Seeking Maximum Value In The Last Mile Market

TELLION FTTH & FTTN/VDSL2 solution

www.tellion.com
Evolution of Access network

FTTO

Core Network

ADSL

DSLAM

ATM / ADSL on copper line (Reach 3 ~ 5 Km)

FTTC or FTTN

Core Network

Ethernet Switch

Fiber Optic

Fiber Optic

VDSL_DSLAM

ATM / VDSL

VDSL_DSLAM

IP / VDSL

UTP (or Optical LAN)

FTTH

Core Network

GbE Switch

AON based

Ethernet Switch (FES, GES)

PON based

OLT

Splitter

ONT
Prediction of Traffic Growth

- explosive traffic growth with smart device like Smart Phone. (during last three years, 70 times growth)
- In green site, Telcos tend to invest FTTH directly instead of xDSL.
Optical access technology enables HDTV distribution to home. Higher bandwidth/capacity more than Giga PON technologies make it possible to come in new attractive services.

- Bandwidth/capacity is increasing.
- We can now fully enjoy the benefits of Gigabit class service.

TDM

WDM, etc.
### The Need for bandwidth

#### Broadband Bandwidth *(Lightwave Aug/05)*

<table>
<thead>
<tr>
<th>Service</th>
<th>Bandwidth (Mb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice (3 lines)</td>
<td>0.4</td>
</tr>
<tr>
<td>Data</td>
<td>5-10</td>
</tr>
<tr>
<td>SDTV (3)</td>
<td>9-12</td>
</tr>
<tr>
<td>HDTV</td>
<td>9-19</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>23-42</strong></td>
</tr>
</tbody>
</table>

#### Bandwidth Requirements

- **EPON:** 1.25G/44.6M = 28 (1:32 split)
- **GPON:** 2.5G/44.6M = 56 (1:64 split)

**Today’s Digital Home**
- 1 phone line = 64 kb/s
- 1 Internet = 1.5 Mb/s
- 1 SDTV = 3.5 Mb/s
- 1 HDTV = 16 Mb/s
- **24.1 Mb/s**

**Tomorrow’s Digital Home**
- 2 phone lines = 128 kb/s
- 1 online shopping & banking = 1.5 Mb/s
- 1 online gaming = 3.0 Mb/s
- 1 TeleWorking (or Learning) = 5 Mb/s
- 1 VOD / PVR = 5 Mb/s
- 2 SDTV = 4 Mb/s
- 2 HDTV = 16 Mb/s
- **44.6 Mb/s**

*In general, 50 Mb/s (100Mb/s?) is a typical bandwidth requirement per subscriber for next-generation triple-play residential services.*
PON / FTTx Deployments Continue to Spread Worldwide

North America
- MSOs

W. Europe
- Other
- China

EMEA

North America
- Telcos

India

Latin America

Japan

Korea

SE Asia

GPON

On-going

EPON

Starting
OECD Broadband Subscribers per 100 inhabitant (2008)
Economies with the Highest Penetration of Fibre-to-the-Home/Building + LAN

- South Korea
- Japan
- Hong Kong
- Taiwan
- Lithuania
- Sweden
- Norway
- Slovenia
- Bulgaria
- Denmark
- USA
- Estonia
- Slovakia
- Singapore
- Finland
- Netherlands
- Latvia
- China
- Russia
- Romania
- Italy
- France
- Portugal
- Czech Republic

**June 2010 Ranking**
Source: Fibre-to-the-Home Council
September 2010

- (blue) Fibre-to-the-Home subscribers
- (orange) Fibre-to-the-Building + LAN subscribers

Economies with greater than 1% household penetration*

Household Penetration

0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60%
G20 Highest Penetration of FTTH/B

G20 Economies with the Highest Penetration of Fibre-to-the-Home/Building + LAN

- South Korea
- Japan
- USA
- China
- Russia
- Italy
- France

Economies with greater than 1% household penetration

June 2010 Ranking
Source: Fibre-to-the-Home Council
September 2010
Broadband Subscribers in Japan

**Forecast**

- **Total 27.8M**
- **>10M**
- **>18M**

**Source:** Ministry of Internal Affairs and Communication of Japan and Yano Research Institute, Ltd. November 2007

- Broadband subscriber is steadily increasing.
- FTTH subscriptions surpass 10 Million (Sept. 2007)
- Meanwhile, DSL subscriptions declined.
Access Network Positioning

System (VDSL, PON, Ethernet, + Home Network)
# Products Line-up

## Layer 3 Level
- **HN 1104Av**
  - RGW w/ Ap & VoIP
- **HN 2104Ap**
  - RGW w/ Ap
- **HN 3104**
  - 4P RGW
- **HN 2204Ap**
  - RGW w/ Ap
- **ES 7324B**
  - 24P L3 Switch
- **ES 7312BF**
  - 12P Optic L3 SW
- **EX 5148P**
  - 48P DSLAM/Pole
- **EP 3180**
  - 80 EPON OLT
- **EP 3116**
  - 16 EPON OLT

## Layer 2 Level
- **EX 5204Ap**
  - RGW w/ Ap & VDSL2
- **EP 3204**
  - 4P EPON ONT
- **EP 3201**
  - 1P EPON ONT
- **EP 6206**
  - 6P mini-FES
- **EX 5124P**
  - 24P DSLAM/Pole
- **EX 5148**
  - 48P DSLAM

## Module & Devices
- **GP 1202**
  - 2P GPON ONT
- **GP 1116**
  - Triplex-ONT
- **GP 1104**
  - 4 GPON OLT
- **EP 1204rf**
  - RF Overlay

## Home Networking
- **HO 1101**
  - Optical HDMI
- **HO 2101**
  - Optical XDMI
- **HP 1102**
  - 2W Home PNA

## Ethernet Switch
- **EXM**
- **FEM**
- **GMII**
- **SGMII**
- **1000Base-Tx**
- **100Base-Fx**

## VDSL2
- **VDSL2**

## PON
- **GPON**
- **EPON**

## Footnotes:
- **GE-PON**
- **G-PON**
What is TDM PON?

- **Downstream** – TDM transmission with multiple “listeners” (encryption to insure privacy)
- **Upstream** – TDMA transmission with upstream transmissions (bursts) scheduled to prevent overlap

Downstream (single-fiber systems):
- 1490 nm
- 1310 nm
- 1555 nm

Upstream:
- 1310 nm
- RF video (if present)

**TDMA**
- Time Division Multiple Access
**CC**
- Cross Connect
**NB**
- Narrow Band
**BB**
- Broadband
**OLT**
- Optical Line Termination
**ONT**
- Optical Network Termination

**E1/DS1/Telephony**
- Data
**E1/T1/Telephony**
- VOIP
- Video
**POTS**
- Data

1:32 Optical splitter
(or 1:64 for shorter reaches or with Reach Extender)

Up to 60 km* physical reach
(* with G.984.6 Reach Extender)
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IEEE EPON</th>
<th>ITU-T GPON</th>
<th>ITU-T BPON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstream line rates, Mbit/s</td>
<td>1250</td>
<td><strong>2488.32</strong></td>
<td>155.52 or 622.08 or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1244.16 (am. 2)</td>
</tr>
<tr>
<td>Upstream line rates, Mbit/s</td>
<td>1250</td>
<td><strong>1244.16</strong></td>
<td>155.52 or 622.08 (am. 1)</td>
</tr>
<tr>
<td>Line coding</td>
<td>8B/10B</td>
<td>NRZ (+ scrambling)</td>
<td>NRZ (+ scrambling)</td>
</tr>
<tr>
<td>Addressing capability (minimum)</td>
<td>32</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>Addressing capability (maximum)</td>
<td>256</td>
<td>128</td>
<td>64</td>
</tr>
<tr>
<td>Logical reach, km</td>
<td>10 or 20</td>
<td>60, with 20km maximum differential logical reach between farthest and nearest subscribers</td>
<td>20km</td>
</tr>
<tr>
<td>Layer 2 protocol</td>
<td>Ethernet</td>
<td>Ethernet over GEM and/or ATM</td>
<td>ATM</td>
</tr>
<tr>
<td>TDM support</td>
<td>TDM over Packet</td>
<td>Native TDM and/or TDM over ATM and/or TDM over Packet</td>
<td>TDM over ATM</td>
</tr>
<tr>
<td>Number of traffic flows per PON system</td>
<td>Depends on number of LLIDs/ONT</td>
<td>4096</td>
<td>256</td>
</tr>
<tr>
<td>Upstream bandwidth capacity for data throughput, Mbit/s</td>
<td>&lt; 960 for Downstream &lt; 700 for upstream (64 Byte packet)</td>
<td>2320 (for 2.488 Gbit/s downstream) 1160 (for 1.244 Gbit/s upstream)</td>
<td>500 (for 622Mbit/s symmetrical)</td>
</tr>
<tr>
<td>OA&amp;M and management</td>
<td>Ethernet OAM, optional SNMP</td>
<td>PL OAM + OMCI</td>
<td>PL OAM + OMCI</td>
</tr>
<tr>
<td>Downstream security</td>
<td>Open AES128</td>
<td>AES (counter mode)</td>
<td>Churning or AES (am. 2)</td>
</tr>
</tbody>
</table>
## POM MAC Chip Market

Why we selected PMC chip set for FTTH solution?
- More field experience in FTTH deployment.

### 2009 market share

<table>
<thead>
<tr>
<th>Company</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teknovus</td>
<td>16%</td>
</tr>
<tr>
<td>Cortina</td>
<td>2%</td>
</tr>
<tr>
<td>Broadlight</td>
<td>11%</td>
</tr>
<tr>
<td>Freescale</td>
<td>8%</td>
</tr>
<tr>
<td>HiSilicon</td>
<td>2%</td>
</tr>
<tr>
<td>FPGA in OLT</td>
<td>5%</td>
</tr>
<tr>
<td>PMC</td>
<td>56%</td>
</tr>
<tr>
<td>Teknovus</td>
<td>16%</td>
</tr>
</tbody>
</table>

[Diagram showing market share distribution]
GPON Applications

- Point-Multipoint communication over a single fiber
- Every ONT/ONU assigned a timeslot (TDM channel)
- Data encapsulation in MAC-level frame
- Ranging needed for synchronization
<table>
<thead>
<tr>
<th>OLT at Central Office</th>
<th>Optical Distribution Network</th>
<th>ONT/ONUs</th>
<th>Customer Premises Equipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP-1140 (40 PONs)</td>
<td>1:64 Splitter</td>
<td>ES-7224 (24 GE Ports)</td>
<td>ATA for VOIP</td>
</tr>
<tr>
<td>GP-1116 (16 PONs)</td>
<td></td>
<td>ES-6224 (24 FE Ports)</td>
<td>HN-2204AP</td>
</tr>
<tr>
<td>GP-1104 (4 PONs)</td>
<td></td>
<td>EX-5124 (24 VDSL2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES-6208 (8 FE Ports)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP-1202 (2 GE Ports)</td>
<td></td>
</tr>
</tbody>
</table>
The Large Capacity OLT (Shelf Type) Supporting 40 G-PON Interface

- **Mechanical Structure**
  - 19 inch Rack mountable shelf (6U Height including Fan Box)
  - Shelf Dimension: 19”(W) x 310mm(D) x 6U(H)

- **Board Configuration**
  - Board Dimension: 203mm(W) x 250mm(D)
  - MSU(Main Switching Unit) : Ethernet Switch & CPU Peripherals
    - 1+1 Redundancy or 2 Working Operation
  - PIU(G-PON Line Unit) : 4PON per Board, 10Boards per Shelf
  - PDU(Power Distribution Unit) : 1+1 Redundancy

- **Switch Fabric & Controller**
  - Switching Capacity: 48x2.5GE + 8x10GE
  - AMCC 440EPX-400MHz
  - Linux 2.4.35
  - 64MB Flash Memory, 512MB DDRII SDRAM, 128Kbyte NVRAM

- **Physical Interface**
  - Down link : 40 G-PON Line
  - Up Link: n x 1000Base-X (n = 4, 8,12,16)

- **Generals**
  - [Tellion GP] G-PON Functions
  - [Tellion GP] Switching Functions
  - [Tellion PON] OAM Functions
  - [Tellion PON] Operational Environments
  - EMS supporting Java based GUI and CLI
  - Switch Lookup Table Entry
    - MAC: 32K, VLAN: 4K
    - Multicast(L2): 1K, Multicast(L3): 4K
    - L3 Table(V4): 16K, L3 Table(V6): 8K
    - LPM(V4): 16K, LPM(V6): 8K, ACL: 5.5K
The Small Capacity OLT (Pizza Box Type) Supporting 16 G-PON Interface

- **Mechanical Structure**
  - 19 inch Rack mountable Pizza Box (2U Height)
  - Box Dimension: 19”(W) x 255mm(D) x 2U(H)

- **Board Configuration**
  - Board Dimension: 203mm(W) x 250mm(D)
  - MSU (Main Switching Unit) : Ethernet Switch & CPU Peripherals
  - GIU (G-PON Line Unit) : 8PON per Board, 2Boards per Box
  - PDU (Power Distribution Unit) : 1+1 Redundancy
  - Pluggable FAN Unit

- **Switch Fabric & Controller**
  - BCM : 24GE + 4x10GE
  - AMCC 405EP-266MHz
  - Linux 2.4.35

- **Physical Interface**
  - Down link : 16 G-PON Line
  - Up Link: 4 x [GEMf] 1000Base-X

- **Generals**
  - [Tellion EP] G-PON Functions
  - [Tellion EP] Switching Functions
  - [Tellion PON] OAM Functions
  - [Tellion PON] Operational Environments
  - EMS supporting Java based CLI
  - Switch Lookup Table Entry
    - MAC: 16K, VLAN: 4K
    - Multicast(L2): 1K, Multicast(L3): 4K
    - L3 Table(V4): 12K, LPM(V4): 12K
    - ACL: 2K

See the "WAN Access Module"
The Small Capacity OLT (Shelf Type) Supporting 4 G-PON Interface

- **Mechanical Structure**
  - 19 inch Rack mountable Pizza Box (1U Height)
  - Box Dimension: 19”(W) x 255mm(D) x 1U(H)
  - Fan Box Embedded on Shelf

- **Board Configuration**
  - Ethernet Switch & CPU Peripherals, 4PON Interface
  - PDU(Power Distribution Unit)

- **Switch Fabric & Controller**
  - BCM 56228: 8GE + 4x2.5GE
  - MIPS-266MHz
  - Linux 2.4.35
  - 32MB Flash Memory, 256MB DDR SDRAM

- **Physical Interface**
  - Down link: 4 x G-PON Line
  - Up Link: 2 x [GEMf] 1000Base-X

- **Generals**
  - [Tellion GP] G-PON Functions
  - [Tellion GP] Switching Functions
  - [Tellion PON] OAM Functions
  - [Tellion PON] Operational Environments
  - Switch Lookup Table Entry
    - MAC: 16K, VLAN: 4K
    - Multicast(L2): 1K, Multicast(L3): 1K
    - L3 Table(V4): 4K, LPM(V4): 8K
    - ACL: 2K
ONT : GP-1202

- Desk-Top Box: 135mm(W) x 96(D)mm x 30mm(H)
- Physical Interface
  - WAN(G-PON) Port : optical (Up/Down: 1310nm/1490nm)
  - LAN Port : 2 x RJ45(10/100/1000Base-Tx)
- Generals
  - [Tellion GP] G-PON Functions
  - Reach up to 20Km
  - L2 Based QoS processor Embedded
  - Dying Gasp H/W Support
  - IEEE802.3ah MPCP
  - IEEE 802.3x Flow control
  - IEEE 802.3p(128KB Queuing with 8 classes)
  - IEEE 802.3q(VLAN)
  - Operational Environment: 0°C ~ +50°C, Max 10~80%Humidity
  - Power Source: 100~240VAC, 50~60Hz, DC 12V/2A
The GES2 (Gigabit Ethernet L2 Switch) Supporting both IPv4 & IPv6 Packet

- **Mechanical Structure**
  - 19 inch Rack mountable Pizza Box (1U Height)
  - Box Dimension: 19”(W)x 250mm(D) x 1U(H)
  - Power Supply Unit Embedded

- **Physical Interface**
  - Down link : 18 x 1000Base-X Optic Link
    - 4 x 1000Base-X (or 1000Base-Tx)
  - Up Link: [GPM] G-PON Combo Module
    - [EPM] E-PON Module (Option)
    - [GEMt/f] 2 x 1000Base-X (or 1000Base-Tx)

- **Switch Fabric & Controller**
  - BCM : 24GE + 4x10GE
  - MIPS-266MHz
  - Linux 2.6.25

- **Generals**
  - [Tellion ES] L2 Switching Functions
  - [Tellion ES] OAM Functions
  - [Tellion ES] Operational Environment
  - IPv4/IPv6 Dual Mode Operations
  - Switch Lookup Table Entry
    - MAC: 16K
    - VLAN: 4K
    - Multicast: 1K
    - ACL: 2K

See the "WAN Access Module"
FES type ONU: ES-6224B

The FES (Fast Ethernet Switch) Supporting both IPv4 & IPv6 Packet

- Mechanical Structure
  - 19 inch Rack mountable Pizza Box (1U Height)
  - Box Dimension: 19”(W) x 250mm(D) x 1U(H)
  - Power Supply Unit Embedded

- Physical Interface
  - Down link: 100Base-Tx 24 Ports
  - Up Link:
    - [GPM] G-PON Combo Module
    - [EPM] E-PON Module (Option)
    - [GEMt/f] 2 x 1000Base-X (or 1000Base-Tx)

- Switch Fabric & Controller
  - BCM: 24FE + 4GE (Gbps)
  - MIPS-266MHz
  - Linux 2.6.25

- Generals
  - [Tellion ES] L2 Switching Functions
  - [Tellion ES] OAM Functions
  - [Tellion ES] Operational Environment
  - IPv4/IPv6 Dual Mode Operations
  - Switch Lookup Table Entry
    - MAC: 16K(8K)
    - VLAN: 4K(4K)
    - Multicast: 1K(256)
      - ** BCM 56025(56014)
    - ACL: 2K

---

See the “WAN Access Module”
**Mechanical Structure**
- 19 inch Rack mountable Pizza Box (1U Height)
- Box Dimension: 450mm(W)x 258mm(D) x 44mm(H)
- Power Supply Unit Embedded

**Physical Interface**
- Down link: 24 x 100Base-Fx, SFP
- Up Link: [GEMf] 1000Base-X

**Switch Fabric & Controller**
- 24FE + 4GE(Gbps)
- AMCC 405EP-266MHz
- Linux 2.4.35

**Generals**
- [Tellion ES] L2 Switching Functions
- [Tellion ES] OAM Functions
- [Tellion ES] Operational Environment
- Switch Lookup Table Entry
  - MAC: 16K
  - VLAN: 4K
  - Multicast: 256
  - ACL: 240

[GPM], [EPM], [GEMt/f],

See the "WAN Access Module"
WAN Access-Module

- **EPM (E-PON Module)**
  - Plug In/Out Type module
  - Physical Interface
    - Up Link: E-PON
    - System: GMII [EPM] SGMII [EPMs]

- **GPM (G-PON Module)**
  - G-PON Combo Module
  - Plug In/Out Type module
  - Physical Interface
    - Up-Link: G-PON & 1000Base-Tx Dual Combo Media
    - System: SGMII

- **FEM (Fast Ethernet Module)**
  - Plug In/Out Type module
  - Physical Interface
    - Up Link: 100Base-Fx
    - System: MII

- **GEM (Gigabit Ethernet Module)**
  - Plug In/Out Type module
  - Physical Interface
    - Up Link: [GEMt] or [GEMf]
    - System: SGMII GMII
RF overlay with G-PON for CATV ISP

GP-1116 G-PON OLT

20 km Reach

FTTH

IP STB

FE

ONT

FE

ONT

FE

GP-3201R ONT with RF overlay

FTTN

MicroNode

STB

COAX

Analogue STB

COAX

FE

HN-2204AP

GP-1202

Tellion
Home Networking with G-PON

10/100/1000 Base-TX

- 10/100Base-TX * 4 port
- USB2.0 for printer and NAS etc
- WiFi 802.11n(2T/2R) for WiFi phone, Smart Phone and PC & notebook
- DECT CAT-iq2.0 for wireless VOIP

Coaxial Cable for CATV or HFC

10/100/1000 Base-TX

GP-1202

RT-1200

G-PON LINE

GP-1201R

HN-5304A

HN-4314ag

HN-4020

HN-5020

HN-4020

HN-4404A

IPTV

5GHz Video Bridge using WiFi 11n (no wireline in Home)

Coaxial Cable for CATV or HFC

Concurrent Dualband AP
2.4GHz for WiFi data, 5GHz for Video bridge

IP-STB

HN-4020

HN-4020

IP-STB

IP-STB

5GHz Video Bridge using WiFi 11n (no wireline in Home)
RFOG & WA-1116A

- The Tellion’s TDMA PON solution, the most spread FTTH technology in the access network world, maximizes the economical efficiency of optical feeders, and provides scalable split ratio according to service requirements and subscriber density. In addition, RFOG (RF over Glass) solution with G-PON & GE-PON system enables a cable operator to pull fiber all the way to the home or business while preserving the MSO’s headend and legacy HFC facilities.

- V-OLT WA 1116A systems integrates OTX, EDFA, and WDM multiplexer into one shelf to support 16 PON lines and 512 subscribers. Micro node RT1200 handles the optical –to– electrical conversion at the premises and deliver all CATV and satellite RF signal to subscriber using 1550nm wave. RFOG allows operators to continue using traditional STB and Docsis Cable modems and EMTA to deliver video, voice, and Internet service.

V-OLT WA 1116A
- Optical transmitter for CATV analog and Digital signal and Satellite using 1550 nm
- Data path for GE-PON and G-PON using 1490 nm and 1310nm
- Wavelength plan : DS (1490nm for Data, 1550nm for RF video), US (1310nm for Data, 1610nm for return path)
- CATV analog, 54~750MHz, Digital 750~870MHz, up to 1,000Mhz (NTSC 100 CH)
- Satellite Digital : 950~2150MHz (up to 130 Channel)
- RF Pre-amplifier (EDFA) with Auto Limiting Control function
- Transmission Distance : 10km, 20km SMF
- support up to 16 PON
Tellion’s Optical Transmitter
Features

- CATV & Satellite band
  - CATV analog: 54~750MHz
  - CATV Digital: 750~870MHz
  - Satellite Digital: 950~2150MHz
- RF Pre-amplifier with Auto Limiting Control function
- CATV: NTSC 110ch
- Satellite: 130ch
- Transmission Distance: 5km, 10km, 20km SMF
- Support up to 16 PON ports (with 1:32 split ratio): support to 512 subscribers.
WDM: WP-1116A
(RF Overlay on WDM link)

BOT: Broadband Optical Transmitter

G/E-PON OLT

GP-1201R
ONT with RF overlay

RF Over PON
VDSL
(VDSL Access Multiplexer & CPE)

An Ethernet Converged DSL Access Solution for Large MDU and FTTC Applications
User Bandwidth requirement: 50 Mbps in down stream to provide Triple play service in the near future.

We can get 50Mbps/10Mbps at the 700 m reach.
100/100 Band Plan based on VDSL2 Standard Profile 30a
IP-VDSL Products

Lower Price
- Subtending allows cost reduction per subscriber line

Scalability
- High density configuration
- Multiple uplink options (100Base-TX/FX, 1000Base-SX/LX)

Flexibility
- Inside premises and outside plant deployments
  - Rack-mounted shelf, outside cabinet mounted shelf
  - Pole & wall mounted shelf
  - Pizza box low profile form factor
- Increments of 24 ports per switch card

Ease of Use and Deployment
- Embedded management (SNMP, CLI & GUI)
- Remote management via in band or out of band connections
- Profile based provisioning & plug-play installation
- Hot swapping
Product Line : VDSL2

- VDSL2
- 100/1000BASE-TX/FX
- EX-5124B+
- EX-5148
- EX-5124Plus
- EX-5201

Ethemet Aggregation (Fast/Gigabit)

100/1000BASE-TX/FX
100/1000BASE-TX/FX(Optional)
GE-PON

Change PTP to PTMP to decrease investment

Passive Optical Network

High-speed Internet Access
Interactive AV
VOD/MOD
LOD/EOD
POTS
VDSL2 Products

- **DSLAM: General type**
  - EX-5148S
  - EX-5124B

- **DSLAM: Die-casting type**
  - EX-5124P

- **Modem**
  - EX-5201
  - EX-5204Ap
EX Basic Functions

- **[Tellion EX] VDSL2 Functions**
  - Standard: ETSI VDSL Standard
  - ITU-T G.993.2 Annex C Band Plan: 25KHz~30MHz Band
  - RFI Notching, ADSL/ISDN Friendly
  - PSD MASK: ETSI, ANSI, ITU-T(G.993.2) VDSL Standards
  - UPBO(Upstream Power Back-up)
  - Long reach asymmetrical transmission rates (0.4mm Cable)
    - 100M/100M up to 300m,
    - 30M/2M up to 1Km
    - 8M/1M up to 2Km
  - Rate limiting
  - Surge Protection: 4KV

- **[Tellion EX] Switching Functions**
  - Wire-speed Packet Processing
  - MAC Address Limiting (1~16)
  - IEEE 802.1q VLAN
  - IEEE 802.1p Priority
  - IEEE802.3x Flow Control
  - IEEE 802.3ad Link Aggregation (LACP)
  - IGMPv1 v2 v3 (Snoop & Proxy supported)
  - DHCP Relay / Filtering
  - Broadcast/Multicast Storm Control
  - Port based ACL Filtering
  - Port Redirection / Port Mirroring
  - WRED, SPQ, WRR, WFQ, SPQ+WRR, SPQ+WFQ
  - NetBEUI, NetBIOS, NBT

- **[Tellion EX] OAM Functions**
  - SNMPv1 v2 v3 for embedded agent
  - Remote download, Loop-back test
  - Auto Rebooting(By Ping Check, Memory Check, Watch-Dog)
  - Auto CLI

- **[Tellion EX] Operational Environment**
  - Temperature: -20°C ~ +60°C
  - Humidity: 7% ~ 90%
  - Power Source: 90 ~ 250 Vac, or -48+/−10% Vdc
The DSLAM(Pizza Box Type) Supporting 24 VDSL2 Ports

- **Mechanical Structure**
  - 19 inch Rack mountable Pizza Box (1.5U Height)
  - Box Dimension: 19”(W) x 330mm(D) x 1.5U(H)
  - Surge Protection & Splitter Module Embedded
  - Pluggable FAN Unit
  - Power Supply Unit Embedded

- **Switch Fabric & Controller**
  - BCM : 24FE + 4GE(Gbps)
  - AMCC 405EP-266MHz
  - Linux 2.4.32

- **Physical Interface**
  - Down link : RJ21 50Pin Champ Connector for VDSL Line
  - RJ21 50Pin Champ Connector for POTS Line
  - Up Link: [GPM] G-PON Combo Module
    - [EPM] E-PON Module
    - [GEMf] 1000Base-Lx

- **Generals**
  - [Tellion EX] VDSL2 Functions
  - [Tellion EX] Switching Functions
  - [Tellion EX] OAM Functions
  - [Tellion EX] Operational Environment
  - Switch Lookup Table Entry
    - MAC: 16K
    - VLAN: 4K
    - Multicast(L2): 256
    - ACL: 256

See the "WAN Access Module"
The DSLAM (Die-Casting Box Type) Supporting 24 VDSL2 Ports

- **Mechanical Structure**
  - Electric Pole / Messenger Wire / Wall Mountable Die-Casting Box
  - Box Dimension: 500mm(W) x 250mm(H) x 200mm(D)
  - Surge Protection & Splitter Module Embedded
  - ARB & ELB, Back-up Battery & OFD Installed
  - Airtight Container: IP 66 Grades, Vibration-free
  - Noiseless Fan-less type

- **Switch Fabric & Controller**
  - BCM: 24FE + 4GE(Gbps)
  - AMCC 405EP-266MHz
  - Linux 2.4.32

- **Physical Interface**
  - Down link: RJ21 50Pin Champ Connector for VDSL Line
    - RJ21 50Pin Champ Connector for POTS Line
  - Up Link: [GEMf] 1000Base-Lx
    - [EPM] E-PON Module

- **Generals**
  - [Tellion EX] VDSL2 Functions
  - [Tellion EX] Switching Functions
  - [Tellion EX] OAM Functions
  - [Tellion EX] Operational Environment
  - DHCP Server, Snoop & Relay (option 82)
  - PIM-SM
  - Static Routing
  - Switch Lookup Table Entry
    - MAC: 16K, VLAN: 4K
    - Multicast(L2): 256, Multicast(L3): 256, VLAN replication: 32
    - L3 Table(V4): 4K, LPM(V4): 16K, ACL: 256 per Line Card

See the "WAN Access Module"
Softbank Deployment in Japan
EX-5124PLUS Water Proof Test

1)  

2)  

3)
Wall mounted in LG U+, Korea
VDSSL2 CPE: EX-5201

- **Desk-Top Box:** 160mm(W) x 120mm(D) x 20mm(H)
- **Physical Interface**
  - WAN(VDSL2) Port: 1 x RJ11
  - LAN Port: 1 x RJ45
  - Premises Phone Line (2 wire): 1 x RJ11
- **Generals**
  - [Tellion EX] VDSL2 Functions
  - Dying Gasp H/W Support
  - Data Speed: Max 100Mbps up to 300m
  - Power Dissipation: Max 6W
  - Power Source: 100~240VAC, 50~60Hz, DC 5V/2A
VDSDL2 RGW: EX-5204Ap

- **Desk-Top or Wall Mountable Box**: 217mm(W) x 115mm(D) x 30mm(H)

- **Ethernet Switch & Controller**
  - Switch Capacity: 6FE
  - MIPS CPU
  - Linux 2.4.32
  - 8MB Flash Memory, 2MB SDRAM

- **Physical Interface**
  - LAN Port: 4 x RJ45
  - WAN Port: VDSL2
  - Antenna 1ea for IEEE802.11b/g

- **Generals**
  - [Tellion EX] VDSL2 Functions
  - [Tellion HN] Software
  - Packet Classification for QoS: 4 Level Priority Queue
    - Layer 2: Src/Dest Mac, VLAN ID, COS
    - Layer 3: Src/Dest IP, DSCP, TOS, Precedence, Protocol
    - Layer 4: Src/Dest TCP/UDP Port
  - Address & policy based Lookup Table
    - Mac Table: 1024 entry
    - Multicast Mac Table: 1024 entry
    - VLAN Table: 64 entry
    - Software NAT Table: 10K
    - QoS Policy Table: 8 entry
  - IEEE802.11b/g Based Wireless LAN
  - Wireless Security, Including WPA/WPA2.0/WEP/WMM/802.1x
  - Operational Environment: 0°C ~ +50°C
  - Power Source: 5Vdc
VDSDL2+6pts Switch: EX-5206

- Desk-Top Box: 190mm(W) x 160mm(D) x 30mm(H)
- Physical Interface
  - WAN(VDSL2) Port : 1 x RJ11
  - LAN Port : 6 x RJ45
  - Premises Phone Line(2 wire): 1 x RJ11
- Generals
  - **VDSL2 Functions**
    - Switching: Full wire speed guaranteed for all packet
    - VLAN: port Based VLAN, Tagged/Untagged frame for each port
    - Multicast: IGMP, IGMP Snooping/Proxy/Join & Leave suppression, Fast Leave
    - NAT: NAT, NATP for any Packet size, DMZ, ALG
    - DHCP: DHCP Server/relay/client
    - QoS
      - 4 label Q, Port rate limiting/sharing
      - DSCP, TOS, IEEE 802.1p classification
      - SPQ, WFQ, WRR, DWRR scheduling
      - Tail drop, RED, WRED
    - **ACL for QoS: Layer 1/2/3/4**
    - Security: Storm control, MAC Counting, Packet filtering, Fire-wall
    - Management: Consol, ANMP, Telnet, Web
    - Data Speed: Max 100Mbps up to 300m
    - Power Source: 100~240VAC, 50~60Hz, DC 12V/2A
**L2 Function**
- Maximum 16K MAC table
- STP, RSTP supported
- 802.1Q VLAN supported
- 802.1X port based Authentication control Function
- 802.1p priority Function supported
- IGMP snooping: maximum 256 groups
- LACP Function supported
- Port based Rate Limiting Function supported(by 64Kbps)
- No of MAC address Function: 1~256
- Monitoring Function by Port based/ACL

**L3 Function**
- Max. 4K IPv4 Host table
- Max. 8/16K LPM table
- ECMP/WCMP
- Static Routing Function supported
- RIP, OSPF, BGP routing protocol supported
- IP multicasting, IGMP proxy
- IP pim-sm : Hardware packet replication Function supported:(max. 8 VLANs)
- DHCP server/Relay Function supported
- DHCP snooping Function supported
QoS capability

- ACL Function Supported
- Max. 256 Routing table supported/(8port, EPIC),
  128ea/port for up-link supported
- Max.8ea COS queue/port supported
- WRED Function supported
- SPQ, WRR, WFQ, SPQ+WRR, SPQ+WFQ Function supported
- Netbios / Netbeui Packet Filtering Function supported
- DHCP packet filtering Function supported
Supported OAM

- **System management**
  - Security and Configuration

- **Configuration management**
  - Configuration (VDSL profile, etc.) setting
  - Configuration status retrieval
  - Software upgrade and download
  - Default configuration

- **Fault management**
  - Automatic alarm and status report/notification
  - Alarm and event history
  - LED indication and acoustic alarm

- **Performance management**
  - VDSL line rate retrieval
  - Ethernet link rate retrieval
Application with VDSL2 CPE

Fiber to the Node

PSTN Network

Gigabit Access

VDSL2 CO

Voice Call

Splitter included

100Mbps

Data

Gigabit Access

FTTN

SOHO

“A” Company

“B” Company

Tellion
Application with VDSL2 CPE + 6pts Switch

P/E

VDSL2 CO Box Type

Data

PSTN Network

Tel-Line

100M LAN(UTP)

VDSL2+ 6pt S/W

VDSL2+ 6pt S/W

VDSL2+ 6pt S/W

VDSL2+ 6pt S/W
Reference Site in Korea

Korea Telecom, SK Broadband’s VDSL, GE-PON, GPON Partner from 2004.

- VDSL2
  - 2004~2007
    - Korea Telecom over 900K
- EPON
  - From 2006~
    - Korea Telecom
    - EP-3201N over 350K
    - HN2204AP over 300K
- GPON
  - From 2009~
    - SK Broadband over 200K