

VMWARE V CLOUD NFV OPENSTACK EDITION

Accelerate NFV service deployment on OpenStack

AT A GLANCE

VMware vCloud® NFV™ OpenStack Edition provides the fastest path for communications service providers (CSPs) to deploy network functions virtualization (NFV) services on OpenStack. VMware vCloud NFV OpenStack Edition combines carrier-grade NFV infrastructure with VMware® Integrated OpenStack Carrier Edition as an NFV virtualized infrastructure manager (VIM) that transforms CSP networks, operations, and business models by delivering agile, secure, and highly available services. The open architecture and integrated operations management with 360-degree visibility across the NFVI layer allows CSPs to accelerate service innovation while delivering network flexibility, performance feedback, and fast remediation capabilities.

KEY BENEFITS

- VMware-supported OpenStack distribution that complies with OpenStack Foundation's 2017.01 interoperability guideline
- Fully integrated, tested, and certified NFVI platform that delivers efficient operations while eliminating the complexities of other OpenStack distributions
- Fast, simple, and hitless OpenStack install and upgrade
- Native support for container-based Virtual Network Functions (VNF) through integrated container management
- 24x7x365 carrier-grade support

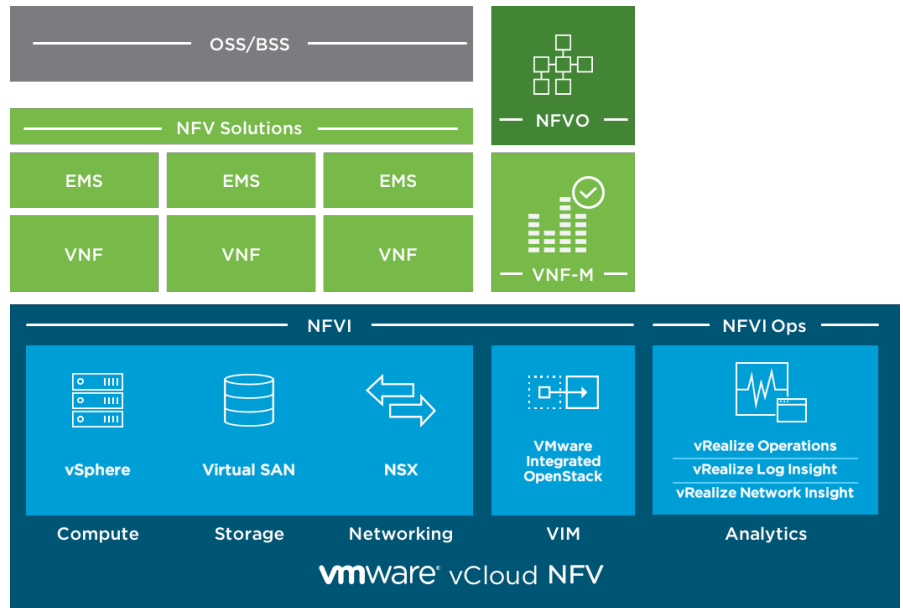


FIGURE 1: VMware vCloud NFV OpenStack Edition Architecture

Accelerate and Simplify Path to OpenStack for NFV

As a significant contributor to OpenStack and many other open source projects, VMware is firmly committed to integrating OpenStack capabilities into its core NFV platform so that CSPs can maximize its advantages. VMware Integrated OpenStack is compliant with OpenStack Foundation's 2017.01 guidelines and it enables easy deployment, upgrades, and operation of an OpenStack cloud on top of a VMware carrier-grade NFVI platform while utilizing open source software and standard APIs. VMware vCloud NFV OpenStack Edition offers several benefits to CSPs:

- **Simplified OpenStack installation and deployment** – VMware Integrated OpenStack provides CSPs with the fastest path to a fully operational OpenStack environment. Using templated install and deployment as a downloaded virtual application within the VMware vSphere® web client, all components required for a production-grade OpenStack infrastructure can be deployed in a few simple steps.
- **Seamless and hitless OpenStack upgrades** – VMware Integrated OpenStack is architected with separation of the control plane and data plane. This offers hitless upgrades and patch updates with VMware vCenter® maintenance mode providing network service continuity during maintenance cycles.

BENEFITS OF VMWARE INTEGRATED OPENSTACK CARRIER EDITION

- Integrated operations management for deep network visibility and analytics provides issue isolation, root cause analysis, and fast remediation capabilities.
- Secure multi-tenancy provides resource-level isolation, guaranteed availability, security, and improved capacity planning for each tenant.
- Dynamic scaling of network resources to respond to real-time network traffic conditions, enables optimal resource utilization and lower operational costs.
- Advanced networking and enhanced platform awareness (EPA) delivers carrier-grade, low latency, high throughput data-plane performance, enabling superior quality of experience (QoE).

- **Simplified operations** – vCloud NFV delivers unique NFVI operational automation with 360-degree visibility, along with proactive and predictive analytics, issue isolation, root cause analysis, and fast remediation capabilities. VMware vRealize® Operations Manager™, vRealize Log Insight™, and vRealize Network Insight™ are fully integrated within vCloud NFV and provide real-time operations monitoring, analytics, and a remediation platform from a single pane of glass that reduces operational costs through fast mean time to understand and repair (MTTU/MTTR).

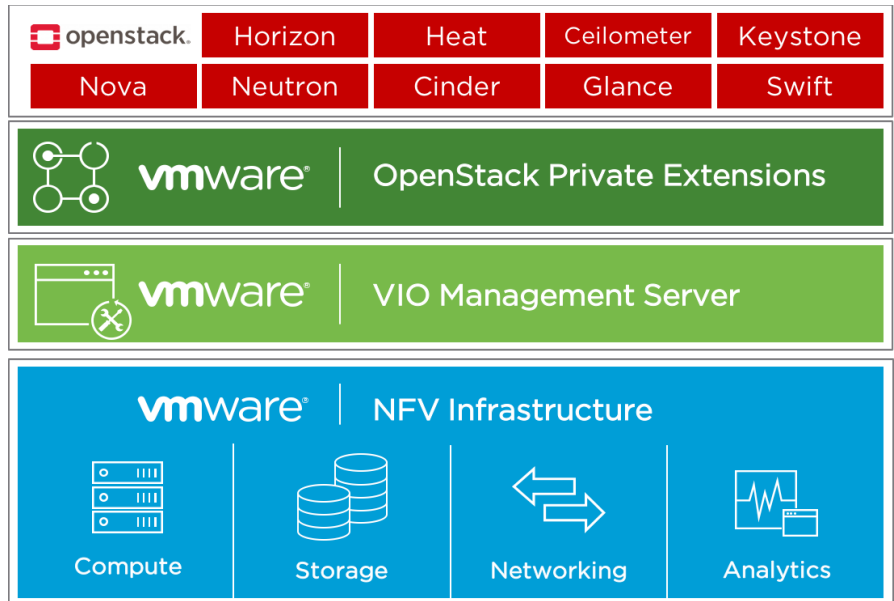
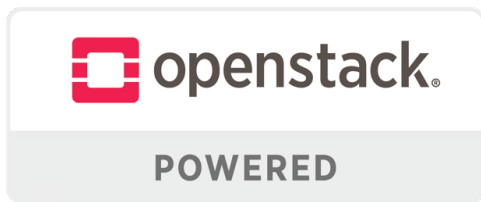


FIGURE 2: VMware Integrated OpenStack is fully integrated and certified with the VMware NFV infrastructure platform.

VMware Integrated OpenStack Carrier Edition

Purpose-built and tuned for CSP requirements

VMware Integrated OpenStack Carrier Edition is based on the open source Ocata platform and is fully integrated, tested, and certified with VMware vSphere, vSAN™, and NSX®. Using VMware Integrated OpenStack, network architects can easily install, upgrade, and operate an OpenStack cloud on top of the VMware NFV infrastructure platform.

In addition, Day 2 capabilities such as monitoring, capacity management, and troubleshooting are provided via deep integration with VMware management tools, providing greater control of the network and reduced operational costs.

VMware Integrated OpenStack Carrier Edition has been developed specifically to address the requirements of CSPs deploying NFV-based network services on OpenStack. The carrier-grade version includes:

- **Multi-tenancy and VNF resource reservation** – provides resource-level tenant isolation and guaranteed resource availability for each tenant, ensuring CSPs can deliver on infrastructure SLAs and improve capacity planning while securing tenants within the network. With the VMware Integrated OpenStack Tenant virtual Data Center (Tenant vDC) construct, each tenant can have one or more dedicated resource pools that provide exclusive compute resource reservation. In addition, each tenant also has clear knowledge of available

capacity. Tenant resources are completely isolated such that a tenant is not impacted by the activities of another tenant. VMware Integrated OpenStack Carrier Edition also provides flexible resource reservation policies including pay-as-you-go, reservation pool, and allocation pool models.

- **Dynamic scaling of network resources** – provides CSPs with an elastic service construct that can seamlessly scale up based on usage patterns, and Ceilometer alarms and triggers, in order to respond to real-time network traffic conditions. With live resizing of running virtual machines (VMs), CPU and memory capacity can be dynamically and incrementally added to VMs under load. This capability allows for very fine-grained resource allocation to VNFs, increasing ROI and utilizing cloud resources more efficiently based on real-time usage patterns. This eliminates the need to overprovision resources, leading to lower operational costs.
- **Enhanced Platform Awareness (EPA)** – delivers carrier-grade data-plane performance with low latency, ensuring CSPs can maintain superior network performance to deliver a high subscriber quality of experience while optimizing resource utilization. The EPA capabilities in VMware Integrated OpenStack Carrier Edition delivers optimal network performance and predictable performance characteristics for latency sensitive workloads through CPU pinning, NUMA alignment, HugePages, and direct passthrough/SR-IOV support. CPU pinning allows virtual CPUs (vCPUs) to be pinned to physical CPUs (pCPUs), ensuring that only the selected workload or VNF is executed within a resource pool. NUMA placement improves VNF performance through an optimized alignment of system resources within the NUMA boundary. In addition, line rate performance through SR-IOV provides superior throughput and low latency.
- **Advanced networking with multiple NIC types** – gives the VNF vendor the ability to use the appropriate interface for each communication channel. Thus, one can use direct passthrough/SR-IOV for data plane traffic and a regular vmxnet3 device for all management and control plane traffic (e.g., configuration, syslog, SNMP, etc.). This reduces operator cost and maximizes the value of their investment.
- **Running containers on OpenStack** – provides CSPs a path to cloud-native architectures with production-ready containers support. This provides an out-of-the-box solution for CSPs who want to run containers on OpenStack and leverage VMware NFV infrastructure.

Expands the Possibilities of VMware vCloud NFV

VMware vCloud NFV delivers on the full range of requirements for NFVI while reducing the total CapEx for telco-grade infrastructure. vCloud NFV OpenStack Edition further expands the options for CSPs to transform their network and service delivery. The VMware vCloud NFV platform provides advanced features and capabilities in several categories, including:

Service Automation

vCloud NFV provides flexible, automated VNF on-boarding and full-service lifecycle management capabilities. With policy-based provisioning and predictable resource consumption, vCloud NFV simplifies the resource allocation for VNFs. This gives service providers a robust multi-tenant infrastructure that automates and accelerates service deployment at scale.

VMware vCloud NFV also offers service providers a programmable platform with open REST APIs, allowing easy northbound integration with MANO systems that manage the entire NFV infrastructure deployment lifecycle.

VCLLOUD NFV BENEFITS

- Accelerate service on-boarding with vendor-agnostic VNF support from a mature and growing VMware certified NFV ecosystem.
- Automate, simplify, and enable an efficient service lifecycle.
- Streamline processes with integrated operations management across services, networks, virtualization, and physical domains.
- Deep visibility into networks and resources.
- Employ software-defined economies in service delivery over a horizontal/shared infrastructure.
- Use open APIs and an open platform to enhance agility.
- Deliver a superior customer quality of experience (QoE).
- Maintain high availability and service uptime.
- Guarantee resource SLA through complete isolation and secure multi-tenancy.

Simplified Operations Management

VMware vCloud NFV provides unique NFVI operational automation with 360-degree visibility along with proactive and predictive analytics to deliver performance feedback and fast remediation capabilities.

With VMware vRealize® Operations™, service providers get full visibility of all components within the deployed service. vRealize Operations gives continuous near real-time data on the health, performance, and capacity of network resources along with prioritized alert notifications for closed-loop integration into resource and service orchestration workflows. In addition, vCloud NFV offers rapid root cause analysis that unifies the alerts and troubleshooting workflows between vRealize Log Insight and vRealize Operations. vRealize Log Insight captures and analyzes logs for detailed analytics for issue isolation. Finally, vRealize Network Insight offers full visibility into the virtual and physical network as well as security engineering analytics.

vCloud NFVs operations management solution offers predictive and network-aware DRS that offers policy based on-demand predictive performance management to ensure services can scale up with no service disruption.

The operations management framework is fully extensible and offers northbound integration with OSS/BSS and third-party solutions to take advantage of third-party domain and technology-specific analytics engines to present a single pane of operational intelligence correlated across services, access, network, virtual, and physical tiers.

Ready for NFV Certification

[VMware Ready for NFV](#) is a certification program that ensures interoperability between VNFs and vCloud NFV. The interoperability tests performed by VMware engineers assist partners in understanding and preparing for cloud operations on vCloud NFV. The Ready for NFV program ensures that VNFs are interoperable with vCloud NFV OpenStack Edition.

Hardware Agnostic

VMware vCloud NFV architecture separates software services from the underlying hardware. This allows software services and hardware to evolve independently, so that CSPs can achieve the best ROI on hardware without having to install/upgrade/update their existing software stack. Software services agnostic to hardware provide CSPs a significant advantage in rolling out new services, increasing profitability, while running on the latest and fastest hardware platforms.

Future-Proof Platform

VMware vCloud NFV helps service providers prepare for future services and capabilities required to handle the impact of emerging IoT and 5G mobile services. As the number of sessions and devices supported by IoT services ramp up, vCloud NFV enables the NFVI platform to become more efficient, provides layered security, and supports increased scaling to support the VNF requirements.

HOW TO BUY

VMware vCloud NFV OpenStack Edition runs on the broadest set of x86-based platforms and include carrier-grade managed support services to meet the most demanding commercial-scale deployments. The vCloud NFV solutions are designed for vSphere environments and are available today as a single bundle option.

CARRIER-GRADE SUPPORT

VMware meets the requirements of CSPs with a broad spectrum of carrier-grade support options, ranging from self-help and basic support to business-critical and mission-critical support offerings, including:

- Add-on services to production support
- New SLAs for service restoration of NFV platform
- MCS SLAs for enterprise environments
- Dedicated support teams, 24x7
- Dedicated service account manager
- Enhanced proactive and reactive support offering
- Limited onsite support as required, or option to purchase onsite resident assistance

LEARN MORE

For additional information about VMware vCloud NFV OpenStack Edition,

CALL

1-877-4-VMWARE (outside North America, dial +1-650-427-5000)

VISIT

<http://www.vmware.com/go/nfv>

VMware vCloud NFV OpenStack Edition: Distinct Advantages

Compared to other solutions, the VMware vCloud NFV OpenStack Edition is uniquely capable of empowering CSPs to achieve the full benefit of NFV. Its combination of modularity, freedom of choice through open standards and multi-vendor VNF support, mature ecosystem, future-ready agility, and carrier-grade support distinguishes it from other competitive offerings. Additional advantages of the vCloud NFV platform include:

- **Deep visibility and insight:** vCloud NFV provides holistic, 360-degree visibility and insight into all network layers along with smart alerts and recommendations.
- **NFV Ready Certification:** VMware has the largest number of certified VNF partners and the most comprehensive testing and certification program with the VMware Ready for NFV program.
- **Proven in production:** vCloud NFV has been deployed in over 90 product implementations in over 50 operators supporting over 500M subscribers
- **Fast access to skilled resources:** CSPs can quickly and easily deploy vCloud NFV in their network with the current talent pool in their organization, due to the large number of VMware-certified individuals working across IT and networking organizations.

Net Result: Higher Business Value

By delivering the capabilities described above, the VMware vCloud NFV platform is uniquely capable of providing a new level of business value to CSPs through three primary attributes:

- **Accelerated service delivery:** CSPs can accelerate delivery and activation of new services and innovations, shorten the time to revenue (TTR), transform networks from static to adaptive, and employ software-defined economies in service delivery.
- **Simplified operations:** Network operators can deepen visibility into networks and resources, automate the delivery of services, maintain high availability and uptime for networks, and reduce total cost of ownership (TCO) while delivering a superior customer experience.
- **Choice:** CSPs achieve freedom of choice and additional benefits from multi-vendor-agnostic VNF support, a mature NFV ecosystem, a common multi-domain platform that is open and supports open APIs, and extensible platform support.

