



WIND RIVER TITANIUM CONTROL

The existing industrial control systems infrastructure has provided a stable, secure, and reliable platform for the past 20 years. But in many areas these legacy systems are reaching end of life, and ongoing maintenance and updates are becoming complicated and cost prohibitive. In addition, legacy equipment was not built to effectively access the data within these systems, which severely limits the usefulness of this data.

With Wind River® Titanium Control, Wind River has built on its experience in real-time operating systems to build from the ground up an on-premise cloud infrastructure for critical services and applications that can improve agility and reduce operating and deployment costs. Our approach is to apply successful IT technologies such as commercial off-the-shelf (COTS) hardware and the mass virtualization and cloud deployment of applications. Technologies such as OpenStack and Kernel-based Virtual Machine (KVM) have emerged as de facto standards for cloud and virtualization. By combining these technologies with data plane acceleration and virtual machine (VM) management services, we are defining a new class of on-premise cloud infrastructure capability for the industrial automation market. Titanium Control is the industry's most reliable and highest-performing on-premise virtualization platform.

Titanium Control is supported by the Wind River Titanium Cloud™ Ecosystem, ensuring a complete end-to-end set of solutions, including validated COTS platforms from leading hardware vendors and pre-validated virtual network applications. Wind River also provides all the support and professional services you need to develop and deliver complete solutions for network virtualization.

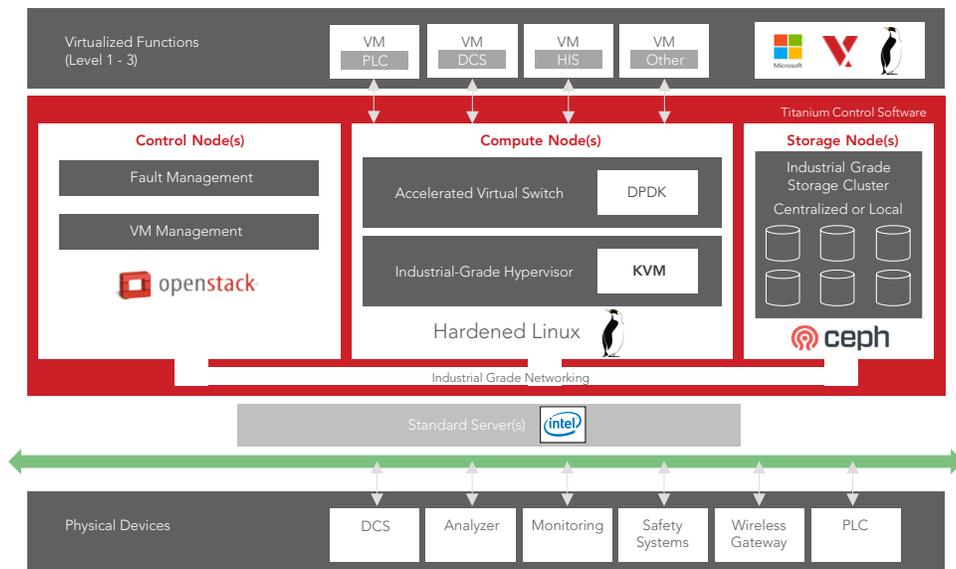


Figure 1. Wind River Titanium Control

KEY BENEFITS

- Leverage on-premise cloud capability that can reside alongside legacy critical infrastructure, allowing for an evolution of legacy services and a platform for new services.
- 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.
- Reduce operating expenses by maximizing the performance and capacity of your virtualization platform.
- Lower your footprint and capital expenses for on-premise applications, while maintaining high reliability and performance.
- Choose between running existing applications and management systems unchanged, or optimizing for high performance and reliability.
- Maximize operational efficiency by giving your teams complete visibility into the network, with control where they need it and automation where they don't.
- Ensure compatibility and future-proofing with open APIs based on open source and de facto open standards.

COMPONENTS

De Facto Standard Open Source Software for Cloud and Virtualization

- **Linux:** Enterprise-focused Linux, plus 700+ patches, provides the reliability, security, availability, and performance needed for industrial automation.
- **Real-time KVM:** Based on years of embedded experience with KVM, Titanium Control adds kernel and user space optimizations to the KVM hypervisor to deliver consistent and deterministic, predictable performance.
- **OpenStack:** OpenStack is the industry's leading open source cloud platform—but OpenStack is designed for IT-grade clouds. Titanium Control adds the reliability and availability extensions required to use OpenStack-based orchestration. 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.
- **Ceph:** Ceph provides a highly scalable, highly available, highly performing distributed storage solution.

High Performance and High Availability Where It's Needed

- **Accelerated vSwitch and inter-VM communication:** A high performance user space vSwitch based on the Data Plane Development Kit (DPDK) enables high performance VM-to-VM communication, bypassing the slow path through the Linux kernel, as well as high performance packet processing resulting in near-real-time performance from the network interface card (NIC) to applications in VMs. Support for DPDK; SR-IOV; and 1G, 10G, and 40G Ethernet ensures ultra-fast packet processing.
- **Virtual infrastructure management:** Management tools designed for the industrial customer are overlooked or nonexistent in IT-based solutions. Titanium Control delivers live

patching of platform components without loss of service, automation facilities for the application of patches throughout the cluster (saving significant manual labor), and hitless upgrade of platform software from one major release to the next for all nodes in the cloud.

KEY FEATURES

Availability

- Fault tolerance to single and multiple software and hardware faults
- Support for a variety of redundancy models, including 1:1, N load-shared, N:1, and N:M, ensuring a single fault cannot impact service
- 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 (60x faster than standard IT grade)
- Fast live migration of VMs—even those using DPDK
- Controller node redundancy and automatic failover (not available in IT-based OpenStack)
- Optional high resolution VM monitoring via guest VM defined health checks
- VM protection groups (ensuring VMs of the same group are created on different compute nodes)
- Minimal loss of service or data on failover

High Availability Management

- Overlay on top of OpenStack cloud VM management, providing six-nines availability
- Software management; live patching and hitless upgrade
- VM/application graceful shutdown
- VM management; fast and easy VM definition and creation
- High availability management of applications
- Comprehensive fault management, isolation, and recovery
- Platform and hardware alarms
- Extensive alarming with support for historical alarm queries
- Event logging for all non-alarm conditions
- Logs generated for all VM state transitions
- Pass-through application fault and performance feeds

Performance and Scalability

- Predictable performance through validated and restricted resource assignment to VMs
- Automatic resource scaling; increasing or decreasing a VM's resources without requiring a restart
- Small two-node configuration ideal for on-premise critical services and applications
- Single node configuration where needed for non-high-availability applications while using single orchestration for on-premise cloud
- High scalability; hundreds of nodes, thousands of VMs, multi-regions
- High performance networking services delivered to VMs

REQUIREMENTS

Processors: Titanium Control requires Intel® Xeon® processors

NICs: 1, 10, and 40 GB DPDK-enabled ports are supported

Operating system: Minimum one core, recommended two cores

Virtual switching: Minimum one core, recommended two cores

RAM: Compute node minimum 32 GB; controller node minimum 64 GB

Disk: Minimum 500 GB

Remaining cores and resources can be used for applications and virtual network functions.

- High performance VM-to-VM communication
- Low latency interrupt and timer services to VMs

Security

- UEFI secure boot and cryptographically signed images for host environment protection
- TLS with certificate storage in TPM hardware to protect management operations
- Industry-leading virtual TPM device (vTPM) that enables highest-security VM deployments
- Critical process monitoring and recovery on Wind River Titanium Cloud nodes for run-time environment protection
- Secure keyring database for storage of encrypted passwords
- Network firewall on external OAM interface for protection of management perimeter
- Role-based access control mechanism
- Secure password enforcement
- Active password aging
- Restricted access to root account and root commands
- Automatic logout of inactive user sessions
- External LDAP integration—keystone

Networking Services

- Guest network abstraction (logical vs. physical)
- High performance DPDK-based accelerated virtual switch for highest packet performance and low latency
- Support for SR-IOV and PCI pass-through
- Support for VM access to high performance hardware encryption and compression accelerators
- Accelerated Distributed Virtual Router (A-DVR); scalable accelerated routing with no single point of failure
- VLAN and VXLAN segment identification protocols
- Link aggregation group (LAG) for link redundancy and protection
- Private and public networking
- Intra-host and inter-host network connectivity
- Guest addressing and configuration (DHCP)
- Guest network isolation and security
- Integrated firewall
- Rate limiting
- Multi-segment and multi-tenant support
- Internet network connectivity
- Guest domain name services (DNS)
- Network interface migration and associated addressing, state, and statistics

