Next Generation EPON

Considerations of ODN, Coexistence and Transmission Speed

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Discussion Topics

- **Optical Distribution Network**
- **Coexistence**
- **Transmission speed**

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Loop Length Discussions in EFM 2001

We had some loop length discussions

- 10Km covers ~99% of subscribers in most of Europe & Japan

  http://www.ieee802.org/3/efm/public/jan02/mickelsson_1_0102.pdf
- 20Km covers ~100% of subscribers in new build areas North America.

  http://www.ieee802.org/3/efm/public/nov01/ford_1_1101.pdf

Most of these data were from the conventional Telco's metallic access networks.

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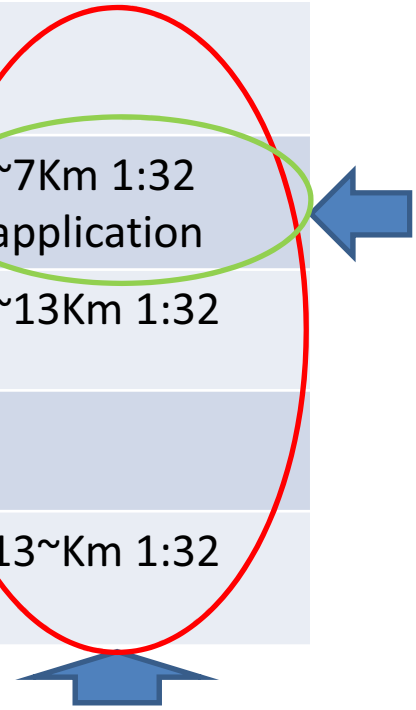
ODN Link Budget

29dB link budget covers more than 98% of 1:32 PON FTTH.
The differences between Std. target and actual applications are observed.

CLASS	Optical Budget	Std. Target Application	Actual Application
PX10	20dB	10Km 1:16	
PX20	24dB	20Km 1:16 10Km 1:32	
PX30	29dB	20 Km 1:32	~7Km 1:32 application
Long Reach	32dB	Non-Standard	~13Km 1:32
PX40	33dB	20 Km, 1:64	
Extended Long Reach	37dB	Non-Standard	13~Km 1:32



~7Km link length, FP lasers support upstream transmission.

Actual application areas are more limited than Std.

Link Loss Calculation of ODN Design

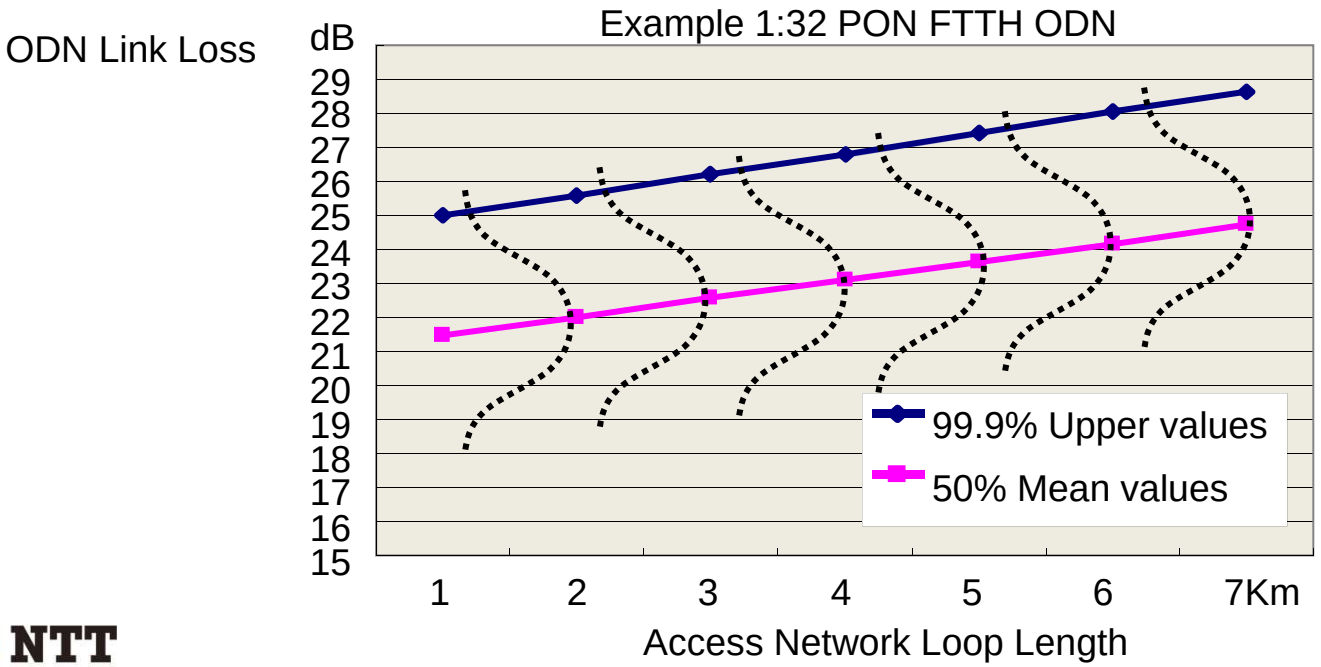
For the long-term use of ODN, the link losses should be carefully calculated.

We use Gaussian statistical calculation for Access Network link budget.

(ITU-T G.982 Appendix IV).

This approach takes the deviation of each passive component loss into account.

The calculated values also include the estimated margins for repairing the network.

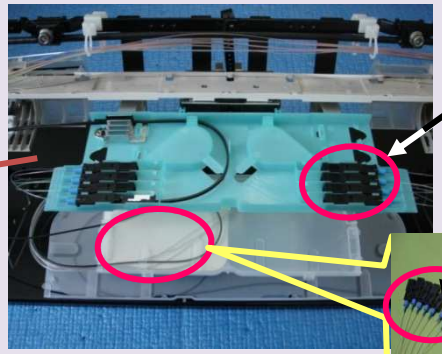


Example of FTTH Access Network

The basic configurations have not been changed for more than 15 years

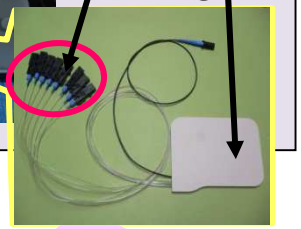
Innovative R&D by NTT

Aerial Section

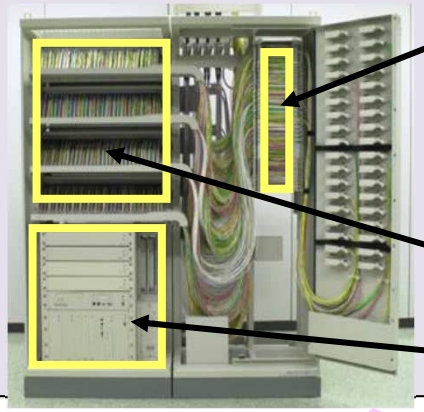


FAS connector

Splitter Module 1:8



Central Office



Splitters 1:4

4000 fibers termination

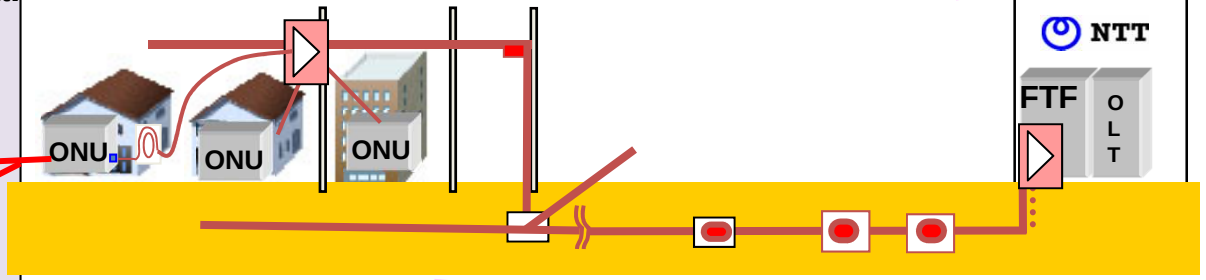
OTDR

Customer Premises

Free Bending Optical Fiber Cord

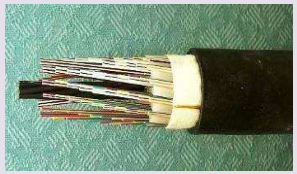
ONU

Optical cabinet

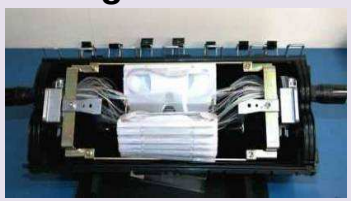


Underground Section

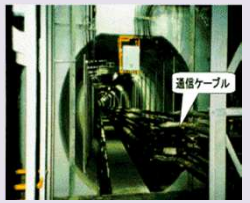
1000-Fiber cable



Underground Closure



Tunnel



Bridge

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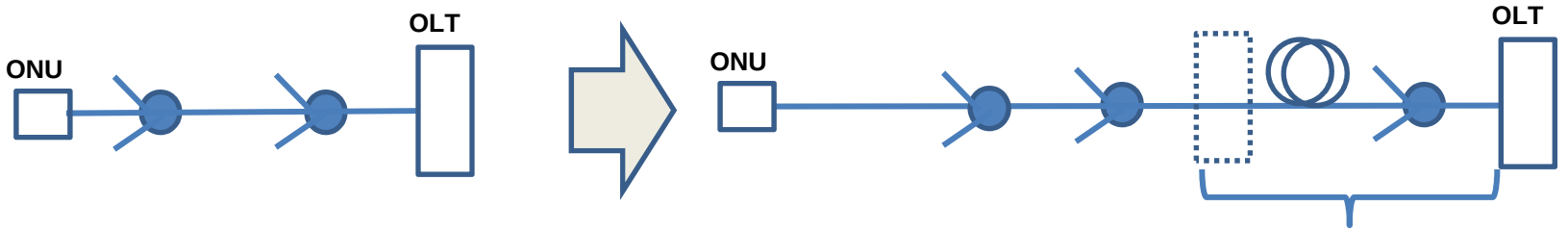
Future ODN

The current ODN configurations will be maintained for long time.

When we design the new ODN in the access network, the basic approach will not be changed.

According to the present calculation approach, over 40Km loop length @ 1:32 may demands 50dB link budget.

1:128 PON network would not just add another 6dB, but different types of network faults and margins for repairing them might be considered. Therefore there are big challenges for CO consolidations and higher PON splitter operations.



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Current Optical Wavelength Allocation

Current FTTH uses 4 λs.

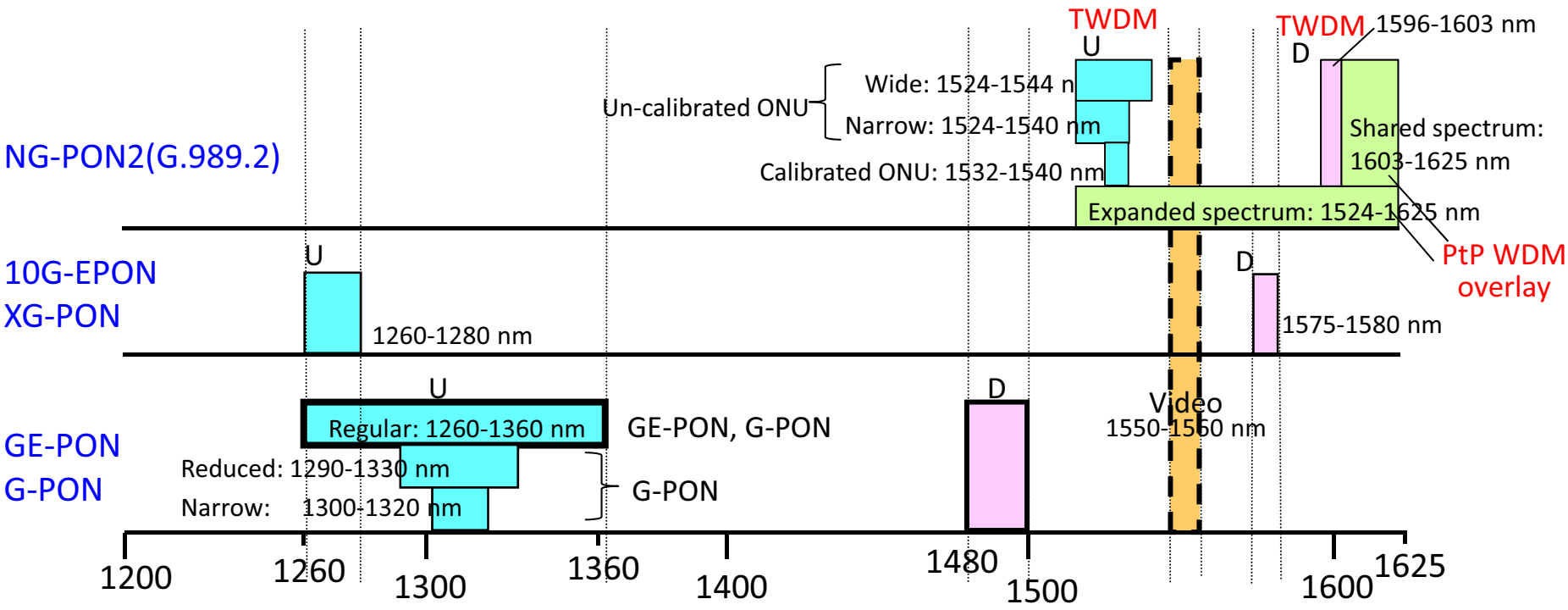
EPON:1260-1360nm, 1480-1500nm

RF-Video: 1550-1560nm

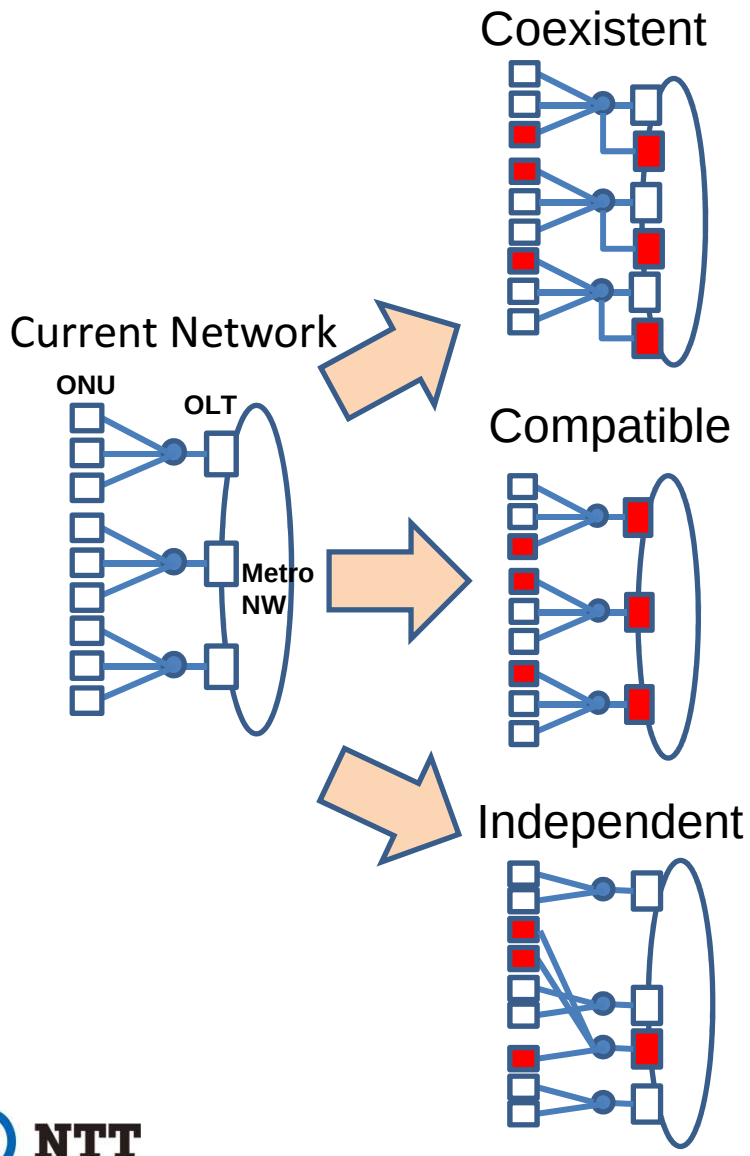
OTDR: 1625-1650nm

The blocking and band-pass filters were considered to meet the 4 λs.

The 100% future coexistence is not guaranteed without any change.



Coexistent, Compatible, Independent



Sharing the ODN

Ex. EPON + RF overlay (Metallic: PSTN+ DSL)

Pros. Reduce the ODN cost
Cons. Restricted by existing ODN

Sharing ODN & Access system

Ex. EPON-ONU & 10GEPON (Metallic: DSL)

Pros. Future service upgradability
Cons. Overinvestment to unsure demands

Using different ODN

Pros. Independent
Cons. Network cost

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The Demand for Higher Bandwidth.

1G FTTH services have been successfully deployed both residential and SOHO business customers.

4K/8K videos and Cloud services would require higher-bandwidth.

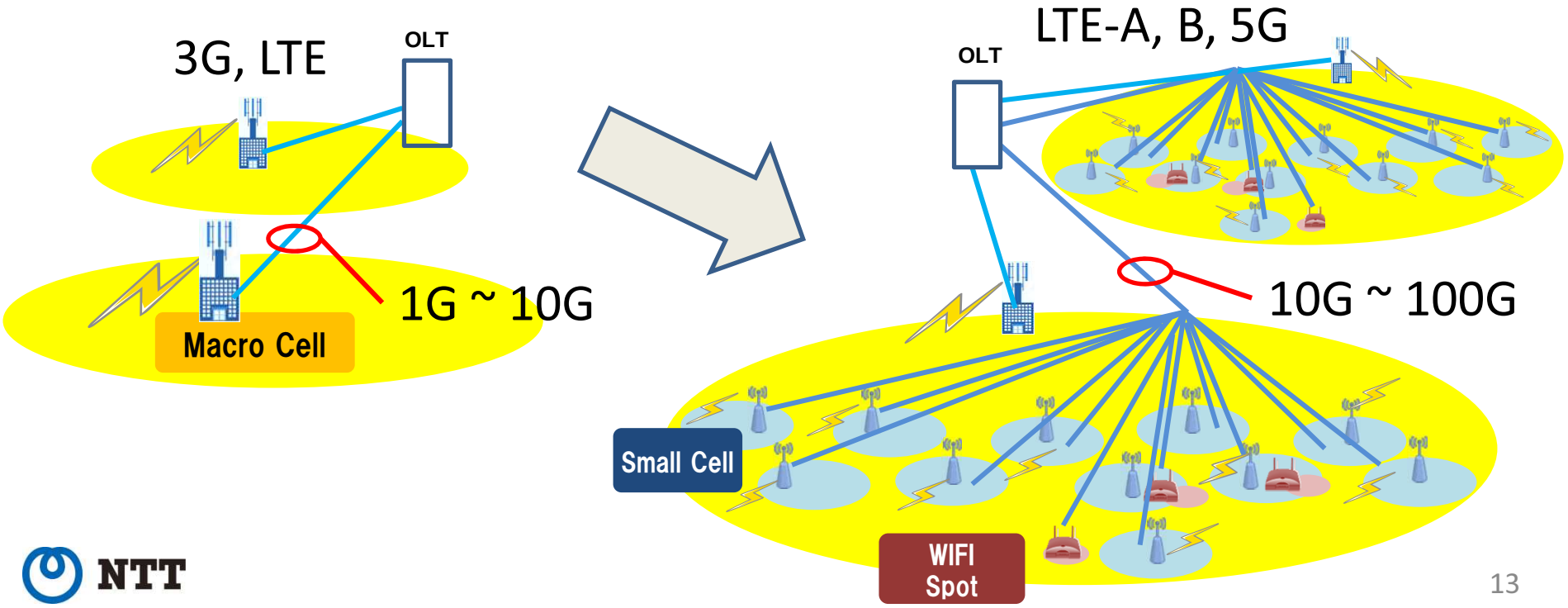
(10GEPON could support them technically, but the current business model could not support them satisfactorily.)

The most promising application in the fiber optic access is the working with Mobile.

- 3G base-station has used 1G backhaul today.
- LTE, LTE-A (4G)uses 1G to10G access for the backhaul.
- The backhaul 5G might support 10G or higher(100G).

Mobile Backhaul Applications

5G mobile will support 1G or higher speed wireless access.
The cell size will be (much) smaller to support higher/wider frequency bandwidth.
The deployment of the backhaul network accommodating a large number of base-stations, which will ask 10G or 100G, might be the most challenge in the access.



Conclusion

Current ODN will be maintained for long time. The basic ODN design approach will be also maintained.

The necessities of coexistence and compatibility depend on operator’s business plans.

From the transmission speed viewpoint, over 10G speed will be required by Mobile backhauls rather than conventional broadband access services.

The cost-effective 100G fiber optic access might be required for the work with the future (5G) mobile networks.