REFERENCE ARCHITECTURE

QxStack VMware® Edition-Performance Optimized SKU _Reference Architecture

vmware®

Version 2.0

Table of Contents

Tables

Figures

1 Executive Summary

Enterprises around the world are facing a drastic information explosion. To address this challenge, enterprise must rearrange their data centers to support new business models. The software-defined data center can answer market demand and help organizations stay ahead by delivering simplified management, agility, and lower total cost of ownership (TCO). However, hundreds of marketplace solutions complicate selection, adding to the burden of cost and effort spent on installation or performance tuning.

To help customers and partners accelerate their data center transformation, Quanta Cloud Technology (QCT), a global data center solution provider, participates in the Intel® Select Solution Program and collaborates with Intel® to provide a ready-to-use software-defined data center solution **QxStack vSAN™ – Performance Optimized SKU** with the following benefits:

- Simplify modernization: reduce time to evaluate, select, and purchase necessary hardware components.
- Accelerate time to value: minimize time to deploy new infrastructure.
- Ensure performance in business-critical scenarios: pre-optimize setting parameters for business common use cases such as E-commerce or scalable web scenario to reach outstanding performance, exceeding Intel® Select program's threshold.

With the aforementioned benefits, **QxStack vSAN™ – Performance Optimized SKU** is the best choice for partners and customers to construct a software-defined data center and stay in a leading position.

2 Reference Architecture Overview

2.1 Purpose

The purpose of this reference architecture is to introduce **QxStack vSAN™ – Performance Optimized SKU** and demonstrate how this solution provides ultra-performance for customers, it will illustrate how the validated configuration and parameters tuning significantly minimize deployment time and simplify the deployment process.

2.2 Scope

This reference architecture:

- Introduces Intel® Select Solution program and the benefits of adopting **QxStack vSAN™ – Performance Optimized SKU** .
- Illustrates the hardware configuration and software components discreetly selected by QCT and Intel® for the solution.
- Simulates the commonly-used workloads in the data center, and demonstrates the ultra-performance and scalability of **QxStack vSAN™ – Performance Optimized SKU** .

2.3 Audience

The intended audience of this document are IT professionals, technical architects, and sales engineers. The document serves to assist them in selecting, implementing, and tuning SDDC products.

3 Solution Overview

This section introduces Intel® Select Solution Program and **QxStack vSAN™ – Performance Optimized SKU**, and highlights the benefits of this solution for customers and partners.

3.1 Intel® Select Solution

In order to address challenges that end customers face in their data center transformation journey, Intel® collaborates with several partners including QCT to launch a "Intel® Select Solution". The Intel Select Program provides rich system solutions for the future-defined, agile data center. The solutions in Intel® Select Program fulfill diverse scenarios in the data center, use cases include virtualized infrastructure, databases, NFVI, and hybrid cloud. Key benefits are listed below:

Simplify Modernization:

The pre-defined and workload-oriented solutions in Intel® Select Program can simplify and speed up the data-center modernization process from evaluation and procurement to integration and deployment.

Workload-Optimized performance:

Developed by Intel® and solution partners, Intel® Select Solution is based on the latest Intel® technologies to provide an accelerated, simplified path to unlock overall performance.

System-level Benchmarking and Verification

With pre-defined settings and rigorous system-wide tuning, Intel® Select Program respectively sets up performance thresholds for different workloads to ensure reliable, workload-optimized performance for complex data center applications.

Additionally, VMware and Intel created a second version of Intel Select Solutions in 2019 for VMware vSAN that goes beyond the capabilities of the prior-generation of Intel Select Solutions for VMware vSAN by facilitating performance for memory-constrained workloads specifically.

3.2 QxStack vSAN™ – Performance Optimized SKU

For Intel® Select Solution, QCT collaborates with Intel® to develop **QxStack vSAN™ – Performance Optimized SKU** - a total solution for software-defined data center transformation. As shown in Fig. 1, **QxStack vSAN™ – Performance Optimized SKU** is composed of QCT's well-designed 2nd Generation Purley server platform and market-leading virtualization software developed by VMware, delivering a reliable and confident choice for customers.

This solution addresses the common business challenges that CIOs face today in the data center such as insufficient resource utility, management inefficiency, reliability issues, and daunting process of deployment and tuning. In the following sections, a solution overview with some benefits will be provided for customers to solve problems.

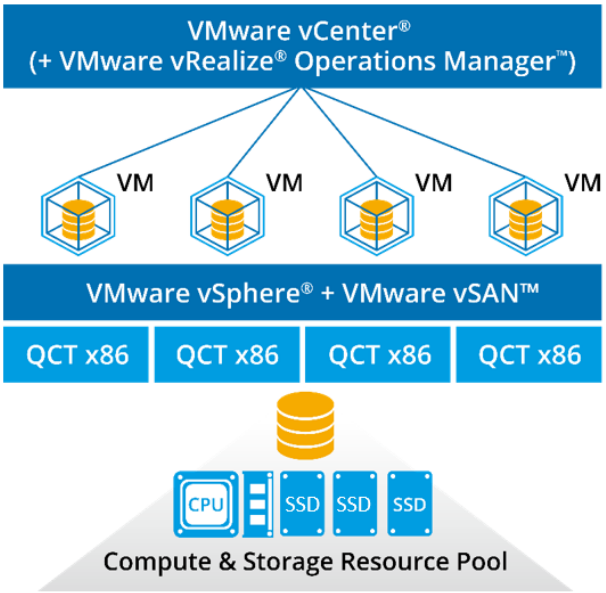

Figure 1. Solution Architecture of QxStack vSAN™ – Performance Optimized SKU.

3.2.1 Manageability, Scalability, and Efficiency- Hyper-Converged Infrastructure

QxStack vSAN™ – Performance Optimized SKU is a hyper-converged infrastructure solution. Traditionally, IT technicians face the challenges of resource management and scalability because compute and storage resources are separated. Hyper-Converged Infrastructure (HCI) is a novel technology which can integrate compute, storage, and virtualization resources in a single hardware box. Every single node is capable of delivering compute and storage resources at the same time. Several benefits are listed in detail below.

Simplified Management

In legacy-converged architecture, compute and storage resources are provided by different servers and storage devices, separating configuration settings and operations management for each, meaning IT administrators must manage two devices through different management tools. To provide a storage device to a server, users need to configure settings from LUN and Volume, and then mount the storage device to the server host for VM to access. In hyper-converged architecture, compute and storage can be regarded as a single system. Users can manage both compute and storage resources with a single management portal. By achieving full "policy-driven management", IT administrators only need to define their own compute and storage resources. The allocation process can be automatically completed by a single management portal, which significantly reduces the management effort.

Scalability and Efficiency

The hyper-converged infrastructure integrates compute and storage resources into a basic unit, called building block. By implementing the clustered architecture, users can add more building blocks to the cluster to expand the overall performance and capacity. This also makes the expansion of the hyper-converged architecture simple and predictable, as shown in Fig. 2.

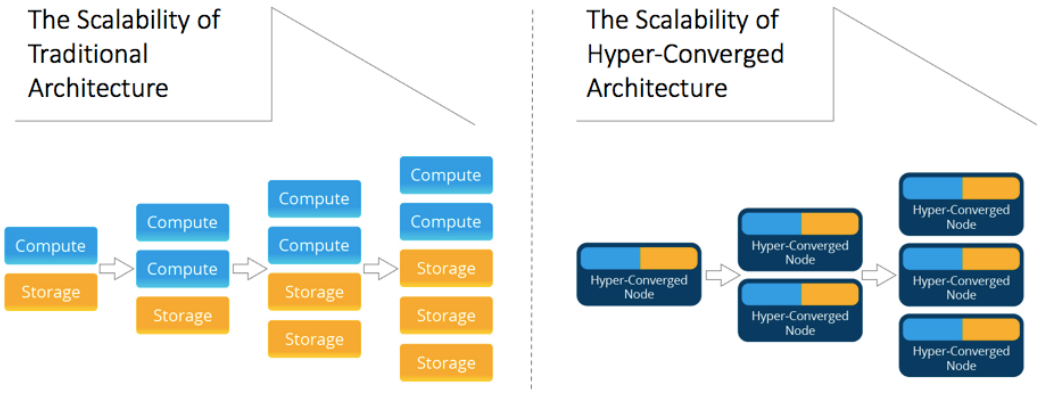

Figure 2. Comparison between Traditional Architecture and HCI.

3.2.2 Reliability - vSAN™ Certification

With this solution validated by QCT, customers can rest assured of its reliability and focus on strategic and productive tasks.

Table 1. QxStack vSAN™ – Performance Optimized SKU.

Components	Details	Quantity
SKU	QuantaGrid D52B-1U	
System	Model: QuantaGrid D52B-1U System Type: Rackmount	1
CPU	Intel® Xeon® Gold 6252 CPU @ 2.10 GHz / 48C/96T	2
Memory	32GB 2666MHz 288-pin DDR4 RDIMM	12
Caching Tier	Model : Intel® SSD DC P4800X Series SSDPED1K375GA (375 GB, AIC) Partner Name: Intel Device Type: NVMe Capacity: 375 GB Performance Class: Class F: 100,000+ writes per second TBW Endurance Class: Endurance Class D >=7300 TBW	2
Capacity Tier	Model : Intel® SSD DC P4510 Series SSDPE2KX020T8 (2 TB, 2.5-inch) Partner Name: Intel Device Type: NVMe Capacity: 2000 GB Performance Class: Class E: 30,000-100,000 writes per second TBW Endurance Class: Endurance Class B >=1825 TBW	4
NIC	Model: Intel Ethernet Network Adapter XXV710-DA2 25GbE	1
Boot Device	Model: SSD DC S4500, 480GB	1

3.2.3 Ultra-performance - Selected Hardware and Brilliant Testing Result

QxStack vSAN™ – Performance Optimized SKU adopts QCT's 2nd Generation Purley server platform which surpasses the physical design limitation and offers high performance and energy efficiency. Besides, the components in this all-NVMe configuration are carefully selected by QCT which boosts the performance to a new level.

Moreover, Intel® Select Solution also sets specified performance benchmark thresholds for solution validation. The VMmark® benchmark tool can simulate the commonly-used cases such as E-commerce and scalable web scenarios. With QCT's knowledge and tuning experience, the performance of **QxStack vSAN™ –**

Performance Optimized SKU exceeds the benchmark thresholds defined by Intel Select Program, and the testing results are shown in Fig. 3. The test results will be explicitly elaborated in section 5.3.

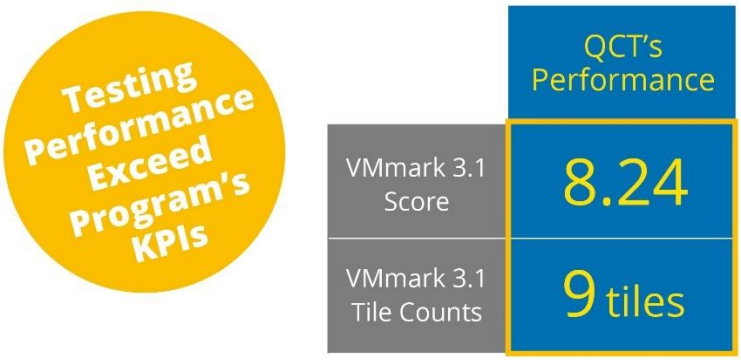

Figure 3.Testing Performance of QxStack vSAN ™ – Performance Optimized SKU.

3.2.4 Time to Value - Easy Deployment

Data center deployment can be a very complex and daunting process due to resource and schedule arrangements for hardware and software installations, not to mention networking topology and performance tuning. QCT understands all the difficulties and takes the following steps to solve customers' problems.

QCT integrates the VMware® vSAN™ software stack into QCT's server platform to reduce your effort and accelerate the installation process. The reference architecture in chapter 5.2 describes the parameter settings of network connectivity, firmware and software optimized configuration, and suggests policy settings that can significantly minimize the guesswork, reducing overall deployment time and expense.

4 Solution Architecture

In this section, we illustrate the hardware and software architecture of **QxStack vSAN™ — Performance Optimized SKU**.

4.1 Hardware Architecture

The QuantaGrid D52B-1U server features both extreme storage density and compute power for the hyper-converged solution. The hardware configuration in this reference architecture is elaborately designed to fulfill Intel® Select Program's reqirements. In this design, four QuantaGrid D52B-1U servers utilize local storage to build a vSAN Datastore. Each server uses two Intel® Xeon® Gold 6252 CPUs with 24 cores for compute and storage services. Each node uses 384GB memory capacity. Each host contains 2 NVMe Intel® Optane™ SSD DC P4800X (375GB) for cache tier and 4 NVMe Intel® SSD P4510 for the capacity tier under vSAN™ architecture, as shown in Fig. 4. Each QuantaGrid D52B-1U host contributes its local disks to a vSAN Datastore and the disks are organized into disk groups. Each host consists of two disk groups. A disk group can be seen as a "fault domain." Generally, if the cache device fails, all HDDs and SSDs in the same disk group will be impacted. However, the design of multiple disk groups can highly reduce the impact when cache device fails on overall disk group.

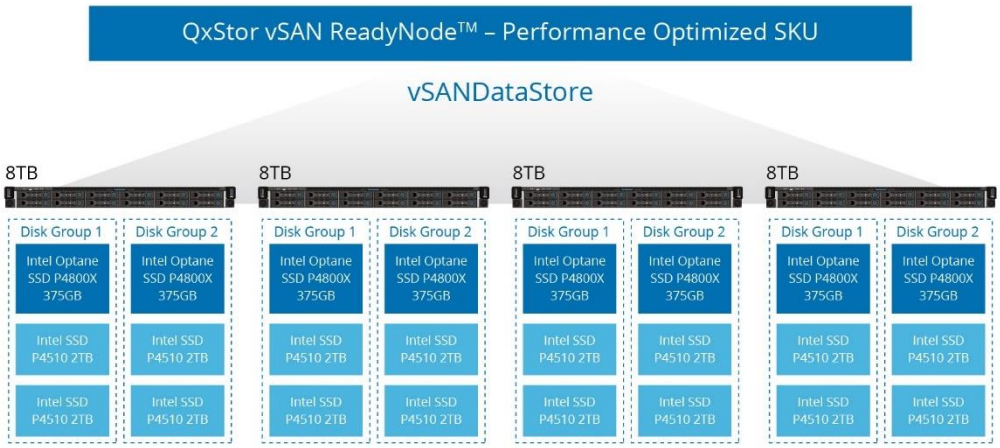

Figure 4. vSANDataStore Configuration of QxStack vSAN™ – Performance Optimized SKU.

4.1.1 Compute: Intel® Xeon® Scalable Processor

Tailored for a software-defined storage solution, QuantaGrid D52B-1U features ultimate compute and storage density in a 1U platform which redefines the physical limitation. QuantaGrid D52B-1U is a rackmount server with Intel® Xeon® Processor Scalable Family, delivering fast socket interconnection, high memory bandwidth and Floating-Point Operations per second (FLOPs) peak performance. The compute capability can empower VMware® vSAN™ by supporting a wide range of critical workloads with low latency in the modern data center.

4.1.2 Storage: Intel® Optane™ NVMe SSD

Caching is a prerequisite not only in today's software-defined storage solution but also necessary for virtualized applications to boost performance. Enterprises that value performance can benefit from the cache tier of the Intel® SSD Data Center (DC) Family with Non-Volatile Memory Express (NVMe). Adopting Optane™ SSD DC P4800X as the cache tier in vSAN™ can deliver extremely high-performance and ultra-low latency while running the write-intensive workload.

1. Intel® Optane™ SSD DC P4800X combines the attributes of both memory and storage which significantly reduces the latency of sensitive workloads and accelerates the overall deployment.
2. Intel® Optane™ SSD DC P4800X is able to deliver 5-8X fast performance to low queue depth workload which exhibits exceedingly high throughput.

4.1.3 Network: Intel® XXV710-DA2 25GbE

According to the best practices of VMware® vSAN™ configuration, at least 10 gigabit Ethernet (GbE) is recommended on all flash vSAN™ configuration. Explicitly selected to fulfill the bandwidth demand between the server for vSAN™ traffic, Intel® Ethernet Converged Network Adapter XXV710-DA2 25GbE not only optimizes performance but also improves the reliability for data center networking.

4.2 Software Configuration

4.2.1 VMware vSphere®

VMware vSphere® is an industry-leading virtualization platform which virtualizes and aggregates physical hardware to provide a virtual resource pool to the data center. By leveraging the virtualization technology, vSphere® can provide a highly-available, efficient, centralized infrastructure for IT administrators to deliver flexible, reliable services. VMware vSphere® provides the following benefits:

1. Proactive high-availability technology to prevent machine downtime.
2. Predictive load balancing technology to fully exert data center resources.
3. Simplifies user experience to deliver a large-scale automation and management.
4. Leverages virtual machine level encryption technology to reduce security risk.
5. Uses REST API to promote IT automation and business flexibility.

4.2.2 VMware vCenter Server®

vCenter server® is a platform which provides centralized management and operation for VMware® virtualization environment. By aggregating all the virtual resources, vCenter server® can provide resource provisioning and monitoring. It is capable of provisioning compute, storage, and other resources to the virtual machine and enabling High Availability (HA), Distributed Resource Scheduler (DRS), vMotion, etc. Currently, in vCenter® 6.7 U3, vCenter server® can support up to 2,000 hosts.

4.2.3 VMware ESXi™

VMware® ESXi™ is an industry-leading hypervisor installed on a bare-metal physical server. ESXi™ enables the virtualization technology which is different from the traditional hardware architecture including compute, storage, and networking. By sharing the resources of a single hardware across multiple environments, a physical system (x86 server) is capable of executing multiple virtual machines with different operation systems (OS). VMware® proposed that “virtualization is the process of creating a software-based (or virtual) representation of something rather than a physical one.” Virtualization can be applied to applications, servers, storage, and networks. It is a single effective way to reduce IT expenses and boost efficiency and agility for all-sized businesses.

4.2.4 VMware vSAN™

vSAN™ is a software-defined storage built into the vSphere® kernel. It is tightly integrated with the hypervisor to minimize the CPU and memory overhead, and optimizes the data I/O path to deliver an outstanding performance. vSAN™ is a hyper-converged solution, particularly designed for virtual machines. It minimizes the effort to configure the storage and simplifies the virtual machine deployment.

vSAN™ is built on the industry-standard x86 server and leverages the local storage on the server. By using the virtualization technology, the under-layer physical disk is a concept of abstract resource pool, aggregated into a virtual resource for providing a shared storage to the server in the cluster. It also makes non-disruptive expansion capacity possible by adding hosts to a cluster or adding disks to a host. SSDs are used as a cache tier to accelerate the I/O performance and HDDs as capacity tier to store data. By leveraging the flash device on server side, vSAN™ can accelerate the read/write I/O processing speed and minimize the storage latency. Administrators can use vSAN™ to define the requirements of virtual machine storage such as performance and availability. The policy requirements are delivered to the vSAN™ layer through the Storage Policy-Based Management (SPBM). SPBM, hence, plays an important role to bridge the upper layer application and the under-layer storage devices. Through pre-defined storage policy, SPBM will drive the vSAN™ layer to adopt these policies when users provision the virtual machine.

5 Solution Validation

In this session, the test methodologies and test results will be demonstrated to guarantee the performance and reliability of this solution.

5.1 Test Overview

With virtualization technology, enterprise can benefit from the flexibility and scalability. VMmark® is a benchmark tool provided by VMware to evaluate the performance and scalability of virtualization platforms. It consists two main workloads including applications and infrastructure operation behaviors to evaluate the overall system performance. VMware chooses three subworkloads to simulate the applications including standby system, scalable web simulation, and E-commerce simulation, as shown in Fig. 5.

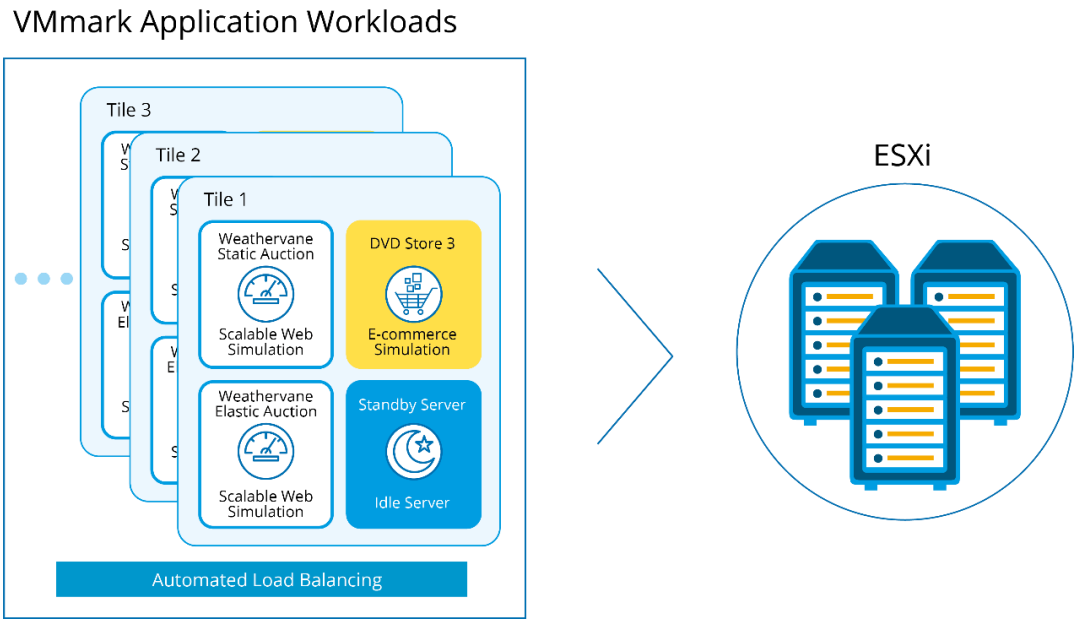

Figure 5. VMmark® Application Workloads.

Scalable Web applications are used to simulate the workloads such as on-line auction websites or social networking behavior. Typically, the web simulation behaviors including the services such as load balancers, message servers, web servers, and database comsume different resources in the infrastructure. VMmark® lervages Weathervane, an application-level benchmark tool, to test and evaluate virtual infrastructure performance. The static and elastic applications are used. For the static

application instance, all of the services mentioned above are run on their own virtual machine to generate consistent load to the system. As for the elastic application instance, all services are shared on a single virtual machine to generate elastic load to the system.

Databases are typically resource intensive and commonly used in a virtualized data center. Most of the transactional workloads are running on the database which is a reasonable reason to evaluate such workloads on the virtualization platform. VMmark® leverages the open source application, DVD Store, to simulate the on-line transaction behavior. It provides an E-commerce application with a back-end database component, a web application layer, and driver programs. The web server communicates with the back-end database to query user account and inventory data, and simulates the behaviors such as users' web login and product browse.

In addition to the application workloads, VMmark® triggers some common virtualization procedures running on the virtual machines, as shown in Fig. 6. The procedures include:

- Virtual machine cloning and deployment.
- Dynamic virtual machine relocation between servers.
- Dynamic virtual machine relocation across storages.
- Simultaneous server and storage virtual machine relocation.
- Automated load balancing.

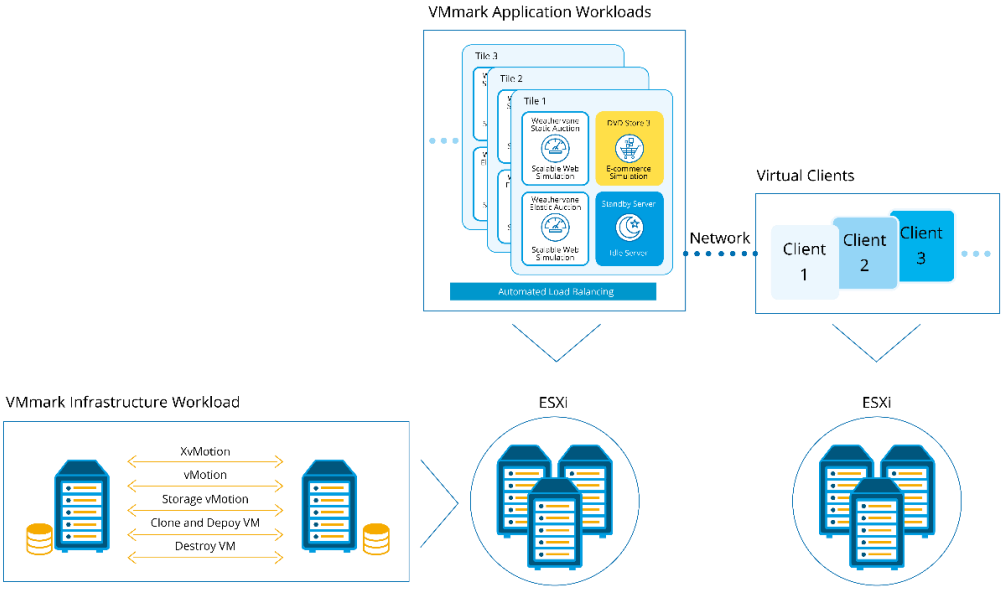

Figure 6. VMmark® Workload Summary.

5.2 Test Configuration

5.2.1 System in Detail

Virtualization Software	
Hypervisor Vendor, Product, Version, and Build/ Availability Date (MM-DD-YYYY)	VMware® ESXi 6.7 U3, Build 14320388 / 08-20-2019
Datacenter Management Software Vendor, Product, Version, and Build /Availability Date (MM-DD-YYYY)	VMware® vCenter Server 6.7 U3, Build 14367737 / 08-20-2019
Supplemental Software	None

Server	
Number of Servers in System Under Test (all subsequent fields in this section are per server)	4
Server Manufacturer and Model	QuantaGrid D52B-1U
Processor Vendor and Model	Intel® Xeon Gold 6252
Processor Speed (GHz) / Turbo Boost Speed (GHz)	2.1 / 3.7
Total Sockets/Total Cores/Total Threads	2 Sockets / 48 Cores / 96 Threads
Primary CPU Cache	32 KB I + 32 KB D on chip per core
Secondary CPU Cache	1 MB I+D on chip per core
Other CPU Cache	35.75 MB I+D on chip per chip
BIOS Version	3B13
Memory Size (in GB, Number of DIMMs)	384, 12
Memory Type and Speed	32GB DDR4 2666MHz RDIMM

Disk Subsystem Type	VMware® vSAN™, iSCSI
Number of Disk Controllers	N/A
Disk Controller Vendors and Models	N/A
Total Number of Physical Disks for Hypervisor	1
Disk Vendors, Models, Capacities, and Speeds	INTEL, SSD DC S4500, 480GB, 6.0Gb/s
Number of Host Bus Adapters	N/A
Host Bus Adapter Vendors and Models	N/A
Number of Network Controllers	1
Network Controller Vendors and Models	Intel Ethernet Network Adapter XXV710-DA2 25GbE
Other Hardware	None
Other Software	None
Hardware Availability Date (MM-DD-YYYY)	04-26-2019
BIOS Availability Date (MM-DD-YYYY)	04-26-2019
Software Availability Date (MM-DD-YYYY)	08-20-2019

Network	
Network Switch Vendors and Models	QuantaMesh BMS T3048-LY8
Network Speed	10Gb

Primary Storage	
Storage Category	VMware vSAN (with default vSAN storage policy)
Array Vendors, Models, and Firmware Versions	4 x QuantaGrid D52B-1U, with VMware vSAN 6.7 U3
Storage Configuration Summary	VMware vSAN (caching tier): 8 x Intel® SSD DC P4800X Series SSDPED1K375GAQ (375 GB, AIC) NVMe SSD, VMware vSAN (capacity tier): 16 x Intel® SSD DC P4510 Series SSDPE2KX020T8 (2 TB, 2.5-inch) NVMe SSD,

Datacenter Management Server	
System Model	QuantaPlex D51BP-1U
Processor Vendor and Model	Intel® Xeon CPU E5-2699 v4
Processor Speed (GHz)	2.20 GHz
Total Sockets/Total Cores/Total Threads	2 Sockets / 44 Cores / 88 Threads
Memory Size (in GB, Number of DIMMs)	160, 10
Network Controller(s) Vendors and Models	QN 10GbE 82599ES
Operating System, Version, Bitness, and Service Pack	VMware ESXi Server 6.7 U3, Build 14320388
Virtual Center VM Number of vCPUs	8
Virtual Center VM Virtual Memory (in GB)	24
Virtual Center VM Operating System, Version, Bitness, and Service Pack	VMware vCenter Server 6.7 U3, Build 14367737
Other Hardware	N/A
Other Software	N/A

Clients	
Total Number of Virtual Clients / Virtual Client Hosts	11/3
System Model(s)	QuantaGrid D51BP-1U

Processor Vendor(s) and Model(s)	Intel® Xeon E5-2699 v4
Processor Speed(s) (GHz)	2.2 GHz
Total Sockets/Total Cores/Total Threads	2 Sockets / 44 Cores / 88 Threads
Memory per Virtual Client Host	192GB
Network Controller(s) Vendors and Models	QN 10GbE 82599ES
Virtual Client Networking Notes	1 vmnic for management, 1 vmnic for workload traffic
Virtual Client Storage Notes	VMware vSAN (caching tier): 6 x Intel® SSD DC P3700 Series SSDPE2MD800G4 (800 GB, 2.5-inch) NVMe SSD, VMware vSAN (capacity tier): 18 x Intel® SSD DC P3500 Series SSDPE2MX020T4 (2 TB, 2.5-inch) NVMe SSD
Other Hardware	N/A
Other Software	VMware ESXi 6.7 U3, Build 14320388

Notes for Workload
Template deployed with disk type: Thick Eager (default: Thick Eager)

Virtualization Software Notes
All VMs are virtual hardware version 11 (default:11)
Cluster DRS Automation Level set to Fully Automated, DRS Migration Threshold set to level 4 (default: Disabled)
Power management Policy = High Performance (default: Balanced)
NTP server set to 216.239.35.4 (default: Disabled)

Server Notes - Server BIOS setting
Intel® Hyper Threading Technology Enabled (default: Enabled).
Intel® Turbo Boost Technology Enabled (Frequency boost up to 3.70 GHz) (default: Enabled).
Intel® Speed Shift Technology: HWP Native (default: HWP Native).
C-States: Disabled (default: Disabled).
Power Management Settings: Performance (default: Balance).
Intel® TXT Enabled (default: Disabled).

Client Networking Notes - vSwitch Configuration
vSwitch0 for the Management, vMotion, vSAN, provisioning services,
vMotion, iSCSI and vSAN traffic on vmnic0 at 10Gb/s and set the MTU 9000
vSwitch0 set the MTU to 9000, and physical switches has set MTU to 9216
vSwitch1 for all VMs on vmnic1 at 10Gb/s.

SUT Networking Notes - vSwitch Configuration
vSwitch0 for the Management, vMotion, iSCSI, vSAN, provisioning services,
vMotion, iSCSI and vSAN traffic on vmnic0 at 10Gb/s and set the MTU 9000
vSwitch0 set the MTU to 9000, and physical switches has set MTU to 9216

vSwitch1 for all VMs on vmnic1 at 10Gb/s.

Storage Notes	
OS was installed on SATA SSD for each host.	
Storage box#1 (System Under Test): Cluster1vsanDatastore(32TB), 3TB cache used	**Hardware Configuration: QuantaGrid D52B-1U.**
	2 x Intel® Xeon® Gold 6252.
	384 GB Memory (12 x 32GB DDR4 2666MHz RDIMM).
	2 x Intel® SSD DC P4800X, 375GB, Gen 3x4 Gbps.
	4 x Intel® SSD DC P4510, 2TB, Gen 3.1x4 Gbps Software Configuration.
	All Flash vSAN with two disk groups, each disk group include 1 Intel® SSD DC P4800X 375GB (AIC) for array cache and 2 Intel® SSD DC P4510 Series 2TB (NVMe) for capacity.
	vSAN Default Storage Policy used for all disk object
	Software Configuration
	All Flash vSAN™ with two disk groups. Each disk group includes 1 Intel® SSD DC P4800X 375GB (AIC) for array cache and 2 Intel® SSD DC P4510 Series 2TB (NVMe) for capacity.
	vSAN™ Default Storage Policy used for all disk objects.
	LUN/VM layout
	LUN1(32TB, 3TB cache): DS3DB*, DS3WebB*, DS3WebC*, AuctionLB*, AuctionNoSQL*, AuctionAppA*, AuctionAppB*, AuctionDB*, AuctionMSQ*, AuctionWebA*, AuctionWebB*, ElasticLB*, ElasticAppA*, ElasticAppB*, ElasticDB*, ElasticWebA*, ElasticWebB* for tile 0-8, template, SVmotion source LUN, XVmotion source LUN, Deploy source LUN.
Storage box#2 (Shared storage): Windows Server 2016 with two volumes shared as iSCSI target to System Under Test, each of volume consist of 500GB	**Hardware Configuration: QuantaPlex D51BP-1U (one node)**
	2 x Intel® Xeon E5-2699 v4 processors
	160GB Memory (10 x 16 GB DIMMs 1600MHz DDR4)
	1 x Intel® SSD DC X25-E 60GB, 2.5", SATA 3Gb/s (used in shelf)
	2 x Intel® SSD DC P4600 Series 1.6 TB, 2.5" NVMe SSD (used in shelf)
	Software Configuration
	Storage Pools were created using Windows Server 2016.
	2 x Intel® SSD DC P4600 1.6 TB were built into 2*500GB iSCSI LUN for volume sharing to SUT
	LUN/VM layout
	LUN0 (500GB, no cache): SVmotion, XVmotion and Deploy target LUN
	LUN1 (500GB, no cache): SVmotion, XVmotion and Deploy target LUN

Datacenter Management Server Notes
QuantaPlex D51BP-1U running VMware ESXi 6.7 U3, Build 14320388 with VMware vCenter Server 6.7 U3, Build 14367737 for SUT and client hosts.
8 vCPUs.
24GB virtual memory.
VMware vCenter Server 6.7 U3, Build 14367737.

Operating System Notes
All hosts (Management, Client and SUT) configured with VMware ESXi 6.7 U3, Build 14320388.

Client Notes
QuantaGrid D51BP-1U was used for client hosts.
Client hosts ESXi 6.7U3, Build 14320388.
Client host1: Client0, Client3, Client6.
Client host2: Client1, Client4, Client7.
Client host3: Client2, Client5, Client8, PrimeClient.

5.2.2 Network Connectivity

A well-designed network topology ensures that vSAN™ traffic can run efficiently, correctly, and be available between hosts. VMware® suggests 10 Gigabit Ethernet (GbE) network for vSAN™ to avoid bandwidth bottleneck. In our network design, a VMkernal port is created on the vSwitch, dedicated for vSAN™ traffic. If administrators need to run multiple streams of traffic on the same NIC, Quality of Service (QoS) can be implemented using Network I/O Control (NIOC). NIOC can allocate the dedicated network bandwidth to the vSAN™ traffic. To achieve the network redundancy on the uplink network adapter, NIC teaming is a way to “team” two NICs together. The two uplink adapters “vmnic1” and “vmnic2” are teamed on a vSwitch to either “two active uplinks” or “an active/standby uplink” for failover and redundancy purposes. In Fig. 7, two physical switches with link aggregation are prepared on the upper layer. The real network topology may vary depending on users’ requirements.

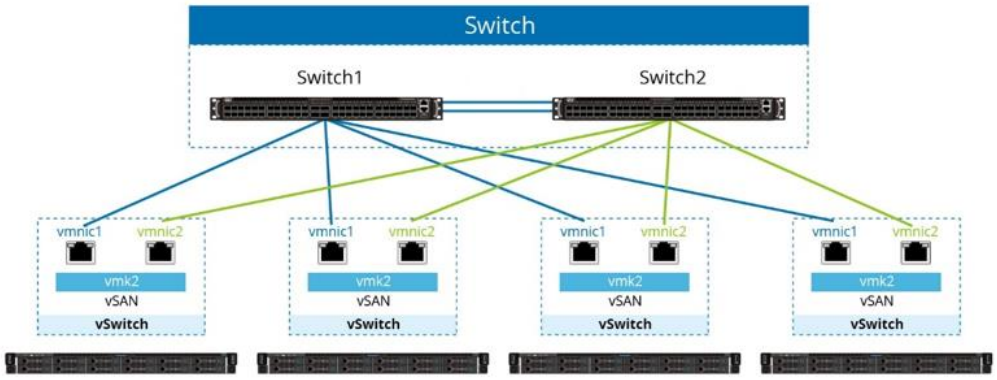

Figure 7. Network Planning of QxStack vSAN™ – Performance Optimized SKU.

5.2.3 Software Configuration for VMmark®

QCT implemented firmware and software optimization according to the guidance of Intel® Select before running the VMmark® test. The server BIOS settings are described below.

- Intel® Hyper Threading Technology Enabled (Default: Enabled).
- Intel® Turbo Boost Technology Enabled (Frequency boost up to 3.70 GHz) (Default: Enabled).
- Intel® Speed Shift Technology: HWP Native (Default: HWP Native).
- C-States: Disabled (Default: Disabled).
- Power Management Settings: Performance (Default: Balance).
- Intel® TXT Enabled (Default: Disabled).

5.2.4 Storage Configuration for VMmark®

The two shared storage configurations listed below are used for different purposes.

Shared Storage 1: Cluster1vsanDatastore

Four QuantaGrid D52B-1U servers utilize their local storage to aggregate into Cluster1vSANdatastore. Each server contains two disk groups. Each disk group includes 1 Intel® SSD DC P4800X 375GB (AIC) for cache and 2 Intel® SSD DC P4510 Series 2TB (NVMe) for capacity. The Cluster1vsanDatastore provides a shared storage for virtual machines when VMmark® runs. It also acts as SVmotion source LUN, XVmotion source LUN, and the deployed source LUN.

Shared Storage 2: iSCSI volume provided by Windows Server 2016

In Windows Server 2016, 2 Intel® SSD DC P4600 1.6TB are configured to two 500GB LUN individually for providing the volume to system under test (SUT) through iSCSI. The volume provides a datastore for SVmotion target LUN, XVmotion target LUN, and the deployed target LUN.

5.2.5 Configuration Diagram

A logical layout for the test environment is shown in Fig. 8. The layout describes the relationship between the virtualization layer and hardware.

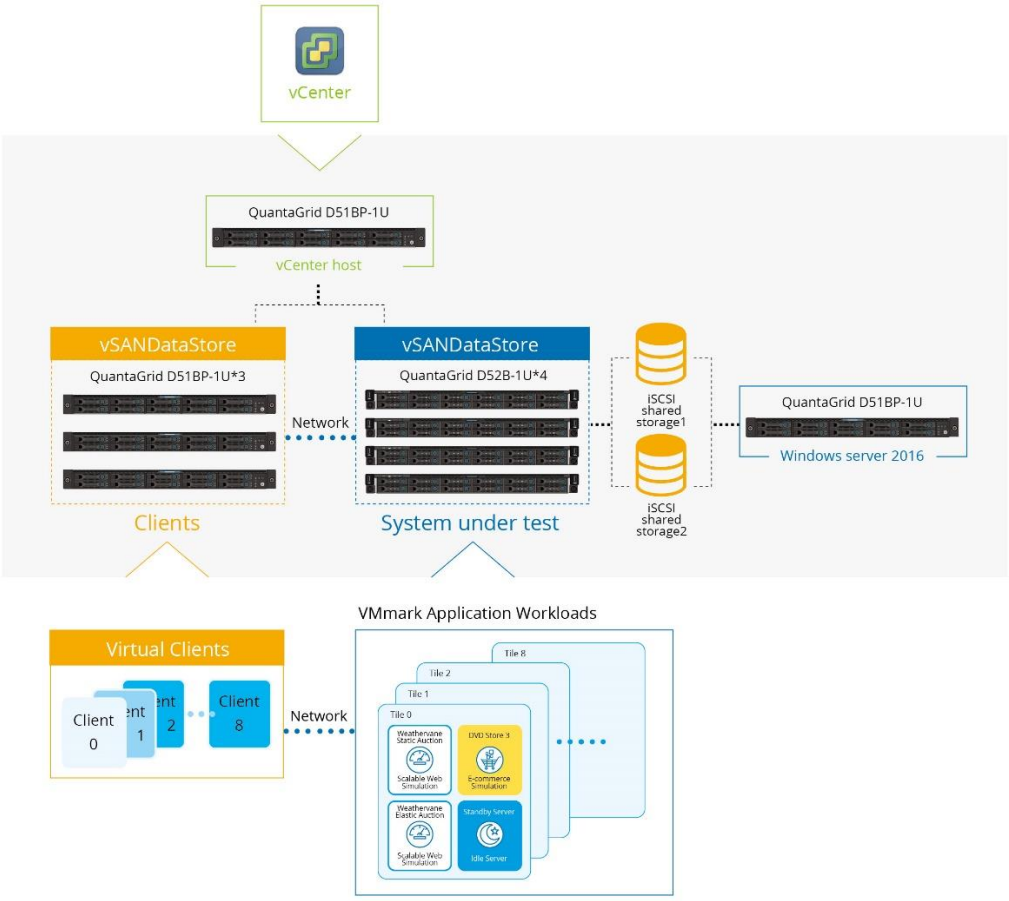

Figure 8. Logical Layout of Test Environment.

System Under Test

To fulfill Intel® Select Program's requirement, four QuantaGrid D52B-1U servers are configured to system under test (SUT). The SUT must also be configured to meet or exceed the requirements listed in VMmark® User Guide.

Clients

Each tile requires a client system to provide loads for the application workload mentioned above. A prime client is needed to run the whole VMmark® test process by activating the VMmark® Harness software to measure the workload. Each VMmark® tile is paired with a virtual client system that drives the tile's virtual machines to perform a variety of tasks. Three QuantaGrid D51BP-1U servers are used to build a cluster for hosting the virtual clients, each hosting three virtual clients, nine virtual clients in total.

Data Center Management Server

One ESXi server is used to install vCenter appliance to manage the entire test system including clients, SUT, and shared storages.

5.3 Test Result

Tile

Tile is a unit in VMmark® containing nineteen virtual machines to simulate a series of diverse workloads. Each tile includes a scalable web, E-commerce, and standby system running on different virtual machines. The tile consumes either compute or storage resources when running the benchmark test. Each application or infrastructure workload generates its relevant performance metric after the benchmark tool finishes the tests. The performance metric in each workload should meet the minimum quality-of-service to make the result compliant when another tile is added. The total number of tiles can help administrators to evaluate the overall performance and the number of virtual machines on a virtualization platform after VMmark® completes the workload tests.

Score

VMmark® collects performance metrics with diverse workloads and normalizes the score based on a reference system provided in SPEC. When the test is finished, VMmark® generates a single overall score to be compared in different virtualization platforms. The score is calculated based on a weighted average of the application and infrastructure workload. It gives 80% weight to the application workload and 20% to the infrastructure workload. When VMmark® runs multi-tiles, an aggregation score is reported by accumulating individual score in each tile. For more information, please refer to VMmark® User's Guide.

To achieve outstanding performance, QCT cooperates with Intel to optimize the setting parameters and adopt the Intel® Select solution's base configuration. The test result reaches up to 9 tiles running on the four systems. Each tile contains standby system, scalable web simulation, and E-commerce simulations. As shown in Table 2, the aggregation score reaches to 8.24, which dramatically exceeds the Intel® select program's minimum performance threshold. For the full test report, please refer to QCT VMmark® test report published on VMware VMmark® website.

In order to improve workload scalability and enhance security, it is the responsibility of the engineer to confirm that the mitigations are enabled according to the test requirement of VMmark® 3.1. Among these, mitigating CVE-2018-3646 disable the hyper-threading function, which may influence the CPU performance.

Table 2. VMmark® Test Result (VMmark® is a product of VMware, Inc.)

Workload	Score
VMmark3_Applications	9.78
VMmark3_Infrastructure	2.06
VMmark3_Total	8.24

6 Conclusion

Modern data center transformation is a main trend to address the dynamic business environment. By joining Intel® Select Program, QCT and Intel® provide innovative and flexible solutions to keep your organization in a leading position.

QxStack vSAN™ – Performance Optimized SKU is a high-performance data center solution that is rapidly deployed, easy to manage, highly certified, and fully integrated into the industry-leading software-defined storage, vSAN™. This reference architecture has proven that the outstanding performance of our solution surpasses the threshold of Intel® Select Program. This solution can minimize customers' time and expense in evaluation, selection, deployment and tuning of a solution.

Leveraging the expertise of QCT and Intel®, customers have a simplified path to a future-defined data center by adopting this solution.

QCT always stays innovative. QCT appreciates any feedback from you. For further inquiry, please visit
https://go.qct.io/solutions/qct-premier-intel-select-solutions/qxstack-vsan-readynodetm-performance-optimized-sku/

7 References

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ABOUT QCT

QCT (Quanta Cloud Technology) is a global datacenter solution provider extending the power of hyperscale datacenter design in standard and open SKUs to all datacenter customers.

Product lines include servers, storage, network switches, integrated rack systems and cloud solutions, all delivering hyperscale efficiency, scalability, reliability, manageability, serviceability and optimized performance for each workload.

QCT offers a full spectrum of datacenter products and services from engineering, integration and optimization to global supply chain support, all under one roof.

The parent of QCT is Quanta Computer Inc., a Fortune Global 500 technology engineering and manufacturing company.

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