FULLY Unbundled Vectored DSLs:
It is absolutely possible!

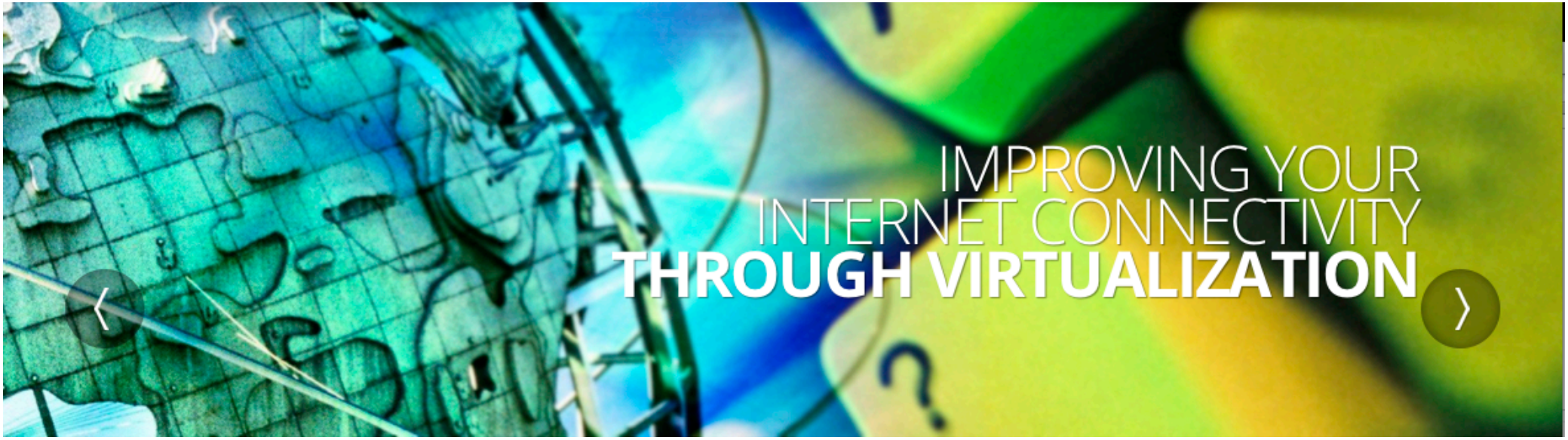
J. Cioffi

CEO/COB ASSIA

(Professor Emeritus, Stanford EE)

G.fast Summit

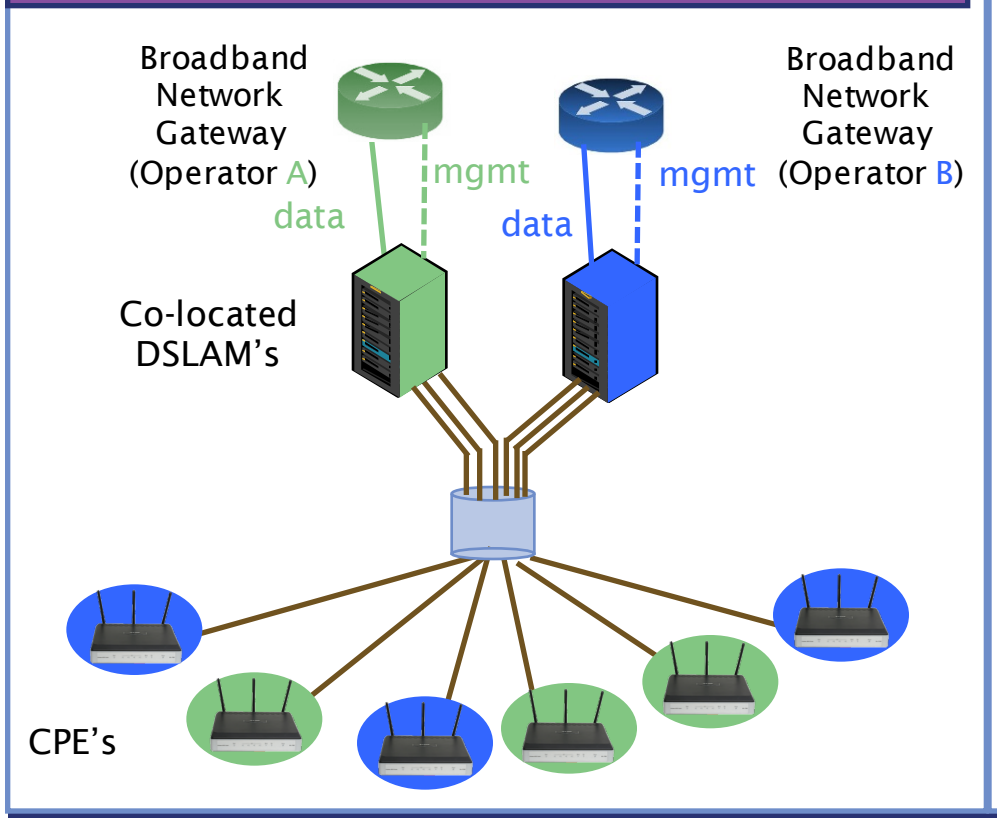
May 19, 2016 – Paris



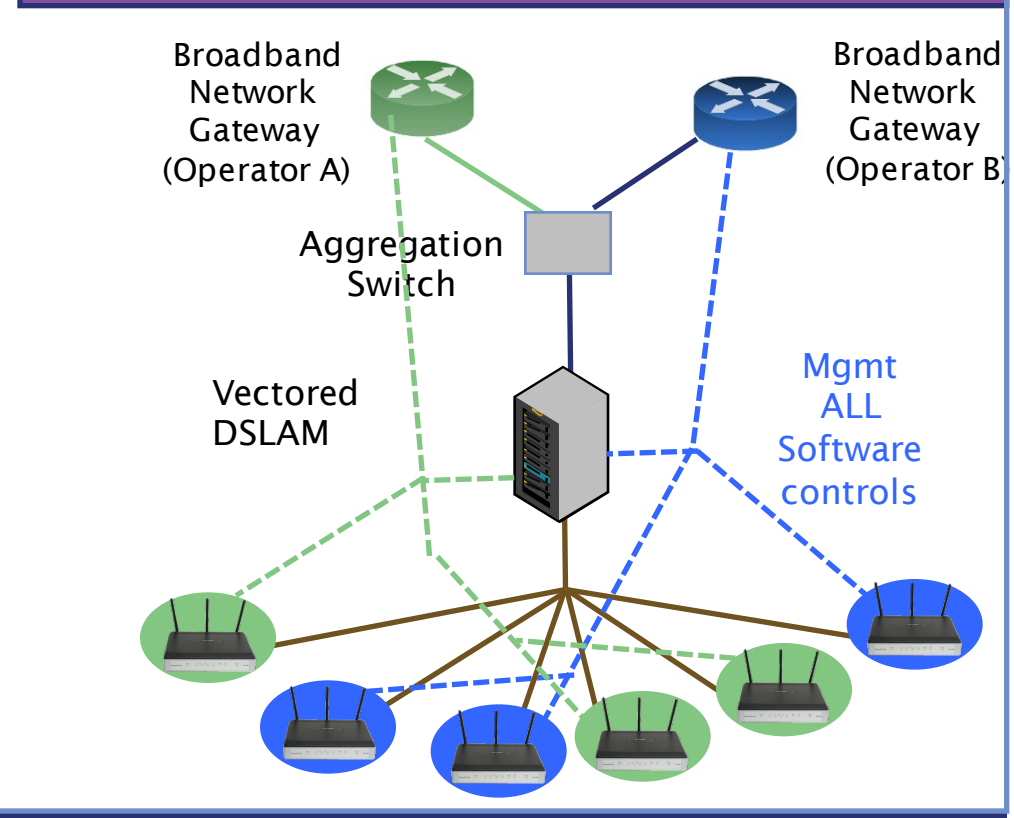
Unbundling: Then and Now

(no longer need "cut and reconnect" with software defined access networks)

Hardware Unbundling 1996



Software Unbundling 2016



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

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)

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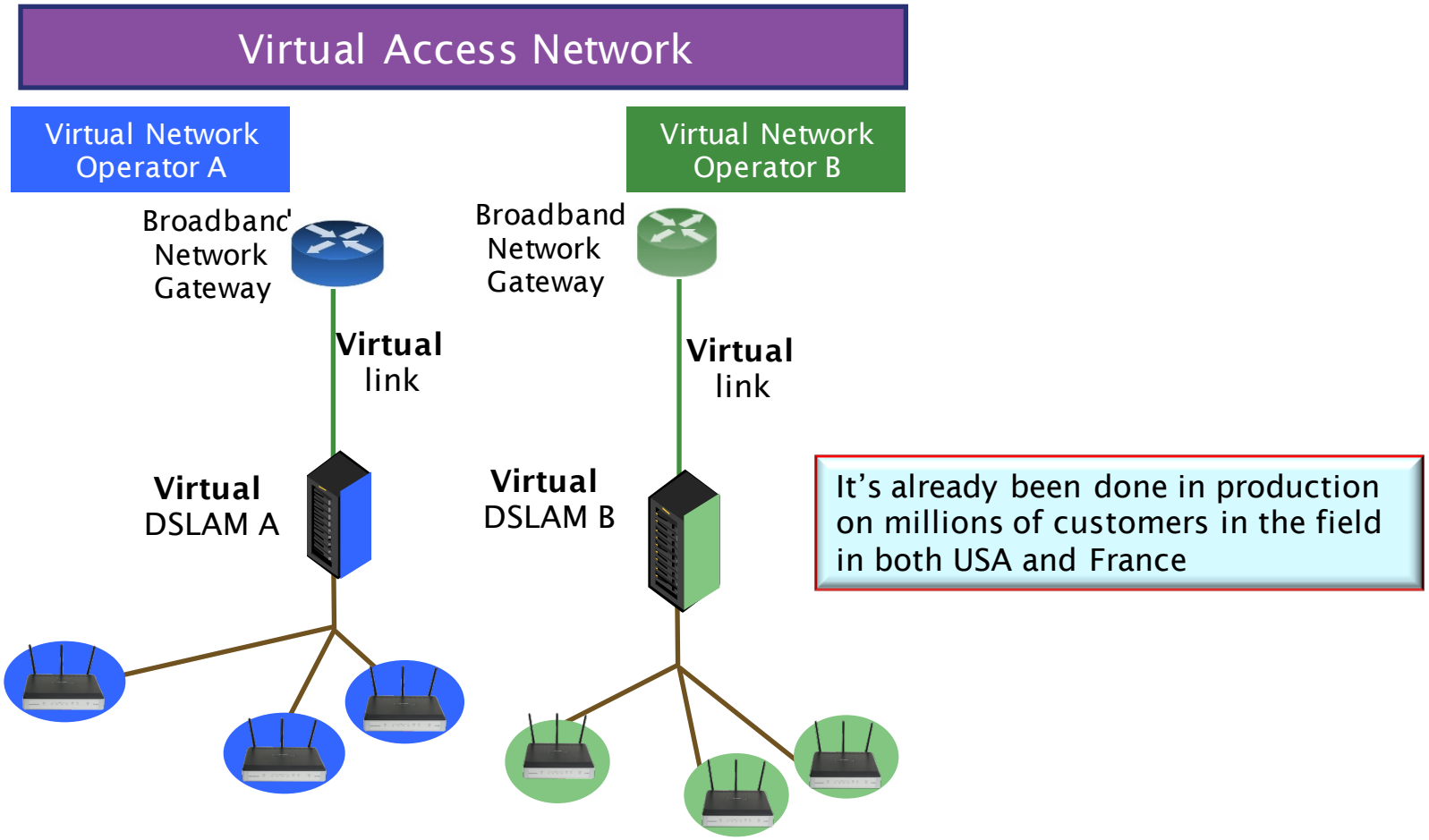
It's the same (actually better) as owning the hardware



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

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Vectoring Technology does not force monopoly

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 golem.de IT-NEWS FÜR PROFIS

- **So-called "Highlander" principle:**
  - **"There can be only one"**
  - HAS NO TECHNICAL BASIS

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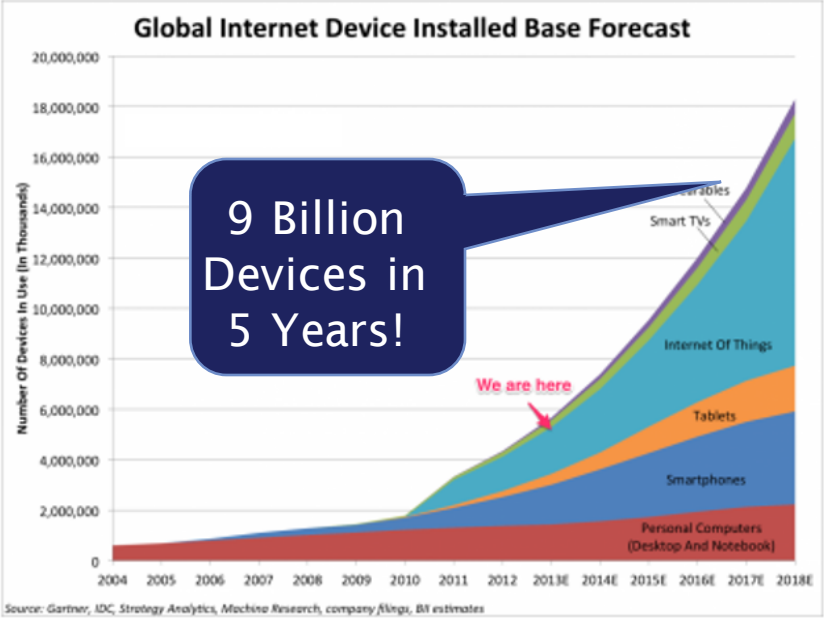
Building Infrastructure as a Service

- **All benefit for drive to larger bandwidth use**
  - Product differentiation
  - Competition
  - Stimulates larger demand, volume
  - → better financial return on IaaS provider's investment

Video side



Other New Apps side

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DSL Data Sharing empowers unbundling

- **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"

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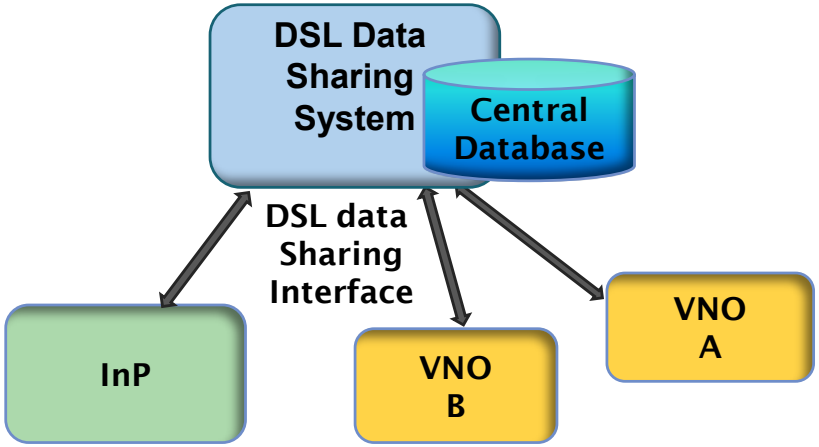
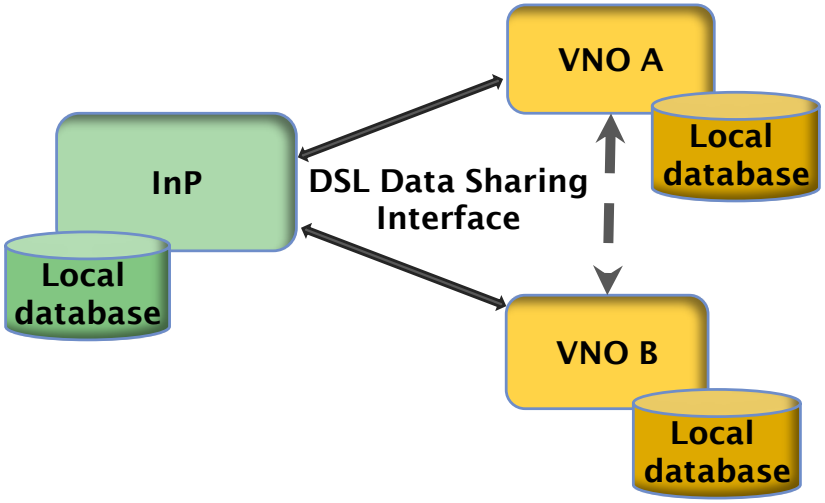
From WT-349

- **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**

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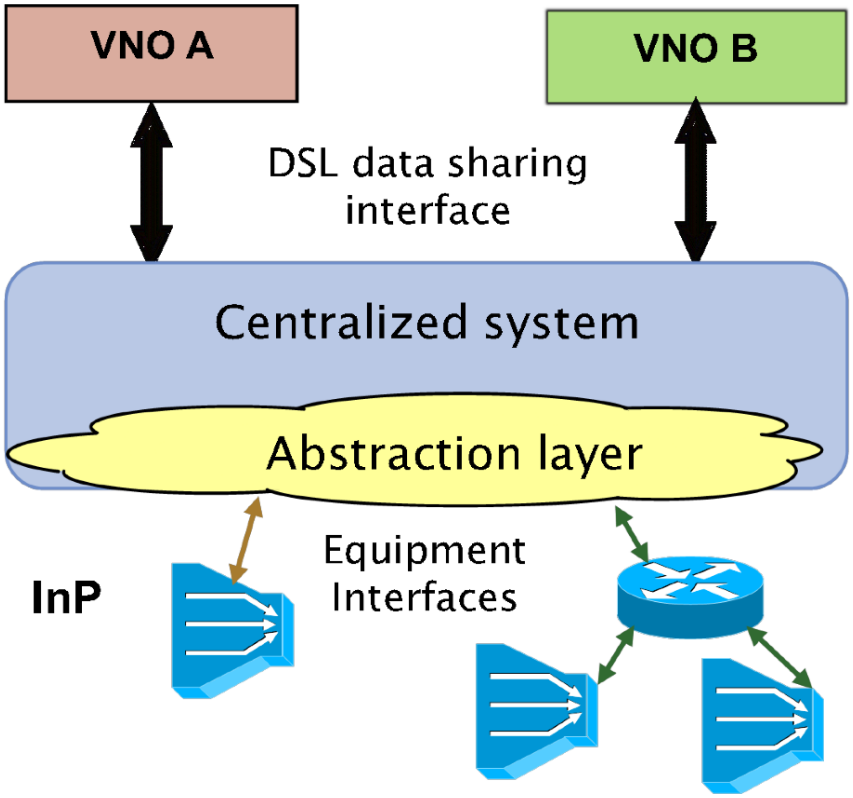
Multi-tenant Software Implementation



From WT-349

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

- **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

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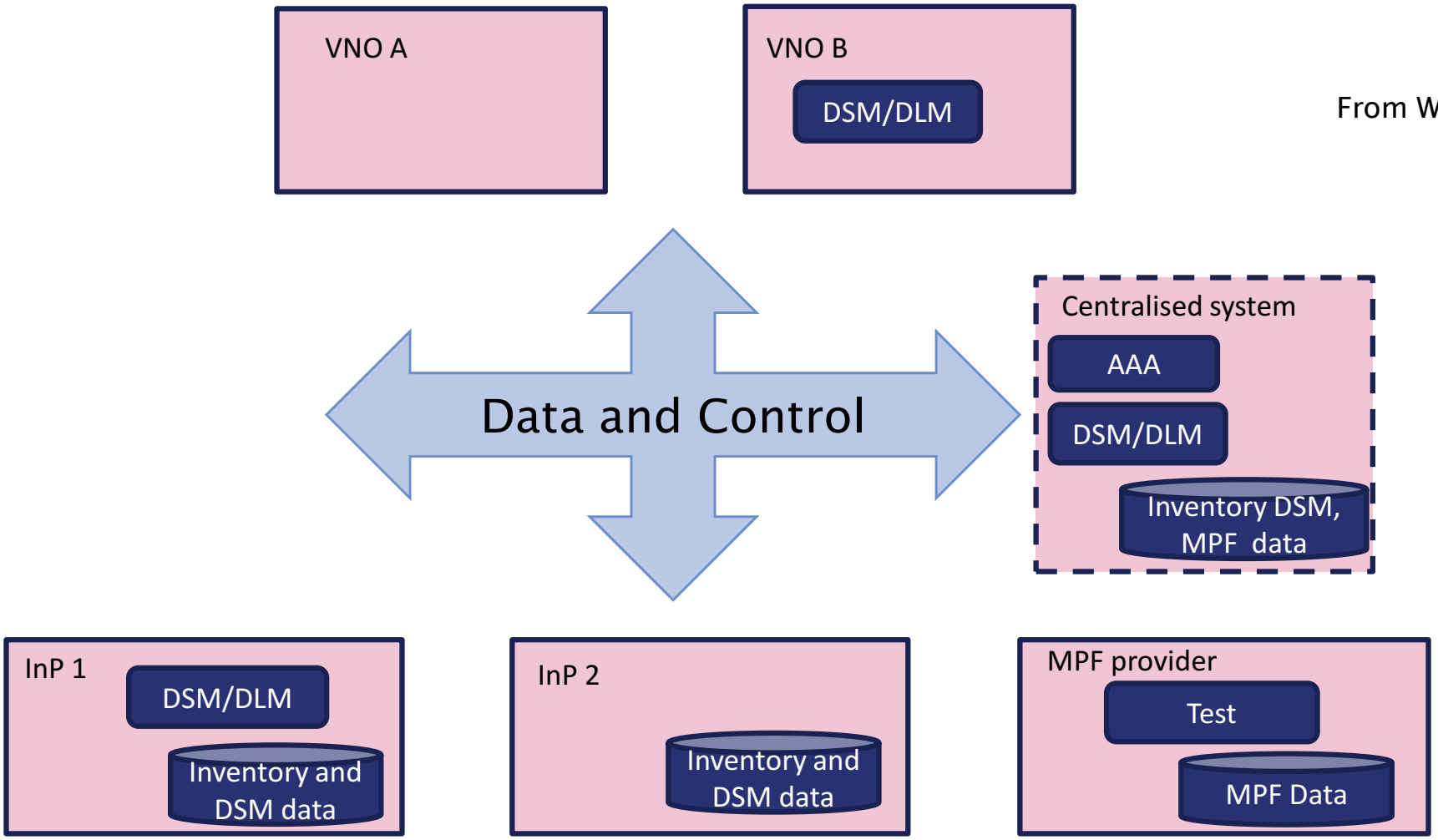
Who Shares? Who Benefits? Who provides centralized system (when it exists)?



From WT-349

ANY of them could provide centralized, or a 3rd party not shown

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What is shared?

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

Use cases extracted from WT-349

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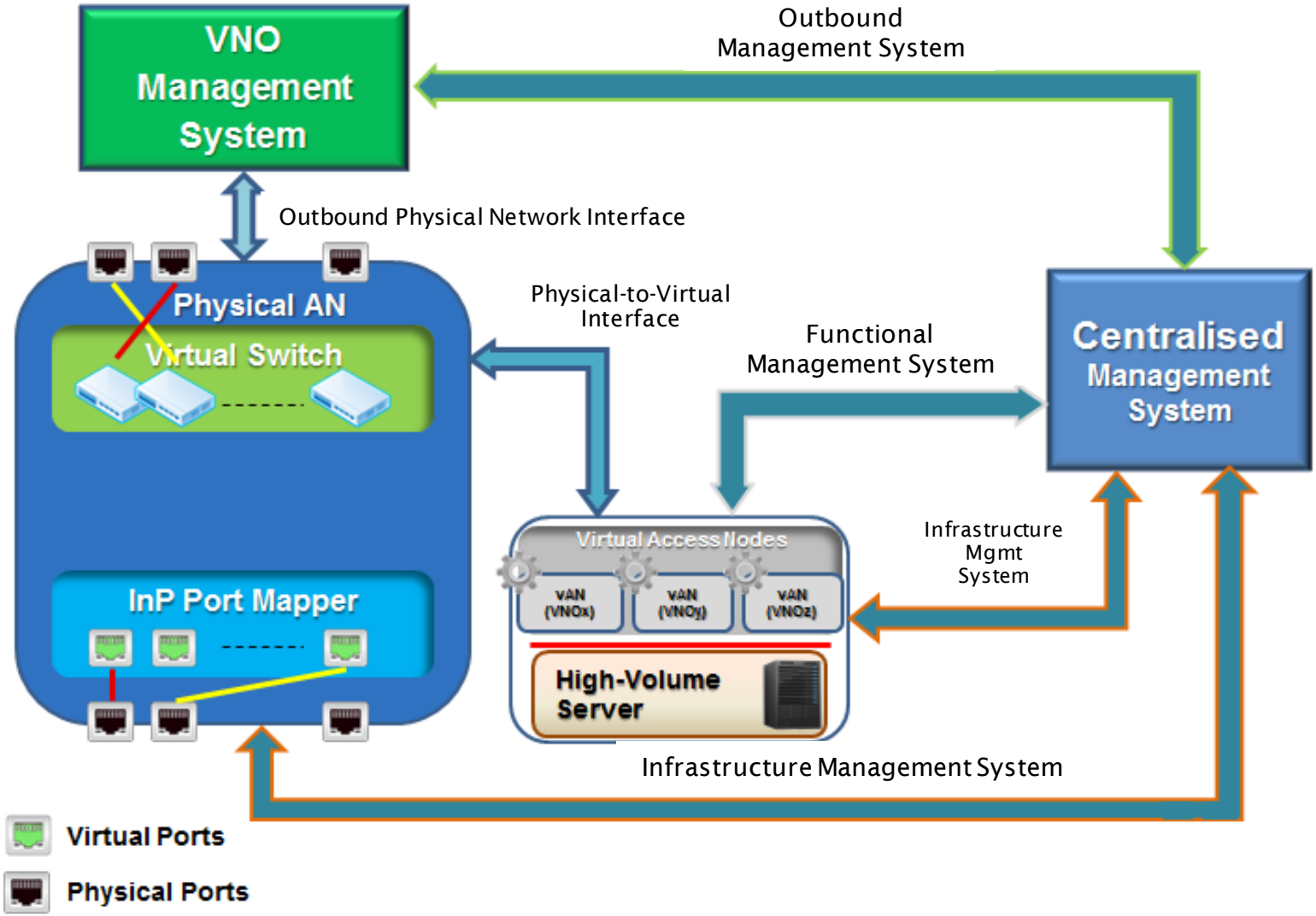
How to Share?



From WT-370: Fixed-Access Network Sharing (FANS)

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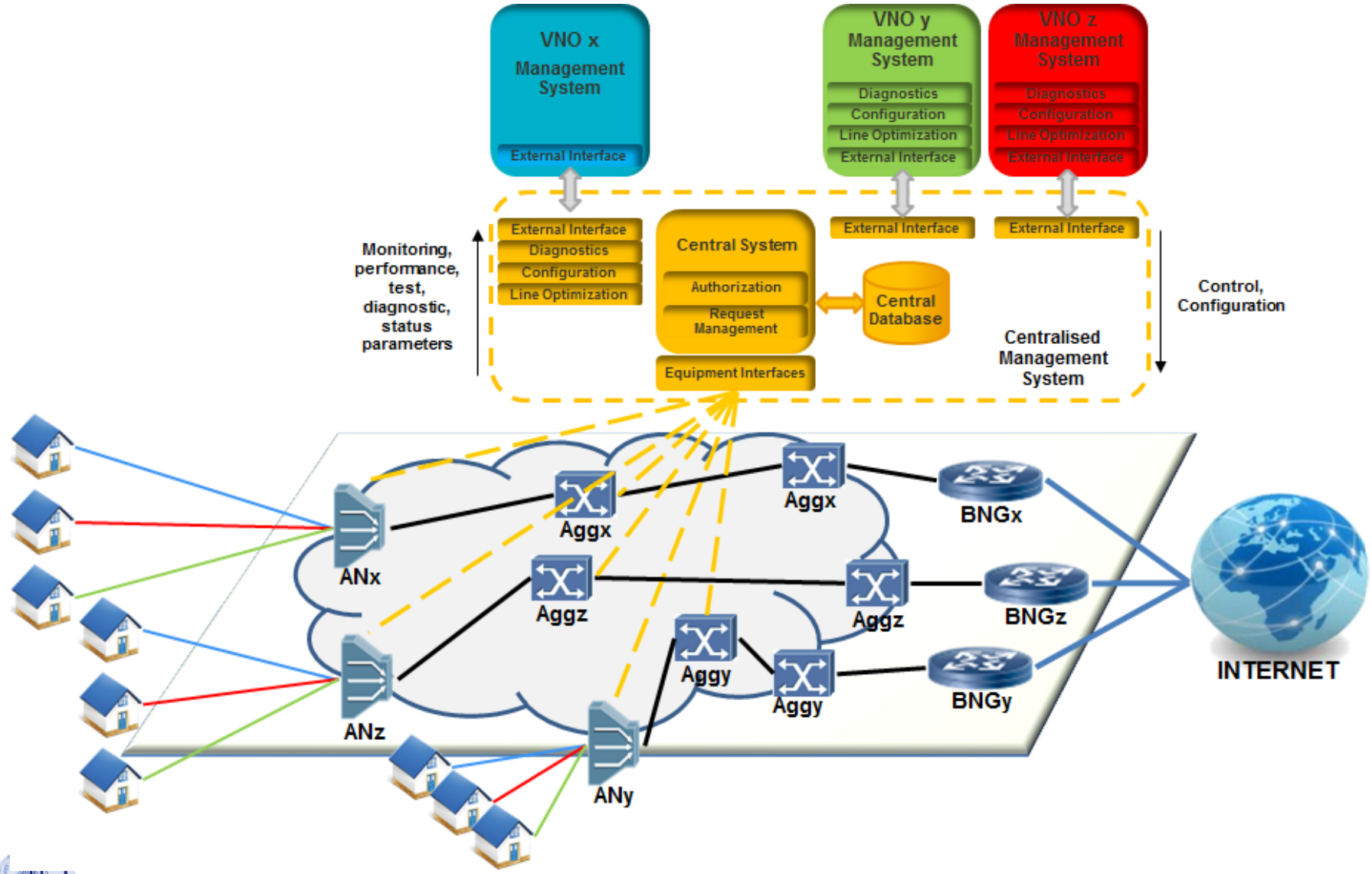
Broadband Forum FANS (WT-370)

"Fixed Access Network SHARING"



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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?**

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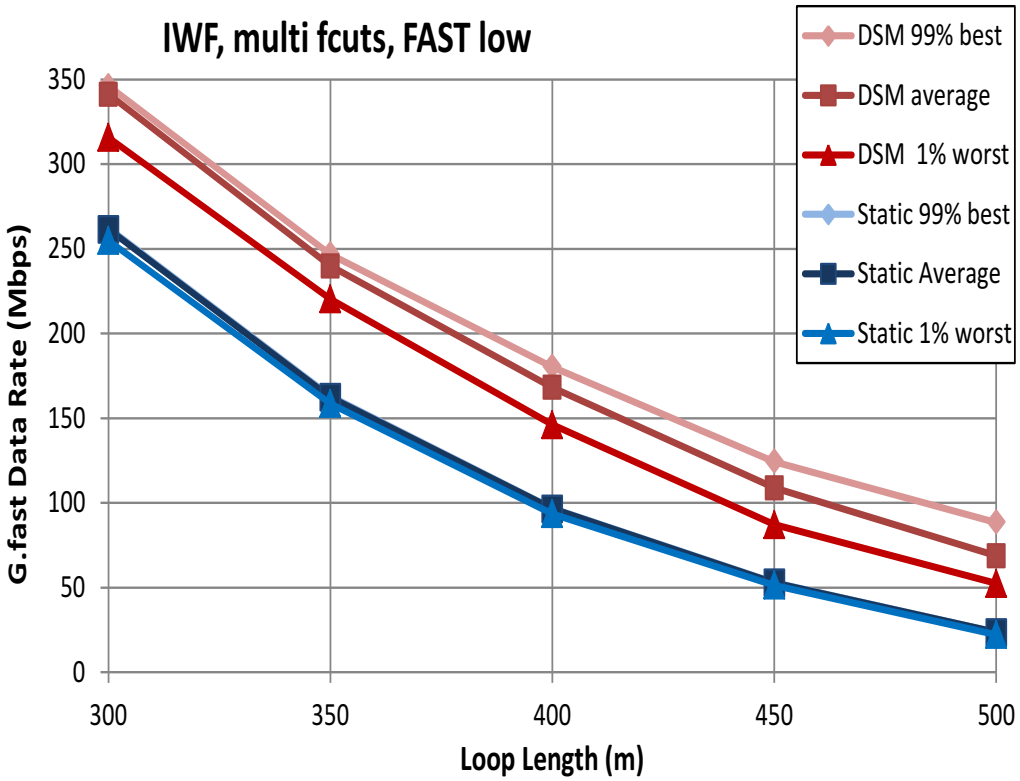
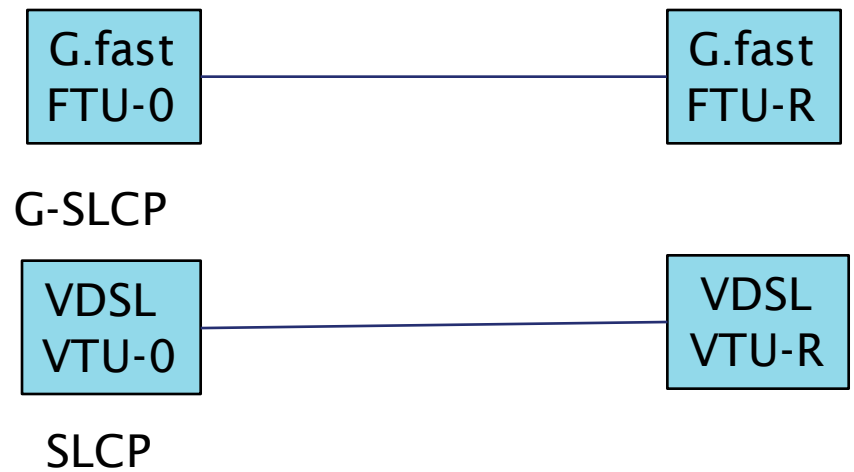
Why Share?
Collocated VDSL and G.fast endpoints

- **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



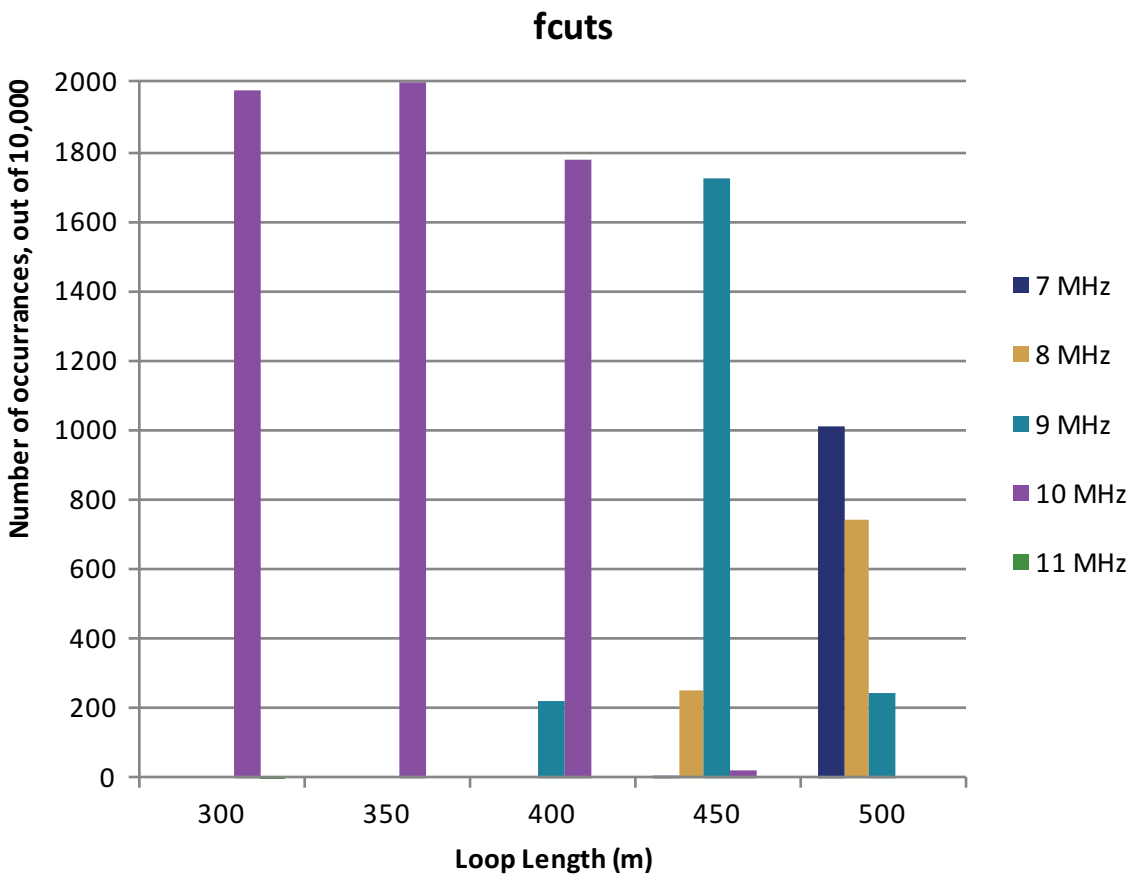


G.fast:
transmits from 2.2 to fcuts MHz
off from fcuts to 17.7 MHz
transmits from 17.7 to 106 MHz

Sum of upstream + downstream G.fast data rates

Adaptive separation frequency "fcuts"

(this slide provides more information on results of previous slide)



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

As length increases, generally fcuts is lower

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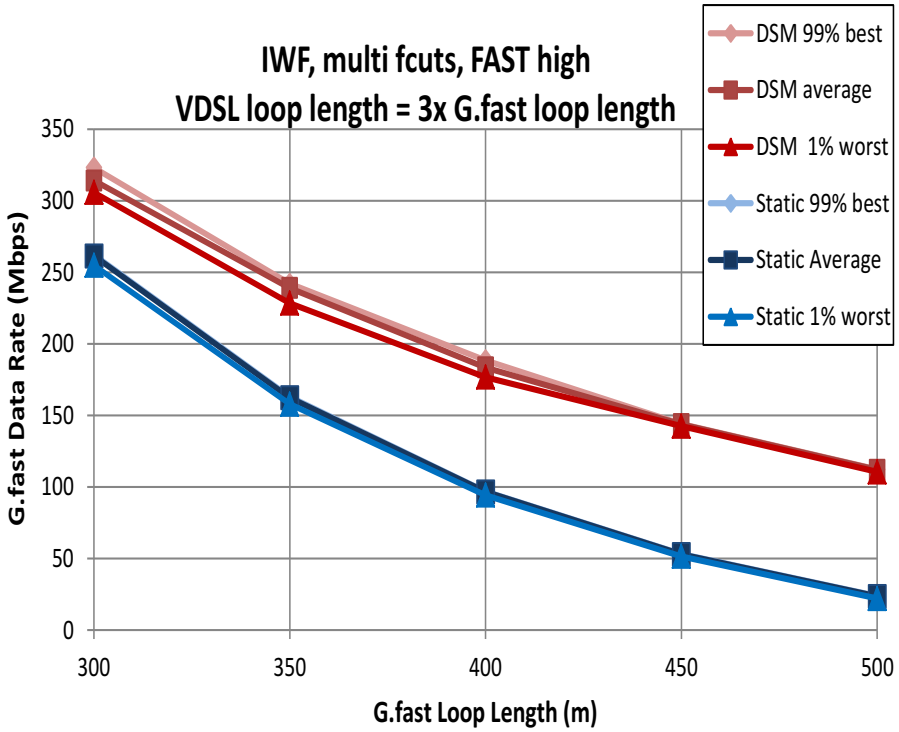
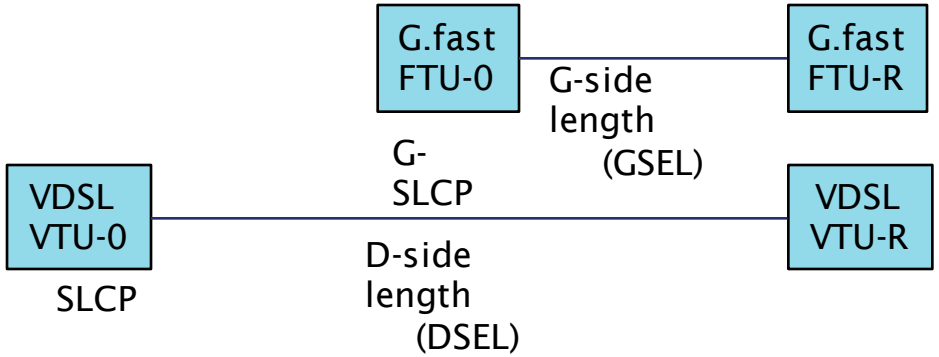
Unequal lengths:
VDSL at cabinet, G.fast at distribution point

DSM = sharing ; Static = no sharing





NICC terminology
ND1602 v6.1.1

Sum of upstream + downstream G.fast data rates

G.fast:
off from 2.2 to fcuts MHz
transmits from fcuts to 106 MHz

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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.

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G.Fast DOES UNBUNDLE

- **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

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Thank you

jcioffi@assia-inc.com