



Software Information Systems, LLC

Technical Proposal

for

State of West Virginia

Scalable Infrastructure Storage Solution
Request for Proposal

7/9/2021

Signature: Jane Andlwood
Name: Jaren Imallwood
Title: Director of Contracts (Compliance

Jocument ID#: 5880RFP01v1

The information contained in this Proposal is valid for 90 days after the proposal due date.



Section I: Submittal Letter

July 9, 2021

Ms. Linda B. Harper Department of Administration Purchasing Division 2019 Washington Street, East Charleston, WV 25305

Dear Ms. Harper,

Please find enclosed the SIS response for CRFP 0705 LOT2100000001 due July 9, 2021. SIS understands the requirements of the RFP and is submitting a response offering Cisco HCI, NetApp UDS, Veeam DPS and Cisco Networking. This response meets or exceeds "should and mandatory" requirements of the RFP for both the Production and Disaster Recovery sites. The Compute and Storage specifications are exceeded. All Professional Services and Training and Knowledge Transfer as specified in the RFP are included and all credentials and certifications specified in the RFP have been met. Cisco HCI provides the West Virginia Lottery with the most advanced Hyper Converged Infrastructure available today. Veeam is the #1 Backup and Recovery solution, and NetApp UDS is unparalleled. All offer the West Virginia Lottery the best in breed technologies. Each technology is listed in their respective Gartner Magic Quadrant.

During the last few years SIS has implemented Compute and Storage systems for Production and DR for the West Virginia State Treasurer's Office using Cisco Compute, NetApp Storage, Veeam DPS and Cisco Networking. Also, SIS has implemented Compute and Storage systems for Production and DR for the WV Oasis using the same technologies. SIS also implemented the Compute and Storage systems for Production and DR for The West Virginia Department of Education using IBM systems. Each of these State of West Virginia entities has given SIS permission to use them as a reference.

Thank you for the opportunity to submit this response and we look forward to further discussions.

Sincerely,

Charles D. Arnett

carnett@thinksis.com

Senior Client Executive

al lab la cisco. NetApp



Enclosures



Section II: SIS Overview

Company Name:

Software Information Systems, LLC

Short Name:

Address:

SIS, A Converge Company or SIS

Year Established:

1982 165 Barr Street, Lexington, KY 40507-1321

Organizational Structure:

SIS is a wholly owned subsidiary of Converge Technology Solutions Corporation (Converge). As of May 1, 2021, Converge has made 19 strategic acquisitions since its establishment in 2016. Converge is building a North American IT Infrastructure provider selling hardware, software, and managed services solutions to Corporate and Government customers by acquiring IT Solution Providers ("ITSPs"). Converge has approximately 1,000 employees and over 2,400 customers. The Management Team, Board, and Founders have extensive acquisition and management experience in both the private and public markets. Converge is on a trajectory for exponential revenue growth, targeting \$3B+ annual runrate revenue in 2–3 years.

Other subsidiaries of Converge to date include:

- BlueChip Tek, Inc.
- Corus Group, LLC
- Key Information Systems, Inc.
- Essex Technology Group, Inc.
- Lighthouse Computer Services, Inc.
- Nordisk Systems, Inc.
- Northern Micro, Inc.
- 10084182 Canada Inc. operating as Becker-Carroll
- Datatrend Technologies, Inc.
- VSS, LLC
- PCD Solutions Inc.
- Unique Digital Technology, LLC
- Workgroup Connections, Inc.
- CarpeDatum, LLC
- Vivvo Application Studios, Ltd.
- Vicom Computer Services, Inc.
- Accudata Systems, LLC
- Dasher Technologies, Inc.

Website:

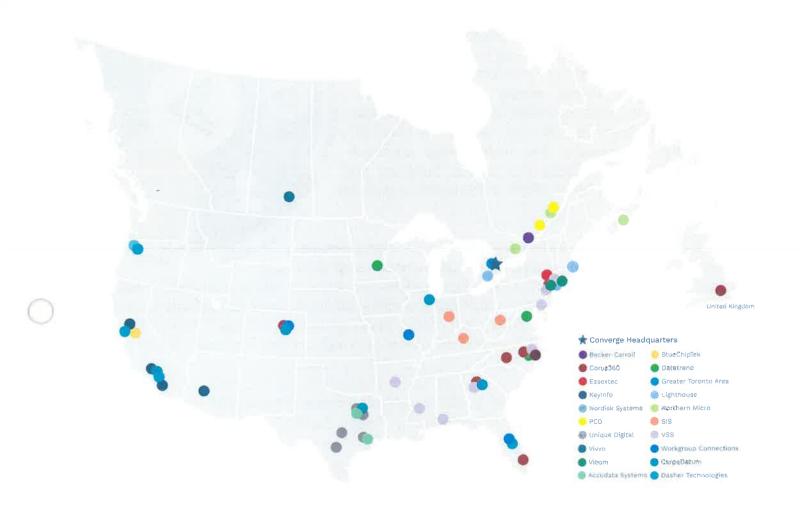
SIS website: https://thinksis.com

Converge website: https://convergetp.com



Phone: (859) 977-4747 **Fax:** (859) 977-4750

Geography:The below figure expresses the footprint of SIS's parent company, Converge Technology Solutions Corporation:



About Us

SIS is a technology solutions and services company, collaborating with clients on innovative data center strategy, technology, and application solutions in the cloud or on-prem. As a nationally recognized technology and managed IT solutions provider, SIS knows to combine predictability with quality to support mission-critical assets. Our top-down strategy, involving management, business decision makers and IT staff in the development process has consistently delivered solutions that reduce costs and improve efficiencies.

DIGITAL INFRASTRUCTURE

CLOUD



Our proven methodology, experienced professionals and innovative technologies help clients infuse technology into a clear strategy to drive results in system availability, recovery, performance and efficiency. Every solution is customized to our clients' unique business requirements, leveraging existing IT investments while keeping scalability and TCO top of mind. CYBERSECURITY

SIS parent company, Converge Technology Solutions Corporation is a software-enabled, IT & cloud solutions provider focused on delivering industry leading solutions and services. Converge's regional sales and services organizations deliver advanced analytics, cloud, cybersecurity, and managed services offerings to clients across various industries. Converge supports these solutions with talent expertise and digital infrastructure offerings across all major IT vendors in the marketplace. This multi-faceted approach enables Converge to address the unique business and technology requirements for all clients in the public and private sectors.

PALENT SOLUTIONS MANAGED SERVICES SIS is proud to maintain a wide variety of service competencies, delivered by our team of trained and experienced engineers and consultants. Further, as a part of the Converge portfolio of companies, SIS is positioned to collaboratively leverage competencies and expertise within our expanding family of IT solution providers, as well as our strategic technology partnerships, to bring our clients quality solutions. Our goal is to be a trusted partner that brings together world-class solutions and services to help reduce costs, increase efficiency, and create competitive advantages.

When the SIS Managed Solution Center ("MSC") opened, SIS was the only IBM partner delivering IBM, Power, Intel and Storage platforms from a single facility. Today, that IBM footprint has expanded to a SSAE 18 SOC Type 2 certified environments that include Cisco, Palo Alto, EMC, NetApp, Dell, VMWare and Microsoft in two regionally-based data centers in Kentucky and Illinois. The MSC is capable of providing up to 10 GB of bandwidth using diverse physical internet connectivity through multiple carriers. Our security matches those of many larger providers including monitored cameras, badge and biometric access, as well as physical security.

The SIS MSC is a multi-million-dollar investment for our customers to partner with us for their cost savings. The MSC combines cutting edge technologies and a certified staff to deliver solutions in a secure multiplatform environment. SIS's MSC offers extremely competitive solutions that include the hosting of mission critical, high volume applications as well as true high availability and disaster recovery for our customers.



Data Center Solutions

SIS Data Center Solutions are comprehensive and state-of-the-art solutions designed and deployed by SIS, with technology from SIS strategic partners.

SIS Cloud Solutions

SIS Cloud Solutions are a combination of SIS technology, vendor technology, and SIS services. This combination is an outcome-based solution vs. the technology or service itself. SIS Cloud Solutions include on-premise, public, and hybrid cloud solutions.

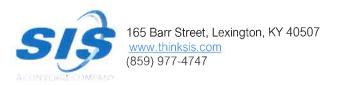
SIS Insights

SIS Insights is an overlay of all solutions offered by SIS. Each engagement has the insights of SIS's brightest technical resources. Each product has SIS Insights included in the services. SIS Insights leverages our strongest asset: our people.

Strategic Partnerships and Market Awards

As a part of the Converge portfolio of companies, SIS is well-positioned to leverage strategic partnerships with industry leading technology firms, such as Microsoft, IBM, Cisco, VMware, NetApp, Veeam, Dell and many more, to offer a wide variety of solutions to our clients. To view a list of some of our valued partnerships, please visit: https://convergetp.com/strategic-alliances/.

SIS has additionally received numerous certifications, designations, and recognitions from third parties. The data behind third-party recognition offers our company in-depth information, which we can apply to strengthen our products, services, and internal operations. Such recognition also enables SIS to measure ourselves against national benchmarks of our competitors; thereby, ensuring we are utilizing best



practices to become a leader in the IT industry. Below represents some of the many recognitions SIS has received throughout the years:

- Inaugural Veeam Innovation Award Winner
- IBM Platinum Business Partner
- Avnet/TechData Analytics and Data Award
- IBM Choice Award North American Top Strategic Partner
- IBM "Big Data" Partner of the Year
- Lane Report Top Technology Services Companies of Kentucky
- CRN Solution Provider 500
- Eight Time Best Places to Work Kentucky Award Winner
- Named as SOC2 (Service Organizational Control) Provider
- Selected as Partner for Veeam Availability Suite
- Talking Cloud 100 Ranking
- IBM Edge Winner
- Named to CRN's Solution Provider 500 List
- Microsoft US Central Region Renewal Partner of the Year
- IBM Collaboration Solutions Award (Winner)
- Microsoft Central Region SMB Partner Award for VAR Champion Partner of the Year
- FINALIST: IBM Best Industry Solution for Health Care
- IBM Global Financing Leadership Award
- Veeam #1 ProPartner Ohio Valley Region
- CRN Top 100 Healthcare VARS
- Microsoft Gold Datacenter Partner
- Inc. 500 "Fastest Growing, Privately Held Companies in America"
- IBM "Leadership Award"
- VAR500 winner
- CRN Technology Elite 250
- Leadership Award for Healthcare Trusted Advisor Award Avnet
- Finalist for IBM Beacon Award Best Industry Solution for Healthcare
- Outstanding PureFlex-Flex Specialty Partner in North America

Section III: Solution Overview

In response to CRFP 0705 LOT2100000001 (the "RFP"), SIS is pleased to present this Technical Proposal to the State of West Virginia (the "State"). In accordance with the State's requirements, SIS is providing the following required documents along with this proposal:



- 1. West Virginia Lottery "Scalable Infrastructure Storage Solution" RFP signed by SIS
- 2. Addendum Acknowledgement Form signed by SIS
- 3. Purchasing Affidavit signed by SIS
- 4. Disclosure of Interested Parties to Contracts signed by SIS

Pursuant to Section 5 "Vendor Proposal" of the RFP, SIS has additionally fulfilled the following requirements:

- ✓ SIS has constructed a simple, economical, and concise response for the State's consideration, referencing online URLs within its response where appropriate to incorporate relevant information for the State's review.
- ✓ SIS is prepared to accept financial responsibility for all expenses incurred by SIS in responding to this RFP, including by not limited to preparation, delivery, and travel.
- ✓ SIS is submitting this Technical Proposal and a separate Cost Proposal to the State. This Technical Proposal contains no cost information; all cost information is contained in the Cost Proposal.
- ✓ The title page of this proposal reflects SIS's corporate contact information, name of the SIS contact person, signature on behalf of SIS, and the date of submission.
- ✓ The table of contents is provided for the State's convenience.
- ✓ The structure of this proposal is such that SIS's responses clearly correlate to the State's requests in Section 4 of the RFP. Please see the below section "SIS Responses to Section 4 of the RFP."
- ✓ SIS understands the need for timely presentation of its response before the bid opening time and is submitting a copy of its Technical Proposal and its Cost Proposal to 2019 Washington Street East, Charleston, WV 25305-0130.

SIS, in partnership with Cisco, NetApp and Veeam, has architected the enclosed solution to meet the requirements outlined in the "Scalable Infrastructure Storage Solution" RFP for the West Virginia Lottery. The solution is designed to be scalable with several tiers of support for compute, storage, networking and recoverability. All included products can be configured to support the various cybersecurity requirements.





Section IV: SIS Responses to Section 4 of the RFP

REQUEST FOR PROPOSAL

State of West Virginia – West Virginia Lottery Scalable Infrastructure Storage Solution

SECTION 4: PROJECT SPECIFICATIONS

4.1 **Background and Current Operating Environment:** The Lottery currently has two major systems that are in need of replacement. The Primary system is installed in the Data Center located at 900 Pennsylvania Avenue in Charleston WV (HQ). Secondary and failover components are installed and configured in the Bridgeport Data Center at 64 Sterling Dr, Bridgeport West Virginia (BDC).

Each location has three (3) HP DL380 Servers acting as VMWARE Hosts under VMWare 5.0 with ESXI operating systems. Each Host Server has a dual Core CPU with VMWare ESXI operating systems installed. The total VMWare licensing is for 12 CPU's for both the primary and secondary site.

Each site has a VNX 5300 disk storage system with 20TB of space, used primarily for VM machine storage and general file storage. Each site also has a Centera DL4P storage system with WORM capabilities (Write Once Read Many) which is used for document imaging and legal hold with 10 TB.

The two sites are currently kept synchronized by the following processes:

SOL

- DBAs run local backup job(s) that are saved directly on a local SQL virtual server.
- EMC Networker performs backups on entire VM which includes the local backups.

EMC Networker

- Machines are backed up incrementally nightly with a full backup performed once per week;
- Backups are retained for either 14 days or 60 days based on server role;
- File-level recovery is available as well as the ability to recover an entire virtual machine.
- Virtual machines are backed up using VADP (basically takes a snapshot of the machine's virtual disks, then mounts them on the Networker server to then be backed up).
- Backups are written to the Data Domain device at HQ which in tum replicates its data asynchronously to the Data Domain in BDC.

Recover Point Appliance (RPA)

- Continuous data protection and provides point-in-time recovery.
- LUNS that require protection are added to RPA Consistency Groups

Snapshots of the protected LUNS are continuously taken and written to the RPAs at HQ.
 They are then immediately replicated (asynchronously) to the RPAs in BDC.

4.1.1 **Definitions**

"AI/ML" means Artificial Intelligence and Machine learning.

"All Flash" means all storage media is composed of solid state media, with no magnetic motorized media.

"Ansible" means an Open Source tool that automates application and IT infrastructure management

"Badged Employee" means a person who works directly for the Vendor or Manufacturer. Has an employee badge and email address matching the domain name of Vendor or OEM respectively not a subcontractor of the winning vendor.

"BGP" (Border Gateway Protocol) means a standardized exterior gateway protocol designed to exchange outing and reachability information among autonomous systems (AS) on the Internet.[I] BGP is classified as a path-vector routing protocol,[2] and it makes routing decisions based on paths, network policies, or rule-sets configured by a network administrator.

"Block Storage" means storage in which the data is saved directly to storage media in fixed size addressable chunks.

CIFS means CIFS stands for "Common Internet File System." CIFS is a dialect of SMB. That is, CIFS is a particular implementation of the Server Message Block protocol, created by Microsoft.

"CLI" means Command Line Interface

"CPU" means Central Processing Unit.

"DR" means Disaster Recovery, the plans and procedures for recovering from a system outage due to hardware or environmental issues.

"DNS" means an acronym that stands for Domain Name System. DNS is the protocol that provides the framework for web browsing.

"DPS" means Data center Backup and recovery Solutions. This includes the following components:

- 1. Data center backup and recovery solutions- Solution consisting of hardware and software designed to capture a point in time copy (backup) of a workload and write the data out to a dedicated and included secondary storage device for the purpose of recovering this data in the future.
- 2. Data Protection storage Physical Storage media and corresponding hardware and software accelerators designed specifically for the purpose of efficient storage and retrieval of point in time copies (Backup) of workloads for future needs.

"Guest" means a virtual machine or Operating system instance that shares resources with other guests when installed on a host.

"GUI" means Graphical User Interface.

"HCI" means Hyper converged infrastructure which is a software-defined, unified system that combines all the elements of a traditional data center: storage, compute, networking and management. This integrated solution uses software and x86 servers to replace expensive, purpose-built hardware.

"Host" means a Server computer designed and supported to run specialized host operating system software that enables virtualization or sharing of resources by multiple virtual machines.

"Inline De-duplication" means a Data reduction feature where data blocks are scanned and identical blocks are eliminated in real time, as data is received from the host, prior to commitment to media. Not post processed after commitment to media.

"Inline Compression" means a Data reduction feature where data blocks are analyzed for patterns; and data compression is applied prior to commitment to media. Not post processed after commitment to media.

"Intel" means the manufacturer of PC microprocessors and the holder of the x86 processor architecture patient. All major PC manufacturers offer the Intel chip as an option for it's high performance.

"LAN" means Local Area Network



"L2" means Layer two (2) in the OSI model. Generally supports the data link layer, functional and procedural means to transfer data between network entities.

"L3" means Layer three (3) in the OSI model. Generally supports the network layer, responsible for packet forwarding, including routing functions.

"Leaf/Spine Fabric" means a two-layer network topology composed of leaf and spine switches. Leaf switches mesh into the spine forming the access layer for server connections.

"LUN" means a logical unit number - In simple terms, a logical unit number (LUN) is a slice or portion of a configured set of disks that is presentable to a host and mounted as a volume within the OS.

"NAS" means Network Attached Storage which is a file-level (as opposed to block-level storage) computer data storage server connected to a computer network providing data access to a heterogeneous group of clients. NAS is specialized for serving files either by its hardware, software, or configuration.

"NAS Appliance" means a network accessible unstructured storage appliance, including CPU, RAM, Media, and any other components required to store and make unstructured data available over the network using protocols of CIFS, SMB, NFS, FTP, HDFS or HTIP.

"Network Efficient Replication" means using global data reduction features across source and target to lessen network impact by only replicating changes to the backups.

"NFS" means Network File System: This distributed file system protocol allows a user on a client computer to access files over a network in the same way they would access a local storage file.

"Node" means a modular hardware unit that may contain CPU, RAM, or storage media devices.

"Non-Blocking" means internal bandwidth can handle all the individual port bandwidths, at the same time, at full capacity. A non-blocking switch is capable of doing this on all ports at once.

"OEM" means original equipment manufacturer. This applies to hardware and software components.

"OEM Premium Installation and Deployment Services" means a complete set of premium level deployment services provided by the OEM. Containing a minimum of these features: TAM engagement, Onsite hardware installation, packaging disposal, project management, Site readiness review, implementation planning, on-site installation and configuration of system software, system testing,

verification, product orientation, project documentation, 30 day post deployment configuration assistance, and configuration documentation capture and delivery to OEM support organization.

"OEM Operational Transition Services" means OEM provided, Expert-level human resources, intended to provide guidance post-deployment of the solution components. This resource will provide on-site infrastructure management, knowledge transfer to WVL, and will ensure OEM best practices are implemented to ensure successful adoption the new solutions. These services are to be offered on-site in one (1) month intervals, with travel and expenses included. One (1) month is defined as 20 contiguous days of work or a maximum of 160 hours.

"OSPF" (Open Shortest Path First) means a routing protocol for Internet Protocol (IP) networks. It uses a link state routing (LSR) algorithm and falls into the group of interior gateway protocols (IGPs).

"Physical Server" means an industry standard X86 server configured to host a single X86 compatible operating system which contains all required CPU, RAM, interfaces, and storage to start, run, and use the installed operating system.

"QoS" means Quality of Service which is the description or measurement of the overall performance of a service, such as a telephony or computer network or a cloud computing service, particularly the performance seen by the users of the network. To quantitatively measure quality of service, several related aspects of the network service are often considered, such as packet loss, bit rate, throughput, transmission delay, availability, etc.

"RAID Controller" means a hardware device in this case used to manage hard disk drives (HDDs) or solidstate drives (SSDs) in a computer or storage array so they work as a logical unit. A RAID controller provides a degree of protection for stored data and may also help to improve computing performance by accelerating access to stored data.

"RBAC" (Role Based Access Control) means a way of separating and restricting software functionality based on logged-in user pre-defined role in the application. Often integrated with external directory services.

"Re-Platforming" means for the purpose defined in this document: re-platforming refers to all activities required to migrate applications to more modem - supported platforms or operating systems.

•These activities should be planned, designed and implemented to maintain the maximum functionality of the applications both in reduced down time and deferring any loss of functionality before, during or after the migration. The overall intent is to maintain the capability of the application but regain supportability.

•These activities will include any application updates as required to gain support for 201x Server as well as, but not limited to Operating system features, configuration, permissions, Shares, Services, etc. that need to be added in order to maintain application functionality. For Example: migrating an application installed on Windows server 2008R2 and moving it to a new server instance such as Windows 2016 Server.

"RoCE" means ROMA over Converged Ethernet

"RDMA" means Remote Direct Memory Access

"RPO" (Recovery Point Objective) means the maximum amount of time permitted between subsequent data replication intervals - also may be considered the maximum time duration where newly generated or modified data could be lost in the event of a disaster.

"RTO" (Recovery Time Objective) means the maximum amount of time after a data loss disaster before data is available from snapshot, restore, or journal replication solution.

"Scale-Out" means modular architecture in which the total amount of disk space can be expanded through the addition of nodes with their own resources for storage, CPU, RAM and any other mandatory components required to make data available over the network.

"Server Aggregation Switch" means a top of rack Ethernet network switch with a large number of server interface ports, high total switching capacity, non-blocking architecture, and aggregation capabilities directly to core/hub routers at extreme high speeds.

"SFP+" (Small Form Factor Pluggable) means SFP and SFP+ transceivers which are virtually identical in size and appearance. The primary difference is that SFP+ is an updated version that supports higher speeds up to 10Gbps. SFP+ specifications are based on SFF-8431.

"SLA's" means service-level agreement (SLA) which defines the level of service expected from a vendor, laying out the metrics by which service is measured, as well as remedies or penalties should agreed-upon service levels not be achieved. It is a critical component of any technology vendor contract.

"Smart Fabric" means network device capability to automate configuration management of HCI connected TOR switch(s).

"Storage Node" means a modular unit that contains storage media, not capable of providing services without other modules containing CPU and RAM, or any other mandatory component not contained within.

"Switch" means a non-blocking Ethernet network switch used to connect and aggregate servers together.

"TAM" means a Technical Account Manager, assigned by the OEM/Vendor to manage incidents/project reporting.

"TOR" means a Top of Rack leaf server network switch.

"UDS" means Unstructured Data Solution as compare to a structured data solution like a SQL database where there is a specific structure in how the data is stored.

"Unstructured Data Solution" means a storage solution optimized for the storage of file or object data sets, not block storage or structured databases.

"Usable Capacity" means electronic storage capacity measured after sparing, redundancy, clustering, overhead, and fault prevention is employed. Useable should be calculated after formatting and before any data deduplication or compression features are enabled.

"VADP" means providing backup products the ability to kick off snapshots and use Changed Block Tracking (CBT) to allow incremental style backups which improve the efficiency of backup solutions by reducing the impact (performance, think storage, network and compute overheads) and duration (backup window).

"Vendor" means the RFP respondent, reseller, or service provider. Not the manufacturer or OEM.

"VLAN" means virtual partitions of a physical LAN that create network boundaries at the data link layer in the OSI model.

"VMware ESXI" means the underlying operating system installed on each of the three physical servers, the 35+ guest VMS run under control of ESXI.

"VMware Virtual Machine" means a software representation of a physical server, including memory, disk and network cards. The Lottery operates in a VM environment with approximately 35 guest VM's under control of three physical servers providing functions like Database/ eMail, etc. VMware is one of several providers of virtual machine management software and has long been used by the Lottery with an existing contract that is not included in this RFP.

"VMware Virtual Environment Tools" means VSPHERE which acts as a management system for the VMware complex and Vmotion as defined below, among others.

'VMware vSphere" means a software suite that includes components like ESXi, vCenter Server, vSphere Client, vCenter Orchestrator, vSphere Update Manager, etc. vSphere components provide virtualization, management, resource optimization and many other features useful for a virtual environment. vSphere is used to virtualize and aggregate the underlying physical hardware resources and to provide the pool of virtual resources to the data center. It also supports some advanced virtualization features such as disaster recovery, high availability, fault tolerance, dynamic resource allocation, etc.

"VMotion" means VMware software features which permits a virtual computer to be moved between hosts or between storage pools without application downtime.

"VXLAN" means a network virtualization technology standard protocol for overlay encapsulation. VXLAN is an encapsulation protocol that provides data center connectivity using tunneling to stretch Layer 2 connections over an underlying Layer 3 network.

"X86" means a family of instruction set architectures initially developed by Intel, based on the Intel 8086 microprocessor and it's 8088 variant.

"Zero Block Elimination" means a data reduction technique that eliminates blocks of data containing only zeroes and prevents them from being written to media. This increases the effectiveness of data reduction and reduced writes to flash media.

This request for proposal (RFP) is organized around the following sections, each of which will require responses from a respondent vendor, it will not be sufficient to respond with a copy of the section as stated in the RFP.

The intent is for the vendor to describe how they can meet or exceed specifications, with technical documentation or industry publications included as deemed necessary.

However, any attachments must be cross referenced to the applicable specification:

Project Goals and Objectives

- General Specifications
- Additional Specifications
 Mandatory Requirements
 Qualifications and Experience
 Mandatory Qualifications



4.2 **Project Goals and Mandatory Requirements**: The primary focus of this project is to refresh the Lottery's existing infrastructure. This infrastructure includes virtualized systems, storage arrays, data protection, networking equipment and replication devices. This would include requisite support and end user training. Migration of services is to include the transition of existing services and applications to the new platform.

WV Lottery is seeking a vendor to provide OEM Hardware, Software, Installation, Migration, Maintenance, Support, Training, Erasure, and Operational Transition Services for our Charleston and Bridgeport, WV data centers. The project will be focused on three major phases:

- Phase I Hardware/Software Modernization and Migration Services;
- Phase II Application Lifecycle Transition Services and Disaster Recovery; and,
- **Contract Term** -These activities/costs apply to the entire duration of the contract and may span both phases.

The detailed project goals and objectives are listed below. Please describe in detail how your proposal will meet or exceed these goals and objectives. Note that marketing material should not be included 'as is" to provide these descriptions. Technical articles or industry information can be included as exhibits to each section with a cross reference to the corresponding feature.

Vendor is to describe in detail (writing) its approach and methodology to meeting or exceeding every objective or requirement documented in the Project Specifications.

This includes each of sections 4.2.1.1through 4.2.1.102.

4.2.1 Project Specifications (Goals and Objectives)

General Specifications

PHASE I Hardware/Software Modernization and Migration Services

Hardware/Software Modernization and Migration Services will include hardware/software delivery, start-up and configuration. The existing VM servers will be moved to the new hardware. At the end of this phase, activities will transition to Application Lifecycle Transition Services, these will include building the new VM server environment, data migrations, post installation premium support and de-commissioning of hardware.



4.2.1.1. Please describe in detail how your solution provides for Firmware and software upgrades across each area of the solution HCI, DPS, UDS and Networking.

Vendor provided solution should include software that simplifies and consolidates all of the appliance hardware and software lifecycle management processes with a single, non-disruptive patch and upgrade capability. Non-disruptively means all data is accessible, writable, usable, and available prior, during, and after the lifecycle process. This simplified update package should also include patches, updates, and new versions of software defined storage software, hypervisor, management tools, security updates, as well as hardware firmware updates and drivers.

→ Response:

Veeam (DPS) Response:

Veeam Backup and Replication has a built-in notification system that will alert you of any patches or major product releases. These notifications are enabled by default, but can be disabled. Notification will also be sent via email. A typical upgrade process is to download the upgrade package (either an iso or. zip file) and apply it to the Veeam Backup and Replication server. Once the Veeam Backup and Replication server is updated, the server will push out the needed software to the other Veeam components (proxies, repositories, WAN accelerator servers...) and perform the upgrade process. Requirements and additional instructions into the upgrade process for each release (update, and major release) are documented in the release notes for an upgrade.

NetApp (UDS) Response:

The solutions proposed from NetApp are all designed to be enterprise class "six nines" (99.9999%) availability products and as such all firmware and software upgrades are designed to be non-disruptive where an update package is downloaded to the system and either executed or scheduled to be executed to install. The system then upgrades and reboots, if required, each controller individually while maintaining workload availability on the redundant controller. NetApp is the one of few vendors who have independently verified "six nines" (99.9999%) across our install base. Details on this verification are available from IDC on the following link. https://www.netapp.com/zh-hans/media/8295-idctechnologyspotlight.pdf

Cisco (Networking) Response:

The Cisco HyperFlex "full-stack" upgrade process involves upgrading the following 3 components:

Cisco HyperFlex Data Platform



- VMware vSphere ESXi
- Cisco UCS Server Firmware

Cisco recommends upgrading all these 3 components in a combined upgrade from HyperFlex Connect. You can choose to upgrade one, two or all three components in the same upgrade workflow. The upgrade process is non-disruptive and upgrades one server at a time.

UCS Fabric Interconnects are upgraded separately in UCS Manager software.

NetApp Cisco (UDS) Response:

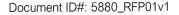
4.2.1.2. Please describe in detail how your solution will provide for contact management including a decision tree that shows how calls would be managed for multiple components. Phone and onsite support for any hardware/software issues including but not limited to HCI, UDS, DPS and Networking.

Vendor provided HCI, UDS, DPS and Networking solution should allow for a streamlined method of contact which minimizes the number of involved parties for all of the integrated components, including the hypervisor, from a single call, single contract, backed by a monitored dial-home secure remote connection for monitoring, diagnosis, and repair for ALL devices in the solution. The manufacturer (OEM) would take ownership of the support incident through the entire process of resolution.

→ Response: Cisco Solution Support provides a primary point of contact which focuses on your deployment as a whole, addressing software and hardware from both Cisco and Solution Support Alliance Partners. Using product, architecture, and interoperability expertise, we either directly resolve your issue or actively manage your case by coordinating product support teams inside and outside of Cisco, remaining accountable from first call to resolution, no matter where the issues reside. 60 months of 24x7x4 with on-site support is included in the solution.

https://www.cisco.com/c/dam/en_us/services/portfolio/documents/solution-support-service-at-a-glance.pdf

4.2.1.3. Please describe in detail how your solution meets the Lottery's Disaster Recovery and Business Continuity requirements as described in this RFP. This process should account for failover and failback. Provided solution should be capable of automated failover of UDS, HCI and DPS services from one location to another. The software should be capable of automating all steps of the failover process, include the capability to automate failover of NAS services, but not limited to Active Directory changes, DNS changes, host and IP Address changes and Windows or Linux client access. Solution should include readiness





monitoring and continuous testing of the DR features that permit non-disruptive testing while data is being replicated.

→ Response: Veeam Backup and Replication provides options to recover after a disaster from backups, from replicas created by Veeam Backup and Replication, and from archived storage snapshots of supported storage arrays, as well as perform non-disruptive testing.

From Backups:

- Full VM restores of VM data stored locally, or at a secondary location to the same location, or a different location
- Restore a full VM to Azure or AWS
- Restore VM configuration files (.vnx, .nvram, .vmdk)
- The ability to run a fully functional VM from a backup image

From storage snapshots:

- Run a VM from a snapshot and migrate it into a VMware datastore
- A list of supported storages can be found in the documentation.

From physical servers:

Full bare metal recovery of Physical servers (Windows, Linux)

- Instant VM Recovery from agent based backups to VMware or Hyper-V
- Restore as a VM to Azure or AWS
- Volume level recovery
- Restore computer disks from volume-level backups and convert them to disks of the VMDK, VHD or VHDX format.

If Veeam Backup and Replication is configured to replicate VMs into a VMware infrastructure the following disaster recovery options are available:

- Failover to Replica. This includes the ability to ReIP the VM (Windows servers only), and place the VM on the proper network segment (Linux and Windows)
- Planned Failover with all the available options as a regular failover
- Failover plans. In a failover plan, you set the order in which VMs must be processed and time delays for VMs. The time delay is an interval of time for which Veeam Backup & Replication must wait before starting the failover operation for the next VM in the list. It helps to ensure that some VMs, such as a DNS server, are already running at the time the dependent VMs start. The time delay is set for every VM in the failover plan except the last VM in the list.
- Permanent failover. When you perform permanent failover, you "commit" failover. You can perform this operation if you want to permanently switch from the original VM to a VM replica and use this replica as



the original VM. As a result of permanent failover, the VM replica ceases to exist as a replica and takes on the role of the original VM.

For advanced Recovery Planning, Veeam offers Veeam Disaster Recovery Orchestrators which can build on top of replica's, backups and certain storage systems and add the following additional functionality:

- Orchestrate disaster recovery create workflows to orchestrate recovery operations performed both for Veeam Backup & Replication backups and replicas, and for replicated storage snapshots created on NetApp storage systems.
- **Automate DR testing** build test schedules to automate the verification of orchestration plans, with isolated and low-impact testing of VM backups, replicas, applications and storage snapshots.
- **Meet DR compliance requirements** generate and automatically update documentation for DR procedures to eliminate the problem of outdated DR plans.
- 4.2.1.4. Please describe in detail how your solution will meet the Lottery's Point in Time Recovery and Recovery Point Objectives.

Vendor provided DPS solution should include software licensing for each WVL data center that provides Point in time recovery for all WVL virtual guests via journal based bidirectional VM replication. The Recovery Point Objective for replication should be 15 minutes or less. This replication software should include features designed to reduce RTO including DR testing, validation, fail-over and fail-back automation, including automation processes for IP address changes and DNS updates. This point in time recovery solution should include and be licensed for the capability of establishing at least five (5) consistency groups of guests which in the event of a failover, have identical RPO's and maintain application consistency as a group or per virtual machine. The product should also provide any point-in-time recovery per VM.

Please describe how your DPS solution simultaneously supports standard applications, platforms, and protocols with application consistent protection (Backups that restore a useable platform), e.g.MS Exchange, SMSSQL, System State and Sharepoint. This is related to structured data backups and restore.

→ Response: Three methods for achieving DR and BC are included. From a standard replica RPO is 15 minutes and RTO is equal to boot time, CDP continuous data protection replication, RPO is < 2 seconds and RTO is equal to boot time. In these cases the replicas are register replicas of production VMs on production class storage not deduped or compress, they are in a ready to run state. Multiple restore points can be maintained for quick rollbacks.

Veeam is application aware and can restore individual objects within the following applications: Active Directory, SharePoint, MSSQL, Exchange, Oracle and Linux and Windows Filesystems. Veeam is extensible and tools are provided to create Application Aware restores for any application.

Additionally with similar RTOs Instant VM recovery from the backup repository is included. RPO in this case is based on backup schedule and restore points.

Standard Replication, Instant VM recovery and CDP replication restore point are application consistent. CDP replicas are crash consistent and journaled.

With instant VM recovery, you can immediately restore a VM into your production environment by running it directly from the backup file. Instant VM recovery helps improve recovery time objectives (RTO), minimize disruption and downtime of production VMs. It is like having a "temporary spare" for a VM: users remain productive while you can troubleshoot an issue with the failed VM.

When instant VM recovery is performed, Veeam Backup & Replication uses the Veeam vPower technology to mount a VM image to an ESX(i) host directly from a compressed and deduplicated backup file. Since there is no need to extract the VM from the backup file and copy it to production storage, you can restart a VM from any restore point (incremental or full) in a matter of minutes.

The archived image of the VM remains in read-only state to avoid unexpected modifications. By default, all changes to virtual disks that take place while the VM is running, are logged to auxiliary redo logs residing on the NFS server (backup server or backup repository). These changes are discarded as soon as a restored VM is removed, or merged with the original VM data when VM recovery is finalized.

To improve I/O performance for a restored VM, you can redirect VM changes to a specific datastore. In this case, instead of using redo logs, Veeam Backup & Replication will trigger a snapshot and put it to the Veeam IR directory on the selected datastore, together with metadata files holding changes to the VM image. Redirecting VM changes improves recovery performance but makes Storage vMotion not possible for ESX 4.x and earlier. As a result, you will not be able to use Storage vMotion to finalize Instant VM Recovery.

To finalize instant VM recovery, you can do one of the following:

• Use Storage vMotion to quickly migrate the restored VM to the production storage without any downtime. In this case, original VM data will be pulled from the NFS datastore to the production storage and consolidated with VM changes while the VM is still running. Storage vMotion, however, can only be used if you select to keep VM changes on the NFS datastore without redirecting them. Please note that Storage vMotion is only available with select VMware licenses.

- Use replication or VM copy functionality of Veeam Backup & Replication. In this case, you can create a copy of a VM and failover to it during the next maintenance window. In contrast to Storage vMotion, this approach requires you to schedule some downtime while you clone or replicate the VM, power it off and then power the cloned copy or replica on.
- Use Quick Migration. In this case, Veeam Backup & Replication will perform a two-stage migration procedure instead of pulling data from the vPower NFS datastore, it will restore the VM from the backup file on the production server, then move all changes and consolidate them with the VM data. For details, see Quick Migration.

In many respects, instant VM recovery gives results similar to failover of a VM replica. Both features can be used for tier-1 applications with little tolerance for business interruption and downtime. However, when you perform replica failover, you do not have dependencies on the backup server. And, unlike instant VM recovery that provides only limited I/O throughput, replication guarantees full I/O performance. Beside disaster recovery matters, instant VM recovery can also be used for testing purposes. Instead of extracting VM images to production storage to perform regular DR testing, you can run a VM directly from the backup file, boot it and make sure the VM guest OS and applications are functioning properly. (For additional information, please see the enclosed insert "The benefits of Veeam over Dell EMC".)

4.2.1.5. Please describe in detail how your solution meets the Lottery's requirements for data compression of backups without additional licenses or hardware additions.

Vendor provided DPS solution should include data reduction software capable of logically storing at least I .56PB of backup data (Lottery currently gets 26: 1 data reduction) on the included data protection storage, without additional licenses or hardware additions. Provide the average compression rate for your DPS solution.

→ Response: Veeam is a software solution that integrates with many hardware based deduplication devices. Deduplication data rate reduction is source data dependent and rates vary and marketing literature frequently quotes higher rates than are actually achievable. Veeam is as a software solution and is horizontally scalable to meet your storage requirements.

Veeam sizes backup data requirements based on the amount of actual source data and the backup and retention policies. Veeam does not charge extra for deduplication or compression. The following describes how deduplication and compression is accomplished in Veeam when not using a deduplication device.

In the absence of a deduplication appliance, as its primary means of data reduction, Veeam uses a performance-optimized combination of deduplication and compression.

Veeam performs deduplication at the backup file level at both the source (i.e., at backup proxy) and the target (i.e., at backup repository):

- Source-side deduplication ensures that only unique data blocks not already present in the previous restore point are transferred across the network
- Target-side deduplication checks the received blocks against blocks already stored in the backup file, thus providing global deduplication across all VMs included in the backup job.

Veeam also offers five levels of compression that allow you to find the right balance of storage consumption and backup proxy load, which, in turn, can affect performance.

Veeam's built-in deduplication and compression work hand in hand to provide the best possible ratio of storage savings to backup performance. Unlike compression, inline deduplication is known to be very taxing on backup performance. Veeam ensures performance by using fairly large block sizes for deduplication, which allows for much better compression levels. The resulting data-reduction ratio is comparable to the ratio achieved by most advanced deduplication technologies — but with a much smaller processing overhead.

BitLooker Technology improves on deduplication

in addition to well-known deduplication and compression techniques, Veeam has BitLooker technology, a new and advanced procession capability that further reduces vSphere or Hyper-V backup file size, facilitating faster data transfers and optimizing storage usage by up to 20%:

- Excluding swap and hibernation files: Unlike competing solutions, which require moving swap files
 to a separate virtual disk and then excluding them from backup, Veeam automatically skips virtual
 disk blocks backing swap files from processing, saving you additional gigabytes of backup
 repository space, per vSphere or Hyper-V VM. Swap exclusion also improves backup
 performance, especially for incremental backups, which no longer need to transfer constantly
 changing swap file blocks.
- Excluding deleted file blocks: While performing file deletion, most file systems do not zero out blocks that belong to deleted files. These "deleted" blocks may result in image-level backups being significantly larger in size than the amount of disk space consumed from the guest OS perspective.
- Excluding user-specified files and folders: This feature lets users exclude individual files and folders during backup and replication, thus further reducing the amount of data that needs to be transferred and stored.

Bpace-less Full Backups

To enhance synthetic operations on Linux Servers, Microsoft Windows, and SMB backup repositories, Veeam Backup & Replication uses the Fast Clone technology. Fast Clone lets you create synthetic full backups and GFS backups without moving data blocks between files. Instead, Veeam Backup & Replication leverages the space-less full backup technology and references data blocks that are already present on the volume. Fast Clone increases the speed of synthetic backup creation and transformation, reduces disk space requirements and load on the storage devices.

For Microsoft Windows Fast Clone is based on Block Cloning. Block Cloning is Microsoft functionality available on ReFS 3.0. Block Cloning allows applications to quickly copy data blocks between different files or within the limits of one file. When an application needs to copy data, the file system does not physically copy data on the underlying storage. Instead, it performs a low-cost metadata operation — it 'projects' data blocks from one region on the ReFS volume to another one.

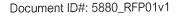
For Linux backup repositories, Fast Clone is based on the XFS reflink technology and operates in the same way as on ReFS.

Both Microsoft ReFS and XFS provide similar disk space savings on the backup repositories.

- 4.2.1.6. Please describe in detail how your HCl solution handles the adding or replacing of compute storage functions without disruptive impact to production.
- → Response: A compute-only node can be added to a HyperFlex cluster, after cluster creation. It is added to provide extra compute resources. The Cisco UCS server does not need to have any caching or persistent drives as they do not contribute any storage capacity to the cluster. If the storage cluster is in an out of space condition, when you add a new node, the system automatically rebalances the storage cluster. This is in addition to the rebalancing that is performed every 24 hours. This process is non-disruptive.

https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/lnstallation_VMWare_ESXi/4-5/b-hx-install-guide-for-vmware-esxi-4-5/m_expand_the_cisco_hx_cluster.html#id_13262

4.2.1.7. Please describe in detail how the vendor provided HCI solution software has the ability to scale-out one node at a time with very few simple steps non-disruptively-and once added, automatically rebalance resources and workloads across the cluster, creating a single pool of resources.





Response: A converged node can be added to a HyperFlex cluster after cluster creation. The storage on a converged node is automatically added to the cluster's storage capacity. Multiple nodes can be added without waiting for re-balancing. After adding a new node, the new storage capacity is immediately available for use. Rebalancing may not start immediately every time after adding the node. The rebalancing initiation will depend upon the cluster storage capacity usage.

https://www.cisco.com/c/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/white-paper-c11-744026.html#Spaceusageseffectonperformance

- 4.2.1.8. Please describe in detail how the vendor provided HCl solution includes software to deliver the capability to provide Quality of Service on a per-VM basis.
- → Response: HyperFlex all-flash delivers consistent performance across all VMs in a cluster, eliminating the need for storage QoS to ensure user satisfaction. Please reference the lab report provided by the Enterprise Strategy Group which compares the performance and consistency of hyperconvered infrastructure.

ESG Lab Report:

https://www.cisco.com/c/dam/global/en_uk/products/hyperconverged-nfrastructure/pdf/ESG_Lab_Validation_Cisco_Hyperflex.pdf

- 4.2.1.9. Please describe in detail how the vendor provided HCl solution includes software to deliver the capability to provide Storage-policy based management on a per-VM basis.
- → Response: HyperFlex all-flash delivers consistent performance across all VMs in a cluster, eliminating the need for storage QoS to ensure user satisfaction. Please reference the lab report provided by the Enterprise Strategy Group which compares the performance and consistency of hyperconvered infrastructure.

ESG Lab Report:

https://www.cisco.com/c/dam/global/en_uk/products/hyperconverged-infrastructure/pdf/ESG_Lab_Validation_Cisco_Hyperflex.pdf

- 4.2.1.10. Please describe in detail how the vendor provided HCl solution software delivers the capability to provide Storage-policy based management on a storage group or pool basis.
- → Response: Cisco Hyperflex data platform have policies to manage storage replication. Incoming data is distributed across all nodes in the cluster to optimize performance using the caching layer. Effective

data distribution is achieved by mapping incoming data to stripe units that are stored evenly across all nodes, with the number of data replicas determined by the policies you set.

https://www.cisco.com/c/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/white-paper-c11-736814.html

- 4.2.1.11. Please describe in detail how your UDS software solution included the capability to add or replace nodes non-disruptively for lifecycle management. Non-disruptively means all data is accessible, writable, usable, and available prior, during, and after the lifecycle process.
- → Response: The solutions proposed from NetApp are all designed to be enterprise class "six nines" (99.999%) availability products which includes upgrading and replacing nodes non-disruptively. NetApp accomplishes this by "clustering" nodes which allows any combination of nodes two or greater to act as a singular device. As such, any of the devices in the cluster can be upgraded and/or replaced while the remaining nodes in the customer remain active and continue serving data. This allows not only for failed nodes to be replaced non-disruptively, but also for nodes to be upgraded to newer or more powerful nodes should the existing nodes no longer meet your performance requirements or have reached the end of their useful or supported life.
- 4.2.1.12. Please describe in detail how your UDS solution provides Ransomware Protection and Auditing/Storage Management functions, including but not limited to:
 - Advanced Auditing software for auditing purposes that includes scheduled reporting, searching, pro-active data protection with automated responses, and interactive user interfaces for viewing audit information.
 - Ransomware Prevention included software to automate the incident response activity in regard to ransomware on a file system. The software feature should provide the capability to actively monitor user behavior analytics, and detect abnormal file access behavior to protect the data. The ransomware prevention feature should include the capability to take automatic snapshots of data in response to abnormal behavior, as well as automatically denying the user who initiated the abnormal behavior until verified and unlocked by an admin.
 - Storage monitoring included software should include software capability to create quota policies with templates, provide granular disk usage reporting,

quota management, and a help desk function to delegate locked and lost file assistance.

→ Response: Veeam Availability Suite, properly configured, will help provide protection against Ransomware attacks. This would include client data and the Backup solution.

- Veeam provides the ability to airgap backup archives. Since the backup archives are completely self-contained they are still independently recoverable if the backup infrastructure is compromised.
- Veeam provides data labs to assist in offline ransomware detection and forensic analysis.
 Workloads can be run in an automated isolated environment for troubleshooting and scanning.
- Veeam provides the ability to scan workloads in-flight during recovery to ensure viruses or other malware are not re-introduced into production.
- Veeam provides the ability to leverage immutability with general purpose Linux Servers, AWS S3, other S3 compatible systems, and select alliance hardware vendors.

In addition, Veeam can help detect ransomware. Veeam ONE contains pre-defined Alarms and Reports and for alerting and reporting on suspicious activity.

Alarm - Possible ransomware activity

Pre-defined alarm called "Possible ransomware activity" which will trigger if there are a lot of writes on disk and high CPU utilization on a Virtual Machine instance

Report - VM Change Rate Estimation (measured from the virtual infrastructure side)

This report predicts the number of changed blocks (measured in GB) for virtual disks based on virtual machines write rate. The report analyzes rates at which data was written to virtual disks during the selected reporting interval, and displays top N VMs that grew faster and slower than other VMs.

- Top 5 VMs with Largest Change Rate (GB) chart shows 5 VMs with the greatest amount of changed blocks within the reporting period.
- Top 5 VMs with Least Change Rate (GB) chart shows 5 VMs with the least amount of changed blocks within the reporting period.
- Details table provides information on the total change rate and the hourly, daily or weekly change rate (depending on the reporting interval).
- Click a VM name to drill down to change rate statistics for each VM disk.

Report - VM Change Rate History (measured from Veeam Backup and Replication side)



This report allows you to track backup and replication jobs whose backup files and replica VMs grow too fast and may quickly consume storage space on the target repository or target datastore.

- VMs with Largest Change Rate (GB) and VMs with Least Change Rate (GB) charts displays the most and least active VMs in terms of the amount of data changes that occurred on their virtual disks.
- Details table provides information on the list of VMs included in the backup and replication jobs, the average and aggregate amount of data changes that took place during the specified reporting interval and the size of the current full backup file*.

Veeam One reporting and monitoring, can generate full audit reports of all operations and monitoring of all backup resources such as storage, with capacity usage and future capacity planning requirements.

Additionally, Veeam features a Scale-out Backup Repository (SOBR). SOBR is a logical entity made of multiple Veeam Repositories, grouped together into a single abstracted object, that can be used as a target for any backup and backup copy job operation. SOBR is an extremely easy way to extend Veeam's storage capacity. Users will be able to add a new extent (that is any of the "simple" backup repositories supported by Veeam Backup & Replication) to the existing SOBR.

NetApp, being an enterprise class solution provides several options for Auditing and Storage Management as well as Ransomware recovery tools. In terms of Auditing and Storage Management, NetApp provides for built in tools as well as exportation to tools such as Splunk. This includes, but is not limited to scheduled reporting, searching, pro-active data protection with automated responses, and interactive user interfaces for viewing audit information. This also includes capabilities such as the ability to create quota policies with templates, provide granular disk usage reporting, quota management, and a help desk function to delegate locked and lost file assistance. NetApp has built in ransomware protection and recovery tools such as SnapShot and SnapLock. Snapshots which can be schedule at whatever frequency you prefer, typically once an hour, allow for granular on box incremental change tracking where if a ransomware attack should occur the data can easily be restored to its last known good without needing to go to backup. NetApp SnapLock can protect legal hold data even further with its WORM capability where the data cannot be changed, even by ransomware and the only way to destroy the data is to physically destroy the hardware. NetApp's ONTAP appliance software does not run on a windows-based kernel as do many storage appliances and gateways. As such, it cannot itself be infected by windows based ransomware and as a result less likely to be susceptible to a ransomware attack.

4.2.1.13. Please describe in detail how the OEM hardware is delivered, setup, configured and testing with respect to support personnel, describe how these services will be delivered (on-site vs. remote) and by whom (vendor/OEM staff).

→ Response: OEM hardware will be delivered based upon availability of equipment and time of order. It will come packaged and will require unboxing and physical installation into the WVL racks at each

location. A trained technical resource will perform the installation, correct cabling, base system configuration, update firmware and software of the hardware (as needed), and verify the equipment is in working order. It is recommended for some "burn in" time to pass before migrating production workloads to the equipment. These services will largely be delivered onsite by a combination of vendor and OEM staff as needed. Some work may be performed remotely if WVL agrees it makes the most sense to do so, but the goal will be to provide onsite services for the deployment of any hardware as part of this RFP response.

- 4.2.1.14. Please describe in detail your proposed plan for OEM onsite residency (dedicated on-site support) and off-site support during the life cycle of the project. This should also include your plan for onsite and remote support for pre and post deployment deliverables.
- → Response: Onsite residency can be provided by either the OEM or the Vendor (this response includes rates for both as options). Any onsite resident will plan be available as needed from 8am-5pm Monday-Friday during the work week (excluding holidays where WVL offices are closed). Offsite support for break/fix or code problems will be handled by the OEM providers. Each OEM provider staffs online and phone available resources 24 hours a day, 7 days a week and will dispatch Engineers to address hardware/software failures as necessary. The Vendor will be available to assist with remediation of any problem encountered with the solution. Should services work be required by the Vendor (outside of the initial deployment and configuration, setup, or migration services specified within the RFP), the rates identified in section 4.2.1.90 will apply.
- 4.2.1.15. Describe how your solution meets the following objectives for the original equipment manufacturer (OEM):
 - 4.2.1.15.1. The manufacturer of the proposed products should be listed on the Gartner Magic Quadrant report as defined below matching the technology type. Gartner Documents provided. (see Appendix 1 for Gartner Reports).
 - HCI -as described in 2019 Gartner Magic Quadrant report for HCI.
 - DPS -as described in 2020 Gartner Magic Quadrant report for Data Center Backup and recovery solutions.
 - UDS as described in 2020 Gartner Magic Quadrant report for Distributed File Systems and Object Storage.

 Networking - as described in 2020 Magic Quadrant for Data Center and Cloud Networking.

For each subsystem (HCI/DPS/UDS/Networking), identify where you are ranked according to the following categories:

Not Listed, Niche, Visionary, Challengers, Leaders

→ Response: HCI - Cisco is listed in Leaders; DPS - Veeam is listed in Leaders; UDS - NetApp is listed in Visionaries; Networking - Cisco is listed in Leaders.

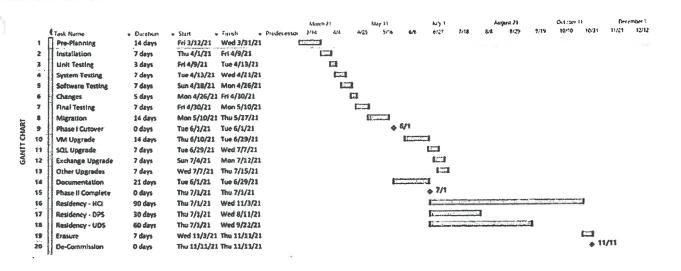
NetApp is consistently named a leader by analysts and is constantly in the upper right of the Gartner Magic Quadrant for general purpose storage which includes the ONTAP solution proposed here. Additionally, Gartner ranks the NetApp AFF solution proposed here as #1 in 3 of the 4 critical use cased for storage. Additional information can be had on the following link: https://www.gartner.com/doc/reprints?id=1-24Q9VXGW&ct=201203&st=sb

In addition to Gartner, IDC also highly ranks NetApp in its whitepaper "A New NetApp on the Rise" available at the following Link:

https://www.netapp.com/pdf.html?item=/media/7589-idc-executive-snapshot.pdf

IDC also names NetApp a leader in Scale Out NAS, report available on the following link https://www.netapp.com/pdf.html?item=/media/7932-ar-idc-marketscape-worldwide-scale-out-vendor-assessment.pdf

4.2.1.16. Describe how your solution can meet or exceed the timeline shown below as a sample. Include all assumptions. An approved timeline will be included as part of the contractual terms for this RFP. Note that pre-planning precedes hardware/software delivery and that hardware/software delivery starts the timeframe for completion of the project.



→ Response: See Attachment # 2 for the WV Lottery Delivery Timeline. It is provided is an example based upon previous experience with clients in the past. Throughout the planning phase, this timeline may change depending upon feedback from WVL.

Additional Specifications

Hardware Specifications

Hyperconverged Hardware (HCI) -Also see mandatory specifications.

- 4.2.1.17. Vendor provide HCI solution should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement.
- → Response: Cisco Intersight management software supports monitoring of Hyperflex clusters health, utilization, status. Also Cisco Intersight enables you to predict the storage utilization for HyperFlex Clusters. The Capacity Runway details view displays the Storage Runway and Utilization Trend. The details on this page enable you to monitor the storage utilization to manage capacity planning.

https://intersight.com/help/features#hyperflex_cluster_details_view

4.2.1.18. Vendor provided HCl solution should include defective media retention feature for 5 years (60 months) or greater.



→ Response: Smart Net Total Care 24x7x4OS (60 Months) is included in the BoM for all servers.

Reference (Cisco Smart Net Total Care Service Data Sheet):

https://www.cisco.com/c/en/us/products/collateral/cloud-systems-management/smart-net-total-care/datasheet-c78-735459.html

Reference (Cisco Onsite Field Services Description):

https://www.cisco.com/c/dam/en_us/about/doing_business/legal/service_descriptions/docs/cx-onsite-field-engineer-duties-description.pdf

- 4.2.1.19. Each HCl solution host should include a minimum of two (2) Hot-swap power supply units.
- → **Response**: Hot swappable PSUs are included and supported. Power supplies are Hot-swappable when redundant as 1+1.

Reference (Pg. 6 of spec sheet):

https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hx-220c-m5-specsheet.pdf

Domain Controllers Hardware (Physical Server) - Also see mandatory specifications.

- 4.2.1.20. Vendor provided server solution should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement.
- → Response: Intersight Advantage is included in the BoM. Cisco Intersight provides a dashboard that spans Cisco UCS and Cisco HyperFlex systems. You can create, customize, rename, and manage multiple dashboard views by adding, removing, or rearranging widgets on the dashboard. The widgets provide a view of the health and inventory status of the managed devices in addition to reporting the following real-time data: Health Summary, Inventory, Version Summary, HyperFlex Version Summary, and more.

Reference (Intersight Features "Dashboard Management"): https://intersight.com/help/features#dashboard_management

- 4.2.1.21. Vendor provided server solution should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to WV lottery via free web and mobile applications for support, capacity planning, health status, and configuration consistency.
- → Response: Intersight Advantage includes a mobile app to view the health and inventory status of the managed devices in addition to reporting the following real-time data: Health Summary, Inventory, Version Summary, HyperFlex Version Summary, and more.

Reference (Intersight Getting started "licensing"): https://intersight.com/help/getting_started#intersight_licensing

- 4.2.1.22. Vendor provided server solution should include a defective media retention feature for 5 years (60 months) or greater.
- → Response: Smart Net Total Care 24x7x4OS (60 months) is included in the BoM for all servers.

Reference (Cisco Smart Net Total Care Service Data Sheet):

https://www.cisco.com/c/en/us/products/collateral/cloud-systems-management/smart-net-total-care/datasheet-c78-735459.html

Reference (Cisco Onsite Field Services Description):

https://www.cisco.com/c/dam/en_us/about/doing_business/legal/service_descriptions/docs/cx-onsite-field-engineer-duties-description.pdf

- 4.2.1.23. Each server should include an internal DVD-ROM drive.
- → Response: Each Cisco server includes support for locally mountable virtual media through the integrated management controller. This includes connectivity support for USB, CD, ISO images, virtual floppy drive images and remote storage.

Reference (Data Sheet): https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/data_sheet_c78-728802.html

4.2.1.24. Each server should include a minimum of two (2) Hot-swap power supply units, all required power cords, racking hardware, and physical chassis to contain and protect the components.

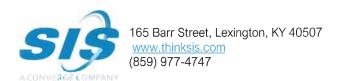


→ Response: Two Hot swappable 1050W AC PSUs are included with each node with two C13-C14 Connectors as well. See BoM for listed parts.

Ball Bearing Rail Kit in included for racking as well as the HX node to house components. See BoM.

UDS Hardware -Also see mandatory specifications.

- 4.2.1.25. Vendor provided unstructured data storage solution should include a minimum of four (4) nodes per location containing the storage media, CPU, RAM, and all required hardware components to deliver a fault tolerant, scale-out, unstructured storage solution with a minimum usable capacity of 23TB. Usable for UDS solution means after data protection policy has been applied and before any data reduction or compression features have been enabled.
- → Response: NetApp has provided an unstructured data storage solution with two nodes per location containing the storage media, CPU, RAM, and all required hardware components to deliver a fault tolerant, scale-out, unstructured storage solution with a minimum usable capacity of 23TB. Usable for UDS solution means after data protection policy has been applied and before any data reduction or compression features have been enabled. Note that we actually exceed the capacity requirements by providing a guaranteed 49.4TB of usable capacity after storage efficiencies and while the solution specifications state that the solution "should" provide four nodes per site, we are proposing two as the NetApp architecture allows for "six nines"(99.9999%) availability with only two nodes and adding two additional nodes to that would only add cost and provide no additional benefit.
- 4.2.1.26. Vendor provided UDS should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement.
- → Response: NetApp's UDS, being an enterprise class "six nines" (99.9999%) availability solution includes integrated health monitoring components that regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement as well as "call home" capability where the controllers can place a service call for themselves in the event of a component failure.
- 4.2.1.27. Vendor provided UDS should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to WV



lottery via free web and mobile applications for support, capacity planning, health status, and configuration consistency.

- → Response: NetApp's UDS, being an enterprise class "six nines" (99.9999%) availability solution includes integrated health monitoring components that regularly report component health, status, utilization, configuration information, to WV Lottery via free web and mobile applications for support, capacity planning, health status, and configuration consistency as well as "call home" capability where the controllers can place a service call for themselves in the event of a component failure.
- 4.2.1.28. Vendor provided UDS solutions should support and include hardware for zero block elimination, inline de-duplication, and inline compression.
- → Response: NetApp's UDS, being an enterprise class "six nines" (99.9999%) availability solution includes hardware for zero block elimination, inline deduplication, and inline compression as well as compaction and additional post write consolidation and compression. This allows NetApp to provide for the solution a guaranteed 3:1 storage efficiency.
- 4.2.1.29. Vendor provided UDS should include all modules, components, hardware, cables, interfaces, switches, or other required components to deliver scale-out architecture and any other UDS technical solution requirements.
- → Response: NetApp's UDS, being an enterprise class "six nines" (99.9999%) availability solution includes all modules, components, hardware, cables, interfaces, switches, or other required components to deliver scale-out architecture and any other UDS technical solution requirements.
- 4.2.1.30. Vendor provided UDS solution should include defective media retention feature for 5 years (60 months) or greater.
- → Response: NetApp's UDS solution includes defective media retention feature for 5 years (60 months).
- 4.2.1.31. Each vendor provided node should include a minimum of two (2) Hot-swap power supply units, all required power cords, racking hardware, and physical rack-mount chassis to contain and protect the components.
- → Response: NetApp's UDS solution includes a minimum of two (2) Hot-swap power supply units, all required power cords, racking hardware, and physical rack -mount chassis to contain and protect the components.

DPS Hardware -Also see mandatory specifications.

4.2.1.32. Vendor provided DPS should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement.

→ Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.32. Veeam Backup & Replication can be configured to provide alerting on the following that will provide information on overall system health.

Global Email Notification: This can be configured to send an email, or via SNMP on all job successes, warnings, or failures.

Per-Job Notifications: Can be used in conjunction with global notifications, this option gives the ability for certain groups or people to get notified, who may not want notification on all jobs.

Low disk space: When a job is run, Veeam Backup & Replication checks disk space on the target backup repository and production storage. If the disk space is below a specific value, Veeam Backup & Replication will display a warning message in the job session details.

Support Contract Expiration: Informs email recipients specified in global notification settings about the support expiration date in every email notification. Veeam Backup & Replication starts sending such notifications 14 days before the expiration date.

New updates and patches: provides an alert when new updates and patches are available for your system.

With Veeam Availability Suite with deep integration into Microsoft System Center, or a standalone product Veeam One it provides deeper visibility.

24/7 real-time monitoring and alerting: Notifies you with alarms of backup and VM performance issues to avoid downtime and meet SLAs.

Resource management and configuration tracking: Veeam helps you evaluate the performance of your infrastructure and ensures your existing configuration meets all known virtualization platform and backup best practices.

Capacity planning and forecasting: Forecast resource usage and utilization trends with "what if" modeling and resource overcommit tracking for your backup and virtual infrastructures.

Chargeback and billing: Gain complete visibility into IT costs of compute, storage and backup repository resources.

Veeam Intelligent Diagnostics: is a feature that allows to automatically detect known issues in configuration and performance of backup infrastructure. It enables Veeam ONE Monitor to parse logs from Veeam Backup & Replication servers and trigger alarms with recommendations based on the results of log analysis. This allows you to eliminate configuration issues without the necessity to address Veeam Support.

- 4.2.1.33. Vendor provided DPS should include integrated health monitoring components that regularly report component health, status, utilization, configuration information, to WV lottery via free web applications for support, capacity planning, health status, and configuration consistency.
- → Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.33. A dashboard overview provides at-a-glance view of the current status of the data protection and replication. It visually provides information on success and failures. It will provide monitoring, alerting and capacity planning information.
- Heatmaps for Veeam Backup & Replication components can be displayed.
 - Repositories free space
 - This widget shows the amount of total and free disk space on each of your backup repositories in a form of a treemap.
 - Proxies usage
 - This widget shows concurrent tasks that backup proxy servers processed during the week.
 - Repositories usage
 - o This widget shows concurrent tasks that backup repositories processed during the week.

Besides heatmaps It has many canned reports that can be customized and automatically delivered through email. When there is a failure, it can initiate action through a script or trigger an SNMP trap.

In addition, Veeam ONE monitoring and reporting provides dashboards and reports with respect to backup and replication performance, capacity monitoring, Includes customizable dashboards and reports and they can be automatically scheduled to run and be delivered to appropriate personnel.

4.2.1.34. Each vendor provided DPS solution should be a factory integrated 2U form factor appliance or less containing all backup application servers, reporting servers, and data protection storage.



→ Response: The vendor provided UCS C240 server hardware is a 2U form factor.

See Spec Sheet: https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c240m5-lff-specsheet.pdf

- 4.2.1.35. Each Vendor provide DPS solution should include all hardware, including but not limited to CPU, RAM, cache, servers, hosts, guests, in order to deliver two (2) independent data protection and recovery solutions as defined by Gartner.
- → **Response**: The provided DPS solution includes all hardware to deliver two independent data protection and recovery solutions.
- 4.2.1.36. Vendor provided DPS solution should include hardware for reporting services that can report and monitor SLA's for backup operations.
- → Response: The provided DPS solution includes hardware for reporting services.
- 4.2.1.37. Vendor provided DPS solution should include defective media retention feature for 5 years (60 months) or greater.
- → Response: Cisco Solution Support provides a primary point of contact which focuses on your deployment as a whole, addressing software and hardware from both Cisco and Solution Support Alliance Partners. Using product, architecture, and interoperability expertise, we either directly resolve your issue or actively manage your case by coordinating product support teams inside and outside of Cisco, remaining accountable from first call to resolution, no matter where the issues reside. 60 months of 24x7x4 with on-site support is included in the solution.

https://www.cisco.com/c/dam/en_us/services/portfolio/documents/solution-support-service-at-a-glance.pdf

- 4.2.1.38. Vendor provided DPS should include all modules, components, hardware, cables, interfaces, switches, or other required components to deliver modular DPS architecture and any other DPS technical solution requirements.
- → Response: The provided DPS solution includes all required components to deliver the architecture and technical solution requirements. NetApp's DPS solution includes all modules, components,

hardware, cables, interfaces, switches, or other required components to deliver modular DPS architecture and any other DPS technical solution requirements.

- 4.2.1.39. Each DPS solution host should include a minimum of two (2) Hot-swap power supply units per chassis, all required power cords, racking hardware, and physical rack-mount chassis to contain and protect the components.
- → Response: NetApp's DPS solution includes a minimum of two (2) Hot-swap power supply units per chassis, all required power cords, racking hardware, and physical rack-mount chassis to contain and protect the components.

Networking Hardware -Also see mandatory specifications.

- 4.2.1.40. Vendor provided networking solution should be able to pass any OEM validation scripts, tools, etc. and therefore be supported as an effective networking solution by the OEM of the Proposed HCI, UDS, DPS, and server solution.
- → Response: The provided HCI, UDS, DPS, server, and networking solution are supported as a whole with Cisco Solution Support. Cisco Solution Support provides a primary point of contact which focuses on your deployment as a whole, addressing software and hardware from both Cisco and Solution Support Alliance Partners. Using product, architecture, and interoperability expertise, we either directly resolve your issue or actively manage your case by coordinating product support teams inside and outside of Cisco, remaining accountable from first call to resolution, no matter where the issues reside. 60 months of 24x7x4 with on-site support is included in the solution.

https://www.cisco.com/c/dam/en_us/services/portfolio/documents/solution-support-service-at-a-glance.pdf

- 4.2.1.41. Vendor provided networking solution should be tightly integrated with the HCl solution lifecycle management process. This should include automatic VLAN configurations when nodes are added, and/or included in the automated firmware update process.
- → Response: Fabric Interconnects with UCS Manager is tightly integrated with Hyperflex with the use of service profiles. Service profiles are the central concept of Cisco UCS. Each service profile serves a specific purpose: ensuring that the associated server hardware has the configuration required to support the applications it will host.

The service profile maintains configuration information about the server hardware, interfaces, fabric connectivity, and server and network identity. This information is stored in a format that you can manage through Cisco UCS Manager. All service profiles are centrally managed and stored in a database on the fabric interconnect.

Every server must be associated with a service profile.

Reference (UCS Manager GUI Configuration Guide):

https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/sw/gui/config/guide/2-2/b_UCSM_GUI_Configuration_Guide_2_2/b_UCSM_GUI_Configuration_Guide_2_2 chapter_010.html

- 4.2.1.42. Vendor provided networking solution should support smart fabric features that reduce the amount of management required for the network components such as VLAN auto-config.
- → Response: Fabric Interconnects with UCS Managers reduce amount of management for networking with the use of service profiles. Each service profile specifies the LAN and SAN network connections for the server through the Cisco UCS infrastructure and out to the external network. You do not need to manually configure the network connections for Cisco UCS servers and other components. All network configuration is performed through the service profile.

When you associate a service profile with a server, the Cisco UCS internal fabric is configured with the information in the service profile. If the profile was previously associated with a different server, the network infrastructure reconfigures to support identical network connectivity to the new server.

Reference (UCS Manager GUI Configuration Guide):

https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/sw/gui/config/guide/2-2/b_UCSM_GUI_Configuration_Guide_2_2/b_UCSM_GUI_Configuration_Guide_2_2 chapter_010.html

- 4.2.1.43. Vendor provided networking solution should be compliant and be certified for use with the HCI OEM solution.
- → **Response**: The networking and HCl components are both manufactured by Cisco which are fully supported for integration with solution support.
- 4.2.1.44. Vendor provided networking solution should include all cables, racking hardware, SFP's interfaces, transceivers, or other components not specifically listed required to connect all hardware included in this entire RFP to the network with two (2) or more connections each.

→ **Response**: Yes, all cables, racking hardware, SFP's interfaces, transceivers, or other components not specifically listed required to connect all hardware in this entire RFP to the network with two (2) or more connections will be included.

Software Specifications

HCI Software -Also see mandatory specifications.

- 4.2.1.45. Vendor provided HCI solution should include software offering a full complement of data efficiency services, including deduplication, compression, and erasure coding as inline processes. This solution should support failure to tolerate of 1 and 2. Raid 5 and 6 configurations should be supported by the solution.
- → Response: Cisco Hyperlex solution provides complete lifecycle management and enhanced data protection in distributed storage environments. These features include replication, always-on inline deduplication, always-on inline compression, thin provisioning, instantaneous space-efficient clones, and snapshots.

Data is replicated by 1 or 2 times depending on the customer preference and written evenly distributed among nodes. This is called Replication Factor 2 or 3. RAID is not used in Hyperflex.

Incoming data is distributed across all nodes in the cluster to optimize performance using the caching layer. Effective data distribution is achieved by mapping incoming data to stripe units that are stored evenly across all nodes, with the number of data replicas determined by the policies you set. When an application writes data, the data is sent to the appropriate node based on the stripe unit, which includes the relevant block of information. This data distribution approach in combination with the capability to have multiple streams writing at the same time prevents both network and storage hotspots, delivers the same I/O performance regardless of virtual machine location, and gives you more flexibility in workload placement. Other architectures use a locality approach that does not make full use of available networking and I/O resources.

https://www.cisco.com/c/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/white-paper-c11-736814.html

4.2.1.46. Vendor provided HCl solution should include software that is able to apply storage policy rules to individual VM objects dynamically no matter where the VM is running in the cluster.

→ Response: Cisco Hyperflex distributed data approach provides the Data blocks that are striped across nodes in the cluster.

Therefore migration of a virtual machine to a new location (HX Data Platform) does not require data to be moved. This approach significantly reduces the impact and cost of moving virtual machines among systems.

- 4.2.1.47. Vendor provided HCl solution should include software that is able to provide data at rest encryption.
- → Response: Using optional Self-Encrypting Drives (SEDs), the HX Data Platform encrypts both the caching and capacity layers of the data platform. Integrated with enterprise key management software or with passphrase-protected keys, encryption of data at rest helps you comply with Health Insurance Portability and Accountability Act (HIPAA), Payment Card Industry Data Security Standard (PCI-DSS), Federal Information Security Management Act FISMA, and Sarbanes-Oxley regulations. The platform itself is hardened to Federal Information Processing Standard (FIPS) 140-1, and the encrypted drives with key management comply with the FIPS 140-2 standard.
- 4.2.1.48. Vendor provided HCI solution should include management software that is integrated tightly with the WV lottery's virtualization solution, VMware vSphere. This management software should support node additions, hardware status reporting, storage group management, storage policy management, QOS management, hardware firmware updates, software updates, from within the vSphere administration console.
- → Response: Cisco Intersight management software is tightly integrated with Cisco Hyperflex solution providing clusters health, utilization, status details. Also, Cisco Intersight enables you to predict the storage utilization for HyperFlex Clusters. The Capacity Runway details view displays the Storage Runway and Utilization Trend. Intersight also provides full-stack upgrade process for Hyperflex cluster.

https://intersight.com/help/features#hyperflex_cluster_details_view

- 4.2.1.49. Vendor provided HCI solution should include software that currently supports integration into potential expansions of WVL's VMware platforms such as VDI, VCF, NSX, Horizon, vRealize Operations, vRealize Automation, SDDC Manager or vRealize Network Insight.
- → Response: Cisco Hyperflex supports VMware vSphere virtualization.

Domain Controllers Software (Physical Server) -Also see mandatory specifications.

4.2.1.50. Vendor provided server solution should include software that leverages integrated health monitoring components to regularly report component health, status, utilization, configuration information, to the OEM for support and repair enablement.

→ Response: The following widgets are available in the HyperFlex cluster table view on Cisco Intersight:

Health—The pie chart provides a visual representation of the health of the HyperFlex clusters.

Connection—The badge displays the number of clusters in connected status.

Storage Utilization—The Status chart displays the amount of storage capacity utilized by the cluster as a percentage. Storage Utilization percentage is computed based on the total capacity and the current capacity utilization.

Capacity Runway—The pie chart provides a visual representation of the number of clusters for which the storage utilization is predicted to exceed predefined threshold of 76%. The predicted time remaining to exceed the storage capacity is represented by one of the following:

Critical—60 days to exceed 76%

Needs Attention—Between 60 to 365 days to exceed 76%

365+ Days—More than a year to exceed 76%

Unknown—Storage Capacity Utilization data for a minimum of 14 days is required to predict the time remaining to exceed the storage utilization threshold.

Types—The pie chart displays an inventory of all HyperFlex Edge, Hybrid, and All Flash clusters.

HyperFlex Versions—The pie chart displays the total number of HyperFlex clusters distributed by the installed HyperFlex Connect version.

https://intersight.com/help/features#hyperflex_cluster_table_view

4.2.1.51. Vendor provided server solution should include software that leverages integrated health monitoring components to regularly report component health, status, utilization,

configuration information, to WV lottery via free web and mobile applications for support, capacity planning, health status, and configuration consistency.

→ Response: Cisco Intersight provides regular health, status and utilization management information and can be accessed through web and mobile application.

https://intersight.com/help/resources/mobile?CCID=cc001268

- 4.2.1.52. Vendor provided server solution should include software providing a comprehensive server management solution including tools and components required to deliver premium functionality via an integrated web-based management GUI and a CLI from within the guest operating system.
- → Response: Cisco Hyperflex solution provides enterprise grade software solutions for management of servers and fabric interconnects.

UDS Software -Also see mandatory specifications.

- 4.2.1.53. Vendor provided UDS software should include licenses and support for HDFS protocol. (Revised)
- → Response: NetApp's provided UDS software includes licenses and support for the following protocols SMBv3, SMBv4, NFS, CIFS, S3, FCoE, FC, and NVMe.
- 4.2.1.54. Vendor provided UDS solution should include all software required to enable scale-out architecture, including software required for any back-end switching, or management tools.
- → Response: Vendor provided UDS solution will include all software required to enable scale-out architecture, including software required for any back-end switching, or management tools.
- 4.2.1.55. Vendor provided UDS solutions should support and include software licensing for zero block elimination, inline de-duplication, and inline compression.
- → Response: NetApp's provided UDS solutions will support and include software licensing for zero block elimination, inline deduplication, and inline compression as well as compaction and additional post write consolidation and compression. This allows NetApp to provide for the solution a guaranteed 3:1 storage efficiency.



4.2.1.56. Vendor provided UDS solution should include software client and connection load balancers. Solution should allow clients to connect to multiple nodes simultaneously and all data across the cluster should be available from or through any node connection pool.

Load balancing software should be policy driven and allow for different policies based on client groups, storage groups, or file system objects.

- → Response: NetApp's provided UDS solution does not include software client and connection load balancers as they are not needed because the nodes are clustered and act as one large resource. This allows clients to connect to multiple nodes simultaneously and all data across the cluster is available from or through any node connection pool. As such, load balancing software is not needed to allow for different policies based on client groups, storage groups, or file system objects.
- 4.2.1.57. Vendor provided UDS software should include the capability to automatically migrate all data for lifecycle management or expansion on the backend storage fabric handled natively by the NAS software.
- → Response: NetApp's provided UDS includes the capability to automatically migrate all data for lifecycle management or expansion on the backend storage fabric handled natively by the NAS software. Being a clustered enterprise class "six nines" (99.9999%) availability solution, it is able to accomplish this live while it is in production without disconnecting clients.
- 4.2.1.58. Vendor provided UDS software should include the capability to transparently tier and migrate data workloads between multiple storage pools. Transparently means the end-user is not aware that their data has, will, or has been moved between storage pools. The UDS solution software should also include the capability to manage this automated storage tiering by policy at folder level.
- → Response: NetApp's provided UDS software includes the capability to transparently tier and migrate data workloads between multiple storage pools without any awareness to the client. The UDS solution software should also include the capability to manage this automated storage tiering by policy at folder level. NetApp actually exceeds this capability and is able to tier to the actual block level of the storage which is significantly more granular and more efficient than at the file level. Additionally, it can tier to any S3 cloud target either on premise or in the commercial cloud.

DPS Software - Also see mandatory specifications.



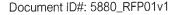
- 4.2.1.59. Each Vendor provided DPS solution should include all software, including but not limited to hypervisor, operating systems, backup software, agents, plug-ins, de-duplication or compression licenses, virtual appliances, guests, in order to deliver two (2) independent data protection and recovery solutions as defined by Lottery requirements.
- → **Response**: Vendor provided DPS solution meets the specifications outlined in 4.2.1.59. Veeam Availability Suite consists of the following stand-alone products: All functions included in single Universal License.
 - Veeam Backup & Replication agentless for VMware, Hyper-V backups, Nutanix AHV, agentless for NAS backups and agent-based for physical backups, Enterprise Applications.
 - Veeam Agent for Windows, Veeam Agent for Linux and Unix, Veeam Agent for Mac to protect physical and cloud based workloads.
 - Veeam ONE for advanced monitoring and reporting.

Additionally and separate from the Veeam Availability Suite:

Veeam Disaster Recovery Orchestrator coupled with Veeam Backup & Replication, automates the
process of creating, documenting and testing disaster recovery (DR) plans of Veeam-powered
backups, replicas, CDP replicas and storage snapshots to ensure business continuity and meet
compliance.

Veeam requires a Windows license for the Veeam Instance, and the Veeam ONE instance. Veeam can scale vertically or horizontally. If you choose to deploy more Veeam Services on more servers no additional Veeam licensing is necessary however a Windows or Linux Operating System must be present.

- 4.2.1.60. Vendor provided DPS solution should include all software required to perform recoveries from data-at-rest in a deduplicated and compressed state.
- → Response: Vendor provided DPS solution meets the specifications outlined in 4.2.1.60. All software necessary to perform recoveries from data at rest in a deduplicated and compressed state is part of the Veeam installation. No license is necessary to read or restore backups.
- 4.2.1.61. Vendor provided DPS solution should include all software required to attach and boot a guest from any restore point on the data protection storage and Vmotion the guest back to primary block storage on the HCl solution.
- → Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.61. With instant VM recovery, you can immediately restore a VM into your production environment by running it directly from the backup file. Instant VM recovery helps improve recovery time objectives (RTO), minimize





disruption and downtime of production VMs. It is like having a "temporary spare" for a VM: users remain productive while you can troubleshoot an issue with the failed VM.

When instant VM recovery is performed, Veeam Backup & Replication uses the Veeam vPower technology to mount a VM image to an ESX(i) host directly from a compressed and deduplicated backup file. Since there is no need to extract the VM from the backup file and copy it to production storage, you can restart a VM from any restore point (incremental or full) in a matter of minutes.

The archived image of the VM remains in read-only state to avoid unexpected modifications. By default, all changes to virtual disks that take place while the VM is running, are logged to auxiliary redo logs residing on the NFS server (backup server or backup repository). These changes are discarded as soon as a restored VM is removed, or merged with the original VM data when VM recovery is finalized.

To improve I/O performance for a restored VM, you can redirect VM changes to a specific datastore. In this case, instead of using redo logs, Veeam Backup & Replication will trigger a snapshot and put it to the Veeam IR directory on the selected datastore, together with metadata files holding changes to the VM image. Redirecting VM changes improves recovery performance but makes Storage vMotion not possible for ESX 4.x and earlier. As a result, you will not be able to use Storage vMotion to finalize Instant VM Recovery.

To finalize instant VM recovery, you can do one of the following:

- Use Storage vMotion to quickly migrate the restored VM to the production storage without any
 downtime. In this case, original VM data will be pulled from the NFS datastore to the production
 storage and consolidated with VM changes while the VM is still running. Storage vMotion,
 however, can only be used if you select to keep VM changes on the NFS datastore without
 redirecting them. Please note that Storage vMotion is only available with select VMware licenses.
- Use replication or VM copy functionality of Veeam Backup & Replication. In this case, you can create a copy of a VM and fail over to it during the next maintenance window. In contrast to Storage vMotion, this approach requires you to schedule some downtime while you clone or replicate the VM, power it off and then power the cloned copy or replica on.
- Use Quick Migration. In this case, Veeam Backup & Replication will perform a two-stage migration procedure — instead of pulling data from the vPower NFS datastore, it will restore the VM from the backup file on the production server, then move all changes and consolidate them with the VM data. For details, see Quick Migration.

In many respects, instant VM recovery gives results similar to failover of a VM replica. Both features can be used for tier-1 applications with little tolerance for business interruption and downtime. However, when ou perform replica failover, you do not have dependencies on the backup server. And, unlike instant VM recovery that provides only limited I/O throughput, replication guarantees full I/O performance.





Beside disaster recovery matters, instant VM recovery can also be used for testing purposes. Instead of extracting VM images to production storage to perform regular DR testing, you can run a VM directly from the backup file, boot it and make sure the VM guest OS and applications are functioning properly.

4.2.1.62. Vendor provided DPS solution should include all software required to use Key Management Interoperability Protocol (KMIP) for data-at-rest encryption.

→ Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.62. Veeam Backup & Replication supports the following encryption standards and methods:

Data Encryption

To encrypt data blocks in backup files and files archived to tape, Veeam Backup & Replication uses the 256-bit AES with a 256-bit key length in the CBC-mode. This is designed to support the FIPS 140-2 standard. More information around that standard can be found here.

As a part of Veeam Backup & Replication's ability to generate a key based on a password, it uses the Password-Based Key Derivation Function, PKCS #5 version 2.0 as a part of NIST Publication 800-132. Veeam Backup & Replication uses 10,000 HMAC-SHA1 iterations and a 512-bit salt. More information can be found here.

Enterprise Manager Keys

Veeam Backup & Replication uses the RSA algorithm with a 4096-bit key length to generate Enterprise Manager keys required for data restore without a password. Veeam Backup & Replication uses the RSA algorithm with a 2048-bit key length to generate a request for data restore from a backup server.

More information can be found https://www.rsa.com/en-us

Veeam Backup & Replication uses the following hashing algorithms:

For digital signature generation: SHA-1, SHA-256

For HMAC generation: HMAC_SHA1

For random number generation: SHA1

For Microsoft Windows-based repositories and software-based encryption for tapes, Veeam Backup &



Replication uses the Windows Crypto API complying with the Federal Information Processing Standards (FIPS 140-2). More information can be found here:

https://csrc.nist.gov/projects/cryptographic-module-validation-program/standards

Veeam Backup & Replication uses the following cryptographic service providers:

Microsoft Base Cryptographic Provider

https://docs.microsoft.com/en-us/windows/win32/seccrypto/microsoft-base-cryptographic-provider?redirectedfrom=MSDN

Microsoft Enhanced RSA and AES Cryptographic Provider

https://docs.microsoft.com/en-us/windows/win32/seccrypto/microsoft-aes-cryptographic-provider?redirectedfrom=MSDN

Microsoft Enhanced Cryptographic Provider

https://docs.microsoft.com/en-us/windows/win32/seccrypto/microsoft-enhanced-cryptographic-provider?redirectedfrom=MSDN

For Linux-based repositories, Veeam Backup & Replication uses a statically linked OpenSSL encryption library, without the FIPS 140-2 support. More information can be found here.

Veeam Backup & Replication encrypts stored credentials using the Data Protection API (DPAPI) mechanisms. More information can be found here.

4.2.1.63. Vendor provided DPS solution should include software for reporting services that can report and monitor SLA's for backup operations.

→ Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.63. Veeam offers several options for job monitoring and reporting.

Email alerting can be configured on each job, job summary, some reports can be configured for output on a shared drive for consumption based on a schedule, and Dashboards can be configured for reporting.

Veeam Backup & Replication

- Real-time statistics
 - The real-time statistics provides detailed data on job sessions: job progress, duration,
 processing rate, performance bottlenecks, amount of processed data, read and transferred



data and details of the session performance, for example, warnings and errors that have occurred in the process of operation.

- Job session results
 - You can view detailed statistics on every job session.
- Job and Job session reports
 - o You can generate reports with details about job and job session performance.

Veeam Enterprise Manager

Veeam Backup Enterprise Manager provides reporting functionality that is based on job data collected from managed backup servers. Veeam Backup Enterprise Manager offers a wide range of reporting options, presenting information about performed jobs in various profiles. Being a common business requirement to IT infrastructure, reports allow you to get granular information about all jobs created on managed backup servers:

- Jobs performed for the last 24 hours
- Jobs performed for the last 7 days
- Data for jobs on specific backup servers
- Data for all performed jobs
- Data for all machines engaged in jobs

You can view on-going reporting data using the web browser as well as export reports to files which can be saved for documenting and archiving purposes. A report file can be open on the client machine using the associated application.

Veeam ONE

- Veeam Backup Agents
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_backup_agents.html
- Veeam Cloud Connect
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_cloud_connect_reports.html
- Veeam Backup Assessment
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_assessment.html
- Veeam Backup Billing
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_billing.html

Veeam Backup Capacity Planning

- https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_capacity_planning.html
- Veeam Backup Monitoring
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_monitoring.html
- Veeam Backup Overview
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_overview.html
- Veeam Backup Tape Reports
 - https://helpcenter.veeam.com/archive/one/100/reporter/veeam_br_tape_reports.html
- Veeam Backup & Replication Dashboard
 - https://helpcenter.veeam.com/archive/one/100/reporter/vbr_dashboard.html
- 4.2.1.64. Vendor provided DPS solution should include all software required to encrypt data-in-flight for replication.
- Response: : Vendor provided DPS solution meets the specifications outlined in 4.2.1.64. Veeam Backup and Replication offers many options to safeguard data including:
- Recovery Verification with Surebackup/Sure Replica
- Health Check for backup files
- Encryption both in-flight and at rest
- **Preferred Networks** -You can choose networks over which Veeam Backup & Replication must transport VM data when you perform data protection and disaster recovery tasks.
- **Network Verification** -Veeam Backup & Replication performs a CRC check for the TCP traffic going between the source and the target.
- Hardened (Immutable) Repository Immutability protects your data from loss as a result of malware activity by temporarily prohibiting the deletion of data.
- 4.2.1.65. Vendor provided DPS solution should include all software required to provide RBAC.
- → Response: Vendor provided DPS solution meets the specifications outlined in 4.2.1.65. Included in base Veeam product:
- You can assign one of the following roles to users or groups of users who plan to work with Veeam Backup & Replication:



- Veeam Restore Operator
- Veeam Backup Viewer
- Veeam Backup Operator
- Veeam Backup Administrator
- Veeam Tape Operator

A role assigned to the user defines the user activity scope: what operations in Veeam Backup & Replication the user can perform. Role security settings affect the following operations:

- Starting and stopping jobs
- Performing restore operations

Users having different roles can perform a different set of operations:

Veeam Restore Operator perform restore operations using existing backups and replicas.

Veeam Backup Viewer has the "read-only" access to Veeam Backup & Replication. It can view existing jobs and review the job session details.

Veeam Backup Operator can start and stop existing jobs, export backups and create VeeamZip backups.

Veeam Backup Administrator can perform all administrative activities in Veeam Backup & Replication.

Veeam Tape Operator can manage tapes and perform the following operations: tape inventory, tape export, tape eject, tape catalog, inventory library, catalog library, rescan library, import tapes, eject tape from drive.

You can assign several roles to the same user. For example, if the user must be able to start jobs and perform restore operations, you can assign the Veeam Backup Operator and Veeam Restore Operator roles to this user.

The user account under which the Veeam Backup Service runs must have the Veeam Backup Administrator role. By default during installation, the Veeam Backup Administrator role is assigned to users in the Local Administrators group. If you change the default settings, make sure that you assign the Veeam Backup Administrator role to the necessary user account. It is recommended to assign the Veeam Backup Administrator role to the user account explicitly rather than the group to which the user belongs. If the Veeam Backup Service is started under the "LocalSystem" account, you do not need to assign any roles to this account.

Built-in administrator accounts (Domain\Administrator and Machine\Administrator) always have full access in Veeam Backup & Replication, even if you exclude them from all Veeam Backup & Replication roles.

We allow the use of VMware vSphere RBAC capabilities to leverage individual accounts or security groups to control the backup storage location and quotas, define backup job settings per account and control or limit job scheduling to maintain Availability. The new capability allows for delegating roles and privileges to users to easily create, restore and monitor assigned backup jobs using the Veeam Enterprise Manager that pre-defines permission scopes managed by IT. It also allows for easily syncing permissions made in existing third-party delegation systems to vSphere permissions to provide select individuals within the same permission scope access to vSphere VMs.

- 4.2.1.66. Vendor provided DPS solution should include all software required to enable the backup application to be aware of and control replication.
- → Response: Vendor provided DPS solution meets the specifications outlined in 4.2.1.66. Veeam Backup and Replication is a single product. All functions are managed from a single management interface.
- 4.2.1.67. Vendor provided DPS solution should include all software required to support replication bandwidth throttling.
- → Response: Vendor provided DPS solution meets the specifications outlined in 4.2.1.67.

Bandwidth/Network Throttling

To limit the impact of Veeam Backup & Replication tasks on network performance, you can throttle network traffic for jobs. Network traffic throttling prevents jobs from utilizing the entire bandwidth available in your environment and makes sure that enough traffic is provided for other network operations. It is especially recommended that you throttle network traffic if you perform offsite backup or replicate VMs to a DR site over slow WAN links.

Network traffic throttling is implemented through rules. Network throttling rules apply to components in the Veeam backup infrastructure, so you do not have to make any changes to the network infrastructure. Network traffic throttling rules are enforced globally, at the level of the backup server. Every rule limits the maximum throughput of traffic going between backup infrastructure components on which Veeam Data Movers are deployed. Depending on the scenario, traffic can be throttled between the following components:

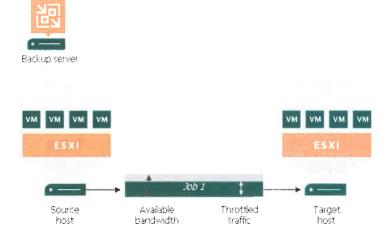


- Backup to a Microsoft Windows or Linux backup repository: a backup proxy and backup repository
- Backup to an SMB share, Dell EMC Data Domain and HPE StoreOnce: backup proxy and gateway server
- VM copy: backup proxy and backup repository
- Backup copy: source and target backup repositories or gateway sever(s), or WAN accelerators (if WAN
 accelerators are engaged in the backup copy process)
- Replication: source and target backup proxies or WAN accelerators (if WAN accelerators are engaged in the replication process)
- Backup to tape: backup repository and tape server

Rules are set for a pair of IP address ranges and are applied to the source and target components between which data is transferred over the network. The range can include a single IP address.

How Network Traffic Throttling Works

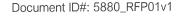
When a new job starts, Veeam Backup & Replication checks network traffic throttling rules against a pair of components assigned for the job. If the source and target IP addresses fall into specified IP ranges, the rule is applied. For example, if for a network traffic throttling rule you specify 192.168.0.1 – 192.168.0.255 as the source range and 172.16.0.1 – 172.16.0.255 as the target range, and the source component has IP address 192.168.0.12, while the target component has IP address 172.16.0.31, the rule will be applied. The network traffic going from source to target will be throttled.



WAN Acceleration

Offsite backup and replication always involves moving large volumes of data between remote sites. The most common problems that backup administrators encounter during offsite backup and replication are:

- Insufficient network bandwidth to support VM data traffic
- Transmission of redundant data



To solve these problems, Veeam Backup & Replication offers the WAN acceleration technology that nelps optimize data transfer over WAN. Veeam WAN acceleration is a built-in feature and does not add complexity and cost to the backup infrastructure. The WAN acceleration technology is specific for remote jobs: backup copy jobs and replication jobs.

- 4.2.1.68. Vendor provided DPS solution should include all software required to provide a web-based management interface capable of monitoring multiple systems, which will provide the capability to monitor both Charleston and Bridgeport solutions from either interface.
- → Response: Vendor provided DPS solution meets the specifications outlined in 4.2.1.68.

Veeam management tools and interfaces are:

- Veeam Backup and Replication Console (Thick client)
 - o The primary management interface for Veeam backup and replication
 - Used for configuration of the backup infrastructure, storage infrastructure, backup job creation/management, and restores
- Veeam Enterprise Manager Web Portal (Web client)
 - Used to federate multiple backup servers
 - Provides backup job management (for Enterprise licenses) and restore capabilities
 - o Provides Self-service restore functionality (for Enterprise Plus licenses)

Other Tools proposed

- Veeam One Monitor OR Veeam Management Pack for Microsoft System Center (more info below)
 - o Provides visibility into the virtual and data protection environments
 - Includes monitoring and alerting of the virtual environment for everything including host/network/datastore/virtual machines
 - o Includes monitoring and alerting of the data protection environment from backup component functionality/hardware/repository/job status
 - Provides knowledge base information for thousands of different error conditions to speed up resolution times
- Veeam One Reporter
 - Provides critical information about the environment in the form of customizable dashboards and reports
 - o Provides reporting for:
 - Capacity Planning for Infrastructure (virtual or data protection)
 - Infrastructure Assessment (virtual or data protection)
 - Summary Data Protection Reports
 - Many other reports (roughly 100 reports out of the box)



4.2.1.69. Vendor provided DPS solution should include all software required to deliver network-efficient replication.

→ **Response**: Vendor provided DPS solution meets the specifications outlined in 4.2.1.69. Veeam uses source-side deduplication, and compresses data between its data movers to utilize bandwidth as efficiently as possible.

For connections with limited bandwidth Network Throttling can be configured, for example, to make sure a shared linked is not consumed fully by backup traffic during production hours, outside of production hours, the schedule can be set to allow all bandwidth to be consumed.

To reduce the amount of bandwidth consumed during inter-site data transfer Veeam provides built-in WAN acceleration. Veeam's WAN Acceleration utilizes a dedicated cache, variable block length data fingerprinting, traffic compression and forward-lookup ability to re-use data already on the target side backup repository to further reduce bandwidth requirements. As Disk, CPU and RAM are used to trade off network speed, this works best for link speeds under or over 50-100Mbps), and will typically reduce data transfer by 10x. For links over 50Mbps direct copy mode will be faster but will consume more bandwidth. Refer to High Bandwidth Mode for over 100Mbps. The WAN Accelerator role can be installed with existing Veeam components and requires no network infrastructure changes.

High Bandwidth Mode

Starting with Veeam Backup & Replication 10, Veeam WAN acceleration introduces the High bandwidth mode. We recommend its use for WAN connections faster than 100 Mbps. If compared with the Low bandwidth mode, it does not leverage the global cache, but utilizes a faster compression method, optimized digests processing and an alternative deduplication mechanism. As a result, the new mode provides better performance and higher speed of data transfer.

Mind that to use the High bandwidth mode, you must enable this option for WAN accelerators at both sites of the data transfer: the source and the target. If the target WAN accelerator has the High bandwidth mode enabled, different source accelerators can parallelly interact with it in different modes, depending on the mode selected for each source WAN accelerator.

Starting with Veeam Backup & Replication v11 supports Continuous Data Protection (CDP) allowing RTO to be described in second instead of minutes or hours. Instead of using the traditional snapshot mechanism, Veeam CDP uses a filter driver in the VMware ESXi IO stack to capture all I/O from a virtual machine towards its disks. This I/O can then be relayed to target side.



To be able to protect VMs with CDP, you must install I/O filter on each cluster where the VMs that you plan to protect reside and where VM replicas will reside. This I/O filter is 100% supported by VMware and is deployed from the Veeam Backup & Replication Console.

Starting with Veeam Backup & Replication v11 supports Continuous Data Protection (CDP) allowing RTO to be described in second instead of minutes or hours. Instead of using the traditional snapshot mechanism, Veeam CDP uses a filter driver in the VMware ESXi I/O stack to capture all IO from a virtual machine towards its disks. This I/O can then be relayed to target side.

Data transfer starts right after Veeam Backup & Replication configures the backup infrastructure components (performs the initial configuration). Data transfer differs during the initial synchronization and during the incremental synchronization. As a rule, the initial synchronization is performed when disk data is sent to the target host for the first time. During the initial synchronization, Veeam Backup & Replication sends data for full copies of virtual disks and creates the very first restore points. During the incremental synchronization, Veeam Backup & Replication mainly sends data for incremental changes made to virtual disks and creates short-term and long-term restore points.

Veeam CDP uses a proxy on the source and target side to buffer the data during a sync interval and scale out. If the connection between the two sites, CDP will switch use "dirty block map" to keep track of what blocks have changed instead of storing the actual data so that the customer does not have to worry about buffers filling up. When the connection is restored, CDP will then sync the changed blocks and once complete, can restart the incremental process of syncing data.

Veeam CDP uses a replication chain. This is a sequence of files that allows you to roll back a VM replica to a specific point in time during failover. Veeam Backup & Replication creates replication chains for each VM added to a CDP policy.

The replication chain contains short-term and long-term restore points. Short-term restore points allow you to roll back VM replica data to a state created seconds or minutes ago, while long-term restore points — to a state created hours or days ago. Short-term restore points are always crash-consistent, long-term restore points can be crash-consistent or application-consistent depending on how long-term restore points are configured. Short-term retention uses a log based system to store the data in a sequential way.

The default RTO setting is 15 seconds but of course the possible RTO depends on the bandwidth and the latency. When the customer has a high bandwidth and low latency, the RTO can be as low as 2 seconds. Veeam CDP has a built-in calculator that can estimate during configuration if there are enough resources to attain the specific configuration.

Networking Software - Also see mandatory specifications.

- 4.2.1.70. Vendor provided networking solution should support smart fabric features that reduce the amount of management required for the network components such as VLAN autoconfig.
- → **Response**: The Cisco networking solution supports smart fabric features designed to provide ease of management, control, automation, monitoring, visualization, and troubleshooting.
- 4.2.1.71. Vendor provided networking solution should be capable of integration, upgrades, and management by the HCl solution lifecycle processes.
- → Response: The Hyperflex solution includes physical network components that are inclusive of the entire HCI stack lifecycle management capabilities.
- 4.2.1.72. Vendor provided networking solution should include zero-touch deployment software features.
- → **Response**: The Cisco networking solution supports zero-touch deployment features to accelerate provisioning from days to minutes, and simplify deployments.
- 4.2.1.73. Vendor provided networking solution software should support automated configuration steps using Ansible as defined above in definitions.
- → Response: The Cisco networking solution supports automated configuration using ansible.

Installation Specifications

- 4.2.1.74. Vendor provided HCI solution should include OEM premium installation and deployment services for all included hardware and software features.
- → Response: Vendor provided HCl premium installation and deployment services are included.
- 4.2.1.75. Vendor provided SERVER solution should include OEM premium installation and deployment services for all included hardware and software features.

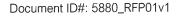


→ Response: Vendor provided Server OEM premium installation and deployment services are included.

- 4.2.1.76. Vendor provided UDS solution should include OEM premium installation and deployment services for all included hardware and software features.
- → Response: Vendor provided UDS OEM premium installation and deployment services are included.
- 4.2.1.77. Vendor provided DPS solution should include OEM premium installation and deployment services for all included hardware and software features.
- → Response: Vendor provided DPS premium installation and deployment services are included.
- 4.2.1.78. Vendor provided NETWORKING solution should include OEM premium installation and deployment services for all included hardware and software features.
- → Response: Vendor provided Networking premium installation and deployment services are included.
- 4.2.1.79. Vendor provided Installation services should include OEM delivered planning, best practices design and onsite configuration of all replication technologies including UDS bidirectional replication, DR capabilities, HCI bi-directional guest replication, and DPS bidirectional replication.
- → Response: Vendor will provide planning, best practices design onsite configuration of all replication technologies as outlined above.
- 4.2.1.80. Vendor provided Installation services should include OEM delivered planning, best practices design, and configuration of all UDS advanced data protection software features and services.
- → Response: Vendor will provide design and configuration of all UDS advanced data protection software features and services, and best practices.
- 4.2.1.81. Vendor provided Installation services should include a minimum of eighty (80) onsite hours of PROJECT MANAGER human resources to assist in project coordination and transition.
- → Response: Compliant Vendor provided installation services shall include a minimum of eighty (80) posite hours of PROJECT MANAGER human resources to assist in project coordination and transition.

Training Specifications

- 4.2.1.82. Vendor should provide OEM delivered training credits, pre-paid vouchers, etc., entitling six (6) WVL designated employees each the opportunity for one (1) unique training class with a minimum duration of five (5) training days averaging eight (8) hours per day for HCl solution.
- → Response: Cisco has provided training credits, pre-paid vouchers, etc., entitling six (6) WVL designated employees each the opportunity to attend 1) a class titled "Implementing Cisco HyperFlex (DCIHX)" which is a 4 day class and 2) a class titled "Introducing Cisco Unified Computing System (DCIUCS)" which is a 2 day class.
- 4.2.1.83. Vendor should provide OEM delivered training credits, pre-paid vouchers, etc., entitling six (6) WVL designated employees each the opportunity for one (1) unique training class with a minimum duration of five (5) training days averaging eight (8) hours per day for UDS solution.
- → Response: NetApp has provided OEM delivered training credits, pre-paid vouchers, etc., entitling six (6) WVL designated employees each the opportunity for one (1) unique training class with a minimum duration of five (5) training days averaging eight (8) hours per day for UDS solution. In addition to the 5 days of instructor led training for six employees, NetApp will also provide free online "Jump Start" training at no cost as well as no cost access to technical sessions held at our last worldwide technical conference.
- 4.2.1.84. Vendor should provide OEM delivered training credits, pre-paid vouchers, etc. entitling (6) WVL designated employees each the opportunity for I unique training class with a minimum duration of five (5) training days averaging eight (8) hours per day for DPS solution.
- → **Response**: Vendor will provide OEM delivered training for the number of employees and training days as outlined in 4.2.1.84.
- 4.2.1.85. Vendor should provide One thousand four hundred and seven (1,407) VMware service credits (OEM delivered pre-paid services and training) for the purpose of training WVL staff on VMware technology and consulting on VMware products. This will be classroom or virtual live instructor OEM training.
- → Response: Compliant Vendor is providing One thousand four hundred and seven (1,407) VMware service credits (OEM delivered pre-paid services and training) for the purpose of training WVL staff on



VMware technology and consulting on VMware products. This will be classroom or virtual live instructor OEM training.

Migration Specifications

- 4.2.1.86. Vendor provided hardware solutions should include OEM delivered migration services for all Data, VM guests, and data protection SLA's from existing platforms to new vendor provided platforms.
- → Response: Compliant Vendor provided solution includes OEM and vendor delivered migration services for all Data, VM quests, and Data protection SLA's from existing platforms.
- 4.2.1.87. Vendor provided solution should include OEM delivered data migration services for migration of all WVL guests from current hosts and storage to the new HCl solution.
- → Response: Compliant Vendor will provide Vendor data migration services to the new HCl solution.
- 4.2.1.88. Vendor provided solution should include OEM delivered data migration services for the migration of all data from VNX 5300 and Centera to the new UDS solution. The migration and installations services should include separation of document (object) data and file (windows) data to separate libraries whereas the document data is configured and protected by WORM policies, and the file data is protected by different storage policies.

See **Appendix II** for an inventory of servers/storage to be upgraded.

→ Response: Data migration services will be provided by the OEM for all file and object storage and ensure libraries are configured with the correct write protection policies.

Other Specifications

- 4.2.1.89. The Vendor should include a detailed bill of materials (price list) that details each billable component of this RFP.
- → Response: Compliant SIS is including a detailed bill of materials (price list) that details each billable component of this RFP in the Cost Proposal.
- 4.2.1.90. Vendor should provide WVL with pricing for optional, additional **OEM deployment resource** services to be ordered at the sole discretion of WVL. For cost scoring purposes, assume



that the services each consist of one unit (1 day, 1/2 day) per type of contracted service. The list of optional quotes include:

- 4.2.1.90.I.I. One (1) business day (8 hours) onsite HCI engineer
- → Response: Compliant SIS is providing for 4.2.1.90.1.1 in the Cost Proposal.
- 4.2.1.90.1.2. One (1) business day (8 hours) on-site UDS engineer
- → Response: Compliant SIS is providing for 4.2.1.90.1.2 in the Cost Proposal.
- 4.2.1.90.1.3. One (1) business day (8 hours) on-site DPS engineer
- → Response: Compliant SIS is providing for 4.2.1.90.1.3 in the Cost Proposal.
- 4.2.1.90.1.4. One (1) business day (8 hours) on-site Project Manager
- → Response: Compliant SIS is providing for 4.2.1.90.1.4 in the Cost Proposal.
- 4.2.1.90.1.5. Half-Day (1/2) (4 hours) Remote HCl engineer
- → Response: Compliant SIS is providing for 4.2.1.90.1.5 in the Cost Proposal.
- 4.2.1.90.1.6. Half-Day (1/2) (4 hours) Remote UDS engineer
- → Response: Compliant SIS is providing for 4.2.1.90.1.6 in the Cost Proposal.
- 4.2.1.90.1.7. Half-Day (1/2) (4 hours) Remote DPS engineer
- → **Response**: Compliant SIS is providing for 4.2.1.90.1.7 in the Cost Proposal.
- 4.2.1.90.1.8. Half-Day (1/2) (4 hours) Remote Project Manager
- → Response: Compliant SIS is providing for 4.2.1.90.1.8 in the Cost Proposal.

PHASE II Application Lifecycle Transition Services and Disaster Recovery

WV lottery is seeking a vendor to assist with application lifecycle activities and related support actions to ensure that WVL's Active Directory, SQL Server, Exchange Server, and other dependent applications are implemented on modem and supported operating systems, platforms, servers, or systems.

- 4.2.1.91. This RFP will include **Vendor professional services** of system design, implementation, and testing related to Applications Lifecycle and disaster recovery activities for WVL with primary emphasis on the DPS sub-system for the disaster recovery component. These activities will require an approved Statement of Work (SOW) utilizing the established contract hourly rates. An Agency Delivery Order (ADO) against the contract established by this RFP (Master Agreement), will be issued and will be used for billing post-installation maintenance/support activities based on an established hourly rate as needed during the duration of this five (5) year project:
 - → Response: Compliant The pricing rates listed within SIS's Cost Proposal includes Vendor professional services of system design, implementation, and testing related to Applications Lifecycle and disaster recovery activities for WVL with primary emphasis on the DPS sub-system for the disaster recovery component. SIS will leverage approved Statements of Work (SOW) utilizing the established contract hourly rates. An Agency Delivery Order (ADO) against the contract established by this RFP (Master Agreement), will be issued and will be used for billing post-installation maintenance/support activities based on an established hourly rate as needed during the duration of this five (5) year project.
 - 4.2.1.91.I. Project Manager
 - → Response: Compliant SIS is providing pricing for 4.2.1.91.1 in the Cost Proposal.
 - 4.2.1.91.2. Microsoft Certified Systems Engineer
 - → Response: Compliant SIS is providing pricing for 4.2.1.91.2 in the Cost Proposal.
 - 4.2.1.91.3. DPS Engineer
 - → Response: Compliant SIS is providing pricing for 4.2.1.91.3 in the Cost Proposal.
 - 4.2.1.91.4. Disaster Recovery Specialist
 - → Response: Compliant SIS is providing pricing for 4.2.1.91.4 in the Cost Proposal.



4.2.1.91.5. Other Staff

→ Response: Compliant – SIS is providing pricing for 4.2.1.91.5 in the Cost Proposal.

- 4.2.1.92. The Lottery reserves the right to approve all staff members assigned to perform Lottery services. The Lottery reserves the right to reject staff and the Vendor/Manufacturer will provide qualified replacements.
- → **Response**: Compliant SIS acknowledges and accepts the staffing requirements in this Section 4.2.1.92.
- 4.2.1.93. Vendor and Manufacturer personnel should be able to work flexible hours due to the need for certain maintenance to be performed after business hours. The vendor will not charge higher rates for after hours or emergency services. The quoted hourly rates will be effective for all services. Vendor should be capable of responding on-site within 4 hours in the event of a system failure or maintenance issue.
- → Response: Compliant SIS acknowledges and accepts the requirements for 4.2.1.93. Vendor and Manufacturer personnel are able to work flexible hours. Vendor will not charge higher rates for after hours or emergency services. The quoted hourly rates defined in the Cost Proposal will be effective for all services. Vendor is capable of responding on-site within 4 hours in the event of a system failure or maintenance issue.
- 4.2.1.94. Server based Microsoft operating systems and SQL database software costs are not included in this project but will be provided by Lottery, vendors proposing an alternative solution should include licensing, maintenance and support costs if a separate product is being proposed.
- → Response: Compliant SIS acknowledges that Server based Microsoft operating systems and SQL database software costs are not included in this project but will be provided by Lottery.

Other Vendor Responsibilities

4.2.1.95. The Vendor should identify these staff members assigned to this project and should provide resumes and documentation supporting the experience. Changes to staffing, during the course of the contract,, should be approved by Lottery personnel and should meet all requirements detailed in this RFP. Vendors should submit these resumes and documentation with the bid but are required to submit them prior to contract award.

→ Response: Vendor will provide a number of resources to ensure we provide a comprehensive approach, which leads to successful results. These resources will collaborate with our extended team and the West Virginia Lottery team to ensure we meet all defined project timelines and milestones. Refer to Attachment #1 for sample SIS Resource Profiles.

CONTRACT TERM

Maintenance Specifications

- 4.2.1.96. Vendor should provide premium **semi-annual OEM software and hardware maintenance remote installation assistance services** covering WVL for but not limited to all supported software, firmware, or quick fix releases for HCI, UDS, DPS, Server, and networking solutions for a term of sixty (60) months from date of delivery.
- → Response: Compliant Vendor will provide premium semi-annual OEM software and hardware maintenance remote installation assistance services covering WVL as outlined in 4.2.1.96.
- Vendor should provide **premium OEM delivered proactive monitoring, issue detection, notification, and automated case creation for accelerated issue resolution for all hardware solutions** provided for a term of sixty (60) months from date of delivery.
- → Response: Cisco Intersight helps prevent problems by delivering new levels of proactive systems support. The information is synthesized and presented to you in an easily consumable, actionable format through the recommendation engine. By combining these insights and recommendations, you can significantly increase efficiency, reduce costs, and accelerate time to resolution. Monitoring alerts you to problems, and log files are shared with the Cisco Technical Assistance Center (TAC), so that Cisco can respond to situations that may arise and provide recommended solutions.

Expertise and information flow seamlessly between Cisco Intersight and IT teams, providing global management and support of your Cisco infrastructure, on your schedule. Cisco Intersight also includes the ability to raise a Service Request SR and a RMA automatically. It authorizes the RMA proactively, thus reducing the time from failure to replacement significantly.

Cisco Smart Call Home is an automated support capability that provides continuous monitoring, proactive diagnostics, alerts, and remediation recommendations. Smart Call Home can help identify and resolve issues more quickly to achieve higher network availability and increased operational efficiency.

Reference (Intersight Solution Brief)

https://www.cisco.com/c/en/us/products/collateral/cloud-systems-management/intersight/solution-overview-c22-742932.html?CCID=cc001268&oid=sowcsm023512

Reference (Smart Call Home Quick Start Guide):

https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/ HyperFlex_Smart_Call_Home_Quick_Start_Guide/b_Cisco_Hyperflex_Smart_Call_Home_QSG/m_auto_s upport_and_smart_call_home_for_hyperflex.html

- 4.2.1.98. Vendor should provide premium **OEM delivered predictive analysis using Al/ML for the purpose of issue prevention and optimization** for a term of sixty (60) months from date of delivery.
- → Response: Cisco Intersight is cloud-based systems management built on a platform that supports artificial intelligence (AI) and machine learning (ML). This allows Cisco Intersight to deliver a wide range of enhanced customer support benefits, especially around systems maintenance and support. The recommendation engine synthesizes information from a variety of sources to provide proactive maintenance and support.

Reference (Intersight Solution Brief)

https://www.cisco.com/c/en/us/products/collateral/cloud-systems-management/intersight/solution-overview-c22-742932.html?CCID=cc001268&oid=sowcsm023512

Support Specifications

- 4.2.1.99. Vendor should provide **OEM delivered third party software support** for eligible software installed on any of the vendor provided solutions as a response to this RFP for a term of sixty (60) months from date of delivery.
- → Response: Compliant Vendor will provide **OEM delivered third party software support** for eligible software installed on any of the vendor provided solutions as a response to this RFP, as outlined in 4.2.1.99.
- 4.2.1.100. All systems and networking tasks should be provided onsite unless approved by the West Virginia Lottery Management. During support hours a four-hour response (onsite) time is



required to both locations. Support Hours are Monday through Friday 8-5 PM. EST. During non-support hours, response by phone should be made within 4 hours of notification.

→ Response: Compliant - All systems and networking tasks will be provided onsite unless approved by the West Virginia Lottery Management. Vendor shall provide support response times as defined in 4.2.1.100.

4.2.1.10 **Vendor should provide hourly rates for ongoing support**, as requested by the Lottery, including, but not limited to Exchange/SQL/Active Directory/Operating Systems:



required to both locations. Support Hours are Monday through Friday 8-5 PM. EST. During non-support hours, response by phone should be made within 4 hours of notification.

→ Response: Compliant - All systems and networking tasks will be provided onsite unless approved by the West Virginia Lottery Management. Vendor shall provide support response times as defined in 4.2.1.100.

4.2.1.101

Vendor should provide hourly rates for ongoing support, as requested by the Lottery, including, but not limited to Exchange/SQL/Active Directory/Operating Systems:



- 4.2.1.102. Vendor should provide for certified, documented, data erasure services, packaging, transportation, and disposal for all components comprising two (2) ENC VNX5300 storage arrays and two (2) EMC Centera storage arrays. One of each system is to be packed, picked up and transported from each of WVL's data center locations.
- → Response: The proposal includes an estimate for onsite data erasure of the specified storage devices. The proposal includes pricing for up to 60x600GB HDD per VNX5300 and up to 30x500GB HDD per each Centera device. A DoD 5220.22-M Sanitization will be performed on the drives. Any drives that fail eradication will be returned to WVL for destruction. One of each system is to be packed, picked up and transported from each of WVL's data center locations. Should the desire of WVL be different than the above expectations, a new price will need to be determined based upon input from WVL.

Mandatory Requirements

4.2.2 Mandatory Project Requirements - The following mandatory requirements relate to the goals and objectives and must be met by the Vendor as a part of its submitted proposal. Vendor must describe how it will comply with the mandatory requirements and include any areas where its proposed solution exceeds the mandatory requirement. Failure to comply with mandatory requirements will lead to disqualification, but the approach/methodology that the vendor uses to comply, and areas where the mandatory requirements are exceeded, will be included in technical scores where appropriate. The mandatory project requirements are listed below.

General Requirements: Vendor is to describe in detail (in writing) its approach and methodology to meet or exceed every objective documented in the Project Specifications as well as those requirements below. This includes sections 4.2.2 through 4.3.

- 4.2.2.1. The Vendor should provide OEM staff, or OEM badged contract staff, for on-site installation and configuration services for hardware as requested in this RFP. (Revised)
- → Response: Compliant SIS shall provide OEM staff, or OEM badged contract staff, for on-site installation and configuration services for hardware as requested in this RFP.
- 4.2.2.2. The Vendor should provide OEM staff, or OEM badged contract staff, for **on-site post deployment services (residency)** for each of the major sub-systems (HCI/DPS/UDS) as requested in this RFP: (Revised)



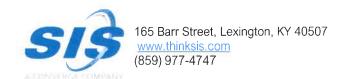


4.2.2.2.1. HCI – 3 months
4.2.2.2.2. DPS – 1 month
4.2.2.2.3. UDS – 2 months

Note - OEM Badged contract staff could be a bidding vendor, or it could be someone they contract with because of their specialized knowledge. We normally see this where a company specializes in several manufacturers rather than any available in the market. The important point is the OEM will stand behind the work they do, and this benefits the Lottery.

Any additional provisions in this RFP mandating OEM installation or support are hereby modified to be a non-mandatory desirable requirement that will be part of the technical evaluation scoring.

- → Response: Compliant SIS shall provide OEM staff, or OEM Badged contract staff for on-site post deployment services (residency) for each of the major sub-systems (HCI/DPS/UDS) as requested in this RFP.
- 4.2.2.3. The Vendor must provide **ongoing support services for the life of the support contract (sixty (60) months.** Support services will be required for incident/problem management of migrated services including but not limited to Active Directory, SQL Server, Exchange Server, VCenter etc. These will be subject to the hourly rates quoted in the response to this RFP.
 - → Response: Compliant Vendor shall provide ongoing support services for the life of the support contract (sixty (60) months as outlined in 4.2.2.3.
 - 4.2.2.4. Vendor must **transfer ownership** of all hardware/software licenses and maintenance contracts to the West Virginia Lottery at the time the system "goes live" (at the end of Phase 1). This shall allow the Lottery to contact the hardware/software OEM directly for support.
 - → Response: Compliant SIS shall transfer ownership of all hardware/software licenses and maintenance contracts to the West Virginia Lottery at the time the system "goes live" (at the end of Phase 1). This shall allow the Lottery to contact the hardware/software OEM directly for support.
- 4.2.2.5. The Lottery reserves the right to **approve all staff members** assigned to perform Lottery services. The Lottery reserves the right to reject staff and the Vendor/Manufacturer will provide qualified replacements.



- → Response: Compliant SIS acknowledges the Lottery reserves the right to . approve all staff members assigned to perform Lottery services. The Lottery reserves the right to reject staff and the Vendor/Manufacturer shall provide qualified replacements.
- 4.2.2.6. Original equipment manufacturer (OEM) for each major component of this solution: **HCI, DPS, and UDS** must provide badged (W-2) employees for the project.
- → Response: Compliant Original equipment manufacturer (OEM) for each major component of this solution: HCI, DPS, and UDS shall be provided by badged (W-2) employees for the project

HARDWARE REQUIREMENTS

Hyperconverged Hardware (HCI)

- 4.2.2.7. Vendor provided HCI solution must include a minimum of 6 VMware compatible hosts per location. Each of these hosts must include all required components in order to host all of the existing and future VM guests for WV Lottery. These include but are not limited to CPU, RAM resources and access to storage on each host.
- → Response: Compliant Cisco Hyperflex solution doesn't enforce any restrictions on number of VMs.
- 4.2.2.8. Each HCl solution host must include a minimum of 96GB RAM running at 2933Mhz, and one Intel Gold CPU model 6248 or greater. If vendor chooses to offer an alternate CPU, the minimum core count per host is 20, and minimum clock speed is 2.5 GHz. Single socket hosts are preferred, but dual socket hosts are acceptable if the additional 12 sockets of VMware vSphere Enterprise Plus software licensing and co-termed premium support are provided as a component of this RFP.
- → Response: Compliant In Cisco Hyperflex Solution for WV Lottery, each node has 6248R CPU with 24 cores and 3 GHz clock speed. Also each node has 192 GB DDR4 2933 Mhz RAM. Please refer to BOM.
- 4.2.2.9. Each HCI solution host must include a minimum of two (2) 25GbE SFP-28 compatible network interfaces.



→ Response: Compliant - Each node has 4 ports 10/25G SFP28 VIC Card. Please refer to BOM.

- 4.2.2.10. Vendor provided HCl solution must include all-flash storage media for the purpose of hosting and optimizing the performance of WV Lottery VMware guests.
- → Response: Compliant Cisco Hyperflex All Flash storage is provided. Please refer to BOM.
- 4.2.2.11. Vendor provided HCI solution must include a minimum of 37T8 of usable, persistent, all-flash, block storage capacity. This must be calculated after all overhead, fault tolerance methods, best practice slack space, and formatting losses have been accounted for.
- → Response: Compliant Hyperflex solution provides minimum of 56.5 TB all-flash capacity. This value is calculated after all overhead, replication factor values with RF3. Values are best practice values. Please refer to BOM.
- 4.2.2.12. Vendor provided HCI solution must include the 37TB usable block storage capacity as defined above while configured with primary level of failures to tolerate configured as 2. This means any combination of two (2) entire hosts, storage nodes, drives, cache drives may be unavailable and the entire 37T8 of block storage capacity must remain online, usable, and available for use.
- → Response: Compliant Hyperflex solution provides minimum of 56.5 TB all-flash capacity. This value is calculated after all overhead, replication factor values with RF3. Values are best practice values including 2 node or drive failure. Please refer to BOM.

Domain Controllers Hardware (Physical Server)

- 4.2.2.13. Vendor provided solution must include three (3) industry standard X86 rack-mount servers. Each of these servers must support and include all required components to be able to host a locally installed Windows Server 201x Operating System. Two servers will be installed in Charleston and one server in Bridgeport.
- → Response: Cisco UCS is based on industry-standard, x86-architecture servers with Cisco innovations. The Cisco UCS C220 M5 Rack Server is among the most versatile general-purpose enterprise infrastructure and application servers in the industry. It is a high-density rack server that delivers industry-leading performance and efficiency for a wide range of workloads, including virtualization, collaboration, and bare-metal applications. The Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of the Cisco Unified Computing System™ (Cisco UCS) to take



advantage of Cisco's standards-based unified computing innovations that help reduce customers' Total Cost of Ownership (TCO) and increase their business agility.

UCS Overview:

https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/solution-overview-c22-744677.html

UCS C220 M5 Data Sheet:

https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/datasheet-c78-739281.html

- 4.2.2.14. Each server must include a minimum of 1608 RAM running at 2666Mhz, and one Intel E-2124 CPU or greater. If vendor chooses to offer an alternate CPU, the minimum core count per server is 4, and minimum clock speed is 3.3Ghz. Single socket servers are preferred, but dual socket servers are acceptable if the additional 3 sockets of Microsoft software licensing and co-termed premium support are provided as a component of this RFP.
- → Response: Each server is configured with 32GB of RAM running at 2933MHz and one Intel 5222 CPU. The Intel 5222 CPU has 4 cores and a clock speed of 3.8Ghz.
- 4.2.2.15. Each server must include a minimum of two (2) 10GbE SFP+ compatible network interfaces.
- → Response: Each server has been configured with a single Cisco UCS VIC 1457 Quad Port 10/25G SFP28 mLOM card designed for the M5 generation of Cisco UCS C-Series Rack Servers. The card supports 10/25-Gbps Ethernet or FCoE and is backwards compatible with SFP+...

UCS VIC 1400 Series Data Sheet:

https://www.cisco.com/c/en/us/products/collateral/interfaces-modules/unified-computing-system-adapters/datasheet-c78-741130.html

- 4.2.2.16. Each server must include a hardware-based RAID controller for the purpose of storage fault tolerance.
- → Response: Each server has been configured with a Cisco 12G SAS RAID controller card with internal SAS connectivity. It supports up to 10 internal SAS/SATA drives, plugs into a dedicated RAID controller slot, and supports RAID 0, 1, 5, 6, 10, 50, 60 and JBOD mode.

Spec Sheet: https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m5-sff-specsheet.pdf

- 4.2.2.17. Vendor provided server solution must include all-flash storage media for the purpose of hosting WV Lottery physical servers.
- Response: Each server has been configured with two 480 GB 2.5 inch Enterprise Value 6G SATA SSD's.
- 4.2.2.18. Each vendor provided server must include a minimum of 480G8 of usable, persistent, all-flash, block storage capacity. This must be calculated after any fault tolerance methods, have been accounted for.
- → Response: Each server has been configured with two 480 GB 2.5 inch Enterprise Value 6G SATA SSD's.
- 4.2.2.19. Each vendor provided server must include the 48008 usable storage capacity as defined above while configured with primary level of failures to tolerate configured as 1 Drive. This should be a hardware-based raid mirror set. This means any storage device may fail and the entire 4800B of storage capacity must remain online, usable, and available for use.
- Response: The Cisco 12G SAS RAID controller supports RAID 1 mirroring. If one of the drives fail in this configuration then the other 480 GB drive will remain online, usable, and available for use.

UDS Hardware

- 4.2.2.20. Vendor provided UDS must include a minimum of 96GB of RAM per node.
- → Response: Compliant Vendor provided UDS meets the requirements outlined in 4.2.2.20.
- 4.2.2.21. Vendor provided UDS must include a minimum of four (4) 25GbE interfaces supporting SFP28 connections for each node.
- → Response: Compliant Vendor provided UDS meets the requirements outlined in 4.2.2.21.
- 4.2.2.22. Vendor provided UDS must deliver 23TB usable storage capacity as defined above while configured with primary level of failures to tolerate configured as 2 drives or 1 node. This means any two storage devices may fail or any one complete node and the entire 23TB of unstructured storage capacity must remain online, usable, and available for use.



→ Response: Compliant – Vendor provided UDS meets the requirements outlined in 4.2.2.22.

DPS Hardware

- 4.2.2.23. Vendor must provide two (2) data center backup and recovery solutions, one to be installed in the WV Lottery primary data center, and the second identical solution to be installed in the WV Lottery secondary data center.
- → Response: Compliant Vendor shall provide two (2) data center backup and recovery solutions as outlined in 4.2.2.23.
- 4.2.2.24. Vendor provided DPS must include a minimum of two (2) 10GbE network connections supporting SFP+ interfaces. Small Form Factor Pluggable
- → Response: The provided UCS solution includes 2 x 10 Intel x550 10Gbase-T embedded (on the motherboard) LOM ports and is configured with a VIC 1457 quad port 10/25G SFP28 MLOM which is backwards compatible with SFP+.

Spec Sheet: https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c240m5-lff-specsheet.pdf

- 4.2.2.25. Each vendor provided DPS solution must include a minimum of 96TB usable capacity of data protection storage hardware per Site. (Removed)
- → Response: Vendor acknowledges 4.2.2.25 was removed.

Networking Hardware

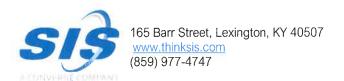
- 4.2.2.26. Vendor provided networking solution must contain a minimum of two (2) L2 and L3 capable 48 port Ethernet TOR server aggregation switches per location.
- → Response: The Cisco networking solution provides two switches per location. Each switch offers a high performance, layer 2 and 3 non-blocking architecture with 48p 1/10G/25G SFP and 12p 40G/100G QSFP28.

- 4.2.2.27. Each Vendor provided networking switch must include a minimum of forty-eight (48) SFP28 interfaces, two (2) QSFP28-DD interfaces, and four (4) QSFP28 interfaces.
- → Response: The Cisco Nexus solution supports 4.8 Tbps of bandwidth and over 2.5bpps. The 48 ports of downlinks support 1/10/25-Gbps. The 12 uplinks ports can be configured as 40- and 100-Gbps ports, offering flexible migration options. The switch is ideal for a non-oversubscribed solution in a compact form factor. The switch has FC-FEC and RS-FEC enabled for 25Gbps support over longer distances.

Data Sheet: https://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-742282.html

- 4.2.2.28. Each vendor provided networking switch must include concurrent support for a forty-eight (48) 25Gbps connections, and eight (8) 100Gbps connections all at full rate and non-blocking.
- Response: The Cisco networking solution supports 4.8 Tbps of bandwidth and over 2.5bpps. The 48 ports of downlinks support 1/10/25-Gbps. The 12 uplinks ports can be configured as 40- and 100-Gbps ports, offering flexible migration options. The switch is ideal for a non-oversubscribed solution in a compact form factor. The switch has FC-FEC and RS-FEC enabled for 25Gbps support over longer distances.

- 4.2.2.29. Each vendor provided networking switch must include scalable a L2 and L3 Ethernet switching with QoS and a full complement of standards based 1Pv4 and 1Pv6 features, including OSPF and BGP routing support.
- → Response: The Cisco networking solution offers comprehensive protocol support for Layer 3 (v4/v6) unicast and multicast routing protocol suites, including BGP, Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP), Routing Information Protocol Version 2 (RIPv2), Protocol Independent Multicast Sparse Mode (PIM-SM), Source-Specific Multicast (SSM), and Multicast Source Discovery Protocol (MSDP). The Cisco Nexus solution offers a full QoS feature set including traffic



classification, packet marking, strict priority queuing, ingress and egress policing, tail Drop and WRED with ECN, shared buffer capability and egress queuing.

Data Sheet: https://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-742282.html

- 4.2.2.30. Each vendor provided networking switch must include L2 multi path support via Virtual link Trunking (VLT) and Routed VLT support, or a similar protocol such as vPC, designed for top of rack switches that minimize VSAN storage traffic on core switches. (Revised)
- → Response: The Cisco networking solution supports Virtual Port-Channel (vPC) technology provides Layer 2 multipathing through the elimination of Spanning Tree Protocol. It also enables fully utilized bisectional bandwidth and simplified Layer 2 logical topologies without the need to change the existing management and deployment models.

Data Sheet: https://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-742282.html

- 4.2.2.31. Each vendor provided networking switch must support VXLAN gateway functionality support for bridging and routing the non-virtualized and virtualized overlay networks with line rate performance.
- → Response: The Cisco networking solution supports VXLAN EVPN fabrics, inclusive of hierarchical multi-site support and provides non blocking network fabrics at web-scale.

- 4.2.2.32. Each vendor provided networking switch must include support for routable RoCE to enable convergence of compute and storage on Leaf/Spine fabric.
- → Response: The Cisco networking solution supports RDME over Converged Ethernet:
- Platform offers lossless transport for RDMA over Converged Ethernet with support of DCB protocols:

- Priority-based Flow Control (PFC) to prevent drops in the network and pause frame propagation per priority class.
- Enhanced Transmission Selection (ETS) to reserve bandwidth per priority class in network contention situation.
- Data Center Bridging Exchange Protocol (DCBX) to discover and exchange priority and bandwidth information with end points.
- Platform also supports Explicit Congestion Notification (ECN) that provides end-to-end notification per IP flow by marking packets that experienced congestion, without dropping traffic. The platform is capable to track ECN statistics of number of marked packet that have experienced congestion.

Data Sheet: https://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-742282.html

- 4.2.2.33. Each vendor provided networking switch must include redundant, hot swappable power supplies and fans.
- → Response: The Cisco Nexus solution includes hot-swappable Power-Supply Units (PSUs) and fans with N+1 redundancy.

- 4.2.2.34. Vendor provided networking solution must include all components to connect all HCI solution nodes at 25Gbs, all UDS solution nodes at 10Gbs, all DPS nodes at 10Gbs, and all servers at 10Gbs.
- Response: The provided solution includes all components to connect all HCl solution nodes at 25Gbs, all UDS solution nodes at 10Gbs, all DPS nodes at 10Gbs, and all servers at 10Gbs.
- 4.2.2.35. Vendor provided networking solution must include all required hardware including but not limited to OM4 fiber cables, switch side transceivers or other components required to create two (2) 40Gbe paths for redundancy from each TOR paths to WVL's existing core network at each location. WVL will provide transceivers for core side equipment only. All other components must be included in this networking solution.



→ Response: Compliant - Vendor will provide the necessary multi-mode 40-gig optics and OM4 fiber patch cables to comply with the specifications outlined in 4.2.2.35.

SOFTWARE REQUIREMENTS

HCI Software

- 4.2.2.36. Vendor provided HCl solution must include all software licensing for software defined storage components required to deliver the WVL solution requirements as documented in the RFP.
- → Response: Compliant The Cisco hyperflex HCl solution includes all software licensing required for software defined storage components.

Domain Controllers Software (Physical Server)

This section has no Mandatory Software Requirements.

UDS Software

- 4.2.2.37. Vendor provided UDS solution should include licenses to support existing NAS protocols for Lottery, SMBV3, NFS, CIFS, FTP and HTTP. (Revised)
- → **Response**: NetApp's provided UDS software includes licenses and support for the following protocols -SMBv3, SMBv4, NFS, CIFS, S3, FCoE, FC, and NVMe.
- 4.2.2.38. Vendor provided UDS solution must include software licenses and capability for WORM storage for 64TB Raw (32TB per Site) to be controlled by policy. This policy enabled WORM storage once written cannot be modified. This replaces the current hardware (Centera) used for Document Imaging.
- → **Response**: Compliant Vendor provided UDS solutions meets the requirements outlined in 4.2.2.38.
- 4.2.2.39. Vendor provided UDS solution must include software licenses and capability for 64TB to replicate file level storage bi-directionally between our two data centers. This software should be controlled by policy with the potential for different replication parameters per folder or content type.

→ Response: Compliant – Vendor provided UDS solutions meets the requirements outlined in 4.2.2.39.

DPS Software

4.2.2.40. Vendor provided DPS solution must include all software required to backup and also to recover operating systems, files, databases, and applications in both physical and virtual environments.

→ Response: Compliant – Vendor provided DPS solutions meets the requirements outlined in 4.2.2.40. Veeam Backup & Replication offers a number of recovery options for various disaster recovery scenarios. All part of the standard product and included.

For VMs:

- Instant VM Recovery enables you to instantly start a VM directly from a backup file.
 - o https://helpcenter.veeam.com/docs/backup/vsphere/instant_recovery.html?ver=110
- Entire VM recovery enables you to recover a VM from a backup file to its original or another location.
 - o https://helpcenter.veeam.com/docs/backup/vsphere/full_recovery.html?ver=110
- <u>VM files restore</u> enables you to recover separate VM files (virtual disks, configuration files and so on).
 - o https://helpcenter.veeam.com/docs/backup/vsphere/vmfile_recovery.html?ver=110
- <u>Virtual disks restore</u> enables you to recover a specific hard drive of a VM from the backup file, and attach it to the original VM or to a new VM.
 - o https://helpcenter.veeam.com/docs/backup/vsphere/virtual_drive_recovery.html?ver=110
- <u>Guest OS File Recovery</u> enables you to recover individual guest OS files from Windows, Linux, Mac and other guest OS file systems.
 - o https://helpcenter.veeam.com/docs/backup/vsphere/guest_file_recovery.html?ver=110
- Quick rollback of changed blocks.

Veeam Backup & Replication uses the same image-level backup for all data recovery operations. You can restore VMs, VM files and drives, application items and individual guest OS files to the most recent state or to any available restore point.

To restore VMware VM data directly from storage snapshots, you can use the capabilities of Veeam



Explorer for Storage Snapshots. For more information, see <u>Veeam Explorer for Storage Snapshots</u>: https://helpcenter.veeam.com/docs/backup/vsphere/storage_snapshots_restore.html?ver=110

For physical servers:

Veeam Agents offer the following restore scenarios:

- You can perform volume-level restore to recover the entire system image (or bare metal recovery)
 of your computer or specific computer volumes. To learn more, see <u>Volume-Level Restore</u>:
 - https://helpcenter.veeam.com/docs/agentforwindows/userguide/restore_volume.html?ver=
 50
- You can perform file-level restore to recover individual files and folders. To learn more, see <u>File-Level Restore</u>:
 - https://helpcenter.veeam.com/docs/agentforwindows/userguide/restore_file.html?ver=50
- You can restore a physical machine to VMware, Hyper-V or AHV.

When performing volume-level restore, you can resize restored volumes to fit available space on target location. To learn more, see <u>Volume Resize</u>:

https://helpcenter.veeam.com/docs/agentforwindows/userguide/data_restore_with_volume_resize.htm | l?ver=50

For both VMs and physical servers with Veeam Agents managed by Veeam Backup and Replication:

To view and recover Microsoft Active Directory, Microsoft SQL Server, Microsoft SharePoint, Microsoft Exchange or Oracle application items, you can use the capabilities of Veeam Backup Explorers. For more information, see <u>Veeam Backup Explorers User Guide</u>:

https://helpcenter.veeam.com/archive/backup/95/explorers/introduction.html

Veeam Agent for Microsoft Windows 2.1 adds full support for mission-critical Microsoft Failover Clusters, SQL Server-based Microsoft Failover Clusters, SQL Always On Availability Groups, and Exchange Database Availability Groups.

You can restore computer disks from Agent volume-level backups and convert them to disks of the VMDK, VHD or VHDX format.

Restore to Microsoft Azure or Amazon EC2: You can use Veeam Backup & Replication to complete the following tasks:

- Restore machines from Veeam backups to Microsoft Azure or AWS EC2.
- Migrate machines from the on-premises infrastructure to the cloud.
- Create a test environment in the cloud for troubleshooting, testing patches and updates and so

on.

4.2.2.41. Vendor provided DPS solution must include all software required to assign backup and retention policies that align with WV Lottery recovery objectives.

→ Response: Compliant – Vendor provided DPS solutions meets the requirements outlined in 4.2.2.41. All part of the standard product and included.

Veeam Backup & Replication provides the following retention options:

- **Simple Retention** is intended for short-time archiving. When you specify retention policy settings for a simple scheme, you define how many restore points you want to retain on the target backup repository.
- **Grandfather-Father-Son Retention** policy is a backup rotation scheme intended for long-term archiving. It lets you keep backups of VMs for an entire year and requires minimum amount of storage space. GFS backups are always full backup files that contain data of the whole VM image as of specific date. Veeam Backup & Replication maintains weekly, monthly, quarterly and yearly backup points.
- Secondary Target archive backup files created with the backup job to a secondary destination (backup repository or tape)
- **Tape Data Retention** policies are: never overwrite data, don't overwrite for a particular time period, and overwrite always. If a tape contains multiple retention periods, the longest retention period gets applied to the tape.
- Object Storage (Capacity Tier) Retention Policies The restore points that fall under the retention policy will be removed from both the extents and object storage repositories in the following manner:
 - An earliest offloaded restore point (that is, a backup file with metadata) will be removed from the backup chain of the associated extent. Backup files with metadata are created, as described in SOBR Offload Job.
 - Offloaded data blocks that correspond to the restore point that is being removed will be purged from the object storage repository upon the next successful session of the offload job.
- Archive Tier Data Transfer Outdated backup files from the capacity tier can be moved to the
 archive tier. After that, the transported files are deleted from the capacity tier. They can stay in the
 performance tier or be deleted from there depending on the data transfer policy of the scale-out
 backup repository:
 - o In case the copy policy is selected (the outdated backup files are copied from the performance tier to the capacity tier), the original file stays in the performance tier.
 - o In case the move policy is selected (the outdated backup files are transferred from the performance tier to the capacity tier), the original file disappears from the performance tier.



4.2.2.42. Vendor provided DPS solution must include all software required to report success and failure of backup or recovery tasks. This includes all web server software and all application server software to provide these reports via email or web applications.

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.42. Please refer to SIS's response in Section 4.2.1.63.

4.2.2.43. Vendor provided DPS solution must include all software required to improve the speed of backup processing to reduce the amount of time to run backups. This includes capability to de-duplicate backup data at source and destination to reduce the amount of data transmitted over the network.

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.43. Veeam Backup & Replication uses Veeam Data Movers to deduplicate VM data on the source and target side.

- The source-side Veeam Data Mover deduplicates VM data at the level of VM disks. Before the source Veeam Data Mover starts processing a VM disk, it obtains digests for the previous restore point in the backup chain from the target-side Veeam Data Mover. The source-side Veeam Data Mover consolidates this information with CBT information from the hypervisor and filters VM disk data based on it. If some data block exists in the previous restore point for this VM, the source-side Veeam Data Mover does not transport this data block to the target. In addition to it, in case of thin disks the source-side Veeam Data Mover skips unallocated space.
- The target-side Veeam Data Mover deduplicates VM data at the level of the backup file. It processes data for all VM disks of all VMs in the job. The target-side Veeam Data Mover uses digests to detect identical data blocks in transported data, and stores only unique data blocks to the resulting backup file.

Storage Optimization

Depending on the type of storage you select as a backup target, Veeam Backup & Replication uses data blocks of different size to process VMs, which optimizes the size of a backup file and job performance. You can choose one of the following storage optimization options:

- The Local target (16 TB + backup files) option is recommended for backup jobs that can produce very large full backup files larger than 16 TB. With this option selected, Veeam Backup & Replication uses data block size of 4096 KB.
- The **Local target** option is recommended for backup to SAN, DAS or local storage. With this option selected, Veeam Backup & Replication uses data block size of 1024 KB.
- The **LAN target** option is recommended for backup to NAS and onsite backup. With this option selected, Veeam Backup & Replication uses data block size of 512 KB. This option provides a better deduplication ratio and reduces the size of a backup file because of reduced data block sizes.
- The **WAN target** option is recommended if you are planning to use WAN for offsite backup. With this option selected, Veeam Backup & Replication uses data block size of 256 KB. This results in



the maximum deduplication ratio and the smallest size of backup files, allowing you to reduce the amount of traffic over WAN.

As an alternative, Veeam provides space reduction technologies that provide a better performance than traditional deduplication.

Fast Clone is the Veeam Backup & Replication technology that helps create quick file copies. Fast Clone increases the speed of synthetic backup creation and transformation, reduces disk space requirements and decreases the load on storage devices.

With this technology, Veeam Backup & Replication references existing data blocks on volumes instead of copying data blocks between files. Data blocks are copied only when files are modified.

Veeam Backup & Replication supports Fast Clone for the following types of backup repositories:

- Linux server
- Microsoft Windows server
- SMB share

Depending on the repository type, Fast Clone uses different technologies and has different requirements and limitations. For more information, see <u>Fast Clone for Linux Repositories</u> and <u>Fast Clone for Microsoft Windows and SMB Repositories</u>:

https://helpcenter.veeam.com/docs/backup/vsphere/backup_repository_block_cloning.html?ver=110# linux

https://helpcenter.veeam.com/docs/backup/vsphere/backup_repository_block_cloning.html?ver=110# microsoft_smb

- 4.2.2.44. Vendor provided DPS solution must include all software required to provide built in fault avoidance and containment of issues in the data protection storage.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.44. Veeam repositories are generally configured on RAID-6 volumes for hardware redundancy. Veeam also has a built-in hardware CRC check to test backup integrity.
- 4.2.2.45. Vendor provided DPS solution must include all software required to provide advanced integration with VMware vSphere VADP which allows for full VM image level backup with change block tracking, incremental virtual machine image file restore, file level restore and single step source to target backup.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.45. Veeam can back up and replicate virtual machines running on VMware and restore VM's, disks and configuration files in addition to granular items contained within the workload.

A Veeam administrator can add VMware vCenter Servers and ESX hosts. If an ESXi host is managed by a VMware vCenter Server, it is recommended that you add the VMware vCenter Server, not a



standalone ESXi host.

Veeam leverages the vSphere API for Data Protection(VADP), vStorage API for Array Integration(VAAI), and Virtual Disk Development Kit (VDDK), and some proprietary Veeam technology to protect virtual machines running on VMware. Veeam uses VMware's Change Block Tracking feature to ensure extremely efficient backups from a size and duration standpoint.

Veeam has a plugin that can be deployed in the vSphere Web Client to provide visibility and manageability to Veeam infrastructure.

Veeam Backup & Replication allows administrators to permit tenants self-service backup and restore operations via web UI based on Veeam Backup Enterprise Manager with the vSphere Self-Service Backup Portal. This feature is designed to add a tenant role permissions management capabilities over the vCenter Servers backup and restore operations. Administrators and tenants have different capabilities using this functionality. Tenants get access to the vSphere self-service web portal. They can select virtual machines to manage backup jobs as well as restore VMs, files and application items within their delegation mode. Tenants also are capable of managing retention, schedule and notification settings as well as guest OS processing options.

In addition Veeam can integrate with VMware Cloud on AWS Azure VMware Solution, GCP VMware Solution, Oracle Cloud VMware Solution and IBM Cloud.

Note that Free ESXi is not supported.

4.2.2.46. Vendor provided DPS solution must include all software to integrate with and support backups and restores directly from Microsoft SQL to include application consistent backups.

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.46. Veeam Backup & Replication provides full and individual item recovery for SQL, application consistent backups are done with Veeam's application aware image process which leverages Microsoft VSS to interact with Microsoft SQL Server. This is supported by physical, virtual, and cloud based infrastructure services.

Veeam Backup & Replication creates a backup of the whole SQL Server, including all SQL Server instances and DBs, which can be full, incremental or reverse incremental backup (depending on the selected backup method). As for native SQL means, they perform backup per database, creating full and differential backups.

The Veeam Explorer for Microsoft SQL Server provides fast transaction- and table-level recovery of SQL databases, including agentless transaction log backup and replay, so you can restore your SQL databases to a precise point in time and achieve short recovery time and recovery point objectives. Should the need arise, you can also publish a SQL Database directly from a backup without restoration.



1.2.2.47. Vendor provided DPS solution must include all software required to natively tier deduplicated data to public or private cloud object storage for long-term data retention.

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.47. Veeam Capacity Tier provides unlimited capacity for long-term data retention by using native, cost-effective object storage integrations with Amazon S3 and S3 Infrequent Access (IA) within AWS's Global, and GovCloud regions. Capacity Tier augments your scale-out backup repository abilities and allows you to comply with possible data storage regulations your organization might be adhering to. For example, you might be running out of space, as your extents (on-premises storage) are only capable of keeping no more than 10 restore points at a time, or your organization policies allow you to store only certain amount of data on your extents, whereas the rest of the data should be stored elsewhere because of its outdated state.

To safely reclaim valuable storage space on your on-premises devices and make it easier to place the backup data to cloud repositories, Veeam Backup & Replication implements proprietary mechanisms that help you efficiently offload your data from the extents to S3 based object storage every 4 hours.

Veeam can be used in conjunction with a VTL Gateway such as the one provided by AWS to send a copy of the backup data into Glacier and Glacier Deep Archive storage.

- 4.2.2.48. Vendor provided DPS solution must include all software required to allow for multiple Ethernet links to be aggregated together for increased performance and failover.
- → Response: The provided solution allows multiple ethernet links to be aggregated together for increased performance and failover.
- 4.2.2.49. Vendor provided DPS solution must include all software required to de-duplicate globally across the entire system and across backup application type.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.49. Veeam performs deduplication at the job level at both the source (i.e., at backup proxy or Veeam Agent) and the target (i.e., at backup repository):
 - Source-side deduplication ensures that only unique data blocks not already present in the previous restore point are transferred across the network
 - Target-side deduplication checks the received blocks against other blocks already stored in the backup file chain, thus providing deduplication in the backup job.

This means that all servers within a specific job are deduplicated against each other.

4.2.2.50. Vendor provided DPS solution must include all software required to provide NFS, CIFS and backup acceleration services at the same time in the same system.

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.50. Veeam customers backup NAS shares using the following methods:

- Direct to Disk
 - o File Share Backup for SMB (CIFS), NFS, and managed Windows, and Linux machines.

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- Direct to Tape
 - Veeam File to Tape Jobs both to tape or disk via a VTL
 - Veeam offers NDMP to Tape.

For large file shares Veeam would recommend File share backup to disk and/or NDMP to tape.

File Share Backup Described

Veeam Backup & Replication supports backup of file shares from the following NAS types:

- SMB file share (version 1,2,3)
- NFS file share (version 3, and 4.1)
- Windows- or Linux-managed server file share

File share backup jobs can read data from the following sources:

- CIFS path
- NFS path
- Path to the storage snapshot folder
- VSS snapshot

Three components are involved in a file share backup

1. Cache repository

 A cache repository is a storage location where Veeam Backup & Replication keeps temporary metadata. Veeam Backup & Replication uses the cached metadata to reduce the load on the file share during the backup procedure. This allows performing incremental backups from the file share very quickly and very efficiently.

2. File proxy

 A file proxy is an architecture component that sits between the file share and other components of the backup infrastructure. The file proxy operates as a data mover that transfers data from the source file share to the backup repository. The file proxy processes jobs and delivers backup and restore traffic.

3. File share backup repository

 A file share backup repository is a short-term storage location where Veeam Backup & Replication keeps backup files and metadata files. Backups stored in the backup repository can be used to restore the entire file share to the state of a specific restore point.

Veeam Backup & Replication performs file share backup in the following way:

- 1. When a new backup job session starts, Veeam Backup & Replication assigns a file proxy to enumerate files and folders on the file share and to create a file tree with cyclic redundancy check (CRC) values.
- 2. The file proxy enumerates files and folders on the file share and creates the file tree with CRC values.
- 3. The file proxy transfers the file tree to the cache repository.
- 4. The cache repository saves the file tree.
- 5. When the cache repository receives a new tree structure from the proxy, it compares it with the file tree created during the previous run of the backup session. If any files or folders of the file share have changed since the previous backup session run, the cache repository instructs the file proxy to start reading changed data from the source file share.
- 6. The file proxy reads new data from the file share.
- 7. The file proxy creates data packages. Data packages contain backup data saved as data files (each 64 Mb in size) and metadata files that contain names and versions of backup files and allocation of data in backup files.
- 8. The file proxy sends new data to the target backup repository.

NDMP to Tape Described

if your NAS device supports the NDMP protocol, you can back up data from it to tape. For this, you need to utilize the file to tape job. NDMP version 4 or higher is required, and only whole volume is supported for backup and restore.

4.2.2.51. Vendor provided DPS solution must include all software required to act as a destination for archive storage and must have the ability to lock files from being edited after they have been archived.

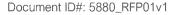
→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.51.

For Performance Tier:

Veeam Backup & Replication allows you to prohibit deletion of data from Hardened Immutable Linux repositories through native Linux capabilities. A service is deployed that cannot be accessed over the network, that will remove the immutability flag based on the attribute. The data mover service runs at a lower privilege can only assign the immutability flag while writing the files.

For Capacity tier/Archive tier:

Yeeam Backup & Replication allows you to prohibit deletion of data from the capacity extent of the capacity tier by making that data temporarily immutable. It is done for increased security: immutability protects your data from loss as a result of attacks, malware activity or any other injurious actions.





To make the data immutable with capacity/archive tier, Veeam Backup & Replication uses the Object Lock technology provided by Amazon and some S3-Compatible providers. Once imposed, the object lock prohibits deletion of data from the capacity extent until the immutability expiration date comes.

You can enable the immutability feature when adding (or editing) an Amazon S3 or S3 Compatible object storage repository as a capacity extent. The immutability expiration date is specified at the same point.

The immutable data within the capacity extent cannot be subject to the following operations:

- Manual removal of data
- Removal of data by the retention policy
- Removal of data using any cloud service provider tools.
- Removal of data by the cloud service provider technical support department
- 4.2.2.52. Vendor provided DPS solution must include all software required to provide the ability for non-disruptive Disaster Recovery testing, without an actual failover.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.52. Veeam provides several options to support automation of DR testing, this ranges from a fully autonomous Orchestrated (Veeam Disaster Recovery Orchestrator) product which can define full scheduling for recursive testing of the whole infrastructure in whole or granular staged tests of departmentalized protected infrastructure, complete control of each step in the testing and failover process and supporting documentation for validation of effectiveness of the tests and failover.

Veeam Backup & Replication also contains the ability to test the function of DR failover using a Failover Plan

If you have a number of VMs running interdependent applications, you need to failover them one by one, as a group. To do this automatically, you can prepare a failover plan.

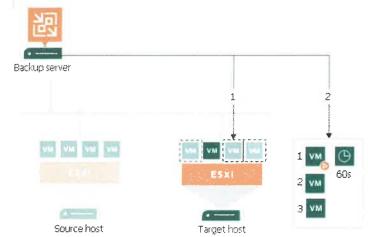
In a failover plan, you set the order in which VMs must be processed and time delays for VMs. The time delay is an interval of time for which Veeam Backup & Replication must wait before starting the failover operation for the next VM in the list. It helps to ensure that some VMs, such as a DNS server, are already running at the time the dependent VMs start. The time delay is set for every VM in the failover plan except the last VM in the list.

The failover plan must be created in advance. In case the primary VM group goes offline, you can start the corresponding failover plan manually. When you start the procedure, you can choose to fail over to the latest state or select the point in time to which VM replicas must be started. Veeam Backup & Replication will look for the closest restore points to this point in time and use them to start VM replicas.

The failover process is performed in the following way:

- 1. For each VM, Veeam Backup & Replication detects its replica. The VMs whose replicas are already in Failover or Failback state are skipped from processing.
- 2. The replica VMs are started in the order they appear in the failover plan within the set time

intervals.



- 4.2.2.53. Vendor provided DPS solution must include all software to replicate at the same time as backups with no requirement for a specific "replication window".
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.53. Veeam Backup and Replication is a single product backup and replication jobs are independent.
 - 4.2.2.54. Vendor provided DPS solution must include all software required to provide functionality to continually verify that the data stored on the system can be accessed and restored in its original form.
 - → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.54. Veeam Backup and Replication offers many options to safeguard data including:
 - Recovery Verification with Surebackup/Sure Replica
 - Health Check for backup files
 - Encryption both in-flight and at rest
 - **Preferred Networks** -You can choose networks over which Veeam Backup & Replication must transport VM data when you perform data protection and disaster recovery tasks.
 - Network Verification Veeam Backup & Replication performs a CRC check for the TCP traffic going between the source and the target.
 - Hardened (Immutable) Repository Immutability protects your data from loss as a result of malware activity by temporarily prohibiting the deletion of data.
- 4.2.2.55. Vendor provided DPS solution must include all software required to de-duplicate data inline into variable length segments before it is written to media.

Agent) and the target (i.e., at backup repository):

→ Response: Compliant - Vendor provided DPS solutions meets the requirements outlined in 4.2.2.55. Veeam performs deduplication at the job level at both the source (i.e., at backup proxy or Veeam

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- Source-side deduplication ensures that only unique data blocks not already present in the previous restore point are transferred across the network
- Target-side deduplication checks the received blocks against other blocks already stored in the backup file chain, thus providing deduplication in the backup job.

This means that all servers within a specific job are deduplicated against each other.

- 4.2.2.56. Vendor provided DPS solution must include socket-based or capacity licenses that activate and enable a minimum of 60TB of usable data storage per solution with equivalent capacity of 1.56TB of storage after compression and de-duplication. (Revised)
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.56. Veeam perpetual licenses are licensed by socket unlimited backup of all virtual workloads on licensed servers

or

Subscription licenses(Preferred method) are 1 universal license per workload (Virtual, Physical or Cloud).

NAS backup licenses are 1 universal license per 500GB.

- 4.2.2.57. Vendor provided DPS solution must include an indexed search function to locate and restore files within the backup set.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.57. Unnecessary for file level recovery but included in base product to increase file searching performance.

Veeam uses its proprietary file indexing mechanism to index machine guest OS files and facilitate search for files in backups with Veeam Backup Enterprise Manager.

- 4.2.2.58. Vendor provided DPS solution must include software licensing for 60TB of NFS compatible file system backup acceleration.
- → Response: Compliant Vendor provided DPS solutions meets the requirements outlined in 4.2.2.58. Acceleration licenses available and are unnecessary as Veeam proprietary incremental NAS backup methodology is already near wire speed fast. Also, Veeam integration with NetApp is even faster file

processing performance.

Networking Software

- 4.2.2.59. Each vendor provided networking switch must include all of the following requirements:
 - 4.2.2.59.1. Software licensing for scalable L2 and L3 Ethernet switching with Qos and a full complement of standards based 1Pv4 and 1Pv6 features, including OSPF and BGP routing support.
 - → Response: The Cisco networking solution licensing includes comprehensive protocol support for Layer 3 (v4/v6) unicast and multicast routing protocol suites, including BGP, Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP), Routing Information Protocol Version 2 (RIPv2), Protocol Independent Multicast Sparse Mode (PIM-SM), Source-Specific Multicast (SSM), and Multicast Source Discovery Protocol (MSDP). The Cisco Nexus solution licensing offers a full QoS feature set including traffic classification, packet marking, strict priority queuing, ingress and egress policing, tail Drop and WRED with ECN, shared buffer capability and egress queuing.

Licensing Guide: https://www.cisco.com/c/en/us/td/docs/switches/datacenter/sw/nx-os/licensing/guide/b_Cisco_NX-OS_Licensing_Guide/b_Cisco_NX-OS_Licensing_Guide_chapter_01.html

Cisco Nexus 9000 Series NX-OS Quality of Service Configuration Guide, Release 10.1(x) https://www.cisco.com/c/en/us/td/docs/dcn/nx-os/nexus-9000/101x/configuration/qos/cisco-nexus-9000-nx-os-quality-of-service-configuration-guide-101x.html

- 4.2.2.59.2. Software licensing for L2 multipath support via Virtual Link Trunking (VLT) and routed VLT support.
- → Response: The Cisco networking solution includes support of Virtual Port-Channel (vPC) technology which provides Layer 2 multipathing through the elimination of Spanning Tree Protocol. It also enables fully utilized bisectional bandwidth and simplified Layer 2 logical topologies without the need to change the existing management and deployment models.

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Licensing Guide: https://www.cisco.com/c/en/us/td/docs/switches/datacenter/sw/nx-os/licensing/guide/b Cisco NX-OS Licensing Guide/b Cisco NX-OS Licensing Guide chapter 01.html

4.2.2.59.3. Software licensing for VXLAN gateway functionality support to bridge and route the non-virtualized and virtualized overlay networks with line rate performance.

→ Response: The Cisco networking solution licensing includes support for VXLAN.

Licensing Guide: https://www.cisco.com/c/en/us/td/docs/switches/datacenter/sw/nx-os/licensing/guide/b Cisco NX-OS Licensing Guide/b Cisco NX-OS Licensing Guide Chapter 01.html

4.2.2.59.4. Software licensing for routable RoCE to enable convergence of compute and storage on Leaf/Spine fabric.

→ Response: The Cisco networking solution licensing supports the transport of RDMA over Converged Ethernet (RoCE) v1 and v2 protocols.

Cisco Nexus 9000 Series NX-OS Quality of Service Configuration Guide, Release 10.1(x) Chapter: Configuring Priority Flow Control

https://www.cisco.com/c/en/us/td/docs/dcn/nx-

os/nexus9000/101x/configuration/qos/cisco-nexus-9000-nx-os-quality-of-service-configuration-guide-101x/m-configuring-priority-flow-control.html

- 4.2.2.60. WV lottery is seeking a vendor to assist with application lifecycle activities and related support actions to ensure that WVL's Active Directory, SQL Server, Exchange Server, and other dependent applications are implemented on modem, supported and supportable operating systems, platforms, servers, or systems including the following requirements:
 - 4.2.2.60.1 The vendor awarded this RFP must be able to perform these activities and actions with employees badged by the RFP responding vendor, unless the requirement is for OEM employees. There are specific vendor responsibilities and capabilities that will be measured with the intent of awarding and open-

end contract for on-going maintenance and support for WVL Microsoft server systems to ensure continued server system functionality.

→ Response: Compliant – Vendor is compliant with section 4.2.2.60.1

4.2.2.60.2 This contract must provide for professional services for system design, implementation, and disaster recovery activities for WVL and will require an approved SOW utilizing the established contract hourly rates. A separate contract release order will be issued and will be used for billing post-installation maintenance/support activities based on an established hourly rate.

Response: SIS acknowledges and accepts the WVL's requirements in this Section 4.2.2.60.2.

4.2.2.60.3 The Server based VMWARE software (VMWARE, VCENTER, VMOTION and VSPHERE) programs are currently licensed to the Lottery and will continue to be used as applications are migrated from legacy to new platforms.

Any proposal that increases the number of required licenses, must include costs for VMWARE software for the duration of this contract (sixty (60) months).

→ Response: Compliant – Vendor is compliant with section 4.2.2.60.3

VENDOR REQUIREMENTS

"OEM Operational Transition Services" means OEM provided, Expert-level human resources, intended to provide guidance post-deployment of the solution components. This resource will provide on-site infrastructure management, knowledge transfer to WVL, and will ensure OEM best practices are implemented to ensure successful adoption the new solutions. These services are to be offered on-site in one (1) month intervals, with travel and expenses included. One (1) month is defined as 20 contiguous days of work or a maximum of 160 hours.

4.2.2.61. Vendor must provide services for application lifecycle transition and re-platforming or any other work designated by the WVL on an as needed basis and will bill hours provided each month. Separate invoices must be provided for work done for the WVL. Invoices shall

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include all activity detail, including date, hours worked, employee name and a reference to the applicable statement of work (SOW).

- → Response: Compliant Vendor shall provide services for application lifecycle transition and replatforming or any other work designated by the WVL on an as needed basis and will bill hours for work done as specified in 4.2.2.61.
- 4.2.2.62. Vendor must provide hourly rate pricing for all custom application lifecycle transition services.
- → Response: Compliant SIS is providing pricing for 4.2.2.62 in the Cost Proposal.
- 4.2.2.63. Vendor provided application lifecycle transition services must plan, document, and implement best practices¹ Active Directory domain controller upgrades, functional level modernization, and directory service best practices and policies for modernization of Microsoft client management features, printing, and deployment.
- → **Response**: Compliant Vendor shall provide application lifecycle transition services as outlined in 4.2.2.63.
- 4.2.2.64. Vendor must provide project management services for the entirety of application lifecycle transition and re-platforming project. Project manager services must be assigned to full time badged employees of the winning Vendor and in partnership with the OEM provider.
- → Response: Compliant Vendor shall provide project management services as outlined in 4.2.2.64.
- 4.2.2.65. Vendor provided application lifecycle transition services must assist WVL with modernization of other non-Microsoft application server products -including evaluation, planning, implementation, and support coordination with OEM of application. This is expected to include but not be limited to application requirements assessment, operating system configuration, database server configuration, and or application server configuration. See **Appendix II** for an inventory of servers/storage to be upgraded.
- → **Response**: Compliant Vendor shall provide application lifecycle transition services to assist WVL with modernization of other non-Microsoft application server products -including evaluation, planning, implementation, and support coordination with OEM of application as outlined in 4.2.2.65.

¹ Best practices would be what is generally included by industry vendors.



- 4.2.2.66. All Vendor(s) must submit documentation for all employees, upon Lottery Request, that will be assigned to work on Lottery Systems. All employees will be required to submit fingerprints for background investigation performed by the Lottery. Anyone failing a background check will not be able to work on this RFP.
- → Response: Compliant SIS conducts background checks for all of its employees and shall ensure that all employees and contractors assigned to work on Lottery Systems submit fingerprints for background investigation, performed by the Lottery.
- 4.2.2.67. Vendor must provide documentation and background references to support the Requirements stated in this RFP. If the Lottery is unable to verify this experience, the Vendor is subject to disqualification.
- → Response: Compliant SIS is providing documentation and background references to support the Requirements stated in this RFP. SIS understands that it is subject to disqualification should the Lottery be unable to verify this experience.
- 4.2.2.68. Vendor must have, and must commit, to maintain for the term of this contract, W-2 employed staff members experienced and qualified to support all technologies utilized in the systems as outlined.
- → Response: Compliant Vendor shall have, and shall commit, to maintain for the term of this contract, W-2 employed staff members experienced and qualified to support all technologies utilized in the systems as outlined.
- 4.2.2.69. The winning Vendor must provide services and support for server buildouts and migrations from Server 2008 to new Windows Server 20xx platforms including but not limited to Clustered Exchange 20xx, Clustered SQL 2017, **note Document Imaging and SharePoint will not be included** in these migrations. See **Appendix II** for an inventory of servers/storage to be upgraded.
- → Response: Compliant Vendor shall provide services and support for server buildouts and migrations from Server 2008 to new Windows Server 20xx platforms including but not limited to Clustered Exchange 20xx, Clustered SQL 2017. Vendor understands that **Document Imaging and SharePoint will not be included** in these migrations.
- 4.2.2.70. Vendors proposing alternative virtualization solutions must include licensing, maintenance, and support costs in addition to all other specifications.

- → Response: Compliant SIS acknowledges that any proposed alternative virtualization solutions must include licensing, maintenance, and support costs in addition to all other specifications. Any such costs shall be included in the Cost Proposal, if utilized.
- 4.2.2.71. On-Site Vendor must provide for the provision of OEM on-site operational transition services in addition to all other components of this RFP:
 - 4.2.2.71.1. Vendor provided HCI solution must include three (3) months of OEM on-site operational transition services.
 - → Response: Compliant Vendor shall include three (3) months of OEM on-site operational transition services in the Cost Proposal.
 - 4.2.2.71.2. Vendor provided UDS solution must include two (2) months of OEM on-site operational transition services.
 - → Response: Compliant Vendor shall include two (2) months of OEM on-site operational transition services. in the Cost Proposal.
 - 4.2.2.71.3. Vendor provided DPS solution must include one (1) month of OEM onsite operational transition services.
 - → Response: Compliant Vendor shall include one (1) month of OEM on-site operational transition services in the Cost Proposal.

Maintenance Requirements

- 4.2.2.72. Vendor must provide premium OEM software and hardware maintenance services entitling WVL to but not limited to all supported software releases for all provided hardware including but not limited to HCI, UDS, DPS, Server, and networking solutions for a term of sixty (60) months from date of delivery.
- → Response: Compliant Vendor shall provide premium OEM software and hardware maintenance services entitling WVL to but not limited to all supported software releases for all provided hardware including but not limited to HCI, UDS, DPS, Server, and networking solutions as outlined in 4.2.2.72.

Support Requirements

"OEM Premium Installation and Deployment Services" means a complete set of premium level deployment services provided by the OEM. Containing a minimum of these features: TAM engagement, Onsite hardware installation, packaging disposal, project management, Site readiness review, implementation planning, on-site installation and configuration of system software, system testing, verification, product orientation, project documentation, 30 day post deployment configuration assistance, and configuration documentation capture and delivery to OEM support organization.

- 4.2.2.73. Vendor must provide premium OEM software and hardware support services entitling WVL to but not limited to support services for all provided hardware including but not limited to HCI, UDS, DPS, Server, and networking solutions for a term of sixty (60) months from date of delivery.
- → Response: Compliant Vendor shall provide premium OEM software and hardware support services entitling WVL to but not limited to support services for all provided hardware including but not limited to HCI, UDS, DPS, Server, and networking solutions as outlined in 4.2.2.73.

Disco Solution Support provides a primary point of contact which focuses on your deployment as a whole, addressing software and hardware from both Cisco and Solution Support Alliance Partners. Using product, architecture, and interoperability expertise, we either directly resolve your issue or actively manage your case by coordinating product support teams inside and outside of Cisco, remaining accountable from first call to resolution, no matter where the issues reside. 60 months of 24x7x4 with onsite support is included in the solution.

https://www.cisco.com/c/dam/en_us/services/portfolio/documents/solution-support-service-at-a-glance.pdf

- 4.2.2.74. Vendor must provide premium OEM software and hardware support services for all proposed hardware and software solutions as a response to this RFP entitling WVL to 24x7 remote technical support for a term of sixty (60) months from date of delivery.
- → Response: Compliant Vendor shall provide premium OEM software and hardware support services for all proposed hardware and software solutions as a response to this RFP entitling WVL to 24x7 remote technical support as outlined in 4.2.2.74.
- 1.2.2.75. Vendor must provide premium OEM software and hardware support services for all proposed hardware and software solutions as a response to this RFP entitling WVL to 4



hour mission critical onsite response technical support for a term of sixty (60) months from date of delivery.

→ **Response**: Compliant - Vendor provided premium OEM software and hardware support services for all proposed hardware and software solutions as a response to this RFP meets the requirements outlined in 4.2.2.75.

Cisco Solution Support provides a primary point of contact which focuses on your deployment as a whole, addressing software and hardware from both Cisco and Solution Support Alliance Partners. Using product, architecture, and interoperability expertise, we either directly resolve your issue or actively manage your case by coordinating product support teams inside and outside of Cisco, remaining accountable from first call to resolution, no matter where the issues reside. 60 months of 24x7x4 with onsite support is included in the solution.

https://www.cisco.com/c/dam/en_us/services/portfolio/documents/solution-support-service-at-aglance.pdf

4.2.2.76. Vendor must provide premium OEM software and hardware support services for all proposed hardware and software solutions as a response to this RFP entitling WVL to priority access to specialized technical support for a term of sixty (60) months from date of delivery.

→ Response: Compliant – Please refer to SIS's response in Section 4.2.2.75

4.2.2.77. Vendor must provide an OEM delivered assigned technical account manager to advocate on behalf of WVL and ensure the best possible proactive and predicable support experience for a term of sixty (60) months from date of delivery.

→ Response: Compliant – Veeam's Customer Success Program provides a technical account manager to advocate on behalf of customers to ensure customer success in using our products.

The West Virginia Lottery has a Cisco account manager and systems engineer who will advocate on the behalf of the West Virginia Lottery and ensure the best possible proactive and predicable support experience.

4.3 **Qualifications and Experience:** Vendor should provide information and documentation regarding its qualifications and experience in providing services or solving problems similar to those requested in this RFP. Information and documentation should include, but is not limited to, copies of any staff certifications or degrees applicable to this project, proposed staffing plans, description

of past projects completed (descriptions should include the location of the project, project manager name and contact information, type of project, and what the project goals and objectives where and how they were met.), references for prior projects, and any other information that vendor deems relevant to the items identified as desirable or mandatory below.

Qualifications and Experience

- 4.3.1. **Qualification and Experience Information**: Vendor should describe in its proposal how it meets the desirable qualification and experience requirements listed below:
 - 4.3.1.1. Vendor should have experience with, and a thorough understanding of, all power requirements and connector specifications for all types of equipment in the data center not limited to switches, Servers, storage, fiber specs, and types, 120/240 Power and PDU.
 - → Response: Vendor is well experienced both within our integration sites as well as with our field engineers to have a thorough understanding and experience with regards to power connectivity and plug types within all Data Center Tiers.
 - 4.3.1.2. Vendor should be able to professionally install hardware cabling and power systems into server equipment racks and cable tray systems and terminate connections in a clean, organized and professionally labeled manner including but not limited to CAT 516 (All Fiber types), etc.
 - → Response: Vendor is expertly skilled with regards to clean and organized delivery methodologies. All deployment resources are trained on the proper implementation techniques for the various products we support. In addition to providing deployment services for client locations, Converge manages and operates 19 owned and hosted sites on behalf of hundreds of clients.
 - 4.3.1.3. Vendor should have Project Management resources with hands on experience in Multiple Technical Areas including Data, Data Network Security, Distributed Systems, and Clustered Applications.
 - → Response: Converge has a team of 30+ project management resources that have experience across all technology practice groups within our portfolio of offerings. A significant number of our project managers come from a technical background where they had hands on experience with the technologies outlined in this RFP. We strive to align project managers with the appropriate skillset and experience level to effectively manage each engagement. Although we do not require project managers to be able to complete the configurations or do the actual technical work during the project, they should be able to work with the technical resource successfully based on a

strong understanding of the solution being implemented. Converge also endeavors to ensure that technical resources are able to translate highly technical language so that all stakeholders, including the project manager, can understand what is being communicated and how it relates to the desired outcome of the engagement. We have found that allowing technical implementation resources to focus on the technical work while allowing the project manager to focus on communication, coordination, and tracking, generally produces better results from both a business outcome and technical perspective.

- 4.3.1.4 Vendor should provide recent reference examples with customer name omitted that prove successful Microsoft Application lifecycle transition services.
- → Response: Vendor is providing the below recent reference examples with customer name omitted that provide successful Microsoft Application lifecycle transition services.

Business/Industry Type	Solution Summary
Industrials (Wire and Cable Industry)	Upgraded and migrated ~25 domain controllers throughout the active directory Forest. Upgraded FRS to DFS-R for SYSVOL replication. Remediated overall health of active directory, FRS/DFSR, and DNS across the domain. Migrated all ancillary services including: RRAS, NPS, RADIUS, DHCP, Certificate Authority. Audited domain controller GPO's and remediated as needed per best practices.
Industrials	Upgraded and migrated ~15 domain controllers throughout the active directory Forest. Upgraded FRS to DFS-R for SYSVOL replication. Remediated overall health of active directory, FRS/DFSR, and DNS across the domain. Migrated all ancillary services including: RRAS, NPS, RADIUS, DHCP, Certificate Authority. Audited domain controller GPO's and remediated as needed per best practices.
Electronics	Upgraded and migrated ~65 domain controllers in a multi-Forest, multi-domain infrastructure. Remediated overall health of active directory, FRS/DFSR, and DNS across the domain. Migrated all ancillary services including: RRAS, NPS, RADIUS, DHCP, Certificate Authority. Audited domain controller GPO's and remediated as needed per best practices.

Healthcare

The client was struggling with a very unorganized active directory where user attributes were not populated consistently, which led to a confusion into deal of about logging areat applications. Additionally, a large percentage of the users were not prepared, from an attribute standpoint, for the transition to Office 365. The environment of approximately one hundred and ten thousand employees had just shy of five hundred thousand enabled user objects which created a huge security vulnerability. The project goal was 100% end user population in OKTA and readiness for Office 365, to reduce the number of user objects per end user to 1 to 1, and reduce all orphaned and dormant accounts enterprise wide. We developed an intricate script-based process by which accounts were identified and then put through a qualification process where the current state of the account was measured and then filtered into one of several remediation processes necessary for population into OKTA and Office365. Already disabled accounts were targeted for separation from enabled user objects, service and application accounts were identified for organization unit (OU) cleanup, and orphaned or dormant accounts were disabled and targeted for removal. Ultimately the project team disabled over 300,000 user objects, adjusted UPN attributes for over sixty thousand user objects which allowed consistent OKTA access and preparedness for Office365, and qualified over twelve thousand objects as requisite service, application, and administrative accounts.

- 4.3.1.5. Vendor should have installed, configured, and implemented Clustered Microsoft SQL Server 2008 or later and Clustered Microsoft Exchange 2013 or later in both physical and virtual environments.
- → Response: Vendor is well experienced in performing the services as outlined in 4.3.1.5.

Mandatory Qualifications

4.3.2. **Mandatory Qualification/Experience/Requirements** – The following mandatory qualification/experience requirements must be met by the Vendor as a part of its submitted proposal. Vendor must describe how it meets the mandatory requirements and include any areas where it exceeds

the mandatory requirements. Failure to comply with mandatory requirements will lead to disqualification, but areas where the mandatory requirements are exceeded will be included in technical scores where appropriate. The mandatory qualifications/experience requirements are listed below.

- 4.3.2.1. Vendor must be a Microsoft Certified Gold partner with Technical certification in the Microsoft defined "Datacenter" competency.
- → Response: Compliant Vendor holds Gold competencies in Datacenter, Cloud Platform, Cloud Productivity, Messaging and several others.
- 4.3.2.2. Vendor must document its staffing plans for on-site installation, configuration and residency services.
- → Response: Compliant Vendor will document staffing plans once contract is finalized. Vendor will be available for onsite project kick-off meetings and scheduled project update meetings as needed for Microsoft projects. Vendor will perform Microsoft services.
- 4.3.2.3. Vendor must provide references as requested in this RFP.
- → Response: Compliant See Section VI of this Technical Proposal for vendor provided references. See section 4.3.1.4 for recent reference examples with customer name omitted that prove successful Microsoft Application lifecycle transition services.
- 4.3.2.4. Vendor badged employees must be qualified and certified with Microsoft Active Directory, Microsoft Radius Authentication Server, Exchange, SQL Server, Disaster Recovery, SharePoint, Clustering Services, and Unified Communications.
- → Response: Compliant Vendor badged employees meet the requirements outlined in 4.3.2.4.
- 4.3.2.5. Vendor must have Badged Employees with the following certifications: MCSE on Windows Server 2012 or later, Exchange 2013 or later, and SQL Server 2012 or later. Resumes, references documenting at least three years full time experience with any of these products may be considered as equivalent certification.
- → Response: Compliant Vendor badged employees meet the requirements outlined in 4.3.2.5. Please refer to Attachment #1 for sample SIS Resource Profiles.

- 4.3.2.6. Vendor must have badged employees with significant security experience, including but not limited to certification as a CISM or CISSP.
- → Response: Compliant Vendor has significant security experience on staff, including but not limited to CISSP, CEH, CCSK, GPEN, GCED certifications.
- 4.3.2.7. Vendor must have assignable employees with primary skills in Data Center infrastructure design, maintenance and migration. Capabilities must include Windows Servers, Cisco Core Networking, Cisco Firewalls, Routers, and Switches, as well as the RFP responding OEM provided HCI, UDS, DPS, Server, and Networking solutions.
- → Response: Compliant Vendor has assignable employees with the appropriate primary skills outlined in 4.3.2.7.
- 4.3.2.8. Vendor must have experience implementing best practices with vSphere 6.7 or later in a multi-site environment. Experience must include experience in planning, creating, managing, and assigning necessary virtual resources such as storage, compute, and network for the purpose of deploying and managing virtualized Servers as required.
- → Response: Compliant Converge is a Principal Partner within VMware with Master Services Competencies for Data Center Virtualization, Network Virtualization, and VMware Cloud on AWS. Converge also holds Solution Competencies in Business Continuity, Hyper Converged Infrastructure, Server Virtualization, Management Operations, VMware on AWS, End Point Protection, Network Virtualization, Desktop Virtualization, and Mobility Management. All of these capabilities are analyzed and re-evaluated by VMware on an annual basis which requires maintaining trained, certified, and experienced engineers within each skill set.
- 4.3.2.9. Vendor must have provided professional services Installing, Configuring, and migrating and implementing Microsoft Active Directory environments on Server 2012 or later. This environment must include multiple locations using site to site replication on at least four (4) Domain Controllers. This environment must have included both Physical and Virtual Domain Controllers. This work must have been for an agency or company of more than 100 users.

Vendor may be requested to provide proof of any of the above listed qualifications before an award is made.

→ Response: Compliant – Vendor has the appropriate professional services as outlined in 4.3.2.9.

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4.3.2.10. Vendor must be able to provide ongoing Microsoft Professional Consulting Services for the West Virginia Lottery (WVL) on an as needed basis.

- → Response: Compliant Vendor is able to provide ongoing Microsoft Professional Consulting Services as outlined in 4.3.2.10.
- 4.4 **Oral Presentations (Agency Option):** The Agency has the option of requiring oral presentations of all Vendors participating in the RFP process. If this option is exercised, it would be listed in the Schedule of Events (Section 1.3) of this RFP. During oral presentations, Vendors may not alter or add to their submitted proposal, but only clarify information. A description of the materials and information to be presented is provided below:

Materials and Information Requested at Oral Presentation: Not applicable.

→ Response: SIS acknowledges that no Oral Presentation is listed in the Schedule of Events for this RFP. Upon request, SIS and the supporting OEMs will be available.

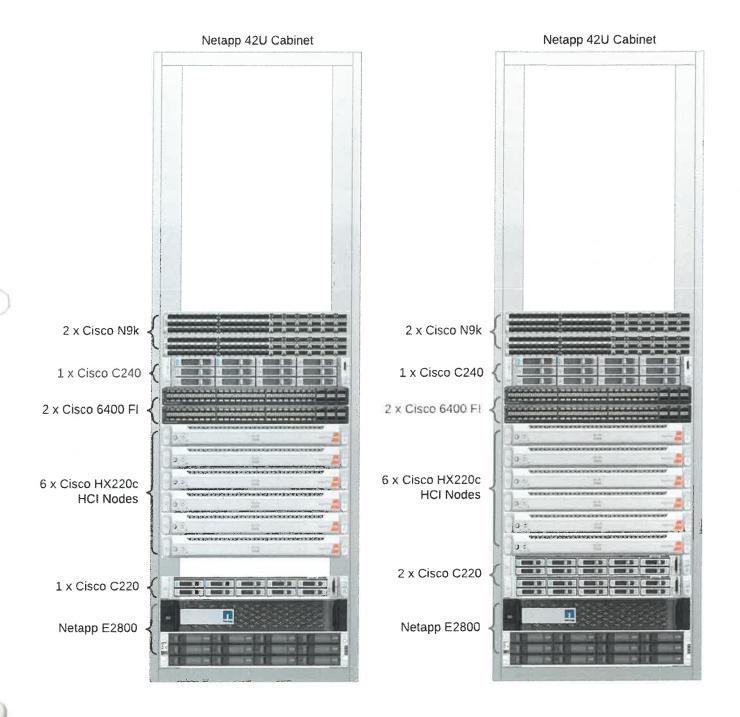


Section V: Proposed Solution

HCI: Cisco Hyperflex (See attached literature)

UDS: NetApp Storage (See attached literature)

DPS: Veeam (See attached literature)



Section VI: References

Reference 1:

Name:	Location:	Contact Information:
West Virginia Department of	Office of Data	Tim Conzett
Education	Management and	Senior Administrator
	Information Systems	Office of Data Management and
	1000 Karawha	Information Systems
	1900 Kanawha Boulevard, East	304.558.8869 P
	Building 6 Suite 750	304.558.2584 F
	Charleston, WV 25305	tim.conzett@k12.wv.us

for all K-12 schools in West Virginia. Largest state network.

Reference 2:

Name:	Location:	Contact Information:
WVOASIS	1007 Bullitt Street Charleston WV 25301	Matt Ellison Chief Technology Officer Phone 304 741.8565 matt.ellison@wvoasis.gov

Reference 3:

Name:	Location:	Contact Information:
West Virginia State	322 70th Street S.E.	Kin Richardson
Treasurer's Office	Charleston, WV 25304	Director of Network Operations
		Direct: 304.341.0727
		richardson@wvsto.gov

Reference 4:

Name:	Location:	Contact Information:
Peoples Bank of Marietta	138 Putnam Street Marietta, OH 45750	Chad Hanson Senior Vice President/Director of IT 740 374-6119 chad.hanson@pebo.com

Solution Provided: Production and Disaster Recovery infrastructure for Core Banking Applications for over 90 Branches and 1000 employees.

Reference 5:

Name:	Location:	Contact Information:
First Community Bank	One Community Place Bluefield, VA 24605	Brian Broyles Chief Technology Officer 304 323-6400 bbroyles@fcbinc.com

Solution Provided: Production and Disaster Recovery infrastructure for Core Banking Applications for over 80 Branches and 900 employees.

Reference 6:

Name:	Location:	Contact Information:
HealthSmart Benefit	602 Virginia Street, East	Kim Ennis, PMP
Management, LLC	Charleston, WV 25301	Senior Director IT
		304 353-8884
		kim.ennis@healthsmart.com

Solution Provided: Production and Disaster Recovery infrastructure for Third Party Administration of healthcare claims by self-insured companies. Infrastructure provided from the SIS Managed Solution Center (SIS Cloud).

Section VII: Attachments

Attachment #1: SIS Resource Profiles

SIS will provide a number of resources to ensure we provide a comprehensive approach, which leads to successful results. These resources will collaborate with our extended team and the West Virginia Lottery team to ensure we meet all defined project timelines and milestones. SIS has provided sample resource profiles.

The Profiles for the above mentioned resources are reflected in this Attachment #1.

Example Solutions Architect

Certifications and Related Skills

Operating systems: Linux, AIX, Solaris, Windows Server

Network Operating Systems: IOS, NX-OS

Security Technologies: Cisco ASA, Vyatta, F5 LTM, RSA SecurID, Sophos UTM

Systems HA: IBM PowerHA, Linux heartbeat, Redhat Cluster Suite

Storage: NetApp, IBM SVC, Cisco Nexus, Cisco MDS-9000, S3, OpenStack

Swift/Cinder

Virtualization: vSphere, IBM PowerVM, Xen, KVM, Amazon AWS, OpenStack

Development: C/C++, Perl, Shell, Ruby

Project History

Industry: Transportation

Project: Multi-site Infrastructure Design and Implementation

Technologies: IBM pSeries & xSeries, PowerHA, vSphere, Cisco UCS, Cisco Nexus,

Cisco Catalyst, IBM SVC, NetApp, IBM TSM, AIX, Linux, IPv4/IPv6, BGP, OSPF

Architected and implemented the infrastructure for a multi-site regional primary/secondary data center capable of supporting simultaneous workloads. The new site design included compute, storage and network technology refresh and consolidation. Managed all technical aspects of the infrastructure implementation and lead the team in planning and migration activities from the existing single-site production facility. Project culminated in a complex, four hour scheduled migration of 300 VMs and 300+TB of storage.

Industry: Financial Services

Project: Multi-site Internet e-Commerce Infrastructure Design and Implementation Technologies: Cisco Catalyst, EMC Storage, IBM xSeries, RedHat Enterprise Linux, Solaris, Veristas Cluster Suite, WebSphere, Apache

Lead architect for a multi-site e-commerce infrastructure of a Fortune 100 financial services company which delivered tailored wealth management and financial reporting to

clients. Served as implementation lead for storage, compute and high availability infrastructure located in the New England area. The design involved three distinct data centers linked with multiple high speed connections necessary to support asynchronous storage replication. The data centers provided primary/secondary recovery capabilities as well as an internal User Acceptance Test environment with access to live data.

Industry Financial Services

Project: Disaster Recovery and Business Continuity

Technologies: IBM pSeries, Sun Microsystems Servers and Storage, EMC Storage

Team lead for Disaster Recovery and Business Continuity of the Open Systems Group for a Fortunate 500 Insurance company. Developed and implemented the technical processes and automation required to meet defined RTO and RPO SLAs. Participated in planned and unplanned disaster recovery tests and oversaw technical teams during the test events.

Industry: Transportation Project: Cloud Migration

Technologies: AIX, Linux, Informix, MySQL, Windows Server 2008, Cisco Catalyst, BGP,

IPsec, Amazon AWS (EC2, S3, EBS, ELB, VPC, RDS, SQS, SNS, SES)

Directed a project to migrate on-premises, internally developed applications to Amazon AWS. Developed the architecture required to integrate multiple regions and availability zones of the public cloud with the on-premises data center's infrastructure and corporate network. Developed data protection schemes for applications and services delivered via public cloud.

Industry: Data Center Co-location

Project: Carrier Diverse Internet and Private Transit Network Design and Implementation Technologies: Cisco Catalyst, IPv4/IPv6, BGP, OSPF, Vyatta

Team lead for the architecture, implementation and transition to a carrier diverse, fully redundant, multi-site Internet and Private transit network for a regional co-location provider. The overall design involved a dual-stack (IPv4/IPv6) implantation of a multi-carrier best-path routing architecture with per client logical networks for private transit between regional co-location facilities. Managed all activities associated with carrier build-in to the facility, circuit commissioning and provisioning and migration to the new implementation.

Example Network Solution Architect

Related Skills

Route / Switch / Core — Cisco IOS / NX-OS / Force 10 / HP / Extreme -- 20+ years Security / Edge — Cisco ASA / Palo Alto / Watchguard / Fortinet / Meraki — 20+ years Collaboration — Cisco CUCM / Asterisk / FreeSwitch / Avaya IP Office — 10+ years Open Systems Networking — Linux / Quagga / NetFilter / BSD-PF / RedHat — 22+ years Programmable Networking — SDN / OpenFlow / Nexus + CSR 1000v / OVS — 2+ years

Project History

Industry: Aerospace Project: SD-WAN

Technologies: Dell Force-10 FTOS w/ OpenFlow, Google RouteFlow, RHEL

Primary Architect for SD-WAN using custom built firewalls and routers. Real time route shifting based on workload and time of day. Custom written software, Linux kernel modifications, various scripts using iptables and Linux iproute2. Dell Force-10 distributed 160gig core at two data centers and 36 domestic sites. Interfaced with legacy network using Google RouteFlow.

Industry: Government

Project: Cisco IP Telephony Deployment

Technologies: Cisco CUCM, UUCX - VPLS, MPLS, Metro-E

Primary Architect for IP Telephony deployment for large metropolitan government. 4500+ end points to include all city government buildings and various call centers including 911.

Industry: Food

Project: Multi-Service WAN

Technologies: Fortinet Gateways, Palo Alto 3050 Firewalls, MPLS, DMVPN

Sr. Consulting Engineer for WAN migration project for a major restaurant chain with 450+ locations in all 50 states. Various protocols and systems used, real time secure transactions, various integration points and perimeters with financial institutions.

Industry: Manufacturing

Project: Cloud Managed WAN Migration

Technologies: Cisco Meraki

Primary Architect for Cisco Meraki cloud-managed WAN / LAN deployment for manufacturer with various locations throughout North America. Abstract topology built on top of MPLS and Internet VPN connectivity.

Industry: Charity Project: Network

Technologies: Cisco Nexus, Cisco ASA, DWDM Optical Transport, VPLS

Primary Architect for new network deployment for a very large charity organization for veterans. Active/Active dual-data center design over DWDM private links as well as VPLS backup. Multiple security perimeters using Cisco ASA Firewalls.

Industry: Higher Education

Project: Multi-Carrier Peering for major university **Technologies**: Juniper JunOS MX Routers, BGP

Primary Architect for project to migrate to connectivity for both IPv4 and IPv6 for a major university. Multiple 20+ gig connections, various bandwidth management and ASpath filtering techniques implemented to reduce costs and increase fault tolerance.

Industry: Communications

Project: Multi-Carrier Peering for regional broadband and telephone company

Technologies: Cisco ASR Routers, BGP, NetFlow, IPv6

Primary Architect for implementation of connectivity to multiple Tier-1 Internet providers at over 200-gigabits combined bandwidth.

Example Senior Solutions Engineer - DPS

Certifications and Related Skills

Server Virtualization – VMware Certified Professional Data Center Virtualization 2020,
 VMware Certified Advanced Professional Data Center Virtualization Design 2019

- Backup Application Veeam Technical Sales Professional 11, Veeam Certified Engineer
 9 and Symantec Backup Exec Sales Expert Plus
- Desktop and Application Virtualization VMware Certified Professional Digital Workspace 2020, VMware Certified Professional Desktop and Mobility 6
- Networking VMware Certified Professional Network Virtualization 2019
- Cloud VMware Master Specialist VMware Cloud on AWS 2020
- Hardware DellEMC VxRail 4.x Deployment and Implementation, DellEMC Server Curriculum 2021, DellEMC High-end Storage Curriculum 2020, DellEMC Client Data Security Curriculum 2020
- Operating System Microsoft Certified Systems Engineer Windows 2003
- Technical Engineering
- Technical Project Management
- Technical Documentation

Industry: Manufacturing

Project: VMware Horizon Upgrade

Project technical lead for a manufacturing client to migrate VMware Horizon 7.5 to 2006 with over 900 clients utilizing 13 hosts

Project History

- Oversaw the project from a technical point of view
- Documented upgrade process for IT committee change control approval
- Worked closely with onsite client project managers for business unit communications
- Performed VMware vCenter and ESXi 6.7 to 7.0 upgrades during normal business hours with no performance impact
- Migrated VMware Horizon after hours with less than thirty minutes downtime

Industry: Healthcare

Project: VMware vSphere Upgrade

Project technical lead for a healthcare client migration from VMware vSphere 6.5 to 7.0 utilizing DellEMC VxRail hardware

- Oversaw the project from a technical point of view
- Documented upgrade process for IT committee change control approval
- Worked closely with onsite client project managers for business unit communications
- Performed VMware vCenter during normal business hours with no performance impact
- Performed virtual machine migration to new version and hardware during normal business hours with no performance impact
- Documented environment for published policy

Industry: Healthcare

Project: VMware vSphere Upgrade

Project technical lead for a healthcare client to upgrade VMware vSphere 5.5 to 6.0 with 155 hosts and 2200 virtual machines with zero downtime

- Oversaw the project from a technical point of view
- Documented upgrade process for IT committee change control approval
- Worked closely with onsite client project managers for business unit communications
- Performed VMware vCenter and ESXi upgrades during normal business hours with no performance impact
- Documented environment for published policy and ISO 9001 requirements

Industry: Manufacturing

Project: VMware vSphere Upgrade and hardware replacement

Project technical lead for a 24/7 manufacturing client to upgrade VMware vSphere 5.1 to 5.5 with 4 hosts and 70 virtual machines with zero downtime

- Oversaw the project from a technical point of view
- Replaced legacy server and SAN hardware with Cisco UCS and IBM Storwize v7000
- Deployed vSphere 5.5 in new environment per business requirements
- Migrated VMware vSphere environment from legacy to new hardware during normal business hours with no performance impact
- Documented environment

Industry: Healthcare

Project: Operating system and application upgrade

Virtualization technical lead for a healthcare client yearlong project to upgrade Windows servers and migrate data

- Within two replicated datacenters, deployed 72 Windows 2008 R2 Server virtual machines to satisfy 8 business units
- Managed low storage resources and migration during upgrade
- Worked with application vendors for application upgrade and Windows 2012 R2 limitation discovery

- Oversaw all virtualization activities during scheduled outage production migration
- Documented environment and all change control requirements

Industry: Education

Project: VMware host and storage integration

Project technical lead to integrate new VMware ESXi hosts and storage into existing postsecondary education environment

- Installed/Configured 3 Lenovo System x3650 M4 servers and an IBM Storwize v3700 SAN into a vSphere 5.5 environment
- Updated vCenter 5.5 to current patch level
- Performed a group knowledge transfer/jumpstart on usage/management of the IBM Storwize v3700 SAN
- Documented environment

Example Solutions Architect - Virtualization

Certifications and Related Skills

- VMware Certified Professional 7– Data Center Virtualization
- VMware Certified Professional Desktop and Mobility 2020
- BCDR Zerto 8 Certified Professional Enterprise Engineer
- HCI VMware Technical Sales Professional Hyper-Converged Infrastructure
- Technical Engineering
- Technical Project Management
- Technical Documentation

Project History

Industry: Healthcare

Project: VMware vSphere & Horizon Upgrade

Lead engineer for a healthcare client for a VMware vSphere 5.5 to 6.7 upgrade and Horizon upgrade

- Worked with Sr Admin client to review and plan the upgrades
- Replaced rack mount x86 servers with Cisco UCS blades
- Deployed new VMware vCenter servers and ESXi Hosts
- Deployed new Horizon 7 components
- Migrated virtual machines from old environment to new environment
- Provided technical Documentation

Industry: State Government

Project: VMware vSphere & Site Recovery Manager Upgrade

Lead engineer for a State Government agency to replace a VMware vSphere 6.5 environment with new hardware and vSphere 6.7 for Production and DR

- Installed new Cisco UCS HW for Prod and DR
- Deployed new VMware vCenter servers and ESXi Hosts for Prod and DR
- Deployed new SRM Servers for Prod and DR
- Provided technical Documentation

Industry: Food

Project: HW Upgrade

Lead engineer for a client to replace aging UCS blades with current generation of UCS blades

- Upgraded UCS Manager firmware
- Performed rolling replacement of UCS blades running a production VMware environment with zero downtime
- Upgraded UCS Blade firmware
- Provided UCS health check post upgrade

Industry: Manufacturing

Project: VMware upgrade & HW replacement

Lead engineer working with client to replace aging x86 servers and upgrade VMware vSphere from 5.5 to 6.7

- Installed new x86 servers and integrated into existing storage
- Deployed new vCenter 6.7 server
- Performed rolling replacement of production VMware Hosts
- Installed and configured ESXi on new servers
- Provided technical Documentation

Example Solutions Architect - HCI

Certifications and Related Skills

- Dell EMC VxRail Architecture Implementation Engineer (DES-6321), August 2020
- Cisco Certified Network Professional Data Center (CCNP), March 2017
- Cisco Certified Specialist Data Center Unified Compute Design (DCUFD), March 2017
- Cisco Certified Specialist Data Center Unified Fabric Implementation (DCUFI), December 2016
- Cisco Certified Specialist Data Center Unified Compute Implementation (DCUCI), September 2016
- VMware Certified Professional 6 Datacenter Virtualization, (VCP6-DCV), August 2016
- Cisco Certified Specialist Data Center Unified Compute Design (DCUCD), March 2016
- EMC Implementation Engineer (EMCIE) VNX Solutions Specialist, June 2014
- IBM Certified Specialist IBM Enterprise Storage Technical Support V4, April 2014
- IBM Certified Specialist IBM XIV Storage System Technical Solutions V3, March 2014
- IBM Certified Specialist IBM PureFlex System Sales V2, January 2014
- IBM Certified Specialist IBM PureFlex Technical Support V2, January 2014
- VMware Certified Professional 5 Datacenter Virtualization, (VCP5-DCV), May 2013
- IBM Certified Specialist System Storage DS8000 Technical Solutions V3, July 2013
- IBM Certified Specialist System Storage XIV Technical Solutions V4, July 2013
- IBM Certified Specialist IBM Storwiz V7000 Technical Solutions V2, May 2013
- VMware Technical Sales Professional, (VTSP), March 2013
- Netapp Certified Data Management Administrator, (NCDA) Cluster-Mode, November, 2013
- Netapp Certified Implementation Engineer, (NCIE)7-Mode, SAN and Virtualization, July, 2011
- Netapp Certified Data Management Administrator, (NCDA) 7-Mode, June, 2011

- SNIA Certified Storage Professional, December 2010
- ITIL V3 Foundations Certification, July, 2010
- IBM Certified Specialist Storwiz V7000 V1, March, 2012
- IBM Certified Specialist System Storage SAN Volume Controller, December, 2008
- IBM Certified Specialist Systems Storage Implementation Entry/Midrange for DS series, May, 2008
- Microsoft Certified Professional (MCP) December, 2007
- Comptia A Plus Certification (A+) February, 2005
- Comptia Network Plus Certification (Net +) August, 2005
- Dell Parts Direct Certification, Printer, and Notebooks (DWD)
- HP Printers, Desktop, and Laptop Certification (ASE)

Project History

Industry: Government

Project: Technology Refresh

Technologies: NetApp, Brocade, VMware Site Recovery Manager

Project was to stand up new production infrastructure and brand new DR site, migrate existing infrastructure, and configure DR site with one hour RPO. My role was to implement two NetApp 6250's, and 12 VMware hosts in Prod and DR utilizing Snapmirror with SRM orchestrating the sync, failover testing, and recovery we were able to meet their tight one hour RPO utilizing a single 1gb link, and provide them with a DR site, and a run book in case disaster does strike.

Industry: Aerospace

Project: Data center Consolidation

Technologies: IBM XIV, SVC, Softek TDMF, NexSAN SATABEAST

Project to consolidate 13 data center spread across the globe into 3 data centers in the United States. My role was to design and implement a solution to migrate data quickly and efficiently given time constrains, and bandwidth restrictions. We migrated over 500TB of data using a mix of SVC tools, Softek TDMF, DD images, and Lift and Ship utilizing Nexsan Satabeast with zero unscheduled downtime, and zero data loss or corruption over the entire project.

Industry: Healthcare Project: Storage Refresh

Technologies: IBM SVC, XIV, DS4800, and DS8100, Softek TDMF

Project was to remove old Hitachi, and HP storage, and virtualize their entire storage landscape and utilize Boot from SAN, and assessed storage demands and performance

metrics to create a tiered data storage environment. After virtualizing various storage subsystems (DS4800, DS8100, V7000, HP, and Hitachi) behind SVC we had the ability to move data from the old SAN to the new SAN with as little 1 reboot, and we were able to phase our moves based on hosts, and not on a storage subsystem basis. This also provided a very efficient way for our customer to stay current of firmware patches with NO downtime or impact to their hosts.

Example Microsoft Data Platform Consultant

Certifications and Related Skills

Microsoft Certified: Azure Database Administrator Associate

- Microsoft Certified: Azure Fundamentals
- Microsoft Certified: Data Management and Analytics (Charter)
- Microsoft Certified Solutions Expert Data Platform
- Microsoft Certified Solutions Associate SQL Server 2012
- MCITP Database Administrator 2008
- MCP Certified Professional
- Microsoft Certified Solution Developer (Visual Studio 6)
- Microsoft Certified Solution Developer (.NET)
- Microsoft Certified Application Developer (.NET)
- MCTS .NET Framework 4 Web
- MCTS SQL Server 2008 Implementation and Maintenance
- MCTS SQL Server 2008 Database Development
- MCITP Database Developer 2008
- Airline Transport Pilot Certificate United States Federal Aviation Administration (FAA)

Project History

Industries: Healthcare, Finance, Production, Manufacturing, Retail, Non-Profit, Government, Insurance and others

Project: SQL Server Database Administrator (DBA) Recurring ServicesSenior Database Administrator (DBA) providing monitoring, proactive and reactive activities/remediation around critical data-centric environments. Deliverables include but are not limited to:

- Risk mitigation/elimination
- Senior DBA expertise as part of a team or where none or minimal exist

- World class monitoring software
- 24/7 monitoring and alerting
- Alert response and review
- Immediate/near-immediate/high priority response and assistance
- Dedicated monitoring/review each month and dedicated DBA activities each month two engagements under one name
- Perpetual SQL Server diagnostics with a goal of iteratively and continually perfecting SQL Server environments
- SQL Server strategy, planning and architecture
- SQL Server performance tuning

Industries: Healthcare, Finance, Production, Manufacturing, Retail, Non-Profit, Government, Insurance and others

Completed SQL Server DBA project work spans many activities that include but are not limited to:

- SQL Server Instance Consolidations
- SQL Server/Database Migrations
- Upgrades to newer versions and/or editions of SQL Server
- High Availability/Disaster Recovery Log Shipping, AlwaysOn Availability, SQL Server Failover Clustering
- · Architecture and Design
- SQL Server diagnostics and performance tuning
- Break fix support ad-hoc/as needed
- SQL Server Diagnostic Checks
- Native SQL Server backup and maintenance automation
- Mentoring

Example Project Manager

Certifications and Related Skills

PMP - Project Management Professional

CSM - Certified Scrum Master

Project Management

Business Analysis and Process Improvement

Needs assessments and technical requirements gathering

Change Management and Risk Management Analysis

Project History

Industry: Financial Institution

Project: Microsoft Azure Application Migration Services

Technologies:

Microsoft Azure

Lead project manager overseeing a team comprised of engineers and business leaders internal to SIS as well as within the customer organization. The goal of the project was to successfully migrate the customer from their existing legacy platform into a Cloud service environment. This solution focused on developing the environment and method by which data would be migrated and create a viable ongoing business solution to streamline operations.

Industry: State Government

Project: Platform Development Project

Technologies:

- Microsoft SharePoint
- Microsoft Project
- Power Bl

Lead project manager of a team of SIS engineers and customer provided resources to architect and develop a project management platform where users throughout the organization could access real-time data related to approximately 200 active projects and historical data at any given time. The project affected more than 300 employees and required changes to over 400 unique identifiers.

Industry: Global Automotive Producer

Project: Power9 Private Cloud HA & Remote Managed Services

Technologies:

IBM Power Systems

Dell Data Domain

Hyper-Availability software for Cloud solutions

Lead project manager of a team of SIS resources working closely with customer executives to acquire and install new hardware to support a Private Cloud and Remote Managed Services solution. This project utilized resources from several divisions within SIS to setup and configure new hardware, support live migration of data within the customer environment and to a Private Cloud solution.

Industry: Healthcare

Project: Exchange Migration to O365

Technologies:

• Exchange Server

Microsoft O365

Lead project manager to support a large Healthcare organization migrate from their legacy Exchange environment to Microsoft O365. Working closely with SIS and customer resources to overcome outdated technologies the team developed a solution for the customer to migrated approximately 1500 users to the O365 Cloud environment.

Industry: Financial

Project: IT Transformation Assessment and Strategic Advisory Services

Lead project manager overseeing a team of internal SIS resources and independent contractors. During this project, our team assessed the existing customer environment and worked with them to evaluate their current and future business needs. Utilizing their desired applications our team developed a detailed roadmap and timeline for the customer to achieve their goals and meet the growing needs of their business. During this project we leveraged and helped them to expand their existing IT footprint and modernized it for current and future initiatives.

Example Senior Enterprise Messaging Consultant

Certifications and Related Skills

- Microsoft Certified: Exchange Server
- Microsoft Certified: Windows Server
- Microsoft Certified: Active Directory
- MCP Certified Professional

Project History

Industries: Healthcare, Industrial, Production, Manufacturing, Retail, Non-Profit

Project: Active Directory Upgrade and remediation of services

Upgrade and migrate 60 domain controllers in 3 Active Directory Forests. Deliverables include but are not limited to:

- Audit all existing domain controllers for overall health
- Remediate active directory sites/services to include proper subnet/site mappings
- Upgrade and migrate all domain controller ancillary services including: NPS,RADIUS, DHCP,Certificate Authority, RRAS
- Upgrade all domain controllers in all Forests/Domains to Server 2016
- Review and test all services
- Configure sites/services as required
- Provide ad-hoc support as needed

Industries: Industries: Healthcare, Industrial, Production, Manufacturing, Retail, Non-Profit

Project: Exchange to O365 migration of 10,000 mailboxes that include but are not limited to:

- Install and configure new Azure Active Directory Connect server for SSO
- Audit existing exchange 2013 servers and increase overall health

- Repair Exchange 2013 DAG and troubleshoot/correct backups
- Install and configure Exchange 2016 hybrid server
- Configure hybrid connectivity with O365 and on-prem infrastructure
- Migrate ~10,000 mailboxes to Office 365
- Remove all exchange 2013 servers and services
- Provide ad-hoc support and administrative training

Industries: Industries: Healthcare, Industrial, Production, Manufacturing, Retail, Non-Profit

Project: Rebuild and restore Active Directory due to Malware

- Audit existing domain controllers due to Malware and encryption
- Work with team to discuss and review changes needed to restore Active Directory
- Build new domain controllers to replace encrypted domain controllers
- Perform authoritive restore of active directory from VSS backup
- Configure and test all services and ancillary services such as DHCP,CA, RADIUS

Industries: Industries: Healthcare, Industrial, Production, Manufacturing, Retail, Non-Profit

Project: Upgrade Exchange 2010 to Exchange 2016

- Audit exchange 2010 services and active directory for overall health
- Build 6 new exchange 2016 services
- Configure all exchange servers for DAG replication
- Configure barracuda load-balancer for layer 7
- Configure exchange 2010 and 2016 coexistence
- Migrate all ~5000 mailboxes to exchange 2016
- Decommission exchange 2010 servers and services
- Provide administrative training and ad-hoc support

Example Technical Lead

Certifications and Related Skills

- Microsoft Certified: Office365 Identities and Access
- MCP Certified Professional
- Cisco Certified Network Associate
- AWS Solutions Architect Associate
- Project Management Professional
- Batchelor of Science (Computer Science) University of Denver
- Master of Business Administration University of Colorado

Project History

Industries: Healthcare, Finance, Manufacturing, Retail, Non-Profit, and others

Project: Citrix Upgrade / Standardization / Expansion

Program Manager responsible for the ultimate delivery of multiple Citrix projects tasked with simplifying, standardizing, and expanding the user base of a Citrix environment in an environment with in excess of one hundred thousand employees. Deliverables include but are not limited to:

- Migrating in excess of two hundred applications from extended support / unsupported farms to long term service release (LTSR) farms with supported virtual desktop agents (VDAs)
- Reducing 17 licensing servers, enterprise wide, down to a single, highly available license infrastructure
- Architect and implement a new, vendor supported, highly available profile infrastructure
- Expand the VDI footprint by at least 2500 users, in multiple regional markets focusing on clinical / hospital areas where desktop refreshes can be avoided.

- Analyze legacy VMware View environment and use cases and implement a Citrix image that meets the needs while eliminating un-needed applications. Migrate existing users to new environment and decommission the legacy environment
- Analyze the user, access, resource, control, hardware and operational layers of the Citrix environment, detail and prioritize the suggested remediations, and implement the highest priority aspects of the findings

Project: Active Directory preparation / organization / cleanup

Project Manager responsible for the standardization of user objects for Okta / Office365 population and reduction of duplicate and orphaned accounts in an Active Directory with over four hundred and fifty thousand enabled user objects. Deliverables included:

- 100% end user population in OKTA across thirty-two user domains and seven forests
- 100% end user object readiness for transition to Office 365 (over 60,000 User Principal Names were adjusted in this effort)
- Disable orphaned and dormant user objects (over 300,000 objects were disabled by the project team)
- Qualify requisite user objects that do not belong to individual end users as:
 - Service accounts (qualified over 10,000)
 - o Application accounts (qualified over 1000)
 - Administrative accounts (qualified over 1000)

Project: VMware analysis, re-design, and implementation planning

Project Manager responsible for the analysis, re-design, and implementation of a VMware environment with over 3500 hosts, 200 clusters, and 50 vCenters. Deliverables included:

- Complete analysis of the environment down to the host level
- A best practice standards recommendation for the environment
- A redesigned environment with host/cluster/vCenter layouts based on the standards recommendations
- An implementation roadmap for the environment with anticipated cost savings (ROI) for VM to host ratios which reduced total host count, reduced vCenter licensing, and reduced management costs given the reduction in cluster counts.

Example <u>Microsoft Team</u> Lead

Certifications and Related Skills

- Microsoft 365 Certified: Security Administrator Associate
- Microsoft Certified Solutions Associate: Office 365
- Microsoft Certified Professional
- Microsoft Certified IT Professional: Enterprise Messaging Administrator on Exchange 2010
- Microsoft Certified Technology Specialist: Microsoft Exchange Server 2010, configuration
- Microsoft Certified IT Professional: SharePoint Administrator 2010
- Microsoft Certified Technology Specialist: SQL Server 2008, Implementation and Maintenance
- Microsoft Certified Systems Engineer: Windows Server 2003
- Pre-Sales Architecture
- IT Solution Design
- Opportunity Qualification
- Technical Documentation
- Active Directory
- Office 365
- Microsoft Exchange
- Skype for Business
- Yammer
- SharePoint
- Azure Cloud

Project History

Furniture Company

Senior consultant responsible for migration from Notes messaging environment of approximately 600 users to Office 365 Exchange online utilizing Dell migration tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

AgroSciences Company

Senior consultant responsible for migration from multiple messaging environments of approximately 9000 users to Office 365 Exchange online utilizing 3rd party tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

Soda Bottling Manufacturing Company

Senior consultant responsible for migration from Exchange 2003 – 2010 messaging environment of approximately 5300 users to Office 365 Exchange online utilizing Exchange Hybrid built-in tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

Natural Gas Company

Senior consultant responsible for migration from Notes messaging environment of approximately 5000 users to Office 365 Exchange online utilizing Quest migration tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

Storage Shelving Company

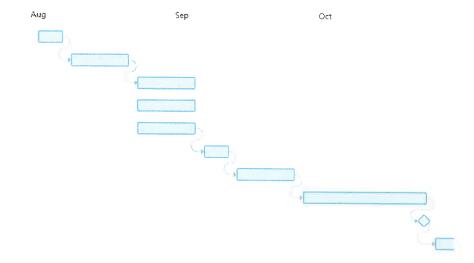
Senior consultant responsible for migration of Exchange 2007 messaging environment of approximately 500 users to Microsoft Exchange 2010 utilizing Quest migration tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

Hotel Company

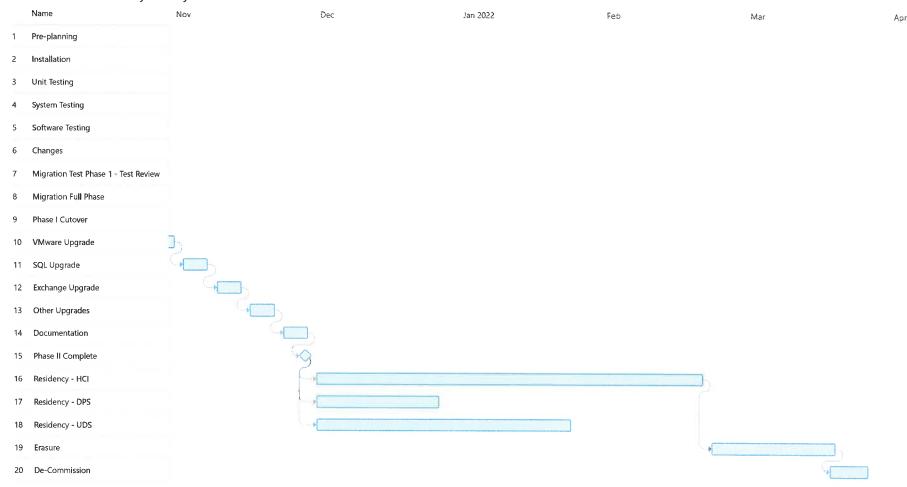
Senior consultant responsible for migration from Exchange 2010 messaging environment of approximately 1500 users to Office 365 Exchange online utilizing built in Exchange Hybrid tools. Responsible for design and implementation of the supporting on premises environment and directory synchronization services. Responsible for implementing coexistence, migrating mailboxes, and knowledge transfer to customer.

Attachment #2 WV Lottery Delivery Timeline

	Name	Assigned to	Start	Finish	% Complete
1	Pre-planning		8/2/2021	8/6/2021	0
2	Installation		8/9/2021	8/20/2021	0
3	Unit Testing		8/23/2021	9/3/2021	0
4	System Testing		8/23/2021	9/3/2021	0
5	Software Testing		8/23/2021	9/3/2021	0
6	Changes		9/6/2021	9/10/2021	0
7	Migration Test Phase 1 - Test Review		9/13/2021	9/24/2021	0
8	Migration Full Phase		9/27/2021	10/22/2021	0
9	Phase I Cutover		10/22/2021	10/22/2021	0
10	VMware Upgrade		10/25/2021	10/29/2021	0
11	SQL Upgrade		11/1/2021	11/5/2021	0
12	Exchange Upgrade		11/8/2021	11/12/2021	0
13	Other Upgrades		11/15/2021	11/19/2021	0
14	Documentation		11/22/2021	11/26/2021	0
15	Phase II Complete		11/26/2021	11/26/2021	0
16	Residency - HCI		11/29/2021	2/18/2022	0
17	Residency - DPS		11/29/2021	12/24/2021	0
18	Residency - UDS		11/29/2021	1/21/2022	0
19	Erasure		2/21/2022	3/18/2022	0
20	De-Commission		3/18/2022	3/25/2022	0



Attachment #2 WV Lottery Delivery Timeline





Department of Administration Purchasing Division 2019 Washington Street East Post Office Box 50130 Charleston, WV 25305-0130

State of West Virginia **Centralized Request for Proposals** Info Technology

Proc Folder:

871666

Doc Description: ADDENDUM - SCALABLE INFRASTRUCTURE STORAGE SOLUTION

Reason for Modification:

Addendum 8 to open technical questions with a deadline of

07/02/2021, 3:00 pm,

Proc Type:

Central Master Agreement

Date Issued

Solicitation Closes

Solicitation No

Version

2021-06-30

2021-07-09 13:30 CRFP 0705 LOT2100000001 9

BID RECEIVING LOCATION

BID CLERK

DEPARTMENT OF ADMINISTRATION

PURCHASING DIVISION

2019 WASHINGTON ST E

CHARLESTON

WV 25305

US

VENDOR

endor Customer Code:

Vendor Name: Software Information Systems, LLC

Address: 165 Barr Street

Street:

City:

Lexington

State:

Kentucky

Country: USA

Zip: 40507

Principal Contact:

Karen Smallwood

Vendor Contact Phone:

859.398.3222

Extension:

FOR INFORMATION CONTACT THE BUYER

Linda B Harper (304) 558-0468

linda.b.harper@wv.gov

Vendor

Signature X

FEIN# 61-1371685

Page: 1

DATE July 6, 2021

Il offers subject to all terms and conditions contained in this solicitation

FORM ID: WV-PRC-CRFP-002 2020\05

Date Printed:

Jun 30, 2021

REQUEST FOR PROPOSAL WV LOTTERY CRFP LOT2100000001

Example:

Proposal 1 Cost is \$1,000,000 Proposal 2 Cost is \$1,100,000 Points Allocated to Cost Proposal is 300

Proposal 1: Step 1 - 1,000,000 / 1,000,000 = Cost Score Percentage of 1 (100%)

Step $2 - 1 \times 300 = \text{Total Cost Score of } 300$

Proposal 2: Step 1-\$1,000,000 / \$1,100,000 = Cost Score Percentage of 0.909091 (90.9091%)

Step $2 - 0.909091 \times 300 = Total Cost Score of 270.27273$

6.8. Availability of Information: Proposal submissions become public and are available for review immediately after opening pursuant to West Virginia Code §5A-3-11(h). All other information associated with the RFP, including but not limited to, technical scores and reasons for disqualification, will not be available until after the contract has been awarded pursuant to West Virginia Code of State Rules §148-1-6.3.d.

By signing below, I certify that I have reviewed this Request for Proposal in its entirety; understand the requirements, terms and conditions, and other information contained herein; that I am submitting this proposal for review and consideration; that I am authorized by the bidder to execute this bid or any documents related thereto on bidder's behalf; that I am authorized to bind the bidder in a contractual relationship; and that, to the best of my knowledge, the bidder has properly registered with any State agency that may require registration.

Software Information Systems, LLC
(Company)
Karen Smallwood, Director of Contracts & Compliance
(Representative Name, Title)
859.398.3222
(Contact Phone/Fax Number)
July 6, 2021
(Date)

Contract Administrator and the initial point of contact for matters relating to this Contract.
(Name, Title) Karen Smallwood, Director of Contracts & Compliance
(Printed Name and Title)
165 Barr Street, Lexington, KY 40507
(Address)
859.398.3222
(Phone Number) / (Fax Number)
ksmallwood@thinksis.com
(email address)
the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.
Software Information Systems, LLC
(Company) Harmally Director of Contracts & Complexee (Authorized Signature) (Representative Name, Title)
Karen Smallwood, Director of Contracts & Compliance
(Printed Name and Title of Authorized Representative)
<u></u>
July 6, 2021
(Date)
859.398.3222
Thona Number) (Fox Number)

STATE OF WEST VIRGINIA Purchasing Division

PURCHASING AFFIDAVIT

CONSTRUCTION CONTRACTS: Under W. Va. Code § 5-22-1(i), the contracting public entity shall not award a construction contract to any bidder that is known to be in default on any monetary obligation owed to the state or a political subdivision of the state, including, but not limited to, obligations related to payroll taxes, property taxes, sales and use taxes, fire service fees, or other fines or fees.

ALL CONTRACTS: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

- "Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.
- "Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.
- "Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (*W. Va. Code* §61-5-3) that: (1) for construction contracts, the vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: Software Information Systems, LLC
7/10/2021
Authorized Signature: Date: Date: Date:
State of Kentucky
County of fayette, to-wit:
Taken, subscribed, and sworn to before me this Land and sworn to be s
My Commission expires January 22 , 2025
1/ 0- 1/
AFFIX SEAL HERE NOTARY PUBLIC VALUE B. Huraly
//

Purchasing Affidavit (Revised 01/19/2018)

West Virginia Ethics Commission



Disclosure of Interested Parties to Contracts

Pursuant to W. Va. Code § 6D-1-2, a state agency may not enter into a contract, or a series of related contracts, that has/have an actual or estimated value of \$1 million or more until the business entity submits to the contracting state agency a Disclosure of Interested Parties to the applicable contract. In addition, the business entity awarded a contract is obligated to submit a supplemental Disclosure of Interested Parties reflecting any new or differing interested parties to the contract within 30 days following the completion or termination of the applicable contract.

For purposes of complying with these requirements, the following definitions apply:

"Business entity" means any entity recognized by law through which business is conducted, including a sole proprietorship, partnership or corporation, but does not include publicly traded companies listed on a national or international stock exchange.

"Interested party" or "Interested parties" means:

- (1) A business entity performing work or service pursuant to, or in furtherance of, the applicable contract, including specifically sub-contractors;
- (2) the person(s) who have an ownership interest equal to or greater than 25% in the business entity performing work or service pursuant to, or in furtherance of, the applicable contract. (This subdivision does not apply to a publicly traded company); and
- (3) the person or business entity, if any, that served as a compensated broker or intermediary to actively facilitate the applicable contract or negotiated the terms of the applicable contract with the state agency. (This subdivision does not apply to persons or business entities performing legal services related to the negotiation or drafting of the applicable contract.)

"State agency" means a board, commission, office, department or other agency in the executive, judicial or legislative branch of state government, including publicly funded institutions of higher education: Provided, that for purposes of W. Va. Code § 6D-1-2, the West Virginia Investment Management Board shall not be deemed a state agency nor subject to the requirements of that provision.

The contracting business entity must complete this form and submit it to the contracting state agency prior to contract award and to complete another form within 30 days of contract completion or termination.

This form was created by the State of West Virginia Ethics Commission, 210 Brooks Street, Suite 300, Charleston, WV 25301-1804. Telephone: (304)558-0664; fax: (304)558-2169; e-mail: ethics@wv.gov; website: www.ethics.wv.gov.

West Virginia Ethics Commission

Disclosure of Interested Parties to Contracts

(Required by W. Va. Code § 6D-1-2)

Name of Contracting Business Entity: Software Information Systems, LLC Address: 465 Barr Street, Lexington, KY 40507
Name of Authorized Agent: Karen Smallwood Address: 165 Barr Street, Lexington, KY 40507 Contract Number: Contract Description: Scalable Infrastructure Storage Solution
Governmental agency awarding contract: Lottery
☐ Check here if this is a Supplemental Disclosure
List the Names of Interested Parties to the contract which are known or reasonably anticipated by the contracting business entity for each category below (attach additional pages if necessary):
1. Subcontractors or other entities performing work or service under the Contract \(\text{\text{M}} \) Check here if none, otherwise list entity/individual names below. No Services, but product OEMs - \(\text{Cisco}, \text{NetAPP} \) Veeam
2. Any person or entity who owns 25% or more of contracting entity (not applicable to publicly traded entities) ☐ Check here if none, otherwise list entity/individual names below.
Converge Acquisition LLC - Converge Technology Solutions Corp
3. Any person or entity that facilitated, or negotiated the terms of, the applicable contract (excluding legal services related to the negotiation or drafting of the applicable contract)
☐ Check here if none, otherwise list entity/individual names below.
Signature: Date Signed: July 6, 2021
Notary Verification
State of Kentucky , County of fayete :: I, Karen Smallwood , the authorized agent of the contracting business entity listed above, being duly sworn, acknowledge that the Disclosure herein is being made under oath and under the penalty of perjury.
Taken, sworn to and subscribed before me this day of, 202.
Notary Public's Signature be completed by State Agency: Date Received by State Agency: Date submitted to Ethics Commission:
Governmental agency submitting Disclosure:

ADDENDUM ACKNOWLEDGEMENT FORM SOLICITATION NO.: LOT2100000001

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:

(Check the box next to each addendum received)

[Addendum No. 1	[] Addendum No. 6
[] Addendum No. 2	[Addendum No. 7
Addendum No. 3	[Addendum No. 8
[Addendum No. 4	[Addendum No. 9
[] Addendum No. 5	[] Addendum No. 10
	(V) Added to 100 1

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Company

Authorized Signature

Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

Revised 6/8/2012

	Cisco HyperFlex System
	Cisco Fabric Interconnects
3	Cisco Nexus 9300-FX Switches
4	Cisco UCS C220 & C240 M5 Servers
5	Cisco Solution Support
6	Veeam and NetApp Data Protection
7	Better Together: NetApp E-Series and Veeam
8	Veeam and NetApp address all Your Availability challenges
9	NetApp E2800 Series
10	IDC Report: The Business Value of Using Veeam And NetApp to reduce Data-Related Risks
11	5 Reasons to Switch Backup
12	Benefits of Veeam over Dell EMC
13	NetApp ONTAP data management Software
14	What's new in Veeam Backup and Replication
15	Veeam, Cisco and NetApp Successes



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Cisco HyperFlex Systems

Manage an explosion of applications

Today's applications are more diverse and distributed than ever, living across a complex, distributed, multidomain world that encompasses enterprise data centers; campus, branch, and edge locations; and private and public clouds. Because these applications form your organization's persona, you need to support the explosion in the number and types of applications, enable cloud-native approaches, and help to drive an ever greater digital reach.

Cisco HyperFlex™ systems with Intel® Xeon® Scalable processors deliver hyperconvergence with power and simplicity for any application, anywhere. Engineered with Cisco Unified Computing System™ (Cisco UCS®) technology, and managed through the Cisco Intersight™ cloud operations platform, Cisco HyperFlex systems can power your applications and data anywhere, optimize operations from your core data center to the edge and into public clouds, and increase agility by accelerating DevOps practices. We accomplish this through:

- An application-centric hyperconverged platform that delivers any application to any location, and at any scale, predictably and securely
- A cloud operating model that enables you to manage and optimize your environment on premises, edge, and public cloud—from anywhere, with the power of data, analytics, and cloud-based management
- Adaptable infrastructure that adjusts to your ever-changing business needs, accelerating innovation by enabling your developers while helping to preserve security and compliance for the business

Cisco HyperFlex is certified as an Intel® Select Solution fo Hybrid Cloud

(intel)

XEON'
PLATINUM
inside

Cisco HyperFlex systems with Intel Xeon Scalable processors



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What you will learn

This document is designed to help explore the benefits and architecture of Cisco HyperFlex systems:

• The solution Cisco HyperFlex systems on page 3 provides a six-page overview, with an emphasis on how our hyperconverged system is a more agile, efficient, adaptable, and scalable solution.

If the overview leaves you wanting to learn more, read "Solution architecture" on page 4 with topics including:

- Platform on page 11
 provides an overview of the platform's clustered, distributed file system, including the enterprise storage features it supports, how it integrates with the hypervisor, how data is distributed, and how the various levels of caching contribute to high performance.
- discusses the benefits of using Cisco UCS technology as the foundation for Cisco HyperFlex, including flexible node configurations, independent resource scaling, our edge offering that can be deployed at scale, and how the platform's integrated networking forms the backbone of the cluster including connectivity to enterprise shared storage.

The challenge: A digitally driven economy

The shift toward a digitally driven economy has accelerated the number and type of applications that organizations are deploying. With applications increasingly representing the face of business, these trends cannot be overlooked. In its FutureScape: Worldwide IT Industry 2020 Predictions, IDC projects that by 2023:

- 300 percent more applications will run in the data center and edge locations.
- 500 million digital applications and services will be developed using cloudnative approaches.
- More than 40 percent of new enterprise IT infrastructure will be deployed at the edge.

The increasing diversity and distribution of applications poses a new challenge to IT organizations. With 46 percent of enterprise products and services expected to be digital, or digitally delivered, by 2022 (IDC, 2019), your business will rely ever more on IT infrastructure. You need solutions that help bridge the gap between IT and business demands with the capability to:

- Power apps and data anywhere. Containers are the virtual machines of this decade, so you must be ready to support cloud-native software with cloud-like resource delivery. You need to deploy these applications with any scale and reach, and you still need to host enterprise applications and virtual desktop environments running in traditional virtual machines.
- Optimize operations. Today's cloud-native applications deploy literally anywhere, in your core data center, at the edge, and in one or more public clouds. You need tools that help you deploy into hybrid cloud environments with application-aware analytics that help maintain performance levels through intelligent resource management.
- Increase agility. You need to be able to deliver the right resources to
 your applications wherever they reside. This takes open, future-proof
 infrastructure that enables rapid iteration through DevOps processes while
 preserving security and maintaining compliance for the business.

The solution: Cisco HyperFlex systems

To help you meet the challenge of deploying large numbers of new applications at any scale, and in any location, we developed Cisco HyperFlex™ systems. In today's world this adaptable platform acts as your on-premises and edge infrastructure that complements and integrates with the workloads that you deploy into public clouds. Tight integration with the Cisco Intersight™ cloud operations platform enables full lifecycle management of your workloads wherever you want to deploy them, locally, at the edge, and into the cloud. With management hosted in the cloud, you have access to unlimited deployment locations and scale.

Meet evolving challenges

Simplify the core

"Over the last two years, IT organizations spent 70% on 'run the business' IT spending, up from 67% in 2013 to 2014, and 65% in 2012."

04/18 Gartner, 2018 Strategic roadmap for compute infrastructure, Chirag Dekate, Daniel Bowers, et. al., April 10, 2018.

Deploy cloud-native applications

"By 2022, 90% of new enterprise applications will be developed as cloud-native applications developed with agile methodologies and based on a hyperagile API-based architecture that leverages microservices architectures, containers, and serverless functions."

04/18 Gartner, 2018 Strategic roadmap for compute infrastructure, Chirag Dekate, Daniel Bowers, et. al., April 10, 2018.

Reach to the edge

"By 2022, more than 50% of enterprise-generated data will be created and processed outside [of] the core data center or cloud."

12/18 Gartner, Gartner IT Infrastructure, Operations & Cloud Strategies Conference Event Presentation, The Future of IT Infrastructures: Always On, Always Available, Everywhere, David J. Cappuccio, Bob Gill, et. al., December 3–6, 2018.

Bridge the gap

Our strategy is to help you bridge the gap by providing the IT capabilities you need in order to help your business thrive in an always-on world (Figure 1):

- App-centric platform: We help you deliver any app, to any location, at
 any scale, both predictably and securely. This starts with infrastructure that
 delivers cloud-like resource delivery that complements what you get from
 the cloud. This helps you differentiate your services from the competition.
- Cloud operations platform: A cloud operating model helps you manage
 distributed operations at scale, from physical and virtual infrastructure
 deployment to workload placement and resource optimization based on
 real-time analysis of your application performance. This delivers true IT
 as a service to your business, helping support the drive to deliver more
 applications in more locations.
- Adaptable infrastructure: We support open, future-proof infrastructure
 you to support your applications. A hyperconverged application platform
 optimized to deliver cloud-native apps delivered as microservices Traditional
 application hosting with both VMware vSphere and Microsoft Windows
 Server Hyper-V virtual machines. This approach supports the DevOps
 processes that your organization is embracing and opens the door to more
 growth opportunities.

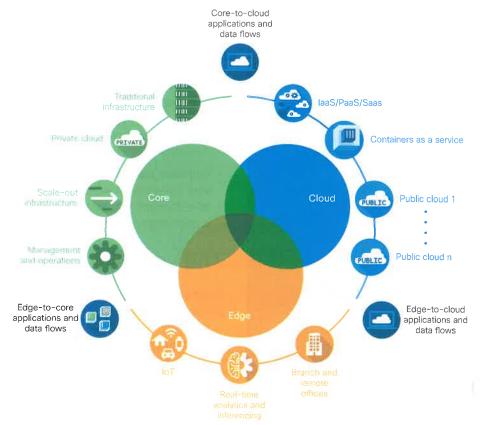


Figure 1 Cisco HyperFlex systems support the data center core, cloud, and edge.

Certified Intel Select Solution

Cisco HyperFlex is now certified as an Intel® Select Solution for Hybrid Cloud. Built on Intel® Xeon® Scalable processors and using Intel® Optane™ Solid State Drives, HyperFlex has been verified as optimized infrastructure for hybrid cloud strategies.



What makes Cisco HyperFlex systems different

Cisco HyperFlex unlocks the full potential of hyperconvergence for a wider range of workloads and use cases. Our innovations include:

- Enterprise-grade application platform with a fully integrated, multitenant Kubernetes environment with full lifecycle management provided by the Cisco Intersight cloud operations platform.
- Fully integrated all-NVMe nodes that are engineered for performance and reliability
- · A unique hardware data compression accelerator
- Full bare-metal deployment and software maintenance managed from the cloud
- · Flexible GPU acceleration in virtual desktop environments
- Powerful GPU acceleration for AI and ML inferencing applications.

The Cisco HyperFlex platform is faster to deploy, simpler to manage, easier to scale, and ready to provide a unified pool of resources to power your business applications. Cisco HyperFlex systems integrate into the data center you have today to form the foundation of your hybrid-cloud straegy. You can deploy Cisco HyperFlex systems wherever you need them, from central data center environments to remote locations and edge-computing environments (Figure 2).

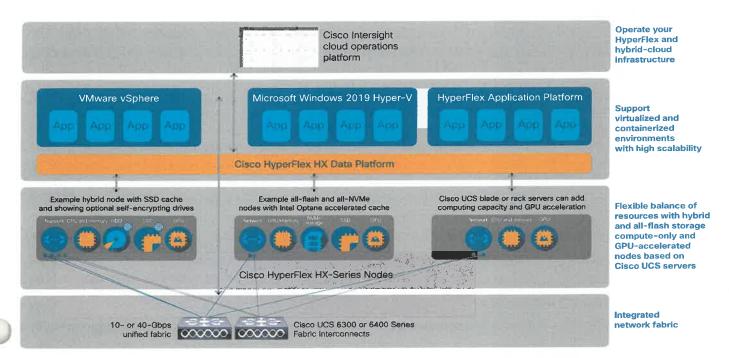


Figure 2 Cisco HyperFlex systems support virtualized and containerized applications and let you choose the exact combination of resources to power your enterprise applications

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What's new?

Cisco HyperFlex systems support:

- · Cisco HyperFlex Application Platform. The software provides an enterprisegrade, multitenant, 100 percent upstream Kubernetes environment without the cost and complexity of licensing underlying virtualization software and manually integrating hardware and software components. Because the platform uses the integrated data platform, the complexity of persistent storage for containers is eliminated. The underlying storage is provided by the Cisco HyperFlex HX Data Platform that protects your data with all of the platform's enterprise storage features
- · Cisco Intersight Kubernetes Service. The Cisco Intersight platform provides full lifecycle management of your application platform with rapid deployment, orchestration, management, and monitoring of containerized environments. These features enable IT organizations to strike a balance between giving developers the power to specify their own containerized infrastructure and the needs of IT organizations to uphold service-level agreements with the reliability and availability needed to maintain them.

Complete end-to-end solution

We engineered Cisco HyperFlex systems to support a broader range of applications and workloads in the data center, private and hybrid clouds, remote locations, and edge-computing environments. This new generation extends the ease of hyperconverged system deployment, management, and support beyond your central data center to hybrid cloud environments and to the network edge.

Cisco HyperFlex systems combine:

- Software-defined computing in the form of nodes based on Cisco Unified Computing System (Cisco UCS) servers
- Software-defined storage provided by the powerful Cisco HyperFlex HX Data Platform software
- Software-defined networking with Cisco Unified Fabric that integrates smoothly with Cisco® Application Centric Infrastructure (Cisco ACI™)
- Cloud-based management with Cisco Intersight that supports full lifecycle management—from initial deployment to workload placement and optimization to single-click, full-stack software upgrades.

Together, these elements comprise an adaptive infrastructure that lets you integrate easily with your existing infrastructure. The result is a cluster that comes up and configures itself quickly and that scales resources independently to closely match your application resource needs.

Ready for all of your applications

The power and performance of Cisco HyperFlex brings lower latency and increased readiness to support a wider range of applications than ever before. We have invested in developing Cisco Validated Designs that have tested and validated many traditional enterprise applications in the Cisco HyperFlex environment to help you speed deployment and reduce risk. These guidebooks for implementation help you accelerate deployment and reduce risk for virtual desktop environments (Citrix or VMware), Epic Electronic Health Record (EHR) environments, Oracle Database, Microsoft SQL Server, big data applications including Splunk and SAP HANA, and graphics-accelerated high-performance computing, artificial intelligence (AI), and machine learning (ML) applications. With flexible configurations, you can deploy Cisco HyperFlex systems in your enterprise data center, to create private clouds, or for edge computing.

The rapid shift to cloud-native development models means that you must establish an on-premises complement to public-cloud deployments so that you can maintain security and compliance with workloads and data that must reside locally. The Cisco Intersight Kubernetes Service provides a ready-to-consume Kubernetes environment that speeds and simplifies containerized applications.



What's new, continued

- · Cisco Intersight Workload Optimizer. This feature helps ensure continuous health of applications across on-premises and cloud environments. The intelligent software continuously analyzes workload consumption, costs, and compliance constraints and automatically allocates resources in real time to support application performance. You can determine when, where, and how to move and resize workloads, maximize elasticity with public cloud resources, and quickly model infrastructure and workload growth scenarios to determine how much infrastructure you will need and when you will need it.
- Core data center enhancements. The data platform now supports iSCSI storage, with initiators in Microsoft Windows, Linux, virtual machines, physical servers, and container persistent volumes able to draw on this block-based storage approach.
- Edge computing enhancements. New, more storage- and GPU-dense enable support for more data at the edge, and N:1 native backup helps keep your data safe in your core data center as well. Security enhancements further harden edge locations.

Engineered on Cisco UCS technology

Cisco UCS provides a single point of connectivity and hardware management that integrates Cisco HyperFlex nodes into a single unified cluster. The system is self-aware and self-integrating so that when a new component attached, it is automatically incorporated into the cluster. Rather than requiring you to configure each element in the system manually through a variety of element managers, Every aspect of a node's personality, configuration, and connectivity is set through management software.

You can independently scale the computing power of your cluster by configuring Cisco UCS servers as computing-only nodes or compute- and GPU-only nodes. This feature lets you adjust the balance of CPU, GPU acceleration, and storage capacity to tune cluster performance to your workloads without the additional costs associated with additional nodes. Incremental scalability allows you to start small and scale as your needs grow. You can accelerate virtual desktop environments with graphics processing units (GPUs) that integrate directly into nodes, speeding graphics-intensive workloads for a smooth user experience.

Cisco Intersight cloud operations platform

Cisco Intersight provides an essential control point for organizations. With Intersight, you can get more value from hybrid IT by simplifying operations across on-premises data centers, edge sites, and public clouds, continuously optimizing and accelerating service delivery.

Cisco Intersight is a unified, secure, software-as-a-service platform comprised of modular services that bridge applications with infrastructure. It provides correlated visibility and management across bare-metal servers, hypervisors, Kubernetes, and serverless and application components, helping you transform your operations with artificial intelligence to reach the scale and velocity your stakeholders demand.

Intersight helps your teams securely collaborate and work smarter and faster together, within and across domains, by automating lifecycle workflows and enabling consistency and governance with extensible, open capabilities that natively integrate with third-party platforms and tools. With Intersight, your teams can intelligently visualize, optimize, and orchestrate all of your applications and infrastructure anywhere they are.

In the context of Cisco HyperFlex systems, Intersight gives you instant access to all of your clusters regardless of where they are deployed. Parallel, heterogeneous deployment supports the scale you need to support distributed locations, and full-stack upgrade allows you to update the entire stack—firmware, hypervisor, and data platform software—to the revision levels your applications need. High-level resource inventory and status are provided by Intersight dashboards. Intersight Kubernetes Service configures and manages 100 percent upstream Kubernetes environment supported by the HyperFlex Application Platform. The Intersight Workload Optimizer monitors



More agile

Cisco HyperFlex systems are more agile because they perform, scale, and interoperate better:

- Deployment is fast and easy. Your cluster ships with the software preinstalled and ready to launch. Installation is the same whether your cluster is in the core data center or at a remote site on the network edge.
- Integrated networking brings high performance.
 Your cluster is interconnected with low, consistent latency, and with 10- and 40-Gbps network bandwidth.
- Scaling is fast and simple. The system automatically discovers new hardware when it is installed. Then adding it to the cluster takes only a few mouse clicks. Logical availability zones allow clusters to grow to up to 64 nodes while minimizing the impact of multiple node failures.
- Interoperability is straightforward. Management capabilities enable you to install and operate your Cisco HyperFlex system in the data center you have today, with high-level management tools that support operations across your hyperconverged and your traditional infrastructure.

application workloads and helps to optimize resource allocation to maintain quality-of-service levels. A recommendation engine helps you proactively respond to impending issues such as the need to scale capacity. Connected Cisco TAC integration can automatically open a support case when errors are detected and can even upload log information needed for case analysis. The Intersight invisible witness supports lightweight 2-node clusters and helps maintain continuous operation in the event of a node or network failure with fully automatic configuration. Storage analytic capabilities can track and monitor compute, network, and storage configurations and provide proactive optimization recommendations.

Powered by next-generation data technology

The Cisco HyperFlex HX Data Platform combines the cluster's storage devices into a single distributed, multitier, object-based data store. It makes this data available through the file system protocols and mechanisms needed by the higher-level hypervisors, virtual machines, and containers.

Performance scales linearly as you scale the cluster because all components contribute both processing and storage capacity to the cluster. The data platform optimizes storage tiers for an excellent balance between price and performance. For example, hybrid nodes use solid-state disk (SSD) drives for caching and hard-disk drives (HDDs) for capacity; all-flash nodes use fast SSD drives or Nonvolatile Memory Express (NVMe) storage for caching and SSDs for capacity; all-NVMe nodes deliver the highest performance for the most demanding workloads with caching further accelerated by Intel Optane™ SSDs.

A full set of enterprise-class data management features are built in: for example, snapshots, thin provisioning, replication for disaster recovery and backup, data encryption, integration with third-party backup tools, and instant and space-efficient cloning. Cisco UCS fabric interconnects secure your data through its lifecycle, with security and compliance controls for protection when you distribute, migrate, and replicate data across storage environments. Security features help you comply with industry and governmental standards. The platform delivers high availability through parallel data distribution and replication, accelerated by the low latency and high bandwidth of the Cisco Unified Fabric. Data is continuously optimized with deduplication, compression, and optional encryption, helping reduce your storage costs without affecting performance. Dynamic data placement in server memory, caching, and capacity tiers increases application performance and reduces performance bottlenecks.

Agile, efficient, adaptable, and scalable solution

Bringing benefits to your IT organization and to your business, Cisco HyperFlex systems are agile, efficient, and adaptable, making them well suited for hosting environments such as virtual desktops, server virtualization deployments, and test and development environments.



More efficient

Our solution is more efficent because of the following:

- Containers without the cost.
 The HyperFlex Application
 Platform supports an
 enterprise-grade Kubernetes
 cluster without the expense of
 licensing hypervisor software.
- Buy only the storage you need. Continuous data deduplication and compression, fast, space-efficient clones, thin provisioning, and optional hardware-accelerated compression all contribute to lowering the cost of your storage.
- Data protection is built in. You can use native HX Data Platform snapshot and replication capabilities with the same data protection solutions you use in your data center because Cisco HyperFlex systems interoperate with leading backup tools.
- Your data is secure. You
 don't need to take extra steps
 to secure your data at rest
 when using self-encrypting
 drives. Cisco HyperFlex
 systems help you save time
 and ensure compliance.
- Save on storage administration. You don't need to install a complex storage network or worry about logical unit numbers (LUNs). Enterprise shared storage can connect directly to your cluster if needed.

- More agile. Cisco HyperFlex systems are more agile because they perform, scale, and interoperate better (see "More agile" on page 8)
- More efficient. Our solution was designed from the beginning with a
 purpose-built, highly efficient data platform that combines the cluster's
 scale-out storage resources into a single, distributed, multitier, object-based
 data store. Features you expect of enterprise storage systems are built into
 Cisco HyperFlex systems (see "More efficient" on page 9).
- More adaptable. Your business needs and your workloads are constantly changing. Your infrastructure needs to quickly adapt to support your workloads and your business (see "More adaptable" on page 11).
- More scalable. Clusters can scale to up to 64 nodes, with protection from multiple node and component failures (see "More scalable" on page 12).

Solution architecture

Cisco HyperFlex systems combine Cisco UCS networking and computing technology, powerful Intel Xeon Scalable processors, and the HX Data Platform to deliver a complete, preintegrated solution. After you install locally or through the Intersight interface, your cluster is ready to work for you whether you need to support virtualized or containerized applications. You get a uniform pool of computing, networking, and storage resources that is designed to power your applications. When you need to provision computing or storage capacity, that capacity is drawn from the entire pool.

Cluster composition with Cisco Hyperflex HX-Series nodes

Physically, a cluster is composed from a set of three or more HX-Series nodes. These are integrated to form a single system through a pair of Cisco UCS 6300 or 6400 Series Fabric Interconnects with 10- or 40-Gbps connectivity (Figure 3). Cisco UCS servers can contribute additional computing and GPU acceleration capacity, participating in the data platform but contributing only computing power (and possibly graphics acceleration) to the cluster. These compute-only nodes can be configured up to a ratio of two compute-only nodes per Cisco HyperFlex node.

Cisco HyperFlex Edge solutions are deployed as fixed sets of two, three, or four edge-specific nodes that use Cisco or third-party Gigabit or 10 Gigabit Ethernet switches, offering the utmost in flexibility for deployment in remote and branch-office environments (see "Hyperconvergence at the network edge" on page 18).

A cluster can reside in a single location or it can be stretched across short geographic distances. An active/active "stretched" cluster synchronously replicates data between the two sites and has a very short recovery time objective (RTO) and zero data loss. Across longer geographic distances, native replication can synchronize data from a primary to a secondary site to support more traditional disaster recovery strategies.

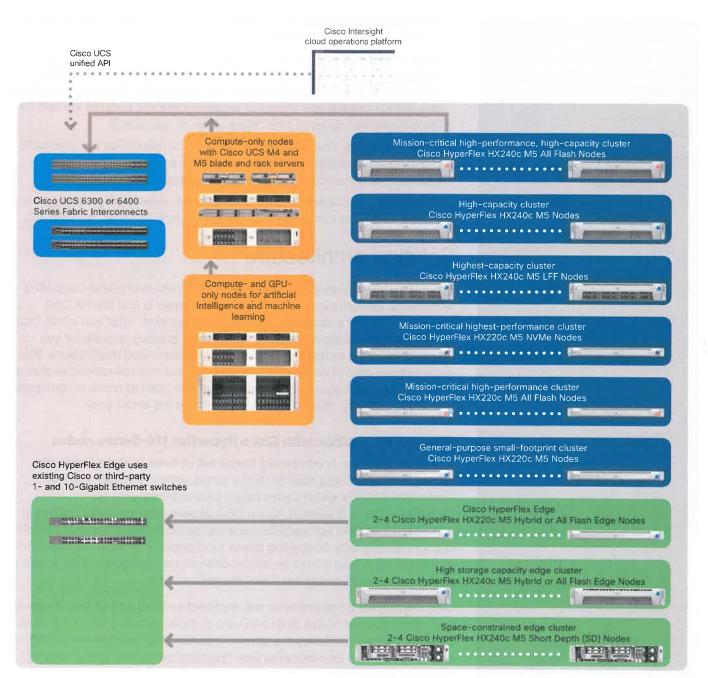


Figure 3 Cisco HyperFlex systems product family

Complete hyperconvergence with Cisco networking

Networking in most hyperconverged environments is an afterthought. We give you complete hyperconvergence with networking as an integral and essential part of the system. Using Cisco UCS fabric interconnects, you have a single point of connectivity and management that incorporates HX-Series nodes and Cisco UCS servers: a key architectural element that no other



More adaptable

Your business needs and your workloads are constantly changing. Your infrastructure needs to quickly adapt to support your workloads and your business.

- Easy resource expansion and contraction. You can scale resources up and out without having to adjust your software or networking capabilities.
- Multisite support. You can stretch a cluster across two sites for immediate recovery from disasters.
 Or you can distribute clusters geographically and replicate data between primary and backup sites.
- Nondisruptive scaling.
 Your infrastructure can easily scale out without the need to take down your cluster to add a node.
- Al and ML support. You
 can adapt your clusters to
 support Al and ML workloads
 by configuring up to 6 GPUs
 in Cisco HyperFlex HX240c
 Nodes, up to 2 GPUs in edge
 nodes, and GPU-only nodes to
 further augment the processing
 capability of your cluster.
- Pay as you grow. You can grow in small increments that won't break your budget, and you can independently scale your computing and capacity resources so they adapt to fit your specific application needs.

hyperconverged vendor can offer. After you deploy a cluster, you can scale it to its maximum size without needing to redesign the network. The solution is designed for easy, smooth scaling. Hyperconverged systems need massive amounts of east-west traffic bandwidth and low latency, and Cisco UCS fabric interconnects deliver both with either 10- or 40-Gbps networking.

Networking is important in hyperconverged systems because the data platform performance depends on it. With Cisco UCS fabric interconnects, you get high-bandwidth, low-latency unified fabric connectivity that carries all production IP, hyperconvergence-layer, and management traffic over a single set of cables. Every connection in the cluster is treated as its own virtual link, with the same level of security as if it were supported with a separate physical link. This makes the integrated network more secure than when commodity approaches are used.

The system is designed so that all traffic, even from blade server computeonly nodes, reaches any other node in the cluster with only a single network hop. This single-hop architecture accelerates east-west traffic, enhancing cluster performance. Our latency is deterministic, so you get consistent network performance for the data platform, and you don't have to worry about network constraints on workload placement.

Integration with Cisco Application Centric Infrastructure

As your environment grows and begins to span your enterprise, you can use Cisco ACI to implement a software-defined network. Cisco ACI provides automated, policy-based network deployment that secures your applications within secure, isolated containers. The network can attach directly to virtual machines and physical servers with increased security, real-time monitoring and telemetry, and automated performance optimization. You get consistency at scale because you can use Cisco ACI to interconnect your entire data center network, including your hyperconverged cluster.

Cisco HyperFlex HX Data Platform

The Cisco HyperFlex HX Data Platform is a purpose-built, high-performance, scale-out file system with a wide array of enterprise-class data management services. The data platform's innovations redefine distributed storage technology, giving you complete hyperconvergence with enterprise storage features. The platform supports the leading hypervisors and also the Cisco HyperFlex Application Platform, bringing enterprise-class storage to cloudnative applications. The platform provides:

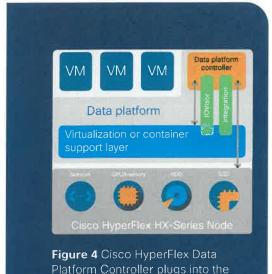
• Enterprise-class data management features required for complete lifecycle management and enhanced data protection in distributed storage environments. Features include deduplication, compression, thin provisioning, fast space-efficient clones, snapshots, native replication, and integration with backup solutions from leading vendors.

More scalable

You need a hyperconverged solution that is up to the scale of today's enterprise and big data applications that need large numbers of nodes to support your business.

- More nodes. We have doubled the maximum scale to 64 nodes, with a maximum of 32 Cisco HyperFlex nodes and 32 Cisco UCS compute-only nodes. Stretch clusters can have 8 data and 8 compute-only nodes in each of two locations
- More resiliency. We have implemented logical availability zones that help you to scale without compromising availability.
- More capacity. You can choose nodes with largeform-factor disk drives for even greater capacity. This allows your cluster to scale to higher capacity for storageintensive applications.

- Multiprotocol support includes providing direct iSCSI connectivity to the data platform. This provides enhanced support for Microsoft Windows Server failover clustering, Oracle software, Microsoft Exchange Server, and Kubernetes support (below). Support for iSCSI also extends access to external iSCSI devices to virtual machines supported on your HyperFlex cluster.
- Integration with cloud-native applications to supply persistent storage with enterprise-class features to enable stateful Kubernetes containers. Through an iSCSI-based Container Storage Interface (CSI) plugin, the platform delivers instant persistent volume creation with no need to move data when Kubernetes pods get rescheduled. This feature supports containers deployed with Intersight Kubernetes Service, native Kubernetes, Google Cloud's Anthos, and Red Hat OpenShift Container Platform.
- Continuous data optimization with always-on data deduplication and compression that does not affect performance, helping increase resource utilization with more headroom for data scaling.
- End-to-end product security includes developing the HyperFlex data platform software to be compliant with Cisco InfoSec standards which includes secure design, coding, and ongoing vulnerability analysis. The platform is secured from the firmware up with a secure root of trust. A reduced attack surface for the HyperFlex data platform helps to increase security of the entire platform.
- Securely encrypted storage optionally encrypts both the caching and persistent layers of the data platform. Integrated with enterprise key management software or with passphrase-protected keys, encryption of data at rest helps you comply with industry and government regulations. The platform itself is hardened to Federal Information Processing Standard (FIPS) 140-1, and the encrypted drives with key management comply with the FIPS 140-2 standard.
- Dynamic data placement optimizes performance and resilience by enabling all cluster resources to participate in I/O responsiveness. Hybrid nodes use a combination of SSD drives for caching and HDDs for the capacity layer; allflash nodes use SSD drives or NVMe storage for the caching layer and SSDs for the capacity layer. NVMe nodes use even higher-performance storage.
- Clusterwide parallel data distribution implements data replication for high availability and performance, accelerated by the low latency and high bandwidth of the Cisco UCS network fabric.
- Stretch clusters span geographic distance with continuous operation in the event of a data center failure with no data loss.
- Logical availability zones increase scalability and availability because they automatically protect data against multiple component and node failures.
- Native replication creates remote copies of individual virtual machines for disaster recovery purposes. With all nodes in both the local and remote clusters participating in the replication activity, the overhead imposed on each cluster node is minimal. Replication for Edge clusters protect virtual



hypervisor in each node

machines from logical corruption or accidental deletion; it protects virtual machines from an edge cluster or site outage; and it supports migrating virtual machines from one edge site to another.

- Linear and incremental scaling provides faster, easier scalability compared
 to enterprise shared-storage systems, in which controller resources become
 a bottleneck and necessitate a complete upgrade of the storage system.
 Instead, whenever you add an increment of storage in Cisco HyperFlex
 systems, you also increment the data platform processing capacity.
- API-based data platform architecture provides data virtualization flexibility
 to support existing and new cloud-native data types. An API for data
 protection allows enterprise backup solutions to create snapshot-based
 backups of virtual machines.
- A simplified approach eliminates the need to configure LUNs or to require
 a storage administrator to configure SANs. Storage and data services can be
 managed through hypervisor tools such as VMware vCenter.

Cisco HyperFlex HX Data Platform controller

A Cisco HyperFlex Data Platform controller resides on each node and implements a distributed scale-out file system (Figure 4). The controller runs in user space within a virtual machine and intercepts and handles all I/O from guest virtual machines. Dedicated CPU cores and memory allow the controller to deliver consistent performance without affecting performance of the other virtual machines in the cluster. When nodes are configured with self-encrypting drives, the controller negotiates with Cisco UCS Manager to receive the encryption keys that enable the drives to encrypt and decrypt data that flows to and from the various storage layers.

The data platform has modules to support the specific hypervisor or container platform in use. The controller accesses all of the node's disk storage through hypervisor bypass mechanisms for excellent performance. It uses the node's memory and dedicated SSD drives or NVMe storage as part of a distributed caching layer, and it uses the node's HDDs, SSD drives, or NVMe storage for distributed storage. The data platform controller interfaces with the hypervisor in two ways:

- **IOVisor:** The data platform controller intercepts all I/O requests and routes them to the nodes responsible for storing or retrieving the blocks. The IOVisor makes the existence of the hyperconvergence layer transparent to the hypervisor.
- Hypervisor agent: A module uses the hypervisor APIs to support advanced storage system operations such as snapshots and cloning. These are accessed through the hypervisor so that the hyperconvergence layer appears just as if it were enterprise shared storage. The controller accelerates operations by manipulating metadata rather than actual data copying, providing rapid response, and thus rapid deployment of new application environments.

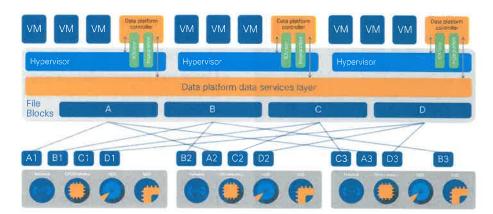


Figure 5 Data blocks are replicated across the cluster

Data distribution

The HX Data Platform controller handles all read and write requests for volumes that the hypervisor accesses and thus intermediates all I/O from the virtual machines and containers. Recognizing the importance of data distribution, the HX Data Platform is designed to exploit low network latencies and parallelism, in contrast to other approaches that build on node-local affinity and can easily cause data hotspots.

With data distribution, the data platform stripes data evenly across all nodes, with the number of data replicas determined by the policies you set (Figure 5). This approach helps prevent both network and storage hot spots and makes I/O performance the same regardless of virtual machine location. This feature gives you more flexibility in workload placement and contrasts with other architectures in which a data locality approach does not fully utilize all available networking and I/O resources.

- Data write operations: For write operations, data is written to the local SSD or NVMe cache, and the replicas are written to remote caches in parallel before the write operation is acknowledged. Writes are later synchronously flushed to the capacity layer HDDs (for hybrid nodes) or SSD drives (for all-flash nodes) or NVMe storage (for NVMe nodes).
- Data read operations: For read operations in all-flash nodes, local and remote data is read directly from storage in the distributed capacity layer.
 For read operations in hybrid configurations, data that is local usually is read directly from the cache. This process allows the platform to use all solid-state storage for read operations, reducing bottlenecks and delivering excellent performance.

In addition, when migrating a virtual machine to a new location, the data platform does not require data movement because any virtual machine can read its data from any location. Thus, moving virtual machines has no performance impact or cost.



Logical availability zones

As the maximum cluster size increases, the risk of a two-node failure shutting down the cluster increases. To mitigate this risk, logical availability zones partition the cluster into several logical zones. The HX Data Platform then ensures that there is no more than one copy of data in every zone. This feature can be enabled and automatically configured with the click of a mouse.

With logical availability zones, multiple node failures in a single zone don't cause the entire cluster to fail, because other zones contain data replicas.

Data read and write operations

The data platform implements a log-structured file system that uses a caching layer to accelerate read requests and write responses, and it implements a capacity layer for persistent storage. The capacity layer is comprised of HDDs (in hybrid nodes), SSD drives (in all-flash nodes), or NVMe storage (in all-NVMe nodes).

Incoming data is striped across the number of nodes that you define to meet your data availability requirements. The log-structured file system assembles blocks to be written to a configurable cache until the buffer is full or workload conditions dictate that it be destaged to the capacity layer. When existing data is (logically) overwritten, the log-structured approach simply appends a new block and updates the metadata. When data is destaged, the write operation consists of a single seek operation with a large amount of data written. This approach improves performance significantly compared to the traditional read-modify-write model, which is characterized by numerous seek operations and small amounts of data written at a time.

When data is destaged to the capacity layer in each node, the data is deduplicated and compressed. This process occurs after the write operation is acknowledged, so there is no performance penalty for these operations. A small deduplication block size helps increase the deduplication rate. Compression further reduces the data footprint. Data is then moved to the capacity tier as cache segments become free (Figure 6).

Read operations in hybrid nodes cache data on the SSD drives and in main memory for high performance. In all-flash and NVMe nodes they read directly from storage. Having the most frequently used data stored in the caching layer helps make Cisco HyperFlex systems perform well for virtualized applications. When virtual machines modify data, the original block is likely read from the cache, so there is often no need to read and then expand the data on a spinning disk. The data platform decouples the caching tier from the capacity tier and allows independent scaling of I/O performance and storage capacity.

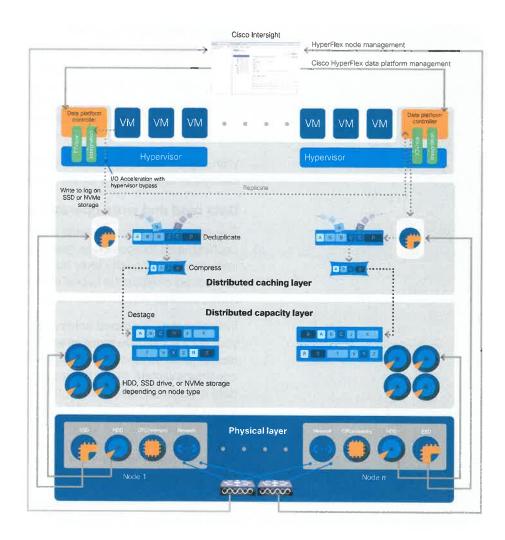


Figure 6 Data write flow through the Cisco HyperFlex HX Data Platform

Enterprise-class storage features

The data platform has all the features that you would expect of an enterprise shared-storage system, eliminating the need to configure and maintain complex Fibre Channel storage networks and devices. The platform simplifies operations and helps ensure data availability. Enterprise-class storage features include the following:

- Replication stripes and replicates data across the cluster so that data
 availability is not affected if single or multiple components fail (depending on
 the replication factor configured).
- Native replication transfers cluster data to local or remote clusters for backup or disaster-recovery purposes. Data transfer is based on a many-tomany relationship between the local and remote cluster nodes: each node participates in the data transfer, minimizing the performance impact.

Cisco HyperFlex **HX-Series** Nodes Cisco HyperFlex HX220c M5 All-NVMe, hybrid, Edge, and All Flash Nodes Cisco HyperFlex HX240c M5, hybrid, All Flash, LFF, and Edge Nodes Cisco HyperFlex HX240c M5 Short Depth Edge Node

- Synchronous replication, or stretch clusters, places copies of data in two locations at the same time, enabling cluster failover with a zero RPO and very short recovery time objective (RTO).
- Data deduplication is always on, helping reduce storage requirements in virtualization clusters in which multiple operating system instances in client virtual machines result in large amounts of replicated data.
- Data compression further reduces storage requirements, lowering costs.
 The log-structured file system is designed to store variable-sized blocks, reducing internal fragmentation.
- **Encryption** protects your data at rest with self-encrypting drives combined with enterprise key management software.
- Thin provisioning allows large data volumes to be created without requiring storage to support them until the need arises, simplifying data volume growth and making storage a "pay as you grow" proposition.
- Fast, space-efficient clones rapidly replicate storage volumes so that virtual machines can be replicated simply through metadata operations, with actual data copied only for write operations.
- Data protection API enables enterprise backup tools to access data volumes for consistent, per-virtual-machine backup operations.

Engineered on Cisco UCS technology

Cisco UCS, the foundation for Cisco HyperFlex systems, is built with a single point of management and connectivity for the entire system. The system is designed as a single virtual blade server chassis that can span multiple chassis and racks of blade and rack server–based nodes. Cisco thus is in the unique position of being able to deliver a hyperconverged solution that can incorporate blade and rack systems in its architecture, offering greater flexibility than any other solution. Because Cisco develops the servers upon which Cisco HyperFlex nodes are based, you can count on having the latest processor technology available to speed your performance.

You can optimize your system with the amount of computing and storage capacity that you need by changing the ratio of CPU-intensive Cisco UCS blade and rack servers to storage-intensive Cisco HyperFlex capacity nodes. You can further optimize environments requiring graphics acceleration such as virtual desktop infrastructure by configuring GPUs into your nodes, speeding graphics rendering and helping to deliver a superior user experience.

Cisco HyperFlex HX-Series Nodes

A cluster requires a minimum of three homogeneous nodes (with disk storage). Data is replicated across at least two of these nodes, and a third node is required for continuous operation in the event of a single-node failure. Each node is equipped with at least one high-performance SSD drive for data caching and rapid acknowledgment of write requests.

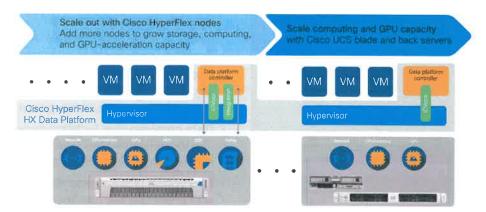


Figure 7 Scaling options for Cisco HyperFlex clusters

- **Hybrid nodes** use SSD drives for caching and HDDs for the capacity layer.
- All-flash nodes use SSD drives or NVMe storage for caching, and SSD drives for the capacity layer.
- All-NVMe nodes use NVMe storage for both caching and the capacity layer.

Hybrid, all-flash, and NVMe options are available in three types of nodes:

- Cisco HyperFlex HX220c M5 Hybrid, All Flash, and All NVMe Nodes balance up to 8 drives or NVMe devices in a 2-socket, 1-rack-unit (1RU) package ideal for small-footprint environments.
- Cisco HyperFlex HX240c M5 Hybrid and All Flash Nodes balance high disk capacity (up to 23 drives) in a 2-socket, 2RU package ideal for storageintensive applications.
- Cisco HyperFlex Edge Nodes are designed to work in simplified two- to four-node clusters using existing 1 and 10 Gigabit Ethernet networks. These nodes are available in 1RU hybrid and all-flash, 2RU hybrid and all flash, and 2RU short-depth form factors. Cisco HyperFlex Edge systems offer the same easy deployment and management as all Cisco HyperFlex systems.

Independent resource scaling with Cisco UCS servers

If you need more computing power or GPU acceleration, you can add Cisco UCS servers to your cluster to increase the ratio of computing power to storage. These servers become computing- and GPU-only nodes that participate in the data platform layer but with no local cache or storage. You need to have a minimum of three HX-Series nodes in your cluster, and you can add Cisco UCS servers up to the point where you have two Cisco UCS servers for each HX-Series node in the cluster. Supported servers include the Cisco UCS B200 M4 and M5 Blade Server and the Cisco UCS C220 and C240 M4 and M5 Rack Servers (Figure 7).

Hyperconvergence at the network edge

We took a comprehensive look at what is needed at the next frontier in the digital transformation, and we developed the capability to deploy virtually



Solving the splitbrain problem

Traditional two-node edge deployments require a witness node in order to prevent a splitbrain situation. This situation can arise if a network failure interrupts communication between the two nodes and each one keeps running. This can result in inconsistent data because two nodes think they own the distributed file system. To prevent this problem, a witness node joins one of the two nodes in the event of a failure. This creates a quorum, a majority vote of two out of three nodes, that allows the cluster to continue to operate without corrupting data.

This adds enormous cost and complexity by having to maintain a virtual or physical node and high-speed connectivity between every edge site and each witness node. Just keeping track of the relationship between edge nodes and witnesses can be daunting when hundreds of remote sites are managed.

We solve this problem with the Intersignt invisible cloud witness. It is automatically deployed in the cloud when you deploy a two-node edge cluster. It is simple and doesn't need your attention or require high-speed networking to the edge location. This simple solution enables you to deploy edge clusters with massive scale.

anywhere with massive scale. The combination of Cisco HyperFlex Edge solutions and Cisco Intersight management helps you extend the simplicity and efficiency of your hyperconverged infrastructure from your core data center to the edge with consistent policy-based enforcement and cloud-powered management. Now you can have an enterprise-class edge platform that powers the growing requirements in branch offices and remote sites while enabling new IoT and intelligent services at the network edge.

One factor giving our solutions a competitive edge is that we manage the entire hardware and software stack, so Cisco HyperFlex Edge nodes can be installed by a technician who needs only connect power and network cables. The entire hardware and software stack can then be installed and the cluster deployed remotely through Cisco Intersight. The Cisco Intersight platform gives you end-to-end lifecycle management of edge sites, and can deploy multiple sites identically, in parallel, with full control over the entire stack including firmware, hypervisor, and data platform. This gives you automatic, worldwide reach that facilitates massive scale.

Ongoing management and monitoring can identify failures and automatically capture log files for rapid root-cause analysis. Enhanced security at the edge includes automated deployment of Cisco SD-WAN solutions to securely tie your edge systems into your enterprise data center. Enhancements to native replication support edge locations with capabilities for both local and remote replication to support use cases described in "Native Replication" on page page 12.

Cisco HyperFlex Edge configurations can use Cisco or third-party 1 or 10 Gigabit Ethernet switches for connectivity (Figure 8). New in the 4.0 platform release is support for a wider range of edge cluster sizes: two, three, and four nodes. Two-node clusters also can use the nodes' built-in 10 Gigabit Ethernet LAN on motherboard (LOM) to interconnect the two nodes at high speed regardless of the local switch bandwidth.

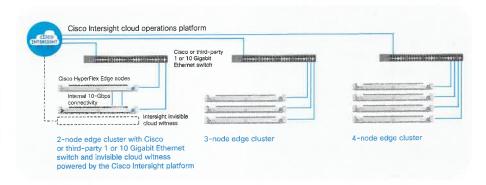


Figure 8 Cisco HyperFlex Edge provides scalable and cost-optimized solutions for anywhere deployment.



Cisco Intersight cloud operations platform

This SaaS interface is available through the cloud or an optional data-centerhosted management appliance. Intersight gives you instant access to all of your clusters-including installation capabilitiesregardless of where they are located. This means that you can ship nodes to the facility of your choosing and install them remotely. Highlevel resource inventory and status is provided by the Intersight dashboard, with drill-down into specific clusters and nodes. New proactive optimization recommendations are derived from telemetry data from each of your clusters.

Connect to external shared storage

Many organizations use external shared storage in existing environments. Your Cisco HyperFlex systems can connect to that shared storage directly through the fabric interconnects. You can connect through 8- or 16-Gbps Fibre Channel or up to 40-Gbps Small Computer System Interface over IP (iSCSI). With this capability you can:

- Boot and run virtual machines stored on the shared storage system
- Migrate virtual machines to your more scalable hyperconverged cluster
- Use shared storage for backing up your existing environment

Fibre Channel storage can be connected directly to each hypervisor with separate Fibre Channel interfaces that are configured through software on the Cisco UCS virtual interface cards (VICs) in each node. These interfaces allow the cluster to be configured to follow the hypervisor vendor's recommended best practices for traffic separation by creating separate network interfaces for each type of traffic, configured through software.

Powered by Intel Xeon Scalable processors

Each Cisco HyperFlex M5 node is powered by two Intel Xeon Scalable processors. These processors deliver significantly improved performance and can serve a much wider arrange of application needs than prior servers. The family delivers highly robust capabilities with outstanding performance, security, and agility. The CPUs provide top-of-the-line memory channel performance and include three Intel UltraPath Interconnect (UPI) links across the sockets for improved scalability and intercore data flow. Each HX-Series node includes a range of processor choices so that you can best serve your application requirements.

Manage your HyperFlex clusters

Bringing you complete infrastructure automation, Cisco UCS management detects any component plugged into the system, making it self-aware and self-integrating. With the system itself able to adapt to changes in hardware configuration, you need only a few mouse clicks to incorporate new servers into a cluster. Every aspect of a node's identity, configuration, and connectivity is set through software, increasing efficiency and security and reducing deployment time.

Cisco HyperFlex systems integrate easily into existing environments and operational processes and are ready to support DevOps processes and support for your local Kubernetes environment. The management API enables integration into higher-level management tools from Cisco and more than a dozen independent software vendors (ISVs). Tools include Microsoft System Center Virtual Machine Manager, Hyper-V Manager, and the VMware vSphere plug-in.

For more information

- Cisco HyperFlex systems
- Cisco HyperFlex Services

Conclusion

With Cisco HyperFlex systems, we deliver a complete, next-generation hyperconverged solution that you can use for a wide range of applications and in any location, including your enterprise data center, remote locations, private cloud, and hybrid cloud environments.

We unlock the full potential of hyperconvergence so that you can use a common platform to support more of your applications and use cases, including virtualized and containerized applications, virtual desktops, big data environments, enterprise applications, databases, and Internet infrastructure applications, along with test and development environments. Cisco HyperFlex systems deliver the operational requirements for agility, scalability, and payas-you-grow economics of the cloud—but with the benefits of on-premises infrastructure.

Part of our broad data center strategy

As part of our overall data center vision, Cisco Intersight with Intersight Kubernetes Service helps you deploy, optimize, and manage a hybrid cloud environment with Cisco HyperFlex systems as your on-premises foundation (Figure 9). When you choose Cisco HyperFlex systems, you take your organization beyond a point-product solution, putting your business on a path to a more agile, adaptable, and efficient future.

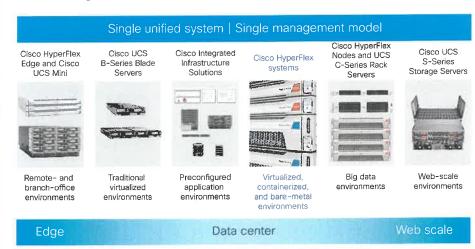


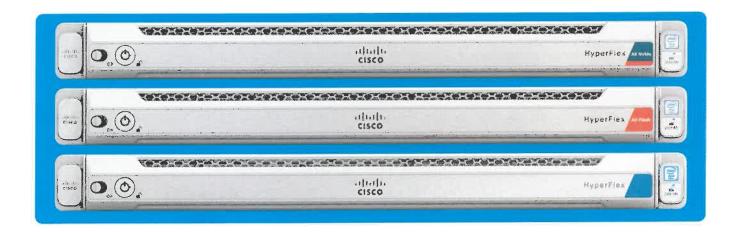
Figure 9 A single management model supports the entire Cisco product portfolio.

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Cisco HyperFlex HX220c M5, HX220c M5 All Flash, and HX220c M5 All NVMe Nodes



Hyperconvergence engineered on the fifth-generation Cisco UCS platform

Mobility, big data, and the Internet of Everything (IoE) are changing application architectures and IT delivery models. Keeping pace requires a systems-centric strategy in your data center. Cisco HyperFlex™ systems deliver adaptability with complete hyperconvergence. These innovative systems combine software-defined networking and computing with the next-generation Cisco HyperFlex HX Data Platform. Engineered on the Cisco Unified Computing System™ (Cisco UCS®), Cisco HyperFlex systems deliver pay-as-you-grow economics and extend model-based management to the cloud.

Simplicity you can build on

With hybrid, all-flash-memory, or all-Non-Volatile Memory Express (NVMe) storage configurations and a choice of management tools, Cisco HyperFlex systems are deployed as a preintegrated cluster with a unified pool of resources that you can quickly provision, adapt, scale, and manage to efficiently power your applications and your business (Figure 1).

Cisco HyperFlex systems now include Cisco UCS M5 rack servers. Based on Intel® Xeon® Scalable processors, these fifth-generation servers have faster processors, more cores, and faster and larger-capacity memory than previous-generation servers. In addition, they can also utilize Intel 3D XPoint nonvolatile memory, which can be used as both storage and system memory, increasing your virtual server configuration options and flexibility for applications.

Cisco HyperFlex HX220c M5, HX220c M5 All Flash, and HX220c M5 All NVMe Nodes

Physically, the system is delivered as a cluster of three or more Cisco HyperFlex HX220c M5, HX220c M5 All Flash, or HX220c M5 All NVMe Nodes that are integrated into a single system by a pair of Cisco UCS 6200 or 6300 Series Fabric Interconnects. The HX220c M5 Node is excellent for general-purpose small-footprint clusters. The HX220c M5 All Flash Node offers excellent performance for mission-critical workloads. The HX220c M5 All NVMe node ushers in a new era in





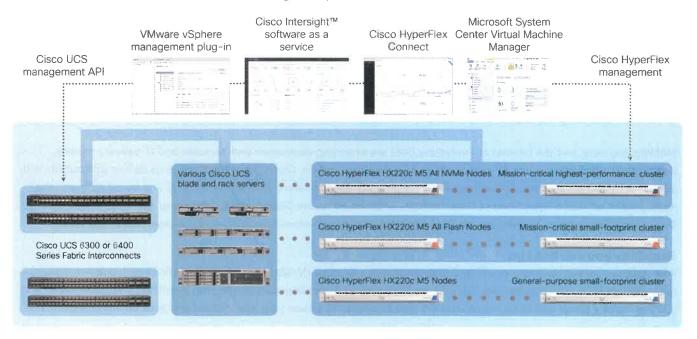
hyperconverged infrastructure performance for the most latency-sensitive workloads. Each node is configured with the following (for details, see Table 1):

- Hard-disk drives (HDDs), solid-state disk (SSD), or NVMe drives for capacity-layer storage (self-encrypting drive options are available for hard-disk drives and solid-state disks)
- Write-logging SAS SSD or NVMe drive (self-encrypting drive options are available for SSDs)
- Data platform logging drive
- M.2 SATA drives as boot drives for VMware vSphere
- One Cisco UCS virtual interface card (VIC)
- VMware vSphere ESXi 6.0 software preinstalled (ESXi 6.5 is supported but is not preinstalled)
- · Cisco UCS service profile templates for automated cluster configuration

All nodes use Intel Xeon Scalable CPUs and next-generation DDR4 memory and offer 12-Gbps SAS throughput. They deliver significant performance and efficiency gains and outstanding levels of adaptability in a 1-rack-unit (1RU) form factor.

Figure 1. Cisco HyperFlex cluster node and management options

Choice of management point for hardware and software



Powering next-generation applications

The HX220c M5 Node, HX220c M5 All Flash Node, and HX220c M5 All NVMe Node with Intel Xeon Scalable CPUs are excellent for a wide range of enterprise workloads, including cloud computing, virtual desktop infrastructure (VDI), databases including SQL, Oracle, and SAP, and server virtualization.

For remote-office and branch-office (ROBO) locations, you can use Cisco HyperFlex Edge, which is based on the HX220c M5 Node, in the following configurations:

- Three nodes connected directly to 1-Gbps switches
- Option for one CPU per node
- · Three or more disk drives in each node



Product features and benefits

Table 1 summarizes the features and benefits of the HX220c M5 Node, HX220c M5 All Flash Node, and HX220c M5 All NVMe Node.

Table 1. Features and benefits

Feature	Benefit
Memory	Up to 3 TB of memory Capability to use 16-, 32-, 64-, or 128-GB DIMMs
1 or 2 Intel Xeon Scalable processors	Built on 14-nanometer (nm) processor technology, Intel Xeon Scalable processors are designed to deliver highly robust capabilities with outstanding performance, security, and agility. * Up to 28 cores in 2-socket configurations
	Top-of-the-line memory-channel performance Three Intel Ultra Path Interconnect (UPI) links across sockets for improved scalability and interconnect data flow Ultra Path Interconnect (UPI) links across sockets for improved scalability and interconnect data flow
	 Hardware-assisted security advancements Low-power, high-speed DDR4 memory technology
	 Increased performance with Intel Automated Vector Extensions 2 (AVX2) Increased virtual machine density
	 Automated energy efficiency that reduces energy costs by automatically putting the processor and memory in the lowest available power state while still delivering the performance required
	 Flexible virtualization technology that optimizes performance for virtualized environments, including processor support for migration and direct I/O
	• Innovation with the latest processors, which increase processor frequency and improve security
	With the increased performance provided by the Intel Xeon Scalable processors, Cisco HyperFlex HX-Series nodes offer ar improved price-to-performance ratio, making HX-Series systems among the best values in the industry.
	Note: The 1-CPU configuration is not supported when choosing either NVMe Caching drives or All NVMe systems
Support for up to 2 PCI Express (PCIe) 3.0 slots	Flexibility, increased performance, and compatibility with industry standards High I/O bandwidth, increased flexibility, and backward compatibility with support for PCIe 2.0
Modular LAN on motherboard (mLOM)	Cisco UCS VICs provide up to 256 I/O devices programmable on demand for hypervisor and virtual machine support. Cisco UCS VIC 1387 provides 2 x 40-Gbps network connectivity to Cisco UCS 6300 Series Fabric Interconnects.
Unified network fabric	Low-latency, lossless, 2 x 40 Gigabit Ethernet
	Wire-once deployment model, eliminating the need to install adapters and recable racks and switches when changing I/O configurations
	Fewer interface cards, cables, and upstream network ports to purchase, power, configure, and maintain
Virtualization optimization	I/O virtualization and Intel Xeon Scalable processor features, extending the network directly to virtual machines Consistent and scalable operational model Increased security and efficiency with reduced complexity
	Capability to move virtual machine security features and policies from rack to rack or rack to blade
Choice of management tools	Managed as a single entity through a vSphere web client plug-in or through the Cisco HyperFlex Connect HTML5 interface Built-in role- and policy-based management through service profiles and templates, enabling more effective use of skilled server, network, and storage administrators
	Automated provisioning and increased business agility, allowing data center managers to provision applications in minutes rather than days by associating a service profile with a new, added, or repurposed HX220c M5 Node or HX220c All Flash Node



Feature	Benefit
Storage	All-flash-memory or hybrid (HDD and SSD memory) storage configurations
	High-capacity configurations for the HX Data Platform capacity layer
	 HX220c M5 Node; 8 x 1.2- or 1.8-TB SAS HDDs
	 HX220c M5 Node with self-encrypting drives: 8 x 1.2-TB self-encrypting SAS HDDs
	HX220c M5 All Flash Node: 8 x 3.8-TB or 960-GB SSD drives
	 HX220c M5 All Flash Node with self-encrypting drives: 8 x 800-GB, 8 x 960-GB, or 8 x 3.8-TB self-encrypting SSD drives HX220c M5 All NVMe Node: 8 x 1-TB or 4-TB NVMe SSD drives
	1 x 240-GB SSD log drive
	Caching or write log drive:
	HX220c M5 Node: SSD caching drive (self-encrypting drive option is available)
	HX220c M5 All Flash Node: SAS SSD (self-encrypting drive option is available) or NVMe write-logging drive
	HX220c M5 All NVMe Node: 1 NVMe SSD caching and 1 NVMe SSD write-logging drive
	Cisco 12-Gbps Modular SAS host bus adapter (HBA) with internal SAS connectivity M.2 SATA SSD drive for boot
Enterprise data	Pointer-based snapshot capabilities
protection	Near-instant cloning
	Inline deduplication and compression
	Native replication for disaster recovery
	Data-at-rest encryption using self-encrypting drives and enterprise key management integration
Cisco® Integrated Management Controller (iMC)	Connection to Cisco UCS management or the Cisco HyperFlex dashboard for automated configuration through a unified interface
Advanced reliability,	Highly available and self-healing architecture
availability, and serviceability (RAS)	Robust reporting and analytics
features	Hot-swappable, front-accessible drives
	Dual-redundant fans and hot-swappable, redundant power supplies for enterprise-class reliability and uptime
	Convenient latching lid for easy access to internal server
	Tool-free CPU insertion, enabling processor upgrades and replacements with less risk of damage
	Tool-free access to all serviceable items, and color-coded indicators to guide users to hot-pluggable and serviceable items
	Nondisruptive rolling upgrades
	Cisco Call Home and onsite 24-hours-a-day, 7-days-a-week (24 x 7) support options
Security features	Trusted Platform Module (TPM), a chip (microcontroller) that can securely store artifacts, including passwords, certificates, and encryption keys, that are used to authenticate the platform (node); TPM 1.2 SPI is supported
	Locking bezel option to protect against unauthorized access to disk drives
Software	Cisco HyperFlex HX Data Platform Software (software subscription)



Product specifications

Table 2 lists specifications for the HX220c M5 Node, HX220c M5 All Flash Node, and HX220c M5 All NVMe Node.

Table 2. Product specifications

Item	Specification
Chassis	1RU of rack space for the node
Processors	1 or 2 Intel Xeon Scalable CPUs (For a complete list of processor options, refer to the node's technical specifications documents.)
nterconnect	3 Intel UPI channels per processor, each capable of 10.4 gigatransfers per second (GTPS)
Chip set	Intel C620 series
Memory	24 DDR4 DIMM slots Support for DDR4 registered DIMMs (RDIMMs) Advanced error-correcting code (ECC) Independent channel mode Lockstep channel mode
Embedded network nterface card (NIC)	Dual 10-Gbps Intel x550 Ethernet ports Support for the wake-on-LAN (WoL) standard
mLOM	Cisco UCS VIC 1387
Power supplies	Up to 2 hot-pluggable, redundant 770-watt (W) or 1050W power supplies
IMC	Integrated baseboard management controller (BMC) IPMI 2.0 compliant for management and control One 10/100/1000 Ethernet out-of-band management interface Command-line interface (CLI) and web GUI management tool for automated, lights-out management Keyboard, video, and mouse (KVM) console
Front-panel connector	One KVM console connector (supplies 2 USB connectors, 1 VGA connector, and 1 serial connector)
Front-panel locator LED	Indicator to help direct administrators to specific servers in large data center environments
Additional rear connectors	Additional interfaces including a Video Graphics Array (VGA) video port, 2 USB 3.0 ports, an RJ45 serial port, a 1 Gigabit Ethernet management port, and dual 10 Gigabit Ethernet ports
Rail-kit options	Cisco ball-bearing rail kit with optional reversible cable-management arm Cisco friction rail kit with optional reversible cable-management arm
Software support	ESX 6.5 ESX 6.0 Cisco UCS Manager 3.1



Ordering information

For a complete list of part numbers, refer to the HX220c M5 Node specification sheet.

Cisco Unified Computing Services

Cisco and our industry-leading partners deliver services that accelerate your transition to Cisco HyperFlex systems. Cisco Unified Computing Services can help you create an agile infrastructure, accelerate time-to-value, reduce costs and risks, and maintain availability during deployment and migration. After you have deployed your system, our services can help you improve performance, availability, and resiliency as your business needs evolve and help you further mitigate risk.

Cisco Capital financing to help you achieve your objectives

Cisco Capital® financing can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce capital expenditures (CapEx), accelerate your growth, and optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital financing is available in more than 100 countries. Learn more.

For more information

For more information about Cisco HyperFlex systems, refer to http://www.cisco.com/go/hyperflex.



Cisco HyperFlex™ systems with Intel® Xeon® Scalable processors

Americas Headquarters Cisco Systems, Inc. San Jose, CA Asia Pacific Headquarters Cisco Systems (USA) Pte. Ltd. Singapore

Europe Headquarters Cisco Systems International BV Amsterdam, The Netherlands

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Data sheet Cisco public



Cisco Intersight

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Product overview

Cisco Intersight[™] is a software-as-a-service (SaaS) infrastructure lifecycle management platform that delivers simplified configuration, deployment, maintenance, and support. It supports Cisco Unified Computing System[™] (Cisco UCS[®]) and Cisco HyperFlex[™] hyperconverged infrastructure, other Cisco[®] Intersight-connected devices, and third-party Intersight-connected devices. The level of functionality may vary.

With Intersight, you get all of the benefits of SaaS delivery and full lifecycle management of distributed Intersight-connected servers and third-party storage across data centers, remote sites, branch offices, and edge environments. This empowers you to analyze, update, fix, and automate your environment in ways that were not possible with prior generations' tools. As a result, your organization can achieve significant TCO savings and deliver applications faster in support of new business initiatives.

The Intersight platform works in conjunction with Cisco UCS Manager, Cisco Integrated Management Controller (IMC), and Cisco HyperFlex Connect. You can simply associate a model-based configuration to provision servers and associated storage and fabric automatically, regardless of form factor. Using profiles, IT staff can consistently align policy, server personality, and workloads. These policies can be created once and used to simplify server deployments, resulting in improved productivity and compliance, and lower risk of failures due to inconsistent configuration. In addition, Cisco provides integrations to third-party operations tools, starting with ServiceNow, to allow customers to use their existing solutions more efficiently.

"We don't have to babysit the data center anymore.

HyperFlex and Intersight have been up and running for two years. We have had zero downtime on the hardware, and have seen a 10x improvement in operational efficiency."

- (David De Roock, ICT Infrastructure Manager, EXMAR)

Cisco Intersight technical features and benefits

Table 1. Main features and benefits

Feature	Benefits
Unified monitoring and management	 Simplify Cisco UCS, Cisco HyperFlex, Pure Storage, and Cisco Network Insights management from a single management platform.
	Increase scale across data centers and remote locations without additional complexity.
	 Use a single dashboard to monitor Cisco UCS and Cisco HyperFlex systems.
	 Cisco UCS Manager, Cisco IMC software, Cisco HyperFlex Connect, and Cisco UCS Director tunneling allow access to element managers that do not have local network access.
Configuration, provisioning, and installation	 Cisco UCS servers and storage are treated as infrastructure resources that can be allocated and reallocated among application workloads for more dynamic and efficient use of server capacity.
	 Policy-based profiles for deployment, configuration, and the creation of multiple server profiles enable you to consistently deploy and configure servers, eliminating configuration errors.
	 Clone profiles to quickly provision Cisco UCS C-Series Rack Servers in standalone mode.
	 Create, deploy, and manage Cisco HyperFlex configurations.
	 Install vMedia-based operating systems on the managed UCS C-Series servers.
	• Ensure consistency and eliminate configuration drift, and maintain standardization across multiple systems.

Feature	Benefits
Orchestration and Workflow Designer	 The Intersight Orchestrator is a framework to create and execute complex workflows in Intersight.
	 Orchestrator includes a library of tasks that you can use to compile a workflow. Each task acts as an independent executable entity, and it can perform an operation in Intersight or on any connected device.
	• Workflow Designer includes a drag-and-drop UI to help you create new workflows to manage devices.
Inventory information,	Display and report inventory information for Cisco UCS and Cisco HyperFlex systems.
status, and capacity	• Use global search to rapidly identify systems based on names, identifiers, tags, and other information.
planning	 Monitor Cisco UCS and Cisco HyperFlex server alerts and health status across data centers and remote locations.
	View Cisco HyperFlex configurations.
	 Proactively scale storage utilization on HyperFlex clusters with HyperFlex capacity planning. Along with additional notifications, a critical alarm is raised when storage utilization is predicted to exceed the recommended capacity thresholds.
	 Track and manage firmware versions across Intersight-connected systems.
	 Track and manage software versions and automated patch updates for all claimed Cisco UCS Director software installations.
Enhanced support and end-customer	 Raise service requests and Return Materials Authorizations (RMA) automatically and proactively authorize the RMA.
experience	Get centralized alerts about failure notifications.
	 Automate the generation, forwarding, and analysis of technical support files to the Cisco Technical Assistance Center (TAC) to accelerate the troubleshooting process.
REST API	 Provides a RESTful API to manage Cisco Unified Computing System and Cisco HyperFlex systems across multiple data centers
	 Supports the OpenAPI Specification (OAS) to provide full programmability and deep integrations systems to efficiently automate IT infrastructure from the data center to edge locations
	 The Python and PowerShell SDKs will enable integrations with Ansible, Chef, Puppet, and other DevOps and IT Operations Management (ITOM) tools.
	 ServiceNow integration provides inventory and alerts to the IT Service Management platform to show Intersight inventory and configuration details, elevating the ITSM experience.
Proactive notifications and advisories	 Cisco Security Advisories alert users about any endpoint devices impacted by Cisco advisories, providing the latest information on severity, impacted products, and available workarounds.
Hardware Compatibility List (HCL)	 Evaluate and mitigate the impact of service issues from running non-validated combinations of firmware, server model, processor, adapters, operating system, and driver versions.
	 Use Cisco UCS tools, a host utility vSphere Installation Bundle (VIB), or OS Discovery Tool (an open-source script) to collect OS and driver information to evaluate HCL compliance.
Seamless integration and upgrades	 Upgrade UCS domains, UCS standalone servers, HyperFlex clusters, UCS Director, Cisco Application Policy Infrastructure Controller (APIC) and Analysis Service Elements (ASE). Installation is supported for HyperFlex Edge and HyperFlex with Fabric Interconnect (FI) clusters.
	 Upgrades to Cisco Intersight are delivered automatically without requiring the resources of traditional management tool upgrades and operational disruptions.
Mobile app (not available for Virtual Appliance or Private Virtual Appliance)	 Access Intersight on Android and iOS devices providing a mobility-optimized connection to the resources managed in your account.
	 Stay up to date with the status of your environment and connect with members of your IT organization to address critical issues on the go.
	Open TAC cases.
	Multi-language support.
Tunneled vKVM	 Capability to launch tunneled virtual Keyboard, Video, and Mouse (KVM) sessions for Cisco UCS C- Series standalone servers.

Flexible deployment options

Cisco Intersight is a SaaS management platform with the flexibility of advanced deployment options. You can take advantage of new features as they become available from Cisco without the challenges and complexity of maintaining your management tools. The majority of our users enjoy the benefits of SaaS; however, if you have data locality or security needs for managing systems that may not fully meet a SaaS management model, you can leverage the Cisco intersight Virtual Appliance software on-premises to connect your servers through Intersight.com.

Alternately, the Cisco Intersight Private Virtual Appliance provides an easy way to deploy a VMware Open Virtual Appliance (OVA), which can be configured, deployed, and run off-premises. The Private Virtual Appliance allows you to still take advantage of much of the SaaS functionality without connectivity back to Intersight.com. Both the Intersight Virtual Appliance and Private Virtual Appliance provide advantages over conventional on-premises management tools.

Simplify application resource management with Cisco Intersight Workload Optimizer

Cisco Intersight Workload Optimizer (IWO) is an optional service that can be purchased with or without Cisco Intersight. It bridges the gap between applications and infrastructure to assure performance of critical workloads while maximizing efficiency and reducing cost across on-premises and in hybrid cloud environments.

For IT teams challenged with balancing performance, efficiency, and cost in today's complex, hybrid cloud environments, Cisco Intersight Workload Optimizer is a real-time decision engine that visualizes complex interdependencies across the stack. It simplifies and automates application resource management at scale by leveraging telemetry data from over 50 targets across a range of hypervisors, compute platforms, container platforms, public clouds and more with a single tool. It relieves IT teams from the day-to-day management of infrastructure and resource availability, giving them time to drive innovation for the business.

Monitoring and capacity planning

To support the complex environments created by modern applications and the dramatically increasing number of endpoints, enterprises require analytics integrated tightly with their operations management tools. To enable these analytics capabilities, every Cisco UCS server, Cisco HyperFlex system, or Cisco UCS Director instance is configured to automatically connect and transmit to Cisco Intersight certain telemetry information over a secure channel (including server serial numbers and iP addresses, the types of software installed on an endpoint, and feature use data). This telemetry information will be used to power the Cisco Intersight recommendation engine. The Cisco Intersight recommendation engine will use the telemetry information to proactively review customer metadata to identify potential issues in customers' environments to prevent problems and improve system uptime in the future.

The HyperFlex performance chart provides details of the cluster performance for HyperFlex clusters and a snapshot of the configurable amount of time, showing Input/output Operations Per Second (IOPS), throughput, and latency data. Using the historical data of used storage capacity along with the predicted storage utilization per HyperFlex cluster, you can proactively scale the storage utilization on the HyperFlex clusters. When the storage utilization is predicted to exceed the recommended capacity limit, an alarm is raised.

Enhanced automation and orchestration

Model-based deployment

Cisco Intersight provides model-based deployment for Cisco UCS and HyperFlex platforms, building on the deployment methodologies of Cisco UCS. A Cisco UCS C-Series rack server can be set up quickly and easily by replicating an existing server profile for rapid configuration. The model-based deployment works for a single system in a remote location or hundreds of systems in a data center to enable rapid, standardized configuration and deployment. HyperFlex platforms can be sent to their destination, have basic Internet connectivity established locally, and then be configured and set up remotely through the cloud-based HyperFlex installer.

Cisco Intersight Orchestrator

Intersight Orchestrator is a framework to create and execute complex workflows in Intersight. A central workflow engine sequences the steps in workflows and automates the execution of workflows. A workflow is a collection of tasks that are orchestrated to perform certain operations. An Intersight Orchestrator (IO) task is a building block of the workflow and it can perform a simple operation or a sequence of operations, including create, update, and delete operations on any infrastructure element. Workflows can consist of a couple of tasks, or they can include dozens of tasks and sub-workflows. For example, provisioning a Pure Storage FlashArray or deploying a new Virtual Machine (VM) from a template involves multiple tasks. For more information on Intersight Orchestrator visit our help site.

Cisco Intersight Assist

The unique Intersight Assist feature enables you to claim storage devices and other endpoints, so they can become Intersight-managed. Cisco Intersight Assist is typically a VM running on-premises. You can install Intersight Assist using the bootstrap OVA that is available on Cisco.com. Currently, you can add Pure Storage devices and VMware vCenter to Intersight after claiming them using Cisco Intersight Assist. Cisco will add support for additional third-party storage and other devices in the future.

There are different layers of control, such as Baseboard Management Control (BMC), which provides a deep-level view and the advanced support capabilities. A managed device can only be added to one Intersight Assist component within an Intersight account. For more information on virtualization objects in Cisco Intersight visit our help site. To learn how to install Cisco Intersight Assist watch this video.

Cisco HyperFlex and SD-WAN cluster deployment

Cisco Intersight provides an installation wizard to install, configure, and deploy Cisco HyperFlex Edge and HyperFlex with fabric interconnect clusters. The wizard constructs a pre-configuration definition of your cluster, called a HyperFlex Cluster Profile. This definition is a logical representation of the HyperFlex nodes in your HyperFlex cluster. HyperFlex Cluster Profiles are built on policies which define the sets of rules and operating characteristics such as the node identity, interfaces, and network connectivity. After gathering the node configuration settings to build a HyperFlex Cluster Profile, the installation wizard validates and deploys the HyperFlex Cluster Profile. More information is available on our help site.

REST API

Cisco Intersight includes an API based on the OpenAPI specification, a powerful definition format to describe RESTful APIs. Support for the OpenAPI specification provides users with access to an interoperable REST API with tools that automate the generation of the Intersight API documentation, API schemas, and SDKs. The Intersight API includes fully functional Python and PowerShell SDKs.

The API is an integral part of the broader open connector framework Cisco has established to enable the Intersight ecosystem to evolve. We currently support a ServiceNow plugin to view Intersight inventory and configuration detail in the ServiceNow interface. The ecosystem will be expanded to eventually support a wide range of Cisco and third-party DevOps software.

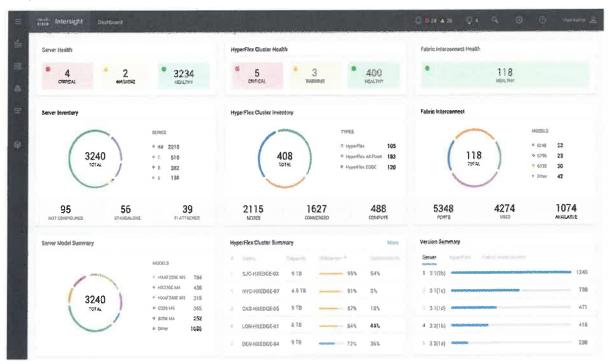


Figure 1. Cisco Intersight dashboard

Customizable dashboard and mobile app

Cisco Intersight provides a dashboard (Figure 1) that spans Cisco UCS and Cisco HyperFlex systems, and third-party Intersight-connected systems. The dashboard is user-customizable, allowing you to focus on the information and tasks that are relevant to your needs. You can create, customize, rename, and manage multiple dashboard views by adding, removing, or rearranging widgets on the dashboard. Intersight supports the display of up to 30 widgets per dashboard. This global dashboard includes features such as:

- Global inventory. Get information about inventory across supported systems, whether they are in the data center or at remote locations.
- Fault monitoring. Manage faults and set up alerting for all managed systems.
- Firmware status. Monitor and manage firmware versions.

Cisco Intersight allows you to monitor systems from a single management tool. However, if you need to look more deeply into a specific platform, Cisco Intersight provides:

- Cross-launch capabilities for virtual Keyboard, Video, Mouse (KVM) sessions.
- Tunneling capabilities for Cisco UCS Manager, Cisco UCS Director, Cisco IMC software, and Cisco HyperFlex Connect to allow secure access to the manager, whether you are inside or outside the corporate network.

The Cisco Intersight mobile app provides visibility on the go with its intuitive view of Intersight-connected systems. You can conveniently keep an eye on your data center—anywhere, anytime. The mobile app is an Apple and Android application to monitor inventory, tasks, and alerts. You can also take actions, such as turning on LED locators and opening Cisco support cases.

Proactive support

The telemetry data and incidents collected from the Cisco Intersight-installed base are transmitted using secure communication mechanisms, and this information is available for use by the Cisco Technical Assistance Center (TAC) to provide insights and more proactive support. When combined with Cisco Smart Call Home, TAC cases can be automatically opened for certain faults. No matter how a TAC case is opened, if the system is connected to Cisco Intersight, the log files are automatically read from the system, attached to the TAC case, and automatically analyzed for known issues. For certain types of hardware failures, Return-Materials-Authorization (RMA) cases are automatically opened. The Cisco Intersight and TAC integration speeds case resolution, limits the impact on IT personnel, and ultimately increases system uptime.

Cisco Intersight also enables users to provide more direct feedback to our products. In addition, the tight integration with the TAC extends the solution scope by enhancing continuous delivery to further speed up fixes and future development.

Platform compliance

Cisco Intersight evaluates your hardware and firmware compatibility to help ensure that your system is compliant with the Cisco Hardware Compatibility List. This process identifies unsupported configurations and alerts you to any potential problems that may arise from unknowingly running unsupported configurations.

Supported software

Cisco Intersight supports Cisco UCS and Cisco HyperFlex platforms with the software versions listed in Table 2.

Table 2. Supported software

Platform	Versions supported
Cisco UCS Manager	Release 3.2(1) and later
Cisco IMC Software	Release 3.0(4) and later
Cisco HyperFlex	Release 2.5.1 and later
Cisco UCS Director	Release 6.6 and later
Pure Storage FlashArray	Purity version 4.8 (API version 1.7) and later
VMware vCenter	6.0, 6.5, 6.7 and later

See the <u>product documentation</u> for a more detailed list of supported versions and caveats,

Virtual appliance system requirements

The Cisco Intersight Virtual Appliance and Private Virtual Appliance OVAs can be deployed on VMware ESXi 6.0 and higher. Table 3 describes the minimum system requirements. For additional information see the <u>Getting</u> <u>Started Guide</u>.

Table 3. Minimum system requirements

Item	Requirement
Supported hypervisors	VMware ESXi 6.0 and higher
Storage	500 GB
RAM	32 GB
vCPUs	16

See product documentation for more details and sizing guidelines.

Licensing

Cisco Intersight is licensed on a subscription basis with multiple license editions to choose from. Capabilities increase with the different license types. Customers can purchase a subscription duration of one, three, or five years and choose the Cisco UCS server volume tier they need for the selected subscription duration.

Each Cisco UCS server, Cisco HyperFlex system, or Cisco UCS Director software automatically includes a subscription to the Cisco Intersight Base tier at no additional cost when the customer accesses the Cisco Intersight portal and claims their devices. In addition, customers can purchase Cisco Intersight Essentials, Cisco Intersight Advantage, or Cisco Intersight Premier tiers using the Cisco ordering tool (Table 4).

Table 4. Cisco Intersight tier

License tier	Description
Base	The Cisco Intersight Base offering is available at no cost to customers with platforms enabled to support Intersight.
	Cisco Intersight-enabled platforms are those Cisco UCS and Cisco HyperFlex systems with a Cisco Intersight device connector, including eligible Cisco UCS Manager, Cisco IMC, Cisco UCS Director, and Cisco HyperFlex software.
	Cisco Intersight Base provides access to a portal that delivers centralized systems health monitoring, TAC support, a basic inventory of managed systems, a customizable dashboard, tagging and search, and the ability to launch native endpoint management interfaces, including Cisco UCS Manager and others.
	Note: The Base offering is available only for the SaaS version on Intersight.com; it is not available for the Cisco Intersight Virtual Appliance or the Cisco Intersight Private Virtual Appliance.

License tier	Description
Essentials	The Cisco Intersight Essentials offering includes all of the Base functionality.
	Intersight Essentials includes centralized setup and configuration capabilities through a policy engine, firmware management, compliance tool integration, access to the mobile app, and other features.
	It also includes a ServiceNow plugin to view Intersight inventory and configuration details in the ServiceNow interface, elevating the IT Service Management (ITSM) experience.
	This license tier also includes configuration management through a unified policy engine. Customers can determine compliance with the Cisco UCS Hardware Compatibility List (HCL) and initiate firmware updates.
	Cisco Intersight Essentials also includes subscription entitlement for Cisco IMC Supervisor and Cisco UCS Central software products at no additional cost. Refer to Cisco IMC Supervisor data sheet and Cisco UCS Central data sheet for more details.
	Note: This is available for both the SaaS version on Intersight.com, the Cisco Intersight Virtual Appliance, and the Cisco Intersight Private Virtual Appliance. See ordering information in the next section.
Advantage	The Cisco Intersight Advantage tier provides all of the functionality of the Base and Essentials tiers.
	It includes storage widgets, storage inventory, storage capacity, and storage utilization, starting with support for Pure Storage and cross-domain inventory correlation across physical compute, physical storage, and virtual environments (VMWare ESXi). It also includes OS installation for supported Cisco UCS platforms and the automated solution deployment of Cisco HyperFlex with SD-WAN.
	It further includes the Cisco Security Advisory service where customers can receive important security alerts and field notices about impacted endpoint devices.
	Note: This is available for both the SaaS version on Intersight.com, the Cisco Intersight Virtual Appliance, and the Cisco Intersight Private Virtual Appliance. See ordering information in the next section.
Premier	In addition to the capabilities provided in the Advantage tier, Cisco Intersight Premier offers Private Cloud Infrastructure-as-a-Service (laaS) orchestration across Cisco UCS, Cisco HyperFlex, and third-party systems, including virtual machines (VMWare vCenter) and physical storage (Pure Storage).
	Additionally, Cisco Intersight Premier bundles full subscription entitlement for Cisco UCS Director at no additional cost. Refer to Cisco UCS Director data sheet for more details.
	Note: This is available for both the SaaS version on Intersight.com, the Cisco Intersight virtual appliance, and the Cisco Intersight Private Virtual Appliance. See ordering information in the next section.

Ordering information

The Cisco Intersight Base tier is automatically included with every Cisco UCS server purchase at no extra cost, including Cisco UCS servers purchased in the past. The Base tier does not have any orderable part number. Cisco UCS and Cisco HyperFlex customers can simply go to https://www.intersight.com. Users log in using their Cisco Connection Online (Cisco.com) user ID and claim their Cisco UCS servers and Cisco HyperFlex devices to start using the Cisco Intersight Base tier. The Base tier is not available on the Cisco Intersight Virtual Appliance or the Cisco Intersight Private Virtual Appliance.

Cisco Intersight paid tiers can be ordered in one-year, three-year, and five-year subscription periods. In addition, volume discounts are available for customers ordering more than 1000 server subscriptions at the same time. Separate license options are detailed in Table 5 for the SaaS version on Intersight.com and the virtual appliance.

Cisco Smart Accounts and Smart Licensing are mandatory for Cisco Intersight. In addition, a Cisco Connection Online (CCO) user account is mandatory to use the Cisco Intersight user interface.

Table 5. Ordering information

Part number	Description
DC-MGT-SAAS	Product family - Cisco Intersight
DC-MGT-SAAS-EST-C	Cisco Intersight SaaS - Essentials
DC-MGT-SAAS-AD-C	Cisco Intersight SaaS - Advantage
DC-MGT-SAAS-PR-C	Cisco Intersight SaaS - Premier
DC-MGT-ONPREM-EST	Cisco Intersight Connected Virtual Appliance - Essentials
DC-MGT-VAPP-AD	Cisco Intersight Connected Virtual Appliance - Advantage
DC-MGT-VAPP-PR	Cisco Intersight Connected Virtual Appliance - Premier
DC-MGT-PVAPP-EST	Cisco Intersight Private Virtual Appliance - Essentials
DC-MGT-PVAPP-AD	Cisco Intersight Private Virtual Appliance - Advantage
DC-MGT-PVAPP-PR	Cisco Intersight Private Virtual Appliance - Premier

Cisco environmental sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's Corporate Social Responsibility (CSR) Report.

Reference links to information about key environmental sustainability topics (mentioned in the "Environment Sustainability" section of the CSR Report) are provided in Table 6.

Table 6. Environmental sustainability

Sustainability topic	Reference
Information on product material content laws and regulations	<u>Materials</u>
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

Cisco makes the packaging data available for informational purposes only. It may not reflect the most current legal developments, and Cisco does not represent, warrant, or guarantee that it is complete, accurate, or up to date. This information is subject to change without notice.

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Flexible payment solutions to help you achieve your objectives

Cisco Capital® financing makes it easier to get the right technology to achieve your objectives, enable business transformation, and help you stay competitive. We can help you reduce the total cost of ownership, conserve capital, and accelerate growth. In more than 100 countries, our flexible payment solutions can help you acquire hardware, software, services, and complementary third-party equipment in easy, predictable payments. Learn more.

For more information

For additional information, visit Cisco Intersight at: cisco.com/go/intersight.

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Cisco UCS 6400 Series Fabric Interconnects

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Cisco Unified Computing System overview

The Cisco Unified Computing System™ (Cisco UCS®) is a next-generation data center platform that unites computing, networking, storage access, and virtualization resources into a cohesive system designed to reduce Total Cost of Ownership (TCO) and increase business agility. The system integrates a low-latency, lossless 10/25/40/100 Gigabit Ethernet unified network fabric with enterprise-class, x86-architecture servers. The system is an integrated, scalable, multichassis platform in which all resources participate in a unified management domain (Figure 1).

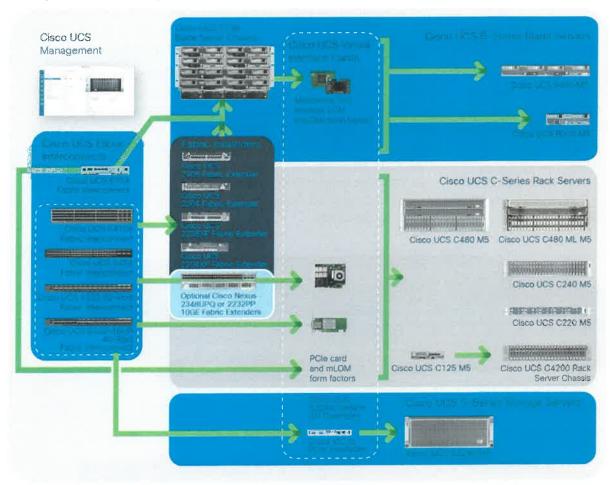


Figure 1.
The Cisco Unified Computing System's highly available, cohesive architecture

Product overview

The Cisco UCS 6400 Series Fabric Interconnects are a core part of the Cisco Unified Computing System, providing both network connectivity and management capabilities for the system (Figure 2). The Cisco UCS 6400 Series offer line-rate, low-latency, lossless 10/25/40/100 Gigabit Ethernet, Fibre Channel over Ethernet (FCoE), and Fibre Channel functions.

The Cisco UCS 6400 Series provide the management and communication backbone for the Cisco UCS B-Series Blade Servers, UCS 5108 B-Series Server Chassis, UCS Managed C-Series Rack Servers, and UCS S-Series Storage Servers. All servers attached to a Cisco UCS 6400 Series Fabric Interconnect become part of a single, highly available management domain. In addition, by supporting a unified fabric, Cisco UCS 6400 Series Fabric Interconnect provides both the LAN and SAN connectivity for all servers within its domain.

From a networking perspective, the Cisco UCS 6400 Series use a cut-through architecture, supporting deterministic, low-latency, line-rate 10/25/40/100 Gigabit Ethernet ports, switching capacity of 3.82 Tbps for the 6454, 7.42 Tbps for the 64108, and 200 Gbps bandwidth between the Fabric Interconnect 6400 series and the IOM 2408 per 5108 blade chassis, independent of packet size and enabled services. The product family supports Cisco low-latency, lossless 10/25/40/100 Gigabit Ethernet unified network fabric capabilities, which increase the reliability, efficiency, and scalability of Ethernet networks. The fabric interconnect supports multiple traffic classes over a lossless Ethernet fabric from the server through the fabric interconnect. Significant TCO savings come from an FCoE-optimized server design in which Network Interface Cards (NICs), Host Bus Adapters (HBAs), cables, and switches can be consolidated.

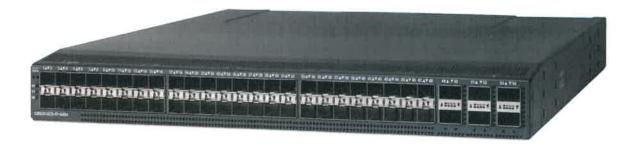


Figure 2.
Cisco UCS 6454 Fabric Interconnect



Figure 3. Cisco UCS 64108

Unified fabric with FCoE: I/O consolidation

The Cisco UCS 6400 Series Fabric Interconnects are built to consolidate LAN and SAN traffic onto a single unified fabric, saving the Capital Expenditures (CapEx) and Operating Expenses (OpEx) associated with multiple parallel networks, different types of adapter cards, switching infrastructure, and cabling within racks. The unified ports allow ports in the fabric interconnect to support direct connections from Cisco UCS to existing native Fibre Channel SANs. The capability to connect FCoE to a native Fibre Channel protects existing storage-system investments while dramatically simplifying in-rack cabling.

Cisco UCS Manager

The Cisco UCS 6400 Series host and run Cisco UCS Manager in a highly available configuration, enabling the fabric interconnects to fully manage all Cisco UCS elements. Connectivity to the Cisco UCS 5108 Blade Server Chassis is maintained through the Cisco UCS 2200 and 2408 Series Fabric Extenders in each blade chassis. The Cisco UCS 6400 Series Fabric Interconnects support out-of-band management, through a dedicated 10/100/1000-Mbps Ethernet management port, as well as in-band management. Cisco UCS Manager typically is deployed in a clustered active/passive configuration on redundant fabric interconnects connected through dual 10/100/1000 Ethernet clustering ports.

Cisco UCS 6454 54-Port Fabric Interconnect

The Cisco UCS 6454 54-Port Fabric Interconnect (Figure 3) is a One-Rack-Unit (1RU) 10/25/40/100 Gigabit Ethernet, FCoE, and Fibre Channel switch offering up to 3.82 Tbps throughput and up to 54 ports. The switch has 28 10/25-Gbps Ethernet ports, 4 1/10/25- Gbps Ethernet ports, 6 40/100-Gbps Ethernet uplink ports, and 16 unified ports that can support 10/25-Gbps Ethernet ports or 8/16/32-Gbps Fibre Channel ports. All Ethernet ports are capable of supporting FCoE.

Front view



Rear view



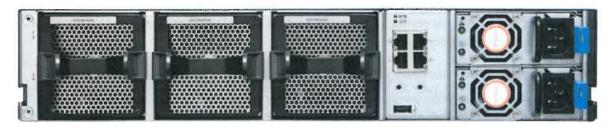
Figure 4. Cisco UCS 6454 (1RU) 54-Port Fabric Interconnect

Cisco UCS 64108 108-Port Fabric Interconnect

The Cisco UCS 64108 Fabric Interconnect (FI) is a 2-RU top-of-rack switch that mounts in a standard 19-inch rack such as the Cisco R Series rack. The 64108 is a 10/25/40/100 Gigabit Ethernet, FCoE and Fiber Channel switch offering up to 7.42 Tbps throughput and up to 108 ports. The switch has 16 unified ports (port numbers 1-16) that can support 10/25-Gbps SFP28 Ethernet ports or 8/16/32-Gbps Fibre Channel ports, 72 10/25-Gbps Ethernet SFP28 ports (port numbers 17-88), 8 1/10/25-Gbps Ethernet SFP28 ports (port numbers 89-96), and 12 40/100-Gbps Ethernet QSFP28 uplink ports (port numbers 97-108). All Ethernet ports are capable of supporting FCoE.

The Cisco UCS 64108 Fabric Interconnect also has one network management port, one console port for setting the initial configuration, and one USB port for saving or loading configurations. The FI also includes L1/L2 ports for connecting two fabric interconnects for high availability.

Front view



Rear view



Figure 5.
Cisco UCS 64108 (2 RU) 108-Port Fabric Interconnect

Table 1 summarizes the characteristics of the Cisco UCS 6400 Series Fabric Interconnects.

Table 1. Characteristics of Cisco UCS 6400 Series Fabric Interconnects

Item	Cisco UCS 6454	Cisco UCS 64108
Description	54-port fabric interconnect	108-port fabric interconnect
Form factor	1RU	2RU
Number of fixed 10/25/40/100-Gbps and FCoE ports with optional unified ports	54 fixed ports	108 fixed ports
Maximum number of unified ports	16 (unified ports 1-16)	16 (unified ports 1-16)
Maximum number of 1-Gbps Ethernet ports	4 (ports 45-48)	8 (ports 89-96)

Item	Cisco UCS 6454	Cisco UCS 64108
Maximum number of 40/100-Gbps Ethernet ports	6 (ports 49-54)	12 ((ports 97-108)
Throughput	3.82 Tbps	7.42 Tbps
Fan modules	3+1	2+1

Note: Breakout cables for uplink are supported on ports 49-54 (FI 6454) and 97-108 (FI 64108) when connecting to Nexus 9K switches.

Note: From 4.1(3) release, Fi 6454 and 64108 supports server-ports on the 40/100G ports after break-out (ports 49-54 and 97-108 respectively). Only direct-connect rack-servers at 10/25G speeds with VIC 1455/1457 are supported on the 40/100G ports. Note that server port at 40/100G speeds are not supported. FI 6454 can support maximum of 64 server-ports and Fi 64108 can support 128 server ports after breakout of 40/100G ports.

Features and benefits

Table 2 summarizes the features and benefits of Cisco UCS 6400 Series Fabric Interconnects.

Table 2. Features and benefits

Feature	Benefits
Power supply	* Two power supplies (AC or DC)
Management by Cisco UCS Manager	 Allows all elements connected to the interconnects to participate in a single, highly available management domain
Unified fabric	 Decreases TCO by reducing the number of NICs, HBAs, switches, and cables required Transparently encapsulates Fibre Channel packets into Ethernet
Fabric extender architecture	 Scales to 20 blade chassis without adding complexity by eliminating the need for dedicated chassis management and blade switches and by reducing the number of cables needed Provides deterministic latency for optimized application performance
Performance	 Provides high-speed, low-latency connectivity to the chassis Provides approximately 50 percent reduction in end-to-end system latency (latency is less than 1 microsecond)
Lossless fabric	 Provides a reliable, robust foundation for unifying LAN and SAN traffic on a single transport
Priority-based Flow Control (PFC)	 Simplifies management of multiple traffic flows over a single network link Supports different classes of service, helping enable both losses and classic Ethernet on the same fabric
Systemwide bandwidth management	• Helps enable consistent and coherent Quality of Service (QoS) throughout the system
Rear ports	Helps keep cable lengths short and efficient
Redundant hot-swappable fans and power supplies	 Helps enable high availability in multiple configurations Increase serviceability Provides uninterrupted service during maintenance

Feature	Benefits
Front-to-back cooling	• Fan-side intake, port-side exhaust
SFP+ ports	 Increases flexibility with a range of interconnect solutions, including copper Twinax cable for short runs and SFP28 and QSFP28 optics for long runs
	 Consumes less power per port than traditional solutions
	 Helps enable cost-effective connections on fabric extenders with Cisco[®] Fabric Extender Transceiver (FET) optics
SFP28-compatible ports	 Allows fixed ports to be configured to operate in 10/25 GB Ethernet mode with the transceiver options specific for use with SFP28-compatible ports in Table 3
QSFP28-compatible Ports	 Allows all ports to be configured to operate in 40/100 GB Ethernet mode with the transceiver options specific for use with QSFP28-compatible ports in Table 3
Port-based licensing options	 Helps enable a pay-as-you-grow model, allowing customers to add capacity as the networking needs of an individual system increase

Product specifications

Transceivers

The Cisco UCS 6400 Series Fabric Interconnects support a wide variety of 10/25/40/100 Gigabit Ethernet connectivity options using Cisco 10/25/40/100 Gbps modules. Unified Ports (UP) on the Cisco UCS 6400 Series support 10/25 Gigabit Ethernet connectivity or 8/16/32 Gigabit Fibre Channel modules. Uplink ports support 40/100 Gigabit Ethernet transceivers and cables. Table 3 lists the supported transceiver options.

Table 3. Cisco UCS 6400 Series Fabric Interconnect-supported transceiver and cable support matrix

Product number	Description
SFP 1-Gigabit transceivers	
GLC-TE	1000 BASE-T SFP transceiver module for Category 5 copper wire
GLC-SX-MMD	1000 BASE-SX short wavelength; with DOM
SFP-GE-T	1000 BASE-T SFP transceiver module for Category 5 copper wire, extended operating temperature range (supported but EOL)
SFP+ 10-Gbps transceivers	
SFP-10G-SR	10GBASE-SR SFP module
SFP-10G-SR-S	10GBASE-SR SFP module, Enterprise class
SFP-10G-LR	10GBASE-LR SFP module
SFP-10G-LR-S	10GBASE-LR SFP module, Enterprise class
SFP-10G-LRM	10GBASE-LRM SFP module
SFP-10G-ER	10GBASE-ER SFP module
SFP-10G-ER-S	10GBASE-ER-SFP module, Enterprise class

Product number	Description
SFP-10G-ZR	Cisco 10GBASE-ZR SFP10G module for SMF
SFP-10G-ZR-S	10GBASE-ZR SFP module, Enterprise class
FET-10G	10G line extender for FEX
SFP28 25-Gbps transceivers	
SFP-25G-SR-S	25GBASE-SR SFP module
SFP-10/25G-LR-S	10/25GBASE-LR SFP28 Module for SMF
SFP-10/25G-CSR-S	Dual Rate 10/25GBASE-CSR SFP Module
QSFP+ 40-Gbps transceivers	
QSFP-40G-SR4	40GBASE-SR4 QSFP transceiver module with MPO connector
QSFP-40G-SR4-S	40GBASE-SR4 QSFP transceiver module, MPO connector, Enterprise class
QSFP-40G-SR-BD	40GBASE-SR-BiDi, duplex MMF (LC)
QSFP-40G-LR4	QSFP 40GBASE-LR4 OTN transceiver, LC, 10KM
QSFP-40G-LR4-S	QSFP 40GBASE-LR4 transceiver module, LC, 10KM, Enterprise class
QSFP-40G-ER4	QSFP 40GBASE-ER4 transceiver module, LC, 2KM
WSP-Q40GLR4L	QSFP 40G Ethernet - LR4 lite, LC, 2KM
QSFP-4X10G-LR-S	QSFP 4x10G transceiver module, SM MPO, 10KM, Enterprise class
QSFP28 100G transceivers	
QSFP-100G-SR4-S	100GBASE SR4 QSFP transceiver, MPO, 100m over OM4 MMF
QSFP-100G-LR4-S	100GBASE LR4 QSFP transceiver, LC, 10KM over SMF
QSFP-40/100-SRBD	100GBASE/40GBASE SR-BiDi QSFP transceiver, LC, 100m over OM4 MMF
QSFP-100G-SM-SR	100GBASE CWDM4 Lite QSFP transceiver, 2KM over SMF, 10-60C
SFP+ 10G copper cables with int	egrated transceivers
SFP-H10GB-CU1M	10GBASE SFP+ cable 1-meter, passive
SFP-H10GB-CU1-5M	10GBASE SFP+ cable 1.5-meter, passive
SFP-H10GB-CU2M	10GBASE SFP+ cable 2-meter, passive
SFP-H10GB-CU2-5M	10GBASE SFP+ cable 2.5-meter, passive
SFP-H10GB-CU3M	10GBASE SFP+ cable 3-meter, passive

Product number	Description
SFP-H10GB-CU5M	10GBASE SFP+ cable 5-meter, passive
SFP-H10GB-ACU7M	10GBASE SFP+ cable 7-meter, active
SFP-H10GB-ACU10M	10GBASE SFP+ cable 10-meter, active
SFP-10G-AOC1M	10GBASE active optical SFP+ cable, 1M
SFP-10G-AOC2M	10GBASE active optical SFP+ cable, 2M
SFP-10G-AOC3M	10GBASE active optical SFP+ cable, 3M
SFP-10G-AOC5M	10GBASE active optical SFP+ cable, 5M
SFP-10G-AOC7M	10GBASE active optical SFP+ cable, 7M
SFP-10G-AOC10M	10GBASE active optical SFP+ cable, 10M
SFP28 25G copper cables with into	egrated San
SFP-H25G-CU1M	25GBASE-CU SFP28 cable 1-meter
SFP-H25G-CU2M	25GBASE-CU SFP28 cable 2-meter
SFP-H25G-CU3M	25GBASE-CU SFP28 cable 3-meter
SFP-H25G-CU4M	25GBASE-CU SFP28 Cable 4 Meter
SFP-H25G-CU5M	25GBASE-CU SFP28 cable 5-meter
SFP-25G-AOC1M	25GBASE active optical SFP28 cable, 1M
SFP-25G-AOC2M	25GBASE active optical SFP28 cable, 2M
SFP-25G-AOC3M	25GBASE active optical SFP28 cable, 3M
SFP-25G-AOC4M	25GBASE active optical SFP28 cable, 4M
SFP-25G-AOC5M	25GBASE active optical SFP28 able, 5M
SFP-25G-AOC7M	25GBASE active optical SFP28 cable, 7M
SFP-25G-AOC10M	25GBASE active optical SFP28 cable, 10M
QSFP 40G cables with integrated t	ransceivers 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
QSFP-H40G-CU1M	40GBASE-CR4 passive copper cable, 1M
QSFP-H40G-CU3M	40GBASE-CR4 passive copper cable, 3M
QSFP-H40G-CU5M	40GBASE-CR4 passive copper cable, 5M
QSFP-H40G-ACU7M	40GBASE-CR4 active copper cable, 7M

Product number	Description
QSFP-H40G-ACU10M	40GBASE-CR4 active copper cable, 10M
QSFP-H40G-AOC1M	40GBASE active optical cable, 1M
QSFP-H40G-AOC2M	40GBASE active optical cable, 2M
QSFP-H40G-AOC3M	40GBASE active optical cable, 3M
QSFP-H40G-AOC5M	40GBASE active optical cable, 5M
QSFP-H40G-AOC10M	40GBASE active optical cable, 10M
QSFP-H40G-AOC15M	40GBASE active optical cable, 15M
QSFP-4SFP10G-CU1M	QSFP to 4xSFP10G passive copper splitter cable, 1M
QSFP-4SFP10G-CU3M	QSFP to 4xSFP10G passive copper splitter sable, 3M
QSFP-4SFP10G-CU5M	QSFP to 4xSFP10G passive copper splitter cable, 5M
QSFP-4x10G-AC7M	QSFP to 4xSFP10G active copper splitter cable, 7M
QSFP-4x10G-AC10M	QSFP to 4xSFP10G active copper splitter cable, 10M
QSFP-4x10G-AOC1M	40GBASE active optical QSFP to 4SFP breakout cable, 1M
QSFP-4x10G-AOC3M	40GBASE active optical QSFP to 4SFP breakout cable, 3M
QSFP-4x10G-AOC5M	40GBASE active optical QSFP to 4SFP breakout cable, 5M
QSFP-4x10G-AOC7M	40GBASE active optical QSFP to 4SFP breakout cable, 7M
QSFP-4x10G-AOC10M	40GBASE active optical QSFP to 4SFP breakout cable, 10M
QSFP28 100G cables with inte	egrated transceivers
QSFP-100G-CU1M	100GBASE-CR4 passive copper cable, 1M
QSFP-100G-CU2M	100GBASE-CR4 passive copper cable, 2M
QSFP-100G-CU3M	100GBASE-CR4 passive copper cable, 3M
QSFP-100G-AOC1M	100GBASE QSFP active optical cable, 1M
QSFP-100G-AOC2M	100GBASE QSFP active optical cable, 2M
QSFP-100G-AOC3M	100GBASE QSFP active optical cable, 3M
QSFP-100G-AOC5M	100GBASE QSFP active optical cable, 5M
QSFP-100G-AOC7M	100GBASE QSFP active optical cable, 7M
QSFP-100G-AOC10M	100GBASE QSFP active optical cable, 10M
	1 A 1485

Product number	Description
QSFP-100G-AOC15M	100GBASE QSFP active optical cable, 15M
QSFP-100G-AOC20M	100GBASE QSFP active optical cable, 20M
QSFP-100G-AOC25M	100GBASE QSFP active optical cable, 25M
QSFP-100G-AOC30M	100GBASE QSFP active optical cable, 30M
QSFP-4SFP25G-CU1M	100GBASE QSFP to 4xSFP25G passive copper splitter cable, 1M
QSFP-4SFP25G-CU2M	100GBASE QSFP to 4xSFP25G passive copper splitter cable, 2M
QSFP-4SFP25G-CU3M	100GBASE QSFP to 4xSFP25G passive copper splitter cable, 3M
QSFP-4SFP25G-CU5M	100GBASE QSFP to 4xSFP25G passive copper splitter cable, 5M
Fibre Channel transceivers	
DS-SFP-FC4G-SW	4 Gbps Fibre Channel-SW SFP, LC
DS-SFP-FC8G-SW	8 Gbps Fibre Channel-SW SFP+, LC
DS-SFP-FC8G-LW	8 Gbps Fibre Channel-LW SFP+, LC
DS-SFP-FC16G-SW	16 Gbps Fibre Channel-SW SFP+, LC
DS-SFP-FC16G-LW	16 Gbps Fibre Channel-LW SFP+, LC
DS-SFP-FC32G-SW	32 Gbps Fibre Channel-SW SFP+, LC
DS-SFP-FC32G-LW	32 Gbps Fibre Channel-LW SFP+, LC

Note:

- 1. FI 6454 supports 1G optics on ports 45-48. FI 64108 supports 1G optics on ports 89-96.
- Transceiver modules and cables that are supported on a specific Fabric Interconnect are not always supported on all VIC adapters, I/O modules, or Fabric Extenders that are compatible with that Fabric Interconnect. Detailed compatibility matrices for the transceiver modules are available here: https://www.cisco.com/c/en/us/support/interfaces-modules/transceiver-modules/products-device-support-tables-list.html.
- 3. SFP-10/25G-LR-S and SFP-10/25G-CSR-S currently works only at 25G speed. (i.e., FI 6454 supported ports 1-48 & FI 64108 supported ports 1-96)
- 4. S-Class transceivers do not support FCoE at 10G and 40G speeds
- 5. QSFP-4X10G-LR-S is supported only for uplink ports.

Cabling

Table 4 provides 10-, 25-, 40-, and 100-Gigabit Ethernet cabling specifications for Cisco UCS 6400 Series Fabric Interconnects.

Table 4. 10-, 25-, 40-, and 100-Gigabit Ethernet cabling specifications

Connector (Media)	Cable	Distance	Power (each side)	Transceiver latency (link)	Standard
SFP+ copper (CU)	Twinax	1, 3, and 5M	Approximately 0.1 watt (W)	Approximately 0.1 microsecond	SFF 8431
SFP+ ACU copper	Active Twinax	7M10M	Approximately 0.5W	Approximately 0.1 microsecond	SFF 8461
SFP+FET	MM OM2MM OM3MM OM4	25 and 100M	1W	Approximately 0 microsecond	IEEE 802.3ae
SFP+ Short Reach (SR) and MMF	MM OM2MM OM3MM OM4	82 and 300M	1 _. W	Approximately 0 microseconds	IEEE 802.3ae
SFP+ Long Reach (LR)	SMF	10 KM	1W	Approximately 0 microseconds	IEEE 802.3ae
SFP+ Long Range (ER)	SMF	40 KM	1.5W	Approximately 0 microseconds	IEEE 802.3ae
SFP+ Long Reach (ZR)	SMF	80 KM	1.5W	Approximately 0 microseconds	IEEE 802.3ae

Performance

- Cisco UCS 6454: Layer 2 hardware forwarding at 3.82 Tbps and 1.2 billion packets per second (bpps)
- Cisco UCS 64108: Layer 2 hardware forwarding at 7.42 Tbps and 2.8 billion packets per second (bpps)
- MAC address table entries: 32,000
- Low-latency cut-through design: Provides predictable, consistent traffic latency regardless of packet size, traffic pattern, or enabled features

Layer 2

- · Ethernet switch mode
- Fibre Channel switch mode
- Layer 2 interconnect ports and 3K VLANs
- IEEE 802.1Q VLAN encapsulation
- Support Virtual SANs (VSANs) per interconnect
- Rapid Per-VLAN Spanning Tree Plus RPVST+
- Internet Group Management Protocol (IGMP) Versions 1, 2, and 3 snooping
- Link Aggregation Control Protocol (LACP): IEEE 802.3ad

- Advanced EtherChannel hashing based on Layer 2, 3, and 4 information
- Jumbo frames on all ports (up to 9216 bytes)
- Pause frames (IEEE 802.3x)
- FC/FCoE slow drain detection and recovery
- Port security

Quality of Service (QoS)

- Layer 2 IEEE 802.1p (class of service)
- Sixteen hardware queues per port (FCoE plus five user-defined)
- Class-of-Service(CoS)-based egress queuing
- Egress port-based scheduling: Weighted Round-Robin (WRR)
- Priority-based flow control (802.1Qbb)
- Enhanced transmission selection (802.1Qaz)

High availability

- · Hot-swappable field-replaceable power suppliers, fan modules, and expansion modules
- 1+1 power redundancy
- N+1 fan module redundancy

Management

- Interconnect management using redundant 10/100/1000 Mbps management or console ports
- All management provided through Cisco UCS Manager. Please refer to the Cisco UCS Manager data sheet for more information about management interfaces

Low-latency, lossless 10/25/40/100 Gigabit Ethernet unified network fabric

- PFC (per priority pause frame support)
- Data Center Bridging Exchange (DCBX) Protocol
- IEEE 802.1Qaz: bandwidth management

Unified ports

 Cisco UCS 6400 Series can be configurable as 10- and 25-Gigabit Ethernet or 8/16/32-Gbps Fibre Channel

Industry standards

IEEE 802.1p: CoS prioritization

IEEE 802.1Q: VLAN tagging

IEEE 802.1s: multiple VLAN instances of Spanning Tree Protocol

IEEE 802.1w: rapid reconfiguration of Spanning Tree Protocol

• IEEE 802.3: Ethernet

!EEE 802.3ad: LACP

IEEE 802.3ae: 10-Gigabit Ethernet

• IEEE 802.3by: 25-Gigabit Ethernet

IEEE 802.3bg: 40-Gigabit Ethernet

IEEE 802.3bm: 100-Gigabit Ethernet

SFP28 support

QSFP28 support

Remote Monitoring (RMON)

Physical specifications

SFP28 and QSFP28 optics

Cisco UCS products support 10-, 25-, 40-, and 100-Gigabit Ethernet SFP28 and QSFP28 copper Twinax cables for short distances, and SFP28 and QSFP28 optics for longer distances. SFP28 and QSFP28 have several advantages compared to other Ethernet connectivity options:

- 10-, 25-, 40-, and 100-Gigabit Ethernet form factor
- Low power consumption
- Hot-swappable devices

Table 5 summarizes the Cisco UCS 6400 Series Fabric Interconnect specifications.

Table 5. Cisco UCS 6400 Series Fabric Interconnect specifications****

Feature	Cisco UCS 6454	Cisco UCS 64108
Ports	48 x 10/25-Gbps SFP28 ports and 6 x 40/100-Gbps QSFP28 ports	96 x 10/25-Gbps SFP28 ports and 12 x 40/100-Gbps QSFP28 ports
Downlink supported speeds	1/10/25-Gbps Ethernet/FCoE8/16/32- Gbps Fibre Channel	1/10/25-Gbps Ethernet/FCoE8/16/32- Gbps Fibre Channel
CPU	6 cores	6 cores
System memory	64 GB	64 GB
Management ports	L1, L2, and RJ-45 ports	L1, L2, and RJ-45 ports

Feature	Cisco UCS 6454	Cisco UCS 64108
USB ports	1	1
Power supplies (up to 2)	650W (AC) or 930W (DC)	Two identical AC or DC
Typical operating power	260W	404W
Maximum power (AC)	650W	1200W
Maximum power (DC)	930W	930W
Input voltage (AC)	100 to 240 VAC	7A at 200 VAC
input voltage (DC)	-40 to -72VDC	23 A maximum at -48 VDC
Frequency	50 to 60 Hz	50 to 60 Hz
Fans	4	3
Airflow	Standard airflow - front (PSU/fan-side) to back (port-side exhaust)	Standard airflow - front (PSU/fan-side) to back (port-side exhaust)
Efficiency (AC)	95 to 98% (50 to 100% load)	95 to 98% (50 to 100% load)
Efficiency (DC)	88 to 92% (50 to 100% load)	88 to 92% (50 to 100% load)
RoHS compliance	Yes	Yes
Hot swappable	Yes	Yes

Cisco UCS 6400 Series physical and environmental specifications

Table 6 summarizes the physical and environmental specifications for Cisco UCS 6400 Series Fabric Interconnects.

Table 6. Physical and environmental specifications

Property	Cisco UCS 6454	Cisco UCS 64108
Physical (height x width x depth)	1.72 in. x 17.3 in x 22.5 in (4.4 cm x 43.9 cm x 57.1 cm)	3.38 in. x 17.42 in x 22.95 in (8.33 cm x 44.25 cm x 58.29 cm)
Operating temperature	32 to 104°F (0 to 40°C)	32 to 104°F (0 to 40°C)
Nonoperating temperature	-40 to 158°F (-40 to 70°C)	-40 to 158°F (-40 to 70°C)
Humidity	5 to 95%	5 to 95%
Altitude	0 to 13,123 ft (0 to 4000m)	0 to 13,123 ft (0 to 4000m)

Weight

Table 7 summarizes the weights for the Cisco UCS 6400 Series.

Table 7. Weight, including power supplies and fan modules

Component	Weight
Cisco UCS 6454 with two power supplies and two expansion modules installed	22.24 lb (10.10 kg), with fans
Cisco UCS 64108 with two power supplies and two expansion modules installed	35.86 lb (16.27 kg), with fans

Regulatory standards compliance: safety and EMC

Table 8 summarizes regulatory compliance for the Cisco UCS 6400 Series Fabric Interconnects.

Table 8. Regulatory standards compliance: safety and EMC

Specification	Description
Regulatory compliance	Products should comply with CE Markings according to directives 2004/108/EC and 2006/95/EC.
Safety	 UL 60950-1 Second Edition CAN/CSA-C22.2 No. 60950-1 EN 60950-1 Second Edition IEC 60950-1 Second Edition AS/NZS 60950-1 GB4943
EMC: Emissions	 47CFR Part 15 (CFR 47) Class A AS/NZS CISPR22 Class A CISPR22 Class A EN55022 Class A ICES003 Class A VCCI Class A EN61000-3-2 EN61000-3-3 KN22 Class A CNS13438 Class A
EMC: Immunity	 EN55024 CISPR24 EN300386 KN 61000-4 series
RoHS	The product is RoHS 5-compliant with exceptions for leaded Ball Grid Array (BGA) balls and lead press-fit connectors.

Ordering information

Table 9 presents ordering information for Cisco UCS 6400 Fabric Interconnects.

Table 9. Ordering information

Table 9. Ordering information				
Part Number	Description			
Fabric Interconnects				
UCS-FI-6454-U	Standalone model: 1RU FI, with no PSU, with 54 ports and includes 18x10/25-Gbps and 2x40/100-Gbps port licenses			
UCS-FI-6454++	Standalone model: TAA-UCS 6454 1RU FI, with no PSU, with 54 ports and includes 18x10/25-Gbps and 2x40/100-Gbps port licenses			
UCS-FI-6454	Configured model: UCS 6454 1RU FI, with no PSU, with 54 ports and includes 18x10/25-Gbps and 2x40/100-Gbps port licenses			
UCS-FI-64108-U	Standalone model: UCS 64108 2RU FI, with no PSU, with 108 ports and includes 36x10/25-Gbps and 4x40/100-Gbps port licenses			
UCS-F!-64108	Configured model: UCS 64108 2RU FI, with no PSU, with 108 ports and includes 36x10/25-Gbps and 4x40/100-Gbps port licenses			
Fabric Interconnect port	licenses			
UCS-L-6400-25G	UCS 6400 series ONLY Fabric Int 1 Port 10/25 Gbps/FC port license			
UCS-L-6400-25GC	UCS 6400 series ONLY Fabric Int 1 Port 10/25 Gbps/FC port license C-direct only (used to connect directly from FI 6454 to C220, C240, C460, C480, and/or C4200)			
UCS-L-6400-100G	UCS 6400 series ONLY Fabric Int 1 Port 40/100 Gbps port license			
Power supply and fan				
UCS-PSU-6332-AC	UCS 6332/6454 power supply/100-240VAC (650 W)			
UCS-PSU-6332-DC	UCS 6332/6454 power supply/-48VDC (930 W)			
UCS-PSU-64108-AC	UCS 64108 power supply/100-240VAC			
UCS-PSU-6332-DC	UCS 64108 Power Supply/-48VDC			
UCS-FAN-6332	UCS 6332/6454 fan module			
UCS-FAN-64108	UCS 64108 fan module			
Accessory and blank				
UCS-ACC-6332	UCS 6332/6454 chassis accessory kit			
UCS-ACC-64108	UCS 64108 chassis accessory kit			

Warranty information

Find warranty information at Cisco.com on the Product Warranties page.

Cisco environmental sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's <u>Corporate Social Responsibility</u> (CSR) Report.

Reference links to information about key environmental sustainability topics (mentioned in the "Environment Sustainability" section of the CSR Report) are provided in the following table:

Sustainability topic	Reference
Information on product material content laws and regulations	<u>Materials</u>
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

Cisco makes the packaging data available for informational purposes only. It may not reflect the most current legal developments, and Cisco does not represent, warrant, or guarantee that it is complete, accurate, or up to date. This information is subject to change without notice.

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For more information

For more information about Cisco UCS, visit https://www.cisco.com/en/US/products/ps10265/index.html.

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Cisco Nexus 9300-FX Series Switches

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Product overview

The Cisco Nexus® 9300-FX Series switches belongs to the fixed Cisco Nexus 9000 platform based on Cisco Cloud Scale technology. The platform support cost-effective cloud-scale deployments, an increased number of endpoints, and cloud services with wire-rate security and telemetry. The platform is built on modern system architecture designed to provide high performance and meet the evolving needs of highly scalable data centers and growing enterprises.

Cisco Nexus 9300-FX series switches offer a variety of interface options to transparently migrate existing data centers from 100-Mbps, 1-Gbps, and 10-Gbps speeds to 25- Gbps at the server, and from 10- and 40-Gbps speeds to 50- and 100- Gbps at the aggregation layer. The platforms provide investment protection for customers, delivering large buffers, highly flexible Layer 2 and Layer 3 scalability, and performance to meet the changing needs of virtualized data centers and automated cloud environments.

Cisco provides two modes of operation for Cisco Nexus 9000 Series Switches. Organizations can use <u>Cisco NX-OS Software</u> to deploy the switches in standard Cisco Nexus switch environments (NX-OS mode). Organizations can also deploy the infrastructure that is ready to support the <u>Cisco Application Centric Infrastructure</u> (Cisco ACi[™]) platform to take full advantage of an automated, policy-based, systems-management approach (ACI mode).

Switch models

Table 1. Cisco Nexus 9300-FX Series Switches

Model	Description
Cisco Nexus 93180YC-FX	48 x 1/10/25-Gbps fiber ports and 6 x 40/100-Gbps QSFP28 ports
Cisco Nexus 93108TC-FX	48 x 100M/1/10GBASE-T ports and 6 x 40/100-Gbps QSFP28 ports
Cisco Nexus 9348GC-FXP	48 x 100M/1G BASE-T ports, 4 x 1/10/25-Gbps SFP28 ports and 2 x 40/100-Gbps QSFP28 ports

The Cisco Nexus 93180YC-FX Switch (Figure 1) is a 1RU switch with latency of less than 1 microsecond that supports 3.6 Tbps of bandwidth and 1.2 bpps. The 48 downlink ports on the 93180YC-FX are capable of supporting 1-, 10-, or 25-Gbps Ethernet or as 16-, 32-Gbps Fibre Channel ports¹, creating a point of convergence for primary storage, compute servers, and back-end storage resources at the top of rack.

The uplink can support up to six 40- and 100-Gbps ports, or a combination of 1-, 10-, 25-, 40, 50-, and 100-Gbps connectivity, offering flexible migration options.

The switch has IEEE compliant, FC-FEC and RS-FEC enabled for 25-Gbps support. All ports support wirerate MACsec encryption². Please see the Licensing guide section to enable features on the platform.

¹ Capabilities to enable FC needs feature license, please see latest software release notes for details.

² Capabilities to enable MACsec needs feature license, please see the Cisco Nexus 9000 Licensing Guide



Figure 1.
Cisco Nexus 93180YC-FX Switch

The Cisco Nexus 93108TC-FX Switch (Figure 5) is a 1RU switch that supports 2.16 Tbps of bandwidth and over 1.25bpps. The 48 10GBASE-T downlink ports on the 93108TC-FX can be configured to work as 100-Mbps, 1-Gbps, or 10-Gbps ports. The uplink can support up to six 40- and 100-Gbps ports, or a combination of 1-, 10-, 25-, 40, 50-, and 100-Gbps connectivity, offering flexible migration options.

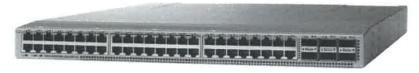


Figure 2. Cisco Nexus 93108TC-FX Switch

The Cisco Nexus 9348GC-FXP Switch (Figure 3) is a 1RU switch that supports 696 Gbps of bandwidth and over 517 mpps. The 48 1GBASE-T downlink ports on the 9348GC-FXP can be configured to work as 100-Mbps, 1-Gbps ports. The 4 ports of SFP28 can be configured as 1/10/25-Gbps and the 2 ports of QSFP28 can be configured as 40- and 100-Gbps ports, or a combination of 1-, 10-, 25-, 40, 50-, and 100-Gbps connectivity, offering flexible migration options.

The Cisco Nexus 9348GC-FXP is ideal for big data customers that require a Gigabit Ethernet ToR switch with local switching.



Figure 3.
Cisco Nexus 9348GC-FXP Switch

Features and benefits

The Cisco Nexus 9300-FX series provide the following features and benefits:

Architectural Flexibility

- Industry leading Software Defined Networking Solution Cisco ACI™ support.
- Support for standards based VXLAN EVPN fabrics, inclusive of hierarchical multi-site support (refer to <u>VXLAN Network with MP-BGP EVPN Control Plane</u> for more information).
- · Three-tier BGP architectures, enabling horizontal, non-blocking IPv6 network fabrics at web-scale.
- Segment routing allows the network to forward Multiprotocol Label Switching (MPLS) packets and engineer traffic without Resource Reservation Protocol (RSVP) Traffic Engineering (TE). It provides a control-plane alternative for increased network scalability and virtualization.

Comprehensive protocol support for Layer 3 (v4/v6) unicast and multicast routing protocol suites, including BGP, Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP), Routing Information Protocol Version 2 (RIPv2), Protocol Independent Multicast Sparse Mode (PIM-SM), Source-Specific Multicast (SSM), and Multicast Source Discovery Protocol (MSDP).

Extensive Programmability

- · Day zero automation through Power On Auto Provisioning, drastically reducing provisioning time.
- Industry leading integrations for leading devops configuration management applications Ansible, Chef, Puppet, SALT. Extensive Native YANG and industry standard OpenConfig model support through RESTCONF/NETCONF.
- Pervasive API's for all switch CLI functions (JSON based RPC over HTTP/HTTPs).

High Scalability, Flexibility, and Security

- Flexible forwarding tables support up to 2 million shared entries on FX models. Flexible use of TCAM space allows for custom definition of Access Control List (ACL) templates.
- IEEE 802.1ae MAC Security (MACsec) support on all ports of 9300-FX models with speed greater than or equal to 10-Gbps, allows traffic encryption at the physical layer and provides secure server, border leaf, and leaf-to-spine connectivity.

Intelligent Buffer Management

- The platform offers Cisco's innovative intelligent buffer management, that offers capability to
 distinguish mice and elephant flows and apply different queue management schemes to them based
 on their network forwarding requirements in the event of link congestion.
- Intelligent buffer management functions are:
- Approximate Fair Dropping (AFD) with Elephant trap (ETRAP). AFD distinguishes long-lived elephant flows from short-lived mice flows, by using ETRAP. AFD exempts mice flows from the dropping algorithm so that mice flows will get their fair share of bandwidth without being starved by bandwidth-hungry elephant flows. Also, AFD tracks elephant flows and subjects them to the AFD algorithm in the egress queue to grant them their fair share of bandwidth.
- ETRAP measures the byte counts of incoming flows and compares this against the user defined ETRAP threshold. After a flow crosses the threshold, it becomes an elephant flow.
- Dynamic Packet Prioritization (DPP) provides the capability of separating mice flows and elephant flows into two different queues so that buffer space can be allocated to them independently. Mice flows, sensitive to congestion and latency can take priority queue and avoid re-ordering that allows to elephant flows to take full link bandwidth.

RDME over Converged Ethernet - RoCE Support

- Platform offers lossless transport for RDMA over Converged Ethernet with support of DCB protocols:
- Priority-based Flow Control (PFC) to prevent drops in the network and pause frame propagation per priority class.
- Enhanced Transmission Selection (ETS) to reserve bandwidth per priority class in network contention situation.
- Data Center Bridging Exchange Protocol (DCBX) to discover and exchange priority and bandwidth information with end points.
- Platform also supports Explicit Congestion Notification (ECN) that provides end-to-end notification
 per IP flow by marking packets that experienced congestion, without dropping traffic. The platform is
 capable to track ECN statistics of number of marked packet that have experienced congestion.

LAN and SAN Convergence

Fibre Channel³ and Fibre Channel over Ethernet (FCoE) N-Port Virtualization (NPV) support enables
the network administrator to control domain IDs and points of management on a Fibre Channel
network as it scales. This feature enables LAN and SAN converged networks on a lossless, reliable
Ethernet network.

Hardware and Software High Availability

- Virtual Port-Channel (vPC) technology provides Layer 2 multipathing through the elimination of Spanning Tree Protocol. It also enables fully utilized bisectional bandwidth and simplified Layer 2 logical topologies without the need to change the existing management and deployment models.
- The 64-way Equal-Cost MultiPath (ECMP) routing enables the use of Layer 3 fat-tree designs. This
 feature helps organizations prevent network bottlenecks, increase resiliency, and add capacity with
 little network disruption.
- Advanced reboot capabilities include hot and cold patching.
- The switches use hot-swappable Power-Supply Units (PSUs) and fans with N+1 redundancy.

Purpose-Built Cisco NX-OS Software Operating System with Comprehensive, Proven Innovations

- Single binary image that supports every switch in the Cisco Nexus 9000 series, simplifying image
 management. The operating system is modular, with a dedicated process for each routing protocol:
 a design that isolates faults while increasing availability. In the event of a process failure, the process
 can be restarted without loss of state. The operating system supports hot and cold patching and
 online diagnostics.
- Data Center Network Manager (DCNM) is the network management platform for all NX-OS-enabled deployments, spanning new fabric architectures, IP Fabric for Media, and storage networking deployments for the Cisco Nexus®-powered data center. Accelerate provisioning from days to minutes, and simplify deployments from day zero through day N. Reduce troubleshooting cycles with graphical operational visibility for topology, network fabric, and infrastructure. Eliminate configuration errors and automate ongoing change in a closed loop, with templated deployment models and configuration compliance alerting with automatic remediation. Real-time health summary for fabric, devices, and topology. Correlated visibility for fabric (underlay, overlay, virtual and physical endpoints), including compute visualization with VMware.
- Network traffic monitoring with Cisco Nexus Data Broker builds simple, scalable, and cost-effective network Test Access Points (TAPs) and Cisco Switched Port Analyzer (SPAN) aggregation for network traffic monitoring and analysis.

Cisco Tetration Analytics Platform Support

• The telemetry information from the Nexus 9300 Series switches is exported every 100 milliseconds by default directly from the switch's Application-Specific Integrated Circuit (ASIC). This information consists of three types of data: (a) Flow information, this information contains information about endpoints, protocols, ports, when the flow started, how long the flow was active, etc. (b) Interpacket variation, this information captures any inter-packet variations within the flow. Examples include variation in Time To Live (TTL), IP and TCP flags, payload length, etc. (c) Context details, context information is derived outside the packet header, including variation in buffer utilization, packet drops within a flow, association with tunnel endpoints, etc.

³ Capabilities to enable FC needs feature license, please see latest software release notes for details.

• The Cisco Tetration Analytics platform consumes this telemetry data, and by using unsupervised machine learning and behavior analysis it can provide outstanding pervasive visibility across everything in your data center in real time. By using algorithmic approaches, the Cisco Tetration Analytics platform provides a deep application insights and interactions, enabling dramatically simplified operations, a zero-trust model, and migration of applications to any programmable infrastructure. To learn more, go to https://www.cisco.com/go/tetration.

• Cisco Network Assurance Engine (NAE)

• Cisco NAE continuously verifies if the network infrastructure is operating as per policy intent and it leverages the power of mathematical models to reason on behalf of the operator in policy, configuration and dynamic state level. NAE can precisely indicate problems in the network, identify which application or part of network is impacted, root-cause the problem and suggest how to fix it. Its continuous verification approach transforms Day 2 Operations from reactive to proactive mode and it does so without using any packet data. NAE helps avoid outages by predicting the impact of changes, reducing network related IT incidents and shrinking the mean time to repair by up to 66%. NAE also helps assure network security and segmentation compliance. To learn more about NAE, visit https://www.cisco.com/c/en/us/products/data-center-analytics/network-assurance-engine/index.html.

Product specifications

The Cisco Nexus 9300-FX series offer industry-leading density and performance with flexible port configurations that can support existing copper and fiber cabling (Tables 2).

Table 2. Cisco Nexus 9300-FX Series Switch specifications

Feature	Cisco Nexus 93180YC-FX	Cisco Nexus 93108TC-FX	Cisco Nexus 9348GC-FXP
Ports	48 x 1/10/25-Gbps and 6 x 40/100-Gbps QSFP28 ports	48 x 100M/1/10GBASE-T and 6 x 40/100-Gbps QSFP28 ports	48 x 1-GBASE-T ports, 4 x 1/10/25-Gbps SFP28 ports and 2 x 40/100 QSFP28 ports
Downlink supported speeds	1/10/25-Gbps Ethernet 16/32-Gbps Fibre Channel	100-Mbps and 1/10-Gbps speeds	100-Mbps and 1- Gbps speeds
CPU	6 cores	4 cores	4 cores
System memory	Up to 32 GB	24 GB	24 GB
SSD drive	128 GB	128 GB	128 GB
System buffer	40 MB	40 MB	40 MB
Management ports	1 RJ-45 port L1 and L2 ports are unused	2 ports: 1 RJ-45 and 1 SFP+	2 ports: 1 RJ-45 and 1 SFP+
USB ports	1	1	1
RS-232 serial ports	1	1	1
Power supplies (up to 2)	500W AC, 930W DC, or 1200W HVAC/HVDC	500W AC, 930W DC, or 1200W HVAC/HVDC	350W AC, 440W DC

Feature	Cisco Nexus 93180YC-FX	Cisco Nexus 93108TC-FX	Cisco Nexus 9348GC-FXP
Typical power (AC/DC)*	260W	276W	178W
Maximum power (AC/DC)	425W	460W	287W
Input voltage (AC)	100 to 240V	100 to 240V	100 to 240V
Input voltage (High-Voltage AC [HVAC])	200 to 277V	200 to 277V	90 to 305V
Input voltage (DC)	-48 to -60V	-48 to -60V	-36V to - 72V
input voltage (High-Voltage DC [HVDC])	-240 to -380V	-240 to -380V	192 to 400V
Frequency (AC)	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Fans	4	4	3
Airflow	Port-side intake and exhaust	Port-side intake and exhaust	Port-side intake and exhaust
Physical dimensions (H x W x D)	1.72 x 17.3 x 22.5 in. (4.4 x 43.9 x 57.1 cm)	1.72 x 17.3 x 22.5 in. (4.4 x 43.9 x 57.1 cm)	1.72 x 17.3 x 19.7 in. (4.4 x 43.9 x 49.9 cm)
Acoustics	57 dBA at 40% fan speed, 68.9 dBA at 70% fan speed, and 77.4 dBA at 100% fan speed	64.2 dBA at 40% fan speed, 68.9 dBA at 70% fan speed, and 77.8 dBA at 100% fan speed	67.5 dBA at 50% fan speed, 73.2 dBA at 70% fan speed, and 81.6 dBA at 100% fan speed
RoHS compliance	Yes	Yes	Yes
МТВГ	238,470 hours	319,790 hours	257,860 hours
Minimum ACI image	ACI-N9KDK9-12.2A	ACI-N9KDK9-12.2A	ACI-N9KDK9~13.0
Minimum NX-OS image	NXOS-703I7.1	NXOS-703I7.1	NXOS-703I7.1

^{*} Typical and maximum power values are based on input drawn from the power circuit. The power supply value (for example, 500W AC power supply: NXA-PAC-500W-PI) is based on the output rating to the inside of the switch

Table 3 lists the performance and scalability specifications for the Cisco Nexus 9300-FX series switches. (Check the software release notes for feature support information.)

Table 3. Hardware performance and scalability specifications*

Item	Cisco Nexus 9300-FX Series Switches
Maximum number of Longest Prefix Match (LPM) routes**	1,792,000
Maximum number of IP host entries**	1,792,000
Maximum number of MAC address entries [™]	512,000
Maximum number of multicast routes	128,000
lumber of Interior Gateway Management Protocol (IGMP) nooping groups	Shipping: 8,000 Maximum: 32,000
Maximum number of Cisco Nexus 2000 Series Fabric Extenders er switch	16
Maximum number of Access Control List (ACL) entries	Single-slice forwarding engine: 5000 ingress 2000 egress
Maximum number of VLANs	4096**
lumber of Virtual Routing and Forwarding (VRF) instances	Shipping: 1,000 Maximum: 16,000
Maximum number of ECMP paths	64
faximum number of port channels	512
laximum number of links in a port channel	32
umber of active SPAN sessions	4
laximum number of VLAN's in Rapid per-VLAN Spanning Tree (RPVST) estances	3,967
laximum number of Hot-Standby Router Protocol (HSRP) groups	490
umber of Network Address Translation (NAT) entries	1,023
aximum number of Multiple Spanning Tree (MST) instances	64
low-table size used for Cisco Tetration Analytics platform***	64,000
umber of Queues	8

^{*} More templates and greater scalability are on the roadmap. Refer to the <u>Cisco Nexus 9000 Series Verified Scalability Guide</u> documentation for the latest exact scalability values validated for specific software

^{** 127} VLANs out of 4096 are reserved

^{***} Raw capacity of flow table

Table 4 lists the environmental properties, and Table 5 lists the weight for the Cisco Nexus 9300-FX series switches.

Table 4. Environmental properties

Property	Description
Operating temperature	32 to 104°F (0 to 40°C)
Nonoperating (storage) temperature	-40 to 158°F (-40 to 70°C)
Humidity	5 to 95% (noncondensing)
Altitude	0 to 13,123 ft (0 to 4000m)

Table 5. Weight

Component	Weight
Cisco Nexus 93180YC-FX without power supplies or fans	17.4 lb (7.9 kg)
Cisco Nexus 93108TC-FX without power supplies or fans	17.4 lb (7.9 kg)
Cisco Nexus 9348GC-FXP without power supplies or fans	14.2 lb (6.44 kg)
350W AC power supply	2.8 lb (1.27 kg)
440W DC power supply	2.6 lb (1.27 kg)
500W AC power supply	2.42 lb (1.1 kg)
930W DC power supply	2.42 lb (1.1 kg)
1200W HVDC/HVAC power supply	2.42 lb (1.1 kg)
Fan tray: NXA-FAN-30CFM-F or NXA-FAN-30CFM-B	0.26 lb (0.12 kg)

Table 6 summarizes regulatory standards compliance for the Cisco Nexus 9300-FX series switches.

Table 6. Regulatory Standards Compliance: Safety and EMC

Specification	Description
Regulatory compliance	Products should comply with CE Markings according to directives 2004/108/EC and 2006/95/EC
Safety	NEBS • UL 60950-1 Second Edition • CAN/CSA-C22.2 No. 60950-1 Second Edition • EN 60950-1 Second Edition • IEC 60950-1 Second Edition
	AS/NZS 60950-1GB4943

Specification	Description
EMC: Emissions	• 47CFR Part 15 (CFR 47) Class A
	« AS/NZS CISPR22 Class A
	CISPR22 Class A
	* EN55022 Class A
	• ICES003 Class A
	VCCI Class A
	• EN61000-3-2
	• EN61000-3-3
	• KN22 Class A
	• CNS13438 Class A
EMC: Immunity	• EN55024
	e CISPR24
	• EN300386
	• KN 61000-4 series
RoHS	The product is RoHS-6 compliant with exceptions for leaded-ball grid-array (BGA) balls and lead press-fit connectors.

Software licensing and optics supported

The software packaging for the Cisco Nexus 9000 Series offers flexibility and a comprehensive feature set. The default system software has a comprehensive Layer 2 security and management feature set. To enable additional functions, including Layer 3 IP unicast and IP multicast routing and Cisco Nexus Data Broker, you must install additional licenses. To meet customer requirements, licensing is available as both subscription and perpetual. The <u>licensing guide</u> illustrates the software packaging and licensing available to enable advanced features. For the latest software release information and recommendations, refer to the product bulletin at https://www.cisco.com/qo/nexus9000.

For details about the optics modules available and the minimum software release required for each supported module, visit

https://www.cisco.com/en/US/products/hw/modules/ps5455/products device support tables list.html.

Ordering information

Table 7 presents ordering information for the Cisco Nexus 9300-FX series switches.

Table 7. Ordering information

Part Number	Product Description
Base Part Numbers	
N9K-C93180YC-FX	Nexus 9300 with 48p 1/10G/25G SFP and 6p 40G/100G QSFP28, MACsec, and Unified Ports capable
N9K-C93108TC-FX	Nexus 9300 with 48p 10G BASE-T and 6p 40G/100G QSFP28, MACsec capable
N9K-C9348GC-FXP	Nexus 9300 with 48p 100M/1G BASE-T, 4p 1/10/25G SFP28 and 2p 40G/100G QSFP28

Part Number	Product Description	
Power Supplies on Nexu	is 9348GC-FXP	
NXA-PAC-350W-PI	Nexus 9000 350W AC PS, Port-side Intake	
NXA-PAC-350W-PE	Nexus 9000 350W AC PS, Port-side Exhaust	
NXA-PDC-440W-PI	Nexus 9000 440W DC PS, Port-side Intake	
NXA-PDC-440W-PE	Nexus 9000 440W DC PS, Port-side Exhaust	
Power Supplies on Nexu	s 93180YC-FX and 93108TC-FX	
NXA-PAC-500W-PI	Nexus 9000 500W AC PS, Port-side Intake	
NXA-PAC-500W-PE	Nexus 9000 500W AC PS, Port-side Exhaust	
NXA-PDC-930W-PI	Nexus 9000 930W DC PS, Port-side Intake	
NXA-PDC-930W-PE	Nexus 9000 930W DC PS, Port-side Exhaust	
N9K-PUV-1200W	Nexus 9300 1200W Universal Power Supply, Bi-directional air flow and Supports HVAC/HVDC	
Fans on Nexus 9300-FX	Series Series	
NXA-FAN-30CFM-F	Nexus Single Fan, 30CFM, port side exhaust airflow	
NXA-FAN-30CFM-B	Nexus Single Fan, 30CFM, port side intake airflow	
Licenses on Nexus 9348	GC-FXP	
C1E1TN9300GF-3Y	ACI & NX-OS Subscription Essential package for 1G Nexus 9K Leaf, 3 Year Term	
C1E1TN9300GF-5Y	ACI & NX-OS Subscription Essential package for 1G Nexus 9K Leaf, 5 Year Term	
C1A1TN9300GF-3Y	ACI & NX-OS Subscription Advantage package for 1G Nexus 9K Leaf, 3 Year Term	
C1A1TN9300GF-5Y	ACI & NX-OS Subscription Advantage package for 1G Nexus 9K Leaf, 5 Year Term	
ACI-ES-GF	ACI Essential SW license for a 1G Nexus 9K Leaf	
ACI-AD-GF	ACI Advantage SW license for a 1G Nexus 9K Leaf	
NXOS-ES-GF	NX-OS Essential SW license for a 1G Nexus 9K Leaf	
NXOS-AD-GF	NX-OS Advantage SW license for a 1G Nexus 9K Leaf	
Licenses on Nexus 93180	OYC-FX and N9K-C93108TC-FX	
C1E1TN9300XF-3Y	ACI & NX-OS Subscription Essential package for 10/25/40G+ Nexus 9K Leaf, 3 Year Term	
C1E1TN9300XF-5Y	ACI & NX-OS Subscription Essential package for 10/25/40G+ Nexus 9K Leaf, 5 Year Term	
C1A1TN9300XF-3Y	ACI & NX-OS Subscription Advantage package for 10/25/40G+ Nexus 9K Leaf, 3 Year Term	

Part Number	Product Description
C1A1TN9300XF-5Y	ACI & NX-OS Subscription Advantage package for 10/25/40G+ Nexus 9K Leaf, 5 Year Term
ACI-ES-XF	ACI Essential SW license for a 10/25/40G+ Nexus 9K Leaf
ACI-AD-XF	ACI Advantage SW license for a 10/25/40G+ Nexus 9K Leaf
NX-OS-ES-XF	NX-OS Essential SW license for a 10/25/40G+ Nexus 9K Leaf
NX-OS-AD-XF	NX-OS Advantage SW license for a 10/25/40G+ Nexus 9K Leaf
Power Cords	
CAB-250V-10A-AR	AC Power Cord - 250V, 10A - Argentina (2.5 meter)
CAB-250V-10A-BR	AC Power Cord - 250V, 10A - Brazil (2.1 meter)
CAB-250V-10A-CN	AC Power Cord - 250V, 10A - PRC (2.5 meter)
CAB-250V-10A-ID	AC Power Cord - 250V, 10A, South Africa (2.5 meter)
CAB-250V-10A-IS	AC Power Cord - 250V, 10A - Israel (2.5 meter)
CAB-9K10A-AU	Power Cord, 250VAC 10A 3112 Plug, Australia (2.5 meter)
CAB-9K10A-EU	Power Cord, 250VAC 10A CEE 7/7 Plug, EU (2.5 meter)
CAB-9K10A-IT	Power Cord, 250VAC 10A CEI 23-16/VII Plug, Italy (2.5 meter)
CAB-9K10A-SW	Power Cord, 250VAC 10A MP232 Plug, SWITZ (2.5 meter)
CAB-9K10A-UK	Power Cord, 250VAC 10A BS1363 Plug (13 A fuse), UK (2.5 meter)
CAB-9K12A-NA	Power Cord, 125VAC 13A NEMA 5-15 Plug, North America (2.5 meter)
CAB-AC-L620-C13	North America, NEMA L6-20-C13 (2.0 meter)
CAB-C13-C14-2M	Power Cord Jumper, C13-C14 Connectors, 2 Meter Length (2 meter)
CAB-C13-CBN	Cabinet Jumper Power Cord, 250 VAC 10A, C14-C13 Connectors (0.7 meter)
CAB-IND-10A	10A Power cable for India (2.5 meter)
CAB-N5K6A-NA	Power Cord, 200/240V 6A North America (2.5 meter)
CAB-HVAC-SD-0.6M	HVAC Power cable for Anderson-LS-25
CAB-HVAC-RT-0.6M	HVAC Power cable with right angle connector for RF-LS-25

Part Number	Product Description
Accessories on Nexus 9	300-FX Series
NXK-ACC-KIT-1RU	Nexus Fixed Accessory Kit with 4-post rack mount kit
NXK-ACC-KIT-2P	Nexus Fixed Accessory Kit with 2-post rack mount kit; supported on 9348GC-FXP only

Warranty, service and support

The Cisco Nexus 9300-FX series has a 1-year limited hardware warranty. The warranty includes hardware replacement with a 10-day turnaround from receipt of a Return Materials Authorization (RMA).

Cisco offers a range of professional, solution, and product support services for each stage of your Cisco Nexus 9300-FX series deployment:

- Cisco Data Center Quick Start Service for Cisco Nexus 9000 Series Switches: This offering provides consulting services that include technical advice and assistance to help deploy Cisco Nexus 9000 Series Switches.
- Cisco Data Center Accelerated Deployment Service for Cisco Nexus 9000 Series Switches: This
 service delivers planning, design, and implementation expertise to bring your project into production.
 The service also provides recommended next steps, an architectural high-level design, and
 operation-readiness guidelines to scale the implementation to your environment.
- Cisco Migration Service for Cisco Nexus 9000 Series Switches: This service helps you migrate from Cisco Catalyst® 6000 Series Switches to Cisco Nexus 9000 Series Switches.
- Cisco Product Support: Support service is available globally 24 hours a day, 7 days a week, for Cisco software and hardware products and technologies associated with Cisco Nexus 9000 Series Switches. Enhanced support options delivered by Cisco also include solution support for Cisco ACI, Cisco SMARTnet™ Service, and Cisco Smart Net Total Care™ service.
- For more information, visit https://www.cisco.com/go/services.

Cisco environmental sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's <u>Corporate Social Responsibility</u> (CSR) Report.

Reference links to **information about key environmental sustainability topics** (mentioned in the "Environment Sustainability" section of the CSR Report) are provided in the following table:

Sustainability topic	Reference
Information on product material content laws and regulations	<u>Materials</u>
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

^{*} For Cisco products only

Reference links to **product-specific environmental sustainability information** that is mentioned in relevant sections of this data sheet are provided in the following table:

Sustainability Topic	Reference
General	
Product Compliance	Table 6. Safety and Compliance Information
Power	
Power Supply	<u>Table 2, Product specifications: Power Supplies, Typical and Max power specification</u>
Material	
Unit Weight	Table 5. Weight
Dimensions and Mean Time between Failures Metrics	Table 2. Product specifications

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For more information

For more information about the Cisco Nexus 9000 Series and latest software release information and recommendations, visit https://www.cisco.com/go/nexus9000.

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CISCO
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Data Sheet

Cisco UCS C220 M5 Rack Server

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The Cisco UCS° C220 M5 Rack Server delivers record-breaking performance for space-constrained environments.

Product Overview

The Cisco UCS C220 M5 Rack Server is among the most versatile general-purpose enterprise infrastructure and application servers in the industry. It is a high-density 2-socket rack server that delivers industry-leading performance and efficiency for a wide range of workloads, including virtualization, collaboration, and bare-metal applications. The Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of the Cisco Unified Computing System™ (Cisco UCS) to take advantage of Cisco's standards-based unified computing innovations that help reduce customers' Total Cost of Ownership (TCO) and increase their business agility.

The Cisco UCS C220 M5 server extends the capabilities of the Cisco UCS portfolio in a 1-Rack-Unit (1RU) form factor. It incorporates the Intel® Xeon® Scalable processors, supporting up to 20 percent more cores per socket, twice the memory capacity, 20 percent greater storage density, and five times more PCIe NVMe Solid-State Disks (SSDs) compared to the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C220 M5 delivers outstanding levels of expandability and performance in a compact package, with:

- Latest (second generation) Intel Xeon Scalable CPUs with up to 28 cores per socket
- Supports first-generation Intel Xeon Scalable CPUs with up to 28 cores per socket
- Up to 24 DDR4 DIMMs for improved performance
- Support for the Intel Optane DC Persistent Memory (128G, 256G, 512G)¹
- Up to 10 Small-Form-Factor (SFF) 2.5-inch drives or 4 Large-Form-Factor (LFF) 3.5-inch drives (77 TB storage capacity with all NVMe PCle SSDs)
- Support for 12-Gbps SAS modular RAID controller in a dedicated slot, leaving the remaining PCle
 Generation 3.0 slots available for other expansion cards
- Modular LAN-On-Motherboard (mLOM) slot that can be used to install a Cisco UCS Virtual Interface
 Card (VIC) without consuming a PCIe slot
- Dual embedded Intel x550 10GBASE-T LAN-On-Motherboard (LOM) ports

Requires a DDR4 DIMM for deployment. The sizes of DCPMM must be the same and the DDR4 DIMMS must the same. But between the DCPMM and DIMMs, the sizes may vary, as shown in the 18-TB configuration described earlier in this data sheet.

Powering Next-Generation Applications

The Cisco UCS C220 M5 Rack Server is well-suited for a wide range of workloads, including:

- IT and web infrastructure
- High-performance virtual desktops
- · Medium-sized and distributed databases
- Middleware
- Collaboration
- Public cloud

C220 M5 servers can be deployed as standalone servers or in a Cisco UCS managed environment. When used in combination with Cisco UCS Manager, the C220 M5 brings the power and automation of unified computing to enterprise applications, including Cisco® SingleConnect technology, drastically reducing switching and cabling requirements.

Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. If also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments.

The Cisco Integrated Management Controller (IMC) delivers comprehensive out-of-band server management with support for many industry standards, including:

- Redfish Version 1.01 (v1.01)
- Intelligent Platform Management Interface (IPMI) v2.0
- Simple Network Management Protocol (SNMP) v2 and v3
- Syslog
- Simple Mail Transfer Protocol (SMTP)
- Key Management Interoperability Protocol (KMIP)
- HTML5 GUI
- HTML5 virtual Keyboard, Video, and Mouse (vKVM)
- Command-Line Interface (CLI)
- XML API

Management Software Development Kits (SDKs) and DevOps integrations exist for Python, Microsoft PowerShell, Ansible, Puppet, Chef, and more. For more information about integrations, see <u>Cisco DevNet</u>.

The C220 M5 is Cisco Intersight™ ready. Cisco Intersight is a new cloud-based management platform that uses analytics to deliver proactive automation and support. By combining intelligence with automated actions, you can reduce costs dramatically and resolve issues more quickly.

Product Specifications

Table 1 lists the specifications for the Cisco UCS C220 M5 Rack Server.

Table 1. Specifications

Item	Specifications
Form factor	1RU rack server
Processors	Intel Xeon Scalable processors (1 or 2) or second-generation Intel Xeon Scalable processors (1 or 2)
Memory	24 DDR4 DIMM slots: 8, 16, 32, 64, and 128 GB up to 2666 MHz
	Support for the Intel Optane DC Persistent Memory (128G, 256G, 512G
PCIe expansion	2 PCle 3.0 slots plus 1 dedicated 12-Gbps RAID controller slot and 1 dedicated mLOM slot
RAID controllers	 Internal controllers: Cisco 12-Gbps Modular RAID Controller (PCle 3.0) with 1 or 2-GB Flash-Backed Write Cache (FBWC), providing enterprise-class data protection for up to 10 SAS and SATA Hard-Disk Drives (HDDs), SSDs, or NVMe PCle SSDs; or Cisco 12-Gbps Modular SAS Host Bus Adapter (HBA)
	 External controller: Cisco 12-Gbps 9400-8e SAS HBA
Internal storage	Backplane options:
	 Up to 10 x 2.5-inch SAS and SATA HDDs and SSDs and up to 2 NVMe PCle drives
	 Up to 10 x 2.5-inch NVMe PCle drives
	 Up to 4 x 3.5-inch SAS and SATA HDDs and SSDs and up to 2 NVMe PCle drives
Embedded Network Interface Cards (NICs)	Dual 10GBASE-T Intel x550 Ethernet ports
mLOM	Dedicated mLOM slot that can flexibly accommodate 1-, 10-, 25-, 40-, and 100-Gbps adapters
Power supplies	Hot-pluggable, redundant 770W AC, 1050W AC, 1050W DC, and 1600W AC
Other storage	 Dual internal Cisco FlexFlash Secure Digital (SD) cards (32, 64, and 128 GB) for installing an operating system or hypervisor
	 Support for RAID 0 mirroring between SD cards
	 Dedicated Baseboard Management Controller (BMC) MicroSD card (32 GB) for server utilities
	Dual M.2 SATA SSD or NVMe
Management	• <u>Cisco[®] Intersight</u> [™]
	Cisco IMC
	Cisco IMC Supervisor
	Cisco UCS Manager
	Cisco UCS Central Software
	Cisco UCS Director
	Cisco UCS Performance Manager

Item	Specifications
Rack options	Cisco ball-bearing rail kit or friction rail kit with optional reversible cable management arm
Hardware and software interoperability	See the <u>Cisco Hardware and Software Interoperability List</u> for a complete listing of supported operating systems and peripheral options

System Requirements

Table 2 lists system requirements for the server.

Table 2. System Requirements

Item	Requirements
Cisco UCS Manager (optional)	Release 3.2(1) or later
Cisco IMC	Release 3.1(1) or later

Ordering information

For information about installing or upgrading your server, see the <u>Cisco UCS C220 M5 hardware installation</u> <u>quide</u>.

For ordering information, see:

- Cisco UCS C220 M5 SFF rack server specification sheet
- Cisco UCS C220 M5 LFF rack server specification sheet

Warranty information

Cisco UCS C220 M5 Rack Servers have a 3-year Next-Business-Day (NBD) hardware warranty and 90-day software warranty.

Augmenting the Cisco UCS warranty, Cisco Smart Net Total Care [™] and Cisco Solution Support services are part of Cisco's technical services portfolio. Cisco Smart Net Total Care combines Cisco's industry-leading and award-winning foundational technical services with an extra level of actionable business intelligence that is delivered to you through the smart capabilities in the Cisco Smart Net Total Care portal. For more information, please refer to https://www.cisco.com/c/en/us/support/services/smart-net-total-care/index.html.

Solution Support includes both Cisco product support and solution-level support, resolving complex issues in multivendor environments on average 43 percent more quickly than with product support alone. Solution Support is a critical element in data center administration, helping rapidly resolve any issue encountered while maintaining performance, reliability, and return on investment.

This service centralizes support across your multivendor Cisco environment for both our products and solution partner products you've deployed in your ecosystem. Whether there is an issue with a Cisco or solution partner product, just call us. Our experts are the primary point of contact and own the case from first call to resolution. For more information, please refer to:

https://www.cisco.com/c/en/us/services/technical/solution-support.html.

Product Environmental information

Product environmental information for users per Commission Regulation (EU) 2019/424 https://www.cisco.com/web/dofc/12135000.pdf

Takeback and Recycle Program

https://www.cisco.com/c/en/us/about/product-innovation-stewardship/product-recycling/takeback-recycle-program.html.

Cisco and Partner Services

Cisco and our industry-leading partners deliver services that accelerate your transition to a Cisco UCS C-Series Rack Servers solution. Cisco Unified Computing Services can help you create an agile infrastructure, accelerate time to value, reduce costs and risks, and maintain availability during deployment and migration. After deployment, our services can help you improve performance, availability, and resiliency as your business needs evolve and help you further mitigate risk. For more information, visit https://www.cisco.com/go/unifiedcomputingservices.

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Flexible Payment Solutions to Help You Achieve Your Objectives

Cisco Capital makes it easier to get the right technology to achieve your objectives, enable business transformation and help you stay competitive. We can help you reduce the total cost of ownership, conserve capital, and accelerate growth. In more than 100 countries, our flexible payment solutions can help you acquire hardware, software, services and complementary third-party equipment in easy, predictable payments. Learn more.

For More Information

For more information about Cisco UCS servers, refer to https://www.cisco.com/go/ucs.

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Data Sheet

Cisco UCS C240 M5 Rack Server

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The Cisco UCS® C240 M5 Rack Server delivers industry-leading performance and expandability.

Product Overview

The Cisco UCS C240 M5 Rack Server is a 2-socket, 2-Rack-Unit (2RU) rack server offering industry-leading performance and expandability. It supports a wide range of storage and I/O-intensive infrastructure workloads, from big data and analytics to collaboration. Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of a Cisco Unified Computing System™ (Cisco UCS) managed environment to take advantage of Cisco's standards-based unified computing innovations that help reduce customers' Total Cost of Ownership (TCO) and increase their business agility.

In response to ever-increasing computing and data-intensive real-time workloads, the enterprise-class Cisco UCS C240 M5 server extends the capabilities of the Cisco UCS portfolio in a 2RU form factor. It incorporates the Intel® Xeon® Scalable processors, supporting up to 20 percent more cores per socket, twice the memory capacity, and five times more.

Non-Volatile Memory Express (NVMe) PCI Express (PCIe) Solid-State Disks (SSDs) compared to the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C240 M5 delivers outstanding levels of storage expandability with exceptional performance, with:

- . The latest second-generation Intel Xeon Scalable CPUs, with up to 28 cores per socket
- Supports the first-generation Intel Xeon Scalable CPU, with up to 28 cores per socket
- Support for the Intel Optane DC Persistent Memory (128G, 256G, 512G)¹
- Up to 24 DDR4 DIMMs for improved performance including higher density DDR4 DIMMs
- Up to 26 hot-swappable Small-Form-Factor (SFF) 2.5-inch drives, including 2 rear hot-swappable SFF drives (up to 10 support NVMe PCle SSDs on the NVMe-optimized chassis version), or 12 Large-Form-Factor (LFF) 3.5-inch drives plus 2 rear hot-swappable SFF drives
- Support for 12-Gbps SAS modular RAID controller in a dedicated slot, leaving the remaining PCle Generation 3.0 slots available for other expansion cards
- Modular LAN-On-Motherboard (mLOM) slot that can be used to install a Cisco UCS Virtual Interface Card (VIC) without consuming a PCle slot, supporting dual 10- or 40-Gbps network connectivity

¹ Requires a DDR4 DIMM for deployment. The sizes of DCPMM must be the same and the DDR4 DIMMS must the same. But between the DCPMM and DIMMs, the sizes may vary, as shown in the 18-TB configuration described earlier in this data sheet.

- Dual embedded Intel x550 10GBASE-T LAN-On-Motherboard (LOM) ports
- Modular M.2 or Secure Digital (SD) cards that can be used for boot

High Performance for Data-Intensive Applications

The Cisco UCS C240 M5 rack server is well-suited for a wide range of enterprise workloads, including:

- · Big data and analytics
- Collaboration
- Small and medium-sized business databases
- Virtualization and consolidation
- Storage servers
- · High-performance appliances

C240 M5 servers can be deployed as standalone servers or in a Cisco UCS managed environment. When used in combination with Cisco UCS Manager, the C240 M5 brings the power and automation of unified computing to enterprise applications, including Cisco® SingleConnect technology, drastically reducing switching and cabling requirements.

Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. If also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments.

The Cisco Integrated Management Controller (IMC) delivers comprehensive out-of-band server management with support for many industry standards, including:

- Redfish Version 1.01 (v1.01)
- Intelligent Platform Management Interface (IPMI) v2.0
- Simple Network Management Protocol (SNMP) v2 and v3
- Syslog
- Simple Mail Transfer Protocol (SMTP)
- Key Management Interoperability Protocol (KMIP)
- HTML5 GUI
- HTML5 virtual Keyboard, Video, and Mouse (vKVM)
- Command-Line Interface (CLI)
- XML API

Management Software Development Kits (SDKs) and DevOps integrations exist for Python, Microsoft PowerShell, Ansible, Puppet, Chef, and more. For more information about integrations, see Cisco DevNet (https://developer.cisco.com/site/ucs-dev-center/).

The C240 M5 is Cisco Intersight™ ready. Cisco Intersight is a new cloud-based management platform that uses analytics to deliver proactive automation and support. By combining intelligence with automated actions, you can reduce costs dramatically and resolve issues more quickly.

Product Specifications

Table 1 lists the specifications for the Cisco UCS C240 M5 Rack Server.

Table 1. Specifications

Item	Specifications
Form factor	2RU rack server
Processors	Intel® Xeon® Scalable processors (1 or 2) or second-generation Intel Xeon Scalable processors
Memory	24 DDR4 DIMM slots: 8, 16, 32, 64, and 128 GB and up to 2666 MHz Support for the Intel Optane DC Persistent Memory (128G, 256G, 512G)
PCIe expansion	6 PCle 3.0 slots plus 1 dedicated 12-Gbps RAID controller slot and 1 dedicated mLOM slot
RAID controllers	 Internal controllers: Cisco 12-Gbps Modular RAID Controller (PCle 3.0) with 2- or 4 GB Flash-Backed Write Cache (FBWC), providing enterprise-class data protection for up to 26 SAS and SATA Hard Disk Drives (HDDs), SSDs, or NVMe PCle SSDs; o Cisco 12-Gbps Modular SAS Host Bus Adapter (HBA)
	 External controller: Cisco 12-Gbps 9400-8e SAS HBA
Internal storage	Backplane options:
monal otorago	• Up to 26 x 2.5-inch SAS and SATA HDDs and SSDs and up to 4 NVMe PCle drives
	 Up to 10 x 2.5-inch NVMe PCle and 16 SAS and SATA HDDs and SSDs
	 Up to 12 x 3.5-inch SAS and SATA HDDs and SSDs, and 2 rear 2.5-inch HDDs and SSDs and up to 4 NVMe PCle drives
Embedded Network Interface Cards (NICs)	Dual 10GBASE-T Intel x550 Ethernet ports
mLOM	Dedicated mLOM slot that can flexibly accommodate 1-, 10-, 25-, 40-, and 100-Gbps adapters
Power supplies	Hot-pluggable, redundant 770W AC, 1050W AC, 1050W DC, and 1600W AC
Other storage	 Dual internal Cisco FlexFlash SD cards (32, 64, and 128 GB) for installing an operating system or hypervisor
	 Support for RAID 0 mirroring between SD cards
	 Dedicated Baseboard Management Controller (BMC) MicroSD card (32 GB) for server utilities
	Dual M.2 SATA SSD or NVMe
Management	• Cisco® Intersight™
vianageon	Cisco Integrated Management Controller (IMC)
	 Cisco Integrated Management Controller (IMC) Supervisor
	<u>Cisco UCS Manager</u>
	Cisco UCS Central Software
	Cisco UCS Director
	<u>Cisco UCS Performance Manager</u>
Rack options	Cisco ball-bearing rail kit with optional reversible cable management farm
Hardware and software interoperability	See the <u>Cisco Hardware and Software Interoperability List</u> for a complete listing of supported operating systems and peripheral options.

System Requirements

Table 2 lists system requirements for the server.

Table 2. System Requirements

Item	Requirements
Cisco UCS Manager (optional)	Release 3.2(1) or later
Cisco IMC	Release 3.1(1) or later

Ordering information

For information about installing or upgrading your server, see the <u>Cisco UCS C240 M5 Rack Server</u> hardware installation quide.

For ordering information, see:

- Cisco UCS C240 M5 SFF rack server specifications sheet
- Cisco UCS C240 M5 LFF rack server specifications sheet

Warranty information

Cisco UCS C240 M5 Rack Servers have a 3-year Next-Business-Day (NBD) hardware warranty and 90day software warranty.

Augmenting the Cisco UCS warranty, Cisco Smart Net Total Care [™] and Cisco Solution Support services are part of Cisco's technical services portfolio. Cisco Smart Net Total Care combines Cisco's industry-leading and award-winning foundational technical services with an extra level of actionable business intelligence that is delivered to you through the smart capabilities in the Cisco Smart Net Total Care portal. For more information, please refer to https://www.cisco.com/c/en/us/support/services/smart-net-total-care/index.html.

Solution Support includes both Cisco product support and solution-level support, resolving complex issues in multivendor environments on average 43 percent more quickly than with product support alone. Solution Support is a critical element in data center administration, helping rapidly resolve any issue encountered while maintaining performance, reliability, and return on investment.

This service centralizes support across your multivendor Cisco environment for both our products and solution partner products you've deployed in your ecosystem. Whether there is an issue with a Cisco or solution partner product, just call us. Our experts are the primary point of contact and own the case from first call to resolution. For more information, please refer to https://www.cisco.com/c/en/us/services/technical/solution-support.html.

Product Environmental information

Product environmental information for users per Commission Regulation (EU) 2019/424 https://www.cisco.com/web/dofc/18799430.pdf

Takeback and Recycle Program

https://www.cisco.com/c/en/us/about/product-innovation-stewardship/product-recycling/takeback-recycle-program.html

Cisco and Partner Services

Cisco and our industry-leading partners deliver services that accelerate your transition to a Cisco UCS C-Series Rack Servers solution. Cisco Unified Computing Services can help you create an agile infrastructure, accelerate time to value, reduce costs and risks, and maintain availability during deployment and migration. After deployment, our services can help you improve performance, availability, and resiliency as your business needs evolve and help you further mitigate risk. For more information, visit https://www.cisco.com/go/unifiedcomputingservices.

Cisco Capital

Flexible Payment Solutions to Help You Achieve Your Objectives

Cisco Capital makes it easier to get the right technology to achieve your objectives, enable business transformation and help you stay competitive. We can help you reduce the total cost of ownership, conserve capital, and accelerate growth. In more than 100 countries, our flexible payment solutions can help you acquire hardware, software, services and complementary third-party equipment in easy, predictable payments. Learn more.

For More Information

For more information about Cisco UCS servers, refer to https://www.cisco.com/go/ucs.

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Cisco Solution Support

This document must be read in conjunction with <u>How Cisco Provides Services</u>, which is incorporated into this document by reference.

Summary

Cisco Solution Support is a Technical Support Service offer that may be bundled with (a) Smart Net Total Care; (2) Software Support Services; and/or (3) Cisco Cloud offers. In some instances Solution Support may be sold independently from a Cisco Technical Support Service. For information on the Cisco Technical Support Services that may be bundled with Cisco Solution Support for the purchased Solution, please reference the applicable service descriptions at www.cisco.com/go/servicedescriptions, incorporated herein by reference.

Cisco Solution Support applies to solutions, infrastructures and appliances ("Solution") that have been documented in a Cisco Solution Support Service Definition Document and are comprised of solely Cisco Products or Cisco Products and products provided by third party vendors ("Solution Support Alliance Partner(s)").

For Cisco Hardware, Software and Cloud Products in a solution, the Cisco Solution Support Services as described in this document are bundled with Cisco Technical Support Services as defined in the relevant service description associated with such Product.

Cisco Solution Support entitles access to a team of Solution experts, who provide a primary point of contact for issues found within the Solution, as well as Product support for the Cisco Hardware, Software and Cloud elements that comprise the Solution. When combined with product support purchased from Solution Support Alliance Partners, Cisco delivers support for the Solution both directly and through coordination of maintenance and support activities needed to troubleshoot and address issues across the Solution.

Cisco Responsibilities:

- a. Cisco Solution Support Center access twenty-four (24) hours per day, seven (7) days per week to assist by telephone, fax, electronic mail or the internet with Solution use, configuration and troubleshooting issues. Cisco will respond within thirty (30) minutes for Severity 1 and 2 calls received. For Severity 3 and 4 calls, Cisco will respond within one (1) hour for all calls received during Standard Business Hours; for calls received outside Standard Business Hours, Cisco will respond within twenty-four (24) hours.
- b. Access to Cisco.com for information on the Solution and Cisco Products being supported. This system provides Customer with helpful technical and general information on the Solution and Cisco Products. Please note that access restrictions identified by Cisco may apply.
- c. To the extent allowed by our Solution Support Alliance Partners, Cisco will provide technical issue management for issues encountered with the Solution.
- d. In the event Cisco determines escalation to a Solution Support Alliance Partner for Third Party Product support is necessary, Cisco will work with the Customer and the applicable Solution Support Alliance Partner to open a case in the Solution Support Alliance Partner's case management system using the Customer's entitlement to support with the Solution Support Alliance Partner.



- e. As part of the Services, it may be necessary for Cisco to disclose Customer information to the applicable Solution Support Alliance Partner. Such information may include logs and contact information.
- f. Cisco will provide information, to the extent allowable, to Solution Support Alliance Partner in support of Solution Support Alliance Partner conducting diagnosis and resolution of the Customer's issue.
- g. Cisco will provide updates on actions taken to resolve the Customer's issue as a primary point of contact.
- h. For some products, Cisco may open cases on behalf of the Customer with the Solution Support Aliance Partner, provided Customer and Solution Support Alliance Partner have agreed to allow Cisco to act in this limited capacity and the Customer is able to provide information that enables the case to be opened with the Solution Support Alliance Partner.
- i. Product Support. As part of the Service, when Technical Support Services for the Product are bundled with Solution Support, Cisco shall provide the services described in the Cisco Responsibilities of the relevant Technical Support Services service descriptions for the Cisco Products that comprise the Solution.

Customer Responsibilities:

- a. Ensure that Cisco Solution Support is purchased with all applicable Cisco Products and areas of coverage that are a part of the covered Solution. If Solution Support is not purchased for all elements in the Solution, support coverage may be delivered at the service level for the applicable Product support (e.g. Smart Net Total Care or Software Support Services).
- b. Customer is required, at the Customer's expense, during the term of the Services, to procure and sustain a level of technical maintenance and support for all elements of the solution including products purchased from Solution Support Alliance Partners. Customers must purchase support for Solution Support Alliance Partner products from the Solution Support Alliance Partner for all of their products used in the Solution. Cisco's ability to interact with the Solution Support Alliance Partner support team is dependent on the service level purchased from the Solution Support Alliance Partner, which should be at no less than a reasonable level for elements operating in a production environment.
- c. Unless otherwise instructed by Cisco, Customer will open all cases, where Solution support is expected, with Cisco using the service contract associated with the Solution.
- d. Customer acknowledges that it will be necessary for Cisco to disclose Customer information to Solution Support Alliance Partners for the purposes of case response, product specific support, advance troubleshooting and product issue resolution and Customer authorizes such disclosure.
- e. Provide, at Customer's expense, reasonable access to Solution elements through the Internet or via modem to establish a data communication link between Customer and the Cisco engineer and/or Solution Support Alliance Partner support personnel as applicable and systems passwords so that problems may be diagnosed and, where possible, corrected remotely.
- f. Customer will be required to have and maintain permissions to access Solution Support Alliance Partner websites for Solution Support Alliance Partner software releases (i.e., patches, updates and upgrades) as well as for specific information, documentation and knowledge base related to Third Party Software that may interact with the Solution.

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- g. For Solution Support Services that require following a Cisco design, Customer will be required to implement and maintain the Solution being covered following the guidance set out in the current version of such design in all material respects.
- h. Update to the latest Cisco, and/or latest Solution Support Alliance Partner software release, if advised by Cisco or Solution Support Alliance Partner, as applicable, to correct a reported problem.
- i. Provide any hardware and/or software required to perform fault isolation.
- j. Product Support. When Technical Support Services for the Product are bundled with Solution Support, Customer shall comply with the Customer Responsibilities described in the applicable Technical Support Services service description for the Cisco Products that comprise the Solution.

1 Veeam and NetApp Data Protection

NetApp and Veeam Backup and Replication or Veeam Availability Suite™ provide solutions that are simple to use and simple to procure. The combination of Veeam's solutions with NetApp E-series, HCI, ONTAP, and hybrid cloud solutions help organizations simplify IT operational management, lower costs, and attain RPO and RTO of seconds—not hours and days that legacy solutions take —for all applications and data.

NetApp and Veeam have partnered to develop solutions that address all of your availability challenges. With Veeam Backup and Replication™, you gain a comprehensive availability strategy that meets, not only RPOs, but also RTOs. Veeam Backup and Replication provides heterogenous data protection solutions that integrate tightly with NetApp ONTAP®'s data protection capabilities. The NetApp and Veeam partnership integrate support for NetApp Snapshot technology into Veeam Backup and Replication. This integration provides a deeper level of protection and availability across NetApp ONTAP, HCI, and E-Series storage platforms.

Veeam Backup and Replication backup from Storage Snapshots leverages NetApp Snapshot copies for quick VM recovery and efficient file-level recovery in VMware environments. Data is read directly from NetApp Snapshot copies. Then these snapshot copies can be replicated to secondary storage systems, whether local or remote, by using SnapMirror and/or SnapVault. This approach provides the shortest possible backup windows, lowest impact on production VMs, and ability to meet your most demanding SLAs.

Integration of Veeam Backup and Replication with NetApp Snapshot technology gives you the ability to achieve:

- Faster backups and quick recovery, including Instant VM Recovery
- Improved protection
- · Cost-effective cloud backup
- Enhanced scalability
- Better return on NetApp storage investments through DataLabs™ sandbox capabilities
- Smooth, easy implementations

Faster Backup and Quick Recovery

Legacy backup tools were not designed to deal with the demands of today's virtual environments and the always-on enterprise. Veeam Explorer for Storage Snapshots gives you the ability to take advantage of the low overhead that periodic array-based snapshots offer by letting you quickly restore guest OS files, application items, or an entire VM in minutes directly from native NetApp Snapshot copies. Recover entire VMs or individual items from NetApp Snapshot, SnapMirror, and SnapVault software. And improve disaster recovery protection by creating instant secondary backups from Storage Snapshots up to 20 times faster than competitive offerings.

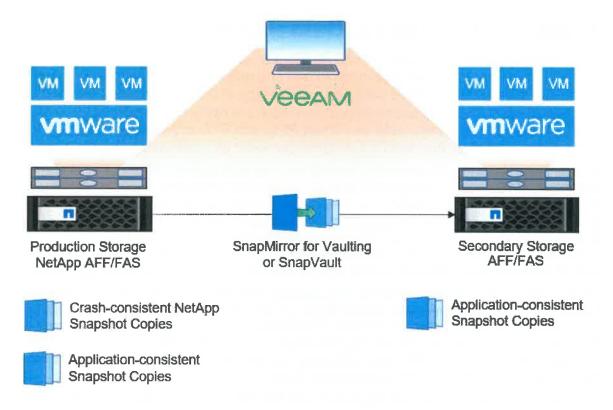


Figure 1: Veeam simplifies management for virtualized environments with Snapshot and SnapVault integration.

Data can be directly restored from these Snapshot copies, eliminating the need for staging. In addition, data and application recoveries can be performed directly from NetApp Snapshot copies on primary or secondary NetApp storage (ONTAP). And Veeam helps reduce the time needed to mount snapshot copies compared with manual processes.

This time efficiency helps you lower your RTOs while avoiding human errors that can occur during critical recovery steps such as mounting snapshot copies. The process takes just a few clicks from the Veeam Backup and Replication interface to restore your data.

Improved Protection

Protect your data using the "3-2-1" rule. You keep three copies of your data stored on two different sets of media with at least one copy stored offsite. Veeam Backup and Replication creates primary and secondary backups directly from NetApp Snapshot copies. By combining the low RPO capabilities of NetApp with Veeam Backup and Replication's fast RTO enablement, NetApp and Veeam provide exceptional levels of data protection and a simple, easy-to-manage suite of capabilities that delivers affordable, industry-leading performance. With the integration of NetApp Snapshot capabilities into Veeam Backup and Replication you get more value out of your backup data by reducing operational and management costs while delivering advanced data protection for the modern data center.

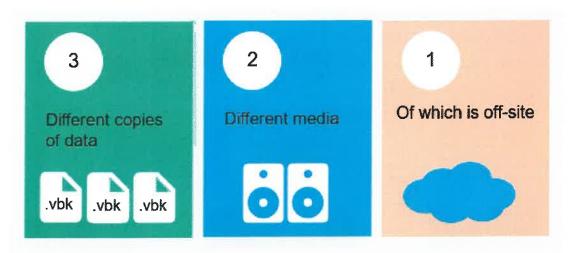


Figure 2: 3-2-1 rule.

Cost-effective Cloud Backup

With the NetApp and Veeam solution you can upgrade your backup solution to replace tape with cloud-integrated backup and archiving. Veeam Backup and Replication provides you with a simple, fast, and efficient way to backup data to the cloud. Use Cloud Volumes ONTAP (CVO) for backup with Veeam Backup and Replication as a cost-effective replacement for tape. CVO provides the following benefits:

- Reduced storage costs as a result of:
 - Compression and de-duplication
 - Tiering to object storage
 - Snapshots and clones
- Efficient snapshots and clones for backup and parallel processing
- Multicloud replication to another virtual or physical ONTAP instance using SnapMirror to:
 - Simplify and speed-up data migrations
 - Facilitate disaster recovery
 - Eliminate cloud lock in

Veeam Backup and Replication can manage and move backup and archived data to lower-cost, cloud-based storage. You can't do that with tape. The Veeam Backup and Replication interface is used to recover the exact data needed, which could reside either on or off premises.

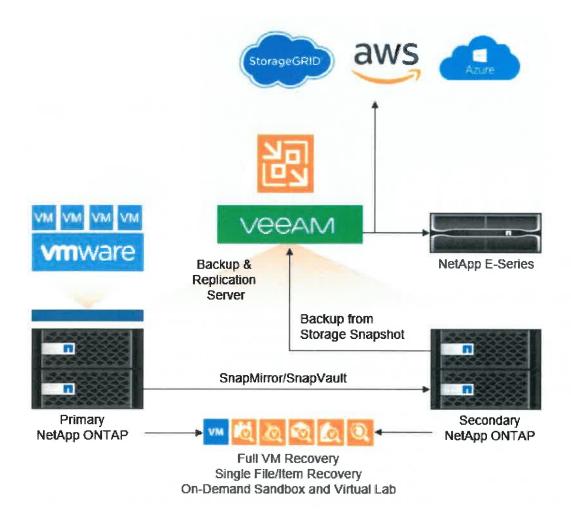


Figure 3: Cloud-integrated backup - Backup, recovery, and archiving with Cloud Backup.

Enhanced Scalability

Veeam Backup and Replication scales efficiently and effectively. It provides backup acceleration technologies that double I/O performance and shorten backup windows by up to five times—all while reducing load on primary storage, backup storage, and vCenter Servers.

"Our data center is 99% virtual and we decided on Veeam because it is built for virtualization as well as being agentless, scalable, simple to deploy and manage. We've standardized on NetApp, and by combining both Veeam and NetApp, our clustered Data ONTAP architecture achieves the outstanding recovery points from snapshots, as well as rapid recovery from Veeam, protecting our data from both large-scale failures as well as common user errors. We can recover whole VMs or individual application items easily and in minutes. Veeam also provides us integration into our Microsoft Systems Center environment for monitoring."

- Brent Dunington, Systems Architect, University of British Columbia

Better Return on NetApp Storage Investments Through DataLabs Capabilities

Veeam's DataLabs for Storage Snapshots integrates Veeam Backup and Replication's long-standing on-demand sandbox capability with NetApp Snapshot and FlexClone technology. This gives you another way to leverage your NetApp storage investment. Using this capability, you can provision a complete, isolated copy of your production environment in just a few clicks by running copies of production VMs directly from FlexClone copies on NetApp primary or secondary storage. So, you can test updates, test disaster recovery plans, or troubleshoot your production environment—plus a variety of similar use cases—at the full speed and scale of production storage.

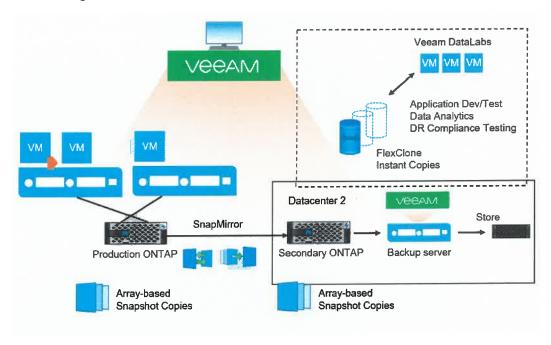


Figure 4: Unified replication – SnapMirror for disaster recovery and backup; Veeam DataLabs for Storage Snapshots.

Smooth, Easy Implementations

Implementations are simple to deploy and easy to manage with no agents. As an agentless architecture that directly integrates with VMware vSphere and Microsoft Hyper-V, Veeam Backup and Replication is simple to install and manage. When you combine Veeam with NetApp powered storage solutions you can simplify IT operational management, significantly improve application availability, and mitigate risk.

"Veeam backs up and replicates 2 petabytes of data from NetApp Storage snapshots very quickly because Veeam integrates with NetApp. High-speed backup enables us to back up all data within specified RPOs to meet our customers' SLAs. Veeam is the only solution we trust for data availability and data protection."

- Daniel Zuthof, Solution Architect, Equinix, Inc.

1 Veeam and NetApp Data Protection

NetApp and Veeam Backup and Replication or Veeam Availability Suite™ provide solutions that are simple to use and simple to procure. The combination of Veeam's solutions with NetApp E-series, HCI, ONTAP, and hybrid cloud solutions help organizations simplify IT operational management, lower costs, and attain RPO and RTO of seconds—not hours and days that legacy solutions take —for all applications and data.

NetApp and Veeam have partnered to develop solutions that address all of your availability challenges. With Veeam Backup and Replication™, you gain a comprehensive availability strategy that meets, not only RPOs, but also RTOs. Veeam Backup and Replication provides heterogenous data protection solutions that integrate tightly with NetApp ONTAP®'s data protection capabilities. The NetApp and Veeam partnership integrate support for NetApp Snapshot technology into Veeam Backup and Replication. This integration provides a deeper level of protection and availability across NetApp ONTAP, HCI, and E-Series storage platforms.

Veeam Backup and Replication backup from Storage Snapshots leverages NetApp Snapshot copies for quick VM recovery and efficient file-level recovery in VMware environments. Data is read directly from NetApp Snapshot copies. Then these snapshot copies can be replicated to secondary storage systems, whether local or remote, by using SnapMirror and/or SnapVault. This approach provides the shortest possible backup windows, lowest impact on production VMs, and ability to meet your most demanding SLAs.

Integration of Veeam Backup and Replication with NetApp Snapshot technology gives you the ability to achieve:

- Faster backups and quick recovery, including Instant VM Recovery
- · Improved protection
- Cost-effective cloud backup
- Enhanced scalability
- Better return on NetApp storage investments through DataLabs[™] sandbox capabilities
- Smooth, easy implementations

Faster Backup and Quick Recovery

Legacy backup tools were not designed to deal with the demands of today's virtual environments and the always-on enterprise. Veeam Explorer for Storage Snapshots gives you the ability to take advantage of the low overhead that periodic array-based snapshots offer by letting you quickly restore guest OS files, application items, or an entire VM in minutes directly from native NetApp Snapshot copies. Recover entire VMs or individual items from NetApp Snapshot, SnapMirror, and SnapVault software. And improve disaster recovery protection by creating instant secondary backups from Storage Snapshots up to 20 times faster than competitive offerings.

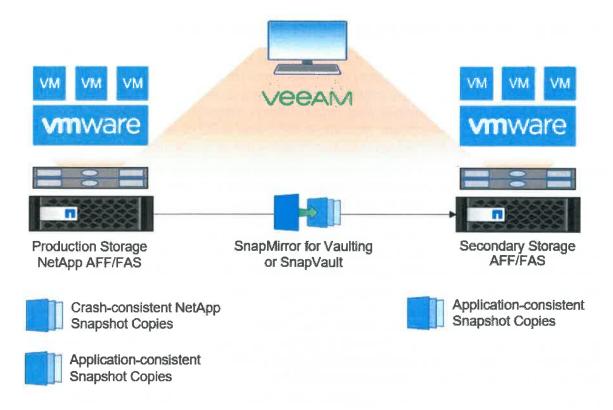


Figure 1: Veeam simplifies management for virtualized environments with Snapshot and SnapVault integration.

Data can be directly restored from these Snapshot copies, eliminating the need for staging. In addition, data and application recoveries can be performed directly from NetApp Snapshot copies on primary or secondary NetApp storage (ONTAP). And Veeam helps reduce the time needed to mount snapshot copies compared with manual processes.

This time efficiency helps you lower your RTOs while avoiding human errors that can occur during critical recovery steps such as mounting snapshot copies. The process takes just a few clicks from the Veeam Backup and Replication interface to restore your data.

Improved Protection

Protect your data using the "3-2-1" rule. You keep three copies of your data stored on two different sets of media with at least one copy stored offsite. Veeam Backup and Replication creates primary and secondary backups directly from NetApp Snapshot copies. By combining the low RPO capabilities of NetApp with Veeam Backup and Replication's fast RTO enablement, NetApp and Veeam provide exceptional levels of data protection and a simple, easy-to-manage suite of capabilities that delivers affordable, industry-leading performance. With the integration of NetApp Snapshot capabilities into Veeam Backup and Replication you get more value out of your backup data by reducing operational and management costs while delivering advanced data protection for the modern data center.

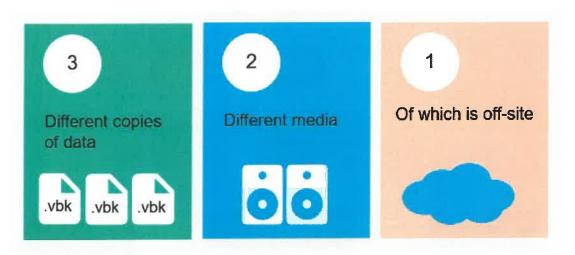


Figure 2: 3-2-1 rule.

Cost-effective Cloud Backup

With the NetApp and Veeam solution you can upgrade your backup solution to replace tape with cloud-integrated backup and archiving. Veeam Backup and Replication provides you with a simple, fast, and efficient way to backup data to the cloud. Use Cloud Volumes ONTAP (CVO) for backup with Veeam Backup and Replication as a cost-effective replacement for tape. CVO provides the following benefits:

- Reduced storage costs as a result of:
 - Compression and de-duplication
 - Tiering to object storage
 - Snapshots and clones
- Efficient snapshots and clones for backup and parallel processing
- Multicloud replication to another virtual or physical ONTAP instance using SnapMirror to:
 - Simplify and speed-up data migrations
 - Facilitate disaster recovery
 - Eliminate cloud lock in

Veeam Backup and Replication can manage and move backup and archived data to lower-cost, cloud-based storage. You can't do that with tape. The Veeam Backup and Replication interface is used to recover the exact data needed, which could reside either on or off premises.

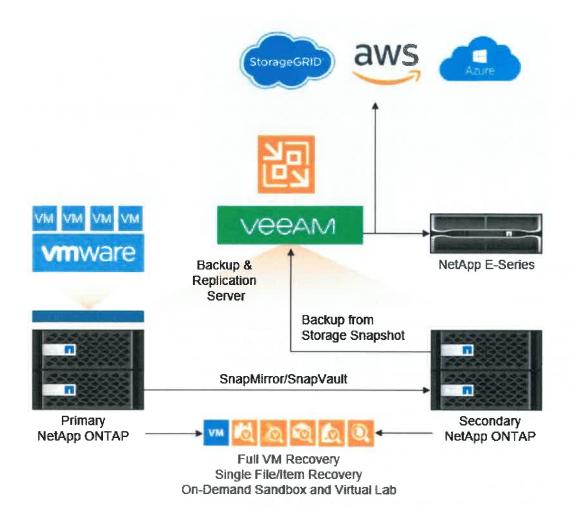


Figure 3: Cloud-integrated backup = Backup, recovery, and archiving with Cloud Backup.

Enhanced Scalability

Veeam Backup and Replication scales efficiently and effectively. It provides backup acceleration technologies that double I/O performance and shorten backup windows by up to five times—all while reducing load on primary storage, backup storage, and vCenter Servers.

"Our data center is 99% virtual and we decided on Veeam because it is built for virtualization as well as being agentless, scalable, simple to deploy and manage. We've standardized on NetApp, and by combining both Veeam and NetApp, our clustered Data ONTAP architecture achieves the outstanding recovery points from snapshots, as well as rapid recovery from Veeam, protecting our data from both large-scale failures as well as common user errors. We can recover whole VMs or individual application items easily and in minutes. Veeam also provides us integration into our Microsoft Systems Center environment for monitoring."

- Brent Dunington, Systems Architect, University of British Columbia

Better Return on NetApp Storage Investments Through DataLabs Capabilities

Veeam's DataLabs for Storage Snapshots integrates Veeam Backup and Replication's long-standing on-demand sandbox capability with NetApp Snapshot and FlexClone technology. This gives you another way to leverage your NetApp storage investment. Using this capability, you can provision a complete, isolated copy of your production environment in just a few clicks by running copies of production VMs directly from FlexClone copies on NetApp primary or secondary storage. So, you can test updates, test disaster recovery plans, or troubleshoot your production environment—plus a variety of similar use cases—at the full speed and scale of production storage.

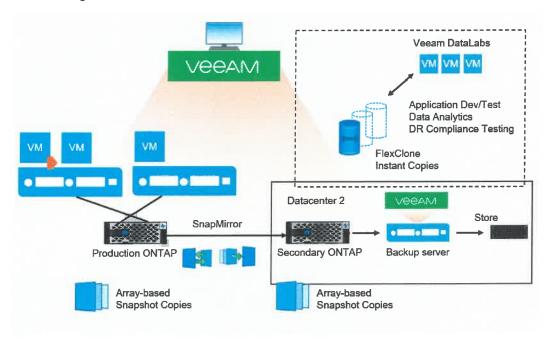


Figure 4: Unified replication – SnapMirror for disaster recovery and backup; Veeam DataLabs for Storage Snapshots.

Smooth, Easy Implementations

Implementations are simple to deploy and easy to manage with no agents. As an agentless architecture that directly integrates with VMware vSphere and Microsoft Hyper-V, Veeam Backup and Replication is simple to install and manage. When you combine Veeam with NetApp powered storage solutions you can simplify IT operational management, significantly improve application availability, and mitigate risk.

"Veeam backs up and replicates 2 petabytes of data from NetApp Storage snapshots very quickly because Veeam integrates with NetApp. High-speed backup enables us to back up all data within specified RPOs to meet our customers' SLAs. Veeam is the only solution we trust for data availability and data protection."

Daniel Zuthof, Solution Architect, Equinix, Inc.

NetApp Snapshot software, the original and most functional point-in-time copy technology, gives you the ability to protect your data with no performance impact and minimal consumption of storage space. NetApp Snapshot technology enables IT administrators to create point-in-time copies of virtual machines or entire datastores. Then, using SnapRestore®, you can restore from these backup copies at any level of granularity—single files, directories, or entire volumes—simply and quickly when required.

Many copies can be made at any time increment in less than one second, with no performance impact, with minimal incremental capacity requirements, no matter how many Snapshot copies are taken. These are not full copies of data; they are only tracking changes and are very efficient in terms of overall storage capacity. Restores can be done rapidly from any of the copies, providing exceptional RTO.

Up to 1,023 Snapshot copies can be created automatically or manually on each volume, aggregate, or LUN. Over 2.M snapshot copies are supported on a single controller. You can use NetApp Snapshot technology to perform backups as often as needed: daily, hourly, and so on. In the event of a recovery, more frequent backups will reduce data lost since the last backup was taken. This greatly enhances your RPO. Each Snapshot copy is RAID protected for reliable backup.

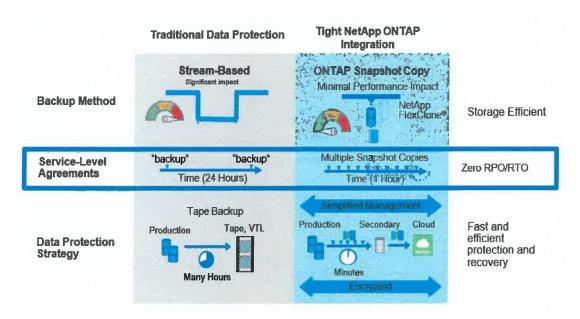


Figure 1: NetApp Snapshot technology – Lets you protect more of your data with minimal performance impact and consumption of storage space You can create a Snapshot copy in less than a second while applications are running, regardless of volume size or level of activity on your NetApp system.

Snapshot creation does not consume extra space on the storage system at create time. When data in the Snapshot copy is overwritten, it starts to consume space for the new data. It is not required to explicitly reserve space upfront for Snapshot space. The space that can be reserved, if needed, for Snapshot copies can be changed at any point in time, depending on the rate of data change, maximizing storage utilization.





Better Together: NetApp E-Series and Veeam

Accelerate recovery and avoid data loss by using Veeam and NetApp

The Challenge

With data growing at astounding rates, IT managers depend more and more on reliable backup and recoverability of their data. High-growth businesses require a complete data protection solution that is reliable, flexible, and easy to use. By virtualizing your environment, you increase the level of data availability, but the need to meet aggressive recovery point objectives (RPOs) and recovery time objectives (RTOs) becomes more difficult. Traditional backup tools were not created for virtualized environments, causing many IT managers to struggle with:

- Unreliable backups
- Lengthy recovery times
- High costs for managing backup data and secondary storage
- Potential lack of compliance because of unreliable backups
- Lost productivity due to management complexity
- · Lack of scalability

The Solution

To meet this challenge, NetApp and Veeam have joined forces to offer high performance storage with reliable data protection that is designed for virtualized environments. Modernize your data protection strategy with a solution that can manage exploding data volumes and can handle the increasing performance and availability demands of a 21st-century infrastructure.

NetApp and Veeam have identified the following compelling use cases for this partnership:

- NetApp® E-Series as a Veeam backup repository. This scalable, modular storage solution delivers excellent performance to fulfill aggressive RTO and RPO requirements. For more information, see this technical report: bit.ly/eseries-veeam-tr.
- NetApp E-Series as a Veeam cloud repository. NetApp E-Series can help drive cloud business by offering service providers high-density and high-capacity storage at a low price point. For more information, read this white paper:
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KEY BUSINESS BENEFITS

- Increase performance and flexibility with a modular, flexible design.
- Reduce operating expenses and the cost of downtime and deployment.
- Improve backup reliability with granular, self-service virtual machine (VM) and file recovery.

NetApp E-Series

A NetApp E-Series system provides simple and reliable SAN storage that integrates seamlessly with most application environments. Its modular design helps decrease operating expenses while offering many options for connectivity, capacity, and performance that easily scale to meet the demands of a growing backup environment.

Veeam Backup & Replication

Veeam Backup & Replication unifies backup and replication in a single solution, reinventing data protection for VMware vSphere and Microsoft Hyper-V virtual environments.

Veeam's agentless design provides multiple backup options to meet your needs. Features such as sourceside deduplication and compression, change-block tracking, parallel processing, and automatic load balancing provide the fastest, most efficient backups possible.

Together, Veeam and NetApp create an optimal staging area for backups, reducing ingest bottlenecks and increasing speed with parallel processing.

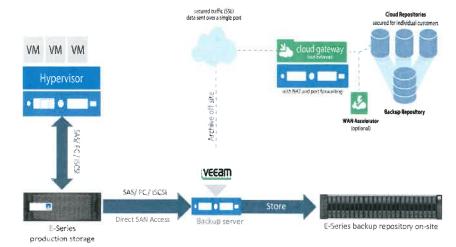


DIAGRAM 1: VEEAM AND E-SERIES SOLUTION.

In addition, Veeam Backup & Replication provides:

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- Automatic verification of every backup, VM, and replica
- Self-service recovery of VMs and guest files without direct network connection to the VM, user permissions, or the need to deploy costly agents
- Instant VM Recovery to recover a failed VM in less than two minutes
- Flexibility to choose what data to back up and where and when to back up and recover your data—whether it's on the premises, on tape, or in the cloud

Veeam and NetApp offer the right solution for performance, flexibility, and reliability, giving you an impressive, modern disaster recovery solution for your vSphere or Hyper-V environment.

New Veeam and NetApp Express Pack Bundles

To make it easy for customers to adopt this solution to handle their data protection needs, Veeam and NetApp are selling a combined Express Pack.

You can find more information in this on-demand webcast: bit.ly/eseries-veeam-expresspacks.

ABOUT VEEAM

Veeam recognizes the new challenges companies across the globe face in enabling the Always-On Enterprise, a business that must operate 24.7.365. To address this, Veeam has pioneered a new market of Availability for the Always-On Enterprise by helping organizations meet recovery time and point objectives.

www.veeam.com

ABOUT NETAPP

Leading organizations worldwide count on NetApp for software, systems and services to manage and store their data. Customers value our teamwork, expertise and passion for helping them succeed now and into the future.

www.netapp.com

VEEAM IN NetApp® Veeam and NetApp address all your Availability challenges

For many organizations, IT complexity is a major impediment impacting their digital transformation initiatives. Higher data volumes, more devices and applications and the need to support hybrid cloud strategies are cited as the main reasons for this increased complexity*. Veeam's integration with NetApp Data Fabric enables digital transformation by simplifying application performance and Availability across multi-cloud workloads while delivering the scalability needed to meet exponential data growth. Benefits include:

ACCELERATED RECOVERY, REDUCED RISK

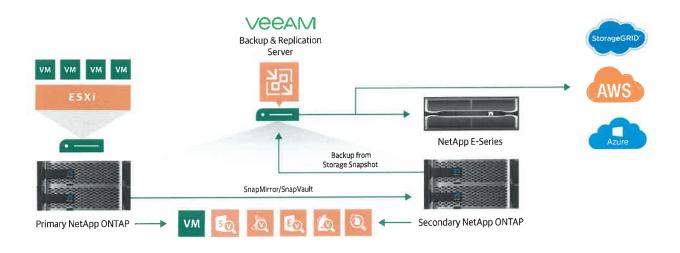
- Instant VM Recovery: VM recovery at the speed of NetApp All-Flash FAS — 78% faster according to IDC.
- Reduced backup windows: 28% shorter data backup windows with Veeam and NetApp storage.
- Increased confidence: 89% less unplanned downtime resulting in greater confidence in IT and reduced risk.

DO MORE WITH YOUR DATA

- Copy Data Management flexibility: Accelerated application development, data analytics and simplified DR testing with Veeam DataLabs and NetApp secondary storage.
- Ransomware Remediation: Leverage Veeam secure restore with NetApp storage to safely recover from ransomware and malware events.

MANAGEMENT SIMPLICITY

- Low-touch IT ops: Veeam's integration with NetApp ONTAP delivers enhanced IT automation so you can spend less time on IT operations and more time helping the organization transform and innovate.
- Rapid deployment: Veeam auto-discovers virtual and physical workloads, along with their associated NetApp Snapshot Copies, to accelerate data protection and reduce risk.
- Scale at speed: Veeam's Scale-Out Backup Repository capabilities combined with software-defined NetApp Data Fabric solutions increases agility.
- Centralized multi-cloud management: Protect applications and data on-premise in remote offices or in the public cloud.



USE CASES



Backup Modernization: Increase IT simplicity through a low-touch agentless architecture that delivers rapid recovery directly from NetApp Snapshot Copies with Veeam Instant VM Recovery™. Perform backups at the speed of flash with zero disruption to business applications. Increase agility through consistent performance and Availability across multi-cloud workloads.



DR Orchestration: Simplify DR through automated workflows. Veeam's integration with NetApp SnapMirror and SnapVault simplifies backup and DR orchestration to deliver greater confidence in critical application and data Availability, whether it's a single file, virtual machine or entire data center recovery — on-premise, remote office or in the cloud.



Multi-Cloud Agility: Protect critical workloads and data across multi-cloud environments from a single management console. Leverage Free Veeam Cloud Tier to archive data in low-cost public cloud storage like AWS, Azure, IBM Cloud and thousands of Veeam Cloud Service Provider (VCSP) data centers.



Application DevTest: Veeam and NetApp copy data management combined with Veeam DataLabs accelerates application development and testing by providing developers with a near real-time copy of production data, in a completely isolated environment, to innovate and iterate.



Data Analytics: Rapidly provision near real-time copies of production data to data scientists and analysts to generate insights.



DR Compliance: Leverage NetApp Snaplock for write-once read many (WORM) file locking. Perform non-disruptive, on-demand DR tests with Veeam DataLabs to quickly and easily prove compliance with organizational data governance and regulatory requirements.



Ransomware Remediation: Mitigate risk by leveraging Veeam secure restore with NetApp secondary storage to quickly and safely recover from a ransomware or malware attack.

SUPPORTED ENVIRONMENT CONFIGURATIONS

	SMALL Bundle	MEDIUM Bundle	LARGE Bundle
Bundle	Value-oriented Larger capacity deployments	Faster performance Space conscious	Greater capacity Data growth/workload consolidation
Ideal for	small org, remote office, local storage	midsize organizations, small enterprises	midsize organizations, small enterprises
NetApp	FAS2720 12x4TB disk (29TB Usable)	FAS272O 12x8TB disk (5OTB usable)	FAS272OA-PACK-124 + Additional Shelf (98TB usable)
Veeam	Protect 50 instances* (3 yr)	Protect 100 instances* (3 yr)	Protect 200 instances* (3 yr)
Average 3 Year Usage HW/SW Support	19TB used for 50 VMs** 3 years	37TB used for 100 VMs** 3 years	70TB used for 200 VMs** 3 years
Express Pack SKU PN	FAS2720A-EXP-101	FAS2720A-PACK-124	FAS2720A-PACK-124 + shelf
Veeam NetApp PN	Qty 5 : SW-SUB-VBRPLS-3Y (total 50 instances)	Qty 10 : SW-SUB-VBRPLS-3Y (total 100 instances)	Qty 20 : SW-SUB-VBRPLS-3Y (total 200 instances)

^{*}Veeam Instance Licensing is a single type of licensing for all workloads including physical, VMware, Hyper-V and AWS workloads, on premises and across public clouds.





^{**} Assumptions: 100GB average VM size, weekly full with incremental daily, 30 days retention, 10% growth, 2:1 data reduction.

^{***}Refer to terms and conditions.





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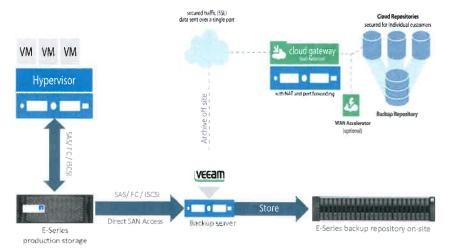


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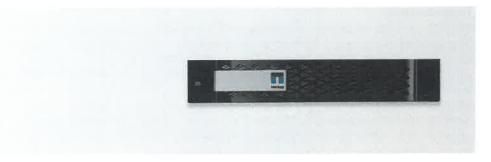
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www.veeam.com

ABOUT NETAPP

Leading organizations worldwide count on NetApp for software, systems and services to manage and store their data. Customers value our teamwork, expertise and passion for helping them succeed now and into the future. www.netapp.com





Datasheet

NetApp E2800 Series

Gain affordable performance and simplicity with our cost-effective hybrid flash arrays

KEY BENEFITS

Affordable Performance

Leverage flash in an affordable hybrid system for a wide range of mixed workloads.

Cloud Connectivity

Enable flexible and cost-effective backup and recovery to the cloud from a NetApp® E2800 Series system with NetApp SANtricity® Cloud Connector.

Proven Simplicity

A modern, on-box, browser-based GUI enables you to get access to your data in under 10 minutes, with simple, flexible administration.

Worry-Free Reliability

The NetApp E2800 is an entry-level product with enterprise-level redundancy, automated management, and field-proven availability.

The Challenge

Many small and medium-sized organizations are seeking new ways to manage growing data requirements with minimal cost and maintenance. Consistent performance and cost-effective delivery are imperative. Yet managing data is increasingly more complex and costly, especially with limited resources, space, and power.

The Solution

The NetApp E2800 is a hybrid flash storage system with a low acquisition cost and even lower cost of ownership. With the E2800, you can streamline your IT infrastructure and drive down costs. Pay-as-you-grow flexibility makes the E2800 an excellent solution for companies of all sizes that are facing rapid, unpredictable growth.

Unlike other storage systems that add file or virtualization layers in the I/O data path, E2800 hybrid arrays are purpose-built to optimize performance for mixed workloads. The E2800 improves IOPS and throughput to help you extract value from your data and take action faster. The intuitive, on-box graphical interface simplifies configuration and maintenance while providing enterprise-level storage capabilities to deliver consistent performance, data integrity, reliability, and security.

Affordable Performance

The E2800 storage system optimizes price and performance to support any workload. Higher performance with solid-state drives (SSDs) enables the E2800 to maximize storage density, requiring fewer disks to meet your performance objectives. The E2800 delivers over 300K sustained IOPS and supports a broad range of high-speed host interfaces, including 32Gb Fibre Channel (FC), 25Gb iSCSI, and 12Gb SAS, to protect investment in storage networks.

The SSD cache feature provides intelligent analytics-based caching capabilities for read-intensive workloads. Hot data is cached by using higher-performance, lower-latency SSDs in the drive shelves, with the full dataset being stored on HDDs. You don't need to set up complicated policies to define the trigger for data movement between tiers. You can simply set it and forget it. The SSD cache is expandable to up to 5TB per storage system.



Proven Simplicity

The E2800 modular design and simple management tools make it easy to scale without adding management complexity. The on-box, browser-based SANtricity System Manager GUI enables you to streamline deployment and start working with your data in under 10 minutes.

Simplicity does not preclude flexibility. NetApp SANtricity software offers a combination of comprehensive features and ease of use. You can use SANtricity System Manager to walk you through workload-appropriate provisioning, or you can provision workloads on your own. NetApp Dynamic Disk Pools (DDP) technology dramatically simplifies RAID management by distributing data, parity, and spare capacity across a pool of drives, with intelligent defaults, minimal decision making, and no stranded capacity after deletions. A single E2800 system can support both DDP and traditional RAID volumes if your workloads require it.

The SANtricity Cloud Connector software solution, part of the NetApp Data Fabric, provides a cost-effective basic backup approach with backup and recovery to the cloud from E-Series systems.

Advanced Data Protection

NetApp SANtricity DDP technology enables storage administrators to simplify RAID management, improve data protection, and maintain predictable performance under all conditions. DDP technology evenly distributes data, protection information, and spare capacity across the entire pool of drives, simplifying setup and maximizing use. This innovative technology minimizes the performance impact of a drive failure and can return the system to optimal condition up to 8x faster than traditional RAID. With shorter rebuild times and patented technology to prioritize reconstruction, DDP capabilities significantly reduce exposure to multiple disk failures, offering a level of data protection that simply can't be achieved with traditional RAID.

With SANtricity software, all management tasks can be performed while the storage remains online with complete read/write data access. Storage administrators can make configuration changes, conduct maintenance, or expand the storage capacity without disrupting I/O to attached hosts. SANtricity software online capabilities include:

- DDP drive allows additions and reductions.
- Dynamic volume expansion enables administrators to increase the capacity of an existing volume.
- Dynamic segment size migration enables administrators to change the segment size of a given volume.
- Dynamic RAID-level migration changes the RAID level of a RAID group on the existing drives without requiring the relocation of data. Supported RAID levels are 0, 1, 5, 6, and 10.
- All firmware updates (controller, drive, IOM) are nondisruptive, with no interruption to data access.

To protect against data loss and downtime events, both locally and over long distances, the E2800 offers advanced data protection that is common to enterprise storage. These features include:

- NetApp Snapshot[™] technology. Create and restore pointin-time copies of datasets in less than a second to protect against accidental data loss on the local array.
- Volume copy. Create a complete physical copy (clone) of a volume for applications that require a full point-in-time copy of production data.
- Asynchronous mirroring. Volume replication over FC or IP long distance to remote site keeps your business operations running no matter what happens.
- **Synchronous mirroring.** Continuous volume replication is enabled over FC at campus distances.
- Cloud backup. SANtricity Cloud Connector enables flexible and cost-effective backup and recovery from on-premises storage to the cloud.

With the E2800 array, you can easily replicate data to another E2800 or other NetApp E-Series system. With this capability, you can create a high-speed, low-latency recovery system that runs at the same speed as your production operations. You can also choose to fail over to a consolidated E-Series system with more cost-effective disk storage. This flexibility in design allows you to choose the profile of performance and cost to meet your business requirements.

High Availability and Enterprise Reliability

The E2800 is based on a field-proven architecture that delivers high reliability and 99.9999% availability when NetApp best practices are followed. The E2800 offers a secure, reliable foundation for your valuable data.

Designed to have no single point of failure, the E2800 has fully redundant I/O paths with automated failover and extensive diagnostic capabilities that alert on and actively help resolve failures. SANtricity Data Assurance (based on the T10 PI industry standard) validates data integrity and protects against silent data corruption. The E2800 also offers data management features such as Snapshot copies, volume copy, and mirroring. All management tasks are performed while the storage remains online with complete read/write data access. Storage administrators can make configuration changes and conduct maintenance without disrupting application I/O.

One of the most critical aspects of an enterprise solution is the ability to detect and resolve issues. In this area, the E2800 all-flash array offers significant depth of capabilities, including:

- Extensive capturing of diagnostic data provides comprehensive fault isolation and simplifies analysis of unanticipated events.
- Background monitoring proactively scans media and tracks drive health against defined thresholds.
- Integrated Recovery Guru diagnoses problems and provides the applicable procedure to use for recovery.
- With DDP technology and RAID 6, a drive rebuild continues even when an unreadable sector or second failure is encountered.
- NetApp Active IQ® telemetry is built into the E2800, so you can take advantage of Active IQ hybrid cloud services to optimize your environment.

Secure Data, Secure Management

NetApp SANtricity drive encryption* combines local key management with drive-level encryption for comprehensive security for data at rest with no impact to performance. Because all drives eventually leave the data center through redeployment, retirement, or service, it's reassuring to know that your sensitive data isn't leaving with them. Customers can choose to manage the drive authentication keys natively for a simple lowest-cost solution or use a KMIP-compliant external key manager for centralized administration.

Management access to the E2800 is protected with role-based access control, LDAP/Active Directory integration, and digital certificate management. The security administrator manages user privileges and password requirements. The exportable audit log gives visibility into management actions taken on the array. All management communication is over HTTPS. In addition, SAML support is available to optionally enable multifactor authentication for further protection against threats.

Modular Flexibility

With the E2800 flexible configuration options, you build just one architecture to support a multitiered data model. This feature is particularly suited for intensive analytics applications such as Splunk, which uses hot, warm, cold, and frozen tiers.

E2800 systems offer multiple form factors and drive technology options to meet your requirements:

- The ultradense 60-drive system shelf supports up to 720TB in just 4U and is optimal for environments with vast amounts of data and limited floor space, with either 2.5-inch or 3.5-inch drives.
- The 24-drive system shelf combines low power consumption and exceptional performance density with its highperformance 2.5-inch drives.
- The 12-drive shelf is a great fit for cost-conscious organizations that need to provide both performance and capacity, with either 2.5-inch SSDs or 3.5-inch drives.

Maximum Storage Density

Today's storage must keep up with continuous growth and must meet the most demanding capacity requirements. The E2800 is designed for capacity-intensive environments that also require efficient data center space, power, and cooling utilization. The system's ultradense, 60-drive, 4U disk shelf provides industry-leading performance and space efficiency to reduce rack space by up to 60%. Its high-efficiency power supplies can lower power and cooling use by up to 40%.

DevOps-Ready System

To enable the automation and agility that are required in the DevOps-based IT revolution, the E2800 supports a full-featured on-box REST API, SANtricity Web Services. Ansible modules are available for open-source orchestration and configuration management. And for easy integration and automation in traditional IT and Windows ecosystems, the E2800 also supports Windows PowerShell and SMI-S 1.6.

Hardware and software for at-rest data encryption are not available in certain countries, including Russia, Belarus, Kazakhstan, and other Eurasian Customs Union countries

ENERGY STAR Certification

All E-Series systems use "85% PLUS" power supplies, exceeding the EPA ENERGY STAR requirement of 80% efficiency. See the latest EPA ENERGY STAR-certified E-Series configurations.

ASHRAE Compliance

All E-Series systems meet the certification requirements of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers), a global society that advances human well being through sustainable technology built for the environment:

- E2812, E2824, DE212C, and DE224C are ASHRAE A4 compliant
- E2860 and DE460C are ASHRAE A3 compliant

About NetApp Services

Gain greater business value from your investment

Whether you're planning your new storage system, need specialized know-how for a major storage deployment, or want to optimize the operational efficiency of your existing infrastructure, NetApp Services and NetApp certified partners can help. Learn more about NetApp Services.

For more information

• NetApp E2800 hybrid flash storage systems

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of applications and data across cloud and on-premises environments to accelerate digital transformation. Together with our partners, we empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize their operations. For more information, visit www.netapp.com. #DataDriven



Sponsored by: Veeam

Authors: Phil Goodwin Matthew Marden

June 2018

Business Value Highlights

286% five-year ROI

89% lower cost of unplanned downtime

56% more efficient backup staff

85% faster data recovery windows

28% shorter backup windows

36% lower hardware costs

The Business Value of Using Veeam and NetApp to Reduce Data-Related Risks

EXECUTIVE SUMMARY

Data is increasingly at the core of any business or organization and is fueling new digital transformation (DX) initiatives. Data runs nearly every aspect of a company, from customer and employee engagement to product and service development to operations. Reflecting the strategic importance of data, an IDC global study of 800 organizations revealed that 47% of enterprises have a chief data officer today. The growing importance of data to remain competitive in today's disruptive business climate requires organizations to break down data silos and provide data services to achieve faster insights, business value, and oversight — especially as data becomes more distributed, dynamic, and diverse. With data at the center of business operations, data availability has never been more essential. Data availability is one of several elements in an effective and holistic data management strategy.

IDC interviewed organizations supporting data backup and recovery environments with Veeam software and NetApp storage hardware to understand the value of the combined approach. These organizations reported making data backup and recovery operations substantially more effective, thereby limiting the operational and business risk associated with data-related incidents. Further, they explained that they are leveraging Veeam and NetApp to make these environments more cost-effective to deploy and operate, with several organizations taking advantage of the integration to support operations such as development not traditionally associated with backup and recovery environments. The result is a strong value from their investment in Veeam software and NetApp storage hardware, which IDC projects will be valued at \$31,642 per 100 users per year (\$2.32 million per organization) over five years and would result in a five-year ROI of 286%, by:

- Enabling more effective and timely data backup and recovery efforts to reduce risk and costs associated with these activities
- Reducing the cost of data-related outages in terms of lost user productivity and revenue
- Minimizing the staff time required to manage and support data backup and recovery environments
- Optimizing the cost of storage hardware through longer life spans and improved data deduplication and compression capabilities



SITUATION OVERVIEW

The Rise of Digital Transformation

In 2017, businesses spent \$1.1 trillion trying to transform into connected, intelligent, and technology-driven organizations. In 2018, businesses are expected to spend an additional \$1.3 trillion. By 2021, businesses worldwide will spend \$2.1 trillion just trying to transform. IDC projects that in that same time frame, 70% of CIOs will have developed a cloud-first strategy to support the infrastructure agility required by transformation. DX is the path forward in a hyperconnected world. To transform, companies must find innovation and agility and be prepared to go to market rapidly, at scale, with new products and services while developing key insights necessary to reach core audiences and open new markets.

IDC asserts that to achieve this transformation, organizations will leverage an intelligent core platform, which turns business activity insight into actionable intelligence in a streamlined, continuous process. IDC describes this as the DX platform; at its center, the platform relies on diverse, distributed, and dynamic data to drive the opportunity. Without data at the center, the DX model fails. In this model, data is critical to business survival and, in turn, makes data integrity and accessibility sacrosanct.

However, the attributes and location of data relevant to a DX platform continue to change. Data has become increasingly diverse, spanning not only structured systems but also unstructured data such as time series data, machine-generated data, and stream data. Data is also increasingly more dynamic; it not only is based on batch runs but also is real time in nature as telemetry data is generated from a growing number of sensors and devices. Further, data is increasingly distributed, located not only in core datacenters but also in edge locations, on devices, and in cloud services. Data being diverse, dynamic, and distributed further exacerbates the ability to employ a centralized and holistic data services framework.

There are significant benefits to holistic data services across the enterprise, including shortening time to value, lowering costs, and creating an environment that encourages innovation, but failing to move in concert can have a negative effect on potential benefit. Moving to a cloud-first strategy, for instance, may be the right plan for your business, but if each business unit is able to use its own providers, services, SaaS, and so forth, the business could duplicate effort and spend or miss out on the economies of scale that may be gained by leveraging a single provider. This creates a significant challenge: How do businesses journey through digital transformation in a concerted way?



The same challenge exists when examining data use. Individual business units may have the need for specific data at specific times. Other business units may have the need for the same data or for data that has been manipulated in a slightly different way. In some organizations, that data may be duplicated time and again for use by different business units. In other businesses, lines of business may not have a full understanding of the types of data available to them at all. Increasingly, the value derived from data is not looking at data sources independently but combining data sets from historically disparate data silos. How is a holistic effort around data management applied across these disparate and increasingly distributed and diverse data sources? How do you encourage innovation and provide everyone with the right level of data access to support their efforts?

In today's regulatory environment, the right level of access may even be paramount to inspiring innovation. The strict rules and potential 4% of revenue fines associated with the General Data Protection Regulation (GDPR) are well documented, but even companies that don't do business with the European Union cannot afford to skimp on data protection mechanisms. About 40% of the world's nations already have privacy laws of some type in place and, given the worldwide coverage of Cambridge Analytica's use of Facebook data, it is entirely likely that additional regulations will continue to emerge.

As a result, businesses are being forced to maintain a delicate data balance. They must encourage innovation, but they cannot innovate without guardrails that establish ways of consistently operationalizing data without exposing data that could generate a regulatory issue against a backdrop of a more complex data use landscape. At the same time, businesses must be able to provide a comprehensive view of their data sources not only to ensure compliance with data controls but also to maximize the value of an increasingly important asset — their data capital.

VEEAM AND NETAPP

NetApp and Veeam have a strategic partnership to deliver Intelligent Data Management for the Hyper-Available Enterprise. The Veeam Availability Suite provides enterprise scalability for backup and replication of mission-critical workloads for applications and data running on NetApp FAS, FlexPod, SolidFire, and E-Series systems. Customers can create image-based backups with little to no impact on production for all applications and data in vSphere and Hyper-V environments.



THE BUSINESS VALUE OF VEEAM SOFTWARE WITH NETAPP STORAGE

Study Demographics

IDC interviewed eight organizations for this study, asking them a variety of quantitative and qualitative questions about the impact of deploying the integrated Veeam and NetApp solution on their IT operations, businesses, and costs.

Table 1 characterizes the attributes of these organizations. As shown in the table, substantial company size is evident with the average number of employees across all organizations at 14,200 and average annual revenue of \$4.94 billion. The sample of companies involved in the study represented a spectrum of geographies and vertical industries. Six companies were based in the United States, one company was based in Belgium, and one company was based in the Netherlands. There was a good level of diversity among vertical industries, which included the biotechnology, education, finance, government (2), healthcare, and manufacturing (2) sectors.

TABLE 1 Demographics of Interviewed Organizations

	Average	Median	
Number of employees	14,200	10,500	
Number of IT staff	938	193	
Number of business applications	696	350	
Revenue per year	\$4.94 billion \$2.9 billion		
Countries	United States (6), Belgium, and the Netherlands		
Industries	Biotechnology, education, finance, government (2), healthcare, and manufacturing (2)		

n = 8

Source: IDC, 2018

At the organizations surveyed, the interviewed IT managers described various reasons for choosing the Veeam and NetApp solution set over alternative approaches. Overall, they cited the advantages of having a combined solution that leveraged the value of NetApp storage hardware and its capabilities while providing additional value from specially designed Veeam software. They also pointed to a number of key selection criteria, including:

- Synergies from a combined solution
- Better data protection and integration
- Enhanced storage performance
- Increased configuration speed



Regarding the value derived from the combined Veeam and NetApp solution, one customer stated: "The additional value from the combination was significant enough to choose NetApp over another competing product. I'd say there's something like 20% more value by having both. It was the deciding factor for us." On the topic of improved data protection, another customer and study participant said: "Veeam and NetApp provide better data protection and better integration. Whether our data is in our datacenter or in the cloud, Veeam plus NetApp provides integrated data protection."

As shown in Table 2, these organizations are using Veeam and NetApp to run and support significant data backup and recovery environments with an average of more than 1.4PB (1,424TB) of data. They are using the Veeam and NetApp solution to support a variety of applications, including:

- Customer-facing websites/portals
- Database workloads
- ERP workloads
- VDI apps

Overall, there was a mix of NetApp storage appliance models deployed, and configurations included Clustered ONTAP, MetroCluster, and a mix of hybrid and all-flash arrays. Table 2 provides additional metrics on the use of the Veeam and NetApp solution by interviewed organizations.

TABLE 2 Environments Supported by Veeam and NetApp

	Average	Median
Number of datacenters	3	3
Number of sites/branches	8	5
Number of users of applications	7,320	3,000
Number of TB	1,424	600

n = 8

Source: IDC, 2018

Business Value Analysis

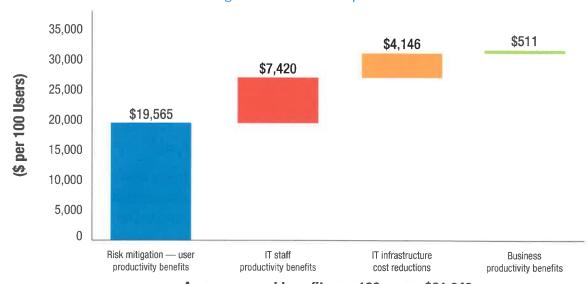
Study participants reported that using Veeam software with NetApp storage hardware is enabling them to reduce risk associated with data backup and recovery activities. They are accomplishing this by speeding up recovery times and compressing backup windows as well as reducing the frequency and duration of impactful data-related interruptions to business operations. Further, the Veeam and NetApp combination is proving cost effective, both from the perspective of maximizing the value of their



investments in storage hardware and in terms of staff time required to support and manage their extensive and often growing data environments. IDC's analysis shows that these benefits translate into significant value for interviewed organizations (see Figure 1), which IDC quantifies at an average of \$31,642 per 100 users per year (\$2.32 million per organization) over five years in the following areas:

- Risk mitigation user productivity benefits. Reducing the frequency of outages and performance degradation related to data backup and recovery activities means higher employee productivity and less revenue loss. IDC puts the value of higher productivity and revenue at an annual average of \$19,565 per 100 users (\$1.43 million per organization).
- IT staff productivity benefits. Enabling faster and more robust data backups and recovery efforts frees up time for these teams, while the combined Veeam and NetApp solution requires less time to manage and support. IDC quantifies the value of these staff efficiencies at an average of \$7,420 per 100 users per year (\$543,100 per organization).
- IT infrastructure cost reductions. Extending life spans of organizations? data backup and recovery hardware through more efficient use reduces costs associated with building and running these environments. IDC calculates these savings at an average of \$4,146 per 100 users per year (\$303,500 per organization).
- Business productivity benefits. Increased confidence in the stability of their backup and recovery environments is enabling organizations to better focus on addressing business opportunities, resulting in additional revenue that IDC projects will have an average value of \$511 per year per 100 users (\$37,400 per organization).

FIGURE 1 Average Annual Benefits per 100 Users



Average annual benefits per 100 users: \$31,642

Source: IDC, 2018



Enhancing Ability to Maintain and Use Data

Study participants spoke about how the Veeam and NetApp solution has made their core processes for data backup and recovery more efficient. By running their data backup and recovery operations on Veeam and NetApp, they perform these operations in less time, more effectively, and with more agility. This not only limits risk related to these activities but also helps ensure business continuity and reduces operational costs associated with backing up and recovering data.

Study participants cited features and capabilities of their Veeam and NetApp environments that are enabling them to achieve efficiencies in the following areas:

- Data backups. Customers cited the benefits of having a greater number of restore points, which enables access to previous data states as needed. In addition, snapshot functionality allows for more frequent and regularly scheduled backups.
- Data loss and recovery. Study participants described recovering data and VMs much faster than with previous approaches when problems did occur. The ability of the Veeam and NetApp solution to automatically add VMs to backup was cited as a factor in smoothing and optimizing the recovery process. Further, the "live restore" capability has largely obviated the need for organizations to take systems offline during recovery efforts.

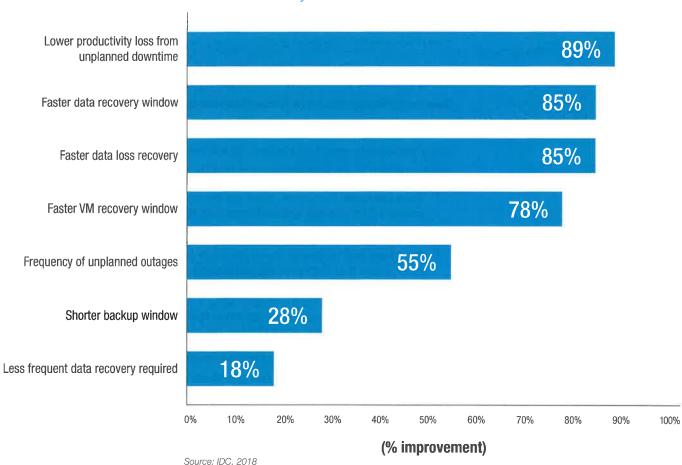
Interviewed organizations provided specific examples of efficiencies they are achieving in the following areas with the Veeam and NetApp solution:

- Streamlined data recovery: "Data recovery used to take 1-2 hours, and now it's down to 3-5 minutes. That huge improvement is the reason we went with Veeam."
- Fewer and more efficient recovery efforts: "We've gone from a couple of data recovery requests per month before Veeam and NetApp to once every month or two. They used to take 4–8 hours to carry out. Now it's done within the hour with live restores, typically in 5–10 minutes."
- Faster restores: "Before Veeam and NetApp, a failure and restore could take 10 hours because the only option was to restore it from a backup repository, depending on what kind of data was involved. But with the Veeam and NetApp integration, the size of the VM doesn't really matter. We can restore the same thing in 5 minutes now because of snapshot integration."

Figure 2 provides granular data on the key benefit metrics derived from IDC's analysis of customer data. Notably, customers are shortening their data recovery windows by an average of 85% and their VM recovery windows by 78% while bringing down the frequency of recovery efforts by an average of 18%. Meanwhile, they are completing backups faster (28% shorter backup window on average), helping them ensure that backup windows do not bleed into normal business hours.







Reducing the Business Cost of Data-Related Risk

Study participants almost uniformly spoke about how the Veeam and NetApp solution has helped them reduce risk related to the use of data. The key dynamic is that having more robust and effective backup environments reduces the chances of data-related outages and events, and recovery is faster and more effective when problems do occur. Risk reduction can be traced to best practices in data protection enabled by the solution set, including:

- More frequent and regular backups using snapshot functionality
- Faster recovery of data and VMs when problems occur
- The creation and availability of more restore points
- The ability to add VMs automatically to backup



Addressing the benefit of reducing impactful downtime, one customer noted: "With Veeam supporting both NetApp snapshots and VMware vSphere snapshots, there's no downtime on running systems. It's like instant snapshotting on your virtual machines. In reality, they do not go offline, and it's all going on behind the scenes.

With respect to the ability to keep applications online, another customer observed: "With Veeam and NetApp, we can do live migrations, live restores, and even live backups. We don't have to tell the user that downtime is needed."

Hourly backups go on during the day, and nobody notices them happening."

Table 3 illustrates the operational impact of the solution set in terms of user productivity losses that occur as a result of unplanned outages. Fewer unplanned outages, less degradation of application performance, and faster resolution combine to lower the overall cost of data-related employee productivity losses by a significant 89% on average.

TABLE 3 Impact of Unplanned Downtime on User Productivity

	Before Veeam and NetApp	With Veeam and NetApp	Difference	Benefit (%)
Frequency per organization per year	24.9	11.1	13.8	55
MTTR (hours)	3.5	0.9	2.6	73
FTE impact per organization per year	7.2	0.8	6.4	89
Value of lost productivity per organization per year	\$504,900	\$55,200	\$449,700	89

Source: IDC, 2018

Meanwhile, application and service outages related to data backup and recovery efforts can take a significant toll on businesses in terms of revenue. Outages can mean that customers are not served, orders are not processed, and new deals are not won. This is reflected in a significant average cost per hour of unplanned downtime of over \$200,000 for interviewed organizations (see Table 4). However, with the Veeam and NetApp solution, study participants have made substantial strides in minimizing the business impact of unplanned outages related to their data environments, reducing revenue losses associated with unplanned outages by an average of \$6.55 million per year.

TABLE 4 Impact of Unplanned Downtime on Revenue

	Per Organization	Per 100 Users
Average cost per hour of unplanned downtime	\$205,620	\$2,809
Revenue lost per year per organization	\$6.55 million	\$89,477
Recognized revenue* lost per year per organization	\$982,500	\$13,422

*IDC applies a 15% operating margin assumption to all revenue benefits for purposes of quantifying revenue for the model.

ANALYZE THE FUTURE

Source: IDC, 2018

Enabling More Efficient Data Backup and Recovery Efforts

Study participants stressed the importance of making storage and disaster recovery teams more effective by enabling more efficient data backup and recovery processes with their Veeam and NetApp storage environments. They traced these benefits to:

- Consistent backups that are easy to manage and troubleshoot
- The availability and use of automation and synchronization
- The benefit of an optimized user interface
- Process simplification and platform stability

Study participants provided specifics of how Veeam and NetApp have positively affected staff responsible for data backups and recovery efforts:

- Less time on backups. "Our team spends most of its time managing and doing data backups. They're saving time because of Veeam and NetApp — probably 60% of all of the time they spend on these activities. Backups that used to take an hour now take 10 minutes."
- Streamlined recovery. "The speed of recovery is completely different with Veeam and NetApp. We've gone from a week to maybe a day or two at the most depending on the extent of the outage."
- Seamless onboarding of new VMs. "The Veeam and NetApp environment is much more automated and much more secure. We went from having a very complicated setup every time we added a new client to not having to do anything because the system actually discovers the new VM created."

With these efficiencies, study participants have freed significant time for their data backup and recovery teams to improve the quality of their efforts and take on other responsibilities. IDC calculates that overall, these teams are an average of 56% more efficient with Veeam and NetApp (see Table 5).

TABLE 5 Impact on Data Backup and Recovery Teams

	Before Veeam and NetApp	With Veeam and NetApp	Difference	Benefit (%)
FTEs per organization (ongoing operations)	5.6	2.5	3.1	56
Hours of staff time per 100 users per year	144	63	80	56
Value of IT staff time per organization per year	\$558,600	\$246,800	\$311,800	56

Source: IDC, 2018



Reducing the Cost of Backing Up and Protecting Data

Study participants also noted that they have been able to create cost-effective data backup and recovery environments with Veeam and NetApp. This is true both in terms of operational expenses, as described previously, and in terms of hardware requirements. According to study participants, hardware costs associated with using Veeam and NetApp are 36% lower than those of alternative solutions they considered. These cost efficiencies can be linked to several factors identified by study participants:

- Over the life span of the system, the solution set allows for more cost-effective growth.
- Flash extends life span because performance levels are extended over time.
- Lower use rates that result from higher performance and improved deduplication capabilities allow for more efficient use of capacity.

Regarding lower storage costs, one customer said: "If we did backups using a more traditional solution, we'd be using another 2–3PB, so we're easily avoiding 1–2PB with Veeam and NetApp, which would cost hundreds of thousands if not a million dollars." The same customer addressed the benefit of a more consolidated environment: "With Veeam and NetApp, we're able to condense our landscape a lot. We've reduced about 300–400 servers."

Figure 3 presents the overall cost of operating these backup and recovery environments over five years with the Veeam and NetApp solution compared with previous and alternative environments. The net financial benefit was a 58% lower cost of operations over five years, resulting from:

- Hardware cost efficiencies
- Efficiencies in managing environments
- Reduced impacts from outages affecting user productivity



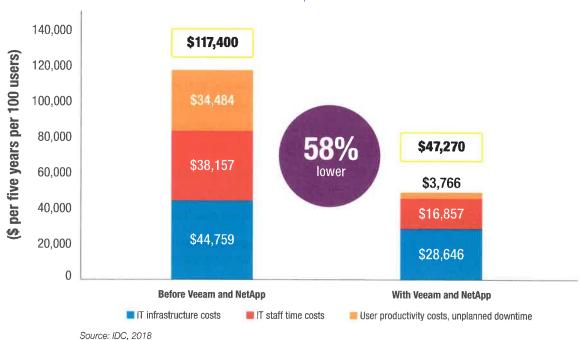


FIGURE 3 Five-Year Cost of Operations

ource: IDC, 2018

Enabling the Business Through Agility and Confidence

In addition to the operational efficiencies cited previously, customers also spoke about forward-looking business opportunities of having a Veeam and NetApp data backup and recovery environment, including potential opportunities related to the development of applications and features. More broadly, the business-focused impact these organizations mentioned centered on aggregate increased levels of confidence, agility, and purpose as the result of risk reduction across a number of specific areas. For example, one organization described the ability to clone VMs and workloads more easily as making it "super agile," thereby opening up the possibility of business units to better serve customers and win additional business. In addition, greater operational efficiency when performance is higher and combined with fewer outages translates to increased revenue opportunities.

Case Study: Intelligent Data Management and Impact on Application Development for Apex Tool Group

As organizations increasingly face an imperative to generate value through data, their data backup and recovery environments, which house and handle significant volumes of key operational data, will increasingly be called upon to enable data use at an organizational level. A key area of focus for many organizations is their development teams, which require consistent and timely access to data as well as compute and storage resources for testing activities.



One interviewed organization, Apex Tool Group, has deployed Veeam and NetApp in a way that provides its development team of several hundred with easier and less expensive access to the storage required to carry out testing activities. An IT manager at Apex explained that by leveraging Veeam's intelligent data management capabilities through the company's integration with ONTAP, the development team now has access to needed storage capacity in significantly less time to perform testing. He commented: "With Veeam and NetApp, we can clone storage and provide it for use in testing without really using it. It's really a major benefit because it saves each developer days per year of time that they otherwise would have spent identifying and waiting for this storage capacity."

The IT manager reported that this flexibility has provided a significant boost to Apex Tool Group's development efforts. He noted that it helps his company avoid the need to scope out development-related work and buy IT resources ahead of time, and it allows the IT team to prepare the entire environment needed for a project in less than a day and have it operationally ready within a day.

The result has been more robust development efforts that align with real-time business demand and an improved ability to serve customers that indirectly results in higher revenue for the company.

ROI Analysis

Table 6 presents IDC's analysis of the benefits and costs associated with interviewed organizations' use of Veeam software and NetApp storage hardware for the organizations' data backup and recovery operations. IDC projects that study participants will realize discounted benefits worth an average of \$112,738 per 100 users (\$8.25 million per organization) over five years based on a discounted investment cost of \$29,199 per 100 users (\$6.11 million per organization). This would result in a five-year ROI of 286%, with these organizations seeing a positive return on their investment in the combined Veeam and NetApp storage environments in an average of nine months.

TABLE 6 Five-Year ROI Analysis

	Per Organization	Per 100 Users
Benefit (discounted)	\$8.25 million	\$112,738
Investment (discounted)	\$2.14 million	\$29,199
Net present value (NPV)	\$6.11 million	\$83,539
Return on investment (ROI)	286%	286%
Payback period	9 months	9 months
Discount rate	12%	12%

Source: IDC, 2018



CHALLENGES AND OPPORTUNITIES

As data becomes more diverse, dynamic, and distributed, it can stymie an effective and holistic data management strategy. A holistic data management strategy is one that spans a myriad of related data services, including data protection, data security, data integration and orchestration, and data location optimization. However, to employ such a solution requires coordination and collaboration among data-related stakeholders. An effective data management strategy is broad in scope and stakeholders, bringing together different constituents. Key stakeholders include not only security, operations, engineering, legal, and risk professionals but also data owners and line-of-business executives. This requires collaboration and planning across organizations with different priorities and depth of knowledge. This organizational dynamic is a challenge commonly seen in larger organizations but can be addressed through C-level strategic planning and priority setting.

CONCLUSION

Data is the lifeblood of any organization. In today's competitive and disruptive business climate, organizations must continue to innovate by leveraging data in strategic ways. This imperative requires organizations to break down data silos and provide holistic data services to achieve faster insights, business value, and oversight — especially as data becomes more distributed, dynamic, and diverse. With data at the center of business operations, data availability has never been more essential.

Data availability is one of several elements in an effective and holistic data management strategy. Together, Veeam and NetApp are providing such a solution.

APPENDIX

IDC's standard ROI methodology was utilized for this project. This methodology is based on gathering data from organizations currently using Veeam software with NetApp storage hardware as the foundation for the model. Based on interviews with study participants, IDC performs a three-step process to calculate the ROI and payback period:

- Measure the savings associated with using Veeam software and NetApp storage hardware in terms of reduced IT costs (staff, hardware, software, maintenance, and IT support), increased user productivity, and business impact measured by revenue over the term of the deployment compared with their previous environments.
- Ascertain the investment made in using Veeam and NetApp.
- Project the costs and savings over a five-year period and calculate the ROI and payback for the deployed solution.



IDC bases the payback period and ROI calculations on a number of assumptions, which are summarized as follows:

- Time values are multiplied by burdened salary (salary + 28% for benefits and overhead) to quantify efficiency and productivity savings. For purposes of this analysis, based on the geographic locations of the interviewed organizations, IDC has used assumptions of an average fully loaded salary of \$100,000 per year for IT staff members and an average fully loaded salary of \$70,000 for non-IT staff members. IDC assumes that employees work 1,880 hours per year (47 weeks x 40 hours).
- Downtime values are a product of the number of hours of downtime multiplied by the number of users affected.
- The impact of unplanned downtime is quantified in terms of impaired end-user productivity and lost revenue.
- Lost productivity is a product of downtime multiplied by burdened salary.
- The net present value of the five-year savings is calculated by subtracting the amount that would have been realized by investing the original sum in an instrument yielding a 12% return to allow for the missed opportunity cost. This accounts for both the assumed cost of money and the assumed rate of return.
- Because every hour of downtime does not equate to a lost hour of productivity or revenue generation, IDC attributes only a fraction of the result to savings. As part of our assessment, we ask each company what fraction of downtime hours to use in calculating productivity savings and the reduction in lost revenue. IDC then taxes the revenue at that rate.

Further, because IT solutions require a deployment period, the full benefits of the solution are not available during deployment. To capture this reality, IDC prorates the benefits on a monthly basis and then subtracts the deployment time from the first-year savings.

Note: All numbers in this document may not be exact due to rounding.

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Introduction

By now, our worlds have been completely flipped upside down. But one thing remains the same. Most legacy backup solutions in the market today...well... aren't very good. Spending too much effort on backup, IT admins lack the time, resources and simply the energy to proactively tackle the real business challenges are holding businesses back and slowing them down. The frustration is real, people!

Here's some data to prove the point. Between September and December 2020, an independent research company asked 3,000 IT pros from 28 countries about their backup and it turned out that only 63% of backups completed on time without errors and 33% of all restore jobs/tasks fail to be successful. Leaves a bad taste in your mouth, doesn't it?

These days, IT needs to think not one, but several steps ahead. Taking ransomware, vendor lock-in, storage capacity, cloud mobility, as well as unpredictable world economical and health factors into the equation.

To add a cherry on top, the events of 2020 and now 2021 have compounded these pressures like a match to a tinderbox. From the explosion of remote working, to the increasing sophistication of security attacks, data protection needs to be a priority. Don't settle for "meh". You can't afford to put it off any longer.

If you're reading this, you can probably attest to some, or maybe even all, of the above. This means you're likely a victim, I mean customer, of one of those mediocre backup solutions.

It's OK. Know this: you're not alone. IT pros around the globe are feeling your pain! This quick read is designed to help you understand the *why* and *when*.

Then, the ball is in your court to determine the how.

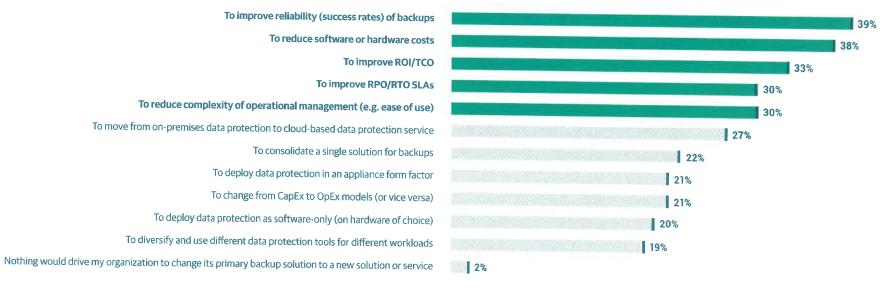




List of the 5 reasons

Here is what 1,500 IT pros from around the globe had to say when asked this simple research question:

Which of the following would drive your organization to change its primary backup solution to a new solution or service?



As you'll see, 3Cs (capabilities, cost and complexity) remain the top themes for switching data protection solutions.

Another very interesting data point from this question:

Only 2% of respondents claimed, "nothing would drive my organization to change its primary backup solution to a new solution or service". If 98% of IT pros having a reason to switch doesn't scream a lack of trust, loyalty and confidence in their current provider, nothing else could!





Reason #1

My current backup is unreliable.

The most popular reason to switch primary backup solutions is reliability, or, a lack thereof. This comes from taking 20-year-old code (or even 30 if you can believe it) and attempting to retrofit it for the IT challenges of today. It's the equivalent of the Winnebago in Spaceballs. Absolutely ridiculous. (If you're too you ng to get that joke, Google it, then watch it. That movie is great. And may the Schwartz be with you!)

In addition, dedupe databases often become error prone and can cause complete data loss. Many solutions lack data recovery verification, or only provide this availability for limited platforms (for example, VMware only). Another issue is simply visibility into what is working and what's not. All too often, IT admins only find out there's an issue when it's too late. It's like discovering a leak in your roof in the middle of a monsoon. Not good.

Many companies chalk this up to lack of training or skills. This is untrue. If a backup solution is stable, reliable and easy to use, then you shouldn't need a PhD to work it. In addition, many IT pros avoid testing due many reasons, but a modern solution can test your backups on schedule in an isolated virtual network.

What you should expect from your next backup solution is peace of mind, and a "set it and forget it" type of confidence. You deserve a solution that's got your back. Plus, imagine actually knowing that you can restore when needed.



Reason #2

Once you add everything up, it costs a lot.

When considering the cost of data protection, it's easy to focus on the traditional costs — hardware, software and storage. Some hardware costs can come at a premium when you're locked-in, and your software isn't flexible enough to handle alternatives. Many software solutions include add-ons, secondary components or ongoing services so make sure nothing is excluded from your calculation. For storage costs, we all know someone who has been burned with hidden charges and data reduction promises that never quite come to fruition. The days of simply pointing to a target are over. You need to find the right balance between performance and cost-efficiency, and the recovery SLAs you're comfortable with for the cost. Without any "gotchas". Those are the worst.

Don't forget the less tangible, often forgotten costs. The cost of downtime and data loss. In addition, impacts that downtime and data loss can have on your relationship with your customers or damage to brand integrity can be quite impactful. The time, effort and resource costs to not only maintain your backup infrastructure, but also to get ramped up, trained and running at full capacity. Another cost is lost productivity. Few things are more frustrating to an IT pro than when they are wasting time and energy reacting to data protection issues, opposed to proactively working on other important projects.

What you should expect from your next backup solution is a simple, yet flexible cost model; where you can use the hardware and storage you want, that can snap in with the software solution you like. You should also be able to make a change in your own environment without setting off a domino-effect nightmare that results in you having to cancel your weekend plans to clean up the mess. This restriction also prohibits your use of modern technologies which perpetuates a long-term effect of reduced efficiency.





Reason #3

That ROI never became a reality.

We've all been promised software could do something only to later find out that it couldn't. Now you're juggling multiple solutions to cover certain aspects of your environment, or that path to simplicity just became more complex. That ROI calculator you were promised drifted away just like Homer Simpson disappearing into the bushes taking your confidence, budget and reputation with him.

Another ROI consideration for your benefit is data re-use. All data protection solutions encapsulate a great deal of data. In today's ecosystem, data is power, and the right ROI calculation isn't simply crunching the numbers of time saved versus money invested, but the value provided by putting your data to work.

What you should expect from your next backup solution (and those that are selling it) is the principle to "under promise and over deliver". No Sales Engineer demo magic tricks. A software-defined trial experience with YOU in the driver's seat, available immediately without waiting on an appliance to be delivered and a Systems Engineer to configure it. Maybe you can even find a solution to help you tap into the power of the data gold mine that you're sitting on. Like adding marshmallow fluff to your peanut butter and banana sandwich, that extra layer makes all the difference.



Reason #4

My recovery times are slow, and backup windows are long.

Some backup vendors might try to wow you with an example, but when you dig into product breadth — backup configurations, architectural flexibility, snapshot integrations, replication capabilities — reality sets in. It takes time, years really, to build the required breadth.

Another key factor is recovery speeds and flexibility. Often, it's not a story of if you can recover, but how easily and quickly can you do it. Count the number of clicks it takes you to recover something simply, they may surprise you. Many solutions either lack the granularity for specific recoveries, or the scalability for bulk restores.

But let's think bigger — what if you can't tolerate even a few minutes of data being lost in the shortest of backup windows? You need the big guns — continuous data protection (CDP). Many would agree that it's the best when it comes built-in with your existing backup solution, operating replicas natively from the same console. However, some vendors still separate CDP as a separately priced product or specialize exclusively on CDP, making you couple it with another product for more regular backup needs.

What you should expect from your next backup solution is a variety of recovery options to satisfy any SLAs, as well as a proven track record of continuous innovation, built on top of a strong foundation of happy customers. Imagine a product release where users are literally giddy to get their hands-on code versus "let someone else QA it".



Reason #5

This is taking too much of my time and resources.

With backup software, ease-of-use cannot be understated. So much so that "babysitting a backup" is a thing. Far too many products in this industry are hard to use and complicated. Kind of like the latest craze to substitute every meal with some ridiculous 14-ingredient protein shake. Good grief just eat a cheeseburger! But we digress...

Other solutions can do what you want, but only through scripting or the right level of PowerShell expertise. It doesn't need to be that hard, and you shouldn't have to build a workaround. You bought software to do that for you!

Another important factor is that your backup software needs to be able to evolve with you — like those adjustable pants we all secretly wish we were wearing for a big holiday meal. If adding a new NAS device or changing cloud storage requires you to change your data protection strategy, spend time re-educating IT staff or losing sleep about whether or not your IT team has the skills do to it successfully, you're doing it wrong.

What you should expect from your next backup solution is the gift of time. Time back to work on other priorities, cut out of work early or actually use that vacation time that keeps piling up.





Questions to consider

Here are some good questions to ask yourself. Or better — ask any future backup vendor you are considering entrusting with your data.



Stability: how often do you encounter stability issues with your current backup solution (bugs, job failures, etc.)?



Flexibility: what is your backup storage plan for the next three to five years, and how will data growth, cloud mobility and security risks alter that strategy?



Data reuse: you sit on a gold mine of business data within your backups — how are you putting that data to work for you to solve key business problems?



Backup/recovery speeds: as business demands for access to data continue to increase, are your RTOs and RPOs getting better, or have they plateaued? Where were they three to five years ago compared to now? Where would you like them to be?



Ease of use: how much time do you spend babysitting your backups? If that time was cut in half, what would you do with that extra time?

And one more:

How is your company doing? What growth has your organization seen in the past month, year or quarter?

Unfortunately, this question is now more important than ever. In today's unstable environment companies that were struggling before may be on the brink of falling apart. It's important that whomever you choose to invest in has the size, growth trajectory and economic protection to weather whatever rough seas this world throws at us.

Conclusion

By now, hopefully the why should be clear and the when equally so. (Hint: that's now).

The how is up to you.

At Veeam*, we believe our products provide unparalleled backup and recovery and would love for you to take them for a spin.

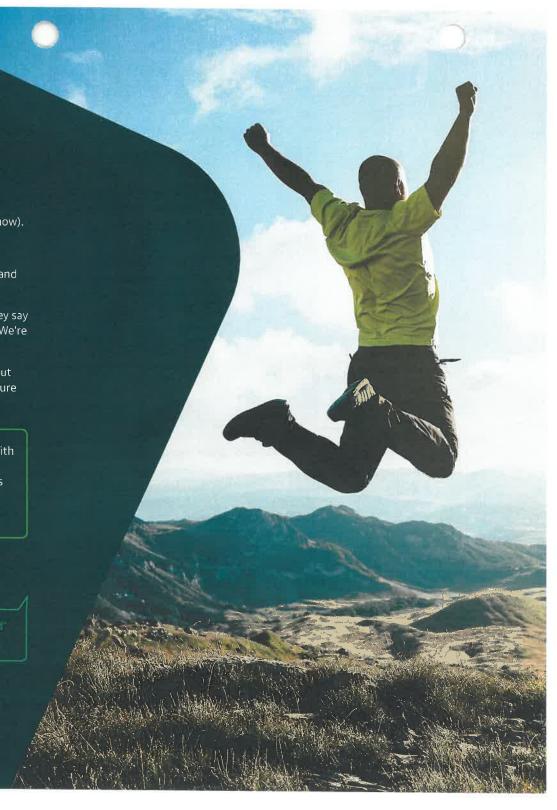
Download a <u>free 30-day trial</u>. Talk to your friends in the industry and see what they say about Veeam, or talk to those people you can't stand even. Just talk to people! We're up for the challenge.

Our mission is to deliver a modern platform that can cover today's backup needs, but more importantly can expand and adapt around whatever you'll need in the future (cloud workloads, cloud mobility, Kubernetes, etc.).

However, if you choose to take action, you'll be glad you did. In a world with way too few handshakes, hugs and high-fives, maybe you'll simply pat yourself on the back. You might even surprise yourself and break out into the floss (the dance we mean, of course. We're confident in your dental hygiene.) Try it; it feels great. The kids these days are onto something.

Veeam Backup Saves the Day More reviews on TrustRadius

> "The Best Backup I Have Ever Used" More reviews on G2





The benefits of Veeam over Dell EMC

Dell EMC is a historic data protection vendor suitable for traditional client-server infrastructures. It may offer some benefits, such as a single vendor for both software and hardware or broad support for physical systems. But it does not meet the needs of modern IT.

The limitations of Dell EMC data protection software compared to Veeam® should be considered carefully, as they include:

- Vendor lock-in. No freedom to use the hardware of your choice, as Dell EMC software needs Dell EMC premium-price hardware to
 store backups and deliver capabilities like deduplication, instant VM recovery, backup tiering to the cloud and DR to the cloud. Moreover,
 the rare Dell EMC software that may integrate with primary arrays is focused on supporting Dell EMC arrays only.
- Complexity. Customers comment that managing data protection with Dell EMC requires twice the resources that Veeam needs. Dell
 EMC's complexity is due to the numerous point-products that must be independently deployed, managed and supported to obtain a
 complete solution. Dell EMC requires over five separate products to match the capabilities of Veeam Backup & Replication™.
- High cost. Dell EMC's complexity drives a higher cost than Veeam. Dell EMC's higher TCO is due to the complexity of deploying and
 managing numerous independent products, as well as the necessity to buy Data Domain premium-priced storage (despite more
 affordable storage alternatives being available). Dell EMC also needs extra license fees and Professional Services for some features.
- Lack of functionality. Limited capabilities and agility for data protection of modern environments, as Dell EMC lacks capabilities that Veeam released up to seven years ago, such as agentless app-aware backup and application-item recovery, storage snapshot integrations, recoverability verification or on-demand sandbox. Dell EMC cannot reuse backup for business purposes like Veeam either.
- Investment risk. Little certainty that Dell EMC can help you address your new data protection needs, as you modernize your IT over the next three years. One may question Dell EMC's ability to keep pace with modern platforms, as there is already a lack of modern capabilities. Dell EMC released few significant features over the past five years, focused on repackaging existing products.

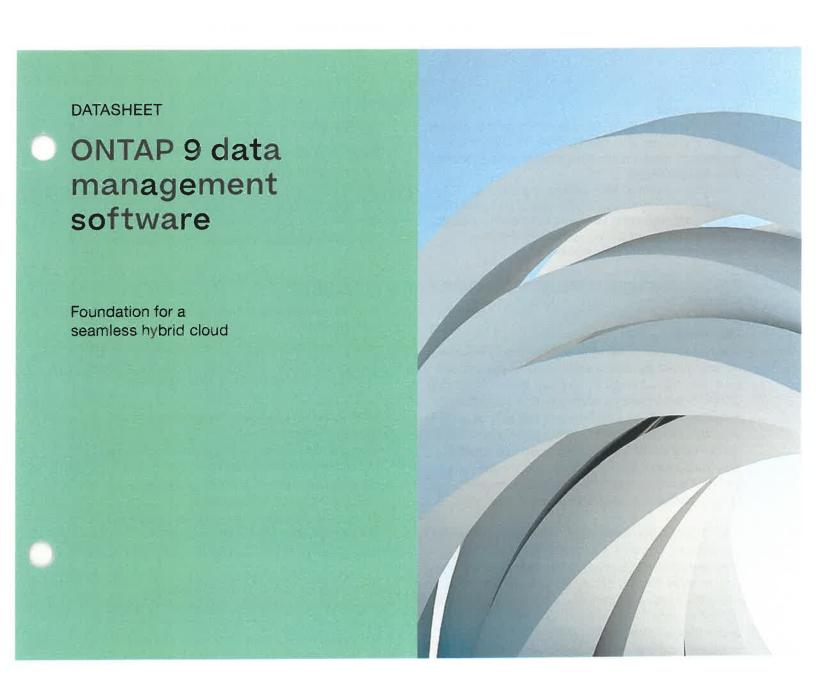
Veeam, a simpler and more powerful data protection for modern IT

To appreciate Dell EMC's limitations, it helps to understand the benefits that Veeam can bring to your environment. Veeam's solutions are:

- **Flexible.** Choose the infrastructure that best fits your business needs and change it when needed with serenity. Veeam works with any equipment thanks to its hardware agnosticism and even enables you to leverage your hardware investments to enhance data protection, thanks to storage snapshot integrations with the leading storage platforms (i.e. HPE, Dell EMC, NetApp and Pure Storage).
- **Simple.** Spend less time administering data protection. Veeam's integrated solution and ease of use allows you to deploy and run data protection with minimal effort, thus freeing time and budget. For instance, you can manage replication, snapshot, backup and long-term retention (object storage), as well as app-item recovery and malware-free restore via a single tool. Moreover, Veeam's intuitive monitoring capabilities give you full visibility into your data protection and helps you automatically <u>diagnose</u> and <u>remediate</u> issues.
- Affordable. Protect data for less, thanks to an affordable license that includes many advanced capabilities (no extra fee for capabilities like VM replication, backup tiering to the cloud or restore to the cloud). Veeam's simplicity also reduces the time and cost of deployment and management. Additionally, Veeam's storage agnosticism enables you to use any infrastructure that best fits your budget. You can even repurpose hardware you already invested in.
- **Powerful.** Perfectly adapt your data protection to your business needs, thanks to many advanced capabilities, such as agentless appaware backup and app-item recovery, recoverability verification, storage snapshot integrations, simple file and app-item recovery, built-in object storage support, malware-free restore and DR orchestration. Veeam even enables you to turn your data protection solution into a business driver, thanks to Veeam <u>DataLabs™ On-Demand Sandboxes</u> for DevTest, security tests & more.
- **Safe.** Gain the serenity that your investment in backup software will keep protecting you as your IT infrastructure evolves. Veeam's powerful capabilities protect current modern platforms and regular releases of new capabilities prepare you for your IT of tomorrow. Veeam's innovation is evidenced by <u>over 200 industry awards</u>, analyst reports (<u>Gartner</u>), users' appraisal (read through the 850+ 5-star reviews from your peers on <u>Gartner Peer Insights</u>, <u>G2</u> and <u>TrustRadius</u>) and a Net Promoter Score of 3.5x the industry average.

The choice is clear

How confident are you that Dell EMC will be able to keep pace with your changing data protection needs as you modernize your IT? Veeam's modern software-defined backup solution provides the flexibility and advanced capabilities that you need to easily address today's data protection challenges, as well as those of tomorrow. Moreover, Veeam enables you to put your backup to work for your business. Whether you want to protect virtual machines, workstations, physical servers or cloud workloads (i.e. Microsoft Office 365), see the simplicity and true power of Veeam for yourself. Download a trial or get a demo!





The challenge

Businesses today are under pressure to quickly respond to new challenges and opportunities. To support their business, IT departments must simultaneously deliver on three key priorities:

- · Reliably support all their current applications.
- Simplify the day-to-day challenges of protecting their data while also easily moving it to where it's needed.
- Prepare for future growth, especially with their expanding use of public clouds.

Plus, they typically must do all of this without additional IT budget.

The solution

Create a storage infrastructure that is the foundation for your hybrid cloud and simplifies how you manage your data that is spread across your business. NetApp ONTAP 9, the industry's leading data management software, brings the simplicity and flexibility of cloud to your data center and brings all the enterprise capabilities of your data center to the public cloud. It combines new levels of simplicity, flexibility, and security with powerful data management capabilities, proven storage efficiencies, and leading cloud integration.

With ONTAP 9, you can you can create an environment that is smart, powerful, and trusted that spans flash, disk, and cloud and is ready to handle your future requirements. Flexibly deploy storage on your choice of architectures—hardware storage systems, software-defined storage (SDS), and the cloud—while unifying data management across all of them. Accelerate your enterprise applications with flash, without compromising on the essential data services that you need. And seamlessly manage your data as it flows to wherever you need it most to help you make the best possible decisions for your organization.

Smart: Simplify operations and reduce costs streamline data management

Whether you're adding new workloads or managing your existing environment, it's important to simplify your processes to maximize the productivity and responsiveness of your staff. ONTAP gives you a common set of features across deployment architectures, which simplifies operations so that your IT team can focus on strategic business priorities. Unify data management across a hybrid cloud that can span flash, disk, and cloud running SAN, NAS, and object workloads. Easily move your data within or between storage clusters, or to the cloud—wherever it is most useful. ONTAP is the foundation for a Data Fabric that gives you flexibility, choice, and control across your storage environment.

Key benefits

Smart: Simplify operations and reduce costs

- Minimize capex and opex with leading storage efficiency.
- Provision storage in minutes for Oracle, SAP, Microsoft SQL, VMware, and other business apps.
- · Tier your cold data to the cloud. Automatically.

Powerful: Respond to changing business requirements

- Accelerate critical workloads with industry-leading performance.
- · Scale capacity and performance without disruption.
- Deploy enterprise applications on NetApp storage systems, commodity servers, or in the cloud.

Trusted: Protect and secure your data across the hybrid cloud

- Guard against data loss and accelerate recovery with integrated data protection.
- Eliminate business disruptions due to failures, maintenance, and site disasters.
- Protect your sensitive company and customer information with built-in data security.

Deploy workloads in less than 10 minutes

Built-in application workflows enable you to quickly and confidently provision storage for key workloads in less than 10 minutes—from power-on to serving data. These workloads include Oracle, SAP, SQL Server, and virtual desktops and servers. Years of NetApp experience and best practices are integrated into the System Manager wizard and factory configurations, enabling you to quickly set up your new configuration just by answering a few questions.

Get proven storage efficiency

With ONTAP, you get a comprehensive, industry-leading portfolio of storage efficiency capabilities. Inline data compression, deduplication, and compaction work together to reduce your storage costs and maximize the data you can store. Plus, you can multiply your savings with space-efficient NetApp Snapshot™ copies, thin provisioning, replication, and cloning technologies.

Tier automatically to cloud

Deliver high performance to your applications and reduce storage costs by automatically tiering cold data from the performance tier to a NetApp StorageGRID object storage solution or a public cloud. FabricPool frees up space on your existing NetApp AFF or FAS infrastructure, so you can consolidate more workloads. For new all-flash purchases, FabricPool enables you to buy a smaller initial AFF configuration.

Maximize investment protection

ONTAP gives you the flexibility to create an integrated, scalable storage environment by clustering storage controllers from different families—AFF all-flash and FAS hybrid-flash systems— and from different generations. You can grow your system with the latest hardware, continue to use your older hardware, and connect all of it to the cloud. When it's time to retire a storage system, you can simply upgrade the controllers and keep data in place on the existing disk shelves.

Get simple, powerful management capabilities

NetApp data management infrastructure software is designed to manage hybrid clouds. You can centrally monitor the health of your environment by viewing metrics on capacity utilization, performance, availability, and data protection. It can also help automate your storage processes and integrate them into your data center orchestration platform for end-to-end service delivery for your private and hybrid cloud services.

In addition, NetApp Active IQ® is a digital advisor that uses AlOps to simplify and automate the proactive care and optimization of your NetApp environment. Continuous risk assessments, predictive alerts, prescriptive guidance, and automated actions help prevent problems before they occur, leading to improved system health, higher system availability and improved security.

Powerful: Respond to changing business requirements

To support your critical applications, you need a storage environment that delivers high performance and availability. But you also need the versatility to scale and adapt as your business changes. ONTAP 9 delivers on all these requirements with flash performance for scalable, nondisruptive operations.

Get flash optimization

ONTAP 9 delivers the high throughput and low latency that enterprise applications require, while providing comprehensive data services. ONTAP 9 is

optimized for flash, including AFF systems with NVMe solid-state drives (SSDs) and NVMe over Fabrics. AFF running the most recent versions of ONTAP provide up to twice the throughput of the same workloads compared to running on prior ONTAP releases, while still delivering consistent submillisecond latency.

ONTAP 9 running on NetApp FAS systems delivers a balance of capacity and performance that is appropriate for many workloads.

Deliver consistent performance

To maintain high customer satisfaction, adaptive quality of service (QoS) helps you deliver consistent performance by automatically adjusting storage resource levels to respond to changes in workloads (number of terabytes of data, priority of the workload, and so on). Adaptive QoS simplifies the implementation of policies to keep your workloads within prescribed minimum and maximum throughput targets.

Stay ahead of business changes with seamless scalability

You can start small and grow with your business by using high-capacity SSDs or HDDs to scale your storage environment. Storage systems that run ONTAP can handle SAN, NAS, and object workloads that range from a few terabytes up to 176PB. You can scale by adding capacity to existing storage controllers or scale out by adding controllers to seamlessly expand your cluster up to 24 nodes.

ONTAP also supports massive NAS data containers that are easy to manage. With NetApp ONTAP FlexGroup, a single namespace can grow to 20PB or 400 billion files while delivering consistent high performance and resiliency.

Future-proof your data infrastructure

ONTAP 9 lets you design and deploy your storage environment across the widest range of architectures, so you can match the approach that's right for your evolving business needs:

- On NetApp hardware systems: AFF all-flash systems, for the best latency for demanding performance, and FAS systems, for a balance of performance and capacity.
- Within a converged infrastructure: FlexPod® converged infrastructure solution from NetApp and Cisco
- As software-defined storage on commodity servers:
 ONTAP Select
- In the cloud: Cloud Volumes ONTAP

You can move your data seamlessly between architectures to place it in the optimal environment for performance, capacity, and cost efficiency.

ONTAP 9 Common Data Management from Edge to Core to Cloud

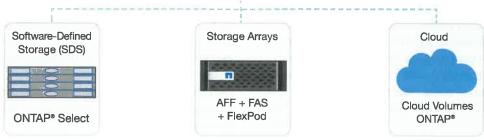


Figure 1) Standardize data management across architectures with a rich set of enterprise data services.

Trusted: Protect and secure your data across the hybrid cloud

Integrated data protection and nondisruptive operations

ONTAP provides NetApp integrated data protection (IDP) to safeguard your operations and keep them running smoothly.

Meet your requirements for local backup with nearly instantaneous recovery by using space-efficient Snapshot copies. Achieve remote backup/recovery and disaster recovery with NetApp SnapMirror® asynchronous replication or with SnapMirror Cloud when replicating data to a cloud object store in a public or private cloud. Or, to step up to zero data loss protection (RPO=0), leverage SnapMirror Synchronous replication.

For your critical applications that require continuous data availability, NetApp MetroCluster™ and SnapMirror Business Continuity technologies synchronously mirror between locations. The storage arrays can be deployed at a single site, across a metropolitan area, or in different cities. MetroCluster is robust, array-based infrastructure for your SAN and NAS workloads. SnapMirror Business Continuity enables flexibility to consolidate multiple workloads and then granularly choose the most critical SAN applications to support with continuous availability if a data center disaster occurs.

With ONTAP, you can service and update your infrastructure during regular work hours without disrupting your business. Dynamically assign, promote, and retire storage resources without downtime over the lifecycle of an application. Data can be moved between controllers without application interruption, so you can get the data on the node that delivers the optimal combination of speed, latency, capacity, and cost.

Robust security

The leading portfolio of security capabilities in ONTAP helps you integrate data security across your hybrid cloud to avoid unauthorized data access and ransomware attacks. With the NetApp Volume Encryption feature that is built in to ONTAP, you can easily and efficiently protect your at-rest data by encrypting any volume on an AFF or FAS system. No special encrypting disks are required. In-flight encryption for backup and replication protects your data in transit. Plus, other features such as multifactor authentication, role-based access control (RBAC), and onboard and external key management increase the security of your data.

Secure consolidation

You can save time and money by sharing the same consolidated infrastructure for workloads or tenants that have different performance, capacity, and security requirements. And with ONTAP, you don't have to worry that the activity in one tenant partition will affect another. With multitenancy, a storage cluster can be subdivided into secure partitions that are governed by rights and permissions.

Rigorous compliance

To meet your stringent compliance and data retention policies, NetApp SnapLock® software enables write once, read many (WORM) protected data for your ONTAP environment. NetApp also provides superior integration with enterprise backup vendors and leading applications. In addition, cryptographic shredding by the NetApp secure purge technology enables you to remediate data spillage online while the system is still in use. It also provides state-of-the-art "right-to-erasure" capability for General Data Protection Regulation (GDPR).

Make a simple, straightforward transition to ONTAP 9

No matter what your starting point is, NetApp streamlines your move to ONTAP 9.

Consult our experts to plan and implement your transition and gain the latest ONTAP advantages from day one. You can use NetApp Services or NetApp Services Certified Partners, you can do it yourself by using our proven tools and processes, or you can combine these approaches.

Plus, when you're running ONTAP, you can use the Managed Upgrade Service to get the most from your investment by ensuring that your ONTAP software is always up to date.

Make your move to ONTAP 9.

About NetApp

In a world full of generalists, NetApp is a specialist. We're focused on one thing, helping your business get the most out of your data. NetApp brings the enterprise-grade data services you rely on into the cloud, and the simple flexibility of cloud into the data center. Our industry-leading solutions work across diverse customer environments and the world's biggest public clouds.

As a cloud-led, data-centric software company, only NetApp can help build your unique data fabric, simplify and connect your cloud, and securely deliver the right data, services and applications to the right people—anytime, anywhere. To learn more, visit www.netapp.com

ONTAP Software and Features

	Function	Benefits
Data compaction	Packs more data into each storage block for greater data reduction	Works with compression to reduce the amount of storage that you need to purchase and operate
Data compression	Provides transparent inline and postprocess data compression for data reduction	Reduces the amount of storage that you need to purchase and maintain
Deduplication	Performs general-purpose deduplication for removal of redundant data	Reduces the amount of storage that you need to purchase and maintain
FabricPool	Automates data tiering to a NetApp StorageGRID object storage solution or a public cloud	Decreases storage costs for cold data and frees up space on your high-performance tier
FlexCache®	Caches actively read datasets within a cluster and at remote sites	Accelerates read performance for hot datasets by increasing data throughput within a cluster, and improves the speed and productivity of collaboration across multiple locations
FlexClone®	Instantaneously creates file, LUN, and volume clones without requiring additional storage	Saves you time in testing and development and increases your storage capacity
FlexGroup	Enables a single namespace to scale up to 20PB and 400 billion files	Supports compute-intensive workloads and data repositories that require a massive NAS container while maintaining consistent high performance and resiliency
FlexVoi [®]	Creates flexibly sized volumes across a large pool of disks and one or more RAID groups	Enables storage systems to be used at maximum efficiency and reduces hardware investment
MetroCluster	Robust infrastructure that combines array-based clustering with synchronous mirroring to deliver continuous availability and zero data loss for SAN and NAS workloads; up to 700km distance between nodes	Maintains business continuity for critical enterprise applications and workloads if a data center disaster occu

Function

Benefits

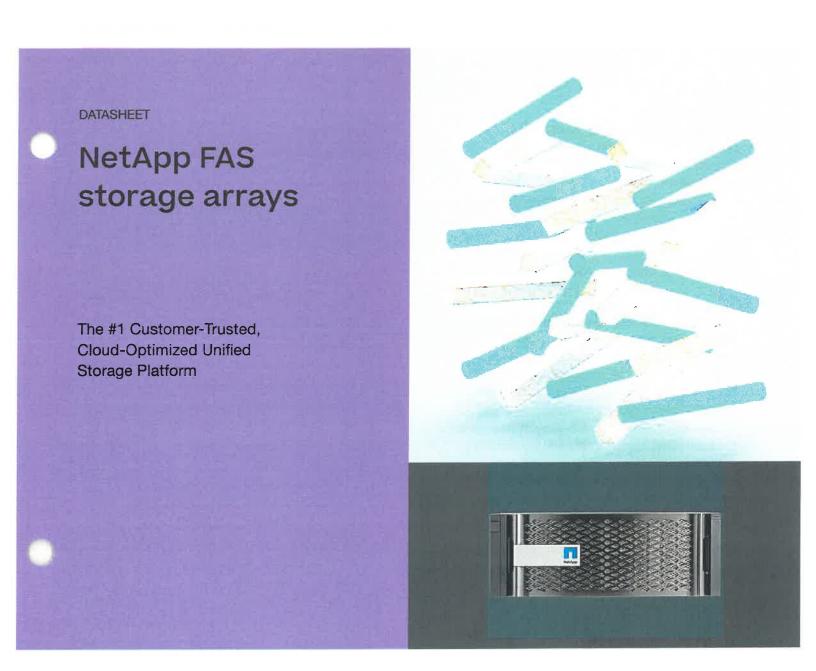
Performance capacity	Provides visibility of performance capacity that is available for deploying new workloads on storage nodes	Simplifies management and enables more effective provisioning of new workloads to the optimal node
QoS (adaptive)	Simplifies setup of QoS policies and automatically allocates storage resources to respond to workload changes (number of terabytes of data, priority of the workload, and so on)	Simplifies operations and maintains consistent workload performance within your prescribed minimum and maximum IOPS boundaries
SnapCenter®	Provides host-based data management of NetApp storage for databases and business applications	Offers application-aware backup and clone managemen automates error-free data restores
SnapLock	Provides WORM file-level locking	Supports regulatory compliance and organizational data retention requirements
SnapMirror	Provides integrated remote backup/recovery and disaster recovery with incremental asynchronous data replication; preserves storage efficiency savings during and after data transfer	Provides flexibility and efficiency when replicating data to support remote backup/recovery, disaster recovery, and data distribution
SnapMirror Business Continuity	Combines flexible array-based clustering with more granular synchronous mirroring to deliver continuous availability and zero data loss for SAN workloads	Consolidate all your workloads and decide on the most critical SAN applications to support with continuous availability to maintain business continuity if a data center disaster occurs
SnapMirror Cloud	Provides integrated remote backup/recovery and disaster recovery with incremental asynchronous data replication leveraging S3 cloud resources	Provides flexibility and efficiency when replicating data to a cloud object store in a public or private cloud, to support remote backup/recovery, disaster recovery, and data distribution
SnapMirror Synchronous	Delivers incremental, volume-granular, synchronous data replication; preserves storage efficiency savings during and after data transfer	Achieve zero data loss protection (RPO=0)
SnapRestore®	Rapidly restores single files, directories, or entire LUNs and volumes from any Snapshot copy	Instantaneously recovers files, databases, and complete volumes from your point-in-time Snapshot copy
Snapshot	Makes incremental data-in-place, point-in- time copies of a LUN or a volume with minimal performance impact	Enables you to create frequent space-efficient backups with no disruption to data traffic
NetApp Volume Encryption	Provides data-at-rest encryption that is built into ONTAP	Lets you easily and efficiently protect your at-rest data by encrypting any volume on an AFF or FAS system; no special encrypting disks are required

Table 1) ONTAP 9 offers a robust set of standard and optional features.

ONTAP Software Offerings Software/Licenses Included		
Core bundle (required)	Protocols, FlexCache, FlexClone, SnapRestore, Encryption¹	
Data Protection bundle	SnapMirror, SnapVault, SnapManager, SnapCenter	
Security and Compliance bundle	SnapLock, Multi-Tenant Key Manager	
Hybrid Cloud bundle	FabricPool, SnapMirror Cloud	

¹ Availability subject to Global Trade Compliance







The Challenge

Simplifying data management across on-premise and public cloud

Organizations of all sizes are increasingly challenged with streamlining their storage operations. They need to store and back up their ever-growing volume of data while budgets are shrinking. They need to find a solution that enables them to meet their on-premise requirements while incorporating their public cloud strategy.

The Solution

Ideal balance of capacity and performance storage that also simplifies your operations with best-in-class data management

NetApp® FAS storage arrays, powered by NetApp ONTAP® data management software, help you build storage infrastructure that is simple, smart, and trusted. FAS systems provide the ideal balance of capacity and performance that's optimized for easy deployment and operations while also having the flexibility to handle future growth and cloud integration.

With their highly available hardware and powerful software, FAS systems cost- effectively deliver the data protection, security, and scalability to safeguard your data and help your staff be more efficient. Whether you're running a small business, a remote office, or a large enterprise, the FAS family's leading range of unified capabilities for SAN, NAS, and object workloads make it an ideal solution for your general-purpose business applications as well as backup and retention.

Simple

Streamline your storage operations

When it comes to long-term investments in storage infrastructure, it's critical to focus on simplifying your storage environment and reducing total cost of ownership. The FAS family offers significant advantages:

- Go from initial power-on to serving data in less than 10 minutes with simple application provisioning.
- Reduce costs and minimize your storage footprint with proven efficiency technologies such as inline deduplication, compression, compaction, and thin provisioning.

Key Benefits

Secure and protect your data across the hybrid cloud

- On-premise & public clouds, we have you covered - Start small and scale nondisruptively as your data requirements grow, on premises and in the cloud.
- The Best Cloud Integration Connect effortlessly to the cloud with leading integration to Amazon AWS, Microsoft Azure, Google Cloud, and others.

Flexibly adapt to your evolving business needs

- · Scale capacity and performance nondisruptively
- · Effortlessly integrate with public clouds
- Optimize your storage infrastructure with predictive analytics and proactive care

Cost effective and proven for diverse workloads

- High volume of unstructured data (media & entertainment, medical imaging, EDA)
- Distributed enterprise business applications, NAS and SAN consolidation (DB, VM's)
- Disaster recovery target and backup consolidation
- Simplify ongoing management by upgrading software or servicing storage with zero downtime during regular business hours.
- Eliminate silos by supporting both NAS, SAN, and object workloads on one unified system.
- Accelerate business operations by leveraging NetApp Snapshot[™] copies to instantly create writeable clones for use in DevTest, report generation, and analytics.
- Increase the efficiency of your staff by using the deep integration of ONTAP with key business applications.

Smart

Scale and adapt to meet changing needs

The FAS family has the flexibility to keep up with your growing business as your capacity and performance requirements change. Scale up by adding capacity or by upgrading controllers. Scale out by growing from 2 nodes with up to a 24-node cluster with 176PB of capacity. Plus, you can cluster different combinations of FAS and AFF models to build out your environment by adding new generations of storage with the latest technologies.

The FAS family also supports massive NAS containers, which are easy to manage. With the NetApp FlexGroup feature of ONTAP 9, a single namespace can grow to 20PB and 400 billion files while maintaining consistent high performance and resiliency.

With nondisruptive addition and replacement of storage systems and components, scaling occurs without maintenance windows or the challenge of coordinating downtime across teams. And you can perform your updates during regular work hours.

Integrate with the cloud

FAS systems running ONTAP are optimized for private and hybrid cloud by providing secure multitenancy, quality of service (QoS), nondisruptive operations, and easily defined tiers of service. Plus, NetApp offers a number of options for extending your FAS system to the hybrid cloud with Amazon AWS, Microsoft Azure, Google Cloud, and other leading cloud providers. Easily move your data between your onpremises FAS system and cloud environments by using NetApp SnapMirror® data replication software.

Optimize your storage with smart management

You don't need to be a storage expert to use the broad range of capabilities in the NetApp storage management portfolio.

 Simplify and speed up day-to-day management activities with ONTAP System Manager. The new GUI provides quick insights into capacity, system health, networking, and performance history. Streamline your management of multiple storage clusters with NetApp Active IQ® Unified Manager.
 Boost the efficiency of your staff by monitoring petabytes of data from a single dashboard, and receive notifications to quickly resolve issues before they affect data services. The latest version of Active IQ Unified Manager provides insights and advice on security risks and compliance.

Utilize insights and recommendations derived from predictive analytics and community wisdom to optimize and protect your storage investments with Active IQ. Expose risk factors and prevent problems before they affect your business. Benefit from insights and best-practice recommendations derived from the collective wisdom of NetApp's large user base. Implement its actionable intelligence to prevent problems, save time, and make smarter decisions when managing your infrastructure with ONTAP System Manager and Active IQ Unified Manager.

Trusted

Secure company and customer data across your hybrid cloud

- Easily and efficiently protect your at-rest data by encrypting any volume on FAS and AFF systems with the NetApp Volume Encryption feature of ONTAP. No special encrypting disks are required.
- Protect against weak administrative passwords, the leading cause of system compromises, by using multifactor authenti- cation (MFA).
- Designate and validate authorized users with role-based access control (RBAC).
- Use storage-level file security to prevent unauthorized administrators from accessing or deleting critical intellectual property.
- Meet privacy standards, including GDPR, by cryptographically shredding and sanitizing individual files.

Protect against data loss and accelerate recovery

FAS systems running ONTAP provide comprehensive, integrated data protection to safeguard your data. Meet your requirements for local backup with near-instant recovery by using space- efficient NetApp Snapshot copies. Achieve remote backup/recovery and disaster recovery with NetApp SnapMirror asynchronous replication. Plus, deep integration with leading backup applications makes management easier.

Achieve unparalleled availability and nondisruptive operations

NetApp MetroCluster™, SnapMirror Business
Continuity, and SnapMirror Synchronous
technologies expand data protection to eliminate risk
of data loss by synchronously mirroring data between
locations for continuous availability of information.
Storage arrays can exist in a single data center or in
two different data centers that are located across a
campus, across a metropolitan area, or in different
cities. No matter what happens, your data can be
protected from loss and, with MetroCluster and
SnapMirror Business Continuity, it is continuously
available to meet business-critical needs.

FAS systems are engineered to meet demanding availability requirements. All models are designed to deliver 99.9999% availability or even higher

through a comprehensive approach that combines highly reliable hardware, innovative software, and sophisticated service analytics.

The NetApp FAS9000 storage systems have an intelligent modular design that enhances reliability, availability, and serviceability (RAS). Service operations are greatly simplified, I/O cards are easily serviced, and controllers can be replaced without disturbing I/O cabling. This modular design simplifies and speeds up servicing and minimizes the risk of errors. The design also increases flexibility, streamlines maintenance, and extends the life of the platform, reducing the disruption and expense that come with tech refreshes. Software and firmware updates, hardware repair and replacement, load balancing, and tech refresh happen without planned downtime.

NetApp FAS Storage Arrays:

- FAS500f: For customers with demanding application performance objectives in a cost-effective, high capacity system.
- FAS9000: Designed with a modular architecture that is optimized for serviceability and availability. Ideal for large consolidated environments
- FAS8700: High-end system that is optimized for high capacity and performance to consolidate multiple business workloads.

Harness the Power of ONTAP to Simplify and Accelerate Your Storage Environment:

Storage efficiency	Reduce costs with leading data reduction technologies and built-in configuration efficiencies.				
Business continuity	Make sure that your critical applications stay online with continuous data availability.				
Nondisruptive operations	Eliminate business disruptions during maintenance and upgrades.				
Performance and scalability	Ensure performance for consolidated workloads, and scale up or scale out capacity and performance.				
Cloud Integration	Easily move your data between your on-premises FAS system and cloud environments.				
Security	Avoid unauthorized data access and secure your data at rest and in transit across your hybrid cloud.				
Compliance	Meet strict governance and data retention policies.				

- FAS8300: Designed for a wide range of midrange deployments that need a balance of capacity, performance, and price.
- FAS2750: Optimized for small and midsize enterprises that require simple deployment and operations. Supports up to 24 SFF internal drives plus external storage shelves.
- FAS2720: Optimized for small and midsize enterprises that require simple deployment and operations. Optimized for high-capacity use cases.

Get it right from the start by using NetApp expertise and tools

Realize the most from your investment by engaging professional services experts from NetApp or our Services Certified partners. When moving data into your new environment, smooth the transition and mitigate risks by using proven NetApp methodologies, tools, and best practices. Learn more at netapp.com/services.

About NetApp

NetApp is the leader in cloud data services, empowering global organizations to change their world with data. Together with our partners, we are the only ones who can help you build your unique data fabric. Simplify hybrid multicloud and securely deliver the right data, services, and applications to the right people at the right time. Learn more at www.netapp.com.

	FAS500f	FAS9000	FAS8700	FAS8300	FAS2750	FAS2720		
Maximum raw capacity per HA pair	734TB	14.7PB	14.7PB	7.3PB	1243TB	1440TB		
Maximum drives per HA pair	48	1440	1440	720	144	144		
NAS scale-out	1-24 nodes (12 HA Pairs)	1-24 nodes (12 HA pairs)	1-24 nodes (12 HA pairs)	1-24 nodes (12 HA pairs)	1-24 nodes (12 HA pairs)	1-24 nodes (12 HA pairs)		
SAN scale-out	1-12 nodes (6 HA pairs)	1-12 nodes (6 HA pairs)	1-12 nodes (6 HA pairs)	1-12 nodes (6 HA pairs)	1-12 nodes (6 HA pairs)	1-12 nodes (6 HA pairs)		
Maximum raw capacity for cluster	8.8PB	176PB	176PB	88PB	15PB	17PB		
Controller chassis form factor	2U	8U	4U	4U	2U / 24 internal drives	2U / 12 internal drives		
OS version	ONTAP 9.8 RC1 and later	ONTAP 9.1 RC1 and later	ONTAP 9.7 RC1 and later	ONTAP 9.7 RC1 and later	ONTAP 9.4 RC1 and later	ONTAP 9.4 RC1 and later		
Storage protocols supported	NVMe-oF, FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB	FC, FCoE, ISCSI, NFS, pNFS, CIFS/SMB	FC, ISCSI, NFS, pNFS, CIFS/SMB	FC, ISCSI, NFS, pNFS, CIFS/SMB	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB	FC, FCoE, iSCSI NFS, pNFS, CIFS/SMB		
Shelves and media	See NetApp.com for current information.							

Table 1) NetApp FAS technical specifications

Note: All HA pair specifications are for dual controller, active-active configurations.



¹ Maximum raw capacity depends on the drive offerings. See the Shelves and Media page on NetApp.com for current information.





Datasheet

NetApp E5700 Series

Achieve field-proven and reliable performance efficiency for modern enterprise applications

KEY BENEFITS

Extreme Performance

 Accelerate performance, boost IOPS, and increase density with a hybrid system that is perfectly suited for modern enterprise applications, such as big data analytics, technical computing, video surveillance, and backup and recovery.

Unmatched Value

- Customize configurations to optimize performance and capacity requirements with three distinct disk system shelves, multiple drive types, and a complete selection of high-speed interfaces.
- Address ever-changing business requirements with the industry's most flexible enterprise-grade storage system.

Proven Simplicity

 Simplify deployment and access to your data with secure, reliable storage, proven with more than 1 million installations.

The Challenge

Your enterprise relies on core applications that are critical to business success. Getting value and insights quickly and reliably from a range of mixed workload environments can differentiate your organization from the competition and accelerate time to market. To compete today, you need data storage systems that can deliver exceptional application performance with nonstop data availability.

The Solution

Your enterprise must have storage that can meet your performance and capacity demands without sacrificing simplicity and efficiency. That's why the NetApp* E5700 system was designed with NetApp SANtricity® OS adaptive caching algorithms, which address a large range of application workloads. Those workloads range from high-IOPS or bandwidth-intensive streaming applications to a mixture of workloads that deliver high-performance storage consolidation.

Requiring just 2U of rack space, the E5700 hybrid array combines extreme IOPS, sub-100 microsecond response times, and up to 21GBps of read bandwidth and 14GBps of write bandwidth. With fully redundant I/O paths, advanced data protection features, and extensive diagnostic capabilities, the E5700 storage systems enable you to achieve greater than 99.9999% availability and provide data integrity and security.

With more than 1 million systems shipped, NetApp E-Series technology is found in enterprise SAN application environments such as big data analytics, technical computing, video surveillance, and backup and recovery. E-Series powers the world's largest enterprises:

- The world's second-largest stock exchange
- The world's largest online media cash register
- The world's largest wealth management firms
- The world's largest data warehouse
- The world's largest online store



Extreme Performance

The E5700 storage system continues the NetApp E-Series longstanding heritage of balanced performance that is designed to cost effectively address the storage requirements of a broad range of workloads. High-performance file systems and data-intensive bandwidth applications benefit from the ability of the E5700 to sustain high read and write throughput. Database-driven transactional applications benefit from the system's high IOPS and low latency. Regardless of the application workload, the E5700 is designed to support maximum performance efficiency.

Designed specifically for performance-intensive workloads environments, including big data analytics, the E5700 delivers more than 1 million sustained IOPS and response times in microseconds. Bandwidth-oriented workloads, such as video surveillance and technical computing, also benefit from the ability of the E5700 to provide up to 21GBps of throughput. The E5700 is also the first hybrid 2U array to support multiple high-speed host interfaces, including 32Gb Fibre Channel (FC), 25Gb iSCSI, 100Gb InfiniBand, 12Gb SAS, 100Gb NVMe over InfiniBand, and 100Gb NVMe over RoCE.

The E5700 increases performance for big data analytics applications such as Splunk by up to 2x, enabling you to search and analyze data in half the time. The hybrid design is built in a 2U or 4U enclosure and delivers the performance of over two-thousand 15,000-RPM drives while requiring under 2% of the rack space, power, and cooling. With up to 98% reduction in space and power consumption, the E5700 hybrid array helps significantly improve the overall efficiency of IT operations while continuing to meet performance requirements from business operations.

Unmatched Value

The E5700 system offers multiple form factors and drive technology options to meet your requirements. The ultradense 60-drive system shelf supports up to 600TB in just 4U and is optimal for environments with vast amounts of data and limited floor space. The 2U, 24-drive system shelf combines low power consumption and exceptional performance density with its cost-effective 2.5-inch drives. All shelves support E5700 controllers, or they can be used for expansion, helping you to optimize configurations to meet your performance, capacity, and cost requirements.

The E5700 hybrid array offers the world's best price/performance ratio with a mix of media, including NL-SAS HDDs for capacity, SAS HDDs for cost-effective performance, and SAS SSDs for ultraperformance. The E5700 offers investment protection to meet future demands without forklift upgrades through the ability to independently scale to 1.8PB of raw SSD capacity and 1.0M IOPS of performance, or up to 4.8PB of raw HDD capacity and up to 21GBps of throughput performance.

Proven Simplicity

The E5700 modular design and simple management tools make it easy to scale without adding management complexity. The modern, on-box, browser-based SANtricity System Manager GUI enables you to simplify deployment and start working with your data in under 10 minutes.

The E5700 hybrid array runs on the enterprise-proven SANtricity OS software platform. SANtricity software allows storage administrators to maximize performance and use of their E5700 through extensive configuration flexibility, custom performance tuning, and complete control over data placement. The SANtricity System Manager graphical performance tools provide key information about storage I/O from multiple viewpoints, allowing administrators to make informed decisions about configuration adjustments to further refine performance.

Flexible Interface Options

The E5700 supports a complete set of host or network interfaces that are designed for either direct server attach or network environments. With multiple ports per interface, the E5700 provides ample bandwidth for high throughput. To protect your investment in storage networks, the E5700 supports a broad range of high-speed host interfaces, including SAS, iSCSI, FC, and InfiniBand. Additionally, the E5700 supports both NVMe over IB and NVMe over RoCE for the lowest latency connectivity.

Maximum Storage Density

Today's storage must keep up with continuous growth and meet the most demanding capacity requirements. The E5700 is purpose-built for capacity-intensive environments that require efficient space, power, and cooling utilization. The system's ultradense 60-drive 4U disk shelf offers industry-leading performance and space efficiency that reduce rack space by up to 60%. Its high-efficiency power supplies and intelligent design can lower power use by up to 40% and can lower cooling requirements by up to 39%. Pull-out drawers improve serviceability, and the system remains operational and available during servicing, enhancing uptime.

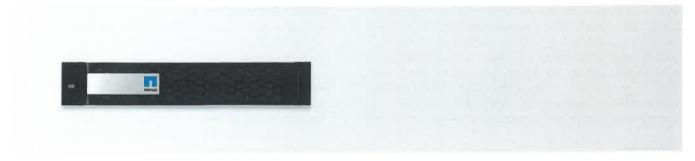


Figure 1) E5724 storage system.

High Availability and Enterprise Reliability

The E5700 storage system delivers high-speed, continuous data access. With more than 20 years of storage development expertise behind it, the E5700 is based on a proven architecture that provides 99.9999% availability with appropriate configurations and service plans.

The E5700 keeps data accessible through redundant components; automated path failover; online administration, including nondisruptive SANtricity OS and drive firmware updates; active drive recovery mechanisms; and user-directed drive data evacuation. The system's advanced protection features deliver high levels of data integrity, including data assurance (T10 PI industry standard) to protect against silent data corruption.

One of the most critical aspects of an enterprise solution is early detection and resolution of issues. In this area, the E5700 provides significant depth of capabilities, including:

- Extensive capturing of diagnostic data provides comprehensive fault isolation and simplifies analysis of unanticipated events.
- Background monitoring proactively scans media and tracks drive health against defined thresholds.
- Integrated Recovery Guru diagnoses problems and provides the applicable procedure to use for recovery.
- With DDP technology and RAID 6, a drive rebuild continues even when an unreadable sector or second failure is encountered.
- NetApp Active IQ® provides proactive dispatch and maintenance.

Advanced Data Protection

Dynamic Disk Pools (DDP) technology simplifies the management of traditional RAID groups by distributing data parity information and spare capacity across a pool of drives. With the DDP feature, there are no idle spares to manage, and you don't need to reconfigure RAID when you expand your system. The DDP technology enhances data protection by enabling faster rebuilds after a drive failure, protecting against potential data loss if additional drive failures occur. DDP dynamic rebuild technology uses every drive in the pool to rebuild more quickly and reduce the exposure window to another failure.

A key feature of DDP technology is the ability to dynamically rebalance data across all the drives in the pool when drives are added or removed. Unlike the rigid configuration of a traditional RAID volume group, which has a fixed number of drives, the DDP feature lets you add or remove multiple drives in a single operation. DDP technology dynamically rebalances across the remaining (or additional) drives more quickly than traditional RAID does. This faster rebalancing also applies to a rebuild case. If additional drives fail, faster rebuilds on failed drives can reduce the exposure window for data loss from days to minutes.

To protect against data loss and downtime events, both locally and over long distance, the EF5700 offers advanced data protection that is common to enterprise storage. These features include:

- **NetApp Snapshot™** technology. Create and restore pointin-time copies of datasets in less than a second to protect against accidental data loss on the local array.
- Volume copy. Create a complete physical copy (clone) of a volume for applications that require a full point-in-time copy of production data.
- **Asynchronous mirroring.** Volume replication over FC or IP long distance to remote site to keeps your business operations running no matter what happens.
- **Synchronous mirroring.** Continuous volume replication is enabled over FC at campus distances.
- Cloud backup. SANtricity Cloud Connector enables flexible and cost-effective backup and recovery from on-premises storage to the cloud.

Secure Data, Secure Management

NetApp SANtricity drive encryption combines local key management with drive-level encryption for comprehensive security for data at rest with no impact to performance. Because all drives eventually leave the data center through redeployment, retirement, or service, it's reassuring to know that your sensitive data isn't leaving with them. Customers can choose to manage the drive authentication keys natively for a simple lowest-cost solution or use a KMIP-compliant external key manager for centralized administration.

Management access to the E5700 is protected with role-based access control, LDAP/Active Directory integration, and digital certificate management. The security administrator manages user privileges and password requirements. The exportable audit log gives visibility into management actions taken on the array. All management communication is over https. In addition, SAML support is available to optionally enable multifactor authentication for further protection against threats.

SSD Cache

The SSD cache feature offers intelligent analytics-based caching capability for read-intensive workloads. Hot data is cached by using higher-performance, lower-latency solid-state drives (SSDs) in the drive shelves. You don't need to set up complicated policies to define the trigger for data movement between tiers. You can simply set it and forget it. SSD cache is expandable to up to 5TB per storage system.

DevOps-Ready System

To enable the automation and agility that are required in the DevOps-based IT revolution, E5700 supports a full-featured on-box REST API, SANtricity Web Services. Ansible modules are available for open-source orchestration and configuration management. And for easy integration and automation in traditional IT and Windows ecosystems, E5700 also supports Windows PowerShell and Storage Management Initiative Specification (SMI-S) 1.6.

Container Microservices

NetApp SANtricity container microservices is a Linux-based Docker Container service for preapproved OEM partners to embed applications on the E5700. It enables cost-effective converged infrastructure for targeted workloads. Examples include applications related to analytics, video surveillance, and high-performance computing workloads.

ENERGY STAR Certification

All E-Series systems use "85% PLUS" power supplies, exceeding the EPA ENERGY STAR requirement of 80% efficiency. See the latest EPA ENERGY STAR-certified E-Series configurations.

ASHRAE Compliant

All E-Series systems meet the certification requirements of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), a global society that advances human well being through sustainable technology for the built environment. The E5724 is ASHRAE A4 compliant. The E5760 is ASHRAE A3 compliant.

About NetApp Services

Gain greater business value from your investment

Whether you're planning your new storage system, need specialized know-how for a major storage deployment, or want to optimize the operational efficiency of your existing infrastructure, NetApp Services and NetApp certified partners can help. Learn more about NetApp Services.

For more information

• NetApp E5700 hybrid flash storage systems

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of applications and data across cloud and on-premises environments to accelerate digital transformation. Together with our partners, we empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize their operations. For more information, visit www.netapp.com. #DataDriven

Veeam Backup & Replication What's new in v11?

Veeam® Backup & Replication™ v11 delivers the single platform for comprehensive data management that is powerful and flexible enough to protect each phase of the data lifecycle, while handling all the complexities of a hybrid, multi-cloud environment. The following is a list of the major new features and enhancements added in V11.

Continuous Data Protection (CDP)

Eliminate downtime and minimize data loss for Tier-1 VMware vSphere workloads and perform immediate recoveries to a latest state or desired point in time with the built-in CDP functionality, achieving the most stringent RTO and RPO.

The unique benefits of the Veeam CDP implementation include:

- No VM snapshots Veeam CDP captures all write I/O directly in the data
 path with the VMware-certified I/O filter driver, eliminating the need to
 create VM snapshots as with classic replication jobs. And with I/O level
 tracking, only the data actually changed is sent over to a DR site, as
 opposed to larger virtual disk blocks returned by changed block tracking.
- No workload or hardware dependency Protect ANY OS and applications
 that can run within a vSphere VM. And unlike storage-based replication,
 Veeam CDP works across non-matching storage arrays, hyperconverged
 storage solutions and even local vSphere ESXi storage.
- Asynchronous replication Unlike synchronous array-based replication, Veeam CDP can be used across any distance while requiring significantly lower bandwidth, thanks to I/O consolidation when the same block is overwritten multiple times and network traffic compression.
- Policy-based protection Unlike with regular replication jobs, you
 don't have to worry about scheduling at all. Just define the required
 RPO (maximum data loss allowed in case of a disaster) and the CDP
 policy will take care of performing the sync cycles as needed. Also, to
 reduce monitoring events spam, you can define acceptable RPO violation
 thresholds so that sporadic connectivity issues do not result in alarms.
- Flexible retention Separately define short-term retention, allowing crash-consistent restores to a point in time with RPO period granularity and long-term retention policy with optional periodic applicationconsistent restore points, providing an additional layer of protection.

NEW Veeam® Backup &
Replication™ v11 eliminates data loss
and ransomware while saving 20X
on your long-term archive retention
costs. The 4-in-1 solution combining
backup, replication, Storage
Snapshots and the NEW Continuous
Data Protection (CDP) under a single
platform delivers faster and more
flexible data protection, recovery
and retention options. Version 11
unlocks unprecedented resiliency for
any size business, offering over 200
new features and enhancements,
including the ability to:

- Eliminate data loss with Veeam CDP
- Eliminate ransomware with immutable backups on a Hardened Linux Repository
- Eliminate downtime with Instant Recovery for NAS, Microsoft SQL and Oracle
- Achieve over 20X lower cost, long-term archive-to-cloud storage on Amazon 53 Glacier & Azure Blob Archive
- Unify cloud-native workload protection with AWS and Azure
- Conquer complexities in your way with Veeam-powered BaaS & DRaaS

Compliment Veeam Backup & Replication v11 with insights, reporting and deep visibility provided by Veeam ONE™ v11 in one enterprise bundle, Veeam Availability Suite™ v11, to meet both your protection and analytics needs.

Add site recovery automation and testing, creating a powerful combination that delivers business continuity with orchestration at any scale with Veeam Disaster Recovery Orchestrator v4.

Supported environments

For a detailed list of supported environments, reference the product <u>Release Notes</u>.

1



- Flexible deployment models Depending on the amount of data under protection, you can opt for virtual CDP proxies or use dedicated physical CDP proxies to completely offload all data processing overhead from your vSphere hosts, removing impact to your VM consolidation ratio. In either case, only one proxy per vSphere cluster is required with additional proxies providing redundancy and increased scalability.
 Note: CDP proxy is the new role that can share a server with other Veeam components.
- Deployment assistant A built-in deployment calculator removes the guesswork by looking at the
 historical I/O of all VMs selected for protection in the CDP policy to estimate the required bandwidth
 needed to achieve the specified RPO and evaluates whether your currently available CDP proxy resources
 are sufficient for the historical change rate.
- No extra costs Veeam CDP is included in your universal license along with existing data protection methods
 for vSphere VMs: host-based backup or replication, agent-based backup, application-level backup and storage
 snapshots. And just as before, using multiple protection methods on the same VM does not consume additional
 licenses! No more picking and choosing which VMs to assign an expensive third-party CDP license to from
 now on, your creativity with DR strategy planning will only be limited to the available bandwidth!

NOTE: Veeam CDP functionality requires deploying the I/O filter to both the source and target vSphere cluster. This can be done by right-clicking the cluster in the newly added clusters tree view on the Backup Infrastructure tab.

Veeam CDP is included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise Plus** edition is required.

Hardened Repository

Keep your backups safe in hardened, malware- and hacker-proof repositories with immutable backups, preventing encryption and deletion by ransomware and malicious actors. This is achieved through the following enhancements for Linux-based backup repositories:

- Single-use credentials Required for the Hardened Repository, the single-use credentials are supplied by the user interactively at the initial deployment time and when installing product updates, but are never stored in the configuration database. This eliminates any possibility for hackers to extract these credentials from a compromised backup server and use them to connect to the repository.
- No SSH protocol dependency All former SSH protocol usage has been encapsulated into the expanded transport protocol. As a result, SSH connectivity is required only at the initial deployment time and when installing product updates. This allows customers to secure SSH with interactive multi-factor authentication (MFA) or even disable the SSH Server completely to protect your repository, even from future zero-day vulnerabilities.
- Immutable backups Wave accidental backup deletions, ransomware and hackers goodbye! You can now
 make your image-level backups immutable for the specified period of time with GFS backups protected
 for the entire duration of their retention policy. This functionality uses the native Linux file immutability
 feature, which restricts modification and deletion of files with the corresponding flag set. The flag can
 only be removed by a user with root privileges, but the single-use credentials ensure root credentials are
 not stored on the backup server. So, just ensure they are not saved into any other application and keep the
 sudoers list empty too!

For redundancy, the immutability expiration timestamp is stored twice: 1) in the special configuration file and 2) in the extended attribute of each backup file. The first is extended automatically as dependent incremental restore points are added into the backup chain and can also be increased (but never reduced) manually for legal-hold purposes using PowerShell. The second timestamp remains as originally set, due to being a part of the already immutable file. The immutability flag is only removed from the backup file when the local time on the repository server exceeds both values.



V11 successfully passed a third-party assessment of compliance with the U.S. financial industry regulations for WORM (Write Once Read Many) storage. A compliant Hardened Repository configuration ensures protection of backup data against manipulation and meets the requirements for non-rewritable, non-erasable storage as specified by SEC 17a-4(f), FINRA 4511(c) and CFTC 1.31(c)-(d) regulations. The compliance assessment was done by Cohasset Associates.

NOTE: Since we're unable to support any backup modes that involve in-place backup file modifications on immutable repositories, this limits your choice to the classic forward incremental backup with periodic full backups. This makes XFS the ideal file system for such repositories, thanks to the spaceless synthetic full technology delivered by our advanced XFS integration (a V10 feature).

Expanded Object Storage Support

Reduce the costs of long-term data archival and retention by up to 20 times, replace manual tape management and achieve end-to-end backup lifecycle management with expanded support for hot object storage in Capacity Tier and support for cold object storage in NEW Archive Tier of Scale-Out Backup Repository™ (SOBR).

For Capacity Tier and NAS file version archiving, in addition to the wide variety of existing choices, you can now use **Google Cloud Storage (GCS)** as the object storage repository. The native integration is built using the proprietary GCS object storage API, but does not support immutable backups at this time, due to the lack of object lock capability in GCS.

For Archive Tier, we're delivering Amazon S3 Glacier (including Deep Archive) and Microsoft Azure Blob Storage Archive Tier support with the new SOBR Archive Tier. Unlike hot cloud object storage, these coldest tiers have their economics tuned for the "Write Once Read Never" use case and are thus best suited for long-term archival of GFS backups. Their significantly higher API and retrieval costs, as well as retrieval times measured in hours, drove the creation of the dedicated Archive Tier to ensure a cost-effective, yet seamless, backup lifecycle management.

The following are the key features of Archive Tier:

- Immutable backups To help meet compliance requirements, in Amazon S3 Glacier, the archived backups
 can be optionally made immutable for the entire duration of their retention policy.
- Policy-based offload Just like with Capacity Tier, there are no offload jobs to manage! Just set your
 archive window high enough to ensure only the restore points you are not likely to access again (outside
 of special circumstances) are archived and being smart, software-defined storage, SOBR will take care of
 data movement across all tiers on its own. Just keep an eye on its daily SOBR status report to make sure it's
 all green!
- **Cost-optimized archiving** Due to the high API costs of cold object storage tiers, offloaded data blocks are repackaged into large objects (up to 512MB in size) using helper appliances automatically provisioned in the public cloud for the duration of the archiving session. In addition, to avoid the early deletion penalty, we automatically skip archiving of restore points with the remaining retention time under the minimum required data storage duration of the used storage class.
- Flexible storage methods To lower your costs, by default the Archive Tier offload uses a forever-incremental approach with only a delta from the previous restore point uploaded and stored for each archived restore point. However, for extremely long retention policies, we also provide an option to store each GFS full backup as standalone. This allows you to avoid the single incremental backup chain spanning decades, while still keeping your overall costs reasonable through leveraging storage classes like Amazon S3 Glacier Deep Archive.



- Self-sufficient archives Archived backups are self-sufficient and not dependent on any external metadata, allowing them to be imported even if the on-premises backup server is lost. Furthermore, there's no "vendor lock-in" because archived backups can be imported from object storage and restored at any future point in time using a Veeam Backup & Replication Community Edition install, which does not require a valid license. In other words, we don't hold your data hostage!
- No extra costs Unlike secondary storage appliance vendors who obviously hate to see the data leaving their expensive on-premises hardware, Veeam does not charge a per-TB subscription for archiving data to object storage. In other words, we have no cloud usage tax!

SOBR Archive Tier is included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise** *Plus* edition is required.

Expanded Instant Recovery

Make even more of the data center's workloads available instantly with the seamless restore of the following new workloads from the pioneer of Instant VM Recovery®:

• Instant Recovery of Microsoft SQL Server and Oracle databases — Database won't start? Developers accidentally dropped a critical table? No problem! Recover any database from backup to the latest state or to an earlier point in time to any production database server or cluster (physical or virtual) in minutes, regardless of its size.

Selected databases are made available to production applications and database clients instantly and can be modified normally with all changes preserved in cache — while the backup itself is, of course, never changed. In the background, Veeam automatically restores database files to the production storage and then keeps syncing the actual (modified) database state to the production storage.

To finalize the recovery, you will need to switch the database over to running from the production storage, which can be done with minimal downtime, equivalent to simply restarting the database. This switchover can be done manually or scheduled to happen automatically — either as soon as the synchronization catches up or during your next maintenance window.

Unlike the interactive Publish functionality, database instant recovery uses a service-based architecture and does not depend on the Veeam Explorer™ user interface running. And should any backup infrastructure component reboot during the instant recovery, the Instant Recovery conveyor will automatically recover itself when all required servers come back online (in case of extended outages longer than one hour, you can resume the instant recovery manually using the Veeam Explorer UI).

Instant database recovery is included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise** or higher edition is required.

Instant Publish of NAS backups — Lost your NAS or file server? Deleted an entire file share accidentally?
 No problem! Just publish SMB file shares from backup to the latest state or to an earlier point in time on the selected mount server, enabling your users to instantly access their data in this temporary SMB file share while you're getting the problem fixed or data restored.

Other use cases discovered by our V11 beta testers involve enabling third-party applications and scripts to instantly access the content of any NAS backup for data mining and other **data reuse** scenarios — to avoid locked files and impact on your production environment, thanks to offloading this activity to backup storage hardware that usually remains idle during production hours. Prototypes were created by community members specializing in the following fields: Machine Learning (ML), searching for Personally Identifiable Information (PII) to aid in compliance processes, and GDPR and Malware detection (automated security analysis of files for sleeping malware with additional antivirus applications).



Instant Recovery of ANYTHING to Microsoft Hyper-V — V11 enables additional data recovery and portability
use cases by letting you instantly recover ANY physical server, workstation, virtual machine and cloud instance
backups to a Microsoft Hyper-V VM, regardless of what Veeam product was used to create the backup.
No learning curve is required, as the recovery just works, thanks to the built-in P2V/V2V conversion logic —
enabling restores and migrations with new levels of speed and flexibility and making hybrid-cloud DR a reality.

And because Veeam backup server runs on Microsoft Windows, the Hyper-V host is effectively built in directly into every backup server and readily available for everyone to use! We even support Windows 10 Hyper-V as the target for this functionality, which, in particular, enables managed service providers (MSP) to build ultra-low-cost Veeam-powered all-in-one DR appliances based on Windows 10 to deploy at their client sites.

Other enhancements

In addition to the above-mentioned major new features, V11 includes over 200 other enhancements, which are a response to customer feedback and ongoing R&D learnings, the most significant of which are listed below:

General

Backup Engine

V11 more than doubles backup performance for all-in-one Veeam deployments on general-purpose server hardware, enabling customers to exceed 11GB/s backup speed per node — so long as primary arrays and storage fabric can keep up! This huge leap in performance is achieved through the multiple improvements aimed at enterprise-class server and storage hardware:

- **System cache bypass** With V11, target data movers will bypass OS cache to ensure it does not interfere with controller-side caching and advanced I/O optimizations of enterprise-grade RAID controllers, both reducing the backup repository CPU usage and increasing performance by up to 50%.
- Aligned writes Unaligned writes impact both storage CPU usage and performance, so V11 will avoid
 them by aligning each backup file data blocks to a 4KB boundary. This feature is enabled by default
 for newly created repositories and can be mass enabled on the existing repositories with the
 Set-VBRBackupRepository cmdlet. Active full backup is not required for the new setting to take effect.
- Improved shared memory transport At a data processing speed approaching 100Gbps, even modern RAM speed starts to make a difference to overall data processing performance. V11 optimizes RAM interactions, significantly improving the speed with which data is passed from source to target data movers when they are running on the same server.
- NUMA awareness To avoid internal bus congestion from cross NUMA node traffic, in multi-CPU servers, dependent processes should ideally be placed within the same node. V11 implements full NUMA awareness and ensures source and target data movers never end up in different nodes.
- Optimal compression improvements We updated our default compression algorithm implementation, delivering a slightly better compression ratio and significantly faster decompression performance.
 For example, the execution of a SQL query returning 30GB of data against Stack Overflow database running in an instantly recovered VM now takes 28% less time compared to V10.
- Resource scheduler improvements We made many optimizations to our backup infrastructure resource scheduler, reducing the time it takes to issue the resource up to 50%, which significantly accelerates job startup time. The improvement should be especially significant in the environments with a large number of backup proxies and SOBR extents.



Restore Engine

After receiving great feedback from applying our advanced data fetcher technology to the virtual tape full export functionality on Windows-based backup repositories in V10, we've expanded this engine to Linux-based repositories. In addition, now we are using it for ALL features and functionality that read backup files content from Veeam repositories. The biggest improvements should be observed on enterprise-grade storage hardware and for functionality that involves bulk data movement, such as full image restores, backup copies, object storage offloads, etc.

PowerShell

- PowerShell module By popular demand, we switched from the PowerShell snap-in to the PowerShell
 module, which can be used on any machine with the backup console installed. We also no longer require
 PowerShell 2.0 installed on the backup server, which is something many customers had problems with.
- New PowerShell cmdlet V11 adds 184 new cmdlets for both newly added functionality and expanded coverage of the existing features with a particular focus on restore functionality.

RESTful API

• RESTful API for backup server — Our current Veeam Backup Enterprise Manager RESTful API has a concept of exposing functionality available in the EM web-UI only, so we're now also adding RESTful API to the backup server itself, where we will focus on the most typical backup server management needs. V11 provides the new REST API to address the most popular use cases from our customers and partners: backup jobs and backup infrastructure management and bulk import/export for simplified deployment and migrations of backup infrastructure and jobs. To helps us prioritize, please leave feedback on our R&D Forums on what you would like to see covered next!

RESTful API is included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise** *Plus* edition is required.

Security

• FIPS compliance — V11 uses FIPS-compliant encryption modules also in the base product build. By default, FIPS-compliant operations mode is disabled to allow processing of legacy platform versions where FIPS-compliant interaction is not possible (such as VMware vSphere versions prior to 6.5, due to their dependency on non-FIPS compliant VDDK versions), as well as to avoid the performance impact from real-time module integrity checks required by the FIPS certification. You can enable the FIPS-compliant operations mode on the Security tab of the Global Options.

Backup

Application-aware processing

- Persistent guest agent You can now optionally use the persistent guest agent for Windows-based VMs by deploying one through Group Policy or your standard software distribution tool. This approach reduces network ports usage down to just a few static ports (depending on functionality used) and eases the account privileges requirements associated with overcoming UAC to deploy a run-time process into the guest, while also reducing network traffic and guest processing time. Only a tiny installer component needs to be distributed to guests; the rest of the components will be deployed (and kept up to date) automatically.
- SQL Server integration Application-aware processing engine will now use the native MSOLEDBSQL
 provider if it is available on the SQL Server, enabling the processing of SQL Servers with forced TLS 1.2
 without requiring registry edits. In addition, database backup preferences for HA groups will now be honored.



• Improved visibility on SQL database protection — The new experimental option for SQL Server allows you to fail the image-level backup session if transaction log backup cannot be initialized or if no SQL databases are found. Use the AAIPSQLShowExperimentalOptions (DWORD, 1) registry value on the backup server to make the corresponding checkbox visible in the application-aware processing settings. Please leave feedback on this new option on the R&D Forums!

Backup jobs

- High priority jobs You can now designate some backup jobs as high priority. Such jobs will place their
 pending tasks into the dedicated resources scheduler queue that is offered for backup infrastructure
 resources before the queue used by normal priority jobs. Use this setting for backup jobs protecting
 workloads sensitive to their backup start time or for periodic jobs with strict RPO requirements.
- Background GFS retention GFS full backup retention is now processed independently from the backup job
 execution as a background system activity on the Veeam repository. This ensures that the expired full backups
 won't continue to consume repository disk space if the backup job gets disabled for extended time periods.
- Orphaned GFS backups retention The retention policy is now applied to GFS backups that no longer
 have a job associated with them, based on their last-known retention policy. This removes the need for
 workarounds, such as keeping the no-longer-necessary jobs protecting a single dummy machine.
- **Deleted VM retention improvements** Deleted VM retention will no longer be applied if the backup job failed to build the processed machines list to avoid backup deletions caused by temporary infrastructure issues.

Backup Copy jobs

Backup Copy jobs now use the same GFS retention logic as the primary backup jobs. This ensures consistency throughout the product and enables compatibility with new features, such as immutable backups of the Hardened Repository or background GFS backup retention. Specifically, this means the following changes:

- Time-based GFS retention GFS retention for Backup Copy is now time-based, as opposed to the number
 of restore points in each generation. This guarantees that the GFS restore points will not be kept for less
 time than necessary, even in the case of accidental manual GFS backup creation.
- GFS full creation time GFS fulls are now created and sealed right on the scheduled day, as opposed to
 when the corresponding restore point becomes the oldest in the incremental backup chain. This should
 remove the continuous confusion and concerns of our customers in regards to this process.
- No quarterly backups For consistency with the primary backup jobs GFS, a quarterly backup option is no longer provided. Existing quarterly schedules will be converted to monthly by increasing their retention value accordingly during the upgrade to V11. Existing Backup Copy jobs with GFS retention enabled will be updated automatically during the upgrade.

Other Backup Copy job improvements include:

- **Repository as source** You can now select the entire repository as a source for the Backup Copy Jobs in immediate copy mode.
- Daily retention Choose between restore point-based and new time-based retention in days for recent backups created by Backup Copy job.

Replication jobs

 NFS repository support — You can now specify an NFS-based backup repository in the replication job wizard for hosting replica metadata.



Quick Migration jobs

• SmartSwitch threshold — Our internal testing showed that Quick Migration in the SmartSwitch mode takes too much time for VMs with lots of RAM — to the point where it no longer makes sense. The root cause is the time it takes to transfer the memory state over NFC protocol. As a result, starting from V11, we will force cold migration (via power off) for machines with more than 8GB RAM. You can use the QMSmartSwitchRAMThresholdGB (DWORD) registry value on the backup server to override the threshold.

Restore

Data Integration API

- Linux target support The Data Integration API (DIAPI) has been expanded to support mounting backup content directly to the Linux server.
- Expanded platform support V11 enables image-based backups of all platforms supported by Veeam to be published through the DIAPI. This includes cloud-native backups for AWS, Microsoft Azure and Google Cloud Platform, as well as Nutanix AHV and VMware Cloud Director backups.

File Level Recovery (FLR)

• Linux FLR without helper appliance — FLR from Linux file systems can now be performed by mounting backup to ANY Linux machine: dedicated, target or the original one (which is always guaranteed to understand the file system you're trying to restore from). This approach removes the requirement for a vSphere or Hyper-V host to run FLR helper appliance on, while eliminating networking complexities and security concerns around the appliance. It also allows customers to perform FLR directly within cloud-based VMware infrastructure offerings.

NOTE: Helper appliance still remains available as an option, for example, from archived backups with file systems you're no longer using in the production environment.

• Linux FLR performance improvements — Performance of FLR from non-Windows file systems has been increased up to 50% whether you're doing recovery with or without the helper appliance.

Veeam Explorer for Microsoft Active Directory

DFS configuration restore — You can now perform restores of the Distributed File System (DFS) configuration in the System Container.

Veeam Explorer for Microsoft Teams

 Microsoft Teams item restore — Restore Microsoft Teams items directly from the image-level backup of the Veeam Backup for Microsoft Office 365 backup server.

Backup infrastructure

Backup Repository

Improved synthetic full performance on ReFS — Synthetic fulls should now complete up to 2X faster
on ReFS, thanks to reduced usage of the relatively long-running Windows API call required for the new
synthetic full backup file creation.



• **Disable ReFS integrity streams** — You can now disable ReFS integrity streams for Veeam backup files using the *DisableRefsIntegrityStreams* (DWORD, 1) registry value on the backup server. While we do not recommend disabling integrity streams because data integrity is paramount in data protection, some customers insisted on having the ability to control this setting to improve performance.

Scale-out Backup Repository

- VeeamZIP™ and exported backups tiering Full backups created with VeeamZIP and Export Backup,
 as well as orphaned backups, are now processed by the Capacity Tier and the Archive Tier policies just like
 regular backups and can be copied or offloaded to object storage normally. Imported backups will not be
 tiered just as before.
- Fast cloning awareness SOBR extent scheduler will now take into account that the newly created synthetic full backup file is to be fast cloned and will not require that the home (preferred) extent has enough free disk space to host non-fast-cloned synthetic full backup files. In the previous versions, this may cause SOBR to "explode" when certain extents get close to its capacity because the scheduler starts assigning all synthetic full backups to non-home extents.
- Offload operations in Windows event log The Capacity Tier and Archive Tier copy and offload operations
 will now create the corresponding events in the system event log for better visibility of these processes for
 users performing event log-based monitoring.

Object storage repository

- Task limit Added the ability to limit concurrent tasks for better compatibility with on-premises object
 storage, which can more easily get overwhelmed by large numbers of concurrent API requests. You should
 not need to use this limit for most public cloud object storage since it is infinitely scalable. However,
 one use case where this limit may be useful is when you specify a gateway server in the object storage
 repository settings to proxy access to the internet since depending on the amount of CPU and RAM, this
 server may run out of compute resources when processing too many concurrent tasks.
- **Restore performance** Restore performance from on-premises object storage backed by slow hardware has been improved a few times.
- ListAllMyBuckets permission no longer required S3 and Google object storage buckets can now be
 specified manually in the Object Storage Repository wizard without having to browse for it. This enables
 service providers to create individual buckets for their clients and delegate permissions with an IAM policy
 without exposing a list of all of their clients (in the bucket names) to other clients.
- **Decompress blocks before storing** You can now have backup data blocks decompressed before they are written to object storage. This enables on-premises object storage devices featuring built-in deduplication to process Veeam backup data more efficiently. To enable this behavior, create the *ObjectStorageDisableCompression* (DWORD, 1) registry value on the backup server.

Veeam Cloud Connect

Cloud Connect Backup MSP mode — When the "Allow this Veeam Backup & Replication installation to be
managed by the service provider" checkbox is selected in the Service Provider wizard on the tenant-side
backup server, backup metadata, like machine names, will not be obscured in the service provider-side
backup server, allowing MSPs to deliver managed backup services more efficiently.



- Microsoft Active Directory-based tenants To simplify remote workstations and laptop protection with standalone Veeam Agent for Microsoft Windows in an enterprise environment, Veeam Cloud Connect now includes support for tenant quotas based on Active Directory (AD) accounts. This allows end users to leverage their existing AD account to connect a cloud repository with the Cloud Connect infrastructure authenticating the tenant through the AD. Ongoing authentication during backups uses a secondary password to prevent missed backups caused by password changes. However, bare-metal recovery from a cloud repository always requires that the account be successfully authenticated with AD using the current password before allowing access to backups. Also, if the AD account is locked out, neither backup nor restore operations will be possible.
- **Tenant evacuation** Tenants can now be evacuated from the Scale-out Backup Repository extents using the Start-VBRCloudTenantBackupEvacuation cmdlet.
- WAN accelerator throttling The "Limit incoming traffic from this tenant" setting now applies also to tenants doing data transfers through built-in WAN accelerators. Previously, it was working for the direct data transfer mode only.
- Cloud Connect server RAM consumption We significantly reduced RAM consumption on the Cloud Connect server during the incoming replication job activity.

Access to Veeam Cloud Connect for Service Providers requires a **Rental license**. For access to Veeam Cloud Connect for the Enterprise, please contact your Veeam sales representative.

Platforms

Google Cloud Platform (GCP)

Veeam Backup for Google Cloud Platform integration — Register Google Cloud Storage (GCS) buckets
with backups created by Veeam Backup for Google Cloud Platform as external repositories, enabling you to
perform all types of restores and copy your GCP VM backups to on-premises backup repositories, or to tape,
for disaster recovery purposes and for compliance with the 3-2-1 Rule.

Linux

• **Persistent data mover for Linux** — Transport components are now deployed persistently when you register a Linux server with Veeam. This improves both performance and scalability, as data movers no longer require being pushed to the server each time a task starts. Required rules for built-in Linux firewalls are created automatically for the duration of the backup job (iptables, ufw and firewalld are supported).

NOTE: For Linux hosts not yet supporting the persistent data mover, such as storage appliances with the Veeam data mover integration, V11 will continue using the run-time data mover.

- Enhanced data mover security When leveraging single-use credentials, the persistent data mover will run as the limited user from the credentials set it was deployed with. As a result, any potential vulnerabilities in the internal data mover API cannot be used by hackers to overtake the operating system.
- Certificate-based authentication As opposed to using the saved Linux credentials, we will now leverage
 Public Key Infrastructure (PKI) technology for authentication between a backup server and transport
 components during backup tasks processing with the key pairs automatically generated at the transport
 deployment time.
- Elliptic curve cryptography To achieve an unprecedented level of security, V11 adds support for elliptic curve (EC)-based SSH key pairs, such as Ed25519 or ECDSA, for establishing SSH connections to Linux servers. If cracking a 228-bit RSA key requires less energy than boiling a teaspoon of water, a 228-bit EC key takes enough energy to boil all water on planet Earth providing security equivalent to a 2380-bit RSA key!



Microsoft Azure

- Fully integrated Azure-native backup Cloud-native Azure data protection is now built directly into the Veeam Backup & Replication console. This requires Veeam Backup for Microsoft Azure v2.
- Azure Stack HCl support Added support for the new hyperconverged infrastructure (HCl) operating system
 from Microsoft, which is, in essence, an on-premises Hyper-V infrastructure delivered as an <u>Azure service</u>.
- Restore to generation 2 VM Added experimental support for Direct Restore to Microsoft Azure to provision
 a generation 2 VM as the target. To enable this functionality, create the AzureEnableGeneration2VMRestore
 (DWORD, 1) registry value on the backup server.

Nutanix AHV

Veeam Backup for Nutanix AHV 2.1 — New functionality includes disk exclusion in backup jobs, better
integration with Nutanix Volume Groups for restore, UI enhancements and more. For the complete list
of new features, please refer to the corresponding Release Notes document.

VMware vSphere

- Instant first class disk recovery When performing instant disk recovery, users can now choose to restore a disk
 from backups as a standard VMDK attached to the specified vSphere VM or as a first-class disk (FCD), which can
 be managed independently of vSphere VMs and consumed directly by next-gen container-based applications.
- AND for vSphere tags In addition to specifying multiple individual vSphere tags as a job scope, you can now use a combination of vSphere tags in which case, only VMs with every selected tag assigned will be processed (classic AND operator behavior). When using this approach, take greater care monitoring unprotected VMs, for example, with Veeam ONE™ as such setup makes it much easier to unintentionally lose VMs from the protection scope and end up with no recent backups for them.
- Two-step failback To make the failback time more predictable for large VMs and reduce downtime, we've made the failback process more controlled. In the first stage of the process, which takes most of the time, the replica VM is still running while digests are calculated and the failback target machine is being restored to the pre-failback snapshot state. Once this process completes, the replica VM is placed into the Ready to Switch status and can be failed back with minimal downtime required for the final delta transfer. The switchover operation can be performed manually or automatically either as soon as the replica is ready for switchover or at the scheduled time during the next maintenance window.
- Linux proxy transport modes Supported transport modes now include Direct Storage Access (for block and NFS storage), Network (NBD/NBDSSL) and Backup from Storage Snapshots (for block storage only).
 In addition, the existing hot-add transport mode performance has been improved significantly with the advanced data fetcher technology, previously leveraged by Windows-based proxies only.
- Linux proxy CBT restore Added support for Quick Rollback functionality to Linux-based backup proxies for full VM restore and failback to the original location.
- NBD multi-threading The backup engine is now capable of establishing multiple NBD connections per VMDK for better performance of network transport mode. At the same time, due to the low limit of max NBD connections per ESXi host, there are reliability concerns associated with increasing the number of such connections. While our resource scheduler tracks NBD tasks per host to ensure they remain within the limit, we decided that a marginal performance benefit is not worth the risk of enabling this new behavior for our entire customer base right away, as there might be external NBD connections too. However, you can use the fully supported VMwareNBDConnectionsPerDisk (DWORD) registry value on the backup server to give this functionality a try. Our internal testing showed that the best performance is achieved with two NBD connections per disk. Please share your results in the Veeam R&D Forums to help us decide whether to enable this functionality by default in future updates!



- VMware Remote Console support The user interface functionality that enables opening a VM console
 now leverages the more secure VMware Remote Console. You will be offered the opportunity to download
 and install the console upon the first attempt to use any related functionality.
- VDDK version update VDDK 6.7 has been updated to version 6.7.3, which, among other issues, should fix issues with asynchronous NBD I/O usage.

VMware Cloud Director

- Cloud Director replication New dedicated replication job type enables service providers to perform vApp replication within and across Cloud Director (VCD) instances. The replication job processes vApp VMs and metadata (such as networking or VM start order) to create a ready-to-use replica vApp in the target Cloud Director that can be leveraged instantly in case of a disaster.
- Native Cloud Director plug-in This new capability allows service providers to extend the Cloud Director tenant UI to include Veeam Backup & Replication functionality, enabling tenants to manage their own backups and restores without leaving the convenience of the Cloud Director web console. This integration is based on Veeam's existing Cloud Director self-service backup portal.
- Multiple Cloud Director servers support Cloud Director self-service backup portal now supports
 environments with multiple VCD servers registered with Veeam Backup & Replication, and you can pick the
 desired VCD server when creating your organization configuration.
- Multiple configuration support Cloud Director self-service backup portal now supports the creation of multiple self-service configurations for the same VCD organization.
- Enhanced Cloud Director portal access flexibility You can now specify custom VCD roles in the vCloudPortalBackupAdminRole (STRING) and vCloudPortalRestoreOperatorRole (STRING) registry values on the backup server to allow all VCD users with the corresponding VCD role to access the self-service backup portal for their respective organization with either the Backup Administrator or Restore Operator role on the portal. Without these registry values populated, behavior remains as it was in the previous versions: only the VCD users with administrative permissions on the VCD organization are allowed to access the self-service backup portal for the corresponding organization with the Backup Administrator portal role.
- Cloud Director 10.2 support Full support for both on-premises installations and cloud-based deployments with VMware Cloud Director service.

Primary storage integrations

General

- Instant disk recovery from storage snapshots Reduce your instant recovery footprint by restoring only the required disks of large vSphere VMs (for example, only OS disk or only data disks) directly from storage-based snapshots. Instantly mount disks from a snapshot to the selected VM for other use cases, for example, comparing the disk content or performing mass file-level recoveries using third-party tools.
- Restore point-based retention for storage snapshots Retention of restore points in storage snapshots
 is now processed on a per-VM basis. Previously, storage snapshots themselves were considered to be
 restore points, which resulted in a number of issues in corner cases, like failed retries, VM migration to
 another volume, etc.



Dell EMC VNX/VNXe/Unity/Unity XT

• Integration tool version — Updated the Dell EMC Navisphere and Unisphere CLI tools to the latest version for TLS 1.2 support.

HPE 3PAR/Primera

- 3PAR Remote Copy support Asynchronous periodic 3PAR/Primera replication is now supported in all
 storage snapshot integration functionality. This includes managing storage snapshot replication, separate
 retention for snapshot replicas and backup from snapshot replicas on the secondary array to avoid impact
 from backup activities on the primary array.
- Nimble multi-protocol support Storage snapshot integration functionality now supports Nimble storage
 having both FC and iSCSI protocols enabled on the same array.
- Versions support Added support for 3PAR OS 3.3.1 MU5 and dropped support for 3PAR OS versions below 3.2.2 and WSAPI prior to version 1.5.

Lenovo

• Lenovo DM support - Added built-in Lenovo ThinkSystem DM Series storage snapshot integration.

NetApp

ONTAP 9.8 support — Added NetApp ONTAP 9.8 support for storage snapshot integration except for
processing of VMs residing on FlexGroup volumes. Note: You can still use regular host-based or agentbased backup for protecting such VMs.

Secondary storage integrations

ExaGrid

- AD authentication support Added support for Microsoft Active Directory-based authentication for registering ExaGrid with Veeam.
- **SOBR placement logic** Per ExaGrid request, in light of the global deduplication they provide, we disabled the special SOBR extent scheduling logic designed for deduplicating storage and making SOBR prefer placing new full backup on the same extent with the previous full backup. You can revert to the previous placement logic by creating *ExaGridEnableNewFullToSameExtent* (DWORD, 1) registry value under the HKLM\SOFTWARE\Veeam\Veeam Backup and Replication key on the backup server.
- **UI defaults** We now recommend setting compression level to Optimal in the backup job wizard when ExaGrid is specified as the target repository and we enabled the "Decompress backup data blocks before storing" option in the backup repository wizard by default when registering an ExaGrid-based repository. This new default will allow ExaGrid to perform deduplication effectively, regardless of the protected workload.

Dell EMC Data Domain

- Data Domain OS support Added support for DD OS versions 7.1, 7.2 and 7.3, while dropping support for all DD OS versions lower than 6.1. Please upgrade your DD OS version prior to upgrading to V11.
- Data Domain Boost SDK version DD Boost SDK has been updated to version 7.0.



HPE StoreOnce

- Backup Copy jobs as source Backup Copy jobs can now also be used as the source for Catalyst Copy jobs.
 Previously, only primary backup jobs were supported as the source.
- Tape out for Catalyst Copy backups Backup to Tape jobs now support Catalyst Copy jobs as the source.
- Health check performance Backup health check performance in Catalyst Copy jobs has been increased a few times through parallel processing.
- **Delayed backup copy deletion UI** Catalyst Copy jobs enable delayed deletion of backup copies from the secondary storage, resulting in longer retention on the Catalyst Copy targets. The deletion delay can now be controlled directly in the user interface, as opposed to the registry setting. This functionality is compatible with both HPE StoreOnce and HPE Cloud Volume Backup storage.
- Cloud Volumes Backup support V11 adds official support for Catalyst Copy jobs to HPE Cloud Volumes Backup.
- Catalyst SDK version HPE StoreOnce Catalyst SDK has been updated to version 4.2.4 with V11 protocol version.
- Catalyst API sessions tagging Veeam file share backup jobs now tag Catalyst API calls with the special VeeamNAS tag. HPE support intends to use this information to differentiate Veeam workloads in their support cases for faster resolution.

Quantum DXi

- Quantum FastClone support V11 officially supports enabling fast cloning on backup repositories backed by Quantum DXi models that support this functionality. Please contact Quantum support to confirm the status of the storage model you're using.
- Improved full VM restore performance We added optimized restore logic for full VM restore, which is
 already used in other deduplicating storage integrations. Veeam backup proxy will now do sequential reads
 from Quantum and random writes to the target disks, as opposed to restoring blocks in the order they are
 stored in the target disk.

Deduplicating storage integrations are included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise** or higher edition is required.

Tape

- Tape copy Easily clone selected tapes for the purposes of creating additional off-site copies, refreshing stored data to combat magnetic media decay over time or migrating your archives to modern LTO generation with migrations to both earlier and later generations supported. The backup server will update the backup catalog with references to the cloned (target) tapes, while also preserving references to the original (source) tapes.
- Tape verification Verify your archived tapes periodically to ensure the stored data is still readable and
 consistent. Tape verification may be required for compliance reasons, and it helps you to sleep better at
 night too!
- **Restore all tape content** Easily salvage all data from a media set that includes a failing tape by dumping all files that are still readable to the specified location.
- Maintenance mode Put entire tape libraries or specific drives into maintenance mode to tell all your tape jobs not to use them temporarily.



- Per-job drive limit You can now limit tape drive usage at the individual job level for Backup to Tape jobs.
- Force tape erase The tape erase process will now ignore all non-critical errors, such as block size or header issues, since they are irrelevant for a tape about to be wiped clean.
- Cluster-aware backup for NetApp ONTAP-based storages Cluster Aware Backup is an NDMP v4 protocol
 extension that enables the NDMP server to establish a data connection on a node that owns a volume,
 optimizing the data flow and improving NDMP backup performance.
- Backup to Tape job sources Backup to Tape jobs can now process backup copies of Nutanix AHV and Mac backups, as well as of cloud-native backups for AWS, Azure and Google enabling you to archive your cloud machine backups to tape for compliance purposes.
- File to Tape job performance improvements Thanks to enhanced File to Tape job pre-processing logic, backup and restore operations now complete up to 10 times faster for datasets with a large number of files and folders in the protection scope.
- File to Tape job protection scope You can now specify the entire data source (Windows Server or SMB/ NFS file server) as the source in File to Tape jobs, which will protect all of its shares and exports, including those newly added. This new capability required changing the File from Tape restore wizard in order to support restore from such backups, which as a side effect now also allows you to configure mass restores of multiple file shares in a single pass of the wizard.
- Enhanced reporting Backup, restore and tape verification jobs will now create a CSV file with all files that it could not process in the job's log folder.
- Restore from Tape UX improvements Required tapes are now automatically displayed for every restore point selected in the wizard. You no longer need to view each of the selected restore points just click Next and wait for the Insert these tapes prompt to appear.
- Tape management UI improvements Added cleaning tape media lifespan to the tape properties dialog
 and tape library and drive serial numbers to the device properties dialog. The tape rescan session now
 indicates when it is completed. The location tag can now be set on NDMP servers. Context menus on the
 Tape Infrastructure tab have been updated for better clarity. Width of all columns was adjusted to fit the
 expected content out of the box.
- LTO-9 support All native tape support functionality in V11 has been successfully validated against engineering samples of LTO-9 tape hardware kindly provided to us by IBM. If tape is the future, then V11 is ready for it!

Backup agents

Agent management

Backup from Storage Snapshots — Microsoft Windows Servers with volumes hosted on supported storage
arrays can now be backed up using "managed by server" agent-based backup jobs from native storage
snapshots. This approach moves the backup data processing load from the protected server to the
dedicated backup proxy. Furthermore, the usage of native storage snapshots eliminates the I/O overhead
from the system running off of Software VSS snapshots for the duration of the backup. By addressing
these two classic agent-based backup challenges, V11 brings LAN-free, zero-impact backups, identical to
off-host VMware and Hyper-V VM backup, to physical servers and clusters, allowing users to protect even
their busiest 24/7 workload without breaching SLAs. All built-in and Universal Storage API-based storage
integrations with iSCSI or FibreChannel connectivity are supported, and no vendor-specific Hardware VSS
Provider is required.



- Protection group for pre-installed agents This protection group (PG) type provides a convenient way to install agents using third-party software distribution solutions, when deploying them from the backup server is not possible due to security and network connectivity restrictions. The PG wizard creates a custom agent installation package that enables an agent to connect to the backup server automatically using the PKI-based authentication with a PG certificate. The backup server then places an incoming agent into the protection group that created their installation package and issues the new personal authentication certificate. At which point, you can use the agent in "managed by agent" backup policies normally. There's no requirement for the backup server to be able to connect to agents over the network, as the agents themselves will query the backup server for changed policy settings several times per day.
- Export as virtual disk improvements Disks from agent-based backups can now be exported as fixed VHD/VHDX disks to allow for mounting them in Microsoft Azure services (previously, disks could only be exported as dynamic).
- Unprotected hosts email notification Added an optional email notification for hosts that were not backed up at least once within the specified number of days with the "managed by agent" backup policy.
- Remove from configuration You can now remove machines from Protection Groups via the context menu on the host.
- Recovery media from backup copies Recovery media can now also be created from backups created by Backup Copy jobs.
- Veeam Agent for Microsoft Windows The agent-based backup job wizard now provides the ability to
 configure the "Backup all volumes except excluded" setting for the volume-level backup mode, exclude
 OneDrive folder from processing and use the new user profile backup mode.

Veeam Agents

- Veeam Agent for Microsoft Windows v5: New functionality includes support for Microsoft Windows 10
 version 20H2, wider Microsoft .NET Framework versions compatibility to avoid the reboot requirement
 following the .NET installation, daily and GFS retention options for servers, user profiles backup in the filelevel mode, improved VPN connection detection, FIPS compliance and more. For the complete list of new
 features, please refer to the corresponding What's New document.
- Veeam Agent for Linux v5: New functionality includes new OS versions support, extended attributes backup
 in the file-level mode, multiple recovery media enhancements, FIPS compliance and more. For the complete
 list of new features, please refer to the corresponding What's New document.
- Veeam Agent for Mac: The new agent delivers managed end-user data backup for any macOS device from
 Veeam Backup & Replication, allowing you to seamlessly integrate Mac laptop and workstation protection
 into your overall data protection strategy. And unlike the built-in Apple Time Machine software, Veeam
 Agent for Mac allows you to meet the 3-2-1 Rule through creating additional on-site and off-site backups
 using the familiar Veeam features and functionality.

Built on the proven Veeam Agent for Linux agent engine, the Mac agent includes the following features:

- Backup of user data and external USB drives content
- · Integration with configuration profiles of MDM solutions
- · Simple self-service file-level restore by end users via a local UI



Enterprise applications plug-ins

General

- **SOBR Capacity Tier support** Backups and backup copies of all enterprise application plug-ins can now be copied or moved to object storage with the SOBR Capacity Tier functionality. Just as with image-level backups, restore from backups offloaded to object storage is fully transparent.
- Performance enhancements We've made major performance improvements on all fronts, particularly
 thanks to the new approach to the metadata handling with per-backup metadata files, dramatically
 improving overall scalability. Please check the upgrade documentation on how to migrate your existing
 backups to the new metadata format.
- **Self-healing metadata** Periodic backup health check scans all restore points every six hours and recreates missing metadata files, which may be caused when backup is interrupted by an external event. You can change this period by creating the *DbPluginMissingMetaRegenerationAttemptIntervalMinutes* (DWORD) value on the backup server.
- FIPS compliance All enterprise application plug-ins now use FIPS-compliant encryption modules.

Veeam Plug-in for Oracle RMAN

- Oracle Data Guard support Full support for backup of Oracle Data Guard deployments.
- Improved RAC compatibility Oracle RAC installations with empty /etc/oratab file are now supported.

Veeam Plug-in for Oracle RMAN on AIX

This new plug-in provides the same functionality, installation and configuration experience as its Solaris counterpart. Supported versions include IBM AIX 6.1, 7.1, 7.2 and Oracle 11, 12, 18, 19 (ppc64 version).

Veeam Plug-in for SAP HANA

SAP HANA 1.0 support — In addition to the existing SAP HANA 2.0 support, this release now supports SAP
HANA Database 1.0 SPS 12 or newer (please refer to KB2997 for the installation instructions). The plug-in
officially certified by SAP for HANA versions 1.0 and 2.0.

Veeam Plug-in for SAP on Oracle

This new SAP certified plug-in provides integration with SAP BR*Tools to enable Oracle database backups directly to Veeam repositories with both util_file and util_file_online backup modes supported. Note that Veeam Plug-ins for Oracle RMAN and for SAP on Oracle can be used together for running backups in rman_util mode. Supported versions include 64-bit versions of:

- OS: SLES 11,12 and 15; RHEL 6 and 7; Oracle Linux 6 and 7
- · Oracle: 11.2 up to 19.1
- · BR*tools: 7.20 Patch 42 or later

Enterprise application plug-ins are included in the **Veeam Universal License**. When using a legacy Socket-based license, **Enterprise** *Plus* **edition** is required.



NAS Backup

General

Root protection scope — You can now specify the entire data source (SMB/NFS file server) as the source
in file share backup jobs, which will protect all of its shares and exports, including newly added. This new
capability required changing the file share restore wizard in order to support restores from such backup,
which, as a side effect, now also allows you to configure mass restores of multiple file shares in a single
pass of the wizard. In addition, storage snapshot folders will be excluded from processing automatically
whenever detected, so you no longer have to explicitly add them to the backup job exclusions list.

NOTE: You can convert existing backups into the format accepted for mapping in a newly created backup job with the root-based scope using the Convert-VBRNASBackupRootFormat cmdlet.

- Improved performance File share backup and Backup Copy job performance are now up to 2X faster, thanks to the usage of multiple upload streams between source and target data movers with transfers over high-latency networks benefiting from this change the most.
- Intelligent load balancer In the presence of multiple backup proxies, file share backup jobs will now
 automatically detect and use the least occupied backup proxy (just like VM backup jobs already do),
 allowing for more even load and full compute capacity utilization.
- Locked file alerts You can now control whether you want to log file and file attributes processing issues as a warning in the overall file share backup job result. In addition, the path to the audit file listing all locked files is now displayed in the job log.
- **Version-based retention** To better control backup repository storage consumption, you can now choose between applying the version-based retention to file versions in the archive repository only (a V10 behavior) or have the cross-cutting retention across both the backup and archive repositories.
- Automatic backup mapping for backup copies Backup copy processes will now attempt to automatically
 detect the presence of the seeded backup upon the first run and will continue the existing backup with an
 increment if a seed is present.

Primary storage integrations

Enterprise NAS filer integration — Native Dell EMC Isilon, Lenovo DM and NetApp FAS integrations
allow you to register the entire filer as a data source and perform file share backups without having to
obtain access permissions to each protected file share. In addition, backup from such data sources will be
performed from native storage snapshots out of the box to avoid locked files without requiring complex
setup and scripts to manage snapshots.

NOTE: You can convert existing backups into the format accepted for mapping in a newly created backup job with the NAS filer-based scope using the Convert-VBRNASBackupStorageFormat cmdlet.

Native changed file tracking integration — V11 file share backup jobs can integrate with Dell EMC Isilon
Changelist API to reduce storage load and improve the performance of incremental backups in scenarios
where backed up file shares have a large number of subfolders with low change rates.

Secondary storage integrations

Large blobs — File share backup and Backup Copy jobs will now automatically switch to using 1GB blobs
when deduplication storage appliances are used as the target. This increases scalability up to 20 times for
storage devices that support a limited amount of files per appliance (e.g., HPE StoreOnce) and improves
backup and restore performance up to a few times for all deduplication storage.



NOTE: You can use Convert-VBRNASBackupStorageFormat cmdlet to upgrade your existing jobs to use large blobs.

Metadata extents — When using Scale-out Backup Repositories consisting exclusively of slow storage, like
deduplicating appliances, you can improve backup and restore performance by a few times by introducing
a small metadata-only extent with fast storage which will only be used to store backup metadata. Being an
advanced feature, it can be configured with PowerShell only using the Set-VBRRepositoryExtent cmdlet.

User interface

Backup console

- No local admin requirement The backup console no longer requires operators to use an account with the Local Administrator group membership on the system that runs the console. This helps to improve security by not having to assign administrative privileges to all console operators. When console update installation is required and for restore scenarios that actually do require Local Administrator privileges, you will be offered the opportunity to restart the console under an administrative account.
- Orphaned backups Backups without an associated job are much easier to track now, thanks to the new
 Orphaned node under Backups. Previously, such backups ended up in the Imported backups node and were
 impossible to distinguish.
- **Filter-based job nodes** You can now add custom job views (a V10 feature) as persistent nodes to the management tree for faster access to the favorite views you are using most often.
- Backup immutability info We added a column showing the Hardened Repository backup immutability expiration time to the backup properties dialog.
- Action log timestamps By popular demand, in addition to the operation duration column, you can now
 display the timestamp column with the time when each operation started. To do this, right-click the action
 log header.
- Windows notification center integration We will now use the Windows notification center to display
 interactive notifications such as a SQL Server configuration database approaching its size limit (new in V11),
 tape job waiting for a tape to be inserted and other important messages that were previously displayed in
 a system tray balloon message.
- No more Finish button confusion The Finish button on the last step of file-level and item-level recovery
 wizards has been renamed to Browse to better convey the fact that the process will continue with the items
 selection. Previously, some users were too scared to click this button due to wrongly assuming the restore
 will start before they actually selected what to restore.
- Swagger console You can now open the new backup server RESTful API interactive documentation (powered by Swagger) directly from the main menu.
- Deprecated features The "Transform previous backup chains into rollbacks" functionality has been
 deprecated, so the corresponding checkbox is no longer present in the user interface for newly created jobs.
 If you need help with transitioning away from this backup mode, please share your use case on the Veeam
 R&D Forums. We plan to remove this capability completely in our next major release in 2022.

Enterprise Manager

Web UI localization — We added the industry-standard GetText localization framework to Enterprise Manager
—and thanks to our local pre-sales engineering team, Veeam Backup Enterprise Manager v11 ships with the
following translations already built in: French, German, Italian, Japanese, Spanish and Simplified Chinese.



- **SSO logon experience** We have changed the logon UI to no longer require entering a username for SSO logons. Instead, we immediately redirect users to the configured identity provider for authentication. This enables users from an organization using credential-less authentication (for example, smartcard-only environments) to log on to the Enterprise Manager and its portals.
- SAML support for vSphere Self-Service Backup Portal The portal has been getting much interest from outside of its original target audience, particularly from service providers. To support this trend, we added SAML integration, enabling service providers to give their tenants access to the portal by assigning quotas to external users and groups. In the case of SAML accounts, the only supported delegation mode is vSphere Tags-based.
- **UI enhancements** For Microsoft Exchange items recovery, we will now display the mailbox name next to the username to avoid confusion for people with similar names. We also added object search functionality when defining the scope of the Restore Operator role.

Licensing

General

- Best change is no changes, finally! V11 uses the same license file format introduced back with V10. Such license files are no longer tied to a particular software version, allowing you to use your existing V10 license file for V11, so long as your maintenance contract is still active.
- License auto update in the setup When performing an in-place upgrade from V9, the setup wizard will offer you the chance to download the V11 license file automatically. This requires uploading your currently installed license to Veeam servers. If your backup server has no internet connection or if you prefer not to have your current license uploaded you can download your license file from the <u>Customer Portal</u> instead.
- License auto update in the product When installing a license file, you will now be offered the opportunity to have license extensions downloaded automatically when you renew or expand your contract. This optional functionality requires the backup server to send the license ID, the installation ID and workload usage counters to Veeam servers periodically. If you'd rather not share this information with Veeam, do not enable this functionality and instead download your updated license files from the Customer Portal and install them manually.
- Simplified license renewal You can now initiate the license renewal process directly from the License Information dialog. The Renew button redirects users to the Veeam website and the license renewal request form with some of the required information already pre-populated based on the currently installed license.

Veeam Universal License (VUL)

- **Doubled NAS protection** After reviewing the average discounts our sales have been providing in VUL-based NAS protection opportunities, we decided to double the amount of NAS data covered by one license from 250GB to 500GB. This change also means that you can now protect the first 500GB of data from any file source at no cost (up from 250GB with V10a). To take advantage of the new NAS backup capacity entitlement, you must upgrade to V11.
- Starter edition removal This edition was discontinued in the fall of 2020, so V11 will not accept such license files. Please download a replacement license file for Veeam Backup Essentials™ from the Customer Portal it's a free upgrade for the remainder of your contract.

Ameritas puts a premium on data availability, and Veeam and NetApp Deliver



"The ability to extract the right data at the right time is immensely valuable in the insurance industry. Big Data is always available thanks to Veeam and NetApp."

Jeff Martinson,
 Director of IT,
 Ameritas

The Business Challenge

Life will never be free from uncertainty, but when uncertainty is minimized, life can be maximized. Ameritas strives to help customers enjoy life by reducing uncertainty, helping grow assets and protecting what is most cherished.

"Big Data is a priceless commodity in our industry," said Jeff Martinson, director of IT at Ameritas. "It helps us develop innovative products and services that differentiate us in a highly competitive market. Big Data also helps us predict what customers want before they ask for it, and that helps Ameritas help customers put worry behind and the future ahead."

Martinson said risk calculation is an important part of developing new products and services.

"Our actuarial teams rely on Big Data to calculate risk. If the information isn't available, they may miss their deadlines, which impacts our time to market. If that happens, we risk losing our customers to competitors."

Additionally, Big Data plays a role in helping develop products and services that are designed for today's market.

"We analyze customer data so we can offer products and services that will meet their precise needs," Martinson said. "If that information isn't available and we can't meet their needs, they may go elsewhere."

A third key use of data is in claims management.

"Our company is built on trust and transparency," Martinson said. "We must process customers' claims quickly and accurately to maintain their trust. Access to data helps us process claims fast and deliver the level of service our customers deserve."

Industry

Insurance, employee benefits and financial services

Company



Ameritas Life Insurance Corp. and its affiliated companies offer a wide range of insurance and financial products and services to individuals, families and businesses. Founded in Nebraska in 1887, Ameritas serves approximately 4 million customers nationwide.

Challenge

As the insurance and financial services industries becomes increasingly competitive, companies must offer products





The Veeam Solution

Veeam® Availability Suite™ helps Ameritas maintain complete and total availability of Big Data, enabling the company to calculate risk, develop new products that will appeal to customers and process their claims quickly and efficiently.

"We deployed Veeam for two reasons," Martinson said. "The primary reason is simplicity and reliability. The second reason is that Veeam integrates fully with NetApp ONTAP in our FlexPod environment, giving us complete availability of applications and data. The ability to extract the right data at the right time is immensely valuable."

Complete availability also translates into serving customers efficiently when claims are made, and offering products and solutions the market and customers demand.

Martinson said legacy backup wasn't optimal because it didn't integrate well with the company's NetApp ONTAP environment. Veeam integrates fully with NetApp ONTAP, enabling Ameritas to protect more than 1,600 VMware vSphere and Microsoft Hyper-V virtual machines quickly and reliably by backing them up from ONTAP storage snapshots.

In addition, Veeam tests the recoverability of backups, which ensures that critical business data will be available should it be lost, deleted or corrupted.

"Veeam's integration with an enterprise-class environment like FlexPod gives us a flexibility we didn't have before, while maintaining data assurance and reliability," Martinson added. "Veeam and NetApp are extremely strong, capable solutions on their own, but they're even better together, and they save time and money."

Veeam and NetApp are easy to manage, allowing Ameritas to reallocate personnel from managing backup and storage to automating business processes. Ameritas also saves money. Veeam was less expensive than legacy backup solutions, resulting in significant annual savings.

In addition, Ameritas uses Veeam Agents for Microsoft Windows and Linux to protect data on physical servers, and Veeam Management Pack™ (MP) for System Center to gain a big-picture view of the entire virtualized infrastructure — all from within the native System Center Management console.

Next Ameritas will use Veeam Cloud Connect to move backups to the cloud.

"Our goal has always been to find a single solution that can deliver full availability in our data centers and the cloud, and that's what Veeam Cloud Data Management and NetApp ONTAP deliver," Martinson said. "Hands down, they're in a class all their own."

and services that differentiate themselves and meet the needs of their customers. This is where Big Data comes in. It helps companies assess risk and set premiums, develop new products and predict customer behavior. Big Data helps companies like Ameritas provide the options their customers demand, so it must be available and accessible at all times.

Solution

Veeam Availability Suite + NetApp ONTAP

Results

- Maintains total availability of Big Data to meet customer demands
- Saves time, enabling automation of additional business processes
- Delivers significant IT infrastructure savings each year





1 + 1 = 3 NetApp + Veeam Better Together

The Results

- Maintains total availability of Big Data to meet customer demands
 "A prerequisite for success in our industry is maintaining complete and total availability of Big Data," Martinson said. "Veeam and NetApp ONTAP let us extract data at any moment in time, giving us a competitive edge in the market."
- Saves time, enabling automation of additional business processes "Veeam and NetApp ONTAP integrate fully, enabling us to reallocate staff time from backup and storage management to system design and automation," Martinson said.
- Delivers significant IT infrastructure savings each year
 "Veeam was less expensive than legacy backup, resulting in significant savings," Martinson said.



Learn more www.veeam.com



Download free trial vee.am/availability

About Veeam Software

Veeam® is the leader in Backup solutions that deliver Cloud Data Management™. Veeam provides a single platform for modernizing backup, accelerating hybrid cloud and securing your data. With 365,000+ customers worldwide, including 81% of the Fortune 500 and 66% of the Global 2,000, Veeam customer-satisfaction scores are the highest in the industry at 3.5x the average. Veeam's global ecosystem includes 70,000+ partners, including HPE, NetApp, Cisco and Lenovo as exclusive resellers. Headquartered in Baar, Switzerland, Veeam has offices in more than 30 countries. To learn more, visit www.veeam.com or follow Veeam on Twitter @veeam.



UBC Delivers IT Services to Students and Universities throughout Western Canada with Veeam and NetApp



"On the business side, Veeam Backup & Replication helps us deliver IT services that are more compelling and cost-effective than other providers. Veeam's support for vCloud Director is critical in delivering cloud services to customers, and because Veeam will be four times less expensive than the legacy backup tool over a five-year period, we're able to provide affordable IT to customers. Veeam MP is also important because it helps us keep customers happy. Veeam MP gives us much-needed visibility into our virtualised environment, which lets us resolve issues before customers are affected."

Mario Angers, Senior Manager,
 Systems University of British Columbia

INDUSTRY

Education

ORGANISATION



The University of British Columbia (UBC) is a global centre for research and teaching. Consistently ranked among the 40 best universities in the world, UBC serves 60,000 students and employs 15,000 faculty and staff. UBC was founded in 1908 and has campuses in Vancouver and Okanagan.

CHALLENGES

UBC provides IT services to its own massive university community as well as to 26 universities in Western Canada. UBC made a commitment to simplify laaS and DR for customers but knew from experience that its backup tool was too complex for them to deploy and use.

UBC didn't have full visibility into its virtualised environment, limiting its ability to identify and resolve issues before they affected customers.

THE BUSINESS CHALLENGE

The Department of Information Technology (IT) at the University of British Columbia (UBC) isn't a typical IT organisation. In addition to providing IT support and services to the UBC community, it also provides infrastructure-as-a-service (IaaS) and disaster recovery (DR) to 26 universities across the province. UBC's IT infrastructure serves more than 250,000 students and 60,000 faculty and staff throughout Western Canada.

To enable this extraordinary level of IT delivery, UBC developed world-class data centres capable of enterprise business operations akin to those of Fortune 500 companies. Thousands of VMs run critical databases and applications containing several petabytes of data that must be available 24.7.365. As a highly regarded medical research university, one of UBC's priorities is to protect data containing important cancer and Alzheimer's research.

As expected, UBC's Department of IT must deliver the highest level of service. This became a problem during deployment of a legacy backup tool in the VMware vSphere environment. Although the legacy tool had backed up UBC's physical servers successfully for 15 years, it was ill fated in a virtualised environment.

"The main problem was complexity—both in deployment and use," said Mario Angers, Senior Manager of Systems at UBC. "Backup jobs either went past our backup window or failed, despite the vendor's assistance during the yearlong implementation. We even participated in a one-week training seminar hosted by the vendor but felt no closer to understanding the tool's complexities. We couldn't ask our customers to use this product for self-service backup and recovery."

It was challenging for UBC's Department of IT to offer service level agreements (SLAs) to customers, much less meet recovery time and recovery points objectives (RTPOs).

"After the vendor suggested that we consider restructuring our IT infrastructure to fit their backup strategy; we knew we needed a solution that would align with our vision, not conflict with it." Angers said. "Our vision is to provide VMDKs for absolutely everything on NFS to gain speed and efficiency, but the legacy backup tool wasn't capable."

The legacy tool had additional drawbacks: It didn't fully integrate with UBC's NetApp FAS system, and it didn't provide VMware vCloud Director support. But that wasn't the only problem. UBC didn't have full visibility into the virtualized environments that support its own university community and 26 other university communities. Reduced visibility also made capacity planning difficult.

"Without full visibility, we couldn't proactively identify and resolve issues before customers were impacted. At times, customers told us about outages before we were aware of them", Angers said. "We spent a lot of time manually monitoring each virtualized environment and dealing with incident-related support requests, which delayed requests that were project-related. And, without full visibility we struggled with capacity and performance management, which play a huge part in ensuring our laaS is successful."

Angers said UBC's customers have the choice to contract with any IT service provider; therefore, simplifying IT for customers and reducing time-to-resolution averages are key competitive advantages.

"From a business perspective, we must deliver IT services that are better, more economical, and more compelling than other providers," he said.



SOLUTION

Veeam Backup & Replication

UBC replaced its backup tool with Veeam Backup & Replication because Veeam scales to meet its growing needs, is easy to use and is affordable.

With Veeam, UBC makes fast, frequent image-based backups from NetApp storage snapshots on the Vancouver campus and replicates VMs to the Okanagan campus for DR.

Veeam Management Pack f or System Center

Veeam MP gives UBC full visibility into its virtualised environment, enabling the university to identify and resolve issues proactively before they impact the UBC community and the universities that rely on UBC for laaS and predicable uptime.

THE VEEAM SOLUTION

Veeam® Backup & Replication™ and Veeam Management Pack™ (MP) for System Center met all of UBC's needs.

Veeam Backup & Replication full integrates with NetApp FAS, enabling the university to establish SLAs for the first time. UBC uses Veeam to make super-fast backups from NetApp storage snapshots with little to no impact on the production environment. Meeting RTPOs is easy because Veeam offers high-speed replication for guaranteed restore points and high-speed recovery features. Instant VM Recovery™ restores VMs to the production environment by running them directly from backup files and Veeam Explorer™ for Storage Snapshots recovers individual items or entire VMs guickly and efficiently from NetApp Snapshot, SnapMirror and SnapVault.

"Veeam made it easy for us to operationalize VM backup and recovery," said Brent Dunington, Systems Architect at UBC. "Veeam is simple to deploy and use, and it integrates so seamlessly with NetApp that meeting RPOs and RTOs became non- issues for us."

Veeam Backup & Replication also helps UBC deliver laaS to customers by backing up and restoring VMs managed by vCloud Director.

"We've performed successful vApp recovery many times with Veeam," Dunington said. "Configuration was simple and required little to no training for our operations staff."

Veeam MP solved UBC's visibility problem by fully integrating with Microsoft System Center to provide complete visibility of all the virtual and physical environments UBC maintains (it's own and those of the 26 universities) from the System Center console, enabling proactive management.

"Before Veeam MP, we had no visibility into our virtualised environment because of limited monitoring and reporting," said Sanja LeBlanc, Manager of Systems at UBC. "We operated in a manual and reactive mode. A customer would call about a problem, we'd figure out what was broken, and we'd fix it, which could take minutes, hours or days."

UBC was in reactive mode when one of the NetApp storage arrays failed. Veeam MP hadn't been deployed yet, so no one knew about the failed array until a customer called to report a problem.

"It took several hours to bring the storage array back online," LeBlanc explained. "Two years later when Veeam MP was monitoring and reporting on our virtual environment, a NetApp controller went offine, and Veeam MP notified us immediately. We resolved the issue quickly before customers were impacted."

For any university, a cost-effective solution is a must. Veeam MP demonstrates its value by helping UBC understand growth areas and trends. For example, before purchasing additional compute and storage capacity for itself and the 26 universities, UBC uses Veeam MP for capacity planning and right sizing to reclaim and reallocate underutilized resources. Therefore, UBC maximizes budgets (for itself and the universities) by avoiding over purchasing hardware.

"When we look at the combination of Veeam Backup & Replication and Veeam MP, we see benefits on both the business and the technology sides," Angers said. "On the business side, Veeam Backup & Replication helps us deliver IT services that are more compelling and costeffective than other providers. Veeam's support for vCloud

Director is critical in delivering cloud services to customers, and because Veeam will be four times less expensive than the legacy backup tool over a five-year period, we're able to provide affordable IT to customers. Veeam MP is also important because it helps us keep customers happy. Veeam MP gives us much-needed visibility into our virtualised environment, which lets us resolve issues before they affect customers."

Angers said Veeam's pricing is easy to understand: Veeam is licensed per CPU socket. "The legacy tool appeared to be licensed based on the temperature outside," he said. Dunington explained Veeam's benefits on the technology side.

"Veeam Backup & Replication integrates so tightly with NetApp that we can make fast, frequent backups from snapshots with zero impact on production. That integration also gives us good dedupe and compression ratios across our backup jobs. Dedupe values average between 2.5 and 6 times and compression levels average 2.5 to 4 times.

"Veeam MP provides technology benefits too. It lets us see our virtual and physical environments under a single pane of glass, which gives us unified monitoring, reporting and capacity planning."



RESULTS



Scalability and ease-of-use deliver on commitment to simplify IT for customers



Integration with NetApp enables first-time creation of SLAs



Proactive management decreases downtime and disruption to customers



Capacity planning and right sizing streamline budgetary decisions

ABOUT VEEAM SOFTWARE

Veeam® has pioneered a new market of Availability for the Always-On Enterprise™ to help companies solve the challenges of keeping their businesses up and running at all times. Veeam enables the Always-On Business™ with solutions that provide recovery time and point objectives (RTPO™) of less than 15 minutes for virtualized applications and data.

THE RESULTS

· Scalability and ease-of-use deliver on commitment to simplify It for customers

The best way for UBC to deliver more compelling and less expensive IT support and service to its growing number of customers is to provide them with predictable and simple self-service VM backup and recovery. Veeam Backup & Replication was the only data protection solution that met UBC's requirements: It's easy to use, supports VMware vCloud Director so UBC can build secure private clouds to deliver laaS and fully integrates with NetApp.

Integration with NetApp enables first-time creation of sLAs

Before deploying Veeam Backup & Replication, UBC couldn't offer SLAs to customers because meeting RTPOs was a challenge. Meeting RTPOs with Veeam is easy. Using Veeam Backup from Storage Snapshots, UBC makes fast, reliable backups from NetApp snapshots to guarantee recovery points. Using Veeam Explorer for Storage Snapshots, UBC gets fast, granular recovery.

Proactive management decreases downtime and disruption to customers

Without full visibility into VMware vSphere, UBC didn't know about problems until customers reported them. Veeam MP integrates with System Center to give UBC a single, unified view of its virtual and physical environments. Complete visibility enables UBC to identify and resolve issues before they disrupt customers.

Capacity planning and right sizing streamline budgetary decisions

With Veeam MP, UBC makes informed planning and budgeting decisions because it has a clear understanding of existing compute and storage resources. With detailed trending and analysis for its own environment as well as customers' environments, UBC ensures compute and storage resources don't sit idle when they could be reallocated to underpowered VMs.



Learn more www.veeam.com



Download free trial veeam.com/backup



Colorado Health Information Exchange Provides Data Caregivers Need to Improve Patient Care with Aid from Veeam and NewCloud



"Veeam and NewCloud help us make health information available instantly to medical providers so they can offer patients the best care and treatment."

- Robert Denson,
Chief Information Officer,

The Business Challenge

CORHIO created one of the largest and most successful networks for health information exchange in the United States.

Nearly 14,000 health care organizations participate in the network including hospitals, doctors' offices, long-term care facilities, labs and imaging centers. CORHIO's network gives them access to accurate, up-to-date patient information so they can provide appropriate care.

"Our network is comprised of 80 million clinical records for 5.4 million patients," said Robert Denson, Chief Information Officer at CORHIO. "That's 52 terabytes of data, and it's growing fast—by more than 20 terabytes each year. Unlike most organizations, we don't delete data after a certain period of time. We keep it forever because health care providers need access to family medical histories when treating the next generation."

CORHIO's challenge was keeping enormous quantities of data available.

"Our sole purpose is to deliver the right health information to the right place at the right time," Denson said. "None of that is possible if data isn't available. If someone is brought to the emergency room and can only tell doctors and nurses her name, the first thing they'll do is check our network for her health data. If it's not available because of a server glitch, they have no way of knowing important information: What medications does she take? Does she have a pre-existing condition like diabetes?

Industry

Technology

Company



The Colorado Regional Health Information Organization (CORHIO) is an independent, nonprofit digital health organization committed to advancing medical care by enhancing information technology and data exchange.



To ensure the security of their data, CORHIO contacted NewCloud Networks, a global cloud services provider.

"CORHIO is in the business of exchanging clinical information, not maintaining an IT infrastructure," said Sam Kumar, Founder and CEO of NewCloud. "We knew what type of cloud solution they needed, and Veeam is at the center of it."

The Veeam Solution

NewCloud designed a customized cloud solution for CORHIO featuring Veeam Availability Suite.

"Veeam and NewCloud help us make health information available instantly to medical providers so they can offer patients the best care and treatment," Denson said. "Veeam and NewCloud also help us preserve patient's privacy."

The Health Insurance Portability and Accountability Act (HIPAA) mandates the protection and confidentiality of patient information. NewCloud's HIPAA-compliant cloud and Veeam's monitoring, reporting, testing and documentation are the perfect fit for CORHIO.

NewCloud and Veeam have something else in common: NetApp®.

"Our cloud platform is built on the best, most reliable data center foundations in the world, including NetApp ONTAP®, FAS and AFF," Kumar said. "The integration between NetApp and Veeam is one of the reasons we're able to offer customers fast, reliable backup as a service (BaaS), disaster recovery as a service (DRaaS) and security as a service (SECaaS)."

Denson said these services give CORHIO the confidence to take on new projects. One project is with the State of Colorado Division of Youth Services.

"The state's 10 medical centers for at-risk youth wanted to improve the care they provide, so they asked for our help," Denson said. "They were having trouble gathering kids' health histories because many don't have parents to keep track of that information. We helped the medical centers become part of our network, and now they have accurate data about each child, enabling them to provide the right care for healthy futures."

Denson said one of CORHIO's favorite sayings is "health care moves at the speed of trust."

"Without trusted partners like NewCloud and Veeam, we wouldn't be able to empower people, providers and communities, enabling healthy outcomes for millions of people."

Challenge

CORHIO created a network for health care providers to exchange information about patients. Regardless of where patients go for medical care in Colorado and some surrounding states, their health records follow them. CORHIO's challenge was making sure health data is always available. If it's not, medical professionals won't have all the information they need before treating patients, including life-threatening drug allergies and chronic conditions such as diabetes and cardiovascular disease.

Solution

Veeam Availability Suite + NewCloud Networks

Results

- Maintains availability of 80 million+ clinical records
- Supports healthy outcomes for 5.4 million patients
- Improves medical care for sensitive populations, such as Colorado's at-risk youth



- Maintains availability of 80 million clinical records
 Health care providers throughout Colorado depend on CORHIO's network for
 - instant access to medical records. This information helps them provide better care, and in some cases, save lives.
- Supports healthy outcomes for 5.4 million patients
 - "Our partnership with NewCloud and Veeam is key to our success," Denson said. "NewCloud built us a customized cloud service to protect patient data, and Veeam is the engine driving data availability."
- Improves medical care for Colorado's at-risk youth
 - "One of our core values is building community through collaboration," Denson said. "Veeam and NewCloud helped us do exactly that with at-risk youth."

About Veeam Software

Veeam is the global leader in Intelligent Data Management. Veeam Availability Platform is the most complete solution to help customers on the journey to automating data management and ensuring the Availability of data.

About NewCloud Networks



NewCloud Networks is a global cloud computing and communications provider specializing in back up, disaster recovery and production cloud. The company delivers real value, maximum performance and solutions that are tailored to customers' needs. NewCloud's guiding principle — take care of customers, partners and employees, and everything will take care of itself — has led to a 95 percent customer-retention rate.



Learn more www.veeam.com



Download free trial vee.am/backup





Yusen Logistics Americas Meets RTO/RPO with Veeam + Cisco HyperFlex, Saving \$300,000 Every 10 Minutes in Downtime



The Business Challenge

Yusen Logistics Americas provides shippers of all sizes with a portfolio of services designed to manage their complex and ever-changing supply chains. The company optimizes cargo transportation and distribution for some of the nation's largest companies including Target and Walmart. Both retailers have recognized Yusen Logistics Americas as partner of the year for extraordinary commitment during peak seasons.

Yusen Logistics Americas deals with a lot of data (1.1 PBs on 600 virtual machines) in three critical, interdependent systems: IBM Sterling B2B Integrator, which receives and processes customers' orders, a proprietary warehouse management system that fulfills orders, and a bespoke transportation management system that coordinates shipment and delivery.

Slow, unstable backup and recovery threatened availability of these critical systems, despite the IT team spending nearly 600 hours trying to resolve the problems. Jermaine Wells, Senior System Engineer at Yusen Logistics Americas, said meeting both recovery time and point objectives (RTO/RPO) was possible only 50 percent of the time.

"We have to meet recovery objectives 100 percent of the time," Wells said. "If our systems aren't available, the business won't run efficiently, and if the business doesn't run efficiently, we risk losing customers. We calculated the cost of downtime, and it's \$300,000 every 10 minutes."

Industry

Transportation

Company



Yusen Logistics Americas Inc. is an award-winning supply-chain logistics company. It's a subsidiary of Nippon Yusen Kaisha, a Japanbased global ocean container carrier, giving it access to one of the largest transportation and warehouse networks in the world. Based in Secaucus, New Jersey, Yusen Logistics Americas employs 1,600 people in 48 locations nationwide.









The Veeam Solution

Yusen Logistics Americas replaced legacy backup with Veeam Backup & Replication.

"Veeam was the obvious choice," Wells said. "It's the best availability solution on the market, and the integration between Veeam and our Cisco HyperFlex infrastructure is outstanding."

Veeam and Cisco have worked together to address the needs of their mutual customers since 2013. Veeam added snapshot integration to the Cisco HyperFlex platform in 2017, which enables lower RPOs without impacting production systems.

"We're meeting RTO and RPO 100 percent of the time, and that's because of the deep integration between Veeam and Cisco HyperFlex," Wells said. "They give us a level of confidence and business resiliency we've never had before."

Veeam backs up, replicates and recovers from storage snapshots, increasing speeds by up to 60 percent. Veeam's SureBackup and SureReplica verify the recoverability of backups and replicas, and Virtual Lab lets the IT team test software code, patches and updates before putting them into production.

"Veeam complements Cisco HyperFlex to improve data protection of the systems that sustain our business," Wells said. "When we had performance issues with B2B Sterling Integrator and the warehouse management system, our development team tested code in Virtual Lab to resolve the issues quickly. Before we deployed Veeam, they had to build clones of virtual machines before they could test anything, and that was time-consuming. Veeam is our Superman. It simplifies data protection and saves tremendous time."

Wells said members of the IT team took turns protecting data before Veeam was deployed. One person spent five hours each day rerunning failed backups and recovering data.

"Veeam is totally different because backups rarely fail, and if we need to recover data, it takes minutes. Data protection is 98 percent faster and so much easier with Veeam, giving us time to update current systems and deploy new ones like Microsoft Office 365."

Wells said data migration is fast and easy too.

"Veeam replicated 400 production virtual machines from one colocation center to another in record time and with zero impact on the business," Wells said. "I can't imagine how long migration would have taken with legacy backup. Veeam is the best availability solution for Cisco HyperFlex."

Challenge

Three critical business systems support world-class transportation and distribution services, but slow, unstable backup and recovery put them in jeopardy. Meeting RTO and RPO was possible only half the time, which threatened business continuity.

Solution

Veeam Backup & Replication + Cisco HyperFlex

Results

- Meets recovery objectives 100 percent of the time
- Supports business resiliency and continuity
- Reduces time spent protecting data by 98 percent







- Meets recovery objectives 100 percent of the time
 Veeam and Cisco HyperFlex help Yusen Logistics Americas protect the
 business-critical systems that underpin its end-to-end supply chain
 solutions for the nation's largest companies.
- Supports business resiliency and continuity
 "Meeting RTO and RPO 100 percent of the time means we can ensure business
 resiliency and continuity 100 percent of the time," Wells said. "That wasn't
 possible before Veeam and Cisco HyperFlex."
- Reduces time spent protecting data by 98 percent
 Veeam and Cisco HyperFlex bring the power of hyperconvergence to data protection, making it fast, easy and seamless for Yusen Logistics Americas.
 The IT team spends its newfound time upgrading systems and deploying new ones including Microsoft Office 365.



Learn more www.veeam.com



Download free trial vee.am/backup

About Veeam Software

Veeam® is the leader in Backup solutions that deliver Cloud Data Management™ Veeam provides a single platform for modernizing backup, accelerating hybrid cloud, and securing data. With 375,000+ customers worldwide, including 82% of the Fortune 500 and 67% of the Global 2,000, Veeam customer-satisfaction scores are the highest in the industry at 3.5x the average. Veeam's 100-percent channel ecosystem includes global partners, as well as HPE, NetApp, Cisco and Lenovo as exclusive resellers. Veeam has offices in more than 30 countries. To learn more, visit ttps://www.veeam.com or follow Veeam on Twitter @veeam.





AVAILABILITY[™] for the Modern Data Center

Oil Company Cuts Operating Expenses and Fuels SLAs with HP StoreOnce, NetApp FAS and Veeam Backup & Replication



"If you've virtualized all critical systems and you're not using Veeam, you're in a shaky situation."

— Hercu Rabsatt Director of Infrastructure and Service Management Mansfield Oil Company, Inc.

INDUSTRY: **Energy**

COMPANY:



Mansfield Oil is a leading North American energy supplier. Through a network of refiners, suppliers and carriers, Mansfield delivers 3.5 billion gallons of fuel each year to corporations, fleets, retailers, convenience stores and government agencies. Established in 1957 and headquartered in Gainesville, Georgia, Mansfield has offices throughout the United States and Canada.

CHALLENGE:

Mansfield had modernized its IT infrastructure but still used several VM backup tools that decentralized management and required excessive administration.

The Business Challenge

No matter what time of day, Mansfield delivers fuel to customers nationwide. Healthcare organizations, government agencies and corporations rely on Mansfield to remain operational. Without fuel, transportation comes to a standstill, and in worst-case scenarios, lives could be at stake. If Mansfield can't recover business operations quickly and deliver fuel 24x7x365, millions of people could be affected.

To safeguard business operations, Mansfield modernized its data center by updating and replacing legacy systems with solutions designed for virtualization including HP servers, Microsoft Windows 2012 R2 and NetApp FAS for tier 1 storage. One of Mansfield's key considerations was the lifespan of each solution.

Next Mansfield focused on deploying tier 2 storage and consolidating backup for 600 virtual machines (VMs) running critical systems such as Microsoft Active Directory, Exchange, SQL Server and SharePoint. Multiple backup tools were in play, which meant additional training, decentralized management and excessive administration—actions that are not acceptable in a modern data center.

"We had to re-evaluate what was important and where we saw the business going," said Hercu Rabsatt, Director of Infrastructure and Service Management at Mansfield. "We were spending 80% of our time running and maintaining backups and only 20% of our time focusing on data center projects that would move the business forward. We needed a single, easy-to-use data protection strategy that integrated tightly with our nearly 100% virtualized environment."

There were other problems associated with multiple backup tools. Backup jobs were unreliable, making more frequent backup a contradiction in terms, and recovery of critical systems could take up to one day. There was no way Mansfield's IT team could offer service level agreements (SLAs) to internal customers because it was impossible to meet recovery time and recovery point objectives (RTPOs).

"Instead of considering our options from a backup perspective, we considered them from an enterprise perspective," Rabsatt said. "How could we guarantee the business in a disaster situation, reduce administration time and save the company money?"

ProSys Information Systems knew how. An IT solutions provider and Veeam Gold ProPartner, ProSys had worked closely with Mansfield for years and knew exactly how to decrease costs while improving data center availability and recovery. ProSys recommended Veeam® Backup & Replication™ for data protection and HP StoreOnce for tier 2 storage.

SOLUTION:

Veeam Backup & Replication

Veeam Backup & Replication simplifies and streamlines backup of nearly 140TB of data and applications to NetApp FAS and HP StoreOnce.

RESULTS:

- Efficient, centralized backup and recovery reduce data center expenses
- Single enterprise data protection solution delivers SLAs for the first time
- Modern data center de livers quantifiable savings through decreased downtime

ABOUT PROSYS INFORMATION SYSTEMS



Based in Atlanta Prosys delivers customized IT solutions backed by comprehensive engineering expertise, best-in-class products and a professional staff of nearly. 350. Founded in 1997, the company helps mid-market, enterprise, public sector and educational organizations assess, and support IT hardware and software solutions. ProSys strives to help clients minimize their cost structures, increase the effective less of their supply chains, secure their networks, improve communications and develop customized storage management solution.

"Veeam and HP integrate well and share the same four attributes: affordability, performance, reliability and ease of use," said Jenny Woodruff, Account Executive at ProSys. "Given how heavily virtualized Mansfield is and their desire for a low-maintenance solution that meets their backup and tier 2 storage needs, Veeam and HP are the best fit."

The Veeam Solution

Veeam Backup & Replication and HP StoreOnce aligned perfectly with Mansfield's strategy to leverage virtualization in its modern data center, centralize backup management and reduce administration time. Together with NetApp, which was already part of the modern data center, the trio helped Mansfield accomplish two major business goals: reduce data center expenses and offer SLAs to internal customers for the first time.

Mansfield reduced operating expenses by simplifying and centralizing backup management with Veeam. Instead of spending 80% of the time troubleshooting backups and 20% of the time working on other data center priorities, Mansfield shifted the ratio to 40% and 60%.

"Veeam's return on investment from a personnel perspective is unmatched in the business," Rabsatt said. "We reallocated people in different positions and backfilled them, enabling us to recoup operating expenses."

The combination of Veeam Backup & Replication, NetApp FAS and HP StoreOnce helps Mansfield save on capital expenses too. Each solution has built-in deduplication; therefore, the backup footprint in NetApp FAS decreased by 30%, and the backup footprint in StoreOnce decreased by 20%. Plus, the combined purchase price of Veeam and HP StoreOnce was 72% less expensive than other backup and storage solutions.

Mansfield's second goal was to offer SLAs to internal customers, which is now possible because the company can meet RTPOs.

Meeting recovery time objectives (RTOs) is now possible because Veeam offers high-speed, granular recovery. Veeam Explorers™ provide visibility and item-level restore in backups of Mansfield's most critical systems: Active Directory, Exchange, SQL and SharePoint. Veeam Explorer for Storage Snapshots helps Mansfield recover individual items, guest files and VMs from NetApp Snapshot, SnapMirror and SnapVault.

To maximize the number of recovery points, Mansfield uses Veeam to back up 12TB of tier 1 data and applications to NetApp FAS. Because Veeam creates backups from storage snapshots with little to no impact on the production environment, backups can be made as often as every 15 minutes. To maximize the number of recovery points for tier 2 data and applications, Mansfield uses Veeam to back up 125TB of data to HP StoreOnce. As Veeam is agentless, backup is fast and frequent backup is feasible, ensuring multiple recovery points.

Rabsatt said Mansfield has the best technology in place for an enterprise environment, but success is based on how the company executes technology specific to business operations.

"We tie technology to metrics specific to our industry—cost per gallon and lift to turn—to demonstrate quantifiable savings," he explained. "If our data center suffered a catastrophic disaster, we could lose millions of dollars per day. With the SLAs we put into place with Veeam, we know we can recover our entire data center within two to four hours. Before Veeam, recovery might have taken several days. If you've virtualized all critical systems and you're not using Veeam, you're in a shaky situation."

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"The business trusts us because the solutions we've deployed have shown immediate value," Rabsatt sad. "The IT team has become a valued partner in business decisions; we have a seat at the table because we earned it."

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Veeam & Cisco deliver enterprise grade cloud data management

Cisco and Veeam deliver solutions to secure, back up and recover your data wherever it resides. By combining Cisco Data Center products and Veeam solutions, customers get fast, reliable and easy to use data protection solutions that eliminate data loss and slow data recovery, helping to minimize risk, decrease downtime and easily adapt to business changes to meet the most stringent recovery objectives.

Veeam pairs with Cisco UCS storage servers and Cisco HyperFlex LFF to offer the ultimate Veeam Availability platform to deliver on the promise of modern, agile & multi-cloud data centers. Benefits include:

FAST RELIABLE RECOVERY & REDUCED RISK

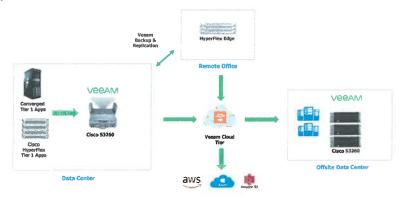
- Rapid Restores: For any workload, physical, virtual or cloud-based.
- 2 in 1 Backup & Replication Advanced replication and failover for disaster recovery. Orchestration & automation to meet SLAs with confidence
- Seriously Powerful NAS Backup Supports SMB, NFS, Windows & Linux with a scalable architecture for the protection of billions of files and PBs of unstructured data.
- Unmatched price and performance: Market-leading price & performance, verified recoverability, secure recovery and fast & item-level.

DO MORE WITH YOUR DATA

- Copy Data Management flexibility: Accelerate application development & simplified DR testing with Veeam DataLabs.
- Ransomware Remediation: Leverage Veeam secure restore to safely recover from ransomware & malware events.
- Dev Ops: Leverage data to accelerate application time to market. Test patches, updates, compliance & new features quickly.

SIMPLE, AGILE, FLEXIBLE

- IT operations: Veeam's simplicity and streamlined operations combined with Cisco UCS manger deliver enhanced IT automation so customers spend less time on IT operations and more time helping the business transform and innovate.
- Seamless scalability: Veeam's Scale-Out Backup Repository capabilities combined with Cisco's independent scaling of storage and compute increases business agility.
- Monitoring & Analytics: Increase efficiency and reduce costs with comprehensive visibility, pro-active monitoring and reporting.
- Centralized multi-cloud management: Protect business applications and data on-premise, in remote offices or in the public cloud.



USE CASES



Backup Modernization: Replace or augment existing legacy backup solutions with modern data protection designed for highly virtualized environments. Increase IT simplicity through a low-touch agentless architecture that delivers rapid recovery with Veeam Instant VM Recovery™. Increase agility through consistent performance & Availability across multi-cloud workloads.



Disaster Recovery & Orchestration: Simplify DR through integrated backup & replication. Advanced, imaged-based replication & streamlined disaster recovery ensuring Availability of mission-critical applications. Veeam & Cisco deliver low RTOs for ALL applications. Automated workflows simplify backup & DR orchestration to deliver greater confidence for critical application & data Availability, whether a single file, virtual machine or entire data center recovery — on-premises, remote office or in the cloud.



Multi-Cloud Agility: Protect critical business workloads & data across multi-cloud environments. Leverage Free Veeam Cloud Tier to archive data in low-cost public cloud storage like AWS, Azure, IBM Cloud and thousands of Veeam Cloud Service Provider data centers.



Ransomware Remediation: Mitigate business risk by leveraging Veeam's immutable backup feature which protect backup copies from modification and deletions and Veeam secure restore with Cisco UCS to quickly & safely recover from a ransomware or malware attack.



Rapid Recovery Veeam & Cisco deliver lightning-fast & reliable restores for individual files, entire VMs multipl VMs, & application items, ensuring confidence in virtually every recovery scenario & assuring the lowest RTOs. Restore entire VMs in minutes with Instant VM Recovery. Run any virtualized application on vSphere or Hyper-V directly from the latest backup, instead of waiting to provision storage extract the backup & copy it to production.



Application DevTest: Veeam and Cisco copy data management combined with Veeam DataLabs accelerate application development and testing by providing developers with a near real-time copy of production data, in a completely isolated environment, to innovate and iterate.



Monitoring & Analytics: Complete visibility into virtual, physical & cloud-based workloads. Provides monitoring, reporting & intelligence tools to help with the automation & control needed to maintain Availability by protecting against potential problems before operational impact.

SUPPORTED ENVIRONMENT CONFIGURATIONS

	UCS C240	UCS S3260	HyperFlex LFF
Package	Small 2U form factor		High Availability
	Value-oriented	Faster Performance Large Capacity	Seamless Scalability
	Reasonable capacity, reasonable price		Data growth/workload consolidation
Ideal for	small org, remote office	midsize businesses, enterprises	midsize businesses, small enterprises
Cisco	Cisco UCS C240	Cisco UCS S 3260	Cisco HyperFlex LFF Up to 16 nodes

^{*} Veeam Instance Licensing is a single type of licensing for all workloads including physical, VMware, Hyper-V and AWS workloads, on premises and across public clouds.



Learn more vee.am/cisco-veeam-hub



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^{***} Refer to terms and conditions.