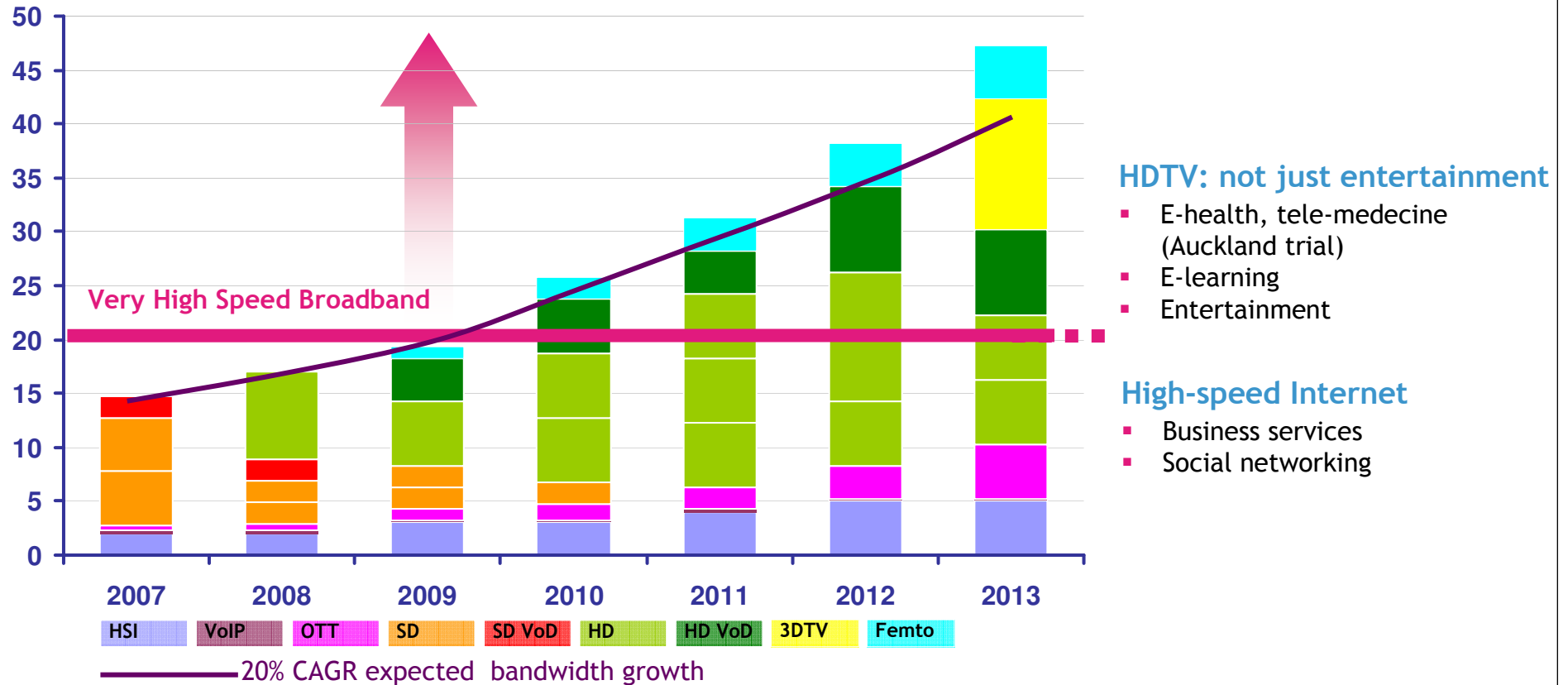


Delivering High Speed Broadband to Rural Customers



Stefaan Vanhastel, DSL Marketing
Wireline Networks, Alcatel-Lucent
November 2009

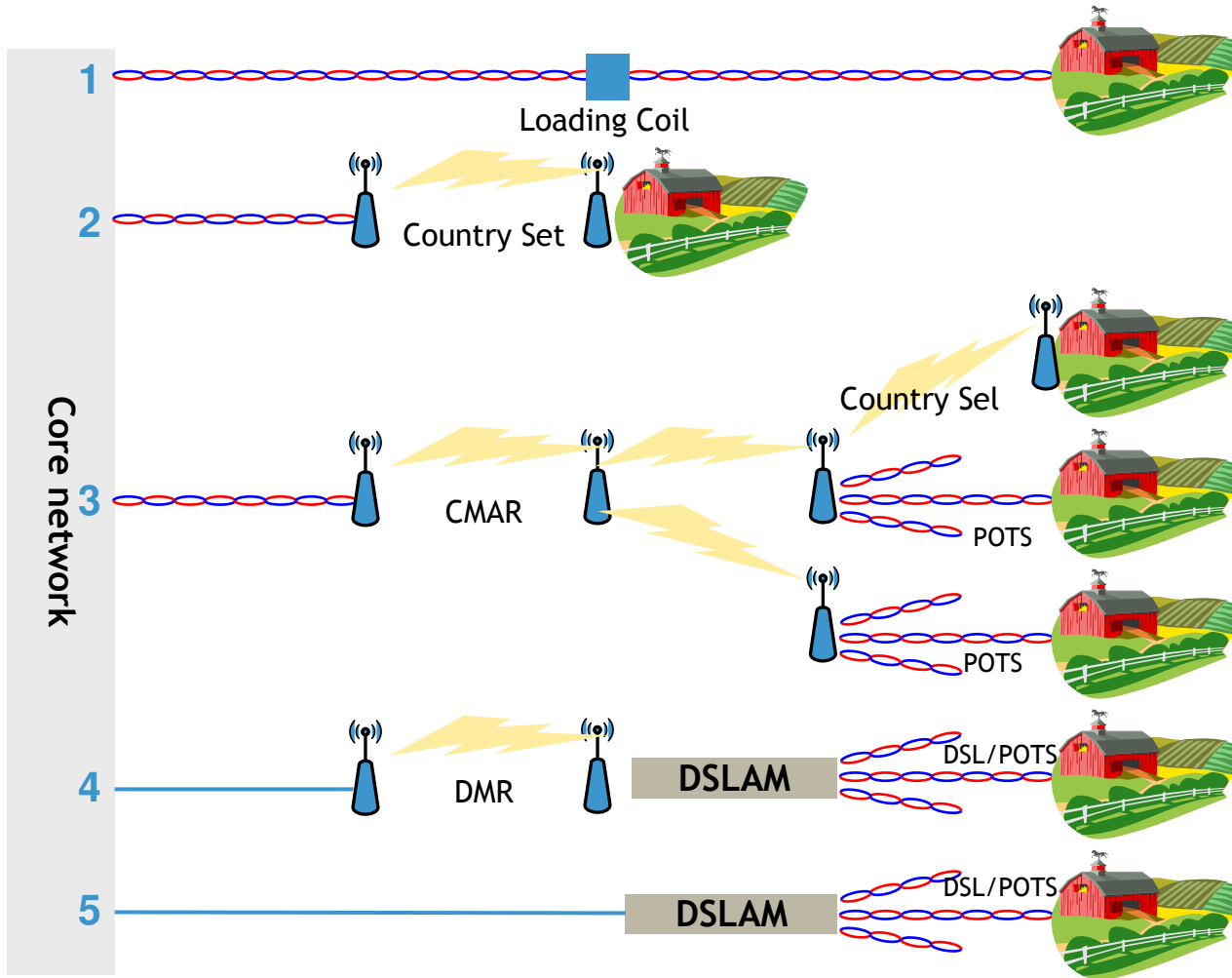
The quest for bandwidth - How much bandwidth is enough?



Sources: FTTH Council; Operators; Alcatel-Lucent

Bandwidth usage grows at a rate of 20% per year
20-40Mbps represents a generous service offering, enabling both “e-fun” and “e-care”

Q: Today's Rural technology - does it really meet the needs?



1. Long copper lines > 5km

- Use of loading coil
- Unsuitable for DSL

2. Narrow-Band Wireless

- VHF/UHF systems
- Unsuitable for broadband

3. Shared Wireless

- Customer Multi-access radio
- Small Communities
- 3 to 20 subs
- Unsuitable for broadband

4. Microwave Backhaul

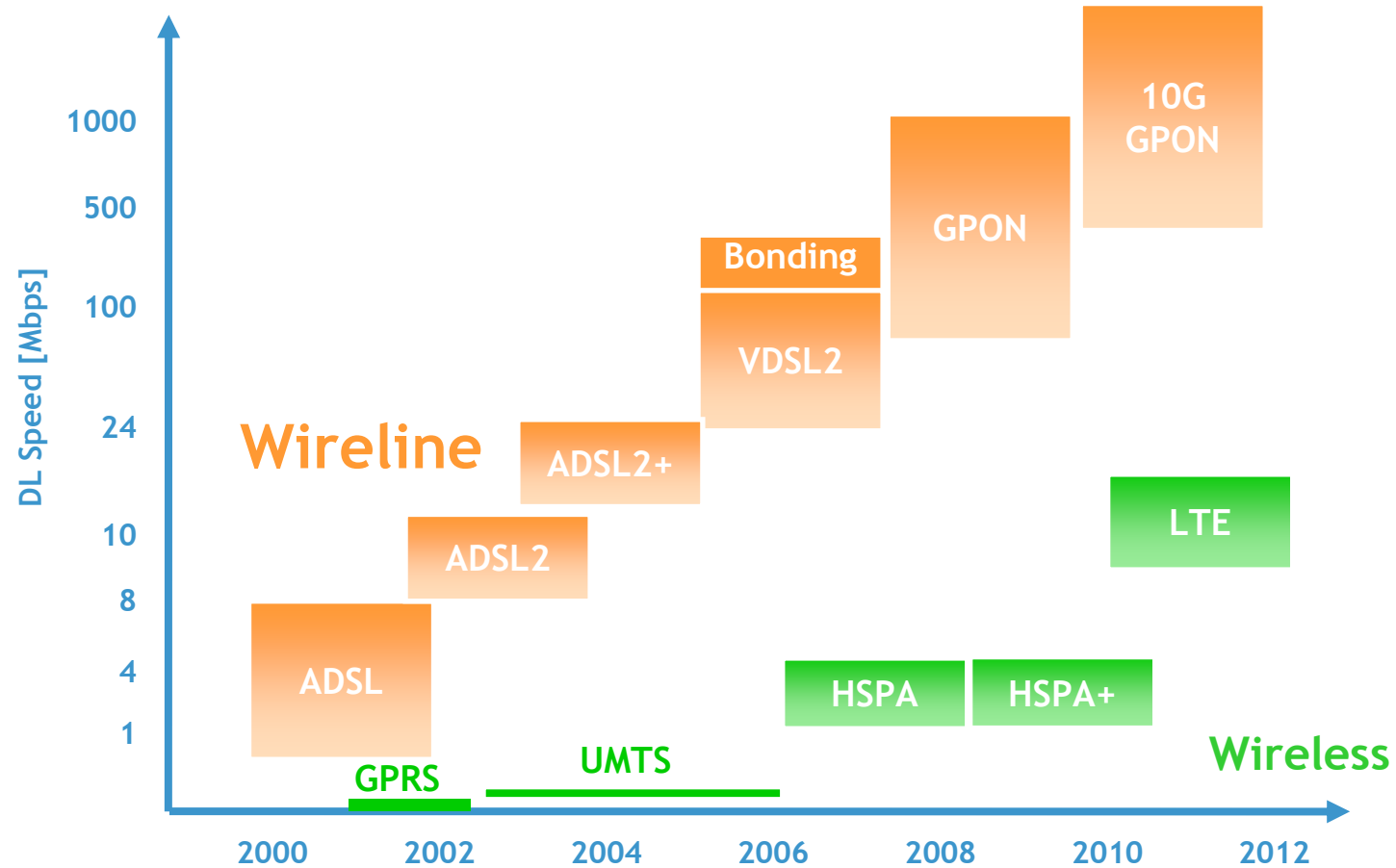
- Digital microwave radio
- Remote communities
- Copper distribution

5. Fibre Backhaul

- Remote communities
- Copper distribution

A: It depends

Technology is evolving



Technology evolution ensures adequate bandwidth for foreseeable future

Comparing rural broadband coverage solutions

Technology	Speed	Strengths/Weaknesses	Ideal for:
VDSL2 from cabinet Fiber backhaul	50Mbps	<ul style="list-style-type: none"> ✓ Cost-effective ✓ Sufficient bandwidth ✗ Short loops (1.5km) ✗ Requires backhaul fiber 	Rural towns and communities
Long-range DSL	12Mbps	<ul style="list-style-type: none"> ✓ Total re-use of copper ✗ Need to install regenerators ✗ Lower bandwidth 	Isolated properties within 10-15km of CO
DSL from cabinet Microwave backhaul	2-8Mbps	<ul style="list-style-type: none"> ✓ No fiber backhaul required ✗ One or more line-of-sight hops ✗ Lower bandwidth 	Remote communities
Mobile Broadband	3Mbps(HSPA) 10Mbps (LTE)	<ul style="list-style-type: none"> ✓ Quick deployment ✗ Requires microwave / fiber backhaul ✗ Low(er) bandwidth 	Wide-area wireless solution
Fiber-to-the-home	100Mbps	<ul style="list-style-type: none"> ✓ “Unlimited” bandwidth ✓ Future proof ✗ High civil works cost 	Strategic locations: schools, hospitals
Satellite	1Mbps	<ul style="list-style-type: none"> ✓ Ubiquitous ✗ High cost (linear with nr of subs) ✗ Low bandwidth 	Hard-to-serve areas

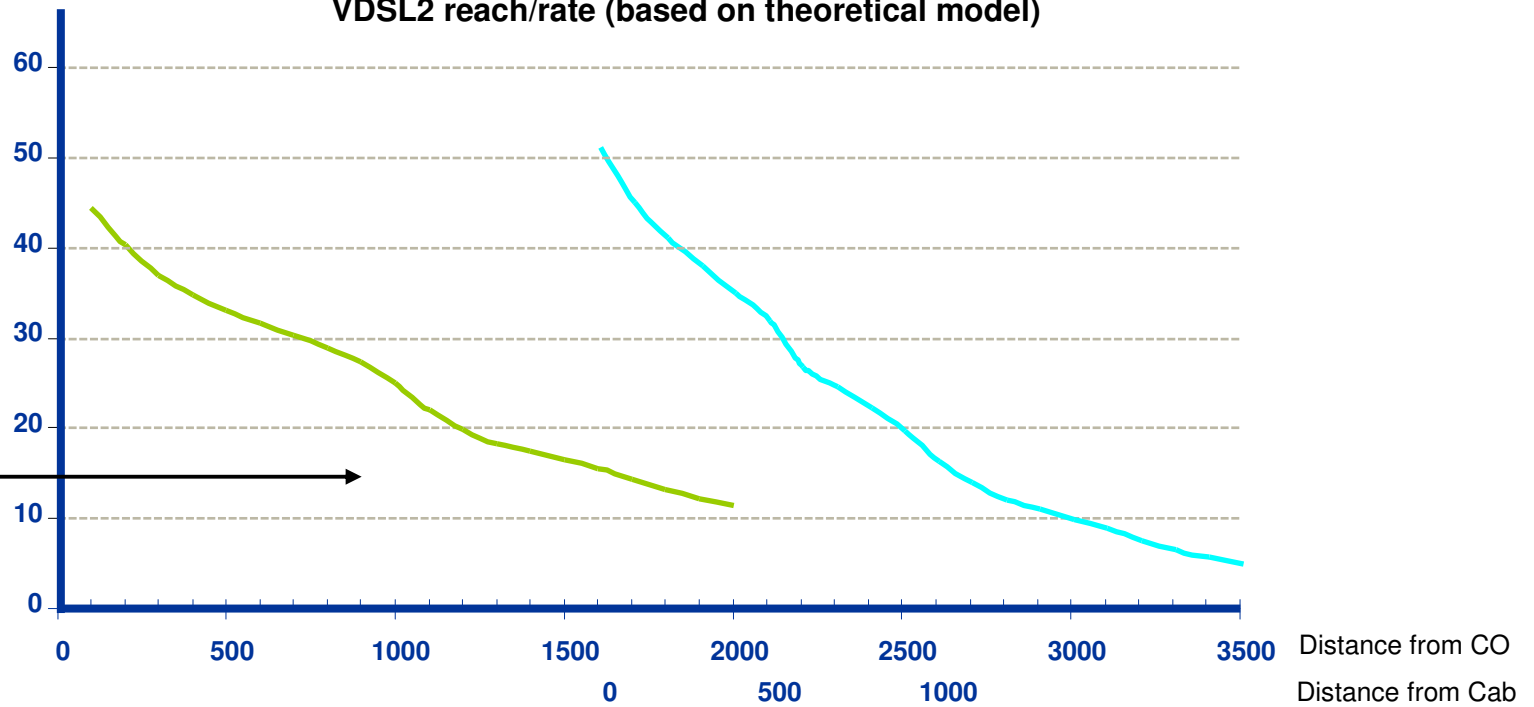
More widely applicable for rural

Best technology for a given area will be selected based on cost and performance

Increasing bitrates: small DSL nodes closer to subscribers to shorten copper loops

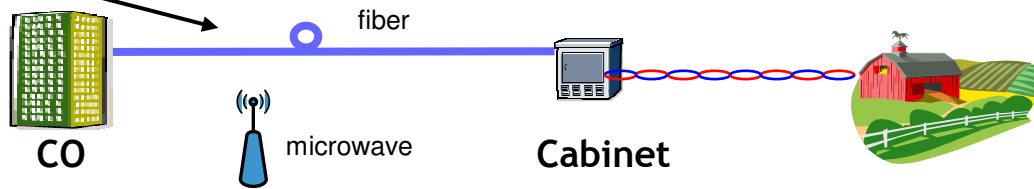
Improving DSL technology for rural deployments

VDSL2 reach/rate (based on theoretical model)



Laws of physics:
Longer distances =
lower bitrates

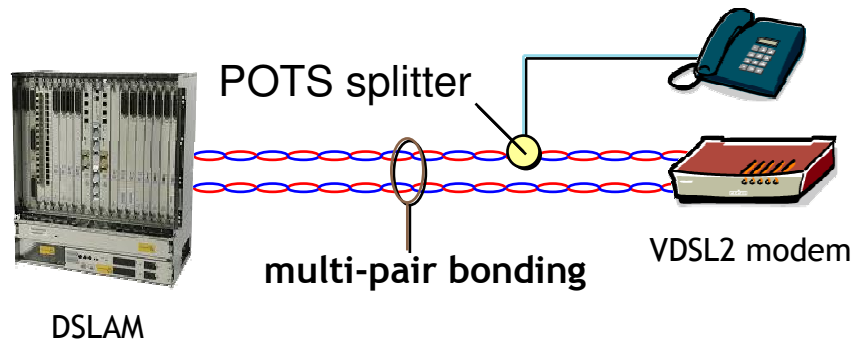
Backhaul: Connecting
the cabinet to the core
network: fiber,
microwave, satellite



Shorter copper loops deliver higher bitrates, but requires adequate backhaul

Increasing bitrates/coverage: VDSL2 Bonding (2 lines) increases reach/rate

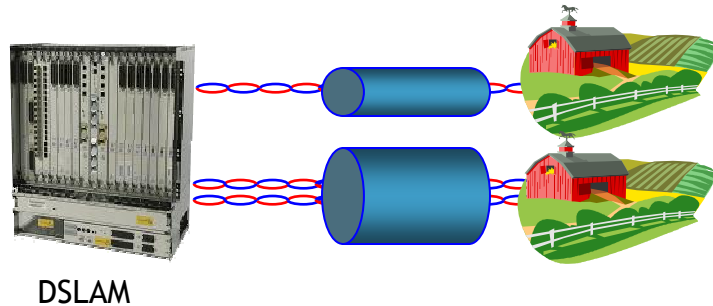
Improving DSL technology for rural deployments



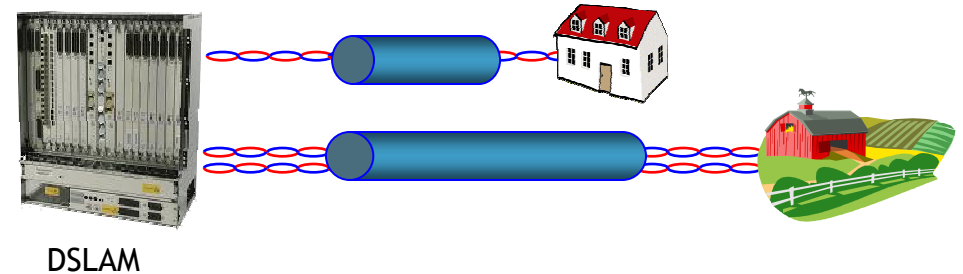
VDSL2 Bonding

Two DSL copper pairs combined into a single virtual DSL line

Double the bitrate at the same reach



Extend reach, for same bitrate



... or any combination of increased reach and rate

Increasing bitrates: VDSL Vectoring could double the rate (ongoing research)

Improving DSL technology for rural deployments

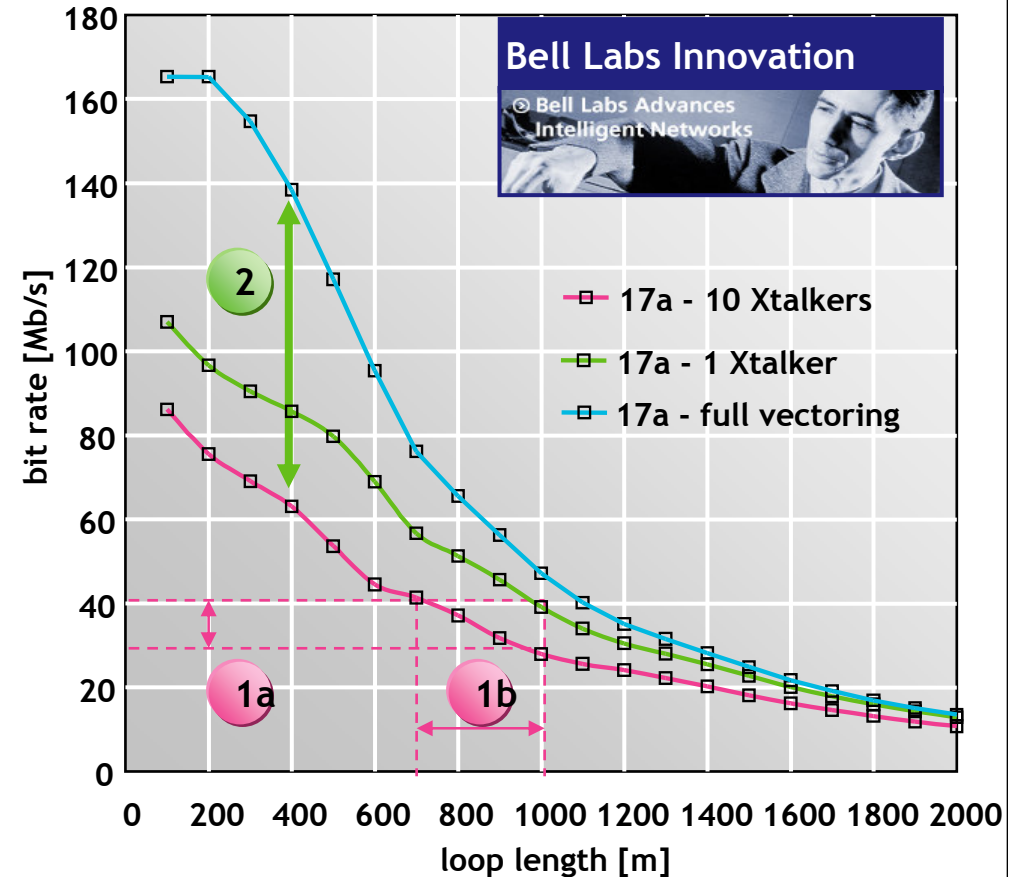
Cancel the noise....



VDSL Vectoring = Noise Cancellation

- Calculate interference of each line with all others in binder
- Cancel the noise with an anti-phase signal

... to extend the reach/rate

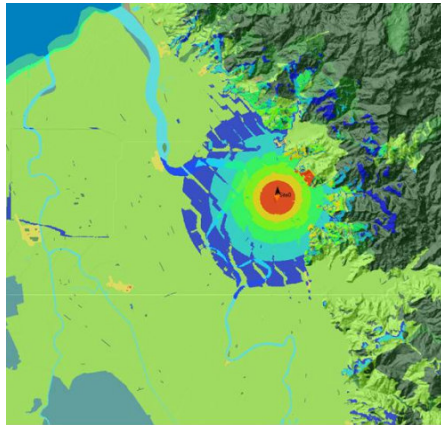


VDSL2 Vectoring: potential gains of 25 to 100 percent, but requires small number of lines (e.g. small nodes in rural deployments)

Increasing coverage: using lower (sub-1GHz) frequencies

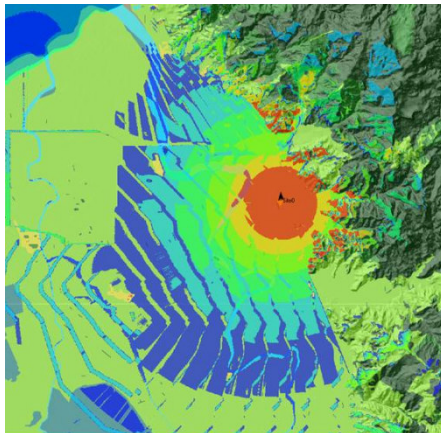
Improving wireless technology for rural deployments

Sub-1GHz available for HSPA today



2 GHz HSPA

Coverage



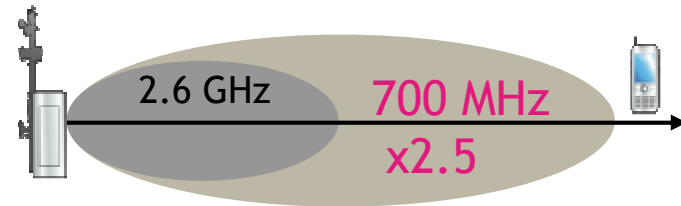
900 MHz HSPA

Coverage

Strongest Pilot Level



Sub-1GHz evolution for LTE



LTE introduction in New Zealand

Phase 1:

- 2600MHz spectrum for LTE expected in New Zealand from about 2011
- Digital dividend: migration from analogue to digital TV frees up spectrum

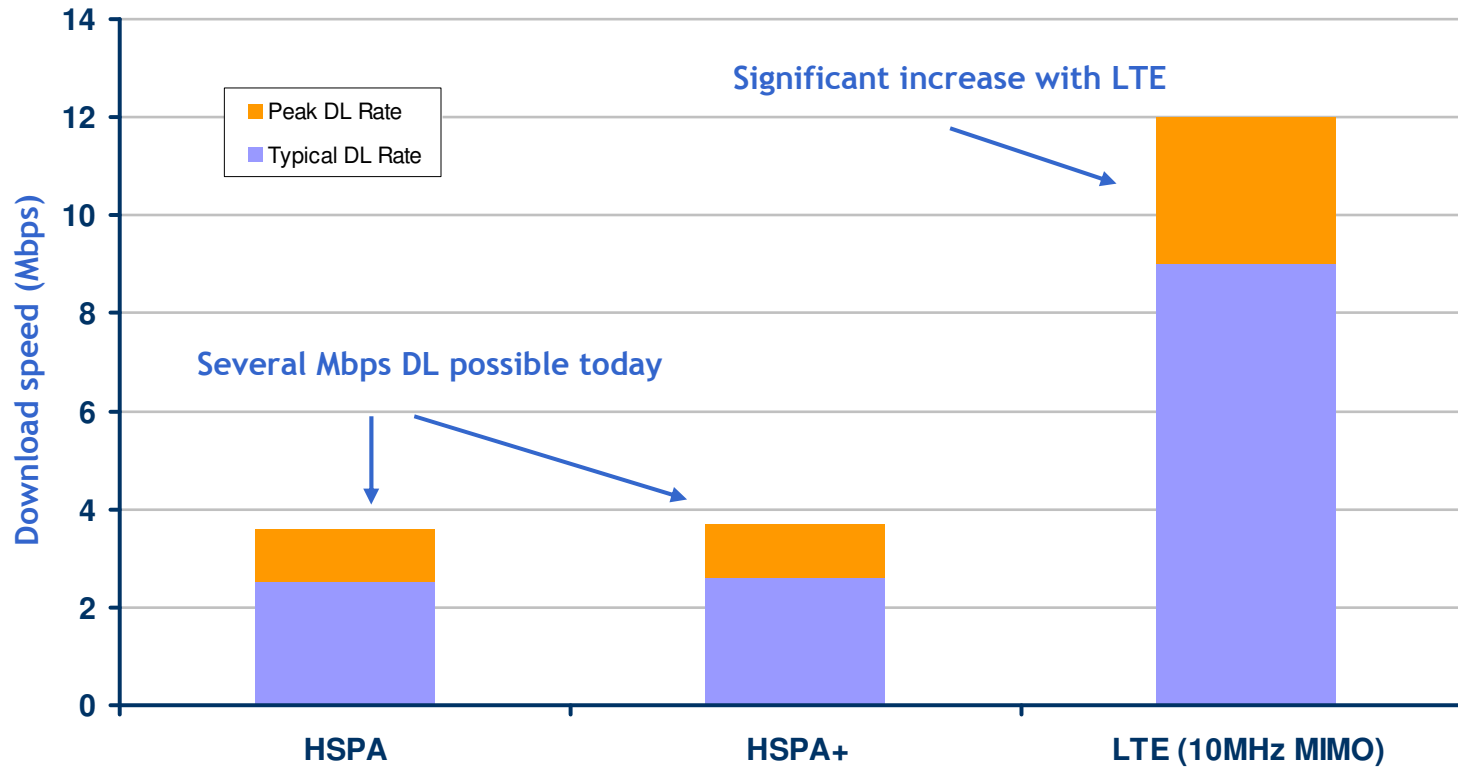
Phase 2:

- 700MHz spectrum for LTE expected in New Zealand by 2013

Sub-1GHz frequencies will drastically increase wireless coverage for rural deployments

Increasing bitrates: LTE (Long Term Evolution) triples bitrate

Improving wireless technology for rural deployments



- Maximum performance unlikely with handsets/USB sticks
- Optimal performance requires radio link designed for fixed rural coverage - cost vs. performance trade-off

Optimal performance will require optimized equipment

Optimizing equipment for rural deployments: wireless solution toolkit

Improving wireless technology for rural deployments

Pole mount antenna +
ruggedized outdoor CPE



Shelter belt



High sites
to
maximise
coverage

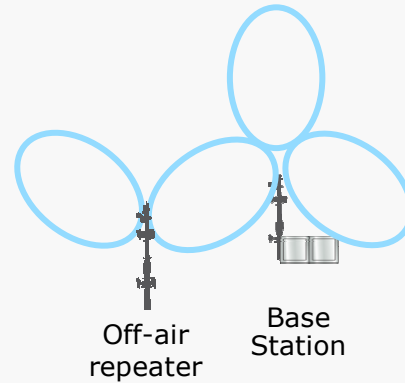


Microwave
Antenna

**Microwave
backhaul to
high sites**

Customised RF design per property
Preferably line-of-sight to basestation

**Sub-1GHz spectrum for optimum
RF propagation**



Off-air
repeater

Base
Station

RF Repeaters

- to get over ridges &
around corners to hard-
to-reach properties

Innovative Power



Solar, Wind,
Compressed Air,
etc.



High Gain Antenna with
indoor CPE

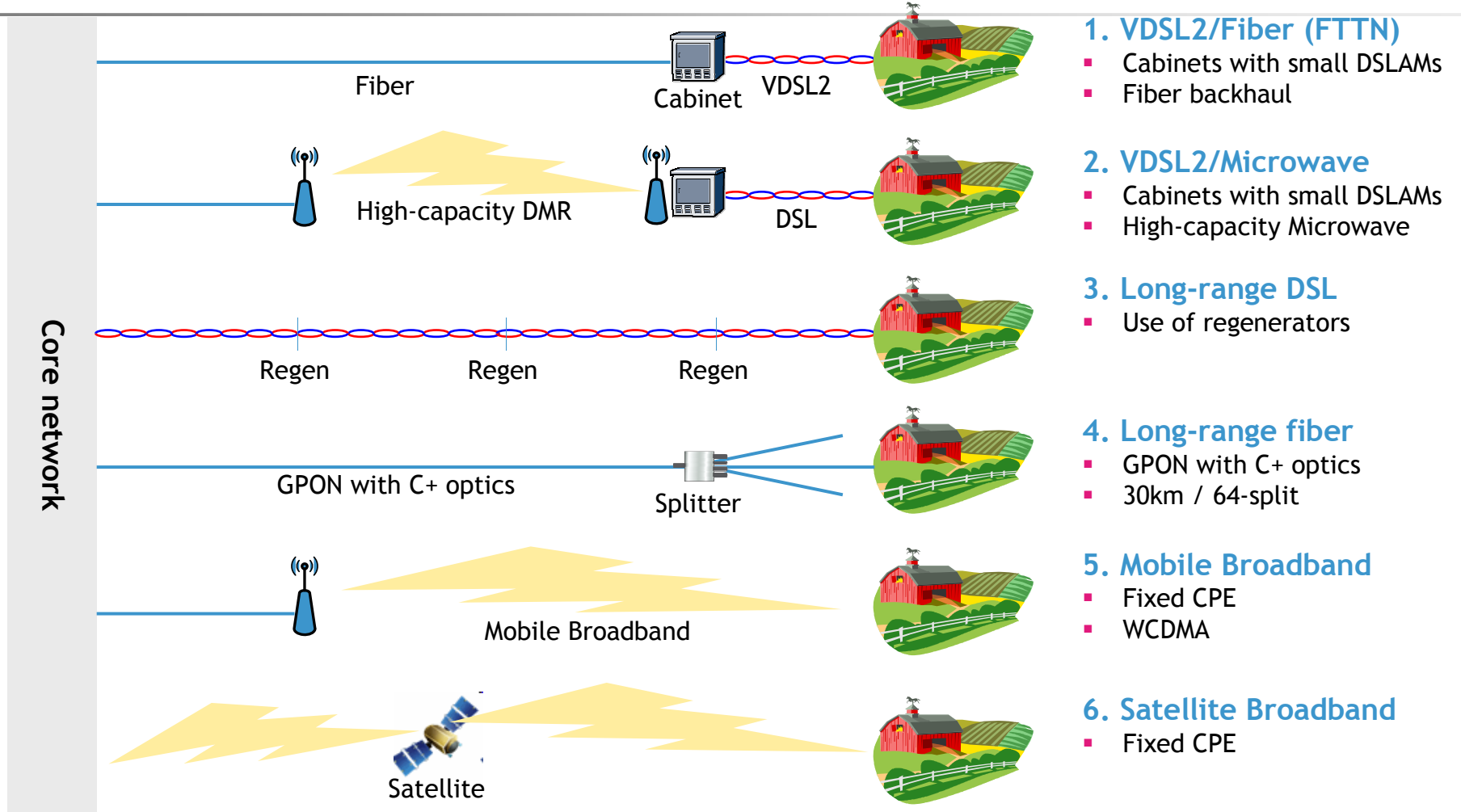
Remote Device Management



Minimise customer visits

Full range of tools and technologies available to support rural deployments

Rural Broadband Coverage tomorrow



- 1. VDSL2/Fiber (FTTN)**
 - Cabinets with small DSLAMs
 - Fiber backhaul
- 2. VDSL2/Microwave**
 - Cabinets with small DSLAMs
 - High-capacity Microwave
- 3. Long-range DSL**
 - Use of regenerators
- 4. Long-range fiber**
 - GPON with C+ optics
 - 30km / 64-split
- 5. Mobile Broadband**
 - Fixed CPE
 - WCDMA
- 6. Satellite Broadband**
 - Fixed CPE

**Reach 100% of rural homes
with a mix of Deep fiber, VDSL2, wireless, and satellite**

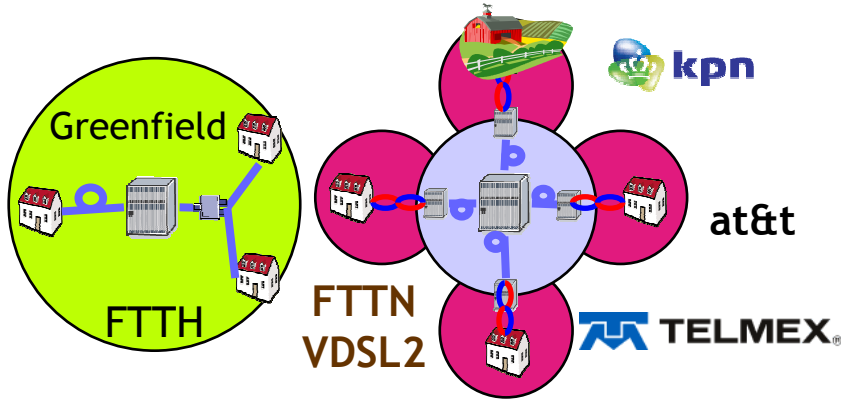
Carriers typically deploy a mix of deployment models

What are other countries / operators doing?

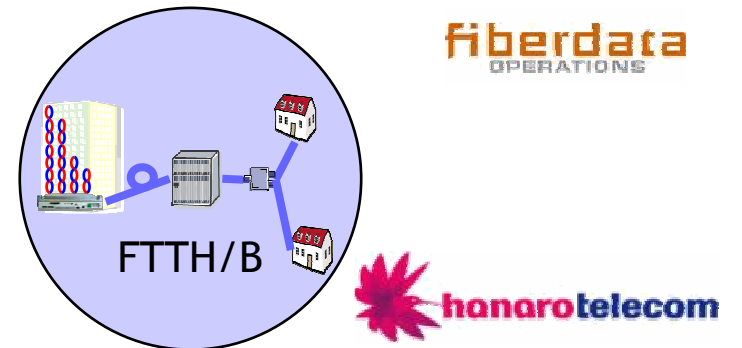
Copper-centric - Typically suburban/rural

Fiber-centric - Typically dense urban areas

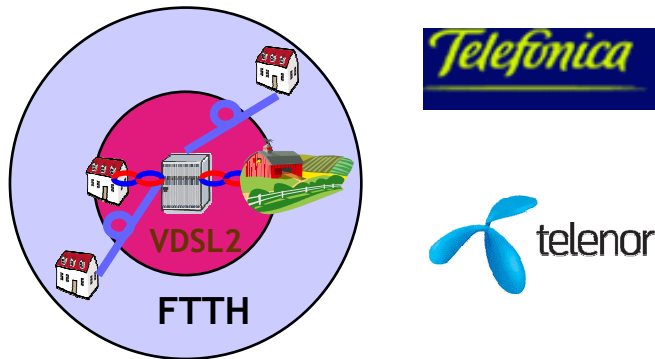
VDSL2/ FTTN
+ long-term FTTH



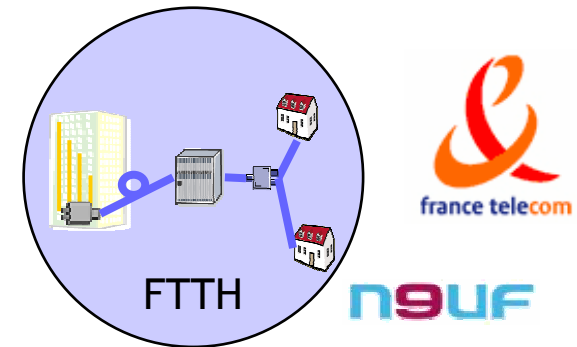
FTTH + VDSL2/FTTB



VDSL2/ CO
+ long-term FTTH



FTTH Only

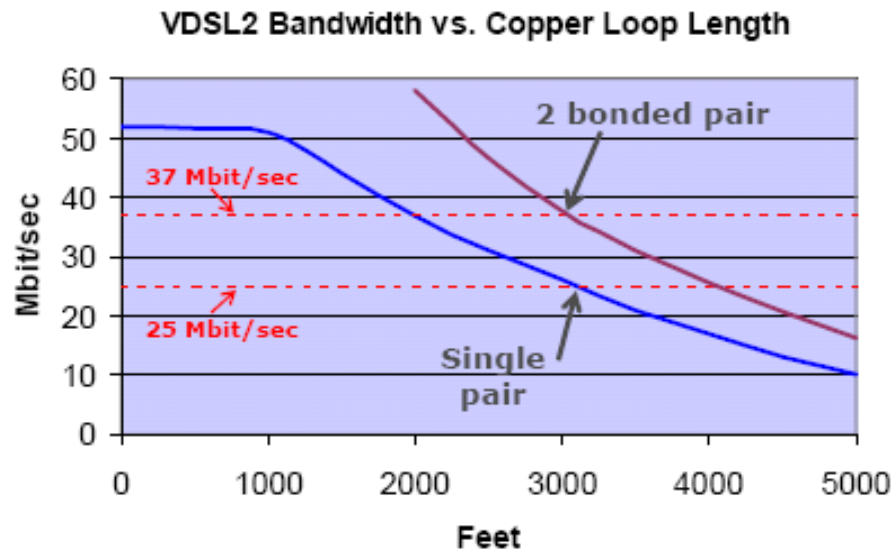


FTTx with VDSL2 for cost-effective coverage and fast time-to-market
FTTH with GPON or P2P in strategic areas and greenfield

USA - VDSL2 Bonding to cover longer distances

What are other countries / operators doing?

VDSL2 bandwidth capability



Design specification examples:

- 25 Mbit/sec
 - Single pair
 - 3000 foot maximum copper distance
- 37 Mbit/sec
 - Single pair - 2000 foot max copper distance
 - 2 bonded pair - 2000 to 3000 foot max copper distance

Figures are from ATIS and are illustrative only, they not intended to depict AT&T's particular experience. Actual throughputs will depend on the specific characteristics of the loop plant and network equipment deployed.

VDSL2 bonding will complement at&t's VDSL2 deployment for longer loops

Belgium: fast roll-out with VDSL2 and re-use of copper

What are other countries / operators doing?

belgacom

Belgium, Early Bird in DSL



The Country

- 10.6 mio Inhabitants
- 4.6 mio Households
- 30.500 km²



DSL in Belgium

- 1998 ADSL, born in Antwerp
- 1999 First **ADSL** commercial offer
- 2002 Fiber-Rich Network Study "**Broadway**"
- 2003 Start Fiber Deployment for VDSL
- 2004 Deploy Remote Optical Nodes. Part in **VDSL1**.
- 2005 National Deployment **ADSL2+** Central Office
- 2005 TV Launch & Soccer Rights.
- 2007 Care for Digital Divide with **Re-DSL** in rural
- 2008 National Offer of 2 HDTV on **VDSL2**

Some figures 1H08

National Coverage

- Internet 1 Mbps 99.85%
- TV 1 stream 84 %
- TV 2 streams 60%
- VDSL2 62.5 %
- HDTV 2 streams 50+ %

New line profiles soon
"All MPEG4" soon

Volumes

1.714.000 DSL (Retail, WS)
391.460 IPTV

**62.5% percent coverage with VDSL2 and growing
14,000+ cabinets in urban, sub-urban, and rural areas**

HSPA widely used today as complement to copper/fiber networks

What are other countries / operators doing?

11 networks launched at 900MHz

190 HSPA devices support 900MHz

27 networks launched at 850MHz

599 HSPA devices support 850MHz

850MHz networks

Telstra, Australia
Telecom,NZ
TIM, Brazil
Claro, Brazil
Vivo, Brazil
CTBC, Brazil
Telus, Canada
Bell Mobility, Canada
Rogers Wireless, Canada
ICE, Costa Rica
Claro, Dominican Rep.
Guamcell, Guam
Pelephone, Israel
Telcel, Mexico

Claro, Nicaragua
Movistar, Nicaragua
Sercom, Nicaragua
Movistar, Panama
Tigo, Paraguay
Personal, Paraguay
Globe, Philippines
Smart Gold, Philippines
Sferia, Poland
Claro, Puerto Rico
AT&T, USA
West Central, USA
Movistar, Uruguay

900MHz Networks

Vodafone, NZ
Optus, Australia
VHA, Australia
Mobistar, Belgium
Proximus, Belgium
Elisa, Estonia
Elisa, Finland
DNA, Finland
Teliasonera, Finland
SFR, France
CSL, Hong Kong
Siminn, Iceland
AIS, Thailand
DTAC, Thailand
Digitel, Venezuela



Fixed wireless devices for most installations



Huge growth in HSPA 850/900MHz in last 2 years - mature ecosystem available today

Celcom Malaysia: Wireless broadband for rough terrain

What are other countries / operators doing?



Urban:

- Wireless BB (WCDMA at 2100MHz)

Rural:

- Fixed mobile on GSM (900MHz) in 2007
- No DSL in rural areas - terrain too rough
- WCDMA at 900MHz planned but currently not permitted by regulator

WCDMA Benefits for Rural

- 10km cell radius (+ 50%) - twice coverage area - ½ number of base stations
- Improvement of > 10x in data speeds compared with GSM
- Expanding eco-system of devices - terminal cost decreasing

Challenges similar to NZ

- Distance and terrain - Rural systems difficult to maintain
- High cost, low ARPU - Low return on investment for operators
- Network resources not optimal for sparsely populated areas

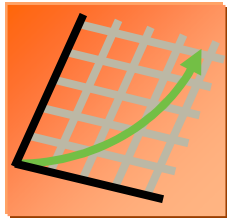


Successfully delivering wireless data to rural Malaysia

Conclusion



Technologies are mature and field-proven



Deliver an attractive broadband service package to boost rural economies...



... in the most cost-effective way

The background is a deep blue color with a fine, light-colored grid pattern. Overlaid on this grid are several abstract, glowing light streaks and curves in shades of light blue and white, creating a sense of motion and depth. The overall aesthetic is clean, modern, and technological.

www.alcatel-lucent.com

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