FULLY Unbundled Vectored DSLs:
It is absolutely possible!

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Unbundling: Then and Now
(no longer need “cut and reconnect” with software defined access networks)

Hardware Unbundling 1996

- Broadband Network Gateway (Operator A)
- Broadband Network Gateway (Operator B)
- Co-located DSLAM’s
- CPE’s

There is much more differentiation (management) possible in 2016, and
The INCUMBENT NEED ONLY OPEN THE MIB

Software Unbundling 2016

- Broadband Network Gateway (Operator A)
- Broadband Network Gateway (Operator B)
- Aggregation Switch
- Vectored DSLAM

See Broadband Forum: WT-349 “DSL Data Sharing”
See Also UK NICC DSM Data-Sharing ND 1518 v1.1.1
(both leverage ITU Standards g.997.x)
It’s the same (actually better) as owning the hardware

The Physical Access Network is mapped to a Virtual Access Network controlled by a Virtual Network Operator – an “SDN” element

It’s already been done in production on millions of customers in the field in both USA and France
Vodafone slams approval of Deutsche Telekom vectoring plan

Friday 8 April 2016 | 12:27 CET | News

Vodafone has reacted to the BNetzA's decision to permit Deutsche Telekom's proposed roll-out of vectoring. In Vodafone's view, the proposal will put Germany on the wrong side of progress.

“The central policy ... [is] ... going far wrong with a monopoly vectoring expansion, as well as the specification of the Advisory Board of the Agency, ...” says (Association of Telecommunications and Value Added Services) CEO Jürgen Grützner, May 6, 2016

- So-called “Highlander” principle:
  - “There can be only one”
  - HAS NO TECHNICAL BASIS
Building Infrastructure as a Service

• All benefit for drive to larger bandwidth use
  – Product differentiation
  – Competition
  – Stimulates larger demand, volume
  – \(\rightarrow\) better financial return on IaaS provider’s investment

Mobile Phones

Video side

Other New Apps side

9 Billion Devices in 5 Years!
• Star Trek ⇔ Highlander
  - And Spock was rewarded greatly in his rebirth (ST: Genesis)

• The “next generation” transcends “fixed spectrum masks”
  - See cognitive radio
  - See Wi-Fi in unlicensed bands
  - See DSL BBF WT-349
    • DSL Data Sharing
      - Yes, it is for G.fast too

Vectoring eliminates the “harm” (crosstalk) between lines technically contradicting “Highlander”
Data sharing is not new wires
- Software MIB information (nothing more) is shared

Centralized DSL data sharing

Distributed DSL data sharing

The shared software information consists of
- “data” (for analytics - data is on performance/measures)
- “controls” (for optimization)

It makes it like (better than) hardware unbundling
Multi-tenant Software Implementation

- **Software Defined Network elements**
  - Allow via “data/controls” the full operation capability that previously occurred only with hardware ownership

- **Standards (like ITU DSLs and PLOAMs) specify limits on**
  - Control parameters
  - Similar to, but more general than, simply spectrum masks

- **Centralized system can be operated by a variety of potential manager candidates**
  - And adheres to the standards

It’s already been done in production on millions of customers in the field in both USA and France

From WT-349
Who Shares? Who Benefits? Who provides centralized system (when it exists)?

ANY of them could provide centralized, or a 3rd party not shown
## What is shared?

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Range</th>
<th>Data parameters</th>
<th>Control parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Case 1. DSM level 1 / DLM</td>
<td>Per line</td>
<td>Fault monitoring, performance monitoring, test, diagnostic, status parameters and counters, and SELT and MELT data.</td>
<td>Profile selection, Creation of new profiles.</td>
</tr>
<tr>
<td>Use Case 2. DSM level 2 Lines</td>
<td>Multiple Lines</td>
<td>DSM level 1 data on multiple lines, Spectral data (per sub-carrier), and Loop data indicating interacting lines.</td>
<td>Profile selection; transmit power, PSD, and margin settings, etc.</td>
</tr>
<tr>
<td>Use Case 3. Vectoring Multiple Lines</td>
<td>Loop information indicating vectored/non-vectored lines, Vector group ID, XLIN, DSM level 2 data.</td>
<td>Vectoring controls, DSM level 2 controls.</td>
<td></td>
</tr>
<tr>
<td>Use Case 4. Line diagnostics and monitoring Per line</td>
<td>DSM level 1 data, packet counters, Ethernet OAM.</td>
<td>Counter intervals, Unsolicited error performance report (alarm) thresholds.</td>
<td></td>
</tr>
<tr>
<td>Use Case 5. Fault correlation Multiple Lines</td>
<td>Multi-line DSM level 1 data, fault monitoring, performance monitoring, test, diagnostic, and status parameters and counters; Loop data; Packet counters; and Ethernet OAM data.</td>
<td>Counter intervals, Unsolicited error performance report (alarm) thresholds.</td>
<td></td>
</tr>
<tr>
<td>Use Case 6. Services differentiation Per line</td>
<td>N/A</td>
<td>Single-line profile selection, Creation of new profiles, Data rate, margin, INP settings.</td>
<td></td>
</tr>
<tr>
<td>Use Case 7. Network planning Multiple Lines</td>
<td>Attainable net data rate, Neighborhood data, Loop data.</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
How to Share?

From WT-370: Fixed-Access Network Sharing (FANS)
Broadband Forum FANS (WT-370)
“Fixed Access Network SHARING”
Is copper sharing so different from wireless and fiber (or coax)?

• **Fiber PONs**
  - Service-level agreements are reached/promoted
  - They have even greater inter-consumer bandwidth dependency
    • Sharing of single wavelength/medium leads to trade offs
  - G.fast may feed to the PON OLT and so
    • Management of sharing of both copper, fiber, (and maybe WiFi thereafter also)

• **Wireless**
  - Cognitive use of spectrum (white spaces from TV, 3.5 GHz)
    • See 3GPP spec on network sharing TS 23.251
  - LTE-U is a distributed form of “data-sharing”
    • LAA (LTE’s successor) allows some centralized controls

• **Shouldn’t DSL/copper’s contribution to NGN/5G be similarly done?**
Why Share?
Collocated VDSL and G.fast endpoints

- **Because Data rate and range increase!**
  - 50% higher speed at same length
  - Extra 100 meters in range (this is worth a lot financially)

DSM = sharing ; Static = no sharing

Sum of upstream + downstream G.fast data rates
Adaptive separation frequency “fcuts”

Retains VDSL speed by insuring specific situation is addressed, not some theoretical worst case.

As length increases, generally fcuts is lower.

(this slide provides more information on results of previous slide)
Unequal lengths:
VDSL at cabinet, G.fast at distribution point

DSM = sharing ; Static = no sharing

NICC terminology
ND1602 v6.1.1

G.fast:
off from 2.2 to fcuts MHz
transmits from fcuts to 106 MHz
Other Reasons why share?

- Automated interfaces lower operational costs, both for the Infrastructure Provider (InP) and the VNOs. With current bitstream or VULA, operations “interfaces” between InP and VNO are often manual (e.g., phone calls).

- Fault correlation across multiple operator’s lines is enabled, again lowering operations costs.

- Multi-line, multi-operator, optimizations are enabled. This increases performance of all lines.
  - The results in this talk are a good example of this.

- Enhanced competitiveness with other media (e.g., cable).

- Multiple companies can share the costs of upgrading to vectoring, G.fast, or fiber.
• Technically is better than old hardware unbundling
  – Allows full differentiation

• Highlander/monopoly is not technically correct

• Standards & Reports exist to support it

• Products exist and are in use that support it

• Incumbents, Regulators, VNO all should support it too!
  – Everyone will profit from it
Thank you

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