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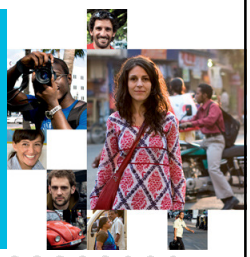
LTE and WiMAX - Where did we come from and where are we going?



Anthony Berkeley

January 2009

Where did they come from and are they really different?

LTE World

Main evolution for 3GPP operators, successor to GSM and UMTS

- Focussed on address broadband needs for users, pure packet system focus
- Driven not as a technology but as a response to business needs, influence of NGMN forum ensuring vendors don't over focus on technology at expense of business objectives

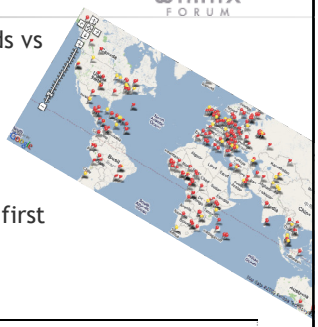
Today: Operators already in trial, RFP/Qs, contract awards already beginning

Major Terminal Vendors	Motorola, Nokia, NEC, LGE, Panasonic, Samsung, Sierra Wireless, Option, Novatel
Major Infrastructure Providers	Alcatel-Lucent, Ericsson, Nokia-Siemens, Huawei
Operators	Asia : Leading operators (Japan, Korea) Europe : All major operator families (Vodafone, T-Mobile, Orange in LSTI) North America: Verizon, New Entrants with AWS spectrum & CDMA operators
Other organizations	3GPP, LSTI (LTE/ SAE Trial initiative), NGMN (Next Generation Mobile Network)

WiMAX World

Already commercially available, driven by IEEE standards vs 3GPP

- Strong demand for fixed and nomadic W-DSL type of services
- Driven by IT companies vs Telco driven LTE
- Large numbers of regional networks deployed, Sprint first to focus on nationwide build out



Major FPGA/ASIC Vendors	Intel, Runcom, Beceem, Sequans, TI, Philips Semiconductor
Major Terminal Vendors	Samsung, Nokia, Motorola, LG, Kyocera…
Major Infrastructure Providers	Alcatel-Lucent, Nortel, NEC, Nokia-Siemens, Huawei, …
Operators	AT&T, BellSouth, BT, KT, Deutsche Telekom, France Telecom, Vodafone, Sprint, Telefonica, TeliaSonera, Orascom, Telecom Malaysia, KDDI…

WiMAX and LTE – What's the Technical difference

	WiMAX	LTE
Downlink	OFDMA	
Uplink	OFDMA	SC-FDMA
Architecture	All-IP	
Spectrum	FDD (802.16m)	FDD and TDD
	TDD	
Spectrum Flexibility	Fixed bandwidth	Flexible bandwidth
Services/Apps	IMS	
Standards	IETF	3GPP

Technically differences are limited, but use cases vary

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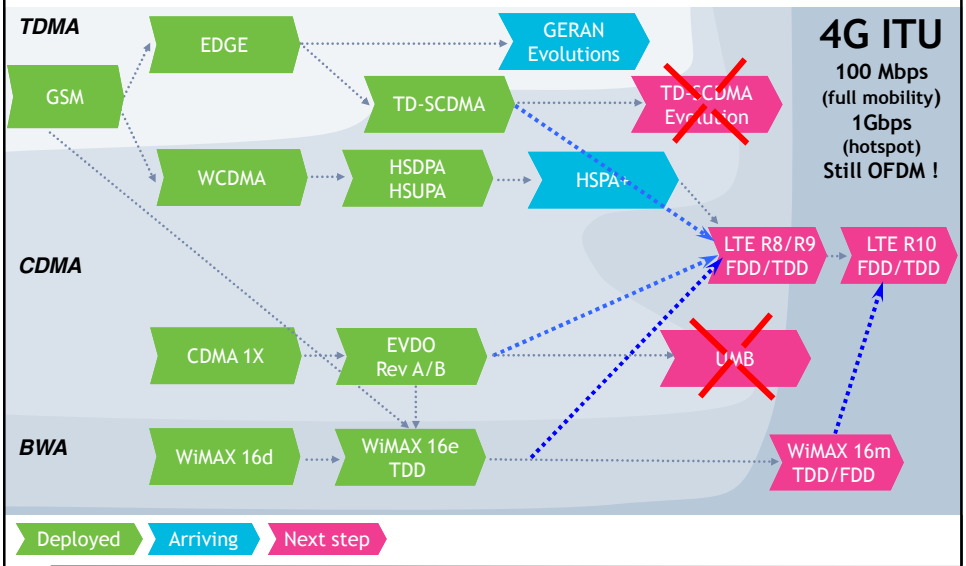
Air Interface evolutions: All technologies have path to LTE



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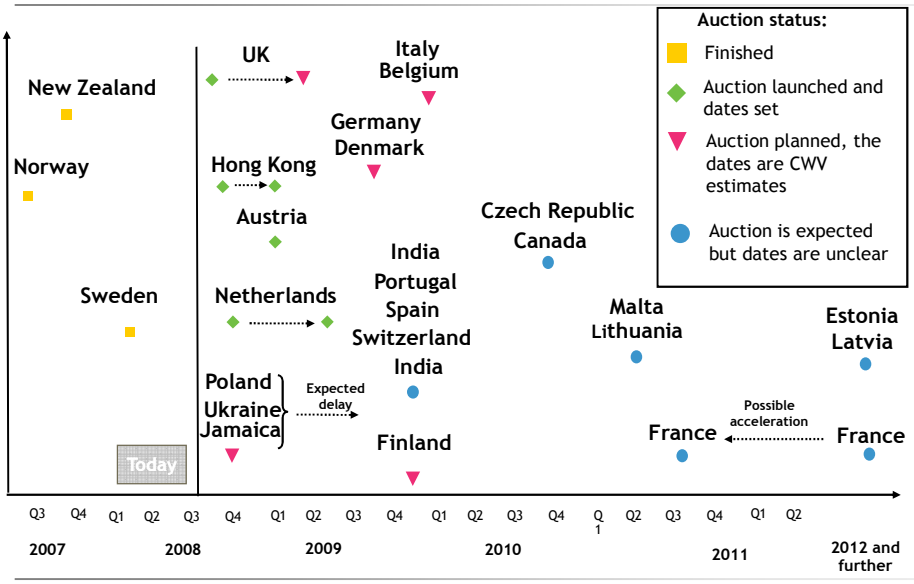
Timeline for 2.6GHz LTE Auctions Worldwide (FDD and TDD)



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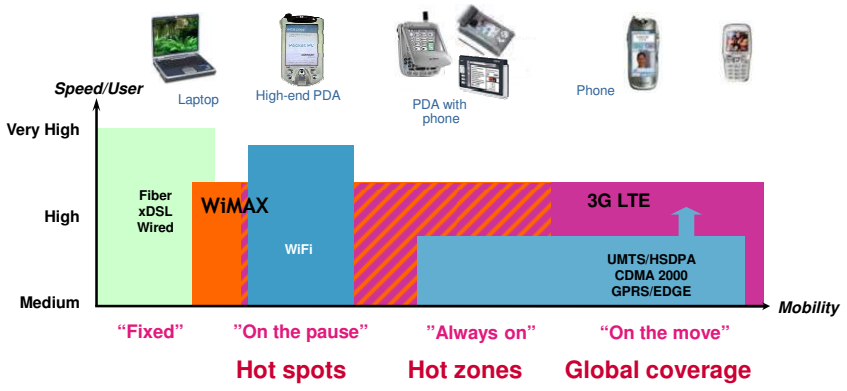
Universal Broadband Wireless Access : Market Requirements



Each technology has a role to play

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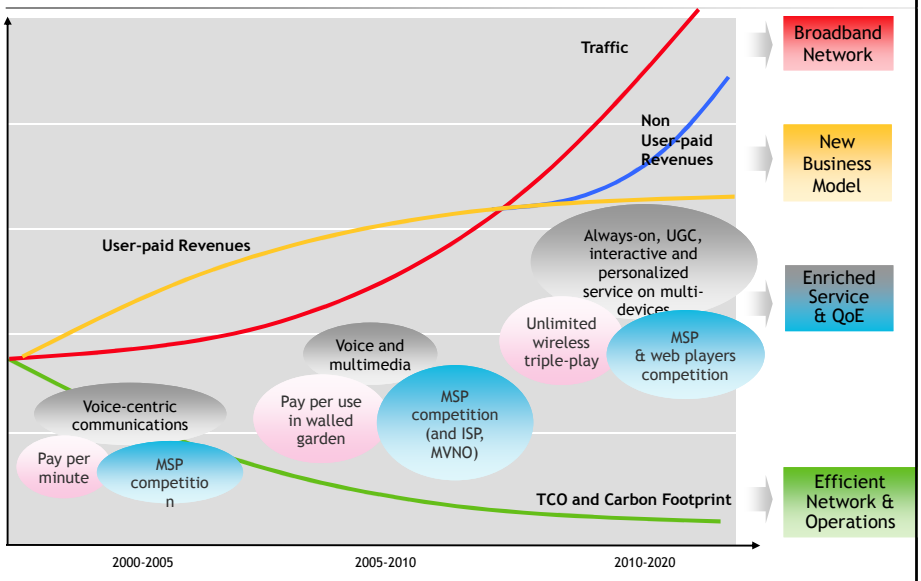
Today's Problem: Next-Gen Wireless Broadband Delivery Requires a New Business Model, Service Offer & Infrastructure



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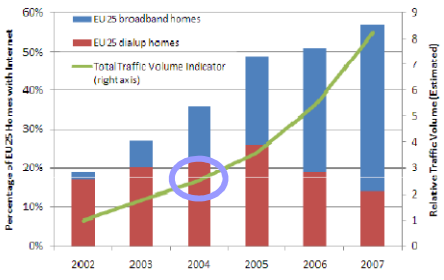
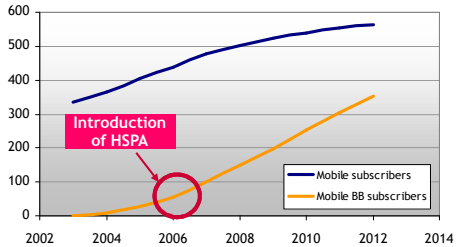
Broadband Access Boosts Usage

Fixed Access



Source: Ventura, Feb. 2008

Mobile Access



Source: Pyramid 2008

- **BB boosts adoption to the Internet**
- **Usage /broadband home:** ~ +20%/year
- **HSPA boosts mobile Broadband subscriptions**

The DSL Fixed success story repeats itself with mobile data

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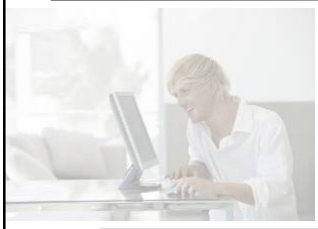
New connected broadband lifestyle



Growing mobile adoption

by 2011 roughly 4 billion people will be carrying mobile phones !

Rise of the millenials

The Millennials generation born and/or raised with Internet (11-25 years old)

Within 5 years, millennials will spread their "early-adopters" life style into their adult lives & enterprises

New applications

Fixed broadband life
Massively adopted now and "exportable" to mobile

flickr, Second Life, World of Warcraft, facebook

Rich ecosystem

My life in my handset
New generation of devices and communicating machines

Connected broadband life style soon becomes mainstream…

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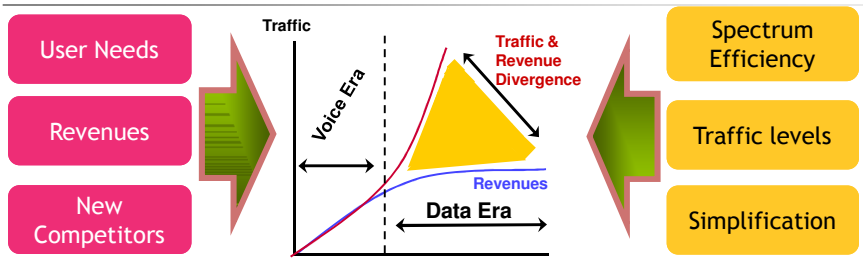
Crazy Ideas that might just make it

- Sat Nav
- Parking Cameras
- Google Maps
- Location Info
- Heads Up Display

Intelligent Windscreen

It's business not just technology



Market & Technology pressures driving the need for LTE deployments

Underlying factor is the need for improved Total Cost of Ownership

Market Key Challenge #1: **Affordability**

How to serve subscribers profitably?

Market Key Challenge #2: **Accessibility**

How to extend broadband into areas profitably?

Market Key Challenge #3: **Versatility/More Broadband**

How to optimize the network for broadband and multimedia?

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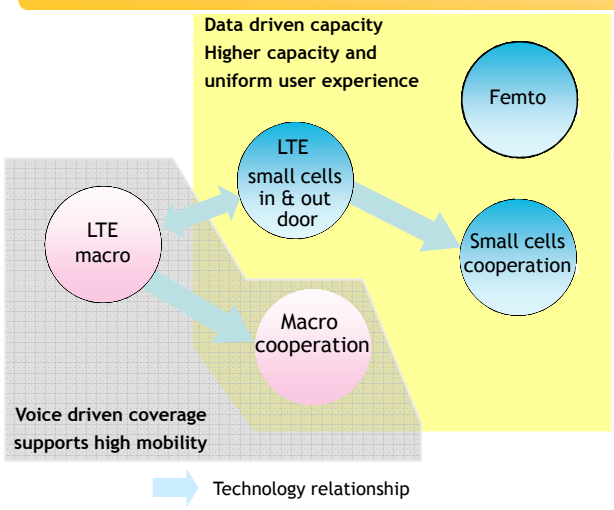
How to optimize the network for broadband and multimedia?

Networks Aren't About Macro Cells Anymore



New generation terminals and data applications require uniform user experience and progressively higher and higher data rates

Implies:

- to limit load & re-use then introduce inter cell cooperation
- to introduce hot spots
- to introduce small cells

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How to extend broadband into areas profitably?

Maximise my Spectrum

Spectrum is a major profitability factor, driving both capex spend and revenue potential

Business challenge is to balance coverage cost / capacity cost with subscriber needs

What is my strategy?

- High Coverage, then – Low frequency band

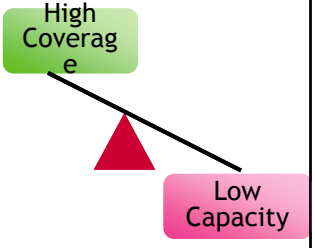
  But limited capacity and lower bandwidth

- High Performance – High frequency band

  Limited area, but high bandwidth

Do I need 20MHz or will 5MHz be enough?

Do I buy new or refarm GSM/UMTS spectrum?



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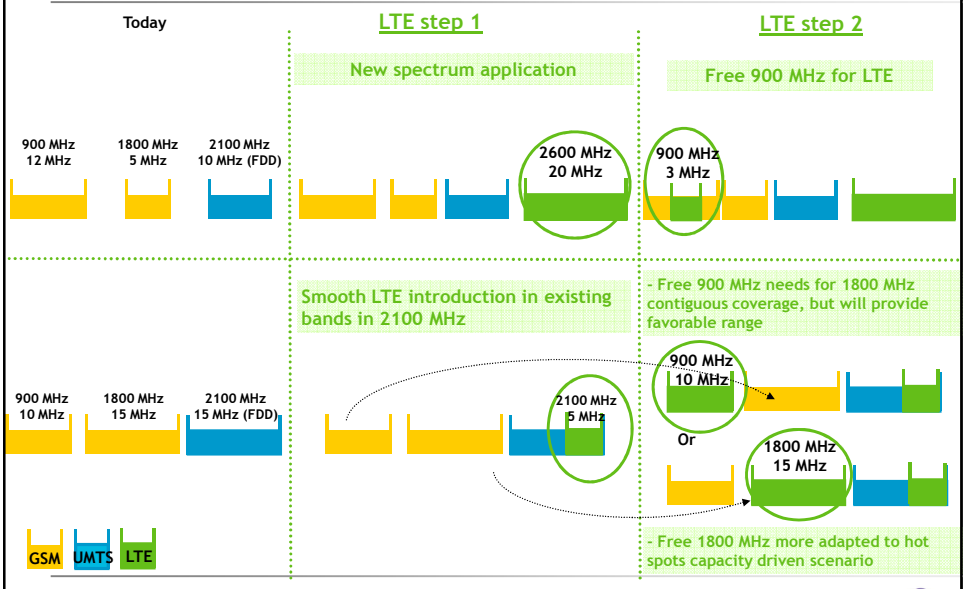
How to extend broadband into areas profitably?



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How to optimize the network for broadband and multimedia?

Dynamic not Static Networks

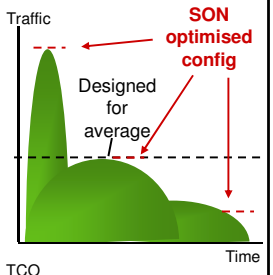
Designing networks for the average or the peak busy hour means wasting resources

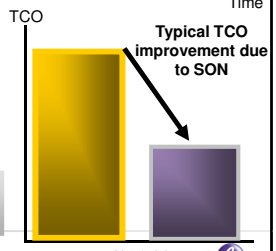
Networks must become dynamic and adapt demands of users and the densification of networks

Self Optimising Networks (SON) will simplify network operations by allowing dynamic configuration significantly improving TCO

SON capability will improve network performance and subsriber satisfaction by adapting to changes in demand & reduce opex (e.g. powering down the BTS during quiet periods)

SON allows "plug-and-play" configuration and optimisation for easy network introduction





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In Conclusion

- Technology is important, but it must serve the business need
- WiMAX or LTE – there is space for both, operator focus and user segmentation will be a key influence
- There is a clear need for mobile broadband, driving the need for network evolution

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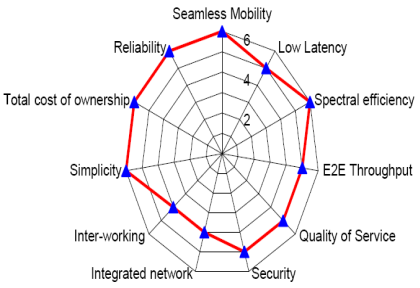
NGMN objective validation

From top requirements to field trials



6 - No Compromise
5 - Strong Requirement
4 - Compromise Possible

Key Performance Tests

- **Peak rates**
- **User throughput**
- **Mobile Performance**
- **Latency**
- **Spectrum efficiency**

NGMN ensures LTE is about business not technology