Migrating your network to 10G, 25G, 50G and 100G

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FN Business Development

Get to Fast Faster 2025

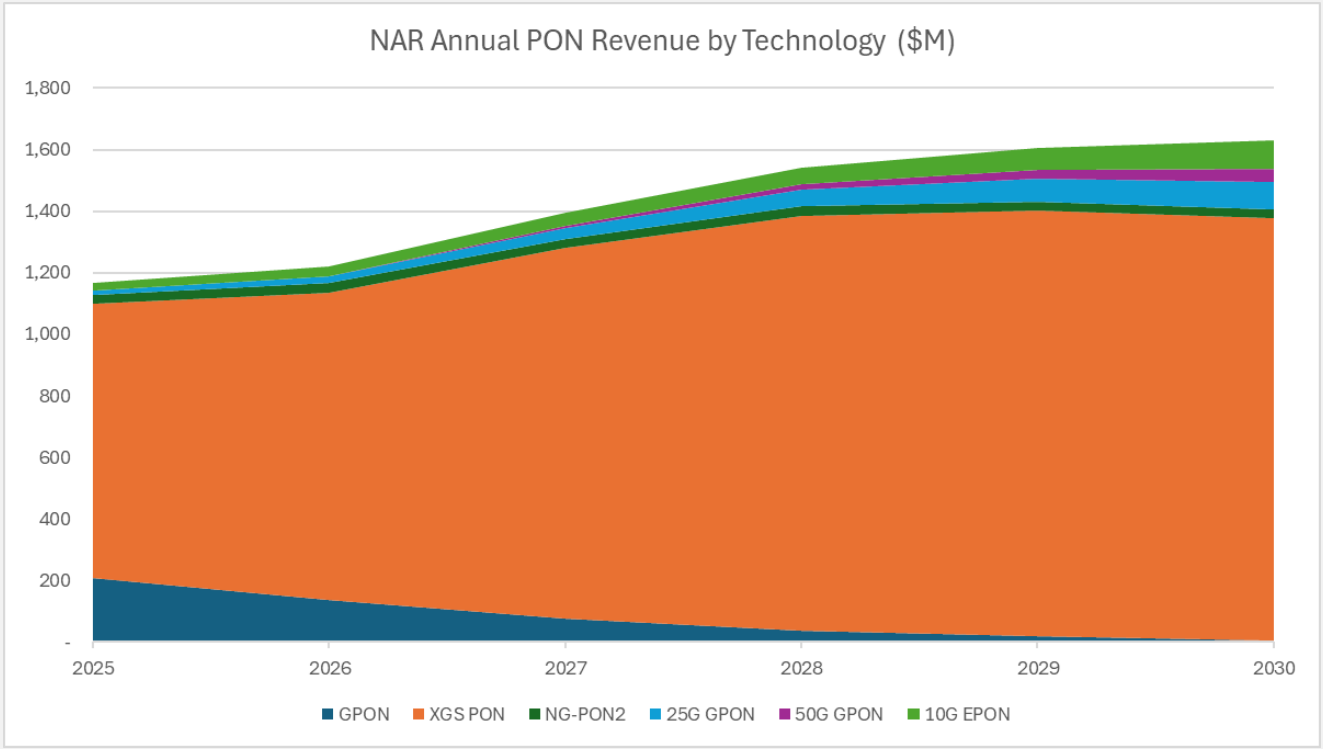
Agenda

1. Where we are we in PON Broadband Access
2. Bandwidth considerations
3. Let's talk coexistence
4. Enhancing the multi-gig ONT portfolio
5. PON evolution considerations and realities
6. Bell Labs – What is on the horizon

Broadband trends

- XGS has become the mainstream technology
- GPON shipments are fading
- Bandwidth offerings are rising – high end residential as well as business
- Bandwidth consumption is continually rising (~700GB per month average), Power users consuming 50x data volume 35TB
- Multi-gig has taken hold, new business applications and business models are emerging
  - US was 35% subscriptions 1G or higher in 2024
  - World-wide expected to be >50% for 1G and higher by 2029
  - Traffic is becoming more “peaky”
- FWA continues to take share from traditional lower bandwidth wireline offerings
- MSOs continue to do coax deployments as well as PON deployments (10G EPON and XGS)
- DOCSIS evolution will offer Multi-gig capabilities similar to XGS via DOCSIS FD or Extended spectrum options
- 25G technology is maturing and portfolio is expanding
- 50G PON is coming to market very slowly, availability of 50G symmetrical is gated by component realities
- AI is changing how we do things in broadband networks

Technology Mix for the coming 5 years

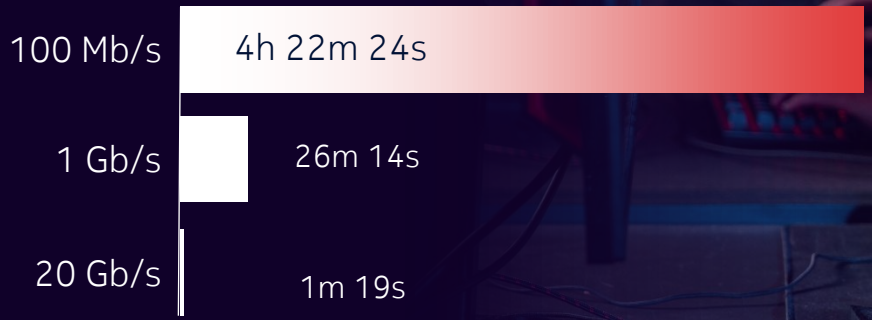


Source: OMDIA, 2025 to 2030 Forecast, April 2025

I feel the need..
the need for peak

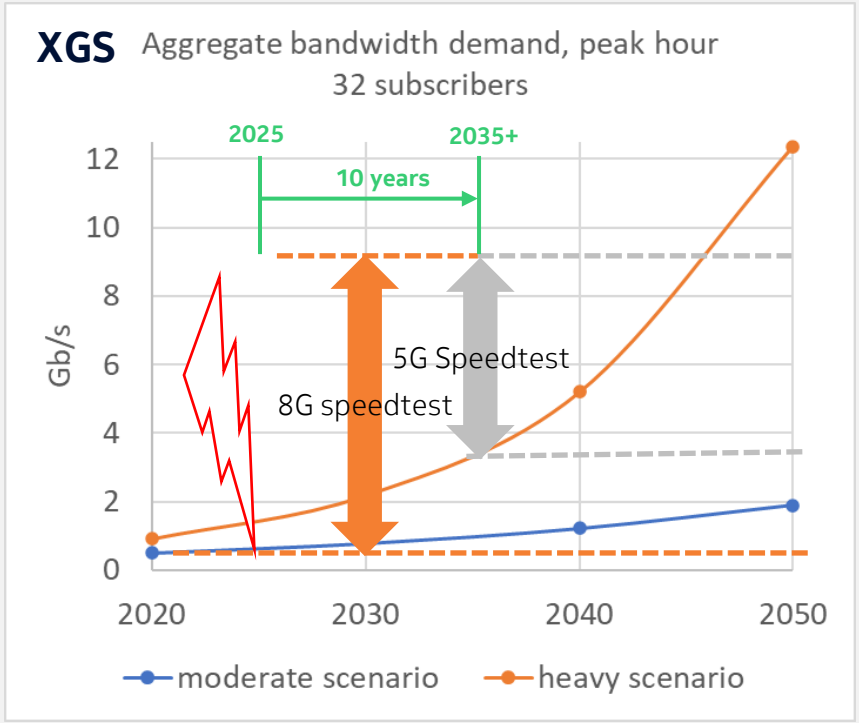
Your customer should never feel they have to wait

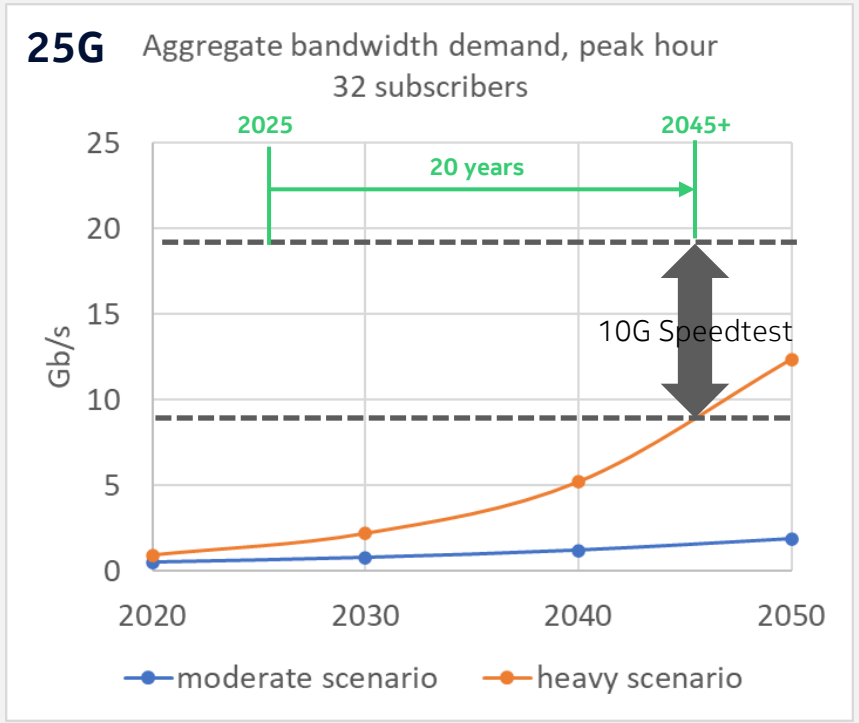
Asset download times:



Grand Turismo 7
Size on SSD: **196.8 GB**

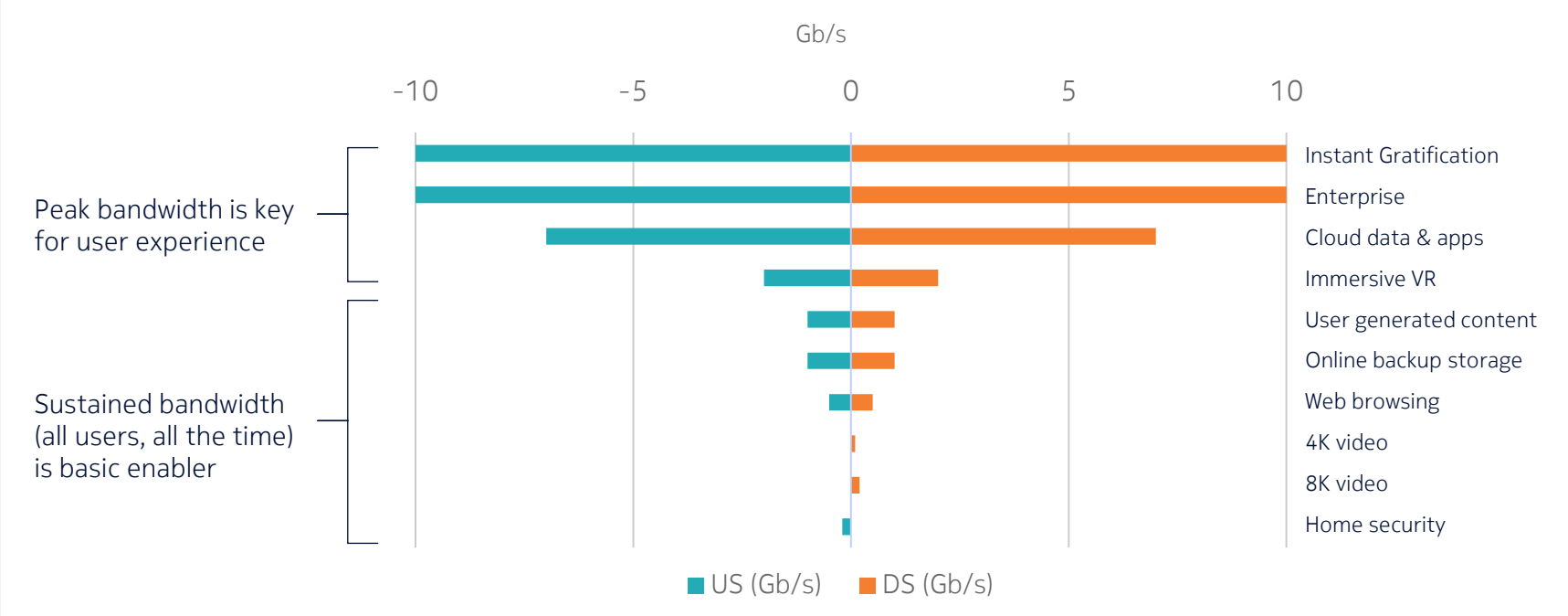
High Multi-Gig on 25G extends the life of network investment





Source: Nokia BW model based on methodology of IEEE Paper 2014, continuously updated, data >2030 extrapolated at same growth rate

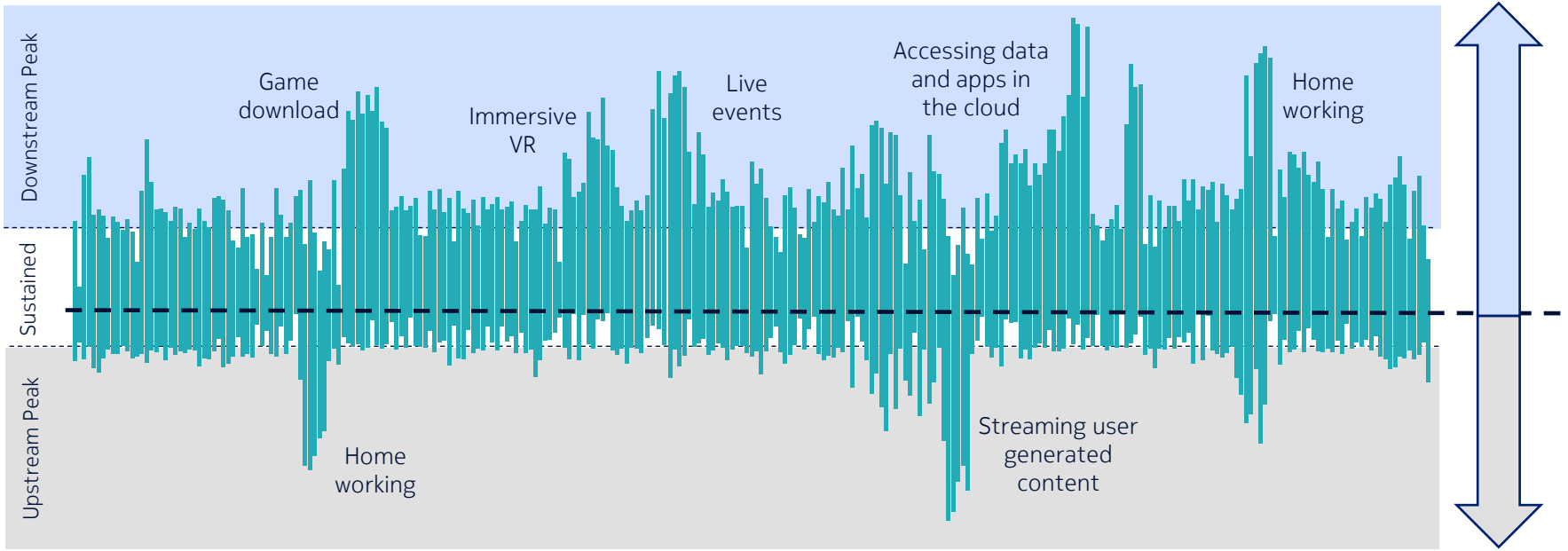
The shift from sustainable bandwidth to peak-ready networks



It does not matter if a packet is dropped due to BER or congestion – it impacts TCP/IP performance

The dynamics are changing: from sustainable to peak bandwidth

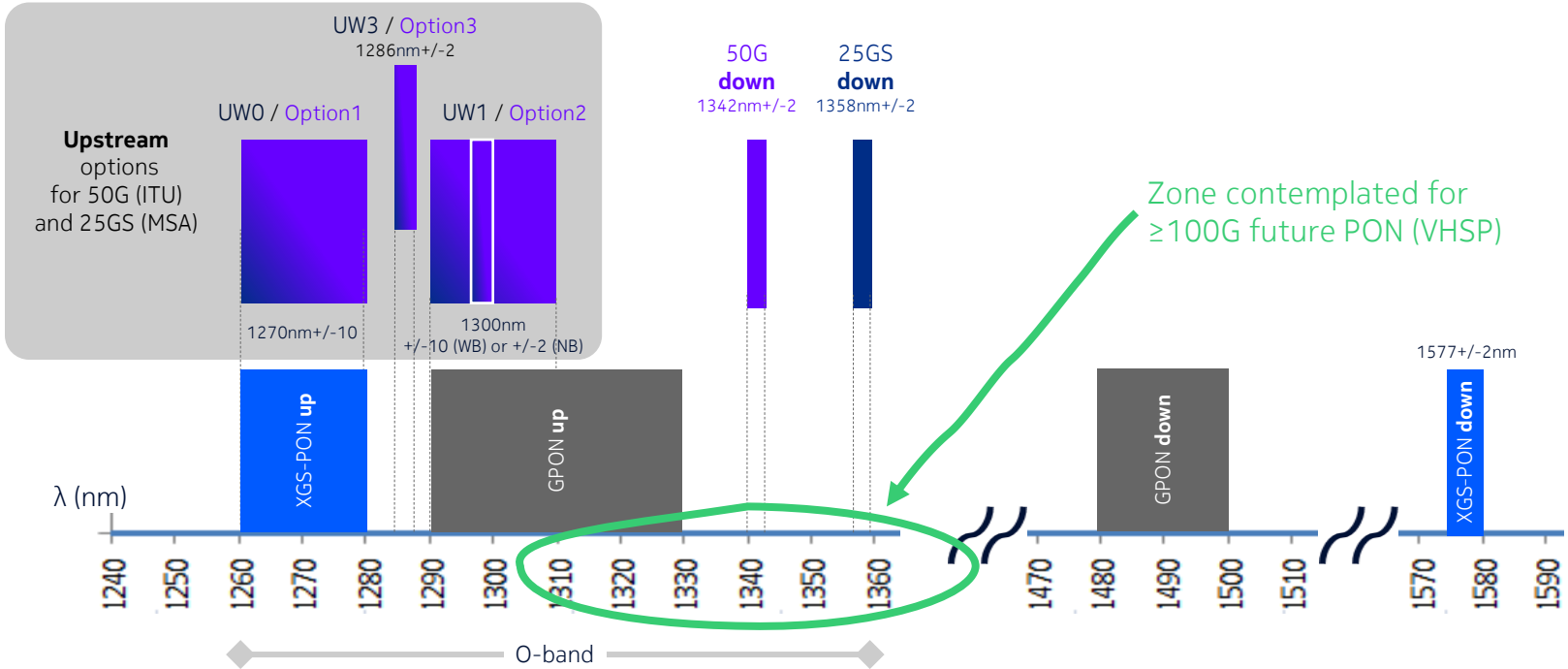
The peaks will enter the head room, reserved for speed test



XGS 25G 50G

Let's talk coexistence

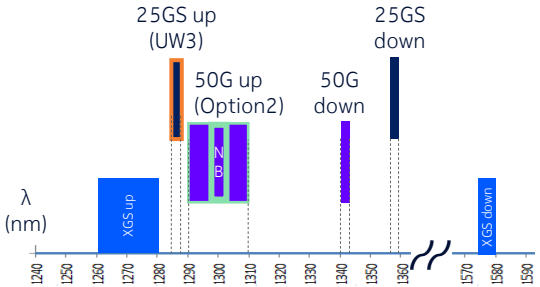
Refresh on PON spectrum: the O-band is quite busy…



1286nm = UW3/Option3
1300nm = UW1/Option2

The baseline Scenario – GPON deployed, upgraded to MPM

25GS-PON deployed, UW3-based, in overlay of GPON and XGS-PON

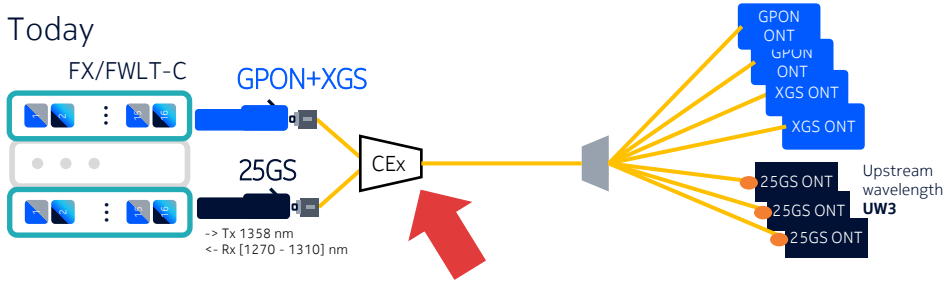


25GS ONT — can be Y-010Y-B, U-010Y-A (with UW3 pluggable optics) or Y-010X (with BoB UW3)

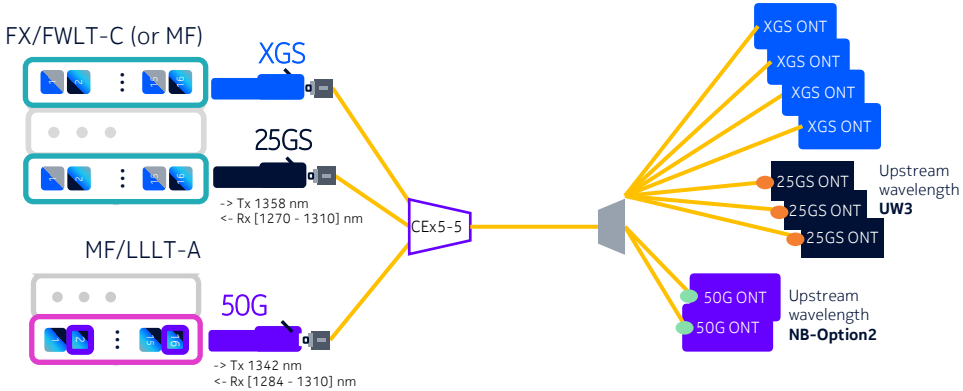
CEx — can be WDMM-C or CEx5-1 initially, both available in Nokia portfolio => will need to be **replaced** by another cassette variant (CEx5-5, targeted early 2026) to allow co-existence of 50G PON based on NB-Option2.

50G ONT — first Nokia commercial 50G PON ONU (L-020L-A) will have a PON cage, so it is day-1 ready for a NB-Option2 pluggable 50G PON ONU optics [however, it must be clear that initial industry focus for 50G PON ONU optics will be on *Option3*]

Today

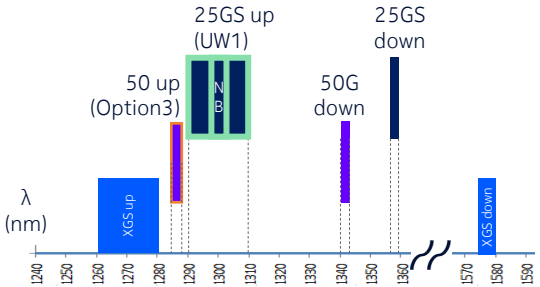


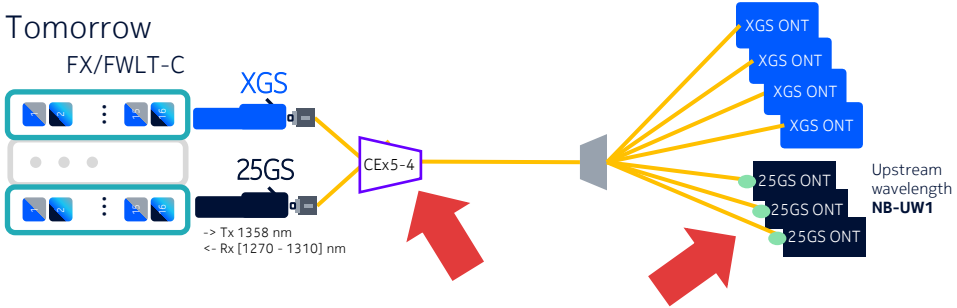
Future – when GPON is removed

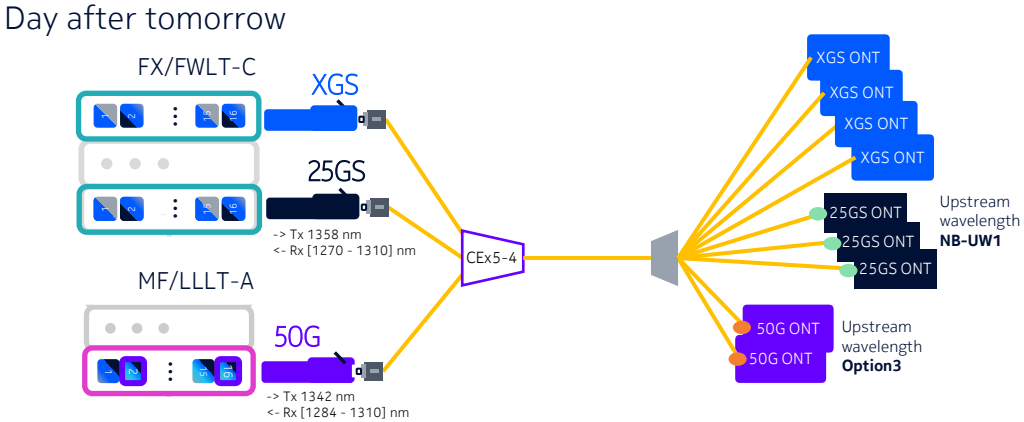


1286nm = UW3/Option3
1300nm = UW1/Option2

If there is no GPON deployed







25GS ONT — can be Y-010Y-B or U-010Y-A (replace UW3 by a NB-UW1 optics) or Y-010X (with BoB NB-UW1 - Q1/26)

CEx5-4 — CEx5-4 (end-2025) to be future-safe for 50G PON Option3

50G ONT — Nokia commercial 50G PON ONU (L-020L-A) will have a PON cage, and initial 50G PON ONU optics will be Option3

PoR for new PON Optics

Timeline	Techno (or combination of)	Power class	Comment
Q4/25	1PM - 50G asymmetric OLT (25Gbps up) and 50G asymmetric ONU with Option3	N1/29dB & N2/31dB	Qualified on MF-2 by end Q4/25, on MF-8 by end Q1/26
2026	3PM - 50G asymmetric + XGS + GPON 2PM - 25GS + XGS 3PM - 25GS + XGS + GPON	B+/28dB & C+/32dB	Qualification targeted 2H26 (detailed planning TBC)
2027- 2028	1PM - 50G symmetric OLT, upstream b-spec and 50G symmetric Option3 ONU, upstream b-spec 3PM - 50G symmetric + XGS + GPON, upstream b-spec 1PM - 50G symmetric, upstream b-spec 3PM - 50G symmetric + XGS + GPON, upstream b-spec	N1b/29dB B+b/28dB N2b/31dB C+b/32d	Dependency on critical 50G/50G components, working closely with optical chip suppliers

10G-25G-50G PON Coexistent Element

Nokia Lightspan CEx5-4 and CEx5-5

- Better option for operators that do not have GPON deployed
- Coexistence of XGS-PON, 25G and 50G PON on the same fiber
- Protects investment and opens the path to higher speed PON
- Passive element device
- Small form factor, high density 16 port
- Low insertion loss
- CEx5-4: XGS, 25G UW1, 50G Option 3
- CEX5-5 (1Q2026): XGS, 25G UW3, 50G Option 2

Nokia Lightspan CEx5-4, CEx5-5

Enhancing the multi-gig ONT portfolio

U-880XP-P

XS-010X-D

XS-2437X-B

25GS-PON SoC-based ONU portfolio, units are shipping

U-010Y-A
Business and Residential

- Media-converter
- Pluggable PON uplink port
  Note: variants with UW1/UW3 BoB targeted for 2026 (Y-010Y-D)
- Pluggable, single UNI port, choice b/w optical (10GEl25GE) or electrical (10GE) client interface
- IEEE1588v2/ToD support (Distributed T-BC) and SyncE on UNI
- I-temp design, passively cooled

up to 20Gbps L2 throughput at end-user side

Y-140Y-A
Residential, with voice support (but no gateway)

- UW3 optics integrated (BoB)
- 1x POTS RJ11 port
- 1x optical UNI cage : 25GEl10GE pluggable (SFP+/28)
- 3x RJ45 UNI ports : 100M/1G/2.5G/5G/10G Eth auto neg
- I-temp design, passively cooled

up to 20Gbps L2 throughput at end-user side

Y-010X-A
Residential and small business

- Media-converter, power-optimized (7~8W)
- UW3 optics integrated (BoB)
  Note: variants with UW1/UW3 BoB targeted for 2026 (Y-010Y-D)
- single RJ45 UNI port : 100M/1G/2.5G/5G/10G Eth auto neg
  - Height: 31.3 mm
  - Width: 135 mm
  - Depth: 155 mm
- passively cooled (-5°C to +45°C)

up to 10Gbps L2 throughput at end-user side

25GS-PON/XGS-PON MDU

U-00240XP-A - for Passive Optical LAN / Enterprise market

Preliminary rendering

Interfaces

- Uplink (SFP28/SFP+ cage):
  pluggable ONU optics,
  XGS-PON or 25GS-PON (UW3/UW1)

- User interfaces: 24 ports Ethernet LAN supporting
- 8 ports 10GE (10GBase-T), POE++ [60W]
- 16 ports 10M/100M/1GE/2.5GE (Base-T), POE+ [30W]

Characteristics

- Compliant with XGS G.9807.1 spec
- Compliant with 25GS-PON MSA spec v3
- OMCI/PLOAM remote management
- 32-TCONTs, 256 GEM port
- Dying-gasp
- Operating temp : 0°C to +55°C
- Reset Button
- 90~265V AC in integrated 935W PSU x1 (ID1)

Nokia 50G ONT for business services

- 50G PON Optical Network Unit
- For enterprises or mobile cell sites
- Pluggable 50G PON symm/asymm uplink interfaces
- Pluggable user interfaces:
  - 4 x 10 Gb/s or 2 x 25 Gb/s
  - Ready for 50Gb/s
- Dual powering AC/Battery or dual DC
- HW ready for fully redundant optical path (type-C)
- Synchronization: 1pps+ToD, IEEE1588v2 and syncE
- AES-256 encryption
- 19” rack mountable

Nokia 50G PON ONT L-020L-A

2026 ONT roadmap items in planning

XS-1427X-A

BE7200 (4+4)

XGS WAN

1x 10GE, 3x1GE LAN

1x POTS

- Shift to an XGS PON device as GPON deployments are declining
- MPM options available w/o needing to change the outside plant
- Higher speed tier support with entry level WiFi 7 device
- Continued voice port offering
- Targeted mesh IOP with Beacon 4

Target Release Mid 2026

Y-220X-A

25GS PON

2x10G

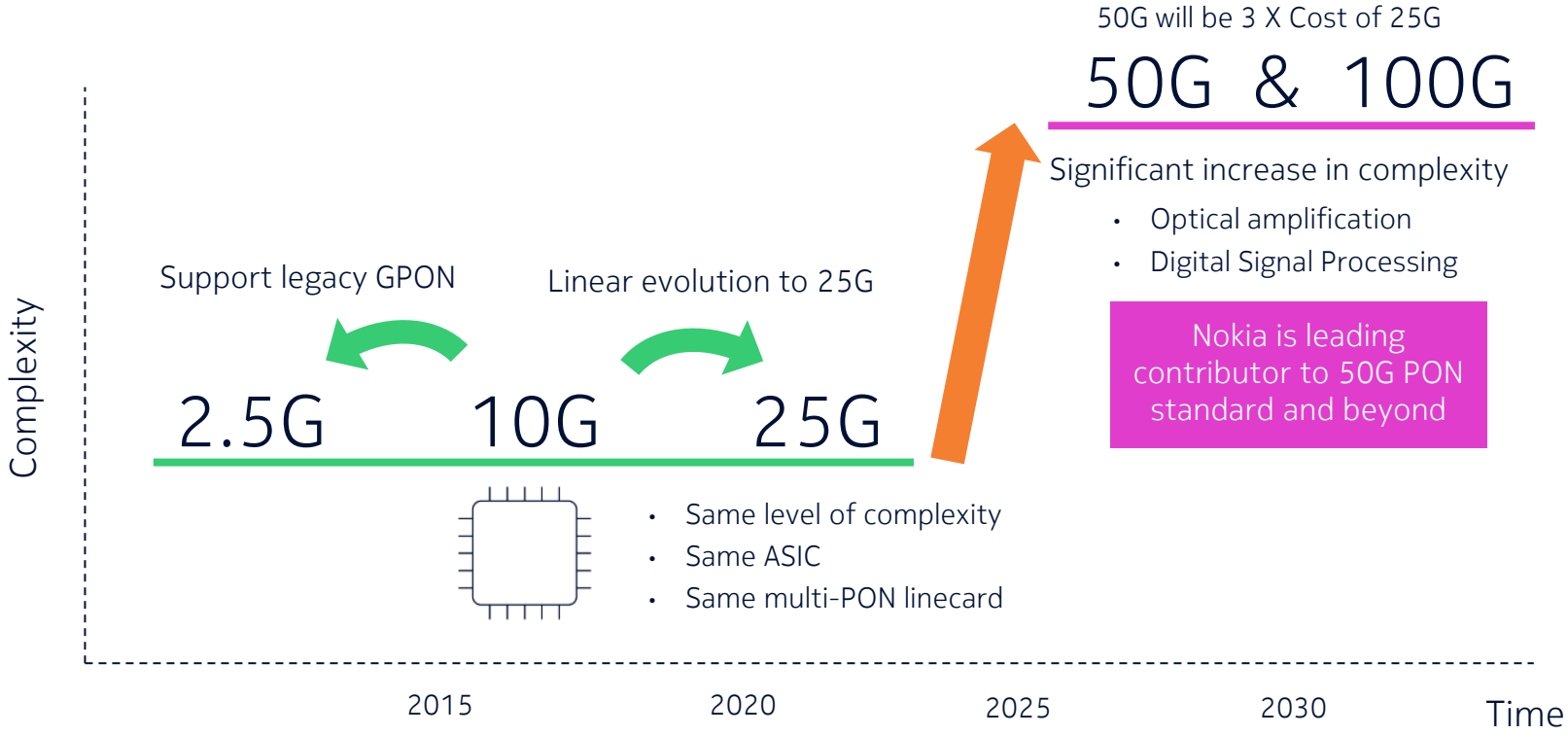
2x POTS

- Adding to 25G portfolio
- Taking advantage of emerging ecosystem of 25G/50G capable SOC offering
- Multiple Ethernet ports to enable 20G delivery capability in more cost-effective manner, or connect to secondary applications outside traditional home network
- Continued voice port offering

Target Release 2H 2026

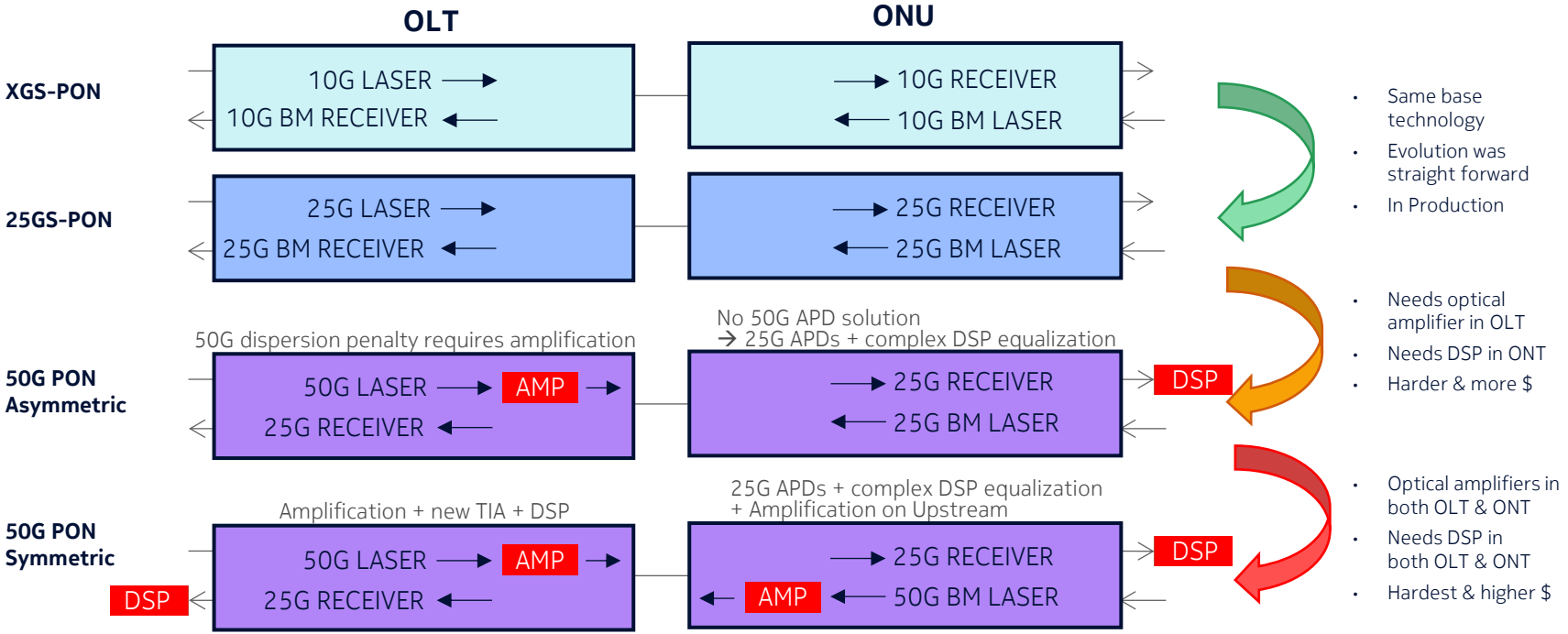
PON evolution considerations and realities

The 25G versus 50G dilemma – Nokia is embracing 50G, yet….



10G / 25GS / 50G PON

Evolution of optical transceiver architecture



Nokia believes in a more viable approach to 50G PON symmetrical

ITU-T defined **two** sub-specs for symmetrical 50G PON implementations

Option “a” (N1/C+ etc.)

Option “b” (N1**b**/C+**b** etc.)

- √ Providing same optical budget
- √ Same cost level
- √ Enabling same service

Major “sponsors” for the two options:

HUAWEI

ZTE NOKIA

Relaxed “min Tx power” at ONU, stretched “min Rx sens” at OLT

- More complex implementation (esp. on OLT side)
- Higher technology uncertainty
- Risk of vendor lock-in

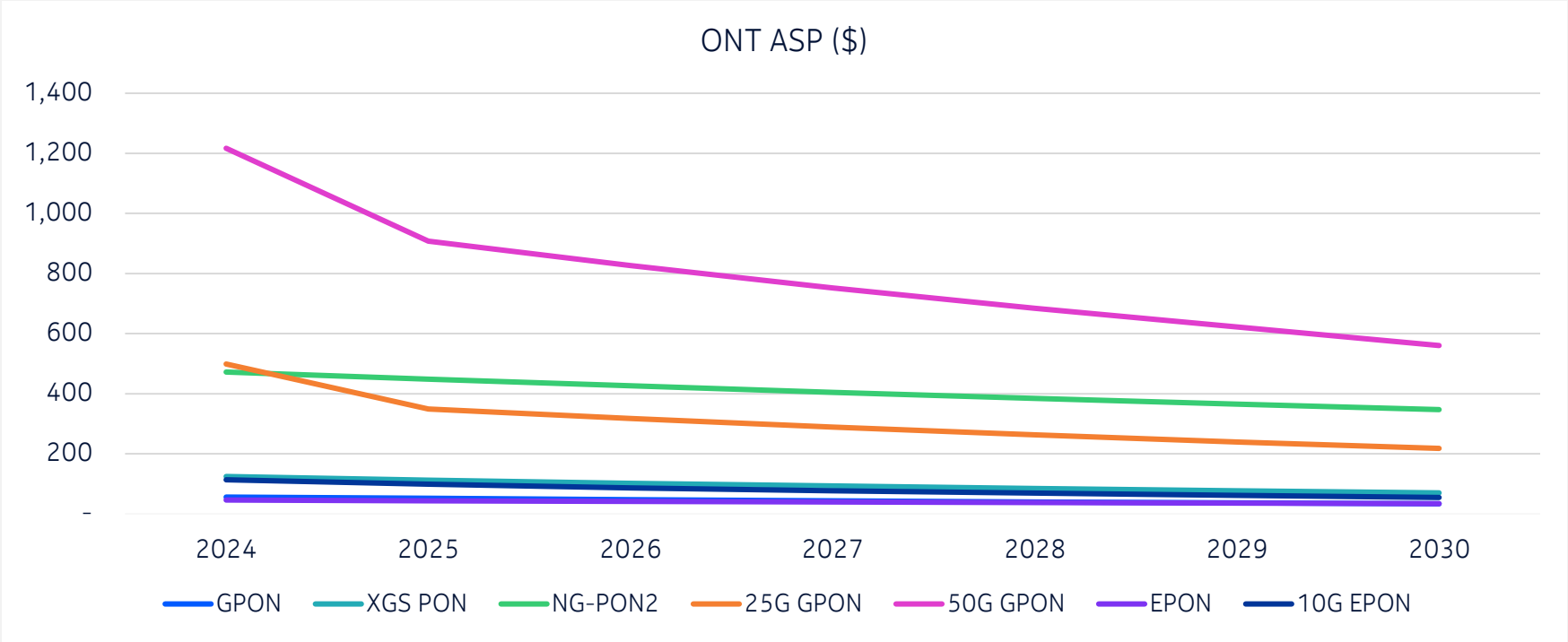
Stretched “min Tx power” at ONU, relaxed “min Rx sens” at OLT

- Simplifies OLT DSP requirements
- **Preferred by optical module vendors**
- **Expected to be supported by a richer eco-system**
- Expected lower total energy consumption (OLT+ONU)
- **Safer path towards higher optical classes**

+ Option-b ONUs can work with Option-a OLT

NOKIA

Analyst Data on ONT price by technology – 50G is very expensive

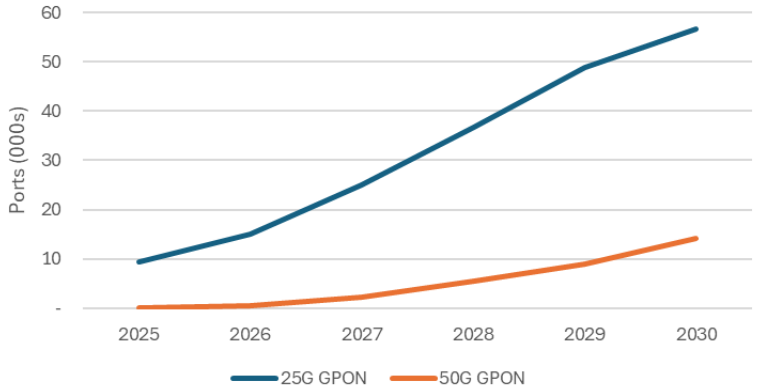


Source: Omdia 2025

25GPON and 50GPON Ecosystem: Analyst view

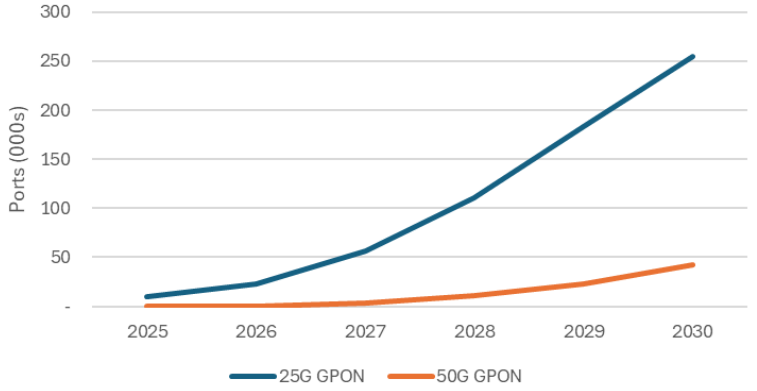
25GPON volumes projected to be 6/8 times larger than 50GPON for the next 5 years

OLT Port shipments North America Region



25GPON cumulative volumes in North America by 2030 will be 193K ports while 50GPON is expected to ship 31K ports

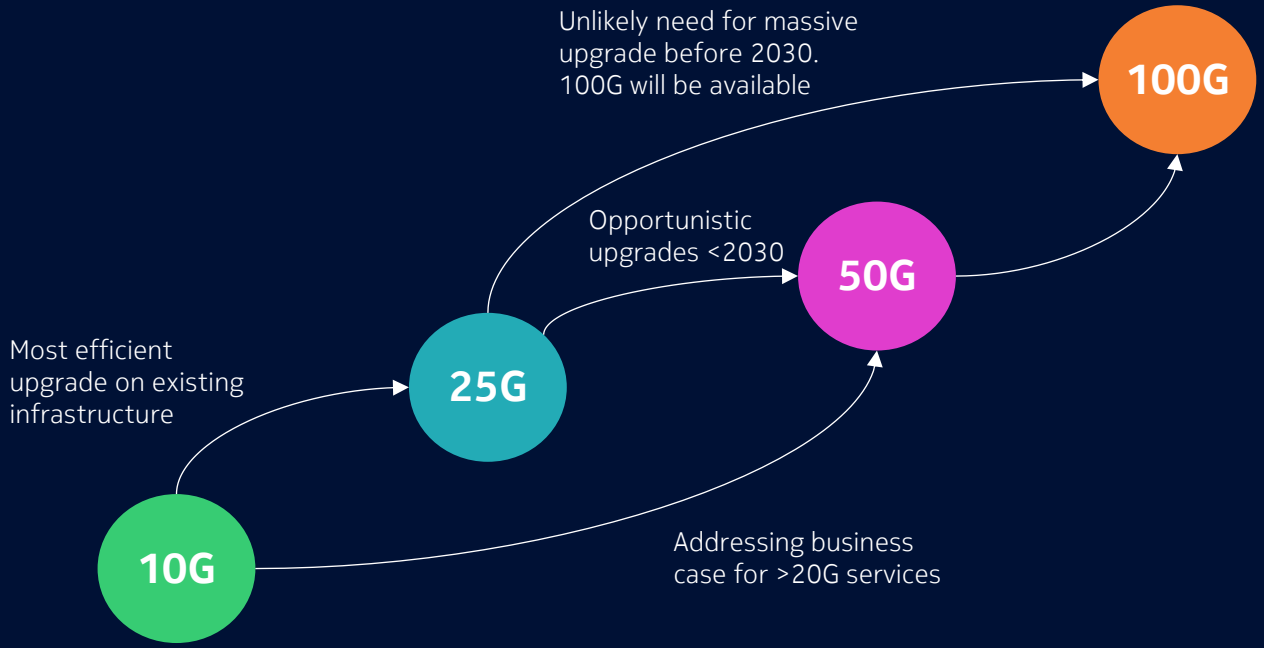
ONU Port shipments North America Region



25GPON ONU cumulative shipments will be 8x vs 50GPON ONU

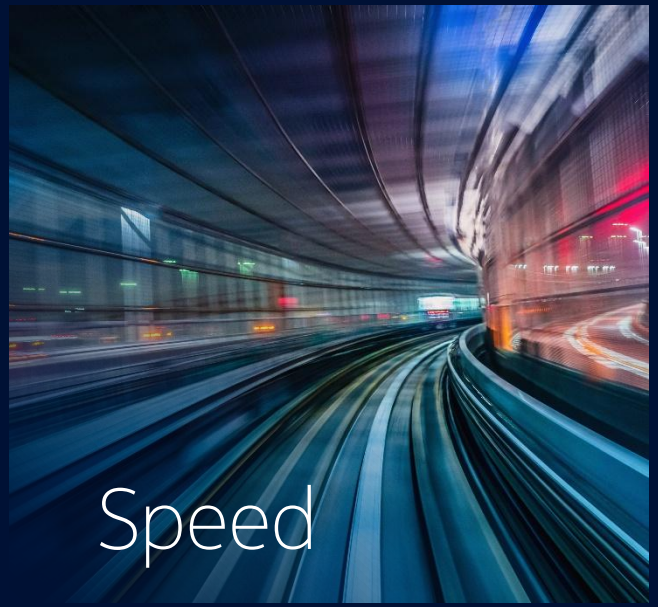
According to OMDIA the ASP of 50GPON in 2030 will be 2.6x 25GPON

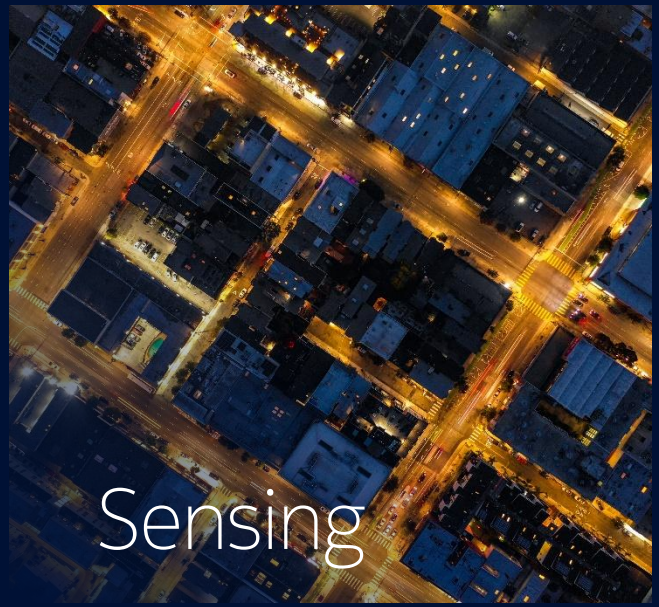
Nokia (and only Nokia) provides all options for diverse needs and upgrade paths



Bell Labs

What is on the horizon





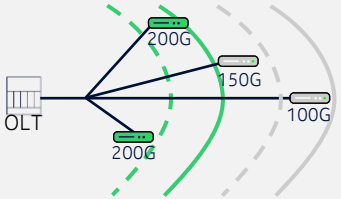
There is no clear limit for IM-DD PON

100G NRZ

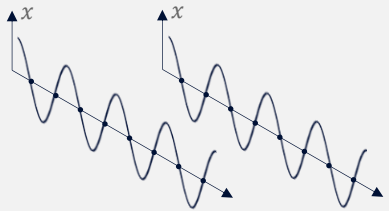
Demonstrated on live operator network

nbn and Nokia press release, 17 April 2024

Flex up to 200G



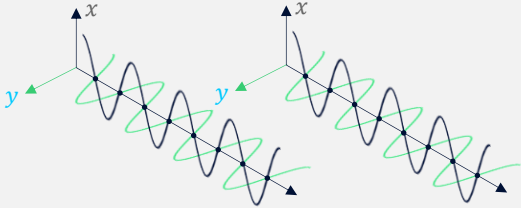
200G using two wavelengths



Demonstrated in Nokia lab

Flex up to 400G

400G using two wavelengths and two polarizations



Demonstrated in Nokia lab

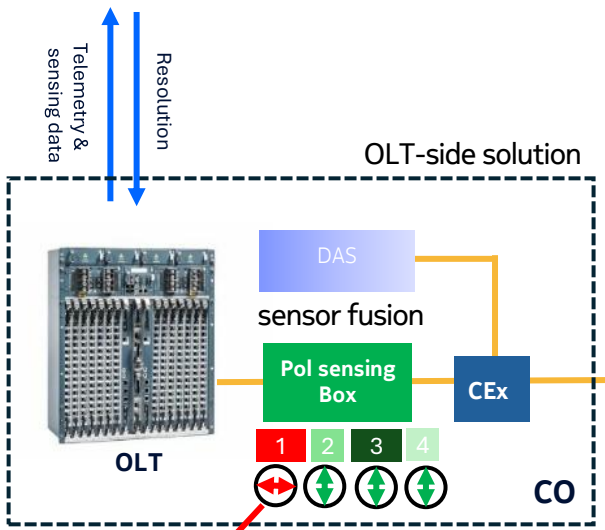
D. Van Veen et al., paper Th1E.1, OFC 2024
R. Borkowski et al., paper Th1E.5, OFC 2024

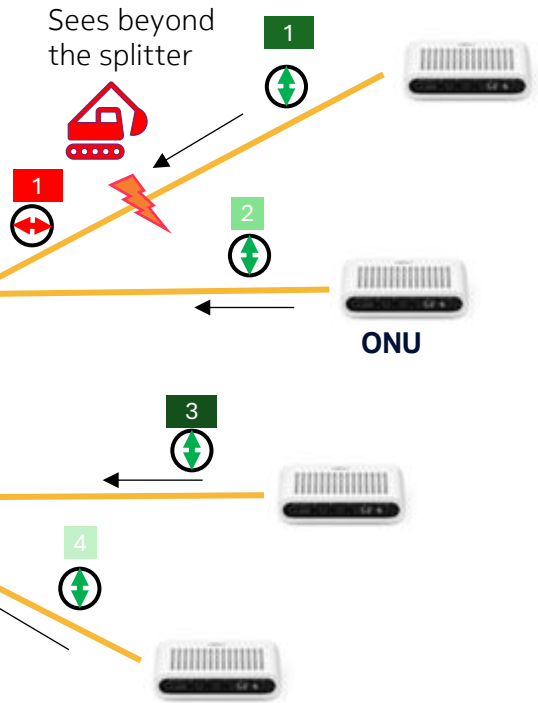
Flex up to 800G

Polarization sensing in PON

Monitoring the polarization changes of each ONU transmission

- Minimizes (cost of) external sensing devices
- Standalone for existing PONs. Might be integrated in future optical modules
- Always on
- Sensed ONU shall be scheduled and synchronized with BW maps





Enables sensing on existing PONs (GPON, XGS-PON, ...)


NOKIA