

Telco Cloud Infrastructure

Operate 5G Network Functions and Services on Consistent Infrastructure

AT A GLANCE

VMware Telco Cloud Infrastructure™ is a consistent, fully integrated, modular, multi-tenant infrastructure solution powered by field-proven compute, storage, networking, and management and operations products. It enables communications service providers (CSPs) to simplify, scale, and protect production telco cloud services.

KEY BENEFITS

- Proven infrastructure stack that some of the world's largest CSPs have deployed in production
- Deployment of multi-vendor virtual network functions (VNFs) on consistent horizontal infrastructure
- Flexible infrastructure deployment to evolve from IaaS to CaaS
- Dynamic provisioning and consumption of the infrastructure resources as code across geographically dispersed locations with VMware Cloud Director
- A fully supported OpenStack distribution that streamlines operations, reduces network infrastructure costs, and implements elastic business models for telecommunication workloads
- Accelerated deployment of innovative services by removing integration challenges between the infrastructure and network functions through the VMware Ready for Telco Cloud program.

Introduction

Telco cloud objectives have evolved significantly from the initial need for CSPs to host virtual network functions (VNFs) at the core of their networks. Future growth of CSPs lies in scaling with products and services into new and adjacent markets. With CSPs wanting to drive faster innovation and rapid service deployment today for 4G networks while preparing for a seamless migration to 5G networks, there is an acute focus on overall operational transformation.

With new applications and services demanding larger bandwidth and low latency, CSPs need to deploy these applications and services at the edge of their networks to improve customer experience. However, the implementation of network functions delivering both high performance and low latency is directly tied to the underpinning infrastructure, where techniques, such as Data Plane Development Kit (DPDK) and Single-Root Input/Output Virtualization (SR-IOV), accelerate packet processing. Furthermore, the underlying infrastructure must be modular, agile, and flexible enough to support current business and technology requirements while accommodating the technological advancements of the future.

VMware Telco Cloud Infrastructure

VMware Telco Cloud Infrastructure is the next evolution of VMware vCloud® NFV™, a modular NFV platform that several of the world's leading CSPs rely on to develop modern cloud computing stacks to support new revenue streams while lowering costs. The ETSI-compliant NFV infrastructure platform supports a broad range of VNFs, supporting a large ecosystem for CSPs to rapidly deliver innovation at scale. The platform's consistent horizontal architecture enables CSPs to deploy various network functions and services at the core and the edge now while empowering



FIGURE 1: The architecture of VMware Telco Cloud Infrastructure, which provides consistent infrastructure to simplify, scale, and protect the operation of multi-vendor network functions.

KEY CAPABILITIES

- Achieve carrier-grade networking and security with significant improvements in data plane performance, resource scaling, service availability, and tenant isolation
- Provide high-performance virtualized switching, routing, firewalling, and load balancing functionality
- Deploying new services on-demand with real-time scaling, monitoring, and remediation
- Achieve the scale and manageability required to efficiently deploy and operate multi-cloud deployments
- Deploy service components programmatically throughout networks from core to edge

REFERENCE ARCHITECTURE

VMware Telco Cloud Infrastructure can be deployed across networks to meet target design and scale objectives. The VMware telco cloud [reference architecture](#) provides guidance for designing and creating an infrastructure and automation solution. The reference architecture describes the high-level design principles and considerations to implement the environment.

CSPs to seamlessly evolve from infrastructure as a service (IaaS) to containers as a service (CaaS) when they are ready, without complex upgrade processes.

Building Blocks

VMware Telco Cloud Infrastructure consists of VMware vSphere® for compute, VMware vSAN™ for storage, VMware NSX® for networking, VMware vRealize® Suite for operations, and VMware Cloud Director or VMware Integrated OpenStack as the virtual infrastructure manager (VIM).

VMware vSphere

VMware vSphere is a server virtualization platform that delivers essential services for the modern telco cloud. It supports both existing and next-generation network functions through simple and efficient management at scale, comprehensive built-in security that starts at the core, and a seamless multi-cloud experience.

VMware vSAN

VMware vSAN, with all flash performance, implements a hyper-converged storage architecture to deliver elastic storage and drastically simplify storage management. It can be co-located with the network functions to minimize jitter and latency.

VMware NSX

VMware NSX is the network virtualization and security platform that enables the virtual cloud network, a software-defined approach to networking that extends across data centers, clouds, and application frameworks.

VMware vRealize Suite

VMware vRealize Suite is a multi-cloud management solution that provides a modern platform for infrastructure automation, consistent operations, and governance based on DevOps and machine learning principles. VMware vRealize Suite Standard edition includes:

- vRealize Operations – Delivers continuous performance optimization, efficient capacity management, proactive planning, intelligent remediation, and integrated compliance—powered by artificial intelligence and predictive analytics
- vRealize Log Insight – Provides centralized log management, deep operational visibility, and intelligent analytics

Infrastructure Orchestration

VMware Telco Cloud Infrastructure offers a choice of two VIM solutions, VMware Cloud Director and VMware Integrated OpenStack, for management and orchestration of the same underlying infrastructure.

FUNCTION	COMPONENT	
Infrastructure orchestration	VMware Cloud Director	VMware Integrated OpenStack
Compute	vSphere Enterprise Plus	
Storage	vSAN Standard	
Networking	NSX-T Data Center	
Operations	vRealize Suite 2019 Standard	

VMware Cloud Director

VMware Cloud Director enables seamless provisioning and consumption of VMware Telco Cloud Infrastructure resources as code across geographically dispersed locations with an Application Programming Interface (API)-driven approach. Its multi-tenant resource pooling capability helps create Virtual Data Centers (VDCs) from common or distributed infrastructure to cater to various tenants' needs, allowing CSPs to host and serve multiple tenants from a single VMware vCenter that may be stretched across distributed physical servers.

In addition, VMware Cloud Director ensures CSPs have secure, isolated virtual resources, independent role-based authentication, and fine-grained access control for network functions deployed throughout their networks. Intelligent network function placement allows CSPs to improve efficiency while delivering outstanding performance and exceeding service-level agreements (SLAs).

VMware Cloud Director provides an open platform for CSPs and their customer developers to build on. Using the programmatic interfaces, automation tools, and extensibility frameworks of VMware Cloud Director, CSPs can provide unique customer experiences by developing innovative services faster.

VMware Integrated OpenStack

While OpenStack plays an important role in CSPs' telco cloud deployments, CSPs are often exposed to complexity, hidden costs, inconsistent tooling, and lack of carrier-grade support. To combat these challenges, VMware offers its own integrated and supported OpenStack distribution based on its Train release, providing a fast and reliable path for CSPs to deploy network functions and services on OpenStack.

With VMware Integrated OpenStack, CSPs can streamline operations, reduce network infrastructure costs, and implement elastic business models for telecommunication workloads. Through open, vendor-neutral APIs to VMware Telco Cloud Infrastructure, CSPs have a proven, high-performance solution based on an open architecture with strengthened support for NFV architectures, advanced networking capabilities, and real-time automated services. These advantages coupled with intelligent operations accelerate deployment of key use cases such as IP telephony, mobile core, private connectivity, and multi-access edge computing (MEC) while supporting the network evolution to 5G. Key VMware Integrated OpenStack features include the following:

- SR-IOV Network Interface Card (NIC) redundancy to support high availability of network connectivity by scheduling virtual NIC provision from different physical NICs
- Neutron Trunk services to allow multiple networks to be connected to an instance using a single virtual NIC
- Load Balancer as a Service (LBaaS) by integrating with the OpenStack Octavia project
- Public API to manage the deployment of VMware Integrated OpenStack 7.0.1

Key Benefits and Capabilities

VMware Telco Cloud Infrastructure is uniquely capable of empowering CSPs to modernize their monolithic and siloed clouds and achieve the full benefit of telco and edge cloud with a consistent horizontal architecture. Its combination of modularity, freedom of choice through open standards and multi-vendor network functions

support, mature ecosystem, future-ready agility, and carrier-grade support distinguish it from other offerings. The infrastructure provides several advanced features and capabilities aiding successful network functions deployments and evolution:

Accelerated Performance

A key aspect of transforming carrier-grade networks to meet today's 4G and 5G use cases is to architect the network for optimum application response times, scale, and service continuity. VMware Telco Cloud Infrastructure delivers a carrier-grade networking for VNFs with continuous availability, service continuity, network performance, and simplified management, enabling CSPs to achieve significant improvements in data plane performance, resource scaling, and service availability. VMware Telco Cloud Infrastructure accomplishes this by offering:

- VMware NSX managed Virtual Distributed Switch in Enhanced Data Path mode (N-VDS (E)) that leverages DPDK techniques to provide fast virtual switching fabric on VMware vSphere
- N-VDS to offload data plane traffic onto a physical NIC to further improve the Enhanced Data Path performance of VMware NSX-T
- Low latency data plane through CPU pinning, fine-grained non-uniform memory access (NUMA) placement, and vertical NUMA alignment
- Improved performance through multi-tiered routing, bare-metal NSX Edge, and huge pages with the increased access efficiency of translation lookaside buffers
- Elastic Multi-Tenant Resource Scaling that provides resource guarantees, isolation, scaling, and availability for each tenant
- Separation and isolation of data plane workloads from control plane and management plane workloads, enabling a CUPS-based architecture for a smooth migration toward 5G core.

Carrier-Grade Networking

Any services for today and tomorrow, regardless of the underpinning technologies, demand networking and security solutions that provide consistent connectivity, QoS, and integrated security to operate a robust end-to-end architecture, delivering applications and services when and where needed. VMware Telco Cloud Infrastructure meets these carrier-grade networking and security requirements with the VMware NSX-T network virtualization solution, offering virtualized switching, routing, firewalling, and load balancing. Technical implementation of the networking and security capabilities includes the following:

- Layer 3 Ethernet Virtual Private Network (L3 EVPN) to provide northbound connectivity option to advertise all Virtual Routing and Forwarding (VRFs) through Multi-Protocol Border Gateway Protocol EVPN Address Family Indicator (MP-BGP EVPN AFI), Route Type 5, to a provider edge
- Virtual Extensible Local Area Network (VXLAN) encapsulation to provide multi-tenant data plane isolation by assigning one VXLAN Network Identifier (VNI) per VRF in VMware NSX-T tier-0 logical router, which enables a provider administrator to process traffic between the logical and physical networks
- Rate-limit all the egress and ingress traffic of the VMware NSX-T tier-1 logical router uplink, designed for a tenant administrator, which is connected to the tier-0 logical router
- Network Address Translation 64 (NAT64) to provide stateful NAT from IPv6 to IPv4 in accordance with the IETF standard RFC 6146

- VMware NSX-T to support Stateful Dynamic Host Configuration Protocol v6 (DHCPv6), providing stateful delivery of IPv6 addresses and associated parameters through the DHCP server of NSX-T.
- Context-aware micro-segmentation to deploy security policies both within and between network functions in both virtual machines (VMs) and containers
- Bidirectional Forwarding Detection (BFD) of link failures for increased network resiliency
- Distributed stateful firewalling up to Layer 7, DNS as a Service (DNSaaS), and L4-L7 LBaaS, eliminating the complexities of deploying third-party solutions

Intent-Based Assurance

CSPs are often constrained by traditional operating models, which may have worked for a pre-defined set of services but were monolithic, siloed, and rigid. Deploying new services on-demand with real-time scaling, monitoring, and remediation has become imperative. With intent-based assurance, VMware Telco Cloud Infrastructure enables CSPs to operate their telco and edge clouds in deterministic ways with:

- Advanced policy-based assurance with express deployment policies that segment network function placement based on licensing, resource management policies, and latency-based placement
- Tenant-level real-time predictive analytics to improve capacity utilization, capacity risk detection, automatic resource reclamation, and right sizing of resources
- Intent-based placement for VMware vSAN workloads and their cluster optimization, including capacity planning and storage cost analysis
- Deep network visibility with automatic topology discovery, converged overlay and underlay visibility, and real-time network insights through VMware vRealize Network Insight, an optional add-on component
- Application-aware monitoring and troubleshooting along with automated proactive network functions management, balancing, and remediation
- Extensible operations management with APIs for northbound integration and automation

Efficient Multi-Cloud Deployments

With the widespread deployment of 4G combined with the advent of 5G, services now require a mix of low latency, high throughput, and high user densities and concurrences. Optimal performance requires a sophisticated service delivery model, a network that supports a mix of highly distributed and centralized functions, and a new way of managing network and infrastructure resources. VMware Telco Cloud Infrastructure achieves the scale and manageability required to efficiently deploy and operate multi-cloud deployments through:

- Efficient cloud services management with the flexibility to deploy centralized VIM for a common management plane across sites or a distributed architecture with federated management
- Multi-site image replication, global and per-site resource/quota management for unified multi-cloud resource scheduling across compute, storage, and networking resources
- Cloud scale performance using a distributed control plane architecture enabled by decoupling VMware NSX-T functionality from VMware vCenter server
- A mature telco cloud ecosystem of deployment-ready network functions that have undergone comprehensive testing and certification with the VMware Ready for Telco Cloud program

VMWARE READY FOR TELCO CLOUD AT A GLANCE

The VMware Ready for Telco Cloud program helps CSPs identify VMware partner network functions that have been validated to work with VMware Telco Cloud Infrastructure. These network functions meet VMware standards for integration and interoperability. The VMware Ready for Telco Cloud logo indicates the unique capabilities of integrated products.



Secure Multi-Tenancy and Enhanced Role-Based Access Control

Securing multi-tenant cloud environments drives the need for tenant isolation. Tenants should be unable to communicate with each other without explicit permission, and tenants should have an independent view of their network. Furthermore, peak loads should not affect neighboring tenants. VMware Telco Cloud Infrastructure delivers this secure multi-tenant isolation by offering the following:

- Organization VDC constructs allow creation of VDCs for tenants, offering tenant resource guarantees and specific SLAs for each network function
- VMware NSX-T network multitenancy that uses a two-tiered architecture, with tier-0 and -1 logical routers, to implement provider and tenant separation of administrative control across the logical switching and routing fabric
- Multi-tenant role-based access control (RBAC) that allows CSPs to create global tenant roles and rights bundles
- Tenant self-service RBAC for self-service management of permissions for tenant users by their own administrators without needing service provider involvement

Open and Extensible Platform

To maximize the benefits of a modernized telco and edge cloud, CSPs are looking for ways to increase the flexibility and efficiency with which they bring new services and applications to market, and there is the need for the use of open, virtualized, and cloud-native designs. Also important is the ability to programmatically deploy service components throughout networks from the core to the edge. VMware Telco Cloud Infrastructure enables CSPs to accomplish these goals through the following:

- Open and extensible APIs and Software Development Kits (SDKs) to manage the network function lifecycle and runtime operations
- YAML and OpenStack Heat template-based automation to import network functions and policies
- A mature telco cloud ecosystem of certified network function partners and a comprehensive testing and certification program

VMware Ready for Telco Cloud Certification Program

VMware further enhances interoperability by certifying partners' network functions through the VMware Ready for Telco Cloud program. With simplified and certified interoperability of functions, CSPs can select the best solutions for their use cases while reducing the risks associated with the complexity of onboarding various network functions.

This award-winning program ensures interoperability and operational readiness between VMware Telco Cloud Infrastructure and the network functions of VMware partners, enabling CSPs to onboard and deploy the functions rapidly throughout their networks. With close collaboration with partners, VMware creates an ETSI-compliant descriptor, workflow, resource, and artifacts for a validated and tested Cloud Service Archive (CSAR).

The program removes time-consuming, difficult integration work so that CSPs can focus on innovation and accelerate the deployment of new services. The objective of the program is to create a multi-vendor ecosystem with numerous network functions.

LEARN MORE

For more information about VMware Telco Cloud Infrastructure, call 1-877-VMWARE (outside North America, dial +1-650-427-5000) or visit <https://telco.vmware.com/>

