



Evolution of PON

Pradap Rajagopal
Global Solutions Leader
Ciena

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T&Cs apply



Some context

John Chapman's "Three laws of Broadband"

Internet speeds increase 1000x every 20 years

1980 – 1200bps | 2000 – 1Mbps | 2020 – 1Gbps | 2040 – 1Tbps?

Core technology leads access technology by 20 years

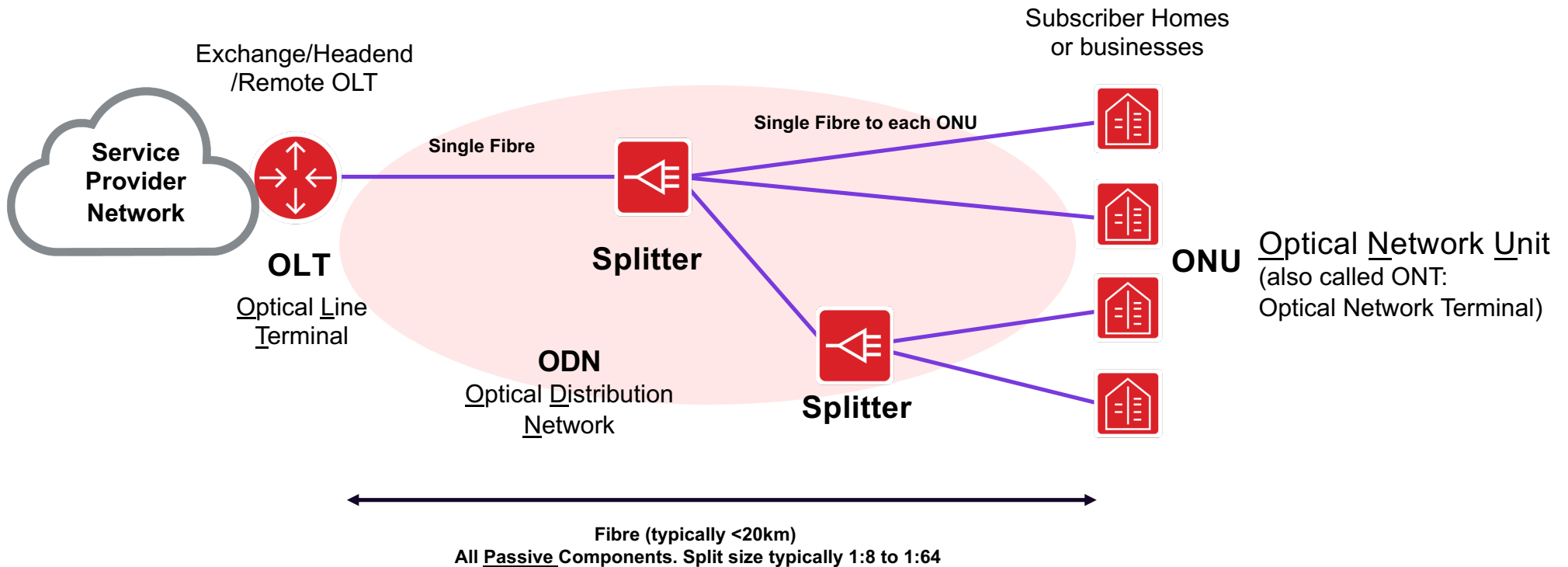
1990 – 1Gbps | 2000 – 10Gbps | 2010 – 100Gbps

In a competitive market, access speed is supply-side driven, not demand-side driven

Operators driving higher ARPUs



Recap of PON – Passive Optical Networks



Single fibre point-to-multipoint, all-passive optical distribution

Sharing via OLT granting upstream access based on ONU requests + more

TDM / TDMA access enables residential oversubscription

Why PON?



Motivation:

- “Low-cost” shared broadband access for residential FTTH markets and high over-subscription
- Focus on keeping subscriber equipment (ONT/ONU) as low-cost as possible

Technology and Market Enablers:

- Always trying to enable the cheapest ONU laser technology in each generation
 - Originally 1310nm lasers were cheap and easy to make
- Reuse existing technology from point-to-point ecosystems that have been mass produced

Going Forward – Keep It Simple:

- Point-to-multipoint ODN leverages TDM / TDMA media access control, transmission convergence
- Generally, the next PON generation just increases the speed

Suited for residential but increasing scope:

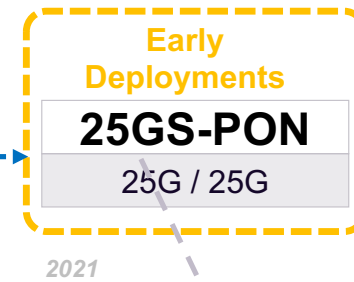
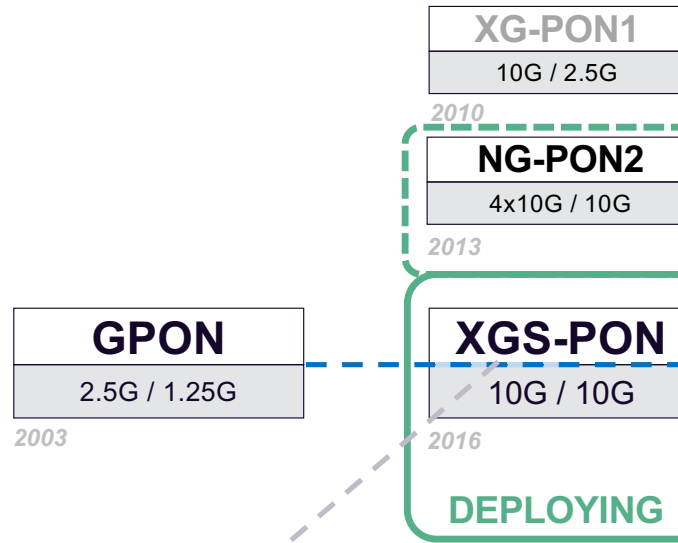
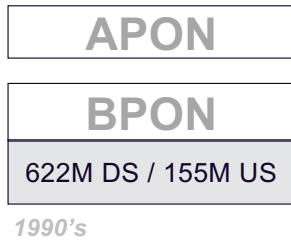
- Optimal for high density, low cost Ethernet service delivery
- To be clear – it’s not the answer for everything



PON Standards and Generations – Previous and Current

History — 1G Gen — 10G Gen — 25G

1987 BT Proposal



XGS PON

X = 10 (as in Roman numeral)
 G = Gig
 S = Symmetrical

25GS PON

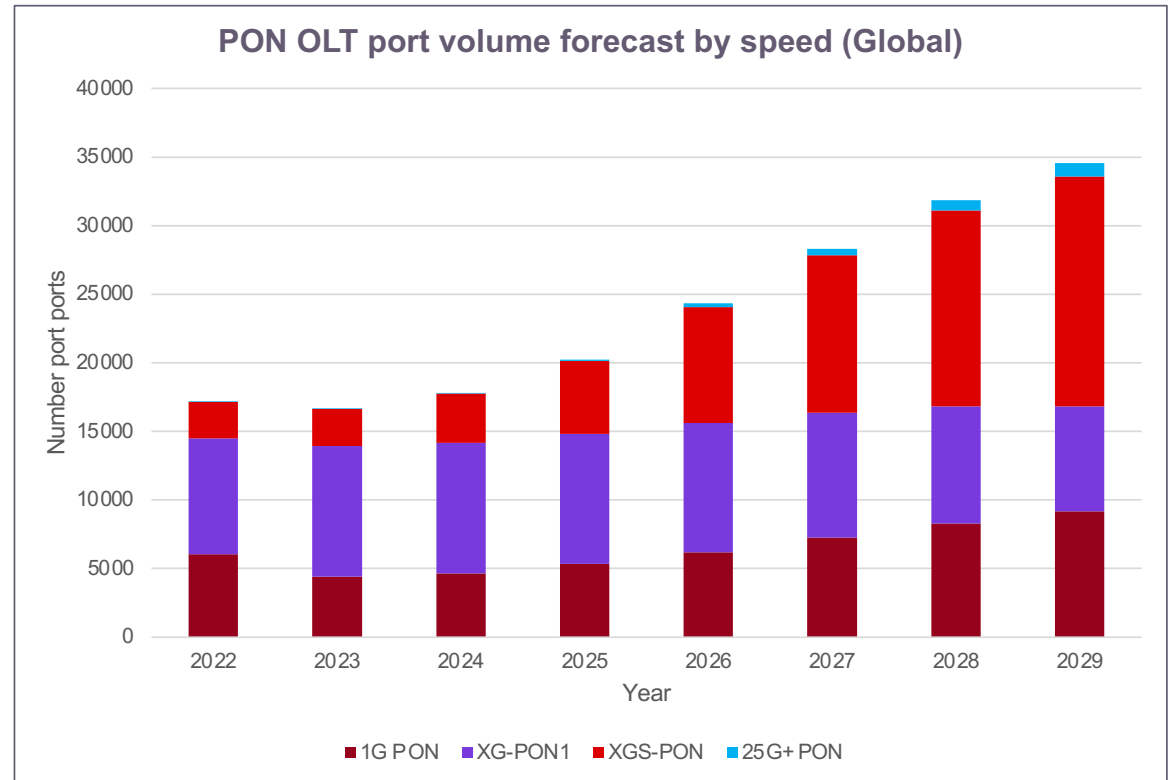
25 = 25
 G = Gig
 S = Symmetrical

EPON (not discussed here but also deployed)



PON adoption globally and speeds

- GPON continued to be deployed in cost-sensitive geographies (eg India)
- Large XG-PON1 (10G/1G) deployments in Asia flattening and moving to XGS-PON
- Growth in XGS-PON
- Early deployments of 25G PON
- Note – Australia and NZ are very different!

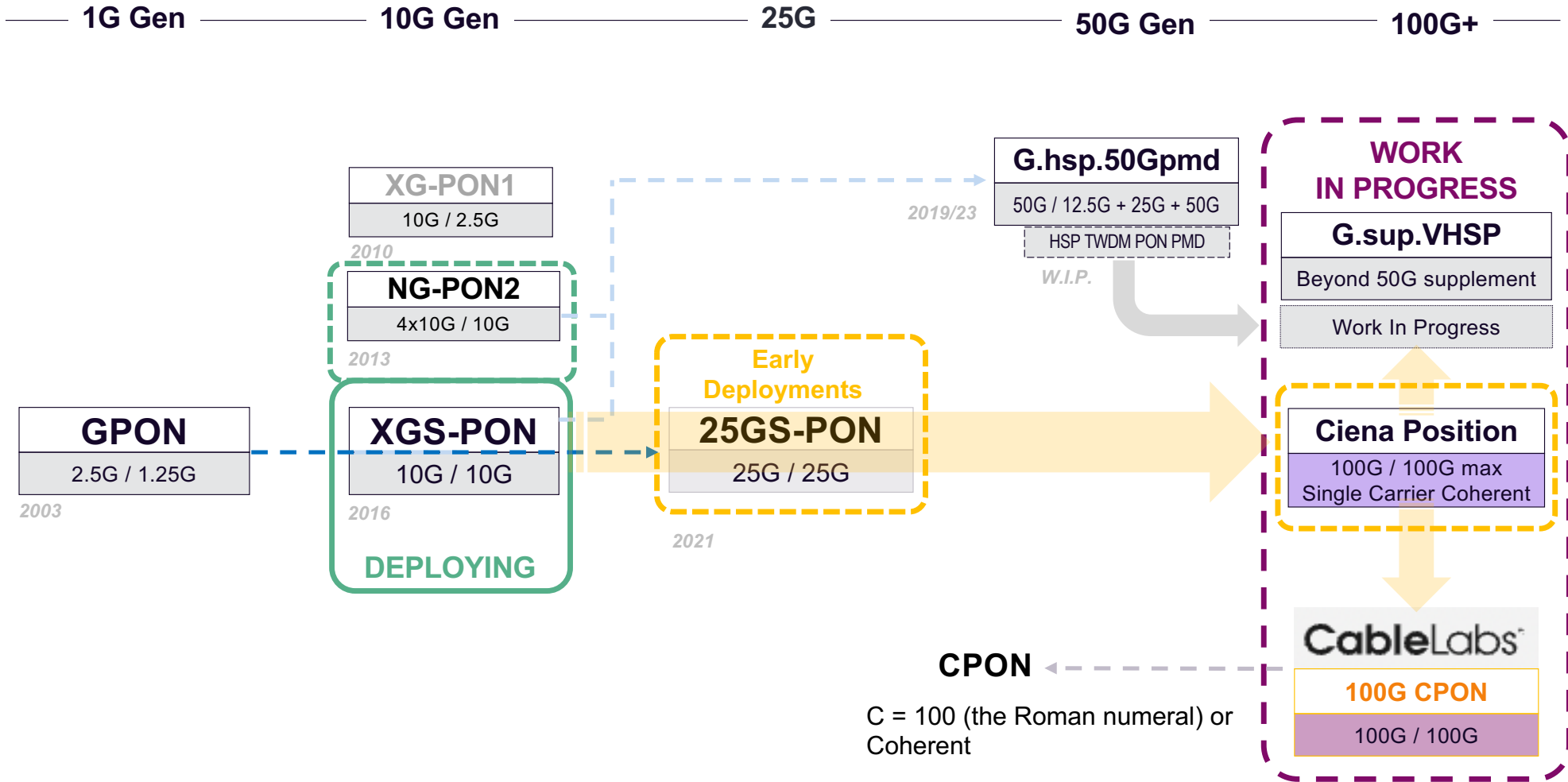


Omdia: Fiber and Copper Access Equipment Forecast: 2024–29 March 2024





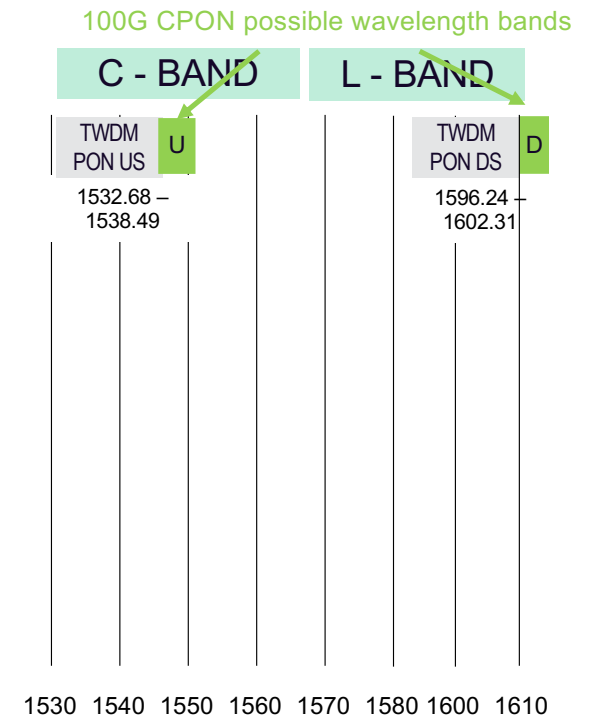
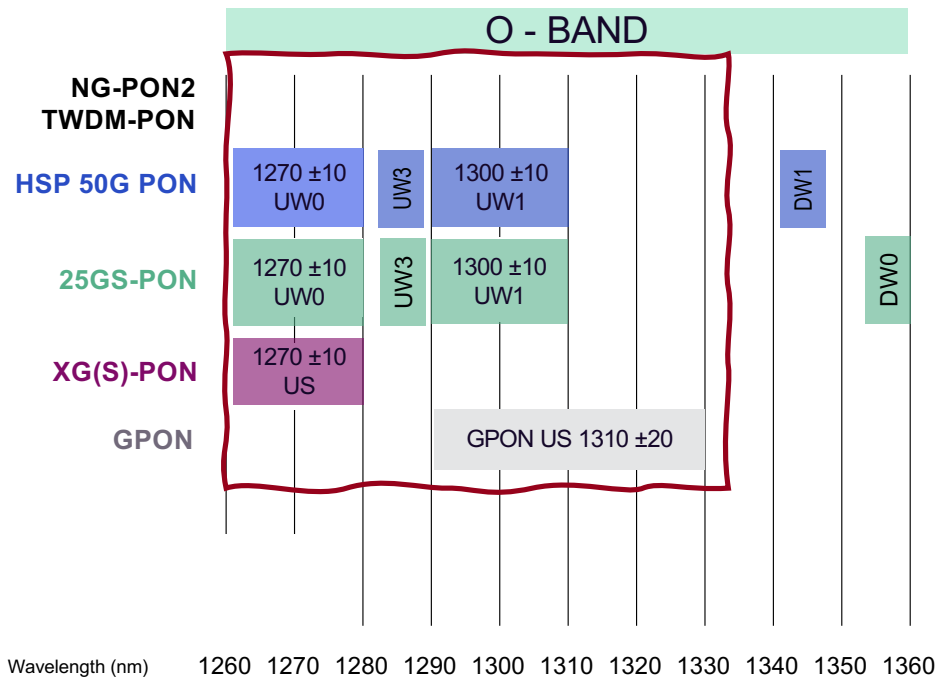
PON Standards and Generations – What next?





Beyond 25G PON – Challenges

- Remember – “Originally 1310nm lasers were cheap and easy to make” – this is why ONU is in O-band for upstream
- ITU-T HSP supports triple generation coexistence: GPON, XGS-PON, HSP 50G PON
- Less “real estate” for future generations



- C and L Bands are rarely used in the access



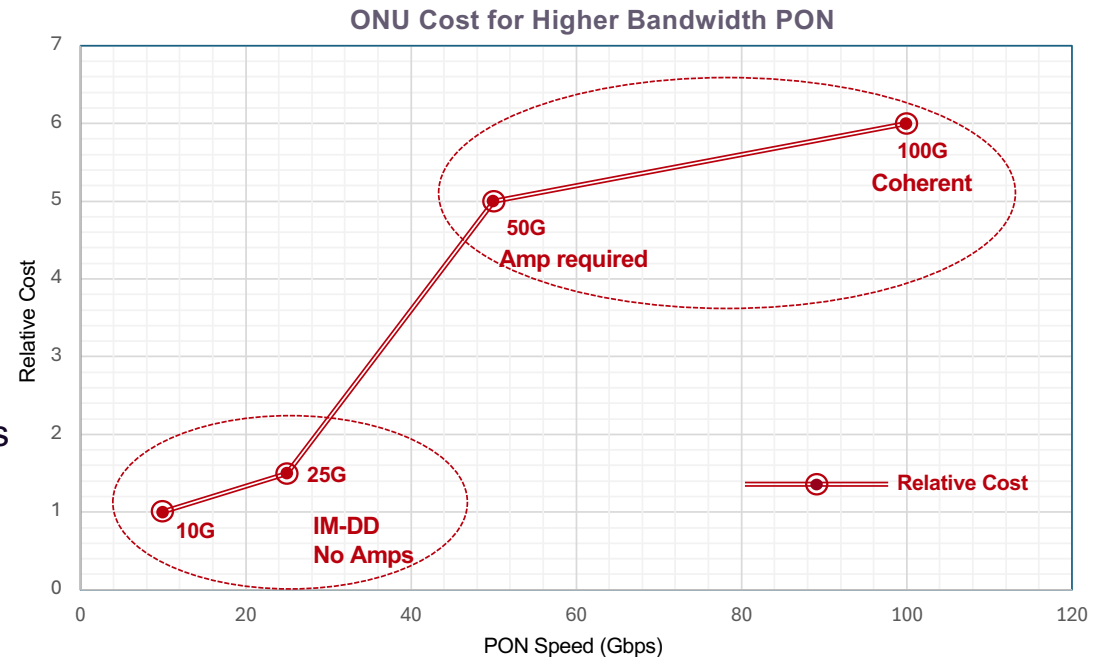
100G CPON – the case for Coherent

Current generations use **IM-DD**:

- Intensity Modulation / Direct Detection
- “1s and 0s”
- Similar to “grey optics”

Higher speeds susceptible to linear impairments:

- Solve with more expensive lasers and amplifiers
- Adds cost – SOA, DSPs, higher speed backplanes



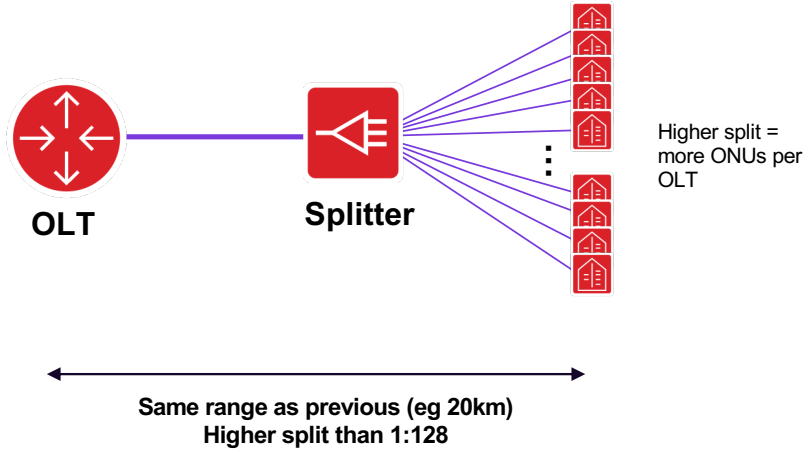
100G Symmetric (Ciena view)

- IM-DD can't meet loss budget – eg 100G QSFP28
- 100G coherent provides balance of cost and performance
- Use C-band – no crowding, especially in access
- Focus on re-use of existing ODN
- Super-rating to 115Gbps – allows true 100G
- Single Carrier Coherent can be cost/power effective at 100G

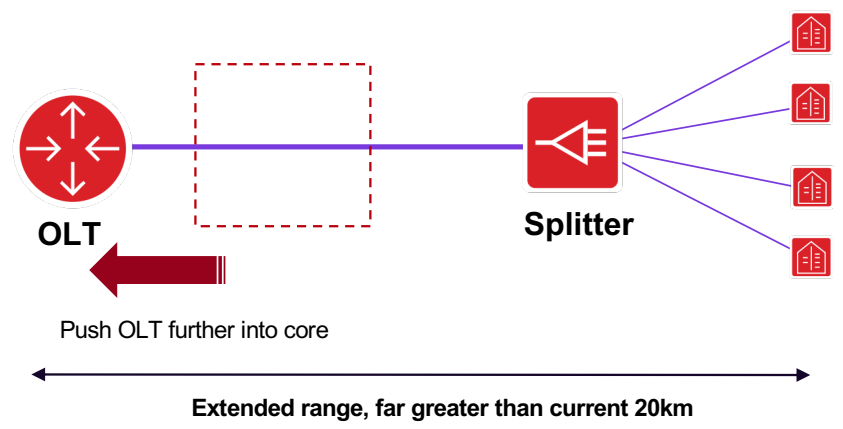


Additional case for Coherent – superior performance

Application 1: Higher split ratio in same ODN



Application 2: Extended reach



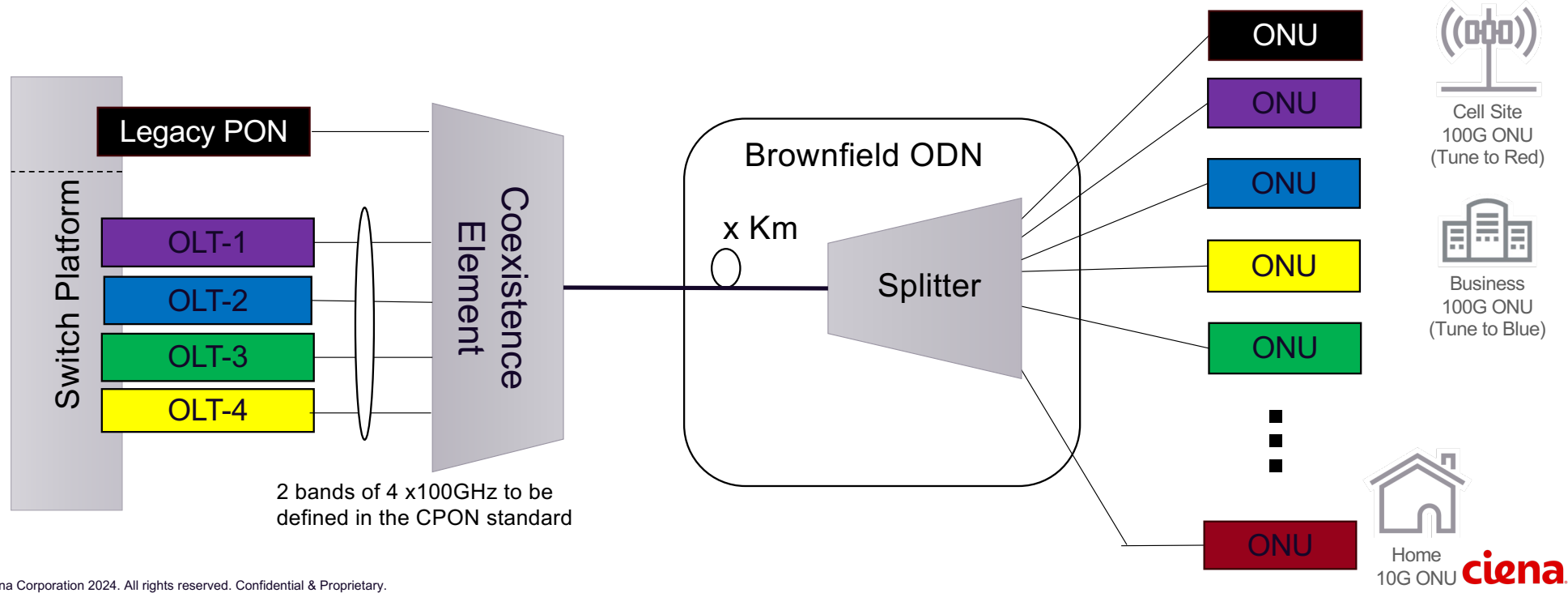
Increased performance of CPON provides flexible deployment options



Additional case for Coherent – 4 x 100G for “almost free”

Leverage NG-PON2 / TDWM-PON single-carrier channel-pair architecture

- Any OLT and ONU can tune to any one of the 4 CPON wavelengths with coherent detection
 - No extra \$, 100G symmetric per channel-pair, up to 4 channel-pairs with same OLT and ONU SKUs
- With 4x100Gbps on a PON fibre network, it is possible to share the fibre between Wireless backhaul, Enterprise, Residential, etc.



Summary



When do we expect 100G CPON products?

- After 25GS-PON mass deployment

Even in Australia, expect adoption of higher speeds in the future:

- Higher speed PON will be key
- Impact on BNG dimensioning
- Impact on nbn POI backhaul

Coherent/100G PON isn't a panacea – increasing use cases with XGS-PON and 25GS-PON today!

Thank You



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Keep PON Pluggable*

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