

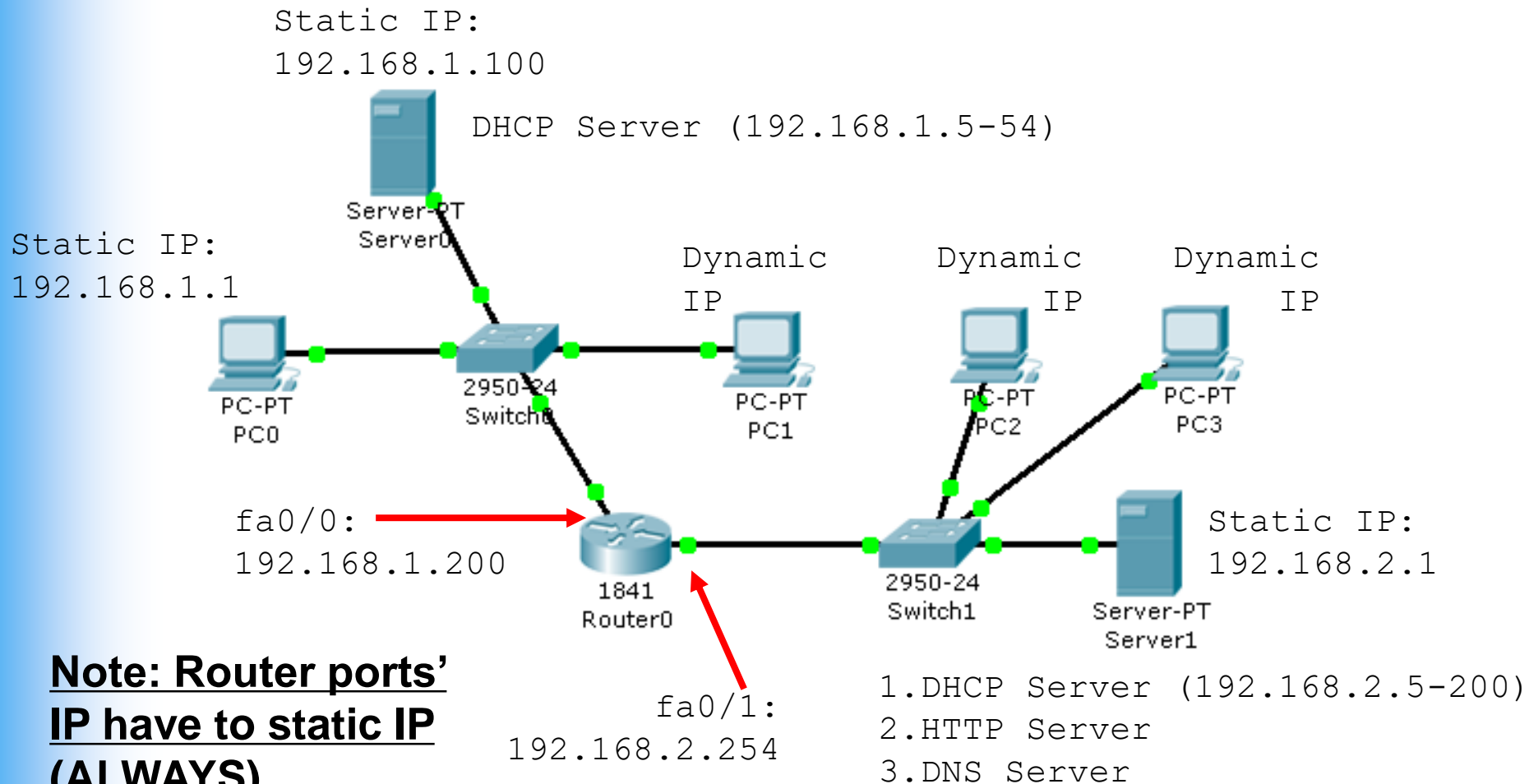
UEEN2013/UEEN2423

TCP/IP Network Fundamentals

(Topic 02)

Managing an Internetwork

IP Address Design Plan

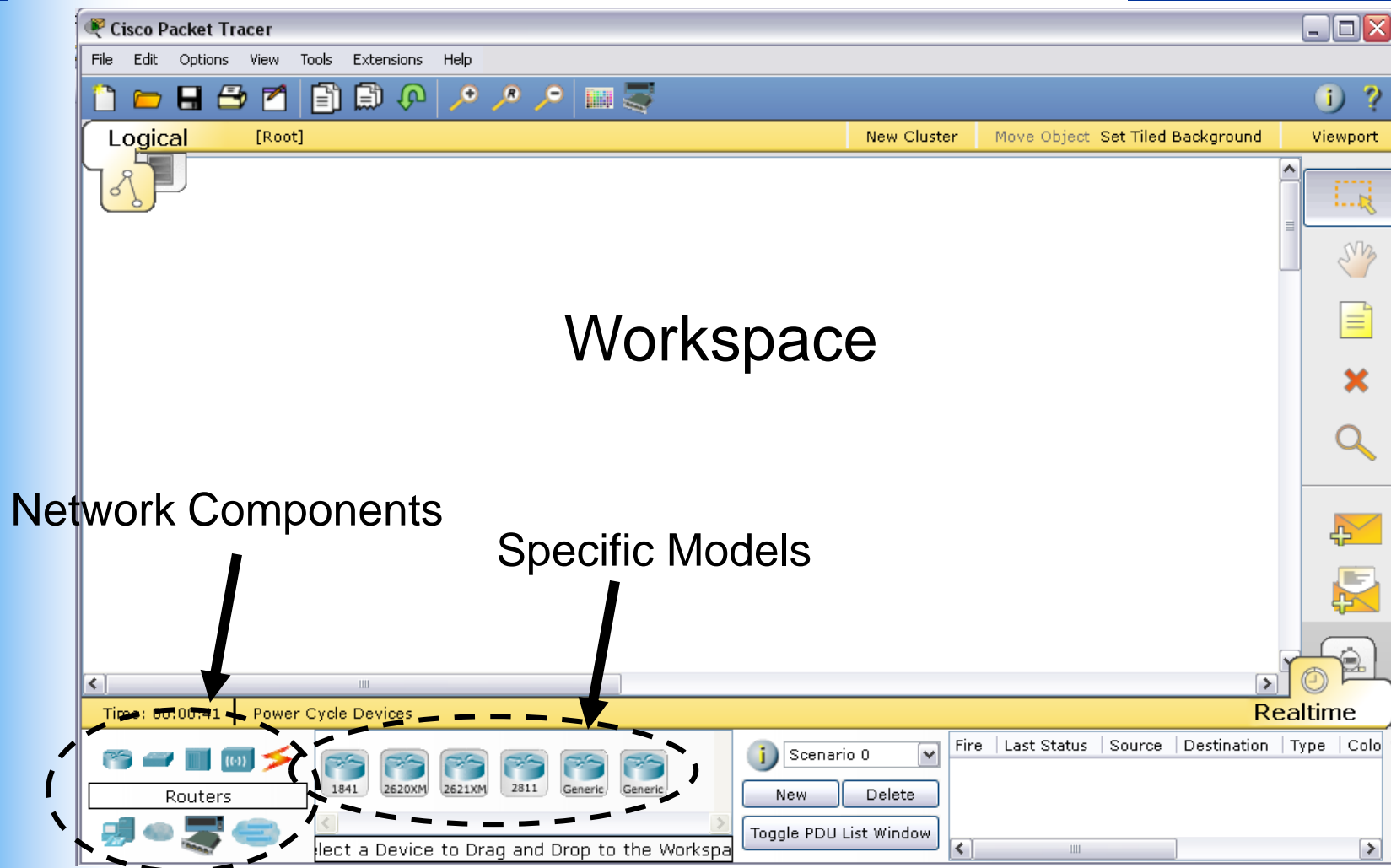


Note: Router ports' IP have to static IP (ALWAYS)

Building your first LAN in Packet Tracer

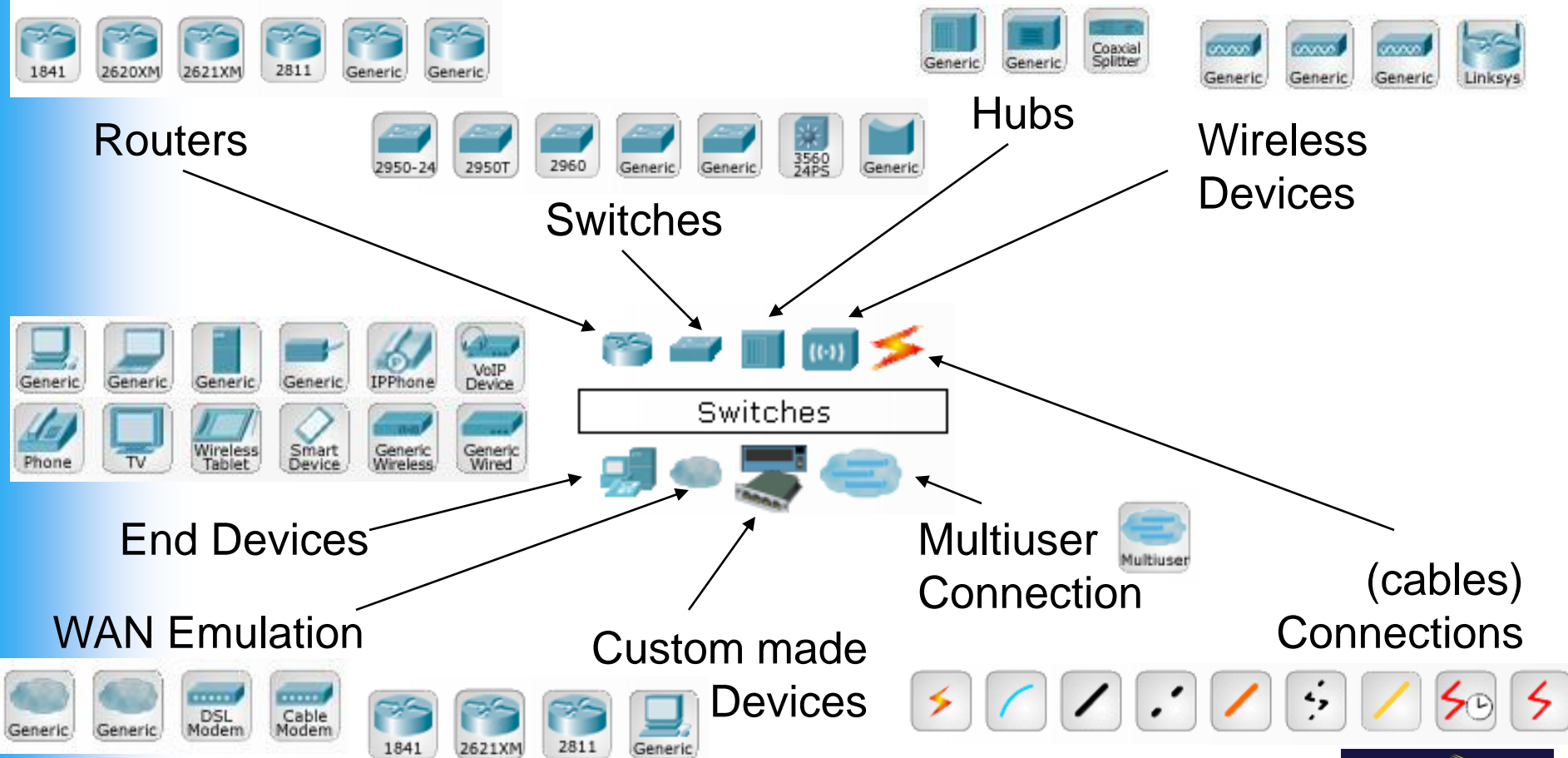
Your first guide on Packet Tracer
Forming a simple LAN
step by step

When you Open Your Packet Tracer

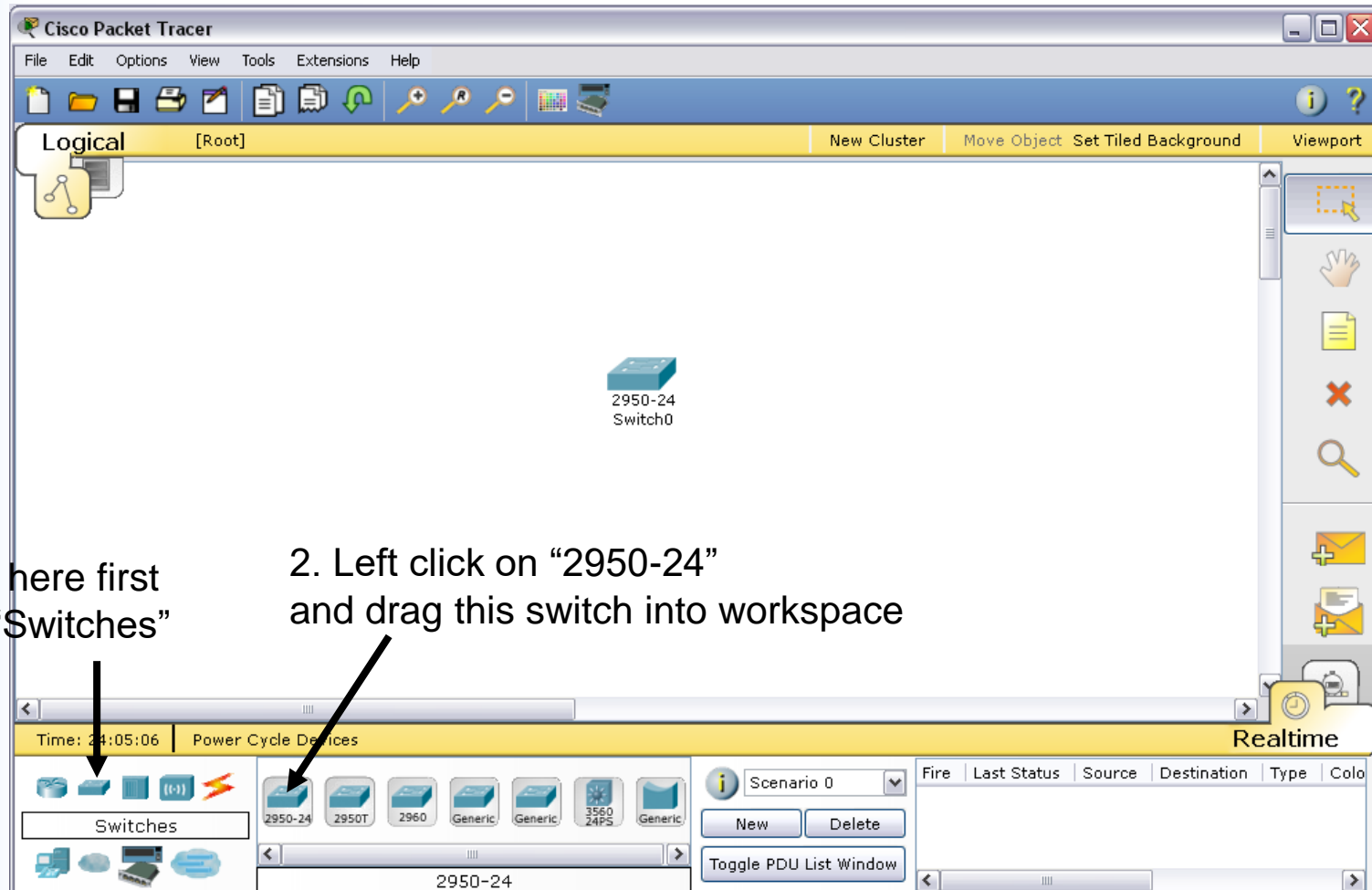


Network Components

- Network components in Packet Tracer 5.3



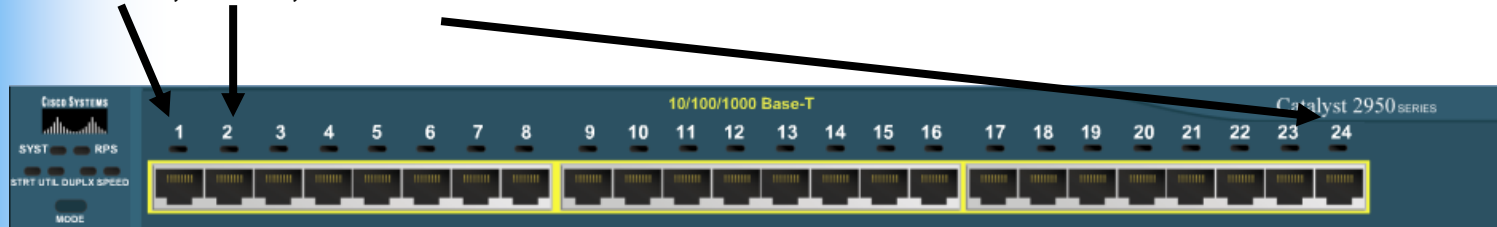
Switch



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



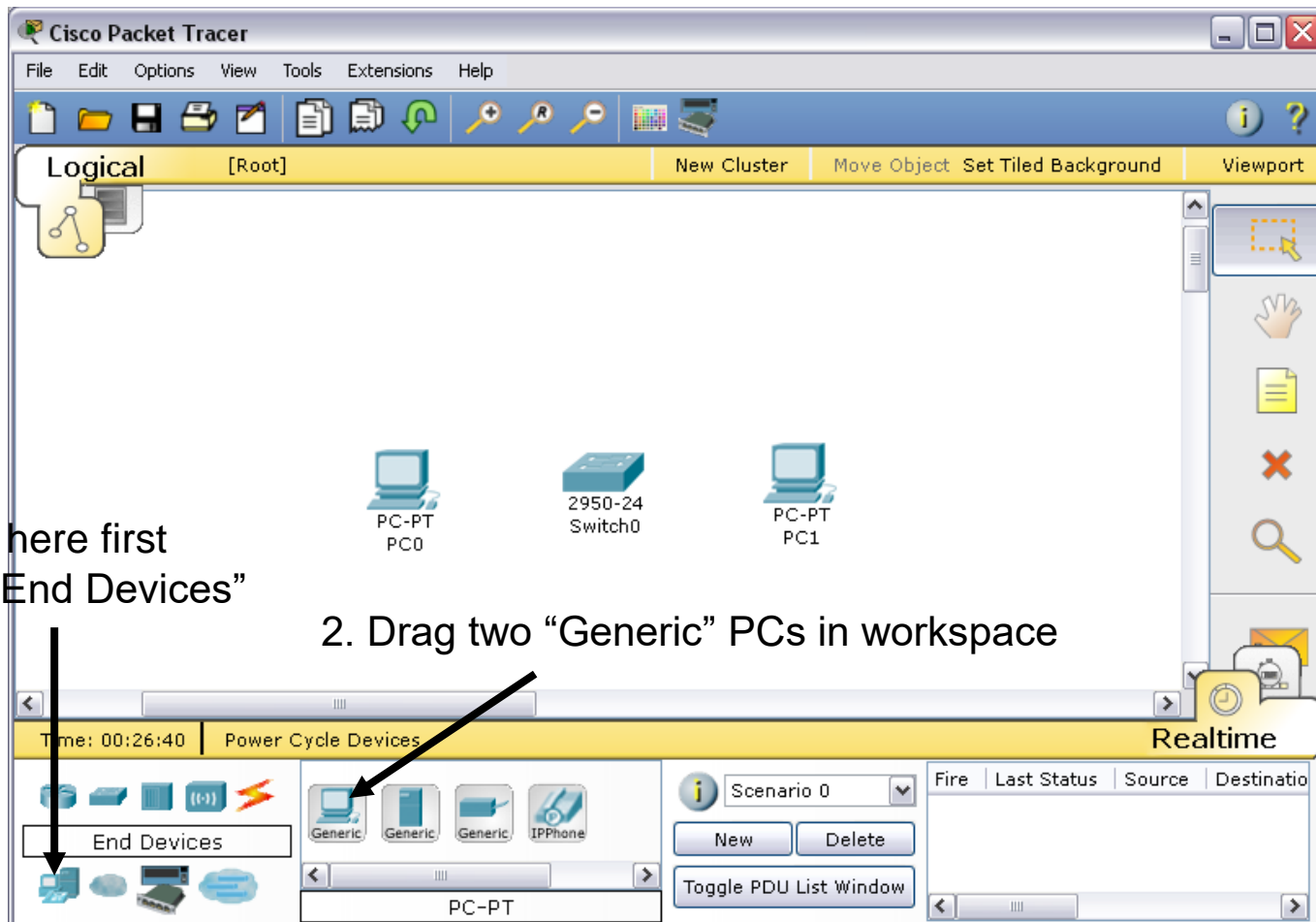
switch ports



PC

1. Click here first
to get "End Devices"

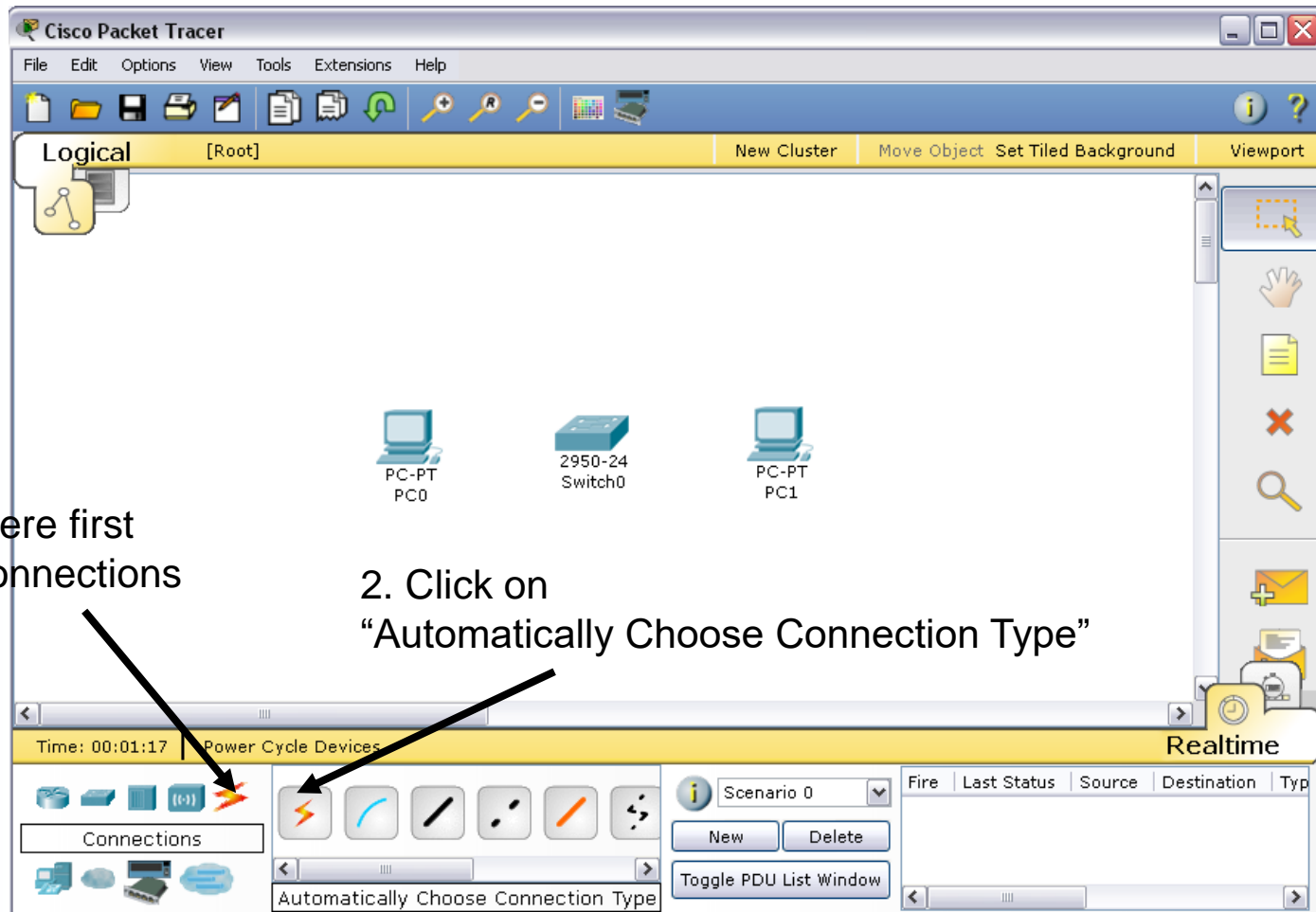
2. Drag two "Generic" PCs in workspace



Connection - 1

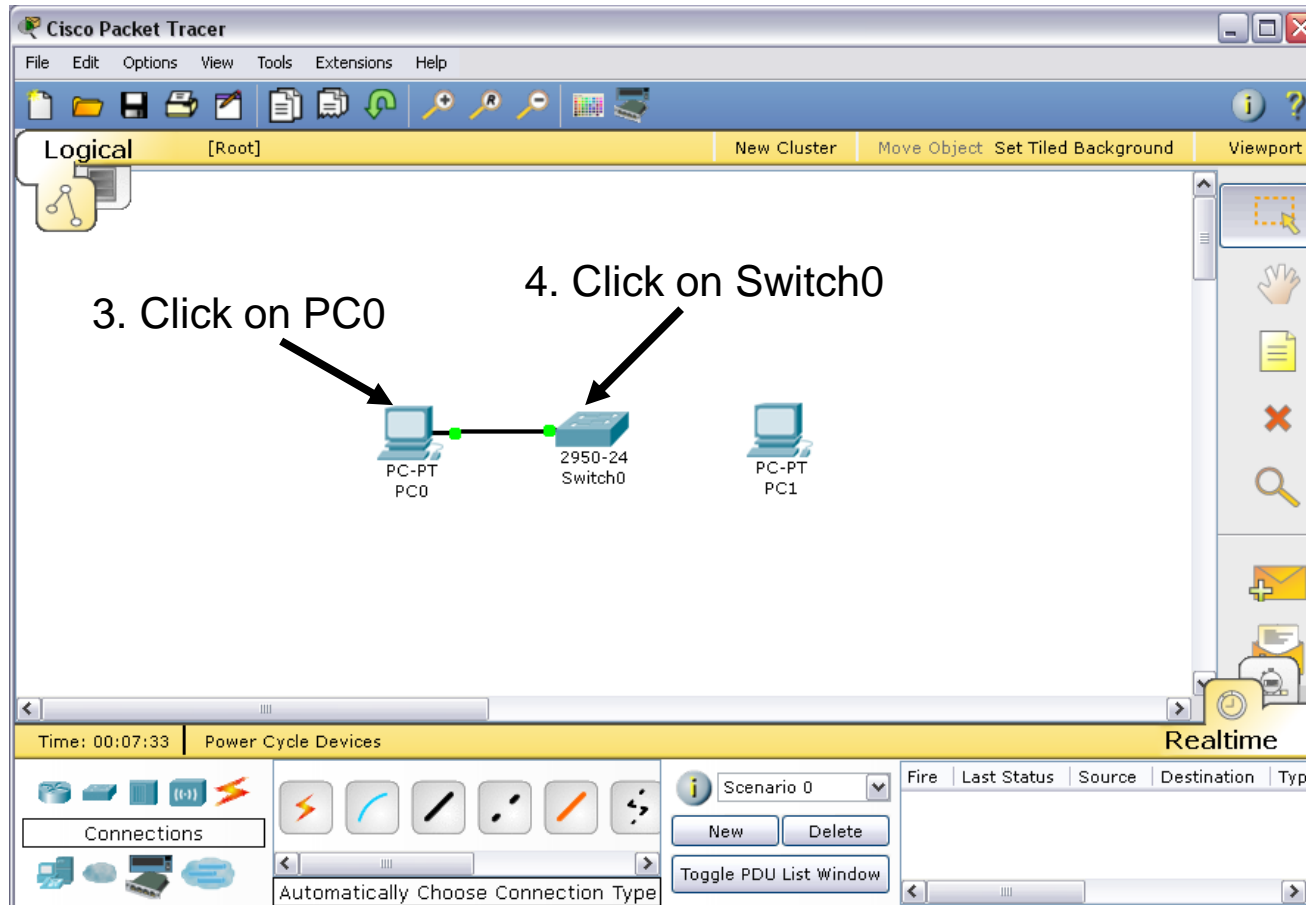
1. Click here first
to get Connections

2. Click on
“Automatically Choose Connection Type”



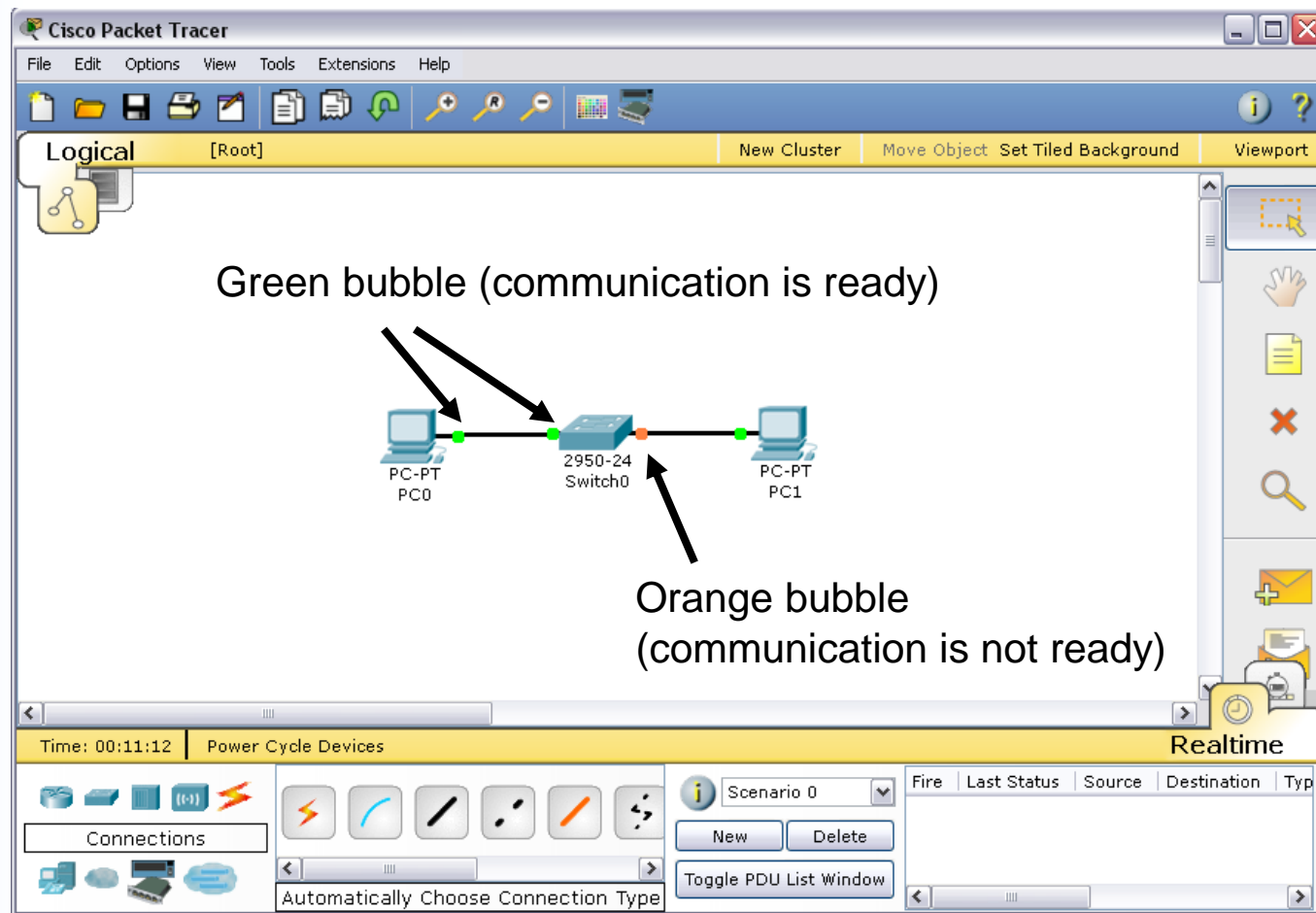
Connection - 2

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



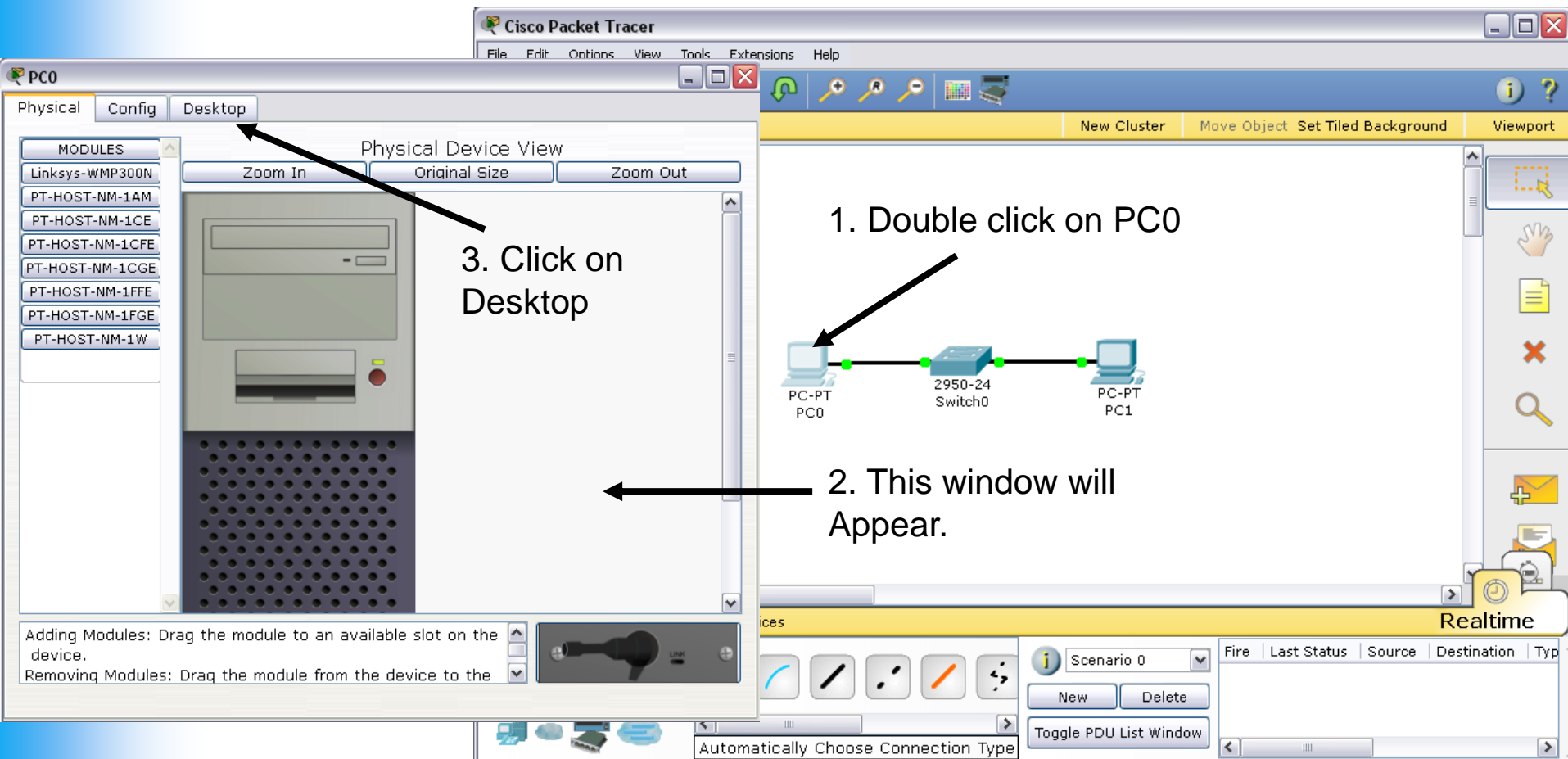
Connection - 3

- Wait for the little orange bubble to turn green.



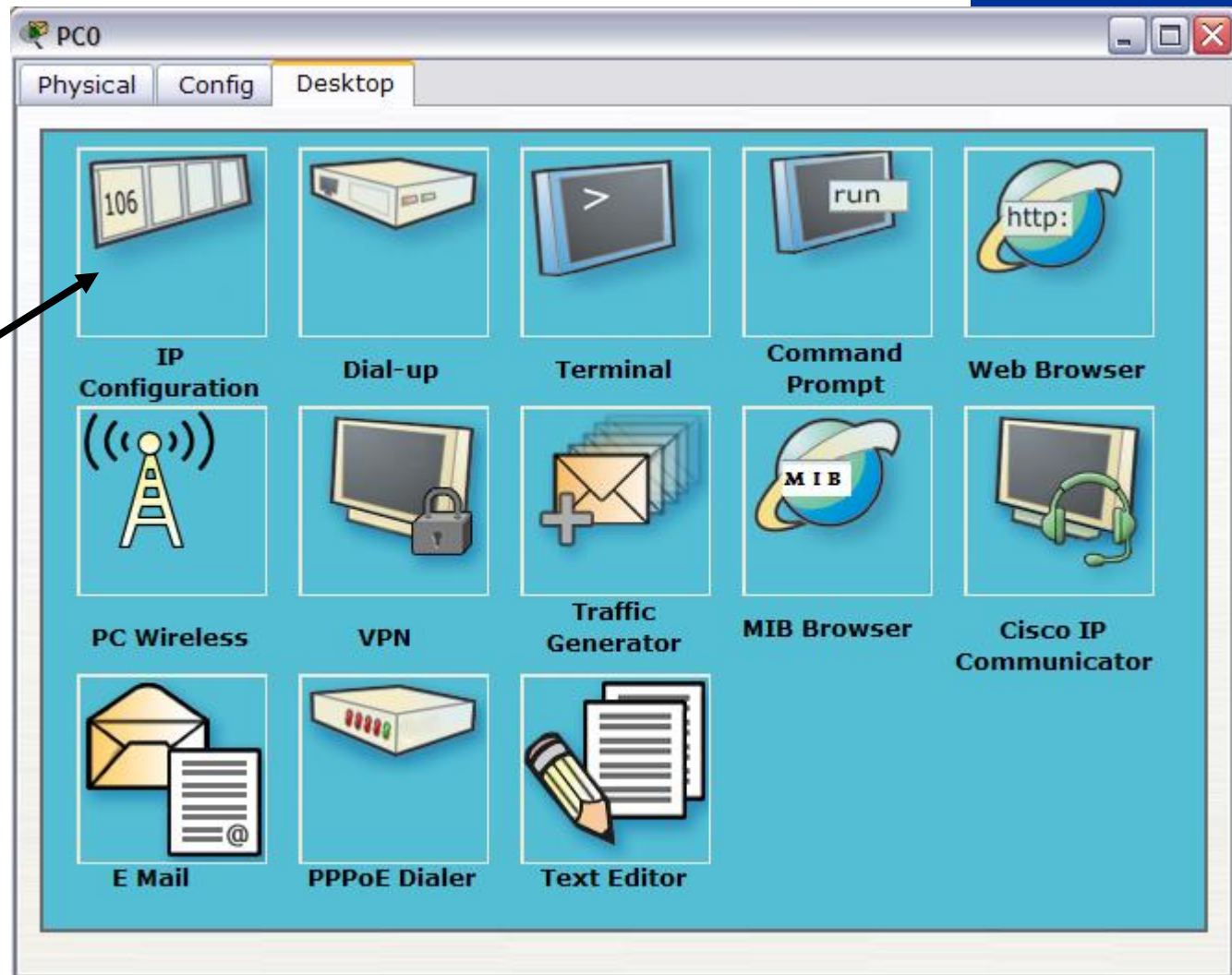
Configuring the PC - 1

- Double click on PC0 to call out the PC0 window

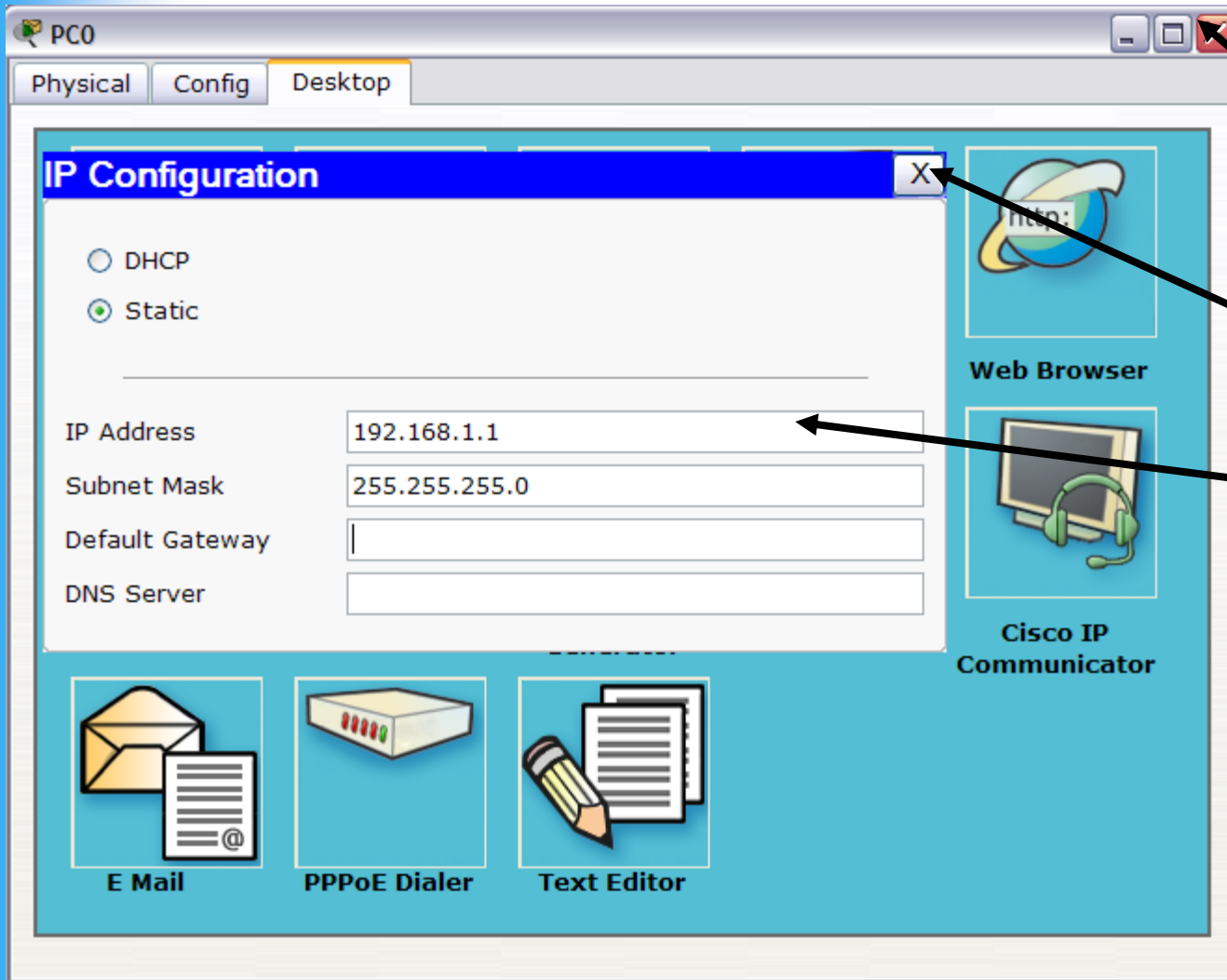


Configuring the PC - 2

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

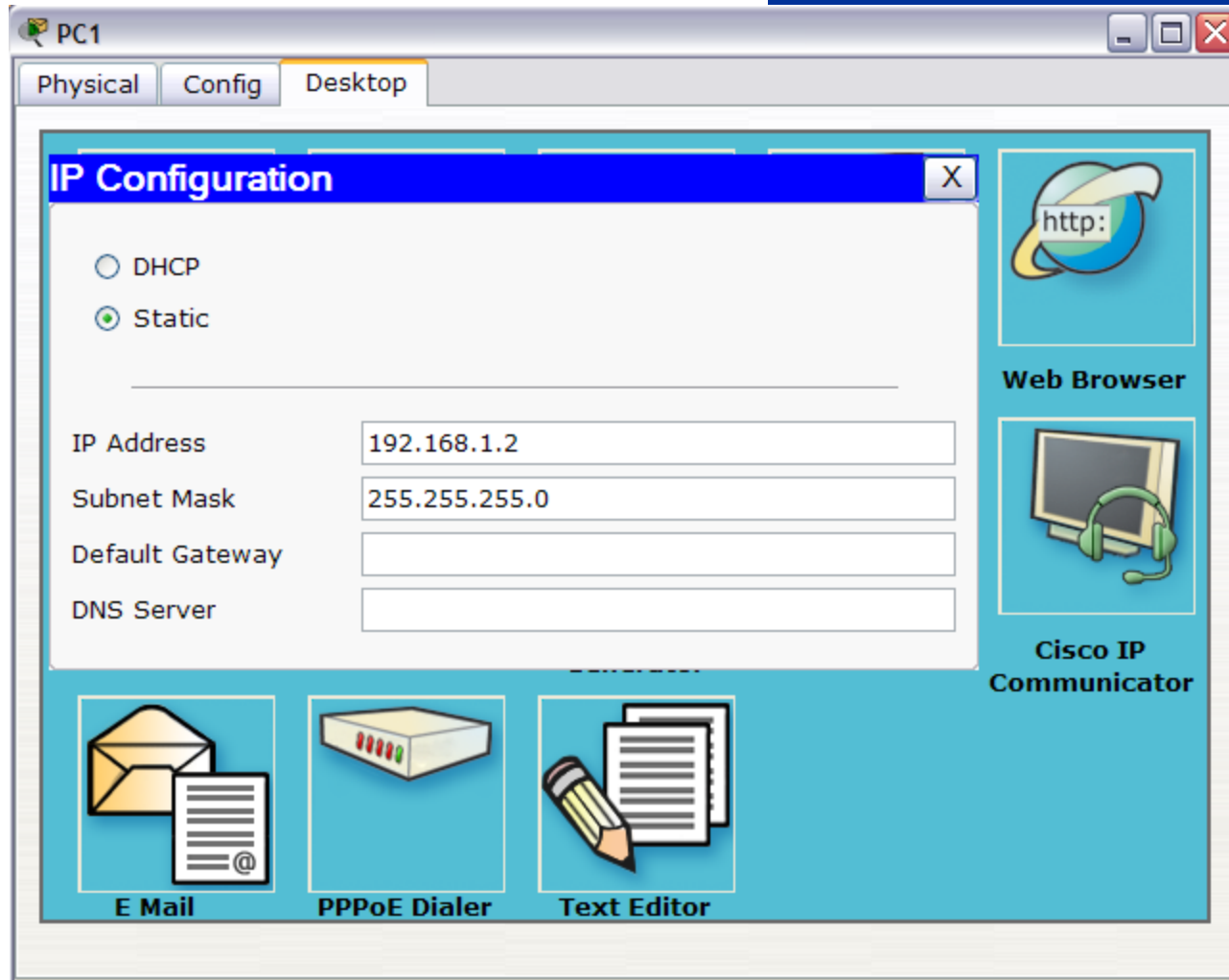
5. Enter 192.168.1.1

6. Press Tab key

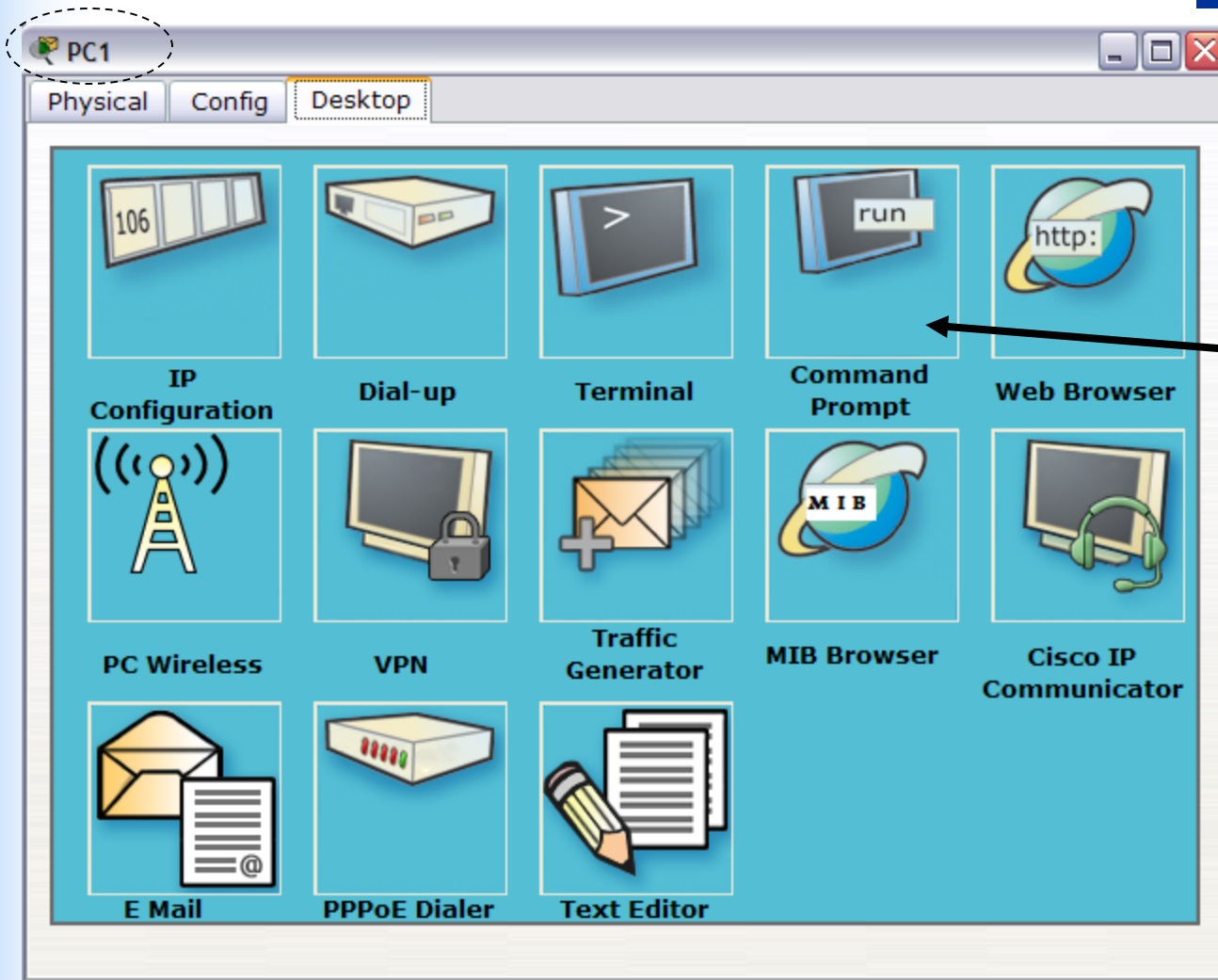
7. 255.255.255.0 will automatically appear

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

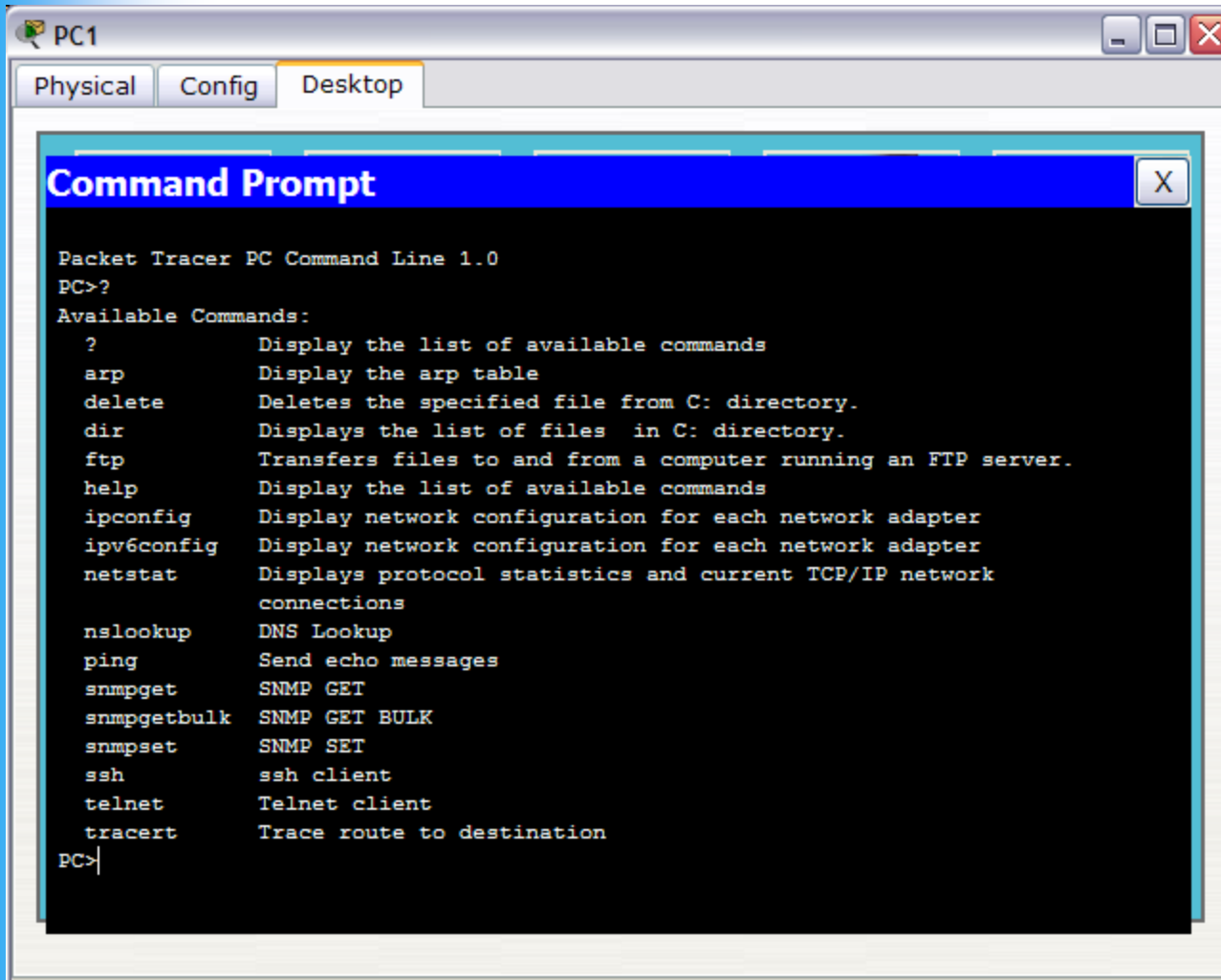


Testing connectivity - 1



1. Click on
Command Prompt

Available Commands in PC



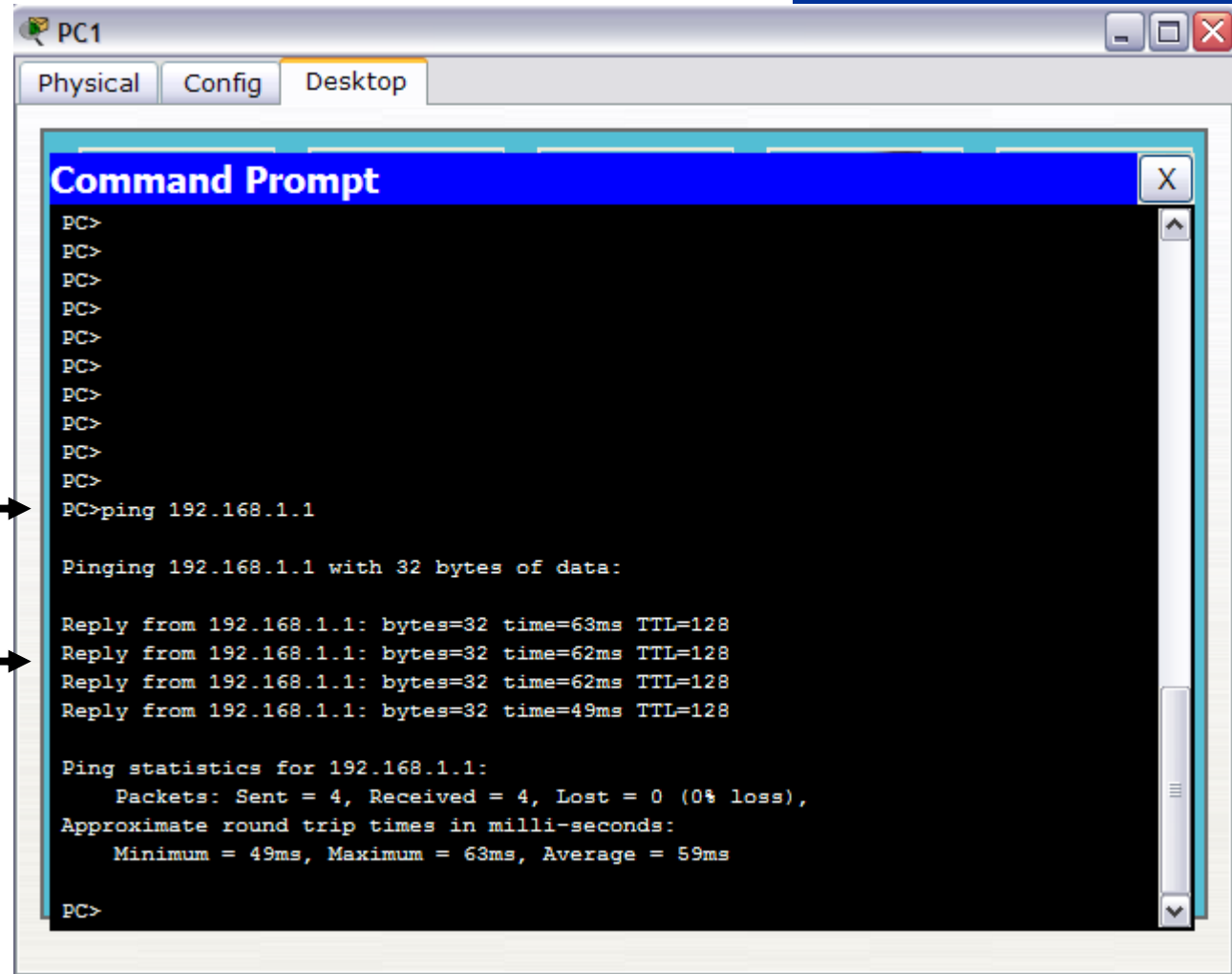
- Command prompt in PC of Packet tracer resembles the real life but with limited sets of commands.

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.



The screenshot shows a PC1 desktop environment with three tabs: Physical, Config, and Desktop. The Desktop tab is active, displaying a Command Prompt window. The Command Prompt shows the following text:

```
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>  
PC>ping 192.168.1.1  
  
Pinging 192.168.1.1 with 32 bytes of data:  
  
Reply from 192.168.1.1: bytes=32 time=63ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=62ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=62ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=49ms TTL=128  
  
Ping statistics for 192.168.1.1:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 49ms, Maximum = 63ms, Average = 59ms  
  
PC>
```

DHCP Server in Your LAN

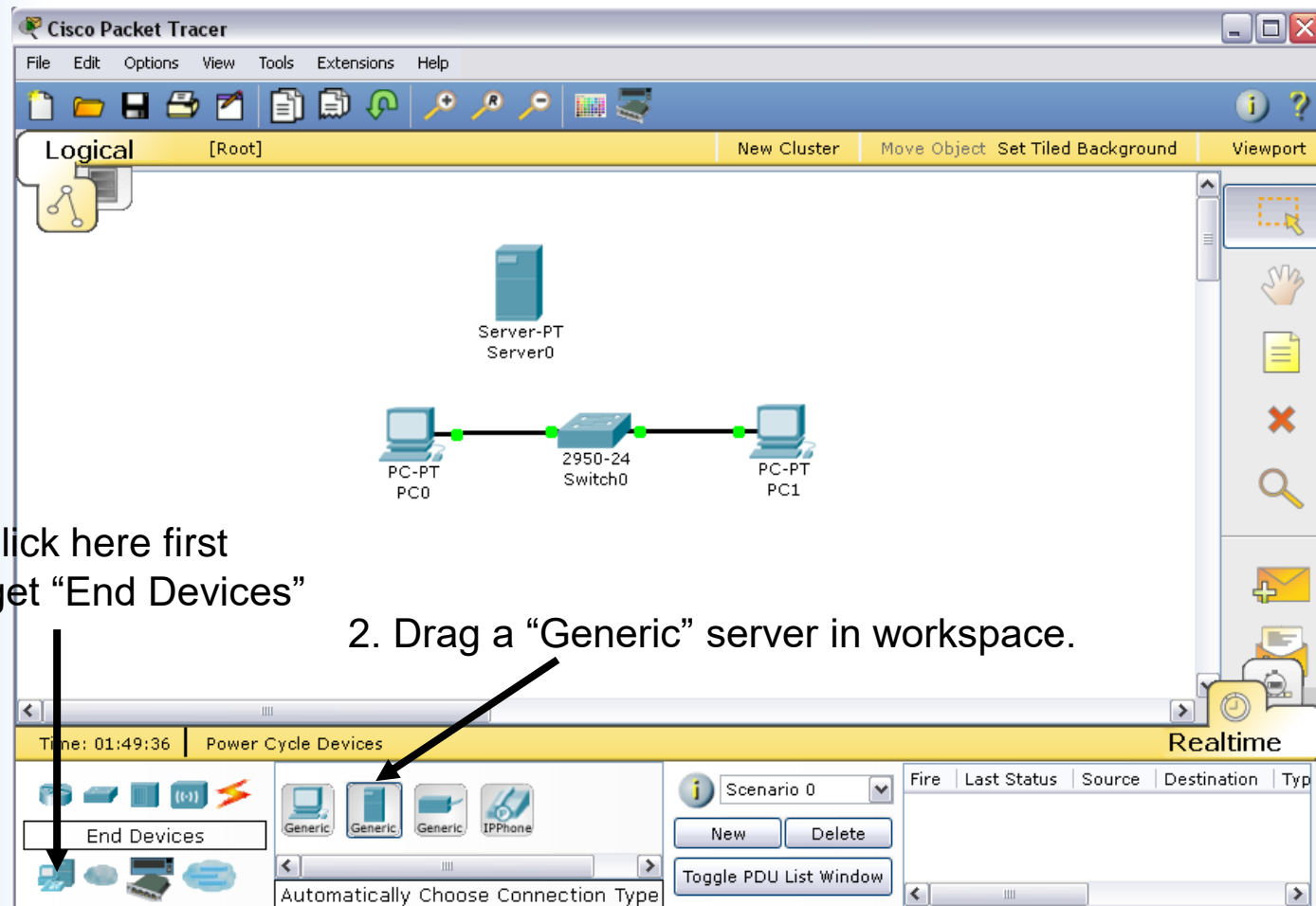
*Adding a DHCP server to your LAN
step by step*

Server

- Drag a server in your “existing” LAN

1. Click here first
to get “End Devices”

2. Drag a “Generic” server in workspace.



Make Connection

- Connect Server0 to Switch0.

The screenshot shows the Cisco Packet Tracer interface in the Logical tab. The network diagram includes a Server-PT (Server0), a 2950-24 Switch0, and two PC-PT (PC0 and PC1). The interface has a menu bar (File, Edit, Options, View, Tools, Extensions, Help) and a toolbar with various icons. The bottom panel shows the 'Connections' button, the 'Automatically Choose Connection Type' button, and a 'Realtime' section with a 'Scenario 0' dropdown and 'New' and 'Delete' buttons. Annotations with arrows point to these buttons and the connection point between Server0 and Switch0.

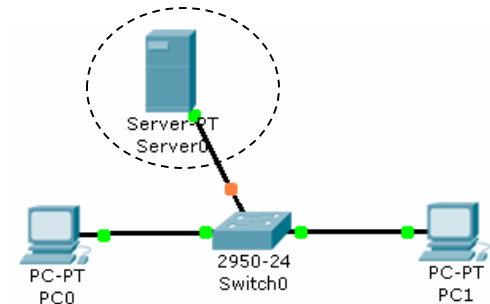
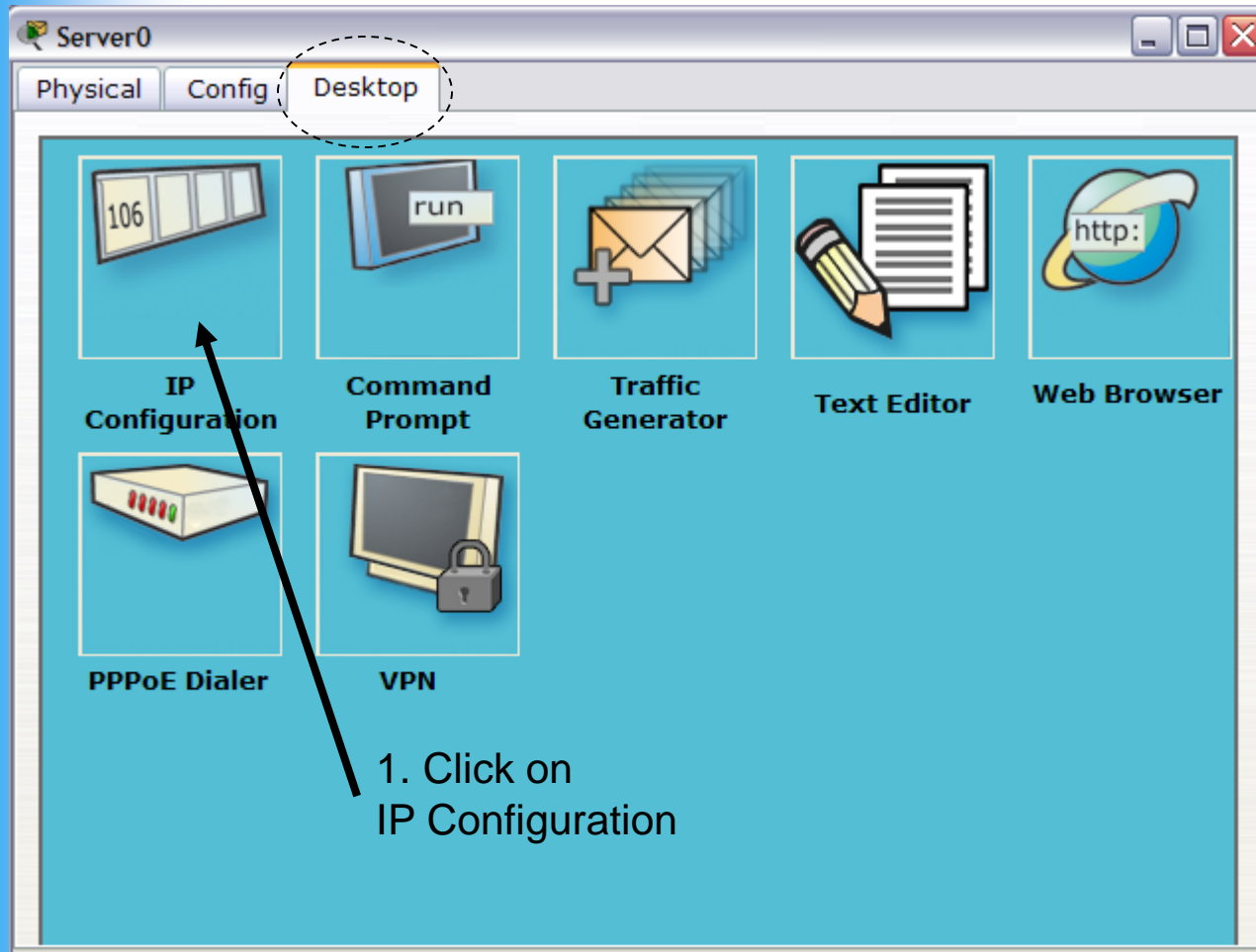
1. Click here first to get Connections

2. Click on "Automatically Choose Connection Type"

3. Click on Server0 and then Switch0 to make a connection.

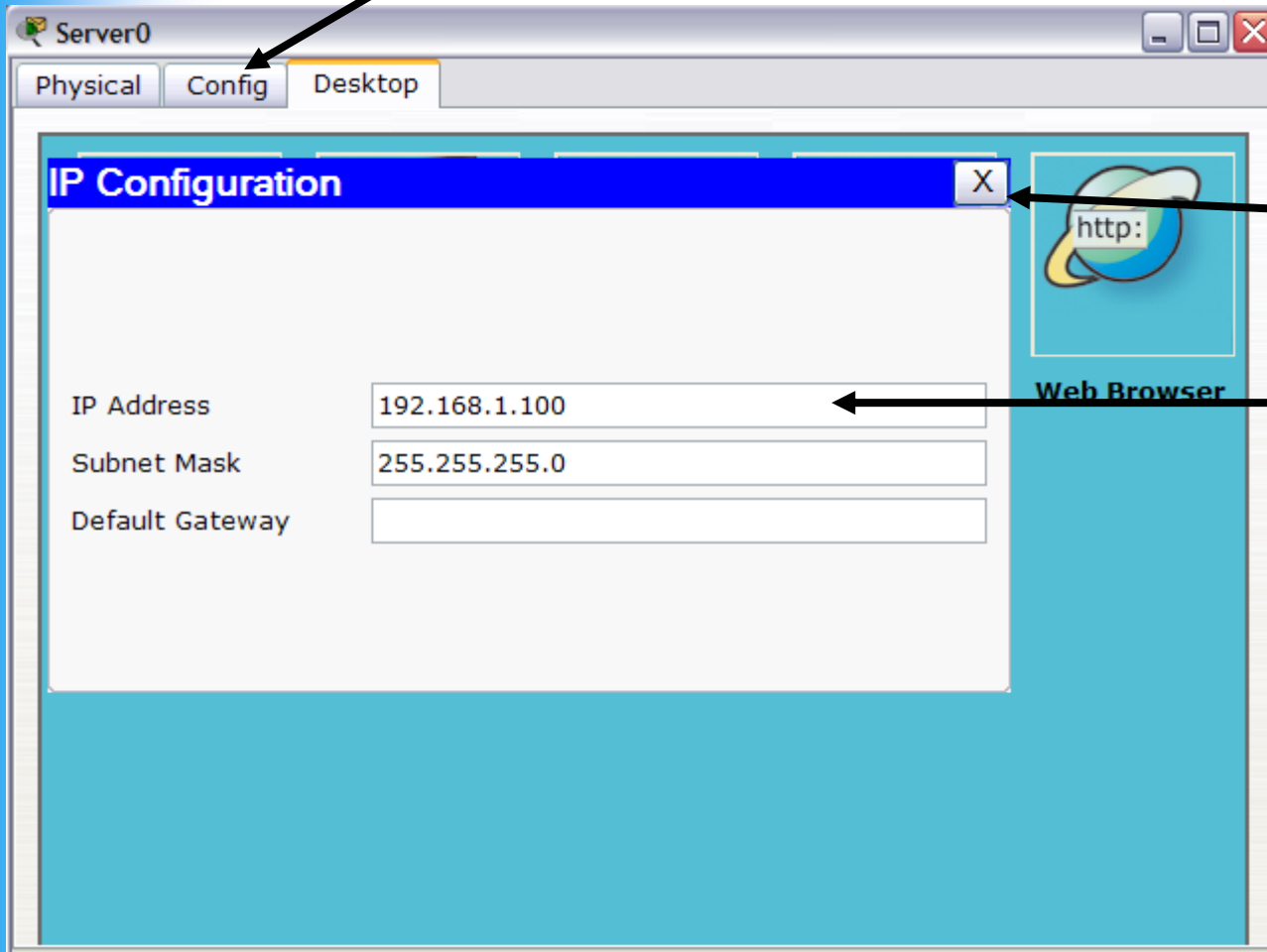
Configuring IP for Server - 1

- 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



The screenshot shows a configuration window for 'Server0' with three tabs: 'Physical', 'Config', and 'Desktop'. The 'Config' tab is active. On the left, there is a sidebar with a tree view containing 'GLOBAL' (with sub-items 'Settings' and 'Algorithm Settings'), 'SERVICES' (with sub-items 'HTTP', 'DHCP', 'TFTP', 'DNS', 'SYSLOG', 'AAA', 'NTP', 'EMAIL', 'FTP'), and 'INTERFACE' (with sub-item 'FastEthernet'). The 'DHCP' service is selected. The main area is titled 'Global Settings' and contains two sections: 'Gateway/DNS' and 'Gateway/DNS IPv6'. In the 'Gateway/DNS' section, the 'Static' radio button is selected, and there are input fields for 'Gateway' and 'DNS Server'. In the 'Gateway/DNS IPv6' section, the 'Static' radio button is also selected, and there are input fields for 'IPv6 Gateway' and 'IPv6 DNS Server'.

Setting DHCP service - 2

Server0

Physical Config Desktop

GLOBAL

Settings

Algorithm Settings

SERVICES

HTTP

DHCP

TFTP

DNS

SYSLOG

AAA

NTP

EMAIL

FTP

INTERFACE

FastEthernet

DHCP

Service ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 0.0.0.0

DNS Server: 0.0.0.0

Start IP Address: 192 168 1 5

Subnet Mask: 255 255 255 0

Maximum number of Users: 50

TFTP Server: 0.0.0.0

Add Save Remove

Pool Name	Default Gat	DNS Ser	Start IP Ad	Subnet Mask	Max Nu
serverPool	0.0.0.0	0.0.0.0	192.168.1.5	255.255.255.0	50

- 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

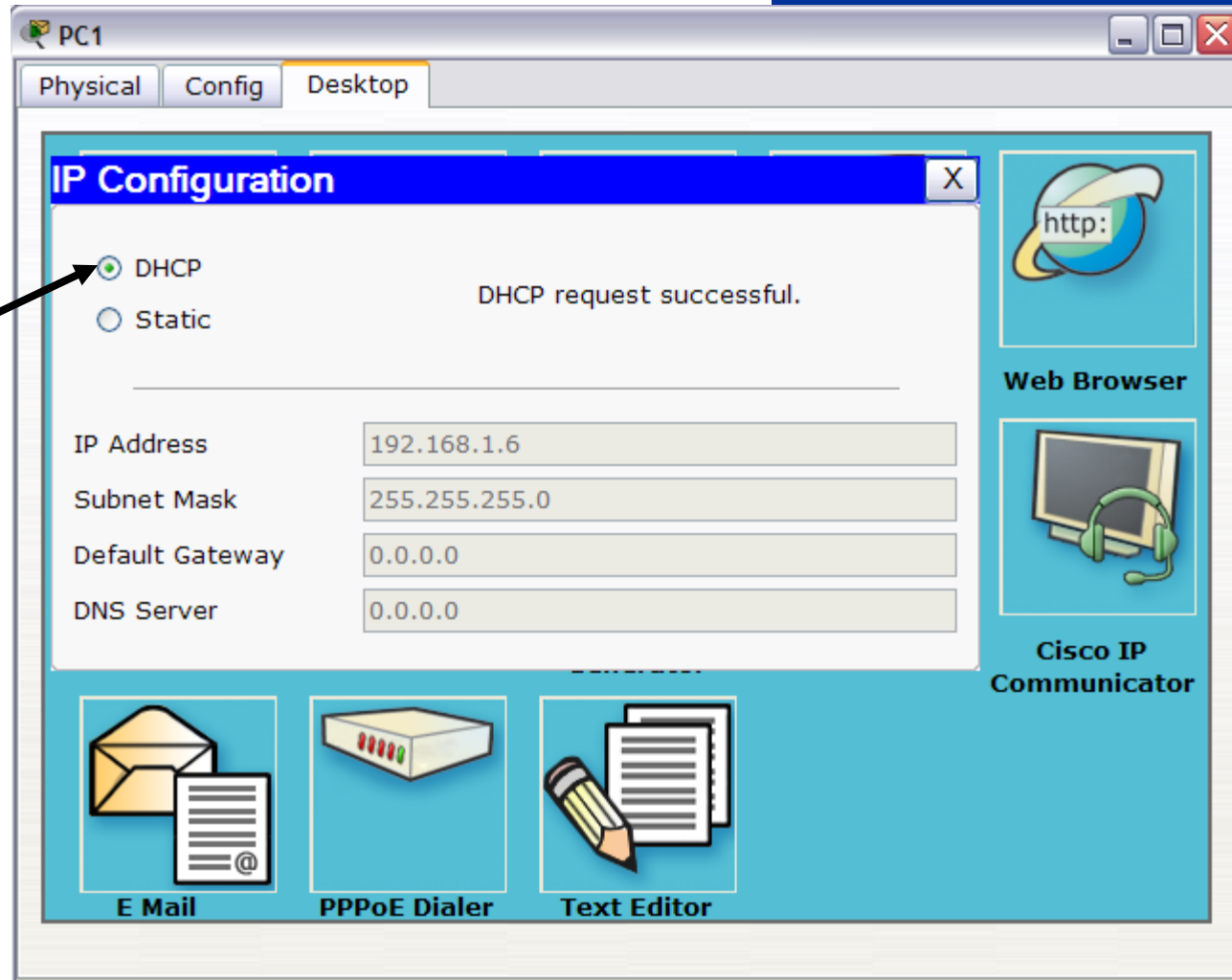
5. If your DHCP is set correctly, you will obtain a dynamic IP

4. Click on DHCP

3. Click on IP Configuration

2. PC1 windows pop up, click Desktop tab.

1. Double click on PC1

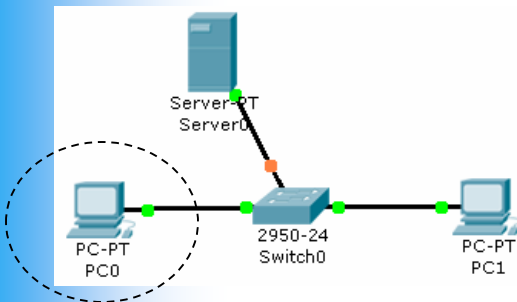
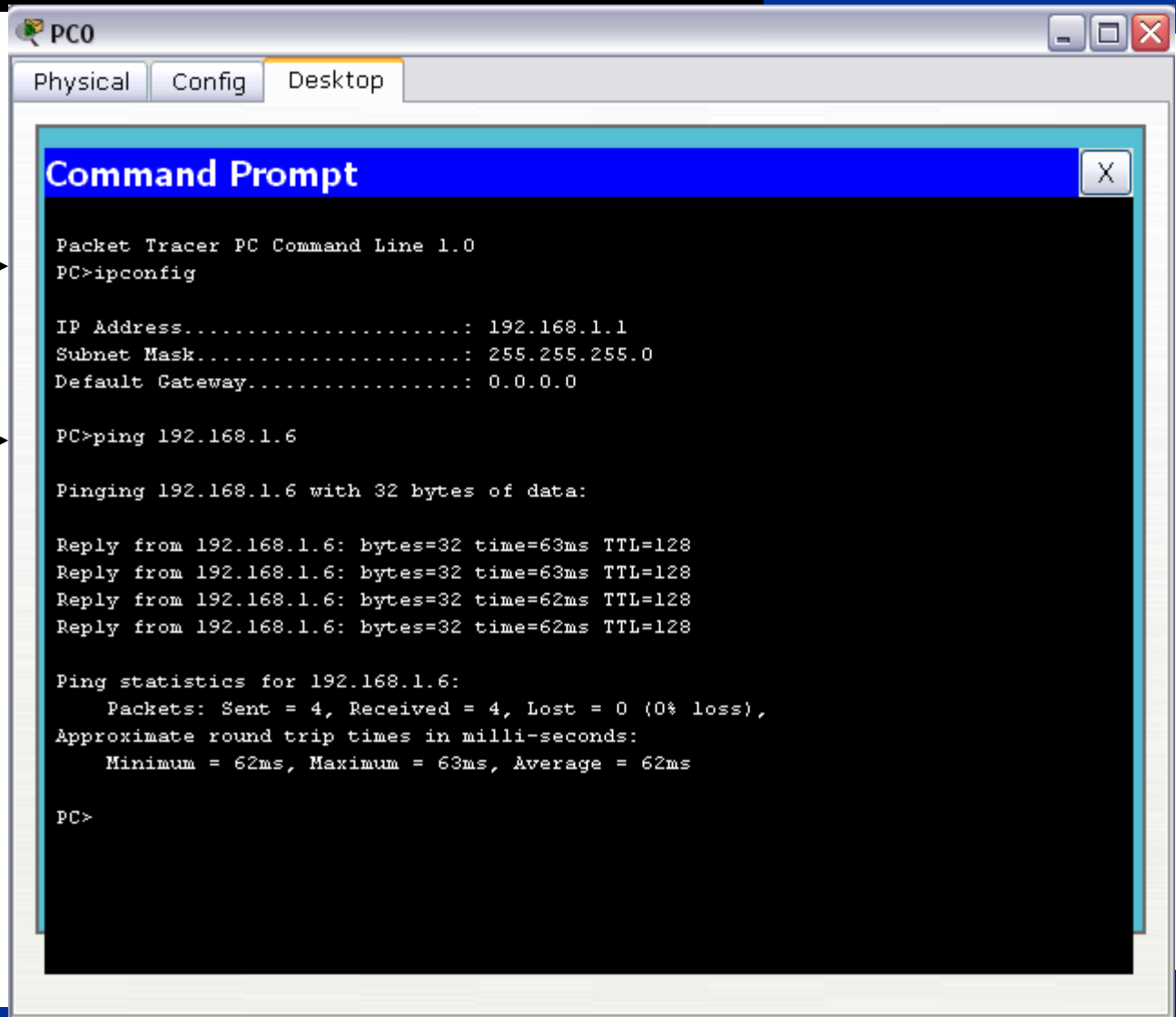


Testing PC1 from PC0

1. Go to command prompt of PC0

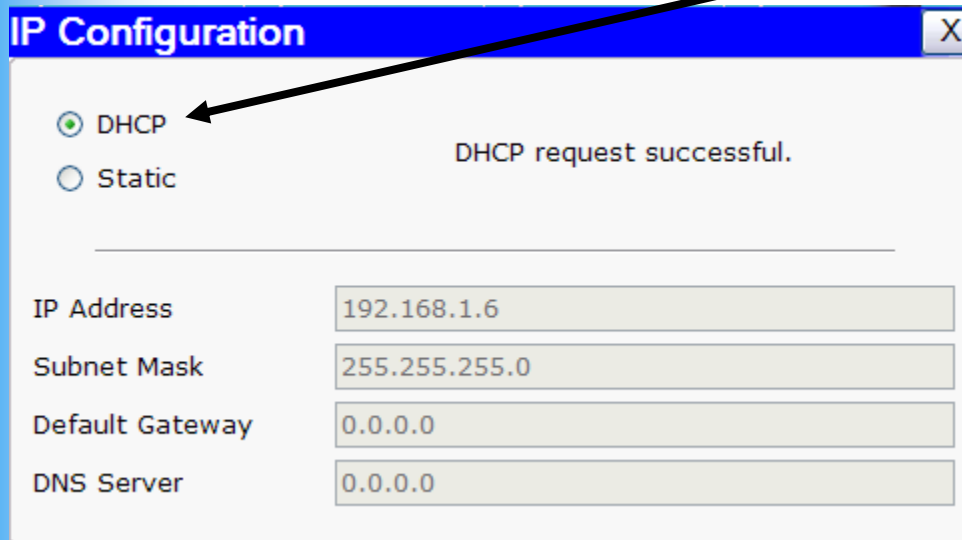
2. Type "ipconfig" to check the IP of PC0

3. Ping PC1



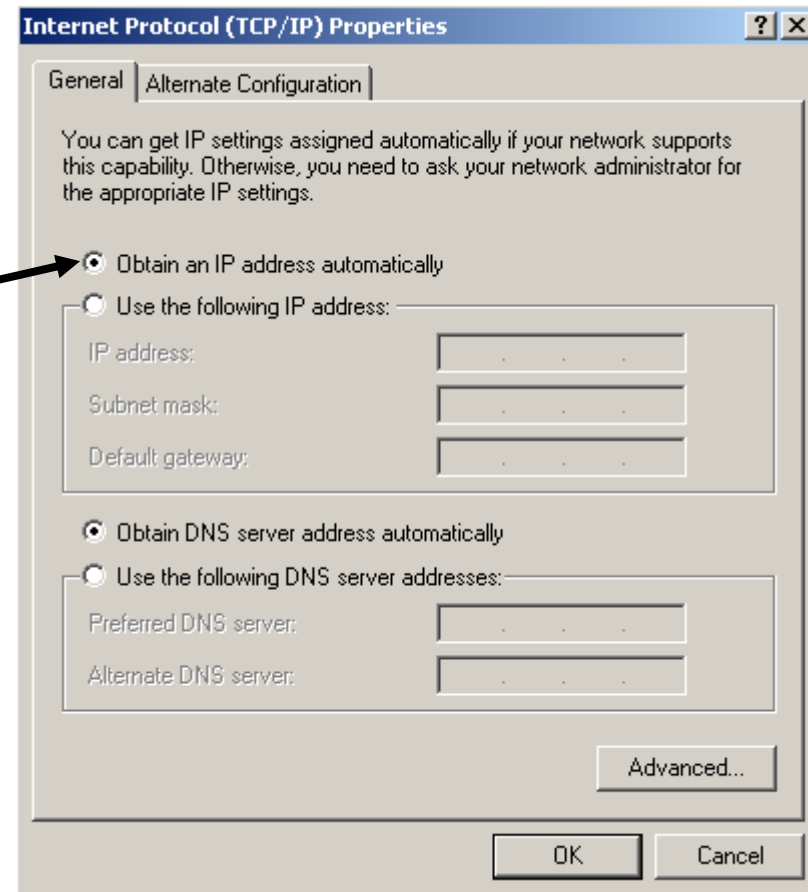
DHCP: Packet Tracer & Real Life

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



Packet Tracer

Real Life

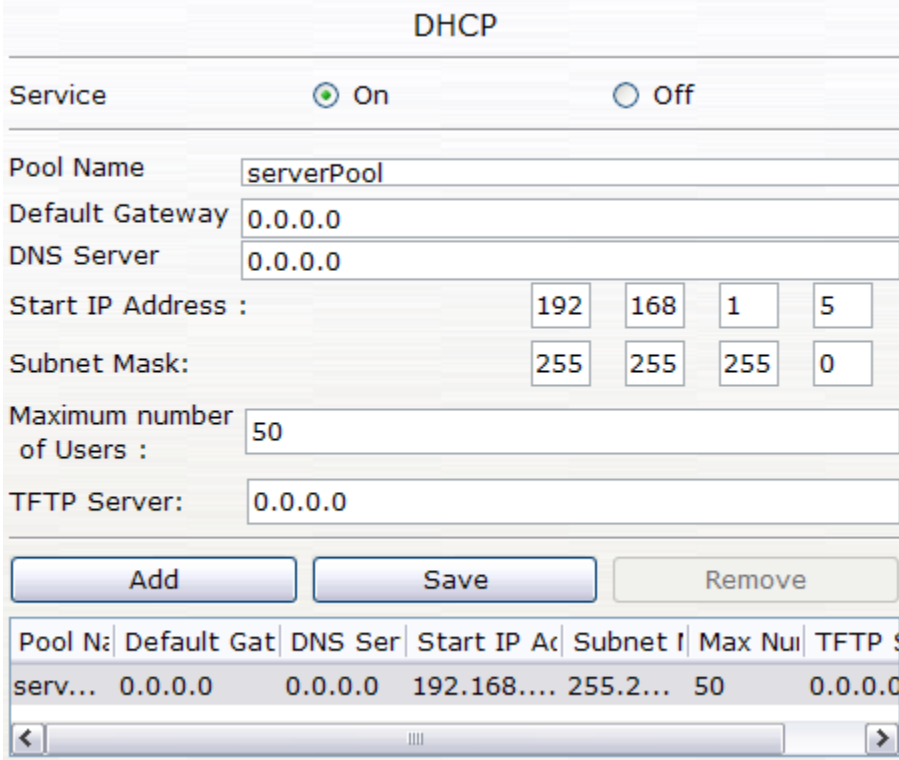


Review: Static IP and Dynamic IP

- 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.



DHCP

Service ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 0.0.0.0

DNS Server: 0.0.0.0

Start IP Address: 192.168.1.5

Subnet Mask: 255.255.255.0

Maximum number of Users: 50

TFTP Server: 0.0.0.0

Buttons: Add, Save, Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users	TFTP Server
serv...	0.0.0.0	0.0.0.0	192.168...	255.2...	50	0.0.0.0

Router in Your LAN

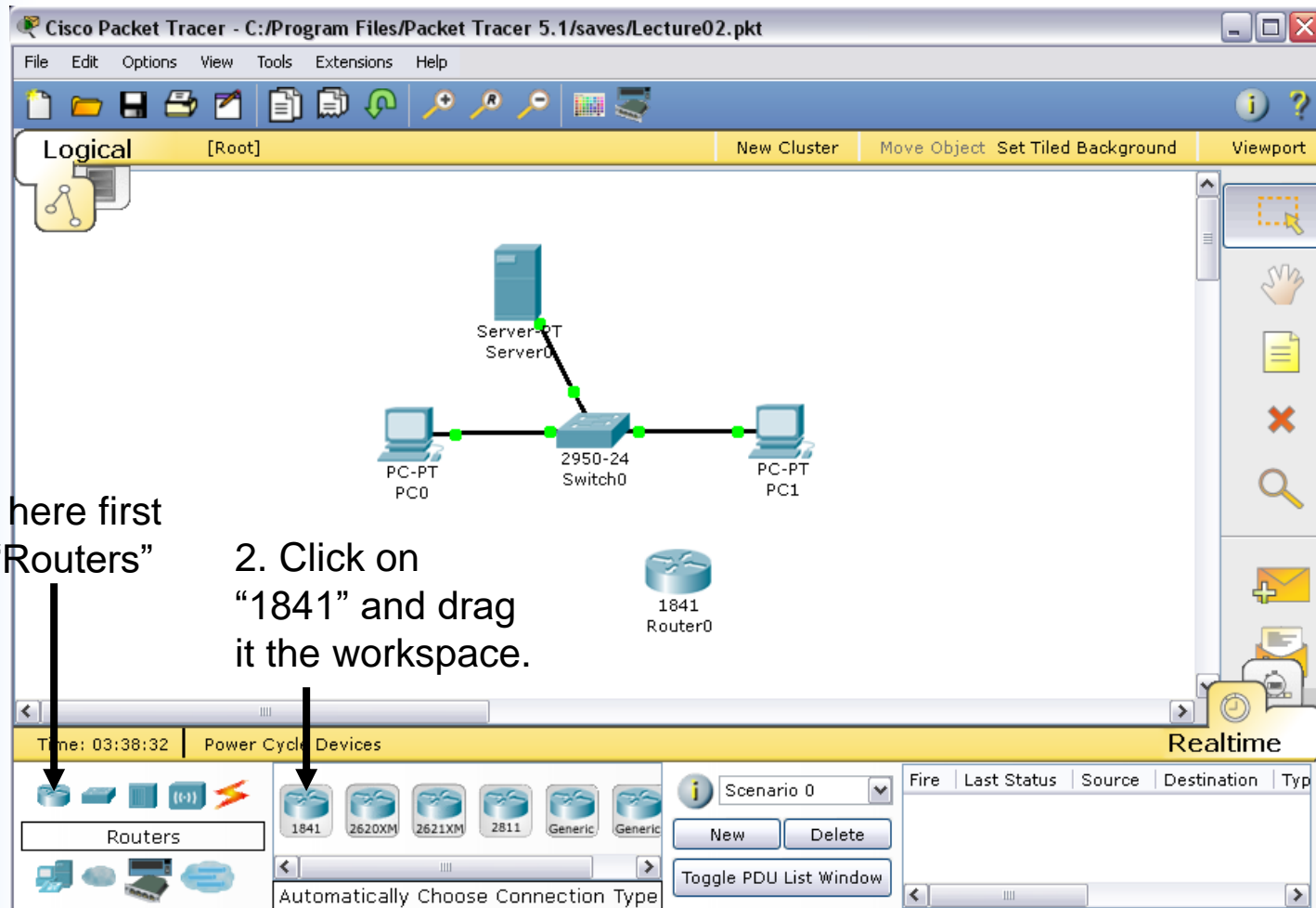
*Adding a Router to your LAN
step by step*

Router

- Drag a 1841 router into the workspace.

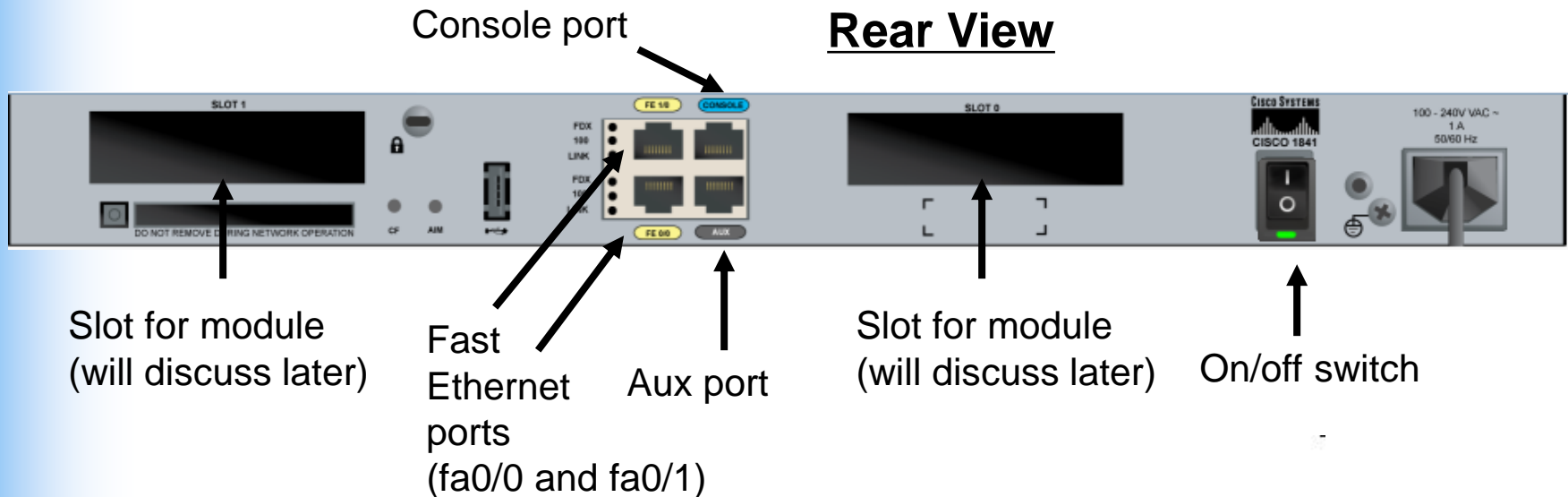
1. Click here first
to get "Routers"

2. Click on
"1841" and drag
it the workspace.



Cisco 1841 router

Rear View

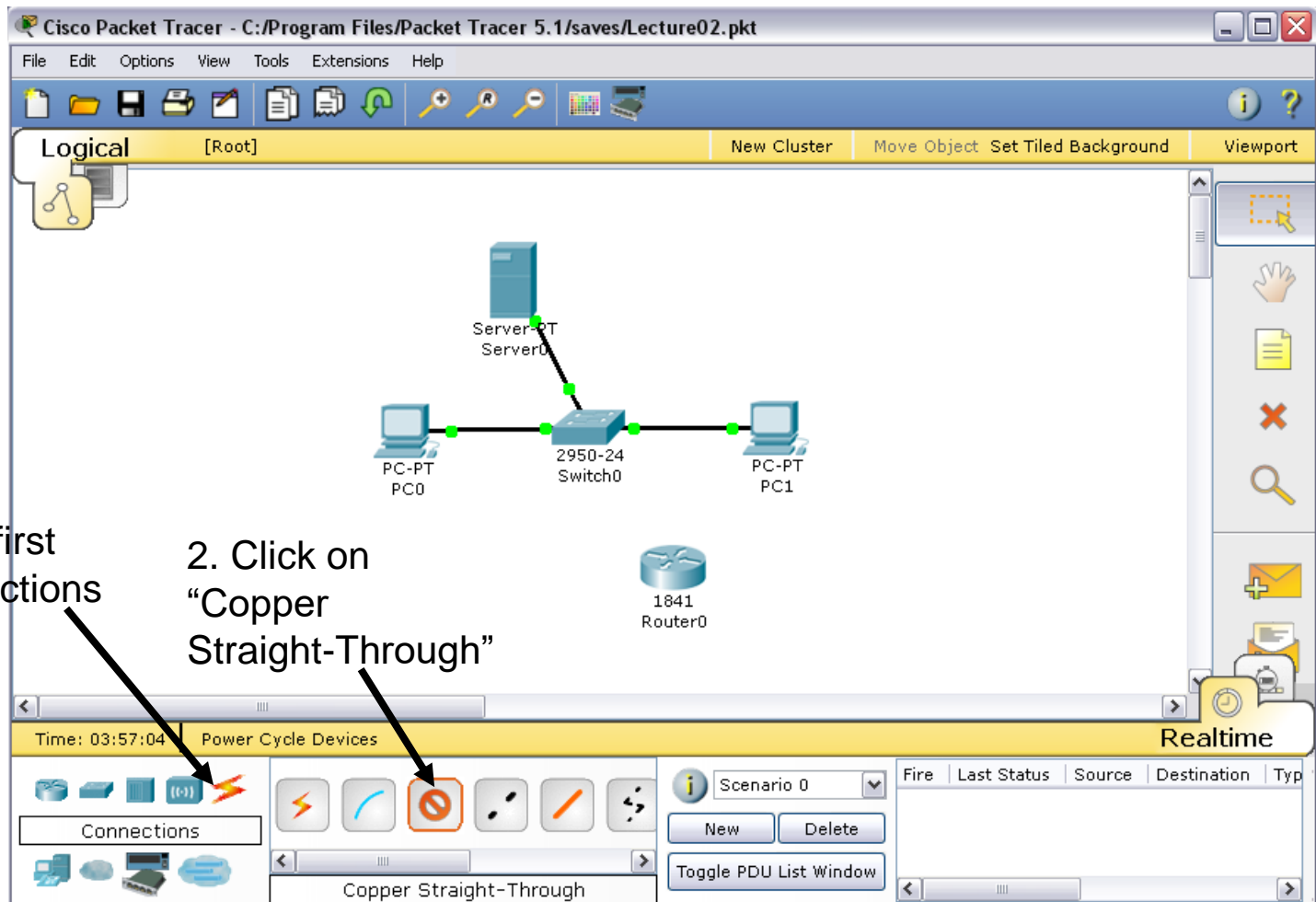


Front View

Connecting Router to Switch - 1

1. Click here first
to get Connections

2. Click on
“Copper
Straight-Through”



Connecting Router to Switch - 2

Cisco Packet Tracer - C:/Program Files/Packet Tracer 5.1/saves/Lecture02.pkt

File Edit Options View Tools Extensions Help

Logical [Root] New Cluster Move Object Set Tiled Background Viewport

3. Click on Router0, a small window pops up.

4. Select FastEthernet0/0, then click on it

Time: 27:59:17 Power Cycle Devices Realtime

Connections

Copper Straight-Through

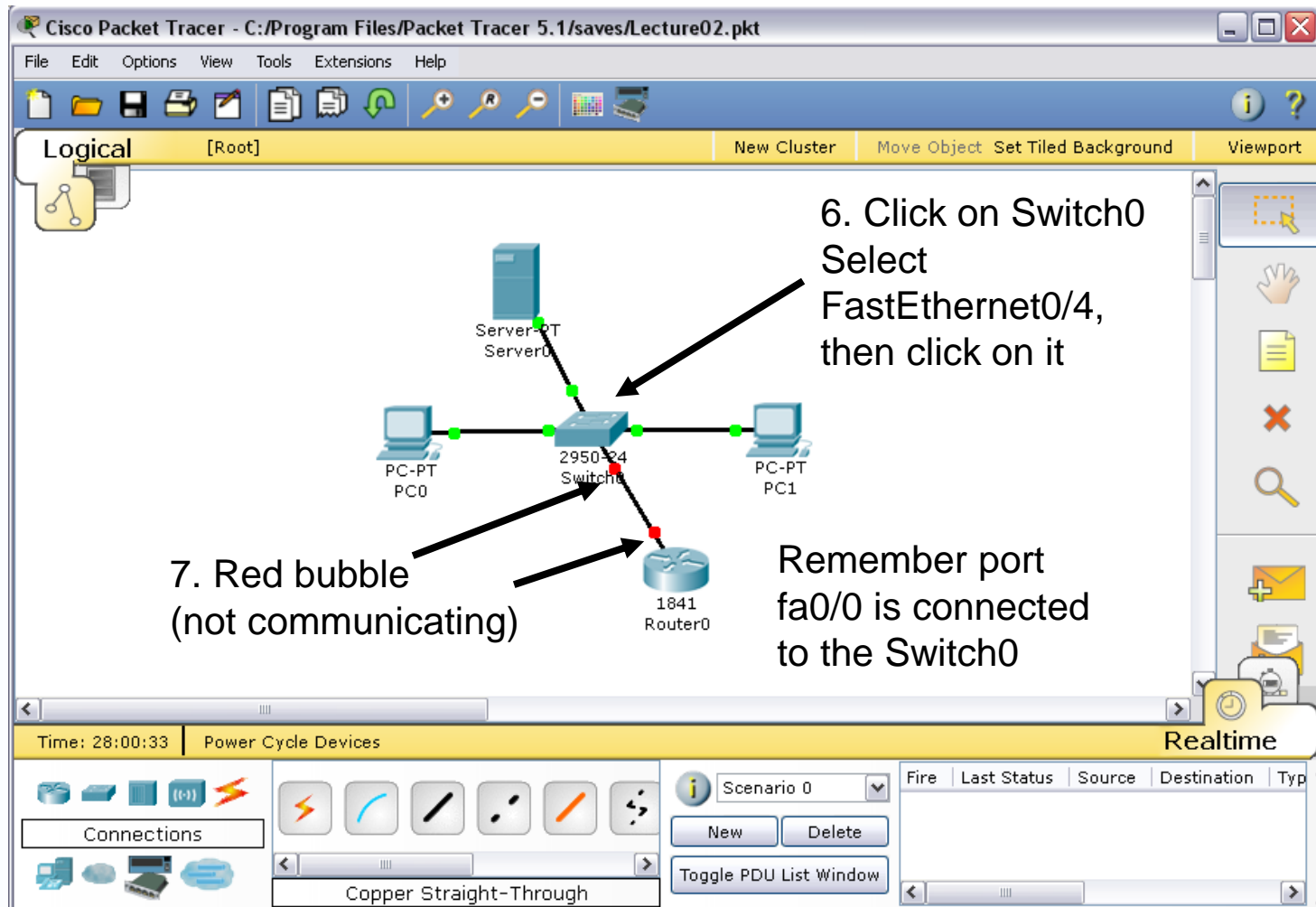
Scenario 0

New Delete

Toggle PDU List Window

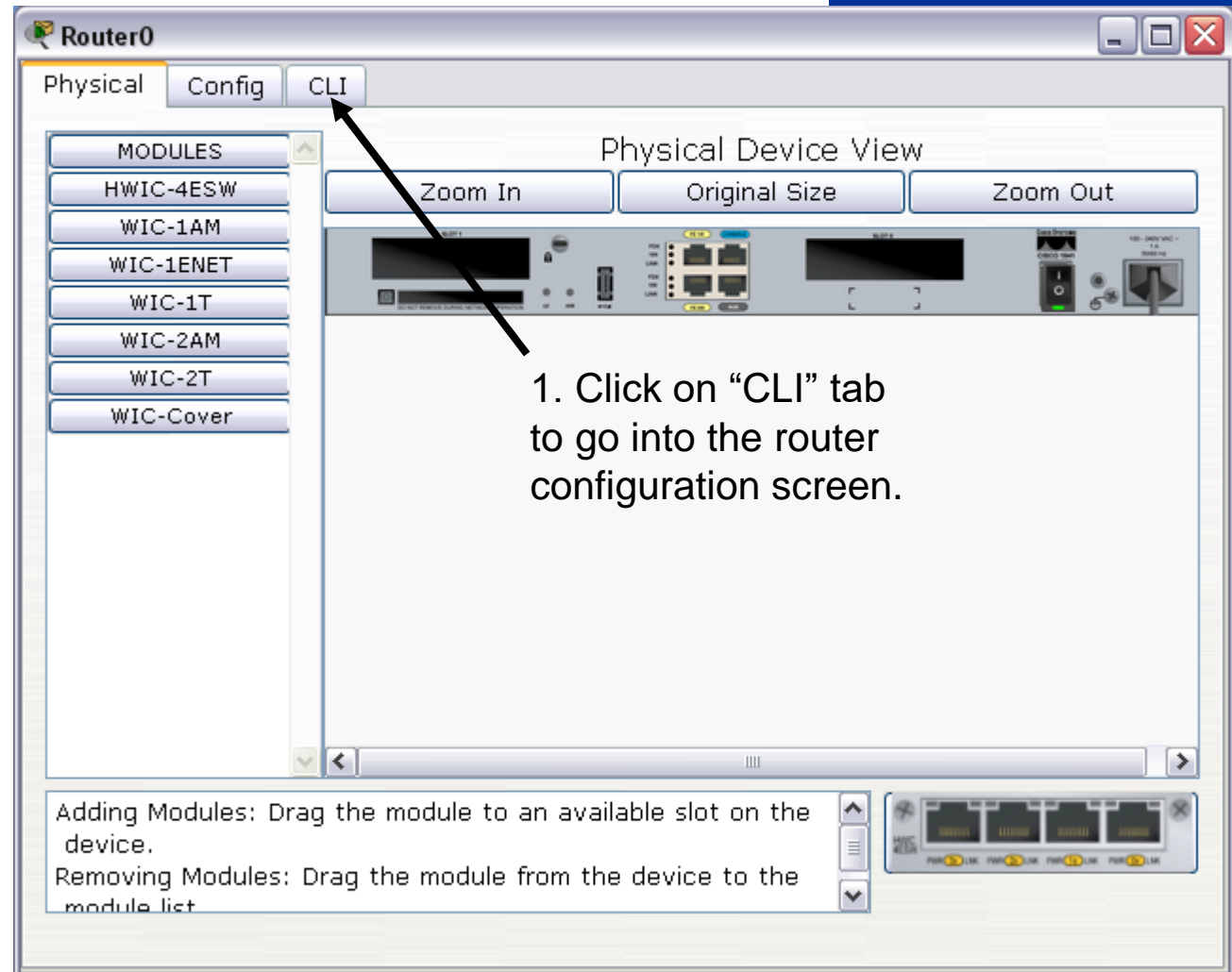
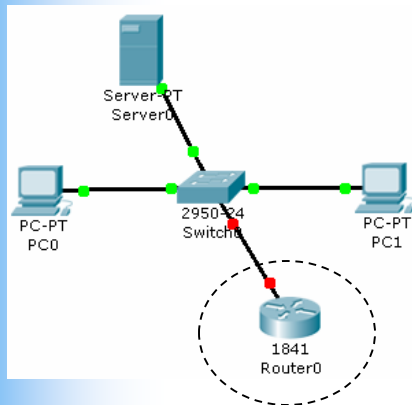
Fire Last Status Source Destination Typ

Connecting Router to Switch - 3



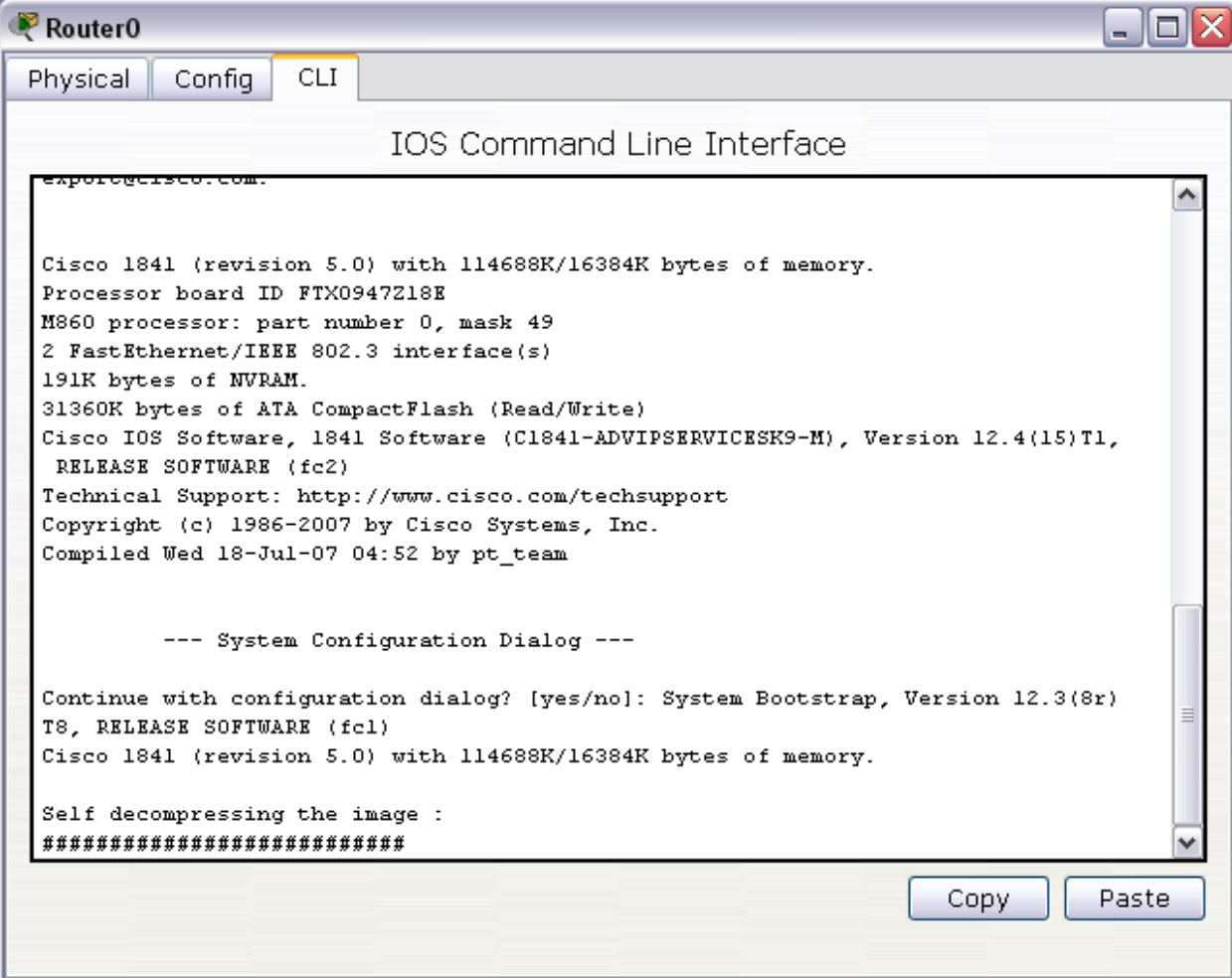
Configuring IP in Router - 1

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



Configuring IP in Router - 2

- Wait for the router to boot up



The screenshot shows a window titled "Router0" with three tabs: "Physical", "Config", and "CLI". The "CLI" tab is active, displaying the "IOS Command Line Interface". The text in the window shows the router's boot sequence, including hardware details and the start of the system configuration dialog.

```
export@cisco.com:

Cisco 1841 (revision 5.0) with 114688K/16384K bytes of memory.
Processor board ID FTX0947218E
M860 processor: part number 0, mask 49
2 FastEthernet/IEEE 802.3 interface(s)
191K bytes of NVRAM.
31360K bytes of ATA CompactFlash (Read/Write)
Cisco IOS Software, 1841 Software (C1841-ADVIPSERVICESK9-M), Version 12.4(15)T1,
RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 18-Jul-07 04:52 by pt_team

--- System Configuration Dialog ---

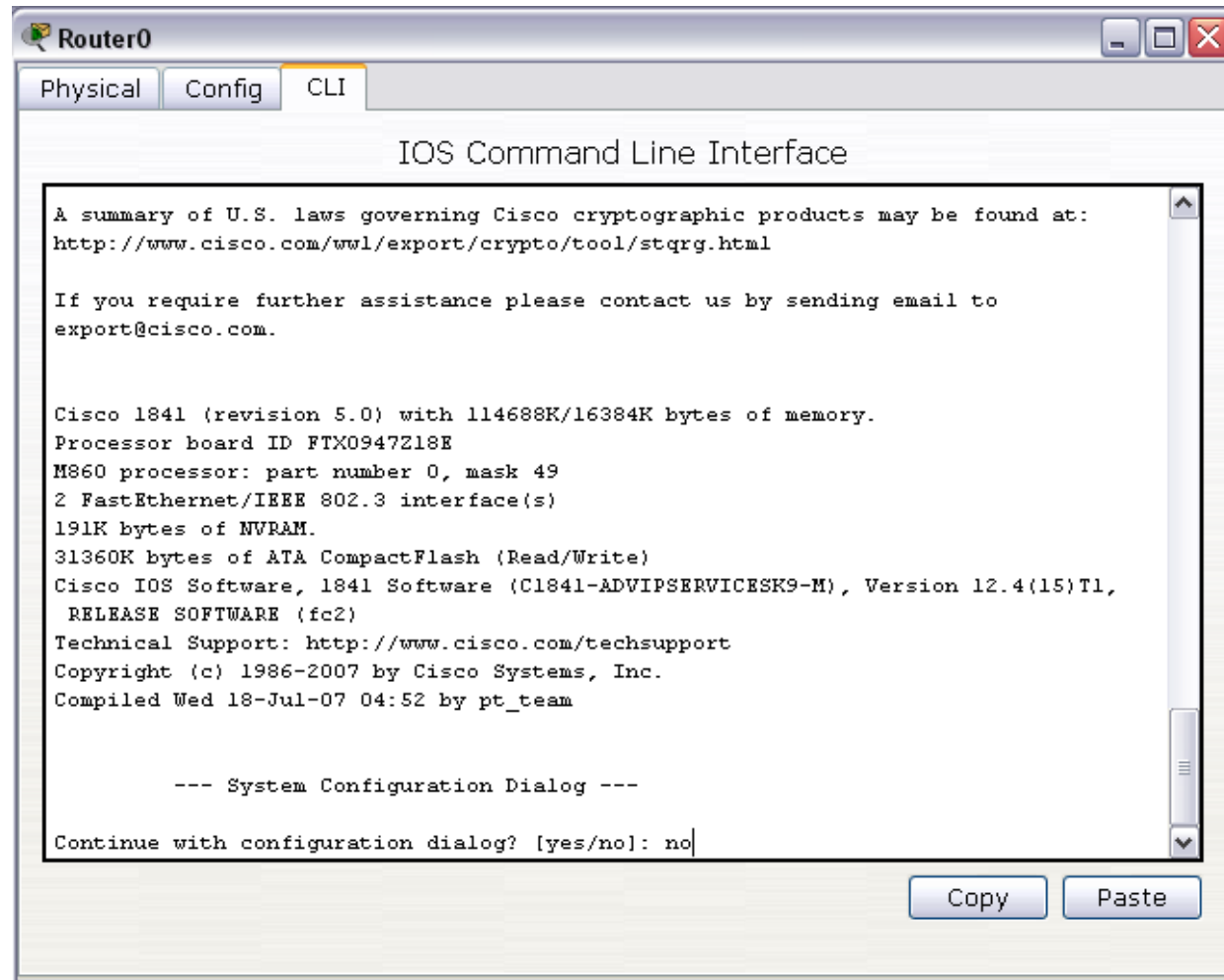
Continue with configuration dialog? [yes/no]: System Bootstrap, Version 12.3(8r)
T8, RELEASE SOFTWARE (fc1)
Cisco 1841 (revision 5.0) with 114688K/16384K bytes of memory.

Self decompressing the image :
#####
```

At the bottom right of the window, there are "Copy" and "Paste" buttons.

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

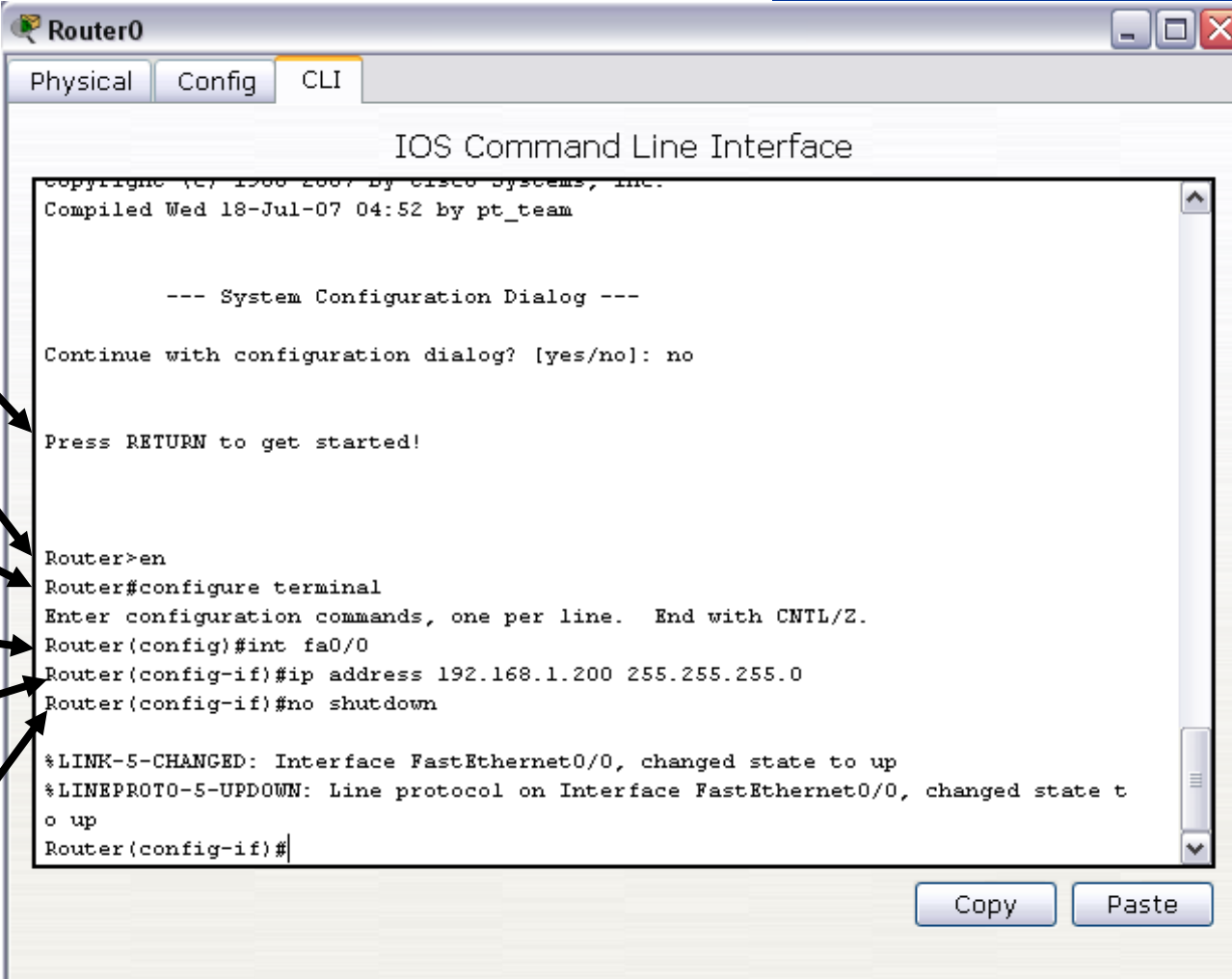
2. Type "enable" or "en"

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"



The screenshot shows a window titled "Router0" with three tabs: "Physical", "Config", and "CLI". The "CLI" tab is active, displaying the "IOS Command Line Interface". The text in the window is as follows:

```
Copyright (c) 1986-2007 by Cisco Systems, Inc.  
Compiled Wed 18-Jul-07 04:52 by pt_team  
  
--- System Configuration Dialog ---  
Continue with configuration dialog? [yes/no]: no  
  
Press RETURN to get started!  
  
Router>en  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#int fa0/0  
Router(config-if)#ip address 192.168.1.200 255.255.255.0  
Router(config-if)#no shutdown  
  
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up  
Router(config-if)#
```

Arrows from the numbered list on the left point to the corresponding commands in the CLI window:

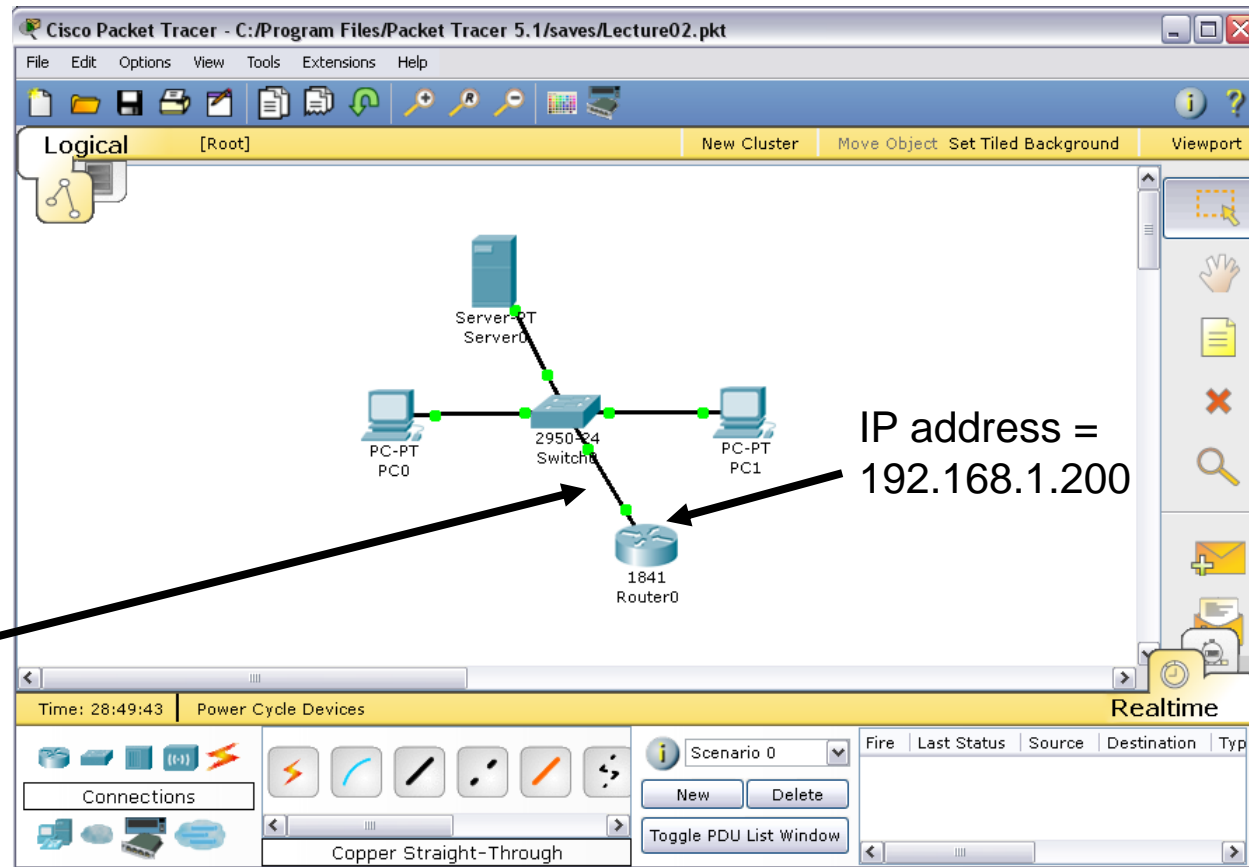
- Arrow 1 points to the initial state (before "en").
- Arrow 2 points to "en".
- Arrow 3 points to "configure terminal".
- Arrow 4 points to "int fa0/0".
- Arrow 5 points to "ip address 192.168.1.200 255.255.255.0".
- Arrow 6 points to "no shutdown".

At the bottom right of the window are "Copy" and "Paste" buttons.

Router IP = Gateway of LAN

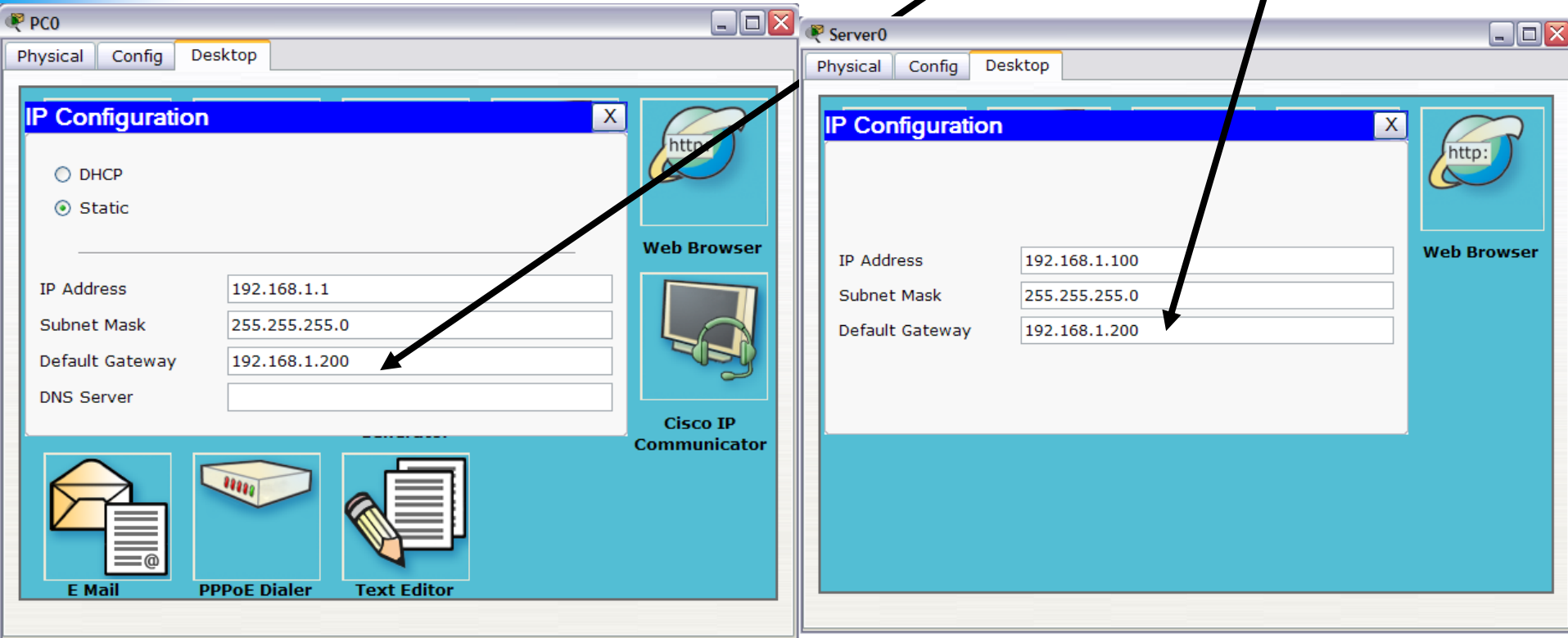
- The interface fa0/0 has a IP of 192.168.1.200.
- This IP will be the default gateway IP for all the hosts in the LAN

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 DHCP service

1. Press "Config" tab

2. Press "DHCP"

3. Change 0.0.0.0 to 192.168.1.200

4. Click on save

Service: ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 192.168.1.200

DNS Server: 0.0.0.0

Start IP Address: 192.168.1.5

Subnet Mask: 255.255.255.0

Maximum number of Users: 50

TFTP Server: 0.0.0.0

Buttons: Add, Save, Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users
serverPool	192.168.1.200	0.0.0.0	192.168.1.5	255.255.255.0	50

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)

Command Prompt

```
PC>ipconfig

IP Address. . . . . : 192.168.1.6
Subnet Mask. . . . . : 255.255.255.0
Default Gateway. . . . . : 0.0.0.0

PC>ipconfig /renew

IP Address. . . . . : 192.168.1.6
Subnet Mask. . . . . : 255.255.255.0
Default Gateway. . . . . : 192.168.1.200
DNS Server. . . . . : 0.0.0.0

PC>ping 192.168.1.200

Pinging 192.168.1.200 with 32 bytes of data:

Reply from 192.168.1.200: bytes=32 time=110ms TTL=255
Reply from 192.168.1.200: bytes=32 time=47ms TTL=255
Reply from 192.168.1.200: bytes=32 time=62ms TTL=255
Reply from 192.168.1.200: bytes=32 time=63ms TTL=255

Ping statistics for 192.168.1.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 47ms, Maximum = 110ms, Average = 70ms

PC>
```

Adding a new LAN

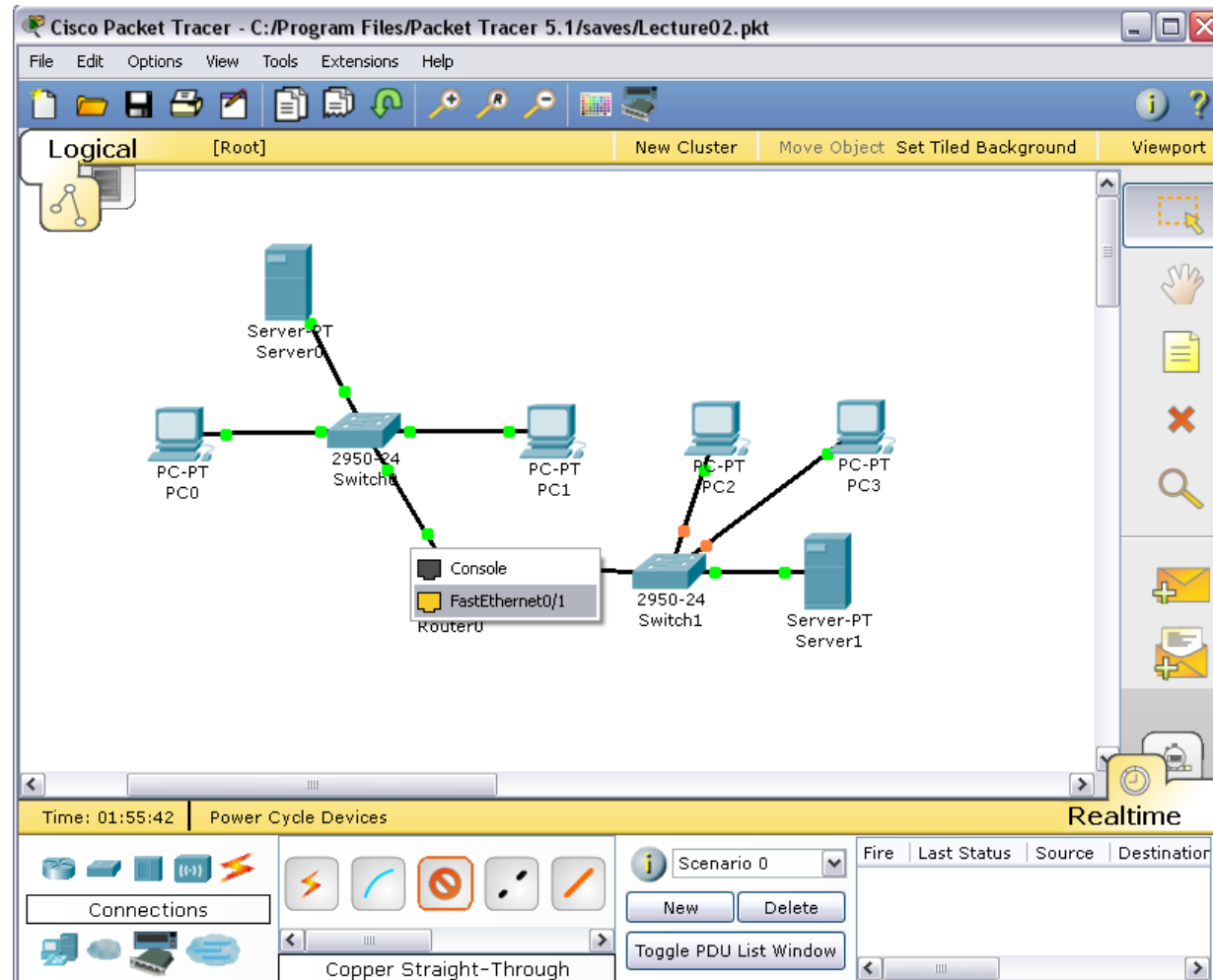
Adding and configure a new LAN on the existing network step by step

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

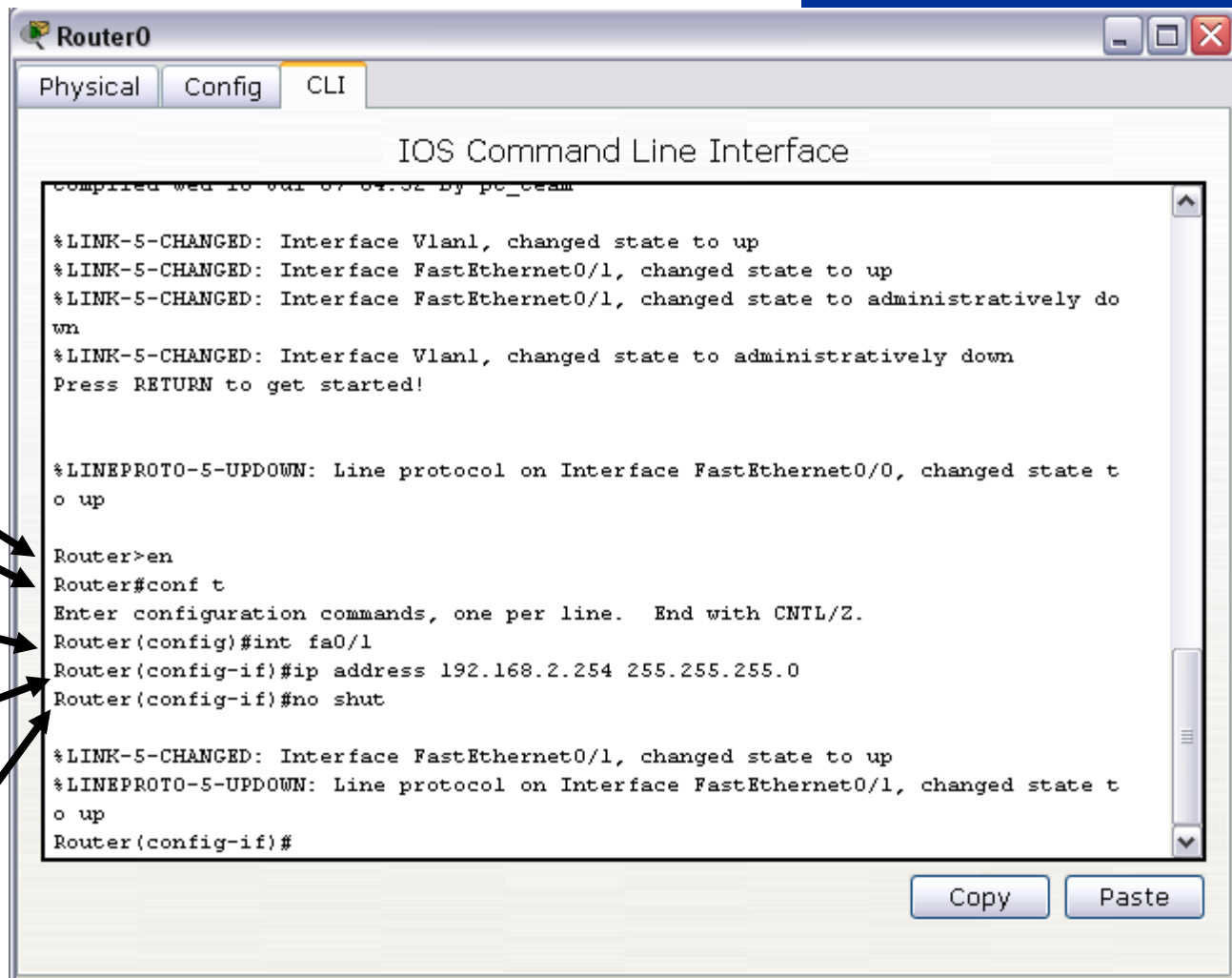
1. Type "en"

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"



The screenshot shows the Router0 CLI interface with the 'CLI' tab selected. The window title is 'Router0'. The interface displays the following text:

```
IOS Command Line Interface  
Compiled wed 10 Jul 07 04:32 By pc_team  
%LINK-5-CHANGED: Interface Vlan1, changed state to up  
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up  
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively do  
wn  
%LINK-5-CHANGED: Interface Vlan1, changed state to administratively down  
Press RETURN to get started!  
  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state t  
o up  
  
Router>en  
Router#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#int fa0/1  
Router(config-if)#ip address 192.168.2.254 255.255.255.0  
Router(config-if)#no shut  
  
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t  
o up  
Router(config-if)#
```

Arrows from the numbered list on the left point to the corresponding commands in the CLI output: 'en' points to 'Router>en', 'conf t' points to 'Router#conf t', 'int fa0/1' points to 'Router(config)#int fa0/1', 'ip address 192.168.2.254 255.255.255.0' points to 'Router(config-if)#ip address 192.168.2.254 255.255.255.0', and 'no shut' points to 'Router(config-if)#no shut'.

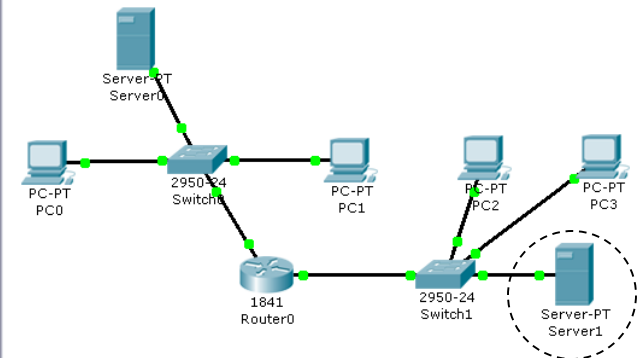
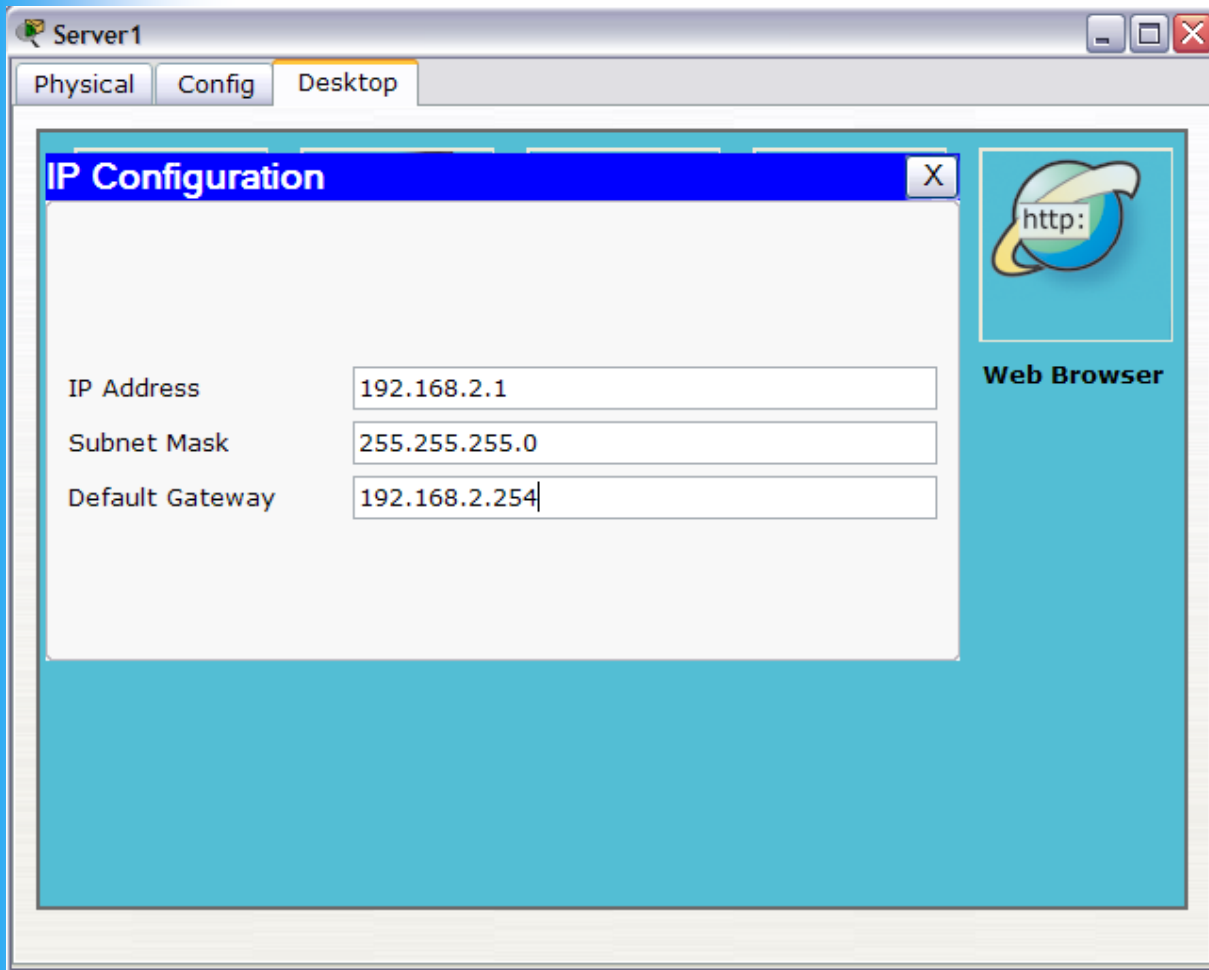
Buttons for 'Copy' and 'Paste' are visible at the bottom right of the CLI window.

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

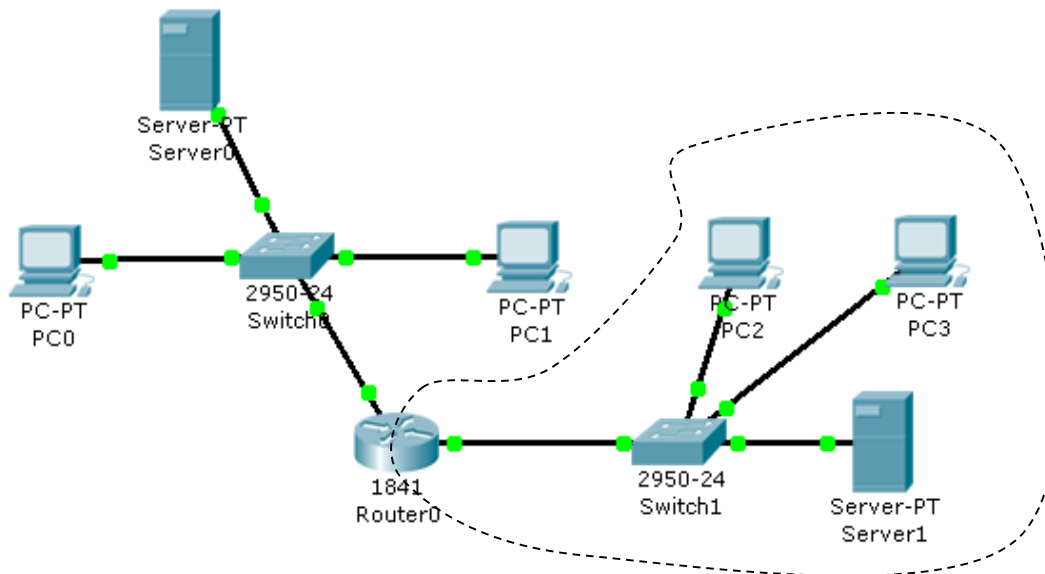
Set Max # of Users
= 201

The screenshot shows the 'Server1' configuration window with the 'Config' tab selected. The left sidebar lists various configuration categories: GLOBAL, Settings, Algorithm Settings, SERVICES, HTTP, DHCP, TFTP, DNS, SYSLOG, AAA, NTP, EMAIL, FTP, INTERFACE, and FastEthernet. The 'DHCP' option under 'SERVICES' is highlighted. The main area displays the 'DHCP' configuration for 'serverPool'. The 'Service' is set to 'On'. The 'Default Gateway' is 192.168.2.254, and the 'DNS Server' is 192.168.2.1. The 'Start IP Address' is configured as 192.168.2.5 with a 'Subnet Mask' of 255.255.255.0. The 'Maximum number of Users' is set to 201, and the 'TFTP Server' is 0.0.0.0. At the bottom, there are 'Add', 'Save', and 'Remove' buttons. Below these buttons is a table showing the configuration for the 'serverPool'.

Pool Name	Default Gatew	DNS Server	Start IP Ad	Subnet Mask	M
serverPool	192.168.2.254	192.168.2.1	192.168.2.5	255.255.255.0	20

Comments on Second DHCP Service

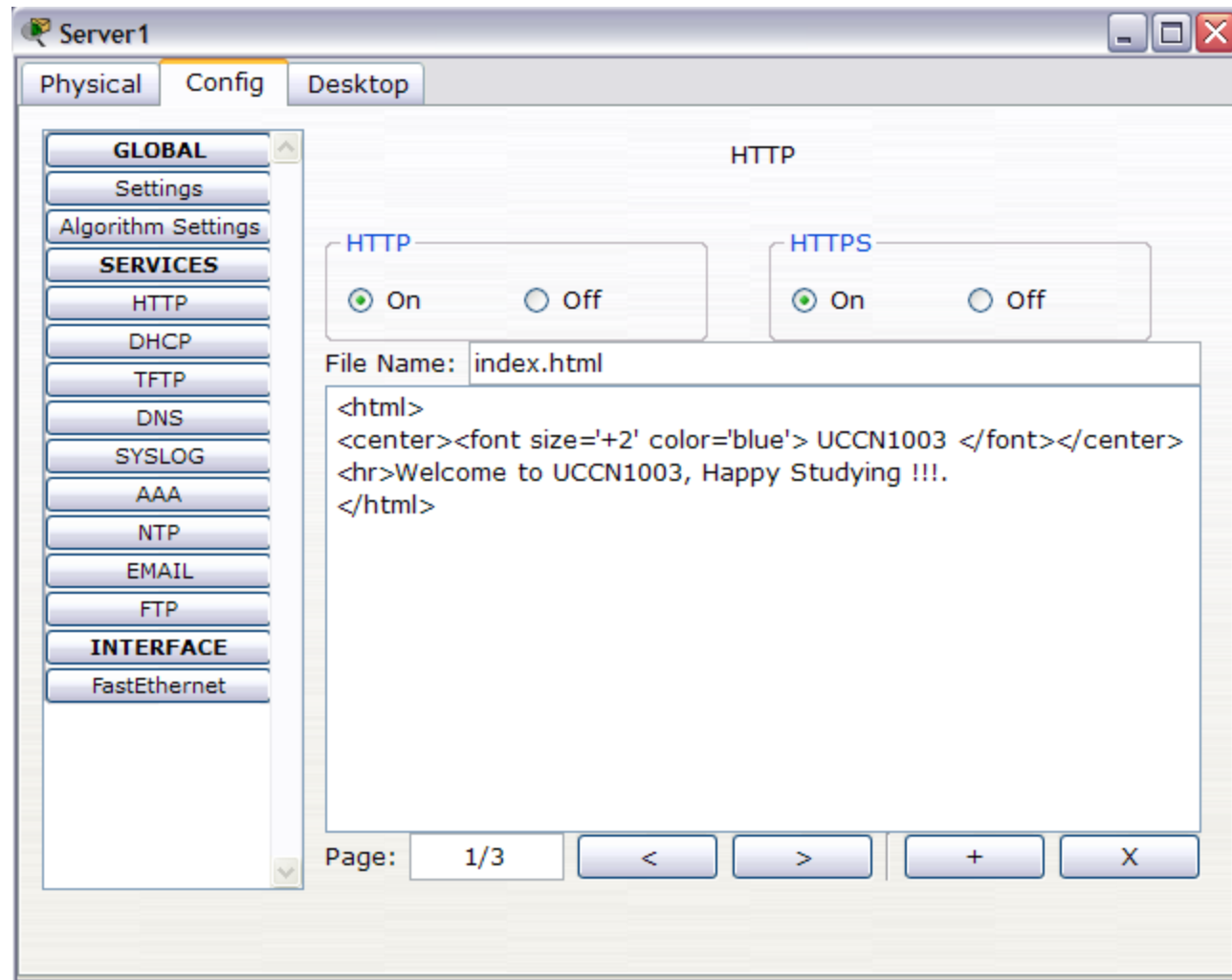
- DHCP service in Server1 does not service PC0 and PC1, it can only service PC2 and PC3.
 - Same as Server0, only servicing PC0 and PC1
 - DHCP service can not “cross” Router.
 - Whereas, HTTP, DNS service can “cross” Router



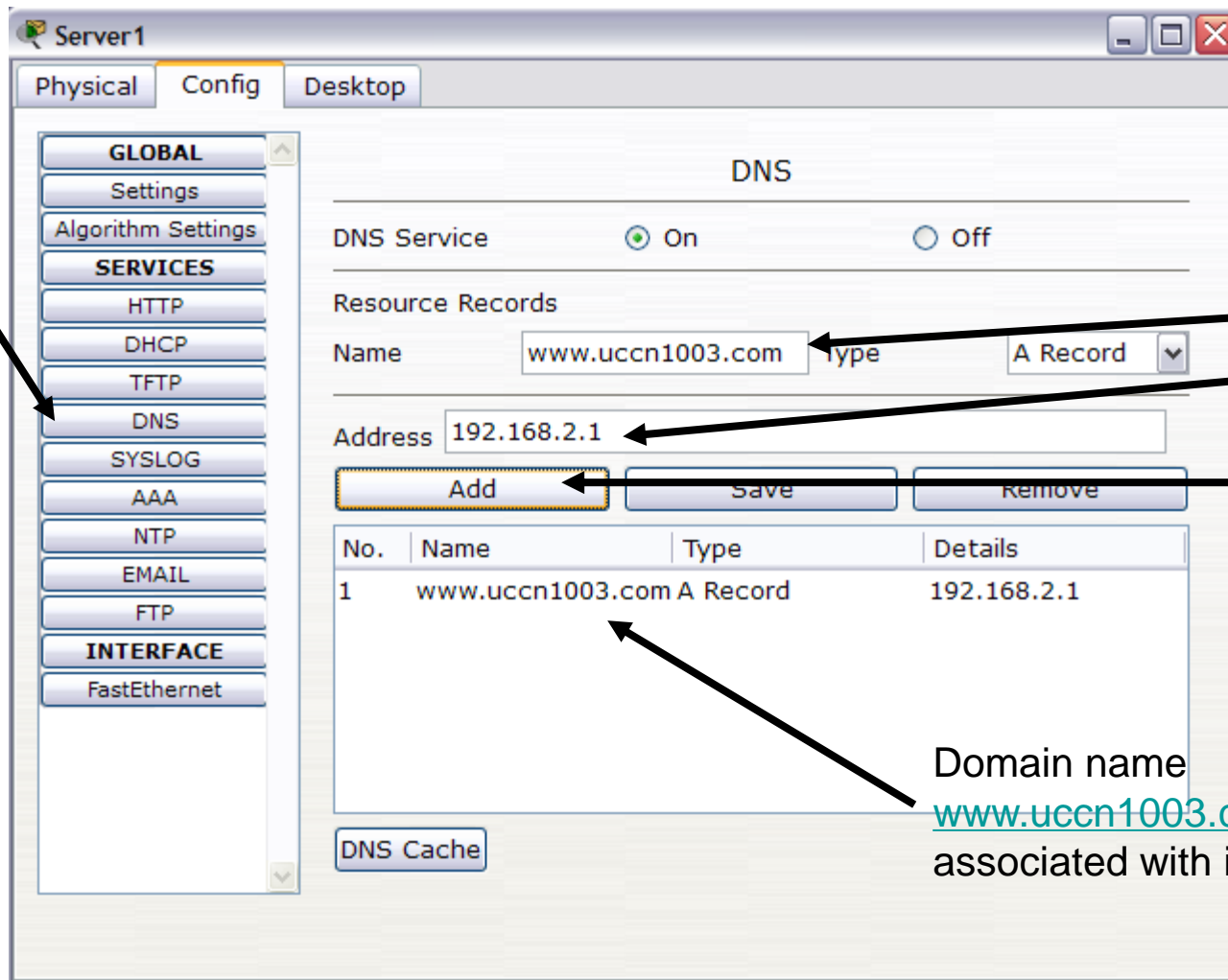
Service boundary of
DHCP service of
Server1

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



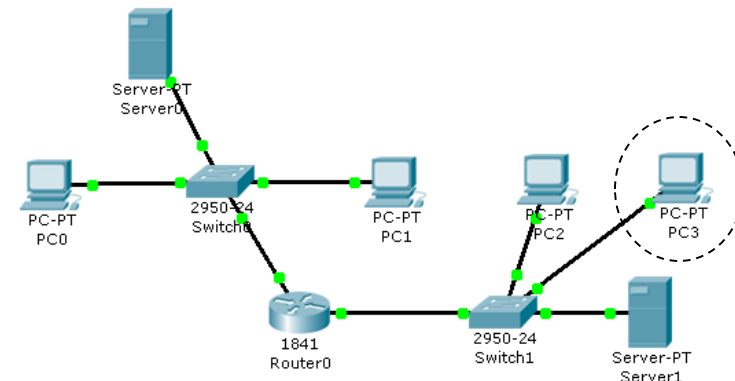
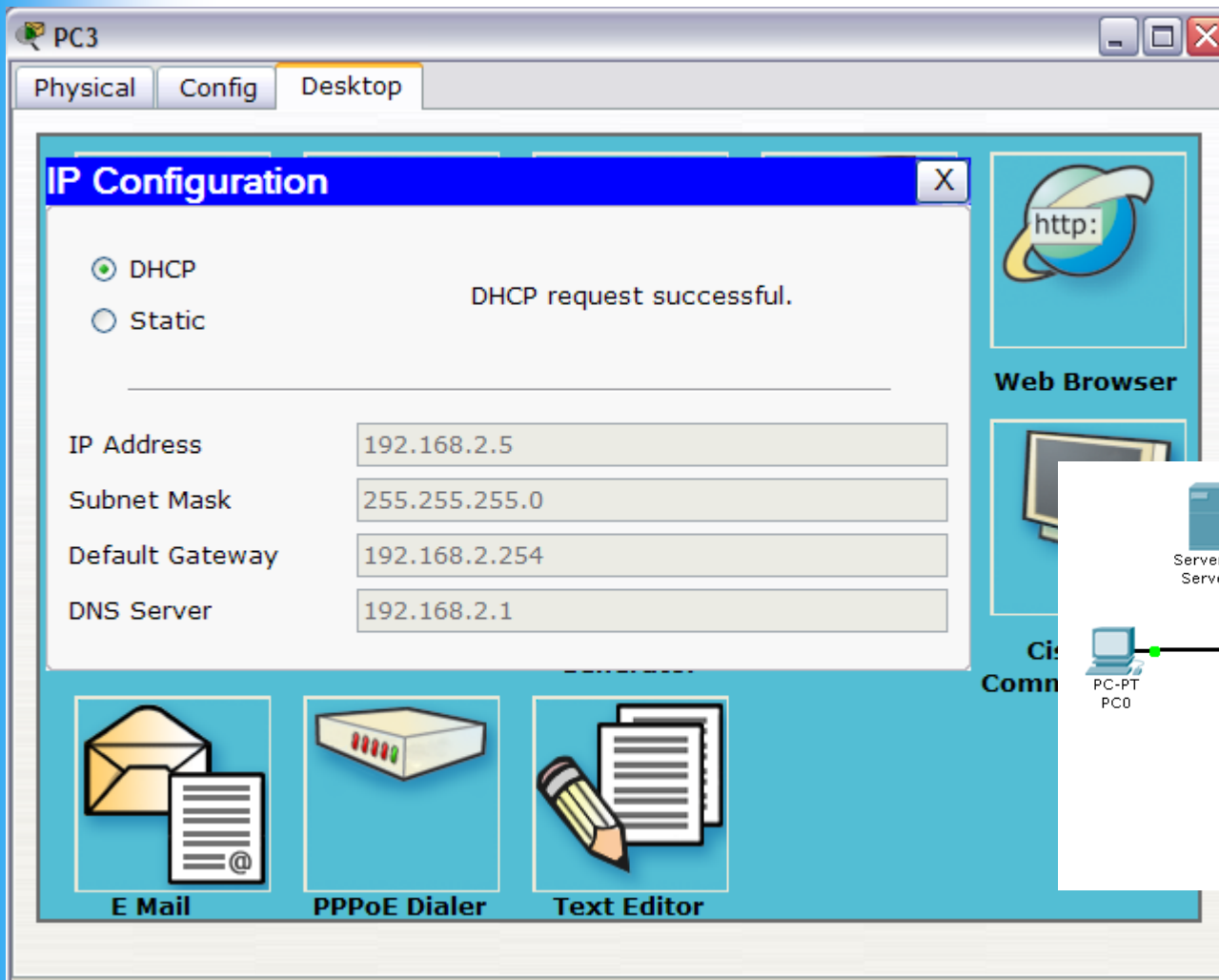
1. Click DNS

2. Type in these

3. Press the "Add" button.

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

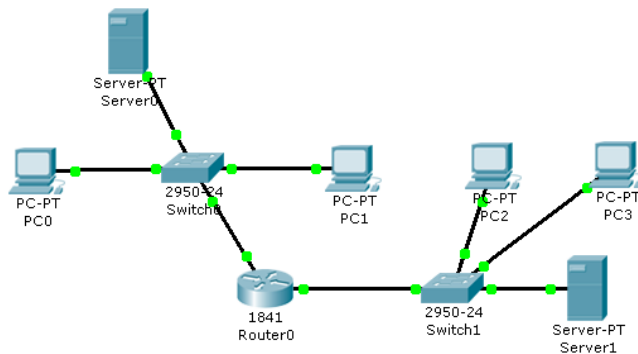
Requesting Dynamic IP for PC3



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

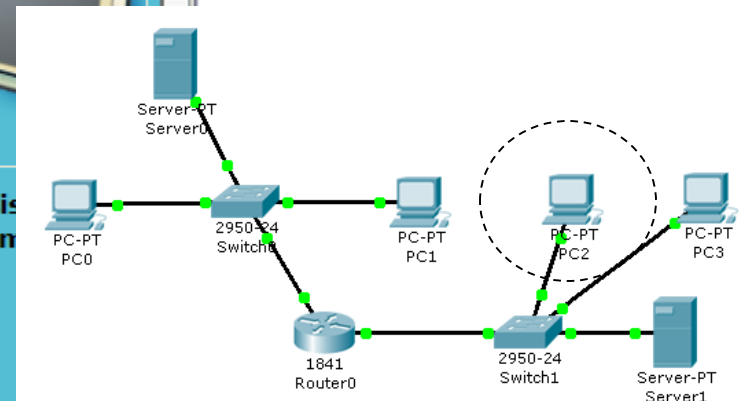
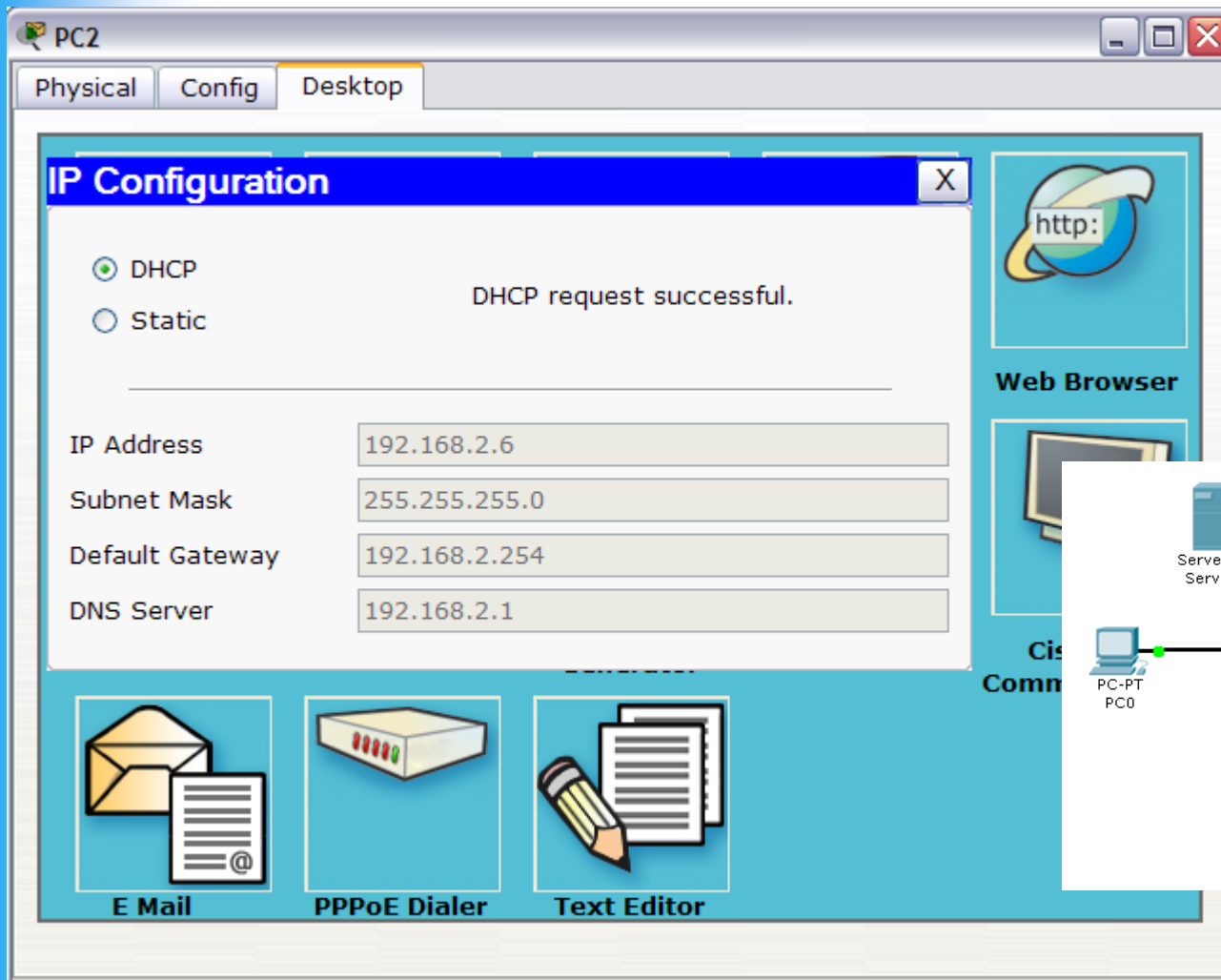
Pinging 192.168.1.1 with 32 bytes of data:

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

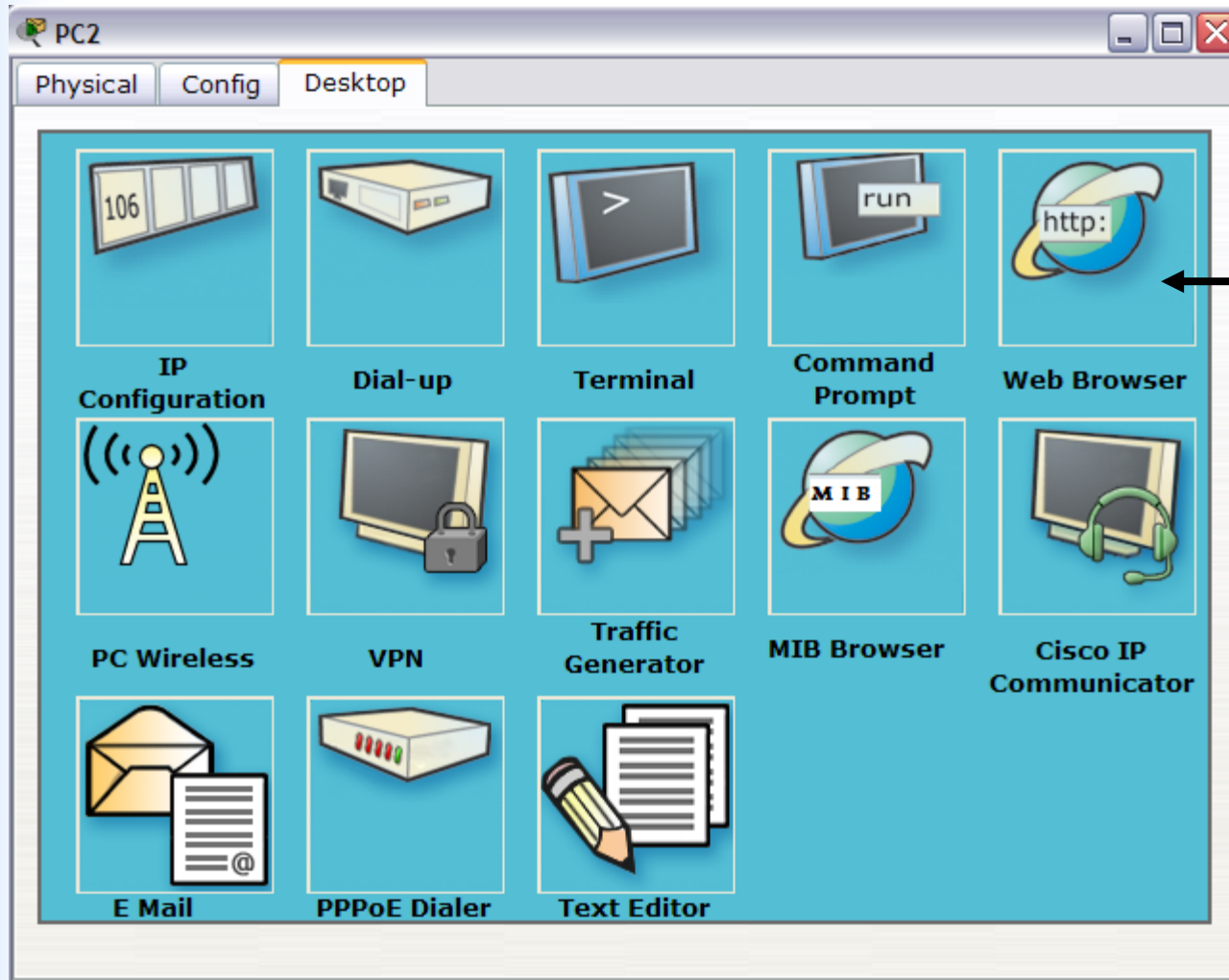
Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 96ms, Maximum = 125ms, Average = 115ms

PC>
```


Requesting Dynamic IP for PC2



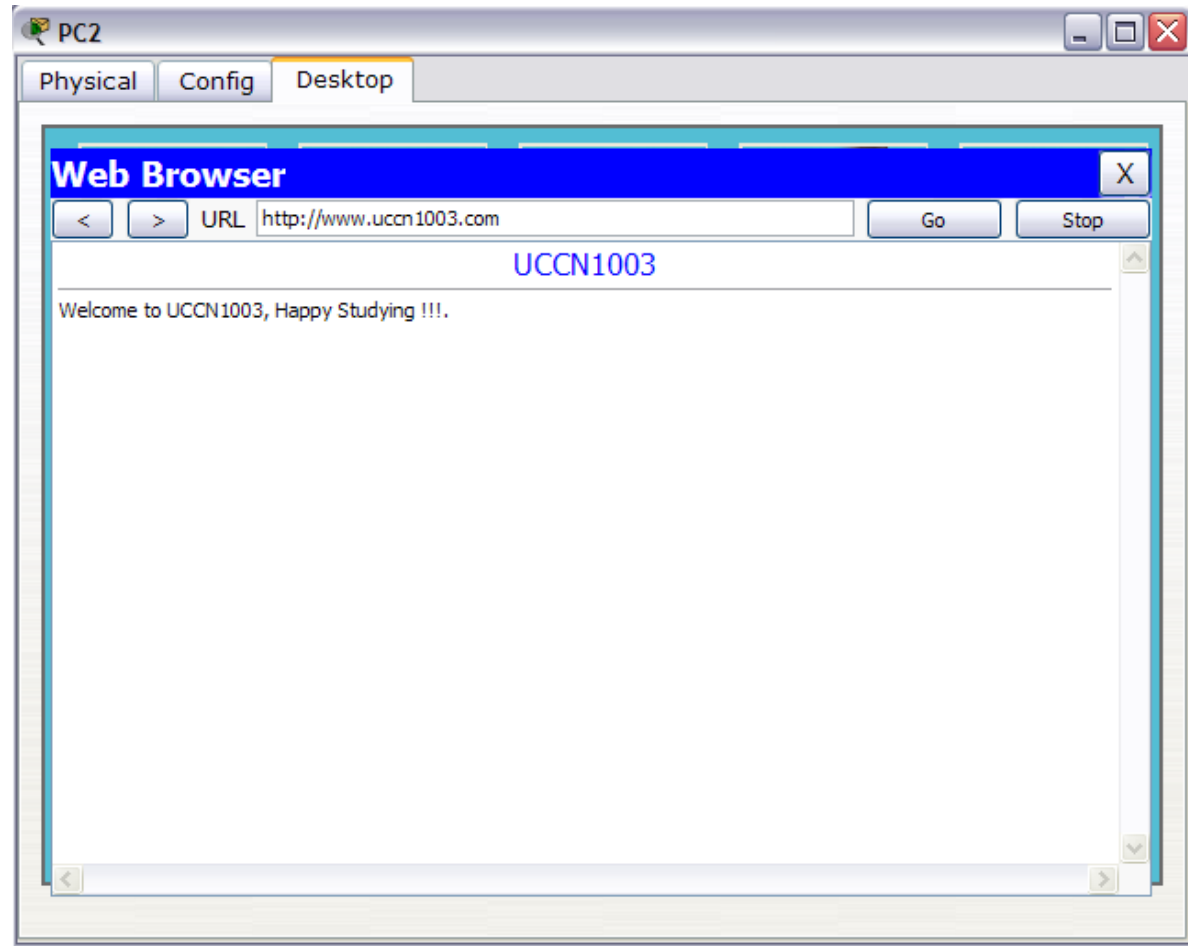
Launch Web Browser for PC2



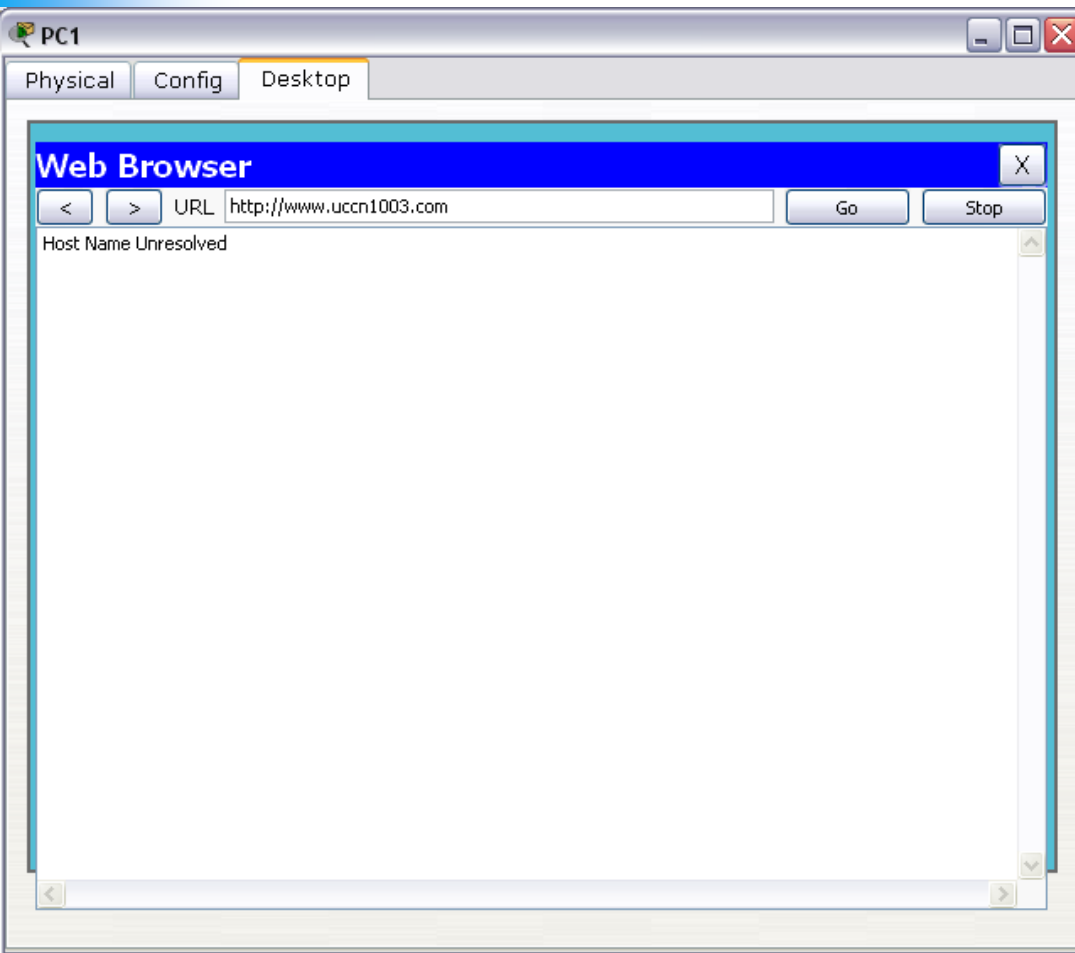
Click on this

PC2 Access Web Page in Server1

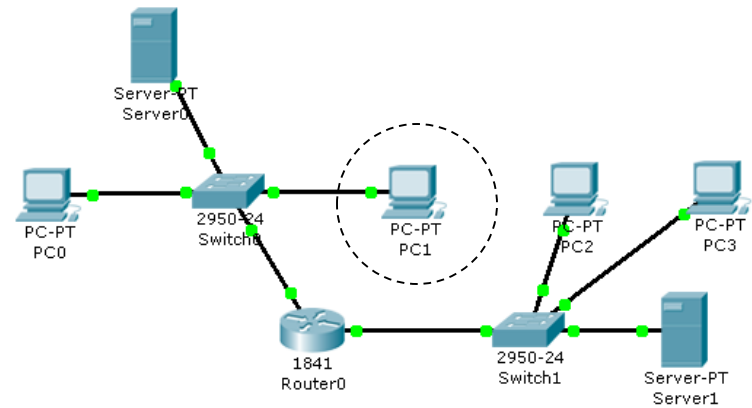
- PC2 has successfully communicate with the DNS to resolve the domain name www.uccn1003.com
- PC2 has successfully access the web page hosted in 192.168.2.1 (Server1)



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.

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

```
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>
```

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"

Server0

Physical Config Desktop

GLOBAL

Settings

Algorithm Settings

SERVICES

HTTP

DHCP

TFTP

DNS

SYSLOG

AAA

NTP

EMAIL

FTP

INTERFACE

FastEthernet

DHCP

Service ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 192.168.1.200

DNS Server: 192.168.2.1

Start IP Address: 192 168 1 6

Subnet Mask: 255 255 255 0

Maximum number of Users: 50

TFTP Server: 0.0.0.0

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users
serverPool	192.168.1.200	192.168.2.1	192.168.1.6	255.255.255.0	50

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:

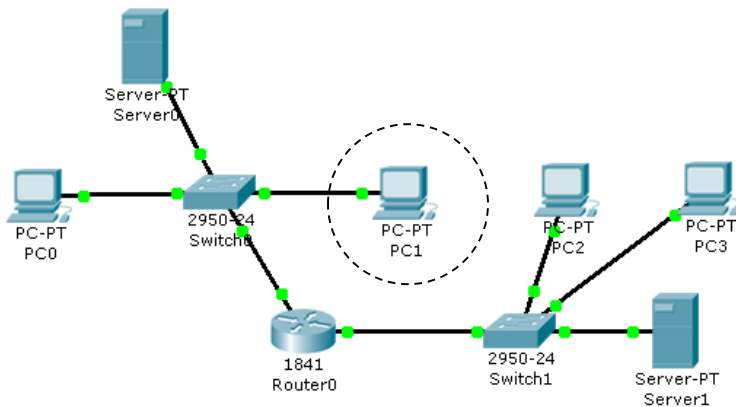
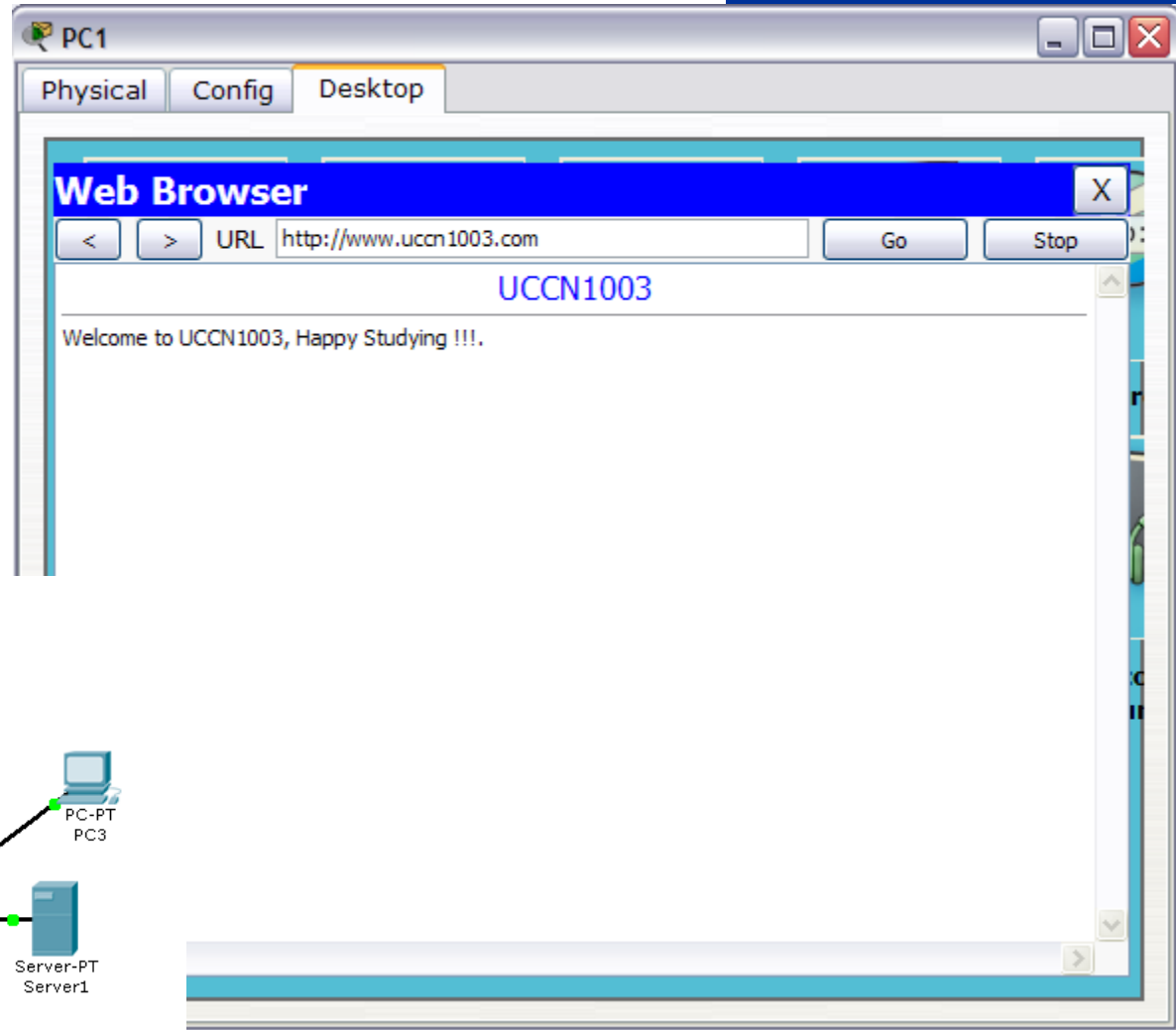
```
Reply from 192.168.2.1: bytes=32 time=109ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127
Reply from 192.168.2.1: bytes=32 time=109ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127
```

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
```

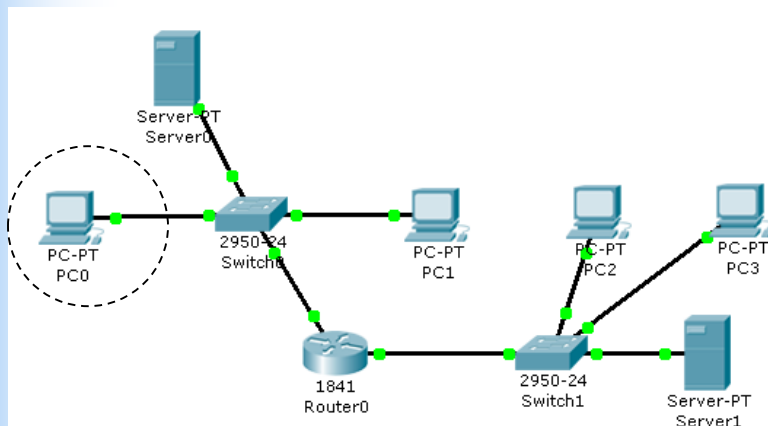
Launch Web Browser in PC1

- 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.



```
PC0
Physical Config Desktop

Command Prompt

Packet Tracer PC Command Line 1.0
PC>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127
Reply from 192.168.2.1: bytes=32 time=125ms TTL=127

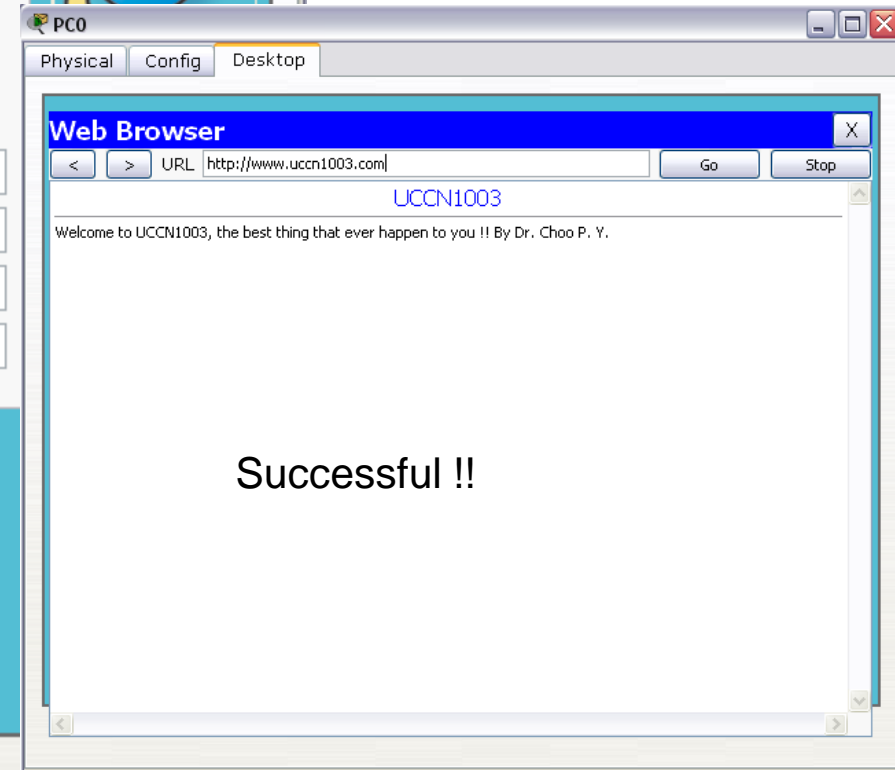
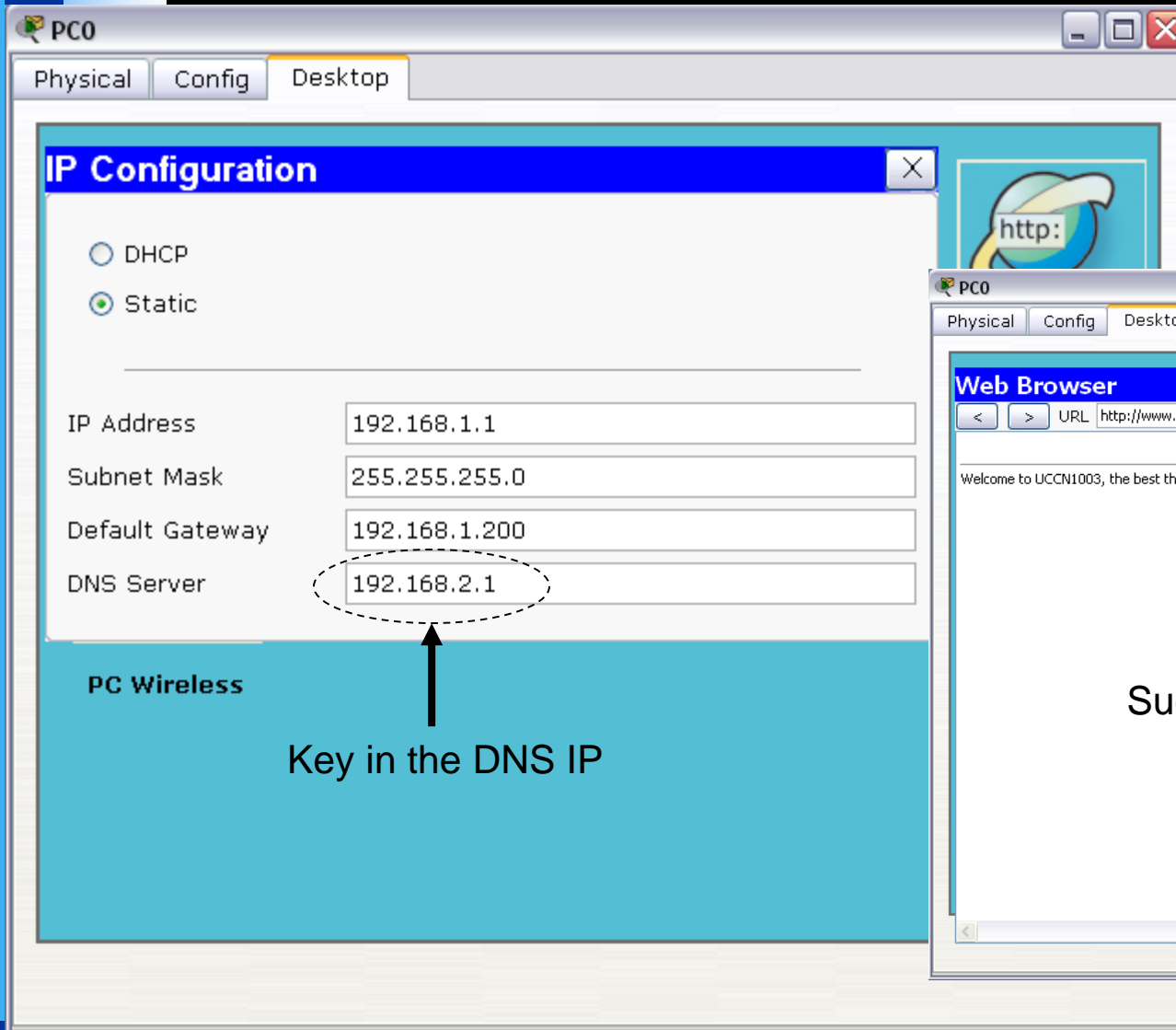
Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 125ms, Maximum = 125ms, Average = 125ms

PC>ipconfig

IP Address.....: 192.168.1.1
Subnet Mask.....: 255.255.255.0
Default Gateway...: 192.168.1.200

PC>
```

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:



PC-PT
PC



Laptop-PT
Laptop



Server-PT
Server



Printer-PT
Printer



7960
IP Phone



PDA-PT
Pda



TabletPC-PT
Tablet PC

- Networking devices:



Router-PT
Router



2950-24
Switch



3560-24PS
Multilayer Switch



Bridge-PT
Bridge



Hub-PT
Hub



Repeater-PT
Repeater



CoAxialSplitter-PT
Coaxial Splitter



Linksys-WRT300N
Wireless Router



AccessPoint-PT
Wireless Access Point



DSL-Modem-PT
DSL Modem

- In LAN design:

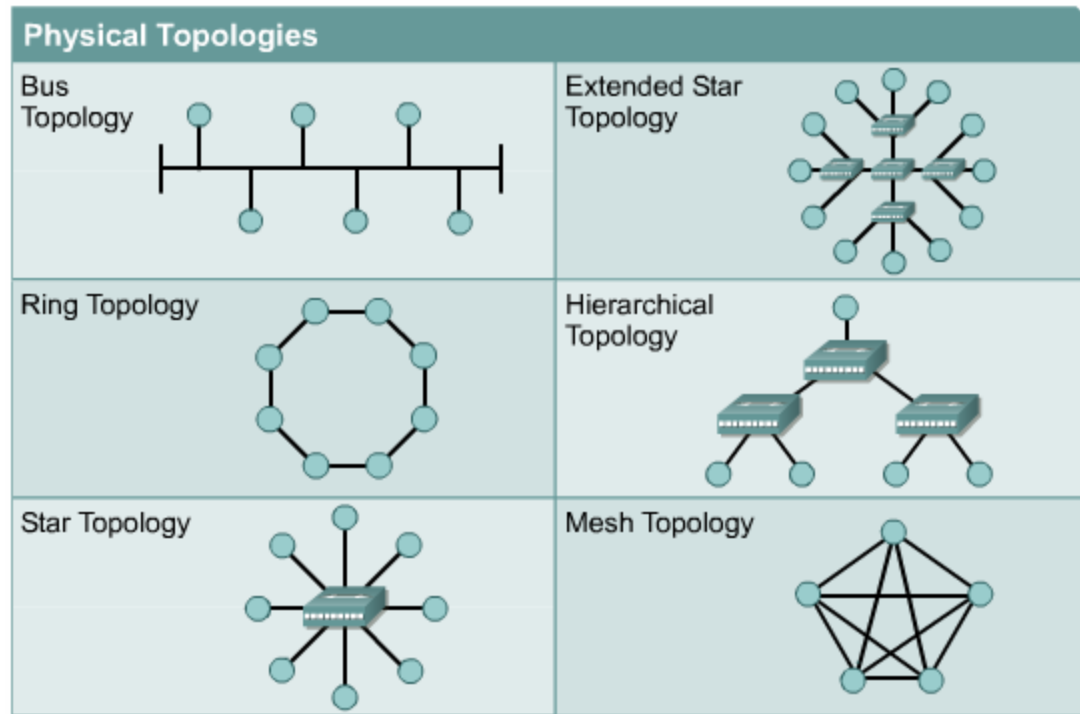
- We need to learn how to connect these devices together with cables in order to form a network.
- Network topology shows us a few way to do this.

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.

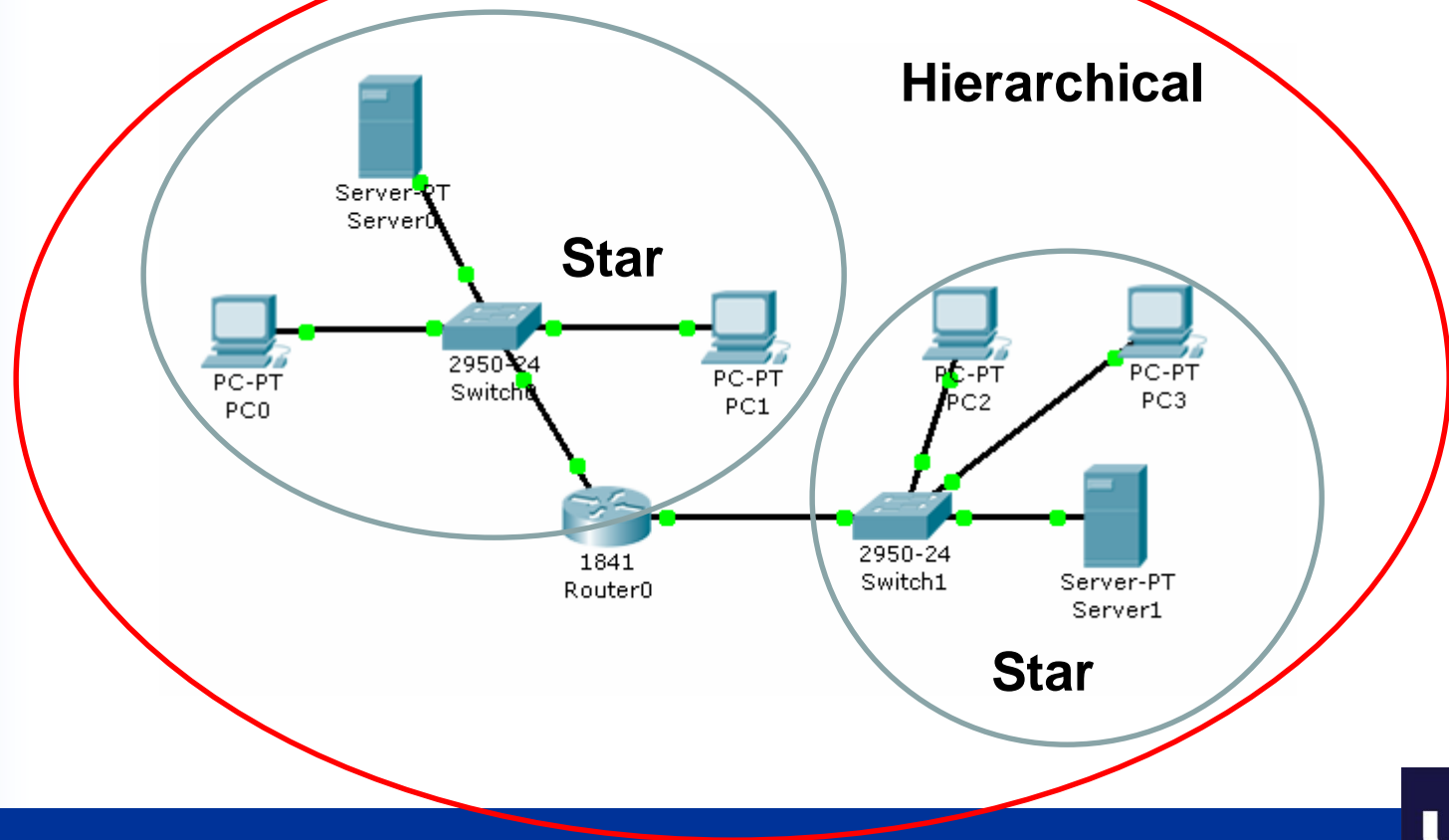
Network Topology - 2

- 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

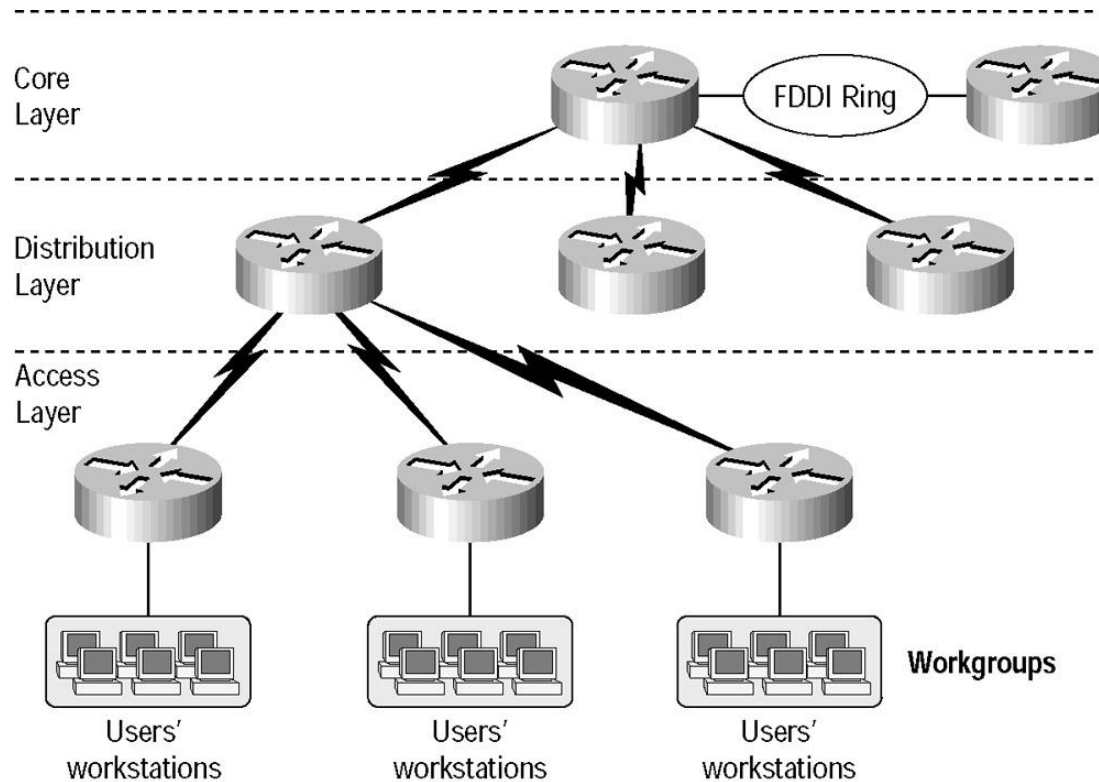


Example 2: LAN

- 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

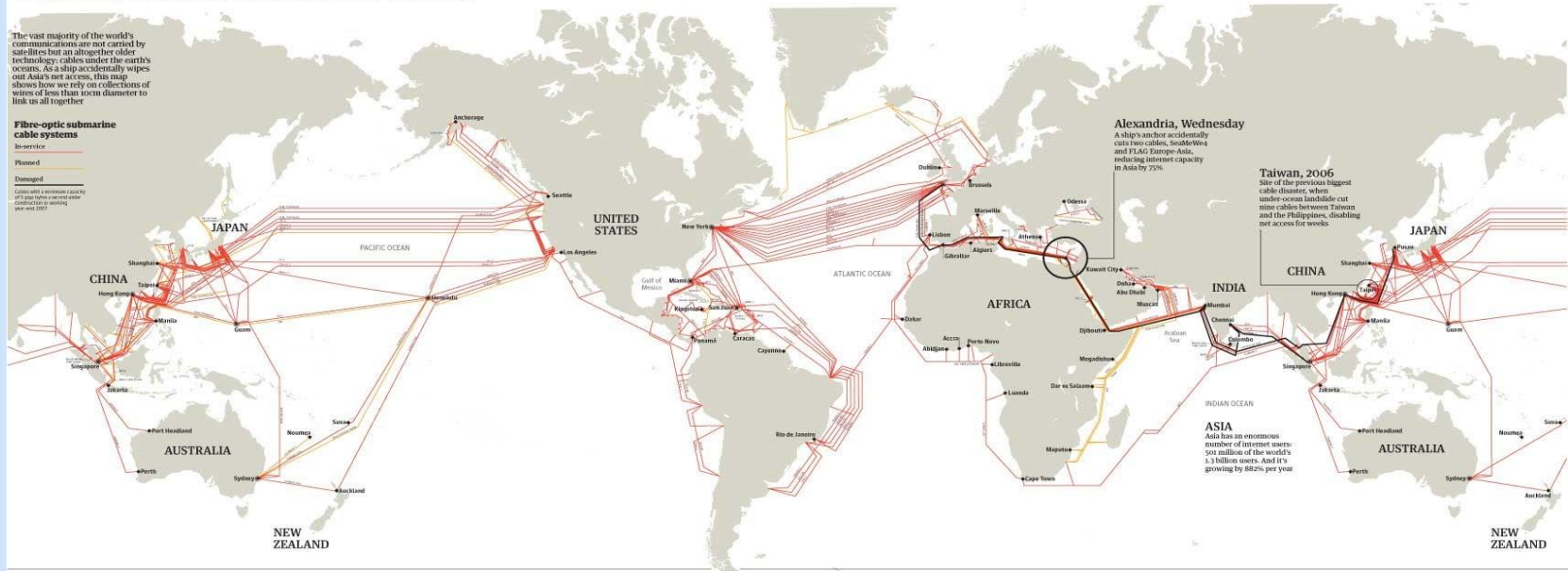
- In enterprise network, hierarchical/tree topology is normally the preferred network topology.
 - An efficient enterprise network is normally organized as a hierarchy/tree of LANs.



Example 4: Internet

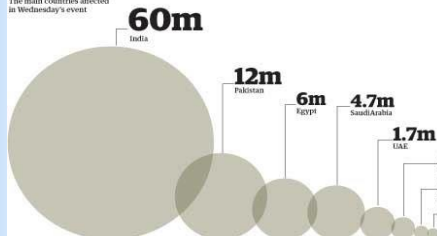
The Internet is a mesh topology.

The internet's undersea world



Internet users affected by the Alexandria accident

The main countries affected in Wednesday's event



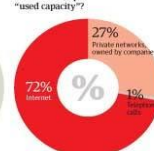
World cable capacity

Submarine cable operators light 0.01m on capacity on their systems to sell bandwidth to other carriers. Carriers buy extra capacity, mainly to hold in reserve. On the trans-Atlantic route 80% of the bandwidth is purchased, but only 29% is used

Capacity in terabytes a second



What makes up "used capacity"?



The longest submarine cables

The SouthWest is proven from Needles in Greenway to Keel, South Korea connects 32 different countries with 39 landing points

SouthWest	39,000 km
Southern Cross	30,500 km
China-ES	30,470 km
FLAG Europe-Asia	28,000 km
South America-1	25,000 km

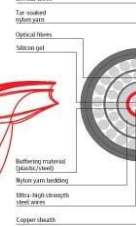
The world's cables in bandwidth

The first transcontinental telephony submarine cable system, TAT-1, connected North America to Europe in 1956 and had an initial capacity of 64,000 bytes per second. Since then, total trans-Atlantic cable capacity has soared to over 7 trillion bps



Cross-section of a cable

Cables of this strength are typically 100mm in diameter and weigh over 10,000 kilograms a kilometre. In deep water, lighter and less insulated cables are used



SOURCE: TELEGRAPHIC COMMUNICATIONS CABLE MAP 2008. INTERNET STATISTICS FROM INTERNETWORLDSTATS.COM

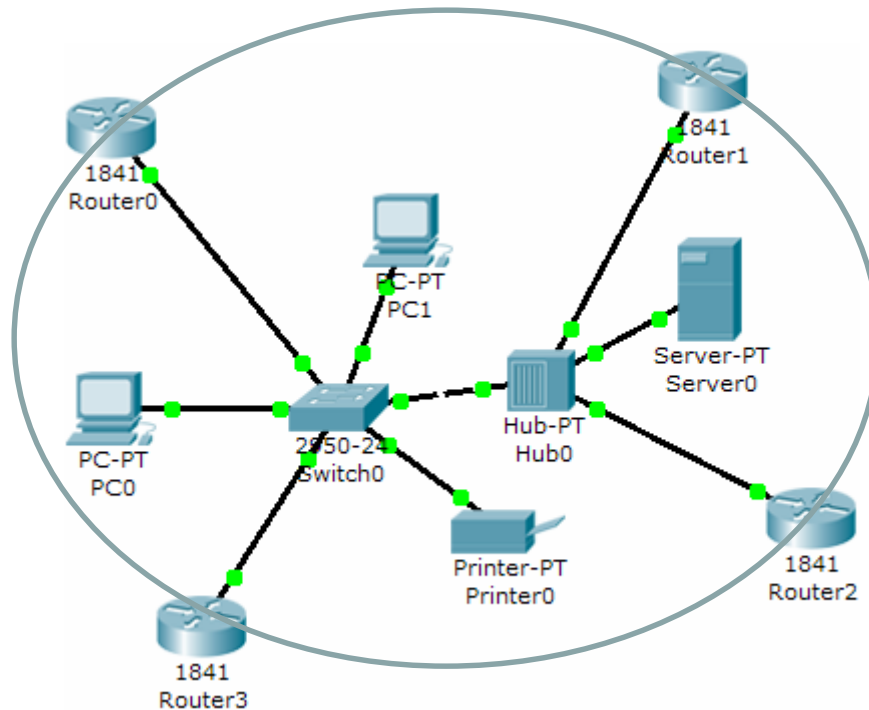
Issues of Network Topology

- 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

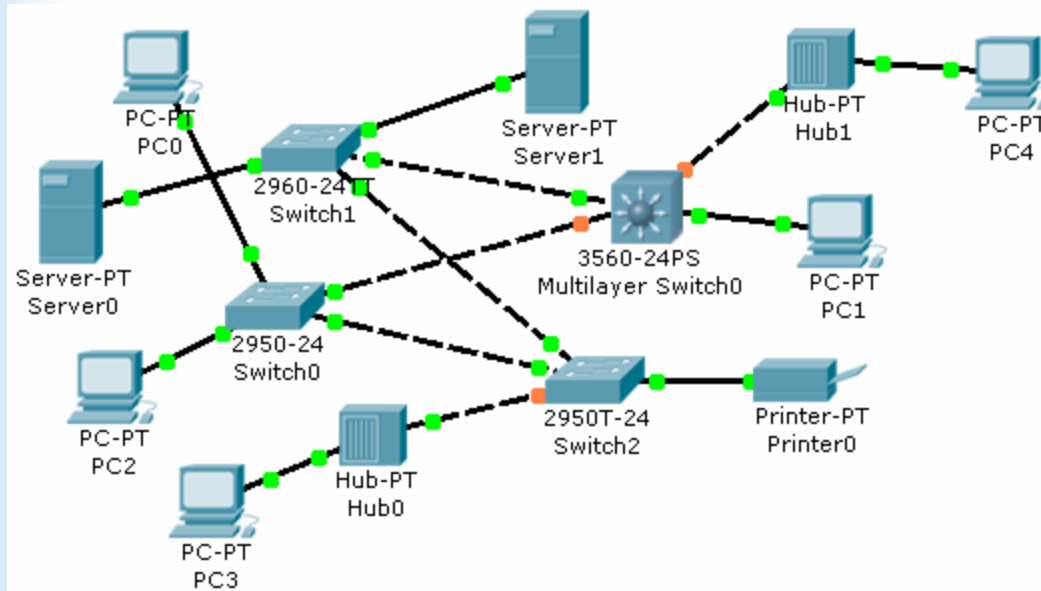
LAN Boundary

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

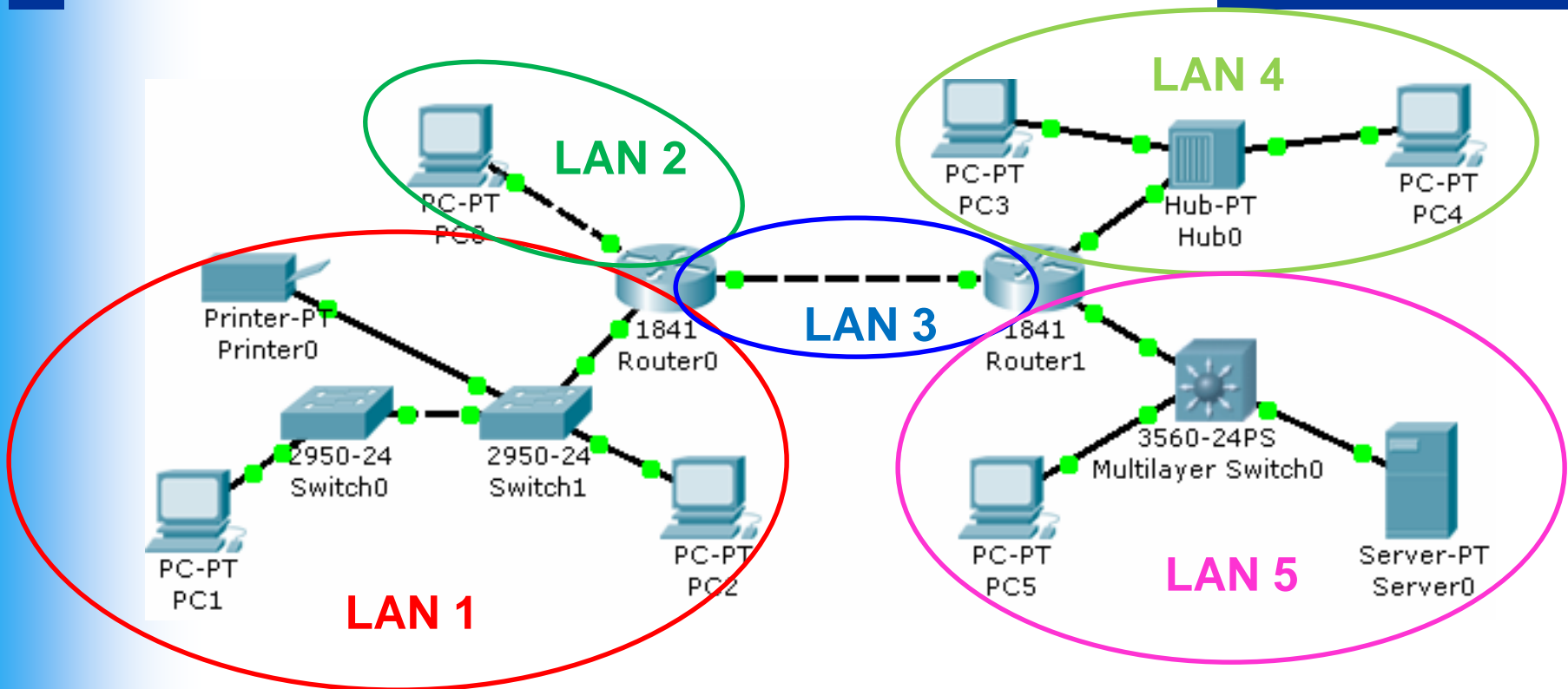


Still 1 LAN

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

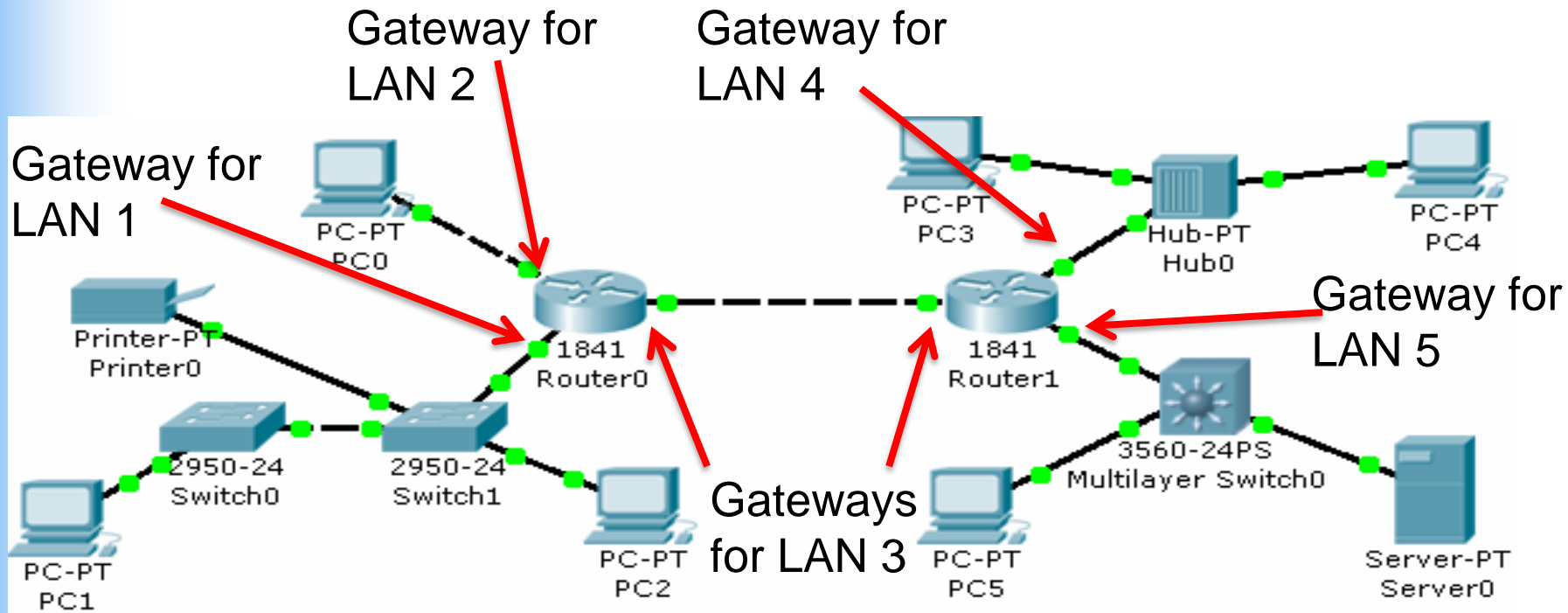
- No matter how many switches and hubs (of different models) are connected together, functionally they still form the same one LAN.

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



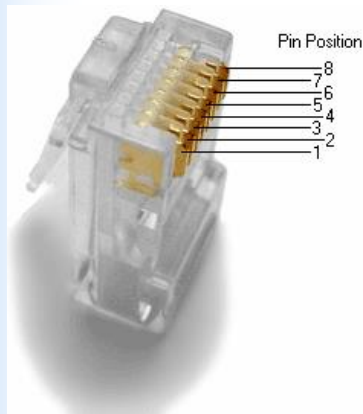
Rollover Cable

- 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.

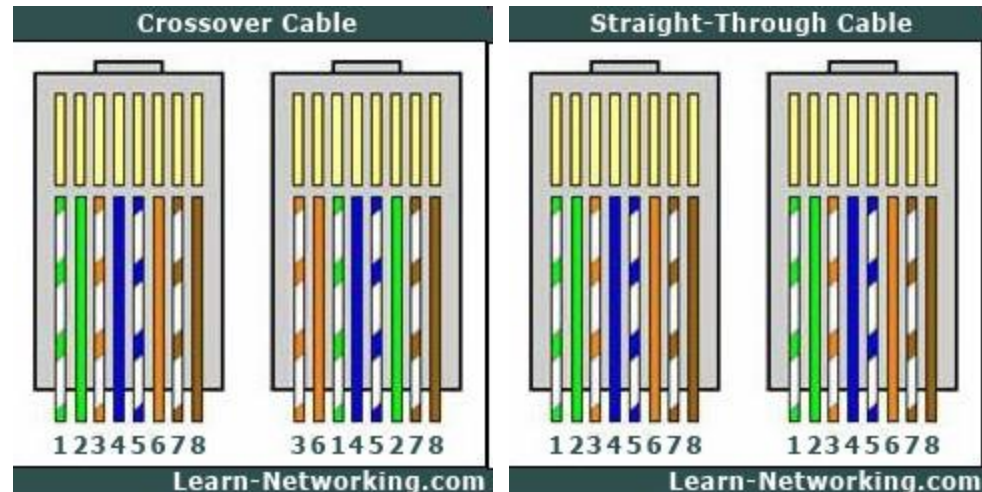


Ethernet Copper Cable (Cat 5)

- 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.

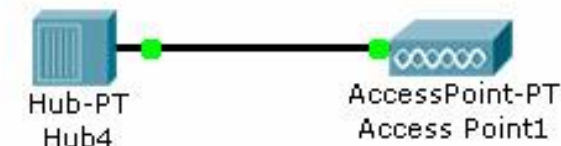
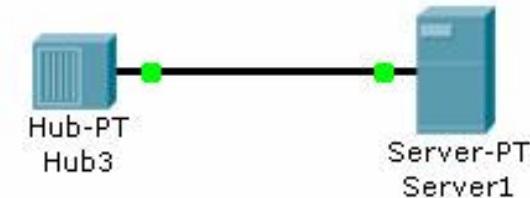
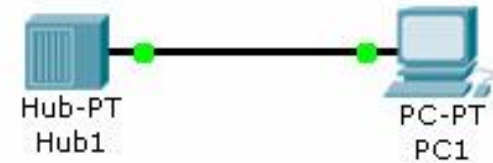
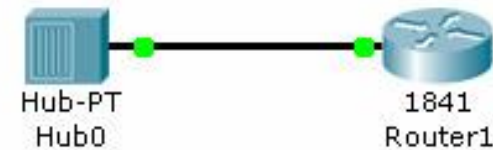
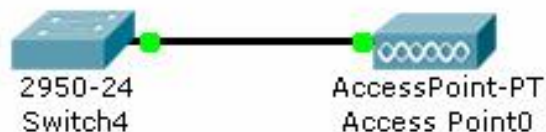
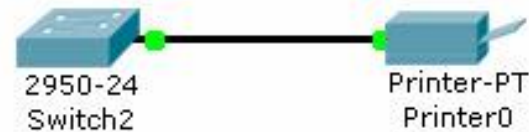
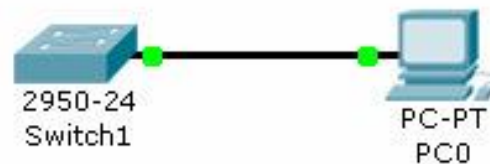
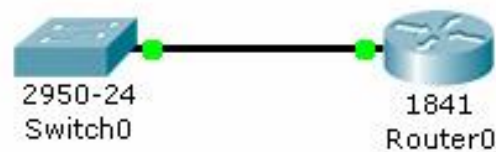


RJ-45 connector



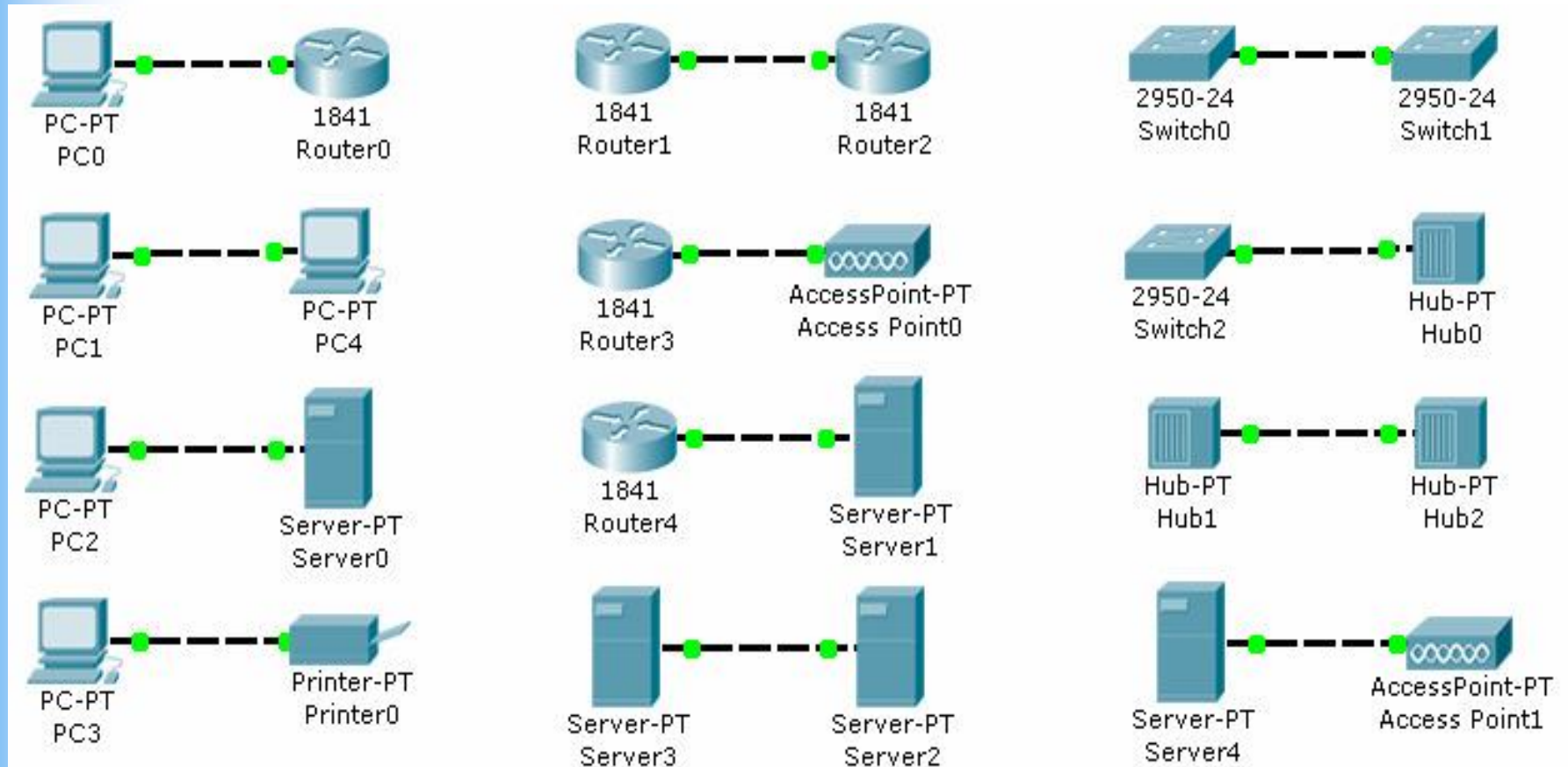
Straight-through cables are used in...

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



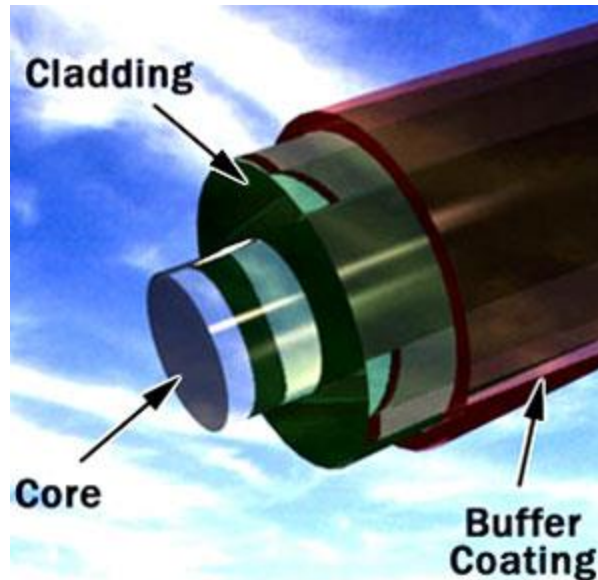
Cross-over cabled are used in...

- 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.



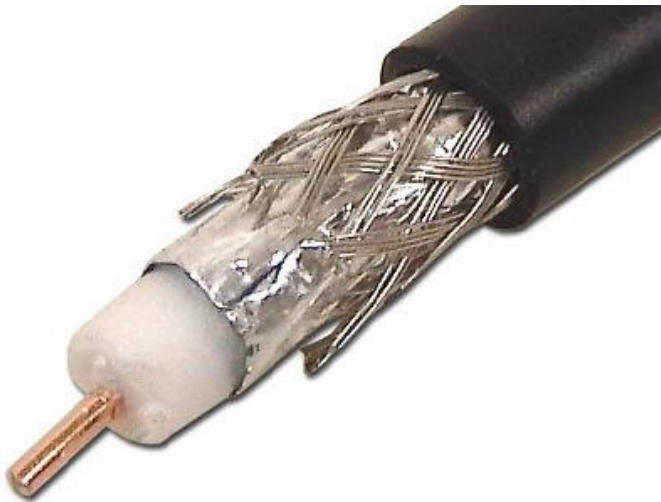
Telephone Cables

- 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.



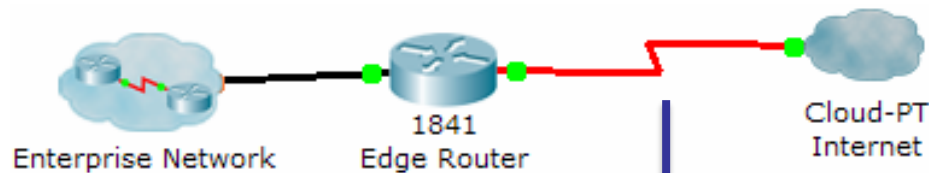
Coaxial Cable

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



Serial Cable

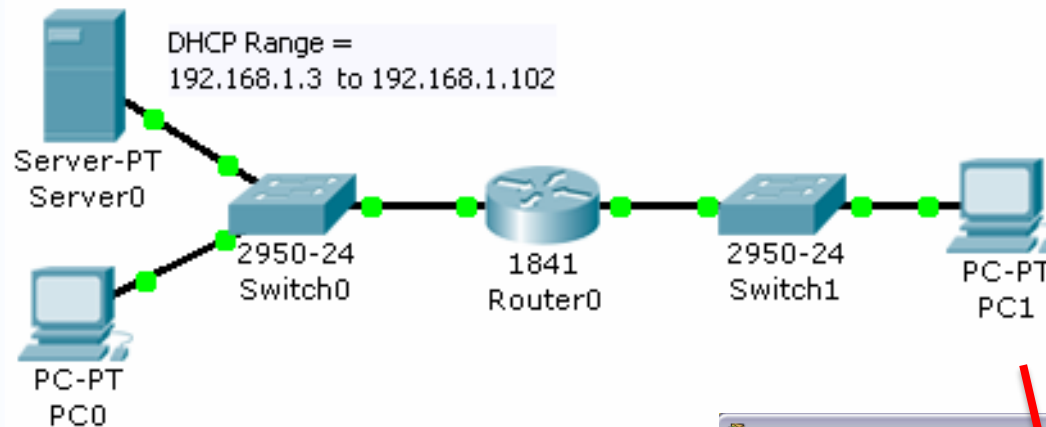
- Used in connecting router of an enterprise network to Internet (via Telephone companies (telco), or Internet service provider (ISP))



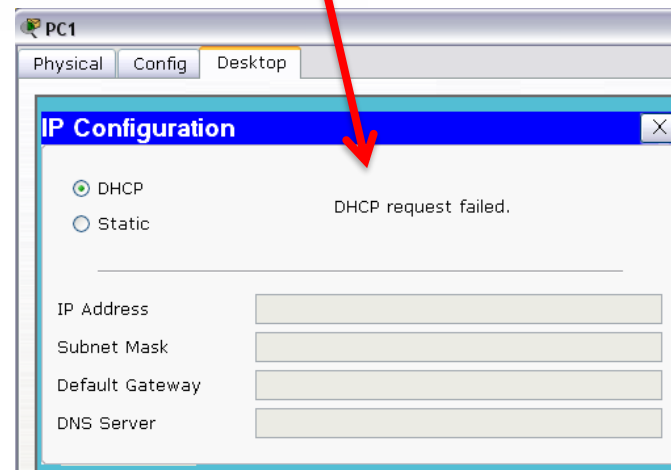
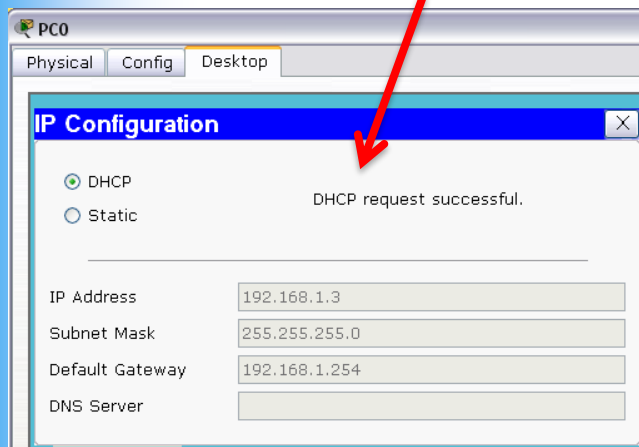
Placement of Services/Servers

DHCP in a LAN

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

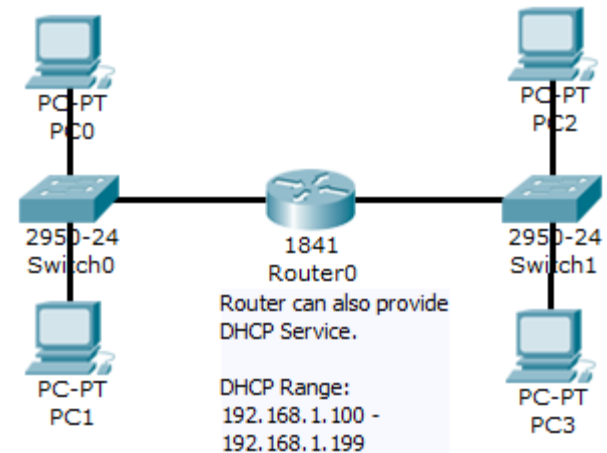
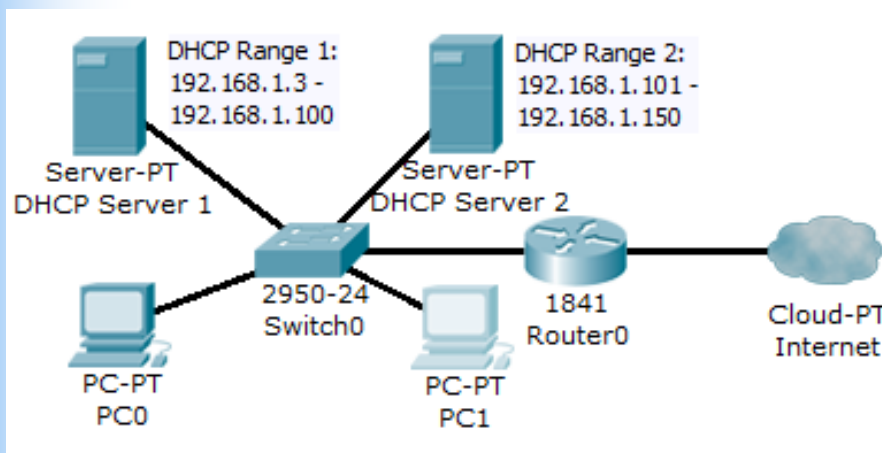


PC1 can't get the dynamic IP from Server0 because Router0 has blocked it.



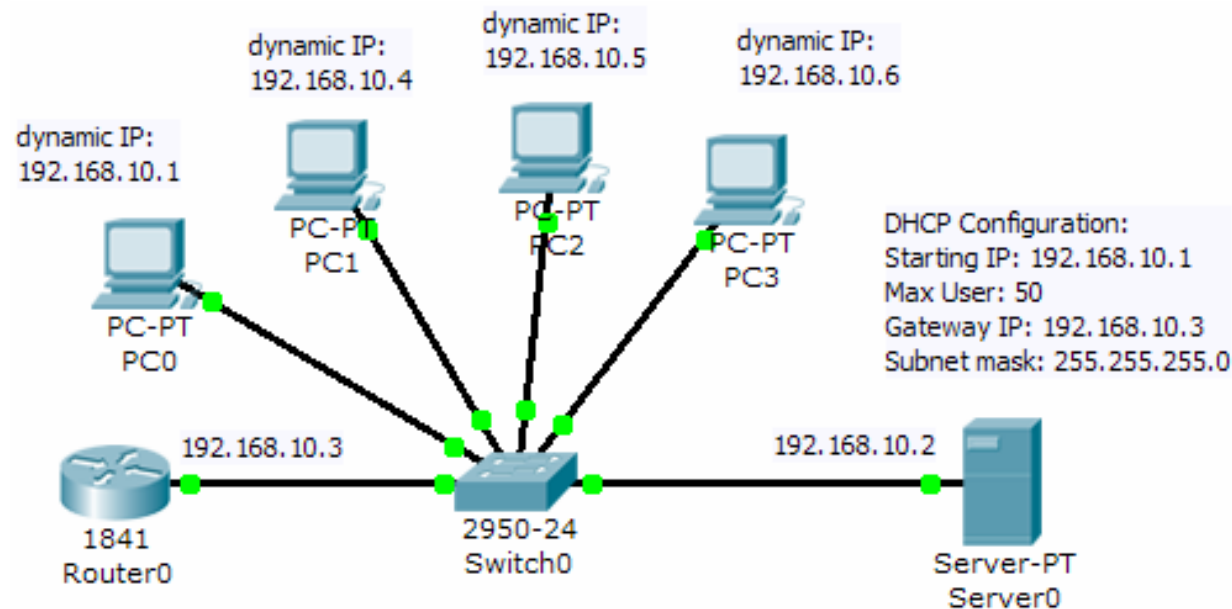
DHCP Server Placement

- 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



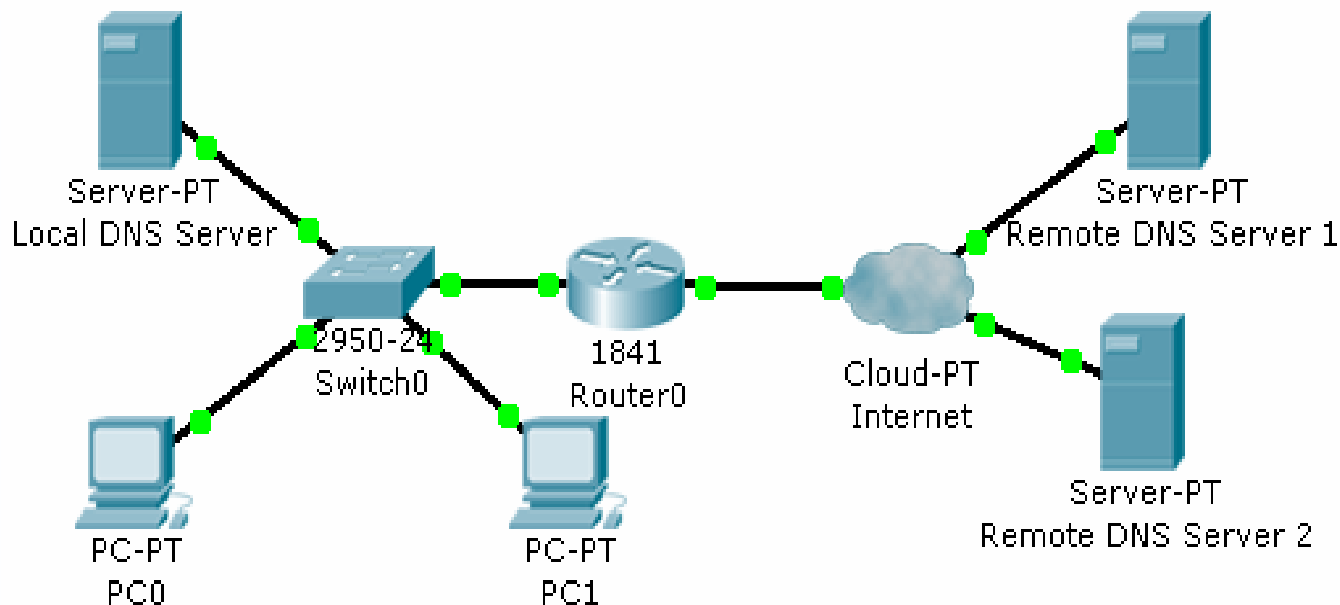
IP Issues on DHCP Service

- 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.