



WDM COEXISTENCE FOR 1G/10G/NG-EPON

CONTACT:

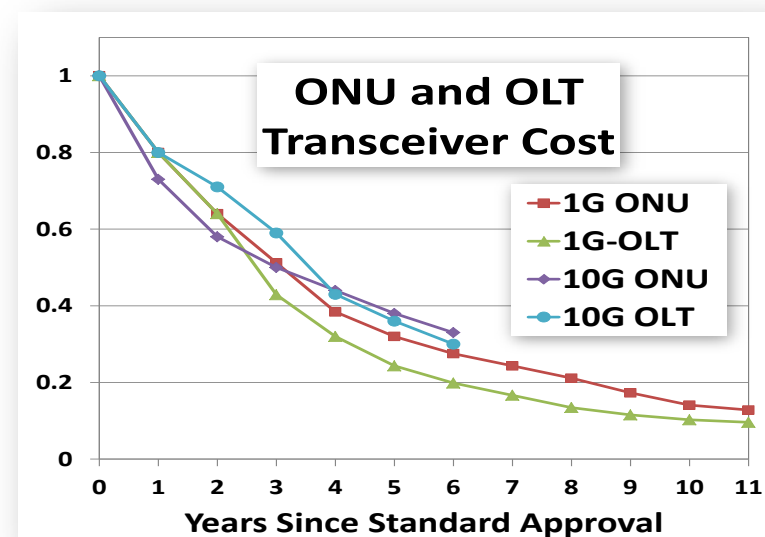
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EPON Cost Trends

- ONU and OLT transceiver costs for 1G-EPON and 10G-EPON have eroded over time
 - Similar trends can be also observed for ONU and OLT equipment cost
- Despite dramatic decrease in 10G-EPON equipment cost, 1G-EPON remains attractive for operators
 - For use for lower tier business customers, with limited bandwidth demand and limited growth forecasts
 - Residential deployments, which are very cost-sensitive, especially as far as CPE equipment is concerned
 - To extend ROI for operators who already have 1G-EPON deployed



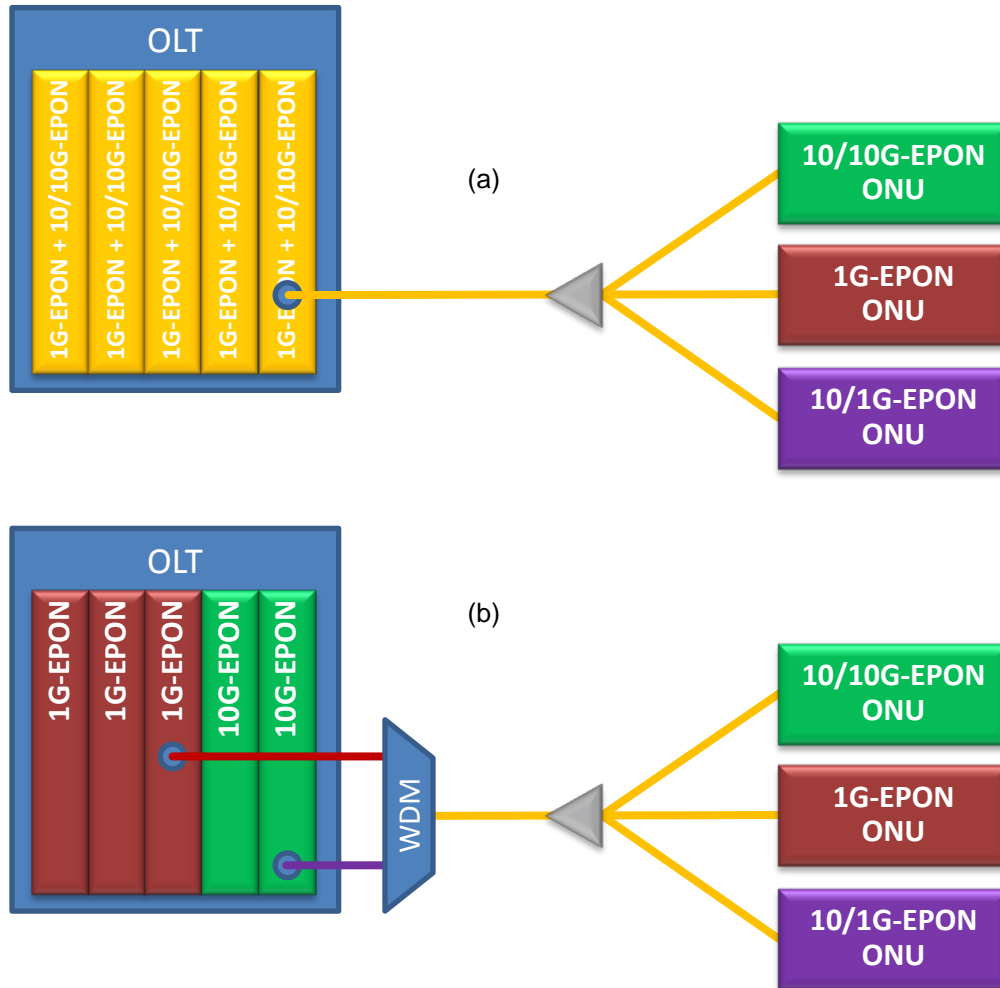
Source: Ligent Photonics

Presented at NG-EPON CFI

1G-EPON remains attractive for operators, even when cost of 10G-EPON equipment sees substantial decrease over time

Coexistence of 1G/10G-EPON

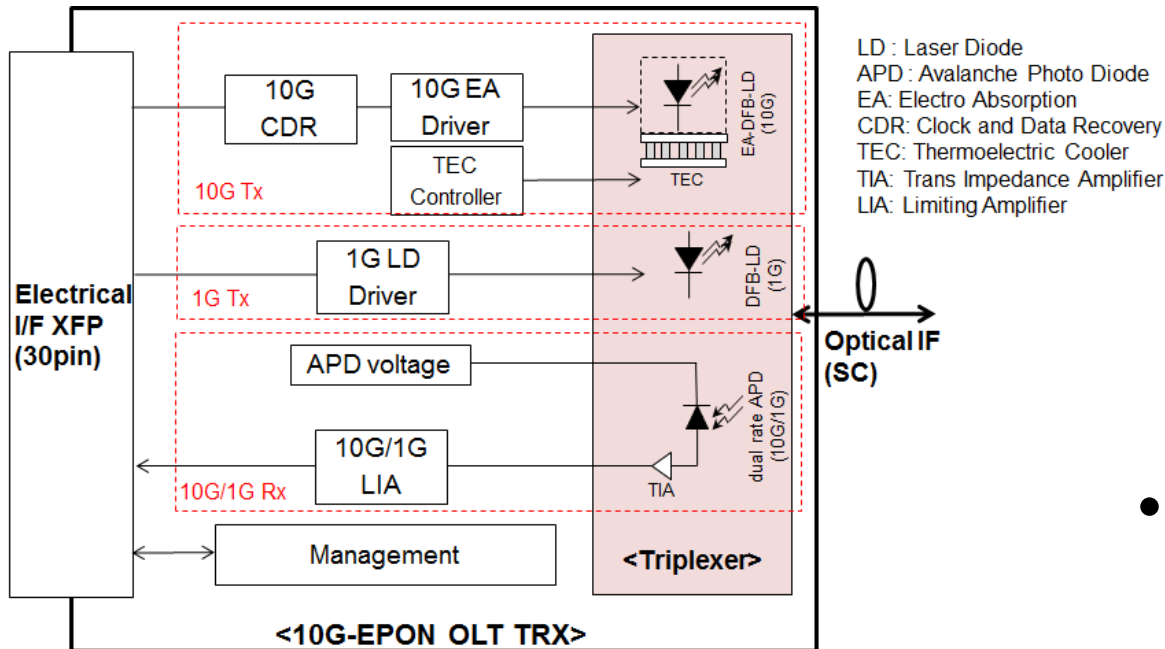
- WDM and TDM coexistence of 1G/10G-EPON on the same ODN is described in IEEE Std 802.3-2015, Annex 75A



- TDM coexistence allows to connect 1G-EPON, 10/1G-EPON, and/or 10/10G-EPON ONUs to the same OLT port
- WDM coexistence requires separate 1G-EPON and 10G-EPON OLT ports, which are then WDM-multiplexed into a single OLT via WDM filter

TDM Coexistence Mode

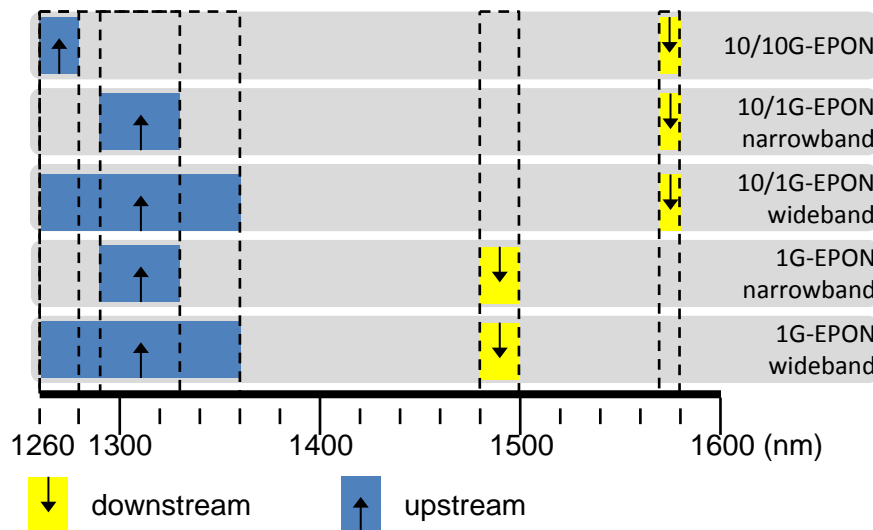
- Dual-rate OLT transceiver is equipped with two independent Tx units (1G and 10G), but only one 1G/10G dual-rate burst-mode receiver
 - Upstream is TDM shared between 1G and 10G ONUs, and effective throughput statistically depends on number of connected ONUs, their services, data rates, etc., and ranges between 1G and 10G
 - In the downstream, 1G and 10G channels operate independently, offering 10G+1G of throughput on the ODN



- TDM coexistence mode designed for systems using wideband 1G-EPON ONUs with upstream Tx (FP lasers) operating in 1260-1360nm range
- WDM coexistence is not possible in such systems

WDM Coexistence Mode

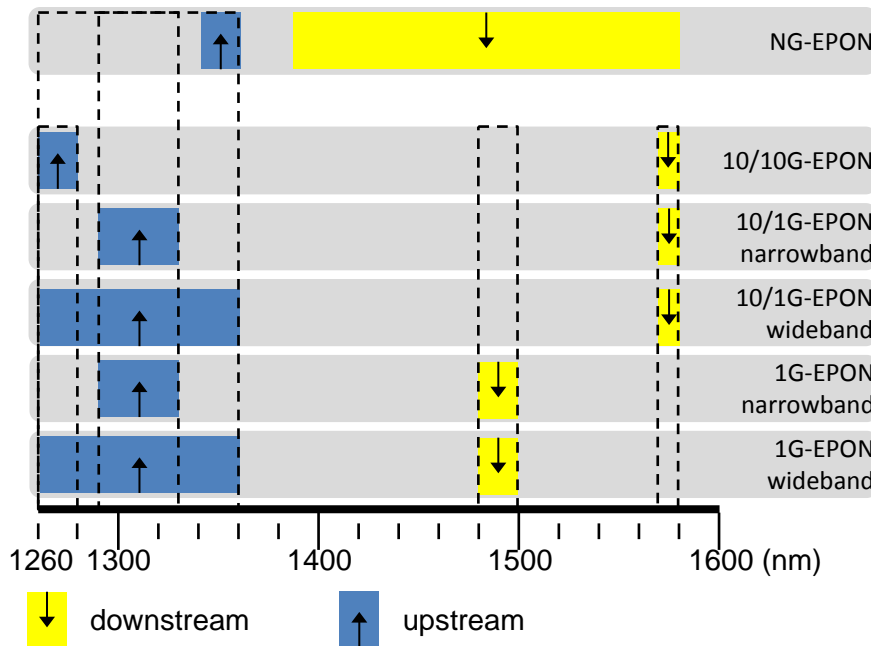
- Two OLTs ports (1G-EPON and 10G-EPON) are WDM-multiplexed onto a single ODN using a WDM filter (similar to XG-PON1 WDM1r)
 - In the downstream, 1G and 10G channels operate independently, offering 10G+1G of throughput on the ODN
 - In the upstream, 1G and 10G channels operate independently, offering 10G+1G of throughput on the ODN
- WDM coexistence mode requires the use of narrow-band 1G-EPON ONUs with DFB Tx, operating in 1290-1330nm range



- Substantial decrease in cost of narrow-band 1G-EPON ONUs unlocks the option of full WDM coexistence of 1G and 10G-EPON on the same ODN
- Ideal for business access for **exclusively symmetric services**

Coexistence in NG-EPON

- Coexistence of NG-EPON with 1G/10G-EPON depends on the selected wavelength allocation plan
- NG-EPON upstream band: 1340-1360nm
 - 60nm guard-band from upstream 10G-EPON (1260-1280nm)
 - 10nm guard-band from narrowband upstream 1G-EPON (1290-1330nm)
 - WDM coexistence with 1G/10G-EPON for narrowband upstream 1G-EPON and TDM coexistence with 1G/10G-EPON for wideband upstream 1G-EPON



- NG-EPON downstream band candidates: ~1550nm, NG-PON2 bands, 1600+nm band.
 - WDM coexistence with 1G/10G-EPON systems can be achieved with minimum development effort
- Non-OOK modulation scheme (if selected) will largely influence selection of wavelength allocation plans for NG-EPON

Priorities for NG-EPON coexistence

- **Priority 1: WDM coexistence with 10G-EPON**
 - For operators moving towards EPON deployments only today, 10G-EPON is the start game. They may never deploy 1G-EPON.
- **Priority 2: WDM coexistence with 1G/10G-EPON**
 - Operators with 1G-EPON, and moving towards 10G-EPON, would like to keep 1G-EPON in production to extend ROI
 - 1G-EPON has still network applications, including voice circuits, lower business access tiers, cost-sensitive residential access, etc.
- **Priority 3: TDM coexistence with 1G/10G-EPON**
 - TDM coexistence as defined in Annex 75A does not provide symmetric bandwidth when multiple ONU generations share the same ODN.
 - Effective only for residential access where symmetric services are offered, but rarely fully utilized by customers.
- **Priority 4: WDM coexistence with RFoG**
 - Hard to justify analog overlay when NG-EPON provides more than 10G of capacity, sufficient to broadcast whole terrestrial lineup in digital format.

Summary

- WDM and TDM coexistence modes defined in IEEE Std 802.3-2015 for EPON are very practical and support evolutionary migration from 1G-EPON to 10G-EPON
- 1G-EPON will not be fully replaced, even by 2020, and will still exist in deployments around the world
- 1G-EPON remains attractive for many network services and many operators around the world
- WDM coexistence with 10G-EPON should be the primary driver for NG-EPON wavelength allocation plan.
 - WDM coexistence with narrowband 1G-EPON should be also considered, especially if incremental cost is not prohibitive
 - TDM coexistence with wideband 1G-EPON ONU could be also defined, but it is not clear whether it can be implemented in a single TRx unit

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NETWORKS



THANK YOU!