VDSL2 -
Taking Broadband Access Evolution to the Next Level

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About VDSL2 - ITU G.993.2

- ITU consent reached in Geneva May 2005
- Multiple Profiles defined to address regional and application specific bandwidth requirements
  - Up to 30 MHz bandwidth
  - Up to 100/100 Mbps
  - ADSL2+ backwards compatibility
Broadband Access Status Quo

Performance – Services - Deployments

**Performance**
- **Downstream (Mbps)**
  - 100M
  - 50M
  - 24M
  - 12M
  - 6M
  - 2M
  - 1M
  - 128k
  - 64k
  - 2M

- **Upstream (Mbps)**
  - 100M
  - 50M
  - 24M
  - 12M
  - 6M
  - 2M
  - 1M
  - 128k

- **Services**
  - Video over Broadband 4%
  - Gaming 12%
  - Home Networking 20%
  - Security 30%
  - Music Downloads 6%
  - VoIP 20%

- **Subscribers**
  - Million Subscribers
  - Source: Del’Oro, Jan., 2006

**Broadband Access Services**
- Source: Point Topic, 2005

**Subscribers**
- Cable Modem
- ADSL-G.SHDSL
- VDSL
- PON
- Other

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ITU-T Workshop “NGN and its Transport Networks”
Kobe, 20-21 April 2006

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Reaching the Next Level in Broadband Access Performance

1988: ISDN
1998: ADSL (G.992.1)
2000: VDSL1 (G.993.1)
2005: VDSL2 (G.993.2)

Broadband Performance [Mbps*km]
Computational Complexity [Bandwidth*Mbps]

60  25  10  1  1  10  10 000  100 000
# VDSL2 Performance advantages over VDSL1

<table>
<thead>
<tr>
<th>Criteria</th>
<th>VDSL1</th>
<th>VDSL2</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth</td>
<td>12MHz</td>
<td>30MHz</td>
<td>Much higher performance for short loops</td>
</tr>
<tr>
<td>Trellis, SRA, GCI</td>
<td>None</td>
<td>Mandatory</td>
<td>Improved performance</td>
</tr>
<tr>
<td>Long Reach</td>
<td>1km</td>
<td>3km</td>
<td>90% customer reach + single technology</td>
</tr>
<tr>
<td>ADSL Compatibility</td>
<td>None</td>
<td>ADSL, ADSL2, ADSL2+</td>
<td>Reuse of existing ADSL infrastructure</td>
</tr>
<tr>
<td>QoS</td>
<td>None</td>
<td>Dual Latency, Dual Bearer, Pre-Emption</td>
<td>Enable Triple - Play applications</td>
</tr>
</tbody>
</table>

### Bandwidth
- VDSL1: 12 MHz
- VDSL2: 30 MHz

### Trellis, SRA, GCI
- VDSL1: None
- VDSL2: Mandatory

### Long Reach
- VDSL1: 1 km
- VDSL2: 3 km...

### ADSL Compatibility
- VDSL1: None
- VDSL2: ADSL, ADSL2, ADSL2+

### QoS
- VDSL1: None
- VDSL2: Dual Latency, Dual Bearer, Pre-Emption
# Reaching the Next Level in Broadband Access Services

<table>
<thead>
<tr>
<th>Interactive Services</th>
<th>Upload Requirement</th>
<th>Time Required (284 Kbps)</th>
<th>Time Required (100 Mbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Photo Sharing</td>
<td>20 photos (5 MB each)</td>
<td>20 minutes</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Video Phones</td>
<td>Broadcast Quality</td>
<td>Not Possible</td>
<td>Possible</td>
</tr>
<tr>
<td>Music Sharing</td>
<td>Transfer 30 songs (5 MB each)</td>
<td>30 minutes</td>
<td>1 minute</td>
</tr>
<tr>
<td>Video Publishing</td>
<td>Upload 50 MB files</td>
<td>5 minutes</td>
<td>15 seconds</td>
</tr>
</tbody>
</table>
High Growth for Video and IPTV expected

Television pictures in **3-Dimensions**
Viewers can see real depth without aids such as shutter or polarisation spectacles... The aim of the collaboration is to produce live images at the Football World Cup 2006 for the pilot sets

**Worldwide subscribers to Digital Video Recording (DVR) services will rise by a factor of seven between 2005 and 2010**

Market will reach 83.4 million users in 2010, representing a compound annual growth rate (CAGR) of 45.3%, from 12.9 million in 2005, according to iSuppli

**Table 2: IPTV Homes by Region, 2005-2010**

<table>
<thead>
<tr>
<th>Region</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>CAGR 2006-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>0.3</td>
<td>1.4</td>
<td>3.9</td>
<td>6.5</td>
<td>9.4</td>
<td>12.9</td>
<td>74%</td>
</tr>
<tr>
<td>Europe</td>
<td>1.4</td>
<td>1.9</td>
<td>5.0</td>
<td>9.5</td>
<td>14.2</td>
<td>19.6</td>
<td>80%</td>
</tr>
<tr>
<td>Japan</td>
<td>0.0</td>
<td>0.4</td>
<td>1.5</td>
<td>3.5</td>
<td>5.1</td>
<td>7.0</td>
<td>107%</td>
</tr>
<tr>
<td>Asia</td>
<td>0.6</td>
<td>1.2</td>
<td>1.9</td>
<td>2.6</td>
<td>3.2</td>
<td>3.6</td>
<td>32%</td>
</tr>
<tr>
<td>China</td>
<td>0.0</td>
<td>0.2</td>
<td>1.3</td>
<td>2.6</td>
<td>5.5</td>
<td>8.8</td>
<td>176%</td>
</tr>
<tr>
<td>India</td>
<td>0.0</td>
<td>0.2</td>
<td>1.1</td>
<td>3.6</td>
<td>5.8</td>
<td>8.1</td>
<td>141%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>0.0</td>
<td>0.1</td>
<td>0.4</td>
<td>0.8</td>
<td>1.5</td>
<td>3.1</td>
<td>129%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.4</strong></td>
<td><strong>5.3</strong></td>
<td><strong>15.0</strong></td>
<td><strong>29.1</strong></td>
<td><strong>44.7</strong></td>
<td><strong>63.1</strong></td>
<td><strong>92%</strong></td>
</tr>
</tbody>
</table>

Source: iSuppli Corp. | December 2005
The Final Challenge and its Solution: Video Home Networking over the “last meters”

POF Solution for Video Home Networking:
- Very thin fiber for simple and invisible installation
- High reliability and speed of 100Mbps and more
- No electromagnetic interference
Reaching the Next Level in Broadband Access Penetration

- Ethernet-Other
- PON
- VDSL
- ADSL-G.SHDSL
- Cable Modem

Total DSLAM port shipments

Source: Infonetics, Aug. 05
Reaching the Next Level in Broadband Access
The Telco World

North America
- VDSL2 compliance
- Service 100/50Mbps & 30/5Mbps
- Profile 30a & 8c
- ADSL/2/2+ Interoperability

Europe
- VDSL2 compliance
- Service 50/10Mbps
- Profile 17a, 30a for business
- ADSL/2/2+ Interoperability

APAC and Japan
- VDSL2 compliance
- Service 100/100Mbps
- Profile 30a
- ADSL/2/2+ Interoperability
VDSL2 – Taking Broadband Access Evolution to the Next Level

- VDSL2 takes broadband performance of xDSL to the next level \( \Rightarrow \) 100/100 Mbps to ADSL2+
- Broadband Performance is Essential for Success of IPTV and HDTV
- VDSL2 ITU G.993.2 Deployments are Happening Today