802.3ca At Crossings

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Background

- After 802.3ca, TF has been working on a 4x25G parallel solution for 2 years. A motion passed at the July meeting to study the 50G serial solution.
- The temporary decision at the July meeting was to work on a 4x25G parallel solution and 50G serial solution in PARALLEL, however,…

The 2 solutions will not converge after departing; a decision has to be made sooner

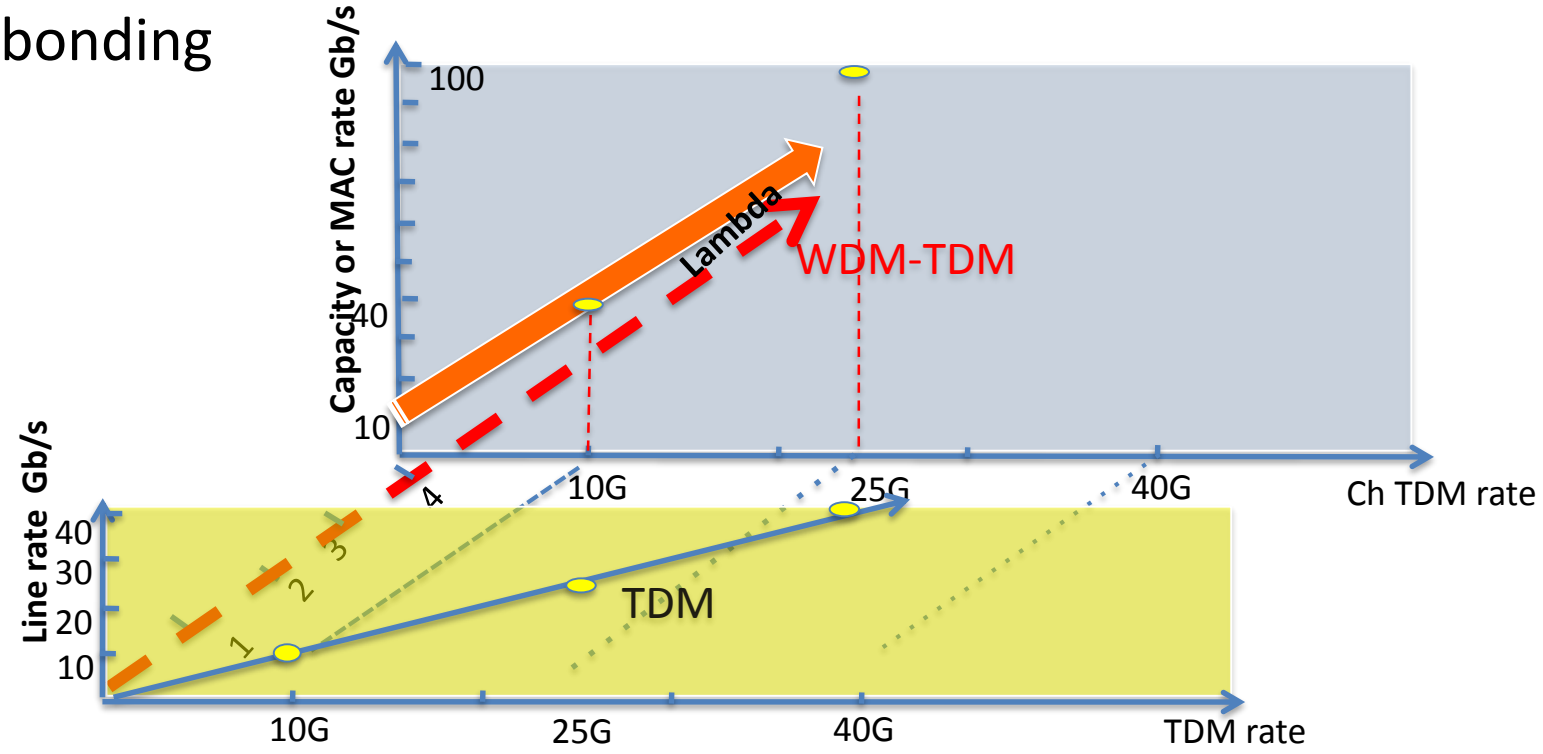
TDM or TWDM is a question again

- Why the serial 50Gbps serial rate came up 2 years after the 4x25Gbps parallel solution headed down the road?
- When looking back, the question of TDM to TWDM has been discussed since SG stage.
- The root of the “TDM or TWDM” question is in the balance of the feasible TDM rate today and the capacity needed in the future
- When defining a standard for the future, how to achieve this balance is not always clear
  - Will a technology become feasible soon?
  - Predicting bandwidth needs in the future is difficult
- The high-cost of TWDM with channel bonding has been always a concern if higher serial rate becomes achievable

TDM or WDM (TWDM) ?

Rule of Sum*

- Consider WDM only after TDM meets the bottleneck under current technology
- Revisit TDM when new technologies become feasible
- Higher serial rate, if achievable, is more economic than channel bonding



* This diagram has been used since 802.3ca SG

What can we learn form TWDM NG-PON2?

- The high-cost of NG-PON2 today is often attributed to tunable optics; however, that's only on the surface.
- The TWDM channel rate of NG-PON2 is at 10Gb/s with 4x10G parallel.
- When NG-PON2 reaches the lab test stage today, the serial TDM rate >10 Gb/s, for example 25Gb/s, is feasible for PON.
- Advanced modulations, such as PAM 4, enable TDM rates beyond achievable by NRZ
- NG-PON2 might adopt TWDM too early
- Even today, TWDM may still be too early at 25Gb/s for PON
    - The 50Gb/s serial PAM4 proposal reflects this concern
    - It's about the balance of the cost and capacity

TWDM PON May Be Too Early Today

Bonding for the future?

- Accurate prediction of future bandwidth needs may need a crystal ball.
- However, analyzing the historic data of PON deployments may shine some lights
- GPON has been deploying since 2006 (>10 years). It's volume may already pass the peak, but the deployment is continuing

- 10G EPON starts around 2010, the volume is still small, far from reaching the peak
- 25G EPON standard may be completed around 2019. Assuming deployment starts at 2020 and takes 8 years to peak at 2028 (faster than 10G EPON)
- When will any significant deployment of 100G PON happen for residential market?

- **Channel bonding is the last resource to meet TODAY's bandwidth needs; not for that in the distant future**
- **At that time, higher serial rate may available, like what happened to TWDM NG-PON2**
- **PON for transport may need higher bandwidth in the near future, bit it has different requirements and cost model**

Less is more, sometimes…

- PON convergence was discussed at 802.3ca
- To make progress in PON convergence, FSAN has to be involved since that's the requirements for GPON family specified.
- There were discussion at FSAN on cooperating with 802.3 on future PON development
- PON convergence is a complicated problem, involving the "past" (coexistence) and the "future"(convergence)
- Before this process starts specifying many wavelengths, not all are needed in the foreseeable future, will make PON convergence more difficult

Specify 25Gb/s rate for PON toady, targeting converge at 50Gb/s

Current status of 802.3ca

- More progress made on MAC control and channel bonding
  - The frame for multi-channel can be reuse in 25G/50G serial
  - Multi-channel and bonding related fields can be specified as reserved fields for future use
- Less progress made on PHY
  - We spend ~2 years on wavelength plan. Main difficulties are
    - Spectra resource limitations in O band and other constrains such as FWM, coexistence, cost, etc.
    - Unless we open to other bands, the difficulty will remain
- Power budget gap is difficulty to fill
  - FEC alone cannot composite the loss of AWG mux/dmux
  - SOA is needed; channelized SOA may be needed because of the 20nm width in channel 0.
  - The cost is a serious concern

Going forward …

- There are three choices 802.3ca is facing
  - A) Continue 4x25G parallel solution. Not consider 50Gb/s serial rate at 802.3ca TF.
  - B) Specify 25G EPON first, meanwhile consider/study 50Gb/s serial rate with advanced modulations.
  - C) Start a CFI for 50Gb/s serial rate PON
- Option A - will continue facing current difficulties; may end up with similar problems NG-PON2 has
- Option B - Complete 25G standard sooner; more opportunity for PON convergence at 50Gb/s
- Option C – Better to wait towards the end of 802.3ca process

Conclusions

- **Specify 25G EPON first, meanwhile consider/study 50Gb/s serial rate that enables fast 25G EPON to market and gives more opportunities for PON to converge at 50Gb/s serial rate**
- **TWDM is still too early at 25Gb/s rate**
- **Channel bonding is not the way to solve anticipated FTTH bandwidth needs in the distant future**
- **PON for transport may need higher bandwidth in the near future, bit it has different requirements and cost model**

Thanks

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