Enabling Cross-Domain Service Activation

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Systems Engineer, Innovation Edge / Agile Development Team
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Agenda

- Introduction
- Key Cisco Orchestration Components
  - NSO
  - ESC
- Services Assurance Platform
- Use case: Virtual PE
- Use case: Virtual IP Multimedia System (vIMS) ClearWater
- Wrap-up
PNF & NFV Orchestration/Automation

What is it and why do we need it?
Market Expectations from the SDN NFV evolution?

Connectivity

Near Past
- Location based (Work / Home)
- Few
- Telecom: 18 months

NOW
- Device based
- Many
- Internet: 6 months

Near Future
- Ubiquitous
- Lots
- Social: Overnight
- Intelligence: Network+Analytics+Policy

Applications

Time to Deliver New Services

Information

How Does the “Networking” Operation Evolve?

Telecom: 18 months

Disjointed

Analytics

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Operations Evolution Drivers

- OpEx Reduction
- Agility
- New Revenue flows
What are the SDN and NFV operational requirements

- Expendable, flexible, Agile and scalable to quickly support New Services
- Automates complex PNF deployment & configuration
- Automates complex VNF deployment & configuration
- Simplifies Services lifecycle management
- Service Impact Root cause Analyse
- SLA – measured and enforced on per services basis
- Services SLA reports – Service Evidences

Agility
OPEX
Optimization

Self order portal

QoE
New Revenue Flows

Services Dashboards
Why Orchestration/Automation?  
**What’s it all about?**

- Automates complex PNF deployment & configuration
  - Flexible deployment policies
- Automates complex VNF deployment & configuration
  - VM relationship, dependencies, bring-up sequencing, affinity rules
  - Flexible deployment policies
- Simplifies VNF lifecycle management
  - Upgrades with minimal downtime
  - KPI monitoring to ensure high availability and performance
- Auto-Scaling & Auto-Healing
- The orchestration expected to be an open solution
  - Support for 3rd party components (VNFs, SDN, Infrastructure)
  - ETSI defined a reference architecture
Cisco Orchestration & Automation Solution

- Modular architecture that conforms to ETSI NFV framework
- Model driven design for declarative NFV & PNF orchestration
- Supports Cisco and 3rd party VNF Managers
- Supports Cisco and 3rd party SDN Controllers
- Supports Cisco and 3rd party VNFs & Devices
Understanding NSO

Cross-Domain Orchestration/Automation
NSO Main Features

Tail-f NCS Main Features

- Model-based architecture
- Transactional guarantees
- In-memory storage of configuration states for all services and all devices
- FastMap* algorithm for service-layer CRUD operations
- Reactive FastMap*

* Patent No.: US 8,533,303 B2

Multivendor physical/virtual Layer 2, Layer 3, and Layer 4-7 Network
NSO Main Feature 1: Model-Based Architecture

No hard-coded assumptions about:
- Network services
- Network architecture
- Network devices

Instead:
- Data models written in YANG (RFC 6020)

Multivendor physical/virtual Layer 2, Layer 3, and Layer 4-7 Network
NSO Main Feature 1: Model-Based Architecture

YANG data models for:
- Network services
- Network topology
- Network devices

YANG data models drive:
- Northbound APIs
- User interfaces
- Southbound command sequences

Benefits:
- Can be used for all types of services and all types of networks

Multivendor physical/virtual Layer 2, Layer 3, and Layer 4-7 Network
NSO Main Feature 2: Transactional Guarantees

**Transactional guarantees:**

- Help ensure fail-safe operations (automated handling of exceptions)
- Keep accurate copy of network configuration state in Tail-f NCS at all times

**Benefits:**

- Automation can be based on accurate real-time view of service and network state
- Much higher degree of automation possible
NSO Main Feature 3: FastMap* Algorithm

**FastMap:**
- Only the CREATE operation needs to be specified
- UPDATE, DELETE and REDEPLOY operations are automatically generated and compute minimal change set needed

**Benefits:**
- Reduces service implementation code by two orders of magnitude
- Supports modifications of services at runtime

* Patent No.: US 8,533,303 B2
NSO Main Feature 4: Reactive FastMap*

**Benefits:**
One algorithm supporting:
- Provisioning
- Orchestration
- Elasticity
- Virtual machine and VNF mobility
- Self-healing network

* Patent No.: US 8,533,303 B2
NSO – Architecture
NSO – Function Packs

- Mobility
- Virtualized Managed Services
- MANO

Function Pack is a package that addresses a specific use-case and is built on top of NSO.

Function Packs are not part of NSO and can be added at run-time.

Function Packs are customizable by customers and system integrators.
# Production Grade

## NEDs coverage

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PoC Grade
NEDs coverage

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NSO – Diversity of Use Cases

(list not exhaustive …)

- Multi-Vendor L2-L3 VPN
- Virtual Managed Services/NFV
- Data Center Automation
- Cloud Services Interconnection

Source: Cisco Global Segments & Architectures
Understanding ESC

Generic VNF Manager
Cisco Elastic Service Controller
ESC – Elastic Service Controller for the VNF life cycle Management

- Open and Modular VNFM
  - Out of the box support for new and 3rd party VNFs
- Agentless VM management and monitoring
- Customizations
  - Across different phases of lifecycle management
  - Service advertisement
  - Monitoring
  - Actions
- Intelligent rules based actions
  - Simple and complex rules
  - Works at Single VM or coupled VM level
- Transaction-level visibility, roll-back (Resume work in progress)
- Out of the box support for both VM and Service-level monitoring
Cisco Elastic Service Controller

**ESC functionality**

- **List of Events**
  - VM Alive
  - Service Alive
  - Upper load threshold crossed
  - Lower load threshold crossed
  - Service Dead
  - VM Dead

- **List of Actions**
  - Notify (callback)
  - Advertise Service
  - Withdraw Service
  - Restart VM
  - Scale up (add a VM)
  - Scale down (remove a VM)
  - Individually customizable action(s) for every event

- **Simple Rules**
  - Service Alive => advertise
  - VM Dead => withdraw
  - Upper load => scale up

- **Complex Rules**
  - Service Alive => Advertise, Notify
  - VM Dead => Withdraw, Notify, Restart
  - Upper load => Scale up, Notify, Advertise

**Agent and Agentless mode supported**

**Elastic Services Controller**

- Service Provisioning
- Service Configuration
- Service Monitor

- **VM Bootstrap process**
  - VM alive
  - Predefined Action
  - Custom Script Action

- **Service Bootstrap Process**
  - Service alive
  - Predefined Action
  - Custom Script Action

- **Service Overloaded/Underloaded**
  - Predefined Action
  - Custom Script Action

- **VM Overloaded/Underloaded**
  - Predefined Action
  - Custom Script Action

- **Service DEAD**
  - Predefined Action
  - Custom Script Action

- **VM DEAD**
  - Predefined Action
  - Custom Script Action

**ESCC functionality**

- ESC functionality
- Service alive
- Predefined Action
- Custom Script Action

- Service Monitor
- Service Provisioning
- Service Configuration

- VM Bootstrap process
- Service Bootstrap Process

- Service Overloaded/Underloaded
- VM Overloaded/Underloaded
- Service DEAD
- VM DEAD

- Custom Script Action
- Predefined Action

- Agent and Agentless mode supported

**ESC functionality**

- ESC functionality
- Service alive
- Predefined Action
- Custom Script Action
Services Assurance Platform
Service Assurance is a Service Lifecycle Problem

**SLA Definition**
- What SLA is required?

**Service Placement**
- Where can it be supported?

**Orchestration**
- Put it there

**Service Assurance**
- Verify the service is available and how it is performing
- Scale-up/down based upon load
- Local recovery actions if the VNF is unavailable/underperforming
- Identify underlying causes and fix them asap

---

**Service Level Definition**
- Service availability
- Loss, latency, jitter, ...

**Service Placement**
- Admission Control
- Workload Placement

**Service Provisioning**
- Service Availability
- Monitoring
- Reporting

**Service Monitoring**
- Service Elasticity and Availability
- Performance Mgmt
- Service Level Monitoring
- Fault management (cause analysis, Impact analysis)
- Incident / problem mgmt.
- Remediation

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New Services Assurance
Service Health - Impact Analysis & Fault and Cause Analysis-Processes

1. Automatically Filters Events
2. Analytics Detects Causal and Impact Anomalies
3. Situation Awareness: Push-Notifies appropriate stakeholders
4. Situation Enabled Workflow
5. Run Book / Playbook Automation
6. Knowledge Capture & Recycling

Triggers 10’s, 100’s, 1,000’s or 1,000,000’s of Events from Apps, Services, Compute & Network

Incident’s Happen!

Single Root Cause? Multiple Real Faults?

Link to the image and text: [Image and Text Link]
Services Assurance Platform - Service Health - Impact Analysis & Fault and Cause Analysis

- Orch. Stack
- UI
- Assurance Stack
- VNFs
- CPEs
- Service
- VNFI
- UCS
- Other EMS

- Event Aggregator
- Metric Aggregator
- Log Aggregator

- Distribution Bus
- Logs
- SNMP Traps
- TCA

- Service Impact Analysis
- Fault Analysis
- Situations & Alarms (Customer, Device, Service)
- Logs (Customer, Device, Service)

- Service Notification
- Log Analysis

- Inventory (Customer, virt, Overlay)
- Inventory (Customer, virt, Overlay Underlay)

- Metric (Customer, Device, Service) Using Metrics API

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Use case: Virtual PE

Demonstration of a cross-domain orchestration with NSO/ESC
Demo Infrastructure

- MPLS VPN with P routers and PE routers
- P3 providing connectivity to Data Center
Fulfillment using a physical PE

- MPLS VPN with P routers and PE routers
- P3 providing connectivity to Data Center
- Classic MPLS VPN site with CE connected to PE
Fulfillment using a vPE

- MPLS VPN with P routers and PE routers
- P3 providing connectivity to Data Center
- Classic MPLS VPN site with CE connected to PE
- Hybrid physical/virtual VPN with a virtual PE
- vPE comes in 4 models
Demo Moving Parts

<table>
<thead>
<tr>
<th>Building Blocks</th>
<th>Function</th>
<th>Vendor</th>
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<td>Network service orchestration and fulfillment</td>
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Use case: vIMS ClearWater

Multi-VIM Orchestration with NSO/ESC
vIMS Orchestration
Prototype Orchestration Overview

Web Portal
Prototype
Angular.JS/JAVA

Cross-Domain
Orchestration
NFV-O
NSO (Tail-f)

Netconf/YANG

Third Party
VNFs
vIMS
Clearwater
Ubuntu

Netconf/YANG

VNF
Management
VNF-M
ESC

DNS
Bind9
UE1 - Live
Testing
Ruby Script

VNF Management
VMWare
vCenter

OpenStack
RH OSP7

NFVI
VMWare

vCenter

OpenStack

vcenter

Compute
Storage
Network
vIMS Orchestration
Prototype Orchestration Overview
Takeaways
Cisco Solution Value

**Robust, modern architecture**
- No hard-coding, no predefined templates
- Full consistency across domains – true transactional model
- Devops/Netops environment across Service Lifecycle

**Loosely-Coupled Modules**
- No dependency between module: Fully open & documented APIs
- Inherently Multi-Vendor and Open Platform

**Field-proven technology**
- Components deployed across Major Tier 1 SPs
- Massively scalable without sacrificing reliability
- Vibrant Ecosystem – Devnet community

**Opportunity for Empowerment**
- Extend your Service offer
- Opportunity for the Cisco customer to provide new services