CS 305 Lab Tutorial
Lab 9 DHCP & Packet-Tracer

Dept. Computer Science and Engineering
Southern University of Science and Technology

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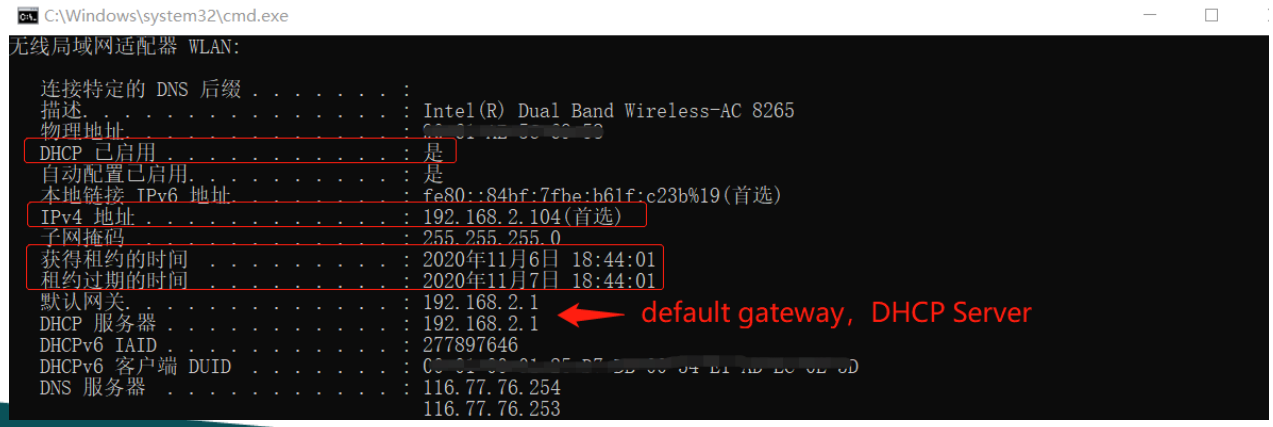
Thanks to Wei WANG

DHCP

DHCP is built on a **Client-Server** model:
where designated **DHCP server** hosts allocate network addresses and deliver configuration parameters to **dynamically configured hosts**.
"**server**" refers to a host providing initialization parameters through DHCP,
"**client**" refers to a host requesting initialization parameters from a DHCP server.

BOOTP is a transport mechanism for a collection of configuration information.
BOOTP using port **67** AND **68** of **UDP**.



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https://www.rfc-editor.org/rfc/rfc2131.txt

DHCP

RFC 2131 Dynamic Host Configuration Protocol March 1997

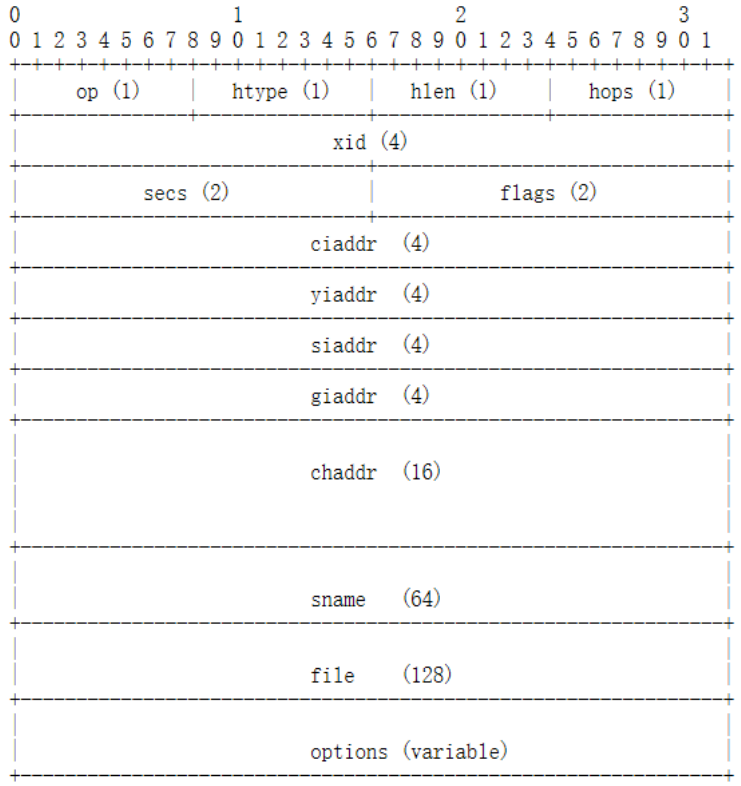

Figure 1: Format of a DHCP message

FIELD	OCTETS	DESCRIPTION
op	1	Message op code / message type. 1 = BOOTREQUEST, 2 = BOOTREPLY
htype	1	Hardware address type, see ARP section in "Assigned Numbers" RFC; e.g., '1' = 10mb ethernet.
hlen	1	Hardware address length (e.g. '6' for 10mb ethernet).
hops	1	Client sets to zero, optionally used by relay agents when booting via a relay agent.
xid	4	Transaction ID, a random number chosen by the client, used by the client and server to associate messages and responses between a client and a server.
secs	2	Filled in by client, seconds elapsed since client began address acquisition or renewal process.
flags	2	Flags (see figure 2).
ciaddr	4	Client IP address; only filled in if client is in BOUND, RENEW or REBINDING state and can respond to ARP requests.
yiaddr	4	'your' (client) IP address.
siaddr	4	IP address of next server to use in bootstrap; returned in DHCPOFFER, DHCPACK by server.
giaddr	4	Relay agent IP address, used in booting via a relay agent.
chaddr	16	Client hardware address.
sname	64	Optional server host name, null terminated string.
file	128	Boot file name, null terminated string; "generic" name or null in DHCPDISCOVER, fully qualified directory-path name in DHCPOFFER.
options	var	Optional parameters field. See the options documents for a list of defined options.

Table 1: Description of fields in a DHCP message

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https://www.rfc-editor.org/rfc/rfc2131.txt

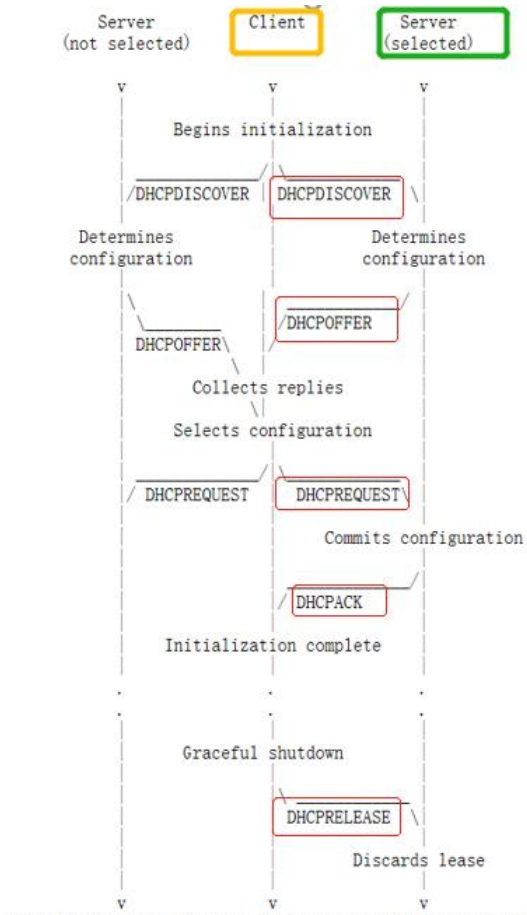
DHCP Session(1)

Client-Server interaction - allocating a network address

Source	Destination	Protocol	Info
0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x3e5e0ce3
192.168.1.1	255.255.255.255	DHCP	DHCP Offer - Transaction ID 0x3e5e0ce3
0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x3e5e0ce3
192.168.1.1	255.255.255.255	DHCP	DHCP ACK - Transaction ID 0x3e5e0ce3
192.168.1.101	192.168.1.1	DHCP	DHCP Request - Transaction ID 0x257e55a3
192.168.1.1	255.255.255.255	DHCP	DHCP ACK - Transaction ID 0x257e55a3
192.168.1.101	192.168.1.1	DHCP	DHCP Release - Transaction ID 0xb7a32733

While network interface card is set as DHCP client,
using 'ipconfig /renew' to request a dynamically assigned IP addresses.
using 'ipconfig /release' to release the dynamically assigned IP addresses.

Tips in Wireshark : DHCP or
udp.port == 67 || udp.port == 68



igure 3: Timeline diagram of messages exchanged between DHCP client and servers when allocating a new network address

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https://tools.ietf.org/html/rfc2131

DHCP Discover

```
> Frame 2: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
> Ethernet II, Src: Dell_4f:36:23 (00:08:74:4f:36:23), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Internet Protocol Version 4, Src: 0.0.0.0 (0.0.0.0), Dst: 255.255.255.255 (255.255.255.255)
> User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
v Bootstrap Protocol (Discover)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x3e5e0ce3
    Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0 (0.0.0.0)
    Your (client) IP address: 0.0.0.0 (0.0.0.0)
    Next server IP address: 0.0.0.0 (0.0.0.0)
    Relay agent IP address: 0.0.0.0 (0.0.0.0)
    Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
  > Option: (53) DHCP Message Type (Discover)
  > Option: (116) DHCP Auto-Configuration
  > Option: (61) Client identifier
  > Option: (50) Requested IP Address
  > Option: (12) Host Name
  > Option: (60) Vendor class identifier
  > Option: (55) Parameter Request List
  > Option: (255) End
    Padding: 000000000000000000
```

```
v Option: (53) DHCP Message Type (Discover)
      Length: 1
      DHCP: Discover (1)
v Option: (116) DHCP Auto-Configuration
      Length: 1
      DHCP Auto-Configuration: AutoConfigure (1)
v Option: (61) Client identifier
      Length: 7
      Hardware type: Ethernet (0x01)
      Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
v Option: (50) Requested IP Address
      Length: 4
      Requested IP Address: 192.168.1.101 (192.168.1.101)
v Option: (12) Host Name
      Length: 4
      Host Name: Noho
v Option: (60) Vendor class identifier
      Length: 8
      Vendor class identifier: MSFT 5.0
v Option: (55) Parameter Request List
      Length: 11
      Parameter Request List Item: (1) Subnet Mask
      Parameter Request List Item: (15) Domain Name
      Parameter Request List Item: (3) Router
      Parameter Request List Item: (6) Domain Name Server
      Parameter Request List Item: (44) NetBIOS over TCP/IP Name Server
      Parameter Request List Item: (46) NetBIOS over TCP/IP Node Type
      Parameter Request List Item: (47) NetBIOS over TCP/IP Scope
      Parameter Request List Item: (31) Perform Router Discover
      Parameter Request List Item: (33) Static Route
      Parameter Request List Item: (249) Private/Classless Static Route (Microsoft)
```

DHCP Offer

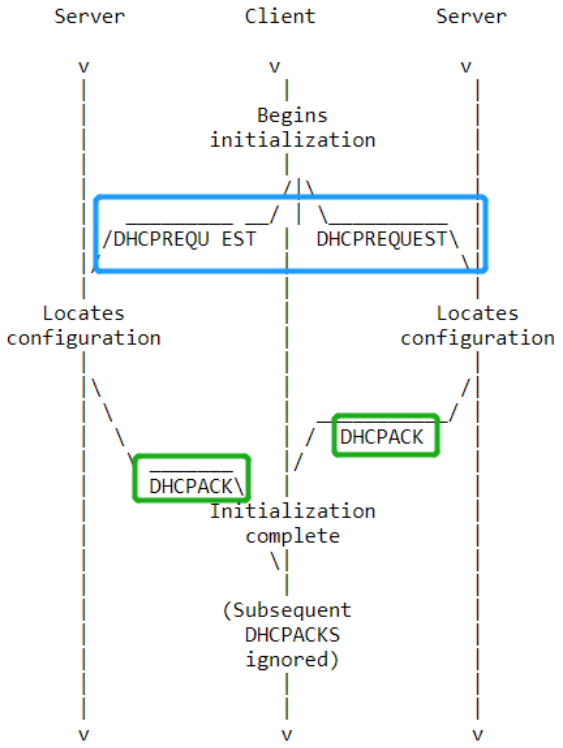
```
> User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
v Bootstrap Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x3e5e0ce3
    Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0 (0.0.0.0)
    Your (client) IP address: 192.168.1.101 (192.168.1.101)
    Next server IP address: 0.0.0.0 (0.0.0.0)
    Relay agent IP address: 0.0.0.0 (0.0.0.0)
    Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
```

```
v Option: (53) DHCP Message Type (Offer)
      Length: 1
      DHCP: Offer (2)
v Option: (1) Subnet Mask
      Length: 4
      Subnet Mask: 255.255.255.0
v Option: (3) Router
      Length: 4
      Router: 192.168.1.1 (192.168.1.1)
v Option: (6) Domain Name Server
      Length: 8
      Domain Name Server: ns10.attbi.com (63.240.76.19)
      Domain Name Server: 204.127.198.19 (204.127.198.19)
v Option: (15) Domain Name
      Length: 22
      Domain Name: ne2.client2.attbi.com
v Option: (51) IP Address Lease Time
      Length: 4
      IP Address Lease Time: (86400s) 1 day
v Option: (54) DHCP Server Identifier
      Length: 4
      DHCP Server Identifier: 192.168.1.1 (192.168.1.1)
v Option: (255) End
      Option End: 255
  Padding: 0000000000000000000000000000000000000000000000000...
```

DHCP Session(2)

Client-Server interaction：

reusing a previously allocated network address



Tips in Wireshark : DHCP or
udp.port == 67 || udp.port == 68

dhcp

Source	Destination	Protocol	Info
activate.adobe.com	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x98bd1be8
192.168.2.1	LAPTOP-RITC8FUU.local	DHCP	DHCP ACK - Transaction ID 0x98bd1be8

https://tools.ietf.org/html/rfc2131

DHCP Request & Ack

```
> User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
v Dynamic Host Configuration Protocol (Request)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x98bd1be8
    Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
    Client IP address: activate.adobe.com (0.0.0.0)
    Your (client) IP address: activate.adobe.com (0.0.0.0)
    Next server IP address: activate.adobe.com (0.0.0.0)
    Relay agent IP address: activate.adobe.com (0.0.0.0)
    Client MAC address: LAPTOP-RITC8FUU.local (90:61:ae:5c:69:58)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
  > Option: (53) DHCP Message Type (Request)
  > Option: (61) Client identifier
  > Option: (50) Requested IP Address (192.168.2.104)
  > Option: (12) Host Name
  > Option: (81) Client Fully Qualified Domain Name
  > Option: (60) Vendor class identifier
  > Option: (55) Parameter Request List
  > Option: (255) End
```

```
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Dynamic Host Configuration Protocol (ACK)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x98bd1be8
    Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
    Client IP address: activate.adobe.com (0.0.0.0)
    Your (client) IP address: LAPTOP-RITC8FUU.local (192.168.2.104)
    Next server IP address: 192.168.2.1 (192.168.2.1)
    Relay agent IP address: activate.adobe.com (0.0.0.0)
    Client MAC address: LAPTOP-RITC8FUU.local (90:61:ae:5c:69:58)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
  > Option: (53) DHCP Message Type (ACK)
  > Option: (1) Subnet Mask (255.255.255.0)
  > Option: (2) Time Offset
  > Option: (3) Router
  > Option: (23) Default IP Time-to-Live
  > Option: (51) IP Address Lease Time
  > Option: (54) DHCP Server Identifier (192.168.2.1)
  > Option: (6) Domain Name Server
  > Option: (58) Renewal Time Value
  > Option: (59) Rebinding Time Value
  > Option: (255) End
    Padding: 00
```

Simulator: Packet Tracer

- **Packet Tracer** allows users to create simulated network topologies by dragging and dropping routers, switches and various other types of network devices.

- Packet Tracer supports an array of simulated Application Layer protocols, as well as basic routing with RIP, OSPF, EIGRP, BGP to the extents required by the current CCNA curriculum.

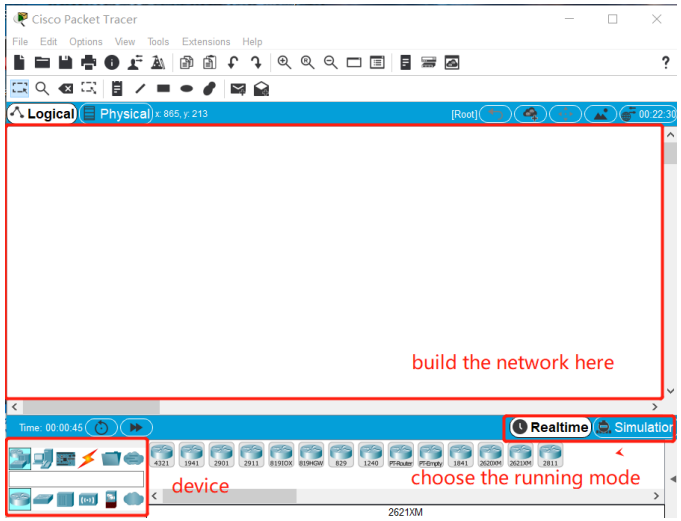
- Packet Tracer can be run on Linux and Microsoft Windows. Similar Android and iOS apps are also available.

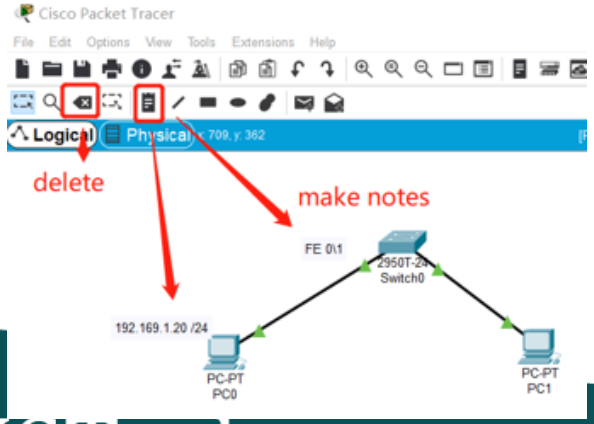
https://en.wikipedia.org/wiki/Packet_Tracer

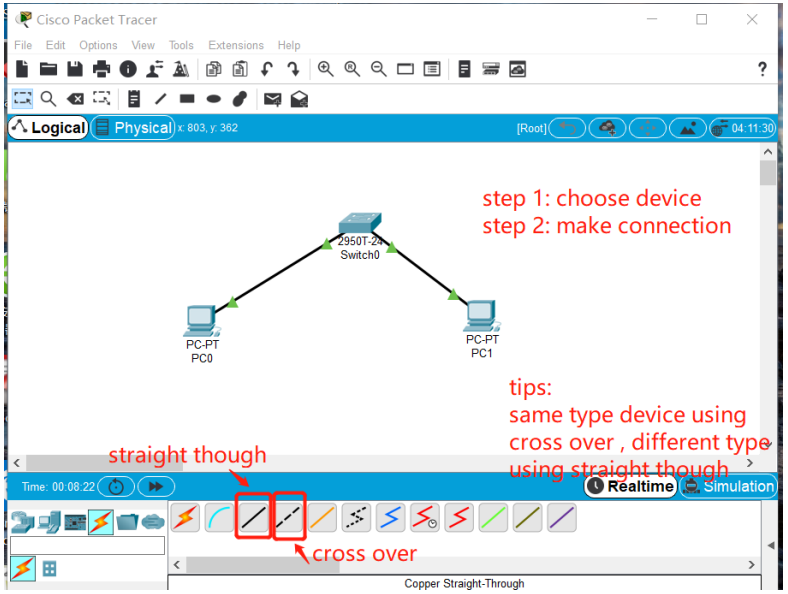
Cisco CLI

- Different views
  - From **user view** to **system view** ,using command "enable" ,
  - From **system view** to **function view**, using function name or object name as command, such as "interface giga 0/0"
- Frequently used commands
  - show //display the info (ip routing table, interface, mac-address table)
  - exit, end //back to upper layer, back to root layer
  - ?, Tab // help to find the rest part of command
  - no //the 1st word of command to cancel the following command, such as: using "route rip" to config rip while using " no route rip" to cancel the setting

Packet Tracer(1) Create Network







Download from
https://www.packettracernetwork.com/download/download-packet-tracer.html

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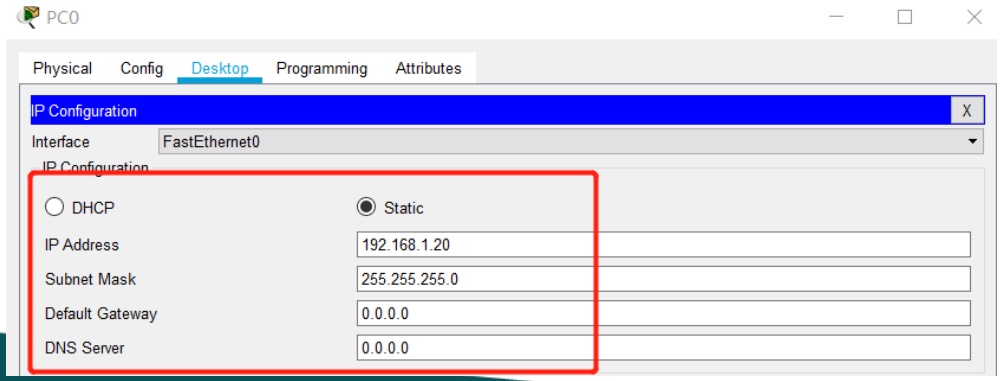
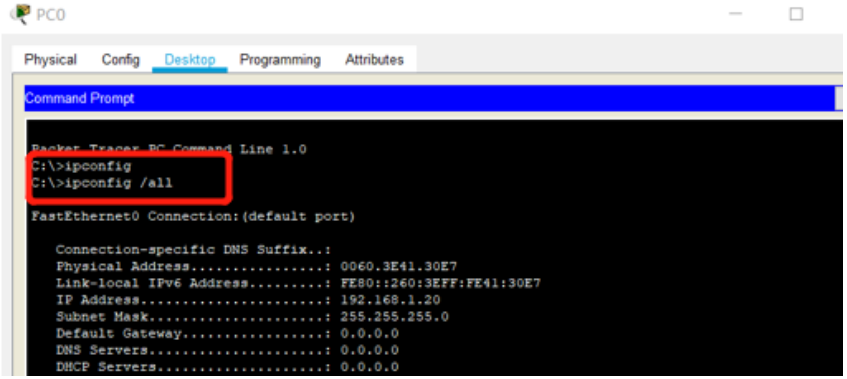
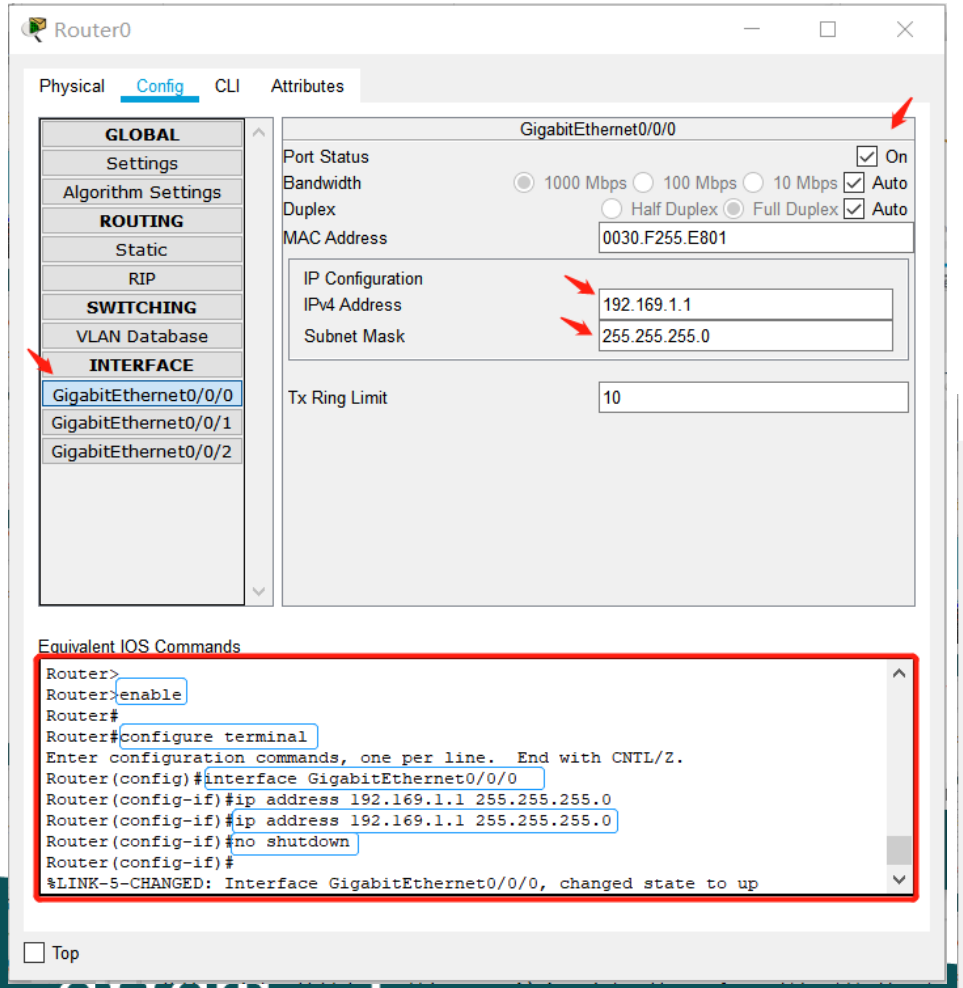
Packet Tracer(2) PC Configuration

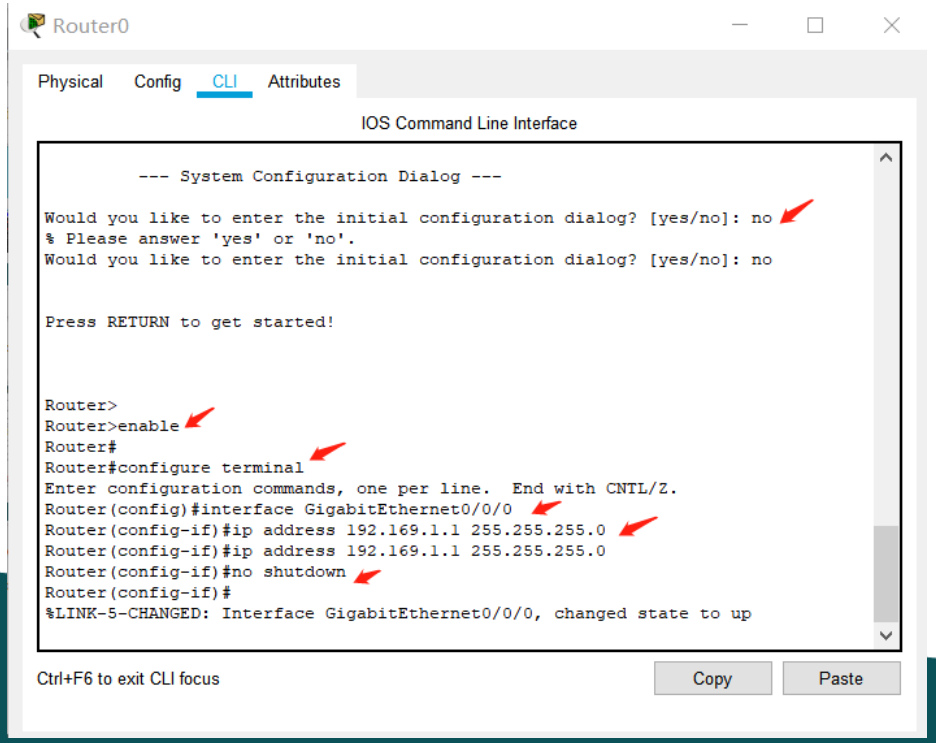
Config and test on PC





Packet Tracer(3) Router Configuration





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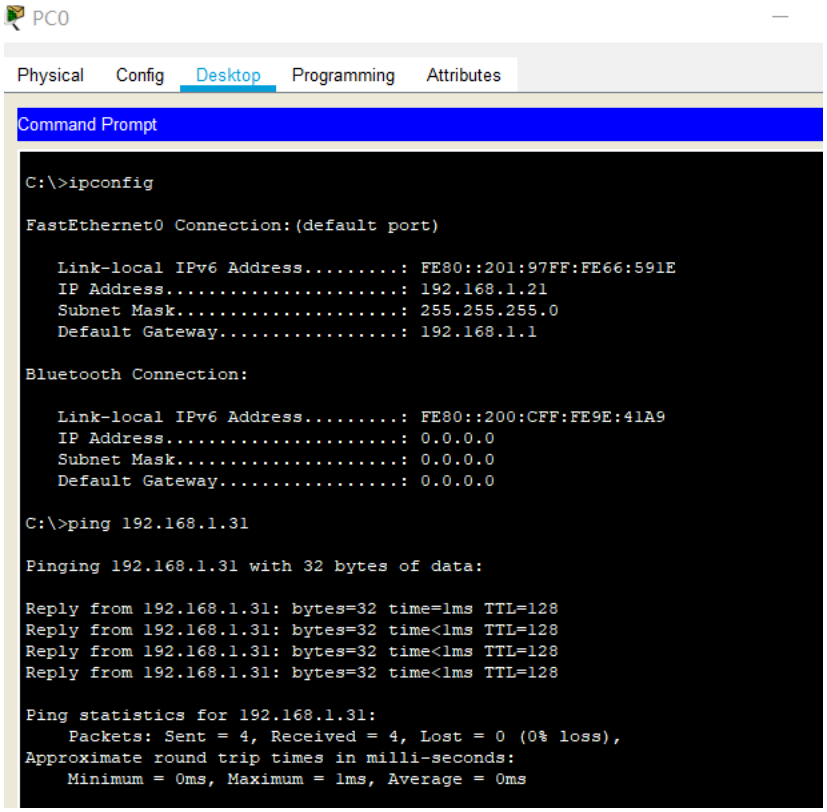
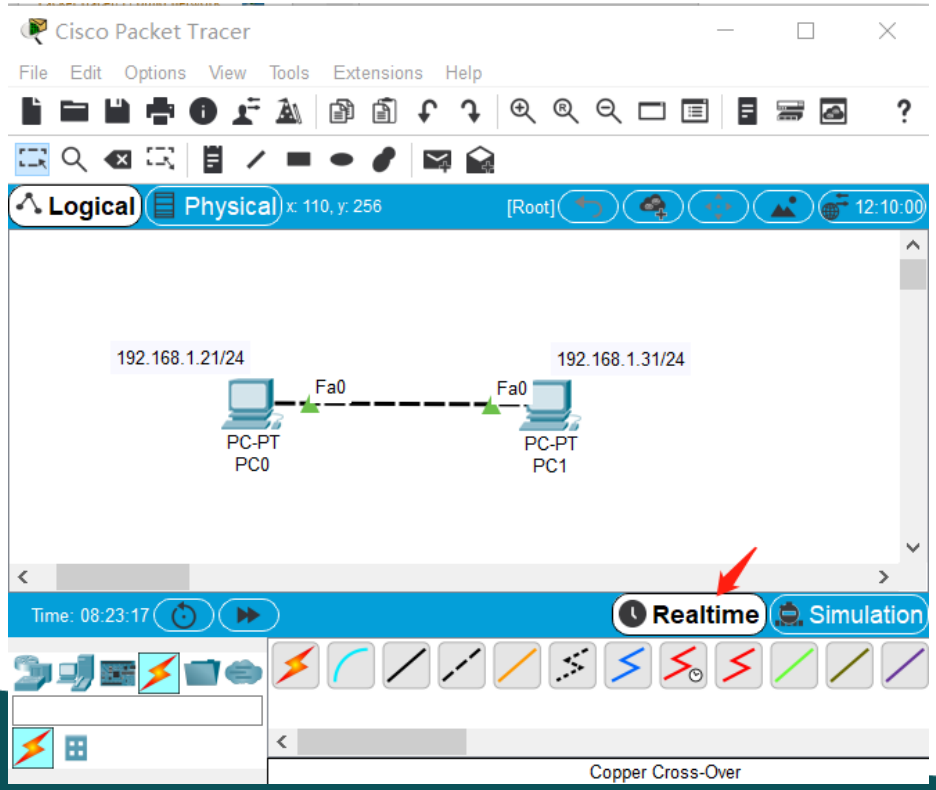
Packet Tracer(3) Realtime Mode





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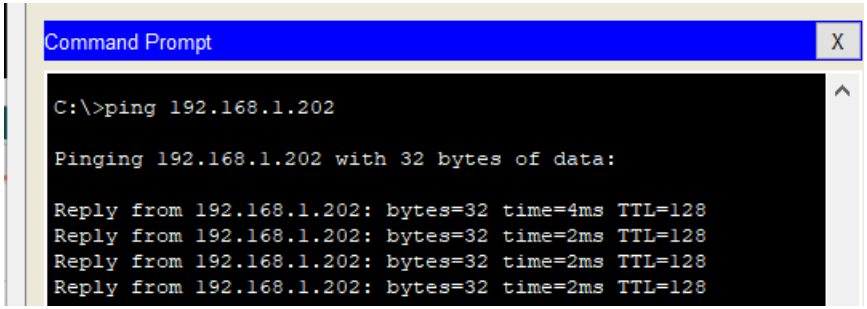
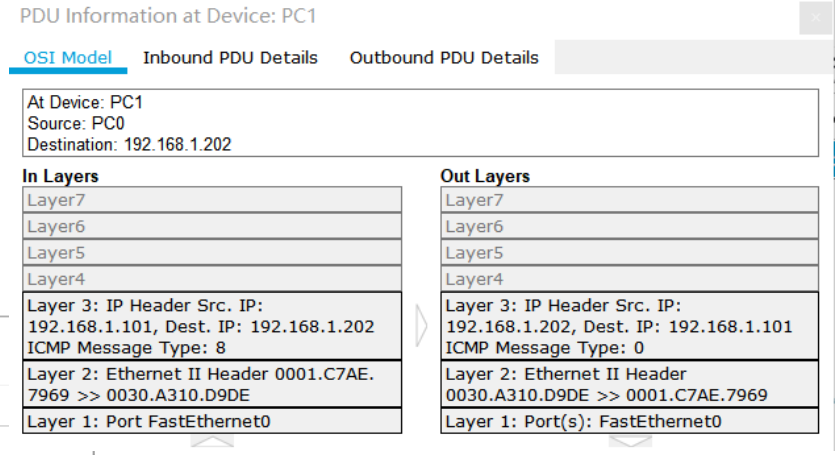
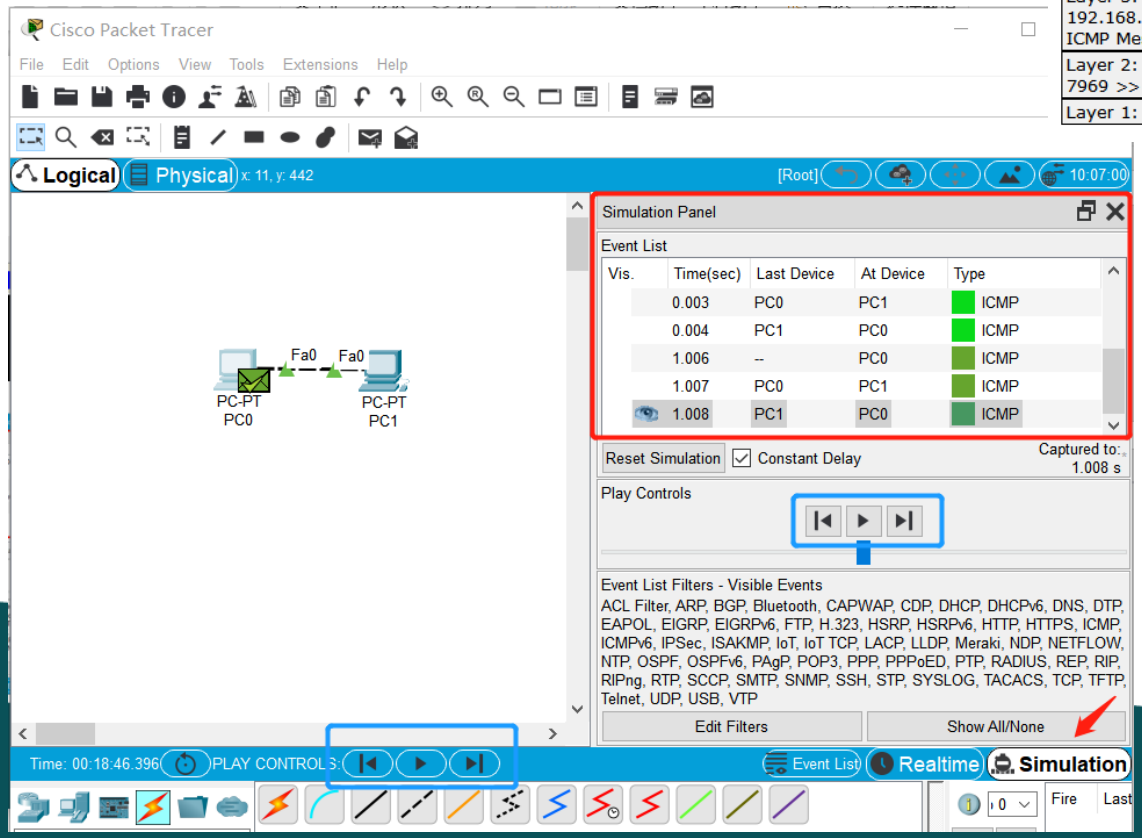
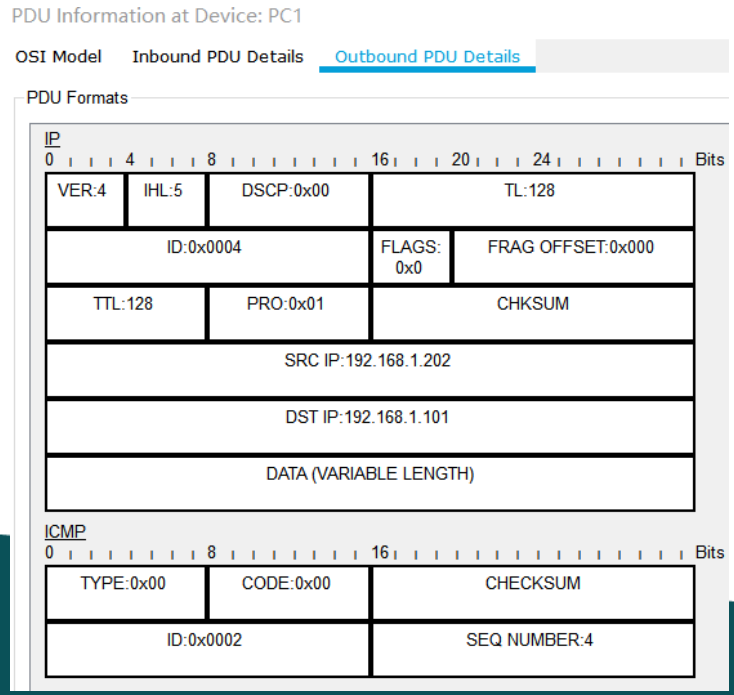
Packet Tracer(4) Simulation Mode



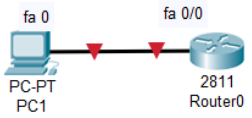


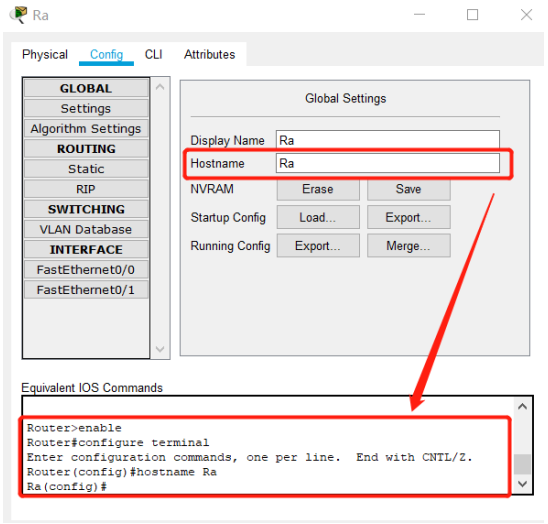


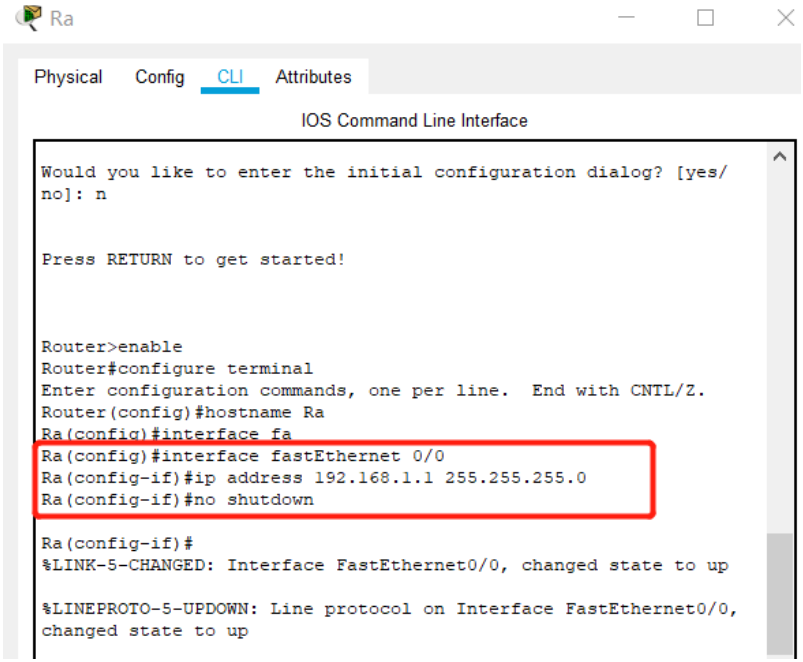


Packet Tracer DHCP(1)

Tips： the state of interface of router is down by default








```
Ra#show interfaces fastEthernet 0/0
FastEthernet0/0 is up, line protocol is up (connected)
  Hardware is Lance, address is 00d0.d30b.0201 (bia 00d0.d30b.
0201)
  Internet address is 192.168.1.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Full-duplex, 100Mb/s, media type is RJ45
```

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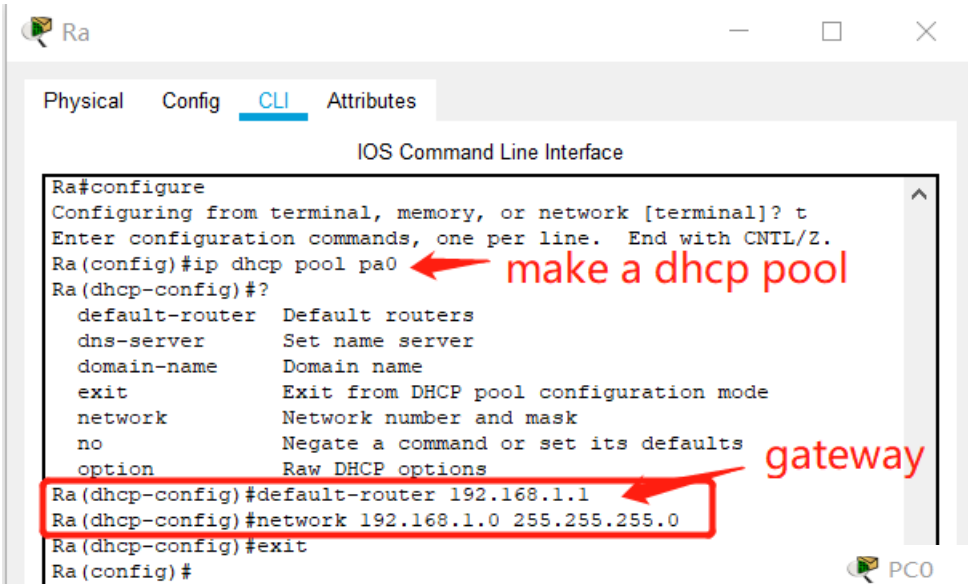
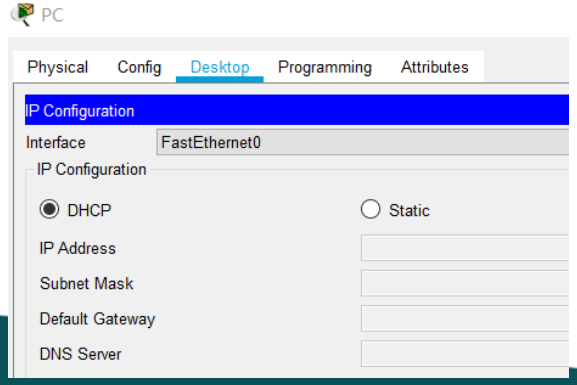
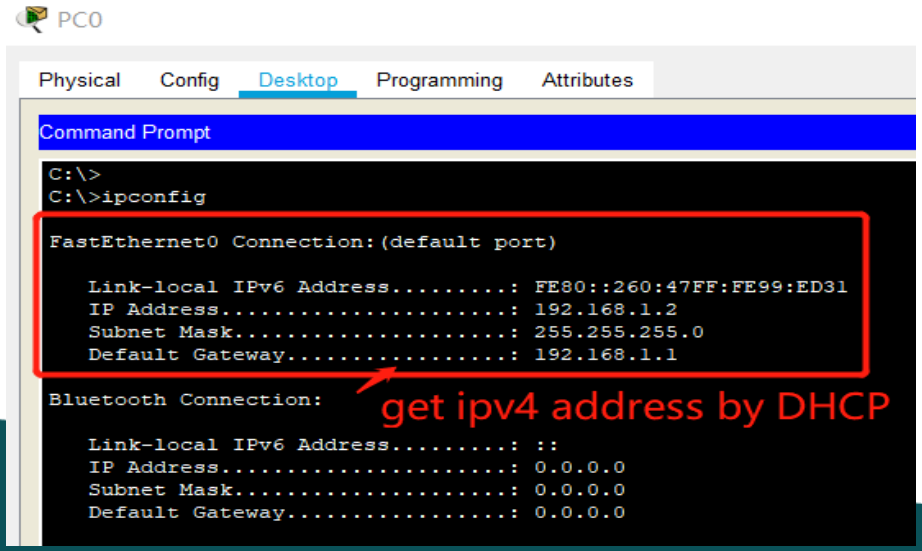
Packet Tracer DHCP(2)



1. Up the interface connect with PC, configure its IP address
2. Make a DHCP pool
   1) Configure the default-router with the IP address of the interface
   2) Configure the network with the same sub-net ID as default-router





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Lab9.1 Assignment

1. Initiates a DHCP session on your Notebook
   - How to initiate a DHCP session? How to find the DHCP session packets?
   - Is DHCP an application protocal or an network protocal? explain how do you make such a judgement.
   - What's the source IP address and destination IP address of a DHCP request? What is the type of these two IP address?
   - What info items are required for a host if it need to contact with others by its name on the Internet?
   - Find the Lease Time of a dynamic IP address, What's its value? In which type of DHCP packet could this field be set?

Please add the necessary screenshots when answering questions.

Lab9.2 Assignment

2. Practice on Packet Tracer
   - Connect two PCs, configure them with static IP address, make them belong to same sub-network, test to see if these two PCs could reach eachother or not.
   - Create a network with a Router and 2 PCs, make the info of interface visible
     - configure the interface of Router with IP address and netmask, 'up' the interface
     - configure the IP DHCP pool with name, default-gateway and subnet
     - configure the PC as DHCP client
     - connect the Router with 2 PCs
     - test if PC could reach the Router, test if 2 PCs could reach eachother or not.
     - how many subnet in this network? what are their net IDs?

Please add the necessary screenshots when answering questions.