EANTC Independent Test Report

Huawei OceanStor Dorado and VMware Interoperability Test

December 2019

Introduction

The current implementations of the cloud data centers (DC) involve a broad spectrum of solutions for the data center infrastructure (compute, network, storage, and hypervisor layer). In most of the cases, each of these components is deployed along with specific and proprietary management software. The management software enables DC administrators to operate, configure, and monitor the DC infrastructure. However, running multiple management software or tracking different web portals add extra pressure on top of the DC administrators or operations team. One solution for that is to integrate various vendor's solutions within one management software or portal.

For this purpose, Huawei commissioned EANTC to verify the compatibility of Huawei OceanStor Dorado V6 Storage solution with some selected VMware platforms and plugins including:

- VMware vSphere Hypervisor (ESXi) version 6.0, 6.5, 6.7
- VMware vCenter Web Client - Huawei NGC plugin

Huawei Storage NGC Plugin provides integrated storage management for VMware infrastructure, including storage discovery, health monitor, capacity management, provisioning datastore, backup and restore services. VMware administrators can access and execute the sample storage management directly from VMware vCenter.

- VMware vRealize Orchestrator (vRO)

vRO plays an orchestration role to support the host mapping management, create and delete the datastores or snapshots.

- VMware vRealize Operations Manager (vROps)

vROps identifies the issues in any monitored system component, using the data collected from system resources. also, vRealize Operations Manager offers rich analytical tools that allow the operation team to review and manipulate object data to reveal hidden issues.

- VMware Site Recovery Manager (SRM)

SRM enables the deployments of the active-active DCs by supporting planned maintenance of one site without any service downtime, prevent service outages and disaster avoidance and the automated initiation of VM restart or recovery.

This report describes the test scenarios and results to verify the interoperability between Huawei OceanStor Dorado V6 and VMware ESXi hypervisor, as well as the functionality of VMware plugins provided by Huawei for VMware vCenter/vRO/vROps/SRM/SRM Stretch.

Test Highlights

→ Improve the operation efficiency by enabling VMware administrators to manage Huawei storage resources within the VMware environment centrally

→ Highly-available storage solution, with verified resilient active-active data centers design

→ Support hardware offload for some storage operation tasks (cloning, VM migration, space reclamation and zeroing) by the direct integration with VMware vSphere Storage APIs (VAAI)

→ Proven ability to integrate with VMware vCenter Web Client using Huawei NGC plugin

→ Proven ability to integrate with VMware vRealize Orchestrator (vRO) using Huawei vRO plugin

→ Proven ability to integrate with VMware vRealize Operations Manager (vROps) using Huawei vROps plugin

→ Proven ability to integrate with VMware Site Recovery Manager (SRM) using Huawei SRA plugin

→ Verified high IOPS operations stability by 12 hours soak testing

Huawei OceanStor Dorado V6

Refer to Huawei website, Huawei OceanStor Dorado V6 is a new-generation all-flash storage system developed by Huawei for core enterprise services. Based on the new hardware platform and SmartMatrix full-mesh architecture, Huawei OceanStor Dorado V6 delivers industry-leading performance and reliability.

Figure 1: Test Product

The product models include Huawei OceanStor Dorado 3000, 5000, 6000, 8000, and 18000 V6.

Systems Under Test (SUT): Hardware and Software Version

Product Name	Version
Huawei OceanStor Dorado 6000 V6	6.0.RC1
Huawei Storage VMware Next Generation Client Plugin (Huawei NGC Plugin)	2.1.16
Huawei Storage Replication Adapter Plugin (Huawei SRA Plugin)	2.1.15
Huawei Storage vRealize Orchestrator Plugin (Huawei vRO Plugin)	2.1.10
Huawei Storage vRealize Operations Manager Plugin (Huawei vROps Plugin)	1.0.16
Huawei OceanStor UltraPath Plugin for VMware (Huawei UltraPath)	21.6.0
VMware Site Recovery Manager (SRM)	8.2.0
VMware vCenter Server Appliance (VCSA)	6.7
VMware vRealize Operations Manager (vROps)	7.5
VMware vRealize Orchestrator Appliance (vRO)	7.6
VMware vSphere Hypervisor (ESXi)	6.0/6.5/6.7

Table 1: Hardware and Software Details

Physical Server Specification

Server Module	Specifications
3 x HPE ProLiant DL380 Gen9	1 x Intel(R) Xeon(R) CPU E5-2699 v3 @ 2.30GHz
	8 x 32GB(256GB) DDR4 RAM
	1 x HPE 1.2TB EG1200JEHMC HDD
	1 x HPE Ethernet 1Gb 4-port 331i Adapter - NIC
	1 x QLogic QLE2692 16GB FC Dual-port - HBA
	System ROM: P89 v2.42
	Intelligent Provisioning: 2.40.79

Table 2: Physical Server Specification

The Test Outlook

EANTC and Huawei defined a test plan consisted of 34 test cases segmented in 5 different test scenarios. EANTC executed all the test cases based on the predefined test plan. All the test cases successfully achieved the expected results and passed the spot-checks.

In the following sections, we will explain each test scenario and the test setup based on the software plugins which we used for the test. As well as, we will declare the achieved results along with a brief explanation about those results. The five test scenarios are segmented as the following:

1. VMware vSphere Hypervisor (ESXi) Interoperability Test

2. Huawei NGC Plugin for VMware vCenter Server Appliance (VCSA)

3. Huawei vRO Plugin for VMware vRealize Orchestrator Appliance (vRO)

4. Huawei vROps Plugin for VMware vRealize Operations Manager (vROps)

5. Huawei SRA Plugin for VMware Site Recovery Manager (SRM)

1. VMware vSphere Hypervisor (ESXi) Interoperability Test

Huawei OceanStor Dorado V6 storage system supports the interoperability with VMware vSphere Hypervisor (ESXi), including the basic operations and advanced high performance and reliability features, such as VMware VAAI and HyperMetro.

Category	Test Case	Verdict
Basic Operation	Mapping a Maximum Number of LUNs	**PASS**
	Adding VMDK and RDM	**PASS**
VAAI	Cloning a VM in the Datas-	**PASS**
	Migrating a VM Between Datastores	**PASS**
	Reclaiming Storage Space	**PASS**
	Creating a Thick Provision Lazy Zeroed/Thick Provision	**PASS**
	Starting Multiple VMs	**PASS**
Reliability	Constructing and Recovering a Faulty Link on a Single Controller	**PASS**
	Restarting a Single Controller	**PASS**
Long Stability Test	Running VMs Stably for 12 Hours Under Heavy I/O Pressure	**PASS**
HyperMetro	Injecting a Remote Replication Link Fault to HyperMetro Storage	**PASS**
	Injecting a Single Storage Array Fault to HyperMetro Storage	**PASS**
	Injecting a Quorum Server	**PASS**

Table 3: ESXi Interoperability Test Results Summary

This test covers the basic operation, VAAI, reliability, long stability, and HyperMetro. EANTC tested the VMware ESXi interoperability with Huawei OceanStor Dorado V6 on ESXi version 6.0, 6.5, and 6.7. Table 3 lists the summary of the test results for VMware ESXi Interoperability Tests.
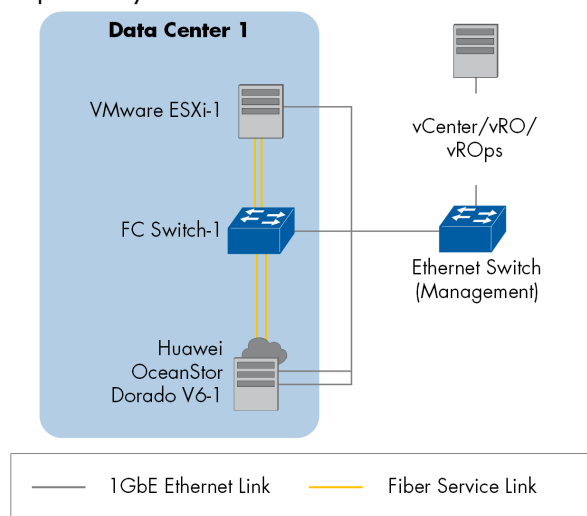

Figure 2: Single Data Center Single Storage Test Topology

Figure 2 illustrates the test topology for the following test categories: Basic Operation, VAAI, Reliability, Long Stability. The following chapters describe the test results for each test category.

Test Category: Basic Operation Tests

This test category is to verify that LUNs on Huawei OceanStor Dorado V6 can be mapped to and correctly identified by VMware ESXi hosts and used as VM disks. Below are the test results for this category.

- Mapping a Maximum Number of LUNs

VMware vSphere Hypervisor (ESXi) 6.0, 6.5, 6.7 supports the mapping of maximum 256, 512, 1024 LUNs, respectively. Since one LUN mapping index is occupied by the host internal storage, in this test, we created the (MAX_NUMBER – 1) of LUNs on Huawei OceanStor Dorado V6 storage system and mapped them to the ESXi host. The test result shows that all LUNs can be mapped to the host successfully.

- Adding VMDK and RDM Disks to Existing VMs

EANTC performed the test to add VMDK and RDM disks to the VMs and verified that the newly added disks could be formatted and used for I/O operations. The test results showed that VMs hosted on ESXi hosts can use the LUNs created on Huawei OceanStor Dorado V6 in VMDK or RDM format.

Test Category: VAAI Test

This chapter is to test the VAAI support by Huawei OceanStor Dorado V6. VMware vSphere API for Array Integration (VAAI) can offload specific I/O operations to the supported SAN storage. It can improve the overall performance and efficiency of VMware vSphere Hypervisor (ESXi) I/O operations.

EANTC tested the support for VMware VAAI Full Copy, Reclaiming Storage Space, Block Zero, and HW Assisted Locking. Below are the test cases and results.

- Cloning a VM in the Datastore/Migrating a VM Between Datastores

EANTC performed the test of Cloning a VM in the Datastore and Migrating a VM between Datastore. The test results showed that Huawei storage supports the VMware VAAI Full Copy feature for the VM clone and VM migration operations. Figure 3 depicts a screenshot of CLI output shows the VAAI support.

```
[root@inb-srv5:~] esxcli storage core device vaai
status get -d naa.6cc64a6100831492052d445e00000000
naa.6cc64a6100831492052d445e00000000
   VAAI Plugin Name:
   ATS Status: supported
   Clone Status: supported
   Zero Status: supported
   Delete Status: supported
```

Figure 3: VAAI support status

- Reclaiming Storage Space

EANTC tested the Storage Space Reclamation by mapping a thin LUN to the VMware ESXi host and add it to a VM as a VMDK disk. After deleting the disk from the VM, the allocated storage space was reclaimed automatically in VMware ESXi 6.5 and 6.7. VMware ESXi 6.0 doesn't support automatic storage space unmap, so we tested it with the ESXi CLI command to trigger the storage space reclamation manually.

- Creating a Thick Provision Lazy Zeroed/Thick Provision Eager Zeroed Virtual Disk

EANTC tested creating two virtual disks with Thick Provision Lazy Zeroed and Thick Provision Eager Zeroed, and results showed that both types of Block Zero were supported.

- Starting Multiple VMs

EANTC tested the hardware accelerated locking (ATS) by creating 10 VMs and starting them at the same time. Results showed that the ESXi host and storage system could support ATS to improve the scalability of the data center and a high density of VMs.

Test Category: Reliability Test

This chapter is to test the reliability of VMware ESXi and Huawei OceanStor Dorado V6 in handling a link failure or a storage node single controller failure. Huawei OceanStor Dorado V6 supports the VMware Native Multipathing Plugin (VMware NMP) to manage the multiple paths between host and storage system. Alternatively, users can choose the Huawei UltraPath multipathing software (Huawei UltraPath) provided by Huawei for the ESXi hosts.

EANTC tested both VMware NMP and Huawei UltraPath multipathing software in the scenario of a single link failure and a storage node single controller failure. Below are the test cases and results.

- Constructing and Recovering a Faulty Link on a Single Controller

The test results showed that both VMware NMP and Huawei UltraPath could be used to manage the path discovery and management, as well as the path failure discovery and recovery. EANTC confirmed that the I/O was suspended for less than 15 seconds while constructing a single link failure. The failure recovery had no impact on the I/O services, and the host can discover the restored paths again.

- Restarting a Single Controller

EANTC confirmed that the I/O was suspended for less than 15 seconds while constructing a storage node single controller failure. The failure recovery had no impact on the I/O services, and the host can discover the restored paths again.

Test Category: Long-run Stability Test

EANTC performed the test of long-run stability by running the continuous I/O of 5 VMs for 12 hours. The test result demonstrated that the Huawei OceanStor Dorado V6 storage system could provide stable and reliable storage services for ESXi hosts. The VMs on the ESXi hosts were running properly after 12 hours, and no I/O error occurred during the test.

Test Category: HyperMetro Test

This chapter describes the HyperMetro test category. HyperMetro is an active-active feature implemented by the Huawei OceanStor Dorado V6 storage system. It allows two LUNs from two storage systems to maintain real-time data consistency. The two storage systems of a HyperMetro deployment can be in the same equipment room, in the same city, or two places within a distance of 300 km, providing flexibility in datacenter disaster recovery design. Running HyperMetro test cases requires at least two storage nodes to form active-active protection in the storage. EANTC executed the HyperMetro tests through the topology illustrated in Figure 4.
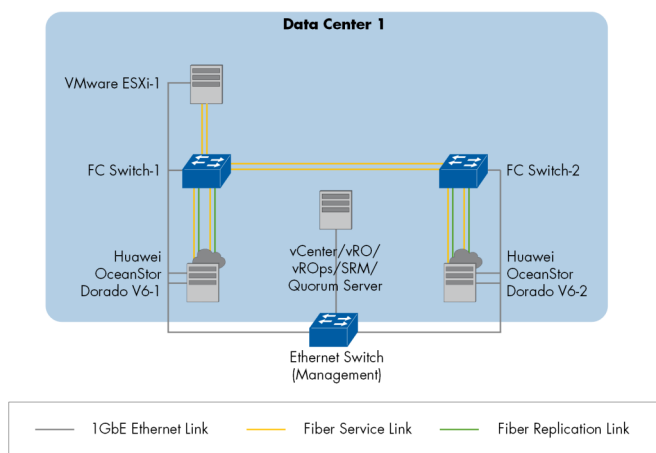

Figure 4: Single Data Center Dual Storage Test

In this test, we deployed a quorum server to avoid split-brain scenarios. If the replication links between the two Huawei OceanStor Dorado V6 storage systems are down, the quorum server determines which storage system continues providing services to ensure service continuity.

EANTC tested the failure and recovery of the remote replication links, one of the storage nodes, and the quorum server. According to a known issue on VMware ESXi6.0(2144657), we upgraded ESXi6.0 to ESXi6.0 Update 2 to test HyperMetro. Below are the test cases and results.

- Injecting a Remote Replication Link Fault to HyperMetro Storage

The test results showed that when all of the remote replication links failed, the I/O session was suspended for less than 15 seconds, then continued normally. When the failure recovered, the service was not affected, and the host can discover the paths to the

recovered storage node and deliver the I/O through all available paths in load-balancing mode.

- Injecting a Single Storage Fault to HyperMetro Storage

The test results showed that when the preferred storage node failed, the I/O session was suspended for less than 15 seconds, then continued normally. When the node failure recovered, the service was not affected, and the host can discover the paths to the recovered storage node and deliver the I/O through all available paths in load-balancing mode.

- Injecting a Quorum Server Fault to HyperMetro Storage

The test results showed that when the quorum server failed, the I/O session was not affected, and the host path status was not changed. When the failure recovered, the service and host path status were also not affected. The host can deliver the I/O through all available paths in load-balancing mode.

2. Huawei NGC Plugin for VMware vCenter Server Appliance (VCSA)

The Huawei NGC Plugin is a storage management plugin developed by Huawei for the VMware vSphere Web Client to manage Huawei OceanStor Dorado V6 storage systems. It facilitates the management and monitoring of Huawei OceanStor Dorado V6 storage systems.

The test for Huawei NGC Plugin includes four categories: Installation & Uninstallation, Storage Management, Alarm & Monitor, Config & Query. EANTC tested the Huawei NGC Plugin with VMware ESXi 6.7 and topology Figure 2.

Table 4 lists the summary of the test results for Huawei NGC Plugin tests.

Category	Test Case	Verdict
Installation & Uninstalla-tion	Installing and Uninstalling Huawei NGC Plugin	**PASS**
Storage Manage-ment	Adding, Deleting, and Editing a Storage Array	**PASS**
Alarm & Monitor	Monitoring Array Basic Information and Querying	**PASS**
Config & Query	Creating and Deleting a Datastore	**PASS**
	Creating and Deleting a Snapshot	**PASS**
	Query VMs' Virtual Disk and Mapping Information	**PASS**

Table 4: Huawei NGC Plugin Test Results Summary

Test Category: Installation & Uninstallation

EANTC tested the installation and uninstallation of Huawei NGC Plugin on VMware vSphere Web Client. The test results showed that the installation and uninstallation of Huawei NGC Plugin were executed successfully. Figure 5 is an example of the Huawei NGC Plugin installed in VMware vSphere Web Client.
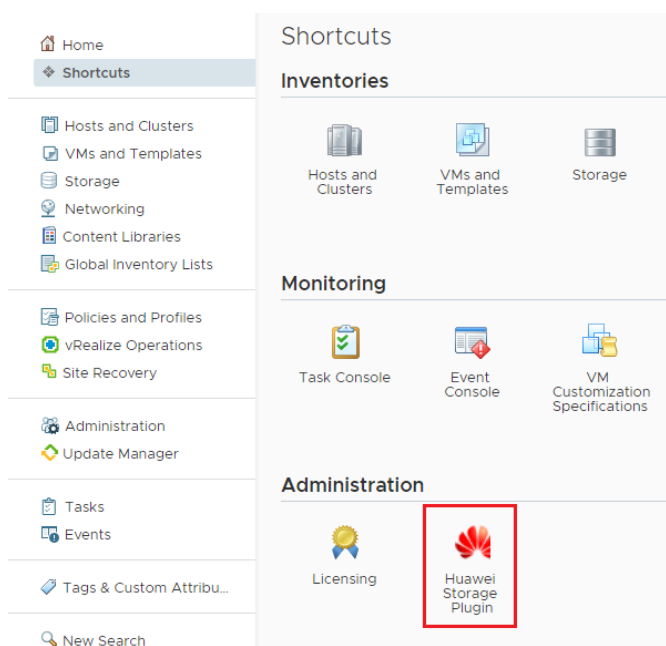

Figure 5: Huawei NGC Plugin Installed

Test Category: Storage Management

EANTC tested the storage management function of Huawei NGC Plugin by adding and editing and removing Huawei OceanStor Dorado V6 storage systems on the VMware vSphere Web Client. The test results showed that Huawei NGC Plugin supported the storage management function.

Test Category: Alarm & Monitor

EANTC tested the alarm and monitoring function of Huawei NGC Plugin for VMware vSphere Web Client. Huawei NGC Plugin can be used to view the basic information, health status, and alarms of the Huawei OceanStor Dorado V6 storage system. This information helps the administrator to quickly learn about the running status of the storage system and handle problems promptly.

Test Category: Configuration & Query

EANTC tested creating and deleting a datastore/snapshot and querying VMs' virtual disk and mapping information through Huawei NGC Plugin. The test results showed that the plugin could provide basic storage operation capabilities through VMware vSphere Web Client.

3. Huawei vRO Plugin for VMware vRealize Orchestrator Appliance (vRO)

VMware vRealize Orchestrator is the core component to manage the VMware workflows automation. Huawei developed the vRO Plugin for VMware vRealize Orchestrator based on the Orchestrator API specifications. Huawei vRO Plugin enables the administrator to create and design complex workflow automation tasks and realize the automatic configuration and management of Huawei OceanStor Dorado V6. Also, VMware vRealize Orchestrator provides a user-friendly designer tool. Users can customize workflows based on specific service processes and requirements, and design complex automation tasks based on workflows in the plugin.

The test for Huawei vRO Plugin includes three categories: Installation & Uninstallation, Storage Management, Orchestrator. EANTC performed the test on the topology illustrated in Figure 2 with VMware ESXi 6.7, and Table 5 lists the summary of the test results for Huawei vRO Plugin tests.

Category	Test Case	Verdict
Installation & Uninstallation	Installing and Uninstalling Huawei vRO Plugin	**PASS**
Storage Management	Registering and Deregistering an Array	**PASS**
Orchestrator	Managing Host Mappings	**PASS**
	Creating and Deleting a	**PASS**
	Creating and Deleting a	**PASS**

Table 5: Huawei vRO Plugin Test Results Summary

Test Category: Installation & Uninstallation

EANTC tested the installation and uninstallation of Huawei vRO Plugin on the VMware vRealize Orchestrator. The test results showed that the installation and uninstallation of Huawei vRO Plugin were executed successfully. Figure 6 shows that Huawei vRO Plugin was installed successfully in VMware vRealize Orchestrator, and Huawei OceanStor Dorado V6 was visible from the Inventory.
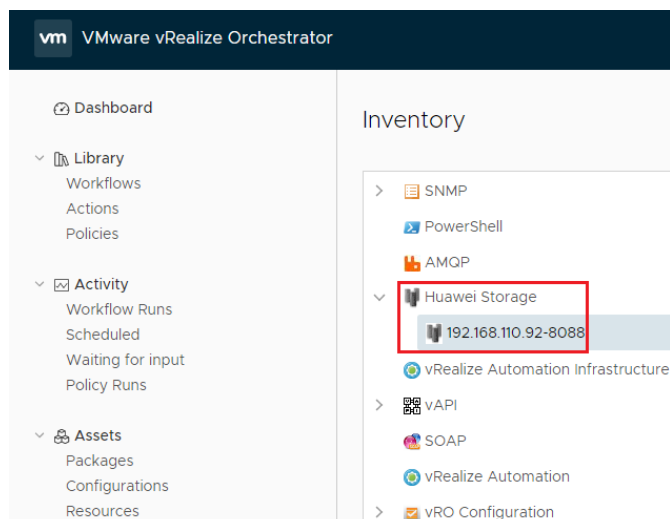

Figure 6: Huawei vRO Plugin Installed

Test Category: Storage Management

EANTC tested the storage management function of Huawei vRO Plugin by registering and deregistering Huawei OceanStor Dorado V6 storage systems on the VMware vRealize Orchestrator. The test

results showed that Huawei vRO Plugin supported the storage management function.

Test Category: Orchestrator

EANTC performed the test to configure the storage array via VMware vRealize Orchestrator. The test results showed that the Huawei vRO Plugin could provide the orchestrator functions for VMware vRealize Orchestrator to manage the Huawei OceanStor Dorado V6 using the Orchestrator API. We verified that the workflows of mapping LUNs to the host, creating and deleting datastores, and creating and deleting snapshots can be successfully executed.

4. Huawei vROps Plugin for VMware vRealize Operations Manager (vROps)

VMware vRealize Operations Manager is an intelligent O&M management solution across physical, virtual, and cloud computing platforms. Based on VMware's design requirements, Huawei developed the vROps Plugin, a storage adapter that enables unified O&M of Huawei OceanStor Dorado V6 on VMware vRealize Operations Manager.

The test for Huawei vROps Plugin includes two categories: Installation & Uninstallation, Monitoring. The test topology for Huawei vROps Plugin is the single data center topology illustrated in Figure 2. EANCT executed the test of Huawei vROps Plugin with VMware ESXi 6.7, and in below Table 6 is the summary of the test results.

Category	Test Case	Verdict
Installation & Uninstallation	Installing and Uninstalling Huawei vROps Plugin	**PASS**
Monitoring	Registering and Deregistering a Storage Array	**PASS**
	Performance Overview	**PASS**
	Alarm Management	**PASS**
	Report Management	**PASS**
	TOP-N Monitoring	**PASS**

Table 6: Huawei vROps Plugin Test Results Summary

Test Category: Installation & Uninstallation

EANTC tested the installation and uninstallation of Huawei vROps Plugin on the VMware vRealize Operations Manager. The test results showed that the installation and uninstallation of Huawei vROps Plugin were executed successfully. Figure 7 shows that Huawei vROps Plugin was installed successfully in VMware vRealize Operations Manager. It provides the dashboards to monitor the performance of Huawei OceanStor Dorado V6 through VMware vRealize Operations Manager.
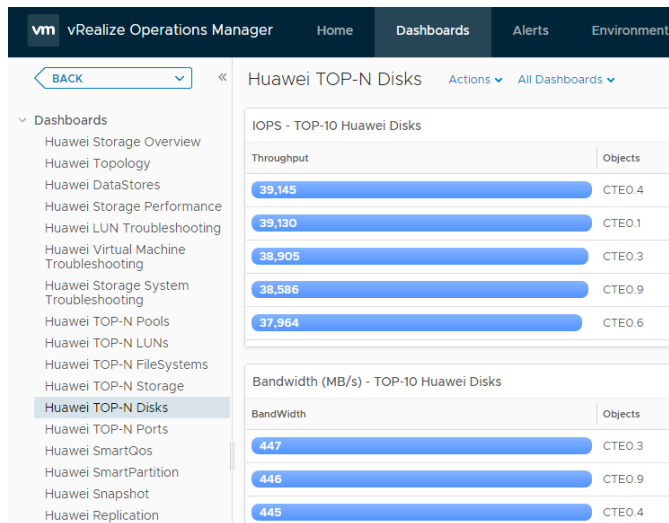
Figure 7: Huawei vROps Plugin TOP-N Monitoring

Test Category: Monitoring

EANTC verified the monitoring functions of the Huawei vROps Plugin installed on VMware vRealize Operations Manager. We tested the storage performance monitoring, alarm management, report management, and TOP-N monitoring.

5. Huawei SRA Plugin for VMware Site Recovery Manager (SRM)

VMware Site Recovery Manager (SRM) is the data center Disaster Recovery (DR) solution for VMware infrastructure. It enables business continuity and data protection among sites in VMware private cloud environments. Based on the requirements of VMware SRM, Huawei developed Huawei SRA Plugin, a storage replication adapter that integrates Huawei OceanStor Dorado V6 into the VMware DR solution.

Huawei OceanStor Dorado V6 also supports the VMware SRM stretch, meeting requirements of the VMware active-active data center DR solution.

EANTC built a dual-datacenter topology to test the Huawei SRA Plugin. As shown in Figure 8, the topology contains two data centers, each of them has one VMware ESXi host and one Huawei OceanStor Dorado V6.
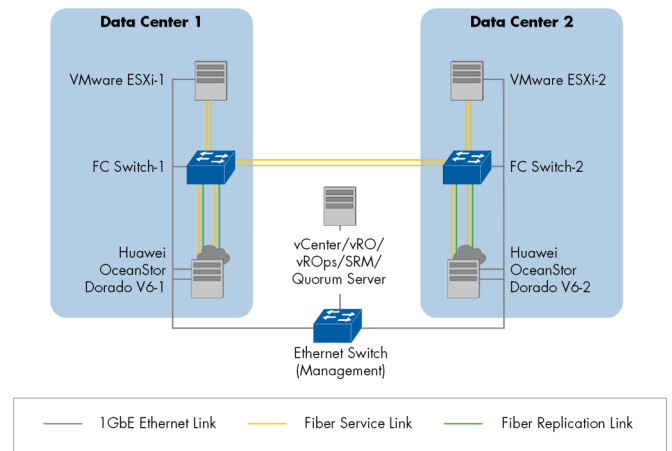

Figure 8: Dual Data Center Test Topology

The test for Huawei SRA Plugin includes three categories: Installation & Uninstallation, SRM Replication, SRM Stretch HyperMetro. EANTC performed the test of Huawei SRA Plugin with VMware ESXi 6.7, and Table 7 lists the summary of the test results for Huawei SRA Plugin tests.

Category	Test Case	Verdict
Installation & Uninstallation	Installing and Uninstalling Huawei SRA Plugin	**PASS**
SRM Replication	Recovering from an ESXi Single-Node Fault - SRM Replication	**PASS**
	Injecting a Single Storage Array Fault to HyperReplication	**PASS**
SRM Stretch HyperMetro	Recovering from an ESXi Single-Node Fault - SRM Stretch HyperMetro	**PASS**

Table 7: Huawei SRA Plugin Test Results Summary

Test Category: Installation & Uninstallation

EANTC tested the installation and uninstallation of Huawei SRA Plugin on the VMware vRealize Operations Manager. The test results showed that the installation and uninstallation of Huawei SRA Plugin were executed successfully. Figure 9 shows that Huawei SRA Plugin was installed successfully in VMware Site Recovery Manager (SRM). The details of Huawei SRA Plugin was visible as one of the Storage Replication Adapters from the SRM Appliance Management page.
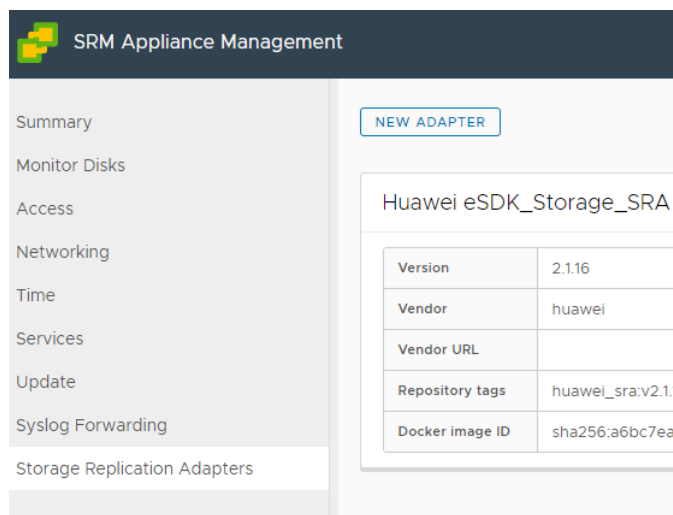

Figure 9: Huawei SRA Plugin Installed

Test Category: SRM Replication

EANTC tested the SRM DR function by simulating a VMware ESXi host failure and a Storage node failure in the protected site and verified the SRM disaster recovery using SRM replication. We used Huawei SRA Plugin to execute the DR plan to recover a VM from the protected site and performed a planned migration and reprotection when the protected site was online again.

Test Category: SRM Stretch HyperMetro

EANTC tested the SRM Stretch DR plan by simulating a VMware ESXi host failure in the protected site. The test results showed that the protected VM could be recovered and started normally at the standby site when the VMware ESXi host failed in the protected site.

Conclusion

During the time of the test campaign in Berlin, EANTC confirmed the interoperability between Huawei OceanStor Dorado V6 Storage solution and multiple versions of VMware ESXi, 6.0, 6.5, 6.7. Besides, EANTC witnessed the integration of Huawei plugins (NGC, vRO, vROps, and SRA), which are used to centrally manage and operate Huawei storage solution through VMware vSphere and vCenter environment. All the test cases passed EANTC verification successfully. The test was evidence of how the management software interoperability can improve the efficiency of the DC administration.

The integration between the hardware storage solution and the virtualization host optimizes the overall performance of the solution. An example of that is deriving the benefit of VAAI integration with Huawei OceanStor Dorado V6. Huawei hardware storage speeds up VMware I/O operations by offloading certain storage operations to the array, which reduces resource overhead on the VMware ESXi hosts and can improve performance for storage-intensive operations such as storage cloning or zeroing.

EANTC executed extensive test cases to verify the usability of VMware platforms for managing Huawei storage solution by a group of the most frequent storage operations. The tested solution demonstrated the capability of storage resources discovery, storage management, monitoring, data replication, resources orchestration, and site recovery management successfully.

About EANTC

EANTC (European Advanced Networking Test Center) is internationally recognized as one of the world's leading independent test centers for telecommunication technologies.

Based in Berlin, the company offers vendor-neutral consultancy and realistic, reproducible high-quality testing services since 1991. Customers include leading network equipment manufacturers, tier 1 service providers, large enterprises and governments worldwide. EANTC's Proof of Concept, acceptance tests and network audits cover established and next-generation fixed and mobile network technologies.