



Technical Report

# Server Fault Protection with NetApp Data ONTAP Edge-T

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## 1 Introduction

The NetApp® Data ONTAP® Edge-T architecture is deployed as a virtual storage appliance on VMware® vSphere®. Data ONTAP Edge-T includes a NetApp Data ONTAP-v operating system to convert a vSphere server's direct-attached storage into a flexible storage platform, providing the same benefits as a dedicated NetApp storage system. A Data ONTAP Edge-T instance can be managed through NetApp OnCommand® System Manager and the NetApp Virtual Storage Console plug-in for VMware vCenter™ in the same manner as traditional NetApp storage systems.

A NetApp Data ONTAP Edge-T storage environment can be configured to provide data recovery to a vSphere environment in the event of a system failure through Snapshot™ and SnapMirror® Data ONTAP technologies. Recovery from a failure can be supported remotely, such as between a field office and a central data center, or within the same physical location to accommodate a local recovery. Setup, configuration, and use of such a solution, local or remote, is the purpose of this guide.

Some experience with VMware vSphere, vSphere Client, and vCenter is assumed for the purposes of this guide.

Please note that the NetApp Data ONTAP Edge and NetApp Data ONTAP Edge-T products are distinct products. NetApp Data ONTAP Edge-T supports NetApp SnapMirror and SnapVault® primary and secondary technologies whereas NetApp Data ONTAP Edge does not. This guide addresses the use of the NetApp Data ONTAP Edge-T product.

## 2 Backup and Disaster Recovery Technology

NetApp Data ONTAP Edge-T and the NetApp Virtual Storage Console provide all the tools necessary to build and maintain local backups and a local or remote disaster recovery infrastructure. This guide demonstrates how to leverage NetApp Snapshot copies and SnapMirror to preserve data and recover from a potential failure with minimal loss of data.

### 2.1 Snapshot

NetApp Data ONTAP Snapshot copies are read-only, point-in-time images of volume data. A Snapshot copy is built nearly instantaneously and requires almost no space by using pointers (metadata) to data in the volume, rather than making full volume copies. New data is written to new locations within the volume, keeping the original data blocks unchanged.

Restoring data from a Snapshot copy is done by rolling back to the pointers the Snapshot copy recorded when it was taken. This results in quick restores that have minimal impact on system performance. The full volume can be restored from a Snapshot copy, as can individual files.

### 2.2 SnapMirror

SnapMirror is a NetApp Data ONTAP technology that asynchronously replicates a source volume to a secondary volume located on another NetApp controller. The replica is created through a Snapshot copy that is copied from the source volume to the target volume; subsequent snapshots are then used to copy any data changes. Initially syncing the volumes may take some time, depending on the amount of data, but updates tend to be very quick.

SnapMirror destination volumes are read-only copies of the primary volume and remain read-only until the source-to-destination relationship is broken. The destination volumes can be copied or cloned to create writable copies of production data for purposes such as testing. The flexibility in the number and location of SnapMirror destination controllers, as well as the ease with which replication can be set up and executed, makes NetApp SnapMirror a useful component in disaster recovery planning.

A disaster is generally considered a situation in which part or all of an IT compute environment has failed in a manner that impacts the business and the expected time to recover exceeds the maximum tolerable outage window. One of the most critical considerations of an IT environment is data integrity. Local or off-site NetApp SnapMirror replicas of production data can be brought online very quickly to restore critical data access to applications and users.

A SnapMirror disaster recovery plan should not be used as a replacement for a good site backup strategy.

### 3 NetApp Data ONTAP Edge-T Installation and Configuration

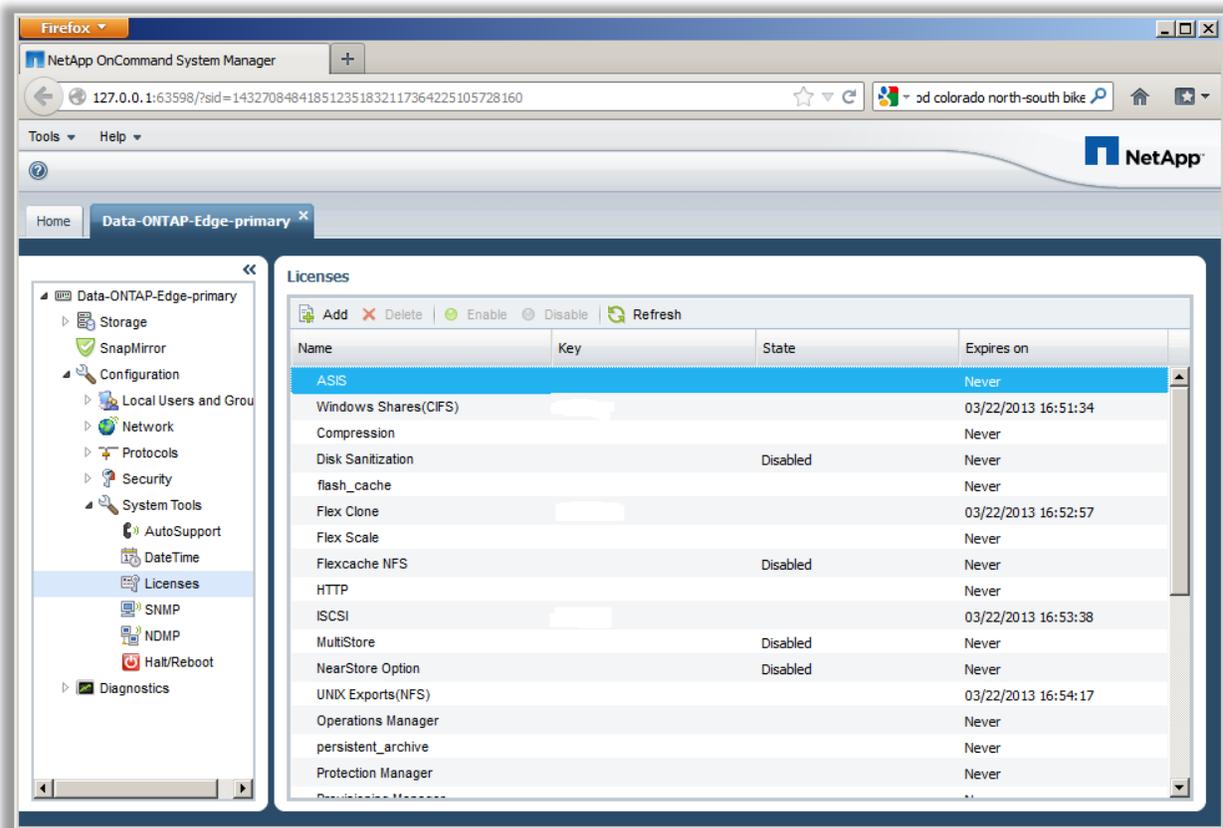
To create the local DR solution described in this guide, two instances of NetApp Data ONTAP Edge-T must already be installed, and each must be available for configuration and use.

#### 3.1 Licensing

All of the features for Data ONTAP Edge-T are included with the purchase price and must be enabled individually. To deploy a SnapMirror-based disaster recovery solution, you need to enable the following feature licenses, at a minimum:

- NFS or iSCSI
- SnapMirror
- SnapRestore®

Connect to the NetApp Data ONTAP Edge-T virtual appliance with NetApp OnCommand System Manager to apply storage feature licenses. To add a feature license, navigate in OnCommand System Manager to System Tools -> Licenses and apply licenses through the Add feature.

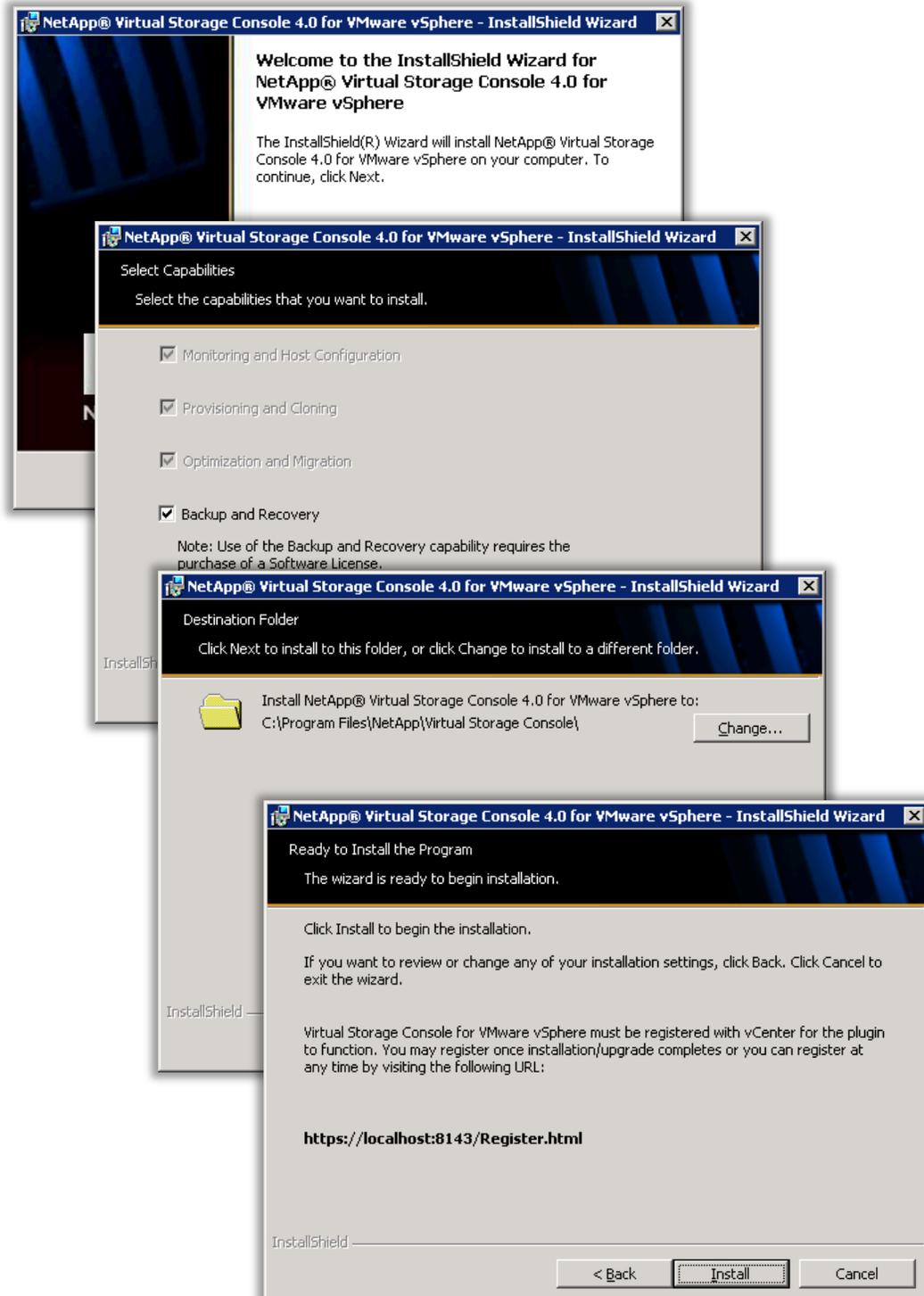


**Note:** These licenses are NetApp Data ONTAP Edge-T licenses. This is different from the NetApp Data ONTAP Edge product, which does not support SnapMirror.

## 3.2 Virtual Storage Console Installation

The NetApp Virtual Storage Console is a VMware vCenter plug-in that manages NetApp storage in the vSphere environment. It will be an integral part of the disaster recovery solution and may be installed into vCenter at any time. Default installation options can typically be selected. The Backup and Recovery option and the software license must be installed to support backing up virtual machines and datastores.

Install the VSC on an appropriate computer.



Also register it through a browser with the vCenter Server.

vSphere Plugin Registration

To register the Virtual Storage Console, select the IP Address you would like to use for the plugin and provide the vCenter Server's IP address and port along with a valid user name and password.

Plugin service information

Host name or IP Address: 10.0.1.71

vCenter Server information

Host name or IP Address: 10.0.1.71

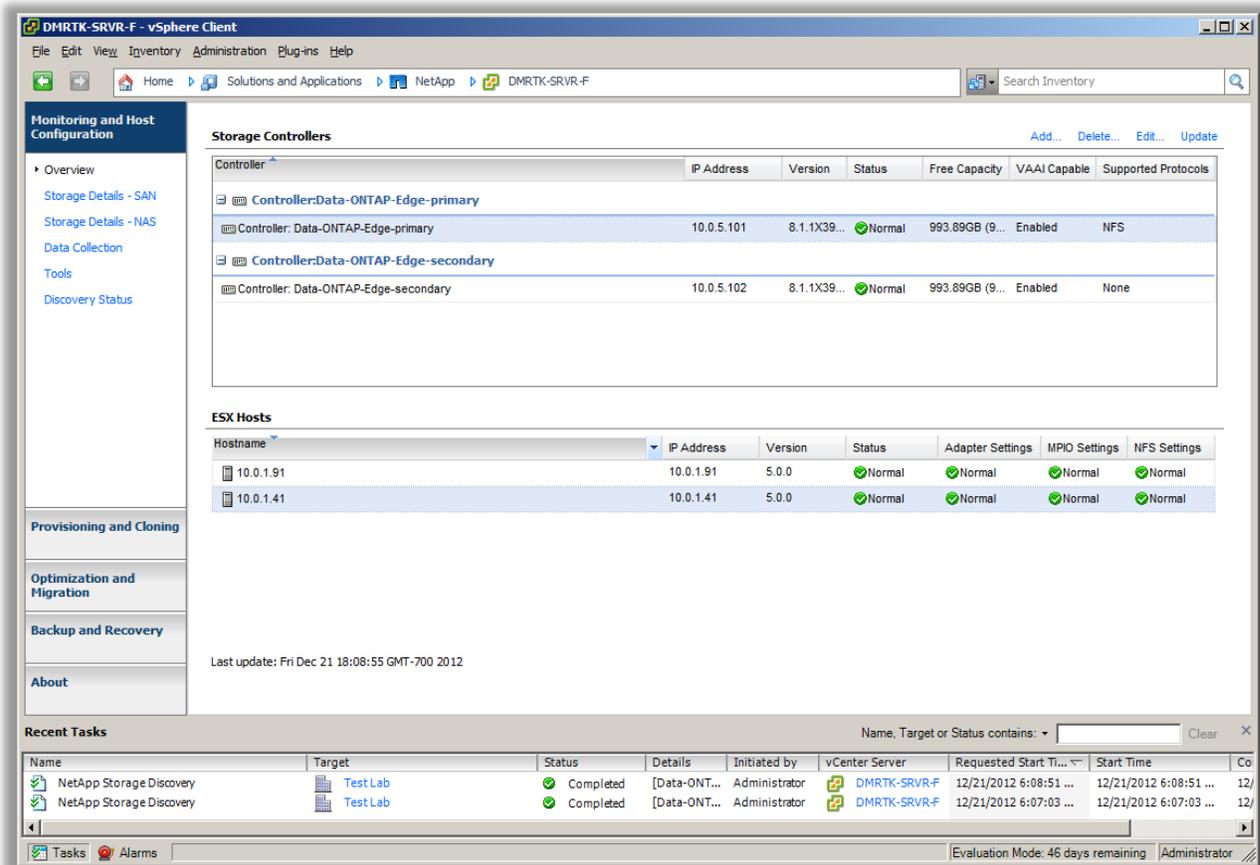
Port: 443

User name: Administrator

User password: ●●●●●●●●●●

Register

The VSC will be available as a tab in the vSphere client Hosts and Clusters inventory and as an option in the Solutions and Applications menu. Navigate to View -> Solutions and Applications -> NetApp and, in the Monitoring and Host Configuration tab, add the NetApp Data ONTAP Edge-T instances as Storage Controllers.



If not already set, the VSC can also configure the adapter, MPIO, and NFS settings of the vSphere hosts by right-clicking the host and selecting Set Recommended Values. Remember to do this as additional vSphere hosts are added to the vCenter server.

## 4 Datastore Provisioning and VM Deployment

### 4.1 Create an NFS Datastore

In the vSphere client, highlight the data center and open the NetApp -> Provisioning and Cloning -> Provision Datastore menu.

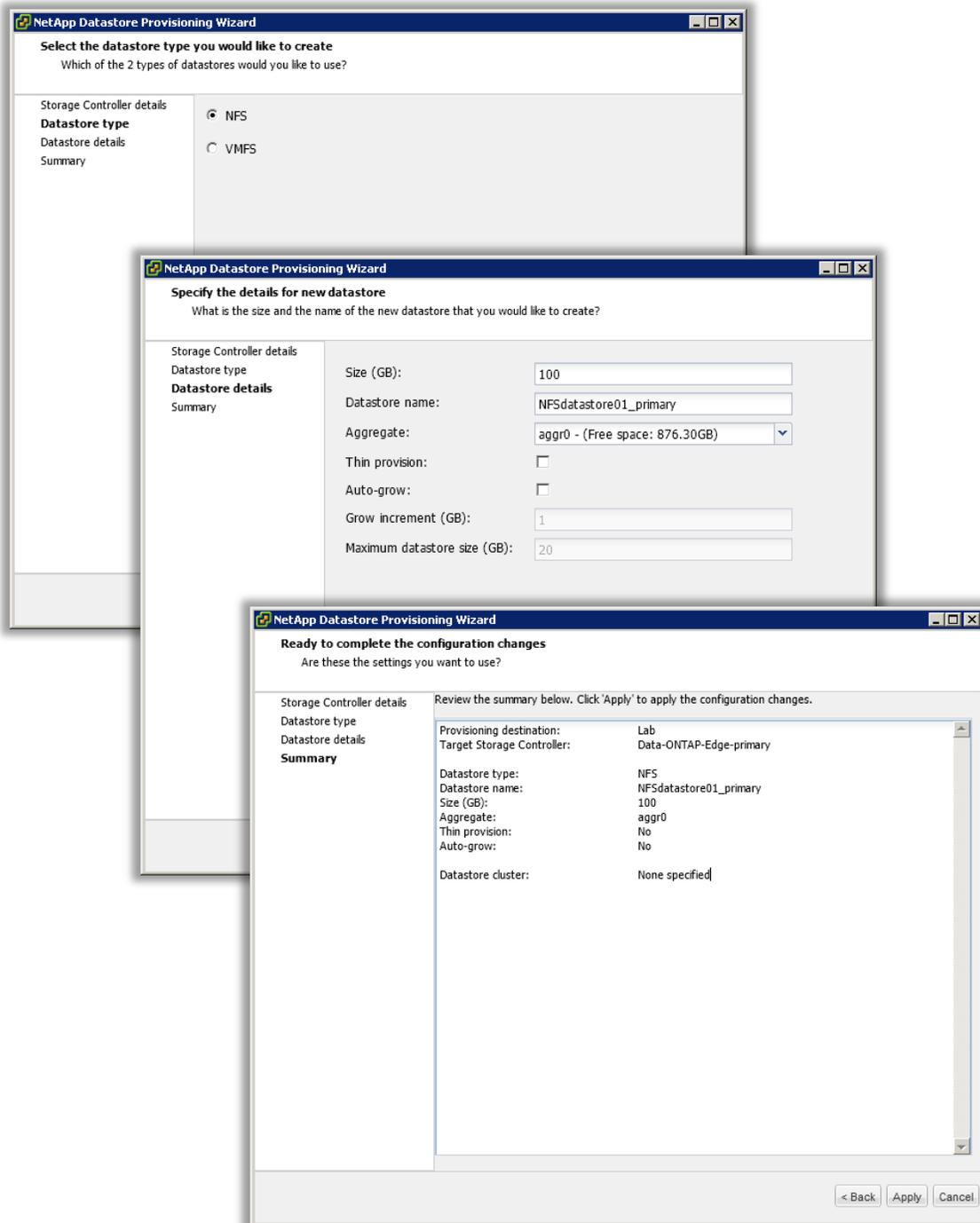
From the Datastore Provisioning Wizard, select the target storage controller.

The screenshot displays the vSphere Client interface for a NetApp storage system. The main window shows the 'Storage Controllers' table with the following data:

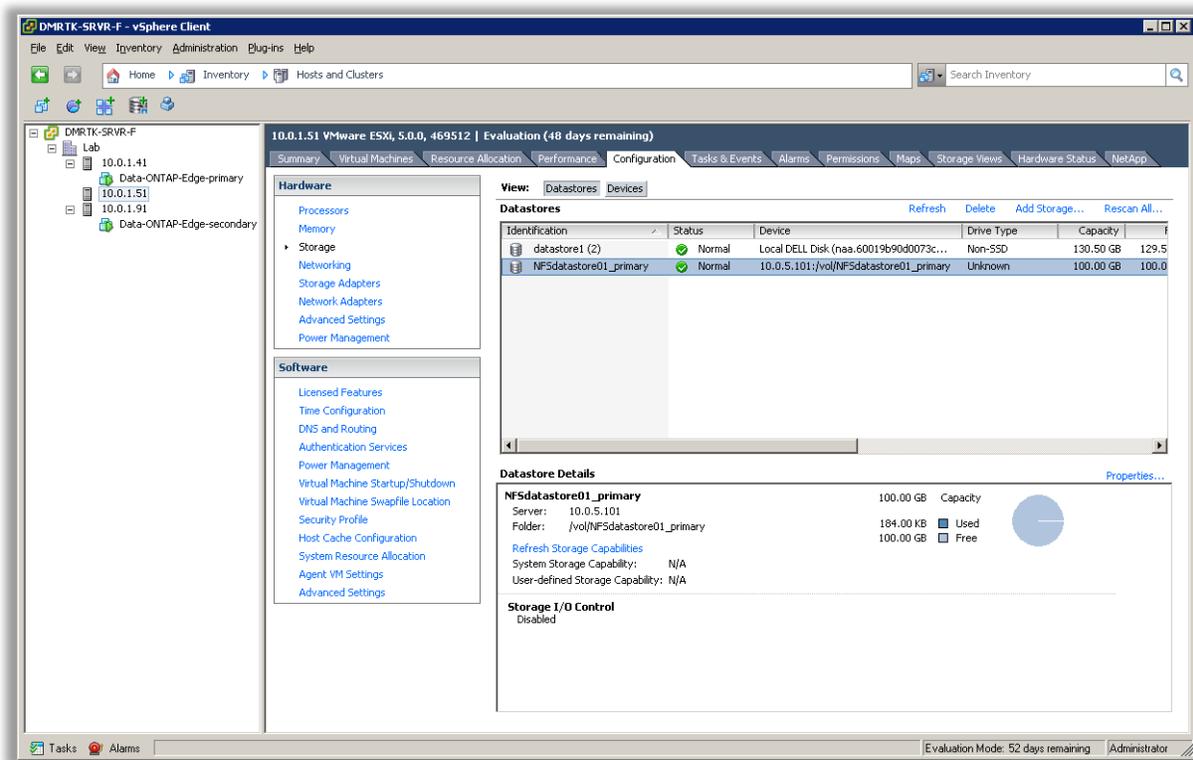
Controller	IP Address	Version	Status	Free Capacity	VAAI Capable	Supported Protocols
<b>Controller: Data-ONTAP-Edge-primary</b>						
Controller: Data-ONTAP-Edge-primary	10.0.5.101	8.1.1X39...	Normal	993.24GB (9...	Enabled	NFS, iSCSI
<b>Controller: Data-ONTAP-Edge-secondary</b>						
Controller: Data-ONTAP-Edge-secondary	10.0.5.102	8.1.1X39...	Normal	993.23GB (9...	Enabled	NFS, iSCSI

The 'NetApp Datastore Provisioning Wizard' dialog is open, showing the 'Specify the target storage controller' step. The 'Target Storage Controller' dropdown menu is set to 'Data-ONTAP-Edge-primary'. The wizard also shows 'Storage Controller details' for the selected controller.

Select the NFS datastore type and define the datastore size, name, NetApp Data ONTAP Edge-T instance aggregate, and thin-provisioning details (if chosen). Confirm the configuration and commit.

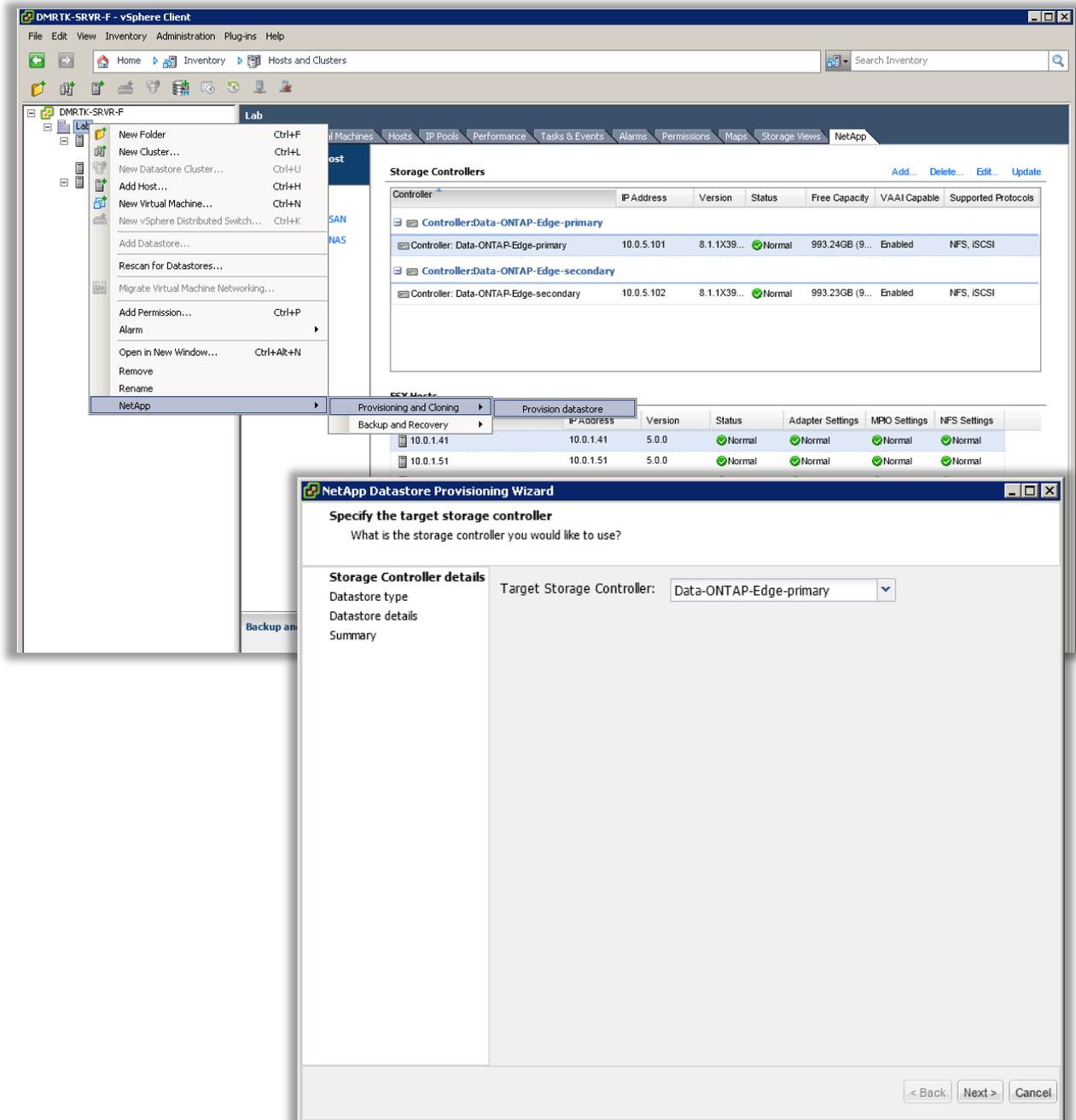


Select a vSphere server and open the Configuration tab, Storage window. The new NFS datastore will be visible in the datastore listing.

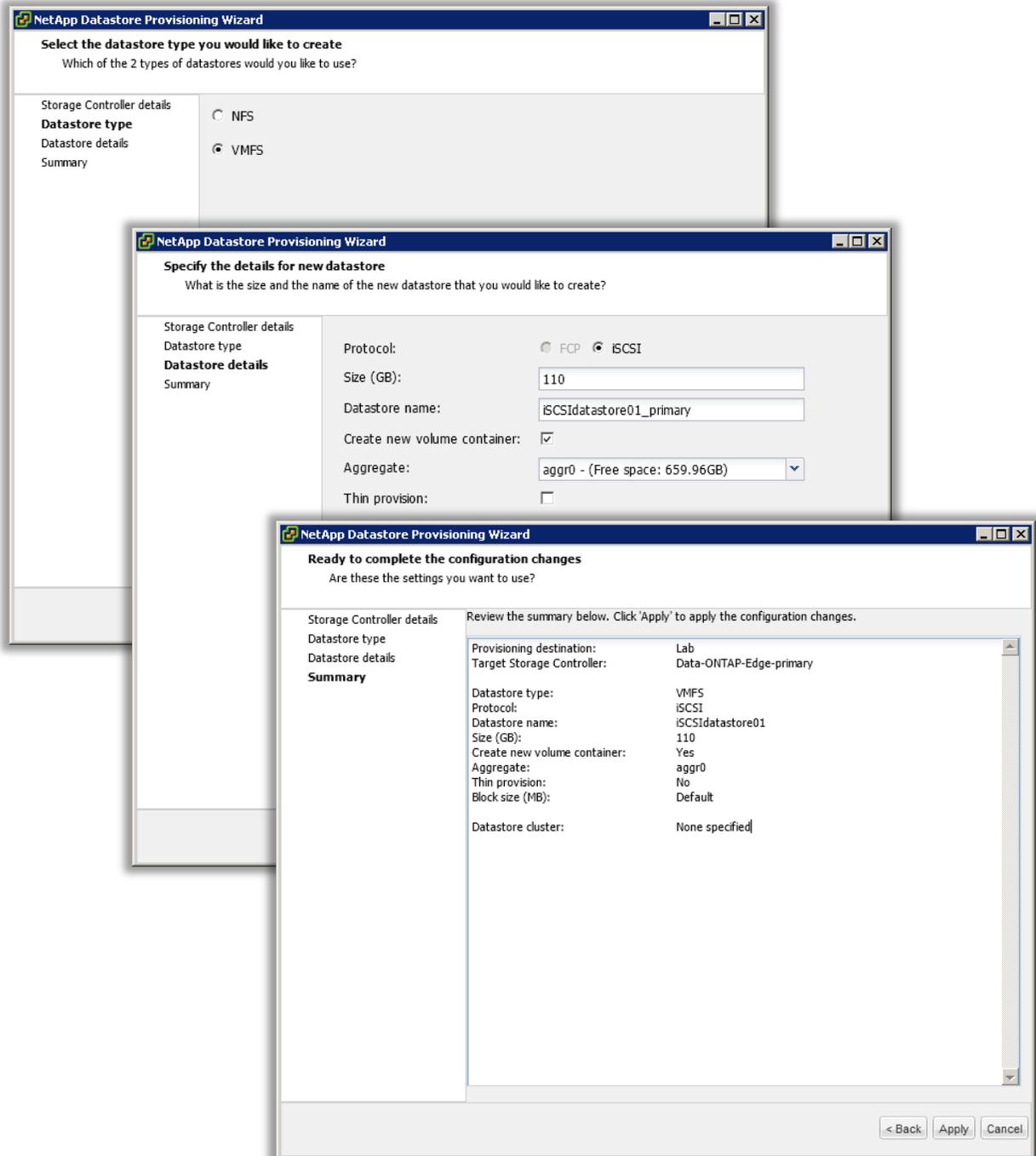


## 4.2 Create an iSCSI Datastore

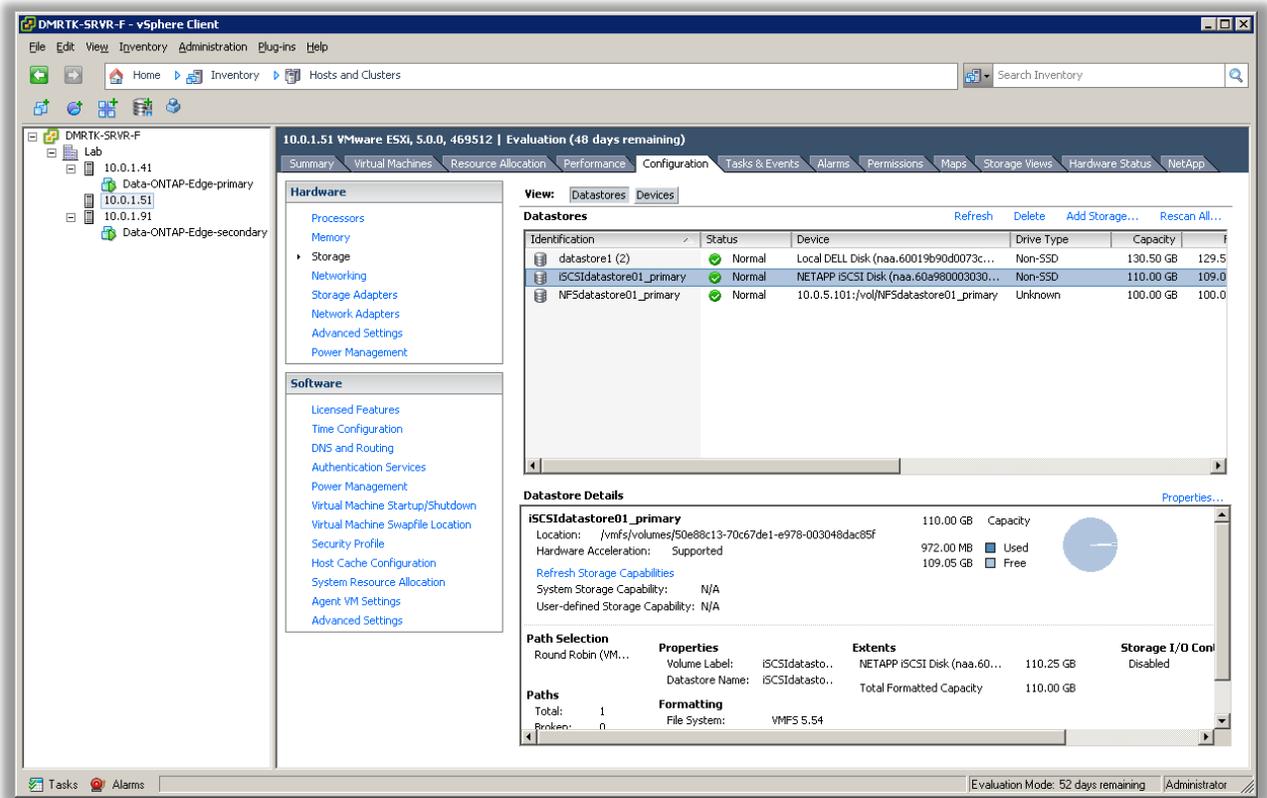
In the vSphere client, highlight the data center and open the NetApp -> Provisioning and Cloning -> Provision Datastore menu. From the Datastore Provisioning Wizard, select the target storage controller.



Select the VMFS datastore type, choose the iSCSI protocol, and define the datastore size, name, target volume (or have a volume be created automatically), NetApp Data ONTAP Edge-T instance aggregate, and thin-provisioning details (if chosen). Confirm the configuration and commit.



Select a vSphere server and open the Configuration tab, Storage window. The new iSCSI datastore will be visible in the datastore listing.



### 4.3 Provisioning Virtual Machines or Applications

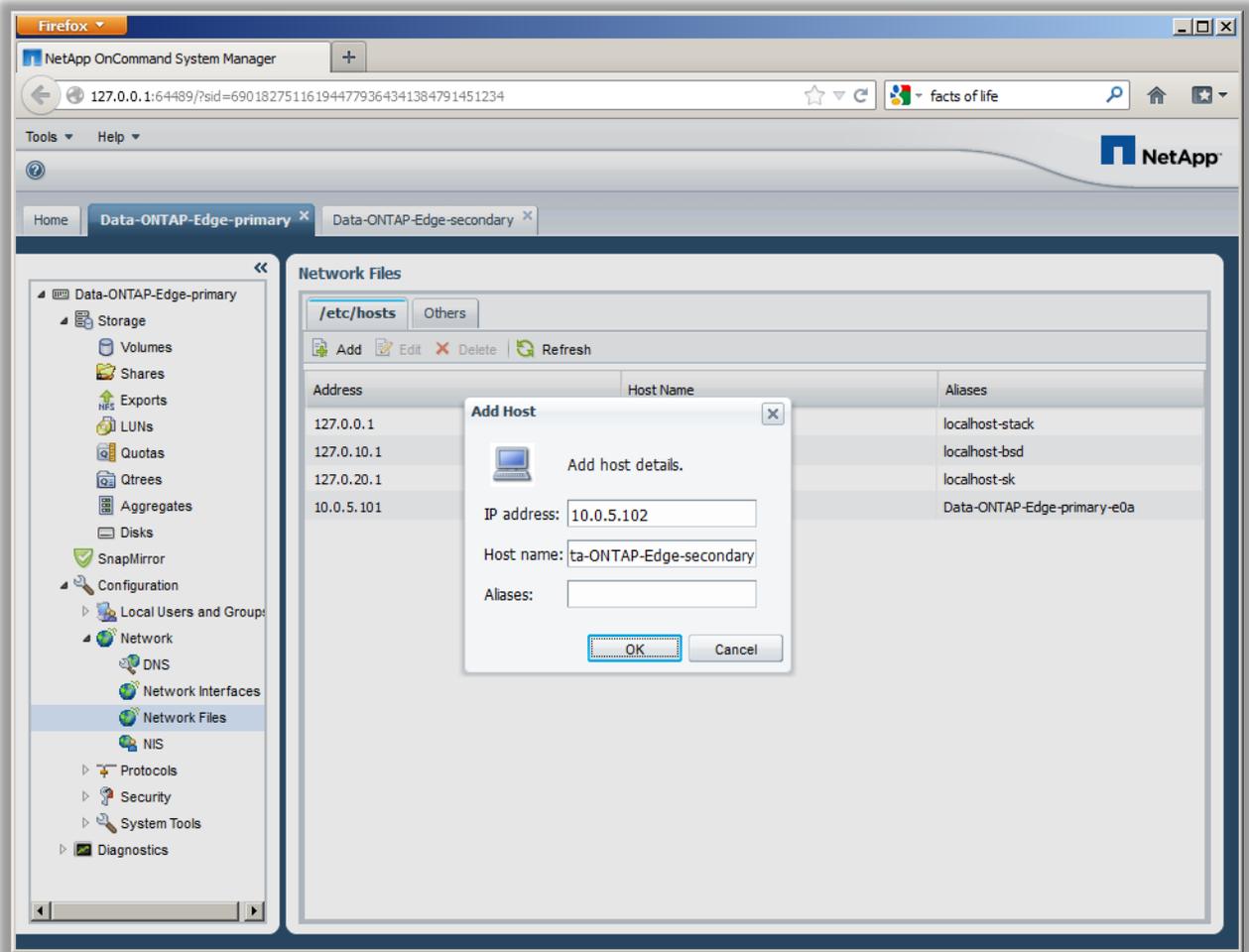
Virtual disks are created as with any other VMware datastore and provisioned for the creation of virtual machines or attached to VMs as application storage.

## 5 Set Up Disaster Recovery Relationships and Replication Schedule

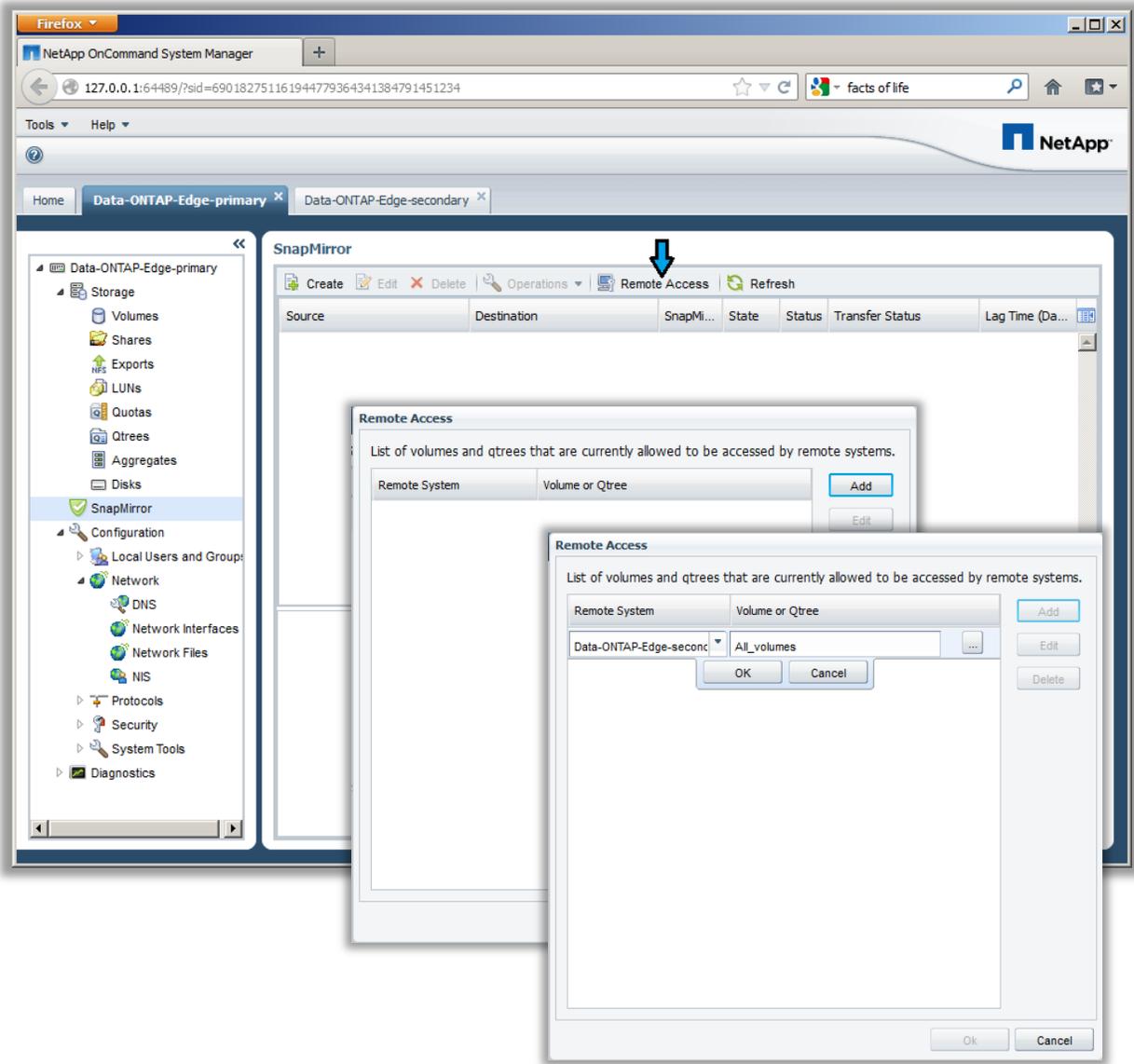
### 5.1 Configure SnapMirror Relationships Between Source and Destination

The SnapMirror source-to-destination volume relationship is configured with NetApp OnCommand System Manager

Using OnCommand System Manager, update /etc/hosts on the source and destination NetApp Data ONTAP Edge-T instances by opening Configuration → Network → Network Files from the menu bar and adding the IP address and host names of both instances to /etc/hosts.

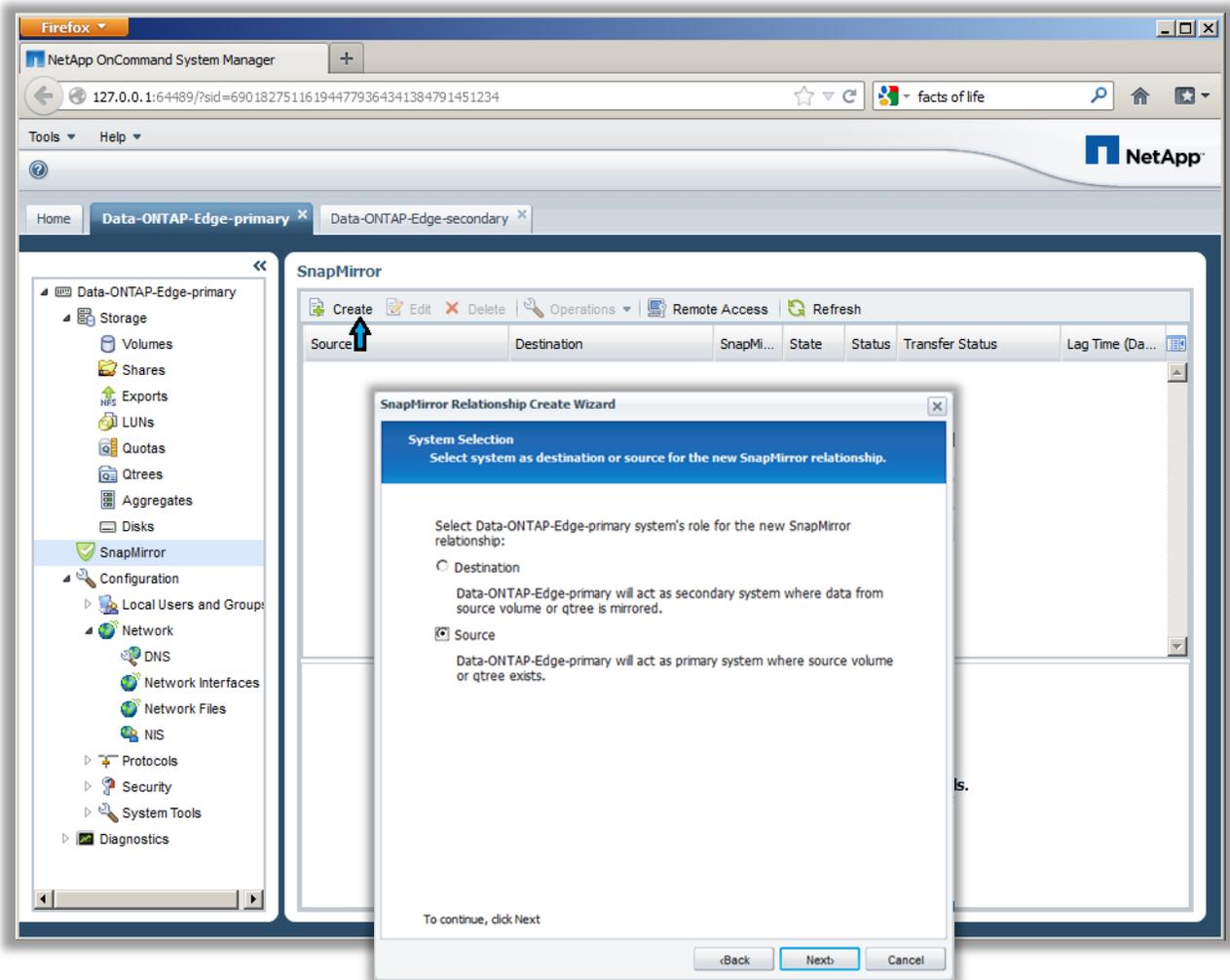


Now, from the source Data ONTAP Edge-T instance, navigate to the SnapMirror menu option to set up remote access between the source and destination Data ONTAP Edge-T instances. Select the `Remote Access` option in the SnapMirror window to open the Remote Access configuration tool. Add the destination Data ONTAP Edge-T instance. Selecting the `All_volumes` option for Volume or Qtree will simplify the setup.

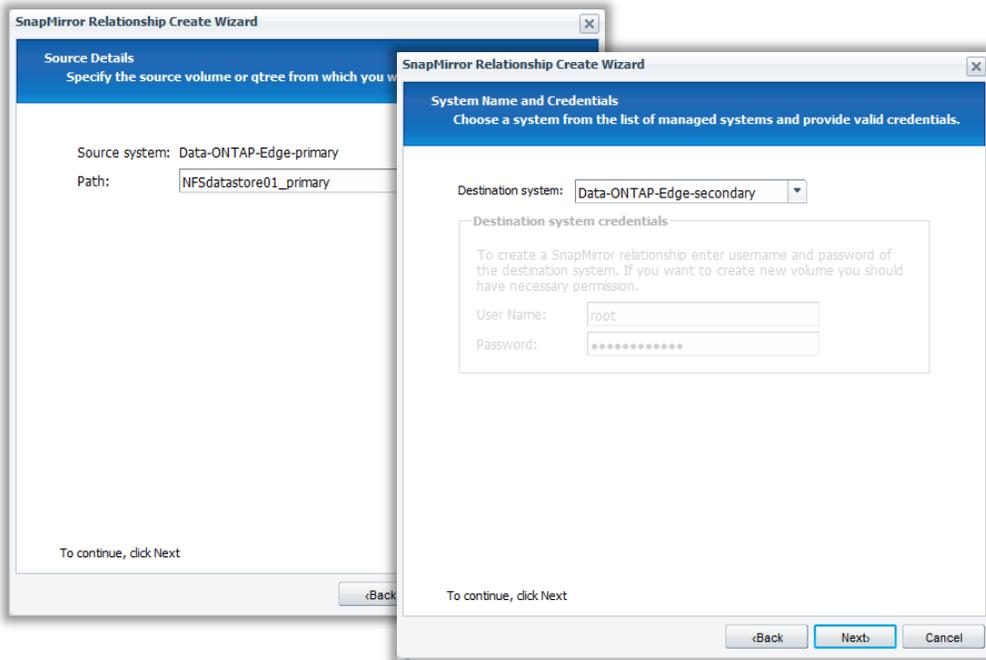


Repeat the remote access configuration from the secondary Data ONTAP Edge-T instance, this time granting access to the source instance.

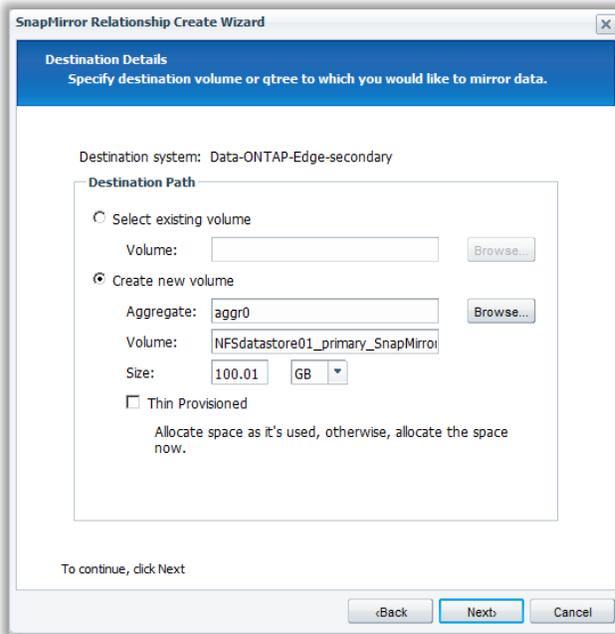
After remote access is configured it's time to set up the source volume-to-destination volume relationship. Select the `Create` option to open the SnapMirror Relationship Create Wizard. This can be done from either the source or the destination instance and does not need to be repeated on the other instance.



Select the volume to be replicated and the SnapMirror destination storage system.

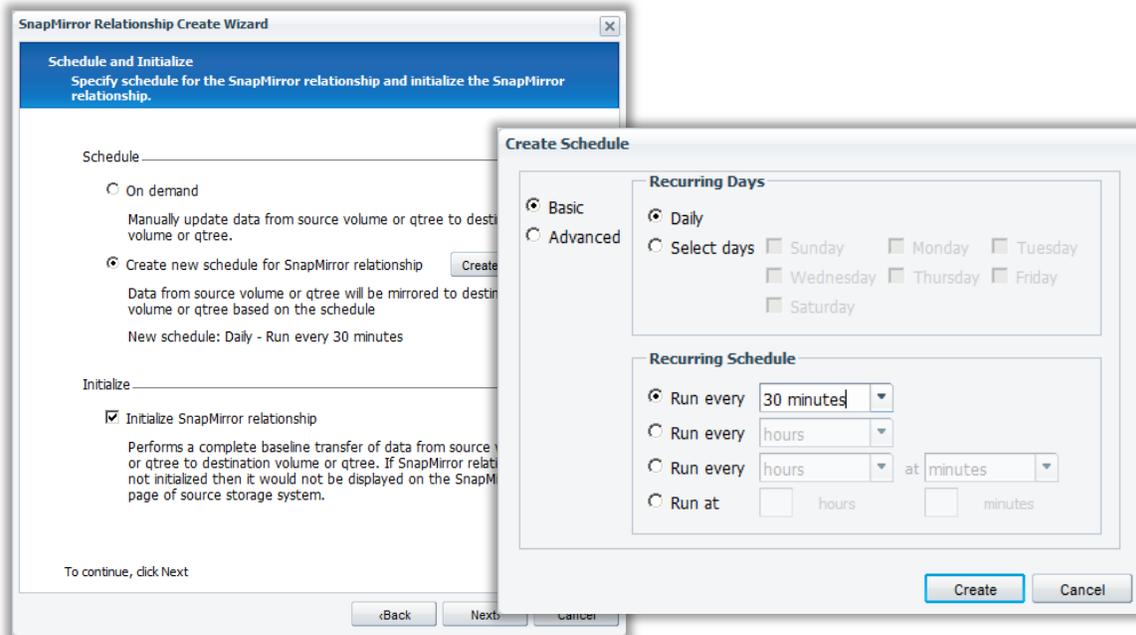


A target volume needs to be established on the destination system. The wizard will create one if none exists. The target volume needs to be the same size as the source volume for an NFS datastore and slightly larger for iSCSI.

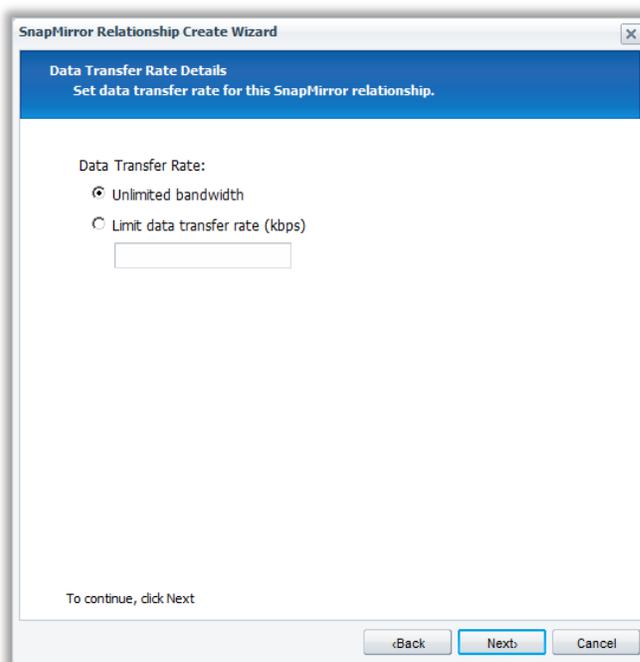


SnapMirror can be executed on demand or scheduled. There are valid reasons to use either approach. If SnapMirror updates will be initiated from the NetApp Virtual Storage Console as part of a local backup policy (discussed later in this guide), an on-demand schedule may be appropriate. Otherwise, the wizard can be used to set up a schedule.

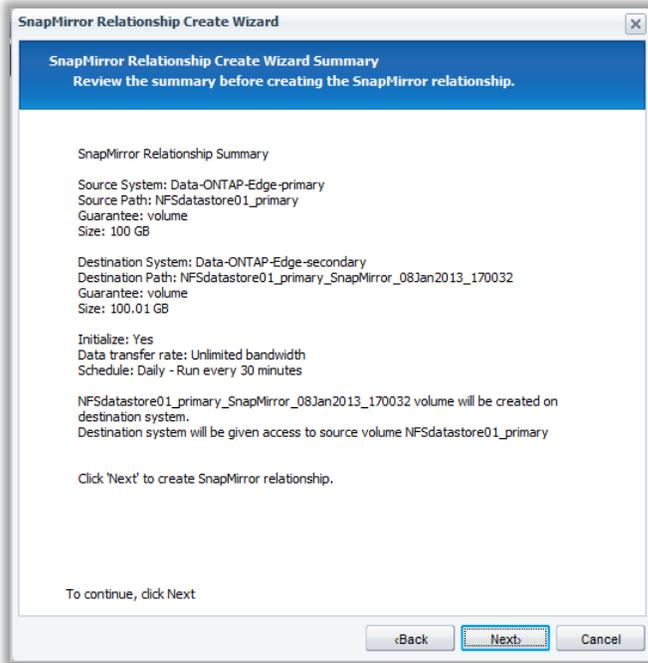
The option to Initialize SnapMirror relationship is available, which will simply create the first snapshot and copy to the destination Data ONTAP Edge-T instance. If that option is not selected now, a manual initialization will have to be executed at a later time



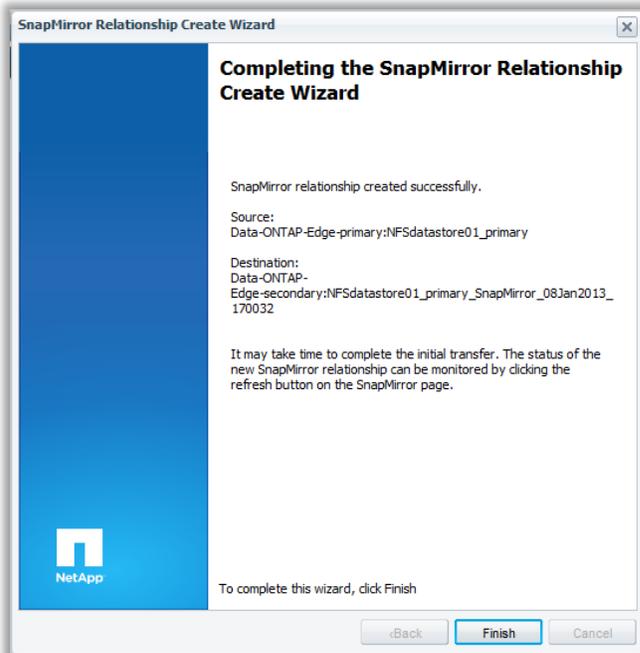
A Data Transfer Rate should be defined if there is any concern about flooding the network bandwidth from the initial sync and subsequent updates. Unless there is a great deal of data continually written to the datastore between SnapMirror updates, updates don't tend to be as significant as the initialization.



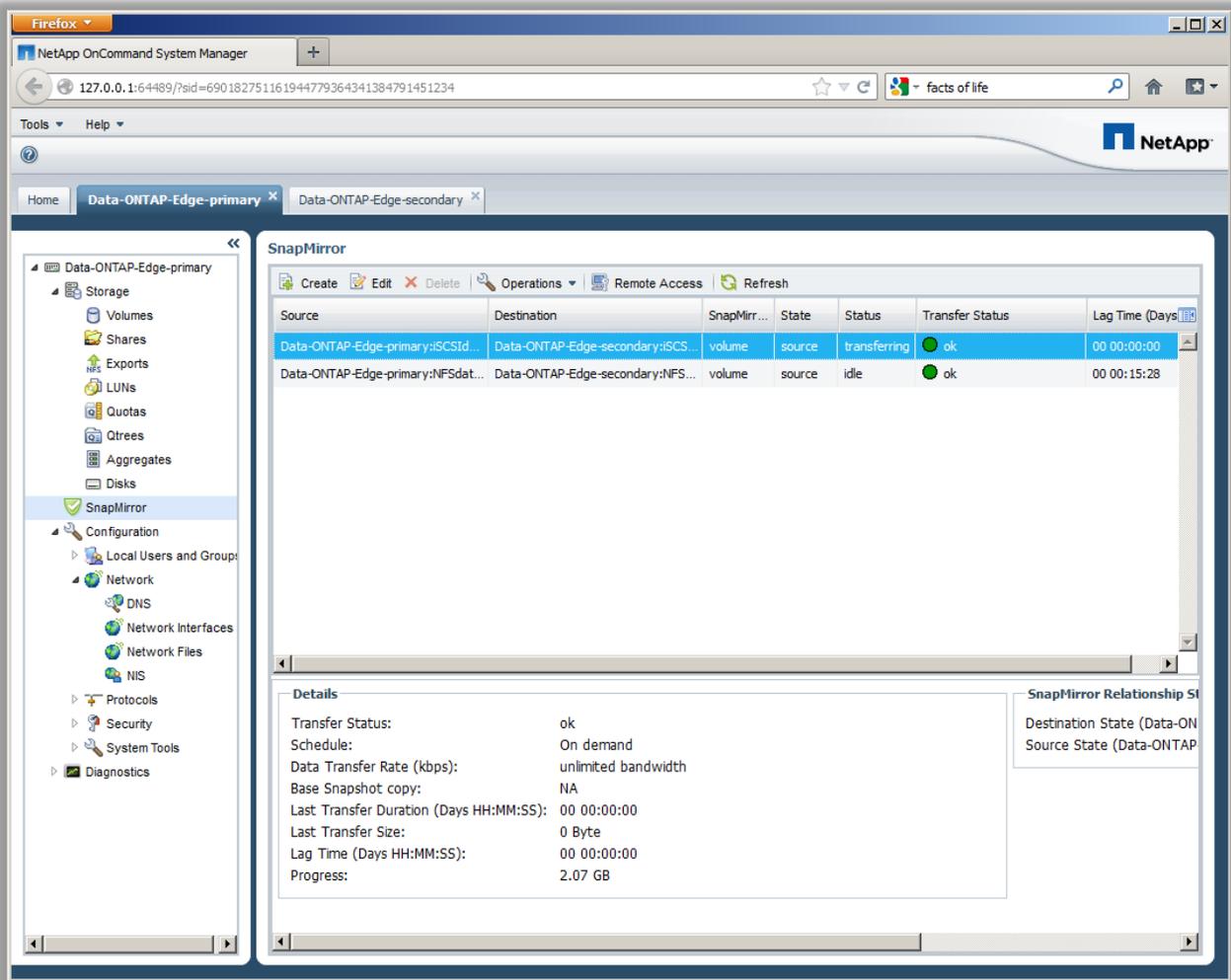
Confirm the SnapMirror configuration between the source and destination for the volume selected.



The final screen of the wizard is an acknowledgement that the SnapMirror relationship has been established and, if selected as an option earlier in the process, the confirmation to begin the SnapMirror initialization. The initialization may take some time, depending on the size of the datastore and the condition of the network between the source and destination.



If an initialization was not executed when the SnapMirror relationship was created, it can be executed from the Operations menu. When complete, the SnapMirror window in NetApp OnCommand System Manager will display the summary and details about the most recent SnapMirror replication.



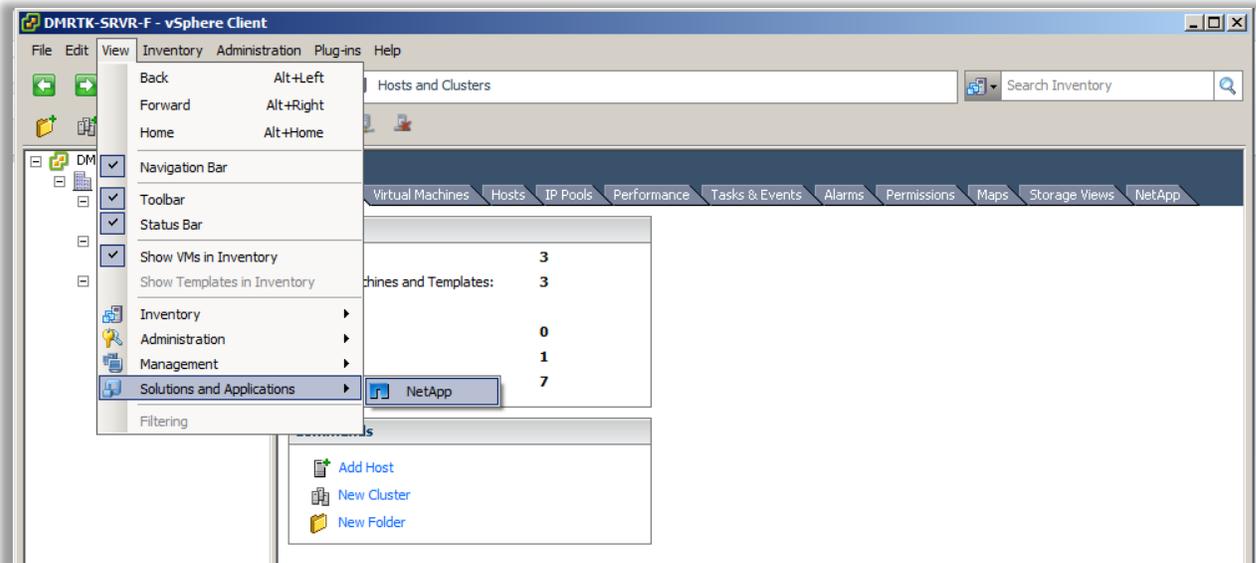
The SnapMirror relationship creation and initialization process is the same regardless of whether the NetApp Data ONTAP Edge-T–provisioned datastores are NFS or iSCSI/VMFS datastores.

## 5.2 Configure Virtual Storage Console for Backup Support

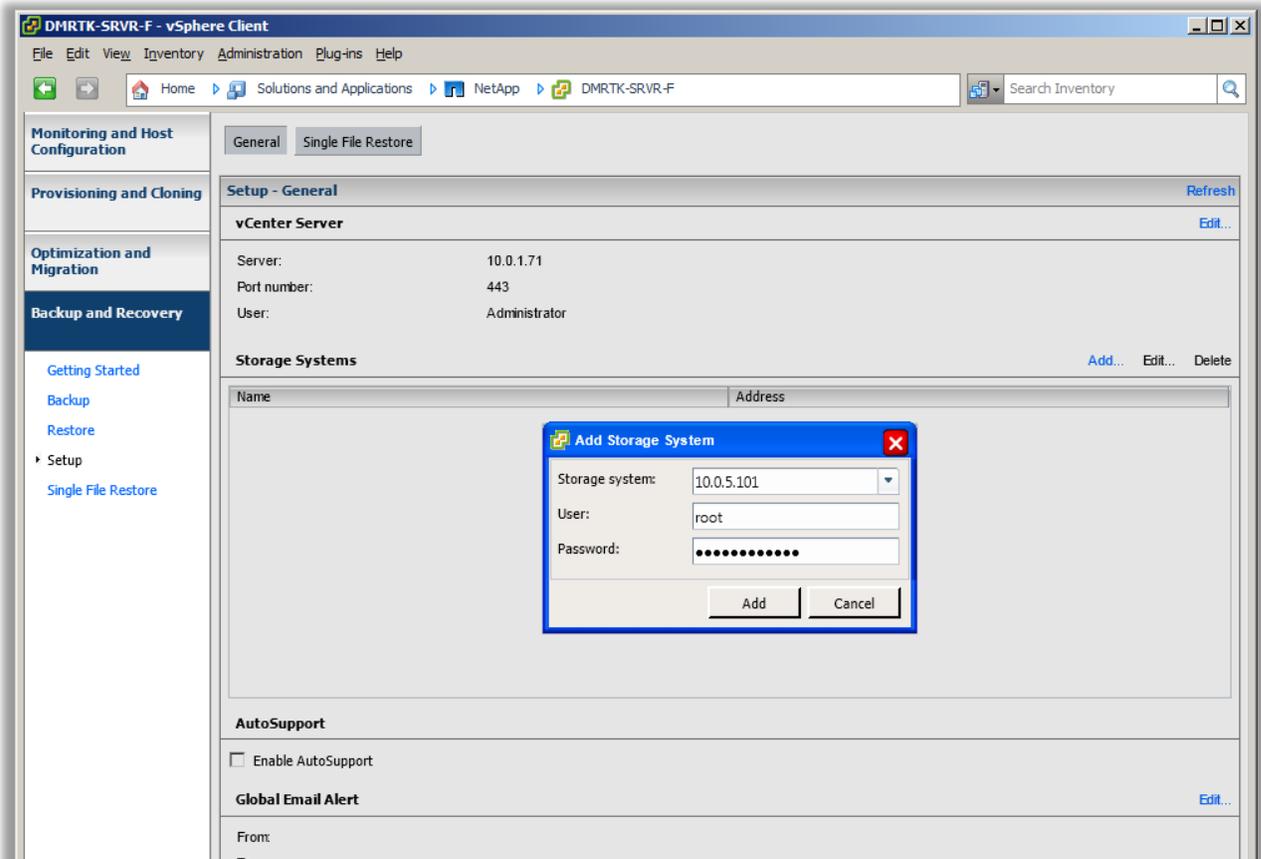
Configuring SnapMirror between two or more NetApp Data ONTAP Edge-T instances is technically sufficient to provide disaster recovery potential. However, the NetApp Virtual Storage Console offers additional tools and features to improve the robustness and usability of this DR solution. The backup and recovery features of the VSC offer additional options to sync source and destination volumes and manage Snapshot copies beyond those of the tools provided by vSphere.

Assuming that the NetApp Virtual Storage Console was installed and licensed with the Backup and Recovery option, add the NetApp Data ONTAP Edge-T primary instance as a storage controller to the Backup and Recovery feature.

In the vSphere client, navigate the View menu to Solutions and Applications -> NetApp.



Open the Backup and Recovery tab, proceed to the Setup window, and add the NetApp Data ONTAP Edge-T instance that supports the existing datastores and virtual machines. This will allow the VSC to manage Snapshot backups of datastores deployed on these instances.



**Note:** Backups taken through the VSC plug-in can be configured to initiate a SnapMirror update once the source-to-destination volume relationships are established. This functionality will be explained in the following section.

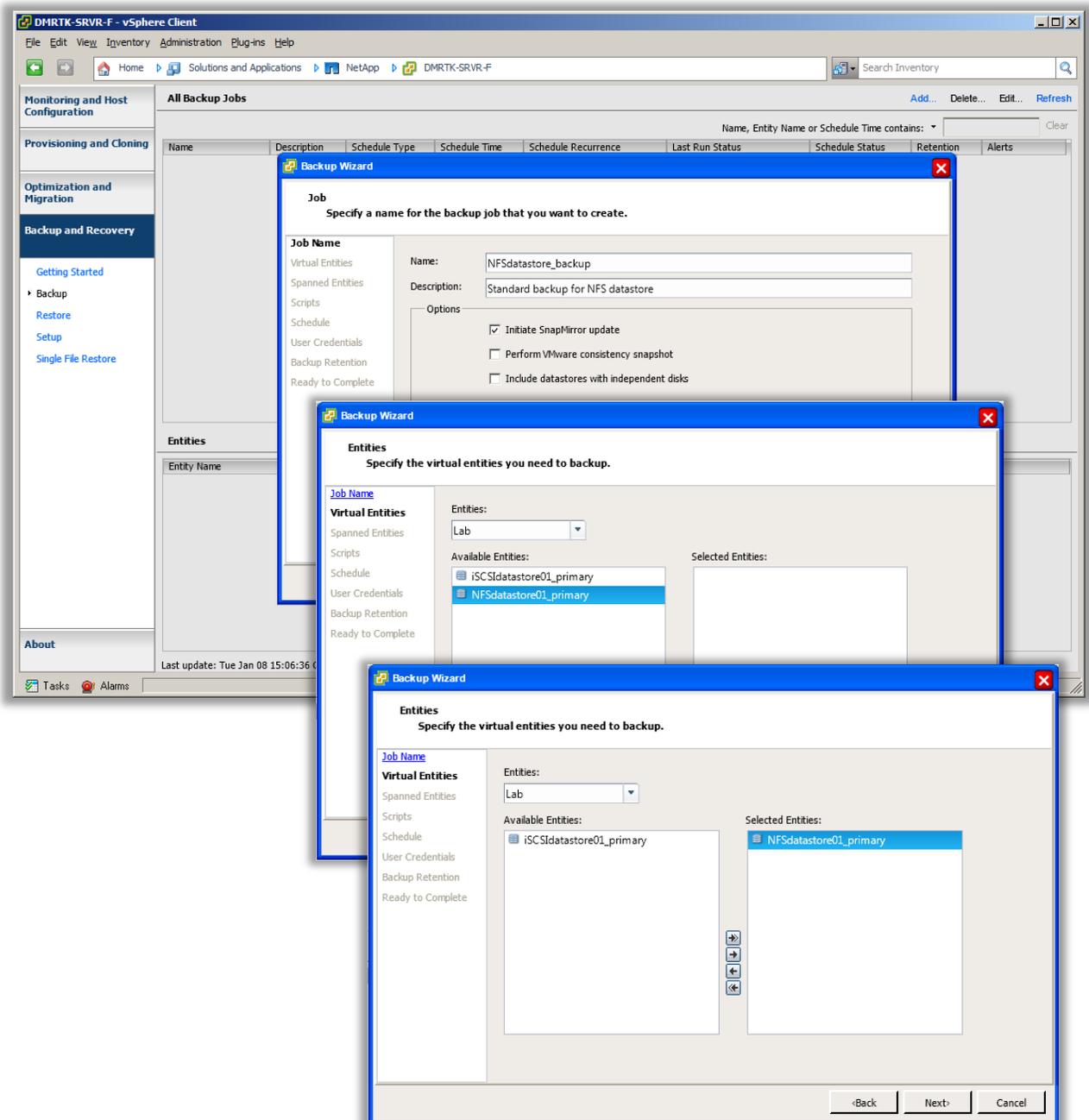
## 6 Using NetApp Data ONTAP Edge-T and Virtual Storage Console Backup and Recovery to Facilitate Disaster Recovery

### 6.1 Configure Local Backup Policy with the Virtual Storage Console

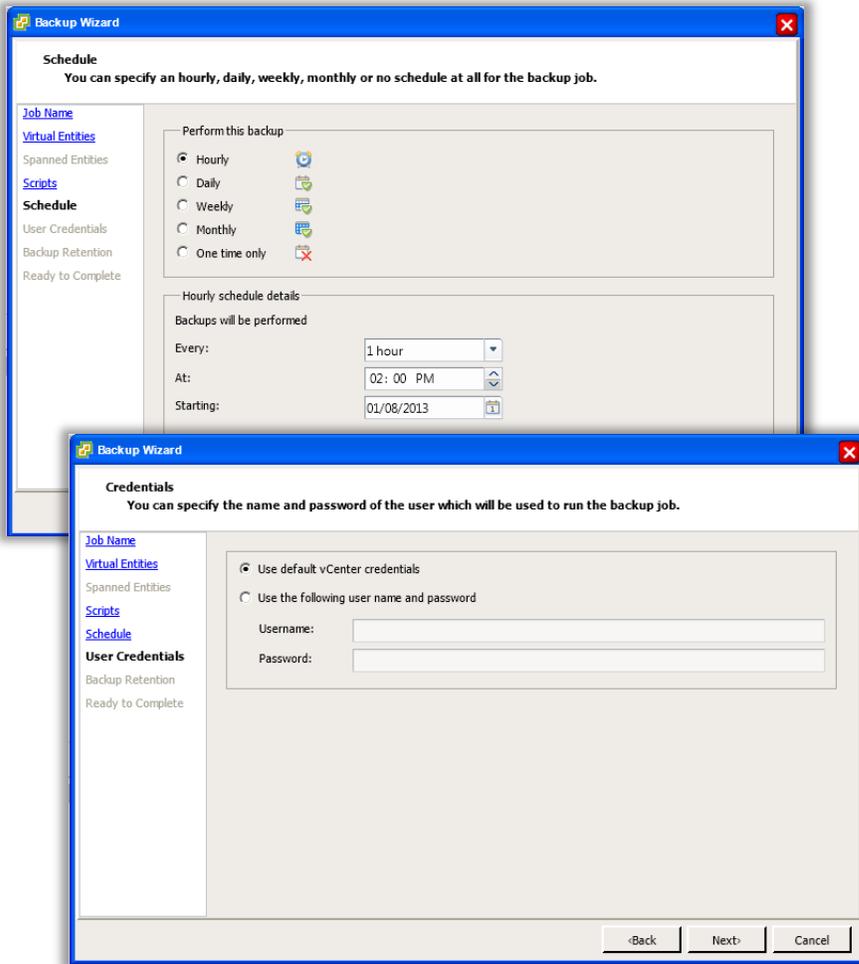
Open the Backup and Recovery tab of the VSC. Navigating to the Backup window provides an interface to configure datastore backups. Clicking on the Add tab brings up the datastore Backup Wizard wherein a datastore backup policy is defined.

Note the option to initiate a SnapMirror update. If selected, the SnapMirror destination will be synced to the source as part of the backup. This can be used in place of defining a schedule as part of the SnapMirror configuration and may be appropriate for backups that require an application to be quiesced.

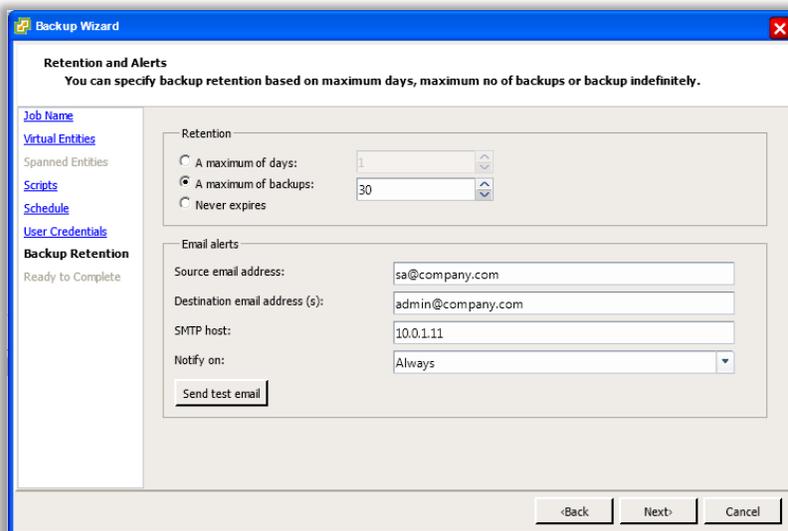
The Backup Wizard will assist with selecting the datastore(s) to be backed up.



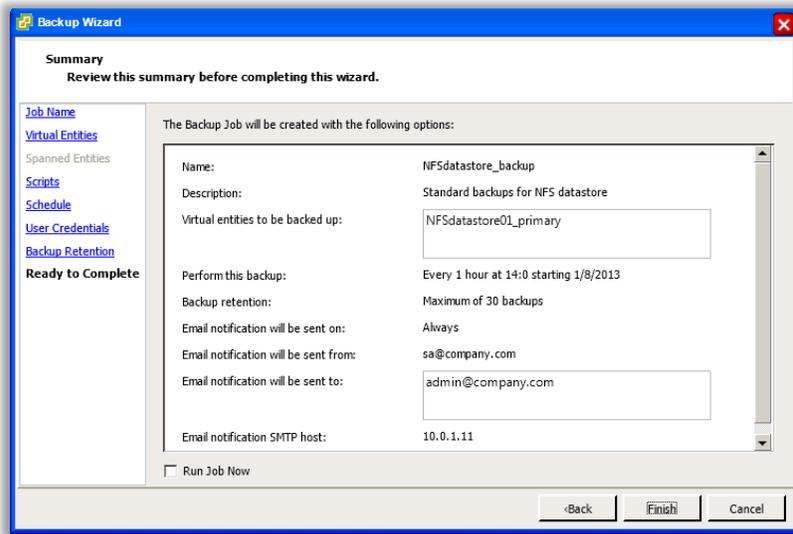
Any custom scripts designed to be run simultaneously with the backup can be included in the policy, with the backup schedule defined and credentials confirmed.



Backup retention and event notification e-mail addresses are added.



The backup configuration is confirmed and approved to create a local backup of the datastore(s) on the NetApp Data ONTAP Edge-T instance.



Datastore Snapshot copies are synced to the SnapMirror destination either when taken (if defined that way in the backup configuration) or on the schedule created when the SnapMirror relationship was established. In the event that a disaster recovery procedure is implemented, the SnapMirror destination will be in sync with the most recent Snapshot copy.

## 6.2 Backup Policy Considerations

Best practices for system and application backups are highly dependent on the type of data and applications deployed. Many resources exist on this topic, including the documentation available for most enterprise applications. It is not this guide's purpose to recommend specific backup policies for all potential virtual machine and application environments. However, some general considerations are offered here.

The simplest, and generally the easiest, backup policy to restore from is an offline backup, with applications and virtual machines in the datastore shut down. This is a good choice for a baseline backup after a virtual machine and applications are initially installed. Since a Snapshot backup is a very quick procedure, the VM does not need to be offline for long. Periodic offline backups are a good policy if the environment and application demands can support it.

However, many production application environments are not intended to be shut down on a regular basis and will therefore have to be backed up live. When backing up live applications, data consistency may be a concern when data is very dynamic. A Snapshot backup may or may not preserve the correct data states and relationships to allow a good application restore. For example, a file server may experience no problems restoring from a backup taken while the system was live whereas a database may see consistency errors between data and logs resulting in unrecoverable data corruption.

Hot backup utilities exist for many applications and software products. Backup policies created through the VSC should take application backup windows into consideration to minimize data loss in the event of a data restore.

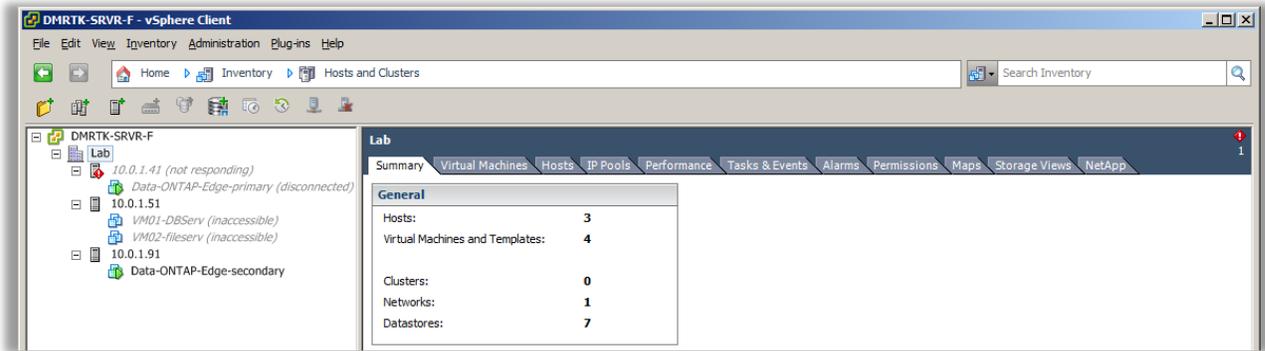
In dynamic environments, frequent backups can minimize data loss. Snapshot copies easily support frequent backups since Snapshot copies are quick and use little space to update pointers. Because of

this, syncing the SnapMirror destination tends to be a quick process as well. There are limits on the maximum number of Snapshot copies, so a backup retention policy should be considered. If data changes less frequently, fewer incremental backups are needed. It is important to know the nature of the application and data before defining backup policies.

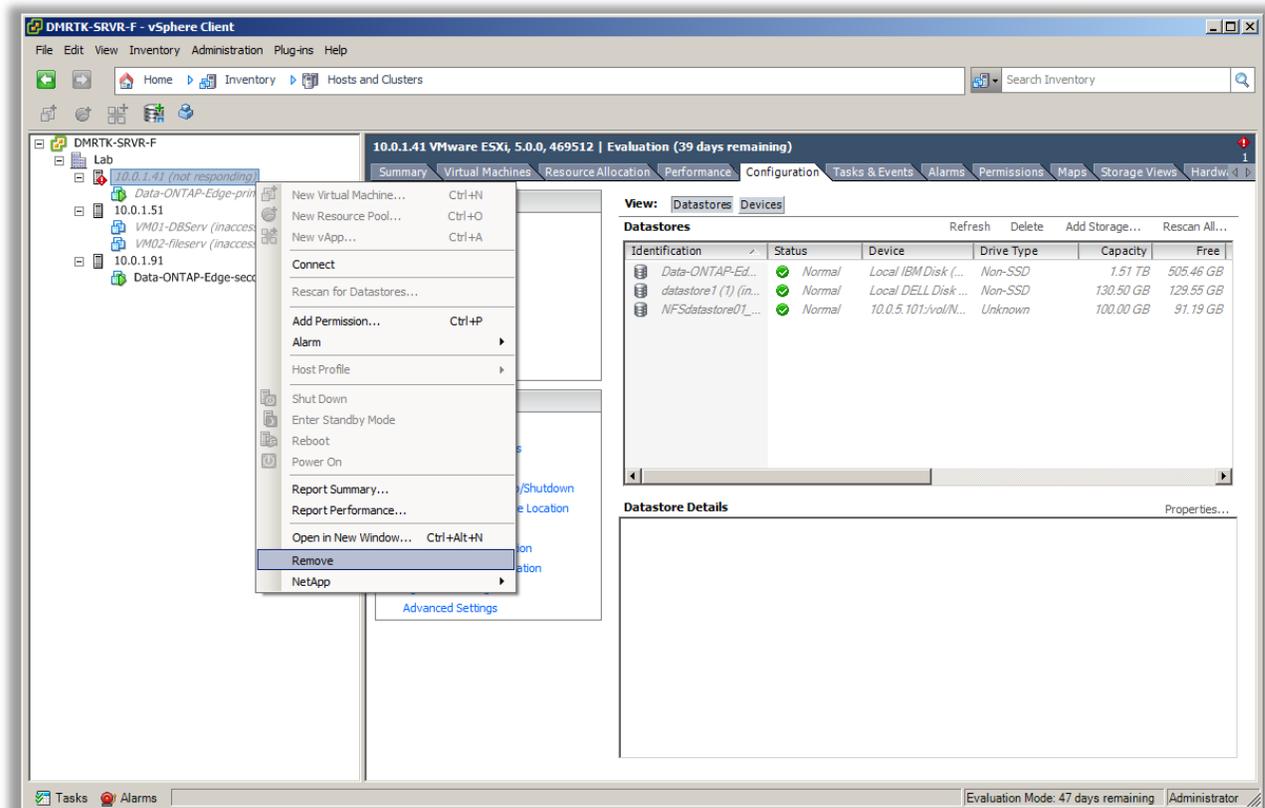
## 7 Disaster Recovery Step-by-Step Execution

### 7.1 Prepare vSphere and NetApp Data ONTAP Edge-T for Recovery

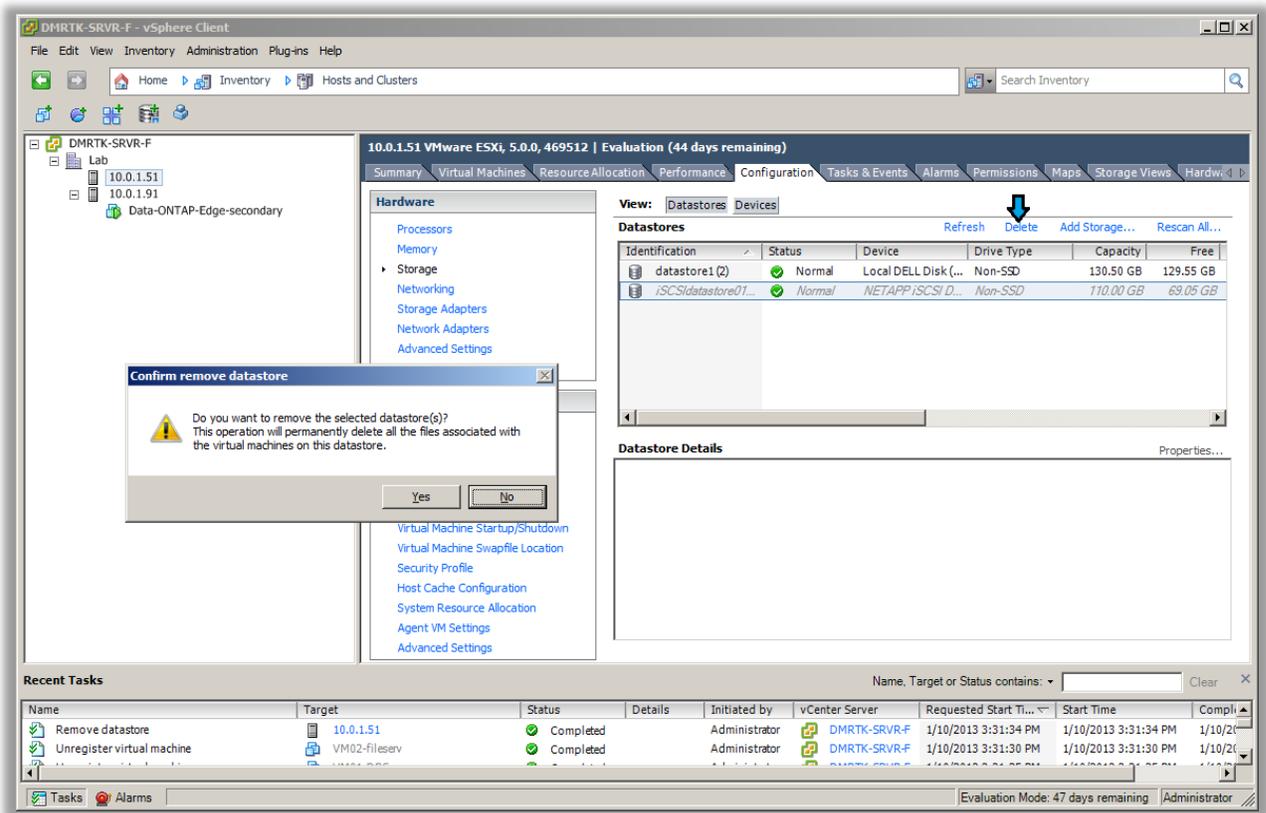
Disaster recovery procedures should be implemented once it is confirmed that an outage cannot be corrected within the service-level-agreement window and that the time to recover the primary servers or datastores will exceed the time required to bring the secondary systems online.



From VMware vCenter™, remove the NetApp Data ONTAP Edge-T instance and the failed VMs from the vCenter inventory.



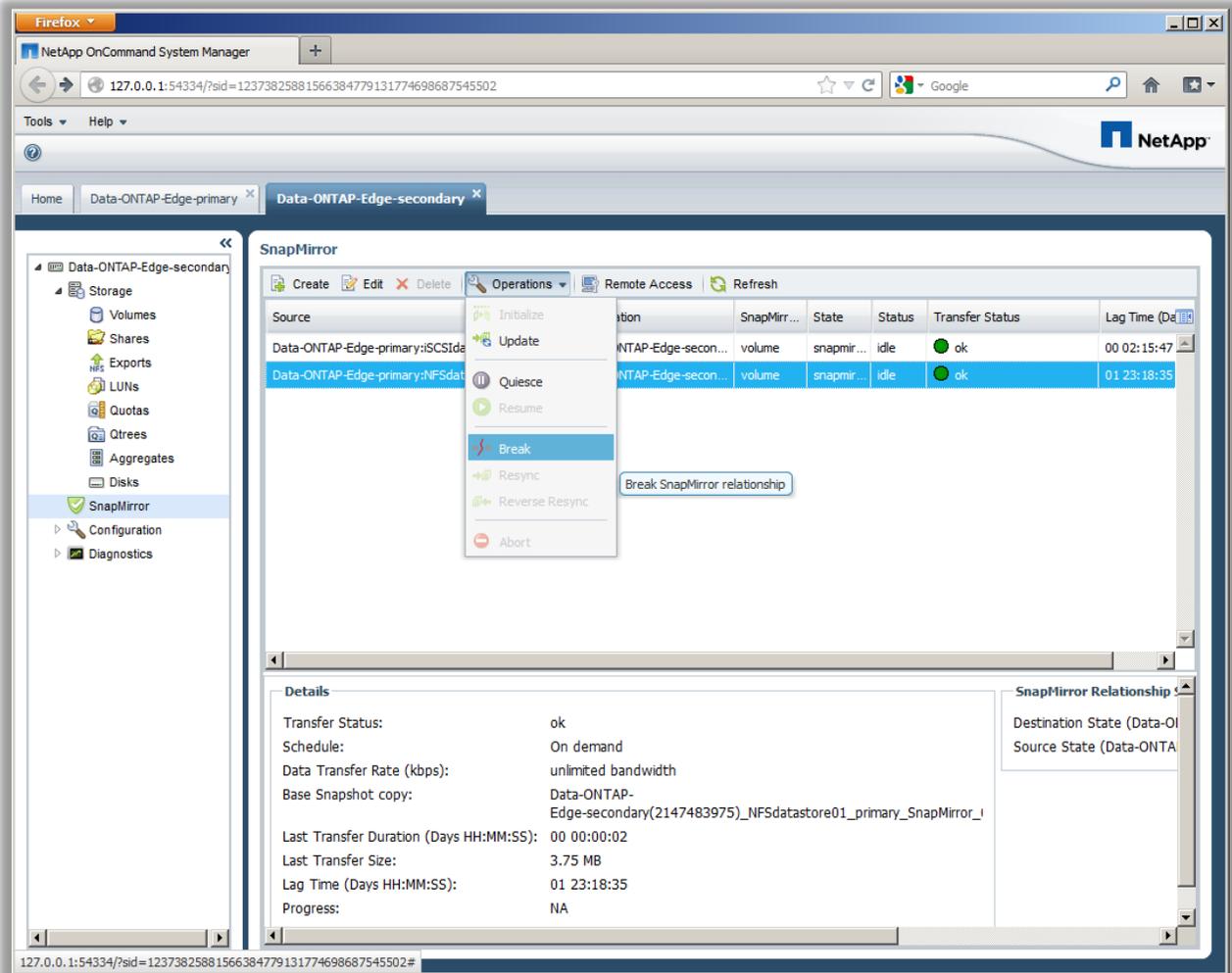
With the VMs removed from the inventory, it is possible to remove the failed datastores from the vSphere host. Rescan the storage adapters when done.



If a new vSphere server is also needed for recovery, add it to the vCenter inventory.

Open the secondary NetApp Data ONTAP Edge-T instance in NetApp OnCommand System Manager. Navigate to the SnapMirror window and break the SnapMirror relationships to make the replica volumes writable.

**Note:** If the primary volume is still online (in a testing scenario, for instance), the SnapMirror relationship should be quiesced before being broken so that no active transfers are in progress.



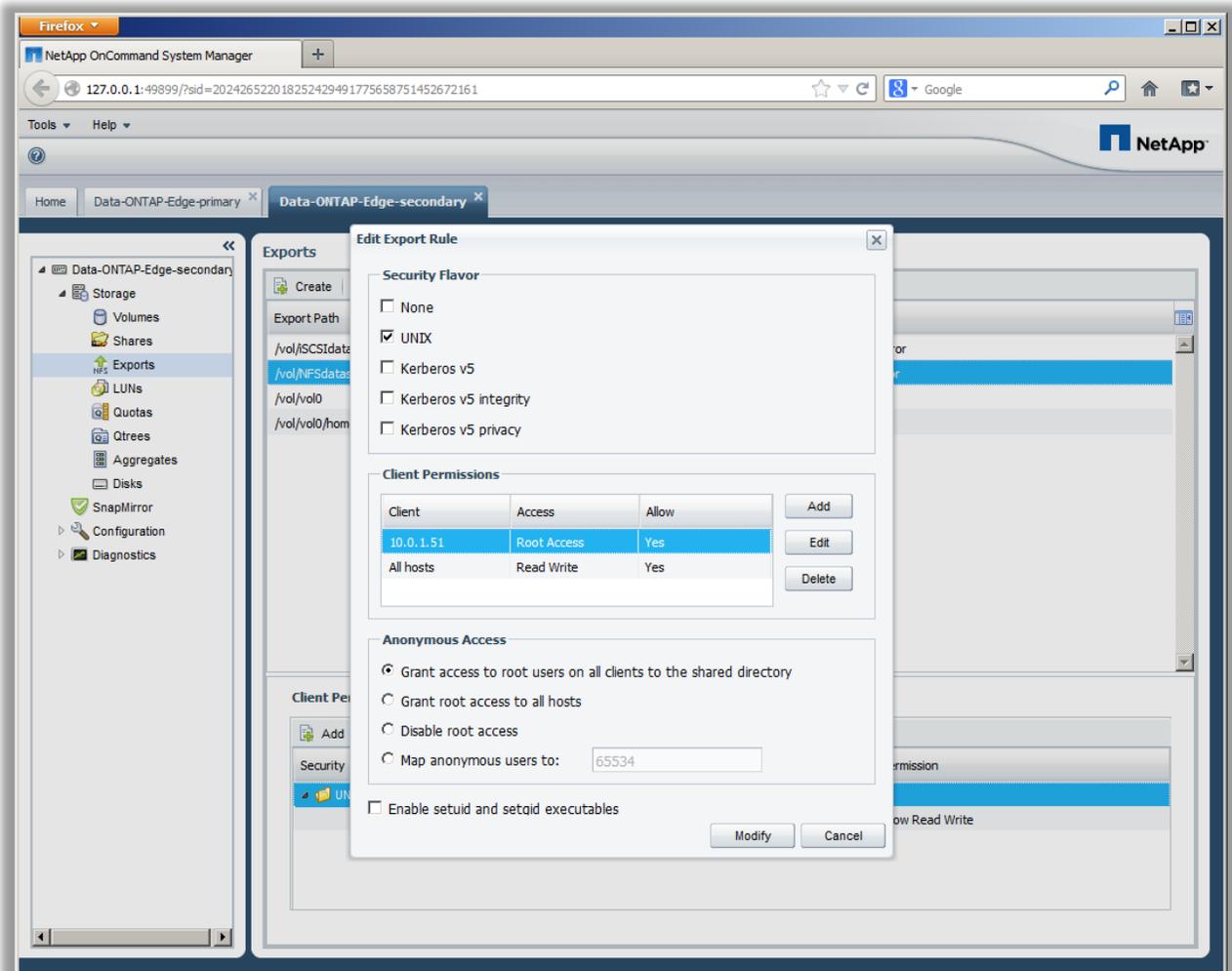
If the SnapMirror break doesn't take effect, it may be necessary to use the Data ONTAP command line to perform these steps. Log onto the secondary NetApp Data ONTAP Edge-T instance with a console tool as the root user and execute the following:

```
# snapmirror quiesce volume_name  
# snapmirror break volume_name
```

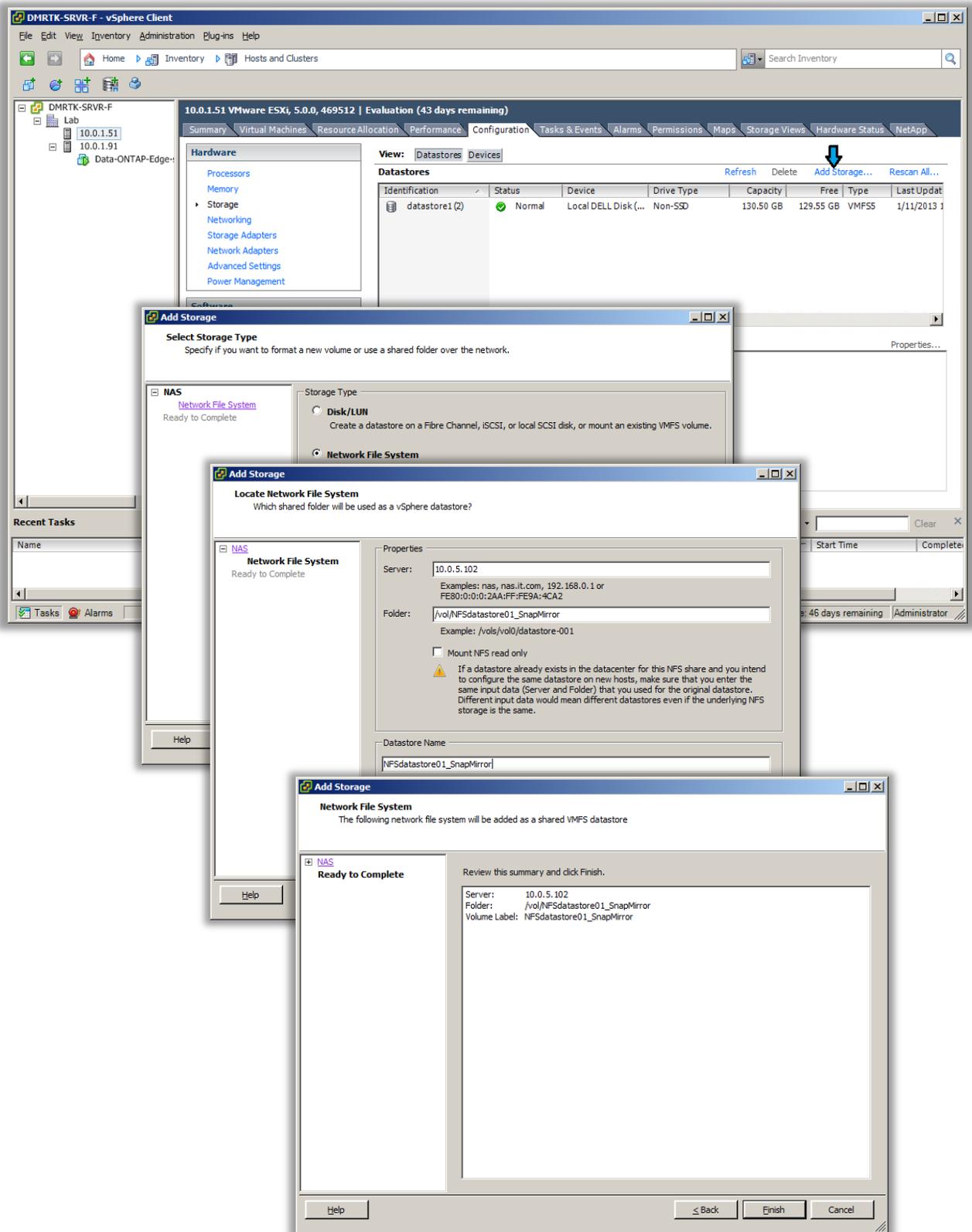
The process for completing the recovery of a SnapMirror datastore will differ depending on whether the datastore is an NFS or iSCSI volume.

## 7.2 Recovering an NFS Datasore

With the SnapMirror relationship broken, the NFS volume is now writable. In OnCommand Manager, navigate to the NFS Exports window and verify that the vSphere host is included in the export rules. If it is not included in the existing rules, add the host and grant it root access to the share.



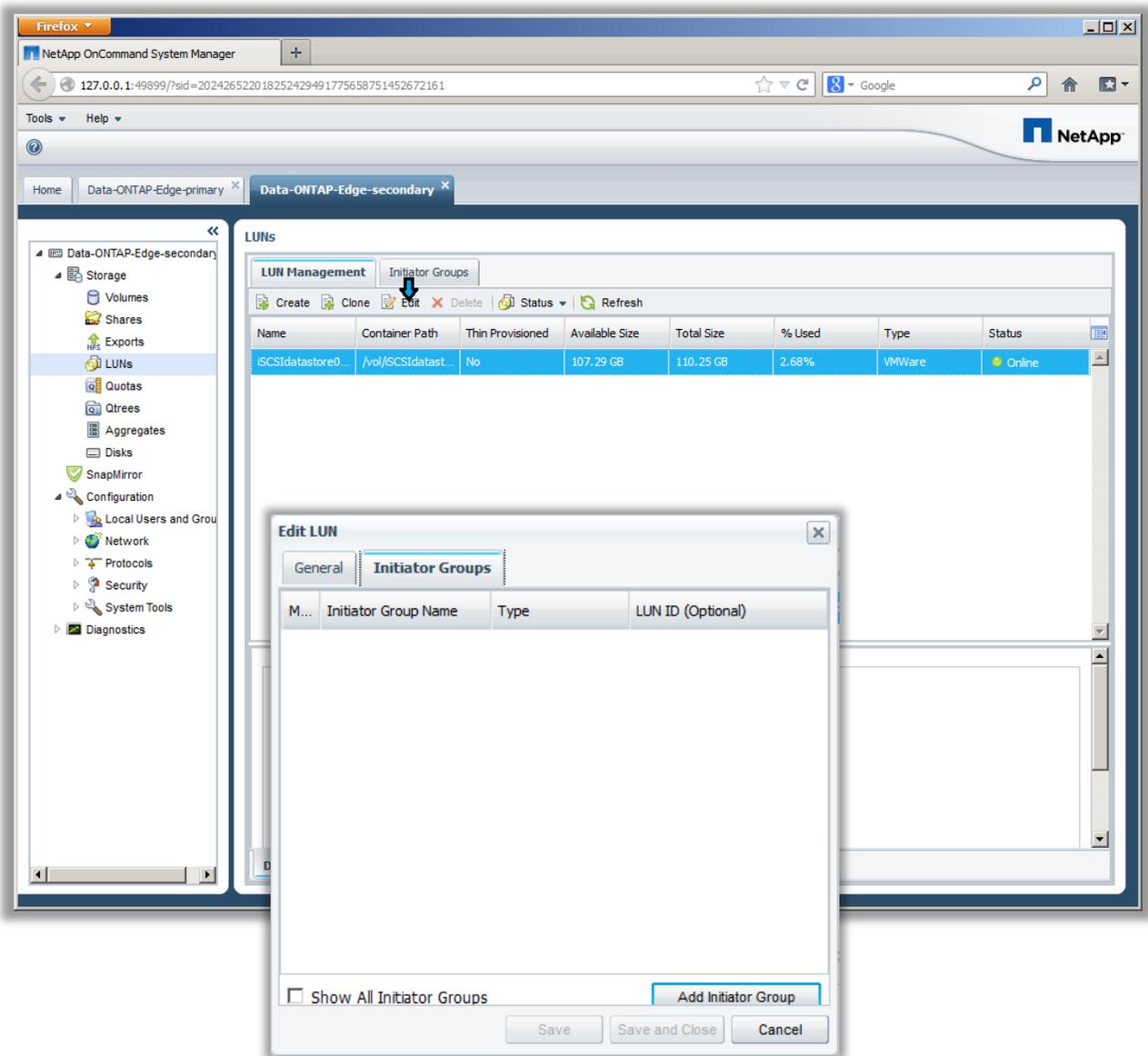
Return to vCenter and add the SnapMirror destination volume as a new NFS datastore to the vSphere host.



### 7.3 Recovering an iSCSI Datastore

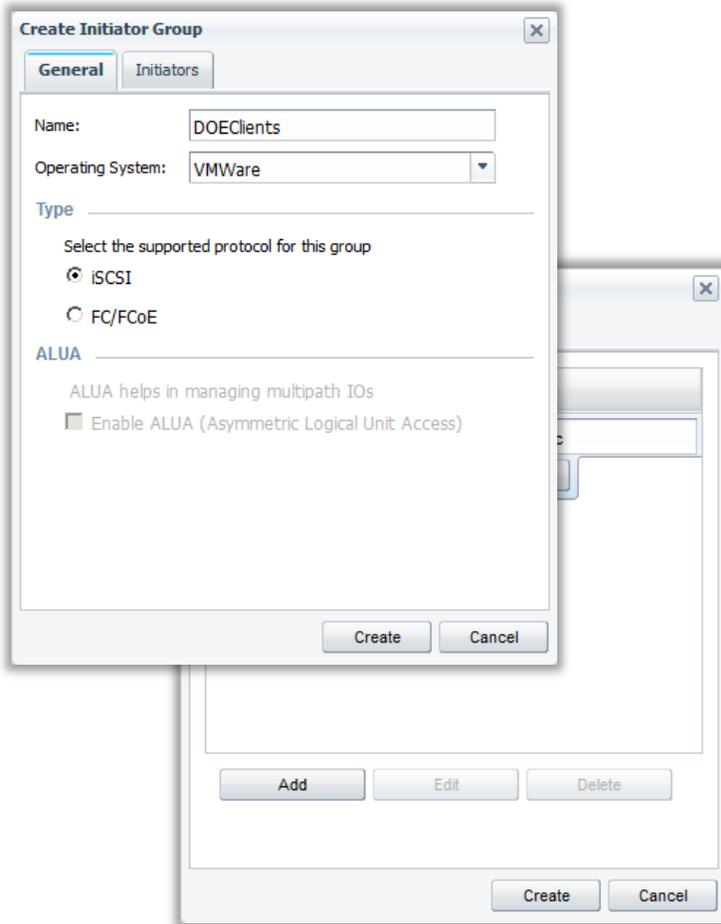
With the SnapMirror relationship broken, the volume holding the iSCSI LUN is now writable. Open OnCommand System Manager and connect to the NetApp Data ONTAP Edge-T secondary instance. Navigate to the LUNs window. Select the SnapMirror LUN and edit its properties to create an iSCSI initiator group with the desired vSphere host.

**Note:** The VMware iSCSI initiator name is found in the vSphere client Configuration tab, Storage Adapters window, of the vSphere host.

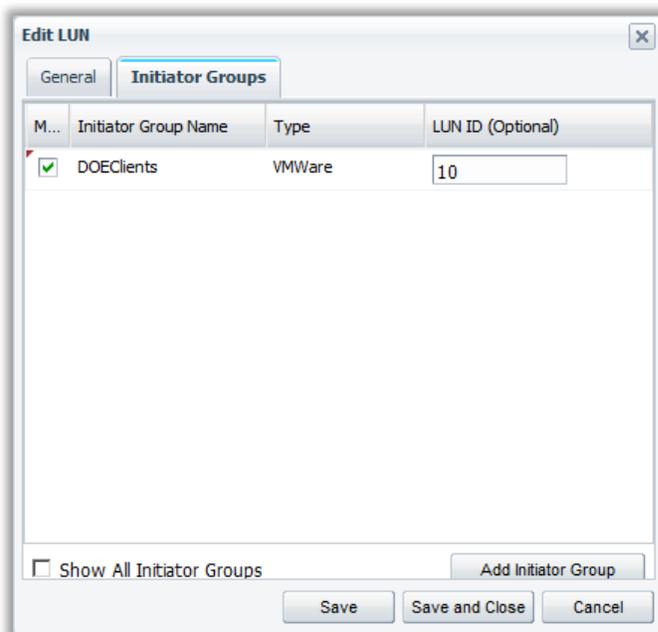


From the Create Initiator Group Wizard, General tab, provide a name for the initiator group, choose VMware for the operating system type, and iSCSI as the protocol. Switch to the Initiators tab to add the vSphere host initiator name. Click Create to build the initiator group and close the Create Initiator Group Wizard.

**Note:** Several vSphere host iSCSI initiators can be placed in the same group for ease of management.



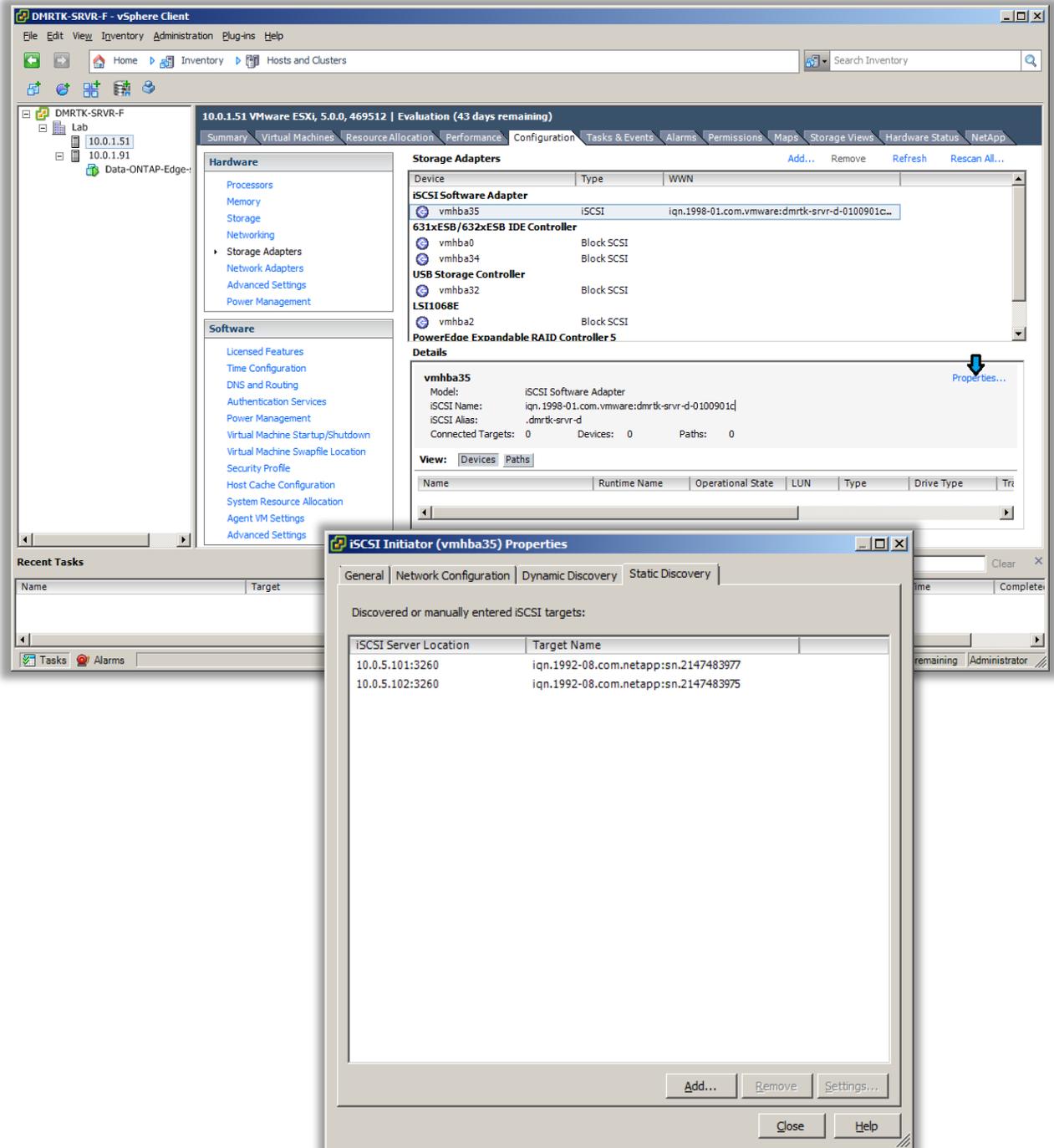
Now select the initiator group and, optionally, provide a LUN ID. Save and close the wizard.



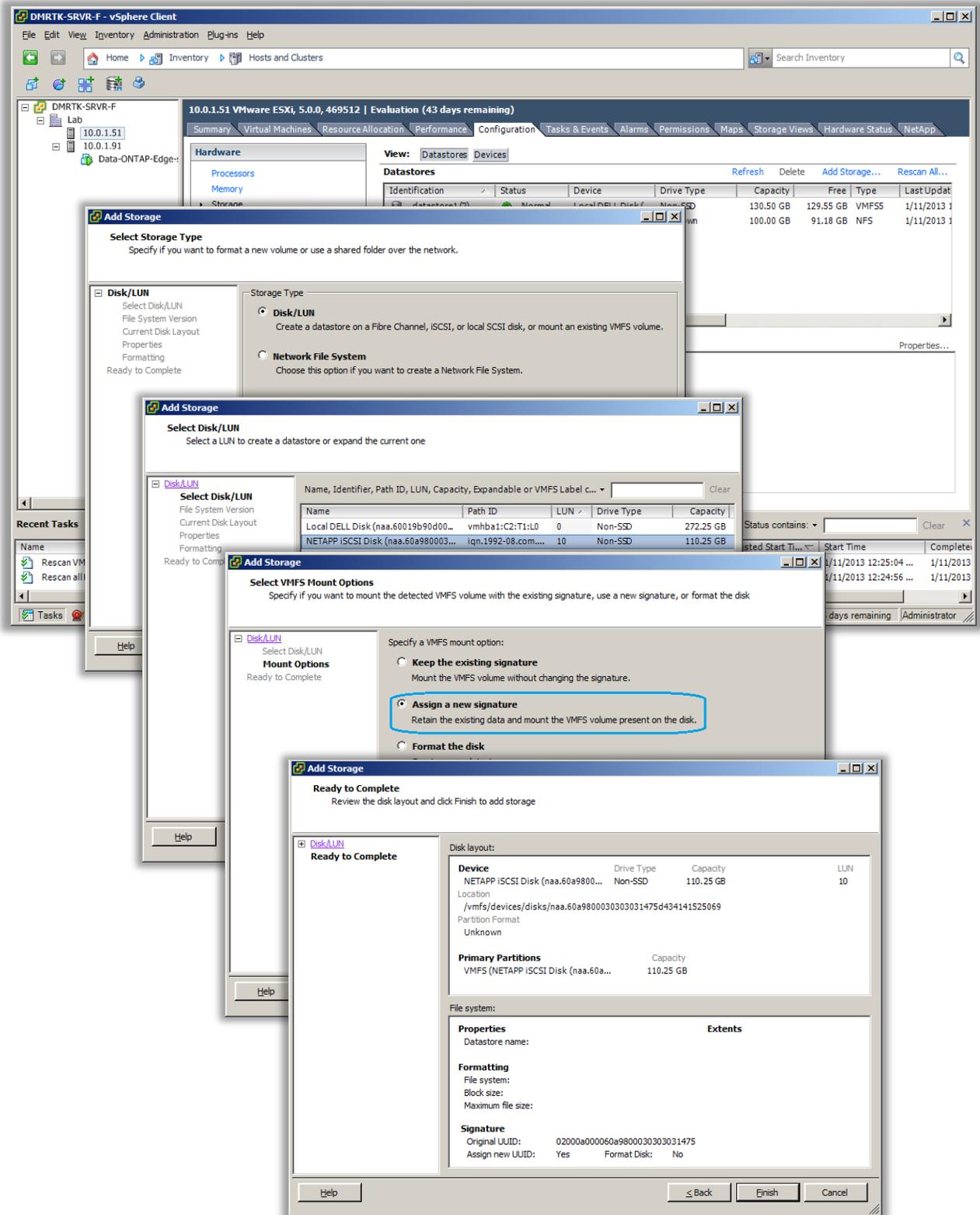
The replica LUN is now ready to be mapped to the vSphere host as a datastore. In vCenter, select the host and navigate to the Configuration tab, Storage Adapters window. Select the iSCSI Software Adapter and open its Properties.

In the Discovery tabs, verify that the NetApp Data ONTAP Edge-T secondary instance and its iSCSI target name are listed. This may already be done if the VSC was previously used to configure storage adapters. If not, add them manually.

**Note:** The NetApp Data ONTAP Edge-T iSCSI target name can be found through OnCommand System Manager in Configuration -> Protocols -> iSCSI.



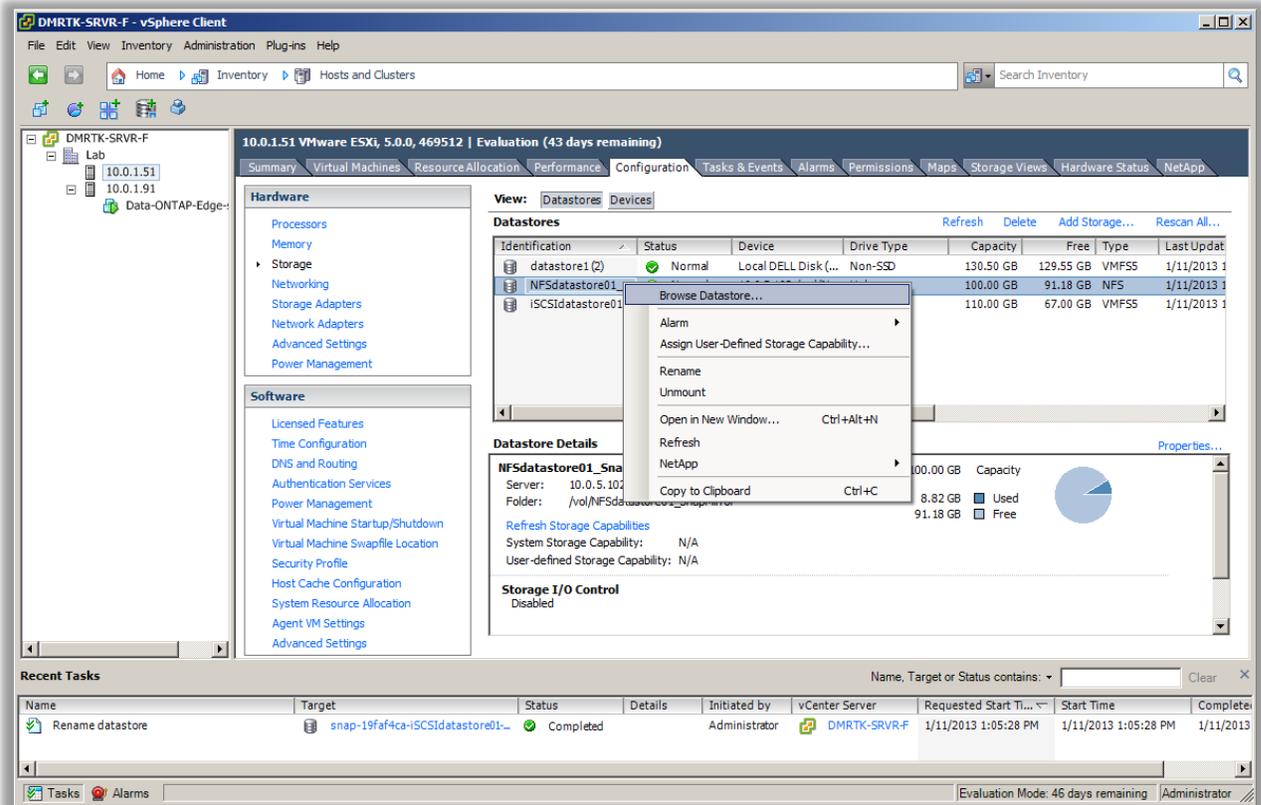
Rescan the storage adapters and open the Configuration tab, Storage window, to add the SnapMirror replica LUN as a new Disk/LUN. The Add Storage Wizard will recognize the LUN as an existing VMFS volume. **Be sure to select the option to assign a new signature to the volume**, or it will not be writable.



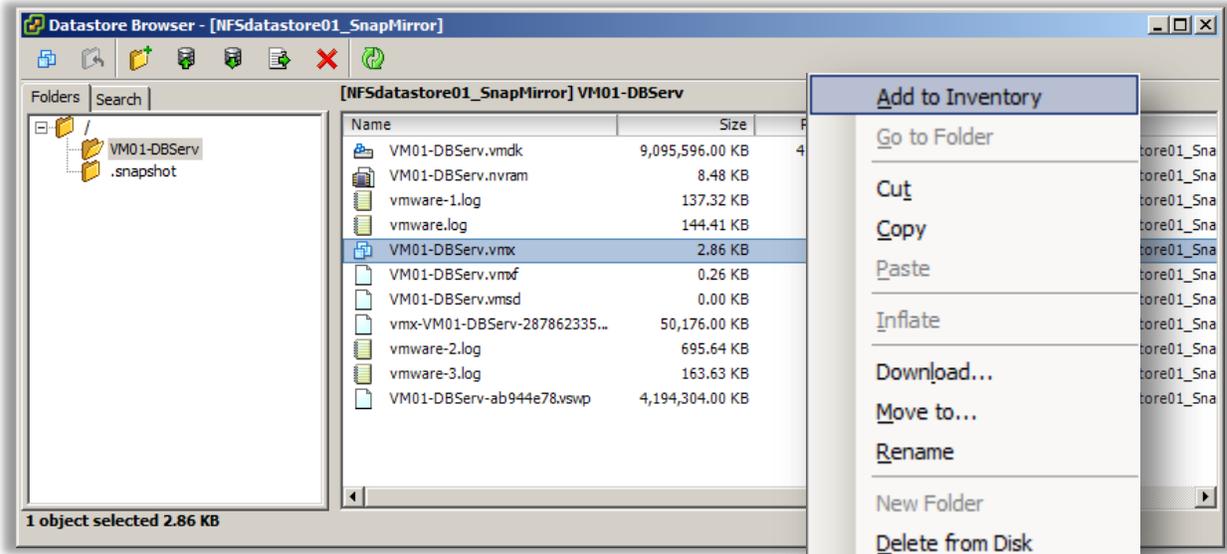
## 7.4 Recovering Virtual Machines and Applications

Once the datastore replicas have been added to the vSphere host, virtual machines can be recovered to the state of the most recent backup.

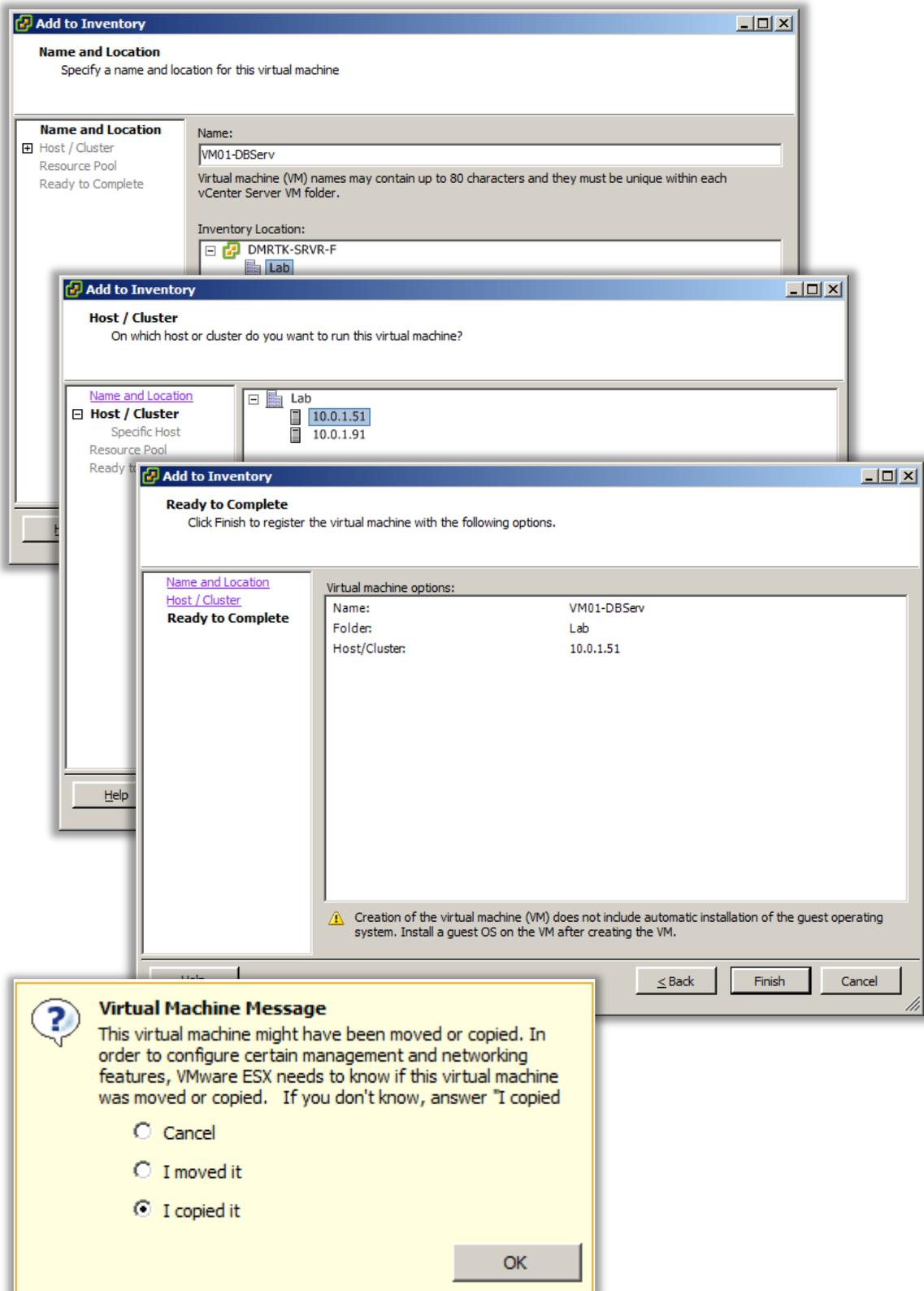
In vCenter, highlight the vSphere host, navigate to the Configuration tab, and open the Storage window. Select a datastore containing a VM to be recovered, right-click it, and select Browse Datastore.



Open the folder for the VM to be restored and right-click the virtual machine file. It will have a .vmx extension. Select Add to Inventory.



The Add to Inventory Wizard will appear. Select the appropriate vSphere host and confirm. When the VM is powered on, the vSphere client will display a message that the VM may have been moved or copied. Confirm that it was copied and the VM will complete powering on.



## 7.5 DR Final Steps

In a best-case scenario, the disaster recovery environment of a NetApp Data ONTAP Edge-T instance is local and the same vSphere hosts are used for the recovered VMs. In this case there is little concern about properly scaling VMs to fit the vSphere server resources. However, if different vSphere servers are used to host the recovered VMs, it's possible that those servers are not scaled identically to the original ones or they may already be hosting other VMs. In that case, the VM administrator must review VM scaling before powering on any new VMs.

If a DR failover environment is going to be run for any length of time, it is critical to verify that proper data protection is put in place. VM and datastore backups must be reinstated to maintain data integrity. Plans should be made to either roll back to the original NetApp Data ONTAP Edge-T instance, when it is recovered, or prepare a new disaster recovery environment.

## 8 Roll Back to Source Datastore and Servers

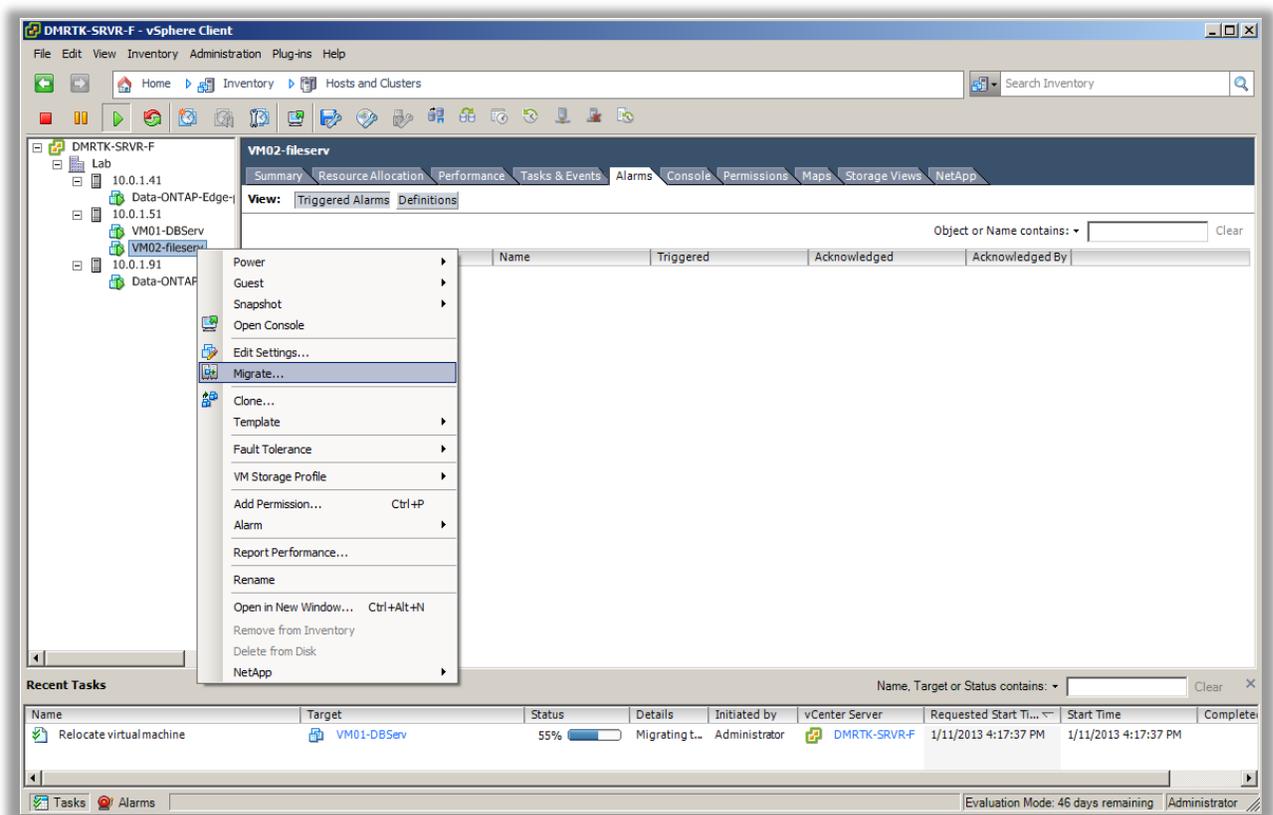
There may be acceptable reasons to maintain a disaster recovery instance of NetApp Data ONTAP Edge-T as the new primary site. However, disaster recovery is typically intended to be a short-term solution and a rollback to the original, primary instance will be implemented once that instance is recovered or replaced.

### 8.1 Change Datastores with VMware Datastore Migration

To roll back simply and with minimal impact on running applications, use VMware's migration tools.

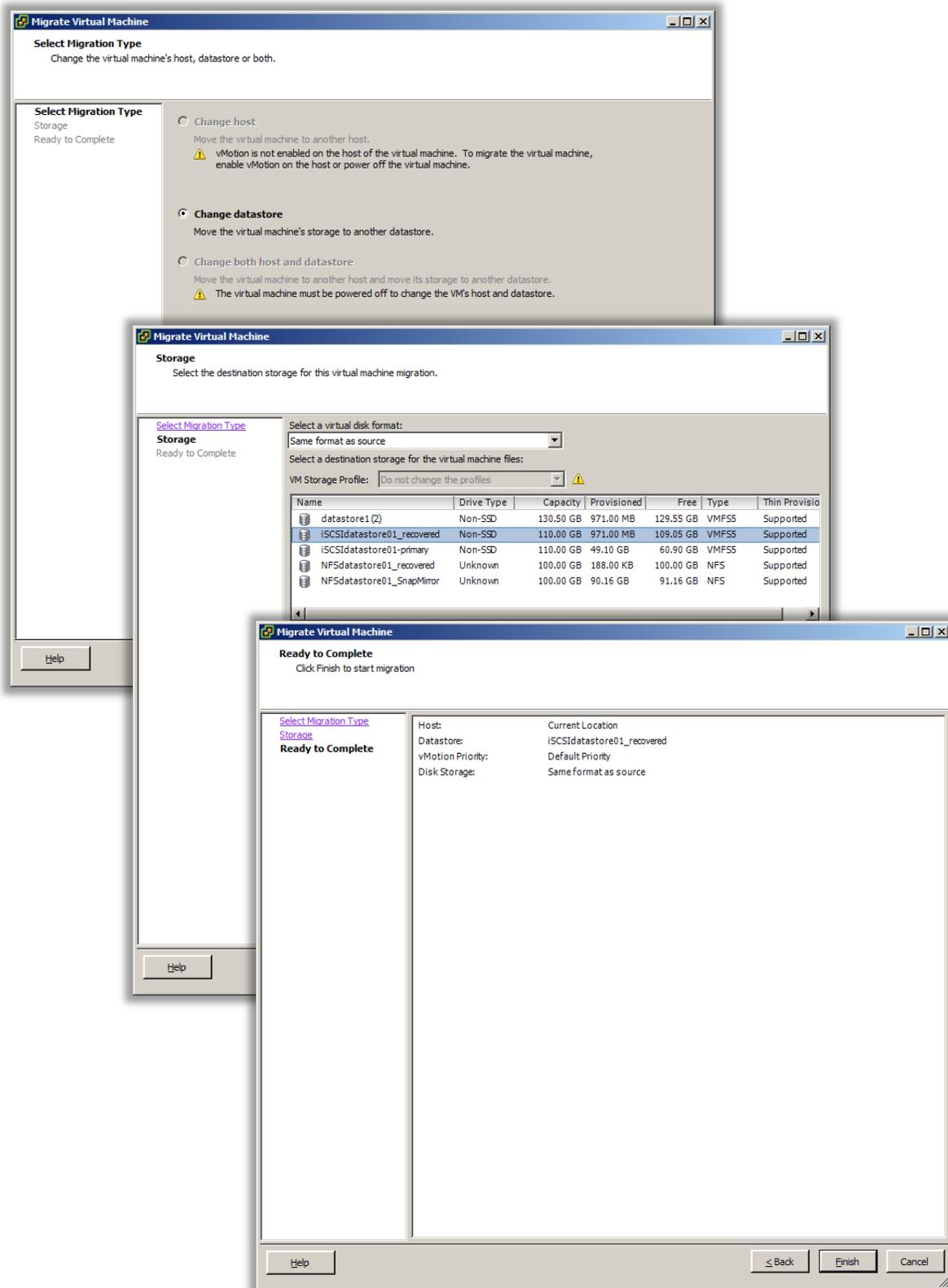
In vCenter, add the vSphere host with the new or recovered NetApp Data ONTAP Edge-T instance and reregister that instance with the Virtual Storage Console. Recreate datastores to the original specifications.

Right-click the VM to be moved to the new datastore and select Migrate.



In the Migrate Virtual Machine Wizard, select Change datastore and choose the appropriate datastore as the destination.

**Note:** It is also possible to migrate a live VM to a new vSphere host if vMotion<sup>®</sup> is enabled on the vSphere servers.



When the VM migration completes, reestablish the SnapMirror relationships between the primary and secondary volumes and redefine the datastore and VM backup policies.

## Appendices

### NetApp Data ONTAP Edge-T Disaster Recovery Setup Checklist

- Register NetApp Data ONTAP Edge-T primary and secondary instances with vCenter and the VSC.
- Edit /etc/hosts of NetApp Data ONTAP Edge-T primary to reference secondary.
- Edit /etc/hosts of NetApp Data ONTAP Edge-T secondary to reference primary.
- Edit /etc/snapmirror.allow on NetApp Data ONTAP Edge-T primary to reference secondary.
- Edit /etc/snapmirror.allow on NetApp Data ONTAP Edge-T secondary to reference primary.
- Enable SnapMirror remote access on NetApp Data ONTAP Edge-T primary and secondary.
  - Create SnapMirror source-to-destination relationship for each volume to be replicated.
  - Create SnapMirror schedule (or leave as On Demand and update with VSC backups).
- Perform SnapMirror initial sync.
- Register NetApp Data ONTAP Edge-T primary in VSC Backup and Recovery tab.
- Create backup policy through VSC for each datastore.

## NetApp Data ONTAP Edge-T Disaster Recovery Implementation Checklist

### Break SnapMirror relationship

- Remove offline NetApp Data ONTAP primary from vCenter inventory.
- Remove offline VMs from vCenter inventory.
- Delete offline datastores from vSphere hosts.
- Quiesce and break SnapMirror relationship between source and destination volumes.

### Recovering an NFS datastore

- Update NFS exports for destination volume to include vSphere host and root access.
- Add destination volume to vSphere host as new NFS datastore.

### Recovering an iSCSI datastore

- Edit destination iSCSI LUN to add iSCSI initiator for vSphere host.
- Map destination iSCSI LUN to vSphere iSCSI initiator.
- Verify that the vSphere host iSCSI software adapter is configured with the NetApp Data ONTAP Edge-T secondary's address/host name and iSCSI target name.
- Add destination iSCSI LUN as datastore to vSphere host.
  - Assign new signature to volume.

### VM and application recovery

- Browse datastore for VM folders.
- Select virtual machine file (.vmx) from VM folder and add to vCenter inventory.
- Adjust VM scaling if recovering on new vSphere hosts.
- Update VM and datastore backups.

### Roll back to primary datastores and server

- Recover or rebuild NetApp Data ONTAP Edge-T primary.
- Add NetApp Data ONTAP Edge-T primary vSphere host to vCenter.
- Register NetApp Data ONTAP Edge-T primary with the VSC.
- Rebuild primary datastores on vSphere hosts.
- Using VMware, migrate utility, move VMs back to primary datastores.
- Reestablish SnapMirror source-to-destination relationships and backup policies.

Refer to the [Interoperability Matrix Tool](#) (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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