The carrier network is undergoing the biggest transformation since the beginning of the Internet. Video, mobile, and cloud usage is driving huge growth in traffic and overwhelming the current networks. The ability to introduce new services quickly and to respond to constantly changing traffic patterns and location-based demographics is the key to success and growth for communications service providers (CSPs) and providers of telecom equipment.

In order to be successful in this telecom transformation, CSPs and equipment providers must find new ways to design and build network architectures that can improve agility and reduce operating costs. Many CSPs are looking to apply successful IT technologies—such as commercial off-the-shelf (COTS) hardware and the mass virtualization and cloud deployment of applications—to the carrier network. This approach has led to the creation of Network Functions Virtualization (NFV), which defines specifications for the virtualization and management of services deployed as software in virtual machines (VMs), rather than tied to physical, proprietary hardware (see Figure 1).

**Figure 1: Network Functions Virtualization**

- Virtual Firewall
- Virtual Packet Inspection
- Virtual Content Delivery
- Virtual Gateway
- Virtual Routing
BENEFITS OF USING WIND RIVER TITANIUM SERVER

• Accelerate your time-to-market by up to 18 months, removing the need to integrate, test and document multiple technology components from different vendors and open source.
• Focus your development activities on revenue-generating applications.
• Maximize the performance of your virtualized applications.
• Ensure your solution achieves the level of reliability that is an absolute requirement for telecom networks.
• Run your existing applications and management systems.
• Maintain carrier levels of security and authentication.

COMPONENTS

• **Carrier Grade Linux**: Industry-leading, carrier grade Wind River Linux provides the foundation for reliability, security, availability, and performance needed for the carrier network.

• **Real-time Open Virtualization**: Wind River Titanium Server adds kernel preemption support to the industry standard Kernel-Based Virtual Machine (KVM) hypervisor, with 40x lower interrupt and high resolution timer latency for deterministic, predictable performance.

• **Accelerated vSwitch and inter-VM communication**: A high performance user space vSwitch based on the Intel® Data Plane Development Kit (Intel DPDK) enables high performance VM-to-VM communication without the need to use the Linux kernel, as well as high performance packet processing from the NIC to applications in VMs. Support for Intel DPDK, SRIOV, and 1G, 10G, and 40G Ethernet ensures ultra-fast packet processing.

• **Carrier grade OpenStack**: OpenStack is the industry's leading open source cloud platform—but OpenStack is designed for IT-grade clouds. Titanium Server adds the reliability and availability extensions required to use OpenStack in the carrier network. This includes VM migration in hundreds of milliseconds rather than minutes, faster VM failure detection, automatic recovery of failed VMs, VM resource management, and faster host and controller node failover.

• **Carrier grade middleware**: Management tools designed for the carrier network are overlooked or non-existent in IT-based solutions. Titanium Server delivers live patching of platform components without loss of service, and hitless upgrade of platform software for all nodes in the cloud.
KEY CARRIER GRADE FEATURES

Availability
- Automatic VM recovery on failure of a host compute node (node failure detection in seconds rather than minutes)
- Automatic VM recovery on failure of a VM (VM failure detection 60x faster than standard IT grade)
- Live migration of VMs using Intel DPDK (not available in IT-grade OpenStack)
- Controller node redundancy and automatic failover (not available in IT-based OpenStack)
- VM monitoring tied into application health checks within the guest
- VM protection groups (ensuring VMs of the same group are created on different compute nodes)

Carrier Grade Management
- Software management; live patching and hitless upgrade
- VM management; fast and easy VM definition and creation
- High availability management of applications
  - Overlay on top of OpenStack, providing five 9s availability
  - Carrier grade fault management, isolation, and recovery
- Simplified telecom deployment
  - Fast and easy VM instance definition and creation
• Centralized OAM services
  – Fault management and performance management
• Seamless integration in telco OSS systems
  – Pass-through application fault and performance feeds
  – Platform and hardware alarms

Performance and Scalability
• Predictable performance through validated and restricted resource assignment to VMs
• High scalability; 100,000+ subscribers
• High performance networking services delivered to VMs
• High performance VM-to-VM communication
• Low latency interrupt and timer services to VMs

Networking Services
• Guest network abstraction (logical vs. physical)
• Private and public networking
• Intra-host and inter-host network connectivity
• Guest addressing and configuration (DHCP)
• Guest network isolation and security
• Multi-segment and multitenant support
• Internet network connectivity
• Guest domain name services (DNS)
• Network interface migration and associated addressing, state, and statistics

Reliability and Availability
• Fault tolerance to single and multiple software and hardware faults
• Designed for carrier grade target of minimum five 9s availability
• Overlay on top of cloud VM management
• Support for a variety of redundancy models, including 1:1, N load-shared, N:1, N:M, ensuring a single fault cannot impact service
• Minimal loss of service or data on failover
• Failure switchover outages in hundreds of milliseconds (depending on application complexity)

WIND RIVER PROFESSIONAL SERVICES
A CMMI Level 3–certified organization, Wind River Professional Services offers consultative thought leadership, deep technical capabilities, and innovative industry solutions to help you overcome your most pressing strategic development challenges. Professional Services offers a variety of services around Titanium Server platforms, including guest OS validation, VNF, orchestrator and server hardware validation, onsite consulting, design and development services, and more. For more information, visit www.windriver.com/services.