DHCP

DHCP

- The host in any network can be assigned the IP address manually or dynamically. In a small home network having 2 or 3 computers, we can assign the IP addresses manually but imagine a network having hundreds of computer and you have to assign the IP addresses to all of them. It can be a nightmare for network administrators!! No two hosts can have the same IP address and assigning them IP address manually can lead to errors and confusion. So, to resolve this problem **DHCP** is needed. The DHCP is needed to simplify the assignment of IP addresses on a network.

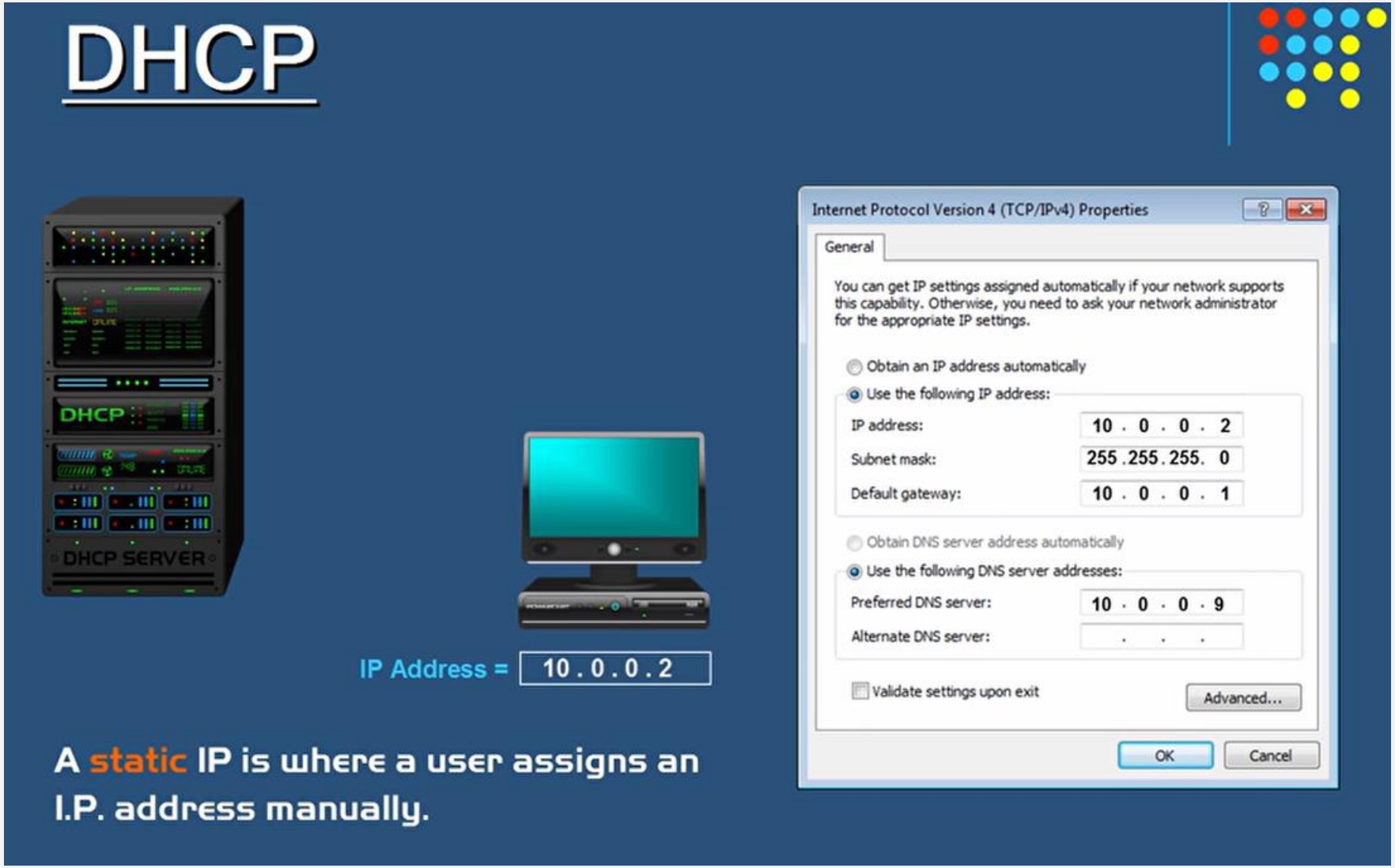
- **Dynamic Host Configuration Protocol** is a network management protocol that is used to dynamically assign the IP address and other information to each host on the network so that they can communicate efficiently. DHCP automates and centrally manages the assignment of IP address easing the work of network administrator. In addition to the **IP address** , the DHCP also assigns the **subnet masks, default gateway** and **domain name server(DNS) address** and other configuration to the host and by doing so, it makes the task of network administrator easier.

WHY USE DHCP?

- DHCP helps in managing the entire process automatically and centrally.
- DHCP helps in maintaining a unique IP Address for a host using the server.
- DHCP servers maintain information on TCP/IP configuration and provide configuration of address to DHCP-enabled clients in the form of a lease offer.

DYNAMIC HOST CONFIGURATION PROTOCOL (DHCP)

STATIC IP


DHCP
DHCP
DHCP SERVER
IP Address = 10 . 0 . 0 . 2
A static IP is where a user assigns an I.P. address manually.
Internet Protocol Version 4 (TCP/IPv4) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address: 10 . 0 . 0 . 2
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 10 . 0 . 0 . 1
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server: 10 . 0 . 0 . 9
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

DHCP

I.P. addresses must be unique.

IP CONFLICT

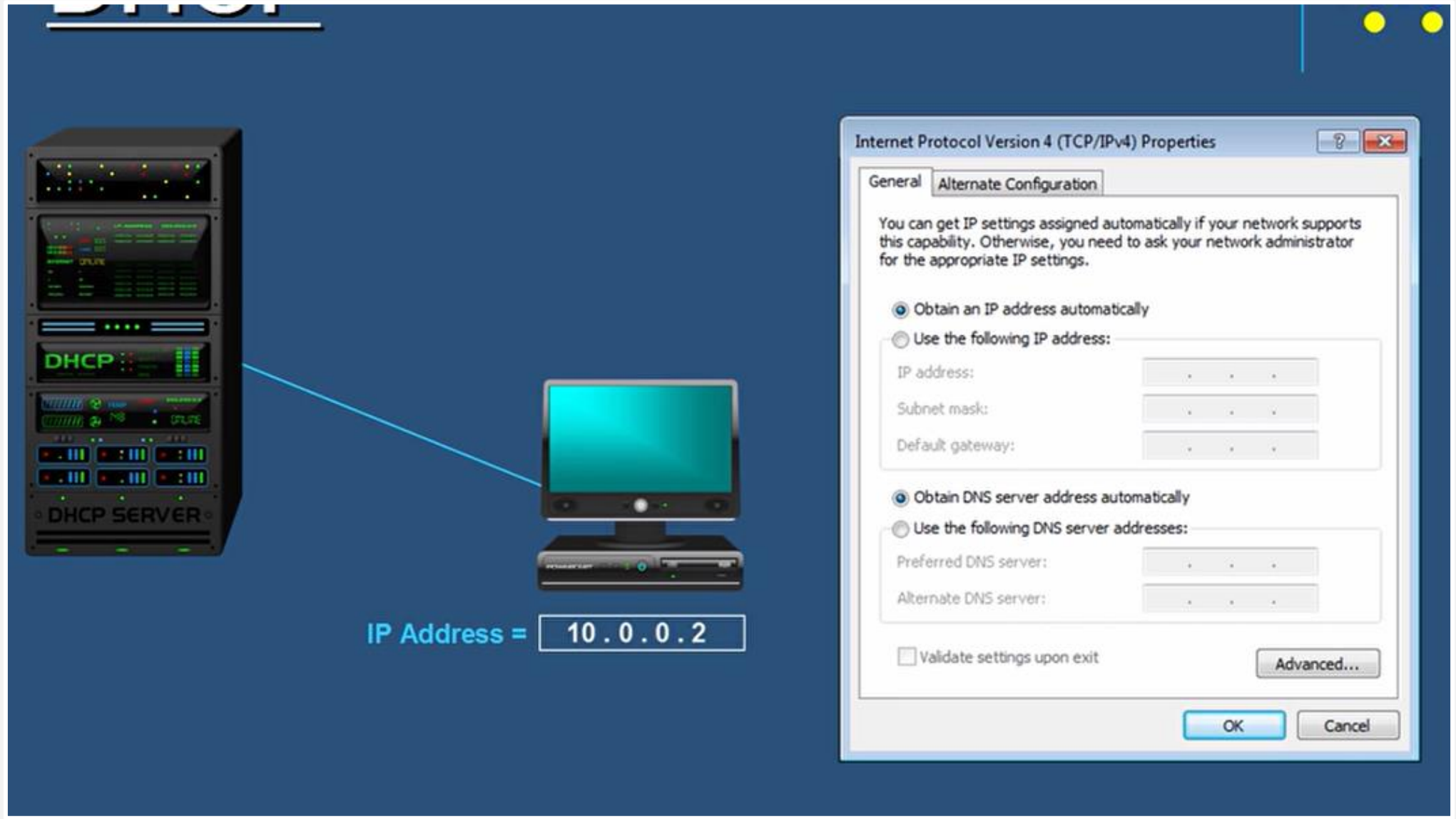
DHCP

DHCP

A dynamic IP is where a computer gets an I.P. address from a DHCP server.

A DHCP server automatically assigns a computer an:

- I.P. address
- Subnet mask
- Default gateway
- DNS server


DHCP
DHCP SERVER
IP Address = 10 . 0 . 0 . 2
Internet Protocol Version 4 (TCP/IPv4) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
Subnet mask:
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

DHCP

DHCP SETTINGS

SCOPE

Start IP Address	10	0	0	1
End IP Address	10	0	0	100

10.0.0.1	10.0.0.11	10.0.0.21	10.0.0.31	10.0.0.41	10.0.0.51	10.0.0.61	10.0.0.71	10.0.0.81	10.0.0.91
10.0.0.2	10.0.0.12	10.0.0.22	10.0.0.32	10.0.0.42	10.0.0.52	10.0.0.62	10.0.0.72	10.0.0.82	10.0.0.92
10.0.0.3	10.0.0.13	10.0.0.23	10.0.0.33	10.0.0.43	10.0.0.53	10.0.0.63	10.0.0.73	10.0.0.83	10.0.0.93
10.0.0.4	10.0.0.14	10.0.0.24	10.0.0.34	10.0.0.44	10.0.0.54	10.0.0.64	10.0.0.74	10.0.0.84	10.0.0.94
10.0.0.5	10.0.0.15	10.0.0.25	10.0.0.35	10.0.0.45	10.0.0.55	10.0.0.65	10.0.0.75	10.0.0.85	10.0.0.95
10.0.0.6	10.0.0.16	10.0.0.26	10.0.0.36	10.0.0.46	10.0.0.56	10.0.0.66	10.0.0.76	10.0.0.86	10.0.0.96

DHCP

The DHCP server assigns the I.P. address as a lease.

A lease is the amount of time an I.P. address is assigned to a computer.

The lease is to help make sure the DHCP server does not run out of I.P. addresses.

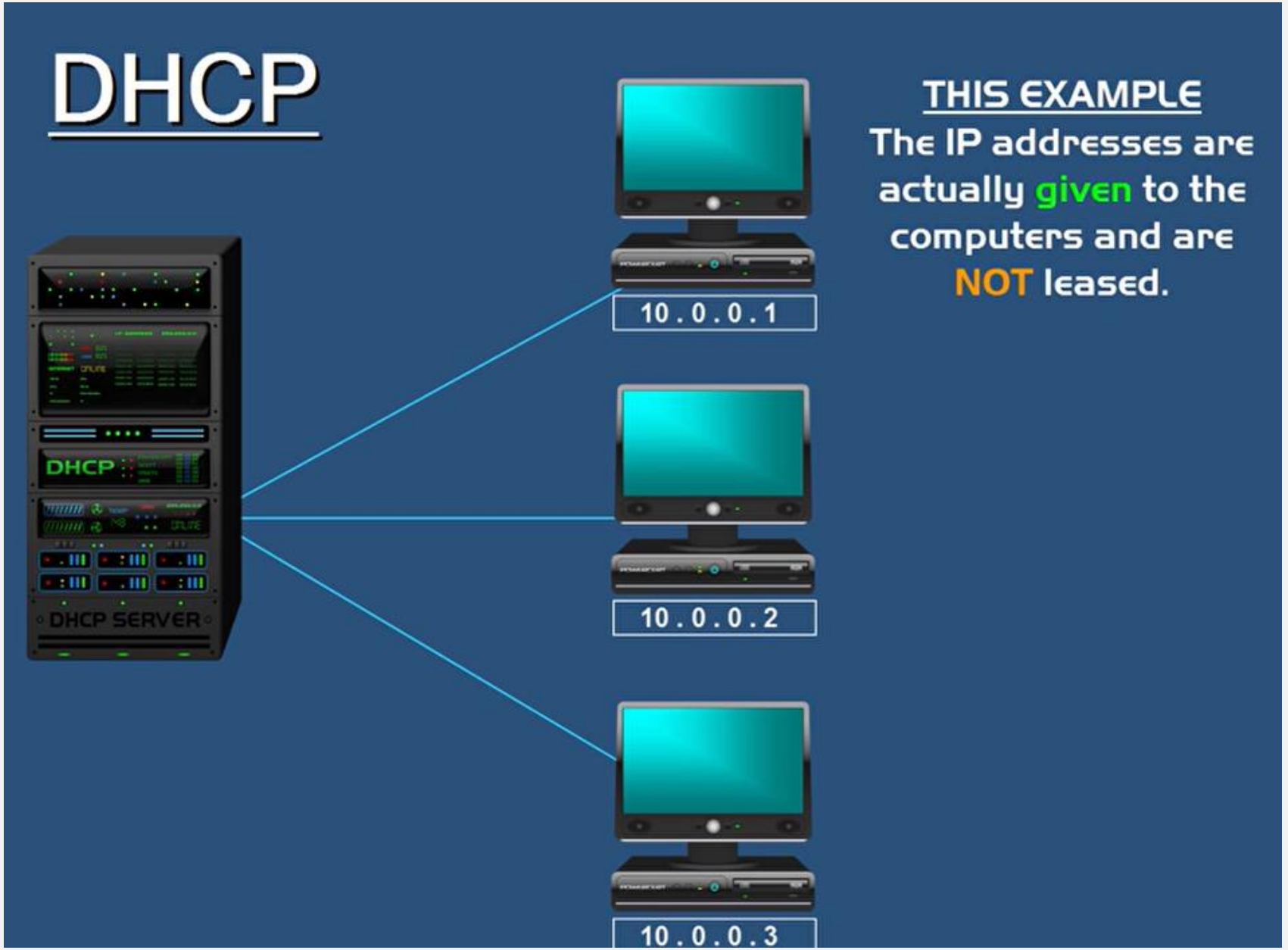
DHCP

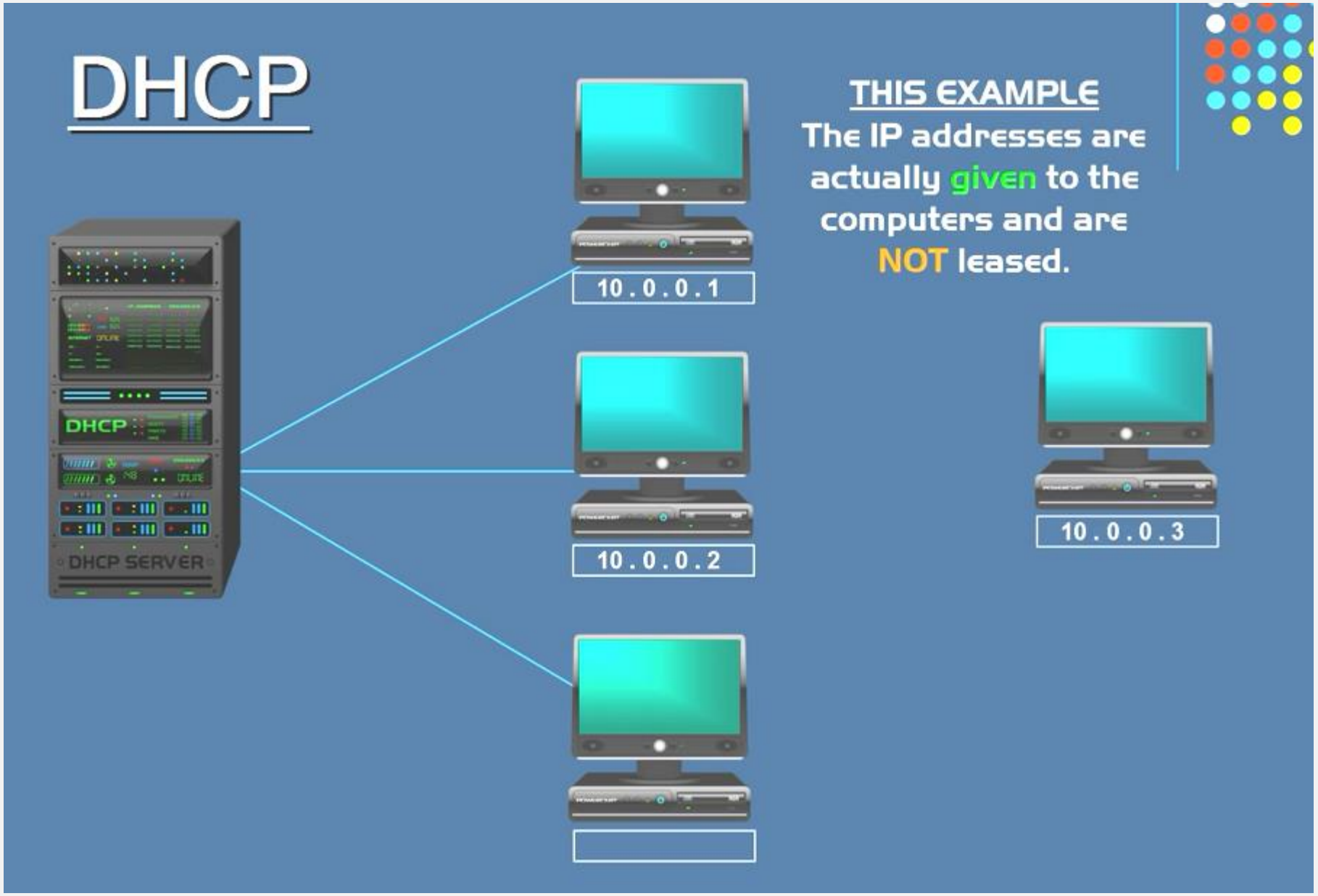
DHCP SETTINGS

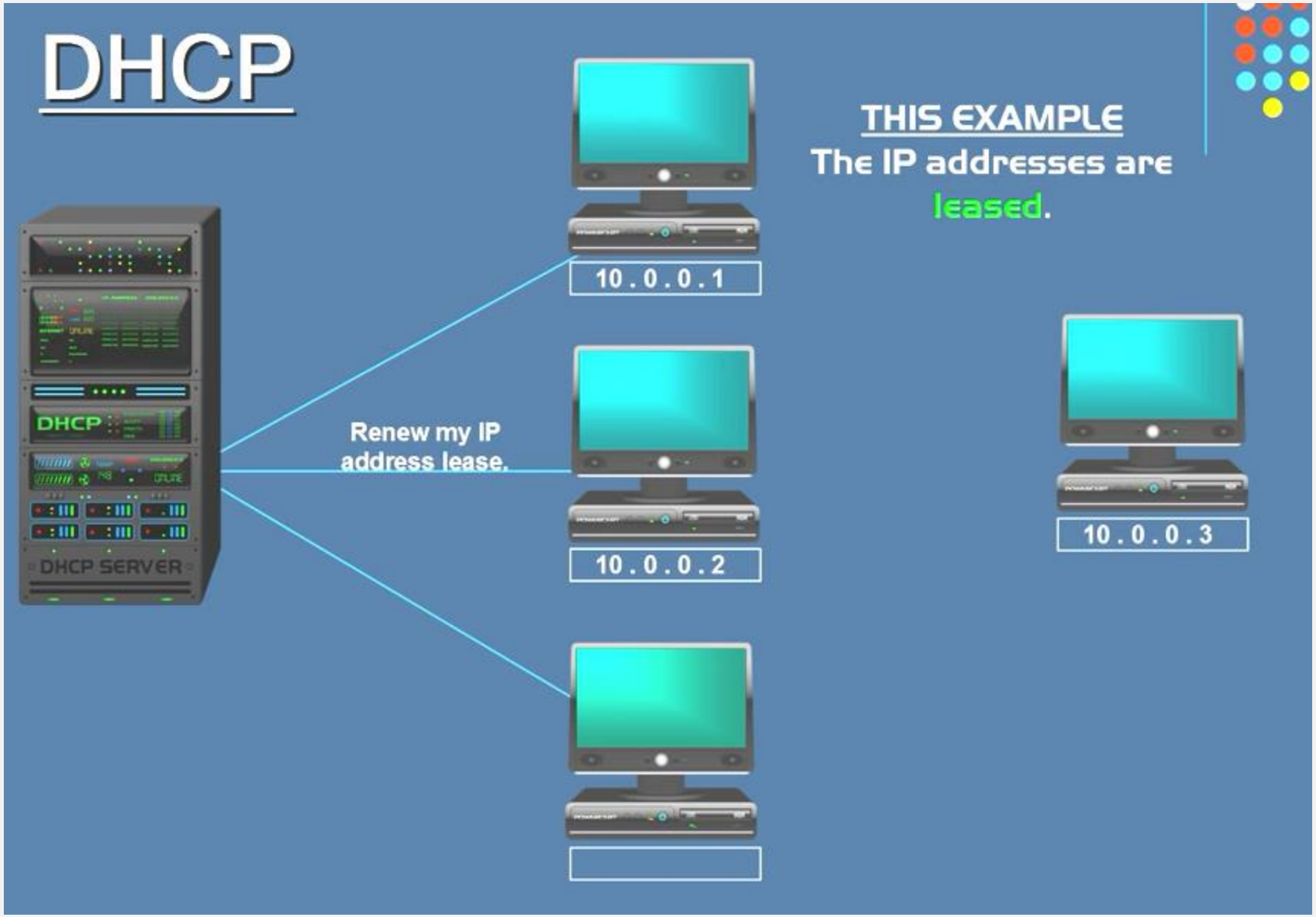
SCOPE

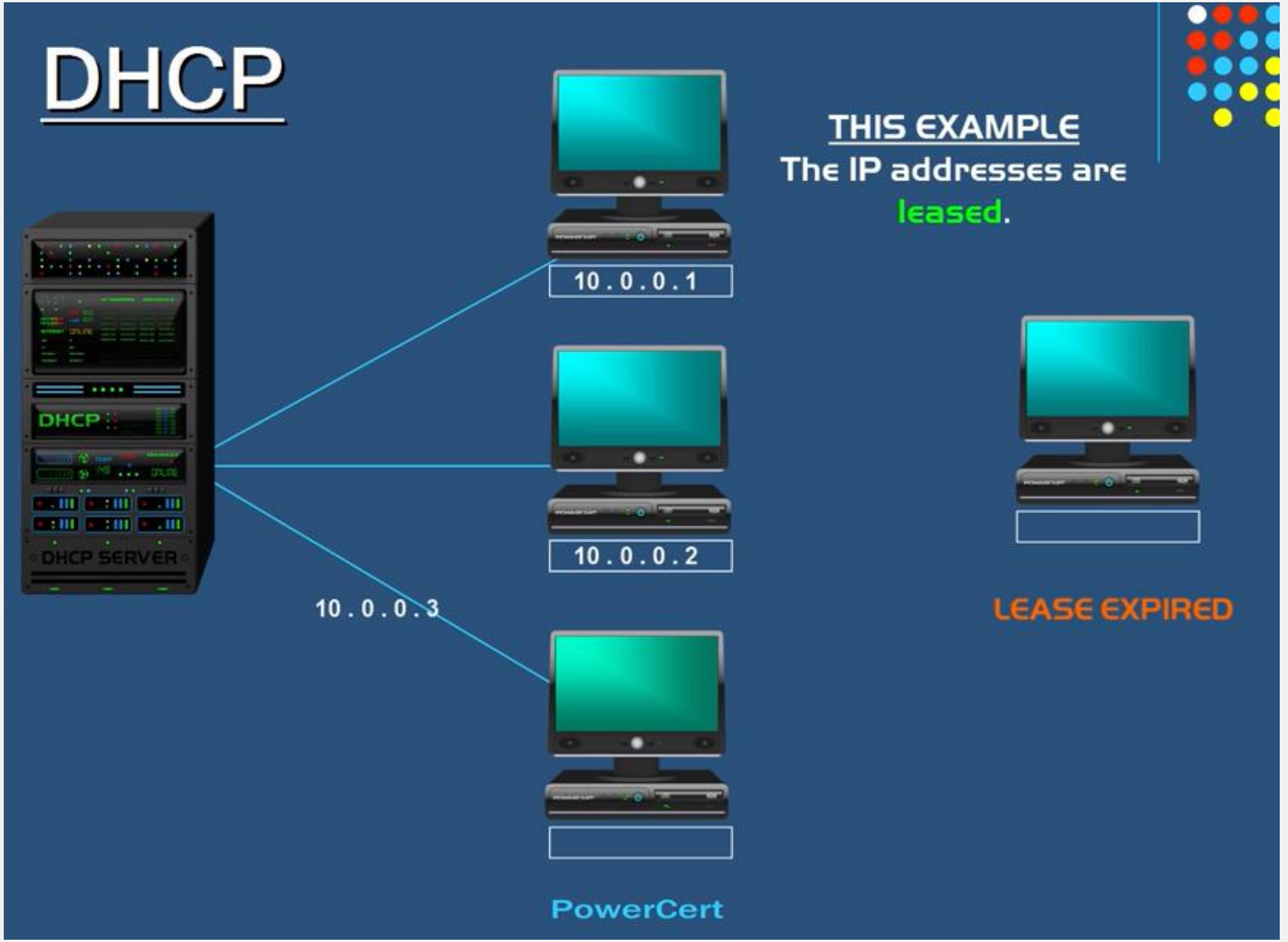
Start IP Address	10 . 0 . 0 . 1
End IP Address	10 . 0 . 0 . 3

10.0.0.1
10.0.0.2
10.0.0.3


DHCP
THIS EXAMPLE
The IP addresses are actually given to the computers and are NOT leased.
DHCP
DHCP SERVER
10 . 0 . 0 . 1
10 . 0 . 0 . 2
10 . 0 . 0 . 3

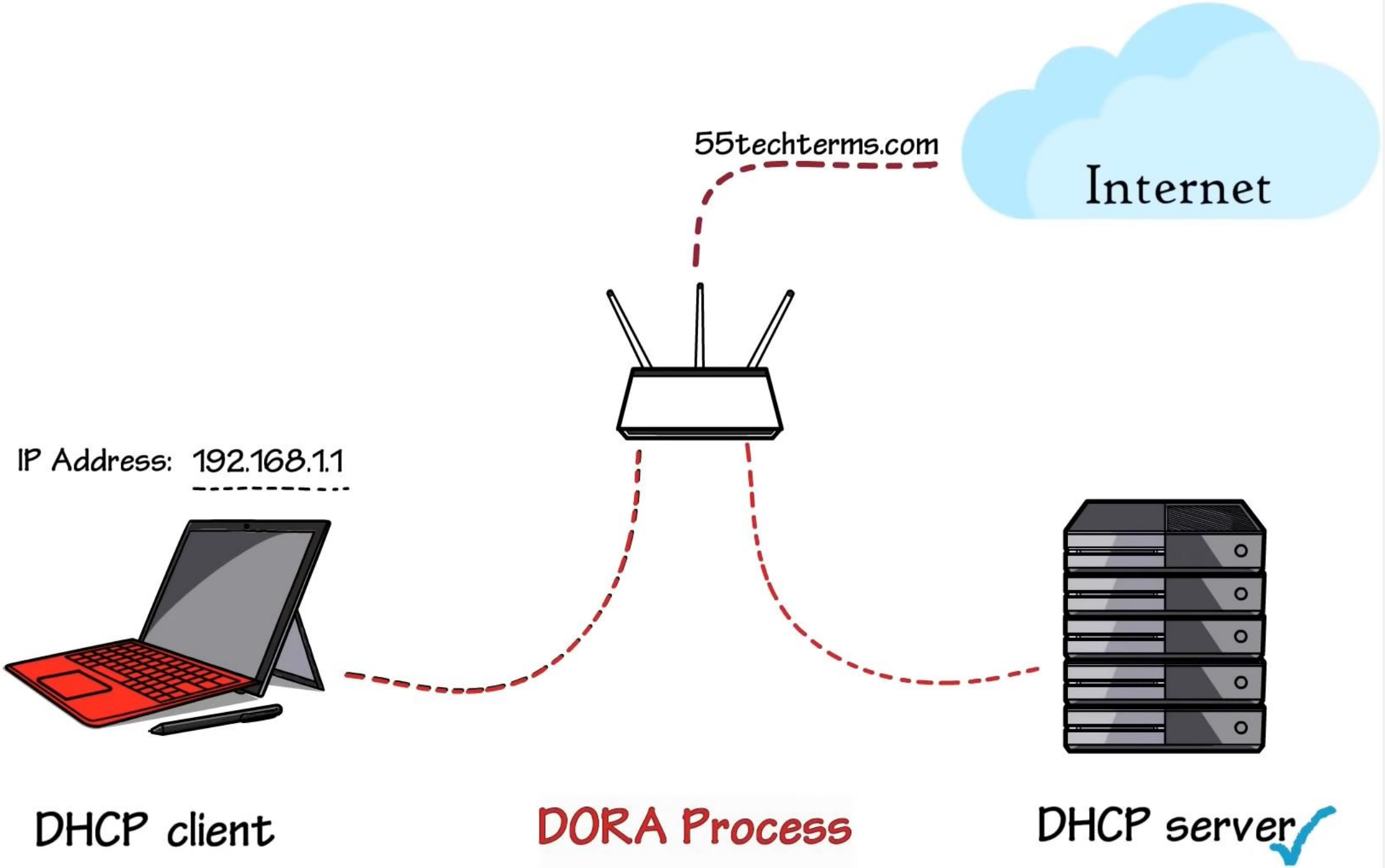

DHCP
THIS EXAMPLE
The IP addresses are actually given to the computers and are NOT leased.
DHCP
DHCP SERVER
10 . 0 . 0 . 1
10 . 0 . 0 . 2
10 . 0 . 0 . 3


DHCP
THIS EXAMPLE
The IP addresses are leased.
DHCP
DHCP SERVER
Renew my IP address lease.
10 . 0 . 0 . 1
10 . 0 . 0 . 2
10 . 0 . 0 . 3


DHCP
THIS EXAMPLE
The IP addresses are leased.
DHCP
DHCP SERVER
10.0.0.1
10.0.0.2
10.0.0.3
LEASE EXPIRED
PowerCert

COMPONENTS OF DHCP

1. **DHCP Server:** It is typically a server or a router that holds the network configuration information.
2. **DHCP Client:** It is the endpoint that gets the configuration information from the server like any computer or mobile.
3. **DHCP Relay Agent:** If you have only one DHCP Server for multiple LAN's then the DHCP relay agent present in every network will forward the **DHCP request** to the servers. This because the DHCP packets cannot travel across the router. Hence, the relay agent is required so that DHCP servers can handle the request from all the networks.
4. **IP address pool:** It contains the list of IP address which are available for assignment to the client.
5. **Subnet Mask:** It tells the host that in which network it is currently present.
6. **Lease Time:** It is the amount of time for which the IP address is available to the client. After this time the client must renew the IP address.
7. **Gateway Address:** The gateway address lets the host know where the gateway is to connect to the internet.


55techterms.com
Internet
IP Address: 192.168.1.1
DHCP client
DORA Process
DHCP server

IP Address

Discover

Offer

Request

Acknowledgment

MORE INFO

Default gateway IP address

Subnet mask

DNS server IP address

Subnet mask: 255.255.255.0

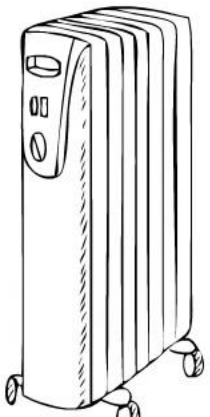
IP Address: 192.168.225.24

Network address | Host address

IP Address

8.8.8.8

DNS server



DHCP client ✓ DORA Process ✓ DHCP server ✓

IP Address

Discover →

← Offer ← IP1

IP1 → Request →

← Acknowledgment ←

MORE INFO

- Default gateway IP address
- Subnet mask
- DNS server IP address
- Lease time
- IP address = IP1

DHCP client ✓ DORA Process ✓ DHCP server ✓

IP Address

Discover →

← Offer ← IP1

IP1 → Request →

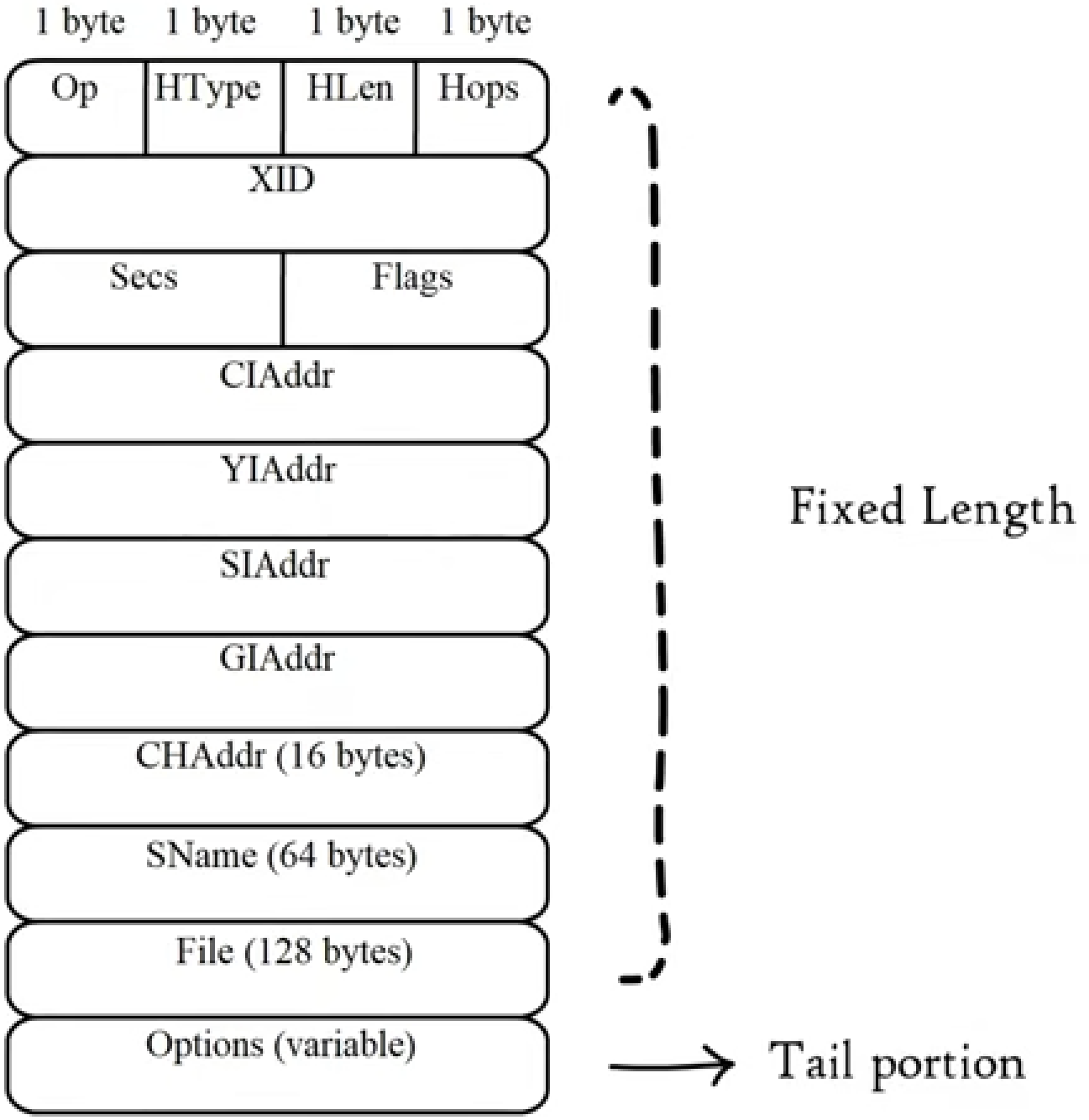
← Acknowledgment ←

MORE INFO

- Default gateway IP address
- Subnet mask
- DNS server IP address
- Lease time
- IP address = IP1

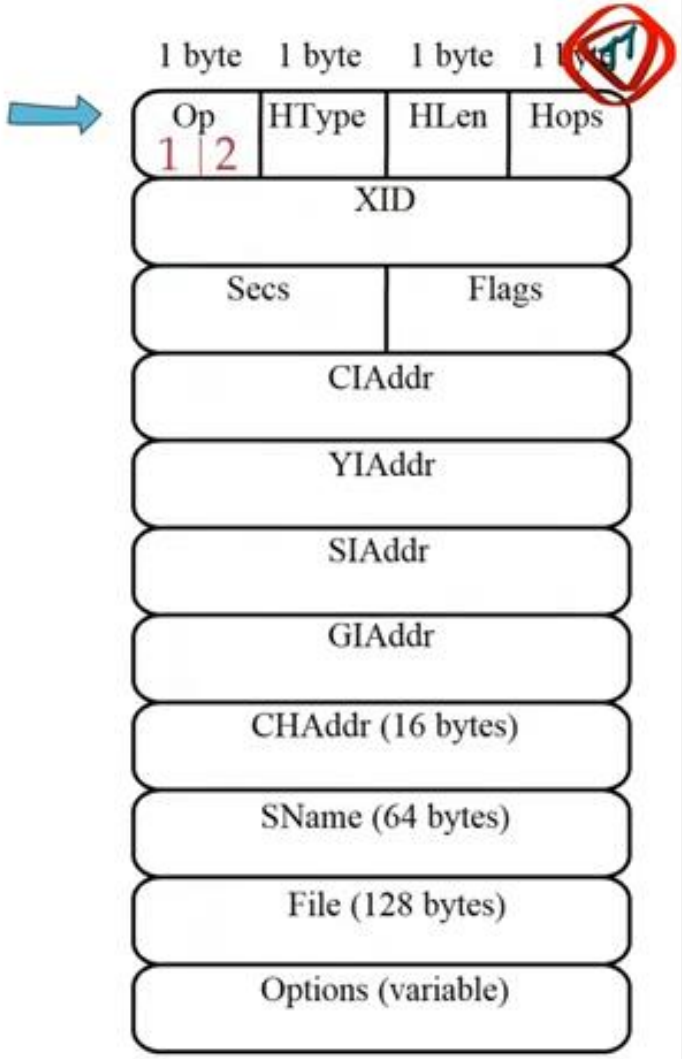
Format ?

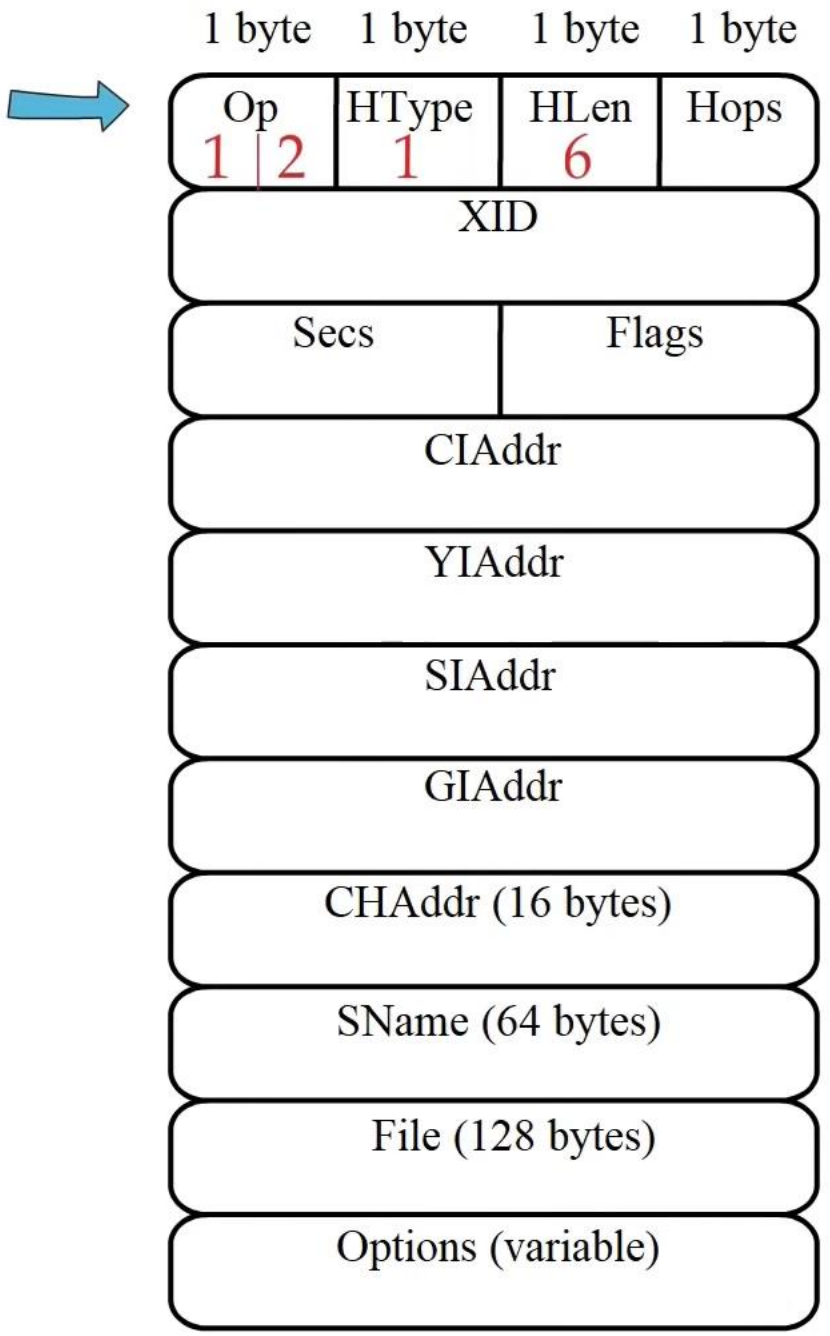
Operation Code	Hardware type	Hardware length	Hop count
Transition ID			
Number of seconds		Flags	
Client IP address			
Your IP address			
Server IP address			
Gateway IP address			
Client hardware address (16 bytes)			
Server name (64 bytes)			
Boot file name (128 bytes)			
Options (Variable length)			


1 byte
1 byte
1 byte
1 byte
Op
HType
HLen
Hops
XID
Secs
Flags
CIAddr
YIAddr
SIAddr
GIAddr
CHAddr (16 bytes)
SName (64 bytes)
File (128 bytes)
Options (variable)
Fixed Length
Tail portion

Discover
Request
} REQUEST

Offer
ACK
} REPLY



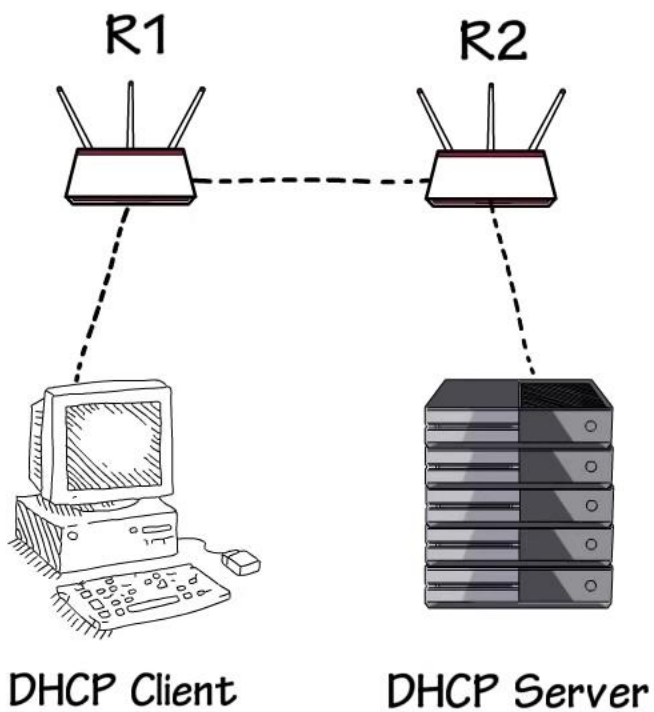


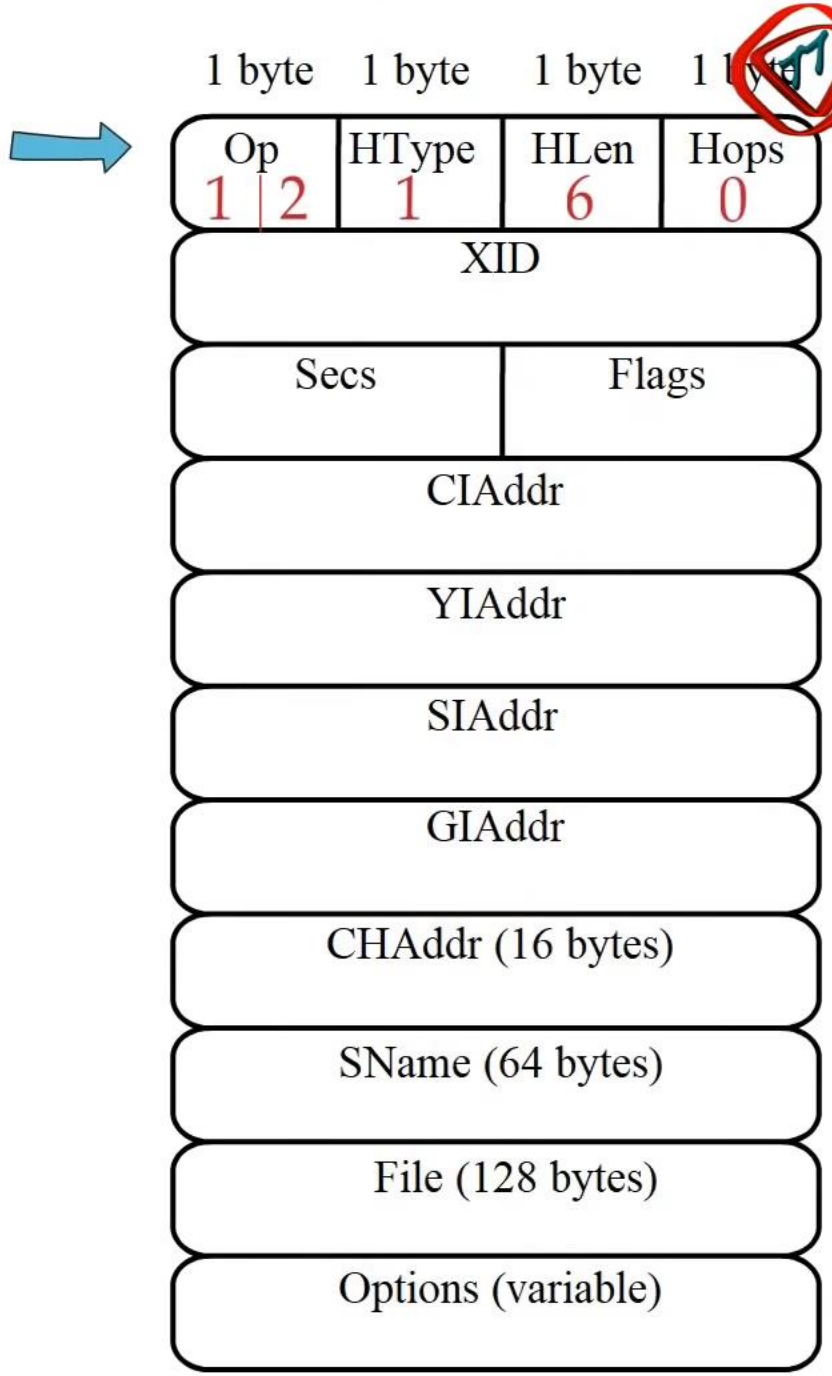
MAC address

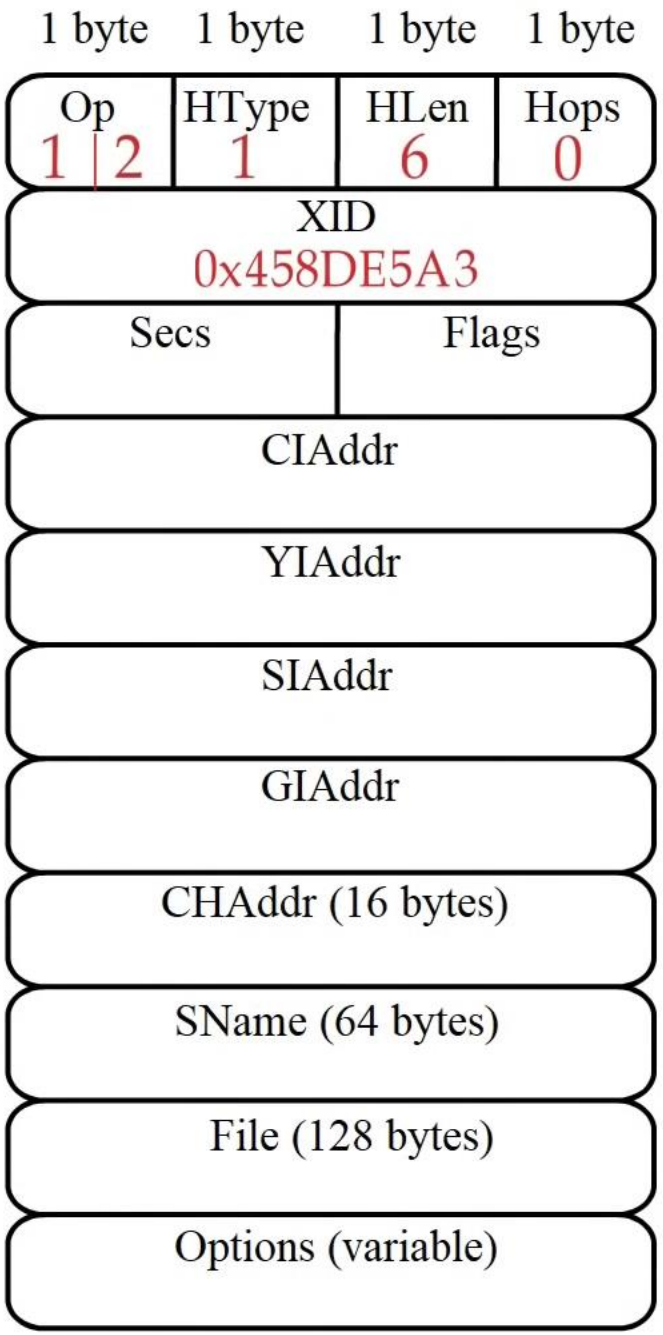
1B:22:34:F4:AB:C6

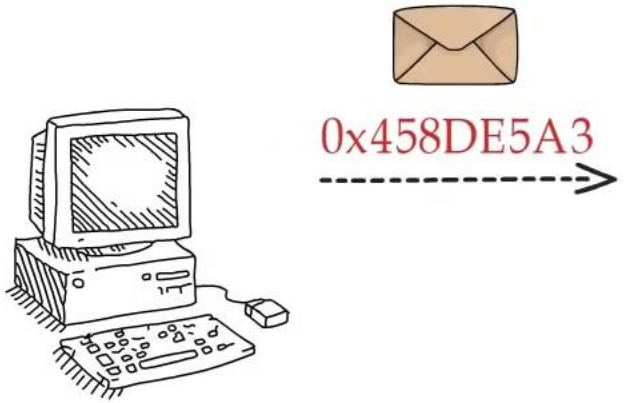
Discover
Request
} REQUEST

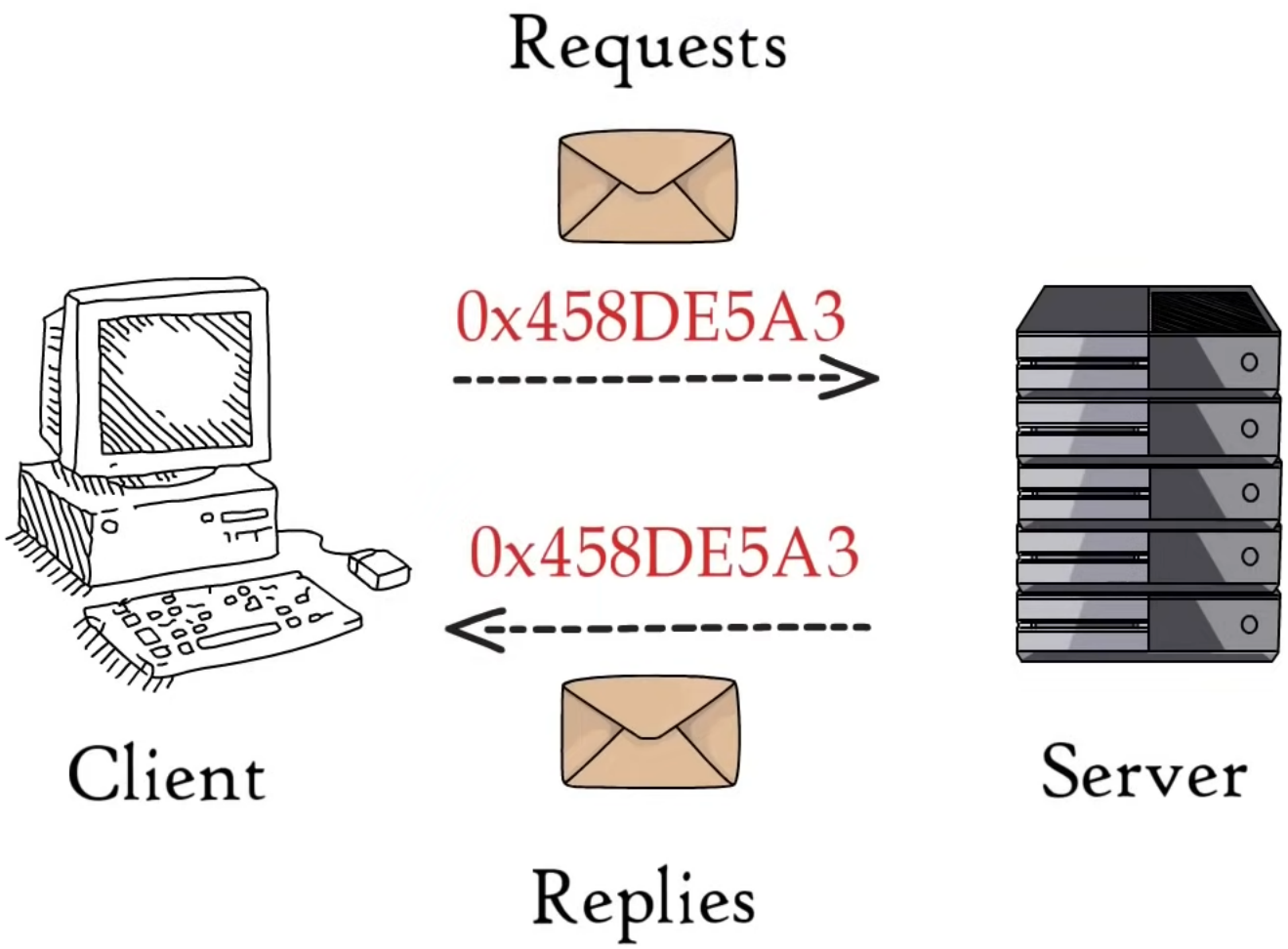
Offer
ACK
} REPLY

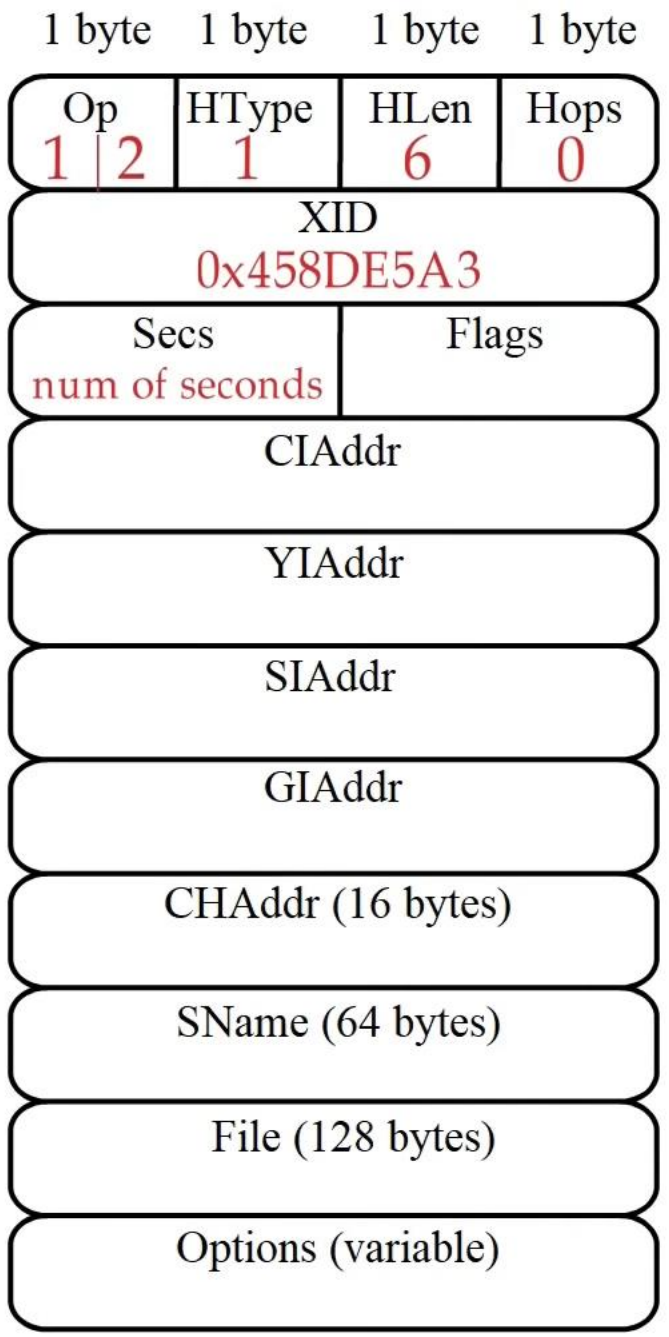


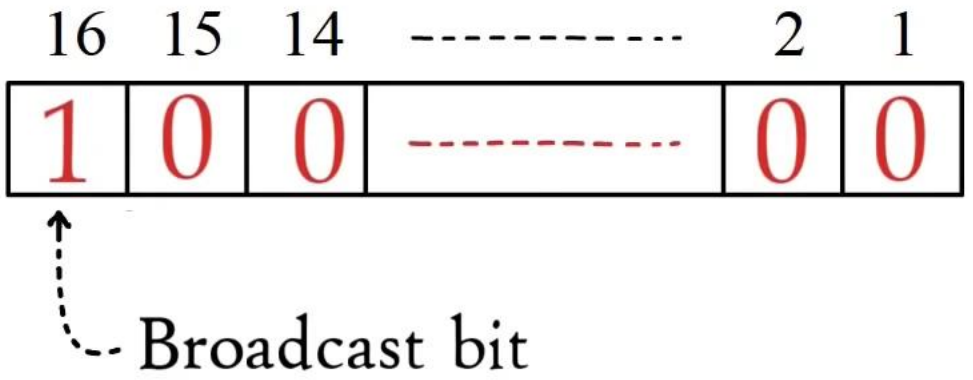


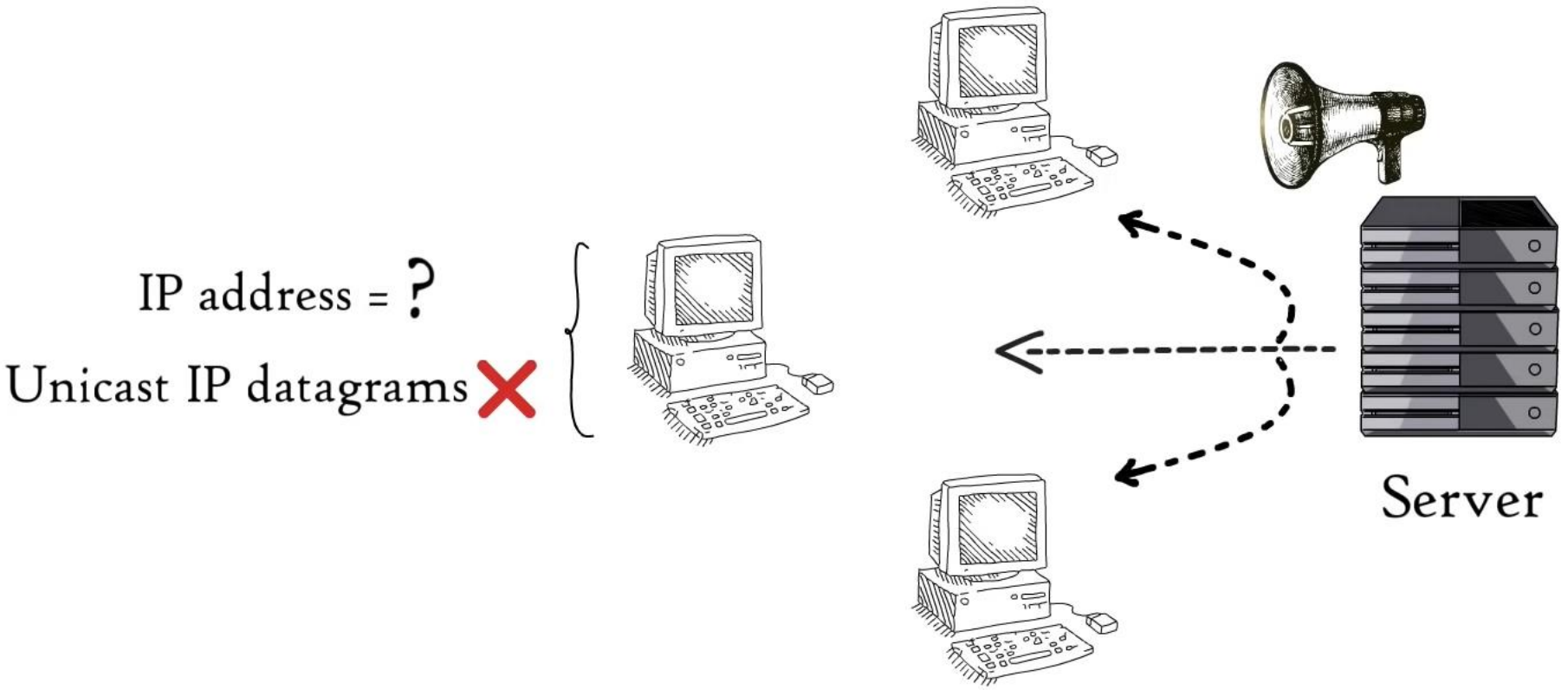

1 byte
1 byte
1 byte
1 byte
Op
1 | 2
HType
1
HLen
6
Hops
0
XID
0x458DE5A3
Secs
Flags
CIAddr
YIAddr
SIAddr
GIAddr
CHAddr (16 bytes)
SName (64 bytes)
File (128 bytes)
Options (variable)

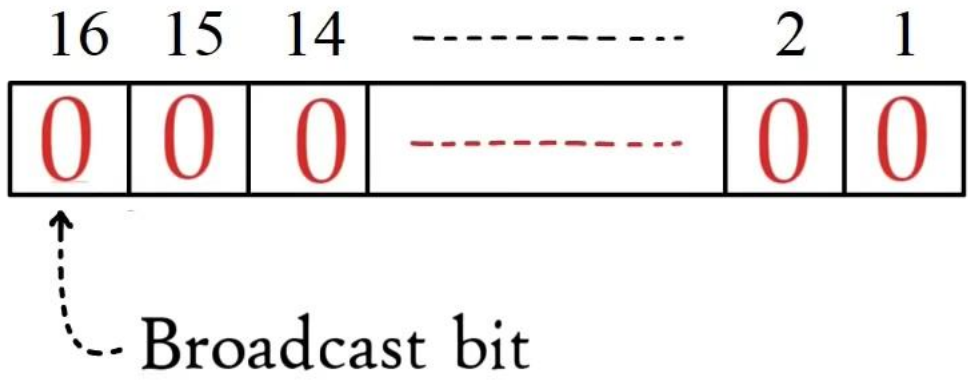

0x458DE5A3

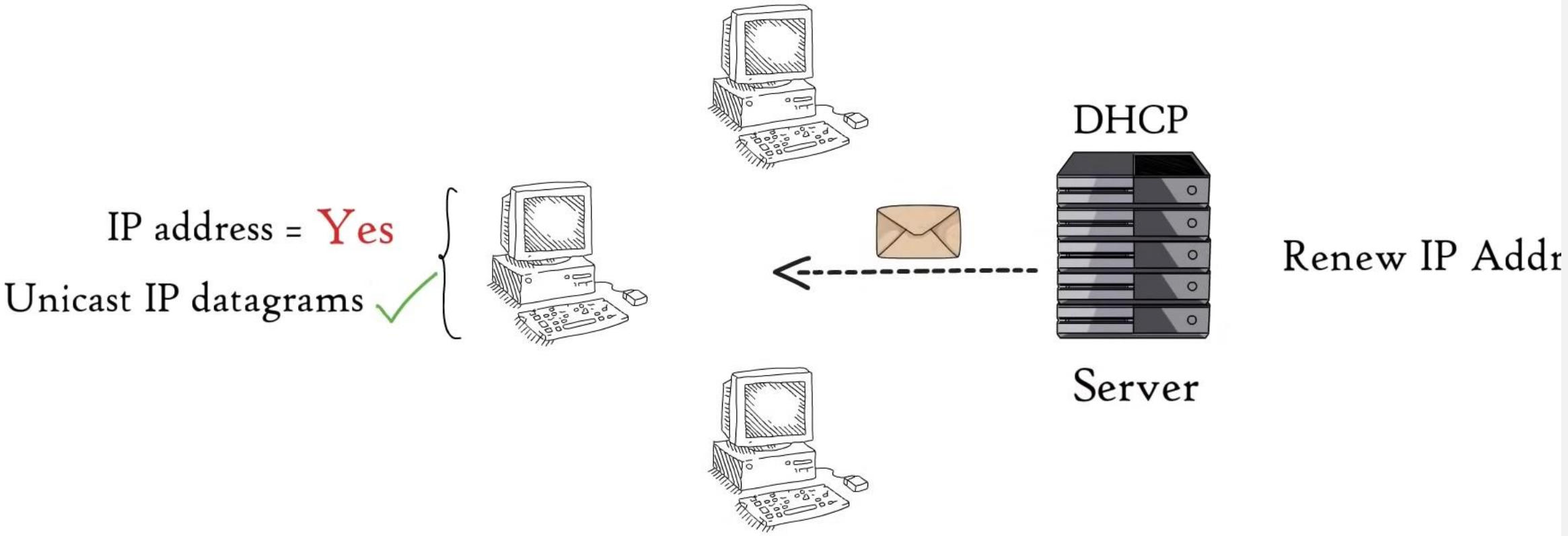

Requests
0x458DE5A3
0x458DE5A3
Client
Server
Replies


1 byte
1 byte
1 byte
1 byte
Op
1 | 2
HType
1
HLen
6
Hops
0
XID
0x458DE5A3
Secs
num of seconds
Flags
CIAddr
YIAddr
SIAddr
GIAddr
CHAddr (16 bytes)
SName (64 bytes)
File (128 bytes)
Options (variable)

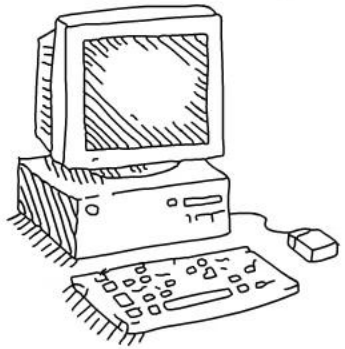

16 15 14 ---------- 2 1
1 0 0 ---------- 0 0
Broadcast bit


IP address = ?
Unicast IP datagrams
Server

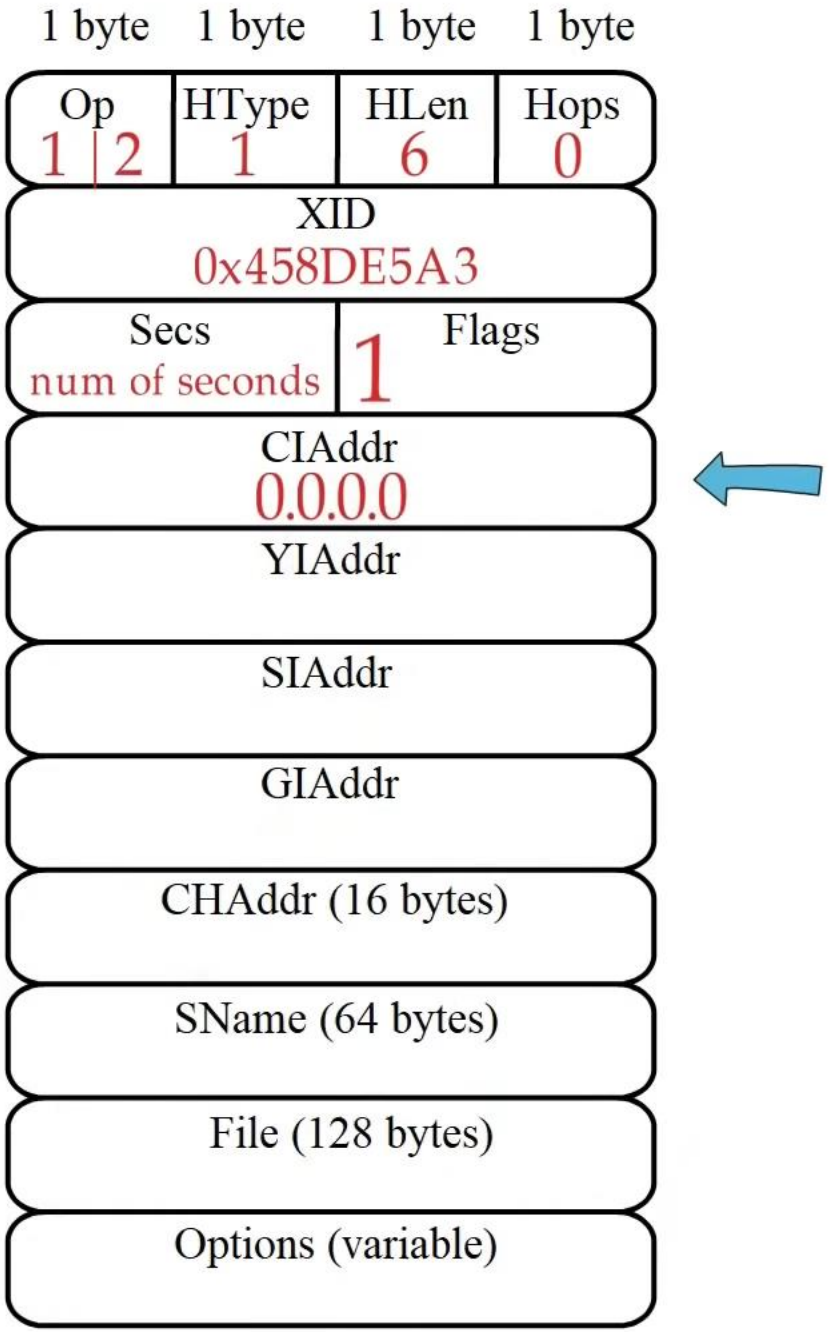

16 15 14 ---------- 2 1
0 0 0 ---------- 0 0
Broadcast bit


IP address = Yes
Unicast IP datagrams
DHCP
Server
Renew IP Addr

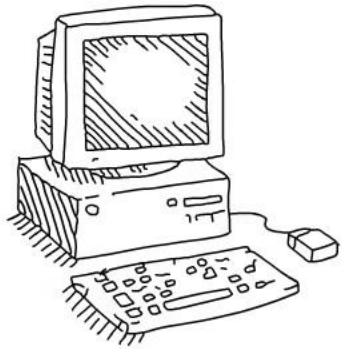
Initial IP Configuration



IP address = ?



Initial IP Configuration

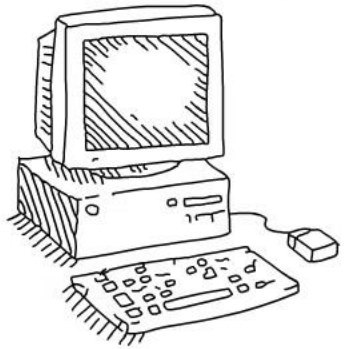


IP address = ?

DHCP Server

1 byte	1 byte	1 byte	1 byte
Op 1 | 2	HType 1	HLen 6	Hops 0
XID 0x458DE5A3			
Secs num of seconds		Flags 1	
CIAddr 0.0.0.0			
YIAddr 172.16.11.125			
SIAddr			
GIAddr			
CHAddr (16 bytes)			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

Initial IP Configuration



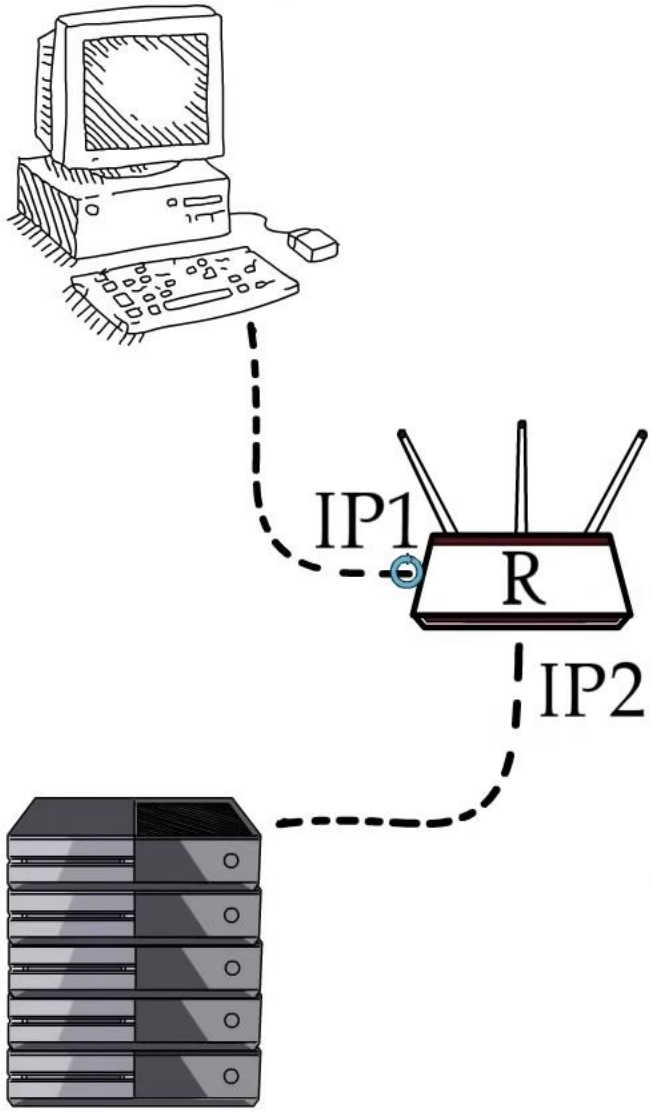
IP address = ?

DHCP Server

1 byte	1 byte	1 byte	1 byte
Op 1 | 2	HType 1	HLen 6	Hops 0
XID 0x458DE5A3			
Secs num of seconds		Flags 1	
CIAddr 0.0.0.0			
YIAddr 172.16.11.125			
SIAddr			
GIAddr			
CHAddr (16 bytes)			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

Bootstrap process

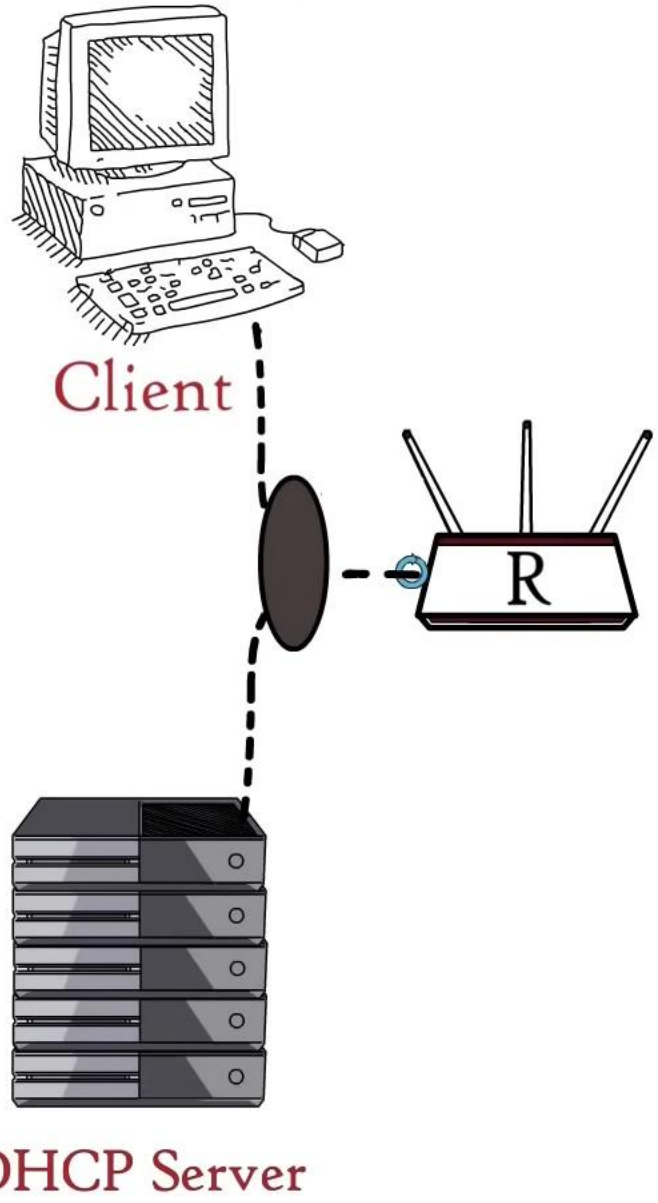
Initial IP Configuration



DHCP Server

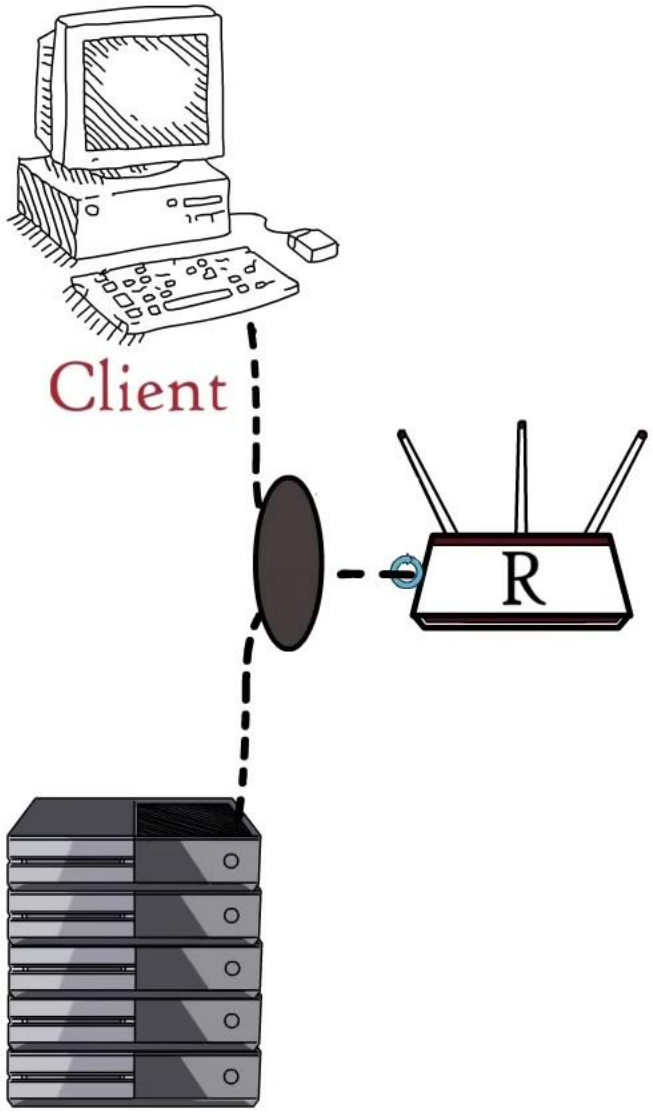
1 byte	1 byte	1 byte	1 byte
Op 1 | 2	HType 1	HLen 6	Hops 0
XID 0x458DE5A3			
Secs num of seconds		Flags 1	
CIAddr 0.0.0.0			
YIAddr 172.16.11.125			
SIAddr			
GIAddr IP1			
CHAddr (16 bytes)			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

Initial IP Configuration



1 byte	1 byte	1 byte	1 byte
Op 1 | 2	HType 1	HLen 6	Hops 0
XID 0x458DE5A3			
Secs num of seconds		Flags 1	
CIAddr 0.0.0.0			
YIAddr 172.16.11.125			
SIAddr			
GIAddr 0.0.0.0			
CHAddr (16 bytes)			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

Initial IP Configuration



1 byte	1 byte	1 byte	1 byte
Op 1 | 2	HType 1	HLen 6	Hops 0
XID 0x458DE5A3			
Secs num of seconds		Flags 1	
CIAddr 0.0.0.0			
YIAddr 172.16.11.125			
SIAddr			
GIAddr 0.0.0.0			
CHAddr (16 bytes) 1B:22:34:F4:AB:C6			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

Option Overloading

Options (variable)

Message type

Message	Value
Discover	1
Offer	2
Request	3
ACK	5

Client Identifier

Client's MAC Address

Server Identifier

DHCP server IP address

Requested IP address

IP address Offered to the DHCP client

IP address lease time

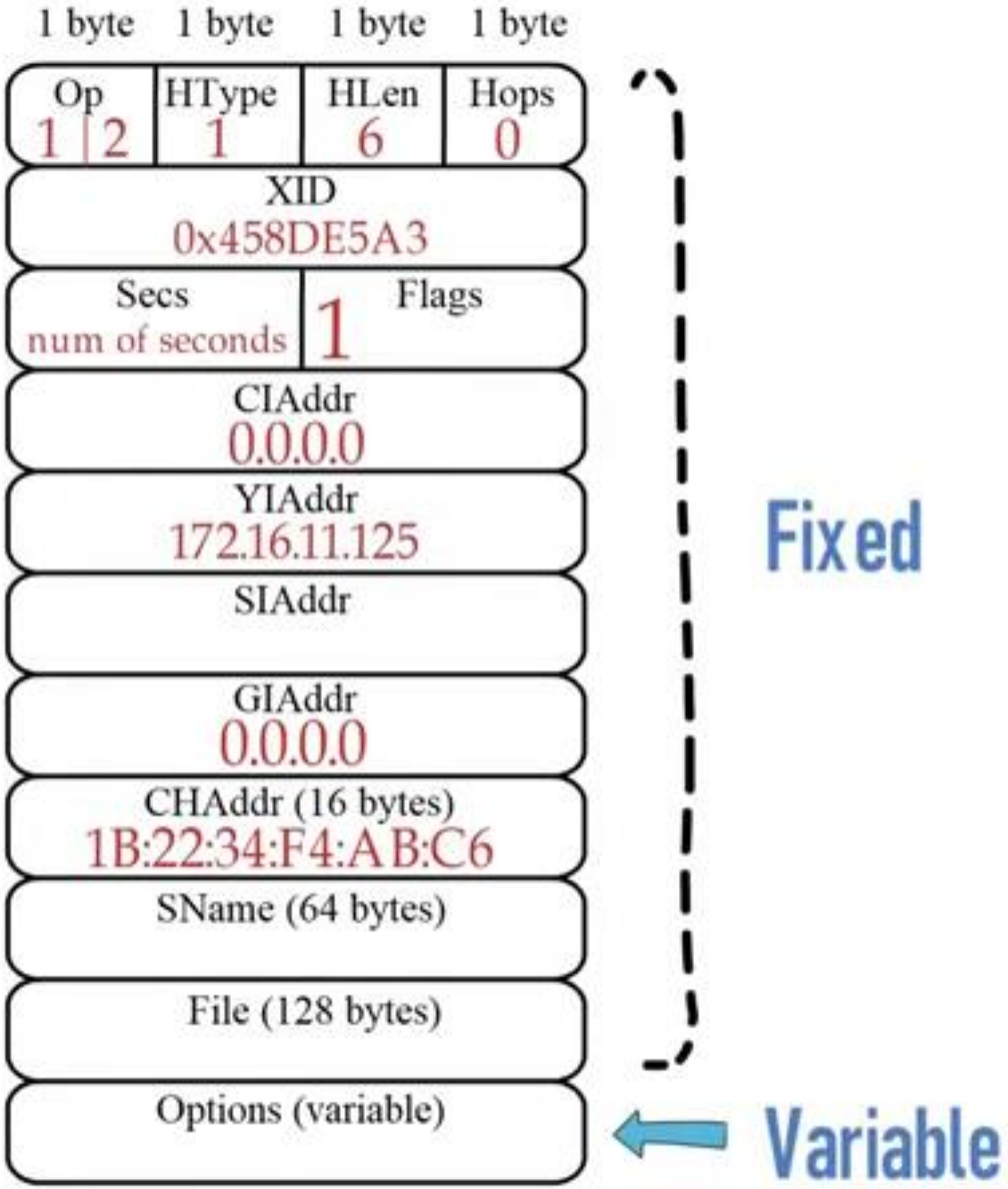
For example: 8 hours

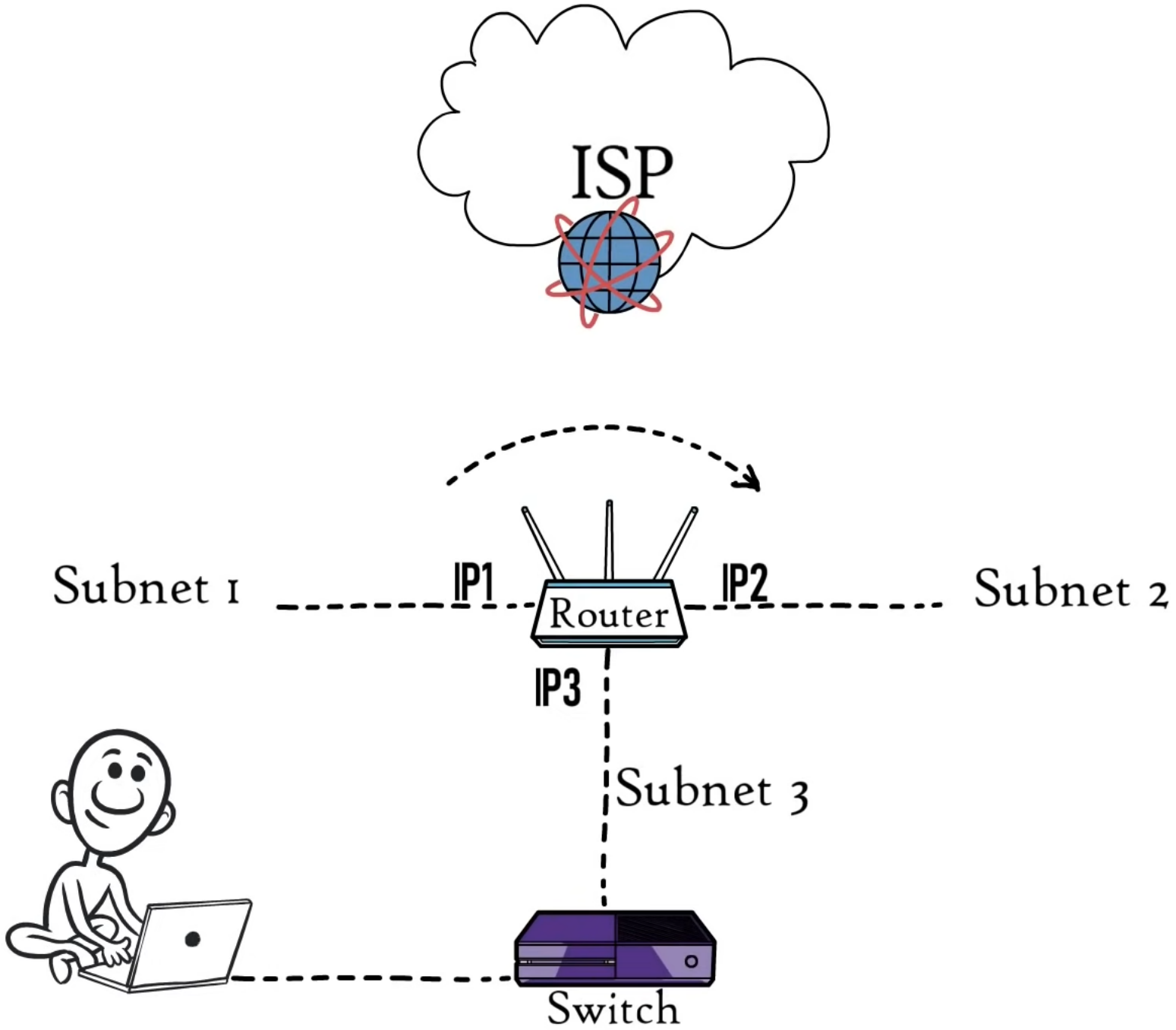
Subnet mask

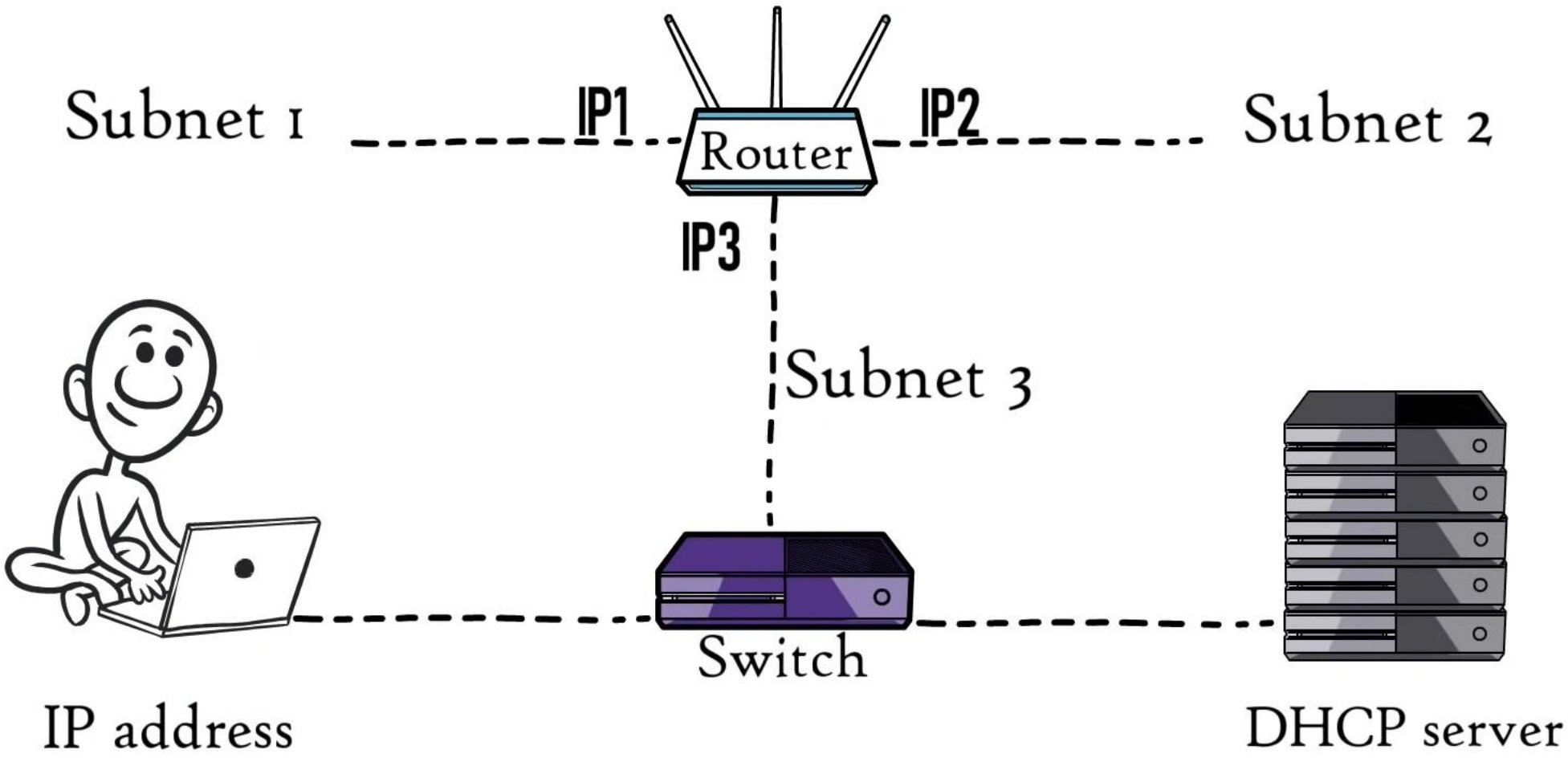
For example: 255.255.255.0

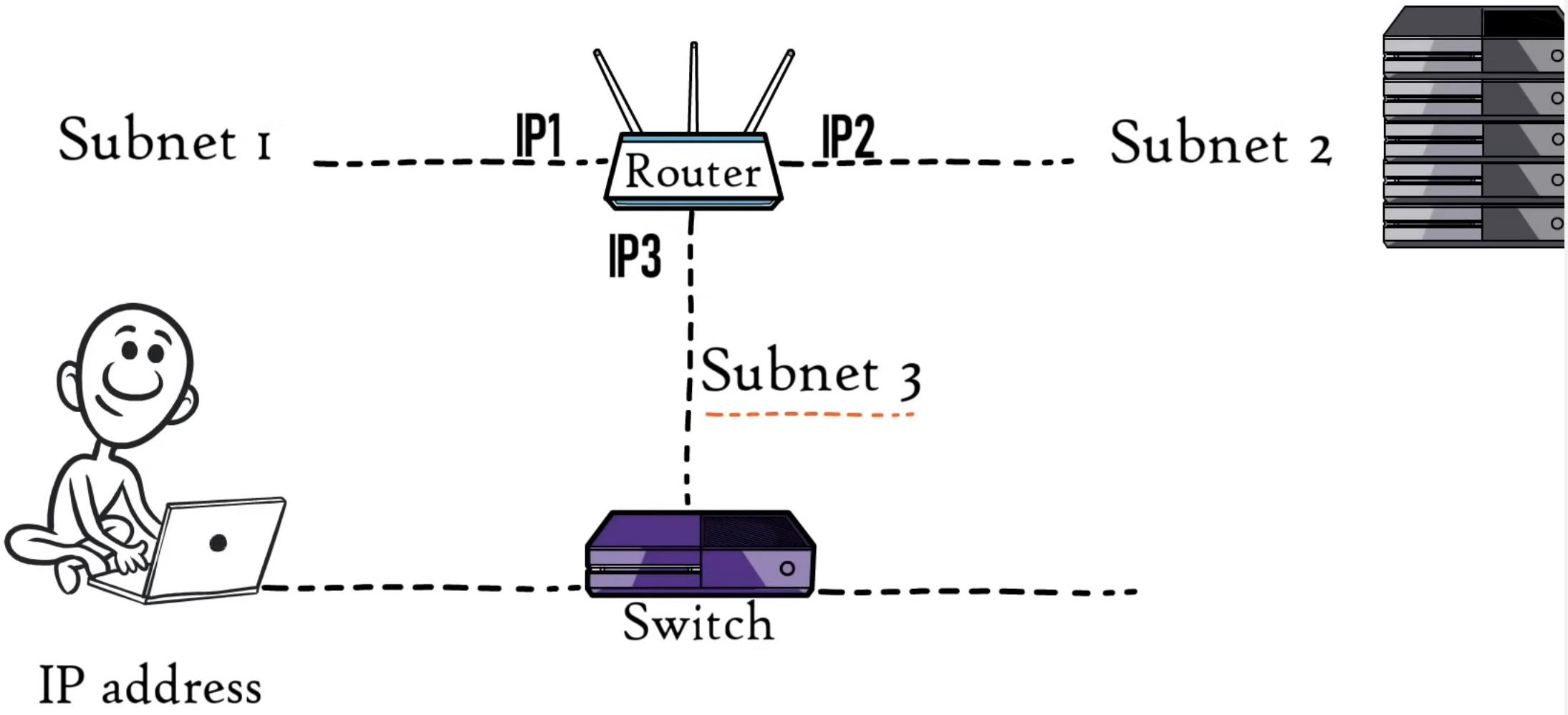
DNS server IP address

DHCP Message Format

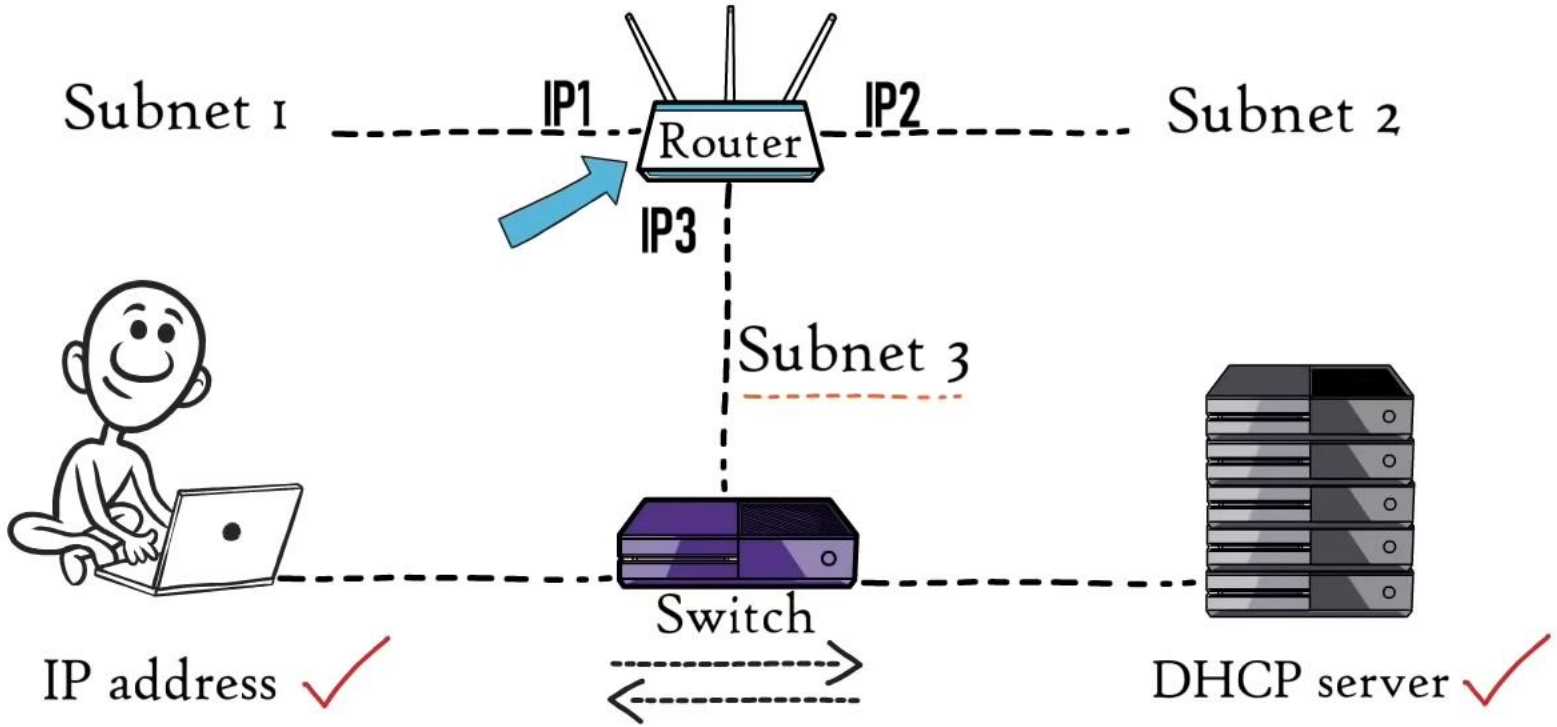



ISP
Subnet 1
IP1
Router
IP2
Subnet 2
IP3
Subnet 3
Switch


Subnet 1
IP1
Router
IP2
Subnet 2
IP3
Subnet 3
Switch
IP address
DHCP server


Subnet 1
IP1
Router
IP2
Subnet 2
IP3
Subnet 3
Switch
IP address

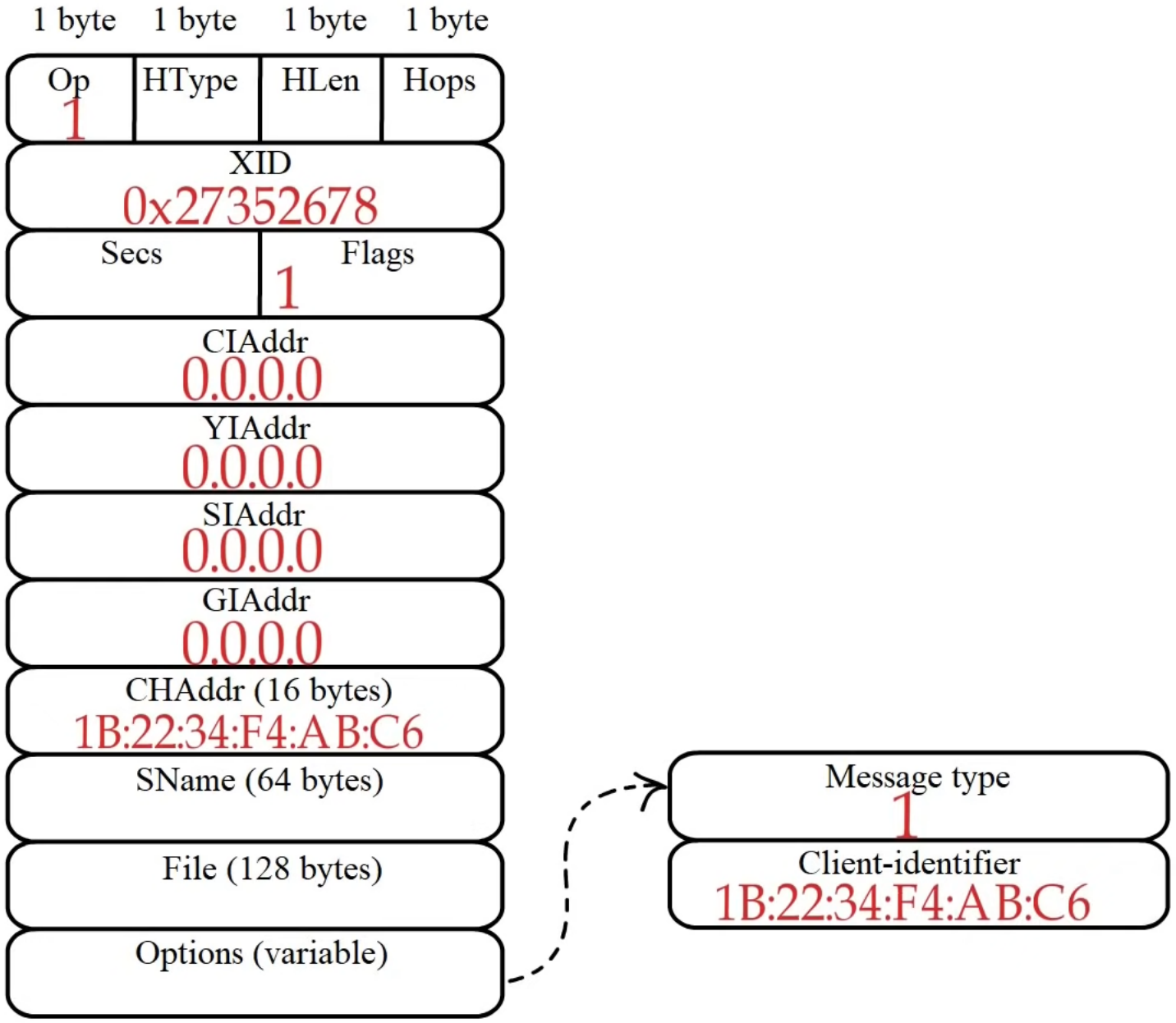
Case 1: Same Subnet



DHCPDISCOVER

1 byte	1 byte	1 byte	1 byte
Op: 1	HType	HLen	Hops
XID			
Secs		Flags: 1	
CIAddr: 0.0.0.0			
YIAddr			
SIAddr			
GIAddr: 0.0.0.0			
CHAddr (16 bytes)			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

DHCPDISCOVER



Application layer

Transport layer

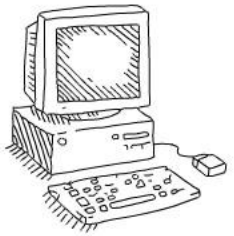
UDP Segment

	Client	Server
		
UDP Port	68	67

Application layer

Transport layer

UDP Segment



DHCP client DHCP server

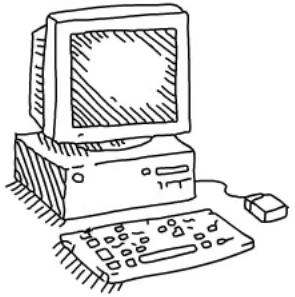
Application layer

Transport layer

UDP Segment

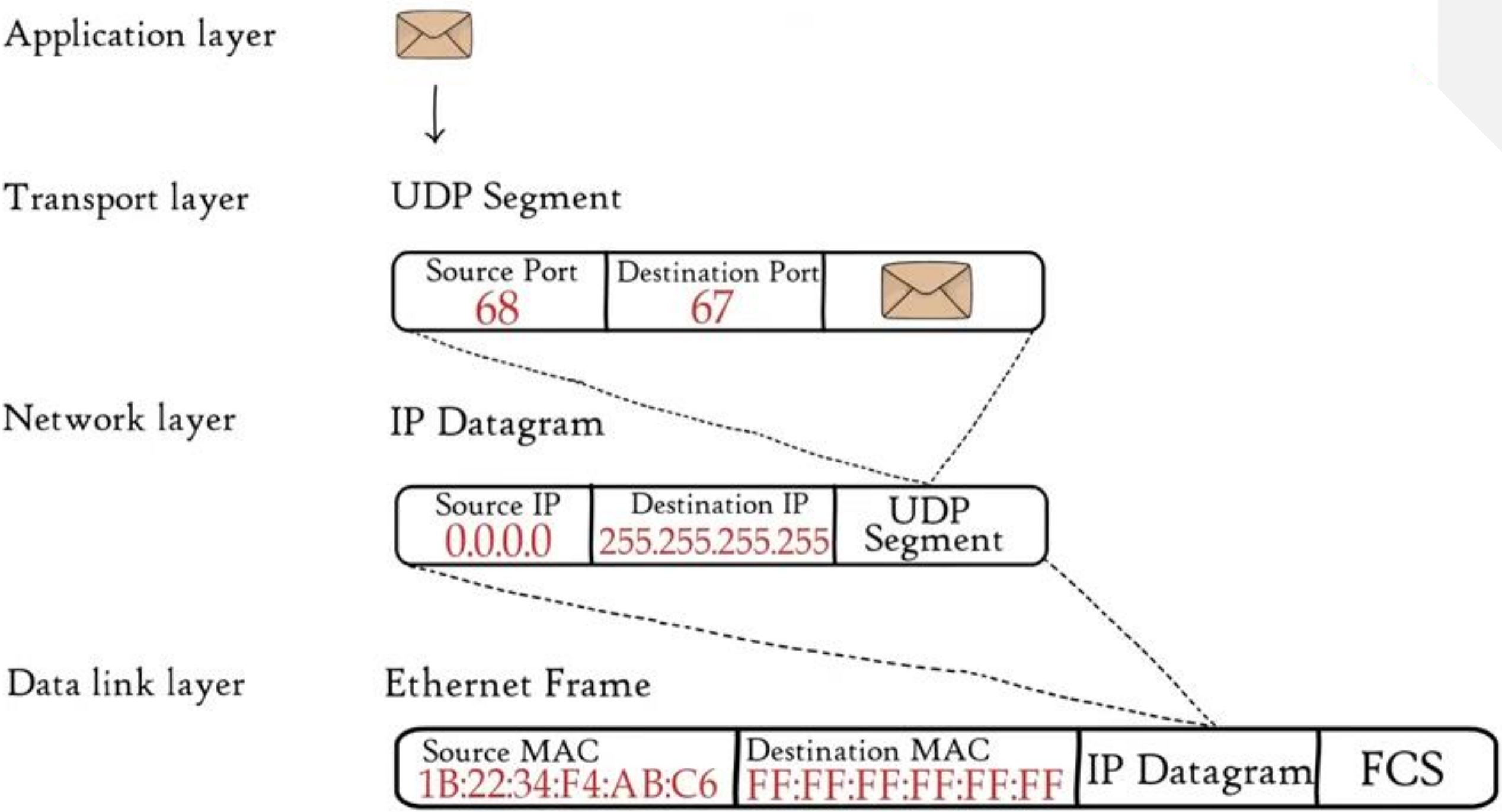
Network layer

IP Datagram



IP Address = ?

IP Address of DHCP server = ?


Application layer
Transport layer
UDP Segment
Source Port
68
Destination Port
67
Network layer
IP Datagram
Source IP
0.0.0.0
Destination IP
255.255.255.255
UDP
Segment
Data link layer
Ethernet Frame
Source MAC
1B:22:34:F4:AB:C6
Destination MAC
FF:FF:FF:FF:FF:FF
IP Datagram
FCS

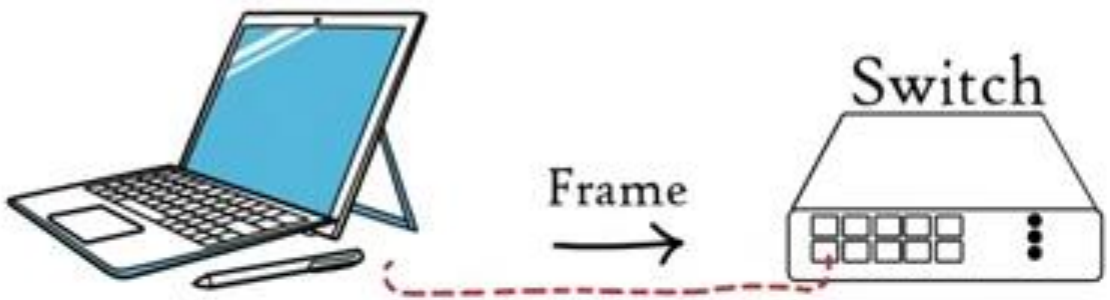
Client Serve

UDP Segment

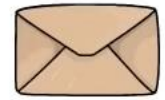
UDP Port 68 67

IP Datagram

Ethernet Frame

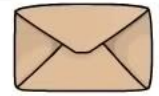


DHCPDISCOVER



Application layer

UDP Segment

Source Port	Destination Port	
68	67	

Transport layer

IP Datagram

Source IP	Destination IP	
0.0.0.0	255.255.255.255	UDP Segment

Network layer

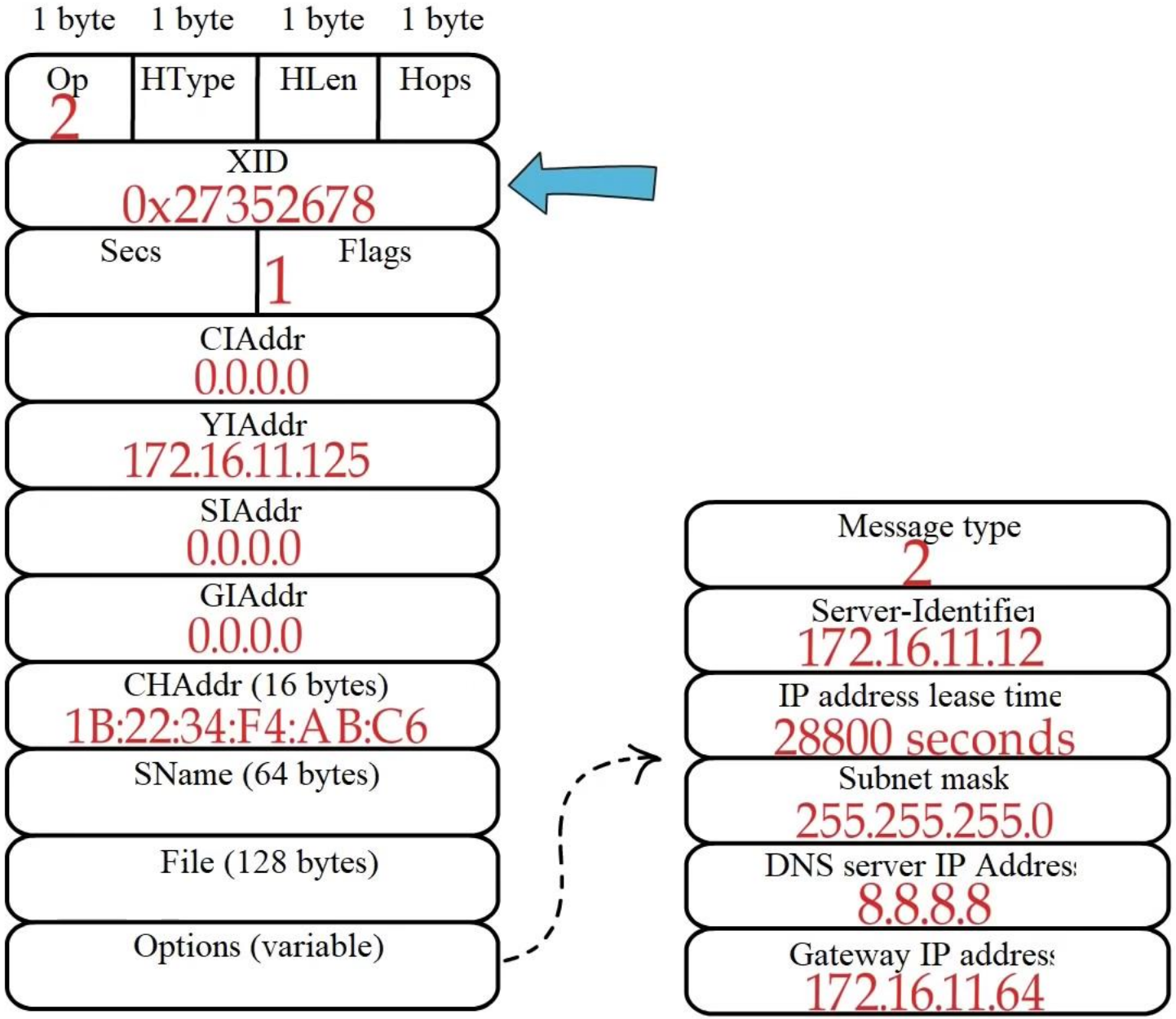
Ethernet Frame

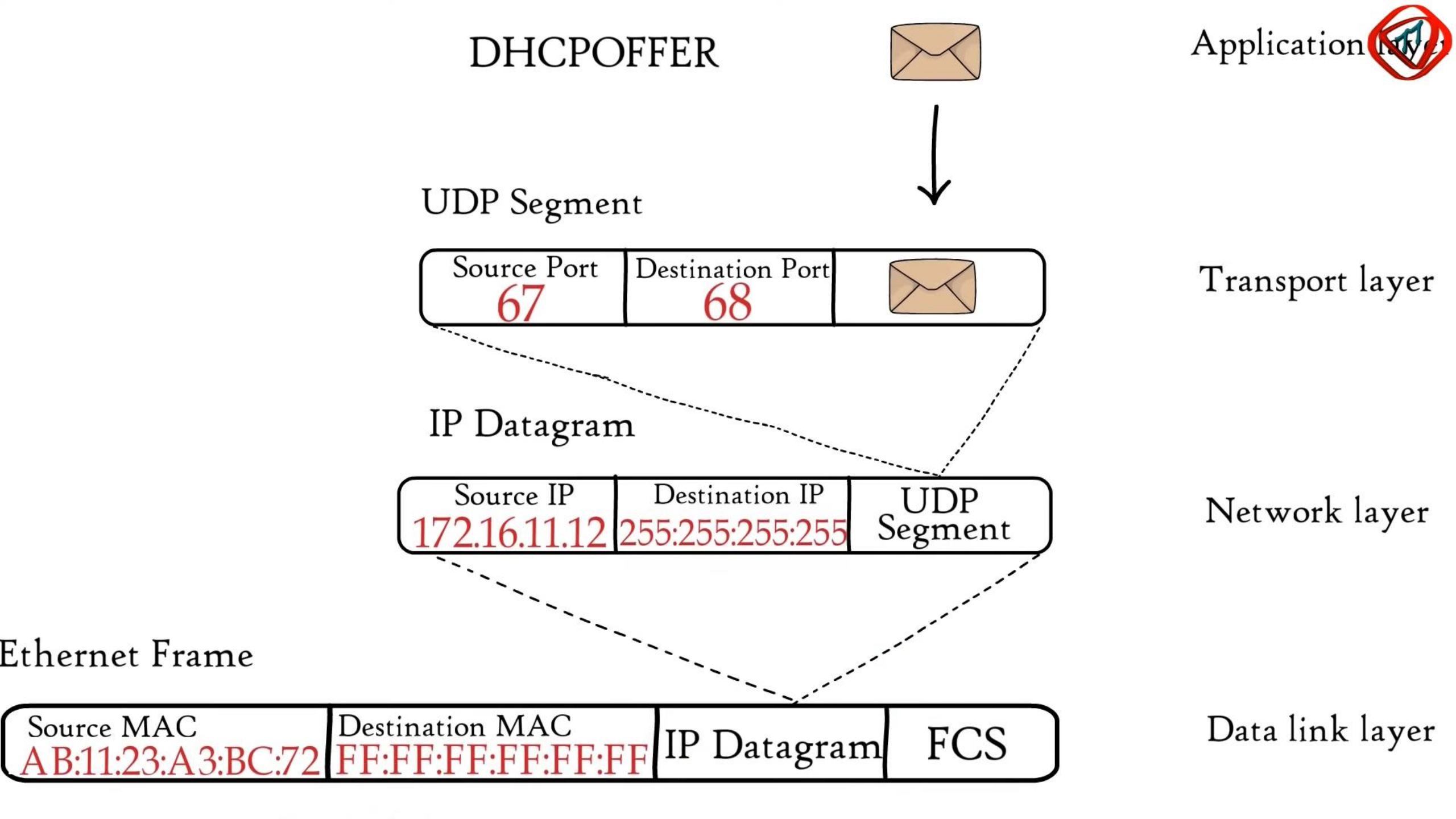
Source MAC	Destination MAC		
1B:22:34:F4:AB:C6	FF:FF:FF:FF:FF:FF	IP Datagram	FCS

Data link layer

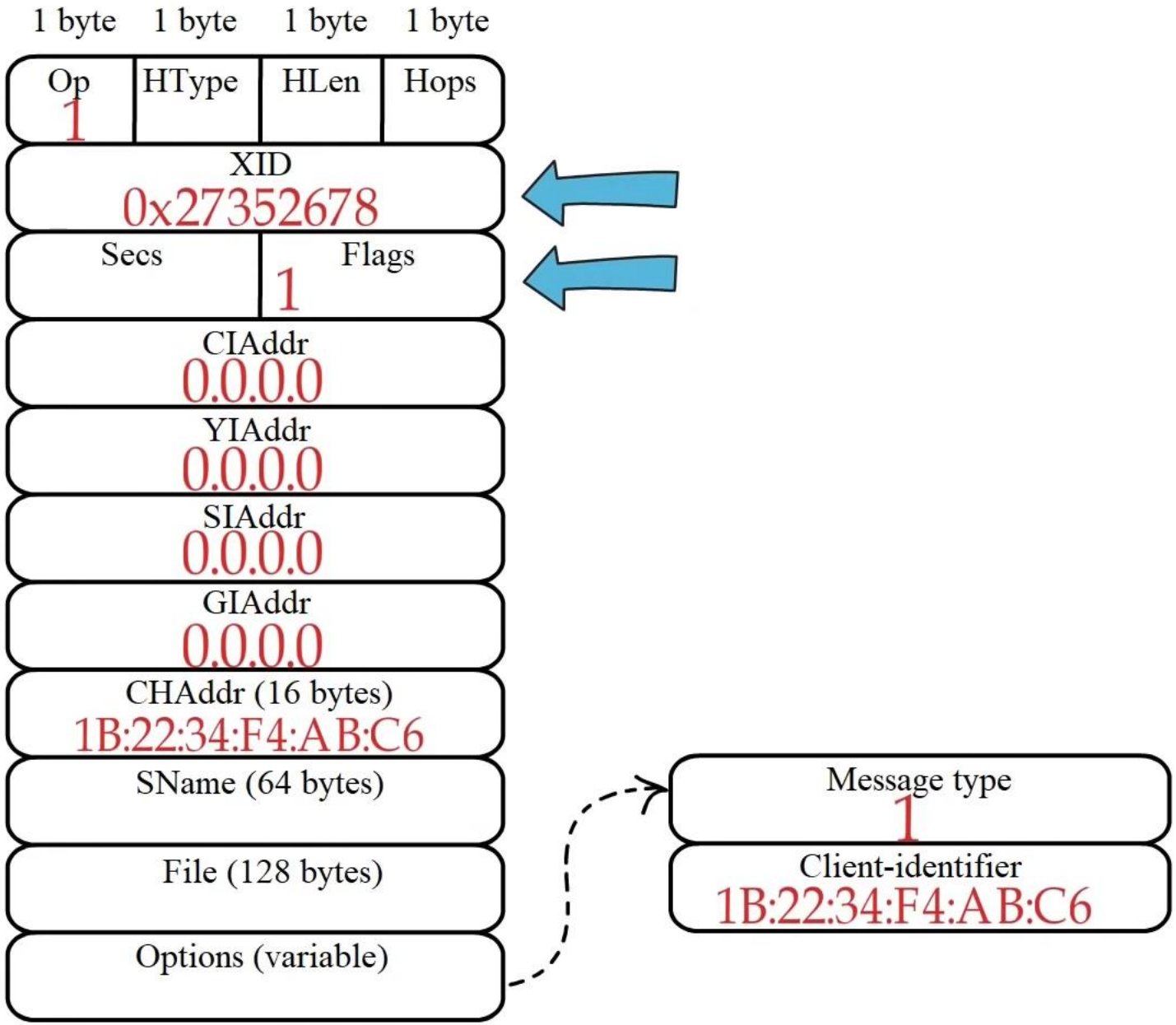
Physical layer

DHCPOFFER


1 byte
1 byte
1 byte
1 byte
Op
2
HType
HLen
Hops
XID
0x27352678
Secs
Flags
1
CIAddr
0.0.0.0
YIAddr
172.16.11.125
SIAddr
0.0.0.0
GIAddr
0.0.0.0
CHAddr (16 bytes)
1B:22:34:F4:AB:C6
SName (64 bytes)
File (128 bytes)
Options (variable)
Message type
2
Server-Identifier
172.16.11.12
IP address lease time
28800 seconds
Subnet mask
255.255.255.0
DNS server IP Address
8.8.8.8
Gateway IP address
172.16.11.64


DHCPOFFER
Application layer
UDP Segment
Source Port
67
Destination Port
68
Transport layer
IP Datagram
Source IP
172.16.11.12
Destination IP
255:255:255:255
UDP Segment
Network layer
Ethernet Frame
Source MAC
AB:11:23:A3:BC:72
Destination MAC
FF:FF:FF:FF:FF:FF
IP Datagram
FCS
Data link layer

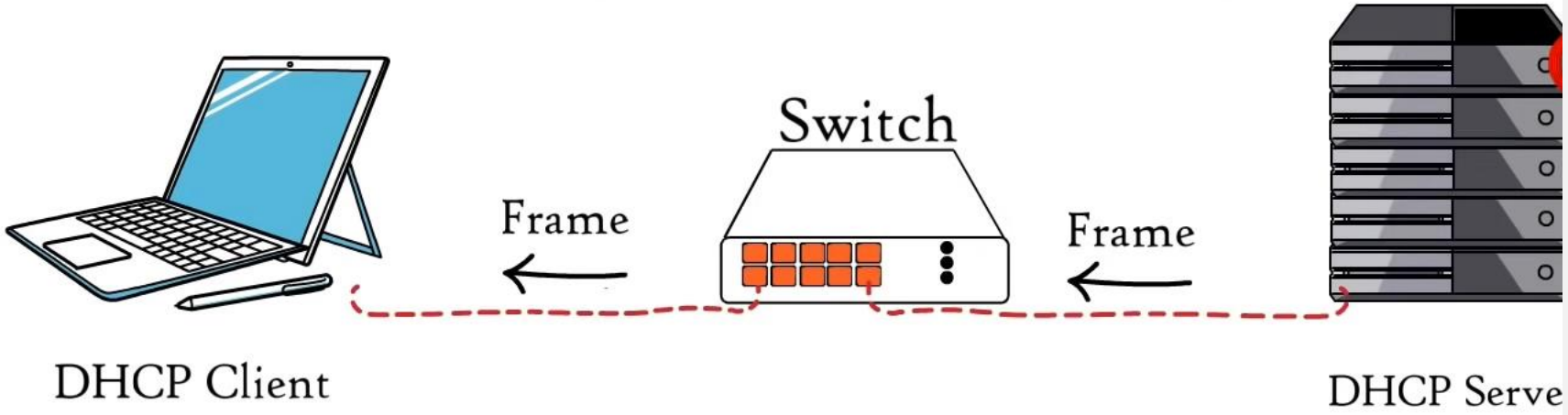
DHCPDISCOVER



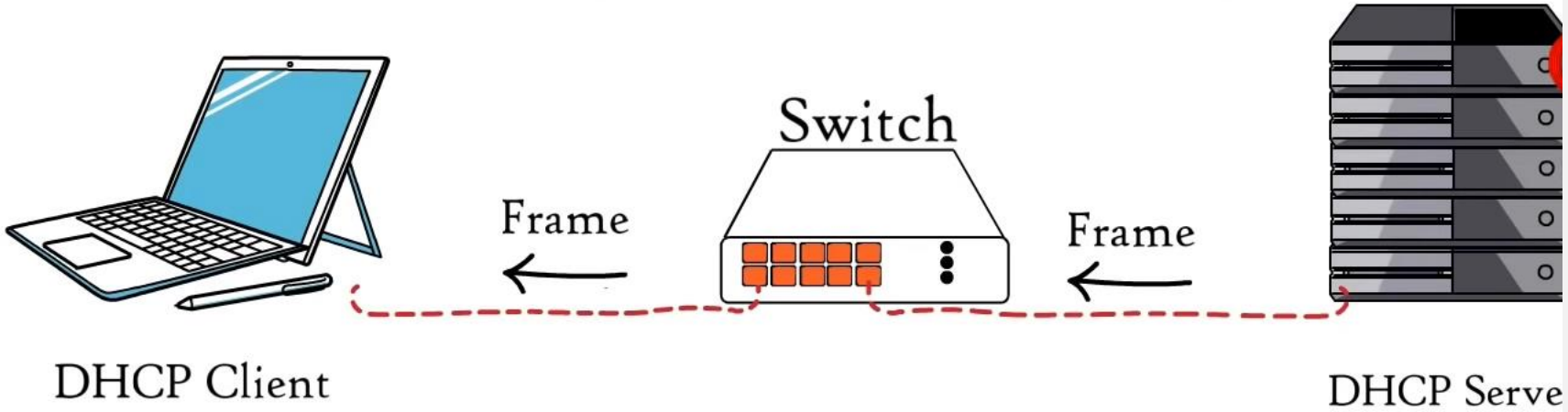
Application layer

Transport layer

Network layer



Data Link Layer	Frame
	↓
Network Layer	IP Datagram
	↓
Transport layer	UDP Segment
	↓
Application Layer	DHCPOFFER



Data Link Layer

Frame

↓

Network Layer

IP Datagram

↓

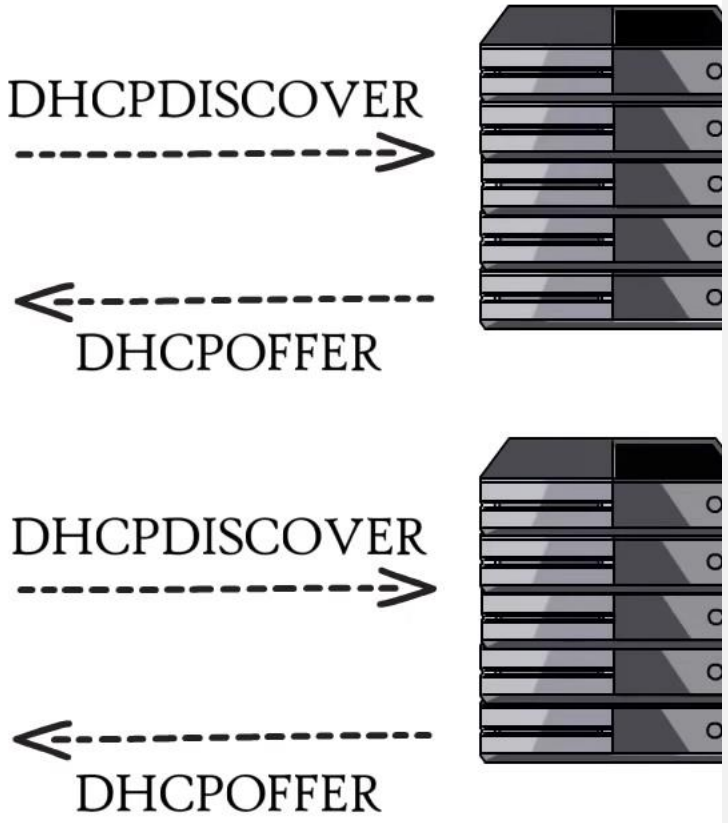
Transport layer

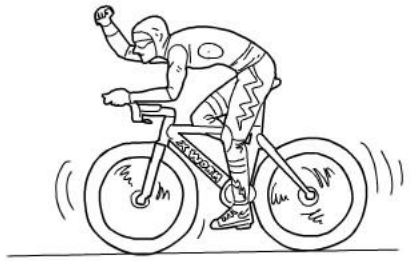
UDP Segment

↓

Application Layer

DHCPOFFER

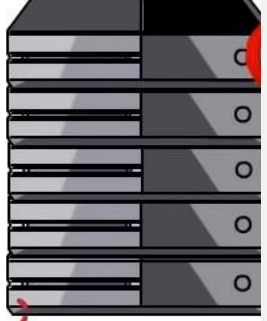




Switch

Frame

Frame



DHCP Client

DHCP Serve

Data Link Layer

Network Layer

Transport layer

Application Layer

Frame

↓

IP Datagram

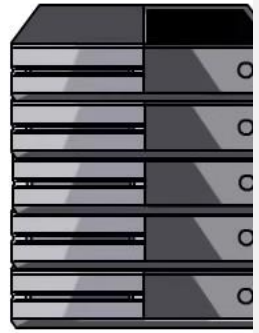
↓

UDP Segment

↓

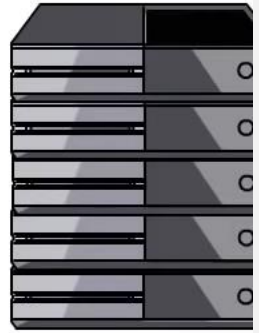
DHCPOFFER

DHCPDISCOVER



DHCPOFFER

DHCPDISCOVER



DHCPOFFER

Switch

Frame

Frame

DHCP Client

DHCP Serve

Data Link Layer

Network Layer

Transport layer

Application Layer

Frame

↓

IP Datagram

↓

UDP Segment

↓

DHCPOFFER

DHCPDISCOVER

DHCPOFFER

DHCPDISCOVER

DHCPOFFER

DHCPREQUEST

1 byte	1 byte	1 byte	1 byte
Op 1	HType	HLen	Hops
XID 0x27352677			
Secs	Flags 1		
CIAddr 0.0.0.0			
YIAddr 0.0.0.0			
SIAddr 0.0.0.0			
GIAddr 0.0.0.0			
CHAddr (16 bytes) 1B:22:34:F4:AB:C6			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

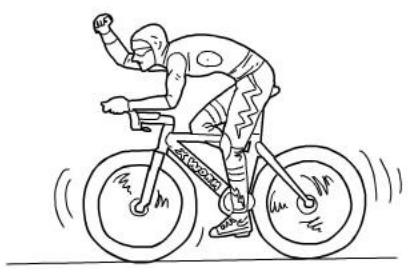
Message type 3
Client-identifier 1B:22:34:F4:AB:C6
Server-Identifier 172.16.11.12
Requested IP address 172.16.11.125

Data Link Layer

Network Layer

Transport layer

Application Laye



Frame

Switch

Frame

DHCP Client

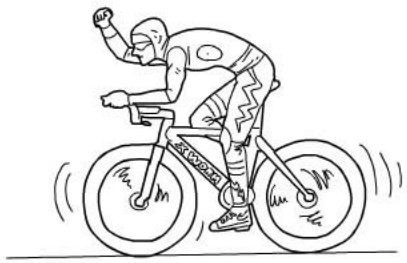
DHCP Server

Data Link Layer — Frame

Network Layer — IP Datagram

Transport layer — UDP Segment

Application Layer — DHCPREQUEST



Frame

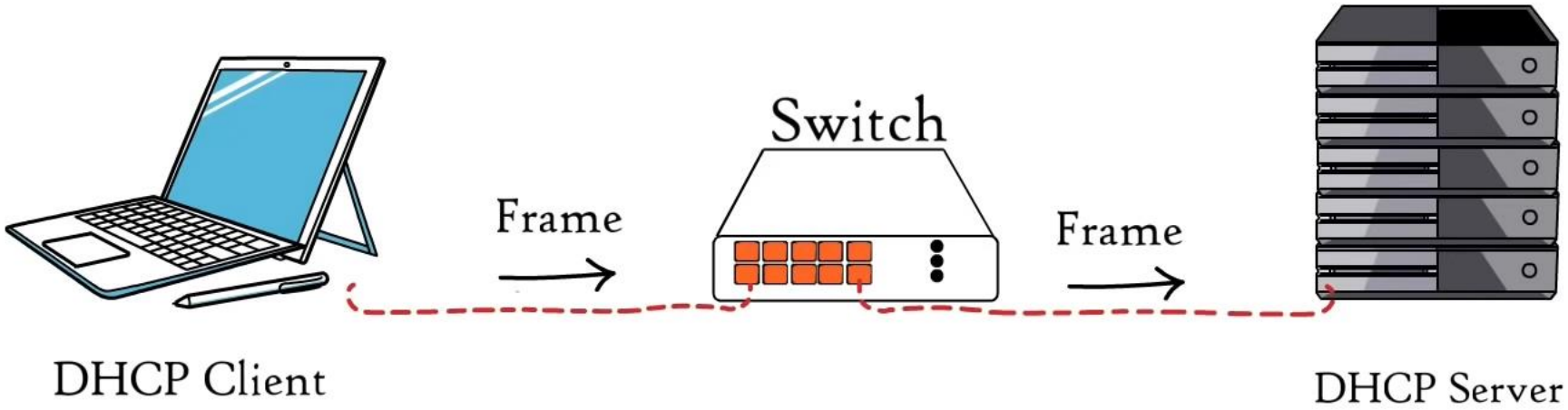
Switch

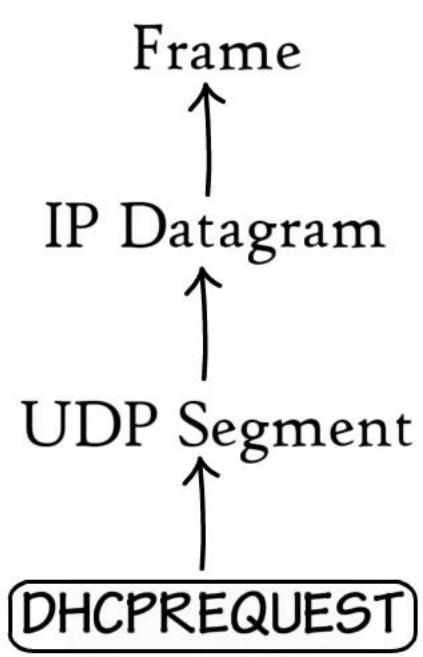
Frame

DHCP Client

DHCP Server

Data Link Layer	Frame	**Source MAC** 1B:22:34:F4:AB:C6	**Destination MAC** FF:FF:FF:FF:FF:FF
Network Layer	IP Datagram	**Source IP** 0.0.0.0	**Destination IP** 255.255.255.255
Transport layer	UDP Segment	**Source Port** 68	**Destination Port** 67
Application Layer	DHCPREQUEST		





Source MAC
1B:22:34:F4:AB:C6

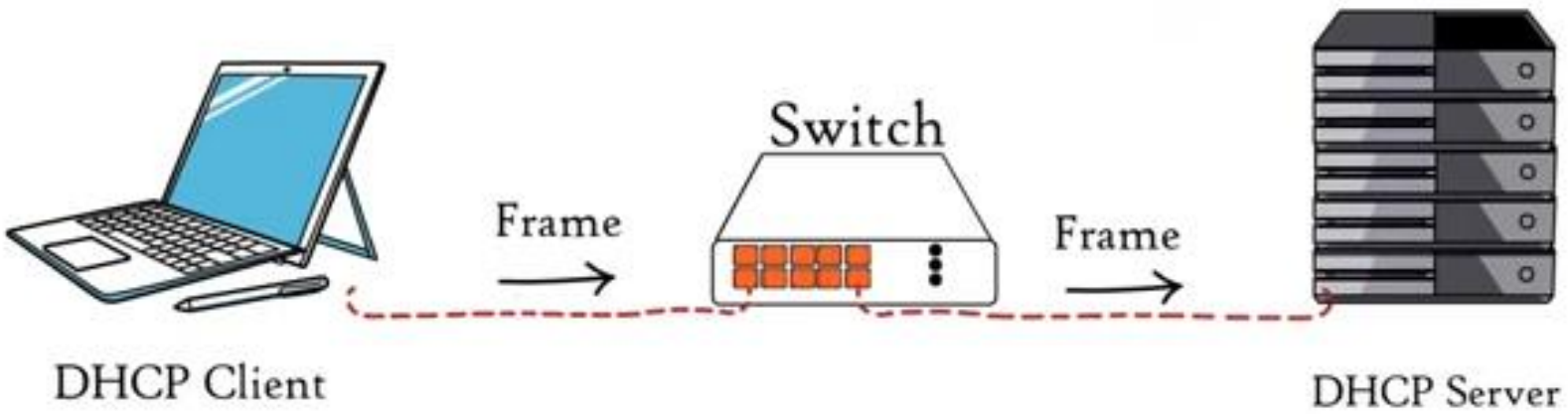
Destination MAC
FF:FF:FF:FF:FF:FF

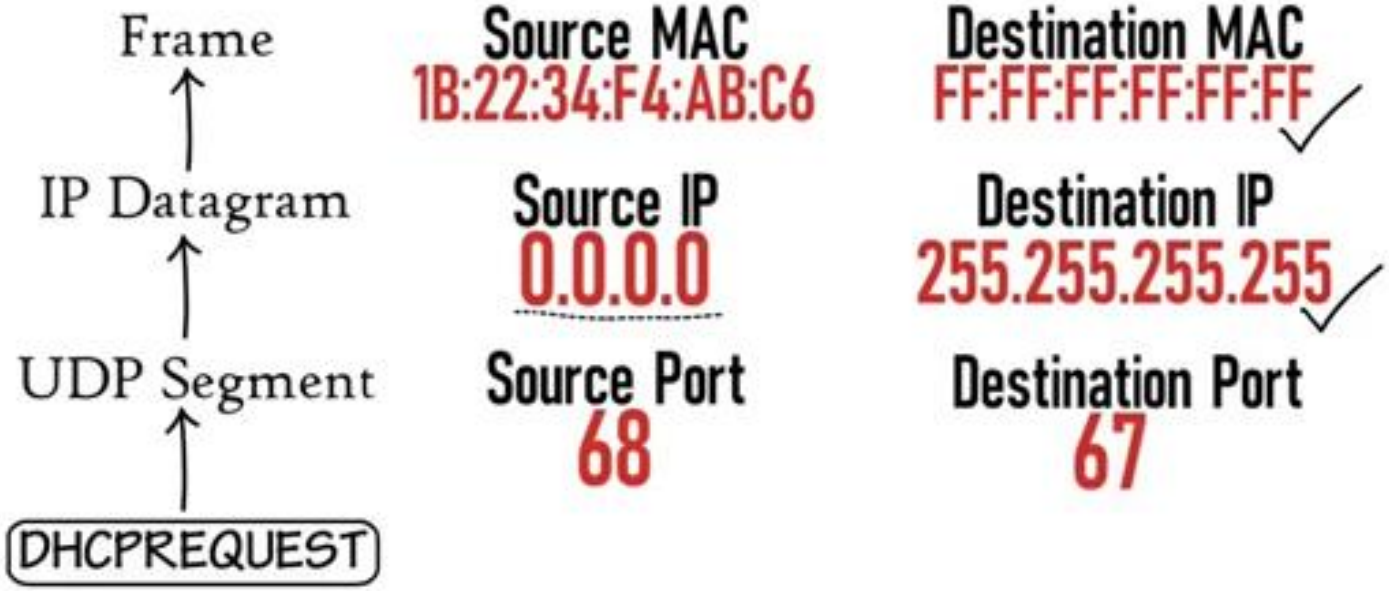
Source IP
0.0.0.0

Destination IP
255.255.255.255

Source Port
68

Destination Port
67


Switch
Frame
Frame
DHCP Client
DHCP Server


Frame
IP Datagram
UDP Segment
DHCPREQUEST
Source MAC
1B:22:34:F4:AB:C6
Destination MAC
FF:FF:FF:FF:FF:FF
Source IP
0.0.0.0
Destination IP
255.255.255.255
Source Port
68
Destination Port
67


DHCP
OFFER
Rejected
DHCP
OFFER
Rejected

DHCPREQUEST

1 byte	1 byte	1 byte	1 byte
Op 1	HType	HLen	Hops
XID 0x27352677			
Secs		Flags 1	
CIAddr 0.0.0.0			
YIAddr 0.0.0.0			
SIAddr 0.0.0.0			
GIAddr 0.0.0.0			
CHAddr (16 bytes) 1B:22:34:F4:AB:C6			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

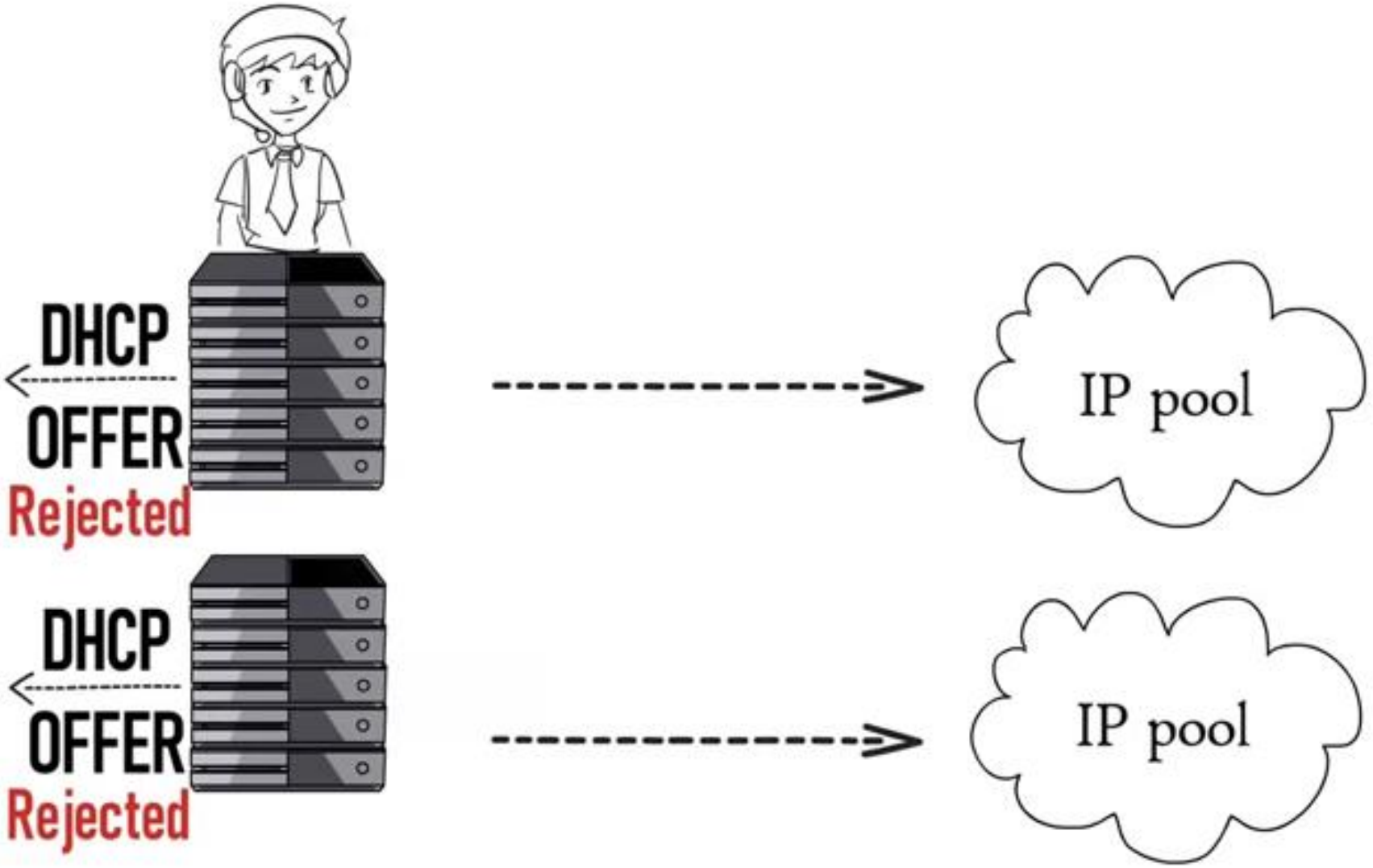
Message type 3
Client-identifier 1B:22:34:F4:AB:C6
Server-Identifier 172.16.11.12
Requested IP address 172.16.11.125

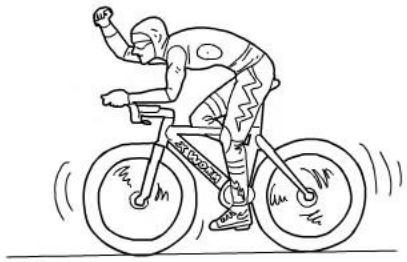
Data Link Layer

Network Layer

Transport layer

Application Layer


DHCP
OFFER
Rejected
IP pool
DHCP
OFFER
Rejected
IP pool



Frame

Switch

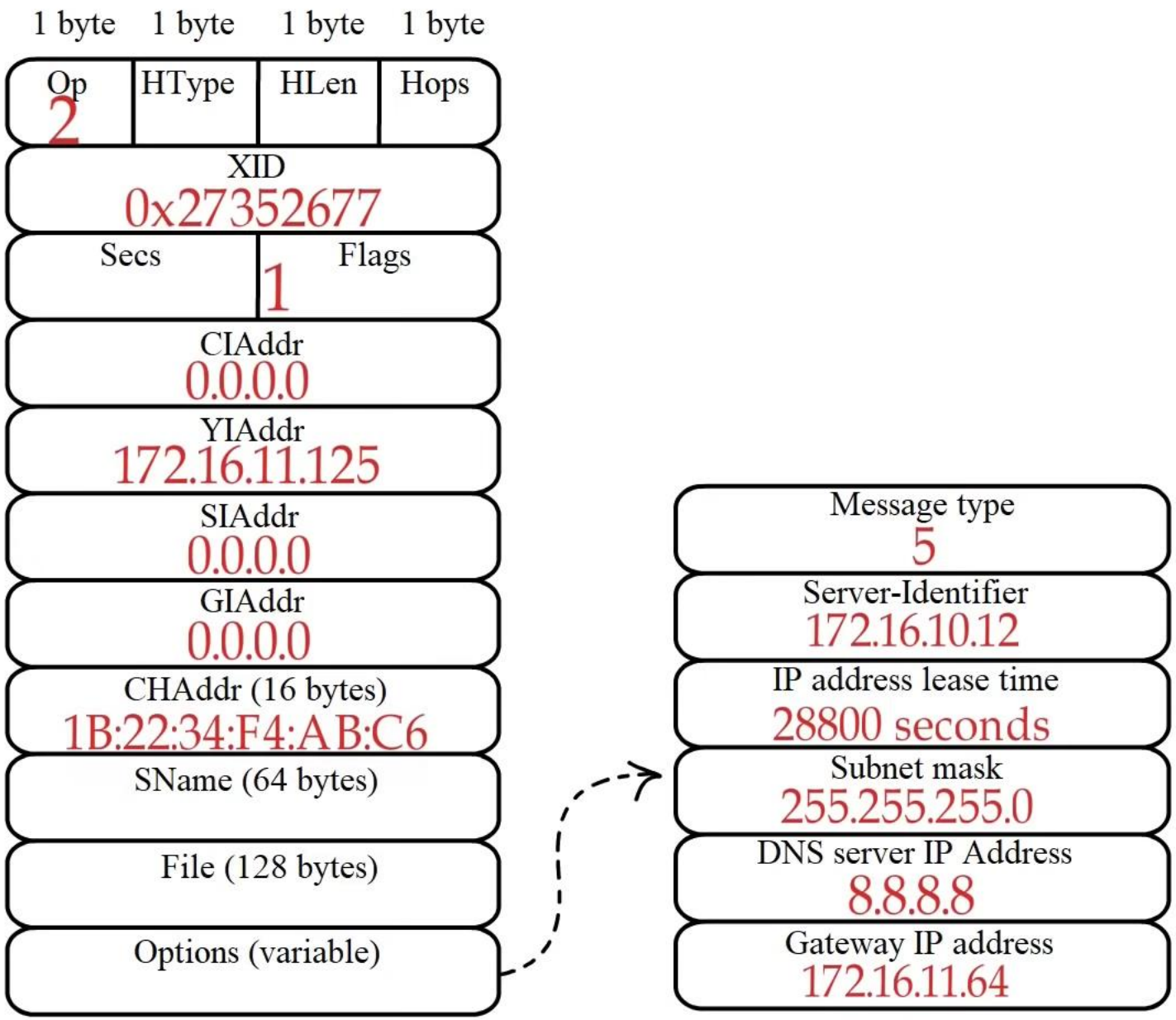
Frame

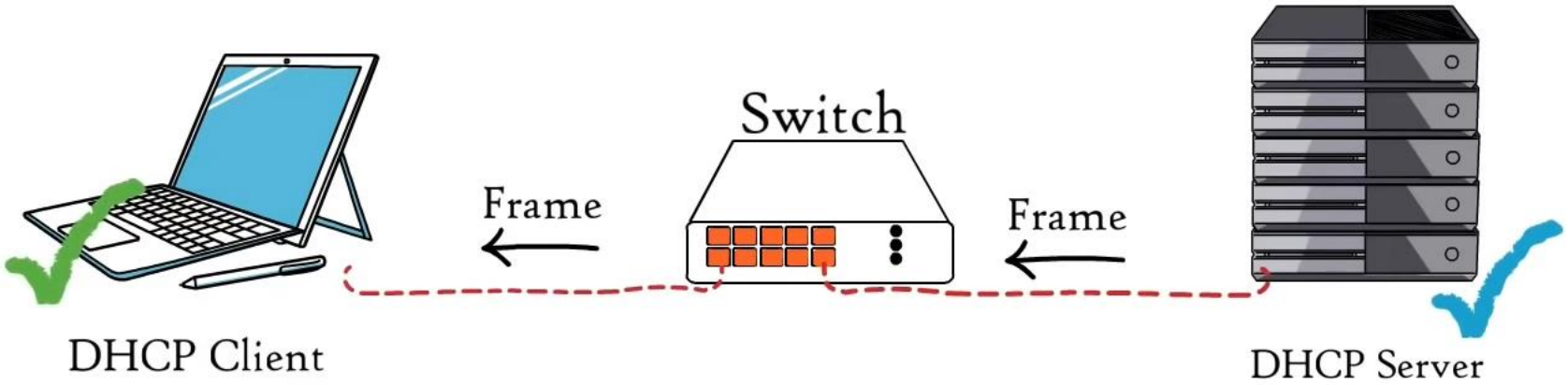
DHCP Client

DHCP Server

Data Link Layer	Frame	**Source MAC** 1B:22:34:F4:AB:C6	**Destination MAC** FF:FF:FF:FF:FF:FF
Network Layer	IP Datagram	**Source IP** 0.0.0.0	**Destination IP** 255.255.255.255
Transport layer	UDP Segment	**Source Port** 68	**Destination Port** 67
Application Layer	DHCPREQUEST		

DHCPACK


1 byte
1 byte
1 byte
1 byte
Op
2
HType
HLen
Hops
XID
0x27352677
Secs
Flags
1
CIAddr
0.0.0.0
YIAddr
172.16.11.125
SIAddr
0.0.0.0
GIAddr
0.0.0.0
CHAddr (16 bytes)
1B:22:34:F4:AB:C6
SName (64 bytes)
File (128 bytes)
Options (variable)
Message type
5
Server-Identifier
172.16.10.12
IP address lease time
28800 seconds
Subnet mask
255.255.255.0
DNS server IP Address
8.8.8.8
Gateway IP address
172.16.11.64



Frame
↓
IP Datagram
↓
UDP Segment
↓
DHCPACK

Destination MAC
FF:FF:FF:FF:FF:FF

Source MAC
AB:11:23:A3:BC:72

Destination IP
255.255.255.255

Source IP
172.16.11.12

Destination Port
67

Source Port
68

Frame
↑
IP Datagram
↑
UDP Segment
↑
DHCPACK

DHCPACK

1 byte	1 byte	1 byte	1 byte
Op: 2	HType	HLen	Hops
XID: 0x27352677			
Secs	Flags: 1		
CIAddr: 0.0.0.0			
YIAddr: 172.16.11.125			
SIAddr: 0.0.0.0			
GIAddr: 0.0.0.0			
CHAddr (16 bytes): 1B:22:34:F4:AB:C6			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

DHCPACK

1 byte	1 byte	1 byte	1 byte
Op: 2	HType	HLen	Hops
XID: 0x27352677			
Secs	Flags: 1		
CIAddr: 0.0.0.0			
YIAddr: 172.16.11.125			
SIAddr: 0.0.0.0			
GIAddr: 0.0.0.0			
CHAddr (16 bytes): 1B:22:34:F4:AB:C6			
SName (64 bytes)			
File (128 bytes)			
Options (variable)			

- Message type: 5
- Server-Identifier: 172.16.10.12
- IP address lease time: 28800 seconds
- Subnet mask: 255.255.255.0
- DNS server IP Address: 8.8.8.8
- Gateway IP address: 172.16.11.64

172.16.11.125

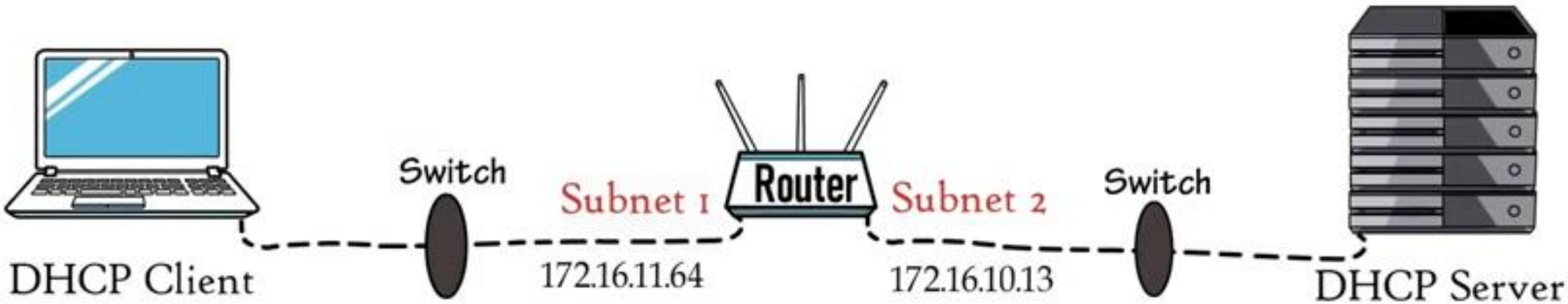
IP Address Lease Time

Subnet mask

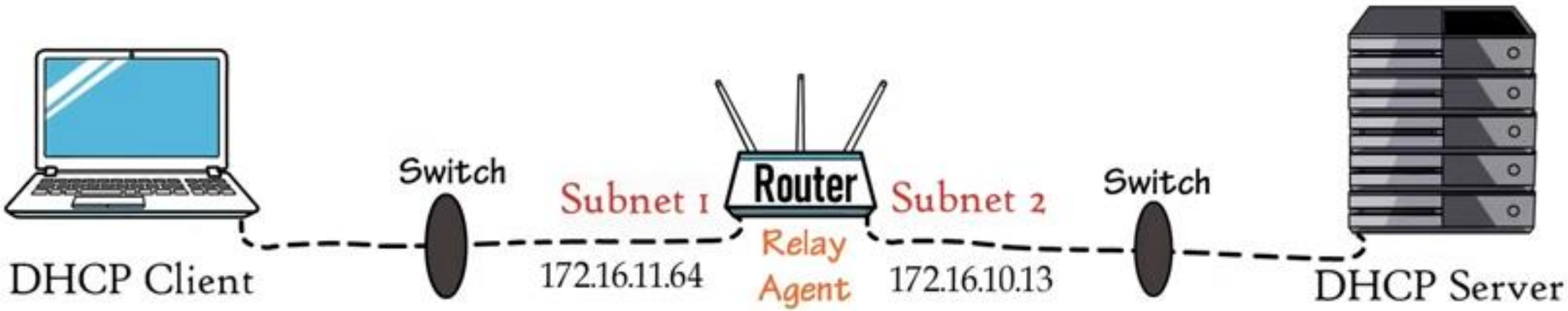
DNS server IP address

Gateway IP Address

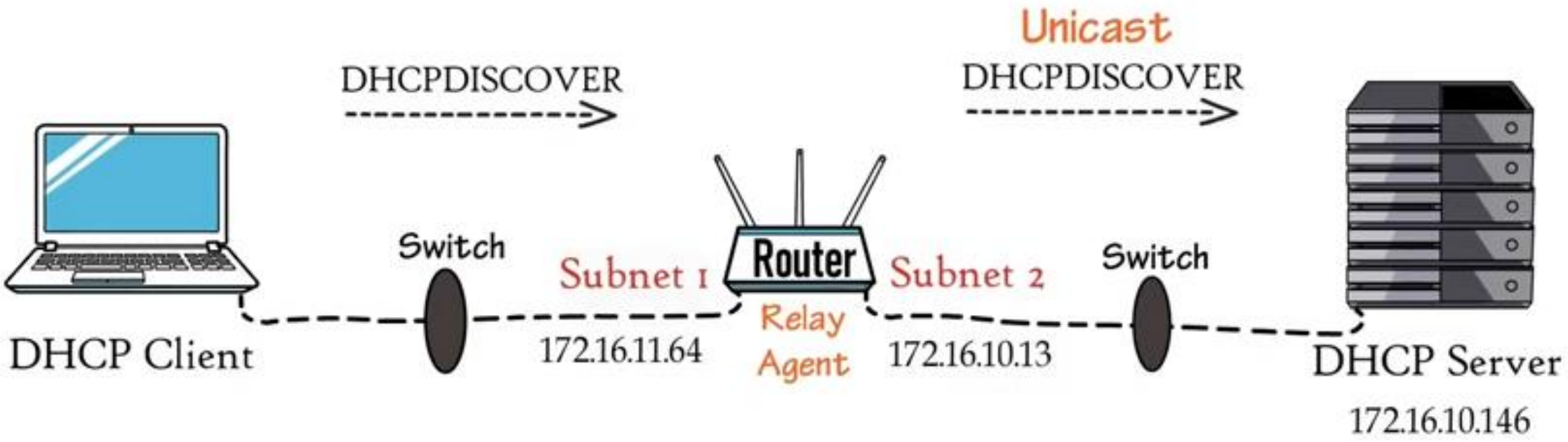
Case 2: Different Subnets



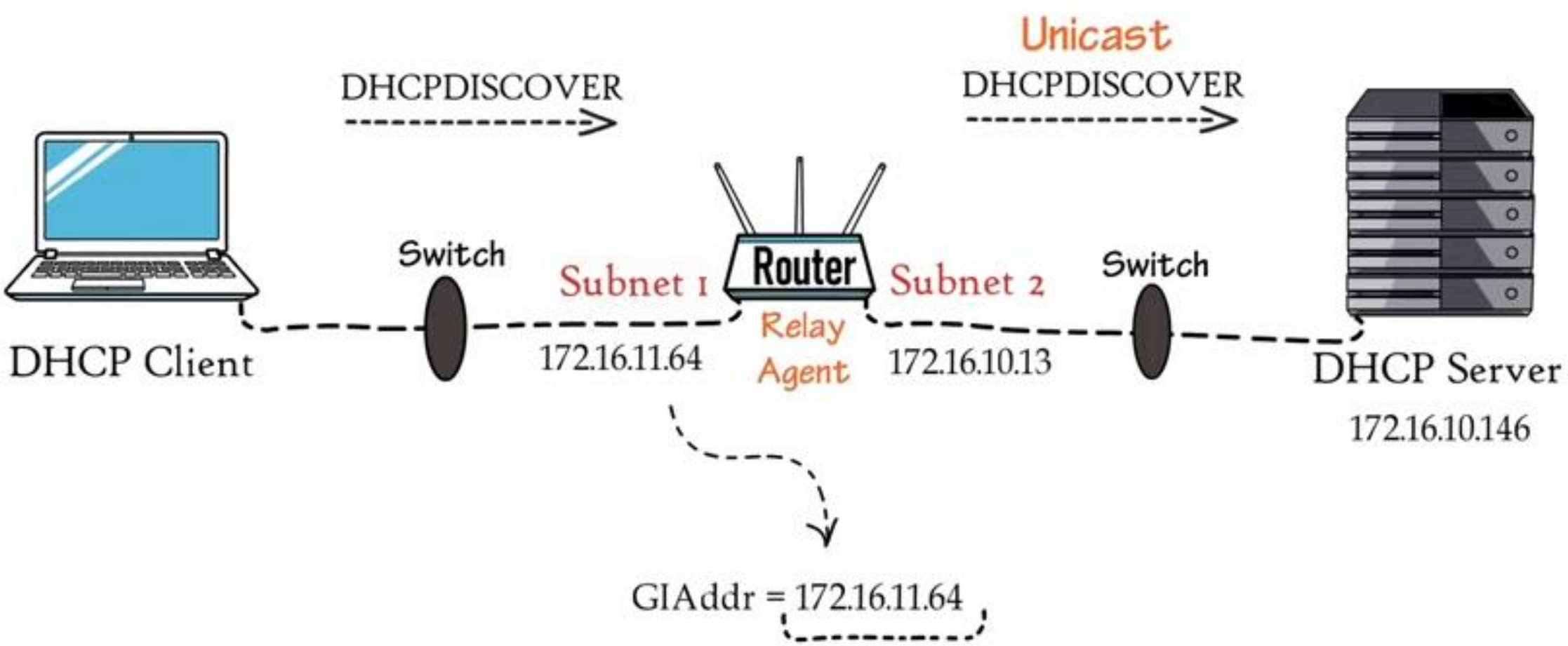
Case 2: Different Subnets



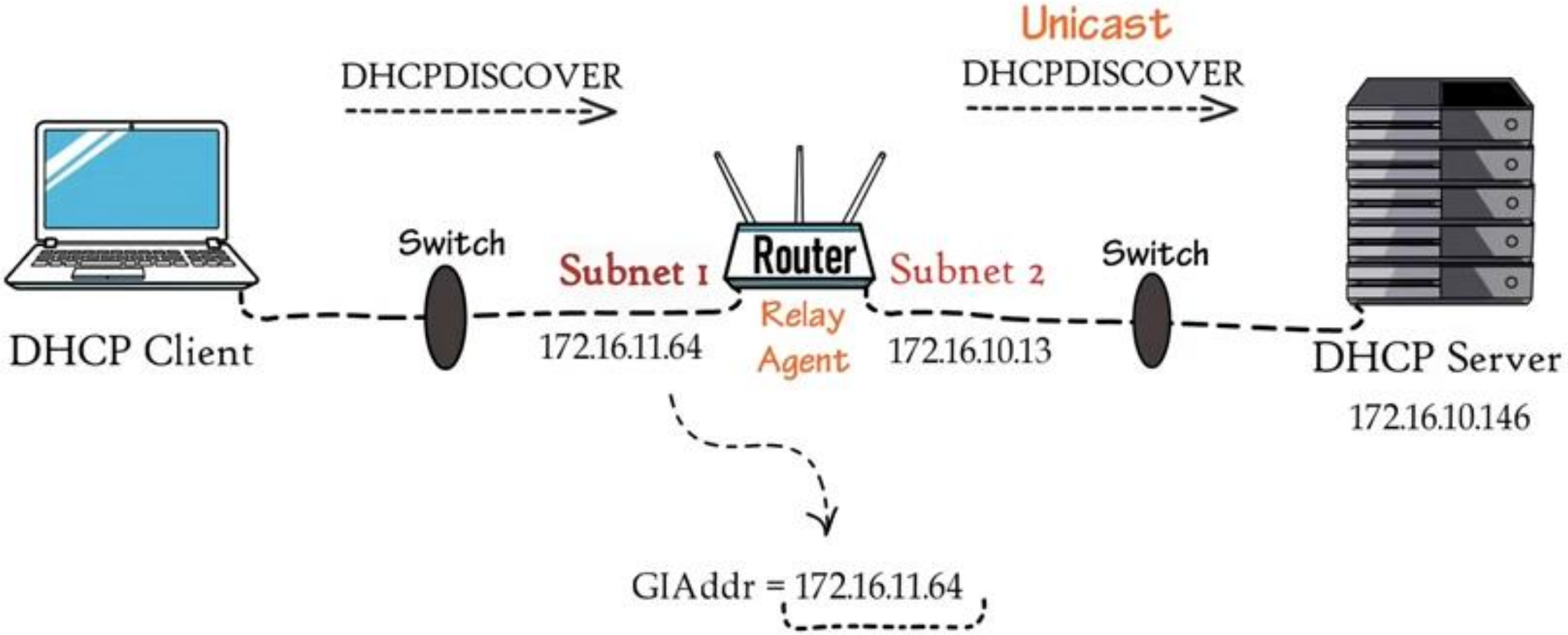
Case 2: Different Subnets



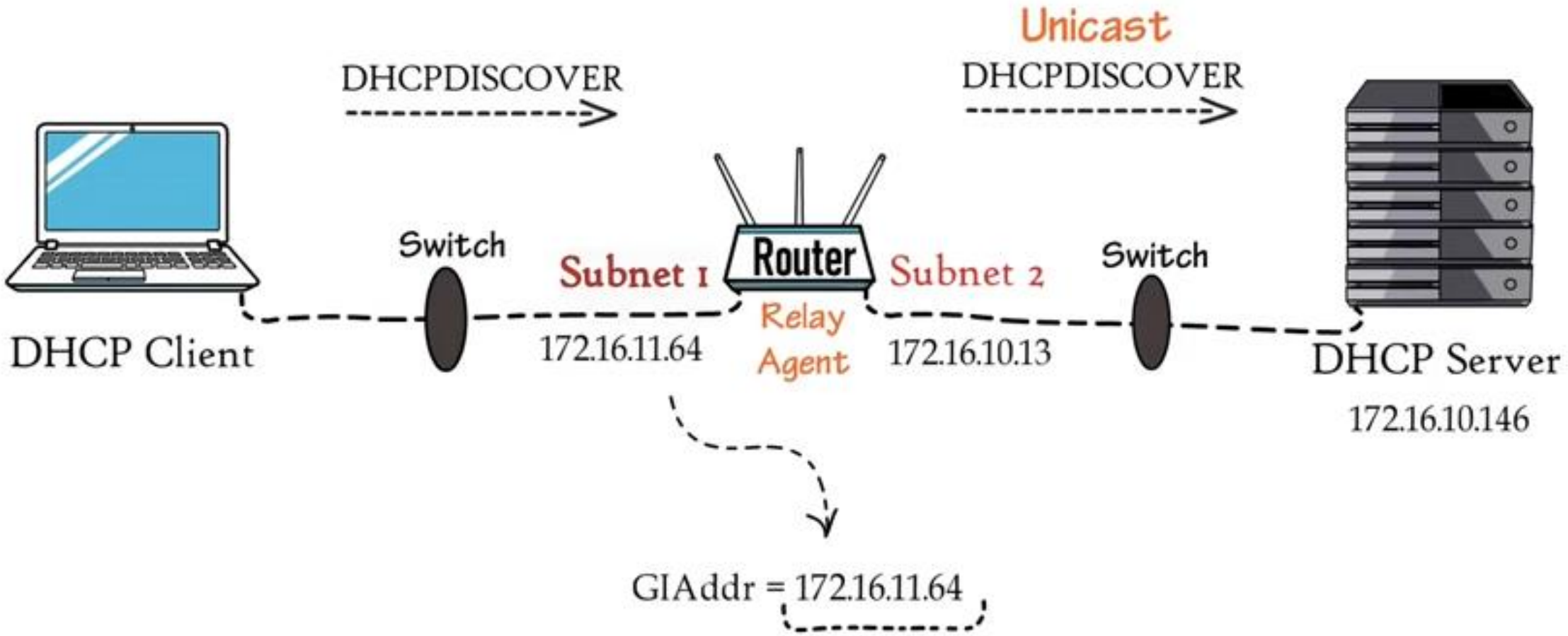
Case 2: Different Subnets



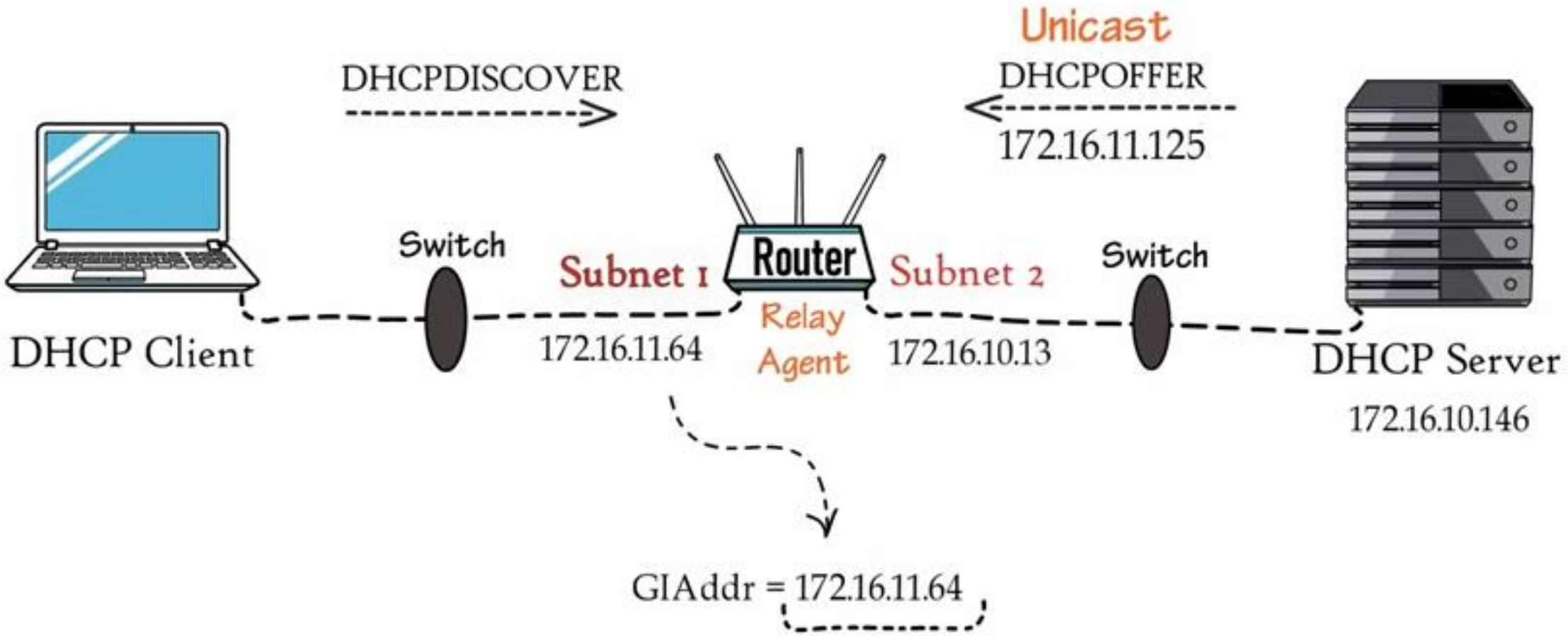
Case 2: Different Subnets



Case 2: Different Subnets



Case 2: Different Subnets



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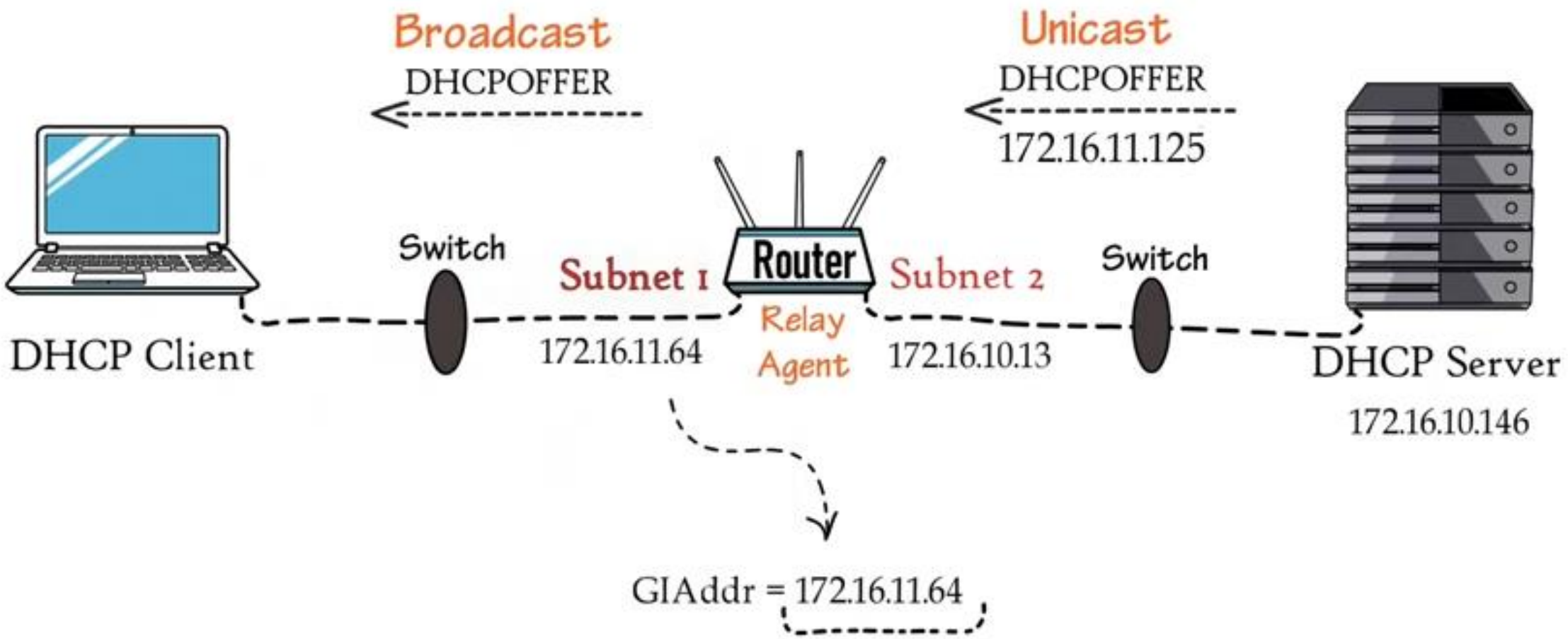
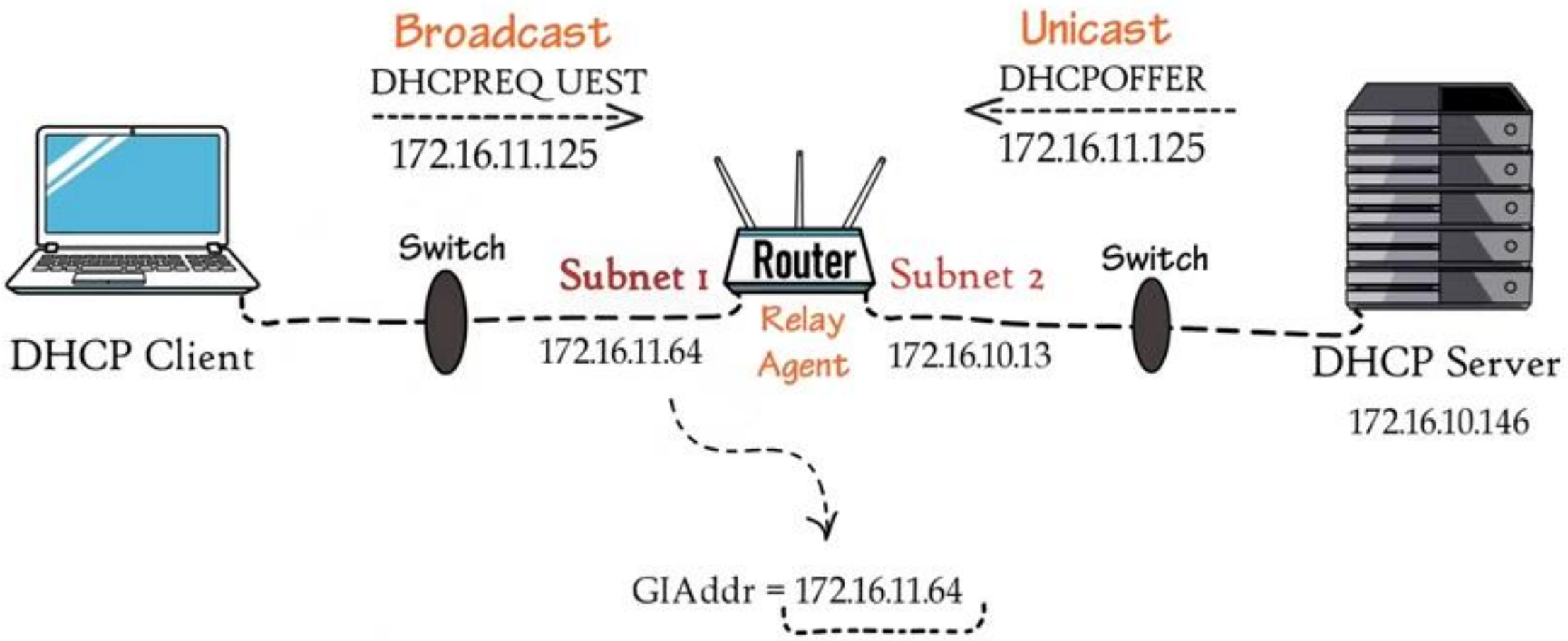
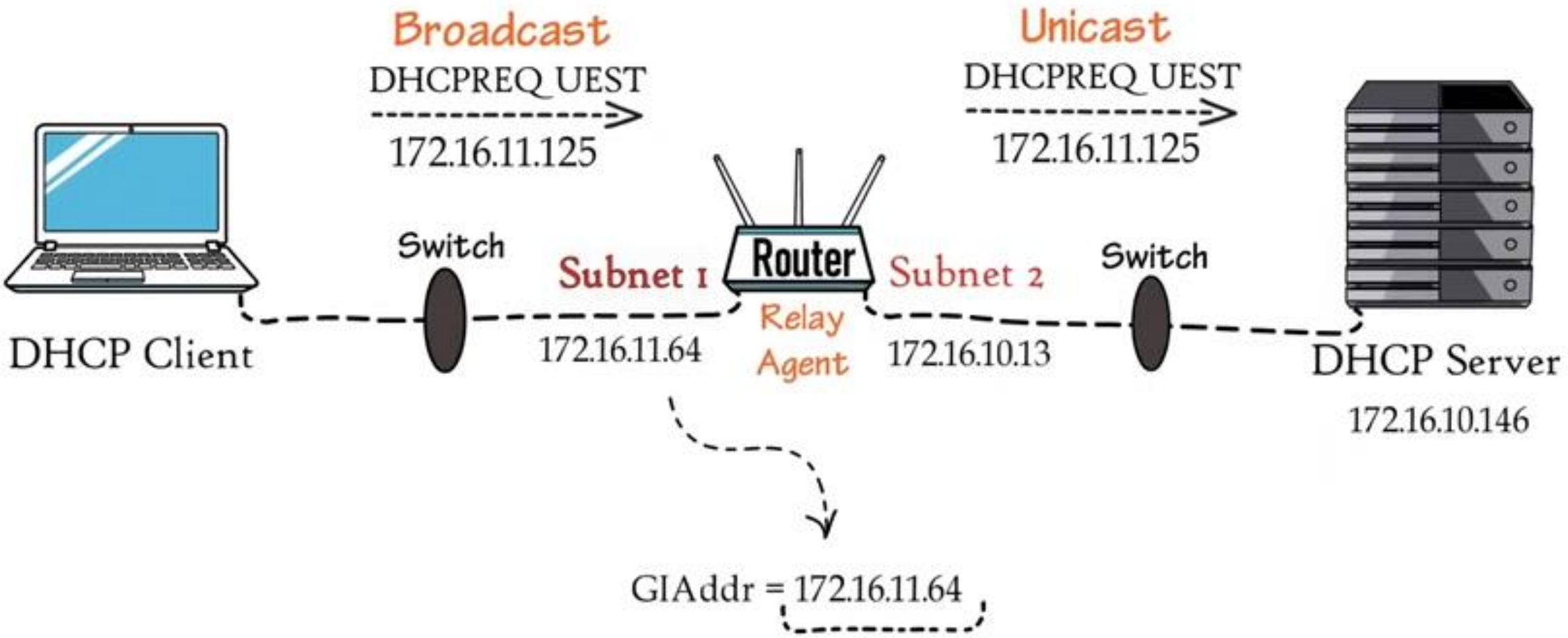


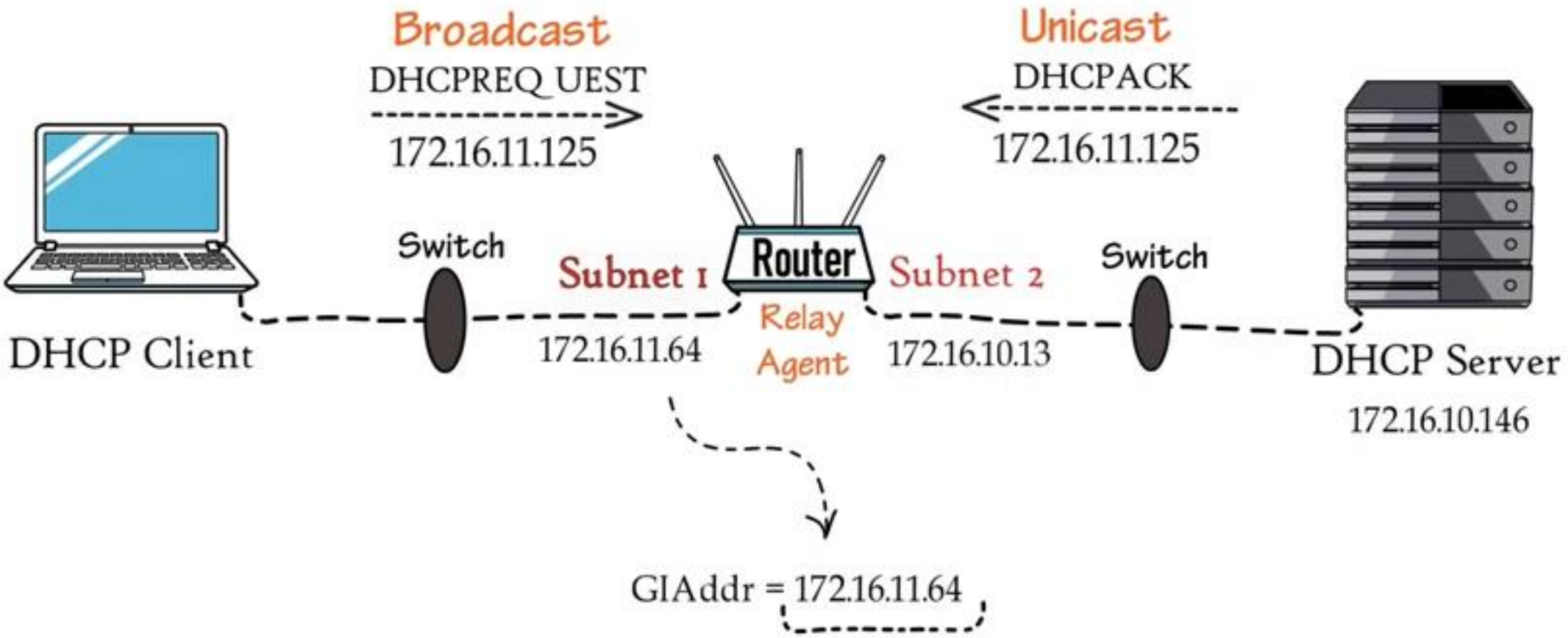
Case 2: Different Subnets



Case 2: Different Subnets



Case 2: Different Subnets



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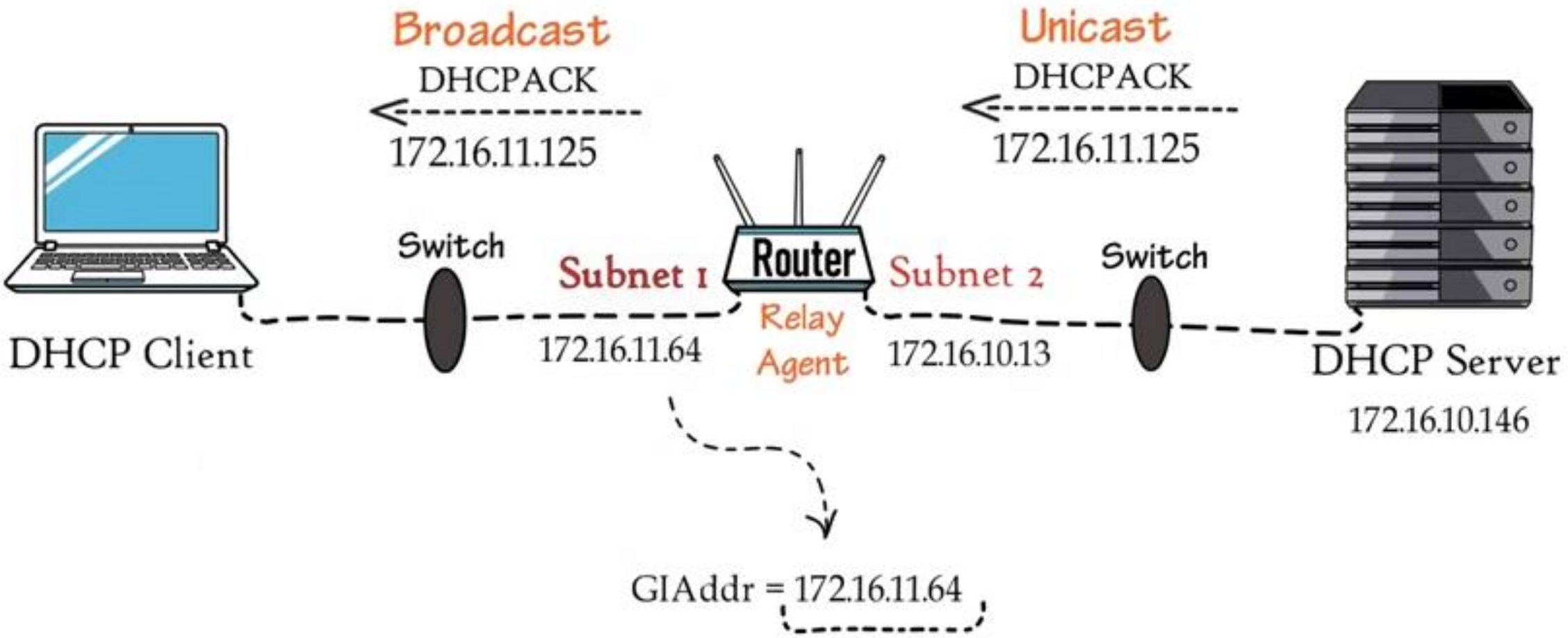

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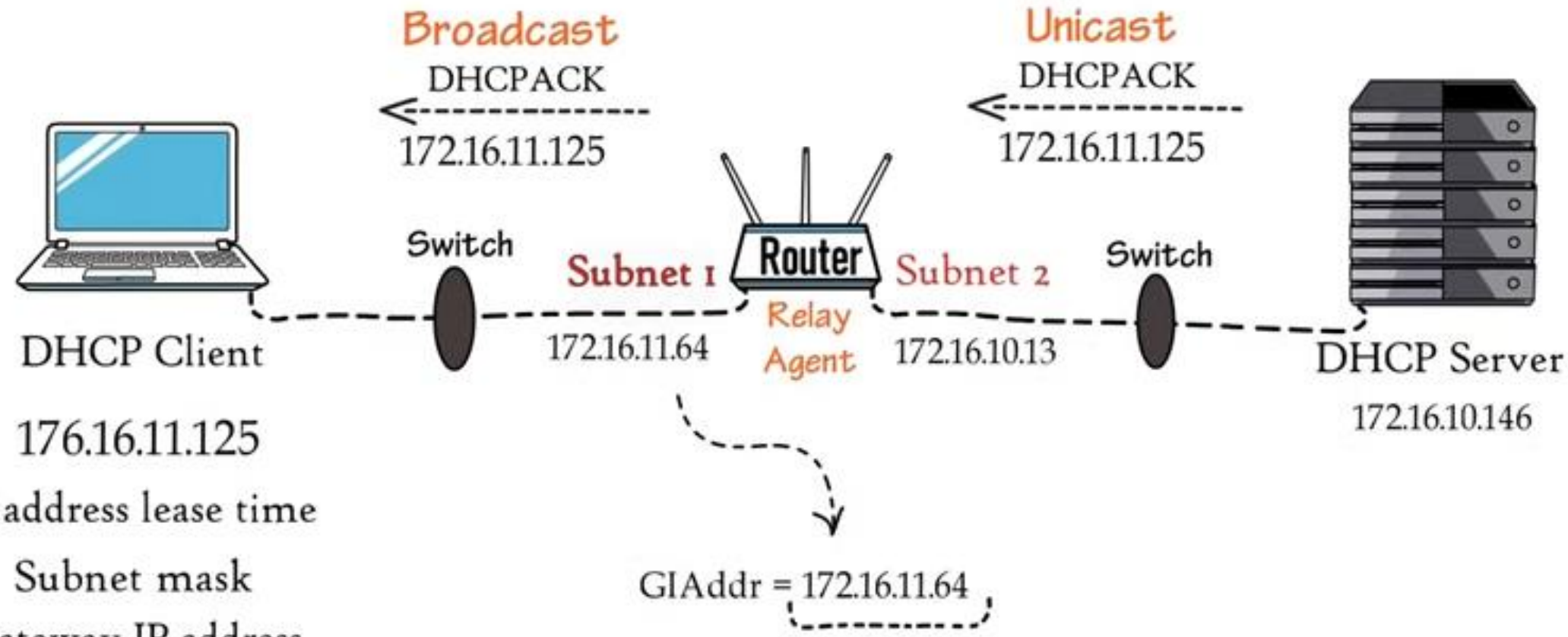


DHCPDISCOVER

DHCPOFFER

DHCPREQ UEST

DHCPACK

DHCPNAK

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

Address Resolution Protocol

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE
DHCPDECLINE

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

Address Resolution Protocol

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE
DHCPDECLINE
DHCPINFORM

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

Address Resolution Protocol

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE
DHCPDECLINE
DHCPINFORM

DHCPACK

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

Address Resolution Protocol

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE
DHCPDECLINE
DHCPINFORM

DHCPACK

YIAddr = Empty

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

Address Resolution Protocol

8 DHCP messages:

DHCPDISCOVER
DHCPOFFER
DHCPREQ UEST
DHCPACK
DHCPNAK
DHCPRELEASE
DHCPDECLINE
DHCPINFORM

DHCPACK

YIAddr = Empty

176.16.11.125

IP address lease time

Subnet mask

Gateway IP address

DNS server IP Address

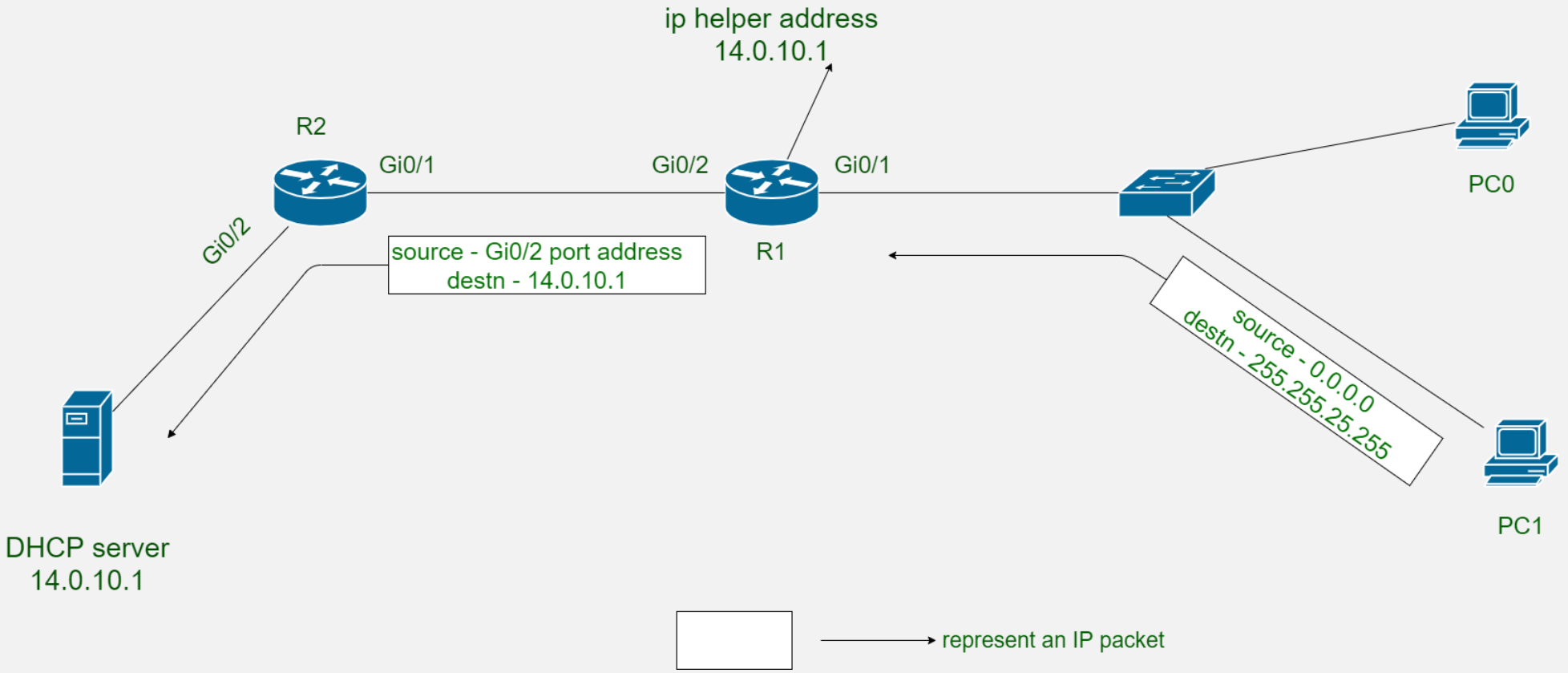
Address Resolution Protocol

DHCP MESSAGE TYPES AND THEIR VALUES:

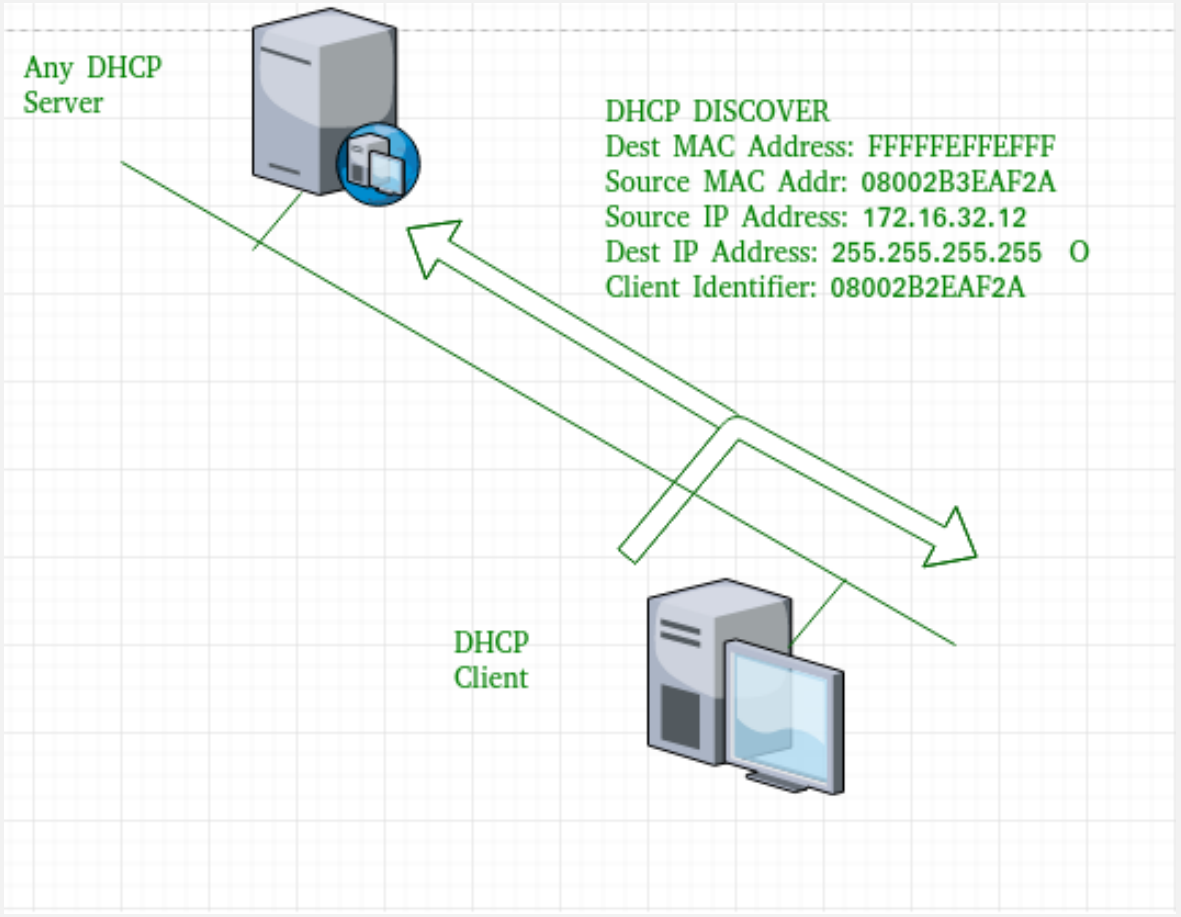
1. **DHCP Discover** - Value: 1
2. **DHCP Offer** - Value: 2
3. **DHCP Request** - Value: 3
4. **DHCP ACK** - Value: 5
5. **DHCP NAK** - Value: 6
6. **DHCP Release** - Value: 7
7. **DHCP Decline** - Value: 4
8. **DHCP Inform** - Value: 8

WORKING OF DHCP

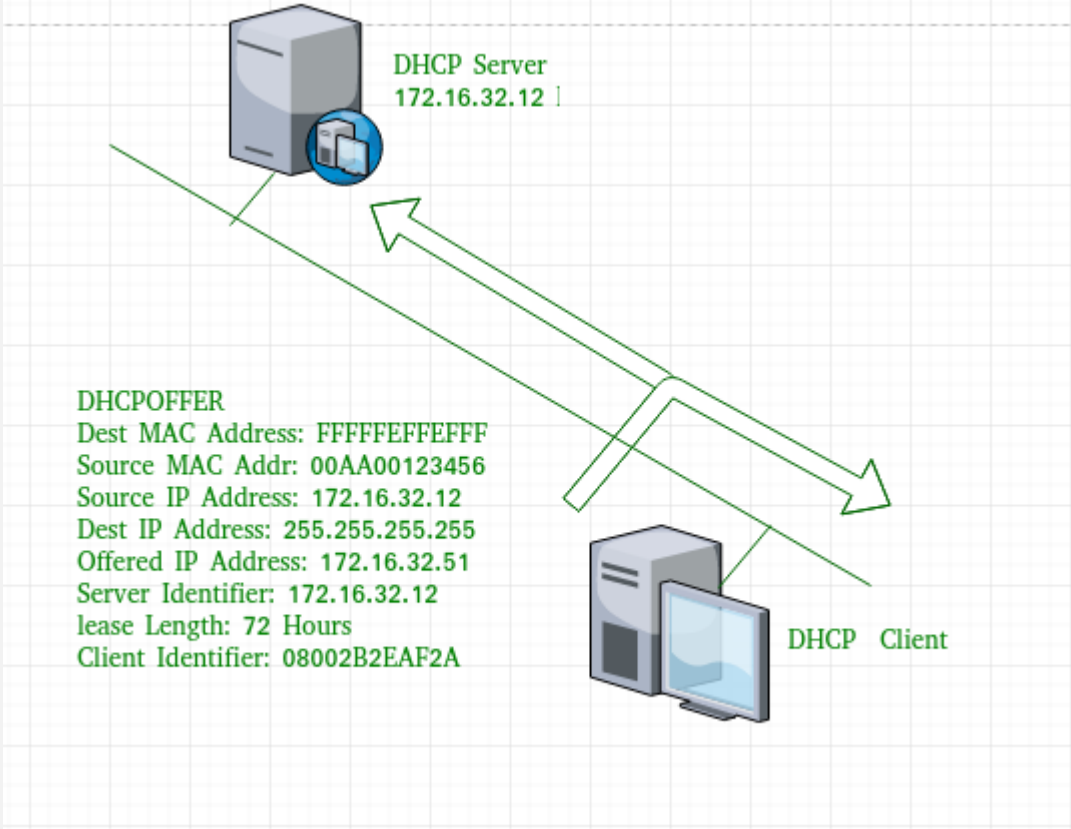
- DHCP works on the Application layer of the TCP/IP Protocol. The main task of DHCP is to dynamically assigns IP Addresses to the Clients and allocate information on TCP/IP configuration to Clients.
- The DHCP **port number** for the server is 67 and for the client is 68. It is a client-server protocol that uses UDP services. An IP address is assigned from a pool of addresses. In DHCP, the client and the server exchange mainly 4 DHCP messages in order to make a connection, also called the DORA process, but there are 8 DHCP messages in the process.



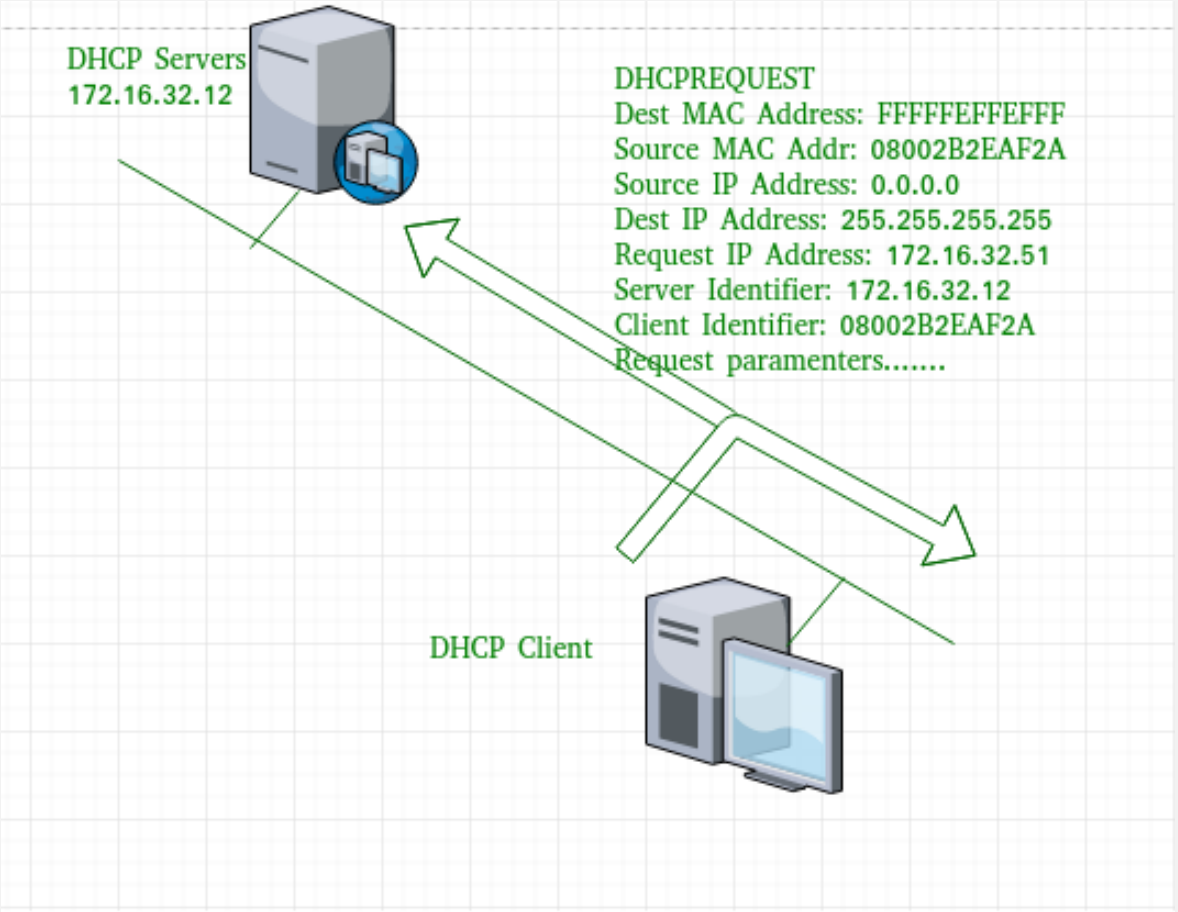
- **1. DHCP discover message:** This is the first message generated in the communication process between the server and the client. This message is generated by the Client host in order to discover if there is any DHCP server/servers are present in a network or not. This message is broadcasted to all devices present in a network to find the DHCP server. This message is 342 or 576 bytes long .
- As shown in the figure, the source MAC address (client PC) is 08002B2EAF2A, the destination MAC address(server) is FFFFFFFFFFFF, the source IP address is 0.0.0.0(because the PC has had no IP address till now) and the destination IP address is 255.255.255.255 (IP address used for broadcasting). As they discover message is broadcast to find out the DHCP server or servers in the network therefore broadcast IP address and MAC address is used.



- **2. DHCP offers a message:** The server will respond to the host in this message specifying the unleased IP address and other TCP configuration information. This message is broadcasted by the server. The size of the message is 342 bytes. If there is more than one DHCP server present in the network then the client host will accept the first DHCP OFFER message it receives. Also, a server ID is specified in the packet in order to identify the server.
- Now, for the offer message, the source IP address is 172.16.32.12 (server's IP address in the example), the destination IP address is 255.255.255.255 (broadcast IP address), the source MAC address is 00AA00123456, the destination MAC address is FFFFFFFFFFFF. Here, the offer message is broadcast by the DHCP server therefore destination IP address is the broadcast IP address and destination MAC address is FFFFFFFFFFFF and the source IP address is the server IP address and the MAC address is the server MAC address.
- Also, the server has provided the offered IP address 192.16.32.51 and a lease time of 72 hours(after this time the entry of the host will be erased from the server automatically). Also, the client identifier is the PC MAC address (08002B2EAF2A) for all the messages.

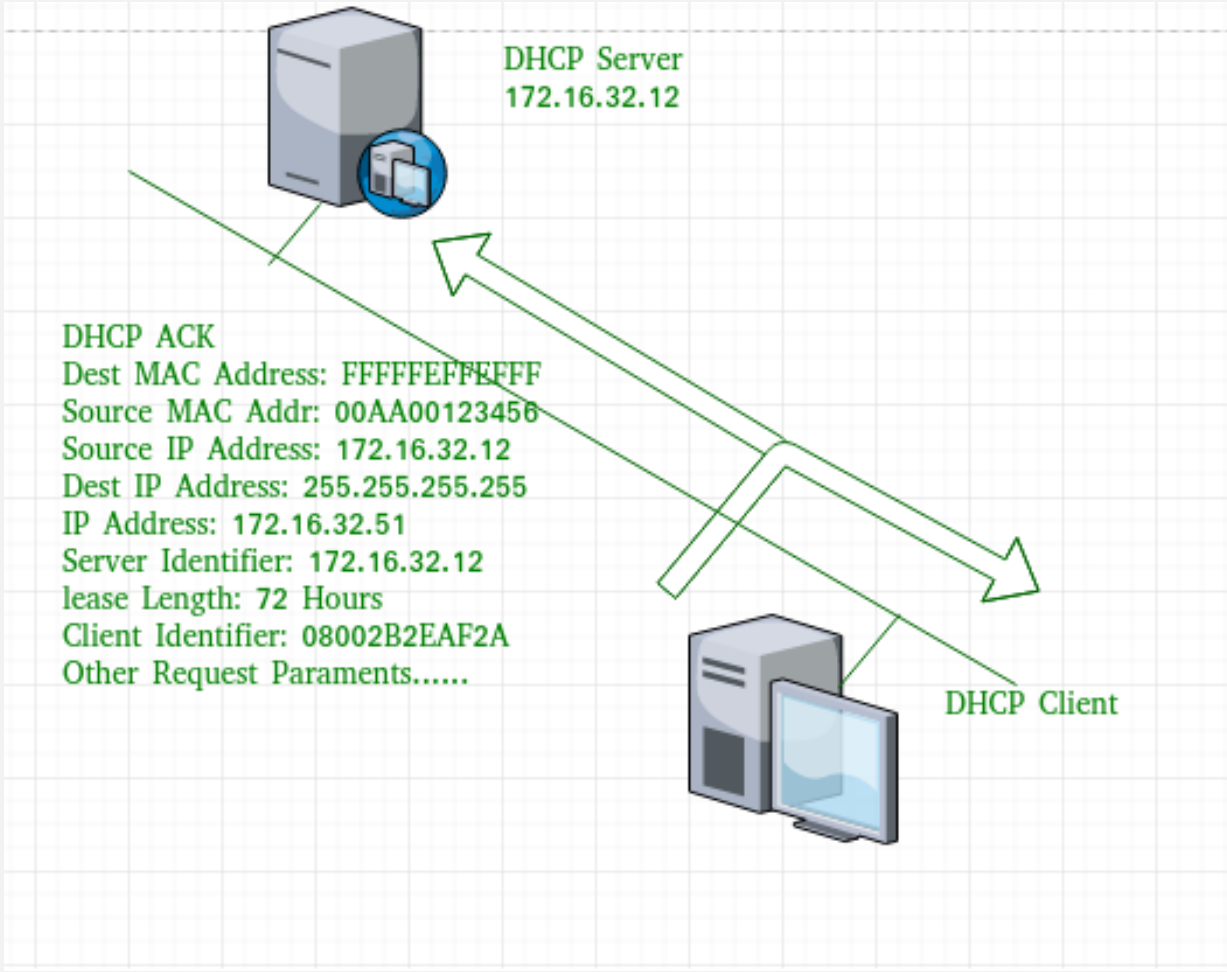


- **3. DHCP request message:** When a client receives an offer message, it responds by broadcasting a DHCP request message. The client will produce a gratuitous ARP in order to find if there is any other host present in the network with the same IP address. If there is no reply from another host, then there is no host with the same TCP configuration in the network and the message is broadcasted to the server showing the acceptance of the IP address. A Client ID is also added to this message.
- DHCP Request: In most cases, the client can receive multiple DHCP offer because in a network there are many DHCP servers(as they provide fault tolerance). If the IP addressing of one server fails then other servers can provide backup. But, the client will accept only one DHCP offer. In response to the offer, the client sends a DHCP Request requesting the offered address from one of the DHCP servers. All the other offered IP addresses from remaining DHCP servers are withdrawn and returned to the pool of IP available addresses.



Gratuitous ARP request is a packet where source and destination IP are both set to IP of the machine issuing the packet and the destination MAC is the broadcast address ff:ff:ff:ff:ff:ff ; no reply packet will occur. Gratuitous ARP is ARP-Reply that was not prompted by an ARP-Request. Gratuitous Address Resolution Protocol is useful to detect IP conflict. Gratuitous ARP is also used to update ARP mapping table and Switch port MAC address table.

- **4. DHCP acknowledgment message:** In response to the request message received, the server will make an entry with a specified client ID and bind the IP address offered with lease time. Now, the client will have the IP address provided by the server.
- Now the server will make an entry of the client host with the offered IP address and lease time. This IP address will not be provided by the server to any other host. The destination MAC address is FFFFFFFFFFFF and the destination IP address is 255.255.255.255 and the source IP address is 172.16.32.12 and the source MAC address is 00AA00123456 (server MAC address).



ADVANTAGES OF DHCP

The advantages of using DHCP include:

1. Centralized management of IP addresses.
2. Centralized and automated TCP/IP configuration.
3. Ease of adding new clients to a network.
4. Reuse of IP addresses reduces the total number of IP addresses that are required.
5. The efficient handling of IP address changes for clients that must be updated frequently, such as those for portable devices that move to different locations on a wireless network.
6. Simple reconfiguration of the IP address space on the DHCP server without needing to reconfigure each client.
7. The DHCP protocol gives the network administrator a method to configure the network from a centralized area.
8. With the help of DHCP, easy handling of new users and the reuse of IP addresses can be achieved.

DHCP SETTINGS

ADDRESS RESERVATION

IP Address	Device Name	MAC Address
10 . 0 . 0 . 1	MY-PC	00:17:30:46:72:04

A reservation ensures that a specific computer or device will always be given the same I.P. address.

DHCP

Reservations are typically given to special devices or computers, such as network printers, servers, routers, etc.

DHCP

DHCP is a service that runs on a server, such as a Microsoft server or a Linux server.