MSO FTTH Infrastructure Realities

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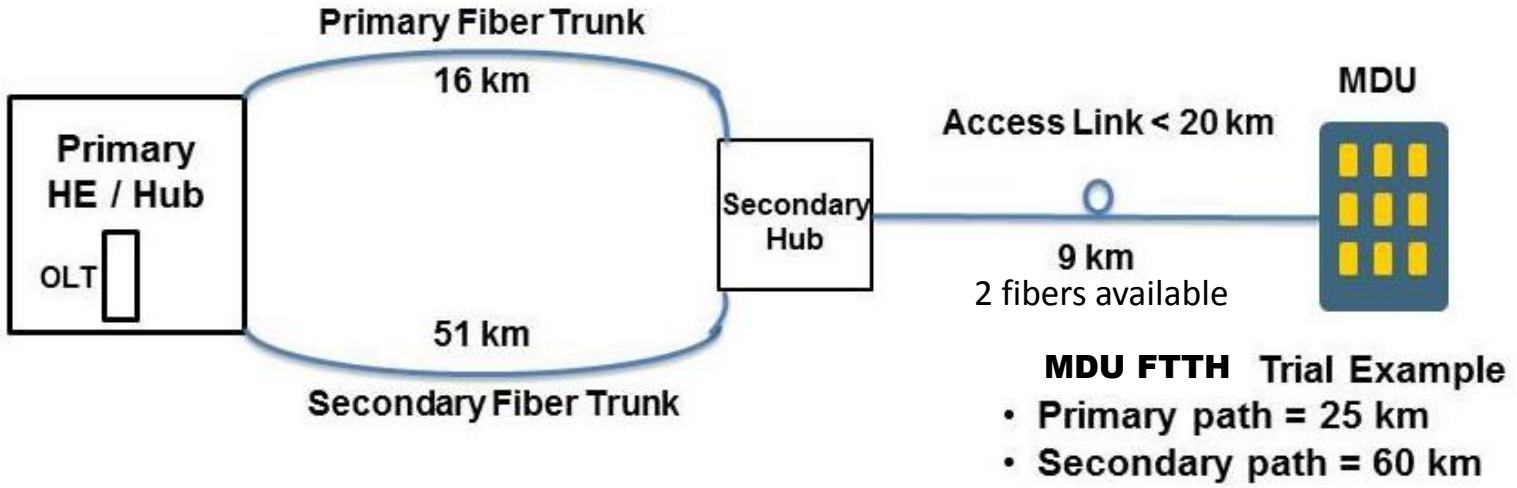
MSO Fiber Plant and Hub Limitations

- MSO networks do not have adequate fiber to support traditional PON deployments without extensive construction
- MSO maximum node fiber link reach typically exceeds 20 km
  - Cox: Link reach up to 28 km
  - TWC: Link reach up to 40 km
  - Comcast: Link reach up to 140 km
- Although most nodes are within 20 km of an existing hub that hub may not be capable of supporting a traditional OLT
  - Many secondary hubs created to serve < 20,000 homes due to HP density
  - Secondary hubs do not have adequate rack space, power, or HVAC
- Building new hubs is not an economical solution

Cable Plant Designs Are Not PON Friendly



- 85% of all node locations are < 20km from the nearest hub
- Significant number of 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

Remote / Distributed Architectures for FTTH

- Link reach and fiber constraints are driving MSO's to deploy distributed architecture solutions for FTTH networks
  - PON Extenders: Basic OEO repeaters providing extended reach and increased fiber utilization using DWDM to PON wavelength conversion
  - Remote OLT: Smaller scale OLT Mac / PHY layer device that is sized to the property being served and co-located at the property site.
- PON link reach as a result of R-OLT or Extenders is < 10 km
  - Usually located on site or within 2 km of the application
  - Allows higher HP split ratio per port
  - Extends reach to 80 km or more
  - Provides significantly higher fiber utilization

Implications of Distributed Access for NG-EPON

- Distributed network architectures will likely become the standard for both HFC and PON deployments for many years
  - Improve hub density issues
  - Collapse un-needed hub locations
  - Scalable, pay as you grow designs
- Link reach of 10 km is sufficient for almost all applications
  - Reduced fiber loss allows higher split ratio
  - Improves optical link budget
  - Potentially allows use of lower cost optical devices

Impact on NG-EPON Optical Requirements

- Fiber distortions are typically a function of link length
  - Reduced Raman (SRS) and chromatic dispersion impacts
  - Lower distortion mitigation complexity
- 10 km link reach standard lowers fiber loss 3 dB
  - Reduced laser power
  - Improve receiver sensitivity
  - Increase split ratio to 64 way or 128 way
- Improves operating impairments for direct modulation lasers
  - Helps to enable NRZ for NG-EPON
- R-OLT optical devices need to be environmentally hardened

Summary

- Traditional PON architecture targets (20 km, 32 HP split ratio) are not consistent with MSO network design or applications
- Optical requirements for 20 km link budgets are challenging and expensive for 25G / 100G NG-EPON device technologies
- Reducing the target link reach to 10 km reduces fiber attenuation and distortion impairments that can improve the application utility of NG-EPON
- Reducing the target link reach to 10 km can translate into lower cost 25G / 100G laser devices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