WIND FORUM KOREA 2017

The Evolution of Legacy Control Systems

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KEY IIOT CHALLENGES

COMPONENT → SYSTEM -LEVEL OPTIMIZATION

COLLISION OF DOMAINS: IT/OT

BUSINESS MODEL DISRUPTION
FACTORY ARCHITECTURE (Today)

Problems
- Rigid, single-purpose
- Siloed & proprietary
- Firmware SW model
- Expensive to deploy
- Air-gap security

Barriers to change
Real-time requirements & compute proximity to Things
SMART FACTORY ARCHITECTURE (Future)

Architecture disruption
- On-demand, flexible
- Open multi-vendor
- New Apps SW spiral
- Rapid deployment
- OpEx instead of CapEx
- APT Security & Countermeasures
REAL-TIME
System-optimized Networking e.g. TSN

SAFE
Virtualization System partitioning Development processes

SECURE
End-to-End Hardware root of trust Lifecycle security
CLOUD CHARACTERISTICS

- On-Demand Self-Service
- Scale Economics & Flexible Pricing
- Rapid Elasticity
- Resource Pooling
- Ubiquitous Network Access
WHERE DOES IT FIT? (CLOUD IS EVERYWHERE)

EDGE – On Premises

MIST

FOG

Virtualized Platform

Gateway

Real-Time Control & Analytics at the Edge

Industrial Control Room
A&D Operations

Hybrid Cloud

CLOUD

AWS, Azure …
DETERMINISM
FUNCTIONAL SAFETY
ACCESSIBILITY
SECURITY
INTEROPERABILITY
SERVICE CONTINUITY
REGULATION
LONG LIFECYCLE
INTERMITTENT NETWORKS

... IN CRITICAL INFRASTRUCTURE WITH UNIQUE CONSTRAINTS?
### Why Now?

#### Motivations for Change

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<tr>
<th><strong>Industrial Pain Points</strong></th>
<th><strong>Technology Enablers</strong></th>
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<td>▪ High integration, maintenance costs</td>
<td>▪ The Internet of Things (IoT)</td>
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<td>▪ Obsolescence cycle</td>
<td>▪ Virtualization</td>
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<td>▪ Capital cost reduction pressure</td>
<td>▪ Cloud</td>
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<td>▪ Current systems limit or lag innovation</td>
<td>▪ Open platforms</td>
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<tr>
<td>▪ Poor component interoperability</td>
<td>▪ Analytics / machine learning</td>
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<td>▪ Insufficient system security model</td>
<td>▪ Proof points from adjacent industries</td>
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**INDUSTRIAL IOT REQUIREMENTS FOR CRITICAL EDGE USE CASES**

| Reliability and Availability | - Fault tolerant to multiple software and hardware faults, no single point of failure  
|                             | - Must be able to run on premises without failing: possible air gap in some use cases  
|                             | - Minimal loss of service or data on failover  
| Management                  | - Software management: live patching and hitless upgrades  
|                             | - Service orchestration: Evolution of current services with minimal disruption to plant  
|                             | - Ability to unlock the data at the edge  
| Performance and Scalability | - Support time-critical industrial applications and services, e.g., soft PLCs  
|                             | - Provide an on-premises critical cloud platform from the device to the data center  
|                             | - Provide high-performance service to service networking with minimal core utilization  
| Security                    | - Support hardware-based security capability  
|                             | - Provide network-level authentication  
|                             | - Provide data protection via encryption  

**Titanium Control meets these requirements**
TITANIUM CONTROL INDUSTRIAL CLOUD PLATFORM

VM – Container System Orchestrator

Host any guest OS
Add high-performance storage cluster
Add high-availability cloud management and middleware functions
Add near real time switching performance low latency
Add critical real-time virtualization performance enhancements
Based on standard open source components

Legend
Existing
New

IT SYSTEMS
Cross-Domain Virtual Functions

Control Node
Industrial Grade Cloud Management and Middleware
VM High Availability Management
OAMP
Fault Management

Compute Node
Industrial-Grade Accelerated vSwitch
Virtual Nics
DPDK

Storage Node
Industrial Grade Storage Cluster

Titanium Control Software

Industrial Grade Linux
Commodity Server HW (Multi-Core x86 Hardware)

Real-Time Service Bus
DCS
DCN
DCN
Analyzer
Machinery Monitoring
Safety Systems
Wireless Gateway
PLC

Real-Time Functions
L1 – L3 Functions
I/O Processing
Regulatory Control Application Hosting

Network Services
Core Real-Time Functions

VM
PLC 1
VM
PLC 1
VM
SCADA
VM
Other

Based on open source components: QNX, Red Hat, Ceph

WHEN IT MATTERS, IT RUNS ON WIND RIVER.
FULLY SCALABLE SYSTEM-LEVEL ARCHITECTURE

Small-Scale Solution

Two nodes

Frame-Level Solution

4–100 nodes

Large-Scale Solution

Hundreds of nodes

Titanium Control: Ideal for vCPE and Enterprise Edge Use Cases

1:1 Protected Pair of Single Servers
EDGE DEVICES: SIMPLEX SYSTEMS

- Single Platform Control, Compute, Storage designed for small footprint out to the edge
- HA functionality limited due to no hardware redundancy
- All other functionality remains
- Integrated orchestration across on premise fog
- Further scaling in progress..
MULTI-FACETED SECURITY

TOP DOWN
- Full Authentication control
- AAA
- Encryption

ACROSS THE SYSTEM
- Integrated Measurement Architecture
- Isolation

BOTTOM UP
- Silicon linked through EPA
- TPM, VTPM
- Encryption
- Secure Boot
TITANIUM CONTROL MINIMIZES OPERATIONAL COSTS

▪ Saves Millions of Dollars in Installation, Commissioning, and Maintenance

▪ Delivered as single, pre-integrated image
  – Operating system plus OpenStack plus Virtualized Infrastructure Manager (VIM)
  – Easily deployed to all nodes without manual intervention: no separate installation nodes
  – Simplifies and accelerates installation and commissioning

▪ In-service software upgrades via system-aware wizard or REST APIs
  – Complete platform upgrades with no service downtime

▪ Intelligent orchestrated patching engine
  – Patch up to hundreds of nodes quickly and with no service downtime

▪ Comprehensive system visibility and alarms
  – Extensive analytics and cloud monitoring to simplify network support
PRE-INTEGRATED SOLUTION ACCELERATES DEPLOYMENTS

- Titanium Control pre-integrated high performance on-premises cloud solution
  - Linux OS plus 700+ carrier grade patches
  - KVM with performance and reliability extensions
  - OpenStack
  - High availability cloud management and middleware
  - Near real time performance vSwitch
  - Ceph storage

Integration brings guaranteed reliability plus accelerated time-to-market.
- Significant advantage compared to roll-your-own approaches
- Based on standard open source components, extended with open and public interfaces
- Complemented by extensive professional services capabilities to accelerate deployment
AVOIDING VENDOR LOCK-IN THROUGH OPEN STANDARDS AND APIs

- Goal Is Multi-Vendor Solutions with Proven Interoperability

- Solution providers’ goal: Leverage best available products at each level of the system
  - Not constrained by monolithic single-vendor products

- Adopt new or better solutions as soon as they’re available
  - Not limited by long release cycles for proprietary, integrated products
  - Telecom market now open to companies with pure software expertise

- Requires proven interoperability with open standards

Titanium Control is 100% open
USE CASE: DIGITAL TWIN

1. Real-time simulation and model feedback: closed loop simulation

2. Consolidate and virtualize control system on same platform
HEALTHCARE EXAMPLE

1. Consolidate and virtualize bedside monitors (>10:1)
2. Perform predictive waveform analysis
3. Change to push / mobility model
GENERALIZATION

1. Drive workload closer to data (LEARNING)

2. Consolidate and virtualize edge systems (CONTROL)
TITANIUM CONTROL BENEFITS

▪ **On premise cloud capability** that can reside alongside legacy critical infrastructure allowing for an evolution of legacy services and a platform for new services.

▪ **Reduced operating and capital expenses** for on premise applications while maintaining high reliability with scalability and near real time performance.

▪ **Accelerated deployment / time-to-market**, removing the need to integrate, test, and document multiple technology components from different vendors and open source.

▪ **Operational efficiency** by giving full visibility and control where it’s needed and automation where it’s not.

▪ **Compatibility, future proofing, and upgrades without service impact** via full decoupling of application layer, cloud infrastructure and hardware using open API’s between layers.