

# Chit-Chat in Lab (CCL)



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# NIC

- NIC: Network Interface Controller
- It connects a device to a computer network
  - A device, e.g., a computer must have an NIC in order to connect to a network
- It is also known as
  - Network Interface Card
  - Network Adapter
  - LAN Adapter
  - Physical Network Interface
- Common manufacturers:
  - Intel, Realtek, Broadcom, Qlogic, Group,



# NIC Address

- In order to communicate with other devices, each NIC needs two kinds of addresses
  - Physical Address
  - Logical Address
- Physical Address
  - One NIC can have only one Physical address
  - This is a lifetime address
  - MAC Address
- Logical Address
  - One NIC may have multiple logical address at the same time (rare use)
  - This is changeable by *Administrator* or *OS* or *DHCP server*
  - IP Address

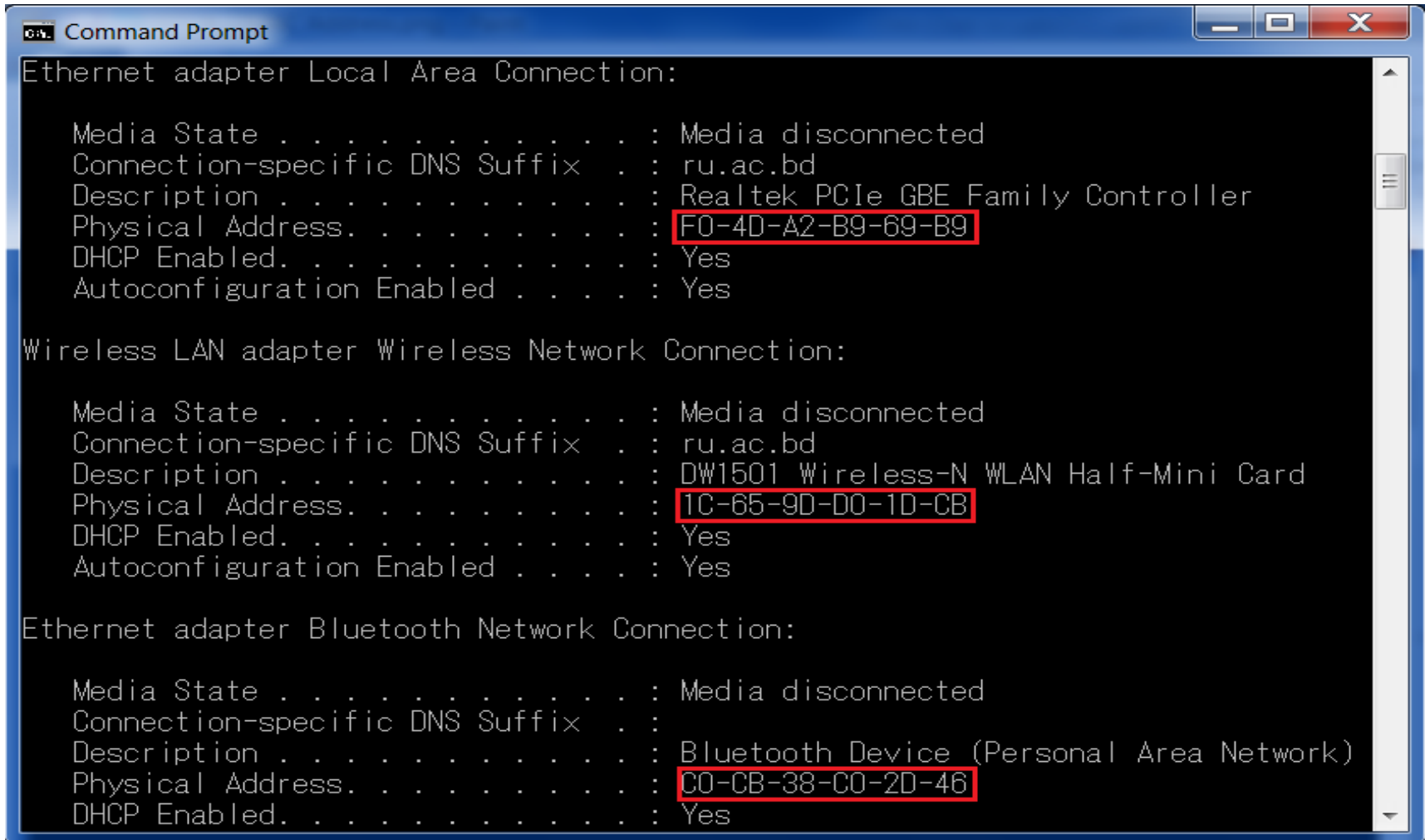
# MAC Address

- MAC: Medium Access Control
  - Each NIC has a **unique** physical address known as MAC address.
  - It is 48 bit long written in either of these formats:
    - MM:MM:MM:SS:SS:SS
    - MM-MM-MM-SS-SS-SS
      - ← OUI → ← NIC specific →
- \*OUI: Organizationally Unique Identifier
- It is assigned by the manufacturer of NIC
    - Inside a read-only memory
    - firmware

# How to Know MAC Address

- In Windows OS
  - Go to the Command prompt
    - Click on Start button, select Run
    - Type 'cmd' and press ENTER
  - In the Command prompt, type **ipconfig /all** and press ENTER
- In Linux OS
  - Go to a terminal
  - In the terminal, type **ifconfig** and press ENTER

# Example: A Laptop having 3 MAC Addresses



```
Command Prompt

Ethernet adapter Local Area Connection:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . : ru.ac.bd
Description . . . . . : Realtek PCIe GBE Family Controller
Physical Address. . . . . : F0-4D-A2-B9-69-B9
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Wireless Network Connection:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . : ru.ac.bd
Description . . . . . : DW1501 Wireless-N WLAN Half-Mini Card
Physical Address. . . . . : 1C-65-9D-D0-1D-CB
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Bluetooth Network Connection:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Description . . . . . : Bluetooth Device (Personal Area Network)
Physical Address. . . . . : C0-CB-38-C0-2D-46
DHCP Enabled. . . . . : Yes
```

# IP Address

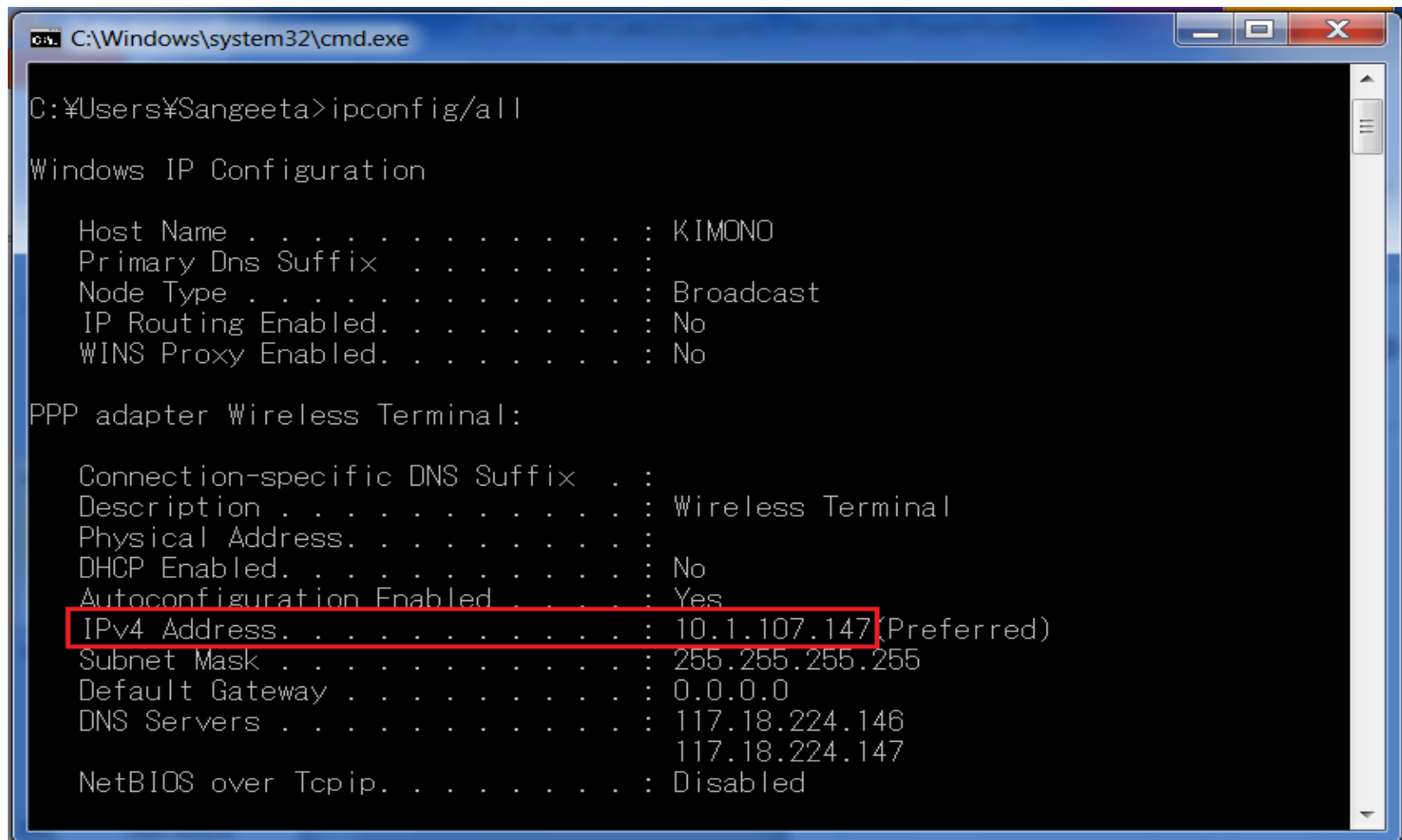
- In order to communicate with other machines in the network based on Internet Protocol, each machine must have an IP (Internet Protocol) address.
- An IPv4(IP version 4) or IP (in short) address is 32 bit long.
  - $2^{32}$  or 4,29,49,67,296 IP addresses.
- An IP address is written by 4 numbers separated by 3 dots.
  - $a.b.c.d$  where  $\{0 \leq \{a, b, c, d\} \leq 255\}$
  - Example: 172.16.0.1

# How to Know IP Address

- In Command Prompt of Windows OS
  - Type **ipconfig/all** and Enter
- In GUI of Windows OS
  - Go to 'Control Panel'
  - Click on 'Network and Internet' → View network status and tasks'
  - Click on 'Connections: '
  - Click on 'Details' Tab
- In Linux
  - Open a terminal
  - Type 'ip addr show' to see all IP addresses
  - Type 'ip addr show eth0' to see IP information about eth0



# Example: IP Address in Command Prompt



```
C:\Windows\system32\cmd.exe

C:\Users\Sangeeta>ipconfig/all

Windows IP Configuration

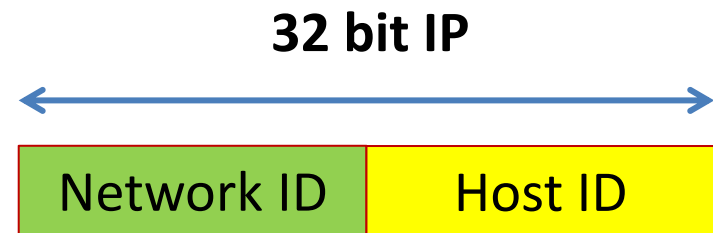
    Host Name . . . . . : KIMONO
    Primary Dns Suffix . . . . . :
    Node Type . . . . . : Broadcast
    IP Routing Enabled. . . . . : No
    WINS Proxy Enabled. . . . . : No

PPP adapter Wireless Terminal:

    Connection-specific DNS Suffix . :
    Description . . . . . : Wireless Terminal
    Physical Address. . . . . :
    DHCP Enabled. . . . . : No
    Autoconfiguration Enabled . . . . : Yes
    IPv4 Address. . . . . : 10.1.107.147(Preferred)
    Subnet Mask . . . . . : 255.255.255.255
    Default Gateway . . . . . : 0.0.0.0
    DNS Servers . . . . . : 117.18.224.146
                           117.18.224.147
    NetBIOS over Tcpip. . . . . : Disabled
```

# Parts of IP Address

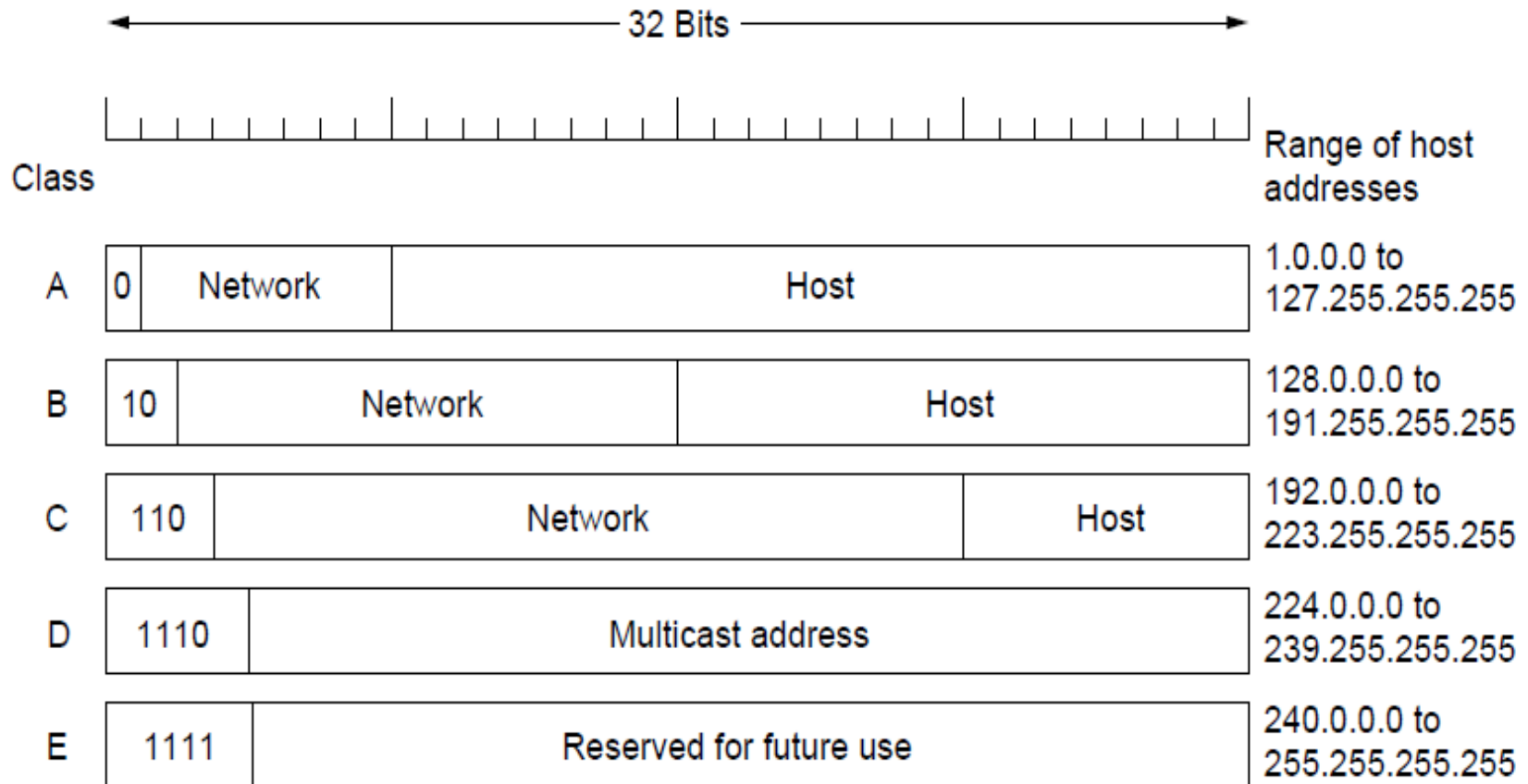
- An IP address does not actually refer to a device. It refers to a network interface.
- If a device, e.g., router, is on two networks, it must have two IP addresses.
- An IP address has two parts
  1. Network ID
  2. Host ID
- There are two ways to decide the boundary of each part:
  - Classful Addressing
  - Classless InterDomain Routing (CIDR)



# Classful Addressing

- For several decades, IP addresses were divided into 5 classes
  - Class A, B, C, D and E
- **Class A:** 128 networks with 16 million hosts  
**Class B:** 16,384 networks with up to 64,000 hosts  
**Class C:** 2 million networks with up to 256 hosts
- This concept is no longer used, only found in literature, because
  - The number of networks connected to the Internet is growing every year. Classful addressing cannot support this growth.

# IP Address Range in Classful Addressing



# Special IP Address

0 0																																This host								
0 0								...								0 0								Host																A host on this network
1 1																																Broadcast on the local network								
Network								1 1 1 1								...								1 1 1 1								Broadcast on a distant network								
127								(Anything)																								Loopback								

# Private Vs Public IP Address

- Uniqueness:
  - Private IP addresses could be duplicate in different home/office/enterprise networks, e.g., LAN, as long as they are not interconnected.
  - Public IP addresses cannot be duplicate. In order to communicate on Internet, each machine must have a **unique global/public/real IP** address.
- Responsible:
  - Network administrator is responsible for deciding private IP addresses for a private network
  - IANA and 5 RIRs(APNIC, AfriNIC, ARIN, LACNIC & RIPE NCC) are responsible for managing real IP addresses.

# Range of Private IP Addresses

- Private IP assigned by network administrator:
  - ❖ 10.0.0.0 - 10.255.255.255
  - ❖ 172.16.0.0 - 172.31.255.255
  - ❖ 192.168.0.0 - 192.168.255.255
- Private IP assigned by Operating System
  - 169.254.0.0 -169.254.255.255
  - It is enabled by default in Microsoft Windows OS.
  - It could occur on a network
    - without a DHCP server, or
    - if a DHCP server is temporarily down for maintenance

# Authority for Managing IP

- **IANA: Internet Assigned Numbers Authority**
- **IANA** is responsible for the global coordination of
  - the DNS Root,
  - **Internet number**
  - other Internet protocol resources.
- Internet number resources include:
  - **IP addresses**
  - autonomous system (AS) numbers
- **RIR: Regional Internet Registry**
- RIR is an organization that manages the allocation and registration of Internet number resources (e.g., **IP addresses**) within a particular region of the world.



# Division of World into RIRs

1. AfriNIC (**African Network Information Centre**): Africa
2. ARIN (**American Registry for Internet Numbers**): the United States, Canada, several parts of the Caribbean region, and Antarctica.
3. APNIC (**Asia-Pacific Network Information Centre**): Asia, Australia, New Zealand, and neighboring countries
4. LACNIC (**Latin America and Caribbean Network Information Centre**): Latin America and parts of the Caribbean region
5. RIPE NCC(**Réseaux IP Européens Network Coordination Centre**): Europe, Russia, the Middle East, and Central Asia

## RIR SERVICE REGIONS



Fig: Service regions of five RIRs nowadays



Fig: Service regions of three RIRs in 2002-2005



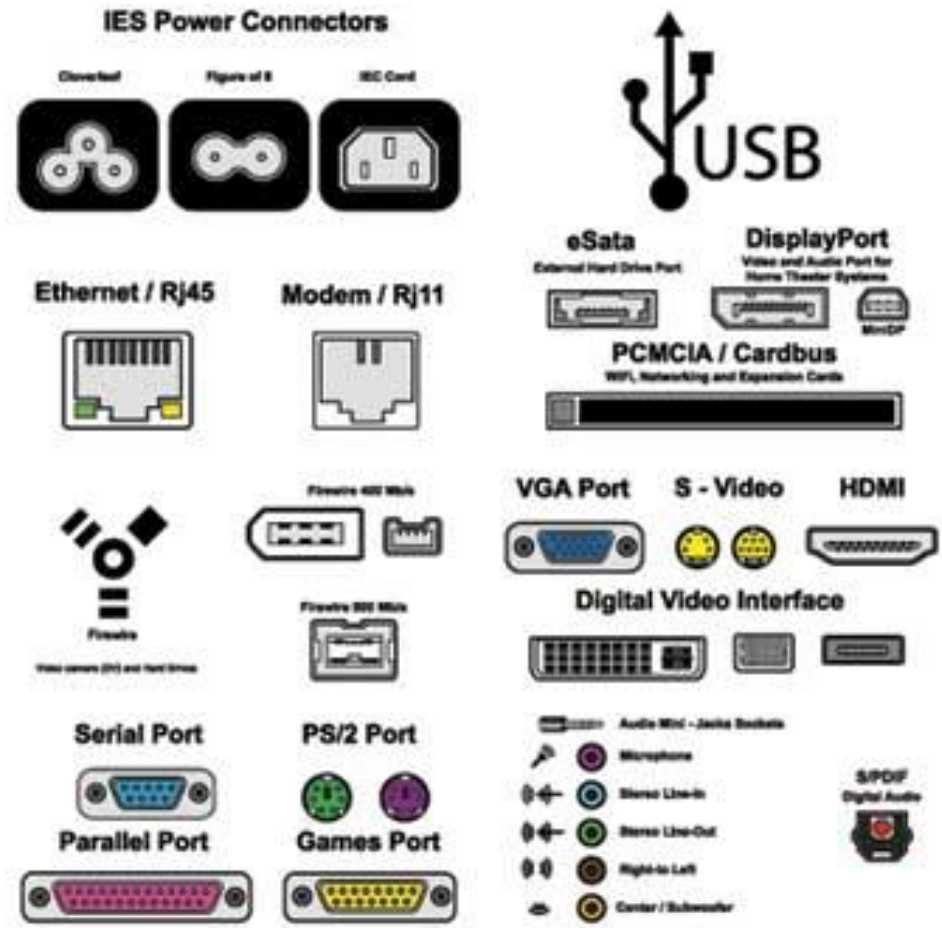
Fig: Service regions of three RIRs in 2002

# APNIC

- Founded: 13 January, 1993
- Focus:
  - **allocating IPv4** and IPv6 address space, and Autonomous System Numbers,
  - maintaining the public Whois Database for the Asia Pacific region,
  - representing the interests of the Asia Pacific Internet community on the global stage.
- Location: Brisbane, Queensland, Australia
- Website: [www.apnic.net](http://www.apnic.net)
- Members: 4,737 from 56 economies
  - **Bangladesh has 207 members** here [**checked on 20.3.2015**]

# Port

- In computer networking 'port' refers to connection points.
- There are two kinds of ports
  1. Physical port
  2. Logical port
- Physical Port:
  - ❖ an interface on a device in which user can insert a connector for that device



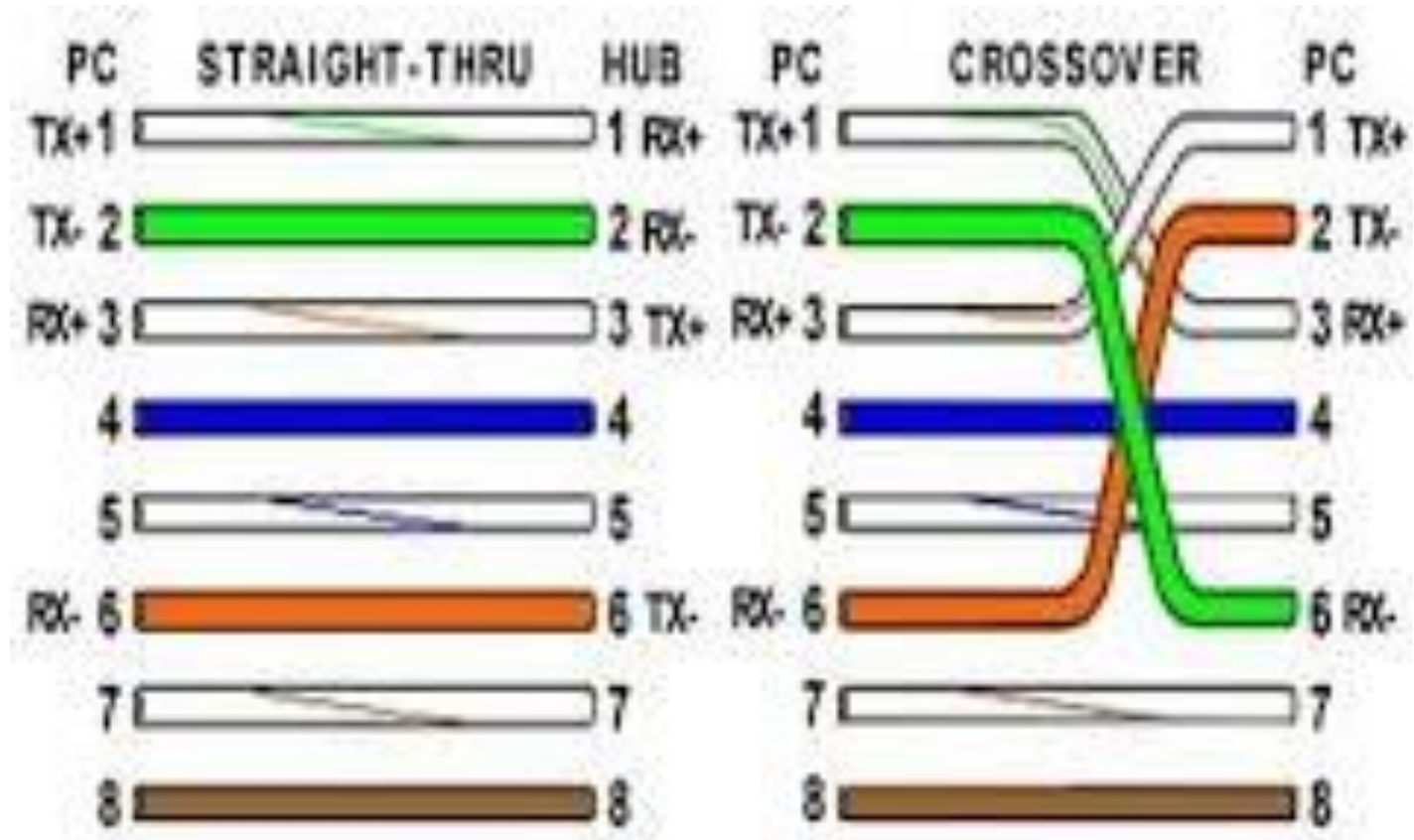
Different kind of Physical Ports



# Logical Port

- A port is an end-point of a logical connection and the way where a client program specifies a particular server program on a computer in a network.
- It is always associated with an IP address of a host and the protocol type of the communication.
- A logical port number is 16-bit long.
  - There are 0-65535 logical port numbers.
  - 0-1024 numbers are used for well-known services.
  - Well-known port numbers are assigned by IANA.
- Some well-known ports
  - 20 → FTP data      21 → FTP control
  - 53 → DNS service      80 → HTTP
  - 546 → DHCP Client      547 → DHCP Server

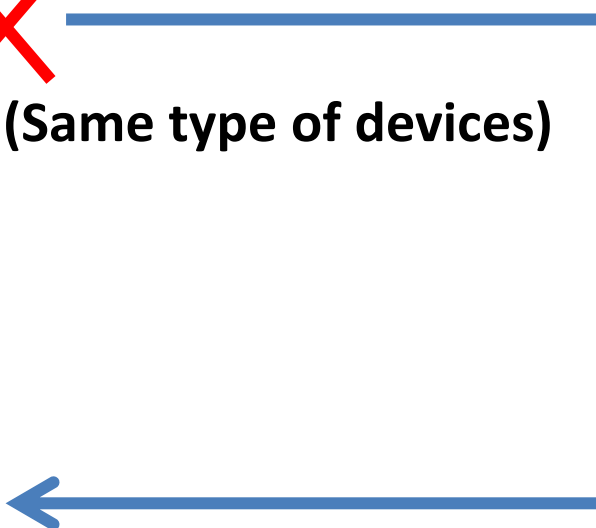
# Connection: Straight-Through vs. Cross-Over



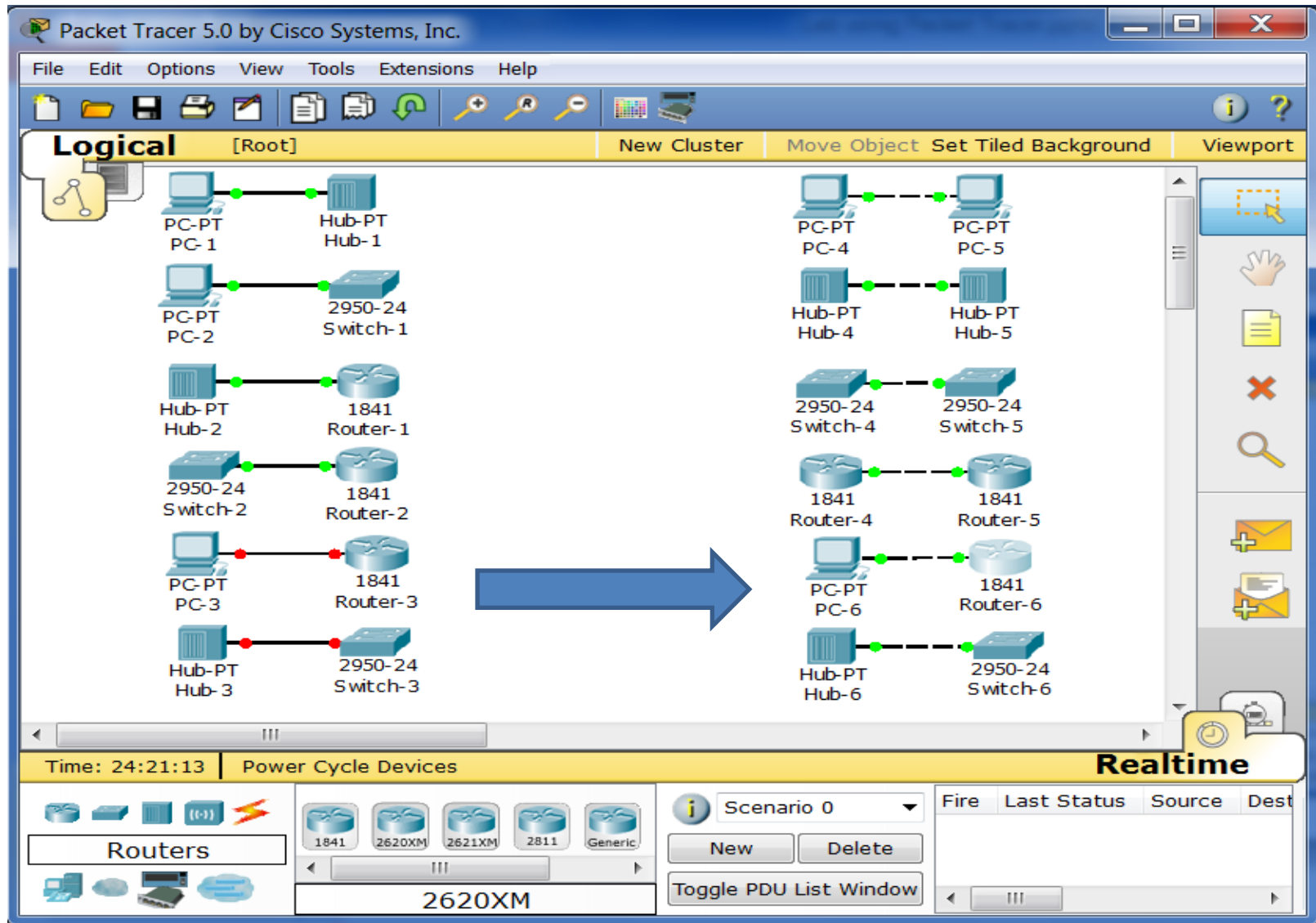
\*\*\* In Cross-over connection, only (1&3) and (2&6) are crossed



# End-points: Straight-Through vs. Cross-Over

- **Straight-Through (Different type of devices)**
    - PC-to-Hub
    - PC-to-Switch
    - Switch-to-Router
    - Hub-to-Router
    - **PC-to-Router**
    - **Hub-to-Switch**
  - **Copper Cross-Over (Same type of devices)**
    - PC-to-PC
    - Hub-to-Hub
    - Switch-to-Switch
    - Router-to-Router
    - **PC-to-Router**
    - **Hub-to-Switch**
- 

# Coper Straight-Through Vs. Cross-Over



# DHCP

- DHCP : Dynamic Host Configuration Protocol
- It is a protocol used to **automatically/dynamically provide network configuration information** to devices connected to an IP network.
- DHCP usually provides:
  - **IP Address**
  - Subnet mask
  - Gateway address
  - Name server address

# Advantages of DHCP(1)

- **Reduced time to configure and deploy:** When the number of hosts is large in a network, DHCP is faster than human engineer especially than inexperienced/ non-technical administrator to allocate unique IP addresses.
- **Reliable IP address configuration:** DHCP minimizes configuration errors caused by manual IP address configuration, such as typographical errors, or address conflicts caused by the assignment of an IP address to more than one computer at the same time.

# Advantages of DHCP(2)

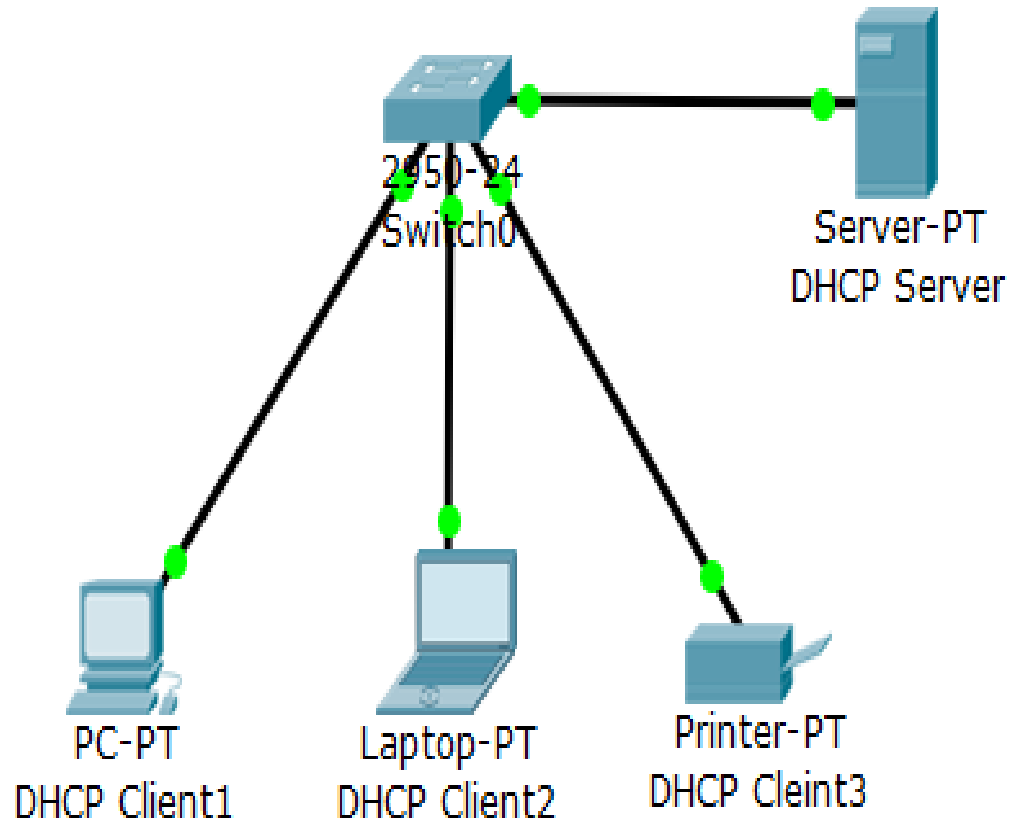
- **Reduced network administration:** DHCP includes features to efficiently handle the IP address changes for clients that must be updated frequently, such as those for portable computers that move to different locations on a wireless network. This feature reduces operational overhead of network administrator.
- **Centralized management:** The DHCP Server maintains configurations for several networks. Therefore, an administrator only needs to update a single, central server when configuration parameters change.

# Advantages of DHCP(3)

- **Reduced costs:**
  - Using automatic IP address assignment at each remote site substantially reduces Internet access costs. Static IP addresses are considerably more expensive to purchase than are automatically allocated IP addresses.
  - Because DHCP is easy to configure, it minimizes costs associated with device configuration tasks and eases deployment by nontechnical users.

# DHCP Server-Client Model

- DHCP is based on a server-client model.
- **DHCP Server:** maintains TCP/IP configuration information and provide address configuration to DHCP-enabled clients in the form of a lease offer.
- **DHCP Client:** obtains an IP address from a DHCP Server dynamically using the DHCP protocol.



# DHCP Address Pool

- Address pool is a set of IP addresses decided by a Network engineer for allocating to DHCP clients by the DHCP server.
- The nature of IP addresses received by DHCP clients will depend on the nature of IP addresses in the pool.
  - For example, if 192.167.23.0 255.255.255.0 is assigned to a pool, DHCP clients will dynamically get **254 real IP** addresses in the range 192.167.23.1-192.167.23.254.
  - On the other hand, if 192.168.23.0 255.255.255.0 is assigned to a pool, DHCP clients will dynamically get **254 private IP** addresses in the range 192.168.23.1-192.168.23.254.



# DHCP Configuration using Packet Tracer 6.1

Recommended PDF :

**Chapter : Configuring DHCP**

**Cisco IOS IP Configuration Guide Release 12.2**

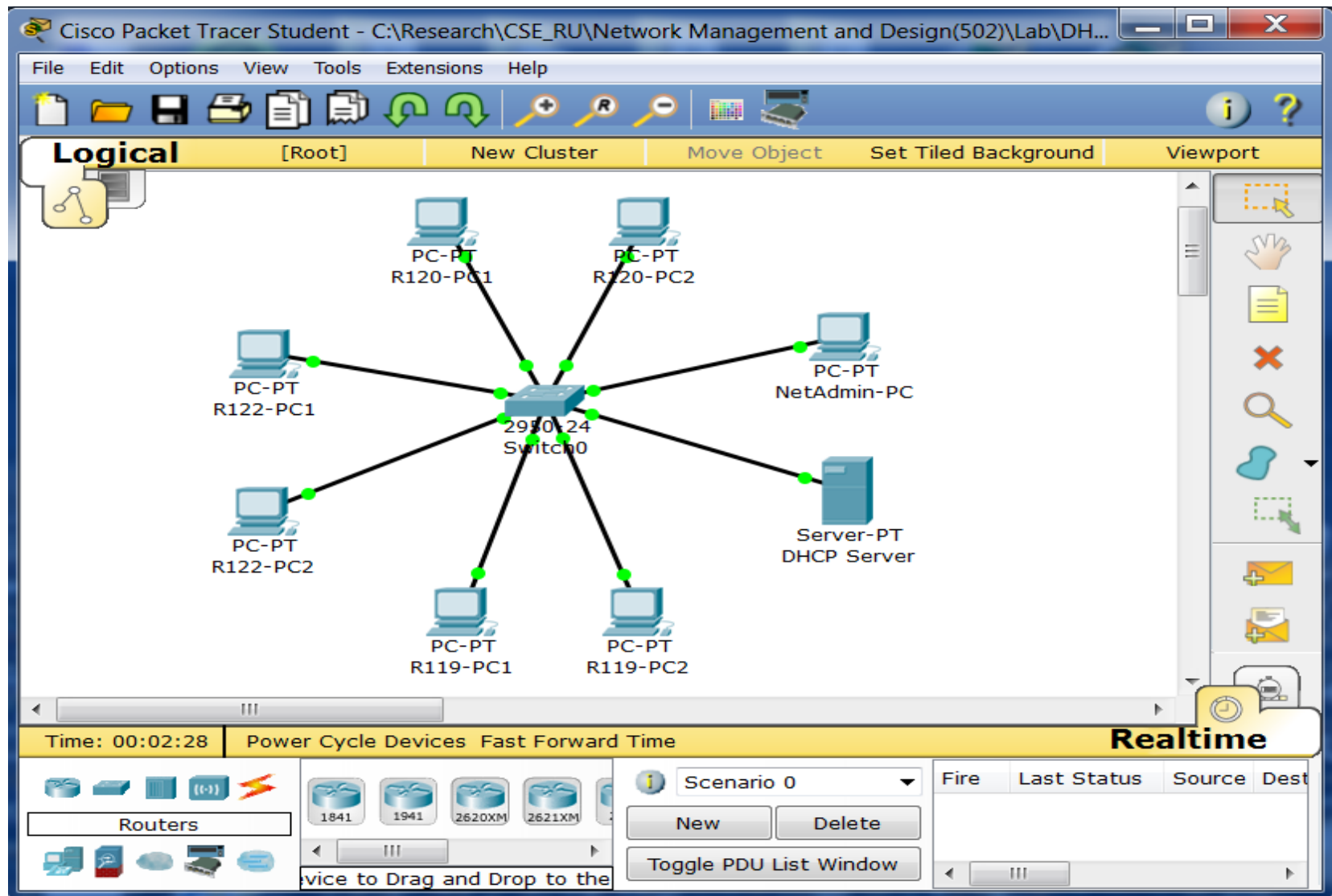
# Problem-1

- Configure a DHCP server for a simple LAN of 8 machines covering four rooms of our CSE department
  - Rooms: admin, R122, R120 and R119
  - At most 30 machines can be attached to this LAN
  - Start IP address: 172.16.0.0
  - DHCP Server's IP address: 172.16.0.1
  - Other machines will get IP addresses from DHCP server when they will be booted. Say if PC-1 of R122 is booted earlier than PC-1 of R119, then R122-PC1 will get lower IP address.

# Solution: CSE Network-1

1. Take one Server and one PC for Admin's room(say, admin).
2. For other three rooms (say R122,R120 and R119), take 2 PCs.
3. Connect all machines to a Switch using **Copper Straight-Through** connector.
4. Wait for a while so that all connections will have green boxes indicating that all machines are connected to Switch.
5. Change name of all machines, eg., R122-PC1, R119-PC1 or NetAdmin-PC, etc. [Figure in next slide]
6. Assign an static IP, say 172.16.0.1, to DHCP server.
7. Rest of the 7 machines will get IP addresses dynamically from the server after DHCP server configuration completed.

# DHCP Server Configured in a Server Machine



# Steps for DHCP Configuration(1)

1. Double click on DHCP server.
2. Open '**Services**' window
3. Click on DHCP
4. Click on Service (On) radio button
5. Put 172.16.0.0 into '**Start IP Address**'.
6. Set Subnet Mask 255.255.255.0
7. Put 30 into '**Maximum number of Users**' box.
8. Click on 'Save' button

The screenshot shows the 'DHCP Server' configuration window. The 'Services' tab is selected, and the 'DHCP' service is listed in the left sidebar. The 'Service' radio button is set to 'On'. The 'Interface' is 'FastEthernet0'. The 'Pool Name' is 'serverPool'. The 'Default Gateway' is '0.0.0.0'. The 'DNS Server' is '0.0.0.0'. The 'Start IP Address' is '172.16.0.0'. The 'Subnet Mask' is '255.255.255.0'. The 'Maximum number of Users' is '30'. The 'TFTP Server' is '0.0.0.0'. The 'Save' button is highlighted.

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users	TFTP Server
serverPool	0.0.0.0	0.0.0.0	172.16.0.0	255.255.255.0	30	0.0.0.0

# Steps for DHCP Configuration(2)

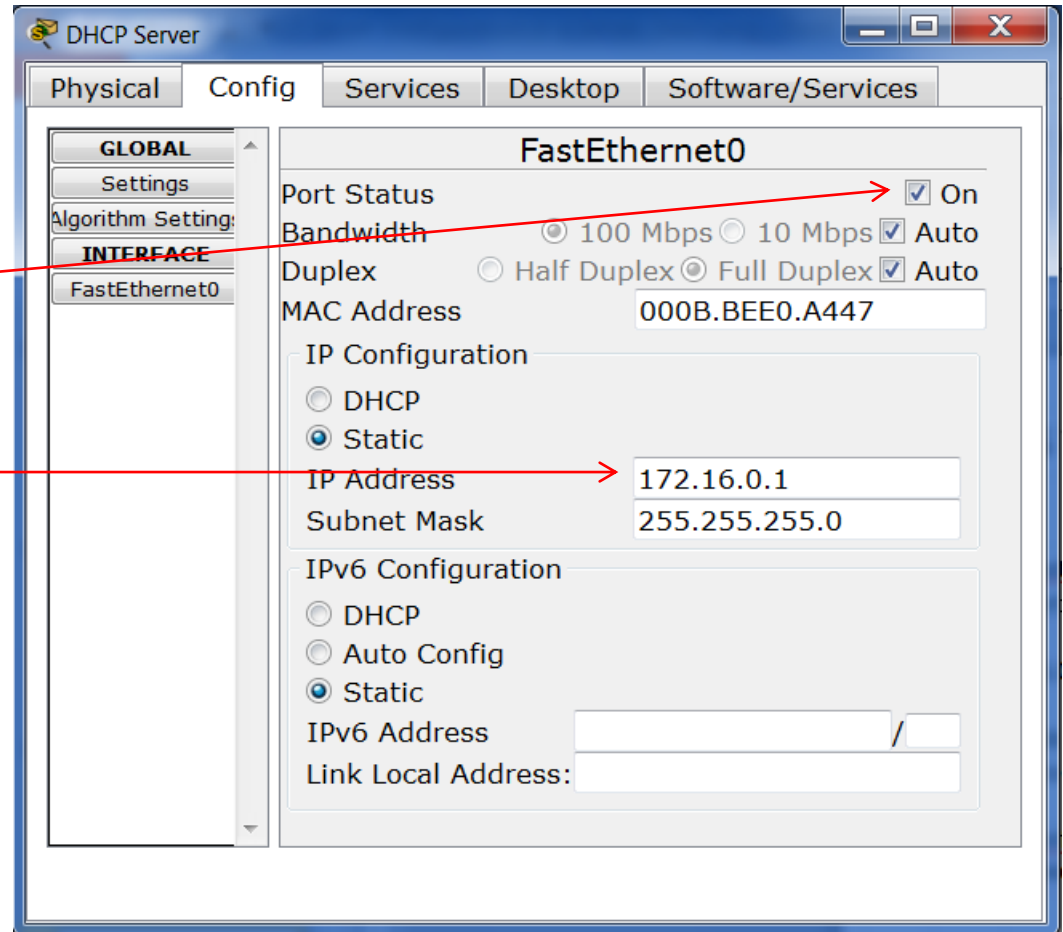
8. Click on Config-> FastEthernet

9. Ensure 'Port Status' is checked.

10. Put 172.16.0.1 into 'IP Address'.

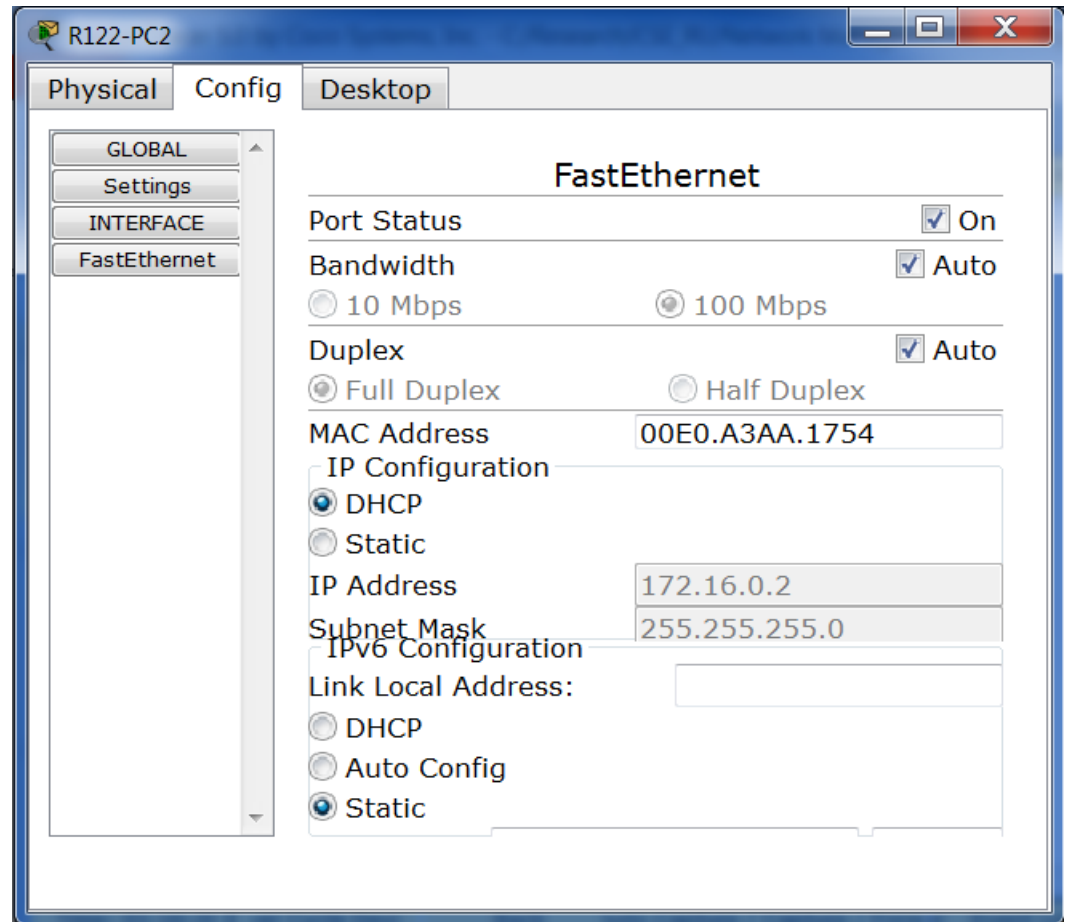
11. Click on Subnet Mask (it will be automatically changed)

12. Close 'Config' window of DHCP Server.



# Steps for IP Address Allocation

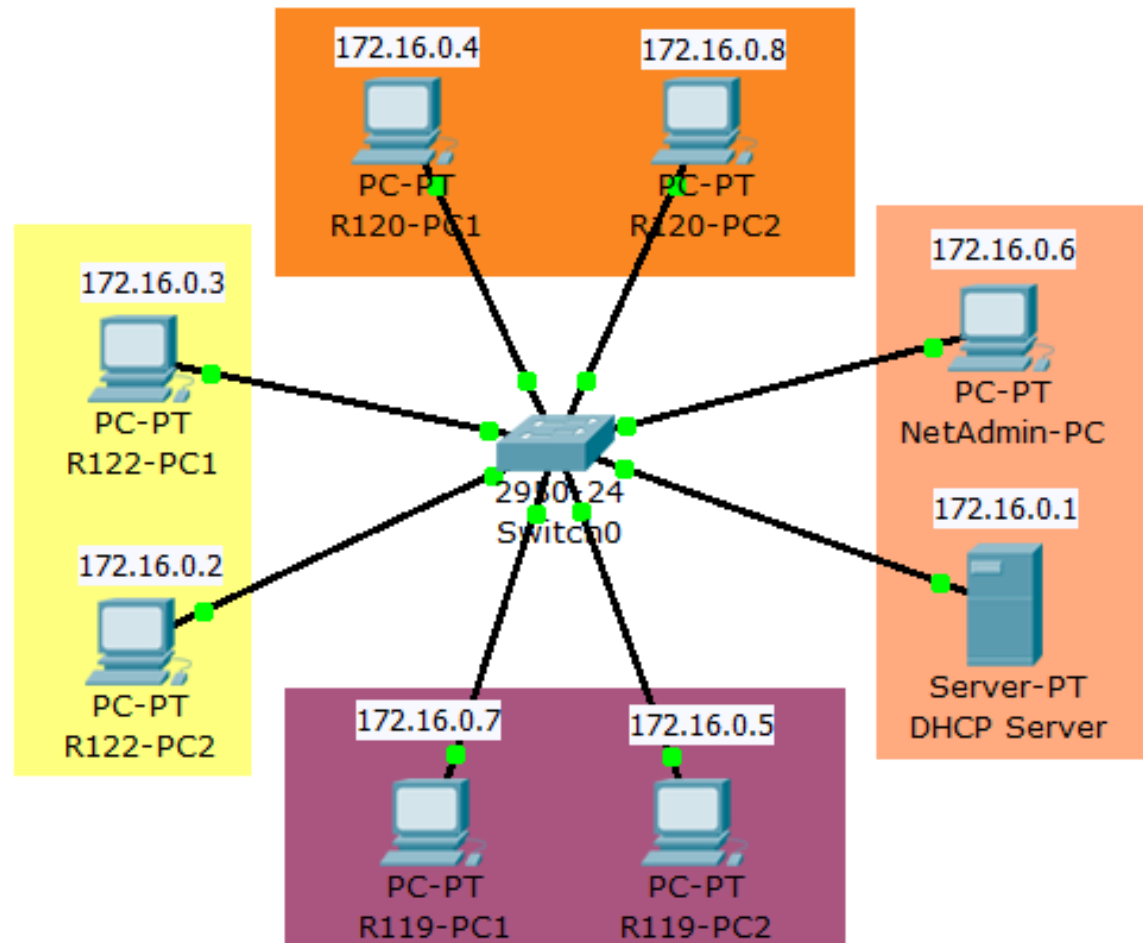
1. Open 'Config' window of a client, e.g., PC.
2. Click on FastEthernet.
3. Ensure 'Port Status' is checked.
4. Click on '**DHCP**' radio button
5. Wait for a while
6. Close 'Config' window of PC.



# Final Look of CSE Network-1

\* PCs of R122 got sequential IP addresses while PCs of other rooms got discontinuous addresses.

\* Allocation of IP addresses was dependent on the clients' booting sequence.





# References

1. Andrew S. Tanenbaum, 'Computer Networks', Pearson
2. Wikipedia
3. <http://www.internetassignednumbersauthority.org/>
4. [http://en.wikipedia.org/wiki/Regional\\_Internet\\_registry](http://en.wikipedia.org/wiki/Regional_Internet_registry)
5. <https://www.ripe.net/internet-coordination/internet-governance/internet-technical-community/the-rir-system>
6. [www.apnic.net](http://www.apnic.net)
7. <http://en.wikipedia.org/wiki/Traceroute>
8. <http://averma82.blogspot.com/2013/05/what-is-portnumber-logical-port.html>

# Confession

- These slides are only for students in order to give them very basic concepts about the giant, “Networking”, not for experts.
- Since I am not a network expert, these slides could have wrong/inconsistent information...I am sorry for that.
- Students are requested to check references and Books, or to talk to Network engineers.