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DENVER, CO
OCTOBER 17-20



IS PON THE FINAL FRONTIER?

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Moving Towards the Light: Migrating MSO FTTP Networks to a Distributed Access Architecture

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1) Need it to meet new competitive challenges

- Property owner expectations
- Competitors installing fiber in greenfield

2) Need it to keep pace with advanced customers

- Gigabit data rates
- Business services
- Offload heavy users from DOCSIS nodes

3) Learn how to scale fiber efficiently for greenfield deployments

- Find ways to lower FTTP construction and installation costs over time
- Goal is to approach cost parity with HFC

4) Replace RFoG!

- No symmetric speeds
- Higher cost / more complexity / OBI mitigation

The New Generation of FTTP Competitors



at&t



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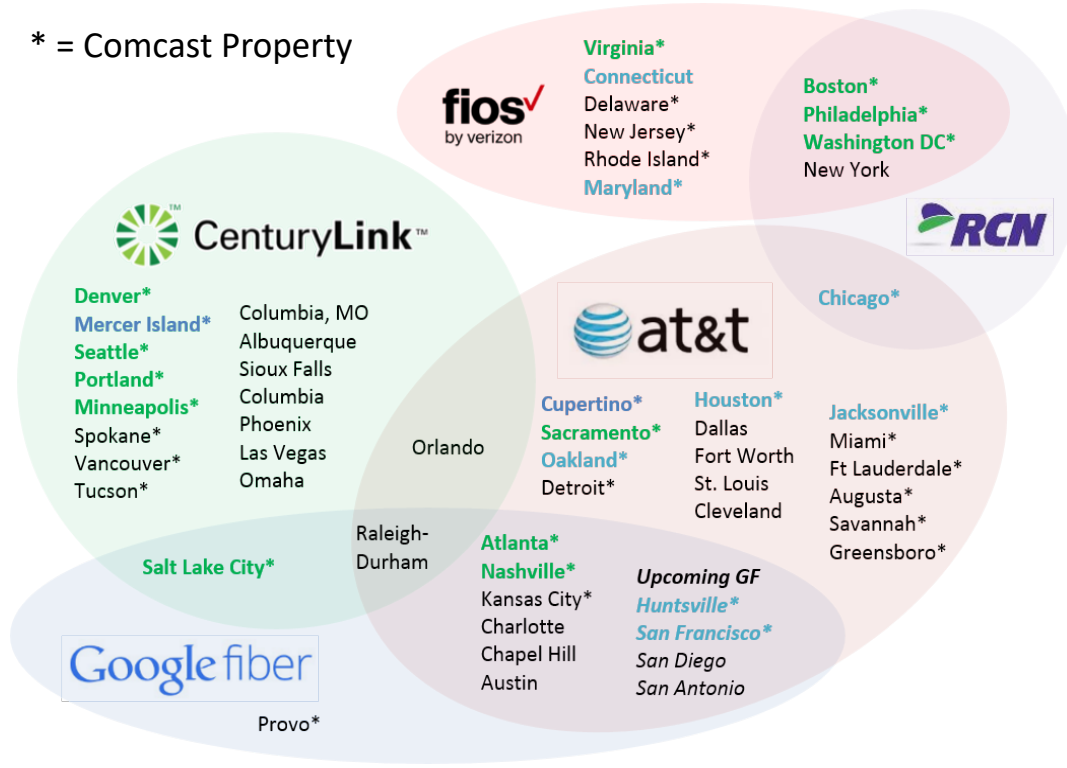


Google fiber



Large and small competitors are targeting MDU opportunities with Internet centric promotions and aggressively-priced 1 Gbps services

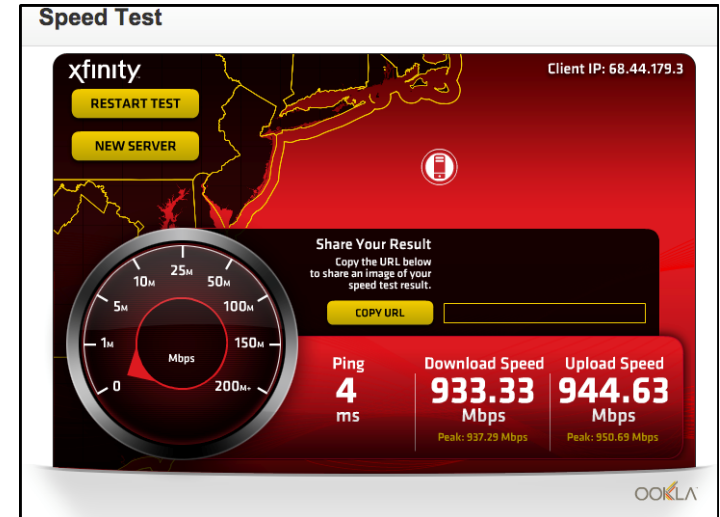
* = Comcast Property



Competitive Pressure

- Established and startup fiber overbuilders are targeting greenfield and MDU applications
 - Gigabit symmetrical service
 - Aggressive pricing

- Capacity & Speed choice
- Leapfrog FiOS and ATT GigaPower (2.5/1.25 GPON)
- Invest in emerging technology over 10-yr old legacy
- Interoperability of EPON equipment suppliers
- Match DS capacity of all IP D3.1 @ 10 Gbps
- Supports Multi-Gigabit symmetric speeds
- Leverage DOCSIS® Back-Office (DPoE™)
- Stimulate the 10G optics cost curve immediately
- Enable commercial services
- EPON standard is under IEEE – driven by MSOs
- It's NOT RFoG

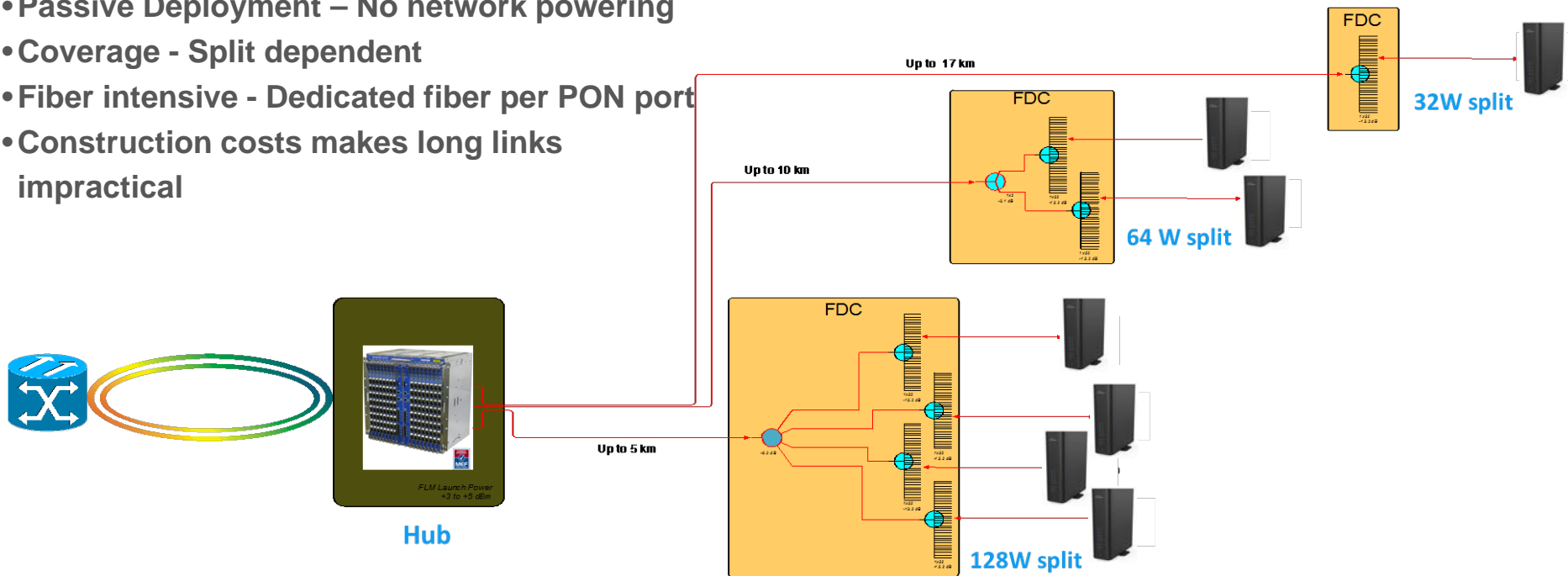


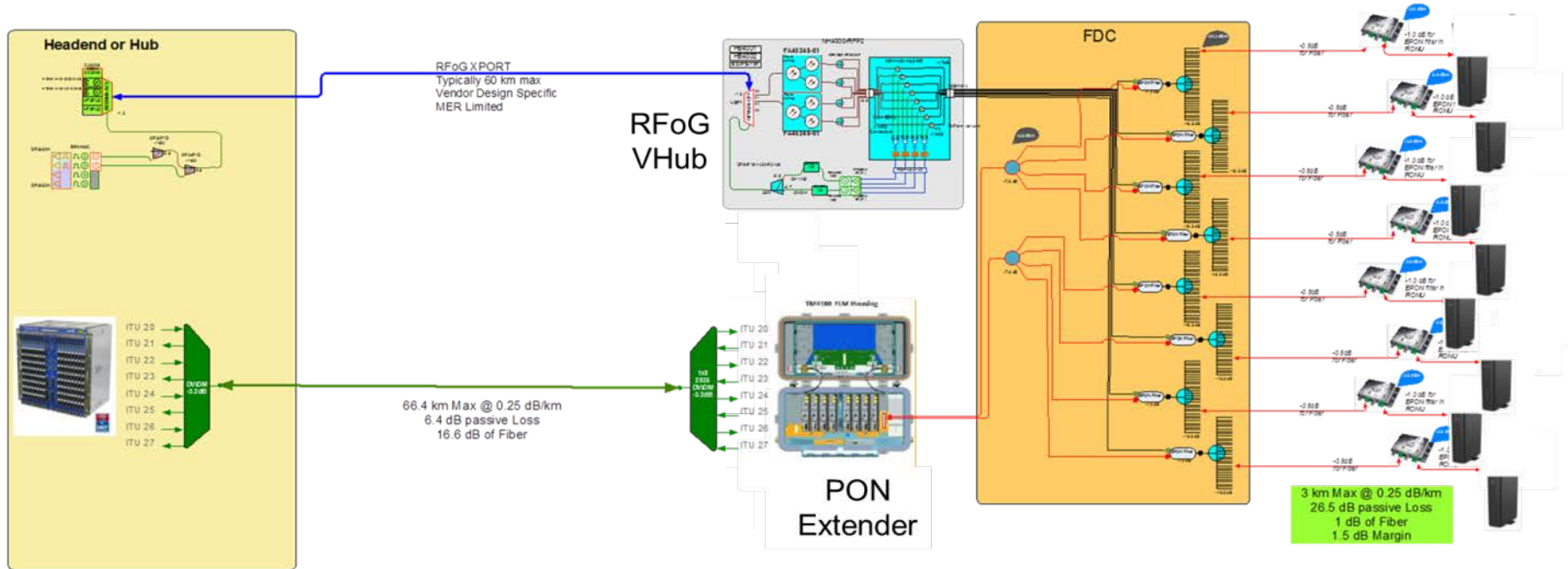
- Available dark fiber rapidly decreasing
- Link reach >> 20 km
- Silicon dependency (One vendor controls 90% of all OLT chip sets)
- High cost of fiber construction and home wiring
- New Customer Care, Billing, Tools, Operations, Processes
- Fiber Handling (Field Tech training, tools, diagnostic equipment)
- Homeowner and MDU Consultants
- “Gigabit” speed, speed tests, servers, dependencies
- HSD offering in mixed DOCSIS and EPON footprint
- External positioning for FTTx (D3.1 versus Fiber comparisons))
- Voice and Video integration (Migration to all IP)

Current FTTP Architecture Designs

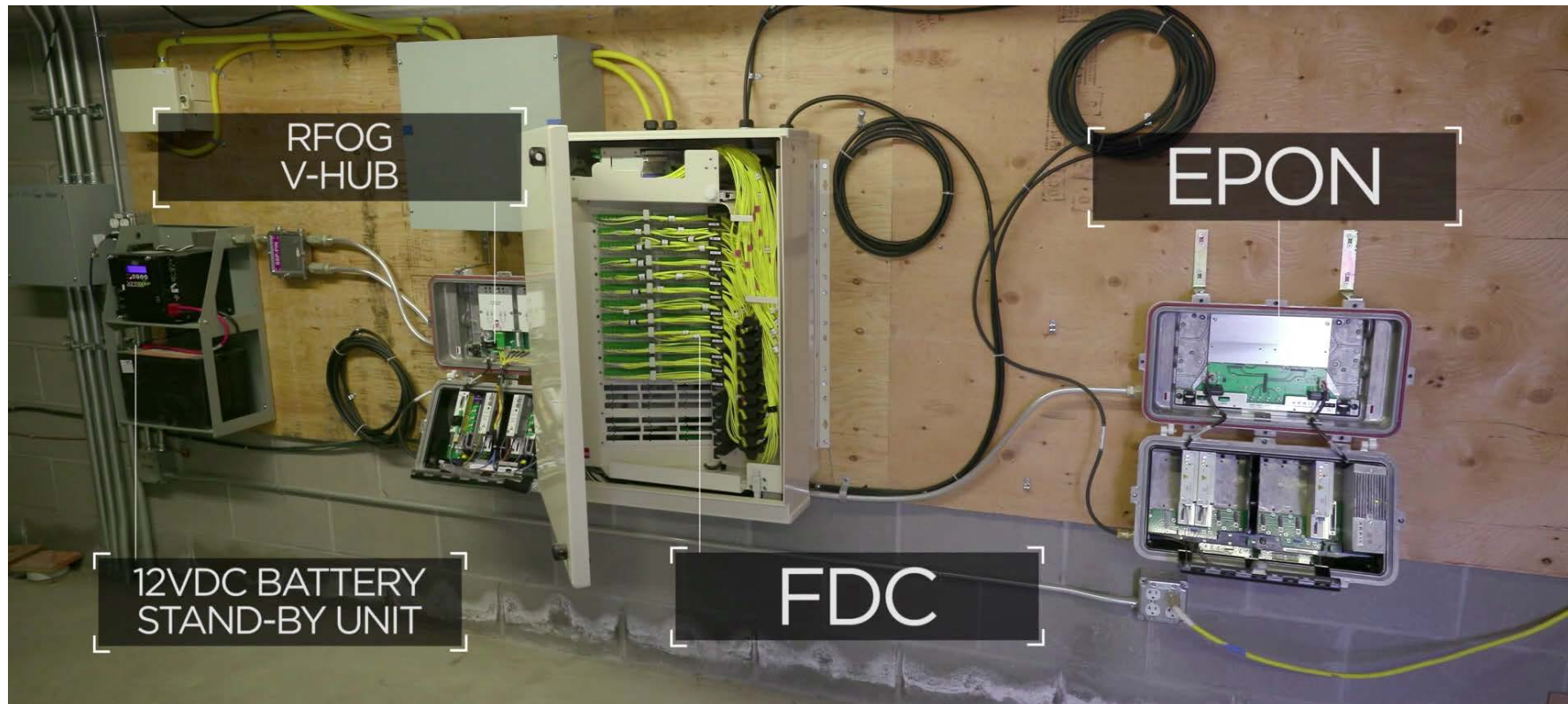
EPON Deployment Direct Feed Coverage

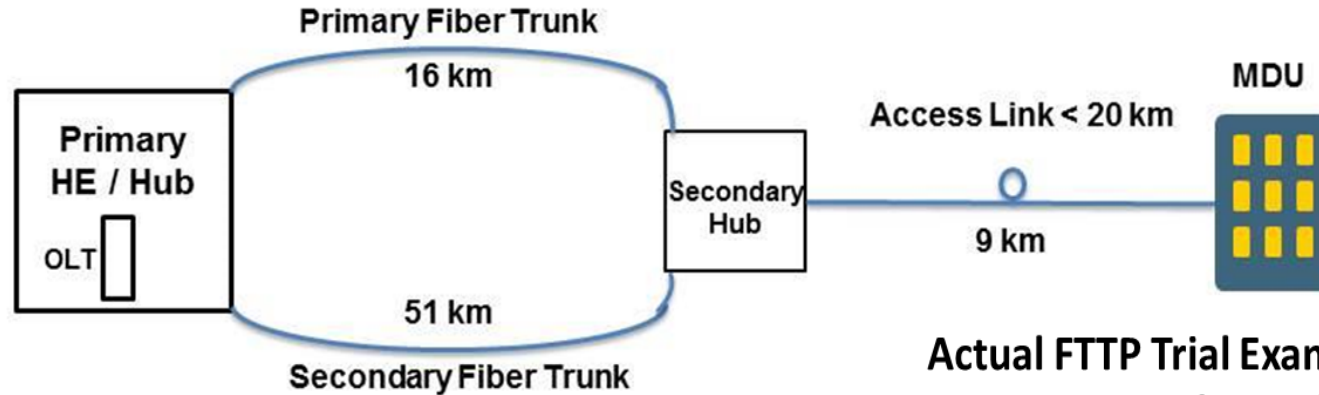
- Passive Deployment – No network powering
- Coverage - Split dependent
- Fiber intensive - Dedicated fiber per PON port
- Construction costs makes long links impractical





- Complicated, expensive configuration
- 2X 128 HP DS/US SG segmentation
- EPON combined at each splitter input



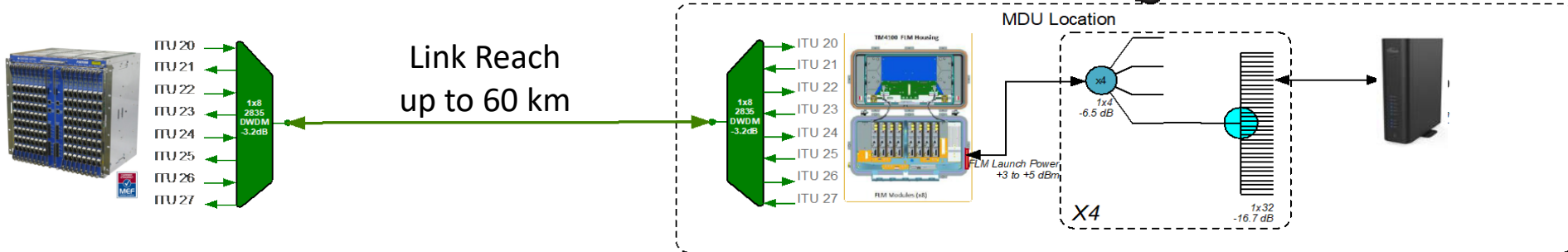


Actual FTTP Trial Example

- Primary path = 25 km
- Secondary path = 60 km

- 85% of all node locations are < 20km from the nearest hub
- Many secondary hubs are too small to support an OLT
- Headend to Hub + Access link typically exceeds 20 km PON reach
- Primary / Secondary path link delta can be significant

- PON Extender provides 8:1 reduction of PON fibers
 - Ethernet WDM input / PON wavelength output
- PON Extender can be used with an RFoG Vhub to provide an RFoG / PON overlay configuration



10G EPON Distributed Access Architecture

A Distributed Access Architecture (DAA) for FTTP has many of the same goals and follows the same trajectory as HFC Remote PHY or Remote MAC-PHY:

- Disaggregation of the data, management, and control planes within the OLT platform
- Reduce Hub rack space and powering requirements
- Distribute the PHY edge closer to the subscriber
- Provide flexible deployment sizes
- Increased link reach and fiber utilization
- Drive interoperability between vendor solutions
- Provides a path to network function virtualization

Remote OLT with 10G EPON

- 4 ports of 10G EPON
- Non-blocking 10G uplink with provisions for aggregation
- Replaceable optical modules (including PON optics)
- Subscriber Management

Hardened OSP enclosure

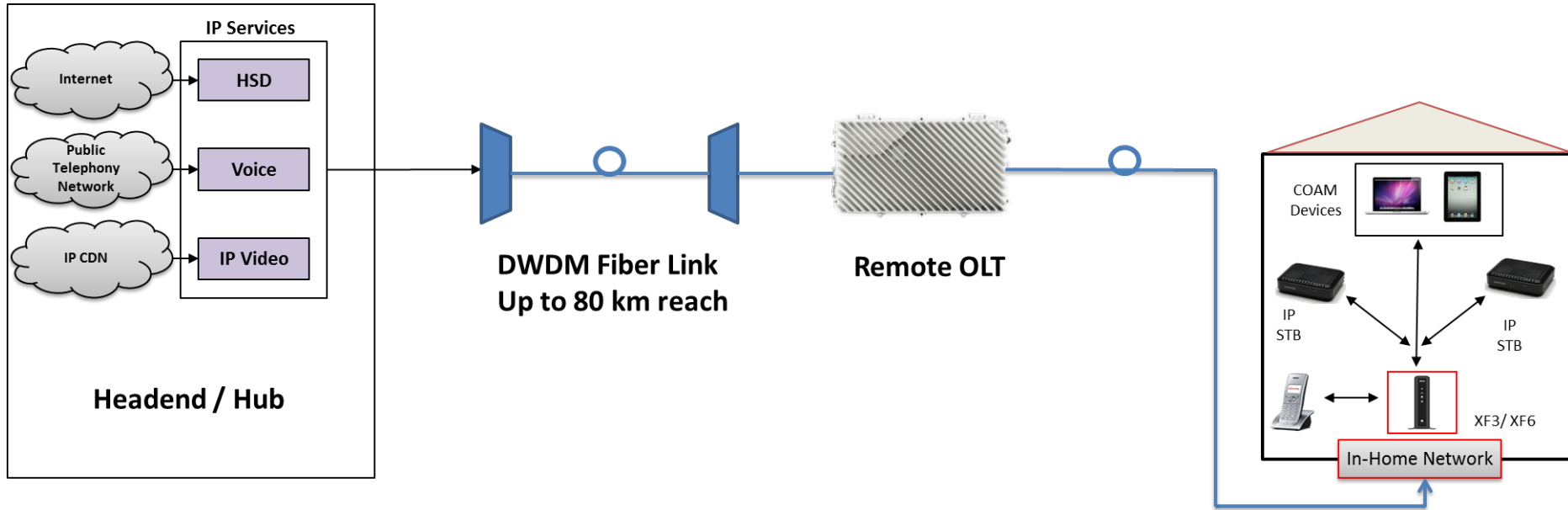
- Strand mount Node enclosure
- Cable plant powered, ≤ 100 W AC Power Consumption

Integrated into vCMTS

- Layer 2 forwarding in the node
- Common Layer 3 forwarding
- Ability to share DHCP address scopes across R-OLTs
- SNMP, CLI, provisioning via controller



Remote OLT provides same efficiencies and virtualization opportunities as DOCSIS DAA

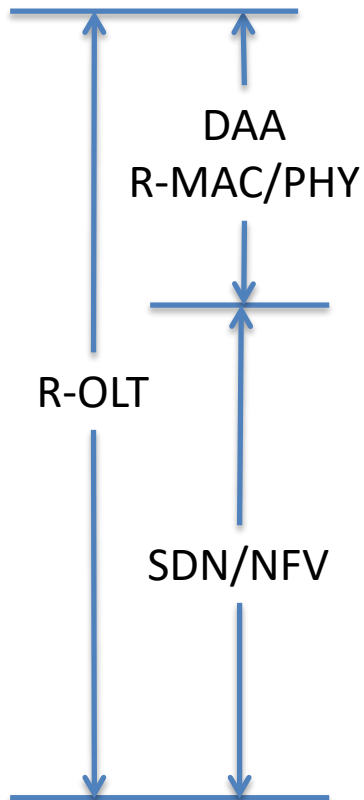


Migration to all IP:

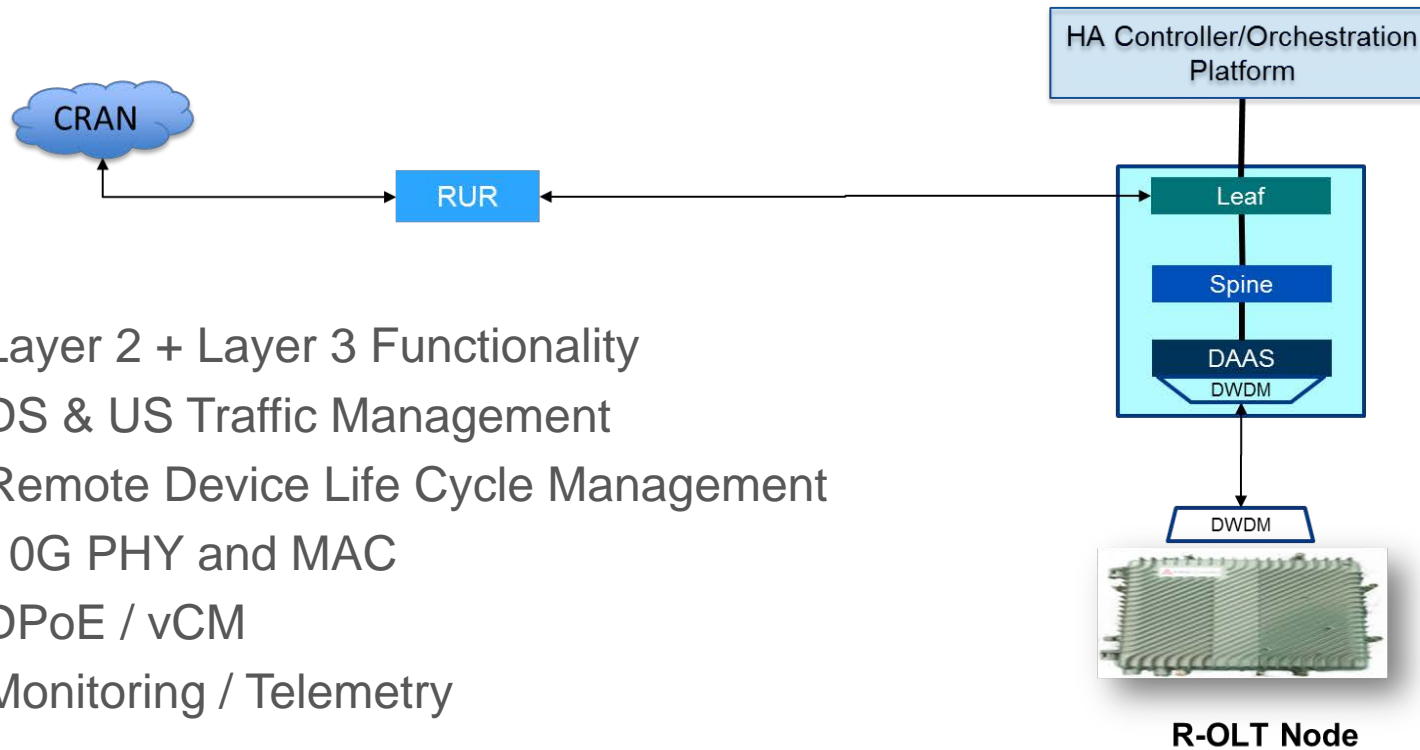
- Next phase in FTTP migration
- Eliminates RFoG Overlay

- Provide triple play services over EPON
- Allows path to virtualized network

Virtualizing the FTTP Network



- Fiber to the home with future-proof access technology
- Support long reach and flexible split ratio
- Better fiber utilization/efficiency
- Flexible deployment sizes
- Better EPON latency/jitter and throughout
- Service agility, new service integration
- Network programmability, scalability and load balancing
- Automation and self optimization
- End-to-end service assurance with better QoE
- Agile development and faster innovation
- Integration into one management and control platform
- Central Office consolidation and power/space optimization
- Reduced cost (interoperable HW and open SW)



- Layer 2 + Layer 3 Functionality
- DS & US Traffic Management
- Remote Device Life Cycle Management
- 10G PHY and MAC
- DPoE / vCM
- Monitoring / Telemetry

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THANK YOU!

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