

802.3bk
Economics and Market
of
Power Budget Extenders

Edwin Mallette, Bright House Networks

Extended EPON SG Review

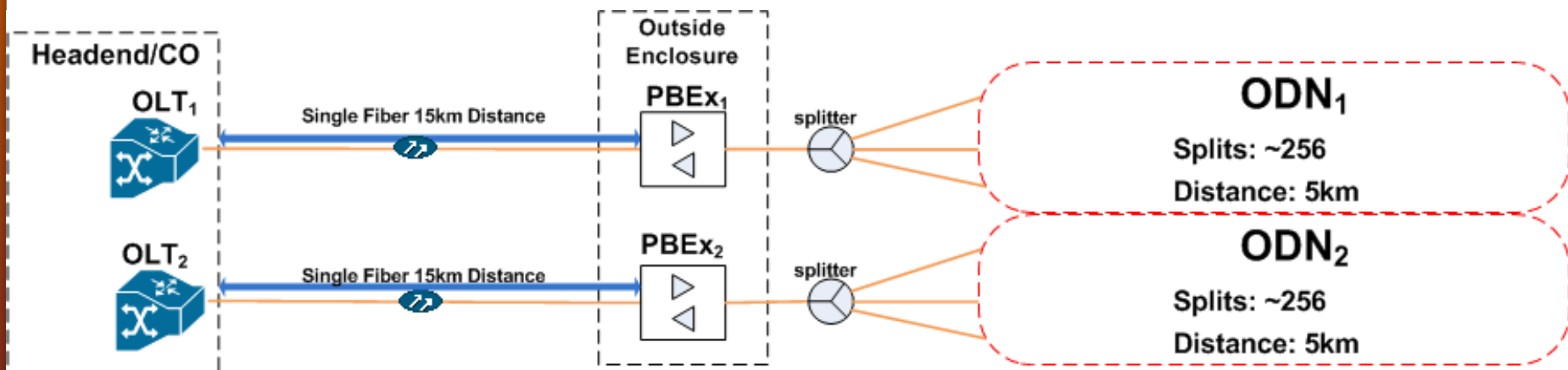
- » Through the Extended EPON Study Group a number of operators communicated the need for EPON to go wider and deeper.
- » Several contributions to the ExEPON TF indicated the need to reach 128 splits (or greater) at 20km, 64 splits (or greater) at 40km, etc.
- » A new PMD power class was considered to reach 128 splits at 20km but we saw no proposals to suggest that such a new power class was a) technically or b) economically feasible.
- » The Power Budget Extender was proposed to fill in the gap to meet the outlying needs of 64 (or greater) splits at 20km or greater distances.

Power Budget Extender

- » It is generally accepted that EPON operators want their ODNs to remain passive.
- » However sometimes there are specific economic conditions (as in the requirement to overbuild existing fiber) that might require operators to discard their preferences.
- » In other words it may be several orders of magnitude more expensive overbuild fiber than to deploy one (or many) PBEs.
- » The following slide reviews a use case for the PBEs.

PBEx Example Scenario

- » Recall: A primary constraint for PBEx need is low “available” fiber count between the Headend/Central office and some point in the field requiring fiber construction without a viable way to extend the power budget.
- » Thus the PBEx is intended to augment the power budget of standard EPON optics to concurrently support a number of splits >64 at distances >20km.
- » One scenario of interest is 500 homes passed with a single pair of fiber run to some initial split point as shown below.
- » The example below depicts two PBEx (one per ODN) being deployed in the same enclosure and supporting different ODNs.



PBEx Cost

- » Below is a table of relative costs between various cost components in operational access networks and a theoretical PBEx:
- > Coax Line Extender is a basic two-port bi-directional RF amplifier used in North America - upstream (5-42MHz) downstream (54-860MHz).
 - > EPON and 10G-EPON PBEx pricing obtained from supplier prototype and the ranges are due to various options OEO, OA, etc.
 - > Fiber build costs are averages used by several MSOs in the US.

Element	Relative Cost
Coax Amplifier/Line Extender (Aerial)	1
EPON PBEx (various options)	.5 to 6
HFC Node	8
10G-EPON PBEx (various options)	6 to 8
15km fiber build (Aerial-over-Lash)	400
15km fiber build (Rural Trench)	2000
15km fiber build (Urban)	4000

Operational Cost of PBEx

- » Referencing noll_01_0112.pdf¹ provides a little context in terms of the number of coax actives supported at Time Warner Cable.
- » In that presentation, Kevin notes that TWC has:
 - > "10's of thousands of HFC fiber nodes"
 - and
 - > "Over 1.5 million RF Amplifiers"
- » The support cost per element is expected to be no different between fiber amplifiers and coax amplifiers.
 - > The number of fiber amplifiers (PBEx) needed to support the same number of passings at the same distance is expected to be significantly smaller than the number of coax amplifiers used today.

1: http://www.ieee802.org/3/epoc/public/jan12/noll_01_0112.pdf

Market of the PBEx

- » The market for the PBEx, if standardized today, is expected to be very small.
- » There are a number of suppliers that manufacture power budget extenders today – some that use WDM technology, as an example, to support multiple ODNs on a single piece of fiber.
 - > These are typically proprietary (or near-prototype) implementations with minimal (or no) inter-supplier interop between the PBEx and the OLT.
- » For the North American Multiple System Operator (MSO) environment the PX40 class optic solves 98-99% of the need.
 - > The remaining 1-2% of the problem would be solved either by a) overbuilding fiber (costly!!) or b) implementing some kind of PBEx.
- » Even though this is expected to be a problem (eventually) for North American MSOs as they build fiber deeper and build fiber to the home, a number of people from these MSOs have expressed that they would prefer the 802.3bk work continue unencumbered by the addition of a PBEx to the workload.