Windows Server 2016 Storage

Contents

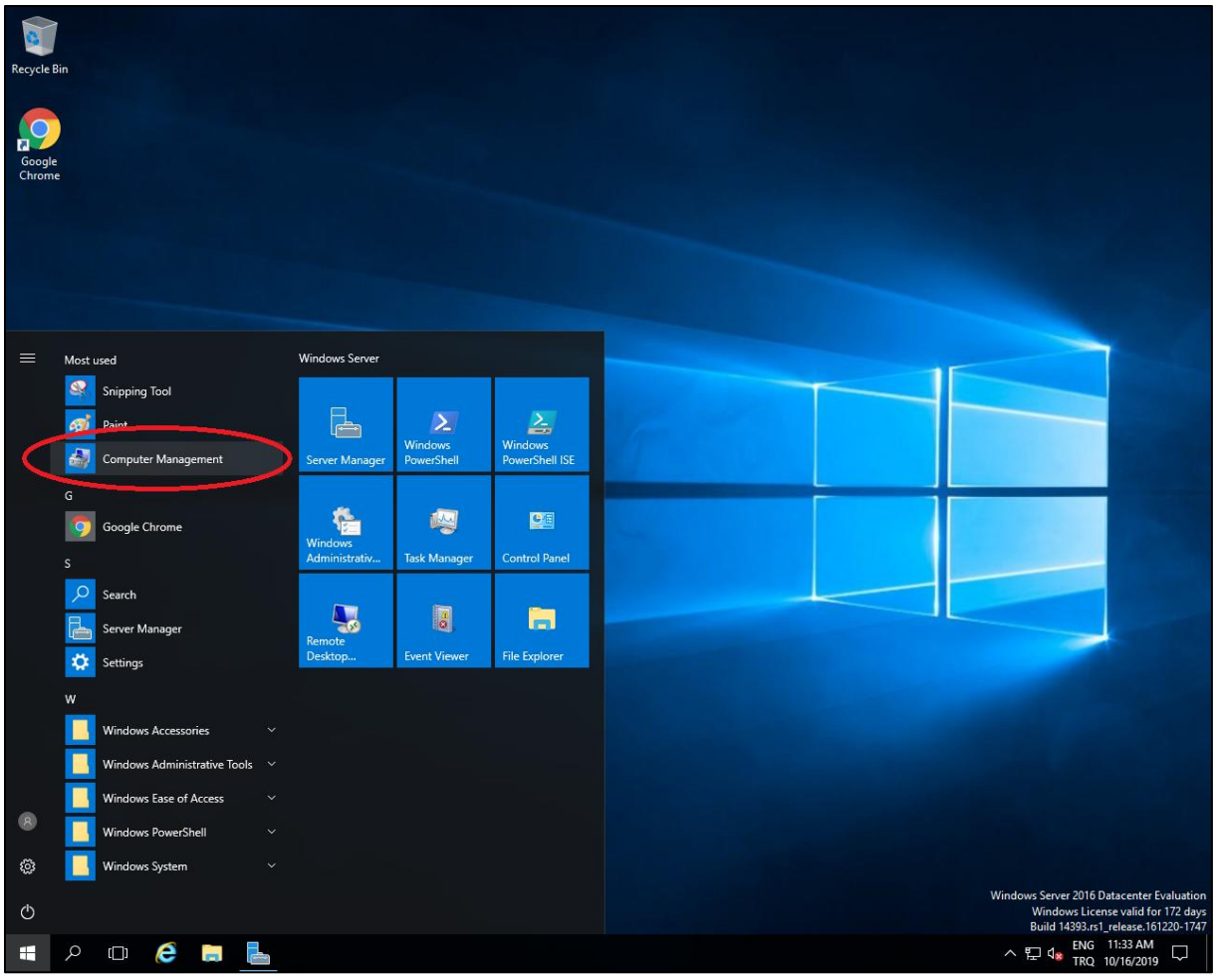
1. Purpose

The purpose of this report is to investigate various storage options, familiarize ourselves with Server 2016's inherent storage application Storage Pool and learn about how Data Deduplication works. There are 3 different types of storage structures that we can use: DAS is simply attaching a disk to our server whereas NAS means the storage server is connected via a network. SAN is a network solely designed and dedicated for storage. In this project, we aim to demonstrate the implementation of all 3. Then, we create a virtual disk via pooling our physical disks with Storage Pool. Using virtual disks and Storage Pool itself enable an easier superintendence of our physical storage area. Lastly, we exhibit how Data Deduplication in Server 2016 works and how efficiently it saves space in our storage by reducing waste.

2. Procedure

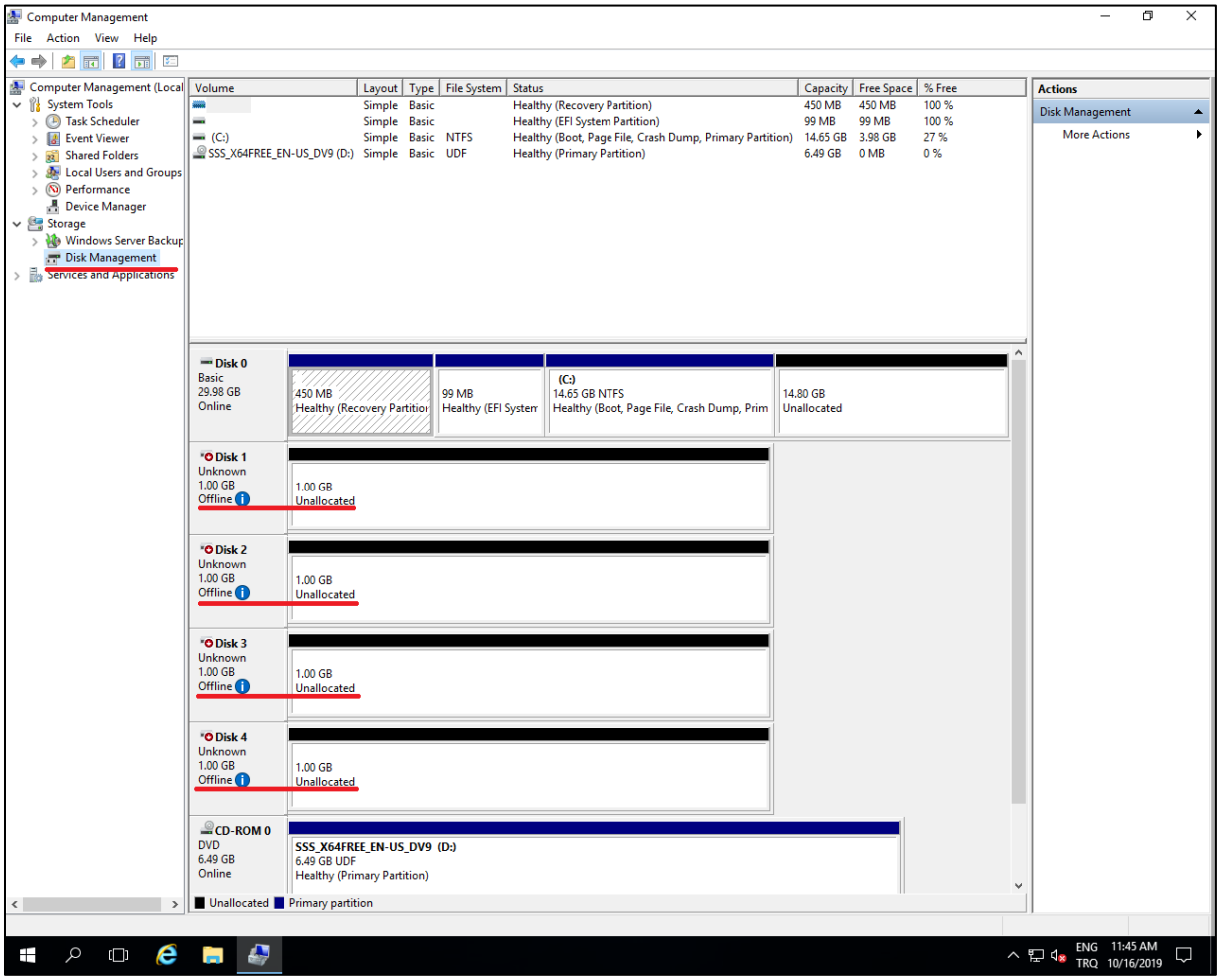
I. Directly Attached Storage (DAS)

For demonstrating DAS, we are constructing a RAID 5. To start our RAID 5 construction first we need to go to Disk Management. This is under Computer Management for Windows Server 2016.

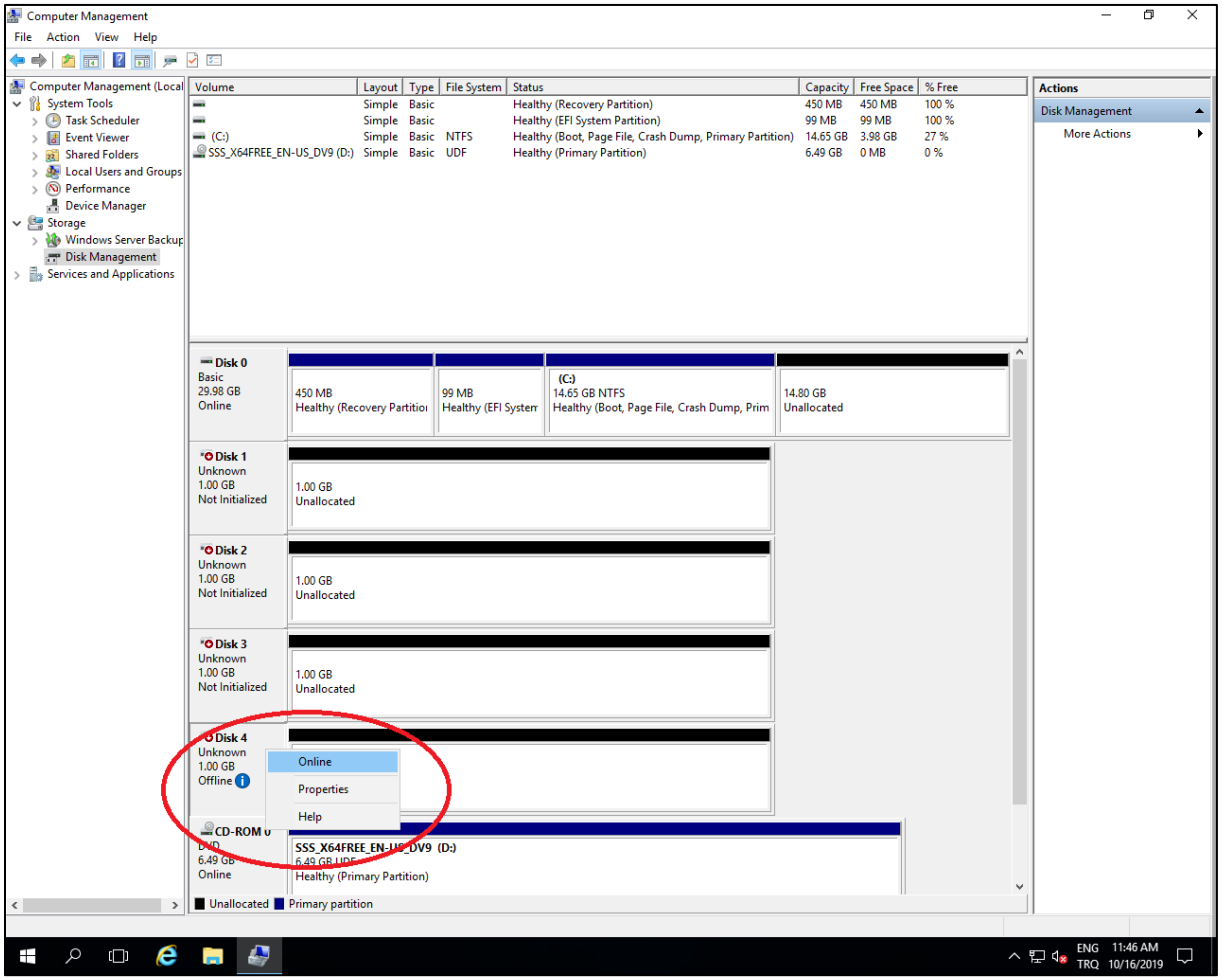


Under Disk Management we can see the new 4 disks named Disk 1-4 that we have added.

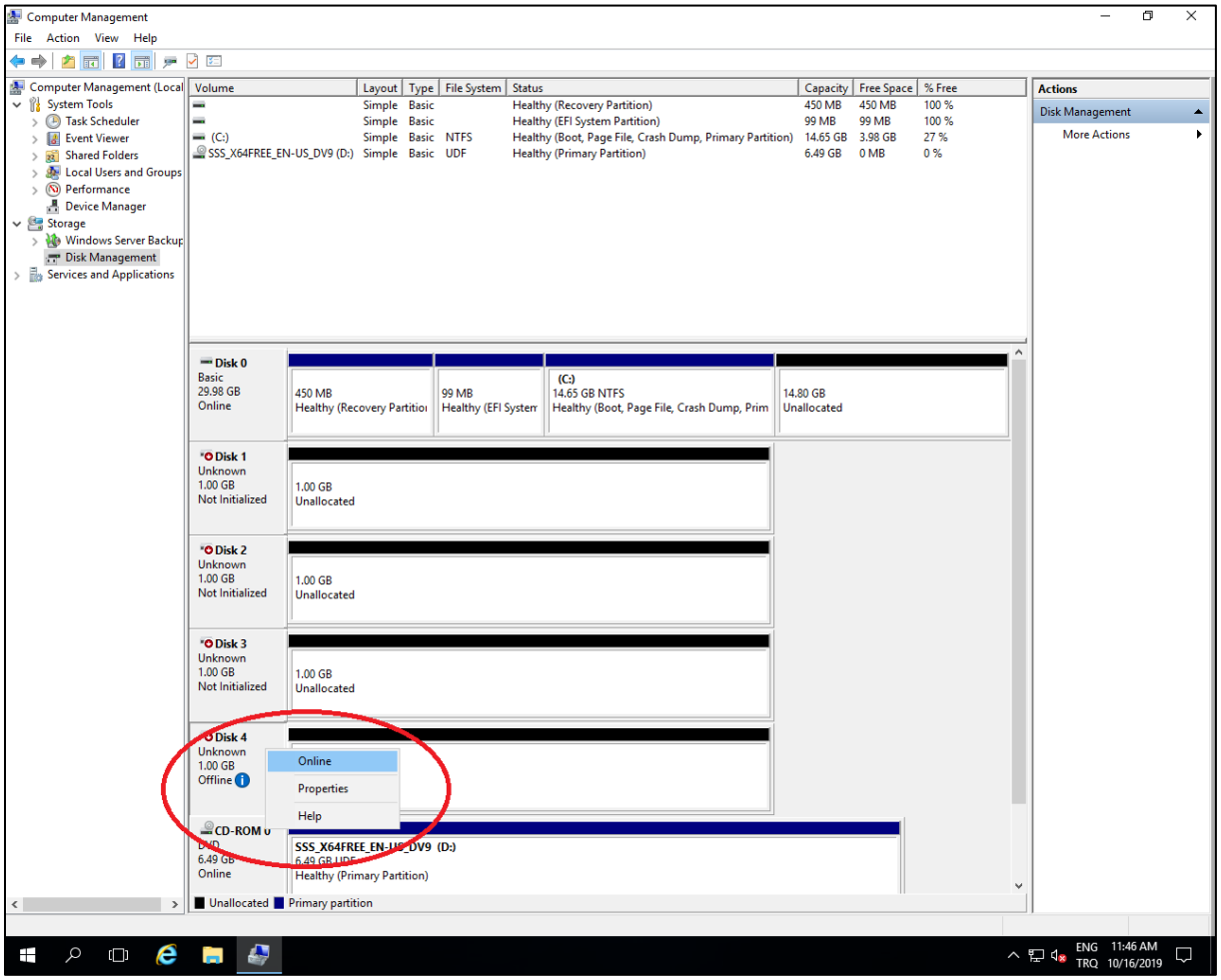
They are all Offline and Unallocated.



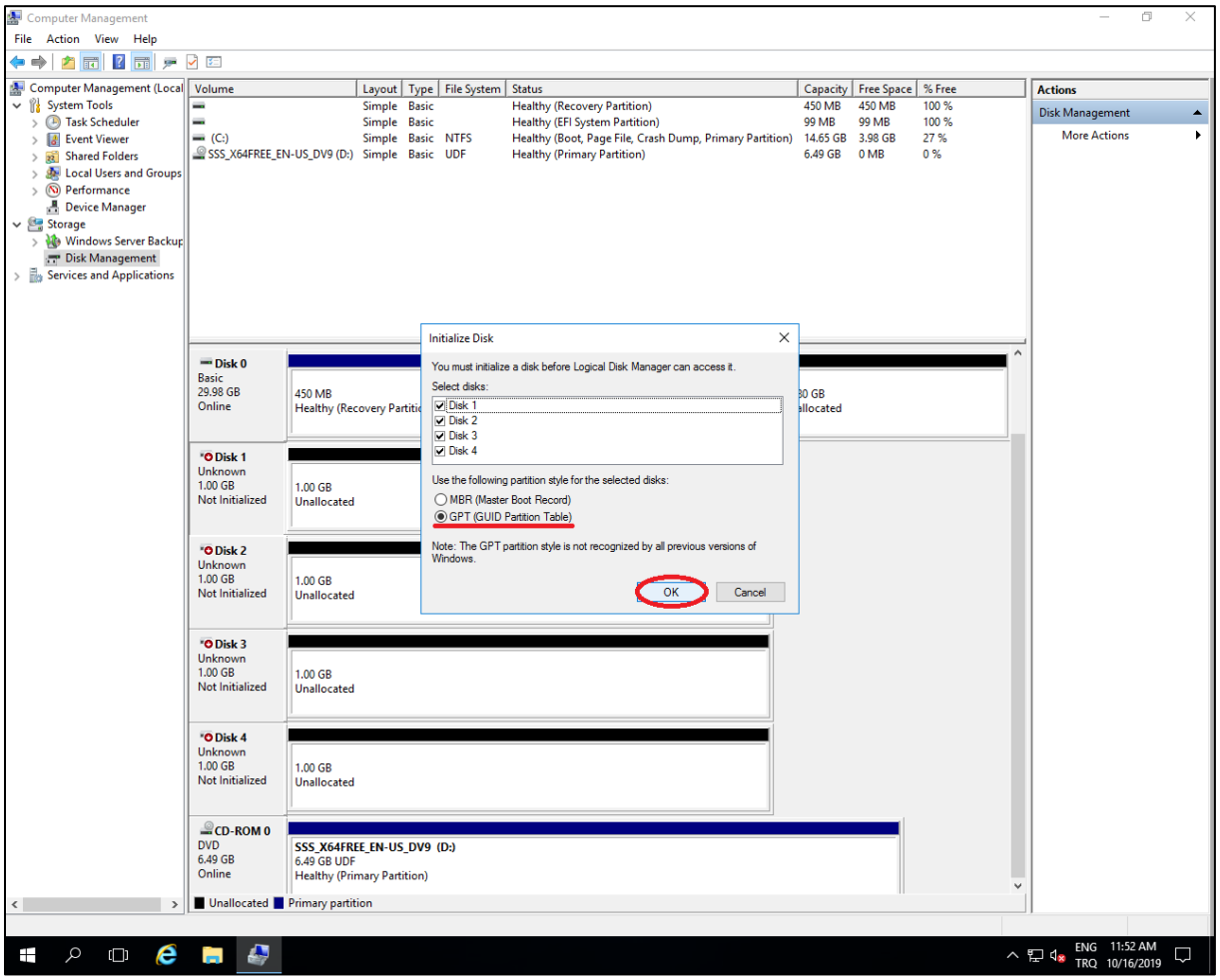
We turn the disks Online by right clicking and selecting Online.



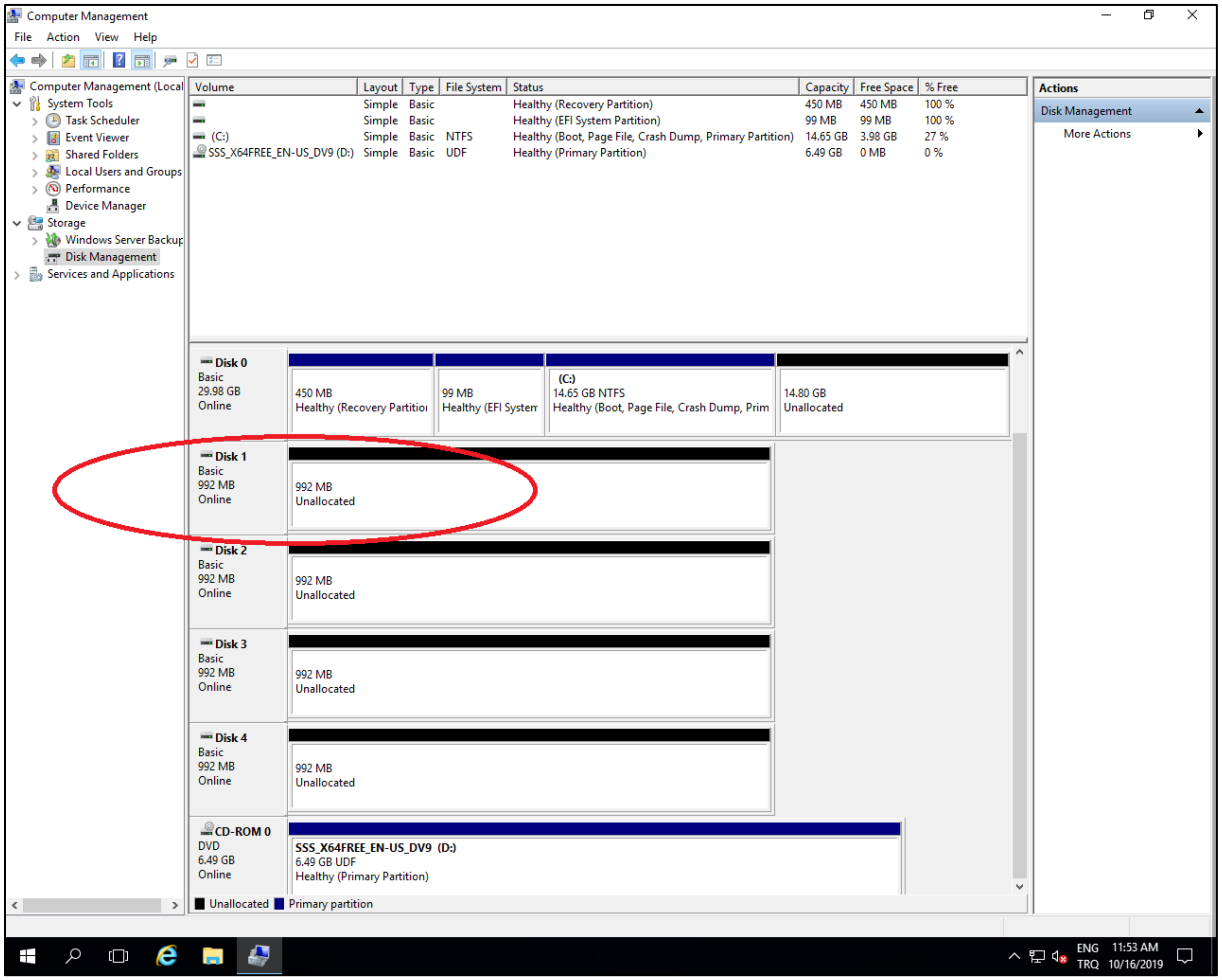
After turning the disks Online, we have to Initialize them. We do so by Right clicking and selecting Initialize.



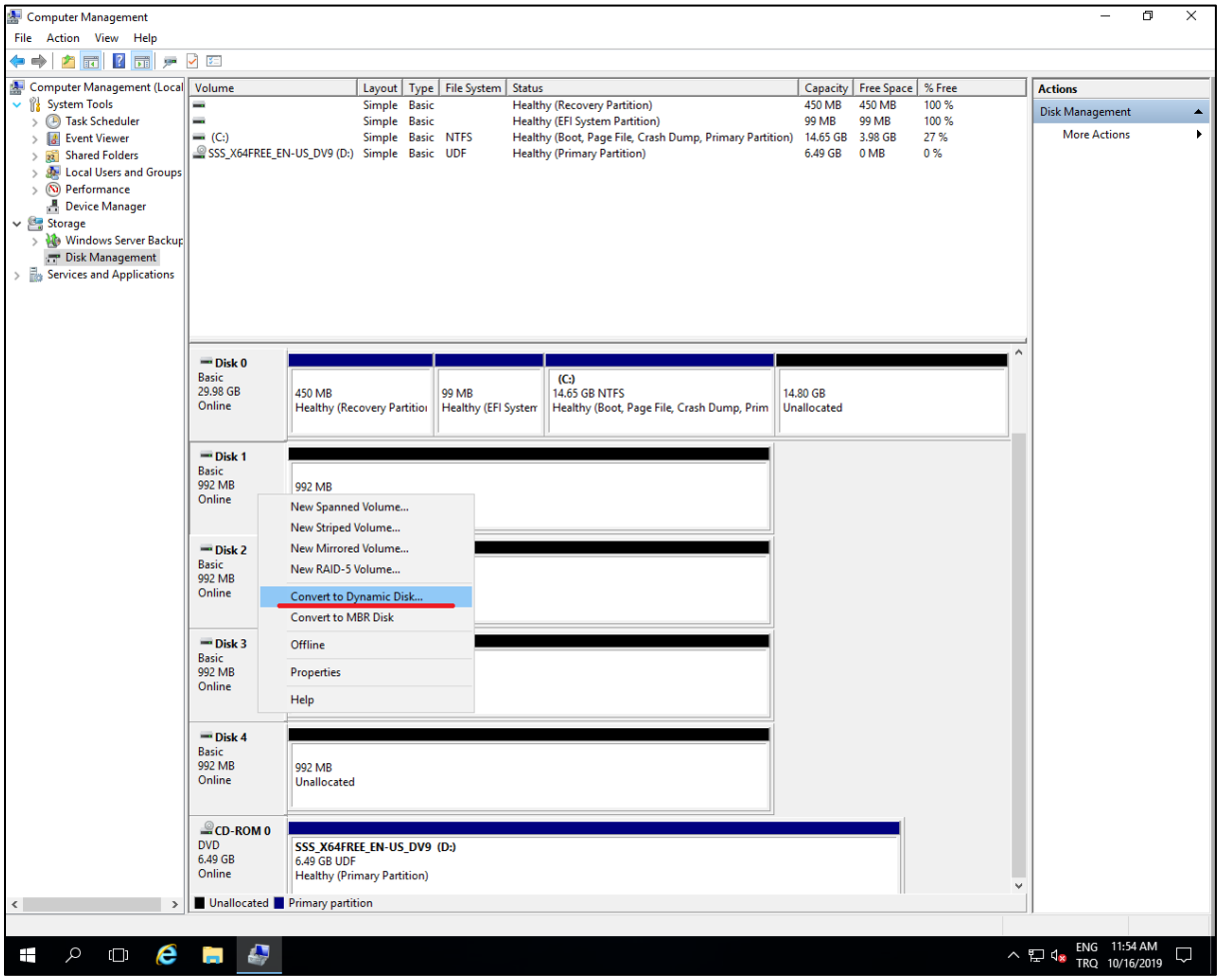
On the pop up menu we have 2 choices for the partition style: GBT and MBR. Since our boot option is UEFI we need to use GBT for the partition style. Note that all disks are initialized together as we can select them together. You can do each separately too.



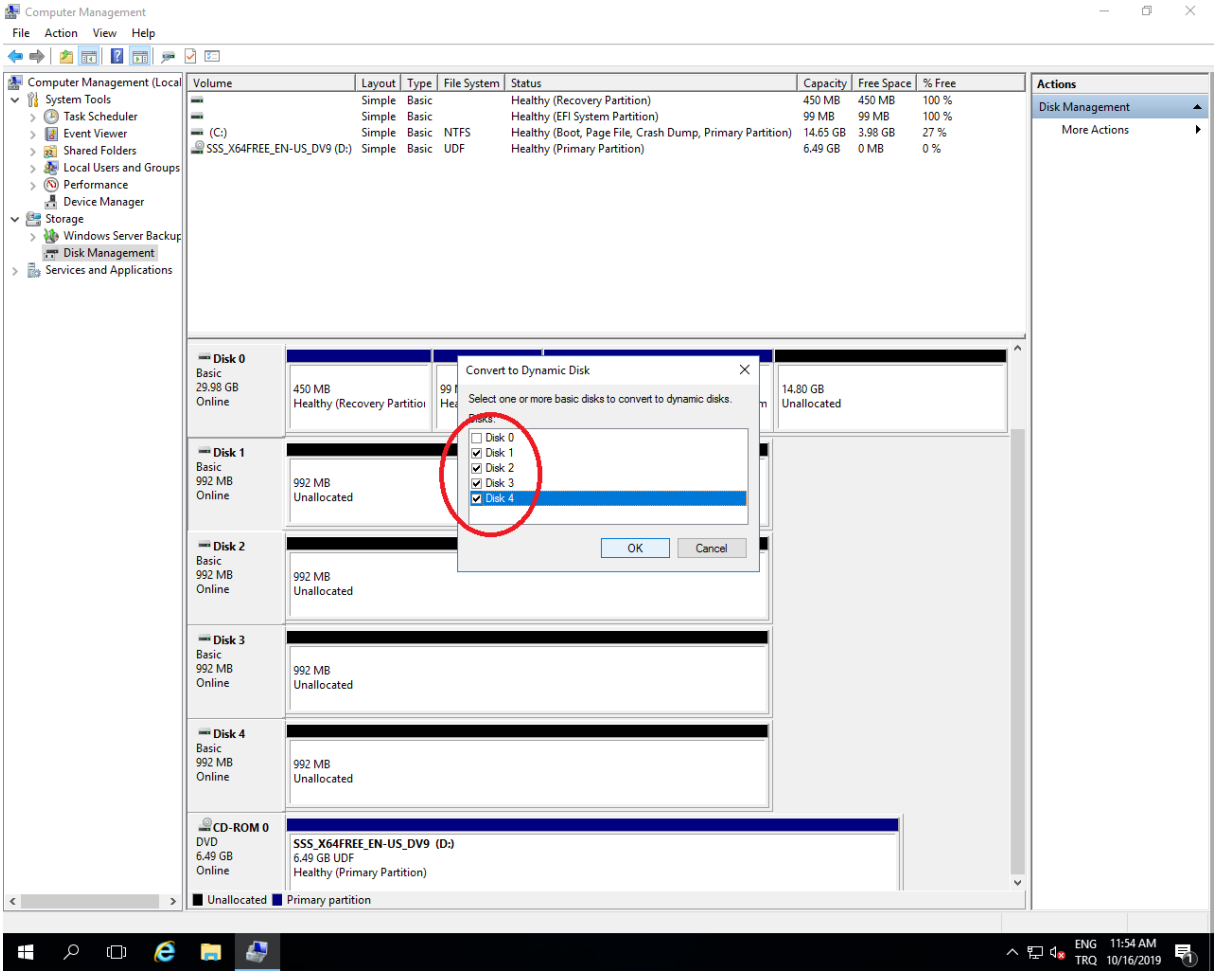
Now we can see that, the disks are initialized with 32 MB are used in each disk for GBT.



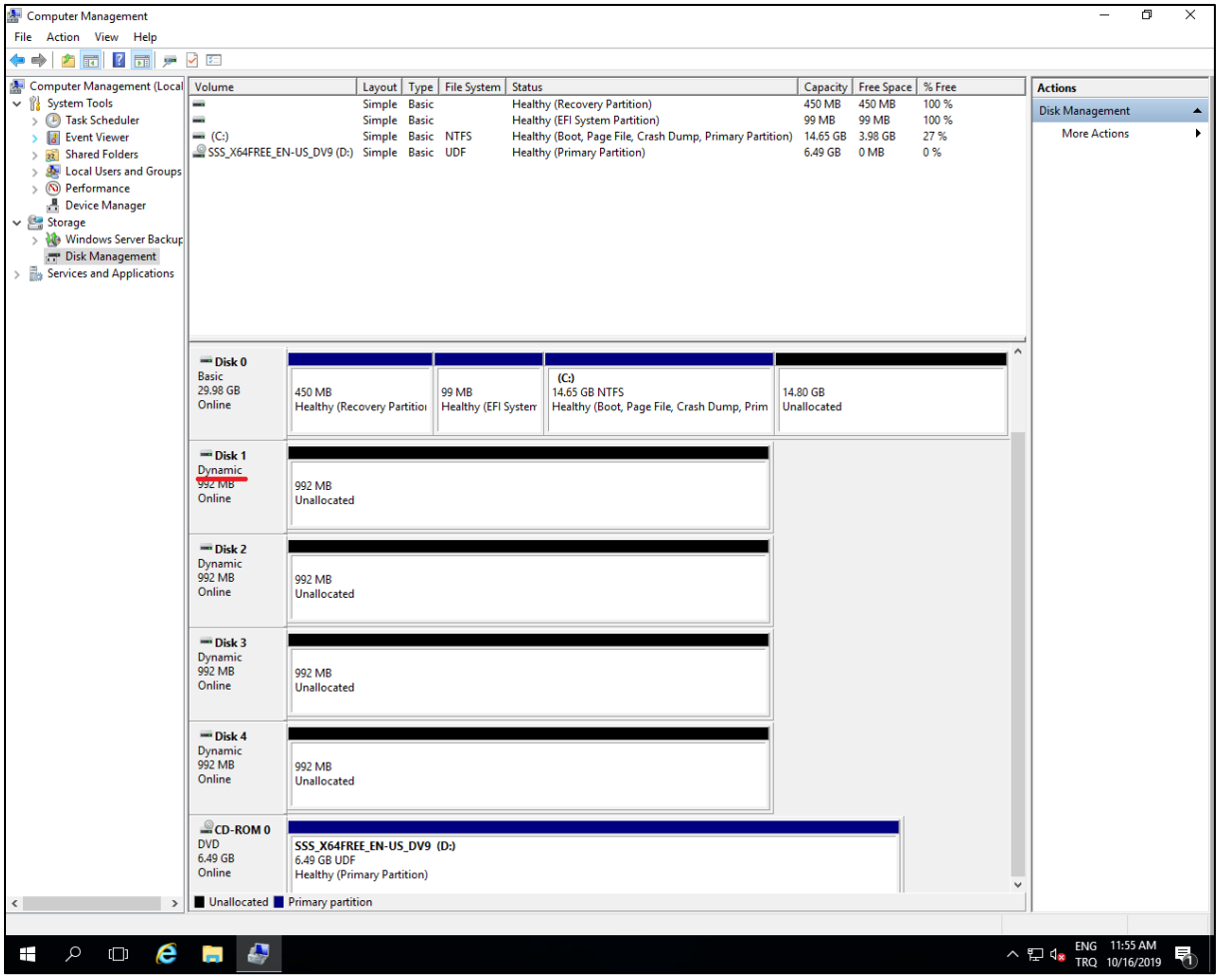
Now we need to turn our disks to Dynamic because in the Basic mode the disks can only be Simple volumes. We have to have Dynamic disks to have RAID 5.



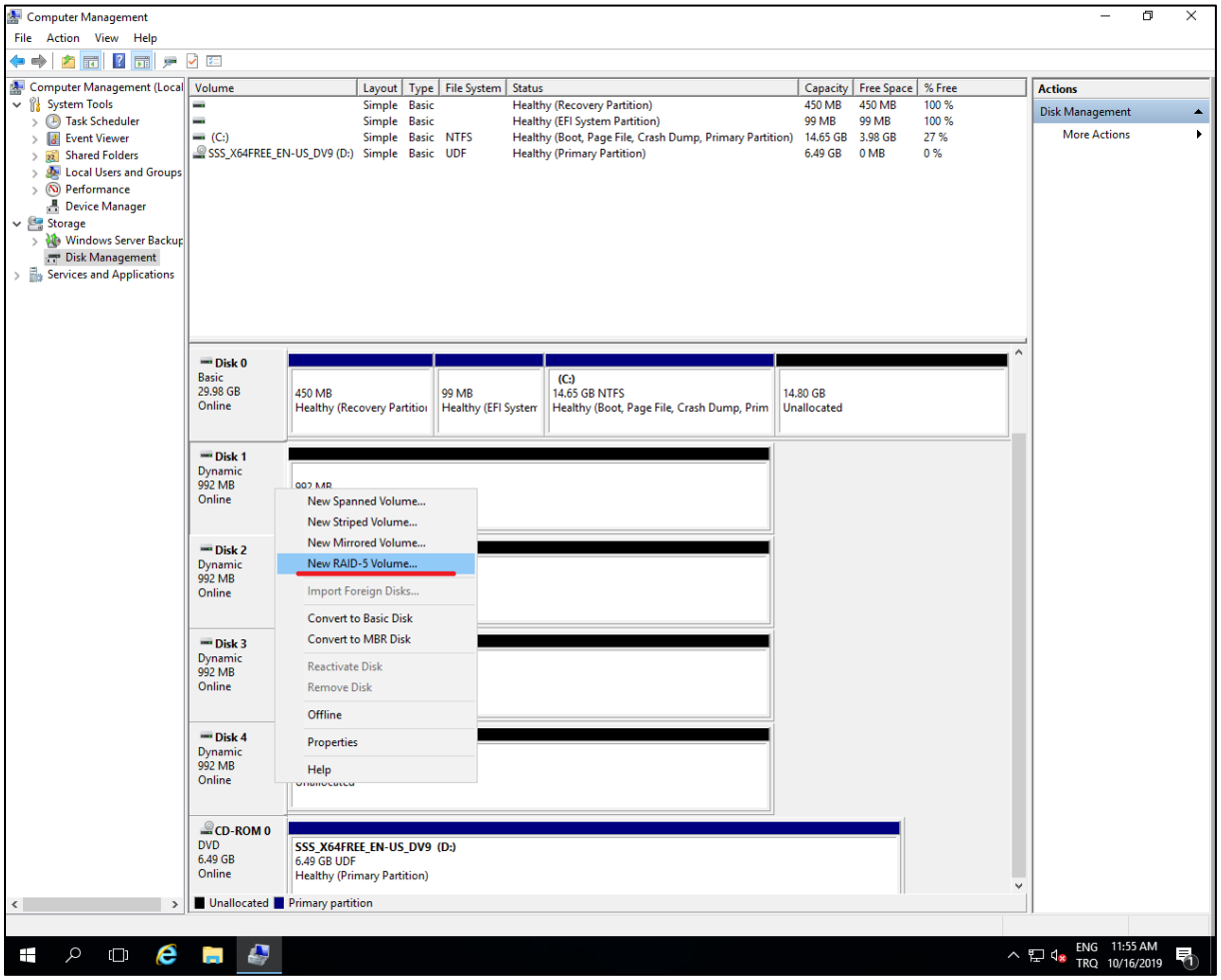
We can select all disks all together to turn into Dynamic.



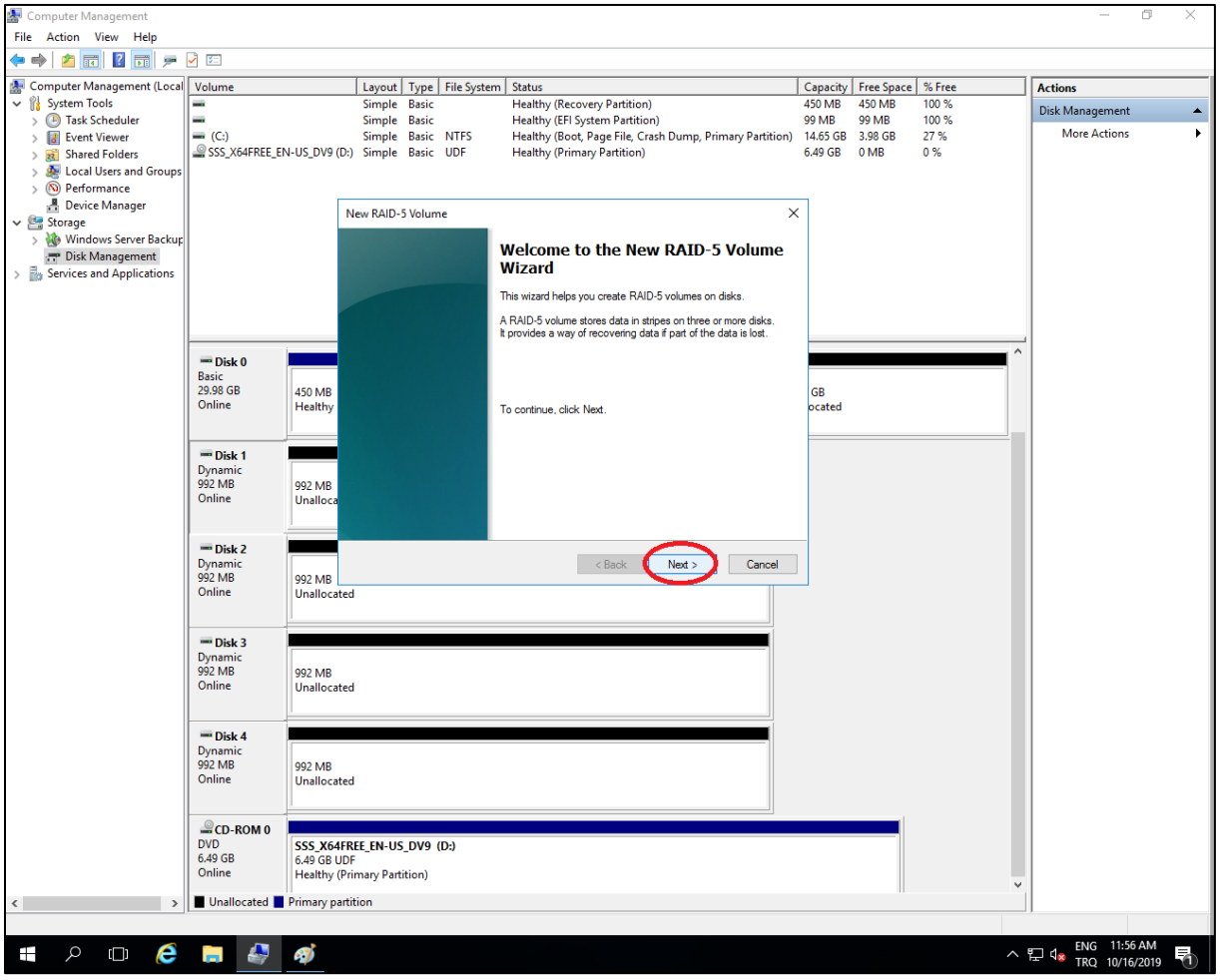
We can observe that they are all Dynamic now.



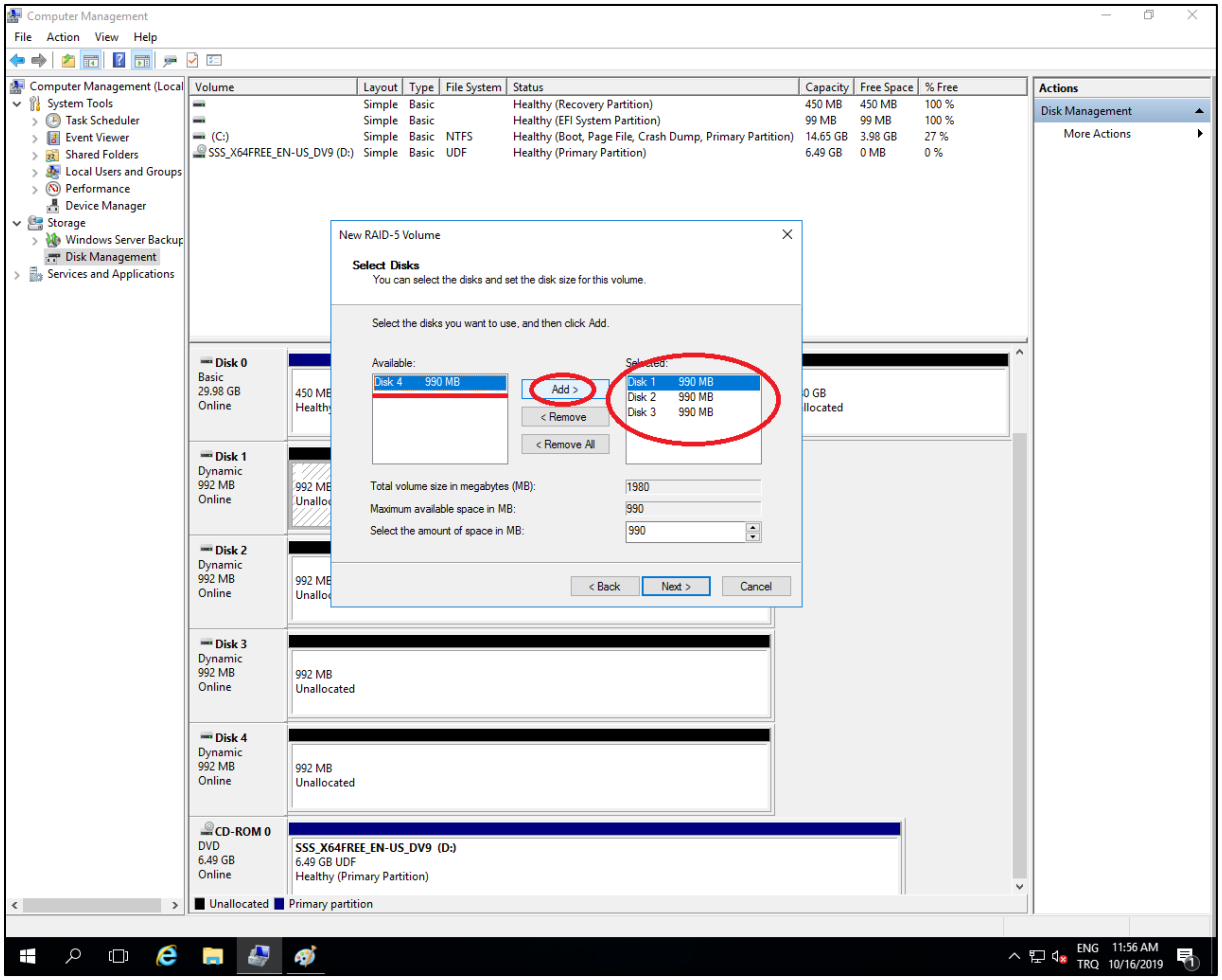
Then, we can start the allocation process and choose RAID 5. We Right Click and choose RAID 5 Volume among the options.



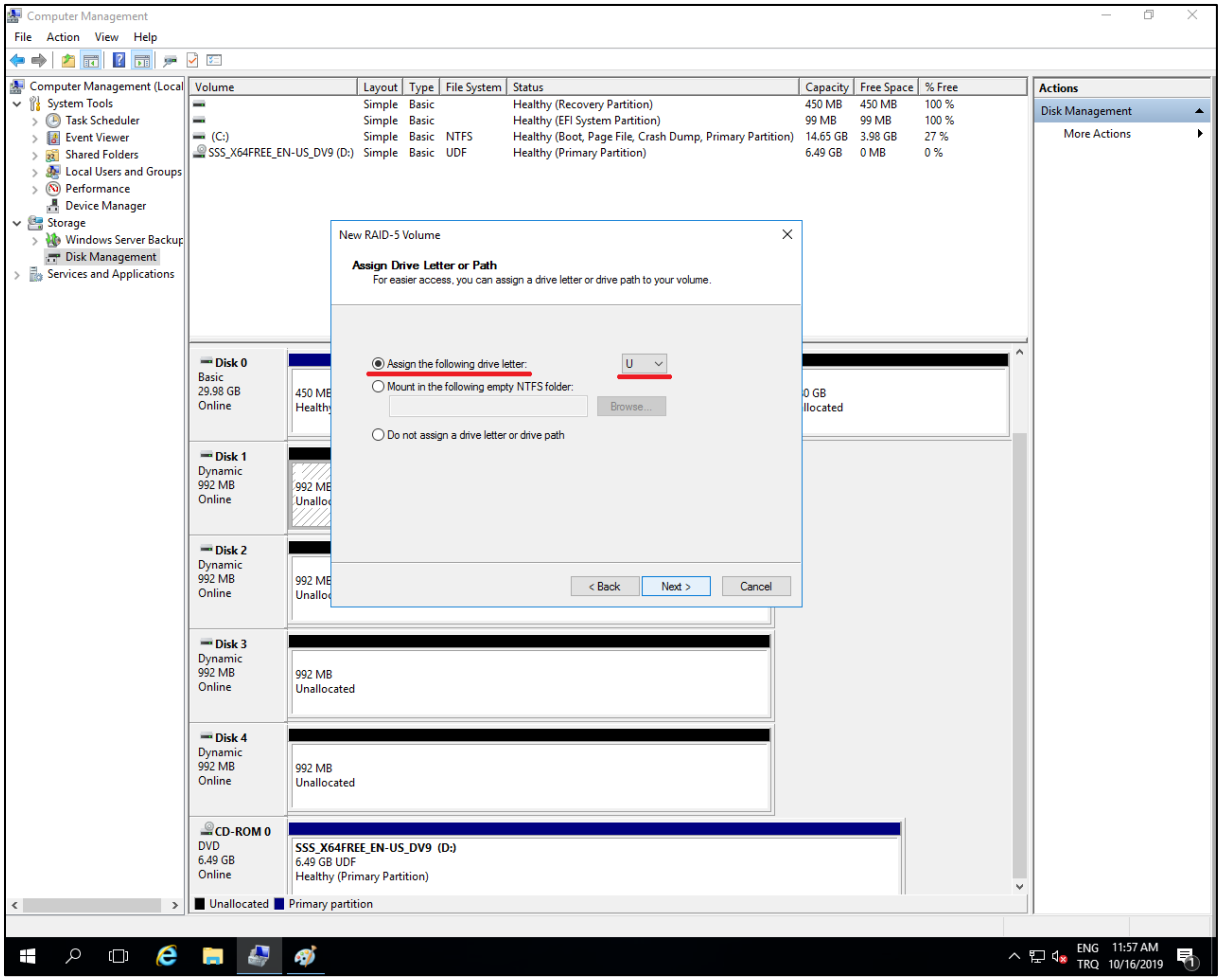
A new menu pops up.



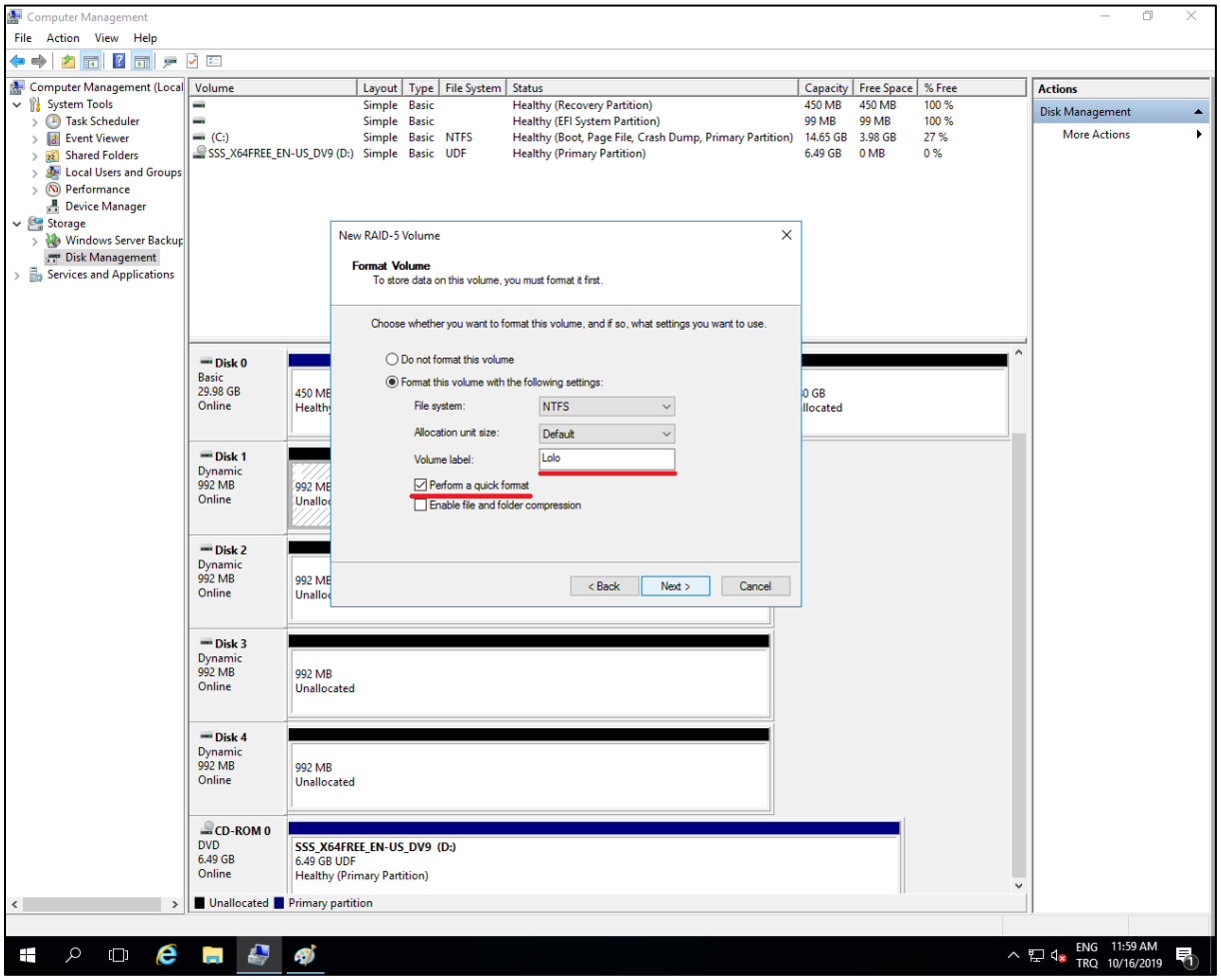
We select all of the disks among the Available using the Add button and click Next.



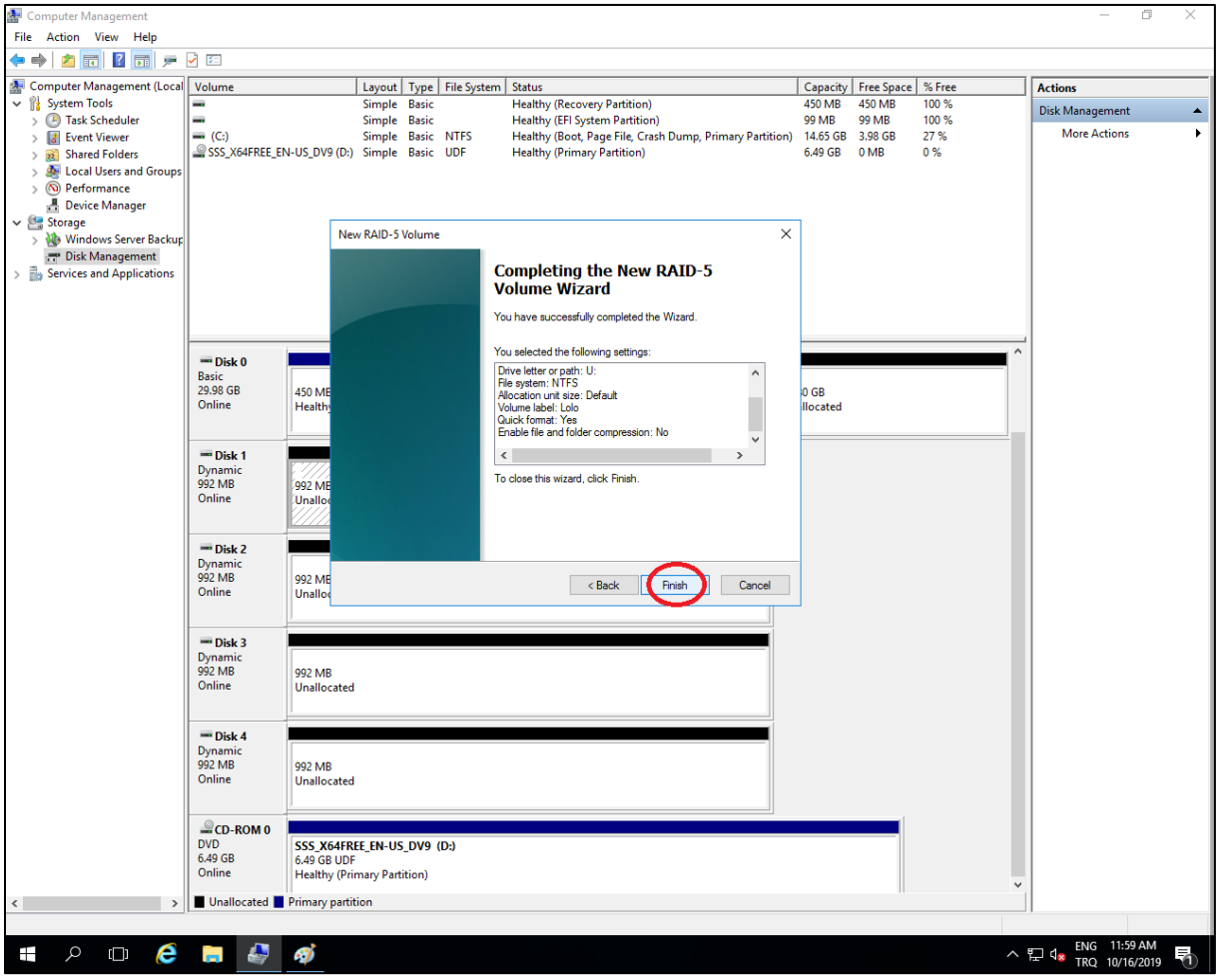
We select how we determine the letter of the drive and then we can click Next.



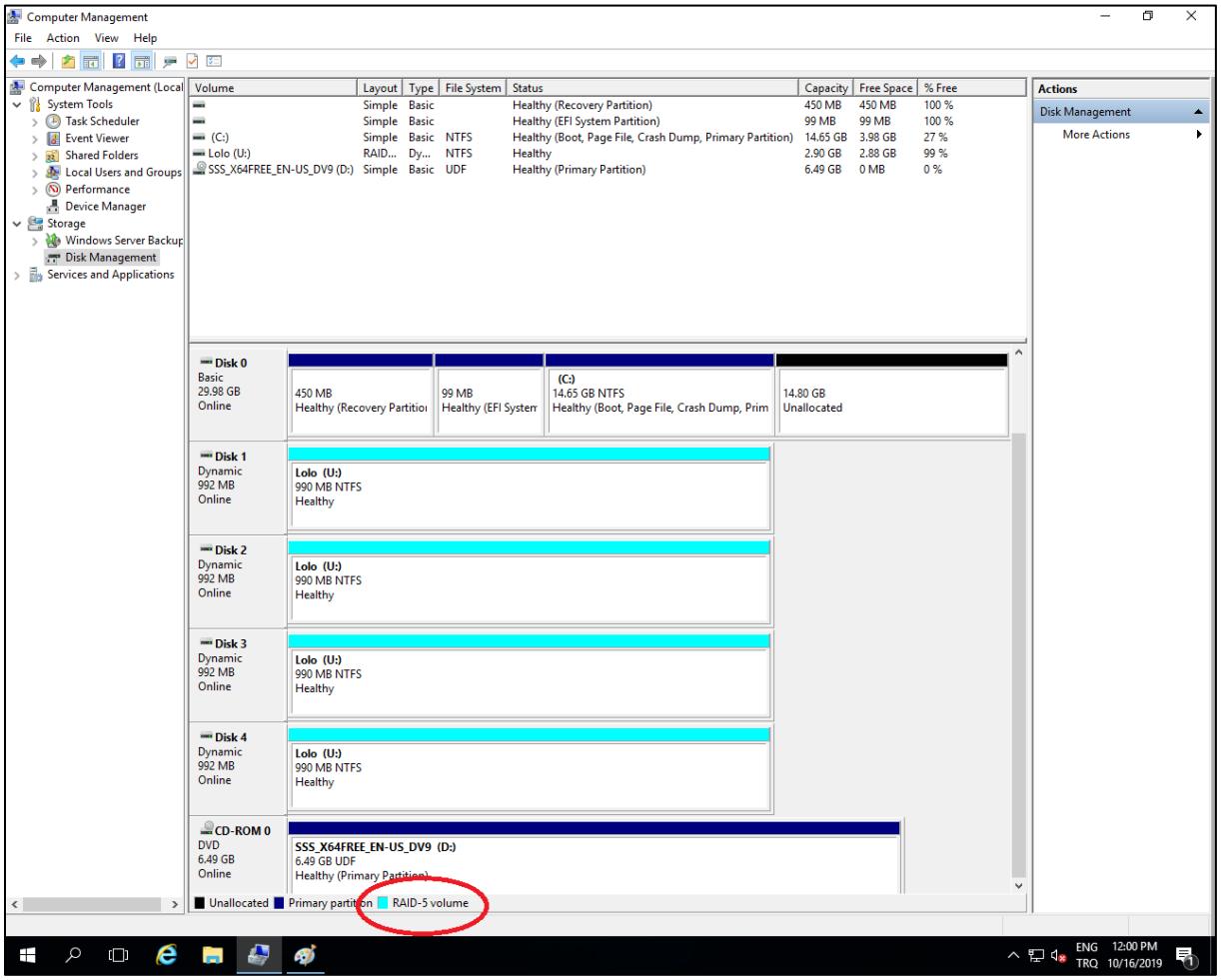
Selecting Perform a Quick Format helps us begin with a freshly formatted disk and it is recommended. After we name the drive as we like, we proceed by clicking Next.



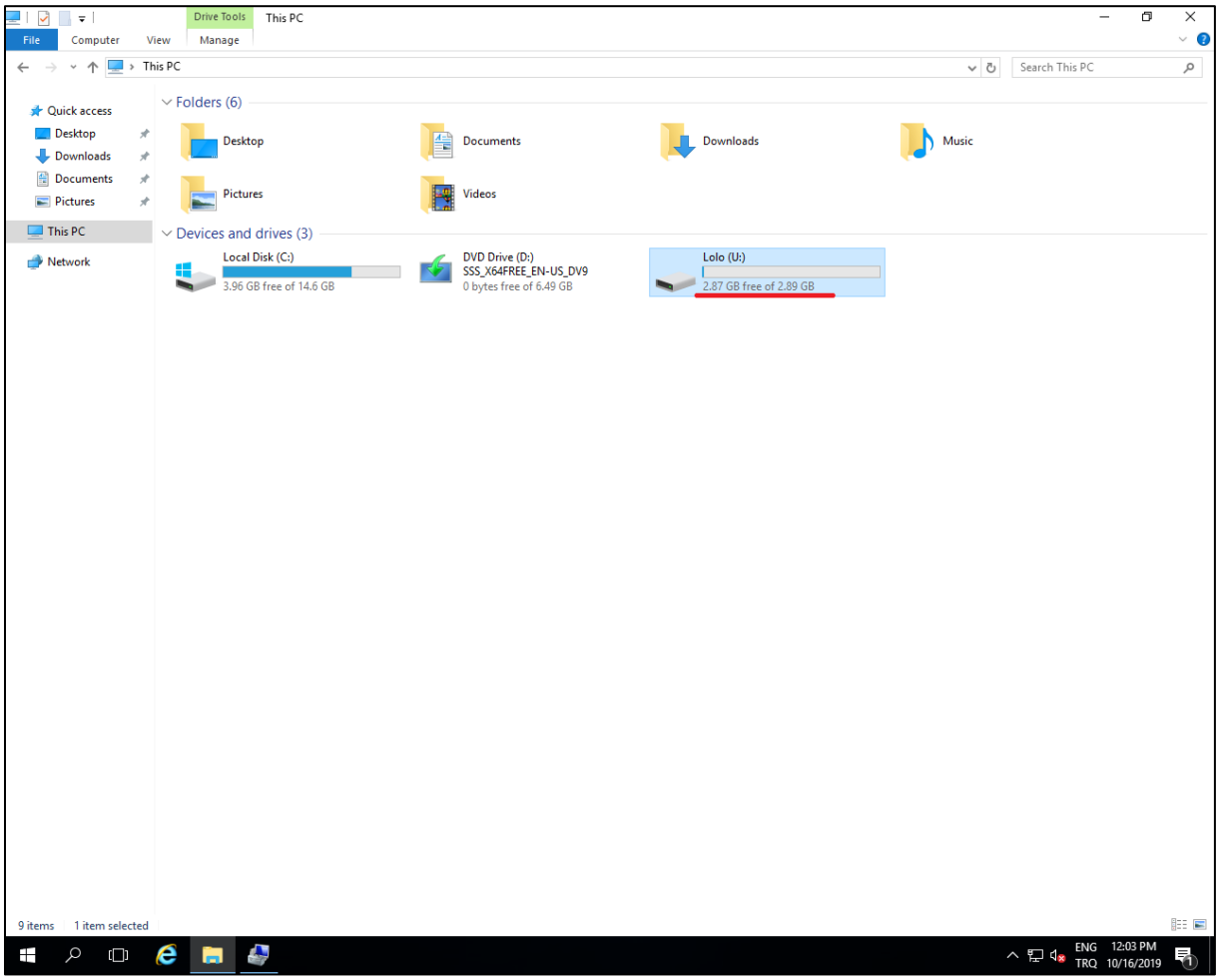
This completes the configuration; hence, we can click Finish and create the RAID 5 Volume.



As we can determine from the allocated disk's color, we finished our RAID 5 Volume setup across Disks 1 through 4 as we intended.

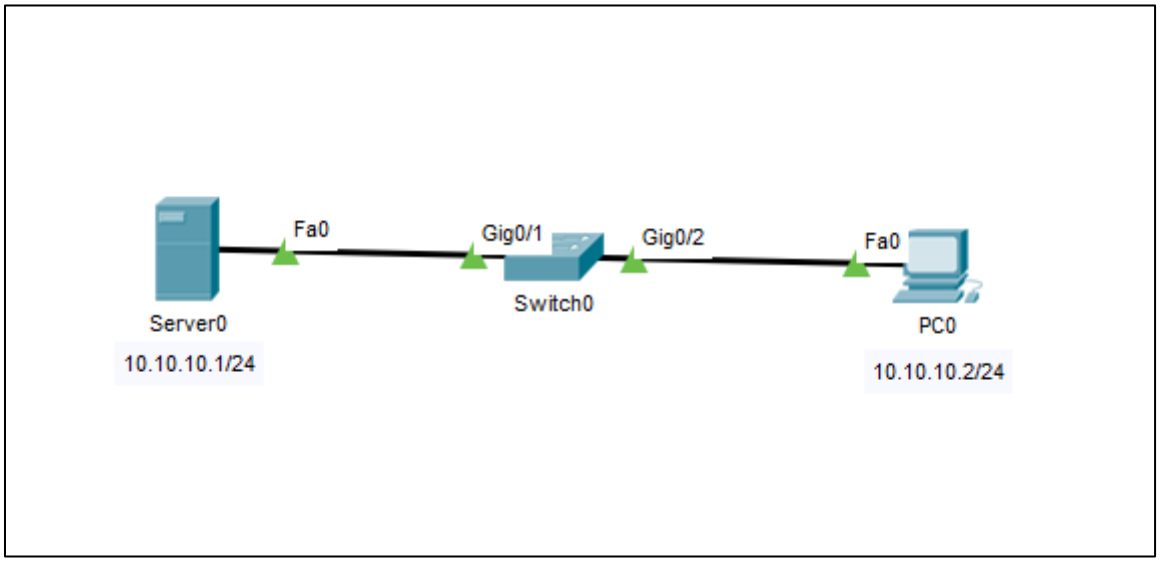


When we peruse the drive under This PC screen, we can see that our new drive Lolo (U:) only has 2.89 GB of maximum space even though we used 4, 1 GB hard drives while setting it. This demonstrates that almost half of the drive is used for Redundancy by RAID 5 Volume.



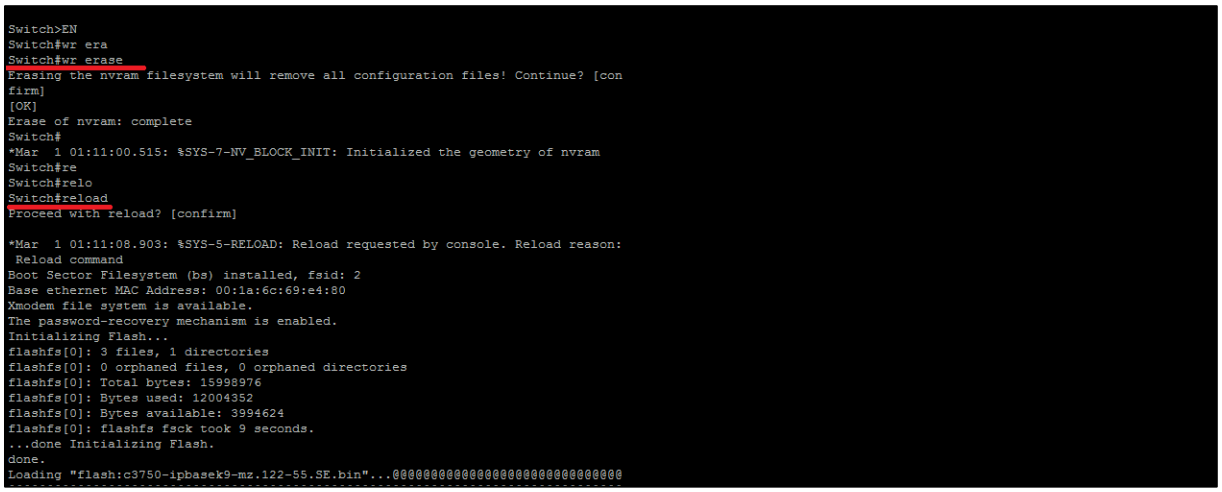
II. Network Attached Storage (NAS)

In a NAS topology, the server solely dedicated to data storage is connected to the hosts via a network. In this project, the topology we used is this:

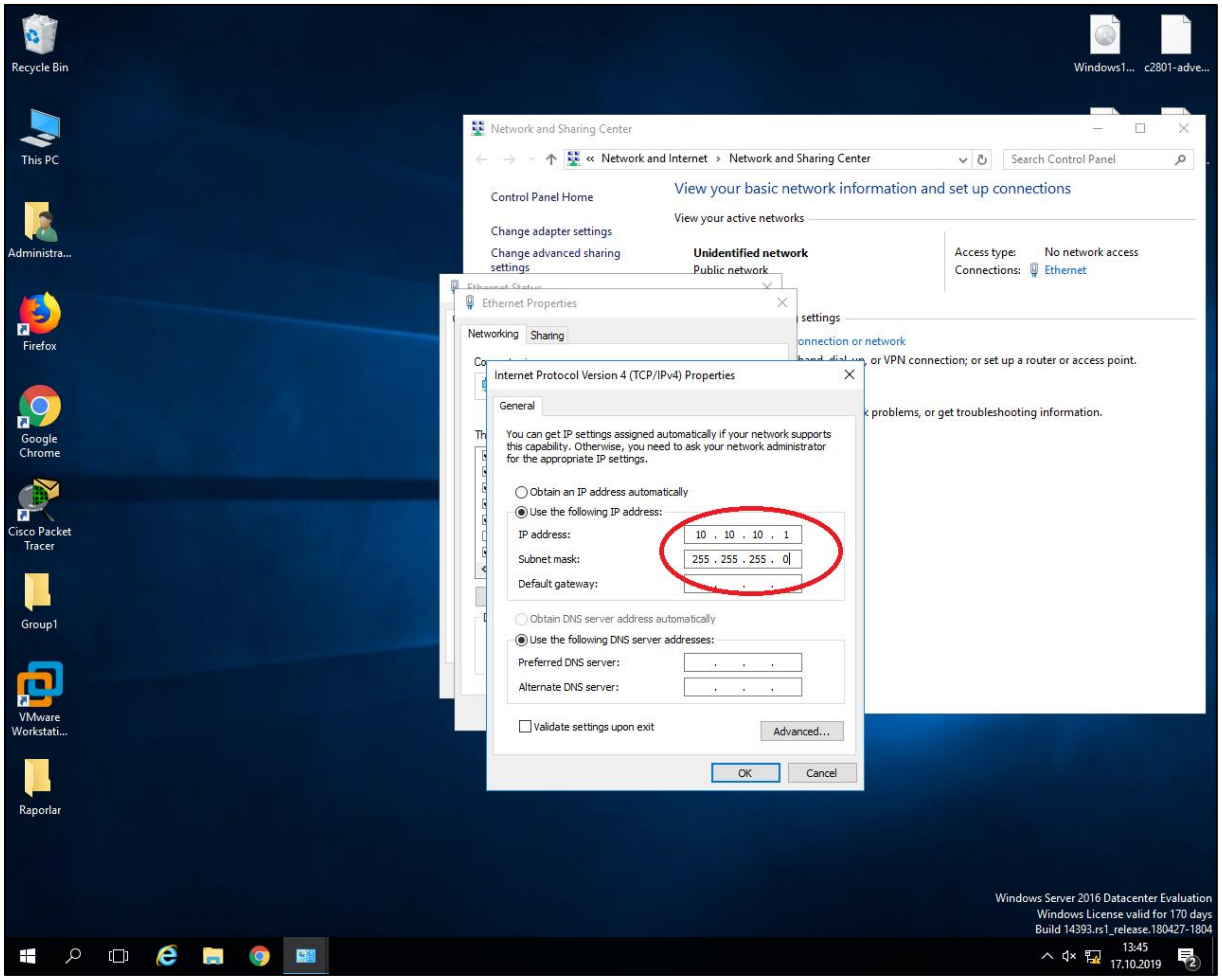


The server and the host are connected via the switch.

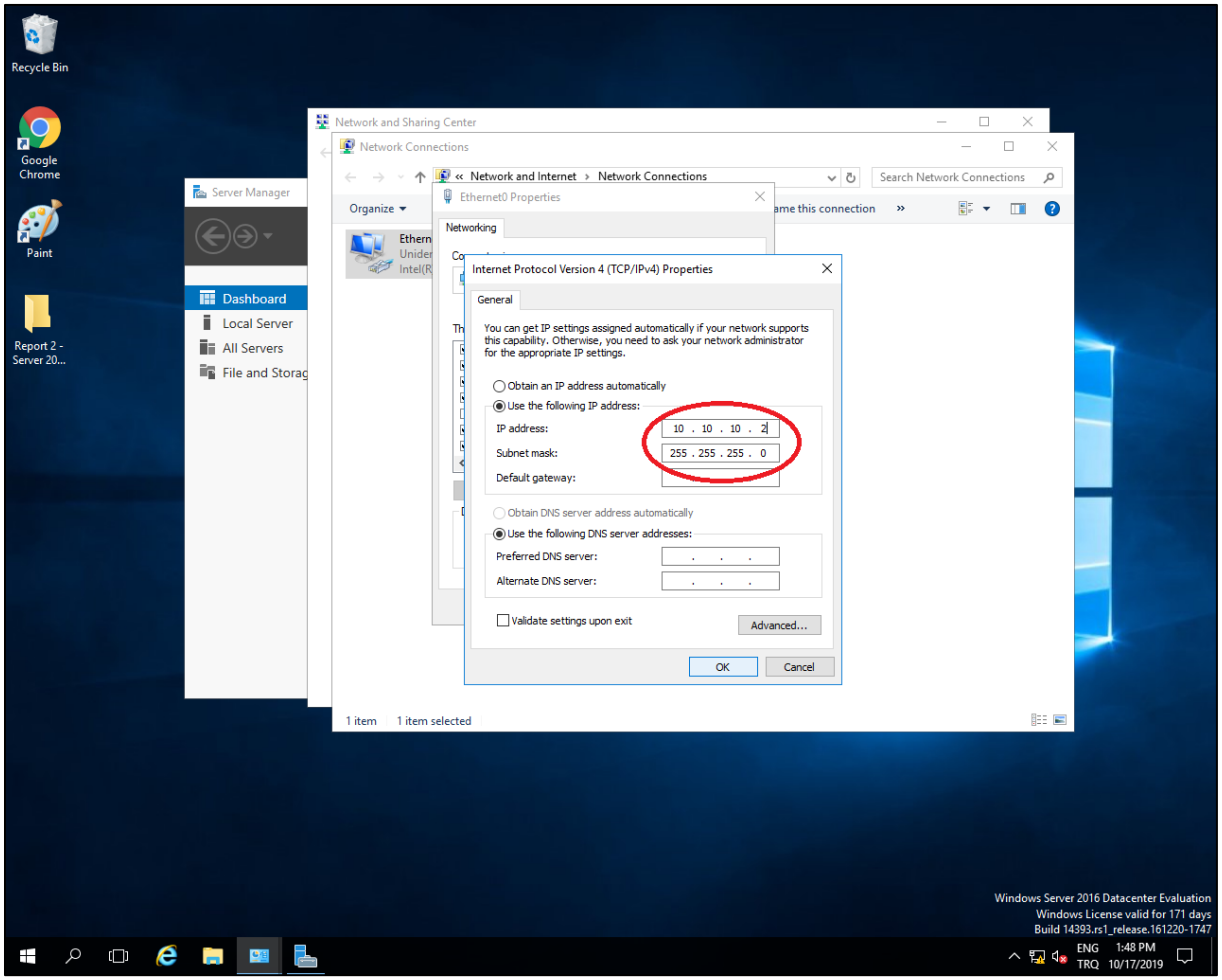
The very first thing we need to do is clear the switch of any previous configuration. We do this by erasing the configuration by the “write erase” command in privileged mode followed by the “reload” command. Then, switch reboots anew.



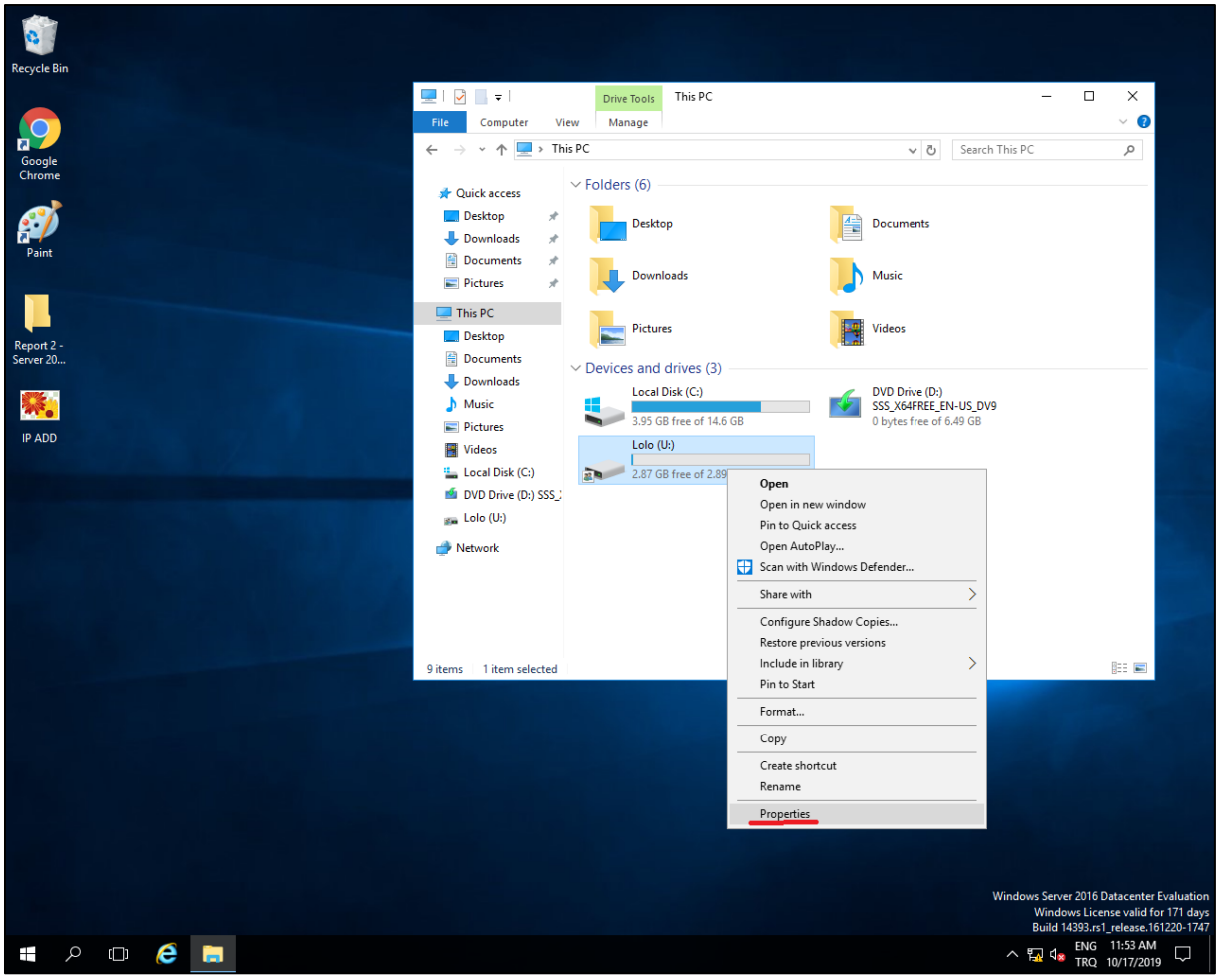
Then, we assign IP addresses to the host and the server in the same network.



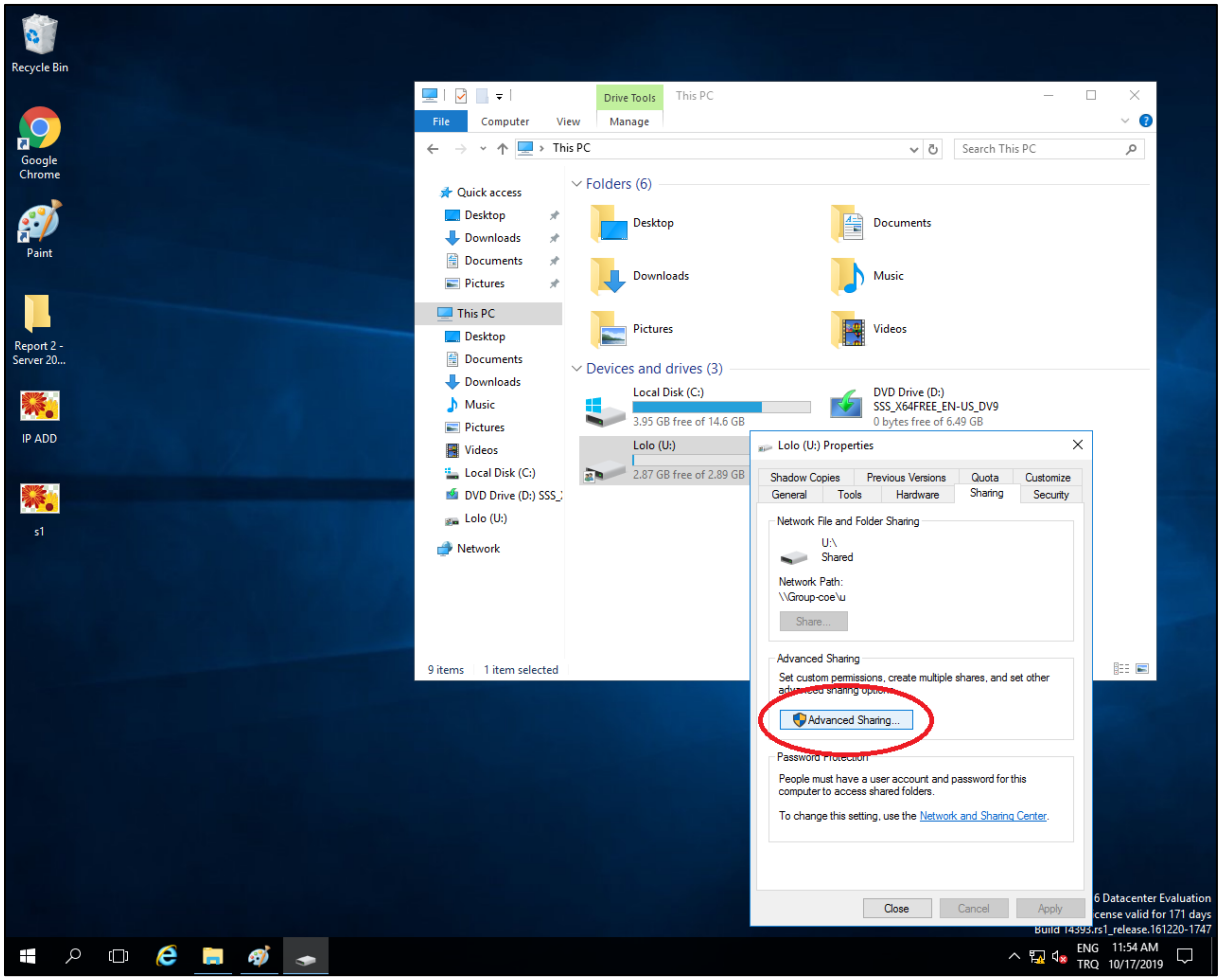
This is the other one’s IP designation.



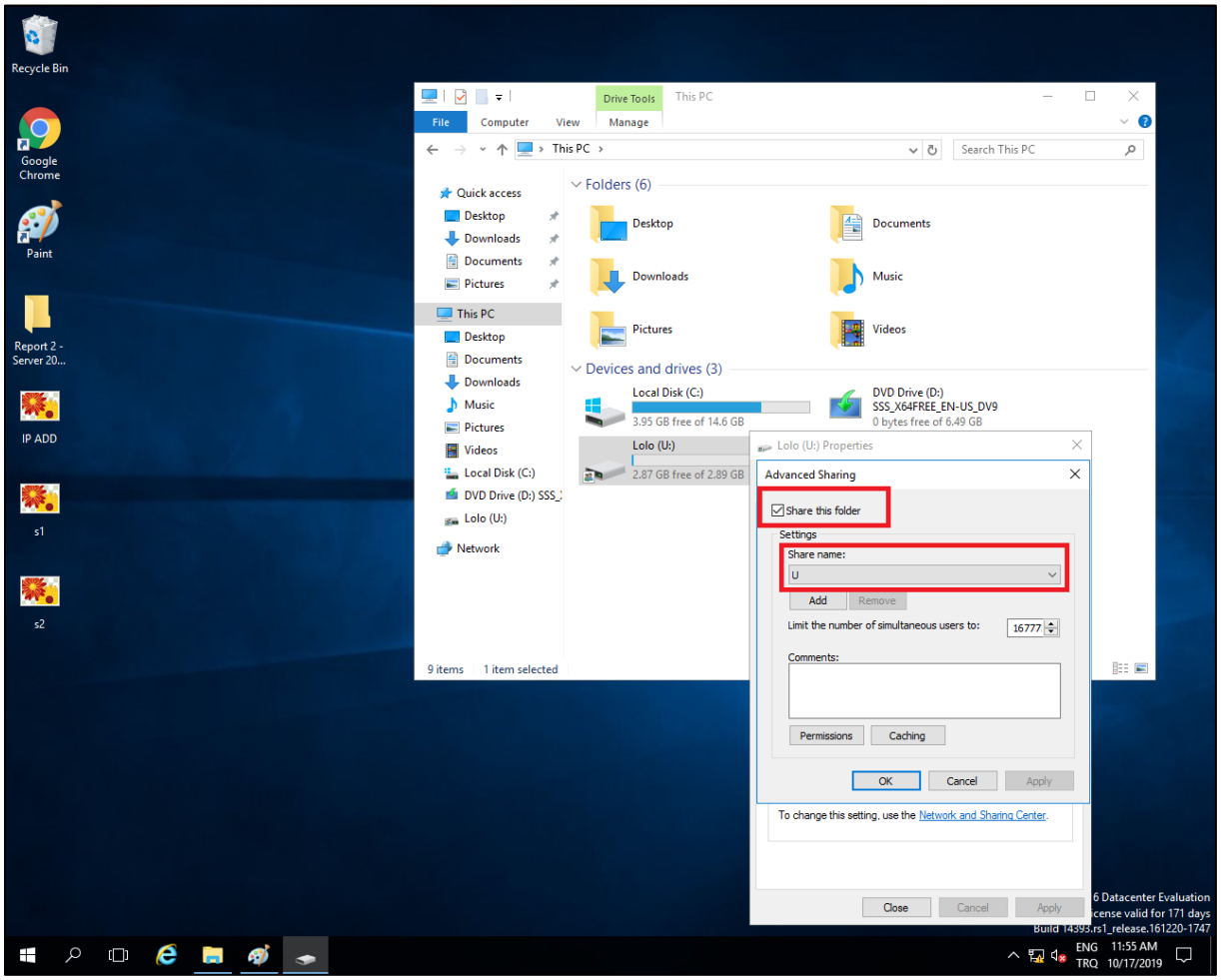
After assigning IP addresses and connecting the server and the host via switch using straight cables, we need to establish a server drive. So we add a physical drive to the server. The steps to do this are exactly the same as creating a RAID 5 drive in DAS mentioned in the previous section of this report. For the details of this, you might refer to page 2. The next thing is to share this new drive to the others who can access it via the network. On the server, we right click on the new drive and select properties.



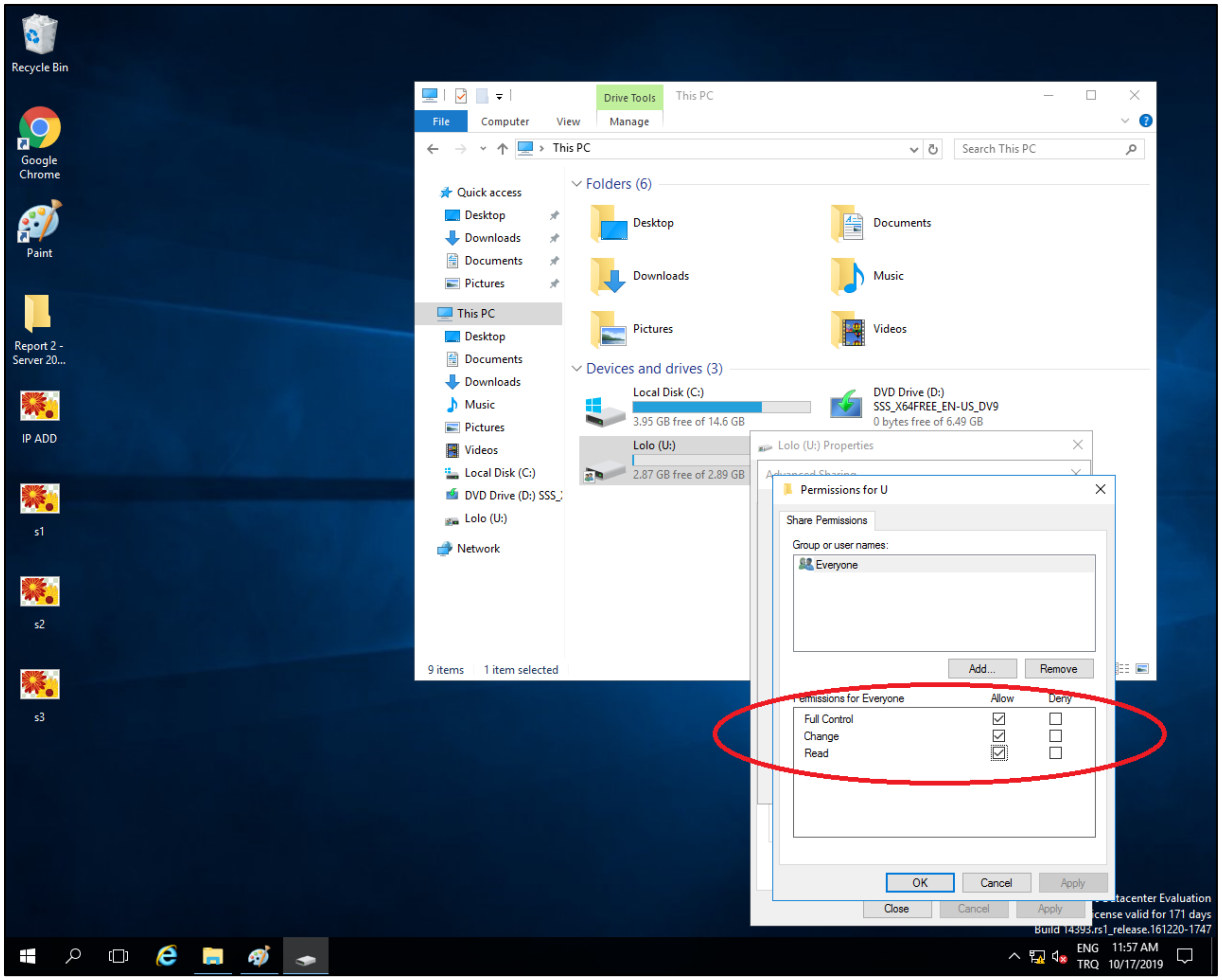
Under Sharing Tab, we click on Advanced Sharing.



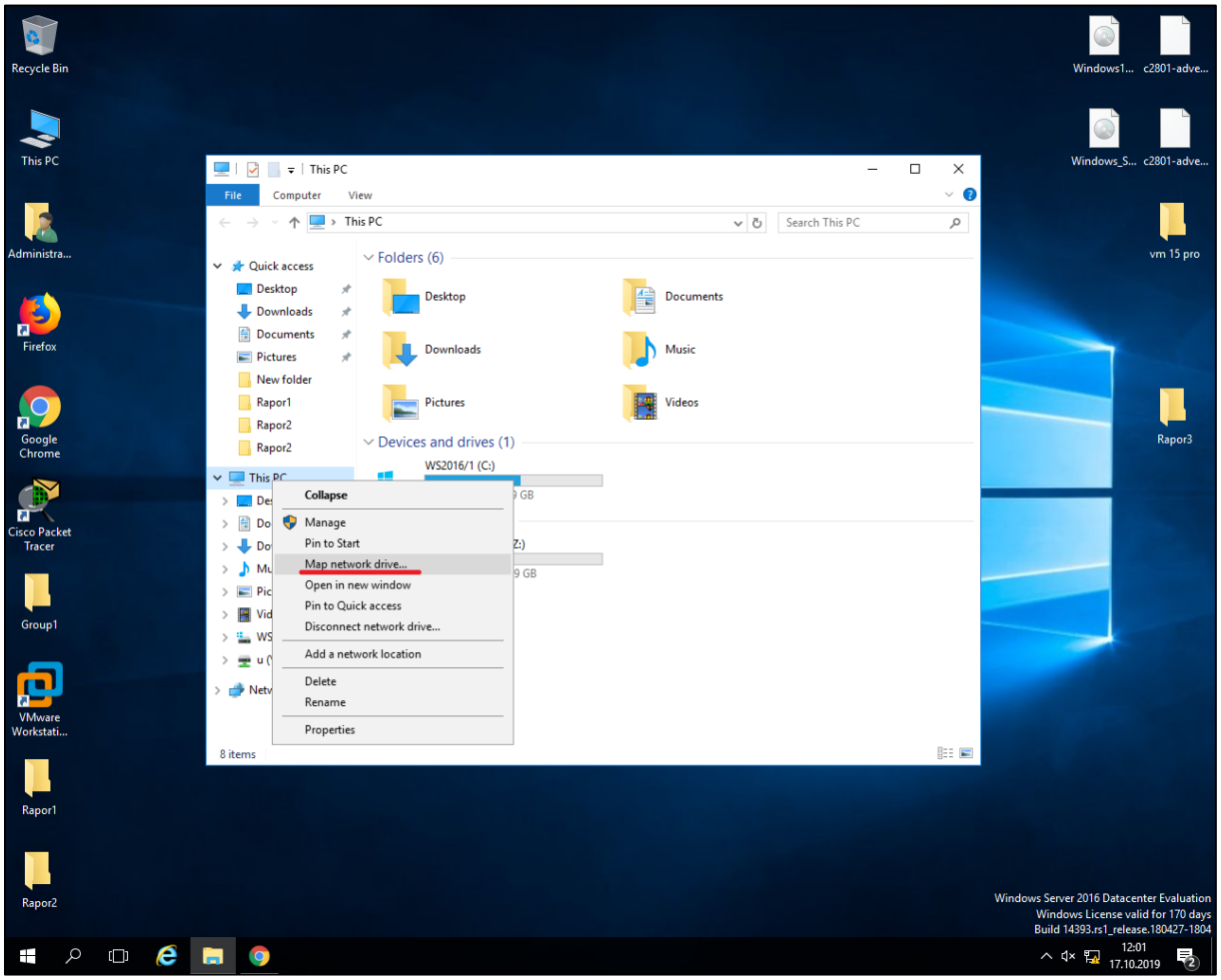
We check the box that says Share this folder and give it a name. The default name is the drive's name on the server.



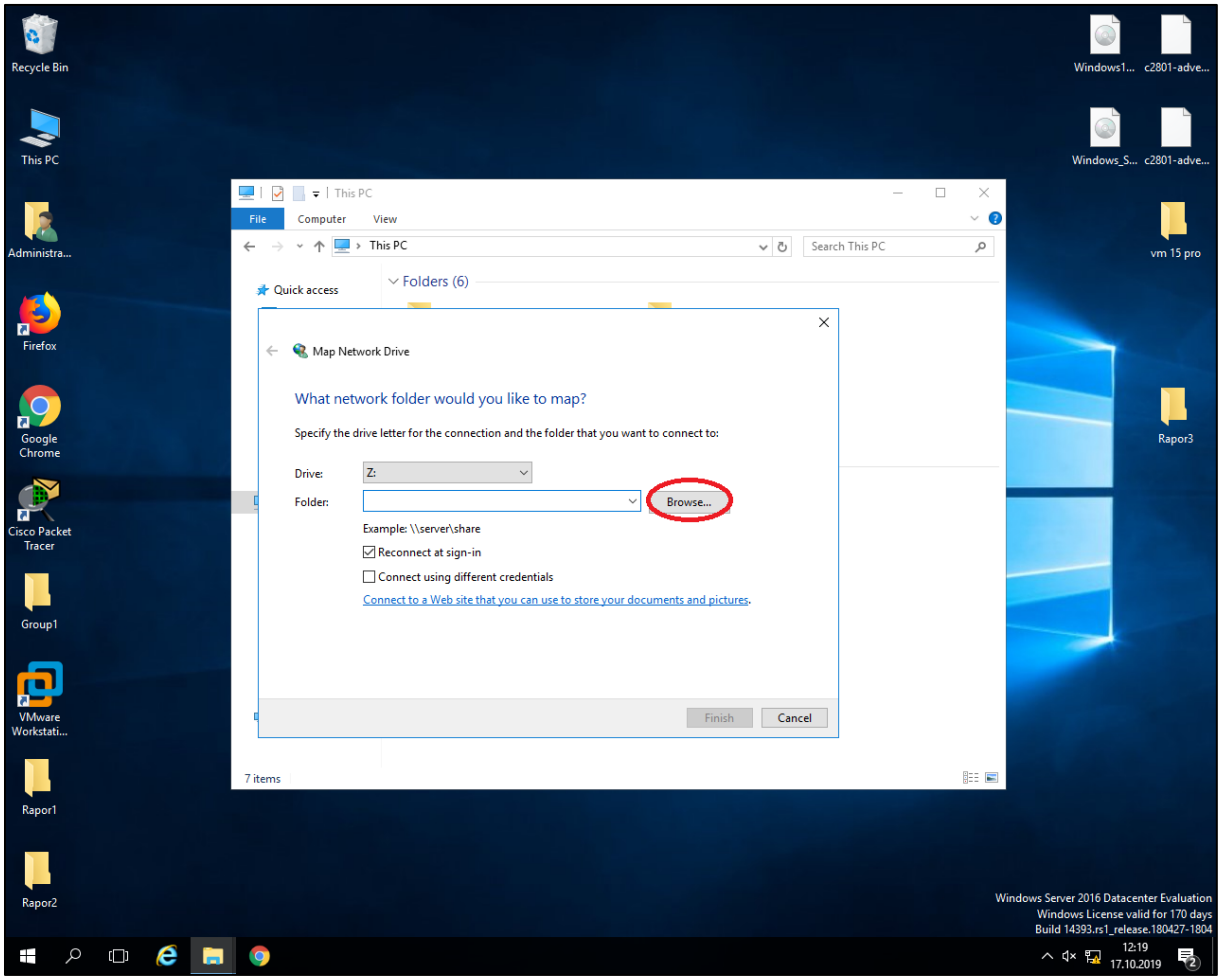
We determine the authorizations we want to give the other users. And click OK.



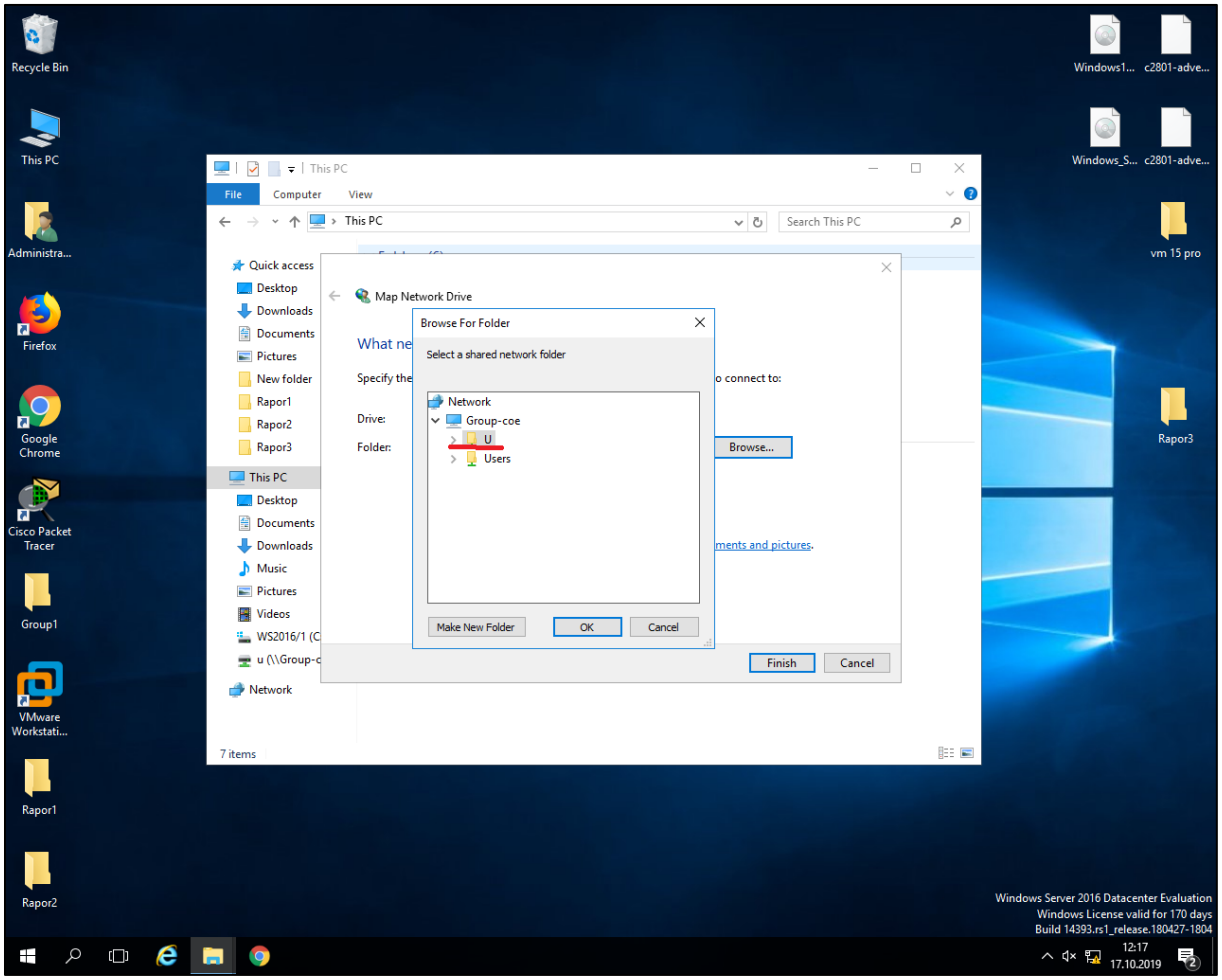
That settles the sharing process, to see its effect we go to the host PC and right click This PC to select Map Network drive…



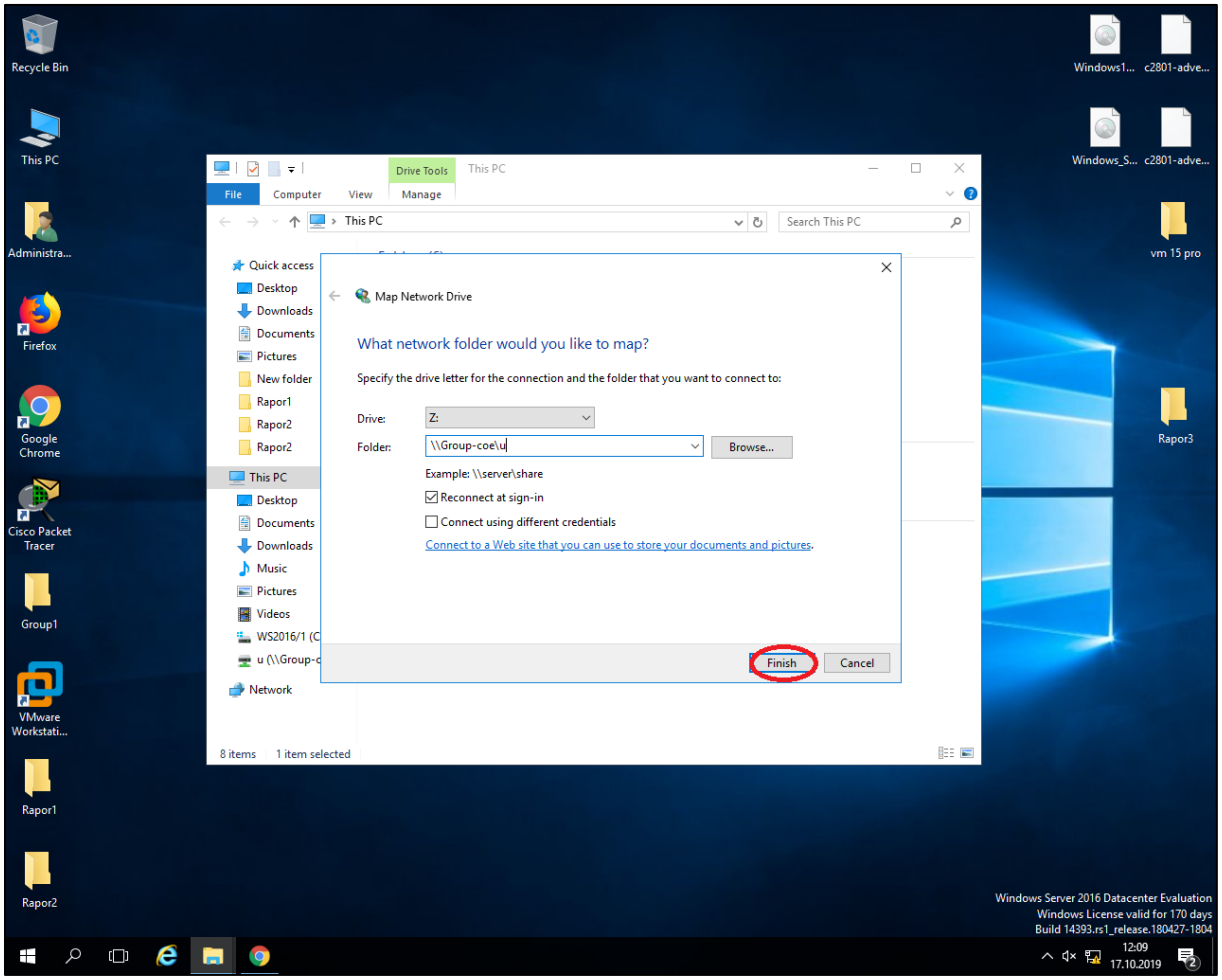
We click Browse to find the shared drive.



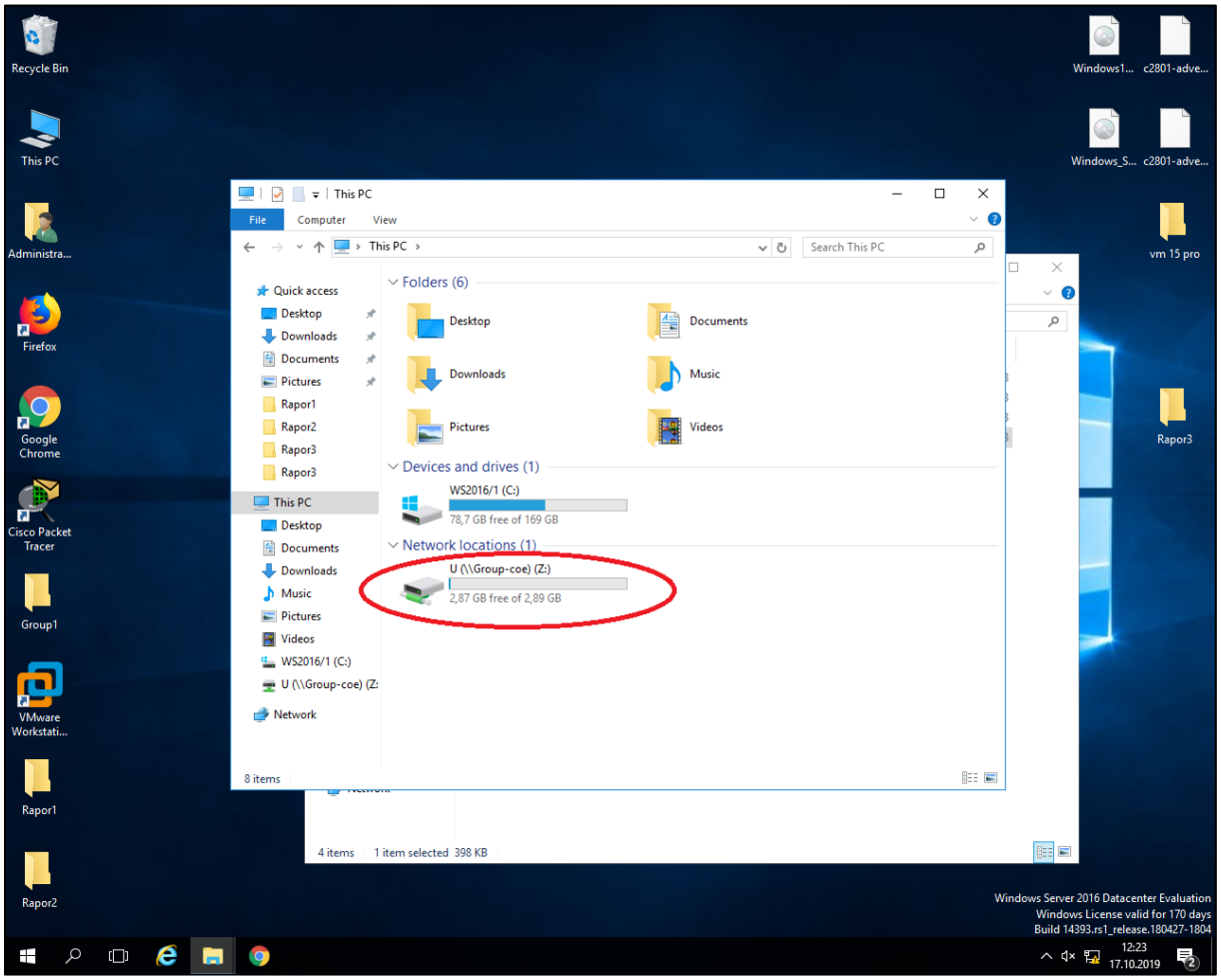
We select the drive whose name is the shared name that we set a few steps back.



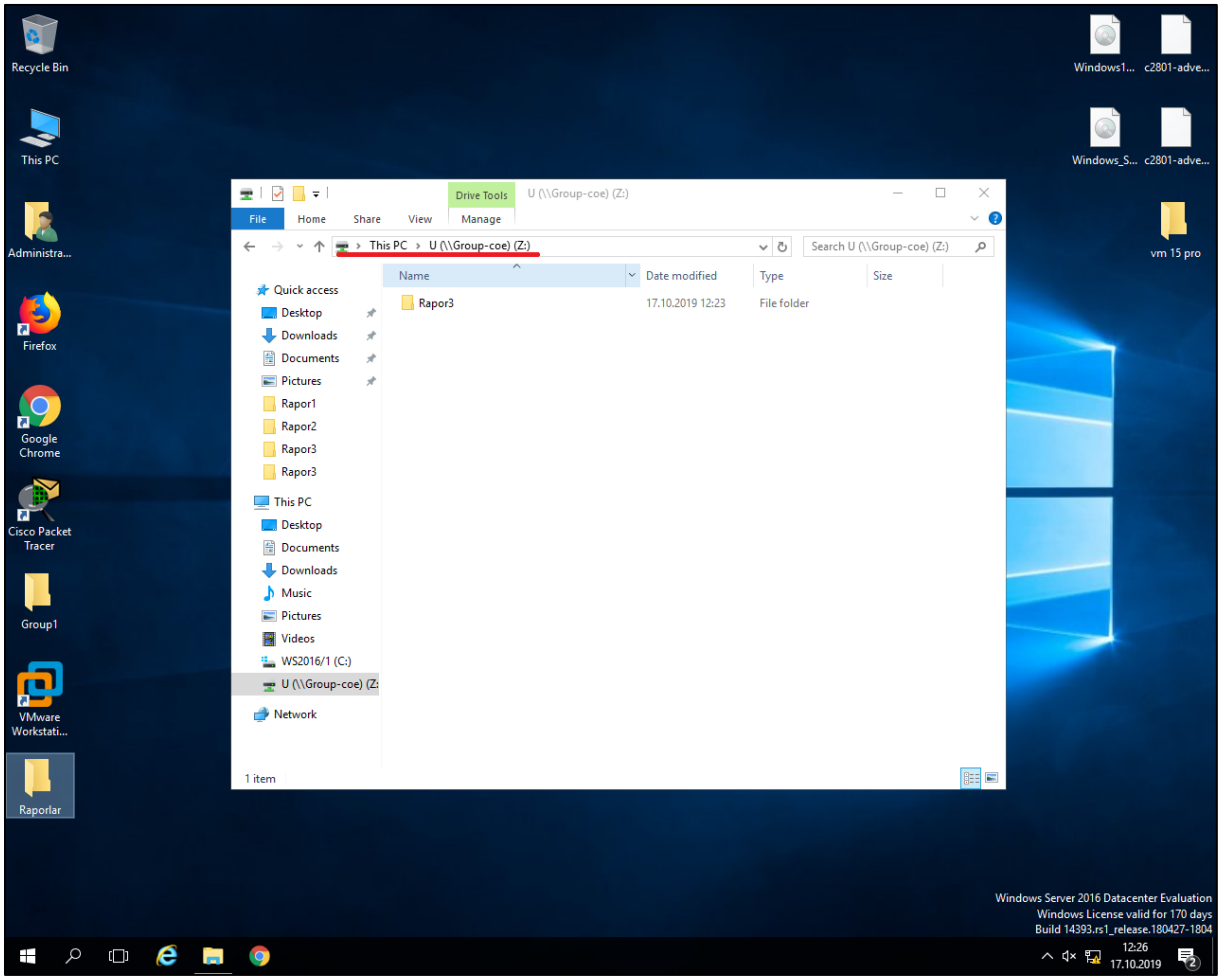
Folder direction is automatically assigned after finding the file via Browse. We simply Finish.



We can see the drive on the server that's connected via the switch and we can read and store data on it easily.

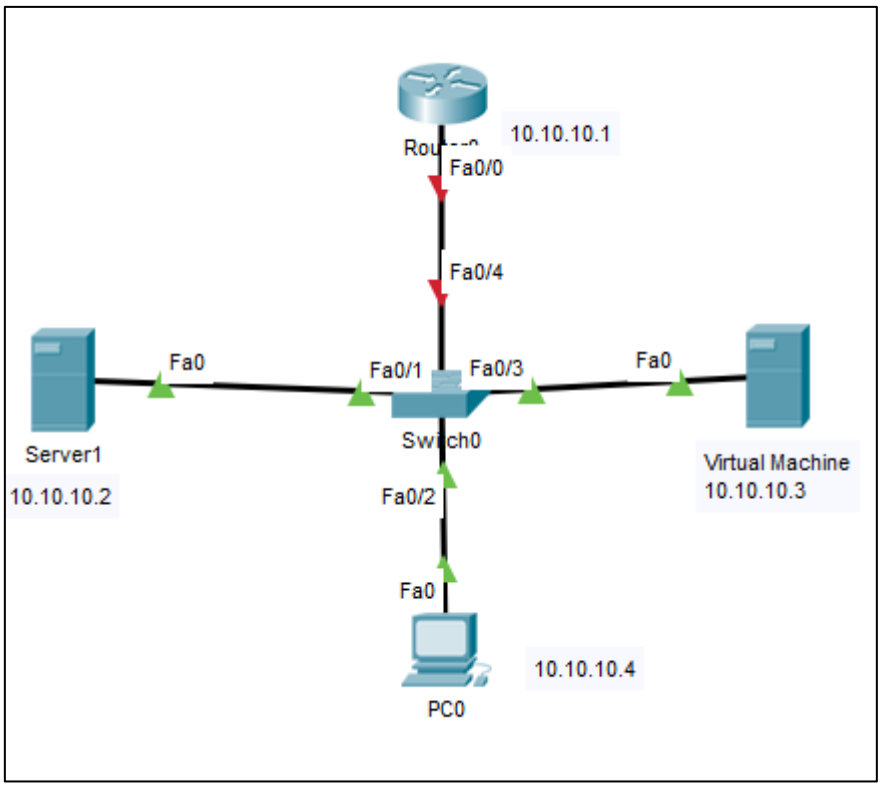


As you can see, the host can access the folders within the shared drive.



III. Storage Area Network (SAN)

For SAN, the topology we used is this:



So that at least one server is purely dedicated to data storage and the router in the network can share the server's location in the network, hence the other hosts from different networks of SAN can also access the server's data. However, we have not essentially done anything novel other than adding a new server and a router to the NAS topology; this is further discussed in Evaluation on page 75.

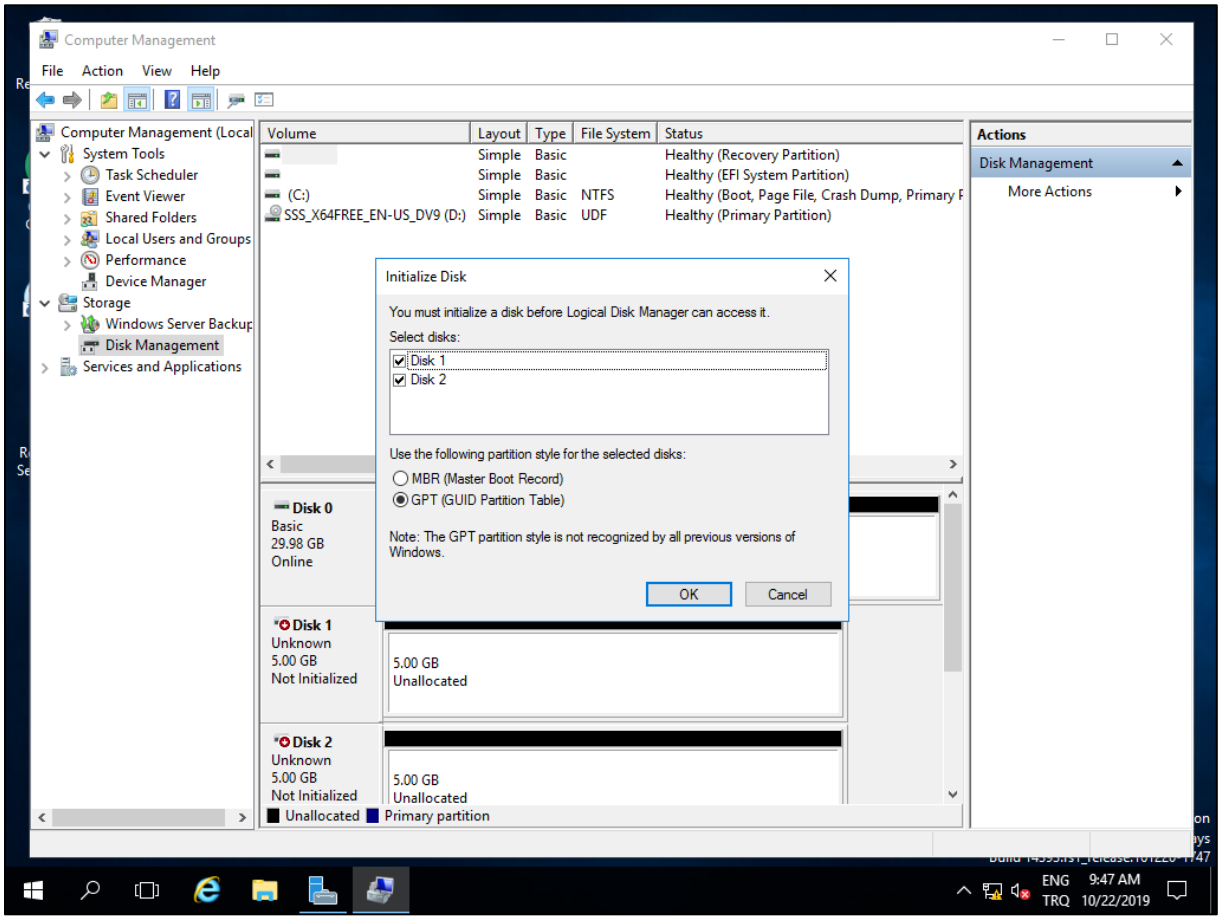
Since we have basically done exactly as the NAS construction, you can follow the relevant steps on page 19.

IV. Storage Pools and Virtual Disk

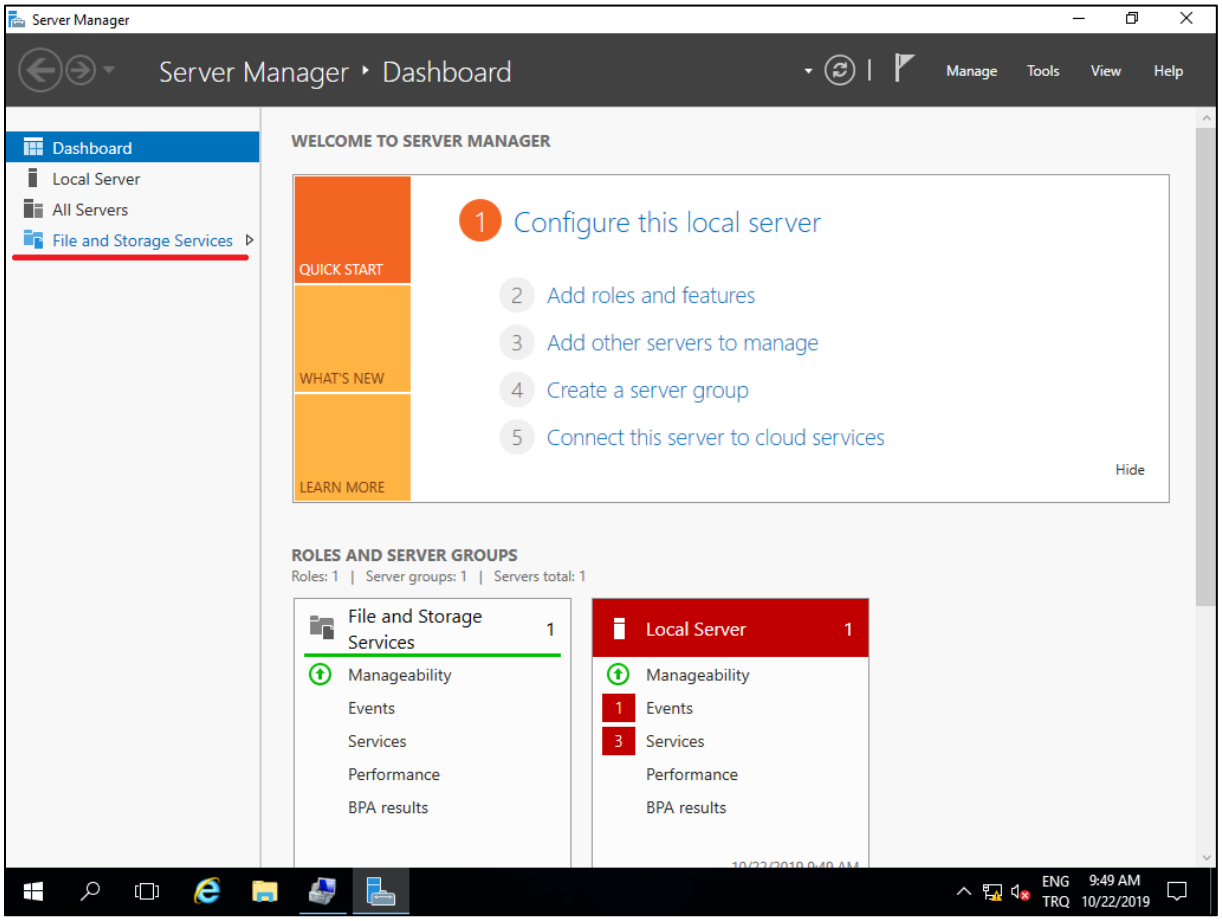
This entire process is subdivided into minor points: management of the physical Disks, creating a storage pool, creating a virtual disk and creating a volume.

Something very important to note here is that the physical disks after the initializing need to be at least 4 GB or else we cannot add them to our storage pool. The disks also shouldn't be formatted nor should we create a volume using them.

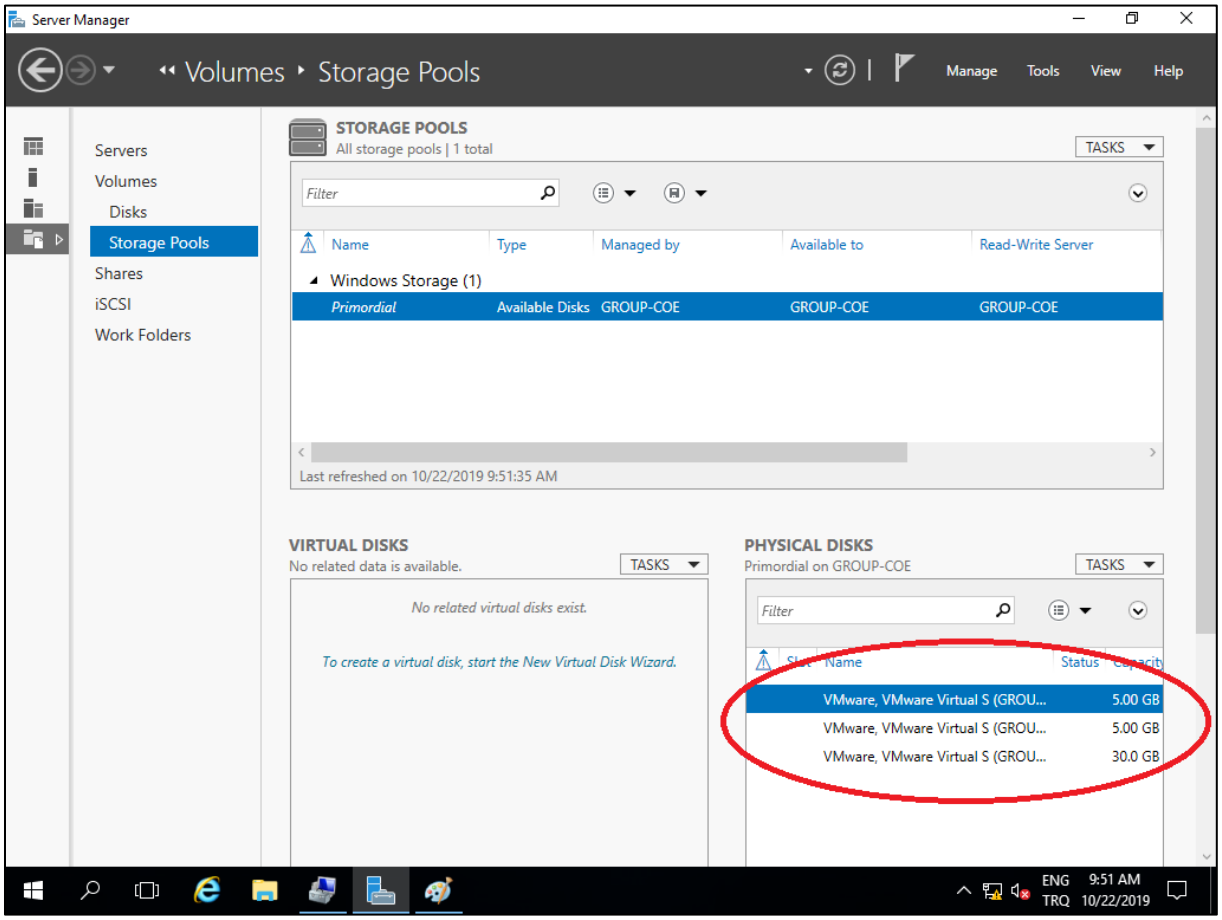
As you can see we're simply Initializing the disks by choosing the GBT partition style for our UEFI machine under Disk Management in Computer Management.



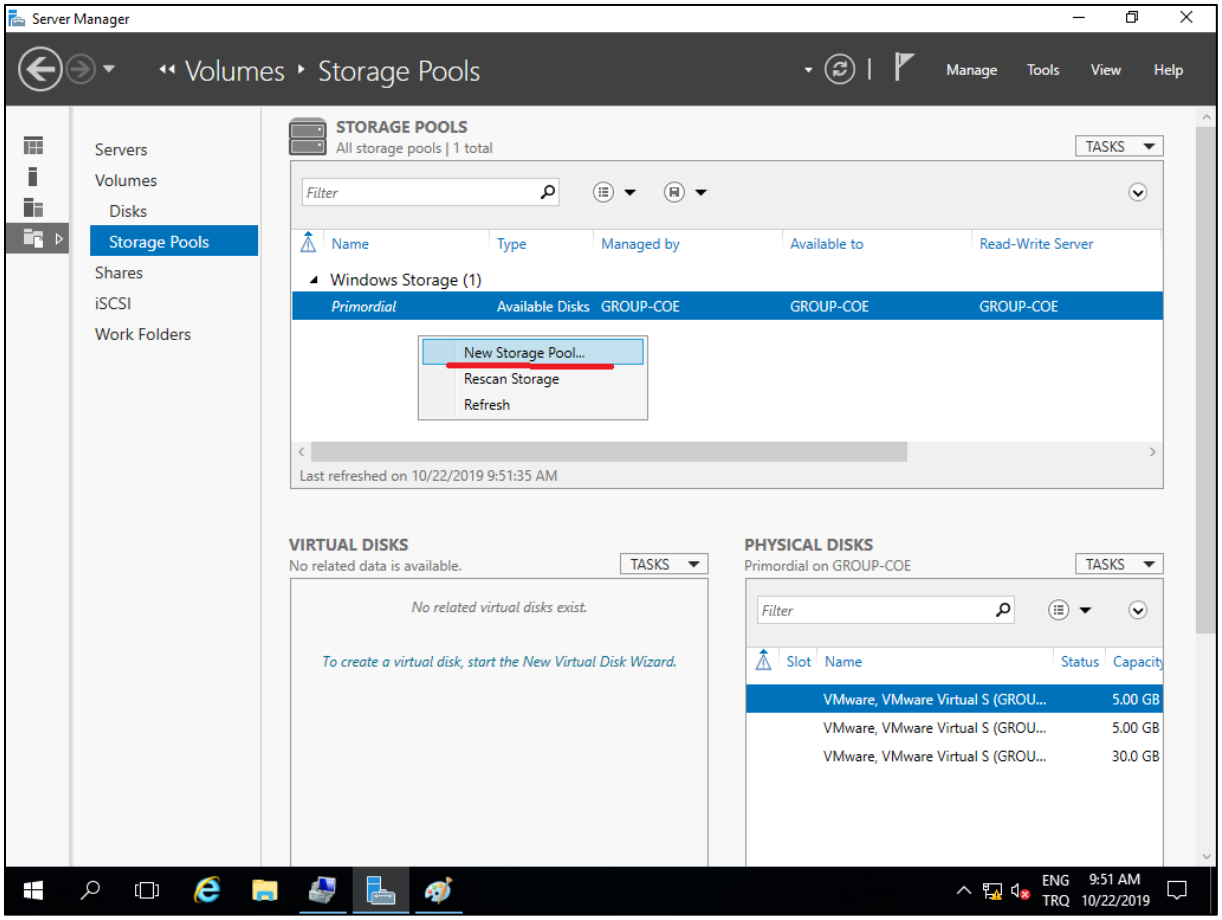
Then we proceed to Server Manager and click on File and Storage Services. You might have to wait a bit for it to pop up under the Dashboard.



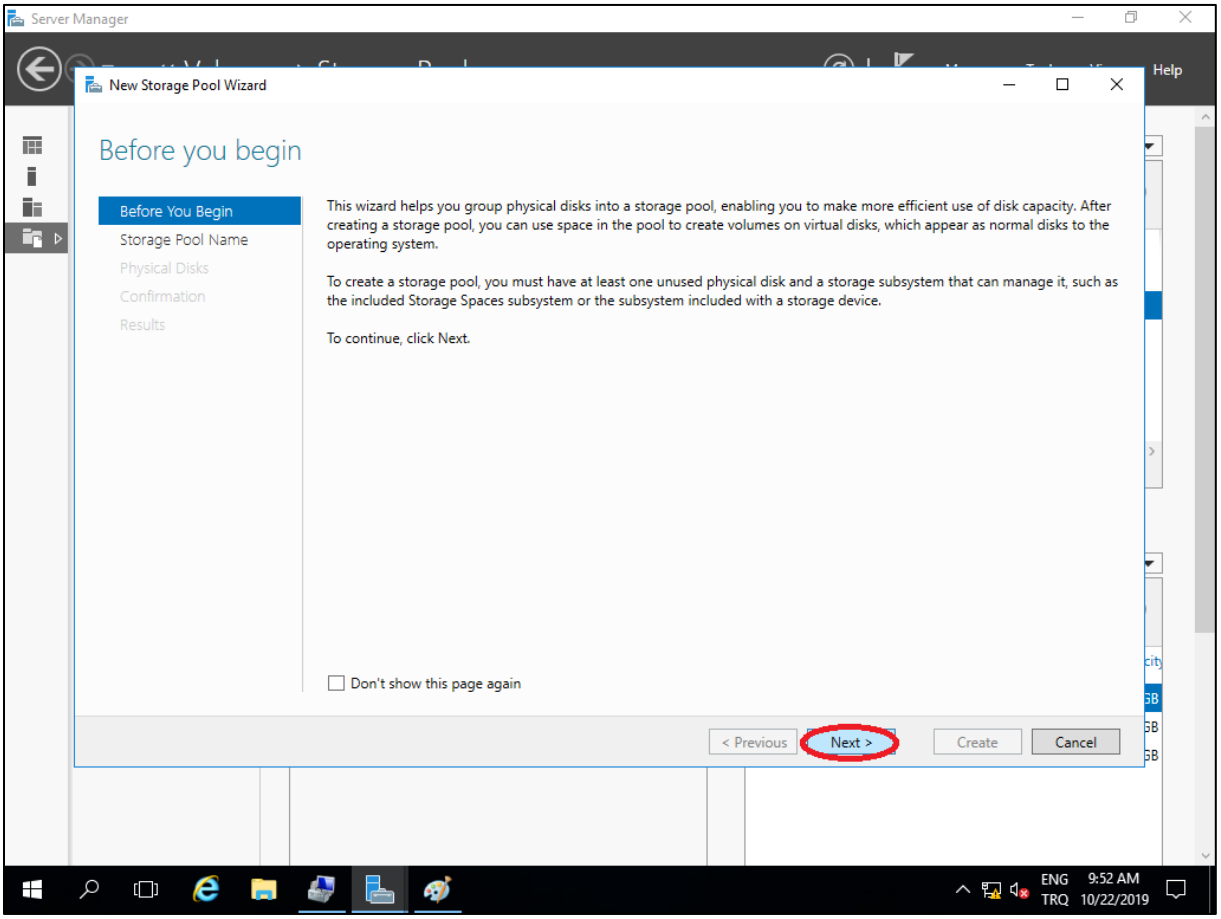
Under File and Storage Services, we can see the physical disks that we have added. If you don't see them right away, you might have to right click to Rescan for the new disks.



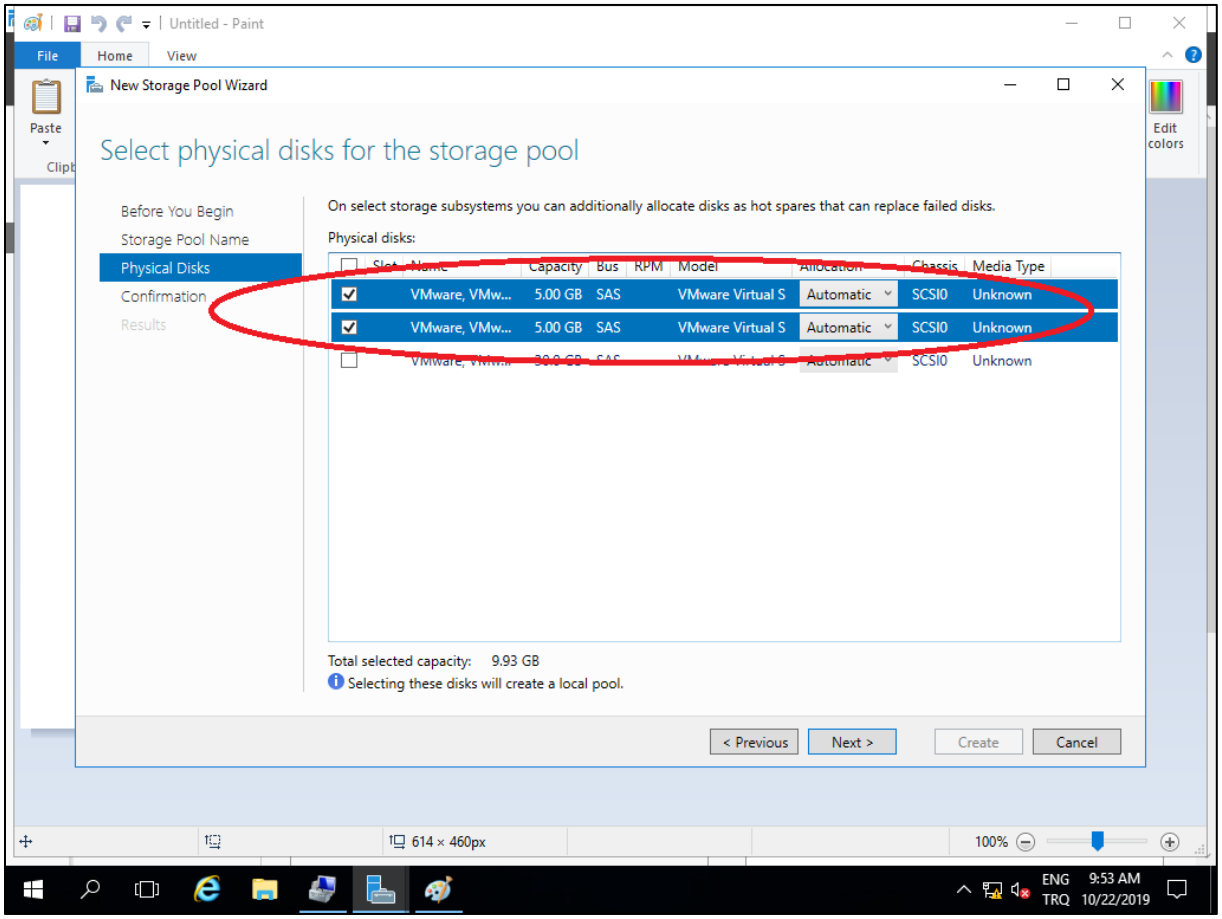
Then, we right click and click Create New Storage Pool.



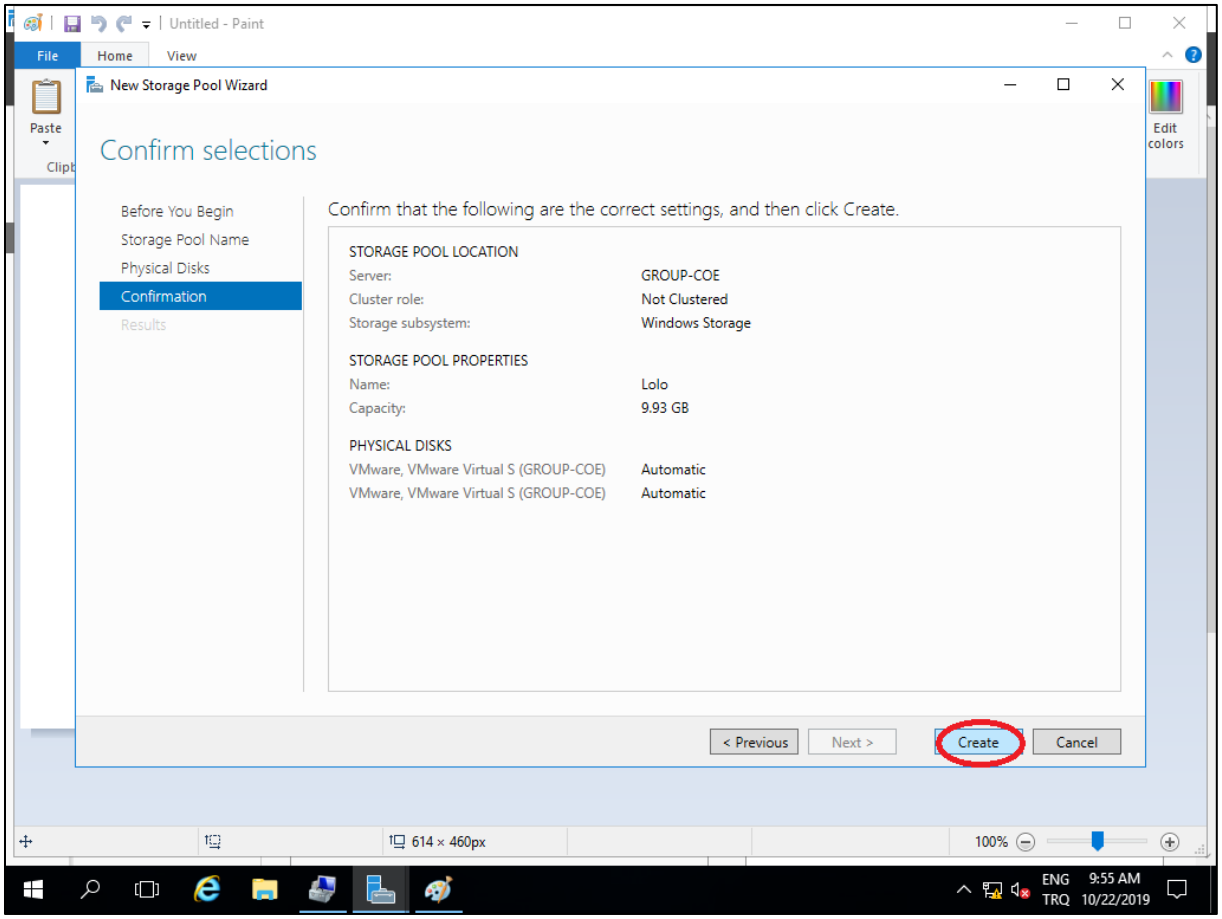
The Storage Pool Wizard pops up.



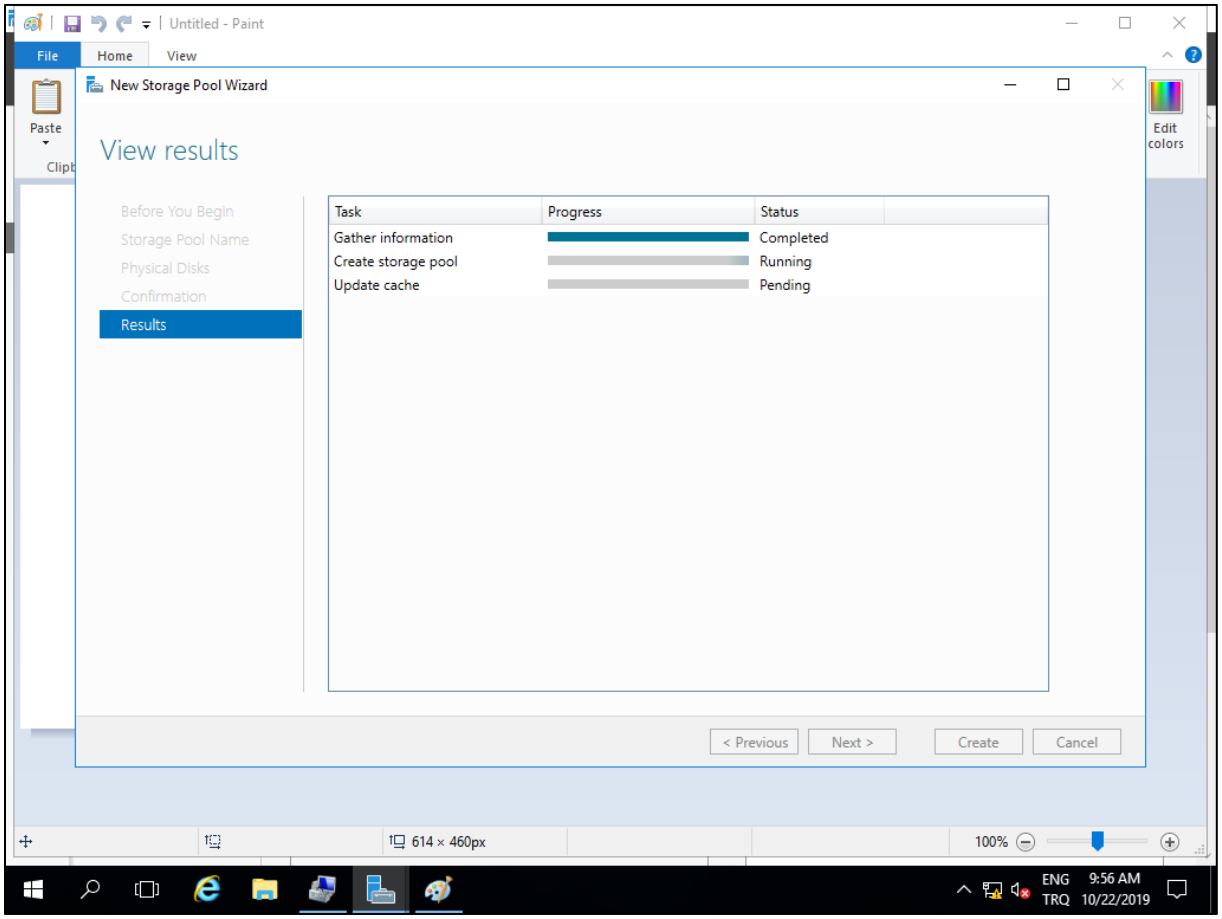
We select the physical disks to add to the pool.



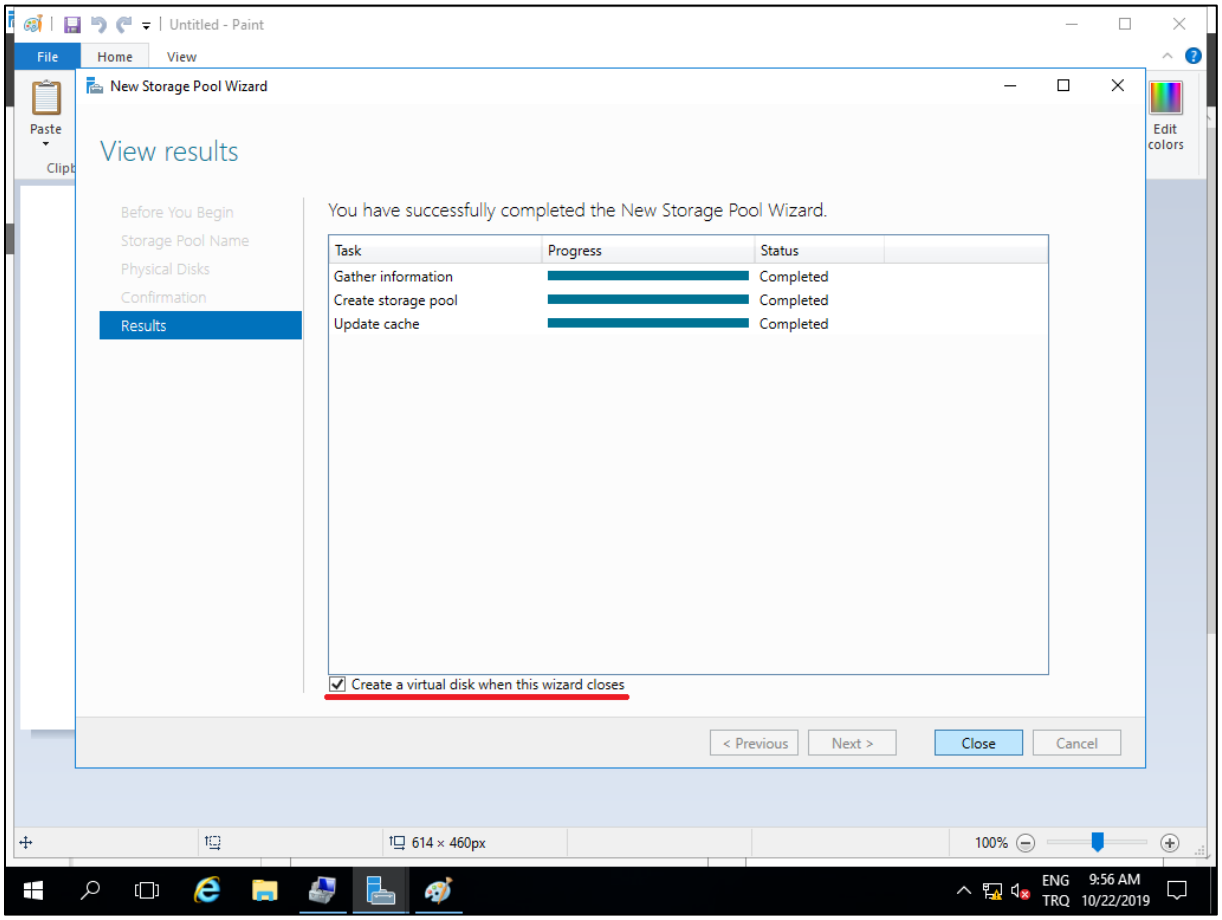
Then, we click on Create…



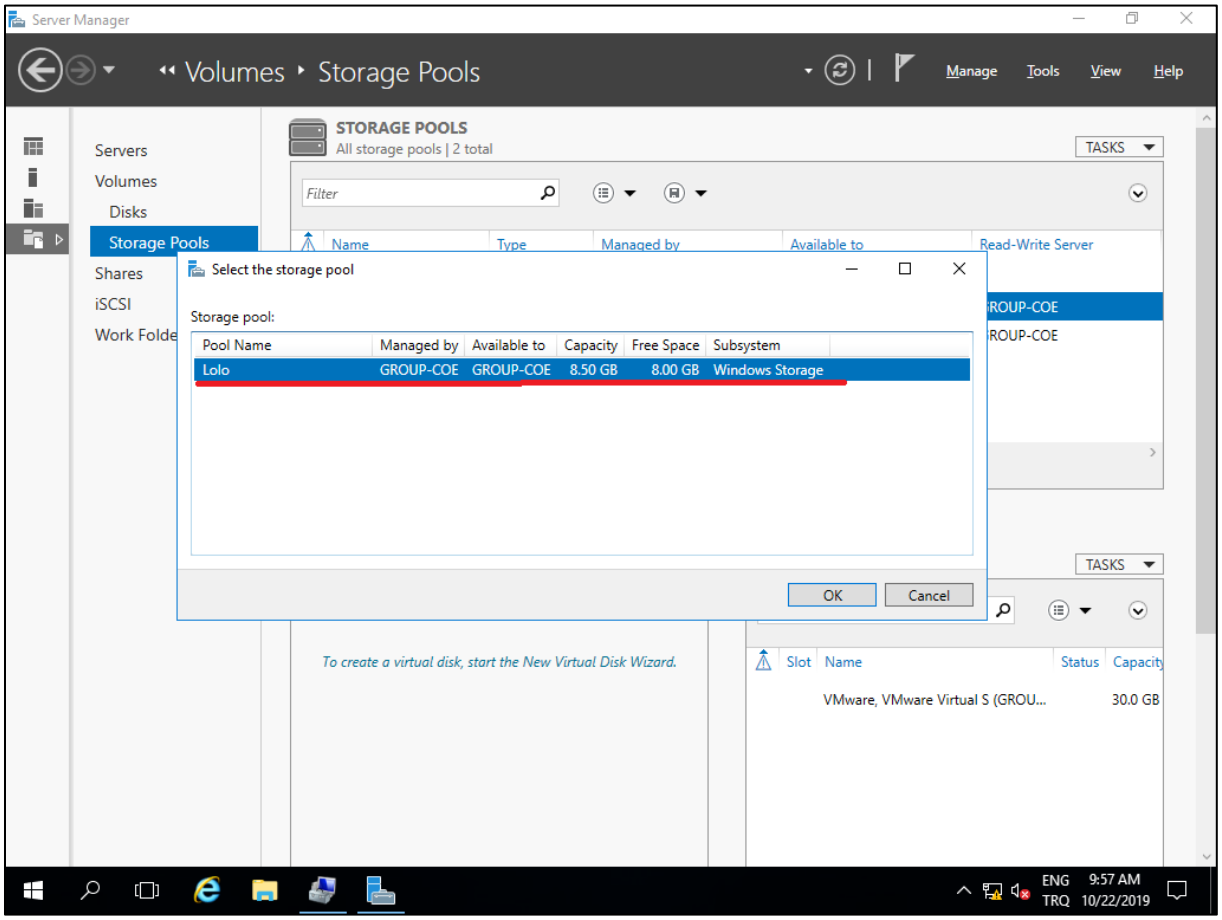
… and the process for creating the pool begins.



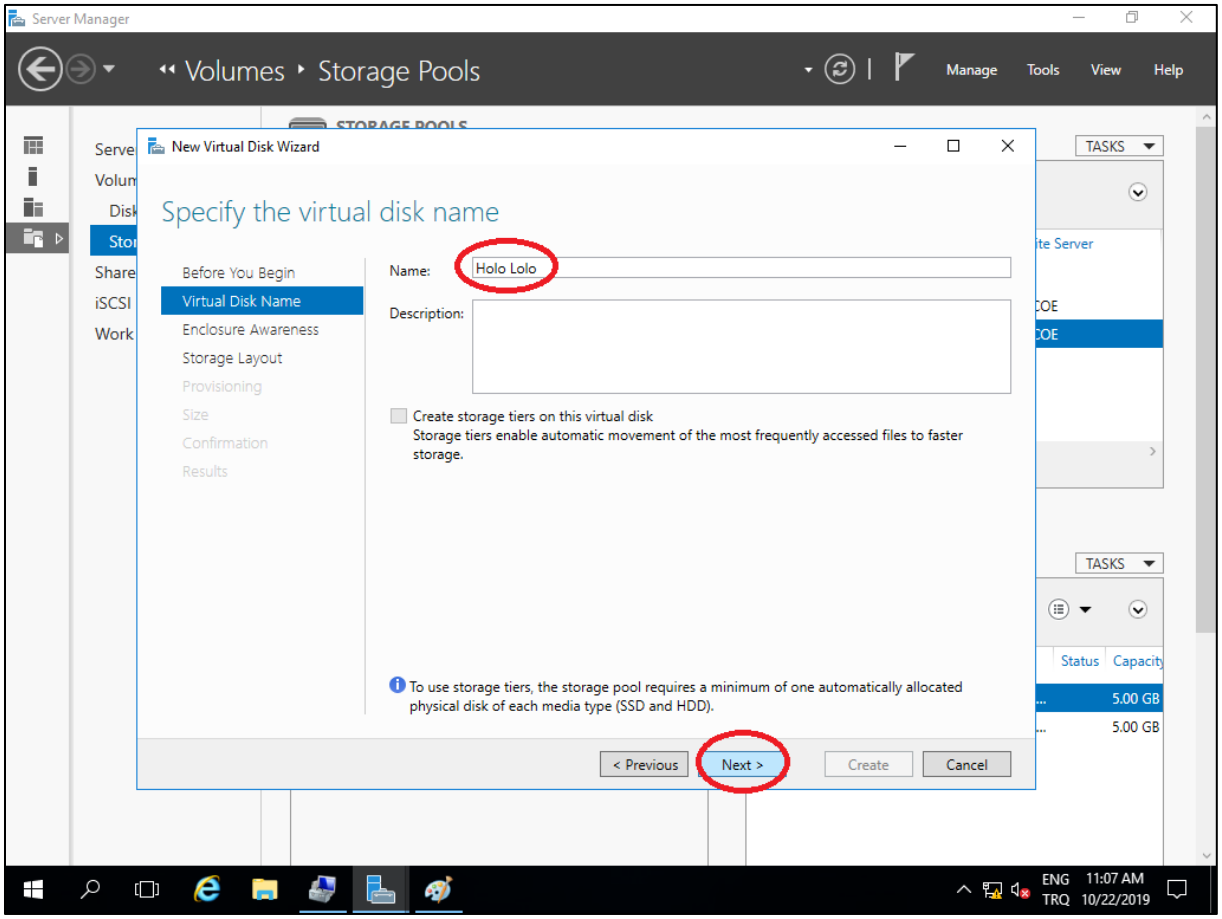
After the process is done, we can check the box at the bottom to directly proceed to creating the Virtual Disk but we could have also started it manually.



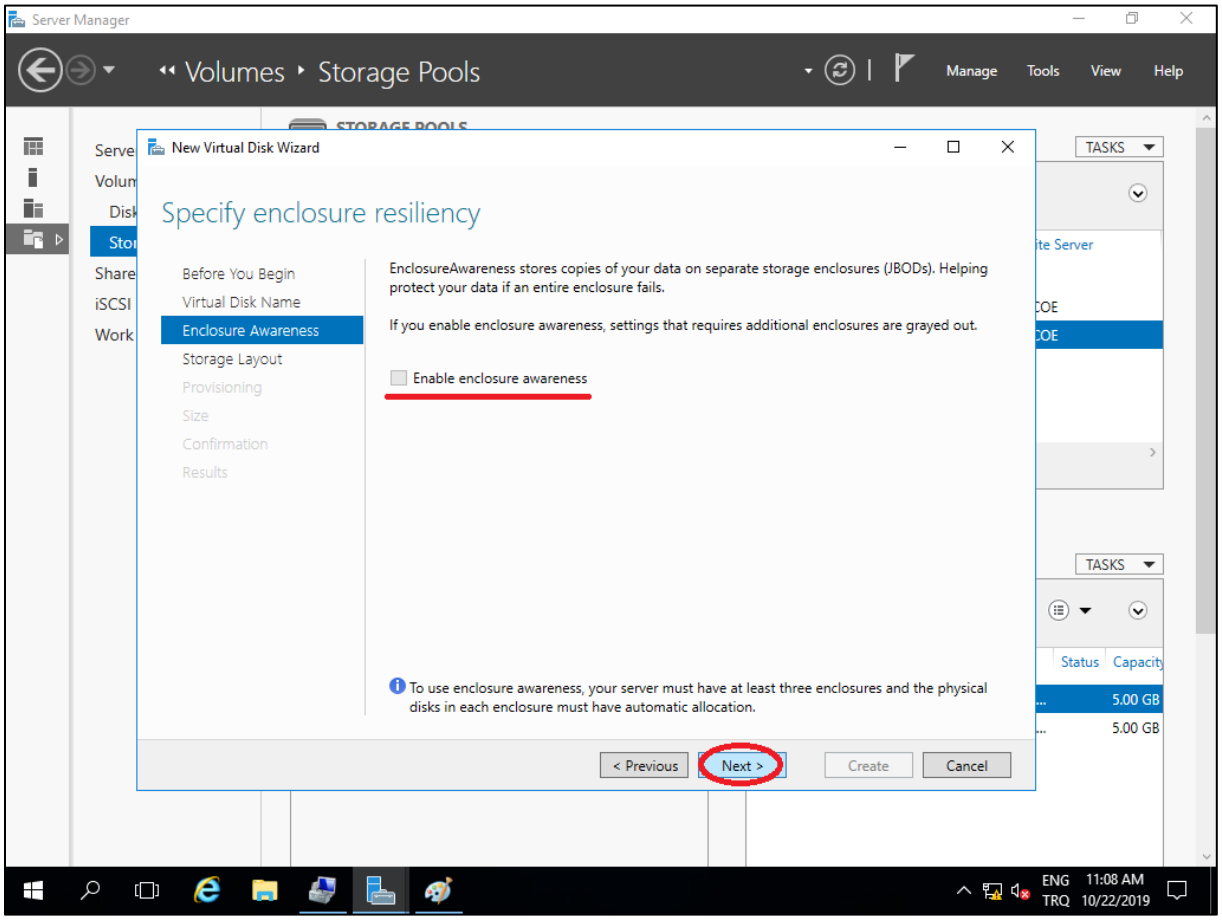
In the new Create a Virtual Disk Wizard, the first thing we do is to select our newly created storage pool.



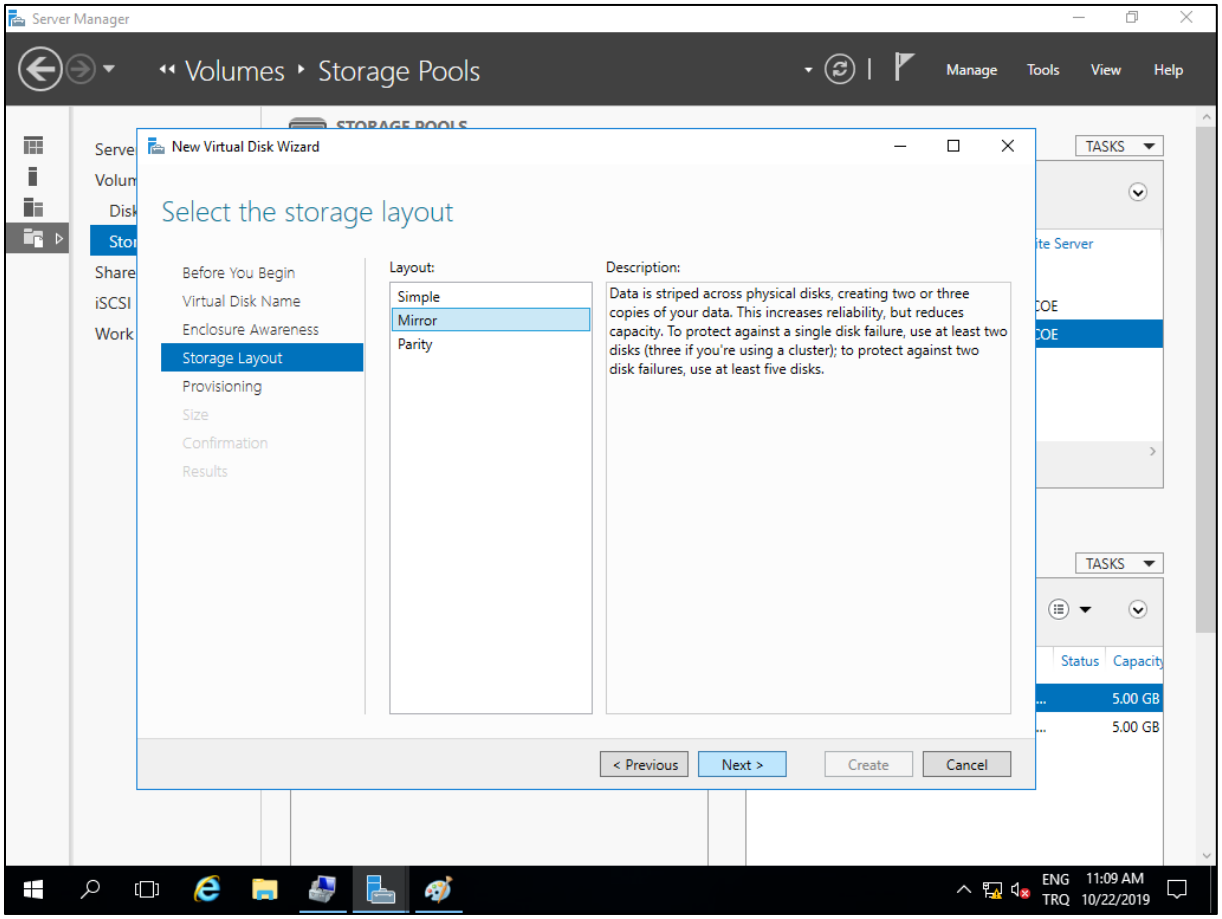
We name our Virtual Disk and proceed.



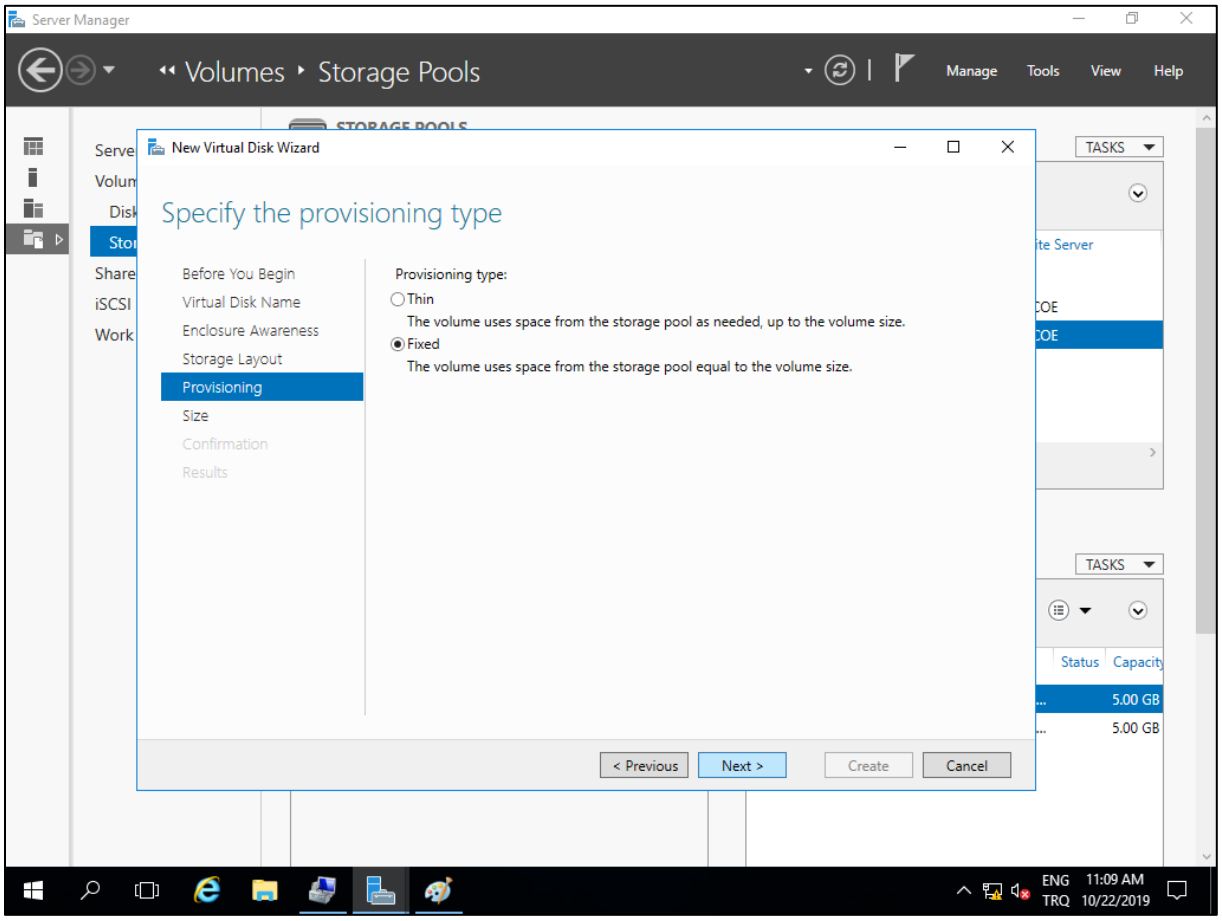
In here we didn't select Enclosure Awareness but we could have. Enclosure Awareness is related to fault-tolerance and selecting it would limit some of our following selections.



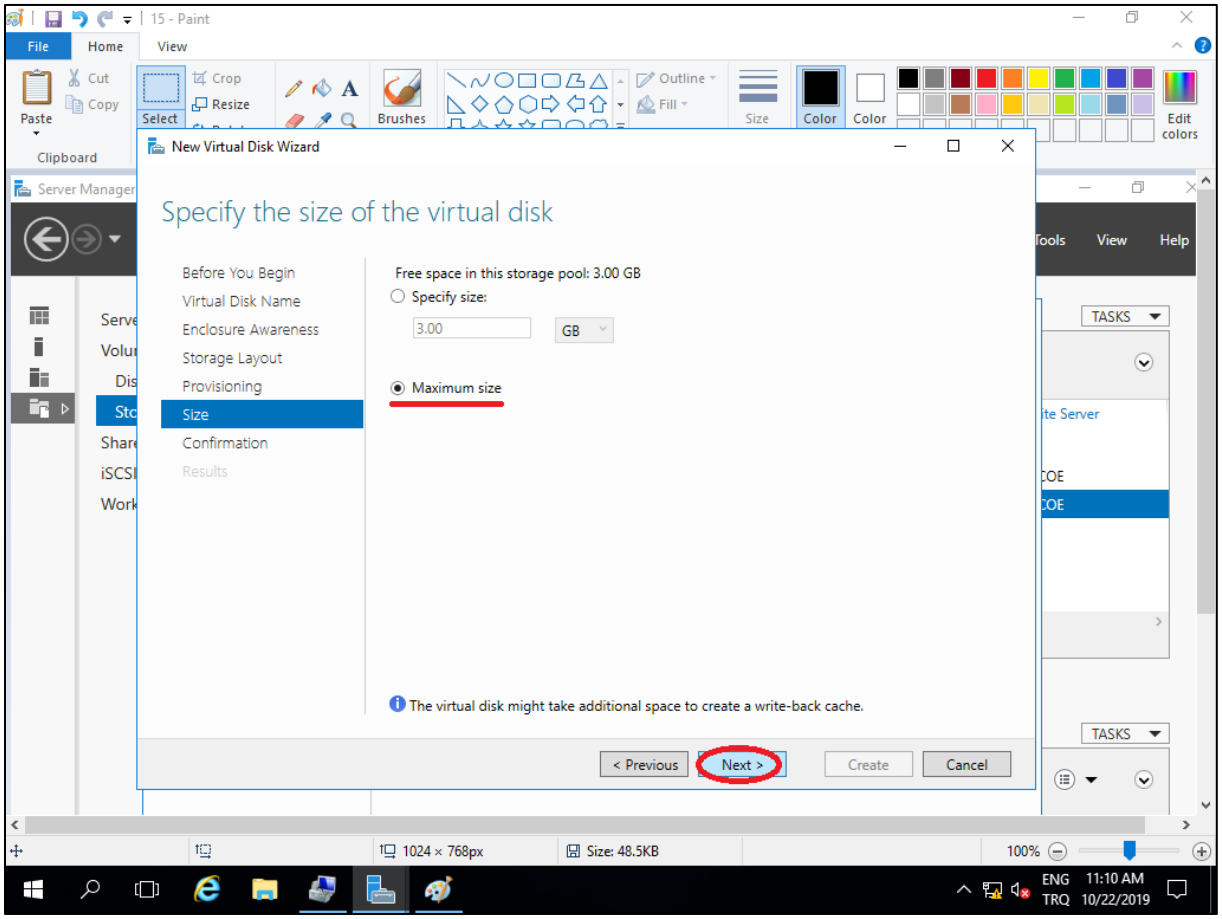
Then, we have various options for the Storage Layout, in this project we have selected mirror.



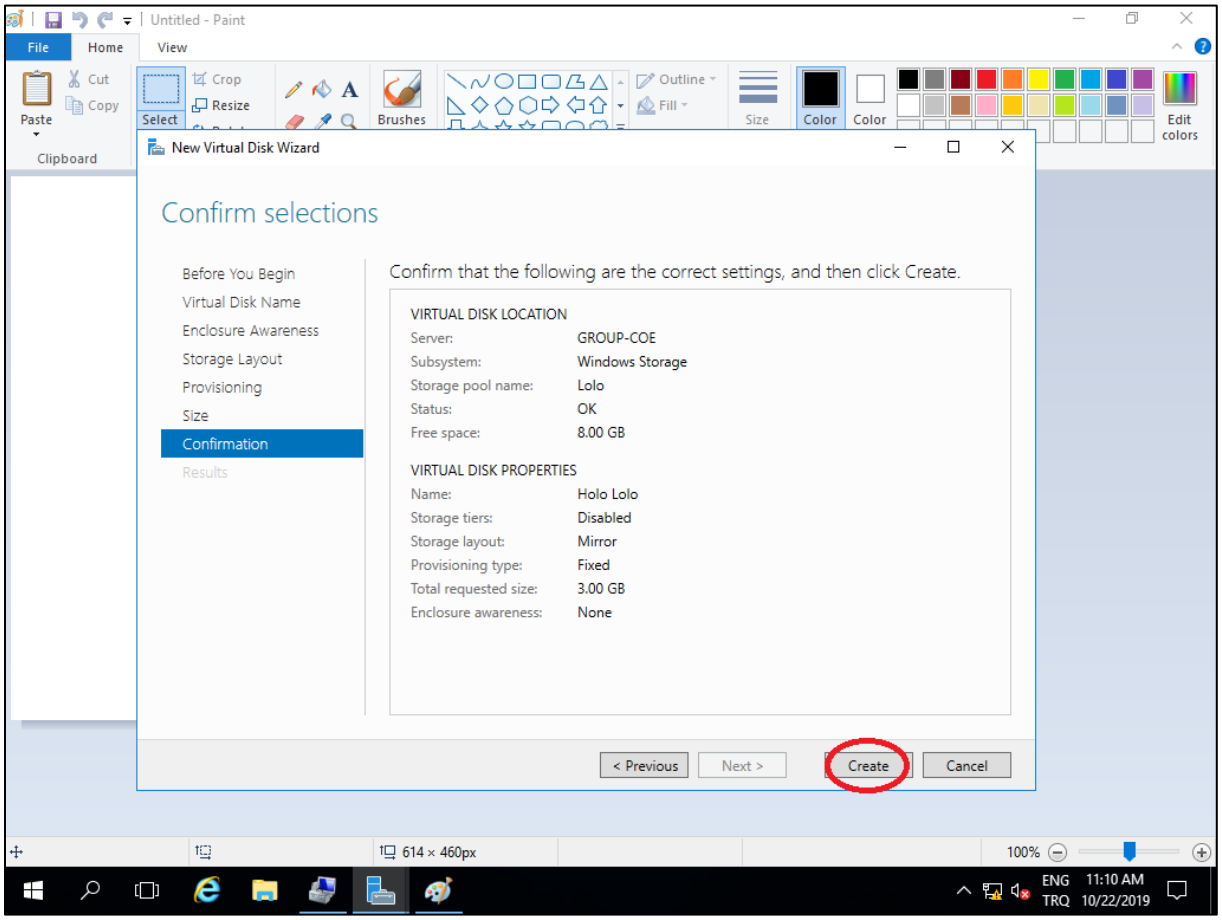
Then, we can select the provisioning, we have two options for that Thin or Fixed. Thin provisioning would mean that the volume uses space from the pool as needed up to the volume size. In Fixed provisioning, the volume uses space from the pool equal to the volume size. We selected Fixed because we wanted to give maximum amount to the volume.



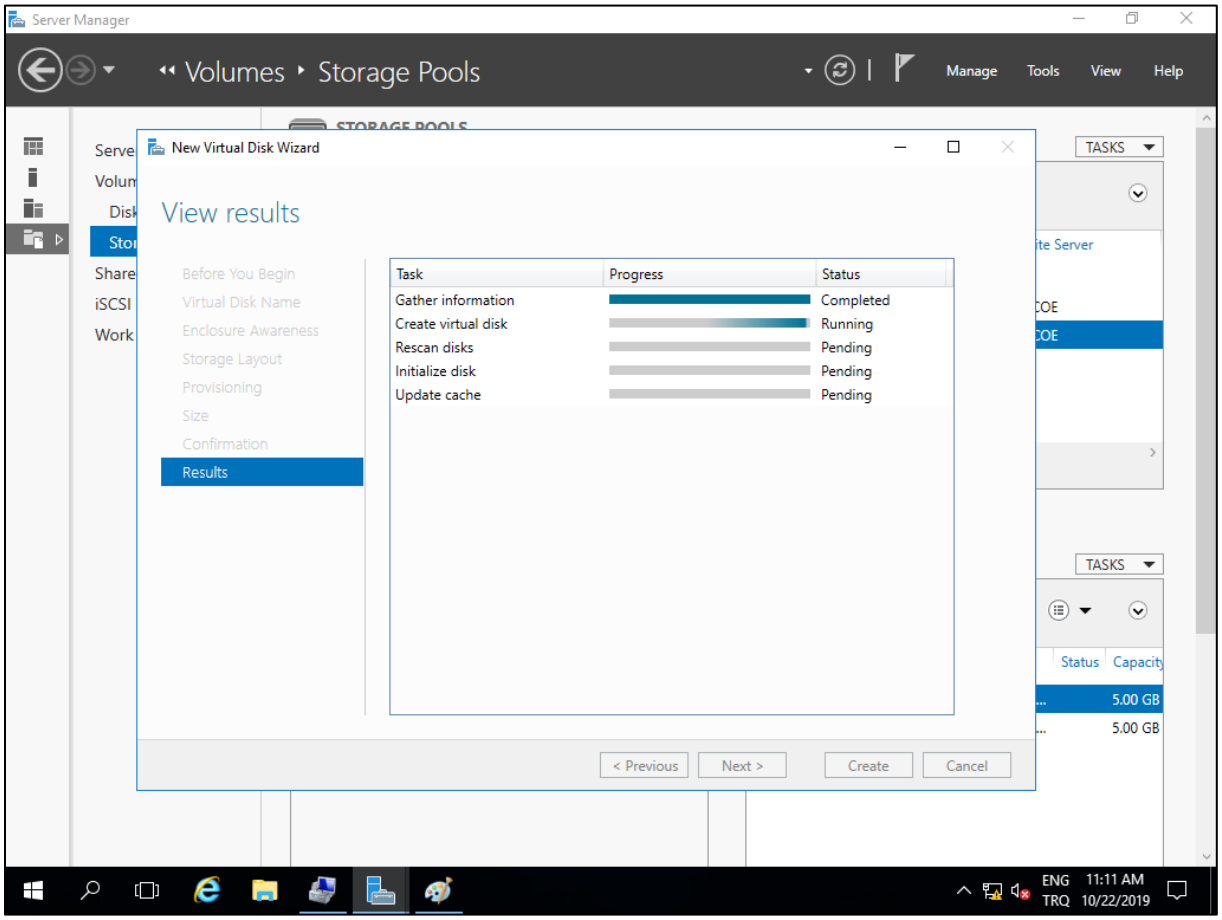
We select the maximum size and proceed.



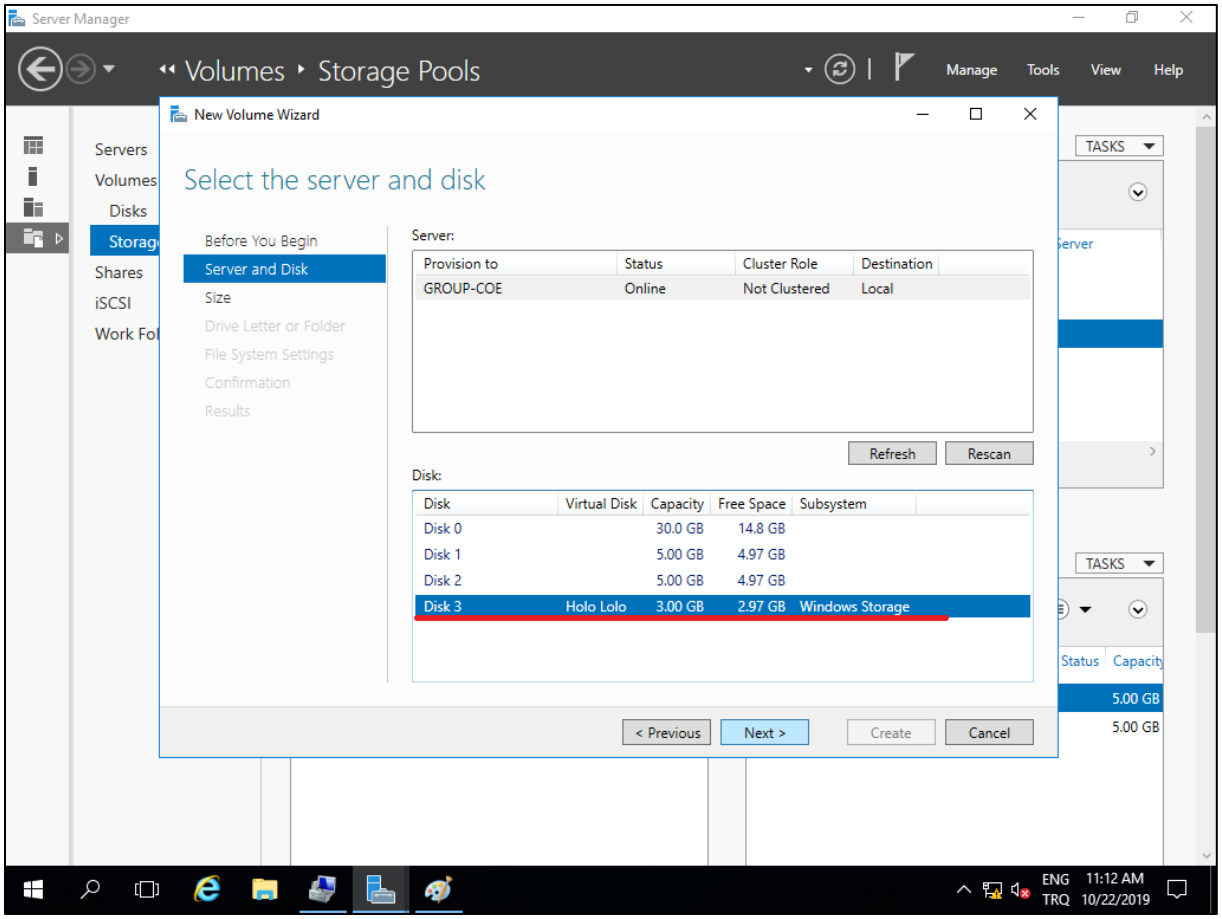
Again, we get a summary of our selections and can create the actual virtual disk creation by clicking on Create.



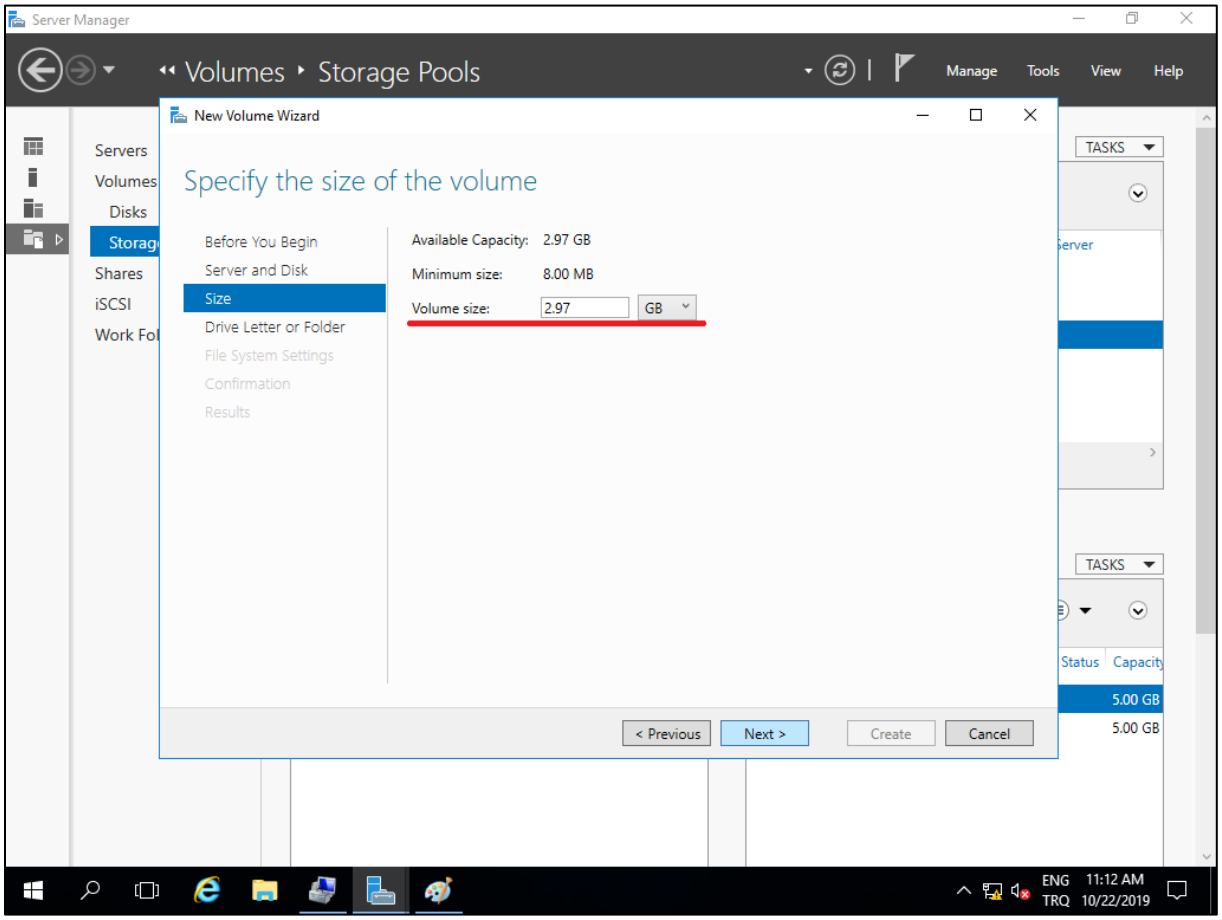
The creation process completes. At the end of it, if you click on the box at the bottom you can directly proceed to the creating a disk by using the virtual disk. You can do this manually too.



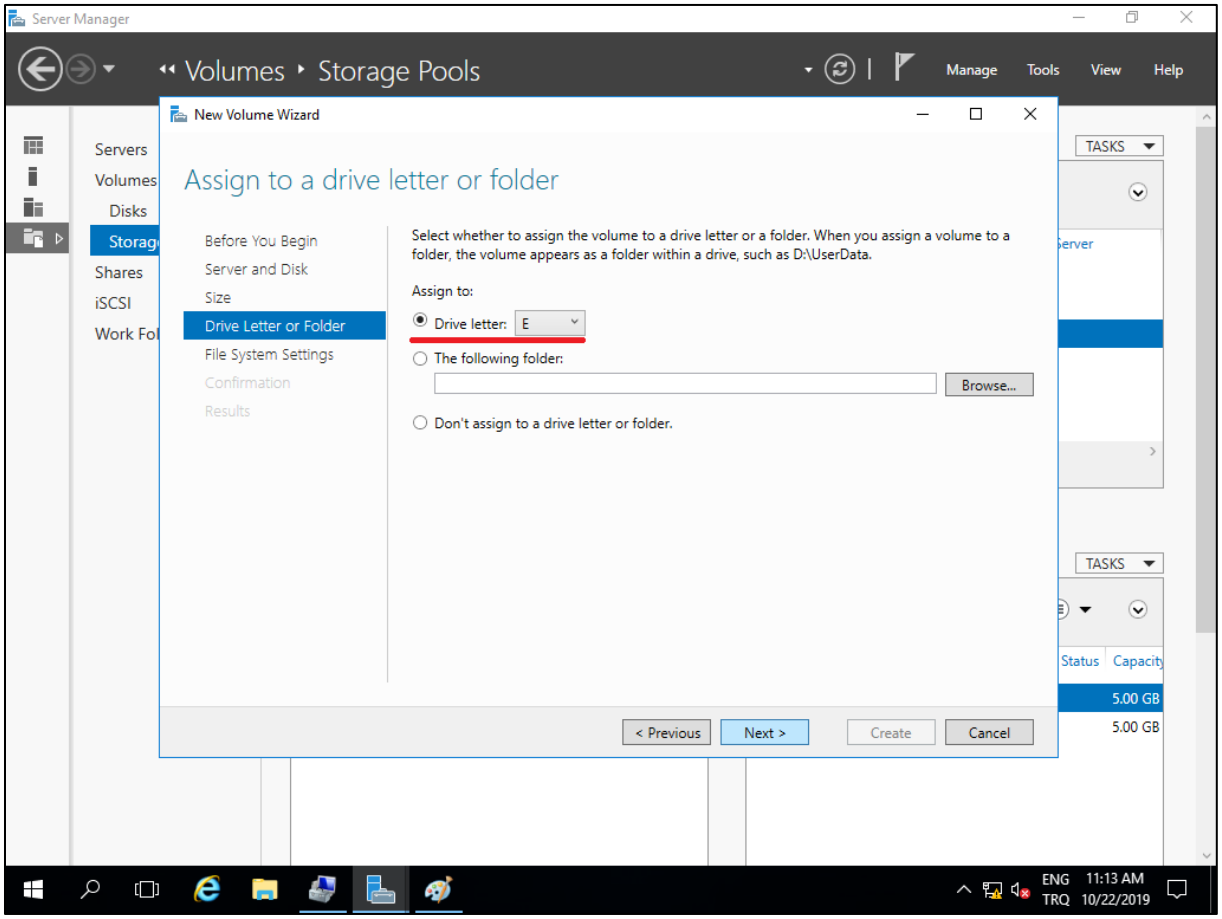
In the New Volume Wizard, we select the new Virtual Disk.



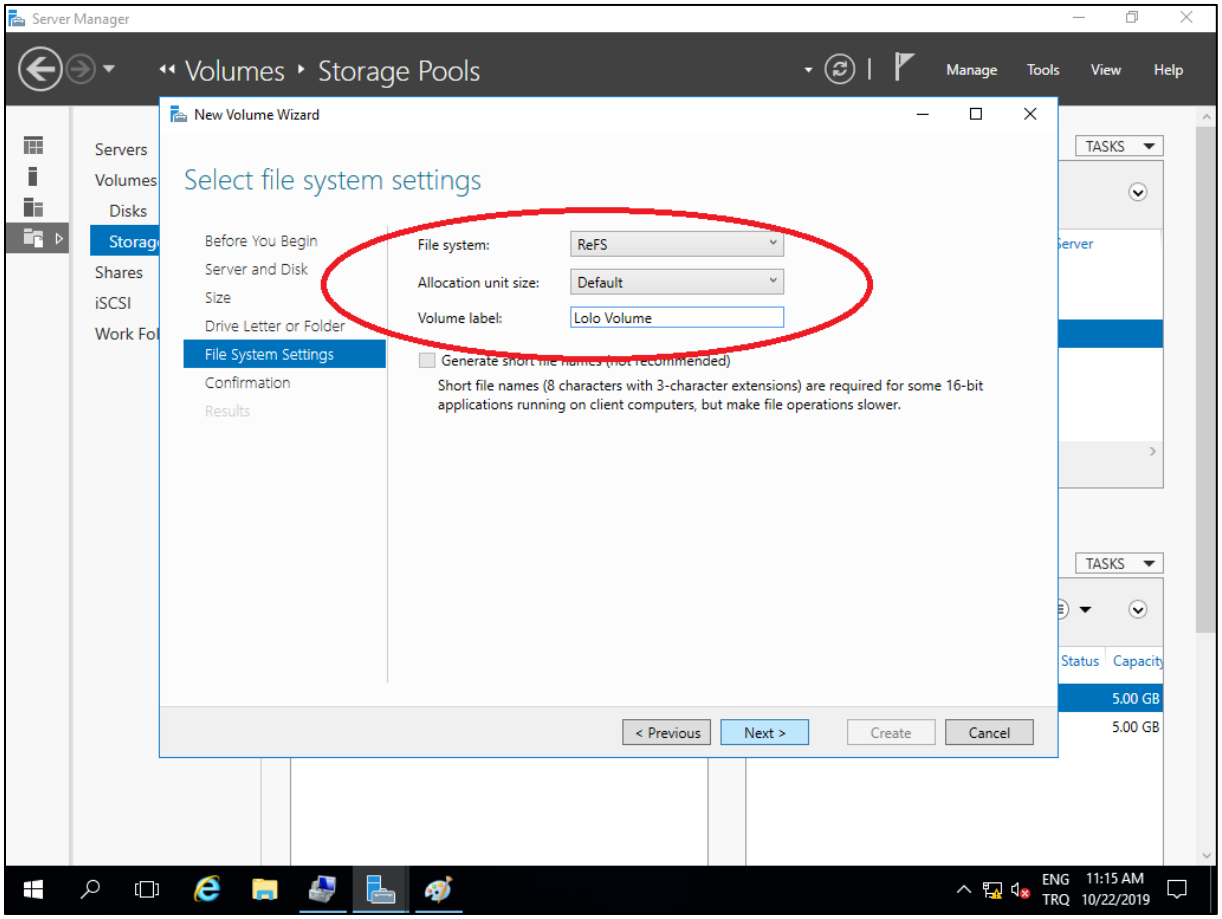
We determine the maximum size for this volume. We have selected to create a disk with all of the Virtual Disk's empty space.



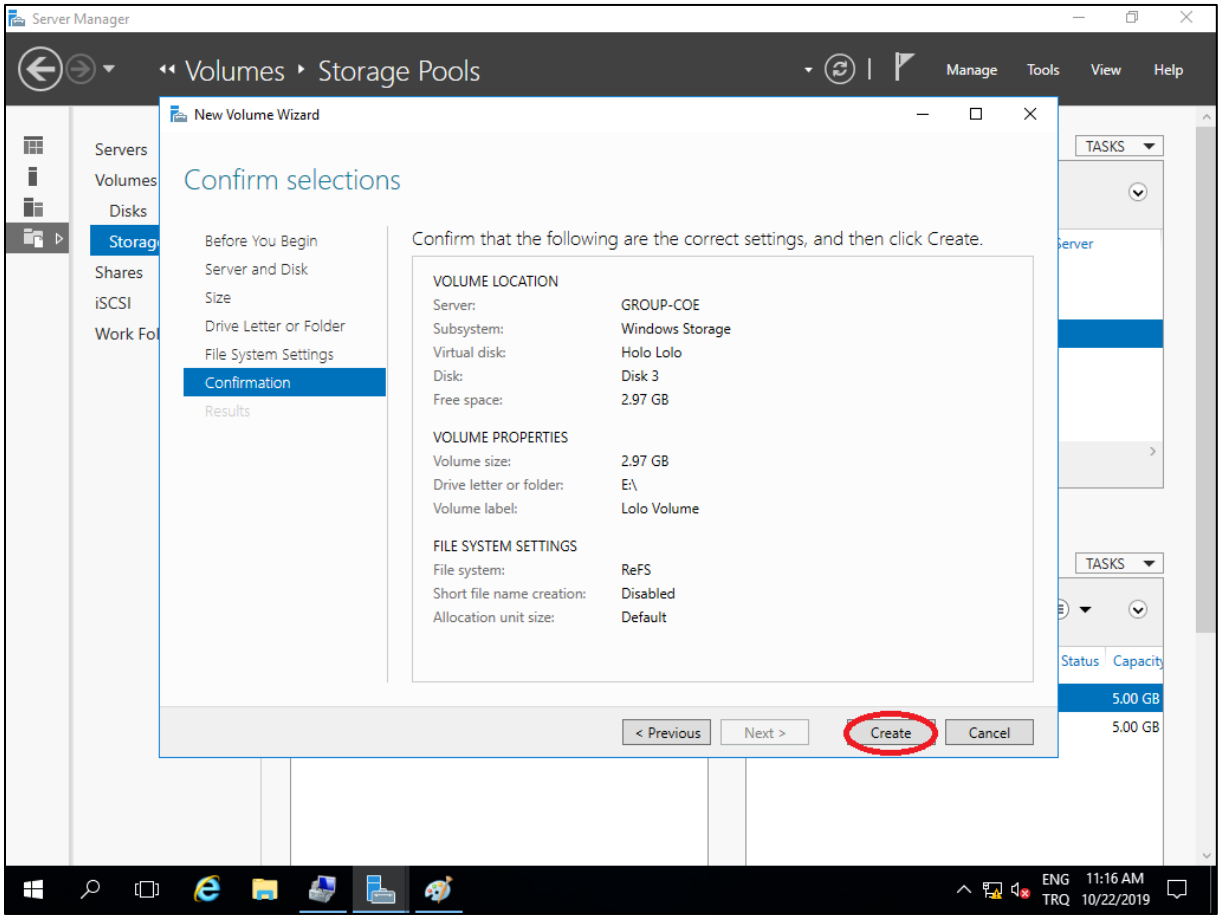
We assign a letter to the drive.



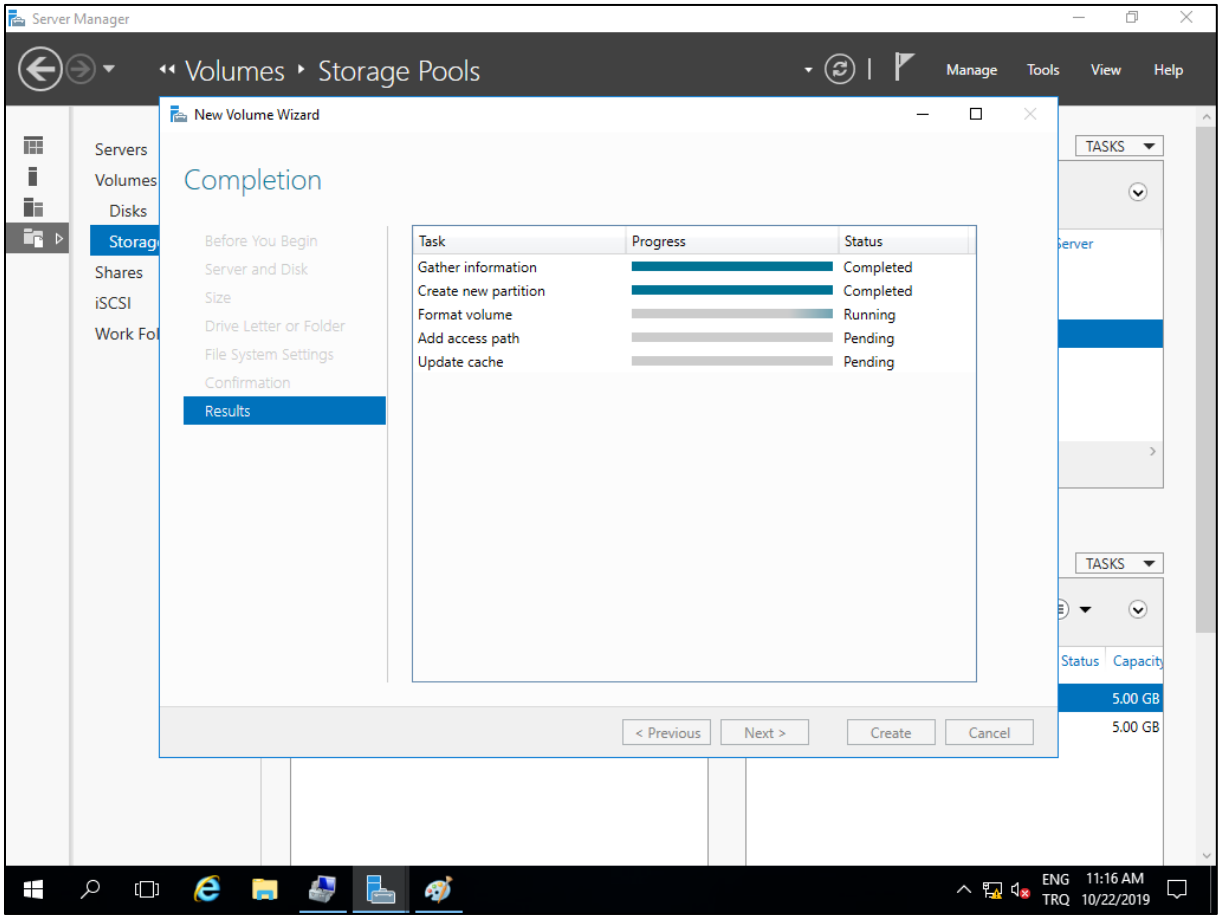
We select the file system (we've selected ReFS instead of NTFS) and name our new volume.



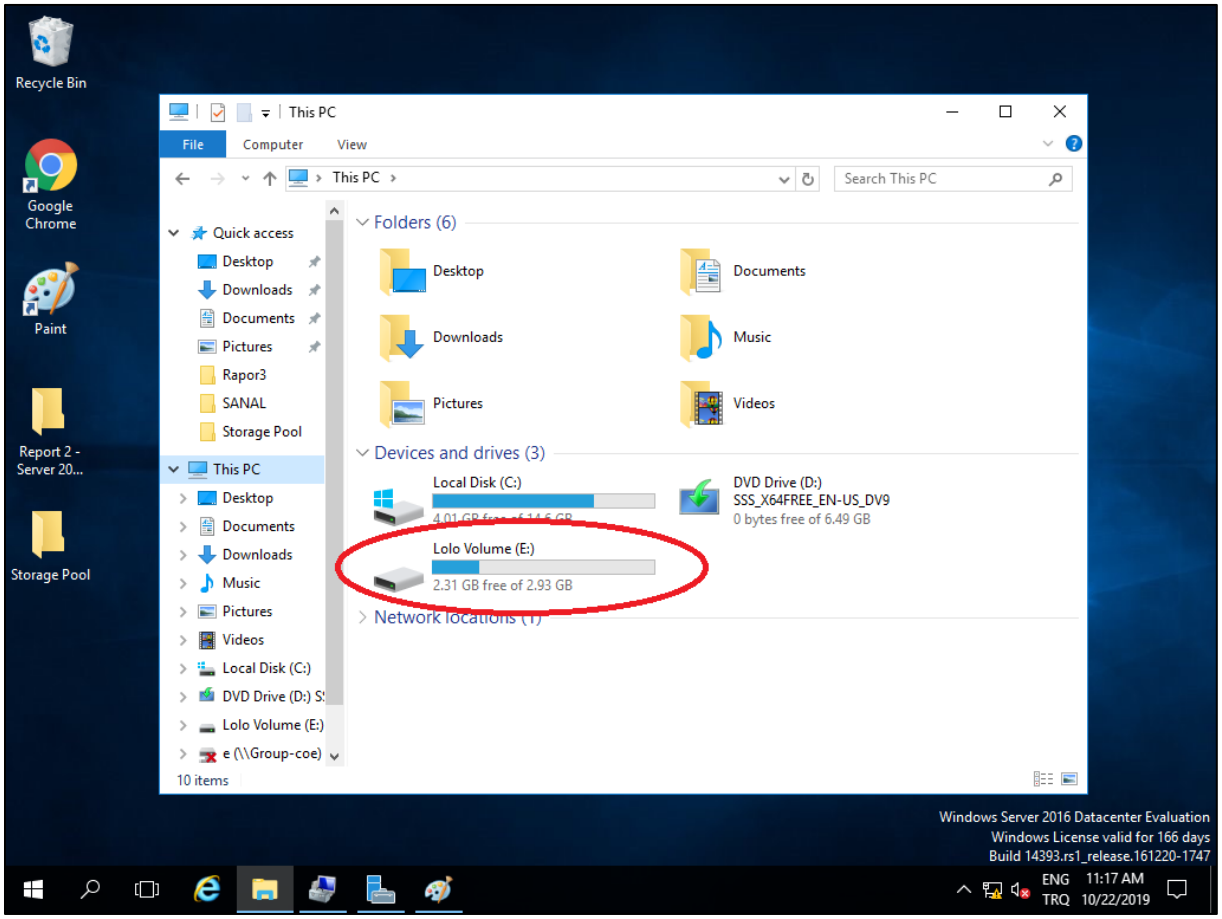
Again, we are faced with a summary of our choices and a Create button.



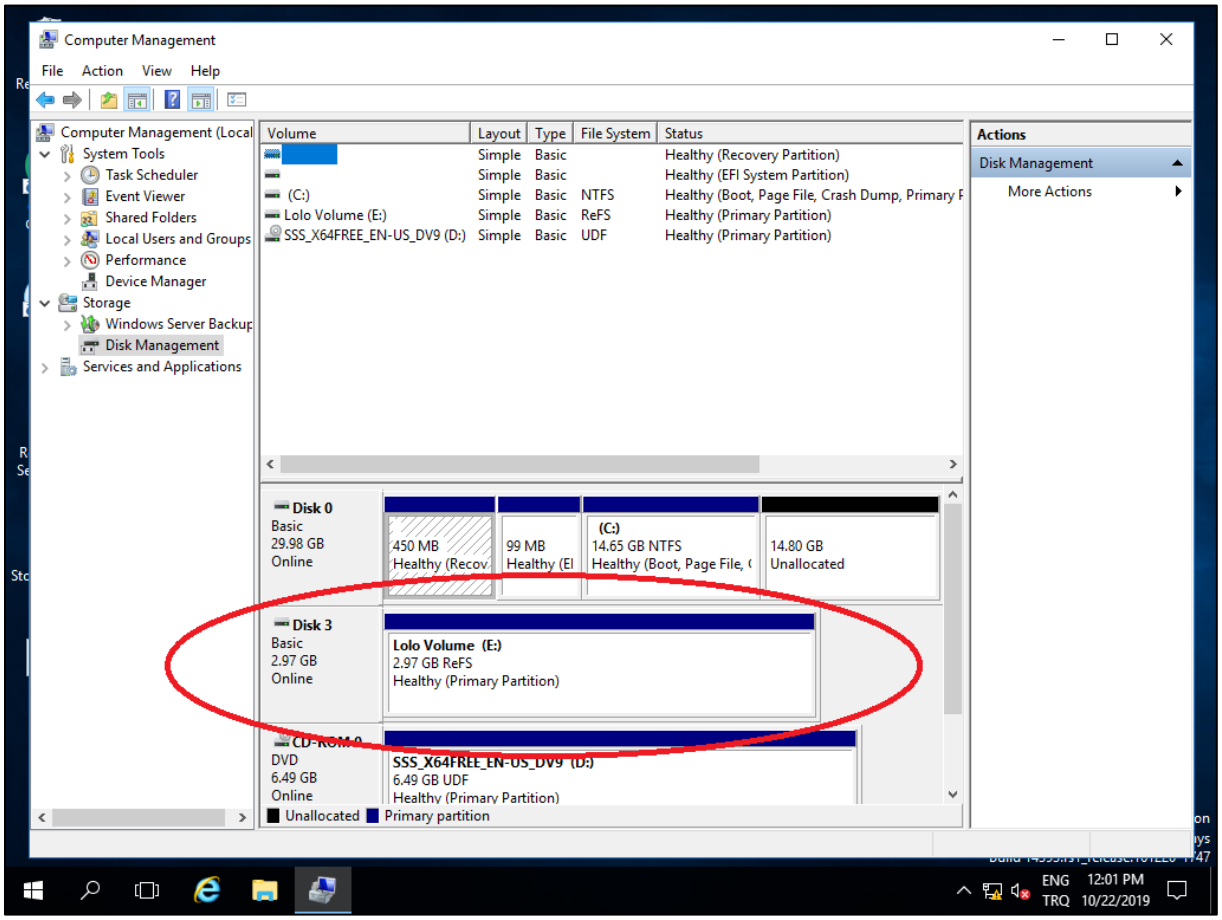
Again the creation process begins and completes…



… at the end we have a new drive.



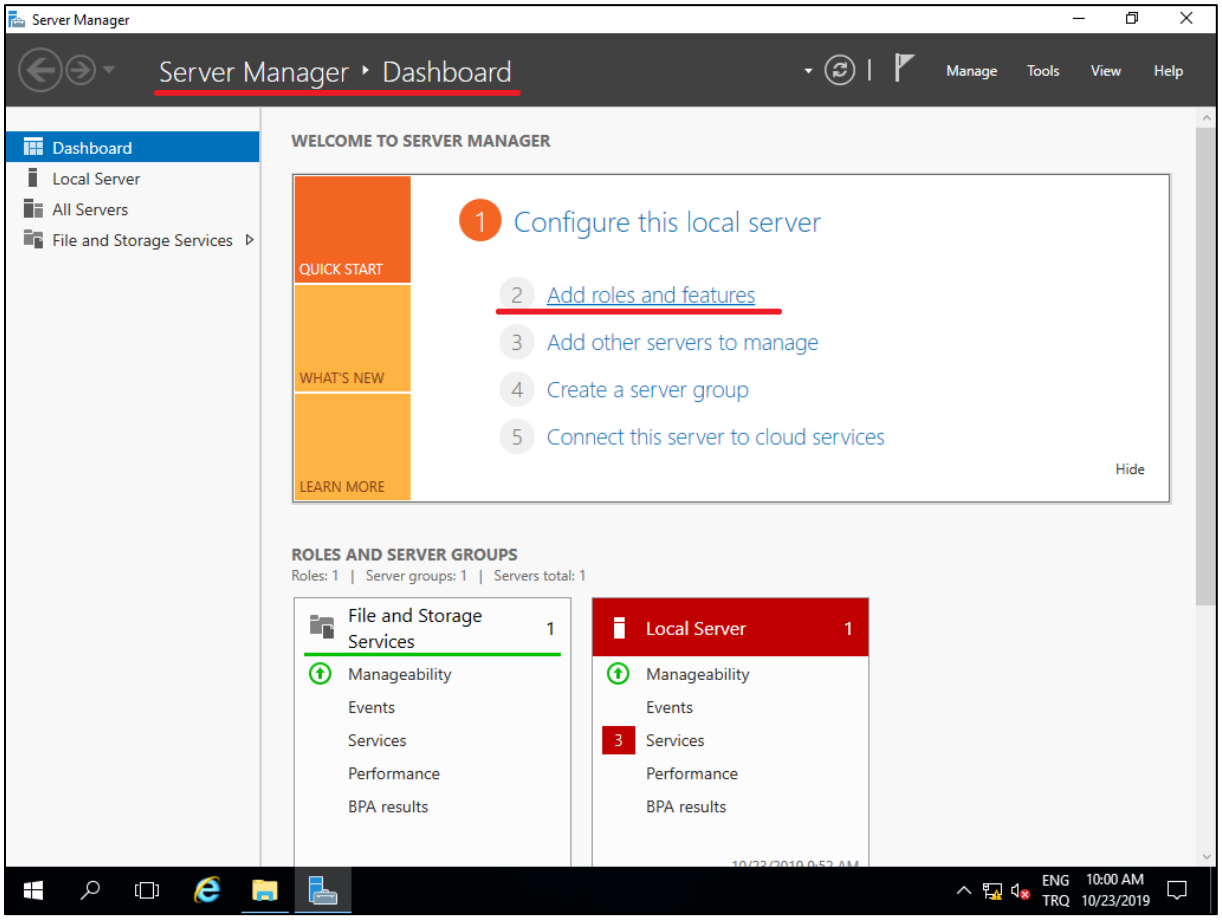
We can see under the disk manager that, multiple unallocated physical disks we had have been turned into one disk with our previously chosen specifications.



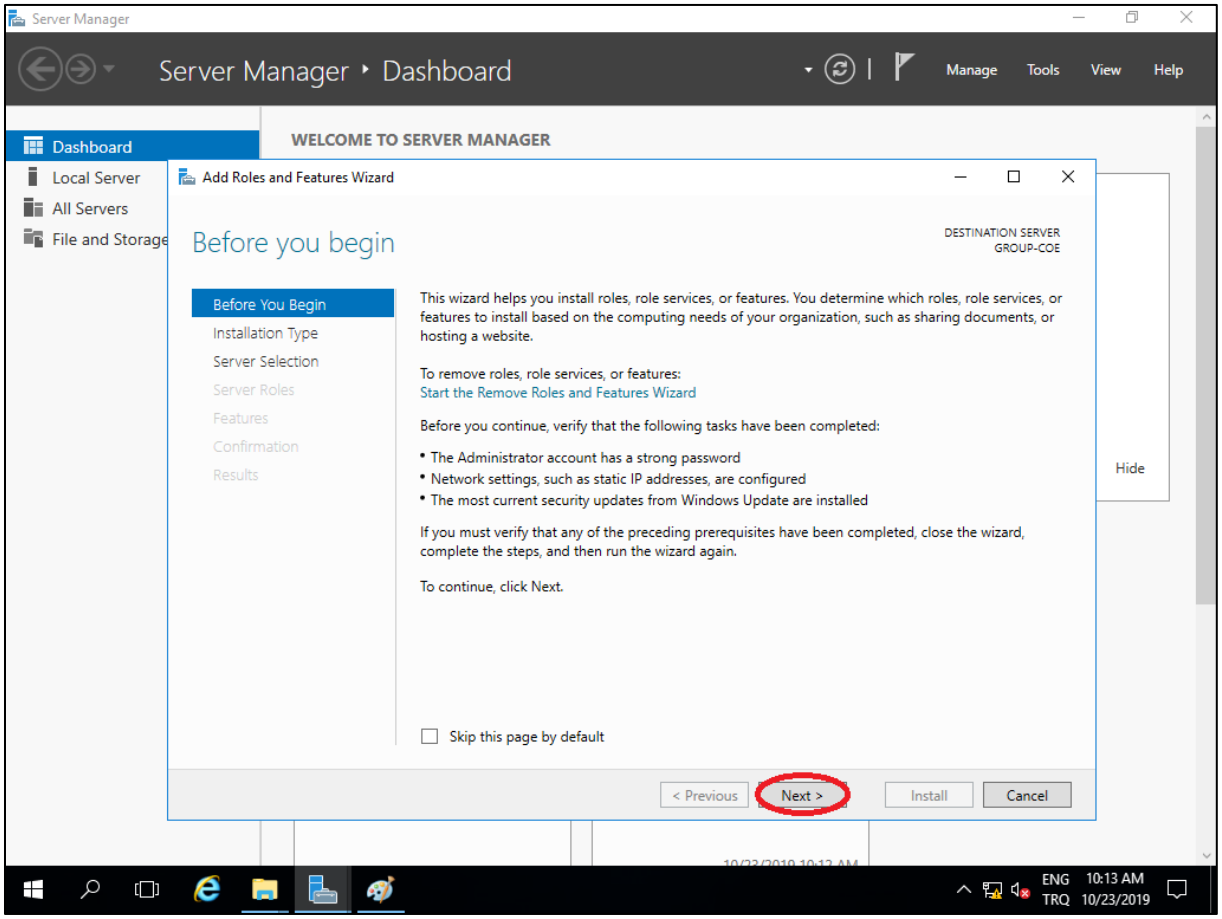
This completes this part of this project.

V. Data Deduplication

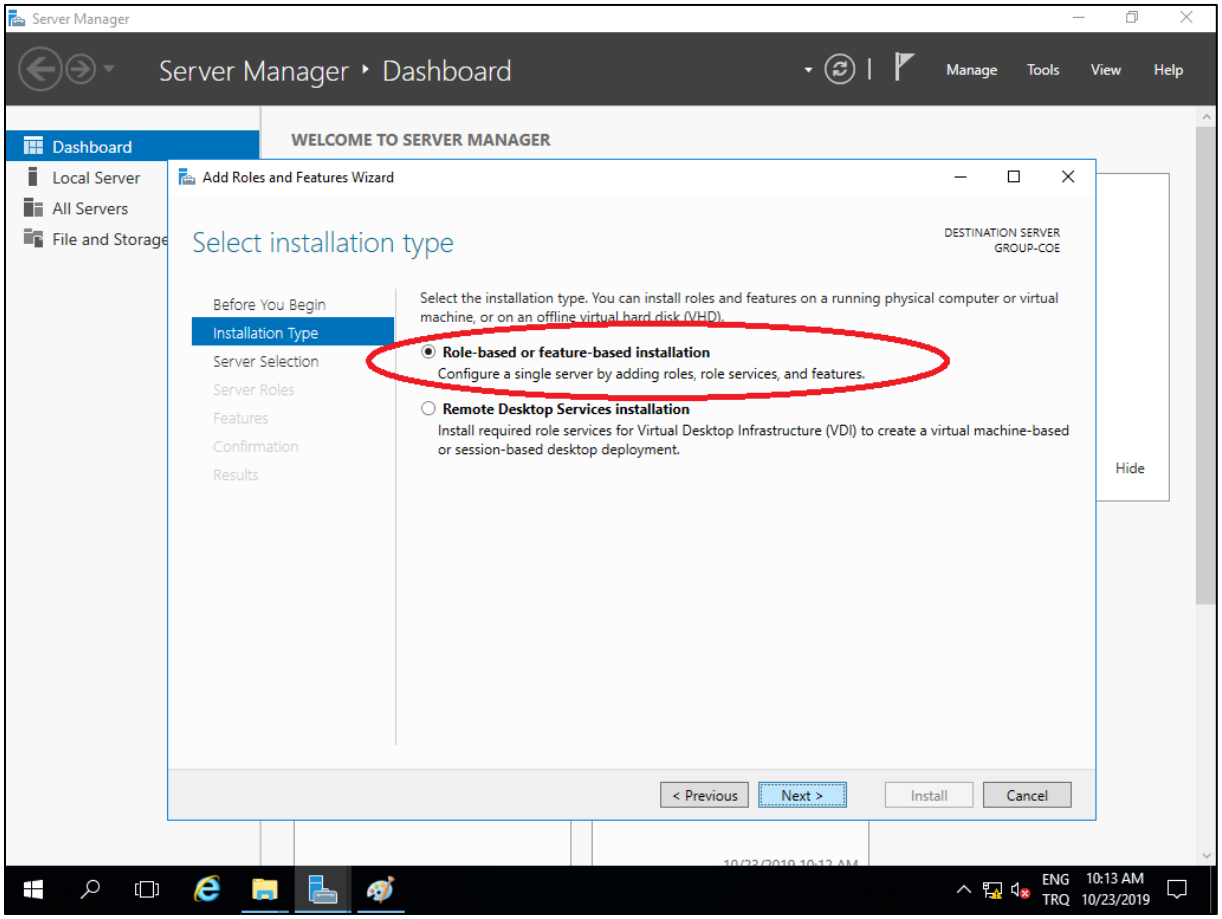
In this part of the project we will be doing an example of Data Deduplication. Firstly, we need to click on Add roles and Features at the Server Manager-Dashboard to install the Data Deduplication role.



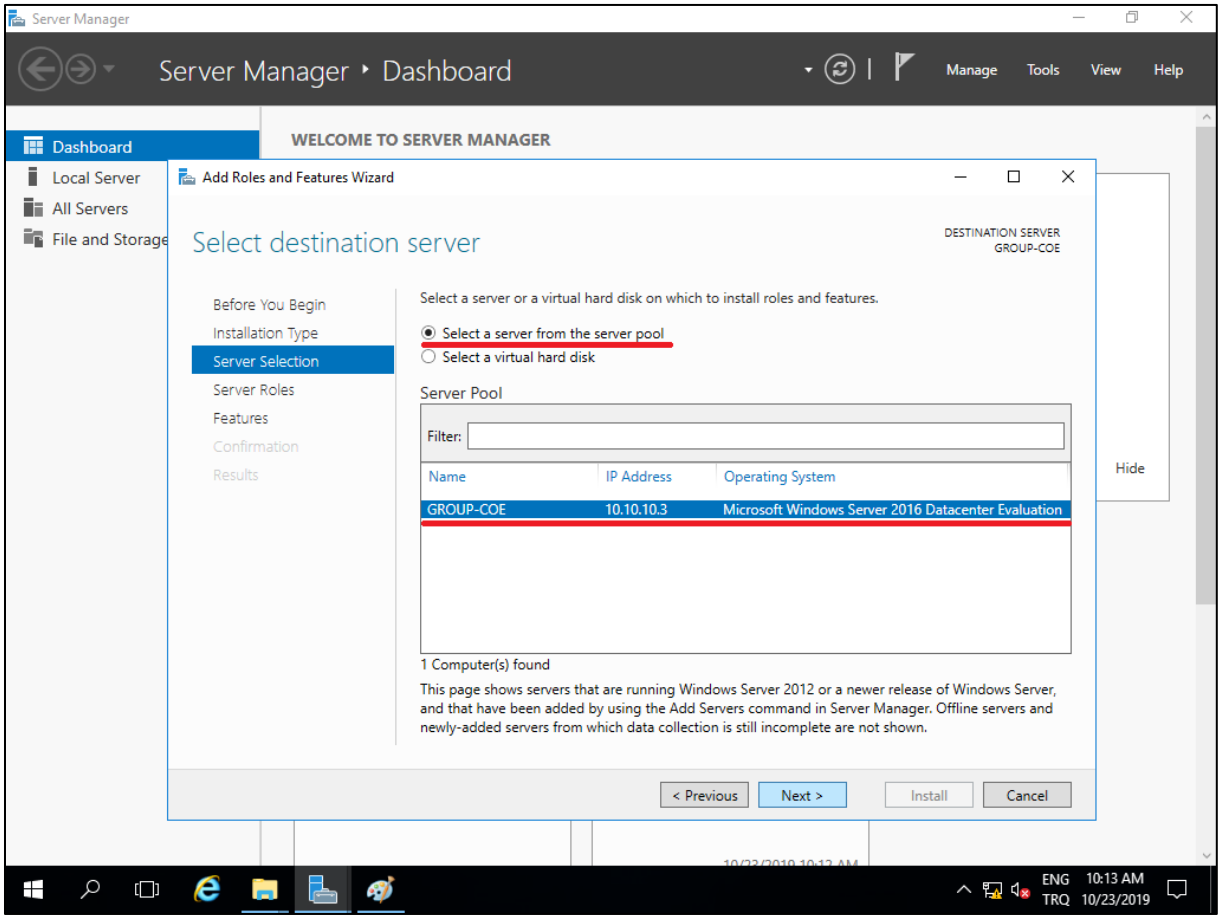
A wizard pops up.



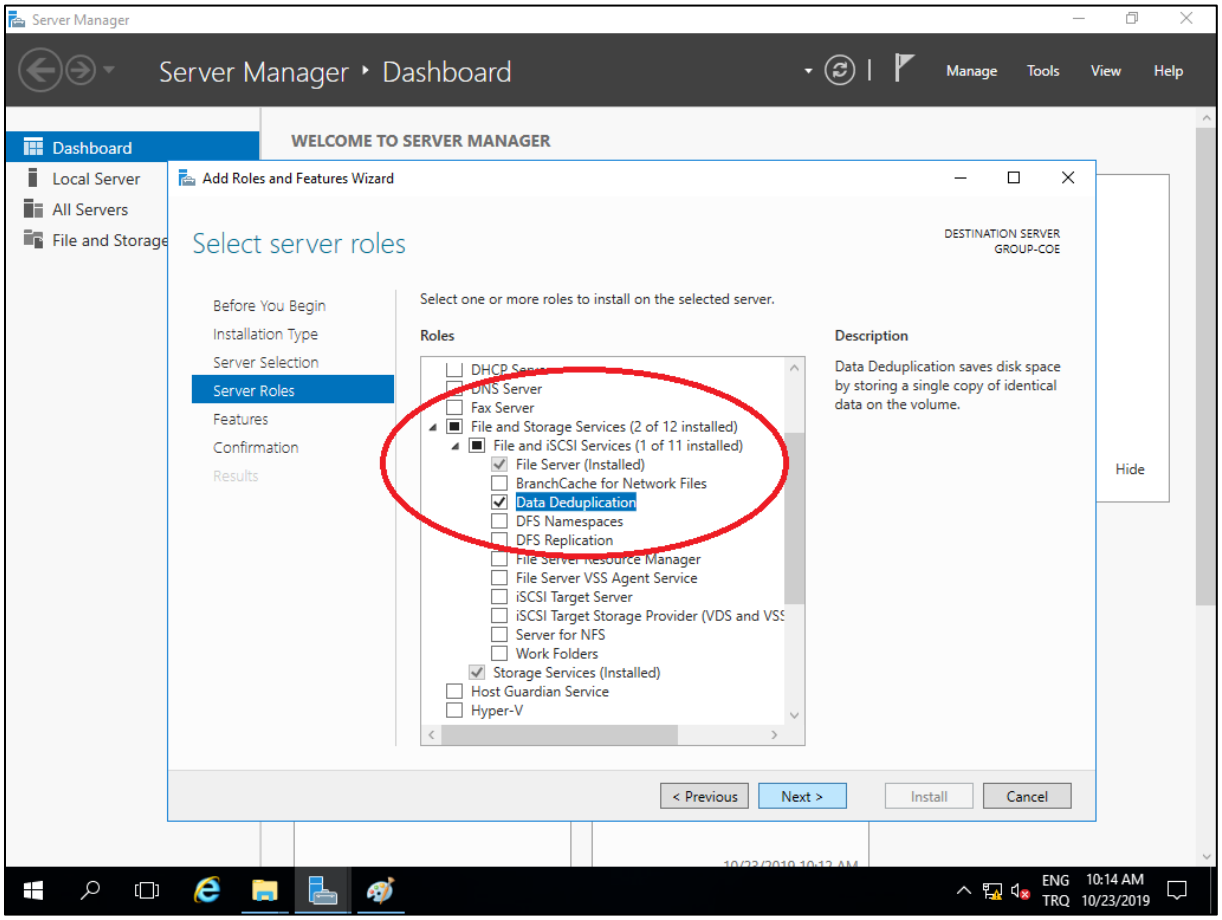
We select role-based or feature-based installation process.



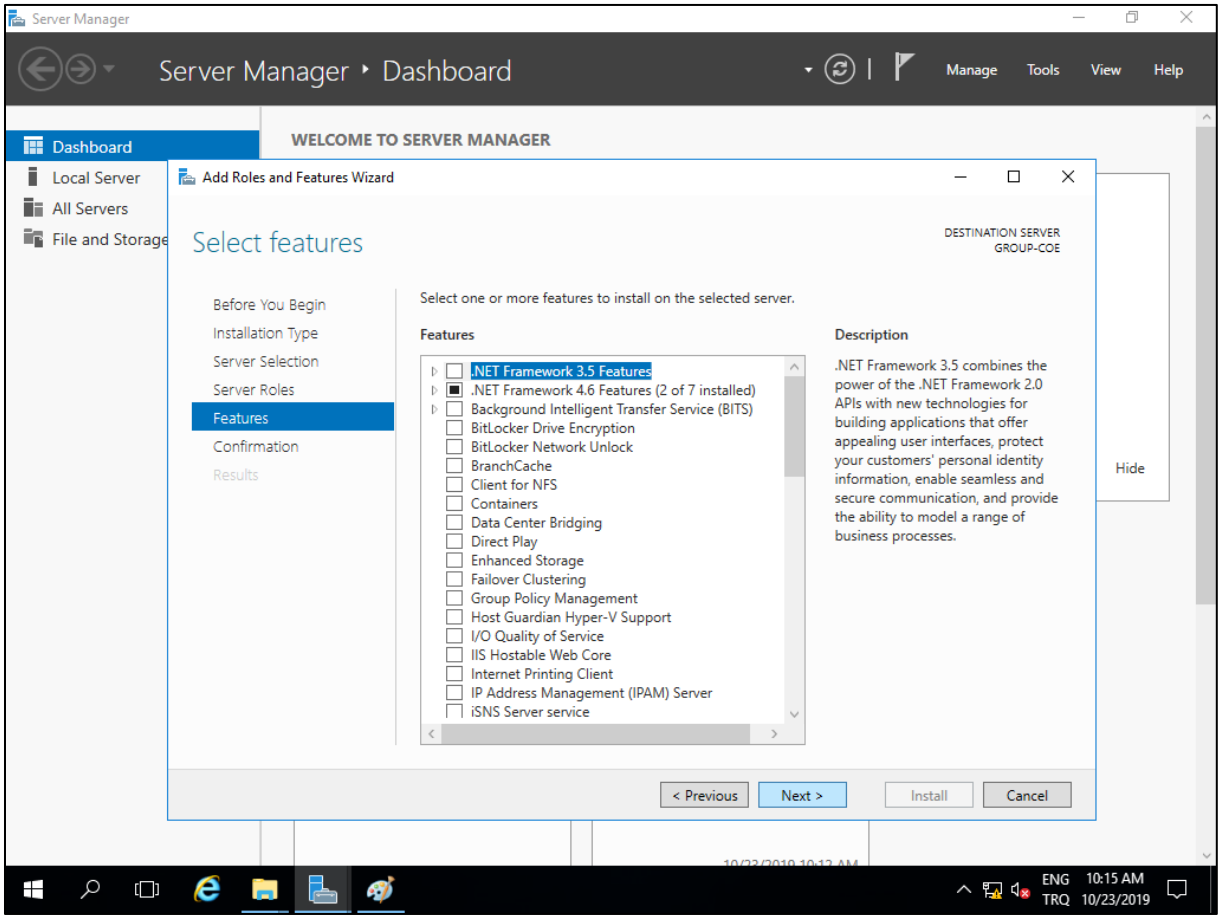
We select the server that we want to do the Data Deduplication in.



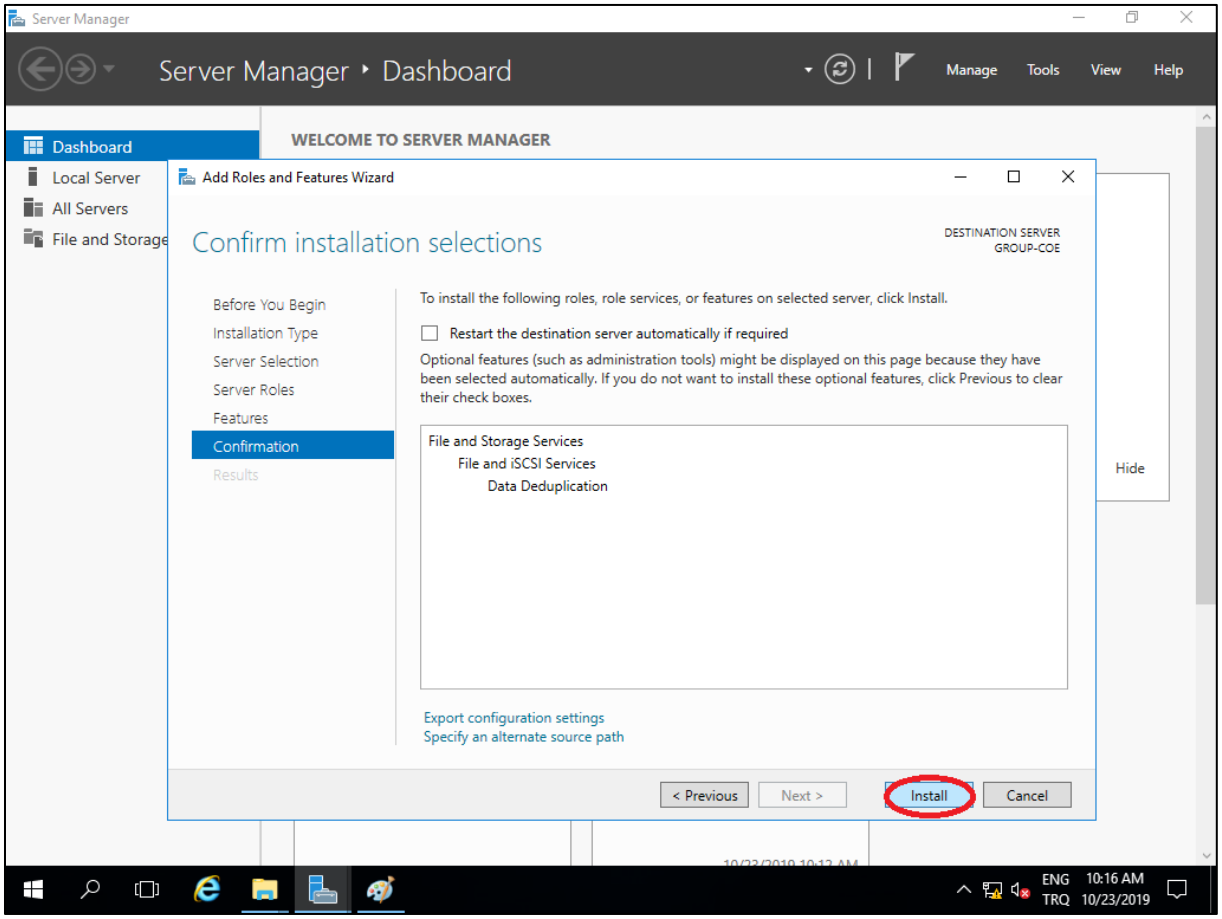
Under File and Storage Services and under File and iSCSI Services we select Data Deduplication and proceed to features.



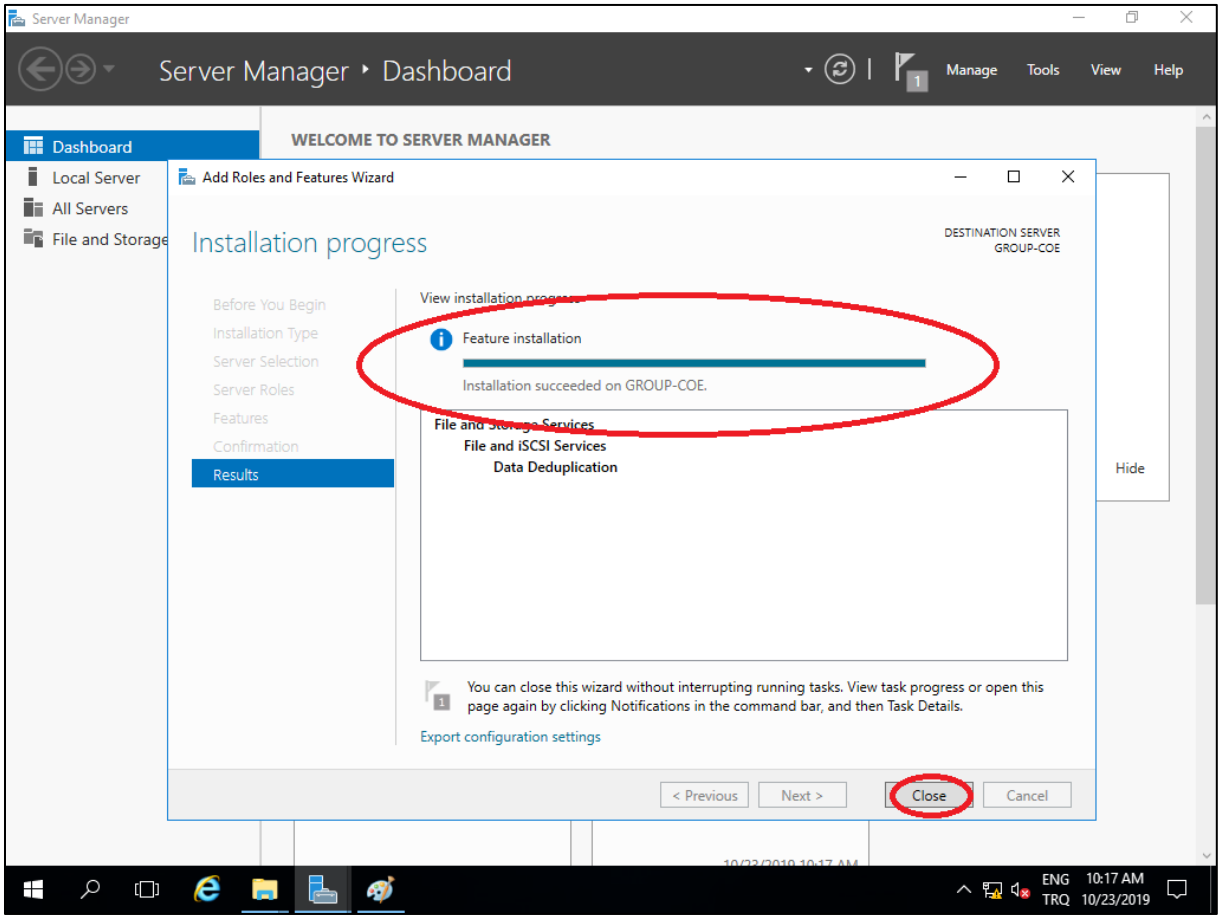
We don’t need any features at this moment so we select nothing here.



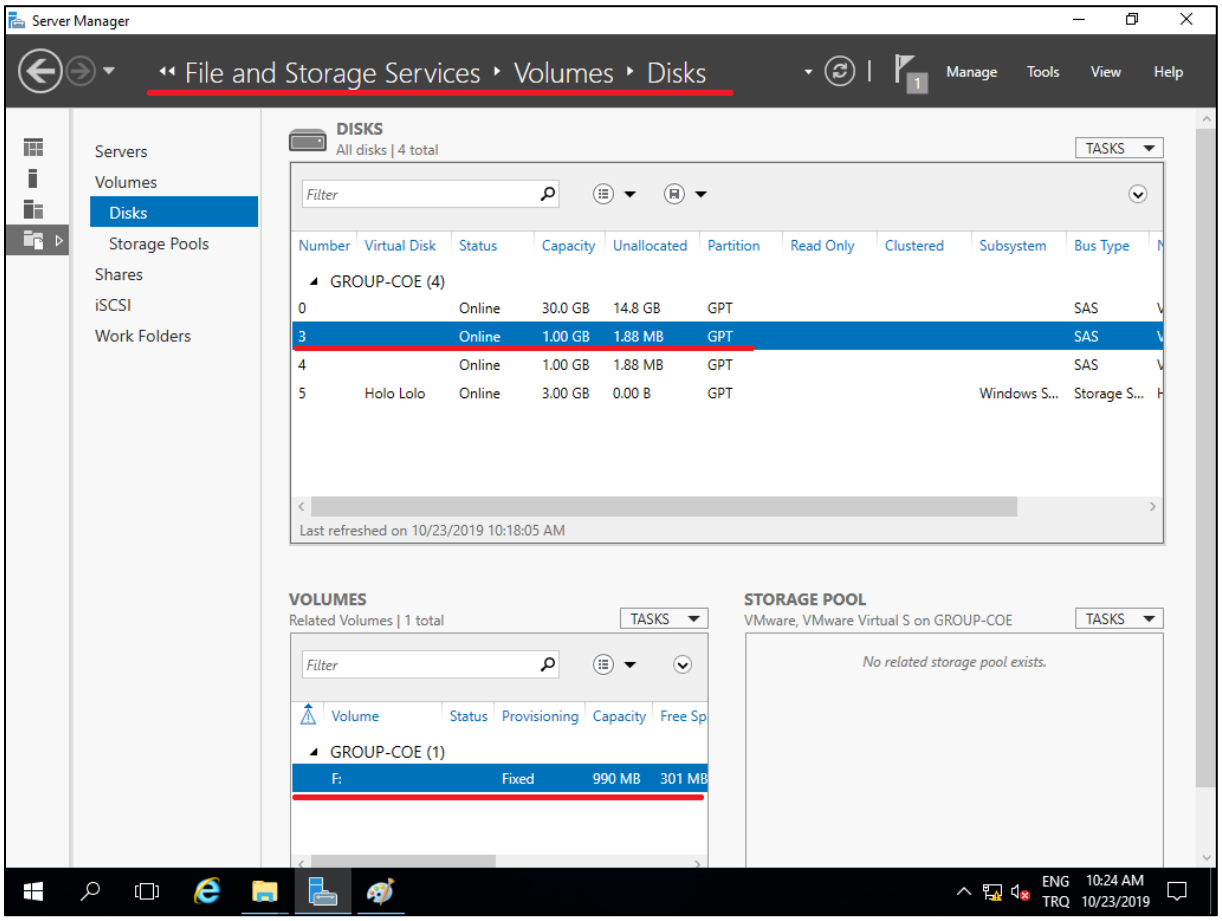
We confirm our selections and start the installation of the Data Deduplication role.



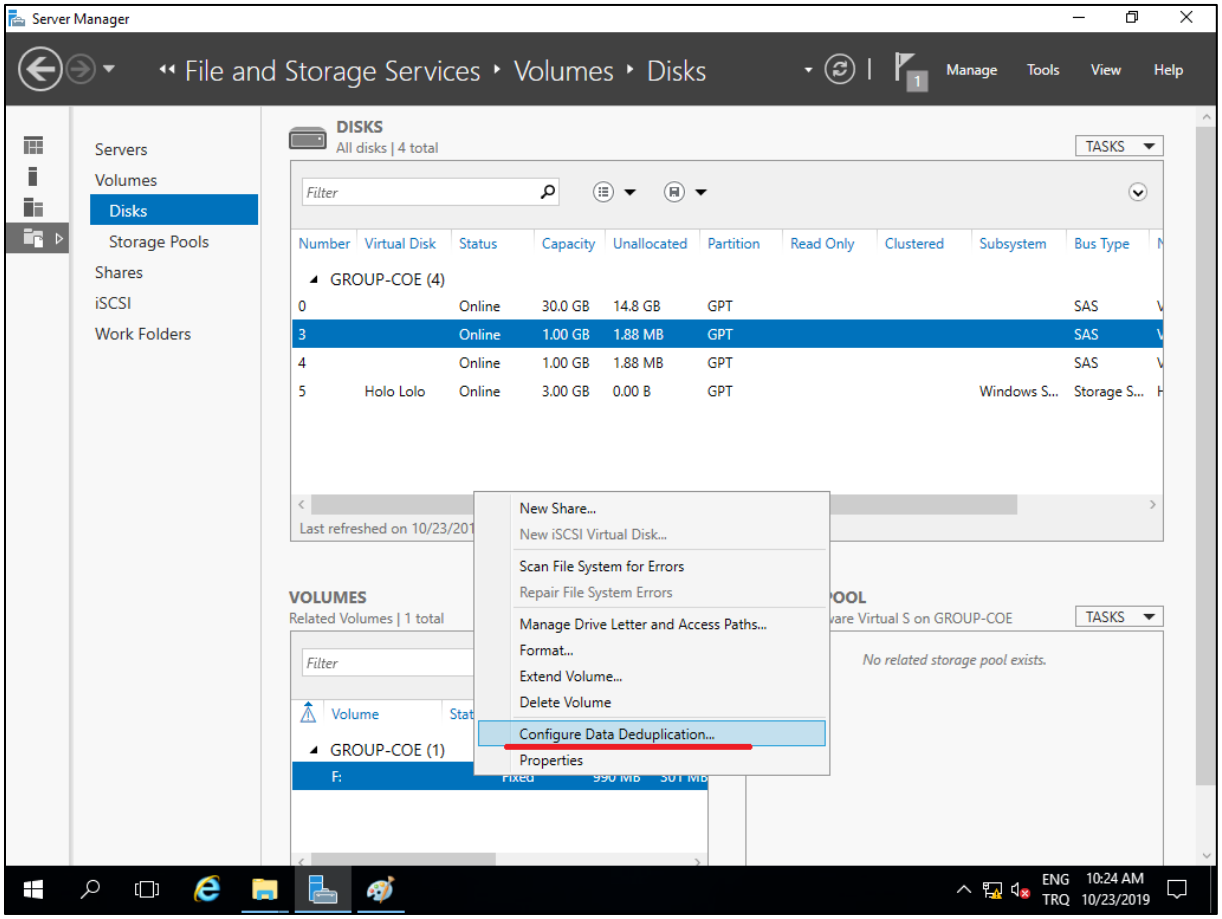
After the installation complete, we can close and start the deduplication process.



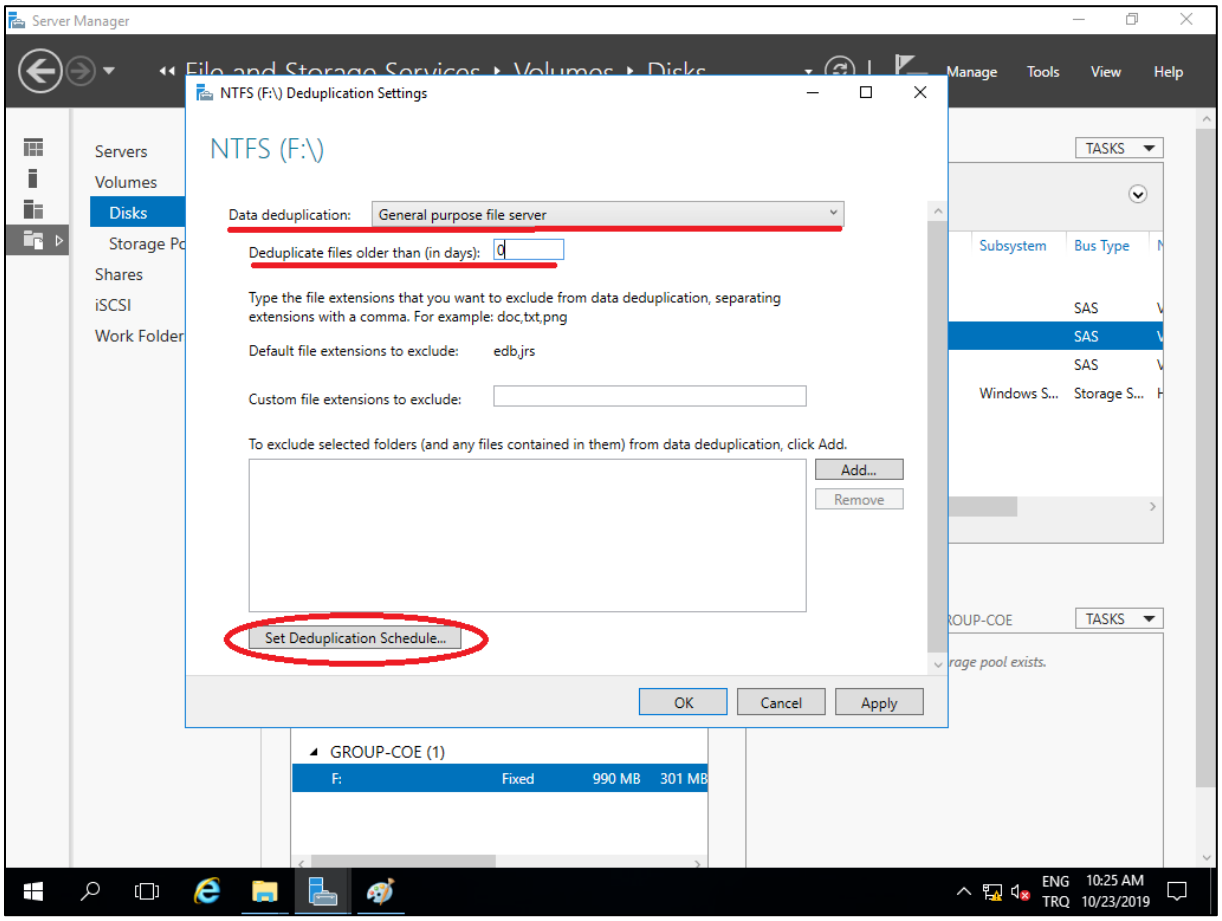
Then we go to Disks under File and Storage Services of the Server Manager. We select the disk that holds the volume that we will use deduplication process on. Under the Volumes tab, our volume should appear.



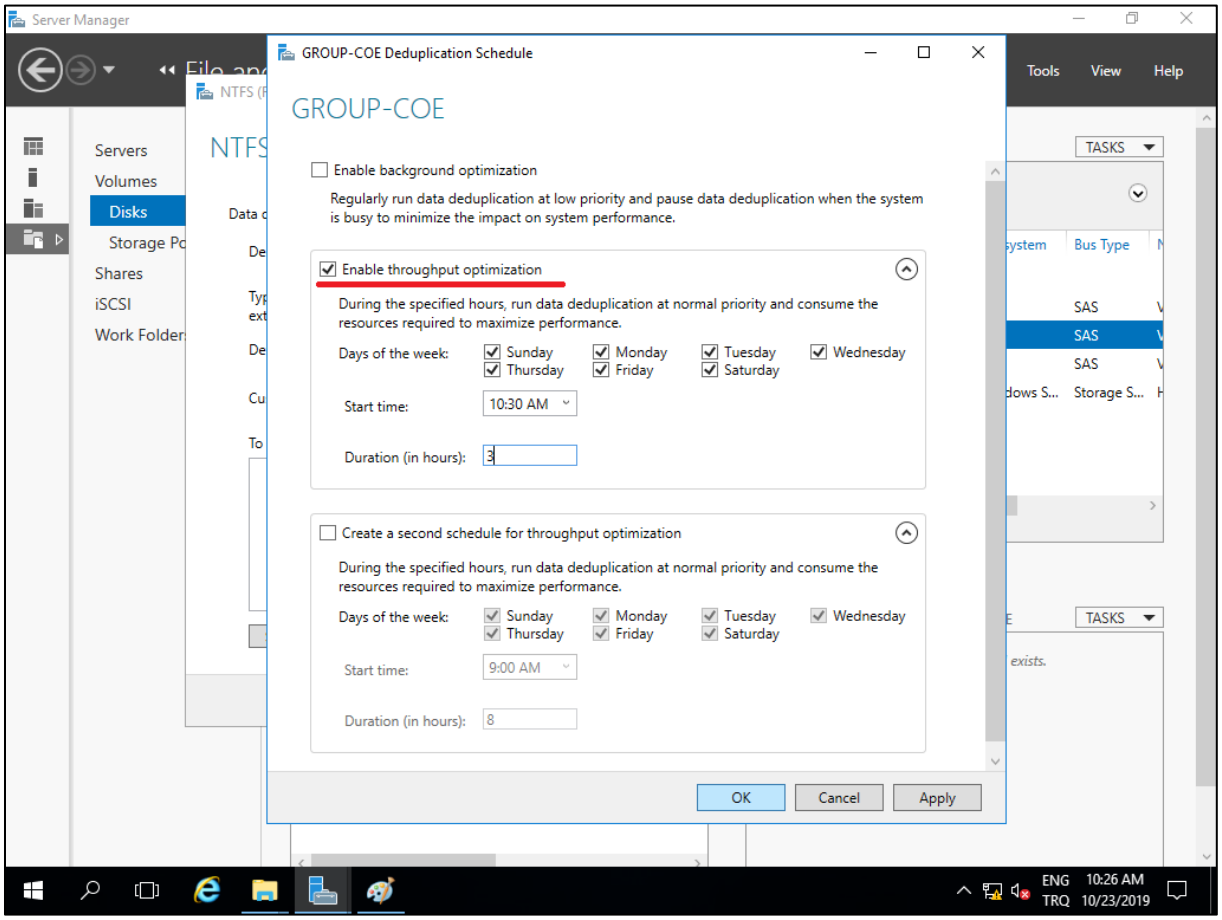
We right click on the volume and click on Configure Data Deduplication.



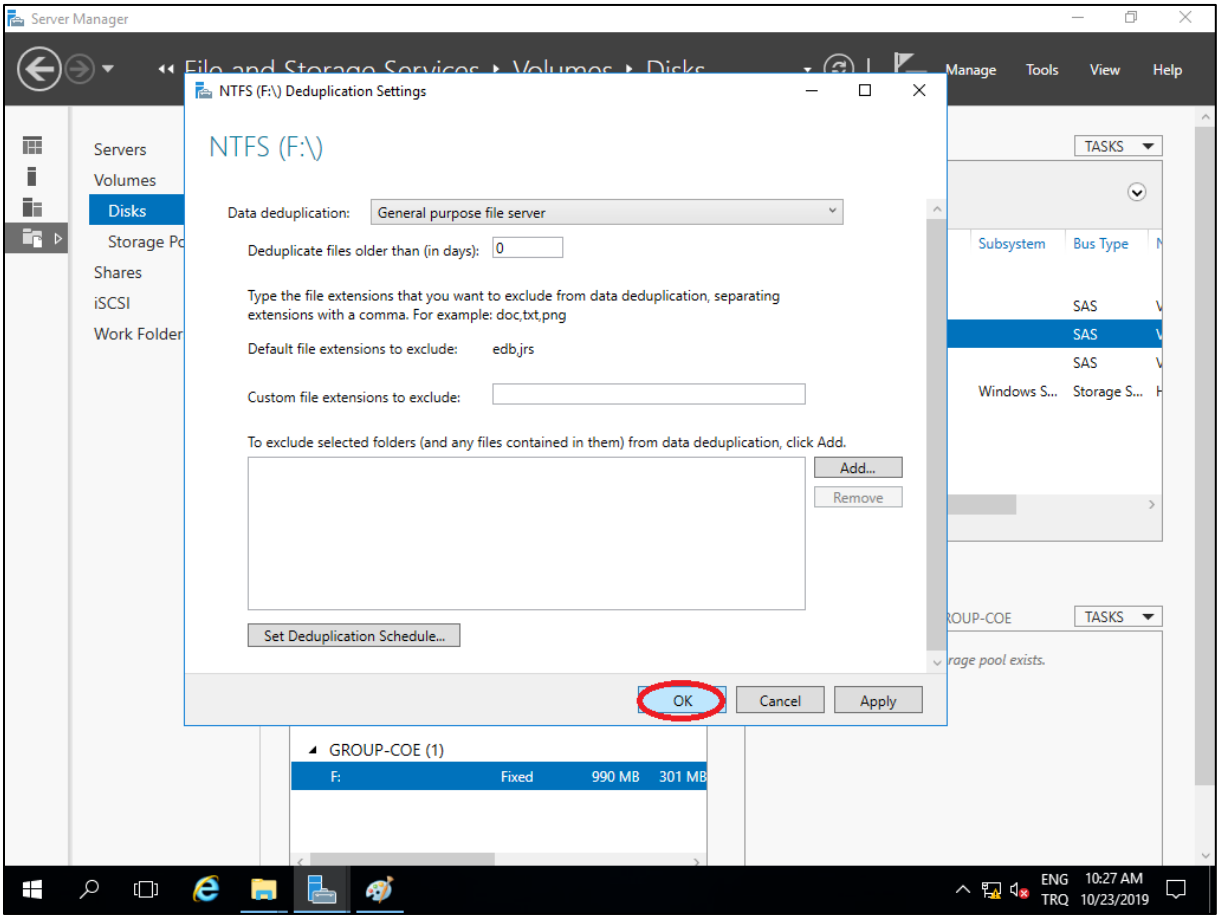
We select General Purpose File Server for the Data Deduplication options and reduce the number of days it needs to pass before deduplication process to begin to 0. Then, we click on Set Deduplication Schedule.



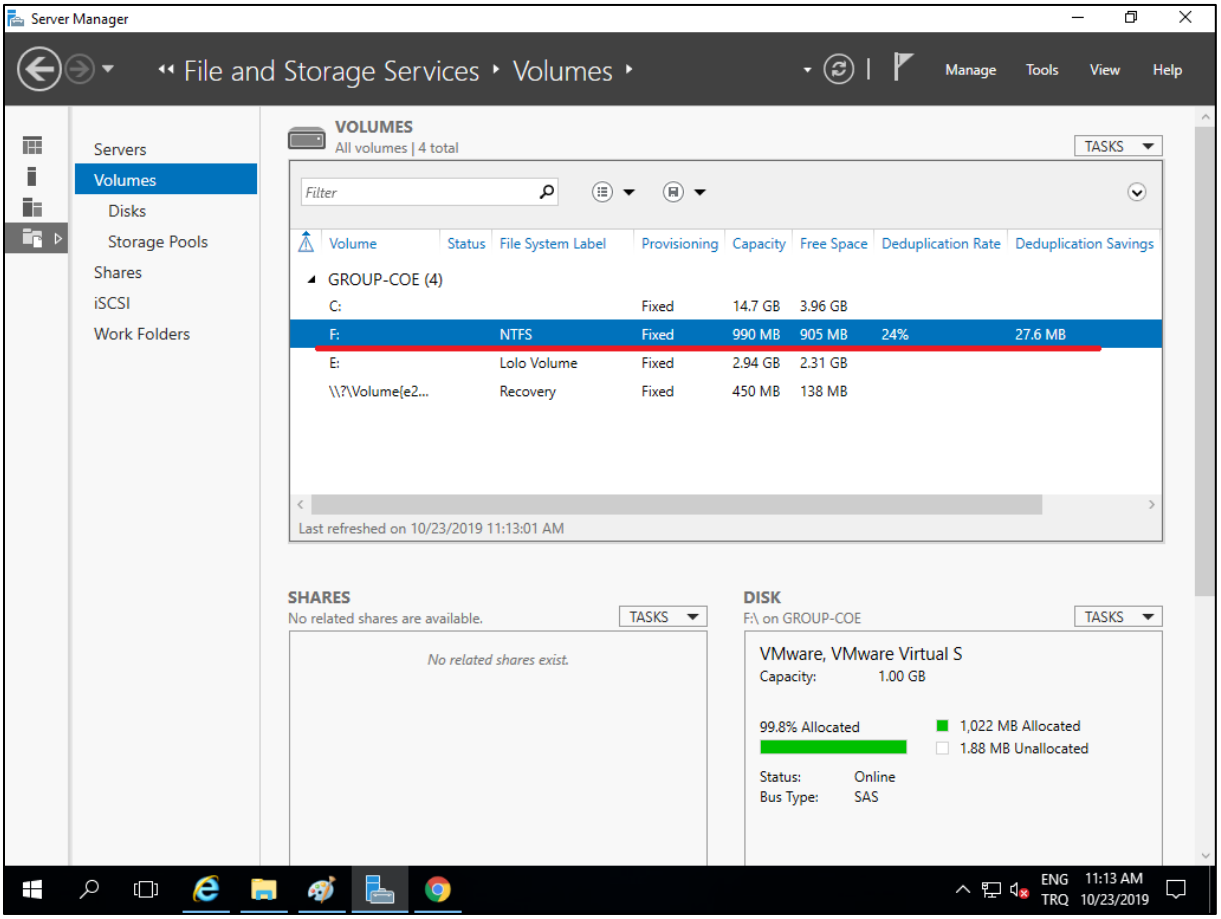
We choose the Enable Throughput Optimization option and set schedule for the deduplication to begin. Setting a time close to real time would mean it would begin soon.



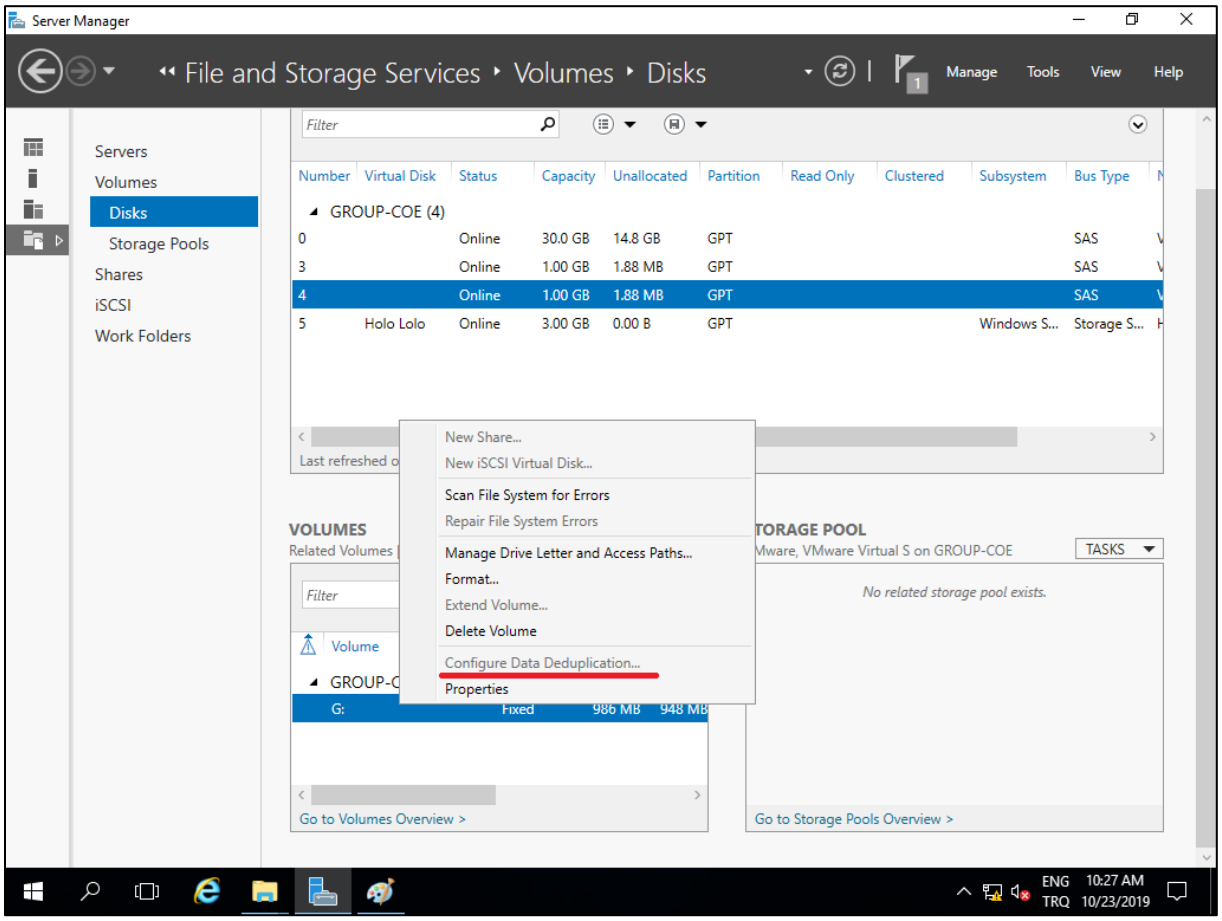
Then, we click OK on the previous screen and finish scheduling Data Deduplication.



After a while we can see that Data Deduplication has already begun and saved some space.



One very important thing to note here is that the disk we are using Data Deduplication had been formatted with NTFS which is the only format that supports Data Deduplication on Server 2016. As an example, here is a disk formatted with FAT32:



As you can see, the Configure Data Deduplication option is grayed out because FAT32 doesn't support Data Deduplication.

3. Conclusion

For DAS part of the project, creating a RAID 5 disk showed the redundancy quite brilliantly as we had a total of 2.89 GB of space in our drive composed of 4, 1 GB disks. The space that is missing is used for redundant copies of the data. Our NAS topology, shared our disk from the server with the client with ease and had no issues. SAN topology also worked since it was basically the NAS topology with a superfluous router added.

While using Storage Pools and creating a virtual disk we learned something quite essential: the physical disks must have at least 4 GB of space after initialization to be added to a pool and they must be unallocated. Restating the process, we initialize but not allocate our physical disks which we then add to a storage pool with Storage Pools. Then, we use this pool to create a virtual disk that is then used to create a volume that appears as a singular distinct disk with its own format, such as NTFS or ReFS. We can portion our virtual disk into volumes as we see fit to our needs easily.

Data Deduplication part of this project showed us that on Server 2016 only NTFS is supported for the deduplication role. Neither FAT32 nor ReFS is supported. Another thing to note is that Data Deduplication does not remove the extra copies of the files as it clears inefficient wasteful space. This is probably due to replacing the duplicate chunk with a parity to the original file rather than deleting the duplicated information.

4. Evaluation

For RAID 5, we have nothing to mention as that part of this project worked splendidly.

For NAS and SAN, the unfortunate lack of working routers and switches lead to simplistic topologies. We'd prefer to demonstrate the difference better; however, a genuine demonstration of SAN would require the server and the client to be in distinct networks. Since at our disposal we only had one router with one Ethernet port we couldn't show that easily. A clever idea was to use VLANs on the switch to behave as different networks and use 802.1Q on the router for the communication but I believe as a group we failed to achieve this. I was sick on the day my group tried this and apparently we simply did the same things as in NAS. If given more time and more resources, we could use multiple routers and establish a SAN topology with our previous network knowledge since this design would require routing protocols at the very least depending on how complicated you want to design the topology.

For Storage Pools and creating virtual disks, we have nothing to mention again since this part of the project also worked well after we discovered the caveat of minimum disk space which is mentioned above.

For Data Deduplication part of the project, we have discovered that the process might take a very long while and seeing %100 on deduplication is rare. Given more time, we would like to see Data Deduplication completed.