# Technology-Driven VMware to OpenStack Migration:

# A Comprehensive Guide

**TRILIO**

# Table of Contents

# Executive Summary

**Rising Vendor Lock-In Risk Drives OpenStack Re-Evaluation**

The Broadcom acquisition of VMware has triggered a strategic shift for cloud deployments. Organizations are increasingly concerned about vendor lock-in and potential cost increases, prompting them to explore alternative solutions. OpenStack, the open-source cloud platform and governed by the OpenInfra foundation (www.openstack.org), emerges as a compelling option due to its potential for significant TCO savings, vendor neutrality, and enhanced agility. This report analyzes the opportunity for migrating workloads from VMware to OpenStack, outlining key decision points and best practices for a successful transition.

Careful planning is crucial to ensure a smooth migration with minimal downtime. This includes categorizing the applications into four categories which are refactoring, rehosting, re-platforming or retiring. The choice between these strategies depends on multiple factors, including the specific requirements of the application, the desired outcomes of the migration, the time, and resources available, and the organization's overall cloud strategy. It is important to carefully consider these factors and choose the strategy that best aligns with the organization's needs and goals.

This paper is focused on the "Rehosting" category for which assessing workloads for compatibility, prioritizing the application sequence for migration, establishing a testing and validation phase are important considerations. Considering these factors, organizations can successfully ease the migration process .

The are many benefits to migrating from VMware to OpenStack such as:

- **Cost Reduction**: OpenStack is open source, eliminating licensing fees associated with VMware products. This can lead to significant total cost of ownership (TCO) savings.
- **Flexibility and Customization**: OpenStack offers greater control and customization over the entire cloud infrastructure compared to VMware. Organizations can tailor the environment to their specific needs.

- **Vendor Lock-In Avoidance**: OpenStack's open-source nature avoids vendor lock-in, allowing organizations to leverage a wider range of compatible technologies and avoid dependence on a single vendor.
- **Innovation**: The OpenStack community fosters ongoing development and collaboration, potentially leading to faster innovation and access to new features.

However, the migration process entails various challenges and considerations, spanning technical complexities, organizational dynamics, and skill set requirements. Effective planning, clear migration strategies, and comprehensive testing are essential to mitigate risks and ensure a smooth transition.

This white paper is focused on technology driven migration from VMware to OpenStack with a focus on how Trilio for OpenStack enables rapid, automated, and efficient technology to plan, pilot, and migrate from VMware to OpenStack.

# Key Takeaways

**Strategic Advantages of OpenStack**

While both VMware and OpenStack offer core virtualization functionalities, choosing OpenStack presents several strategic advantages in the current cloud landscape:

- **Cost Optimization:** OpenStack's open-source nature eliminates vendor licensing fees associated with VMware, leading to significant TCO savings.
- **Vendor Independence:** OpenStack fosters vendor neutrality, allowing organizations to leverage best-of-breed solutions across the cloud ecosystem and avoid vendor lock-in.
- **Enhanced Agility and Innovation:** OpenStack's open-source development model facilitates faster innovation and access to new features, enabling organizations to adapt to evolving cloud technologies.

**Technology-Driven Migration for Efficiency and Scale**

Leveraging technology during the migration process offers significant benefits:

- **Reduced Resource Requirements:** Streamlining migration tasks, minimizes resource utilization.
- **Repeatable and Predictable Process:** Trilio software ensures consistent execution of migration steps, leading to predictable outcomes.
- **Scalable Approach:** Trilio software is scalable and can accommodate all types of migrations.
- **Train the Trainer Model:** Technology enabled migration enables a "train the trainer" model which allows for knowledge transfer within your organization or with a trusted partner. This approach fosters internal expertise and operational efficiency, resulting in reduced long-term costs.

# Overview of VMware and OpenStack (Side by Side)

The following table outlines key VMware product capabilities and analogous OpenStack Projects and Services.

| VMware Product/Terminology | Comparable OpenStack Projects/Terminology |
|---|---|
| vSphere | OpenStack Services |
| VMware vSphere is a suite of virtualization products that includes ESXi (the hypervisor), vCenter Server (management), and other components. | OpenStack includes a collection of services to pool and manage various resources in the cloud. Most notable are Nova, Cinder, Neutron, Glance, and Keystone. |
| Virtual Machine (VM) | Nova Instances (Compute Service) |
| A VM represents a virtualized instance of an operating system running on a hypervisor. It encapsulates the guest OS, applications, and associated resources. | OpenStack virtual machines are called instances and are managed by a service called Nova. |
| vCenter Server | Nova Services |
| vCenter Server is the central management platform for vSphere environments. It oversees tasks like VM provisioning, monitoring, and resource management. | OpenStack does not have a central server. Instead, it has a collection of services, each providing its own APIs. |
| vMotion | Nova Live Migration |
| vMotion enables live migration of VMs between hosts within a vSphere cluster. | Nova's live migration feature allows VMs to be moved between compute nodes. |
| Distributed Resource Scheduler (DRS) | Nova Scheduler |
| DRS automatically balances VM workloads across vSphere hosts based on resource utilization. | OpenStack Nova scheduler helps allocate VM resources that best fit the VM needs. |
| vSAN | Ceph / Cinder (Block Storage Service) |
| VMware vSAN is a software-defined storage solution that aggregates local storage across vSphere hosts to create a shared storage pool. | Ceph storage platform that provides object storage, block storage, and file storage built on a common distributed cluster foundation.<br><br>Cinder manages block storage volumes for VMs, including features like snapshots and cloning. |
| NSX-T | Neutron (Networking Service) |

| NSX-T provides network virtualization and security for vSphere environments. It includes features like overlay networks, load balancing, and micro segmentation. | Neutron manages networking services in OpenStack, such as creating virtual networks, routers, and security groups. |
| --- | --- |
| vRealize Automation (vRA) | Heat (Orchestration Service) |
| vRA automates VM provisioning, deployment, and scaling. It integrates with vSphere and other platforms. | Heat allows users to define and manage infrastructure as code (IaC) using templates (e.g., HOT or YAML) for resource orchestration. |
| vRealize Operations (vROps) | Ceilometer (Telemetry Service) |
| vROps provides performance monitoring, capacity planning, and analytics for vSphere environments. | Ceilometer collects telemetry data (e.g., metrics, alarms) from OpenStack services for monitoring and billing purposes. |

# Mapping VMware and OpenStack Concepts and Capabilities

Below is a table to help you map between these two environments which is automated with Trilio for OpenStack.

| | VMware | OpenStack |
| --- | --- | --- |
| Virtual Machines | VMs of any size can be created with various amounts of RAM, Storage, etc. | OpenStack supports flavors which is an available hardware configuration for a server. It defines the size of a virtual server that can be launched<br><br>Therefore, you must map VMs to Flavors. |
| Networking | Supports port groups for group management of ports within a distributed switch. | Networks are virtual and require virtual routers to interact with providers and external networks such as the Internet. Self-service networks also usually provide DHCP and metadata services to instances.<br><br>Therefore, you must have the ability to map a port group to an OpenStack tenant network. |
| Security Groups | Virtual firewalls. | Construct for virtual firewall rules that control ingress (inbound to instances) and egress (outbound from instances) |

| | | network traffic at the port level.<br><br>Therefore, you need to convert from firewall rules in VMware per port to specific security groups in OpenStack. |
|---|---|---|
| Storage | Aggregates a host cluster's local or direct-attached capacity devices and creates a single storage pool shared across all hosts in the vSAN cluster. | A provisioning layer supporting numerous third-party storages. Supports NFS, iSCSI, and Fiber Channel for SAN storage.<br><br>Therefore, you need to map a datastore to a volume type in OpenStack. |
| Storage - Snapshots | Storage snapshots and clones are managed through storage virtualization layers like VMFS, vSAN. Change block tracking (CBT) for implementing efficient VM backups. | OpenStack VM snapshot is considerably basic. The functionality's intention is to create a VM template that can be used to create additional VM clones.<br>Change block tracking is not a standard feature in OpenStack.<br><br>Therefore, for specific migration types CBT will need to be enabled on the VMware side. |
| Guest Agent | VMware Tools is a set of services and modules that enable several features in VMware products, such as better management of guests' operating systems and seamless user interactions with them. | QEMU Guest Agent is available on all Linux distributions and Windows. It offers very limited functionality.<br><br>Not all functionalities can be mapped from VMWare to OpenStack (i.e., video memory). Backup vendors use VMWare Tools to get application consistent backups - this needs to be replaced by OpenStack's Qemu guest agent.<br><br>This component is important to note. However, not necessary for migration purposes noted in this paper. |

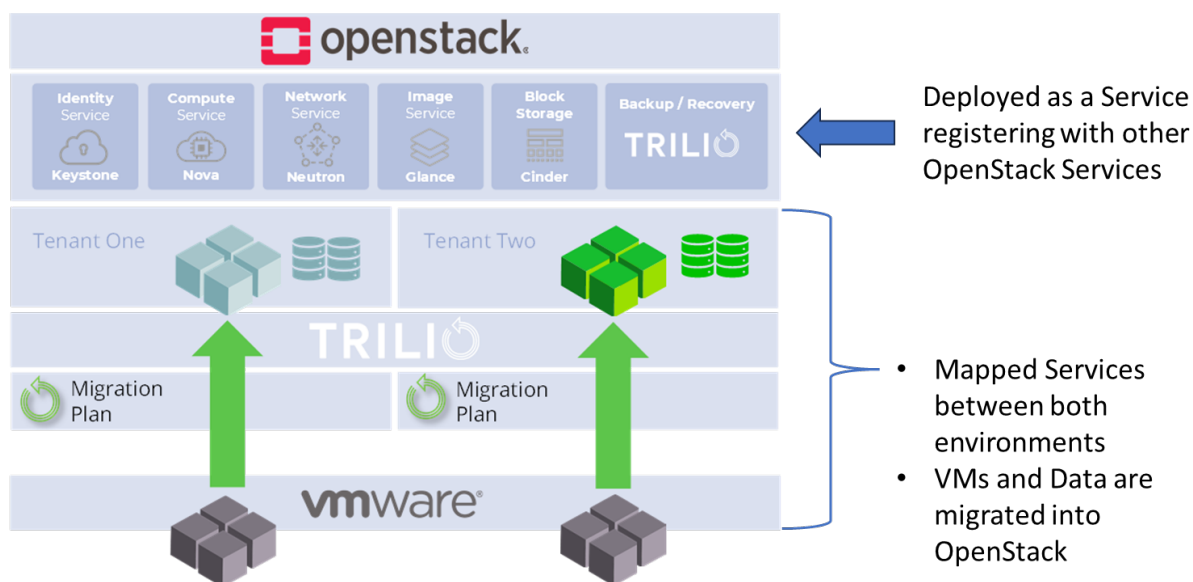# Product Overview :Trilio for OpenStack (T4O)

The VMware to OpenStack virtual machine migration offering from Trilio is part of the Trilio for OpenStack (T4O) solution, a backup and recovery platform that runs as an OpenStack-native service similar to Nova, Cinder, Glance, etc.
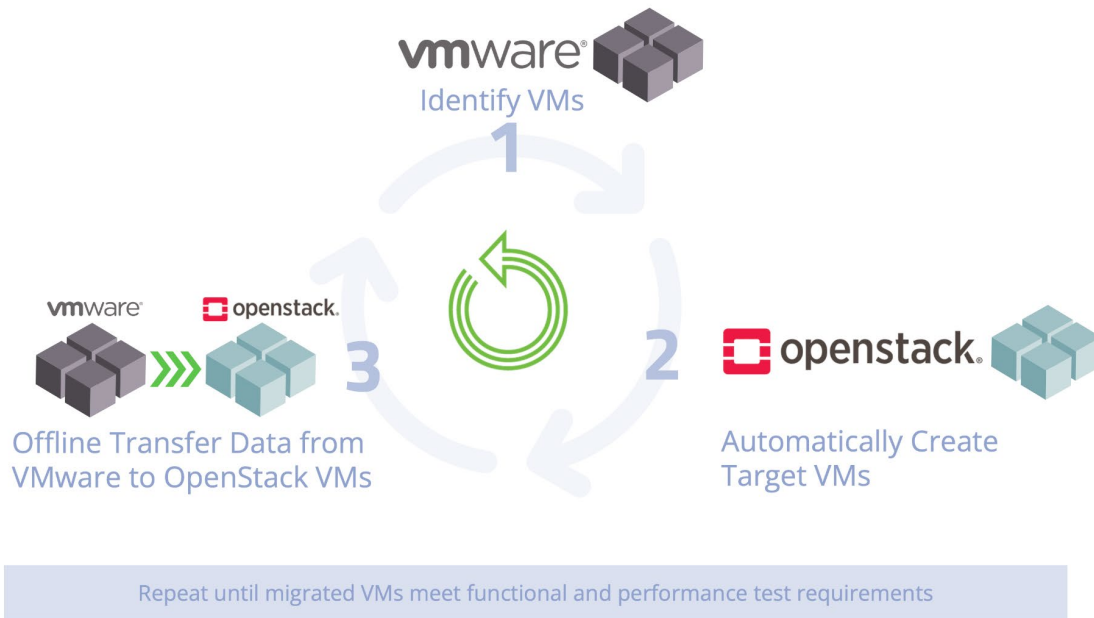
With T4O, you can recover any OpenStack application quickly in the event of any mishaps, for example data loss or misconfiguration. Trilio enables easy restoration of entire workloads that reflect the cloud's last best-known state.

This software-only solution can be deployed using OpenStack distribution-specific DevOps scripts for any distribution of OpenStack. For example, since Trilio's solution is native to OpenStack platforms including the Red Hat OpenStack Platform (RHOSP), it can be deployed and managed using Red Hat Director.

Trilio's native in-band approach to VMware migration helps organizations implement an effective organization-wide migration strategy. Below is an architecture diagram followed by a detailed description of Trilio for OpenStack migration services and capabilities in the subsequent sections.



Deployed as a Service registering with other OpenStack Services

- Mapped Services between both environments
- VMs and Data are migrated into OpenStack

## Trilio's 1-2-3 Approach to VMware to OpenStack Migration Process



Please see the appendix for additional information that will help you plan your migration processes.

## Trilio for OpenStack Migration Steps

Once you are done with planning and looking to begin migrating virtual machines, execute on the following to move VMs from VMWare to OpenStack:

- Create VMs, networking, security groups, and storage volumes based on VMware VM configuration.
- Populate boot disk and storage volumes from ESX servers using virt-v2v tooling.
- Trilio ensures that Nova makes the best judgment on the VM placement based on defined policies.
- Trilio creates the VM blueprint, Migrates VMs with designated networking and security groups.
- Choose the storage types for the migrated VMs.
- Populate the data from VMware. Test the migrated VM
- Repeat this process until the user is completely satisfied with the migrated workload
- Perform the final cutover to OpenStack.

# Trilio's for OpenStack Migration Software Capabilities Overview

As mentioned before the migration features are available as a new workflow in Trilio for OpenStack (T4O), along with backups, one-click restore, and selective restore. Below is a list of capabilities that will aid in the migration process.

## Discovery and Planning Workflow

Helps with discovery and planning - enabling the users to create migration plans. As follows:

- VM to OpenStack Flavors and Tenants
- OpenStack Glance Image to Boot Options (UEFI and BIOS)
- Datastores to Volume OpenStack Types
- Tenant Network availability

The benefit of this migration workflow is that it automates and simplifies the migration process.

## Migration Types:  Dry-run vs Cold Migration vs Warm Migration

Trilio's migration functionality supports three types of migrations: Dry-Run, Cold Migration, and Warm Migration:

### Dry run

Dry run lets users create the VMs on OpenStack with storage volumes, networking, and security groups attached. It does not migrate VMs from VMware to OpenStack. It is a useful feature for users to test VMs and their interconnectivity before migrating VMs.

### Cold Migration

Cold migration shuts down the VMware VMs and migrates the VMs to OpenStack. Depending on the size of the data to migrate, cold migration can take minutes to hours to complete, and during the entire duration, the applications are unavailable. Cold migration is more disruptive than warm migration.

## Warm Migration

Warm migration leverages VMware snapshot and changes block tracking functionality to migrate VMs with less disruption. It first takes the VM snapshot and copies the full snapshot data to OpenStack. It then shuts down the VM, takes another snapshot of the VM, copies the blocks that were changed since the last snapshot, and reboots OpenStack VMs. So warm migration incurs less disruption compared to cold migration.

The following chart depicts the Pros and Cons of Cold and Warm Migration processes:

| Cold vs Warm Migration | Pros | Cons |
|---|---|---|
| Cold Migration | · Predictable Downtime<br>· Minimal Risk<br>· Resource Efficiency.<br>· Simplicity | · Downtime<br>· Extended Migration Time<br>· Impact on Workflows |
| Warm Migration | · Reduced Downtime<br>· Flexibility<br>· Resource Continuity<br>· Incremental Data Transfer | · Complexity<br>· Resource Overhead<br>· Dependency Management<br>· Risk of Data Loss |

These options provide organizations with a spectrum of choices based on their priorities: speed, optimization, or long-term transformation. By understanding these strategies, decision-makers can align their cloud migration approach with their business goals and technical requirements

## Converting VMware VM Blueprints to OpenStack

Trilio for OpenStack helps users map and convert VMware blueprints to OpenStack and allows tenants to manage their migrations. In addition to this feature, each tenant can source their cloud and start using migrations via CLI commands.

The benefit of this approach is that it allows users to leverage automation tools such as Ansible to perform efficient migrations with Trilio at scale.

## Conclusion

The transition from VMware to OpenStack presents a complex undertaking, yet adopting a strategic and technology-driven approach can markedly streamline this migration while mitigating the risk of data loss and operational disturbances.

The potential benefits of migrating to OpenStack extend far beyond a simple platform shift. This strategic move unlocks the full potential of cloud-native technologies and open standards. Organizations gain:

- **Cost Savings:** Eliminate vendor licensing fees and gain greater control over cloud infrastructure expenses.
- **Enhanced Agility:** OpenStack's open-source nature fosters rapid innovation and allows you to leverage a broader technology ecosystem, enabling faster adaptation to changing market demands.
- **Future-Proofing Your Cloud:** Open standards and a vibrant developer community ensure continuous innovation and access to cutting-edge features, positioning your organization for sustained success in the digital era.

This strategic transition empowers organizations to break free from vendor lock-in and embrace a future of cloud optimization, cost efficiency, and leadership within the ever-evolving digital landscape.

# APPENDICES

# Migration Planning

The following workflow is our recommendation for three phases of the technology driven migration process.

| Plan | Execute | Pilot | Scale 1 | Scale 2 | Scale 3 |

## Planning
- Assemble Team & Assess Apps & VMs
- Refactor, Rehost, Replatform, Retire
- Data Gather – Trilio Questionnaire, VMWare/OpenStack Credentials, etc.

## Implement
- Integrate OpenStack, VMWare, Trilio
- Understand Mappings & Workflow, and Migration Types
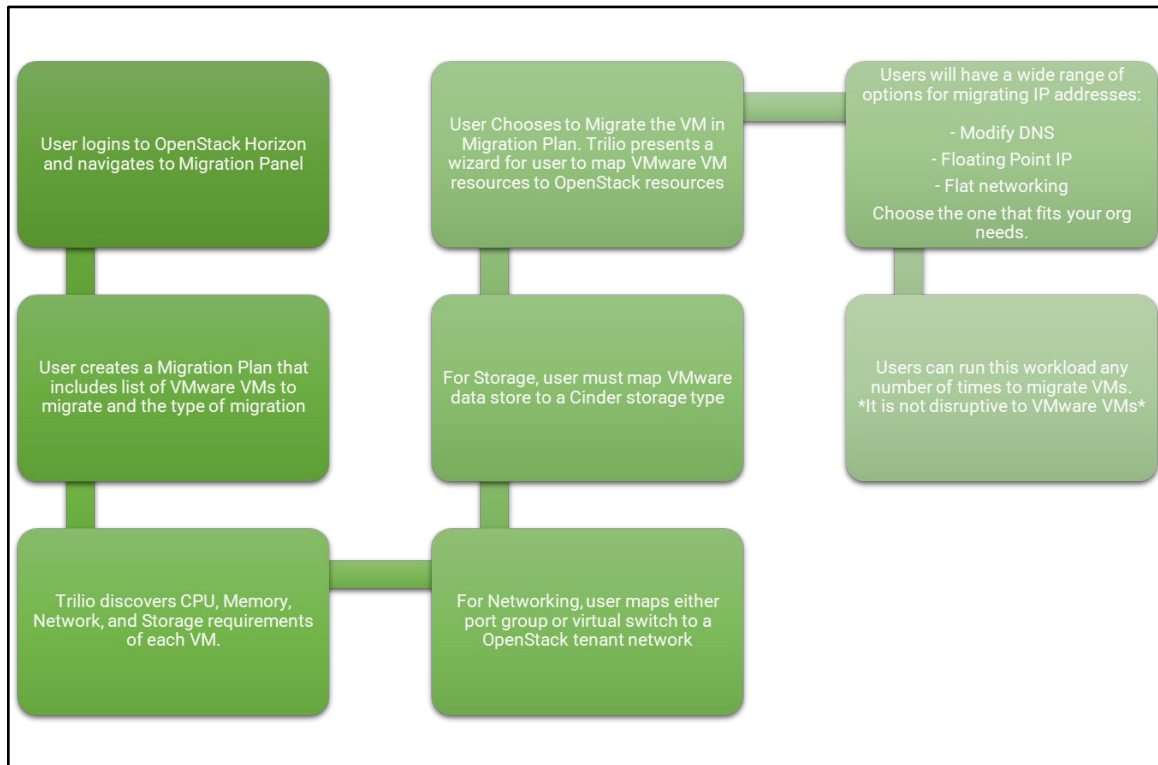
### <<EXECUTE>>

## Pilot
- Tests / Proof of Concept
- Finalize Representative Test VMs to Migrate
- Gather feedback & adjust

## Scale 1, 2, 3
- Leverage Trilio Migration Plans to execute according to a defined timeline
- Redeploy as many times as required and Report

Once the planning is solidified the detailed workflow for implementation is below:



As it relates to mapping data centers, clusters, and folders to OpenStack regions, tenants, and availability zones this is an organizational decision rather than a technical problem. A lot depends on how and where VMs and applications are placed meets your business unit's needs, and how they are met in OpenStack.

The following reflects the migration mappings and path as VMs, Network, and Storage are mapped from disparate VMware to OpenStack systems.
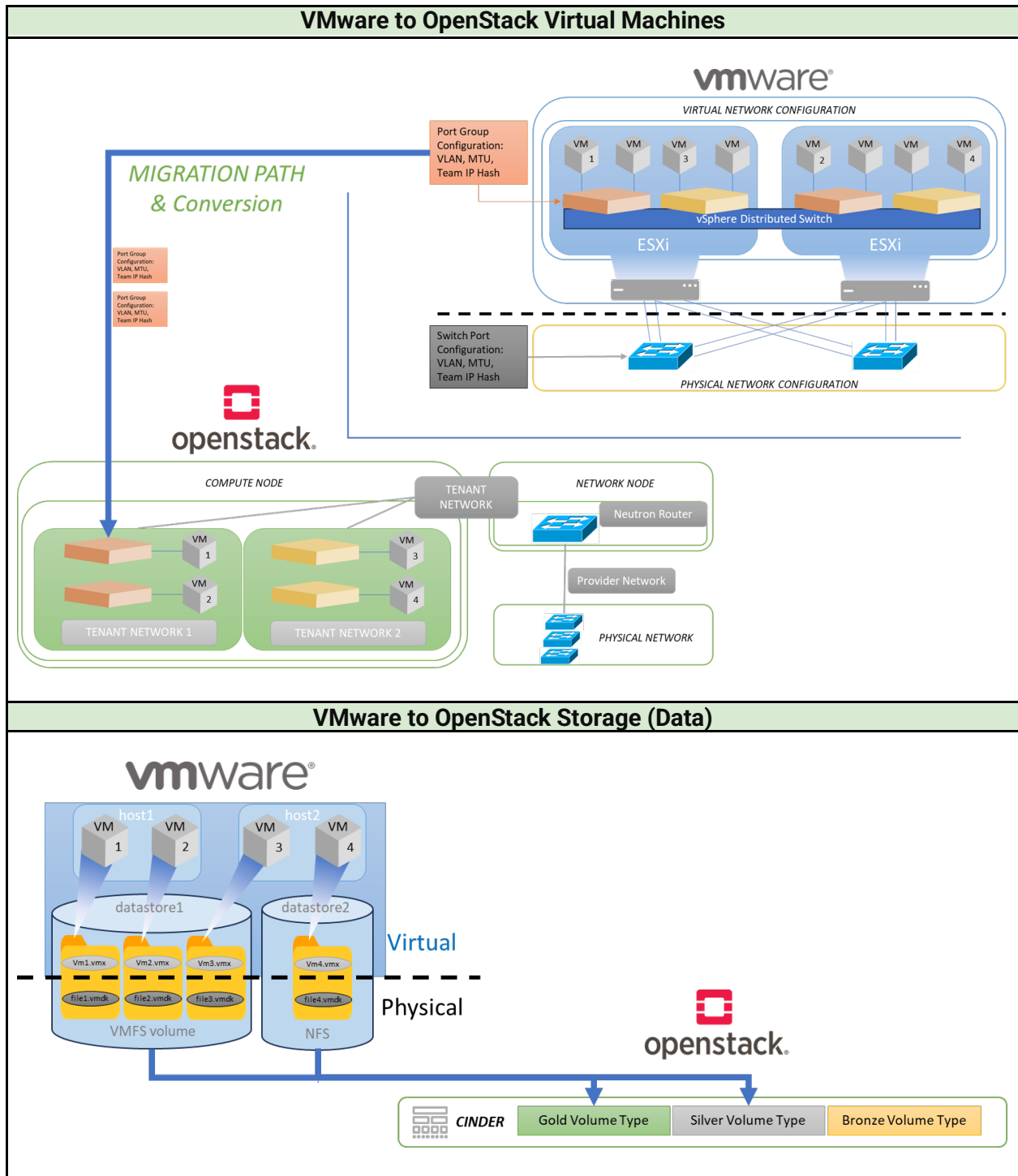
# Glossary

**API (Application Programming Interface):** A set of rules and protocols that allow different software applications to communicate with each other. OpenStack provides APIs for managing various components, including compute, storage, and networking.

**BIOS:** Set of instructions that controls the booting process of a VM.

**Boot Disk:** A removable digital data storage medium from which a computer can load and run (boot) an operating system or utility program.

**Cinder:** Cinder is the OpenStack Block Storage service for providing volumes to Nova virtual machines, Ironic bare metal hosts, containers and more.

**Cold Migration:** A migration method where the virtual machine is shut down before being transferred to the new host. This method typically involves longer downtime but may be necessary for certain types of migrations or when live migration is not feasible.

**ESXi:** VMware's bare-metal hypervisor used to virtualize servers. It runs directly on the physical hardware without the need for a separate operating system.

**Glance:** Image service project that provides a service where users can upload and discover data assets that are meant to be used with other services. This currently includes images and metadata definitions.

**Hypervisor:** Software that enables multiple operating systems to share a single hardware host. It provides virtualization services, allowing VMs to run independently.

**Inline Migration:** The migration process usually involves moving virtual machines from a source platform to a target platform.

**JSON (JavaScript Object Notation):** A lightweight data-interchange format commonly used for transmitting data between a server and a web application. OpenStack APIs often use JSON for request and response payloads.

**Libvirt:** An open-source toolkit used for managing virtualization platforms. It provides a common API for interacting with different hypervisors, including VMware and KVM.

**Live Migration:** A technique that allows a virtual machine to be moved from one physical host to another without interrupting its operation or causing downtime for users. Live migration is crucial for maintaining service availability during hardware maintenance or load balancing.

**Migration Planning:** The process of assessing VM workloads, dependencies, and requirements to develop a migration strategy. Migration planning involves identifying potential challenges, risks, and dependencies to mitigate issues during the migration process.

**Networking Configuration:** The process of configuring network settings for virtual machines, including IP addresses, subnets, gateways, and DNS servers. Networking configurations may need to be adjusted during VM migration to ensure connectivity in the new environment.

**Nova Compute:** The service within OpenStack Nova responsible for managing compute resources, including launching, and terminating VM instances.

**Nova Hypervisor:** A component of OpenStack Nova responsible for interfacing with different hypervisors to manage VM instances.

**Nova Scheduler:** The component within OpenStack Nova responsible for selecting the appropriate compute node to deploy a new VM instance based on various criteria such as resource availability and workload constraints.

**OpenStack:** An open-source cloud computing platform that enables the creation and management of public and private clouds. OpenStack provides numerous services, including computing, storage, networking, and identity services.

**OpenStack Nova:** The compute component of the OpenStack platform responsible for managing and orchestrating VM instances.

**Out-of-band:** A separate network used to manage, orchestrate, and troubleshoot the primary production network.

**The Migration Toolkit for Virtualization (MTV) by Red Hat:** Enables users to migrate virtual machines from VMware vSphere to OpenShift Virtualization, an add-on to OpenShift Container Platform (OCP v4.7 onward).

**Red Hat Director:** A toolset for installing and managing a complete RHOSP environment. Director is based primarily on the OpenStack project TripleO. With director you can install a fully-operational, lean, and robust RHOSP environment that can provision and control bare metal systems to use as OpenStack nodes.

**Refactor:** Refactoring modifies applications to better support the cloud environment.

**Rehost:** Rehosting involves moving applications to the cloud as-is, without making significant changes.

**Replatform:** Replatforming moves applications to the cloud, taking advantage of cloud benefits, but without major code changes.

**Resource Mapping:** The process of mapping virtual machine resources (CPU, memory, disk, etc.) from the source environment to the target environment during migration. Resource mapping ensures that VMs have adequate resources after migration.

**Security Groups:** Sets of IP filter rules that are applied to all project instances, defining networking access to those instances.

**Target Platform:** Destination platform (or cloud) to which virtual machines or applications are migrated to.

**UEFI:** A specification that defines the architecture of the platform firmware used for booting the computer hardware and its interface for interaction with the operating system.

**vCenter Server:** A centralized management tool provided by VMware for managing VMware vSphere environments. It enables administrators to manage clusters of ESXi hosts and virtual machines.

**Virt-v2v:** Virt-v2v converts a single guest from a foreign hypervisor to run on KVM. It can read Linux and Windows guests running on VMware, Xen, Hyper-V, and some other hypervisors, and convert them to KVM managed by libvirt, OpenStack, oVirt, Red Hat Virtualization (RHV) or several other targets. It can modify the guest to make it bootable on KVM and install virtio drivers so it will run quickly.

**Virtual Machine (VM):** A software-based emulation of a physical computer that operates within the confines of another computer's operating system.

**Virtual Machine Flavors:** In OpenStack, flavors define the compute, memory, and storage capacity of nova computing instances. To put it simply, a flavor is an available hardware configuration for a server. It defines the size of a virtual server that can be launched.

**Virtual Machine Migration:** The process of moving a virtual machine from one physical host or hypervisor to another, typically for reasons such as load balancing, hardware maintenance, or technology upgrades.

**VMware Virtual Machine (VM):** A software-based emulation of a physical computer that runs an operating system and applications. VMware provides a suite of virtualization products allowing multiple VMs to run on a single physical server, increasing resource utilization and flexibility.

**VMware vSphere:** A suite of virtualization products from VMware that includes a hypervisor (ESXi), management tools, and numerous services for building and managing virtualized environments.

**VM Flavors:** Templates in OpenStack that define the compute, memory, and storage capacity of nova computing instances.

**VM Metadata:** Data that provides information about other data, in this case, the VMs that are being migrated.

## About Trilio

Trilio is a leading provider of cloud-native Data Protection software solutions, supporting private, public and hybrid-clouds, engineered from the ground up for Kubernetes, KubeVirt and OpenStack environments. At Trilio, we believe that data protection should be effortless, automated, and predictable. Our platforms deliver a modern data protection experience that gives customers more power and control over their applications and data. Cloud Architects, Platform Engineers, ITOps and DevOps departments, rely on Trilio technology for operational resiliency to perform critical tasks such as data backup and recovery, migration, ransomware protection, application mobility and disaster recovery.

Either in place, or into other clusters and clouds, Trilio's software dramatically reduces the amount of time spent on restoration and migration activities empowering customers from diverse sectors, such as telecommunications, financial services, defense, automotive and healthcare with the ability to easily deploy, manage and scale applications with confidence. Trilio has been a Premier Red Hat partner since 2017.

For more information, visit or contact us:

Trilio.io
linkedin.com/company/Trilio
Tel: + 1 (508) 233 3912
e-mail: info@trilio.io

**TRILIO**