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Evaluating Cloud-Native Platform Capabilities To Run Multi-Vendor CNFs

Assessing the Readiness of Telco Platforms for Automating Containerized Network Functions

vmware®

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Introduction

With the shift to 5G, deploying the right cloud-native platform is key to the success of your telecommunications network. The objective of this paper is to help you understand the deployment considerations, requirements, and business value of cloud-native technology so you can make an informed decision about the best platform for your organization, its use cases, its network functions, and its goals.

Cloud-Native Principles and Requirements

The Cloud Native Computing Foundation hosts key open source projects like Kubernetes. Cloud-native technology empowers you to deploy and run scalable containerized network functions (CNFs) on modern infrastructure and clouds. Its cloud-native definition says that "containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach" — techniques that produce manageable, observable, and resilient systems.

The fundamental concepts driving this cloud-native approach include such things as loose coupling, microservices, low overhead, and immutable infrastructure as well as a declarative consumption model and APIs across layers. Critically, cloud-native systems, the CNCF says, are designed for automation. For more information, see *cloud-native principles*.

With automation, you can optimize the use of your computing resources to extend your service provider's agility, adaptability, innovation, competitive advantage, and global reach. Here are some of the benefits of these cloud-native principles for telecommunications platforms and networks:

- Consolidate servers and reduce costs through efficient resource utilization.
- Speed up application deployment.
- Streamline software development processes by fostering DevOps, site reliability engineering (SRE), and continuous integration and delivery (CI/CD).
- Decouple applications from machines for portability, flexibility, and interoperability.
- Easily modify, update, extend, or redeploy applications without affecting other workloads.
- Improve resilience through automation.
- Dynamically scale infrastructure and applications to meet changes in demand.
- Improve flexibility and agility for your organization and business.

Assessing Cloud-Native Capabilities

These sections demonstrate how some of these principles translate into requirements that you can use to evaluate the cloud-native capabilities and claims of vendors. Cloud-native technology from VMware can help provide the basis for your assessment.

The following components of a service provider platform are assessed through a cloud-native lens:

- Kubernetes
- Support for CNFs
- Automation, especially for CNF onboarding and lifecycle management
- Networking

Kubernetes

Deploying a cloud-native network with Kubernetes requires that your infrastructure support multiple versions of Kubernetes simultaneously. Furthermore, to deploy a cloud-native network with flexibility, you will want your infrastructure to support multiple

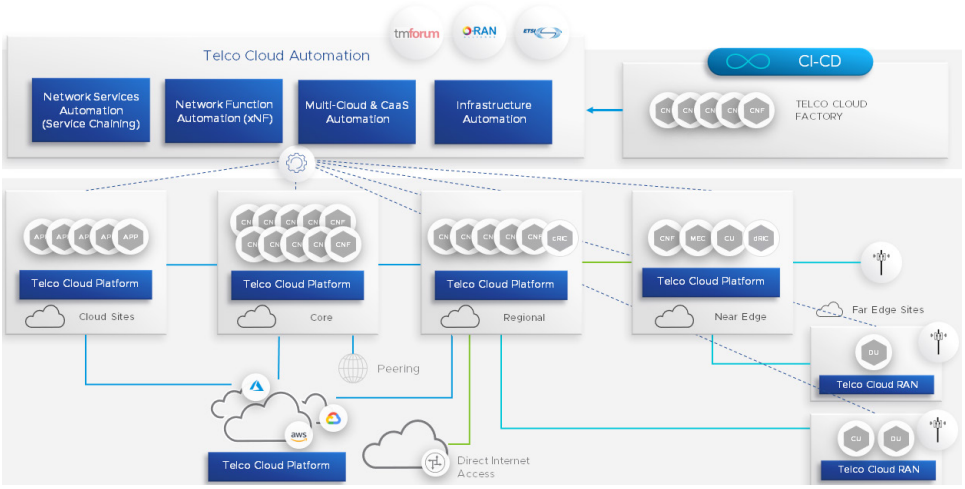

Figure 1: The key capabilities of VMware Telco Cloud Automation—including cloud-native technologies and automation—power flexible solutions for 5G. Access to CNFs, VNFs, and applications from multiple vendors supply extensible building blocks to deploy new services and explore emerging use cases.

containerized network functions (CNFs) from different vendors as well as multiple Kubernetes releases.

Here are some considerations to help conduct an assessment:

Running multiple versions of Kubernetes to support multi-vendor CNFs

VMware supports three Kubernetes versions for each instance of VMware Tanzu™ Standard for Telco. At present, VMware Telco Cloud Platform™ supports three Kubernetes releases. Supporting three Kubernetes release is important because CNFs from different vendors run on different versions of Kubernetes; you should have the flexibility to select the best CNFs for your network.

Other vendors might also support three Kubernetes versions, but the support might be limited to only the most recent Kubernetes releases. If that is the case, it might require you to constantly update your CaaS platform to support a vendor's CNFs.

If you need to deploy network functions from multiple vendors, there is also the risk that those network functions might be incompatible with the newer Kubernetes versions required by another vendor's platform, which could lead to operational overhead as you scramble to upgrade a network function to a version that is compatible with the latest releases of Kubernetes, assuming a compatible version is available.

Operationally, some CSPs find it difficult to keep up with this aggressive release schedule and often request longer term support for older Kubernetes releases.

There is another problem closely related to support for Kubernetes versions: Is the vendor of the platform using Kubernetes only for its own network functions and applications? If so, the vendor might make its applications or network functions available on the same day a given Kubernetes version is released. Such an approach can undercut testing and validation not only of the newly released Kubernetes version but also of the applications from others that will run on that vendor's platform but not use Kubernetes.

(VMware, it should be noted, provides a telco cloud platform but does not offer CNFs; validated CNFs from other vendors, however, are available through the VMware Ready for Telco Cloud program.)

Can the vendor you are considering run multiple versions of Kubernetes to support multi-vendor CNFs?

THE SYNERGY OF CONTAINERS AND VIRTUAL MACHINES

VMs solve infrastructure-related problems by better utilizing servers, improving infrastructure management, and streamlining IT operations.

Containers solve application-related problems by streamlining DevOps, fostering a microservices architecture, improving portability, and further improving resource utilization.

Running containers on VMs produces a synergy that helps CSPs transition from 4G to 5G networks with ease.

BENEFITS OF HYPERVISORS AND VIRTUAL MACHINES FOR CNFs

- Onboard, deploy, and manage CNFs at scale through automation
- Establish strong security boundaries for containers
- Isolate workloads and apply built-in security measures like micro-segmentation
- Select the best Linux kernel version for your workload
- Optimize the performance of large Kubernetes clusters and mixed workloads on shared infrastructure
- Automate lifecycle management of Kubernetes clusters, RAN functions, and 5G services
- Optimize the placement and performance of CNFs with programmable resource provisioning
- Scale CNFs without the pain of adding, configuring, and managing physical hardware
- Streamline operations and reduce OpEx

Onboarding and instantiating CNFs correctly with version flexibility

Another discussion point in assessing a vendor's platform is to check whether its version of Kubernetes lets you onboard and instantiate your CNFs correctly.

Although best practices point to onboarding with the latest Kubernetes release, some network functions require an older release. To maximize flexibility, VMware supports multiple versions of Kubernetes.

Does the vendor you are considering support multiple versions of Kubernetes or limit you to the most recent version?

Support for Kubernetes lifecycle functions

When analyzing cloud-native platforms from different vendors, you should consider those platforms' explicit support for Kubernetes lifecycle functions, such as autoscaling.

For any CNF, the most critical lifecycle functions are instantiation and termination, which are required for functional testing. In addition to supporting the instantiation and termination of network functions, VMware Telco Cloud Automation™ supports the following lifecycle functions and NFVO workflows:

- Instantiate
- Terminate
- Instantiate Start
- Instantiate End
- Scale Start
- Scale End
- Update Start
- End Terminate State
- End
- Custom workflows

With the VMware platform, all workflows can be instantiated on demand or through CI/CD processes.

Each CNF vendor supports a different set of lifecycle functions, and all the functions will not apply to every CNF. The VMware Ready for Telco Cloud program works with vendors to define and test workflows to validate supported lifecycle functions. Generally, cloud-native network functions support a wider variety of lifecycle functions.

Does the vendor's platform that you are considering support a range lifecycle functions and NFVO workloads? Is there lifecycle support for the CNFs and VNFs that you want to host on the platform, both now and in the future? Will you be able to upgrade them through automation?

Crucially, can the scale out of network functions be automated through Kubernetes autoscaling on the platform you are evaluating?

Orchestration and workload placement with scale-out capability

The use of orchestration to manage network functions is closely related to lifecycle management.

With VMware Telco Cloud Automation, network functions can be instantiated, terminated, scaled out, scaled in, upgraded, and healed, all of which is critical to take full advantage of cloud-native architectures. When network functions are fully orchestrated, you can also decide whether functions should be automated—for example, scaled out on demand—or such steps will be manually executed by the operations team.

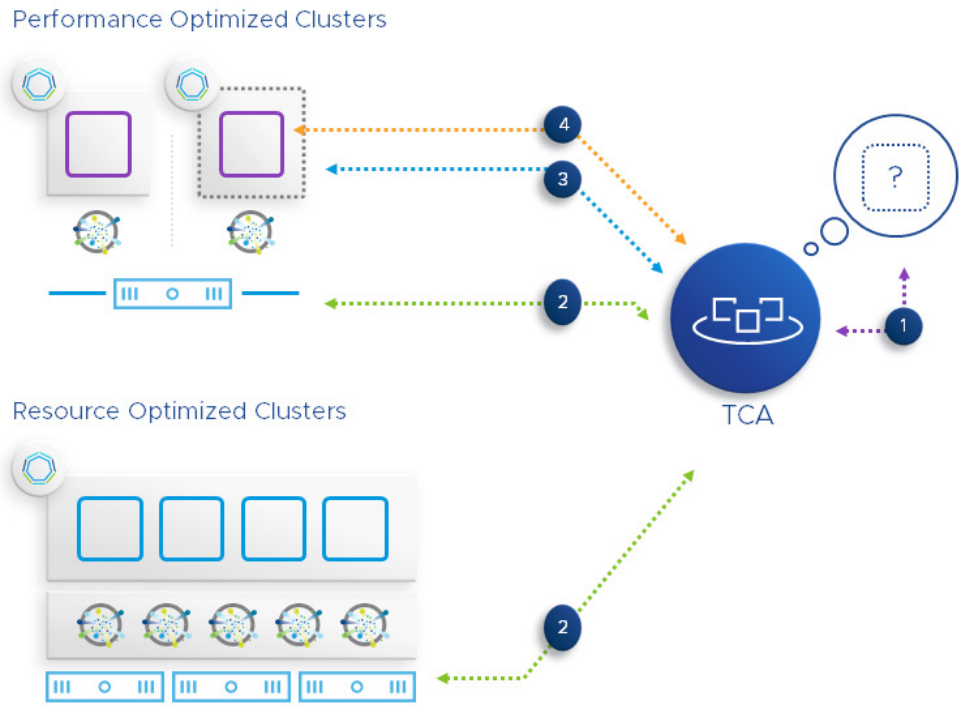

Figure 2: With VMware Telco Cloud Automation, programmable resource provisioning optimizes the placement of 5G services and CNFs to maximize resources and performance through the following steps, which are illustrated by the numbered steps in the figure:
1. Assess a service's requirements.
2. Gauge the resources of Kubernetes and the hardware and infrastructure.
3. Deploy a performance-optimized Kubernetes cluster.
4. Place service on the cluster.

You should also be able to decide where to place workloads. CNFs can be placed in a data center and should have limited requirement for affinity and anti-affinity.

When the network functions are given the compute, memory, and storage that they request, VMware Telco Cloud Automation supports flexibility in how and where workloads are placed in the data center.

Do the platforms from other vendors that you are evaluating support automation for scaling out and flexibility for workload placement? A related question is whether other vendors' prescriptive approach limits your flexibility for placement, scaling, and other requirements.

Separation of concerns

Another concern is separation of the platform from the network functions. The platform on which you run network functions should be separate from the network functions themselves.

VMware Telco Cloud Automation orchestrates network functions (NFVO) and sets up the Kubernetes environment, which lets you separate the EMS/NMS from the network functions. When a single orchestrator manages all the different vendor network functions in a CSP network, it dramatically simplifies your operational requirements.

Traditionally, the lifecycle functions for a network function were managed by the EMS of that network function's vendor. This approach, however, becomes cumbersome in a multi-vendor environment. For this reason, it is imperative that 5G vendor network functions can use third-party orchestration as opposed to being orchestrated by their own EMS.

MULTI-LAYER LIFECYCLE MANAGEMENT AUTOMATION

- VMware Telco Cloud Platform RAN lets CSPs centrally manage and automate the virtualized architecture, from CaaS to network services.
- Application management (G-xNFM) unifies and standardizes network function management across the VM and container-based infrastructure.
- Domain orchestration (NFVO) simplifies the design and management of centralized or distributed multi-vendor network services. CSPs can onboard VNFs and CNFs using standard-compliant TOSCA templates.
- The multi-cloud infrastructure and CaaS automation ease multi-cloud registration (VIM/Kubernetes), enable centralized CaaS management, and synchronize multi-cloud inventories and resources.
- *Kubernetes clusters can be created and optimized automatically to align with the requirements of network functions and services.*

Automation for onboarding and lifecycle management

Capabilities for creating a CSAR file

VMware Telco Cloud Automation offers a designer for the creation of Cloud Service Archive (CSAR) packages, which can be done as part of the VMware Ready for Telco Cloud validation process.

VMware works with vendors to test their CSAR package file to help ensure that it is appropriate for the type of deployment they want to create.

VMware Telco Cloud Automation also supports legacy CLI-based network functions, network functions requiring custom scripts, and network functions using a REST API to fetch data. If a network function uses a hard-coded artifact, the VMware process ensures that they are removed from the CSAR and replaced with reference variables. In addition, VMware Telco Cloud Automation also supports running pre- and post-custom scripts during LCM operations.

Do the other solutions that you are considering have the capability to create a CSAR file and support various network functions to foster the use on the same platform of network functions from multiple vendors.

Automated operations for instantiation, placement, pinning, and SR-IOV

Another key aspect of a cloud-native platform to evaluate is whether a network function can be instantiated with minimal human intervention, including enhancements such as NUMA placement, CPU pinning, and SR-IOV.

The VMware Ready for Telco Cloud program tests and validates the automated instantiation of network functions using VMware Telco Cloud Automation.

Key requirements for the network function, such as late bindings to set the networking between the network function and the Kubernetes network, are detailed in the CSAR and executed by VMware Telco Cloud Automation. For example, if a network function needs CPU pinning or SRI-OV network access, it will be specified in the CSAR.

As part of its ability to manage workflows, VMware Telco Cloud Automation can execute individual CLI commands in the CSAR. It can also execute scripts or make REST API calls without human intervention. However, there can be times when it is impossible to fully automate a network function, which is typically due to the implementation of the network function itself.

Microservices and scalability

Microservices ease the scaling of network functions. The platform should be able to scale each network function as a single instance if it is designed with a microservices architecture.

VMware Telco Cloud Automation supports all the LCM functions of a containerized network function, including scaling it up or down as a single instance when additional capacity is required.

Security and isolation

A platform should ensure security and isolation, especially when the platform is running network functions from multiple vendors.

The VMware platform is horizontal; it is not dependent on any vendor or network function. The VMware platform is powered by the VMware ESXi™ hypervisor and, optionally, VMware NSX®, which enables multiple Kubernetes clusters to be created on the same server or in the same cluster to support network functions from multiple vendors. The platform is designed to isolate these network functions from one another so they do not interfere in each other's operation. By isolating different CNFs in their own VLANs and by

TELCO-GRADE KUBERNETES

The CaaS functionality of VMware Telco Cloud Platform simplifies the operation of Kubernetes for multi-cloud deployments, centralizing management and governance for clusters. The platform provides telco-grade CaaS enhancements, such as the following:

- Multus to attach multiple container networking interfaces to Kubernetes pods through its plugins
- Topology Manager to optimally allocate CPU memory and device resources on the same NUMA node to support performance-sensitive applications
- Kubernetes cluster automation to simplify deployments and management of Kubernetes master and worker nodes.

With these enhancements, CSPs can take advantage of a telco-grade Kubernetes platform to address emerging 5G use cases at the RAN.

using Kubernetes capabilities such as Helm charts, the VMware platform can ensure that the CNFs can communicate with each other when required but are also isolated from each other when that is required.

One question to ask when evaluating other vendors' platform is whether VLANS can be assigned to different vendors.

Third-party support for PaaS functions

Third-party support for platform-as-a-service functions is an important cloud-native consideration.

The VMware platform supports PaaS functions. It deploys PaaS functions in the same way it deploys other network functions. PaaS functions have cluster requirements and Helm charts, and the VMware Telco Cloud Automation platform can instantiate and terminate these functions. After a PaaS function is deployed in a cluster, the PaaS function is available to the network functions in that cluster for visibility, reporting, and metrics.

Networking

Firewall capabilities

VMware Telco Cloud Platform provides L4 and L7 firewalling capabilities through VMware NSX when it is added to the stack. Data plane elements like the UPF need a firewall to protect them from malicious traffic in the user plane.

Networking capabilities required by network functions

What is the list of those networking capabilities that network functions requires? Is stateless or stateful load balancing required?

VMware supports various CNI plug-ins, including Multus, Calico, and Antrea. Although Kubernetes provides a standard stateless load balancer, many of the network functions might require stateful load balancer. VMware offers a leading load balancer, NSX Advanced Load Balancer (Avi).

Network functions often need networking support, and that networking might be a part of the Kubernetes environment that the CSP supports. If a network function needs trunking, for example, it will need Multus.

Support for physical VLANs

Is it necessary to use a physical VLAN?

The VMware platform supports physical VLANs. Network functions will often require access to physical VLANs in the data center to function correctly. The CSP will need to configure these VLANs in the data center before the deployment of the CNFs.

Support for data plane acceleration

Support data plane acceleration and the implications for virtual networking are another important consideration when choosing a platform.

The VMware platform supports various data plane performance enhancement capabilities, including EDP, SR-IOV, and DPDK. These capabilities as well as other infrastructure requirements like NUMA alignment are automated through VMware Telco Cloud Automation. (NUMA systems are advanced server platforms with more than one system bus. They can harness large numbers of processors in a single system image with superior price-to-performance ratios.)

Workload migration can be a concern if another vendor's platform links a workload to the physical network in the data center. One advantage of using cloud-native approaches to managing workloads is ease of migration. Check whether the platform you are considering supports such capabilities as EDP to ensure that workloads can be migrated if needed.

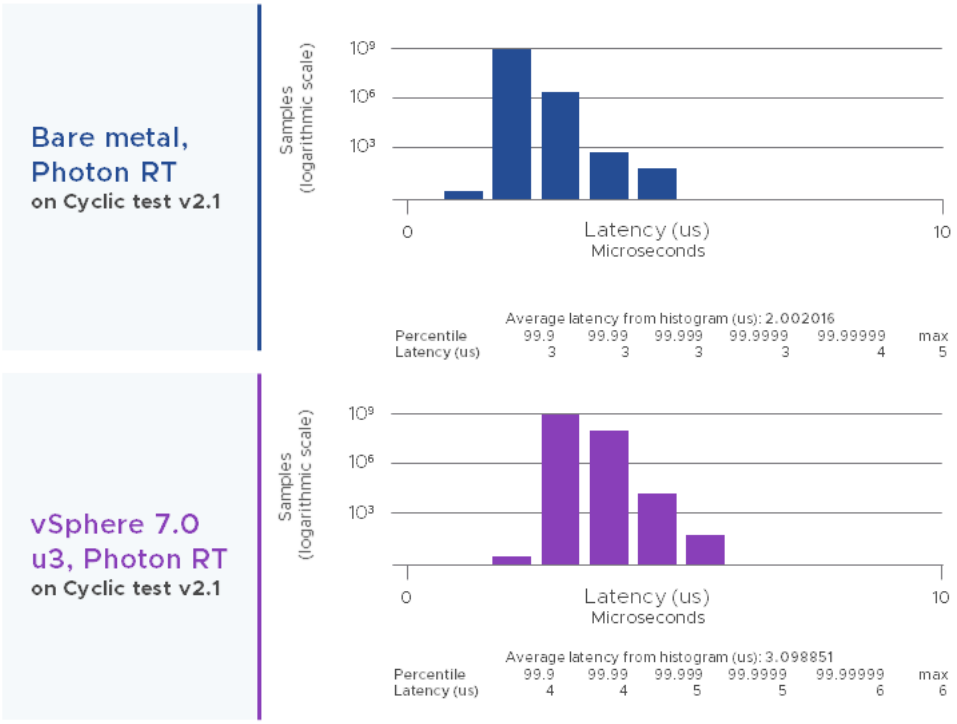

Figure 3: Cyclic tests prove that latency on both vSphere 7.0 Update 3 and bare metal was less than 10 microseconds, which is ideal for RAN workloads.

RAN Workload Performance Is Equivalent on Bare Metal and vSphere

Some vendors claim that bare-metal servers provide better performance for RAN workloads than VMware vSphere.

Is there a performance tax for real-time RAN workloads on VMware vSphere? The answer is no. VMware ran industry-standard real-time micro-benchmarks, namely cyclictest and oslat, to compare the performance of RAN workloads on VMware vSphere and bare metal and found that performance is equivalent.

The tests show that there is no performance penalty or latency tax with VMware vSphere 7.0 Update 3. The performance of RAN workloads on VMware vSphere 7.0U3 vs. bare metal, as measured by the real-time micro-benchmarks cyclictest and oslat, is equivalent.

Cyclictest, which uses a hardware-based timer to measure platform latency and jitter, demonstrated that the latency on both vSphere 7.0U3 and on bare metal was less than 10 microseconds. A 10-microsecond latency is well within the latency requirements of RAN workloads.

The oslat performance test is an open-source micro-benchmark that measures jitter in a busy loop. Instead of using hardware-based timers, this benchmark uses a CPU bound loop as its measurement—which emulates a virtualized RAN workload in a real-world scenario, such as a polling thread using the Data Plane Development Kit (DPDK).

Photon RT was used for both the bare metal and vSphere tests, with the same configurations, to create a fair comparison.

For the oslat test results and details about the cyclictest and oslat tests as well as the configuration that was used, see the white paper titled *vSphere Performance Is Equivalent to Bare Metal for RAN Workloads*.

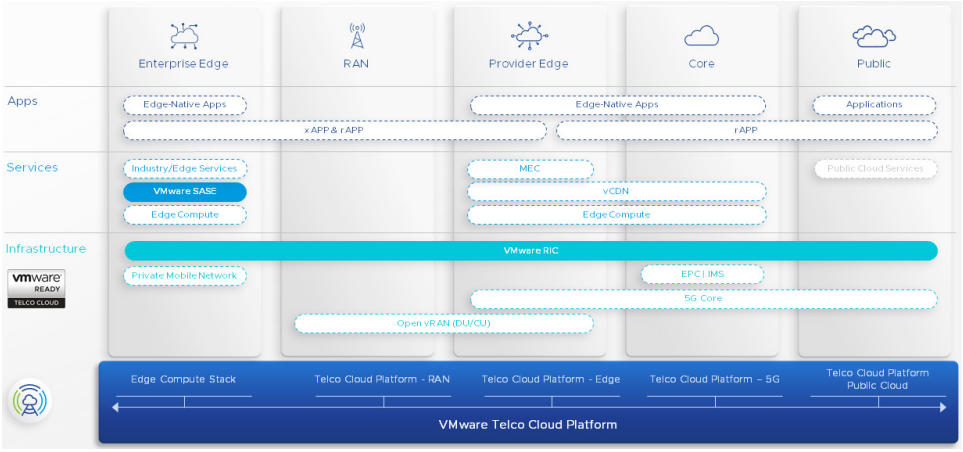

Figure 4: VMware Telco Cloud Platform includes solutions for the enterprise edge, RAN, service provider edge, 5G core, and public cloud — all with built-in cloud-native capabilities to deploy, manage, automate, and optimize 5G networks.

VMware Telco Cloud Platform

By solving the problems that undermine the architecture of existing telecommunications networks—monolithic stacks marred by complexity, silos, and vendor lock-in—VMware Telco Cloud Platform empowers you to launch innovative services on consistent infrastructure, reducing operational complexity and radically improving agility.

The fundamental elements of this architecture are VMware vSphere and VMware Telco Cloud Automation. VMware Telco Cloud Operations can be added to furnish visibility for seamless operations and consistent service delivery.

The Fast Path to Automated Cloud-Native Networks

VMware Telco Cloud Platform establishes an open, disaggregated, and vendor-agnostic ecosystem to streamline 5G service innovation. From service creation to deployment and lifecycle management, VMware Telco Cloud Platform establishes a *unified architecture* that simplifies innovation. This developer-friendly architecture includes capabilities for resource optimization, operational consistency, multi-cloud mobility, and multi-layer automation. Amid the monumental shift that is taking place with 5G rollouts, the following capabilities empower you to modernize your network architecture, transform your business, and accelerate the delivery of 5G services:

- Cloud-native architecture: You can deploy, orchestrate, and optimize cloud resources and processes with intent-based placement. The platform's architecture includes compute, networking, automation, and CaaS. Network resiliency, cross-cloud application continuity, and multi-tenant service isolation help you address business requirements and compliance regulations, such as high availability and SLAs.
- Unified and consistent platform: The platform's hybrid IaaS and CaaS modernizes existing clouds so they can run both VNFs and CNFs across consistent horizontal infrastructure. This architecture fosters low-latency performance in the data plane and improves scalability through virtualized networking with VMware NSX.
- Carrier-grade Kubernetes: The platform lets you capitalize on a microservices architecture. You can use microservices with a resource-optimized Kubernetes runtime for device attachment, NUMA alignment, resource reservation, and placement. This architecture delivers the capability to roll out 5G networks with Multus, DPDK modules, an SR-IOV plugin, CPU/Topology Manager, and Kubernetes cluster automation tailored for telco use cases.
- Zero-touch provisioning: You can automate the onboarding and upgrading of network

VMWARE TELCO CLOUD PLATFORM AT A GLANCE

VMware Telco Cloud Platform™ is powered by the field-proven compute and networking of VMware Telco Cloud Infrastructure™ coupled with VMware Telco Cloud Automation™ and VMware Tanzu™ Standard for Telco, which is a telco-grade Kubernetes distribution. This combination empowers CSPs to *rapidly deploy and efficiently operate multi-vendor CNFs and VNFs with agility and scalability*.

KEY CAPABILITIES AND BENEFITS

- Deploy and manage virtual network functions (VNFs) and containerized network functions (CNFs) on consistent horizontal infrastructure
- Use microservices and optimize resources with a telco-grade Kubernetes distribution
- Automate lifecycle management of Kubernetes clusters, network functions, and 5G services
- Accelerate the deployment of network functions through the VMware Ready for Telco Cloud program

functions and infrastructure components with zero-touch provisioning. Full lifecycle management can define and apply policies using a decisioning engine to automate deployments, operations, and maintenance.

The Role of VMware Telco Cloud Automation

VMware Telco Cloud Automation is an orchestrator that accelerates time to market for network functions and services while igniting operational agility through unified automation across any network and any cloud. The system enables multi-cloud placement, easing workload instantiation and mobility from the network core to the edge and from private to public clouds. It also offers standards-driven modular components to integrate any multi-vendor MANO architecture.

With VMware Telco Cloud Automation delivers a cloud-first solution where all the layers—from infrastructure to domain orchestration (NFVO)—are coupled for consistency and optimized for deployment and workload management across any cloud. VMware Telco Cloud Automation is a foundational element of VMware Telco Cloud Platform.

Conclusion: ABI Research Competitive Ranking for 5G Telco Cloud-Native Platforms Names VMware No. 1 Overall

In conclusion, this paper has shown that in assessing the cloud-native capabilities of telco platforms, the capabilities of VMware Telco Cloud Platform meet a wide range of requirements for deploying, managing, and automating CNFs.

The ABI Research Competitive Ranking for 5G Telco Cloud-Native Platforms recently ranked VMware as the **Overall Leader**, **Top Innovator**, and **Top Implementer**.[1]

Here are some highlights from the *ABI Research Competitive Ranking*, ABI Research Report Number CA-1330, Q1 2022:

- "For the telecommunications industry, it has worked with more than 140 CSPs in deploying NFVI and cloud-native networks. It offers a cloud-native platform called VMware Telco Cloud Platform for 5G networks, which supports more than 220 third-party VNFs/CNFs, including NFs from Nokia, Cisco, Ericsson, and Metaswitch. Recently, VMware Telco Cloud Platform was used in a 5G deployment with DISH, deploying multi-vendor NFs on top of a consistent horizontal platform, with the ability to dynamically move and scale workloads in the cloud. Telia has also selected VMware Telco Cloud Platform as the common network horizontal digital platform on top of which 4G and 5G CNFs—both virtualized and containerized—will run."
- "VMware offers an interoperability certification program, VMware Ready for Telco Cloud, that enables CSPs to quickly validate multi-vendor VNFs and CNFs on VMware Telco Cloud Platform with a dedicated VMware team or through a self-certification process for a faster time-to-market. These certifications help ensure that VNFs/CNFs can interoperate at the core infrastructure layer of VMware Telco Cloud Platform, as well at the orchestration level. Furthermore, VMware vSphere Enterprise Plus, which is the cloud computing virtualization platform that is part of VMware Telco Cloud Platform, offers the abstraction and management layer that helps enable a multi-vendor ecosystem. VMware Telco Cloud Platform also supports a variety of Operating Systems (OSs), including CentOS, Ubuntu, Amazon Linux, Red Hat Enterprise Linux, and Photon OS. VMware thus scores a perfect 10 for their ability to orchestrate and support multi-vendor NFs."
- "In terms of open source, VMware is the number two contributor to Kubernetes and offers native Kubernetes access through command-line tools like kubectl. VMware also contributes to other open-source communities, such as ONAP, OPNFV, O-RAN, and OSM. VMware Telco Cloud Platform's CaaS engine, Tanzu, is an upstream Kubernetes project, and uses open-source projects, such as Harbor, Cluster API, Velero, and Sonobuoy, to deliver additional capabilities."

1 See *https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/docs/vmw-abi-research-competitive-ranking-five-g-telco-cloud-native-platforms.pdf*

- "Regarding container security, virtualization provided by VMware vSphere offers inherent security in the hypervisor, which separates the VM's OS from the underlying hardware's OS and isolates tenants. (Note that this level of segmentation cannot be achieved with bare metal deployments at the moment without using virtualization technology, such as KubeVirt.) Pod-level micro segmentation is also enabled through VMware NSX, which is VMware Telco Cloud Platform's networking and security solution. VMware scores very high in terms of container security due to the inherent security brought about by vSphere and NSX, which are based on virtualization technology, enabling isolation of tenants and hypervisor security for containers."
- "VMware Telco Cloud Platform is purpose-built for the telecommunications industry and offers telco-grade Kubernetes through Tanzu, which includes telecommunications-specific enhancements, such as Multus Container Network Interface (CNI), support for DPDK, SR-IOV, and automated cluster provisioning and configuration."
- "VMware Telco Cloud Platform also provides additional telco-specific features, such as a low latency data plane through Central Processing Unit (CPU) pinning, fine-grained Non-Uniform Memory Access (NUMA) placement, and vertical NUMA alignment. Carrier-grade reliability, High Availability (HA), and resiliency are also ensured through VMware ESXi, a type-1 hypervisor. Rollbacks and upgrades are also possible without the need to take assets offline and reroute traffic."
- "For container orchestration, VMware Telco Cloud Platform uses late binding, which automates workload instantiation and configures cloud environments based on VNF/CNF requirements. With late binding, VNF/CNF customization time is reduced by 75% compared to manual configuration methods. Late binding also optimizes performance by helping avoid over- and under-provisioning of infrastructure resources."
- "In terms of cloud-native capabilities, VMware supports CI/CD with VMware Telco Cloud Automation SDK and API-based integrations to major third-party CI/CD toolchains, such as Jenkins and GitLab. Container orchestration and LCM is done through Tanzu Standard for Telco, which provisions and manages the life cycle of Tanzu Kubernetes clusters."
- "Both VNFs and CNFs run in VMs as part of VMware's value proposition, which provides operational flexibilities and innate security through the separation of the Guest and Host OS. This flexibility gives CSPs a consistent singular horizontal platform across the core, edge, RAN, and public cloud to run legacy VNFs and future CNFs as CSPs transition into a cloud-native environment and way of working."

LEARN MORE

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

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