Next Generation Optical Access

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One World Connected

- Broadband everywhere
- Everyone and everything connected
- Internet is the heartbeat of the modern society
- Multitude of services and business models
Put the customer in the center – evolve to the **Network of One**

- One Unified management & charging
- One Simplified network
- One Convergent service control
- One Business-optimized operation
- One View of customer data
- One Unified management & charging
- One Simplified network
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Our holistic approach to boost efficiency and experience
One Simplified network
The road to broadband IP everywhere, anytime

Realize the optimized mobile broadband experience

Converge to an optimized photonic IP transport network

Simplify wireline access and aggregation to enable the Gigabit experience
It becomes difficult to satisfy bandwidth hunger with today’s access technologies.

**Applications bandwidth demand**

- Super HDTV
- Video Sharing
- HDTV
- Gaming
- Web surfing

**Access technology capabilities (today)**

- ADSL
- ADSL2+
- VDSL2
- Docsis3.0
- GPON

TV streams, Web surfing, sharing and gaming will easily fill the pipe.
Bandwidth hunger is ever increasing Video & TV drive needs

Applications bandwidth demand

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<th>100</th>
<th>50</th>
<th>50</th>
<th>100</th>
<th>150</th>
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<th>300 Mbps</th>
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<td>50</td>
<td>100</td>
<td>200</td>
<td>300 Mbps</td>
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</table>

NHK will start experimental test transmissions of its Ultra-HD system in 2011-12

May, 2008

DirectTV will launch 3D HDTV channel in US next year

December, 2009
Next Generation Access
Where to go and what are the differences

AON
1 household per fiber port

WDM-PON
e.g. 1000 households per fiber port

TDM-PON
64 households per fiber port (GPON)

H-PON
e.g. 512 households per fiber port

One wavelength per fiber

Multiple wavelengths per fiber

Dedicated wavelength

Time-shared wavelength

wavelength

64 households per fiber port

1 household per fiber port

deleted 1000 households per fiber port

delated 512 households per fiber port

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National Strategies for ultrabroadband … 26 - 27 April 2010
Next Generation Optical Access – NGOA¹)
Shaping the colorful future of broadband access

One wavelength per customer: unshared 1Gbps symmetrical
Up to 100 km reach²) and high splitting factor of ≤ 1000²)
Reuse of existing metro fibre – convergence of access and metro aggregation

¹) Nokia Siemens Networks research project
²) depending on choice of cascaded splitter / filter design
Next Generation Optical Access Technology Ingredients

**Coherent Detection**
- High wavelength density
- High receiver sensitivity

**Electronic Signal Processing**
- Relaxed tunable lasers requirements
- High flexibility in modulation concepts
- Software defined radio for carrier recovery and channel decoding

**Low-cost Tunable Lasers**
- Linewidth < 200 kHz
- Serves as local oscillator for coherent detection
- Serves as upstream signal

**Photonic Integration**
- Single integrated ONU optical component
- Single integrated OLT optical component
- Generation of multiple downstream wavelengths out of a single laser source
Technology Comparison

NGOA vs. DSL vs. GPON

<table>
<thead>
<tr>
<th>Technology</th>
<th>Client Speed</th>
<th>Home Building</th>
<th>Distribution Network</th>
<th>LO/CO</th>
<th>Metro Area</th>
<th>Edge</th>
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</thead>
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<tr>
<td>VDSL2</td>
<td>50/10 Mbps unshared</td>
<td>100bT</td>
<td>meters</td>
<td>20 km</td>
<td>100bT/1000bT</td>
<td>1000bT</td>
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<tr>
<td>GPON</td>
<td>2.5/1.2 Gbps shared</td>
<td>100bT</td>
<td>20 km</td>
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<td>100bT/1000bT</td>
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<tr>
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<td>1000bT</td>
<td>up to 100 km</td>
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</table>
Open Lambda Initiative
Creating a virtualized PON network environment

Framework for dynamic wavelength management and allocation

Rules for coexistence of technologies

Division of optical fibre spectrum for different operator models

Some guidance for outside plant planning

Ensure interoperability of technologies

GPON
XG-PON1

O-Band
E-Band
S-Band
C-B.
L-Band
U-Band

NGOA 1000 of λ's up & down

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Open Lambda Concept
Diversity of vendors, technologies, and services

- Need for simple integration with existing PON deployments
- Flexible multi-homing redundancy concept
- Smooth migration to higher data rates and new technologies

Multiple technology options, possibly filters
Passive filter/combiner
Long distance office
System A
System B
System C
Practical use case: Fiber-sharing & Spectrum unbundling

- Apply the open lambda environment for unbundling and sharing
- Secure network isolation by wavelength filtering
- Opportunity to evolve to a virtualized optical access network
Let’s ride the wave

The ultimate Gigabit experience through Next Generation Optical Access
Thank you!