
SCTE®
CABLE-TEC EXPO®
FAST FORWARD 2021
ATLANTA, GA
OCTOBER 11-14
SCTE
a subsidiary of CableLabs®
UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
2021 Fall Technical Forum
SCTE® • NCTA • CABLELABS®

SCTE
a subsidiary of CableLabs®

Wireline Access Network

Modernizing Cox Communication's Access and Aggregation Network for Remote PHY

Deependra Malla

Lead Network Design Engineer
Cox Communications Inc.

2021 Fall Technical Forum
SCTE • NCTA • CABLELABS

SCTE CABLE-TEC EXPO FAST FORWARD 2021
VIRTUAL EXPERIENCE
OCTOBER 11-14

Agenda

- Introduction
- Legacy Access Networks in Cox and its Limitations
- Access and Aggregation Network Evolution in Cox
  - Distributed Access Architecture (DAA)
  - Cox Distributed Access Architecture
  - Cox Converged Interconnect Network Architecture
  - Timing Distribution (PTP) Architecture
- Access Aggregation Network Standardization and Automation
- Conclusion

Why we had to evolve our existing Access Network

Rapid Growth in Bandwidth Demand

Business need to provide Next Generations of Multi-Services

Legacy RF cable plant stretched to the capacity limits

- Upstream and Downstream congestion

Cox Remote PHY deployment:

- One of the largest in North America
- Currently ~40% of Cox footprint covered by R-PHY

Legacy Access Network in Cox

Cox HFC Architecture

- Cox access fiber network is a diverse ring topology
- Passive optical architecture

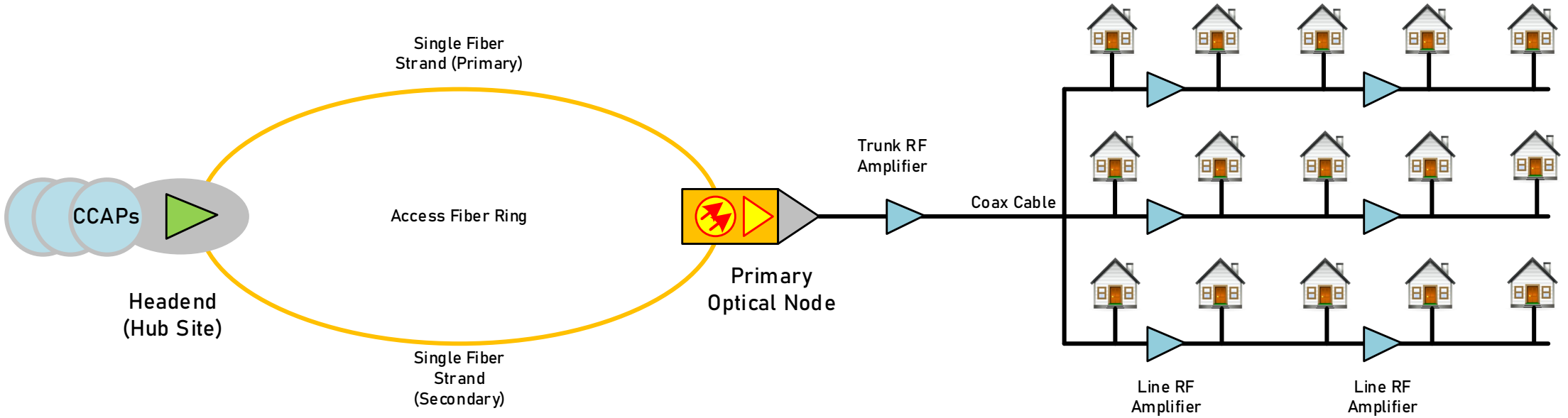

Fig. Cox HFC Architecture

Cox Legacy Cable Infrastructure

- Current cable architecture is based on Integrated CCAP

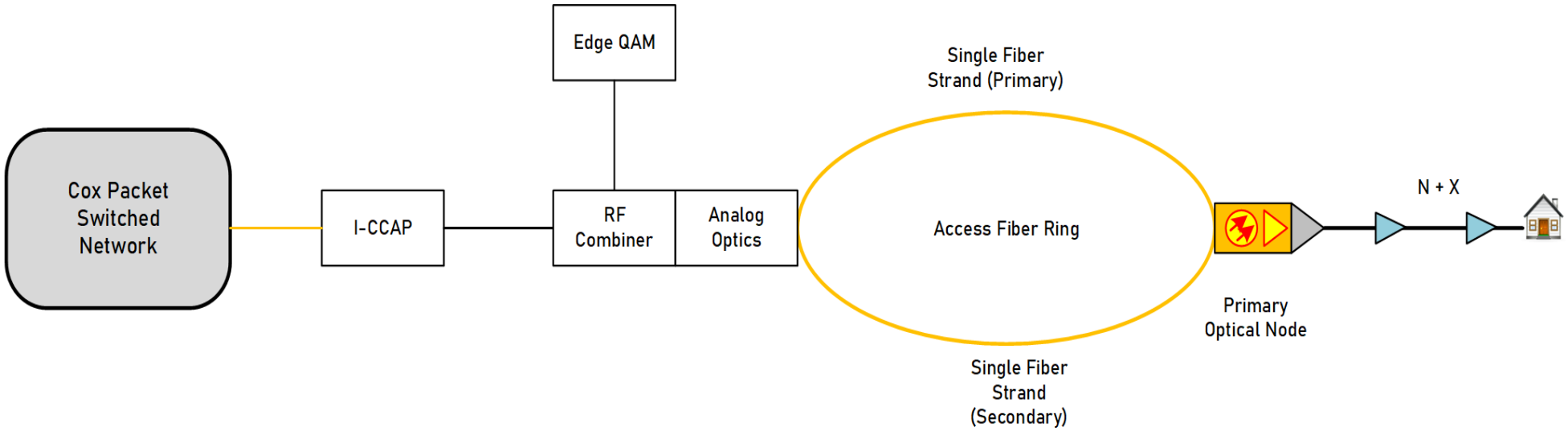

Fig. Cox Legacy Cable Infrastructure

Legacy Cable Plant Limitations

- Legacy cable plant prone to signal quality degradation
- Distance Limitation
- Capacity Constraints
- Expensive to maintain and operate
- Limited real time performance monitoring of analog equipment

DAA Variants

- Remote PHY
  - Relocate PHY closer to subscribers
  - Remote PHY Devices (RPDs) replaces existing Fiber Node/Primary Optical Node
  - Cox's current technology for DAA
  - 12,000+ RPDs deployed covering 3.55 Million HHP and serving 2.31 Million subscribers

- Remote MAC PHY
  - Relocates MAC and PHY closer to the subscribers to provide lower latency
  - Remote MAC PHY Devices (RMDs) replaces Fiber Nodes and co-exists with RPDs for some time
  - Currently under testing

High – Level Cox Network Architecture

- Tiered Network Topology
- Core backbone connects markets, data centers and peering center

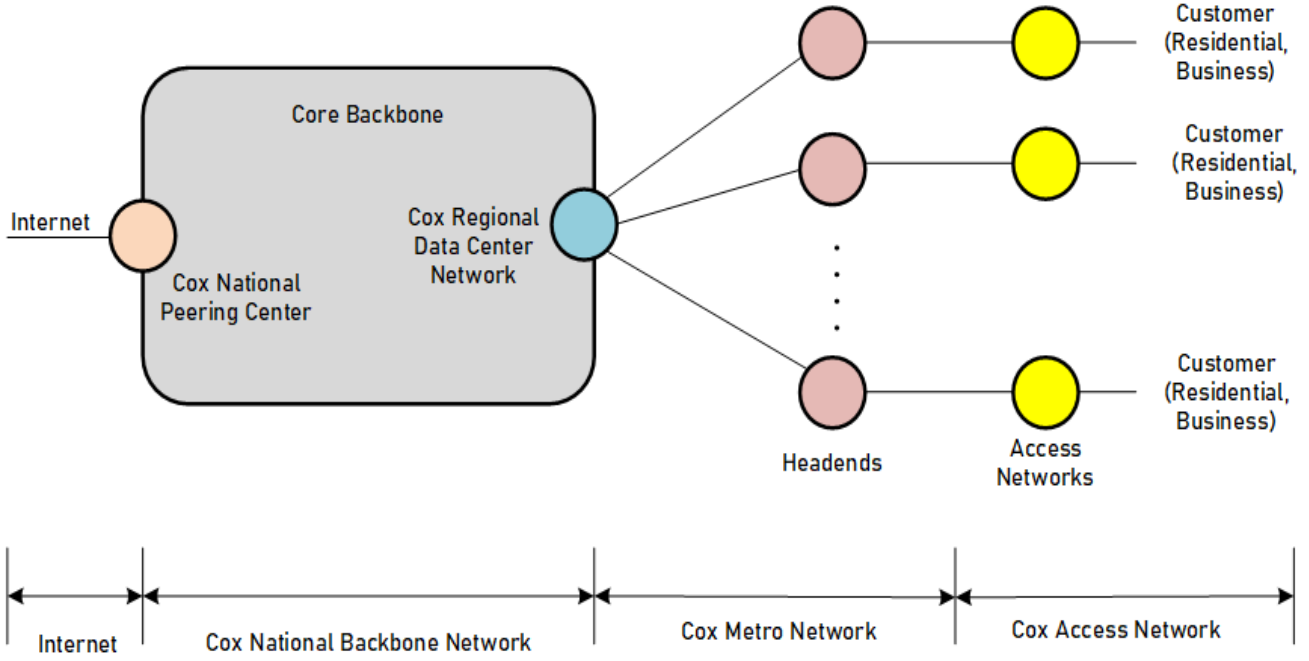

Fig. Cox High Level Network Architecture

Cox DAA Topology

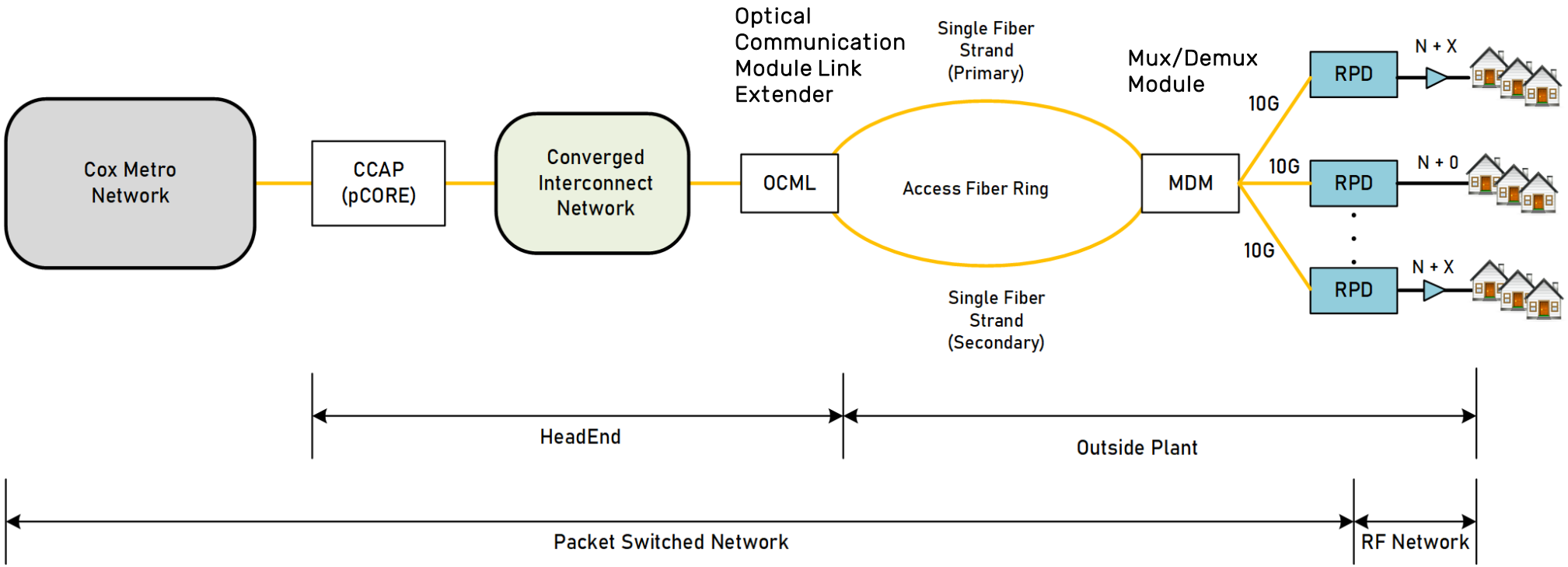

Fig. Cox High Level DAA Topology

CIN Design Principles

- Efficiently utilize existing network assets and architectures
- Standard deployment using one common architecture for small and large sites
- Provide any-to-any connectivity between RPDs and CCAP
- Routed Layer 3 network with IPv6 only
- Utilize existing access fiber “ring” topology
- Automation friendly and ZTP capable
- Elastically scalable

CIN Spine and Leaf Architecture

Spine Layer:

- Hub Aggregation Routers

Leaf Layer:

- RPD Aggregation Routers (RPAs)
- DPIC Aggregation Routers (DPAs)

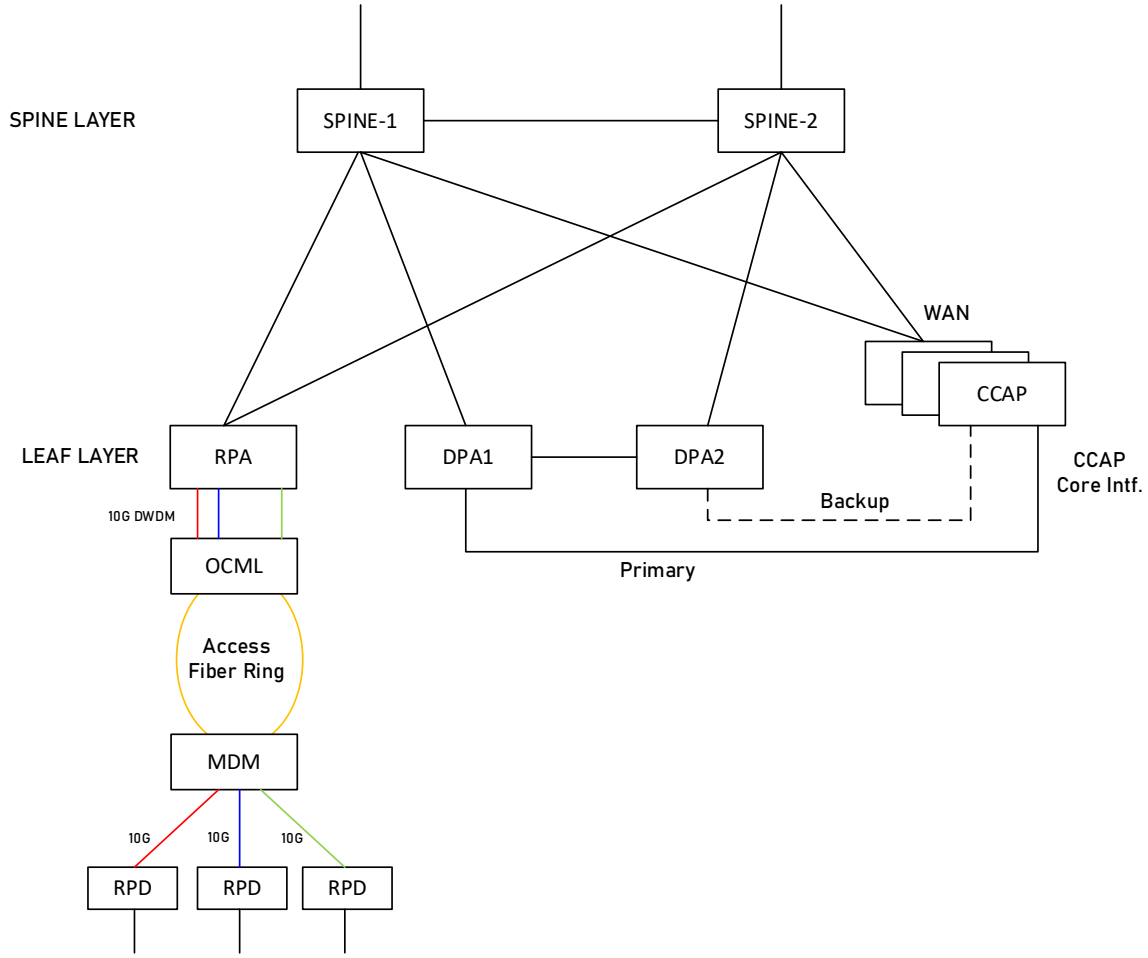

Fig. Cox High Level CIN Architecture

CIN Routing Design

- Routed IPv6 Network
  - Eliminates dependency on IPv4
  - Eliminates need for complex logical architecture
  - Supports any-to-any connectivity between RPDs and CCAPs
- ISIS as an IGP
  - IS-IS Multi Topology used to advertised infrastructure prefixes (Loopbacks and P2P Links addresses)
- MP-BGP
  - MP-BGP with unicast and multicast AFI
  - Advertises non-infrastructure prefixes
  - Multicast sources are advertised to BGP SAFI 2

CIN Routing Design

- PIM-SSM
  - More than 99% of CIN traffic is IPv6 multicast
  - Source Specific Multicast (SSM) is used for multicast delivery mechanism
  - RPF check against BGP SAFI 2 table
  - MLDv2 enabled on RPD facing interface on RPD aggregation routers to discover multicast listeners
- Quality of Service
  - Mark, classify and prioritize various types of traffic
  - Buffer management to smooth out bursty traffic
- Security
  - 802.1x for authenticating RPDs

Extended CIN Routing Design (E-CIN)

- Provides any-to-any connectivity between RPDs and CCAP Cores
- Deployed at headends where Cox has space and power constraints
- Host site CCAPs serve remote sites RPDs
- Traffic kept to "optically" shortest path between host and remote sites using IGP traffic engineering
- Proactive bandwidth management to ensure enough capacity between host and remote sites

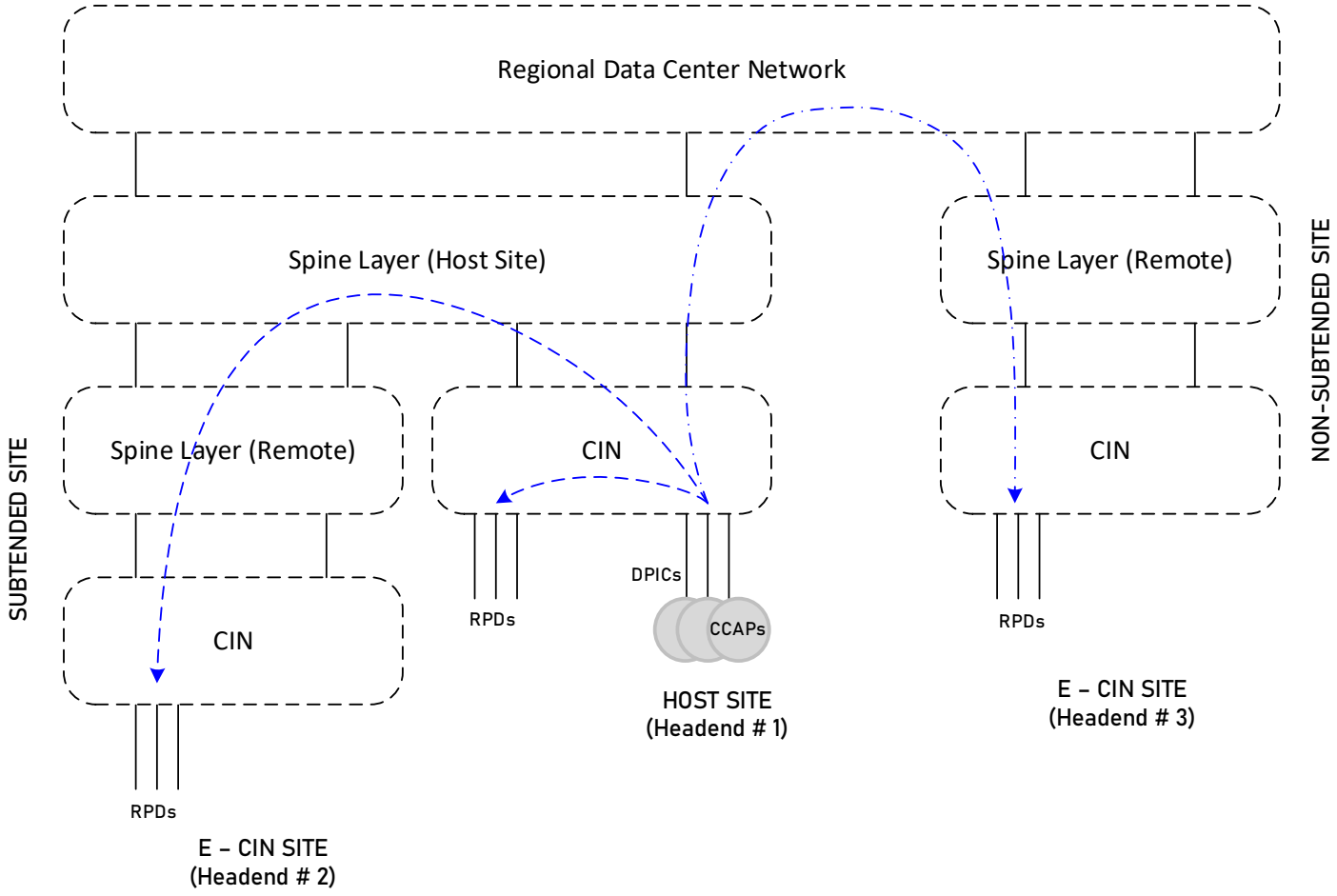

Fig. Cox E-CIN Architecture

Timing Distribution Architecture

- A pair of IPv6 only enabled Grandmaster Clock deployed at each RDC supporting that market
- Several “dual stack” boundary clocks deployed at each hub sites to support RPDs and CCAPs
- Timing distribution architecture is hierarchical with GM clocks serving as master to BCs. BCs are masters to CCAPs and RPDs

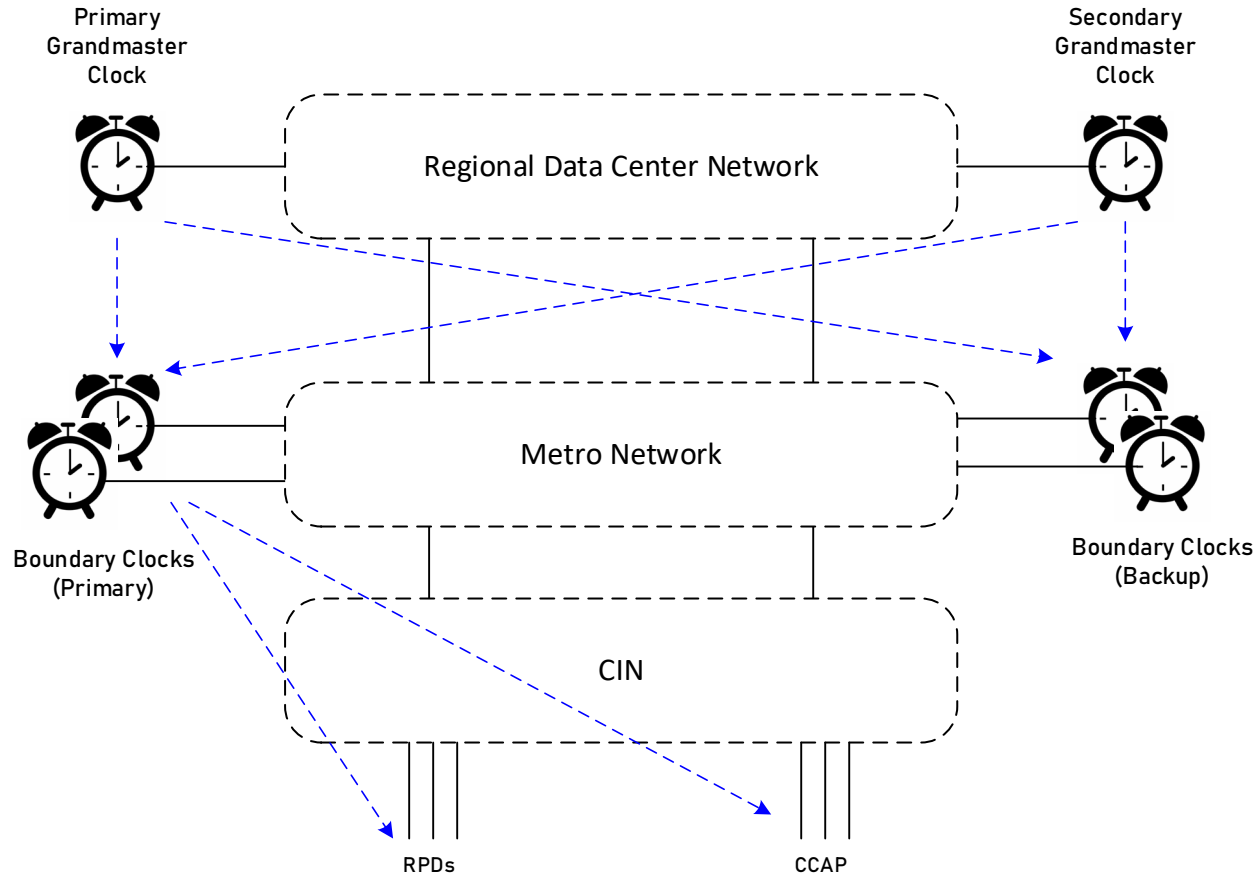

Fig. Cox PTP Architecture

Network Standardization

- Standardization necessary for Large scale deployment
- “CIN Playbook” documents protocols and configuration
- Automation friendly configuration – easy information parsing

Zero Touch Provisioning (ZTP)

- Large number of RPD aggregation and DPIC aggregation routers are being deployed
- Manual provisioning OpEx intensive
- Zero Touch Provisioning (ZTP) used to provision RPAs, DPAs and HUBs
- ZTP Engine automatically creates and updates provisioning records
  - IPAM, Granite, Device databases etc.

Conclusion

- Modernization of access and aggregation network in Cox has long-term positive impact on Cox network
- Digital Fiber Architecture able to meet increasing traffic demands; improved traffic quality
- Access agnostic access and aggregation network capable of delivering IP and non-IP services
- Improved digital capabilities and versatilities as demanded by new and emerging technologies like R-OLT, 5G Backhaul, Dedicated Lambdas, possibility of 100G

SCTE® CABLE-TEC EXPO® FAST FORWARD 2021

ATLANTA, GA
OCTOBER 11-14

SCTE®
a subsidiary of CableLabs®

Thank You!

Deependra Malla

Lead Network Design Engineer
Cox Communications Inc.
6305 Peachtree Dunwoody Road
Atlanta, GA 30328
deependra.malla@cox.com

2021 Fall Technical Forum
SCTE® • NCTA • CABLELABS®

COX