Responses to editors' requests in NG-EPON IC Report R09 comments proposed .docx for additional input

Ed Harstead, Jan. 9, 2015

[e2]: Editorial: the first page of text in this section is generic for any fiber access architecture, not just WDM PONs. Suggest that this text be a separate section, named "Taxonomy of Access Network Technologies"

[KN1223] AIP – how about "Taxonomy of PON-based Access Network Technologies"?

That's even better.

[e3]: Propose to delete mention of CO. Remote OLTs can be located in the OSP.

[KN1223] We need a abstract term to describe all the locations that might house an OLT. CO was chosen (as defined below). Please suggest an alternative.

Usually, the CO means a specific location in the network, the central office, analogous to the MSO's headend or hub. I think it would be equally strange to call the HFC fiber node a "hub" just because an OLT was located there. Perhaps simply "OLT location"? (Also applies to [e6]).

[e4]: Or outside

[KN1223] AIP – how about "directly on the premises" which could be construed as inside or outside

Perfect.

[e7]: Propose to change to "hybrid PON"

[KN1223] REJECT – why?

Maybe I misinterpret Figure 1. WDM PON is defined in 3.1 as providing dedicated wavelengths, while the two quadrants on the right of Figure 1 appear to have shared wavelengths—in fact the heading says "shared channels". So it appears to me that Figure 1 covers both WDM PON and hybrid PON. Perhaps the Figure caption should indicate "multi-wavelength PONs".

[e10]: I believe NTT East begin deploying 1G EPON commercially in 2004.

[KN1223] REJECT – this text was submitted to the group. Please provide a reference if you believe it is incorrect.

Reference is H. Shinohara, "FTTH experiences in Japan", *J. of Optical Networking*, v. 6, no. 6, June 2007.

It says:

- NTT introduced EPON as a successor to BPON in December 2004.

- NTT East and West launched Hyperfamily service and Premium-family service as successors to the Family service in December 2004 and April 2005, respectively. Family service is offered on a broadband passive optical network (BPON) system, while Hyperfamily and Premium are provided by gigabit EPON.

[e21]: This section focuses on FTTH. It could easily be modified to also address FTTB (up to, say, 512 subscribers). This was a topic in email among Glen, Duane, Marek and I, which I believe was not resolved.

[KN1223] please submit proposed changed text

I can do this after the Atlanta meeting

[DRR32]: TR – this statement is not supported by the figure which shows that a 10Gb/s WDM PON system has 1/3 more headroom than 10G-EPON.

Strike "or a WDM-PON must support a per wavelength bit rate of"

[KN1223] Wasn't this to be updated per the SAT meeting?

I thought this text was agreed to by DRR (refer to my email to the editors on Nov. 8, 2014), so to propose to leave as is.

(Rationale: DRR is correct that 10G/wavelength WDM PON can offer a higher residential peak rate than 10G EPON in 2024, actually 25% more. But the key phrase in the sentence is "to significantly differentiate itself from existing 10G EPON". New standards and technologies are usually not created for 25% more bandwidth. Traditionally it is a factor of 4x (ITU-T) or 10x (IEEE 802.3), although with 25 Gigabit Ethernet is only a factor of 2.5. Still, 25% is small compared to 250% and in this context I don't think it is significant).

[MH33]: Not clear why this statement is needed in the first place – the point is not to build something different for the sake of being different but to address the operator demand in the following years

Remove

[KN1223] REJECT – I believe the contributor's intent was to establish a threshold at which an NG-EPON would be useful. Can EH confirm and reword?

Kevin, that's exactly what I meant. I propose to append a the sentence to the end of the paragraph if more clarity is required (see text in italics):

> Figure 12 indicates, from a residential bandwidth point of view, that to significantly differentiate itself from existing 10G EPON, an NG-EPON system will need to support more than 10 Gb/s service. In other words, a TDM-PON MAC must support an aggregate bit rate or a WDM-PON must support a per-wavelength bit rate of more than 10 Gb/s. *Failing that, NG-EPON would not support significantly superior bandwidth service than can already be provided by 10G EPON*.

[e48]: With splitters in cabinets, this approach is also widely used in residential networks. Still, for various reasons the average ONU/OLT ratio is significantly less than the optical split ratio.

[KN1223] REJECT – are you proposing a change to the text?

I'm reacting to this sentence, "In the case of business services, the deployment model is typically different. ". I don't think residential vs. business services is the right distinction when it comes to impact on splitter fill. Here's some proposed text:

> *ODN splitter architectures can be grouped into two categories, which will impact splitter fill rates: (1) co-located, connectorized splitters in a cabinet that allow grooming and pay-as-you grow, and (2) hard-wired splitters. In case (1), on day 1, a single OLT port, feeder fiber, and splitter are lit up, and subscribers are connected. Once the splitter is filled, a second OLT port, fiber, and splitter are lit up. This scenario maximizes utilization of resources and leads to relatively high splitter fill. In case (2), on day 1, every home passed is hard-wired to a splitter port, and all splitters and upstream OLT ports are lit. This*

requires higher day 1 capex, and relatively lower splitter fill (on average, equal to the take rate). The advantage is lower opex, as no truck rolls to the splitters are required to connect new subscribers.

[e92]:, if required

KN1223 - AIP - please clarify the edit

Propose to add to beginning of sentence (new text in italics):

For multi-wavelength PONs (WDM PON or hybrid PON), in order to alleviate inventory and logistical tasks for service providers, it is highly desirable that the allocation of the downstream and/or upstream wavelength channels to an ONU be configurable dynamically via the OLT.

[e95]: Not true for triple-play all-IP networks. Internet service is indeed BE, but there is QoS for voice and managed video service (IPTV).

KN1223 - AIP - please submit proposed edits

Proposed edit, see text in italics replacing existing text (I also deleted the bit about SLA, as I have not heard of any operators offering SLA for residential services).

Many operators today support prioritized traffic management for voice and managed IPTV services. Internet access is usually provided best-effort (BE) service, with an associated ~~with a~~ service profile that ~~is described in terms of~~ *specifies* peak bandwidth

[e115]: I propose a re-write for this section.   Assumptions about dispersion penalties drive conclusions that are not necessarily valid. Distinction between NRZ and advanced modulation is often missing.

KN1224 - REJECT - pleas submit proposed rewrittne text

MH1229: should be marked as REJECT then – no text was submitted to date.

OK. I can collaborate with Tao Minghui and submit new text for a section on TDM PON after the Atlanta meeting.

[e124]: baud

KN1224 - AIP - will everyone reading this understand that BAUD refers to the raw signaling rate on the line?

I think so. If not, there is a good entry for it on Wikipedia :-)

[e177]: Should be a mention of the various specifications in ITU-T G.652.

KN1224 - AIP - please submit proposed text

Proposed text to add:

ITU-T G.652 defines several single mode fiber types: A and B for legacy fibers with unspecified loss in the E-band (shown in Figure 32 as "pre 1990" and "~2000"), and modern types C and D with low E-band attenuation (shown as "post 2003").

[e180]: Would it be more appropriate to cite ITU-T : G.671 which specifies performance for PON splitters for 1260-1360, 1480-1625nm, but E-band performance is not specified.

KN1224 - Please make a submission

Proposed text to add:

> ITU-T G.671 also specifies performance for PON splitters, including loss over 1260-1360 and 1480-1625 nm (but E-band performance is not specified).

I don't see 1590 nm in either the SCTE or the IEC specs. Marek, do you have any references you can point us to?

This comment refers to the text:

> There have been announcements of DML transmitters developed for O-band as well [TBD, reference missing].

A reference, for example, are GPON ONUs that use O-band DMLs, so they are commonplace. Also 10G/10G EPON ONUs.

You might consider some additional changes. Regarding this text:

> The dispersion in C-band is much higher when compared with O-band, and thus typically EML transmitters are used

Both DML and EML are used in the C-band. An example of DML are lower bit rate /shorter distance CWDM lasers.

Regarding this text:

> However, there are no broadly available C-band components supporting power budgets in excess of 29 dB

Could be true, but there are S-band (E/GPON) and L-band (10G EPON) transmitters supporting 29 dB or more, so not really a big deal to do the same for C-band, I think. No harder than it was to do 1577 nm for 10G EPON.

I propose two changes to resolve the problem (new text in italics):

(1) Re-word the sentence above Table 4 as follows: "Table 4 presents a comparison of different wavelength allocation plans for NG-EPON, summarizing the key characteristics of specific plans presented in the previous sections, *including wavelength overlaps with legacy technologies (avoiding wavelength overlap is not the same thing as achieving co-existence. Filter bandwidths and NEXT/FEXT should be considered)* ."

(2) for the entries in Table 4, replace the word "Coexistence" with "No overlap".

Propose to add text (new text in italics):

> *If NG-EPON is a WDM PON or hybrid PON, t*unable lasers provide a number of advantages when used in the *ONU* ~~access network~~, including…