Alcatel-Lucent antwoord op

ONTWERPBESLUIT VAN DE RAAD VAN HET BIPT VAN 20 DECEMBER 2010

BETREFFENDE DE ANALYSE VAN DE BREEDBANDMARKTEN

Frank Van der Putten
Alcatel-Lucent Bell N.V.
18 februari, 2011

Dit antwoord (inclusief bijvoegsels) bevat geen vertrouwelijke informatie, behalve slide 19 (Belgacom vectoring results) die confidentieel is.

Waarom dit antwoord op de consultatie ?

Aangaande het ontwerpbesluit: (paragraaf 479 op pagina 200)

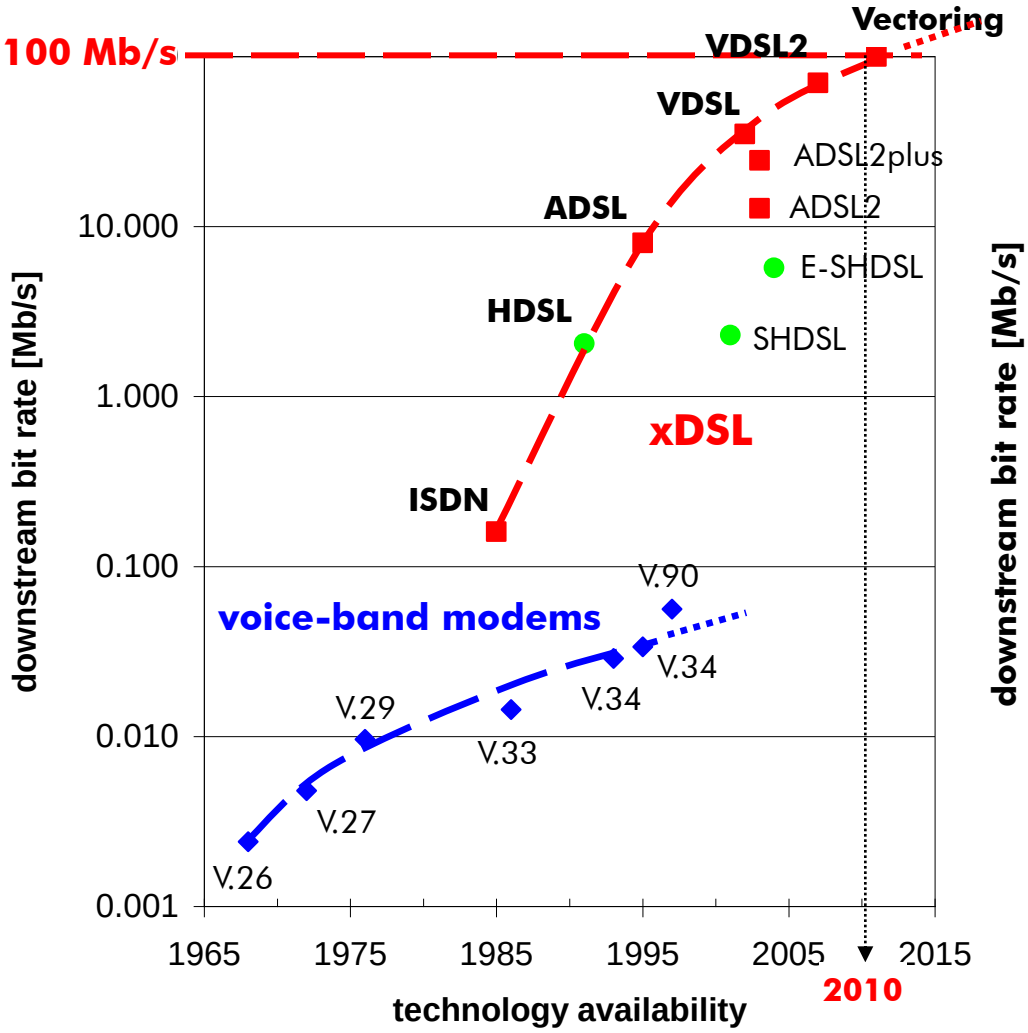
"De verplichting tot ontbundeling van het subaansluitnetwerk alsook alle ondersteunende maatregelen die uitsluitend verband houden met de ontbundeling van het subaansluitnetwerk worden dus afgeschaft. "

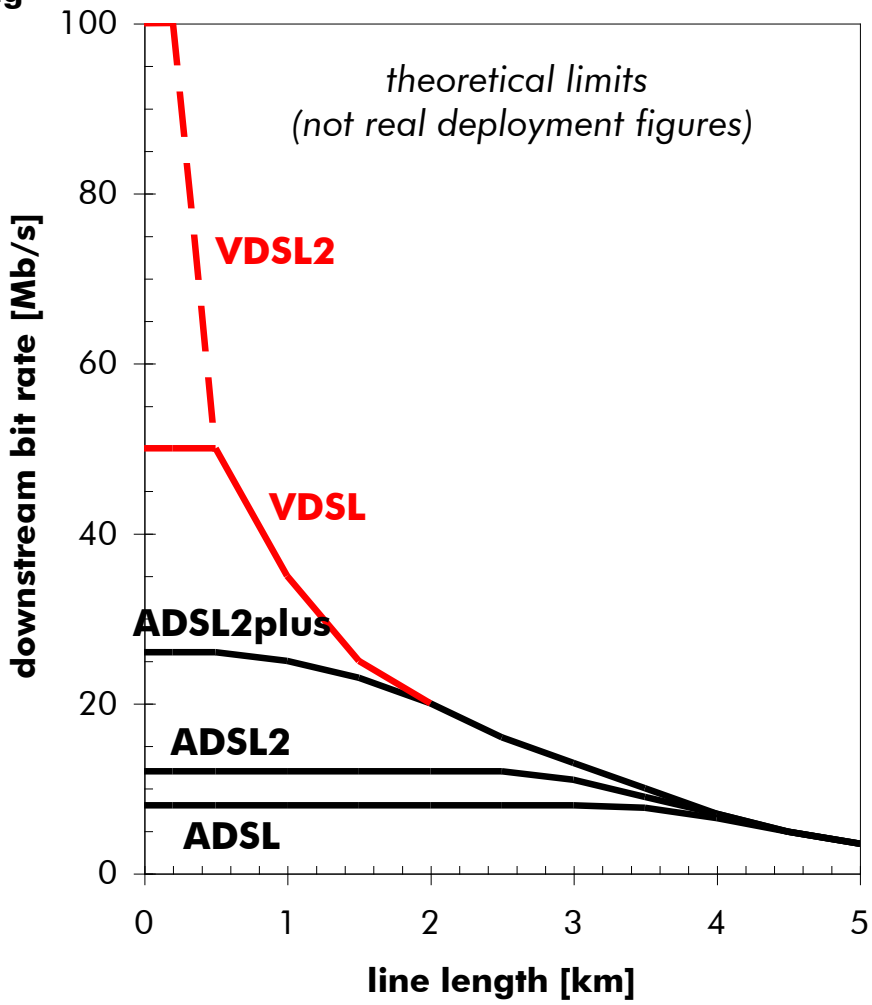
- Alcatel-Lucent wil met dit antwoord steun uitdrukken voor de afschaffing van deze onevenredige maatregel, en dit op basis van de technologische impact en de economische realiteit, zoals gesteld door BIPT in sectie 4.5.2.1 van het ontwerpbesluit.
- De afschaffing van de verplichting tot ontbundeling van het subaansluitnetwerk is noodzakelijk voor de introductie van VDSL2 vectoring en dus ook voor de verdere ontwikkeling van een kopertoegangsnetwerk dat competitief blijft met het kabeltoegangsnetwerk na introductie van DOCSIS3 (introductie die vandaag al een feit is). Vectoring is een noodzaak om de infrastructuurcompetitie in stand te houden. De voordelen die voortvloeien uit een vectoring met maximale return zal bovendien alle gebruikers van het VDSL2 netwerk op gelijke wijze van een reële performantiewinst doen genieten.
  - In bijlage wordt een overzicht gegeven van de VDSL2 vectoring technologie, en de internationale belangstelling voor introductie van VDSL2 vectoring. Dit overzicht toont het belang aan van vectoring en toont eveneens aan dat subloopontbundeling incompatiebel is met VDSL2 vectoring.
- Alcatel-Lucent wil ook opmerken dat een deel van de eindgebruikers direct verbonden is aan de LEX. Hierbij wordt de vraag gesteld welke maatregelen opportuun zouden zijn om ook hen voordeel te laten halen uit de introductie van VDSL2 vectoring.

Bijlage : VDSL2 vectoring

Overview of technology and benefits

xDSL technology evolution





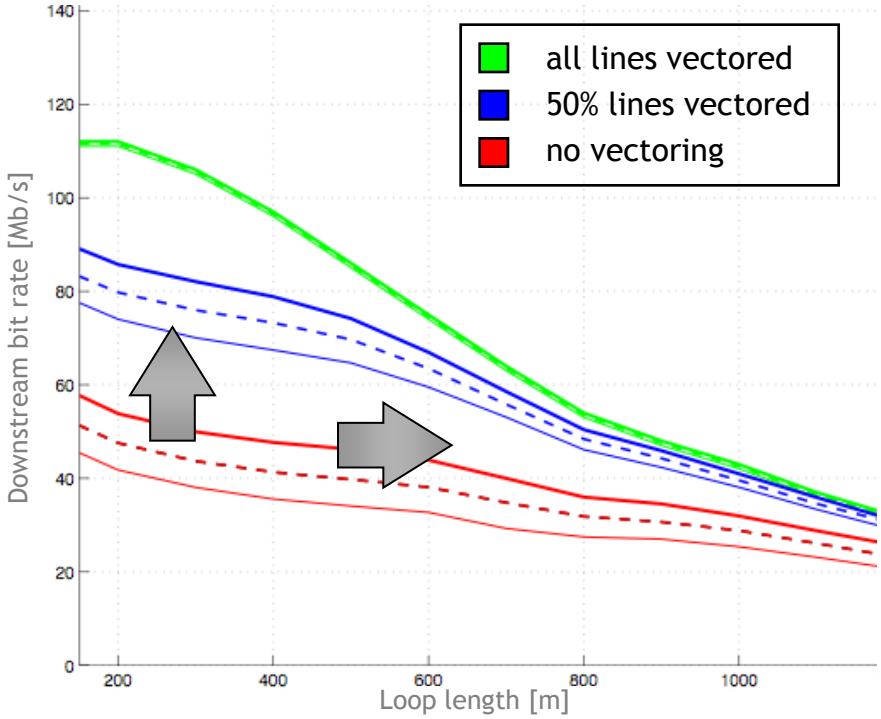
Pushing further the limits of the copper: VDSL2 Vectoring

Crosstalk = dominant disturber for VDSL2

VDSL Vectoring = Noise Cancellation

- measure crosstalk from each line into all other lines in binder
- cancel the noise with an anti-phase signal

80 VDSL2 lines in 300-pair binder

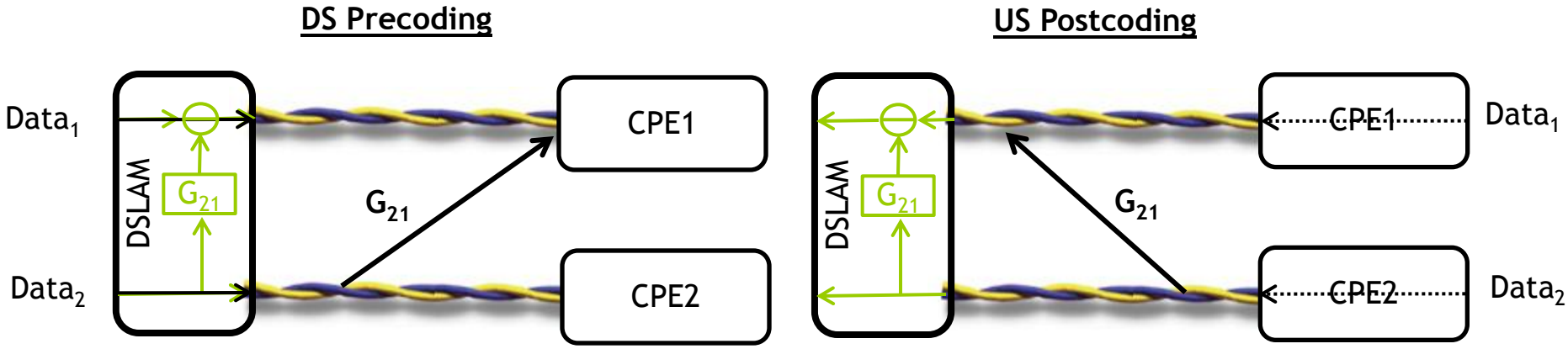


Vectoring cancels noise (lab proven) - potential for 25%-100% bit rate increase
Field trials ongoing

Vectoring Howto: The main principle

Crosstalk cancelling by injecting an "anti-signal" on each crosstalk-impaired line

- Requires full synchronization over the full vectored system
  - All data samples are shared between all the lines
- Requires calculation of the "anti-signals"
- Requires a crosstalk estimating mechanism to derive the crosstalk coefficients
  - Mechanism specified in ITU-T G.993.5 (G.vector) standard for DSLAM/CPE interoperability



Vectoring standard - G.993.5 (G.vector)

- first vectoring standard G.993.5 (aka G.vector) approved May 1st, 2010
  - took 2.5 years to complete (started June 2007)
- editor: Frank Van der Putten (Alcatel-Lucent)
- functionality included in first standard
  - initialization sequence extended to allow for estimation of pre-coder coefficients
  - allows for orderly and simultaneous joining/leaving of pair(s) into/from a vectored group
  - backchannel from CPE to DSLAM to send back error samples
  - management objects per line
- outlook for G.vector amendments
  - next consent opportunity is Feb 2011 or at interim WP1 Oct 2010

First vectoring standard G.993.5 approved May 1st, 2010

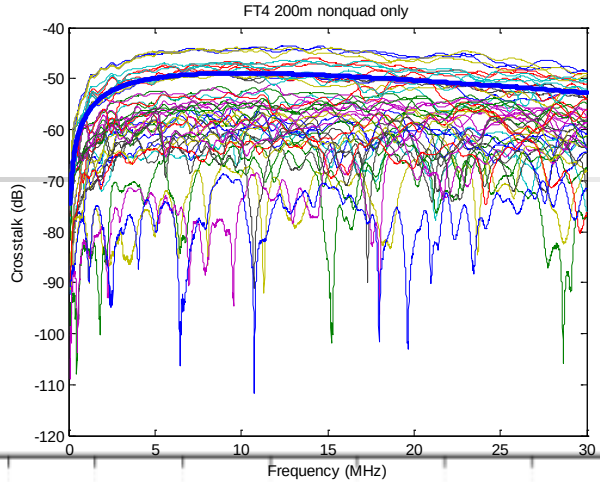
Vectoring simulated performance

Disclaimer

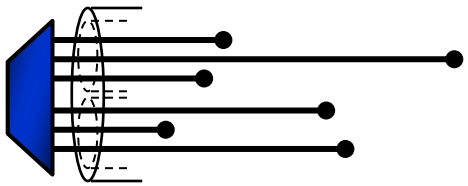
- the figures on the following slides are simulated, not measured, intended to illustrate the incompatibility of vectoring and SLU and the degrading effect of non-G.vector compatible (or non-G.vector friendly) CPE's on performance of other vectored lines in the same cable (binder)

- the simulations are for a particular cable type and noise environment and with specific VDSL2 configurations parameters (band plan, DPBO, SNRM, …) that may not be representative for the situation in Belgium
- network statistics of the Belgacom network may differ from the simulation assumptions
  - crosstalk coupling statistics of historical network
  - loop length distribution
  - mix of cable sizes and types
- also, the simulations are based on a theoretical model that does not take implementation limitations into account
- therefore, no rate - reach deployment conclusions should be drawn from these slides

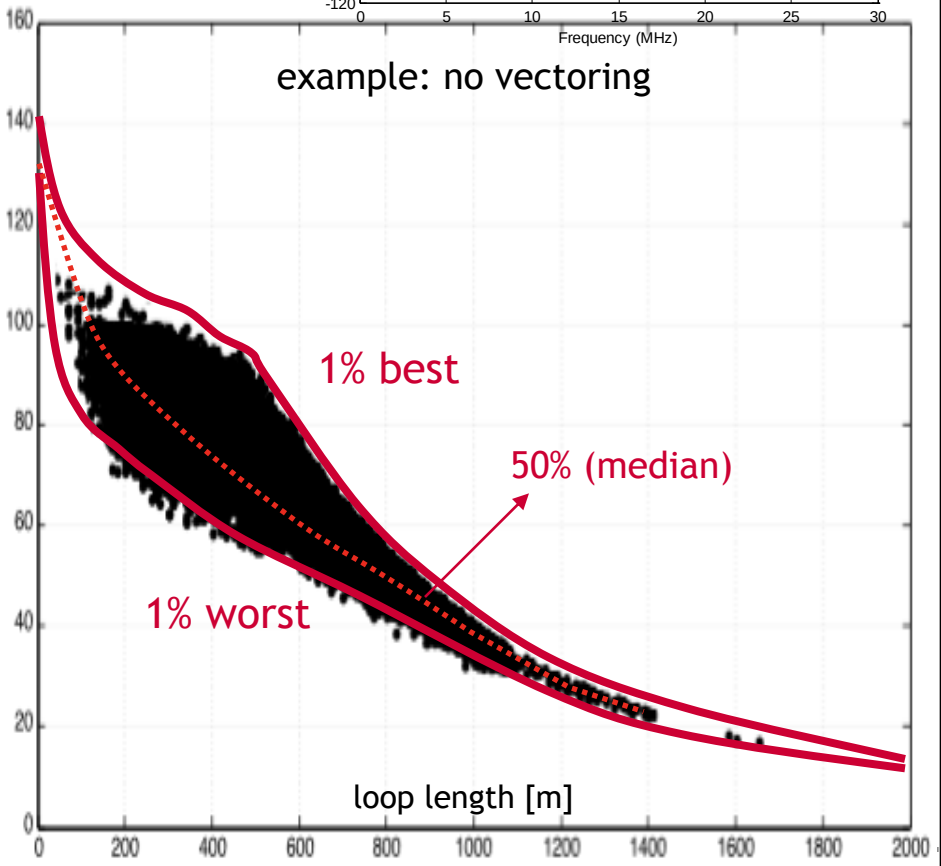
Reading the rate-reach plots



- on following slides, different colors are used for no vectoring (0%), full vectoring (100%) and partial vectoring (e.g. 50%)
- for each color, there are 3 curves:
  - bottom curve indicates the 1% worst performing lines at that distance (this roughly corresponds to simulations based on 99% worst-case assumptions)
  - middle (dotted) curve represents 50% percentile (median)
  - top curve represents the 1% best performing lines
- statistical crosstalk model used = beta model agreed in ANSI and referred to by ITU
- loop length distribution taken into account



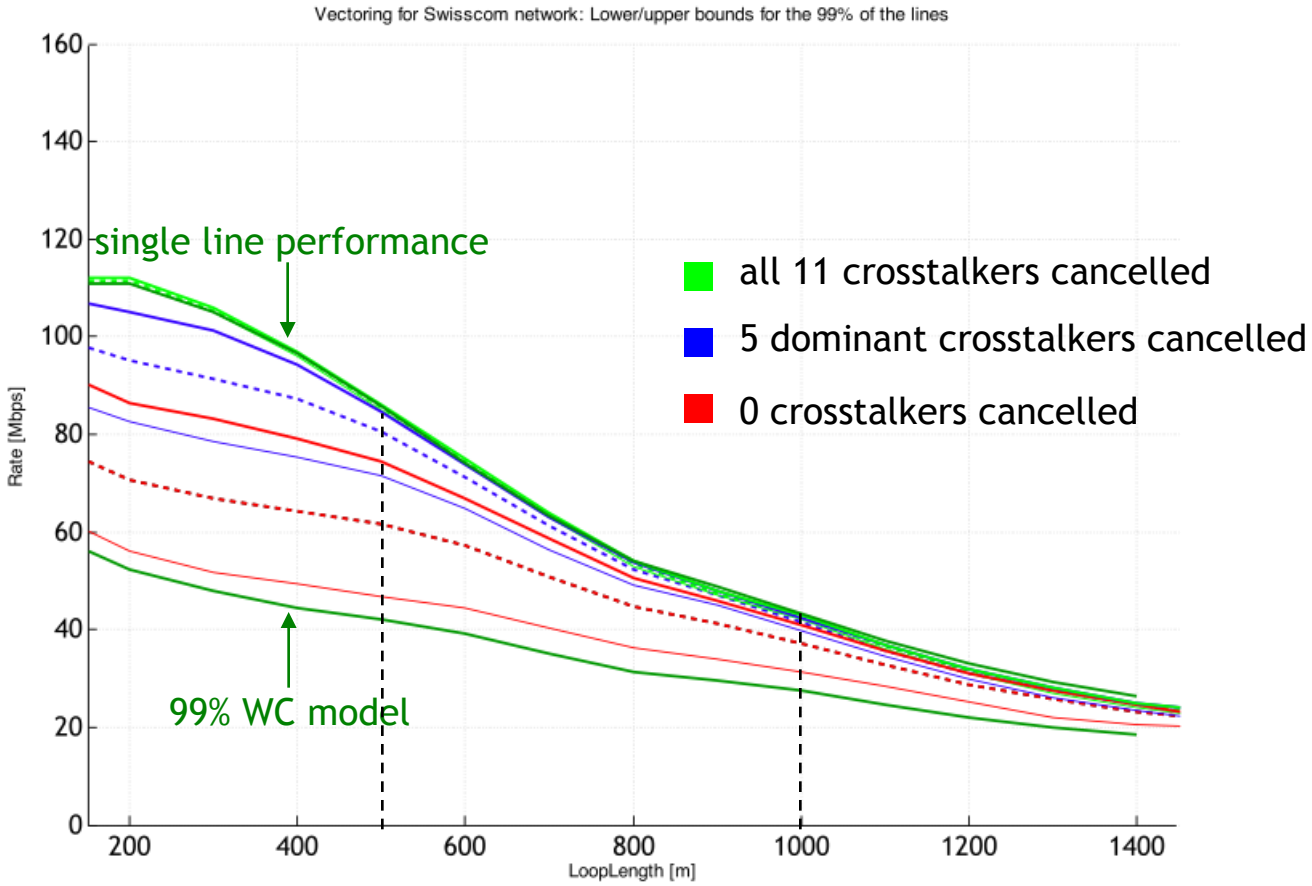
- both combined (Xtalk model and loop length distribution) lead to observed spread in rates at a certain distance



Alcatel·Lucent

Vectoring simulated performance

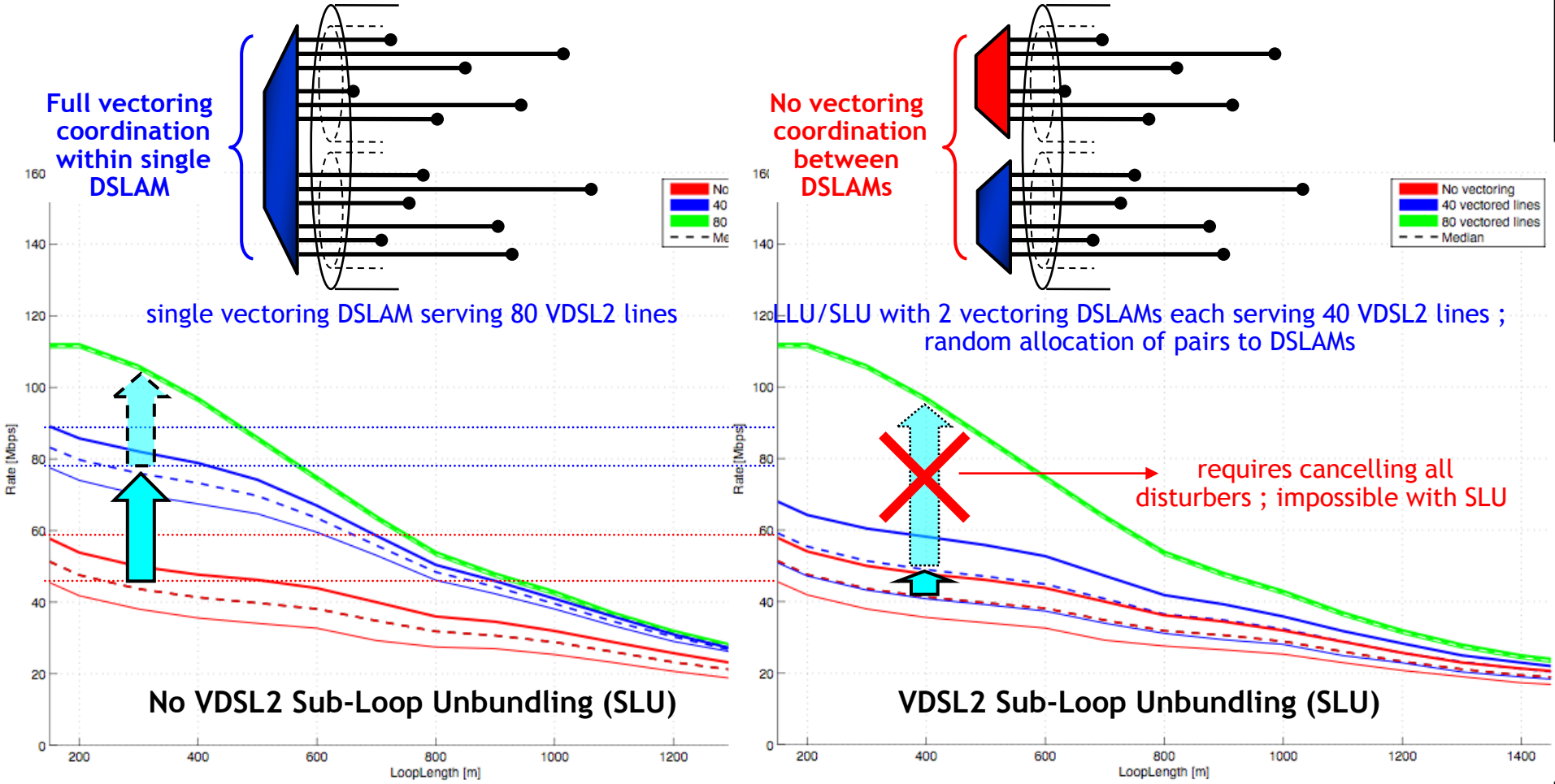
Example: 12 VDSL2 lines in 50-pair binder



Vectoring has potential for very significant bit rate increase

Vectoring in Unbundled environment

Example: 80 VDSL2 lines in 300-pair binder



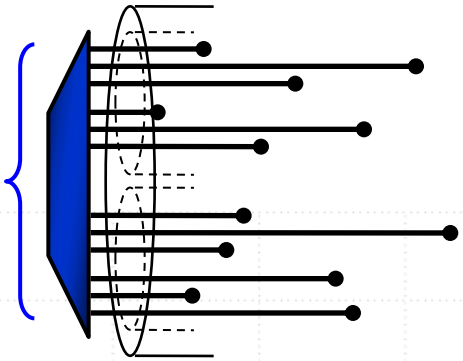
Vectoring gain is drastically reduced if no control over all VDSL2 lines in binder e.g. due to VDSL2 LLU/SLU

Vectoring in presence of non-G.vector CPE

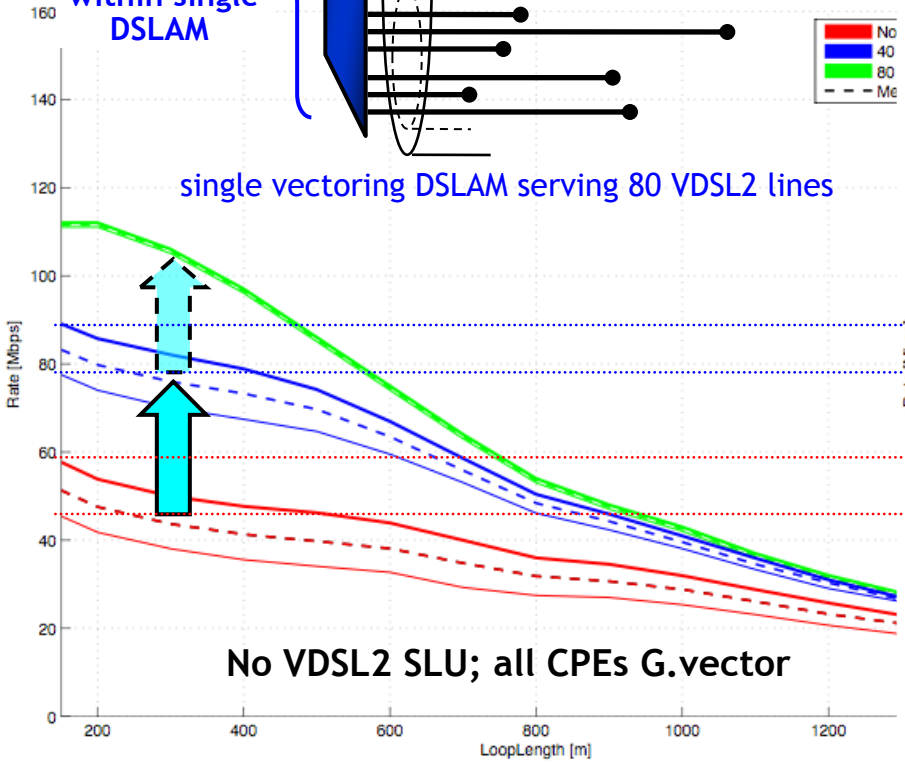
Example: 80 VDSL2 lines in 300-pair binder

Dominant disturber with non-G.vector (or non-G.vector friendly) CPE

Full vectoring coordination within single DSLAM

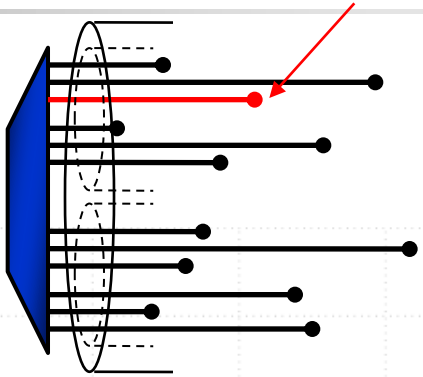


single vectoring DSLAM serving 80 VDSL2 lines

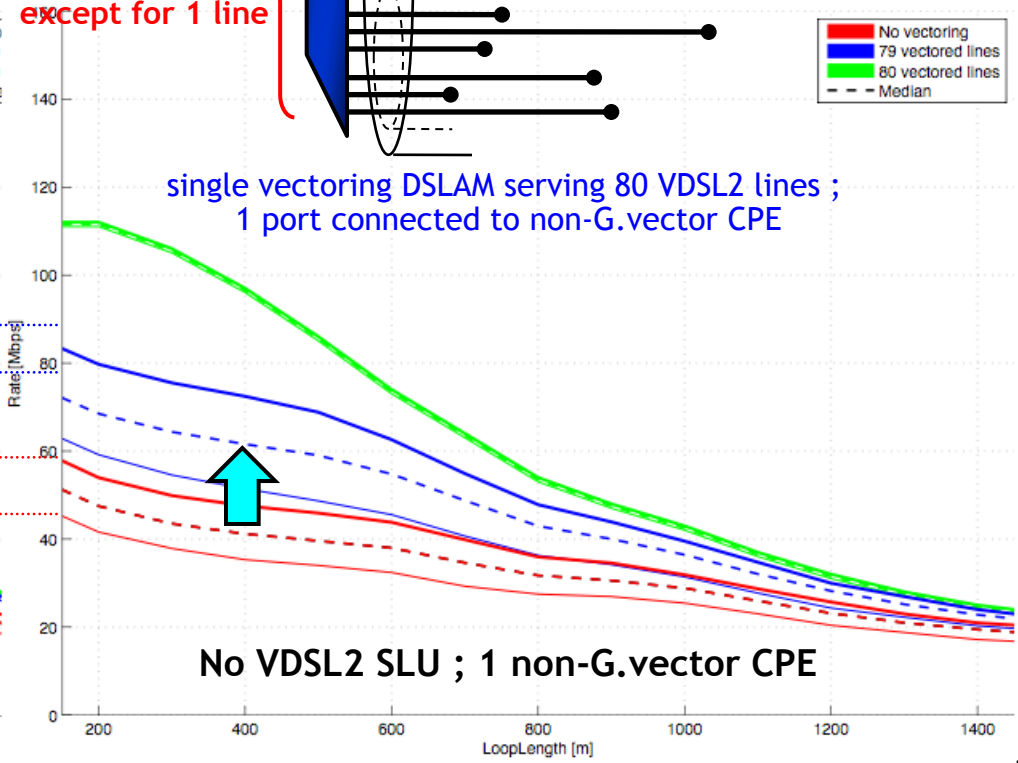


No VDSL2 SLU; all CPEs G.vector

Full vectoring coordination except for 1 line



single vectoring DSLAM serving 80 VDSL2 lines ; 1 port connected to non-G.vector CPE



No VDSL2 SLU ; 1 non-G.vector CPE

Vectoring gain is drastically reduced if no control over all VDSL2 lines in binder e.g. due to non-G.vector CPE

G.Vector ‘friendly’ CPE

- G.vector ‘friendly’ CPEs should not harm the vectoring group
  - but G.vector friendly lines will not benefit from the vectoring gain unless SW upgraded to full G.vector compliance or replaced with G.vector compliant CPE
- Rationale of G.vector friendliness:
  - some legacy VDSL2 CPEs may have HW limitations to be SW upgraded to full G.vector compliance while SW upgrade to G.vector friendliness may feasible (or easier)
- Defined in Annex to G.993.2 (VDSL2) to provide requirements for G.vector ‘friendliness’
  - minimum capabilities needed for a VDSL2 CPE to allow estimation of the crosstalk channel from the legacy line into vectoring group
  - ensure that transients on G.vector friendly lines do not cause errors on or fault-propagation towards G.vector line (under study)

Bijlage: VDSL2 vectoring

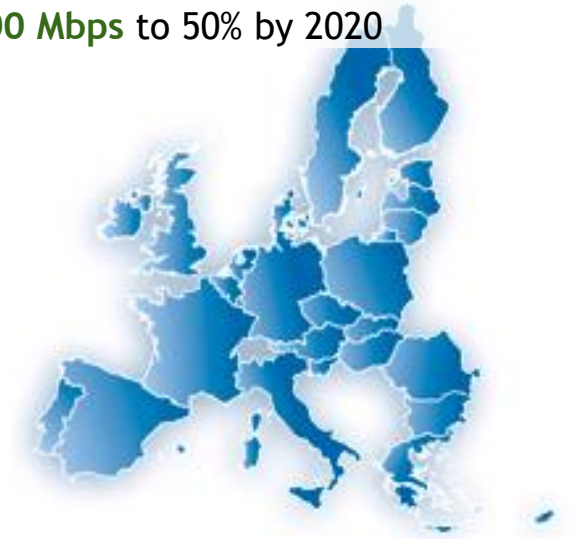
Overview of operator interest and trials

Towards ubiquitous very high-speed broadband

The Challenge

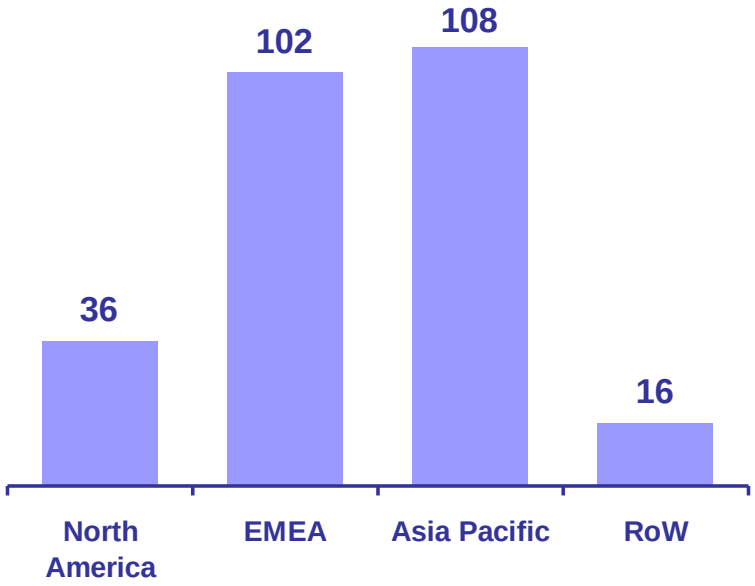
EC Digital Agenda

- broadband connectivity to all by 2013
- **30 Mbps** to all subscribers by 2020
- **100 Mbps** to 50% by 2020



FCC's National Broadband Plan (USA)

- **100 Mbps to 100 Mio** households by 2020



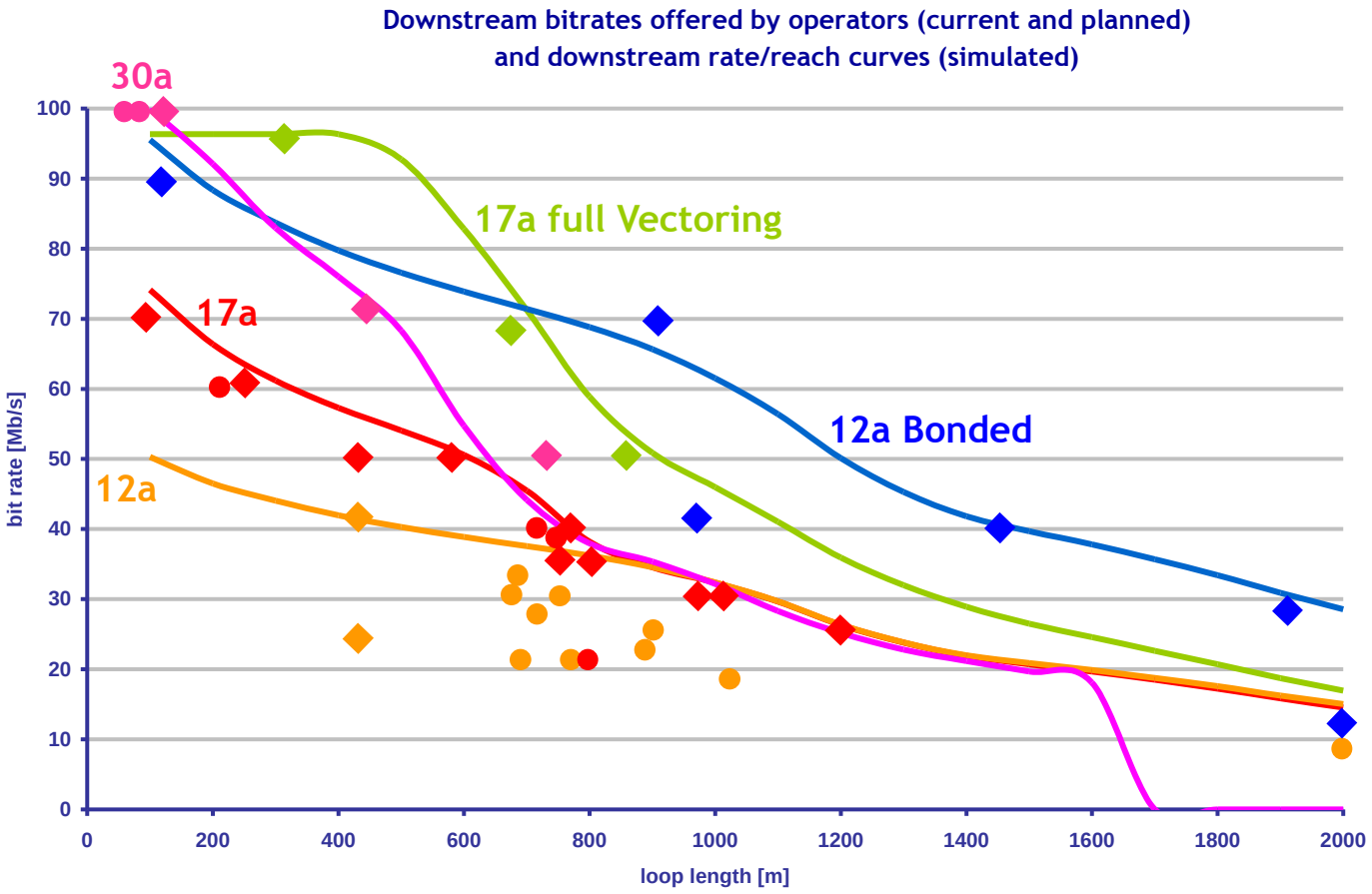
The Opportunity

DSL subscribers (millions), Dell'Oro 2Q10

- **100M+** households in EMEA on DSL broadband
- **250M+** households worldwide

FTTx + VDSL2 is the fastest path to universal coverage

VDSL2 service offers & deployment practices



Current

- 8x/12a profiles
- 17a profile
- 30a profile

Each dot = actual VDSL2 service offer

Planned / targeted

- From 8/12 to 17a, to increase bitrate
- To 17a bonding, to increase reach or rate
- To 30a for up to 100Mbps in FTTB
- To vectoring, to increase bitrates

Each diamond = planned VDSL2 service offer

Rate/reach points in above figure are indicative. In reality, performance depends on many factors e.g. loop topology, (target) service penetration and deployment parameters. Also, service offerings may be maximum values for marketing purposes.

Today: 20-40Mbps with 8x/12a/17a profiles (30a for FTTB)
Next: 40-100Mbps with 17a, VDSL2 bonding & Vectoring

1st large-scale VDSL2 Bonding deployment by at&t

AT&T's U-verse TV Gets Into 'Bonding'

Source: Interview with Randy Tomlin, sr VP U-verse field operations, Multichannel News and other publications

AT&T Using DSL-Extension Technology to Boost Bundle's Reach

By Todd Spangler -- Multichannel News, July 15, 2010

AT&T is turning to a cheaper way to expand its U-verse to reach 30 million homes.

This week the telco is starting to deploy digital subscriber line "pair bonding" in the last-mile copper portion of its U-verse fiber-to-the-neighborhood network, according to Randy Tomlin, senior vice president of U-verse field operations.

The technology -- which uses two copper wires together, instead of one -- will extend U-verse's reach by between 1,000 and 2,000 feet in a neighborhood. The variety of DSL that AT&T is using, very high bit-rate DSL, has a useful range of around 3,000 feet from the video-ready access devices (VRADs) that are the fiber-fed nodes in the U-verse network.

Using DSL pair-bonding combined with new U-verse buildouts, Tomlin said, AT&T expects to pass 30 million homes by end of 2011, up from 23.8 million at the end of March 2010. Pair bonding is much less expensive than planting new fiber, he noted, though he declined to specify costs.

"It uses the network we have in place," he said. "We don't have to dig up streets, alleys or yards."

The telco plans to use pair-bonding across its entire footprint, encompassing 22 states and 122 markets. Its existing DSL vendors, Alcatel-Lucent and 2Wire, are providing the low-power equipment for pair bonding.

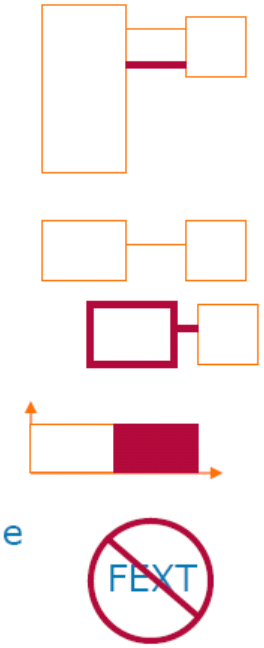
AT&T had previously expected to use pair-bonding starting in 2008. Tomlin said the telco worked with its suppliers to get the electronics to be lower powered and reliable enough to deliver voice, video and data to its satisfaction.

Bonding extends IPTV reach from 3,000 to 5,000ft - HP from 23.8M (1Q2010) to 30M (E2011)

Pushing further the limits of copper – AT&T's view

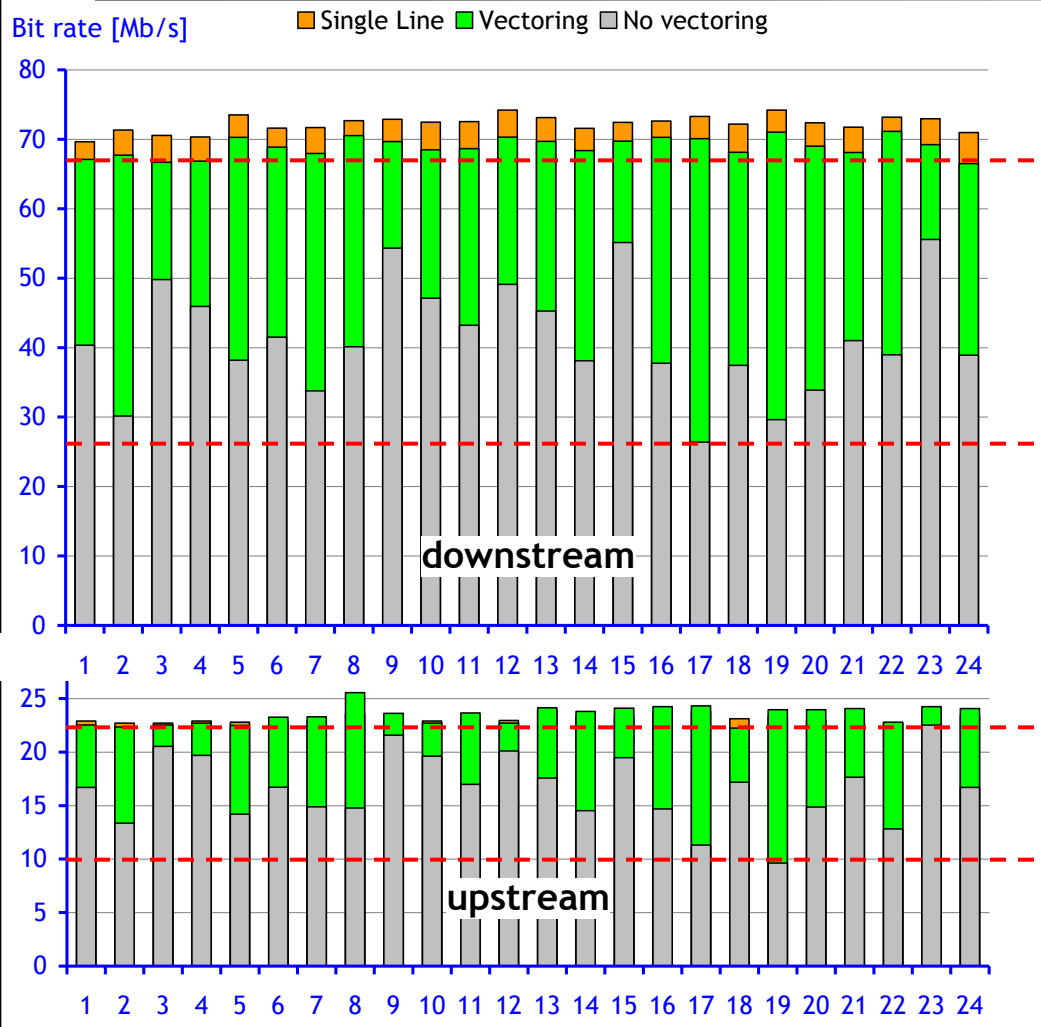
How FTTN can provide higher bit-rates – a multifaceted approach

- Selective 2-pair bonding of VDSL2 lines
  - About 50% longer loop reach for existing bit-rates, or
  - Double the bit rate for the same distance
  - To reduce cost, use only one line for the shorter lines
- Shorten the lines to at most 2.5 kft
  - Place DSLAM closer to the customers
  - Often requires more DSLAMs, each with fewer ports
  - Also, place NT at side of house, not inside
- Increase the VDSL2 bandwidth
  - 17 MHz profile increases both down & upstream
- Apply ITU-T G.993.5 vectoring standard to cancel the effects of far-end crosstalk
- Increasing upstream bit-rate is as important as downstream, especially for business customers.



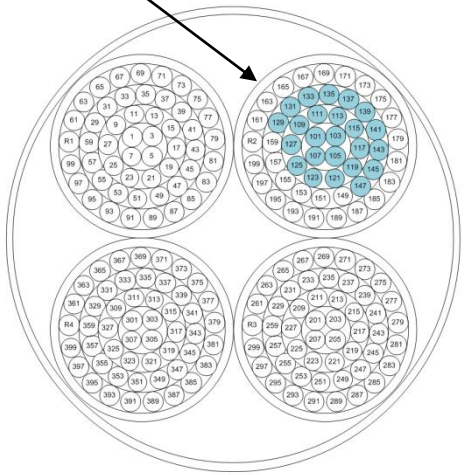
Satisfying the need for speed, Tom Starr –AT&T, BBWF 2010, Paris

Vectoring results
Swisscom lab (1/2)



(minimum)
Downstream
+150%

(minimum)
Upstream
+130%

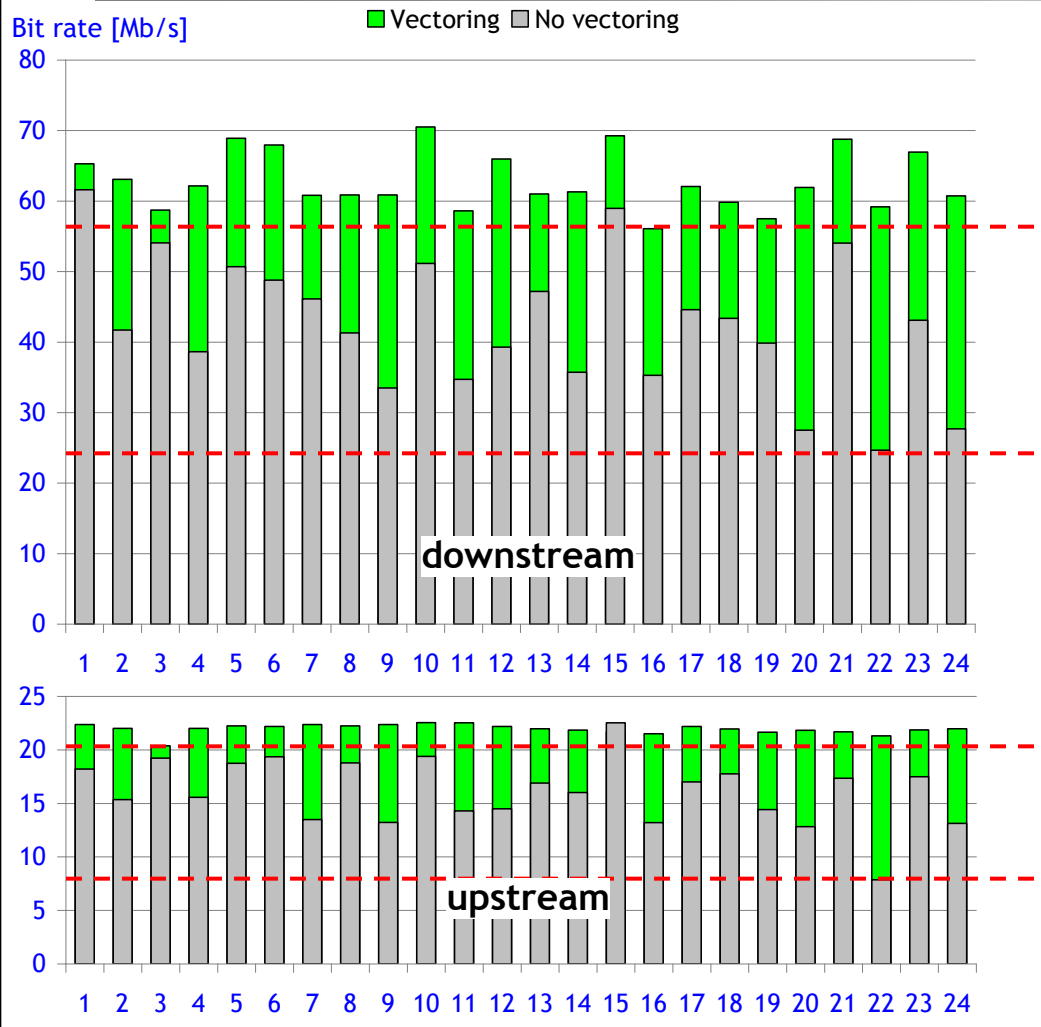


Swisscom lab tests

- 400p cable consisting of 4 binders of 100 pairs each
- paper insulated, 0.4 mm, 500m
- 24 VDSL2 in same binder
- no alien crosstalk

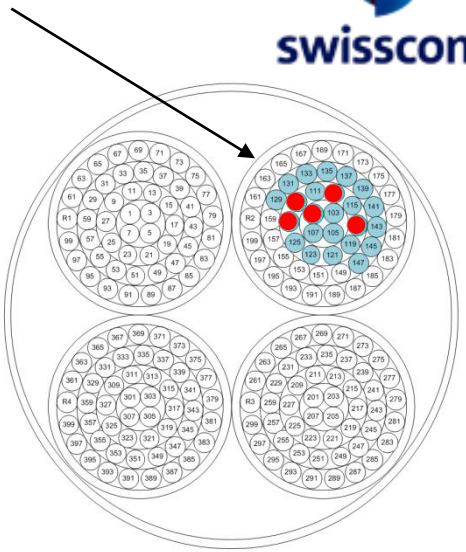
Vectoring realizes significant bit rate gains, and reduces the spread between lines
All lines within 95% of single-line performance

Vectoring results –alien Xtalk
Swisscom lab (2/2)



(minimum)
Downstream
+120%

(minimum)
Upstream
+150%

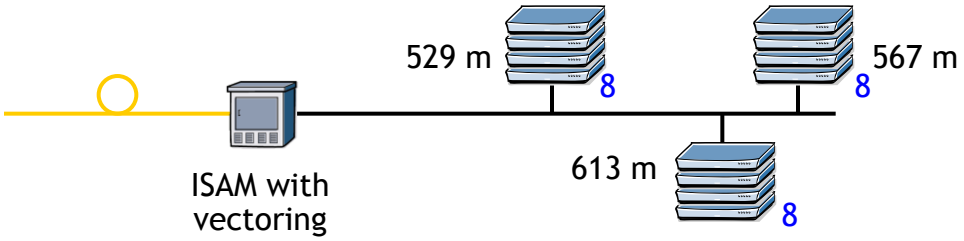


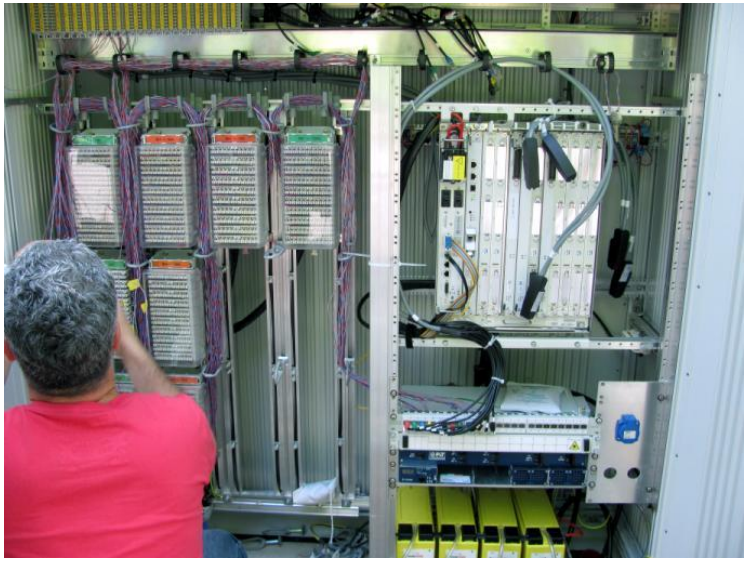
Swisscom lab tests

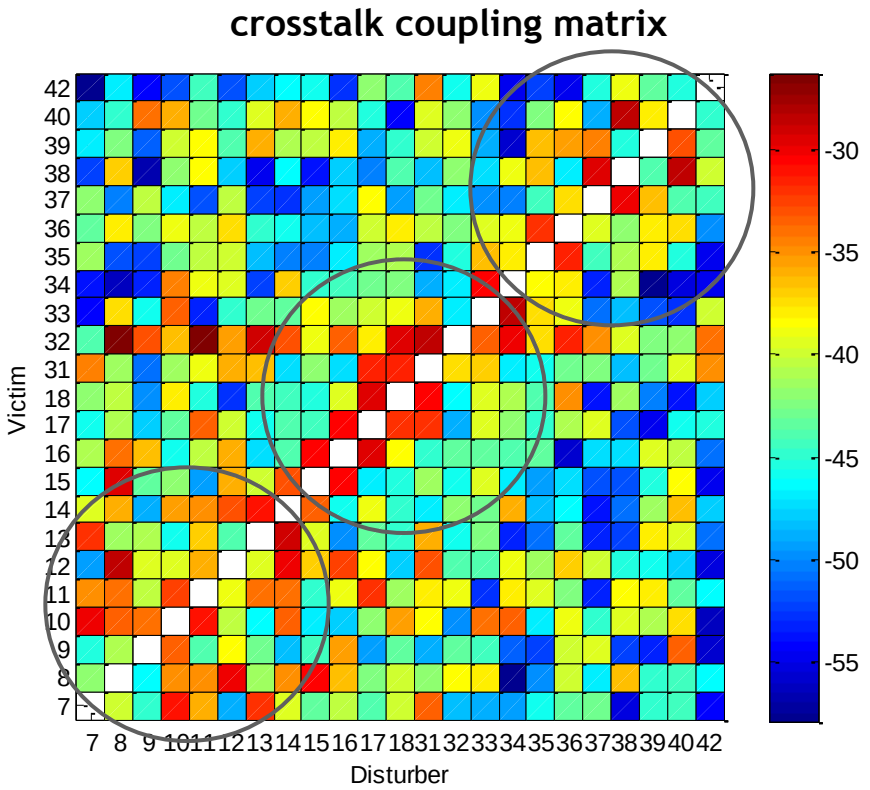
- 400p cable consisting of 4 binders of 100 pairs each
- 0.4 mm, 500m
- 24 VDSL2 in same binder
- 5 ADSL2plus lines sharing same quad as VDSL2 line

Even in an unbundled ADSLx environment, Vectoring still realizes significant gains

Vectoring results
P&TLux field trial

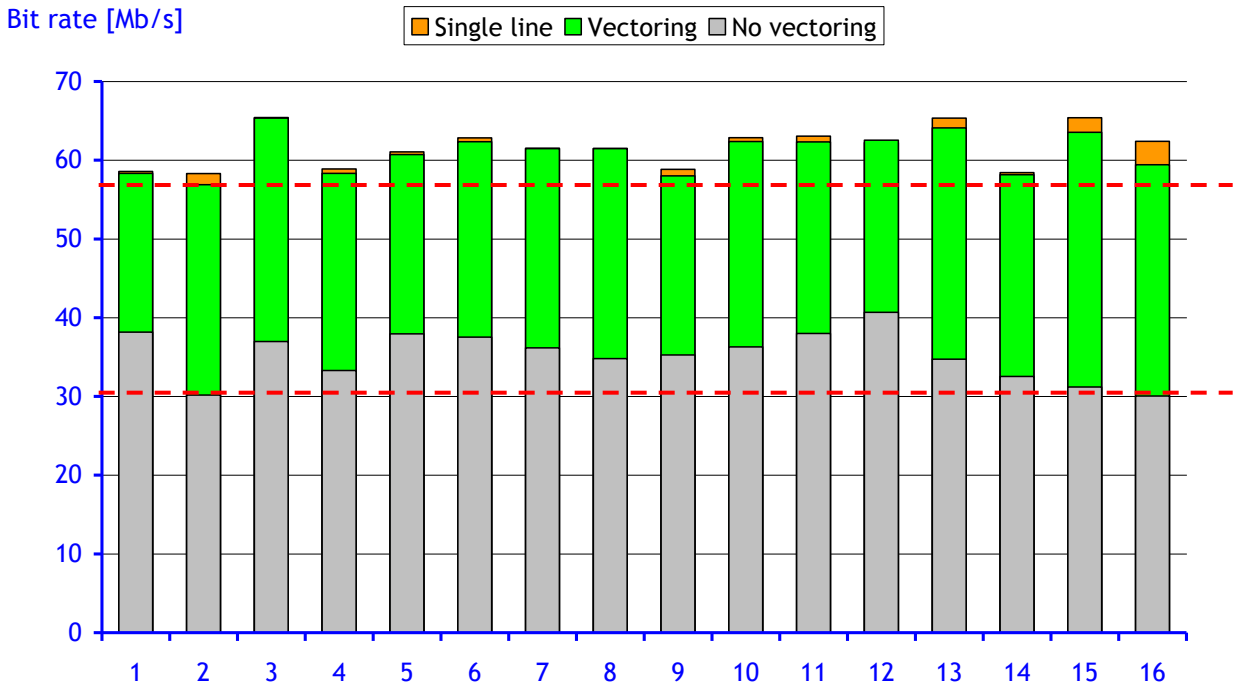






First vectoring field trial

Vectoring results
P&TLux field trial



Downstream
+90%

mix of 529m, 567m and 613m length VDSL2 lines

Vectoring bit rates at 95% of single line performance in field

Telekom Austria engages with Alcatel-Lucent on Vectoring

A1 Telekom Austria

Press Information
Vienna, December 17th, 2010

A1 Telekom Austria and Alcatel-Lucent trial new technologies that extend the life of networks

Copper networks have not yet reached their maximum performance: A1 Telekom Austria and Alcatel-Lucent demonstrate new ways to dramatically increase the speed of traditional DSL-technology

By year-end 2010, A1 Telekom Austria plans to provide high-speed broadband to 40% of all Austrian households and commercial businesses through its nationwide GigaNet - which uses FTTC (Fiber-to-the-curb) and FTTEx (Fiber-to-the-exchange, also known as VDSL@CO) to connect Telekom Austria's central office equipment with the "last-mile" copper network.

Together with Alcatel-Lucent, A1 Telekom Austria today therefore demonstrated in front of investors the possibilities of technologies such as VDSL Vectoring and the so-called "Phantom Mode".

Austria Telekom evaluating Alcatel-Lucent vectoring and Phantom VDSL2 for offering fiber-like speeds over copper

Türk Telekom engages with Alcatel-Lucent on Vectoring

Türk Telekom engages with Alcatel-Lucent to look into the benefits brought by next-generation DSL

Alcatel·Lucent

Paris, October 26, 2010 - Türk Telekom recently announced that it is looking into the benefits brought by next-generation DSL, leveraging Alcatel-Lucent's VDSL2 Bonding and Vectoring expertise and the innovative DSL Phantom Mode technology demonstrated by Alcatel-Lucent Bell Labs. As such, Türk Telekom aims at providing its customers with higher-speed and higher-quality broadband, while contributing to Turkey's efforts to build a knowledge society.

Türk Telekom, the leading telecommunications provider in Turkey, has been co-operating with Alcatel-Lucent and its famous Bell Labs to offer Turkey's broadband subscribers technologies and solutions that enhance their ways of living and communicating, and now intends to further improve the bandwidths supported by its DSL network. To this end, Türk Telekom will utilize Alcatel-Lucent's expertise in VDSL2 Bonding and Vectoring while laying the foundation for the deployment of further DSL innovations such as DSL Phantom Mode, which has been demonstrated earlier this year by Alcatel-Lucent's research arm, Bell Labs.

"Our purpose is to offer fiber-like speeds over copper"

"Readying ourselves to meet the future bandwidth requirements of our customers on our existing copper infrastructure, we are now considering which speeds can be enabled by next-generation DSL. Offering fiber-like speeds over copper, without having to wait until the transition to fiber has been completed, is a priority to us. Together with the specialists of Alcatel-Lucent, we will therefore evaluate the advantages of VDSL2 Bonding, Vectoring and future technologies such as DSL Phantom Mode," said Celalettin Dinçer, Türk Telekom Operation manager: "Moreover, the launch of these revolutionary technologies aims at contributing to Turkey's efforts to build a knowledge society."

Speeds of up to 100 Mbps over DSL

VDSL2 Bonding is available for use today, and almost doubles the capacity of VDSL2. The more

Türk Telekom evaluating Alcatel-Lucent bonding, vectoring and Phantom VDSL2 for offering fiber-like speeds over copper

Conclusion

1

DSL is a critical part of operators' FTTx strategies

- Short & Medium term complement, until fiber is ubiquitous
- Fastest way to provide universal coverage for very high speed broadband

2

Technology to boosts rates becoming available

- Profile upgrades to 17a, 30a for FTTB
- VDSL2 Bonding
- VDSL2 Vectoring
- VDSL2 Phantom transmission

3

First customer deployments & trials successful

- First large-scale bonding deployments have started
- First vectoring field results confirm potential
- First Phantom mode test results are promising

www.alcatel-lucent.com