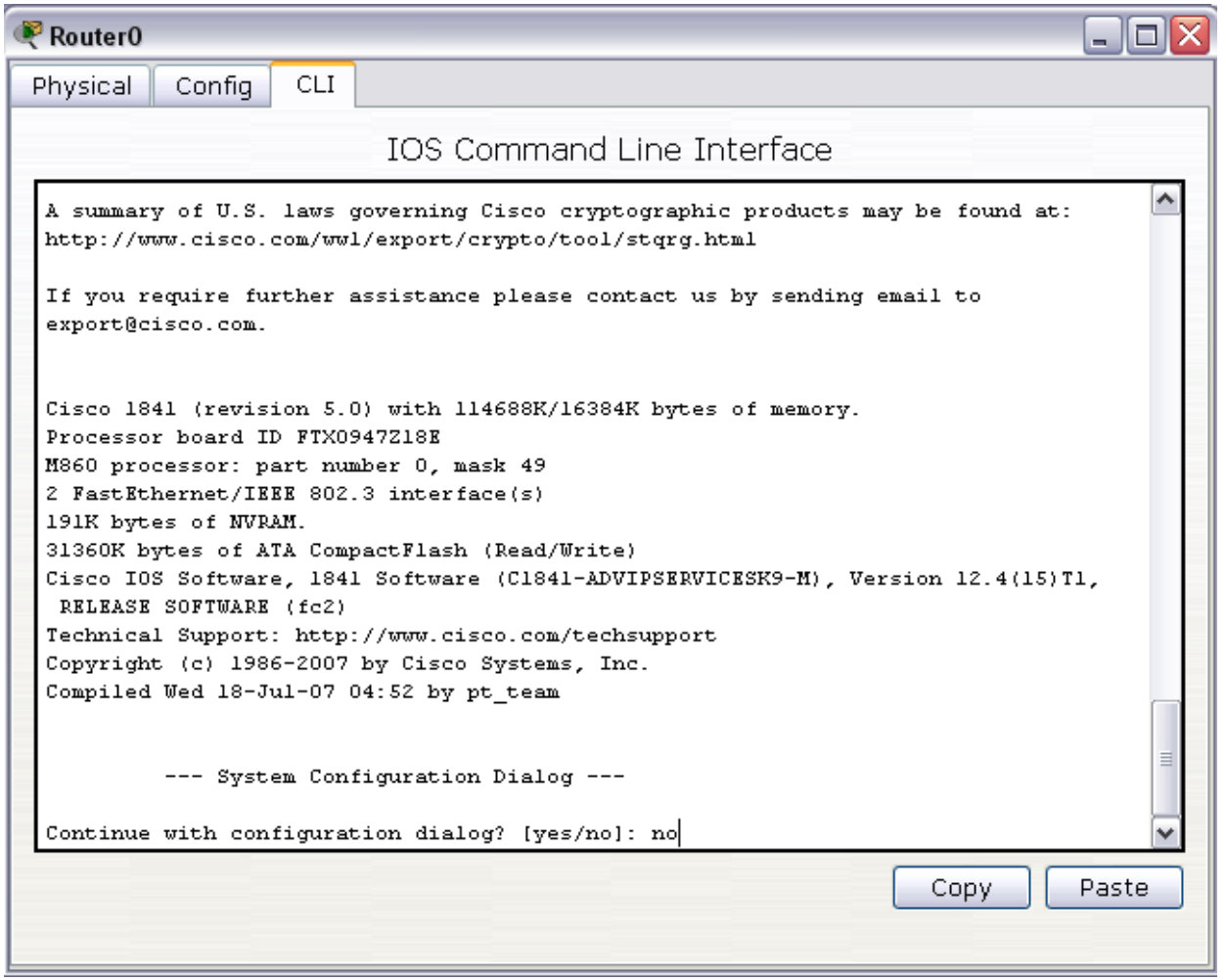
Configuring IP in Router - 2

- Wait for the router to boot up



Configuring IP in Router - 3

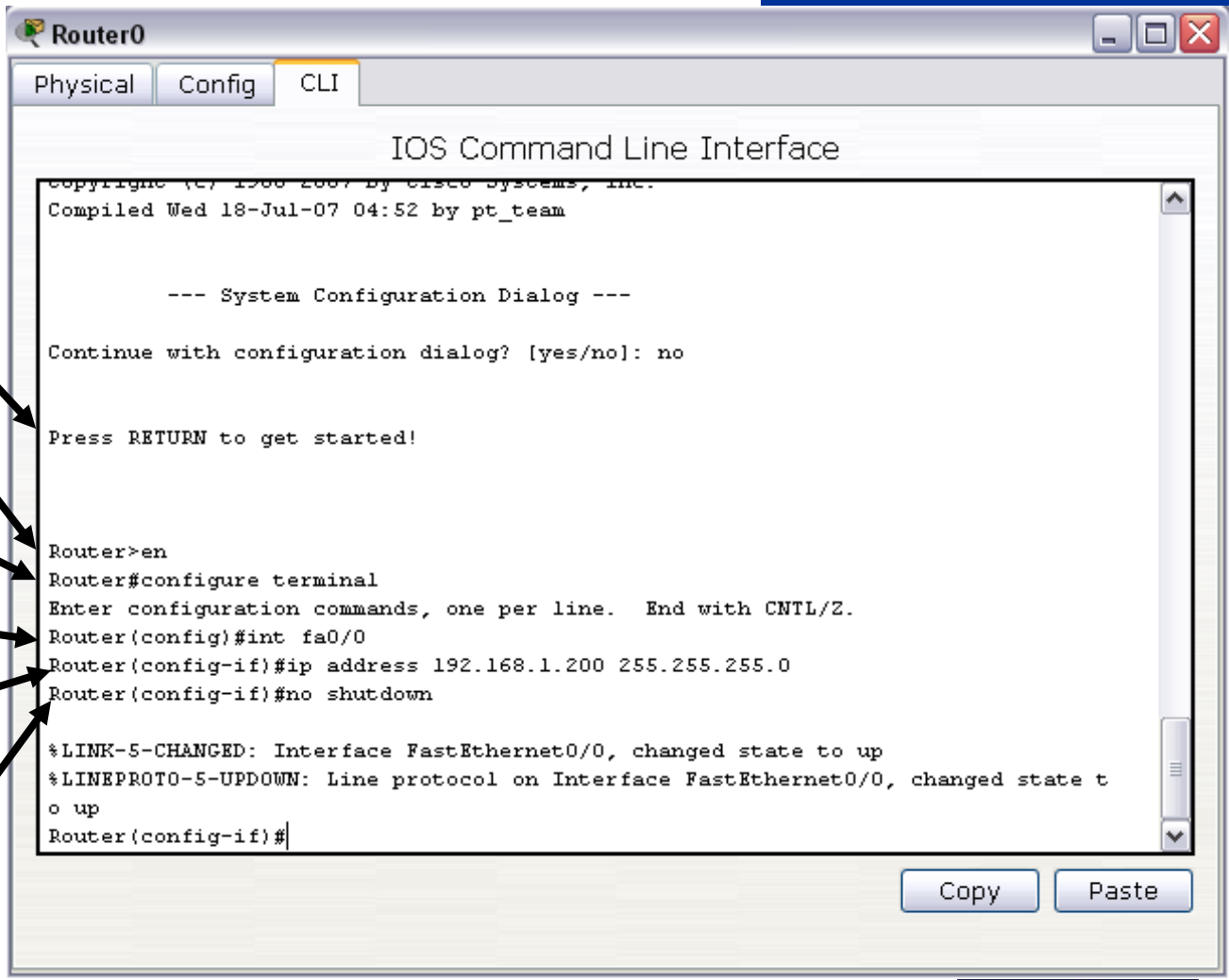
- Type “no” and press enter to continue.



Configuring IP in Router - 4

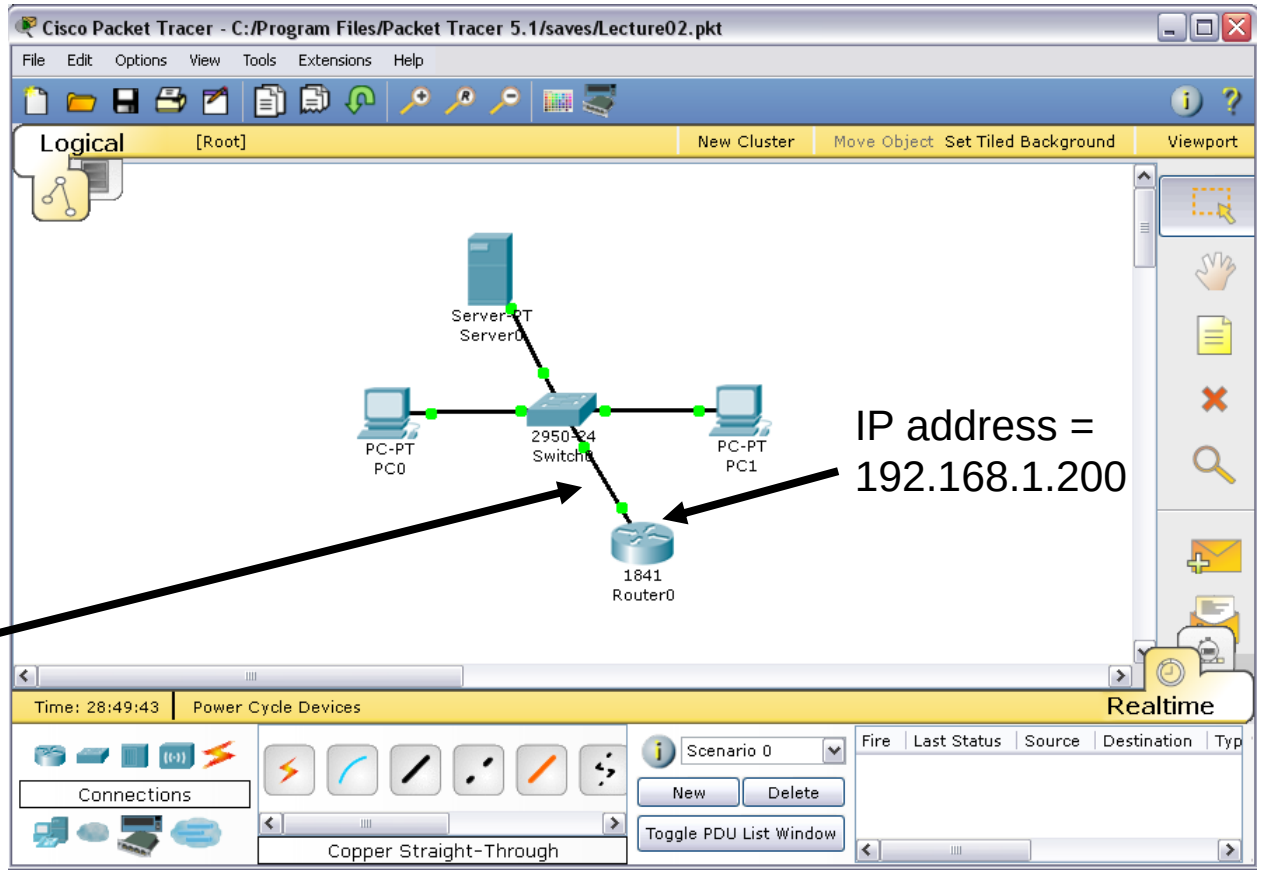
Set port fa0/0 to have ip = 192.168.1.200

1. Press "enter" to continue
2. Type "`enable`" or "`en`"
3. Type "`configure terminal`" or "`conf t`"
4. Type "`interface fa0/0`" or "`int fa0/0`"
5. Type "`ip address 192.168.1.200 255.255.255.0`"
6. Type "`no shutdown`"



Router IP = Gateway of LAN

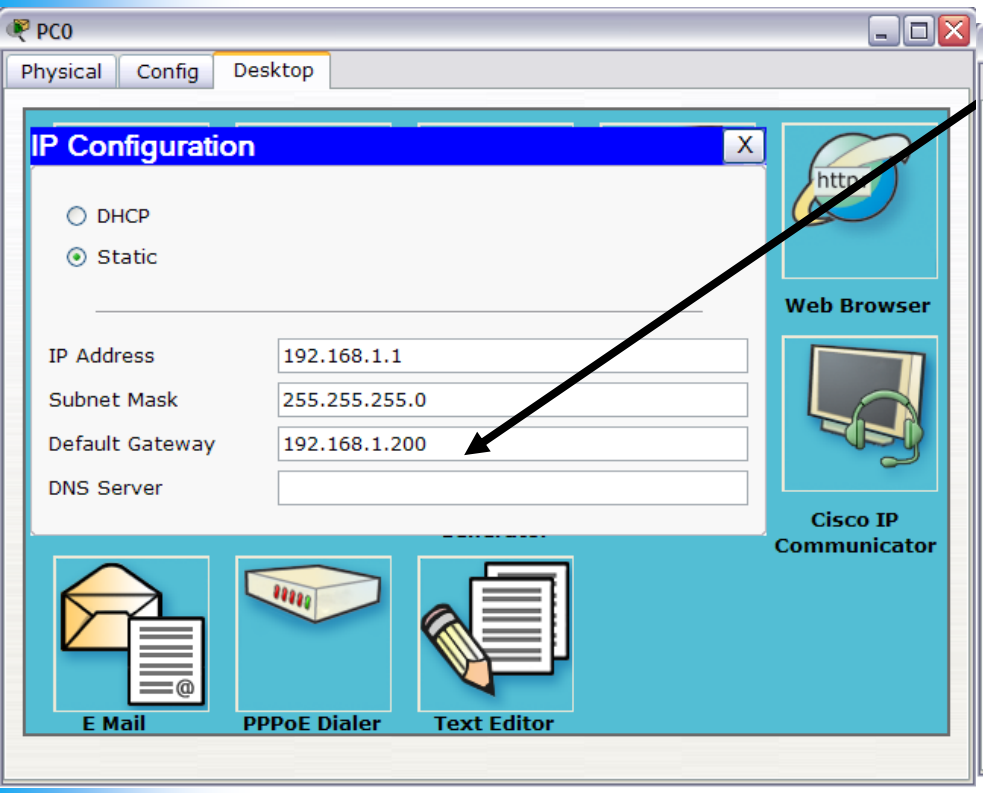
- The interface fa0/0 has a IP of 192.168.1.200.
- This IP will be the default gateway IP for all the hosts in the LAN

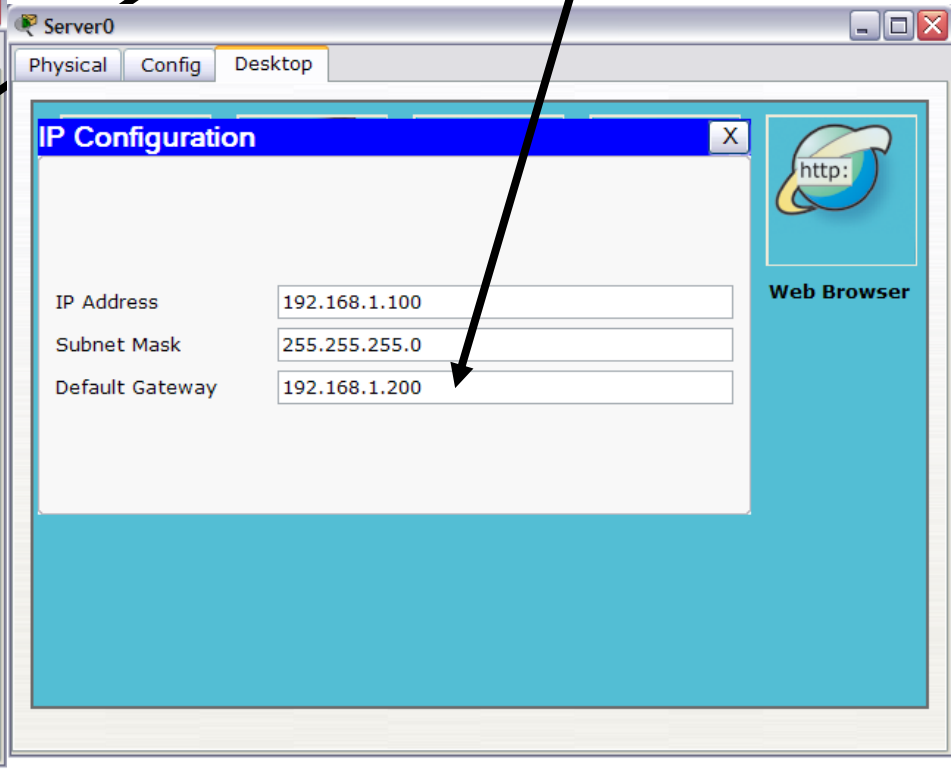


Turn from red to green bubbles after the command "`no shutdown`" (ready to communicate)

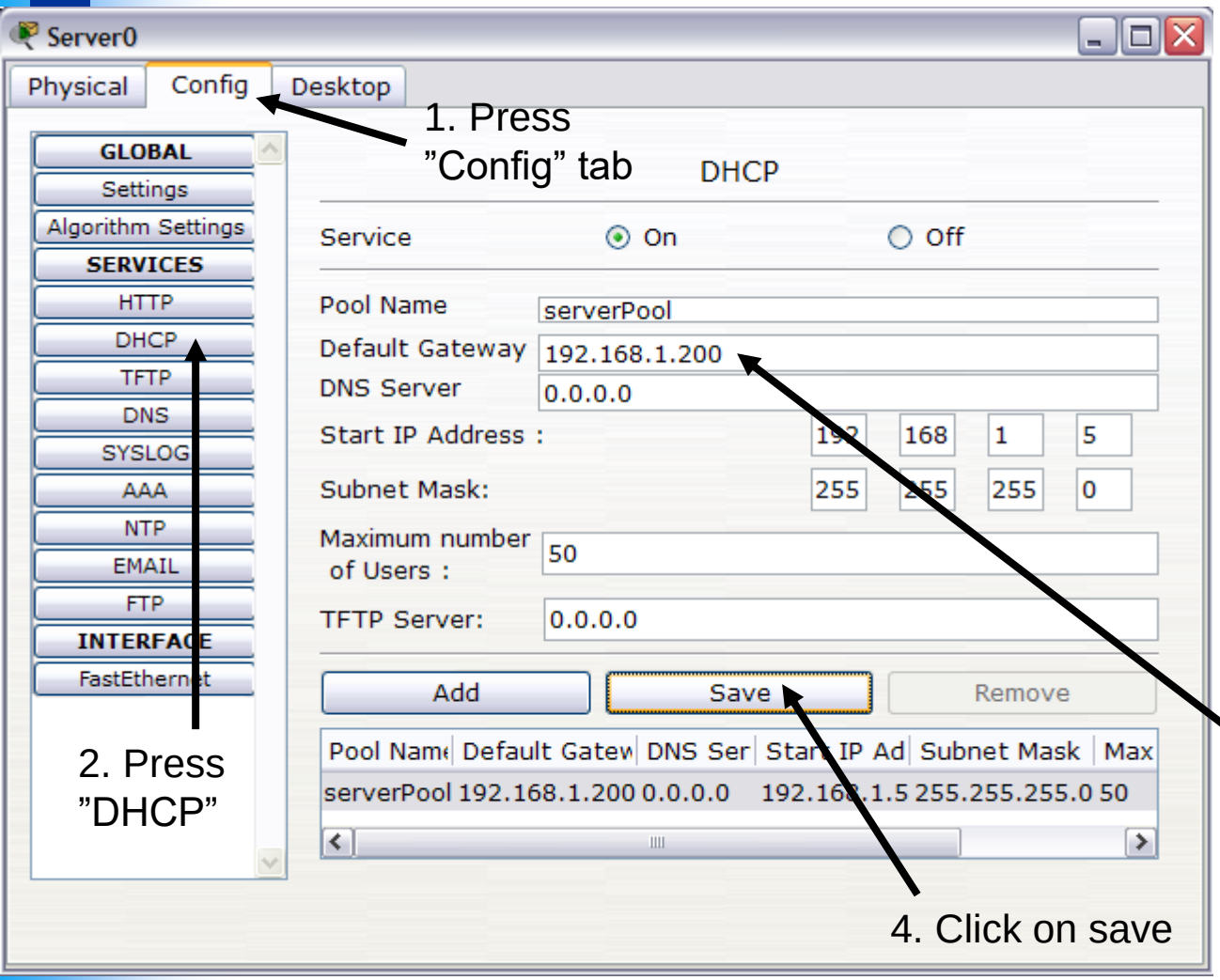
Key in Default Gateway IP in Hosts

- Key in 192.168.1.200 as the default gateway of PC0 and Server0
  - Since both hosts are configured as static IP





Key in Default Gateway IP in DCHP service



The default gateway IP in DHCP service is different from the default gateway IP of Server0 in terms of functionality

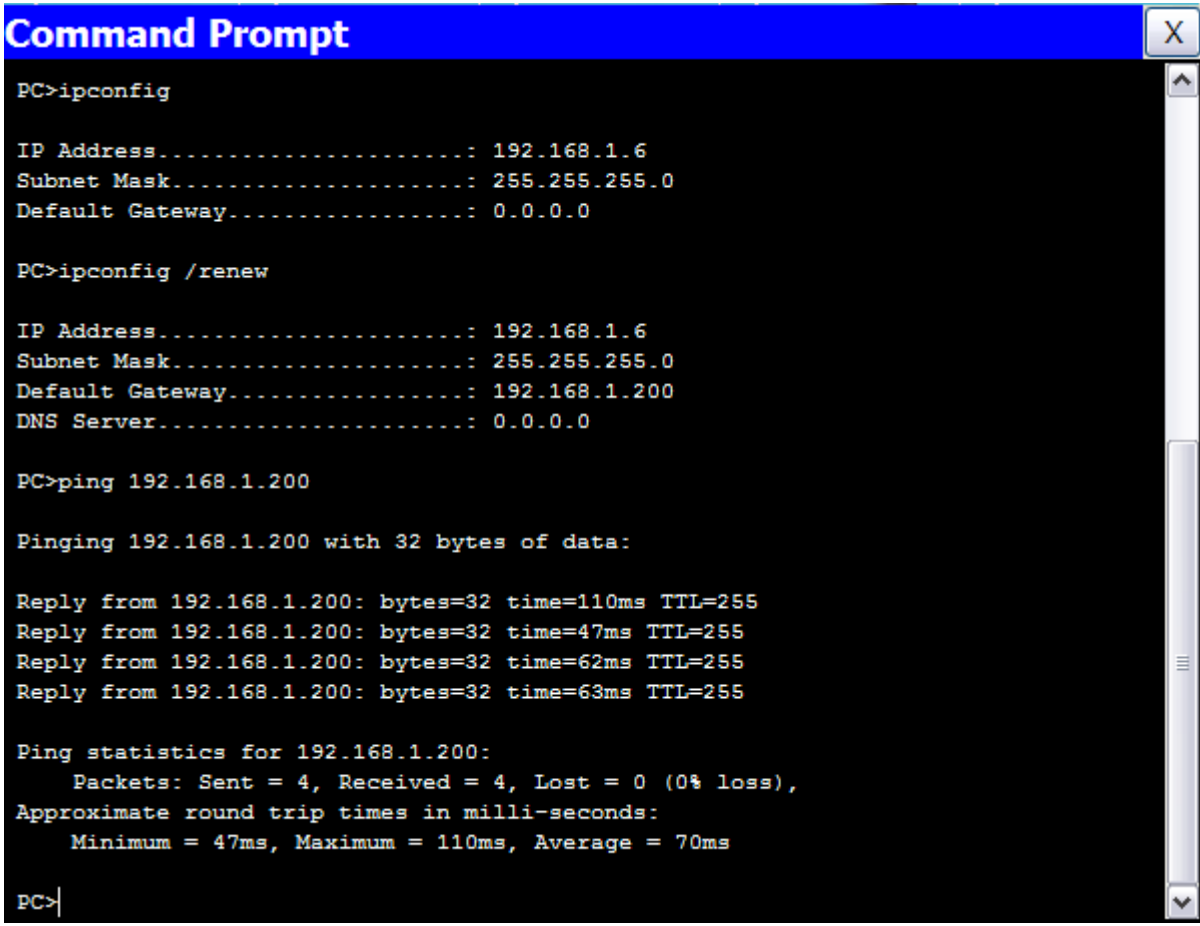
- Default gateway IP in Server0 belongs to Server0 itself.
- Default gateway in DHCP service is for other host that request DHCP service.
- The same default gateway IP in DHCP service can't be sent to Server0 itself.

Dynamic IP in PC1

1. Type "`ipconfig`" to check the existing IP

2. Type "`ipconfig /renew`" to renew the dynamic IP from DHCP service, since the default gateway IP is added.

3. Type "`ping 192.168.1.200`" to check the connectivity to router interface (default gateway)



Adding a new LAN

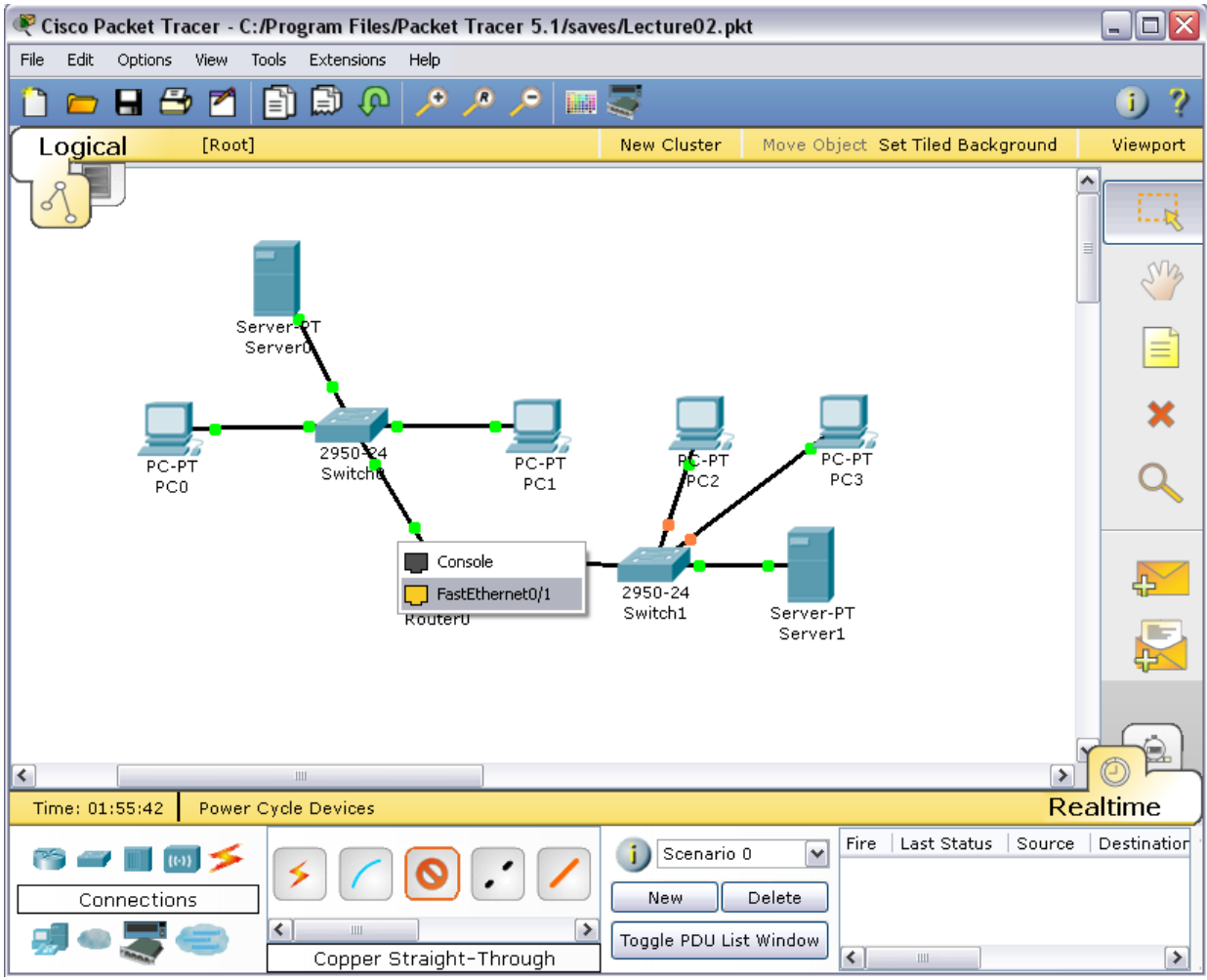
Adding and configure a new LAN on the existing network step by step

The design plan for second LAN

- Keep it as a good habit to plan for your network design.
- The design plan for second LAN:
  - The network components needed
    - 1 Switch
    - 2 PCs
    - 1 server
  - The services
    - DNS: Set 192.168.2.1 as “www.uccn1003.com”
    - HTTP
    - DHCP (dynamic IP for PCs in 2nd LAN)
      - Server IP (preferred static) = 192.168.2.1
      - Default gateway IP = 192.168.2.254
      - DHCP range for the PCs => 192.168.2.5 to 192.168.1.200
      - DNS IP = Web Server IP = 192.168.2.1

Adding new network components

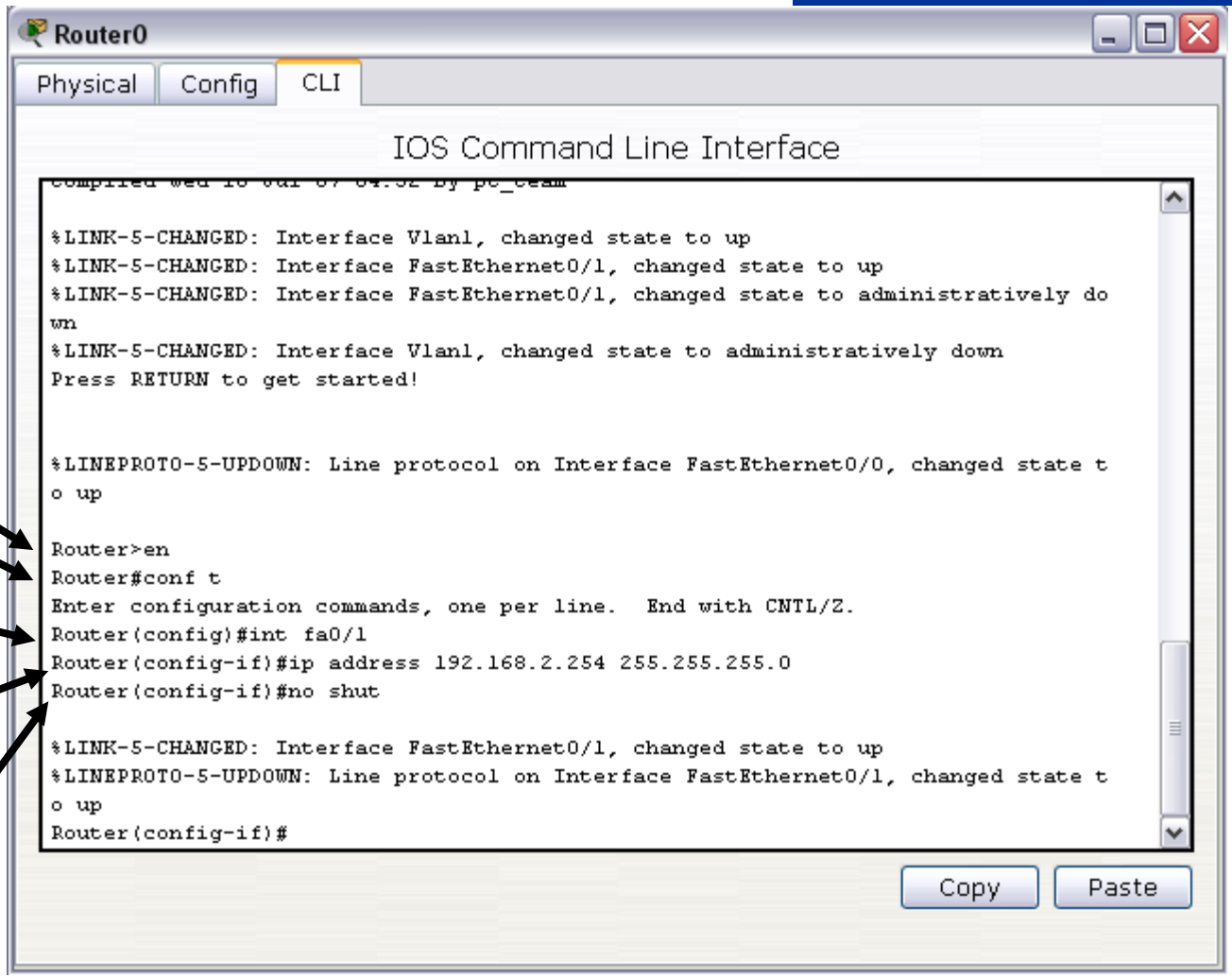
- Add to the workspace
  - 1 2950-24 switch
  - 2 Generic PCs
  - 1 Generic server
- Make connection with "Automatic Choose Connection Type" for
  - PC2 to Switch1
  - PC3 to Switch1
  - Server1 to Switch1
- Make connection with "Copper Straight-Through"
  - Switch1 to Router0
  - FastEthernet0/1 of Router0
  - FastEthernet0/4 of Switch1



Setting IP for Fa0/1 in Router0

Set port fa0/1 to have ip = 192.168.2.254

1. Type "en"
2. Type "conf t"
3. Type "int fa0/1"
4. Type "ip address 192.168.2.254 255.255.255.0"
5. Type "no shut"

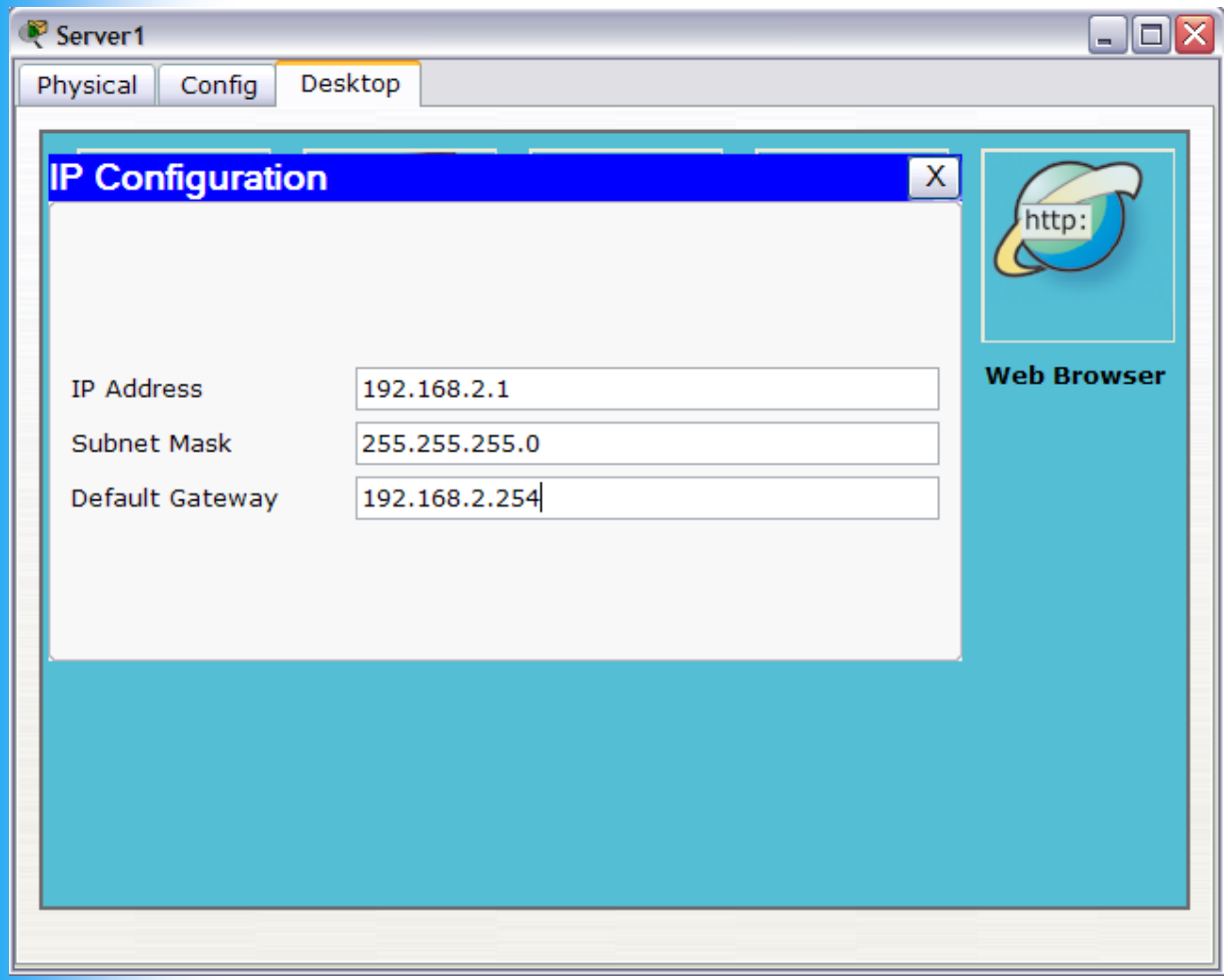


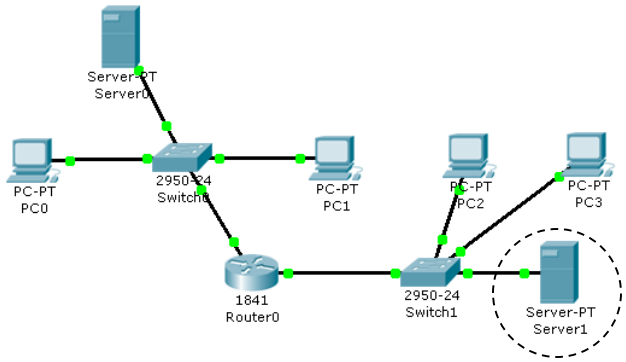
Caution on Setting IP on Router

- Router ports (e.g. fa0/0, fa0/1) are set with static IP.
  - Note: the port here is a physical port, not the port number (services) that we have discussed.
- Make sure that you set your IP on the correct Router ports. For example:
  - The original design
    - fa0/0 = 192.168.1.200,
    - fa0/1 = 192.168.2.254
  - But you mistakenly set
    - fa0/0 = 192.168.2.254 (fa0/1 ‘s IP)
    - fa0/1 = 192.168.1.200 (fa0/0 ‘s IP)

IP Configuration of Server1

- The setting of the server IP, subnet mask and gateway.





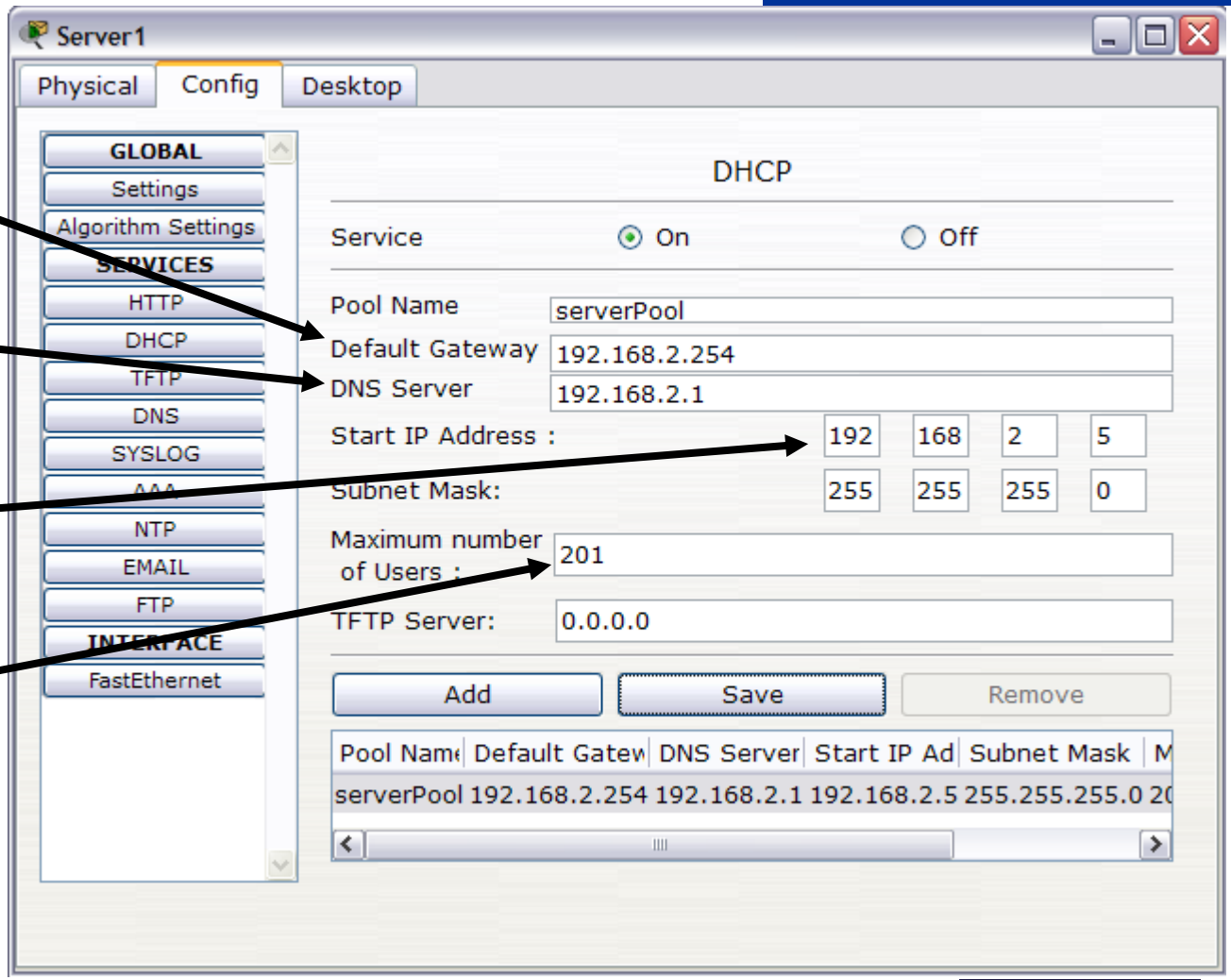
DHCP service setup of Server1

Set Default Gateway IP
= 192.168.2.254

Set DNS IP
= 192.168.2.1

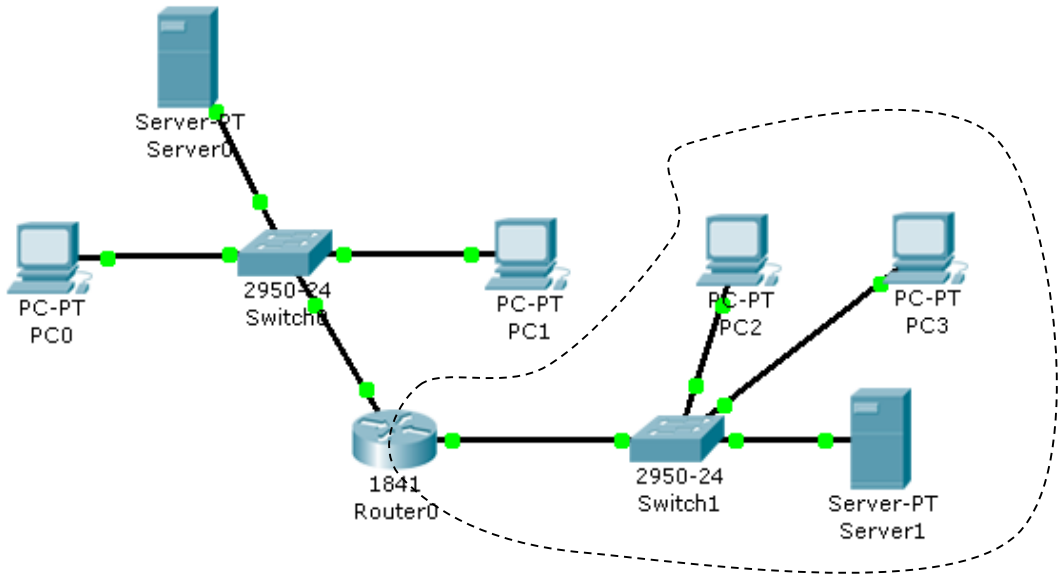
Set Start IP address
= 192.168.2.5

Set Max # of Users
= 201



Comments on Second DHCP Service

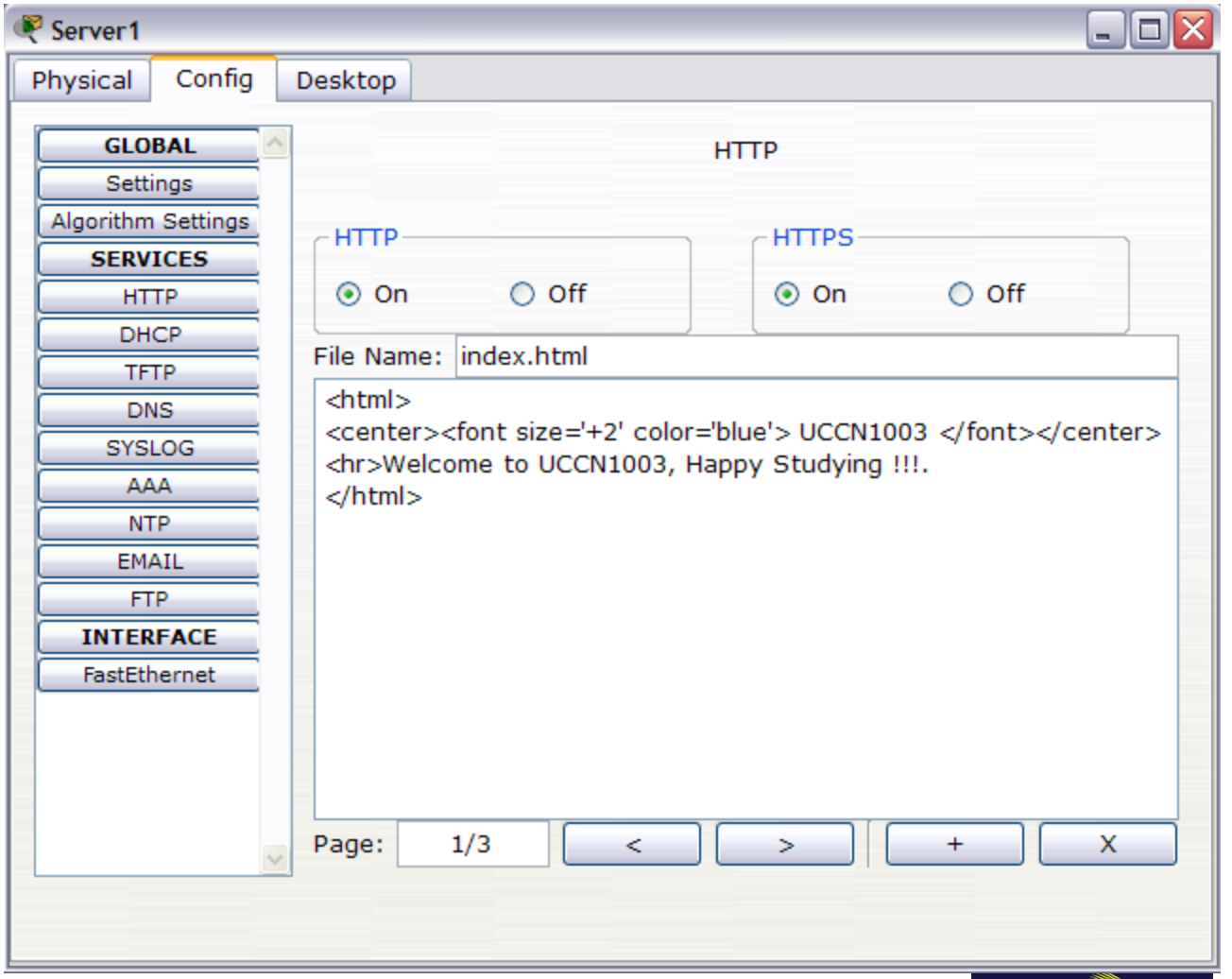
- DHCP service in Server1 does not service PC0 and PC1, it can only service PC2 and PC3.
  - Same as Server0, only servicing PC0 and PC1
  - DHCP service can not “cross” Router.
    - Whereas, HTTP, DNS service can “cross” Router



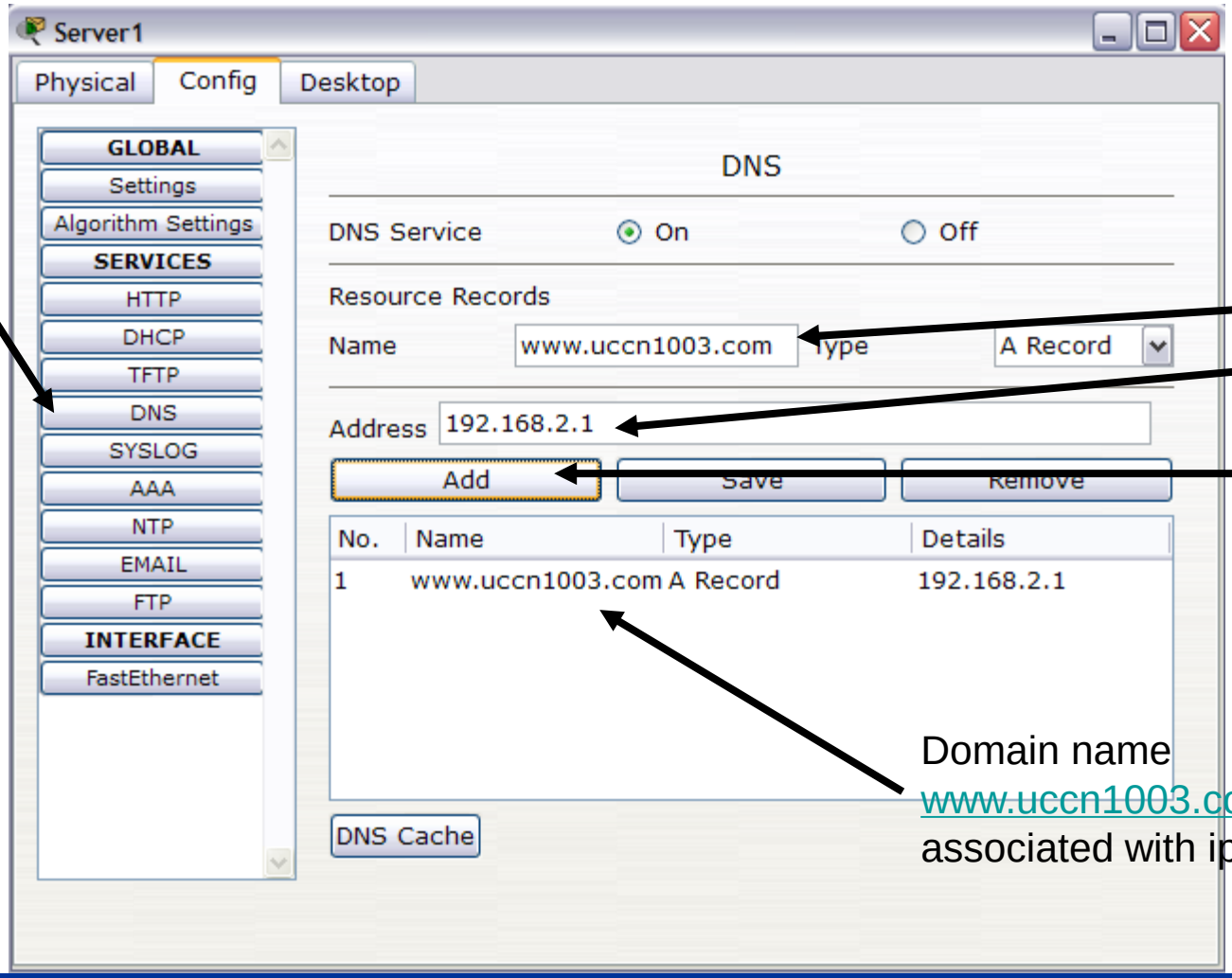
Service boundary of DHCP service of Server1

HTTP service setup of Server1

- Click on “Config” tab and then “HTTP” button to go the HTTP screen.
- Type in or modify the web page as shown



DNS Service setup of Server1



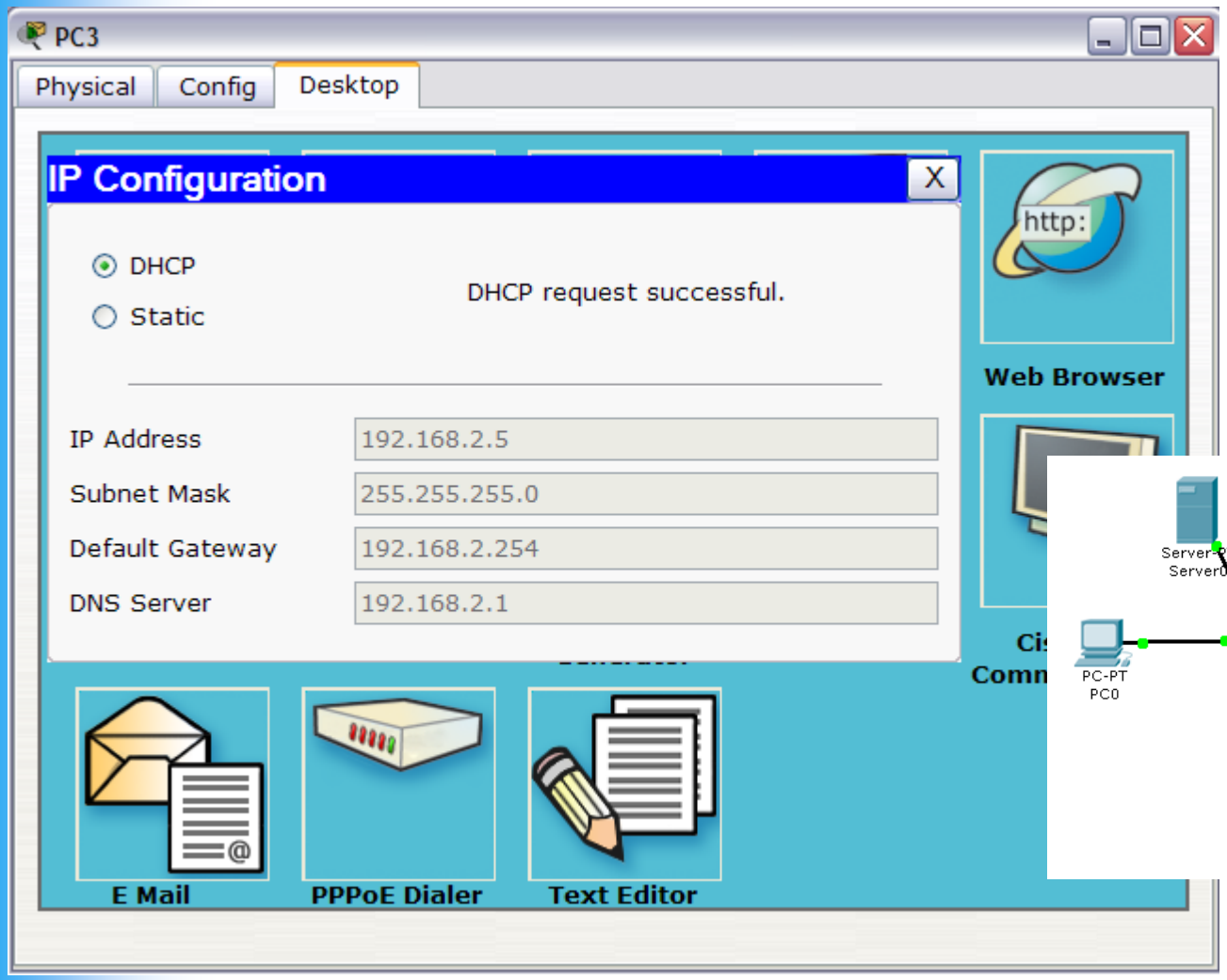
1. Click DNS

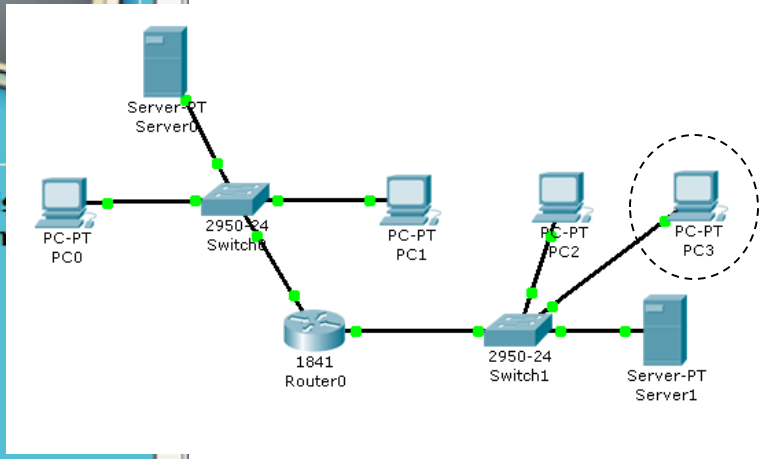
2. Type in these

3. Press the "Add" button.

Domain name www.uccn1003.com is now associated with ip 192.168.2.1

Requesting Dynamic IP for PC3

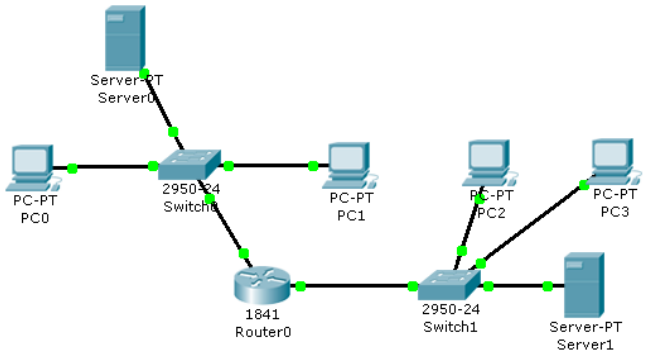




Testing Connectivity for PC3

PC3 ping gateway (fa0/1 of Router0)

PC3 ping PC0



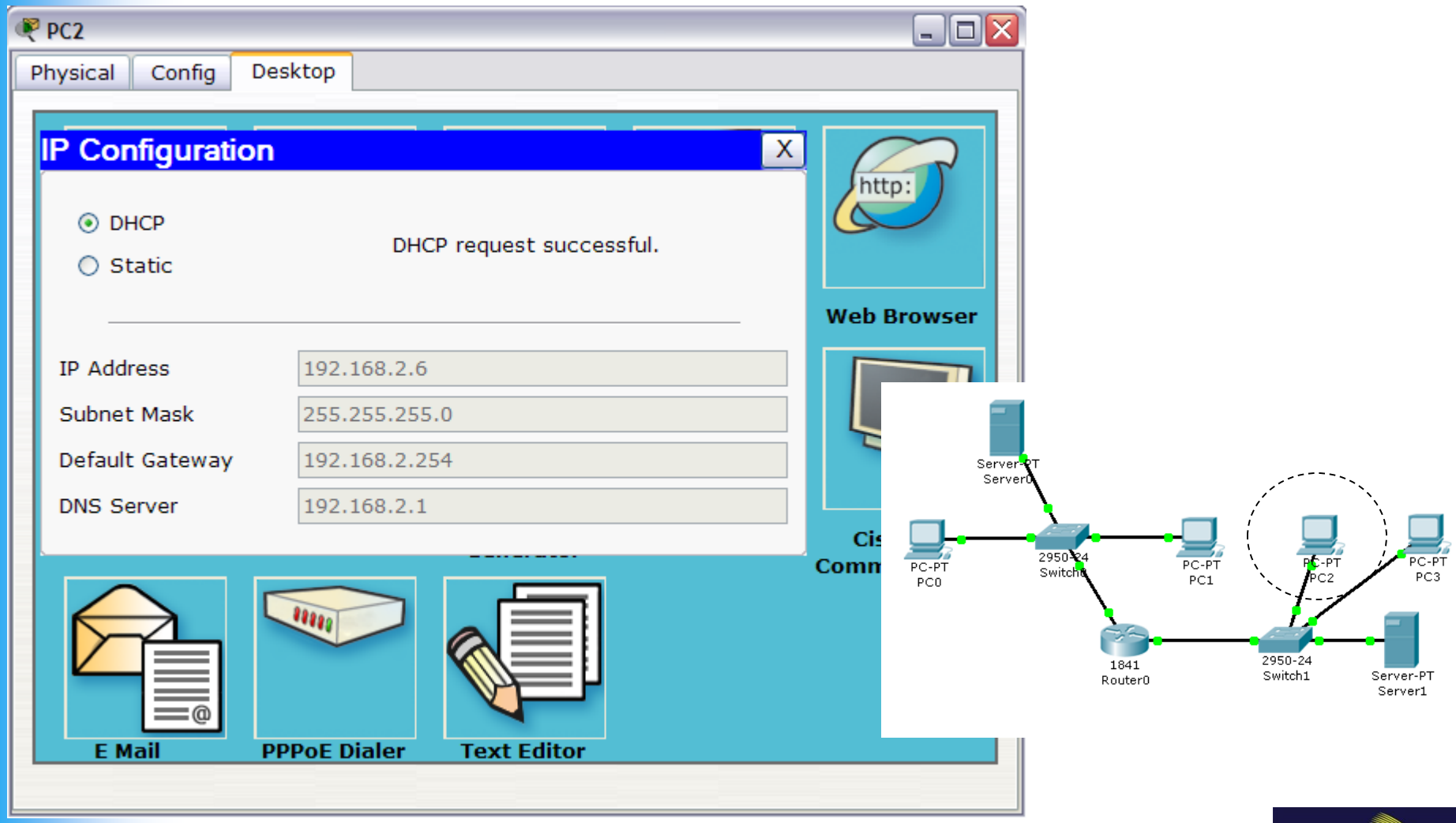
PC3

Physical | Config | Desktop

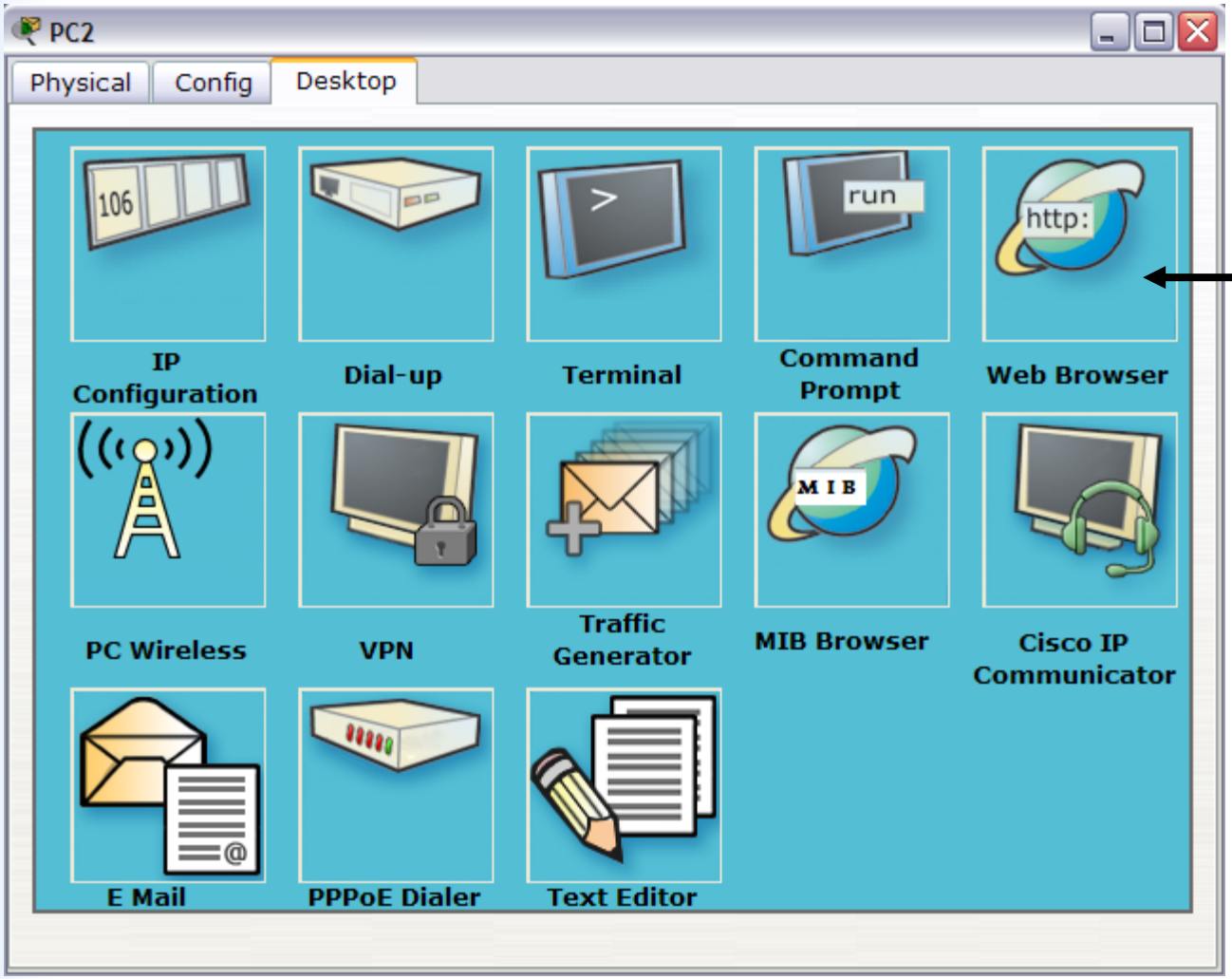
Command Prompt

```
Packet Tracer PC Command Line 1.0
PC>ping 192.168.2.254

Pinging 192.168.2.254 with 32 bytes of data:

Reply from 192.168.2.254: bytes=32 time=78ms TTL=255
Reply from 192.168.2.254: bytes=32 time=62ms TTL=255
Reply from 192.168.2.254: bytes=32 time=62ms TTL=255
Reply from 192.168.2.254: bytes=32 time=62ms TTL=255

Ping statistics for 192.168.2.254:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 62ms, Maximum = 78ms, Average = 66ms

PC>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.1.1: bytes=32 time=125ms TTL=127
Reply from 192.168.1.1: bytes=32 time=125ms TTL=127
Reply from 192.168.1.1: bytes=32 time=96ms TTL=127

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 96ms, Maximum = 125ms, Average = 115ms

PC>
```

Requesting Dynamic IP for PC2

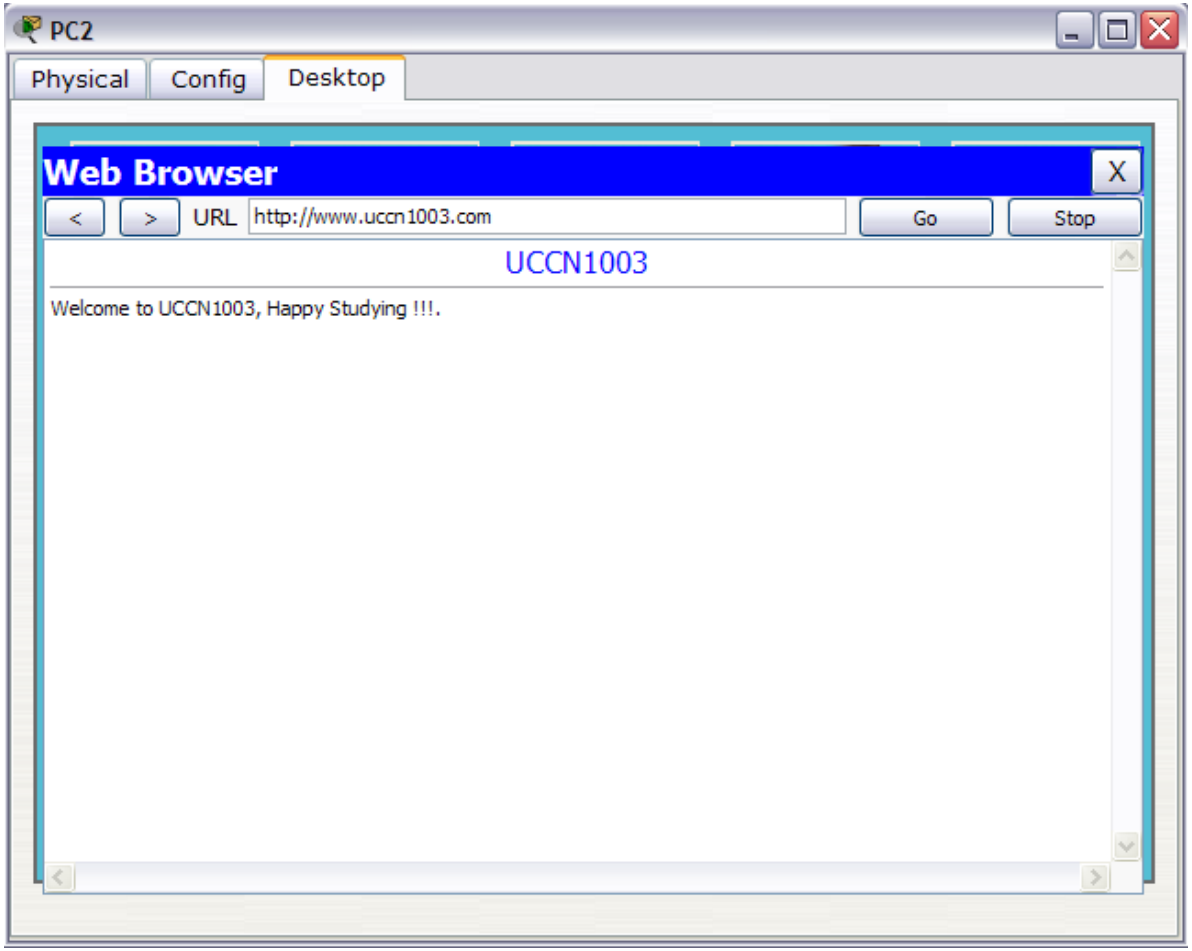


Launch Web Browser for PC2

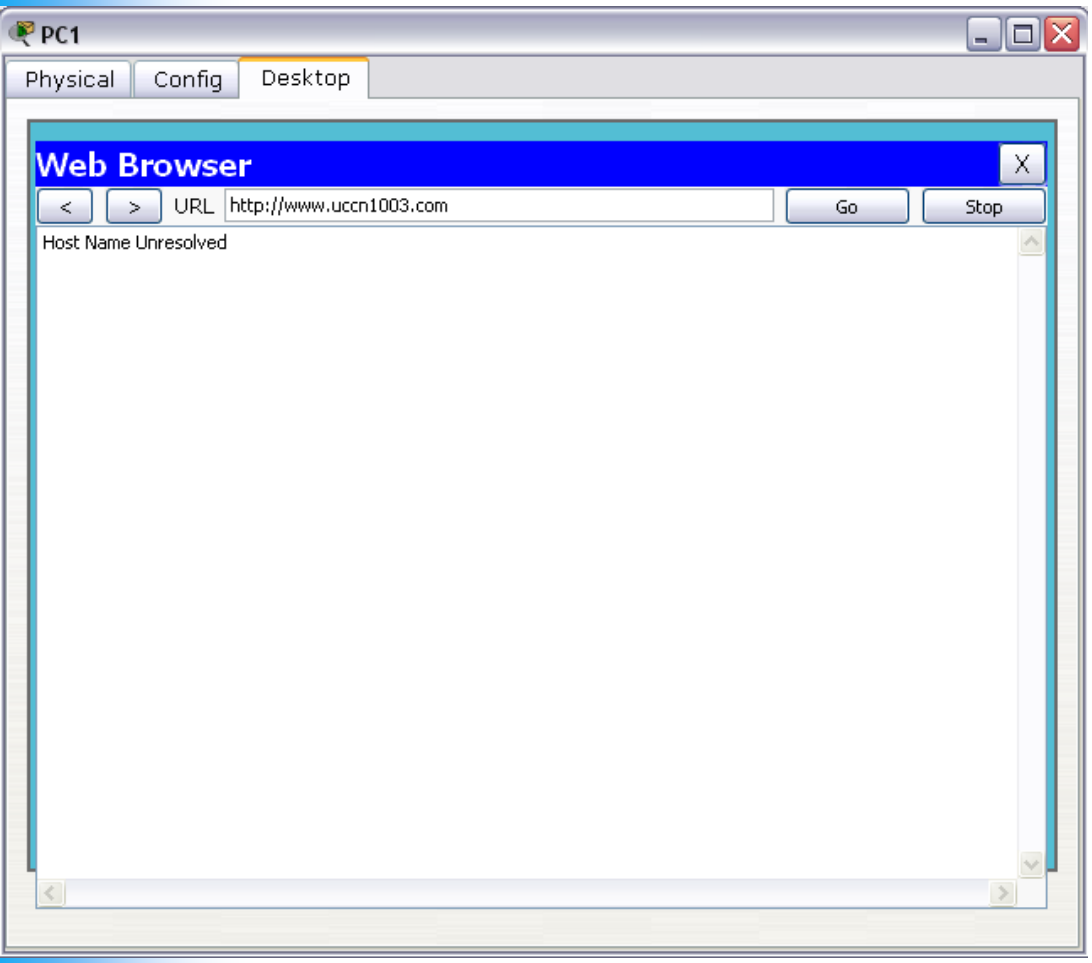


PC2 Access Web Page in Server1

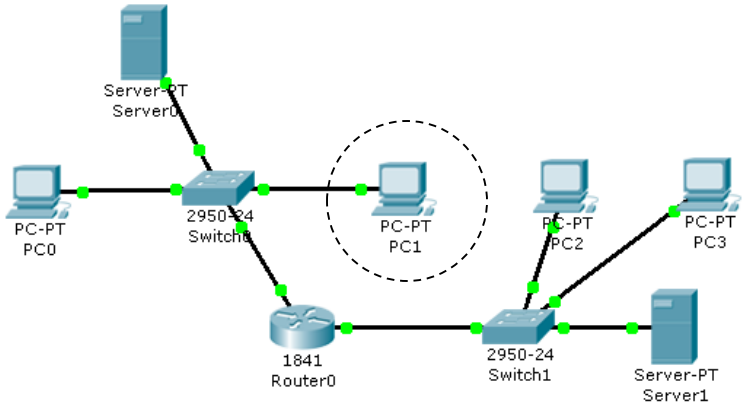
- PC2 has successfully communicate with the DNS to resolve the domain name www.uccn1003.com
- PC2 has successfully access the web page hosted in 192.168.2.1 (Server1)



PC1 Access Web Page in Server1



- PC1 unsuccessfully access the web page since the hostname is unresolved.
- Need to troubleshoot the DNS mechanism…



Troubleshoot PC1: ipconfig

- Check PC1 with “ipconfig /all”.
- The DNS IP is missing = 0.0.0.0
- Check with nslookup => Not working
- PC1 is under dynamic IP
- We need to fix it first on the DHCP server.

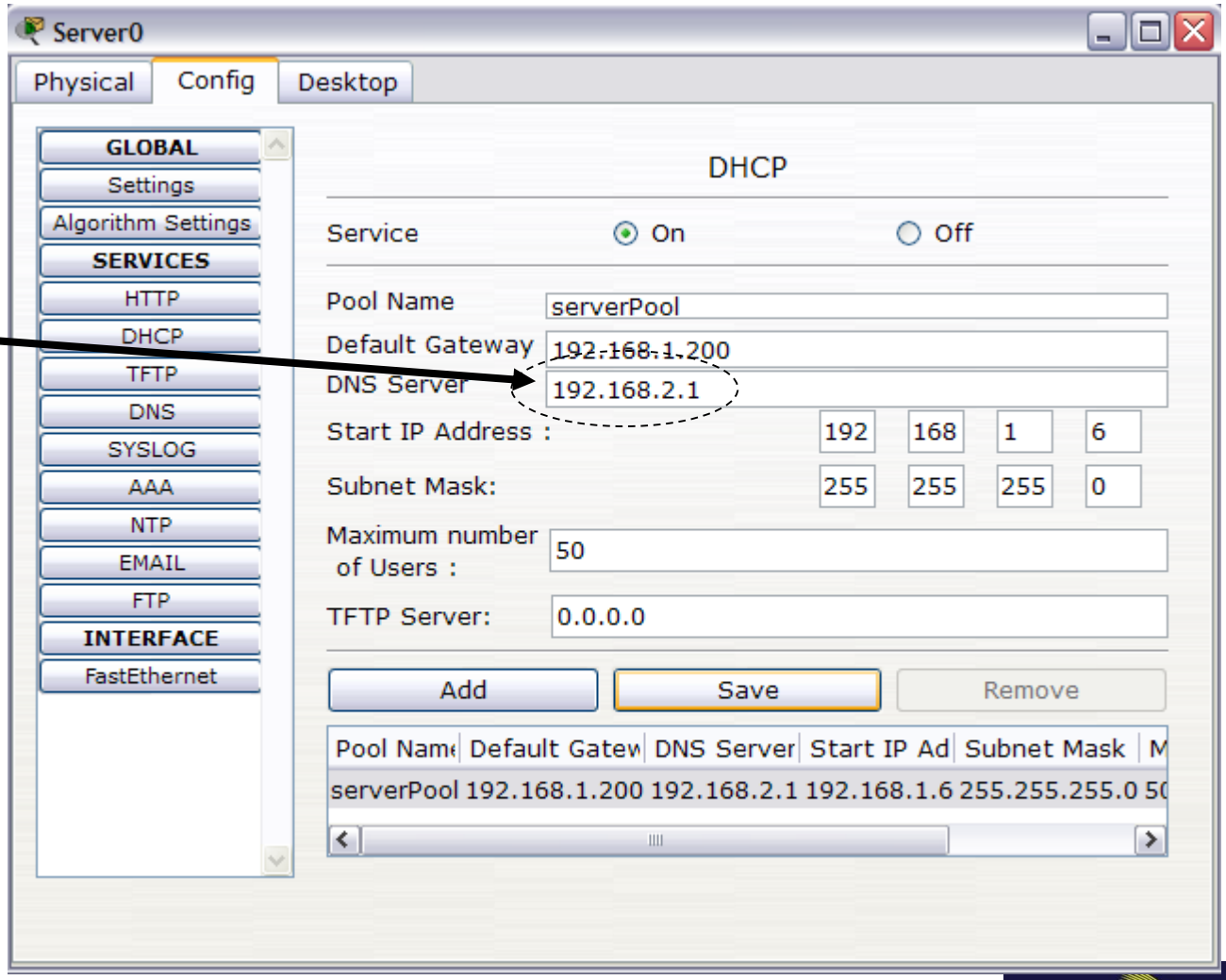
```
PC>ipconfig /all

Physical Address.....................: 0002.1685.4144
IP Address...........................: 192.168.1.6
Subnet Mask..........................: 255.255.255.0
Default Gateway......................: 192.168.1.200
DNS Servers..........................: 0.0.0.0


PC>nslookup www.uccn1003.com

Server: [255.255.255.255]
Address:   255.255.255.255
DNS request timed out.
        timeout was 10000 milli seconds.
DNS request timed out.
        timeout was 10000 milli seconds.
DNS request timed out.
        timeout was 10000 milli seconds.

PC>
```

Note: Keep it as a habit that whenever you troubleshoot the network always start with “ipconfig”

Fixing the DNS IP in DHCP

Change the DNS Server IP from 0.0.0.0 to 192.168.2.1

Remember to click "Save"



Request New Dynamic IP in PC1

Renew Dynamic IP
Since DNS server IP is added

```
PC>ipconfig /renew

IP Address.....................: 192.168.1.6
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.200
DNS Server.....................: 192.168.2.1
```

Check again with nslookup on domain name "www.uccn1003.com"

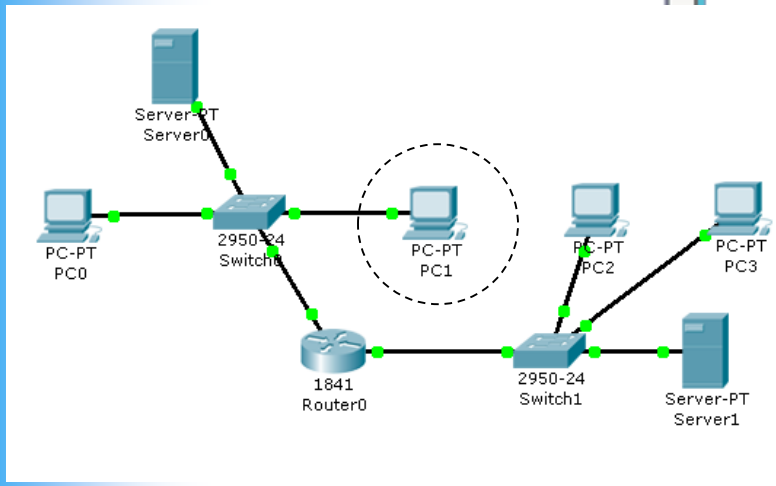
```
PC>nslookup www.uccn1003.com

Server: [192.168.2.1]
Address:  192.168.2.1

Non-authoritative answer:
Name:    www.uccn1003.com
Address:   192.168.2.1
```

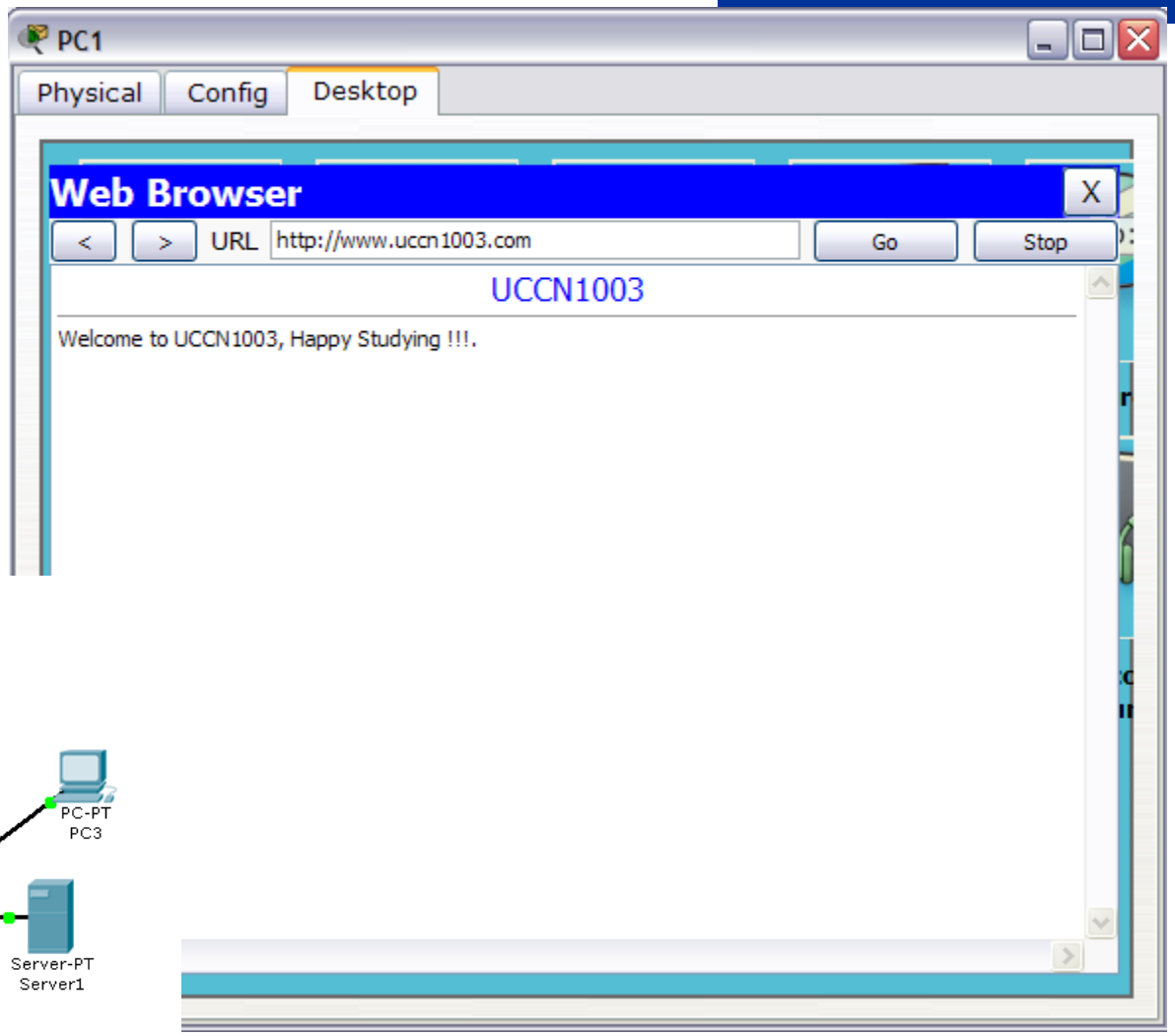
PC1 ping web server

```
PC>ping www.uccn1003.com

Pinging 192.168.2.1 with 32 bytes of data:

Reply from 192.168.2.1: bytes=32 time=109ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127
Reply from 192.168.2.1: bytes=32 time=109ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 109ms, Maximum = 125ms, Average = 117ms
```

Launch Web Browser in PC1

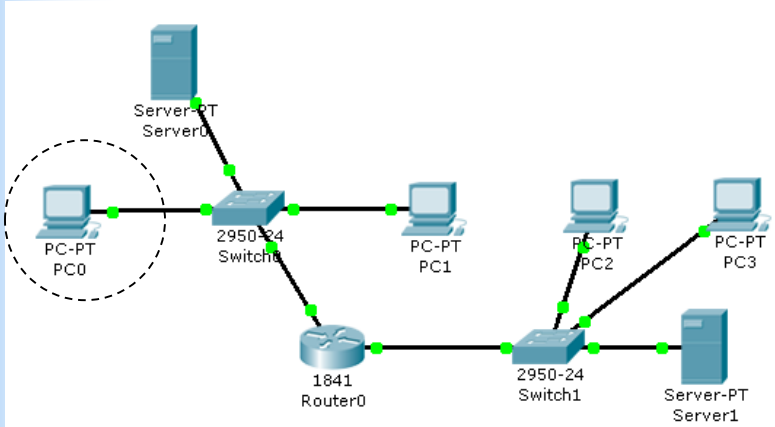
- PC1 Successfully access web page www.uccn1003.com

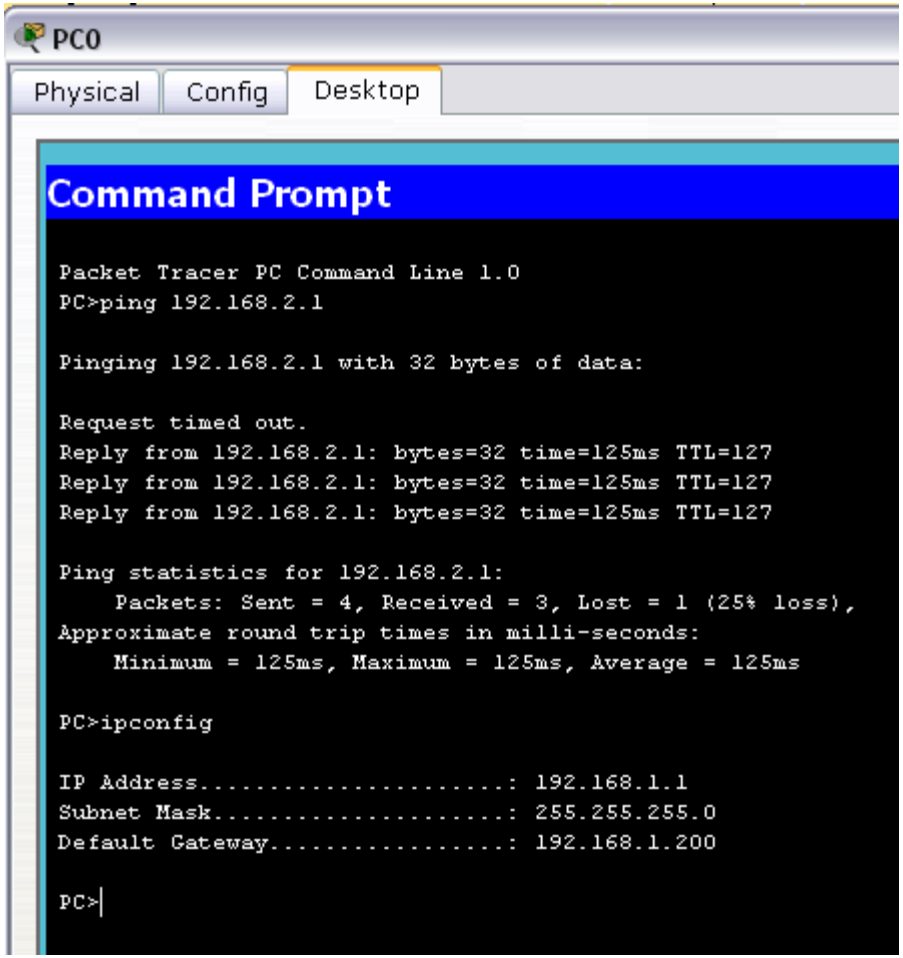




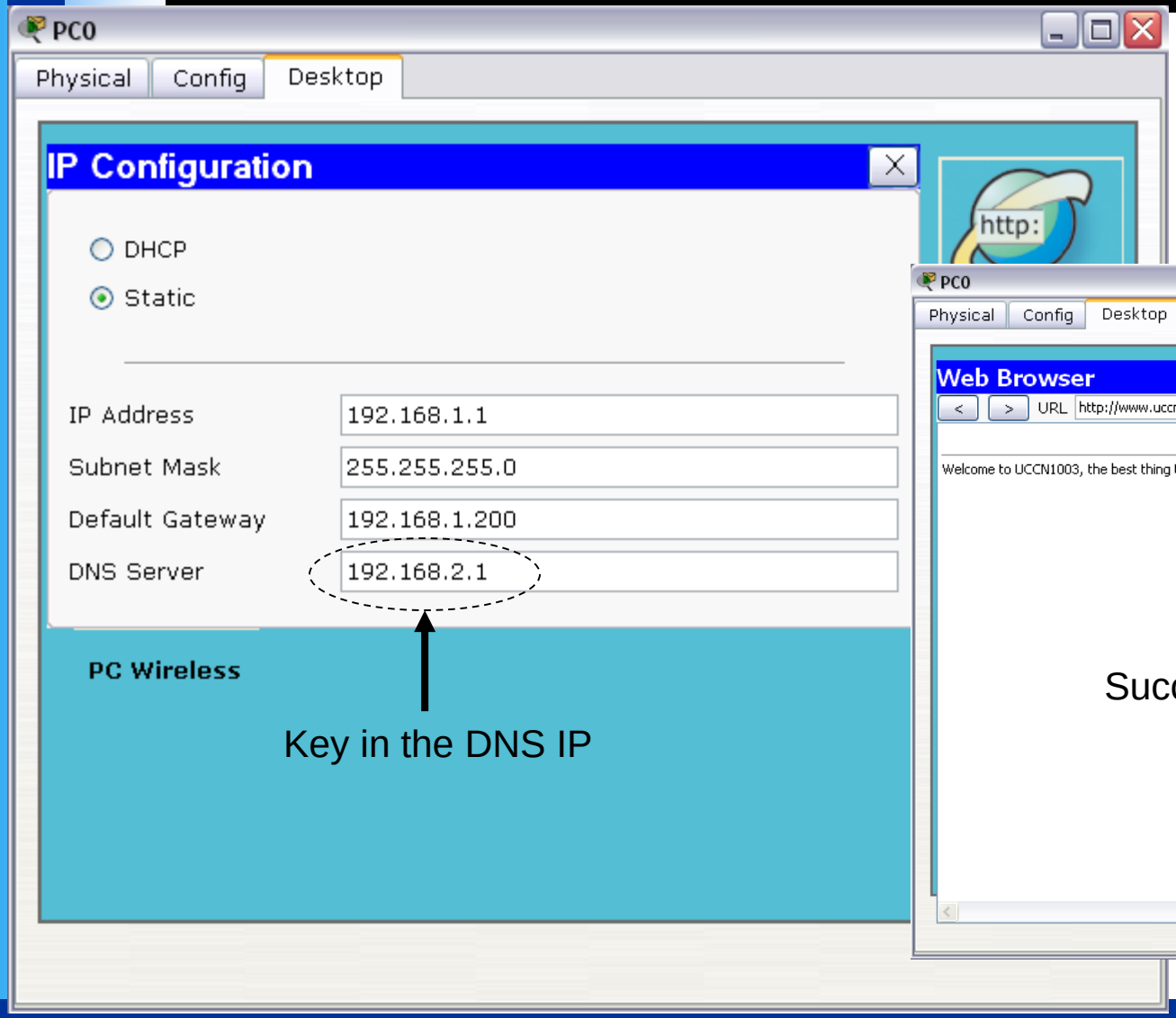
PC0 and DNS

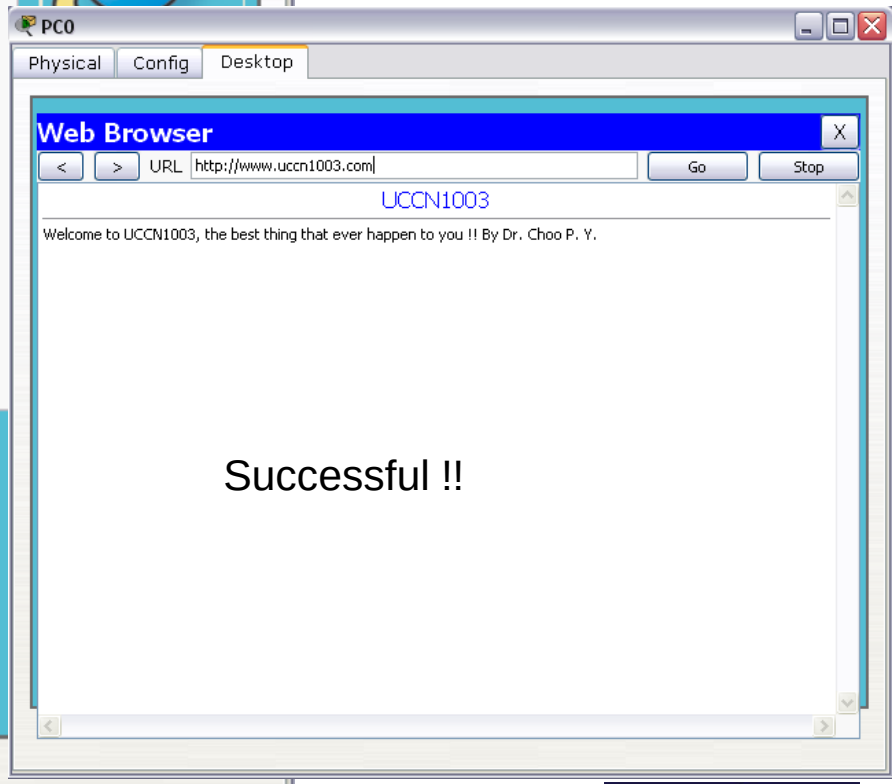
- Though PC0 can ping DNS, this does not mean you can resolved hostname in the web browser.
  - Since PC0 doesn't have the DNS server IP.
- PC0 is set under static IP.





Launch Web Browser in PC0





LAN Design Issues

Describing various design issues, principles, and guidelines of LAN, especially on the physical aspect of LAN (e.g. topology, cables, boundary of LAN, etc)

Overview of LAN Design Issues

- There are two aspect of LAN design issues:
  - Physical issues
  - Issues from IP address
- Physical Issues of LAN deals with
  - Network Topology
  - LAN boundary
  - Cables and connecting the equipments
  - Placement of servers/services
- Issues from IP address (Later lecture)
  - IP address design after physical LAN layout
  - IP subnet rules

Network Topology

End Devices & Networking Devices

- End-devices:

- Networking devices:

- In LAN design:
  - We need to learn how to connect these devices together with cables in order to form a network.
  - Network topology shows us a few way to do this.

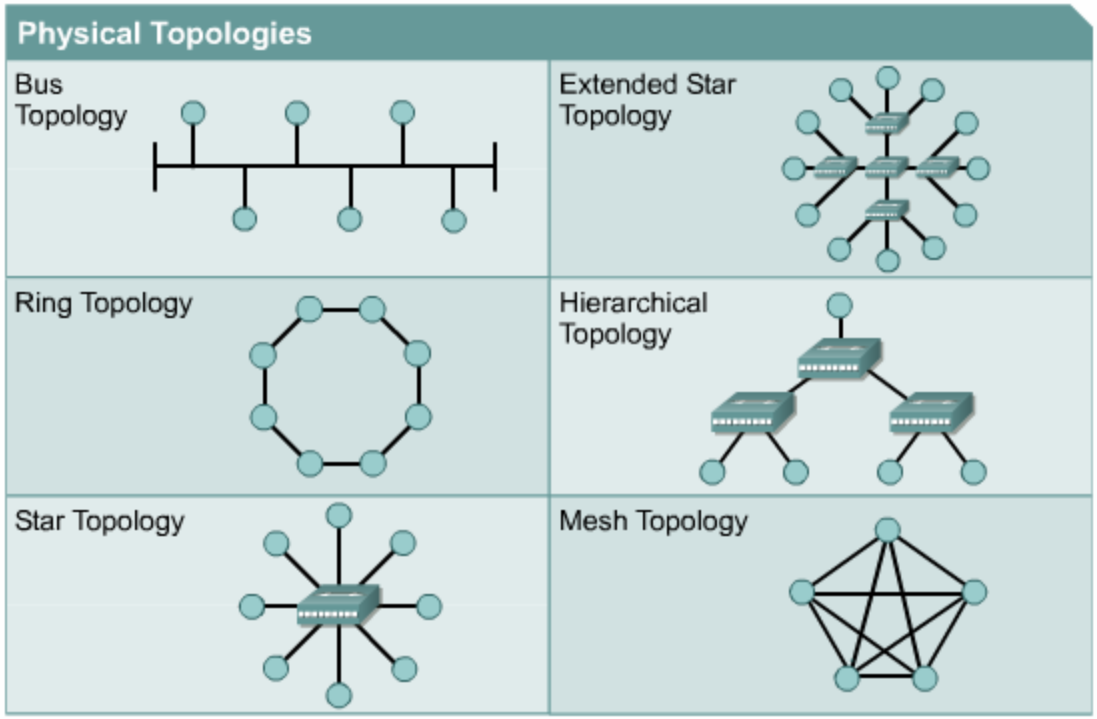
Network Topology - 1

- Network topology: is the study of the arrangement or mapping of the elements (links, nodes, etc.) of a network, especially the physical (real) and logical (virtual) interconnections between nodes.
  - Bus topology: the nodes connect to a common backbone or trunk.
  - Star topology: links all nodes of the network to a central node.
  - Ring topology: each node connects to another in a closed loop.
  - Mesh topology: nodes are “randomly” connected to one or many nodes.

  * A node can be an end device or a network device.

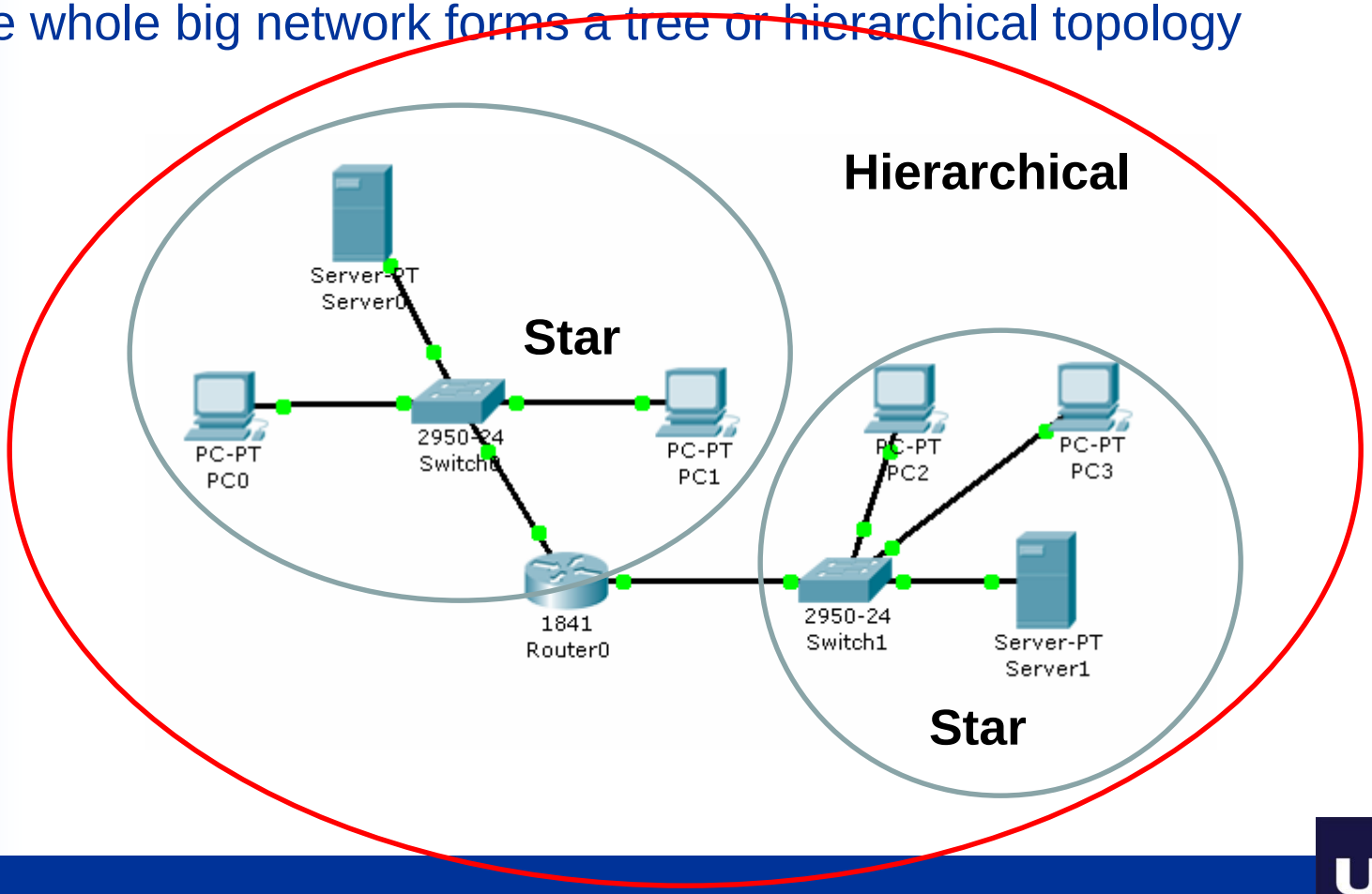
Network Topology - 2

- Network can be formed with any combination of these network topologies in order to connect the network devices.



Example 1:

- LAN where PCs and server connected to a switch forms a star-topology
- The whole big network forms a tree or hierarchical topology

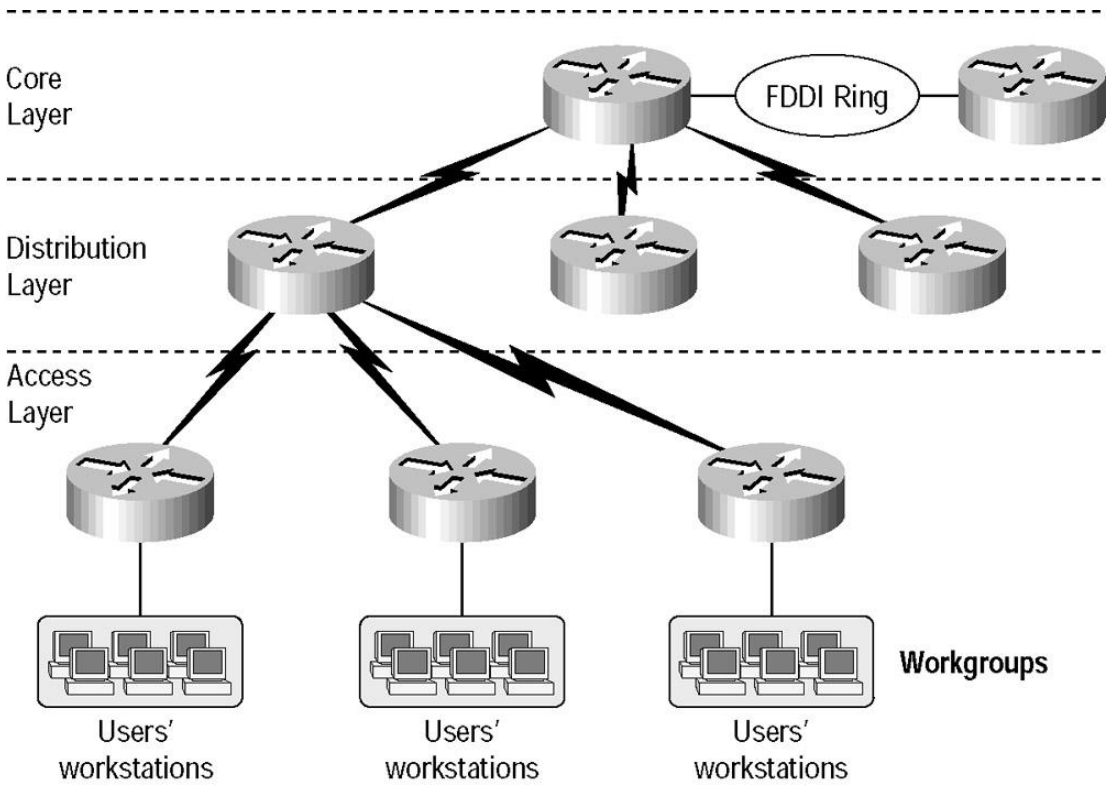


Example 2: LAN

- In LAN design, the most common topology is star topology
  - All data that is transmitted between nodes in the network is transmitted to this central node, then retransmits the data to some or all of the other nodes in the network
- Star-topology LAN is normally formed by connecting the servers and PCs to a switch, or a hub.
  - Switches and hubs are normally not required to be configured to form a LAN.
  - Switches and hub will automatically communicate and transfer data among hosts (PCs), once these hosts are connected to the switch or hub.
- Switch is a much superior central node than hub since switch provide higher data transmission (or bandwidth) than hub.

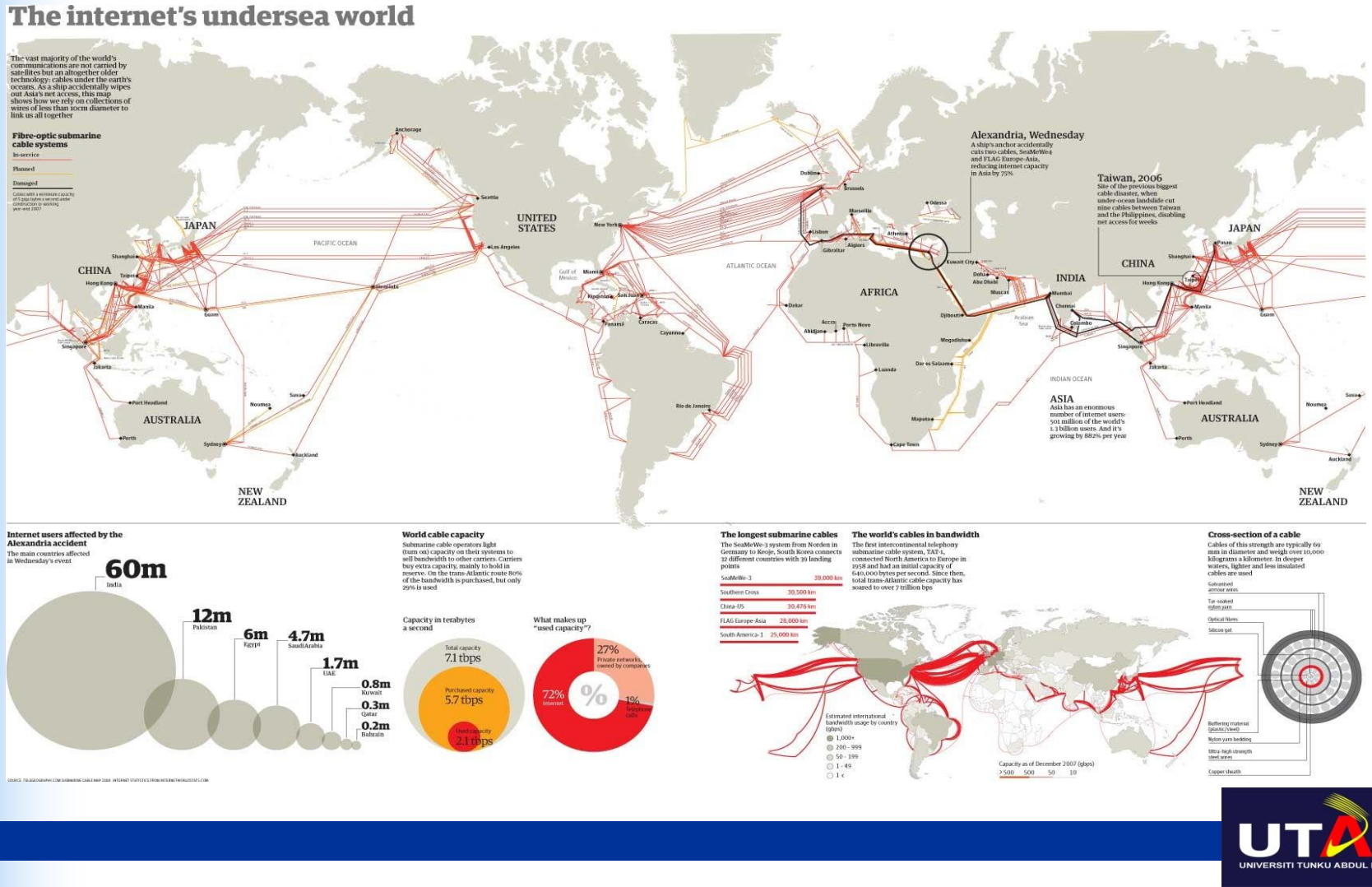
Example 3: Enterprise Network

- In enterprise network, hierarchical/tree topology is normally the preferred network topology.
  - An efficient enterprise network is normally organized as a hierarchy/tree of LANs.



Example 4: Internet

The Internet is a mesh topology.



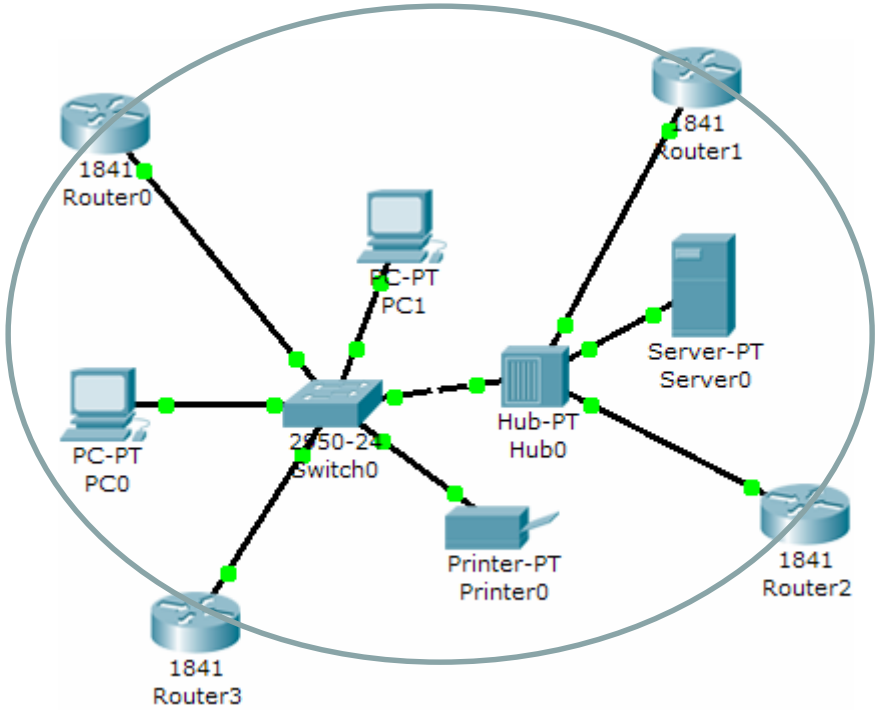
Issues of Network Topology

- Bus
  - Least wire used
  - Disastrous if link is fail. Not efficient as host increases
- Star and Extended Star
  - Cheaper than mesh, good fault isolation, easy to install, good connectivity
  - Bottle neck in the central hub.
- Ring
  - Less wire used than mesh
  - Medium efficiency and fault isolation
- Mesh
  - Full connectivity, good fault isolation
  - Require a lot resources (cable, I/O ports)
- Hierarchical (or tree)
  - Hierarchical organized, most widespread network infrastructure topology
  - Need multiplexing equipment, bottleneck at the top node

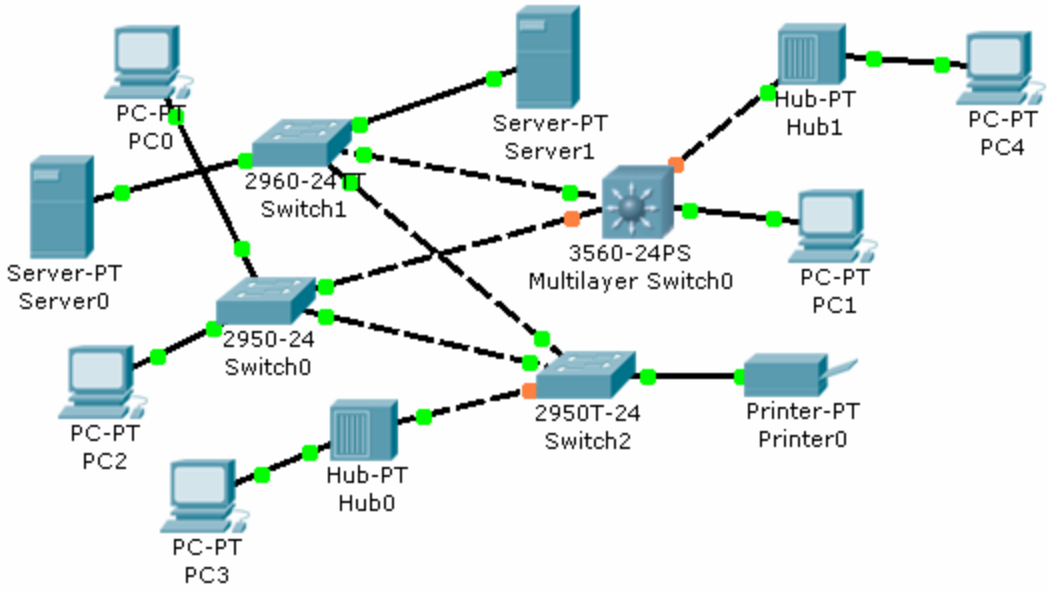
LAN Boundary

Overview of LAN Boundary

- A LAN is a set of end-devices connected to switches/hubs bound by routers.



Still the same LAN with switches and hubs

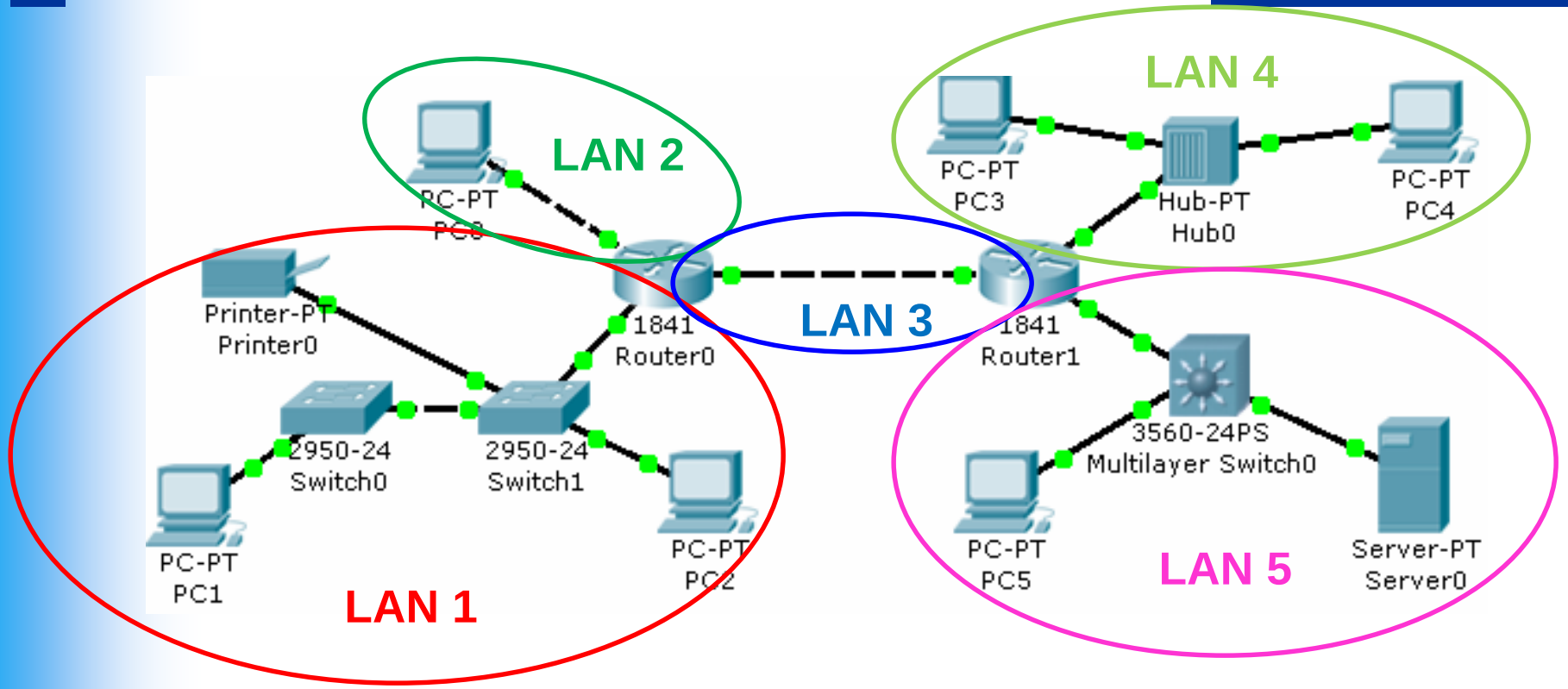


Still 1 LAN

PC0 is still in the same LAN as Server1, Printer0, PC1, PC2, PC3,…

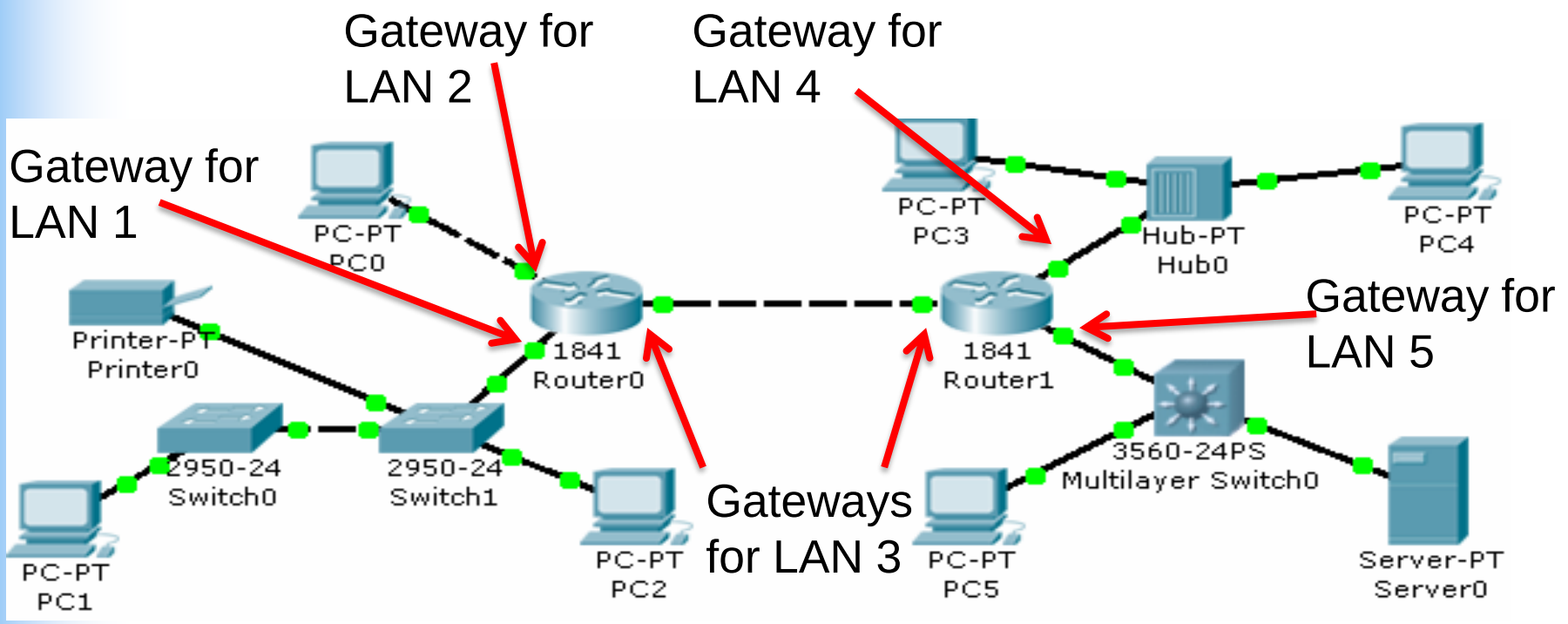
- No matter how many switches and hubs (of different models) are connected together, functionally they still form the same one LAN.

Routers – Boundary of LAN



- Router is the boundary of the LAN
- This “boundary” of a LAN is the location of the gateway, which is router port configured with an IP address.
- Every host in that LAN has to set its gateway to that IP address.

Routers – Boundary of LAN



- Unlike switches, you have to configure a router before it can be used in a network
  - At least you need to configure the IP addresses for the router ports
- Gateways are the “escape door” from a LAN to the next LAN.
- A LAN can have more than 1 gateway.

Cables and Connections

Common Types of Cables in Network

- In networks, we use cables to connect various end devices and networking devices.
- Examples of types of cables used:
  - Rollover cable
  - Ethernet copper straight through
  - Ethernet copper cross-over
  - Fiber optics
  - Telephone cables
  - Coaxial
  - Serial cables

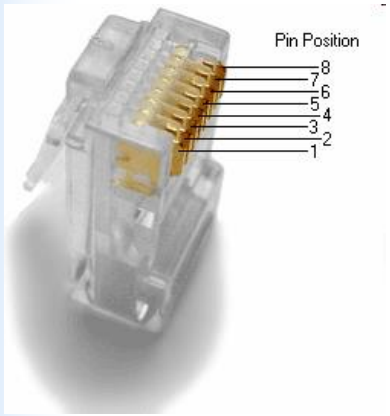
The cables below are available in Packet Tracer simulator

Rollover Cable

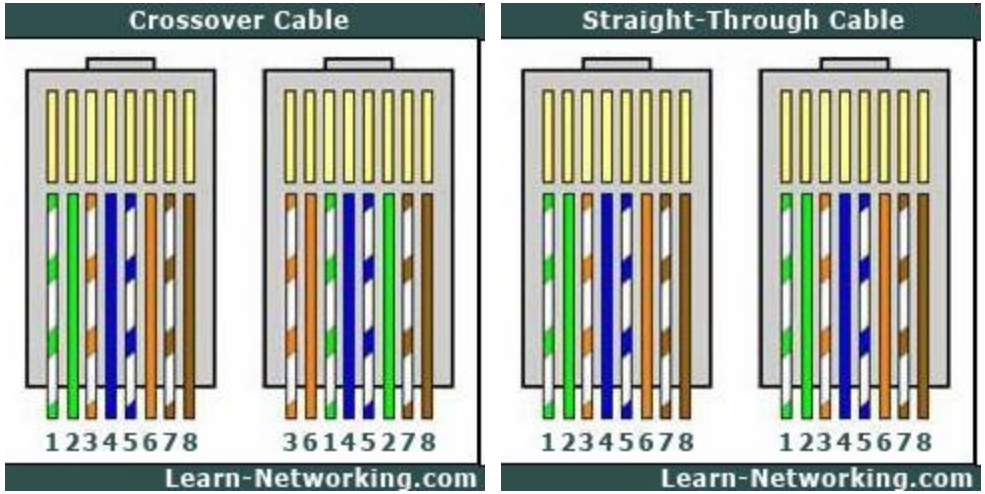
- Rollover cable is a cable with a serial connector at one end, and a RJ-45 connector at the other end.
- Rollover connects the serial (comm) port of a PC to the console port of a router.
- Rollover cable is **only** used for **router configuration**, not data transfer in network.

Ethernet Copper Cable (Cat 5)

- There are two types of cable to connect the Ethernet ports in the LAN of the PC, switches, and routers.
  - Straight-through and Crossover
- Both type of cables are a type of twisted pair copper wire cable for LAN use for which the **RJ-45** connectors at each end
- Both of them look the same, except for the conductors arrangement shown below.
- Straight-through cables have the same pinout (i.e., arrangement of conductors).
- Crossover cable, the wires on the cable are crossed over so that the receive signal pins on the connector on one end are connected to the transmit signal pins on the connector on the other end.

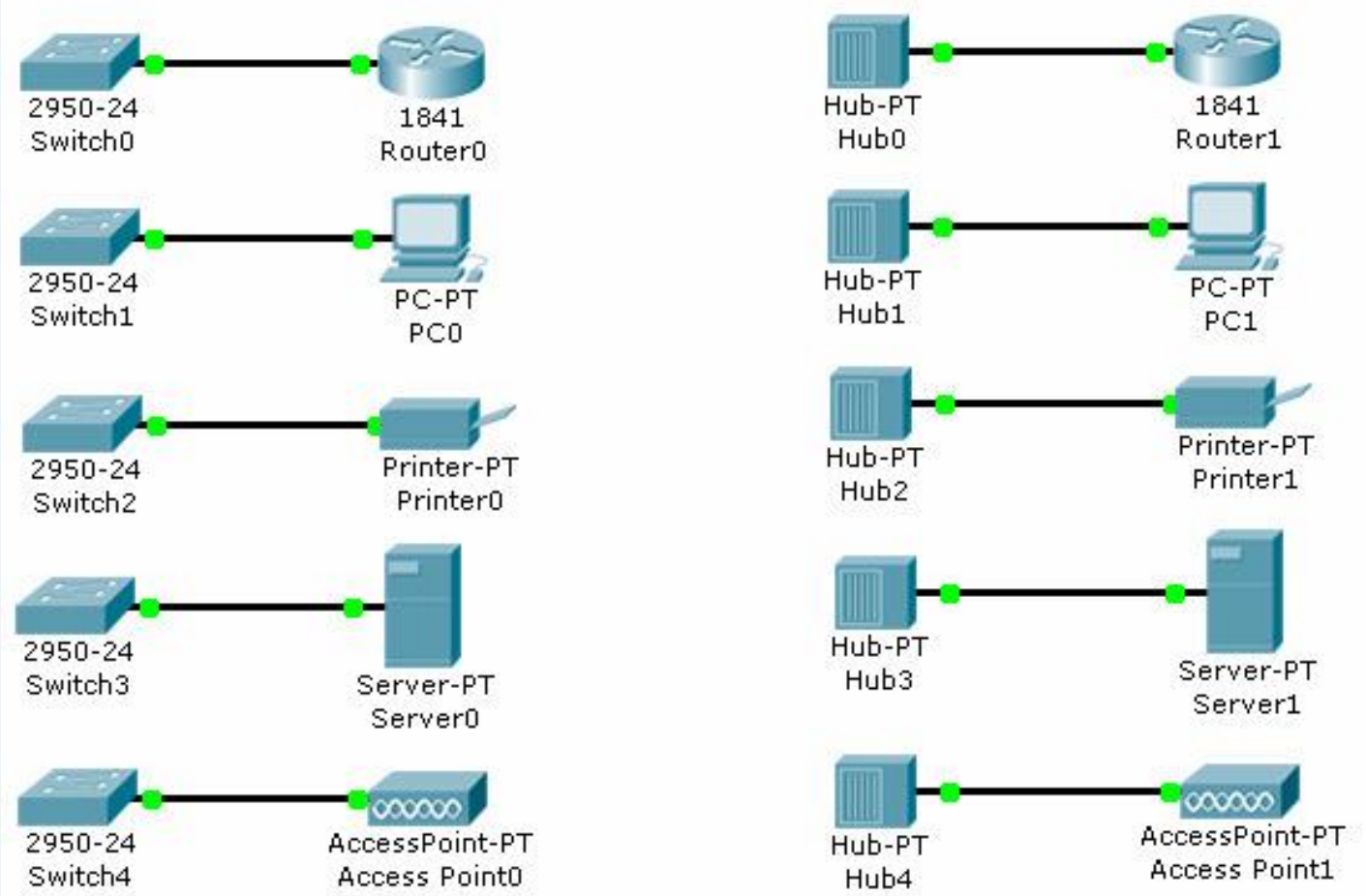


RJ-45 connector



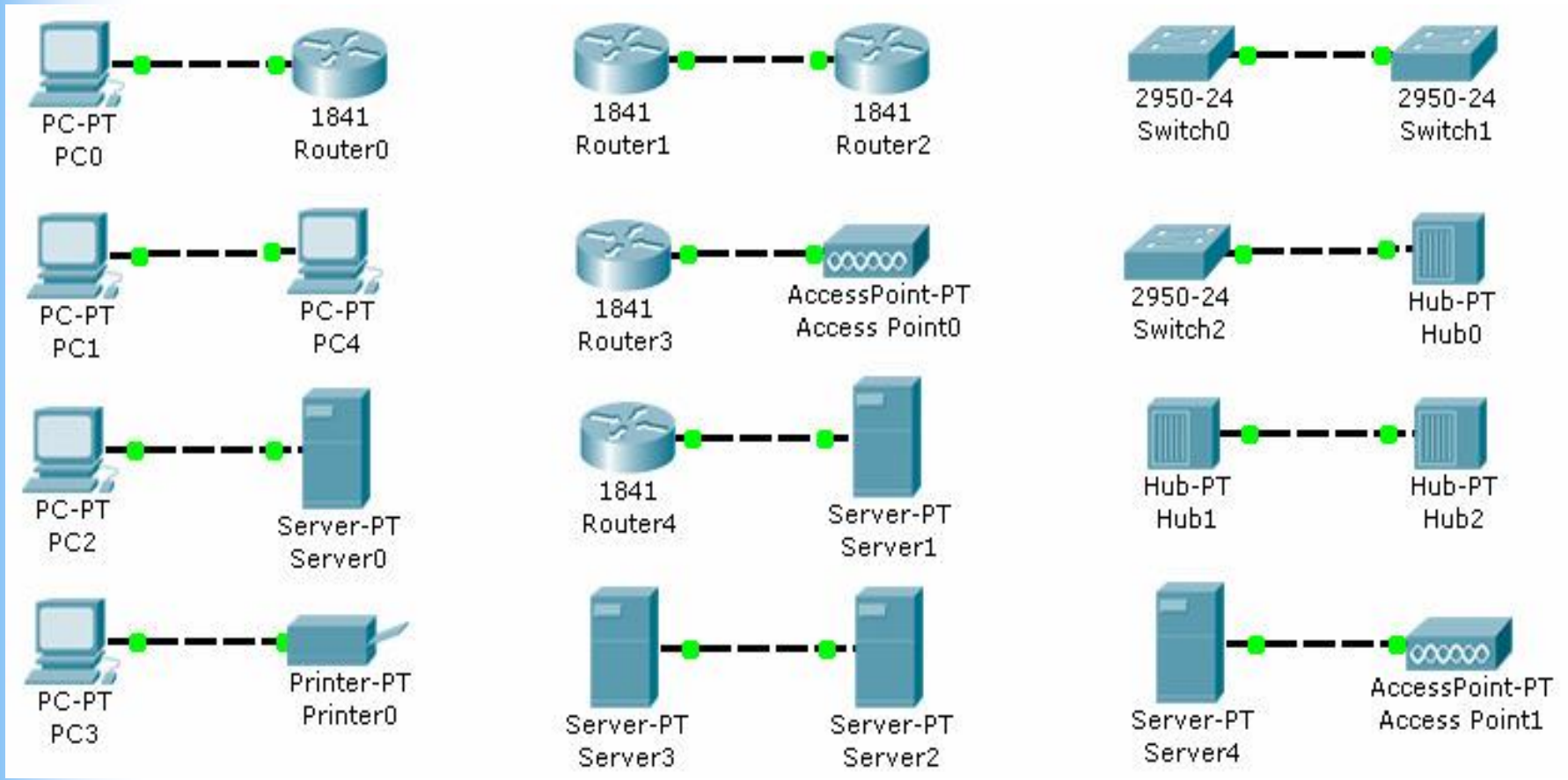
Straight-through cables are used in…

- Straight-through cables are represented by **solid line** in Packet Tracer



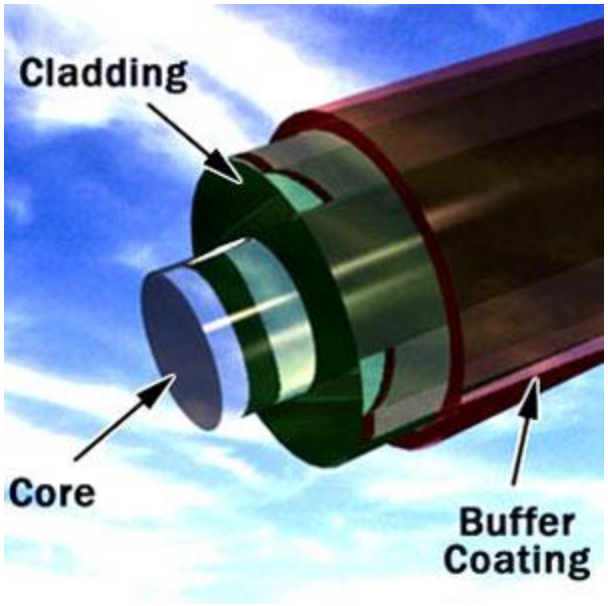
Cross-over cabled are used in…

- Cross-over cables are represented by **dashed line** in Packet Tracer



Fiber Optics

- Optical fibers are used to transmit data using light, which permits transmission over longer distances and at higher bandwidths (data rates) than other forms of communications.
  - Undersea Internet cables are almost all in fiber-optics.
  - Transmit up to tens of gigabits per second.
  - Immune to electromagnetic interference.



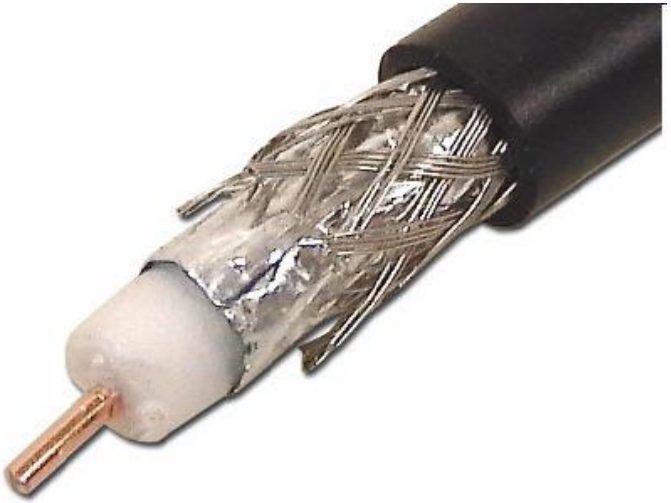
Telephone Cables

- Traditionally used to connect telephones.
- Also used in xDSL modems to connect to phone plug for accessing the Internet.
- Quite similar to Ethernet cable but smaller.

RJ45 (Ethernet) RJ11 (Phone)

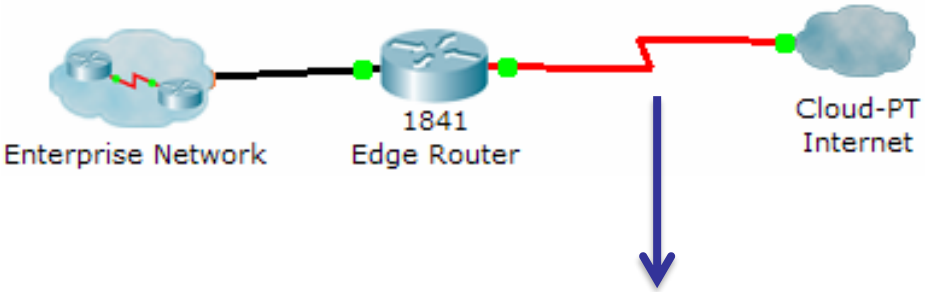
Coaxial Cable

- Traditionally for TV use.
- Also used in connection:
  - from cable modem to cable TV outlet/plug
  - from satellite dish to decoder (Astro)



Serial Cable

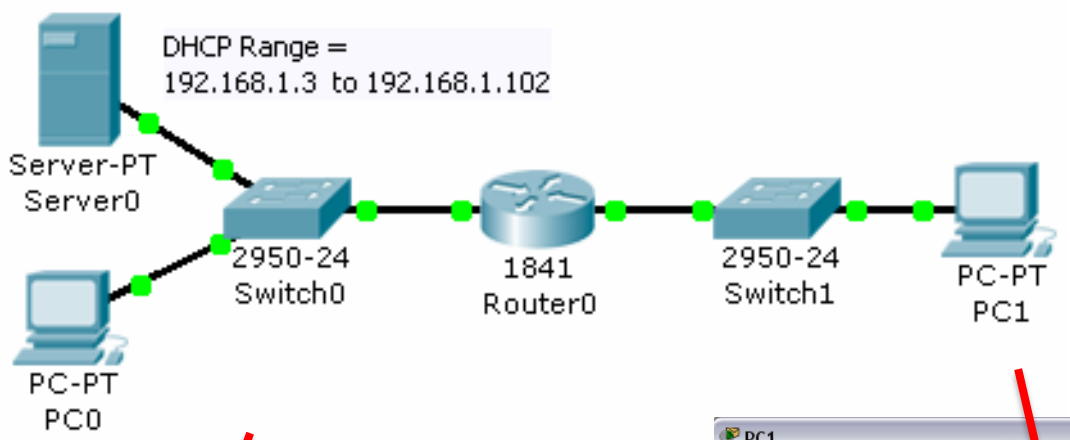
- Used in connecting router of an enterprise network to Internet (via Telephone companies (telco), or Internet service provider (ISP))



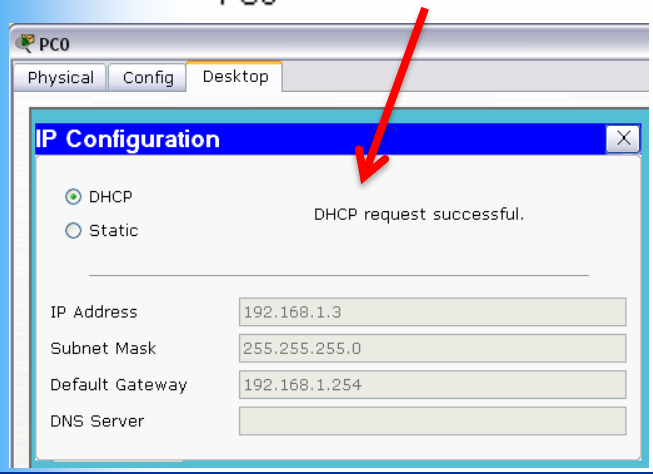
Placement of Services/Servers

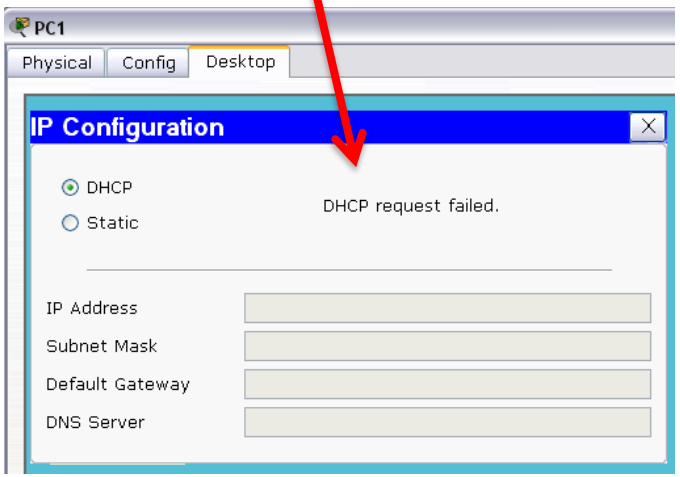
DHCP in a LAN

- DHCP service only works within a LAN
- DHCP service does not function beyond a router unless otherwise configured



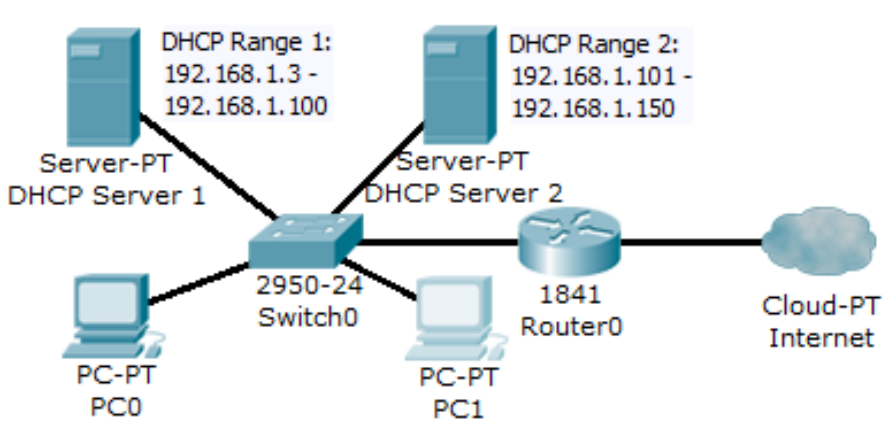
PC1 can't get the dynamic IP from Server0 because Router0 has blocked it.

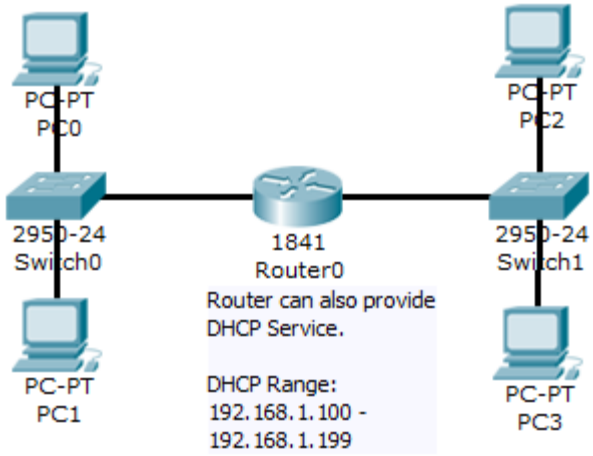




DHCP Server Placement

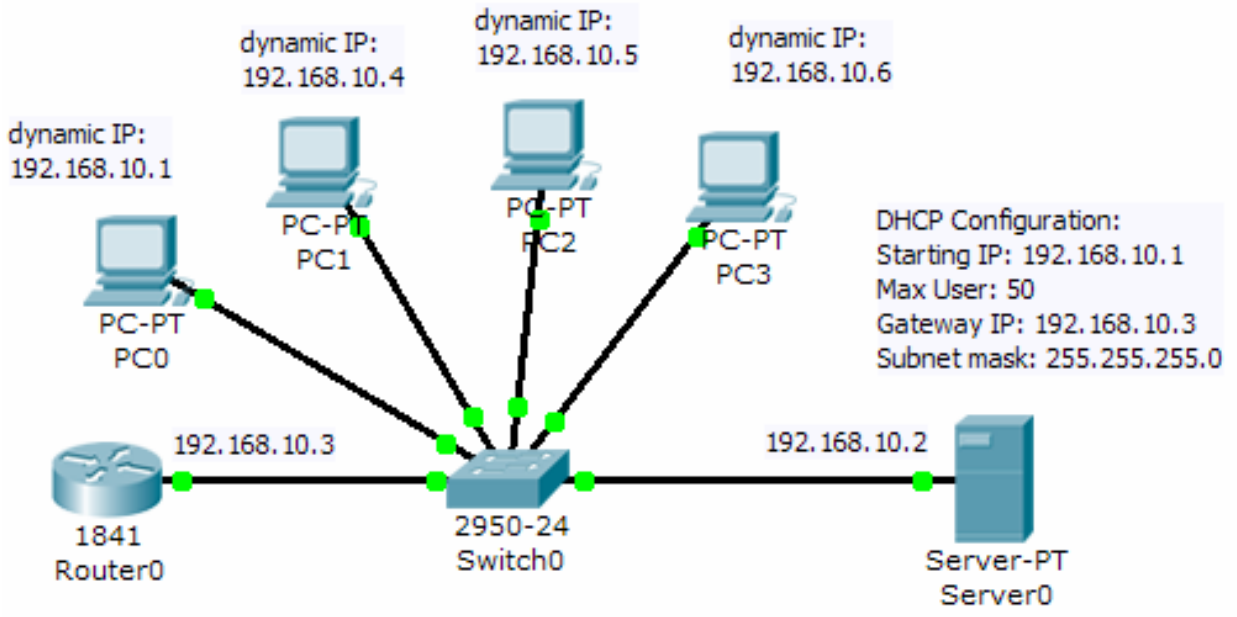
- 1 DHCP server serve 1 LAN
- 2 LANs need 2 DHCP servers (or service).
- Router (and wireless router) can provide DHCP service.
- You can have a few DHCP service within a LAN
  - As long as the DHCP IP range does not clash with each other
  - Will serve as good backup in case one DHCP server fails





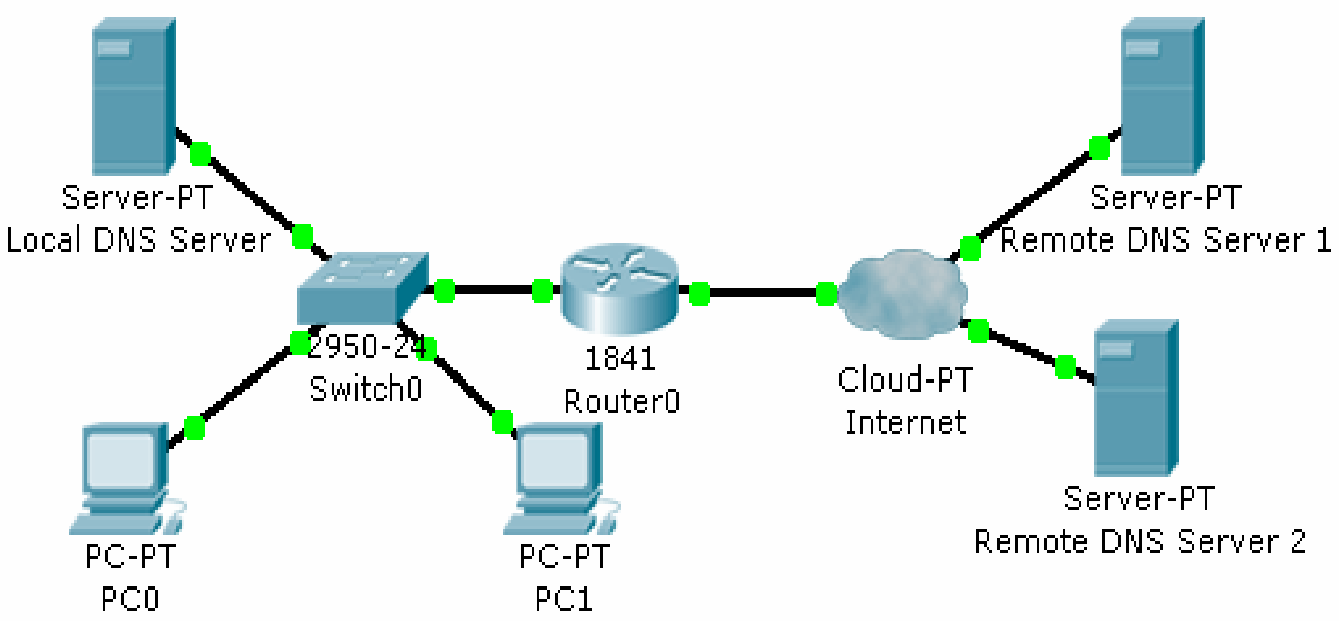
IP Issues on DHCP Service

- **The DHCP servers has to set with static IP!!**
  - You can NOT set the IP of DHCP servers to dynamic IP!!!
- In the following example, the DHCP static IP and gateway IP are in the range of the DHCP service
  - DHCP service can detect it and won't assign duplicate IP in the LAN.



DNS Server

- DNS server can be set within the LAN (local DNS server).
- Unlike DHCP, you can request DNS service beyond your LAN.
- Public DNS servers are a GLOBALLY linked.
  - All the public DNS servers in the world work as “a team” to provide the service to the world.



Local Servers & Remote Servers

- Local servers : servers that are best placed within LAN (or within the enterprise network)
  - TFTP server *
  - DHCP server
  - Print server
  - Security server
- Remote servers: servers that can be accessed across the Internet
  - Email server
  - Web server
  - DNS server
  - FTP server *

* Difference between TFTP & FTP

- Both FTP and TFTP are file services
- TFTP (trivial file transfer protocol)
  - Unsecured, no login and password
  - As a LAN backup file server
  - Best not to be assessed across the Internet
  - Not widely deployed.
- FTP
  - Secured, with login and password
  - sftp (secure ftp), where login, password, and data are encrypted.
  - For Internet access.