Ethernet Access and WDM-PON

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April 2010
LG-Nortel Company Description

LEADERSHIP IN TELECOMMUNICATIONS

> Leading equipment supplier in Korea: No. 1 Wireless 3G, No. 1 Enterprise Voice
> Franchise position with largest Korean carriers (SKT, KTF, LGT)
> Global Enterprise vendor (No. 1 in select international markets)
> One of Korea’s largest telecom equipment vendors
> Over 30 years of telecom innovation
> Best-in-class resources develop leading edge telecommunications equipment

• A US$1 Billion revenue company with approximately 1,300 employees
• 800 employees focused on R&D, 500 employees in Sales and Operations
Ethernet Fiber Access WDM-PON Team

LG-Nortel
- Product Leadership
- Hardware / Software / System Integration
- Merge WDM-PON Specialist Novera Optics
- Key IPR

Nortel
- Optical Pedigree
- End-to-end Ethernet solution
- World-wide global sales channel

KT
- Leading initial market requirements
- First WDM-PON commercial deployment
- 160K lines of FTTPole and 2k of FTTH
- Collaborating standardization
Fiber Access Technologies

**TDM / GPON**
- Simplified CO Fiber Management
- Passive OSP Plant Solution
- Low power consumption
- Standards/Mature Technology
- Subscriber Density
- Interoperability
- Shared Bandwidth (DS & US)

**Point to Point**
- Future Proof Architecture
- Follows Telco wiring Practices
- Simple Engineering & Planning
- Interoperability
- CO Fiber Management
- Fiber Availability
- Power Consumption
- Subscriber Density

**WDM PON**
- Future Proof Architecture
- Follows Telco wiring Practices
- Carrier Grade Ethernet
- Simple Engineering & Planning
- Interoperability
- Simplified CO Fiber Management
- Passive OSP Plant Solution
- Colorless Optics
- Interoperability
- Subscriber Density
- Power Consumption
- Standards Maturity
WDM PON Technology

Key Values

- Symmetrical bandwidth – Gigabit in both directions
- Secure service delivery – Physical separation of customer traffic
- Simple deployment model - Colorless ONTs, Auto Wavelength Selection
- Optimized Outside Plant - No Outside Plant Electronics, Single Fiber Working

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

Broadband Light Source

Wavelength Filter

Laser

Spectrum before locking

Spectrum after locking

1530nm 1560nm

1530nm 1560nm

BLS

Spectral Slicing

1530nm 1560nm

Colourless ONUs

➔ Low inventory management cost

➔ Elimination of high cost wavelength-specific lasers
WDM PON product
Carrier-grade 11-slot chassis, 8 Service Slots
- 19” (W) x 10U (H) x 14” (D); 4 shelves/2.2m rack
- Integrated cooling units & maintenance ports
- 8 Universal Service Slots

Integrated Packet Fabric
- Redundant, 1+1 protected 240G Switch Fabric
- Up to 8 SFP+ uplinks (GE / 10GE) per Switch card

Service Interfaces

- Ethernet WDM PON
  - Single Port/Single Fiber Working/Colourless
  - ITU-T G.8032 E-SPRING Support
  - 32 wavelength / 100Mbps
  - 16/32 wavelength / 1Gbps
- E1/T1 Circuit Emulation Service card
  - 32xE1/T1 per CES interface card

Next Generation Fiber Access platform with an evolution to 40G per slot
Business services: E1/T1 Circuit Emulation Service

- CES for TDM/legacy backhaul applications
  - Up to 32 E1/T1 ports per unit
  - Up to 4 cards can be equipped on the shelf
    - consideration based on copper wiring cabling
  - Equip PON Service unit from Left to Right Slot (1 – 8), T1/E1 CES unit from Right to Left (Slot 8 -> 1)
  - T1/E1 capable provide sync timing to wireless bay station [futures]

Upto 128 T1/E1 Hand-off per shelf
distributed architecture

100M/100M Only per λ

Up to 4 E1/T1

1G/1G Only per λ

Up to 4 E1/T1

Up to 4 E1/T1
Business services: 1+1 protection

Customer Sites

Provider Network

G.8032 E-SPRing

ONT

CO

OLT

Customer Site

Provider Network

G.8032 E-SPRing

ONT

CO

OLT

Internal View

Link Protection (E-SPRING)

Up to 32 x E-SPRING Per RN

Access Card Protection (E-SPRING)

Internal View

PI card

SW card
### Business services: Ethernet OAM - 802.1ag, Y.1731

- **Fault Detection using ETH-AIS**
- **Fault Notification using ETH-AIS**
  - ETH-AIS Transmission
  - ETH-AIS Reception (ONT/ONU only)
- **Fault Isolation using LBMs, LTMs**
  - Loopback L2 Ping
  - Linktrace L2 Traceroute
- **Fault Verification using**
  - LBMs for MTU validation
  - LBMs for SLA validation (BW stress test)
  - LBMs for Round Trip Delay measurements
  - LTMs to discover service topology
- **ONU Client Port Conditioning**
  - P2P Services
  - Business ONT/ONU only

- **Remote fault verification**
- **Remote fault isolation**
- **In-service fault detection, notification, isolation, verification, and client port conditioning**
Ethernet Access 1100
Ubiquitous Ethernet Services & OAM

EMS
- Interfaces: XML, Corba
- NE Discovery
- Fault Management
- Provisioning
- Inventory
- Performance
- EMS Redundancy
- Security
- Service Manager

OLT/ONT

East West OAM
- 802.3ah OAM Slow Protocol
  - Discovery
  - Critical Events: link fault, dying gasp
  - Event Notification
  - Remote Loopback Requests
- 802.3ah Extensions
  - Provisioning, Performance monitoring, Fault monitoring, System Recovery, Upgrades
- 802.1ag/Y.1731 Ethernet OAM
  - Loopback
  - Link trace
  - Round Trip Delay
  - Client Port Conditioning via AIS

North-South OAM
- Command Line Interface
- XML/Netconf
- SNMP V3
- Syslog

Residential Services

Business Backhaul Services

Quality of Service

Flexible Classification
- Layer 1: Physical port
- Layer 2: 802.1q (VLAN ID or Pits) or Ethertype
- Layer 3: ToS or DSCP
- Layer 4: Source/Destination TCP/UDP port

Metering, Marking and Policing
- Dual rate three color metering and marking algorithm.
  - Configurable bandwidth profiles.

Queuing/Scheduling
- 8 queues per port
- Active Q Mgmt (RED, WRED)
- Strict Priority and/or DWRR
- Per Class Shapers

L2/L3 Services
- 802.1q/802.1ad/QiQ encapsulation
  - 802.1Q ingress and Egress VID translation.
  - 802.1Q VID translation with QiQ
- MEF Services
  - EPL, EVPL, E-LAN, E-TREE
  - Feature rich UNI capabilities at ONT and OLT
  - Layer 2/3 Control Protocol transparency
  - Circuit Emulation (E1, T1)
- TR-101 Services
  - 1: 1 and 1:N service mappings
  - Service and Subscriber based tagging Models
  - Wholesale Services
  - Multicast - IGMP v2/v3, PIM SM/SSM, IPTV ACL
  - Voice (SIP), Security, SyncE

Transparent to underlying topologies – WDM PON, Ethernet

Always Surpassing Customers Expectations
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Ethernet Access 1100
Passive Outside Plant Components

Outside Plant Enclosures collaboration with Ecosystem partners

- Partnering with lead global FTTH supplier
- AWG Component Integration within existing OSP solutions
- Coexistence with PLC power splitter technologies

- WDM Filter based on AWG technology
  - Athermic, Cyclical design
  - Extended temperature application
- Flexible/ Ruggedized packaging available for multiple applications and installations
  - Pole Mount, Cabinet Style, manhole/buried
  - Mechanical Packaging available for flexible deployment models
Ethernet Access 1100
ONU Residential Portfolio Strategy

Indoor Residential Design
- Stylish, Compact and Environmentally friendly design
- Voltage power adaptor (90~264Vac)
- Optional UPS Power Connector
- Installed vertically or horizontally with available cradle
- Temperature: 0° to 50 °C, Humidity: 5 ~ 95%
- Interfaces
  - Multi-port RJ45 e/w upto 4 10/100 Base-T
  - Upto 4 RJ11 Ports
  - Optical Connector – SC/APC

Outdoor Residential Design
- Small Form Factor (SFU, SBU only)
- NEBS, GR1350, GR63, GR49 - Enhanced Lightening Protection 6Kv
- -40c to +65c (+45c with solar load)
- Optional outdoor Slack Fiber Management
- Optional Internal Fiber Raceway

Optional Residential Gateway Capabilities
- Small Form Factor (SFU, SBU only)
- Interfaces
  - Multi-port RJ45, 4 10/100 Base-T
  - 2xPOTS RJ11 Ports, WiFi b/g/n
  - Home Networking
# Fiber Access Landscape

<table>
<thead>
<tr>
<th></th>
<th>G-PON</th>
<th>WDM-PON</th>
<th>P2P Ethernet</th>
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<tbody>
<tr>
<td><strong>Fiber Utilization</strong></td>
<td><strong>Optimized fiber infrastructure</strong> reducing first-in FTTH deployment cost and recurring OPEX</td>
<td><strong>Passive OSP</strong> drives reduction in OSP installation and recurring OPEX</td>
<td><strong>High fiber counts</strong> being home run to CO</td>
</tr>
<tr>
<td><strong>OSP Infrastructure</strong></td>
<td><strong>Passive OSP</strong> drives reduction in OSP installation and recurring OPEX</td>
<td><strong>Active equipment consolidation</strong> into CO</td>
<td><strong>Active equipment distributed</strong> in Small Office or Active Cabinets</td>
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<tr>
<td><strong>Applications / Services</strong></td>
<td><strong>Tailored for Residential 3-play</strong></td>
<td><strong>Residential, business &amp; backhaul</strong> enabled by symmetric, dedicated bandwidth</td>
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<tr>
<td><strong>Network Simplicity</strong></td>
<td><strong>Shared asymmetric bandwidth per subscriber</strong></td>
<td><strong>Dedicated symmetric</strong> bandwidth to all subscribers</td>
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<td><strong>Network Evolution</strong></td>
<td><strong>Complex upgrade → scaling end-user b/w requires OSP changes</strong></td>
<td><strong>Deterministic → simplified capacity planning</strong></td>
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<tr>
<td><strong>Security</strong></td>
<td><strong>Logical customer &amp; service separation only</strong></td>
<td><strong>Dedicated wavelength providing physical separation for simplified security, fault isolation &amp; service disconnect</strong></td>
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WDM-PON provides the fiber relief of PON solutions while maintaining the operational values of P2P Ethernet.
Applications
Applications

IP-DSLAM backhaul (residential)

Business services (SOHO). GPON coexistence

Business services. Large corporations
- Secure, Scalable (QiQ)
- Redundancy (E-SPRing)
- Remote Diagnostics (802.1ag,Y1731)
- TDM circuit extension

Wireless Backhaul
- Secure, Scalable (QiQ)
- Redundancy (E-SPRing)
- Remote Diagnostics (802.1ag,Y1731)
- TDM circuit extension
- Synchronization Distribution
Applications (1/4) – IP-DSLAM Backhaul
Always Surpassing Customers Expectations

Applications (2/4) - Business services. SOHO (over GPON)

Advantages

- Optimized Ethernet based fiber edge offering advanced business services
  - Scalable up to 1GE per user
  - Symmetrical Bandwidth
  - Single Fiber
  - 32 wavelengths per PON
  - Not shared
- Carrier Grade Protection
  - E-Spring (ITU-T G.8032) Protection – To prevent traffic disruption; 50mSec restoration
- Carrier Grade OAM
  - Layer 2/3 Control Protocol transparency
  - 802.1Q, QiQ Support, ELAN
  - Multi QoS, Metering, configurable BW, WRED/RED, DSCP
- Remote Monitoring
  - 802.1ag, Loopback, Link Trace, CCM Generation
  - Y1731 Capabilities - Round Trip Delay, Client Port AIS
Applications (3/4) – Large corporations (IP/MPLS)

- G.8032 Rings (Future)
- Single Tenant Units
- VPLS Network
- Wholesale Provider
- IP/MPLS Core
- Offnet Ethernet services
- Provider 2
- Provider 1
- OLT Local Switching
- VPLS Network
- G.8032 E-SPRing
- MTU
- PON SFP or ONT
- STU
Advantages

- Optimized Ethernet fiber edge offering for cost effective network transition to 3G/4G/WiMAX backhaul
- Scalable Fiber infrastructure
  - symmetrical bandwidth per λ
  - Upto 1G services, Single Fiber
  - 32 wavelengths per PON
  - Secure, not shared
- Network Resiliency
  - E-Spring G.8032 Line Protection – To prevent traffic disruption
- Synchronization – For efficient handoff between BTS/NodeB and remotes
  - Local BITS Timing
  - Physical Line – Sync E
  - Adaptive Clock Recovery -1588v2 Ready
- TDM Support – For backhaul 2G/3G/4G cellular traffic
  - CESoE Encapsulation
  - Headend T1/OC3/12 handoff

End Sites | Mobile Backhaul | Service Provider Network
---|---|---
GSM | WDM PON | Packet
WCDMA | | EA1100
LTE | ESPring | SDH/PDH
WiMAX | P2P | 

Future Proof Wireless Infrastructure
Lead customers
Summary

Passive Outside Plant Designs
  • Leverages the passive outside plant design principles

Technology
  • WDM PON – Tailored for Backhaul and Advanced Business Service
    • Sustainable bidirectional bandwidth than alternative technologies
    • Dedicated point to point bandwidth per wavelength that is secure and scalable
    • New subscriber turn up is independent of existing subscribers

LG-Nortel EA1100 Platform cost effectively support Business, Residential and backhaul applications ubiquitously