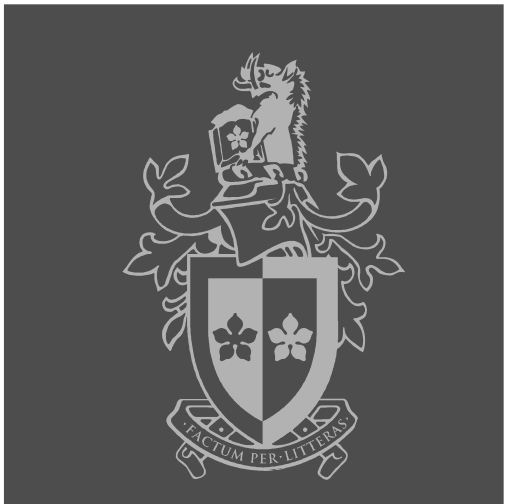
SWINBURNE UNIVERSITY OF TECHNOLOGY

TNE20002 / TNE70003

Topic 7. DHCP



Rev. 1.3

Outline

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- DHCP address allocation

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- Four Step Process to assign IP address
- DHCP Discover & DHCP Offer
- DHCP Request & DHCP Acknowledge
- DHCP Client Action

7.3 DHCP Configuration & Verification

- Specify DHCP excluded addresses
- Specify DHCP Pool , DHCP Default Gateway
- Verify dhcp binding , DHCP server statistics

7.4 DHCP Relay

- Configuring ip–helper address

Dynamic Host Configuration Protocol (DHCP)

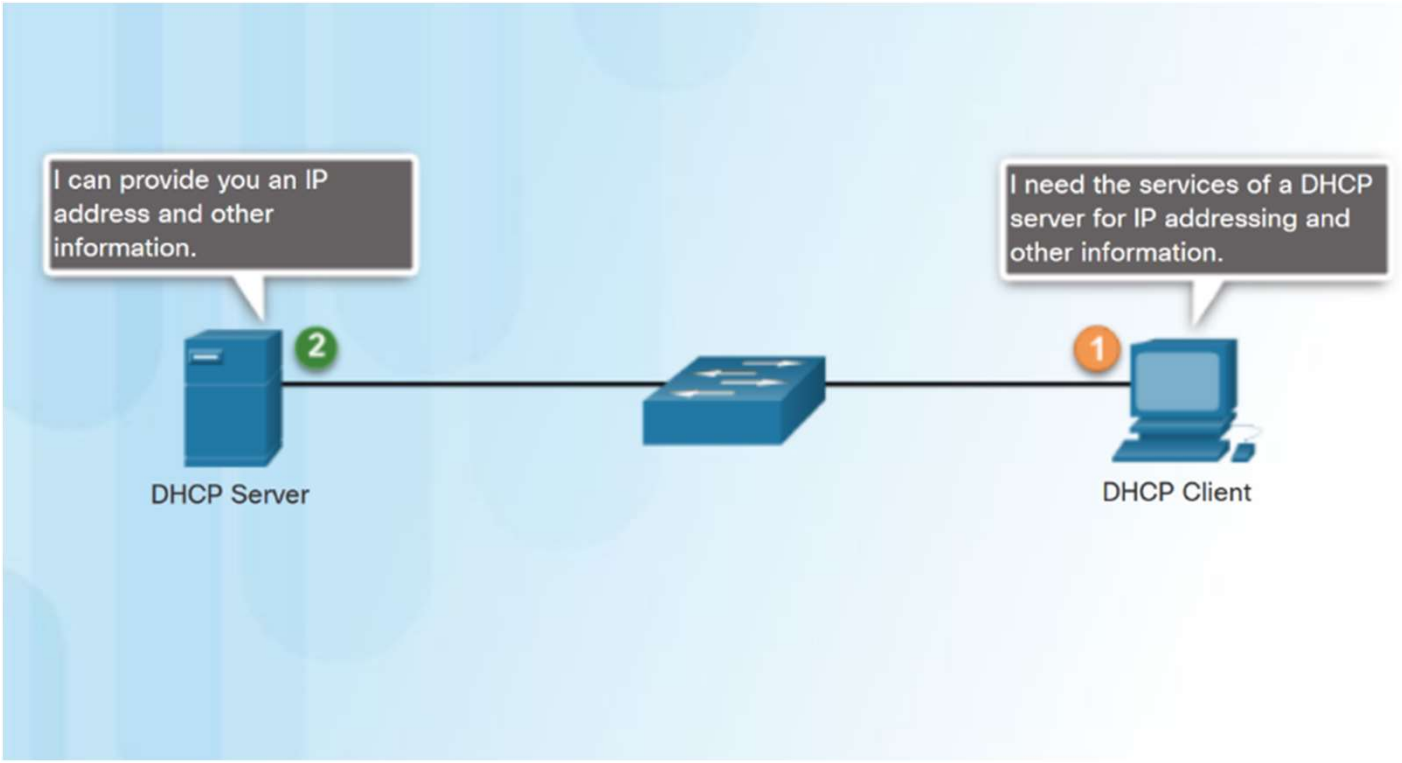
Introducing DHCP

All devices including PCs, switches, IPhones, printers, servers etc need an IP address to connect to a network.

DHCPv4 assigns IPv4 addresses & other network configuration information dynamically.

A dedicated DHCPv4 Server is easy to manage & scalable.

A Cisco router can be be configured to provide DHCP services in a small network.



Static IP addresses

- Network administrators assign static IP addresses to routers, servers and other network devices whose locations (physical and logical) are not likely to change.
- Devices such as routers, servers, printers, photocopiers need an address that will not change
- Static address assignment is required

Dynamic IP addresses

- User computers in an organization PCs, Laptops in an organization often change locations, physically and logically:

- With changing operating conditions Dynamic address assignment is required
- A workstation can use any address within a range of IP addresses,
- This range is typically within an IP subnet.

Dynamic Host Configuration Protocol (DHCP)

DHCP address allocation - - > MAD !

DHCP offers three ways to allocate IPv4 addresses

Manual Address Allocation

Administrator assigns an IP address for the client, and

DHCP can be used to convey the assigned address to the client.

Automatic Address Allocation

DHCP assigns a permanent address to the client.

Dynamic Address Allocation

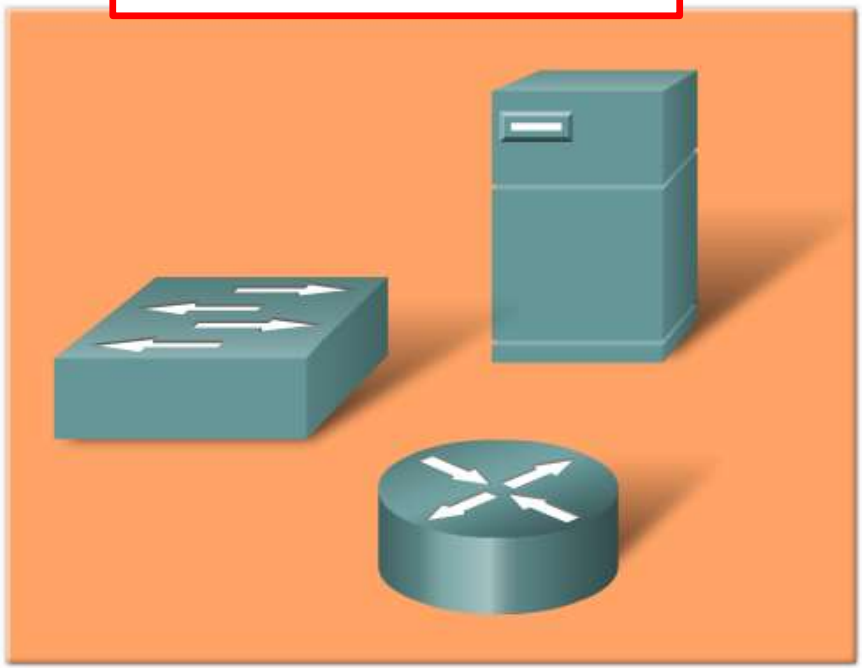
DHCP assigns an IP address for a fixed period of time (lease period)

or until the client relinquishes the address.

DHCP Address Allocation - MAD

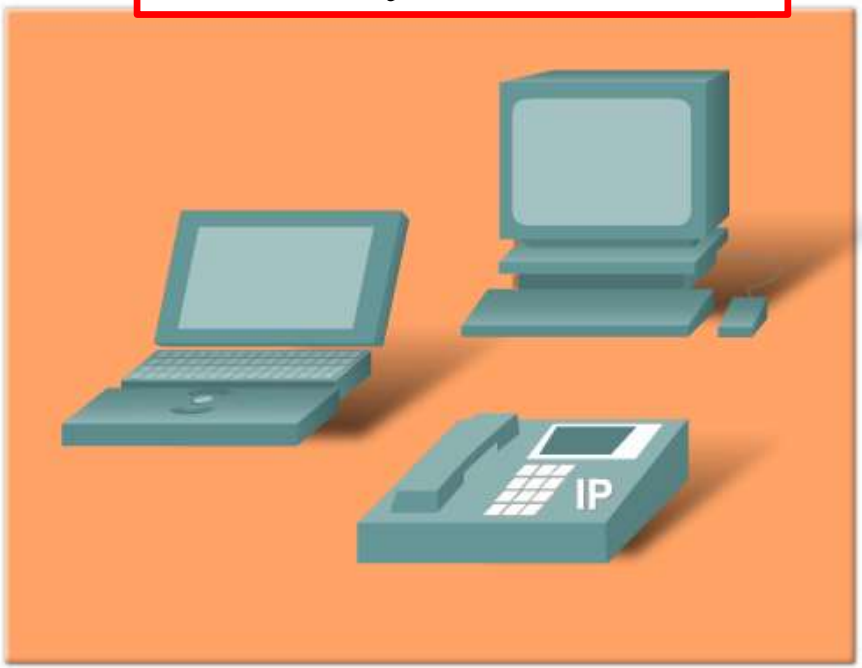
Automatic

Manual



Network devices that remain in the same place (logically and physically) are assigned static IP addresses.

Dynamic



Network devices that are added, moved or changed (physical and logical) need new addresses. Manual configuration is unwieldy.

Manual

The IP address for the client is pre-allocated

by the administrator

and

DHCP conveys the IP address

to the client.

Automatic

DHCP selects from an address pool,

automatically assigns

a permanent IP address to a client

with no lease period.

Dynamic

DHCP selects from an address pool

and leases the IP address to the client

for a limited period of time.

7.2 DHCP Operation

- Four Step Process to assign IP address
- DHCP Discover & DHCP Offer
- DHCP Request & DHCP Acknowledge
- DHCP Client Action

Dynamic Host Configuration Protocol (DHCP)

DHCP Operation

Four Step Process for a Client to obtain a lease

DORA

DHCPDiscover,

DHCPOffer,

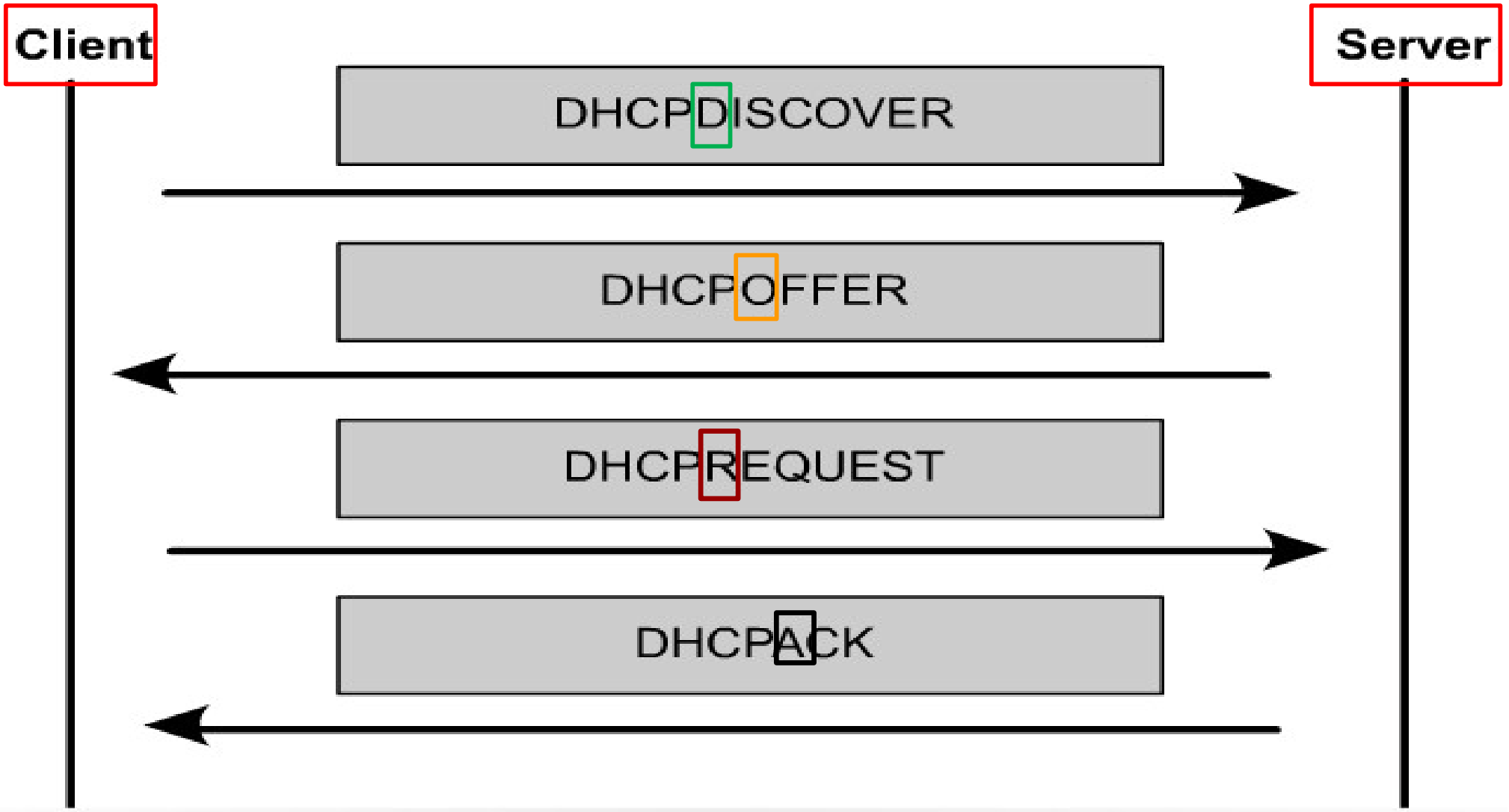
DHCPRequest,

DHCPAcknowledge

Client Action

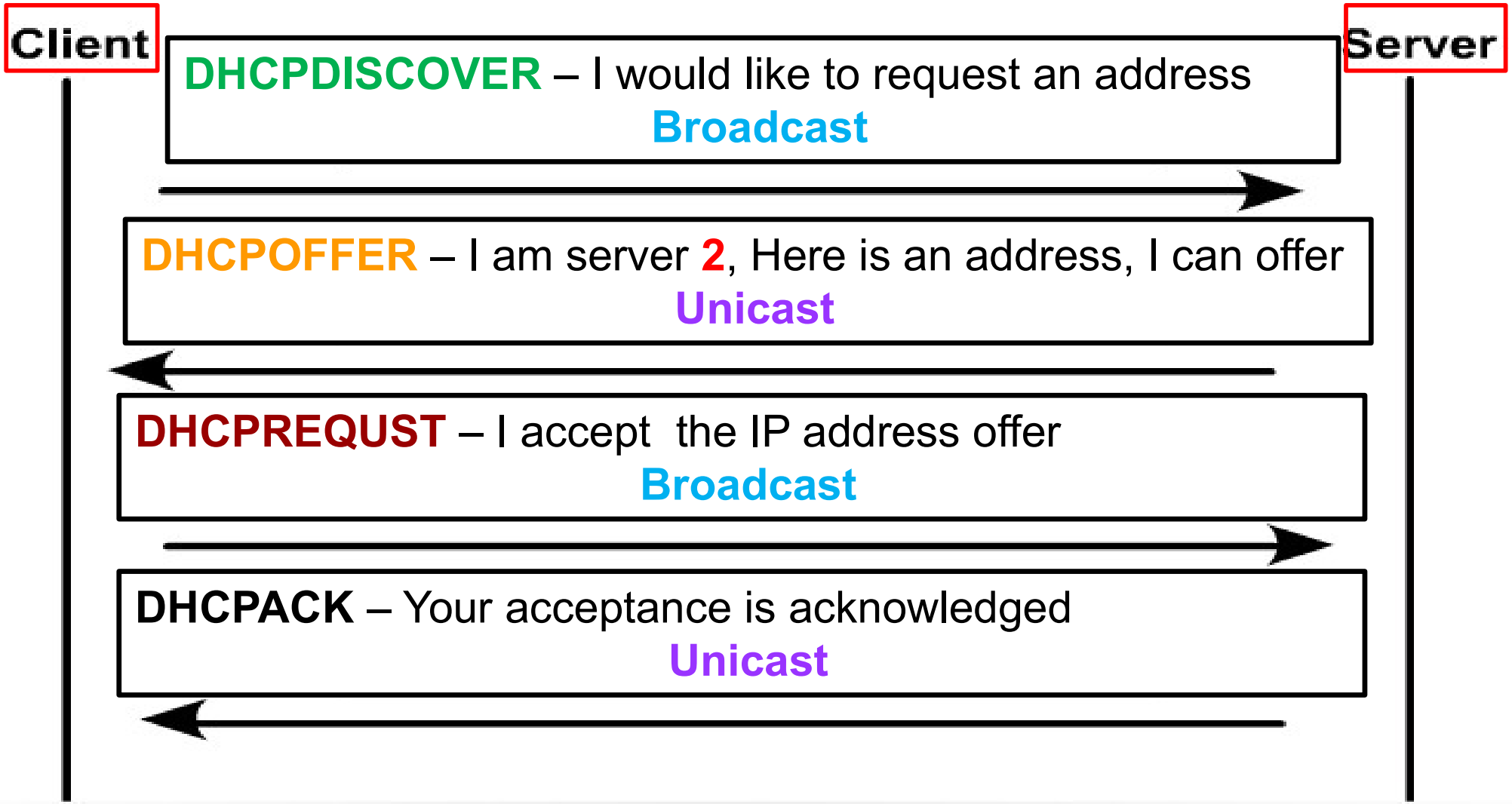
Final Verification

DHCP Operation – Four Messages - DORA



DHCP messages in the order they are transmitted

DHCP Operation – Four Messages - DORA



DHCP messages in the order they are transmitted

DHCP Operation – Obtaining a Lease – Discover

1. DHCP Discover (to Server)

Client (PC) broadcasts DHCPDISCOVER message

DHCPDISCOVER finds DHCP server(s)

Uses layer 2 (FF:FF:FF:FF:FF:FF) and layer 3 broadcast addresses to communicate with server(s)

DHCP Operation – Obtaining a Lease – Offer

2. DHCP Offer (to Client)

DHCP Server

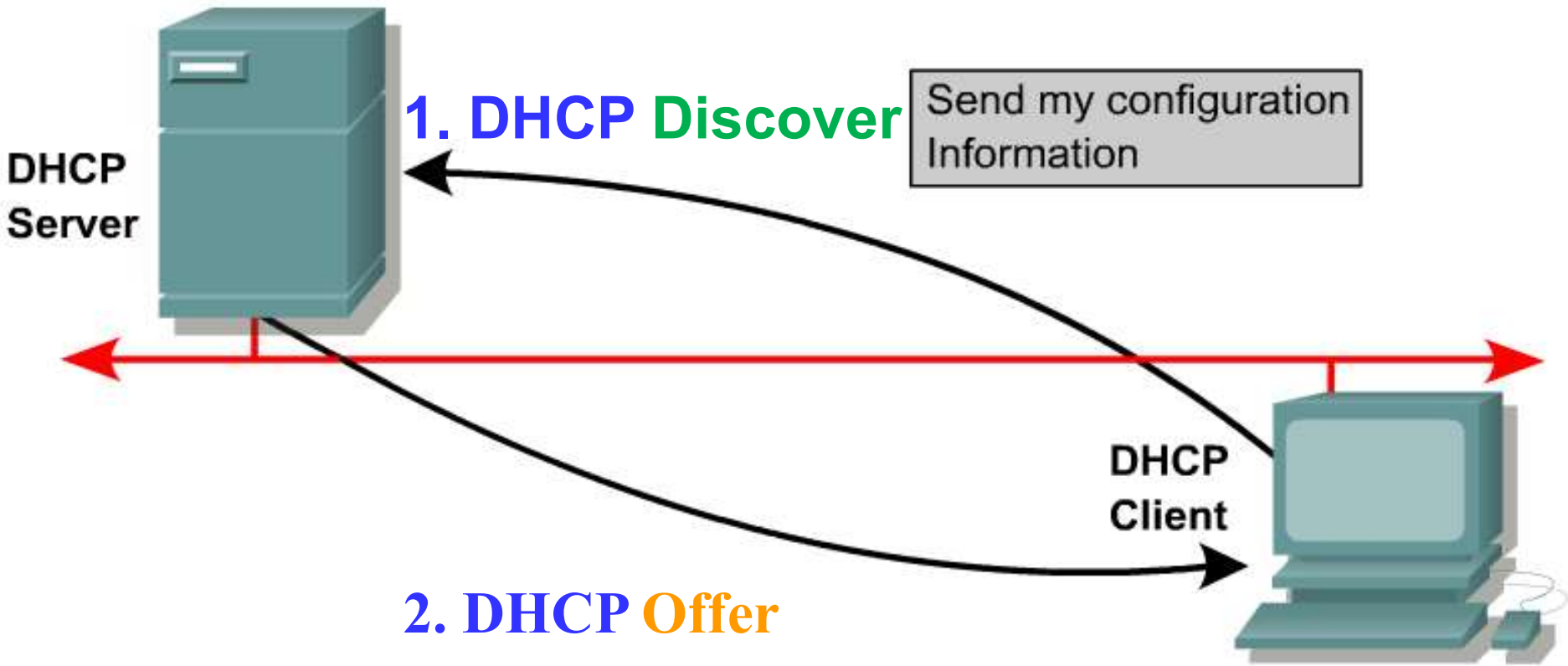
finds available IP address to lease

creates and ARP entry in its ARP table consisting of the MAC address of requesting host and the leased IP address

Sends DHCP**OFFER** message to Client

Unicast using server's layer 2 MAC address as source and client's layer 2 MAC address as destination

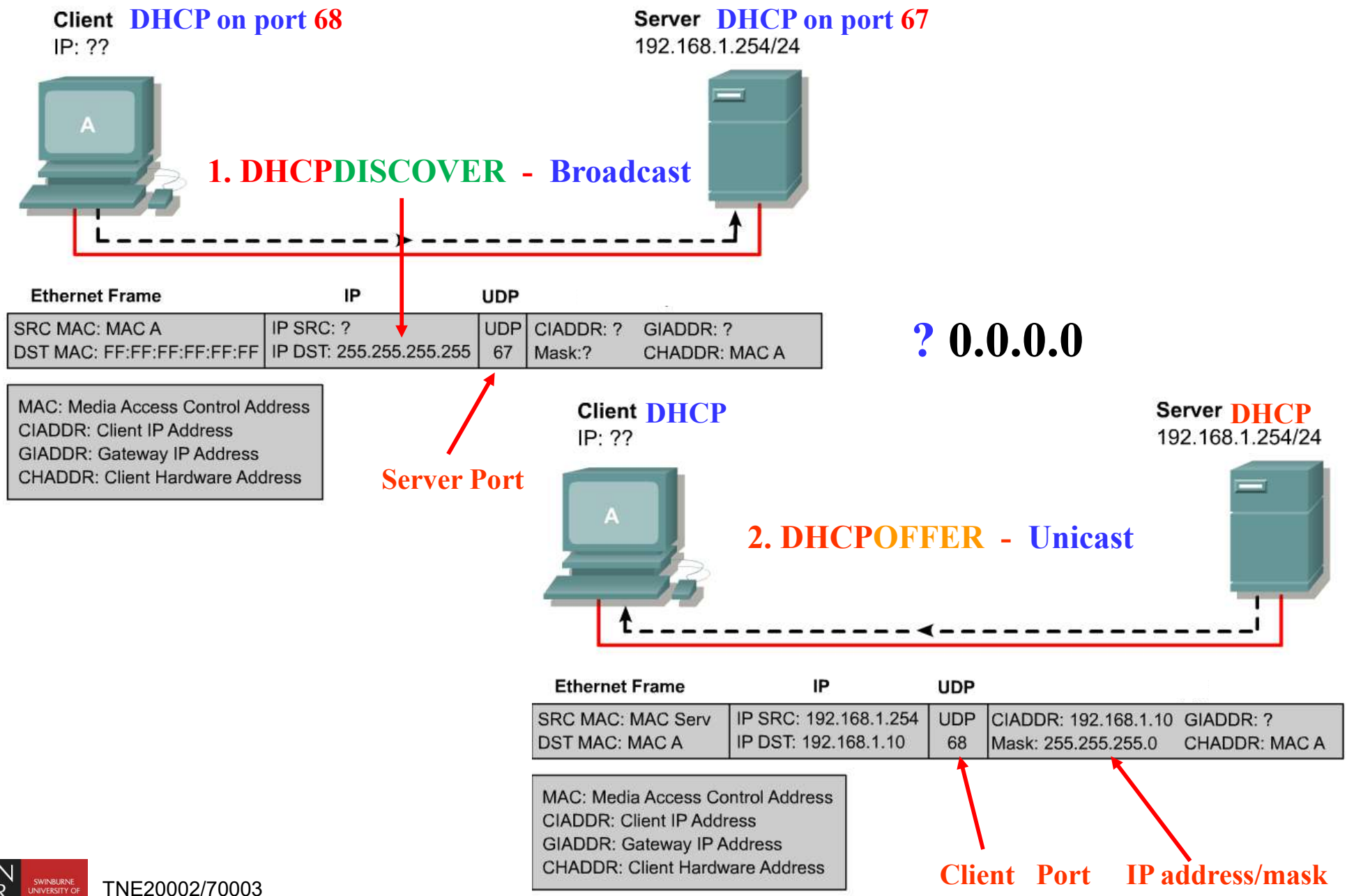
DHCP Operation - Messages Discover and Offer




```
Here is Your Configuration:
• IP Address: 192.204.18.7
• Subnet Mask: 255.255.255.0
• Default Gateway:  192.204.18.1
• DNS Servers: 192.204.18.8, 192.204.18.9
• Lease Time: 5 days
```

Offer Details

DHCP Operation – Messages Discover and Offer



DHCP – Obtaining a Lease – Request

3. DHCP Request (to Server)

Client broadcasts DHCP**REQUEST** message, two purposes:

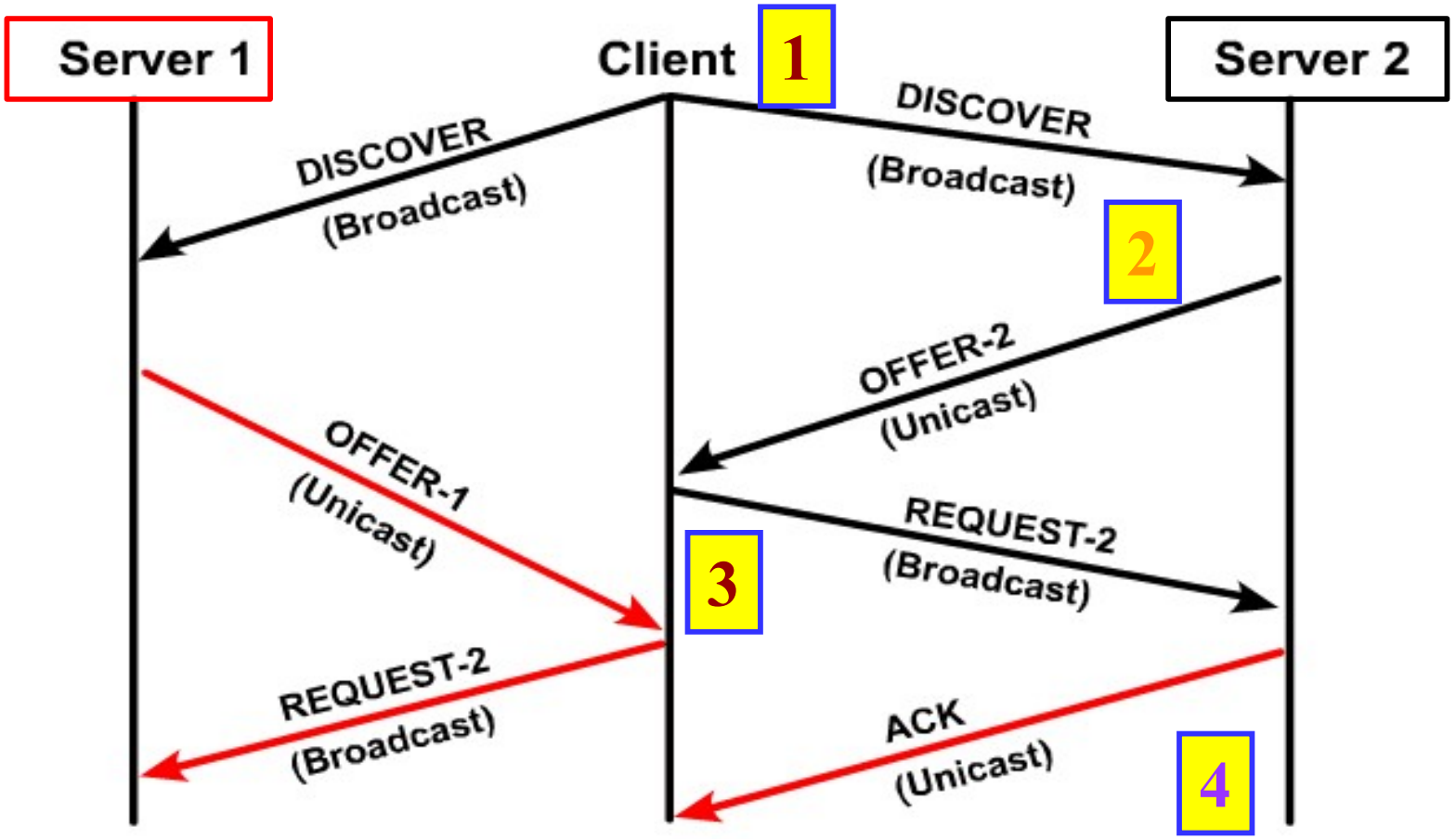
Requests IP lease information be verified to ensure assignment is still valid

Serves as a binding acceptance notice to the selected server and an implicit decline to any other DHCP servers that may have given the client an offer

4. DHCP Acknowledgement (to Client)

Server replies with unicast DHCP**ACK**

DHCP Operation – DORA Messages 1, 2, 3 and 4



- DHCP client broadcasts DHCPDISCOVER packet on local subnet
- DHCP servers send OFFER packet with lease information
- DHCP client selects lease and broadcasts DHCPREQUEST packet
- Selected DHCP server sends DHCP ACK packet

DHCP – Client Action

Client checks IP address is not a Duplicate within Subnet

Client sends ARP request (does any host within the subnet have this IP address ?) using new IP address

If no other hosts in subnet reply, the IP address is not a duplicate, hence it can use the IP address

7.3 DHCP Configuration & Verification

- Specify DHCP excluded addresses
- Specify DHCP Pool , DHCP Default Gateway
- Verify dhcp binding , DHCP server statistics

Configuring DHCP

```
Router(config)#ip dhcp pool pool-name1
```

Specify the DHCP pool

```
Router(dhcp-config)#network ip-address mask
```

Specify the range of addresses in the pool

- Creates an IP DHCP pool, and gives it a name
- Multiple DHCP pools can be created on one server
- Specify the IP range of addresses using an IP network address and mask

The **network** statement **enables** DHCP on **any router interfaces belonging** to that **network**.

- The router will act as a DHCP server on that interface.
- It is also the pool of addresses that the DHCP server will use.
- Pool **NaMe** (vs **nAmE**) is case sensitive

Configuring DHCP

```
Router(config)#ip dhcp excluded-address ip-address [end-ip-address]
```

```
Router(config)#ip dhcp excluded-address 172.16.12.1  172.16.12.10
Router(config)#ip dhcp excluded-address 172.16.12.254
```

```
Router(config)#ip dhcp pool subnet12
Router(dhcp-config)#network 172.16.12.0 255.255.255.0
Router(dhcp-config)#default-router 172.16.12.254
Router(dhcp-config)#dns-server 172.16.1.2
Router(dhcp-config)#netbios-name-server 172.16.1.3
Router(dhcp-config)#domain-name foo.com
```

The **ip dhcp excluded-address** command configures the router to exclude an **individual** address or **range** of addresses when assigning addresses to clients.

IP configuration values such as the **default gateway** can be set.

Configuring DHCP – Manual Allocation

DHCP Manual Allocation

Manually allocating an IP address to a printer, photocopier etc

- Router(config)# ip dhcp pool SUBNET12
- Router(dhcp-config)# host 172.16.12.5 255.255.255.0

DHCP unique-identifier

Router(dhcp-config)# client-identifier <*unique-identifier*>

- The *unique-identifier* of the client - the printer, is specified in dotted hexadecimal notation, for example, 01b7.0813.8811.66, where 01 represents the Ethernet media type, followed by client's MAC address
- When this printer's DHCP Client requests an IP address it will receive 172.16.12.5

Configuring a Cisco Router as a DHCP Server

Enabling the DHCP service:

To enable the service:

```
Router(config)#service dhcp
```

To disable the service:

```
Router(config)#no service dhcp
```

Configuring DHCP - Options

Command	Description
network *network-number* [*mask* | *prefix-length*]	Specifies the subnet network number and mask of the DHCP address pool. The prefix length specifies the number of bits that compromise the address prefix. The prefix is an alternative way of specifying the network mask of the client. The prefix length must be preceded by a forward slash (/).
default-router *address* [*address2...address8*]	Specifies the IP address of the default gateway for a DHCP client. Although one address is required, up to eight addresses can be specified in one command line.
dns-server *address* [*address2...address8*]	Specifies the IP address of a DNS server that is available to a DHCP client. Although one address is required, up to eight addresses can be specified in one command line.
netbios-name-server *address* [*address2...address8*]	Specifies the NetBios WINS server that is available to a Microsoft DHCP client. Although one address is required, up to eight addresses can be specified in one command line.
domain-name *name*	Specifies the domain name for the client.
lease {*days* [*hours*] [*minutes*] | infinite}	Specifies the duration of the lease. The default is a one-day lease.

Verifying and Troubleshooting DHCP

```
Router#show ip dhcp binding
IP address      Hardware address    Lease expiration       Type
172.16.12.11    0100.10a4.97f4.6d   Mar 02 1993 12:38 AM   Automatic
Router#
```

```
Router#debug ip dhcp server events
Router#
00:22:53: DHCPD:checking for expired leases.
00:22:23: DHCPD: assigned IP address 172.16.13.11 to client
0100.10a4.97f4.6d
00:22:49: DHCPD:retured 172.16.13.11 to address pool remote.
00:22:59: DHCPD: assigned IP address 172.16.13.11 to client
0100.10a497f4.6d.
```

Verify DHCP

* show ip dhcp server statistics

* show ip dhcp pool

7.4 DHCP Relay

- Configuring ip–helper address

DHCP Relay

DHCP clients use IP broadcasts to find DHCP server located in the same Broadcast domain.

Problem.

What happens when DHCP Server is in a different subnet?
The server and client are not on the same segment and are separated by a router.

Routers do not forward these broadcasts to other segments.

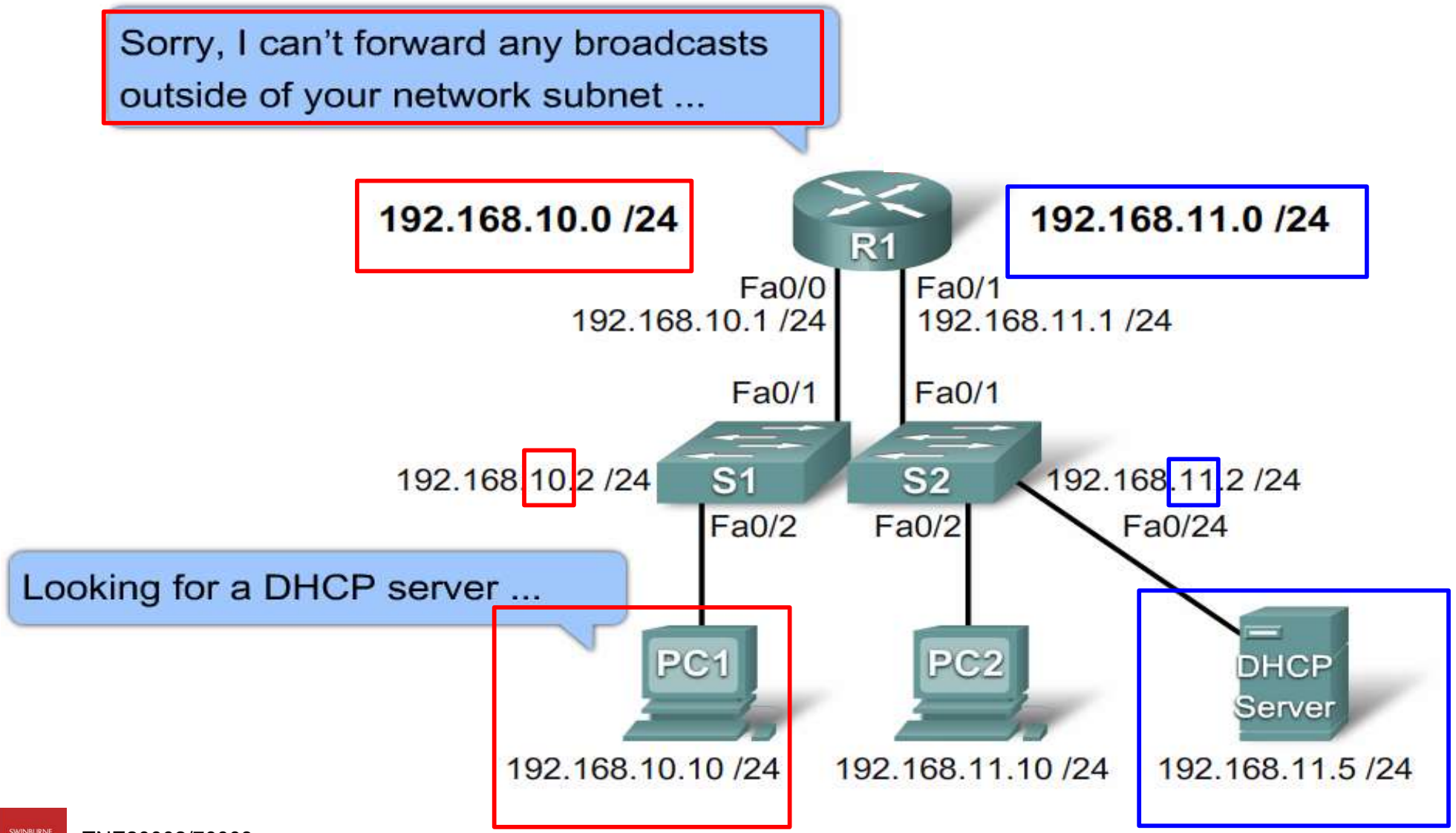
Solution

A Cisco IOS helper address is configured, router acts as a relay agent forwarding the message to the DHCP server.

When possible administrators use the ip helper-address command to relay broadcast requests for these key UDP services

DHCP Relay – DHCP Server in a different subnet

DHCP Relay



DHCP Relay – DHCP Server in a different subnet