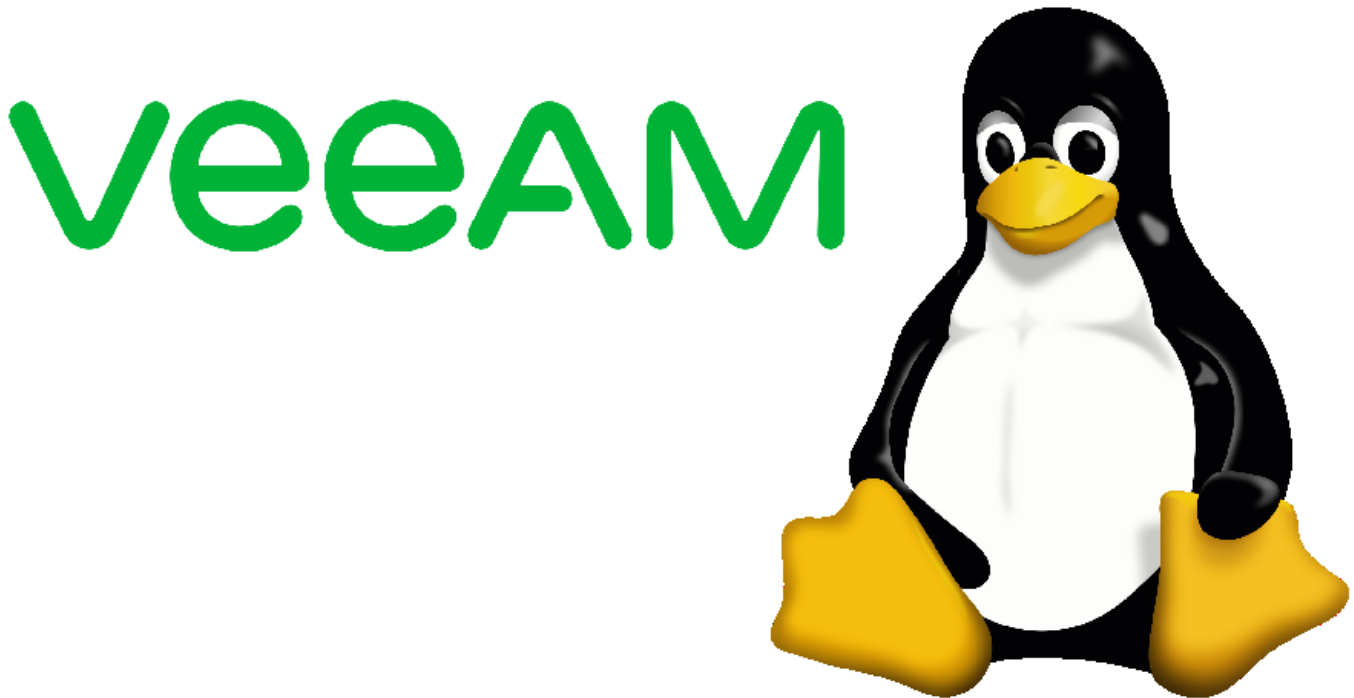


Build an immutable backup repository for Veeam Backup & Replication. Part 4



This guide will show you, step by step, how to create and implement a disk-based immutable Veeam backup repository from scratch. In this part: Create the immutable Veeam backup repository

Introduction

Purpose of these articles

You are a Windows administrator running [Veeam Backup & Replication](#) and wish to raise protection against malware attacks and hackers without reverting to shuffle or rotate physical media.

This you can accomplish by *immutable backups* stored on a physical server running Linux. However, you have no Linux servers running and don't want to.

But, like it or not, that is your only option, as the XFS file system is the only one capable of immutability, and XFS only runs under Linux.

Thus, a Linux server is a must. When you have accepted this fact, then what? Where to start?

Like me, you have about zero experience with Linux and, therefore, hesitate to set up a Linux server, indeed in a production environment.

If so, this guide is for you. Here, nothing about Linux is taken for granted.

Sections

The guide has been split in eight parts. This allows you to skip parts you are either familiar with or wish to implement later if at all.

1. [Prepare the install of Linux](#)
2. [Install Linux on the server](#)
3. [Prepare the Linux server for Veeam](#)
4. [Create the immutable Veeam backup repository](#)
5. [Prepare for backup of the Linux server itself](#)
6. [Backup of the Linux server itself](#)
7. [Bare Metal Recovery of the Linux server](#)
8. [Tighten security on the Linux server \(MFA/2FA\)](#)
9. [Maintenance and deactivation/reactivation of MFA/2FA](#)

Requirements

You are familiar with:

- the usual tasks administering at least a small network with one Windows Server
- *Veeam Backup & Replication* and have it installed and running
- the command line - from PowerShell, Command Prompt, or even DOS

Veeam Backup & Replication is assumed to be of *version 11* or later. It can be a licensed trial or paid version or even the free [Community Edition](#).

XFS and the virtual air gap

The [XFS](#) file system was introduced by SGI in 1993 for its [IRIX 5.0](#) operation system which was based on UNIX System V Release 4.

XFS was ported to Linux in 2001. As SGI ceased operations in 2009, Linux is today the only operating system supporting XFS.

Why is this important? Because XFS is the only file system offering immutability:

Once the file is set immutable, this file is impervious to change for any user. Even the root cannot modify, remove, overwrite, move or rename the file. You will need to unset the immutable attribute before you can tamper with the file again.

For the details about handling this, study *Dan Nanni's* blog on Xmodulo: [How to make a file immutable on Linux](#).

Applying immutability to your backup files hosted on a physical server introduces a virtual *air gap* in your backup chain, protecting the backup files from anything else than direct physical access. This way, the backup files will be protected from any attack caused by advanced malware or possible hackers.

The effect is the same as if you back up to tape or DVD and, when done, remove the media from its drive.

Part 4. Create the immutable Veeam backup repository

In this section we will create the immutable backup repository for Veeam on the Linux server we prepared for this in Part 3.

Elevating the Veeam user account

Veeam Backup & Replication (which always runs on a Windows server) will install the *Veeam Linux Agent* on the Linux server to be able to communicate with this.

As the installation of the Veeam agent on the Linux server requires administrator rights, and we for security reasons do not wish to store the password (even when encrypted, as it would be) for a Linux administrator in the Veeam database (on the Windows server), we temporarily must elevate the *veeamuser* account we created in Part 2.

So, open PowerShell and connect via SSH to the Linux server using this command where *hostname* is the hostname or the IP-address of the Linux server:

```
ssh linuxadmin@hostname
```

Then call this command to assign our user *administrator rights* by signing the user in to the *sudo* group:

```
sudo usermod -a -G sudo veeamuser
```

As a result, for this session or until cancelled, user *veeamuser* has been assigned administrator rights.

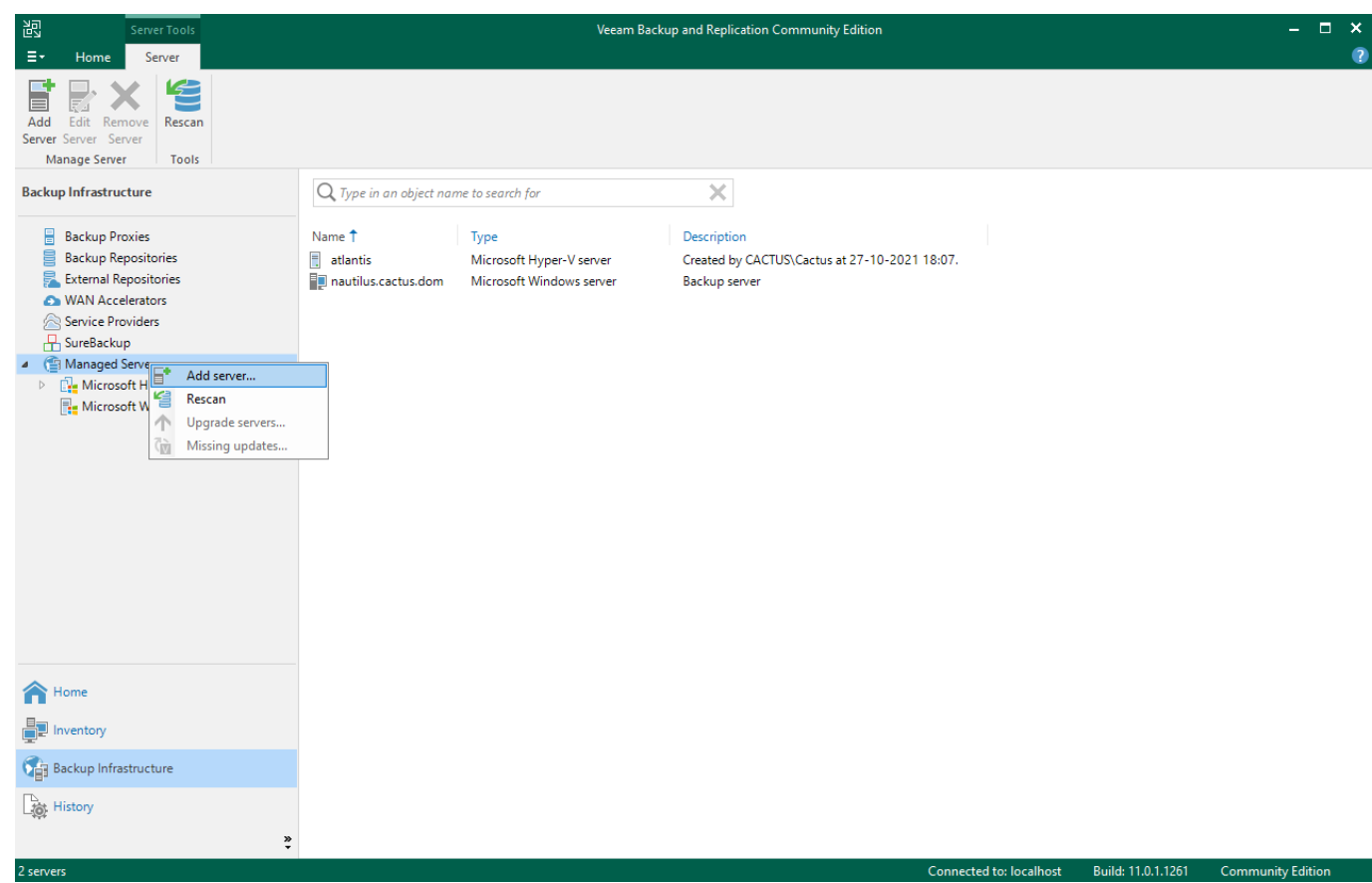
Installing the Veeam Linux Transport

Now is the time to match Veeam and the Linux server.

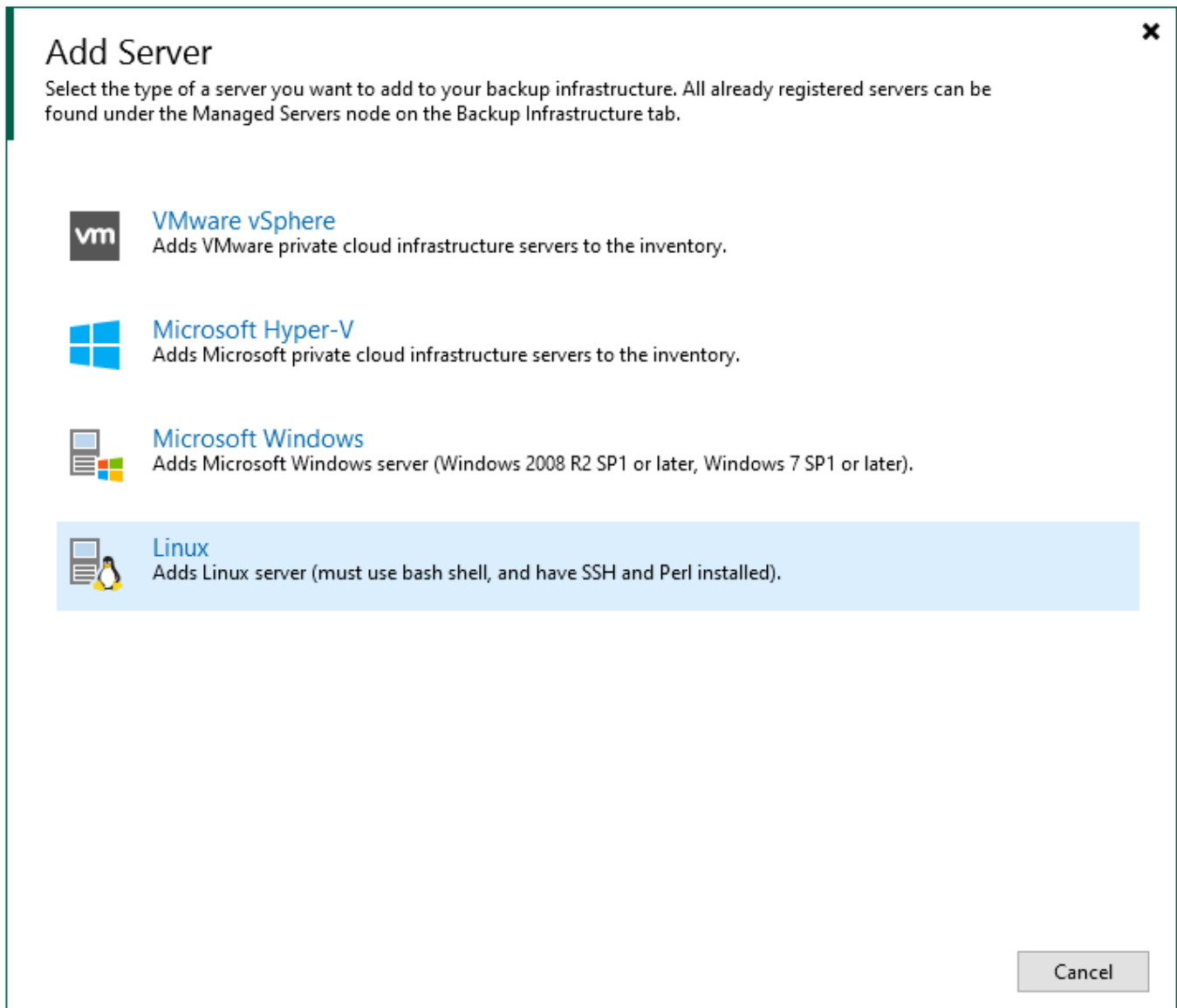
Open your *Veeam Backup & Replication Console* and navigate to:

- Backup Infrastructure
 - Managed Servers

and click *Add server ...*:

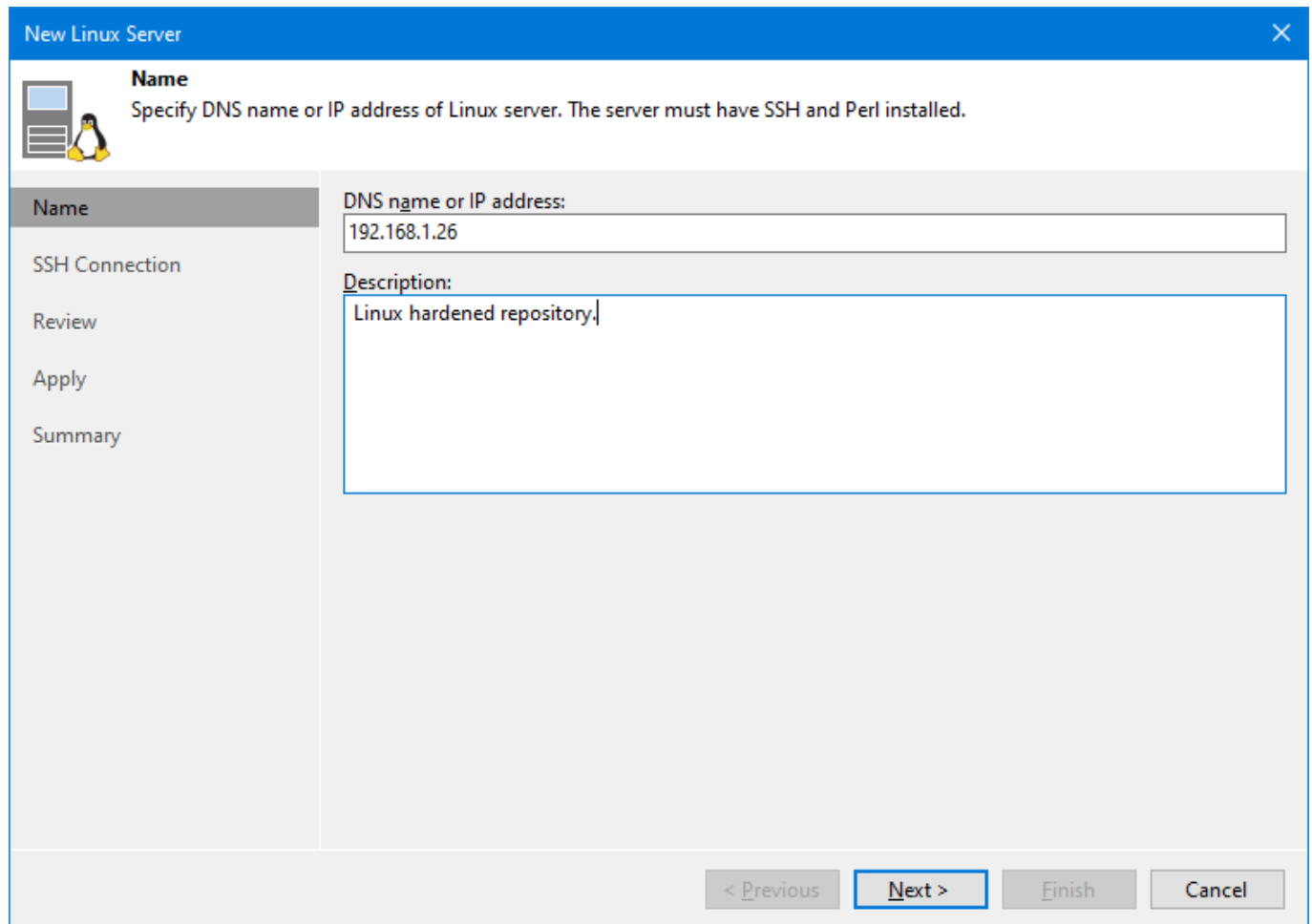


Select *Linux*:



The *New Linux Server* wizard opens.

Enter the hostname or IP address of the Linux server and a meaningful description:



New Linux Server

Name
Specify DNS name or IP address of Linux server. The server must have SSH and Perl installed.

Name

SSH Connection

Review

Apply

Summary

DNS name or IP address:
192.168.1.26

Description:
Linux hardened repository.

< Previous **Next >** Finish Cancel

Click *Next*.

Now comes an important step. Veeam can *use a set of credentials for this session only, without storing it anywhere*. This means, that even if a hacker or some malware should gain access to the Veeam database and break the encryption, nothing will be found about admission to the hardened Linux repository.

So, click *Add ..* and then select:

- Single-use credentials for hardened repository ...

New Linux Server

SSH Connection

Provide credentials for service console connection, and adjust secure shell (SSH) port number using advanced settings if required.

Name

SSH Connection

Review

Apply

Summary

Credentials:

Add...

Manage accounts

Linux account...

Linux private key...

Single-use credentials for hardened repository...

Customize advanced connection settings, such as SSH and data mover ports

Advanced...

< Previous

Next >

Finish

Cancel

Then enter the credentials for our *veeamuser* account:

Credentials

Username: veeamuser

Password:

SSH port: 22

Non-root account

☒ Elevate account privileges automatically

☐ Add account to the sudoers file

☐ Use "su" if "sudo" fails

Root password:

Description:

Temporary sudo user.

OK

Cancel

Click OK, and you will be prompted for a confirmation of the connection:

Veeam Backup and Replication

!

192.168.1.26 SSH key fingerprint: ssh-rsa 3072 26:6e:26:9c:d7:d5:4e:81:93:10:e0:02:ad:ea:fd:87
Do you trust this server?

Yes

No

Click Yes

At this point, click *Advanced* if you wish to adjust the *SSH Settings*. Most likely, the defaults will be fine:

SSH Settings

Service console connection

SSH timeout: 20000 ms

Data transfer options

Port range: 2500 to 3300

Preferred TCP connection role

☐ Run server on this side

Management port: 6162

OKCancel

In the wizard, click *Next* and browse the *Review* pane:

New Linux Server

Review

Please review your settings and click Apply to continue.

Name

SSH Connection

Review

Apply

Summary

Due to these modifications the following components will be installed or removed on the target host:

Component name	Status
Transport	will be installed

After you click Apply missed components will be installed on the target host.

< Previous


Apply

Finish

Cancel

Click *Apply* and, after a little while, the Linux will have had the Veeam components installed:

New Linux Server



Apply
Please wait while required operations are being performed, this may take a few minutes.

Name	Message	Duration
SSH Connection	✓ Starting infrastructure item update process	0:00:02
	✓ Checking if Veeam Data Mover service is supported by the Linux server	
Review	✓ Discovering existing Veeam Data Mover service	
	✓ Installing Veeam Data Mover service	0:00:05
Apply	✓ Discovering existing Veeam Data Mover service	
	✓ Setting server certificate	
	✓ Resolving server certificate thumbprint	
	✓ Setting client certificate	
	✓ Configuring Veeam Data Mover service	
	✓ Restarting Veeam Data Mover service	
	✓ Testing Veeam Data Mover service connection	0:00:01
	✓ Collecting hardware info	0:00:02
	✓ Creating database records for server	0:00:01
	✓ Linux server saved successfully	
Summary		

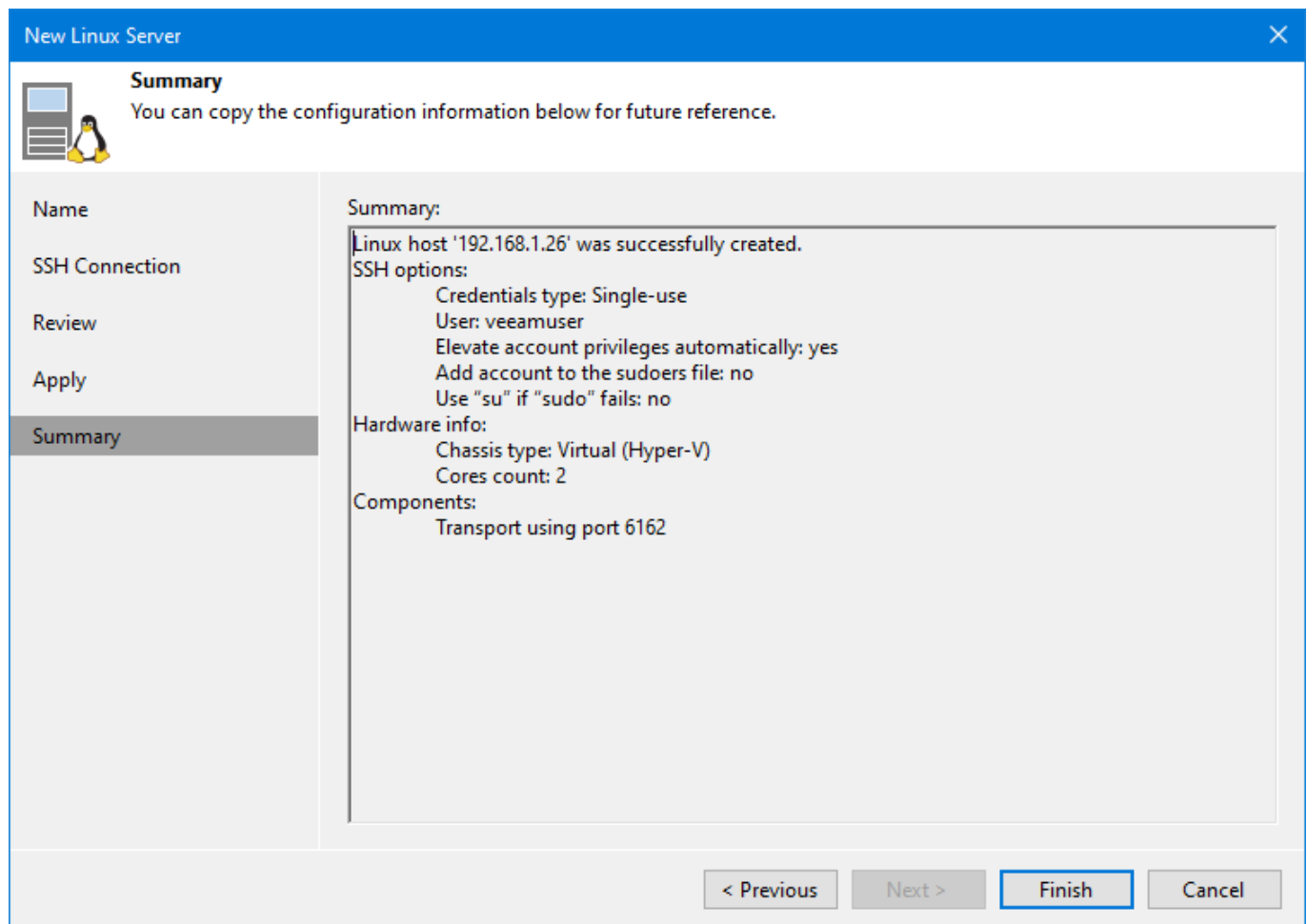
< Previous

Next >

Finish

Cancel

Click *Next* to view the *Summary*:



Click *Finish* to close the wizard.

The Linux server will now be listed under:

- Managed Servers
 - Linux

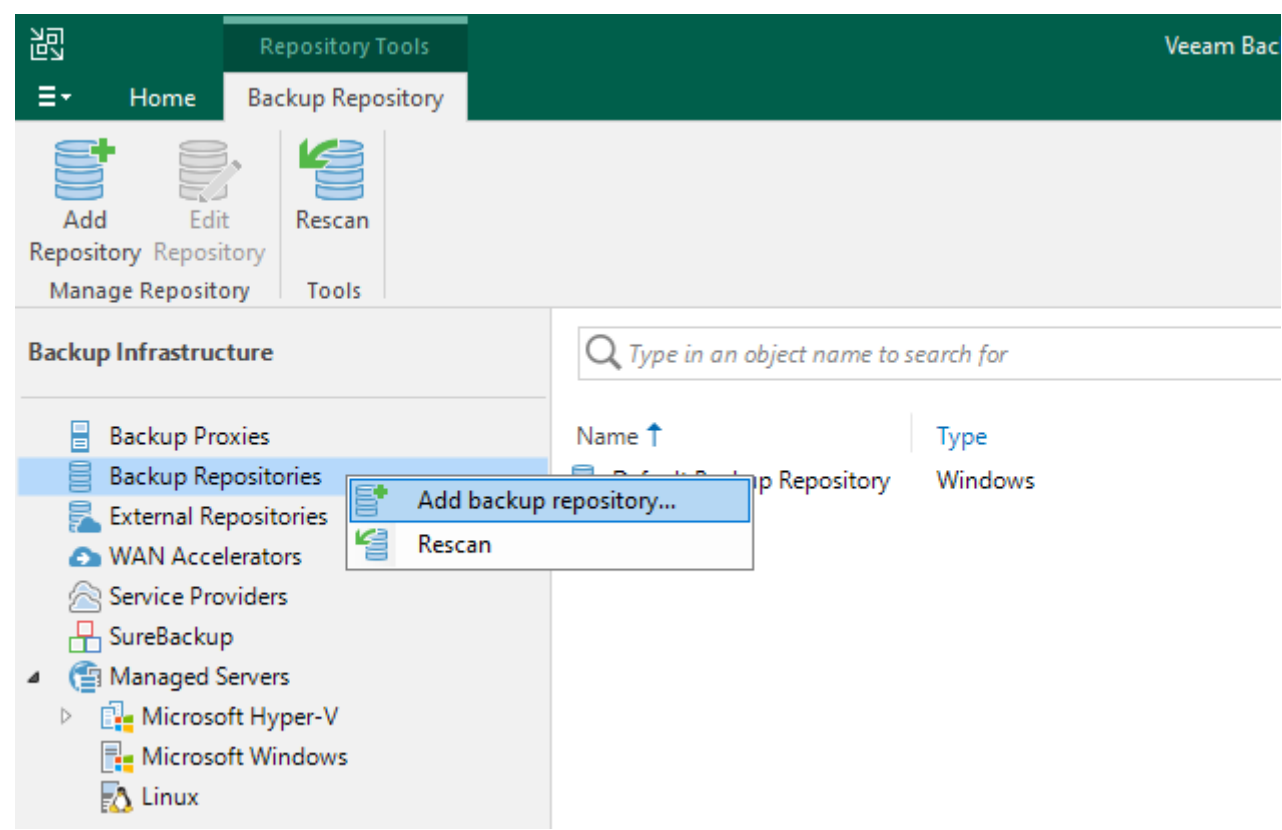
Set up the hardened repository

Veeam Backup & Replication is now aware of the Linux server, which makes it possible to add a hardened repository hosted on this server to the backup infrastructure.

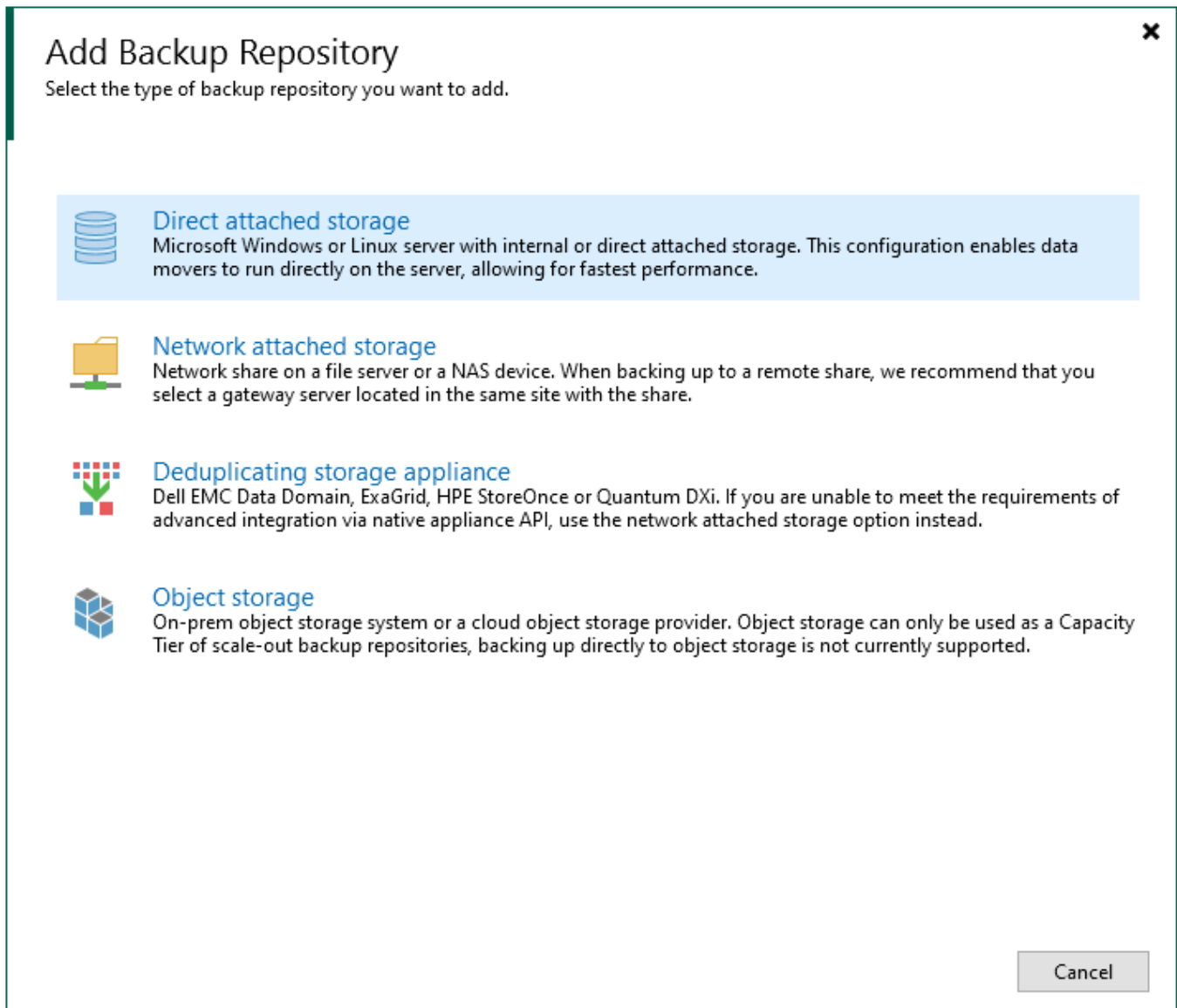
Navigate to:

- Backup Infrastructure
 - Backup Repositories

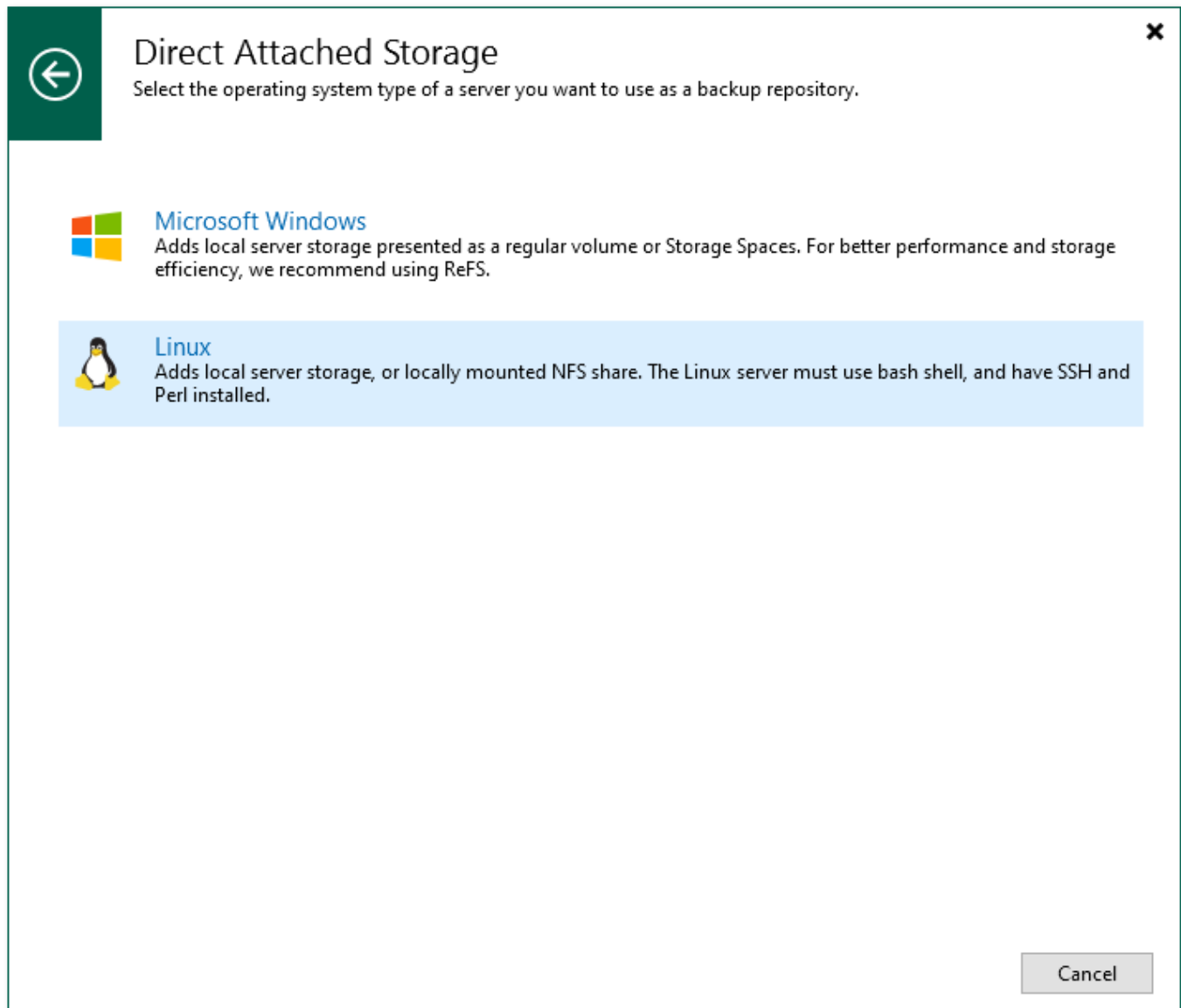
Right-click *Backup Repositories* and select *Add backup repository ...*:



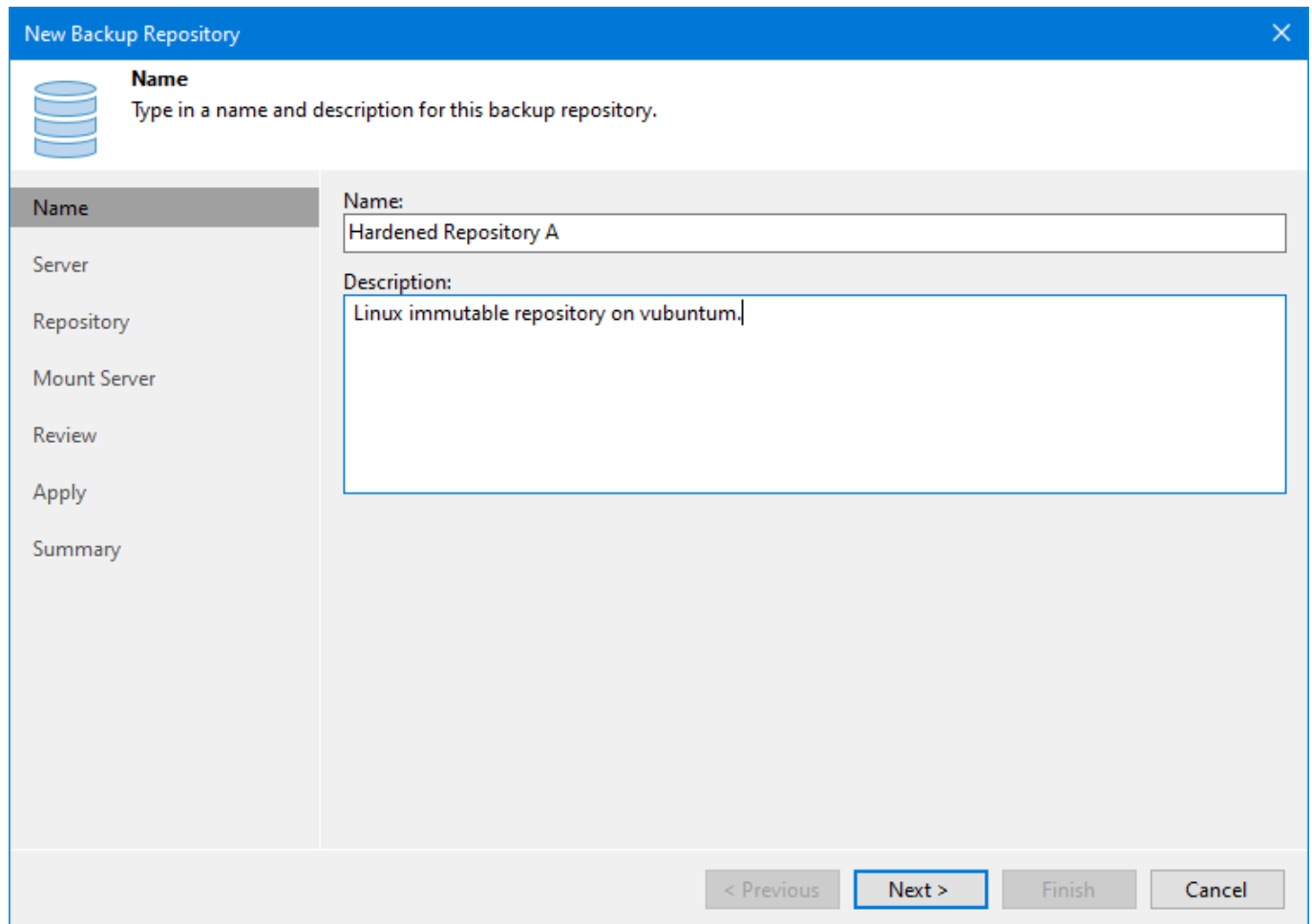
Add Backup Repository opens:



Click *Direct attached storage*, and you can select the server type:



Click *Linux* to open the wizard. Assign a meaningful *Name* and *Description* to the new backup repository:



New Backup Repository

Name
Type in a name and description for this backup repository.

Name:
Hardened Repository A


Description:
Linux immutable repository on vubuntum.

< Previous **Next >** Finish Cancel

Click *Next* and, for the *Repository server*, select the server we added above.

Then click *Populate* to list the available paths at the server, and mark `/mnt/veeam`:

New Backup Repository



Server

Choose repository server. You can select server from the list of managed servers added to the console.

Name

Repository

Mount Server

Review

Apply

Summary

Repository server:

192.168.1.26 (Linux hardened repository.)

Path

Capacity

Free

/ (/dev/mapper/ubuntu--vg-ubuntu--lv)

57,1 GB

49 GB

/boot (/dev/sda2)

975,9 MB

705,2 MB

/boot/efi (/dev/sda1)

511 MB

505,8 MB

/dev (udev)

917,1 MB

917,1 MB

/dev/shm (tmpfs)

961,3 MB

961,3 MB

/mnt/veeam (/dev/sdb)

1,8 TB

1,8 TB

/run (tmpfs)

192,3 MB

191,3 MB

/run/lock (tmpfs)

5 MB

5 MB

/run/user/1000 (tmpfs)

192,3 MB

192,3 MB

/snap/core18/2128 (/dev/loop1)

55,5 MB

0 B

/snap/core18/2246 (/dev/loop0)

55,5 MB

0 B

/snap/core20/1169 (/dev/loop2)

61,9 MB

0 B

/snap/lxd/21029 (/dev/loop6)

70,4 MB

0 B

/snap/lxd/21835 (/dev/loop5)

67,3 MB

0 B

/snap/snand/12704 (/dev/loop4)

32,4 MB

0 B

Add New...

Populate

< Previous

Next >

Finish

Cancel

Click *Next* and the server will be connected using the */mnt/veeam* mounting point. By default, Veeam here creates a folder */backups*.

Click *Populate*, and the values for *Capacity* and *Free space* should change from to the current values, here **1.8 TB**:

New Backup Repository

Repository
Type in path to the folder where backup files should be stored, and set repository load control options.

Name

Server

Repository

Mount Server

Review

Apply

Summary

Location

Path to folder:
/mnt/veeam/backups Browse...

Capacity: 1,8 TB
Free space: 1,8 TB Populate

☒ **Use fast cloning on XFS volumes (recommended)**
Reduces storage consumption and improves synthetic backup performance.

☒ **Make recent backups immutable for: 7 days**
Protects backups from modification or deletion by ransomware or hackers. GFS full backups are made immutable for the entire duration of their retention policy.

Load control

Running too many concurrent tasks against the repository may reduce overall performance, and cause I/O timeouts. Control storage device saturation with the following settings:

☒ **Limit maximum concurrent tasks to: 4**

☐ **Limit read and write data rate to: 1 MB/s**

Click Advanced to customize repository settings. Advanced

< Previous Next > Finish Cancel

Important

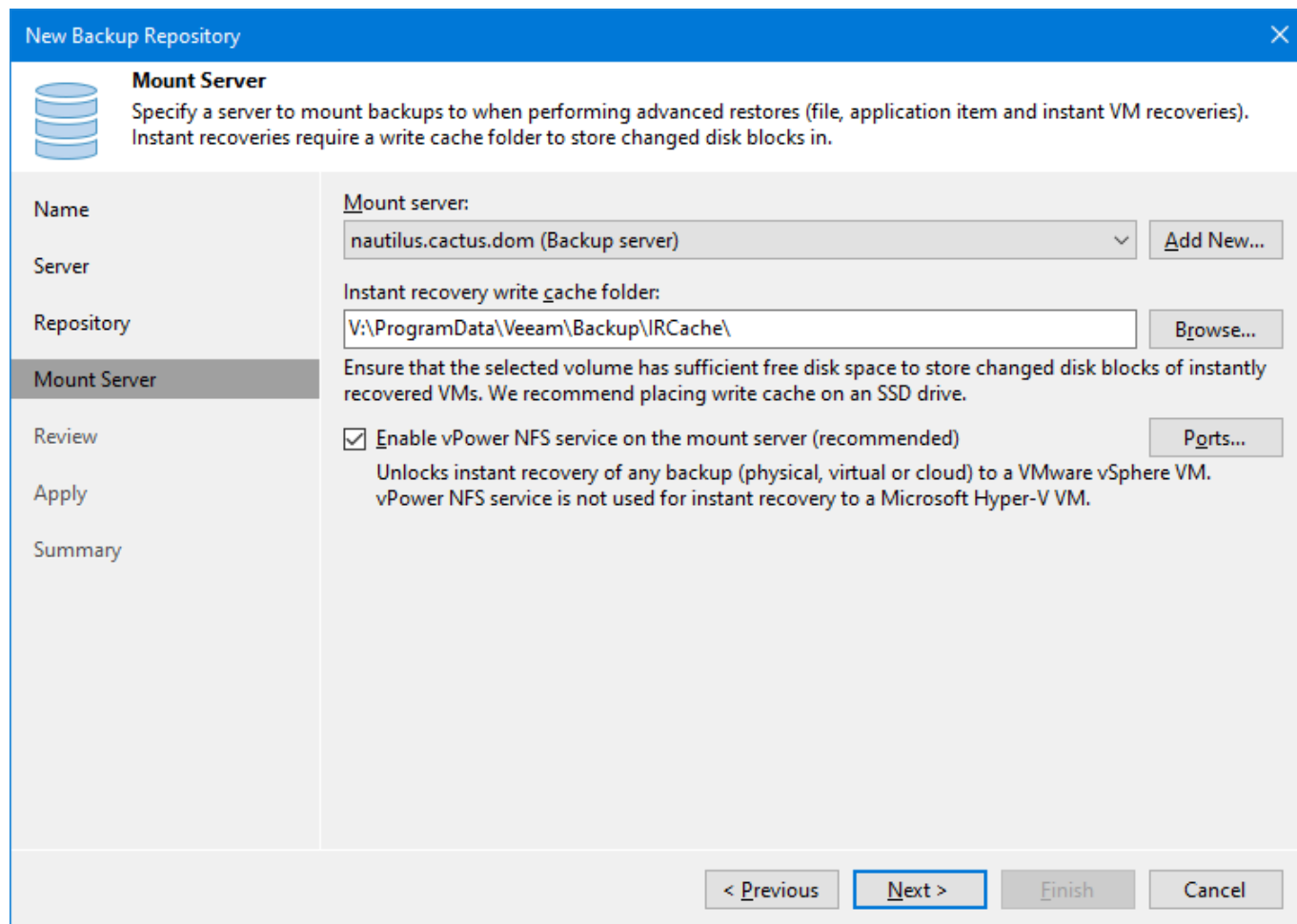
Do mark the two options (as shown above):

- Use fast cloning on XFS volumes (recommended)
- Make recent backups immutable for 7 days

Here, **7** is the default and the minimum value. You may wish to use a longer period, though that may consume a lot of space.

The settings under *Advanced* should be left as is.

Click *Next*, and Veeam will check if the XFS conditions are met. They should be, and the wizard will ask for a server to mount backups to when performing advanced restores:



The screenshot shows the 'New Backup Repository' wizard with the 'Mount Server' step selected. The wizard has a blue header bar with the title and a close button. On the left is a sidebar with steps: Name, Server, Repository, Mount Server (highlighted), Review, Apply, and Summary. The main area contains the following fields and options:

- Mount server:** A dropdown menu showing 'nautilus.cactus.dom (Backup server)' with an 'Add New...' button.
- Instant recovery write cache folder:** A text box containing 'V:\ProgramData\Veeam\Backup\IRCache\' with a 'Browse...' button.
- Enable vPower NFS service on the mount server (recommended):** A checkbox that is checked, with a 'Ports...' button.
- Instructions:** Text stating 'Ensure that the selected volume has sufficient free disk space to store changed disk blocks of instantly recovered VMs. We recommend placing write cache on an SSD drive.' and 'Unlocks instant recovery of any backup (physical, virtual or cloud) to a VMware vSphere VM. vPower NFS service is not used for instant recovery to a Microsoft Hyper-V VM.'

At the bottom are four buttons: '< Previous', 'Next >' (highlighted with a blue border), 'Finish', and 'Cancel'.


Leave the default values.

If you don't have VMware running, you can clear:

Enable vPower NFS service on the mount server.

Click *Next* to go to the *Review* pane listing the components needed:

New Backup Repository



Review

Please review the settings, and click Apply to continue.

Name

Server

Repository

Mount Server

Review

Apply

Summary

The following components will be processed on server nautilus.cactus.dom:

Component name	Status
Transport	already exists
vPower NFS	already exists
Mount Server	already exists

☐ Search the repository for existing backups and import them automatically

☐ Import guest file system index data to the catalog

< Previous


Apply

Finish

Cancel

Click *Apply*, and the install will run and finish shortly after:

New Backup Repository



Apply

Please wait while backup repository is created and saved in configuration, this may take a few minutes.

Name

Server

Repository

Mount Server

Review

Apply

Summary

Message	Duration
✓ Starting infrastructure item update process	0:00:02
✓ [nautilus] Discovering installed packages	
✓ [nautilus] Registering client NAUTILUS for package Transport	
✓ [nautilus] Registering client NAUTILUS for package vPower NFS	
✓ [nautilus] Registering client NAUTILUS for package Mount Server	
✓ [nautilus] Discovering installed packages	
✓ All required packages have been successfully installed	
✓ Detecting server configuration	
✓ Reconfiguring vPower NFS service	
✓ Creating configuration database records for installed packages	
✓ Collecting backup repository info	
✓ Checking write permissions for the repository folder...	
✓ Creating database records for repository	0:00:04
✓ Backup repository has been added successfully	

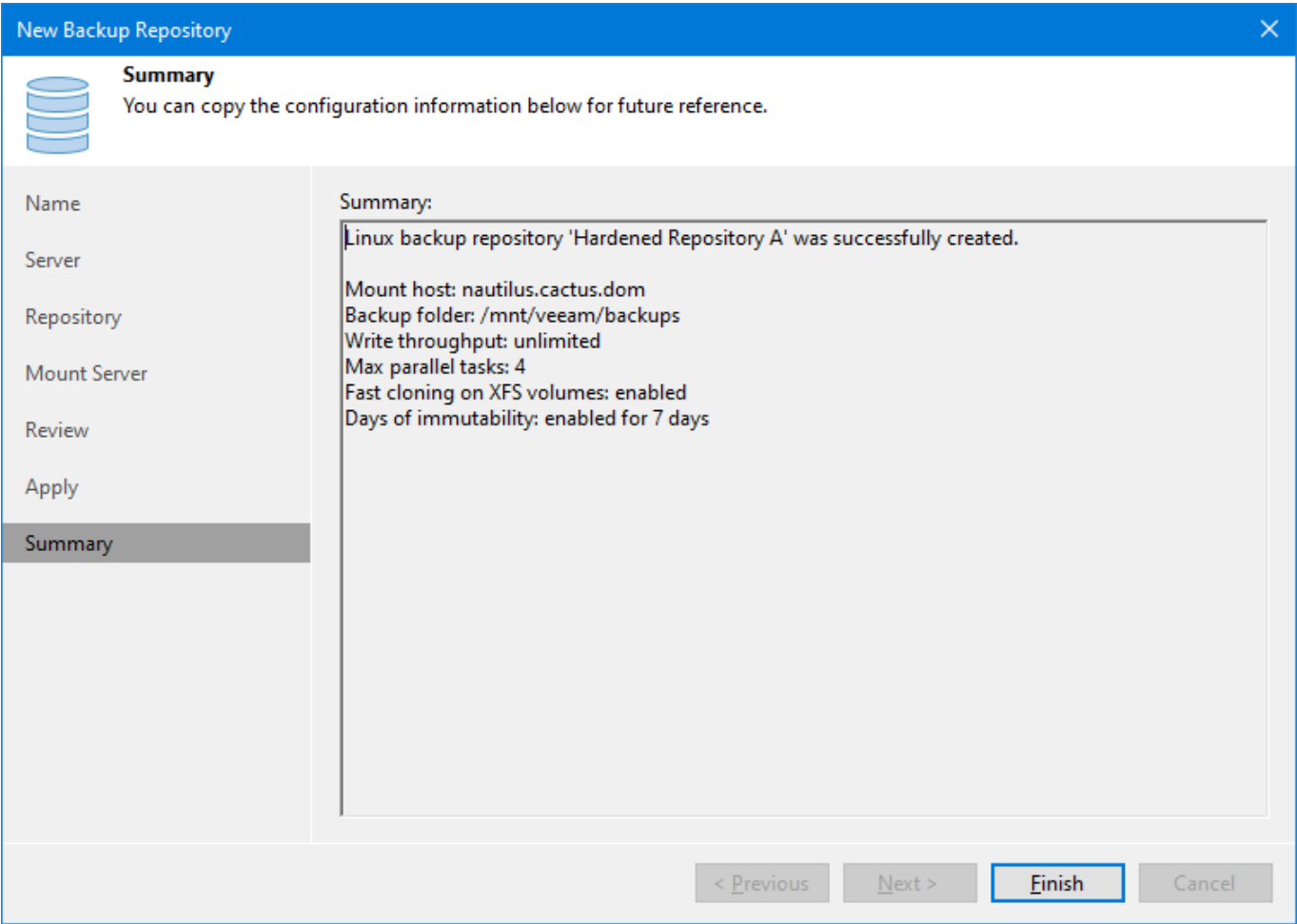
< Previous

Next >

Finish

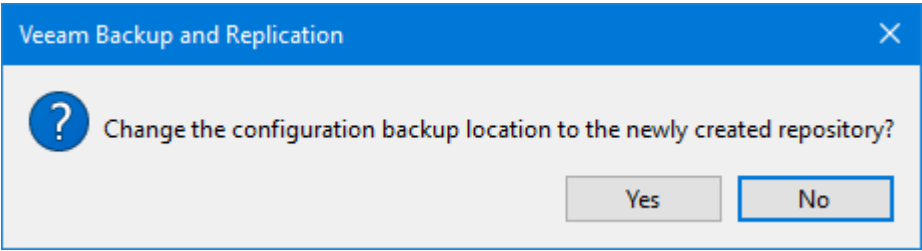
Cancel

Click *Next* to view the summary:



Click *Finish* to close the wizard.

A message box may pop up:



Click *No*.

Verify, that the hardened repository is listed among the other backup repositories you may have:

Type in an object name to search for							
Name	Type	Host	Path	Capa...	Free	Used Sp...	Description
Default Backup Repository	Windows	nautilus.cactus.dom	V:\Backup	9,1 TB	9 TB	51,3 GB	Created by Veeam Backup
Hardened Repository A	Linux	192.168.1.26	/mnt/veeam/backups	1,8 TB	1,8 TB	0 B	Linux immutable repository on vubuntum.

The hardened repository is now ready.

Demote the Veeam user account

This is an important step.

Remember, that we initially elevated the Veeam user account to allow it to install the Veeam components on the Linux server?

As these now have been installed, it is time to demote the account. Use this command to carry that out by removing the user account from the sudo group (*veeamuser* is the name of the Veeam user account):

```
sudo deluser veeamuser sudo
```

The command may indicate, that it will delete the account, but that is not the case; it will only *remove* it from the sudo group.

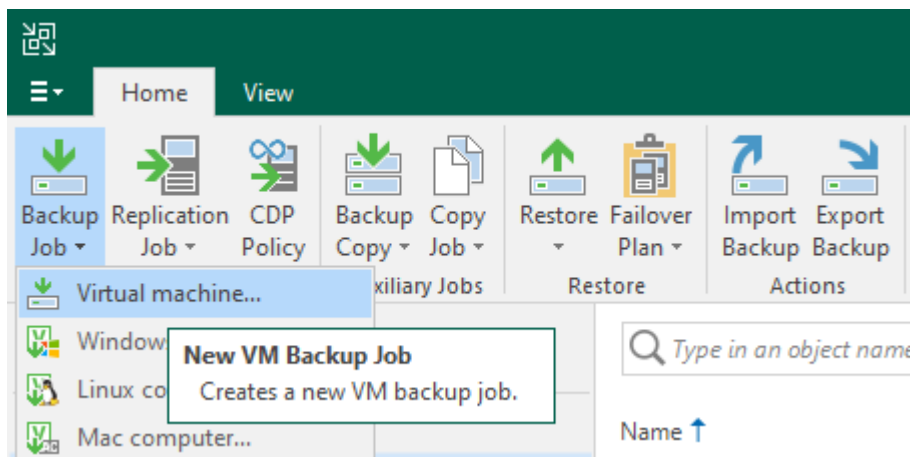
The response will be:

```
Removing user `veeamuser' from group `sudo' ...  
Done.
```

Check immutability

Let's create a small backup job to demonstrate the immutability.


In Veeam B&R Console, navigate to *Home* and click *Backup Job* in the band:



Select and click *Virtual machine ...* to open the wizard that will help you to configure the backup job.

Enter a meaningful *Name* and *Description* for the job:

New Backup Job



Name
Type in a name and description for this backup job.

Name

Virtual Machines

Storage

Guest Processing

Schedule

Summary

Name:

Media Linux Backup

Description:

Immutable backup of media

☐ High priority
Backup infrastructure resources are offered to high priority jobs first. Use this option for jobs sensitive to the start time, or jobs with strict RPO requirements.

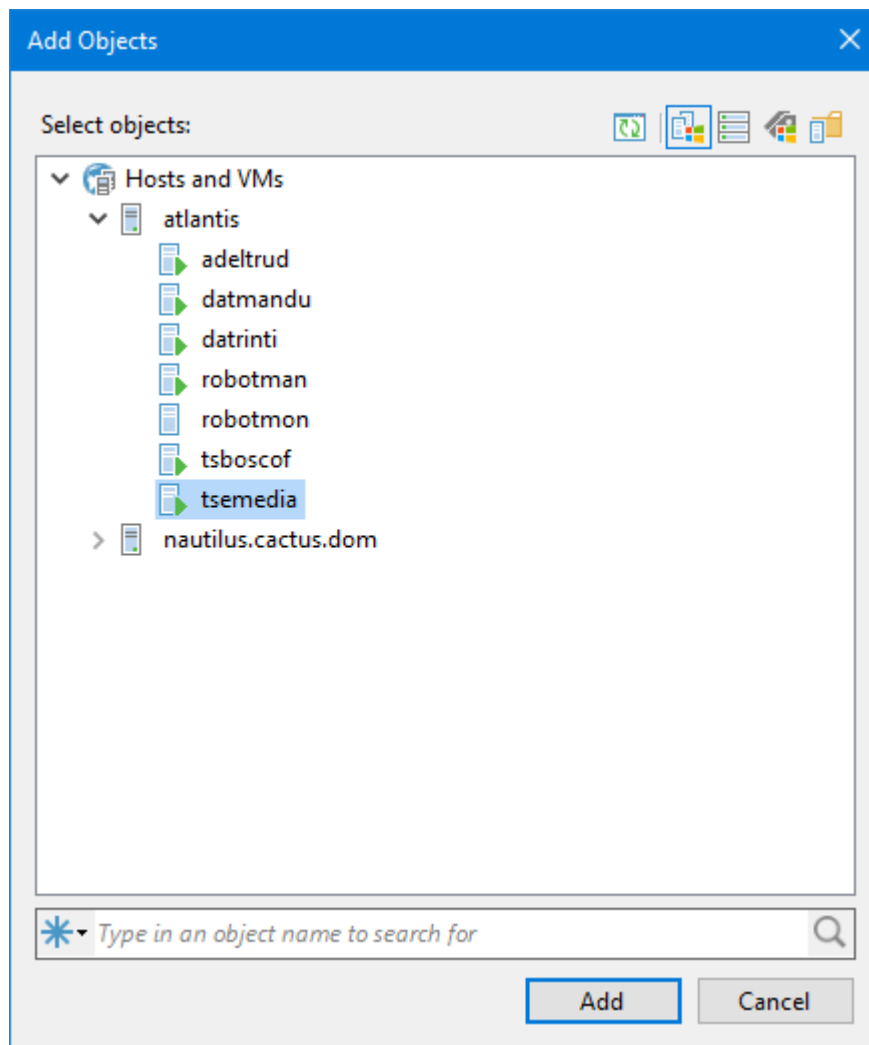
< Previous

Next >

Finish

Cancel

Click *Next* and, in the *Virtual Machines* pane, click *Add* to select a virtual machine to backup:



Select a machine and click *Add*. The machine will be listed for backup:

New Backup Job

Virtual Machines

Select virtual machines to process via container, or granularly. Container provides dynamic selection that automatically changes as you add new VM into container.

Name

Virtual Machines

Storage

Guest Processing

Schedule

Summary

Virtual machines to backup:

Name	Type	Size	
tsemedia	VM	39,3 GB	

Add...

Remove

Exclusions...

Up

Down

Recalculate

Total size:
39,3 GB

< Previous

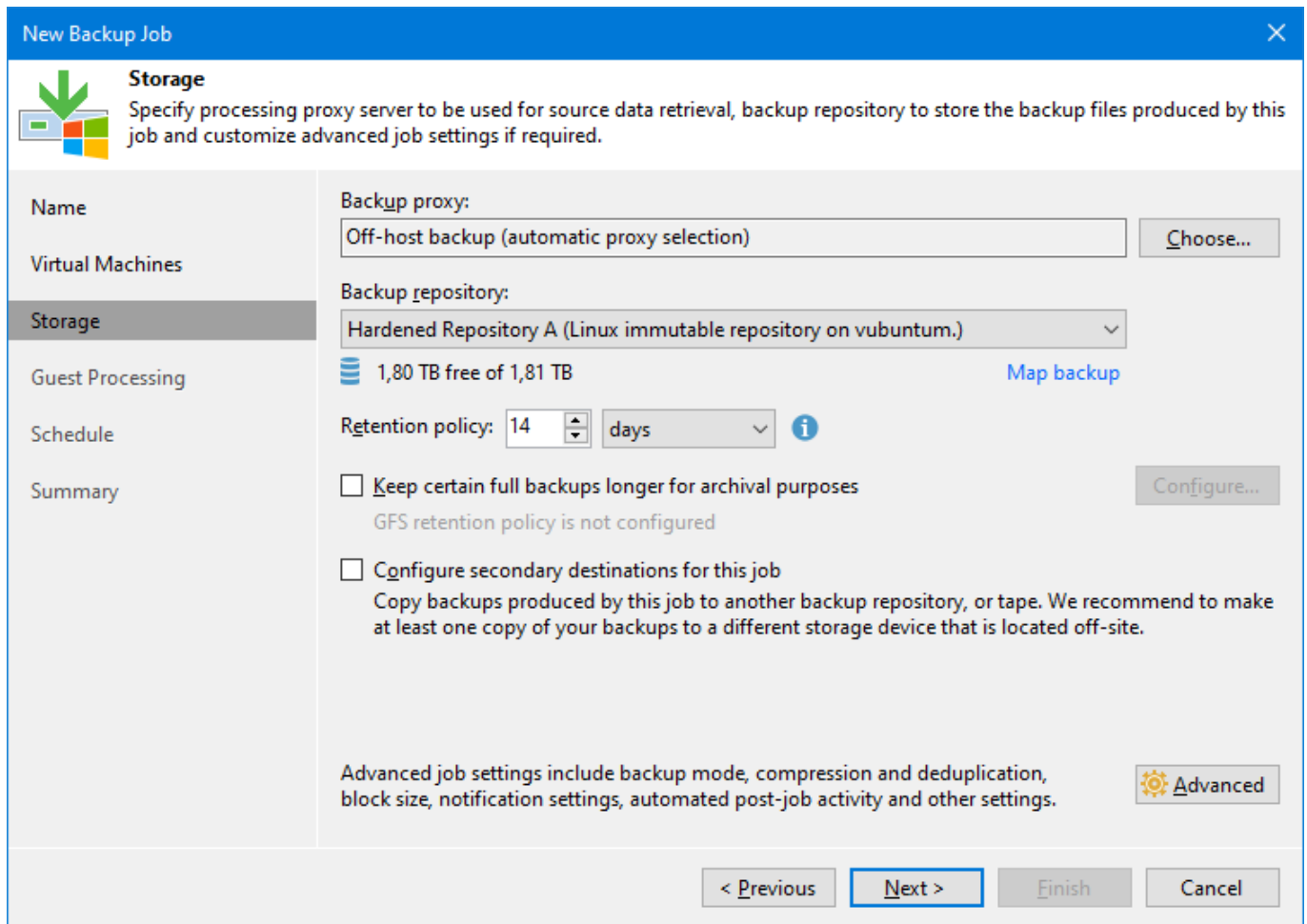
Next >

Finish

Cancel

Click *Next* to proceed to the *Storage* pane.

For *Backup repository*, select the hardened repository:



The screenshot shows the 'New Backup Job' wizard with the 'Storage' tab selected. The left sidebar contains links for Name, Virtual Machines, Storage (selected), Guest Processing, Schedule, and Summary. The main area is titled 'Storage' and includes a description: 'Specify processing proxy server to be used for source data retrieval, backup repository to store the backup files produced by this job and customize advanced job settings if required.' The configuration options are as follows:

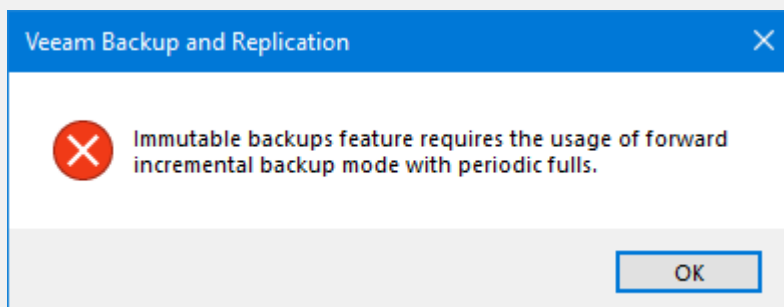
- Backup proxy:** A dropdown menu showing 'Off-host backup (automatic proxy selection)' with a 'Choose...' button.
- Backup repository:** A dropdown menu showing 'Hardened Repository A (Linux immutable repository on vubuntum.)' with a 'Map backup' link.
- Retention policy:** A numeric input set to '14' and a unit dropdown set to 'days', accompanied by an information icon.
- Advanced options:** Two checkboxes: 'Keep certain full backups longer for archival purposes' (with a 'Configure...' button and the note 'GFS retention policy is not configured') and 'Configure secondary destinations for this job' (with a note: 'Copy backups produced by this job to another backup repository, or tape. We recommend to make at least one copy of your backups to a different storage device that is located off-site.').
- Advanced settings:** A note at the bottom states: 'Advanced job settings include backup mode, compression and deduplication, block size, notification settings, automated post-job activity and other settings.' with an 'Advanced' button.

At the bottom of the wizard are four buttons: '< Previous', 'Next >' (highlighted), 'Finish', and 'Cancel'.

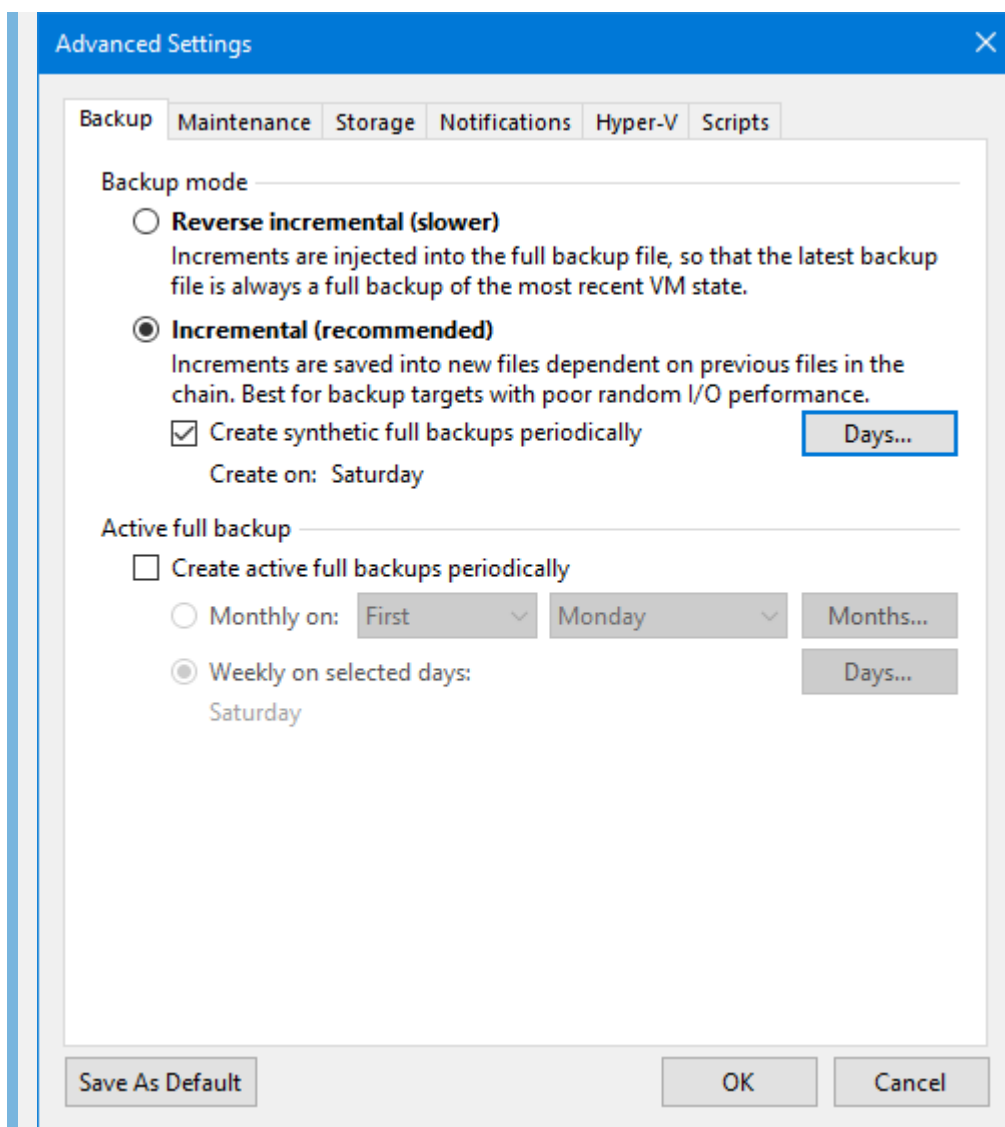
For testing, set *Retention policy* to a few days (not 14 as shown).

When ready, click *Next*.

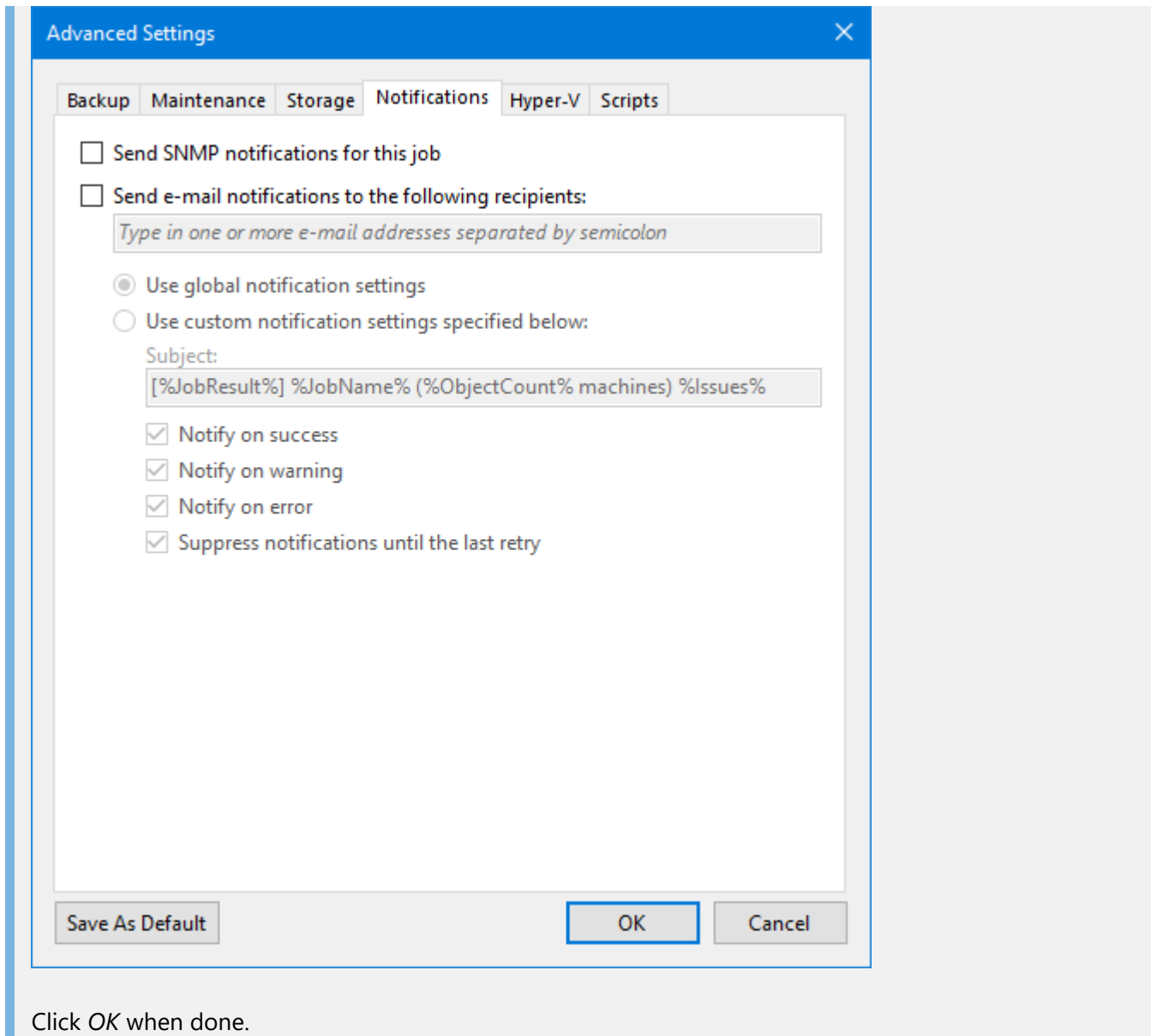
If this message pops up:



then click *OK* and then *Advanced* to open the settings for *Backup* and select **Incremental**:



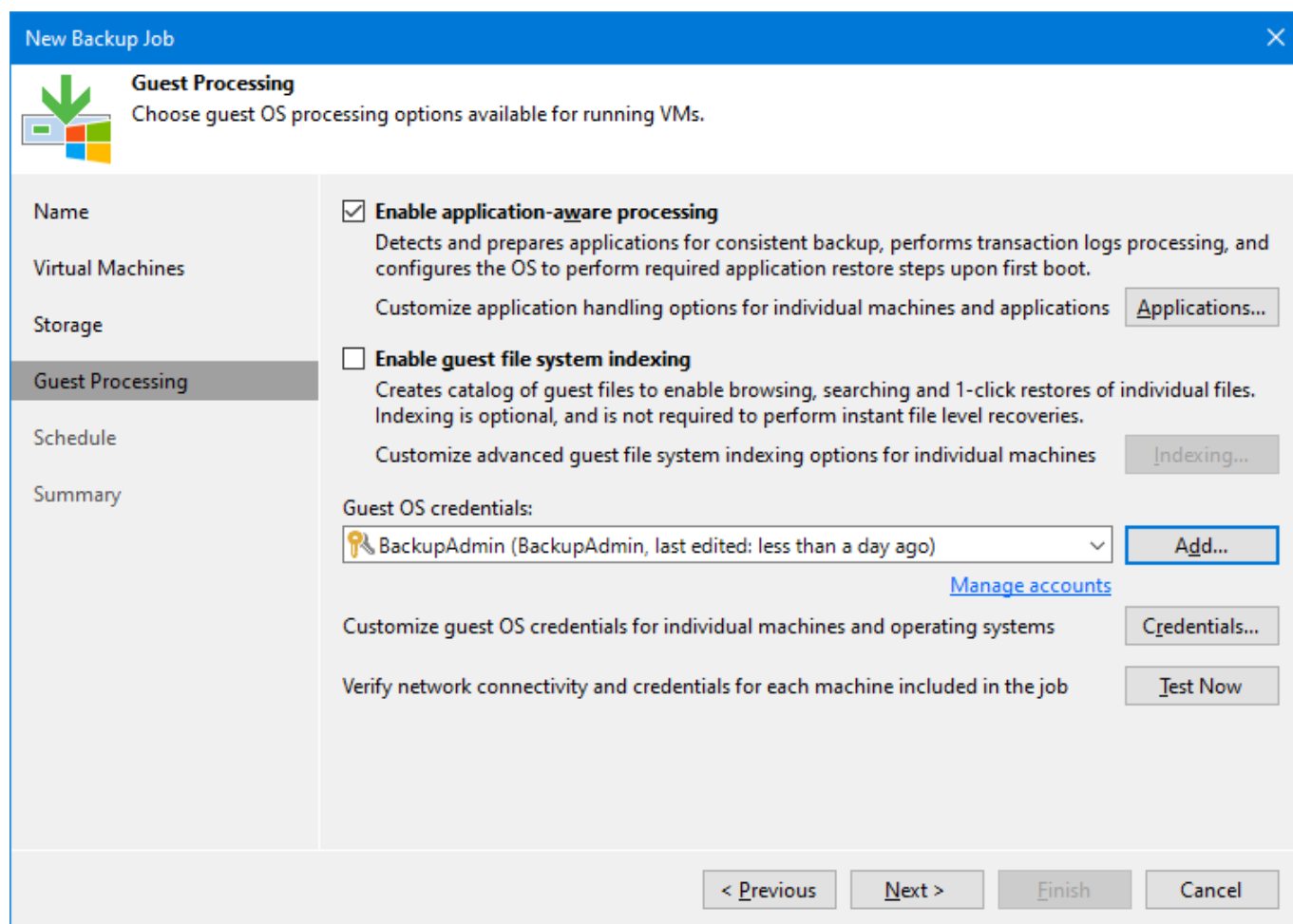
You may also adjust *Notifications* (if you don't, the default notification method will be used):



The screenshot shows a Windows-style dialog box titled "Advanced Settings" with a close button (X) in the top right corner. The dialog has several tabs: "Backup", "Maintenance", "Storage", "Notifications" (which is selected), "Hyper-V", and "Scripts". Inside the "Notifications" tab, there are two unchecked checkboxes: "Send SNMP notifications for this job" and "Send e-mail notifications to the following recipients:". Below the second checkbox is a text input field with the placeholder text "Type in one or more e-mail addresses separated by semicolon". There are two radio buttons: "Use global notification settings" (which is selected) and "Use custom notification settings specified below:". Below the radio buttons is a "Subject:" label followed by a text input field containing the placeholder text "[%JobResult%] %JobName% (%ObjectCount% machines) %Issues%". Below the subject field are four checked checkboxes: "Notify on success", "Notify on warning", "Notify on error", and "Suppress notifications until the last retry". At the bottom of the dialog are three buttons: "Save As Default", "OK" (which is highlighted with a blue border), and "Cancel".

Click OK when done.

Click *Next* to view *Guest Processing*:



The screenshot shows the 'New Backup Job' wizard with the 'Guest Processing' step selected. The left sidebar contains links for Name, Virtual Machines, Storage, Guest Processing (highlighted), Schedule, and Summary. The main area is titled 'Guest Processing' with the subtitle 'Choose guest OS processing options available for running VMs.' It features two checkboxes: 'Enable application-aware processing' (checked) and 'Enable guest file system indexing' (unchecked). Below these are buttons for 'Applications...', 'Indexing...', and 'Add...' (next to a dropdown menu showing 'BackupAdmin (BackupAdmin, last edited: less than a day ago)'). There is also a 'Manage accounts' link, a 'Credentials...' button, and a 'Test Now' button. At the bottom are navigation buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

New Backup Job

Guest Processing
Choose guest OS processing options available for running VMs.

Name

Virtual Machines

Storage

Guest Processing

Schedule

Summary

☒ **Enable application-aware processing**
Detects and prepares applications for consistent backup, performs transaction logs processing, and configures the OS to perform required application restore steps upon first boot.
Customize application handling options for individual machines and applications [Applications...](#)

☐ **Enable guest file system indexing**
Creates catalog of guest files to enable browsing, searching and 1-click restores of individual files. Indexing is optional, and is not required to perform instant file level recoveries.
Customize advanced guest file system indexing options for individual machines [Indexing...](#)

Guest OS credentials:
[BackupAdmin \(BackupAdmin, last edited: less than a day ago\)](#) [Add...](#)
[Manage accounts](#)

Customize guest OS credentials for individual machines and operating systems [Credentials...](#)


Verify network connectivity and credentials for each machine included in the job [Test Now](#)

< Previous Next > Finish Cancel

If you mark *Enable application-aware processing*, an account must be selected.

Click *Next* to adjust the *Schedule* for the job:

New Backup Job



Schedule

Specify the job scheduling options. If you do not set the schedule, the job will need to be controlled manually.

Name

Virtual Machines

Storage

Guest Processing

Schedule

Summary

☒ Run the job automatically

☒ Daily at this time: 22:00 Everyday Days...

☐ Monthly at this time: 22:00 Fourth Saturday Months...

☐ Periodically every: 1 Hours Schedule...

☐ After this job: NAUTILUS System (Created by CACTUS\cactus at 18-09-2021 11:24.)

Automatic retry

☒ Retry failed items processing: 3 times

Wait before each retry attempt for: 10 minutes

Backup window

☐ Terminate job if it exceeds allowed backup window

If the job does not complete within allocated backup window, it will be terminated to prevent snapshot commit during production hours.

Window...

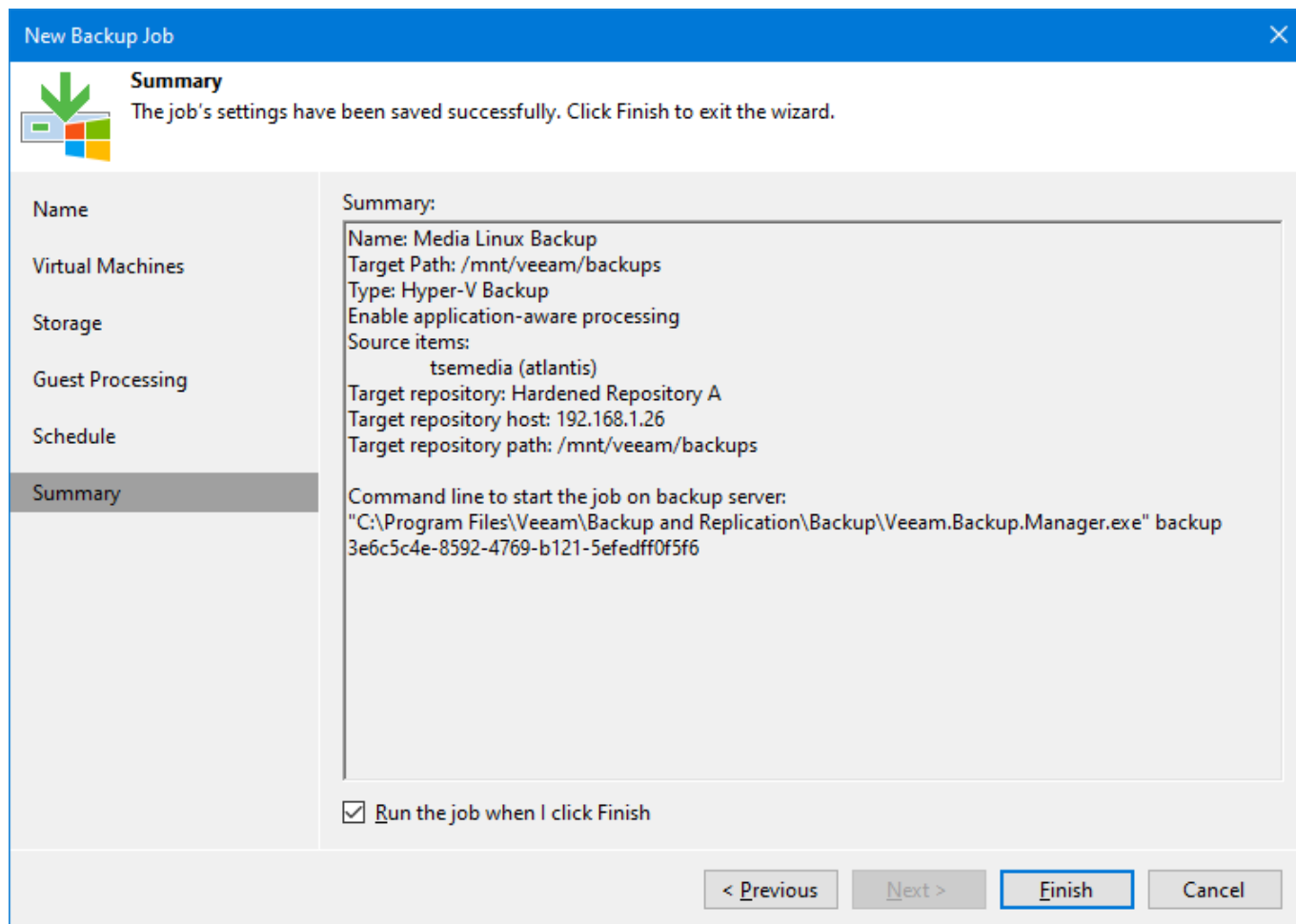
< Previous

Apply

Finish


Cancel

When ready, click *Apply* and the *Summary* will be displayed:



The screenshot shows the 'New Backup Job' wizard in Veeam Backup & Replication. The 'Summary' step is selected in the left-hand navigation pane. The main area displays a summary of the job settings, including the name 'Media Linux Backup', target path '/mnt/veeam/backups', and type 'Hyper-V Backup'. It also lists source items and target repository details. A checkbox labeled 'Run the job when I click Finish' is checked. At the bottom, there are buttons for '< Previous', 'Next >', 'Finish' (highlighted with a blue border), and 'Cancel'.

New Backup Job [X]

 **Summary**
The job's settings have been saved successfully. Click Finish to exit the wizard.

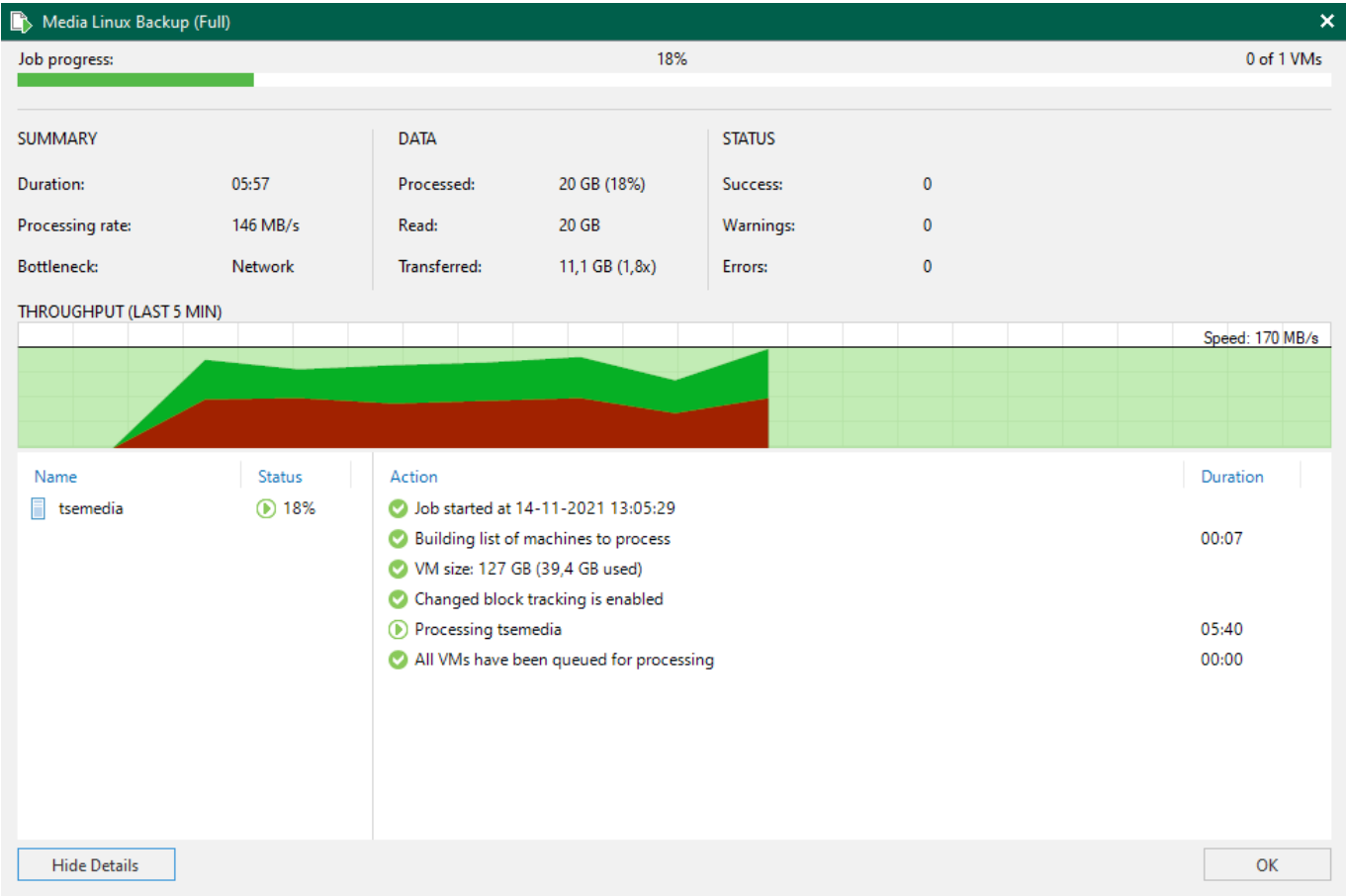
Summary:
Name: Media Linux Backup
Target Path: /mnt/veeam/backups
Type: Hyper-V Backup
Enable application-aware processing
Source items:
tsemedia (atlantis)
Target repository: Hardened Repository A
Target repository host: 192.168.1.26
Target repository path: /mnt/veeam/backups
Command line to start the job on backup server:
"C:\Program Files\Veeam\Backup and Replication\Backup\Veeam.Backup.Manager.exe" backup 3e6c5c4e-8592-4769-b121-5efedff0f5f6

☒ Run the job when I click Finish

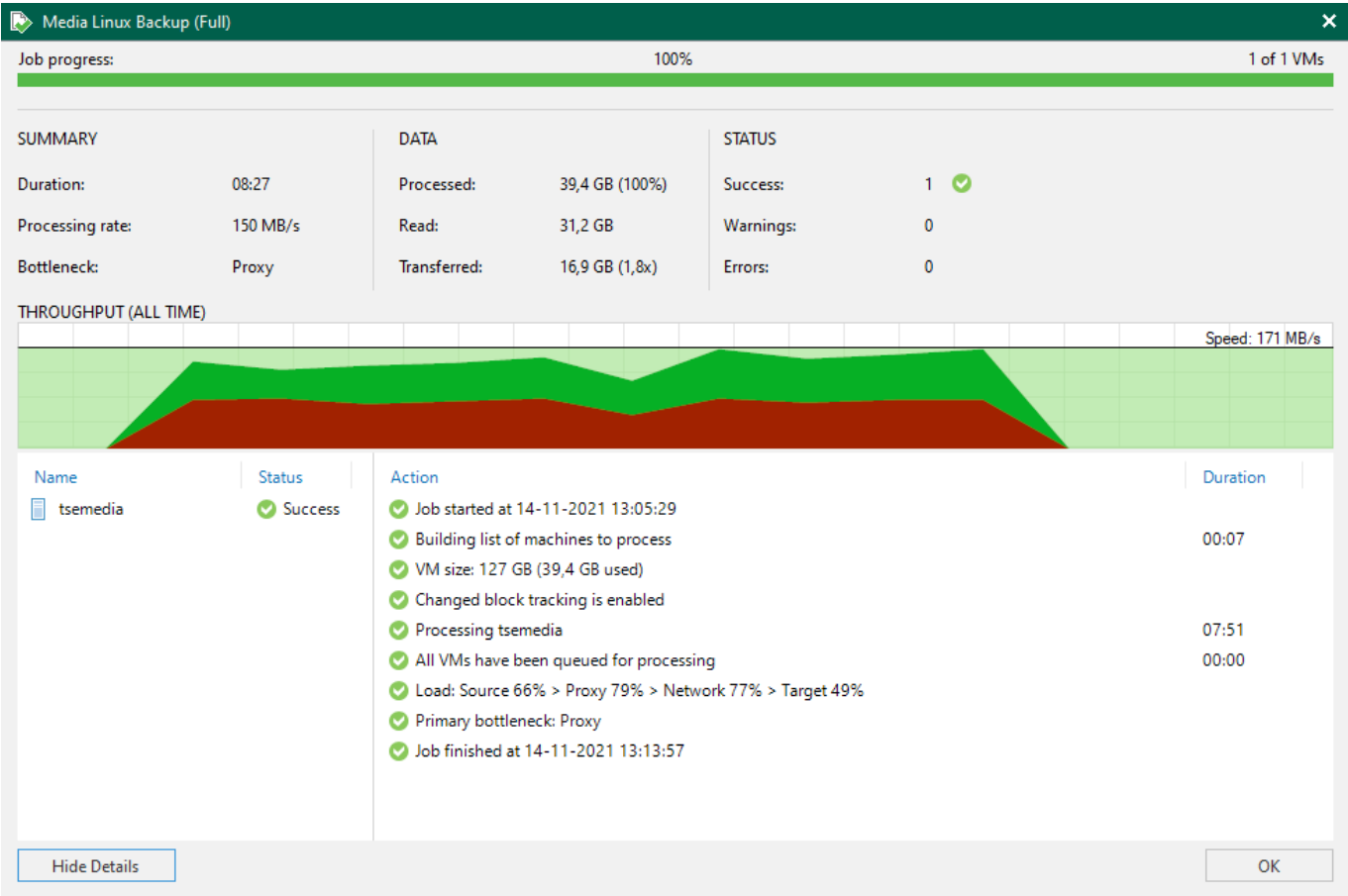
< Previous Next > **Finish** Cancel

Mark *Run the job when I click Finish*.

Click *Finish*, and the job will start:



and finish:

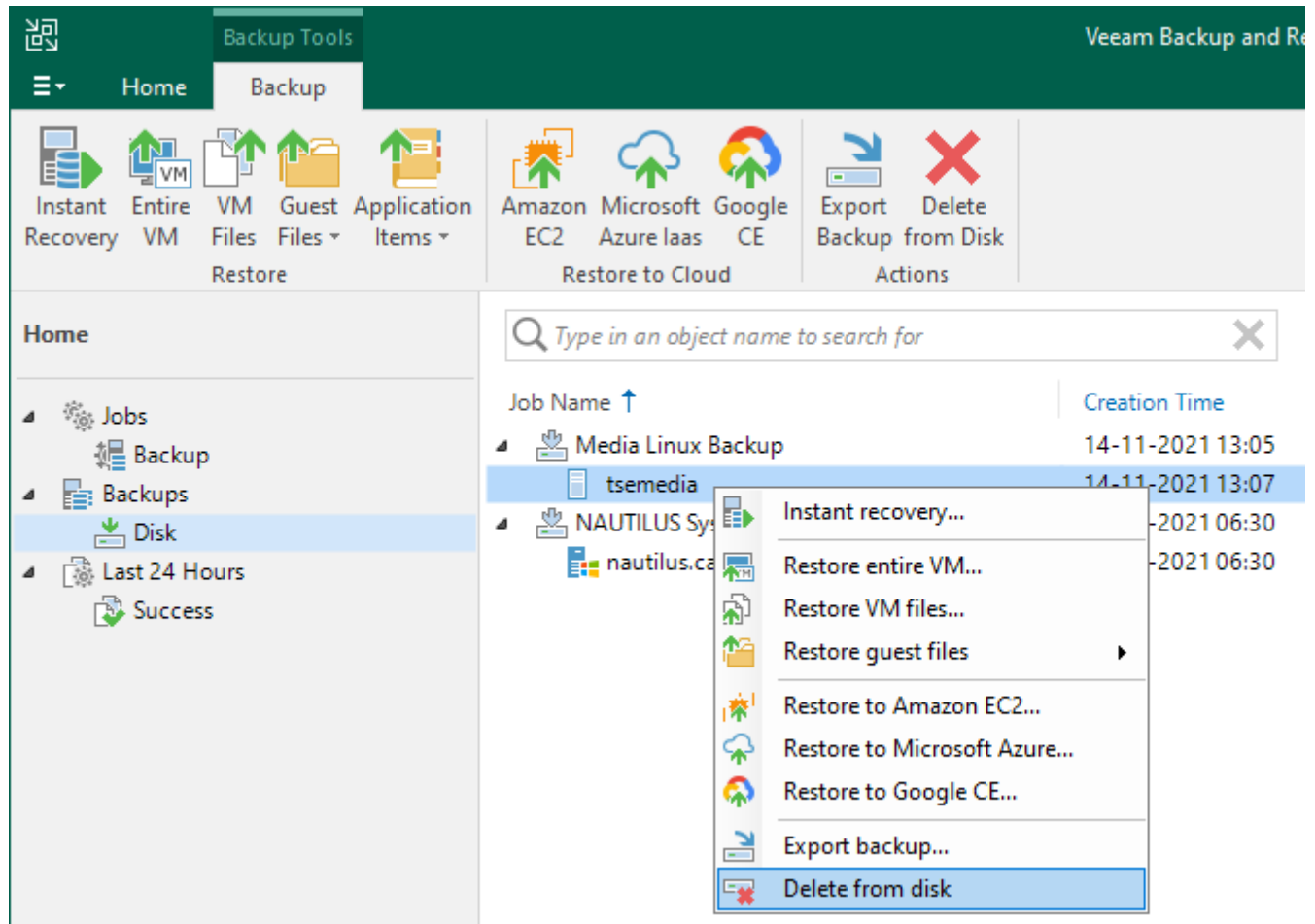


When *Status* reports *Success*, navigate to:

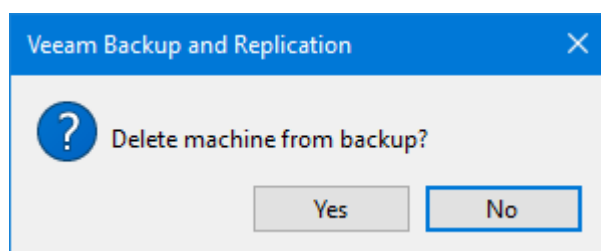
- Home
 - Backups
 - Disk

In the right pane, unfold the backup job, right-click the backup, and from the popup menu select:

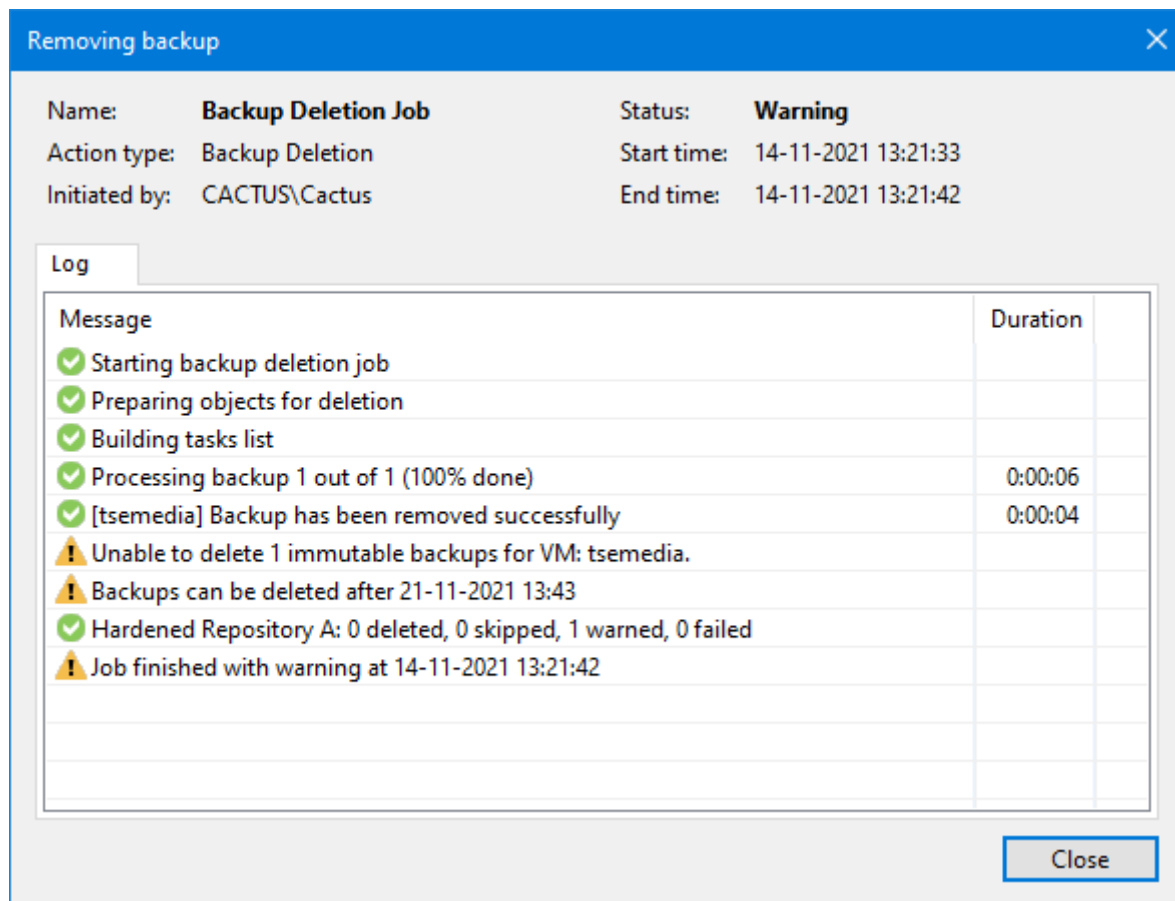
- Delete from disk



You will be prompted:



Click Yes and watch the progress of the deletion job and the warnings:



As you will see, the Linux server refused to delete the backup file at this moment. It also tells, at which time it will be possible to delete the file.

The hardened repository is ready.

Conclusion

The server has now proved its ability to host a backup and keep it immutable for a certain amount of days.

The only option to delete the backup file is to have physical access to the machine or to have the credentials for administrator.

However, you can tighten the security further by implementing MFA/2FA authentication making it impossible to login to the server having only the credentials. This we will establish in **Part 8** of this series:

[Build an immutable backup repository for Veeam Backup & Replication. Part 8](#)

Next step, however, is to establish *backup of the Linux server* itself. This we will arrange for in **Part 5** of this series:

[Build an immutable backup repository for Veeam Backup & Replication. Part 5](#)