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Automation-First Approach to Network Infrastructure Modernization for 5G & Beyond

Arghya Mukherjee, Principal Architect

BRKNWT-2203

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Agenda

- 5G – Automation imperatives
- 5G – Automation approaches
- 5G & Beyond – Automation use cases
- Takeaways

Automation imperatives for 5G
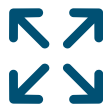
Challenges for Service Providers
Bandwidth Continues to Grow 50% Year-over-Year

The world has gone mobile

Changing Customer Expectations With AI, VR

3X Mobile Data Traffic Growth
(13–44 Mbps) From 2018-2023

Ubiquitous Access
to Apps & Services

Massive IP traffic growth, driven by video

27% CAGR 2018-2023

Year	Value
2018	268
2019	371
2020	493
2021	621
2022	755
2023	891

Connected 4K TV Sets (M)

UHD 15 –18 Mbps
HD 5 - 7.2 Mbps
SD 2 Mbps
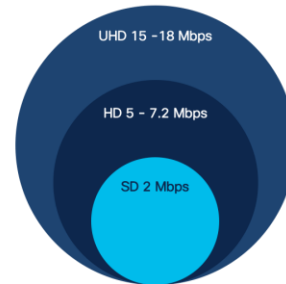
Rise of cloud computing

Changing SP Architectures/ Service Delivery

Changing Enterprise Business Models
Efficiency & Capacity

Digitization leading to IoT

Emergence of the Internet of Things

People + Process + Data + Things

Source: Cisco Annual Internet Report

OPEX pressures are driving SPs to take on automation & Orchestration initiatives

OPEX Pressures

- CSPs' network opex has been increasing since 2012.

- Opex as a percentage of revenue grew from 11% in 2012 to 15% in 2017

- Revenue declined by 13% during the same period.

- This is an unsustainable trend that will be exacerbated with the

Analysis Mason : Network automation: a solution framework for service agility and cost economics in cloud enabled 5G networks ; February 2020

Impact on Orchestration & Automation

50% of CSPs consider network automation to be a top-three initiative

Opex reduction is the main driver for network automation for **72%** of CSPs

52% of CSPs are already implementing basic network automation use cases

Source: Analysys Mason

Analysis Mason : Network automation survey: CSPs' automation initiatives ; MARCH 2020

Automating 5G End-to-End

A Transformational Journey driven by New Technologies & Operational process

Technology Transformation

Cross Domain

- 5G RAN & Open Ran
- Transport-SDN
- Telemetry-ML-AI
- Edge-Compute
- Telco Cloud
- 5G Core

5G End-to-End Orchestration = Automation & Service Assurance

Operations Transformation

Cross Organization

- Key Processes Evolution
- CI/CD
- Site Reliability Engineering
- DevOps
- New Skills and Roles
- AI Ops
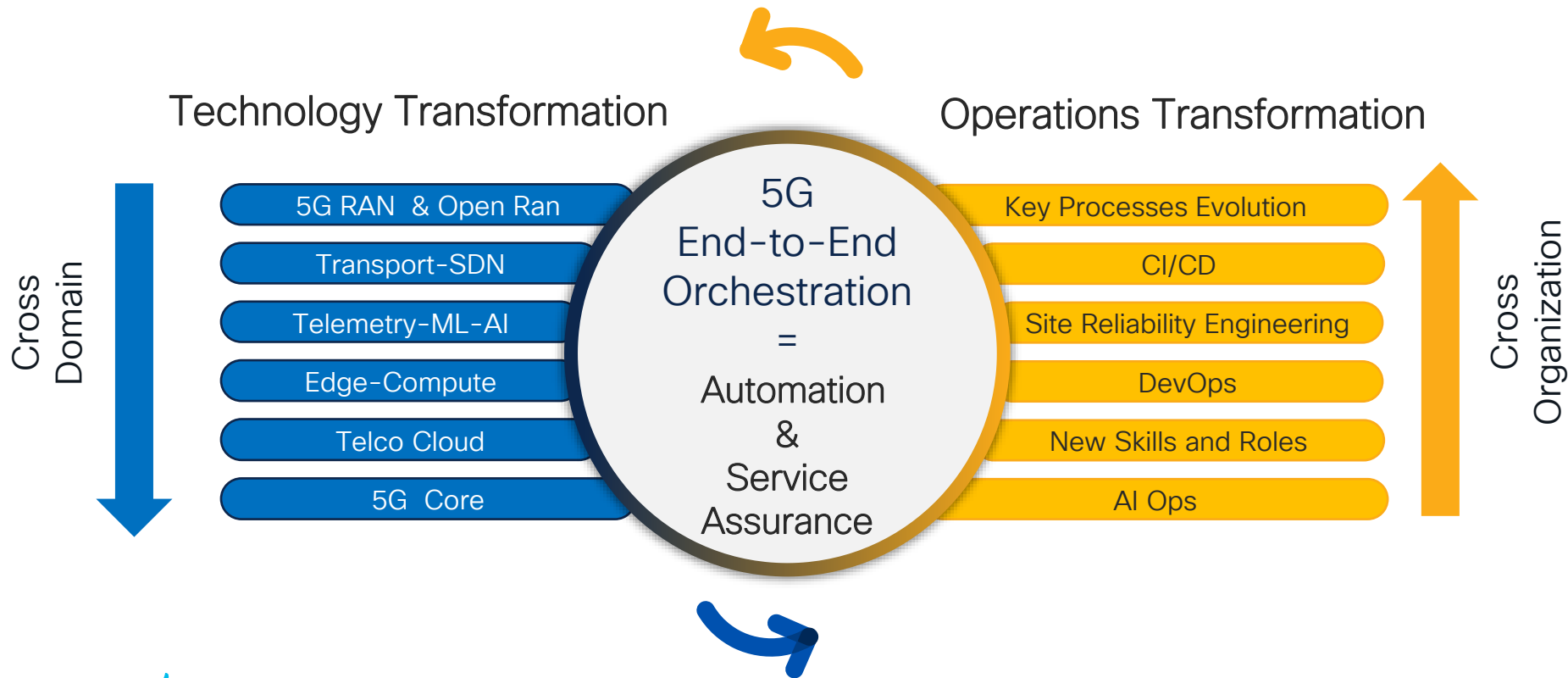
5G Automation

Principles & approaches

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Automation Architecture Principles

Separation of concerns in management

Advanced Operations

Intent-based

Model-driven, open interfaces

Closed-loop management and automation

Service composability

Designed for automation

Automation and Service Assurance Functional Taxonomy

Customer Facing Services

- Service Catalog
- Service Administration
- Service Monitoring
- External API Gateway

Baseline Services

Resource Facing Services

Design-Time Services

Service Design Center	Network Design
Service Catalog	Workflow Design
Resource Catalog	Capacity Planning
VNF Catalog	Simulation & Staging

Run-Time Services

Assurance

Inventory Management	Resource Management
Topology	VNF Management
Service Assurance	Container Management
Network Optimization	Capacity Management
Fault Management	Policy Management
SLA Management	Compliance Management

Orchestration

- Service Implementation & Testing
- Resource Onboarding
- VNF Onboarding
- Workflow Management

Analytics

- Network Analytics
- Service Analytics
- Customer Experience Analytics
- ML Service

Security

Data Protection	Firewalling	Security Analytics
Identity Management	Lawful Intercept	Intrusion Detection / Prevention
Access Control	Policy Enforcement	

CI/CD & Test Automation

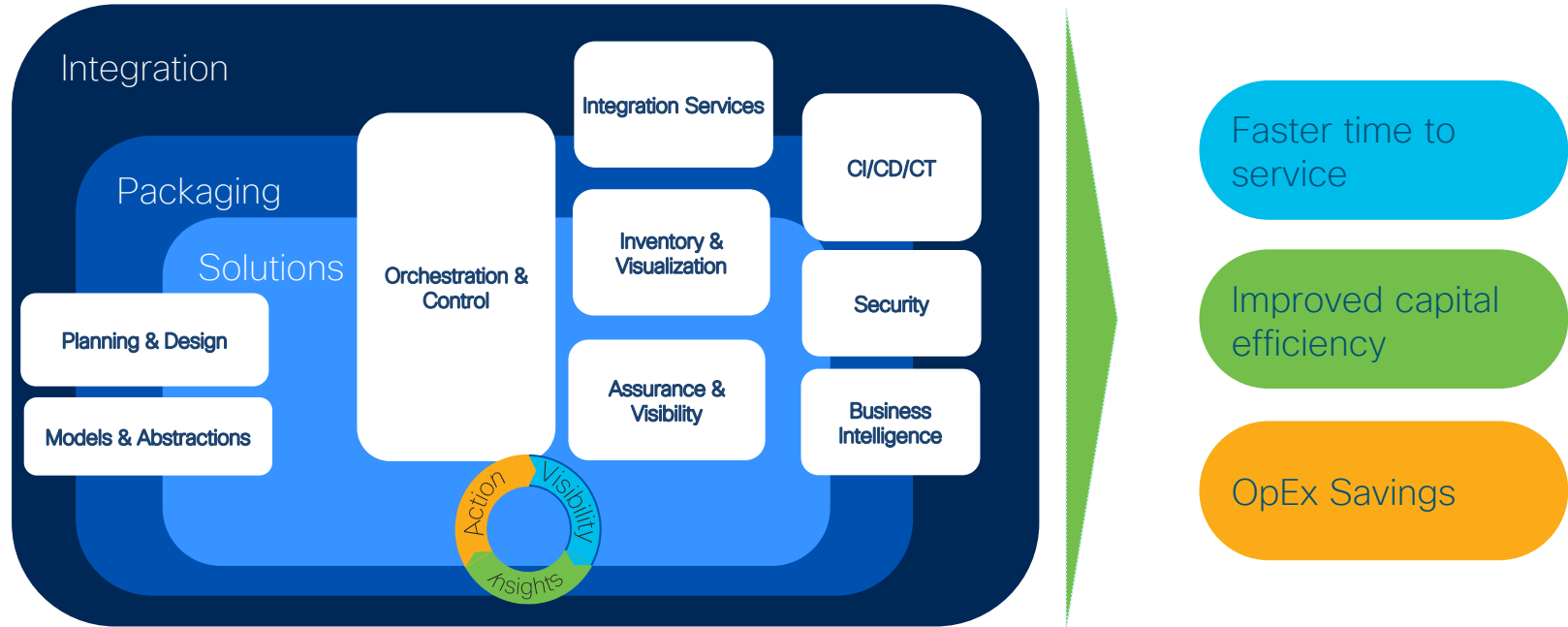|		
CI/CD Pipeline	Test Case Library	Version Management
RFS Check	Test Regression Suite	Service Activation Test
Deployment Automation	Test Automation Framework	

Automation building blocks – simplified

Integration

Packaging

Solutions

Orchestration & Control

Integration Services

Inventory & Visualization

Assurance & Visibility

CI/CD/CT

Security

Business Intelligence

Planning & Design

Models & Abstractions

Action · Visibility · Insights

Faster time to service

Improved capital efficiency

OpEx Savings

The automation journey – apply principles within and across domains

BSS / Customer Order Management

Cross-Domain Level — Cross-Domain

Domain Level — RAN/Access | Transport | Data Center / Cloud | Subscriber Services Core

Network Infrastructure — Physical | Private Cloud | Public Cloud

Common Services — CI/CD/CT | Security | Business Intelligence
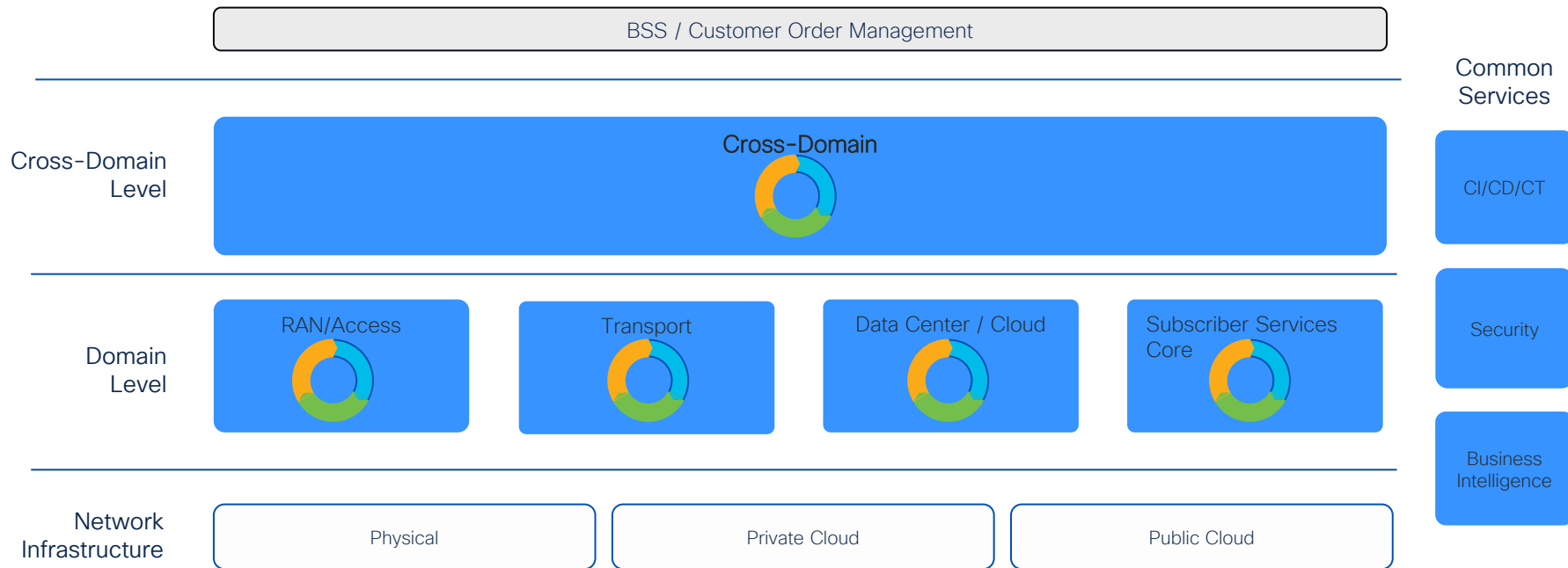
Automation and Service Assurance is Required in the Domain as Well as the Cross-Domain Levels

Common Services

BSS / Customer Order Management

Cross Domain Level

Cross-Domain Automation and Service Assurance

Cross Domain Orchestration	Cross Domain Assurance

NOC/SOC Systems

Domain Level

RAN-Domain Automation	Transport-Domain Automation	DC/NFV/EDGE Automation	Cable Automation	Mobile Core Domain Automation

CI/CD

Security

Managed Resources

VNF	CNF
VIM	CISM

SDN
PNF

Compute

CNF	VNF

Public Cloud

Automation System Objectives – Using 5G As an Example

Operations

- Design
- Catalog
- Initiate
- Observe
- Validate
- Activate
- Upgrade
- Heal/Repair
- Modify
- Scale-out
- Scale-in
- Backup
- Restore
- De-activate

- Use case A
- Use Case B
- Use case C

RAN/Access	Transport	Data Center	Core

Service

Service

Slice

| Subnet-Slice | Subnet-Slice | Subnet-Slice |

Application

Application

| VNF | CNF |

Host OS

Infra

| SDN | Hypervisor |
| Routers | Compute | Storage |
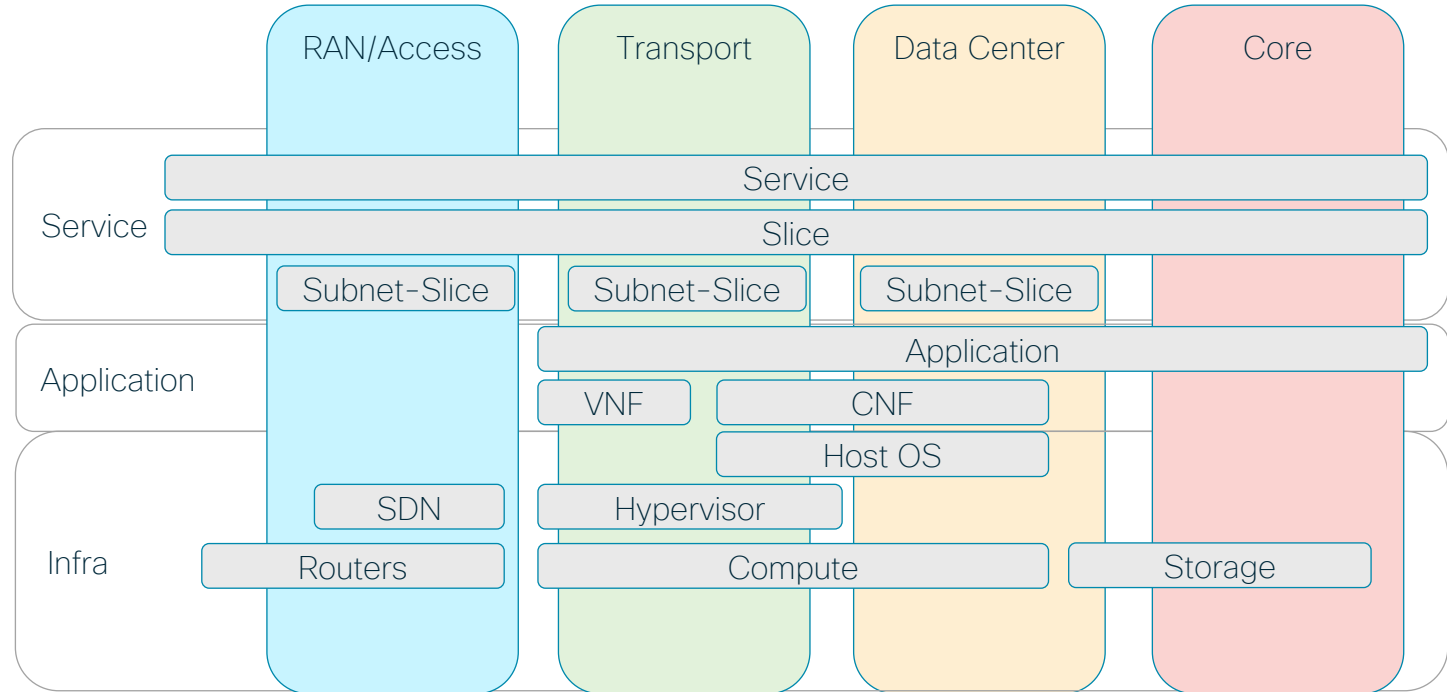
Assurance and Observability

Assurance

Assure your current level of success
- Enforce system objectives (SLA/SLO)
- Deliver well-defined outcomes
- Ops Aligned

Is it working?
What is broken?
How do we fix it?

← Increased Understanding

Observability

Drive to new levels of success
- Understand system behavior
- Answer open-ended questions
- DevOps Aligned

What makes it work better?
What is making it slower?
What should I improve first?

Fault | Perf

Metrics | Logs | Events | Traces

Collector

Telemetry

Monolithic Apps/Infra

→ Greater Complexity & Agility

Service — Services

Application — Network Functions — Applications

Infra — Private Cloud — Hybrid Cloud — Public Cloud — Transport — DC

High Level Standards View – TMF/ETSI etc.

**Figure 5.6.6-1: Logical Architecture of CLADRA
(Copyright © TM Forum 2020. All Rights Reserved.)**

High Level Standards View – TMF/ETSI etc.
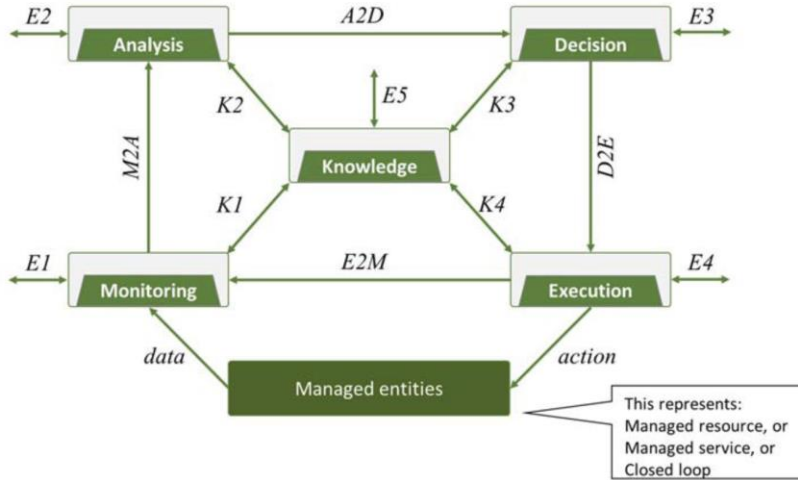
Figure 7.2.1-1: Functional view of a Closed Loop and its stages within the ZSM framework

Cross Domain Automation

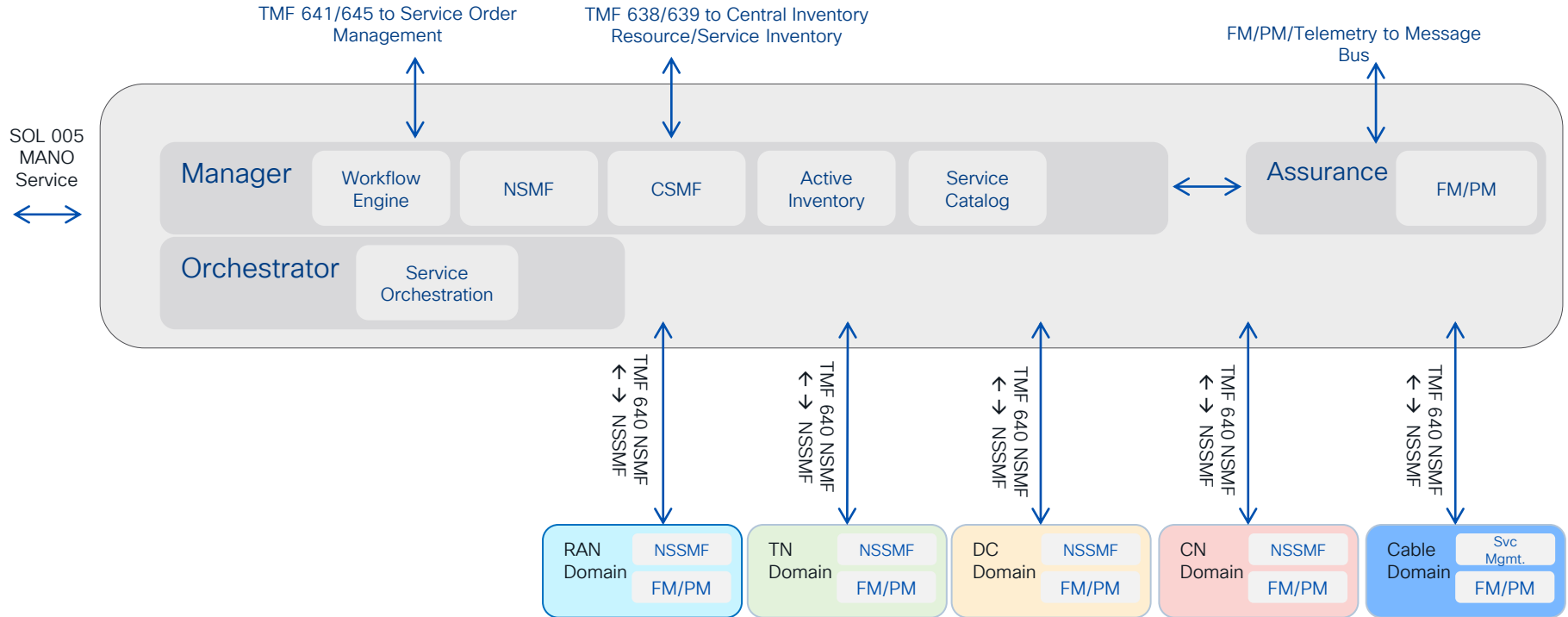# Cross-Domain Level Opportunities / Challenges

Opportunities
• Service and product agility
• Consolidated operations for all application platforms
• Reduced cost of operation
• New business models
• Opensource lowers s/w costs and potentially increases development velocity
• DevOps/CI-CD promise much higher feature velocity

Challenges
• Standardization for all domains is immature
• Service visibility and correlation is complex
• Require both application knowledge and infrastructure skills
• Each domain's requirements are different
• Complexity managing multi-domain services

Cross-Domain Automation

TMF 641/645 to Service Order Management

TMF 638/639 to Central Inventory Resource/Service Inventory

FM/PM/Telemetry to Message Bus

SOL 005 MANO Service

Manager

| Workflow Engine | NSMF | CSMF | Active Inventory | Service Catalog |

Assurance — FM/PM

Orchestrator — Service Orchestration

TMF 640 NSMF ↑↓ NSSMF

RAN Domain	NSSMF / FM/PM
TN Domain	NSSMF / FM/PM
DC Domain	NSSMF / FM/PM
CN Domain	NSSMF / FM/PM
Cable Domain	Svc Mgmt. / FM/PM

X-Domain Slice Management

Background

- Cross-Domain coordination
- Network slice management
- Performance guarantee and isolation
- Slicing resources and requirements

Solution Diagram
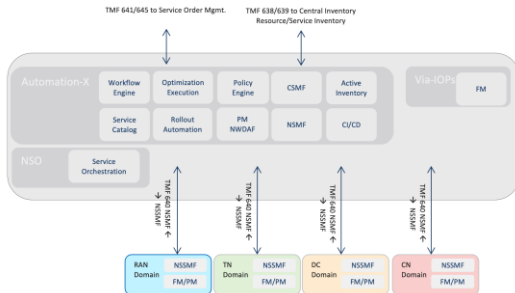
Components & Feature List

- Manager
  - Service Catalogue
  - Workflow Management
  - Integration and API management
- Orchestrator
  - Service Orchestration/Activation
  - Network Slice Template
  - Service Inventory

Value Added

- Consolidated Management of E2E service operation
- Delivered and Managed Network slices
- Enabled Zero touch operational model
- Optimize OPEX and TCO

Automation use cases

Tier 1 US SP: 5G Automation

Customer Needs

AWS Cloud greenfield deployment

Zero touch provisioning of 25,000+ CSRs, PE and vRouters using NSO

OS upgrade of 25,000 CSRs as part of ZTP

Golden configuration Audit of 25,000+ CSRs, PE and vRouters

Use Blue Planet Inventory (BPI) for querying transport data. IP address and VLAN management in Infoblox

Solution & Use Cases

NSO for pushing Day1 configuration to all CSRs along with configurating uplinks to PE devices

NSO for automatic OS upgrade of CSRs when not on target OS version.

Golden configuration audit and remediation using NSO

ZTP Orchestration across multi-vendor devices

Customer Outcomes

Provisioned 100+ sites per day with minimum user intervention. Reduced days and weeks of manual provisioning to few hours.

Reduced occurrences of devices going out of compliance by automatic and on demand golden config audits.

Automatic OS upgrade eliminated occurrences of devices getting provisioned with outdated OS on day1.

Deliver massive deployment and lifecycle scale through automation

Increase network stability and reliability through automation and observability

Tier 1 US SP – Observability & Assurance

Admins & Operators

Transport Domain

Data Center Domain

SNMP & Syslog

Telemetry

CISCO CNC

Data Gateway

Topology discovery, telemetry collection, syslog collection, SNMP and events

CISCO Matrix

Data Collector

Collects telemetry

Consumer

Calculates KPIs

Worker

Data analysis, anomaly detection

GUI/Presentation Layer

Observability Data Store

Raw stats and processed KPIs

Event Data Store

Raw faults, signals, and incidents

VITRIA VIA

RCA

Correlation

Signal Detection

Enrichment

Transport Telemetry

Calculated KPIs

Alerts

snowflake

Telemetry Message Bus

Syslog Message Bus

Alarms and Events Message Bus

KPI Anomalies Message Bus

kafka

Tier 1 US SP: 5G Automation

Software platform for automation, observability and assurance

amazon
web services

AUTOMATION

ZERO TOUCH PROVISIONING

- Automated new device activation
- Configuration generation
- Mass scale deployment
- Pre/post operations

CONFIGURATION MGT

- Golden configurations
- Scan for drift
- Drift remediation

AUTOMATED TESTING

- Automated NRFU tests
- Consistent health checks
- On-demand latency/jitter reports

DEVICE LIFECYCLE MGT

- Automated change management
- Automated software upgrades
- Backup & recovery

ANALYTICS

OBSERVABILITY

- **Performance Management**
- Health scores
- Top-N dashboards
- Inventory dashboards
- Anomaly detection
- Threshold alarms
- Event generation
- National and individual market-level visualization

ASSURANCE

- **Fault Management**
- Event and log analysis
- Machine learning pattern recognition
- Event de-duplication
- Noise reduction
- Event correlation
- Root cause analysis
- Trend analysis

Tier 1 US SP – By the Numbers

Platform

14 on-time releases of SDN-C

4,200 user stories, enhancements and bug resolutions

Devices

8,000 under management as of January 2023

50,000 under management by end of 2023

Analytics

Capacity of more than 7k Zero Touch devices deployed per month

1,000 device configs audited and remediated per night

9,500 KPI thresholds calculated daily

900k SNMP traps and alarms received and correlated daily

9.5M logs collected and processed daily

254M telemetry data points collected and processed daily

Tier 1 EMEA Mobile SP: Telco Cloud Automated workload onboarding and LCM

Customer Needs

New Telco cloud infrastructure deployment under a single partner owning integration / operation over 5y

Automated infra management, certification and onboarding for 30+ telco workloads on 7+ datacenters

Adoption of DevOps practices in engineering and operations, to be scaled later throughout the entire organization

Solution & Use Cases

Workflow driven, CICD enabled workload certification and onboarding using 4 distinct pipelines from Dev to Production

Automated testing of workloads and infrastructure

Automated infrastructure deployment using Infra-as-Code principles

Advanced LCM use-cases including Auto-scaling and Self-healing

Customer Outcomes

30% improvement in infrastructure deployment time over legacy TC

50% improvement in workload certification time over the entire process (design to production ready)

12% improvement in TCO due to solution standardization and reduced operational burden

---

Automated infrastructure deployment and workload certification by leveraging CICD / NSO / Infra-as-Code and Test Automation leading to significant improvement in service TTM and TCO.

"As a leading digital operator in the region, we have achieved a lot of transformative change in a short time. We have an opportunity with our cloud-first approach to improve the economics of 5G & Cloud stacks to transform the way we are dealing with our network to create faster and more compelling experiences at scale. We work together with Cisco seeking new ways to drive market differentiation and deliver business outcomes through agile, secure infrastructure, at every stage of the technology journey." - ***Customer Executive***

Tier 1 EMEA Mobile SP: Automation Architecture

Tier 1 UEA SP: 4G/5G NSO Automation
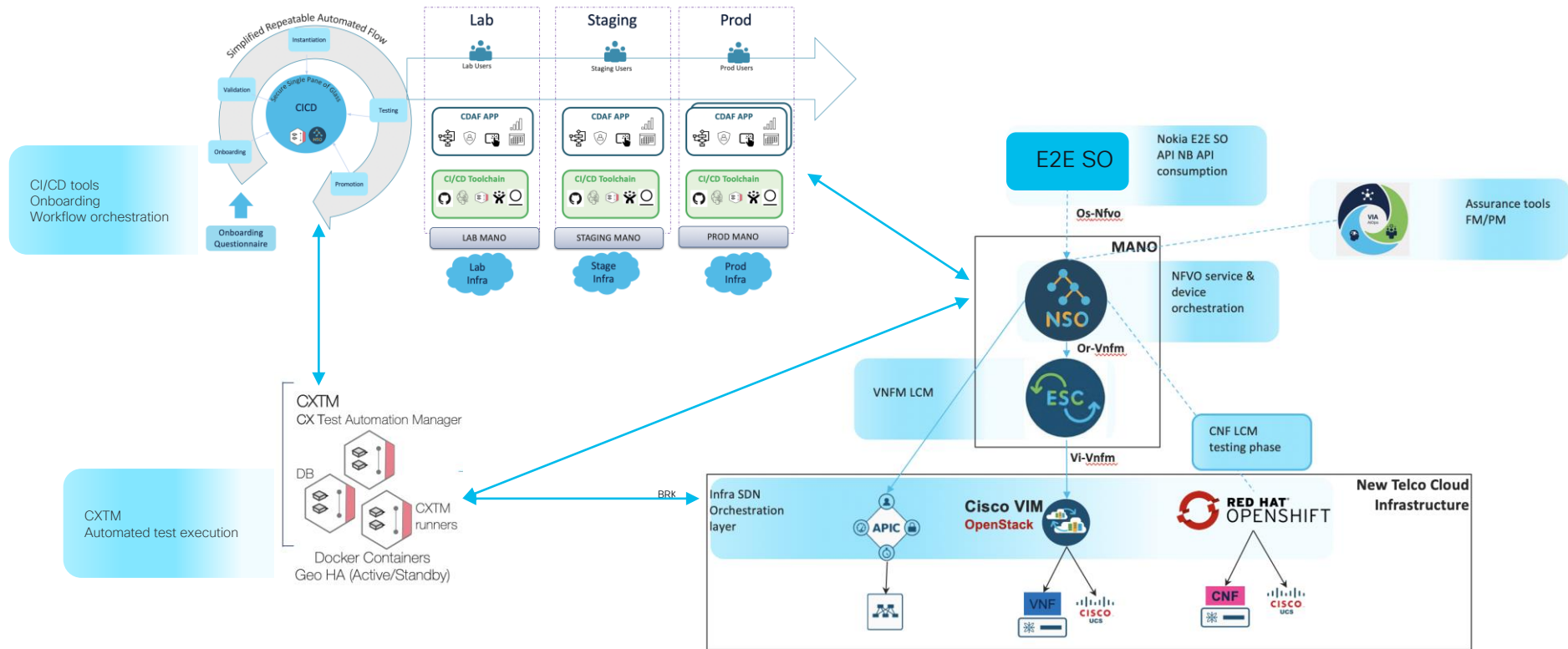
Customer Needs

Complete overhaul of existing networks to cater high bandwidth requirement by delivering high-speed Mobile and IP services and modernise network operations to achieve fully autonomous network.

Solution & Use Cases

Introduced and integrated ASR920/NCS540 as (CSG) and NCS57C3 as (SCSG's) to provide higher resilience and service availability.

Fully Automated Enterprise Services on Transport network

Fully Automated GPON Subscriber Based AAA customers.

Several Closed Loop Self-healing and automated Provisioning Use Cases .

Automating with NSO for Accuracy, Speed Standardization, and simplification.

Achieved using
Scaled Agile Framework (SaFe) and DevOps

Customer Outcomes

7500+ Cell Site automation

Bulk Speed Upgrade- 3months to 9 hrs.

BGP Optimization and Activation – 4hrs to 5 mins

Mobile service migration -20min to 5 mins

ACL rules Provisioning 5 min-2 sec

Along with more than 40 use cases, helped du achieve outstanding business results across various domains.

Significant improvement of Operations and Time to Market Metrics

Use Cases Progress Summary

Enterprise Services

1. EBB
2. IPTV
3. Voice
4. L3VPN L2VPN
5. Bulk Speed Upgrade
6. Orchestrated Assurance

Mobile Service

1. Provisioning and Migration For:
   - 2G,3G,4G,5G
   - EKMS,FTTA
2. DF File Generation
3. Cell Site Rollout

IGW

1. BGP Public Peering Optimization
2. BGP Private Peering Optimization
3. BGP Transit Optimization
4. BGP Links Reconciliation
5. BGP Links Activation
6. Backhaul Links Optimization
7. BGP DDOs Attach Resolution

Residential Broadband Management (AAA)

1. Internet Package Management
2. Bulk Migration
3. Subscriber Management

GPON Services

1. OLT Management
2. CPE Management
3. Free IPTV
4. Residential Voice (HCS)
5. Residential Internet
6. Voice M-TRIX
7. V4CPE
8. CPE Management
9. OLT Migration

Data Center

1. Firewall Policy Intent Automation
   - ASR
   - FW
   - LB
2. ACI Automation

Infrastructure

1. ZTP
2. Port/Lag Migration
3. Network Visualization
4. OS Upgrade
5. Backup/Restore
6. Port Cleanup/Reservation
7. Automated Capacity Management
8. APN Reporting

MISC

1. DPI
2. SDWAN
3. ODR
4. ACL
5. MOP Automation
6. Executive Mobile App
7. Webex ChatBot
8. Field Engineer Support App
9. Dashboards

| < 50% | 50%-75% | 75%-100% |

Business Value Realization

Use Case	Before Automation Baseline		After Automation Improvement
ACL Rules Provisioning	5 min	→	2 sec
Mobile Service Provisioning	15 min	→	5 min
Mobile Service Migration	20 min	→	10 min
Zero Touch Provisioning	90 min	→	20 min
BGP Optimization and Activation	4 Hours	→	5 min
ODR Reporting	3 Weeks	→	30 Min
Bulk Speed Upgrade	3 Months	→	9 Hours

Tier 1 US Mobile SP: 4G/5G NSO Automation

Customer Needs

New technology and deployment for 10000+ Mobile Core Gateways

Config Management for 10000+ Mobile Core Gateways, including CIQ Data Base to NSO Integration

Upgrade Management for 10000+ Mobile Core Gateways

Solution & Use Cases

UAS/UAME for Day-0 deployment across the Largest Mobile Core Customer Install Base

NSO for LTE, CUPS, UPF and SMF Config Management. Automated Config Management

NSO for StarOS BIN, VNF & CNF Upgrade. Automated Upgrade Management

Customer Outcomes

Recorded Deployment Time for the largest Ultra-M, VNFs & CNFs Across U.S.

Reduced Gateway's Config Management time from 2-3 Days per POD (~38 GWs) to 1-2 Hrs per Multiple PODs

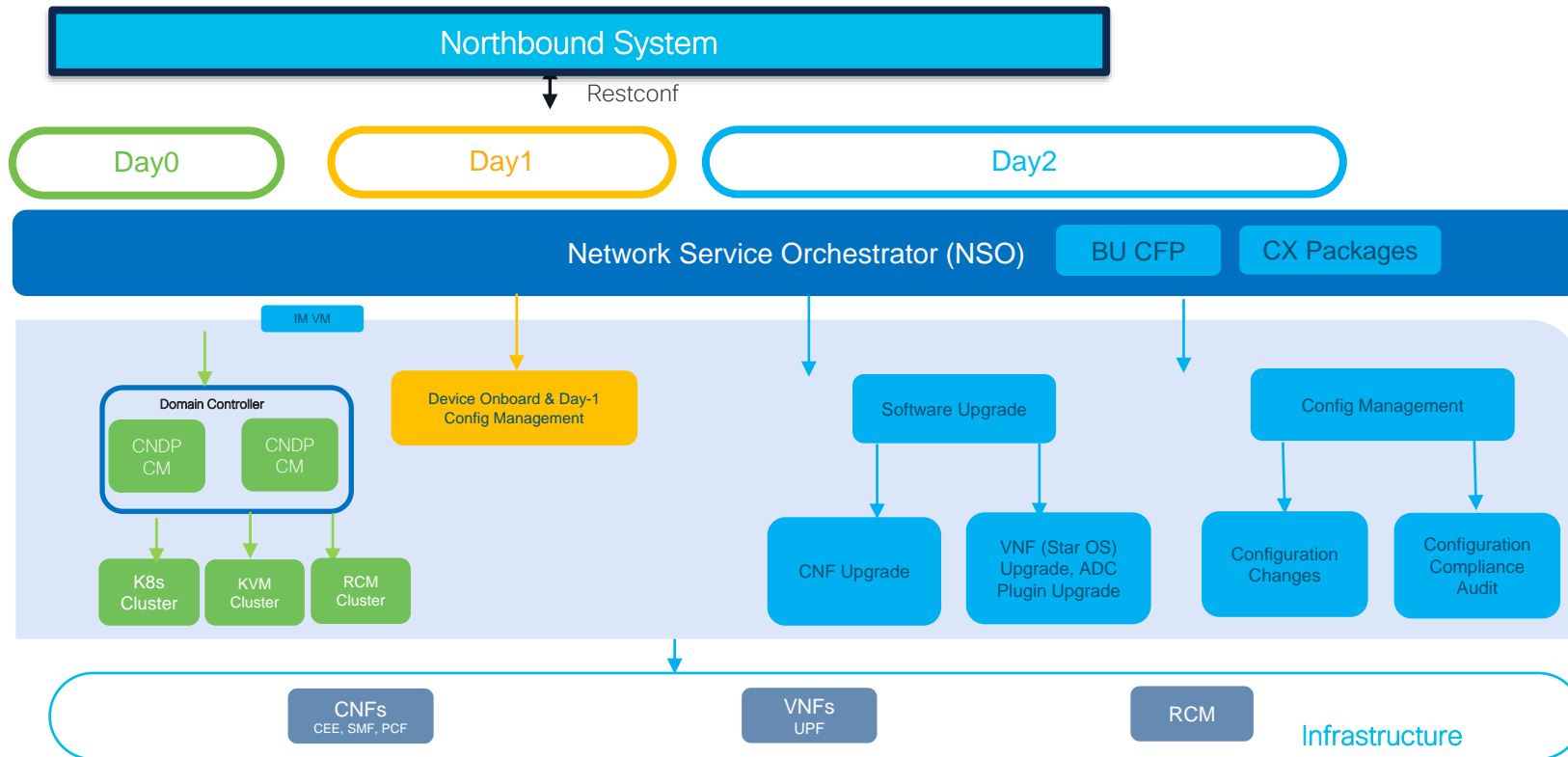Reduced Gateway's Upgrade Management time from 1-2 Days to 2-3 Hrs Per POD (~38 GWs)

Callouts

Fully Automated Cisco solution that uses a broad mix of Cisco's flagship networking solutions, including Cisco 8k Series routers, 5G & 4G packet core GWs, Cisco (UCS), Nexus 9k Series Switches with NSO

"This cloud native core gateway takes our network to new heights, allowing us to push 5G forward by delivering next-level performance for consumers and businesses nationwide while setting the stage for new applications enabled by next-gen networks" - **Customer Executive**

Tier 1 US Mobile SP: 4G/5G NSO Automation

#4

Northbound System

Restconf

Day0

Day1

Day2

Network Service Orchestrator (NSO) — BU CFP — CX Packages

IM VM

Domain Controller

CNDP CM

CNDP CM

K8s Cluster

KVM Cluster

RCM Cluster

Device Onboard & Day-1 Config Management

Software Upgrade

CNF Upgrade

VNF (Star OS) Upgrade, ADC Plugin Upgrade

Config Management

Configuration Changes

Configuration Compliance Audit

CNFs
CEE, SMF, PCF

VNFs
UPF

RCM

Infrastructure

Tier 1 Cable Service Provider in US

Customer Needs

Multivendor device management

Cisco/Vecima/Teleste RPHY lifecycle management across multiple SmartPHY instances

Calix PON lifecycle management across multiple Calix SMx instances

Automated OS Upgrade

Wifi Router/Switch config backups

Solution & Use Cases

Cisco-staffed Agile Team joins customer's Scaled Agile group for network automation

BPA/NSO Automated OSUpgrade of 550 CBR8, 450 Hubrouters

RPHY Password Change for California Compliance Law

Pre/Post checks for 7000 adTran Voice Devices

Backup of 1600 wifi devices to bitbucket using NSO

Customer Outcomes

OS Upgrade process time reduction from 10 days to 2 hrs /device

ZTP time reduction from 5 days to 1 hr

Allows accelerate deployment time for CBR8 and Hubrouter OSUpgrades

Backup of configs into bitbucket provides historical record of changes

Agile best practices implemented to ensure quality of feature development

Co-development with Customer

Continued Expansion & Adoption over years

Architecture: Tier 1 Cable Service Provider in US
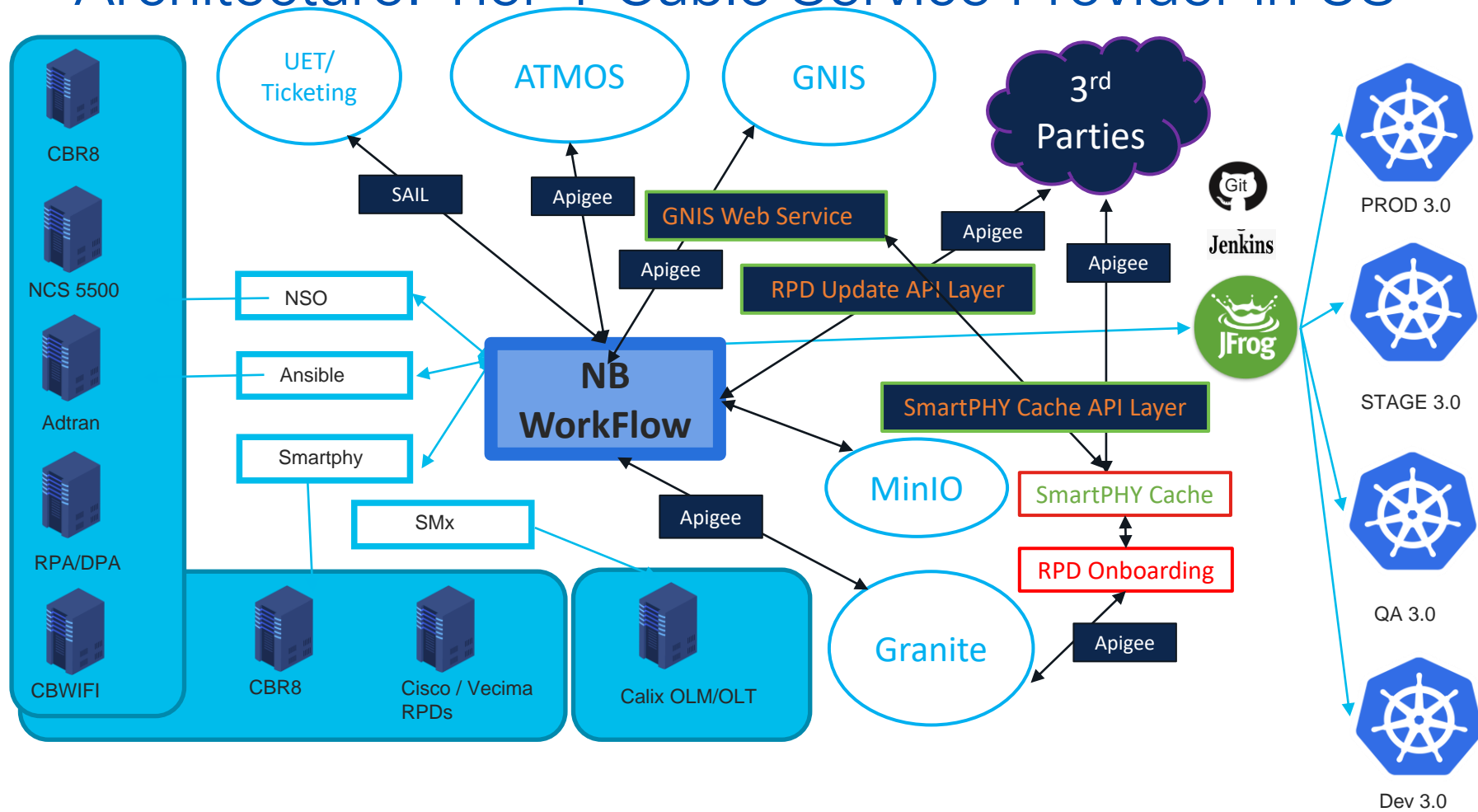
Tier 1 SP, APJ – Massive Scale Automation for heterogeneous brown field network

Customer Needs

- Automation of VPN services
- Automation across heterogeneous multi vendor network
- 88k devices| 650k services
- Continuous detection of out of band changes
- Zero tolerance to outages
- Low automation failure rates
- Observability
- Adapt to increasing load
- 24/7 system availability
- 2G/3G/4G/5G

Solution & Use Cases

- First Time complete network reconciliation
- On-demand reconciliation for every modify use case to detect out of band changes in the network
- Robust prechecks
- Detection of neighbor and aggregator devices
- Interactive Dashboards for insights
- Workflows that meet scale
- Agile | CI/CD/CT
- Automated regression testing
- Performance testing

Customer Outcomes

- ~ 90% adoption of provisioning
- ~ 1500 orders per day
- Service Reconciliation into NSO managed mode
- Day 2 Automation on Cisco and 3rd party devices
- Automated/Standardised Operations
- Seamless Service Migration
- Dashboards, reports, automated failure categorisation and analysis
- Manual processing decreased by 70%

Callouts

Fully Automated Cisco solution that uses a broad mix of Cisco's flagship network automation solutions to drive a mass scaled complex automation on Cisco, Nokia, Huawei, Juniper, ECI(Ribbon), Ciena devices over L2, L3, ISP services

Tier 1 SP – APJ – Brownfield Automation

OSS/BSS

| Day0 | Day1 | Day2 |

Business Process Automator (BPA)

BITs (Data Collection and Aggregation)

Network Service Orchestrator (NSO)

CX Packages

| Device Onboarding | Reconciliation | Pre Checks | Service Management | Migration |

CLI NEDS

Controller NEDs

Netconf NEDs
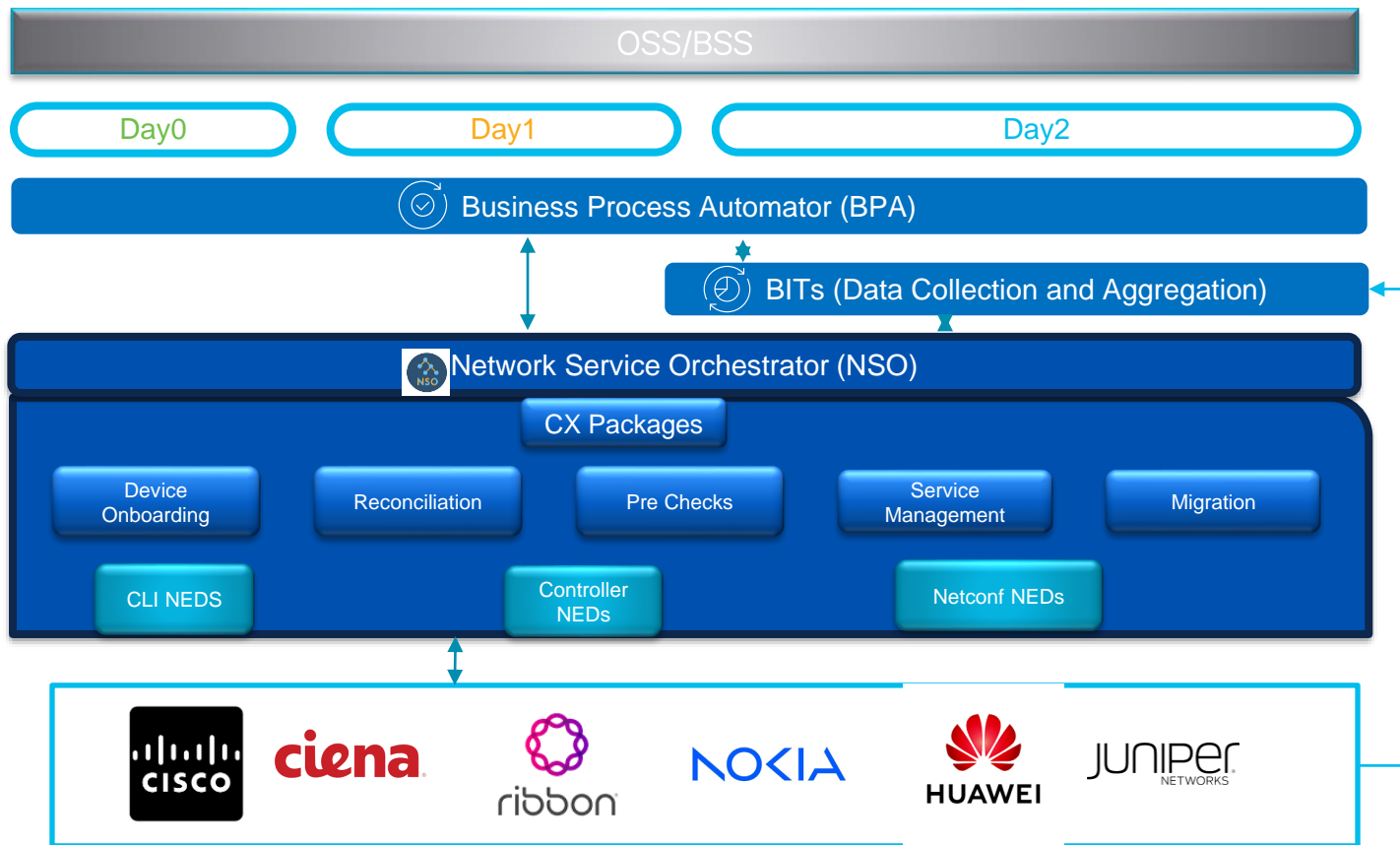
Telco Cloud Solution – Tier1 SP ASEAN

Customer Needs

- Common Infrastructure using the NFVI
- Network/Telco and IT workloads
- Platform to allow automated on-boarding of VNFs with common Physical and Virtual Infrastructure.
- Deliver the best quality service in Mobile and Fixed Network.
- Carrier Grade Platforms across all Technology Groups
- Close integration with multiple VNF vendors

Solution & Use Cases

- Open, Secure and Distributed Carrier Grade Horizontal NFVI Platform for Hosting Multi Vendor VNF's
- VNF Management and Network Orchestration with Automation
- Cisco CVIM NFVi | UCS-C Compute layer| APIC + ACI TOR Switches and catalyst 9300 (OOB) network Layer
- Onboarding & Validation testing of Cisco & 3rd Party VNF's (42 Unique VNFs)
- MANO Layer (BPA|NSO|ESC) for automation and orchestration
- 3rd Party VNF onboarding and validation in Testbed, Staging environments and supporting production roll-out.

Customer Outcomes

- Successfully deployed NFVi and Unified Management solution in 9 sites within stipulated timeframe
- (3 x Main DC, 2 x Regional DC and 2 x Edge DC sites including 1 x staging and 1 x testbed environments)
- Cisco MANO (BPA/NSO/ESC) deployed across 2 x Main DC sites (Geo-redundant)
- Automated onboarding over 20 VNFs (Nokia, Huawei, Ericsson, and others) in Staging and testbed environment and some VNFs already live in Production
- Proposal for multiple other automation & orchestration solutions
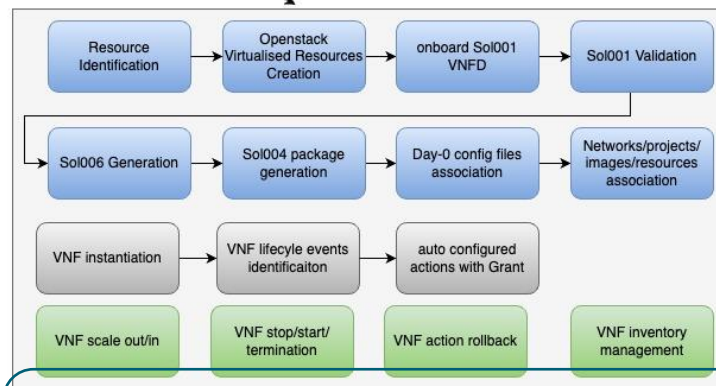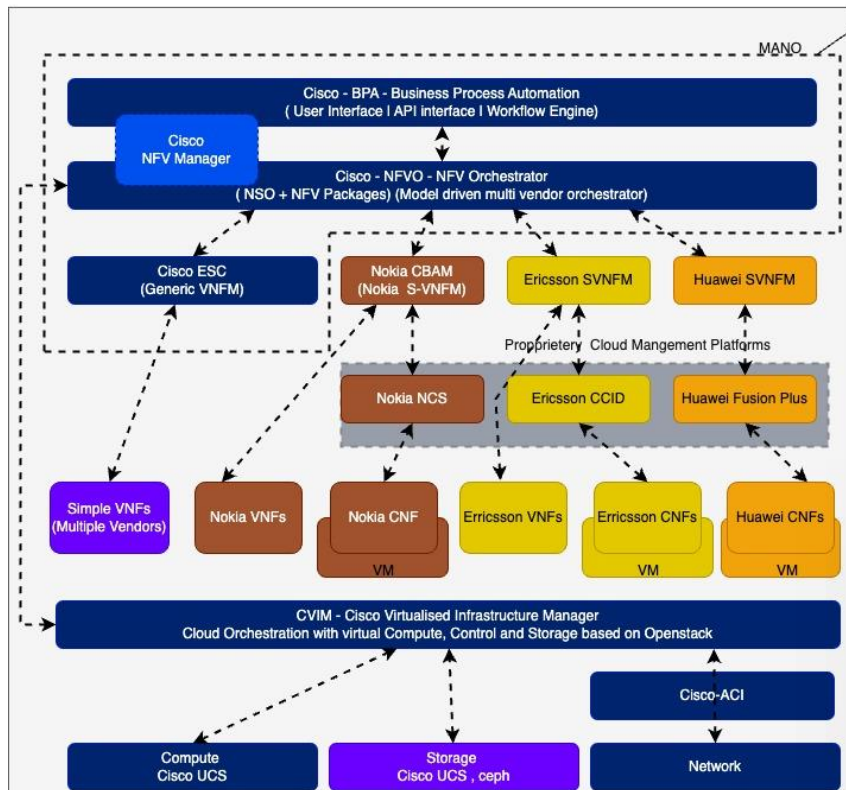
Callouts

- Automated onboarding over 20 VNFs, expected to reach 142
- Proposal for automating Infra provisioning including SDN ACI Fabric and CE Routers (Part of VNF onboard)
- Proposal for Automated FM (with AIOps), Performance Management and CI/CD Framework and Automated Testing
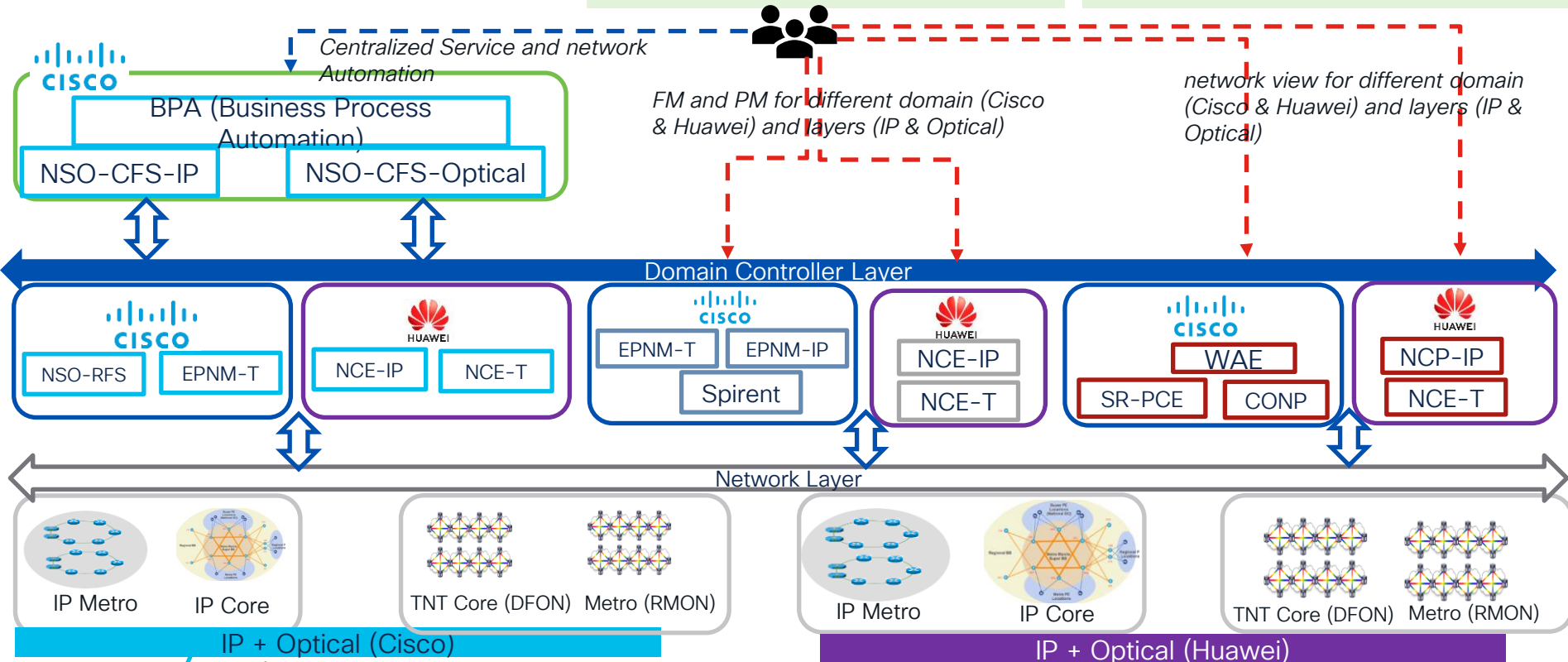- Customer evaluating Cisco lead solution for Telco Cloud container Network Function (cNF) platform.

Transport Network Automation - Tier-1 SP ASEAN

Service Orchestration & Process Automation

NMS/EMS, Network Visualization & Assurance

Network Planning (Visualization, optimization, Path Computation)

CISCO

Centralized Service and network Automation

BPA (Business Process Automation)

NSO-CFS-IP

NSO-CFS-Optical

FM and PM for different domain (Cisco & Huawei) and layers (IP & Optical)

network view for different domain (Cisco & Huawei) and layers (IP & Optical)

Domain Controller Layer

CISCO
NSO-RFS | EPNM-T

HUAWEI
NCE-IP | NCE-T

CISCO
EPNM-T | EPNM-IP
Spirent

HUAWEI
NCE-IP
NCE-T

CISCO
WAE
SR-PCE | CONP

HUAWEI
NCP-IP
NCE-T

Network Layer

IP Metro | IP Core

TNT Core (DFON) | Metro (RMON)

IP Metro | IP Core

TNT Core (DFON) | Metro (RMON)

IP + Optical (Cisco)

IP + Optical (Huawei)

Service Orchestration and Process Automation

Transport Service Orchestration for Infra, Mobile and

35+ UCs

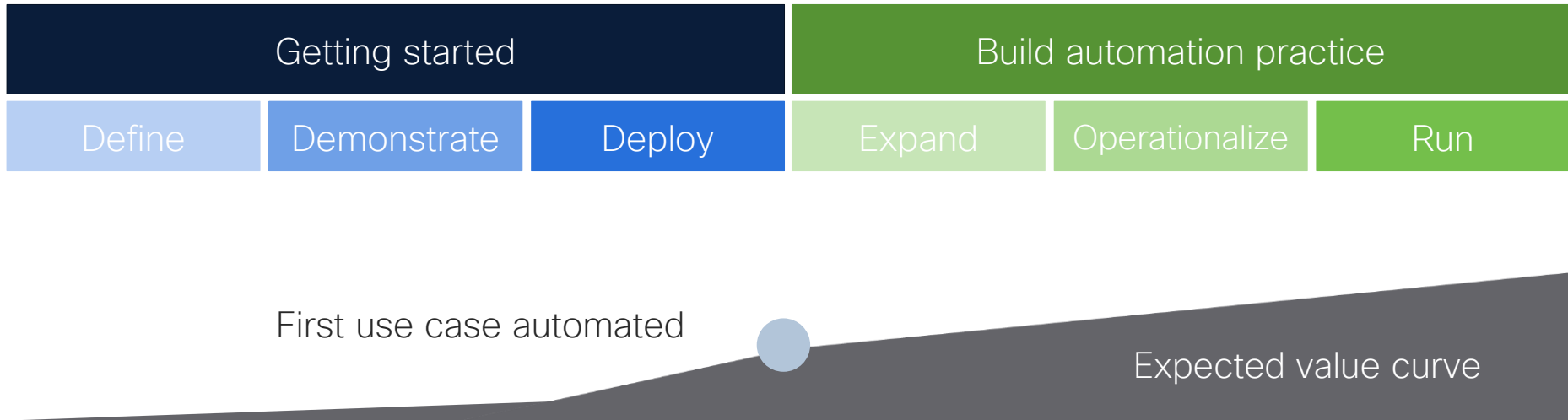|	
Service Provisioning (IP)	L3VPN (H&S, FM), Multicast, L2VPN EVPN (ELINE, ELAN, ETREE), L2VPN Legacy (ELINE, ELAN, ETREE), SR-TE (Static, Dynamic, ODN), L3VPN (Hybrid), L2L3VPN (Distributed Multisite,Single Site), Standard QoS, DHCP Relay & Server, Bulk Provisioning, Standard RPL, Network Infra (Port-aggregation)
Service Provisioning (optical)	DFON (OTN + DWDN*) (With or Without Protection) – 10G, 100G, OTU4, OTU2, STM-64 PIIBL (OTN + DWDM*)(with or without Protection) – 10G, 100G, OTU4, OTU2, STM-64 RMON (with or without Protection) - 10G, 100G, OTU4, OTU2, STM-64 [*Only for cisco domain]
Visualization (service specific)	Service topology, Custom built vendor agnostic inventory, Search page or dashboard
Process Automation	Business Catalog designer, RBAC over Catalogs, Port Reservation, Bandwidth Calendaring, Bandwidth on Demand
Resource Management	Auto resource Allocation app Global or local service resource management (Cisco & Huawei) Global Pools – running no. (RD&RT), AC, PWs, Local Pools (Per device) – EVI-Ids, evpl-ids BD-IDs

Optical & IP - Multivendor

TOOLS

Master Controller - BPA, NSO CFS IP, NSO CFS Optical
Domain Controller - NSO RFS IP, EPNM Optical, NCE-IP, NCE-T

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Key takeaways

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Automation Value Curve

Getting started			Build automation practice		
Define	Demonstrate	Deploy	Expand	Operationalize	Run

First use case automated

Expected value curve

Automation Value Proposition per Step

Getting started			
Define	General automation knowledge increased		
Demonstrate	Stakeholder awareness created	Mindshift towards automation begun	Increased organizational readiness for automation
Deploy	Positive momentum built		First small MVP use case in production

Automation Value Proposition per Step

Build automation practice		
Expand	Additional MVPs in production delivering incremental value	Increased capability for automating more sophisticated MVPs
Operationalize	Predictable, repeated success at scale	Automation mindset part of organizational DNA
Run	Continuous return on the investment	
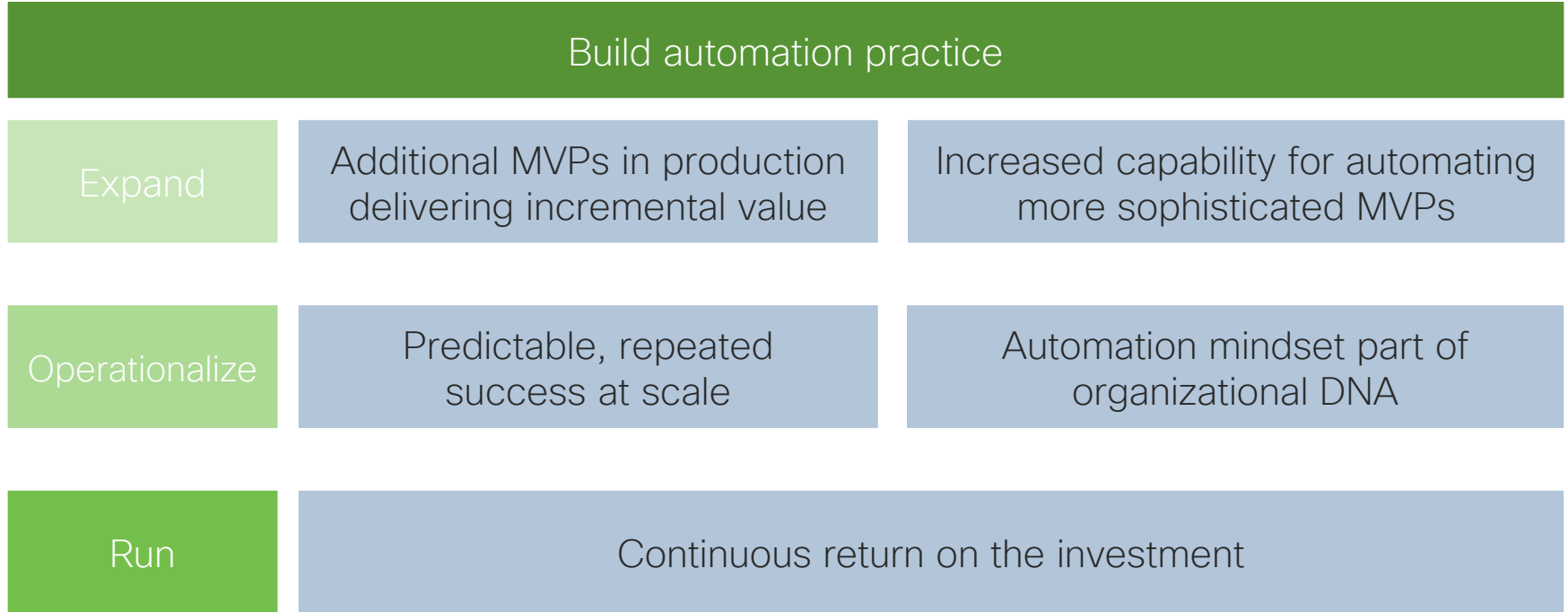
Fill out your session surveys!

Attendees who fill out a minimum of four session surveys and the overall event survey will get **Cisco Live-branded socks** (while supplies last)!

Attendees will also earn 100 points in the **Cisco Live Challenge** for every survey completed.

These points help you get on the leaderboard and increase your chances of winning daily and grand prizes

Continue your education

- Visit the Cisco Showcase for related demos

- Book your one-on-one Meet the Engineer meeting

- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs

- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand
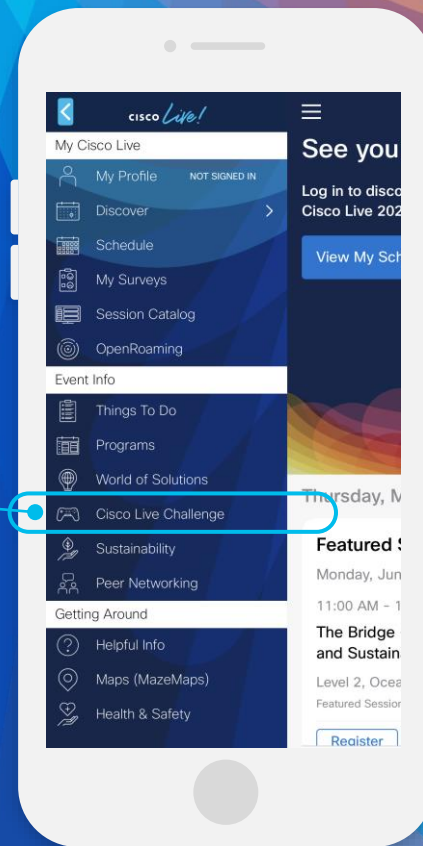
Thank you

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Cisco Live
Challenge

Gamify your Cisco Live experience!
Get points for attending this session!

How:

1. Open the Cisco Events App.

2. Click on 'Cisco Live Challenge' in the side menu.

3. Click on View Your Badges at the top.

4. Click the + at the bottom of the screen and scan the QR code:

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Let's go

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