

Five Criteria Broad Market Potential

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Broad Set of Applications

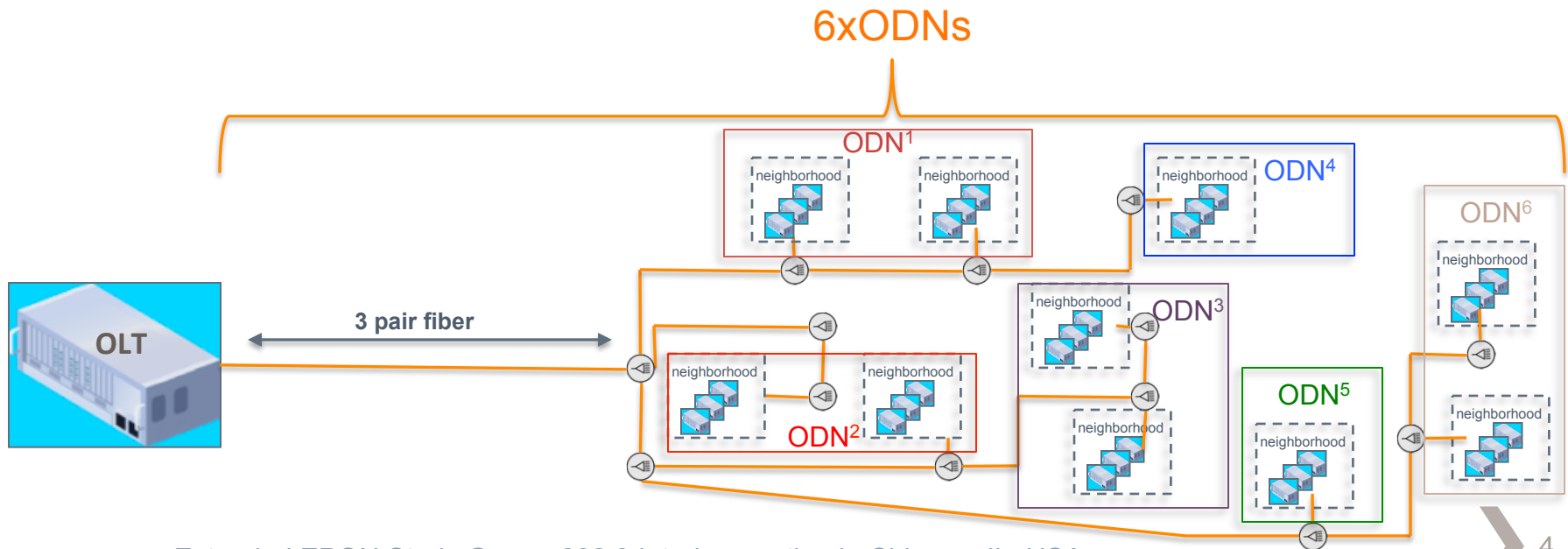
- a) **Broad set of applications**
 - b) **Multiple vendors, multiple users**
 - c) **Balanced cost, LAN vs. attached stations**
- » ExEPON is specifically attractive for networking environments supporting bandwidth-intensive applications that require fast, reliable, scalable, first-mile connections at distance / split ratios not supported by existing EPON PMDs (802.3 Clause 60 and Clause 75).
 - » Such applications include Broadcast TV (expanded HDTV content), IPTV, time-shifted TV, rich unicast based VOD content libraries, 3D Online Interactive Games, UltraHigh Speed Internet, Personal Video Casting, Business Ethernet Access, Distributed Network Attached Storage, Medical Imaging, HDTV Video Conferencing, Video Email, Virtualized Multimedia Network applications, Grid Computing Interconnect, Next Generation Wireless Access Backhaul, MDU backhaul, and BPL backhaul.
 - » Extended power classes will allow an operator to provide these services at a greater distance from the Central Office or to higher number of subscribers per port, allowing operators to reach more customers than currently considered .
 - » In a response to the Call For Interest during the July 2011 IEEE 802 LMSC plenary meeting in San Francisco, CA, USA, attendees voted 41 to 0 with 34 abstaining to form an Extended EPON Study Group. Among those represented were **12** companies including optical component manufacturers, equipment vendors, and service providers and **16** individuals who expressed interest in participating in the activities of Extended EPON Study Group and consequent Task Force.

Target applications for ExEPON

- » A few specific examples of transport applications that take advantage of these proposed extended power classes are:
 - > Operators who are fiber constrained in the first mile need to reach dense groups of subscribers over a single trunk fiber.
 - > Operators who need to go deeper in rural area deployment to be cost effective.
 - > Operators who desire greater operational flexibility to more freely combine or distribute service groups across some set of EPON resources.
 - > Operators who are deploying co-existent technologies over the same fiber – RFOG, EPON, 10G-EPON – and need to support higher split ratios due to a mix of technologies.

Application Example

- » Many North American Cable Operators have legacy fiber plant with as few as two count fiber for as many as 1000 homes passed.
- » This example depicts a fiber constrained first mile – 6 count fiber for ~600 homes passed.
- » This tends to be a fairly typical distribution among North American Cable Operators.
- » LECs deploying FTTC with a DSL last mile also have similar fiber constraints and could use similar extended reach optics to go to the house optically.



[New] Operator Fiber Constraint

- » Placeholder Slide to add information from Operators such as fiber strands per number of homes passed including fiber route distance from CO to most distant home.

1:32 Split for EPON

- a) Broad set of applications
- b) Multiple vendors, multiple users**
- c) Balanced cost, LAN vs. attached stations**
- » Many operators worldwide have deployed super-compliant EPON optics such as PX20+ and PX20-E to meet their need to go wider and deeper than the PX20 optical budget allows.
- » These super-compliant EPON optics are being marketed and sold by at least 4 OLT and 4 ONU suppliers. ~~vendors with varying optical characteristics across manufacturers introducing interoperability challenges.~~
- » **These super-compliant EPON optics (PX20+ and PX20-E) have varying optical characteristics across manufacturers which introduces interoperability challenges.**
- » PR30/PRX30 29dB ChIL upstream optics are already defined in 10G-EPON.
- » In excess of *1.2 Million*¹ PX20+/PX20-E EPON ports (includes both ONU and OLT ports) have been shipped worldwide to date.
- » ~~As depicted by the existing market,~~ There's a need to close the loop by providing standardized downstream optics compatible with EPON PRX30 to eliminate this interoperability challenge.
- » The cost of PX20+ PMDs is comparable to PX20 PMDs and the expected cost of standardized interfaces will be no different given the market value and existing manufacturing capabilities.

¹ – values obtained via system vendor poll

1:64 Split for EPON

- a) Broad set of applications
 - b) Multiple vendors, multiple users**
 - c) Balanced cost, LAN vs. attached stations**
- » Operators emphasized under the ExEPON SG the need to support 64+ splits on a PON.
 - » China Communication Standards Association has specified the increased link budget for PR/PRX40 optics (33dB) in their extension to the standard 10G-EPON technology.
 - » PX20++ optics are already being manufactured and shipped by at least one OLT/ONU supplier.
 - » ITU defined Class C+ optics - 32dB ChIL – see G.984.2, amendment 2.
 - » This Class C+ optic is being marketed and sold to a number of operators worldwide.
 - » In excess of 40,000¹ Class C+ GPON ports and PX20++ ports have been shipped worldwide.
 - » Following the 802.3 PHY layer design methodology and open standard development process it can be asserted that the new PHY interfaces will eventually exhibit a similar cost balance as existing EPON and 10G-EPON standard PMDs.

¹ – values obtained via system vendor poll

1:128 Split for EPON

- a) Broad set of applications
 - b) Multiple vendors, multiple users**
 - c) Balanced cost, LAN vs. attached stations**
- » Operators have expressed the need to support 128 splits on a PON to reach a dense set of subscribers over a fiber-constrained first mile infrastructure.
 - » While 128 splits is possible with optics capable of 64 splits at 20km, the diameter of the PON is significantly reduced.
 - » Much of the market demand for high splits (>64 splits) also requires 20km reach.
 - » ~~China Communication Standards Association has specified the increased link budget for PR/PRX50 optics (37dB) in their extension to the standard 10G-EPON technology.~~
 - » While many operators would prefer a completely passive solution, active in-field components are acceptable to many operators.
 - » At this split ratio the economic balance for the market is often between the cost of purchasing and deploying a solution to provide the needed optical reach versus new fiber construction.
 - » Following the 802.3 PHY layer design methodology and open standard development process it can be asserted that the new PHY interfaces will eventually exhibit a similar cost balance as existing EPON and 10G-EPON standard PMDs.