FTTx Network Trends and ITRI’s Related Research and Promotions

Purpose: Information
Submitted by: Chinese Taipei
FTTx Network Trends and ITRI’s Related Research and Promotions

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National Broadband Networks and Fibre to the Premises Industry Round Table, APEC TEL41, Thursday, May 6, 2010
Agenda

- Broadband Access Network Developments
- Broadband Access Network Convergence
- The Market of Globe Optical Access Networks
- ITRI’s Research and Local Companies’ FTTx Network Developments
- Conclusions
1. Broadband Access Network Developments
Rapid Development of Broadband Services


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3D Interactive TelePresence
True Sense of Being There

• Cisco’s new Telepresence requires 15 Mbps symmetrical bandwidth
• A one-hour conference call = 13.5 gigabytes
• 30 exabytes per year of telepresence traffic is expected in 2012.
• In 2009, the total US Internet traffic is 20 exabytes
• 1 exabyte = $10^{18}$ bytes, 1 gigabyte = $10^9$ bytes
Live Panorama Ultra-HD Quality Programs
Feel Like You’re Really A Member of The Audience
PON Standards Are Being Developed Continuously to Increase More Bandwidth

Source: IEEE & ITU-T & FSAN
Evolution of Optical Access Networks
Towards XGPON with Reach Extender

1. 10G GPON ~ 2011/12
2. GPON B+ Today
3. GPON C+ 2009
4. Extended GPON 2009

More BW
For FTTB & backhaul

Increased split ratio

More BW & symmetry per subs.

Reach
- 20 km
- 30 km
- 60 km

Split
- 32
- 64
- 128

Less dense areas addressed and central office consolidation

Source: FTTH Council 2009
Mobile Network Traffic Volumes Have Increased Substantially Since 2007

- The growth of data is much higher than voice services in the North American networks
- Mobile data traffic will continuously and explosively double every year
- Internet video becomes the platform of people’s social interaction and self-expression

Source: Rysavy Research 2009

Source: Cisco, January 2009

Via Legacy TDM

Movies, music, news, more music, text, web, more content ..
Mobile Data Growth Outpaced Revenue Growth
Operators Have to Find A Cost Effective Solution

- Experts estimate that in the next 5 years, there will be a 100 fold growth of aggregate data compared to twice the growth of revenue.

Source: Edited from Cisco, from Operators’ network data and Analysts, 2008
Challenges to Upgrade the Wireless/Mobile Networks

- Higher Bit Rate & Higher Carrier Frequency → Smaller Cells
- Higher Bit Rate & More Packeted Traffic → Higher Peak Bit Rate

Traffic/User

- Car phones
- Cell phones
- Smartphones
- Universal Personal Communicator

Coverage Limited

- AMPS
- GSM
- UMTS/HSPA
- LTE/WiMAX

Capacity Limited

- 1G Analog
- 2G Digital TDM
- 3G Digital CDMA
- 4G Digital OFDM

User Density

Source: ADC Inc.
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2. Broadband Access Network Convergence
Today: Three Separate Infrastructures for Fixed, Mobile And Wireless Access Networks

- Currently, FTTx construction in the fixed broadband field is separated from the construction of the mobile infrastructure. As a result, the investment in fixed services and that in mobile services do not build upon each other.

Source: France Telecom, OFC 2009, Workshop "Migration Scenarios toward Future Access Networks I"
Access Networks Convergence via XGPON

Convergence of Fixed Residential, Enterprise And Mobile BS

- Reuse deployed optical fibers, saving Opex and Capex
Access Networks Convergence via Optical Access Links

Convergence of Fixed Residential, Enterprise And Mobile BS

- Reuse deployed optical fibers, saving Opex and Capex
3. The Market of Globe Optical Access Networks
FTTH/B Subscribers Connected (Sept. 2009)

Source: International Advisory Group FTTH Council (September 2009)
[FTTH.C NAR/Mike Randers (Sept 2009); FTTH.C Eur/Date (June 2009; including Russia); FTTH.C AP/Ovum (June 2009)]

~6.8M
~2.8M
~32.2M
Global FTTx Subscribers Will Increase by 20 Million Every Year

- Cable service subscribers have leveled out, the DSL market has stabilized. Future growth of FTTx users will be the most obvious service.
- In 2012, the broadband subscribers of FTTH and FTTB in Asia Pacific will increase to over 100 million users.

Source: Ovum, ITRI IEK (2009/09)
The Shipment of 10GPON Will Increase Gradually After 2012

Source: MIC March 2009

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4. ITRI’s Research and Local Companies’ FTTx Network Developments

- Developed FTTx Key Technologies
- Established GPON Test Center
- Accelerated GPON IOP Testing
- Established FTTx + PLC Demo Site and Field Trial
- Assisted Taipei City to Be an International Fiber-Optic City
ITRI 2.5Gbps GPON Technologies

- ITRI developed advanced PON technologies to accelerate the development of local vendors’ FTTx products

2.5G GPON Research Results

- 2.5G GPON Transmission Key Modules
  - Developed GPON OLT / ONT MAC with transmission data rate achieves 2.488Gbps/1.244Gbps. Optical Triplexer.

- 2.5G GPON OLT
  - Developed Pizza-Box-Type GPON OLT, the features are:
    - Total 16 GPON ports, bandwidth up to 40Gbps
    - Total support up to 1024 ONTs
    - Provide fiber line fair-over function
    - 4 OLT modules design with cost flexibility

Partners

- FY 99: EDIMAX, DNI
- FY 98: Billion, Gemtek, Sercomm, Accton, Acradyan
- FY 97: Tecom, DNI, Tailyn, Hitron
- FY 96: ZyXEL
- FY 95: Alpha, Comtrend
ITRI Advanced 10Gbps XG-PON Prototype

- **ITRI XGPON OLT and ONU**
  - Following FSAN and ITU-T G.987
  - Downstream: 10Gbps @ 1577nm
  - Upstream: 2.5Gbps @ 1270nm
  - Support 10GE/GE, T1/E1 interfaces

- **XGPON Key Technologies**
  - 10Gbps FEC Encoder/Decoder
  - 2.5Gbps Burst Mode CDR
  - 10Gbps BM CDR is under development
  - Circuit Emulation Service Technology
  - Embedded Sync Technology via IEEE 1588 for wireless backhauling is under development
Operators in FSAN asked the vendors to propose the solution for NGPON2

- The major requirements include the 40Gbps throughput and cost effective architecture.

ITRI proposed 40Gbps Optical OFDM PON technology to FSAN

- Subcarriers can be allocated to different ONUs and specific wireless nodes.
- OFDM can encode vector signals in each subcarrier, thus reducing bandwidth requirements.
  - 40Gbps 16QAM signal only occupy 11GHz bandwidth, while 64QAM signal only occupy 7GHz BW
- Benefits of bandwidth reduction
  - XGPON 10Gbps optical components can be reused.
  - Components and transmission issues, like receiver thermal noise, linearity, and dispersion, can be reduced.
ITRI Built the Optical Communication Technologies Test Center to Provide GPON Test Services

• GPON Test Items
  – ONU/OLT Transmitter
  – Optical Distribution Network (ODN)
  – ONU/OLT Receiver
  – Synchronization
  – Optical Compatibility Verification
  – ONU Turn-Up and Management
  – OMCI Functionality
  – Interoperability Plugtest Test

• ISO/IEC 17025 Certificated

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ITRI Held FTTx/GPON IOP to Increase the Interoperability of Optical Access Equipment

- Interoperability between CO and CPE equipment is essential in telecommunications

- **Strategies**
  - Hold IOP events: Define the test plan and invite important CO site vendors
  - Establish permanent IOP center

- **Benefits**
  - Achieve cost (travel and usage fee) and time savings
  - Increase the interoperability and interaction between local CPE vendors and CO vendors.

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**2008 IOP Events**

- **CO Vendors**
  - Huawei
  - PLC-Sierra
  - ALU
  - Ericsson
  - Broadlight

- **CPE Vendors**
  - Zyxel
  - Alpha
  - Askey
  - Tainet
  - Tainet

- **Activities**
  - 2008/2009

**Achievements**

- Cooperated with CHT to hold two GPON IOP events (2008/5, 2008/11)
- Increase the interoperability between CPE vendors and CO vendors

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**2010 Permanent IOP Facilities**

- **IOP Center**
  - CHT Sparq, TWM
  - OLT
  - ONT

- **CEP Vendors**
  - Zyxel
  - Alpha
  - Tecom

**Strategies**

- Continue cooperating with CHT to hold IOP events
- Cooperate with CO vendors to establish the FTTx/GPON IOP center to create a permanent IOP testing facility
ITRI Established a FTTx + PLC Technologies Verification Environment

- Increased FTTx+ PLC network planning and establishment experience
- Verified the performance of broadband services in FTTx + PLC + Wi-Fi networks

- Area：Kaohsiung Science Park
- Network Architecture：FTTx (EPON+GE-Switch) + PLC + Wi-Fi
- Test Items：
  1. HomePlug 1.0 (14Mbps)
  2. Indoor PLC (DS2, 200 Mbps)
  3. Outdoor PLC (DS2, 200 Mbps)
  4. EPON (OLT + ONU)
- Applications：Plant monitoring, Internet access via PLC, Video application (IPTV...), Wireless Internet
ITRI Helped to Build the FTTx+PLC Field Trial Networks in Urban and Remote Areas

- Use of broadband PLC so that networks can be connected to every family, and also breaks through barriers to access household wiring, and reduces network construction costs.
- cooperated with Taipower, Sparq, TFN Media, Digital United, Sony to establish FTTx+PLC field trial in Taipei city and Dahu Village in Fanlu Township of Chiayi County.
Assisted Taipei City to Become an International Fiber-Optic City

- Optical fiber deployment in Taipei is restricted by the laws and cost of road excavation.
- A Feasibility study of the fiber optic network construction in the sewers → Overcome the restriction of road excavation
  - Helped promote the Taipei optical network pilot project (2006 ~ 2007)
  - Evaluate the feasibility
- Prove the concept of fiber optic network construction in sewage system
- Break through the network established restrictions

Help Taipei city to officially launch the fiber optic deployment project via sewage trenches (2008/10)
- Serve as the consultant team of Taipei city fiber optic deployment project (2009~2010). To assist the city government with network planning, business model analysis, network and technical education training.

Target
- 760K household connections / 50 Mbps Capacity
- In 2 years, Taipei city hoped to achieve 760K household connections and the deployment of fiber-optic cable and related equipment (the coverage rate is 80%)
- Provide their citizens with >50Mbps bandwidth for a low fee
- Achieve public broadband application using a fiber-based network platform

Benefits
- Broadband network construction in the sewage pipes to improve the economic value by reducing the amount of additional new construction.
- Reduce road excavation and the waste problem
## Development Status of Local Manufacturers’ GPON Products

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<th>MDU</th>
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- **GPON OLT**
- **GPON ONT** (Single Family)
- **GPON MDU (ONT+VDSL)** (Multiple Dwellings)
- **GPON Residential Gateway (ONT + WLAN/PLC/HPNA/…)**
In 2009, the number of local fixed broadband subscribers was close to 5 million.

- Optical access subscribers increased by 120K in Q4 2009, it amounted to 1.64 million, and the proportion of all fixed broadband subscribers was 33%;
- There were 2.56 million xDSL subscribers, and the proportion continued to decrease to 52% in Q4 2009; There were 0.76 million cable modem subscribers, the proportion was 15%.
In 2009, local PON ONT/ONU production value is 1.489 billion NTD, and the annual growth rate is 49.6%.

The key component of ONT/ONU is the optical transceiver.
Global Broadband Internet and Mobile Internet Vendors

Provide more than 80% of broadband network CPE equipment all over the world

FTTx will be Next!

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<th>2009 Local network communication vendors’ global market share</th>
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<td><strong>WLAN</strong></td>
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<td><strong>DSL Modem, Cable Modem</strong></td>
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<td>&gt; 80%</td>
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<tr>
<td><strong>Home Gateway / IP Broadband Router</strong></td>
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<td>80%</td>
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Thank You for Your Attention