> BUSINESS MADE **SIMPLE**

**WDM-PON Technology:**
How it can facilitate the last mile

Olivier Couderc
Market Development Leader, France Middle East and Africa

TERENA – Amsterdam, December 2008
Agenda

1. Market trends and requirements
   - Market dynamics
   - Market requirements
   - Deployment options
   - Standardization in progress

2. Nortel’s vision of Next Gen Access
   - Key Technologies and benefits
   - Solution Overview

3. Conclusion
Market Dynamics
The Challenge for Service Providers

**Dynamics:** Bandwidth and Content
- More bandwidth hungry applications
- More devices designed to access the network
- Digital content is driving massive bandwidth demand
- Growing competition to win End user
- End users are consuming more than ever

**Challenge:** Overcoming the Last Mile bottleneck

Service Providers are re-evaluating their access networks strategy and business models to remain competitive
South Korea leads the way…

Global FTTH/FTTB Ranking

Economies with the Highest Penetration of Fiber-to-the-Home / Building+LAN

Mid-Year 2008 Ranking
Source: Fiber-to-the-Home Council – Jul 08
Real Consumer demand for Higher Bandwidth

- Nielsen’s law for bandwidth is analogous to Moore’s Law for silicon

- Defined several years ago but our study of historical data for several European countries suggests that it provides a good guide to what is happening

- Spain and UK just behind N curve – other countries are ahead

Source: Ventura study for FTTH Council Europe

<table>
<thead>
<tr>
<th></th>
<th>CAGR</th>
<th>Compound over 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nielsen</td>
<td>Bandwidth</td>
<td>50%</td>
</tr>
<tr>
<td>Moore</td>
<td>Computing</td>
<td>60%</td>
</tr>
</tbody>
</table>

Presentation to MEGNA FTTx Conference Oct 2008 – Page 16
Fiber Access Assertions

> **Ethernet** will be **Everywhere**
> **Residential, Business** and **Backhaul services** will converge to single infrastructure
> **Fiber** will progressively replace copper in the access to cope with traffic increase
> **New cable laying remains the #1 cost**, thus PON technologies which optimize usage of the existing fiber are key
> But legacy TDM PON (GPON) is not Future Proof and is not well suited to converged Residential/Business/Backhaul infrastructure
> **OPEX** considerations are critical in the Last Mile

**NextGen Fiber Access solutions required for continued Service Evolution and Innovation**
Next Generation Ethernet Fiber Access: Key attributes wish list

- Operations Simplicity
- Support Converged Business/Residential services
- Highly Scalable, Deterministic Solution
- Dedicated, Point-to-point, Symmetrical Bandwidth
- In-Built Security
- Evergreen
Fiber Access Deployment options

**Point to Point**
- Future Proof Architecture
- Follows Telco wiring Practices
- Bit Rate & Protocol Independent
  - CO Fiber Management
  - Fiber Availability

**TDM PON**
- Simplified CO Fiber Management
- Passive OSP Plant Solution
- Low power consumption
- Maturing Technology
  - Shared Bandwidth (DS & US)
  - Real time Software Intensive
  - Complex upgrade evolution

**Active Remote**
- Simple deployment model
- Flexibility of #Users vs Line Rate
- Bandwidth Upgradeability
  - Shared Bandwidth
  - Active electronics in OSP
  - High power consumption
  - Sub-Optimal Scalability

**WDM Fiber Access**
**ADVANTAGES of P2P & TDM PON**
- Secure, Reach, Scalability
- No Wavelength Planning & Limited Engineering
Standardization Evolution

- **Point2Point Ethernet**
- **G-PON**
- **GE-PON**
- **WDM PON option Ethernet over WDM**
- **XG-PON**
  - (Up: 2.5G to 10G, Down: 10G)
- **NG-PON1 incl. long-reach option**
  - WDM option to enable to overlay multiple G / XGPONs
- **NG-PON2**
  - Common infrastructure
  - High Capacity
  - Secure and Symmetrical
  - Native Ethernet

**WDM PON current availability sets a new standards path!**
Our plan on NG-PON2

- KT is going to start the commercial deployment of NG-PON2 (WDM-PON) from the next year
- In this reason, we wish to initiate a discussion on the revision of NG-PON2 timeline in FSAN NG-PON standard roadmap
- Also, We propose FSAN vendors to more actively participate in NG-PON2 R&D and its standardization process
Nortel’s vision of Next Gen Access
Fiber Access Made SIMPLE

Central Office Flexibility
Outside Plant Simplicity
End User Performance

What matters in FTTH?
- To build for the long term, especially on the outside plant construct
- To make operations easier
  - Automatic wavelength selection upon activation
  - Dedicated and Symmetrical P2P or P2MP bandwidth
  - Consistent Operations and Engineering methodologies
Nortel’s Ethernet Access

Service Provider Benefits

> Provides a **future proof** point to point construct with a secure bi-directional wavelength per customer

> Provides a **simple deployment** and OPEX friendly architecture
  
  • passive splitter, Colorless ONTs, single fibre working

> Service Velocity - Tailored to scale for Residential and/or Business services on a per user basis

The future of fibre Access, available today
Fiber Access Overview

WDM PON → Key Values

OLT: Optical Line Terminal
ONT: Optical Network Termination
WDM: Wavelength Division Multiplexing

Simple Engineering & Deployment
- Infrastructure independent service evolution
- “Plug & Play” colourless optics at end use

Flexibility
- Point-to-point and point-to-multi-point connectivity

Performance
- Symmetrical bandwidth (upstream/downstream)
- Dedicated wavelength/ bandwidth per end user
WDM Fiber Access
Enabling Technology

Automatic Wavelength Locking

Identical, **Colourless** ONUs using low-cost lasers

- Elimination of high cost wavelength-specific lasers
- Low inventory management cost
Ethernet Access 1100 Portfolio Summary

OLT
Ethernet Access Service Terminal
- 13 slot Chassis
- Upto 8 Service Slots
- 5 Slots reserved for Commons
- Redundant switch fabrics
- Network Interface/ Switch Units
  - Up to 8 Network Interfaces
- Mixed Access technology support
  - WDM-PON
  - Point-to-Point Ethernet
- Density
  - Upto 1024 λ / rack (4 shelves)
  - Advanced L2/L3 Packet Engine

ONT
Ethernet Access Residential/Business Unit
- Indoor Residential Design
- Stylish, Compact and Environmentally friendly design
- Low power consumption
- Installed vertically or horizontally with available cradle
- Identical, colorless ONT/ONU
  - Fully colourless operation
  - Low inventory management cost
- Interfaces
  - 4 10/100Base-Tx RJ-45 ports
  - Optical Connector – SC/APC
  - Advanced QoS and Classification

EMS
Ethernet Access Manager 1100
- Alarm & Event Management
- Configuration Management
- Provisioning Management
- System/PON Port
- Backup & Restore
- Statistics Management
- Software Version Management

Remote Nodes
Wavelength Passive Filter
- WPF1132c Cabinet Tray
- WPF1132r/p Ruggedized / Pole

EAST 1100

EARU 1112

ONT

EMS

Remote Nodes
Wavelength Passive Filter
Engineering Considerations
Nortel’s Ethernet Fiber Access vs others xPON

**Ethernet Fiber Access Engineering**
- **Low Density Suburban/Rural**
  - 32 or (4 x 8) Wavelengths
  - > 40km

- **Medium Density Urban/Suburban**
  - 32 Wavelengths
  - 20 – 40km

- **High Density Core**
  - 32 or 64 Wavelengths
  - < 20km

**Number of Wavelengths (λ)**

**TDM PON Engineering**
- **Passive Splitter**
  - **HIGH Loss components**
  - 32 power split ~ 17db loss;
  - 64 Split ~ 20db loss

- **User bandwidth is inversely proportional to distance and # of subscribers**

**CANNOT maintain a consistent Engineering methodology**

**Passive OSP WDM Filter**
- LOW loss components
- # Port independent ~ 5db loss
- User bandwidth independent of #subscribers
- Reach is independent of bit rate

**Simple & Flexible OSP operations model**
Technology Direction

- Colorless laser
- BLS
- AWG
- GEth WDM-PON
- Low Noise Broadband Seeding Light Source
- Photonic Integrated Circuits
- Increased λ capacity
- Increased density
- Increased reach
- >2009

- Lossless filter
- Increased line rate
- Increased flexibility
- Open solution
- SFP Design
- 2009

- Operationally simple Ethernet WDM for business and residential access with unmatched capacity
- 2008
Conclusion
Customer Trials and Summary of Engagements

Since 1Q - 2008

✓ 2 public on-going deployments
✓ 15+ Lab and/or Field trials performed
✓ Understanding and validating applications
  ✓ Business/Residential Services: VPN, Residential
  ✓ Wireless Backhaul
  ✓ Backhauling remote DSLAMs
Nortel’s Ethernet Access Solution with WDM-PON
Thank you