

CS 305 Lab Tutorial

Lab 8 DHCP & Packet-Tracer

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

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**.

```
C:\Windows\system32\cmd.exe
无线局域网适配器 WLAN:

    连接特定的 DNS 后缀 . . . . . : 
    描述. . . . . : Intel(R) Dual Band Wireless-AC 8265
    物理地址. . . . . : 88-31-4E-50-80-70
    DHCP 已启用 . . . . . : 是
    自动配置已启用. . . . . : 是
    本地链接 IPv6 地址. . . . . : fe80::84bf:7fhe:b61f:c23b%19(首选)
    IPv4 地址. . . . . : 192.168.2.104(首选)
    子网掩码. . . . . : 255.255.255.0
    获得租约的时间. . . . . : 2020年11月6日 18:44:01
    租约过期的时间. . . . . : 2020年11月7日 18:44:01
    默认网关. . . . . : 192.168.2.1
    DHCP 服务器. . . . . : 192.168.2.1
    DHCPv6 IAID. . . . . : 277897646
    DHCPv6 客户端 DUID. . . . . : C8-82-83-84-85-86-87-88-89-8A-8B-8C-8D-8E-8F-90
    DNS 服务器. . . . . : 116.77.76.254
    . . . . . : 116.77.76.253
```

default gateway, DHCP Server

DHCP

RFC 2131

Dynamic Host Configuration Protocol

March 1997

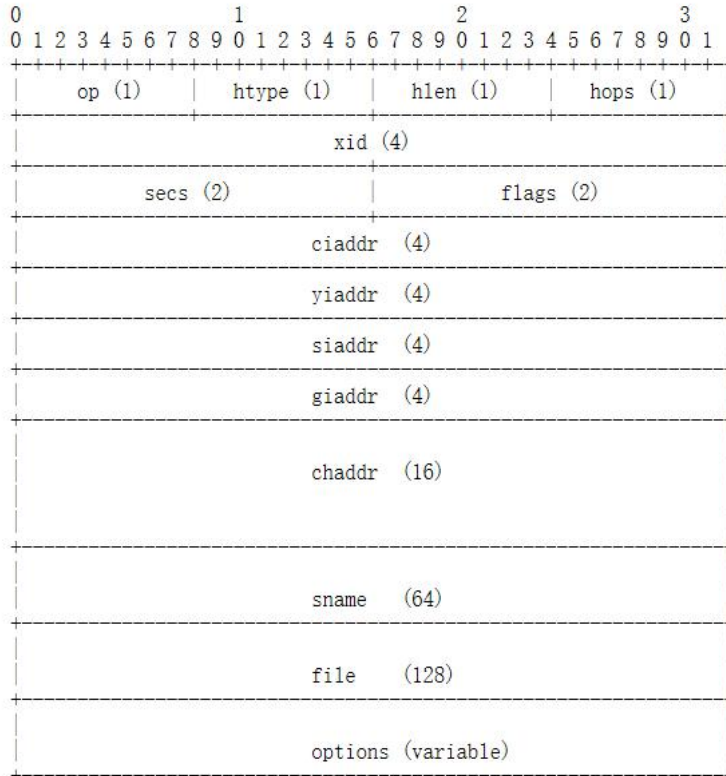


Figure 1: Format of a DHCP message

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 DHCP OFFER, DHCP ACK 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

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

广播地址

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

断开无线

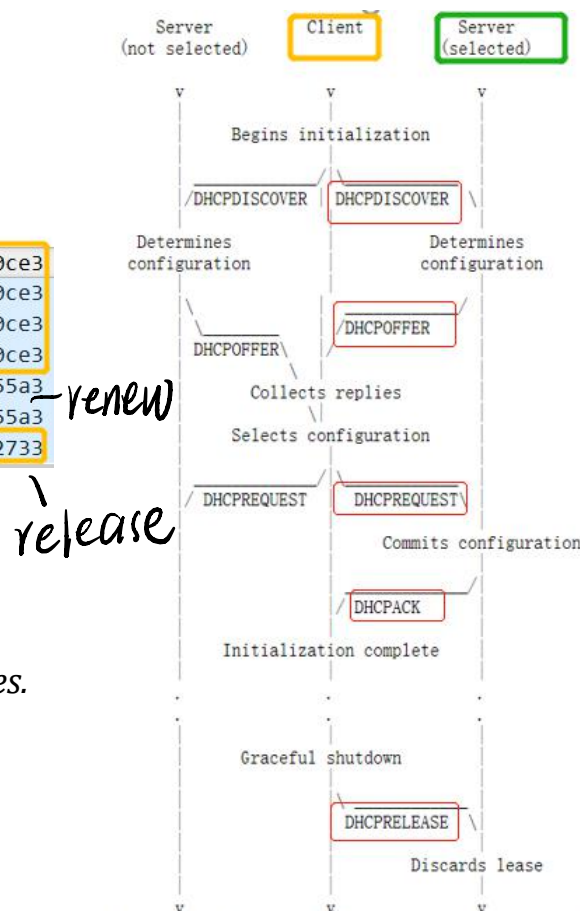


Figure 3: Timeline diagram of messages exchanged between DHCP client and servers when allocating a new network address

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)
✓ 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: 00000000000000000000
```

```
✓ Option: (53) DHCP Message Type (Discover)
  Length: 1
  DHCP: Discover (1)
✓ Option: (116) DHCP Auto-Configuration
  Length: 1
  DHCP Auto-Configuration: AutoConfigure (1)
✓ Option: (61) Client identifier
  Length: 7
  Hardware type: Ethernet (0x01)
  Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
✓ Option: (50) Requested IP Address
  Length: 4
  Requested IP Address: 192.168.1.101 (192.168.1.101)
✓ Option: (12) Host Name
  Length: 4
  Host Name: Noho
✓ Option: (60) Vendor class identifier
  Length: 8
  Vendor class identifier: MSFT 5.0
✓ 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 Server 通常部署在默认网关上。

上

```

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

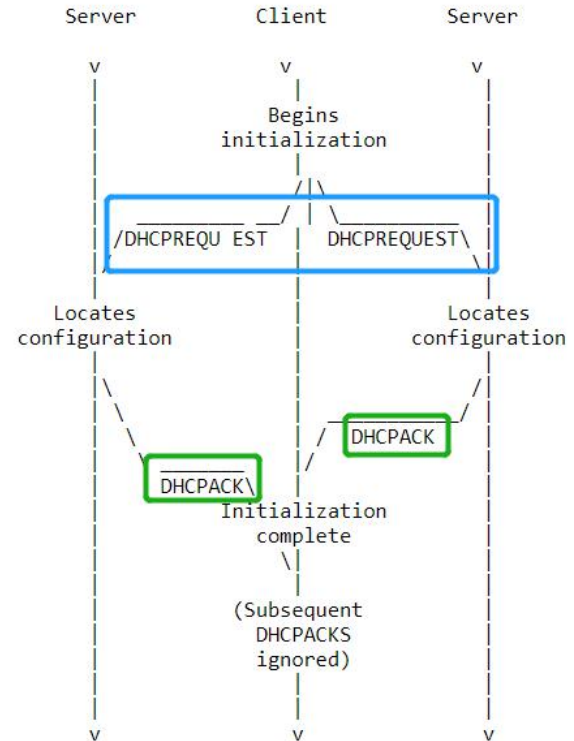
```

- 租约时长

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

DHCP Request & Ack

```
> User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
  > 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
```

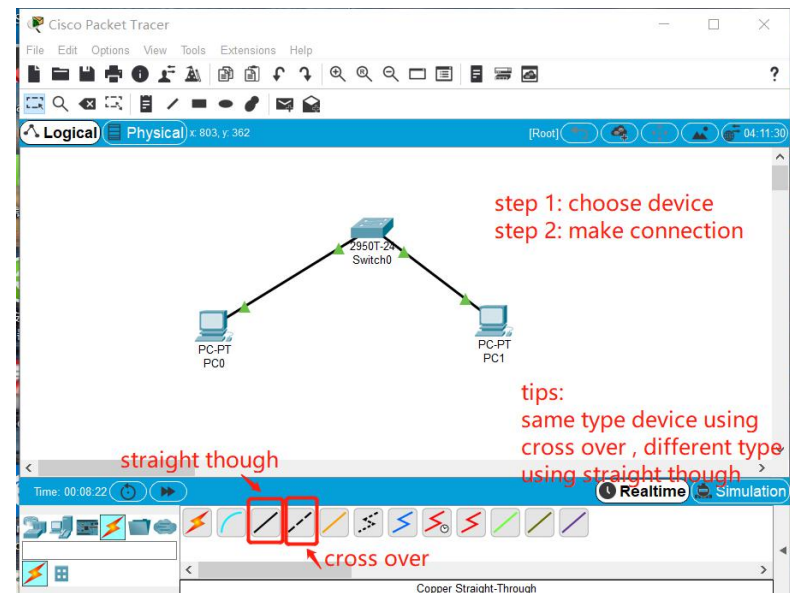
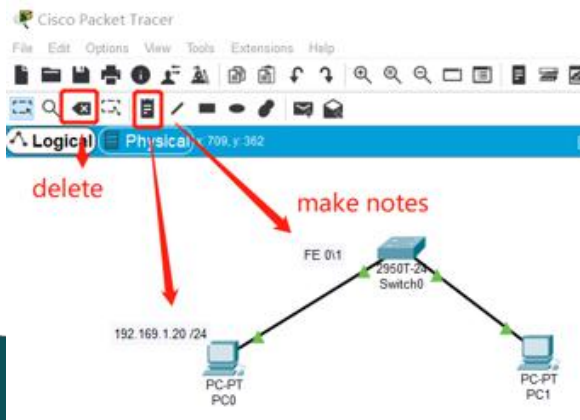
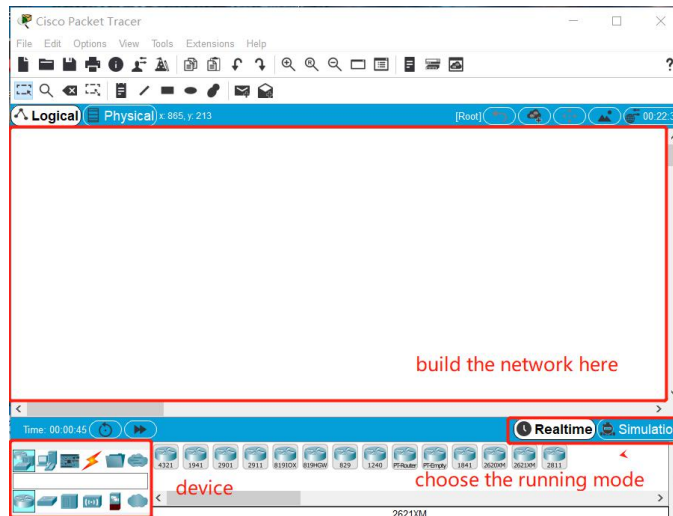

Simulator: Packet Tracer

- **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.

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

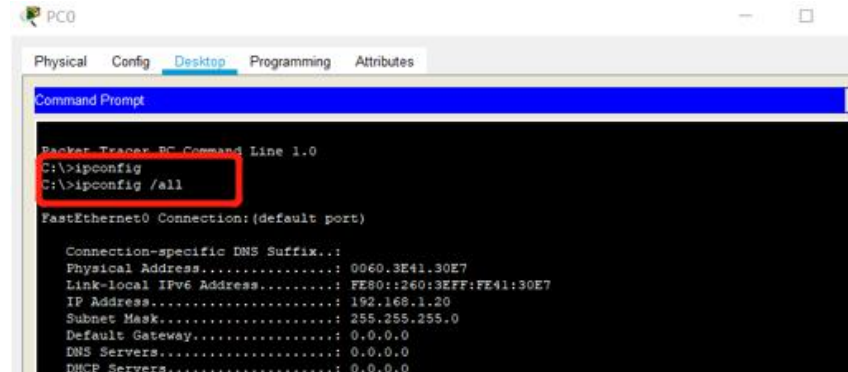
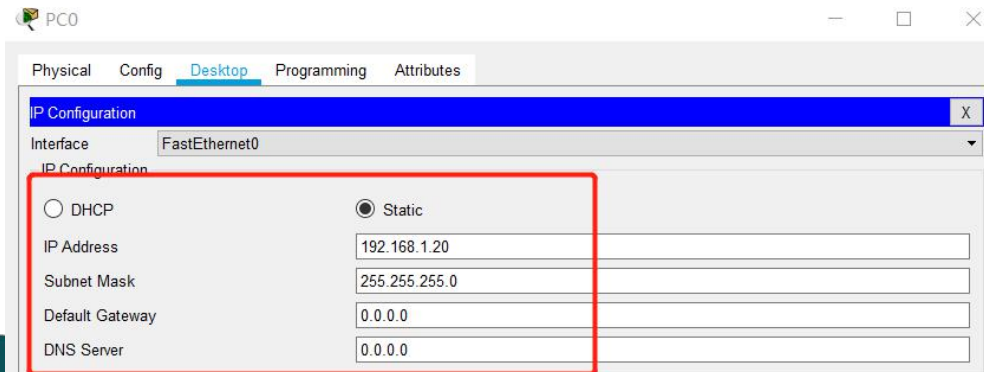
Packet Tracer(1) Create Network



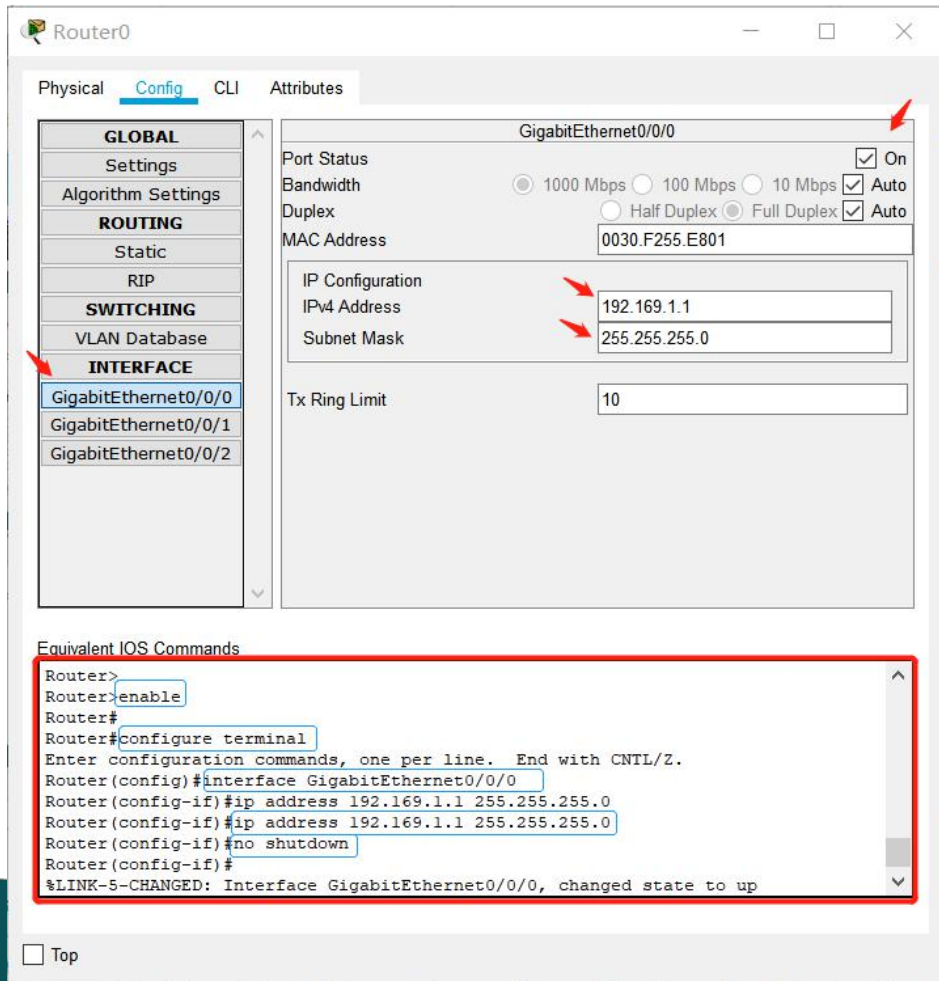
Download from
<https://www.packettracernetwork.com/download/download-packet-tracer.html>

Packet Tracer(2) PC Configuration

Config and test on PC



Packet Tracer(3) Router Configuration



Router0

Physical Config CLI Attributes

GLOBAL

- Settings
- Algorithm Settings

ROUTING

- Static
- RIP

SWITCHING

- VLAN Database

INTERFACE

- GigabitEthernet0/0/0
- GigabitEthernet0/0/1
- GigabitEthernet0/0/2

GigabitEthernet0/0/0

Port Status ☒ On

Bandwidth ☒ 1000 Mbps ☐ 100 Mbps ☐ 10 Mbps ☒ Auto

Duplex ☐ Half Duplex ☒ Full Duplex ☒ Auto

MAC Address 0030.F255.E801

IP Configuration

IPv4 Address 192.169.1.1

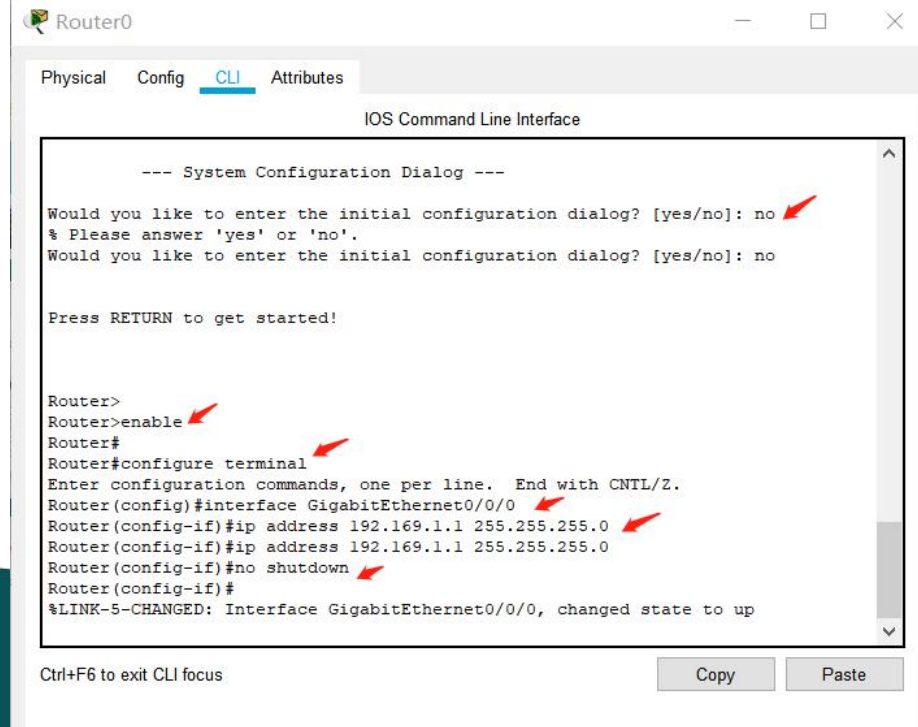
Subnet Mask 255.255.255.0

Tx Ring Limit 10

Equivalent IOS Commands

```
Router>
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#ip address 192.169.1.1 255.255.255.0
Router(config-if)#ip address 192.169.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up
```

☐ Top



Router0

Physical Config CLI Attributes

IOS Command Line Interface

--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: no

% Please answer 'yes' or 'no'.

Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

```
Router>
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#ip address 192.169.1.1 255.255.255.0
Router(config-if)#ip address 192.169.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up
```

Ctrl+F6 to exit CLI focus

Copy Paste

Packet Tracer(3) Realtime Mode

```
PC0
Physical Config Desktop Programming Attributes
Command Prompt

C:\>ipconfig

FastEthernet0 Connection: (default port)

Link-local IPv6 Address . . . . . : FE80::201:97FF:FE66:591E
IP Address . . . . . : 192.168.1.21
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1

Bluetooth Connection:

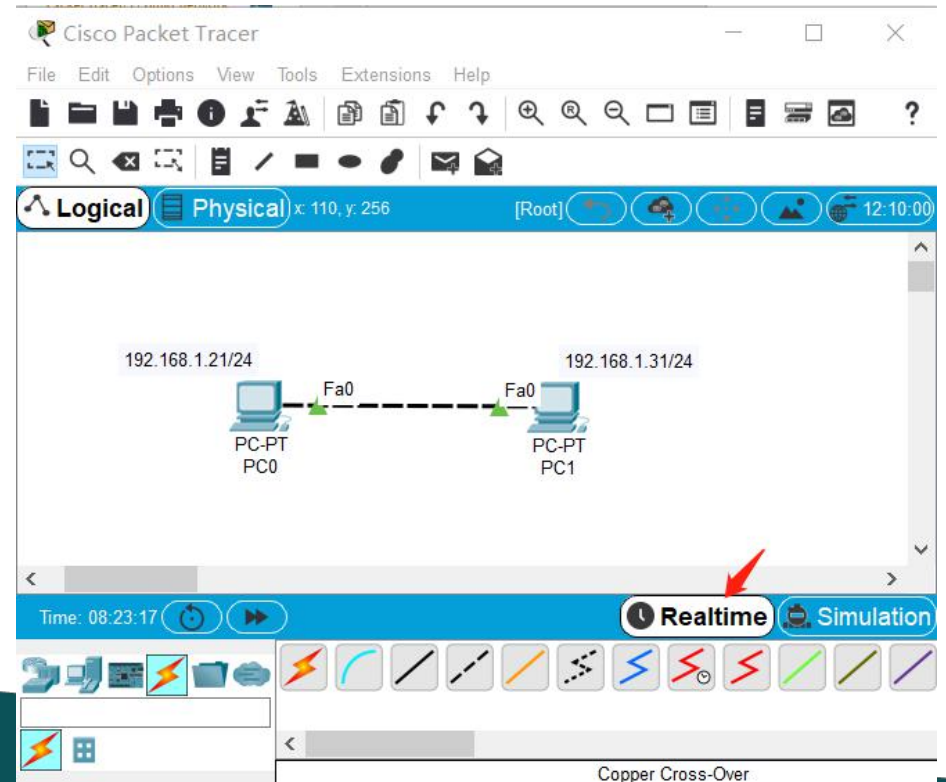
Link-local IPv6 Address . . . . . : FE80::200:CFF:FE9E:41A9
IP Address . . . . . : 0.0.0.0
Subnet Mask . . . . . : 0.0.0.0
Default Gateway . . . . . : 0.0.0.0

C:\>ping 192.168.1.31

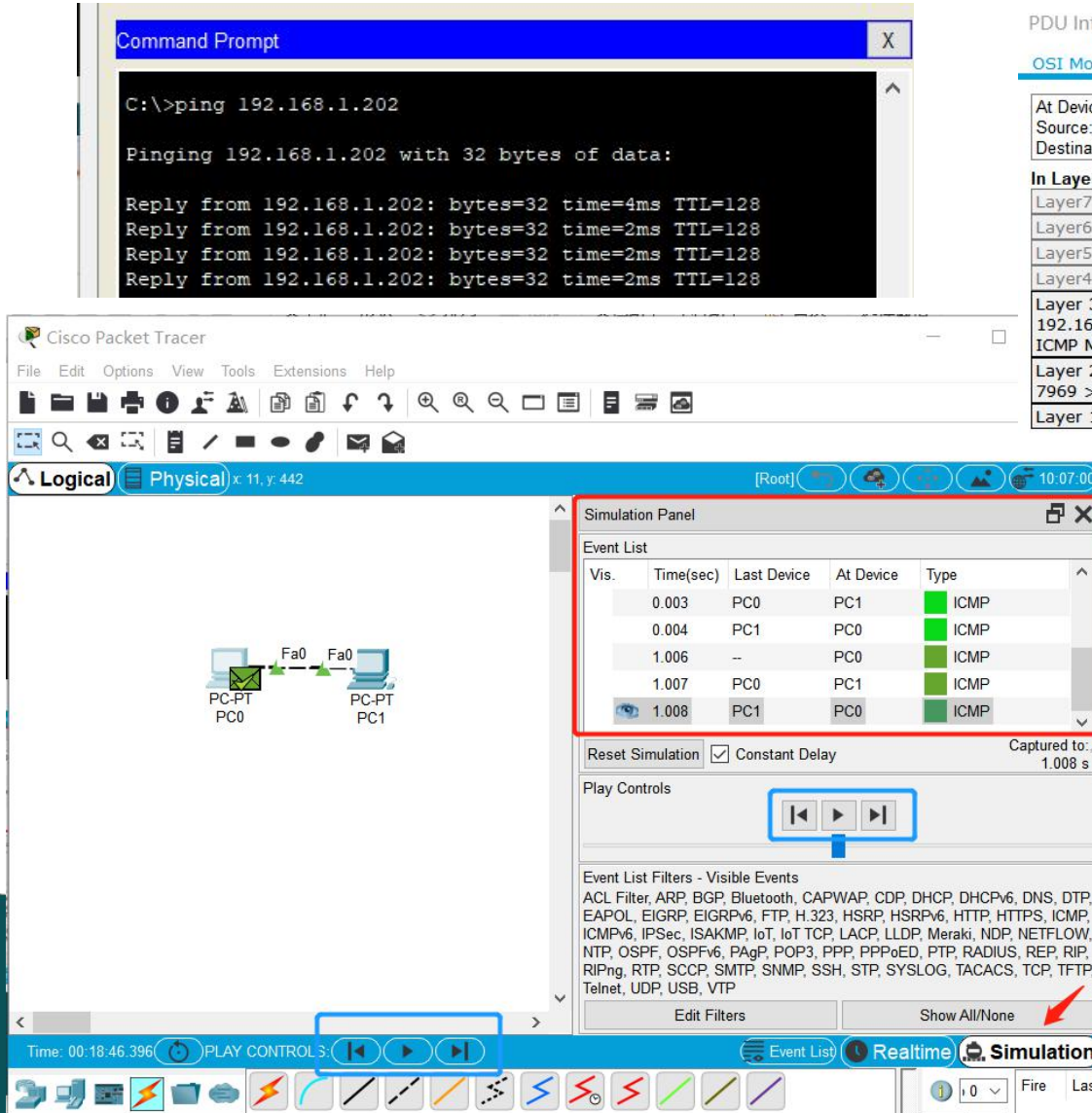
Pinging 192.168.1.31 with 32 bytes of data:

Reply from 192.168.1.31: bytes=32 time=1ms TTL=128
Reply from 192.168.1.31: bytes=32 time<1ms TTL=128
Reply from 192.168.1.31: bytes=32 time<1ms TTL=128
Reply from 192.168.1.31: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.31:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms
```



Packet Tracer(4) Simulation Mode



PDU Information at Device: PC1

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: PC1

Source: PC0

Destination: 192.168.1.202

In Layers

Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 192.168.1.101, Dest. IP: 192.168.1.202 ICMP Message Type: 8

```
Layer 2: Ethernet II Header 0001.C7AE.  
7969 >> 0030.A310.D9DE
```

Layer 1: Port FastEthernet0

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 192.168.1.202, Dest. IP: 192.168.1.101 ICMP Message Type: 0

Layer 2: Ethernet II Header
0030.A310.D9DE >> 0001.C7AE.7969

Layer 1: Port(s): FastEthernet0

PDU Information at Device: PC1

OSI Model

Inbound PDU Details

Outbound PDU Details

PDU Formats

IP
0 4 8 16 20 24 Bits

VER:4	IHL:5	DSCP:0x00	TL:128	
ID:0x0004			FLAGS: 0x0	FRAG OFFSET:0x000
TTL:128		PRO:0x01	CHKSUM	
SRC IP:192.168.1.202				
DST IP:192.168.1.101				
DATA (VARIABLE LENGTH)				

The diagram illustrates the structure of an ICMP header. It is a 32-bit field, as indicated by the '0' to '31' bit markers at the top. The header is divided into five fields:

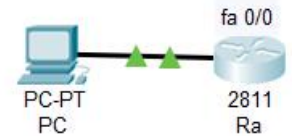
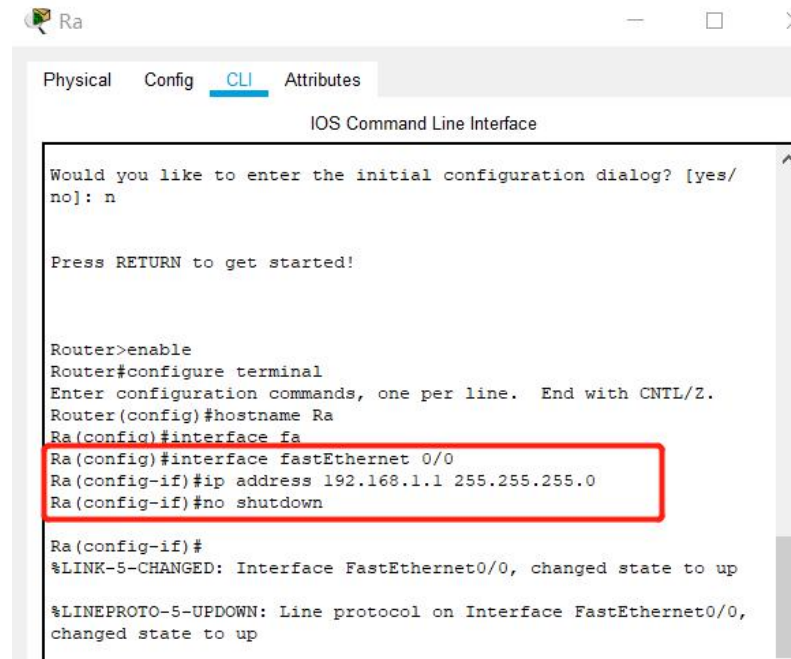
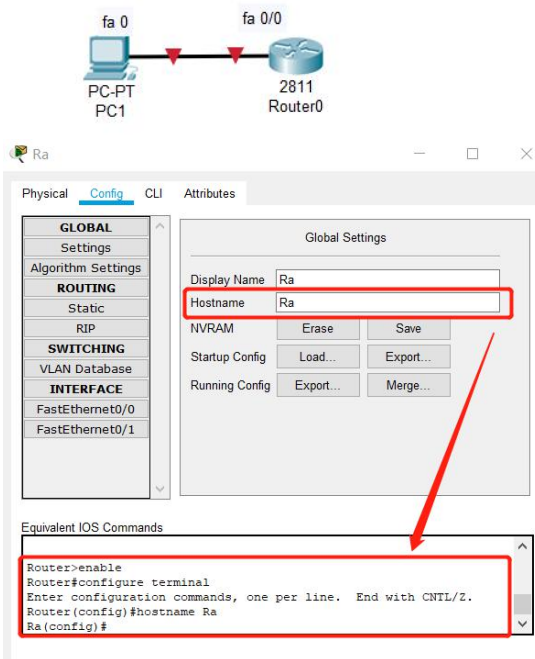
- TYPE:0x00**: 8 bits (bits 0-7)
- CODE:0x00**: 8 bits (bits 8-15)
- CHECKSUM**: 16 bits (bits 16-31)
- ID:0x0002**: 16 bits (bits 0-15)
- SEQ NUMBER:4**: 32 bits (bits 16-31)

The fields are arranged in a 2x2 grid:

TYPE:0x00	CODE:0x00	CHECKSUM	
ID:0x0002		SEQ NUMBER:4	

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
```

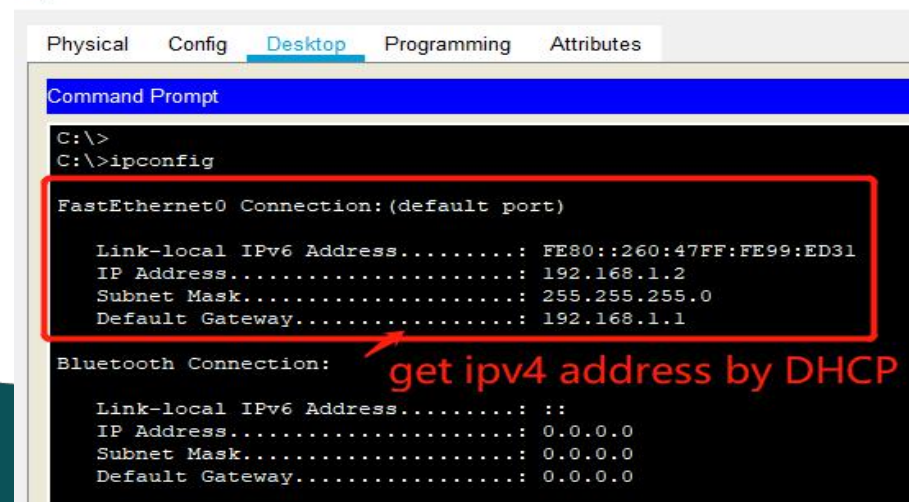
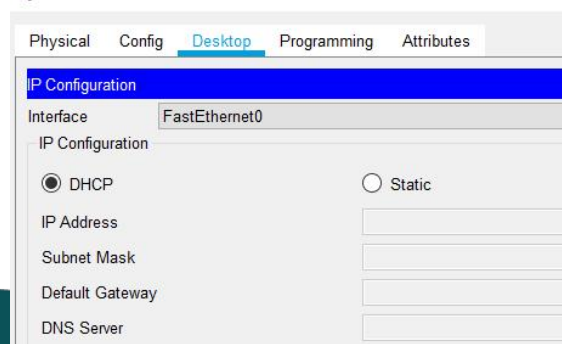

Packet Tracer DHCP(2)



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

```
Ra#configure
Configuring from terminal, memory, or network [terminal]? t
Enter configuration commands, one per line. End with CNTL/Z.
Ra(config)#ip dhcp pool pa0
Ra(dhcp-config)#?
  default-router  Default routers
  dns-server      Set name server
  domain-name     Domain name
  exit            Exit from DHCP pool configuration mode
  network         Network number and mask
  no              Negate a command or set its defaults
  option          Raw DHCP options
Ra(dhcp-config)#default-router 192.168.1.1
Ra(dhcp-config)#network 192.168.1.0 255.255.255.0
Ra(dhcp-config)#exit
Ra(config)#
```

Annotations: "make a dhcp pool" points to `ip dhcp pool pa0`; "gateway" points to `default-router 192.168.1.1`.



Practise 8.1

1. Initiates a DHCP session on your Notebook, capture the session
 - 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?

Practise 8.2

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 communicate with the Router, test if the 2 PCs could communicate with eachother.

Practise 8.2

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
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 - test if PC could communicate with the Router, test if the 2 PCs could communicate with eachother.