

Frequency Spectrum

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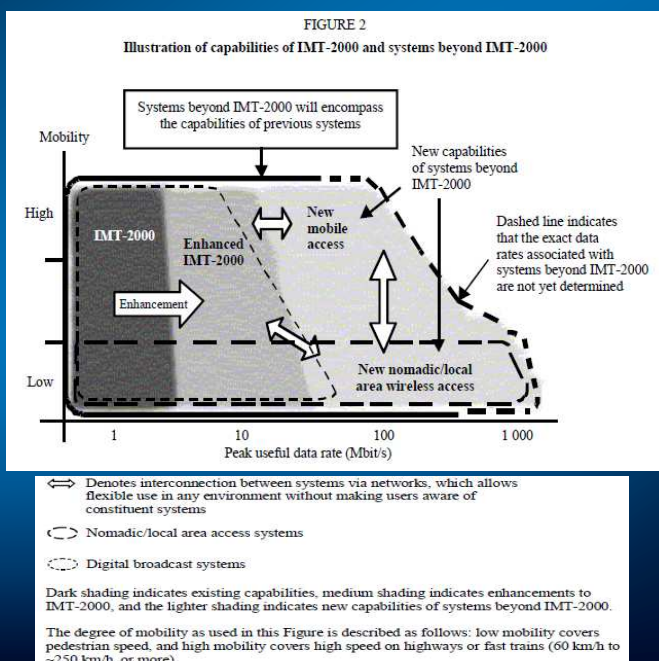
Outline

- Wireless broadband – forecast and implementation
- Capacity and coverage
- Business and investments
- Spectrum availability
- Regulatory framework
- Conclusions

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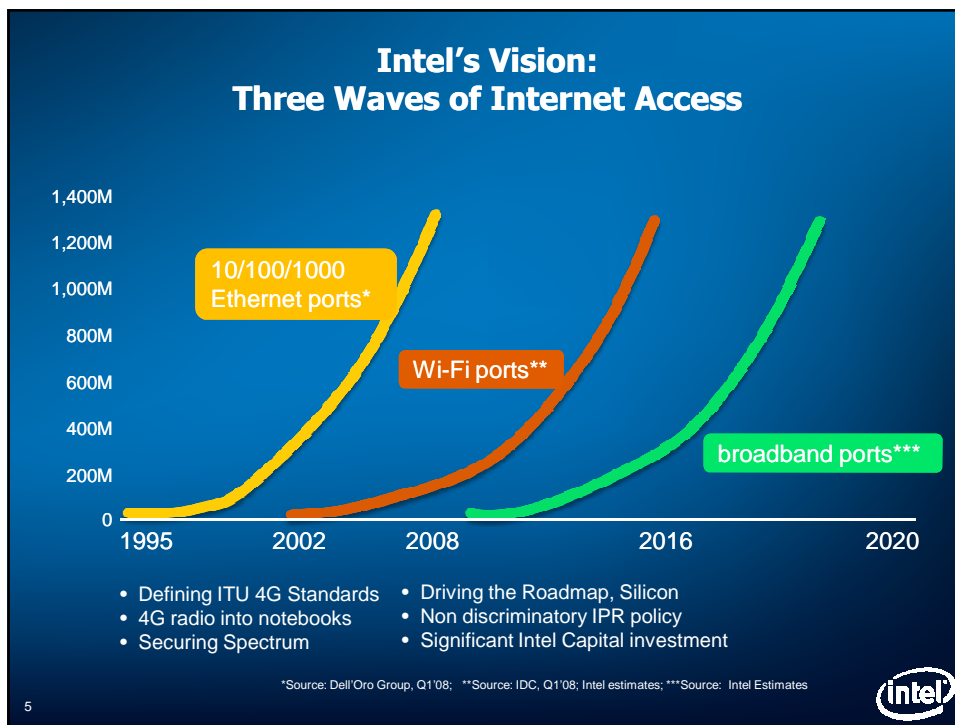


ITU-R wireless forecast in Recommendation M.1645





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Mobile Voice vs. Mobile Internet

Traffic Equivalents*

1 Smartphone = 30 Handsets
1 Laptop = 450 Handsets

~ 10 Kbps Constant Rate


1-5 Mbps Burst Traffic

A network optimized for mobile voice cannot handle high numbers of mobile internet users

*More Spectrum Needed
More Backhaul And Different Network Architecture Required*

Mobile Internet Requires a Technology Revolution

* Source: Cisco Visual Networking Index, July 2008



Ubiquitous connectivity

European Digital Dividend
790-862 MHz result of WRC-07
arranged 2x30 MHz + 12 MHz

2012 ~2 billion computers
wide spectrum channels and
optical fibre are necessary


Missing Implementation of the concept
macro → micro → pico

Digital Dividend + LTE
Example Germany - 12% rural population
average 230 people/km², 58 households/km²
Assumptions:
cell radius = 10km, cell area = 314km²,
58 laptops/km², 18212 laptops/cell, 10% active
1 Mbit/s/laptop, 1 bit/Hz/s,
Required capacity per cell:
 $10\% * 18.212 * 1/1 = 1.821 \text{ Mbit/s}$
of continuous transmit in 30 MHz bandwidth

2.6 GHz
Example Germany - 88% urban population
Berlin: 984km², 3750 people/km², 1000 households/km²
Assumptions:
cell radius = 0,3km, cell area = 0,3km²,
1000 laptops/km², 300 laptops/cell, 10% active
10 Mbit/s/laptop, 2 bit/Hz/s,
Required capacity per cell:
 $10\% * 300 * 10/2 = 150 \text{ Mbit/s}$
of continuous transmit in 20 MHz bandwidth

State of the art HSPA offers ~15 Mbit/s in 5 MHz per cell of 500 m radius

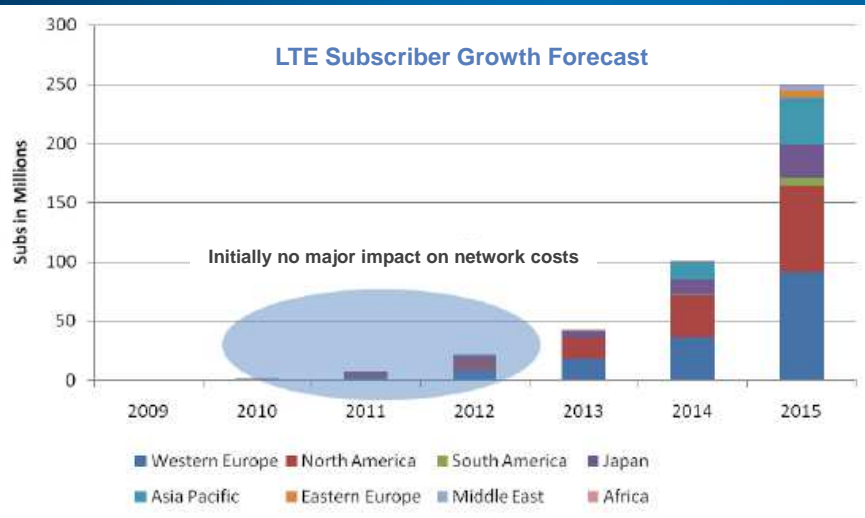
Broadband Wireless Access is not coverage limited
- it is capacity limited




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Wireless broadband towards the Yottabyte Era

LTE Subscriber Growth Forecast



Massive investments into infrastructure are necessary:
faster time table for all IP + optical fibre + 4G radio



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Source: Chetan Sharma Consulting, 2010, http://www.chetansharma.com/Managing_Growth_and_Profits_in_the_Yottabyte_Era_Second_Edition.pdf

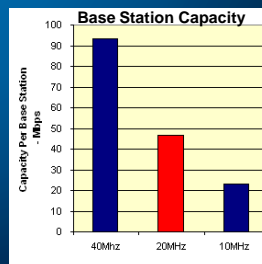
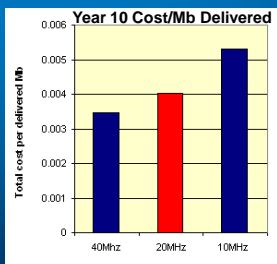
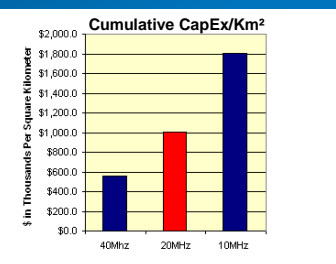
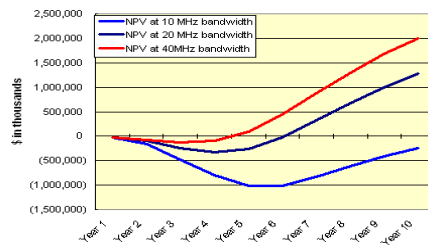
Spectrum Aggregation*

Total Available spectrum impacts the economical viability of a business model - and scalability

- Impacts the viable deployment scenario
- Impacts the business case by effecting all major levers of the business case
- Impacts the Quality of service and range of services offered including ARPU charged

* Analysis based on Standard network deployment in Mexico City

NPV Analysis - Total Bandwidth Analysis



Need sufficient spectrum for Broadband
Spectrum caps subject only to anti-trust review



Examples of broadband spectrum availability 2011 800 MHz and 2.6 GHz

Country	Current Status
Belgium	2.6 GHz auction likely starting ~30th November 2011.
Czech	800, 1800, 2600 MHz common auction expected in 2012
France	2.6 GHz auction in Q4/2011; FDD only, no TDD, 800 MHz early 2012
Germany	360 MHz incl DD & 2.6 GHz auctioned in 2010
Greece	Spectrum to be re-auctioned within the next 18 months 900-1800-1900- (2.6 GHz) since original leases expiring (20 years since 1992-94).
Hungary	2.6 GHz auction 2012 and 800 MHz auction 2013.
Israel	Will not be 2011
Italy	800, 1800, 2000 e 2600 MHz and refarming of 1800 MHz early August 2011??
Latvia	The Latvian Public Utilities Commission (PUC) announced to auction part of the 2.6 GHz band by 30 January 2012, with usage rights starting for the winners on 1 January 2014.
Poland	50 MHz @ 2.6 GHz auctioned in 2010, the rest of the band 2011/2012
Portugal	450, 800, 900, 1800 MHz, 2.1 GHz and 2.6 GHz spectrum auction could take place in Q4/2011??
Spain	6th July 2011 Spanish spectrum auction begun 270 MHz spectrum being released; 58 blocks at 800 MHz, 900 MHz and 2.6 GHz bands.
Switzerland	Auction of 800 MHz, 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz bands planned for Q1'12
UK	800 MHz and 2.6 GHz to be released H1/2012

Administrations do not hurry to release broadband spectrum



transition of 2.6 GHz in USA

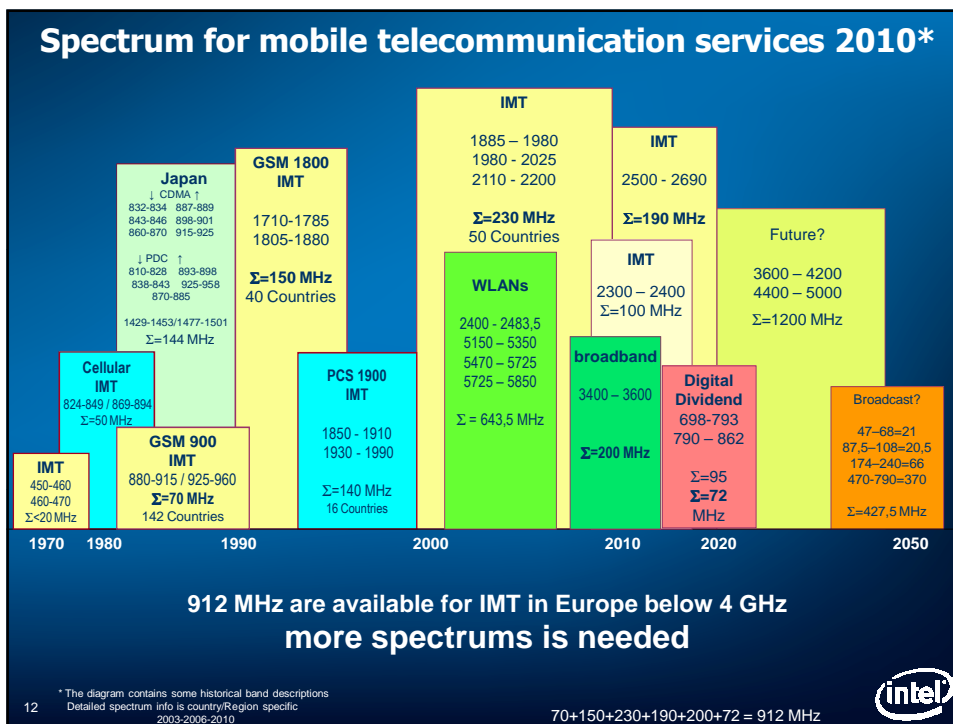
- FCC goals were:
 - Encourage innovation by maximizing flexibility
 - Promote broadband deployments
 - Provide incumbents with reasonable opportunity to continue current uses
 - Enable a quick transition to the new band plan.
- 3 year transition period
- Spectrum leasing (secondary market)
- Technology neutral
- Permitted mobility
- Allows FDD or TDD operation

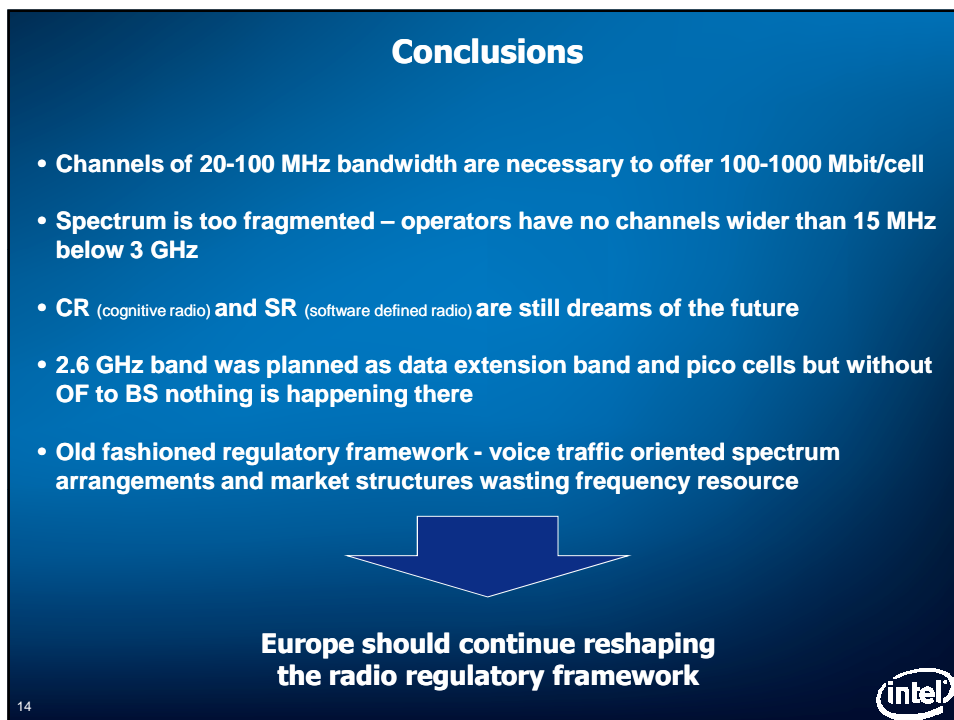
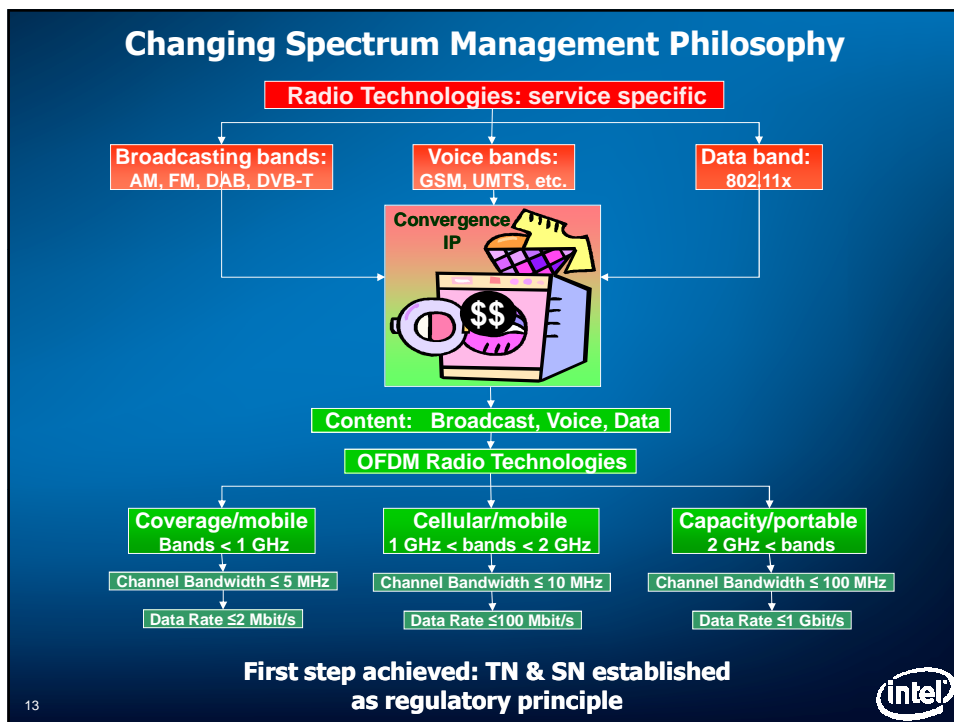
Regulatory flexibility and cooperation between stakeholders were the keys to success

http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-135A1.doc



Spectrum for mobile telecommunication services 2010*





Thank You

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