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ITAS 141 - Windows Server Management I - Spring 2022

Project 3 - Windows Clustered File Services with FreeNAS

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Introduction

This document for Project 3 will detail the steps and processes used to create Windows Clustered file servers using the FreeNAS storage system. The VMs used for this project will be running on the ITAS ESXi infrastructure. The document will include the steps taken to setup the cluster storage configuration, as well as how the iSCSI connections were configured between the nodes. The configuration of the cluster services on each node will also be documented. And finally, a network diagram will be created, illustrating the topology of our network and how our cluster nodes can communicate to the FreeNAS server as well as showing the network redundancy. The goal of this project is to setup high availability for services and software between our clustered file servers. This will be demonstrated partly in the document but also in the video attached at the bottom of the document. See YouTube link.

Part 1 – Server Creation

Objective: Create three servers on the ITAS ESXi infrastructure. Two windows servers and one FreeNAS server. This part will be kept brief as it is not required in the document guidelines.

1. For the windows servers create two Windows Server 2016 Standard or Datacenter (Desktop Experience). These servers will not require a lot of RAM or CPU power. 2 Cores and 4GBs of RAM will suffice. Add an additional NIC as well with PrivateLAN.
2. For the FreeNAS server install with the ISO located in the VMDatastore1. Make sure in the server creation process in vCenter that you select either FreeBSD 11 (64 Bit) or Ubuntu Linux (64-bit). Give the server 4GBs of RAM and 1 CPU Core. Set the default drive to 20GB thin provisioned then add three additional 10GB drives thin provisioned the finally, an additional PrivateLAN NIC will be added.

Part 2 – Initial Network Setup

Objective: In part one a redundant network setup will be applied to our servers in use. The IPs will be set statically and multiple NICs will be used with each server.

Steps 1 to 8 will cover both Windows Servers. Note they will need different IP addresses.

1. Power on and log into one of the Windows Cluster Servers.
2. Open the adapter settings by right clicking the Windows logo and selecting Network Connections.
3. Inside you will see two network adapters right click Ethernet0 and select properties.
4. Double click the IPv4 setting. See figure 1.
5. Enter in your IP address in the subnet range that was given to you. For example mine would look like this, 192.168.19.230. Use your correct subnet and use 230 and 231 for the two Windows Servers. For Gateway

and DNS use the address of your Domain Controller.

6. Press okay, then okay again to confirm these settings.

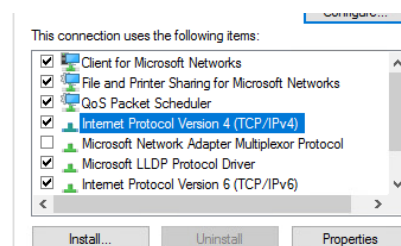


Figure 1 Ethernet0 Properties

7. Now change the IP address in Ethernet1 to 172.16.31.230. This will end with the same numbers as the class C addresses. We use another class B address for our heartbeat and also for the element of redundancy. And of course add your Domain Controllers address for the gateway and DNS addresses.
8. After setting up the two adapters run ipconfig in Command Prompt to Verify the changes.

```

Ethernet adapter Ethernet0:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::e446:9d76:8c1b:ec2f%3
    IPv4 Address. . . . . : 192.168.19.230
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.19.1

Ethernet adapter Ethernet1:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::49b8:8a93:aa3d:57e7%8
    IPv4 Address. . . . . : 172.16.19.230
    Subnet Mask . . . . . : 255.255.0.0
    Default Gateway . . . . . : 172.16.19.1

```

Figure 2 Ipconfig After Step 8

Now that the Windows servers networks have been setup, we can setup the FreeNAS network.

9. Power on and log into the FreeNAS server.
10. You will see a menu with eleven options. To select an option, enter the corresponding number on the menu and press enter.
11. To configure the Network Interfaces, enter 1.
12. Type 1 to edit the settings of em0, and 2 to edit em1.
13. Enter n, n then y. Type em0 for the Interface name. Then enter an IP Address.

```

Enter an option from 1-11: 1
1) em0
2) em1
Select an interface (q to quit): 1
Remove the current settings of this interface? (This causes a momentary disconnection of the network.) (y/n) n
Configure interface for DHCP? (y/n) n
Configure IPv4? (y/n) y
Interface name:em0
Several input formats are supported
Example 1 CIDR Notation:
    192.168.1.1/24
Example 2 IP and Netmask separate:
    IP: 192.168.1.1
    Netmask: 255.255.255.0, /24 or 24
IPv4 Address:192.168.19.240

```

Figure 3 FreeNAS Network Interface Setup

14. Next it will ask for a net mask, use 255.255.255.0 for the Class C and 255.255.0.0 for the class B addresses.

15. When asked to setup IPv6 type n and press enter.
16. At the end of part 16 you should have a screen on your FreeNAS server that looks like figure 4.

```
Restarting network: ok

Console setup
-----

1) Configure Network Interfaces
2) Configure Link Aggregation
3) Configure VLAN Interface
4) Configure Default Route
5) Configure Static Routes
6) Configure DNS
7) Reset Root Password
8) Reset Configuration to Defaults
9) Shell
10) Reboot
11) Shut Down

The web user interface is at:

http://172.16.19.240
http://192.168.19.240
https://172.16.19.240
https://192.168.19.240

Enter an option from 1-11: █
```

Figure 4 FreeNAS Post Step 17

17. Now we need to add a DNS server to the FreeNAS Server. Type 6 and press enter.
18. Enter your local domain name and press enter.
19. FreeNAS allows you to add three IPs after entering the domain name. Enter your class C and B addresses and press enter after each one. It will ask for a third address, just press enter and it will save the DNS configuration.
20. You will need to complete steps 9-15 twice just using the other range of IP addresses. See figure 4 for an example of the addresses used.

Part 2 – FreeNAS Browser GUI

Objective: Using the FreeNAS Web GUI we will setup the shared storage for the file share. A RAIDz volume will be created then after the creation of the RAIDz volume two zvol volumes will be created.

1. To access your web GUI, use one of your IP addresses you assigned to the FreeNAS server in figure 4. Open a web browser of your choice. Enter the address that matches with figure 4.
2. You should see a FreeNAS login screen. Use root as the user and your FreeNAS password that you created when installing.
3. Now that you're logged in and at the dashboard, we need to start up some of the FreeNAS services. Click the services tab on the left toolbar.
4. We will need to turn on the iSCSI service. Locate the iSCSI option and click the slider to on then enable automatic Startup.



Figure 5 Enabling iSCSI Service

5. Now that iSCSI is enabled click the Storage dropdown menu and select Pools. There will be no pools by default.
6. Press Add in the top right corner. We need to create a new pool.
7. After creating the pool, we will need to fill out how we want the pools settings.
8. For the name use sharedStorage, then select the three disks below the naming section. There should be three 10GB disks to be added. Use the arrow to move them over. See figure 6.

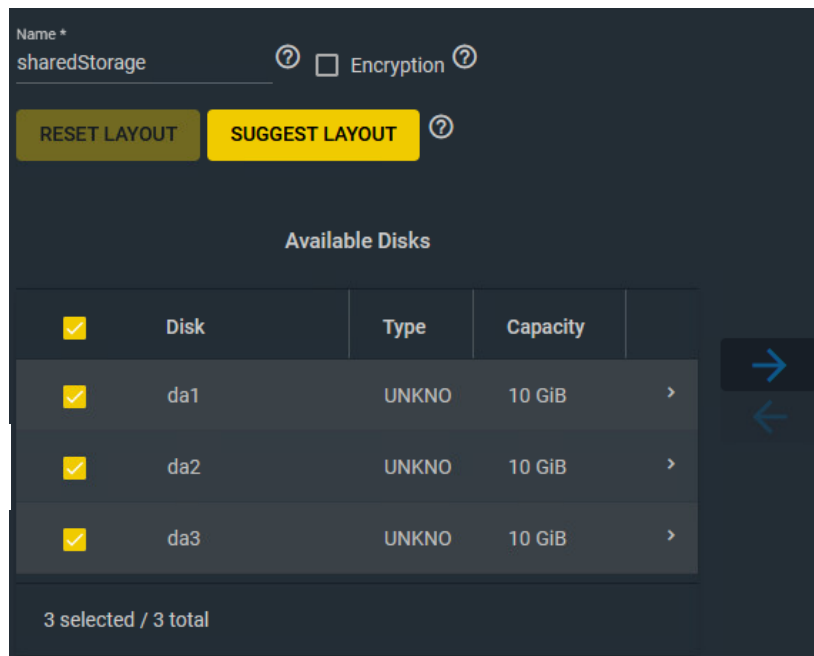
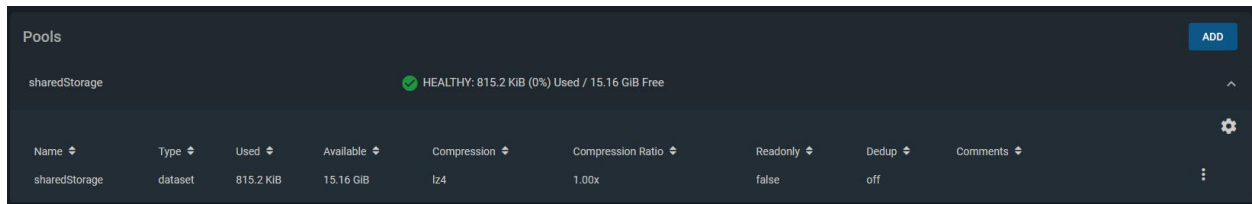


Figure 6 Storage Name and Disk Selection

9. Now that the drives have been moved to the right, press create at the bottom left of the page.

10. The drives are only 10GBs each so this should not take to long. After completion you should see what is pictured in figure 7.



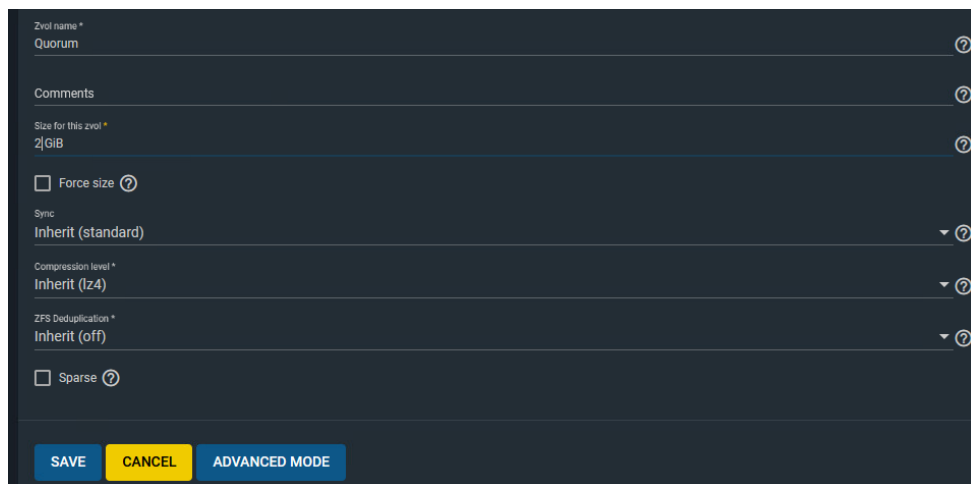
The screenshot shows the 'Pools' section of the FreeNAS web interface. At the top, it says 'sharedStorage' with a green checkmark and 'HEALTHY: 815.2 KiB (0%) Used / 15.16 GiB Free'. Below this is a table with columns: Name, Type, Used, Available, Compression, Compression Ratio, Readonly, Dedup, and Comments. The table has one row for 'sharedStorage' which is a 'dataset' type, with 815.2 KiB used and 15.16 GiB available. It uses 'lz4' compression with a 1.00x ratio. Readonly is 'false' and Dedup is 'off'. There are three vertical dots at the end of the row for configuration.

| Name | Type | Used | Available | Compression | Compression Ratio | Readonly | Dedup | Comments |
|---------------|---------|-----------|-----------|-------------|-------------------|----------|-------|----------|
| sharedStorage | dataset | 815.2 KiB | 15.16 GiB | lz4 | 1.00x | false | off | |

Figure 7 sharedStorage Created

You can see we have created a RAIDz pool of 15.16GBs.

11. Now we can add the Zvol's. We will be making a 10GB volume and a 2GB volume. Click the three vertical dots at the right of the sharedStorage then select Add Zvol.
12. The fist Zvol will be named Quorum with a size of 2GBs. Press save to create.

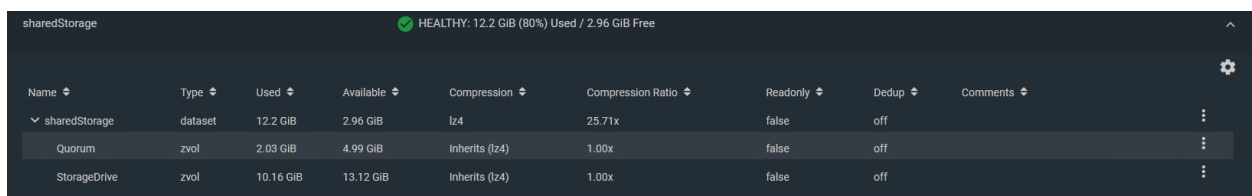


The screenshot shows the 'Add Zvol' form. Fields include: 'Zvol name' (Quorum), 'Comments' (empty), 'Size for this zvol' (2 GiB), 'Force size' (unchecked), 'Sync' (Inherit (standard)), 'Compression level' (Inherit (lz4)), 'ZFS Deduplication' (Inherit (off)), and 'Sparse' (unchecked). At the bottom are 'SAVE', 'CANCEL', and 'ADVANCED MODE' buttons.

Figure 8 Add Zvol

13. Repeat step 12, replace the name with StorageDrive and the change the size to 10 GBs.

Your shared storage pool should look like this.



The screenshot shows the 'Pools' section of the FreeNAS web interface. The 'sharedStorage' pool is now expanded, showing two Zvol's: 'Quorum' (2.03 GiB used, 4.99 GiB available) and 'StorageDrive' (10.16 GiB used, 13.12 GiB available). Both Zvol's use 'lz4' compression and have 'Dedup' set to 'off'.

| Name | Type | Used | Available | Compression | Compression Ratio | Readonly | Dedup | Comments |
|---------------|---------|-----------|-----------|----------------|-------------------|----------|-------|----------|
| sharedStorage | dataset | 12.2 GiB | 2.96 GiB | lz4 | 25.71x | false | off | |
| Quorum | zvol | 2.03 GiB | 4.99 GiB | Inherits (lz4) | 1.00x | false | off | |
| StorageDrive | zvol | 10.16 GiB | 13.12 GiB | Inherits (lz4) | 1.00x | false | off | |

Figure 9 SharedStorage After Zvol Additions

Now that we have created the Zvol's we need to now configure the iSCSI sharing settings from within FreeNAS.

14. Open the dropdown menu for Sharing and select Block Shares (iSCSI).

15. Once in the Block Shares page press the Portals tab then press add. In the IP address section, you will be entering the class C address of the FreeNAS server. If you press the dropdown menu it will add the IP by just selecting it. Click save.

Figure 10 Block Share Portals

16. Now we need to add a target. Click the Targets tab then press Add.
17. For the name enter iscsi-target and for portal group enter 1. Press save to create the target.
Your target will now be listed under the Targets tab.
18. Press the Extents tab and press add. We will be adding the name and the device.
19. For the name use 1uorum-extent and select the 2GB Quorum storage. Press save.
20. Add another extent, this time name it storage-extent and select the 10GB storage device.

You should now see two extents listed.

| Extent Name | Description | Serial | NAA | |
|----------------|-------------|----------------|------------------------------------|---|
| quorum-extent | | 005056bdef6b00 | 0x6589cfc0000002205b44189b7c57896 | ⋮ |
| storage-extent | | 005056bdef6b01 | 0x6589cfc0000001722e6041ed3a70e312 | ⋮ |

Figure 11 Storage and Quorum Extents

21. Select the Associated Targets tab and press Add.
22. Click the Target and select iscsi-target then select the quorum extent. Repeat this for the storage extent.

| Target | LUN ID | Extent | |
|--------------|--------|----------------|---|
| iscsi-target | 0 | quorum-extent | ⋮ |
| iscsi-target | 1 | storage-extent | ⋮ |

Figure 12 Associated Targets

That concludes the setup for now with FreeNAS.

Part 3 – Windows Server iSCSI Initiator

Objective: Using the Windows Server 2016 built in iSCSI initiator we will attach the FreeNAS storage to the cluster nodes. File services will be added as a cluster service and the 2GB drive will be used as the Quorum. After the targets have been brought online NTFS volumes will be created on them.

1. Power on and log into your Windows Server 2016 VM.
2. In Server Manager press tools then select iSCSI initiator. This will open the iSCSI Initiator Properties window.
3. For the target enter the class C IP address of your FreeNAS server then press Quick Connect and press done on the Quick Connect window that appears. You should now have the FreeNAS target listed in Discovered Targets.

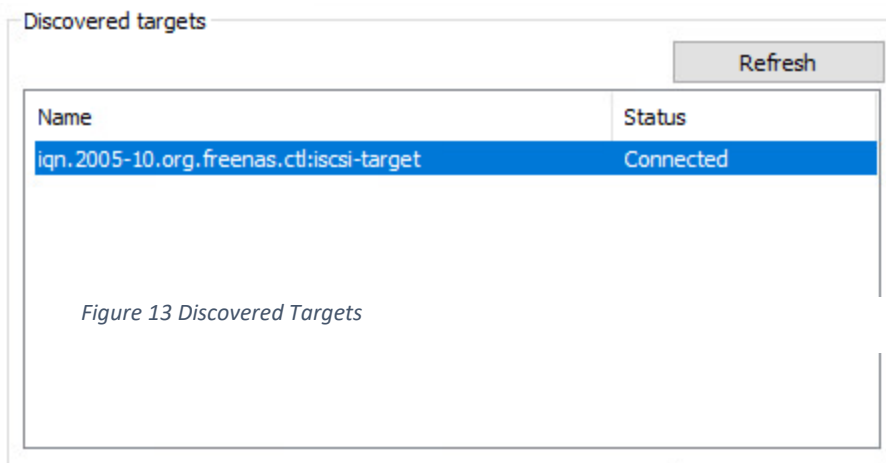


Figure 13 Discovered Targets

4. Right click the Windows logo and press Disk Management. You should see your two iSCSI drives listed. They will be offline and unknown.
5. Right click one of the disks and press Online.
6. Right click and press Initialize Disk, in the window select Disk 1 and 2 two initialize both at once.

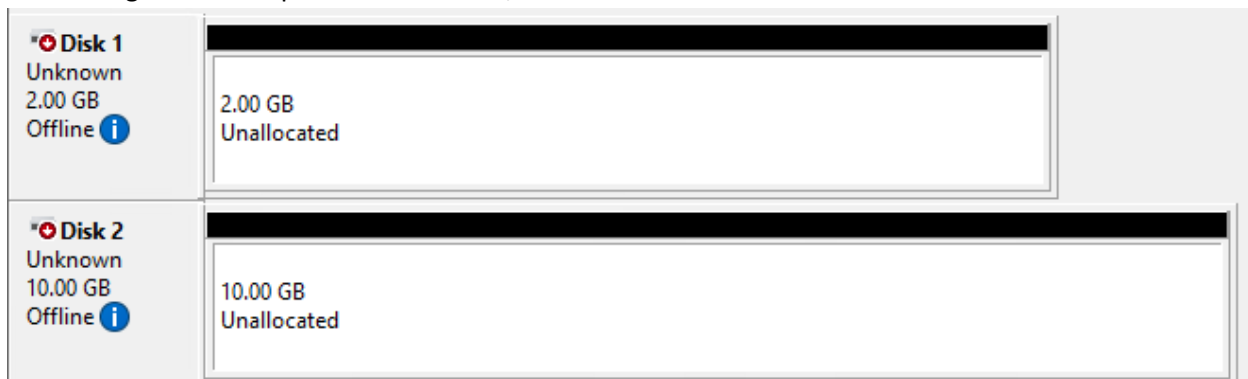


Figure 14 iSCSI Disks in Disk Management

7. Then right click on the white empty space and choose New Simple Volume.

8. Name the 2GB volume Quorum and the 10GB volume Storage. Leave the rest default. You should end up with the result like figure 15.
9. Go back into the iSCSI initiator tool, select the Volumes and Devices tab then press Auto Configure. Your two drive letters should now appear.
10. Repeat steps 1-9 for both Windows Servers. Note that you will not have to format the iSCSI drives a second time.

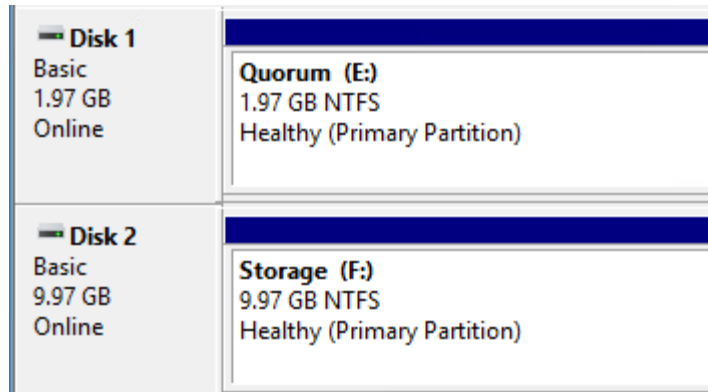


Figure 15 NTFS Volumes

Part 4 – Configuring Shared Storage for Failover Clustering

Objective: The iSCSI Target role will be installed on our Windows Servers. The Quorum and The Storage will be added and used by our cluster nodes for high storage availability.

1. To begin we need to install the Failover clustering role to our Windows Servers.
2. Open PowerShell as Administrator and enter this command
`Install-WindowsFeature Failover-Clustering -IncludeManagementTools`
3. After installation open Server Manager, then under tool select Failover Cluster Manager.
4. Click the Create Cluster under the actions tab.
5. Add your servers by server name to the Select Server window and click next.

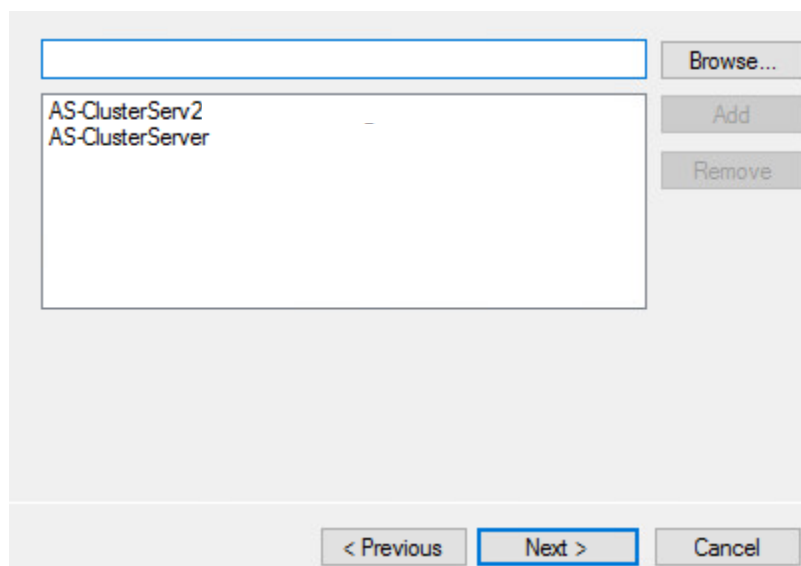


Figure 16 Add Servers to Cluster

6. Name the cluster Project3-Failover.
7. Click the address section for the IP addresses. Use your subnet and end the addresses with 243. See figure 17.

Cluster Name:

The NetBIOS name is limited to 15 characters. One or more IPv4 addresses could not be configured automatically. For each network to be used, make sure the network is selected, and then type an address.

| | Networks | Address |
|-------------------------------------|-----------------|----------------|
| <input checked="" type="checkbox"/> | 172.16.0.0/16 | 172.16.19.243 |
| <input checked="" type="checkbox"/> | 192.168.19.0/24 | 192.168.19.243 |

Figure 17 Naming and Addressing

8. On the confirmation screen press next. Then Finish.
9. Now we will have our servers listed as nodes in the Failover Manager.

| Nodes (2) | | | | |
|---|--------|---------------|--------------|------|
| <input type="text" value="Search"/> <input type="button" value="Queries"/> <input type="button" value="Save"/> <input type="button" value="Refresh"/> | | | | |
| Name | Status | Assigned Vote | Current Vote | Site |
| AS-ClusterServer | Up | 1 | 0 | |
| AS-ClusterServ2 | Up | 1 | 1 | |

Figure 18 Nodes Up and Running

10. Now we need to add our other server to the cluster. On the other server open the Faiover Cluster Manager and select connect to Cluster.
11. Press okay. And just like that you are connected to the cluster. Usually when things happen this easily on Windows you should be afraid, but everything seems to be working good.

Part 5 – File Server Role

Objective: We will now be setting up the File Server Role on the failover cluster.

1. To begin we need to install the File Server Role. Launch PowerShell as Admin.
2. Type Install-WindowsFeature FS-FileServer then press enter.
3. Do step 2 on both Windows Servers.
4. Open the Failover Cluster Manager on one of the Servers.
5. Right click the Roles on the left tab, then select Configure Role.
6. Choose the File Server role and press next.
7. Leave File Server Type default, press next.

- In the Client Access Point enter the name Failover then for the address use your subnets and end them with 244. Press next.

Name:

The NetBIOS name is limited to 15 characters. One or more IPv4 addresses could not be configured automatically. For each network to be used, make sure the network is selected, and then type an address.

| | Networks | Address |
|-------------------------------------|-----------------|----------------|
| <input checked="" type="checkbox"/> | 192.168.19.0/24 | 192.168.19.244 |
| <input checked="" type="checkbox"/> | 172.16.0.0/16 | 172.16.19.244 |

Figure 19 Client Access Point Configuration

- In the Select Storage menu choose the 10GB Cluster Storage option. It should be the only option. Click next.
- Review the information in the Confirmation window, and then click Next. Then click Finish. You should now see the Failover listed in the roles.

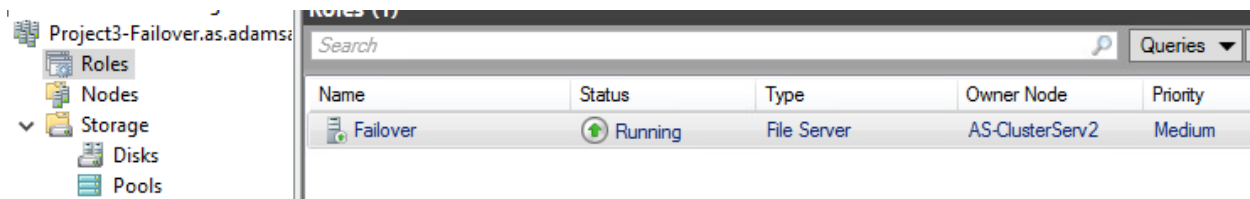


Figure 20 FS File Server Failover Role

That concludes the setup of the FS File Server Role. You can verify it is working by accessing the share from a Windows 10 client on your network.

Part 6 – Map Shared Folder to Windows 10

Objective: Using Windows File Explorer we will mount the shared storage created by our FS File Server.

- Power on and log into a Windows 10 machine on your network.
- Open File Explore by pressing the folder icon in the taskbar.
- Press This PC then Select Computer located at the top of the File Explore window.

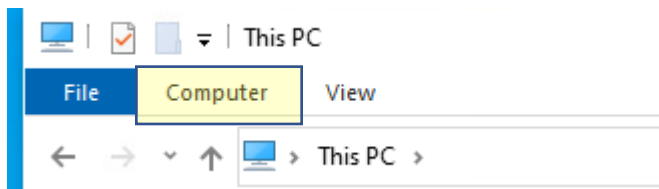


Figure 21 This PC - Computer

4. In the Toolbar at the top select Map Network Drive.
5. In the folder text box enter \\Failover\F\$. see figure 22. My share was assigned the letter F. You can verify yours by going into Failover Manager, Roles then select the failover role and click the shares tab. See figure 23.

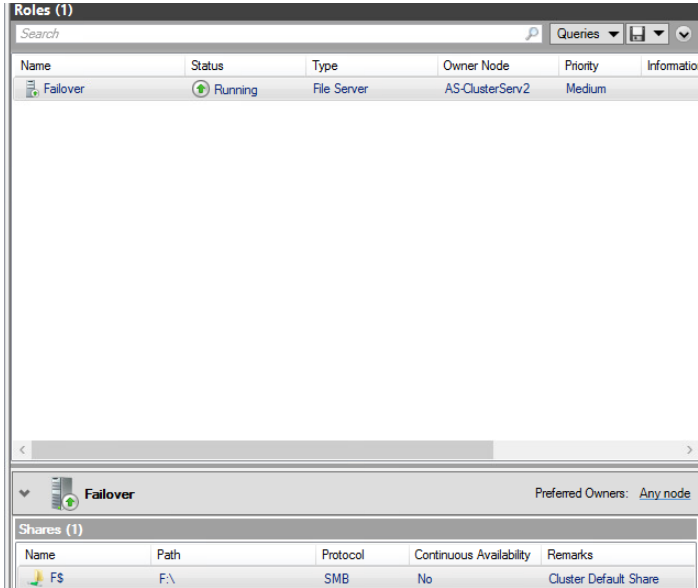


Figure 23 F\$ Share Location

What network folder would you like to map?

Specify the drive letter for the connection and the folder that you want to connect to:

Drive:
Folder:
Example: \\server\share
☒ Reconnect at sign-in
☐ Connect using different credentials
[Connect to a Web site that you can use to store your documents and pictures.](#)

Figure 22 Adding Share to Windows

6. After pressing finish enter your domain admins credentials to allow you access to the share.
7. It will now be mounted and accessible.

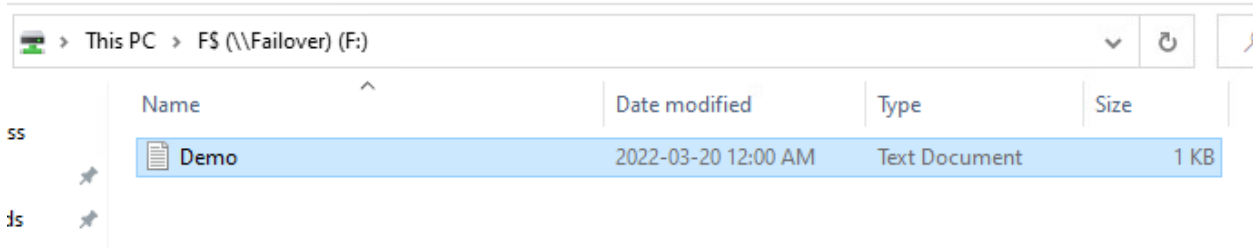


Figure 24 Failover Share Mounted

That concludes the drive mapping process for our Shared Failover folder to Windows 10.

Conclusion

To summarize Project three, we have created network accessible storage using FreeNAS. With the FreeNAS storage iSCSI targets were created allowing us to connect the storage to our Windows servers. A Failover Cluster was then created allowing for high storage availability using two nodes. The FS File Server role was installed allowing us to access the shared folder on another Windows 10 client. The Failover shared folder will have a high-level availability which allows for one of the clustered file servers to go offline while keeping the share online. Giving the Windows client the ability to read and write to files and documents in the case of a node failure. I really enjoyed this project, learning about ways to create high availability is something I like to learn about as it will be an extremely important part of my career. Being able to implement a solution for a client where in the result of a server failure they wouldn't even notice would be very satisfying to me. I am excited to learn more about how to create server redundancy and to achieve the goal of five nines!

Video

<https://youtu.be/fLRD6GrLc5c>

References:

Creating iscsi storage with FreeNAS v11.3 | TSR - YouTube. (n.d.). Retrieved March 22, 2022, from <https://www.youtube.com/watch?v=XiEm8-oFuWM>

Manticore, B. (n.d.). Black Manticore. Retrieved March 21, 2022, from <https://www.blackmanticore.com/207b4d8732f86b199278b93c8b588183>