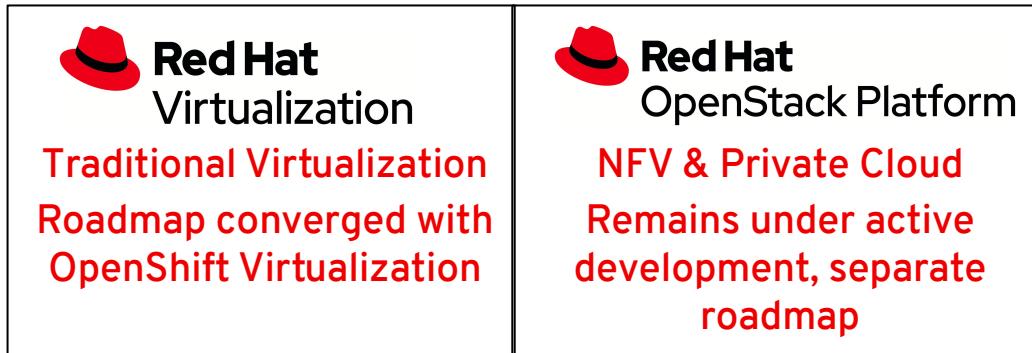
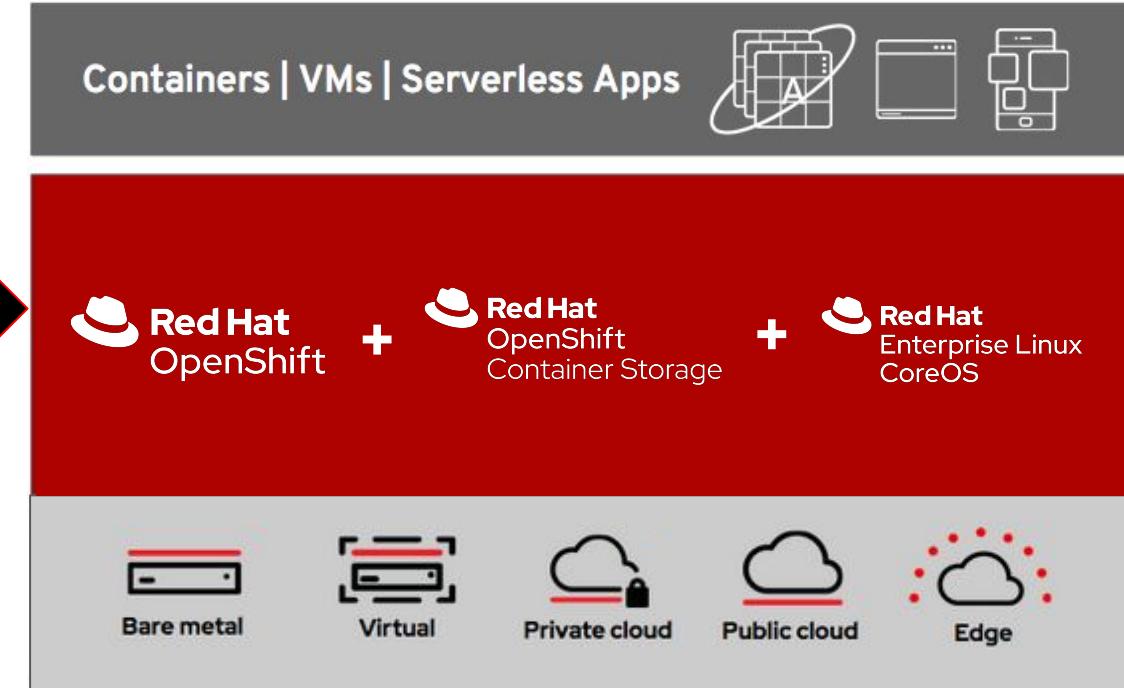


# Virtualisation Technologies

# Red Hat's Virtualization Strategy and Plan



Modernization →



- Rock solid stability, performance and scale for current long life use cases and MMS migrations from VMware to RH infrastructure
- Provide customers with migration path, services, tooling to modernize current applications and workloads
  - To VMs and containers running on OpenShift
- Integration with Red Hat OpenShift, OpenShift Virtualization

2

- Application modernization, future-proof migrations from VMware, RHV, RHOSP
- **Strategy, continuity and roadmap** for Virtualization from Red Hat across all footprints



# Red Hat Virtualization

# Use Cases



## PERFORMANCE SENSITIVE

Unmatched scale and performance for enterprise workloads, including SAP® and Oracle, on x86 and IBM POWER8/9



## DEV AND TEST ENVIRONMENTS

Simple, inexpensive self-serve infrastructure for enterprise development environments



## HYBRID AND MULTIHYPERVISOR

Integrates with Red Hat OpenStack® Platform and easily managed by the leading cloud management platform (CMP) for a smooth transition into private and public clouds



## TECH WORKSTATIONS

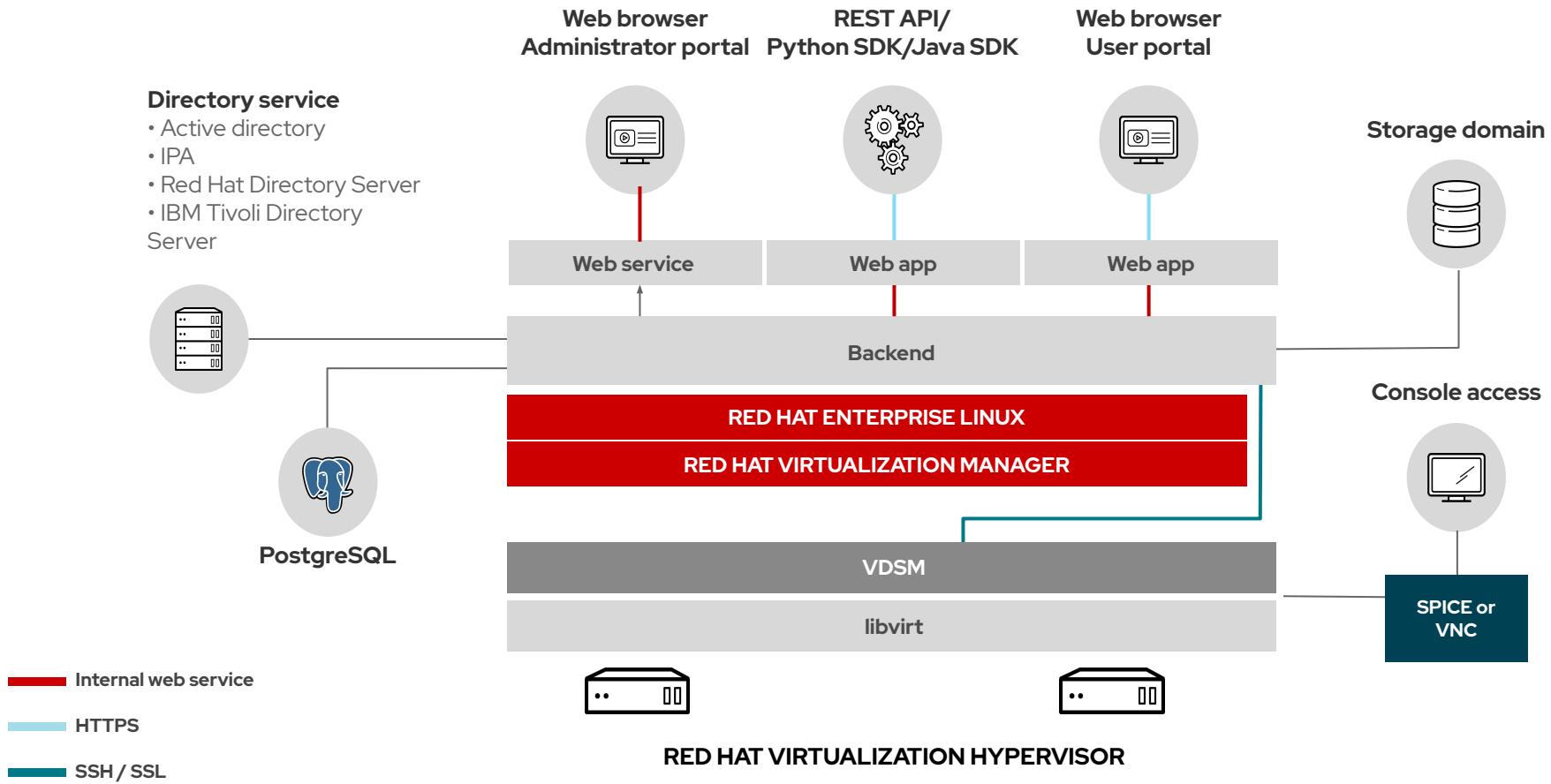
Gain performance and reduce cost of resource-intensive Linux workstations—e.g. computer-aided design (CAD) and computer-aided manufacturing (CAM)



## SERVER CONSOLIDATION

Red Hat Virtualization delivers a low TCO, faster return on investment (ROI), and an accelerated break-even point

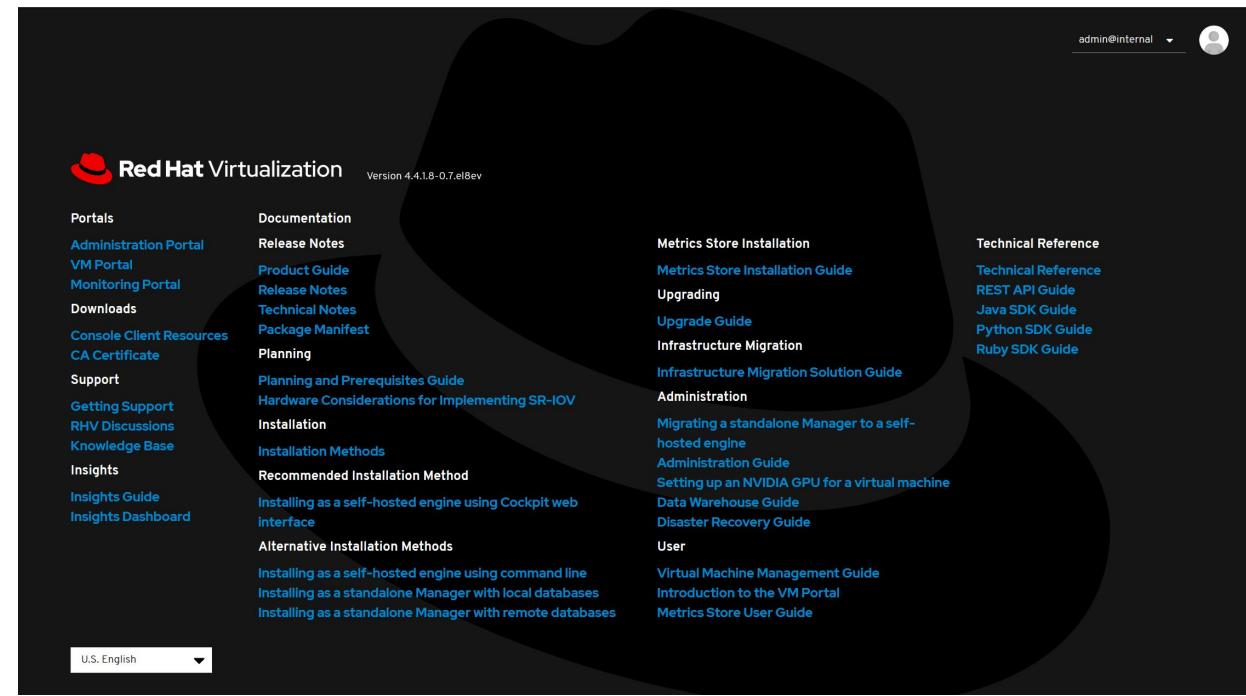
# Architectural Overview



# Infrastructure and VM management

# Red Hat Virtualization Manager

- Primary management interface for RHV
  - Ability to create, manage, and control configuration of physical (hosts, storage), logical (datacenter, cluster, etc.), and virtual machine resources
  - Administrator interface for managing RHV resources
  - Virtual machine portal for non-administrators
  - Grafana interface for metrics and trend analysis
- REST API for automation and integration
  - Multiple SDKs available (Python, Java, Ruby)



# Administrator dashboard

Red Hat Virtualization

Last Updated 7/30/2020, 12:51:11 PM EDT

1 Data Centers | 1 Clusters | 2 Hosts | 1 Data Storage Domains | 1 Virtual Machines | 24 Events

1 | N/A | 1 | 1 | 1 | 24

Global Utilization

CPU: 100% available of 100% | Virtual resources - Committed: 0%, Allocated: 13%

Memory: 30.1 GiB available of 31.3 GiB | Virtual resources - Committed: 0%, Allocated: 3%

Storage: 0.7 TiB available of 0.7 TiB | Virtual resources - Committed: 0%, Allocated: 0%

0% Used | 1.3 GiB Used | 0.0 TiB Used

Cluster Utilization

CPU: < 65% | Memory: < 65%

Storage Utilization

Storage: < 65%

Legend: > 90% (Red), 75-90% (Orange), 65-75% (Yellow), < 65% (Light Blue)

The screenshot displays the Red Hat Virtualization Administrator dashboard. The top navigation bar includes the Red Hat logo and the title "Red Hat Virtualization". A header bar shows the last update time as "7/30/2020, 12:51:11 PM EDT". Below this are six summary cards: "1 Data Centers" (status 1), "1 Clusters" (status N/A), "2 Hosts" (status 1 | 1), "1 Data Storage Domains" (status 1), "1 Virtual Machines" (status 1), and "24 Events" (status 24). The main content area is divided into sections: "Global Utilization" (CPU at 100% available, 13% allocated; Memory at 30.1 GiB used of 31.3 GiB; Storage at 0.7 TiB used of 0.7 TiB); "Cluster Utilization" (CPU and Memory both at < 65% usage); and "Storage Utilization" (Storage at < 65% usage). Each section includes a donut chart and a horizontal bar chart. A legend at the bottom defines four color-coded ranges: > 90% (Red), 75-90% (Orange), 65-75% (Yellow), and < 65% (Light Blue).

# Virtual machine portal

The screenshot displays a virtual machine portal interface for Red Hat Virtualization. The top navigation bar includes the title "RED HAT VIRTUALIZATION" and user icons for search, profile, and notifications. A "Create Virtual Machine" button is located in the top right corner. The main area shows a grid of seven virtual machine instances:

- Row 1:** Four instances of "RED HAT ENTERPRISE LINUX 8.X X64".
  - VM Name: tie\_bomber\_01. Status: Off. Action: Run.
  - VM Name: tie\_fighter\_01. Status: Off. Action: Run.
  - VM Name: tie\_fighter\_02. Status: Off. Action: Run.
  - VM Name: tie\_fighter\_03. Status: Off. Action: Run.
- Row 2:** Three instances of "RED HAT ENTERPRISE LINUX 7.X X64".
  - VM Name: tie\_fighter\_04. Status: Off. Action: Run.
  - VM Name: tie\_interceptor\_01. Status: Off. Action: Run.
  - VM Name: tie\_interceptor\_02. Status: Off. Action: Run.

# Virtual machine portal - details

RED HAT VIRTUALIZATION

Virtual Machines > tie\_bomber\_01

Run Suspend Shutdown Reboot Console Remove

**tie\_bomber\_01** RED HAT ENTERPRISE LINUX 8.X X64

Running (up 1 minute, 41 seconds)

**Details**

Host	stardestroyer-01	Template	Blank
IP Address	N/A	CD	[Empty]
FQDN	tie_bomber_01	Cloud-Init	ON
Cluster	Imperial_Fleet	Boot Menu	OFF
Data Center	Galactic_Empire	Console	SPICE   VNC
		Optimized For	Server
		CPUs	1
		Memory	512 MiB

**Snapshots** 0

+ Create Snapshot

**Utilization**

CPU: 97.2% Available of 100% (2.8 % Used)

Memory: 131 Available of 512 MiB (380.2 MiB Used)

Networking: 100% Available of 100% (0 % Used)

Disk: 8.26 Unallocated of 10 GiB Provisioned (2 GiB Allocated)

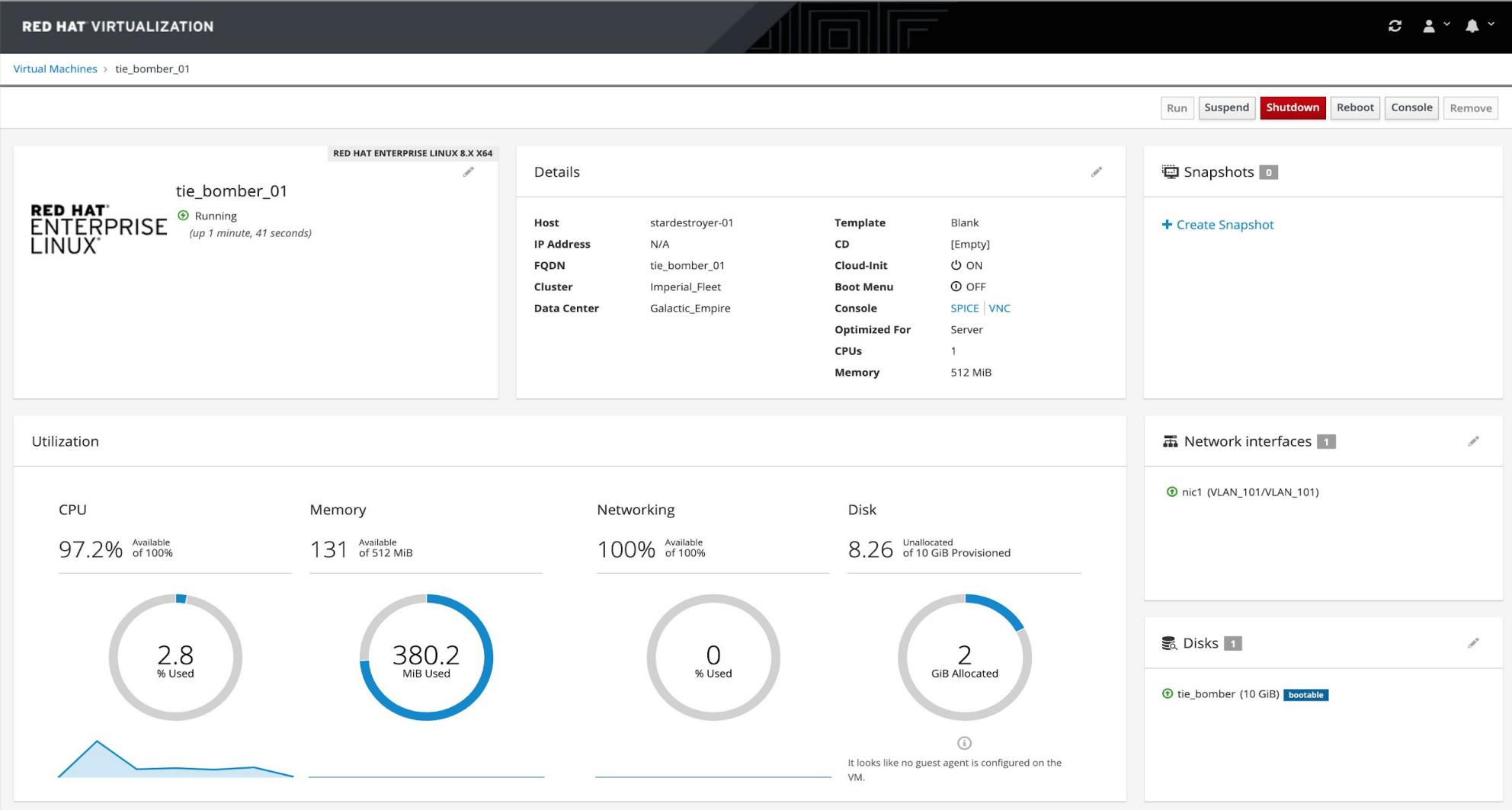
It looks like no guest agent is configured on the VM.

**Network interfaces** 1

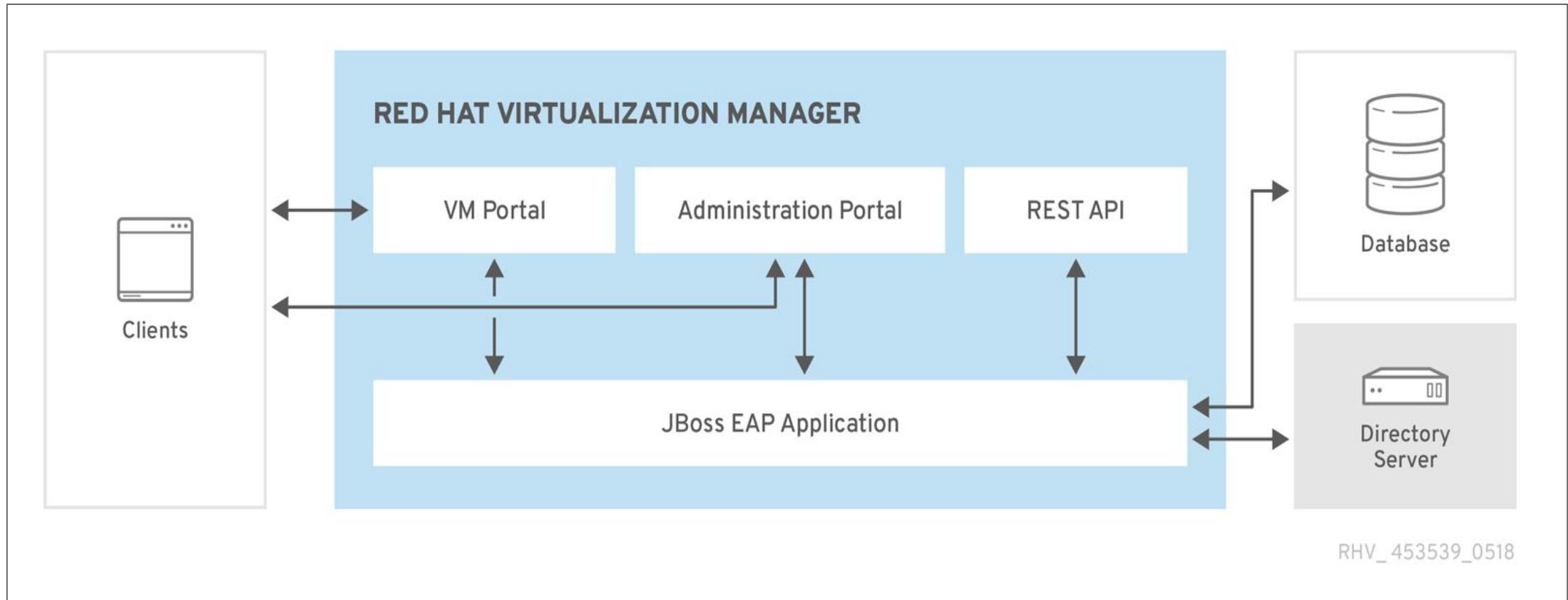
nic1 (VLAN\_101/VLAN\_101)

**Disks** 1

tie\_bomber (10 GiB) bootable



# RHV-M Architecture



# Compute

# Hypervisors

- 2 different hypervisor “models”
  - Appliance: Red Hat Virtualization - Host (RHV-H)
  - Traditional OS: Red Hat Enterprise Linux (RHEL) w/RHV packages
- Both result in the same capabilities!
  - RHV-H has a smaller footprint, having only what's needed to be a hypervisor
- Configuration and management are both handled the same by RHV-M
  - Updates/upgrades, power management, etc. all equivalent
  - Logical entities (e.g. networks and storage) are created and managed the same
- Do you want/need to customize the hypervisor OS layout and/or package set **extensively**?
  - Yes - RHEL
  - No - RHV-H

# Hypervisor Options

## **Red Hat Enterprise Linux**

- Manage using traditional tools and practices
  - Monitoring and alerting
  - Automation
- Customize to your organization's needs
  - Storage layout
  - Packages
- Cockpit optional (but recommended)

## **Red Hat Virtualization Host**

- Fewer packages, smaller footprint
- Hands-off, appliance management model
  - Cockpit required
  - Automatically tuned for virtualization workloads
- Limited customization
  - Add packages only if needed
  - Storage layout is semi rigid

**USE CASE DETERMINES WHICH ONE IS BEST FOR YOUR ENVIRONMENT**

# RHV-M host detail view

Red Hat Virtualization

Compute > Hosts > **hypervisor01** 

Edit Remove Management ▾ Installation ▾ Host Console Copy Host Networks :

General	Virtual Machines	Network Interfaces	Host Devices	Host Hooks	Permissions	Affinity Labels	Errata	Events
Hostname/IP: SPM Priority: Active VMs: Logical CPU Cores: Online Logical CPU Cores: Boot Time: Hosted Engine HA:	hypervisor01.lab.lan Medium 0 4 0, 1, 2, 3 Jul 27, 2020, 3:43:35 PM [N/A]	iSCSI Initiator Name: Kdump Status: Physical Memory: Swap Size: Shared Memory: Device Passthrough: Disabled	iqn.1994-05.com.redhat:e766cf2af Disabled 16031 MB total, 641 MB used, 15390 MB free 8079 MB total, 0 MB used, 8079 MB free 0%	Max free Memory for scheduling new VMs: Memory Page Sharing: Automatic Large Pages: Free Huge Pages (size: amount): SELinux mode: Cluster Compatibility Version:	15645 MB Active Always 2048: 0, 1048576: 0 Enforcing 4.2,4.3,4.4			

Action Items

-  A new version is available. [Upgrade](#)
-  Power Management is not configured for this Host. [Enable Power Management](#)

# Logical Compute

- Compute resources (hosts) are pooled into logical clusters
  - Up to 400 hosts per cluster
- Clusters control many properties of the physical hosts, which affect virtual machines
  - Homogenize CPU capabilities to the lowest common denominator
  - Overcommitment policy
  - Scheduling policy
- Virtual machines may freely migrate to any host in the cluster
  - Manual migration, triggered by the administrator
  - Automatic migration, triggered by cluster policy
- RHV-M schedules virtual machines to cluster nodes based on policy
- All policies are configurable based on desired behavior

# Virtual Machines

- RHEL and Microsoft Windows (server and desktop) operating systems supported
- Templates and instance sizing helpers to simplify provisioning
- Optimization profiles automatically pre-tune the virtual machine for the workload
  - Desktop, server, high performance
- VMs support Non-uniform memory access (NUMA) pinning, CPU pinning, CPU masking and passthrough, large (2MiB) and huge pages (1GiB)
- VM resources may be reserved or allowed to overcommit, as desired
- High availability is enabled on a per-VM basis
  - Specify startup priority, guest watchdog, and resume behavior
- May have as many disks, NICs, etc. as the underlying virtual hardware (i440fx, Q35) supports
- PCI passthrough and SR-IOV for direct access to host resources

# RHV Limits

	<b>Component</b>	<b>Limit</b>
Maximum per hypervisor	Logical CPUs	768
	RAM	12TB
	VMs	250
Maximum per cluster	Hosts	400
	VMs	4000
Maximum per VM	CPUs	384
	RAM	4TB
	Single disk size	8TB

# Virtual machine summary

The screenshot shows the Red Hat Virtualization interface. On the left, there's a sidebar with navigation links: Dashboard, Compute (selected), Network, Storage, Administration, and Events. The main content area is titled "rhel-server-01". The top navigation bar includes "Compute", "Virtual Machines", "rhel-server-01", and various action buttons: Edit, Remove, Run, Suspend, Shutdown, Reboot, Console, Create Snapshot, and a more options button. Below the title, there's a breadcrumb trail: Compute > Virtual Machines > rhel-server-01. The main content is a table with tabs for General, Network Interfaces, Disks, Snapshots, Applications, Containers, Host Devices, Vm Devices, Affinity Groups, Affinity Labels, Guest Info, and Permissions. The General tab is selected. It displays detailed configuration for the VM, including Name (rhel-server-01), Description (Blank), Template (Blank), Operating System (Red Hat Enterprise Linux 8.x x64), BIOS Type (Default), Graphics protocol (SPICE + VNC), Video Type (QXL), Priority (Low), Optimized for (Server), Defined Memory (1024 MB), Physical Memory Guaranteed (1024 MB), Guest OS Memory (Not Configured), Free/Cached/Buffered (Not Configured), Number of CPU Cores (1 (1:1:1)), Guest CPU Count (N/A), Guest CPU Type (Intel SandyBridge IBRS SSBD Family), Highly Available (No), Number of Monitors (1), USB Policy (Disabled), Created By (admin), Origin (RHV), Run On (Any Host in Cluster), Custom Properties (Not Configured), Cluster Compatibility Version (4.3), VM ID (b4c030b1-0a57-470b-9084-84811a3c72fd), and Hardware Clock Time Offset (Etc/GMT).

General	Network Interfaces	Disks	Snapshots	Applications	Containers	Host Devices	Vm Devices	Affinity Groups	Affinity Labels	Guest Info	Permissions
Errata	Events	Red Hat Documentation									
Name: rhel-server-01	Description: Blank	Template: Blank	Operating System: Red Hat Enterprise Linux 8.x x64	BIOS Type: Default	Graphics protocol: SPICE + VNC	Defined Memory: 1024 MB	Physical Memory Guaranteed: 1024 MB	Guest OS Memory Free/Cached/Buffered: Not Configured	Number of CPU Cores: 1 (1:1:1)	Origin: RHV	Run On: Any Host in Cluster
										Custom Properties: Not Configured	
										Cluster Compatibility Version: 4.3	
										VM ID: b4c030b1-0a57-470b-9084-84811a3c72fd	
										Hardware Clock Time Offset: Etc/GMT	

# Templates and Pools

- Templates
  - Rapidly create virtual machines using templates
    - Hardware, software, and VM config stored in template
    - Customization using Sysprep or Cloud-Init
  - VMs created from a template depend on the template
    - Thin provisioned, COW instance of template disk image
  - VMs cloned from a template have no dependency
    - Full clone of template disk image
- Pools
  - Group(s) of VMs based on a template
  - Non-persistent: Created and changed data is lost at shutdown
  - Users are assigned to a pool, randomly given a VM from the pool each time

# Capabilities

Live migration	High-availability virtual machines
CPU pinning	Non-uniform memory access (NUMA) support
Role-based access control (RBAC) and tiered access	Browser-based management
Host power management	PCI passthrough
VM templates	USB passthrough
Firewall/Security-Enhanced Linux (SELinux)	REST API
Full support for Red Hat Enterprise Linux and Windows	Python, Ruby, and Java™ SDKs

# Advanced Capabilities

Host affinity and anti-affinity

Migrate and import VMs

Automated resource management and load balancing

CPU quality of service (QoS)

NVIDIA vGPU support

Hot add memory and CPU

Hot unplug CPU

Native site-to-site failover (disaster recovery)

Resource reservation

Automatic VM reset

Resource overcommit

Memory page sharing

Large page support

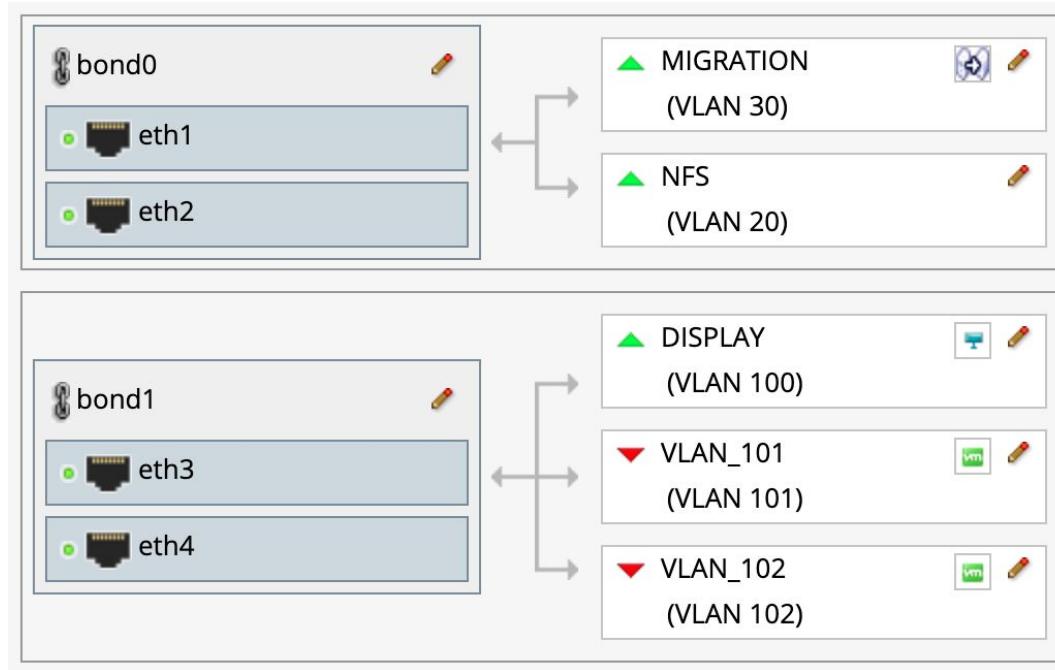
`virt-sparsify`

Import VMs from VMware

Metrics store and visualization

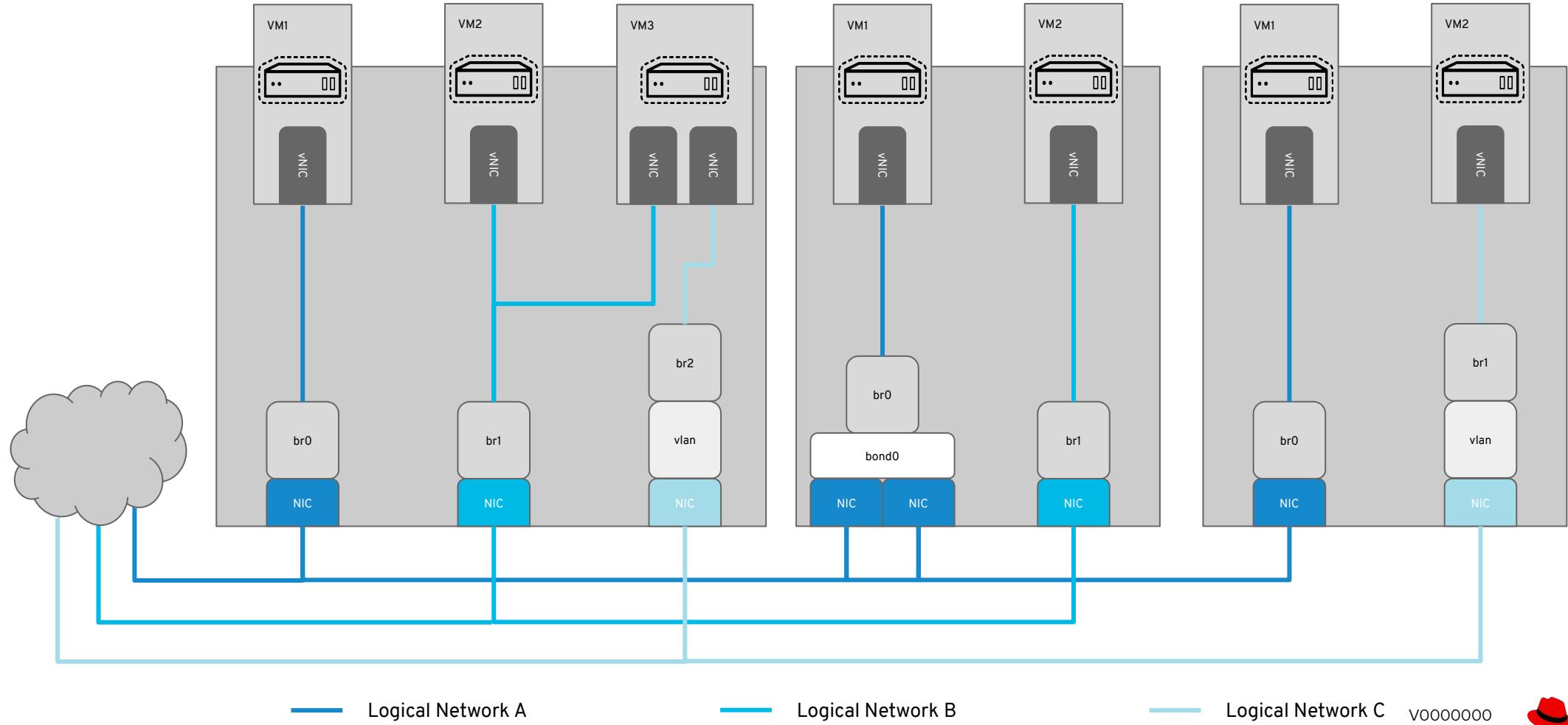
# Network

# Host Network Interfaces



- Single/standalone or bonded interfaces
- Bond modes supported for virtual machine networks
  - 1(active-passive)
  - 2(XOR)
  - 3(broadcast)
  - 4(802.3ad / LACP)
- Modes 0(round robin), 5(xmit LB), and 6(xmit + rcv LB) are not supported for virtual machine networks

# Logical Networks



# Network definitions

The screenshot shows the 'Networks' page within a management interface. The left sidebar includes links for Dashboard, Compute, Network (selected), Storage, Administration, and Events. The main area displays a table of network configurations:

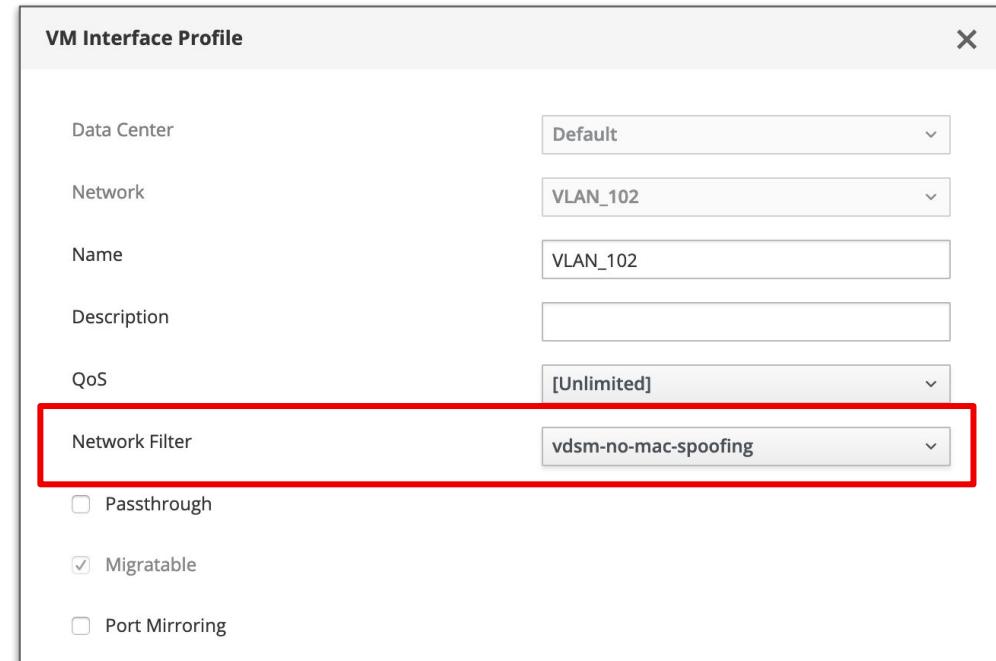
Name	Comment	Data Center	Description	Role	VLAN Tag	QoS Nam	Label	Provider
DISPLAY		Default	VM console		100	-	-	
MIGRATION		Default	Live migration		30	-	-	
NFS		Default	NFS storage		20	STORA...	-	
ovirtmgmt		Default	Management Network		-	-	-	
VLAN_101		Default	10.0.101.0		101	-	-	
VLAN_102		Default	10.0.102.0		102	-	-	
VLAN_103		Default	10.0.103.0		103	-	-	

# Network Controls

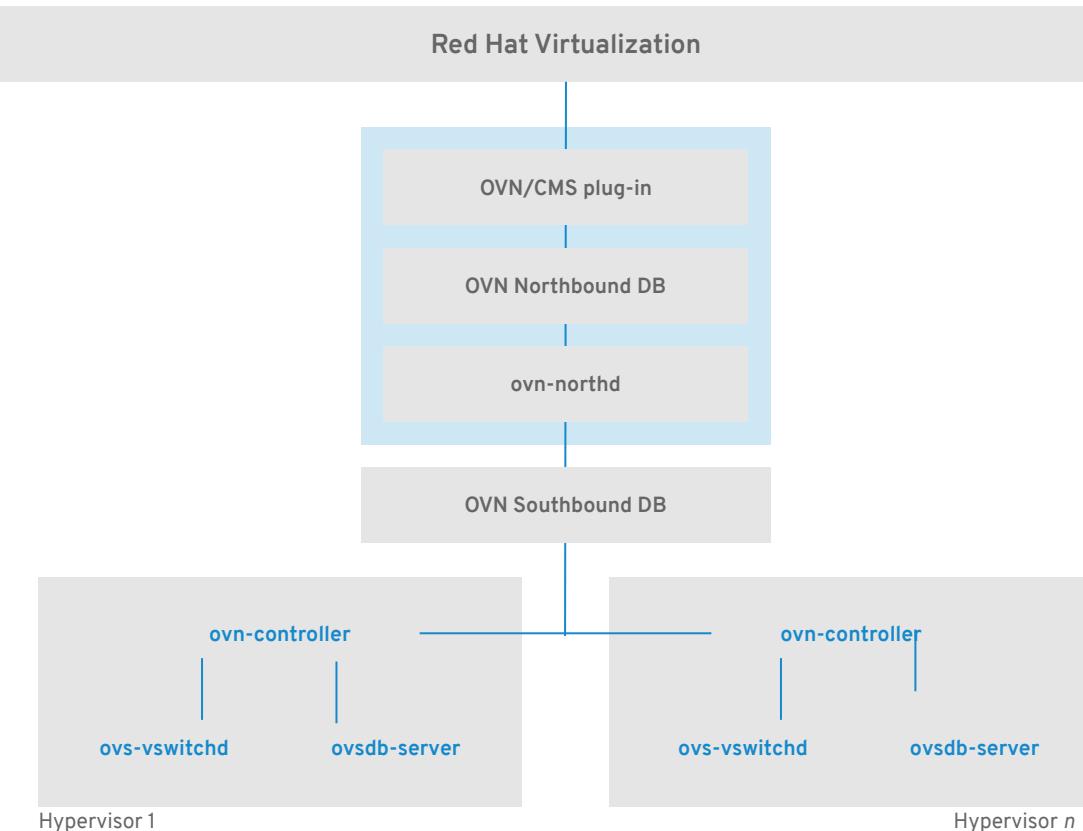
- Virtual network interface card (VNIC) profiles are created to modify characteristics of how the host or virtual machine connects to the logical network
  - Network filter - apply rules to how traffic is handled to/from the VNIC
  - Passthrough - for VNF / SR-IOV functionality
  - Port mirroring - mirrors traffic to another port for analysis
- QoS policies place controls on network min/max throughput and share prioritization
  - Rate limit
  - Committed rate
  - Weighted share
  - QoS policies may be defined on a per-(logical) network basis or on a per-VNIC profile basis
- VNIC profiles may apply to both VM and host logical network interfaces

# Network filters

- Enforce rules about how VNIC network traffic is handled, what is and is not allowed
  - Example: prevent packets not matching the VM's MAC from passing outbound (MAC spoofing)
- Applied at the hypervisor level
- Commonly used filters:
  - vdsms-no-mac-spoofing (default) - prevent MAC spoofing
  - clean-traffic - prevent MAC, IP, and ARP spoofing
  - clean-traffic-gateway - As with clean-traffic, but only allow communication to provided MAC(s) as the gateway. Used for private VLAN functionality.
  - no filter - allows all traffic, unaffected, to/from the VNIC



# Software-defined Networking



- Create and manage OVN networks
- Connect / disconnect virtual machines to SDN
- Integration with Red Hat OpenStack Platform Neutron via external network provider
  - Create and manage security groups and rules

# Storage

# Storage Concepts

## STORAGE DOMAINS

- Storage domains exist at the datacenter level
- One Storage Pool Manager (SPM) per datacenter manages metadata
- Data storage domain - used for virtual machine data disks, leases, ISOs, cluster/datacenter metadata
- **Export and ISO domains are deprecated!**

## STORAGE TYPE

- Block - uses SCSI commands to communicate with the underlying disks. Objects are stored as logical volumes.
- File - uses file protocols (e.g., NFS) to communicate with a remote storage host. Objects are stored as files.

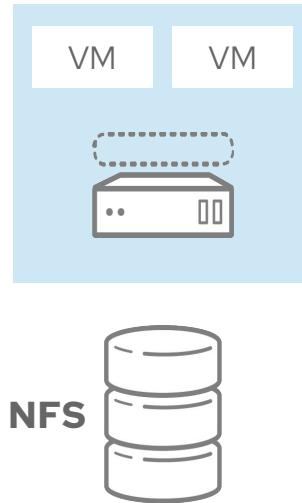
Both are valid. Choose based on application requirements!



# Protocol, Allocation, and Format

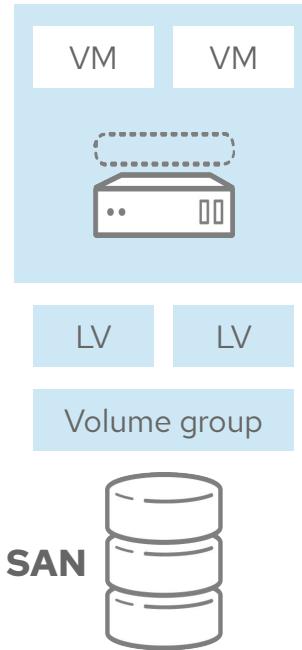
## FILE

- All disks, snapshots, and templates are **files**
- Protocols
  - NFS / pNFS
  - GlusterFS
  - Other POSIX



## BLOCK

- All disks, snapshots, and templates are **logical volumes**
- Protocols
  - iSCSI
  - FCP / FCoE
  - Local



Both support preallocated and sparse disks using QCOW2 and/or raw formats

# Integration

# OpenShift Virtualization integration

- Familiar interface to bridge the transition between technologies and teams
- Create, manage, and destroy OpenShift Virtualization VMs using the RHV-M interface
  - Console access, trigger live migration, etc. all supported
- Add OpenShift Virtualization clusters as external providers
  - Multiple clusters supported

Name	Hostname/IP	Status	Load
talayan-pytest-zjbhf-master-0	talayan-pytest-zjbhf-master-0	Unassigned	0 VMs
talayan-pytest-zjbhf-master-1	talayan-pytest-zjbhf-master-1	Unassigned	0 VMs
talayan-pytest-zjbhf-master-2	talayan-pytest-zjbhf-master-2	Unassigned	0 VMs
talayan-pytest-zjbhf-worker-29ws7	talayan-pytest-zjbhf-worker-29ws7	Up	0 VMs
talayan-pytest-zjbhf-worker-fjprj	talayan-pytest-zjbhf-worker-fjprj	Up	1 VMs
talayan-pytest-zjbhf-worker-g8xxt	talayan-pytest-zjbhf-worker-g8xxt	Up	1 VMs

# Ansible Integration



## Red Hat Ansible Automation Platform

**Red Hat Virtualization and Red Hat Ansible Automation are integrated in order to provide streamlined configuration for:**

- Virtual machines, templates, and pools
- Networks, storage, hosts, and datacenters
- Red Hat Virtualization Manager
- Disaster recovery
- Updates



**Extended automation capabilities  
For Red Hat Virtualization**

### **Automation functionality:**

- **Removes** manual steps from deployment and reconfiguration
- **Streamlines** operations, freeing up resources to focus on strategic initiatives
- **Provides** a single support stack for virtualization and automation
- **Includes** and supports Ansible roles for Red Hat Virtualization

# Portfolio Integration



**Red Hat Virtualization provides the latest support for Red Hat OpenStack Platform:**

- Glance image services
- Neutron network services
- Red Hat OpenStack Platform director
- Director and overcloud control plane virtualization

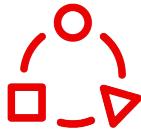


**Red Hat Virtualization provides the latest capabilities for Red Hat Satellite:**

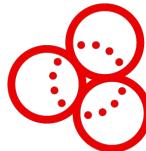
- Provisions and updates nodes and VMs
- Enforces compliance, including OpenSCAP
- Queries errata with Red Hat Virtualization Manager for hosts and guests
- Receives and applies software updates from Satellite
- Simplifies updates for hosts and VMs with host update manager.

# Summary

# Red Hat Virtualization



**Optimized** for Microsoft Windows and Linux guests



**Integrated** with a trusted and proven solution stack including:

- Red Hat Enterprise Linux
- Red Hat CloudForms
- Red Hat Storage
- Red Hat OpenStack Platform
- Red Hat Ansible Automation



- **Co-engineered** with Red Hat Enterprise Linux
- **Designed** for high performance and scalability
- **Enterprise-hardened** security with sVirt and SELinux
- **Global** support, training, certification, and professional services
- **Predictable** cost model, lower cost of IT optimization, and higher ROI
- **Complete portfolio** to build a foundation for future technologies

# OpenStack

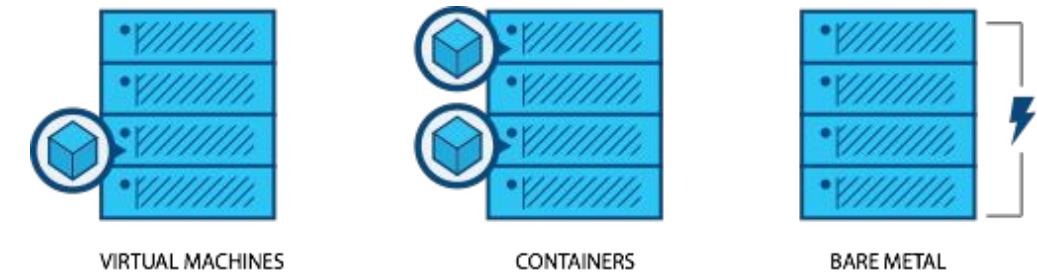
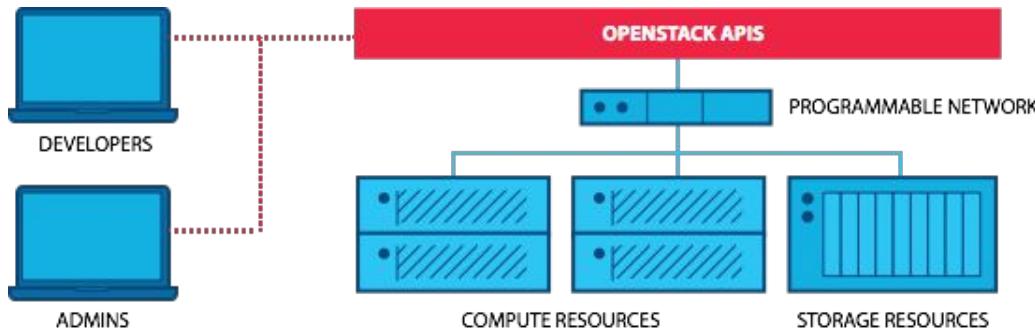
Presenter's Name

Title

Presenter's Name

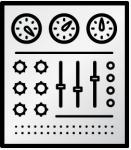
Title

# What is OpenStack?

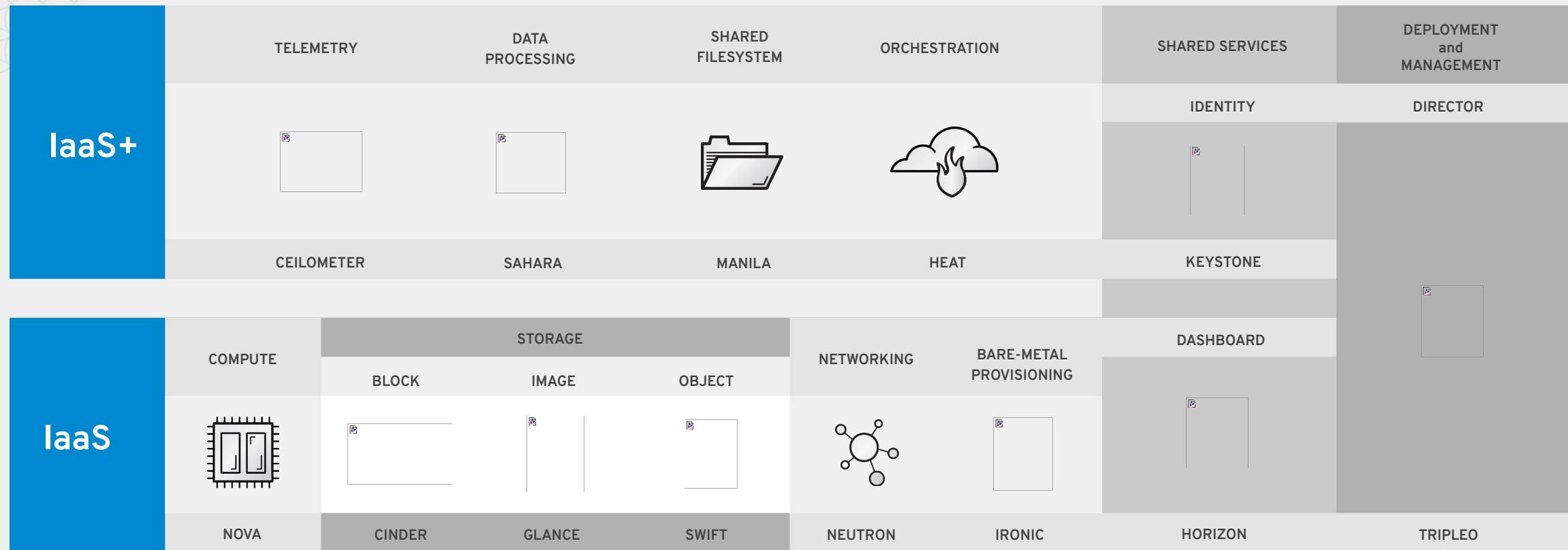


**Programmable infrastructure** that lays a common set of APIs on top of compute, networking and storage to provide a cloud infrastructure-as-a-service (IaaS)

**One platform** for virtual machines, containers and bare metal



# Core Components



Certified Red Hat OpenStack Platform plugins: <https://access.redhat.com/articles/1535373>



# OpenStack connects two worlds

Tenant view – the actual OpenStack IaaS user

Limited by what the Operator decides to offer in that cloud

The screenshot shows the tenant view of the Red Hat Enterprise Linux OpenStack Platform. It includes sections for 'Limit Summary' with pie charts and usage counts for Instances, VCPUs, RAM, Floating IPs, Security Groups, Volumes, and Volume Storage. Below this is an 'Usage Summary' section where users can select a time period to query usage. It displays active instances, RAM, and CPU hours, along with a table of usage details for specific instances like vmC and vmD.

Operator view – often the same role that has root access to the systems

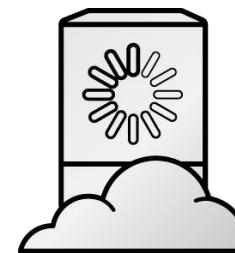
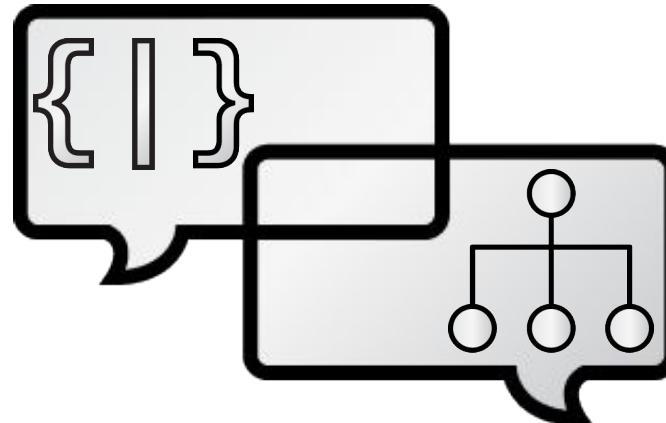
Combines configuration files and API actions to create a working environment for his tenants.

The screenshot shows the operator view of the Red Hat Enterprise Linux OpenStack Platform. It includes a 'Hypervisor Summary' section with pie charts for VCPU, Memory, and Local Disk usage. Below this is a table of host details for four compute hosts named overcloud-compute-1, -2, -3, and -controller, showing metrics like Type (QEMU), VCPUs used, RAM used, and local storage usage.



# Compute (Nova)

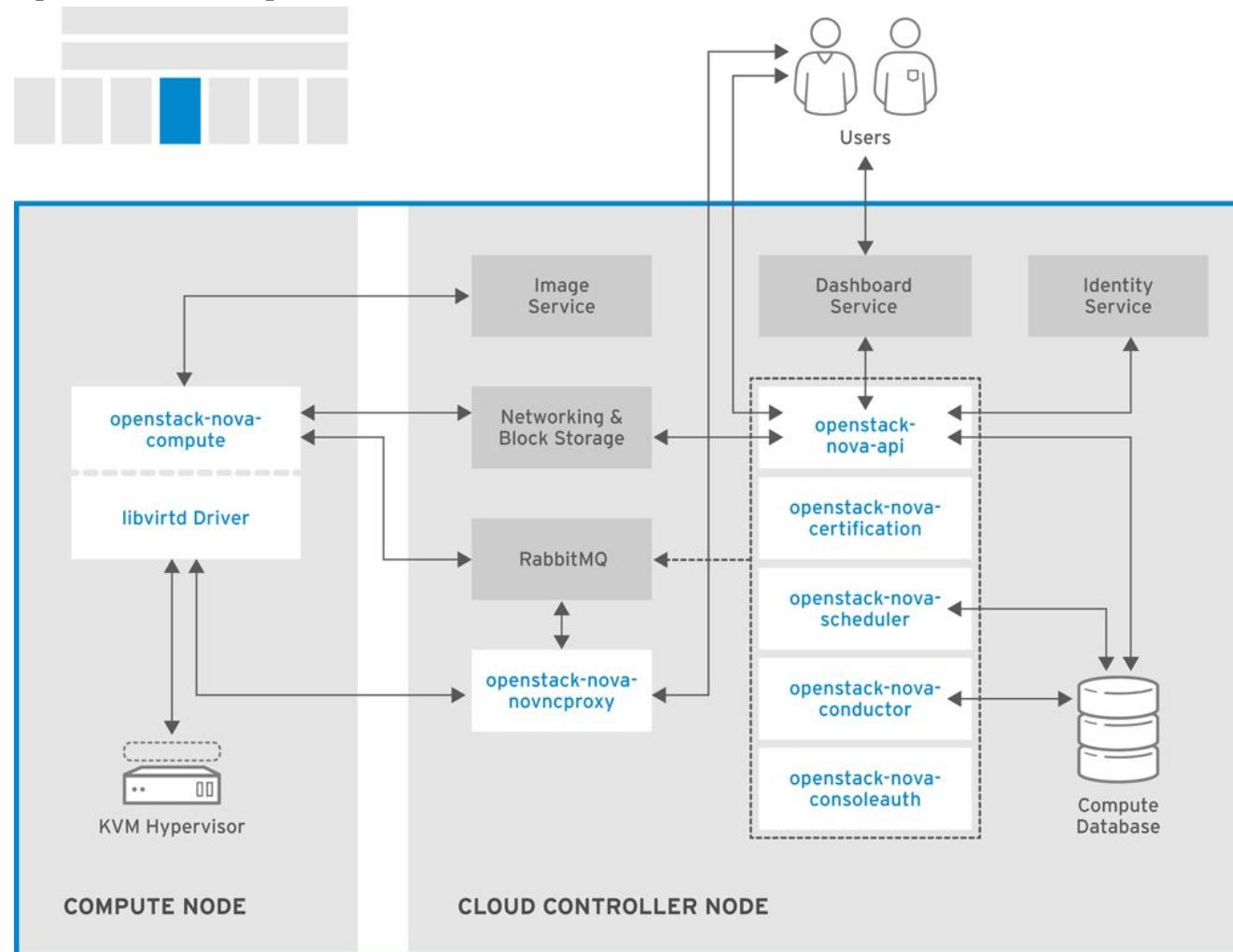
- I need VMs, anytime
- How many can I have?
- It must be secure
- SSH and VNC please?



- I have hardware capacity available
- This is how you consume it
- I set usage quotas
- I design for performance and scalability



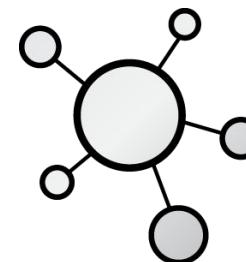
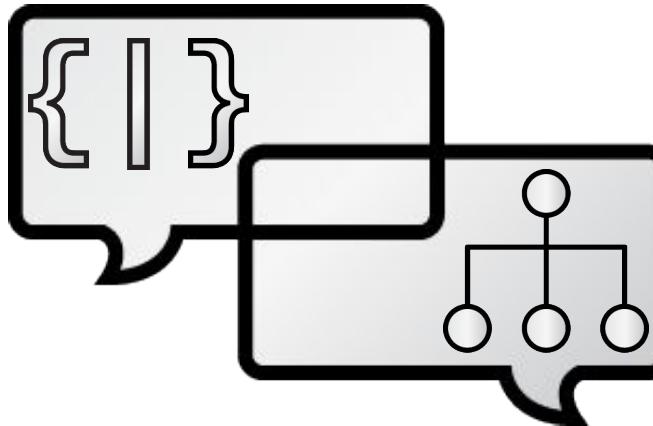
# Compute (Nova)





# Networking (Neutron)

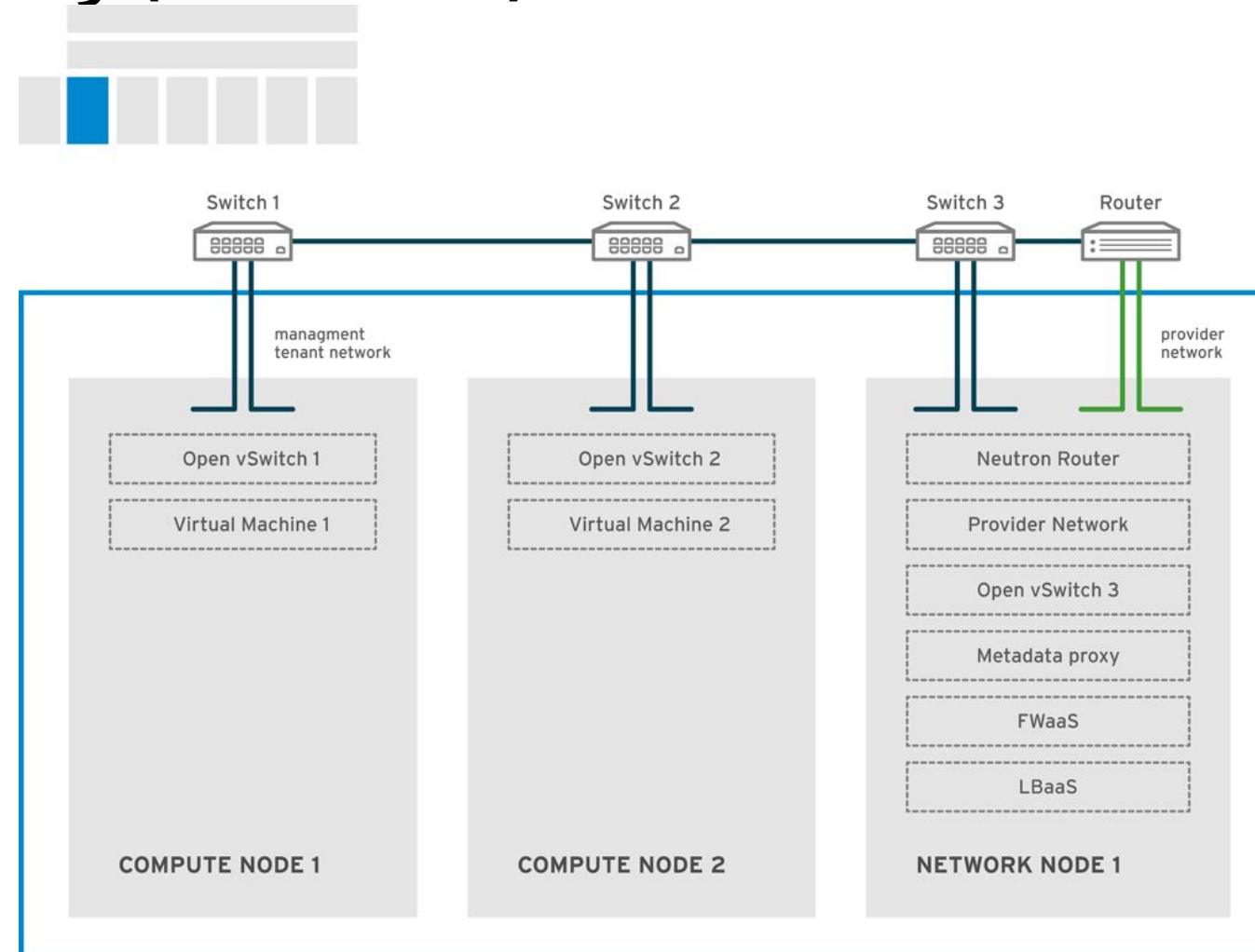
- I need my own network, isolated from others
- Some private IPs, some public IPs
- These are my QoS specs
- Let me share networks with others



- I design a network overlay and provide external access
- I have very few Public IPs
- I set rules, policies, quotas
- With SDN, I can centrally manage and monitor it all



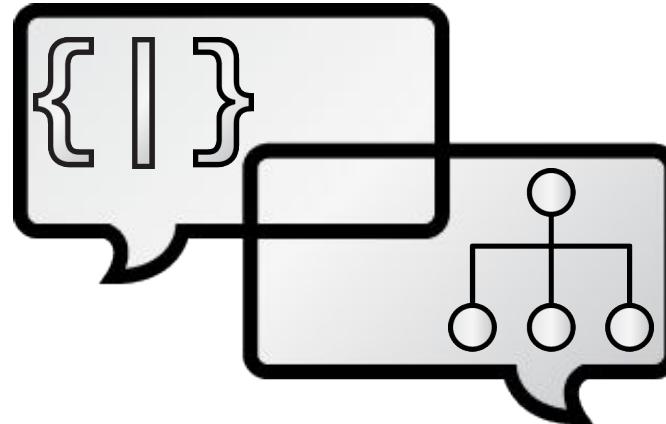
# Networking (Neutron)





# Block Storage (Cinder)

- Too much data in my VMs!
- I need permanent storage
- Can I snapshot and backup/rollback?
- Encrypted, please!

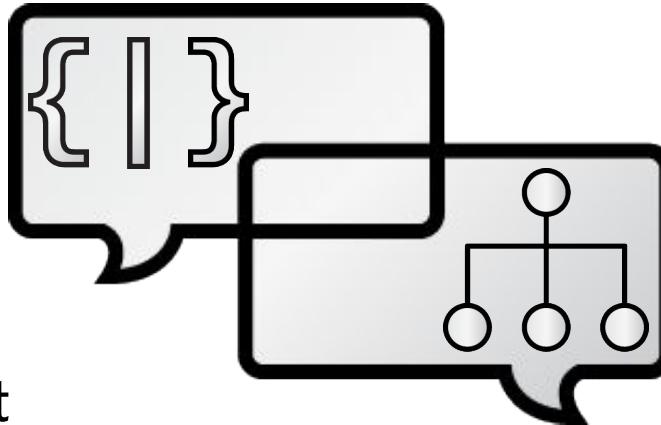


- I constantly buy storage
- I must allocate space to tenants
- I can combine different tiers of technologies (NAS, SAN, NFS)
- I set rules, policies, quotas



# Object Storage (Swift)

- My application needs object storage (files, media)
- I can use HTTP(s)
- Stateless please! No time for mounting filesystems

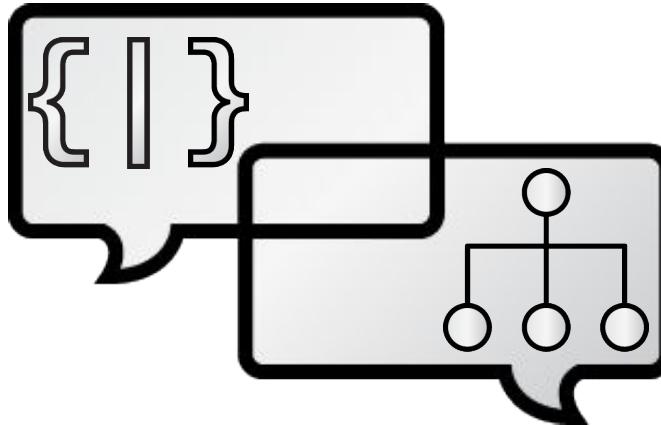


- I will offer a private S3-like experience
- I must scale without limits
- I want advanced features



# VM Image Storage (Glance)

- What OS's can I use?
- This is my own version, store it just for me
- Is the OS image genuine?
- I need encrypted images.

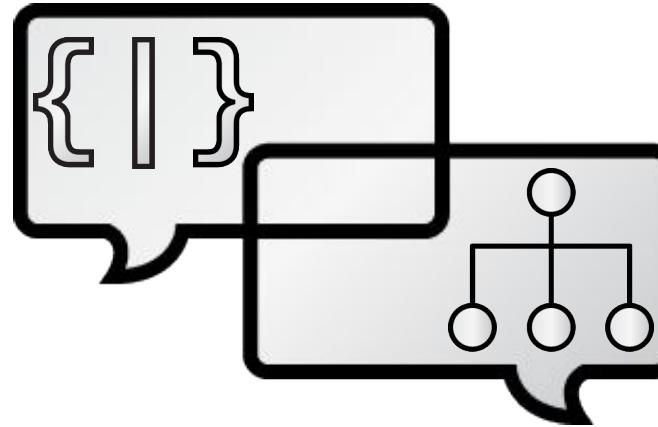


- Only approved OS can be used in my cloud
- Centrally offer updated OS
- Leverage storage integration to reduce network usage



# Identity and Access Control (Keystone)

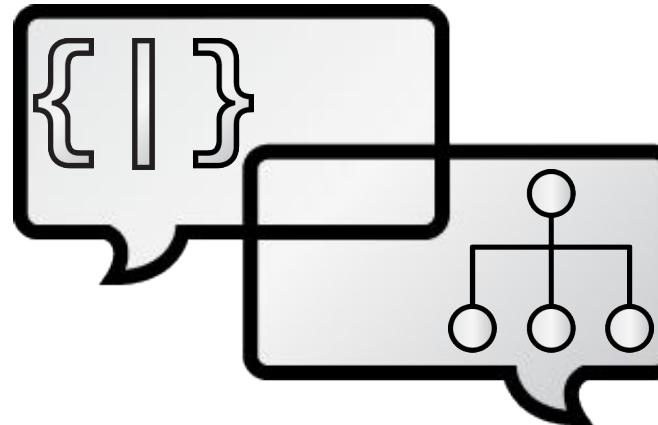
- Trust my identity!
- My boss just gave me permission to ask for VMs
- Where are all the services?
- I am a project lead, I must be admin of my project



- Who are you?
- Let me validate with LDAP
- I must integrate with my company's SSO
- I must secure entry points with TLS Certificates



# Orchestration engine (Heat)



- This is the blueprint of my application deployment: dependencies, config, etc
- Can you run this for me?
- Scale it out when this threshold is reached

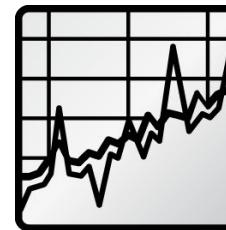
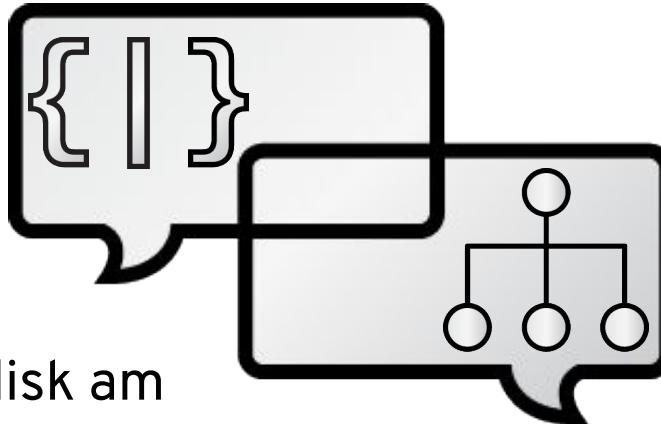


- I want to automate as much as I can and offer public-cloud-like efficiency
- Auto-scaling, load balancers and quotas allow me to monitor and predict demand



# Telemetry (Ceilometer)

- How much CPU, RAM, and disk am I using, i.e. per hour, per week?
- Allow me to set alarms and use my own infra to react

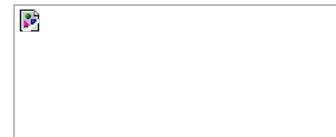
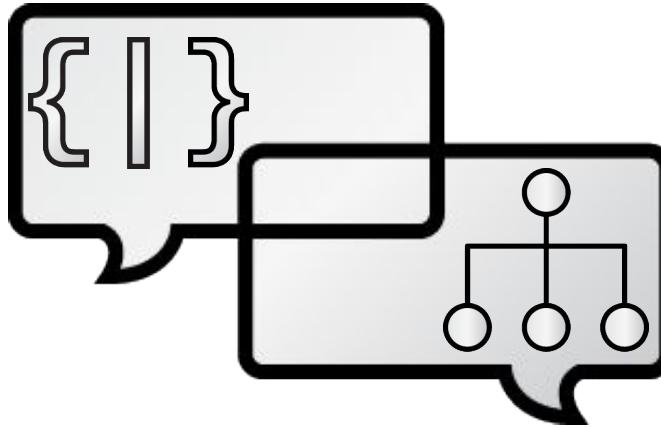


- I wish I could charge back / show back how much every user is consuming
- This is useful for my own internal usage!



# Baremetal for tenants (Ironic)

- I need a “physical” VM!
- I don’t have many security or isolation concerns, nor network protection needs

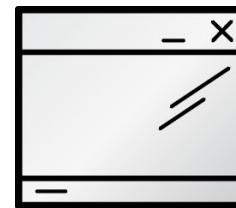
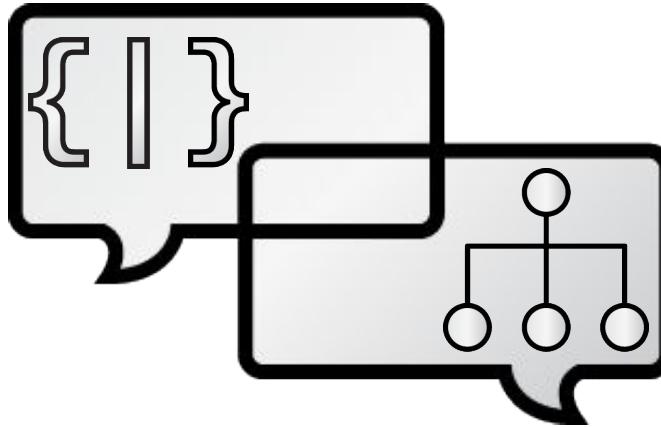


- I have some spare nodes in a separate cluster, with shared network
- I will offer them to trusted users groups
- I will provide the OS image



# Dashboard (Horizon)

- I need a UI to manage my workloads or troubleshoot
- I prefer to use GUI's or have staff who are learning
- I want to see my Heat topologies
- Quickly display my quota usage and default options

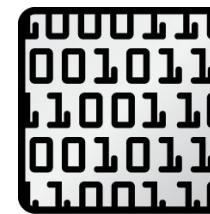
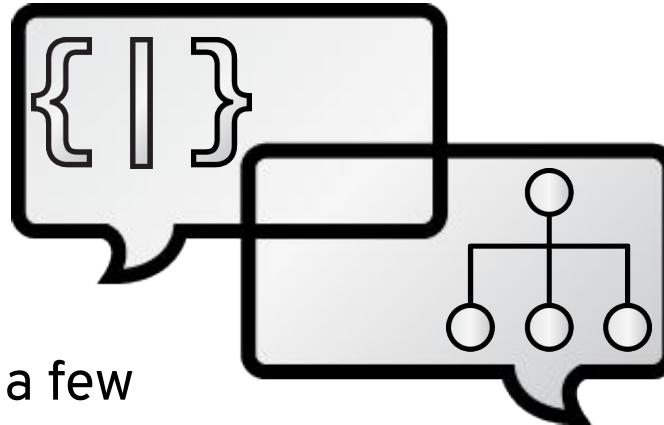


- I want an admin panel
- I want a quick access to my Red Hat Access account
- I want to see all Neutron networks and routers



# Data Processing (Sahara)

- I need a Hadoop cluster for a few hours
- I need to try different Big Data platforms
- I want my clusters to scale automatically



- I don't have the manpower to customize big data platforms to all my tenants
- I will get 3<sup>rd</sup> party providers and deliver their stack as a service

# OpenStack is open source software based on Linux

## HERE'S WHY THAT MATTERS

**Choice & control:** ability to choose between and switch vendors

**Widely adopted** open source APIs are the new standards

**Ability to contribute** or directly influence the roadmap

**Part of a vibrant community** to share knowledge and help each other; inherits the base of Linux for hardware and software ecosystem, security, and innovation

## OPENSTACK PRINCIPLES

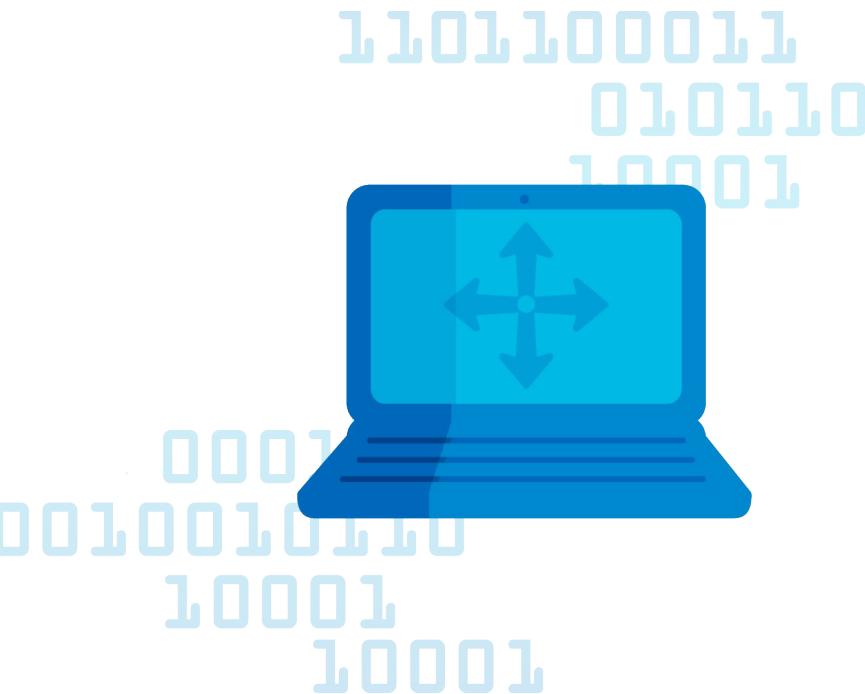
1 | OPEN SOURCE

2 | OPEN DESIGN

3 | OPEN DEVELOPMENT

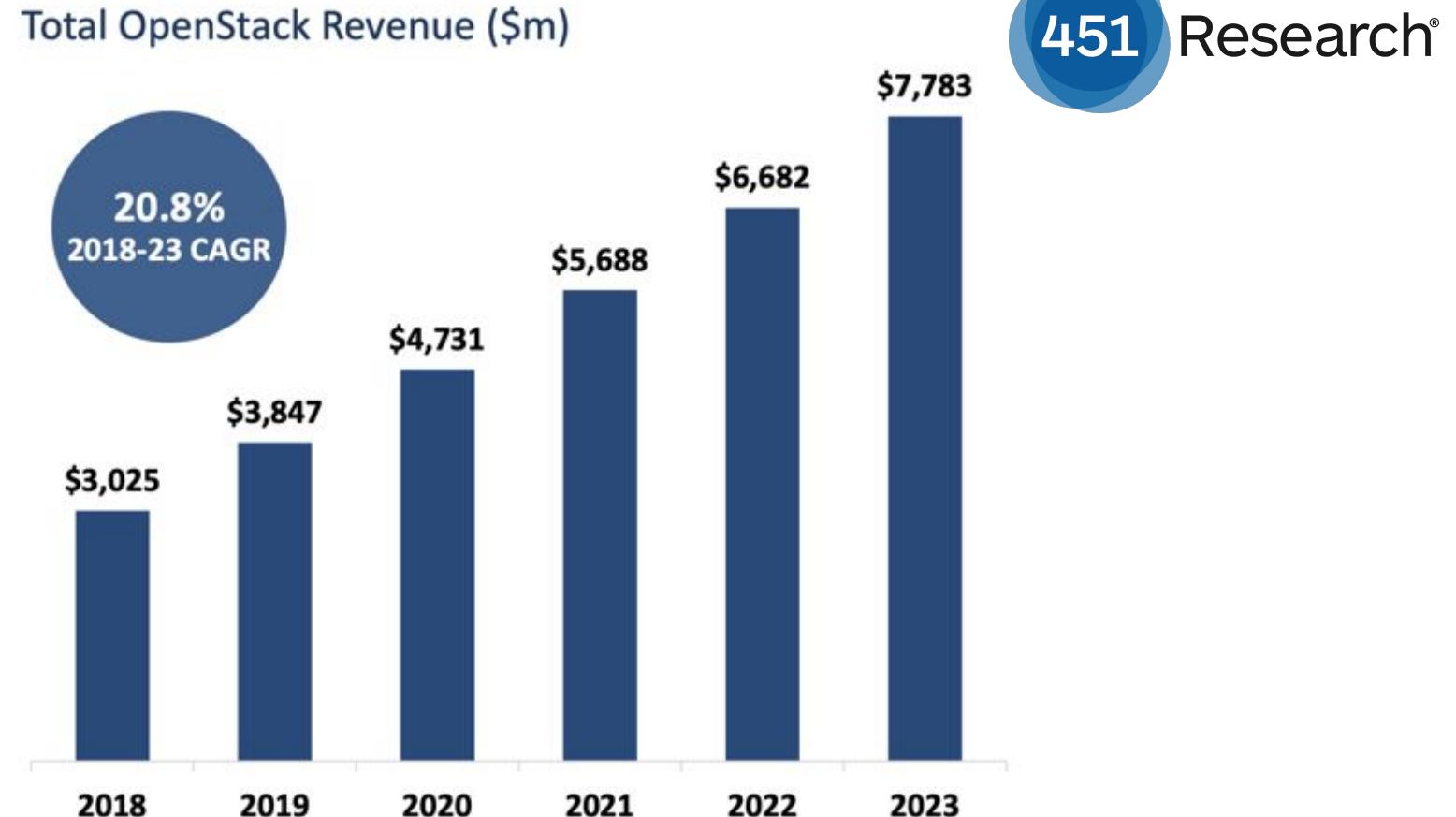
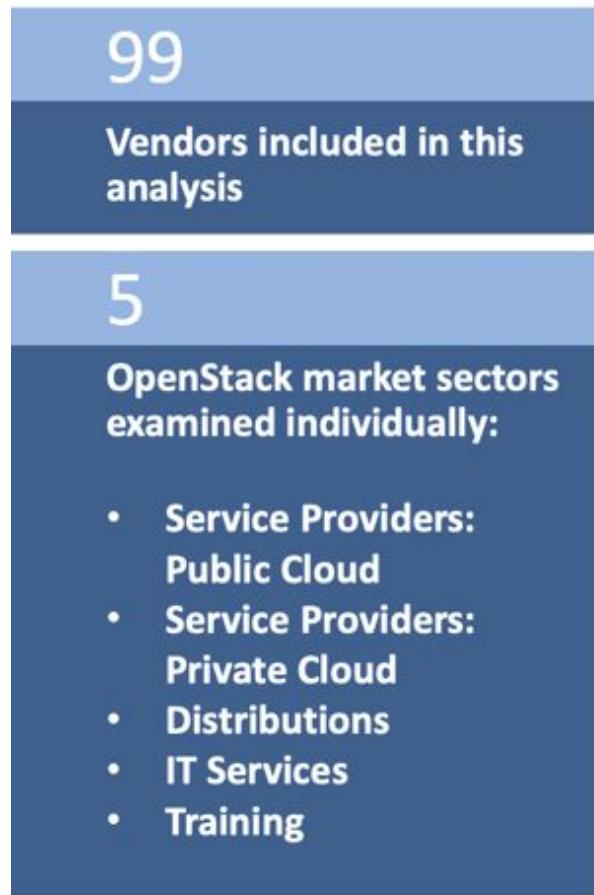
4 | OPEN COMMUNITY

# OpenStack Powers Digital Business



- || **Brings** public cloud capabilities into your datacenter
- || **Provides** massive on-demand (scale-out) capacity:  
1,000's | 10,000's | 100k's of instances
- || **Removes** vendor lock-in
- || **Open source** provides high-degree of flexibility to customize and interoperate
- || **Community** development = higher “feature velocity”
- || **Features & functions** you need, faster to market over proprietary software
- || **Greater automation**, resource provisioning, and scaling

# OpenStack Market Opportunity 2018-2023



# Which industries choose OpenStack?

## RETAIL/E-COMMERCE



## ENERGY AND MANUFACTURING



## FINANCIAL



## TELECOM



## ACADEMIC/RESEARCH



## INSURANCE



## ENTERTAINMENT



# What is OpenStack used for?



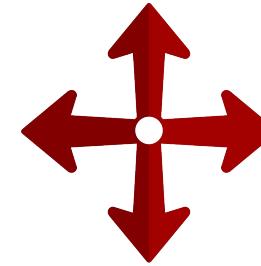
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NETWORK FUNCTION  
VIRTUALIZATION



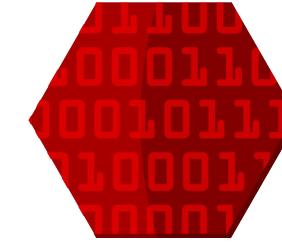
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DEVELOPER CLOUD



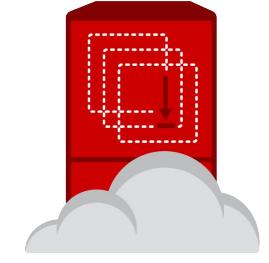
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EDGE COMPUTING



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AI/ML/HPC

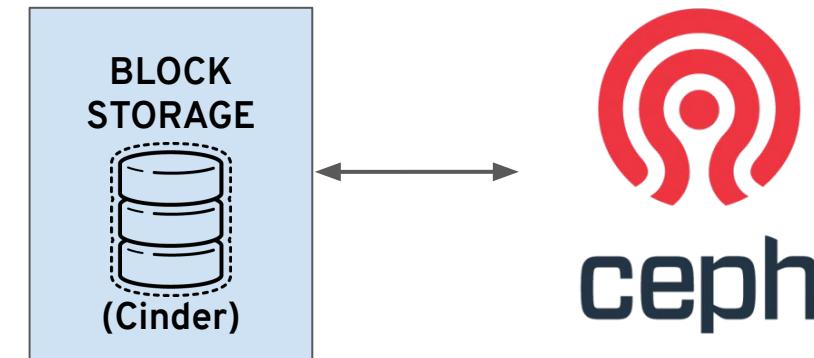
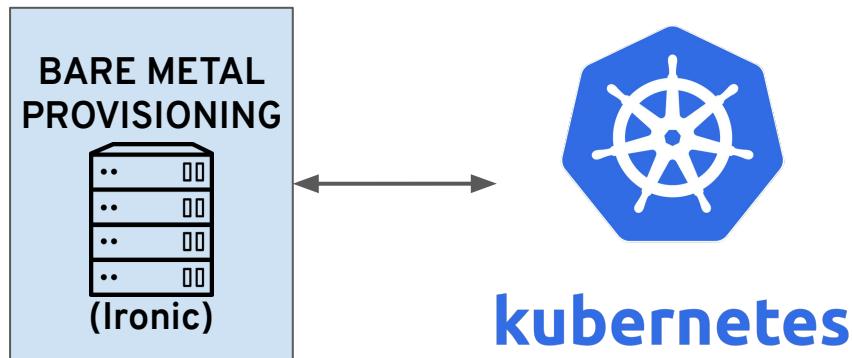
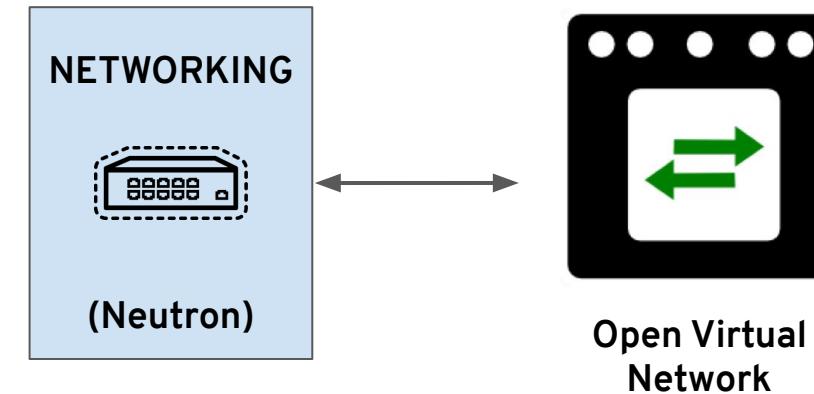
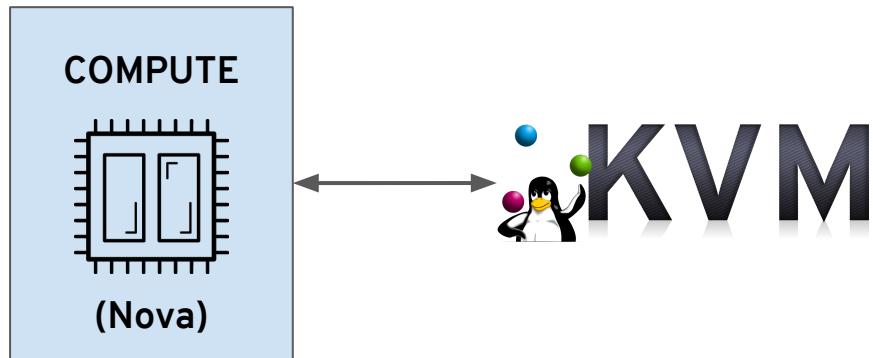


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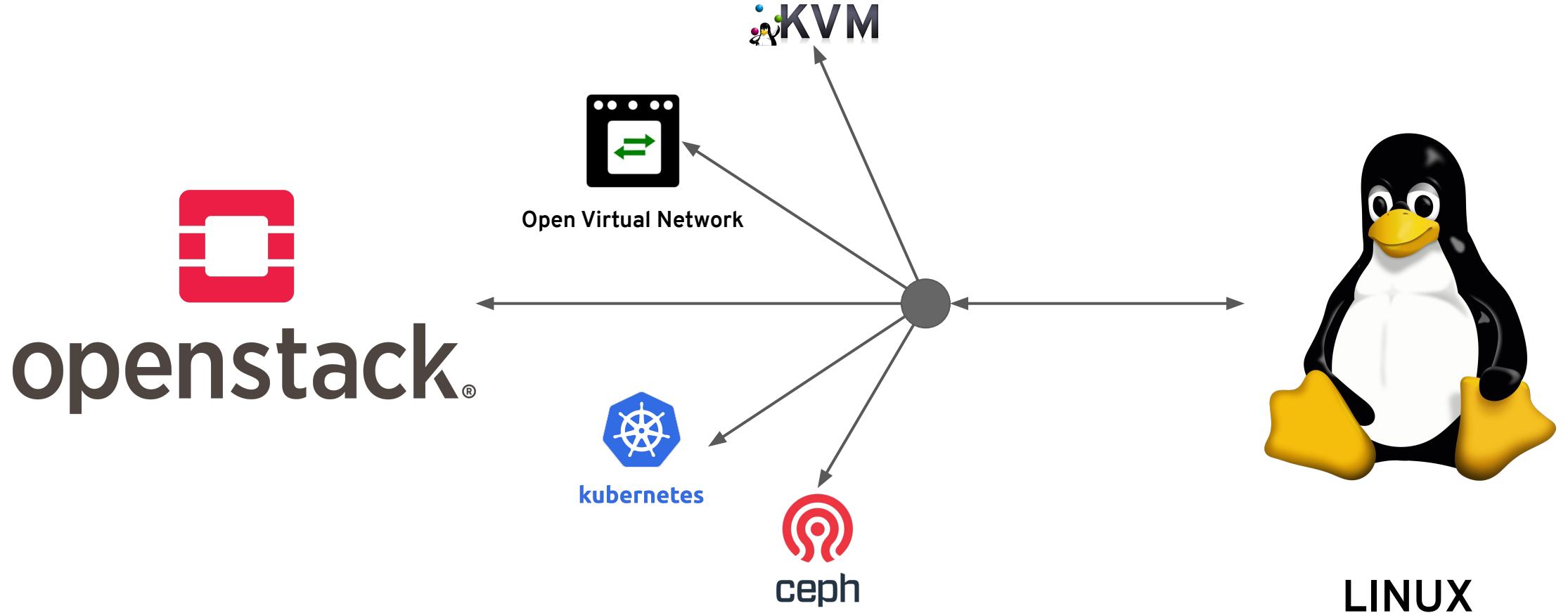
SERVICE PROVIDER

# OpenStack Services and open infrastructure integrations

## Native OpenStack Services

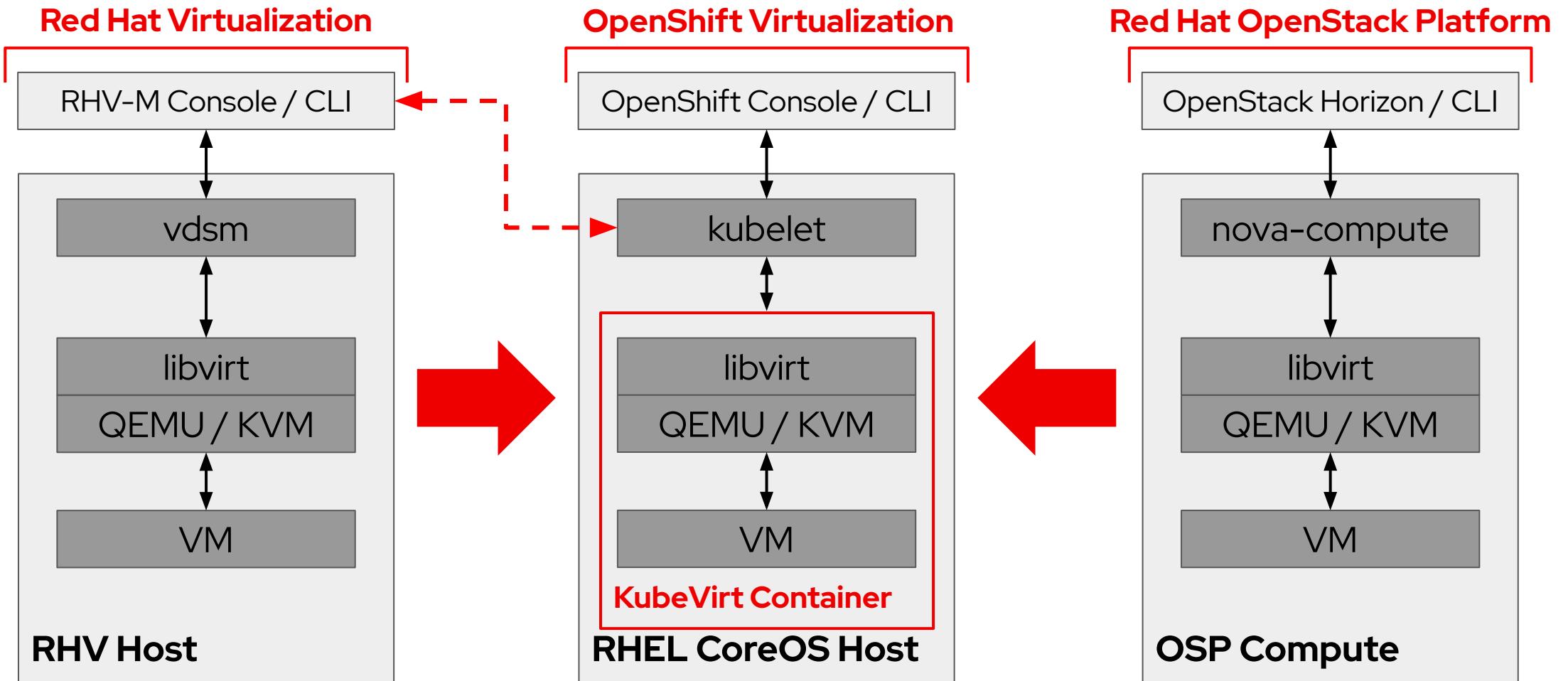


# OpenStack and open infrastructure depend on Linux



# Containerizing KVM

Trusted, mature KVM wrapped in modern management and automation



# Thank you

Red Hat is the world's leading provider of enterprise open source software solutions. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500.

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