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IMAGINE  
THE POSSIBILITIES...



2020 Fall  
Technical Forum

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WIRELINE ACCESS NETWORK

# The Power of Distributed Access Architectures

John J. Downey

Sr. CMTS Technical Leader

Cisco Systems



IMAGINE  
THE POSSIBILITIES...

SPONSORED BY:



- Background
- Benefits
- Space and Power Savings
- Power of Digital & IP
  - RF Combiner & Node Splitting Conundrum Solved
  - Advanced D3.1 Profiles & FDX Achieved for Higher Speeds
  - Service Activation, SDN, Orchestration, Virtual Functionality
- “Real-Life” Testing & Results
- Conclusion & Summary

## Remote PHY Device (RPD) – Node Module or Shelf

D3.1 DS upper bandedge of 1.218 GHz

DS lower bandedge dictated by diplex filter; 54, 108, 258

US upper edge of 42, 65, 85, &/or 204 MHz

D4.0 FDX with 108-684 US/DS OFDMA/OFDM overlap

D4.0 FDD (ESD) with 1.8 GHz DS bandedge

D4.0 US extends as high as 684 MHz with 834 MHz DS start

## Remote PHY Device Signals

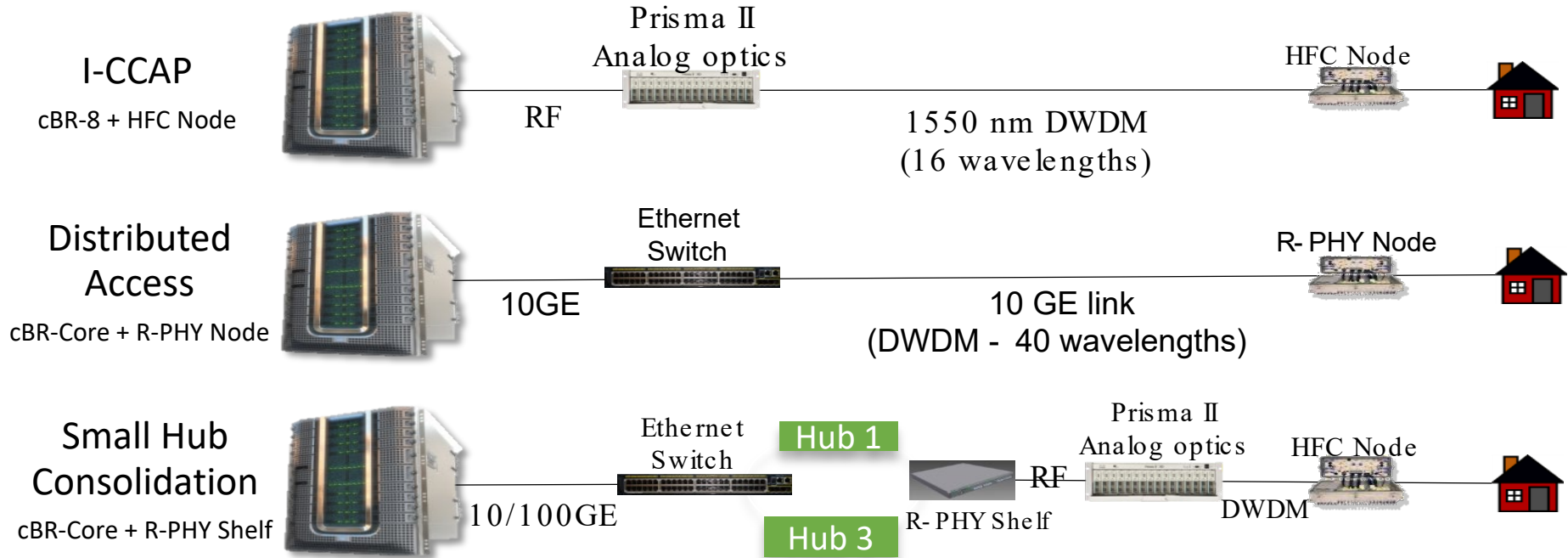
Meant to generate multiple simultaneous DS signals

- CW carriers for leakage test signals, AGC pilots, and alignment tones
  - Four leakage equipment vendors' proprietary test signals
    - Two simultaneously (e.g., 138 MHz & 612 MHz)
  - Ability for placement on visual carrier freq & levels ~6 dB > SC-QAMs
- DOCSIS SC-QAMs (1.1, 2.0, 3.0) & D3.1 OFDM (multiple 192 MHz blocks)
- MPEG video; DVB as well
- Out-of-band (OOB) signaling for legacy STB; 55-1 = Motorola; 55-2 = SA/Cisco

Full US support

- 8 SC-QAMs (ATDMA/TDMA)
- 2 OFDMA 96 MHz blocks

# Deployment Scenarios



\* Also port/SG expansion in HE

## Digital Optics Benefits

### Better MER

- D3.1 higher modulation schemes possible

### No laser clipping

- US of 204 MHz and greater - probably a requirement

### Much longer distance

- Helps consolidate real estate (hubs)

### More optical wavelengths possible

- 40 vs 16 (cost/wavelength mile)

**Note :** Assumes analog video retired or some type of overlay & US RF testing and spectrum analyzer now required at RPD

## R-PHY Operational Benefits

Enables hub site consolidation

Lower power per SG in Hub

Enables Ethernet to the node

Lower optics costs (10 G)

Enables sharing commercial and residential plants

Enables HFC fiber to become a full-service IP network

More SG per wavelength

Lower plant maintenance costs

Simpler fiber design rules

Replaces RF combining with switching

**Note** : N+0 not required

## Space Savings

RF combining goes away, but optical splitting/combining happens

- Switches, routers, timing servers

Two, 13 RU chassis can be collapsed into 1 chassis

- Less CMTSs = less:
  - Power
  - HVAC
  - Rack space

## Power Output Comparison

cBR-8#sh environment power

=====

R0	FRU Power	709 W	
2	FRU Power	390 W	<<< Regular RF linecard with RF PIC
9	FRU Power	150 W	<<< RPHY specific linecard
9/1	FRU Power	18 W	<<< DPIC with 8 SFP+ (SR)

- 
- **Note** : Even though PHY moved to node, node < 160 W
  - Typical fully loaded chassis with 56 SGs drops from 5 kW to 4 kW
  - If Video incorporated, much more power and rack savings!

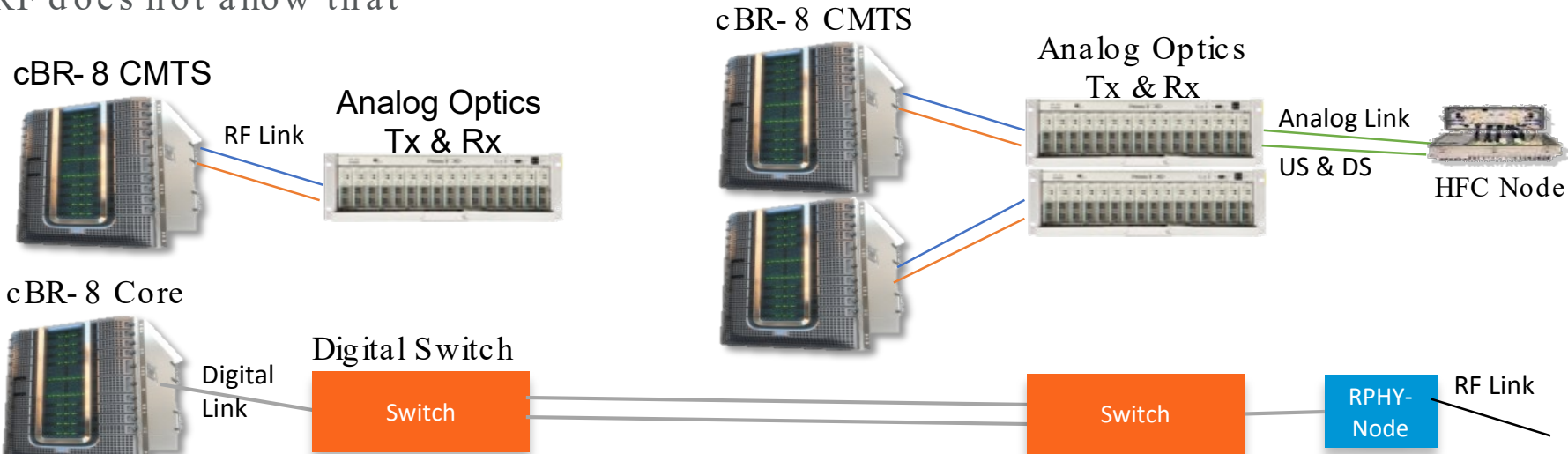
# RF Splitting/Combining Conundrum

Node splits = more SGs = more connections = more CMTSs

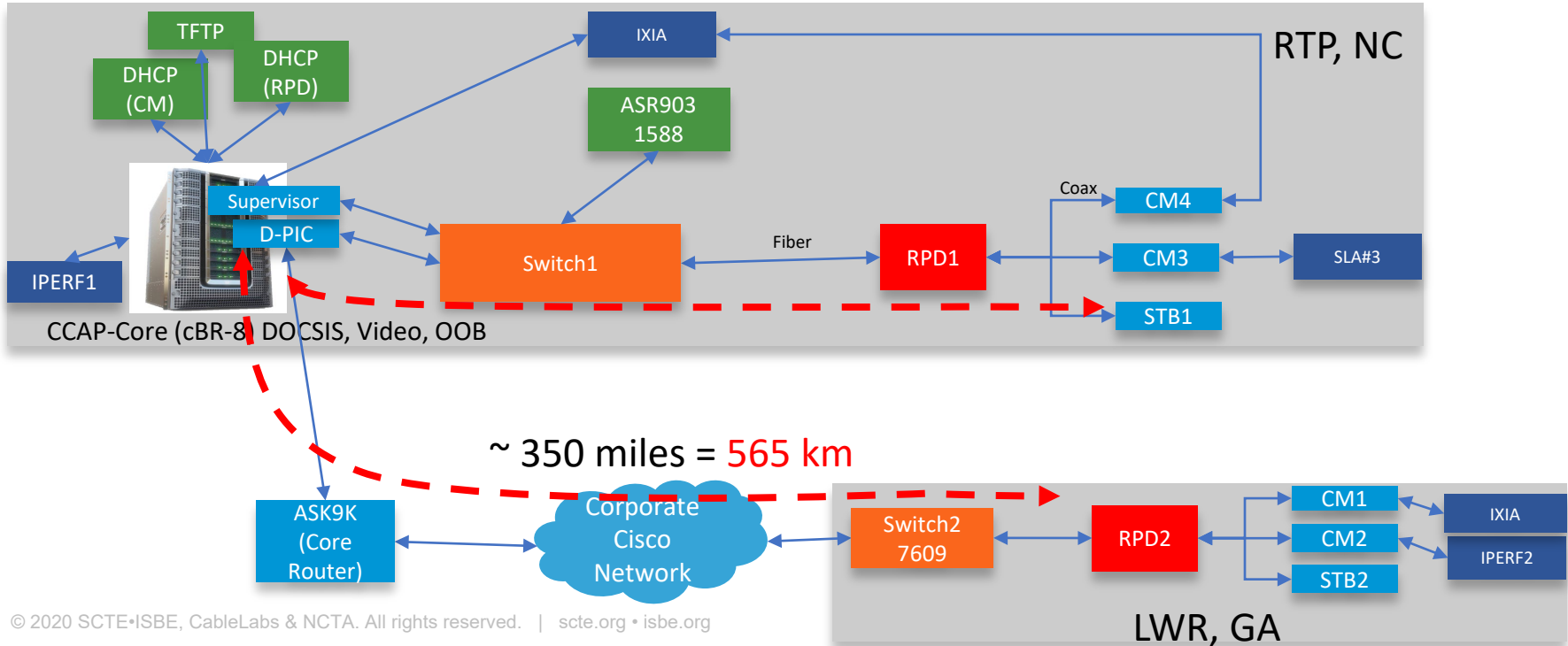
- More RF cabling, rack space, powering

Digital optics allow splitting/combining in time domain with faster digital links

- RF does not allow that



# Topology Diagram



# Summary and Observations

Roundtrip time delay between CMTS in RTP & LWC RPD: 18 ms (avg)

2000 km of fiber = ~ 10 ms

- Our fiber delay was only ~ 3 ms
- Router & switch delay could be very high & unpredictable!

Linux box MTU packet set to 1434 bytes, MTU across IT link set to 1500

- If BPI+ enabled, MTU on Unix boxes changed to 1428 in order to accommodate extra bytes used in DOCSIS Extended Header

PTP stability/reliability of utmost importance

D3.0 CM could register D2.0 mode (US and/or DS) with consequences

- DPS may be warranted

DLM affects MAP Advance

# The Little Things - Don't Forget/Neglect Layer 1

## Correct Fiber and SFPs

- Tx & Rx criss-cross
- Single mode vs multi-mode
  - Yellow, orange, blue
- Power and optical attenuators
  - 20 (SR), 40 (LR), & 80 km (ZR) optics
- UPC vs APC
  - Black/red vs green
- LC vs SC

## DWDM - Proper ITU

- Hard-set
- Adjustable (manual or automatic)

## Patch Panels

- Fiber (AOC) or copper (twinax), break out fibers (QSFP)
- Replacing RF combining/splitting with routing/switching

## Redundancy and Daisy-Chaining

- Ethernet ring translates to 2 different length redundant paths

## CIN traffic cost/overhead

- No oversubscription

# Remote Phy - Separating Facts from Fiction

It's simple and it works

Min components in RPD yields

- Best cost
- Lowest node & plant power
- Max SG density for given power budget
- Best availability

Same consistent approach for DOCSIS, Video, & OOB

DAA needed for

- US expansion to 204 MHz & beyond
- Virtualization
- FDX

MAC and Scheduler can be scaled as needed since they are central

Much better visibility of node with RPD vs old transponder technology/nothing

DOCSIS & Video traffic encrypted on fiber

Centralized software

Security; CMTS SW kept in secure location

Interoperability

- Supported by multiple silicon vendors
- OpenRPD Forum

# Thank You!

John J. Downey  
Sr. CMTS Technical Leader  
Cisco Systems  
jdowney@ cisco.com