

# Examining the Evolution of the Access Network Topology

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Matthias Fricke, Deutsche Telekom, Network development and evolution



# Agenda

- Evolution of the access network topology
- Drivers for fiber access and passive optical networks
- GPON and WDM-PON
- Power Budget and Power Levels
- NGOA – Coherent Detection Simplified
- NGOA – Multi-service support and open business models
- Conclusions



# Evolution of the access network topology

## Background

Currently there is a heated discussion in the telecommunication industry with respect to future access network topologies. The discussion focus regarding access network evolution is not only an access issue, but rather a total network cost optimization opportunity.

Why is it so important?

- Considerable OPEX originate from central office operations– reducing the number of offices is the key for reducing costs.
- FTTH is the most OPEX-friendly scenario, because it allows for completely passive access networks through minimizing number of active components in the network.

In particular, office consolidation enlarges the access network footprint and demands enhanced capabilities from the access technologies. New questions arise in the context of the access network evolution:

- How can FTTH deployments be supported in a cost-efficient manner when considering office consolidation strategies?
- What is the impact on network architectures and related technologies?



# Evolution of the access network topology

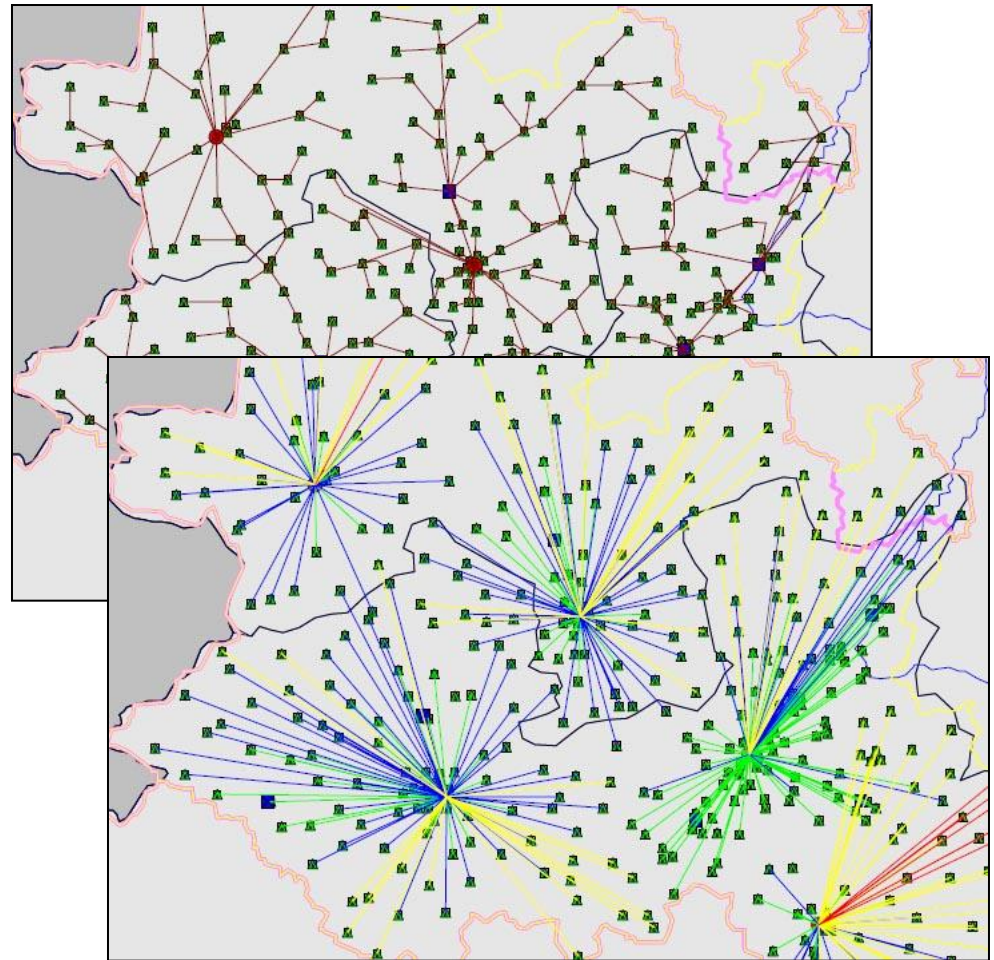
## Access backhauling to aggregation office locations

Results drawn from a network architecture example:

- The number of central offices can be significantly reduced
- Assumption based on fiber availability

Access technology impact:

- The optical backhauling distance between subscribers and aggregation offices increases to
  - 20 km - typical
  - 50 km - maximum

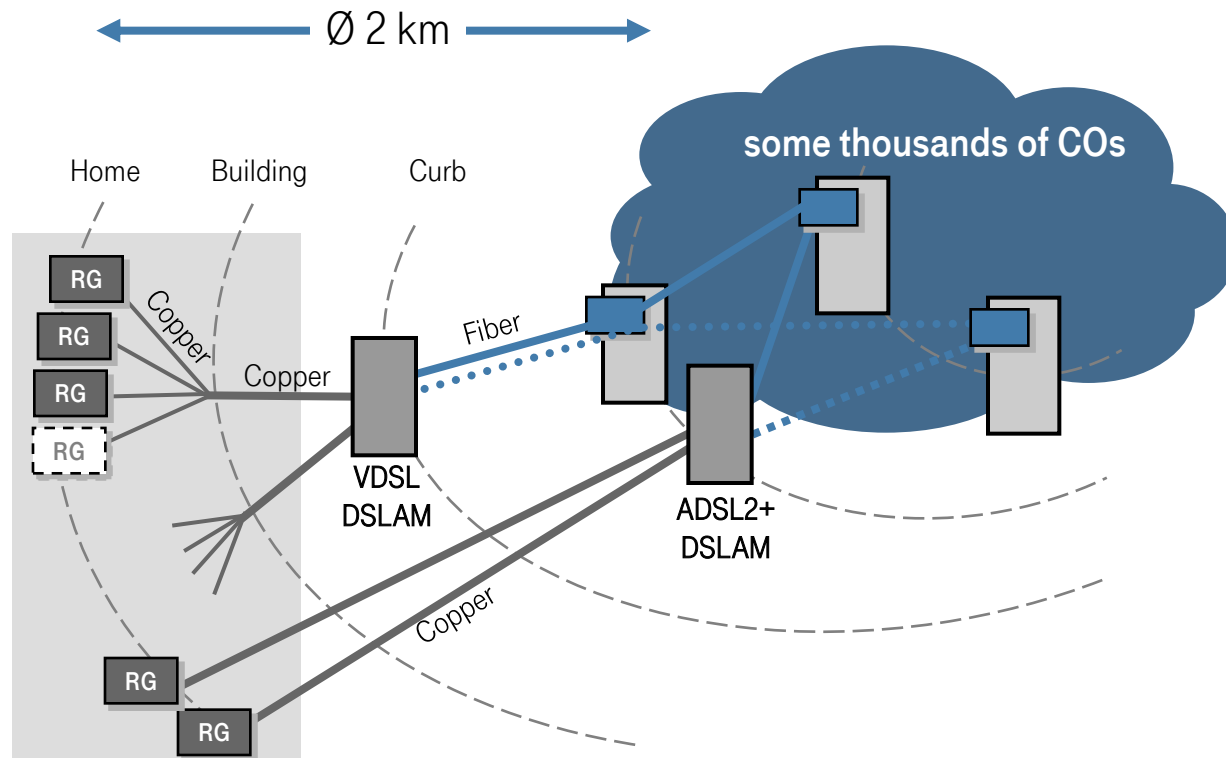


Source: P. Greil, Deutsche Telekom, Detecon Networks Forum 2007, Dresden



# Evolution of the access network topology

## The access network architecture – today's example



RG = Residential Gateway

Number of central offices

- resulted from the historical growth of PSTN
- used for ADSL2+-based broadband services
- average distance of 2 km between customer premise and CO
- must support a few thousand customers per CO on average

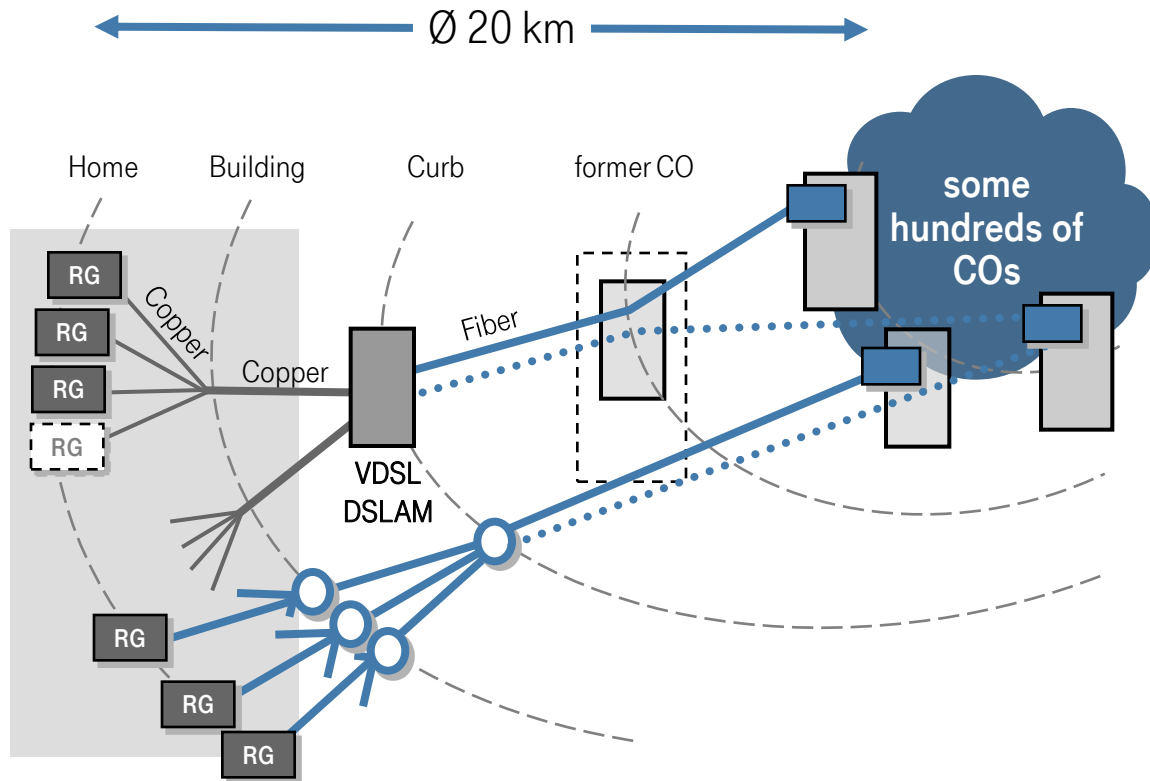
Fiber to the Curb

- VDSL2 can provide up to 50 Mbit/s access for triple play services



# Evolution of the access network topology

## The access network architecture – tomorrow's option



..... Redundancy optional

### Reduced number of COs

- promises significant OPEX savings
- means an average distance of 20 km between customer premise and CO
- must support on average tens of thousands of customers per CO
- requires efficient fiber utilization resources between former and remaining COs



# Drivers for fiber access and passive optical networks

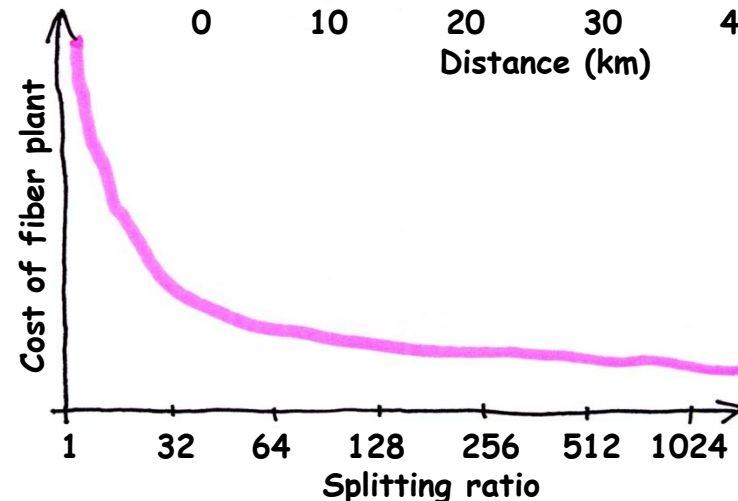
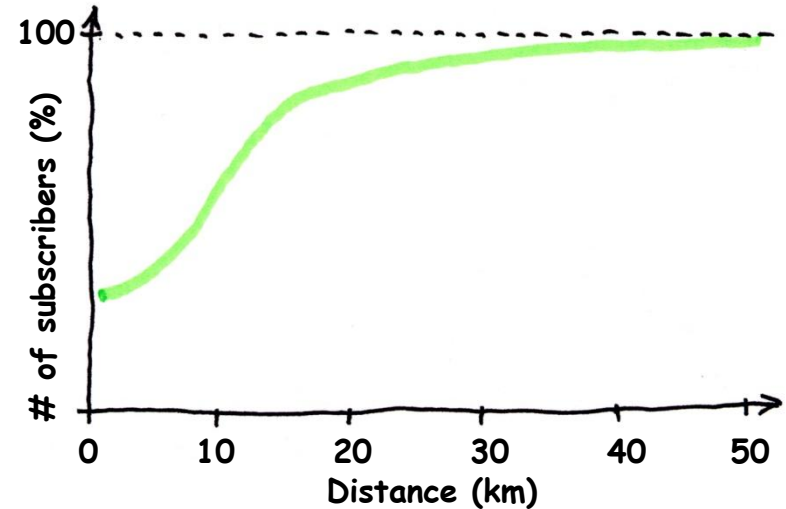
## Cost-benefit of subscriber concentration

### Access distance

- Selection of the remaining COs needs to be aligned with subscriber density
- Typical resulting distances can be bridged easily by current fiber optic technologies

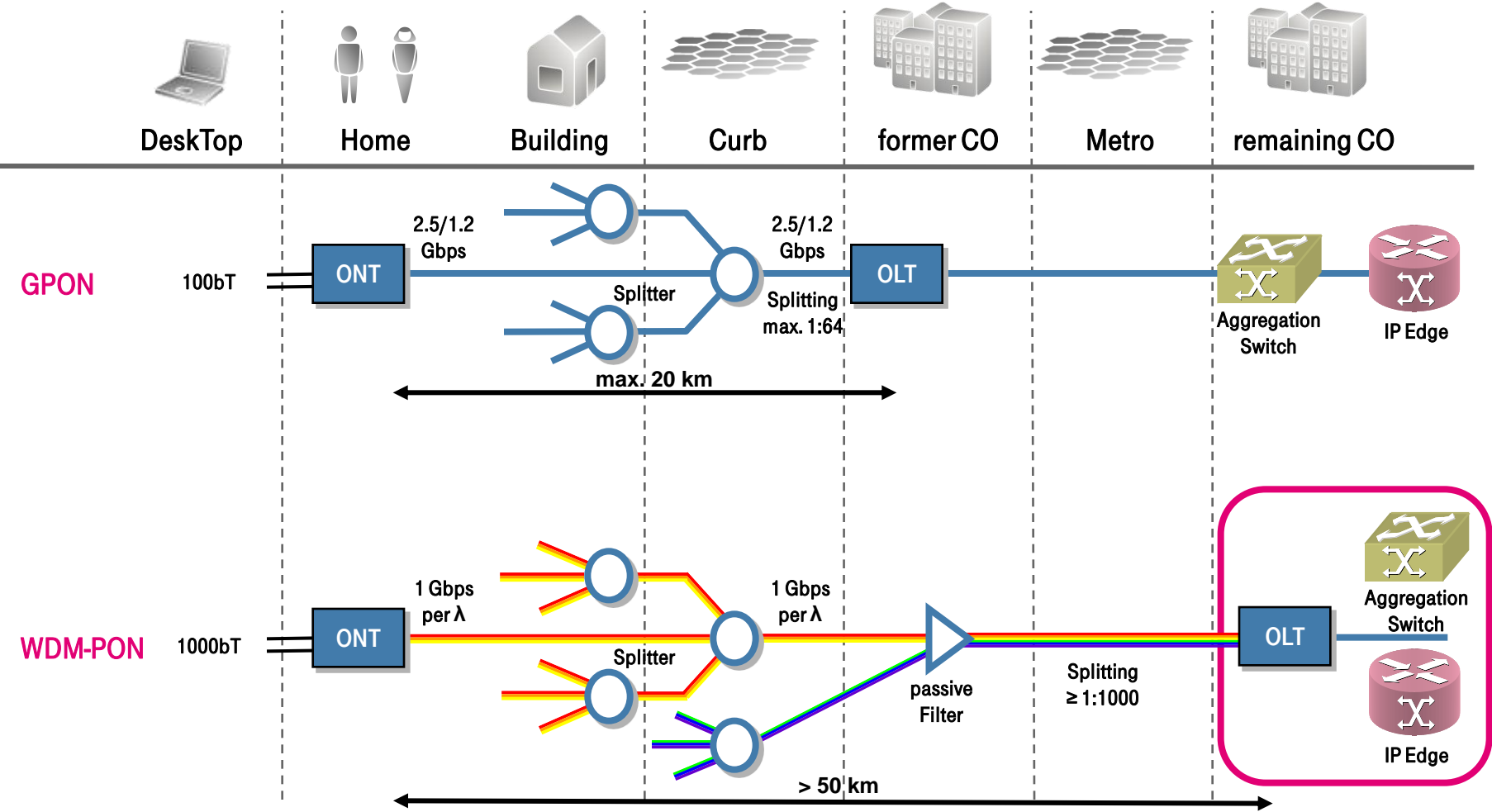
### Splitting ratio

- A high splitting ratio (or aggregation of customer traffic) is a highly desirable cost saving factor



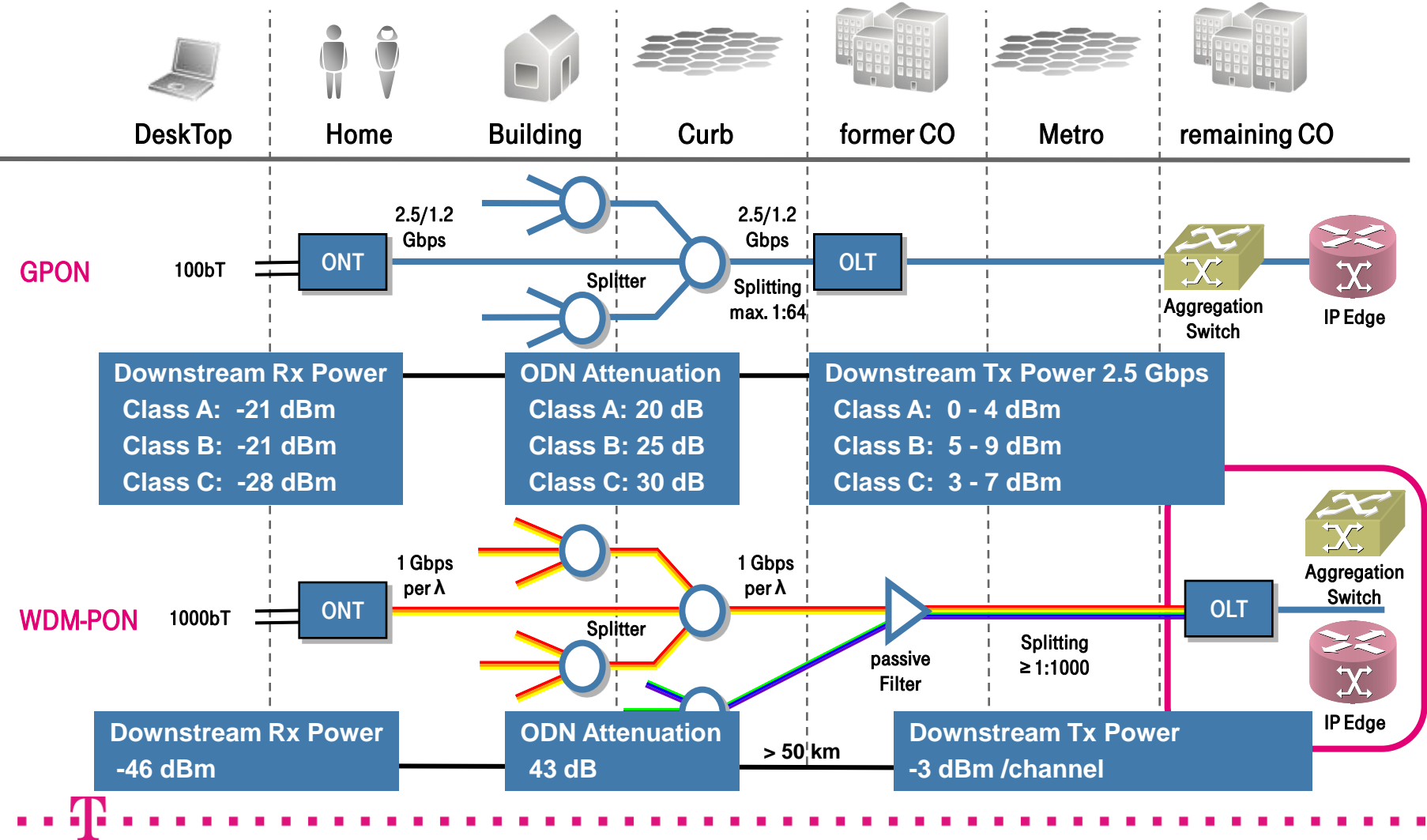
# GPON and WDM-PON (NGOA)

## Comparison of network topologies



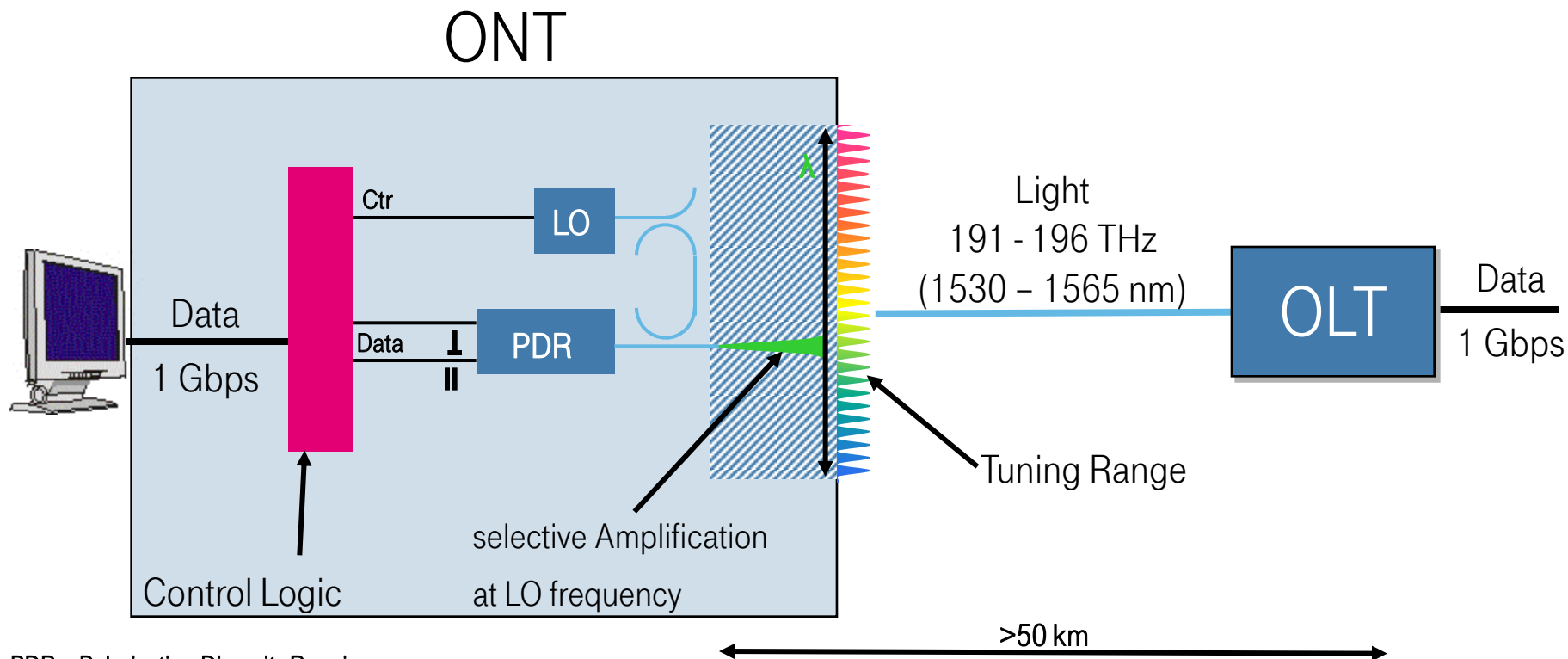
# GPON and WDM-PON (NGOA)

## Power budgets and power levels



# WDM-PON (NGOA)

## Coherent detection simplified



PDR – Polarization Diversity Receiver  
 LO – Local Oscillator

Downstream Rx Power  
 -46 dBm

ODN Attenuation  
 43 dB

Downstream Tx Power  
 -3 dBm /channel



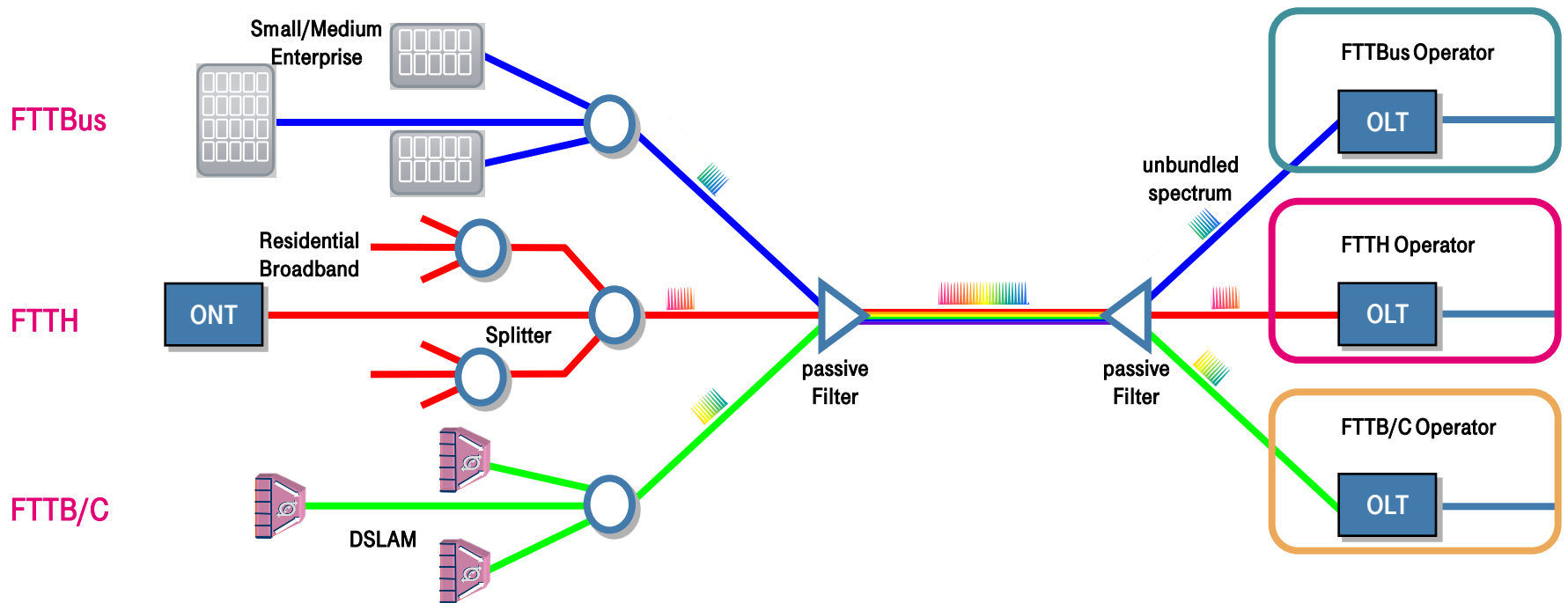
# WDM-PON (NGOA)

## Multi-service support and open business models

Gigabit Ethernet design in conjunction with WDM-PON supports full flexibility for multi-service deployments:

FTTH, FTTB, FTTC, FTTBus, Mobile Backhauling, ...

Logical point-to-point design on wavelengths enables new, innovative business models and supports legacy deployments by wavelength bundling.



# Conclusions

- There is a global network development trend towards office consolidation
- Optical fiber access technologies support office consolidation
- The outlook is positive regarding requirements for:
  - bandwidth
  - reach
  - low fiber consumption
  - TCO
  - coexistence of GPON and WDM-PON solutions
- NGOA with coherent detection is an interesting option to further optimize access networks

Office consolidation utilizing optical access technologies can help prepare networks to deliver diverse future services in a cost-efficient manner.



Thank you for your attention!

