Open discussion on channel bonding

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outline

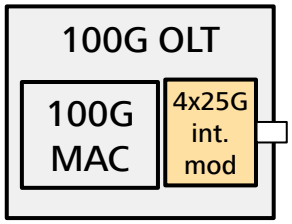
- Introduction
- Application discussion of channel bonding
- Proposal

Introduction

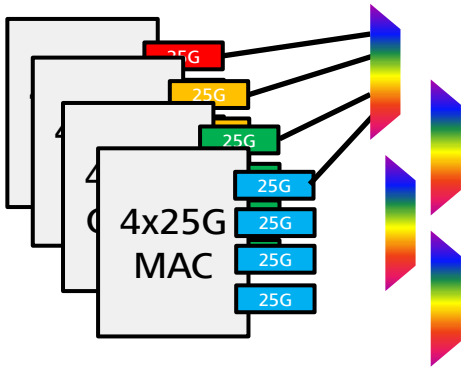
- Channel bonding is one of the most important requirement factors which may introduce big change on current EPON/10G-EPON architecture and protocol.
- In previous meetings, couples of channel bonding approaches (RS level channel bonding, MPCP+, MLCP, etc.) came up for discussion, but these discussion were just focusing on technologies, without taking application engineering factors of 100G-EPON into account.
- Meanwhile the bandwidth requirement of single service flow also has big impact on the choice of channel bonding approach.
- It's proposed that it is necessary to further review engineering factor and bandwidth requirement of single service flow factor before we make decision on channel bonding approach.

Deployment mode analysis of channel bonding

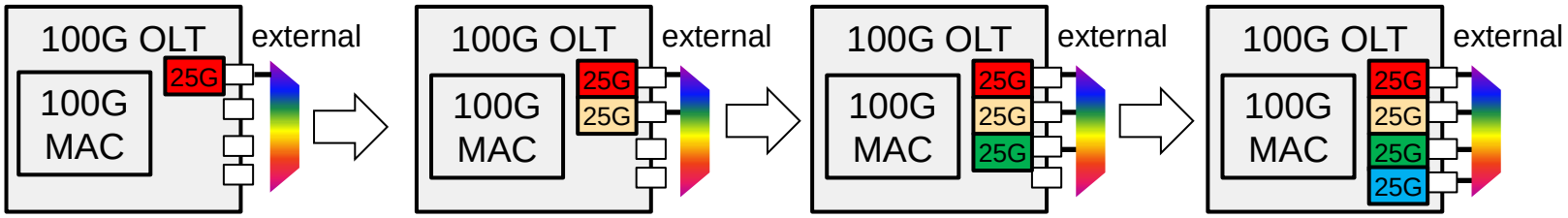
Option 1: one single 4x25G integrated module at one single OLT line card: can't support pay as you grow



Option 2: 4 separate 25G modules at four separate 25G OLT line cards: pay as you grow by horizontal adding 25G TRx modules.



Option 3: 4 separate 25G modules at single OLT line card: pay as you grow by vertically adding 25G TRx module.



	Approach 1: RS bonding, MLCP, MPCP+, etc.	Approach 2: Link aggregation at >=L2
Option 1	√	√
Option 2	X	√
Option 3	√	√

Summary:

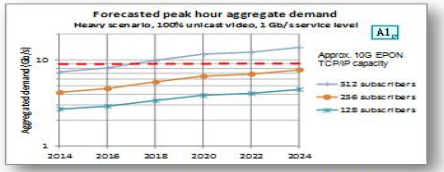
- **There are different deployment modes for 100G-EPON considering day one cost and pay as you grow requirement.**
- **Different channel bonding approaches may have different flexibility to satisfy different deployment modes.**

What is the maximum BW requirement of single service flow in PON system

Residential demand can break 10G-EPON

- A large fraction of broadband users lives in Multi-Dwelling Units (MDUs)

- Fiber-to-the-Building (MDU) aggregates hundreds of subscribers on a single PON
- In dense MDU environments, the 10G-EPON capacity is predicted to be insufficient



E. Harstead, R. Sharpe, "Forecasting of Access Network Bandwidth Demands for Aggregated Subscribers using Monte Carlo Methods", IEEE Comm. Mag., Mar. 2015.

Bandwidth Targets (Business Access)

- In a typical business access scenario, the NG-EPON is expected to serve a combination of small, medium, and large businesses, and to provide backhaul connectivity for cellular towers.

Subscriber Type	Guaranteed Access Bandwidth Range (2018-2025)
Small Business	0.1–1 Gbps
Medium Business	1–2.5 Gbps
Large Business	5–10 Gbps
Cellular Backhaul	1–5 Gbps

Typical Combinations of Subscribers				Required PON Capacity
Small Business	Medium Business	Large Business	Cellular Tower	
24	8	-	-	~30 Gbps
16	8	-	8	~32 Gbps
-	16	1	8	~38 Gbps
16	8	2	4	~40 Gbps A1

- The future BW requirement for 100G-EPON has been analyzed in CFI, and 40G+ and 25G+ will be required respectively for business scenario and residential BB scenario. But the BW forecast is too rough to be used as the BW requirement input/guide of channel bonding design because it is a total BW requirement. And BW requirement of single service flow granularity is more specific and important for channel bonding design guide.
- BW requirement of single service flow is missing:
  - What is the largest BW forecast of a single service flow: 1G? 5G? 10G? 25G? 25G+?
  - The largest BW requirements for D/S and U/S are the same? Or totally different?
  - If there is no service flow which will require 25G+ BW, is it necessary to design a 100G EPON-MAC(by channel bonding) with the cost of breaking conventional EPON architecture and inducing big complexity?

Proposal

- Channel bonding has huge impact on the system architecture and final production of 100G-EPON.
- More application/deployment factors deserve further review:
  - Deployment modes of 100G-EPON
  - Maximum BW requirement of single service flow

Thank you

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