«Economics of fixed Access networks to deliver IP based Broadband multi-services everywhere»

- Description of the techno-economic framework assumptions for the MUSE project;
- Presentation the major results of the fixed broadband access network economics from TONIC and EURESCOM P1245

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Outline

- Objective & Research Questions
- Multi-service access “everywhere” - What is the story about?
- Methodology & Framework assumptions
- Results from TONIC and EURESCOM P1245
  - Network architectures & results
    - Fibre to the cabinet (FTTC)
    - Fibre to the home/ office (FTTH/O)
  - General view & main conclusions
Objective & Research Questions

> Provide techno-economic validations of architectural choices, ensuring that the proposed MUSE access architecture fulfils its objective of multi-service everywhere and for everyone:

- **How to enable new revenues** → business models are sought
- **How to lower the CAPEX** → which technology deployment in different part of the access networks
- **How to lower the OPEX** → analyse the benefits of introduction intelligence in the access networks

We are still at the beginning of the work
Multi-service access “everywhere”

> First mile solutions that covers >80% of European Citizens
> Allow for large scale deployment of BB services

**Total Broadband Customer Targets by All Fixed Platforms in the EU**

<table>
<thead>
<tr>
<th>Percentage of the fixed lines (176 Mn in 2004)</th>
<th>1st January values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Corporate Data Services based on: ATM, Frame Relay, leased lines E1, dedicated IP VPN ≥ 2 Mbit/s</td>
<td></td>
</tr>
</tbody>
</table>

- Optimistic: 95 Mn (54%)
- Pessimistic: 67 Mn (38%)
- 22.9 Mn (13%)
- 73 Mn (42%)
Highly efficient delivery of BB services for “50 Euro /user /month”

> Typical monthly fee for ADSL/Cable today: 25-75 Euro
  • Users will not spend more, but will desire more for the same fee
  • Flat fee model for connectivity: margins eroding due to competition

> Ability to deliver value added services is essential

> How to achieve ubiquitous BB service delivery?
  • Get the business case profitable for every player in the value chain
Improving the BB access business case

> New revenues by
  - Enabling new services
  - Connecting home devices other than PCs
  - Improved content and end-user satisfaction: by open business models

> Lower opex by
  - Improved efficiency in specialised organisations (open business models)
  - Easy interoperability, plug and play
  - Automated OAMP

> Lower capex by
  - Targetted R&D in low cost technology
  - Economies of scale
Allow each player in value-chain to tap on revenue stream
Demand for the Telecommunications Services

Tool - environment

- Services
- DB
- Architectures
- Geometric Model

Revenues

OA&M Costs

Investments

Cash flows, Profit & loss accounts

Year 0
Year 1
Year n
... Year m

First Installed Cost - CAPEX

NPV
IRR
Payback Period

IST-2000-25172 “TONIC”

Thomas Monath, 29.6.2004
General Assumptions

- Case study approach with focus on Access & Edge Network
- Study period 2005 – 2010
- Wholesale Business Model which seeds back a certain percentage of the revenues to all players
- Discount Ratio equals to 10% for all scenarios
- Network elements in general will be modelled based on list price information of different vendors combined with learning curves & Maintenance costs
- OA cost model considers:
  - Network Operations incl. Management, Control,
  - Employees depending expenditures
  - Provisioning costs
  - Sales and Marketing
### Area Description and Potential Market

#### Connectivity: 65,536

<table>
<thead>
<tr>
<th>Area Description</th>
<th>Dense Urban</th>
<th>Urban</th>
<th>Suburban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Cable Length</td>
<td>1,400m</td>
<td>2,200m</td>
<td>2,400m</td>
</tr>
<tr>
<td>Customer Density/ km²</td>
<td>5,461</td>
<td>2,048</td>
<td>410</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td>1,024</td>
<td>2,048</td>
<td>16,384</td>
</tr>
<tr>
<td>Customers per Building</td>
<td>64</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>Local Exchange to Cabinet duct availability</td>
<td>95%</td>
<td>55%</td>
<td>25%</td>
</tr>
<tr>
<td>Cabinet to Building duct availability</td>
<td>65%</td>
<td>30%</td>
<td>0%</td>
</tr>
</tbody>
</table>

#### Market Potential

- Customer Base/ Access Area: 16,384
- Total Business Customer Share: 10%
- Business/ Access Area: 1,638
- Households/ Access Area: 14,746
- Incumbents Market share (residential): 90%
- Incumbents Market share (business): 60%

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1) Digging and Ducting cost (four channel duct): 105 k€/km!
## Definition of Service Classes

Access Classes have to support everything, but with different SLA’s, QoS levels and security requirements.

<table>
<thead>
<tr>
<th>Service Class</th>
<th>Downstr. Capacity [Mbps]</th>
<th>Upstr. Capacity [Mbps]</th>
<th>Examples of Interface Type</th>
<th>voice services: (Voice over Packet, e.g. VoIP/DSL)</th>
<th>audio services: Audio on Demand, Audio Conferencing</th>
<th>video services: TV/Video Broadcast, [Near] Video on Demand (IPTV) Conferencing</th>
<th>data services: SMS, File Transfer, WWW, Email, E-mail, E-business</th>
<th>bearer services: On Demand bearer, VPN, SLA’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic-Residential</td>
<td>1</td>
<td>0.5</td>
<td>10BaseT</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Silver-Residential</td>
<td>3</td>
<td>1</td>
<td>10BaseT</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Gold-Residential</td>
<td>10</td>
<td>2</td>
<td>10BaseT</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Premium-Residential</td>
<td>50</td>
<td>10</td>
<td>10/100BaseT</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum-Residential</td>
<td>100</td>
<td>100</td>
<td>10/100BaseT</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic-Business</td>
<td>2</td>
<td>2</td>
<td>10/100baseT; E1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver-Business</td>
<td>10</td>
<td>10</td>
<td>10/100baseT; 5xE1; ATM255P</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gold-Business</td>
<td>50</td>
<td>50</td>
<td>10/100baseT (E3/ATM255A)</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Premium-Business</td>
<td>100</td>
<td>100</td>
<td>10/100baseT (E3/ATM255A)</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Platinum-Business</td>
<td>1000</td>
<td>1000</td>
<td>1000baseT</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### Technologies
- ADSL
- FTTC
- VDSL
- FTTC
- VDSL
- Fibre
- HDSL/SDSL
- FTTC
- VDSL
- Fibre
MUSE Residential Service Class Forecast

Based on different technology Forecasts:

Percentage of the fixed lines (176 Mn in 2004)
Based on different technology Forecasts:

Corporate Data based on: ATM, Frame Relay, leased lines E1, dedicated IP VPN ≥ 2 Mbit/s
Tariff Model

Tariff incremental for doubling the capacity:
- Residential Multiplier 17%
- Business Multiplier 25%

Monthly Tariff Evolution

Platinum Business: Has to be defined

Monthly Flat Rate Internet Access

Connection Tariff
Network element: Switch Router GbE
Application: Central Exchange

Core

Central Exchange (CEx)

Downlink interfaces

Uplink interfaces

1000Base SX (short distance; MM) 8
1000Base LX (long distance; SM) 8
1000Base LX (medium distance; SM) 8
OC3c-POS-Interface (long distance; SM) 4

16 slots

Basic Equipment (Chassis + Basic modules + Software)

Switch Router GbE

OC3c-POS-Interface (long distance; SM) 1

Ether_CE_Swith Basic

Learning curve [k€]

2003 2004 2005 2006 2007 2008 2009 2010

0 5 10 15 20 25 30 35 40 45 50

Thomas Monath, 29.6.2004
Results have been observed within the following projects:

**IST-2000-25172 “TONIC”**
TechnO - EcoNomICS of
IP Optimised Networks and Services
Duration: 01/2000 – 12/2002

**P1245 “EASY”**
Ethernet Based Access Networks
Duration: 11/2002 – 03/2003
Hybrid Fibre Copper (FTTC) Comparison Architectures

- Active Optoelectronic
- WAN Interfaces
- VDSL interface
- Fibre cable
- Copper cable
- Passive couplers

Central Exchange (CE)

Local Exchange (LE)

Main cable

Cabinet (Cab)

Distribution cable

Subscriber location

Core network

ATM STM4

GbE

Customers < 750m

ATM (P-t-MP) FTTC

Ethernet (P-t-P) FTTC
Differences have nothing to do with the protocol architecture, but rather with interface granularity and fibre consumption!
Economic results are positive only for dense urban and urban areas in case of FTTC deployment.

Differences are caused by the Point-to-Point and PON architecture.
Pure Fibre (FTTH/O) Comparison Architectures

- **Central Exchange (CE)**
  - ATM STM4

- **Local Exchange (LE)**
  - OLT

- **Main cable**
  - ATM PON

- **Cabinet (Cab)**
  - E- PON

- **Distribution cable**

- **Subscriber location**
  - ONT
  - ATM (P-t-MP) FTTH/O
  - Ethernet (P-t-MP) FTTH/O
  - Ethernet (P-t-P) FTTH/O

- **New solution!**
  - GbE
  - 100BaseFx

- **Core network**

- **Active Optoelectronic**
- **WAN Interfaces**
- **VDSL interface**
- **Fibre cable**
- **Copper cable**
- **Passive couplers**

New solution!
Equipment investments of ATM or Ethernet PON under comparable conditions are in the same range.

Differences have nothing to do with the protocol architecture, but rather with interface granularity and fibre consumption – Point-to-Point compared to PON!

In Suburban area Digging & Ducting are most dominant.
FTTH/O: NPV comparison

- Positive NPV (10% discount ratio) for all cases only in dense urban areas!
FTTH/O: Cash Balance comparison

- Only dense urban areas are profitable (Pay Back - 5 years) within the study period!
- Comparable behaviour of EPON & APON
## Techno-economic Analysis - General view on the Results

<table>
<thead>
<tr>
<th>Network</th>
<th>Option</th>
<th>Dense Urban</th>
<th>Urban</th>
<th>Suburban</th>
</tr>
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<tbody>
<tr>
<td>Fibre to the Cabinet</td>
<td>ATM PON &amp; VDSL</td>
<td>Profitable: requires less OLTs and ONUs than EoVDSL.</td>
<td></td>
<td>Uneconomical due to required infrastructure investments</td>
</tr>
<tr>
<td></td>
<td>GbE &amp; EoVDSL</td>
<td>Profitable but requires more OLTs and ONUs than ATM PON.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibre to the Home / Office</td>
<td>Ethernet point-to-point (GbE/FE)</td>
<td>Profitable, Payback 7 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet PON</td>
<td>Profitable, Payback 5 years.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ATM PON</td>
<td></td>
<td></td>
<td>Extremely uneconomical due to required infrastructure investments</td>
</tr>
</tbody>
</table>
Main Conclusions

- Equipment investments of ATM or Ethernet based access networks under comparable conditions are in the same range
- FTTC is the most profitable solution in dense urban and urban areas
- FTTH/O is feasible only in dense urban area
  - Introduction of high capacity services (50Mbit/s) improves the business case
- Differences between areas mainly due to:
  - Infrastructure in terms of duct length and duct availability
  - Interface granularity and fibre consumption (p-t-p versus point-to-multipoint)

> FTTH/O: a cost comparison of Ethernet and ATM based networks revealed that Ethernet CPE terminations are less expensive but this saving is balanced by the fact that Ethernet PON interfaces are more expensive at present

> Due to the required infrastructure investments FTHH/O (ATM or Ethernet) in urban and suburban areas is unprofitable
Thank you for your attention!

Further information:
Thomas Monath, et all; “Economics of fixed broadband access network strategies”
IEEE Communications Magazine;
“Broadband Access Series”; September 2003

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