



WDM-PON technology

Profitable deployment scenarios in carrier networks

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Vice President Marketing
October 2009

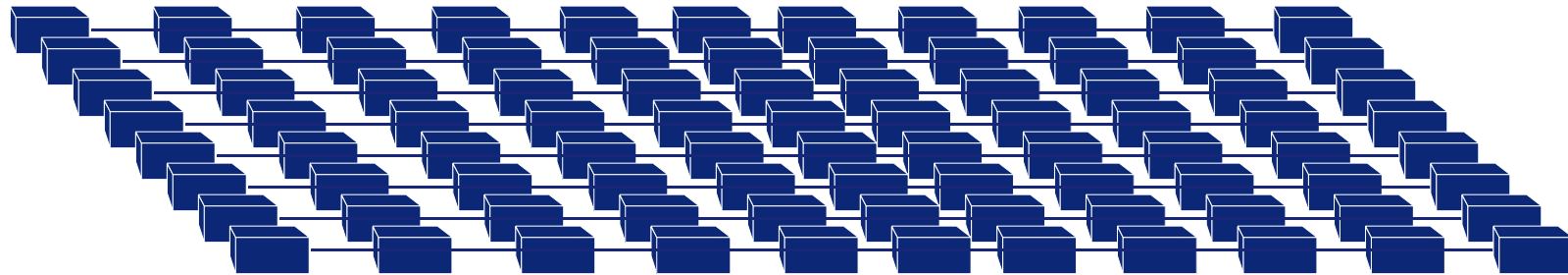
Outline

- ▶ Introduction
- ▶ Next-Generation Access (NGA) drivers
- ▶ The role of WDM in NGA
- ▶ Profitable deployment scenarios – a case study
- ▶ The NGA solution center

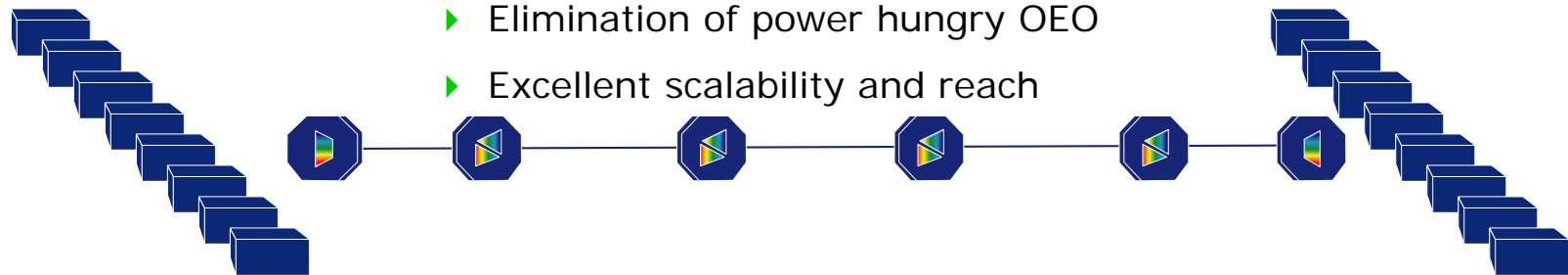
Many thanks to Dr. Klaus Grobe, principal engineer, ADVA Optical Networking

WDM – the early years

TDM networks



WDM networks



- ▶ Elimination of sites
- ▶ Elimination of power hungry OEO
- ▶ Excellent scalability and reach

WDM radically changed the cost per bit km equation

Be happy – we are in a growth industry

"... the long term, bandwidth consumption is around **40% to 50% per year** on average.
...The applications continue to be ... video and ubiquitous connectivity to the Internet."
DellOro, January 2009

1



**Video
AND ENTERTAINMENT**



"EAD worldwide revenue ...will reach \$1.6B in 2013,
with a 2008-2013 **CAGR of 33%** ... This is a healthy and
growing market that is strongly influenced
by Ethernet service uptake."

2 **TRANSITION TO
Ethernet**

Infonetics, May 2009

"... the growth rate of storage capacity in 2009 will be
fairly consistent with prior years, at around **50%**"

Goldman Sachs Global Investment Research, February 2009

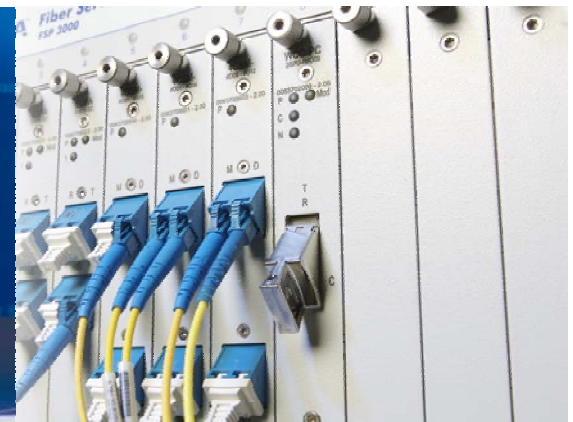
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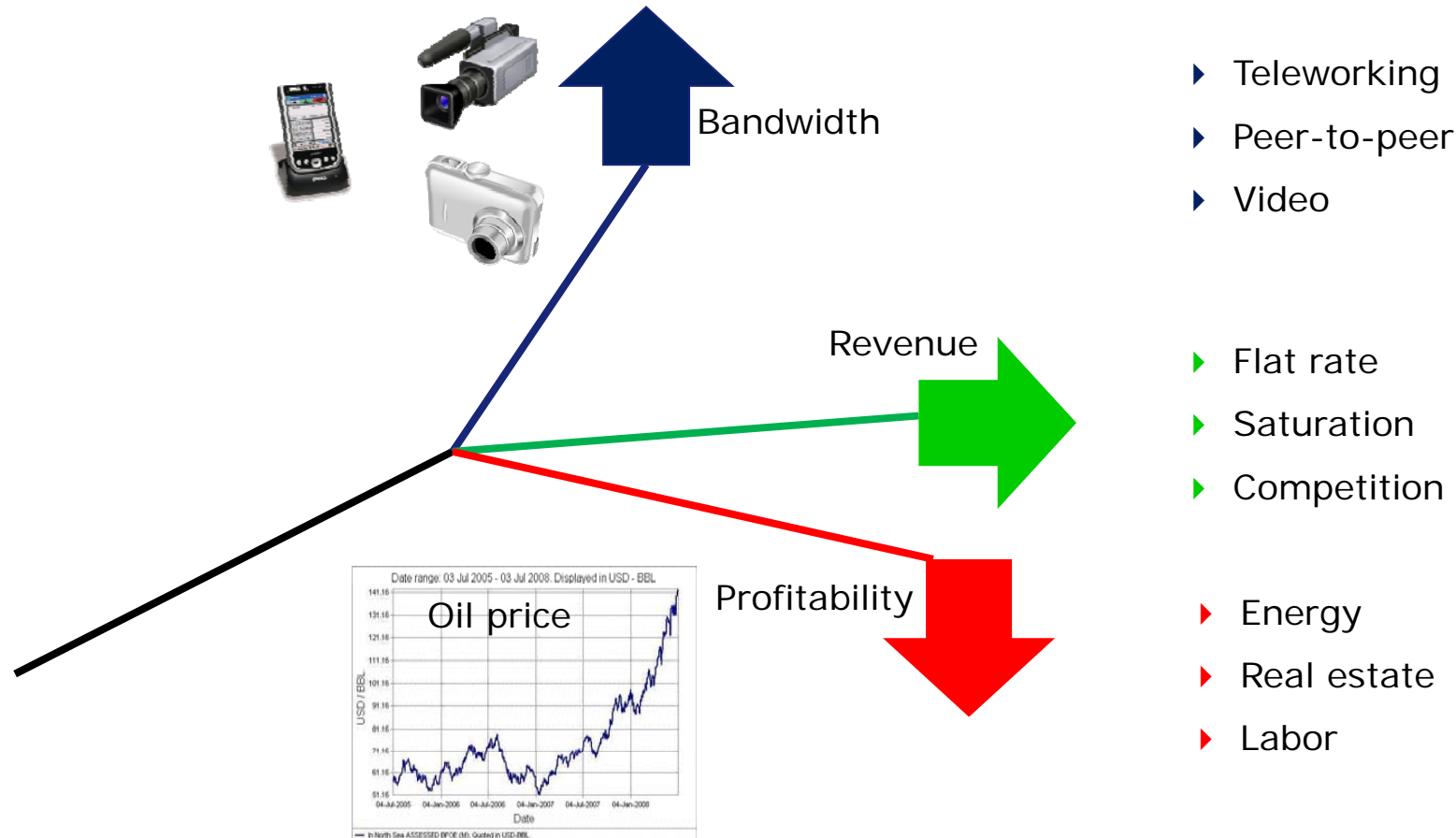
**Storage
DATA CENTER CONNECTIVITY**

**Three solid growth trends drive sustainable demand for
our converged Optical+Ethernet transport solutions**

Next Generation Access (NGA) drivers



NGA – dilemma or opportunity?



Need to deliver more bandwidth to more endpoints at lower OPEX

NGA requirements: more for less

1) More bandwidth to more endpoints

2) Energy-efficient and simple
(using less power consuming equipment in fewer sites)

3) Serving all user groups
(Residential, business, wholesale)

Scalable, supporting high fan-out ratios

Passive, transport-centric supporting long reach

Converged, using fewer purpose-built platforms

From multiple purpose-built networks to unified next-generation access and backhaul

Services by user group

Residential

... become more symmetrical

- ▶ 2 x HDTV (8 ... 16Mbit/s per channel),
→ TV offering in total:
- ▶ High-speed Internet access:
- ▶ Voice communications (POTS/VoIP):
- ▶ Upstream services:



**Teleworking
Image/video upload**

- 4 x SDTV (1.5 ... 4Mbit/s)
22 ... 48Mbit/s
- up to 5Mbit/s
- 100Kbit/s
- up to 100Mbit/s

Business

- ▶ TDM leased lines:
- ▶ LAN interconnection (VLAN):
- ▶ Virtual Private Networks (VPN):
- ▶ Storage Area Networking (SAN):
- ▶ High-performance computing:

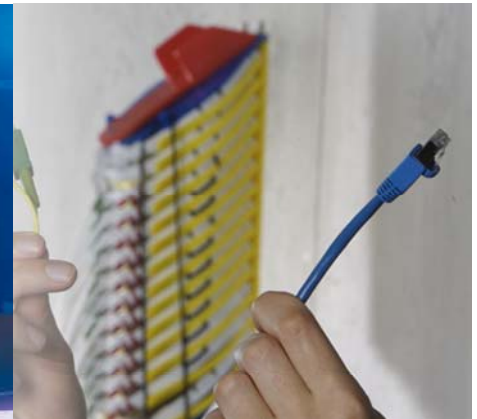
- e.g., E1/DS1
- 100BT, GbE
- 100BT, GbE
- 1/10 GbE, 4/8/10G FC
- InfiniBand (2.5...10Gbit/s)

Carrier wholesale

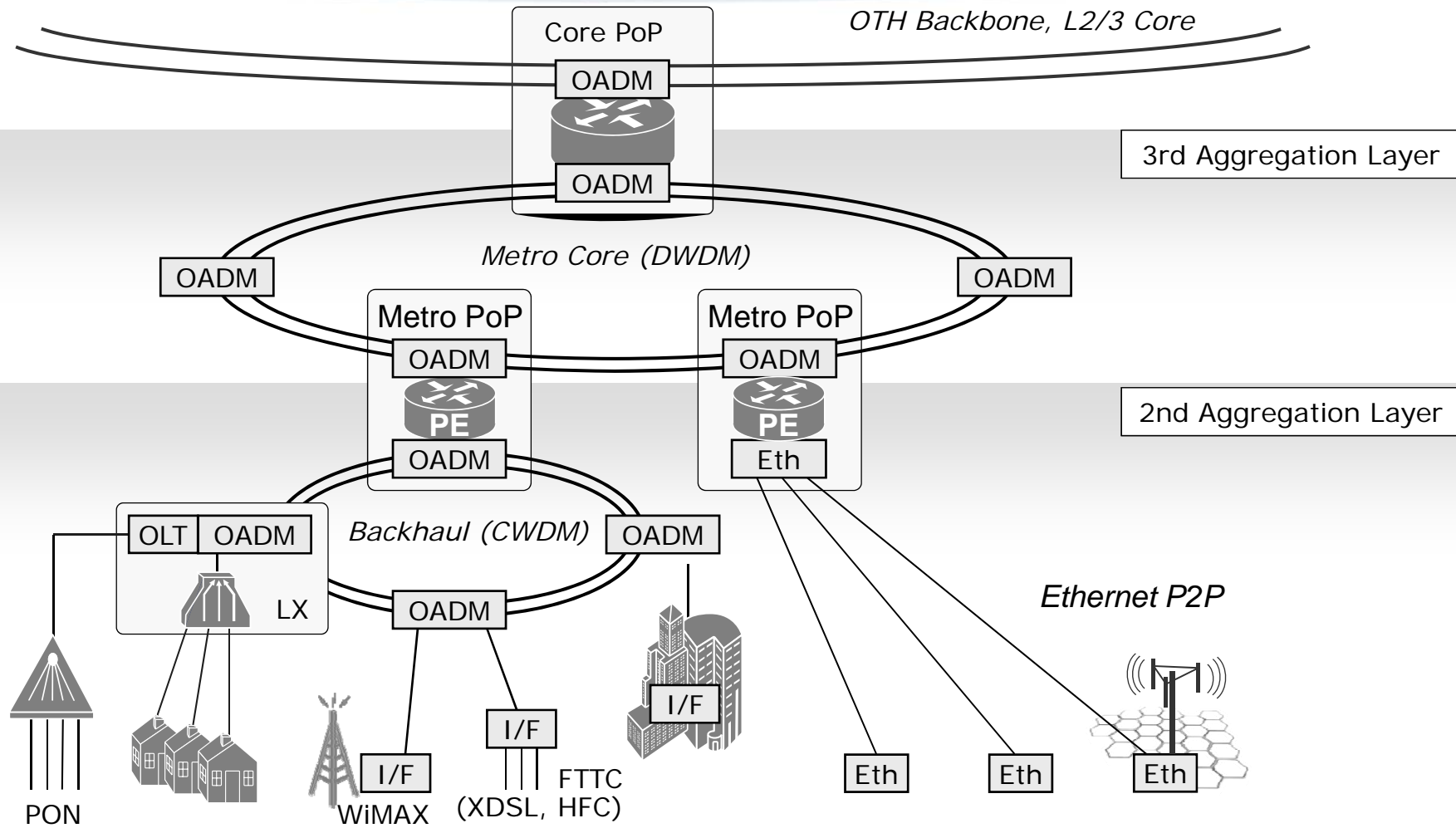
- ▶ xDSL backhaul: nx1GbE
- ▶ Hybrid Fiber Coax/CaTV network backhaul: nx1/10GbE
- ▶ Multi-Service Operator (MSO) network backhaul: nx1/10GbE
- ▶ Wireless network backhaul (e.g., connecting base stations): E1/DS1, 100BT, GbE

**Services become more alike (symmetrical, Ethernet centric)
-> opportunity for convergence**

The role of WDM in NGA

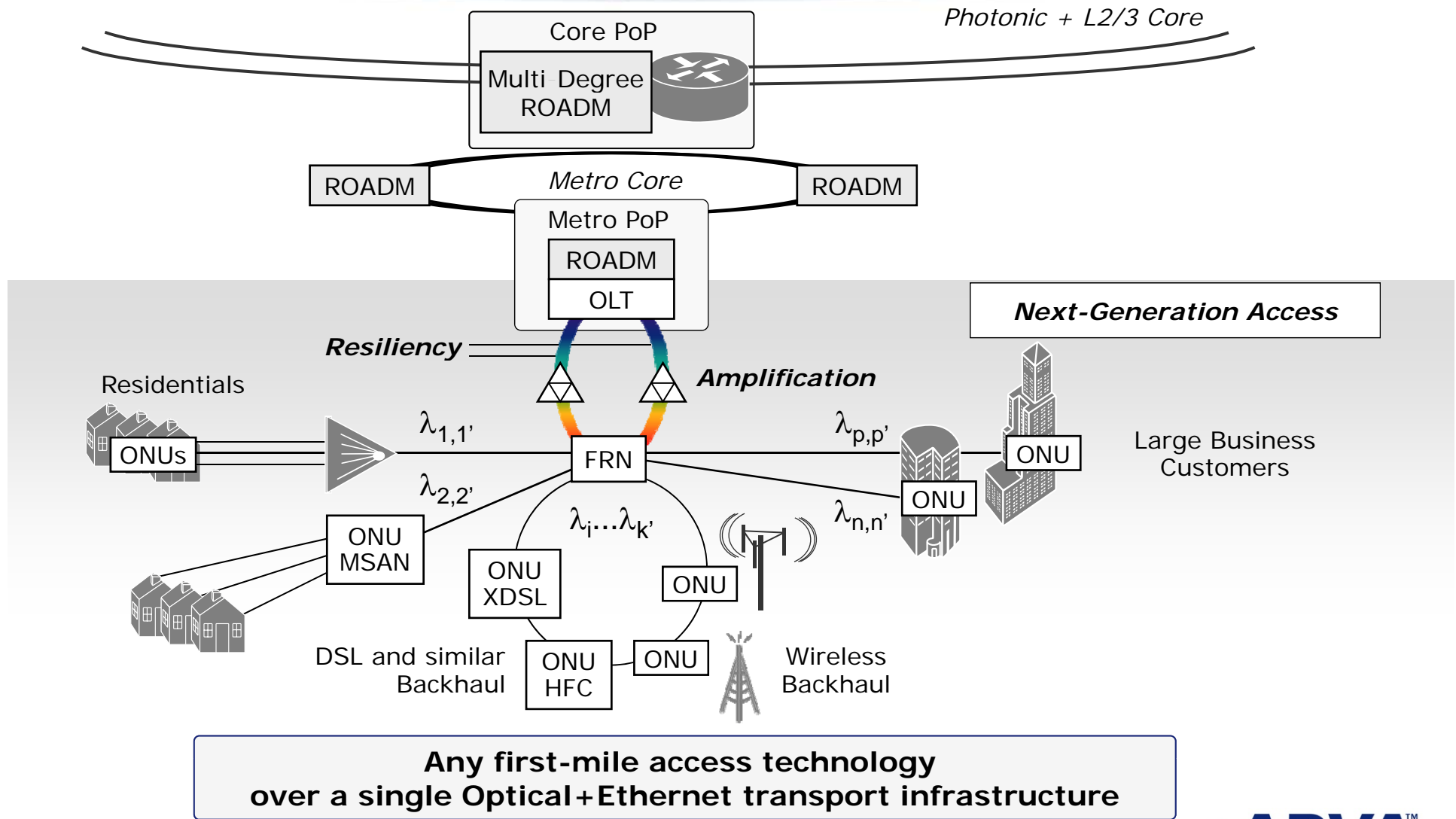


Metro network today

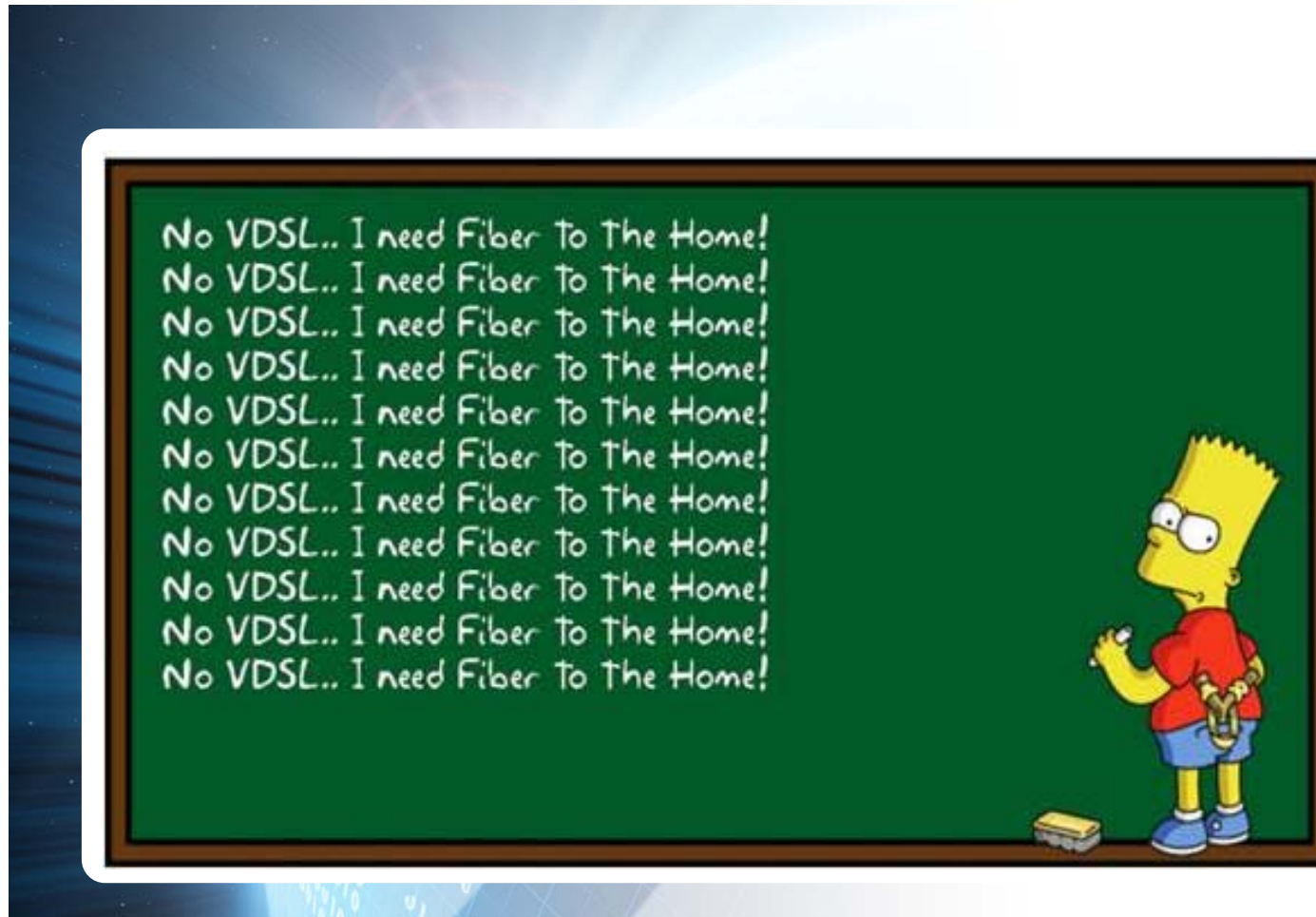


Need to simplify and unify access and backhaul

Future de-layered metro network

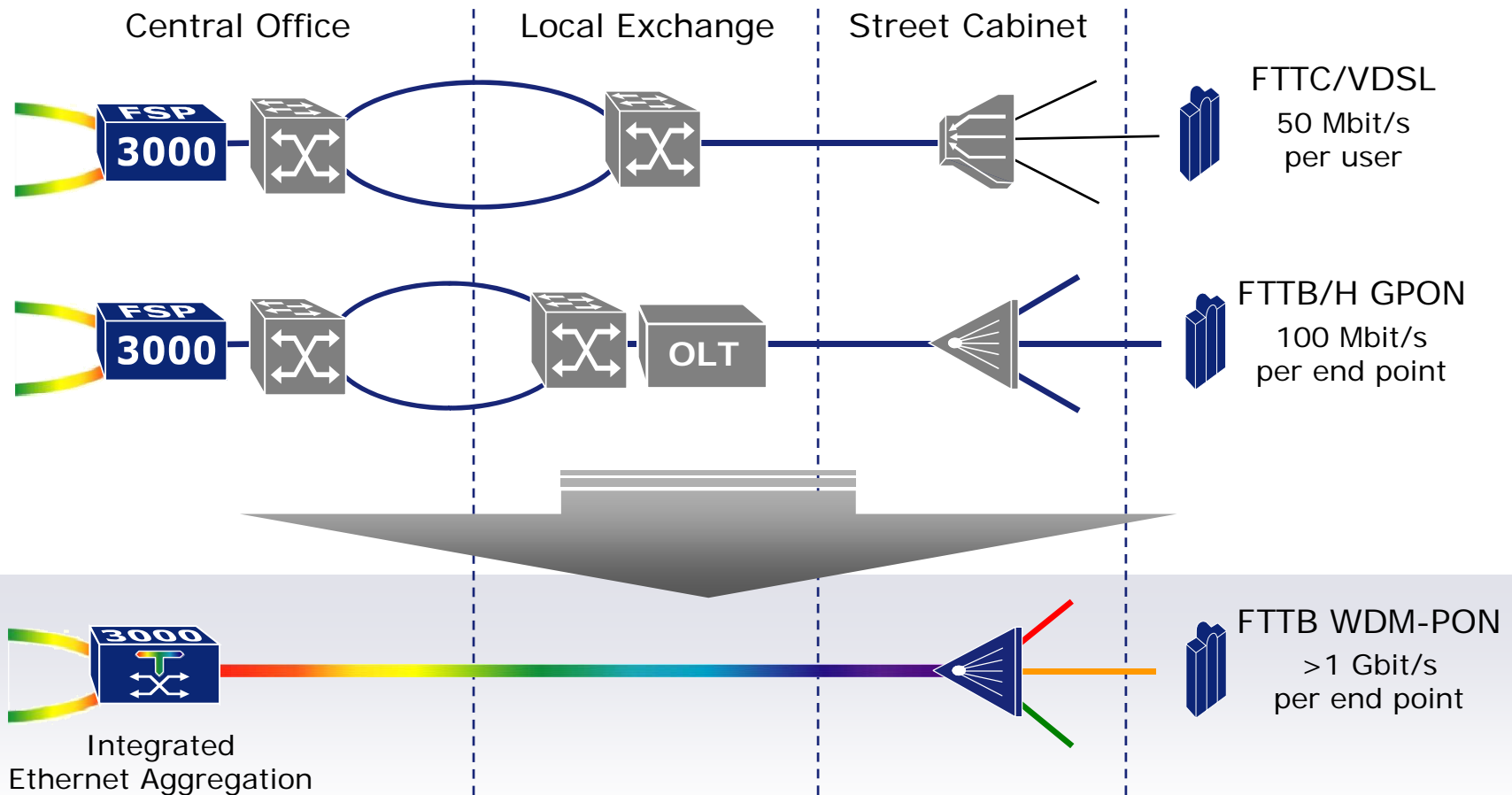


All that talk about FTTH



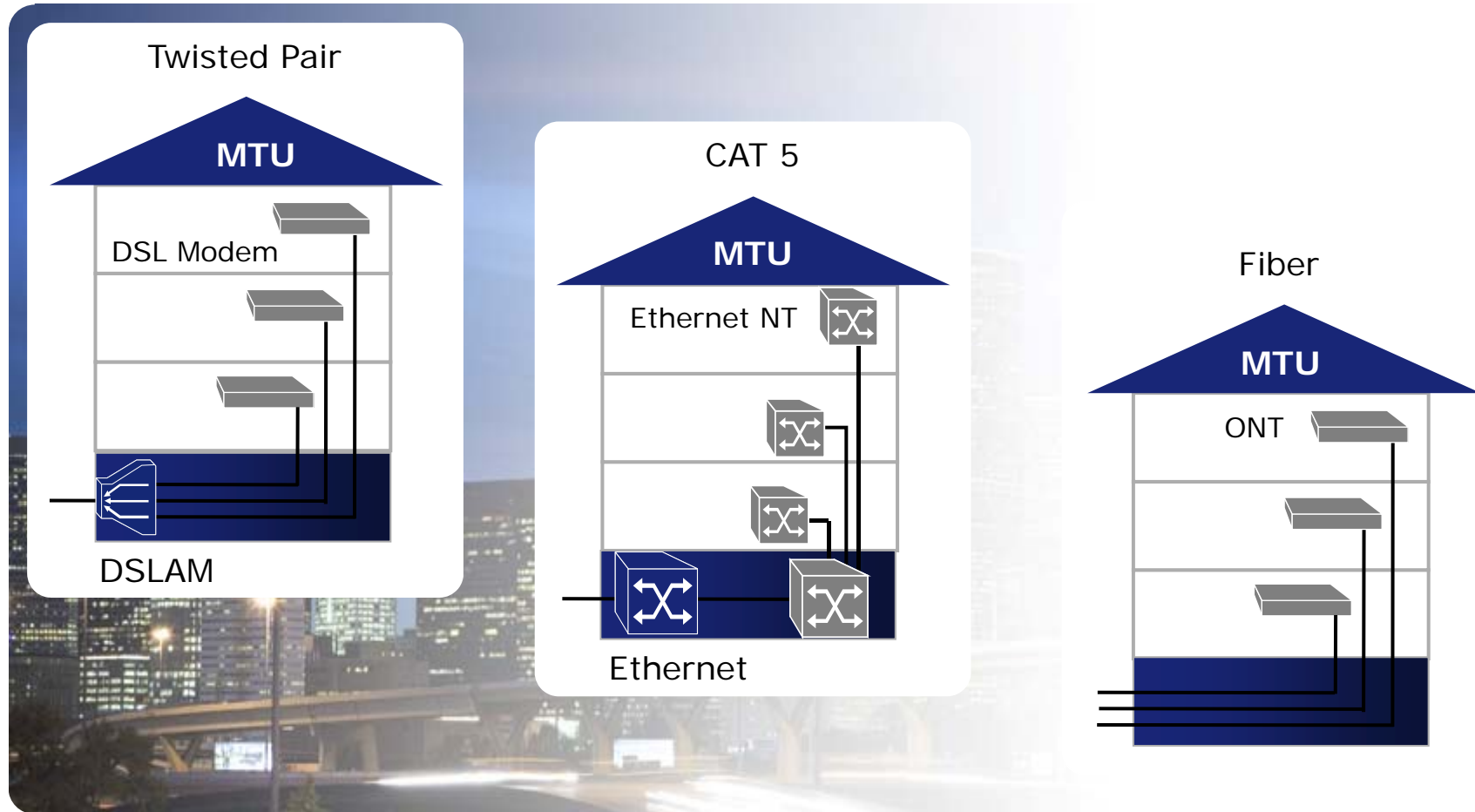
This presentation is not about wavelengths to the home or desk

Focus on access AND backhaul



Increases reliability while reducing network maintenance costs associated with fewer active locations

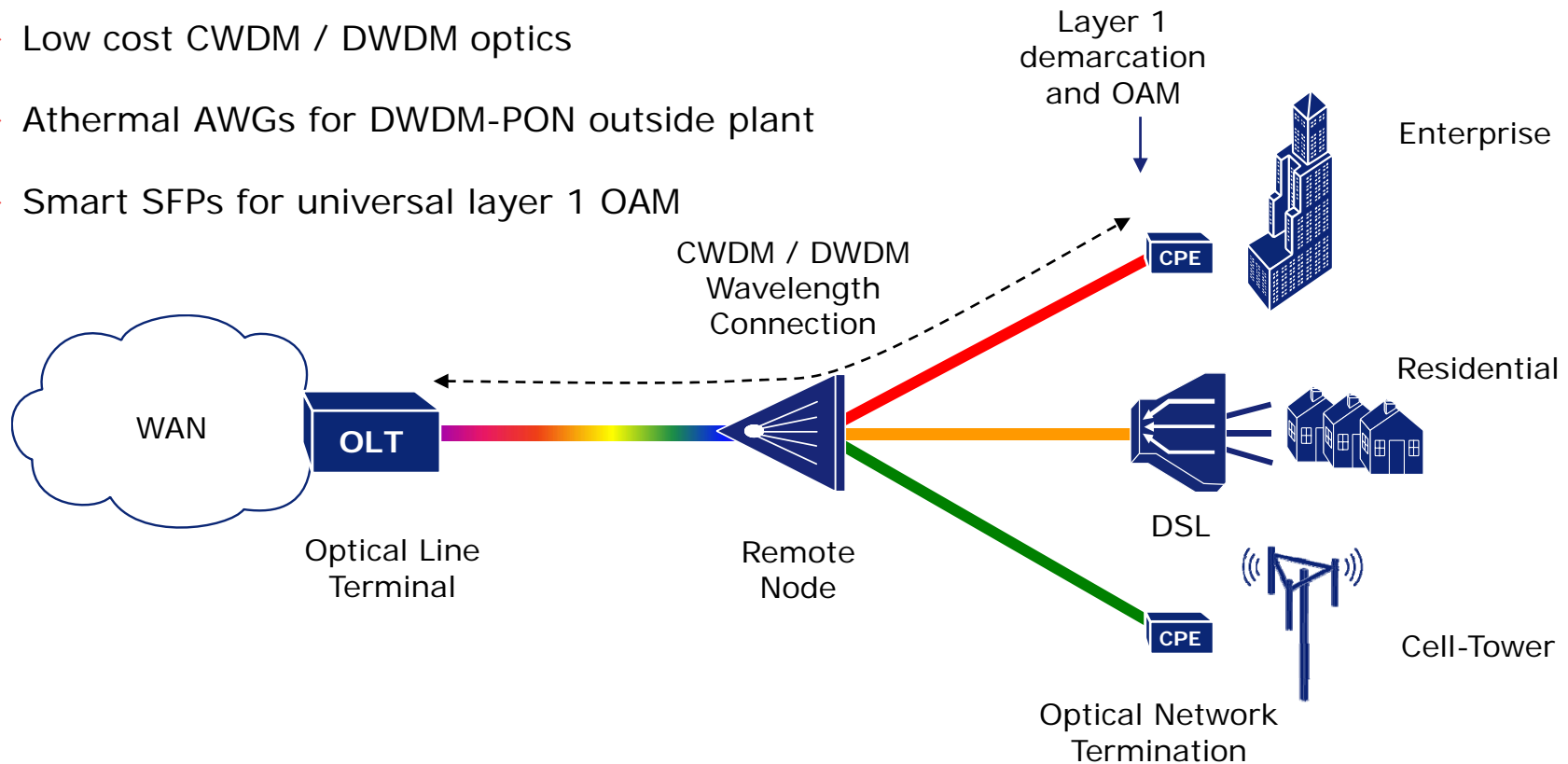
Common FTTx in-house solutions



Unified access and backhaul

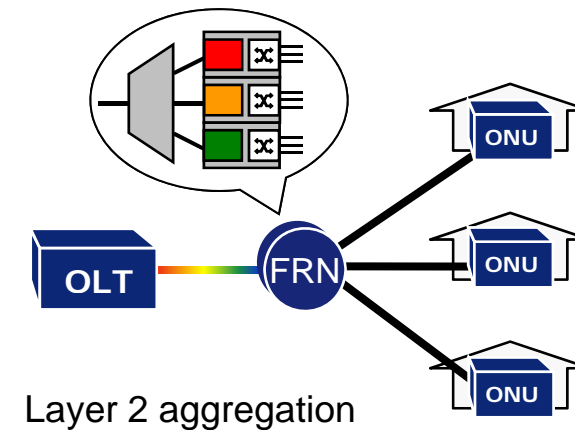
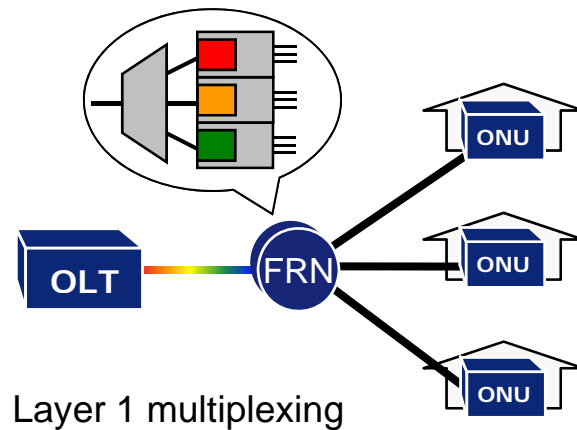
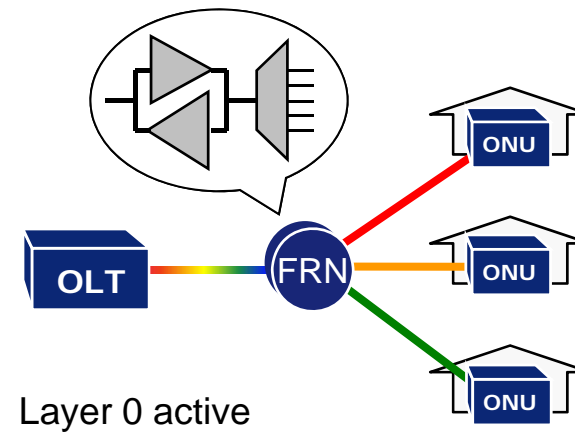
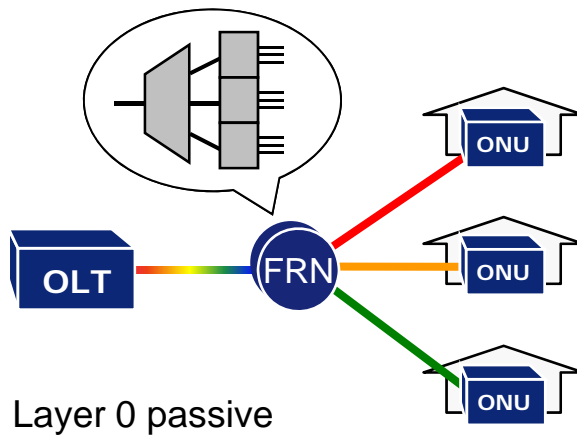
Technology drivers

- ▶ Low cost CWDM / DWDM optics
- ▶ Athermal AWGs for DWDM-PON outside plant
- ▶ Smart SFPs for universal layer 1 OAM



Combining point-to-multi-point topology with Point-to-point secure traffic separation and scalability

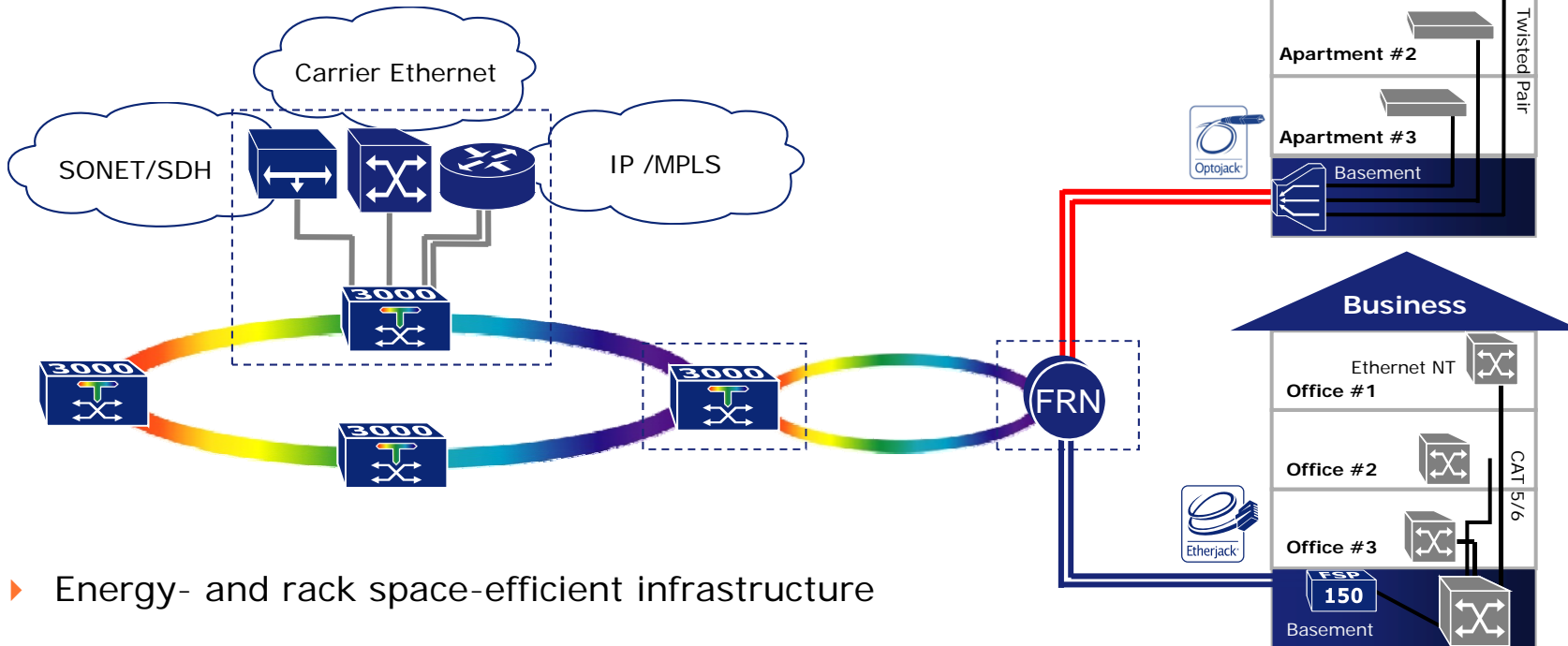
Flexible Remote Node (FRN)



FRN: flexibility, reach, scalability, secure traffic separation

NGA using point-to-multipoint WDM

- ▶ Cost-effective and fiber-effective solution
- ▶ Scalable and transparent service and bandwidth per customer
- ▶ Each customer can be upgraded independently



- ▶ Energy- and rack space-efficient infrastructure

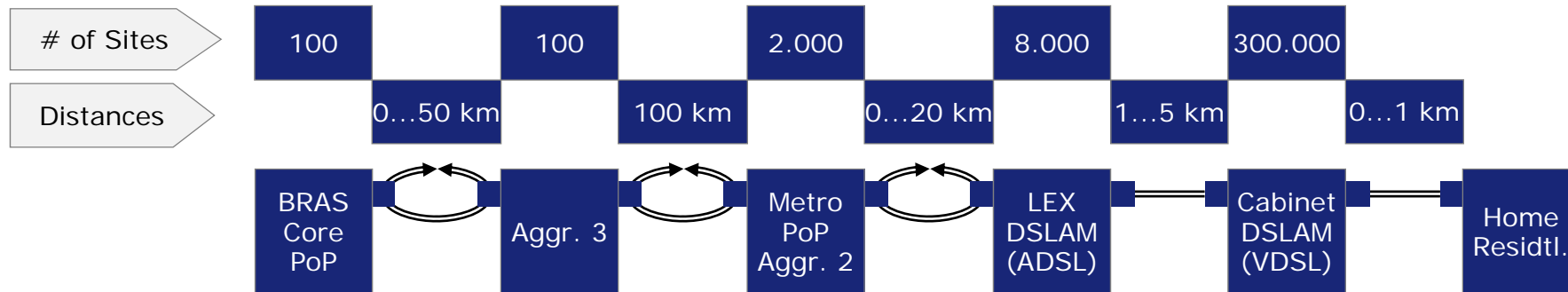
Unified access and backhaul for residential, business and wholesale

Case study

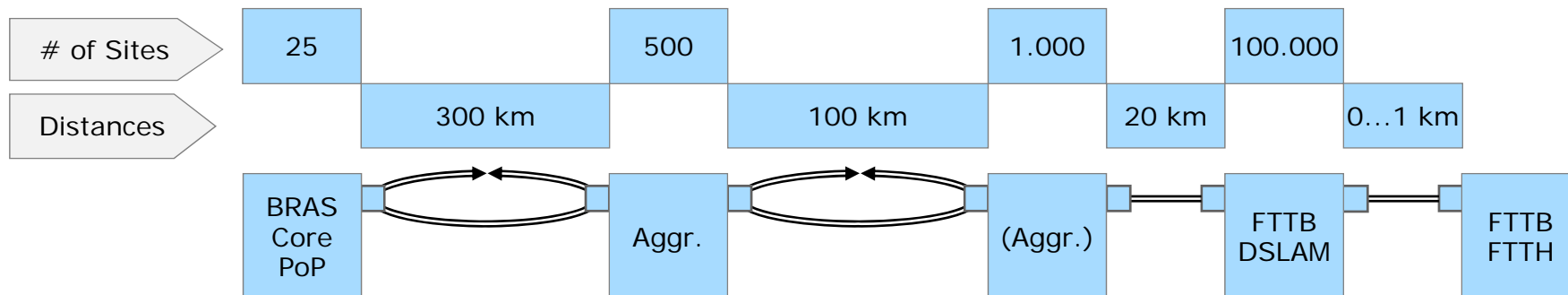


Site and power reduction scenario

Typical scenario of European incumbent today



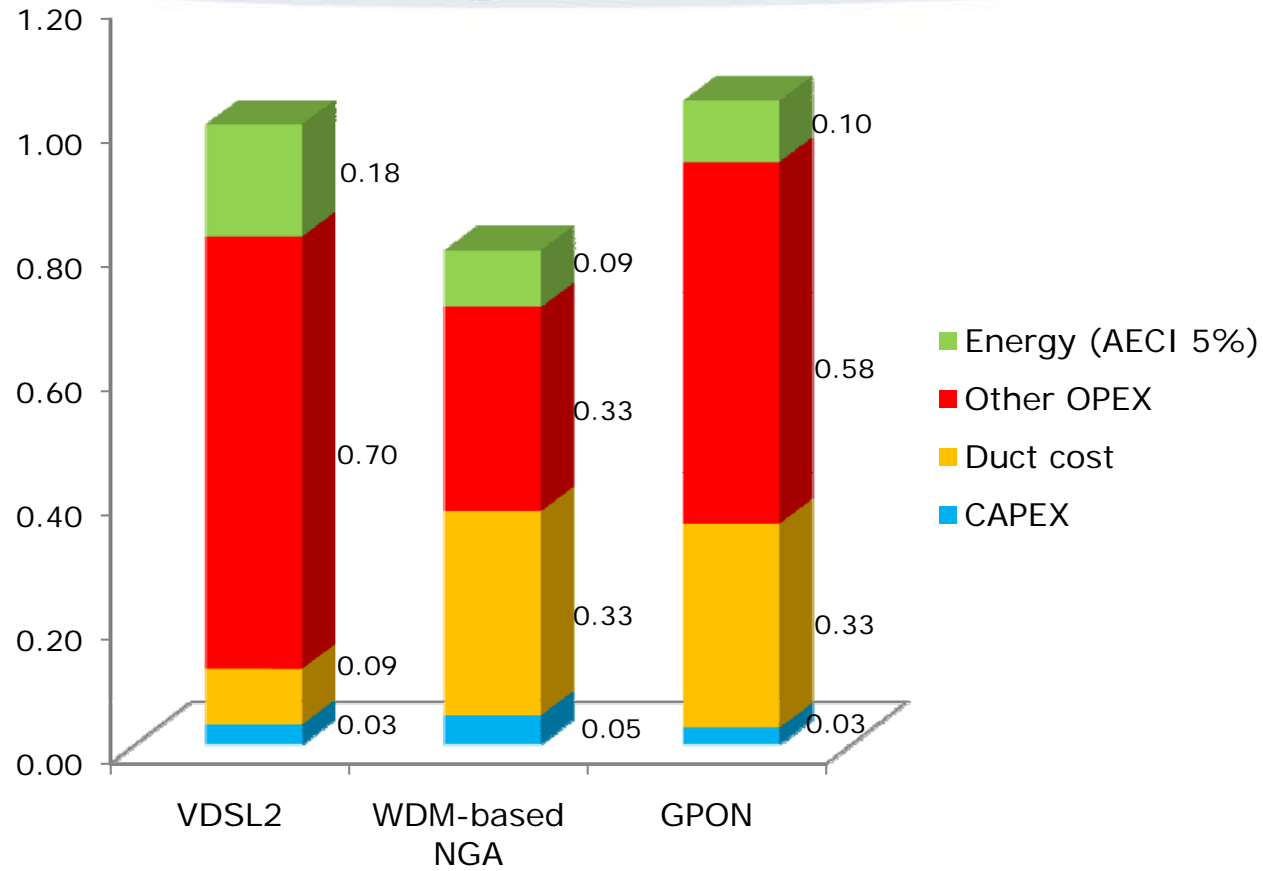
Targeted next-generation network



TCO analysis

- ▶ TCO for 3 NGA scenarios compared
- ▶ 25 years lifetime, incl. 3 systems generations, considered to account for the massive invest for new passive fiber infrastructure
- ▶ 1,000,000 residential clients w/ ~75Mb/s symmetrical CIR (non-oversubscribed)
- ▶ 10,000 enterprise customers, 90% w/ GbE and 10% w/ 10GbE dedicated access
- ▶ All scenarios protected for the feeder part
- ▶ CapEx (cost) considered in detail
- ▶ OpEx drivers considered
 - ▶ Energy (AECI 2%, **5%**, 10%)
 - ▶ Planning, Provisioning
 - ▶ Operations, administration, maintenance
 - ▶ General overhead
- ▶ Annual Energy Cost Increase (AECI) has clear impact (80 €/MWh assumed for Year 1)
- ▶ Final result does not change significantly when any single parameter is changed
- ▶ Most relevant is the capability to save on sites and feeder fibers

TCO result



Long reach, high-splitting ratio and Optical+Ethernet integration make point-to-multipoint WDM with L2 aggregation the best solution for NGA and backhaul!

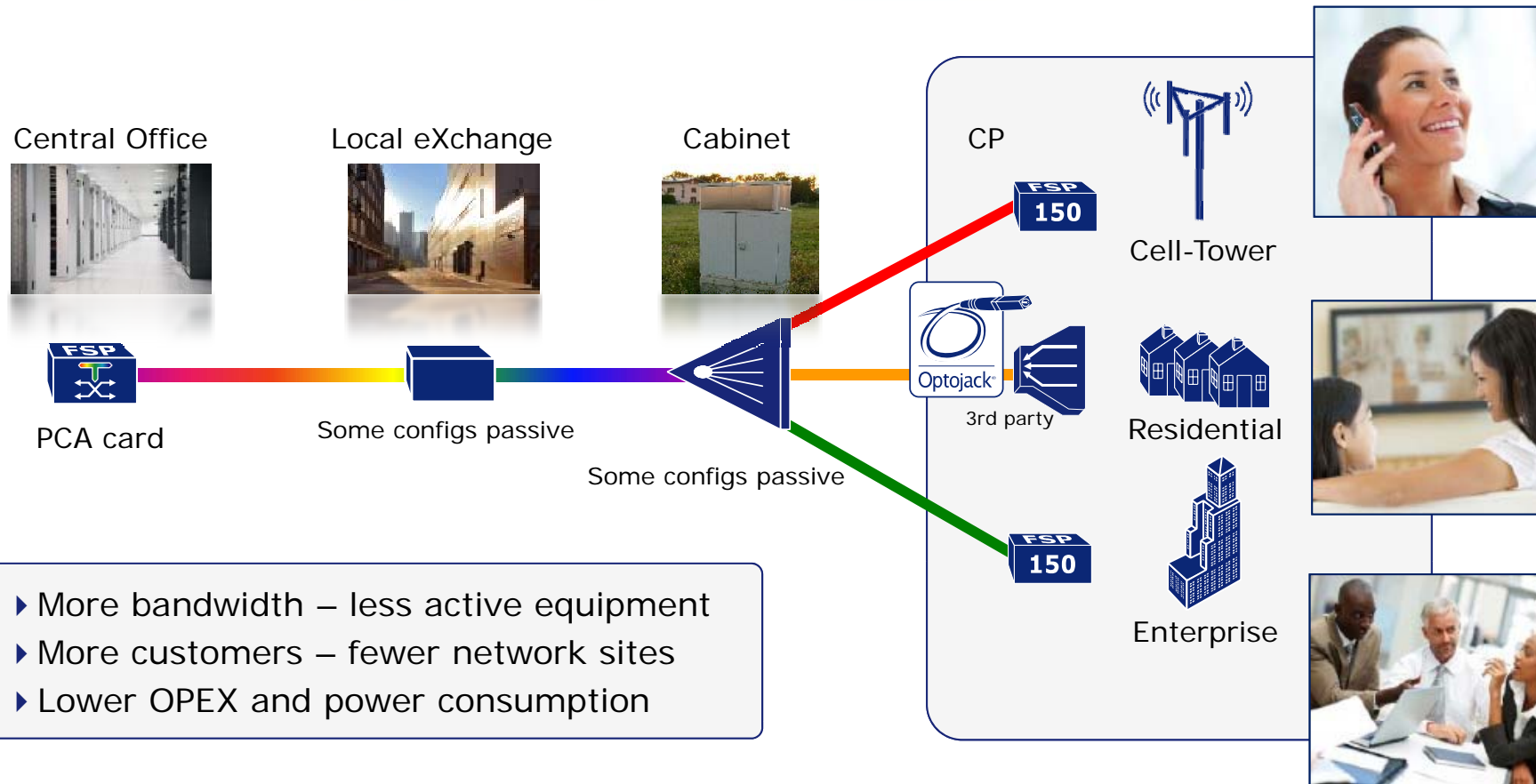
Quick explanation

- ▶ “GPON OLT placed in LX/FRN” has limitations
 - ▶ Higher energy consumption due to TDMA running on aggregate bit rate
 - ▶ GPON/pWDM does not support business customers efficiently
 - ▶ GPON more difficult to upgrade

- ▶ “Active WDM-PON + L2” outperforms all other approaches
 - ▶ Best energy efficiency; L2 concentrated in FRN, instead being dispersed (TDMA)
 - ▶ Cheapest grey (i.e., colorless) SFPs for the multitude of ONUs
 - ▶ Best BW efficiency and optical power budgets

- ▶ “WDM + (VDSL2) DSLAMs” expensive long term (though cheaper in CapEx)
 - ▶ Higher energy consumption for copper drivers – even for VDSL2
 - ▶ Shorter (copper, last mile) reach, more difficult to upgrade

NGA solution center



WDM-based NGA: combining point-to-multi-point fiber topology with secure point-to-point traffic separation and scalability

The ADVA logo is a large, light blue circular emblem with a stylized 'A' shape inside, positioned on the right side of the slide. The background of the slide features a blue gradient with abstract light patterns and the word 'ADVANCE' in a light blue, sans-serif font on the left side.

ADVANCE

Thank you

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