



IN&OUT AG

**Interoperability Test Report between Huawei Storage
and 'Veeam Backup and Replication V12'**

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Preliminary Note

This report was created independently and neutrally by In&Out.

In&Out AG

In&Out AG from Zurich is supporting its customers as an independent and vendor-neutral consulting company in the areas of IT infrastructure and data centers for years. In&Out has proven years of experience in performance measurements and optimization and has developed the benchmark tool IOgen™.

Huawei

Founded in 1987, Huawei is a global leader in storage systems with 194,000 employees. Analysts rank Huawei as one of the leaders in storage systems.



Figure 1 - Gartner Magic Quadrant Primary Storage (2022), Source: Gartner

Veeam Backup & Replication V12

Veeam released on February 14, 2023, a new major release of their backup software suite Backup & Replication. This release allows backups directly to object storage, can create immutable and spaceless full backups. In this report we will test many of the new features in combination with the corresponding Huawei storage products and features

Huawei OceanStor Pacific Scale-Out Storage

Huawei OceanStor Pacific Scale-Out Storage systems are dedicated storage systems for unstructured data. The Huawei OceanStor Pacific series (formerly known as OceanStor 100D) is an intelligent Scale-Out Storage product with scale-out and supports the business needs of both today and tomorrow.

OceanStor Pacific series provides on-demand file, object, HDFS, and block storage for upper-layer applications by organizing local storage resources of each node with storage system software. It implements cost-effective storage for mass data, maximized efficiency for diversified data, and everlasting operations for online services. The OceanStor Pacific series is available with three characteristics: performance, balanced and archive models.

Huawei OceanProtect Backup Storage

Huawei OceanProtect Backup storage features rapid backup and rapid recovery, efficient reduction, and solid resilience, and helps to implement efficient backup and restoration and greatly reduce the TCO. It is widely used in government, financial, carrier, healthcare, and manufacturing industries. In addition, it offers easy-to-use management modes and convenient local/remote maintenance modes, significantly decreasing the management and maintenance costs.

Huawei OceanStor Hybrid Flash Storage

Huawei OceanStor Hybrid Flash storage systems offer comprehensive and superb solutions by using diverse efficiency boost mechanisms to provide industry-leading performance. Those solutions help customers maximize their return on investment (ROI) and meet the requirements of different application scenarios such as online transaction processing (OLTP), online analytical processing (OLAP), high-performance computing (HPC), server virtualization, and virtual desktop infrastructure (VDI).

Objective

To subject the new Veeam V12 Backup & Replication software in combination with suitable storage systems to an intensive test. In particular, the following points were to be tested:

- I. Backup and restore functionality with NAS service and object service of Huawei storage.
- II. Immutable backups using hardened repository which from Huawei storage.
- III. Immutable backups with the WORM feature of Huawei OceanStor Pacific.

All tests were run with Veeam Backup & Replication software version 12.

Management Summary

We can summarize the results of our measurements and tests as follows:

- I. The three tested Huawei storage systems which are OceanStor Hybrid Flash Storage, OceanProtect Backup Storage and OceanStor Pacific Scale-Out Storage can act as an NAS backup repository for Veeam V12.
- II. The Huawei OceanStor Hybrid Flash storage system was tested with a hardened repository for Veeam. Here also every backup and restore scenario was handled as usual. But it was not possible to delete any backup data written to the storage system, even on the Linux command line.
- III. The Huawei OceanStor Pacific Scale-Out Storage system was used as an S3 compatible backup repository. All backup and restore operations were handled as usual.
- IV. The Huawei OceanStor Pacific Scale-Out Storage system was used as an S3 compatible and immutable backup repository (WORM functionality). Also, all backups and restores run as usual. On the other side we were not able to delete one backup bucket from the Veeam side and from within an S3 browser tool.

The stability and behavior of the systems were always flawless in the test. We did not notice any failures or inexplicable performance fluctuations. The operation of the storage system is familiar to experienced Huawei storage administrators and easy even for users who are not familiar with the system.

Test Setup

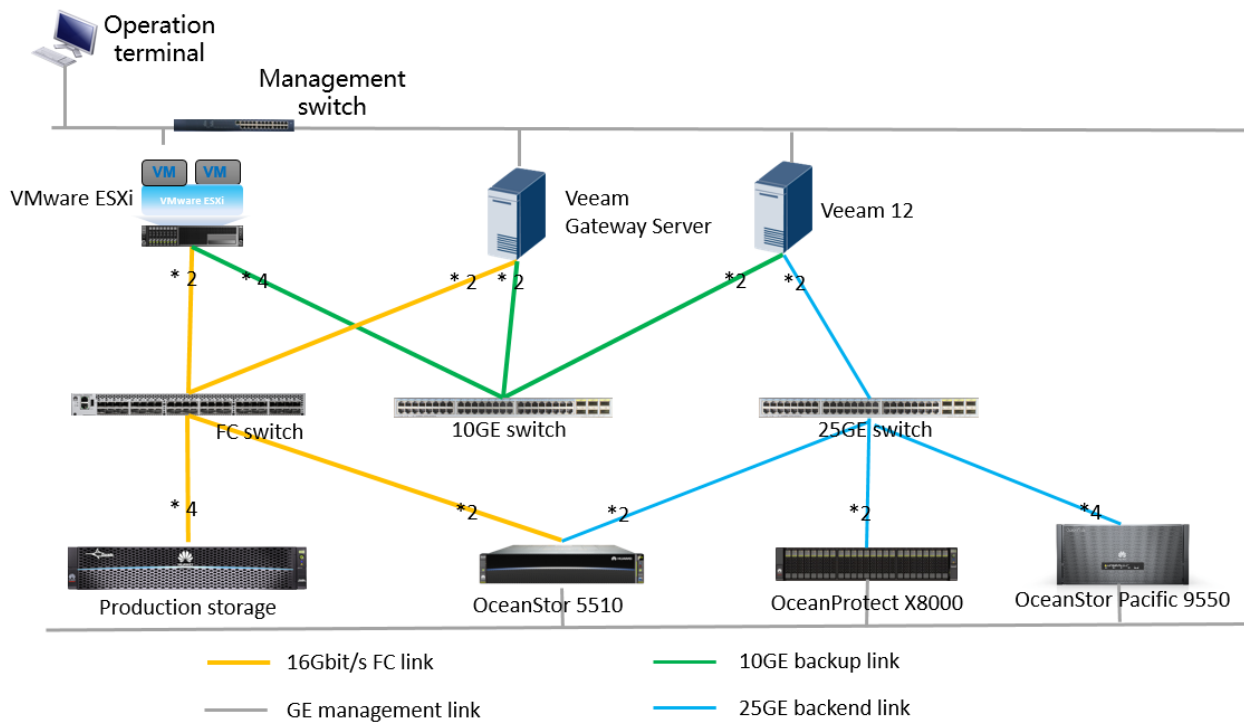


Figure 2 - Test setup (here using the example for Veeam)

Throughout the functional test one VM running on the VMware ESXi host, was backed up with several backup repositories which created with Huawei storage NAS service and Object service.

The VMware ESXi host is connected to the backup network with 4 network ports, each with 10 Gbit/sec (green in the Figure).

The backup server is connected to the storage switch via two 25 Gbit/sec connections each. The Huawei OceanStor 5510 and OceanProtect X8000 storage systems are connected by two 25Gbit/sec connections to the backup switch. The OceanStor Pacific has four 25Gbit/sec connections to the backup switch.

In detail, the following hardware was used for the test setup:

Device	Description	Quantity
ESXi	X86 server, CPU: 2 x Silver 4110, Storage: 2 x 16 Gbit/s FC-AL, Backup network: 4 x 10 Gbit/s	1
Backup server	X86 server, CPU: 2 x Gold 5120, backup network: 2 x 10 Gbit/s, backup storage: 2 x 25 Gbit/s	2
IP Switch	Huawei CE 6860 10GE Switch	1
IP Switch	Huawei CE 6863 25 GE Switch	1
FC Switch	Huawei SNS2248 16Gbps FC switch	1
Backup Storage	OceanProtect X8000 with two controllers, 20 x 7.68 TB SSD, 4 x 4-port 25GE Software version: 1.2.0	1
	OceanStor 5510 with two controllers, 3.84TB SSD*16, 2.4TB SAS *9, 2 x 4-port 25GE Software version: 6.1.5	1
	OceanStor Pacific 9550 with 4 nodes, 10TB NL_SAS * 144, 4 x 2-port 25GE Software version: 8.1.5	1

Table 1 - Hardware used

The following software products and versions were used:

Component	Description
CentOS Linux 7	Linux operating system, for clients
Windows Server	Veeam server, Version 2019
Veeam	Backup & Replication 12

Table 2 - Software used

Veeam Standard Backups and Restores

We tested all three Huawei storage as standard NAS protocol and S3 protocol:

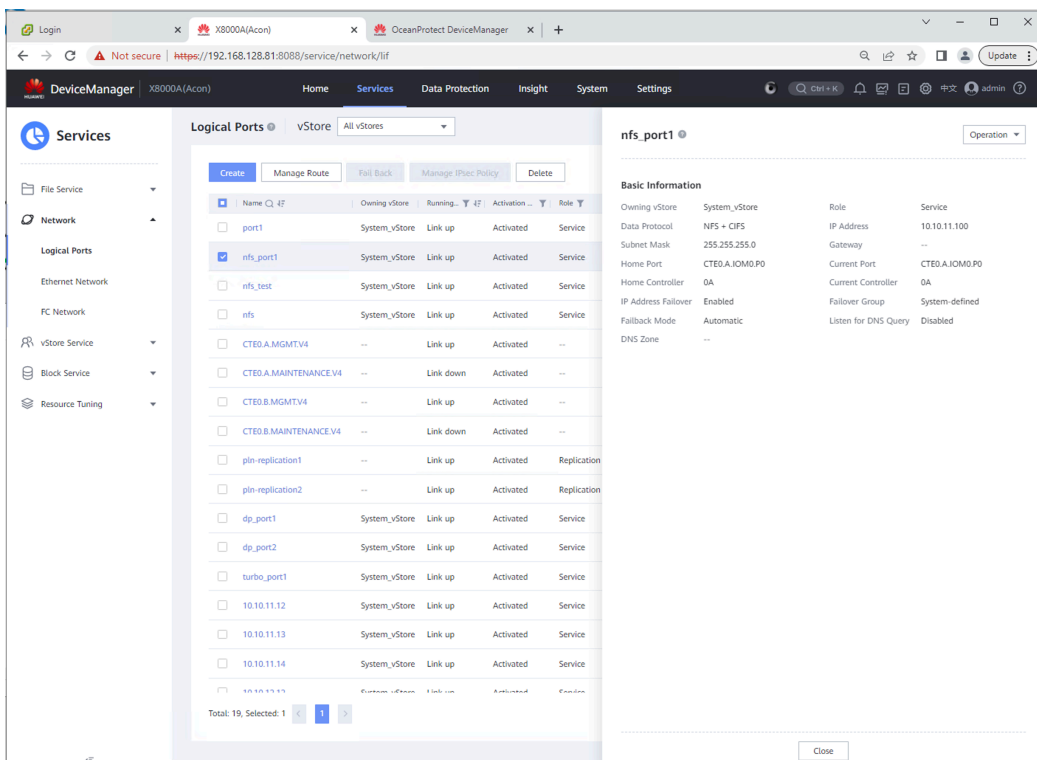
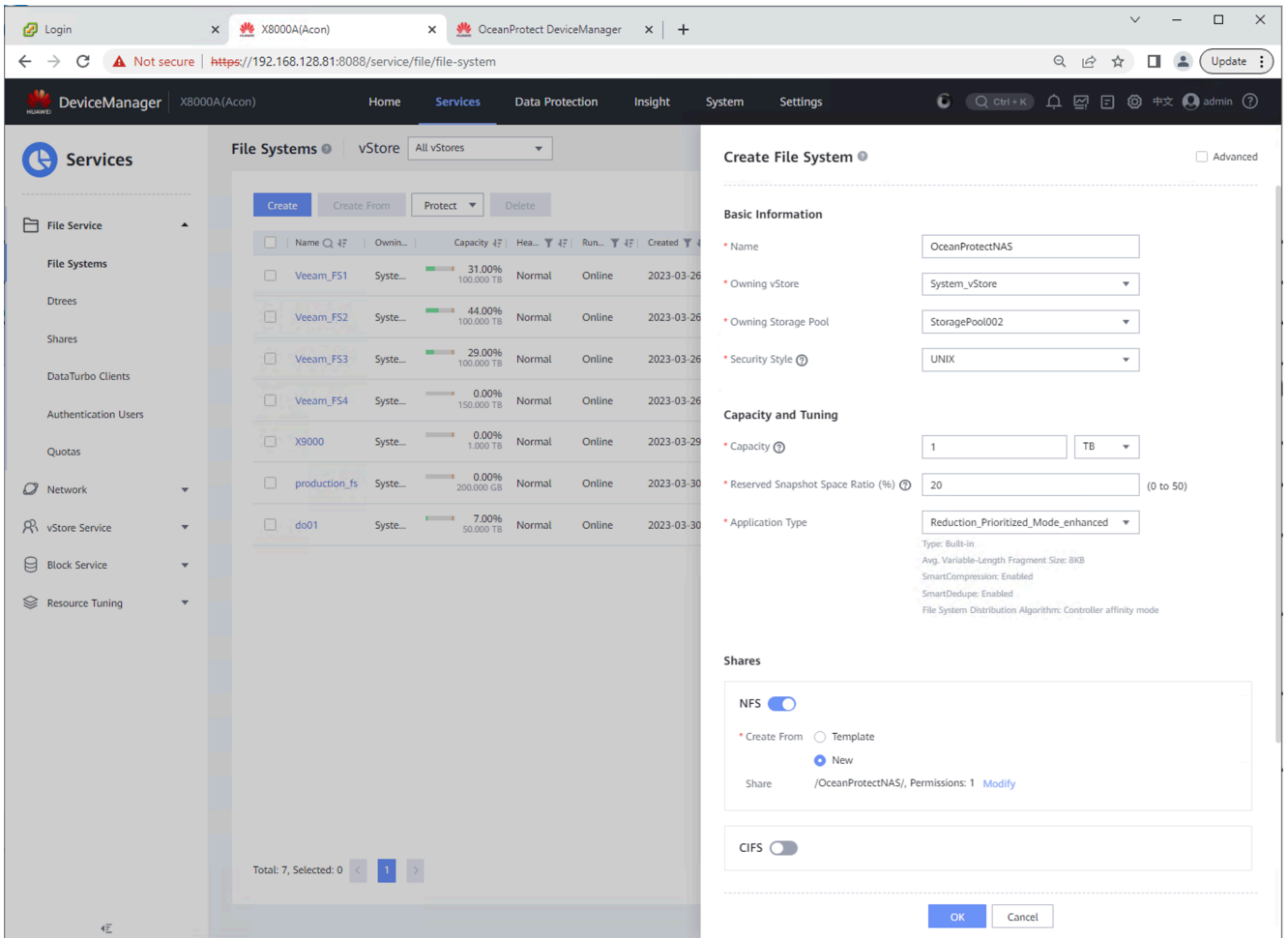
- I. OceanProtect X8000 with NAS share.
- II. OceanStor 5510 with NAS share.
- III. OceanStor Pacific 9550 with NAS share.
- IV. OceanStor Pacific 9550 with Object service.

All three Huawei storage systems were able to successfully perform backups and restores of VMware VMs. They can store the backup data of whole VMs as full and incremental backups.

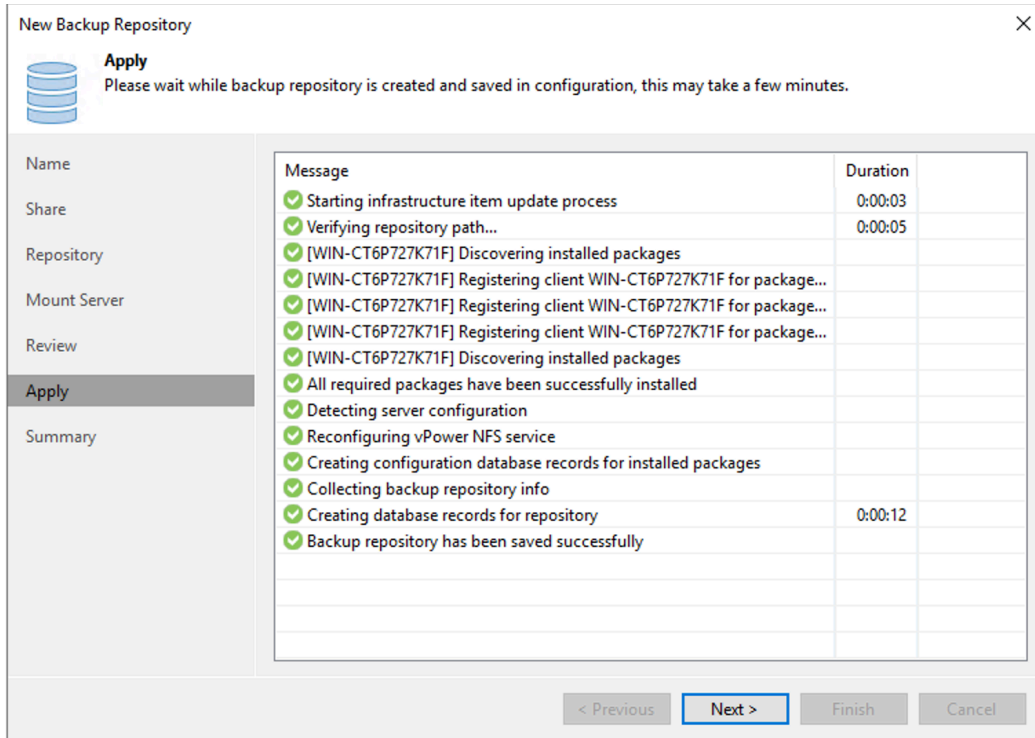
Veeam version 12 offers the feature to use an S3 or S3-compatible storage as backup storage. We tested this feature in combination with the OceanStor Pacific 9550. Also, more important than backups, all restores, whole VM and single file restores from full and incremental backups run successful with all three Huawei storage backup solutions.

Test 1 OceanProtect NAS service as the Backup Repository

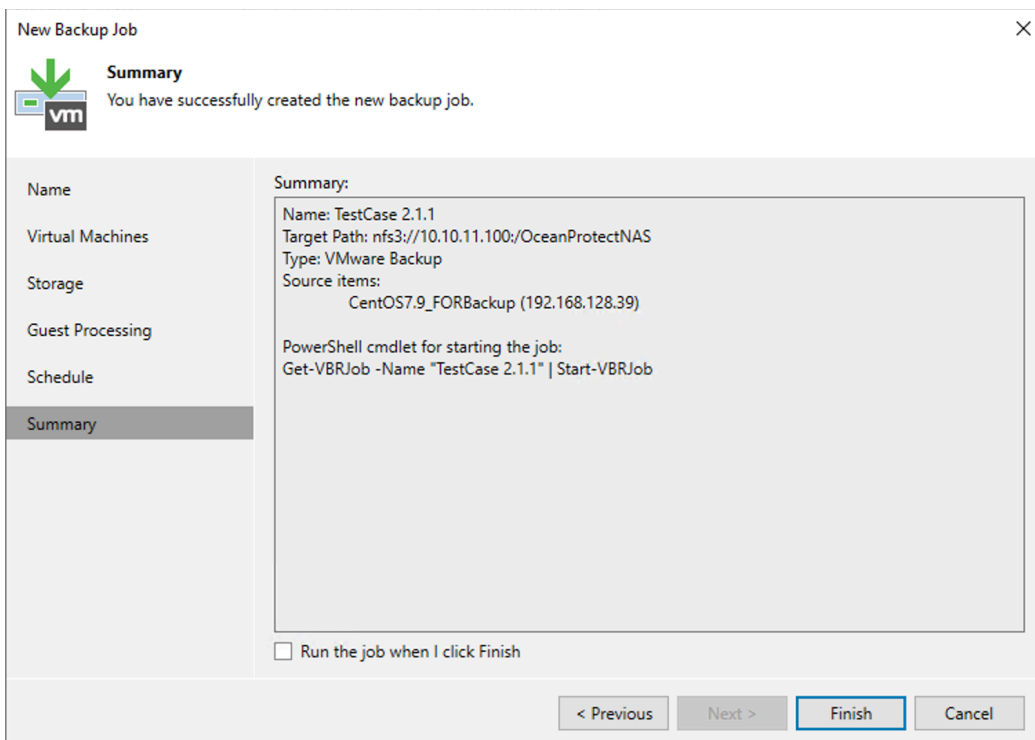
In the first test case we created one file system and one NFS share on the OceanProtect X8000.



Then, create one repository based on the NFS share of OceanProtect X8000.

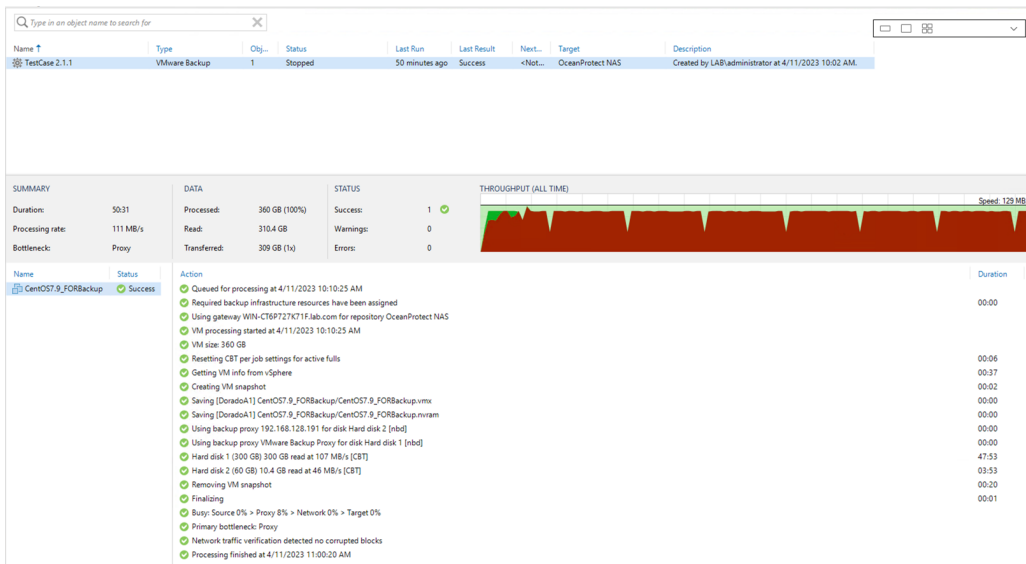


At last, create one new backup job for VM, the target path is the repository which created previous step.

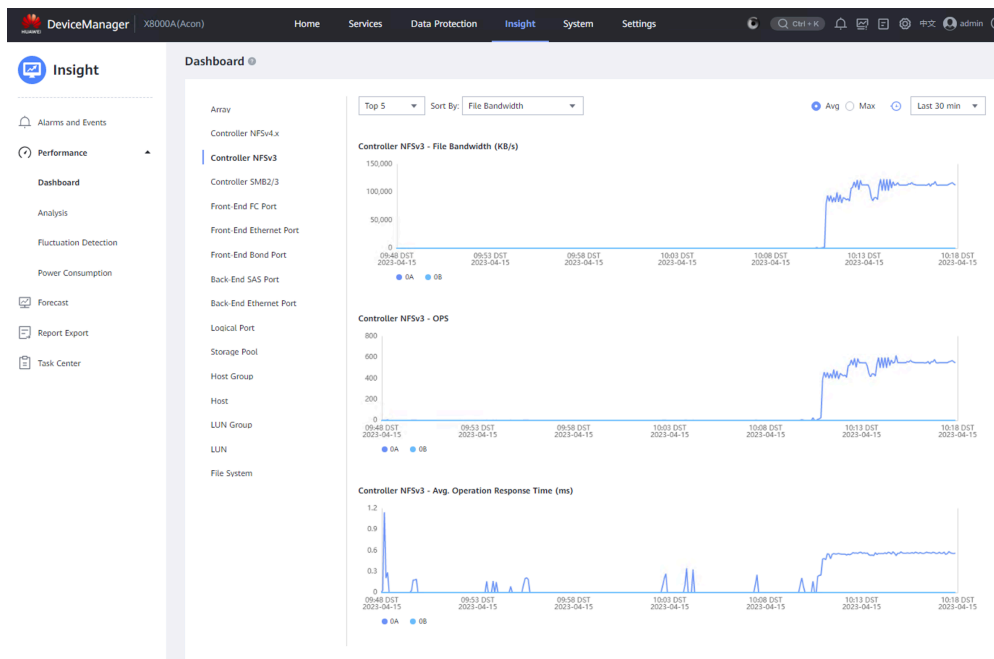


Test 1.1 Full backup

Start the new backup job and it executed successfully.



We can see, the performance metric OPS and bandwidth on OceanProtect have value and almost same with the Veeam 12.



Test 1.2 Incremental backup

Next step, copy 5 files to the directory of VM to simulate the incremental date.

```
[root@host141 vdbench50407]# ll /fs1
total 8
-rwxrwxrwx. 1 root root 68 Apr 11 13:19 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 11 13:20 vdb.1_1.dir
-rwxrwxrwx. 1 root root 176 Apr 11 13:20 vdb_control.file
[root@host141 vdbench50407]# ll /fs1/vdb.1_1.dir/
total 5242888
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0004.file
[root@host141 vdbench50407]#
```

Then start the incremental backup and it executed successfully too.

SUMMARY		DATA	STATUS	THROUGHPUT (ALL TIME)	
Duration:	03:33	Processed:	360 GB (100%)	Success:	1
Processing rate:	517 MB/s	Read:	5 GB	Warnings:	0
Bottleneck:	Target	Transferred:	1.0 GB (2.8s)	Errors:	0

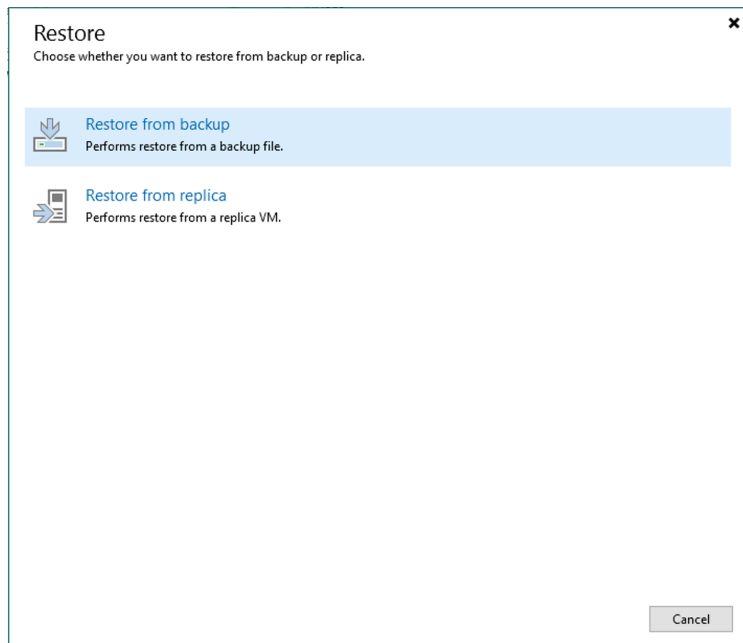
Name	Status	Action	Duration
CentOS7_9_FORBackup	Success	Queued for processing at 4/11/2023 11:06:01 AM	
		Required backup infrastructure resources have been assigned	00:00
		Using gateway WNN-CT6P727K7F1ab.com for repository OceanProtect NAS	
		VM processing started at 4/11/2023 11:06:04 AM	
		VM size 360 GB	
		Getting VM info from vSphere	00:49
		Creating VM snapshot	00:02
		Saving [DoradoA1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.vmx	00:00
		Saving [DoradoA1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.nvram	00:00
		Using backup proxy 192.168.128.183 for disk Hard disk 2 [Hotadd]	00:37
		Using backup proxy 192.168.128.183 for disk Hard disk 1 [Hotadd]	00:25
		Hard disk 1 (300 GB) 0 B read at 0 KB/s [CBT]	00:00
		Hard disk 2 (60 GB) 5 GB read at 676 MB/s [CBT]	00:07
		Removing VM snapshot	00:02
		Finalizing	00:00
		Busy: Source 0% > Proxy 24% > Network 0% > Target 81%	
		Primary bottleneck: Target	
		Network traffic verification detected no corrupted blocks	
		Processing finished at 4/11/2023 11:08:55 AM	

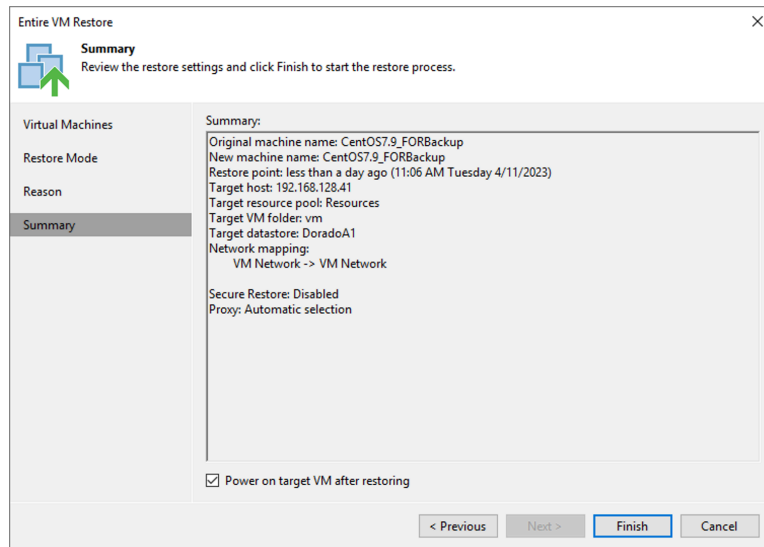
Test 1.3 Restore VM

Then we are trying to restore the VM from the backup data, so calculate the hash value of the 5 files and delete them.

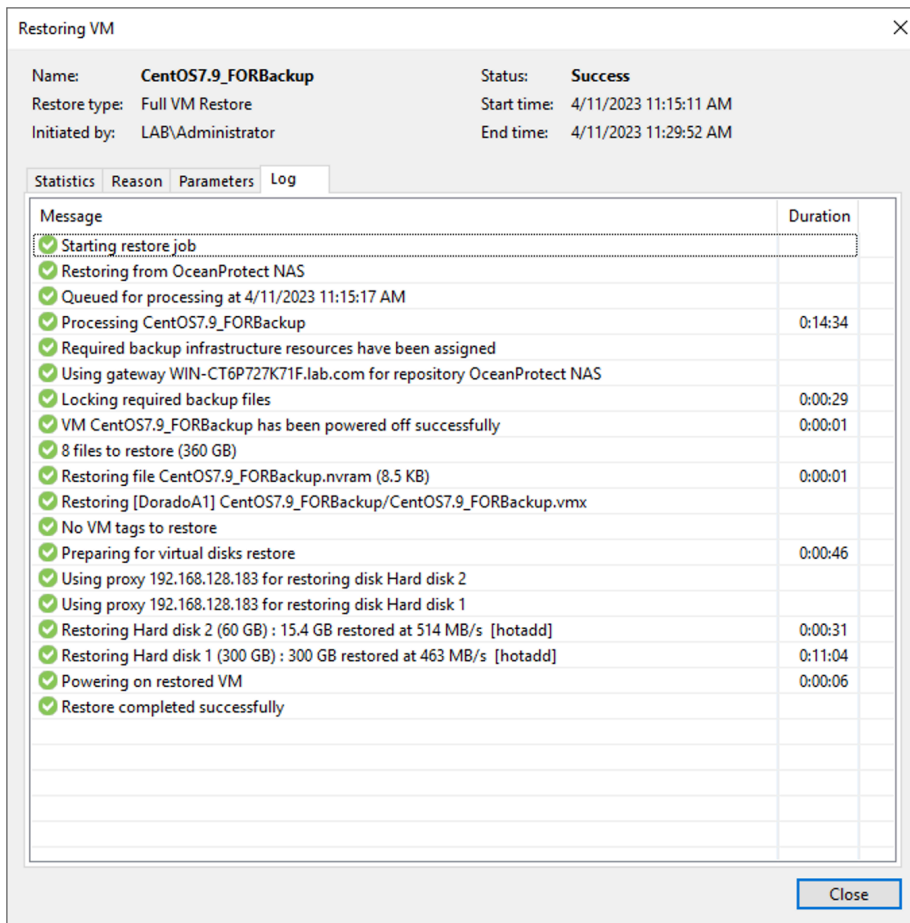
```
[root@host141 vdbench50407]# ll /fs1
total 8
-rwxrwxrwx. 1 root root 68 Apr 11 13:19 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 11 13:20 vdb_1_1.dir
-rwxrwxrwx. 1 root root 176 Apr 11 13:20 vdb_control.file
[root@host141 vdbench50407]# ll /fs1/vdb_1_1.dir/
total 5242888
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0004.file
[root@host141 vdbench50407]# sha256sum /fs1/vdb_1_1.dir/*
4ff79455c48b7c43209086a5cb1907a564fd3a7e25c1299a5f2ad753164ee51a /fs1/vdb_1_1.dir/vdb_f0000.file
cf0323c98f49874080a9b7e317d03ecbcb773b14f29a4784e7bbad5a31867c1 /fs1/vdb_1_1.dir/vdb_f0001.file
779504eaf25e58910f7b1e60ac4ce44671505dcfd5a17f3cb3d5da8508264b2a /fs1/vdb_1_1.dir/vdb_f0002.file
70860809b74f0f9e62f08cdca147c3f96da37871fc4815a84a794f6e2dc1604f /fs1/vdb_1_1.dir/vdb_f0003.file
da398a1e8ad4c6fa400b3c020dd7e6dc345828c7fec36b830ddf23032eb6a51a /fs1/vdb_1_1.dir/vdb_f0004.file
[root@host141 vdbench50407]#
[root@host141 vdbench50407]#
[root@host141 vdbench50407]# rm /fs1/vdb_1_1.dir/*
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0000.file'? z
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0004.file'? y
[root@host141 vdbench50407]# rm /fs1/vdb_1_1.dir/*
rm: remove regular file '/fs1/vdb_1_1.dir/vdb_f0000.file'? y
[root@host141 vdbench50407]# ll /fs1/vdb_1_1.dir/*
ls: cannot access '/fs1/vdb_1_1.dir/*': No such file or directory
[root@host141 vdbench50407]#
```

Start the restore from backup job after the files were deleted.





And the restore VM is completed and successes.



Check the hash value after the VM power on, and the value is the same with before for every file.

```

login as: root
root@192.168.128.141's password:
Access denied
root@192.168.128.141's password:
Last failed login: Tue Apr 11 13:47:38 CEST 2023 from 192.168.128.222 on ssh:notty
There was 1 failed login attempt since the last successful login.
Last login: Tue Apr 11 12:57:43 2023 from cell.lab.com
[root@host141 ~]# ll /fsl/vdb.1_1.dir/
total 5242888
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 vdb_f0004.file
[root@host141 ~]# sha256sum /fsl/vdb.1_1.dir/*
4ff79455c48b7c43209086a5cb1907a564fd3a7e25c1299a9f2ad753164ee51a /fsl/vdb.1_1.dir/vdb_f0000.file
cf0323c98f49874080a9b7e317d03ecbcb773b14f29a4784e7bbad5a31867c1 /fsl/vdb.1_1.dir/vdb_f0001.file
779504eaf225e58810f7b1e60ac4ce44671505dcfd5a17f3cb3d5da8508264b2a /fsl/vdb.1_1.dir/vdb_f0002.file
70860809b74f0f9e62f08cdda147c3f96da37871fc4815a84a794f6e2dc1604f /fsl/vdb.1_1.dir/vdb_f0003.file
da398ale8ad4c6fa400b8c020dd7e6dc345828c7fec36b830ddf23032eb6a51a /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
    
```

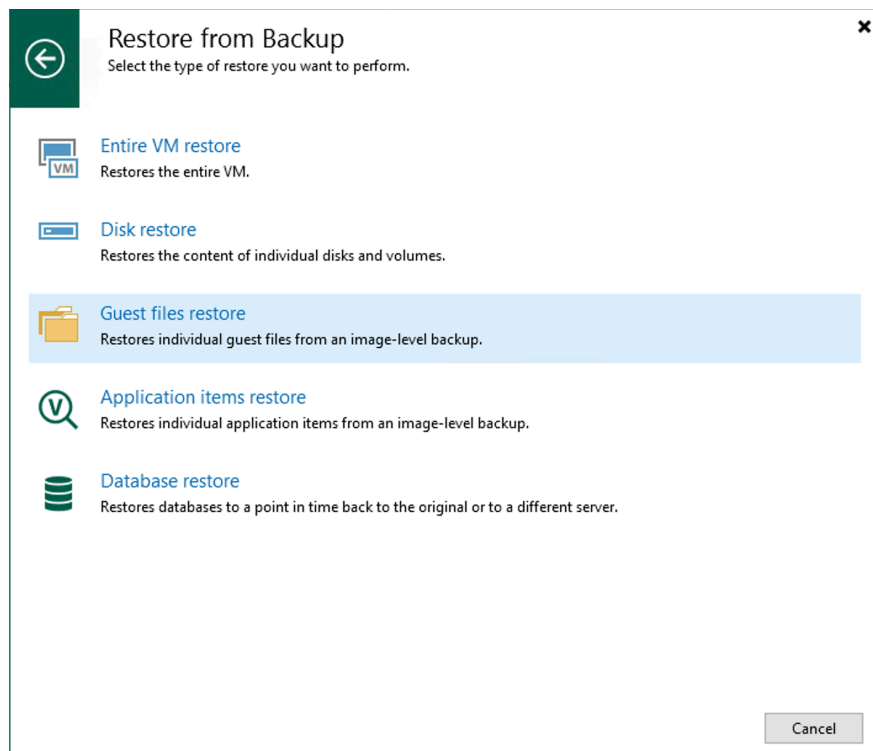
Test 1.4 Restore Guest-OS files

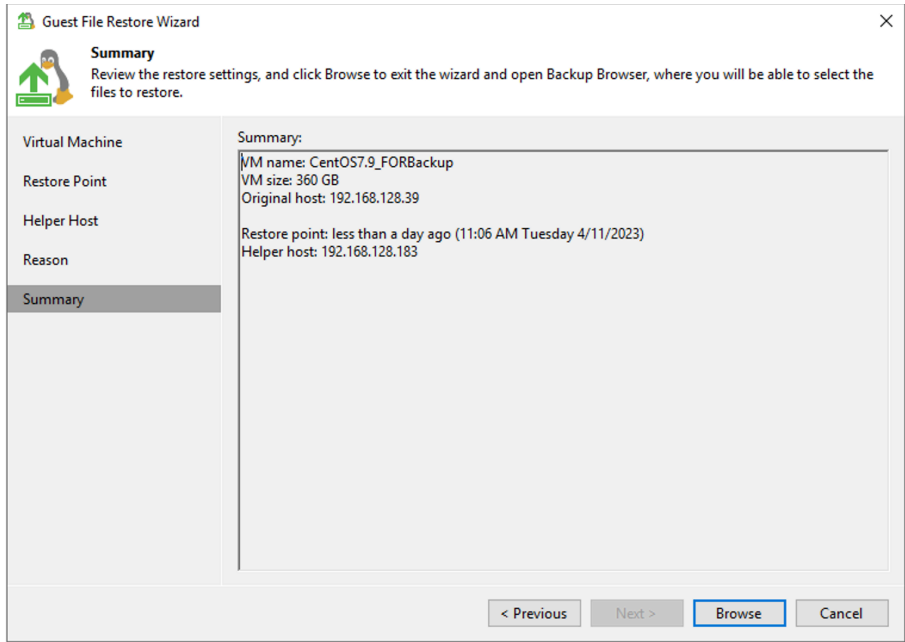
Then delete the files again, we are going to restore the files only.

```

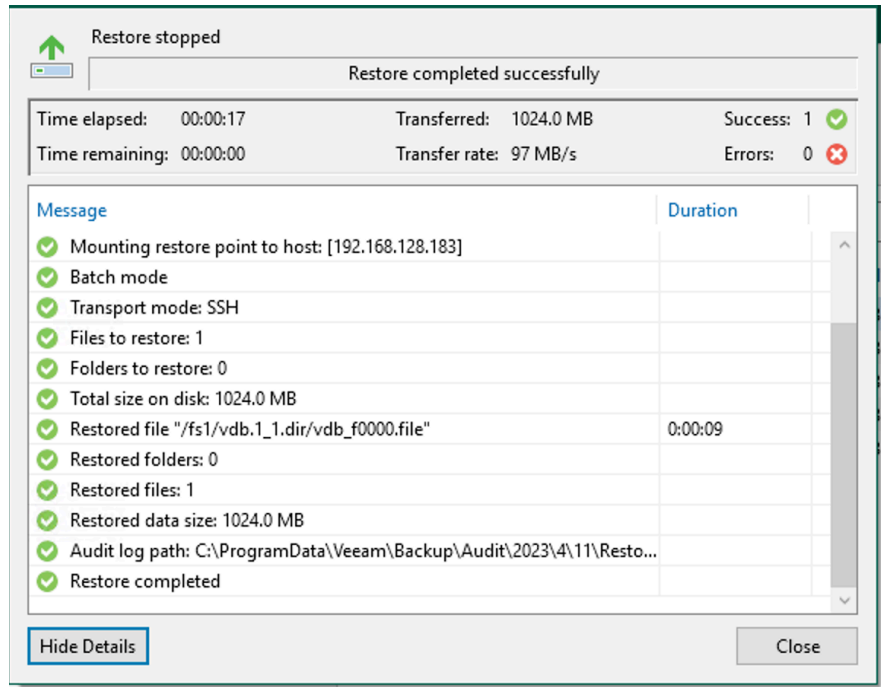
root@host141:~
[root@host141 ~]# sha256sum /fsl/vdb.1_1.dir/*
4ff79455c48b7c43209086a5cb1907a564fd3a7e25c1299a9f2ad753164ee51a /fsl/vdb.1_1.dir/vdb_f0000.file
cf0323c98f49874080a9b7e317d03ecbcb773b14f29a4784e7bbad5a31867c1 /fsl/vdb.1_1.dir/vdb_f0001.file
779504eaf225e58810f7b1e60ac4ce44671505dcfd5a17f3cb3d5da8508264b2a /fsl/vdb.1_1.dir/vdb_f0002.file
70860809b74f0f9e62f08cdda147c3f96da37871fc4815a84a794f6e2dc1604f /fsl/vdb.1_1.dir/vdb_f0003.file
da398ale8ad4c6fa400b8c020dd7e6dc345828c7fec36b830ddf23032eb6a51a /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# rm /fsl
fsl/ fsl01/ fsl02/
[root@host141 ~]# rm /fsl
fsl/ fsl01/ fsl02/
[root@host141 ~]# rm /fsl/vdb.1_1.dir/vdb_f0000.file
rm: remove regular file '/fsl/vdb.1_1.dir/vdb_f0000.file'? z
[root@host141 ~]# rm /fsl/vdb.1_1.dir/vdb_f0000.file
rm: remove regular file '/fsl/vdb.1_1.dir/vdb_f0000.file'? y
[root@host141 ~]#
[root@host141 ~]# ll /fsl/vdb.1_1.dir/vdb_f0000.file
ls: cannot access /fsl/vdb.1_1.dir/vdb_f0000.file: No such file or directory
[root@host141 ~]# ll /fsl/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
    
```

Start the guest files restore job.





And the files are restore completed and successes.

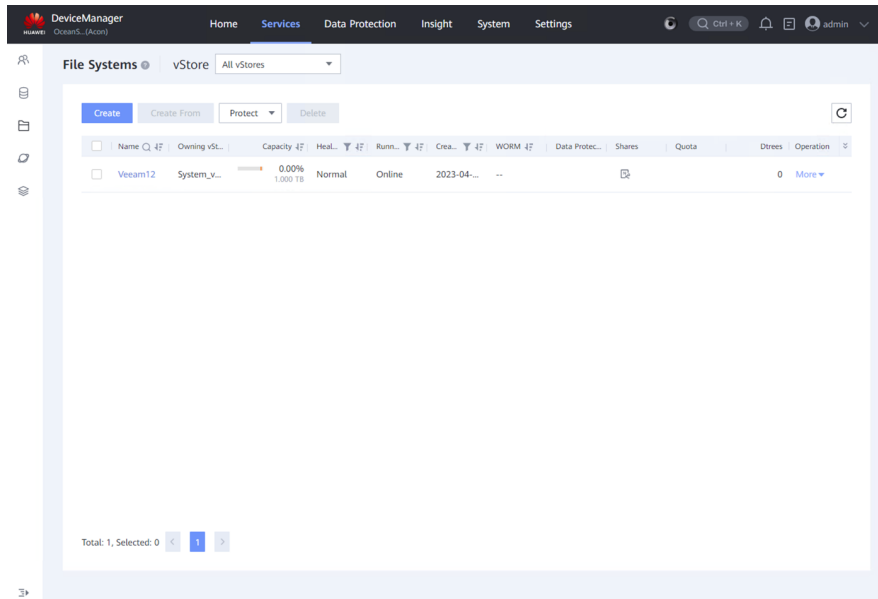


Check the hash value for each file, the value is the same with before.

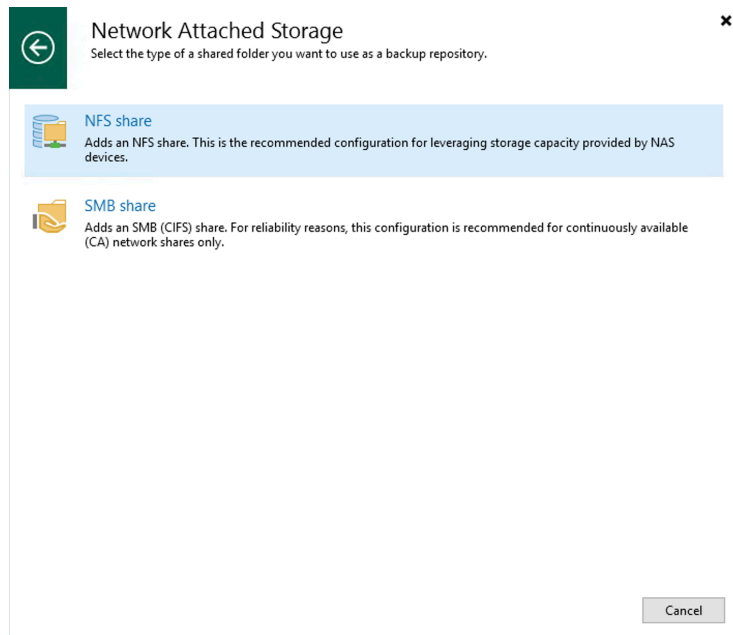
```
root@host141:~# sha256sum /fsl/vdb.1_1.dir/*
4ff79455c48b7c43209086a5cb1907a564fd3a7e25c1299a9f2ad753164ee51a /fsl/vdb.1_1.dir/vdb_f0000.file
cf0323c98f49874080a9b7e317d03ecbcb773b14f29a4784e7bbad5a31867c1 /fsl/vdb.1_1.dir/vdb_f0001.file
779504ea225e58810f7b1e60ac4ce4671505d0fd5a17f3cb3d5da8508264b2a /fsl/vdb.1_1.dir/vdb_f0002.file
70860809b74f0f9e62f080dca147c3f96da37871fc4815a84a794f6e2dcl604f /fsl/vdb.1_1.dir/vdb_f0003.file
da398ale8ad4c6fa400b8c020dd7e6dc345828c7fec36b830ddf23032eb6a51a /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# rm /fsl
fsl/ fsl01/ fsl02/
[root@host141 ~]# rm /fsl
fsl/ fsl01/ fsl02/
[root@host141 ~]# rm /fsl/vdb.1_1.dir/vdb_f0000.file
rm: remove regular file '/fsl/vdb.1_1.dir/vdb_f0000.file'? z
[root@host141 ~]# rm /fsl/vdb.1_1.dir/vdb_f0000.file
rm: remove regular file '/fsl/vdb.1_1.dir/vdb_f0000.file'? y
[root@host141 ~]#
[root@host141 ~]# ll /fsl/vdb.1_1.dir/vdb_f0000.file
ls: cannot access /fsl/vdb.1_1.dir/vdb_f0000.file: No such file or directory
[root@host141 ~]# ll /fsl/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# ll /fsl/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 13:20 /fsl/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /fsl/vdb.1_1.dir/vdb_f0000.file
4ff79455c48b7c43209086a5cb1907a564fd3a7e25c1299a9f2ad753164ee51a /fsl/vdb.1_1.dir/vdb_f0000.file
[root@host141 ~]#
```

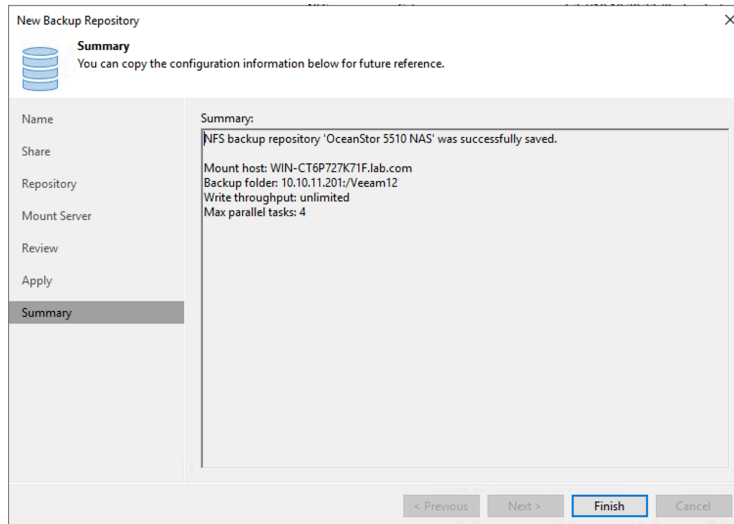
Test 2 OceanStor NAS service as the Backup Repository

Next case we created one file system and one NFS share on the OceanStor 5510.



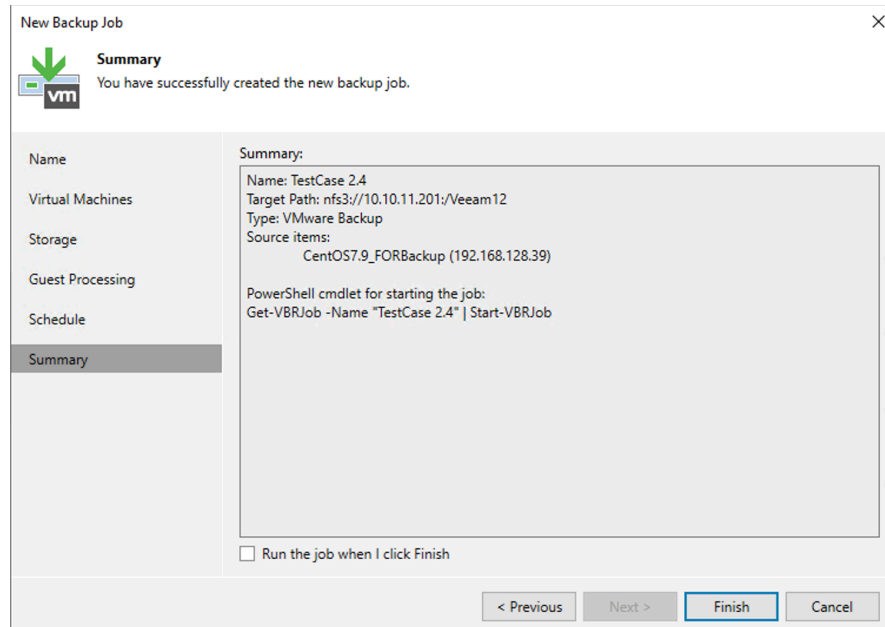
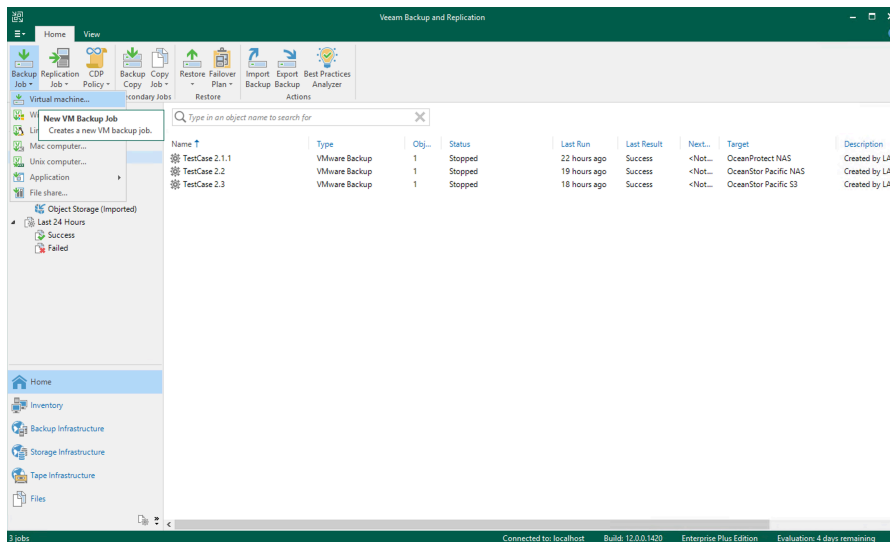
Then, create one repository based on the NFS share of OceanStor 5510.





Test 2.1 Full backup

Start the new backup job and it executed successfully.



SUMMARY	DATA	STATUS	THROUGHPUT (ALL TIME)
Duration: 03:27	Processed: 60 GB (100%)	Success: 1	
Processing rate: 612 MB/s	Read: 27.5 GB	Warnings: 0	
Bottleneck: Target	Transferred: 14 GB (2x)	Errors: 0	

Name	Status	Action	Duration
CentOS7_9_FORBackup	Success	<ul style="list-style-type: none"> Queued for processing at 4/12/2023 9:43:23 AM Required backup infrastructure resources have been assigned Using gateway WIN-CT6P72K71F.lab.com for repository OceanStor 5510 NAS VM processing started at 4/12/2023 9:43:32 AM VM size: 60 GB Resetting CBT per job settings for active fulls Getting VM info from vSphere Creating VM snapshot Saving [Dorad0A1]CentOS7_9_FORBackup/CentOS7_9_FORBackup.vmx Saving [Dorad0A1]CentOS7_9_FORBackup/CentOS7_9_FORBackup.nvram Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd] Hard disk 1 (60 GB) 27.5 GB read at 612 MB/s [CBT] Removing VM snapshot Finalizing Busy: Source 0% > Proxy 25% > Network 0% > Target 70% Primary bottleneck: Target Network traffic verification detected no corrupted blocks Processing finished at 4/12/2023 9:46:26 AM 	00:00

Test 2.2 Incremental backup

Then copy 5 files to the directory of VM.

```
12:05:33.708 Vdbench execution completed successfully. Output directory: /root/vdbench50407/output

[root@host141 vdbench50407]# ll /fs4/vdb
vdb.l_l.dir/      vdb_control.file
[root@host141 vdbench50407]# ll /fs4/vdb.l_l.dir/
total 5242900
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0004.file
[root@host141 vdbench50407]#
[root@host141 vdbench50407]# sha256sum /fs4/vdb.l_l.dir/*
dbfa6d9efde05d6057ed8e6598d0290dceac738810579bbb3203c16f0289718b /fs4/vdb.l_l.dir/vdb_f0000.file
49bdd39199f331e1035f9159c4520e13502ee1ea133acb8d8a8088cf9a27b71b /fs4/vdb.l_l.dir/vdb_f0001.file
13546807ea77699cc66a7ae63ea600c3e26f4ef51143509198a8e45ea77c61e /fs4/vdb.l_l.dir/vdb_f0002.file
e37712d39fb3a24fac01520ca33f6863c4898fb4f91ffc8532b42ba24f3d1407 /fs4/vdb.l_l.dir/vdb_f0003.file
172949d12e3c64c980808b6d246d0df3ba9a98da06ecb49ecab3511b1f2e5f13 /fs4/vdb.l_l.dir/vdb_f0004.file
[root@host141 vdbench50407]#
```

Then start the incremental backup and it executed successfully.

The screenshot shows the Veeam Backup and Replication console. The 'Jobs' list on the left shows several backup jobs, with 'TestCase 2.4' selected. The main pane displays the summary for this job, which is 'CentOS7_9_FORBackup'. The summary shows a successful completion with a duration of 03:27, a processing rate of 612 MB/s, and a bottleneck at the target. The job details list actions such as 'Job started at 4/12/2023 9:43:01 AM', 'Building list of machines to process', 'VM size 60 GB', 'Changed block tracking is enabled', 'Processing CentOS7_9_FORBackup', 'Load: Source 0% > Proxy 25% > Network 0% > Target 70%', 'Primary bottleneck: Target', and 'Job finished at 4/12/2023 9:46:28 AM'.

SUMMARY	DATA	STATUS	THROUGHPUT (ALL TIME)
Duration: 03:03	Processed: 60 GB (100%)	Success: 1 ✔	
Processing rate: 517 MB/s	Read: 5 GB	Warnings: 0	
Bottleneck: Target	Transferred: 1.8 GB (2.8x)	Errors: 0	

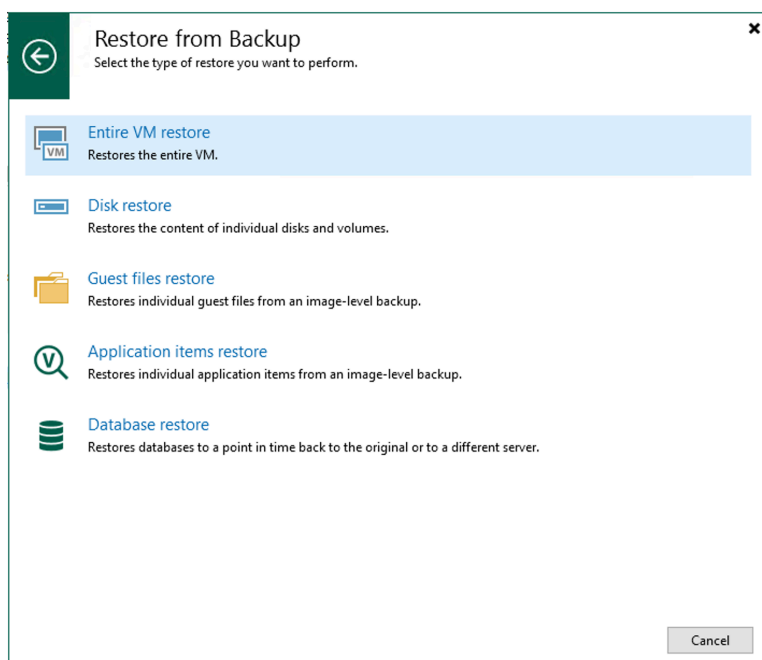
Name	Status	Action	Duration
CentOS7.9_FORBackup	Success	<ul style="list-style-type: none"> ✔ Queued for processing at 4/12/2023 9:51:12 AM ✔ Required backup infrastructure resources have been assigned ✔ Using gateway WIN-CT6P727K71F.lab.com for repository OceanStor 5510 NAS ✔ VM processing started at 4/12/2023 9:51:15 AM ✔ VM size: 60 GB ✔ Getting VM info from vSphere ✔ Creating VM snapshot ✔ Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.vmx ✔ Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.nvram ✔ Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd] ✔ Hard disk 1 (60 GB) 5 GB read at 800 MB/s [CBT] ✔ Removing VM snapshot ✔ Finalizing ✔ Busy: Source 0% > Proxy 28% > Network 0% > Target 78% ✔ Primary bottleneck: Target ✔ Network traffic verification detected no corrupted blocks ✔ Processing finished at 4/12/2023 9:53:42 AM 	

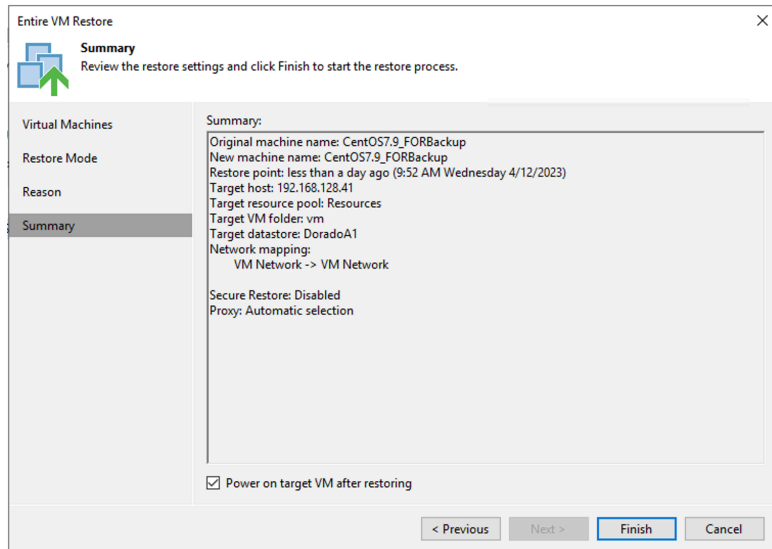
Test 2.3 Restore VM

Then we are trying to restore the VM from the backup data, so calculate the hash value of the 5 files and delete them.

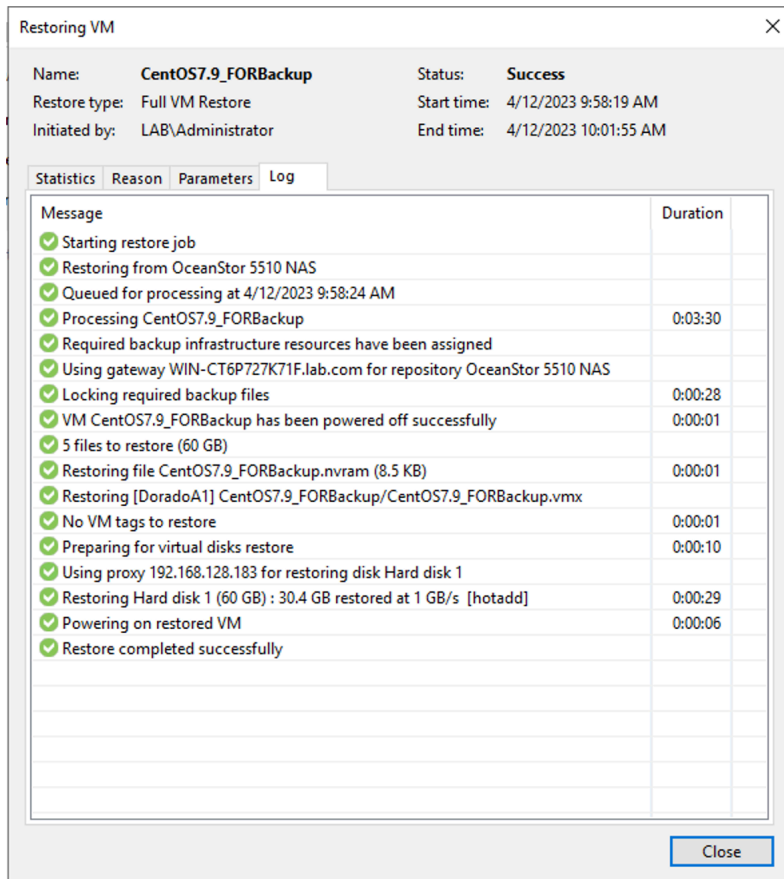
```
[root@host141 vdbench50407]# ll /fs4/vdb.1_1.dir/
total 5242900
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0004.file
[root@host141 vdbench50407]#
[root@host141 vdbench50407]# sha256sum /fs4/vdb.1_1.dir/*
dbfa6d9efde05d6057ed8e6598d0290dceac738810579bbb3203c16f0289718b /fs4/vdb.1_1.dir/vdb_f0000.file
49bdd39199f331e1035f9159c4520e13502ee1ea133acb8d8a8088cf9a27b71b /fs4/vdb.1_1.dir/vdb_f0001.file
13546807ea77699c66a7ae63ea600c3e26f4ef511435509198a8e45eae77c61e /fs4/vdb.1_1.dir/vdb_f0002.file
e37712d39fb3a24fac01520ca33f6863c4898fb4f91ffc8532b42ba24f3d1407 /fs4/vdb.1_1.dir/vdb_f0003.file
172949d12e3c64c980808b6d246d0df3ba9a98da06ecb49ecab3511b1f2e5f13 /fs4/vdb.1_1.dir/vdb_f0004.file
[root@host141 vdbench50407]#
[root@host141 vdbench50407]#
[root@host141 vdbench50407]#
[root@host141 vdbench50407]#
[root@host141 vdbench50407]# rm /fs4/vdb.1_1.dir/*
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 vdbench50407]# ll /fs4/vdb.1_1.dir/
total 0
[root@host141 vdbench50407]#
```

Start the restore from backup job after the files were deleted.





The restore VM is completed and successful.



Check the hash value after the VM power on, and the value is the same with before for every file.

```

login as: root
root@192.168.128.141's password:
Last login: Wed Apr 12 11:34:56 2023 from win-ct6p727k71f.lab.com
[root@host141 ~]# ll /fs4/vdb.1_1.dir/
total 5242900
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0004.file
[root@host141 ~]# sha256sum /fs4/vdb.1_1.dir/*
dbfa6d9efde05d6057ed8e6598d0290dceac738810579bbb3203c16f0289718b /fs4/vdb.1_1.dir/vdb_f0000.file
49bdd39199f331e1035f9159c4520e13502eelea133acb8d8a8088cf9a27b71b /fs4/vdb.1_1.dir/vdb_f0001.file
13546807ea77699c66a7ae63ea600c3e26f4ef511435509198a8e45eae77c61e /fs4/vdb.1_1.dir/vdb_f0002.file
e37712d39fb3a24fac01520ca33f6863c4898fb4f91ffc8532b42ba24f3d1407 /fs4/vdb.1_1.dir/vdb_f0003.file
172949d12e3c64c980808b6d246d0df3ba9a98da06ecb49ecab3511b1f2e5f13 /fs4/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#

```

Test 2.4 Restore Guest-OS files

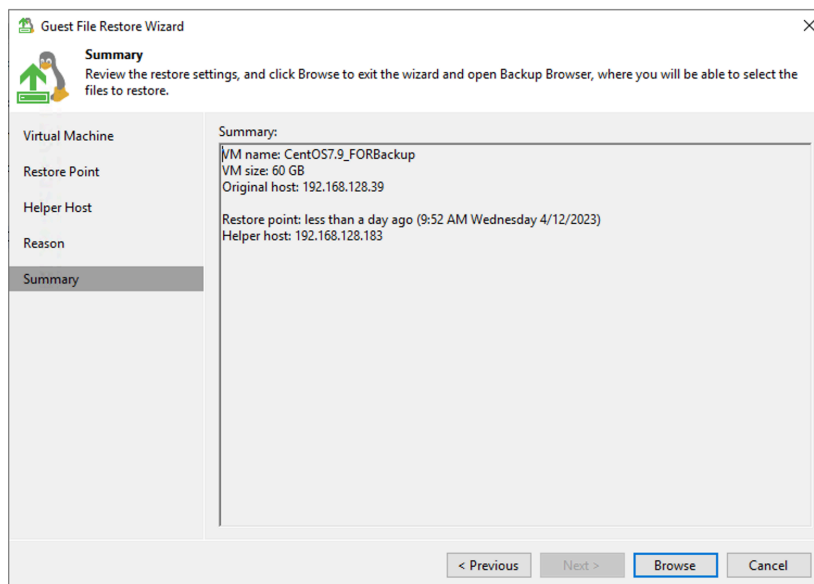
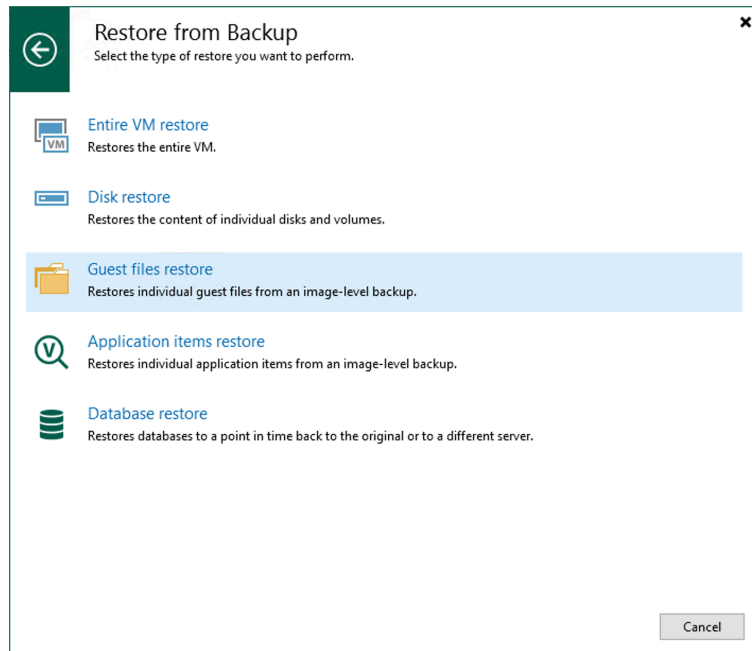
Then delete the files again, we are going to restore the files only.

```

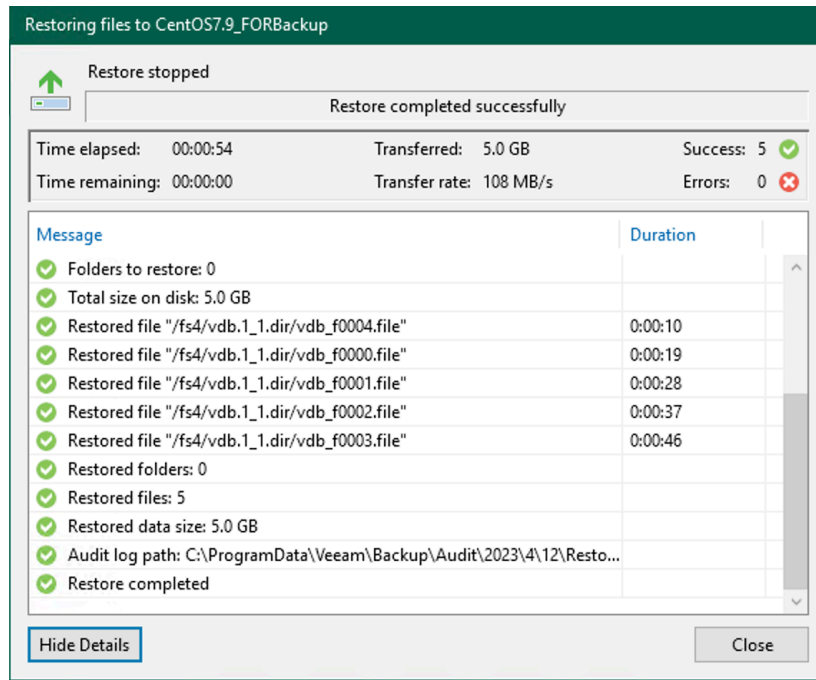
[root@host141 ~]# ll /fs4/vdb.1_1.dir/
total 5242900
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0004.file
[root@host141 ~]# sha256sum /fs4/vdb.1_1.dir/*
dbfa6d9efde05d6057ed8e6598d0290dceac738810579bbb3203c16f0289718b /fs4/vdb.1_1.dir/vdb_f0000.file
49bdd39199f331e1035f9159c4520e13502eelea133acb8d8a8088cf9a27b71b /fs4/vdb.1_1.dir/vdb_f0001.file
13546807ea77699c66a7ae63ea600c3e26f4ef511435509198a8e45eae77c61e /fs4/vdb.1_1.dir/vdb_f0002.file
e37712d39fb3a24fac01520ca33f6863c4898fb4f91ffc8532b42ba24f3d1407 /fs4/vdb.1_1.dir/vdb_f0003.file
172949d12e3c64c980808b6d246d0df3ba9a98da06ecb49ecab3511b1f2e5f13 /fs4/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# rm /fs4/vdb.1_1.dir/*
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/fs4/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 ~]# ll /fs4/vdb.1_1.dir/
total 0
[root@host141 ~]#

```

Start the guest files restore job.



And the files are restore completed and successes.



Check the hash value for each file, the value is the same with before.

```
[root@host141 ~]# ll /fs4/vdb.1_1.dir/
total 5242880
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 12:05 vdb_f0004.file
[root@host141 ~]# sha256sum /fs4/vdb.1_1.dir/*
dbfa6d9efde05d6057ed8e6598d0290dceac738810579bbb3203c16f0289718b /fs4/vdb.1_1.dir/vdb_f0000.file
49bdd39199f331e1035f9159c4520e13502ee1eal33acb8d8a8088cf9a27b71b /fs4/vdb.1_1.dir/vdb_f0001.file
13546807ea77699c66a7ae63ea600c3e26f4ef511435509198a8e45eae77c61e /fs4/vdb.1_1.dir/vdb_f0002.file
e37712d39fb3a24fac01520ca33f6863c4898fb4f91ffc8532b42ba24f3d1407 /fs4/vdb.1_1.dir/vdb_f0003.file
172949d12e3c64c980808b6d246d0df3ba9a98da06ecb49ecab3511b1f2e5f13 /fs4/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
```

Test 3 OceanStor Pacific NAS service as the Backup Repository

We created one namespace and enable NFS share on the OceanStor Pacific 9550.

Create Namespace

Basic Information

Account backup

* Name BackupTests

* Storage Pool StoragePool01

Redundancy Ratio +2

* Security Style UNIX

Recycle Bin

Directory Quota

Access

DPC

NFS

Share /BackupTests/, Permissions: 1 [Configure](#)

CIFS

Object

[Advanced >](#)

Create Namespace

Execution Result

Total 3 Successful 3 Failed 0

Operation	Status	Details
Creating namespace BackupTests	Successful	--
Create NFS Share	Successful	--
Adding client *	Successful	--

Total: 3 < 1/1 >

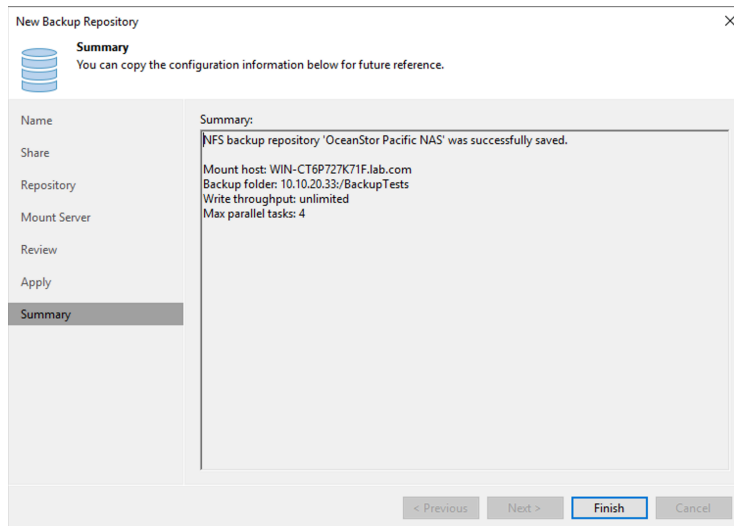
Then, create one repository based on the NFS share of OceanStor Pacific 9550.

New Backup Repository

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

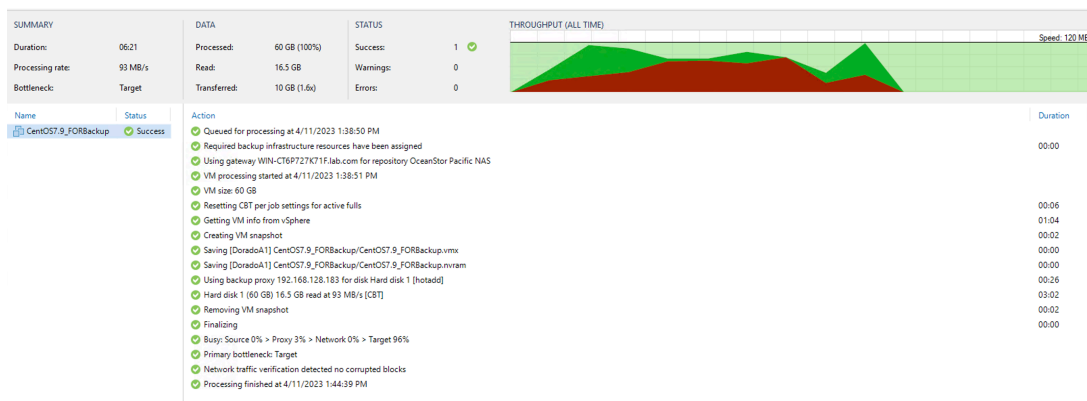
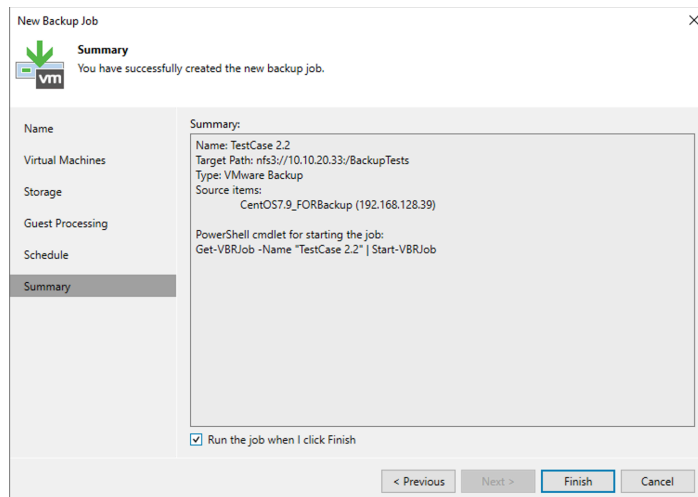
Message	Duration
Starting infrastructure item update process	0:00:03
Verifying repository path...	0:00:02
[WIN-CT6P727K71F] Discovering installed packages	
[WIN-CT6P727K71F] Registering client WIN-CT6P727K71F for package...	
[WIN-CT6P727K71F] Registering client WIN-CT6P727K71F for package...	
[WIN-CT6P727K71F] Registering client WIN-CT6P727K71F for package...	
[WIN-CT6P727K71F] 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	
Creating database records for repository	0:00:03
Backup repository has been saved successfully	

< Previous **Next >** Finish Cancel



Test 3.1 Full backup

Start new backup job based on the repository from OceanStor Pacific 9550 and it executed successfully.



Test 3.2 Incremental backup

Next step, copy 5 files to the directory of VM to simulate the incremental date.

```
[root@host141 vdbench50407]# ll /fs2
total 8
-rwxrwxrwx. 1 root root 68 Apr 11 16:05 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 11 16:06 vdb.1_1.dir
-rwxrwxrwx. 1 root root 175 Apr 11 16:06 vdb_control.file
[root@host141 vdbench50407]# sha256sum /fs2/vdb.1_1.dir/*
77d8d0a7d7c0ab66a7237a36160828441c126183a999c3ec60b1361b2be8906e /fs2/vdb.1_1.dir/vdb_f0000.file
60c7e8acac4a011f2feae55992e9b353a82abe6752ddbfb8f8ce226068d6d496 /fs2/vdb.1_1.dir/vdb_f0001.file
6f4882569165067dc73150780e6fe3700689b98f0b905b894c8bd01560fal056 /fs2/vdb.1_1.dir/vdb_f0002.file
f9e52359e3882f1b05f6cee92181d5f9c0eb1f54c3ba5d7192e55792014c10be6 /fs2/vdb.1_1.dir/vdb_f0003.file
47d125178e5211147901490ac9e820698bc57ede837ef44bf84bc41ad382b896 /fs2/vdb.1_1.dir/vdb_f0004.file
[root@host141 vdbench50407]#
```

Then start the incremental backup and it executed successfully too.

The screenshot shows a backup job summary with the following details:

SUMMARY	DATA	STATUS	THROUGHPUT (ALL TIME)
Duration: 03:17	Processed: 60 GB (99%)	Success: 1	[Throughput graph showing speed up to 90 MB/s]
Processing rate: 93 MB/s	Read: 5 GB	Warnings: 0	
Bottleneck: Target	Transferred: 1.8 GB (2.8s)	Errors: 0	

Below the summary is an action log:

- Queued for processing at 4/11/2023 1:51:09 PM
- Required backup infrastructure resources have been assigned
- Using gateway WIN-CT672K71F.lab.com for repository OceanStor Pacific NAS
- VM processing started at 4/11/2023 1:51:13 PM
- VM size: 60 GB
- Setting VM info from vSphere
- Creating VM snapshot
- Saving [DoradoA1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.vmx
- Saving [DoradoA1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.nvram
- Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd]
- Hard disk 1 (60 GB) 5 GB read at 93 MB/s [CBT]
- Removing VM snapshot
- Finalizing
- Busy: Source 0% > Proxy 3% > Network 0% > Target 96%
- Primary bottleneck: Target
- Network traffic verification detected no corrupted blocks
- Processing finished at 4/11/2023 1:53:57 PM

Test 3.3 Restore VM

Then delete the 5 files which copied in the VM.

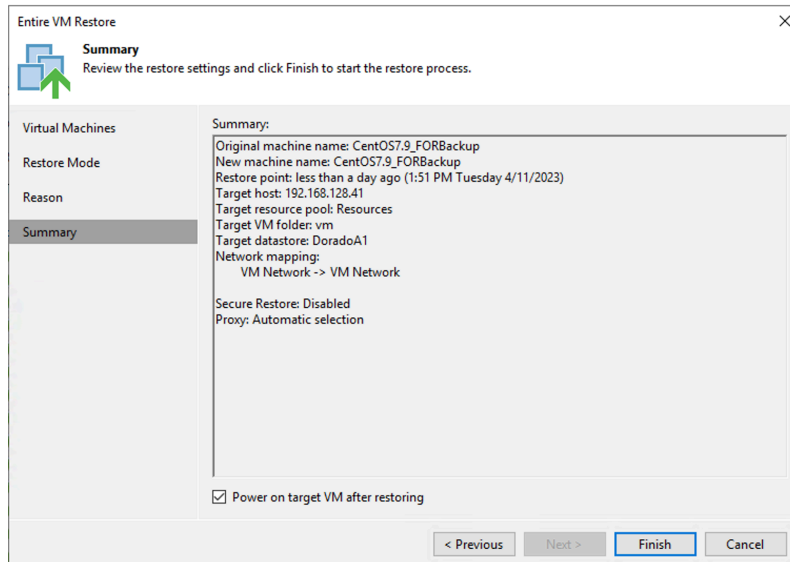
```
[root@host141 vdbench50407]# rm /fs2/vdb.1_1.dir/*
rm: remove regular file '\fs2/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '\fs2/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '\fs2/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '\fs2/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '\fs2/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 vdbench50407]#
[root@host141 vdbench50407]#
[root@host141 vdbench50407]# ll /fs2/vdb.1_1.dir/*
ls: cannot access /fs2/vdb.1_1.dir/*: No such file or directory
[root@host141 vdbench50407]#
```

Start the restore from backup job after the files were deleted.

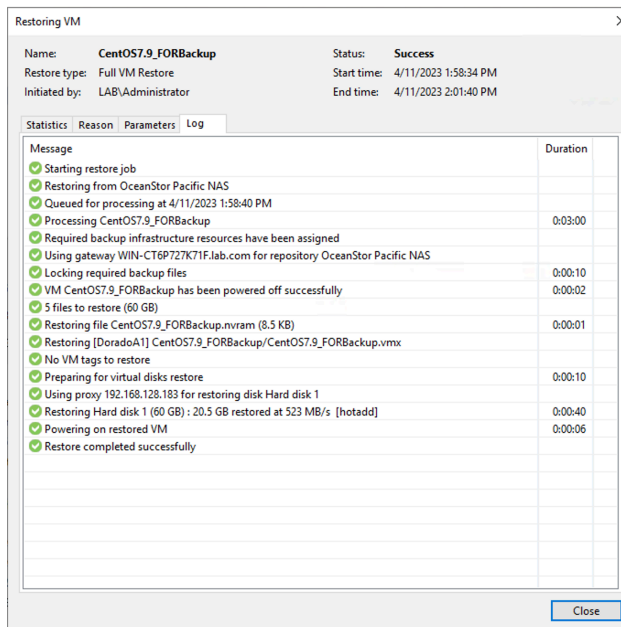
The screenshot shows a 'Restore from Backup' dialog box with the following options:

- Instant recovery**: Instantly recovers a virtual machine by running it directly from backup. Remember to finalize the restore by moving the VM to your production storage.
- Entire VM restore**: Restores entire VM to the original or a new location, and registers it with the vSphere infrastructure.
- Restore to public cloud**: Restores any backup as a public cloud virtual machine. Amazon EC2, Google Compute Engine and Microsoft Azure IaaS are supported.

A 'Cancel' button is located at the bottom right of the dialog.



The restore VM is completed and successes.



Check the files after the VM power on, all files are restored.

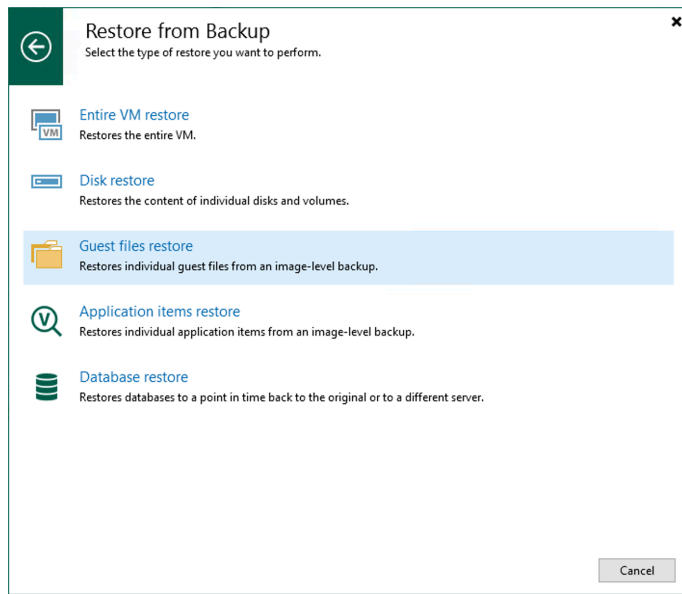
```
[root@host141 ~]# ll /fs2/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /fs2/vdb.1_1.dir/*
77d8d0a7d7c0ab66a7237a36160828441c126183a999c3ec60b1361b2be8906e /fs2/vdb.1_1.dir/vdb_f0000.file
60c7e8acac4a011f2fae55992e9b353a82abe6752ddbfb8f8ce226068d6dd96 /fs2/vdb.1_1.dir/vdb_f0001.file
6f4892569165067dc73150780e6fe3700689b98f0b905b894c8bd01560fa1056 /fs2/vdb.1_1.dir/vdb_f0002.file
f9e52359e3882f1b05f6ce92181d5f9c0eb1f54c3ba5d7192e55792014c10be6 /fs2/vdb.1_1.dir/vdb_f0003.file
47d125178e5211147901490ac9e820698bc576de837ef44bf84bc41ad382b896 /fs2/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
```

Test 3.4 Restore Guest-OS files

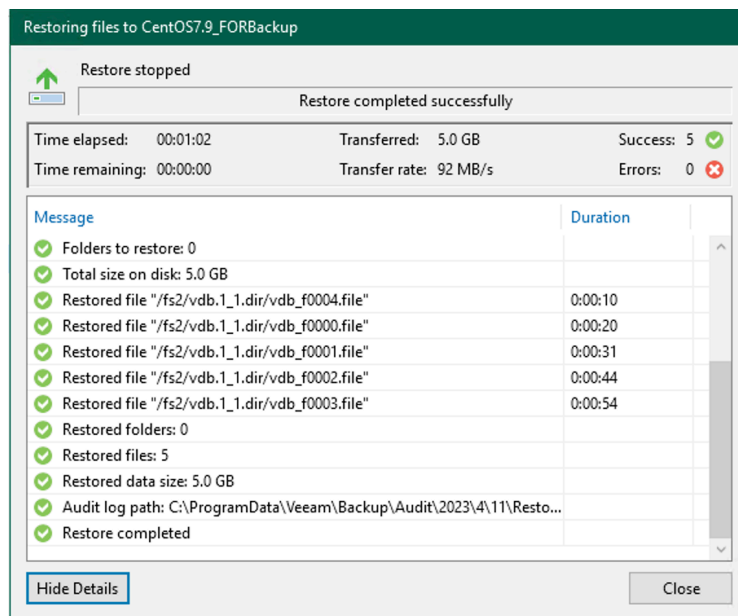
Then delete the files again, we are going to restore the files only.

```
[root@host141 ~]#
[root@host141 ~]# rm /fs2/vdb.1_1.dir/*
rm: remove regular file '/fs2/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '/fs2/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/fs2/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/fs2/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/fs2/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# ll /fs2/vdb.1_1.dir/*
ls: cannot access /fs2/vdb.1_1.dir/*: No such file or directory
[root@host141 ~]#
```

Start the guest files restore job.



And the files are restore completed and successes.



Check the files in the directory, every file is restored successfully.

```
[root@host141 ~]# ll /fs2/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 16:06 /fs2/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /fs2/vdb.1_1.dir/*
77d8d0a7d7c0ab66a7237a36160828441c126183a999c3ec60b1361b2be8906e /fs2/vdb.1_1.dir/vdb_f0000.file
60c7e8acac4a011f2feae55992e9b353a82abe6752ddbfb8f8ce226068d6dd96 /fs2/vdb.1_1.dir/vdb_f0001.file
6f4892569165067dc73150780e6fe3700689b98f0b905b894c8bd01560fa1056 /fs2/vdb.1_1.dir/vdb_f0002.file
f9e52359e3882flb05f6ce92181d5f9c0eb1f54c3ba5d7192e55792014c10bee6 /fs2/vdb.1_1.dir/vdb_f0003.file
47d125178e5211147901490ac9e820698bc576de837ef44bf84bc41ad382b896 /fs2/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# █
```

Test 4 OceanStor Pacific Object service as the Backup Repository

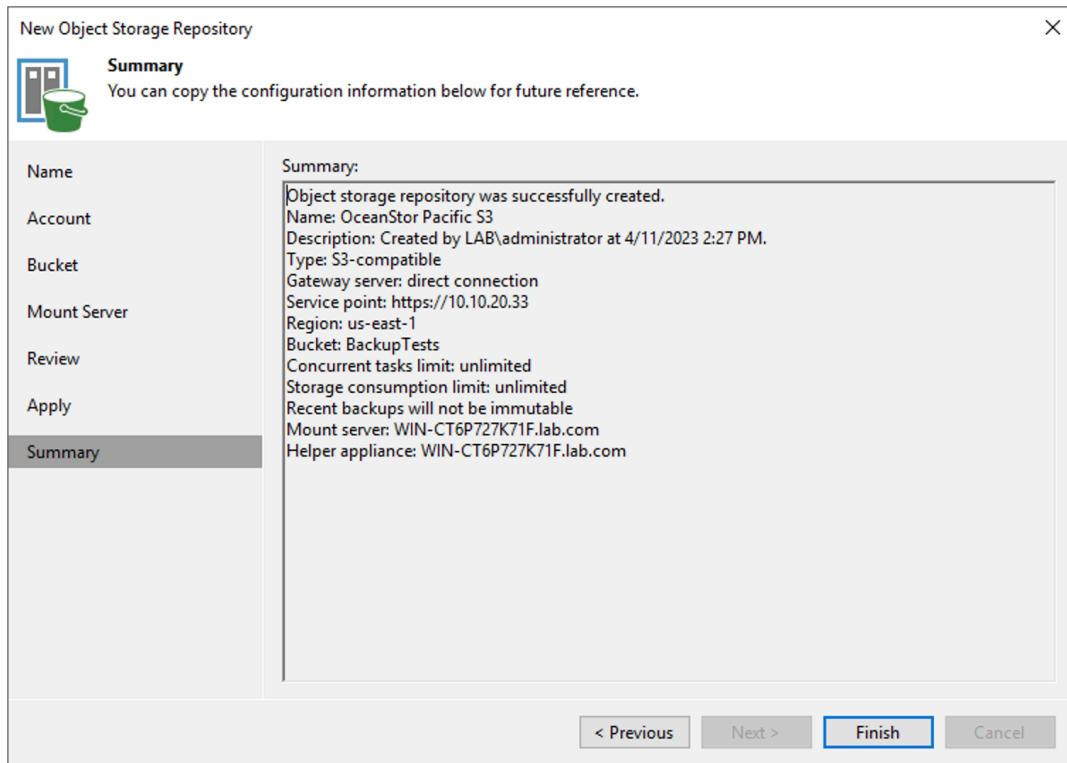
Enable the object protocol based on the namespace on OceanStor Pacific 9550:

The screenshot shows the 'BackupTests' namespace configuration in the OceanStor Pacific 9550 console. The 'Namespace' is 'BackupTests', the 'Account' is 'backup', and the 'Storage Pool' is 'StoragePool01'. The 'Running Status' is 'Normal'. The 'Object' protocol is selected under the 'Protocol' tab, and the 'Enable Object Protocol' button is visible. The 'Bucket Permission' is set to '--'. The 'Permission' section shows 'Create Bucket Policy' and 'Policy Mode' options.

The next step is to configure a new backup repository with S3 compatible type in Veeam 12 console:

The screenshot shows the 'Object Storage' configuration dialog in the Veeam 12 console. The dialog prompts the user to 'Select the type of object storage you want to use as a backup repository.' The 'S3 Compatible' option is selected, and the 'Amazon S3' option is highlighted. Other options include Google Cloud Storage, IBM Cloud Object Storage, Microsoft Azure Storage, and Wasabi Cloud Storage. A 'Cancel' button is visible at the bottom right.

It must be a S3 compatible storage type. We must declare the access and secret key, the bucket to be used and other information. In summary, the new definition looks like this:

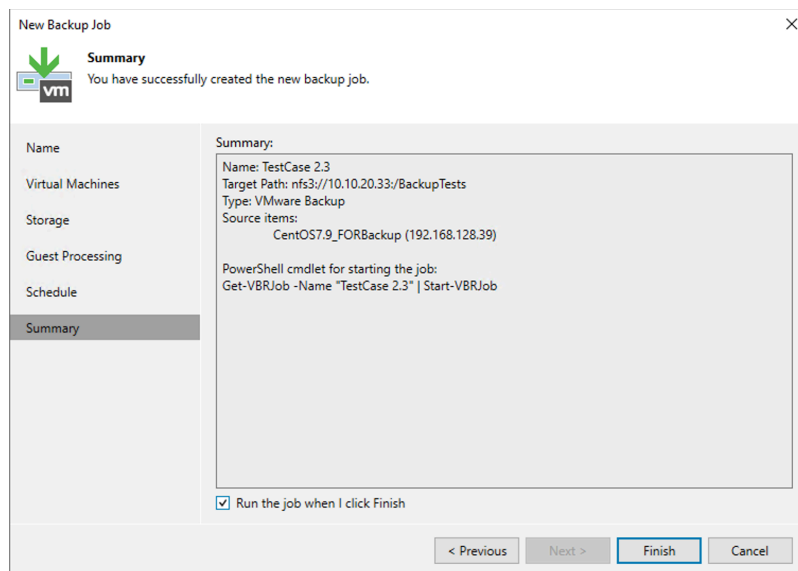


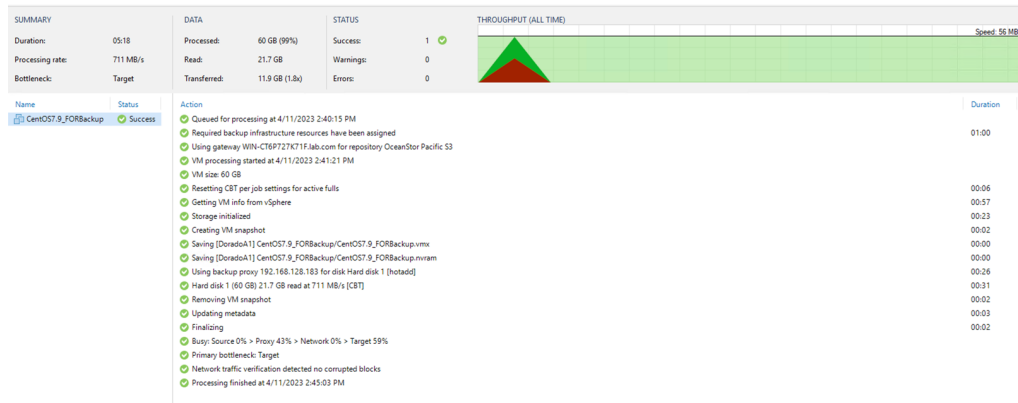
To test the functionality of this backup repository type we run full and incremental backups and full and incremental restore operations with the whole VM and single files.

Every test run without any issues and was executed successful.

Test 4.1 Full backup

Start new backup job based on the object repository from OceanStor Pacific 9550 and it executed successfully.





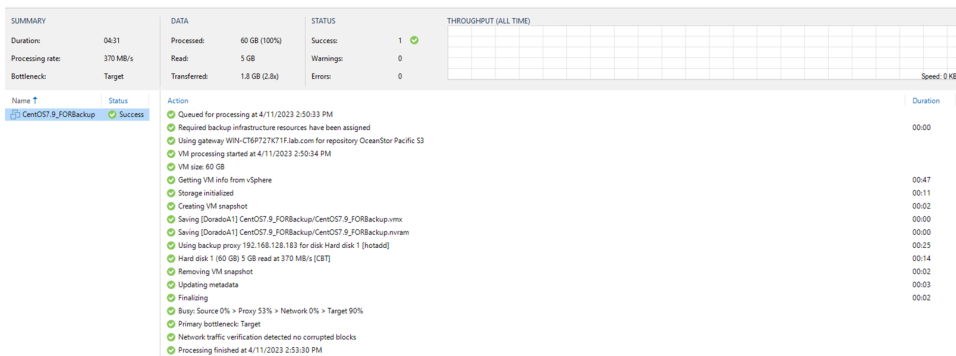
Test 4.2 Incremental backup

Next step, copy 5 files to the directory of VM to simulate the incremental date.

17:04:44.069 Vdbench execution completed successfully. Output directory: /root/vdbench50407/output

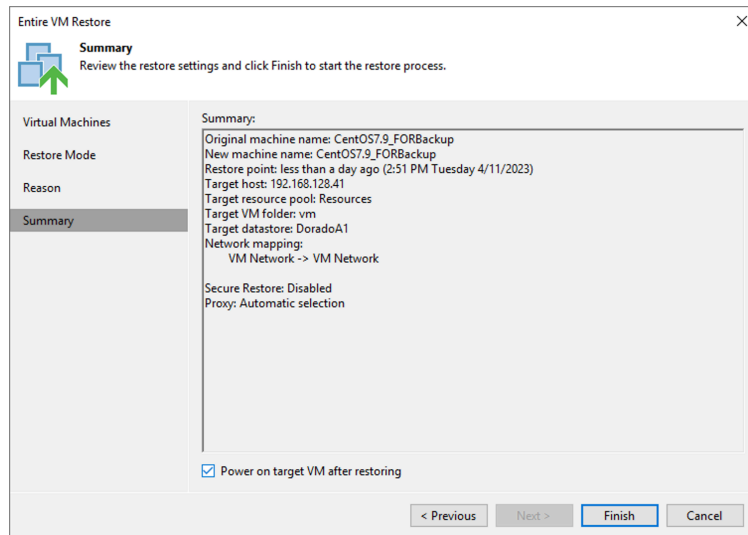
```
[root@host141 vdbench50407]# ll /fs3
total 8
-rwxrwxrwx. 1 root root 68 Apr 11 17:04 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 11 17:04 vdb.1_1.dir
-rwxrwxrwx. 1 root root 175 Apr 11 17:04 vdb.control.file
[root@host141 vdbench50407]# ll /fs3/vdb.1_1.dir/
total 5242896
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 vdb_f0004.file
[root@host141 vdbench50407]# sha256sum /fs3/vdb.1_1.dir/*
06a39ba09bf89d603aac37643d7c0540b1670c62f040f39c37b034f316bb0d08 /fs3/vdb.1_1.dir/vdb_f0000.file
928b240f9106a9280473a0ed9dfc1cfa0ae15804444ae6a30bd99c335c1e07fc /fs3/vdb.1_1.dir/vdb_f0001.file
f6ac7e57c9ba1e9c3677319fc9449403d91c2c0590b00523b20edb888e109276 /fs3/vdb.1_1.dir/vdb_f0002.file
8da790335c097149b9ec4b1122e0b6867f3891ee7f950ae56906196eada9d672 /fs3/vdb.1_1.dir/vdb_f0003.file
2b6f06dded4a3470a3ea771b42e9e251723de918954a327eb3a9f62d8f2622ee /fs3/vdb.1_1.dir/vdb_f0004.file
[root@host141 vdbench50407]#
```

Then start the incremental backup and it executed successfully.

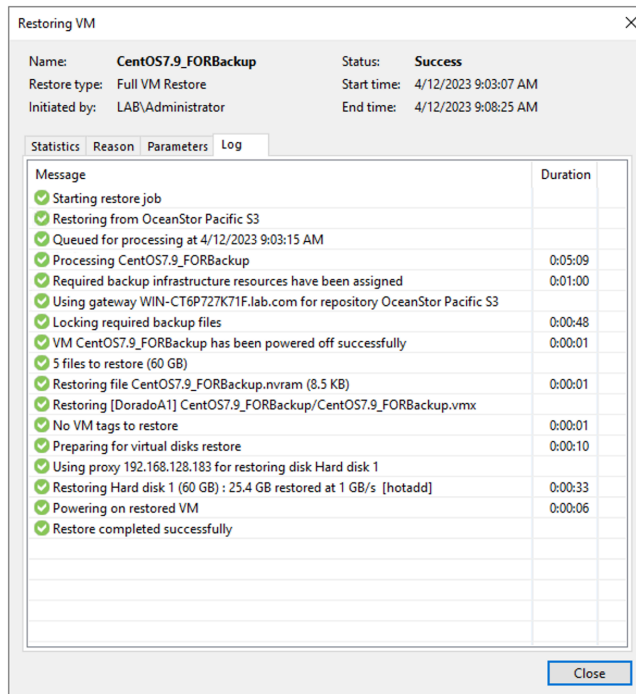


Test 4.3 Restore VM

Start the restore from backup job after the files were deleted in the VM.



The restore VM is completed and successes.



Check the hash value after the VM power on, and the value is the same with before for every file.

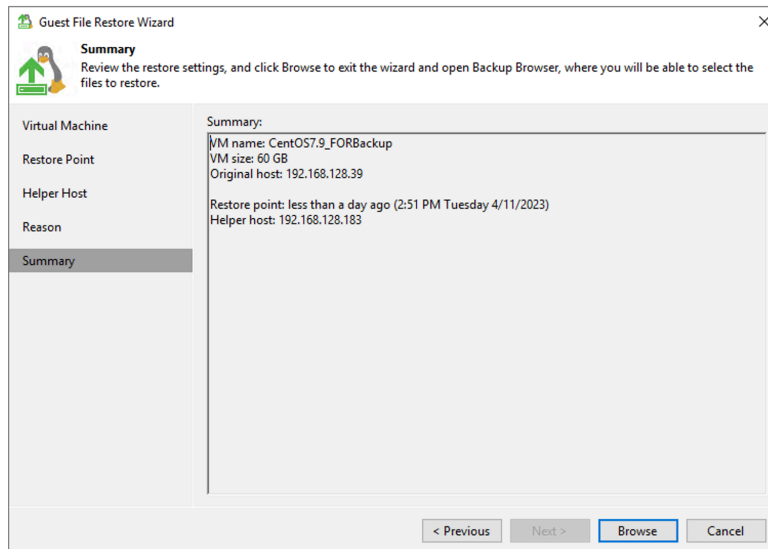
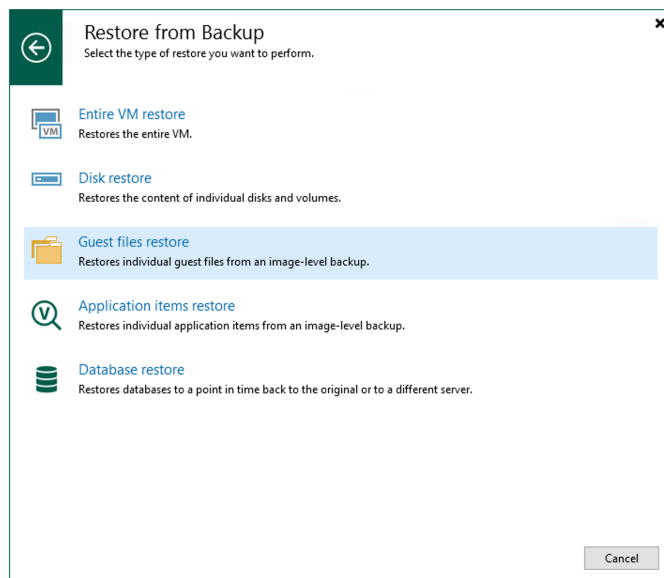
```
[root@host141 ~]# ll /fs3/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /fs3/vdb.1_1.dir/*
06a39ba09bf89d603aac37643d7c0540b1670c62f040f39c37b034f316bb0d08 /fs3/vdb.1_1.dir/vdb_f0000.file
928b240f9106a9280473a0ed9dfc1cfa0ae15804444ae6a30bd99c335c1e07fc /fs3/vdb.1_1.dir/vdb_f0001.file
f6ac7e57c9bale9c3677319fc9449403d91c2c0590b00523b20edb888e109276 /fs3/vdb.1_1.dir/vdb_f0002.file
8da790335c097149b9ec4b1122e0b6867f3891ee7f950ae56906196eada9d672 /fs3/vdb.1_1.dir/vdb_f0003.file
2b6f06d6ed4a3470a3ea771b42e9e251723de918954a327eb3a9f62d8f2622ee /fs3/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# █
```

Test 4.4 Restore Guest-OS files

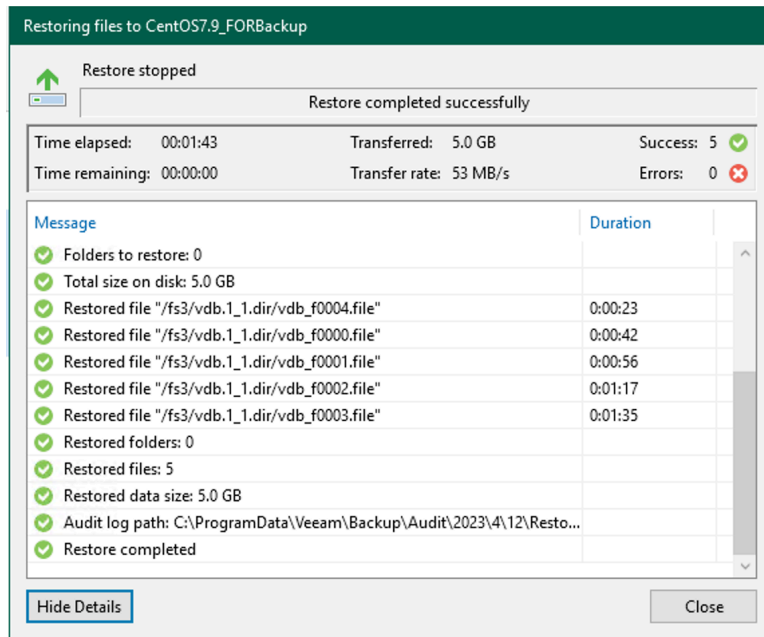
Then delete the files again, we are going to restore the files only.

```
[root@host141 ~]# ll /fs3/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 11 17:04 /fs3/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /fs3/vdb.1_1.dir/*
06a39ba09bf89d603aac37643d7c0540b1670c62f040f39c37b034f316bb0d08 /fs3/vdb.1_1.dir/vdb_f0000.file
928b240f9106a9280473a0ed9dfc1cfa0ae15804444ae6a30bd99c335c1e07fc /fs3/vdb.1_1.dir/vdb_f0001.file
f6ac7e57c9bale9c3677319fc9449403d91c2c0590b00523b20edb888e109276 /fs3/vdb.1_1.dir/vdb_f0002.file
8da790335c097149b9ec4b1122e0b6867f3891ee7f950ae56906196eada9d672 /fs3/vdb.1_1.dir/vdb_f0003.file
2b6f06d6ed4a3470a3ea771b42e9e251723de918954a327eb3a9f62d8f2622ee /fs3/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# rm /fs3/vdb.1_1.dir/*
rm: remove regular file '/fs3/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '/fs3/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/fs3/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/fs3/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/fs3/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 ~]# ll /fs3/vdb.1_1.dir/*
ls: cannot access /fs3/vdb.1_1.dir/*: No such file or directory
[root@host141 ~]#
```

Start the guest files restore job.



And the files are restore completed and successes.



Veeam Special Backup and Restore Features

Veeam version 12 offers the immutable backup feature. Backups cannot be changed or deleted anymore, even from direct access on the storage layer. We tested this feature with OceanStor 5510 and OceanStor Pacific 9550.

In this report we will focus on the special features of the storage systems and new features in Veeam 12:

- I. OceanStor 5510 with FC block storage and hardened repository
- II. OceanStor Pacific with immutable object storage

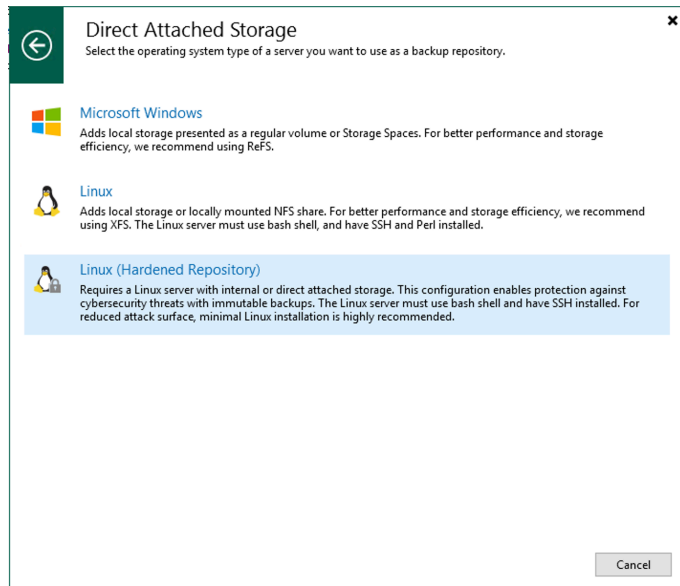
Test 5 OceanStor block service as hardened repository

In this test case we created a normal LUN on the OceanStor 5510 storage system and made it visible to the backup server:

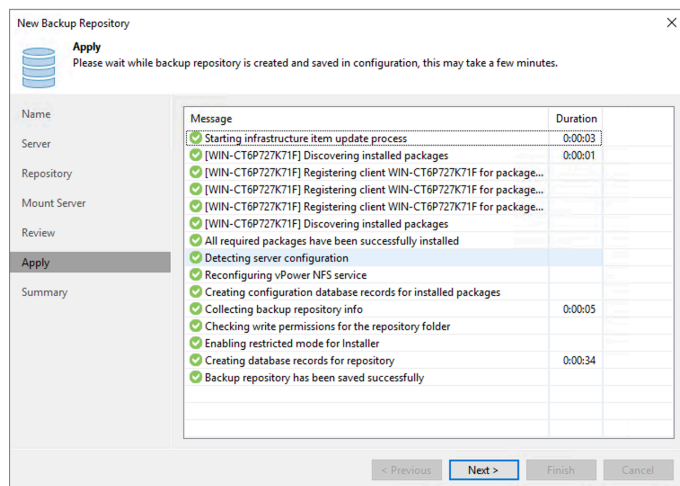
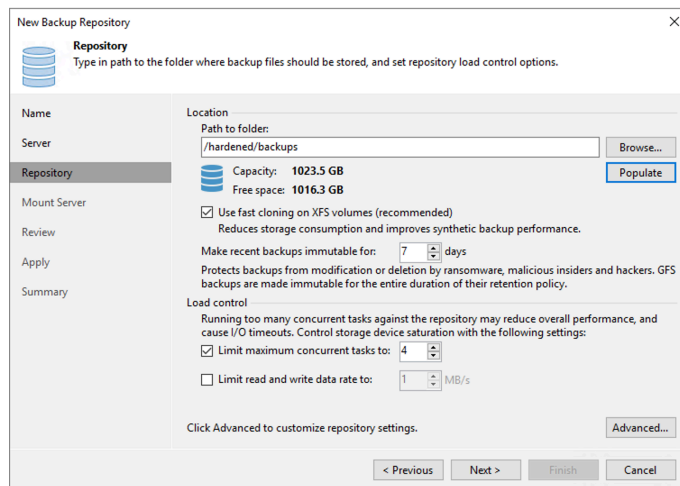
Then, created an XFS file system (because it is a Linux server) on it and mounted the filesystem:

```
[root@gw43 ~]# lsescsi -i
[0:0:1:0] enclosu HUAWEI Expander 12Gx28 128 - -
[0:2:0:0] disk AVAGO AVAGO 4.66 /dev/sda SAVAGO_AVAGO_00124fbd2b22157e2b950daa5b820300
[15:0:1:1] disk HUAWEI XSGI 6000 - -
[16:0:0:1] disk HUAWEI XSGI 6000 - -
[17:0:0:0] cd/dvd Virtual DVD-ROM VM 1.1.0 225 /dev/sr0 Virtual_DVD-ROM_VM_1.1.0-0:0
[18:0:0:1] disk up updisk 6000 /dev/sdb Sup_updisk_2102354SEN10N91000030001
[root@gw43 ~]# lsblk -l
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINT
sda 8:0 0 557.9G 0 disk
|--sda1 8:1 0 600M 0 part /boot/efi
|--sda2 8:2 0 1G 0 part /boot
--sda3 8:3 0 556.3G 0 part
|-cl-root 253:0 0 50G 0 lvm /
|-cl-swap 253:1 0 4G 0 lvm [SWAP]
--cl-home 253:2 0 502.3G 0 lvm /home
sdb 8:16 0 1T 0 disk
--sdb1 8:17 0 1024G 0 part
sr0 11:0 1 7.7G 0 rom
up-0 252:0 0 1T 0 disk
up-1 252:1 0 1T 0 disk
[root@gw43 ~]# upadmin show vlun
-----
Vlun ID Disk Name Lun WWN Status Capacity Ctrl(Own/Work) Array Name Dev Lun ID No. of Paths(Available/Total)
-----
0 sdb LUN_Hardened 63ca37e100e87434014c3ca500000001 Normal 1.00TB --/-- OceanStor_5510 1 2/2
-----
[root@gw43 ~]#
```

The next step is to create a new backup repository in Veeam, here as a direct attached storage repository with the type Linux (hardened Repository):



And enable fast cloning on XFS volumes.



As the next step we execute a full and an incremental backup of one VM. Backing up some VMs and files is OK, but they are useless without corresponding restore functionality. Therefore, we tested the restores of the full VM and of single files, too. Everything went without any failures.

Test 5.1 Full backup

Start new backup job based on the hardened repository from OceanStor 5510 and it executed successfully.

The image shows two screenshots from a backup management interface. The top screenshot is a 'New Backup Job' dialog box. It has a 'Summary' tab selected, showing a success message: 'You have successfully created the new backup job.' The job details include: Name: TestCase 2.5, Target Path: /hardened/backups, Type: VMware Backup, Source items: CentOS7.9_FORBackup (192.168.128.39), and PowerShell cmdlet: Get-VBRJob -Name 'TestCase 2.5' | Start-VBRJob. There are 'Previous', 'Next', 'Finish', and 'Cancel' buttons at the bottom.

The bottom screenshot shows the backup job's progress window. The job 'TestCase 2.5' is shown as 'Stopped' with a 'Success' status. The progress table is as follows:

SUMMARY		DATA		STATUS		THROUGHPUT (ALL TIME)	
Duration:	03:02	Processed:	60 GB (100%)	Success:	1		
Processing rate:	2 GB/s	Read:	33.2 GB	Warnings:	0		
Bottleneck:	Proxy	Transferred:	16 GB (2.1s)	Errors:	0		

Below the table is a list of actions with their durations:

Name	Status	Action	Duration
CentOS7.9_FORBackup	Success	Queued for processing at 4/12/2023 12:09:00 PM	00:00
		Required backup infrastructure resources have been assigned	
		VM processing started at 4/12/2023 12:09:06 PM	
		VM size: 60 GB	
		Resetting CBT per job settings for active fulls	00:06
		Getting VM info from vSphere	00:23
		Creating VM snapshot	00:02
		Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.vmx	00:00
		Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.nvram	00:00
		Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd]	00:21
		Hard disk 1 (60 GB) 33.2 GB read at 2 GB/s [CBT]	00:20
		Removing VM snapshot	00:02
		Finalizing	00:00
		Busy: Source 0% > Proxy 32% > Network 0% > Target 0%	
		Primary bottleneck: Proxy	
		Network traffic verification detected no corrupted blocks	
		Processing finished at 4/12/2023 12:11:32 PM	

Test 5.2 Incremental backup

Next step, copy 5 files to the directory of VM to simulate the incremental date.

```
[root@host141 vdbench50407]# ll /home/fs5/
total 8
-rwxrwxrwx. 1 root root 68 Apr 12 14:31 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 12 14:31 vdb.1_1.dir
-rwxrwxrwx. 1 root root 180 Apr 12 14:31 vdb_control.file
[root@host141 vdbench50407]# ll /home/fs5/vdb.1_1.dir/
total 5242896
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 vdb_f0004.file
[root@host141 vdbench50407]# sha256sum /home/fs5/vdb.1_1.dir/*
6b1b1c8174c07c09613c1c2a5e85d46a10c633d4a1644880f5d40dbfa90f3291 /home/fs5/vdb.1_1.dir/vdb_f0000.file
62274b01d5539c5367823566069df08e2a93c547a33870410744d425a4c3882f /home/fs5/vdb.1_1.dir/vdb_f0001.file
2fa0d64b51b2121a8e900cae0e1068f329cdce98b9155f0c13e3d8e0d814872d /home/fs5/vdb.1_1.dir/vdb_f0002.file
5f4d4ee6e7cca54f03410122a36b67c9b9ff8d60834309bcc0d84a3968328380 /home/fs5/vdb.1_1.dir/vdb_f0003.file
bc6e0a83abe99b5309810calc7a78043722361e25db387e50bbb9afe91cf6f9a /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 vdbench50407]#
```

Then start the incremental backup and it executed successfully.

The screenshot shows a backup job summary for 'CentOS7.9_FORBackup'. The job is 'Stopped' and 'Success', completed 3 minutes ago. The summary table is as follows:

SUMMARY		DATA		STATUS		THROUGHPUT (ALL TIME)	
Duration:	03:16	Processed:	60 GB (100%)	Success:	1		
Processing rate:	516 MB/s	Read:	5 GB	Warnings:	0		
Bottleneck:	Proxy	Transferred:	1.8 GB (2.8s)	Errors:	0		

The log below the summary shows the following actions:

- Queued for processing at 4/12/2023 12:16:46 PM
- Required backup infrastructure resources have been assigned
- VM processing started at 4/12/2023 12:16:49 PM
- VM size: 60 GB
- Getting VM info from vSphere
- Creating VM snapshot
- Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.vmx
- Saving [DoradoA1] CentOS7.9_FORBackup/CentOS7.9_FORBackup.nvram
- Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd]
- Hard disk 1 (60 GB) 5 GB read at 2 GB/s [CBT]
- Removing VM snapshot
- Finalizing
- Busy: Source 0% > Proxy 75% > Network 0% > Target 0%
- Primary bottleneck: Proxy
- Network traffic verification detected no corrupted blocks
- Processing finished at 4/12/2023 12:19:06 PM

Test 5.3 Synthetic full backup

Check the advanced setting on backup job, the synthetic full backup is enabled.

The 'Advanced Settings' dialog box is shown with the 'Backup' tab selected. The 'Backup mode' section has 'Incremental (recommended)' selected, with the option 'Create synthetic full backups periodically on: Mon, Tue, Wed, Thu, Fri' checked. The 'Active full backup' section has 'Create active full backups periodically on: Saturday' unchecked.

Check the backup job, the synthetic full backup is executed automatically and successfully.

The screenshot shows a backup management interface. At the top, there is a search bar and a table of backup jobs. Below the table, there is a summary section and a detailed log of the backup process.

Name	Type	Obj.	Status	Last Run	Last Result	Target	Next Run	Description
TestCase 2.1.1	VMware Backup	1	Stopped	9 days ago	Success	OceanProtect NAS	<Not scheduled>	Created by LAB\administr
TestCase 2.2	VMware Backup	1	Stopped	9 days ago	Success	OceanStor Pacific NAS	<Not scheduled>	Created by LAB\administr
TestCase 2.3	VMware Backup	1	Stopped	9 days ago	Success	OceanStor Pacific S3	<Not scheduled>	Created by LAB\administr
TestCase 2.4	VMware Backup	1	Stopped	8 days ago	Success	OceanStor 5510 NAS	<Not scheduled>	Created by LAB\administr
TestCase 2.5	VMware Backup	1	Stopped	6 days ago	Success	OceanStor 5510 Hardened	<Not scheduled>	Created by LAB\administr

SUMMARY

Duration: 09:32
 Processing rate: 15 MB/s
 Bottleneck: Proxy

DATA

Processed: 60 GB (100%)
 Read: 148 MB
 Transferred: 47.9 MB (3.1%)

STATUS

Success: 1
 Warnings: 0
 Errors: 0

THROUGHPUT (ALL TIME)

Speed
0 KB/s

Action Log:

- Queued for processing at 4/14/2023 10:00:55 PM
- Required backup infrastructure resources have been assigned
- VM processing started at 4/14/2023 10:01:00 PM
- VM size 60 GB
- Getting VM info from vSphere
- Creating VM snapshot
- Saving [Dorado01] CentOS7.9_FORBackup/CentOS7.9_FORBackup.vmx
- Saving [Dorado01] CentOS7.9_FORBackup/CentOS7.9_FORBackup.nvram
- Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd]
- Hard disk 1 (60 GB) 148 MB read at 148 MB/s [CBT]
- Removing VM snapshot
- Finalizing
- Required backup infrastructure resources have been assigned
- Synthetic full backup created successfully [fast clone]
- Busy: Source 0% > Proxy 36% > Network 0% > Target 0%
- Primary bottleneck: Proxy
- Network traffic verification detected no corrupted blocks
- Processing finished at 4/14/2023 10:03:30 PM

Test 5.4 Immutability of hardened repository

But here we have a hardened repository and we want to test if we can change the backup information directly from the filesystem of the Linux backup server:

```
[root@gw43 TestCase 2.5]# ll
total 18762112
-rw-r--r--. 1 user01 user01      17831 Apr 12 12:20 CentOS7.9_FORBackup_9E395.vbm
-rw-r--r--. 1 user01 user01 17264443392 Apr 12 12:12 CentOS7.9_FORBackup.vm-141D2023-04-12T120839_606A.vbk
-rw-r--r--. 1 user01 user01 1947938816 Apr 12 12:19 CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib
[root@gw43 TestCase 2.5]#
[root@gw43 TestCase 2.5]#
[root@gw43 TestCase 2.5]#
[root@gw43 TestCase 2.5]# id
uid=0(root) gid=0(root) groups=0(root) context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
[root@gw43 TestCase 2.5]# mv CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib.bernd
mv: cannot move 'CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib' to 'CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib.bernd': Operation not permitted
[root@gw43 TestCase 2.5]# ls -ald
drwxr-xr-x. 2 user01 user01 186 Apr 12 13:24 .
[root@gw43 TestCase 2.5]# cd
[root@gw43 ~]# su -m user01
bash: /root/.bashrc: Permission denied
bash-4.4$
bash-4.4$
bash-4.4$
bash-4.4$
bash-4.4$ exit
[root@gw43 ~]# su - user01
[user01@gw43 ~]# cd /hardened/backups/
[user01@gw43 backups]# ll
total 0
drwxr-xr-x. 2 user01 user01 186 Apr 12 13:24 'TestCase 2.5'
[user01@gw43 backups]# cd TestCase\ 2.5/
[user01@gw43 TestCase 2.5]# ll
total 18762112
-rw-r--r--. 1 user01 user01      17831 Apr 12 12:20 CentOS7.9_FORBackup_9E395.vbm
-rw-r--r--. 1 user01 user01 17264443392 Apr 12 12:12 CentOS7.9_FORBackup.vm-141D2023-04-12T120839_606A.vbk
-rw-r--r--. 1 user01 user01 1947938816 Apr 12 12:19 CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib
[user01@gw43 TestCase 2.5]# mv CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib.bernd
mv: cannot move 'CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib' to 'CentOS7.9_FORBackup.vm-141D2023-04-12T121558_146E.vib.bernd': Operation not permitted
[user01@gw43 TestCase 2.5]#
```

As you can see in the screen shot, it was not possible to change or delete the backup pieces belonging to the backups of the VM. We can't do this with the root account or with the user who owns the files.

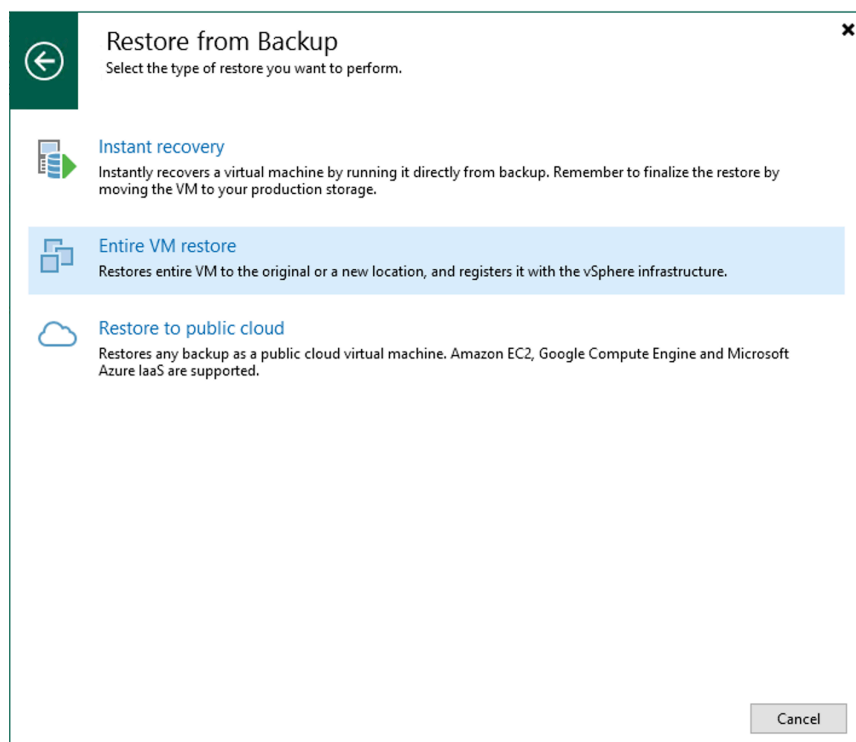
So, a hardened repository is immutable.

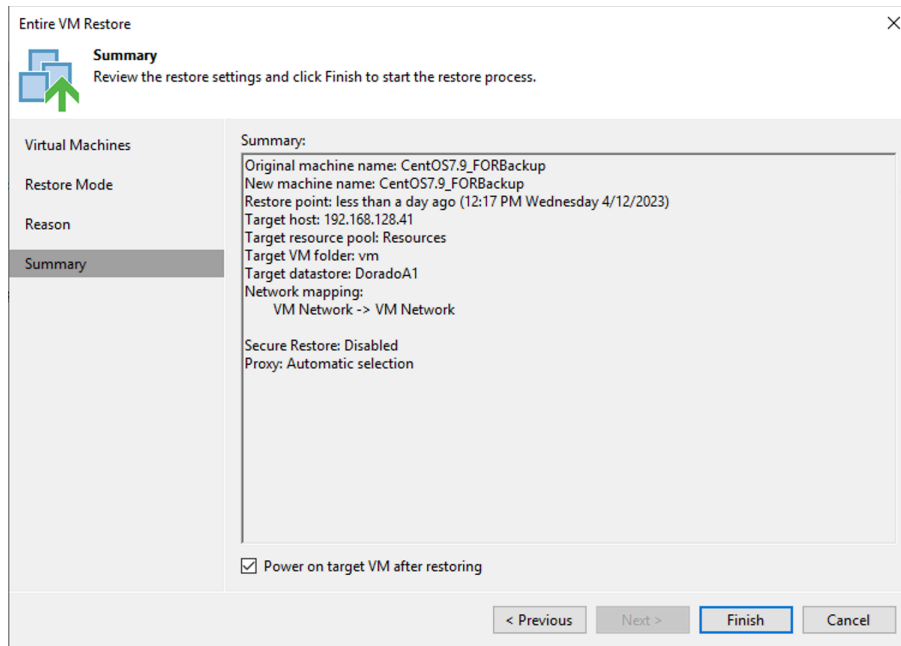
Test 5.5 Restore VM

Then delete the 5 files which copied in the VM.

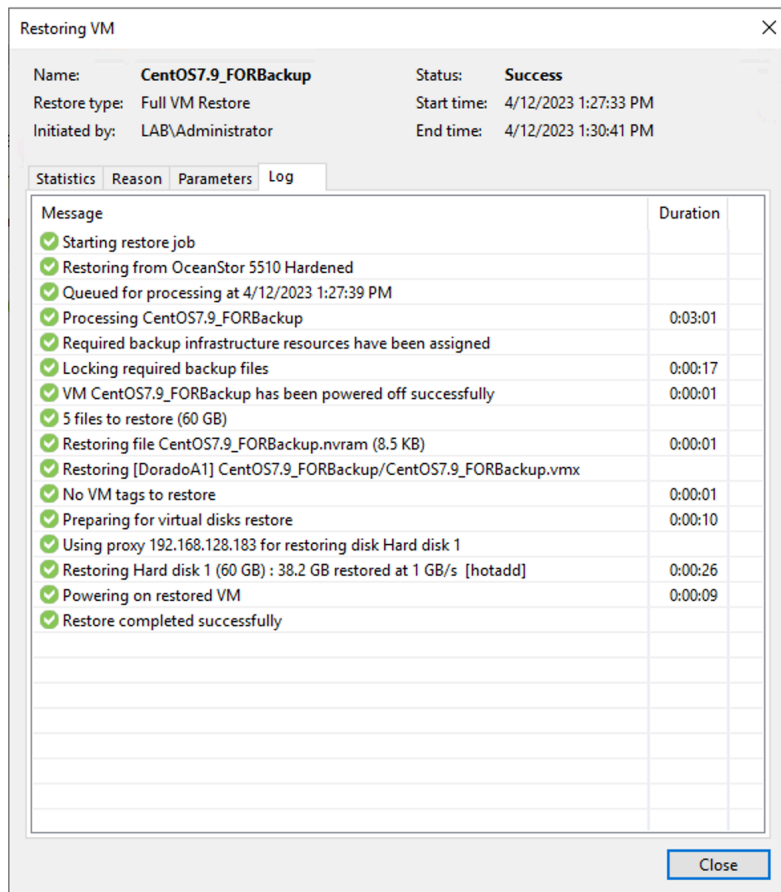
```
[root@host141 vdbench50407]# sha256sum /home/fs5/vdb.l_1.dir/*
6b1b1c8174c07c09613c1c2a5e85d46a10c633d4a1644880f5d40dbfa90f3291 /home/fs5/vdb.l_1.dir/vdb_f0000.file
62274b01d5539c5367823566069df08e2a93c547a33870410744d425a4c3882f /home/fs5/vdb.l_1.dir/vdb_f0001.file
2fa0d64b51b2121a8e900cae0e1068f329cdce98b9155f0c13e3d8e0d814872d /home/fs5/vdb.l_1.dir/vdb_f0002.file
5f4d4ee6e7cca54f03410122a36b67c9b9ff8d60834309bcccd84a3968328380 /home/fs5/vdb.l_1.dir/vdb_f0003.file
bc6e0a83abe99b5309810calc7a78043722361e25db387e50bbb9afe91cf6f9a /home/fs5/vdb.l_1.dir/vdb_f0004.file
[root@host141 vdbench50407]# rm /home/fs5/vdb.l_1.dir/*
rm: remove regular file '/home/fs5/vdb.l_1.dir/vdb_f0000.file'? y
rm: remove regular file '/home/fs5/vdb.l_1.dir/vdb_f0001.file'? y
rm: remove regular file '/home/fs5/vdb.l_1.dir/vdb_f0002.file'? y
rm: remove regular file '/home/fs5/vdb.l_1.dir/vdb_f0003.file'? y
rm: remove regular file '/home/fs5/vdb.l_1.dir/vdb_f0004.file'? y
[root@host141 vdbench50407]# ll /home/fs5/vdb.l_1.dir/*
ls: cannot access /home/fs5/vdb.l_1.dir/*: No such file or directory
[root@host141 vdbench50407]#
```

Start the restore from backup job after the files were deleted in the VM.





The restore VM is completed and successes.



Check the hash value after the VM power on, and the value is the same with before for every file.


```

login as: root
root@192.168.128.141's password:
Last login: Wed Apr 12 12:27:24 2023 from win-ct6p727k71f.lab.com
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# ll /home/fs5/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /home/fs5/vdb.1_1.dir/*
6b1b1c8174c07c09613c1c2a5e85d46a10c633d4a1644880f5d40dbfa90f3291 /home/fs5/vdb.1_1.dir/vdb_f0000.file
62274b01d5539c5367823566069df08e2a93c547a33870410744d425a4c3882f /home/fs5/vdb.1_1.dir/vdb_f0001.file
2fa0d64b51b2121a8e900cae0e1068f329cdce98b9155f0c13e3d8e0d814872d /home/fs5/vdb.1_1.dir/vdb_f0002.file
5f4d4ee6e7cca54f03410122a36b67c9b99ff8d60834309bcccd84a3968328380 /home/fs5/vdb.1_1.dir/vdb_f0003.file
bc6e0a83abe99b5309810calc7a78043722361e25db387e50bbb9afe91cf6f9a /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#

```

Test 5.6 Restore Guest-OS files

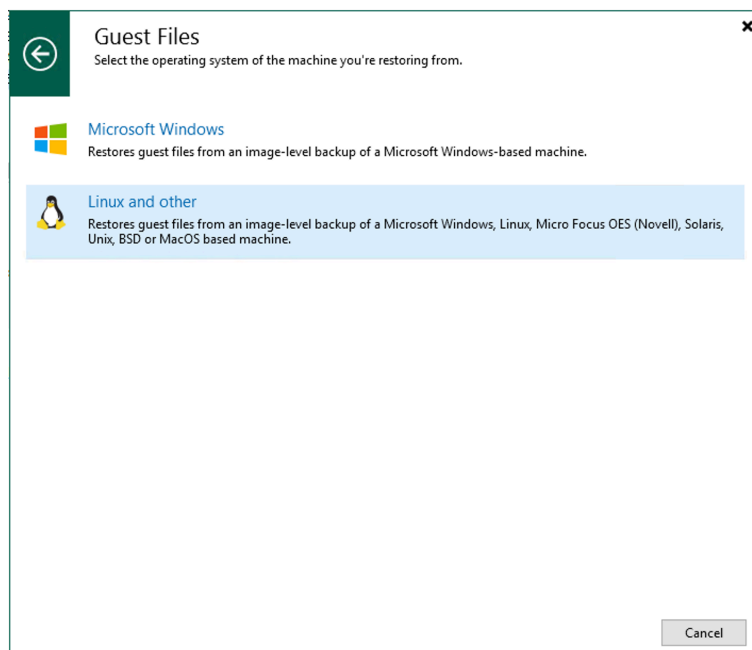
Then delete the files again, we are going to restore the files only.

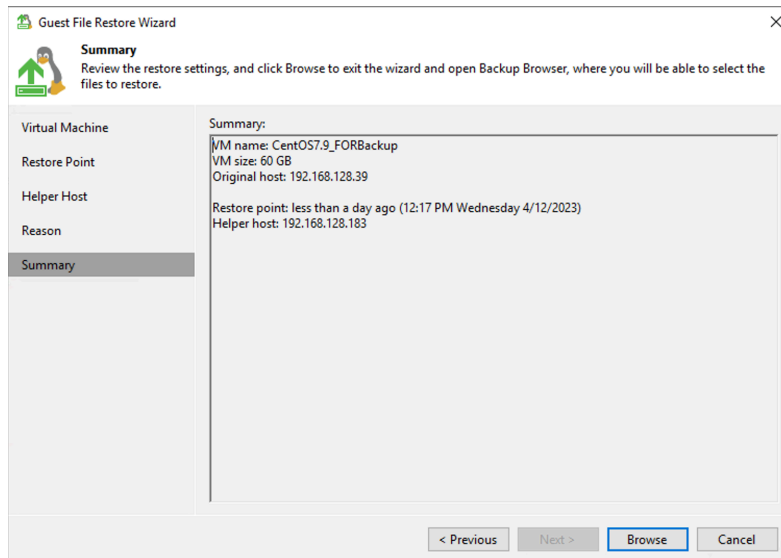
```

root@host141:~
[root@host141 ~]# ll /home/fs5/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /home/fs5/vdb.1_1.dir/*
6b1b1c8174c07c09613c1c2a5e85d46a10c633d4a1644880f5d40dbfa90f3291 /home/fs5/vdb.1_1.dir/vdb_f0000.file
62274b01d5539c5367823566069df08e2a93c547a33870410744d425a4c3882f /home/fs5/vdb.1_1.dir/vdb_f0001.file
2fa0d64b51b2121a8e900cae0e1068f329cdce98b9155f0c13e3d8e0d814872d /home/fs5/vdb.1_1.dir/vdb_f0002.file
5f4d4ee6e7cca54f03410122a36b67c9b99ff8d60834309bcccd84a3968328380 /home/fs5/vdb.1_1.dir/vdb_f0003.file
bc6e0a83abe99b5309810calc7a78043722361e25db387e50bbb9afe91cf6f9a /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# rm /home/fs5/vdb.1_1.dir/*
rm: remove regular file '/home/fs5/vdb.1_1.dir/vdb_f0000.file'? y
rm: remove regular file '/home/fs5/vdb.1_1.dir/vdb_f0001.file'? y
rm: remove regular file '/home/fs5/vdb.1_1.dir/vdb_f0002.file'? y
rm: remove regular file '/home/fs5/vdb.1_1.dir/vdb_f0003.file'? y
rm: remove regular file '/home/fs5/vdb.1_1.dir/vdb_f0004.file'? y
[root@host141 ~]# ll /home/fs5/vdb.1_1.dir/*
ls: cannot access /home/fs5/vdb.1_1.dir/*: No such file or directory
[root@host141 ~]#

```

Start the guest files restore job.



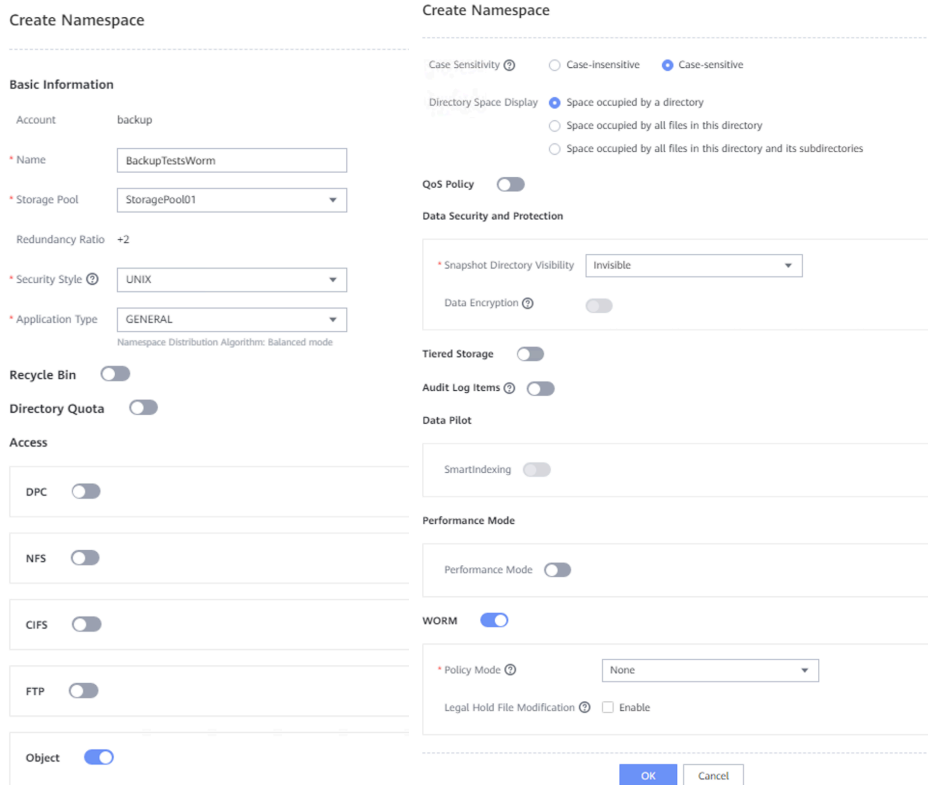


Check the files in the directory after the restore job finish, every file is restored successfully.

```
[root@host141 ~]# ll /home/fs5/vdb.1_1.dir/*
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 12 14:31 /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]# sha256sum /home/fs5/vdb.1_1.dir/*
6b1b1c8174c07c09613c1c2a5e85d46a10c633d4a1644880f5d40dbfa90f3291 /home/fs5/vdb.1_1.dir/vdb_f0000.file
62274b01d5539c5367823566069df08e2a93c547a33870410744d425a4c3882f /home/fs5/vdb.1_1.dir/vdb_f0001.file
2fa0d64b51b2121a8e900cae0e1068f329cdce98b9155f0c13e3d8e0d814872d /home/fs5/vdb.1_1.dir/vdb_f0002.file
5f4d4ee6e7cca54f03410122a36b67c9b9ff8d60834309bcccd84a3968328380 /home/fs5/vdb.1_1.dir/vdb_f0003.file
bc6e0a83abe99b5309810c1c7a78043722361e25db387e50bbb9afe91cf6f9a /home/fs5/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
```

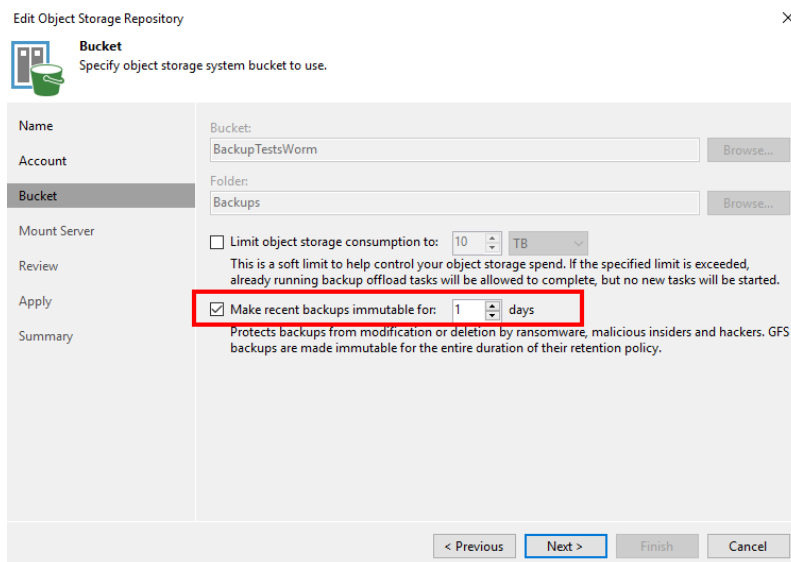
Test 6 OceanStor Pacific Object service with WORM as the Backup Repository

One namespace with WORM functionality on the OceanStor Pacific 9550 is created.



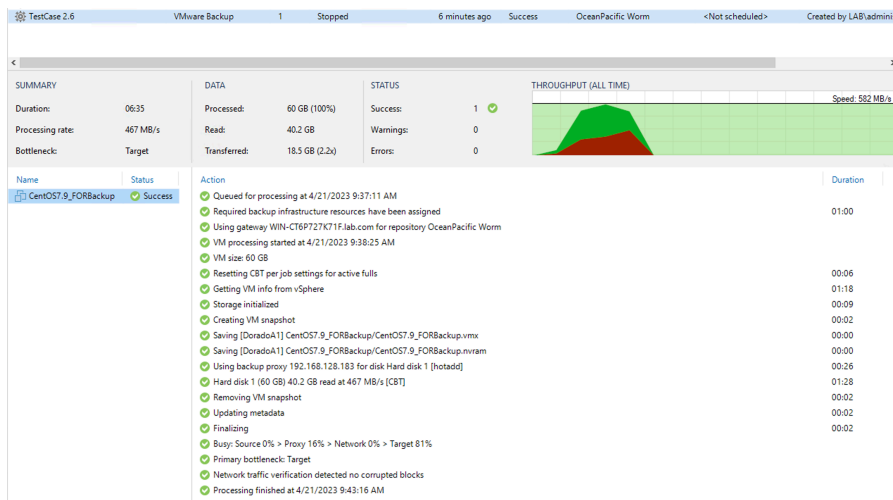
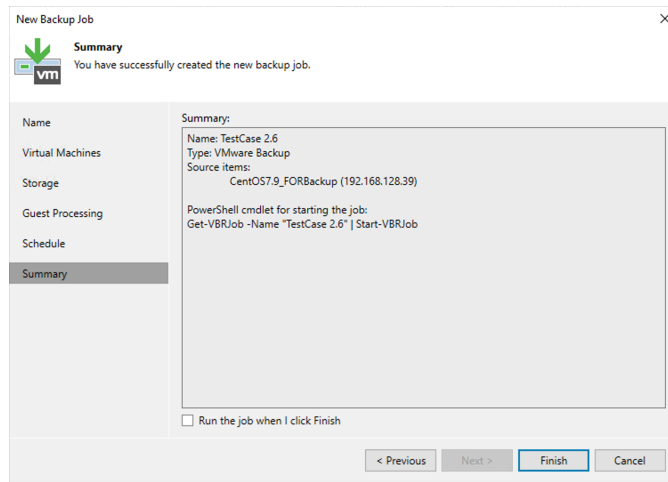
The above two screenshots show the creation of the same namespace. The WORM functionality is selected on the second picture in the lower part.

The next step is to create an S3 compatible backup repository, checked “make recent backups immutable for:” and set 1 day, then finish the creation of Object Storage Repository.



Test 6.1 Full backup

Start new backup job based on the object repository with immutable from OceanStor Pacific 9550 and it executed successfully.



Test 6.2 Incremental backup

Next step, copy 5 files to the directory of VM to simulate the incremental date.

```

12:02:48.225
12:02:48.225 Miscellaneous statistics:
12:02:48.225 (These statistics do not include activity between the last reported interval and shutdown.)
12:02:48.225 WRITE_OPENS          Files opened for write activity:          2          1/sec
12:02:48.225
12:02:48.939 Vdbench execution completed successfully. Output directory: /root/vdbench50407/output

[root@host141 vdbench50407]# cd /home/fs6
[root@host141 fs6]# ll
total 8
-rwxrwxrwx. 1 root root 68 Apr 21 12:02 no_dismount.txt
drwxr-xr-x. 2 root root 116 Apr 21 12:02 vdb.1_1.dir
-rwxrwxrwx. 1 root root 180 Apr 21 12:02 vdb_control.file
[root@host141 fs6]# cd vdb.1_1.dir/
[root@host141 vdb.1_1.dir]# ll
total 5242892
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0004.file
[root@host141 vdb.1_1.dir]# sha256sum vdb_f000*
51560a3cf06ede594e200a88290b40e060629d0fad2ea58cb547c8b27174d02 vdb_f0000.file
1913dd70dae80da9b4e658630fc5586a6be39d3362076028773c4d61c6ad3d42 vdb_f0001.file
b7afd25882e02c55e6edd8195d96bc43e52a83ad42718b141aa73467f475c46b vdb_f0002.file
b87f2200103f07adc89c3919dd540232f137a8531dd4dad967dd9fe000f582d vdb_f0003.file
ee7c7c40629e3cf6fde4e9262e05a0f098772c010c78ad96bd873a3d61de3cc7 vdb_f0004.file
[root@host141 vdb.1_1.dir]# █
    
```

Then start the incremental backup and it executed successfully.

Test Case 2.6 VMware Backup 1 Stopped 5 minutes ago Success OceanPacific Worm <Not scheduled> Created by LAB/administ

SUMMARY	DATA	STATUS	THROUGHPUT (ALL TIME)
Duration: 04:40	Processed: 60 GB (100%)	Success: 1	
Processing rate: 422 MB/s	Read: 5 GB	Warnings: 0	
Bottleneck: Target	Transferred: 1.8 GB (2.8s)	Errors: 0	Speed: 0 KB/s

Name	Status	Action	Duration
CentOS7_9_FORBackup	Success	Queued for processing at 4/21/2023 9:49:36 AM	00:00
		Required backup infrastructure resources have been assigned	
		Using gateway WIN-CT6P727K71F.lab.com for repository OceanPacific Worm	
		VM processing started at 4/21/2023 9:49:39 AM	
		VM size: 60 GB	
		Getting VM info from vSphere	01:01
		Storage initialized	00:09
		Creating VM snapshot	00:02
		Saving [Doradoc1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.vmx	00:00
		Saving [Doradoc1] CentOS7_9_FORBackup/CentOS7_9_FORBackup.nvram	00:00
		Using backup proxy 192.168.128.183 for disk Hard disk 1 [hotadd]	00:21
		Hard disk 1 (60 GB) 5 GB read at 422 MB/s [CBT]	00:12
		Removing VM snapshot	00:02
		Updating metadata	00:02
		Finalizing	00:02
		Busy: Source 0% > Proxy 13% > Network 0% > Target 85%	
		Primary bottleneck: Target	
		Network traffic verification detected no corrupted blocks	
		Processing finished at 4/21/2023 9:52:42 AM	

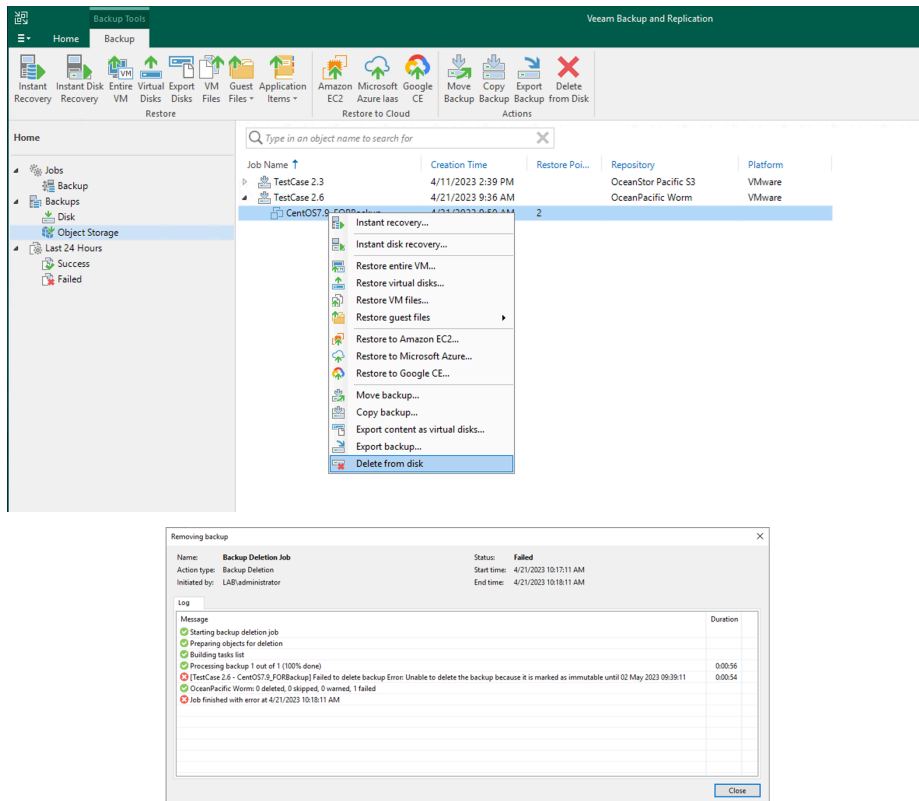
Test 6.3 Immutability of hardened repository

After successful backup and restore tests (as above, without any failures) we could see several buckets with the S3 Browser:

Name	Size	Type	Last Modified	Storage Class
11621_2527ed3c5052228b66495e286802c4_0000000000000000000000000000000000	180 KB	File	4/21/2023 9:51:52 AM	STANDARD
15171_1c1c3e4d7892c59730b6bd41d59692c7_0000000000000000000000000000000000	303 KB	File	4/21/2023 9:51:52 AM	STANDARD
15178_7e0d4aa69ad1addda74c68d80ba22_0000000000000000000000000000000000	361 KB	File	4/21/2023 9:51:52 AM	STANDARD
15179_9eaf038ed2f569c71494a23a415214ac_0000000000000000000000000000000000	142 KB	File	4/21/2023 9:51:52 AM	STANDARD
15720_86dbccfa2683463481d7b6e33e5705_0000000000000000000000000000000000	269 KB	File	4/21/2023 9:51:52 AM	STANDARD
15721_9c69339546790e6041214236a4314c7_0000000000000000000000000000000000	270 KB	File	4/21/2023 9:51:52 AM	STANDARD
15722_3a9d3c36a0d7af1e5840b41f5483a_0000000000000000000000000000000000	323 KB	File	4/21/2023 9:51:52 AM	STANDARD
15723_4a9d0b460594e519455145e841b0_0000000000000000000000000000000000	272 KB	File	4/21/2023 9:52:03 AM	STANDARD
15724_82b3c76c0f20a9c8ee7b64caaa58f_0000000000000000000000000000000000	350 KB	File	4/21/2023 9:52:03 AM	STANDARD
15725_026e32421814524959293365722a_0000000000000000000000000000000000	142 KB	File	4/21/2023 9:52:03 AM	STANDARD
15726_265e4b5293ab751169e363b05911473_0000000000000000000000000000000000	408 KB	File	4/21/2023 9:52:03 AM	STANDARD
15727_9178e3c2113766b2506ac039a79ec34_0000000000000000000000000000000000	220 KB	File	4/21/2023 9:52:03 AM	STANDARD
15728_0081b60a2a2c0f0bec95ca5d4694a0_0000000000000000000000000000000000	141 KB	File	4/21/2023 9:52:03 AM	STANDARD
15729_bc074474d1f5c385c557ac8b7893b1a_0000000000000000000000000000000000	345 KB	File	4/21/2023 9:52:03 AM	STANDARD
15730_a085eac4fc022288b4820698dbb81_0000000000000000000000000000000000	268 KB	File	4/21/2023 9:52:03 AM	STANDARD
15731_6c8ea9b60e59424b9e10e413882c91_0000000000000000000000000000000000	142 KB	File	4/21/2023 9:52:03 AM	STANDARD
15732_620e3946535c1102a98417a09b9ca_0000000000000000000000000000000000	225 KB	File	4/21/2023 9:52:03 AM	STANDARD
15733_704269a2493a617b6e7316af022969e_0000000000000000000000000000000000	232 KB	File	4/21/2023 9:52:03 AM	STANDARD
15734_80c00a767a2e5b165c9b2093da7395b_0000000000000000000000000000000000	365 KB	File	4/21/2023 9:52:03 AM	STANDARD
15735_31378a33682428da2a3b1d8dccc29117_0000000000000000000000000000000000	273 KB	File	4/21/2023 9:52:03 AM	STANDARD
15736_226c101d5a9682a9f1d2d9555795252_0000000000000000000000000000000000	340 KB	File	4/21/2023 9:52:03 AM	STANDARD
15737_a5ea14649d8410f72c491c0aed879ee_0000000000000000000000000000000000	285 KB	File	4/21/2023 9:52:03 AM	STANDARD

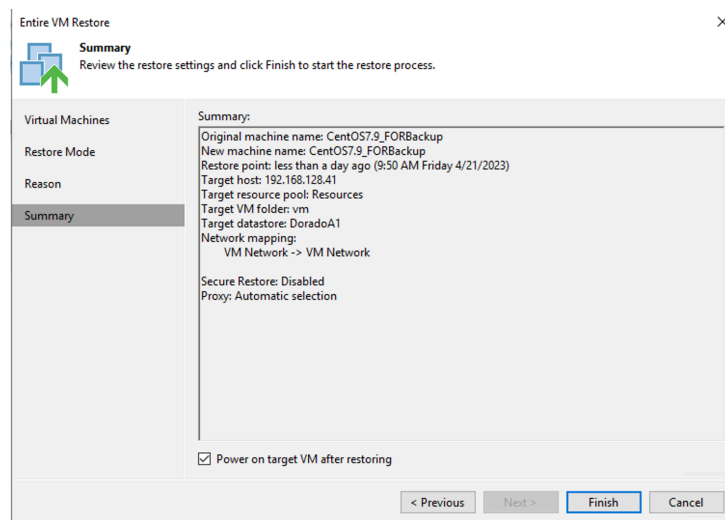
Header	Value	Read-only
x-amz-request-id	c0a9640c168206362381400001131000	Yes
x-reserved	amazon, aws and amazon web services are trademarks or registered trademarks of Amazon Technologies, Inc	No
x-amz-version-id	v043a516122804000	Yes
x-amz-object-lock-mode	COMPLIANCE	Yes
x-amz-object-lock-retain-until-date	2023-05-02T07:39:11	Yes
x-amz-object-lock-legal-hold	OFF	Yes
x-amz-storage-class	STANDARD	No
x-amz-id-2	32AAAQAAEAAABAAAQAAEAAABAAAQAAEABCS1sQae003-zXcBSNlyz2HlsYlR2ax	Yes
Accept-Ranges	bytes	Yes
Content-Length	408286	Yes
Content-Type	application/octet-stream	No
Date	Fri, 21 Apr 2023 07:53:43 GMT	Yes
ETag	"112ca127e0e41a802053e721ce44e691"	Yes
Last-Modified	Fri, 21 Apr 2023 07:52:03 GMT	Yes
Server	OBS	Yes

Now we tried to delete one of the backup pieces from within Veeam, the deletion is failed. Here the WORM functionality of OceanStor Pacific protected the backup files.

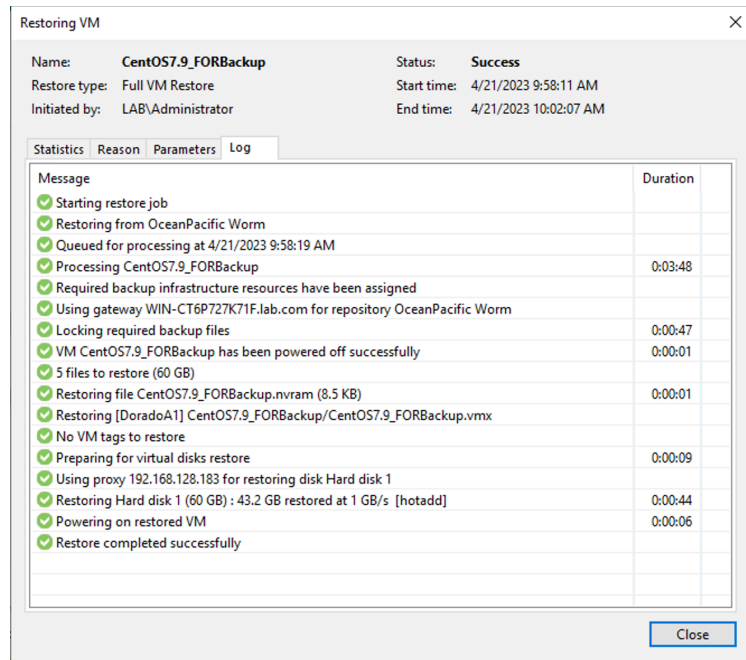


Test 6.5 Restore VM

Start the restore from backup job after the files were deleted in the VM.



The restore VM is completed and successful.



Check the hash value after the VM power on, and the value is the same with before for every file.

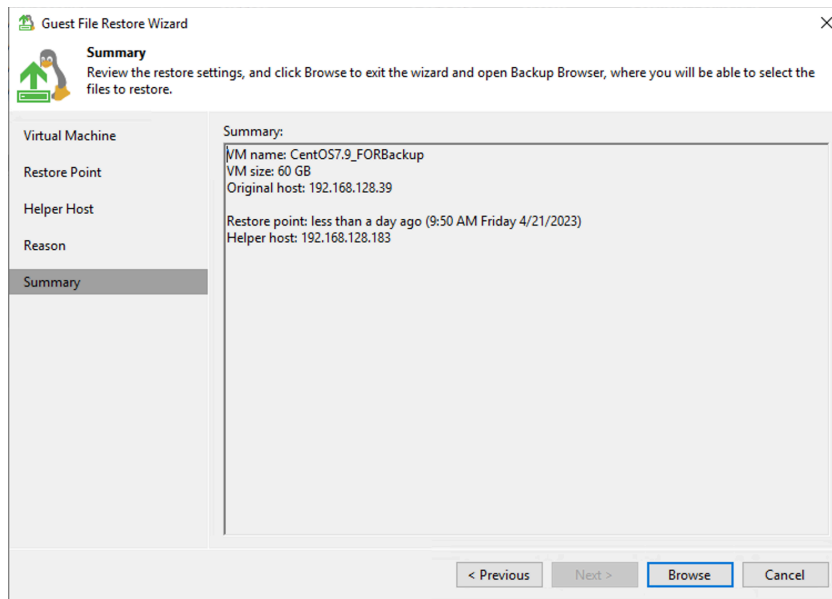
```
[root@host141 vdb.1_1.dir]# ll
total 5242892
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0004.file
[root@host141 vdb.1_1.dir]# sha256sum vdb_f000*
51560a3cf06ede594e200a88290b40e060629d0fad2ea58c1b547c8b27174d02 vdb_f0000.file
1913dd70dae80da9b4e658630fc5586a6be39d362076028773c4d61c6ad3d42 vdb_f0001.file
b7af2582e02c55efedd8195d96bc43e52a83ad42718b141aa73467f475c46b vdb_f0002.file
b87f22b00103f07adc89c3919dd540232f137a8531dd4dad967dd9fe000f582d vdb_f0003.file
ee7c7c40629e3cf6fde4e9262e05a0f098772c010c78ad96bd873a3d61de3cc7 vdb_f0004.file
[root@host141 vdb.1_1.dir]#
[root@host141 vdb.1_1.dir]#
[root@host141 vdb.1_1.dir]# rm vdb_f000*
rm: remove regular file 'vdb_f0000.file'? y
rm: remove regular file 'vdb_f0001.file'? y
rm: remove regular file 'vdb_f0002.file'? y
rm: remove regular file 'vdb_f0003.file'? y
rm: remove regular file 'vdb_f0004.file'? y
[root@host141 vdb.1_1.dir]#
[root@host141 vdb.1_1.dir]# ll
total 0
[root@host141 vdb.1_1.dir]#
login as: root
root@192.168.128.141's password:
Last login: Thu Apr 20 16:55:04 2023 from win-ct6p727k71f.lab.com
[root@host141 ~]# uptime
12:19:43 up 1 min, 1 user, load average: 0.07, 0.03, 0.01
[root@host141 ~]# ll /home/
fs5/ fs6/ user01/
[root@host141 ~]# ll /home/fs6/vdb
vdb.1_1.dir/ vdb_control.file
[root@host141 ~]# ll /home/fs6/vdb.1_1.dir/
total 5242892
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0000.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0001.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0003.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 vdb_f0004.file
[root@host141 ~]# sha256sum /home/fs6/vdb.1_1.dir/*
51560a3cf06ede594e200a88290b40e060629d0fad2ea58c1b547c8b27174d02 /home/fs6/vdb.1_1.dir/vdb_f0000.file
1913dd70dae80da9b4e658630fc5586a6be39d362076028773c4d61c6ad3d42 /home/fs6/vdb.1_1.dir/vdb_f0001.file
b7af2582e02c55efedd8195d96bc43e52a83ad42718b141aa73467f475c46b /home/fs6/vdb.1_1.dir/vdb_f0002.file
b87f22b00103f07adc89c3919dd540232f137a8531dd4dad967dd9fe000f582d /home/fs6/vdb.1_1.dir/vdb_f0003.file
ee7c7c40629e3cf6fde4e9262e05a0f098772c010c78ad96bd873a3d61de3cc7 /home/fs6/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
```

Test 6.6 Restore Guest-OS files

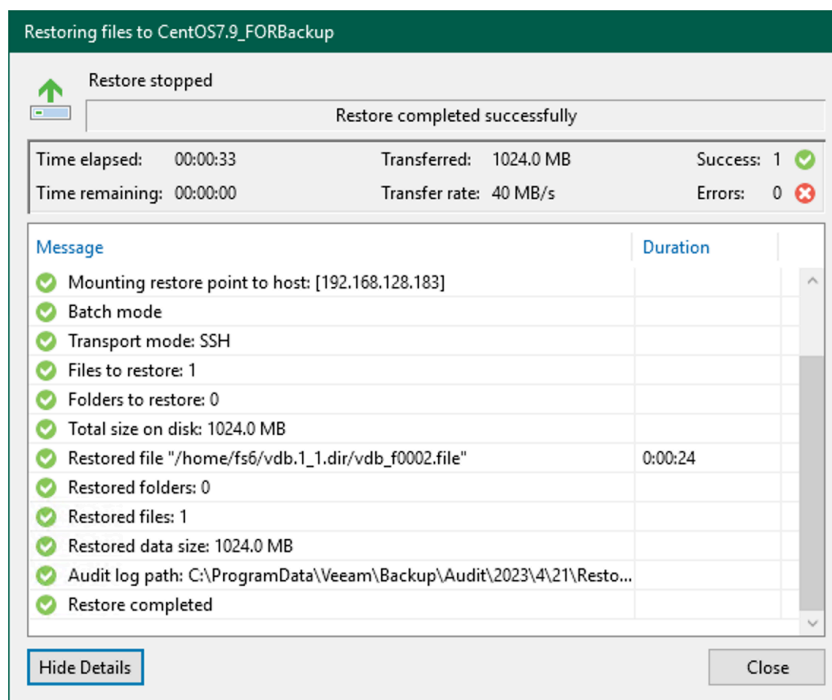
Then delete one file again, we are going to restore the files only.

```
[root@host141 ~]# sha256sum /home/fs6/vdb.1_1.dir/*
51560a3cf06ede594e200a88290b40e060629d0fad2ea58c1b547c8b27174d02 /home/fs6/vdb.1_1.dir/vdb_f0000.file
1913dd70dae80da9b4e658630fc55896a6be39d3362076028773c4d61c6ad3d42 /home/fs6/vdb.1_1.dir/vdb_f0001.file
b7afd25882e02c55e6edd8195d96bc43e52a83ad42718b141aa73467f475c46b /home/fs6/vdb.1_1.dir/vdb_f0002.file
b87f22b00103f07adc89c3919dd540232f137a8531dd4dad967dd9fe000f582d /home/fs6/vdb.1_1.dir/vdb_f0003.file
ee7c740629e3cf6fde4e9262e05a0f098772c010c78ad96bd873a3d61de3cc7 /home/fs6/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
rm: cannot remove '/home/fs6/vdb.1_1.dir//home/fs6/vdb.1_1.dir/vdb_f0002.file': No such file or directory
[root@host141 ~]#
[root@host141 ~]# rm /home/fs6/vdb.1_1.dir/vdb_f0002.file
rm: remove regular file '/home/fs6/vdb.1_1.dir/vdb_f0002.file'? z
[root@host141 ~]# rm /home/fs6/vdb.1_1.dir/vdb_f0002.file
rm: remove regular file '/home/fs6/vdb.1_1.dir/vdb_f0002.file'? y
[root@host141 ~]# ll /home/fs6/vdb.1_1.dir/vdb_f0002.file
ls: cannot access '/home/fs6/vdb.1_1.dir/vdb_f0002.file': No such file or directory
[root@host141 ~]#
```

Start the guest files restore job.



And the files are restore completed and successes.



Check the file is restored to the directory successfully and the hash value is same with before.


```
[root@host141 ~]# sha256sum /home/fs6/vdb.1_1.dir/*
51560a3cf06ede594e200a88290b40e060629d0fad2ea58cb547c8b27174d02 /home/fs6/vdb.1_1.dir/vdb_f0000.file
1913dd70dae80da9b4e658630fc5596a6be39d3362076028773c4d61c6ad3d42 /home/fs6/vdb.1_1.dir/vdb_f0001.file
b7afd25882e02c55e6edd8195d96bc43e52a83ad42718b141aa73467f475c46b /home/fs6/vdb.1_1.dir/vdb_f0002.file
b87f22b00103f07adc89c3919d540232f137a8531dd4dad967dd9fe000f582d /home/fs6/vdb.1_1.dir/vdb_f0003.file
ee7c740629e3cfc6fde4e9262e05a0f098772c010c78ad96bd873a3d61de3cc7 /home/fs6/vdb.1_1.dir/vdb_f0004.file
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# rm /home/fs6/vdb.1_1.dir//home/fs6/vdb.1_1.dir/vdb_f0002.file
rm: cannot remove '/home/fs6/vdb.1_1.dir//home/fs6/vdb.1_1.dir/vdb_f0002.file': No such file or directory
[root@host141 ~]#
[root@host141 ~]# rm /home/fs6/vdb.1_1.dir/vdb_f0002.file
rm: remove regular file '/home/fs6/vdb.1_1.dir/vdb_f0002.file'? z
[root@host141 ~]# rm /home/fs6/vdb.1_1.dir/vdb_f0002.file
rm: remove regular file '/home/fs6/vdb.1_1.dir/vdb_f0002.file'? y
[root@host141 ~]# ll /home/fs6/vdb.1_1.dir/vdb_f0002.file
ls: cannot access '/home/fs6/vdb.1_1.dir/vdb_f0002.file': No such file or directory
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]#
[root@host141 ~]# ll /home/fs6/vdb.1_1.dir/vdb_f0002.file
-rw-r--r--. 1 root root 1073741824 Apr 21 12:02 /home/fs6/vdb.1_1.dir/vdb_f0002.file
[root@host141 ~]# sha256sum /home/fs6/vdb.1_1.dir/vdb_f0002.file
b7afd25882e02c55e6edd8195d96bc43e52a83ad42718b141aa73467f475c46b /home/fs6/vdb.1_1.dir/vdb_f0002.file
[root@host141 ~]# █
```

Conclusion

We can summarize the results of our tests as follows:

- I. In every tested backup repository configuration, all backup and restore operations worked as usual. We could not find any differences to normal standard repositories.
- II. The hardened repository type worked perfectly. It was not possible to delete any data in the backup repository, even from the Linux command line as a super user (root) nor the owner of the files. Protection of the backup data is really given.
- III. Also, the worm functionality (immutable) of the OceanStor Pacific Scale-Out Storage system works perfectly. It is not possible to delete any backup data, also in conjunction with the object storage functionality.

The stability and behavior of the systems was always flawless in the test. We did not notice any failures or inexplicable performance fluctuations. The operation of the Huawei Storage Systems is intuitive and easy even for beginners.

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Bernd Patolla studied computer science at the University of Passau and joined In&Out AG in 2005. Bernd Patolla is specialized in Oracle and PostgreSQL databases, Unix operating systems, backup environments and storage systems.

In&Out has many years of practical experience in architecture, conception, benchmarking and tuning of storage and system platforms, especially for core applications for banks and insurance companies.