Wavelength Plan for PON Convergence

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March, 2017
Vancouver BC, Canada

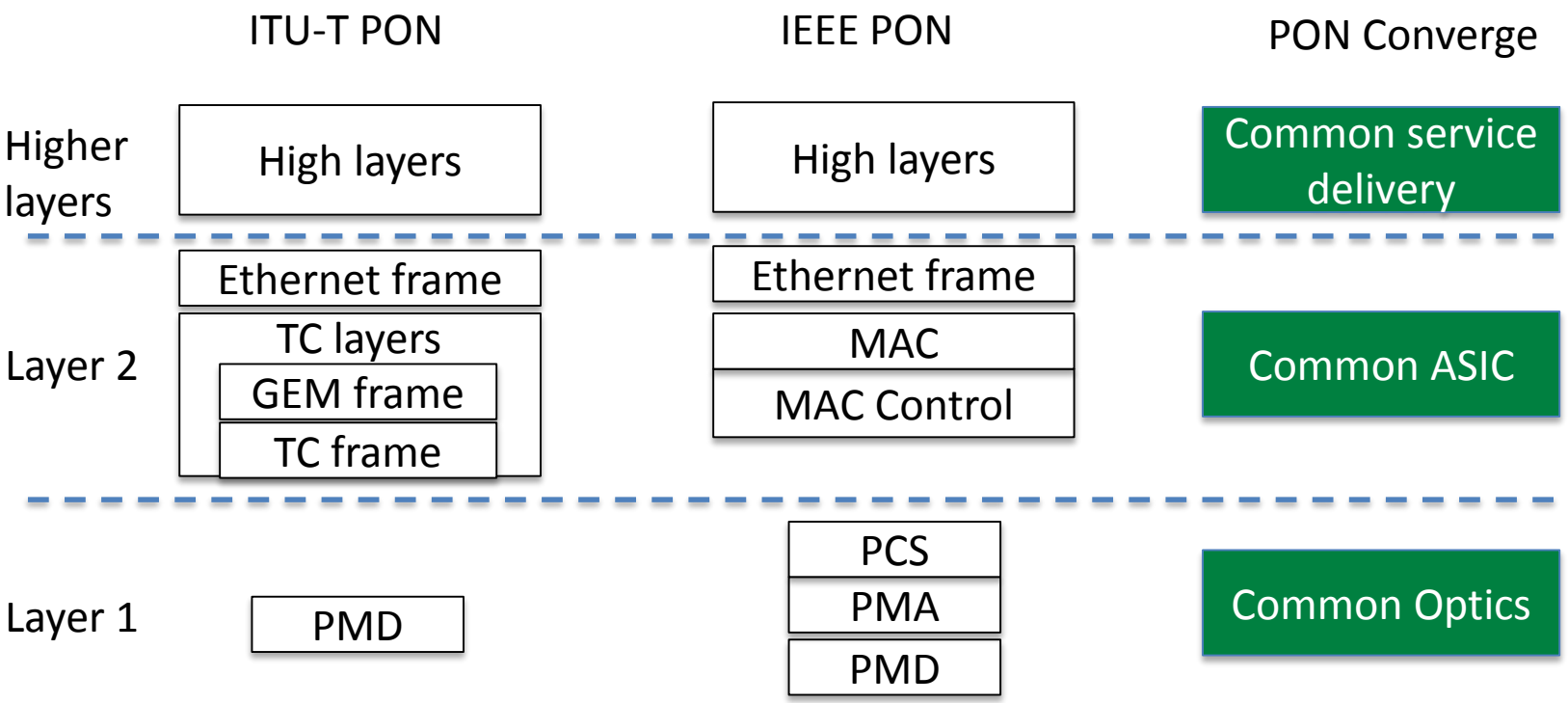
Outline

- Background
- The requirements for converged WDM wavelength plans
- Converge now or later

Background

- **At the January 2017 interim meeting, IEEE 802.3 sent a liaison letter to ITU-T SG-15 Q2 on a common wavelength plan for multiple channel PON at a 25Gbps channel rate**
- **An ad-hoc meeting on PON convergence was held at the January 2017 interim as well**
- **This contribution discusses the possible wavelength plans for converging IEEE PON and FSAN/ITU-T PON at the PMD layer**

PON Convergence – Various Ways



- **PON convergence could happen at three levels**
- **Convergence at all three levels leads to a single PON standard**

Which one is more important?

PON Convergence does not equal a Single PON Standard

- Higher layers converging may lead to SDNs
  - Management plane convergence
  - Control plane separation
- MAC layer convergence
  - Common P2MP forwarding protocols
- PHY layer convergence
  - Common optics

- However, SDN is about the separation of the control plane from forwarding plane; it is not about common forwarding
- From experience in NG-PON2 products, the high cost of high-seed PON optics is the key issue
- **Common optics are more important to IEEE and FSAN/ITU-T**

Common Optics Require a Common Wavelength Plan

- **Physical layer convergence is important for multi-channel PONs**
  - **Conserve wavelength resources**
  - **Common WDM optics lead to high volumes, lowering the cost**

Three possibilities:

- **Should 100G EPON converge to NG-PON2 wavelength plan**
- **The future NG-PON2+, as published in FSAN road map, converges to 100G EPON all O-band wavelength plan**
- **Convergence at PMD layer will not happen**

Converge Now

- NGPON2 reserves C-band 1524nm to 1544nm for upstream WDM channel and L-band 1596nm to 1609nm for downstream WDM channel
- Scale to 8 pairs of TWDM channels
- More channels for PtP WDM

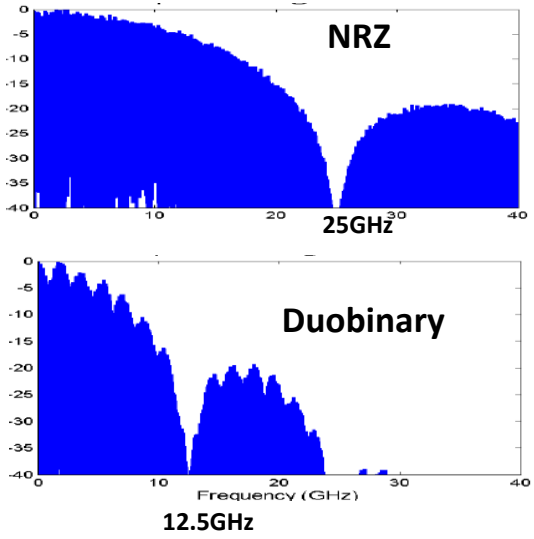
The 100G EPON:

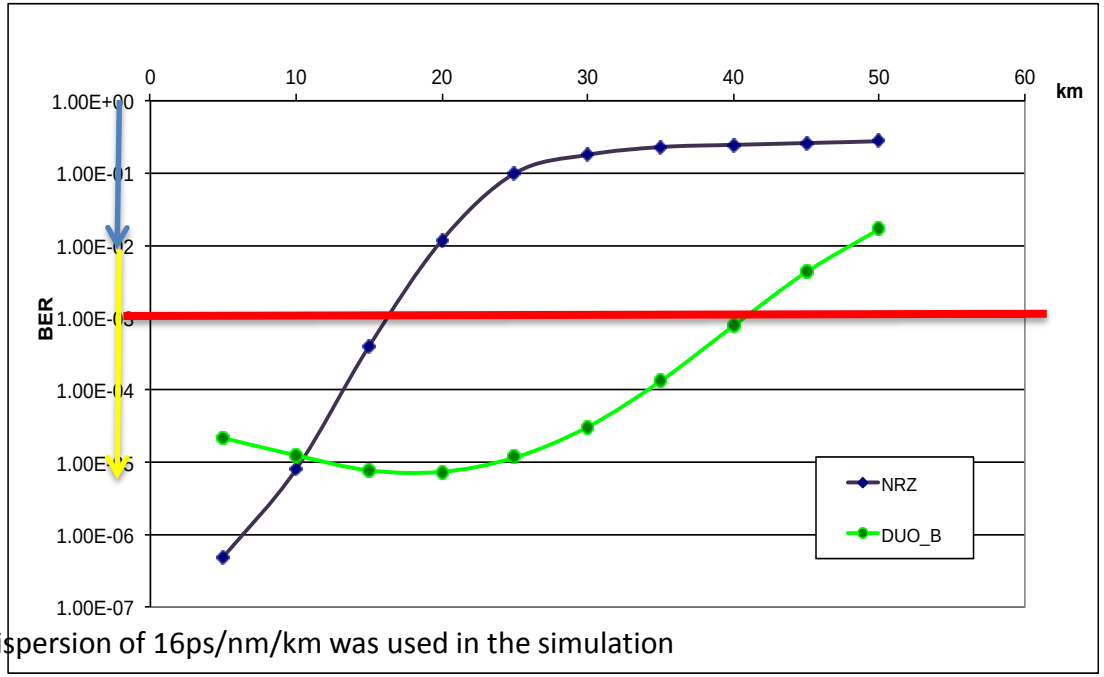
- **Upstream operates in C-band from 1524nm to 1544nm**
- **Downstream operates in L-band from 1596nm to 1609nm**

- **There is enough spectra space for DS/UP guard-band**
- **There are enough spectra for wide channel spacing**
- **Dispersion can be treated symmetrically for US and DS**

Dispersion Compensation may be avoided with new line codes

C band BER versus fiber length (25Gbps, fixed RX power)





* Dispersion of 16ps/nm/km was used in the simulation

- **Dispersion compensation may be avoided by using Duobinary or Pam 4**
- **Other dispersion compensation methods are also available**

Converge then …

- IEEE defines a new set of WDM channels for 100G EPON now
- FSAN/ITU-T reuses this set of WDM channels for multi-channel hybrid WDM -TDM PON at 25Gbps channel rate, for example could be NG-PON2+

So the IEEE and FSAN/ITU-T PON converge at a 25Gbps channel rate PMD layer

Will it happen?

It depends on whether the 100G EPON WDM wavelength plan meets the NG-PON2 requirements, but…

The Requirements for Converged WDM Wavelength Plans

- At a 20Gbps channels rate, the applications of multi-channel hybrid WDM-TDM PON will be beyond the scope of current TDM PON
- More network transport applications, such as 5G mobile backhaul and fronthaul, network backhaul for RPHY (remote PHY)…(dai_3ca_01a_0317)
- ODN distance may scale to >20km. For example maximum NG-PON reach is 40km
- WDM channel pairs may scale to >4 pairs. For example the TWDM channel pairs for NG-PON2 scales to 8 pairs

Will NG-PON2+ requires less? We cannot make such assumptions now.

Are O-band Plan A&B Scalable?

- In the 800 GHz spacing O-band plan, A & B are not scalable in channel count
  - Both plans consume all the spectra resources in O-band
- In the 800 GHz spacing O-band plan, A & B are not scalable in ODN distance
  - Both plans are limited in 20km reach because 2 channels are either in or at the edge of the zero dispersion region
- Besides, both Plans suffer from in band optical noises due to FWM coupled SBS in some cases with non-zero possibility (dai_3ca_01a_0117)

The O band wavelength plans A&B are not suitable for converged PONs at PMD layer

How Much Do We Love Converged PONs?

- IEEE PON and FSAN/ITU-T PON share common optics which will significantly lower the equipment cost for high-speed PONs, and therefore greatly benefit operators
- The NG-PON2 WDM wavelength plan is scalable in both channel count and ODN reach
- It is possible to achieve converged PMD for IEEE PON and FSAN/ITU-T PON with NG-PON2 WDM wavelength plan

Or, is convergence just Lord Ye's love of dragons?

Thanks

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