Joint ITU-T / IEEE Workshop on Next Generation Optical Access Systems

Requirements for Next Generation PON

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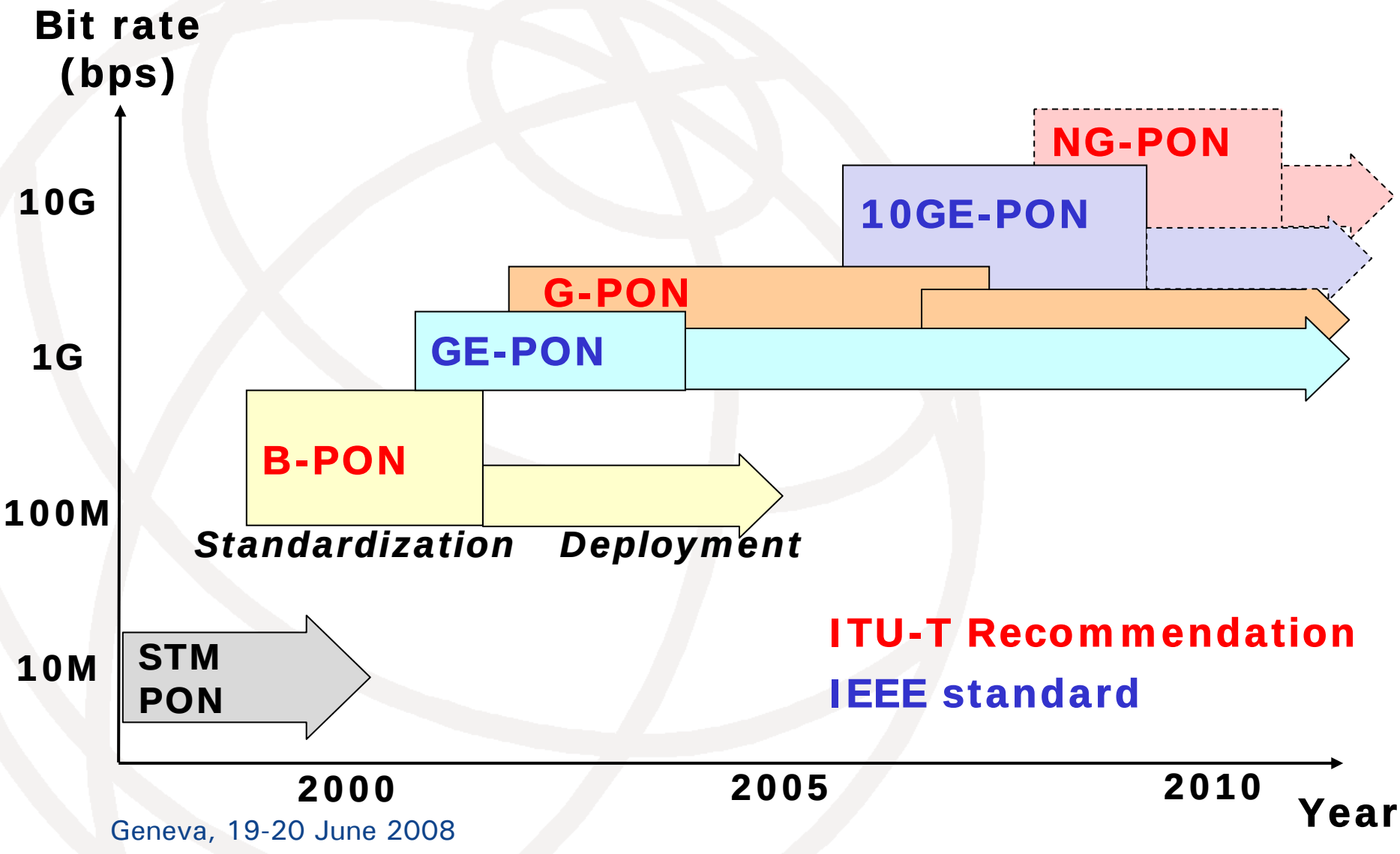
Outline

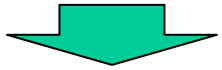
- Introduction
- Evolution scenario
  - NG-PON1 and NG-PON2
- Requirements for NG-PON1
  - Architecture/infrastructure
  - Power saving
  - Operational functions
- Perspective for NG-PON2
- Summary

PON evolution



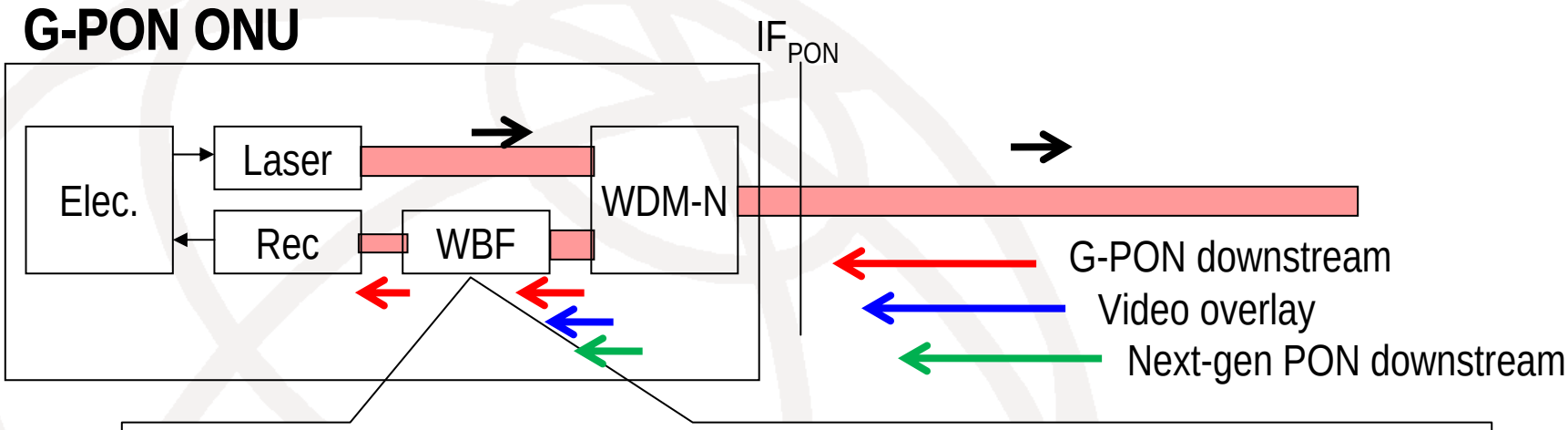
Current PON deployment

- Typically enabled services
  - High-speed Internet access (e.g. via Fast Ethernet)
  - TV services
    - RF video overlay or IP-TV: depends on the business case
  - Telephony
    - POTS emulation or VoIP: depends on the business case
- Preparedness for future upgrade
  - Reuse installed ODN as much as possible
  - Upgrade individual customers without loss of service to other customers
  - Minimize manual intervention in ODN

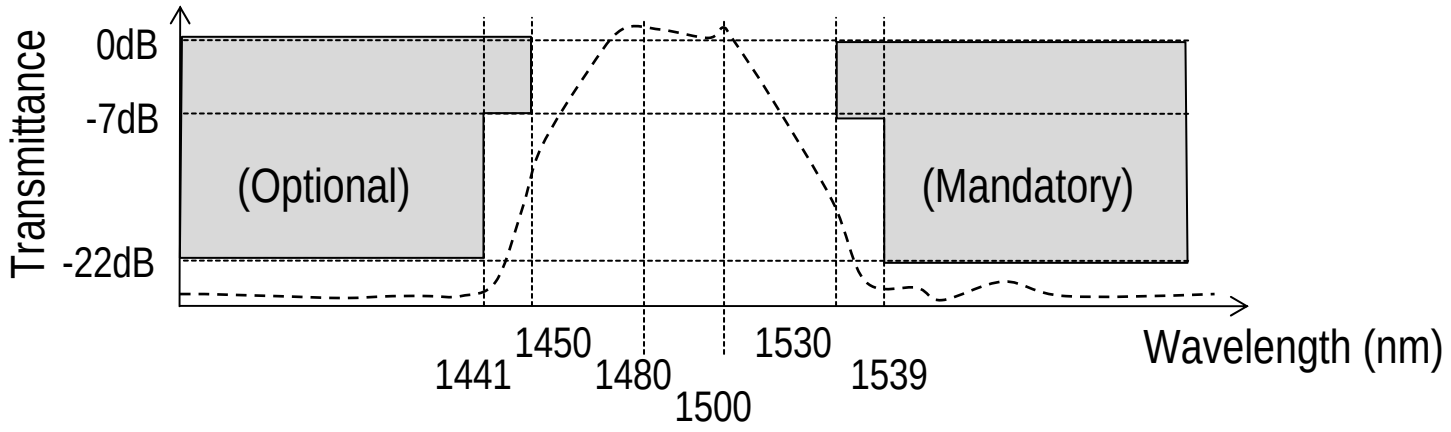


  - G.984.5 recommends to pre-install Wavelength Blocking Filter (WBF) in G-PON ONU.

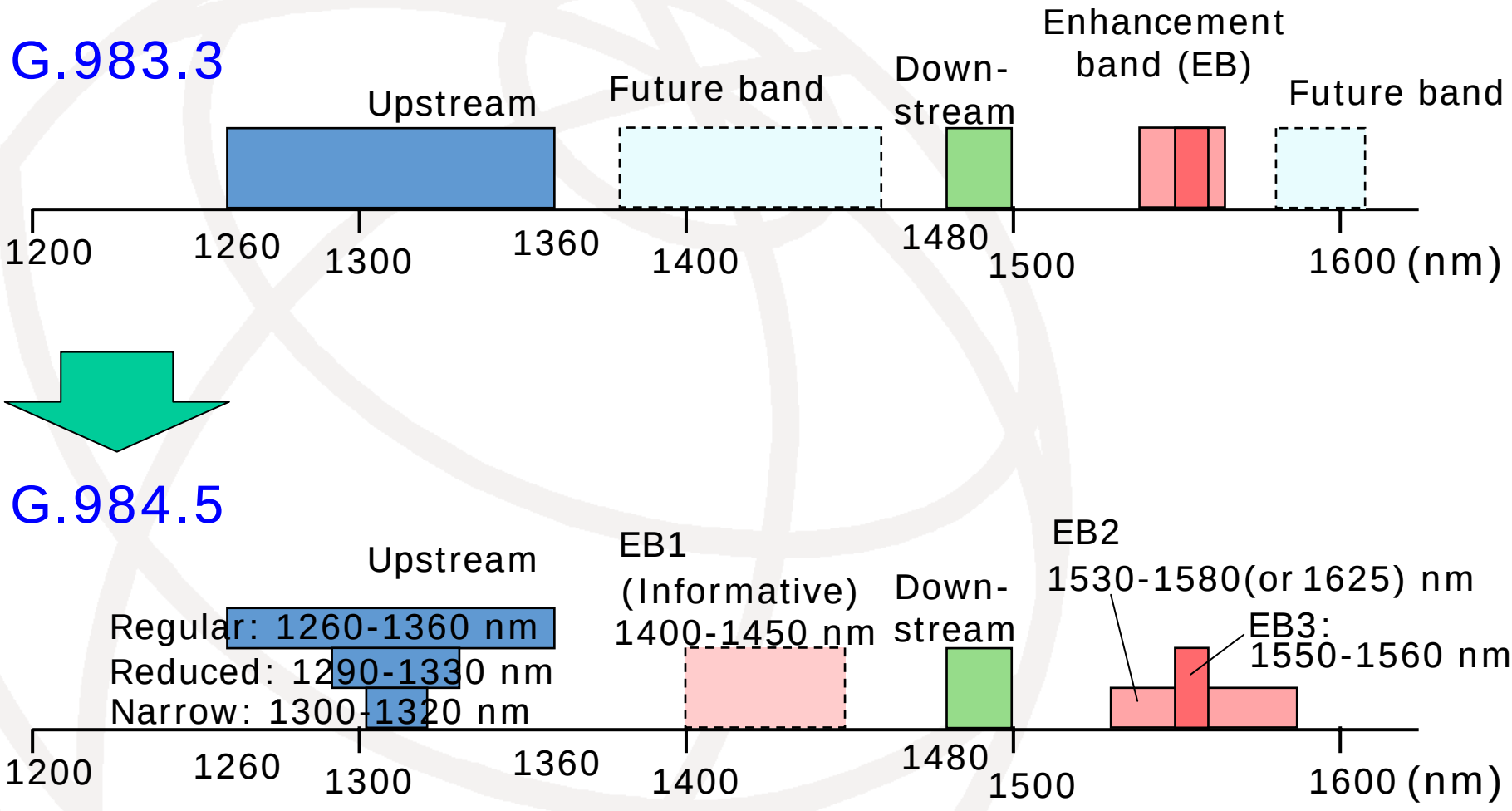
WBF in G.984.5



G.984.5 describes wavelength-blocking characteristics of G-PON ONU assuming to employ WBF



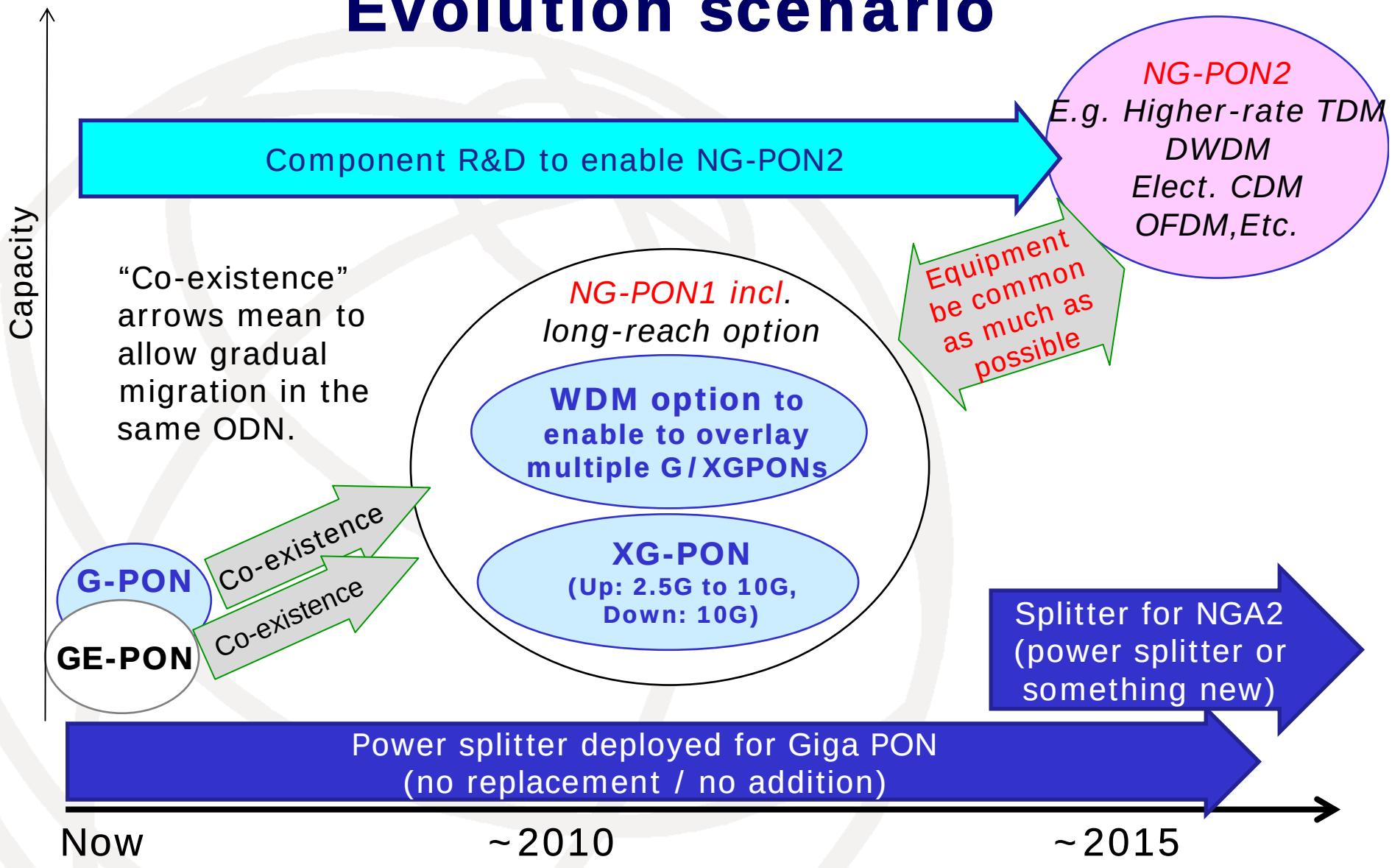
Wavelength bands in G.984.5



Expectations for NG-PON

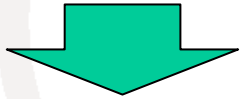
- Broader bandwidth for enabling new services
- Smooth migration from the present PONs
- Advanced functionalities for issues extracted from the massive PON deployment

Evolution scenario



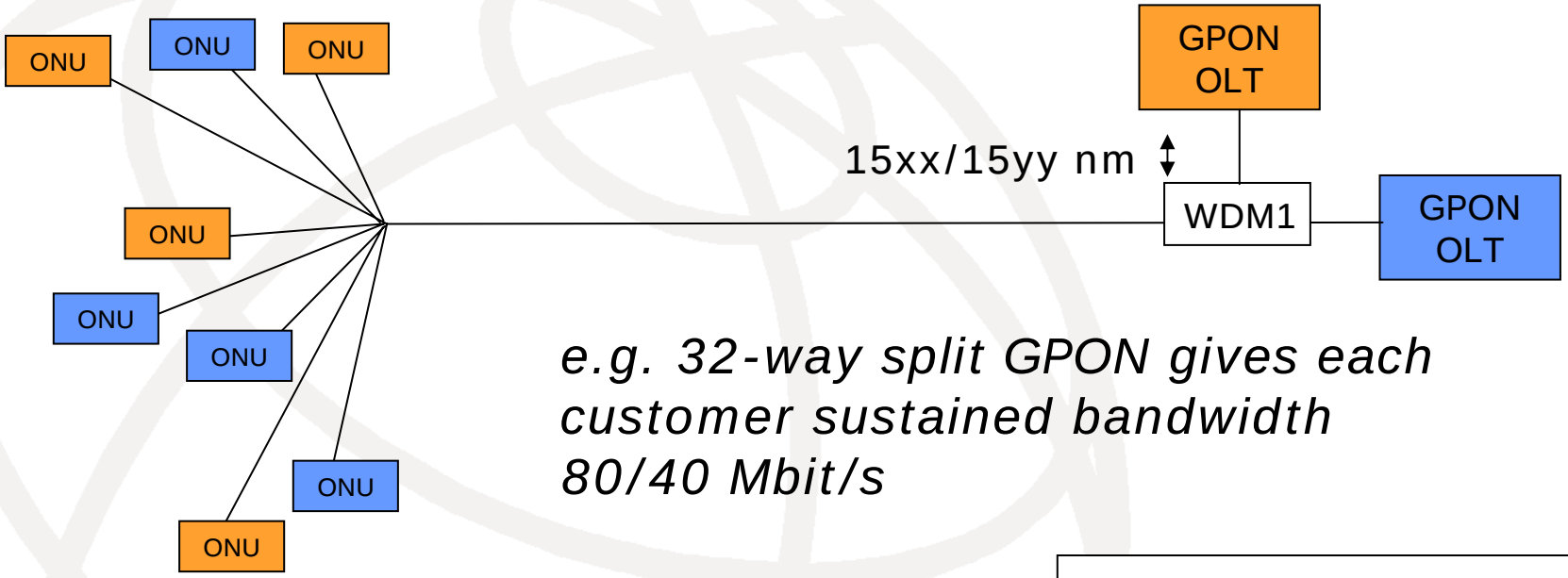
NG-PON1 options

- Capacity higher than G-PON
- Use foreseeable cost-effective technologies



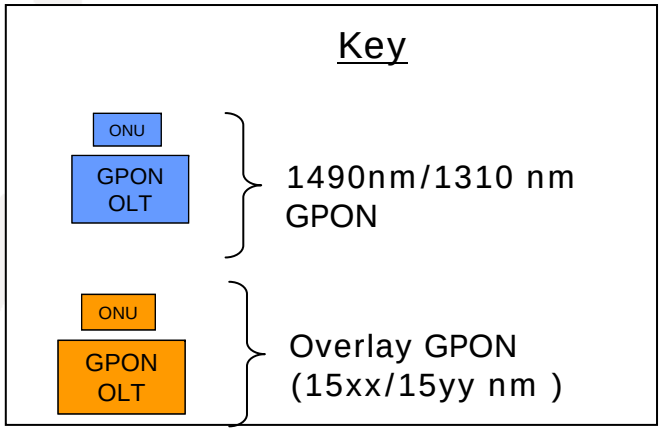
- XG-PON
  - Downstream 10G
  - Upstream 2.5 to 10G TBD
- Overlay G/XG-PON
  - Multiple G/XG-PON in one fiber via WDM
- Options for co-existence with G-PON
  - Full Enhancement-Band (EB) approach
  - Partial EB approach
  - Non-EB approach

Overlay G-PON with full EB approach



e.g. 32-way split GPON gives each customer sustained bandwidth 80/40 Mbit/s

e.g. upgrade 4 customers to overlay GPONs giving them 622/155 Mbit/s each



Examples of NG-PON1 services

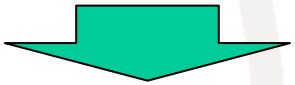
No.	Service	
1	Telephony	VoIP
2		POTS emulation
3		ISDN emulation
4	TV (real time)	IP-TV
		digital TV broadcasting
5	Leased line	T1/E1
6	High speed Internet access	GbE UNI
7	timing-related services	clock delivery

NG-PON1 general requirements on architecture / infrastracture

- Common system for FTTH, FTTBulding, FTTCabinet/Curb, etc.
- Common system for single-stage and multi-stage splitter ODNs.
- Class C as baseline and Class C++ as amplified option for ODN budget
- Protection option that does not impact the fixed cost of unprotected PON

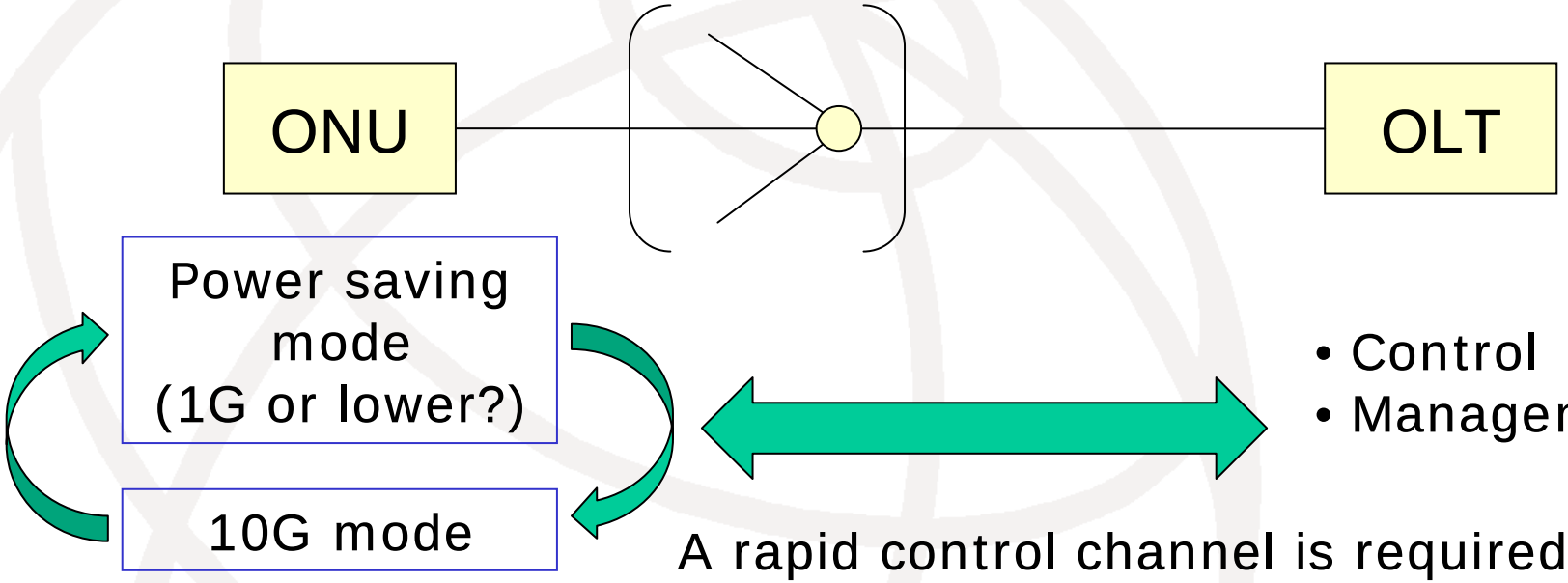
Power saving

- As for the XG-PON, it is mandatory to employ enhanced energy efficient function in its TC and above layer(s).



- Lifeline service with minimum power consumption
  - e.g. 4 to 8 hour sustainability with battery
- 10G as the turbo mode
  - 10G PON LSI is estimated as consuming 4 to 8 times power compared with Giga PON LSI.

Power saving function for XG-PON (example)



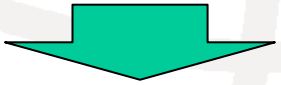
- Control
- Management

A rapid control channel is required
- PLOAM (rapid PON-layer OAM)
- Ether OAM
- etc.

Transceiver options for ONU
- Parallel 1G/10G TRx
- Single TRx for 1G/10G

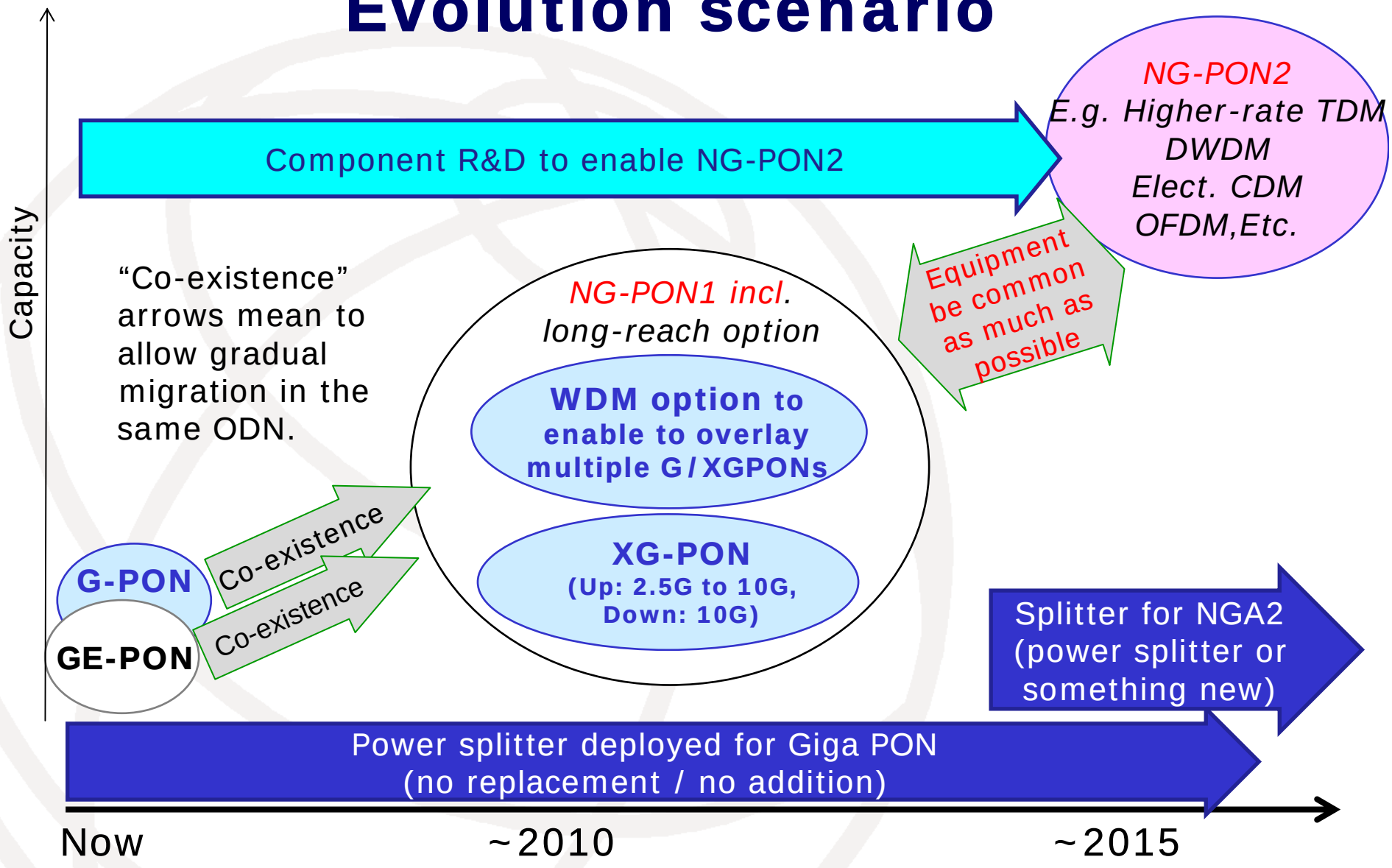
Operational requirements

- Keeping ONT conditions under control to comply with SLA
- Offering an access to UNI to other service providers in some cases



- Concepts and approaches for G-PON OMCI should be reused.

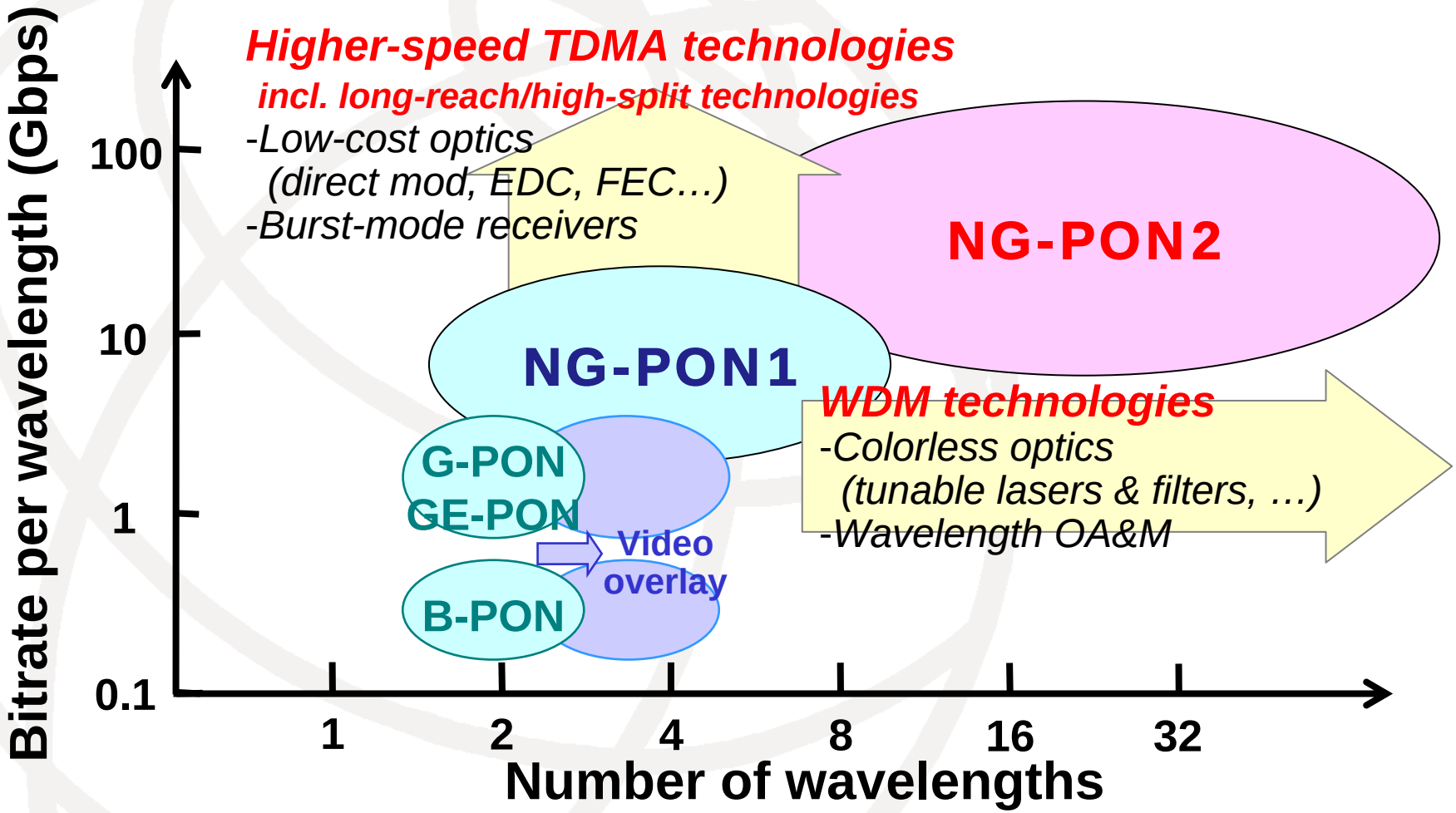
Evolution scenario



NG-PON2

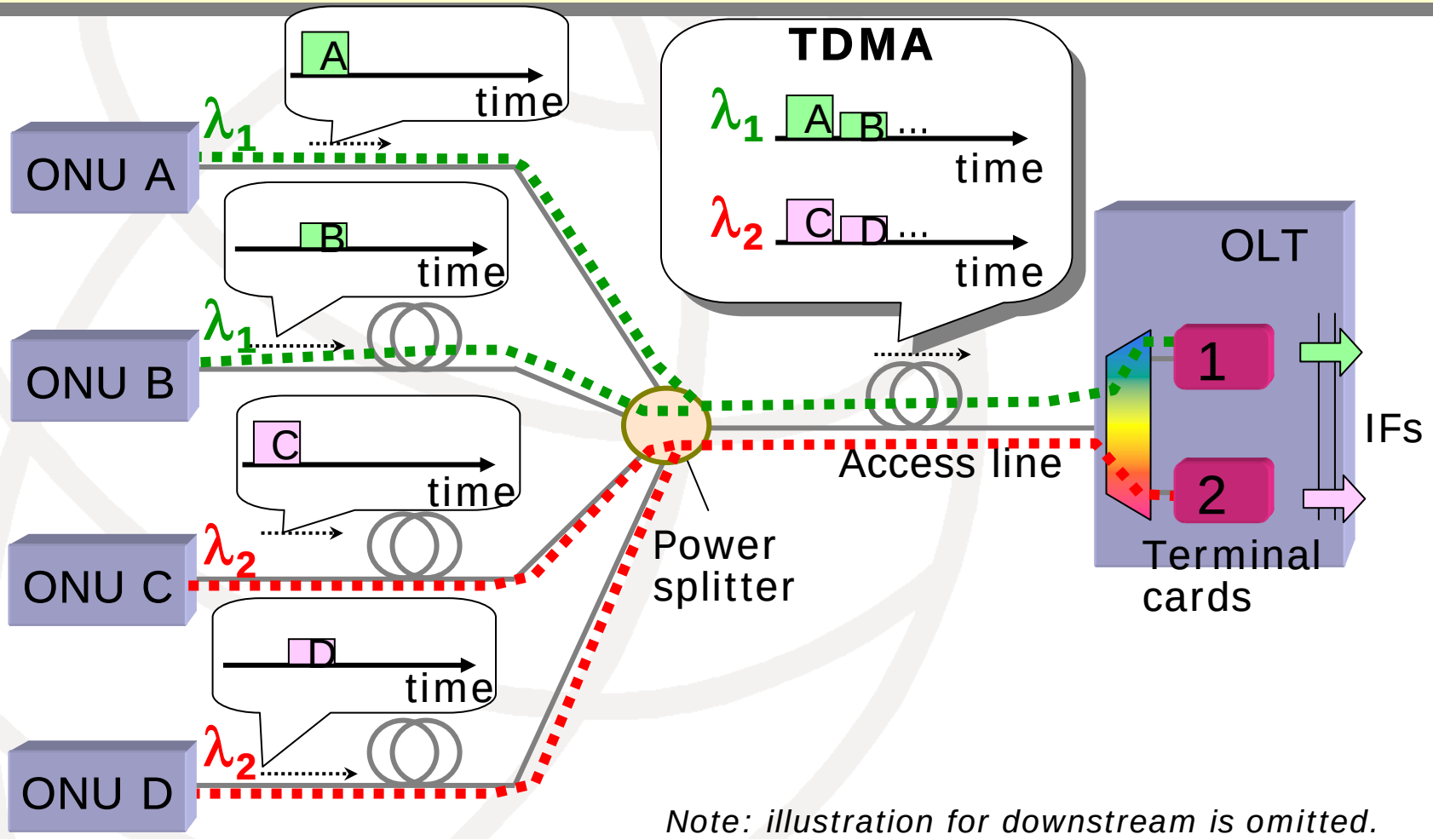
- Longer-term solution.
- Significantly higher capacity than GPON, GE-PON
  - E.g. ~ 1 Gbit/s sustained per customer
- Component R&D needs to start now
  - E.g. tunable transmitters and receivers etc.
  - Cost reduction
- Co-existence requirement could be relaxed as long as cost-effective upgrade strategy from earlier generations is identified.

Technical Direction



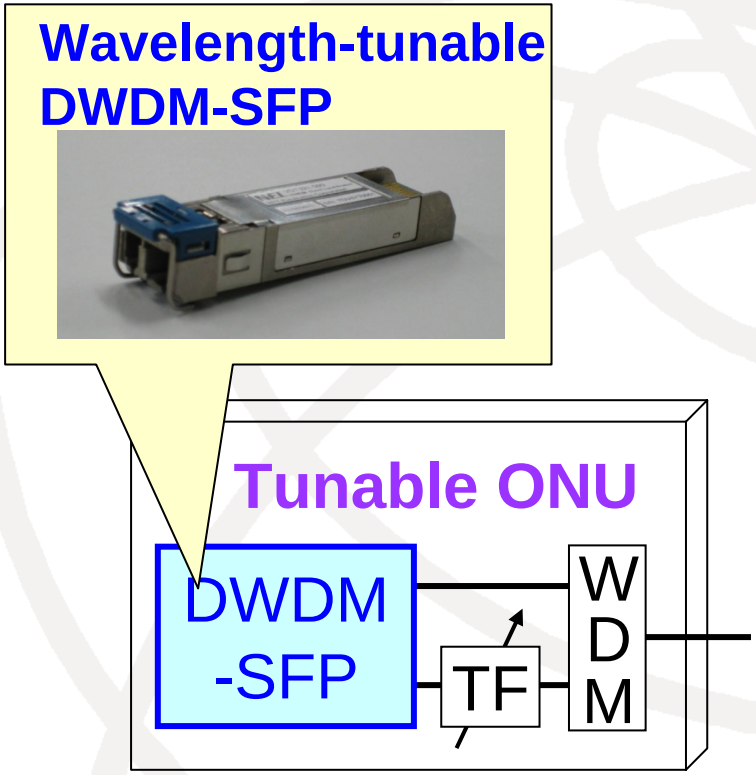
Example of architecture: hybrid WDM/TDMA

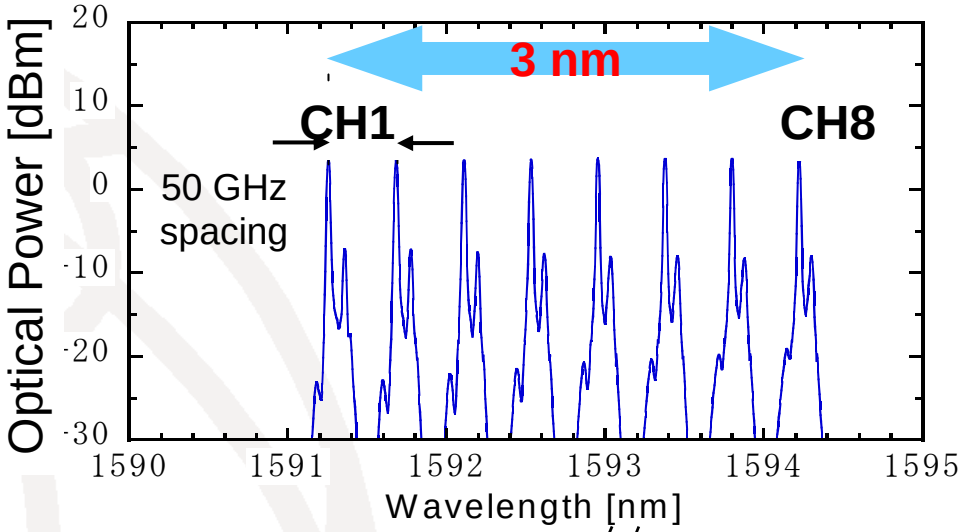
- Plural TDMA-PONs can be overlaid on an ODN with static wavelength assignment of several wavelengths.
- Colorless ONUs are desirable for this application as well as for simple WDM access.

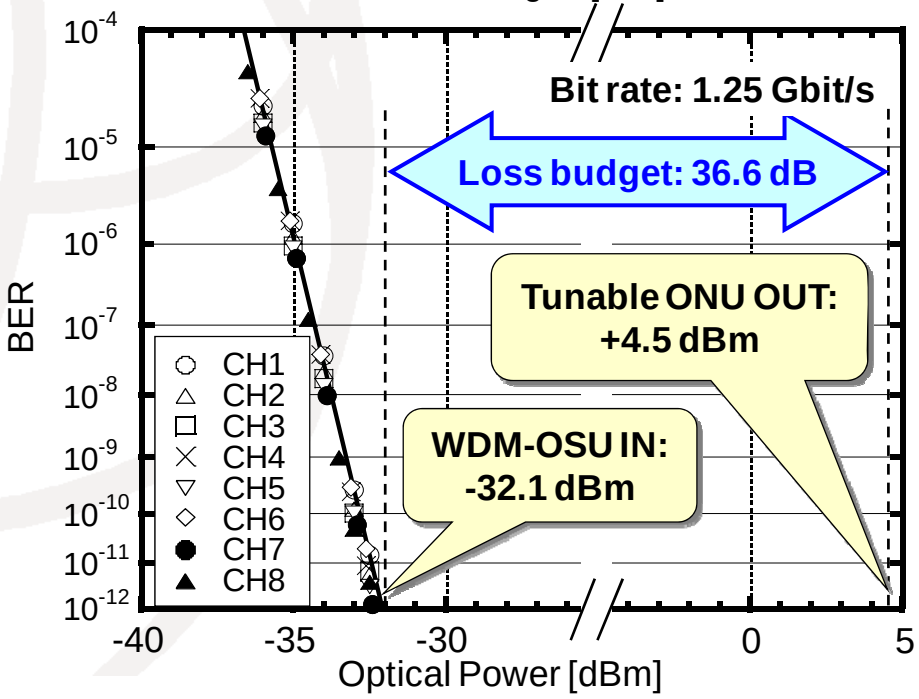


Note: illustration for downstream is omitted.

Colorless ONU with wavelength-tunable DWDM-SFP







H. Suzuki, et al, "**Wavelength-Tunable DWDM-SFP Transceiver with a Signal Monitoring Interface and Its Application to Coexistence-Type Colorless WDM-PON," ECOC 2007, PD-3.4.**

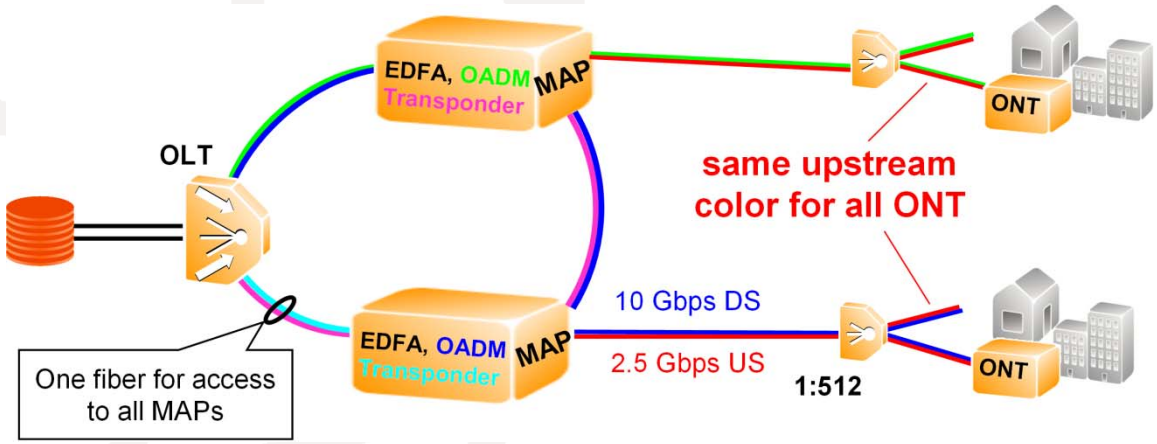
European project on NG-PON: MUSE SP E (2006-2007)

Hybrid TDM / WDM - PON with higher bitrate, extended split factors and reach

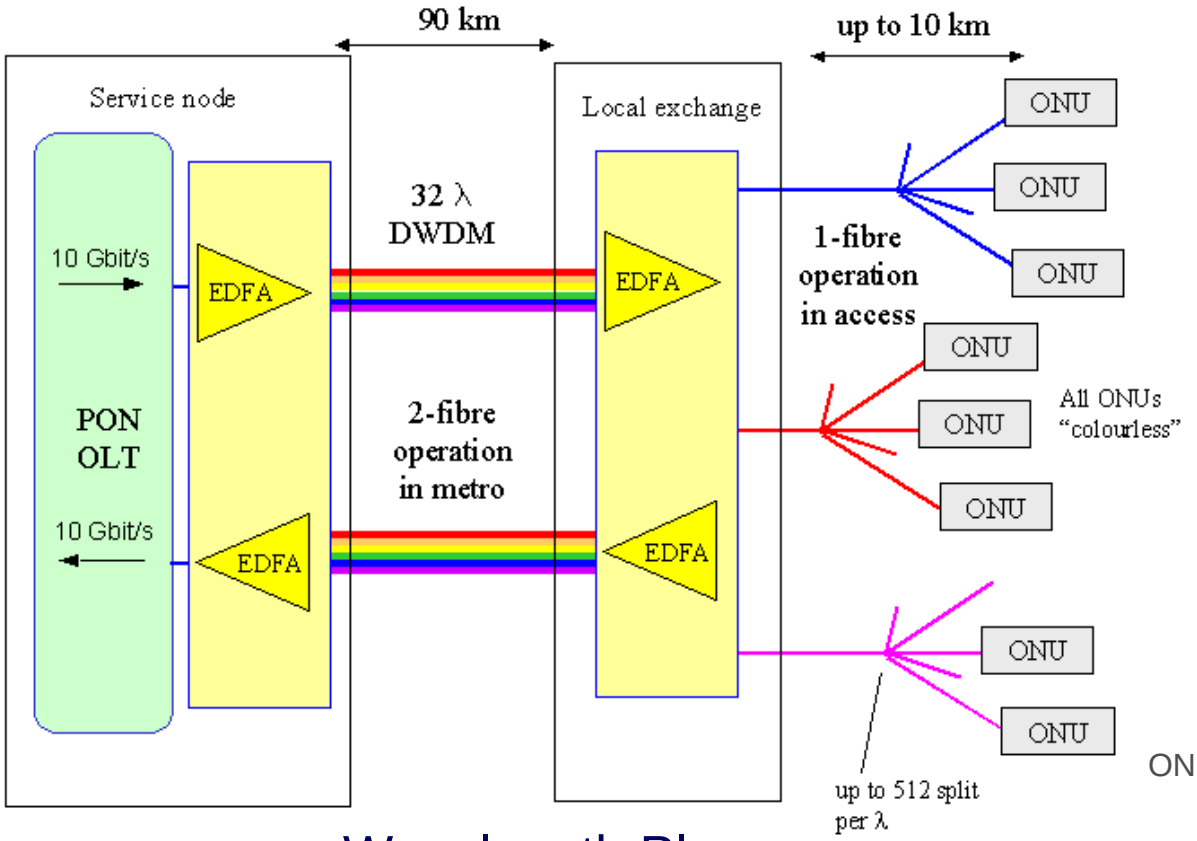
Bypassing conventional local exchange and centralising the functionality

Contributors: Nokia Siemens Networks, Siemens, British Telecommunications, Telekomunikacja Polska

- Prototype system with real traffic
  - TC-layer implemented
- 10Gbit/s downstream
- 2.5Gbit/s upstream
- 1:512 splitting ratio
- 100km total reach
  - 30km in ODN
- Same color ONTs
  - Burst-mode transponder for 2.5Gbit/s upstream



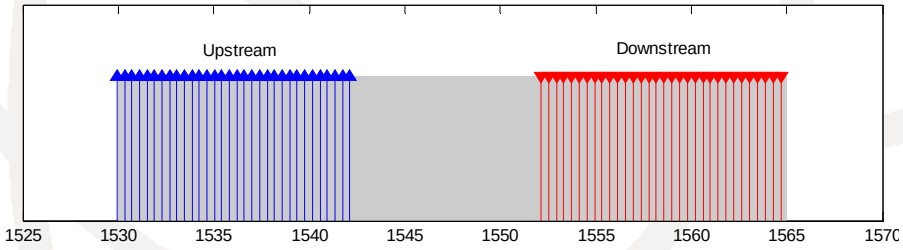
EU FP6 PIEMAN



- 100km reach
- Split up to 512
- 10 Gbps symmetric
- 32 TDM PONs:
  - 32 λ Downstream
  - 32 λ Upstream

ONU=Optical Networking Unit

Wavelength Plan



C-Band
- 50 GHz channel spacing
- no Video overlay

Summary

- NG-PON1 requirements
  - Smooth migration from gigabit PONs is the essential requirement.
  - Advanced functionalities such as power saving are also important.
- NG-PON2 perspective
  - Technical directions include higher-speed TDMA and full WDM.
  - Component R&D should be started now.