Transforming the Cable Access Network with Remote PHY

Cisco Knowledge Network Webinar
December 18, 2018

cisco

Remote PHY Overview and Market

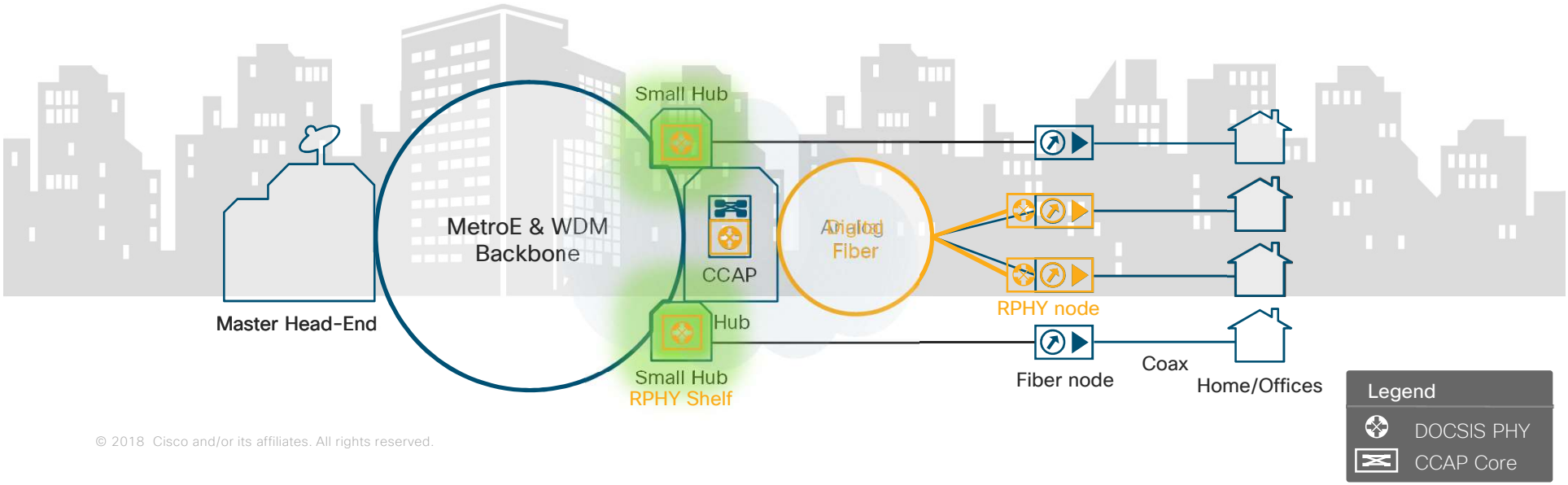
James Brannan
Sr. Manager, Business Development

Polling Question

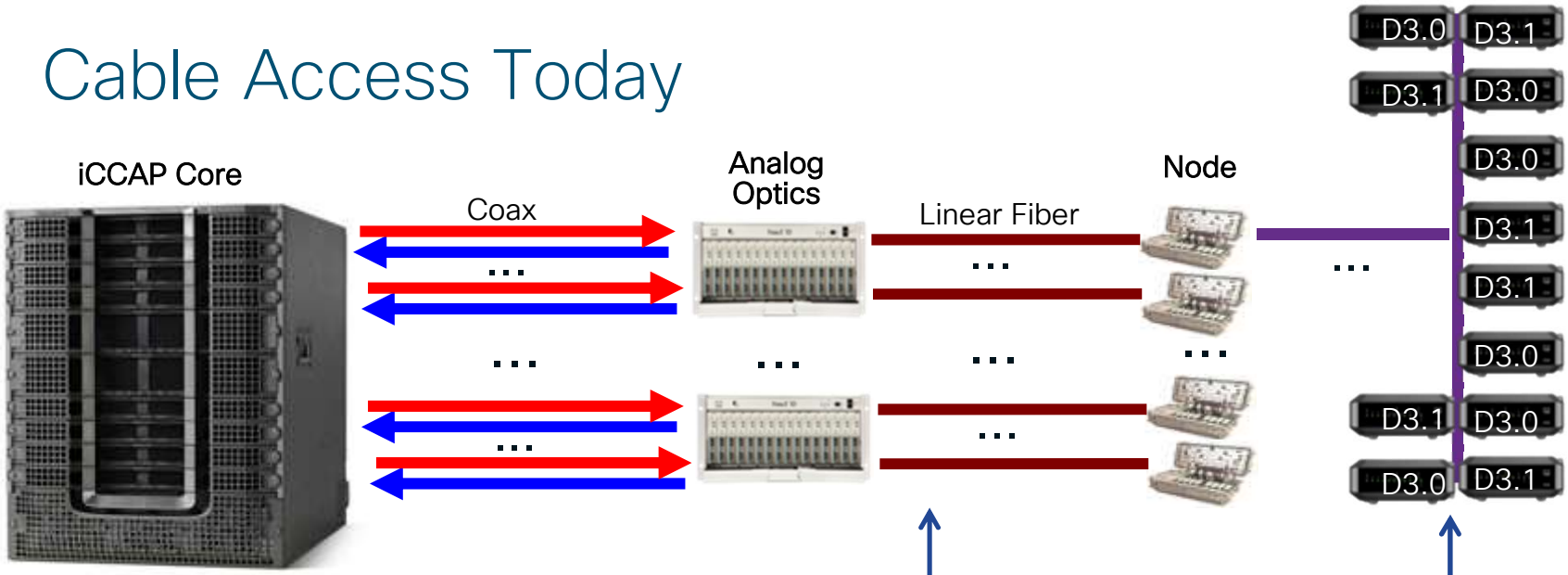
- When will your company begin RPHY deployments?
  - Already started
  - Next year (2019)
  - 2 to 5 years out
  - More than 5 years away
  - What is RPHY?

Distributed Access Drives Change

- RPHY distributes DOCSIS PHY across hubs and nodes
- Saves rack space and power with FD growth, reducing CAPEX and OPEX
- Makes an analog network, an IP network
- Provides the foundation for cloud native CMTS



Cable Access Today

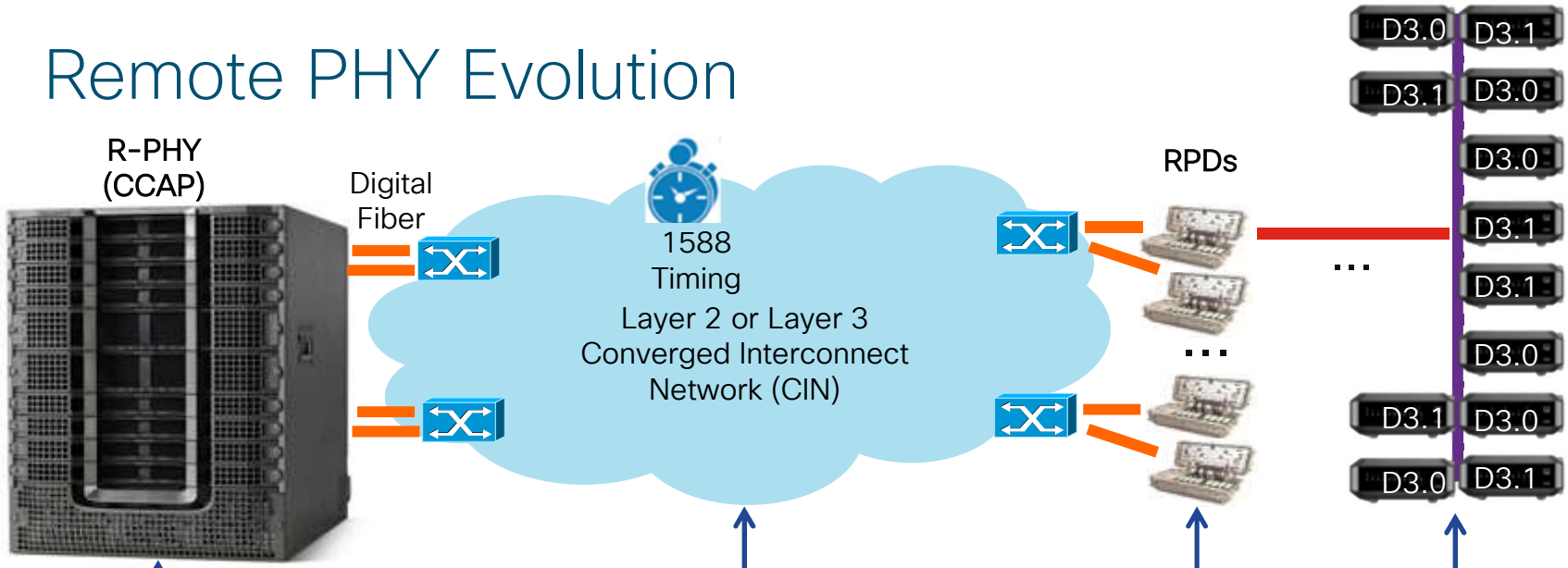


- With HA limited to 56 SGs due to limit of 56 DS ports and 112 US ports

- Linear fiber may limit achievable MER (max 38-40 dB)
- Linear fiber distance limited and supports fewer usable wavelengths

- DOCSIS 3.1 modems MAY be unable to use higher order modulations

Remote PHY Evolution



- RF PICs replaced with digital optics PICs
- No longer port constrained
- Space & power savings

- Digital fiber enables higher MER (43-45db)
- Supports 3-4x more wavelengths
- Links could be over a L2 or L3 CIN

- RPD – Remote PHY Device
- R-PHY module can be added to existing nodes

- DOCSIS 3.1 modems now able to use higher order modulations

The Cisco Remote PHY Solution

- Open Standards compliant, the only *Standard* in town…
- First company to submit R-PHY Code for the RPD to Open Source
- Partnering and interoperability validation of Remote PHY
- First company to bring multiple Remote PHY Devices (RPDs) to market
  - GS-7000 1x2 and 2x2 BAU RPD
  - RPD Shelf in compact and Full HA modular form factors
- Minimal Core Changes
  - cBR-8 only requires a change to a DPIC, beyond that it's just a software upgrade
  - Instantly doubles the number of Service Groups to 16 per LC
  - Virtual Splitting and Combining capabilities

Interoperability – Core and RPD

Cisco Compatible

Cisco Core Interoperability

CISCO
ARRIS
MAXLINEAR
TELESTE
VECTOR TECHNOLOGIES
intel
BROADCOM
PBN Pacific Broadband Networks
XILINX
BKtel
vecima networks
SED a division of CALIAN Ltd.

Cisco RPD Interoperability

ARRIS ⟷ CISCO ⟷ harmonic

Market Status

- Comcast and Cox have publically committed to RPHY
- Cisco has delivered over 10,000 RPDs to date
- Active rollout of RPD's ongoing at Tier 1 MSOs in the US
- Dozens of shelf customers worldwide are replacing aging CMTS equipment
- Lab trials and field trials with almost every MSO WW
- OpenRPD worked, enabling RPD market particularly in EMEA & APJC
- Beginning to see conversation shift to 'virtual'

Cisco Remote PHY Portfolio

Scott Raaf
Product Manager

Cisco Remote PHY Portfolio

cBR-8

Shipping

Features

- RPHY Core
- Enablement with D-PIC

GS7000 / iNODE Remote PHY 120

Shipping

Features

- GS7000 SHO Node
- iNODE
- 1x2 RPD

Remote PHY 300/600

Shipping

Features

- RPHY Compact Shelf
- 1RU 3/6 SG
- Small HUB

GS7000 Remote PHY 220

Shipping

Features

- GS7000 BAU Node
- 2x2 BAU RPD

Remote PHY 7200

Shipping

Features

- RPHY High Availability Shelf
- 7RU 72SG
- 12+1 HA
- Medium to large hub

FDX Capable NODE / RPD

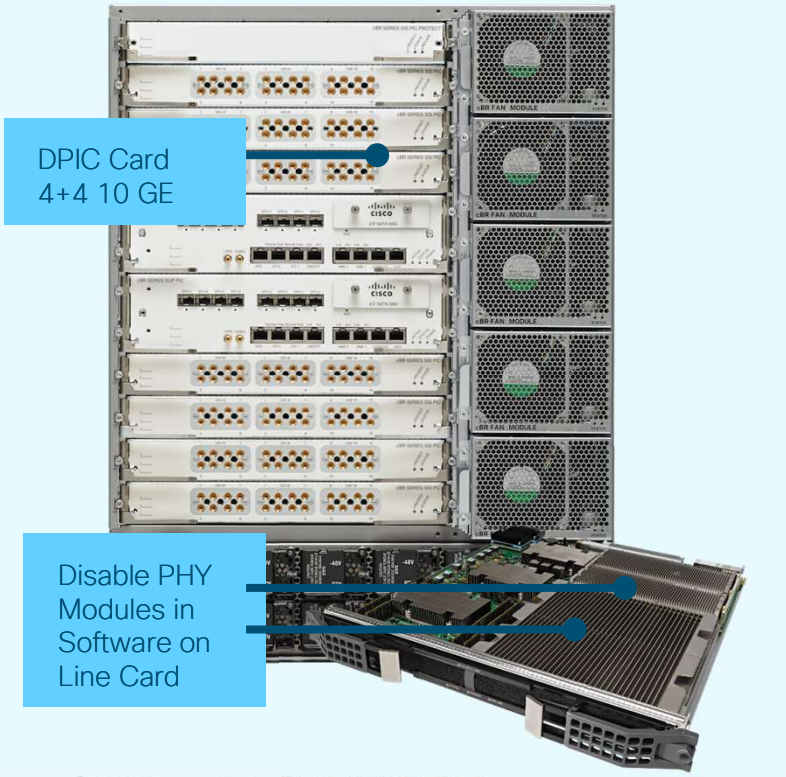
H2CY19

Features

- FDX Capable Node
- RPD Operates in Legacy or FDX Mode
- Full Spectrum FDX

cBR-8 Core and Remote PHY Module

Evolving Cable SP Network Architectures



Benefits

- Scaling service groups beyond the port capacity of the traditional CMTS
- Decoupling the scaling from dependency on the integrated PHY ports
- Allowing Digital Fiber / Ethernet to be driven deeper into the network
- Enabling migration to a cloud-centric ecosystem focused on service velocity and value creation

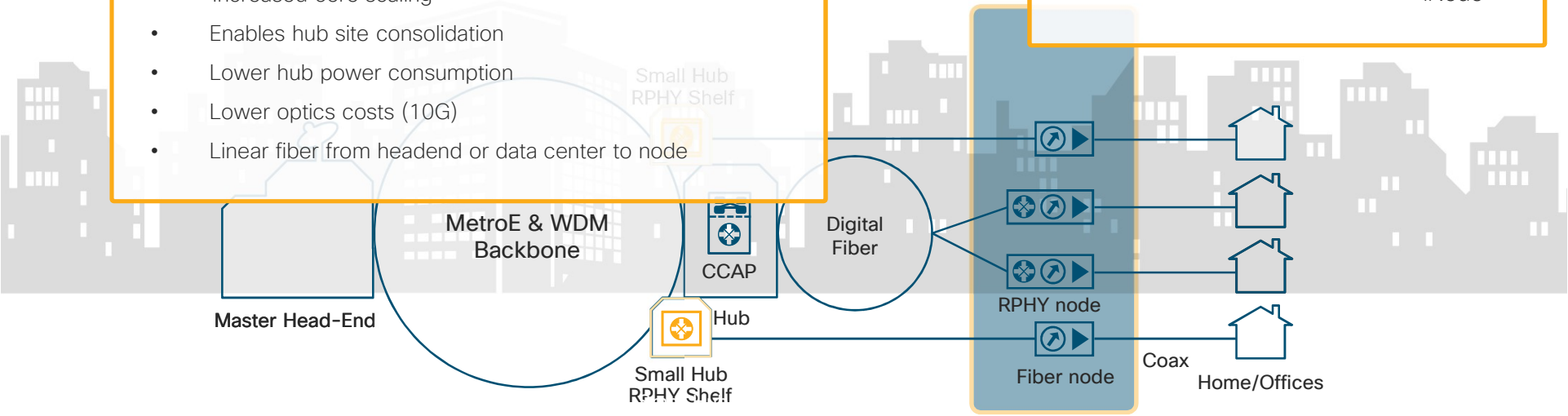
Why RPHY in the Node?

Consolidation to leverage CMTS Capacity

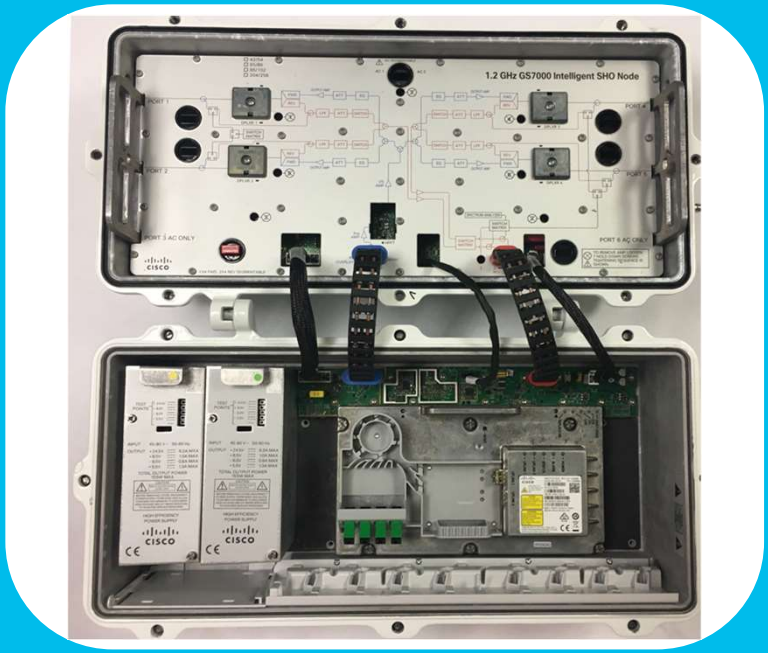
- Enables Cloud Native CMTS migration
- Enables Ethernet to the node which increase plant value
- Increased core scaling
- Enables hub site consolidation
- Lower hub power consumption
- Lower optics costs (10G)
- Linear fiber from headend or data center to node

Remote PHY Nodes

SHO Node BUA Node iNode

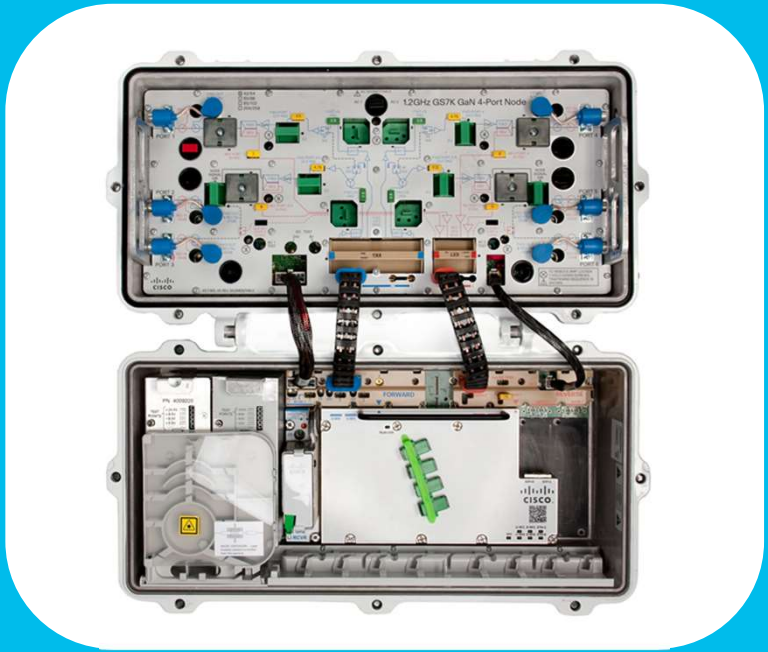


Remote PHY 120 RPD



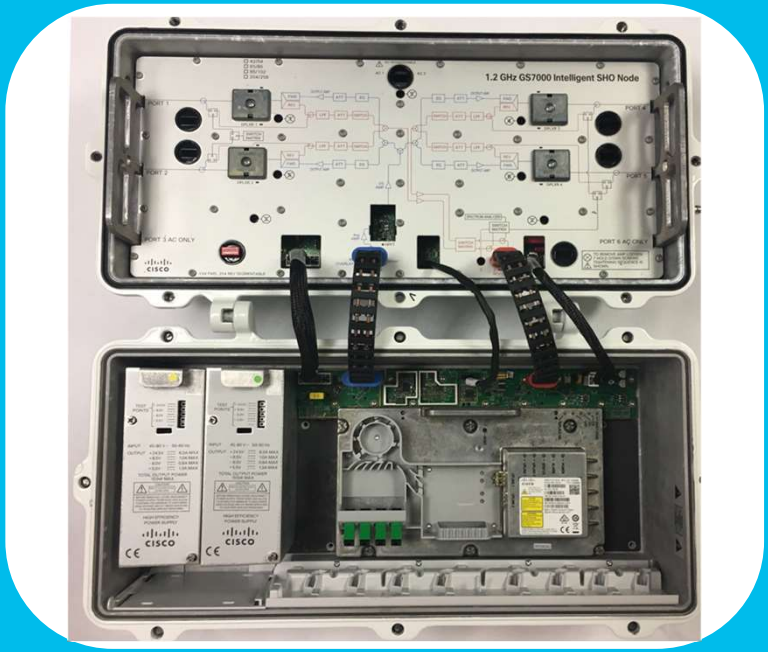
- Supported by GS7000 BAU, SHO nodes and iNODE
- Designed for fiber deep architectures
- 1x1 or 1x2 service group support
- Full Spectrum D3.0 and D3.1 capable HW
  - 160 DS QAMs
  - 6 blocks 192MHz OFDM
  - 12 US channels (12 ATDMA or 8 ATDAM + 4 SCDMA)
  - 2 blocks 96MHz OFDMA
- Video QAM and 55-1,2 support
- Integrated FFT enables advanced spectrum monitoring of entire 0 to 300 MHz upstream
- NDR/NDF support
- Shipping in volume!

Remote PHY 220 BAU RPD



- Supported by GS7000 BAU node
- Supports two 1x1 service groups
- Full legacy spectrum D3.0 and D3.1 support
- FPGA based PHY enables flexible channel plans for evolving networks
  - Deploy Day1 with 96 BC QAM, 32 DS NC QAM and 1 OFDM - migrate to 2 OFDM in the future via firmware upgrade
  - 4 US ATDMA channels per port
  - 1 block 48Mhz OFDMA per port
- Video QAM and 55-1,2 support
- Integrated FFT enables advanced spectrum monitoring of entire US spectrum on both ports
- NDR/NDF support
- Available NOW!

FDX Node & RPD

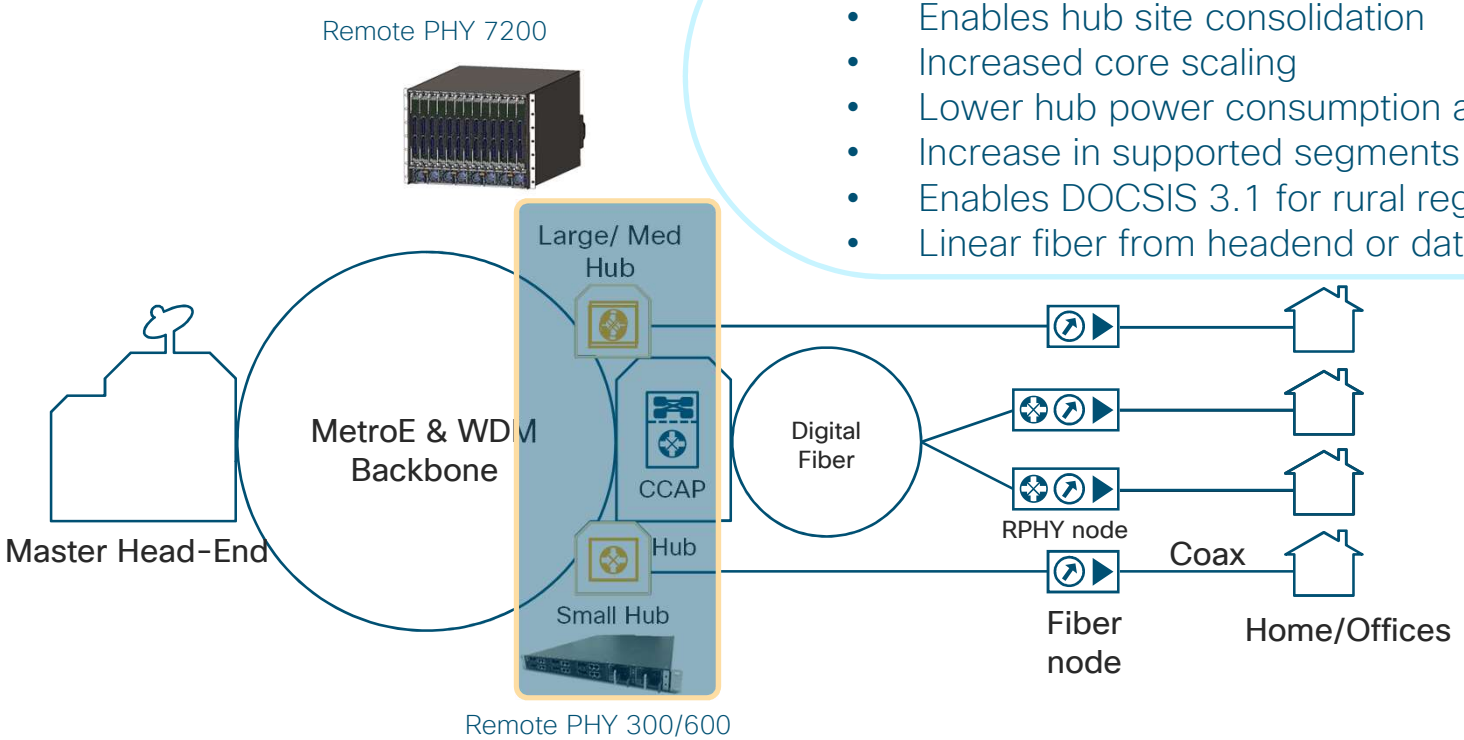


- Future proof node platform
- Common node platform as all GS7000
- Supports fiber deep applications
- New FDX capable RPD
  - Operates as RPHY 1x2 or FDX 1X1
  - DPD for reduced power
  - Full spectrum FDX
  - FDX EC
- Field characterization now!
- Node available mid-2019
- FDX RPD late 2019

Why RPHY in the Shelf?

Consolidation to leverage CMTS Capacity

- Enables Cloud Native CMTS
- Enables hub site consolidation
- Increased core scaling
- Lower hub power consumption and smaller footprint
- Increase in supported segments on the CMTS (2x/4x)
- Enables DOCSIS 3.1 for rural regions
- Linear fiber from headend or data center to node



Remote PHY 300/600 Compact Shelf

Features

- 3x6 and 6x12 SG Configurations
- Packages QTY 3 or 6 GS7000 (1x2) RPD Modules
- 1+1 modular power supplies (AC and DC Options)
- N+1 modular fans
- Total power budget: 320/530 W max
- Stackable for greater SG densities
- 1.75” (H) x 17.45” (W) x 23.6” (D)
- -40°C to 60°C, -200 to 13,700ft
- Shipping and deployed in production

Monitoring and Management

- Open RPD and standards compliant
- Managed as an extension of cBR-8 digital PIC port
- Power supply and fan status reported by cBR-8
- Local interfaces for connection faulty diagnosis
- Smart PHY integration

Front

Rear

Remote PHY 7200
High Availability RPHY Shelf

Chassis Size:

- 7RU, 19” rack mount chassis (10.5” H x 17.3” W x 24” D)
- 13 slots for RPD line cards (6 DS x12 US, total 18 physical ports each)

Capacity:

- 72 DS SG (1x2 ratio) with redundancy
- Each RPD line cards contains six 1x2 RPD modules (6x12)
- 160 narrowcast QAMS or 6 x192 MHz OFDM blocks per service group
- 12 US channels or 2 OFDMA blocks (96 MHz) per port
- 96 broadcast QAMs per RPD line card (shared across ports)
- Downstream frequency range:54MHz - 1.218 GHz
- Upstream frequency range:5MHz – 204 MHz

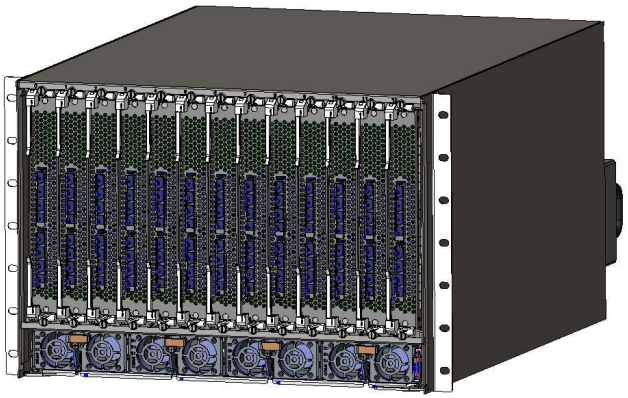
Power Supplies:

- cBR-8 power supplies
- 2 + 2 redundancy for both AC and DC applications.
- Chassis power budget – 3800W

Fan Shelf:

- N+1 fan Configuration (4+1) – operates indefinitely with 1 fan failure
- System can operate during fan tray replacement

Supervisor-less Design



- High Availability
- High Density
- Power Efficient
- Standard Compliant

OSS Support

Leakage Detection and Pilot Tones

- 4 Dedicated Tone Generators
- Any QAM can be configured to generate a tone
- Integrated with Commsonics, Trialithic and Arcomm leakage detection meters

SCTE55-1 and 2 OOB

- Supported in RPD PHY

Return Path Monitoring

- Support for narrowband monitoring via cBR-8 MIBs
- Wideband return path monitoring via triggered spectrum management
- Integrated with leading tool vendors

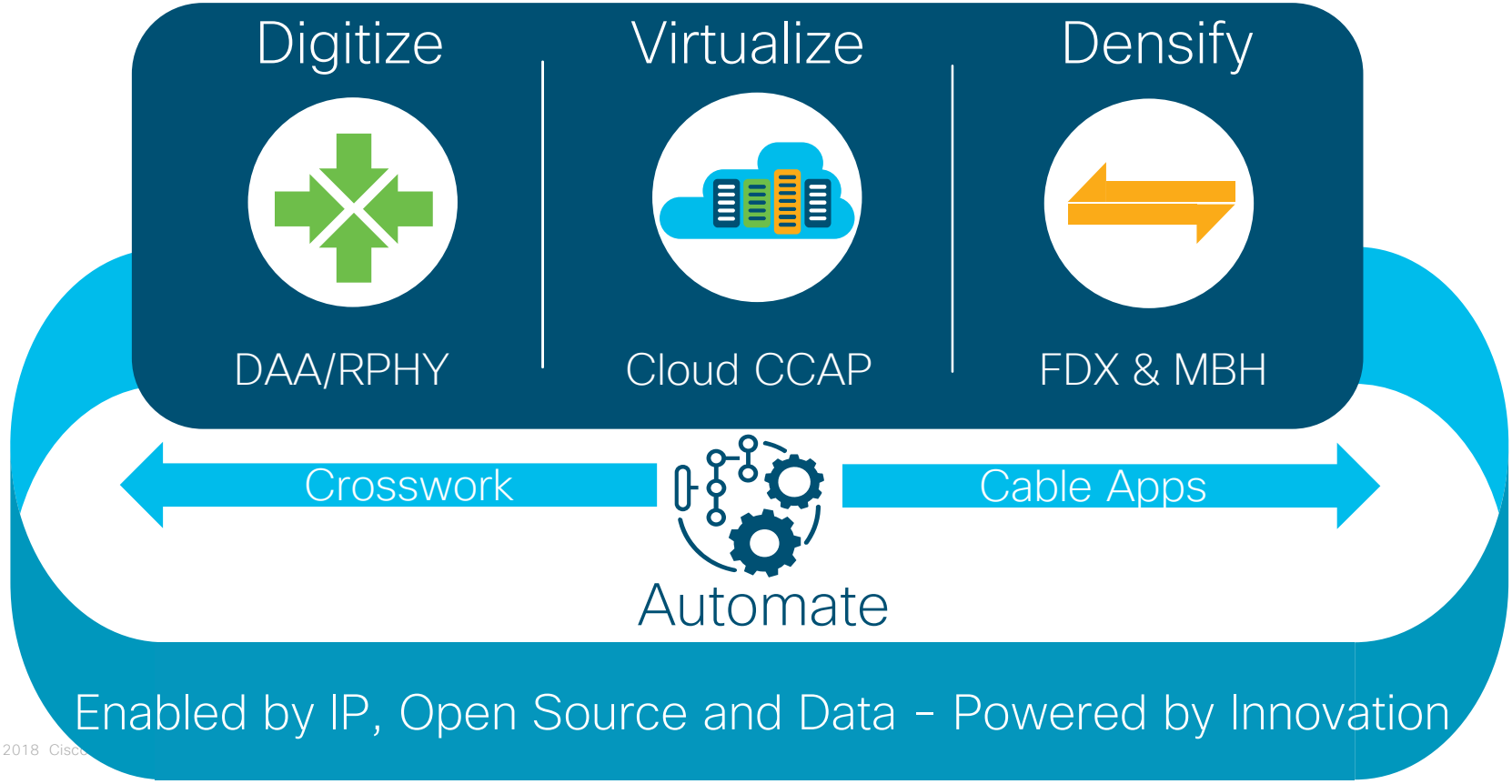
Modulated OOB (FM, HMS Transponders, DAB/Digital Radio)

- Supported by NDR/NDF
- Currently integrated with NDR/NDF Headend Converter Devices

Cable Automation and Orchestration

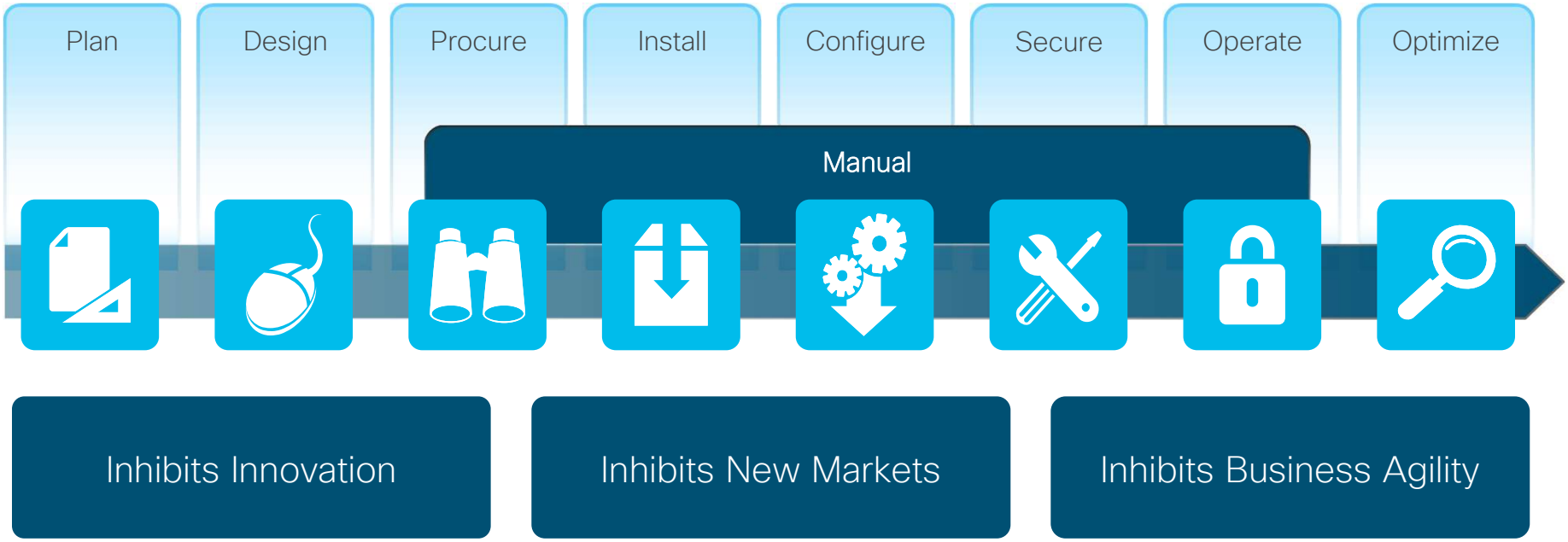
Ben Bekele
Director, Product Management

Core Cable Access Strategy



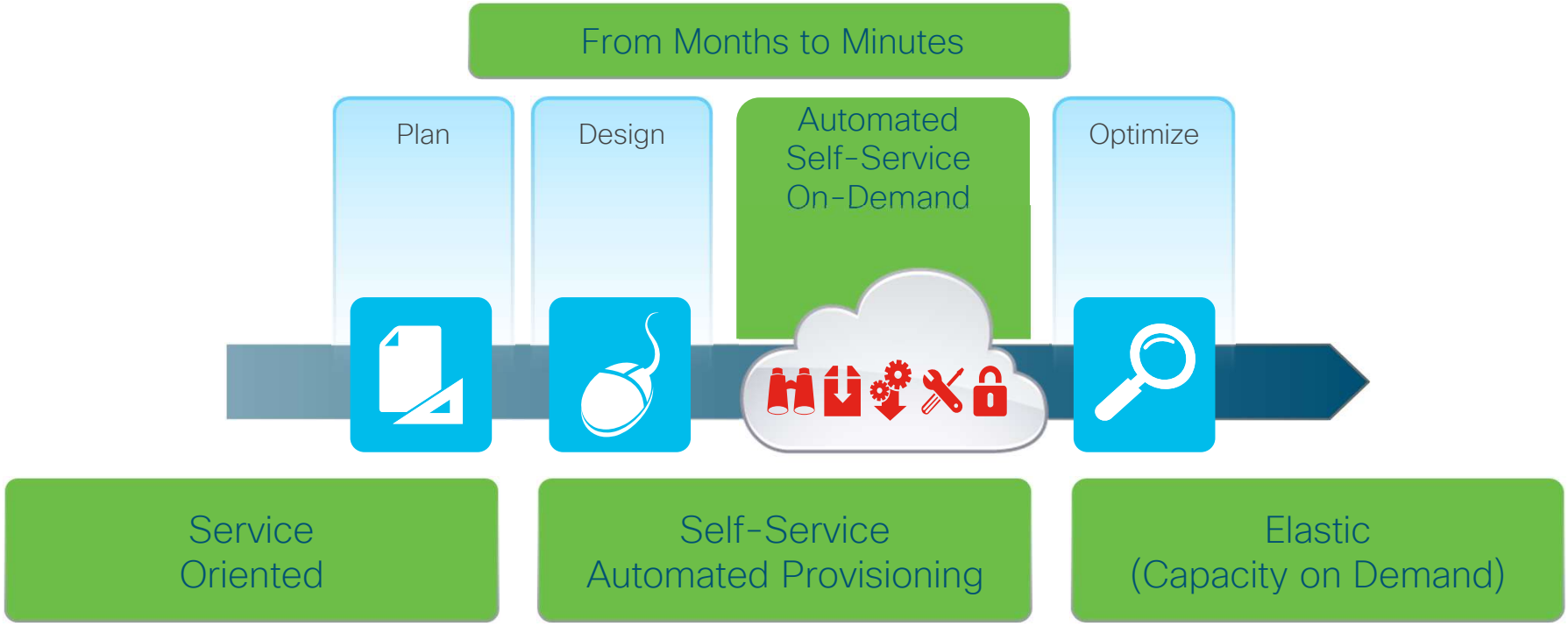
Major Barrier To Transformation: Complexity

Time-consuming, rigid operations, high operations costs—cannot scale!



From Complexity to Simplicity with Automation

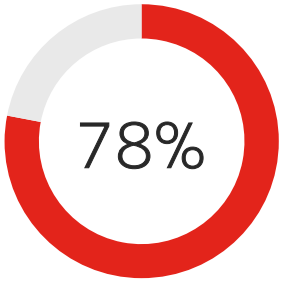
A Platform for Innovation



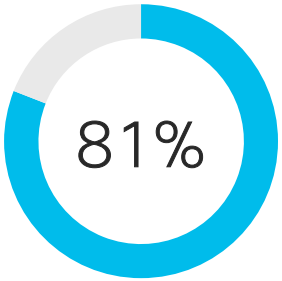
Improved Customer Outcomes with Automation

Time to Value
Configuration & Change Automation

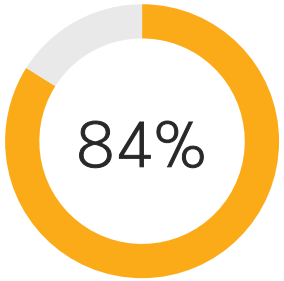
Time to Remediation
Automated Fault Remediation



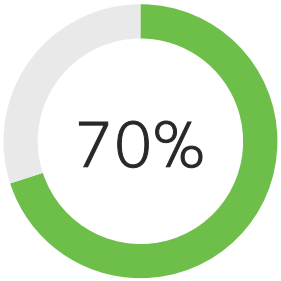
Faster Customer Service Onboarding



Faster Execution of Change Requests



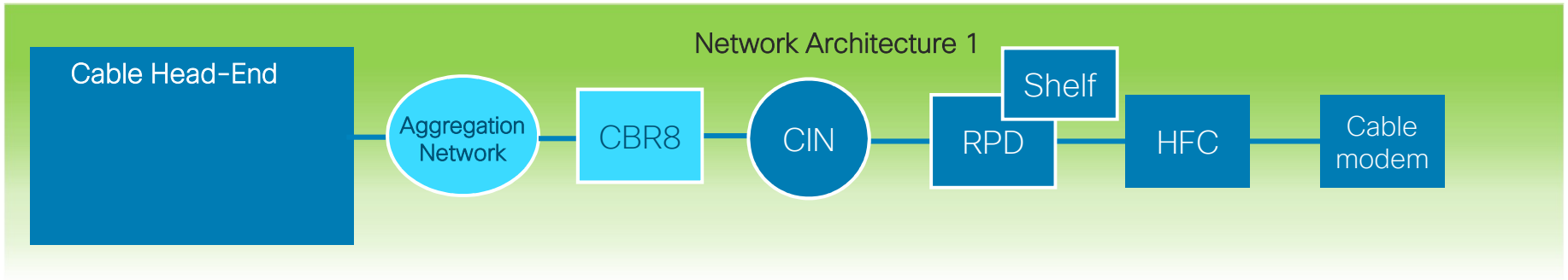
Faster Execution of Maintenance Procedures

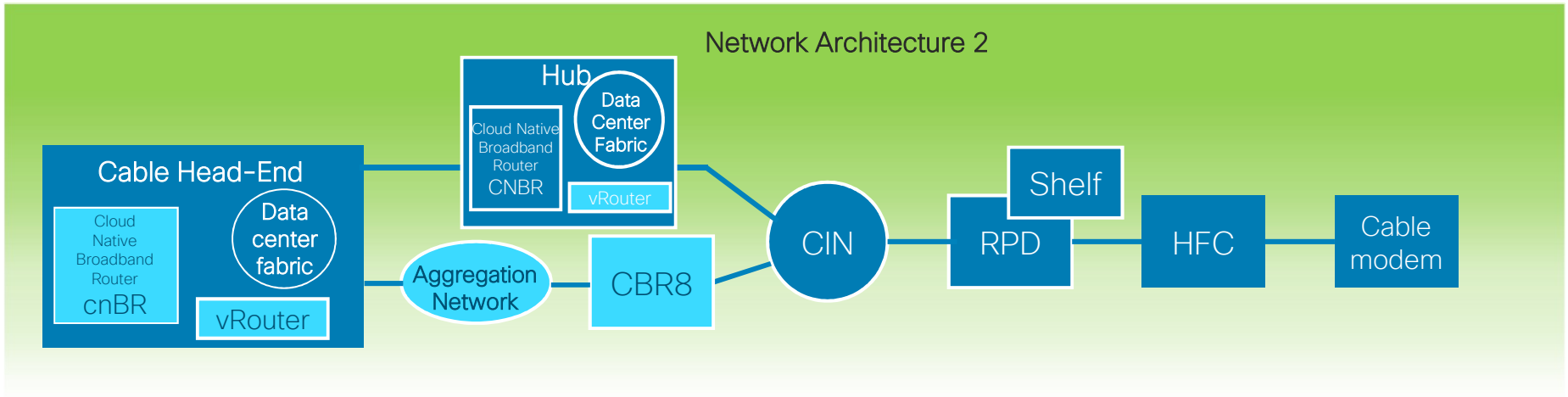


Improvement in Mean Time to Repair

Specific improvements vary and depend on many factors
Source: Cisco Automation Benchmark of 5 SP Customers

Cloud & DAA Network Architectures





Polling Question

- Where should operators focus their automation efforts when it come to DAA & Cloud?
  - Operations
  - Configuration
  - Optimization
  - Assurance
  - All of the above

Cable Automation Application Focus Areas For DAA & Cloud CMTS Architecture

Configuration

- Provisioning and activation
- Software upgrade
- Move, decommission RPDs
- Node split

Status Monitoring

- Topology – Service and Network
- CCAP, RPD, CIN status/health
- Capacity utilization
- RF – Upstream spectrum

Trending & Reporting

- Network capacity
- SG/User BW utilization
- RF health

Assurance

- Capacity
- Network SLA
- Firmware management

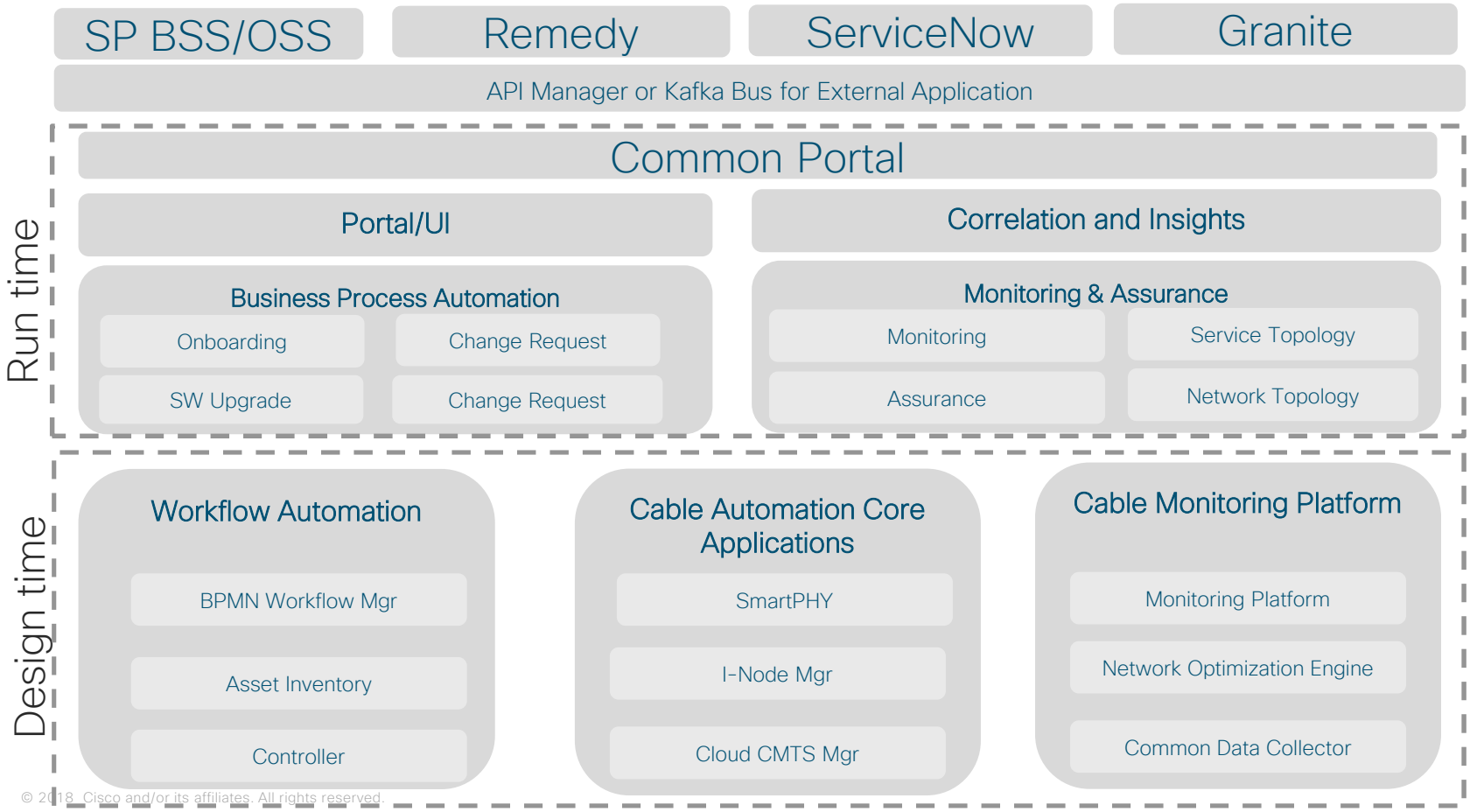
Planning

- Capacity planning
- Plant maintenance planning
- Node split planning
- Cloud CMTS migration planning

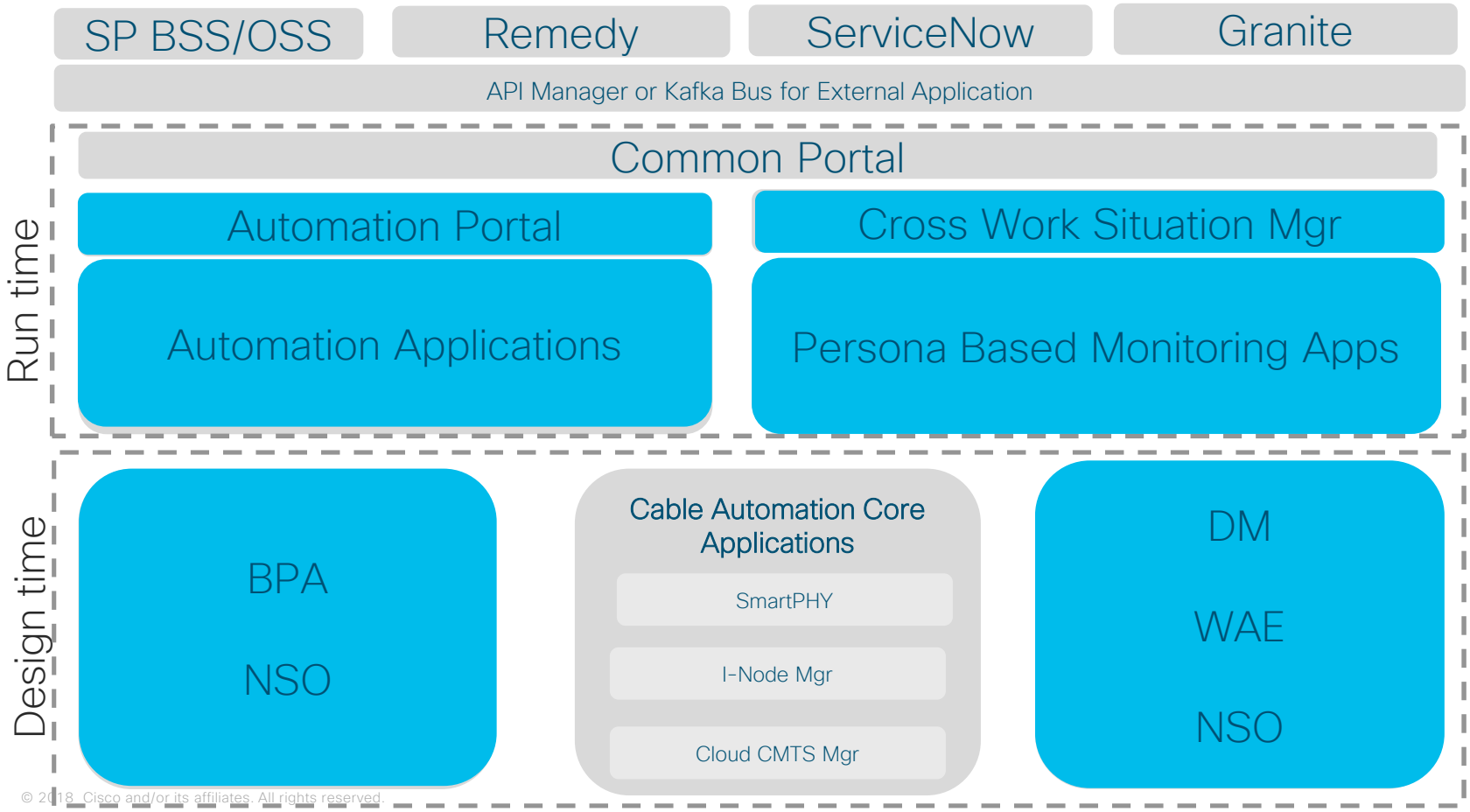
Insights & Optimization

- MTTR improvement
- Bandwidth optimization
- Node cluster power management
- OFDM profile management

Cable Automation Architecture



Cable Automation Architecture



DAA & cnBR Automation Use Cases

Customized using the baseline use cases

Operations Automation

- Day 0, Day 1, Day 2, Day N Operations
- Device Onboarding – CCAP, CIN, RPD
- Device configuration – CCAP, CIN…
- Service onboarding
- MOP process automation
- Device Lifecycle Management
- Software upgrade process

Platforms

- BPA
- NSO

NetOps

Monitoring & Assurance

- Topology– Physical & Network
- Device visualization
- CCAP, RPD, CIN status/health
- Capacity utilization
- RF monitoring
- Upstream spectrum capture
- PNM
- Root cause analysis – MTTR improvement

Platforms

- DataMiner
- Crosswork Situation Manager

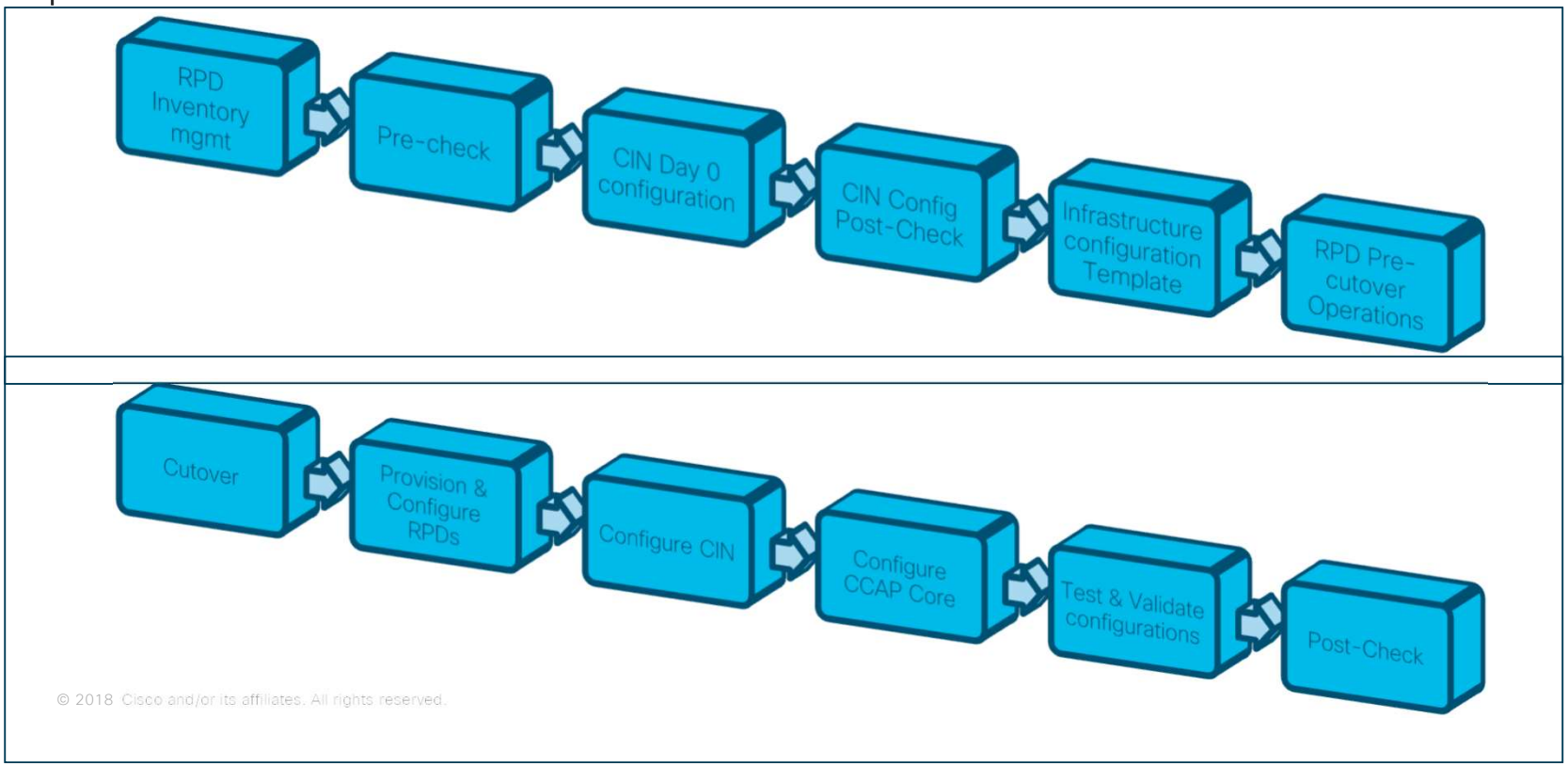
FCAPS

High Level DAA Onboarding Workflow – Day 0

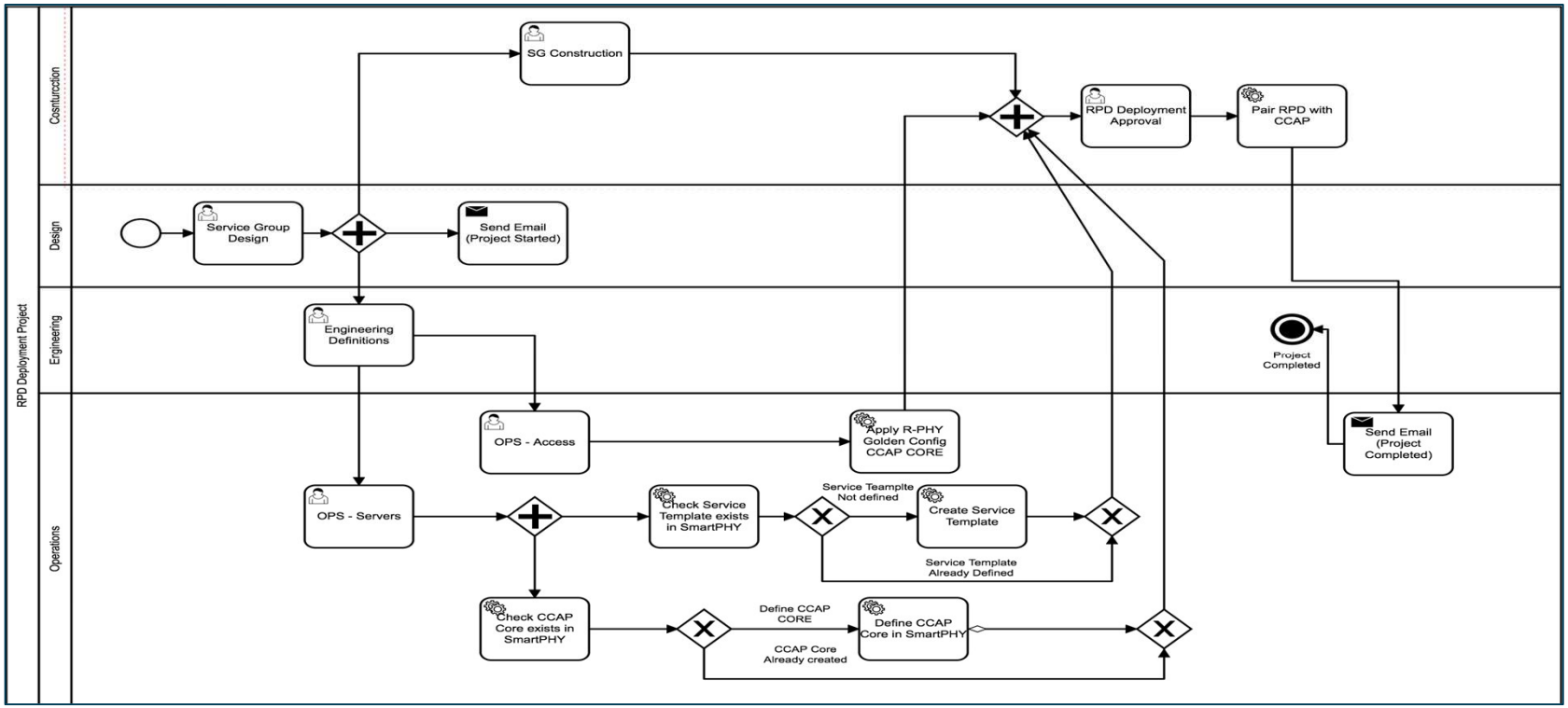
Elements- RPD, CIN and CCAP Core

Operation- Install, configure and activate DAA

Operations Flow



CCAP and RPD Onboarding Automation



Cable Automation – Applications Dashboard

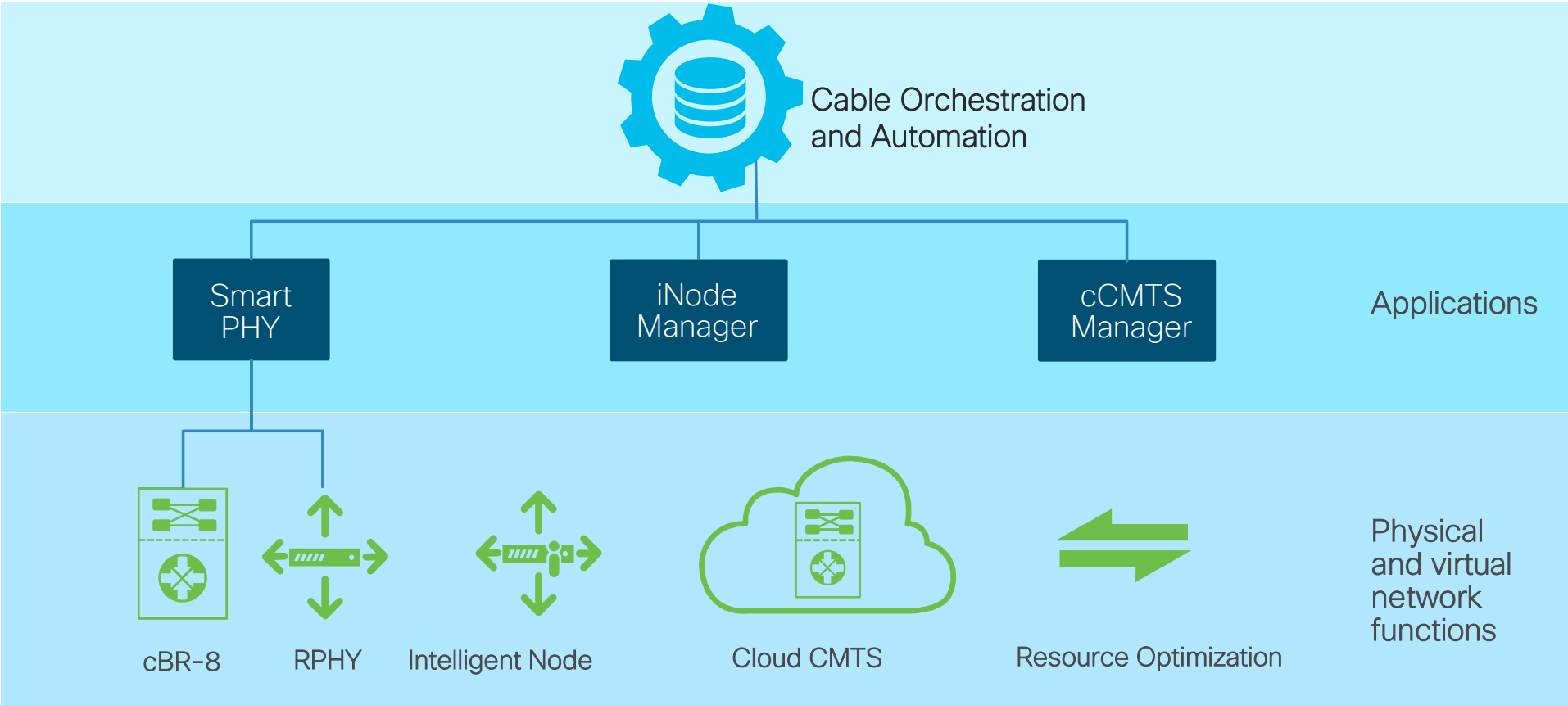
Device Onboarding (RPD, CIN, CCAP…)	Network Optimization	Network Monitoring	Capacity Planning	cnBR Migration Analysis	Workflows
Config Audit/ Golden Config	Service Group Migration	Network & service Assurance	Node Split Planning	Inventory Mgmt	Device Lifecycle Mgmt
cnBR Onboarding	Software Upgrade	Topology Mgmt	Network/Plant Maintenance Planning	Network Insights, Reporting and Trending	Service Lifecycle Mgmt

Smart PHY

Remote PHY Deployment Automation

Gitesh Shah
Product Manager

Cable Automation & Orchestration Suite

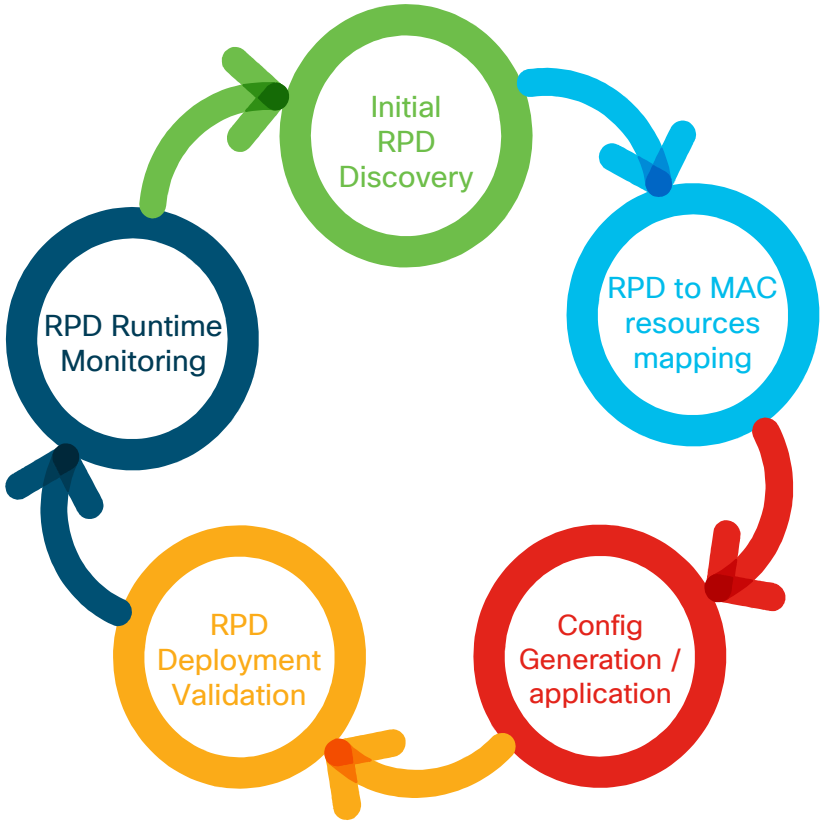


Current RPD Deployment Challenges

- Manual Configuration
  - Error prone at scale
  - Difficult to keep track of resources used
  - Per RPD configuration
- Provisioning Requirements
  - DHCP Server must know the CCAP/Video Cores
    - Inflexible load balancing
  - Validation and debugging manually
  - Monitoring based on Syslog messages
- Change Operations such as RMAs and Splits

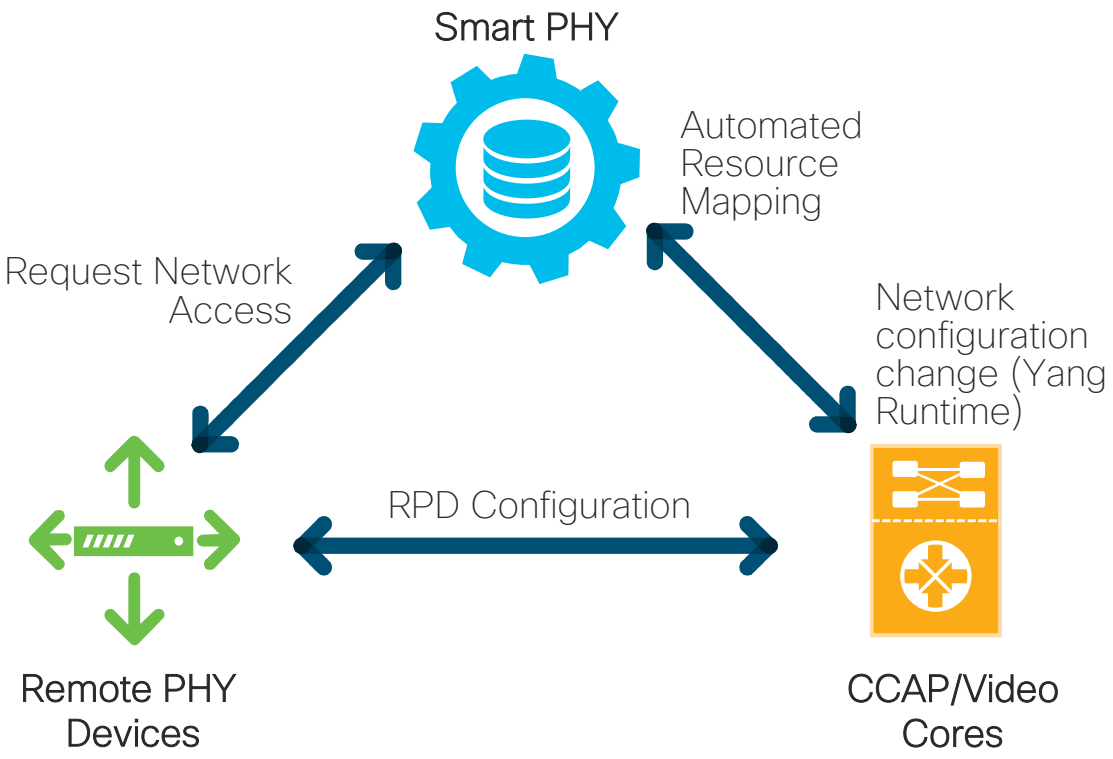
Automated RPD Deployment

- In large scale RPD deployment, automation is a must
  - Dozens of steps per RPD
  - 250-500 RPDs per cBR-8
  - 100s of cBR8s in typical network / region
- Key steps for RPD deployment automation
  - Initial RPD Discovery
  - RPD grouping into SGs
  - SG to cBR MAC resource mapping
  - Config generation and application to cBRs
  - RPD deployment validation
  - Ongoing health Monitoring



Smart PHY - RPD Deployment Automation

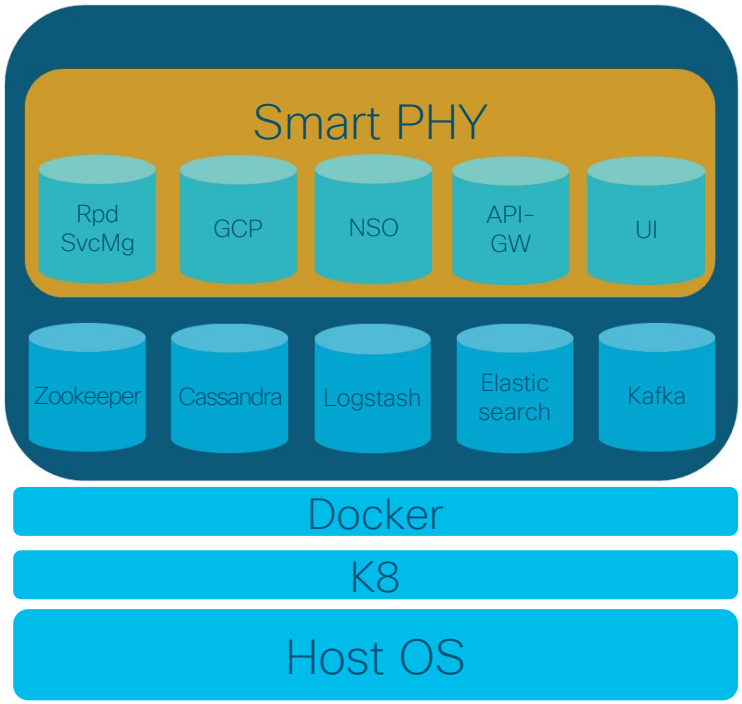
- **Deployment Simplified**
  - Resource Selection
  - DOCSIS & Video
  - cBR-8 and RPD orchestration
- **Unified Provisioning**
  - Common DHCP Policy
  - Flexible RPD to SG mapping without managing one-offs
- **Cloud Native Platform**
  - Cloud Infrastructure
  - API-Centric Design
- **Advanced Monitoring & Troubleshooting**



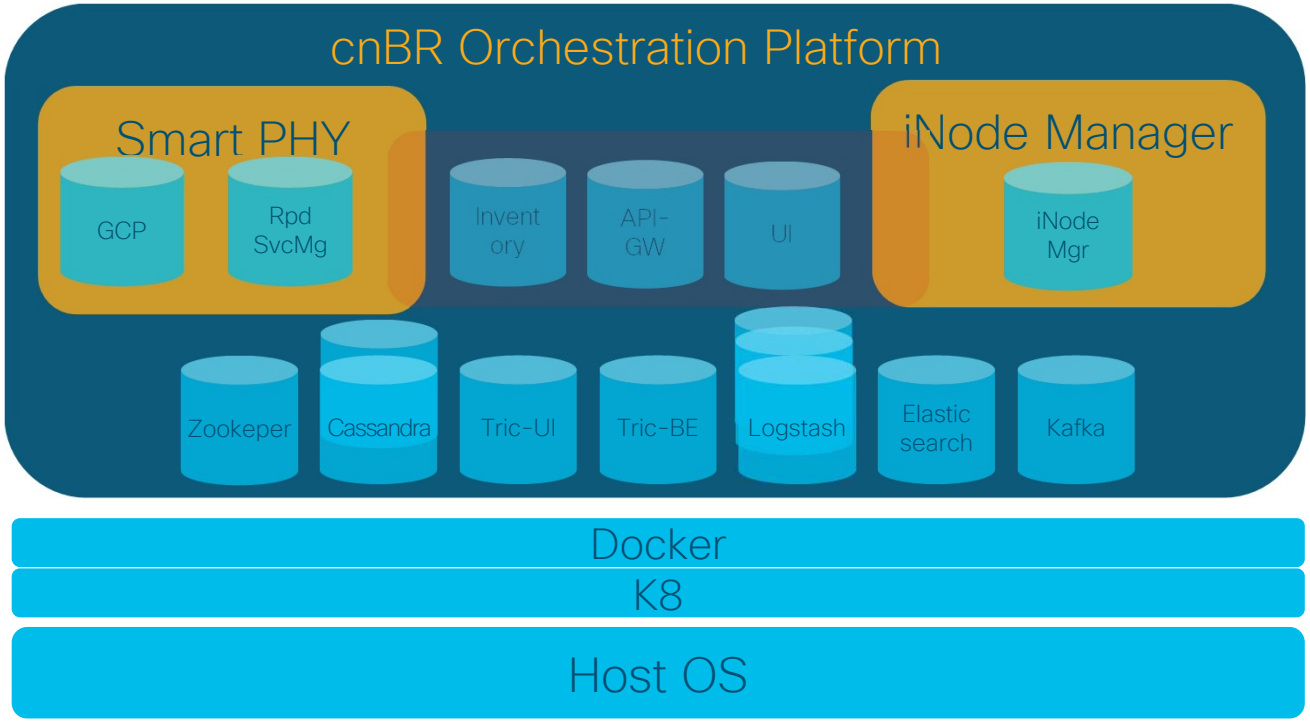
Cloud Native Software Architecture

Smart PHY 2.0 Architecture

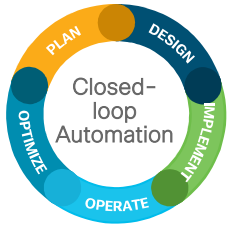
- Common micro-service platform as cnBR and iNode Manager
- Kuberenetes platform for micro-service orchestration
- Multi-node clustering for SW resiliency, HW redundancy and load-balancing
- Critical infrastructure (i.e. Cassandra DB) with multiple replicas across the cluster



Cable Automation & Orchestration Architecture



Transforming Cable with Automation
Executive Summary



Element and Architecture Lifecycle Management

Automate Network Operations

Monitor and Optimize Network Performance

Provide Real-Time Analytics and Insights

Operator Cross Domain Workflow Automation and Orchestration

End to End Network Monitoring and Optimization

Real Time Analytics, Insights and Correlation

Q&A

CISCO