NetApp

Get started

NetApp virtualization solutions

NetApp
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Get started

Learn about using NetApp for any virtualization solution

Discover how NetApp ONTAP provides a robust foundation for virtualization, especially in response to recent VMware licensing changes. Explore strategies to optimize VMware environments, migrate to VMware Cloud Foundation or alternative hypervisors, and take advantage of NetApp's advanced data management, protection, and cloud integration features.

Introduction

Given VMware's recent licensing changes, organizations must adapt their virtualization strategies to maximize cost efficiency and scalability and minimize business risks. Optimizing existing VMware environments, considering migration from standalone vSphere to VMware Cloud Foundation (VCF) using existing enterprise storage and embracing a multi-hypervisor or hybrid cloud approach are pivotal steps. Notably, VCF 5.2.1 introduced enhanced flexibility by allowing the use of external storage solutions in place of vSAN, simplifying organization's ability to adopt the new licensing models while using enterprise storage functionalities and maintaining continuity.

ONTAP is the best platform for any hypervisor on-premises or in the cloud. ONTAP supports all the prominent hypervisors in on-premises environments and has first-party data services in each major cloud, supporting VMware cloud offerings and cloud native workloads. This enables organizations to navigate the licensing changes easily by choosing the appropriate deployment model for their workloads.

This paper outlines strategies for optimizing VMware deployment costs, evaluates multi-hypervisor adoption, details the migration of VMs from vSphere to VCF and migration of VMs to alternate hypervisors, covering all available options.

What Changed

Broadcom's acquisition of VMware has led to a significant shift in VMware's licensing model. The new approach is transitioning to a subscription-based bundle pricing structure, while in line with industry trends, is expected to result in substantially higher costs for customers. Here are three major points to keep in mind:

Subscription-Based Licensing: VMware is moving away from perpetual licenses to subscription-based models.

Bundled Packaging: VMware Cloud Foundation (VCF) bundles several products together in a single offering for enterprises and service providers.

Per socket to core: The shift from per socket to per CPU core pricing indicates a significant change that could substantially increase costs.

Key takeaway - These changes are prompting customers to evaluate their virtualization needs, optimize utilization more effectively, and explore alternative options.
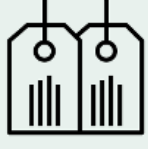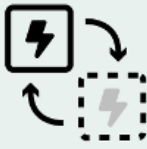
Why ONTAP

NetApp storage solutions empower and enable customers to take full advantage of all the benefits of a virtualized infrastructure. With NetApp solutions, customers can rapidly deploy comprehensive data

management software, delivering automation, efficiency, data protection, and leading security capabilities while meeting any demanding performance needs. Combining ONTAP software with VMware vSphere allows you to reduce host hardware and VMware licensing expenses, ensure data is protected at lower cost, and provide consistent high performance.

Virtualized workloads are inherently dynamic. Consequently, administrators utilize VMware Storage vMotion to migrate VMs across VMFS, NFS, or vVols datastores, all within the same storage system. This allows them to explore various storage strategies, including All-Flash Systems or the latest ASA models, leveraging SAN innovations for enhanced cost efficiency.

Peace of mind, guaranteed
Continually evolve your storage environment with confidence

Ransomware Recovery Guarantee	6 Nines (99.9999%) Data Availability Guarantee	Predictable Support Pricing	Media Replacement Assurance	Storage Efficiency Guarantee
OPTIONAL PROGRAM[1]	INCLUDED w/ ASA[2]	INCLUDED w/ Support	INCLUDED w/ Support	INCLUDED w/ ASA/AFF

Best-in-class ownership experience to accompany NetApp AFF/FAS/ASA solution purchase

The ONTAP storage solution offers the following benefits:

- **Independent scaling:** Offload workload data management, protection, and mobility to storage integrated with vSphere to scale storage without adding compute

- **Blazing Fast Performance:** Provide sub-millisecond latency and high throughput with cutting-edge NVMe and ASA architectures. Optimize flash, NVMe, and GPU performance for traditional VMs and modern Kubernetes or AI deployments.

- **Comprehensive Data Services:** Compress, dedupe, and compact data using built-in capabilities for 5-30X less storage with 85-90% more data center efficiency

- **Seamless Clustering and High Availability:** Utilize SnapMirror active sync or MetroCluster for effortless stretch clustering and robust disaster recovery.

- **Multi-Protocol:** ONTAP supports access to data through multiple protocols, i.e., NFS, iSCSI, SMB and S3. Systems running ONTAP are unified in several significant ways. Originally this approach referred to both NAS and SAN protocols, and ONTAP continues to be a leading platform for SAN along with its original strength in NAS.

- **Automated provisioning and orchestration:** Leverage ONTAP tools for VMware and its REST APIs, vSphere plugins, and SPBM (Storage Policies) to automate and streamline storage management.

- **Integrated Data protection and low-cost Disaster Recovery:** Offload virtual workload backup and restore using NetApp SnapCenter. Utilize NetApp Disaster Recovery to achieve a lower RPO and reduced RTO data replication. This eliminates the need for costly alternative infrastructure, offering affordable disaster protection for VMware workloads. Whether from on-premises to on-premises NetApp ONTAP

environments or to VMware Cloud, NetApp-powered storage ensures robust protection.

- **Ransomware Detection:** Extend VMware-level security and compliance to data to improve protection, detection, remediation, and recovery capabilities via built-in autonomous ransomware protection and zero trust compatibility by enabling multifactor authentication, role-based access, comprehensive logging, and user behavior anomaly detection

- **Integrated Hybrid Cloud:** Simplified and integrated for workload mobility, backup and restore, and disaster recovery into any hyperscaler cloud (Elastic VMware Service, Azure VMware Solution, and Google Cloud VMware Engine).

- **Storage Lifecycle Program (SLP):** Non-disruptively upgrade to the next generation controller or opt for cloud storage if organization is ready to take that step.

Key takeaways

- Use ONTAP to eliminate CPU impact and overhead on ESXi hosts by offloading CPU-intensive tasks such as storage efficiency, encryption, snapshots, and more. This optimization reduces the total cost of ownership (TCO) by requiring fewer cores on each host.

- With ONTAP, start with initial capacity and leverage superior data reduction and movement techniques, reducing costs by 20-50% without adding new hosts.

- ONTAP storage can be used with multiple workload domains and not constrained to a specific cluster, thus improving the overall utilization across multiple clusters.

- ONTAP Snapshot, integrated with SnapCenter, offers exceptional and cost-free data protection for both VM and datastore level backups, as well as granular restores. Additionally, ONTAP enables the offloading of snapshots to object storage for long-term retention.

- Experience seamless storage with no RAID or storage pools to configure, ongoing data reduction, and encryption.

- With ONTAP One, access all ONTAP features and robust security without licensing barriers. Pairing with NetApp Disaster Recovery further reduces cost.

Right-size and optimize

As these licensing changes become effective, every IT organization is under the stress of potentially increased Total Cost of Ownership (TCO), sometimes more than 10x. A well-optimized VMware environment maximizes performance while controlling licensing expenses. This ensures effective resource management and capacity planning. With the right set of tools, you'll quickly identify wasted or idle resources to reclaim the cores, thus reducing the core count which in turn reduces the overall licensing cost.

NetApp offers a powerful suite of tools to overcome these challenges, providing enhanced visibility, seamless integration, cost efficiency, and robust security. By using these capabilities, organizations can survive and even thrive during this disruption and be prepared for any challenges the future brings.
Note: Keep in mind, most organizations are already doing this as part of their cloud assessment, and it is the same processes and tools that help in avoiding the cost panic in the on-premises world and save any immediate emotion driven migration cost to alternate hypervisors.

How NetApp helps

NetApp TCO Estimator: NetApp's Free TCO estimation tool

- Simple HTML based calculator

- Uses NetApp VMDC, RVTools or manual input methods

- Easily project how many hosts are required for the given deployment and calculate the savings to optimize the deployment using NetApp ONTAP storage systems.
- Shows the possible savings

> ⓘ The [TCO estimator](#) is only accessible to NetApp field teams and partners. Work with NetApp account teams to assess your existing environment.

VM Data Collector (VMDC): NetApp's Free VMware Assessment Tool

- Lightweight, point-in-time collection of configuration and performance data
- Simple Windows-based deployment with web interface
- Visualizes VM topology relationships and exports Excel reports
- Specifically targets VMware core licensing optimization

VMDC is available [here](#).

Data Infrastructure Insights (formerly Cloud Insights)

- SaaS-based continuous monitoring across hybrid/multi-cloud environments
- Supports heterogeneous environments including Pure, Dell, HPE storage systems and vSAN.
- Features AI/ML-powered advanced analytics that identifies orphaned VMs and unused storage capacity - deploy for detailed analysis and recommendations for VM reclamation.
- Provides workload analysis capabilities for right-sizing VMs before migration and ensure critical applications meet SLAs before, during and after migration.
- Available with 30-day FREE trial period

With DII, dive deep into analyzing the workload IO profiles across virtual machines using real-time metrics.

> ⓘ NetApp provides an evaluation called Virtualization Modernization Assessment which is a feature of the NetApp Architecture and Design Service. Every VM is mapped on two axes, CPU utilization and memory utilization. During the workshop, all details are provided to the customer for both on-premises optimization and cloud migration strategies to promote effective utilization of resources and cost mitigation. By implementing these strategies, organizations maintain a high-performance VMware environment while effectively managing costs.

Key takeaway

VMDC serves as a quick first assessment step before implementing DII for ongoing monitoring and advanced AI/ML-driven analytics across heterogeneous environments.

VCF Import Tool: Run VCF with NFS or FC as principal Storage

With the release of VMware Cloud Foundation (VCF) 5.2 comes the capability to convert existing vSphere infrastructure to VCF management domains and import additional clusters as VCF VI workload domains. With this, VMware Cloud Foundation (VCF) can now fully be run on NetApp storage platforms without the requirement to use vSAN (yes, all of this without vSAN). Converting a cluster, with an existing NFS or FC datastore running on ONTAP, involves integrating existing infrastructure into a modern private cloud, which means there is no need for vSAN. This process benefits from the flexibility of NFS and FC storage, to ensure seamless data access and management. After a VCF management domain is established through the conversion process, administrators can efficiently import additional vSphere clusters, including those using

NFS or FC datastores, into the VCF ecosystem. This integration not only enhances resource utilization but also simplifies the management of private cloud infrastructure, ensuring a smooth transition with minimal disruption to existing workloads.

> ⓘ Only supports NFS v3 and FC protocol when used as principal storage. Supplemental storage can be used either vSphere supported NFS protocol v3 or 4.1.

Key takeaway:

Importing or converting existing ESXi clusters enables to leverage existing ONTAP storage as the datastore and there is no need for deploying vSAN or additional hardware resources, thus making VCF resource-efficient, cost optimized and simplified.

Migration from Existing vSphere to VCF using ONTAP storage

If VMware Cloud Foundation is a greenfield installation (creating a new vSphere infrastructure and Single Sign-On domain), then existing workloads running on older vSphere versions cannot be managed from Cloud Foundation. The first step is to migrate current application VMs running on existing vSphere environments into Cloud Foundation. The migration path depends on the migration choices—live, warm, and cold—and by the version of any existing vSphere environments. The following are the options in the order of priority depending on the source storage.

- HCX is the most feature-rich tool currently available for Cloud Foundation workload mobility.
- Leverage NetApp Disaster Recovery
- vSphere replication with SRM can be an easy-to-use vSphere migration tool.
- Use 3rd party software using VAIO and VADP

Migration of VMs from non-NetApp storage to ONTAP storage

The easiest method in most cases is to use Storage vMotion. The cluster should have access to both the new ONTAP SAN or NAS datastore and the storage you are migrating the VMs from (SAN, NAS, etc.). The process is simple: Select one or more VMs in the vSphere Web Client, right-click the selection and click Migrate. Choose the storage-only option, select the new ONTAP datastore as the destination, and proceed with the last few steps of the migration wizard. vSphere will copy the files – VMX, NVRAM, VMDK(s), etc. – from the old storage to the ONTAP powered datastore. Note that vSphere will potentially be copying large amounts of data. This method does not require any downtime. The VMs continue to run as they are being migrated.
Other options include host-based migration, and 3rd-party replication to perform the migration.

Disaster Recovery using Storage Snapshots (optimize further with storage replication)

NetApp offers an industry-leading SaaS-based disaster recovery solution that can significantly lower the costs and reduce complexity. There's no need to acquire and deploy expensive alternative infrastructure.

Implementing disaster recovery through block-level replication from the production site to the disaster recovery site is a resilient and cost-effective method for safeguarding workloads against site outages and data corruption events, such as ransomware attacks. Using NetApp SnapMirror replication, VMware workloads running on on-premises ONTAP systems with NFS or VMFS datastores can be replicated to another ONTAP storage system located in a designated recovery data center where VMware is also deployed.

Use NetApp Disaster Recovery, which is integrated into the NetApp Console wherein customers can discover their on-premises VMware vCenters along with ONTAP storage, create resource groupings, create a disaster recovery plan, associate it with resource groups, and test or execute failover and failback. SnapMirror provides storage-level block replication to keep the two sites up to date with incremental changes, resulting in an RPO

of up to 5 minutes. It is also possible to simulate DR procedures as a regular drill without impacting the production and replicated datastores or incurring additional storage costs. NetApp Disaster Recovery takes advantage of ONTAP's FlexClone technology to create a space-efficient copy of the NFS or VMFS datastore from the last replicated Snapshot on the DR site. Once the DR test is complete, simply delete the test environment, again without any impact to actual replicated production resources. When there is a need (planned or unplanned) for actual failover, with a few clicks, NetApp Disaster Recovery will orchestrate all the steps needed to automatically bring up the protected virtual machines on designated disaster recovery site. The service will also reverse the SnapMirror relationship to the primary site and replicate any changes from secondary to primary for a failback operation, when needed. All of these can be achieved at a fraction of the cost compared to other well-known alternatives.

> ⓘ 3rd party backup products that support replication functionality and VMware Live Recovery with SRA are other prominent alternate options.

Ransomware

Detecting ransomware as early as possible is crucial in preventing its spread and avoiding costly downtime. An effective ransomware detection strategy must incorporate multiple layers of protection at ESXi host and guest VM levels. While multiple security measures are implemented to create a comprehensive defense against ransomware attacks, ONTAP enables adding more layers of protection to the overall defense approach. To name a few capabilities, it starts with Snapshots, Autonomous Ransomware Protection, and tamper-proof snapshots.

Let's look at how the above-mentioned capabilities work with VMware to protect and recover the data against ransomware.

To protect vSphere and guest VMs against attacks, it is essential to take several measures including segmenting, utilizing EDR/XDR/SIEM for endpoints and installing security updates and adhering to the appropriate hardening guidelines. Each virtual machine residing on a datastore also hosts a standard operating system. Ensure enterprise server anti-malware product suites are installed and regularly updated on them which is an essential component of multi-layered ransomware protection strategy. Along with this, enable Autonomous Ransomware Protection (ARP) on the NFS volume powering the datastore. ARP leverages built-in onbox ML that looks at volume workload activity plus data entropy to automatically detect ransomware. ARP is configurable through the ONTAP built-in management interface or system Manager and is enabled on a per-volume basis.

In addition to the multiple layered approach, there is also a native built-in ONTAP solution for protecting unauthorized deletion of backup Snapshot copies. It is known as multi-admin verification or MAV which is available in ONTAP 9.11.1 and later. The ideal approach will be to use queries for MAV specific operations.

> ⓘ With the new NetApp ARP/AI, there is no need for a learning mode. Instead, it can go straight to active mode with its AI-powered ransomware detection capability.

Key takeaway

With ONTAP One, all the security feature sets that act as an additional layer are completely free. Access NetApp's robust suite of data protection, security and all the features that ONTAP offers without worrying about licensing barriers.

VMware Alternatives to consider

Every organization is evaluating a multi-hypervisor approach, which supports a multi-vendor hypervisor strategy, thus strengthening operational flexibility, mitigating vendor dependency, and optimizing workload placement. By combining multiple hypervisors, organizations can tailor infrastructure to meet diverse workload

demands while managing costs. Organizations then streamline multi-hypervisor management by leveraging interoperability, cost-effective licensing, and automation. ONTAP is the ideal platform for any hypervisor platform. And a key requirement in this approach is dynamic virtual machine mobility based on the SLAs and workload placement strategy.

Key Considerations for Multi-Hypervisor Adoption

- **Strategic Cost Optimization:** Reducing reliance on a single vendor optimizes operational and licensing expenses.

- **Workload Distribution:** Deploying the right hypervisor for the right workload maximizes efficiency.

- **Flexibility:** Supports optimization of VMs based on business application requirements along with data center modernization and consolidation.

In this section, let's cover a quick summary of different hypervisors considered by organizations in their order of priority.

> (i) These are the common alternative options considered by organizations, however the priority order differs for each customer based on their assessment, skillset and workload requirements.
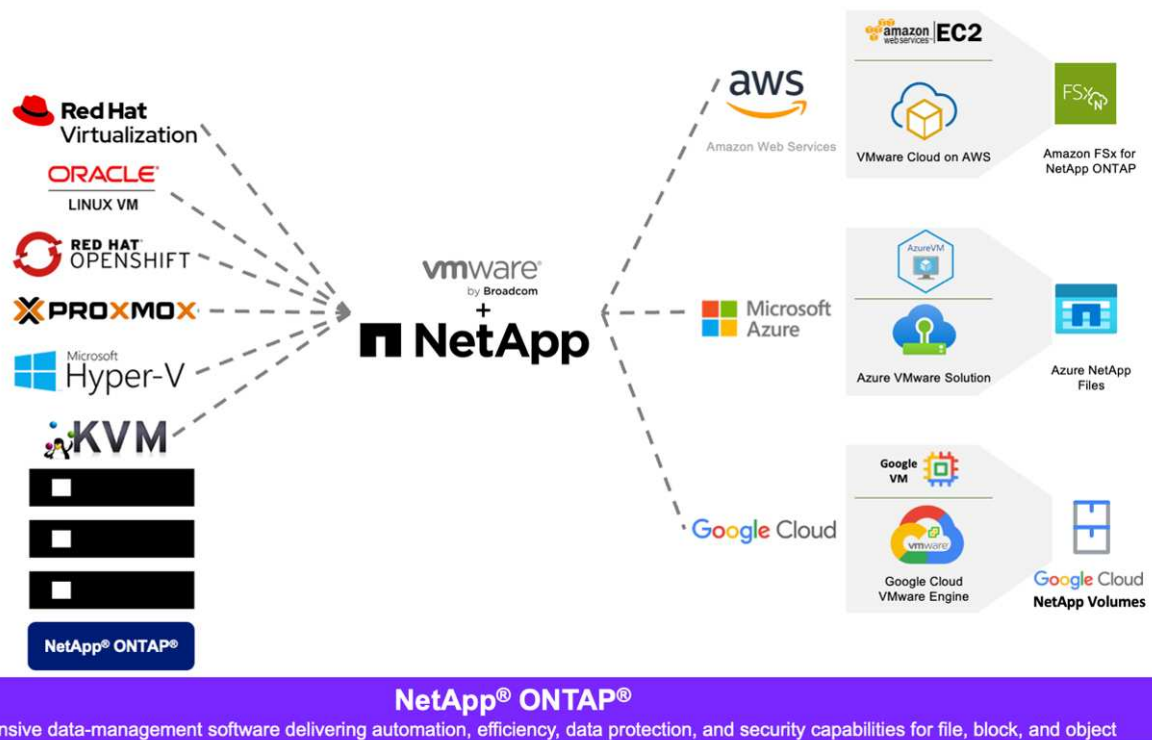
Hyper-V (Windows Server)

Let's explore it:

- A well-known, built-in feature in Windows Server versions.

- Enables virtualization capabilities for virtual machines within Windows Server.

- When integrated with the capabilities of the System Center suite (including SCVMM and SCOM), Hyper-V delivers a comprehensive set of features rivalling other virtualization solutions.

- NetApp SMI-S Provider integrates dynamic storage management for both SAN and NAS with System Center Virtual Machine Manager (SCVMM).

- Many third-party backup partners also support integrating ONTAP snapshot and SnapMirror support for fully optimized array-native backup and recovery.

- ONTAP remains the only data infrastructure system that allows native copy offload between SAN and NAS for flexibility and storage consumption, and ONTAP also offers native space reclamation across both NAS (SMB3 TRIM over SMB/CIFS) and SAN (iSCSI and FCP with SCSI UNMAP) protocols.

- SnapManager for Hyper-V for granular backup and recovery (PVR support required).
Hyper-V could be a viable choice if:

- Recently upgraded to new hardware or made significant investments in on-premises infrastructure.

- Using a SAN or NAS for storage (Azure Stack HCI will not be an option)

- Need storage and compute to grow independentlyUnable to modernize due to factors such as hardware investments, political landscapes, regulatory compliance, application development, or other existing obstacles

OpenShift Virtualization (RedHat KubeVirt implementation)

Let's explore it:

- Using the KVM hypervisor, running in containers, managed as Pods
- Scheduled, deployed, and managed by Kubernetes
- Create, modify, and destroy virtual machines, and their resources, using the OpenShift web interface
- Integrated with container orchestrator resources and services for persistent storage paradigm.

Integrations

- Trident CSI allows to dynamically manage storage over NFS, FC, iSCSI, and NVMe/TCP in a way that is both VM-granular, and classful.
- Trident CSI for provisioning, snapshot creation, volume expansion, and clone creation
- Trident Protect supports crash-consistent backups and restores of OpenShift Virtualization VMs, storing them in any S3-compatible object storage buckets.
- Trident Protect also provides disaster recovery with storage replication and automated failover and failback for OpenShift Virtualization VMs.

OpenShift Virtualization may make sense if:

- Consolidating virtual machines and containers to a single platform.
- Reduce the licensing overhead as OpenShift virtualization is part of OpenShift which may be already licensed for container workloads.
- Move legacy VMs into cloud native ecosystem without full refactor on day one.

Proxmox Virtual Environment (Proxmox VE)

Let's explore it:

- Comprehensive open-source virtualization platform for Qemu KVM and LXC

- Based on the Linux distribution Debian

- Can be operated both as a stand-alone machine or in a cluster consisting of several machines

- Uncomplicated, efficient deployment of virtual machines and containers

- User-friendly web-based management interface and features like live migration and backup options.

Integrations

- Use iSCSI, NFS v3, v4.1, and v4.2.

- All the great things that ONTAP has to offer, like rapid cloning, snapshots, and replication.

- With the nconnect option, the number of TCP connections per server can be increased up to 16 connections for high NFS workloads

Proxmox may make sense if:

- Open source, eliminating licensing costs.

- Easy-to-use web interface streamlines management.

- Supports both virtual machines and containers, offering flexibility.

- Single interface to manage VMs, containers, storage, and networking

- Full access to features without restrictions

- Professional service and support via Credativ

VMware Cloud offerings (Azure VMWare Solution, Google Cloud VMware Engine, VMware Cloud on AWS, Elastic VMware Service)

Let's explore it:

- VMware in the Cloud offers a "private cloud" hosted in the respective hyperscaler data center that makes use of a dedicated bare-metal infrastructure to host VMware infrastructure.

- Allows for up to 16 hosts per cluster, with VMware features including vCenter, vSphere, vSAN, and NSX

- Rapid deployment and scaling up/down

- Flexible purchasing options: Hourly On-Demand, 1- and 3-Year Reserved Instances, with 5-Year option available in certain hyperscalers.

- Offers familiar tools and processes to help land migration from on-premises VMware to VMware in cloud.

Integrations

> (i) NetApp is the only external storage vendor with first party integrated high performance storage supported with VMware in the cloud across all 3 major hyperscalers.

- NetApp powered storage (Azure NetApp Files, FSx for ONTAP, Google Cloud NetApp volumes) in each Cloud supplements vSAN storage instead of having to add extra compute nodes.

- Consistent performance, metered file storage service

- Efficient snapshots and clones to rapidly create copies and checkpoint changes at scale

- Efficient incremental block transfer-based replication for regional DR and backup

- Storage-intensive applications will cost less to run using NetApp powered Cloud storage as datastores

- Ability to mount guest-owned file systems such as NFS or iSCSI managed by the guest for high performance workloads apart from external datastore connectivity

Reasons to migrate to VMware Cloud offerings:

- Storage-intensive deployments save money by offloading storage capacity instead of adding more compute nodes

- Requires less upskilling compared to transitioning to Hyper-V, Azure Stack, or potentially even native VM formats

- Locks in pricing that won't be affected by changes in other licensing costs for up to 3 or 5 years (depending on the Cloud provider).

- Offers BYOL (bring your own licensing) coverage

- Lift and shift from on-premises help to potentially lower costs in key areas.

- Build or shift disaster recovery capabilities to the cloud, lower cost and remove operational burden

For those customers looking to use VMware Cloud on any hyperscaler as the disaster recovery target, ONTAP storage powered datastores (Azure NetApp Files, FSx ONTAP, Google Cloud NetApp volumes) can be used to replicate data from on-premises using any validated third-party solution that provides VM replication capability. By adding ONTAP storage powered datastores, it will enable cost optimized disaster recovery on the destination with fewer number of ESXi hosts. This also enables to decommission the secondary site in the on-premises environment thus enabling significant cost savings.

- View detailed guidance for Disaster Recovery to FSx ONTAP datastore.
- View detailed guidance for Disaster Recovery to Azure NetApp Files datastore.
- View detailed guidance for Disaster Recovery to Google Cloud NetApp Volumes datastore.

Cloud Native Virtual Machines

ⓘ   NetApp is the only vendor with first party integrated high performance multi-protocol storage in the cloud across all 3 major hyperscalers.

Let's explore it:

- Optimize computing resources with flexible virtual machine sizes to meet specific business needs and eliminate unnecessary expenses.

- Smooth transition to the future with Cloud flexibility.
Reasons to migrate to Cloud native virtual machines with NetApp powered storage:

- Leverage enterprise storage capabilities like thin provisioning, storage efficiency, zero footprint clones, integrated backups, block level replication, tiering and thus optimize migration efforts and have a future-proof deployment from day 1

- Optimize the current storage deployment used on native cloud instances within cloud by incorporating ONTAP and using the cost-optimizing features it provides

- Ability to save cost

  ◦ using ONTAP data management techniques

  ◦ via reservations over numerous resources

  ◦ via burstable and spot virtual machines

- Take advantage of modern technologies like AI/ML

- Reduce instance total cost of ownership (TCO) as compared to block storage solutions by rightsizing the cloud instances to meet the necessary IOPs and throughput parameters.

Azure Local or AWS Outpost or any other HCI model

Let's explore it:

- Runs on a validated solution
- Packaged solution that can be deployed within premises to serve as core for hybrid or multi cloud.
- Provides users with access to cloud infrastructure, services, APIs, and tools tailored for any environment: on-premises, cloud, or hybrid.

> ⓘ   Must have or lease/purchase HCI-compatible hardware.

> ⓘ   Azure local doesn't support external storage, however AWS Outpost supports ONTAP

Reasons to migrate to Azure Local or AWS Outpost:

- If HCI compatible hardware is already owned
- Control workload execution and data storage.
- Meet local data residency and process data in local regions using respective services, tools, and APIs
- Use guest connected storage for iSCSI, NFS and SMB connectivity for guest VMs.

Cons:

- Not all options support SAN, NAS or standalone storage configuration
- Does not support independent scaling of storage and compute

Other hypervisor options that are being considered in customer environments

- **KVM** is generally supported on ONTAP per the parent Linux distro, simply refer to the IMT for the reference Linux.
- **SUSE Harvester** is a modern hyperconverged infrastructure (HCI) solution built for bare metal servers using enterprise-grade open-source technologies including Linux, KVM, Kubernetes, KubeVirt, and Longhorn. Designed for users looking for a flexible and affordable solution to run cloud-native and virtual machine (VM) workloads in your data center and at the edge, Harvester provides a single pane of glass for virtualization and cloud-native workload management. NetApp Astra Trident CSI driver into a Harvester cluster enables NetApp storage systems to store storage volumes usable by virtual machines running in Harvester.
- **Red Hat OpenStack Platform**, and OpenStack, in general, is also an incredible private cloud solution and the fact that the NetApp Unified Driver is baked into the upstream OpenStack code means that NetApp data management integration is built right in. Meaning, there is nothing to install! Storage management functions support NVMe, iSCSI or FC for block protocols, and NFS for NAS. Thin provisioning, dynamic storage management, copy offload, and snapshots are all supported natively.

Key takeaway

ONTAP is the right platform for any hypervisor in on-premises or for any workload in the cloud. ONTAP supports prominent hypervisors in on-premises environment and has widely adopted first party offering in each cloud. This enables customers to handle the licensing changes easily by navigating through the appropriate

deployment model.
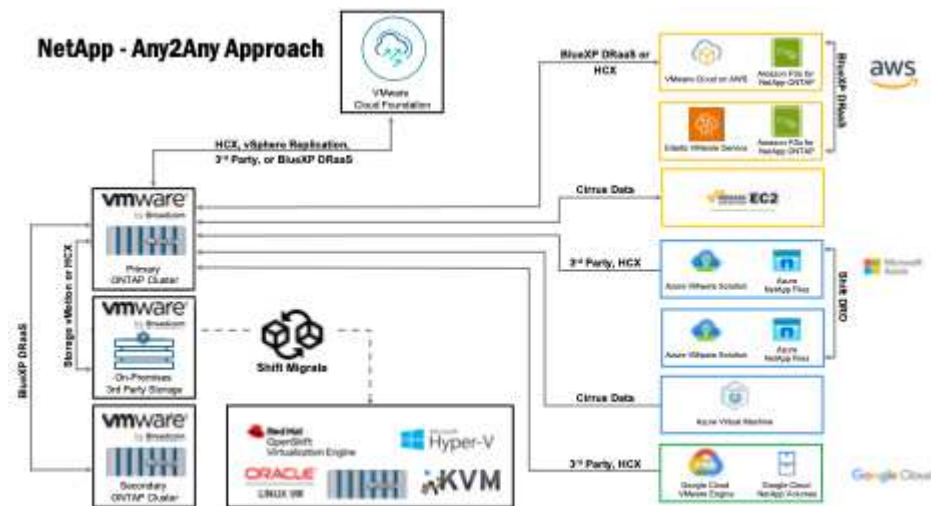
To summarize, VMware continues to be the de facto hypervisor for organizations. However, every IT organization is evaluating alternate options and ONTAP will play an important role in any option they select.

Wicked Fast (100x faster) Migrations

Shift Toolkit

As covered above, solutions like VMware, Microsoft Hyper-V, Proxmox, and OpenShift Virtualization have become robust and reliable choices for virtualization needs. Given that business requirements are dynamic, the selection of a virtualization platform must also be adaptable and instant virtual machine mobility becomes important.

Migrating from one hypervisor to another involves a complex decision-making process for businesses. Key considerations include application dependencies, migration timeline, workload criticality, and the impact of application downtime on the business. However, with ONTAP storage and Shift toolkit, this is a breeze.

The NetApp Shift toolkit is an easy-to-use, graphical user interface (GUI) solution that allows to migrate virtual machines (VMs) between different hypervisors and convert virtual disk formats. It utilizes NetApp FlexClone technology to quickly convert VM hard disks. Additionally, the toolkit manages the creation and configuration of destination VMs.

For detailed information, see Migrating virtual machines (VMs) between virtualization environments (Shift Toolkit).

NetApp Shift Toolkit – Introducing VM conversion
Automated solution for migrating VMs between hypervisors
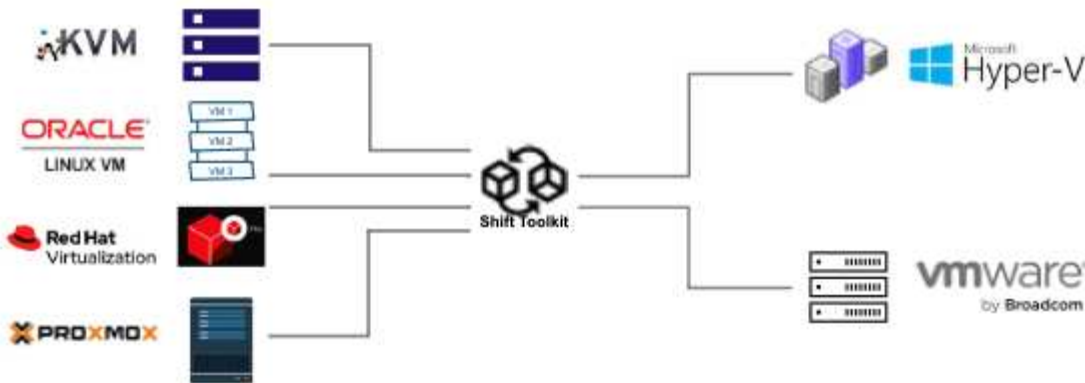
Note: VMs to be migrated / converted should leverage NetApp NFS storage.
Note: Shift Toolkit supports HyperV E2E migration
Note: Shift Toolkit supports conversion for KVM

The pre-requisite for Shift toolkit is to have VMs running on NFS volume residing on ONTAP storage. This means if the VMs are hosted on block based ONTAP storage (specifically ASA) or on third party storage, then VMs should be moved using Storage vMotion to the designated ONTAP based NFS datastores.
Shift toolkit can be downloaded here and is available for Windows Systems only.

Cirrus Data MigrateOps

An alternative to Shift toolkit is a partner-based solution which relies on block level replication. Cirrus Data can seamlessly migrate workloads from traditional hypervisors to modern platforms, enabling more flexible hybrid workloads, accelerated modernization efforts, and improved resource utilization.
Cirrus Migrate Cloud, together with MigrateOps, make it possible for organizations to automate the change from one hypervisor to another with a secure, easy-to-use, and reliable solution.

Key takeaway: There are multiple alternatives for migrating a VM from VMware to another hypervisor. To name a few – Veeam, Commvault, StarWind, SCVMM and so on. The objective here is to showcase the possible options, however, Shift toolkit would provide the fastest migration option by orders of magnitude. Depending on the scenario, alternate migrate options can be adopted.

Common Projected Deployment model (in a multi-hypervisor environment)

A customer had large scale virtualized environment with 10,000 VMs (a mix of windows and Linux workloads). To optimize the licensing cost and simplify the future of virtualization infrastructure, multi-hypervisor and virtual machine placement strategy was important. They chose the VM placement strategy based on the workload criticality, operating system type, performance requirement, hypervisor functionality and licensing cost.

The strategy to organize was split across three hypervisors:

- VMware vSphere → Critical workloads supporting business-critical applications stay on VMware

- Microsoft Hyper-V → 5,000 Windows VMs migrate to Hyper-V, leveraging Windows licensing benefits

- OpenShift Virtualization → 3,000 Linux VMs migrate here, for cost-efficiency and Kubernetes-native

management.

This multi-hypervisor approach balances cost, performance, and flexibility, ensuring that critical workloads remain on VMware, while Windows and Linux workloads migrate to optimized hypervisor platforms using Shift toolkit for efficiency and scalability.
The above is one example, however there are different permutations and combinations that can be applied at each application level to optimize the environment.

Conclusion

In the wake of the Broadcom acquisition, VMware customers are navigating a complex landscape of integration, performance optimization, and cost management. NetApp offers a powerful suite of tools and capabilities to overcome these challenges, providing enhanced visibility, seamless integration, cost efficiency, and robust security. By using these capabilities, you can stay with VMware, enable a multi-vendor approach, and prepare yourself for future disruptions.

Leveraging VMware Cloud Foundation 5.2.1 and later allows businesses to adopt modern private cloud practices without being limited to vSAN. This facilitates seamless migration from existing vSphere environments while protecting investments in ONTAP storage.

Furthermore, integrating a multi-hypervisor strategy ensures organizations retain control over their virtualization roadmap, reduce costs, and tailor their infrastructure to the unique needs of each workload. Hyper-V, OpenShift Virtualization, Proxmox, and KVM each offer unique advantages. To determine the best fit, evaluate factors such as budget, existing infrastructure, performance requirements, and support needs. No matter what hypervisor platform is selected or where it is – on-premises or cloud, ONTAP is the best storage.

Learn about enhancing virtualized IT environments with ONTAP

Virtualization optimizes IT environments, enabling efficient resource use and flexibility while supporting modern applications like AI systems. Learn about its impact on network, compute, and storage infrastructure, and how NetApp ONTAP enhances virtualized systems.

Overview

Traditionally, datacenters consisted of physical servers, networking and storage, each dedicated to specific tasks. This approach created silos of resources that were often greatly underutilized. At the core, virtualization involves decoupling physical resources from the requirements and functions of the organization. This is achieved by creating virtual representations of the three main infrastructure components: **network**, **compute**, and **storage**. The deployment of virtual infrastructure enables organizations to achieve increased utilization of the underlying physical resources through these logical constructs.
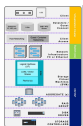
Virtualization is a case where the whole is greater than the sum of the parts through automation, policy-driven workflows and scalability. By improving efficiency, flexibility and while lowering TCO of IT Infrastructure, virtualization empowers organizations to optimize their technological resources to a greater extent. A virtual infrastructure powered by NetApp inherits key benefits of ONTAP:

- Provisioning, backup, and data protection with industry leading plug-ins and integrations

- Enterprise grade storage efficiencies

- Multiprotocol support for varying workload needs

- Policy-driven storage configuration and adaptive QoS

- Support for applications and workloads whether on-premises or the public clouds with one storage operating system

To learn more about NetApp ONTAP, see the following:

- ONTAP: The Leading Unified Storage Operating System

Network virtualization

Network virtualization refers to the abstraction of the physical network components (switches, routers, firewalls, interfaces, etc.) into logical constructs. These logical constructs, operating independently of the underlying physical infrastructure, deliver secure communication between clients, storage and other components in the network. Network virtualization is key to running the business as it allows for the sharing of resources while simultaneously allowing for the restriction of network traffic according to policies.

Network virtualization can combine multiple physical networks into one virtual fabric, or it can facilitate dividing a physical network into separate, discreet virtual networks. Multiples networks can be created and customized to meet specific IT requirements. Often network virtualization refers to Ethernet-based use cases but in many instances virtual fabrics can be configured dependent upon the switch manufacture's capabilities. Whether employing virtual LANs or virtual SANs, organizations achieve greater operational efficiency and overall improved network performance through network virtualization.

For more information on networking virtualization, see the following:

- Cisco virtual networking
- VMware virtual networking

Compute virtualization

Compute or server virtualization is perhaps the most well-known form of virtualization. With compute virtualization, hypervisors mimic the functions of physical servers allowing, operation teams to run multiple virtual machines on a single physical node. With compute virtualization, resources such as sever memory and CPU are shared. This sharing allows for an oversubscription of the underlying resources to the degree that is acceptable for the workloads and applications deployed.

With compute virtualization, each virtual machine has its own operating system and installed applications and resources; functioning independently of each other. Among the numerous advantages with compute virtualization include increased server utilization, reduced hardware expenditures, simplified management using the hypervisor's user interface (UI), and improved disaster recovery functionality. Additionally, with hypervisor plug-ins, storage administration, backups and protection relationships can be configured to further simplify operational tasks.

For more information on compute virtualization, see the following:

- VMware vSphere
- Red Hat OpenShift Virtualization
- Microsoft Hyper-V

Storage virtualization

Much like the network and compute virtualization, storage virtualization is important to a modern datacenter. NetApp ONTAP facilitates storage virtualization through Storage Virtual Machines (SVMs) which serve data to clients and hosts. SVMs are logical entities that allow for storage resources to not be tied to physical media. SVMs can be deployed based on workload type, application needs and organization groups for access.

There are multiple types of SVMs which aide in data access, administration and cluster and system level tasks. Data SVMs serve data to clients and hosts from one or more volumes, through one or more network logical interfaces (LIFs). These volumes and LIFs are logical constructs and are mapped through to storage aggregates and physical or logical network ports. This logical data access allows for the mobility of volumes or LIFs during maintenance scenarios or resource rebalancing much like compute virtual machines.

For more information on storage virtualization, see the following:

- ONTAP Storage Virtualization Overview

Closing

The components of virtual infrastructure described here: network, compute and storage provide same the same functionality as typical physical resources but through software. The allocation of virtual resources over physical resources accelerates time to value and allows for policy-driven configuration of resources. Pairing ONTAP with compute and network virtualization allows for clients and hosts to access resources through a software-defined virtual infrastructure.