PON Convergence and 100G EPON Wavelength Plans

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Outline

- PON convergence
- 100G EPON and NG-PON2 share wavelength resource
- Three types of wavelength plans

PON Convergence

- **PON convergence mainly applies to IEEE EPON family and ITU-T GPON family**
- **PON convergence could be addressed at three layers**
  - **Physical layer**
  - **MAC layer**
  - **Higher layers**
- **Higher layers convergence may links to SDN concept**
  - **Management plane, control plane, SDN** …
- **MAC layer convergence**
  - **Common frame structures and scheduling protocols**
- **PHY layer convergence**
  - **Common wavelength bands, common channel plans**

PON Convergence at MAC and Higher layers

- **Higher layers convergence**
  - **At management layer Ethernet OAM and OMCI may be convergence to a common management protocol, for example Netconf with assistance from Yong data model**
  - **It can be further extended to SDN**
  - **This is the most possible/practical scenario**
- **MAC layer convergence**
  - **Common frame structures, common scheduling protocols**
  - **This will leads to common logics for ASIC; the benefit is lower chip cost**
  - **It is feasible, however consider the history of the two standard originations, it is unlikely to happen**

PON Convergence at Physical Layer

- **Physical layer convergence is important for multi-channel PON**
  - **Conserve wavelength resources**
  - **Similar WDM optics for large volumes and therefore lower cost**
- **Both NG-PON2 and 100G EPON using WDM technologies**
  - **NG-PON2 is a minimum 4 pairs DWDM channels system with tunable transceivers**
  - **100G EPON is a maximum 4 pairs WDM channels system with fixed transceivers**
- **100G EPON and NG-PON will not be able to share same optics, however they may share the same wavelength bands**

Wavelength Plan Type I
Converge with NGPON2 on Wavelength Bands

- Common wavelength bands conserves wavelength resources
- Common wavelength bands facilitates migration to WDM PON in the future
- NGPON2 reserves C-band 1524nm to 1544nm for upstream and L-band 1596nm to 1609nm for downstream

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**

Wavelength Plan Type II
All O Band Wavelength Plan

- There are two subtypes of all O band wavelength plans
  - Plan A: 800GHz channel spacing, there is one channel in the zero dispersion region of SMF(johnson_3ca_1a_0916.pdf)
  - Plan B: 400GHz even or uneven channel spacing, no channels are in the zero dispersion region of SMF(dai_3ca_2(a,b)_1116)
- Plan A suffers from in band optical noises due to FWM coupled SBS
- Plan B has 400GHz channel spacing. It does not impacted by in band optical noises as in plan A

All O band wavelength plan is feasible with 400GHz channel spacing

Wavelength Plan Type III
Split Band Wavelength Plan

- Type III wavelength plans have several variations
  - Upstream in O band
  - Downstream in S band
  - Downstream in C band
- Type III wavelength plans have to face asymmetric dispersion compensation problem
  - Only compensate downstream
- Need additional filters to separate wavelength bands, adding more lost to the already tight power budget

Asymmetric dispersion compensation should be avoided if possible

Comparison of the Three Types of Wavelength Plans

- Type I wavelength plan is a converged wavelength plan. It uses the same WDM wavelength resource as NG-PON2.
  - Save spectra resources; avoid further spectra fragmentation
  - Facilitates migration to WDM PON in the future
- Type II is all O band wavelength plan
  - Avoids dispersion compensation in both US/DS
- Type III is a split band wavelength plan
  - Need asymmetric dispersion compensation
  - Need additional filters to separate wavelength bands

Conclusions

- **Type I converged wavelength plan and type II all O band wavelength plans have their own strengths**
- **Type III split band wavelength plans are less desirable**

Thanks

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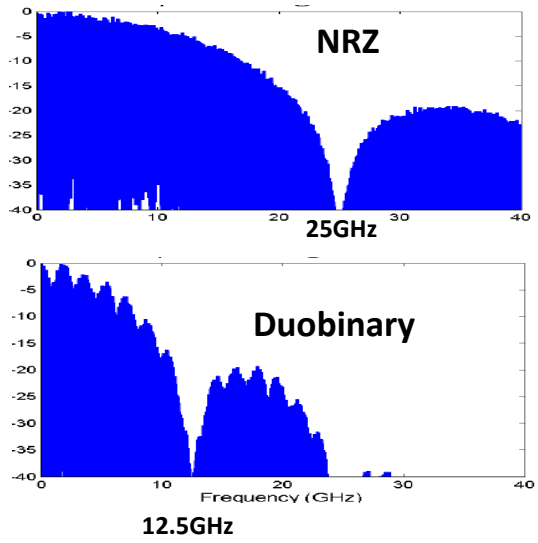
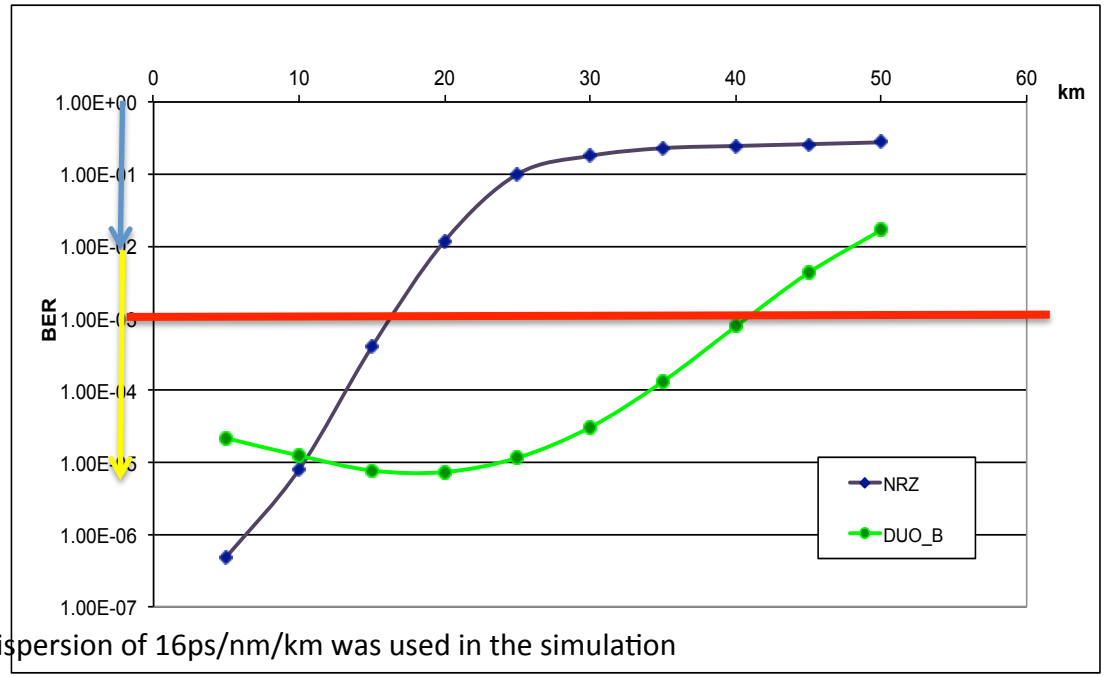
Line code choice for C*/L band

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





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

- **Needs dispersion compensation for 20km reach in C/L band for NRZ**
- **Dispersion compensation may be avoided by using Duobinary**
- **Optimized line code for C/L bands is Duobinary**