CABLE-TEC EXPO® 2017

SCTE · ISBE

THE NEXT BIG...

DEAL
CONNECTION
INNOVATION
TECHNOLOGY
LEADER
NETWORK

SCTE·ISBE CABLE-TEC EXPO 2017

DENVER, CO
OCTOBER 17-20

2017 Fall Technical Forum
SCTE·ISBE • NCTA • CABLELABS

SCTE · ISBE

DWDM Access for Remote PHY Networks
Integrated Optical Communications Module Link Extender (OCML)

Harj Ghuman
Network Architecture & Technology Strategy
Cox Communications

SCTE·ISBE CABLE-TEC EXPO 2017
DENVER, CO
OCTOBER 17-20

ACKNOWLEDGEMENTS

- **COX Communications:**
  - David Job
  - Tee Harton
  - Chris Palmquist
  - Robert Kuse

- **AcceLink:** Weyl Wang

INTRODUCTION

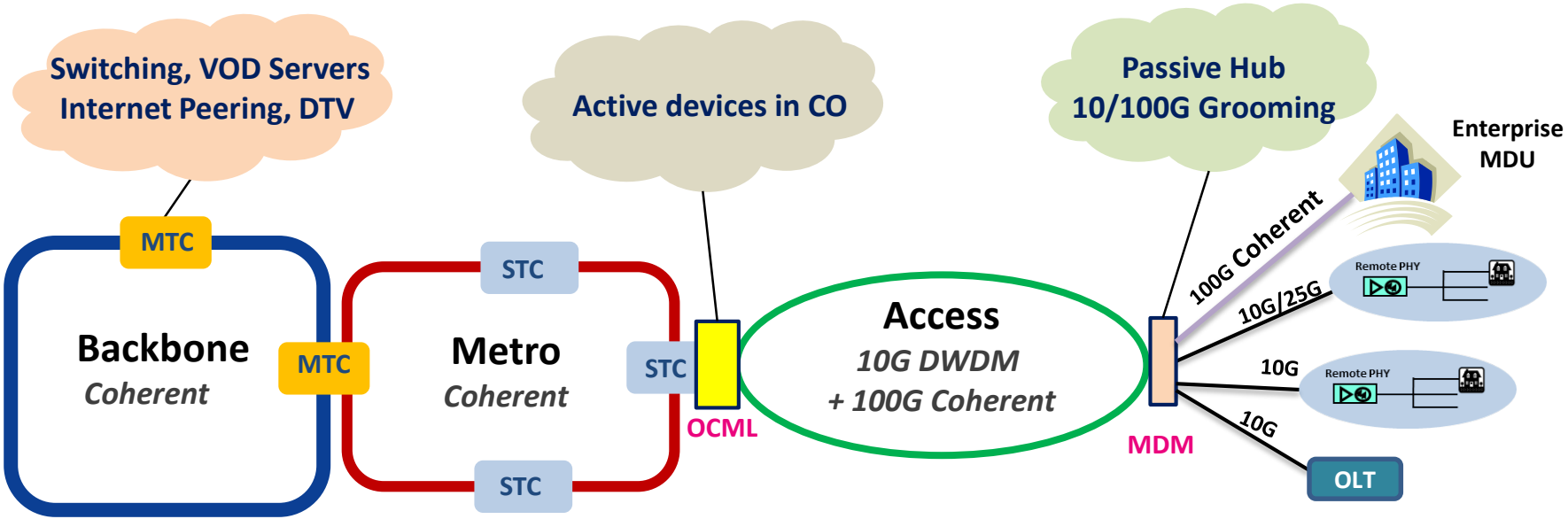
- Remote Phy (RPD) Optical Access - 10G DWDM or 100G Coherent

- 10G NRZ DWDM
  - Low cost & mature, scalable to emerging 25G NRZ
  - Operationally simple field DWDM passive

- Hybrid: 10G DWDM + Coherent
  - Same fiber 10G DWDM & 100G coherent, retains passive outdoor plant
  - 10G DWDM - RPDs, 100G coherent - high capacity requirements

Key Takeaways	• **Optical Access Should Allow Coexistence of 10G & 100G Coherent** • **Flexible, Scalable & Technology Agnostic Access**

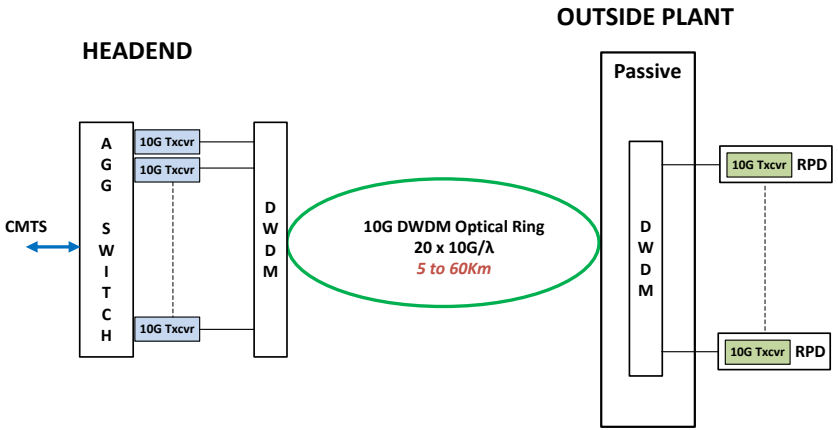
OPTICAL ACCESS NETWORK WITH PASSIVE HUB



Key Takeaways	• Technology Agnostic Access, 10G DWDM + 100G Coherent • 10G DWDM - RPDs, 100G Coherent - High Capacity Applications

10G DWDM OPTICAL ACCESS

10G DWDM

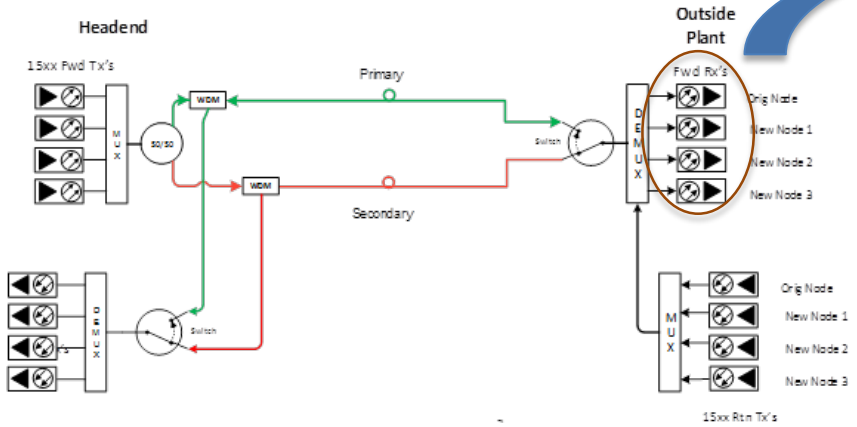


10G DWDM Pros & Cons

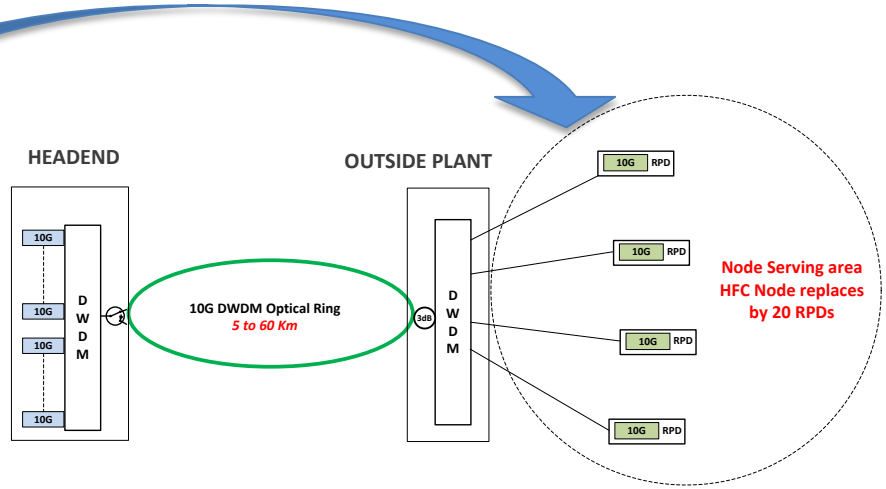
- 10G NRZ low cost and mature
- Limited future price reductions
- Total 440G capacity, 44 X10Gbps links
- 25G NRZ emerging
- Pay-As-You-Grow - add 10G as needed
- All passive outside plant
- Low Op-Ex

Key Takeaways	• 10G Low Cost, Mature, 88 WLs • Pay-As-You Grow, Scalable To 25G When Available

TYPICAL MULTIWAVE LENGTH HFC NODE



HFC NODE CONVERTED TO 10G RPD

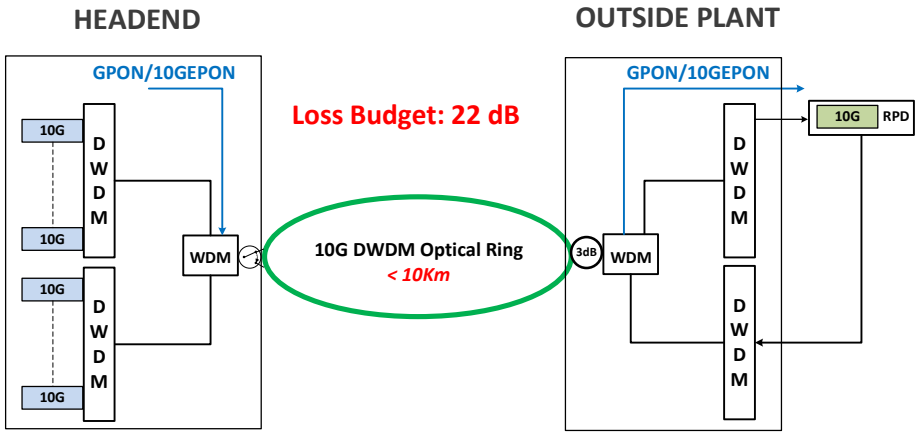


Key Takeaways

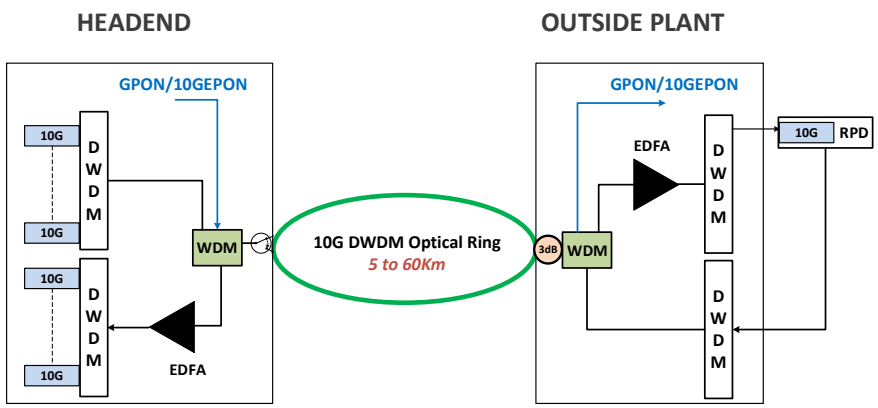
- Existing Analog DWDM Converted To 10G DWDM For RPD
- 10G DWDM Allows Easy Migration To An All Digital Network

10G DWDM ACCESS + 10GPON/10GEPON LINK BUDGETS

10G DWDM PASSIVE LINK < 10 KM ONLY



CONVENTIONAL 10G DWDM LINK WITH OPTICAL AMPLIFIERS UPTO 60 Km



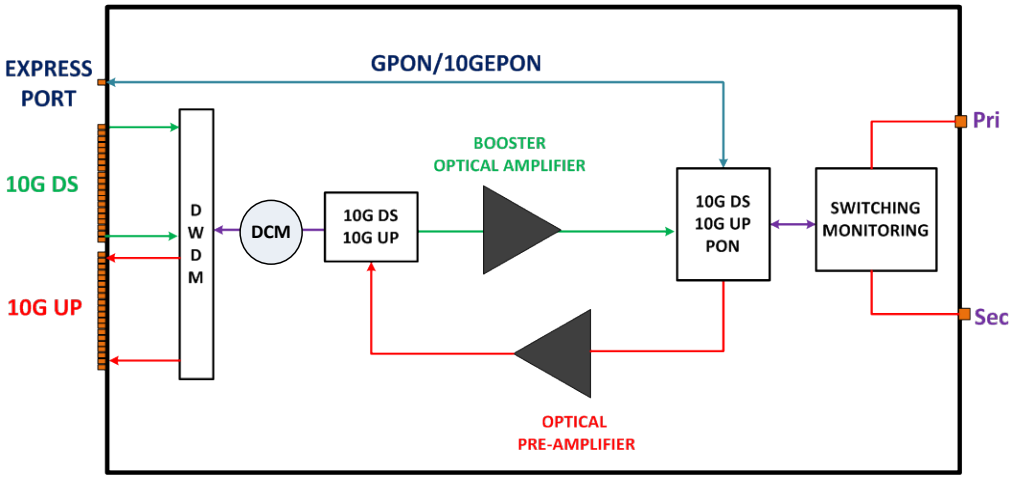
Key Takeaways	• Fiber Redundancy, 40 CH Passives & PON Overlay Restrict Link < 10km • Field Amplifiers Required for Most Links

OPTICAL COMMUNICATIONS LINK EXTENDER - OCML

OCML OVERVIEW

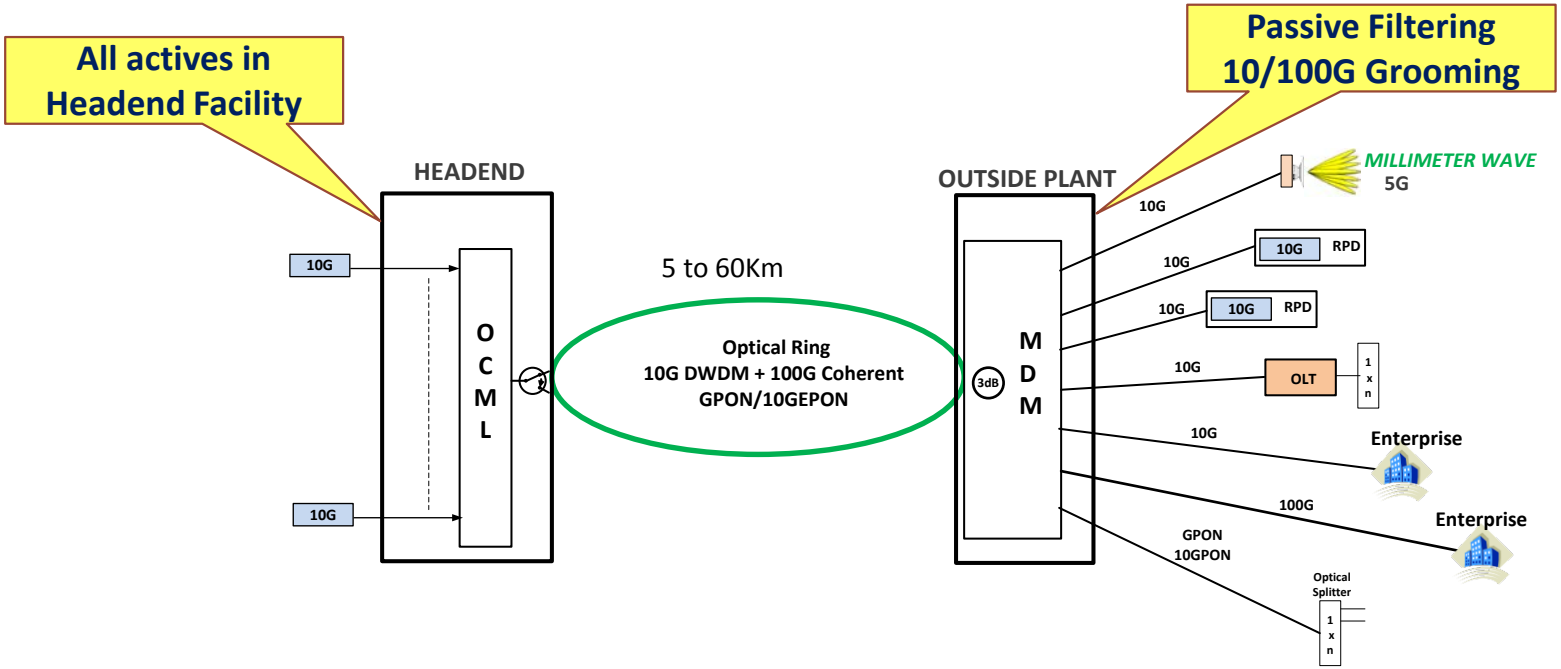
- 5 to 60 km dual rings
- 20 Bi-Dir. Wavelengths
  - 10G DWDM
  - GPON/10EGPON
  - 100G PON
- 100G Coherent
- Facilitates STC/Hub elimination
- **Integration reduces cost**

OCML BLOCK DIAGRAM



Key Takeaways	• Integrated Solution, Cost Reduction, easy installation • Active Devices Stay In Indoor Facility Only

OCML MDM NETWORK



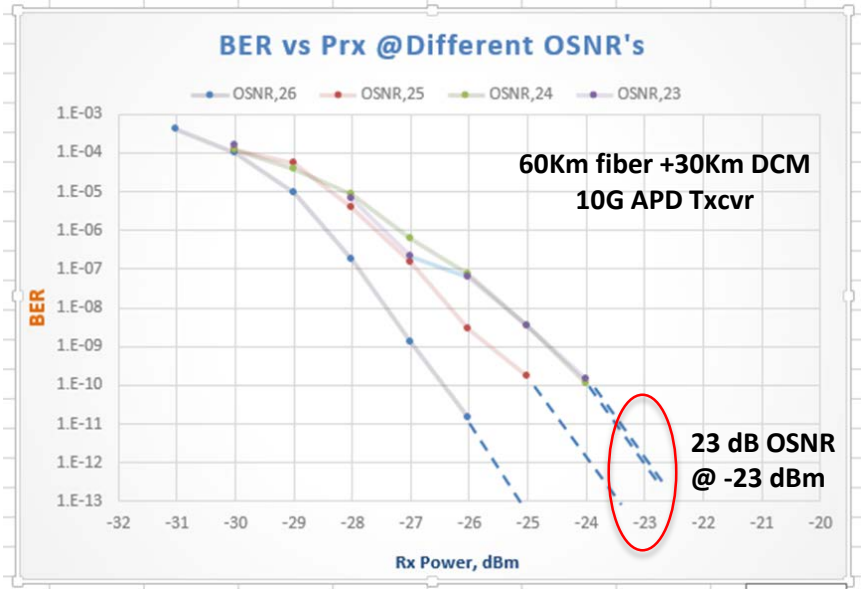
Key Takeaways	• OCML – MDM Network Allows Many Applications • Passive Hub Reduces Outside Plant Op Ex

OCML KEY TECHNICAL CONSIDERATIONS

OCML LINK

- System Requirements:
  - 5 to 60 Km dual fiber
  - 10GDWDM, PON/10GEPON
- 10G Link performance depends on:
  - 10G Txcvr Rx Power
  - Dispersion & OSNR
- Design Parameters:
  - BER > Without FEC 10^{-12}
  - DS: OSNR > 30dB, Rx > -22dBm
  - UP: OSNR > 23dB, Rx > -13dBm

BER Vs TRANSCEIVER RX POWER



Key Takeaways

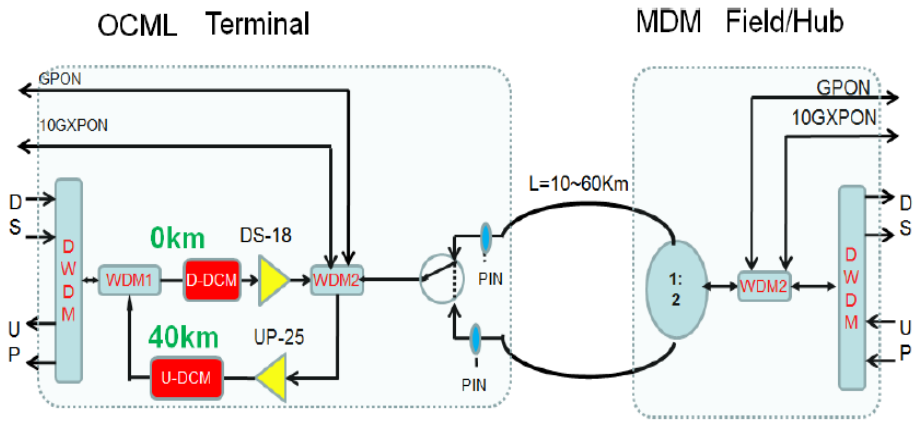
- **OCML Stretches Dynamic Range**
- **Powerful & Scalable Solution For RPD,PON/10GEPON & 100G Coherent**

OCML POC TEST RESULTS

POC TEST RESULTS SUMMARY

- Design parameters met
- 5-60Km links, Error free BER > 10^{-12}
- Downstream OSNR > 40 dB
- Upstream OSNR > 26 dB
- Threshold
  - 20dB OSNR
  - Pwr -17 dBm for 10G PIN
  - Pwr -23 dBm for 10G APD
- DCM adds 2 dB noise penalty margin

OCML POC TEST SYSTEM



Key Takeaways	• OCML Design Parameters verified • DCM Adds Robustness and Allows Use Of 10G PIN TXcvrs

SUMMARY

- **OCML**
  - 10G DWDM - low cost, mature, Pay-As-You-Grow
  - Integrated module with active devices
  - Supports 5 to 60 km variable dual fiber links – all passive outside plant Mux/DeMux
  - 10G + GPON/10GEPON

- **10G + 100G coexistence**
  - OCML supports technology agnostic network - 10G DWDM +100G coherent
  - 10G DWDM – RPDs; 100G coherent - high capacity requirements

Key Takeaways	
	• **10G DWDM is Low Cost & Mature, Provides Capacity For Next 10 Years For RPDs**
	• **OCML Can Coexist 10G & 100G Coherent**

SCTE · ISBE

THANK YOU!

Harj Ghuman
Harj.ghuman@cox.com
404-449-4711

SCTE · ISBE CABLE-TEC EXPO 2017

DENVER, CO
OCTOBER 17-20

COX