



Cable Access Networks Next Gen Business Services & 5G xHaul

Andy Smith

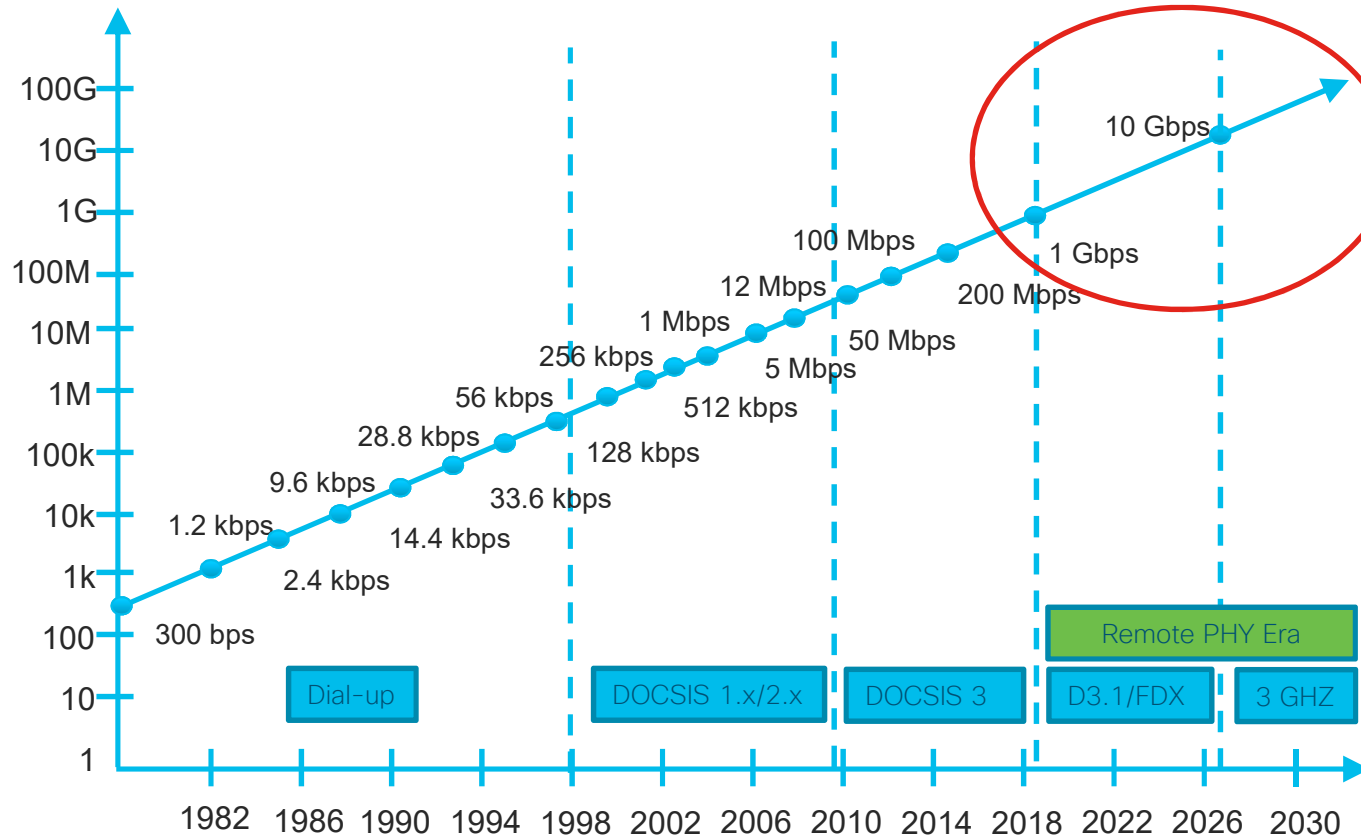
Principal Engineer

5 Feb 2019

Cable is changing, and change is accelerating

- Relentless growth of Internet services is colliding with realities of the legacy access architecture
 - Analog laser transport, analog node, at their practical limits
 - Physicality of cable hubs (RF combining, space, power, cooling)
 - All create an inherent scaling constraint for cable data services
- Cable has embraced **Distributed Access Architectures**
 - Fiber-deep with Ethernet transport, Remote PHY, Software CMTS
 - Massive reduction in HHP per Service Group (~75)
 - Enables graceful scaling of bandwidth with standard technology
- **What else can be done with this transition?**

Top Cable Data Speeds



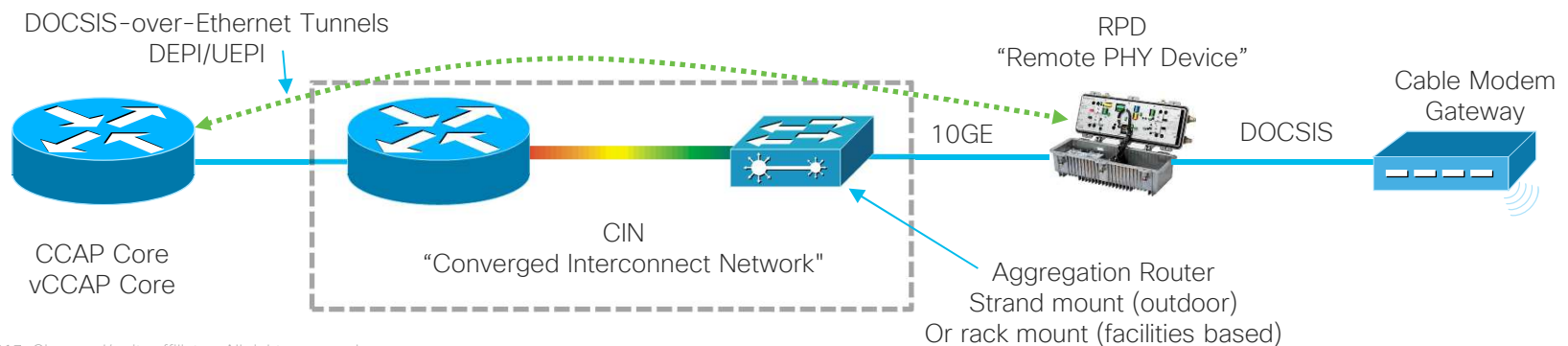
© 2017 Cisco and/or its affiliates. All rights reserved.

Emergence of distributed cable architectures, enabled by IP, Ethernet and Remote PHY, dramatically increase capacity, reliability and agility of the cable access network.

Can we start to adjust upwards our expectations for DOCSIS access networks?

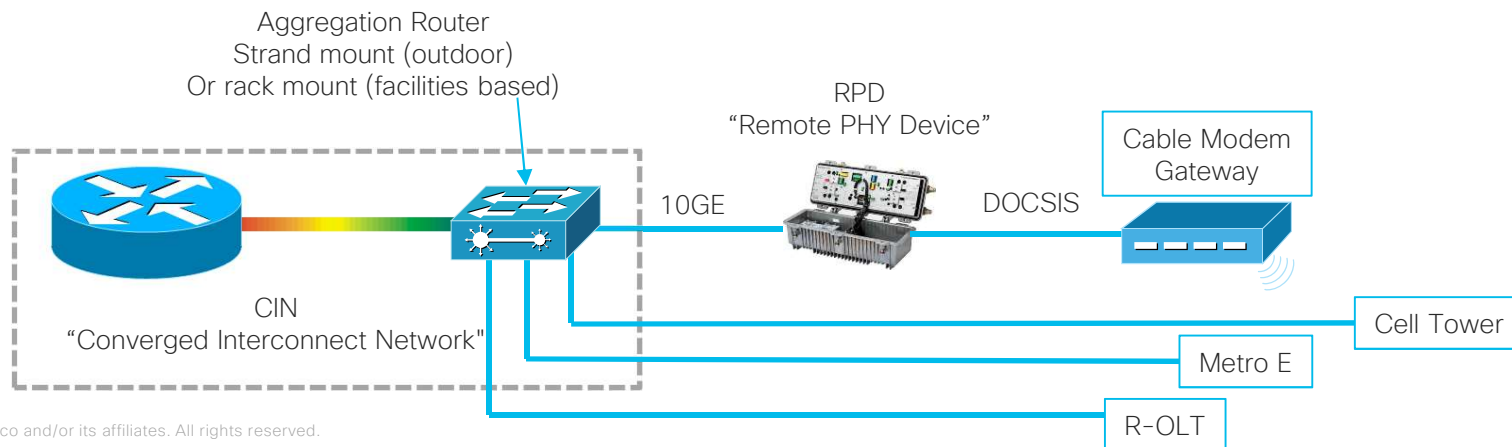
High Level DAA Architecture

- Distributed Access Architectures modernize the coax last mile by distributing the signal generation of a CMTS closer to the home
- DOCSIS flows in tunnels over IP and Ethernet over fiber
- Cable specific hardware compressed to just the node and any devices south of it (amps, taps).
- What else can be done with this network?



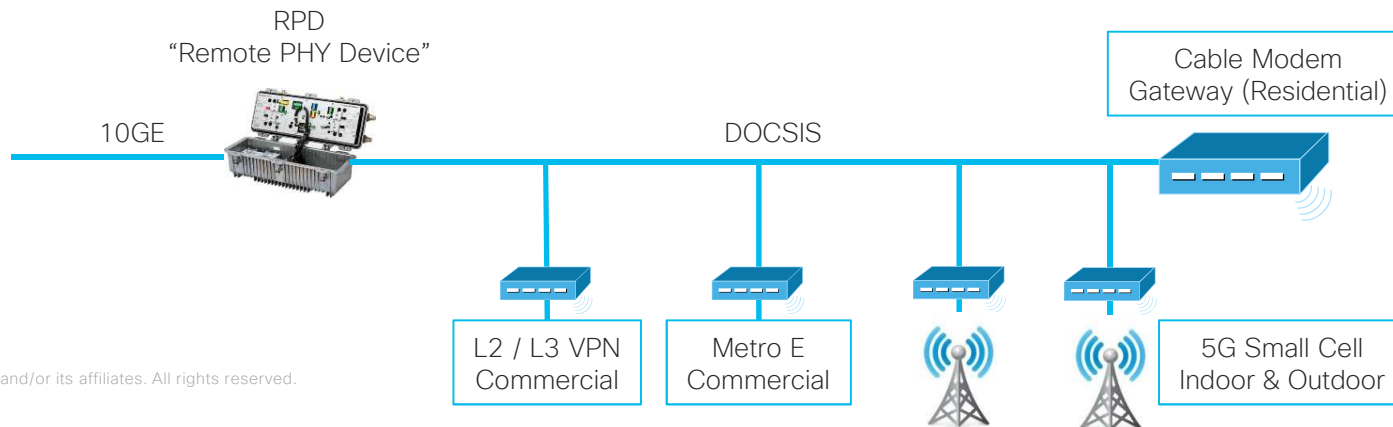
The CIN

- CIN is the Ethernet network functioning as the underlay for Remote PHY
- Unlike analog laser, IP & Ethernet have packet statmux, can be routed, and carry any number of services
- Goal should be **any service on any port with full automation**



DOCSIS

- DOCSIS via Remote PHY is a much cleaner, stronger, more capable carrier of data services
- FDX brings 10Gb downstream, ~5 Gb upstream speeds
- Prime candidate for mass aggregation of 5G small cells
- Viable alternative to Ethernet for MetroE / L2VPN



What is a commercial service?

- A commercial service, in telecom, is transport of data with:
 - Value added (L2VPN, L3VPN, NAT, Firewall, Content, etc)
 - Assurance (Resiliency, availability, SLA)
 - Division of responsibility (SP/MSO and Customer demarc)

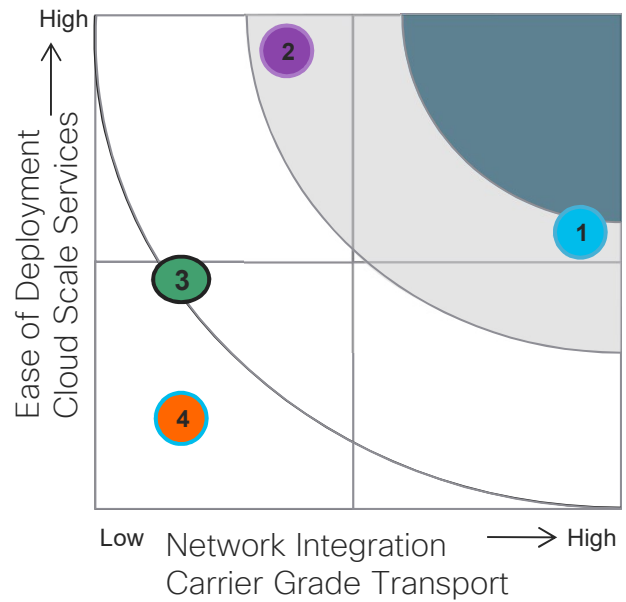
Network based

- High degree of assurance
- VPN integral to network (VRF)
- Transport any kind of data
- Large enterprise, cell backhaul, 5g xHaul, carrier serving carrier

Over-the-top based

- Leverage Internet for transport
- VPN agnostic to network (OTT)
- High velocity of cloud based services, typically IP-only
- Small/medium enterprises, remote teleworker, branch

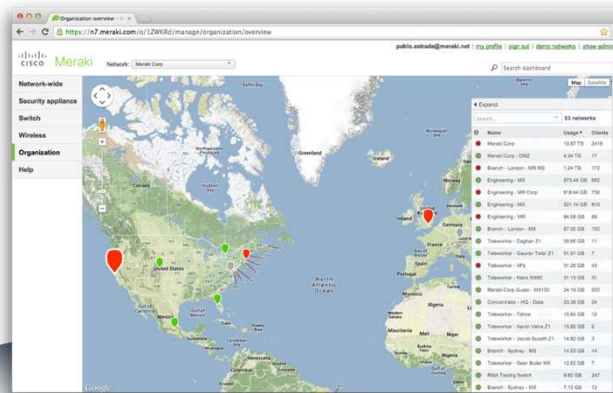
Cable VPN Options Compared



- 1 CMTS / Network based L2/L3VPN (MPLS transport)
- 2 Cloud based SD WAN (Meraki)
- 3 Automated IP Tunnels (ipsec)
- 4 Manual IP Tunnels (ipsec)

Meraki - simplifying managed services with cloud

- A complete cloud managed networking solution
- Wireless, switching, security, communications, EMM, and security cameras
- Integrated hardware, software, and cloud services



- Leader in cloud-managed networking
- Among Cisco's fastest growing portfolios
- Over 250,000 unique customers
- Over 3.5 million Meraki devices online



MR
Wireless LAN



MX
Security Appliances



MS
Ethernet Switches



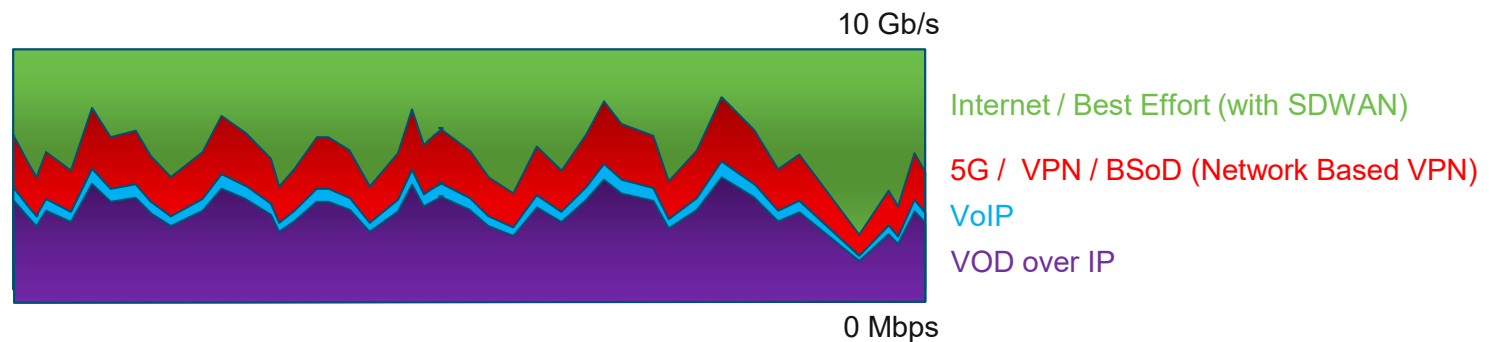
Systems Manager
Mobility Management



MV
Security Cameras

Network Based VPN – Packet Stat Mux

- Integrating VPN services into the network allows us to differentiate the service while preserving packet stat mux
 - One network, multiple services, distinct service levels
 - Converges operations, transport, provisioning, management
- Emergence of DAA and remote PHY brings new level of capability to CMTS based VPN's



DOCSIS Small Cell

All radios need:

- Location – urban furniture
- Power
- Xhaul (back-haul, mid-haul, front-haul)

The xHaul should have

- Ample bandwidth – DOCSIS has it
- Low latency (new)
- Support for 1588 timing as a service (new)



The Cable Opportunity

Most mobile operators do not have a good wireline network to support a massive small cell deployment

- HFC passes 93% of homes in the US
- DOCSIS over HFC is just Ethernet over Cable
- 10G Ethernet to the neighborhood; DOCSIS to the door.

Mobile represents a new revenue growth for Cable

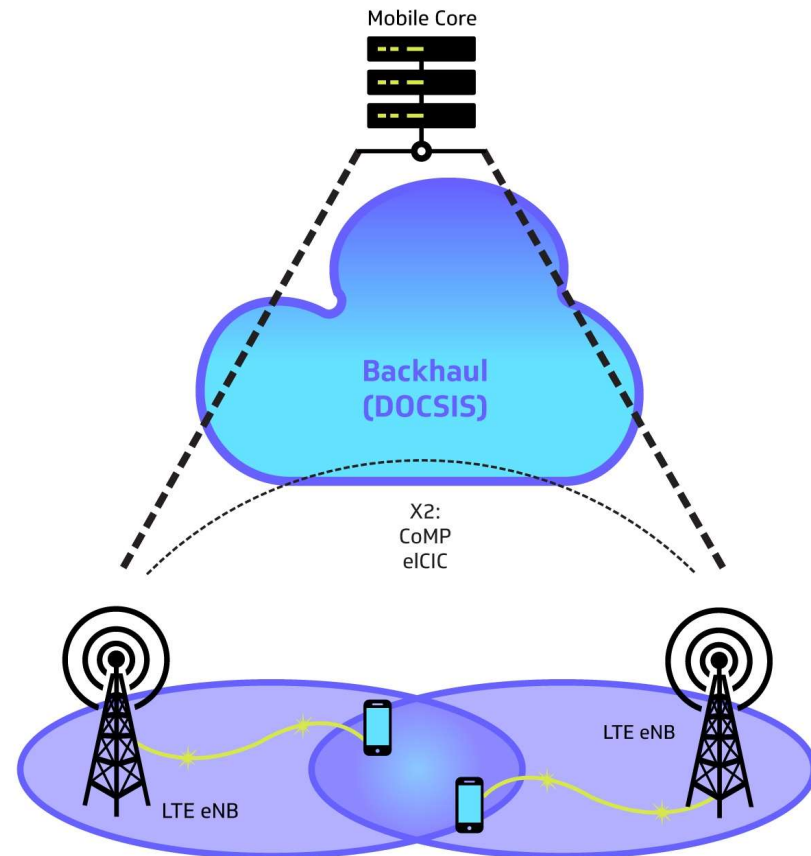
- Cable operators can provide backhaul as a service for mobile operators
- CIN can leverage this backhaul over Ethernet or DOCSIS as needed

LTE-A CoMP & ICIC

LTE-A features reduce RF interference and improve user experience at cell edge

CoMP and ICIC require low eNB to eNB latency

DOCSIS must provide a low latency path between neighboring small cells or small cell & macrocell (HetNet)



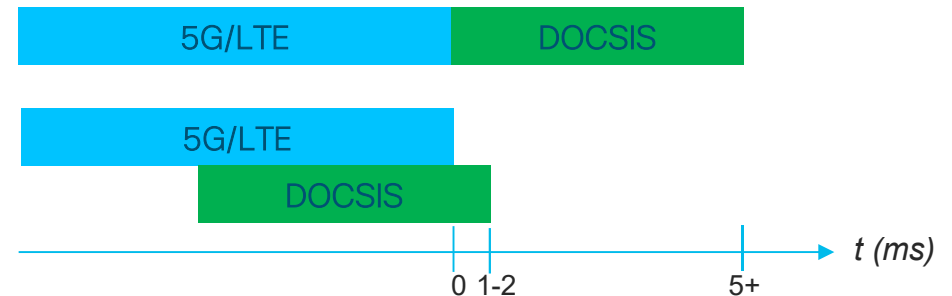
Spotlight – MBH over DOCSIS with DTP/1588 & BWR



1588 Network Timing

- CMTS is a PTP clock slave
- CM is a PTP clock master
- DOCSIS connects them together
- DTP calculates the time offset.
- Eliminates local GPS receiver

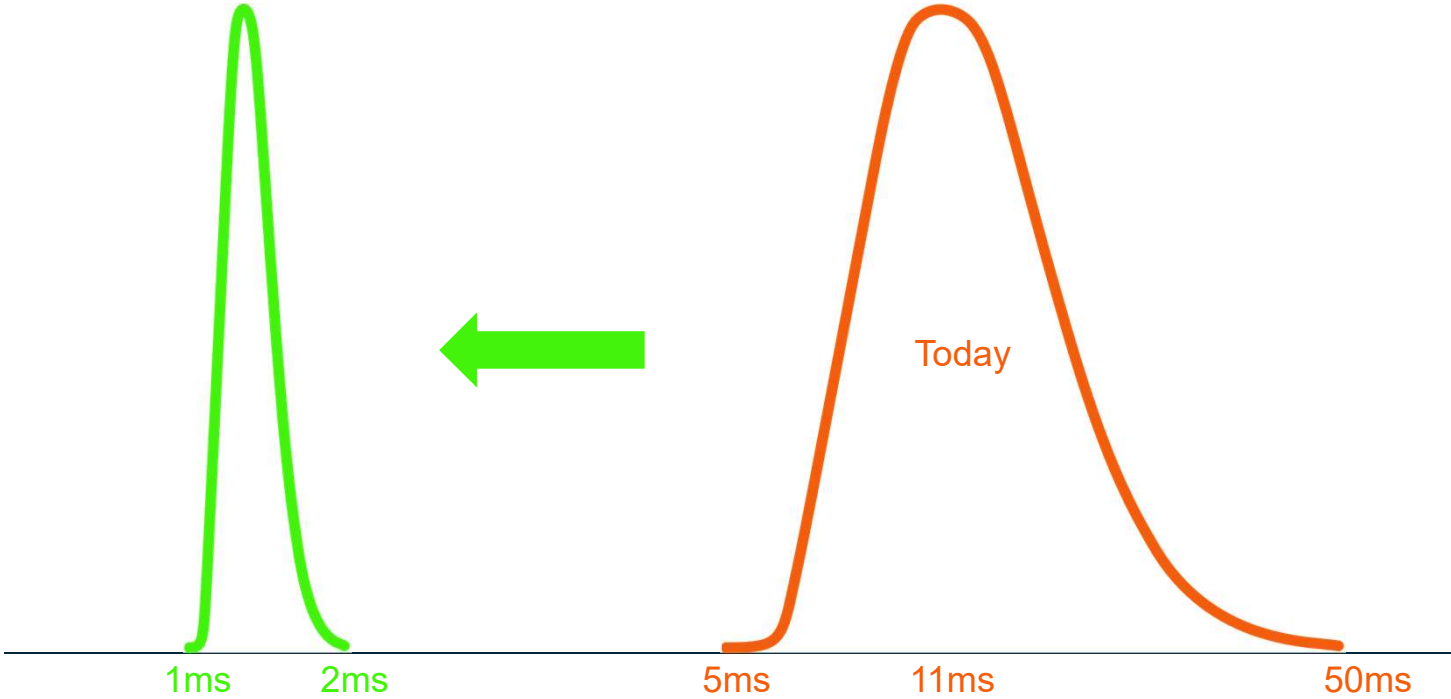
© 2017 Cisco and/or its affiliates. All rights reserved.



Lowering Latency

- BWR – Bandwidth Report
- BWR connects the eNB small cell scheduler to the CMTS DOCSIS scheduler to create a pipeline.
- Allows DOCSIS to preschedule grants

DOCSIS Network Latency



Innovation for 5G over DOCSIS

1588-PTP/SyncE timing over DOCSIS

- DTP – DOCSIS Time Protocol

Low Latency DOCSIS techniques

- BWR – Pipelines the eNB and DOCSIS scheduler
- DPS – DOCSIS Predictive Scheduler
- PGS – Predictive Grant Service
- Waterfall granting – Multiple queues per Service Flow; grant sharing across queues in the CM
- Shorter MAPS – 1 ms or smaller DOCSIS MAPs
- Split Scheduler – Low level scheduler in RPD HW or SW
- L4S – Dual queue for DC-TCP with network congestion signaling

Cable and Commercial Services

- Cable, via Remote PHY and FDX, is well suited for commercial services
 - SLA-based network centric services
 - Internet-based cloud centric services
- A convergence of bandwidth, availability, agility and services is naturally occurring in the deployment of Remote PHY
- DOCSIS can carry any kind of data we want it to – just need to deploy it in a manner capable of monetizing the opportunity
- Mass aggregation of 5G small cell radios could be a very lucrative application of this technology for cable

