

Five Criteria Broad Market Potential

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Broad Market Potential (1)

- a) **Broad set of applications**
- b) **Multiple vendors, multiple users**
- c) **Balanced cost, LAN vs. attached stations**

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- » EPON is applicable in multiple environments to support bandwidth-intensive applications that require fast, reliable, scalable, first-mile connections. 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 to provide these services at a larger distance from the Central Office or to higher number of subscribers per port.
 - » Some of the transport applications for Extended EPON are:
 - > Operators who are fiber constrained in the first mile and need to reach dense groups of subscribers.
 - > Operators who are deploying in rural areas (and need to go deeper to be cost effective).
 - > Operators who desire to utilize EPON bandwidth effectively for competitiveness.
 - > Operators who are deploying co-existent technologies over the same fiber – RFOG, EPON, 10G-EPON.



Broad Market Potential (2)

- a) Broad set of applications
- b) **Multiple vendors, multiple users**
- c) **Balanced cost, LAN vs. attached stations**

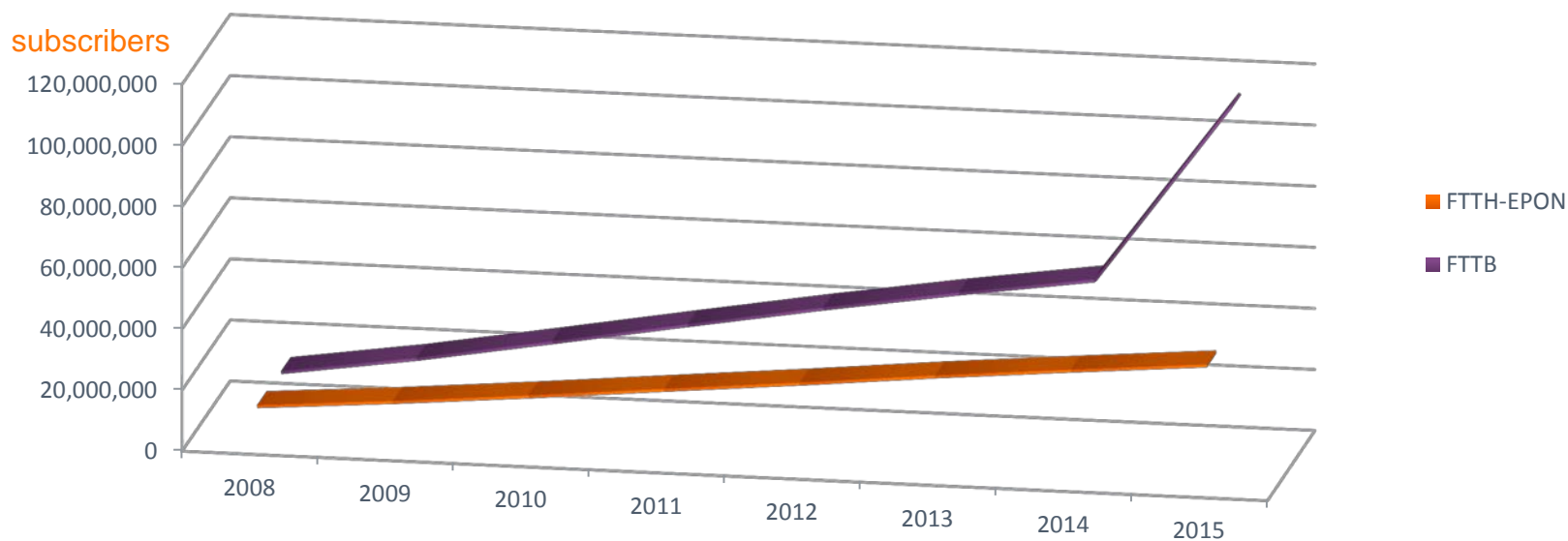
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- » There is already an existing rich ecosystem of EPON vendors (both for ONUs and OLTs.) This already rich ecosystem is being augmented by “traditional” cable equipment providers.
 - » EPON has been adopted across multiple service-provider market segments.
 - > EPON is continuing to grow in traditional service-provider markets.
 - > In the MSO service-provider market, there is a rise of interest. DOCSIS Provisioning of EPON, in addition to the number of relatively recent deployments in major North American MSOs, is evidence of that interest.
 - » In a response to the Call For Interest during the July 2011 IEEE 802 LMSC plenary meeting in San Francisco, CA, USA, attendees voted 63 to 0 with 34 abstaining to form an Extended EPON Study Group. Among those represented were **XX** 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.
 - » 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.



EPON Market

- a) FTTH with EPON forecasted to reach *40 million* subscribers by CY 2015
 - b) FTTB forecasted to reach *112 million* subscribers by CY 2015 (mix of EPON, GPON)
- ☐ FTTB in this statistic includes subscribers at MXUs.

FTTH-EPON and FTTB Market

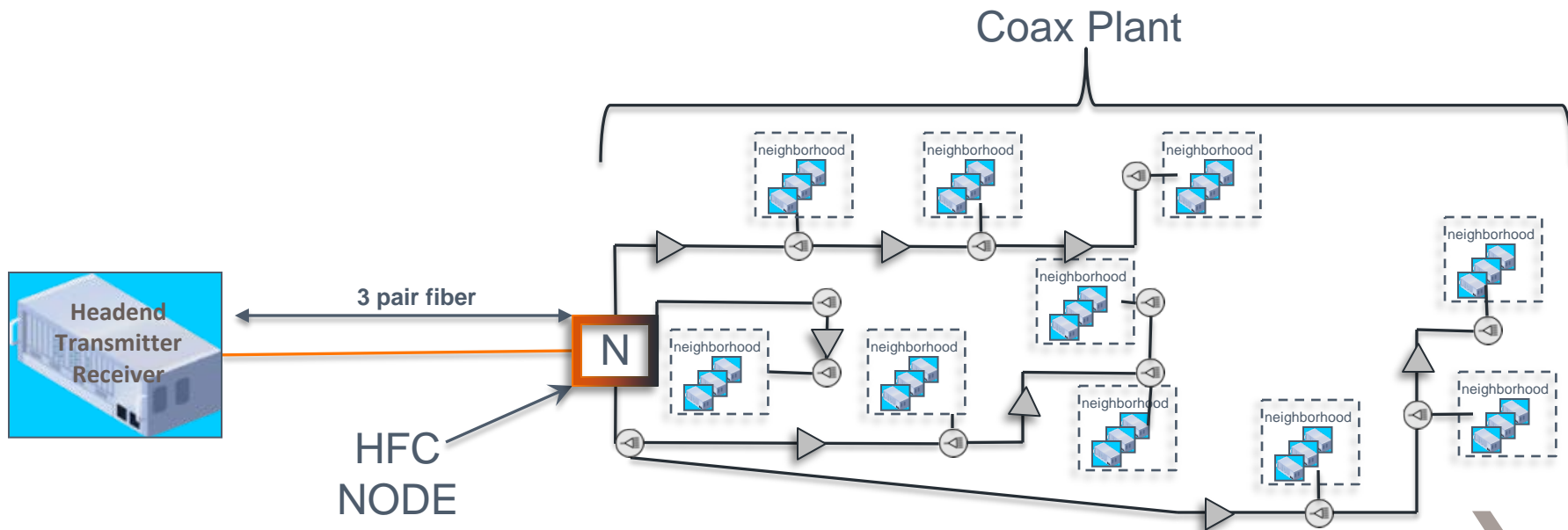


Statistics from Infonetics.

1) Fiber Constrained First Mile

Example-Hybrid-Fiber-Coax Build:

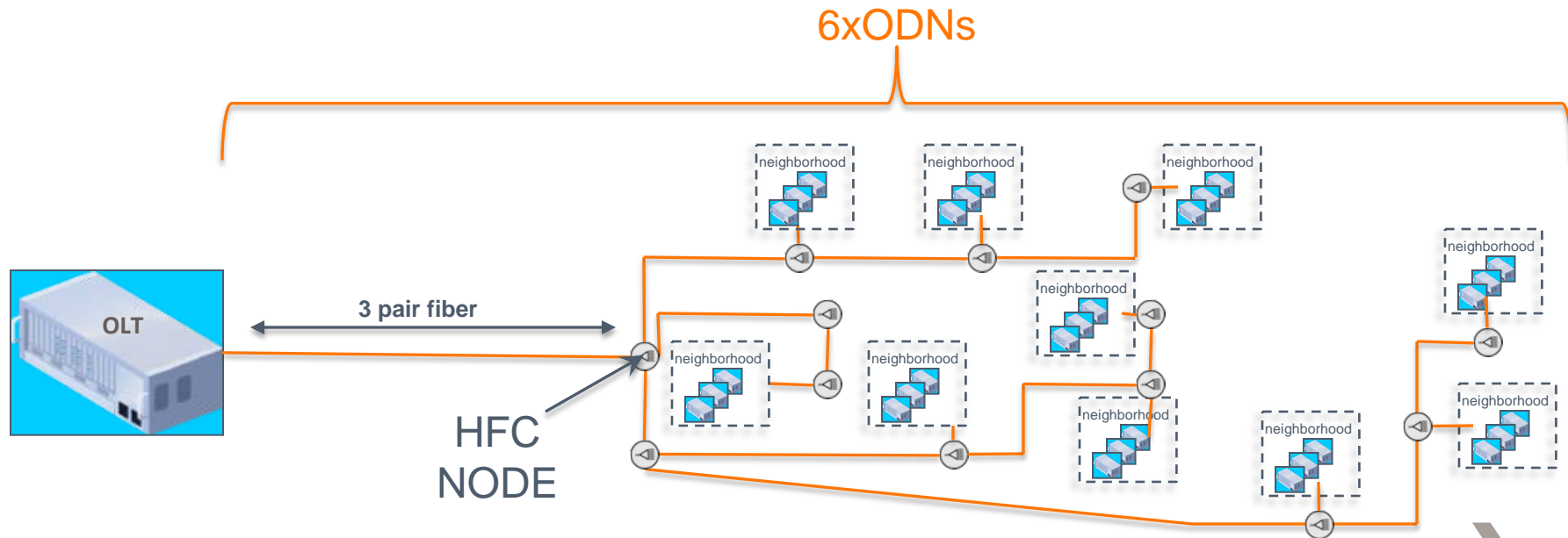
- » In typical North American MSO builds, a fiber segment is constructed to an HFC node serving ~600 subscriber passings.
- » Typical HFC deployments have 6 count fiber to the HFC node.
- » In HFC the node is responsible for the Optical-to-RF conversion.



1) Dense HFC Overlay

Example - EPON HFC Overlay:

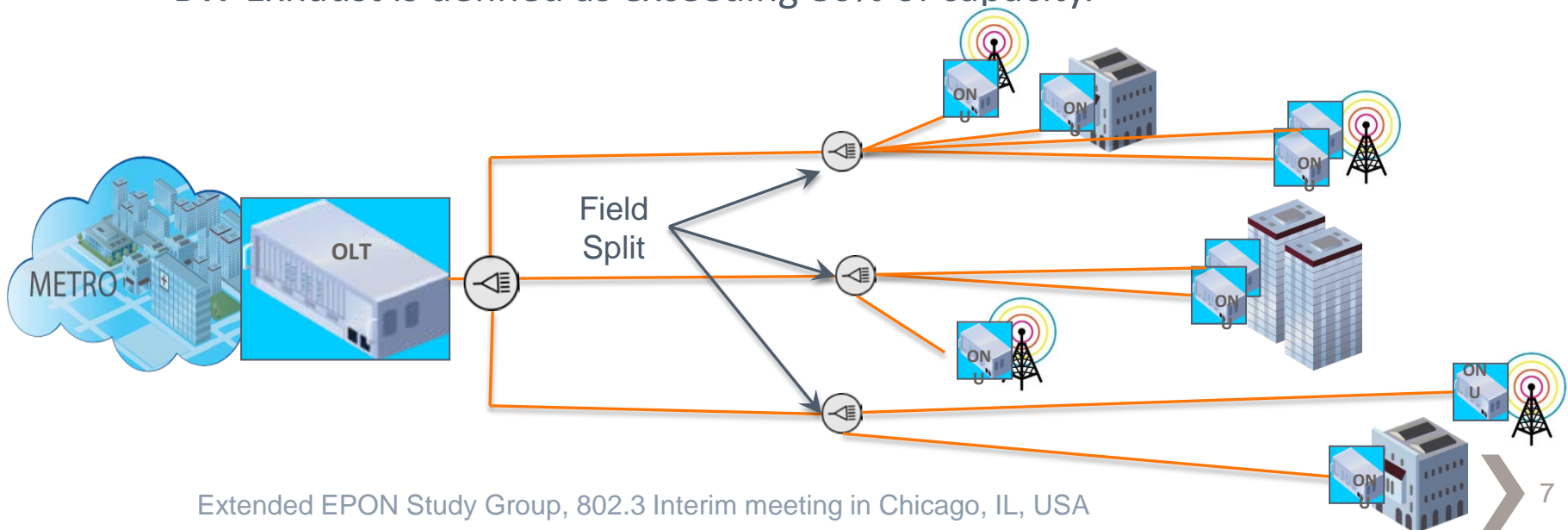
- » To service the same ~600 Passings segment on 6-count fiber would require 128 splits.
- » This use case drives towards an optical link budget that supports 20km distance and 128 splits.
- » As a point of market comparison - in 2011 there are 85 million DOCSIS3.0 ports in North America alone.



2) Effective EPON BW Utilization

Operational Intent is to efficiently utilize available bandwidth resources on all EPON ports.

- » In one North American MSO Deployment Profile - 50% of EPON ODN Deployments EPON link budgets are exhausted before available bandwidth resources on a given EPON port.
 - > Typical Max (commercial) deployment is 12 ONUs per ODN.
 - > Average EPON subscription is 50mbps Symmetric.
 - > Average max of distance of an ODN is 12km
 - > Optics are all PX20, PX20+.
 - > BW Exhaust is defined as exceeding 80% of capacity.



2) Effective EPON BW Utilization

- » This link budget exhaust is expected to become more pronounced with broad deployments of 10G-EPON.
 - > 10G-EPON broad deployment is expected to begin when 10G-EPON ASICs are widely available.
 - > Deployment of 10G-EPON is desirable to defer future operational costs as customer bandwidth demands grow.
 - > Greater reach in 10G-EPON optics makes earlier deployment more operationally efficient.
 - > Not every 10G-EPON deployment is expected to be multiple gigabits per second – some may be 50mpbs symmetric, some may be 1+gbps CWDM replacement.

3) EPON and Co-Existence

- » Operational considerations and overall cost effectiveness of 10G-EPON are expected to drive deployment of 10G-EPON to service low bandwidth services -> 50mbps symmetric for instance.
- » Commercial requirements such as 1mbps symmetric service across the same fiber drive 10/10G-EPON coexistence with EPON.
- » Intent is to effectively utilize both EPON and 10G-EPON bandwidth effectively in the co-existence case.
- » Additional optical splits are required to support technologies like RFOG and Ethernet CWDM over the same fiber.

