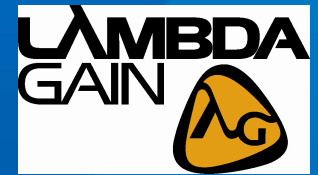




FIBEREX



- »» Future-Proofing PONs with WDM Muxes
- ✓ **PON evolution relies on WDM**
 - ✓ **PON unbundling is not standardized**
 - ✓ **Example of a flexible WDM portfolio**

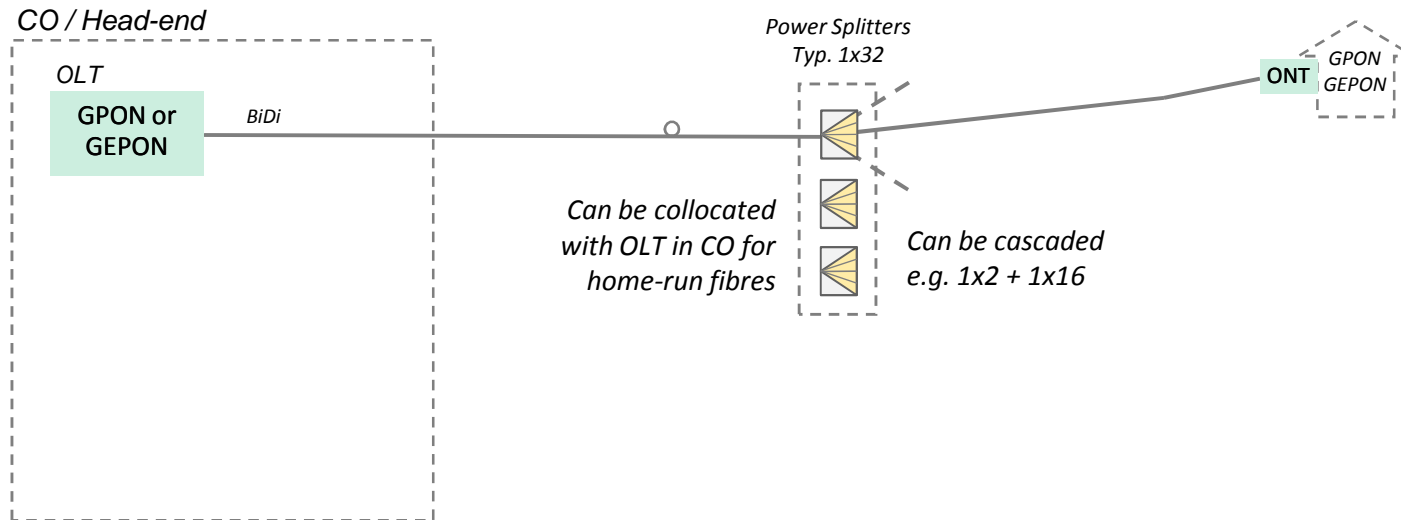
FONEX Corporate Profile

- » **Provider of carrier-class telecommunications equipment solutions**
 - Specialized in best-of-breed and purpose-built Access and Metro Edge network solutions
 - Serving both wireline and wireless network operators
 - E.g. broadband access: DSL and GPON systems, Ethernet copper bonding...
 - Exclusive supplier of LambdaGain™ WDM muxes, PON splitters and Ethernet pluggables

- » **National Canadian presence**
 - Headquartered in Montreal with branch offices in Toronto and Vancouver
 - Offices in Paris (France) and Milano (Italy)
 - Privately-held company, established in 1989



Legacy GPON / GEPON



nm	Down	Up
1270	-	-
1310	-	GPON / GEPON
1490	GPON / GEPON	-
1550	-	-
1578	-	-
1610	-	-

» Typical PON reach

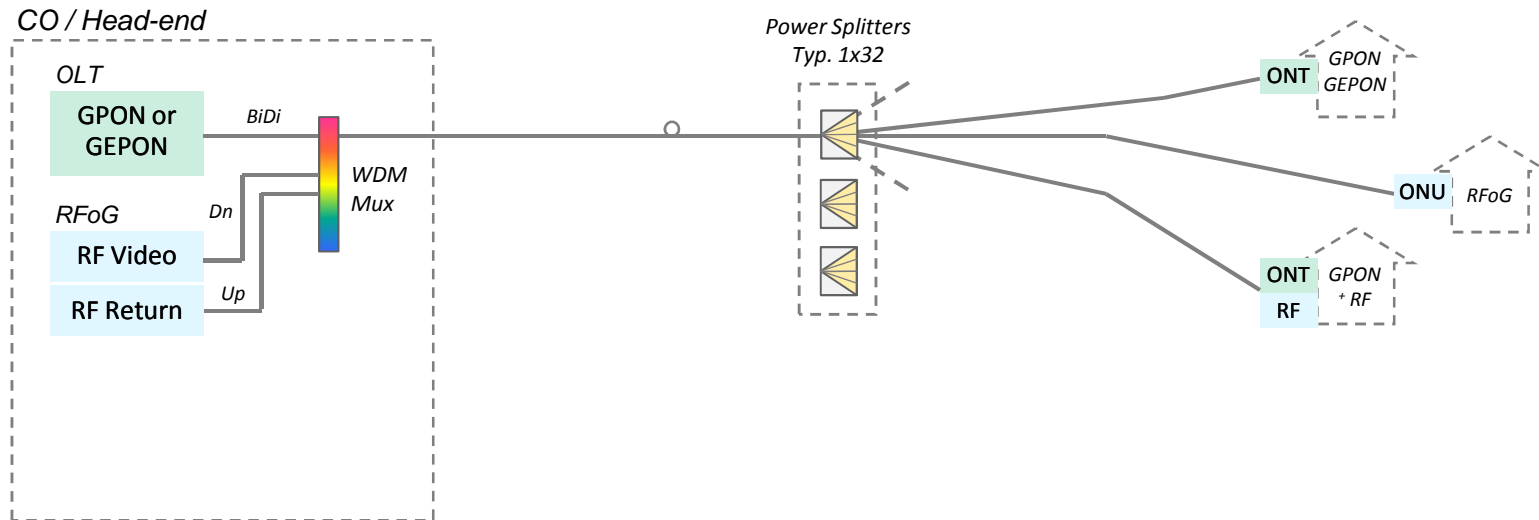
- Up to 20 km with 1x32 split
- Factor of 2 increases or decreases by ~ 10 km

» Standards enhancements for extended reach

- GPON 40 km (ITU G.9841r) differential reach
- GPON RE (ITU G.984.6) with active remote node
 - Not really a "PON" anymore

OLT: Optical Line Terminal
 ONT: Optical Network Terminal

Legacy GPON / GEPON with RFoG



nm	Down	Up
1270	-	-
1310	-	GPON / GEPON
1490	GPON / GEPON	-
1550	RFoG	-
1578	-	-
1610	-	RFoG*

* 1310 also allowed for RFoG return if no overlay

HFC: Hybrid Fibre-Coax

ONU: Optical Network Unit

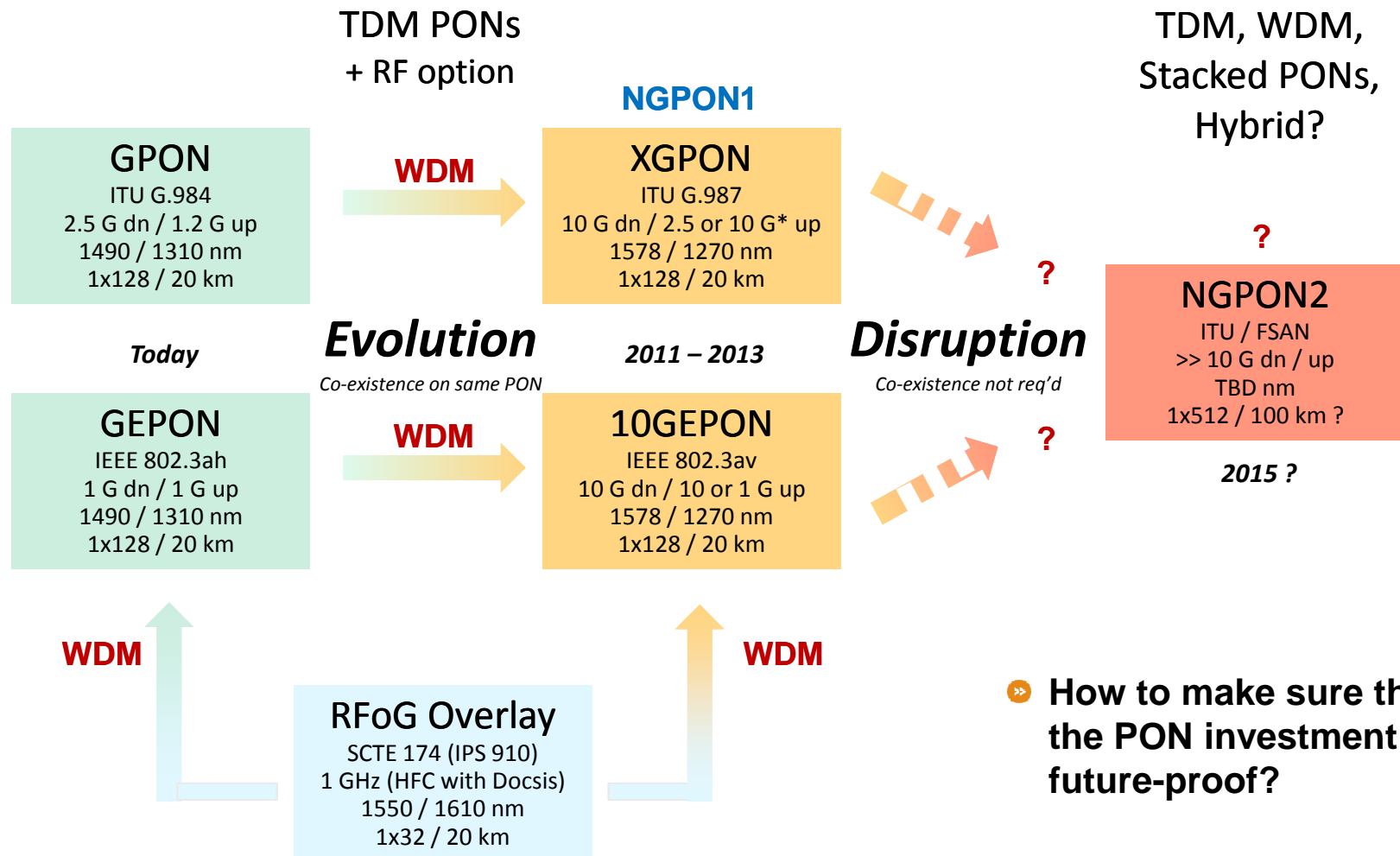
RFoG: RF over Glass

» RFoG extends the HFC network on fibre right to the home

- Advances the deployment of FTTH
- Leverages HFC infrastructure and operations model
- Can co-exist with GPON deployments
- With downstream RF video only, or with RF Return

» RFoG ONU standalone or integrated with GPON ONT

NGPON Evolution Relies on WDM



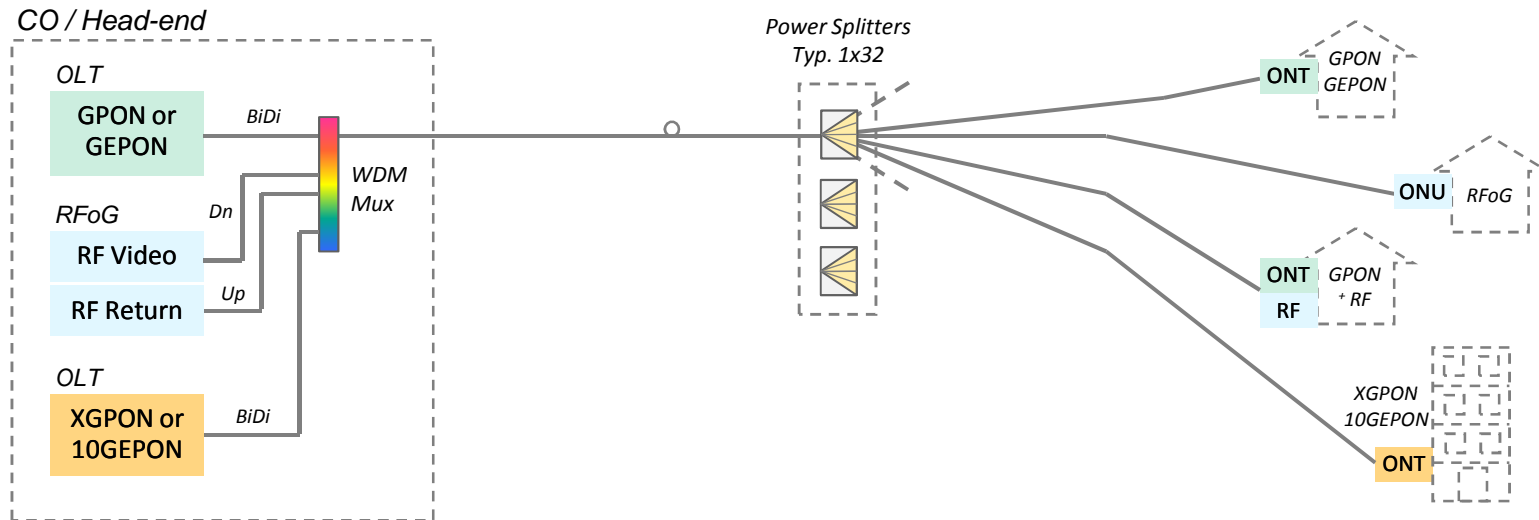
» How to make sure that the PON investment is future-proof?

PON: Passive Optical Network
RFoG: RF over Glass

TDM: Time-Division Multiplexing
WDM: Wavelength-Division Multiplexing

*Note: 10 G up is for further study

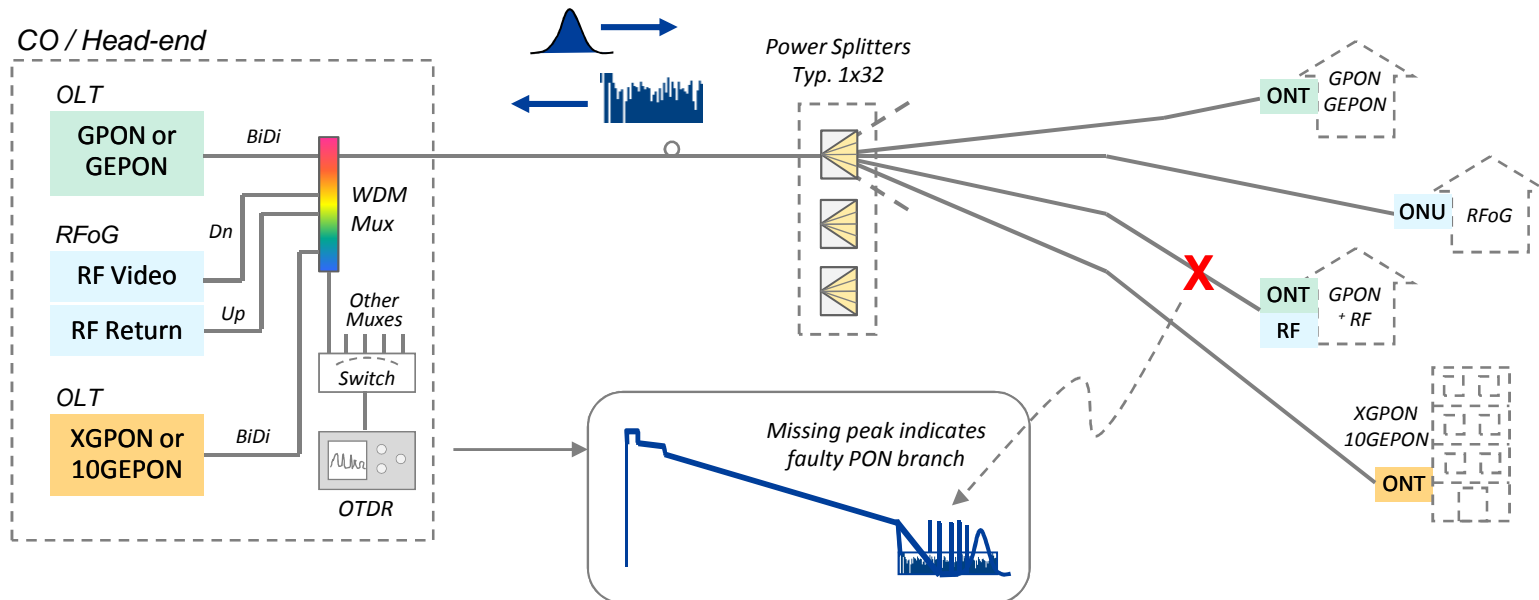
Evolution to XGPON / 10GEPON Overlay



nm	Down	Up
1270	-	XGPON / 10GE
1310	-	GPON / GEPON
1490	GPON / GEPON	-
1550	RFoG	-
1578	XGPON / 10GE	-
1610	-	RFoG

- » Wavelengths coordinated between ITU, IEEE and SCTE
- » Makes co-existence possible with legacy PONs

Mux with Test Access Option can Reduce Opex

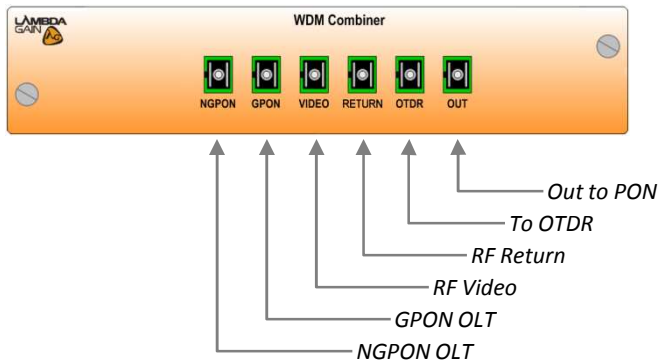


nm	Down	Up
1270	-	XGPON / 10GE
1310	-	GPON / GEAPON
1490	GPON / GEAPON	-
1550	RFoG	-
1578	XGPON / 10GE	-
1610	-	RFoG
1650	Test Access for OTDR	

- **OTDR trace pinpoints fibre fault locations before dispatch**
 - Fault can be before or after the splitters
 - 1610 nm option also available (not compatible with RFoG)
- **Cost delta for test access on mux is almost negligible**
 - Low % per port cost
 - Reduces Opex with more effective truck rolls
 - Improves QoE with less service downtime and customer outages

Future-Proof Wavelength-Division Multiplexer

- Combines GPON, NGPON, RF Video, RF Return, and Test access

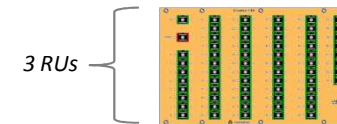
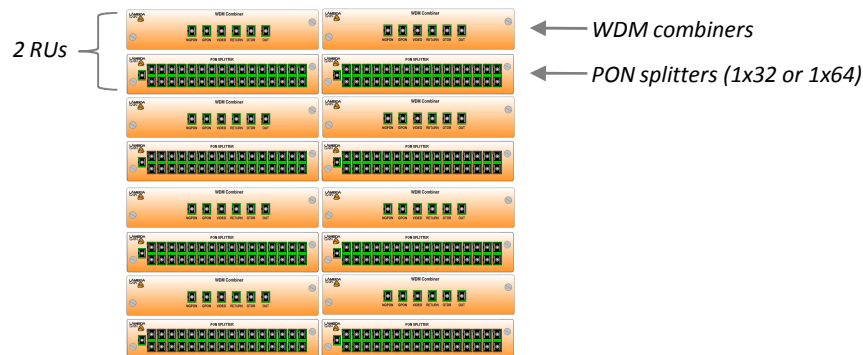


- Two units per 1-RU in 19" or 23" rack
- Can be customized for the application / services



- PON splitters can be collocated with the Muxes in the CO

- Same or separate racks

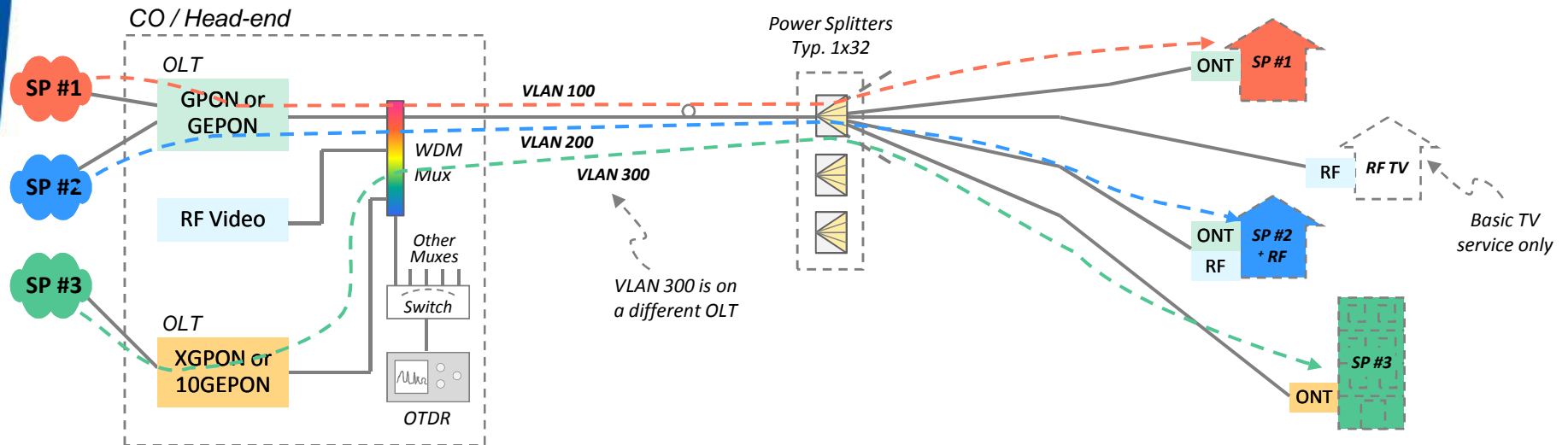


- LGX design also available depending on the application

PON Unbundling

- » **Open Access Networks**
 - **PON infrastructure sharing**
 - **Service providers segregation**
- » **No universal standard**
- » **Two examples:**
 - **Logical layer (VLAN)**
 - **Physical layer (WDM)**

PON Unbundling at Ethernet Layer with VLANs



nm	Down	Up
1270	-	XGPON / 10GE
1310	-	GPON / GEPON
1490	GPON / GEPON	-
1550	RF Video	-
1578	XGPON / 10GE	-
1610	-	-
1650	Test Access for OTDR	

OAN: Open Access Network
SP: Service Provider

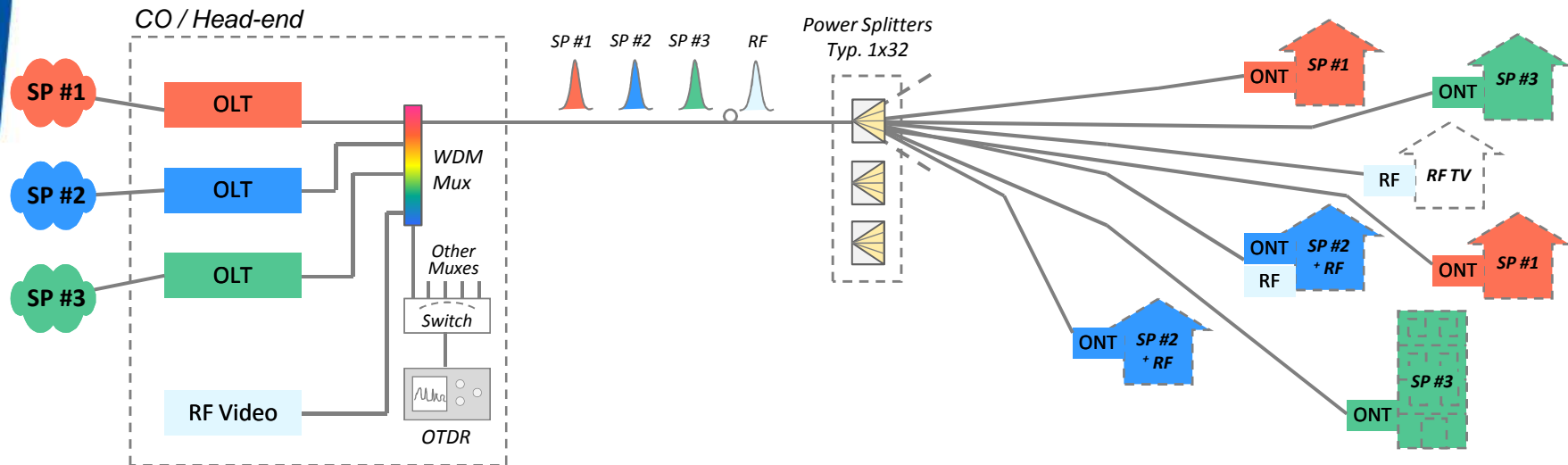
➤ No change to the PON infrastructure

- SPs use colorless ONTs provided by OAN
- Basic TV service may be a regulatory requirement for OANs

➤ SPs interconnect with OAN at Ethernet layer

- Unbundling is done at logical layer through VLANs
- Each SP can provide competing voice, data and video services
- The OAN controls the VLAN assignments
- Special requirement for handling IGMP multicast addresses

PON Unbundling at Optical Layer with Wavelengths



nm	Down	Up
λ #1u	-	SP #1
λ #2u	-	SP #2
λ #3d	SP #3	-
1550	RF Video	-
λ #1d	SP #1	-
λ #2d	SP #2	-
λ #3u	-	SP #3
1650	Test Access for OTDR	

- » **SPs deploy their own OLT and ONTs and use OAN fibre**
 - ONTs are not colorless, but only one color per SP
 - SPs retain control of their service configuration parameters
- » **No change to outside plant infrastructure**
 - Can use the same splitters
- » **Requires new wavelength allocation scheme**
 - Stacked XGPON option for NGPON2 could be a solution (TBD)

OAN: Open Access Network
 SP: Service Provider

Example of Flexible WDM Portfolio: LambdaGain™

» xWDM muxes

- xPON / NGPON / RFoG / Test Access / TAP
- CWDM, DWDM, Hybrid WWDM / CWDM



» PON splitters

- Up to 1x64
 - 2x64 option for redundancy
- Hardened equipment : -40C to +75C
- Compact PLC components for field deployment
- Modular rackmount cassettes for cabinets deployment



» Pluggables

- SFP, SFP+, XFP, BiDi, CWDM, DWDM
- Compatibles with major OEM vendors
- SFP Bridges / Converters (EoTDM, EoPDH)
- Optical budget 20 – 41 dB (100+ km)



- *Guaranteed stability of supply and of adherence to specs*
- *Local support and inventory*



FONEX



>> Thanks

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