

Market tendencies in optical networks

(Tendencias de mercado para las redes ópticas)

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NEC

Agenda

- Introduction

- Optical Technologies
 - FTTx (Fiber to the home, building, cabinet, etc.)

 - Carrier Ethernet

 - WDM (Wavelength Division Multiplexing)

- Technology Movement

- Introduction**

- Optical Technologies

 - FTTx (Fiber to the home, building, cabinet, etc.)

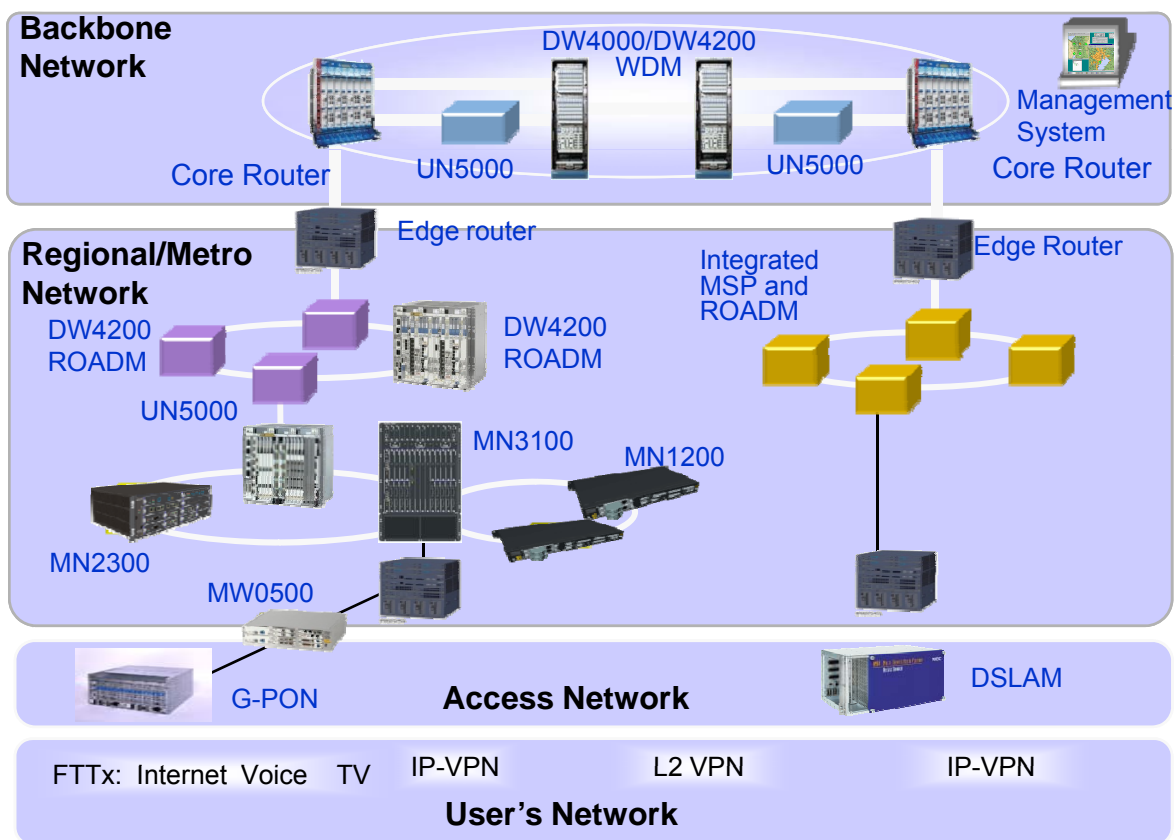
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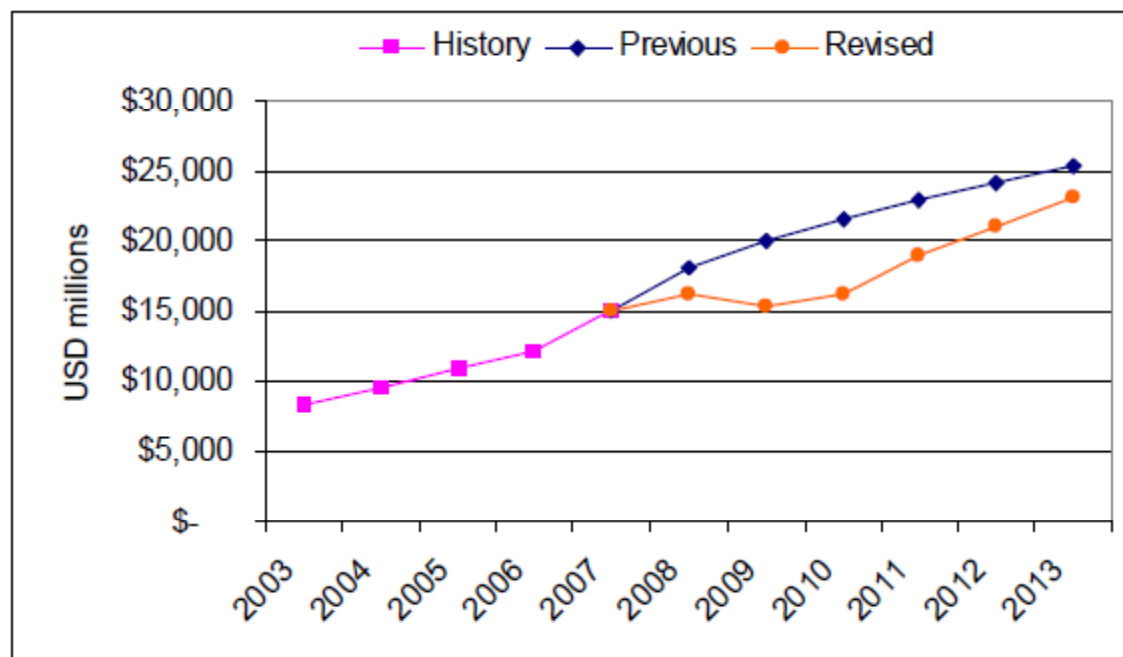
Introduction

The optical communications has an important role within telecommunications networks, in fact this networks are present in several layers as, Backbone, Regional and access



Expectation for Global Optical

Figure 1 Top-line market forecast revision vs. previous forecast

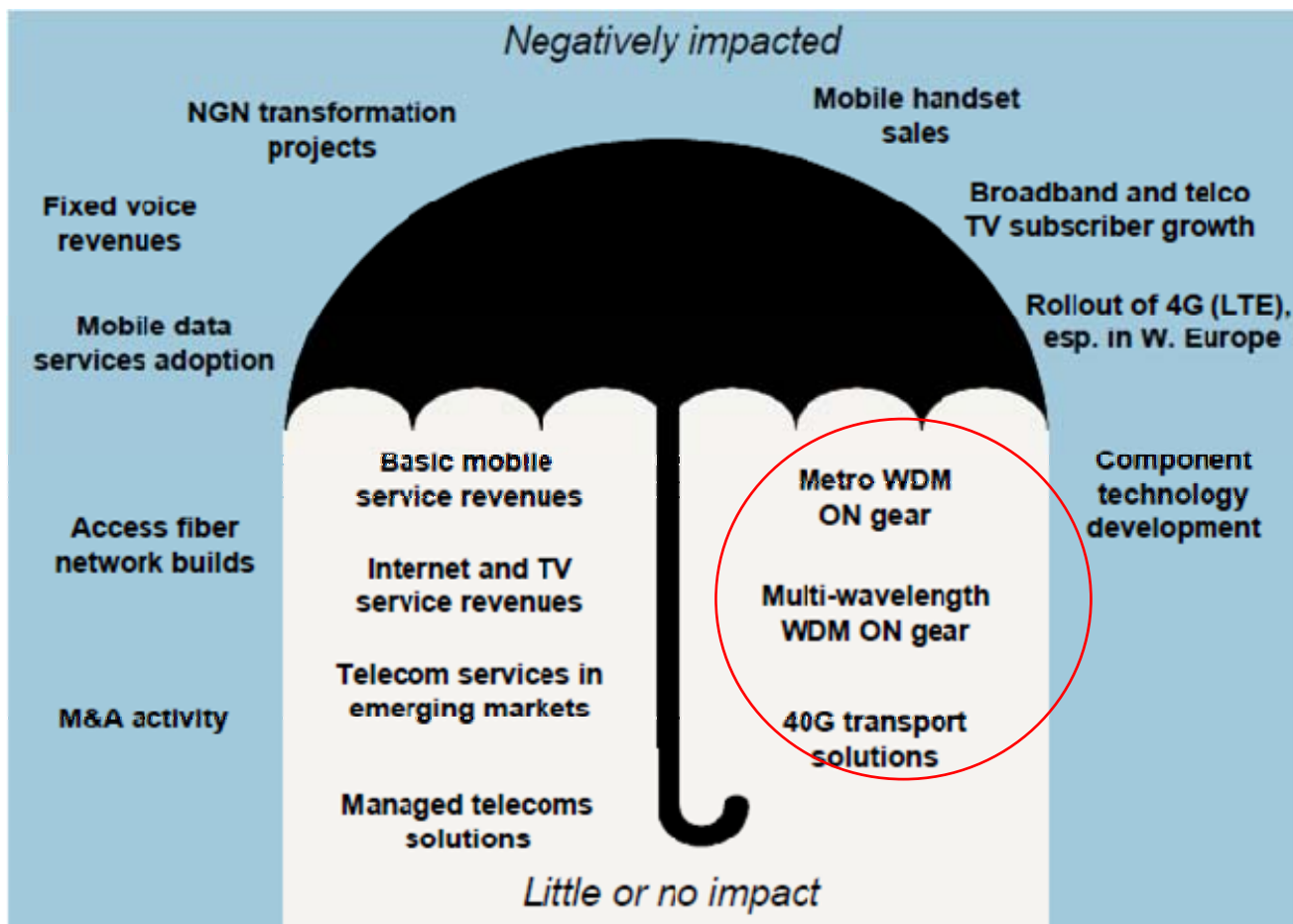


Source: Ovum (DEC2008)

- Expecting at least a 5% spending decline in 2009 followed by only modest growth at best in 2010.

Impact from Financial Meltdown

Figure 1 The impact of the financial meltdown and recession on telecom



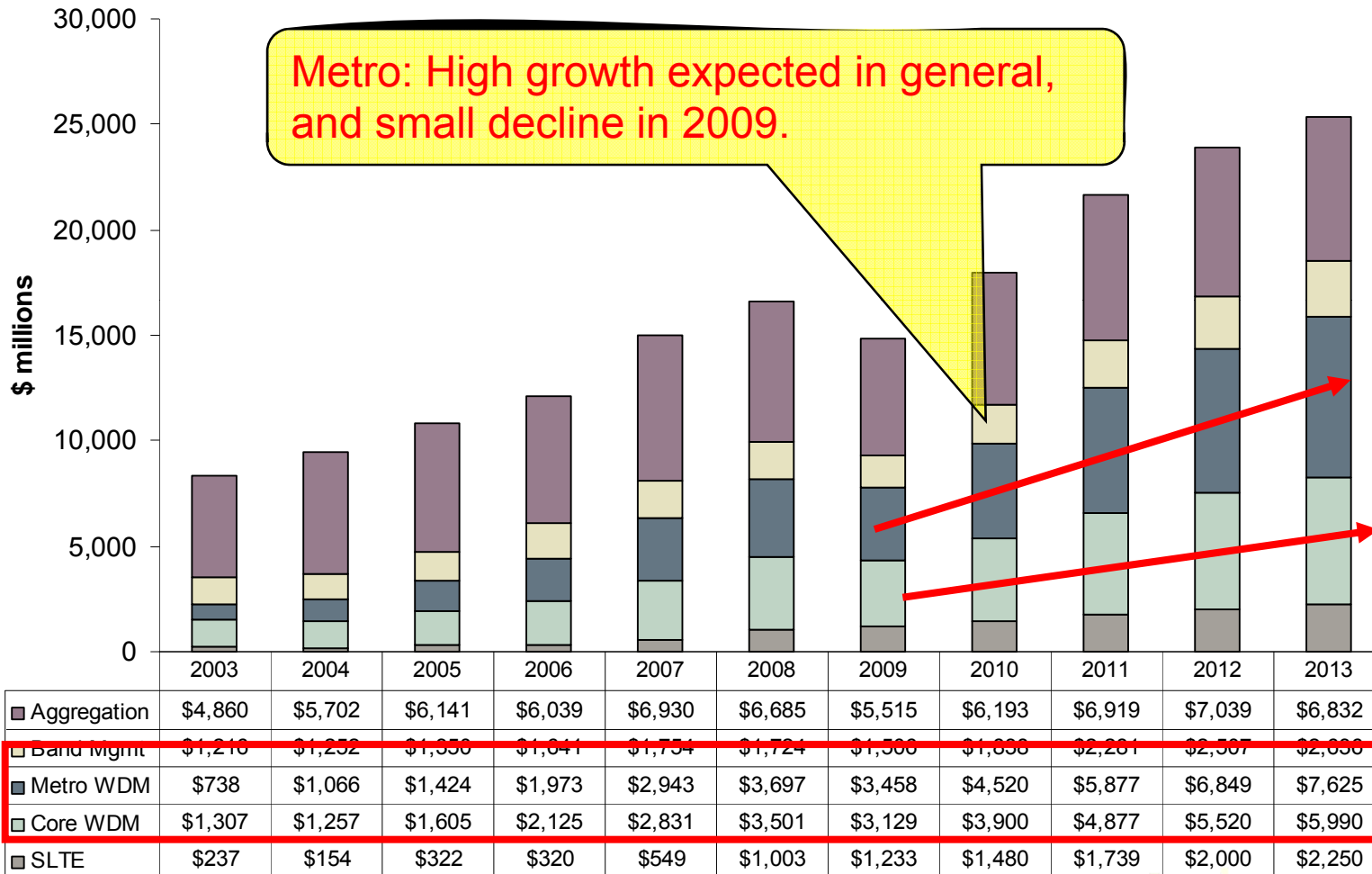
Source: Ovum

NEC

Empowered by Innovation

Optical Transport Market

■ SLTE □ Core WDM ■ Metro WDM □ Band Mgmt ■ Aggregation



Forecast by product group, Optical Network Global, 2003–2013

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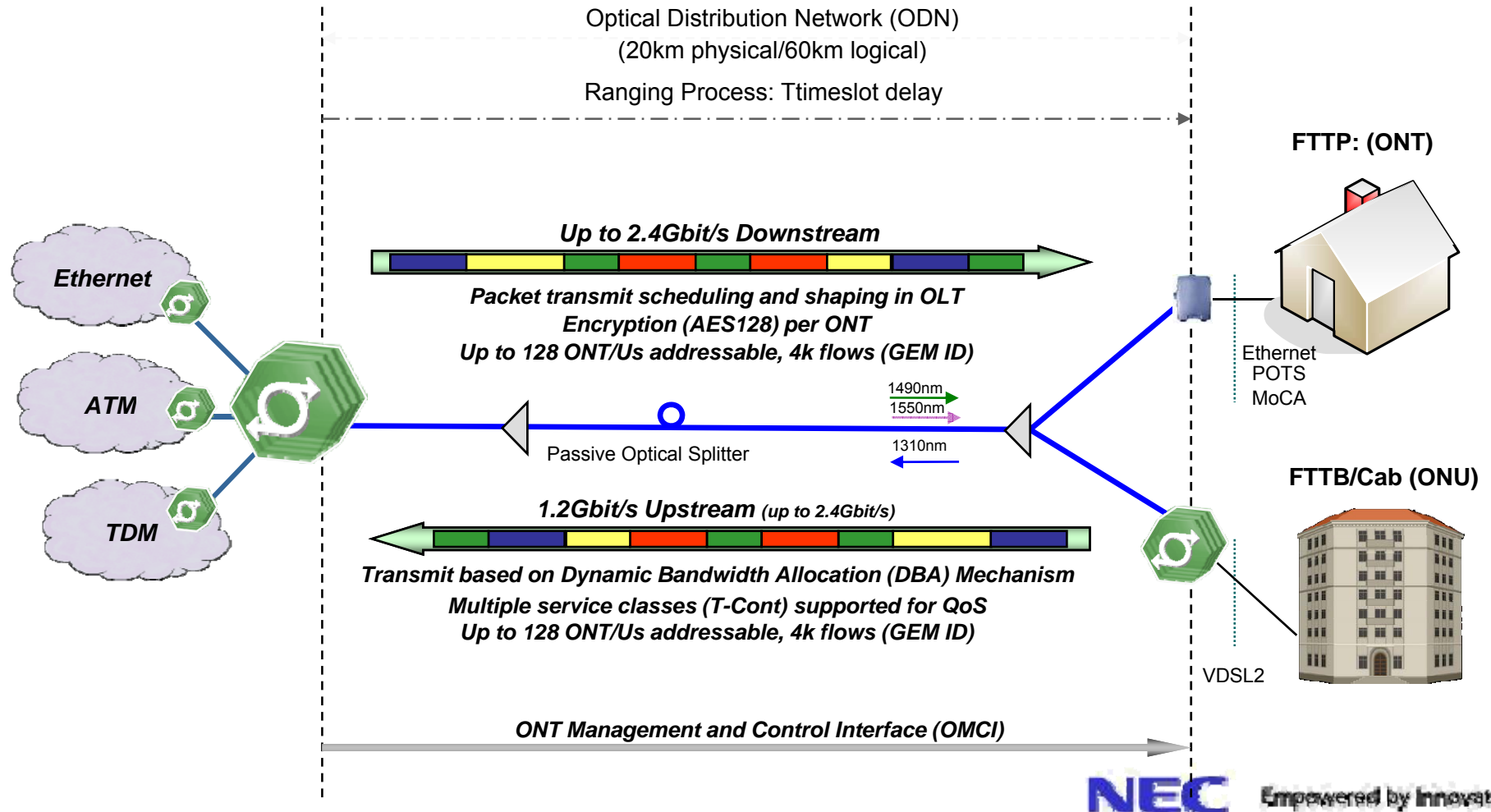
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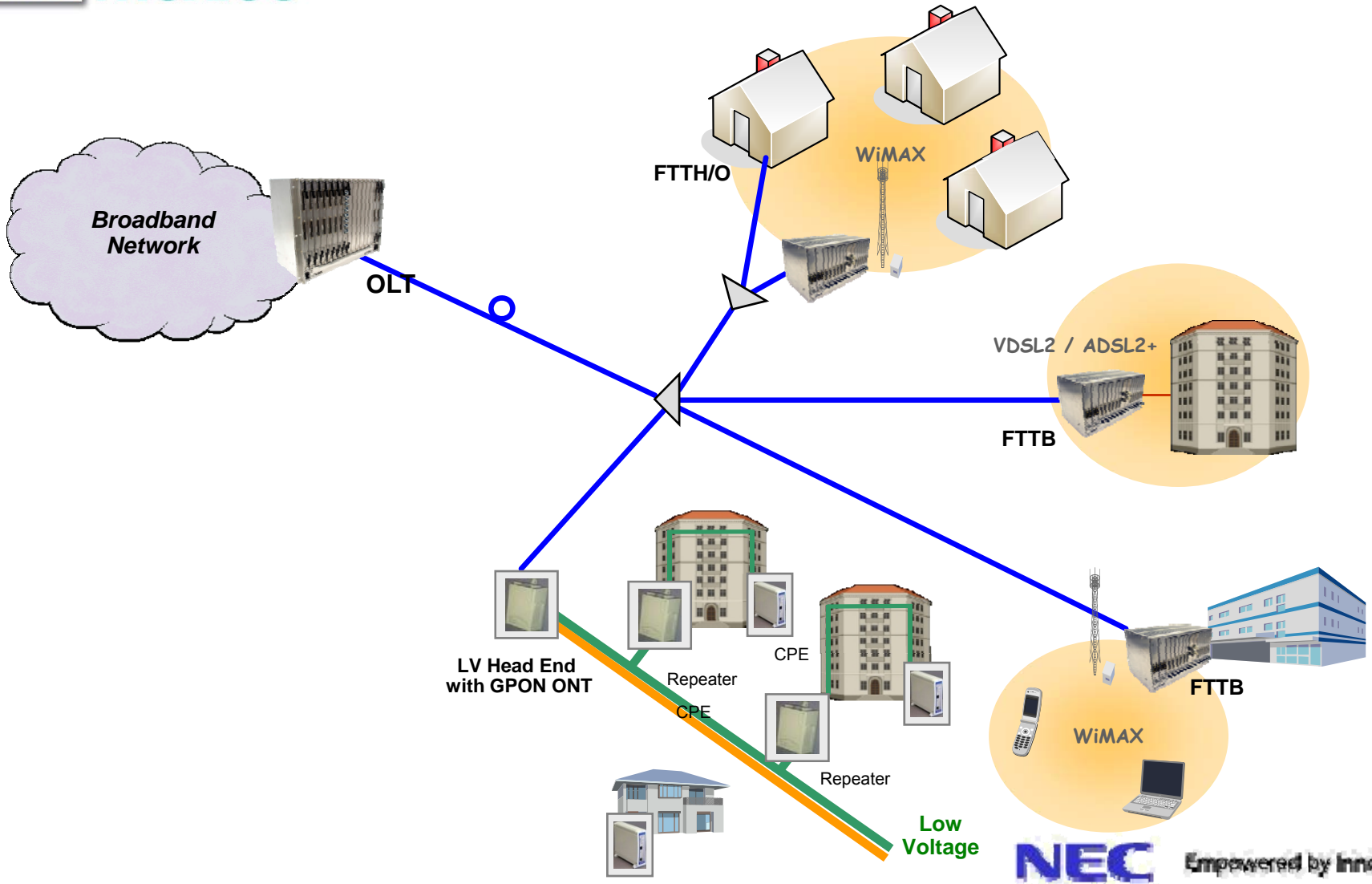
FTTX GPON: Overview

Optical Line Termination (OLT)
 CO-site or Remote

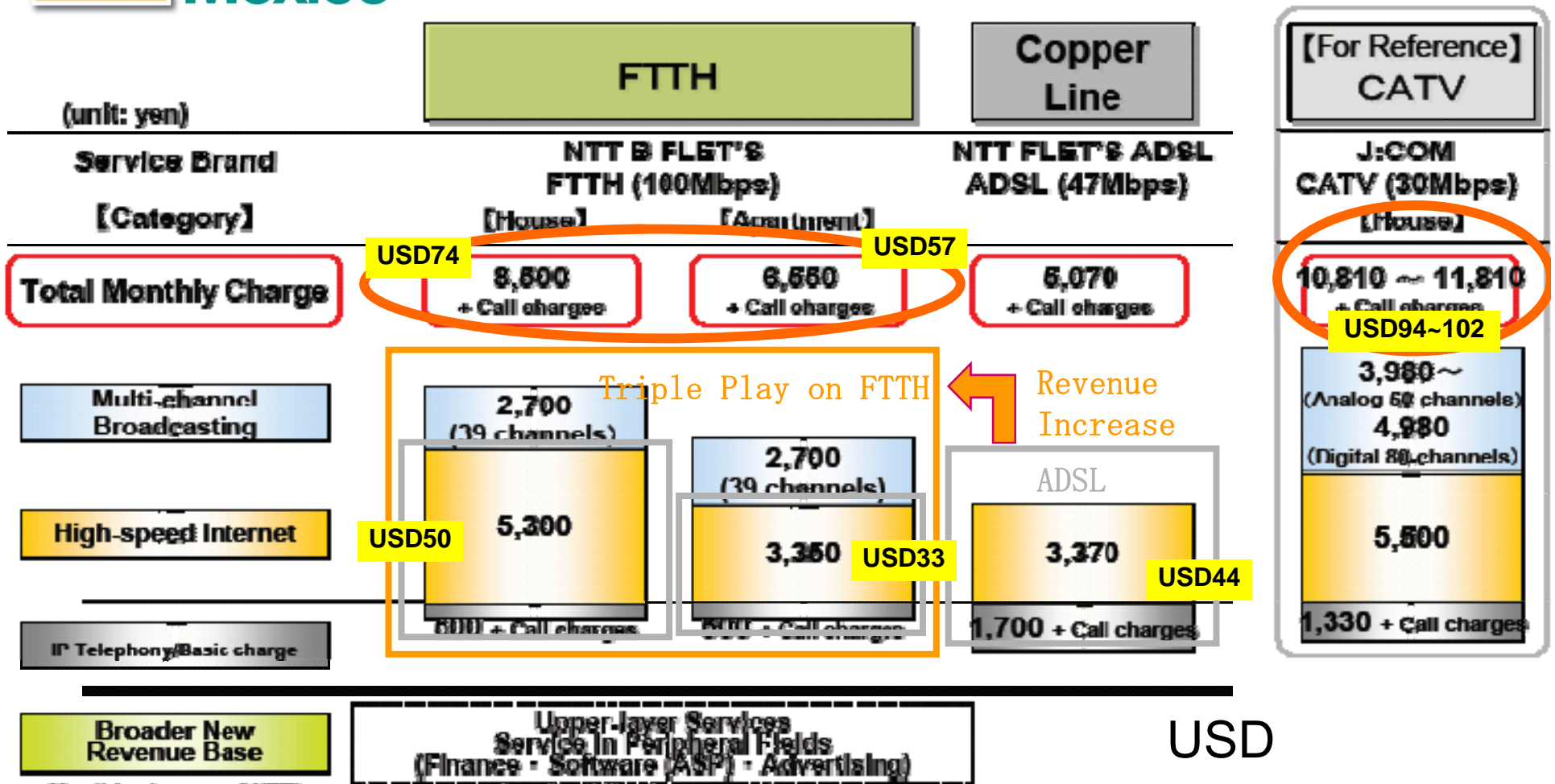
Optical Network Unit/Termination (ONU/ONT)
 FTTH/O, FTTB



GPON Everywhere: DSL, Wimax and Power Lines



Comparison of Broadband Triple-Play



- Introduction

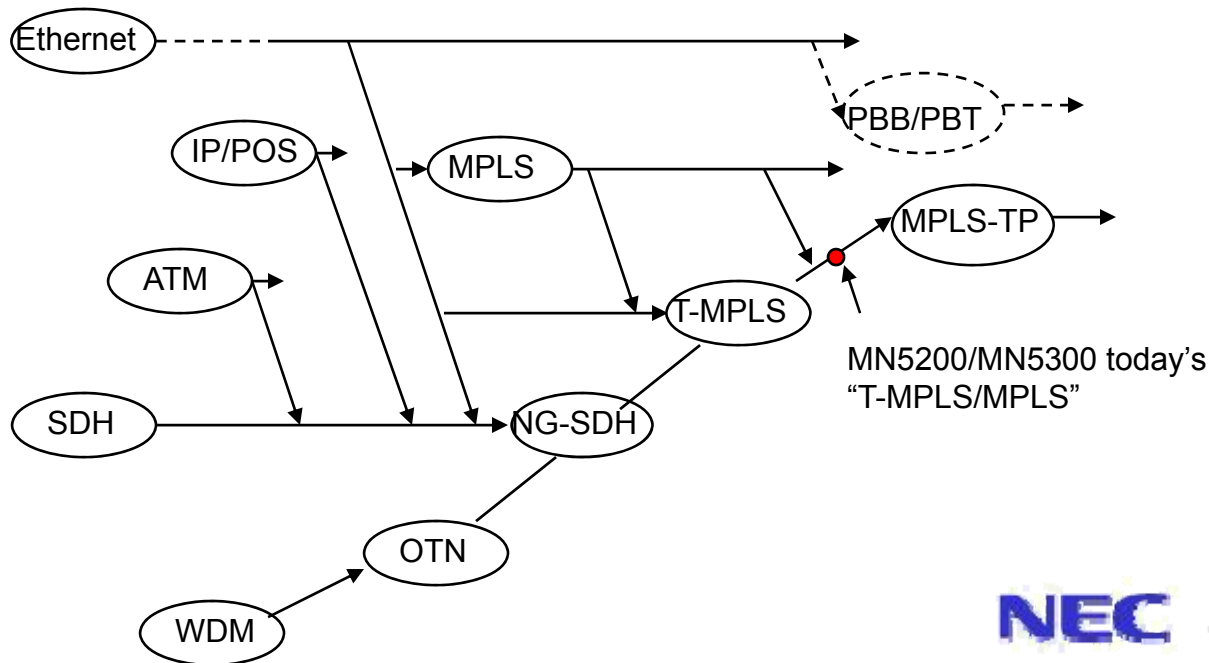
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Technical Trend in Packet Transport Technologies

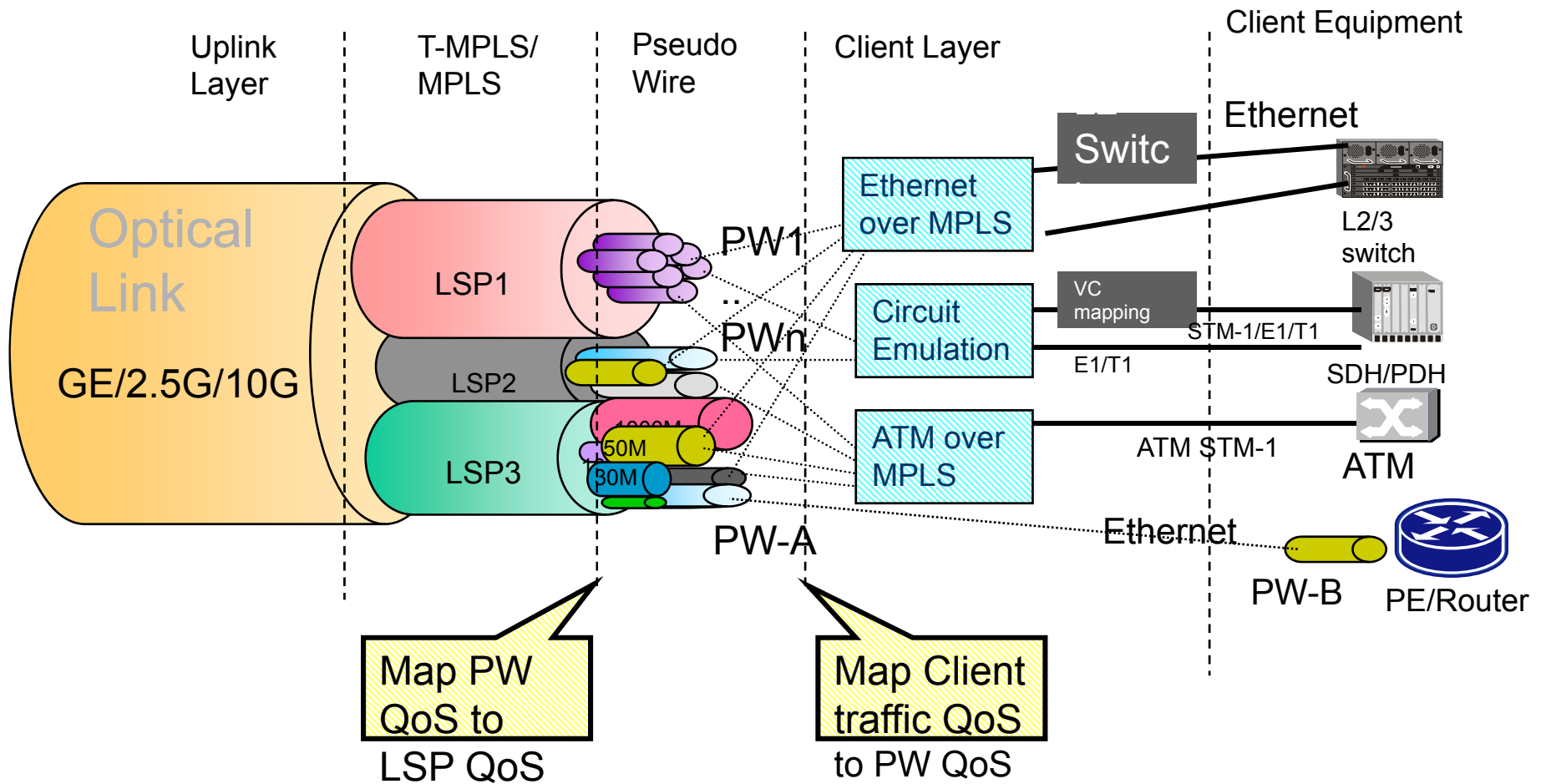
- Current packet transport technologies
 - MPLS-TE + PWE3
 - T-MPLS and MPLS-TP
 - PBT
- NEC MN5200/MN5300 today's "T-MPLS/MPLS" solution



Technical Comparison - All With PWE3

Technology	MPLS-TE	T-MPLS	MPLS-TP
Service Type	P2P, LAN	P2P	P2P, LAN
Tunnel	PW/LSP	PW/LSP	PW/LSP
QoS	E-LSP/L-LSP	E-LSP/L-LSP	E-LSP/L-LSP
Control Plane	Routing Signaling	Not now	Routing Signaling
Management Style	Data style	Transport style	Transport style
OAM	LSP Ping/Tracert	Packet APS OAM	MPLS OAM
Protection	Fast Rerouting	Linear/Ring APS	Linear
Typical Topology	Mesh	Ring, Linear	Mesh
Multicast	IP Routing	Not Design	VPLS optimization
Synchronization	No	Support	Support

Traffic flow in the network



- Introduction

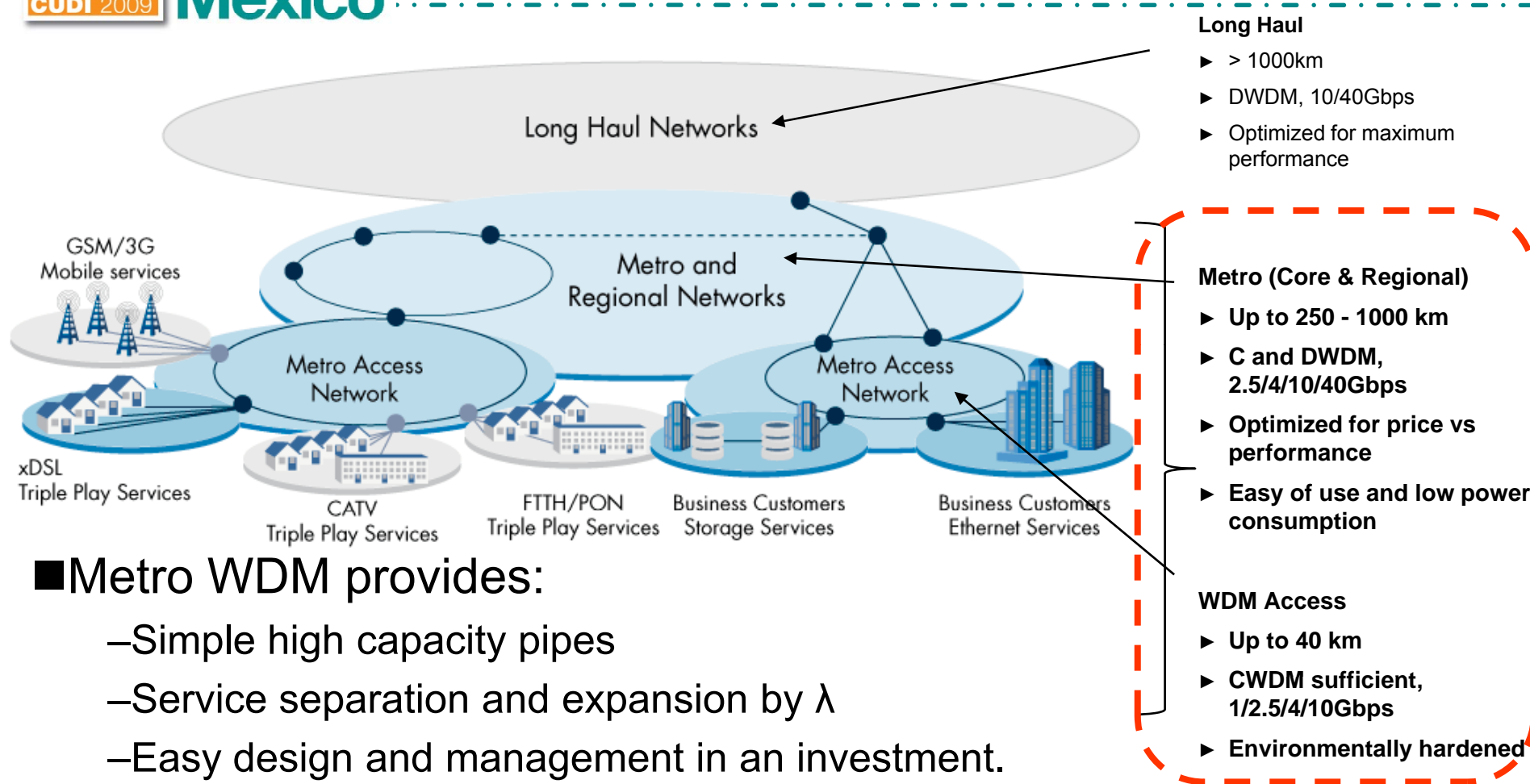
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What is Metro WDM?

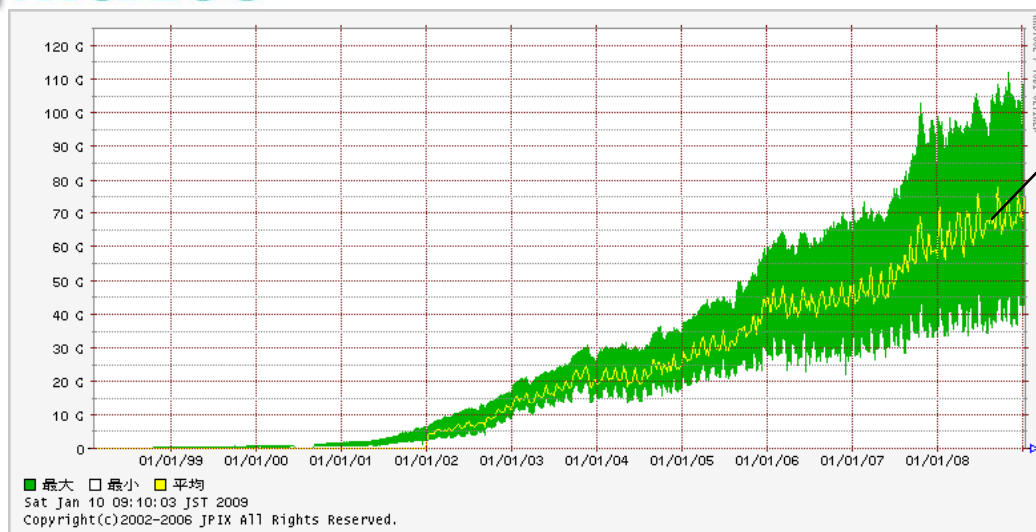


■ Metro WDM provides:

- Simple high capacity pipes
- Service separation and expansion by λ
- Easy design and management in an investment.

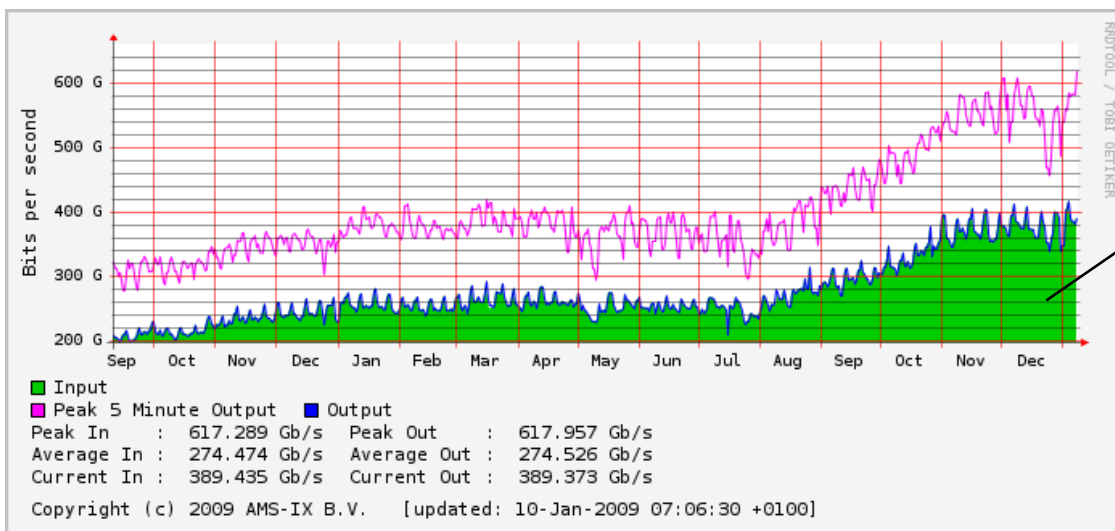
■ Metro WDM is not only for Telco with high capacity transmission but also for alternative operators.

Internet Traffic Growth (Residential)



10G growth per year

Source: JPIX Jan '08



100G growth in 3 months

Note: The monitor point of traffic shown here is IX (Internet exchange). That means its volume is just a part of internet which goes through IX point and it does not necessarily include MBH and IPTV traffic.

Source: AMS IX Jan '08

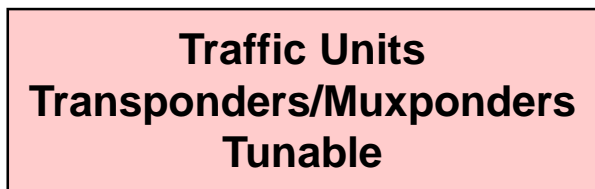
TM Series Architecture



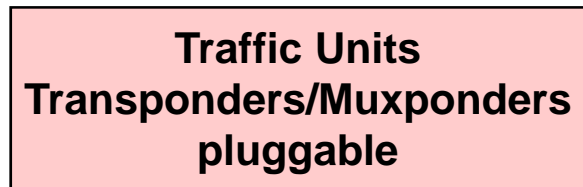
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+



or



3 types. High and Medium Capacity Central Office type, and single λ CPE type.

CWDM type and DWDM type
Capacity growth by modular

Lowest spare part costs, long-haul



Flexible Service combination, enabling CWDM/DWDM and reconfigurable HW solutions

- Multi-service
- Multi-reach
- Seamless integration of CWDM and DWDM
- Low power
- Pay as you grow
- Flexible configurations
- Single-fiber and fiber-pair configurations
- Low Operational costs (OPEX)

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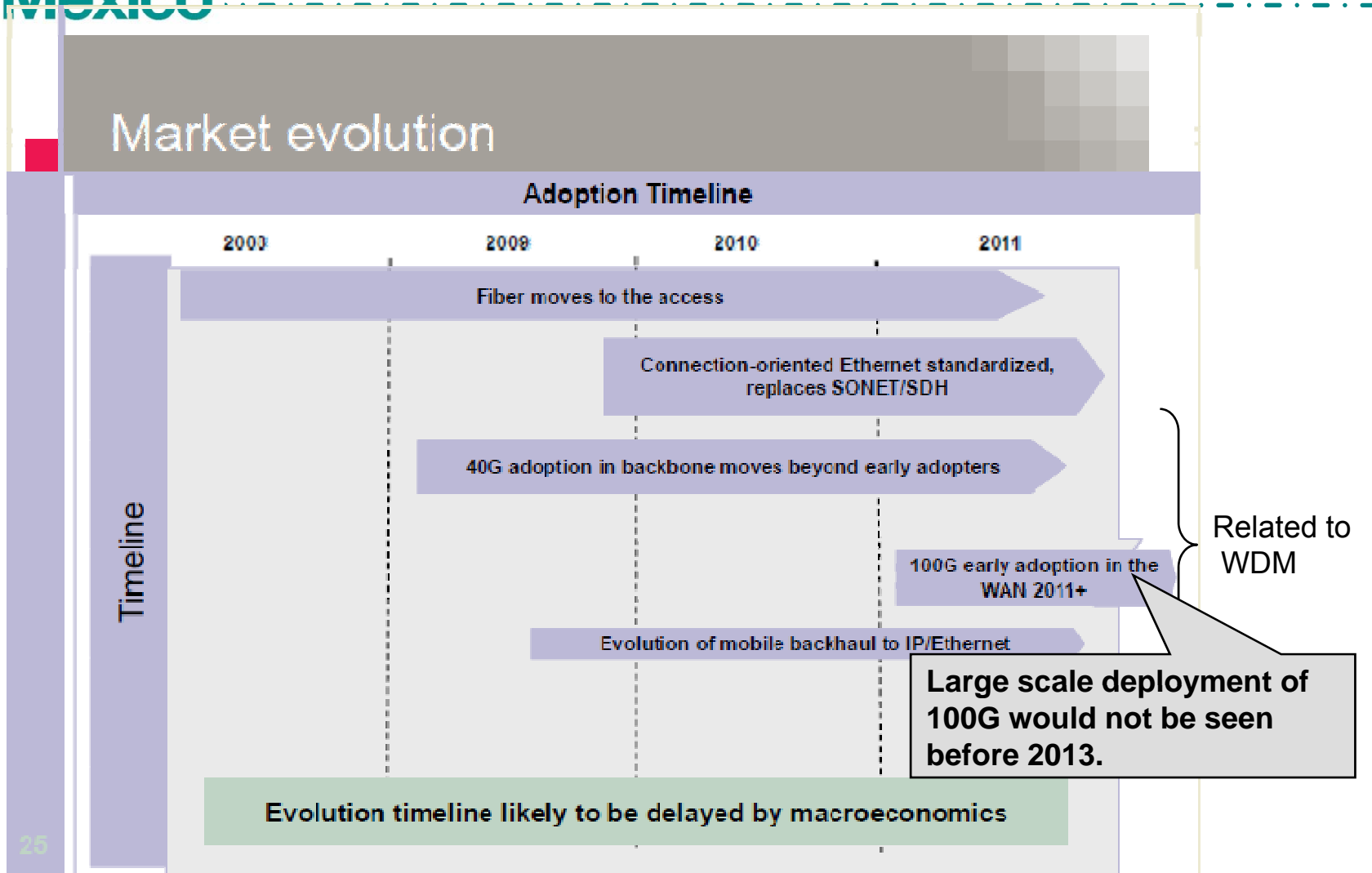
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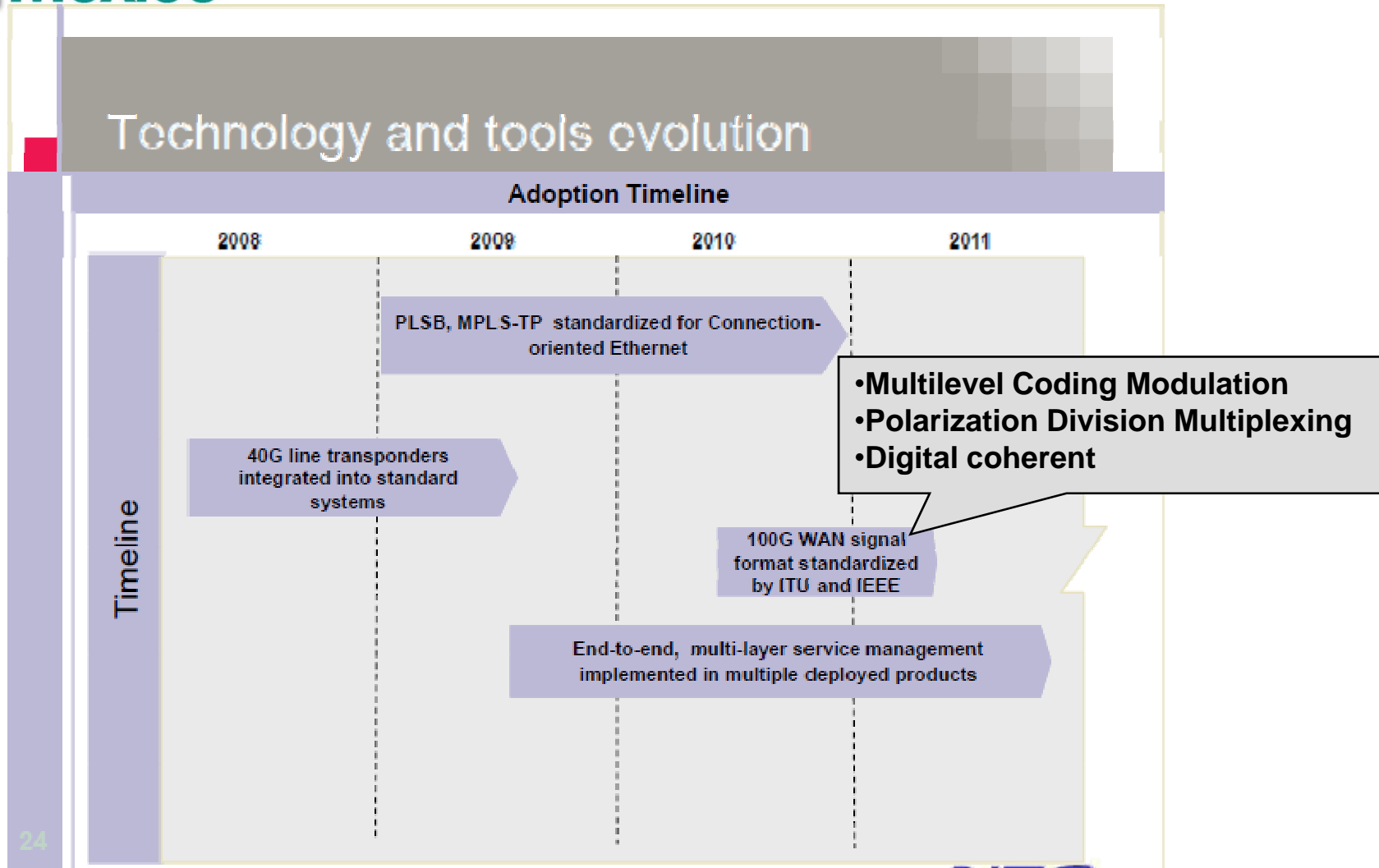
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Optical Market evolution



Source: Ovum, Dec 2008

Technology evolution

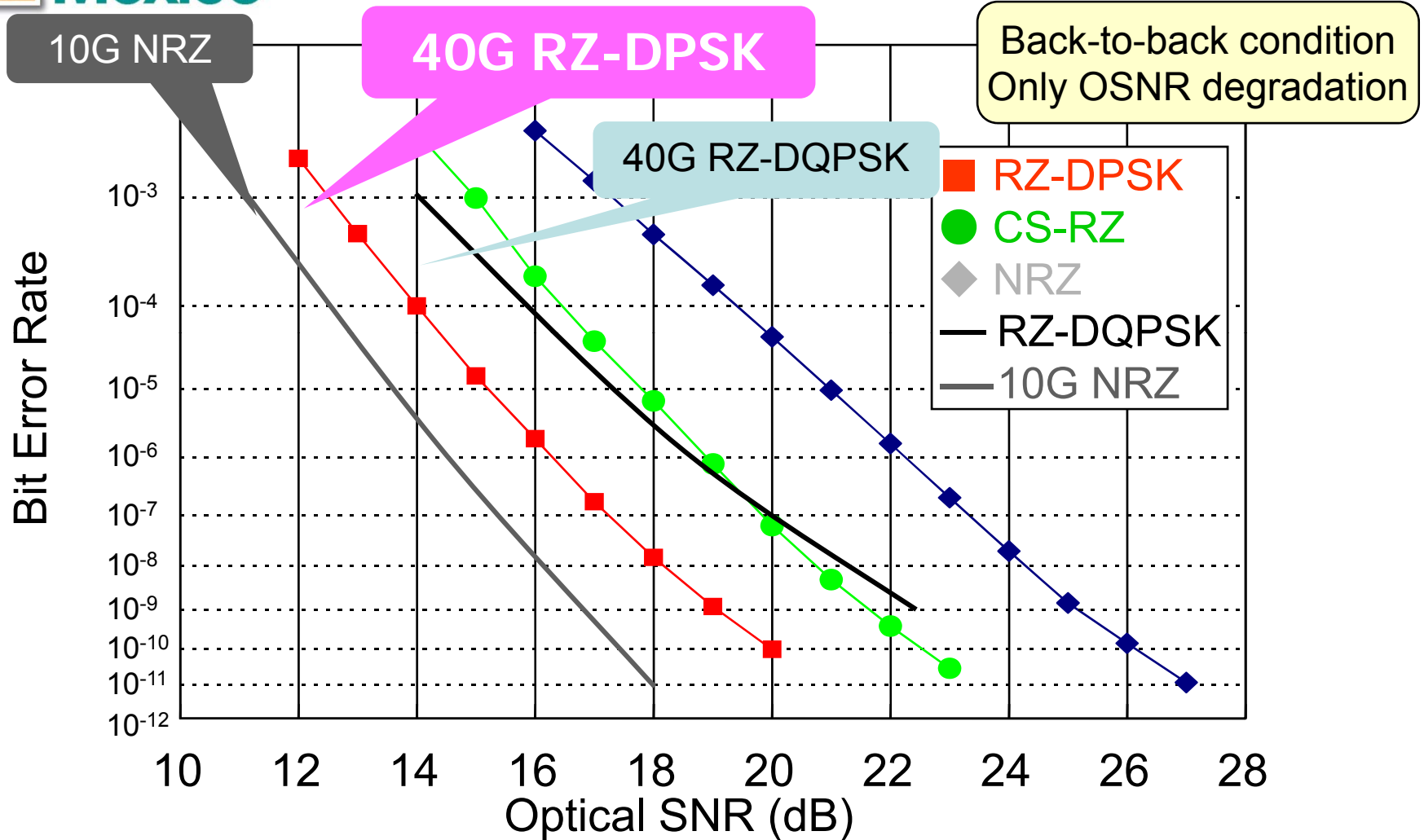


In case of 40G (technology) - 1

Modulation technique	Application	Pros	Cons
Non-return-to-zero (NRZ)	Metro (200–300km before regeneration)	Low cost, spectrally compact, simple tx/rx configuration (single modulator)	Vulnerable to polarization mode dispersion, limited distance
Carrier-suppressed return-to-zero (CS-RZ)	Metro/long haul (~500km before regeneration)	High tolerance to nonlinear effects; similar performance on different fiber types	More expensive than NRZ: will not fit in 50GHz spacing, requires two modulators
Optical duobinary (ODB)	Metro/long haul (~500km before regeneration)	More spectrally efficient than conventional DPSK, enables 50GHz channel spacing; currently offers a good compromise between performance and price	Sensitive to non-linearity, can't compensate by increasing power
Differential phase-shift keying (DPSK)	Ultra long haul (~2,000km)	Excellent performance at long distances, better receiver sensitivity	Expensive, requires costly receiver; StrataLight and Mintera are both introducing adaptive receivers to improve performance and combat non-linearities
Quadrature phase shift keying (QPSK)	Metro regional, long haul (~1,000km)	Excellent CD and PMD tolerance, high spectral efficiency, enabling 50GHz channel spacing	Expensive: Requires two or three modulators, four receivers, and a double delay line interferometer
Dual polarization quadrature phase shift keying (DP QPSK)	Ultra long haul (~3,000km)	Excellent performance: pre-distance, dispersion tolerance, 50GHz channel spacing	Expensive, complex pre-conditioning and receiver required. Lack of merchant A/D converters

Customers are moving from ODB to DPSK.

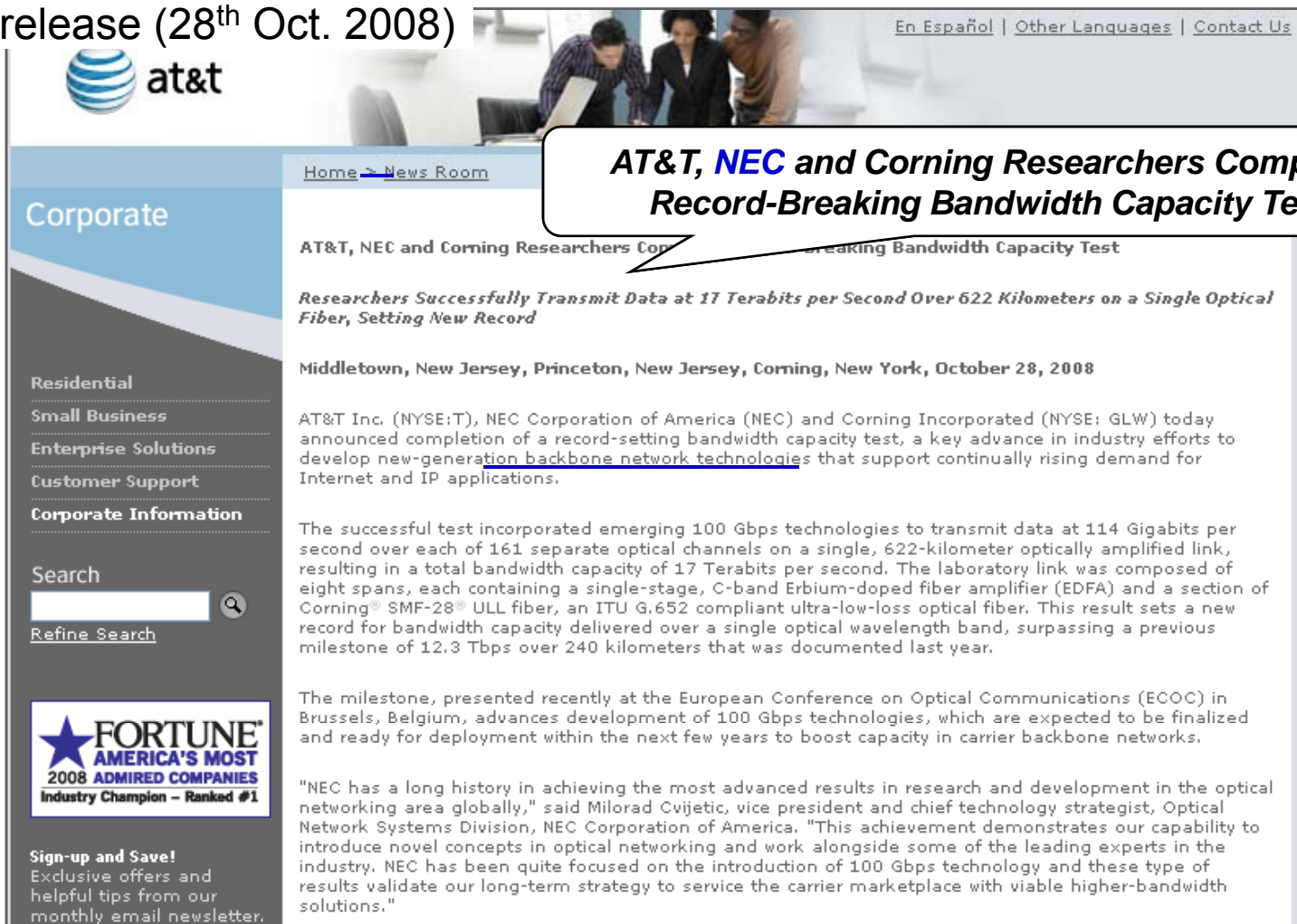
In case of 40G (technology) - 2



OSNR for Different Modulation Schemes

In case of 100G (technology) - 1

Press release (28th Oct. 2008)



The screenshot shows the AT&T website's news page. At the top left is the AT&T logo. Below it is a navigation menu with links for Corporate, Residential, Small Business, Enterprise Solutions, Customer Support, and Corporate Information. A search bar is also present. The main content area features a headline: "AT&T, NEC and Corning Researchers Complete Record-Breaking Bandwidth Capacity Test". Below the headline is a sub-headline: "Researchers Successfully Transmit Data at 17 Terabits per Second Over 622 Kilometers on a Single Optical Fiber, Setting New Record". The date and location are listed as "Middletown, New Jersey, Princeton, New Jersey, Corning, New York, October 28, 2008". The main text describes the test, mentioning 100 Gbps technologies, 114 Gigabits per second, and 17 Terabits per second. A quote from Milorad Cvijetic, vice president and chief technology strategist, is included at the bottom of the article. A Fortune logo is visible in the bottom left corner of the screenshot, indicating AT&T was ranked #1 in its industry in 2008.

AT&T, NEC and Corning Researchers Complete Record-Breaking Bandwidth Capacity Test

AT&T, NEC and Corning Researchers Complete Record-Breaking Bandwidth Capacity Test
 Researchers Successfully Transmit Data at 17 Terabits per Second Over 622 Kilometers on a Single Optical Fiber, Setting New Record

Middletown, New Jersey, Princeton, New Jersey, Corning, New York, October 28, 2008

AT&T Inc. (NYSE:T), NEC Corporation of America (NEC) and Corning Incorporated (NYSE: GLW) today announced completion of a record-setting bandwidth capacity test, a key advance in industry efforts to develop new-generation backbone network technologies that support continually rising demand for Internet and IP applications.

The successful test incorporated emerging 100 Gbps technologies to transmit data at 114 Gigabits per second over each of 161 separate optical channels on a single, 622-kilometer optically amplified link, resulting in a total bandwidth capacity of 17 Terabits per second. The laboratory link was composed of eight spans, each containing a single-stage, C-band Erbium-doped fiber amplifier (EDFA) and a section of Corning® SMF-28® ULL fiber, an ITU G.652 compliant ultra-low-loss optical fiber. This result sets a new record for bandwidth capacity delivered over a single optical wavelength band, surpassing a previous milestone of 12.3 Tbps over 240 kilometers that was documented last year.

The milestone, presented recently at the European Conference on Optical Communications (ECOC) in Brussels, Belgium, advances development of 100 Gbps technologies, which are expected to be finalized and ready for deployment within the next few years to boost capacity in carrier backbone networks.

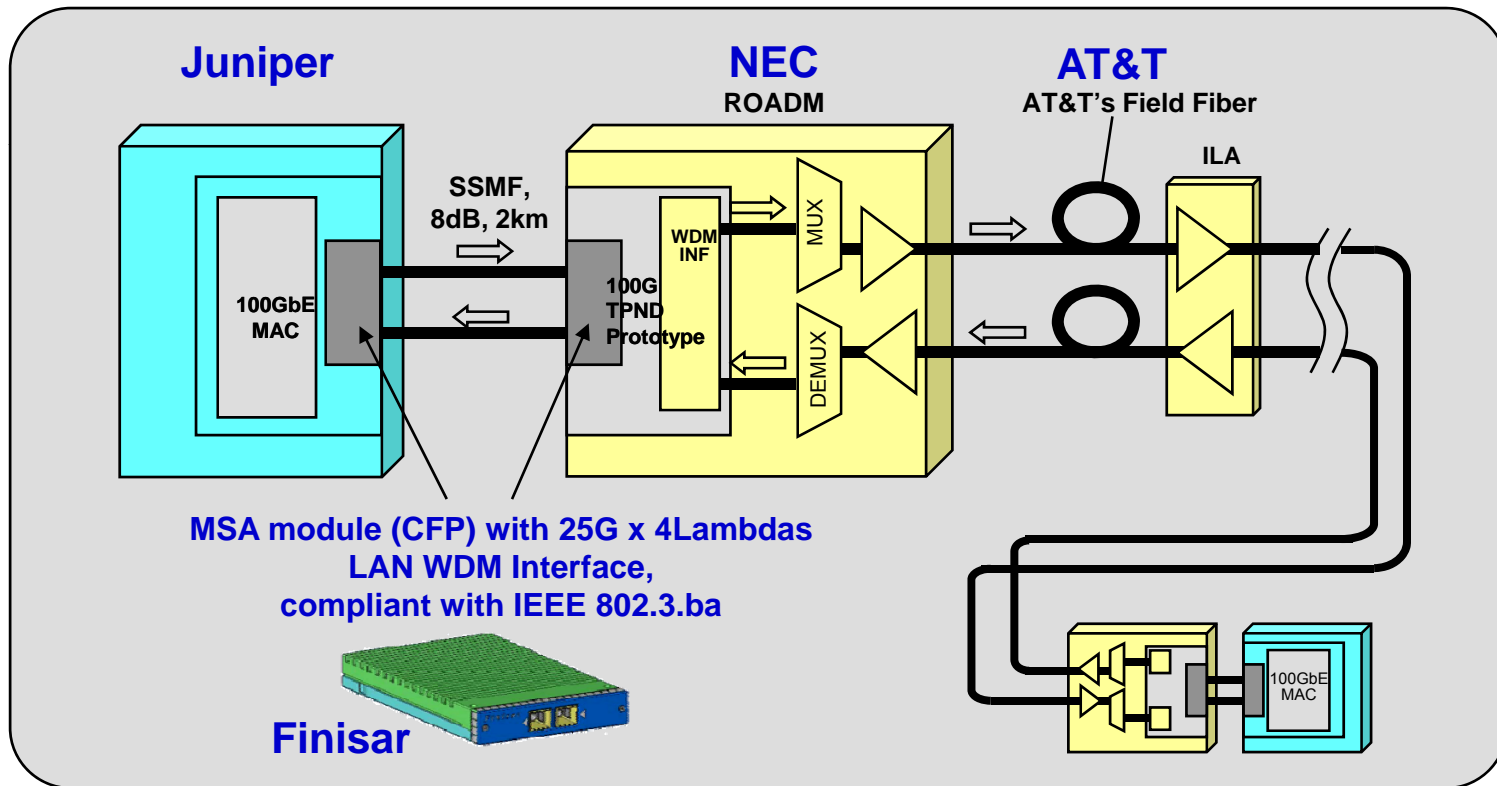
"NEC has a long history in achieving the most advanced results in research and development in the optical networking area globally," said Milorad Cvijetic, vice president and chief technology strategist, Optical Network Systems Division, NEC Corporation of America. "This achievement demonstrates our capability to introduce novel concepts in optical networking and work alongside some of the leading experts in the industry. NEC has been quite focused on the introduction of 100 Gbps technology and these type of results validate our long-term strategy to service the carrier marketplace with viable higher-bandwidth solutions."



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In case of 100G (technology)-2

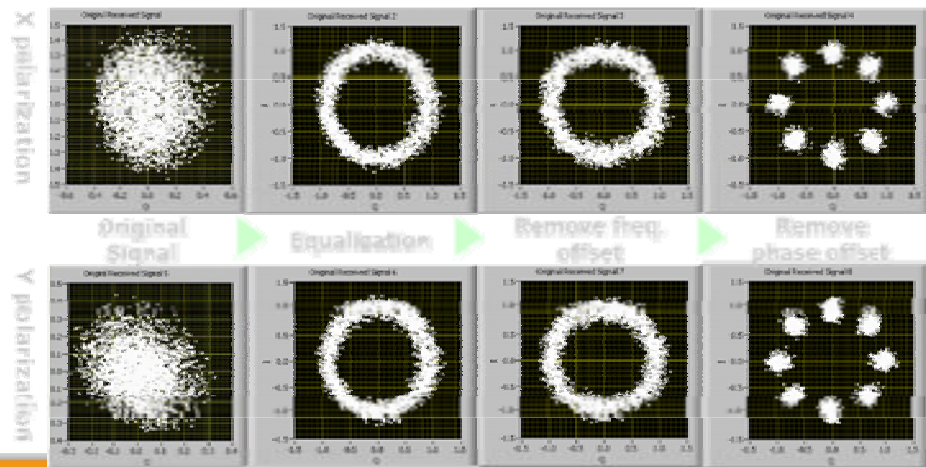
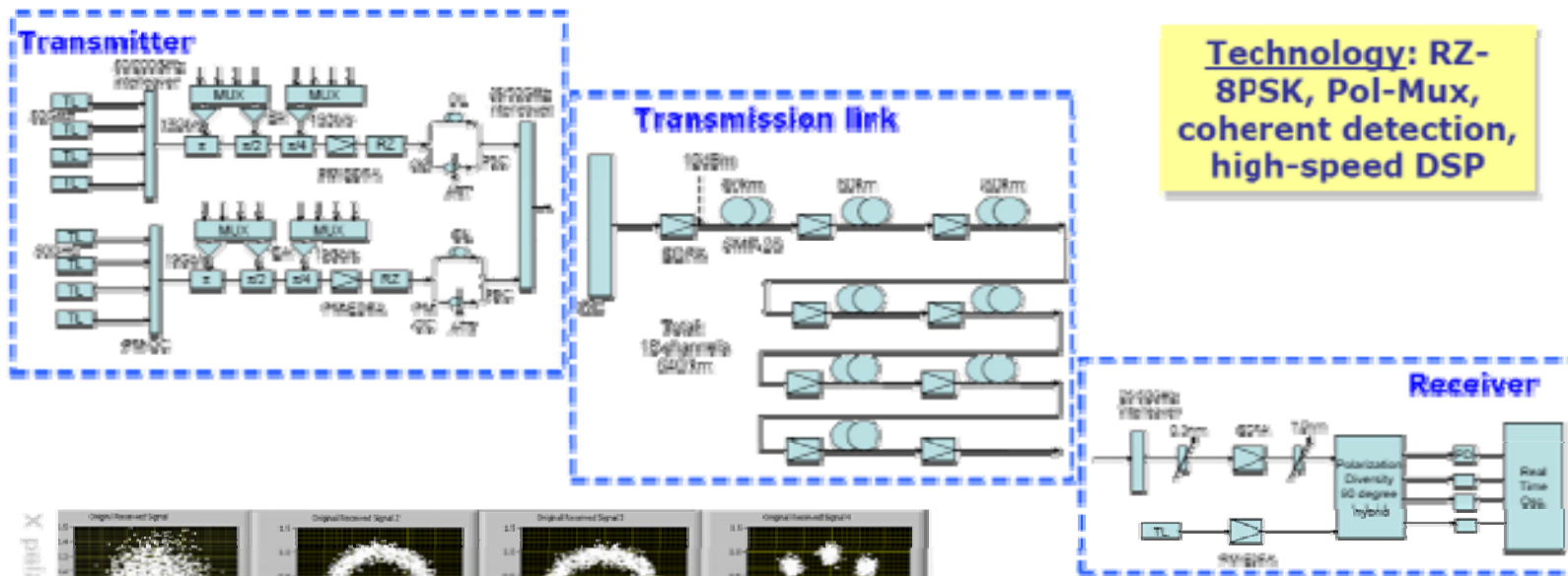
- Corporation with Juniper to provide the trial system.
- Applied 25G x 4Lambdas for SMF as a client interface (CFP).
- Established cooperative relation with Finisar which is primal SFP supplier.



In case of 100G (technology)-3

Latest Achievement: 113Gbps over 25 GHz and 640km DWDM

NEC Laboratories America
 Relentless passion for innovation



NEC Empowered by Innovation
 BER can reach below 10e-3

This activity was presented at OFC2008 as PDP1.

Questions & Answers

Empowered by Innovation

NEC



Thank you for your attention