



Seeding the Cloud

Use Case Automation for Sandvine's Cloud Deployments

A joint whitepaper
written by



and



EXECUTIVE SUMMARY

Network operators are working feverishly to meet the challenge of moving their existing complex multi-vendor services from proprietary hardware deployments to a more dynamic cloud infrastructure. The pressure is on to drive down total cost of ownership (TCO), increase service velocity, and maximize flexibility in their networks to stay competitive and profitable. The pending introduction of 5G is also driving mobile operators to aggressively move their core to the cloud to prepare for the architecture transition; however, wishing it were so, does not simply make it so. Migrating services to the cloud offers lower cost and higher flexibility features, but introduces many challenges with existing software solutions as it requires an entirely new deployment paradigm. There are performance, scalability, reliability, increased complexity, and especially architectural framework immaturity challenges that are faced daily by the trailblazers moving to cloud deployments today.

It can be argued that Network Function Virtualization (NFV) has failed to deliver on its promise to remove dependencies on vendor hardware; it has so far, as everyone underestimated how hard the business and technology transition would be. At the same time, NFV is an architectural framework that underpins the virtualization of software that runs in the cloud, so NFV has moved the industry forward even though new cloud challenges are arising.

Apart from the vendors that have the most to lose from the cannibalization of their existing installed base, network vendors have embraced the cloud transition. Some are more aggressive than others, with many new vendors starting from a cloud-native foundation and others taking longer to transition from their existing hardware-centric solutions. The lack of maturity of cloud platforms and its impact on VNF vendors is making the transition hard for network operators to attain their cloud nirvana.

This whitepaper has been jointly produced by Sandvine and Wind River. It details how Sandvine, a leading network intelligence vendor, migrated use case solutions into the cloud and its certification effort with Wind River, a prominent cloud infrastructure provider.

MIGRATING TO THE CLOUD: CHALLENGES AHEAD

Operators are tackling this challenging journey step by step, one part of the network at a time. This transition has meant changing the underlying hardware, processes, platforms, and new approaches in software development and delivery.

Sandvine's approach to all of this has been to move along this path without compromising on features or capabilities. Sandvine realizes that a "component by component" and a "VM by VM" approach to cloud leaves too much complexity to be managed by the operator. Instead, Sandvine is approaching the problem from a solution packaging, or as Sandvine calls them, use cases with a cloud delivery approach. This involves tailoring a set of VNFs, or a network service (NS), for solving a particular problem with a particular solution.



This compartmentalized approach drastically simplifies a long list of problems that the operator does not have to deal with when solutions are self-contained:

- **Scaling the solution:** Not just a VM, but also the dependencies between VMs and scaling them at the right time is tricky and requires building new network paths, new control plane elements, scaling APIs and data paths.
- **Sequencing:** “First do that, then start that, then configure that, then bring that up, then call that, then register there” logic across a whole network solution is really complex, but reducing the scope to “ready to go use cases” automates all of that sequencing and simplifies the challenge.
- **Solution resilience:** What does component A do when component B goes down? How does the fault tolerance work across the components in the solution?
- **Platform dependencies:** Being cloud platform agnostic – Sandvine’s packaging of use cases has been developed to be agnostic of the underlying cloud technology. Sandvine makes use of technology that “always works” and “works out-of-the-box.” Sandvine then rigorously tests on all supported platforms, use case by use case, platform by platform, and then retest, in regression, for each of the software releases over time.
- **Acceptance testing:** These test tools, test cases, and test plans are also available to the operators to speed up testing efforts in the wild and deploy as easily as our use cases.

All in all, the Sandvine use case packaging brings radical simplicity to deploying a solution to the operator that the Telco world has not seen before. Much like launching a ready-to-go product from AWS Marketplace, the Sandvine use case packages brings a “menu” of solutions to the Telco cloud.

The cloud framework allows network operators to choose different vendors at each layer of the framework. This forces vendors to not only evolve their products for cloud, but also integrate/certify their solutions with other vendor’s solutions at different layers of the framework stack. Sandvine has invested heavily on migration of its solutions to cloud. As part of this, Sandvine has converted all physical network functions (PNFs) into virtual network functions (VNFs) and then whole solutions or use cases to network services (NSs). Besides this, Sandvine has certified solutions on multiple cloud platforms with leading orchestration solutions to create an ecosystem that is well-tested for interoperability. In fact, each use case package comes pre-packaged at the orchestration level, with ready to go orchestration templates for the supported cloud platforms.

MEETING THE CLOUD PLATFORM CHALLENGE

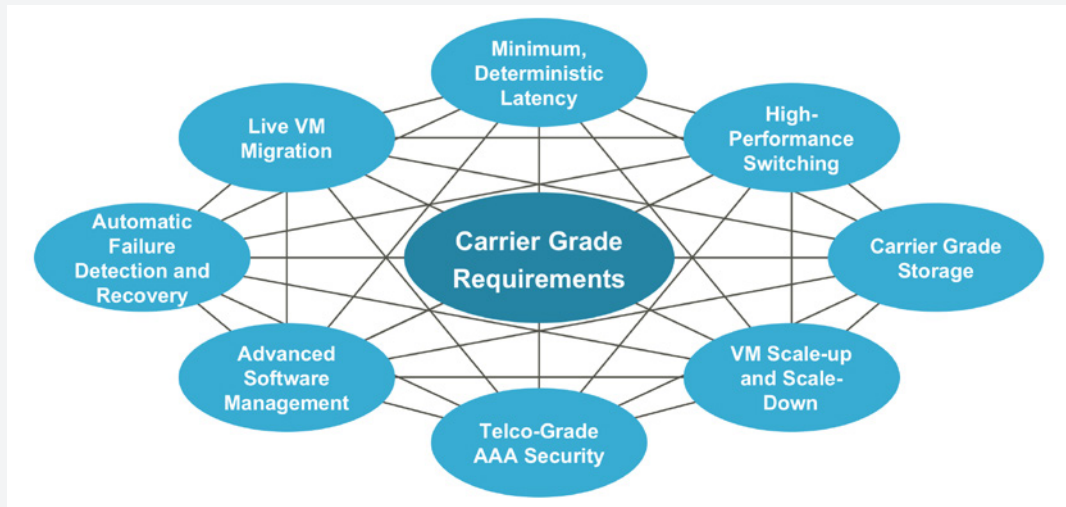
The operator journey to the cloud started with the introduction of NFV and SDN into the operator community. Network operators began modernizing their network using SDN and NFV, which provided flexibility to choose best of breed solutions at different layers of the ecosystem. However, this introduced a new interoperability challenge that needs to be addressed by the network suppliers. To accelerate this process, Sandvine is certifying its solutions across multiple vendor’s NFVI and cloud stacks, which ensures that these platforms will interoperate in commercial deployments without exhaustive integration and testing by the customer to enable real world deployments.

In modernization of their network, network operators need to deliver services with the same—or better—carrier grade reliability and performance as they have on their traditional hardware-based networks. Doubts about NFV’s carrier grade capabilities have lingered among operators since the concept was first introduced. To achieve carrier grade reliability, the core cloud software (mainly the open source OpenStack) needed to be hardened and optimized to deliver carrier grade performance and reliability.



Figure 1

Titanium Cloud:
True Carrier Grade
Reliability



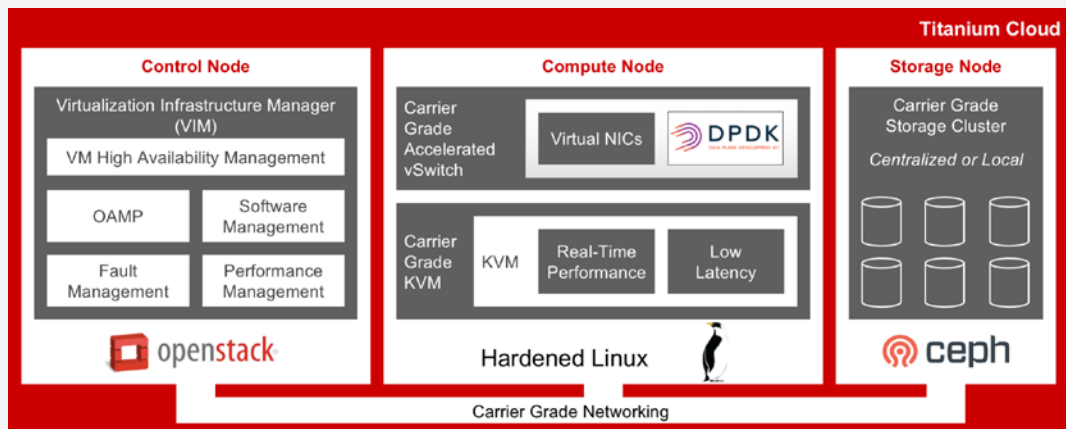
Titanium Cloud is the industry's only fully integrated, ultra-reliable, and deployment-ready virtualization platform that enables operators to deploy services faster, at a lower cost and with guaranteed uptime.

When service uptime is critical for profitability, Titanium Cloud products ensure virtualized services run when, where and how they need to, by providing the following:

- Flexibility to scale services up, down, in, and out – rapidly and efficiently, deploying new services dynamically
- Ultra-low latency with deterministic performance optimized per use case
- Streamlined management and orchestration across all Titanium Cloud systems
- Validated customer's end-to-end use cases to meet their needs
- Carrier grade reliability needed to keep services up – always

Figure 2

Titanium Cloud
Components



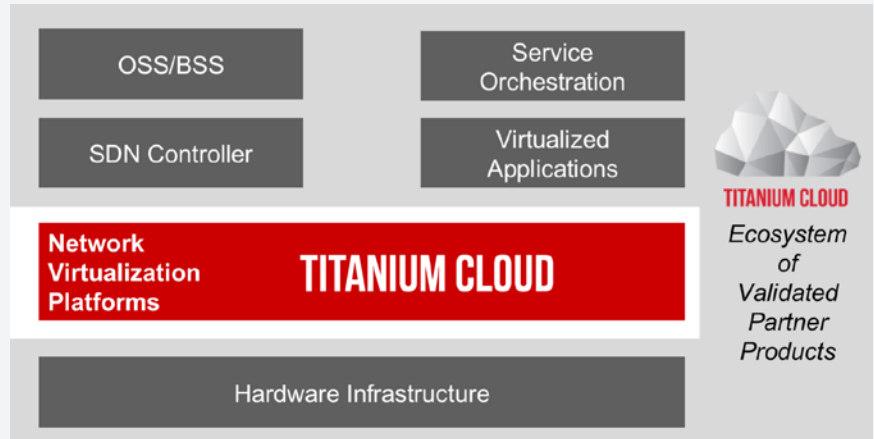
Titanium Cloud is based on StarlingX, the OpenStack virtual infrastructure platform that meets the stringent performance, manageability, security, and reliability requirements of service providers. With features like fast, secure virtual machine failover and live migration with less than 150 milliseconds downtime, Titanium Cloud ensures SLAs continue to be met as technology continues to be virtualized. In addition, Titanium Cloud offers a unique ability



to scale down to a minimum of two servers while still delivering the full feature set and high reliability. Lastly, to ensure services run as they demand, there is deterministic low latency support for use cases and applications.

Figure 3

Titanium Cloud Ecosystem:
Proven Multi-vendor Compatibility



MEETING THE CLOUD PACKAGING CHALLENGE

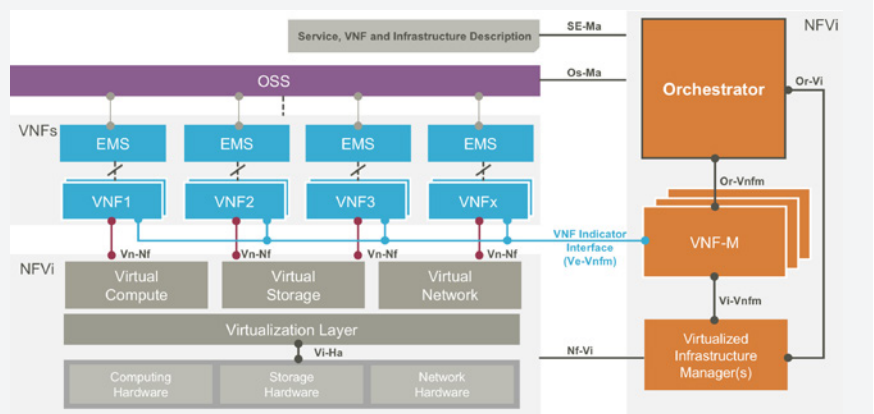
The networking industry has been heavily influenced by the transformation of network functions from a fixed hardware-centric approach to a highly agile, software-based approach. Among many, one of the major reasons for this transformation is the scalability constraints of these network functions and the cost associated with it, which was not compatible with the demands of a dynamic and changing NS market. Leveraging on the success of IT virtualization and cloud, NFV opens the door for required agility in delivering NSs with extreme efficiency.

In November of 2012 under ETSI, NFV ISG (Industry Specification Group) was founded. This specification group developed the ETSI NFV framework, which includes the Management and Orchestration (MANO) framework. Figure 4 depicts the NFV-MANO ETSI framework. This structure has the building blocks needed to develop a cloud-based environment for network operators and is used by both operators and vendors alike.

Backed by industry-leading PacketLogic technology, which can be deployed as hardware,

Figure 4

ETSI NFV MANO Reference Framework
(Sandvine VNFs shown in blue)

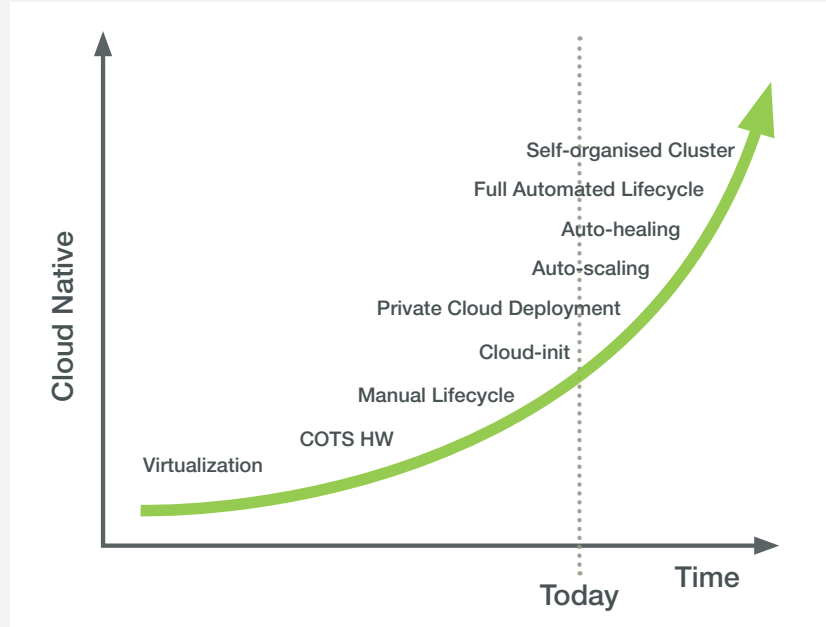




software, or a cloud-orchestrated VNF without performance or feature compromises, Sandvine has been leading the network intelligence and subscriber QoE market throughout the networking industry transformation journey. Now, Sandvine is a software-focused company that provides use cases consisting of various VNFs, which are packaged solutions as a NS, fully supported by a best-in-class partner ecosystem.

Figure 5

Sandvine Solutions' "Cloud Native" Journey



The Figure 5 above presents at the high level Sandvine's solutions journey towards cloud native. We are continuously adding features to the Sandvine solution to increase the industry's pace towards cloud native Active Network Intelligence use cases.

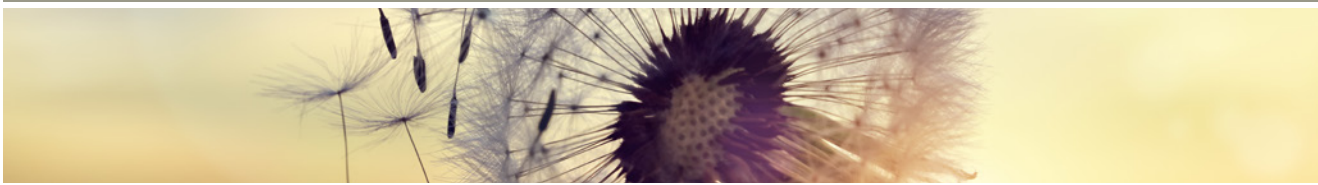
SANDVINE USE CASES IN CLOUD

This section details Sandvine's solutions' interoperability testing with Titanium Cloud. Figure 6 represents Sandvine's VNFs and Wind River's Titanium Cloud solutions' interoperability relationship with respect to the NFV framework.

Figure 6

Sandvine and Wind River's Titanium Cloud Interoperability Testing



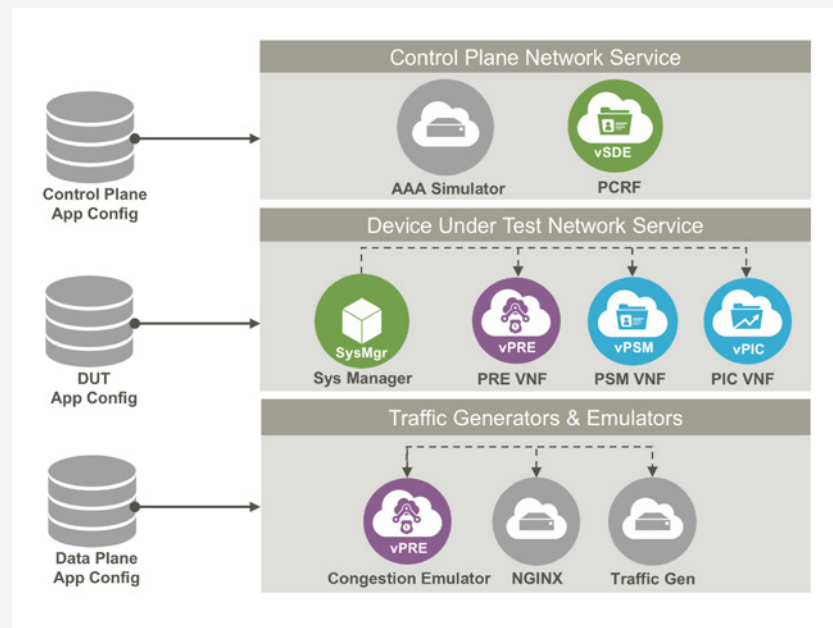


For this certification, Titanium Cloud platform, which is based on OpenStack, was used on Dell servers. For the cloud orchestration, Heat along with HOT template was used, although other options for orchestration have been certified as well. All Sandvine use cases consisting of various VNFs are instantiated as per the Heat packages written in YAML.

Figure 7 shows the architecture of the Sandvine NS certified with Wind River and other vendor's solutions. In order to completely test the solution, both control plane and data plane are tested.

Figure 7

Network Service Test Architecture



Sandvine's certification solution consisted of three NSs (network services). Each of them were instantiated individually with separate Heat package.

- **Device Under Test Network Service (DUT NS):** This is the main NS which represents the PacketLogic Cloud solution. It consists of a number of vPRE, vPSM and vPIC VNFs. Internal networks used to interconnect VNFs within NS were also created as part of the DUT NS. The use case functionalities to be tested are implemented in DUT NS.
- **Traffic Generators & Emulators:** This emulates data plane network elements (vEPC, CMTS, traffic generators, etc.). Different types of traffic are used for different Sandvine use cases.
- **Test Control Plane NS (Test CP NS):** This emulates control plane network elements (PCRF, AAA, etc.). Different types of Test CP NSs are used for different Sandvine use cases.

These NSs are connected through an internal network, which is instantiated separately.

WIND RIVER TITANIUM CLOUD KEY CAPABILITIES TESTED

Wind River Accelerated Virtual Switch (AVS)

Wind River Accelerated Virtual Switch (AVS) has been used to provide the OpenStack networking backend for Sandvine VNFs. AVS uses vhost DPDK/user-level backend for VirtIO networking. Vhost reduces virtualization overhead by moving VirtIO packet processing tasks out of the qemu process and sending them directly to the DPDK-accelerated vSwitch, via the vhost-user driver. Sandvine VNFs use VirtIO driver to communicate with Wind River AVS.



Enhanced Platforms Awareness (EPA)

Wind River Titanium Cloud supports multiple EPA features. These features were used by Sandvine in the interoperability testing:

- **CPU Pinning:** Dedicated CPUs were used by Sandvine for the data plane VNF (PRE). Control Plane VNFs, which do not use high packet processing rates, shared CPUs amongst each other.
- **Guest Memory Backing:** Huge Pages with 1 GB size were used for Sandvine's data plane VNF (PRE).
- **NUMA Awareness:** NUMA-aware memory allocation was used in order to collocate guest VM memory inside single hypervisor NUMA node.

Neutron Port Security

Port security allows Neutron to drop packets whose destination MAC and IP are different from Neutron port MAC/IP. Since Sandvine VNFs need to receive pass-through traffic, Neutron port security needs to be disabled. Neutron port security in Wind River Titanium Cloud is disabled by default, which was used for this testing.

SANDVINE PACKETLOGIC KEY CAPABILITIES TESTED

Service Discovery and Health Checks

The Sandvine PacketLogic Cloud solution includes a mechanism for VNF service registration and discovery. This allows a Sandvine VNF to register itself as a service in the distributed key-value store and write its own metadata as well. Other VNFs in NS will utilize information in the key-value store for configuration purposes, retrieving it via the distributed key-value store REST API. This approach is used to form the configuration flow procedure and track changes in VNF states.

Use Case Configuration Automation

The use case configuration automation has been implemented for the Sandvine PacketLogic solution. The System Manager VNF acts as a point of configuration distribution. During startup, each VNF retrieves its configuration data from System Manager and applies it locally. Sandvine VNF uses information stored in the distributed key-value, in order to enrich configuration with required metadata and know state of other VNFs in NS. This configuration approach applies for all NSs.

Auto-scaling

The Sandvine PacketLogic Cloud solution supports auto-scaling as described in Figure 8 on the following page. The auto-scaling group consists of a number of PacketLogic vPREs, which together forms a cluster. The number of vPREs in the cluster is defined by Heat template attribute. The load balancing mechanism between vPRE instances is based on Linux bridge with bonding (implementing a Link Aggregation Group). The SysMgr VNF collects vPRE metrics via the VNF Indicators interface, calculates the average metrics of the vPRE and triggers scaling the process in OpenStack Heat, if the calculated value is outside the configured thresholds.

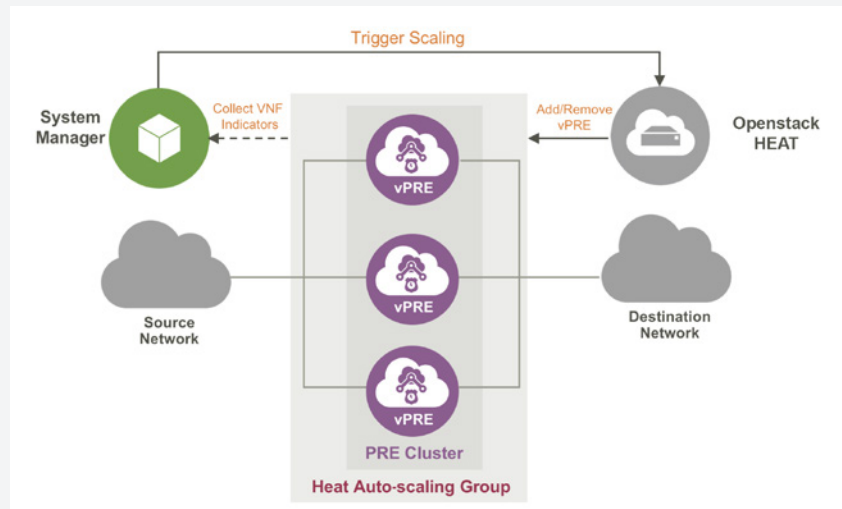
External APIs

The Sandvine PacketLogic Python API and REST API were used for VNF configuration purposes. The VNF was monitoring with SNMP protocol.



Figure 8

Auto-scaling Architecture



Detailed Specifications Used for Testing

In order to certify Titanium Cloud, a single controller node and two compute nodes were used. Separate 10 GB interfaces were used for provider and tenant networking. This table shows details of the environment.

Table 1: Certification Specifications

Solution Area	Use Case
Hardware	Dell R740 rack servers
Software	Wind River Titanium Cloud 17.1 (Release 4)
VNF	PacketLogic 19.0
Traffic Generation	TRex in ASTF mode
Test Setup	Sandvine wireless and wireline IMIXs

Current Sandvine Use Cases Tested in the Cloud

Sandvine's use cases make networks more efficient, enable service differentiation, rationalize a variety of data sources, and create the possibility of increasing profit margins. Sandvine enables network operators to deploy these use cases to ensure that their networks deliver a high quality of service to their users as advertised. Sandvine is committed to provide all use cases available in cloud and is making tremendous progress on this front. All new use cases will be made available in cloud as well. Table 2 shows current use cases available in the cloud.

Table 2: Certification Specifications

Component	Details
Analytics	Performance and Operational Monitoring Capacity Planning User Behavior and Demographics Analysis
Network Optimization	Fair Usage and Congestion Management for Mobile Networks Fair Usage and Congestion Management for Cable Networks Fair Usage and Congestion Management for Satellite Networks Fair Usage and Congestion Management for WiFi Networks Carrier Grade NAT Traffic Steering/Divert Video Streaming Management Wholesale and Peering Link Management Heavy User Management



THE PATH FORWARD

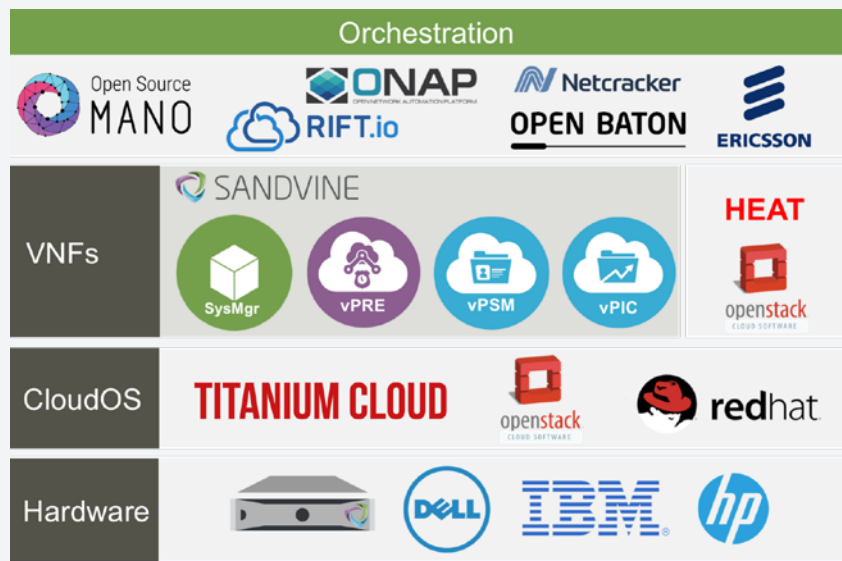
Rich Ecosystem with Extensive Interoperability Certification

While certification with Wind River’s Titanium Cloud is a big step forward, Sandvine believes in ensuring a rich ecosystem with various prominent cloud infrastructure and orchestration providers being certified.

Figure 9 shows the certification progress to-date from both cloud infrastructure providers and orchestration solution providers. More and more vendors are being added in this ecosystem after thorough certification testing.

Figure 9

Rich Ecosystem after thorough interoperability testing



Customer Demo and Proof of Concept in the Cloud

Sandvine has set up cloud-based environments with COTS hardware and open source OpenStack software to showcase its various solution capabilities. This allows customers to get a clearer view of Sandvine’s cloud-based solutions’ capabilities, and the additional value it brings to customers’ environments at an early stage.

To see a carrier-ready, cloud-based demo of Sandvine solutions or to speak with one of our experts, please contact the sales team at sales@sandvine.com

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ABOUT SANDVINE

Sandvine helps organizations run world-class networks with Active Network Intelligence, leveraging machine learning analytics and closed-loop automation to identify and adapt to network behavior in real-time. With Sandvine, organizations have the power of a highly automated platform from a single vendor that delivers a deep understanding of their network data to drive faster, better decisions. For more information, visit sandvine.com or follow Sandvine on Twitter at [@Sandvine](https://twitter.com/Sandvine).



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