Technicolor:
Frontrunner in next-gen ultra broadband technologies that boost the speed of your network!

- G.Vector
- Bonding
- Vectored bonding
- G.fast
- FTTdp
Make your access technologies evolve to support bandwidth hungry services!

New demanding services and applications are driving access bandwidth needs up...

Source: “Fast Forward” - How the speed of the internet will develop between now and 2020”, Dialogic & Eindhoven University of Technology (June 2014)
Copper

ADSL

VDSL

Bonding/Vectoring

G.fast

ADSL2

Fiber

BPON

GPON

10GPON

10GE

GE

FE

100 Mb/s

10 Mb/s

1 Mb/s

1995

2000

2005

2010

2015

2020

10 Gb/s

1 Gb/s

100 Mbps

1 Gbps

HDTV 1080p

HDTV 720p

Social & Sharing

YouTube

Flickr

Hulu

Netflix

Ultra HD

Business & Smart Home

Multiscreen

Share & Download

Online Video

SDTV

Voice

Web

Email

Streaming Video

HDTV Stream

Data
At Technicolor, we can help you to...

- Deliver ultra-broadband speeds to more end users by extending your coverage and reach

- WHILE Reducing costs by:
  - Re-using existing copper wires
  - Enabling incremental investments in fiber penetration
  - Ensuring low complexity & compatibility with existing xDSL services
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- G.Vector
G.vector to extend the reach and throughput of your VDSL2 network

Double your VDSL bandwidth (from 30 Mbps to 100 Mbps for up to 80% of your customer base)

- Measures the crosstalk noise between all lines in the binder
- Cancels the crosstalk with an anti-phase signal

- 2 types of Vectoring:
  - BLV (Board Level Vectoring): requires that all lines in a bundle are in 1 line card
  - SLV (System Level Vectoring): requires that all lines in a bundle are in 1 DSLAM

- Introduction requirements: low incremental investment

<table>
<thead>
<tr>
<th>Network Technology</th>
<th>Average Cost</th>
<th>Main Cost Contributors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber to the Home</td>
<td>2500$-5000$</td>
<td>Civil works, digging</td>
</tr>
<tr>
<td>VDSL</td>
<td>800$-1000$</td>
<td>Cabinet, fiber to the cabinet</td>
</tr>
<tr>
<td>Upgrade VDSL --&gt; VDSL with Vectoring</td>
<td>250$-400$</td>
<td>New linecard, for SLV: new server card, a recent gateway with the right software</td>
</tr>
</tbody>
</table>

Available @ Technicolor since 2012
Technicolor has been working with >10 of the most advanced NSPs around the world to successfully introduce vectoring in their networks on a nation-wide scale.

>>> From lab testing via field testing, to final roll-out

Examples:

- Proximus
- A1
- Belgacom
Complete VDSL Vectoring Test Setup in Technicolor Lab

> 10 DSLAMs with:
- 4 vectoring line cards (192 lines)
- 1 vectoring server card (for SLV)

Bundle with 192 copper pairs (300m long)

192 Technicolor CPEs with vectoring software

Technicolor performing Best in Class at UNH*’s interop events on vectoring, organized by

*University of New Hampshire, US
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- DSL bonding
DSL bonding to increase the capacity of your VDSL2 network

Double your bandwidth at the same reach (up to 100 Mbps for +/- 50% of your customer base)

or

Extend your reach at the same bandwidth

- Enables to increase available capacity or extend your copper network’s reach by combining 2 regular DSL lines into a single, virtual “big pipe”

- *Introduction requirements*: considerable investment & not universally deployable
  - Changes in the OSS/BSS, rewiring @ CO, ...
  - A dedicated gateway
  - Only possible with 2 pairs of copper of +/- the same length

Available @ Technicolor since 2012
Successful bonding implementations @ NSPs around the world

Technicolor, your partner for DSL bonding

Technicolor has its own dedicated portfolio of bonded VDSL gateways deployed worldwide, at several Tier 1 and Tier 2 operators

>>> The scale and experience to deliver at a competitive price!

Examples:

MediaAccess bonded VDSL Gateway with optional HPNA
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■ Vectored bonding
Combine both technologies and double your WAN bandwidth & throughput, *> 200 Mbps aggregate*

To reach fiber optic speeds*

**100 Mbps for >90% of your subscribers**

**LINES BONDED & CROSSTALK NOISE CANCELLED WITH ANTI-PHASE SIGNAL**

Combine both technologies and double your WAN bandwidth & throughput, *To reach fiber optic speeds*!

Available @ Technicolor since 2013

VDSL2 Vectored Bonding to up the speed of your VDSL network x 4!
Technicolor:
Frontrunner in next-gen ultra broadband technologies that boost the speed of your network!

- G.fast
The next big thing after vectoring, to match or beat DOCSIS & xPON technologies

- Use frequency spectrum till 106 MHz
- Time division multiplexing

G.Fast to shift the limits of copper, for speeds up to 1 Gbps!
G.Fast to shift the limits of copper, for speeds up to 1 Gbps!

The next big thing after vectoring, to match or beat DOCSIS & xPON technologies

- A new DSL technology allowing for speeds of 500Mbps - 1 Gbps
- Based on TDM (Time Division Multiplexing vs Frequency DM for standard ADSL/VDSL), allowing for higher frequencies on the twisted copper pair
- Backwards compatible with previous DSL technologies
- Versatile: flexible DS-US ratio, scalable power consumption, mobile backhaul, also for P2P coax

**Introduction requirements:** standard currently still under development

- ITU-T standardization around year end 2014, with chipsets available from 2015
- Mass deployment not expected before 2016 BUT Technicolor already has commercial samples available!
- Works best when combined with G.vector, cancelling the crosstalk noise
Helping to define the standard, with first commercial samples available!

Technicolor is actively participating in defining the technology.
Key choices are made in line with VDSL2 technologies (e.g. initialization protocol, support for bonding / vectoring, etc.), in which Technicolor is also a frontrunner.

>>> Technicolor : 1st to demonstrate G.fast in a real product, with a commercial chipset @ BBWF 2014

Available in 2015: our 1st G.fast gateway!
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- FTTdp
FTTdp: the next step in bringing fiber speeds closer to subscribers
FTTdp: the next step in bringing gigabit speeds closer to subscribers

Taking the fiber closer to the home

- Most effective when combined with G.fast: making use of the shorter distance from DPU to CPE to deliver gigabit speeds without the expense & disruption caused by FTTH (in brownfields*)

  However: G.fast currently not mature yet => for now, FTTdp + VDSL2 is the only option

- Reverse power feed: DPU can be powered from the customer premises to reduce network complexity

- **Introduction requirements**: significantly lower cost than FTTH in brownfields*

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<tbody>
<tr>
<td>FTTH</td>
<td>4500$</td>
</tr>
<tr>
<td>FTTdp (*)</td>
<td>1500$-2000$</td>
</tr>
<tr>
<td>FTTC (with VDSL)</td>
<td>1000$</td>
</tr>
</tbody>
</table>

(*) Source: TNO case study for Amsterdam and The Hague

dd 24 May 2014

* Area already served by a broadband network but in need of updating
Technicolor, partnering with TE Connectivity to deliver next-gen FTTdp solutions

More than a Decade-long expertise in access technology

Key technology & CPE expertise:
• Own GPON gateway portfolio with tested & proved interoperability
• VDSL enhancing technologies

Delivering outstanding solutions

Partnership with market leader in outside mechanical units to guarantee:
• Shortest service interruption time
• Support of both reverse and forward powering
• Easy upgrade from VDSL2 > G.fast
• Smooth upgrade path to FTTH
• Sustainability in harsh conditions

Introducing End 2 End solutions

Co-developing low port count FTTdp solutions
• Technicolor to provide DPU as well as CPE
• Technicolor to manage DPU network management on top
Technicolor: Your expert partner to help you get the most out of your network
Thought leader in DSL physical layer & interoperability

R&D expertise center in Belgium
- Since the birth of DSL technology 20 years ago
- ~10 DSL physical layer experts
- Systems, software, validation

High-quality hardware
- Specs for DSL performance criteria
- Review and approval of hardware design results

Driving Interoperability
- With the most common DSLAMs & line cards
- (ALU, Huawei, ECI, Ericsson, Ftel, Zhone, ZTE, Zyxel, ...)
- Frequent participation to interoperability events (e.g. UNH)
- Extensive test equipment in internal lab: DSLAMs, loop
- Simulators, noise and traffic generators from all major vendors

Active standardization member
- ITU-T
- Broadband Forum
- ETSI, ANSI
- Regulations: Arcep, Bipt, Ofcom, ...

Early to market with DSL performance improvements
- VDSL profile 30a (2011)
- G.INP (2011)
- G.vector (2012)
- Bonded vectoring (2013)
- G.fast (2014)

Close customer support
- In-house DSL validation lab for operators
- Custom design for operators
GPON & interoperability expert

Dedicated R&D team in Belgium & China
- Building knowledge from scratch since 2009
- Growing fiber team of 25 people
- GPON labs en Edegem and Beijing

Driving Interoperability
- With the most common OLTs (Huawei, ALU, ZTE, FiberHome, Zhone...)
- BBF.247 GPON certification in Q1 2015
- Extensive test equipment in internal lab: OLTs, Tracespan GPON analyzer, BBF.247 simulator, agilent digital analyzer, optical multimeters, RF overlay testing facilities...

Strong partnerships with...
- Leading chipset vendors
- ODMs with large production capabilities
- Vendors for optical modules and BOSA on board kits

High-quality hardware & software
- Single box integrated GPON gateways to simplify deployment
- OLT independence to prevent E2E vendor lock-in
- Same reliable software in all product lines to speed up TTM

Bringing fiber closer to the home
- FTTdp as a next step towards FTTH

Close customer support
- In-house GPON validation lab for operators
- Custom design for operators