



Flexibility, Performance, and Reliability for Managed Business Services

A Complete Enterprise vCPE Solution from Wind River, Versa Networks,
and Dell EMC

WHEN IT MATTERS, IT RUNS ON WIND RIVER

EXECUTIVE SUMMARY

Virtual customer premises equipment (vCPE) is a virtualized platform for delivering managed services to enterprises at lower operational cost and with greater agility than via traditional physical appliances. As Network Functions Virtualization (NFV) and Software Defined Networking (SDN) adoption increases, enterprise vCPE has emerged as one of the strongest use cases addressing many of the cost and efficiency challenges that communication service providers (CSPs) currently face.

For CSPs, enterprise vCPE provides a significant opportunity to accelerate the delivery of managed services, rapidly introduce new revenue-generating services, and reduce operating costs. For telecom and server equipment suppliers, enterprise vCPE offers the potential to expand product portfolios to address new markets, such as enterprises and data centers.

Wind River®, Versa Networks, and Dell EMC have joined forces to create a complete, pre-integrated enterprise vCPE solution that comprises everything service providers need to get started with the flexibility, performance, and carrier grade reliability that they require:

- Versa FlexVNF™ includes the broadest set of virtual network functions (VNFs) in the industry, making it possible to design rich managed services and enterprise architectures and deliver them with agility to work seamlessly together.
- Wind River Titanium Cloud™ is the industry’s only fully integrated, ultrareliable, and deployment-ready family of software virtualization platforms that enable service providers to deploy virtualized services faster, at lower cost, and with guaranteed uptime.
- Dell EMC PowerEdge R430 series of powerful, two-socket rack servers delivers outstanding performance for a wide range of workloads, configuration flexibility, high availability, and intuitive management in a compact chassis, making it an ideal hardware platform for enterprise vCPE use cases.

In this paper we describe the business value of vCPE and discuss the unique benefits achieved by using the components listed above:

- Flexible deployment options
- Best-in-class manageability
- Maximum resource utilization and performance
- Avoidance of vendor lock-in
- Better solution than build-your-own

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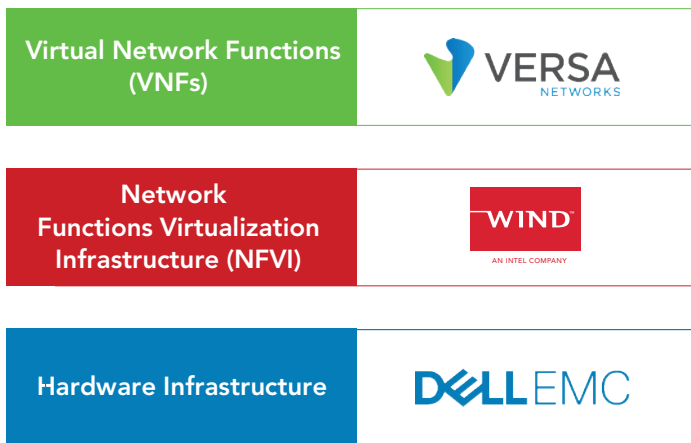


Figure 1. Components of a vCPE solution

INTRODUCTION

Enterprise vCPE provides a tremendous opportunity for CSPs to grow managed business service revenue, minimize operating costs, and differentiate service offerings. As the adoption of NFV and SDN continues, enterprise vCPE is one of the strongest use cases and is gaining market momentum. In fact, most NFV deployments in 2017 and beyond will be for enterprise vCPE, according to a recent [IHS Markit survey](#) on NFV strategies.

While the managed business services market is growing steadily and estimated to be worth a healthy \$146 billion globally in 2018 by [Analysys Mason](#), the traditional way of delivering services limits CSPs' ability to rapidly introduce new services and increase revenues. Nearly every type of business network service—whether it's Multiprotocol Label Switching or Ethernet connectivity, virtual private networks (VPNs) or security—requires CSPs to install a dedicated physical appliance on the customer premises. Deploying a new service, even for an existing business customer, typically involves sending experienced technicians to the premises to install and activate a new piece of equipment, a process that can take weeks or months. Making changes to existing services often requires CSPs to send their technicians back to the site to reconfigure the networking gear. The process is inefficient and inflexible, which prevents CSPs from maximizing their return in the business services market.

Enterprise vCPE addresses many of the challenges CSPs currently face. As a virtualized platform, vCPE enables CSPs to deliver managed services to enterprises at lower operational cost and with greater agility than via traditional physical appliances. Rather than dedicated physical appliances, VNFs run as virtual machines (VMs) on standard server hardware in cloud and data center environments. Costly proprietary appliances are replaced with reusable standard servers, which reduces equipment capital expenditure (CAPEX). The amount of on-premise equipment is also reduced, which allows CSPs to minimize truck rolls and reduce operating expenditure (OPEX).

As a software-based networking solution, vCPE offers much faster time-to-market for managed services compared to deploying dedicated appliances at the customer premises. It also introduces an easier way to upsell additional revenue-generating services because the platform allows CSPs to dynamically scale and deploy existing or new services. Service adoption cycles are further accelerated through the more effective self-provisioning that is enabled by network virtualization.

According to [Analysys Mason's business case modeling for enterprise vCPE](#), a first-mover Tier 1 operator with 100,000 vCPE subscribers would achieve a 156% return on investment (ROI) over five years and 47% operational cost savings per site per year. Over a five-year period, the model shows that the CSP would also produce 5% more revenue per site per year, which would amount to \$1.4 billion in new revenues. The additional revenue is driven mainly by the upselling and cross-selling opportunities for new services enabled by network virtualization, such as dynamic VPN and WAN configuration, self-service bandwidth on demand, security as a service (such as firewall and DDOS protection), or WAN optimization.

Breaking down the costs savings in the [Analysys Mason](#) model, vCPE results in 42% combined CAPEX and OPEX savings due to the replacement of dedicated appliances with standard servers. By removing inefficient manual equipment installation and service provisioning processes, CSPs can cut order-to-cash costs by 72%. And through the elimination of most truck rolls and use of remote fault resolution, CSPs will see a 61% reduction in trouble-to-resolve costs.

But the business drivers for vCPE go beyond the needs of service providers. For telecom and server vendors, the shift to vCPE represents an opportunity to expand further into the enterprise market by displacing legacy, dedicated network appliances at the customer premises. This is especially the case as dedicated appliances reach end of life and enterprises look for better solutions that provide greater flexibility and cost savings. vCPE also opens the door to data center and PoP equipment contracts that can be leveraged for other NFV use cases in addition to vCPE. Rather than viewing network virtualization as a threat to their existing equipment business, vendors can seize the opportunity to grow in new markets, as the vCPE use case shows.

For CSPs and equipment suppliers, enterprise vCPE is the use case that best demonstrates the cost savings and service agility benefits promised by NFV. But to fully realize the promise, a vCPE solution must be as reliable and high performing as equivalent physical network-based solutions. In the transition to network virtualization, CSPs cannot afford to sacrifice service quality. A broken service level agreement (SLA) has a direct, negative impact on business service revenue while increasing customer churn.

CSPs need an integrated, pre-validated vCPE solution for enterprise-managed services that not only provides all the components to get started but also delivers the carrier grade reliability that they require. This solution brief presents the complete vCPE solution from Wind River, Versa Networks, and Dell EMC.

COMPLETE ENTERPRISE vCPE SOLUTION

The combination of Versa Networks’ FlexVNF virtual functions powered by the Wind River Titanium Cloud family of software virtualization platforms, running on Dell EMC’s PowerEdge rack servers, results in an incredibly flexible, high-performance range of trusted virtual CPE solutions that meet today’s business needs.

- **Versa FlexVNF** includes the broadest set of VNFs in the industry, from a full set of networking capabilities—including market-leading SD-WAN functions and full carrier grade routing—to a wide range of basic and advanced security functions such as stateful and next-generation firewall, secure web gateway,

unified thread management (UTM), DDOS protection, antivirus intrusion protection, and domain name server security. This makes it possible to design rich managed services and enterprise architectures and deliver them with agility to work seamlessly together.

- **Titanium Cloud** is the industry’s only fully integrated, ultrareliable, and deployment-ready family of virtualization platforms that enable service providers to deploy virtualized services faster, at lower cost, and with guaranteed uptime.
- **Dell EMC PowerEdge R430** series of rack servers provides powerful computing for space-constrained environments. Powered by the Intel® Xeon® E5-2600 v4 family of processors, the hardware platform delivers peak two-socket performance for a wide range of workloads, including high-performance computing (HPC), web serving, infrastructure scale-out or surveillance, and site security, making it an ideal hardware platform for enterprise vCPE use cases.

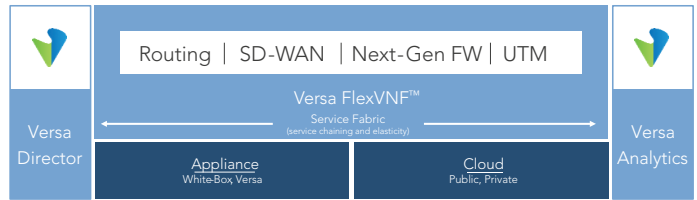


Figure 2. Versa FlexVNF

THIN BRANCH OR THICK BRANCH

The first consideration when deploying a vCPE solution is to decide where to host the network function workloads: in a central location (the thin branch model) or onsite at the customer premises (the thick branch model), or in a hybrid configuration of both deployment models. Each model has different implications for the cost and management of vCPE deployments. But they all require solutions that can promise carrier grade reliability and high performance to ensure that CSPs can deliver on SLAs for business customers, while also reducing CAPEX and OPEX.

- **Thin branch:** In the thin branch model, the compute resources are centralized in a CSP data center, central office, or point of

presence (PoP). Most of the VNFs are run as VMs from the centralized location, and the CPE is a thin client device with minimal compute resources to run minimal core VNFs on premise. This model is suited to small and medium-sized businesses that do not require intense processing capabilities on premise. It is also imperative that the customer be served by high-capacity carrier Ethernet connectivity. This model enables CSPs to automatically provision and easily maintain managed vCPE services from a centralized location as well as pool server resources to serve multiple business customers.

- **Thick branch:** The thick branch model, also described as a distributed architecture, requires vCPE servers with significant control, storage, and compute resources at the customer premises. This model is suited for businesses that require very low-latency services and high network security, such as a bank or large retail store. In this model, CSPs can scale vCPE services with demand and provision new services remotely without having to send engineers to the premises.
- **Hybrid deployment:** For some CSPs, a hybrid approach that blends both thin and thick branch deployment models will be preferred. A hybrid deployment is best suited for large-scale vCPE deployments serving a variety of customers, from medium-sized to large enterprises, where reliability and security are mission critical.

FLEXIBLE DEPLOYMENT OPTIONS

Designed to provide operators with agility and maximum flexibility, a combined Wind River–Versa Networks–Dell EMC solution meets the needs of both thick and thin branch deployment models. Both Wind River and Versa Networks offer product configuration and deployment options that allow customers the freedom to choose the model that best fits their business needs and budgets without sacrificing product features, reliability, or performance. Furthermore, Dell's short-depth (24-inch) rack servers are powerful and compact, fitting into a variety of data centers and customer premises, especially where space is limited, and giving CSPs a flexible, scalable hardware platform for vCPE deployments.

The Wind River Titanium Core product is ideally suited for providing high-capacity VNF hosting when a thin branch model is preferred. Titanium Core delivers a high-reliability, fully redundant control, storage, and compute environment that scales as needed from four nodes to dozens of nodes to hundreds of nodes, as sites are on-boarded and compute and storage demands increase.

Wind River Titanium Edge is specifically targeted at the thick branch market. This configuration is deployed on a single redundant pair of combined control, storage, and compute servers, offering the same functions and features of the Titanium Core product, but scaled down to fit the needs of medium-sized and small thick branch offices.

Dell's PowerEdge R430 hardware platform is flexible enough to thrive in thick or thin branch models. Internal storage capacity is scalable and the platform is expandable to handle changing workload conditions. Dell's FailSafe Hypervisor provides hypervisor redundancy to protect virtualized workloads as CSPs expand services.

Paired with Titanium Cloud and the PowerEdge hardware platform, Versa Network's FlexVNF provides carrier grade VNFs that scale in or scale out on demand, maintaining service continuity and delivery and leveraging all the resources (control, storage, compute) provided by the underlying Titanium Cloud platform.

As a thin branch solution, Versa FlexVNF and Titanium Core can deliver the required routing, SD-WAN, and security features needed to support thousands of remote offices. This is enabled in part by FlexVNF's robust multi-tenant architecture, which enables operators to maximize the use of the platform's capabilities, partitioning capacity across tenants or user groups as dictated by demand or policy.

Equally suited to thick branch deployment, Versa FlexVNF presents operators with the same best-in-class, broad VNF feature set on the smaller form factor Titanium Edge product. This deployment model may be more economical or practical for some branch sites. While the overall capacity of this configuration may be more constrained, the same rich VNF features and high reliability characteristics of the larger solution are fully maintained.

Wind River, Versa Networks, and Dell EMC have the products, experience, and expertise to enable successful thick branch or thin branch vCPE deployments.

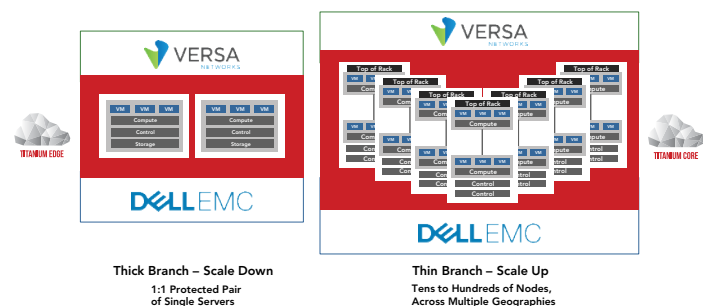


Figure 3. Thick branch and thin branch deployments

BEST-IN-CLASS MANAGEABILITY

All systems deployed, whether in thick or thin branch models, must be managed and maintained to ensure continuity of service. Operators need solutions that ease this burden, limiting OPEX to a minimum while ensuring high-quality service delivery.

The Titanium Cloud family of virtualization platforms is peerless in system manageability.

- A comprehensive fault detection and alarming system instantly notifies operators of issues that could impact service, with highly visible on-board notification and off-board reporting systems. This system feeds directly into existing OSS/BSS systems.
- A powerful patch delivery and orchestration engine independently manages the rollout and activation of product updates across all nodes.
- Upgrades from one major product release to the next are managed in place, with no system outages or service downtime.
- System debugging and problem investigation are accelerated through powerful log analytic tools and clear graphical visualization facilities.

Building on the platform's capabilities, Versa FlexVNF is itself fully operations ready, providing deep application insights through industry standard protocols and log formats and integrated big-data analytics. SNMP, IPFIX, and SYSLOG support ensures that existing network management, monitoring, and reporting systems integrate cleanly with FlexVNF.

Versa Director is the Versa management application, which simplifies the creation, automation, and delivery of network services using Versa FlexVNF software. It provides the essential management and orchestration capabilities needed to deliver Versa VNF-based network and security services for a variety of use cases. Network functions managed by Versa Director range from basic connectivity to branch security to SD-WANs with layered security.

Versa Director provides a single pane of management for connectivity and services. It scales to thousands of end customers through multi-tenancy and role-based administration.

Combined with Versa FlexVNF, Versa Director provides complete VNF infrastructure lifecycle management, from deployment and configuration to ongoing monitoring and change management of Versa and third-party VNF-based services with automatic action such as auto-healing and auto-scaling.

Dell's PowerEdge hardware platform also provides critical management tools that save time, minimize the potential for error, and improve efficiency. The integrated Dell Remote Access Controller 8 (iDRAC8) automates operating system deployment, server configuration, and updates, which increases time to production and return on investment (ROI). Dell's OpenManage Mobile feature allows CSPs to maximize data center uptime and control energy use by providing status updates on hardware health.

These features delivered by Wind River, Versa Networks, and Dell EMC provide operators with best-in-class vCPE manageability.

MAXIMUM RESOURCE UTILIZATION AND PERFORMANCE

FlexVNF delivers an unmatched set of network functions, providing incredible flexibility and enabling the rapid activation of new features as operators' needs change. All features, however, require underlying system resources to operate and deliver service. When running on the Titanium Cloud family of virtualization platforms, Versa FlexVNF has more cores available to it per processor than when on any competing virtualization platform. What's more, the network throughput for FlexVNF is also greater on Titanium Cloud.

Titanium Cloud includes an advanced virtual switch (AVS) built from the ground up for NFV deployment. The engineers who built AVS have more than a decade of experience working with the Data

Plane Development Kit (DPDK). By focusing on the NFV market, AVS is able to achieve line rate virtual switching performance using fewer processor cores than any other virtual switch. This frees up more cores per processor than do competing solutions, enabling a greater density of FlexVNF functions and ultimately ensuring that operators are driving the greatest number of services possible out of their platform investment.

A further advantage of the AVS architecture is that Versa FlexVNF achieves a much higher network throughput than on standard systems based on open vSwitch (OVS)—15 to 40 times higher, depending on the application.

From a network function perspective, Versa FlexVNF supports a broad set of deployment options and can be installed in both legacy network and new SDN environments. It takes full advantage of multi-socket and multi-core processors and DPDK support for maximum use of underlying hardware resources, resulting in excellent performance and throughput.

Lastly, Titanium Cloud has been uniquely optimized for use on Intel architecture processors, resulting in consistent and predictable application performance. Enhanced Platform Awareness (EPA) features are deeply embedded into Titanium Cloud, which ensures that operators can tune FlexVNF functions to deliver exactly the degree of performance they require, according to their customer SLAs.

The foundation for the vCPE solution's high performance is Dell's PowerEdge hardware platform. Powered by latest Intel Xeon E5-2600 v4 family of processors, with up to 22 cores per processor, the 1U two-socket rack servers deliver performance, density, and internal expandability for customized workloads, including high-performance computing, infrastructure scale-out, collaboration, and productivity applications as well as surveillance and site security. Performance can be accelerated and memory capacity expanded because PowerEdge features 12 DIMM (dual in-line memory module) slots and DDR4 memory. I/O performance is further increased with up to 10 high-IOPS hard drives and two PCIe 3.0 I/O slots.

Only vCPE solutions with FlexVNF running on Titanium Cloud and supported by Dell EMC PowerEdge servers can deliver these advanced resource utilization and performance benefits.

BREAKING VENDOR LOCK-IN AND ENABLING CHOICE

As CSPs undergo the transition of their businesses from a model characterized by purely physical network functions to the realm of virtualized network functions, they are eagerly aiming to break free from vendor lock-in and adopt standardized solutions across their network. Suppliers will flourish if they support this model by implementing standard interfaces and open APIs, with portability across virtualized infrastructures and hardware platforms.

The virtual CPE solutions offered by Wind River, Versa Networks, and Dell EMC are steeped in the traditions of choice and openness. From the rich set of Versa FlexVNF virtual network functions themselves to the underlying Titanium Cloud platforms, the solution components are 100% software solutions, and each one is fully independent of any underlying infrastructure or hardware device. While this solution uses Dell edge servers for vCPE, Wind River and Versa also support a broad range of physical servers from the industry's largest suppliers, including major telecom equipment manufacturers (TEMs) and enterprise IT leaders.

Open interfaces and APIs are supported at every solution level, including standard management and orchestration APIs offered over REST, SNMP interfaces for OSS/BSS systems, and standard logging interfaces for problem investigation and troubleshooting. Should new or unforeseen application needs arise, Titanium Cloud supports a broad catalog of pre-integrated applications, so that operators are free to grow and add functions to their vCPE solution as the situation dictates. Even third-party network functions can be managed by Versa Director, further underscoring the openness of this solution.

Wind River and Versa are committed to supporting CSP choice and breaking vendor lock-in.

PRE-INTEGRATED SOLUTION VERSUS BUILD-YOUR-OWN

Some companies may prefer to develop and build their own vCPE solutions rather than working with trusted partners. While this may seem attractive in the short term, the costs can be significant in terms of direct expenditure as well as lost market opportunity.

Together, Wind River, Versa Networks, and Dell EMC have dedicated teams of architects, software engineers, and validation specialists who have deep experience designing, building, and maintaining carrier class virtualization platforms, network functions, and physical servers. These individuals are plugged into industry-leading open source projects and forums and are helping to advance the state of the art in their respective fields. Companies that look to staff their own development efforts will find that attracting talent of this nature is difficult, costly, and time-consuming.

It is estimated that choosing a pre-integrated infrastructure solution offers a 12- to 24-month time-to-market advantage over in-house development, which assumes that the team fielded already has the necessary expertise in Linux, KVM, DPDK, OpenStack, virtual switching, security, and a myriad of networking stacks and protocols.

Companies choosing to deploy this Wind River–Versa Networks–Dell EMC solution are able to focus their own resources on immediately accelerating customer trials and the deployment of new revenue-generating services. That's very attractive compared to the alternative of putting those efforts on hold for more than a year while in-house teams try to catch up and build something that comes close to the award-winning¹ performance and reliability we deliver today.

Rather than just taking our word for it, we encourage companies to plug their own numbers into the Wind River ROI calculator (Contact Wind River) to see for themselves what a difference a pre-integrated solution can make to their revenue and profitability.

COMPLETE vCPE SOLUTION DELIVERS BUSINESS BENEFITS

The complete enterprise vCPE solution from Wind River, Versa Networks, and Dell EMC delivers the flexibility, performance, and carrier grade reliability that enterprise customers expect from

managed service offerings. For CSPs, these advantages translate into business value that includes lower OPEX, ensured revenue, and faster time-to-market.

- With AVS performance that is up to 40 times faster than OVS, VM density is maximized to allow CSPs to serve more customers from the same server, which reduces operating costs. The virtualization platform is optimized so that the AVS uses fewer cores for switching traffic, while Versa Networks VNFs—which are customer-serving, revenue-generating workloads—have more cores to use per processor than any competing platform.
- The solution's carrier grade reliability enables CSPs to maintain service uptime and guarantee SLAs for enterprise customers, which protects service revenue. The combined solution delivers 99.9999% availability (less than 30 seconds of downtime per year), which is facilitated by the ability of Titanium Cloud to perform hitless upgrades and patches, automatic fault detection and recovery, accelerated VM migration, and telecom-grade security.
- With the fully integrated solution comprising the virtualization platform, a broad set of VNFs, and the server hardware, CSPs can increase time-to-market by shortening development time frames and focusing on services.

CONCLUSION

Enterprise vCPE provides a significant opportunity for service providers to accelerate the delivery of managed business services, capitalize on upselling additional services, and greatly reduce operating costs. But without the right solution, vCPE will be a missed opportunity. In the transition to network virtualization, service providers need vCPE solutions that deliver carrier grade reliability as well as flexibility, service agility, and cost savings.

The integrated solution from Wind River, Versa Networks, and Dell EMC delivers what service providers need for successful vCPE deployments. With the broadest set of VNFs for a variety of business services, running on a virtualized platform that delivers industry-leading performance and carrier grade reliability, underpinned by compact and powerful Intel Xeon family hardware, CSPs have a complete enterprise vCPE solution that is ready for deployment today.

REFERENCES

1. Versa Networks awards: [Frost & Sullivan, 2016 SD-WAN Vendor of the Year](#); Gartner Cool Vendor 2016; [Current Analysis “Very Strong” SD-WAN Vendor](#). Wind River awards: [2016 Carrier Networks Virtualization Award NFV of the Year](#), [2016 Internet Telephony’s NFV Product of the Year](#).

APPENDIX 1: TITANIUM CLOUD ECOSYSTEM FOR ENTERPRISE vCPE AND OTHER USE CASES

In addition to developing pre-integrated, complete enterprise vCPE solutions that are ready for deployment, Wind River works with a variety of suppliers through the Titanium Cloud Ecosystem partner program. All NFV solutions in the partner program have been validated and pre-integrated with Titanium Cloud, providing more choice for service providers when evaluating vCPE options.

The ecosystem spans four NFV product categories: OSS/BSS systems, NFV orchestration solutions, VNF providers, and standard server platforms.



Figure 4. Titanium Cloud Ecosystem

APPENDIX 2: TITANIUM CLOUD FEATURES

The Titanium Cloud portfolio includes the industry’s only fully integrated, ultrareliable, and deployment-ready family of virtualization platforms that enable service providers to deploy virtualized

services faster, at lower cost, and with guaranteed uptime. When service uptime is critical for profitability, Titanium Cloud products ensure that virtualized services run when, where, and how they need to by providing:

- Flexibility to scale your services—up, down, in, and out—rapidly and efficiently, deploying new services dynamically both when and where they are needed
- Performance to maximize the number of subscribers you support on each server while minimizing operating costs
- The carrier grade reliability you need to keep your services up—always

The following highlights the key features of Titanium Cloud:

- **99.9999% reliability:** Titanium Cloud ensures uptime SLAs can be met as required by telecom applications. This is achieved with carrier grade availability and reliability optimized throughout the software stack, such as fast VM failover that’s up to 50 times faster than standard IT grade systems.
- **Packet performance:** 20 Gbps line-rate performance achieved using only two cores, which is the industry’s best vSwitch performance. Live VM migration is achieved with less than 150 milliseconds.
- **Fully integrated, open, and interoperable:** Titanium Cloud is built from OpenStack using carrier grade plugins. It includes industry-standard Linux, KVM, and Ceph, and it is compliant with industry-recognized telecom open standards.
- **Scalable:** Titanium Cloud is a complete, turnkey product, pre-integrated and ready for deployment, supporting deployments from as small as two nodes up to hundreds of nodes across geographies. It supports open APIs for provisioning and management to enable thousands of VMs.
- **Supported by the Titanium Cloud Ecosystem:** A rich ecosystem of NFV hardware, management software, and VNFs has been validated with Titanium Cloud, creating an open and flexible environment to enable third-party software.

