

Modernize to Monetize: Reimagine the Telco Cloud to Capitalize on 5G

Efficiently design, deploy, operate, and protect
5G networks with a common horizontal platform





Table of contents

Designing, Deploying, and Operating 5G Networks Takes a New Paradigm	2
Monoliths, Silos, and Lock-In: Problems Undermining Change	4
Solving Industry Problems with a Common Horizontal Platform.	5
Finding Agility, Assurance, and Automation in Commonality	6
Designing and Developing 5G Networks, Functions, and Services	7
Deploying Network Functions.	8
Streamlining Operations and Optimizing Resources.	9
Protecting the Telco Cloud	11
Modernizing the RAN	12
Technology Transformation.	13
The End Game: 5G Monetization.	14
Driving Monetization with Commonality and Consistency.	14

THE VMWARE TELCO CLOUD FOR 5G AT A GLANCE

VMware helps communications service providers build, operate, protect, and monetize their telco cloud. Our technology empowers CSPs to accelerate the deployment of 5G networks and services, streamline operations, compete in a multi-cloud world, and turn their radio access network into a multi-services hub.

35%-50%

Reduction in hardware costs (Source: Forrester, Understanding the Total Economic Impact Of A Common Platform Approach to NFV)

40%-50%

Reduction in platform management effort through simplification (Source: Forrester, Understanding the Total Economic Impact Of A Common Platform Approach to NFV)

18%

Revenue increase from the ability to bring services to market faster (Source: ACG, Economic Benefits of VMware Telco Cloud Automation and Horizontal Infrastructure)


Designing, Deploying, and Operating 5G Networks Takes a New Paradigm

The rollout of new 5G services will intensify the already fierce competition among communications service providers and their more agile hyperscaler counterparts. CSPs are encumbered by rising network and spectrum costs, vertical stacks locked in silos, rigid resources, and unforeseen shifts in demand. These challenges are squeezing profit margins, slowing down 5G deployments, and hampering innovation.

At the same time, 5G carries new requirements. On-demand services, enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultra-reliable low-latency communications (URLLC) demand new capabilities.

The complex, siloed architecture of CSPs' existing networks stands in the way of rapid innovation and operational agility. These networks, which tend to be founded on vertically integrated monolithic stacks designed to run vendor-specific virtual network functions, make automating deployment and management difficult. VNFs locked in silos require separate tools and operational processes for each vendor's layer.

5G also calls for cloud-native architectures and the use of containerized network functions (CNFs). Running CNFs alongside VNFs adds complexity and complicates operations. Traditional orchestration tools lack telco-centric features to automate multi-tenant, distributed CNFs and to deliver the resiliency and reliability required in a highly regulated industry with strict service-level agreements (SLAs) and demanding consumers. Operations that take place in silos make end-to-end visibility nearly impossible, dampening the prospect of tailored 5G services.

An aerial night view of a city, likely New York City, with numerous skyscrapers and city lights. Overlaid on the image are several glowing blue arcs that represent a network or data flow. A large, semi-transparent blue and green diagonal shape is in the top left corner. The text is centered in the lower half of the image.

“ As Canada's 5G leader we need to work with the best of the best in the industry, that's why we partnered with industry leading vendor VMware. Because building a 5G network is a very complex problem and you really need the right pieces in the right places to get that vision together. ”

LUCIANO RAMOS, SENIOR VICE PRESIDENT NETWORK
DEVELOPMENT AND CORE ENGINEERING
ROGERS

Monoliths, Silos, and Lock-In: Problems Undermining Change

Rigid Resources

64%

of operators say that their CapEx planning is driven by technology, not business objectives
(Source: PWC)

Rising Competition and Less Revenue

50%-90%

less revenue for CSPs because of over-the-top applications
(Source: World Economic Forum)

Rising Network Costs

4+%

decline in gross margins 2014 to 2019 from increasing pressures, including CapEx
(Source: Ready Ratios)

The list of requirements for CSPs to capitalize on 5G is long.

- Break down complex, monolithic software stacks and eliminate silos of network layers and dedicated management tools
- Reduce the reliance on and cost of specialized physical network appliances
- Follow a multi-vendor strategy that reduces or eliminates vendor lock-in
- Replace existing hardware-centric operating models with software-defined approaches and DevOps practices
- Develop the agility and automation to respond to changing market conditions by quickly launching or modifying services
- Deliver the right resources, in the right place, at the right time
- Manage and automate multi-vendor network functions in a unified way
- Reduce operational complexity and operating costs
- Implement new cloud-native approaches to be able to quickly deploy enterprise services like security, network slicing, private cellular networks, and multi-access edge computing (MEC)

To fulfill these requirements, CSPs must take a tactical approach to designing and operating services across heterogeneous infrastructure while supporting interoperability with various vendors.

The complexity of coordinating network functions and managing multiple services demands a simple, automated approach that speeds up 5G deployments, streamlines operations, reduces risks, and lowers costs.



FIGURE 1: The path to modernization for 5G.

CAPITALIZE ON 5G WITH CLOUD-NATIVE TECHNOLOGY AND CLOUD-FIRST AUTOMATION

Capitalizing on the opportunities of 5G in a multi-cloud world hinges on two key ingredients: cloud-native technology and cloud-first automation.

Cloud-native technology decouples containerized functions from the infrastructure so they can be deployed quickly, shared among services, updated easily, and managed independently. Orchestration and automation dynamically scale network functions to meet changes in demand. With containers as a service (CaaS), CSPs can use the same technology to meet different requirements and design more efficient 5G networks.

Cloud-first automation unites multi-cloud resources in a centralized orchestration system and then uses intent-based placement to automatically align the requirements of network functions and 5G services with resources and capabilities.

MODERNIZE THE RAN TO MONETIZE THE EDGE

Virtualization and cloud-native technology can be extended to the radio access network, bringing efficiency, flexibility, and automation. A common platform can turn the RAN into a 5G multi-services hub that lets you deploy non-RAN CNFs alongside vRAN functions. As a result, you can monetize 5G by quickly introducing new edge services while streamlining operations.

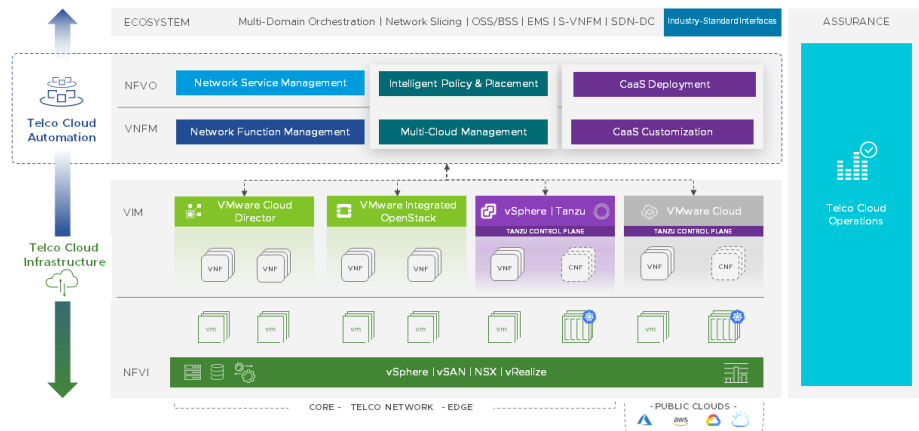


FIGURE 2: The VMware Telco Cloud establishes a common horizontal architecture for 5G.

Solving Industry Problems with a Common Horizontal Platform

The path to deploying 5G quickly and cost-effectively is paved by adopting a common horizontal architecture, cloud-native technology, multi-layer automation, and built-in security.

- Common horizontal infrastructure plays a critical role in modernization by uniting clouds and multi-vendor networks in a single platform. With common infrastructure, service providers can avoid creating new network silos when they build out 5G. By simplifying complex heterogeneous environments, horizontal architectures deliver centralized management at scale.
- Cloud-native principles are a defining ingredient of modernization. Kubernetes, containers, and microservices supply methods for establishing the kind of flexible operations required to thrive with 5G. The automated operations and agile methods that come with cloud-native technology can streamline the development, deployment, and management of 5G services.
- Multi-layer automation can unite multicloud resources in a centralized orchestration system and then use intent-based placement for optimization.
- An integrated approach to service assurance that takes advantage of machine learning can monitor your whole 5G landscape, predict impacts of network changes, and automate actions to further optimize the network.
- Built-in security can protect the infrastructure, network, and applications from the inside out.

A common architectural foundation speeds up the design and deployment of 5G services, automates operations, optimizes resources, and protects dynamic networks. The VMware Telco Cloud combines telco-specific cloud-native solutions and multi-layer automation with horizontal infrastructure and holistic service assurance to solve the problems standing between CSPs and the promise of 5G.

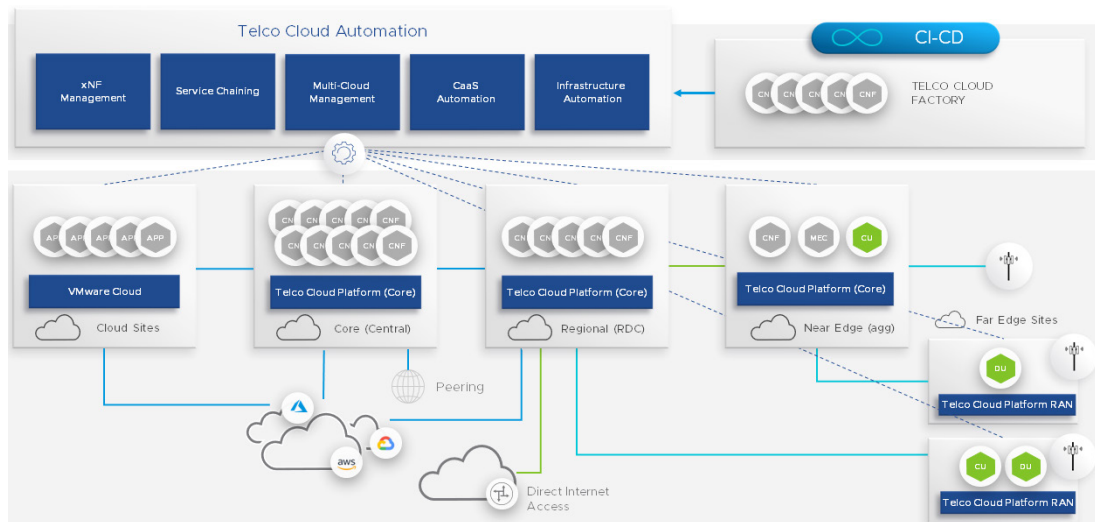


FIGURE 3: The VMware Telco Cloud for deploying, automating, and managing a 5G network, from the core to the radio access network.

Finding Agility, Assurance, and Automation in Commonality

VMware Telco Cloud Platform and its components radically simplify the design, deployment, management, and optimization of 5G networks by using a common horizontal architecture. VMware Telco Cloud Platform includes compute, networking, Kubernetes, and multi-layer automation.

Software-Defined Infrastructure

VMware Telco Cloud Platform supplies infrastructure as a service (IaaS) and containers as a service (CaaS) with VMware vSphere®, VMware NSX-T™ Data Center, and VMware Tanzu for Telco, a Kubernetes distribution. VMware vSAN™ is an optional add-on, and VMware Telco Cloud Operations can be added to provide assurance across the stack.

A version of the platform is tailored to support the radio access network (RAN). VMware Telco Cloud Platform RAN™ is a RAN-optimized platform that runs virtualized baseband functions, virtualized distributed units (vDUs), and virtualized central units (vCUs) in accordance with RAN performance and latency requirements.

Automation and Orchestration

VMware Telco Cloud Automation orchestrates network functions, services, and resources from a centralized location. The platform integrates with virtual infrastructure managers (VIMs) and Kubernetes clusters to form a powerful multi-tenant environment to securely manage the service and application layer. VMware Telco Cloud Automation centralizes the provisioning and management of clusters.

Designing and Developing 5G Networks, Functions, and Services

To quickly design and develop network functions and services, you can customize network function data models, build custom workflows, select certified network functions from a broad ecosystem of partners, and integrate with a continuous integration and delivery pipeline (CI/CD).

- Create, customize, and update network function data models by using a simple, intuitive network function designer. You can drag and drop virtual deployment units (VDUs) or Helm charts and virtual links to simplify configurations and connectivity.
- Customize network design with a visual composer and scripts.
- Import and build custom workflows with the VMware vRealize® suite.
- Design and automate TOSCA-compliant network functions.
- Access a broad ecosystem of certified network functions and services from a variety of vendors through the VMware Ready for Telco Cloud program.
- Onboard network functions using standards-based templates and model network services based on multi-vendor network functions.
- Integrate your development pipeline with your 5G deployment platform to streamline the development process.
- Test CNFs on Kubernetes.

A point of integration to connect your CI/CD pipeline with a deployment platform is a container image registry, which helps speed up the development, testing, and deployment of CNFs and 5G services while improving security.

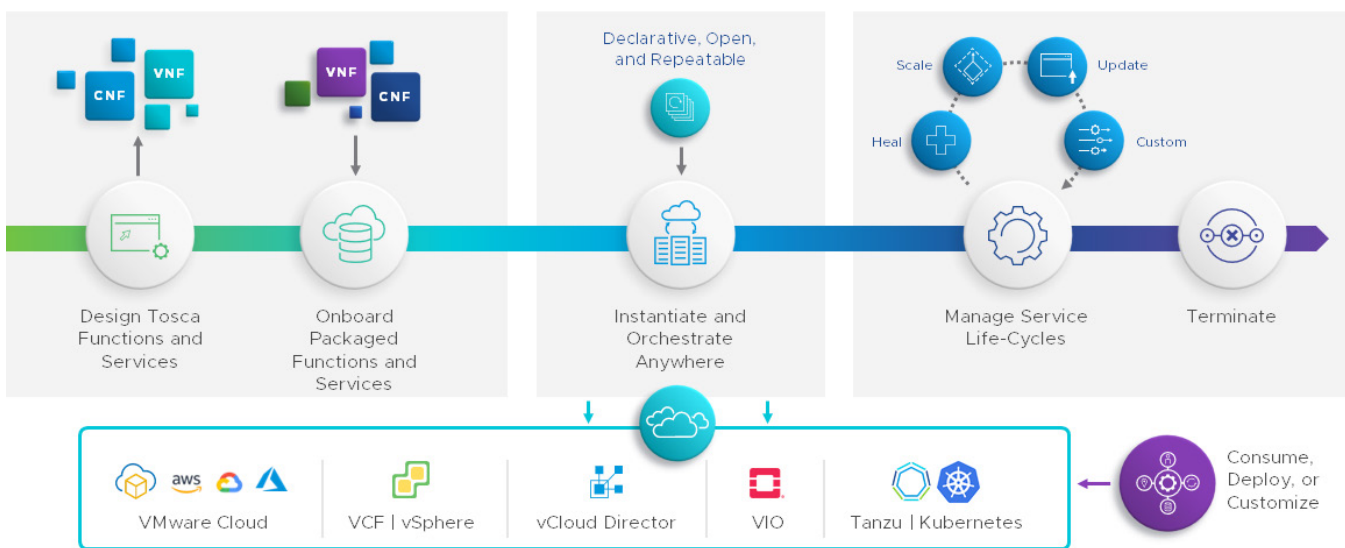


FIGURE 4: Lifecycle management that streamlines the design, deployment, and operations of VNFs and CNFs.



Deploying Network Functions

In the shift to 5G, speed and scale are of the essence. Both, however, can be expensive. How will you expand your network and deploy new network functions and services at scale while minimizing costs? The key is to use automation to efficiently deploy network functions across thousands of locations.

By moving from the rigidity of traditional monolithic stacks to the flexibility of common virtualized infrastructure, you gain the power to expand your network and deploy new network functions without having to disrupt your operations or overhaul your network design.

- Use predefined templates to define configurations once for all central, core, and edge sites across your environment. Whenever you need to expand, the network automatically deploys a software-defined data center (SDDC) based on the template optimized for that site.
- Simplify the deployment of virtual infrastructure for a site, create the Kubernetes clusters, and instantiate network functions. With centralized configuration and management, the platform dynamically deploys Kubernetes clusters to run the right cloud-native network resources, in the right place.
- Programmatically provision network functions across distributed sites when needed. This automated approach lets you quickly tailor and scale 5G services to target markets to help create new revenue streams.
- Isolate network functions in the virtualization layer and then apply consistent security policies to all your sites to improve security for network functions and reduce the chance of configuration errors or other changes that can heighten risk.
- Reduce the time-to-deploy for RAN sites by automating their provisioning with standardized templates describing required appliances and configurations.
- Monetize 5G by quickly introducing new edge services while managing them from a central location to keep costs low.

A BROAD SPECTRUM OF MULTI-VENDOR NETWORK FUNCTIONS

The VMware Ready for Telco Cloud program helps CSPs identify VMware partner network functions that have been validated to work with the VMware Telco Cloud. These network functions meet VMware standards for integration and interoperability. VMware works with multiple network function vendors to certify their functions. This comprehensive program ensures interoperability and operational readiness between third-party network functions and the VMware Telco Cloud. The program removes time-consuming, difficult integration work so that CSPs can focus on innovation and accelerate the deployment of 5G services.

Streamlining Operations and Optimizing Resources

In contrast to a vertical architecture, a horizontal architecture shares a common platform using the same hypervisor and the same storage and networking solutions. The architecture itself is simplified, less expensive, and easier to maintain.

This commonality brings consistency and efficiency to operations. You can use the same tools for operational tasks like patching, monitoring, alarm handling, fault handling, and troubleshooting.

With a common platform and common operational tools, automation and orchestration becomes much easier so you can do the following with ease:

- Automate lifecycle management of infrastructure, Kubernetes clusters, network functions, and 5G services.
- Orchestrate network functions, services, and resources from a centralized location.
- Integrate closed-loop operations driven by machine learning and artificial intelligence
- Automate root cause analysis and correlate alarms with network topologies
- Automatically prioritize responses to incidents affecting important services, high-profile customers, and high-cost SLA violations
- Resolve issues faster through full-stack monitoring, end-to-end visibility, and automated responses

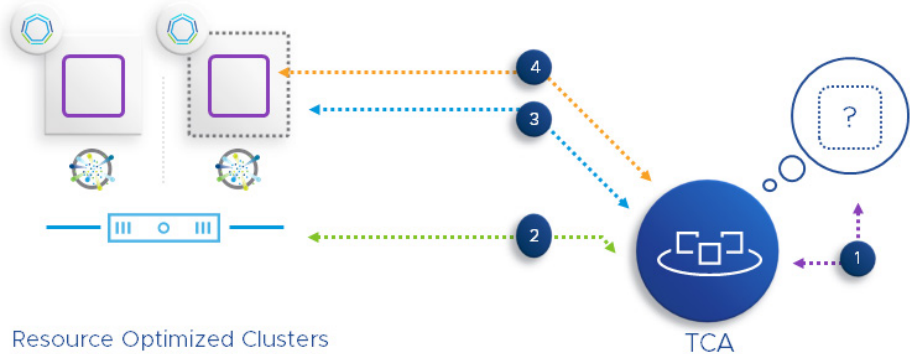
VMWARE TELCO CLOUD PLATFORM AT A GLANCE

VMware Telco Cloud Platform is powered by field-proven compute and networking combined with VMware Telco Cloud Automation™ and VMware Tanzu™ Standard for Telco, which is a telco-grade Kubernetes distribution.

KEY CAPABILITIES

- Deploy and efficiently operate multi-vendor VNFs and CNFs on consistent horizontal infrastructure
- Use microservices and optimize resources with a telco-grade Kubernetes distribution
- Manage CNFs at scale
- Automate lifecycle management of Kubernetes clusters, network functions, and 5G services
- Follow a reference architecture to implement a solution that works best for your requirements

Performance Optimized Clusters



Resource Optimized Clusters

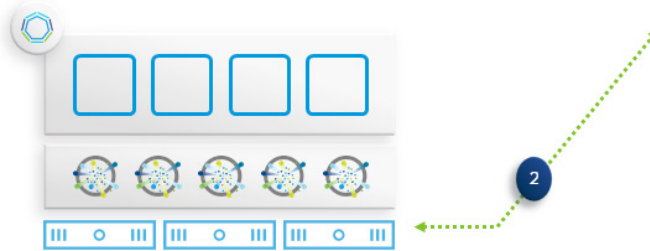


FIGURE 5: Optimizing the placement of services and CNFs is key to maximizing resources.

Optimizing Service Placement on Kubernetes

One key to the optimization of 5G services and containerized network functions (CNFs) is to use programmable resource provisioning to match resources with requirements. Here's the process for doing so:

1. Assess the 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.

The result maximizes the use of resources.

PROTECTING CNFs

As you work to develop and deploy CNFs, you should consider how to secure the container lifecycle. Adopting 5G technology carries new risks and exposes systems to new threats. How will you do the following?

- Protect CNFs as they move through a CI/CD pipeline
- Implement a trusted container image registry with role-based access control and vulnerability scanning
- Inspect containers against security benchmarks
- Automate security patching of containers
- Isolate, protect, and monitor the communications of CNFs and microservices
- Enforce policies governing CNF connectivity
- Protect your CNF supply chain by establishing end-to-end security from code provenance to production
- Embrace DevSecOps and new security principles to address emerging threats

Protecting the Telco Cloud

Security risks and requirements are shifting as CSPs transition to 5G networks. The service-oriented architecture of the 5G core network introduces a broader range of data and services than 4G, increasing the attack surface. The common web protocols and APIs of 5G networks open up more attack vectors. Containers shift the security burden to virtual machines and the development and operations lifecycle. Kubernetes and cloud-native patterns require security enhancements to, for example, lock down API interfaces, manage microservices, and protect network end points.

A lack of common security standards across multiple domains can make management complex and difficult, which increases the risk of configuration errors or other changes that expose vulnerabilities or attack vectors.

Security that is integrated with the software and built into the infrastructure helps solve the challenges of 5G by making security programmable, automated, adaptive, and context-aware. Intrinsic security improves visibility, reduces complexity, and focuses your defenses by letting you apply and automate adaptive measures like micro-segmentation in the right place.

A common horizontal platform drives many security benefits. With a common platform, security operations become simpler, with faster, more agile responses.

- Isolate containerized network functions (CNFs) on virtual machines and the VMware hypervisor, VMware ESXi™, to establish strong security boundaries and prevent lateral movement.
- Protect sensitive data by segmenting and encrypting workloads and storage.
- Keep the virtualization fabric, container images, and VMs up to date and patched.
- Use a security-hardened, real-time Linux host optimized for vSphere.
- Scan container images for vulnerabilities, sign them as trusted, and secure them with role-based access control.
- Architect the infrastructure with built-in security by using automated provisioning, automated management, secure administration, and micro-segmentation.
- Strictly control access to and use of management layers by using the principles of least privilege and separation of duties.

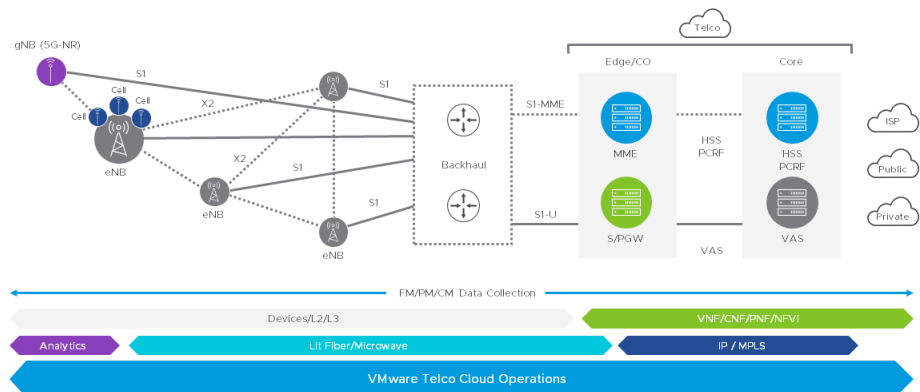


FIGURE 6: VMware Telco Cloud Operations monitors the layers of a 5G network to help protect availability, integrity, and confidentiality.

VMWARE TELCO CLOUD PLATFORM RAN

VMware Telco Cloud Platform RAN™ is a RAN-optimized version of the platform tailored to support the radio access network (RAN). The platform runs virtualized baseband functions, virtualized distributed units (vDUs), and virtualized central units (vCUs) in accordance with RAN performance and latency requirements.

VMware Telco Cloud Platform RAN paves a clear path to RAN modernization by enabling CSPs to evolve from their traditional RAN to vRAN and, eventually, open RAN.

KEY BENEFITS AND CAPABILITIES

- Optimize the placement of DUs and CUs through programmable resource provisioning
- Use the same common platform to virtualize the RAN now and migrate to open RAN in the future
- Deploy and operate both RAN and non-RAN workloads on a horizontal platform
- Transform the RAN into a 5G multi-services hub
- Use a security-hardened Linux host called Photon OS that is optimized for running containers on VMware vSphere®
- Automate lifecycle management of infrastructure, Kubernetes clusters, vRAN functions, and 5G services

LEARN MORE

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

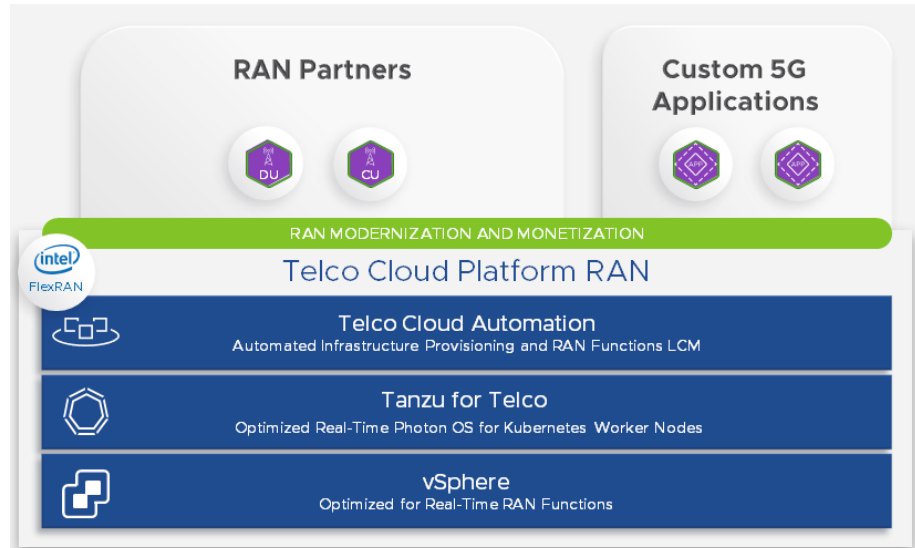


FIGURE 7: The flexibility and automation of VMware Telco Cloud Platform RAN empowers you to monetize the radio access network. A common platform turns the RAN into a 5G multi-services hub that lets you deploy non-RAN CNFs alongside virtualized RAN functions.

Modernizing the RAN

Although CSPs have started virtualizing, and in some cases containerizing, their core networks, the radio access network (RAN) is still often built and operated with legacy purpose-built hardware equipment because of the stringent requirements associated with RAN. A key to lowering the cost of deploying 5G is to virtualize RAN functions and further disaggregate them so that different virtualized RAN functions can be instantiated on a horizontal platform and deployed at their optimal locations.

The ability to host a multitude of network functions regardless of their locations and to automate operations across 5G networks are integral aspects of virtualizing the RAN. Offering new 5G services relies on the ability to develop, deploy, and operate applications close to end customers — and the RAN is the prime location to do so. For new 5G services to scale across distributed RAN sites, a common horizontal platform to support both virtualized RAN functions and custom applications becomes essential.

VMware Telco Cloud Platform RAN paves a clear modernization path: Your CSP can move from your traditional RAN to virtualized RAN and start to move in the direction of open RAN. VMware Telco Cloud Platform RAN transforms the RAN into a 5G multi-services hub that enables you to develop and deploy custom 5G applications alongside virtualized RAN functions.

VMware Telco Cloud Platform RAN is powered by the field-proven virtualized compute solution, carrier-grade containers as a service (CaaS), and multi-layer automation that are consistent with its 5G core offering. This end-to-end consistency enables you to efficiently provision and operate 5G services tailored to different enterprise and consumer markets. As a result, you can monetize the RAN.

Technology Transformation

"With VMware, we've undertaken a technology transformation while also changing our processes, governance and operating models. We're becoming more agile and efficient, and gaining the cloud skills we need to embrace new features in the future."

RITA FUZIOL, DIRECTOR OF
DATA CENTER, CLOUD AND
INFRASTRUCTURE, MILLICOM

The End Game: 5G Monetization

To capitalize on the opportunities of 5G and to improve their competitive position, CSPs are seeking to overcome the limitations of their existing network architectures and transform their businesses into an agile force with streamlined operations.

By combining telco-specific cloud-native solutions and multi-layer automation with consistent infrastructure and holistic assurance, you can propel your organization into the future with agility and efficiency while maintaining carrier-grade performance and reliability. Use cases like customized on-demand services, enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultrareliable low-latency communications (URLLC) all move a step closer to reality.

Driving Monetization with Commonality and Consistency

But it goes one step further than that. Consistent infrastructure coupled with consistent operations and dynamic service assurance lets you capitalize on the opportunities of 5G, turn RAN sites into 5G multi-services hubs, and monetize every aspect of your 5G network from the core to the edge.



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