



# Edge Computing Operations: *Day-1 Deployment & Day-2 Management*

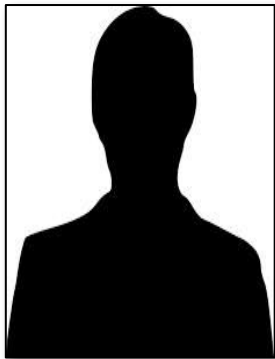
Titanium Cloud

Brent Rowsell & Greg Waines  
(Wind River Systems)



**WHEN IT MATTERS,  
IT RUNS ON WIND RIVER.**

# Who we are




## Brent Rowsell

- Principal Architect of Titanium Cloud,
- Wind River's Lead Project Member in StarlingX,
- Working with OpenStack since 2013,
- 25+ years of Telecom Experience.



## Greg Waines

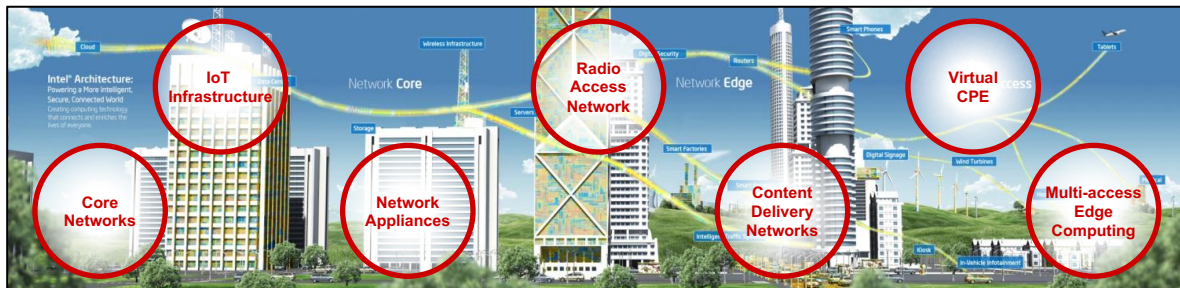
- Senior Architect of Titanium Cloud,
- Member of StarlingX Project,
- Contributing to OpenStack Vitrage and OpenStack Masakari,
- Working with OpenStack since 2013,
- 25+ years of Telecom Experience.



Our software has been deployed in over **2 billion devices**; into environments, systems, and applications subject to the highest standards of safety, security and performance.

# Wind River® Titanium Cloud Addresses Key Challenges

## Telco Infrastructure



- Proven, integrated virtualization platform saves Time-To-Market
- Delivers latency, resiliency and performance for Edge use cases
- Streamlined installation, commissioning and maintenance
- End-to-End security and ultra-low latency for Edge applications
- Full support for multi-layer HW and SW decoupling



## Energy



## Smart Buildings



## Manufacturing



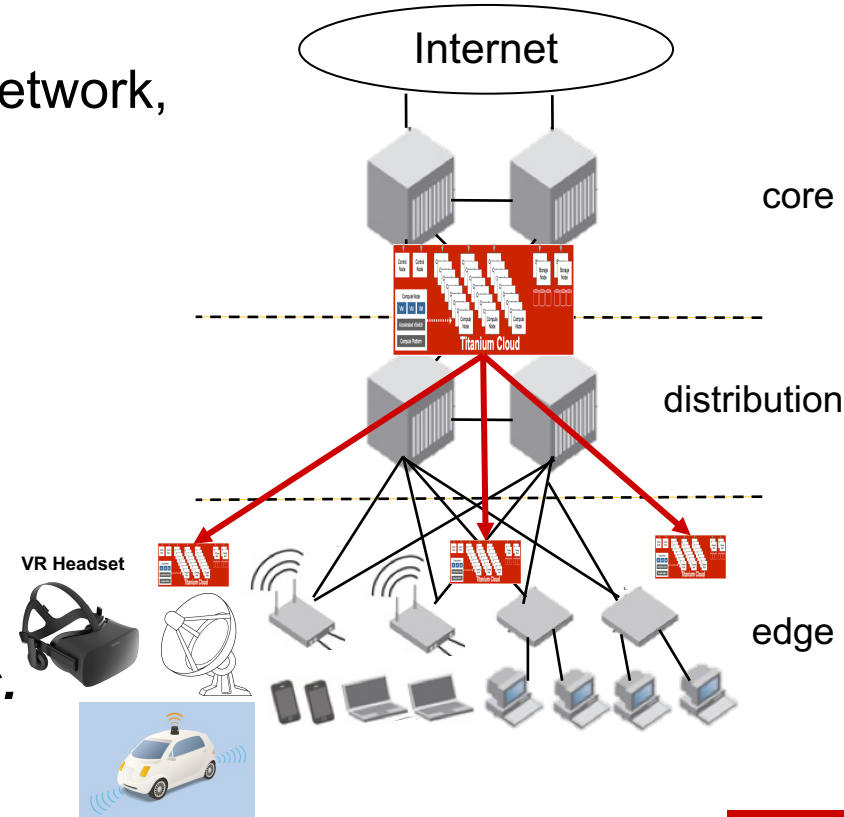
# Introducing StarlingX

- StarlingX is a new project being hosted by the OpenStack Foundation
- Formed with seed code from the Wind River Titanium Cloud portfolio
- Project will provide a fully integrated openstack platform with differentiators for high availability, Quality of Service, performance and low latency needed for industrial and telco use cases
- Aligned with the OpenStack Foundation Edge Working Group and the Linux Foundation Akraino Edge Stack

# Edge Computing

- Extending the cloud to the edge of the network, near the source of data,
- Reducing the latency between 'cloud services' and 'end-user devices',
  - Cloud Computing,
  - Cloud Storage,
  - Cloud Networking.

➔ ***Enabling new genres of applications.***





# Titanium Cloud – Distributed Cloud Project

Part of StarlingX Project

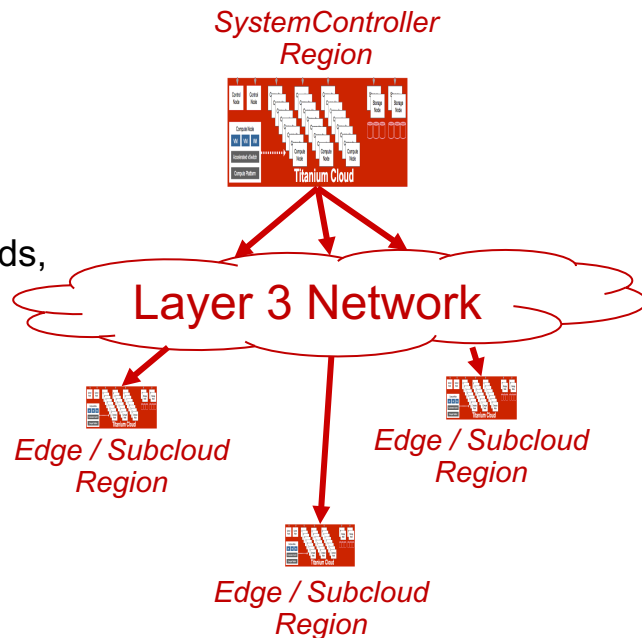
## Objectives:

- **Centralized Management** across *all* Edge Subcloud Deployments
- **Zero Touch Provisioning**
  - Day-1 Edge Subcloud Installation and Commissioning Simplicity
- **Single Pane of Glass**
  - Day-2 Centralized Management of System-Wide Configuration across *all* Edge Subclouds
- Scale to Large Number of Edge Subclouds,
- Scale Edge Subclouds both Small (i.e. Single Server) and Large (i.e. 100s of Servers),
- Maximize Edge Subcloud autonomy when communication to central control is lost.



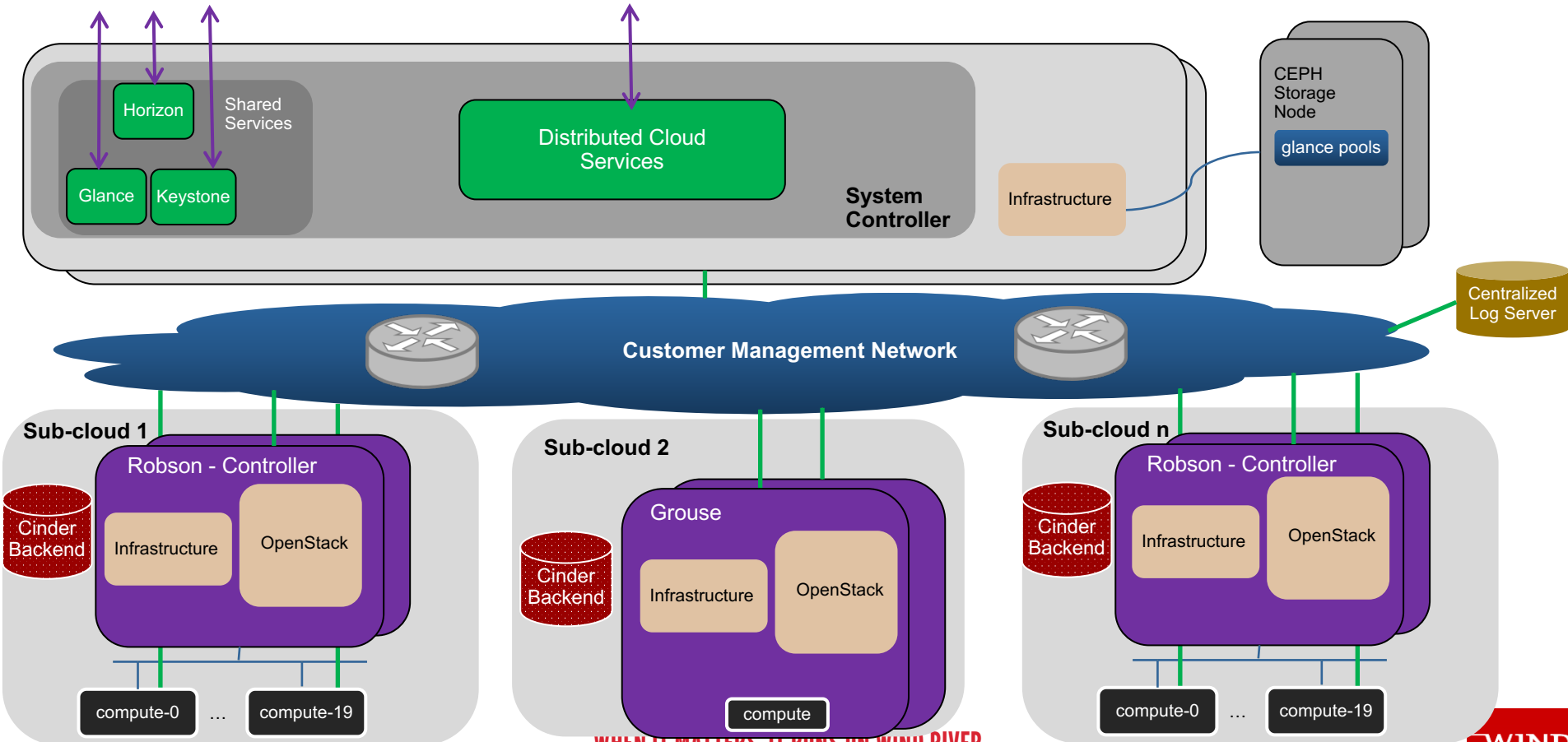
# Distributed Cloud - Solution Overview

- Based on OpenStack Regions,
- Central SystemController Region:
  - Hosting Shared Services and
  - System-wide Infrastructure Orchestration functions:
    - Deployment and Management of Subclouds,
    - Configuration portal for shared configuration across all Subclouds,
    - Fault aggregation,
    - Patching orchestration.
- Remote Edge / Subcloud Regions:
  - Geographically dispersed,
  - Connected via L3 network,
  - Running reduced Control Plane.
- Inter-Region Communications strictly REST APIs / L3.





# Distributed Cloud Project - Architecture

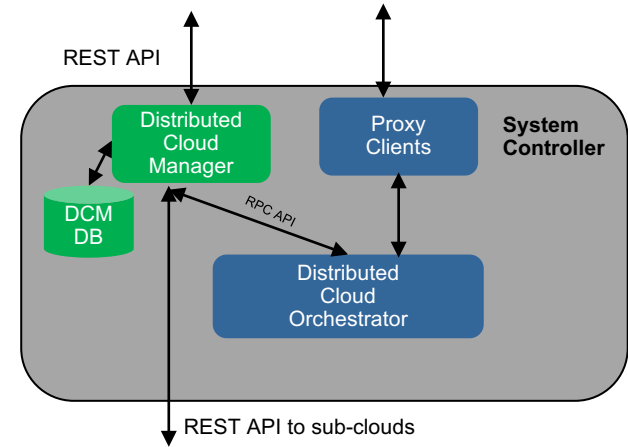


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# Distributed Cloud - Manager

- CLI/REST API to add/delete/modify/query Subclouds
- Manages Subcloud configuration and status
  - Configuration: name, management subnet, etc.
  - Status: availability, sync status, etc.
- Provides administrative commands to manage/unmanage Subcloud
- Manages alarms for Subcloud availability
- Audits Subclouds to determine overall availability status
- REST API for system wide patch orchestration



# Shared OpenStack Services

## ■ Keystone

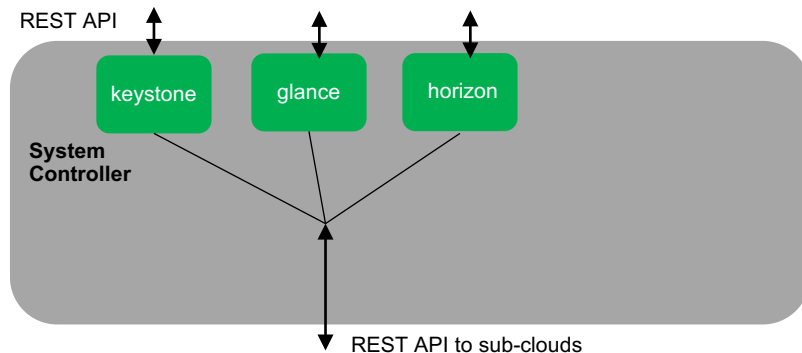
- Centralized Project and User Management,
- Future Blueprints:
  - Distributed across all Subclouds,
  - Centralized configuration portal and synchronization across all Subclouds.

## ■ Glance

- Centralized image management,
- Partially distributed solution; images are cached in Subclouds, reducing latency impact.
- Future Blueprints:
  - Distributed across all Subclouds,
  - Centralized configuration portal and synchronization across all Subclouds.

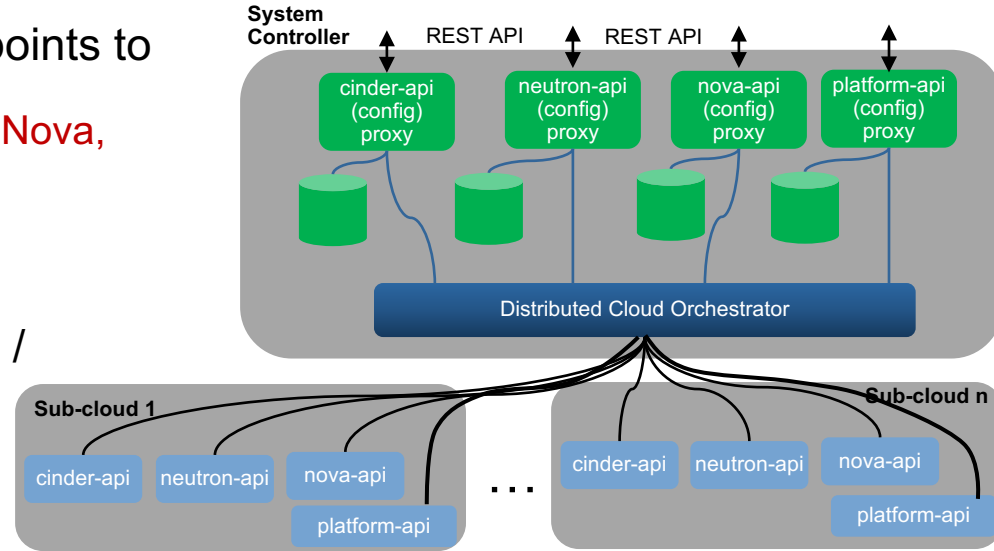
## ■ Horizon

- Single Central Horizon instance which can switch between Subcloud contexts.



# Distributed Cloud – Orchestrator: Synch Shared Config

- SystemController exposes external endpoints to provision
  - synchronized **OpenStack** configuration for **Nova**, **Neutron** and **Cinder**,
  - Synchronized **Infrastructure** configuration.
- Configuration updates made on the SystemController are applied to all Edge / Subclouds,
- As part of Edge / Subcloud Installation, synchronized **OpenStack** configuration is *automatically* applied.



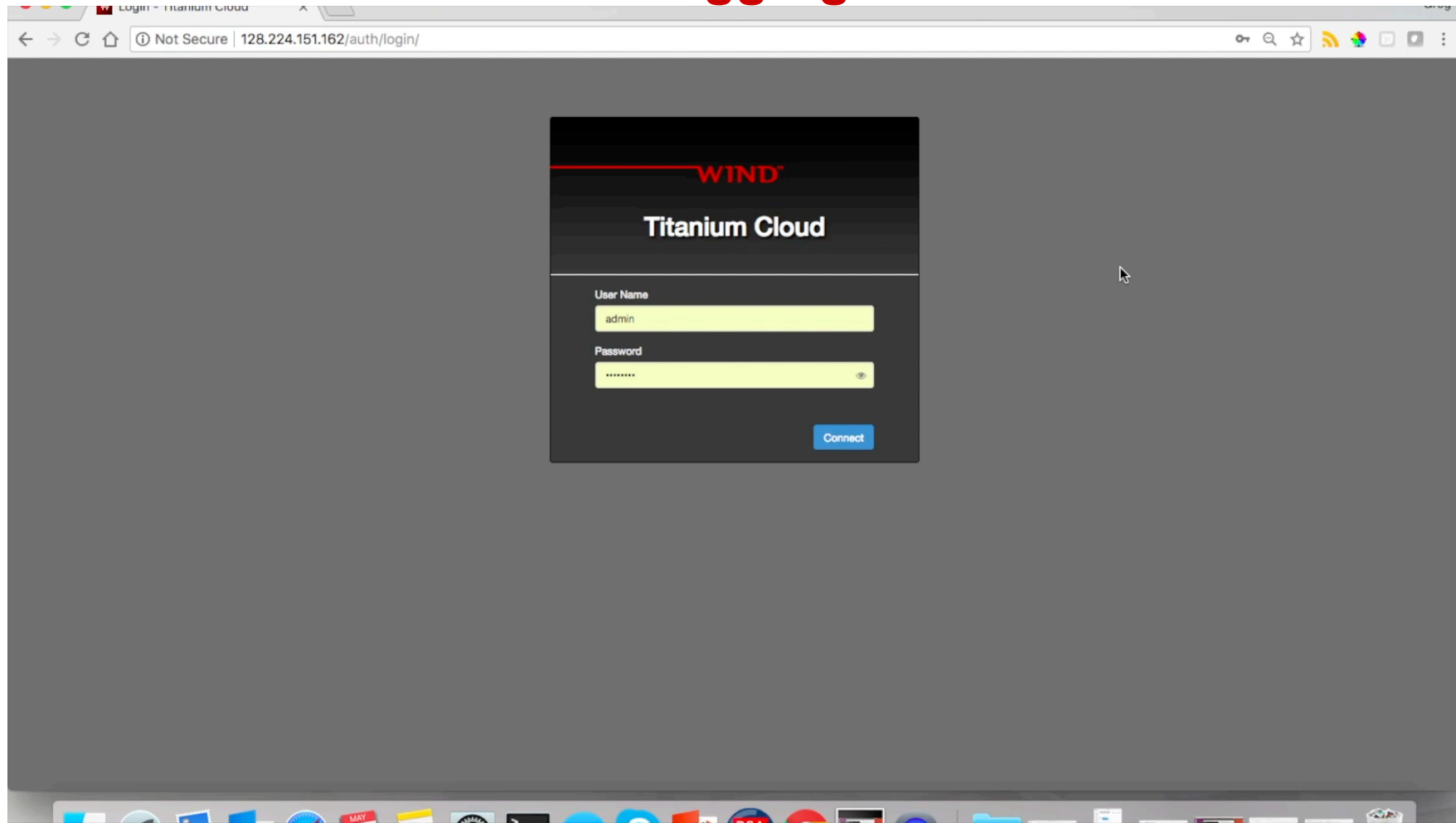
## Openstack Resources Synchronized:

- Nova: flavors, flavor extra-specs, keypairs, quotas
- Neutron: security groups, security group rules
- Cinder: quotas

## Infrastructure Resources Synchronized:

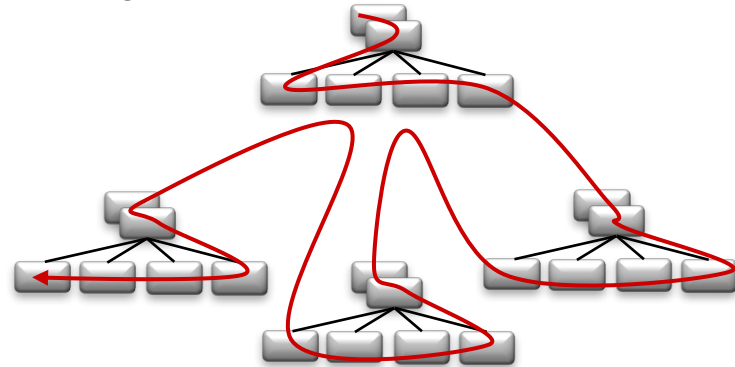
- DNS IP addresses
- NTP IP addresses
- OAM Firewall settings
- SNMP community and trapdest settings
- Remote logging settings

# Distributed Cloud - Alarm Aggregation & Subcloud Status



# Distributed Cloud - Software Patching Orchestration

- Patch == Software Update containing Bug Fixes and/or New Features.
- Orchestrate the application of software patches across entire distributed cloud.
- Applies Patch to SystemController Region first
  - Automatically iterating through all nodes of SystemController Region, ... and installs patch(es).
- Automatically **recursively** iterating
  - Through all Edge / Subcloud Regions,
    - And through all nodes in each Edge / Subcloud Region and installs patch(es).
- Automatically migrates VMs throughout procedure.
- A **MUST** for Edge Computing Systems
  - Improvement in usability of applying patches
  - Improvement in time to apply patches



# Distributed Cloud - Software Patching Orchestration

The screenshot displays the Titanium Cloud Distributed Cloud Admin interface. The top navigation bar includes the 'Titanium Cloud' logo, a sidebar menu with 'Project', 'Admin', 'Distributed Cloud Admin', 'Cloud Overview' (selected), 'Software Management', and 'Identity', and a top status bar showing the date and time (5/17/2018, 7:50:34 PM) and cloud status (Critical: 0, Degraded: 0, OK: 8).

## Cloud Overview

### System Controller

System Name	Alarm Status	Location	Actions
> Distributed-Cloud-Lab	OK	Ottawa-PhoenixLab-Aisle_3-Rack_A	Alarm & Event Details

### Subclouds

Filter

Cloud Name	Management State	Availability Status	Alarm Status	Sync Status	Location	Actions
> subcloud-1	managed	online	OK	in-sync	Ottawa-PhoenixLab-Aisle_3-Rack_B	Alarm & Event Details
> subcloud-4	managed	online	OK	in-sync	Ottawa-PhoenixLab-Aisle_3-Rack_C	Alarm & Event Details
> subcloud-5	managed	online	OK	in-sync	Ottawa-PhoenixLab-Aisle_4-Rack_B	Alarm & Event Details
> subcloud-6	managed	online	OK	in-sync	ottawa lab	Alarm & Event Details

Displaying 4 items

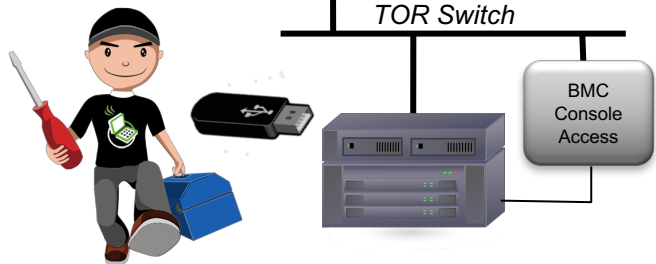
Connecting...



# Subcloud ZTP Installation

## At remote site

1. Server(s) are physically installed
  - TOR cabling, config and verification
  - BMC cabling, config and verification
2. Power up first controller
3. Load is installed on the first controller
  - Installation options:
    - USB stick
    - Pxeboot server on customer network
    - Staged prior to delivery to remote site
    - Login and set initial wrsroot pw



SystemController



## Remotely

1. Via remote BMC console, run pre-bootstrap utility
  - Sets up basic network connectivity
2. Add & Configure Subcloud via GUI,
3. Generate '*bootstrap configuration file*', Transfer to the Subcloud,
4. Run '*config\_subcloud*' bootstrap wizard,
5. Select '*Manage Subcloud*' to synchronize shared data to Subcloud.

➔ *Subcloud is ready for workloads.*

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# Subcloud ZTP Installation

The screenshot displays the Titanium Cloud interface for Subcloud ZTP Installation. The left sidebar shows the navigation menu with options: Project, Admin, Distributed Cloud Admin, Cloud Overview, Software Management, and Identity. The main content area is divided into three panes:

- Terminal Pane (yow-cgcs-wildcat-89):** Shows the connection process to the subcloud. The output is:

```
Trying 128.224.148.228...
Connected to 128.224.148.228.
Escape character is '^'.
Login:
You are now master for the port.
Escape Sequence is: Control-]
```
- VLM Client Pane (gwaines@yow-cgcs3-lx):** Displays a list of subcloud targets under the 'Network Labs' tab. The 'Target List' includes subclouds from yow-cgcs-wildcat-61 to yow-cgcs-wildcat-93. The 'yow-cgcs-wildcat-89' entry is highlighted.
- Target Information Pane:** Shows details for the selected target. The 'Property' table includes fields like Target Alias, BSP, IP Address, IP Addr Alias, IP Mask, Gateway, MAC Addr, Barcode, Architecture, CPU, CPU Bitsize, Clock Speed (MHz), L1 I-Cache (KB), L1 D-Cache (KB), L2 Cache (KB), Memory Size (MB), Flash Size (MB), Endianness, Boot Device, Boot ROM Version, Boot ROM Built with, Zone, Reserved By, Reserve State, Reserve Date, Reserve Note, and Power Off Upon Unre... The 'My Reserved Target' table shows the Barcode and Target Name for the selected subcloud.

Property	Value
Target Alias	yow-cgcs-wildcat-89
BSP	
IP Address	
IP Addr Alias	
IP Mask	
Gateway	
MAC Addr	
Barcode	
Architecture	
CPU	
CPU Bitsize	
Clock Speed (MHz)	
L1 I-Cache (KB)	
L1 D-Cache (KB)	
L2 Cache (KB)	
Memory Size (MB)	
Flash Size (MB)	
Endianness	
Boot Device	
Boot ROM Version	
Boot ROM Built with	
Zone	
Reserved By	
Reserve State	
Reserve Date	
Reserve Note	
Power Off Upon Unre...	

Barcode	Target
23517	yow-cgcs-wildcat-89
38294	yow-cgcs-wildcat-89

# Summary and Next Steps



## ■ Summary:

- Synchronization of OpenStack & Platform configuration & quotas across Subclouds,
- Fully Automated Orchestration of Patches across Subclouds,
- Aggregation of Alarms across all Subclouds,
- ZTP Installation of Subclouds.



## ■ Future Blueprints:

- Distributed Keystone for scalability and Subcloud autonomy,
- Securing Inter-Region Communications,
- Fully Distributed and Synchronized Glance,
- Synchronization of Configuration to 'selected' Subclouds,
- Inter-Subcloud VNF Lifecycle Management,
- Geo-Redundant SystemController,
- Upgrade Orchestration.

