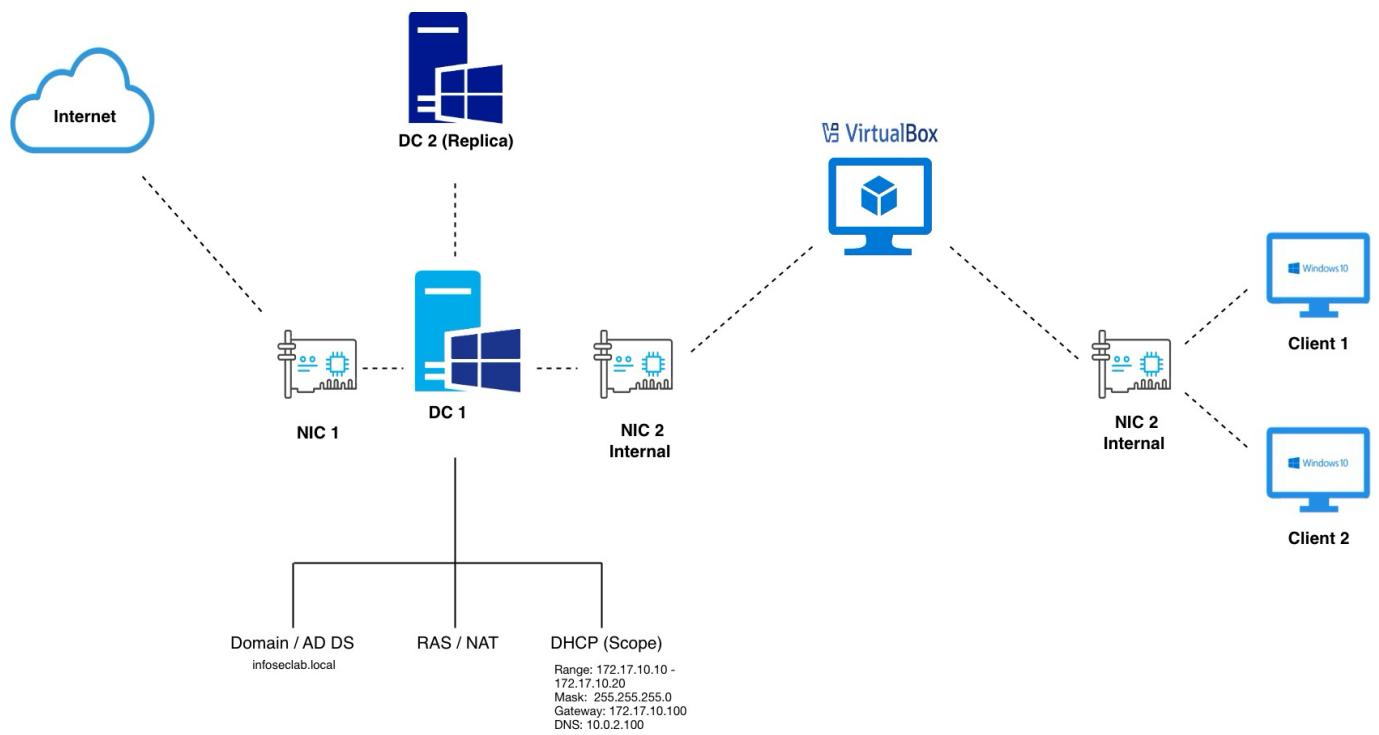


Building an Active Directory Home Lab

By: Nadia HA

Network Topology



Lab Overview

The Active Directory Home Lab project demonstrates the deployment of a functional Windows Server 2022 environment designed to simulate a small enterprise network. The lab includes domain controllers, DHCP and RAS configurations, and Active Directory management using both graphical and PowerShell tools. The goal of the lab is to provide a secure, scalable, and realistic environment for testing Windows Server features such as domain management, DHCP failover, user account automation, and network routing within VirtualBox.

This setup replicates a professional IT infrastructure by integrating core services: DNS, DHCP, AD DS, and RAS, allowing centralized authentication, IP address management, and remote connectivity. The lab also supports testing user and group management through automated PowerShell scripts.

Hardware Requirements

Component	Minimum Specification	Recommended
CPU	4-core processor	6–8 cores
RAM	8 GB	16 GB or more
Storage	100 GB available	150+ GB SSD
Network	VirtualBox NAT + NAT Network	Configured as "win cluster" (172.17.10.0/24)

Software Requirements

- **VirtualBox** – Used to create and manage virtual machines.
- **Windows Server 2022 ISO** – Installed on the domain controller VMs.
- **Windows 10 ISO (or client OS)** – Used for testing domain join and DHCP.
- **PowerShell 5.1+** – For user management automation.
- **Text editor (Notepad, VS Code)** – For editing PowerShell scripts.

Virtual Machines

VM Name	Role	IP Address	Description
DC1	Primary Domain Controller, DHCP, RAS	172.17.10.100	Hosts main AD DS, DNS, and routing
DC2	Secondary Domain Controller	172.17.10.110	Replica domain controller and DHCP failover
Client1	Test workstation	DHCP-assigned	Used to verify domain connectivity
Client2	Test workstation	DHCP-assigned	Used for failover and redundancy testing

Introduction

This lab focuses on designing and deploying an Active Directory Home Lab using Windows Server 2022 in a virtualized environment. The project emulates a small business network setup, showcasing critical Windows Server functions such as domain creation, DNS configuration, DHCP setup, and remote access routing.

The main objective is to provide hands-on experience in:

- Setting up and promoting Windows Servers to Primary and Secondary Domain Controllers (DC1 and DC2).
- Configuring DHCP scopes and failover between domain controllers.
- Setting up RAS for internal/external routing.
- Managing users and organizational units (OUs) through PowerShell scripting for automation and scalability.

By completing this lab, the user gains practical experience in building a secure, structured, and scalable Windows Server infrastructure, reinforcing system administration and network configuration skills relevant to real-world enterprise environments.

1. Prerequisite

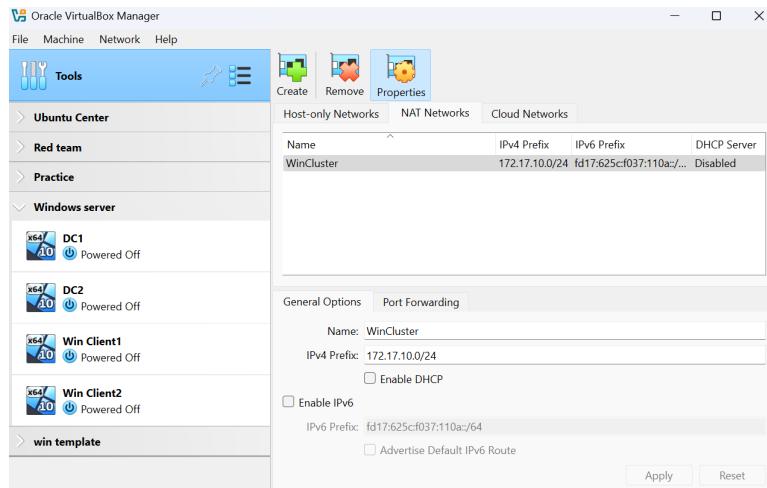
Windows Environment Setup

The setup involves configuring a virtual environment using VirtualBox, comprising Windows Server 2022 instances acting as domain controllers and a virtual router.

1. Network Configuration in VirtualBox:

A NAT Network is created in VirtualBox for the internal network. I used the name "win cluster" and configured it with the IP range 172.17.10.0 network. However, you can choose a different subnet as long as it's a private network.

- The NAT network interface is accessed via VirtualBox tools > network > NAT network.



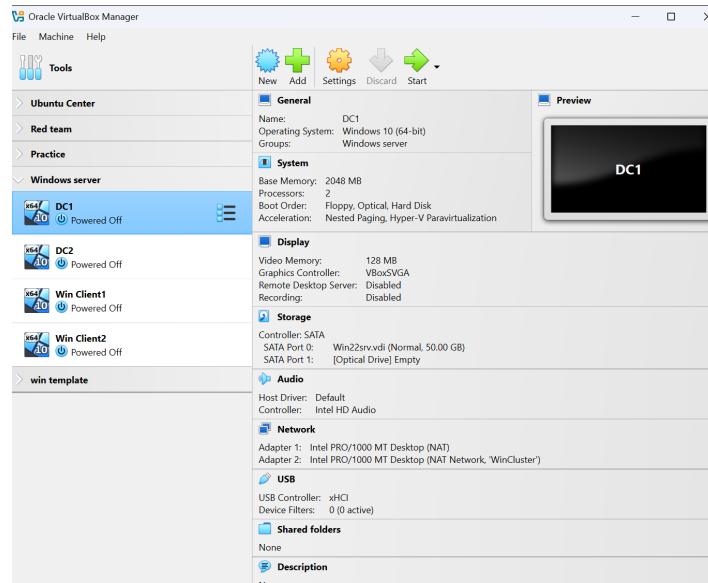
2. Windows Server 2022 Template Creation:

A new virtual machine is created in VirtualBox, named "win 2022 main temp" or similar. The Windows 2022 ISO is attached. The "skip unattended" option is selected to avoid issues later.

Memory (RAM) and processor cores are allocated. The hard disk size is configured. Two network adapters are configured for the server template.

- Adapter 1: Set to NAT (for internet access)

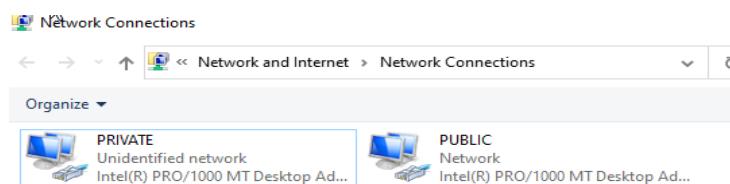
- Adapter 2: Set to NAT Network (for the internal network), specifically the "win cluster" NAT network created earlier. For the NAT Network adapter, it's important to go to advanced settings and generate a new MAC address before cloning to prevent conflicts.



- Proceed with the Windows 22 installation, choosing the Standard Evaluation with Desktop Experience (GUI). The installation involves accepting the ULA and performing a custom installation. Essential tools like Windows PowerShell and Command Prompt are pinned to the taskbar for easy access.

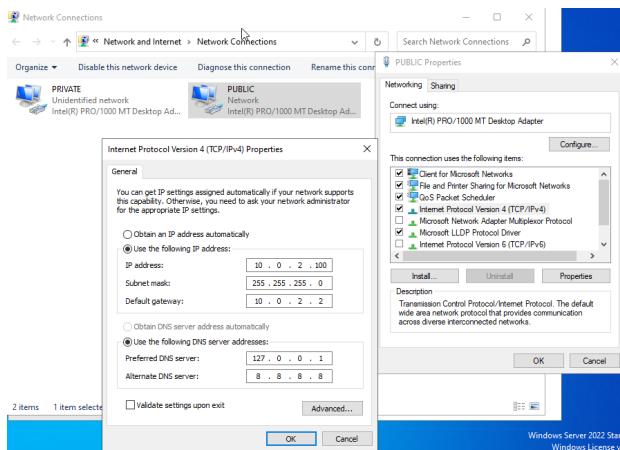
3. Static IP Configuration: The server's IP addresses are configured statically.

- Access Network and Internet settings > advanced > change adapter options.
- Identify the network adapters. The NAT (public) adapter is on the 10 network, and the NAT Network (private) adapter is on the 172 network. The adapters are renamed to "public" and "private" for clarity.



4. For the "public" adapter (NAT):

- IPv6 is unchecked.
- IPv4 properties are set.
- A static IP address is assigned. The source uses 10.0.2.100 (last octet 100 for the server) with subnet mask 255.255.255.0.
- The Default Gateway is set to 10.0.2.2, which is the VirtualBox NAT gateway.
- DNS is pointed to itself (127.0.0.1) and a public DNS (e.g., 8.8.8.8 for Google DNS).
- See image 1.4 for Public Network Configurations



For the "private" adapter (NAT Network)

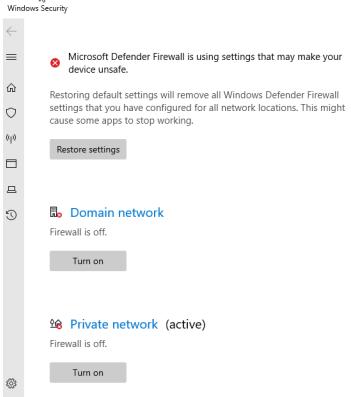
- IPv6 is unchecked.
- IPv4 properties are set.

A static IP address is assigned, using the 172.17.10.0/24 subnet. The source uses 172.17.10.100 with subnet mask 255.255.255.0.

- No gateway is needed as this is an internal-only network.
- DNS is pointed to itself (127.0.0.1).
- See image 1.5 for Private Network Configurations

4. Firewall/Enhanced Security Configuration:

The firewall is temporarily turned off for public and private networks for easier setup. Internet Explorer Enhanced Security Configuration is also turned off



5. Sysprep:

The Sysprep tool is run to prepare the template for cloning, ensuring a clean copy without machine-specific information.

1. Click the Windows search icon
2. Type in Run sysprep6.
3. Select Generalize and Shutdown options.
4. Click OK. The server shuts down after Sysprep finishes.

6. Server Name Change:

The computer name is changed (e.g., to DC1), but the restart is deferred. This step is ideally done *after* cloning the template for DC1, as the template itself shouldn't be named DC1.

1. Server Role Installation & Domain Role Promotion

Active Directory Domain Services Setup for DC1

1. Prepare the Server:

Before starting the installation, ensure that the computer name is configured, the firewall is turned off (at least temporarily), and both the public and private IP addresses are configured.

2. Start Adding Roles and Features:

Click on "Manage", then select "Add Roles and Features".

3. Navigate the Wizard:

Proceed by clicking "Next".

4. Select Installation Type:

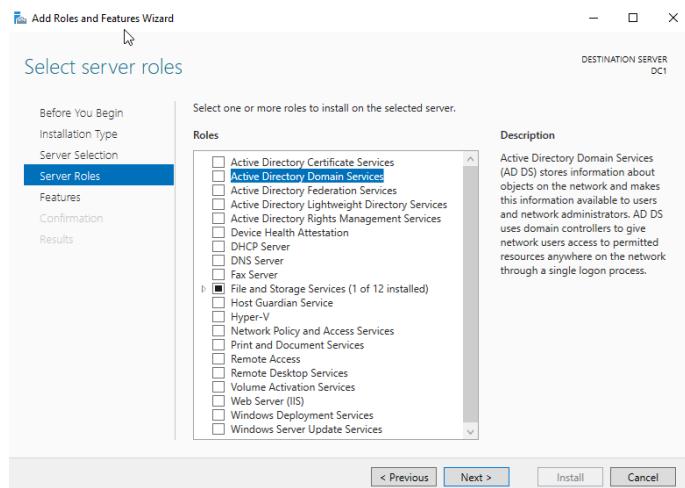
Click "Next" again to confirm the default installation type.

5. Choose Destination Server:

Make sure the correct server is highlighted. It's usually the only domain available for selection. Click "Next".

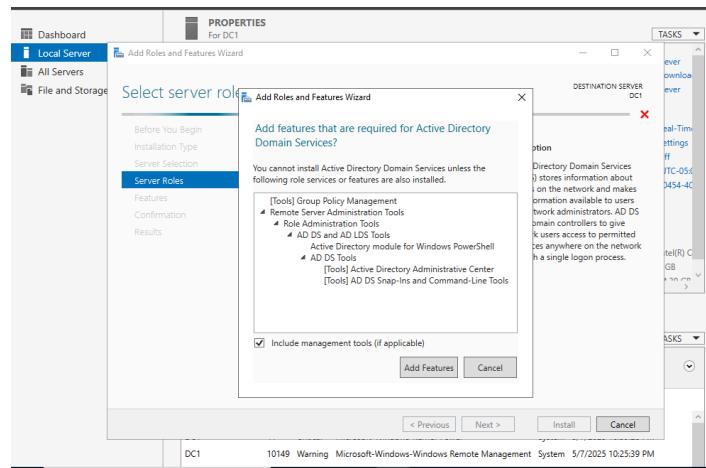
6. Select Active Directory Domain Services:

Under the list of server roles, choose "Active Directory Domain Services".



7. Add Features:

Click "Add Features" when prompted.



8. Continue Through Wizard:

Click "Next" to continue.

9. Review and Confirm:

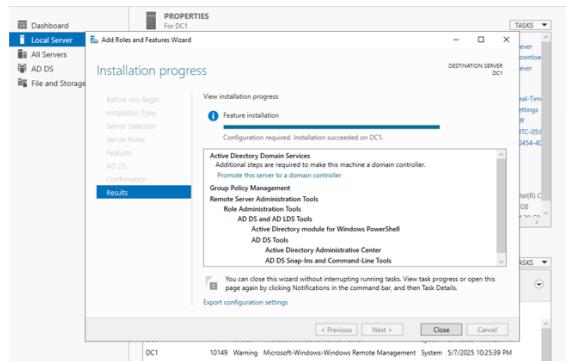
Click "Next" through the features and confirmation steps.

10. Select Restart Option:

Check the box "Restart the destination server automatically if required". Click "Yes" to confirm.

11. Begin Installation:

Click "Install" to start the role installation process. This may take a few minutes.

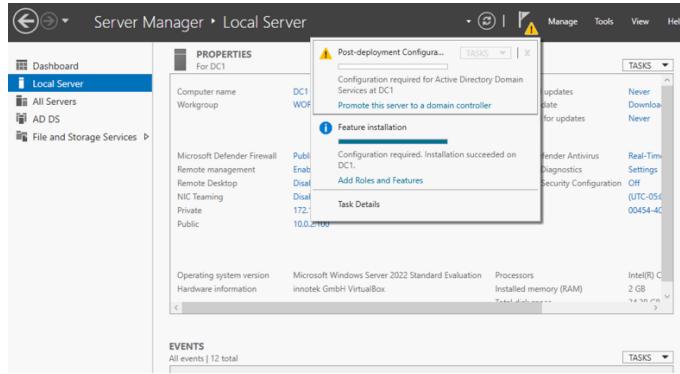


12. Close Installation Window:

Once the installation is complete, click "**Close**".

13. Promote Server to Domain Controller:

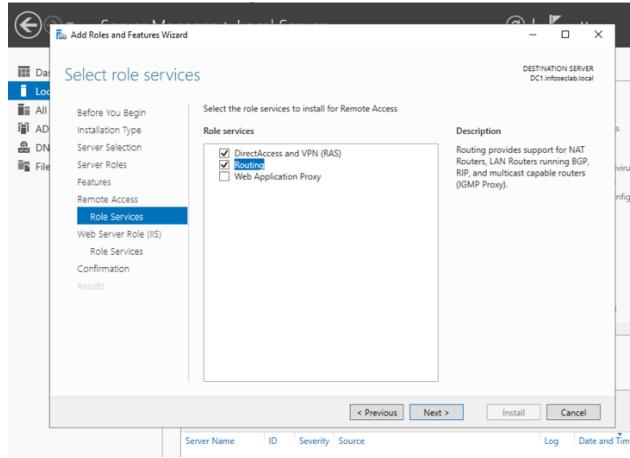
Click the yellow notification flag, then select "**Promote this server to a domain controller**".



Install DHCP and RAS

1. Install Remote Access (RAS)

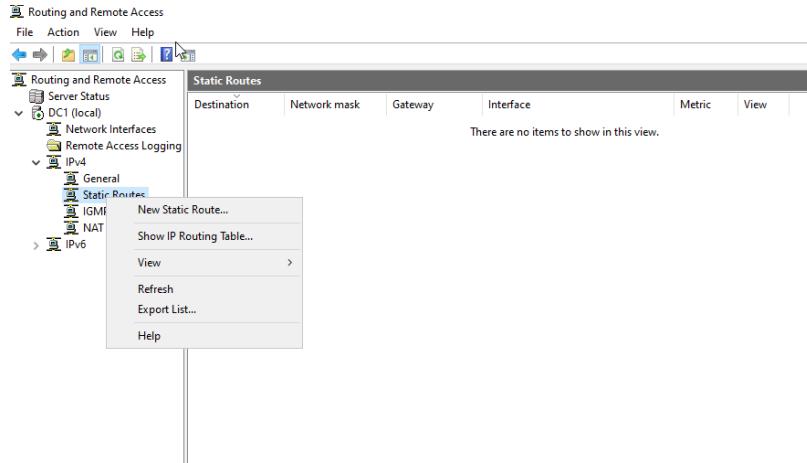
1. Log into the Windows Server as an administrator.
2. Open **Server Manager** and click **Manage > Add Roles and Features**.
3. Click **Next** through the introduction screen.
4. Choose **Role-based or feature-based installation**, then click **Next**.
5. Select your server and click **Next**.
6. Under **Server Roles**, select **Remote Access**.
7. Click **Next** through the Features screen.
8. On the **Role Services** screen, select **Routing**.
9. Click **Add Features** when prompted.



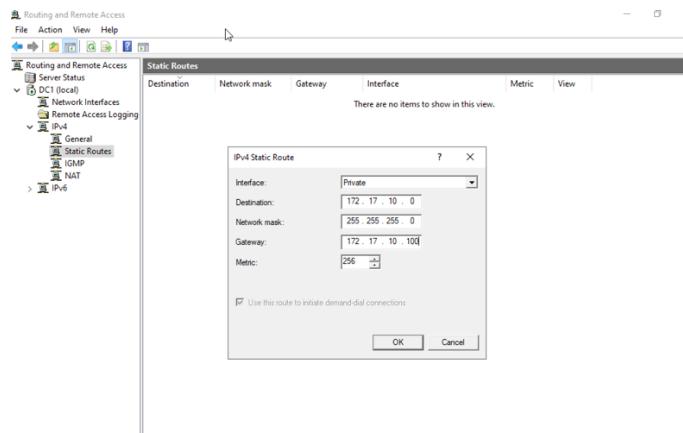
10. Click **Next**, then again on the confirmation screen.
11. Check the box for "**Restart the destination server automatically if required**", then click **Yes**.
12. Click **Install** and wait for the process to complete.
13. Click **Close** when finished.

2. Configure Remote Access (RAS)

1. After installation, click the yellow notification flag in Server Manager.
2. Click **Open the Getting Started Wizard** (or go directly to **Tools > Routing and Remote Access**).
3. In the console, right-click the server name and select **Configure and Enable Routing and Remote Access**.
4. Click **Next**.
5. Choose **Custom configuration**, then click **Next**.
6. Select **NAT** and **LAN routing**, then click **Next**.
7. Click **Finish**, then click **Start service** when prompted.

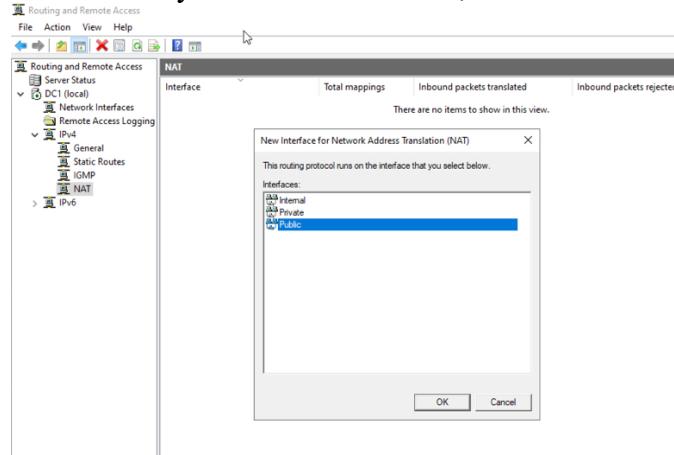


8. Under **IPv4**, right-click and select **New Static Route**.
9. Choose the internal interface (e.g., Private).
10. Enter:
 - **Destination:** e.g., 172.17.10.0
 - **Network Mask:** 255.255.255.0
 - **Gateway:** your server's internal IP, e.g., 172.17.10.100

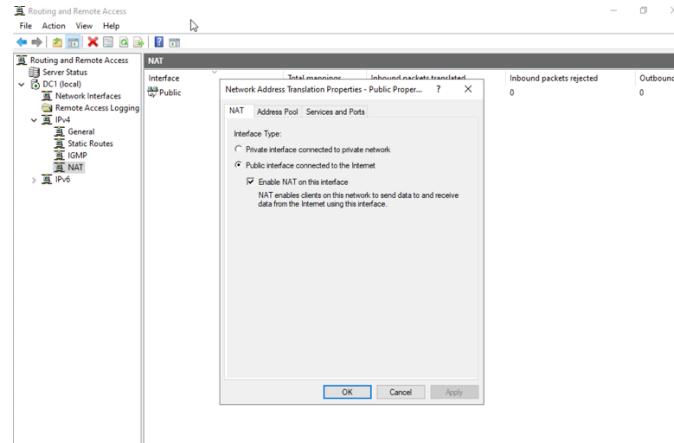


11. Click **OK**.
12. Expand **IPv4**, right-click **NAT**, and select **New Interface**.

13. Select your **Public interface**, click **OK**.



14. In the next window, enable NAT for the interface.

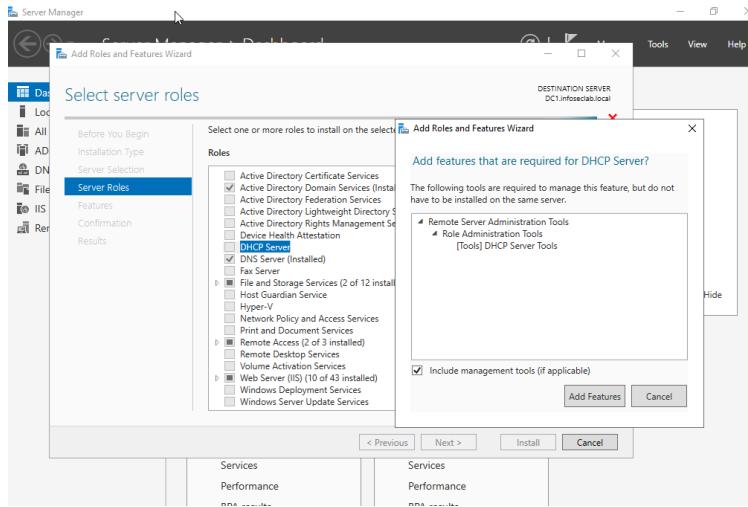


15. Click **Apply**, then **OK**.

16. Restart the Routing and Remote Access by right clicking **DC1 > All Tasks > Restart**.

3. Install DHCP Server

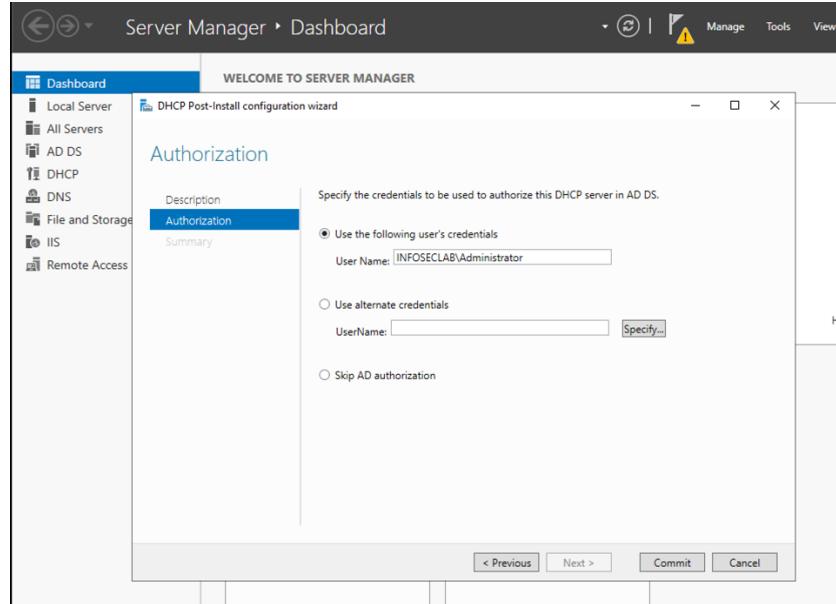
1. Open **Server Manager**.
2. Click **Manage > Add Roles and Features**.
3. Click **Next** through the wizard screens.
4. Under **Server Roles**, select **DHCP Server**.
5. Click **Add Features** when prompted.



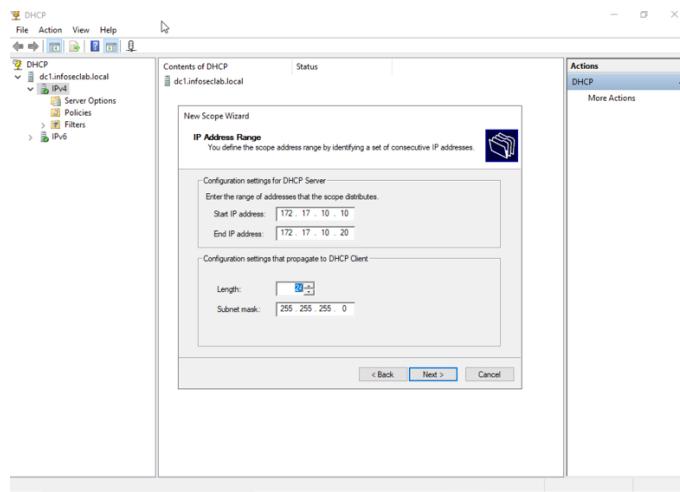
6. Click **Next** until the confirmation screen.
7. Check the box to **Restart the destination server automatically if required**, then click **Yes**.
8. Click **Install**, then **Close** once completed.

4. Configure DHCP Server

1. After installation, click the yellow notification flag and select **Complete DHCP configuration**.
2. Click **Next**, then **Commit**.
3. Click **Close**.



4. In **Server Manager**, go to **Tools > DHCP**.
5. In the DHCP console, expand your server name, then **IPv4**.
6. Right-click **IPv4** and select **New Scope**.
7. Click **Next**.
8. Enter a scope name (e.g., 172.17.10.10-20) and click **Next**.
9. Enter:
 - **Start IP:** 172.17.10.10
 - **End IP:** 172.17.10.20
 - **Subnet mask:** Length 24 (255.255.255.0)



10. Click **Next** through exclusions (exclude any server address that's part of the scope).

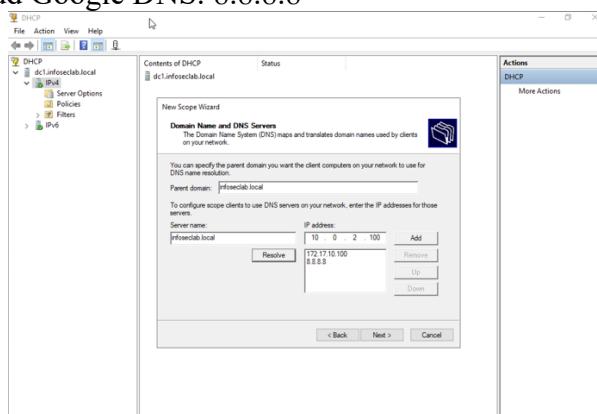
11. Leave the lease duration as default (8 days) or customize it.

12. Choose **Yes, I want to configure these options now**, then click **Next**.

13. On the **Router (Default Gateway)** screen, enter 172.17.10.100, and 10.0.2.100 click **Add**, then **Next**.

14. On the **DNS screen**, enter:

- **Domain:** e.g., infoseclab.local
- **DNS Server:** 172.17.10.100
- (Optional) Add Google DNS: 8.8.8.8

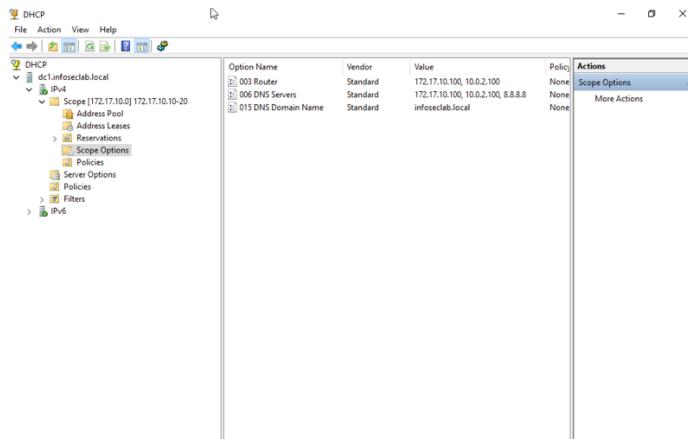


15. Click **Next** through WINS.

16. Choose **Yes, activate the scope now**, then click **Next** and **Finish**.

17. Confirm the scope is active and shows the router and DNS settings.

18. Restart the server again for good measure.



Setting Up the Secondary Domain Controller (DC2)

1. Clone the Primary Domain Controller

- In VirtualBox, clone your DC template.
- Name the new VM **DC2**.
- Make sure "**Generate new MAC addresses for all network adapters**" is selected.
- Place the new VM in your desired VirtualBox group or folder for organization.

2. Power on DC2 and Complete Initial Setup

- Turn on DC2.
- Accept the EULA and create a password for the Administrator account.
- Log into the system.

3. Change the Computer Name

- Rename the computer to **DC2**.

- Do **not** restart yet.

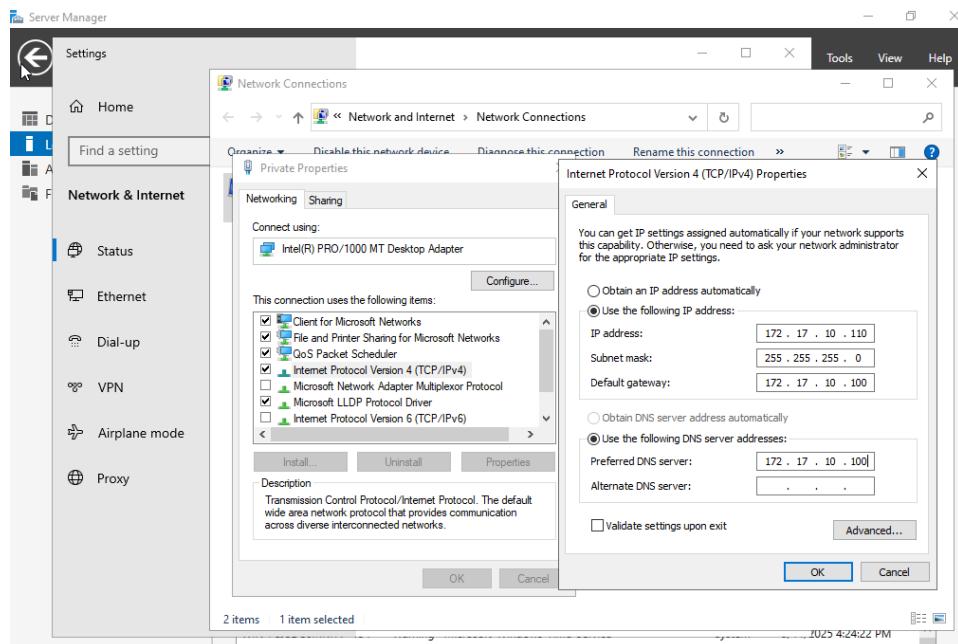
4. Verify Network Adapters

- Ensure the VM has **two network adapters** configured.
- Go to **Control Panel > Network and Sharing Center > Change adapter settings**.

5. Configure Static IP Addresses

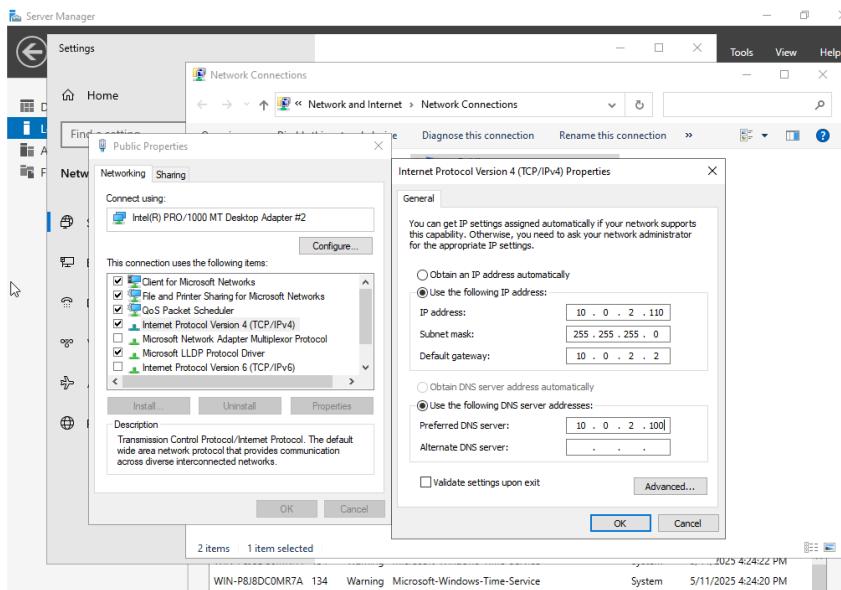
Private Adapter (172.17.10.x):

- Uncheck **IPv6**.
- Set **IPv4** manually:
 - IP address: 172.17.10.110
 - Subnet mask: 255.255.255.0
 - Default gateway: 172.17.10.100 (DC1)
 - Preferred DNS: 172.17.10.100 (DC1)



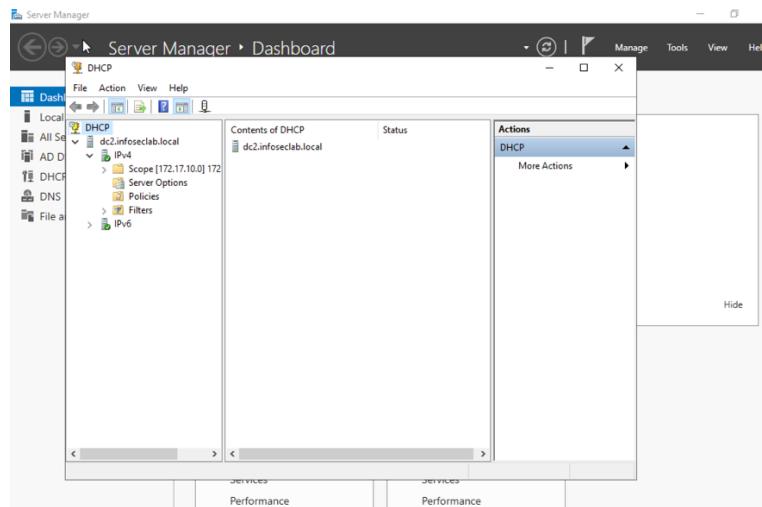
Public Adapter (10.0.2.x):

- Uncheck **IPv6**.
- Set IPv4 manually:
 - IP address: 10.0.2.110
 - Subnet mask: 255.255.255.0
 - Default gateway: 10.0.2.2
 - Preferred DNS: 10.0.2.100 (NAT IP of DC1)



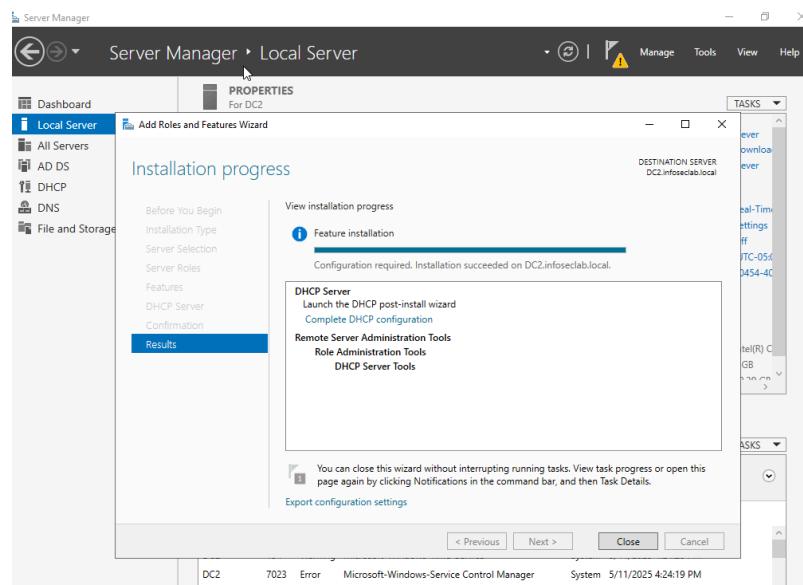
6. Restart DC2

- Restart the VM so the network and computer name changes take effect.



Install the DHCP Role on DC2

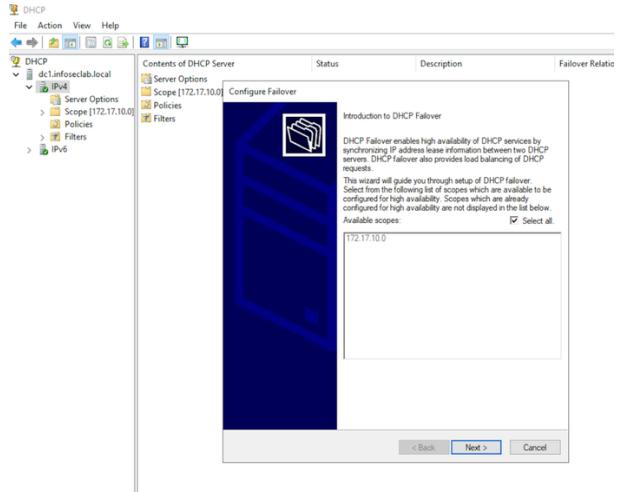
- In Server Manager > Manage > Add Roles and Features.
- Select **DHCP Server** under Server Roles.
- Install the role and required features. When it's finished installing complete the configuration.



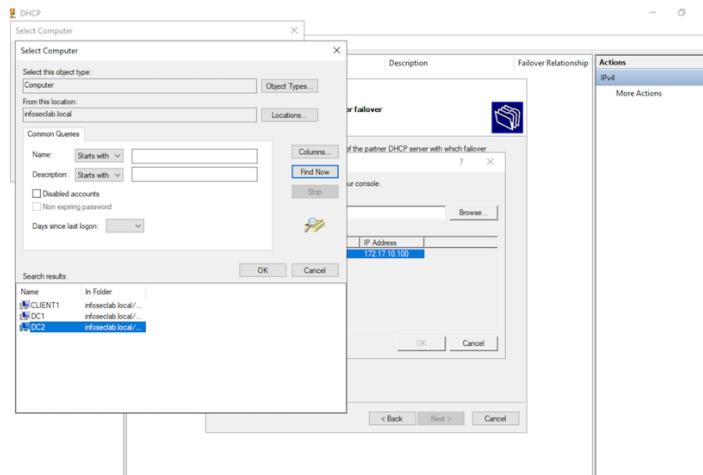
Configure DHCP Failover on DC1

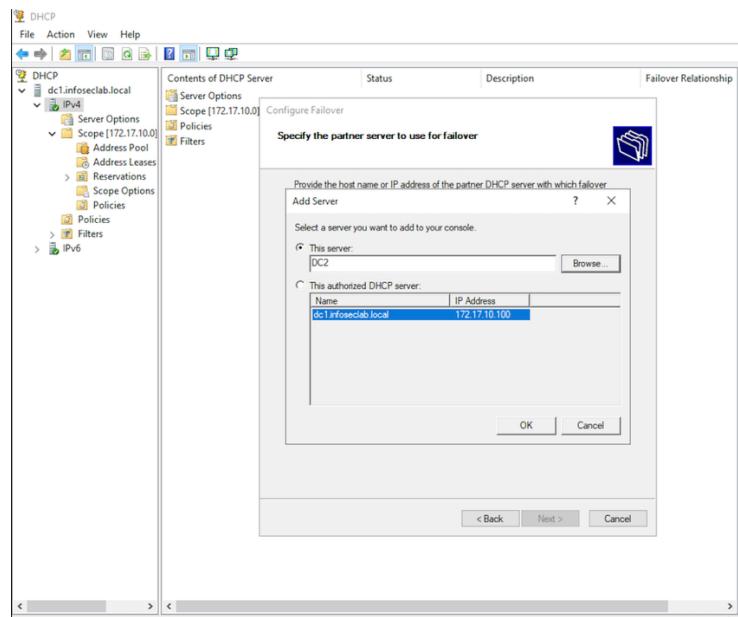
- On DC1, open the **DHCP console** (Tools > DHCP).

- Expand **IPv4** and right-click it (or a specific scope).
- Select **Configure Failover...**
- Choose the scope(s), click **Next**.

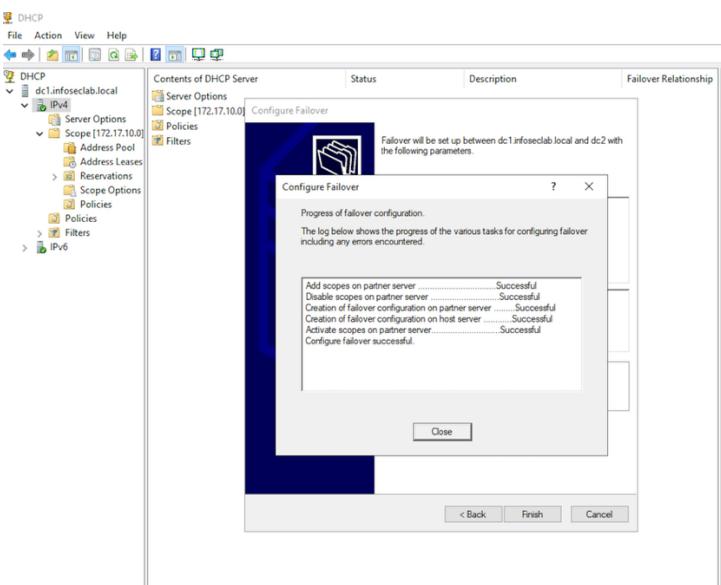


- Click **Add Server**, select **DC2**. You have to click “advanced” and then “find now”. See below.





- Choose **Load Balance** and deselect **Enable Message Authentication**.
- Finish the wizard.

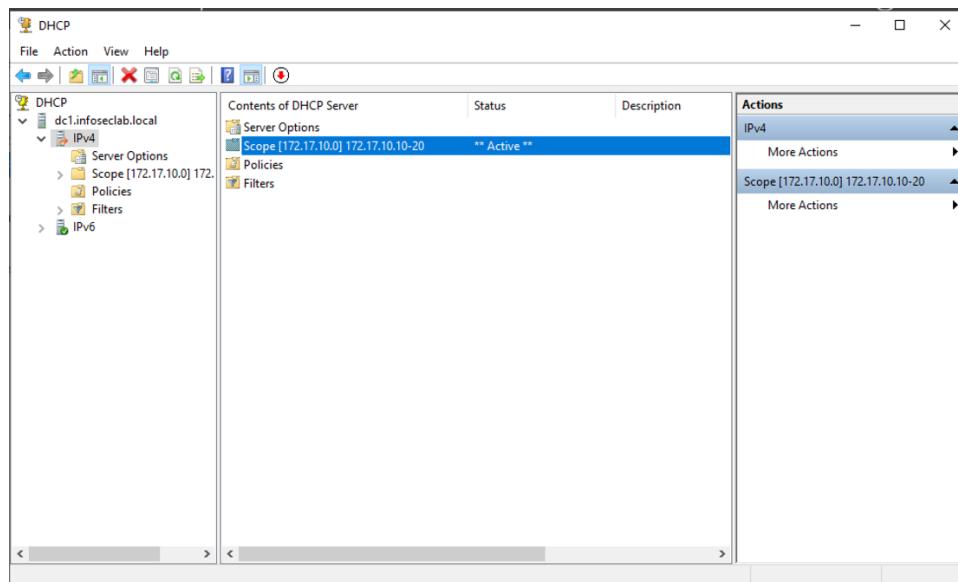
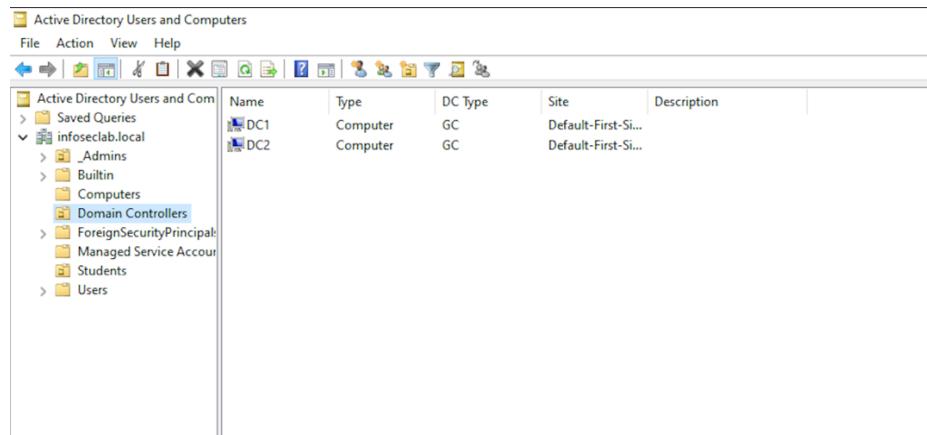


Verify DHCP on DC2

- On DC2, open **DHCP console**.
- Confirm the replicated scopes from DC1 are visible.

Verify Domain Controllers in ADUC

- In Active Directory Users and Computers, check under Domain Controllers to confirm both DC1 and DC2 are listed.

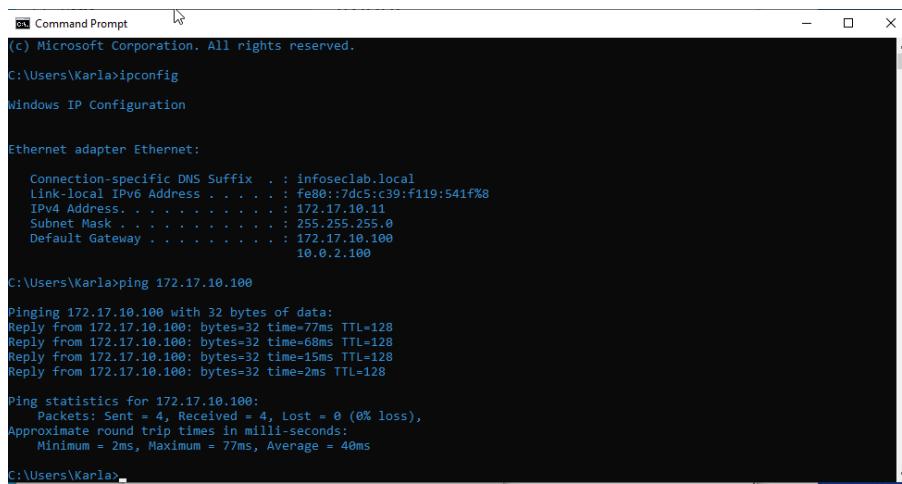


Testing and Client 1 and Client 2 Connection

Client 1

1. On a client machine (e.g., Windows 10), open **Command Prompt** and run: ipconfig
 - Confirm the client receives an IP from the DHCP scope (e.g., 172.17.10.11)

- Confirm the default gateway and DNS server are set to the server's IP (172.17.10.100)
2. Test connectivity: ping 172.17.10.100



```

Command Prompt
(c) Microsoft Corporation. All rights reserved.
C:\Users\Karla>ipconfig
Windows IP Configuration

Ethernet adapter Ethernet:
  Connection-specific DNS Suffix . . : infoseclab.local
  Link-local IPv6 Address . . . . . : fe80::7dc5:c39:fi19:541f%8
  IPv4 Address . . . . . : 172.17.10.11
  Subnet Mask . . . . . : 255.255.255.0
  Default Gateway . . . . . : 172.17.10.100
                                         10.0.2.100

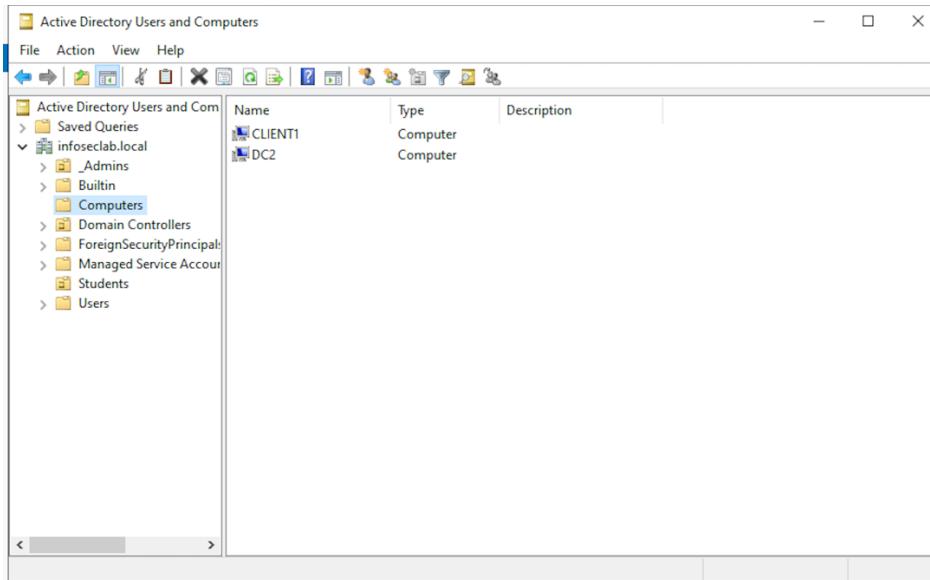
C:\Users\Karla>ping 172.17.10.100

Pinging 172.17.10.100 with 32 bytes of data:
Reply from 172.17.10.100: bytes=32 time=7ms TTL=128
Reply from 172.17.10.100: bytes=32 time=68ms TTL=128
Reply from 172.17.10.100: bytes=32 time=15ms TTL=128
Reply from 172.17.10.100: bytes=32 time=2ms TTL=128

Ping statistics for 172.17.10.100:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 77ms, Average = 40ms

C:\Users\Karla>

```

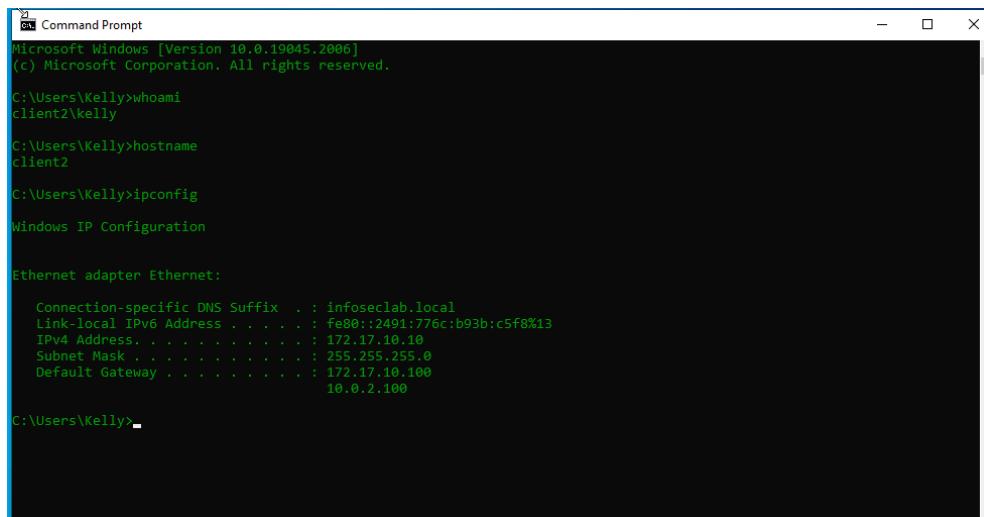


Name	Type	Description
CLIENT1	Computer	
DC2	Computer	

Client 2

1. On a client machine (e.g., Windows 10), open **Command Prompt** and run: ipconfig

- Confirm the client receives an IP from the DHCP scope (e.g., 172.17.10.10)
- Confirm the default gateway and DNS server are set to the server's IP (172.17.10.100)



```

Command Prompt
Microsoft Windows [Version 10.0.19045.2806]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Kelly>whoami
client2\kelly

C:\Users\Kelly>hostname
Client2

C:\Users\Kelly>ipconfig

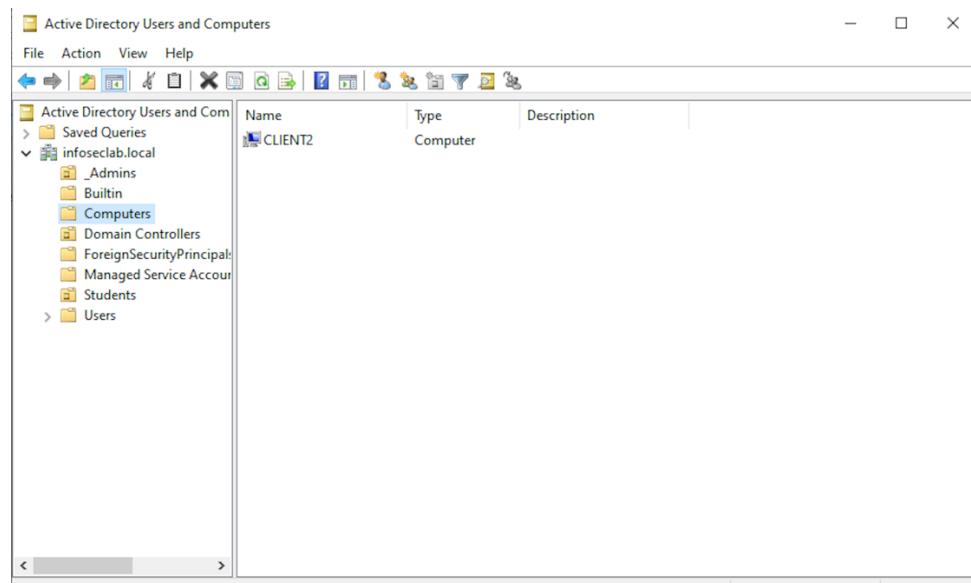
Windows IP Configuration

Ethernet adapter Ethernet:

  Connection-specific DNS Suffix . : infoseclab.local
  Link-local IPv6 Address . . . . . : fe80::2491:776c:b93b:c5f8%13
  IPv4 Address . . . . . : 172.17.10.10
  Subnet Mask . . . . . : 255.255.255.0
  Default Gateway . . . . . : 172.17.10.100
                                         10.0.2.100

C:\Users\Kelly>

```



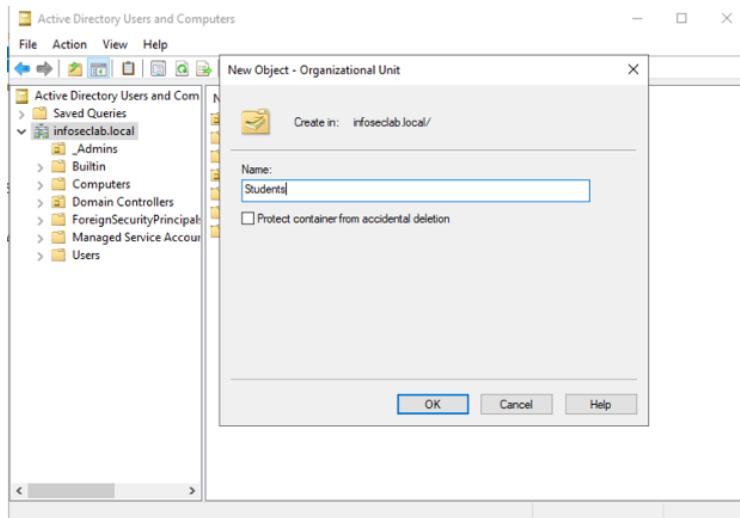
The screenshot shows the Active Directory Users and Computers snap-in. The left pane displays the navigation tree under "Active Directory Users and Computers". The "Computers" node under "infoseclab.local" is expanded, showing sub-nodes like "_Admins", "Builtin", "Computers", "Domain Controllers", "ForeignSecurityPrincipals", "Managed Service Accounts", and "Students". The right pane displays a table with one row, showing a computer object named "CLIENT2" with a type of "Computer".

Name	Type	Description
CLIENT2	Computer	

2. User Management Using PowerShell

a. Creating OUs and Assigning Users

Create “student” OU

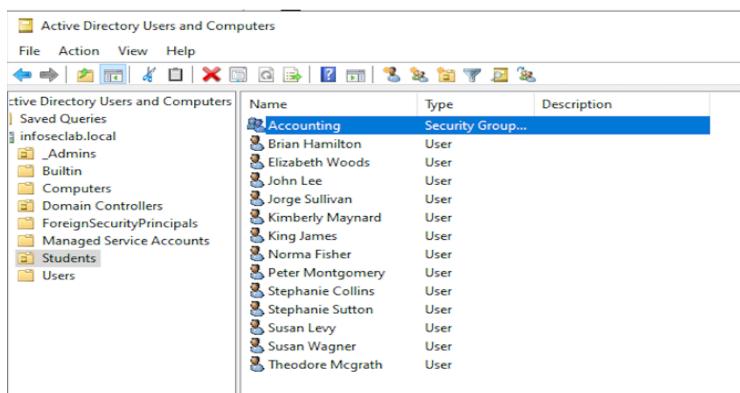


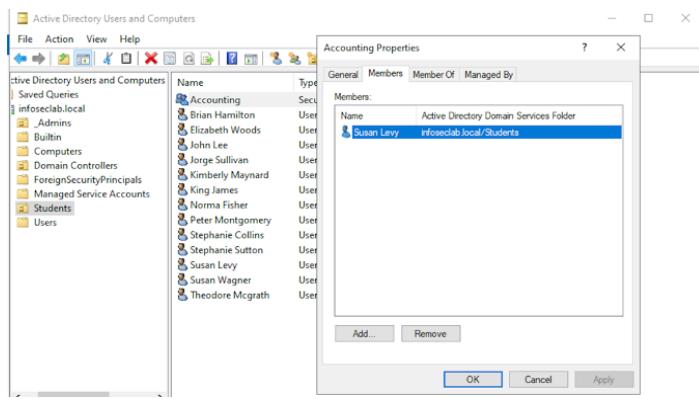
Open PowerShell as Administrator

Run the script assigning Susan Levy under accounting

```
Administrator: Windows PowerShell
PS C:\Users\Administrator> New-ADGroup -Name "Accounting" -Path "OU-Students,DC=infoseclab,DC=local" -GroupScope Global -GroupCategory Security
PS C:\Users\Administrator> Add-ADGroupMember -Identity "Accounting" -Members "Susan.Levy"
PS C:\Users\Administrator>
```

Verifying Susan Levy is under accounting





a. Creating Individual Users

Open PowerShell as Administrator

Run the following script

```
Administrator: Windows PowerShell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Administrator> New-ADUser ` 
>> -Name "Kimberly Maynard" ` 
>> -GivenName "Kimberly" ` 
>> -Surname "Maynard" ` 
>> -SamAccountName "Kimberly.Maynard" ` 
>> -UserPrincipalName "Kimberly.Maynard@infoseclab.local" ` 
>> -AccountPassword (ConvertTo-SecureString "P@ssw0rd123" -AsPlainText -Force) ` 
>> -Path "OU=Students,DC=infoseclab,DC=local" ` 
>> -Enabled $true ` 
>> -ChangePasswordAtLogon $true
PS C:\Users\Administrator>
```

-Kimberly Maynard should show up under Students

Name	Type	Description
John Lee	User	
Kimberly Maynard	User	
King James	User	

a. Bulk User Creation

Creating 10 users

1. Open notepad Create txt file with 10 names



```
names - Notepad
File Edit Format View Help
Norma Fisher
Jorge Sullivan
Elizabeth Woods
Susan Wagner
Peter Montgomery
Theodore McGrath
Stephanie Collins
Stephanie Sutton
Brian Hamilton
Susan Levy
```

Use the script to create the 10 users under **create-10users.ps1**

```
Create-10Users - Notepad
File Edit Format View Help
# Read only the first 10 names from names.txt
$names = Get-Content "C:\ADLab\names.txt" | Select-Object -First 10
# Loop through the list and create AD users
foreach ($name in $names) {
    $splitName = $name -split ' '
    $firstName = $splitName[0]
    $lastName = $splitName[1]
    $username = "$firstName.$lastName"
    $password = ConvertTo-SecureString "P@ssw0rd123" -AsPlainText -Force
    New-ADUser `

        -Name "$firstName $lastName" `

        -GivenName $firstName `

        -Surname $lastName `

        -SamAccountName $username `

        -UserPrincipalName "$username@infoseclab.local" `

        -AccountPassword $password `

        -Enabled $true `

        -Path "OU=Students,DC=infoseclab,DC=local" `

        -ChangePasswordAtLogon $true
}
```

Run the scripts in Powershell under ADLab directory

```
Administrator: Windows PowerShell
PS C:\ADLab> .\Create-10Users.ps1
PS C:\ADLab>
```

you should see the 10 users created under students

The screenshot shows the 'Active Directory Users and Computers' management console. On the left, the navigation pane displays the following structure:

- Active Directory Users and Com
- Saved Queries
- infoseclab.local
 - _Admins
 - Builtin
 - Computers
 - Domain Controllers
 - ForeignSecurityPrincipals
 - Managed Service Accounts
 - Students
 - Users

The 'Students' container is selected, indicated by a blue highlight. On the right, a table lists the 10 newly created users:

Name	Type	Description
Brian Hamilton	User	
Elizabeth Woods	User	
John Lee	User	
Jorge Sullivan	User	
Kimberly Maynard	User	
King James	User	
Norma Fisher	User	
Peter Montgomery	User	
Stephanie Collins	User	
Stephanie Sutton	User	
Susan Levy	User	
Susan Wagner	User	
Theodore McGrath	User	

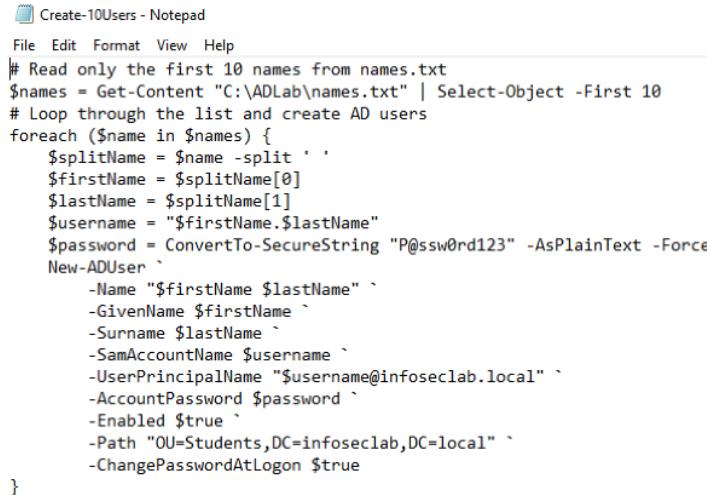
3. Conclusion & Questions

1. What steps did you take to promote the servers to Primary and Replica Domain Controllers using the Server Manager GUI

I used Server Manager to install the Active Directory Domain Services (AD DS) role. After installation, I clicked the yellow notification flag to initiate the server promotion process. On the primary domain controller (DC1), I created a new forest. For the replica domain controller (DC2), I chose "Add a domain controller to an existing domain" and authenticated using domain administrator credentials.

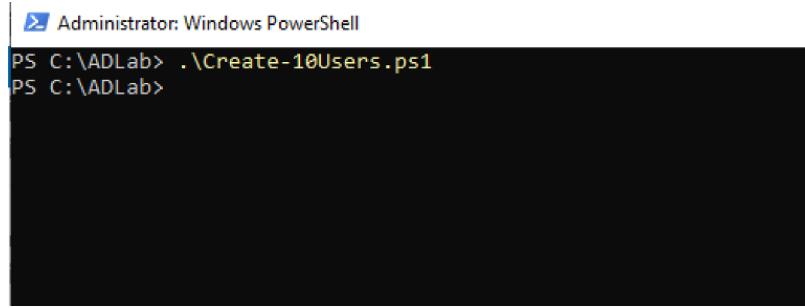
2. How did you create bulk users using PowerShell? Briefly explain the script, the input file format, and the steps you followed.

1. Create the PowerShell Script to Add AD Users
2. Open Notepad
Press Windows + R, type notepad, and press Enter.
3. Paste the Script



```
>Create-10Users - Notepad
File Edit Format View Help
# Read only the first 10 names from names.txt
$names = Get-Content "C:\ADLab\names.txt" | Select-Object -First 10
# Loop through the list and create AD users
foreach ($name in $names) {
    $splitName = $name -split ' '
    $firstName = $splitName[0]
    $lastName = $splitName[1]
    $username = "$firstName.$lastName"
    $password = ConvertTo-SecureString "P@ssw0rd123" -AsPlainText -Force
    New-ADUser `n        -Name "$firstName $lastName" `n        -GivenName $firstName `n        -Surname $lastName `n        -SamAccountName $username `n        -UserPrincipalName "$username@infoseclab.local" `n        -AccountPassword $password `n        -Enabled $true `n        -Path "OU=Students,DC=infoseclab,DC=local" `n        -ChangePasswordAtLogon $true
}
```

4. Save the Script
 - Click File > Save As
 - Save to: C:\ADLab\Create-10Users.ps1
 - Set Save as type to: All Files
 - Click Save
5. Run the Script under ADLab Directory



A screenshot of a Windows PowerShell window titled "Administrator: Windows PowerShell". The window shows the command ".\Create-10Users.ps1" being run at the prompt "PS C:\ADLab>". The rest of the screen is blacked out.

3. What are some benefits of using PowerShell to manage users in Active Directory instead of the graphical interface?

PowerShell is faster for bulk tasks, supports automation, ensures consistency, scales well for large environments, and offers advanced control not always available in the GUI.

4. What issues or challenges did you encounter during the setup process—whether with the domain controller configuration or PowerShell scripting—and how did you troubleshoot or resolve them?

DHCP was not enabled when I was setting up the VM. It was pulling DHCP addresses via VM not the DC1 server.