Virtual Machine Migration Utilities

NetApp Solutions

NetApp
December 19, 2024

Table of Contents

Virtual Machine Migration Utilities

Migrating virtual machines (VMs) between virtualization environments (Shift Toolkit)

With the NetApp Shift toolkit, migrating virtual machines (VMs) is no longer a concern. This standalone product enables fast and efficient migration of VMs from VMware ESXi to Microsoft Hyper-V. Additionally, it supports disk-level conversions between various virtual disk formats.

Usecase

Every organization is now seeing the benefit of having multi-hypervisor environment. With recent changes in the market, every organization is deciding on the best course(s) of action by weighing technical and commercial risks including migrating workload VMs to alternate hypervisors and focus on achieving business-defined objectives, and controlling vendor lock-in. This enables them to operate in an optimized fashion wrt licensing cost and extend IT budget on the right areas than spending for those unused cores on a specific hypervisor. However, the challenge has always been around migration time and the associated downtime.

With the NetApp Shift toolkit, migrating virtual machines (VMs) is no longer a concern. This standalone product enables fast and efficient migration of VMs from VMware ESXi to Microsoft Hyper-V. Additionally, it supports disk-level conversions between various virtual disk formats. Thanks to the out-of-the-box capabilities provided by ONTAP, these migrations can be incredibly swift, with minimal downtime. For example, converting a 1TB VMDK file typically takes a couple of hours, but with the Shift toolkit, it can be completed in seconds.

Toolkit Overview

The NetApp Shift toolkit is an easy-to-use, graphical user interface (GUI) solution that allows to migrate virtual machines (VMs) between different hypervisors and convert virtual disk formats. It utilizes NetApp FlexClone® technology to quickly convert VM hard disks. Additionally, the toolkit manages the creation and configuration of destination VMs.

Shift toolkit provides flexibility in a multi-hypervisor environment by supporting bidirectional conversion between the following hypervisors:

- VMware ESXi to Microsoft Hyper-V
- Microsoft Hyper-V to VMware ESXi (Upcoming release)

Shift toolkit supports disk-level conversions of virtual disks between hypervisors for the following disk formats:

- VMware ESX to Microsoft Hyper-V (virtual machine disk [VMDK] to virtual hard disk format [VHDX])
- VMware ESX to KVM compatible hypervisors (VMDK to QCOW2)

Shift toolkit can be downloaded here and is available for Windows Systems only.

Benefits of VM portability

ONTAP is ideal for any hypervisor and in any hyperscalar. With FlexClone technology. VM portability in minutes is a reality than waiting for longer downtimes or settling down with pass through options.

Shift toolkit:

- helps minimize downtime and enhances business productivity.
- offers choice and flexibility by reducing licensing costs, lock-in, and commitments to a single vendor.
- enables organizations looking to optimize VM licensing costs and extend IT budgets.
- reduces virtualization costs with VM portability and is offered free from NetApp.

How Shift toolkit works

At conversion time, Shift toolkit connects to Microsoft Hyper-V and VMware ESXi hosts and to shared NetApp storage. Shift toolkit leverages FlexClone to convert VM hard drives from one hypervisor to another by using three key NetApp technologies:

- Single volume and multiple protocols

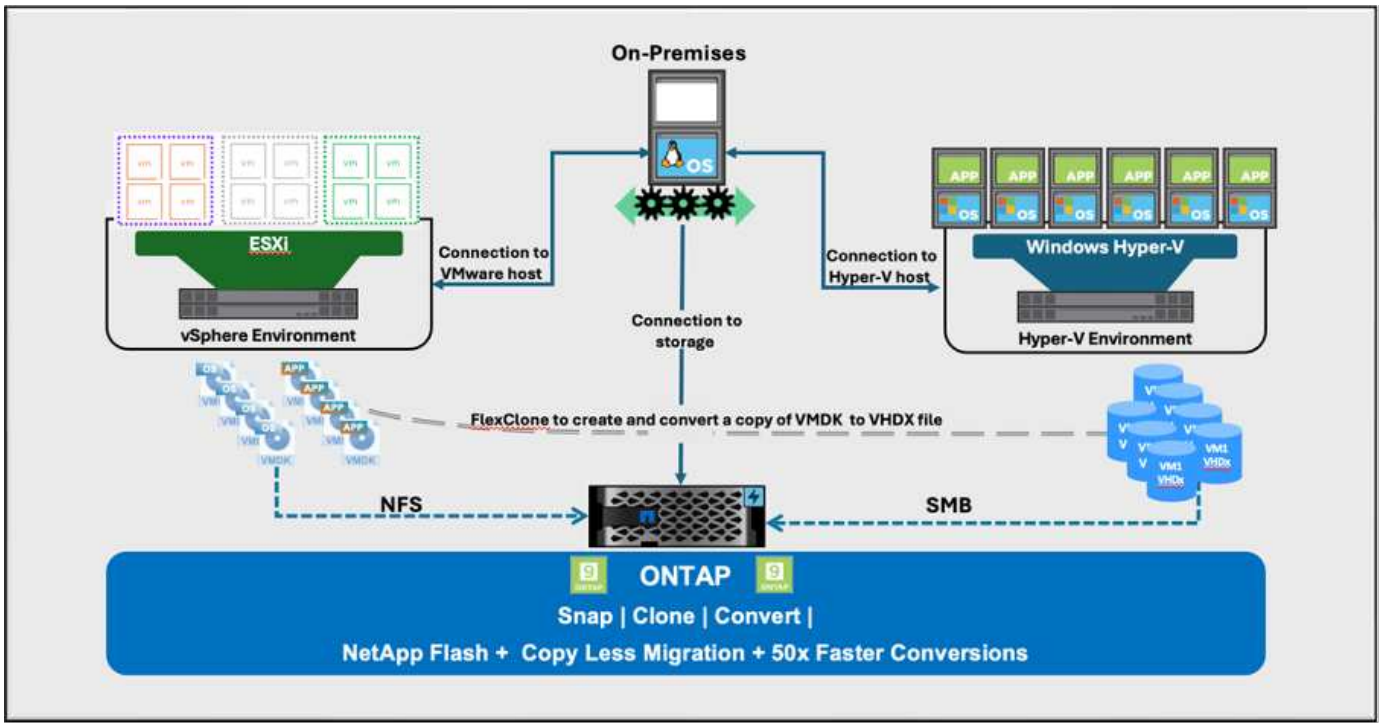
  With NetApp ONTAP, multiple protocols can be easily used to access a single volume. For example, VMware ESXi can access a volume that is enabled with the Network File System (NFS) protocol, and Microsoft Hyper-V can access the same volume with the CIFS/SMB protocol.

- FlexClone technology

  FlexClone allows the rapid cloning of entire files or volumes with no data copy. Common blocks on the storage system are shared between multiple files or volumes. As a result, large VM disks can be cloned very quickly.

- VM disk conversion

  The NetApp PowerShell Toolkit and Shift toolkit contain a large number of workflows that can be used to perform various actions on a NetApp storage controller. Included are PowerShell cmdlets that convert virtual disks to different formats. For example, VMware VMDK can be converted to Microsoft VHDX, and vice versa. These conversions are performed with FlexClone, which enables very rapid cloning and conversion of disk formats in one step.



Protocols and communication methods

Shift toolkit uses the following protocols during conversion or migration operations.

- HTTPS - Used by the Shift toolkit to communicate with the Data ONTAP cluster.
- VI Java (VI SDK), VMware PowerCLI - Used to communicate with VMware ESXi.
- Windows PowerShell module - Used to communicate with Microsoft Hyper-V.

Installing and Setting Up Shift toolkit

To get started with the toolkit, use a windows operating system on a designated virtual machine and make sure you meet the prerequisites, then install the package.

Shift toolkit can be run on Windows 2019 and 2022 version. Download the Shift toolkit package from NetApp Toolchest and then unzip the package and run the batch file to install and start the service.

Shift toolkit can be installed on a Microsoft Hyper-V server or on a stand-alone server (physical or virtual), and it is a best practice to install Shift toolkit on its own VM. This approach allows you to target different Microsoft Hyper-V servers or VMware ESXi servers with a single Shift toolkit server.

Pre-requisites:

Hardware requirements

Ensure that Shift server host meets minimum hardware requirements.

- CPU - 2vCPUs
- Memory - 4GB minimum
- Disk Space – minimum 10 GB

Connectivity requirements

- Ensure the hypervisor and storage environment is configured so that Shift toolkit can interact properly with all components in the environment.
- Shift toolkit can be installed on a Microsoft Hyper-V server or on a standalone Windows server (physical or virtual).
- The Shift server, Data ONTAP CIFS server, Hyper-V server, and guest operating systems must be on the same Windows domain.
- Multiple LIFs for CIFS and NFS are supported for use with Storage Virtual Machine when doing VM conversions. The Hyper-V server and ESXi hosts access the Storage Virtual Machine (SVM) at the IP addresses of these LIFs.
- For CIFS operations, the time settings for the Windows domain controller and the NetApp storage controller must be synchronized.

Creating a New SVM (recommended)

Move the VMs to be migrated or converted to a new designated Data ONTAP Storage Virtual Machine (SVM) using Storage vMotion. It is a best practice to configure a new SVM for the VMs, so that you can be sure you are not converting VMs on a production SVM. Use the ONTAP CLI or System Manager to create the new SVM.

Follow the steps provided in this link to provision a new SVM allowing both NFS and SMB protocol.

For ESX to Hyper-V conversion, specifies the fully qualified path name of the CIFS share (specifically, CIFS qtree on the controller) as the destination path.

Note: It is a good practice creating a new SVM to be sure that the SVM meets the Shift toolkit requirements without having to modify the production SVM in ways that might be disruptive.
Note: The destination path must be on the same volume of the source VM.
Note: Shift toolkit only supports the conversion of VMs residing in a NAS environment (NFS). It does not support the conversion of VMs residing in SAN environments (LUNs).

Supported operating systems

Ensure that a supported versions of Windows and Linux for guest operating systems are used for conversion and that Shift toolkit supports the version of ONTAP.

Supported VM guest operating systems

The following versions of Windows are supported as guest operating systems for VM conversions:

- Windows Server 2016
- Windows Server 2019
- Windows Server 2022

The following versions of Linux are supported as guest operating systems for VM conversions:

- Red Hat Enterprise Linux 6.7 or later
- Red Hat Enterprise Linux 7.2 or later
- Red Hat Enterprise Linux 8.x
- Red Hat Enterprise Linux 9.x
- Ubuntu 2018
- Ubuntu 2022
- Ubuntu 2024
- Debian 10
- Debian 11
- Debian 12

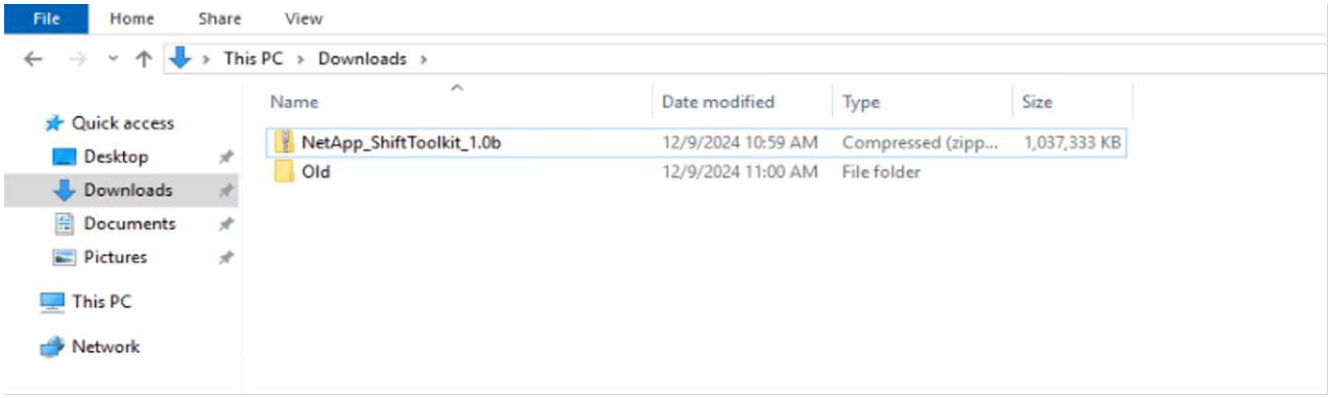
CentOS Linux/RedHat for Red Hat Enterprise Linux 5 is not supported.

Supported versions of ONTAP

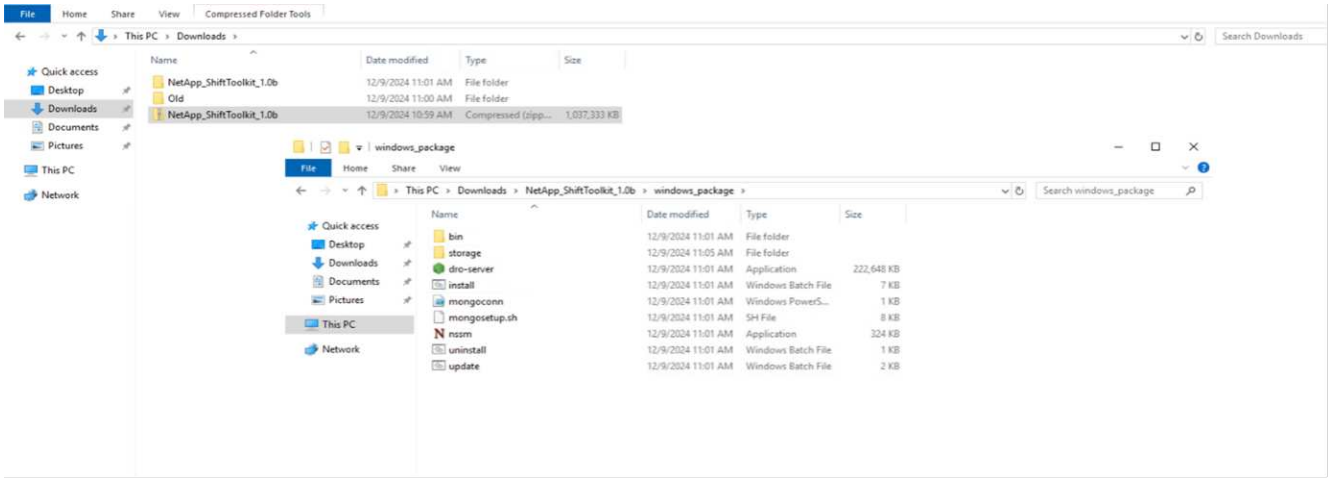
Shift toolkit supports platforms that are running ONTAP 9.14.1 or later.

Installation

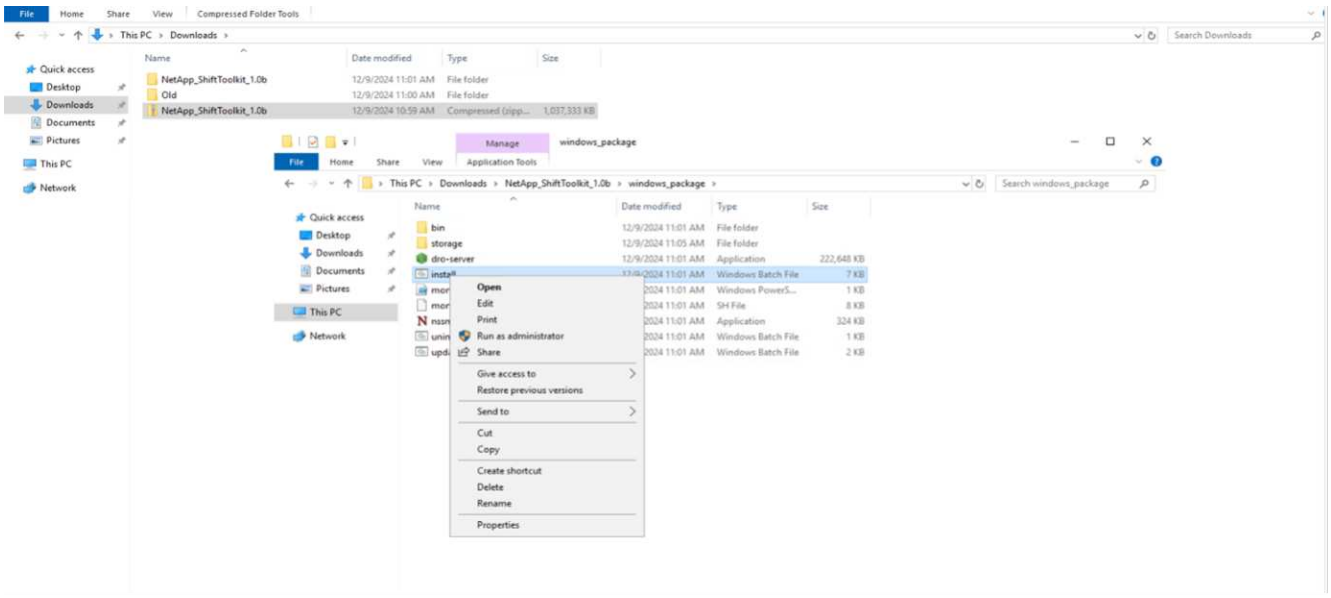
1. Download Shift toolkit package.



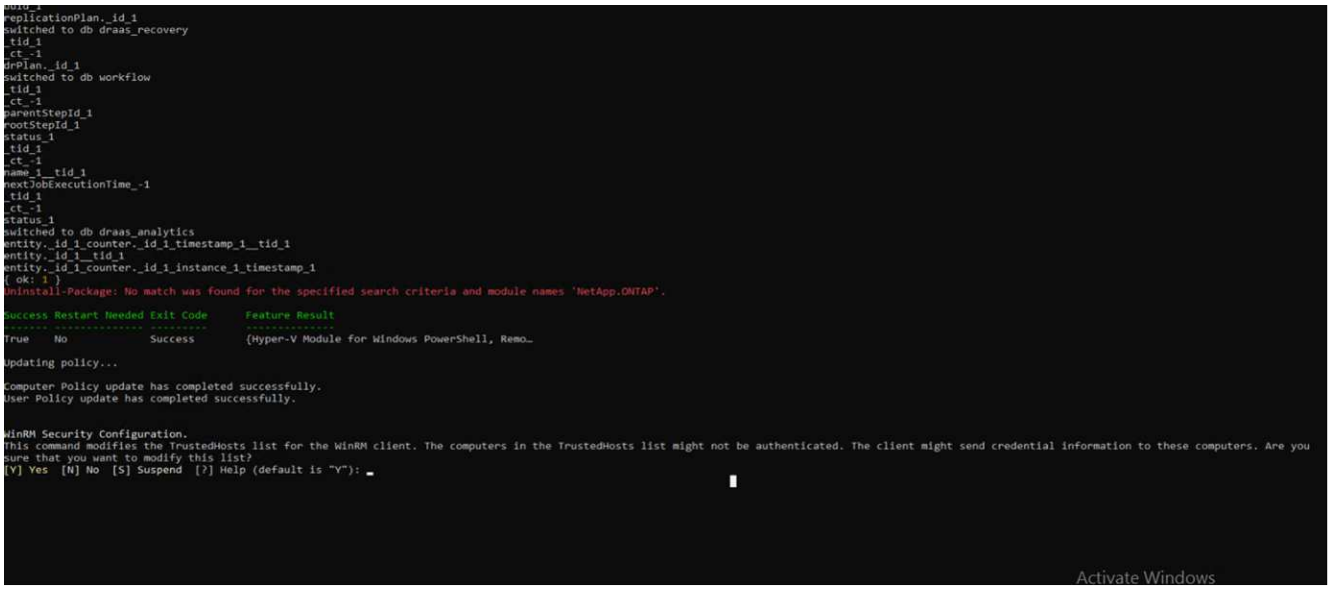
2. Extract the package to the designated folder.



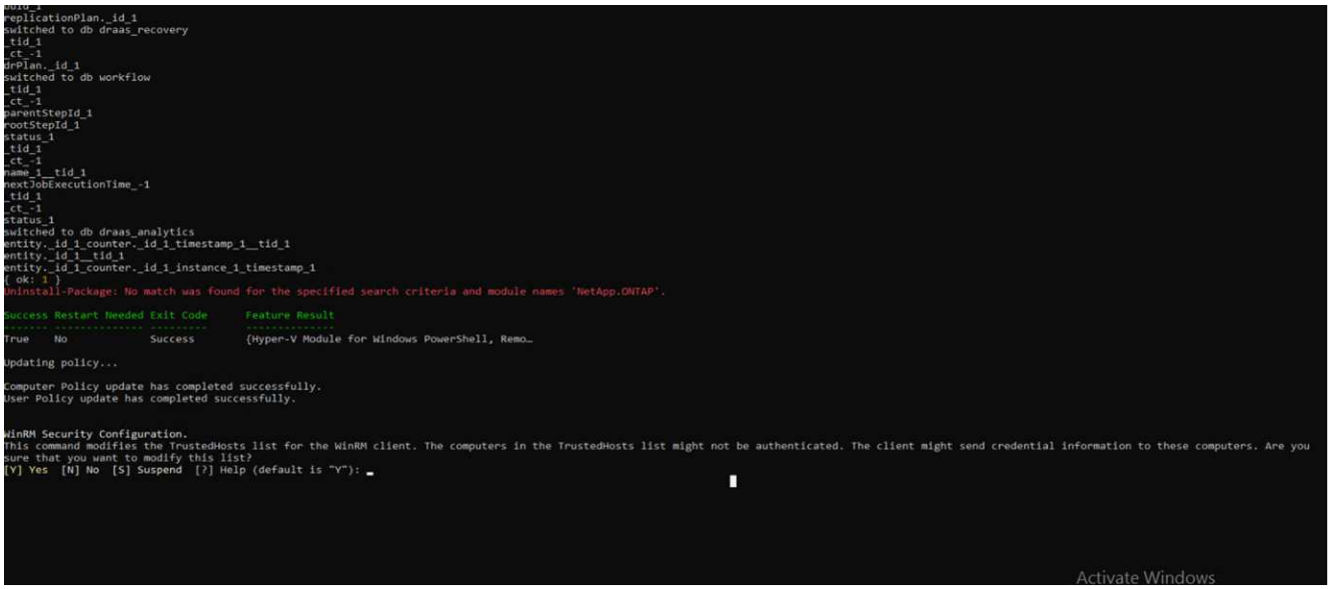
3. Run the Shift toolkit package by clicking on **install** batch file.



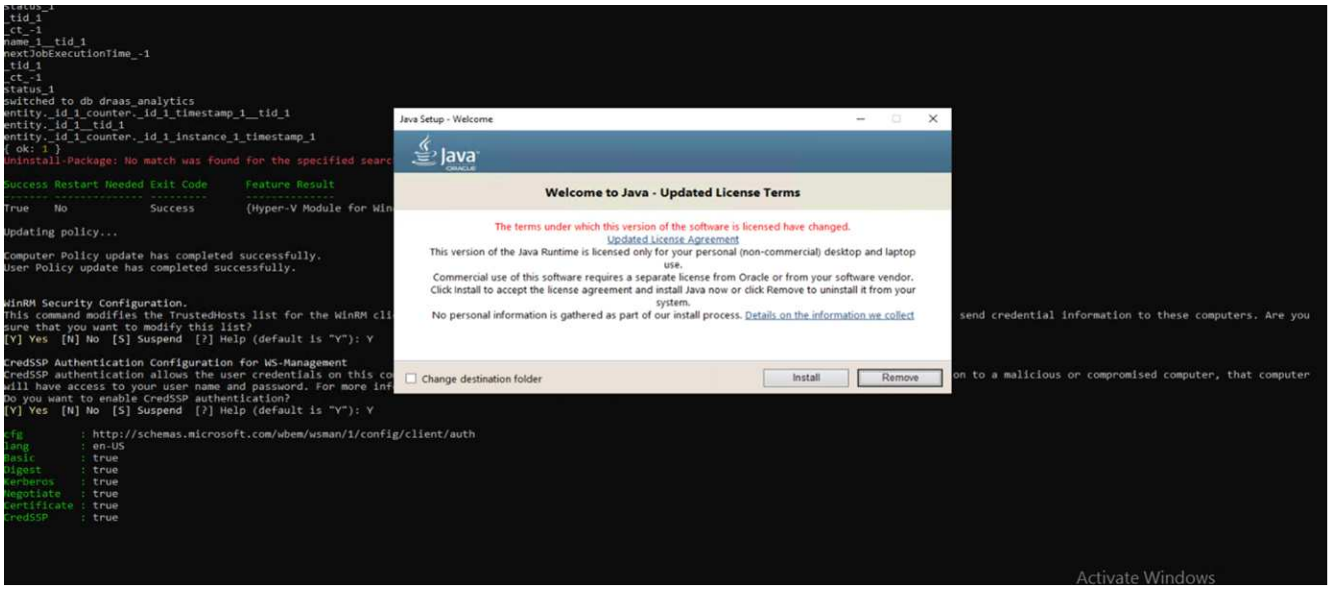
4. The installer will begin the installation process. This will open the command prompt and start installing the pre-requisites including MongoDB, Windows PowerShell 7, NetApp ONTAP PowerShell Toolkit, Hyper-V module for Windows PowerShell, VMware.PowerCLI package and Java which is all packed into the package.



5. After this, CredSSP is enabled which is in interactive prompt. Press Y and continue.



6. After enabling CredSSP, the installer will install the JAVA package (required for qcow conversion).



7. Once done, the installer will prompt to enter the IP address that will be used to access Shift toolkit UI.

8. Once done, “Press any key to continue” to close the command prompt.

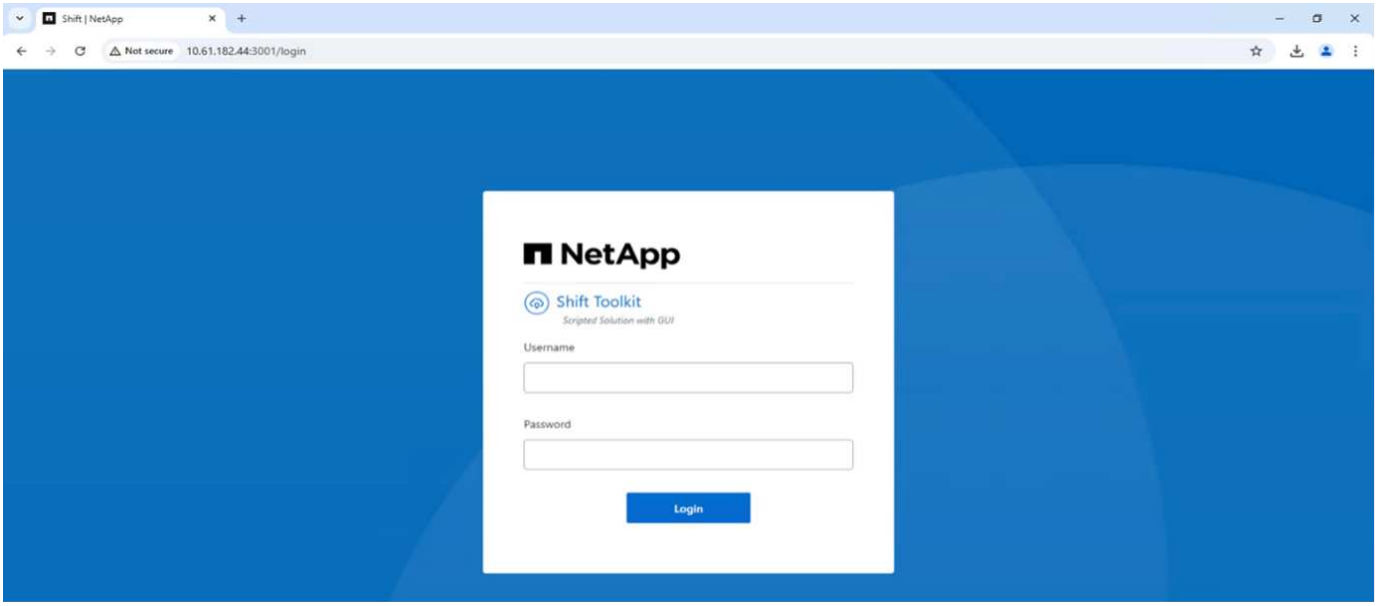
The installation can take 8-10mins.

Using the GUI

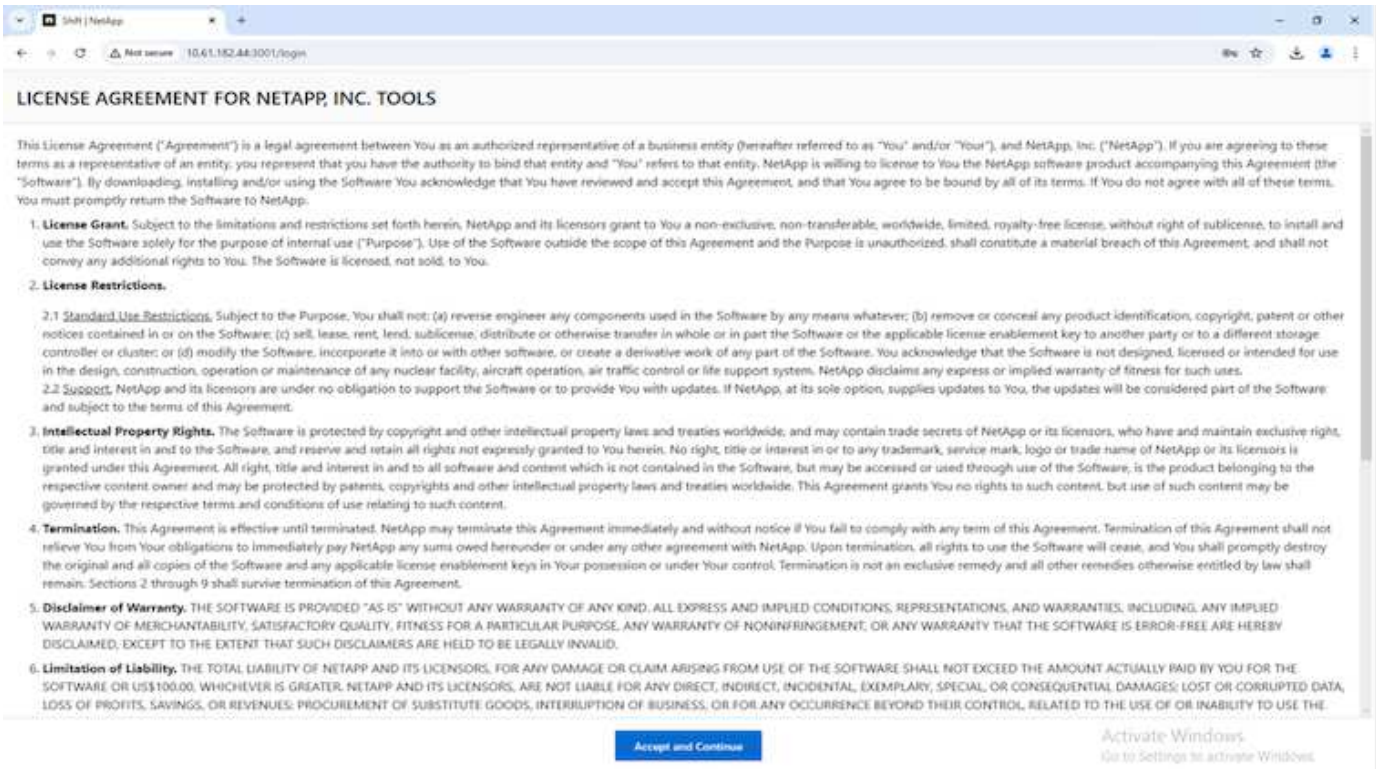
Run Shift toolkit

- Using the browser, access Shift toolkit UI by entering the `http://<IP address specified during installation>:3001`.
- Access the UI using default credentials as below:
  Username: admin
  Password: admin

The admin credential can be changed using “Change Password” option.



Accept the legal EULA by clicking on “Accept and Continue”

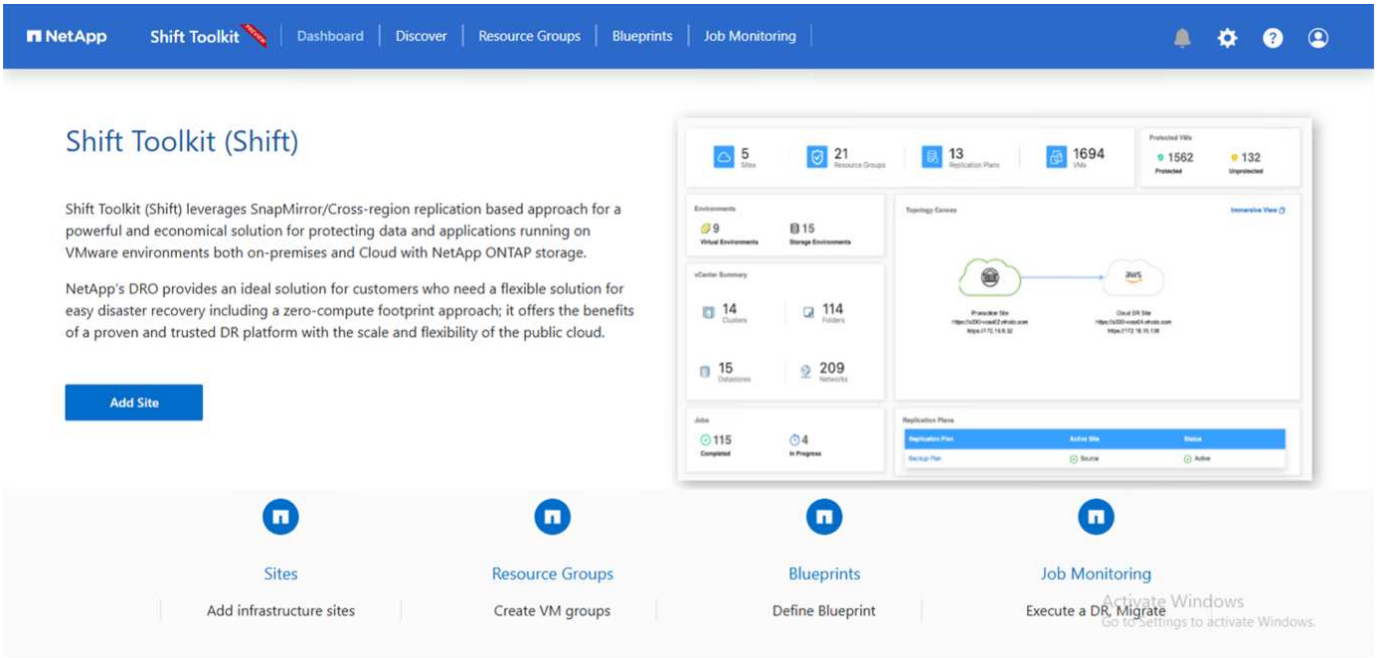


Shift Toolkit Configuration

Once the storage and connectivity to both the source and destination hypervisors have been configured properly, begin configuring Shift toolkit to automate the migration or conversion of the virtual machine VMDK to appropriate format, leveraging the FlexClone functionality.

Add Sites

The first step is to discover and add the source vCenter and then the target Hyper-V details (both hypervisors and storage) to Shift toolkit. Open Shift toolkit in a supported browser and use the default username and password (admin/admin) and Add Sites.



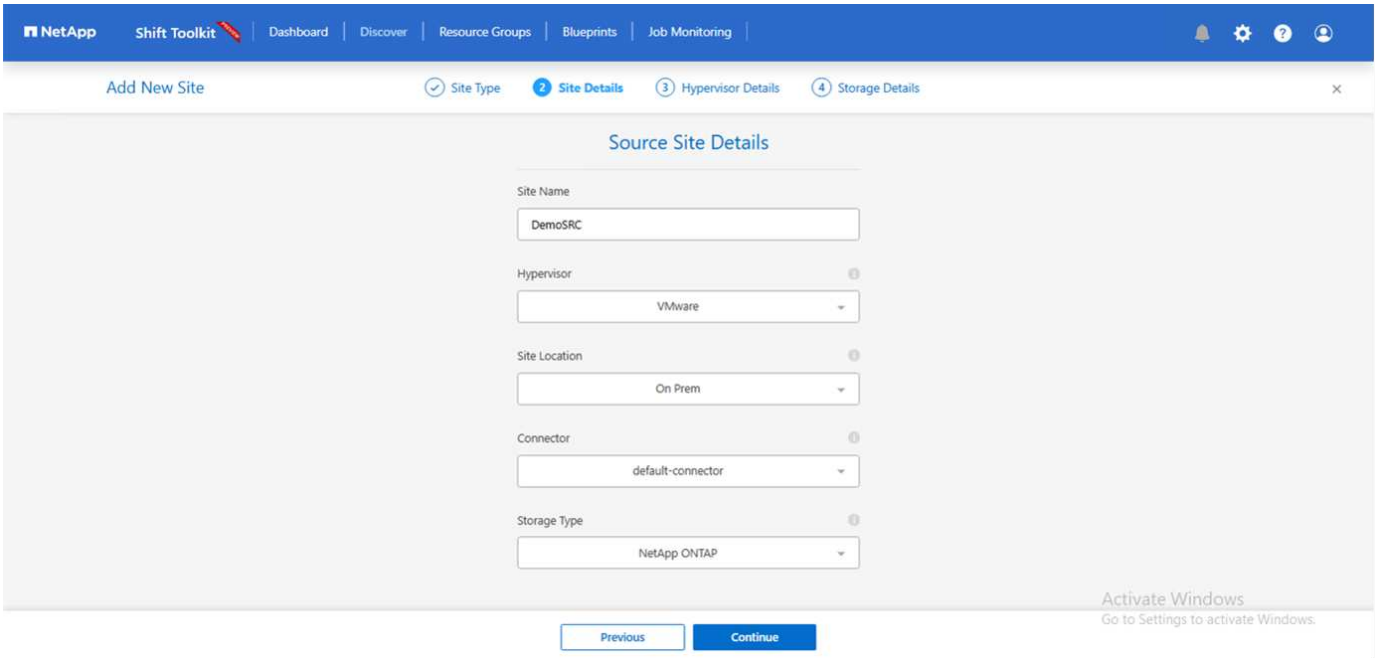
Sites can also be added using Discover option.

Add the following platforms:

Source

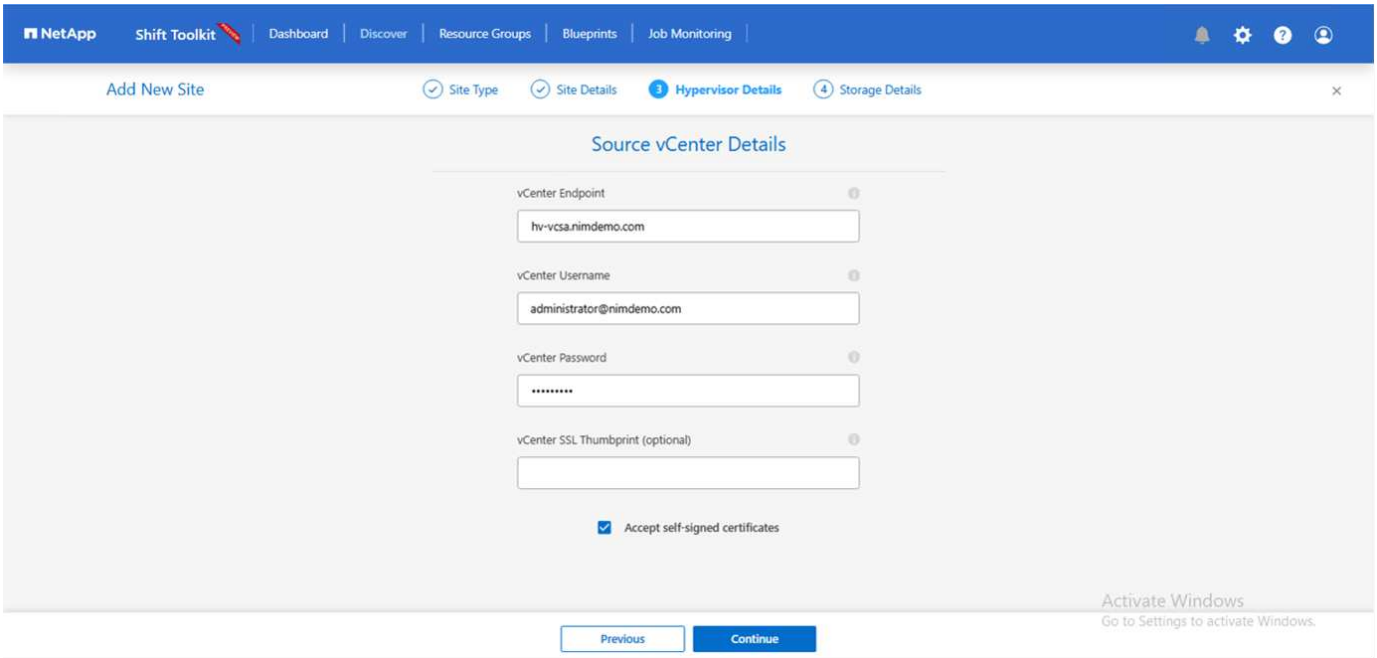
- Source Site Details
  - Site Name - Provide a name for the site
  - Hypervisor – Select VMware as the source (only option available during preview)
  - Site Location – Select the default option
  - Connector – Select the default selection
  - Storage type – Select the default option

Once filled, click Continue.

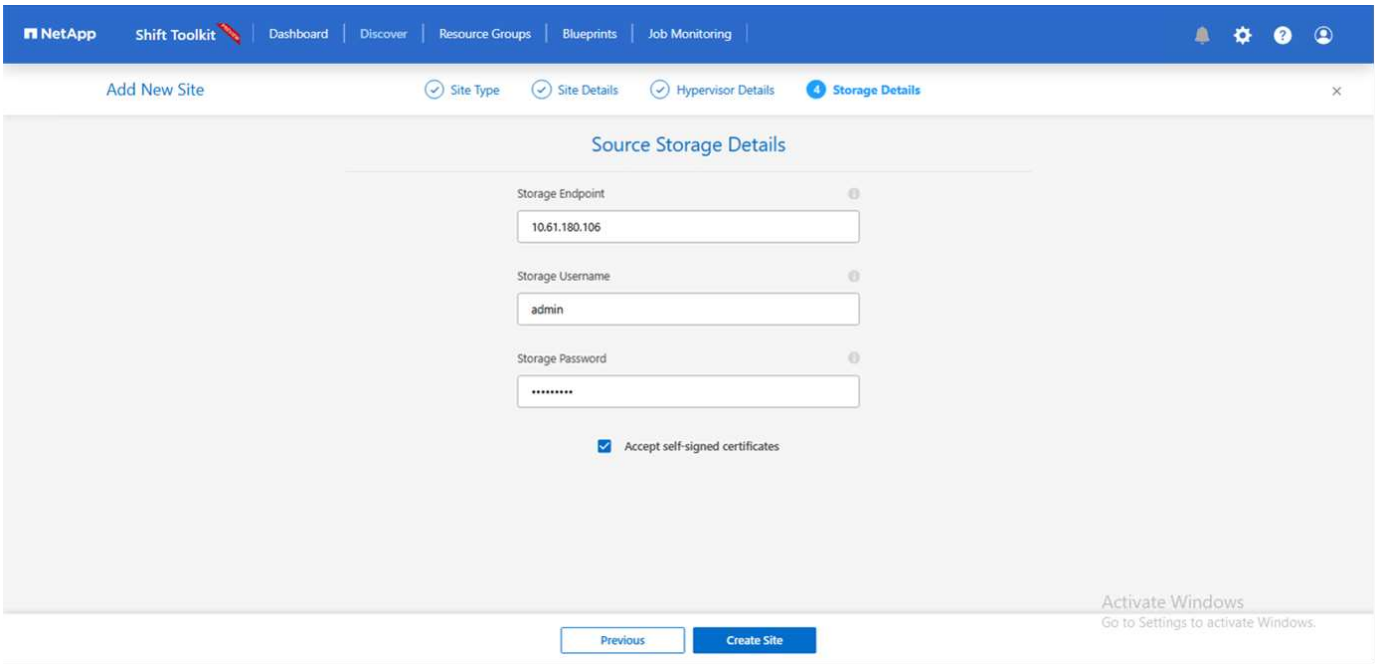


- Source vCenter
  - Endpoint - Enter the IP address or FQDN of the vCenter server
  - Username - username to access the vCenter (in UPN format: username@domain.com)
  - vCenter Password – Password to access vCenter for performing inventory of the resources.
  - vCenter SSL Thumbprint (optional)

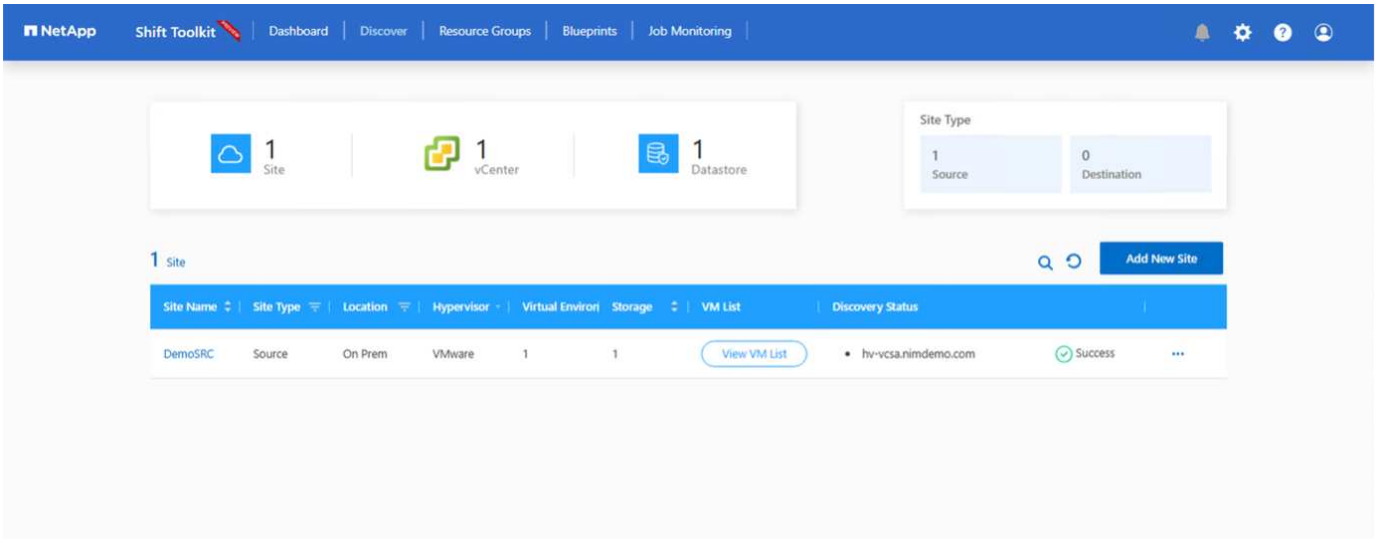
Select “Accept Self signed certificate” and click Continue.



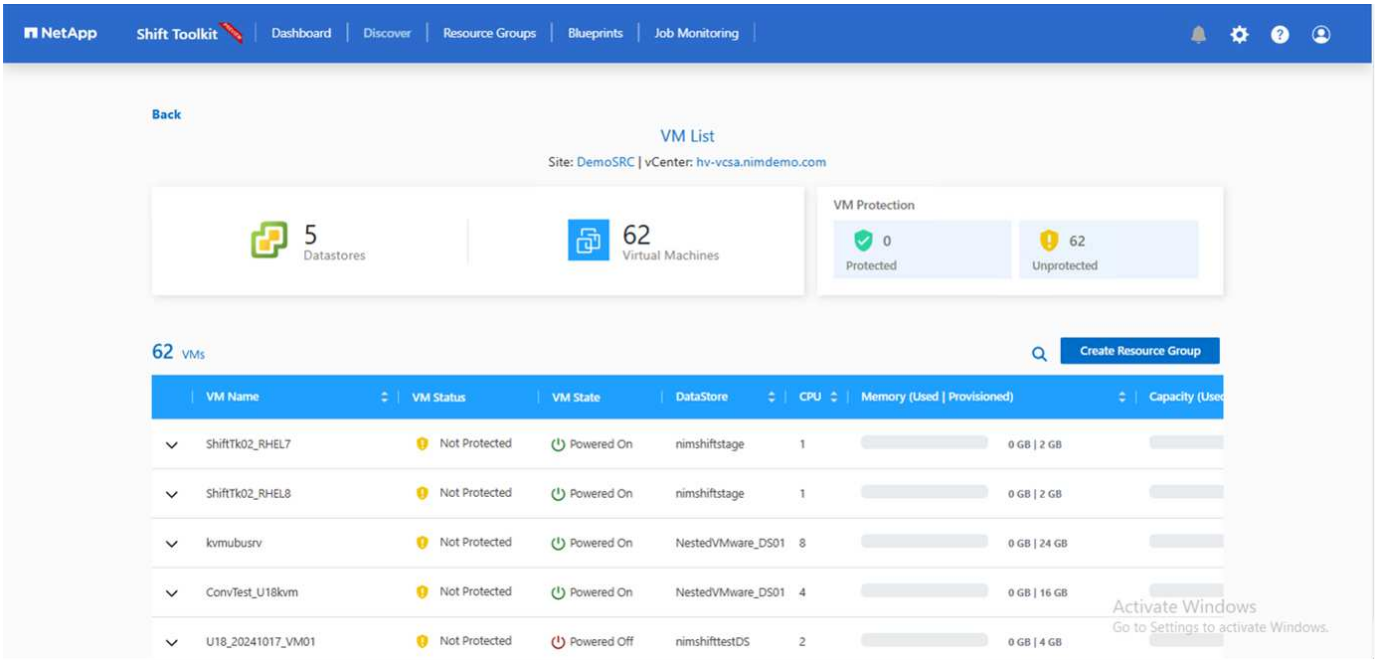
- ONTAP Storage system credentials



Once added, Shift toolkit will perform an automatic discovery and display the VMs along with the relevant metadata information. Shift toolkit will automatically detect the networks and portgroups used by the VMs and will populate them.



To view the data for a specific vCenter, go to the dashboard, click on “View VM List” against the appropriate site name. The page will display the VM inventory along with the VM attributes.

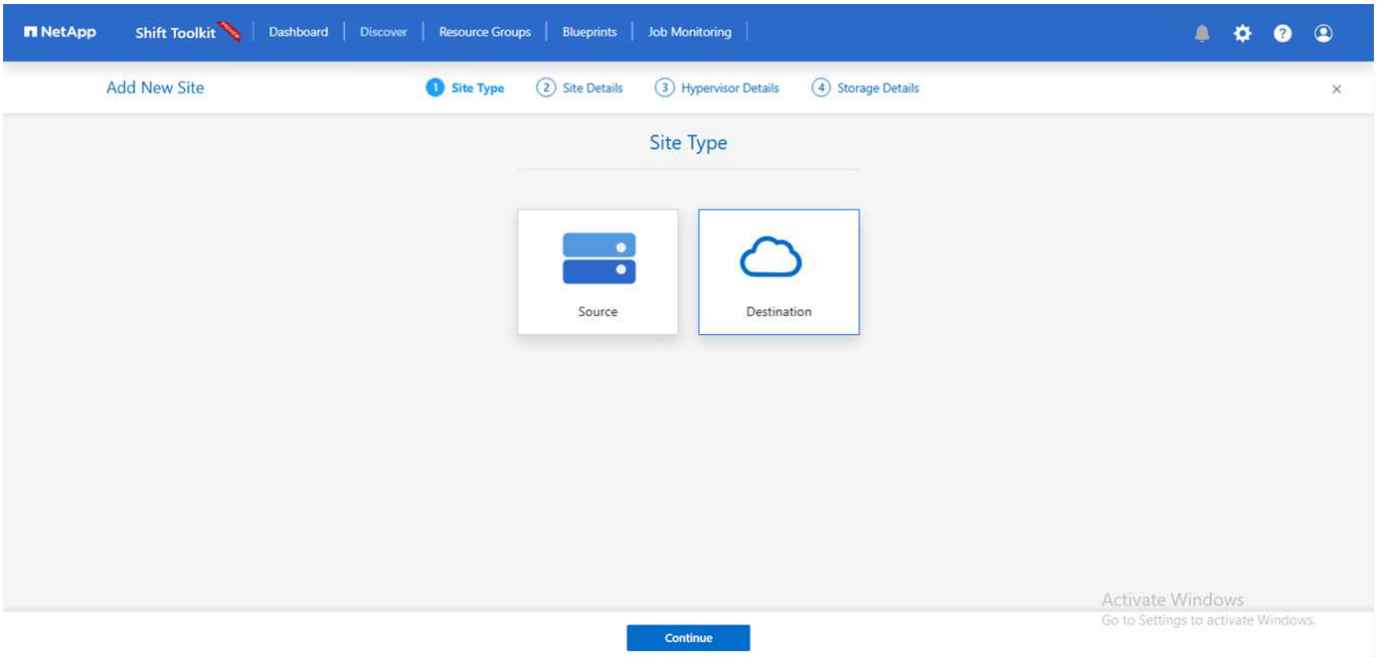


The VM inventory is refreshed every 24 hours.

Shift toolkit supports ESXi version 7.0 and later

Next step is to add the destination hypervisor.

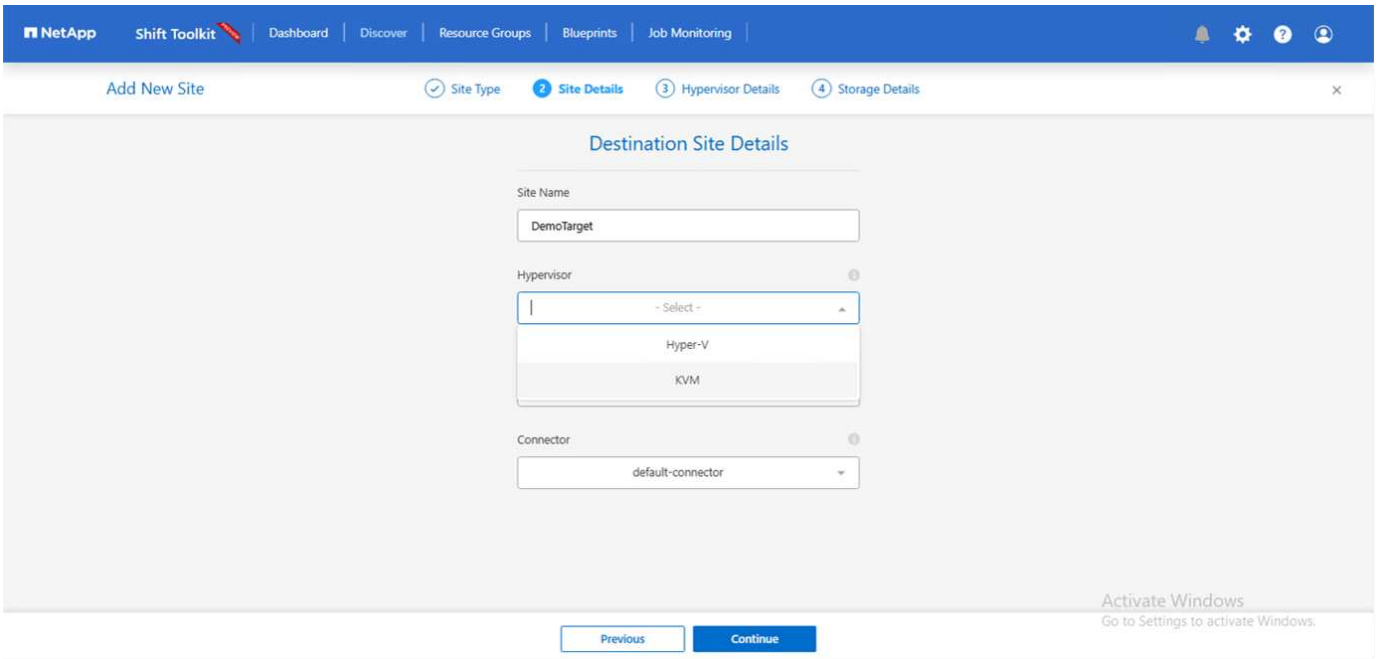
Destination



- Destination Site Details
  - Site Name - Provide a name for the site
  - Hypervisor – Select Hyper-V or KVM as the target
  - Site Location – Select the default option

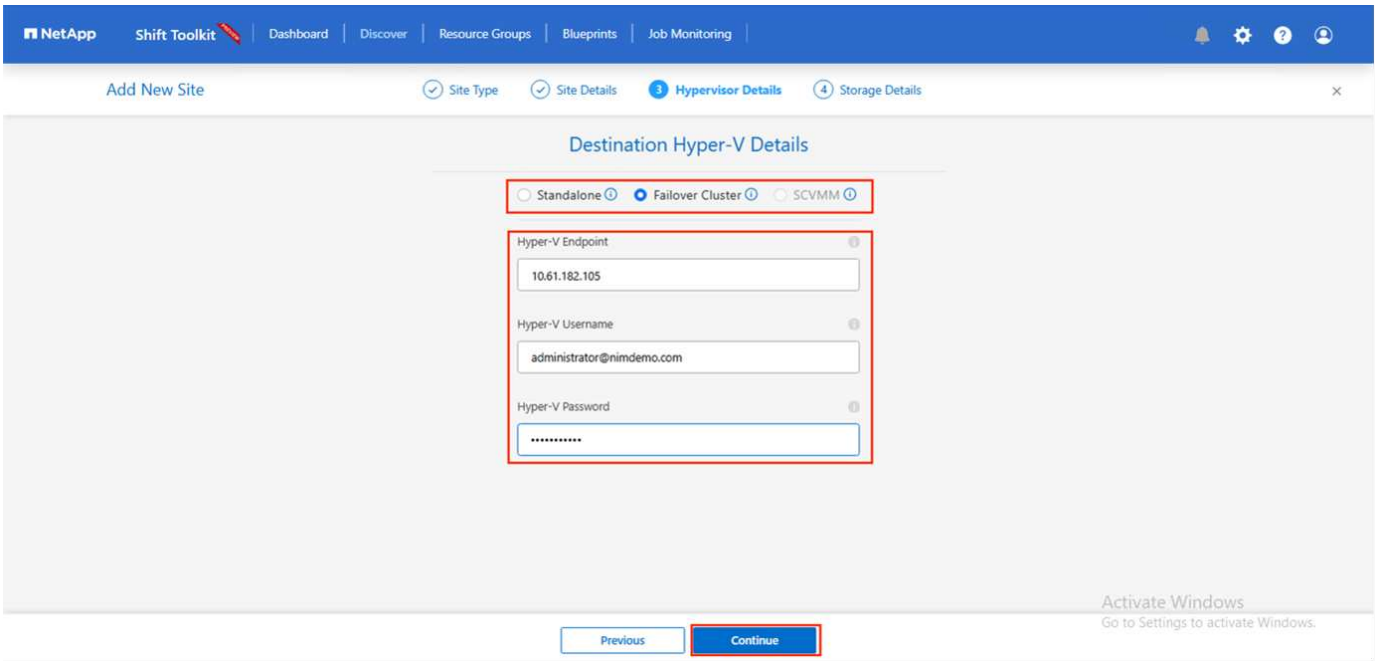
- Connector – Select the default selection

Once filled, click Continue.



Based on the hypervisor selection, fill in the necessary details.

- Destination Hyper-V details
  - Hyper-V Standalone or failover cluster manager IP address or FQDN
  - Username - username to access Hyper-V (in UPN format: username@domain.com)
    Password – Password to access Hyper-V for performing inventory of the resources.



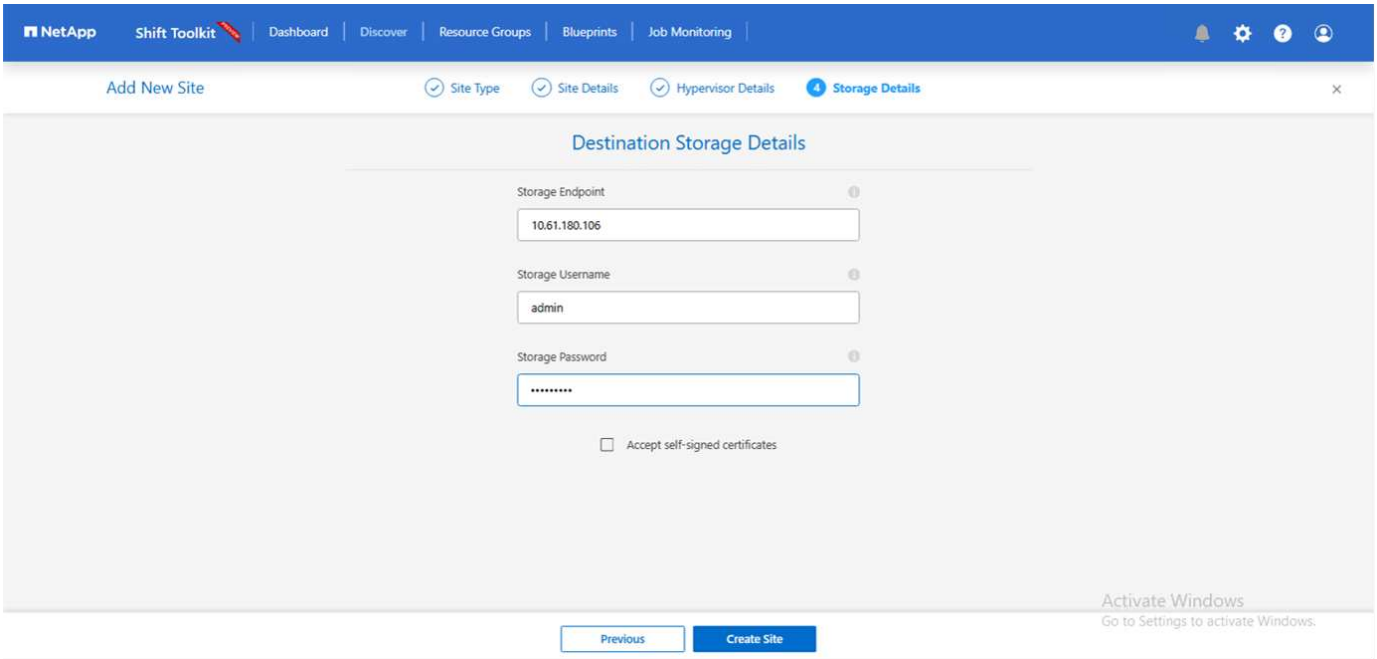
Once done, Click Continue

Shift toolkit does not communicate with System Center directly in the current release.

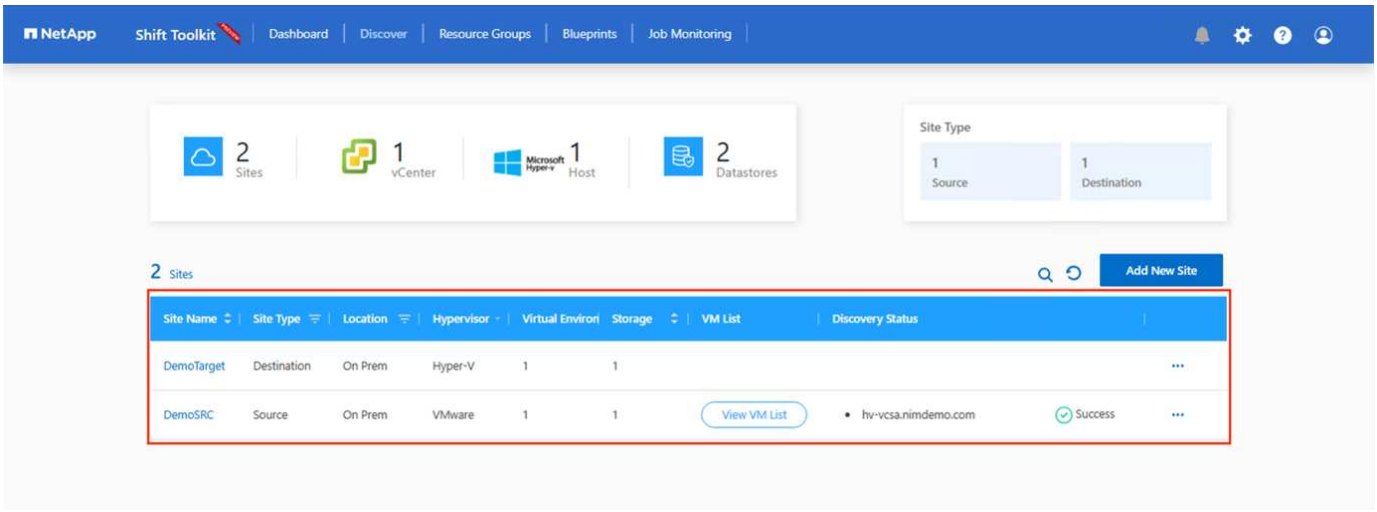
In the current release, end to end virtual machine migration is supported with Hyper-V only.

In the current release, for KVM as the destination, VMDK to qcow2 conversion is the only supported workflow. Hence, if KVM is selected from the dropdown, hypervisor details are not required. The qcow2 disk can be used for provisioning virtual machine on KVM variants.

ONTAP Storage system



The source and destination storage system should be the same as the disk format conversion happens at the volume level.



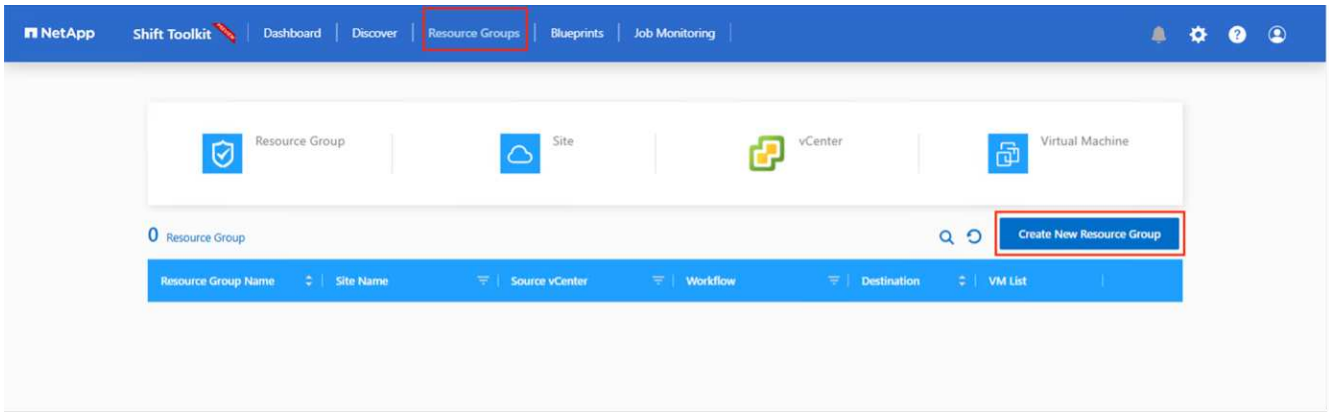
Next step is to group the required VMs into their migration groups as resource groups.

Resource Groupings

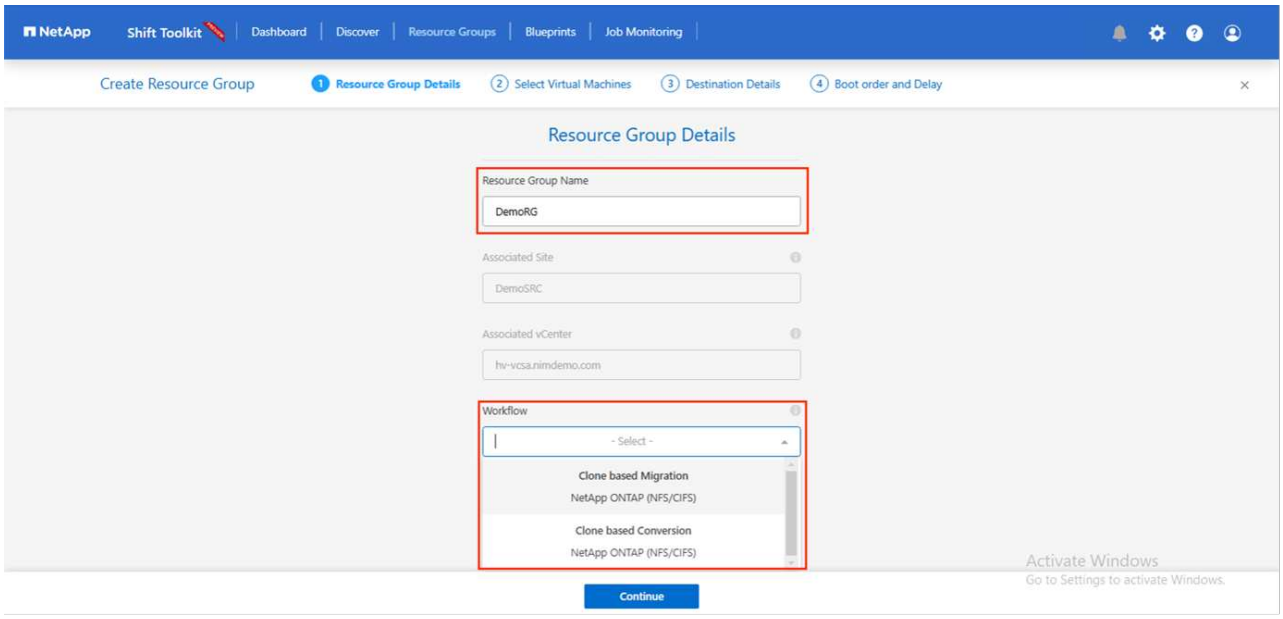
Once the platforms have been added, group the VMs you want to migrate or convert into resource groups. Shift toolkit resource groups allow you to group set of dependent VMs into logical groups that contain their boot orders, boot delays, as well as optional application validations that can be executed upon recovery.

To start creating resource groups, click on the “Create New Resource Group” menu item.

1. Access Resource groups, click on “Create New Resource Group”.

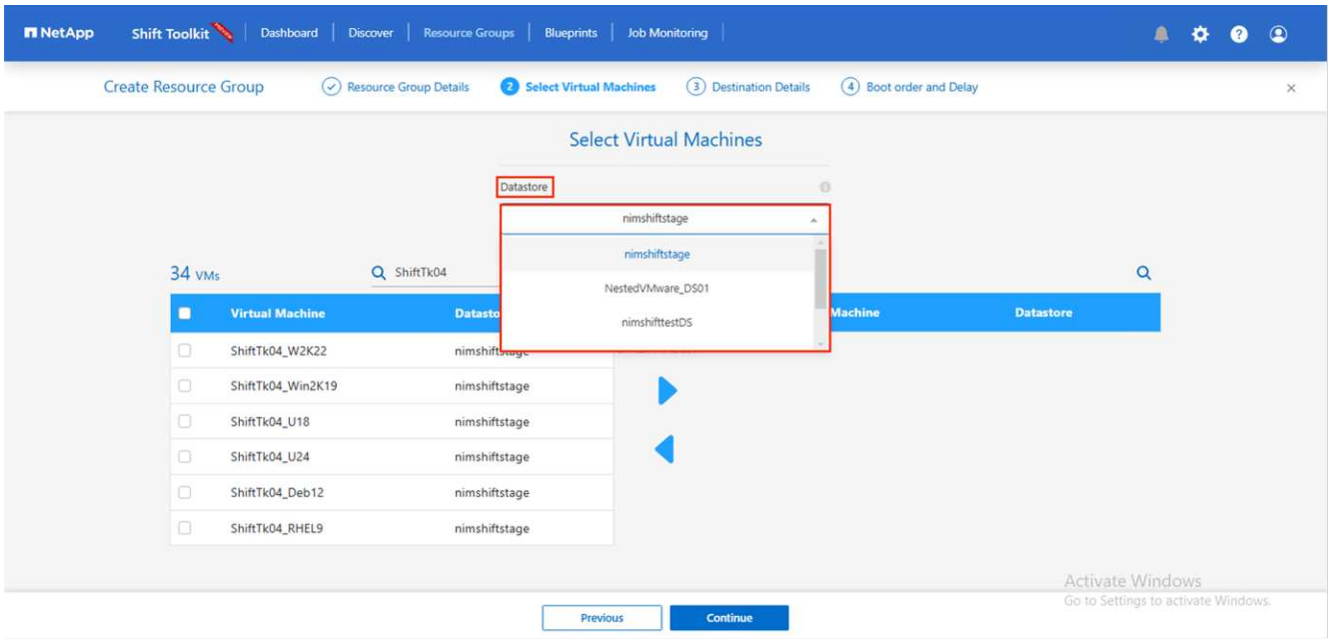


2. On the “New resource group”, select the Source site from the dropdown and click “Create”
3. Provide Resource Group Details and select the workflow. The workflow provides two options
   a. Clone based Migration – performs end to end migration of the VM from source hypervisor to destination hypervisor.
   b. Clone based Conversion – Performs conversion of the disk format to the selected hypervisor type.

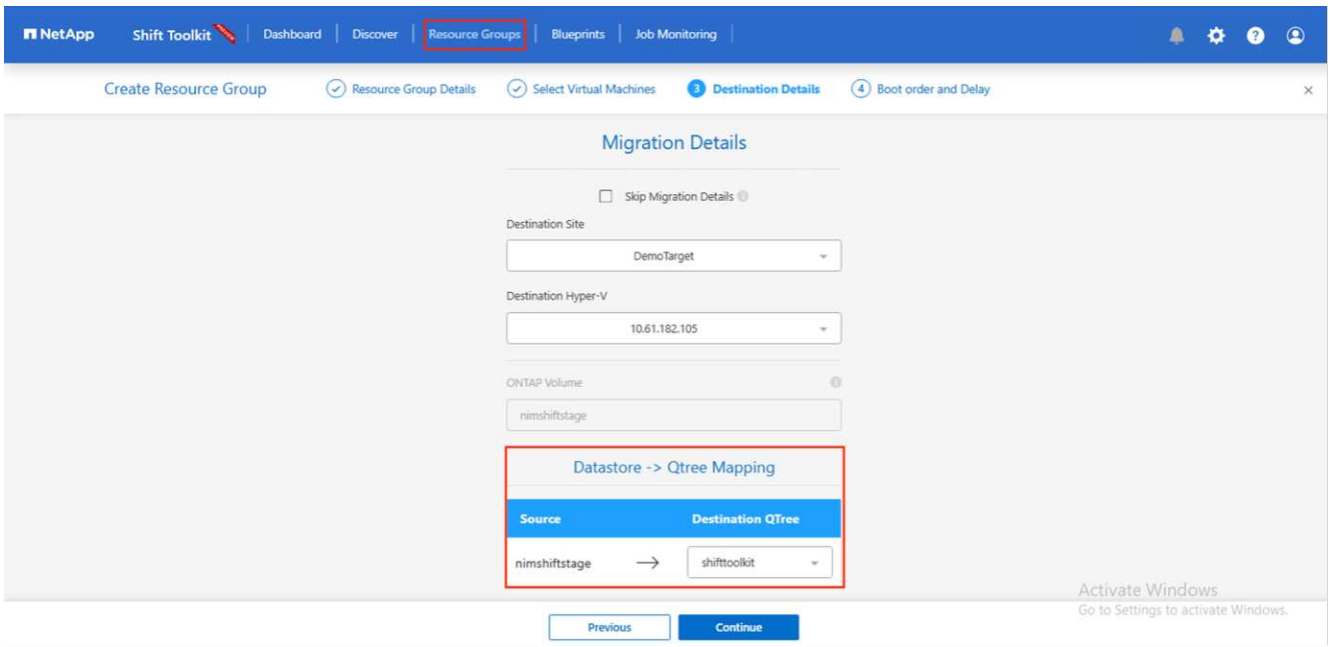


4. Click on “Continue”
5. Select appropriate VMs using the search option. The default filter option is “Datastore”.

Move the VMs to convert or migrate to a designated datastore on a newly created ONTAP SVM before conversion. This helps isolating the production NFS datastore and the designated datastore can be used for staging the virtual machines.



6. Update the migration details by selecting “Destination Site”, Destination Hyper-V entry” and Datastore to Qtree mapping.

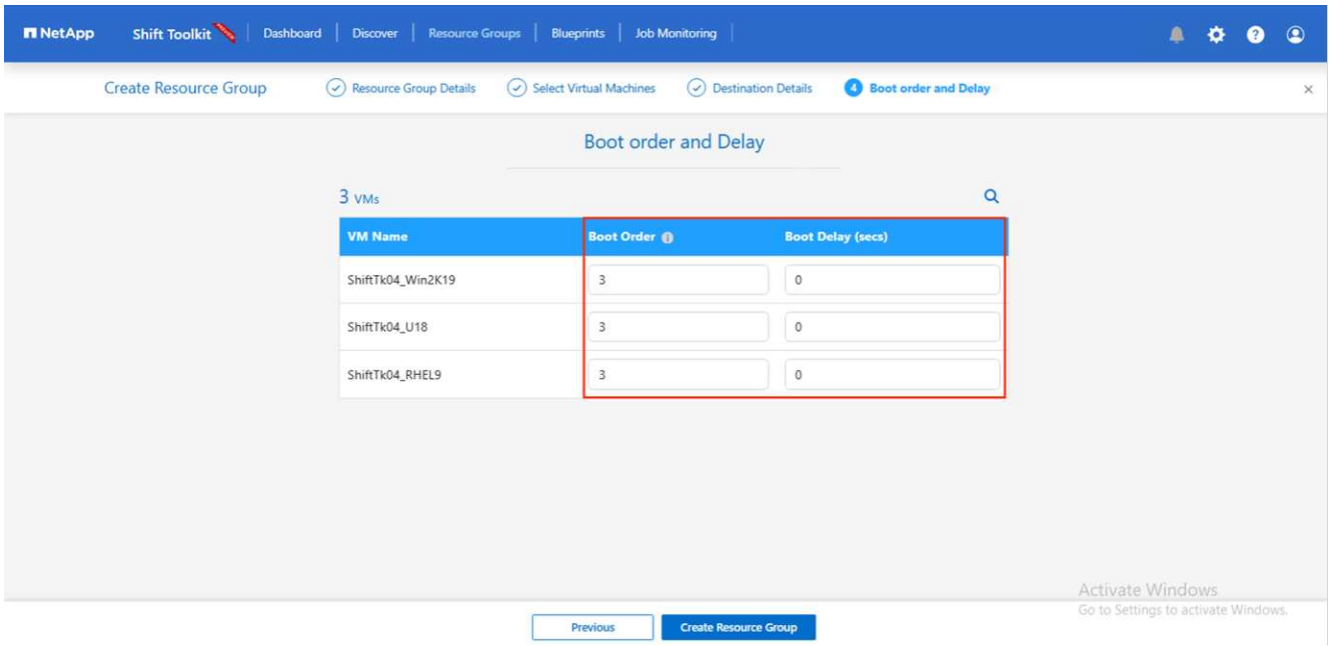


Make sure that the destination path (where the converted VMs are stored) is set to a qtree when converting VMs from ESX to Hyper-V. Set the destination path to the appropriate qtree.

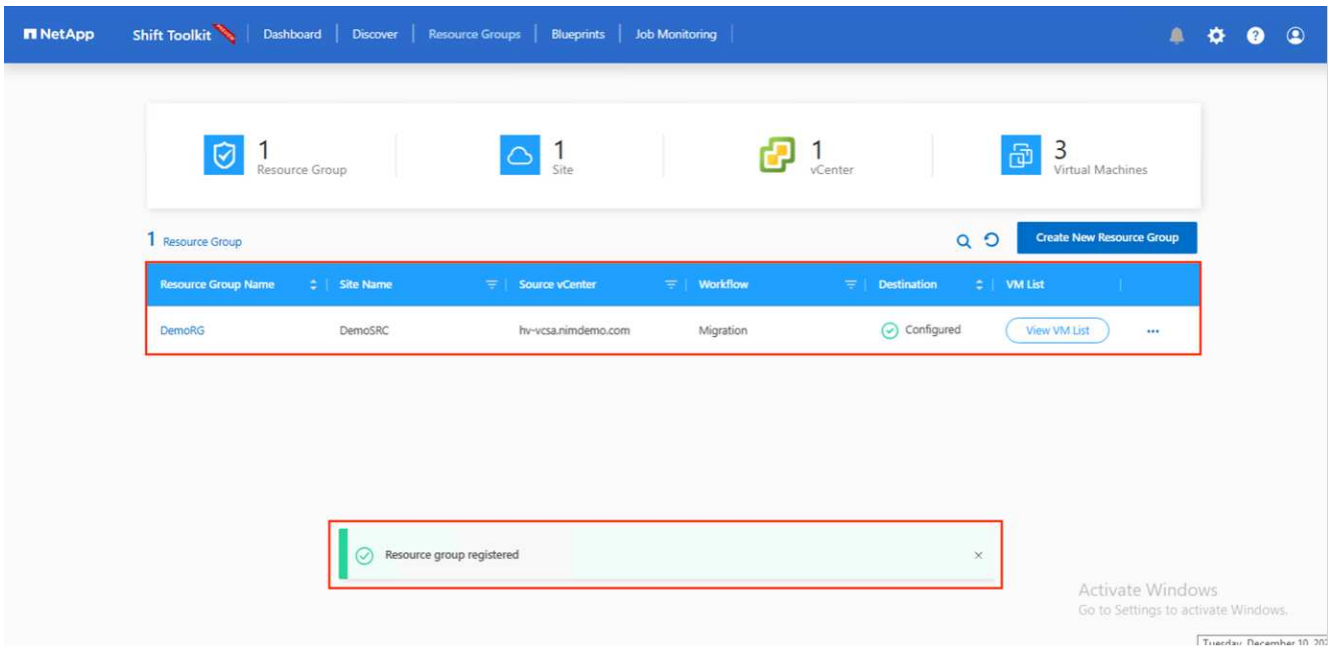
7. Select the Boot Order and Boot delay (secs) for all the selected VMs. Set the order of power on sequence by selecting each virtual machine and setting up the priority for it. 3 is the default value for all virtual machines.

Options are as follows:

1 – The first virtual machine to power on
3 – Default
5 – The last virtual machine to power on



8. Click on “Create Resource Group”.



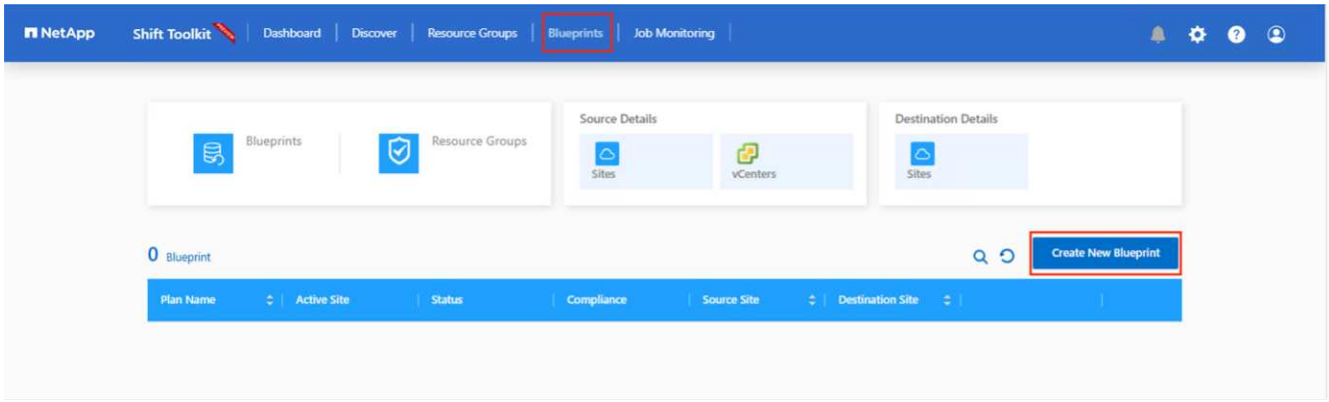
Blueprints

To migrate or convert virtual machines, a plan is necessary. Select the source and destination hypervisor platforms from the drop down and pick the resource groups to be included in this blueprint, along with the grouping of how applications should be powered on (i.e. domain controllers, then tier-1, then tier-2, etc). These are often called as migration plans as well. To define the blueprint, navigate to the “Blueprints” tab and click on

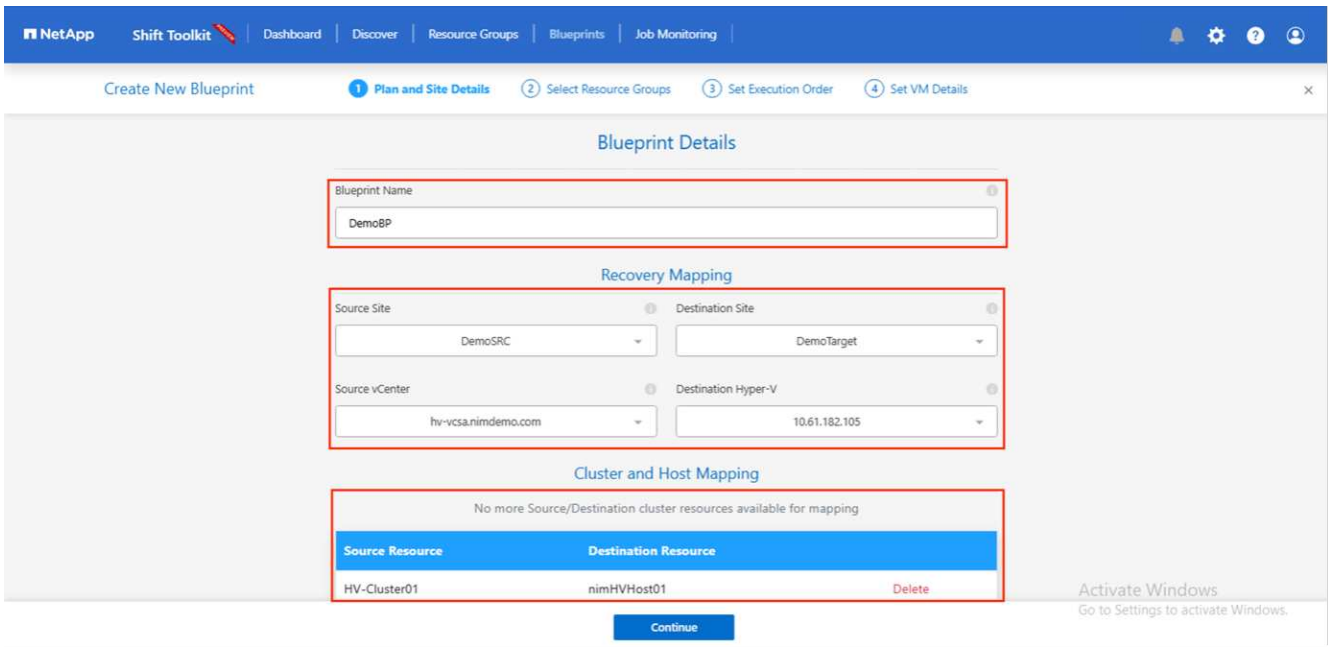
“Create New Blueprint”.

To start creating blueprint, click on the “Create New Blueprint”.

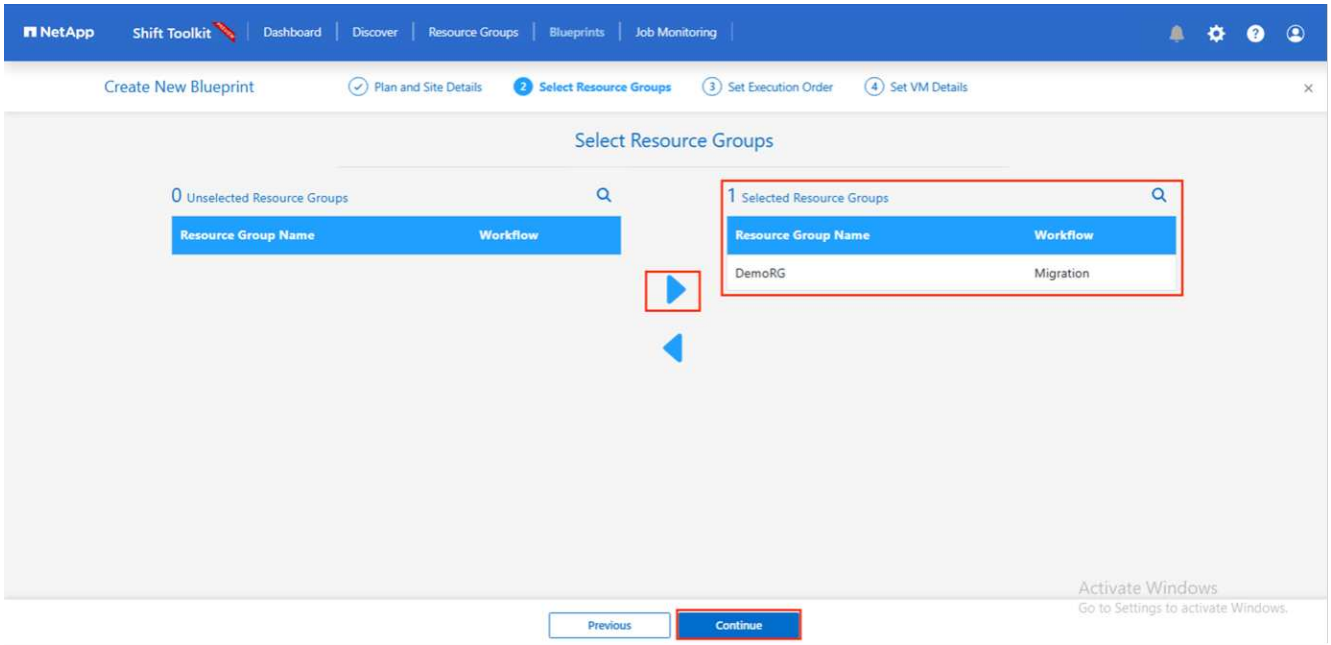
1. Access Blueprints, click on “Create New Blueprint”.



2. On the “New Blueprint”, provide a name for plan and add necessary host mappings by selecting Source Site, associated vCenter, Destination Site and associated Hyper-V hypervisor.
3. Once mappings are done, select the cluster and host mapping.



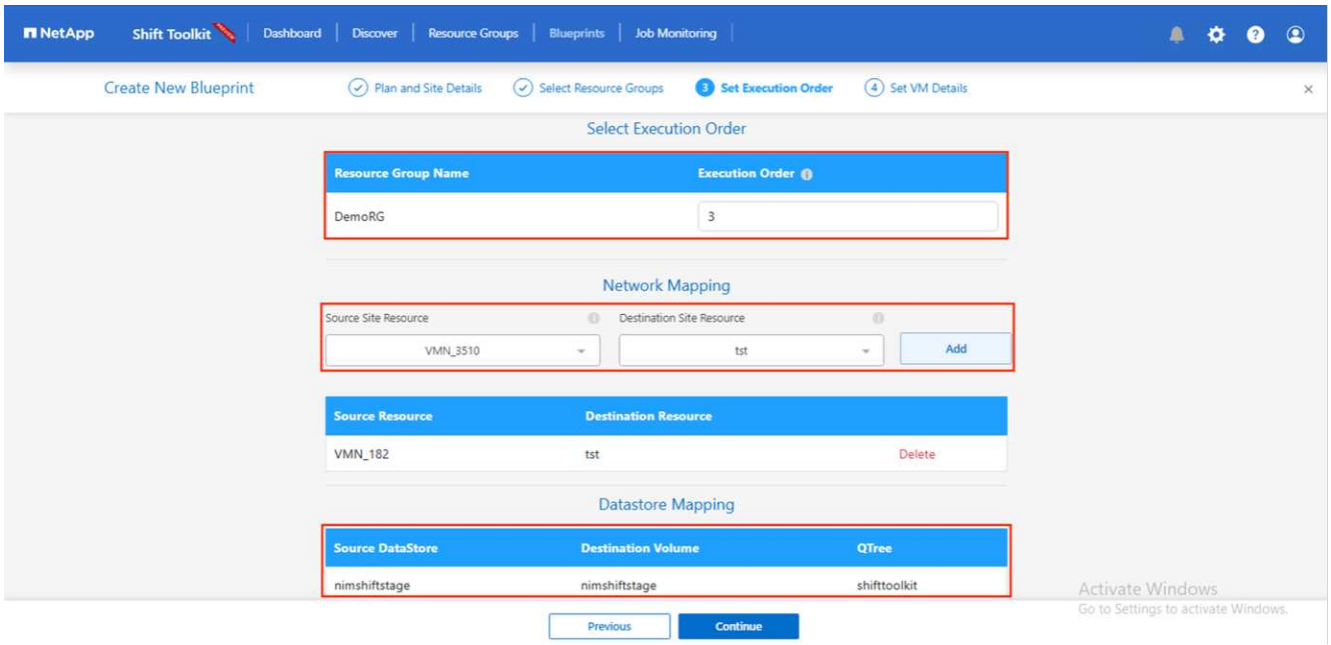
4. Select Resource Group Details and click on “Continue”



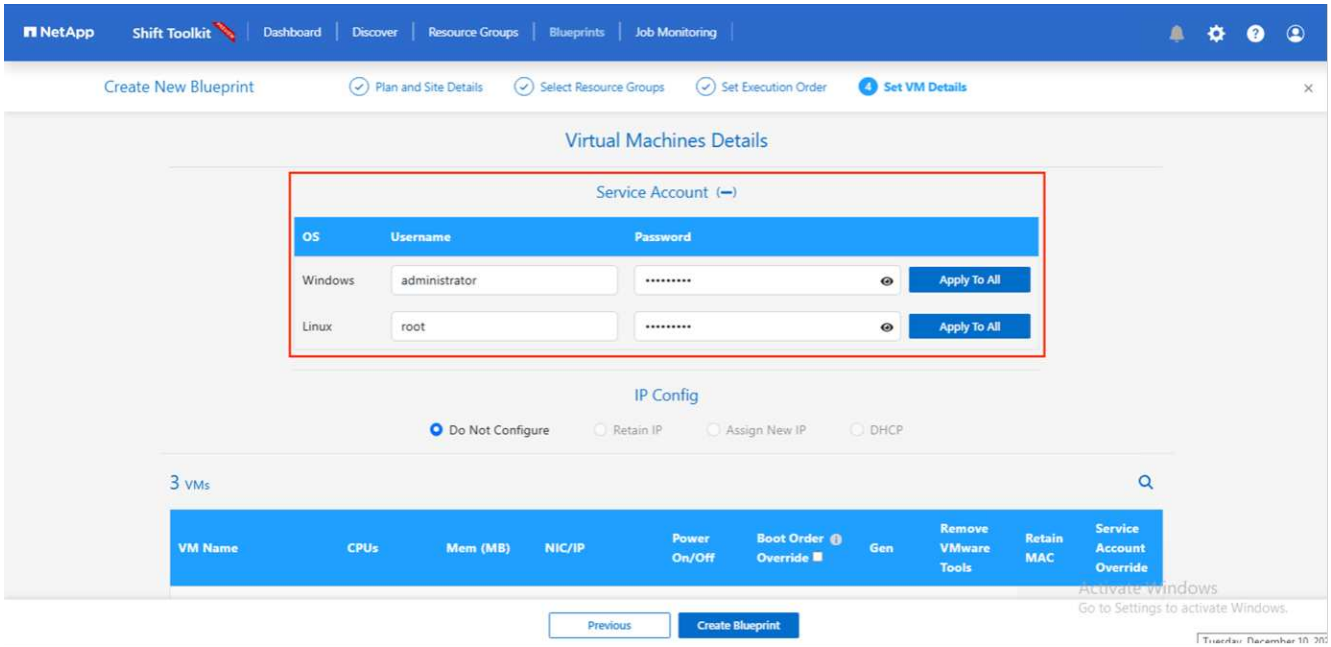
5. Set Execution Order for Resource Group. This option enables to select the sequence of operations when multiple resource groups exist.
6. Once done, select Network Mapping to the appropriate virtual switch. The virtual switches should already be provisioned within Hyper-V.

The virtual switch type “External” is the only supported option for network selection.

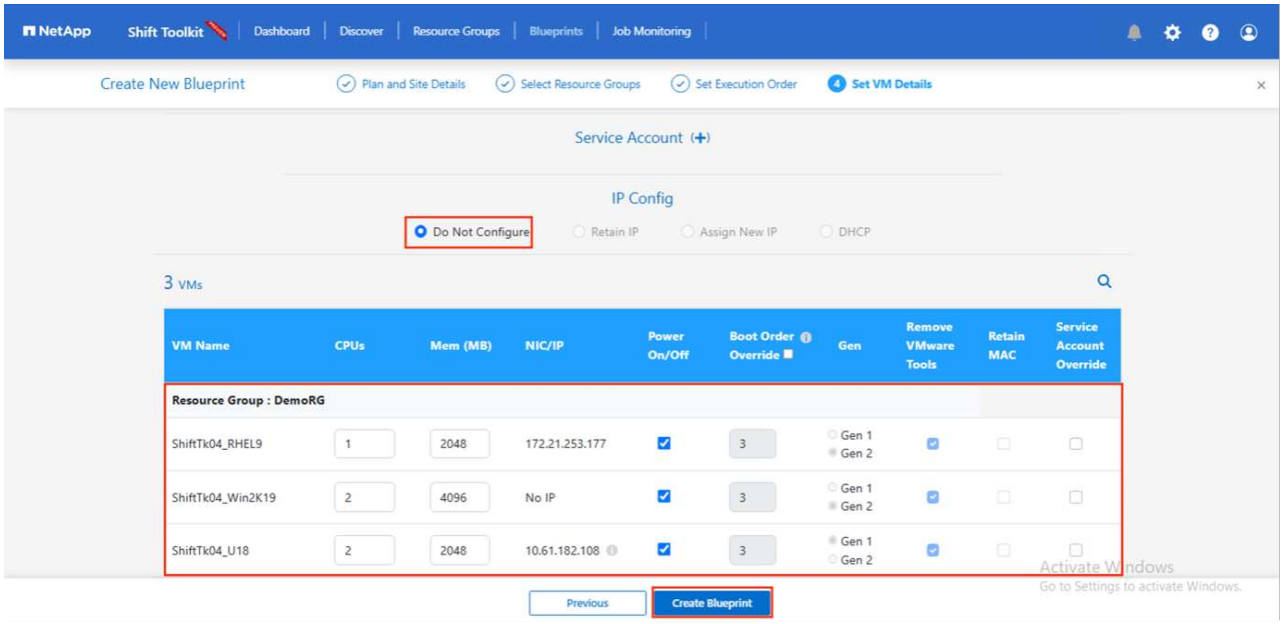
Although network mapping is available in the GUI, Shift toolkit does not perform IP address assignment in the current release, however in the upcoming release, “Retain IP” will be an option. In the current release, “Do no configure Network” is the default selection. Once the disk is converted and virtual machine is bought on Hyper-V side, manually assign the network switches to match the relevant portgroups and vLANs on the VM ware side.



7. Based on the selection of VMs, storage mappings will be automatically selected.
   Note: Make sure the qtree is provisioned beforehand and the necessary permissions are assigned so the virtual machine can be created and powered ON from SMB share.
8. Under VM details, provide service account details for each OS type. This is used to connect to the virtual machine to create and run certain scripts that are necessary for removing VMware tools and backing up IP configuration details.



9. Again, under VM details, select the IP config option. This release do not support IP address assignment, hence “Do not configure” is selected by default.
10. The next step is VM configuration.
    - Optionally resize the VMs CPU/RAM parameters which can be very helpful for resizing purposes.
    - Boot Order override: Also modify the Boot Order and Boot delay (secs) for all the selected VMs across the resource groups. This is an additional option to modify the boot order if any changes required from what was selected during Resource group boot order selection. By default, the boot order selected during resource group selection is used, however any modifications can be done at this stage.
      *Power ON: Uncheck this option if workflow should not power ON the virtual machine. Default option is ON meaning the VM will be powered ON.
    - Remove VMware tools: Shift toolkit removes VMware tools before the conversion. This option is selected by default.
    - Generation: Shift toolkit uses the following rule of thumb and defaults to the appropriate one- Gen1 > BIOS and Gen2 > EFI. No selection is possible for this option.
    - Retain MAC: The MAC address of the respective VMs can be retained to overcome licensing challenges for those applications relying on MAC. This option is disabled since the network is not modifiable in this release.
    - Service Account override: This option allows to specify a separate service account if the global one cannot be used.



11. Click on “Create Blueprint”.

Migration

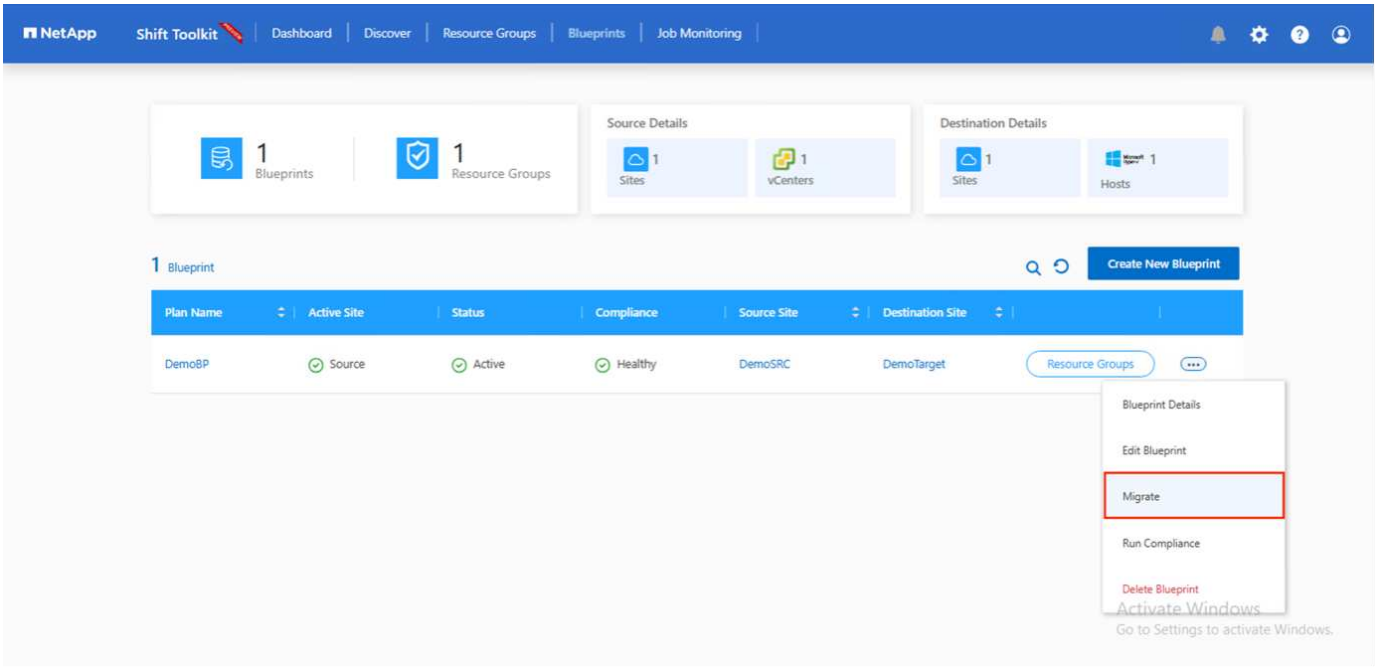
Once the blueprint is created, “Migrate” option can be exercised. During migrate option, shift toolkit performs a series of steps to convert the disk format and use the converted disk to create virtual machine on Hyper-V host as defined in the blueprint. The high level steps performed are as follows:

- Trigger VM snapshots for Blueprint – at source
- Trigger volume snapshots
- Prepare VM by cloning network configuration and removing VMware Tools for all VMs
  - Based on the OS type, necessary Hyper-V drivers are added <optional>

> For detailed information, refer System stucked in dracut after the migration of a RHEL VM to hyper-v

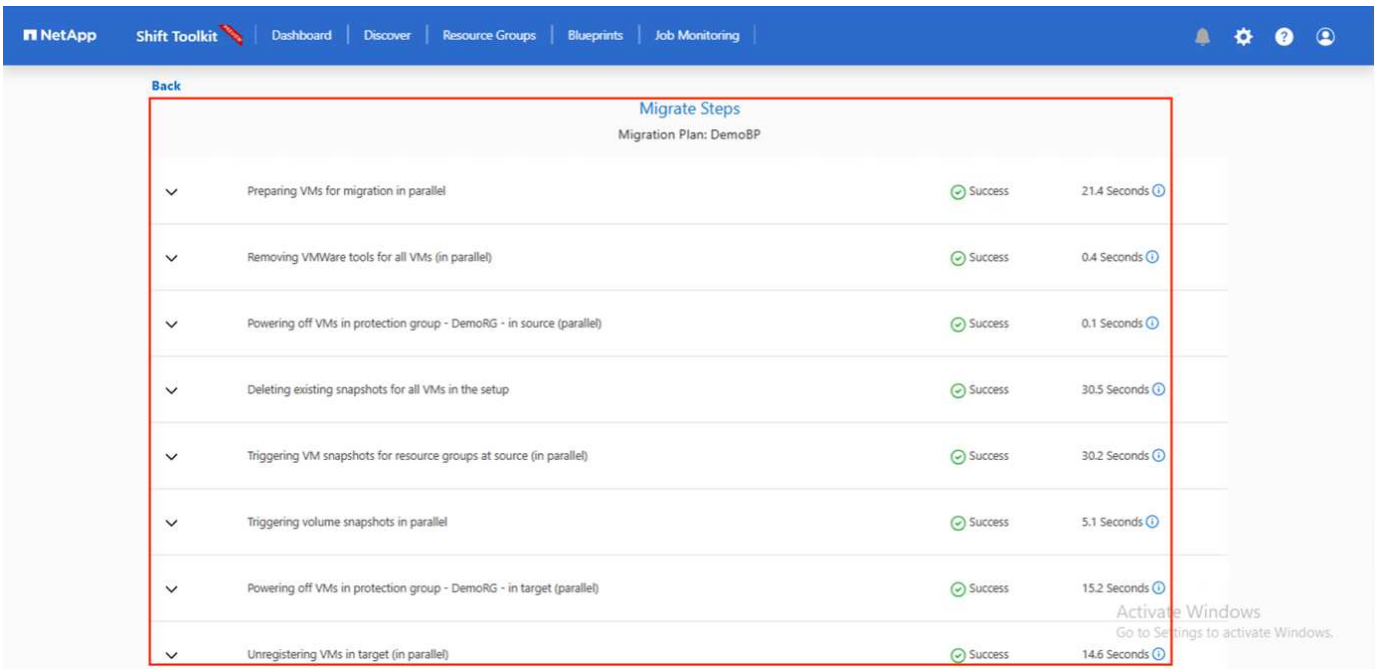
- Power OFF VMs in the protection group – at source
- Delete existing snapshots for all VMs in the blueprint
- Clone and Convert VMDK to VHDx format for all VMs
- Power ON VMs in protection group – at target

To trigger Migrate workflow with the configuration specified in Blueprint as is, click on Migrate.

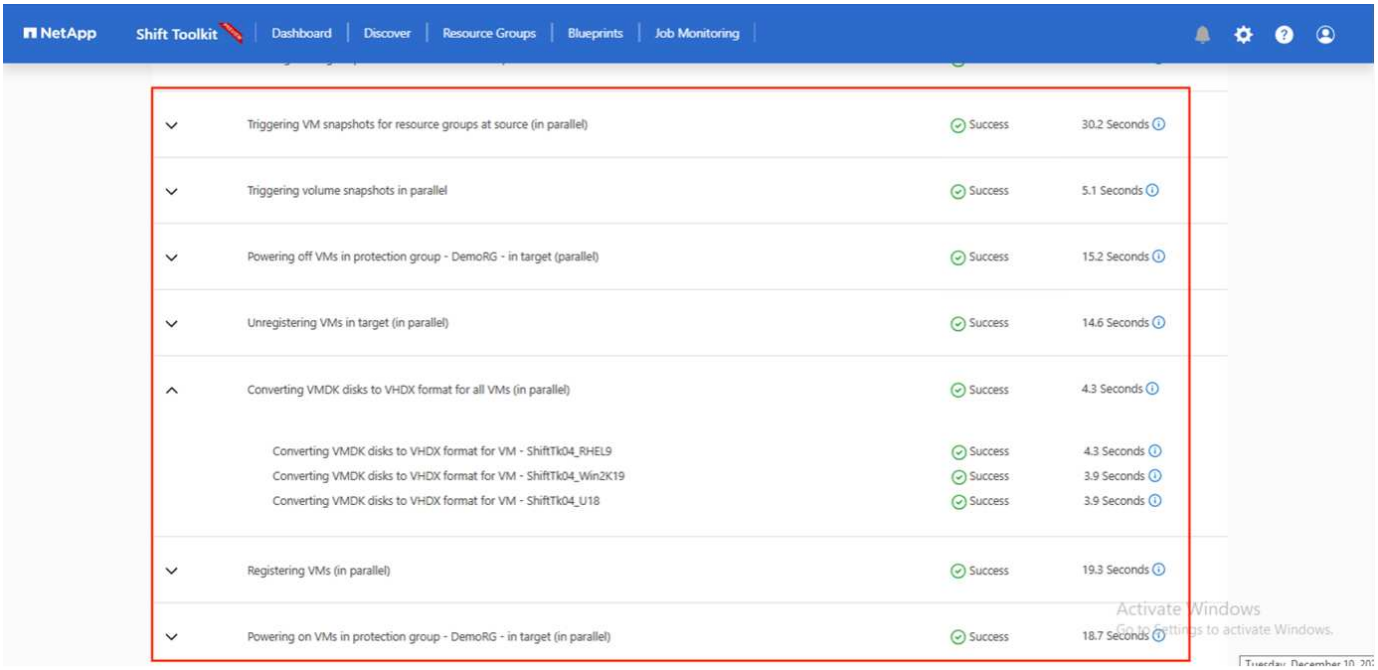


Once triggered, the preparation stage kicks in and the conversion process runs through the steps mentioned above.

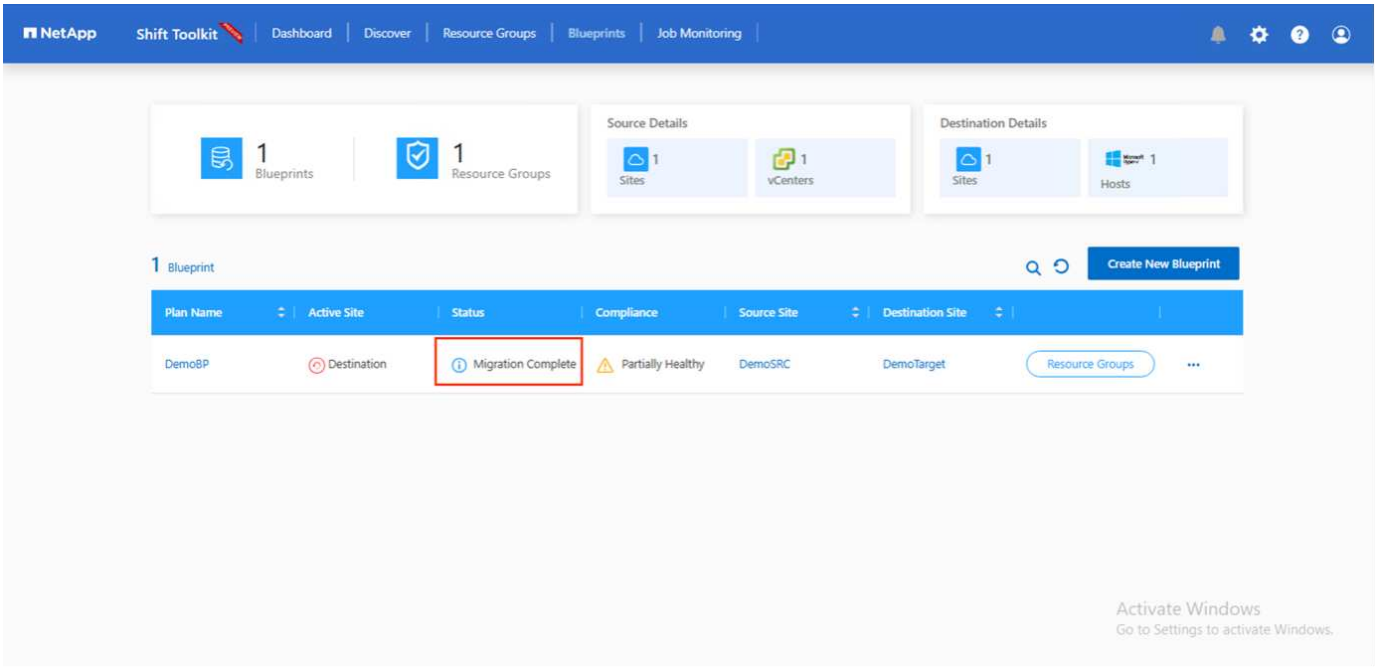
We recommend that no more than ten conversions be triggered parallelly from the same ESXi source to the same Hyper-V destination



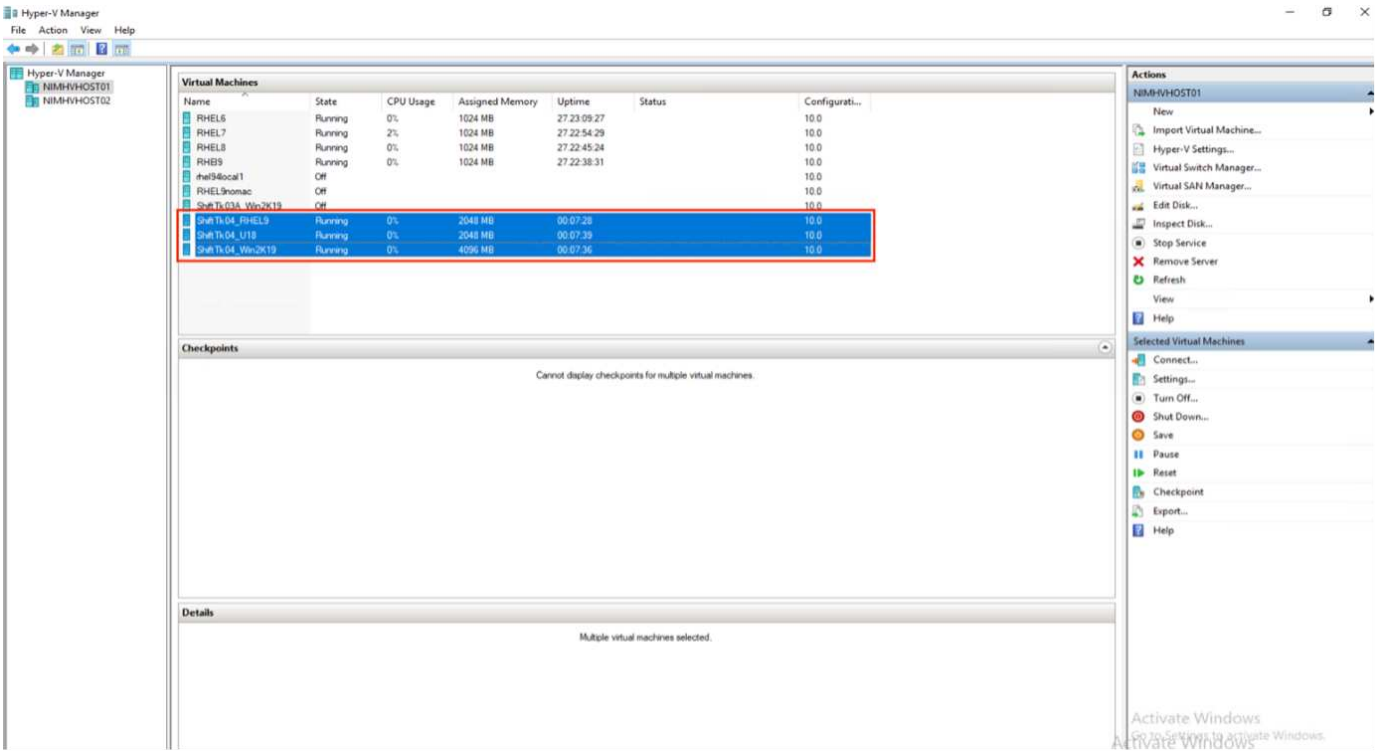
The conversion of VMDK to VHDx happens in seconds which makes this approach the fastest of all the options that are available for an additional cost. This also helps to reduce VM downtime during migration.



Once the job is complete, the status of the blueprint changes to “migration Complete”.



With migration complete, it’s time to validate the VMs on Hyper-V side. Below screenshot shows the VMs running on the Hyper-V host that was specified during the blueprint creation.



After conversion, all the VM disks except for the OS disk will be offline. This is because the NewDiskPolicy parameter is set to offlineALL on VMware VMs by default.

Conversion

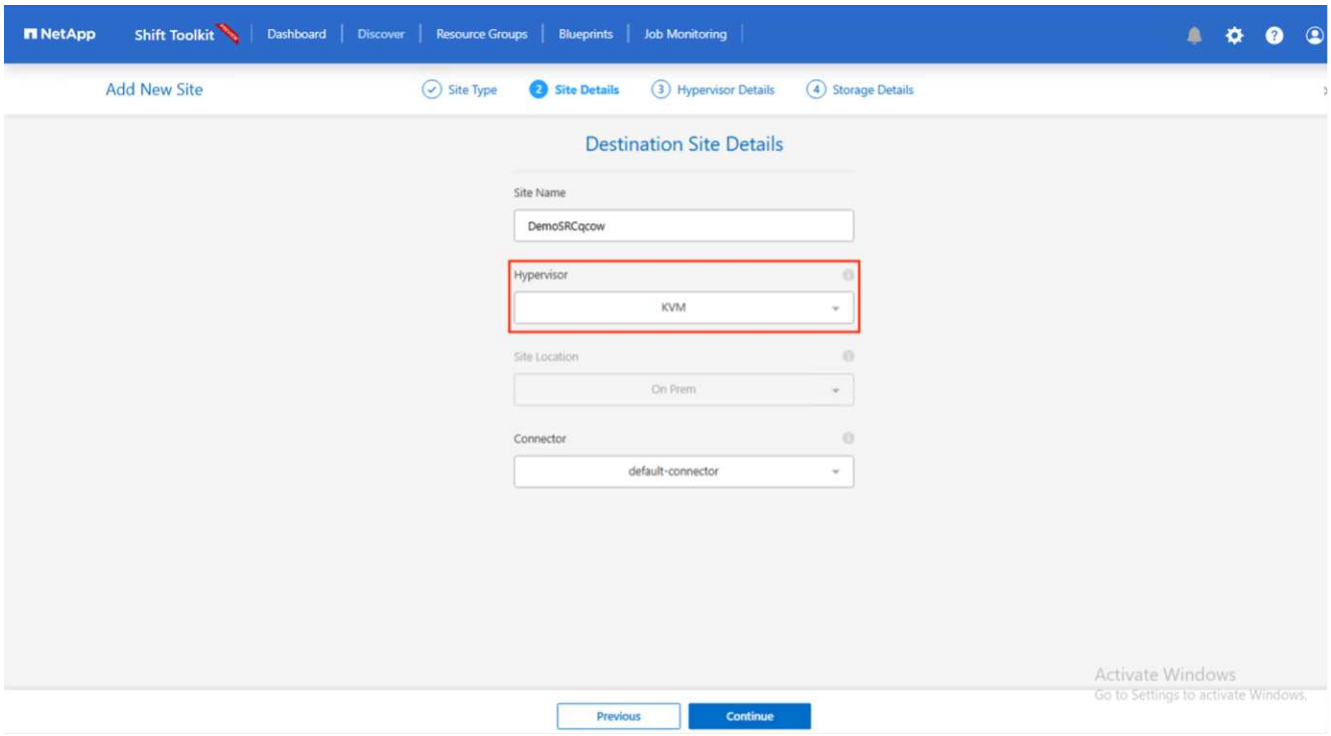
The Clone based conversion option allows to simply convert the virtual disk between hypervisors for the following disk formats:

- VMware ESX to Microsoft Hyper-V (VMDK to VHDX)
- VMware ESX to Red Hat KVM (VMDK to QCOW2)

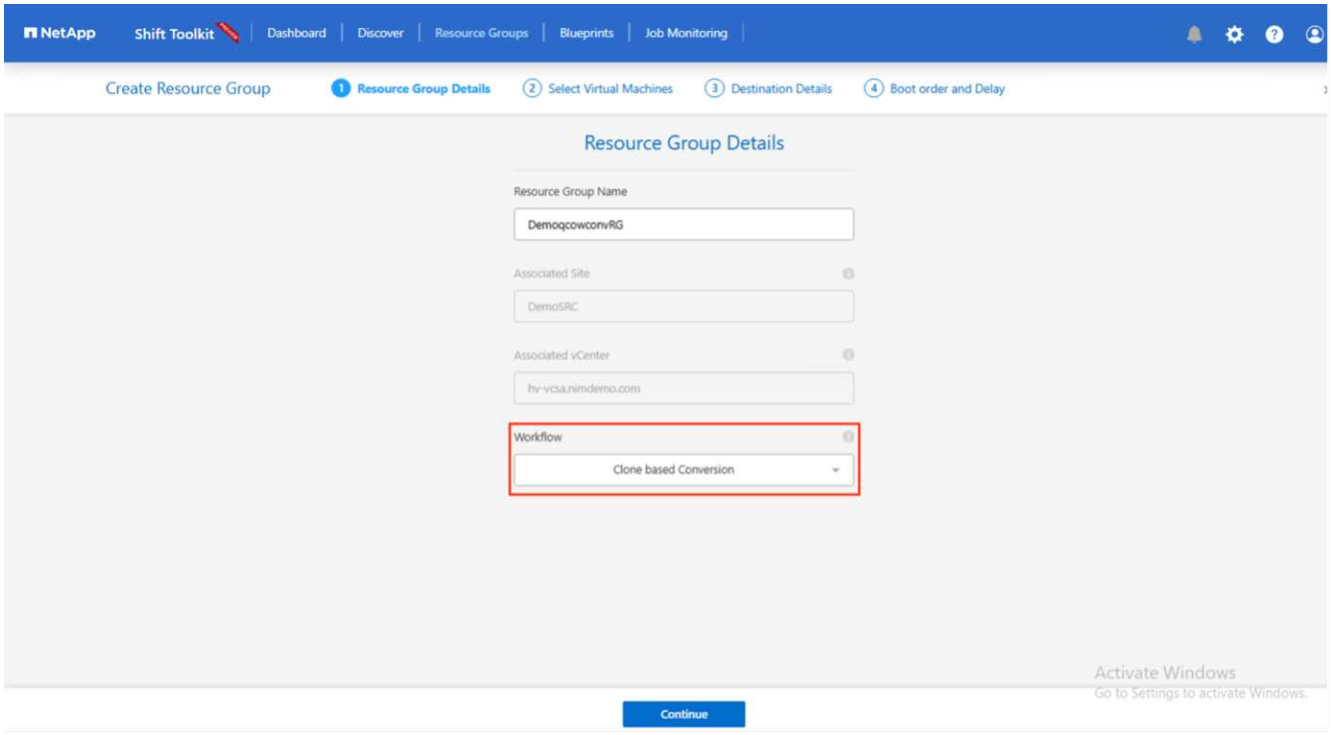
Convert to QCOW2 format

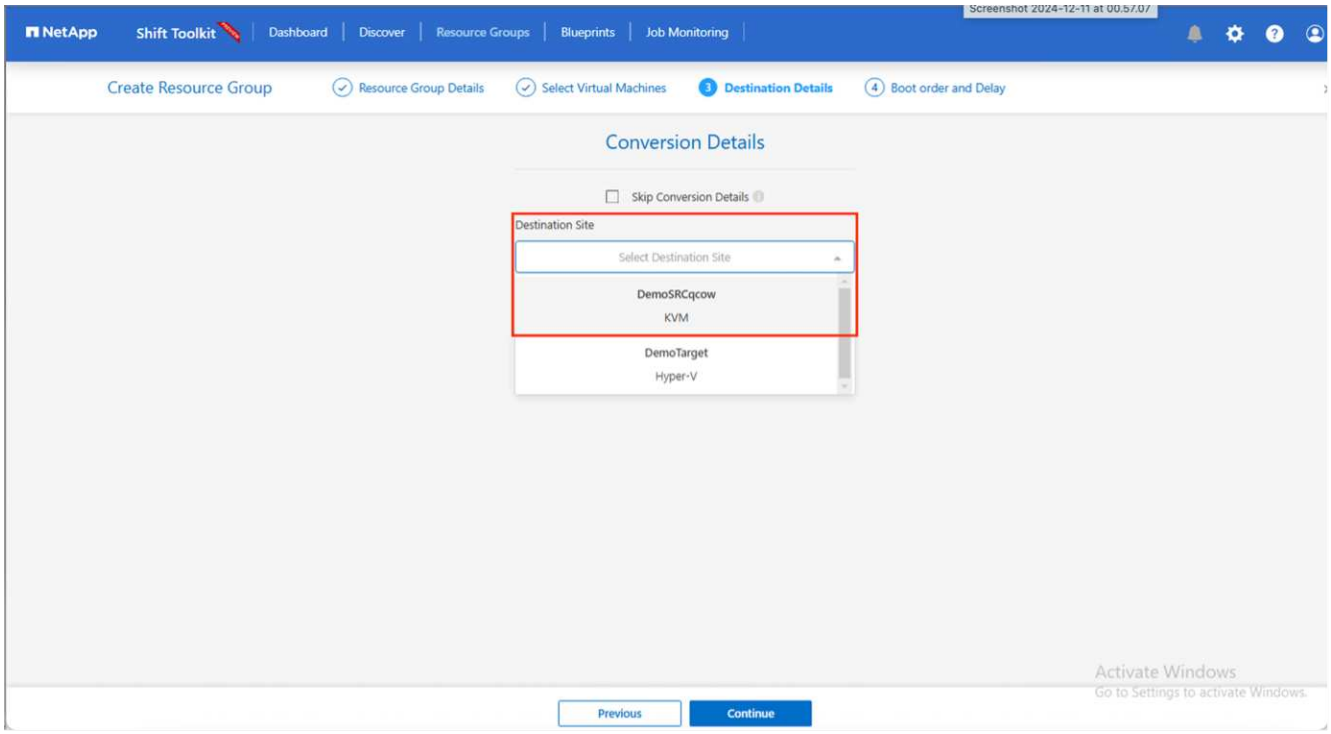
To convert the virtual disks to QCOW2 format with NetApp Shift toolkit, follow these high-level steps:

- Create a destination site type specifying Hyper-V or KVM as the hypervisor.
  Note: Hypervisor details are not required for KVM.

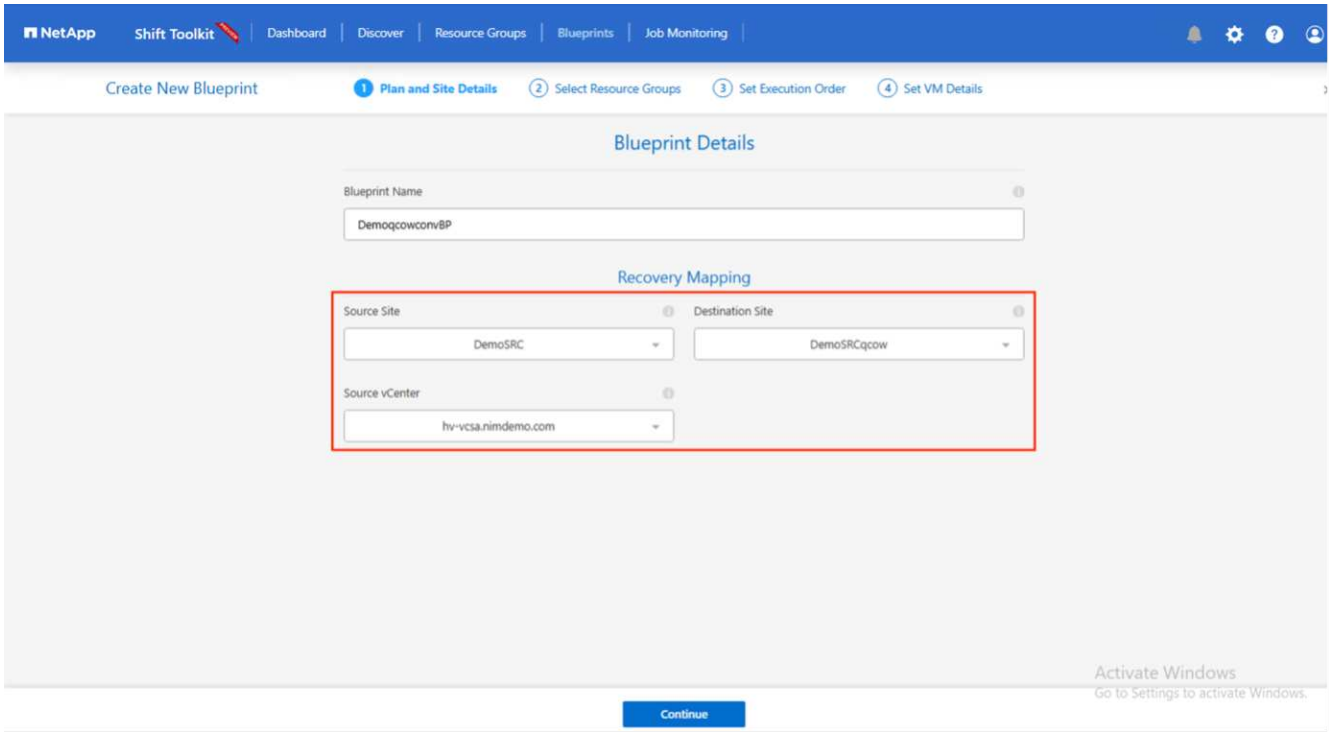


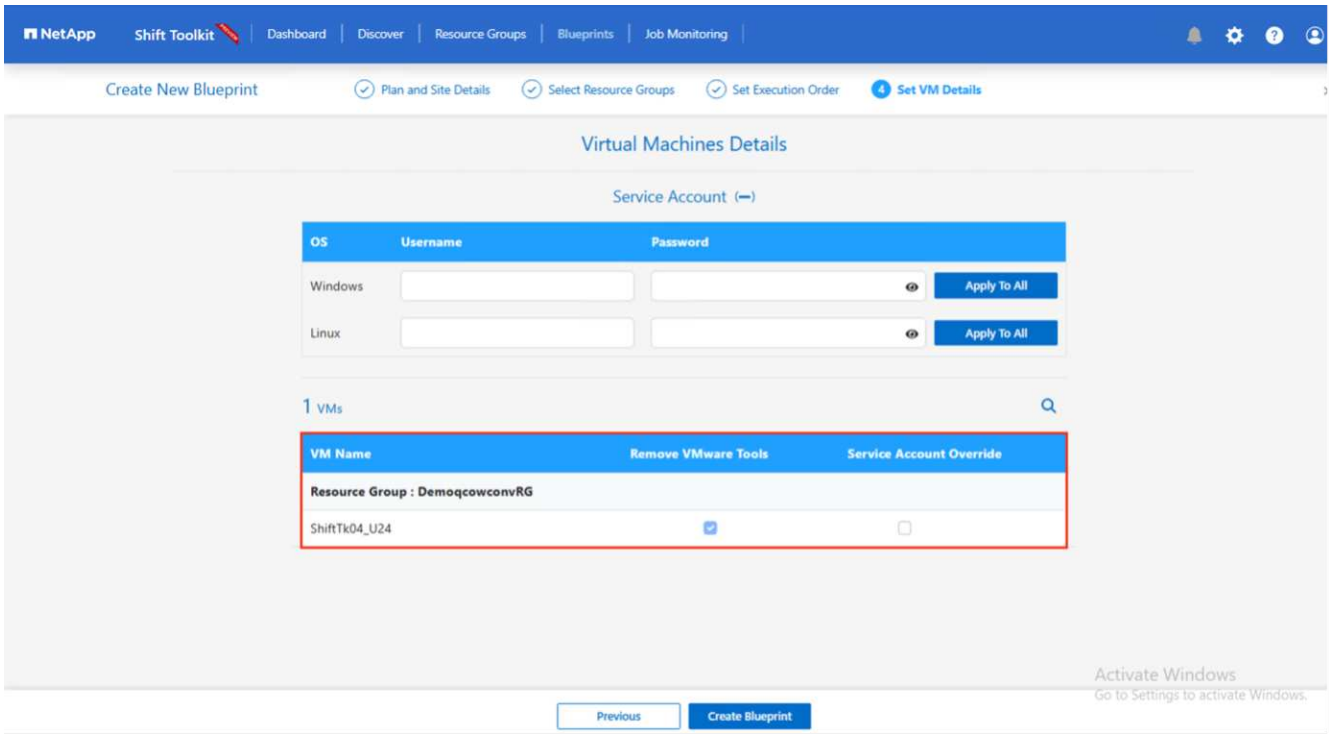
- Create a resource group with the VMs for which the disk conversion is required



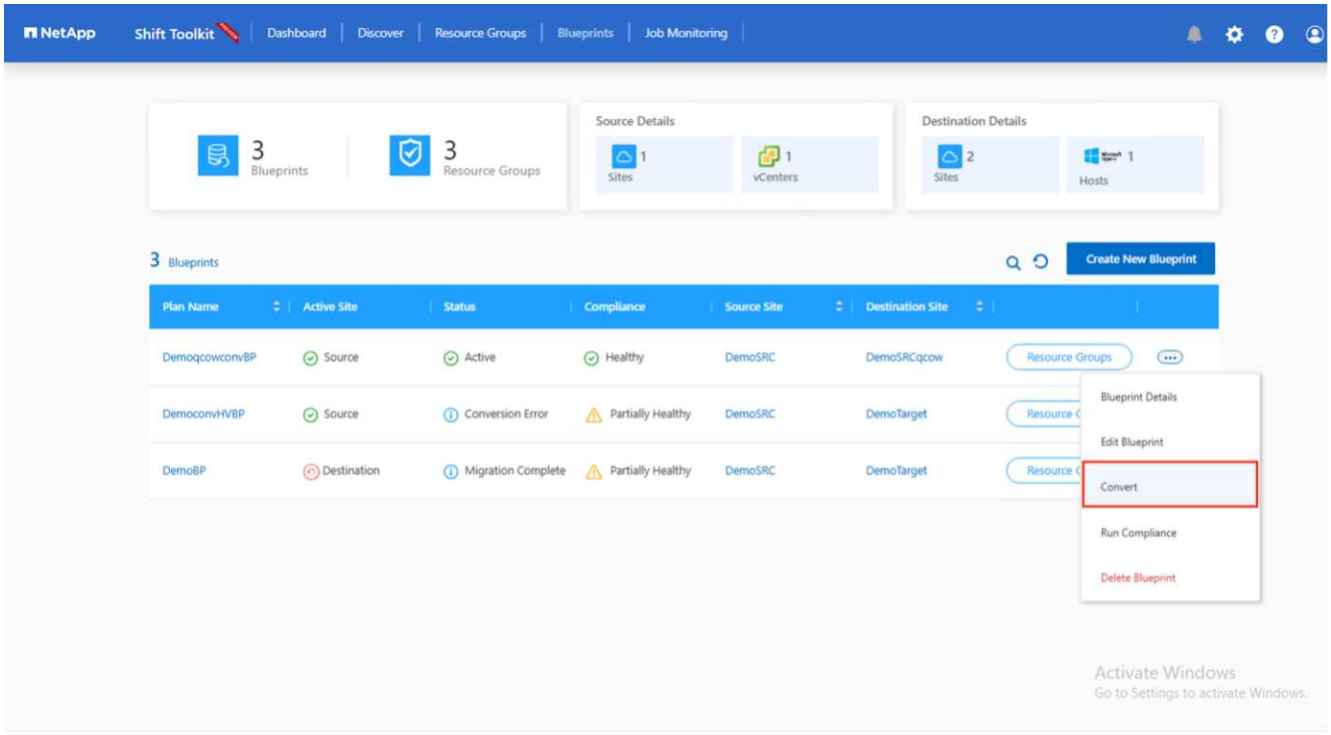


- Create the blueprint to convert the virtual disk to QCOW2 format.

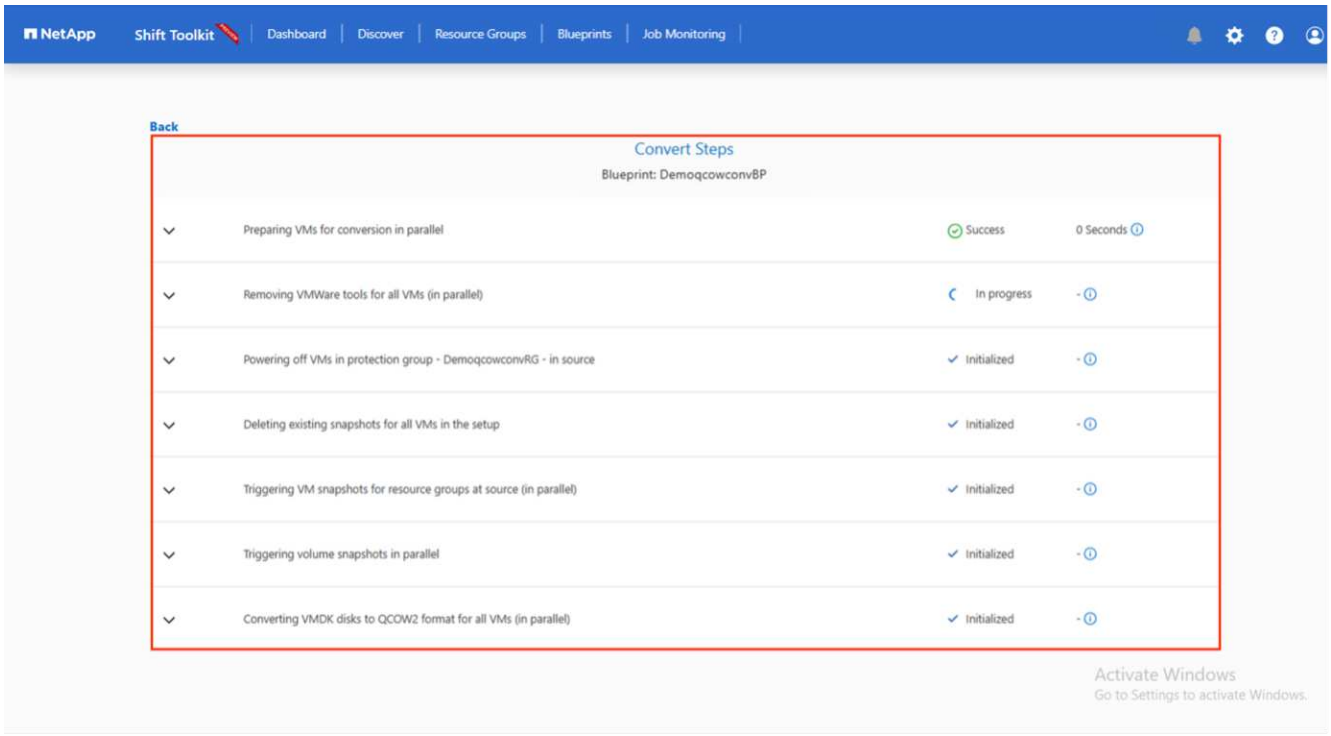


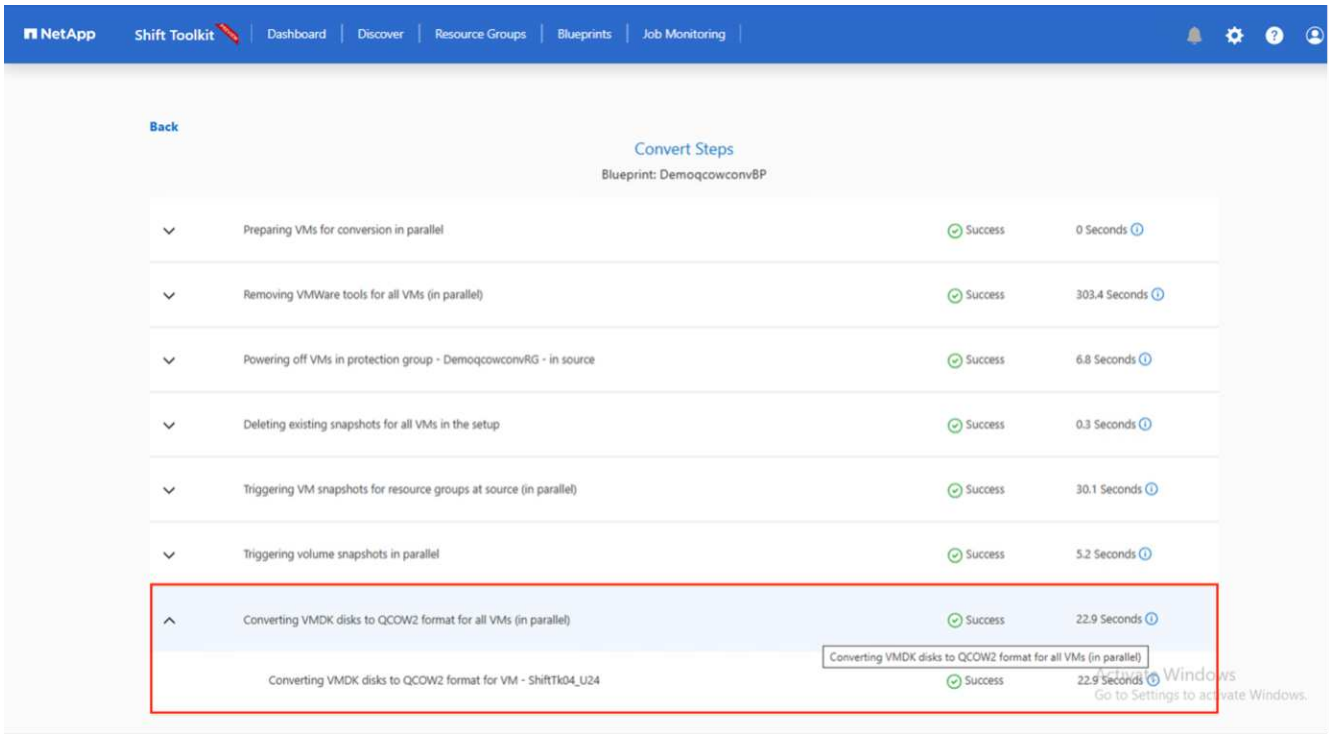


- Select “Convert” once the necessary downtime is raised for the VMs.

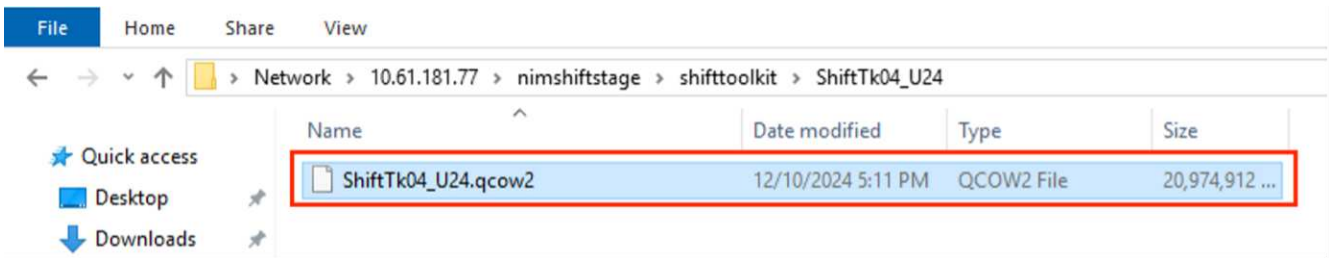


- The convert operation executes each operation against the VM and respective disk to generate the appropriate format.





- Use the converted disk by manually creating the VM and attaching the disk to it.



Shift toolkit only support disk conversions. They do not support VM conversion. To use the converted disk in a VM, the VM must be created manually, and the disk must be attached to it.

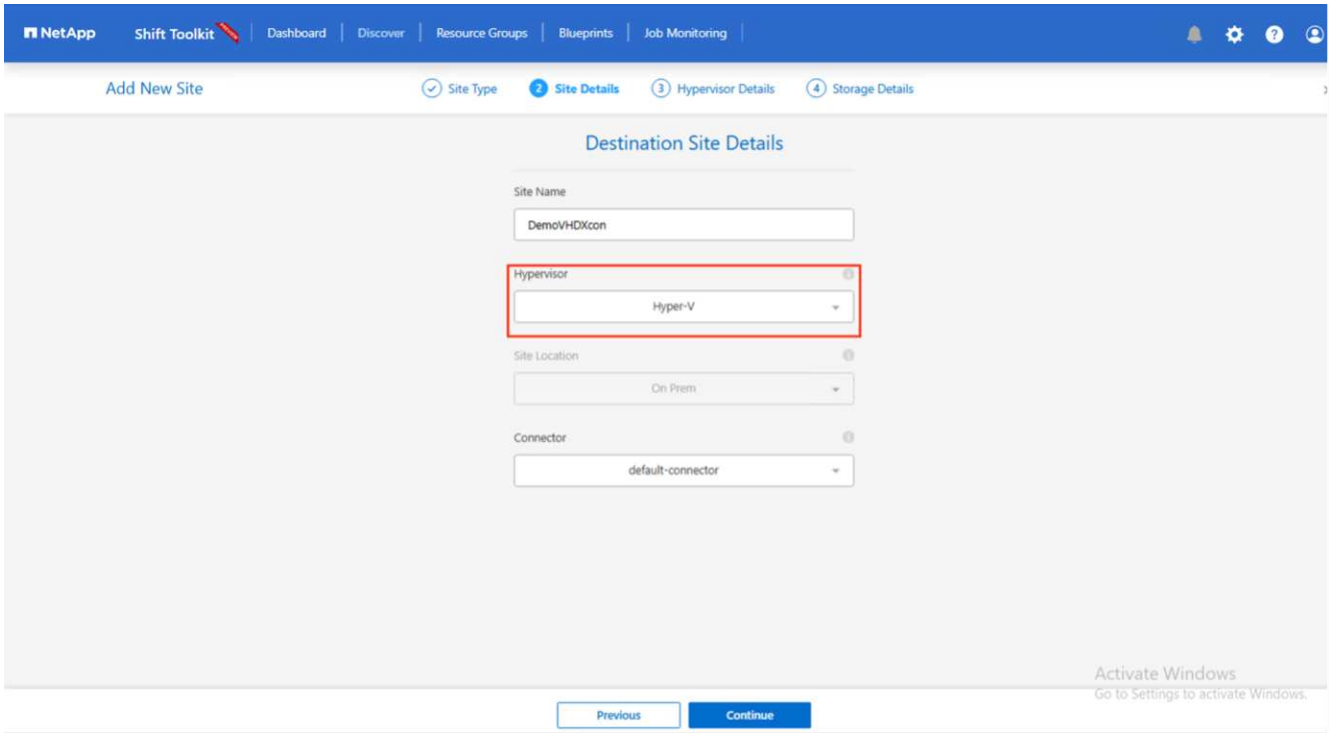
Shift toolkit does not support VM-level conversions for the KVM hypervisor. However, it does support disk conversions to QCOW2 disk format, a virtual disk format used by the KVM hypervisor.

Convert to VHDX format

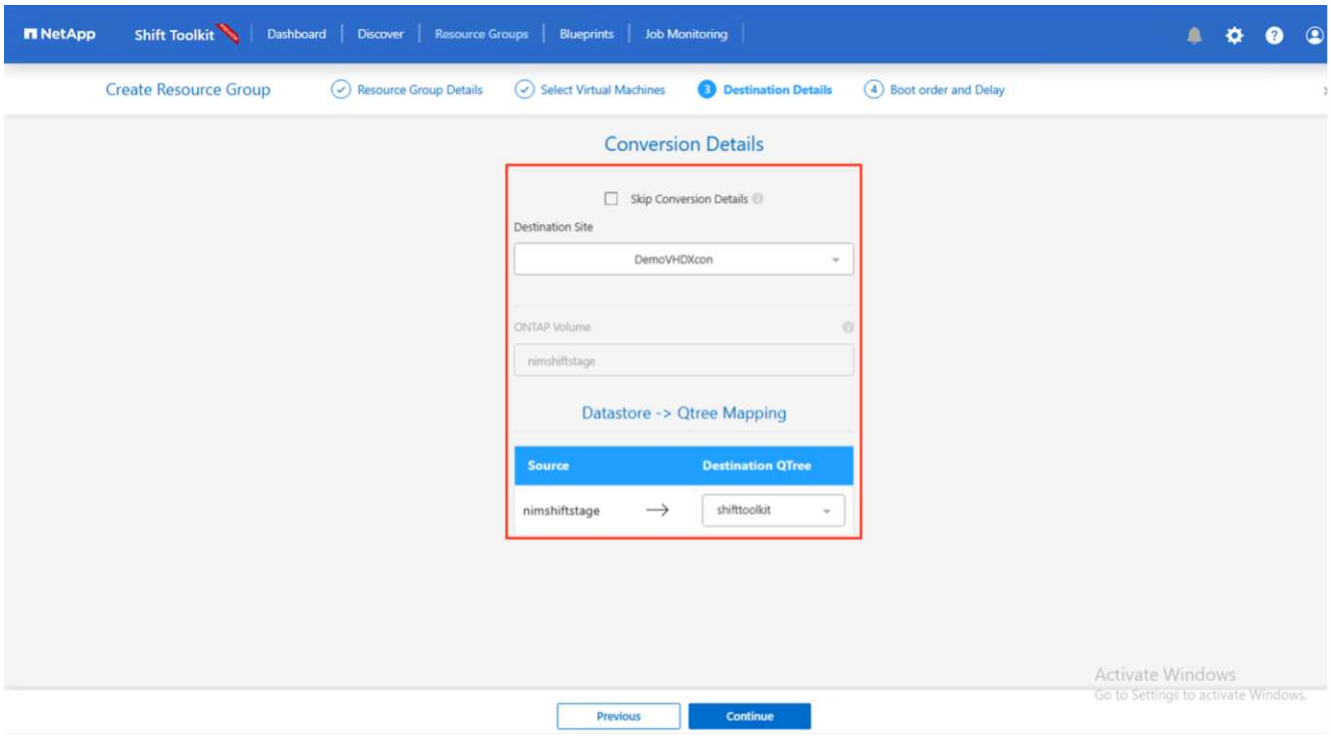
To convert the virtual disks to VHDX format with NetApp Shift toolkit, follow these high-level steps:

- Create a destination site type specifying Hyper-V or KVM as the hypervisor.

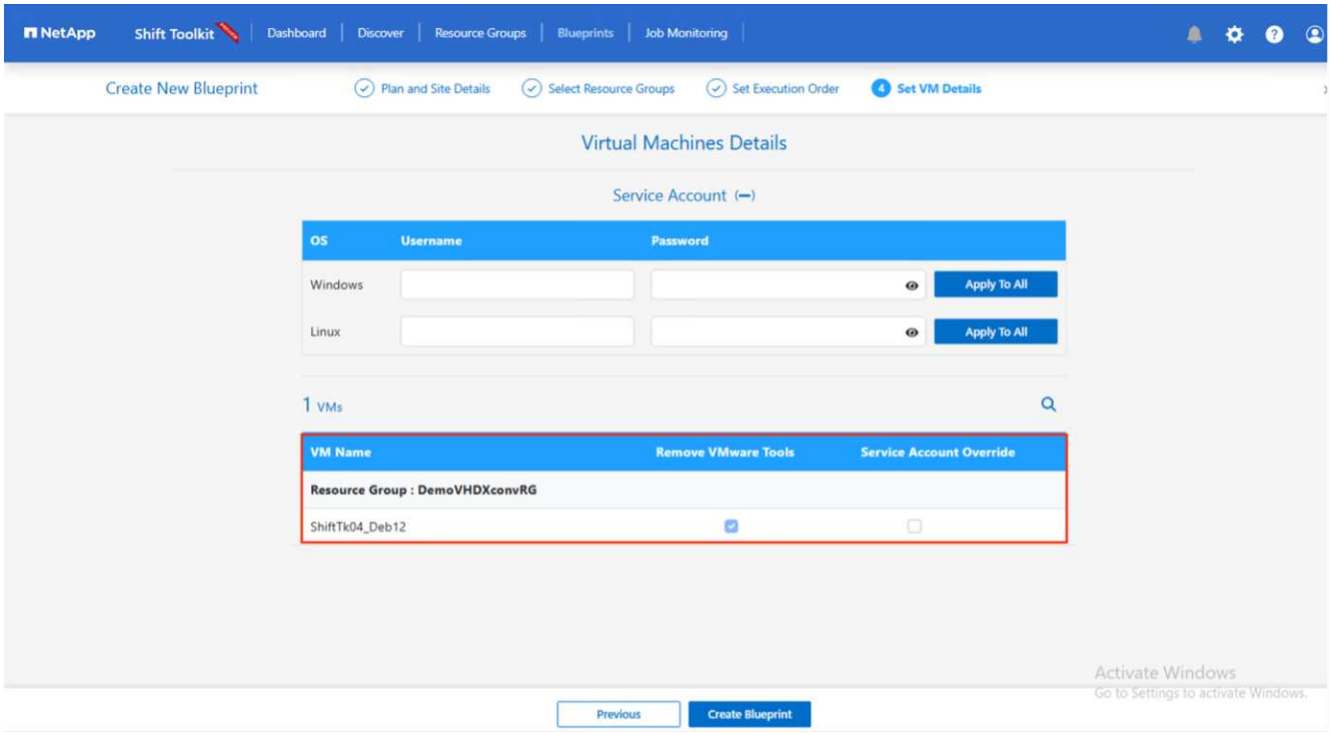
  Hypervisor details are not required for KVM.



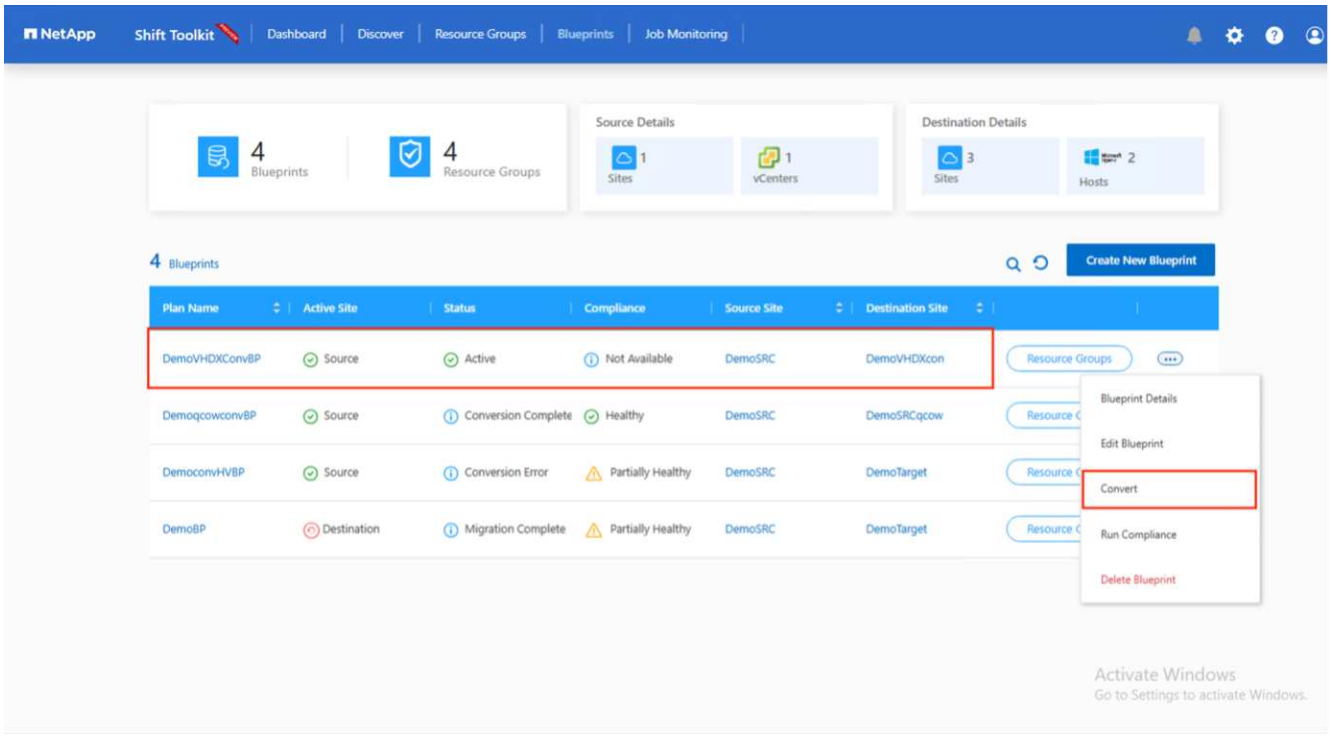
- Create a resource group with the VMs for which the disk conversion is required



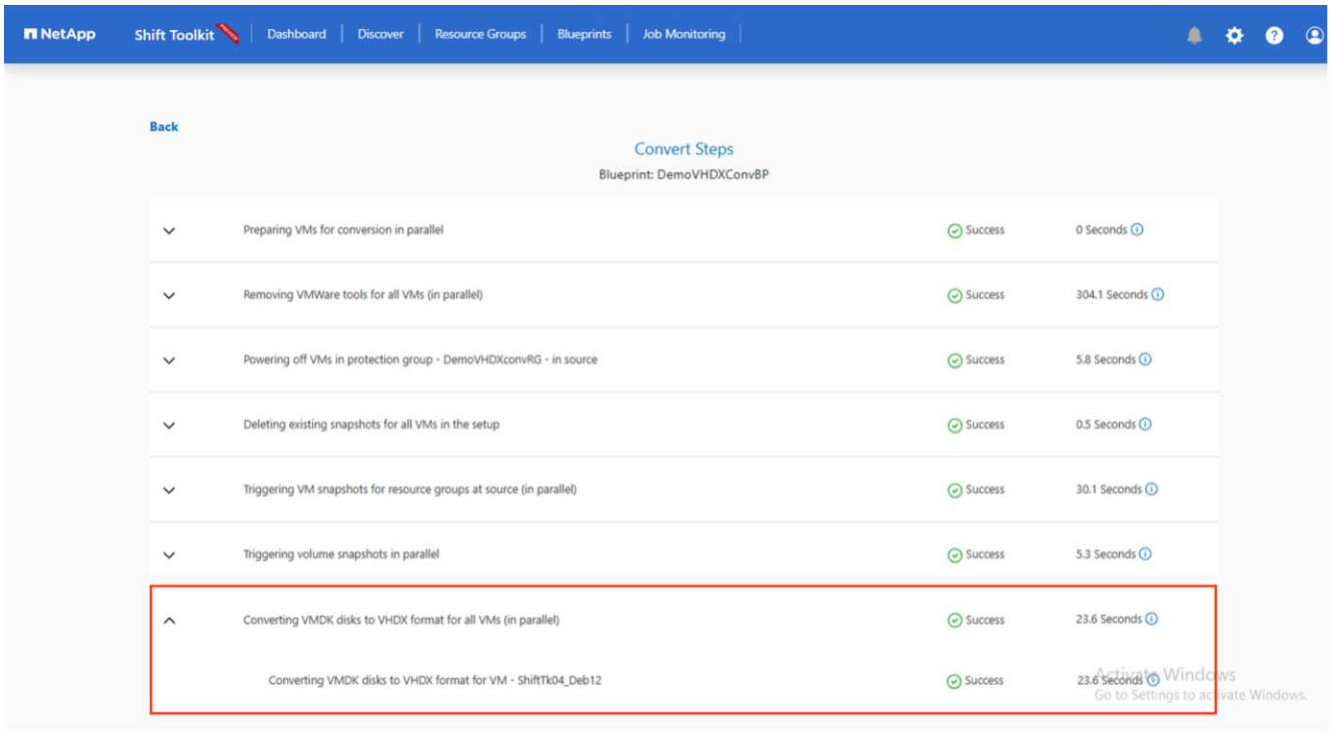
- Create the blueprint to convert the virtual disk to VHDX format.



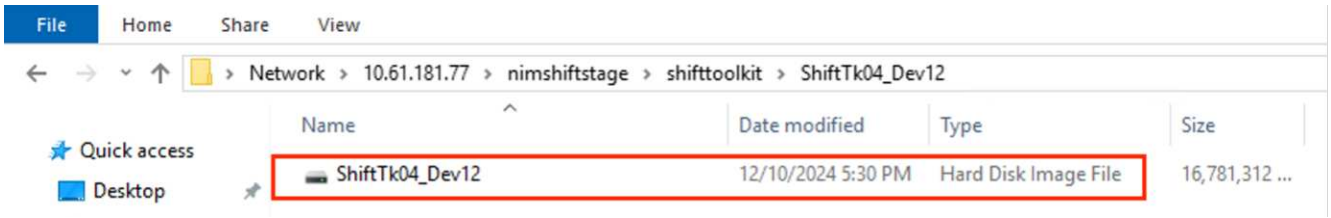
- Select “Convert” once the necessary downtime is raised for the VMs.



- The convert operation executes each operation against the VM and respective disk to generate the appropriate VHDX format.



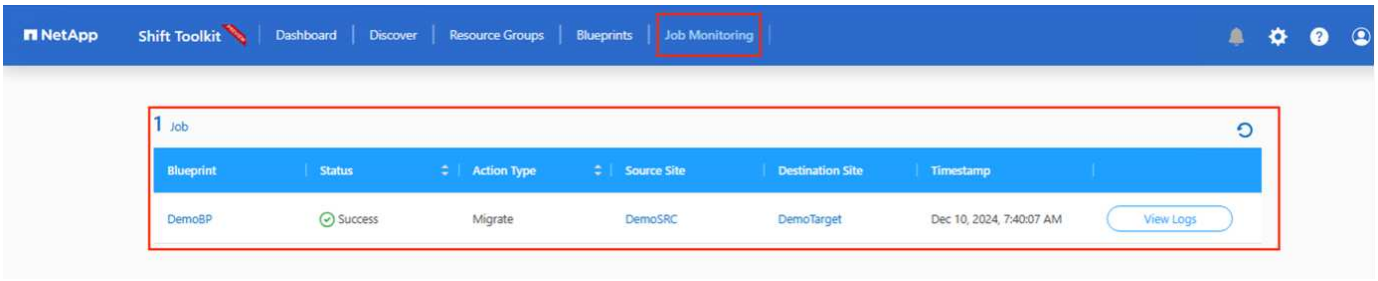
- Use the converted disk by manually creating the VM and attaching the disk to it.



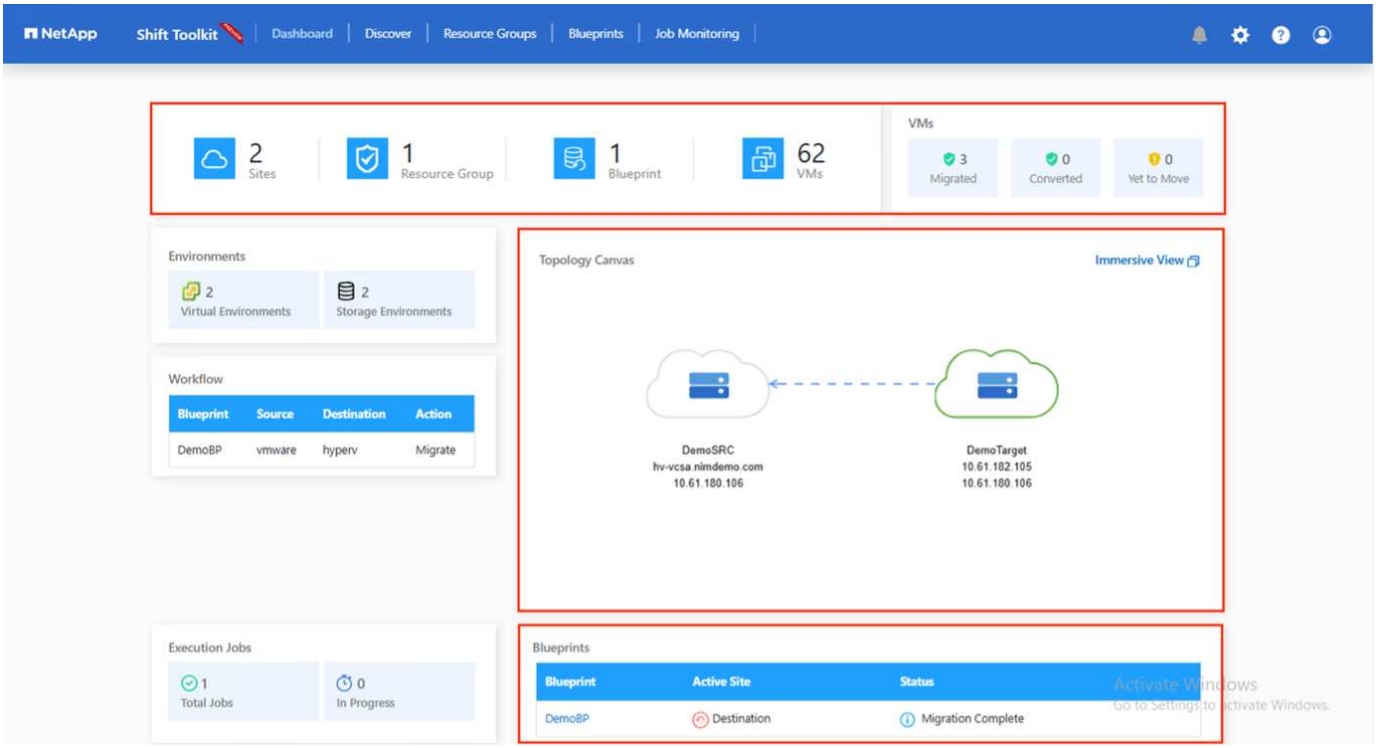
To use the converted VHDX disk in a VM, the VM must be created manually via Hyper-V manager or PowerShell commands, and the disk must be attached to it. Along with this, network should also be mapped manually.

Monitoring and Dashboard

Monitor the status of the jobs using Job Monitoring.

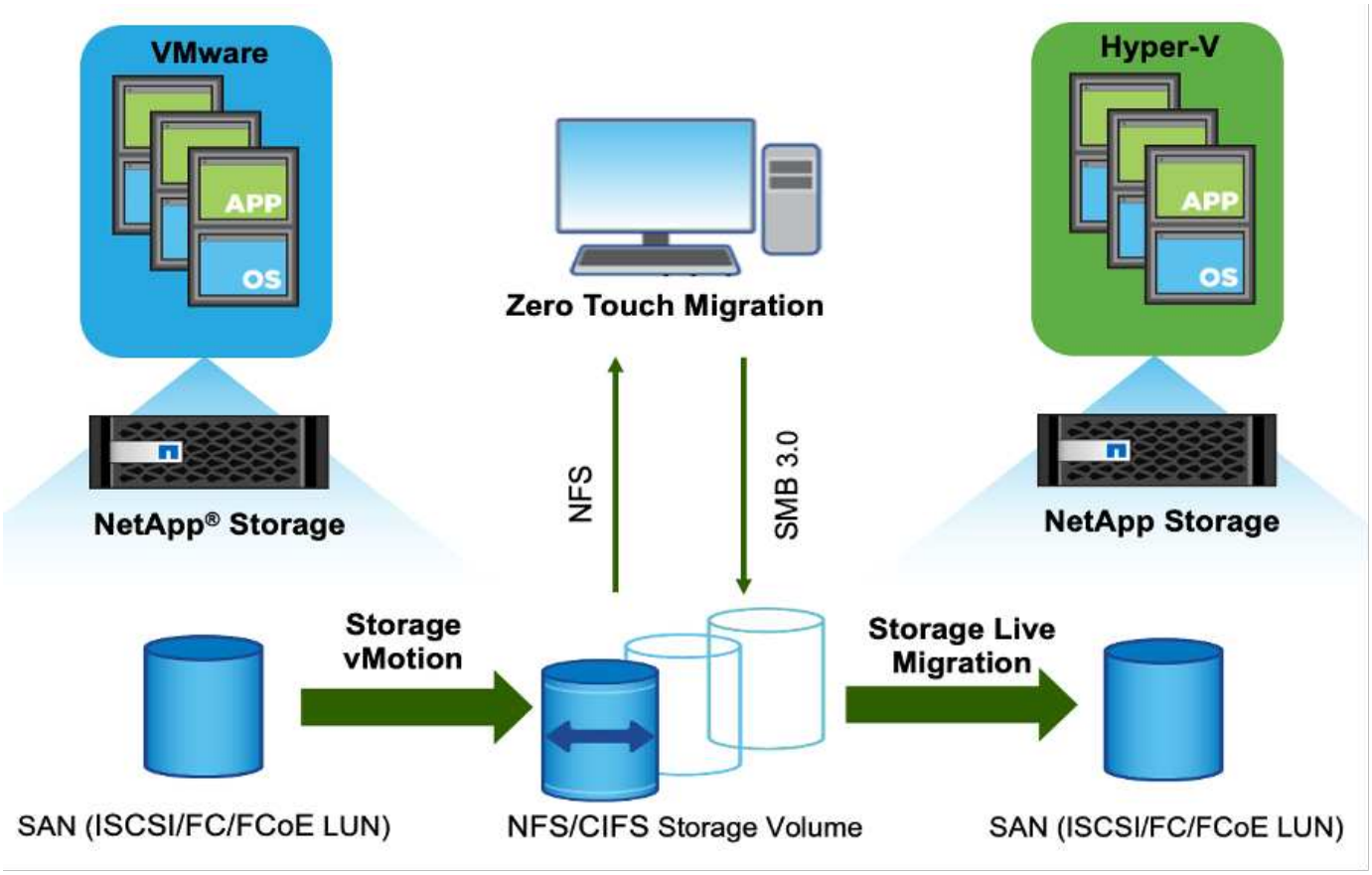


With the intuitive UI, confidently evaluate the status of migration, conversion and blueprints. This enables administrators to swiftly identify successful, failed, or partially failed plans along with the number of VMs migrated or converted.



SAN Environments

As a key requirements of Shift toolkit, the VMs to be converted must reside in a NAS environment (NFS for ESX). If the VMs reside in a SAN environment (iSCSI, FC, FCoE, NVMeFC), then they must be migrated to a NAS environment before conversion.



The approach above depicts a typical SAN environment in which VMs are stored in a SAN datastore. The VMs to be converted from ESX to Hyper-V along with their disks are first migrated to an NFS data-store with VMware vSphere Storage vMotion. Shift toolkit uses FlexClone to convert the VMs from ESX to Hyper-V. The converted VMs (along with their disks) reside on a CIFS share. The converted VMs (along with their disks) are migrated back to the SAN enabled CSV with Hyper-V Storage Live Migration.

Conclusion

NetApp Shift toolkit helps an administrator to rapidly and seamlessly convert VMs from VMware to Hyper-V. It can also convert just the virtual disks between the different hypervisors. Therefore, Shift toolkit saves you several hours of effort each time that you want to move workloads from one hypervisor to the other. Organizations can now host multi-hypervisor environments without having to worry about whether workloads are tied down to a single hypervisor. This capability increases flexibility and reduces licensing costs, lock-in, and commitments to a single vendor.

Next Steps

Unlock the potential with Data ONTAP by downloading Shift toolkit package and start migrating or converting the virtual machines or the disk files to simplify and streamline migrations.

To learn more about this process, feel free to follow the detailed walkthrough.

Copy less migration from ESX to Hyper-V

Copyright information

Trademark information