



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Trawsnewid Addysg, Trawsnewid Bywydau
Transforming Education, Transforming Lives

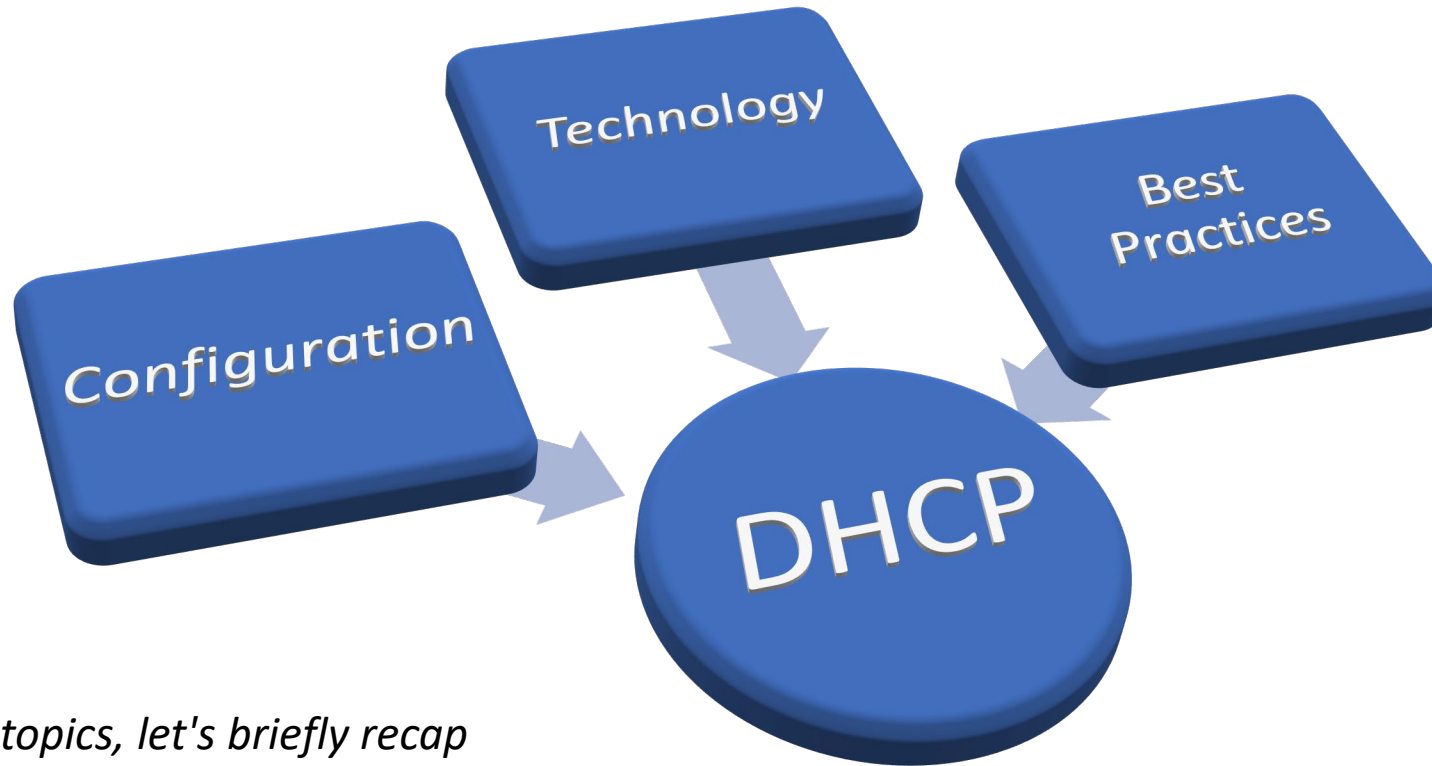
Dynamic Host Configuration Protocol

Network Operating Systems and Services

ACCA5023

Today's Discussion

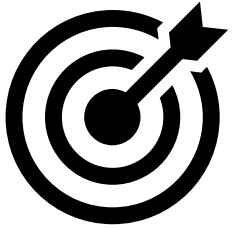
In our preceding session, we delved into the intricacies of VPN. As we progress into this week's lecture, our attention turns towards DHCP services. Throughout this session, we will explore fundamental DHCP concepts and its underlying technologies. Furthermore, we will proceed to implement this service within the context of our established network infrastructure.



Before we dive into today's topics, let's briefly recap what we covered so far.



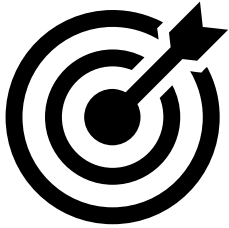
Milestone



Coursework 1:

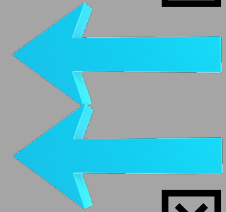
- ✍ Choose your Hypervisor based on your research (Q.2.1)
- ✍ Download (use Evaluation Copy) and Setup your Virtual Machines – as per the topology (Q. 2.2)
- ✍ Research on IP Address (Based on the Group Discussion earlier)
- ✍ Download Debian Linux
- ✍ Configure IP Address for Windows Server and Client – Successful Ping
- ✍ Install Debian Server and Client
- ✍ Configure IP Address for Debian Server and Client – Successful Ping
- ✍ Test and Troubleshoot (if required) your network.
- ✍ Research on Routing and Network Services.
- ✍ Submit your Coursework 1 – **03/03/2026**





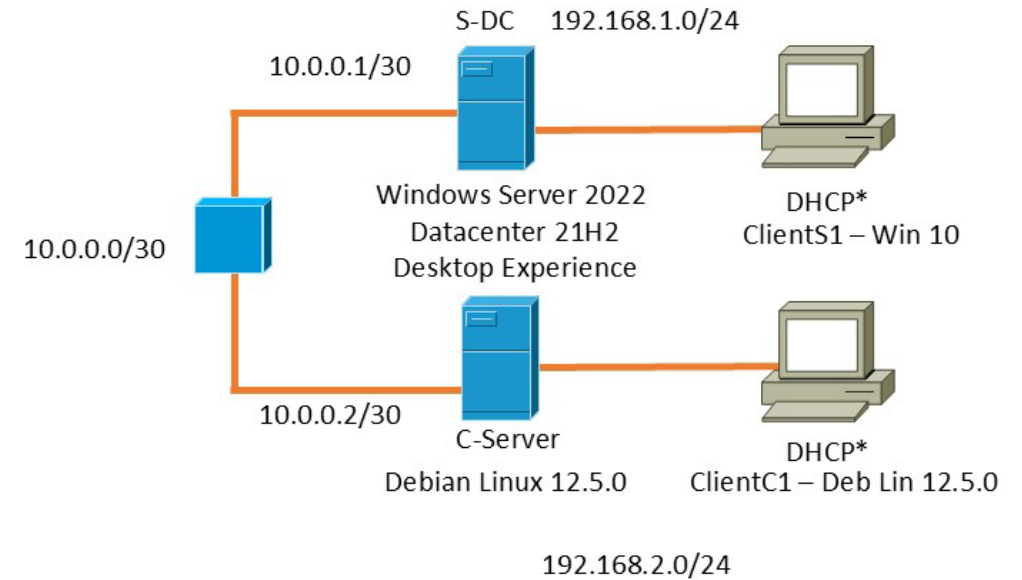
Coursework 2:

- ✍ Coursework 2 – Walkthrough
- ✍ Plan to work on your Topology – Gantt Chart !!! (Reading Week)
- ✍ Continue with your Topology – Firewall Rules/ Policies
- ✍ Installing RRAS Services, AD-DC, DNS, S2S VPN
- ✍ Configuring DHCP, Mount Second Disk, Export/ Create User Accounts
- ✍ Work on other Aspects (Sharing Disk Drive, IIS Server, RDS)
- ✍ Troubleshoot if necessary
- ✍ Submit your Coursework 2 – **11/05/2026** (Submission: 1500)



50 M

1. Routing: **10 M**
 - a) Modify Firewalls
 - b) Install Routing and Remote Access
 - c) Persistent IP Forwarding
2. Domain Server (Swansea) **10 M**
 - a) **Promote Domain Controller**
 - b) **DNS A Records, Reverse Lookups**
3. Domain Membership **5 M**
 - a) **Domain Membership CS1**, LCD, CL1
4. Encrypted Connection between Swansea and London **5 M**
 - a) VPN – Persistent Connection
5. Users **5 M**
 - a) PowerShell Scripts/ Manual Addition
6. DHCP Server **10 M**
 - a) DHCP Server and Relay
7. Test and Troubleshoot **5 M**
 - a) All Machines Ping Successfully

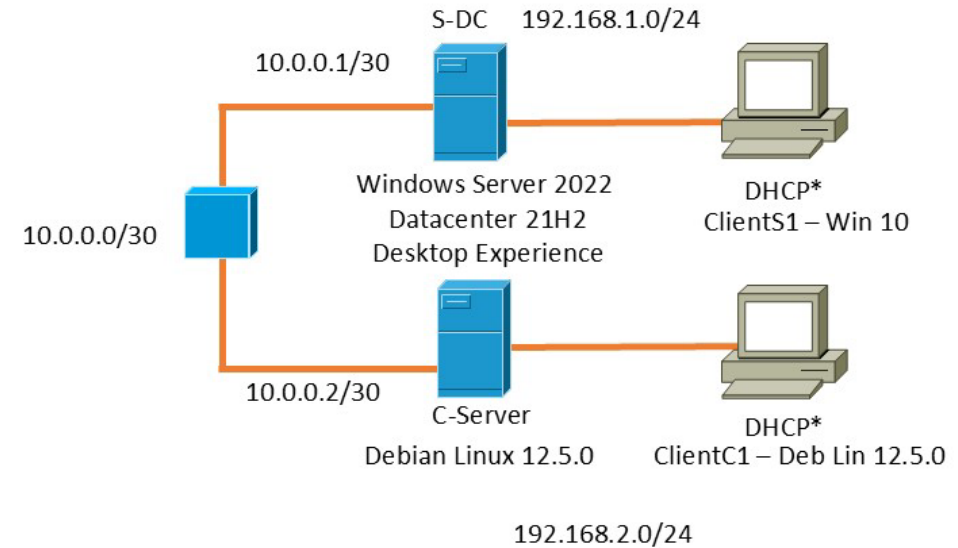


* Will do when DHCP Services are installed

3 Weeks Before Easter Break

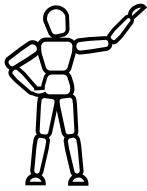
35 M

1. Disk Drive: **15 M**
 - a) Mount E:\ SwanseaFiles **5 M**
 - b) Sharing Disk Drive in both Swansea and London **5 M**
 - c) Full Control Permission **5 M**
2. IIS Server **10 M**
 - a) Create a Website with Internal Authentication **5 M**
 - b) All Users Authenticated **2 M**
 - c) Presented with “Welcome Message” **3 M**
3. Remote Desktop Services **10 M**
 - a) Successful remote desktop access **5 M**
 - b) Create a Login page (HTTP/HTTPS) **1 M**
 - c) Functional [HTTPS://rds.yourname.acca](https://rds.yourname.acca) **2 M**
 - d) Fully Functional [HTTPS://rds.yourname.acca](https://rds.yourname.acca) with Certificates **2 M**



* Will do when DHCP Services are installed

Action



As we conclude today's lecture on DHCP, you will be having a comprehensive understanding of DHCP fundamentals and their significance in modern networking. Awareness of the DHCP Operations and familiarity with configuring DHCP and their roles will help you in ensuring efficient network management/ communication.

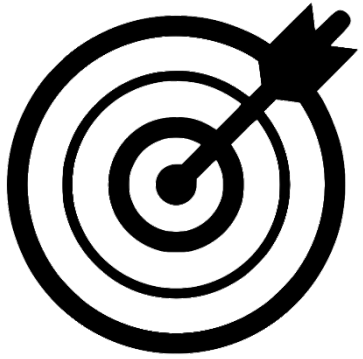
I trust you equip yourselves with the knowledge and skills necessary to effectively implement DHCP, fostering a deeper comprehension of their configuration and operation within network environments.

By actively engaging in DHCP implementation during tutorials, you will solidify your understanding of theoretical concepts and cultivate practical skills essential for leveraging DHCP technology effectively in real-world scenarios. With this foundational knowledge in place, I encourage you to

✍ Install and Configure DHCP



Objectives



[This Photo](#) by Unknown Author is licensed under [CC BY-NC](#)

- ✍ Understand DHCP Concepts
- ✍ Continue with your Coursework 2
- ✍ Submit your report – **11th May 2026 @ 1500**
- ✍ Demonstration – **12th May 2026**

DHCP: Introduction

○ Why Dynamic Host Configuration Protocol (DHCP)?

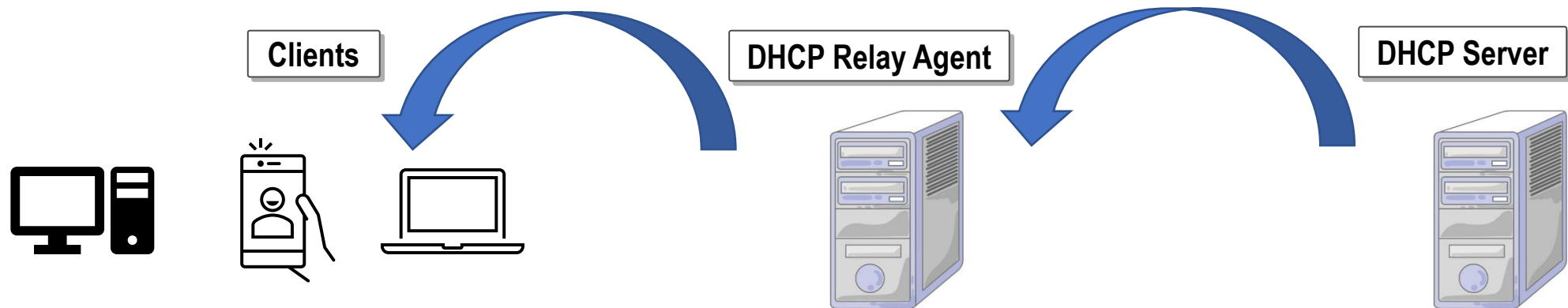
- assigns IPv4 addresses and other network configuration information dynamically.
- Because desktop clients typically make up the bulk of network nodes, DHCP is an extremely useful and timesaving tool for network administrators.
- The DHCPv4 server dynamically assigns, or leases, an IPv4 address from a pool of addresses for a limited period chosen by the server, or until the client no longer needs the address.
- Clients lease the information from the server for an administratively defined period.
- Administrators configure DHCP servers to set the leases to time out at different intervals.
- The lease is typically anywhere from 24 hours to a week or more.
- When the lease expires, the client must ask for another address, although the client is typically reassigned the same address.

○ How DHCP?

- A dedicated DHCP server is scalable and relatively easy to manage.
- However, in a small branch or SOHO location, a Cisco router can be configured to provide DHCP services without the need for a dedicated server.

DHCP: Operation

- DHCPv4 works in a client/server mode.
 - When a client communicates with a DHCPv4 server, the server assigns or leases an IPv4 address to that client.
 - The client connects to the network with that leased IPv4 address until the lease expires.
 - The client must contact the DHCP server periodically to extend the lease.
 - This lease mechanism ensures that clients that move or power off do not keep addresses that they no longer need.
 - When a lease expires, the DHCP server returns the address to the pool where it can be reallocated, as necessary.



DHCP: Operation



The DHCP client sends a directed IP broadcast with a DHCP request. The server notes the field as well as the hardware address of the client.

"I would like to request an address."

DHCPDISCOVER Broadcast

DHCP OFFER Unicast

The DHCP server picks an IP address from the available pool for the segment, as well as the other segment and global parameters. The server adds these values to the appropriate fields of the DHCP packet. Using the hardware address of the client, it sends this frame back to the client.

"I accept the IPv4 address offer."

DHCPREQUEST Broadcast

DHCPACK Unicast

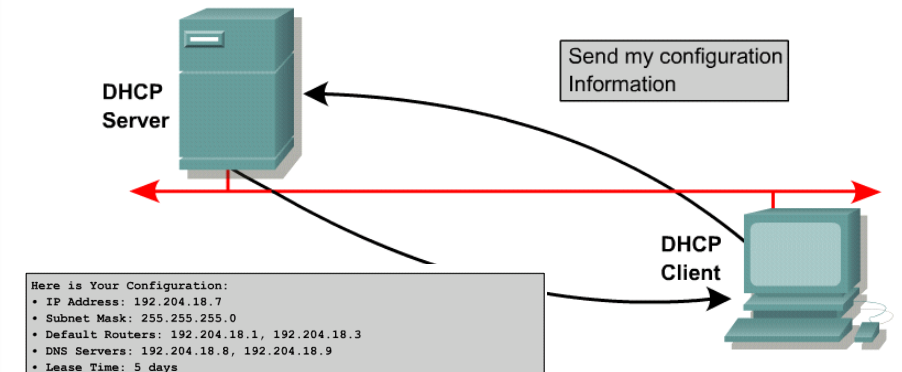
"Your acceptance is acknowledged."



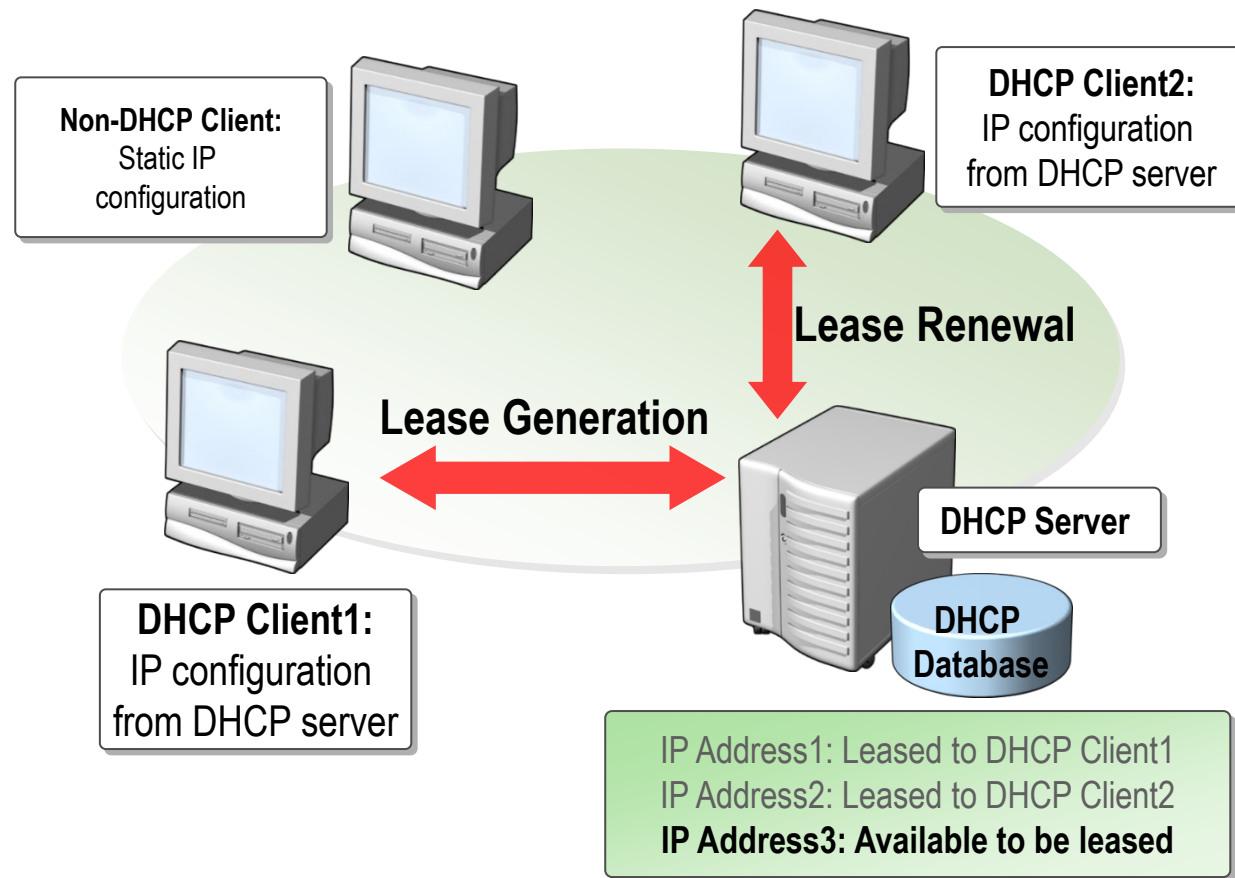
Ethernet Frame	IP	UDP	DHCP Request
SRC MAC: MAC A DST MAC: FF:FF:FF:FF:FF:FF	IP SRC: ? IP DST: 255.255.255.255	UDP 67	CIADDR: ? Mask: ? GIADDR: ? CHADDR: MAC A



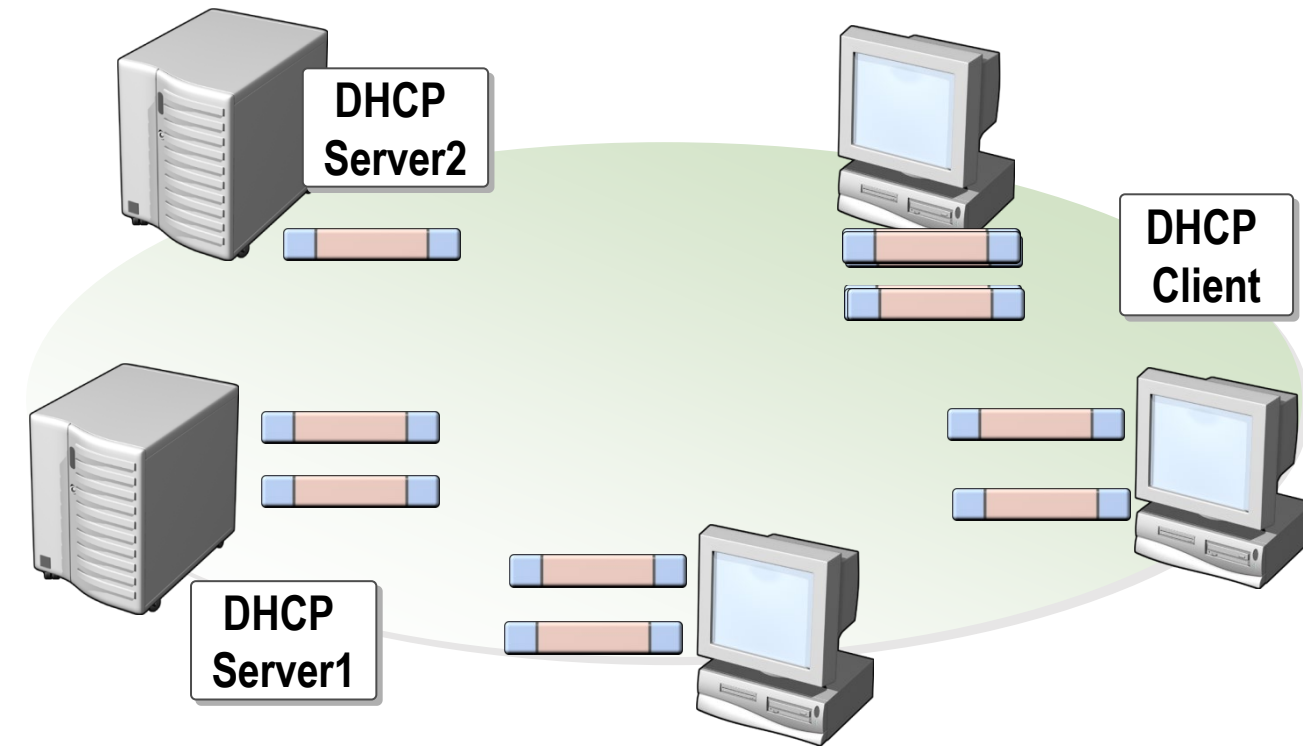
Ethernet Frame	IP	UDP	DHCP Reply
SRC MAC: MAC Serv DST MAC: MAC A	IP SRC: 192.168.1.254 IP DST: 192.168.1.10	UDP 68	CIADDR: 192.168.1.10 Mask: 255.255.255.0 GIADDR: ? CHADDR: MAC A



DHCP: Operation



DHCP: Operation



1 DHCP client broadcasts a DHCPDISCOVER packet

2 DHCP servers broadcast a DHCPOFFER packet

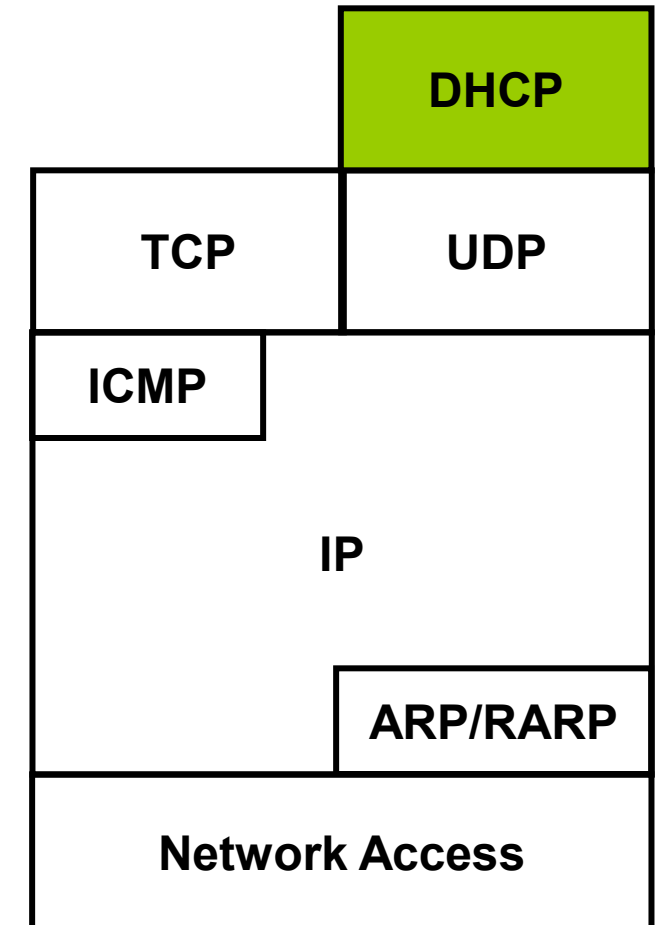
3 DHCP client broadcasts a DHCPREQUEST packet

4 DHCP Server1 broadcasts a DHCPACK packet

DHCP: Protocol

- Successor to BOOTP
- DHCP allows a host to obtain its IP address quickly and dynamically
- DHCP server required
- DHCP server is allocated a pool of IP addresses
- Host contacts server and is allocated an address from the pool
- Uses UDP to transport DHCP messages between DHCP clients and servers and IP to send and receive DHCP messages over a network.
- DHCP server listens on port 67 to receive DHCP messages from DHCP clients and port 68 to receive DHCP messages from DHCP servers.

BOOTP	DHCP
Static mappings	Dynamic mappings
Permanent assignment	Lease
Only supports four configuration parameters	Supports over 20 configuration parameters



BOOTP - DHCP

BOOTP	DHCP
<i>BOOTP supports <u>ONLY a limited number of client configuration parameters</u>. It is called as <u>Vendor Extensions</u></i>	<i>DHCP supports <u>a larger and extensible set of client configuration parameters</u> called <u>options</u></i>
<i>In addition to IP address, can contain <u>address of router, address of BOOTP server and vendor specific information</u></i>	<i>In addition to the IP address, much <u>more configuration information</u> can also be sent to the host (e.g. the network mask, DNS Name Server)</i>
<i>BOOTP uses a <u>two-phase bootstrap configuration</u> process in which clients contact BOOTP servers to perform address determination and boot file name selection. clients contact Trivial File Transfer Protocol (TFTP) servers to perform file transfer of their boot image.</i>	<i>Where as DHCP uses a <u>single-phase boot configuration</u> process where as a DHCP client negotiates with a DHCP server to determine its IP address and obtain any other initial configuration details it needs for network operation.</i>
<i>BOOTP clients <u>do not rebind or renew configuration</u> with the BOOTP server except when the system restarts</i>	<i>DHCP clients <u>do not require a system restart to rebind or renew configuration</u> with the DHCP server. Clients automatically enter the Rebinding state at set timed intervals to renew their leased address allocation with the DHCP server. This process occurs in the background and is transparent to the user.</i>

DHCP: Advantages

DHCP reduces the complexity and amount of administrative work by using automatic TCP/IP configuration

Manual TCP/IP Configuration

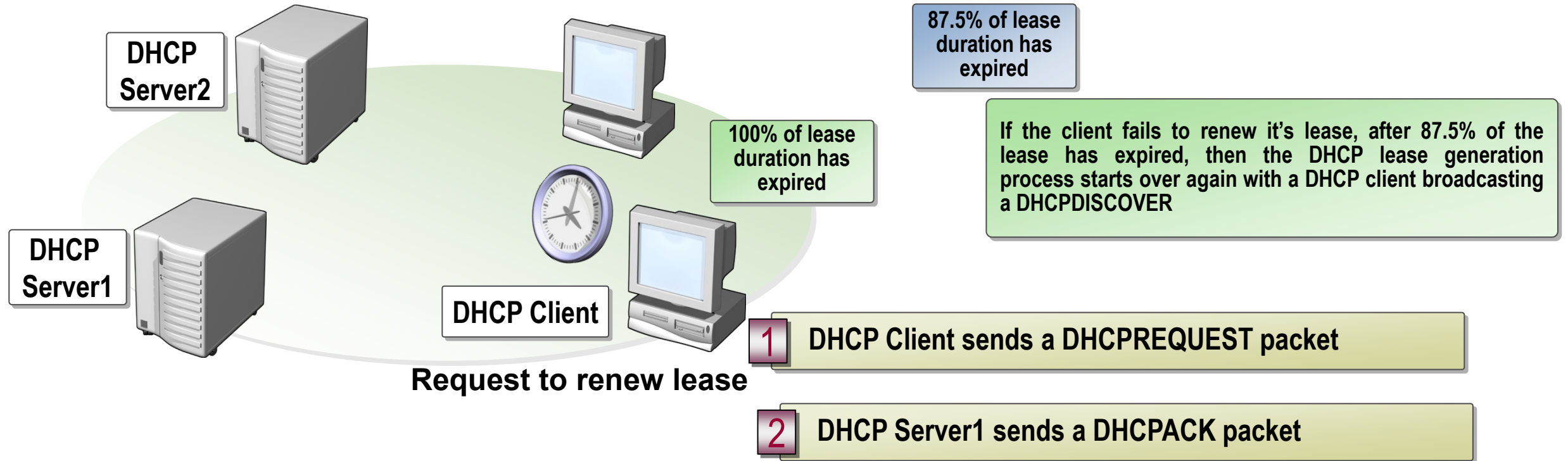
- IP addresses are entered manually on each client computer
- Possibility of entering incorrect or invalid IP address
- Incorrect configuration can lead to communication and network issues
- Administrative overload on networks where computers are frequently moved

Automatic TCP/IP Configuration

- IP addresses are supplied automatically to client computers
- Ensures that clients always use correct configuration information
- Client configuration is updated automatically to reflect changes in network structure
- Eliminates a common source of network problems

DHCP: Lease

- Clients must report back periodically to keep lease.
- Lease expires (configurable lease period).

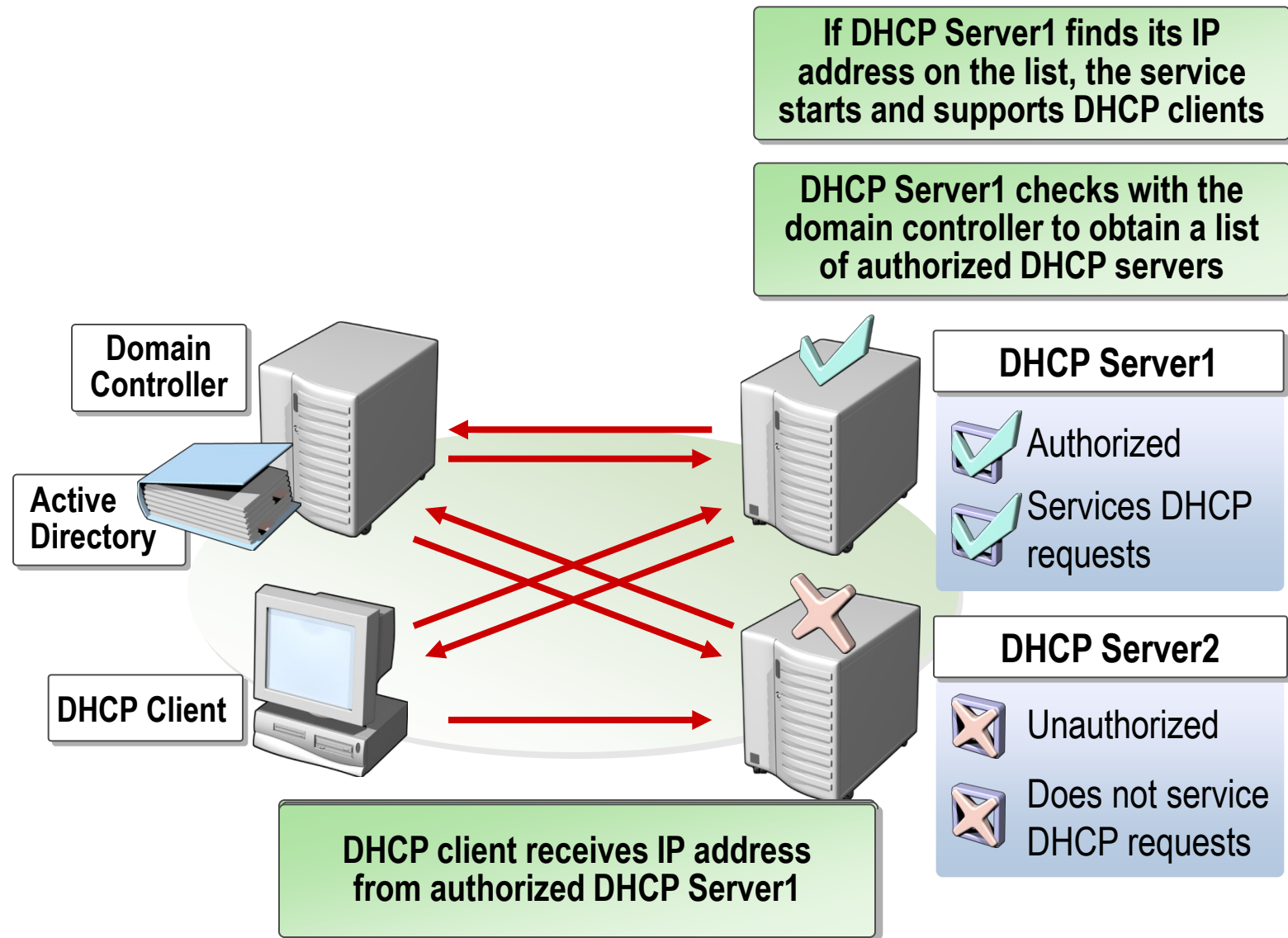


DHCP: Security?

- It is possible for an attacker to “fake” a **DHCP server**, Known as a rogue DHCP server
- Can lead to Denial-of-service attack, Clients get assigned a load of illegal IP addresses
- Can setup DHCP as a standalone server

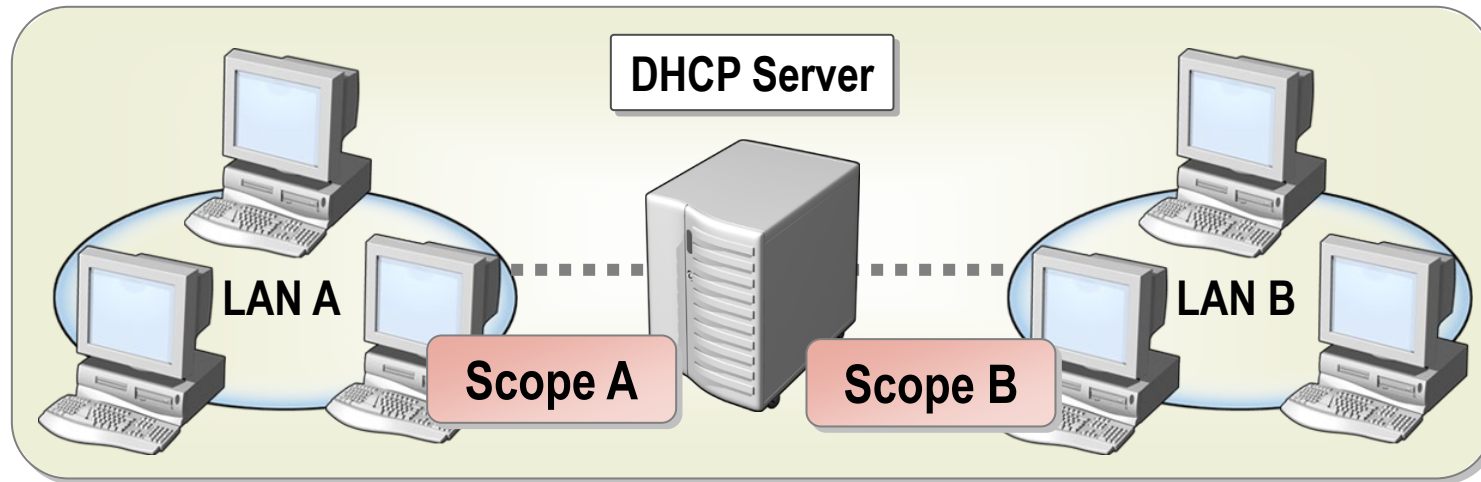
If network is using Active Directory

- **DHCP authorization** is the process of registering the DHCP Server service in the Active Directory domain to support DHCP clients
- **Authorize DHCP server** → won't start if server is not registered with Active Directory domain controller



DHCP: Scope

A scope is a range of IP addresses that are available to be leased



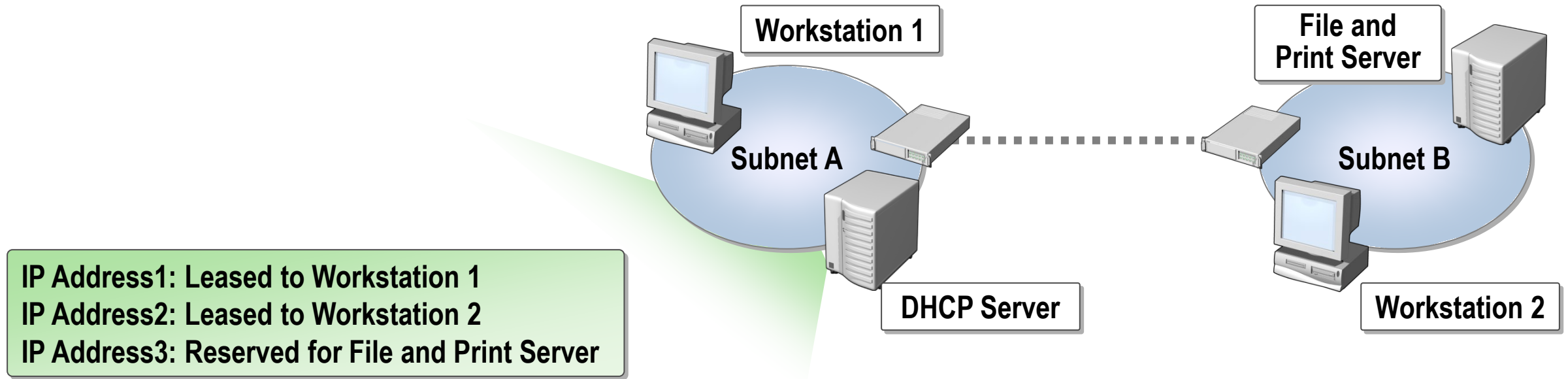
- Network ID
- Subnet mask
- Network IP address range

- Lease duration
- Router

- Scope name
- Exclusion range

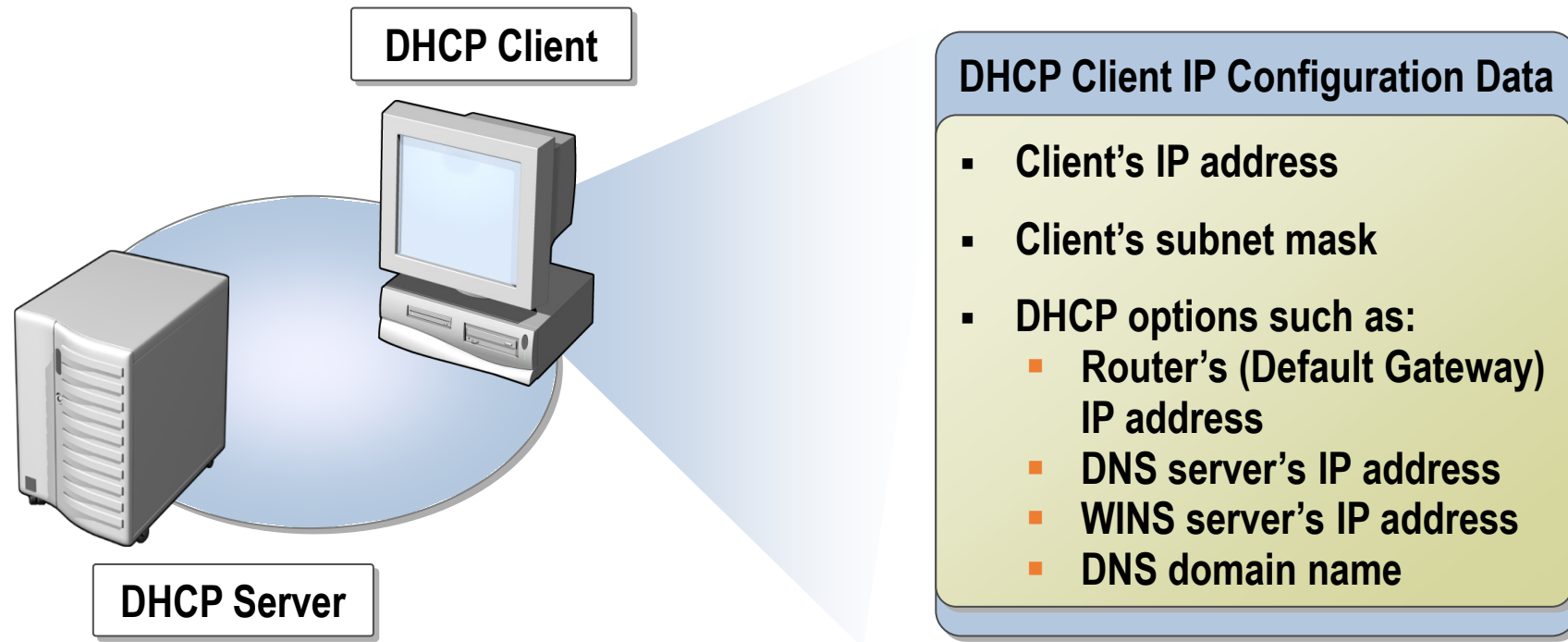
DHCP: Reservation

A reservation is a specific IP address, within a scope, that is permanently reserved for leased use to a specific DHCP client



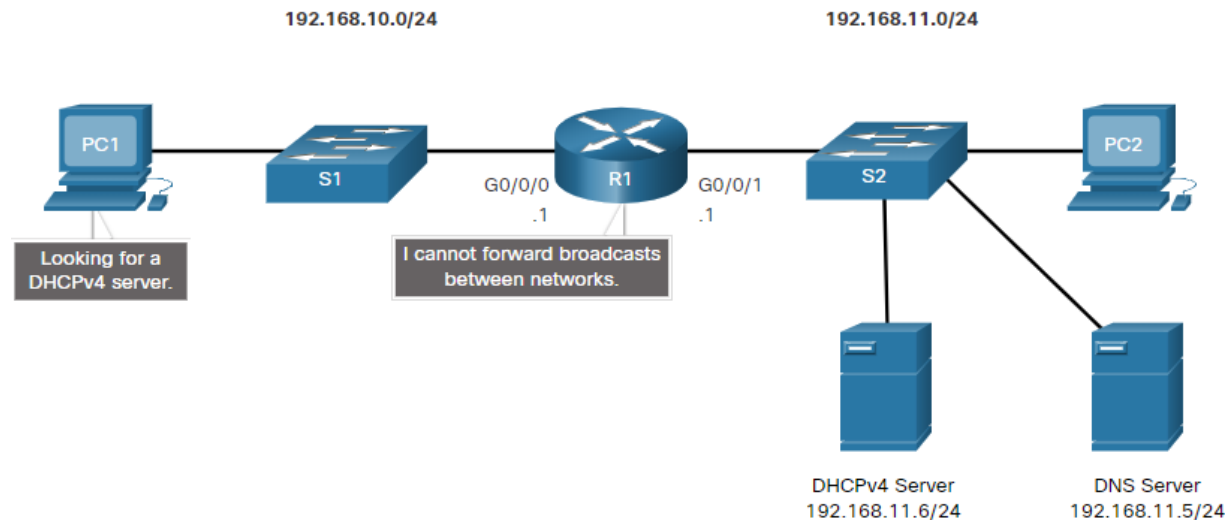
DHCP: Options

DHCP options are configuration parameters that a DHCP service assigns to clients along with the IP address and default gateway



DHCP: Relay Agents

- In a complex hierarchical network, enterprise **servers are usually located centrally**.
- These servers may provide DHCP, DNS, TFTP, and FTP services for the network. Network clients are not typically on the same subnet as those servers. In order to locate the servers and receive services, clients often use broadcast messages.
- Routers don't pass broadcast packets and hence, DHCP Discovers, Requests, etc, don't get forwarded across subnets
- Agents forward Requests across subnets through routers (don't use broadcasts to do this)
- ***No need for DHCP servers for each subnet (and their backups)***
- Provide fault tolerance by allowing DHCP servers on different subnets to cover for each other

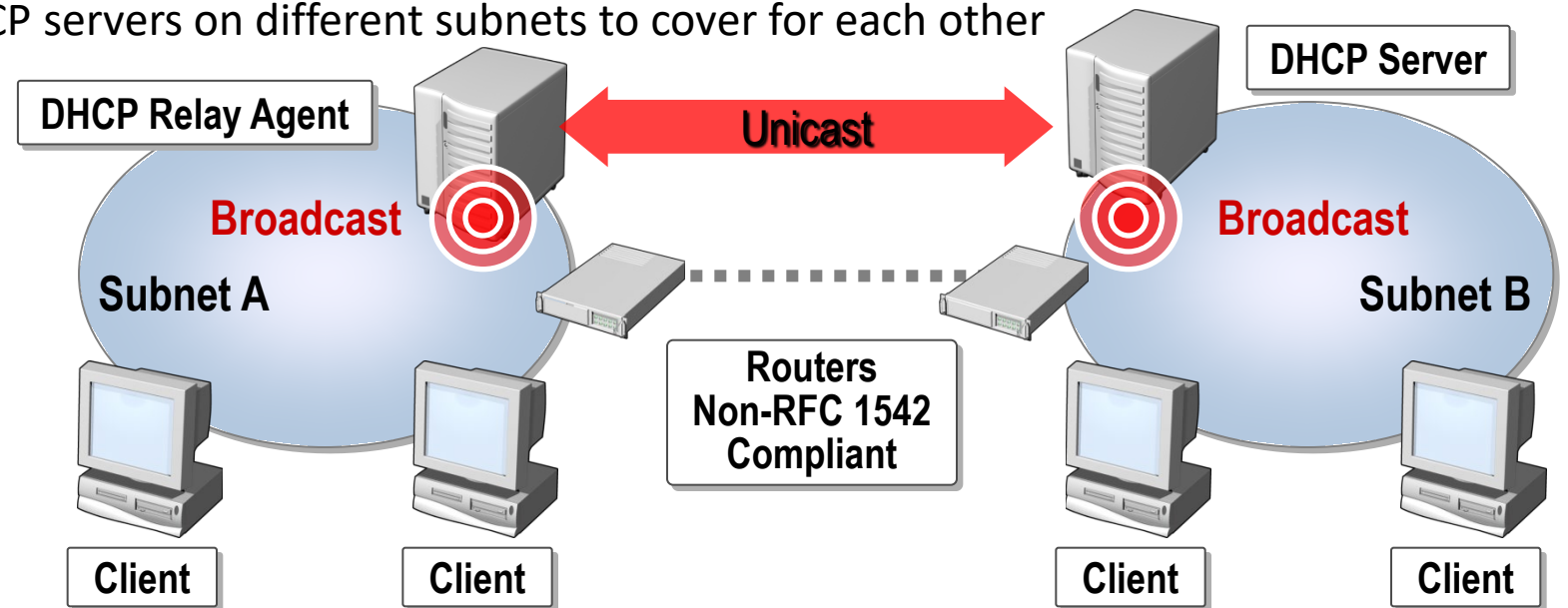


In the figure, PC1 is attempting to acquire an IPv4 address from a DHCP server using a broadcast message. In this scenario, R1 is not configured as a DHCP server and does not forward the broadcast. Because the DHCP server is located on a different network, PC1 cannot receive an IP address using DHCP. DHCP relay must be configured to send these messages to the DHCP server.

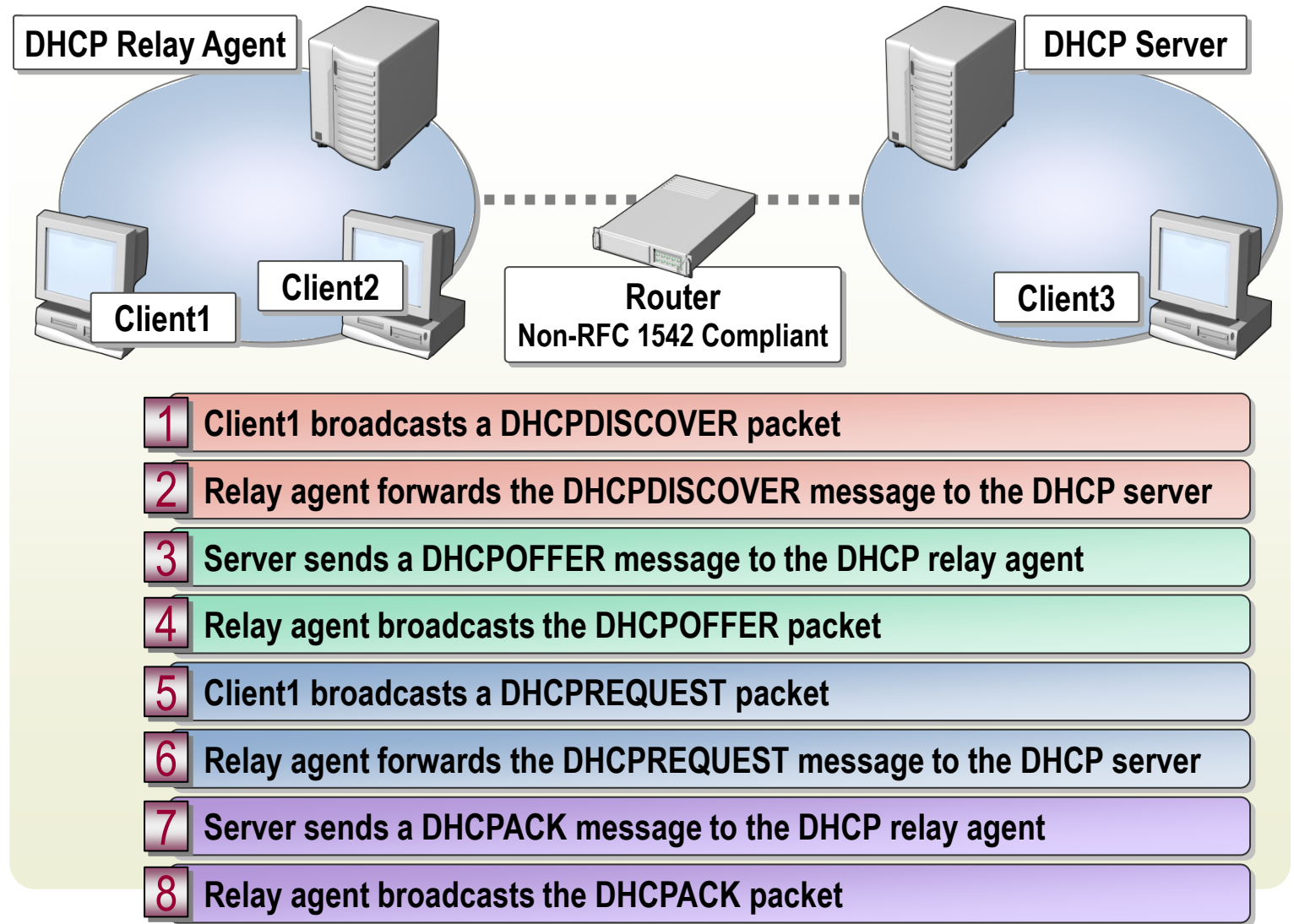
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A DHCP relay agent is a computer or router configured to listen for DHCP/BOOTP broadcasts from DHCP clients and then relay those messages to DHCP servers on different subnets



DHCP: Relay Agents



Backup Folder: Takes backup automatically every hour...

Database containing tables for IP-address-Owner-ID & name-to-IP-address mapping

DHCP: Storage Log Files & Reserved Log Files, Checkpoint File Contains info on leases, scope, reservations, options, etc

Temp. db file (also known as a swap file) used for database maintenance operation

- backup
- dhcp.jfm
- dhcp.mdb
- dhcp.pat
- DhcpSrvLog-Thu
- DhcpSrvLog-Wed
- DhcpV6SrvLog-Thu
- DhcpV6SrvLog-Wed
- j50.chk
- j50
- j50res00001.jrs
- j50res00002.jrs
- j50tmp
- j5000001
- j5000002
- j5000003
- j5000004
- j5000005
- tmp.edb

18/02/2021 14:27File folder

24/02/2021 12:19JFM File16 KB

24/02/2021 12:19MDB File1,024 KB

DhcpSrvLog-Thu - Notepad

File Edit Format View Help

Microsoft DHCP Service Activity Log

Event ID	Meaning
00	The log was started.
01	The log was stopped.
02	The log was temporarily paused due to low disk space.
10	A new IP address was leased to a client.
11	A lease was renewed by a client.
12	A lease was released by a client.
13	An IP address was found to be in use on the network.
14	A lease request could not be satisfied because the scope's address pool was exhausted.
15	A lease was denied.
16	A lease was deleted.
17	A lease was expired and DNS records for an expired leases have not been deleted.
18	A lease was expired and DNS records were deleted.
20	A BOOTP address was leased to a client.
21	A dynamic BOOTP address was leased to a client.
22	A BOOTP request could not be satisfied because the scope's address pool for BOOTP was exhausted.
23	A BOOTP IP address was deleted after checking to see it was not in use.
24	IP address cleanup operation has begun.
25	IP address cleanup statistics.
30	DNS update request to the named DNS server.
31	DNS update failed.
32	DNS update successful.
33	Packet dropped due to NAP policy.
34	DNS update request failed.as the DNS update request queue limit exceeded.
35	DNS update request failed.
36	Packet dropped because the server is in failover standby role or the hash of the client ID does not match.
50+	Codes above 50 are used for Rogue Server Detection information.

QResult: 0: NoQuarantine, 1:Quarantine, 2:Drop Packet, 3:Probation,6:No Quarantine Information ProbationTime:Year-Month-Day H

ID,Date,Time,Description,IP Address,Host Name,MAC Address,User Name, TransactionID, QResult,Probationtime, CorrelationID,Dhci

00,02/18/21,12:27:15,Started,,,,,0,6,,,,,,0

55,02/18/21,12:27:21,Authorized(servicing).....0.6.....0

24/02/2021 12:19EDB File20 KB

Local Disk (C:) > Windows > System32 > dhcp

Summary

➤ BOOTP

➤ DHCP

- Protocol
- Operation
- Lease
- Security
- Scope
- Options
- Reservations
- Relay Agents



Diolch/Thank You Any Questions?

Books Referred: *Dauti, Bekim. Windows Server 2019 Administration Fundamentals: A beginner's guide to managing and administering Windows Server environments, 2nd Edition . Packt Publishing.*

Links referred in this presentation:

- Microsoft Virtual Academy