Current issues and long term perspectives for 3G/UMTS spectrum and technology

Bosco Eduardo Fernandes

UMTS Forum

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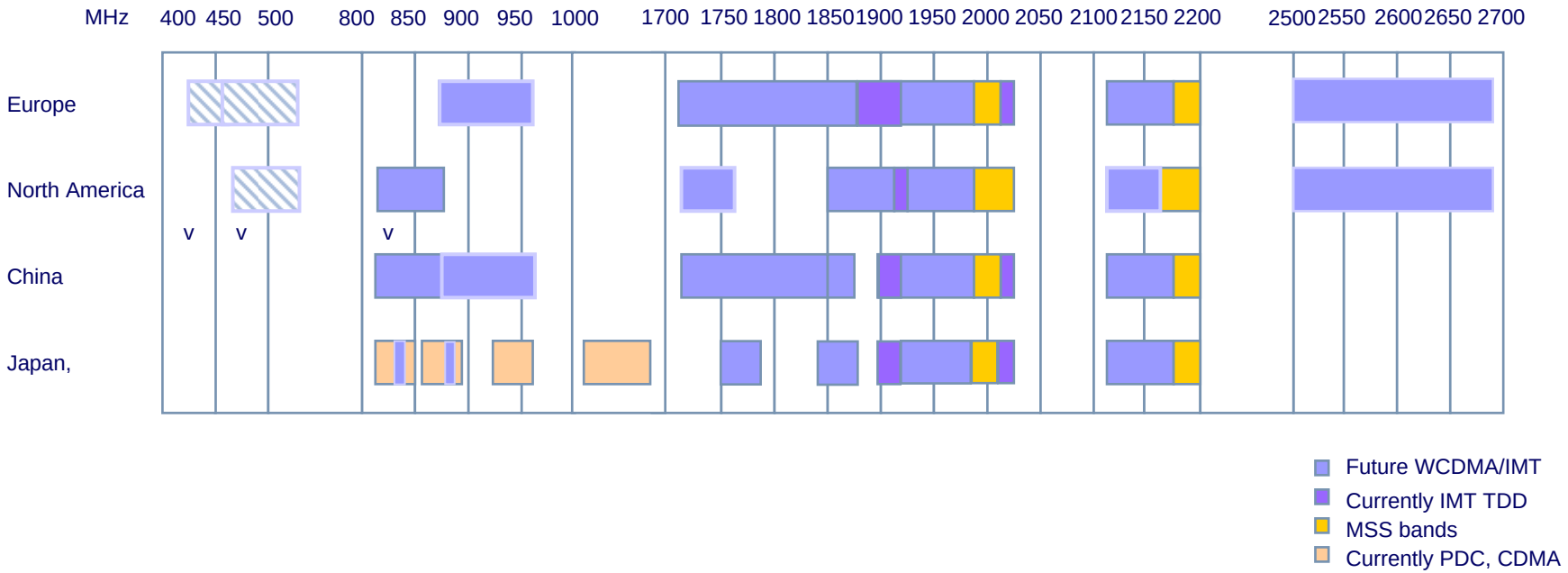
Content

- GSM → UMTS/IMT-2000 (and its enhancements) → IMT-Advanced
- Future demand of spectrum
- Wide area mobile communication vs short range high bit-rate communications
- Benefits of harmonization
- Conclusions

GSM → UMTS/IMT-2000→IMT-Advanced

- GSM networks implemented in 900 MHz and 1800 MHz bands. GSM offers voice services and 'medium data rates' (up to 100 kbit/s) and almost global coverage. The available data rates and spectrum limit the offered services.
- The number of users increases in emerging markets, penetration in developed countries is close to 100%
- UMTS/IMT-2000 and its enhancements increase the available bit rates (up to several Mbit/s) and facilitate new services for the users. In the beginning, coverage demand is satisfied by dual mode GSM/UMTS operation.
- IN the future a new system is needed for the provision of high bit rate, full mobility services, capable of 100 Mbit/s, 100 km/h
  - High bit rate coverage in large areas of low population density needs to be solved, too

Spectrum for UMTS and its evolutions



• It is expected that all GSM and IMT-2000 bands will be available for UMTS and its evolutions in line with the ITU-R RR (Radio regulation) identification.

GSM → UMTS/IMT-2000→IMT-Advanced

More spectrum is needed in the future, because IMT-Advanced services, with predicted data volumes and 100Mbps/1Gbps peak bit rates, cannot be feasibly delivered using today's mobile spectrum bands

- Due to increased traffic (e.g. Forum Report #37 forecasts that the traffic in 2020 will be 23 x the traffic in 2012): Traffic increases ➔ More base stations ➔ limit, how much sites can be added feasibly:

  -In theory site density can be always increased to meet the capacity need

  -However, for continuous coverage, guaranteed quality of service and full mobility with reasonable cost (CAPEX and OPEX), macro and micro cells is an attractive solution

  There is also a deployment issue as towers & antennas cannot be build at all places.

  ➔ Current mobile spectrum do not allow a cost efficient offering of mobile broadband services with reasonable site density

- Due to new technologies: High bit-rates requires new radio technology ➔ needs wider bandwidths (e.g. 100MHz) than available today (5MHz)

  - IMT-2000 and its evolution will not be able to support such high bit-rates (100M/1G)

  - WLAN offers high bit rates, but does not support wide-area coverage and mobility

GSM → UMTS/IMT-2000→IMT-Advanced

- The Forum study[1] shows that about 1 GHz new spectrum is needed around 2020 to fulfil the capacity needs, the study is based on market studies made by the Forum[2] and FMS[3] (Future Mobile Services).
- The Forum Report #38[4] highlights the economic value of the band 470 – 600 MHz in coverage compared to the existing IMT-2000 bands.

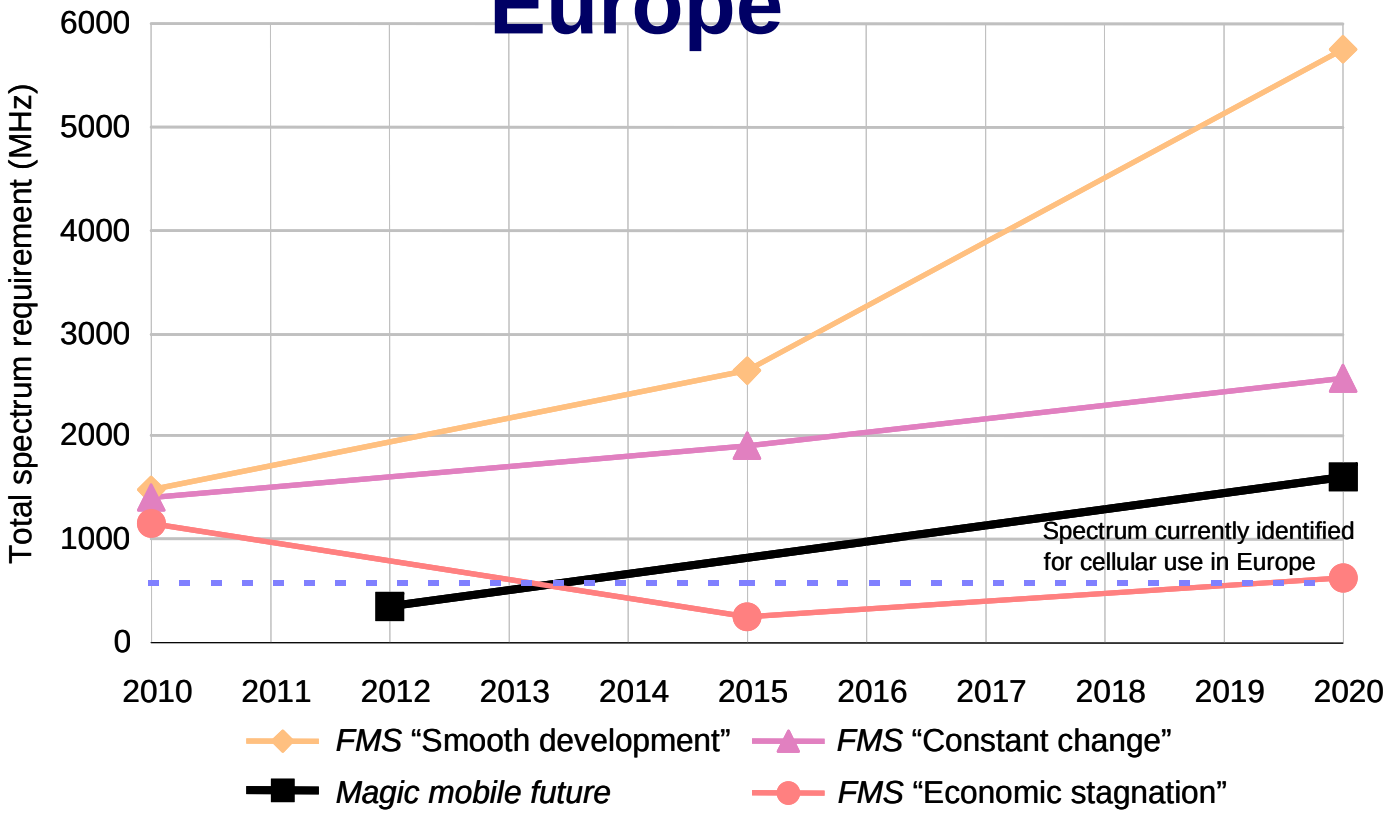
[1]Report prepared on behalf of UMTS Forum by Analysys Consulting Ltd: Development of spectrum requirement forecasts for IMT-2000 and systems beyond IMT-2000 (IMT-Advanced)

[2]UMTS Forum Report#37: Magic Mobile Future

[3]http://fms.jrc.es/FMS FINAL REPORT.pdf

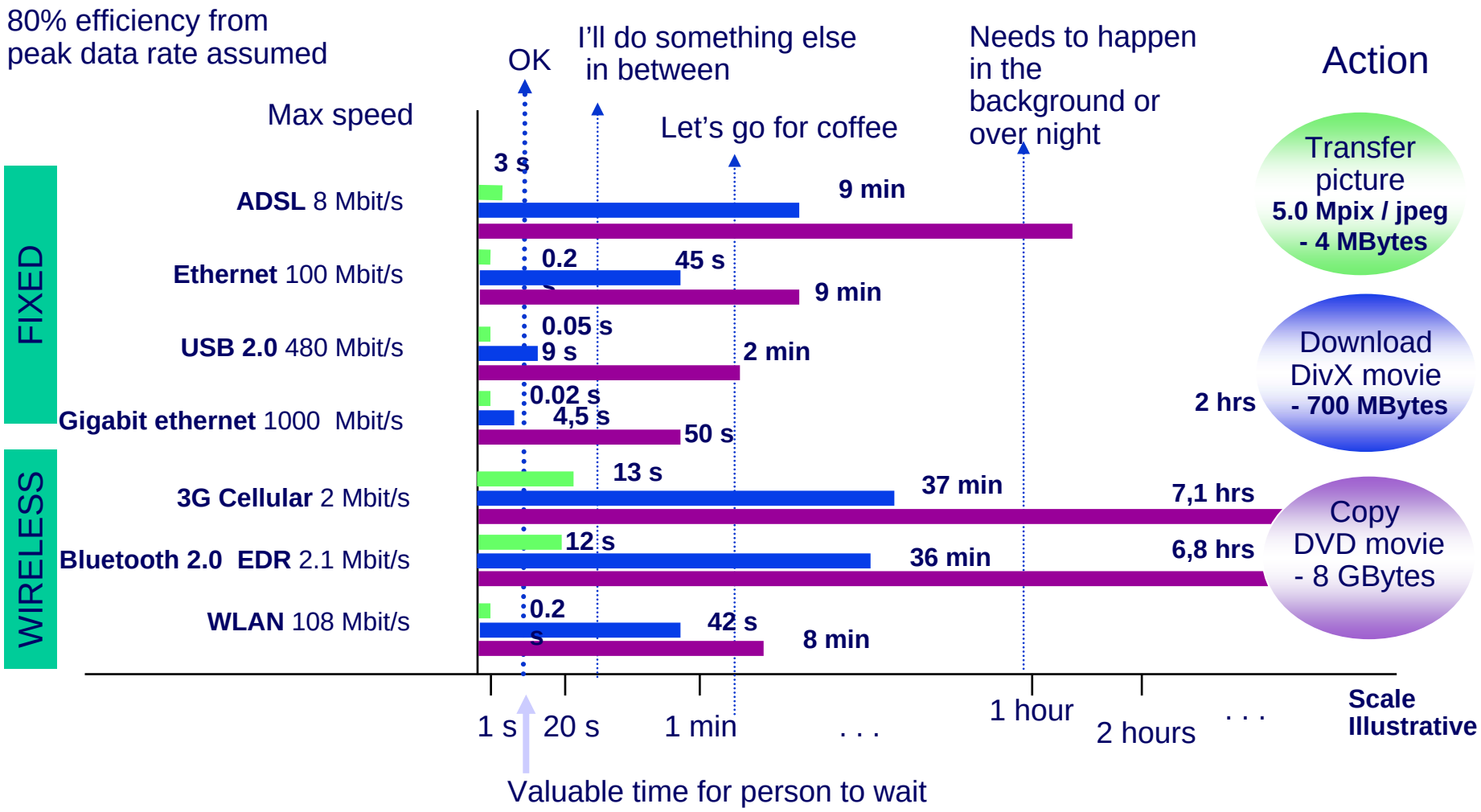
[4]Report #38: Coverage Extension Bands for UMTS/IMT-2000 in the bands between 470-600 MHz

Spectrum requirements calculated using the spectrum forecasts in Europe



The spectrum currently identified for cellular use is 585MHz and includes the 900MHz and 1800MHz GSM bands the 2GHz UMTS band (including the band that is currently used for DECT), and the 2.5GHz expansion band.

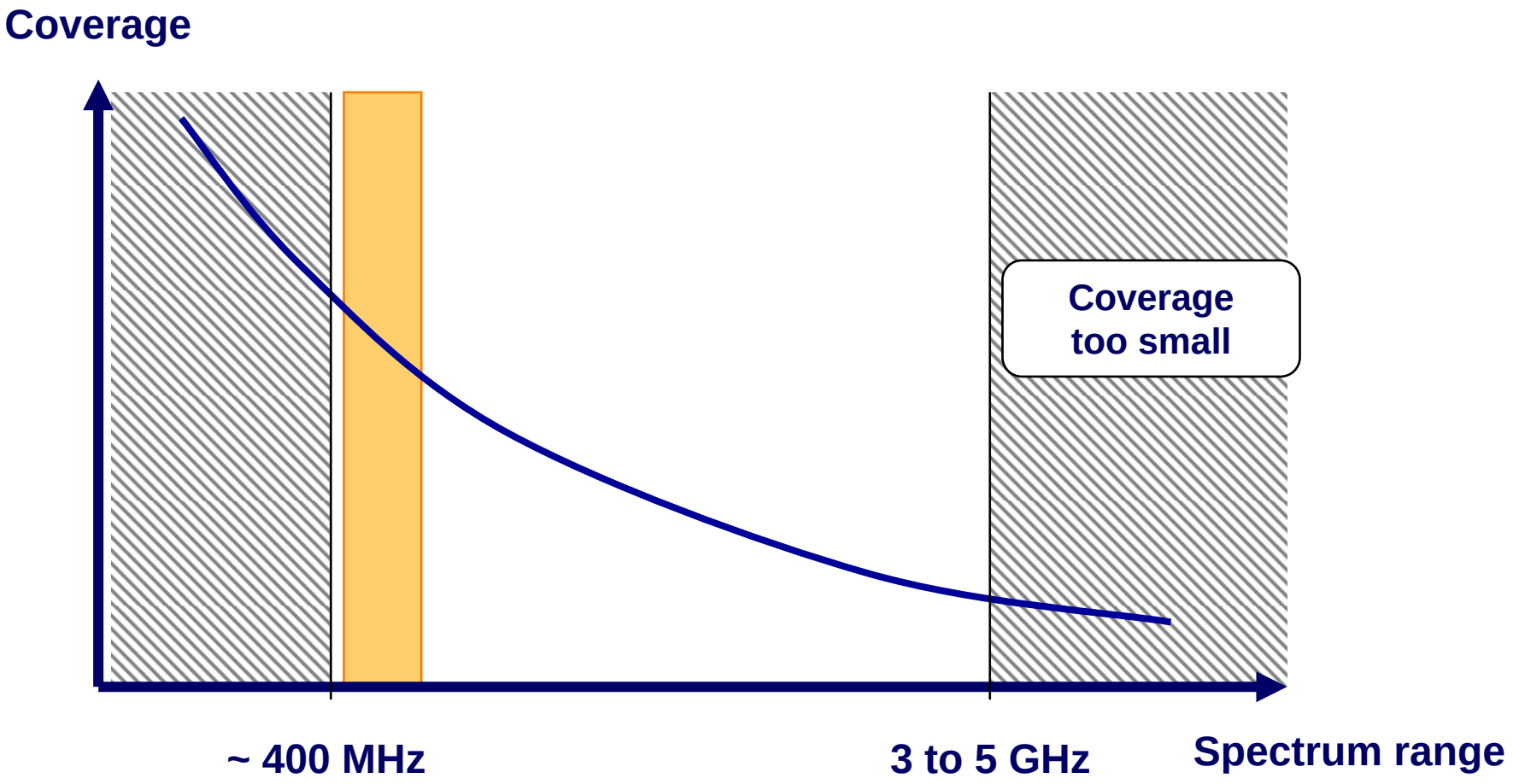
100++ Mbps wireless connectivity is needed for good user experience



Coverage requirements

- UMTS deployment started in most densely populated areas, where it has brought a significant addition to the network capacity.
  - •Provision of UMTS bit rates in large areas of low population density has become a challenge to operators; 2 GHz is a high frequency for coverage building.
  - •Most of the UMTS operators build UMTS networks on the top of their existing GSM networks and have seamless handovers between the networks (handsets are dual-mode), so, the coverage (but not with the required high bit rates) demand has been fulfilled
- Solution for UMTS/IMT-2000 coverage could be UMTS900 (in the near future) and a new frequency band below 1 GHz (longer term)
  - •UMTS Forum Report #38 “coverage extension bands for UMTS/IMT-2000 in the band between 470 – 600 MHz” recommends part of the band 470 – 600 MHz as the best solution for the coverage needs in the future.

Frequency vs coverage for mobile

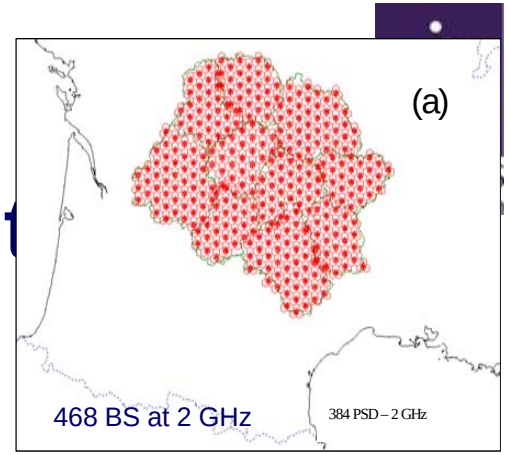


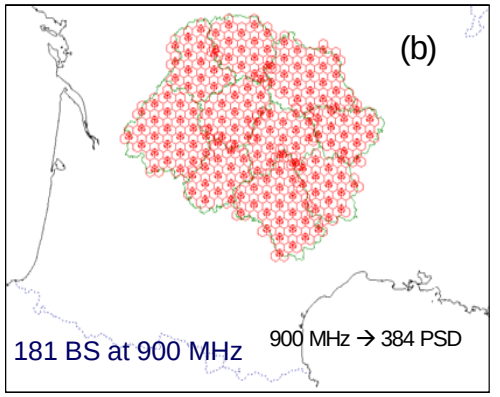
Coverage in 500 MHz: more economic and more efficient

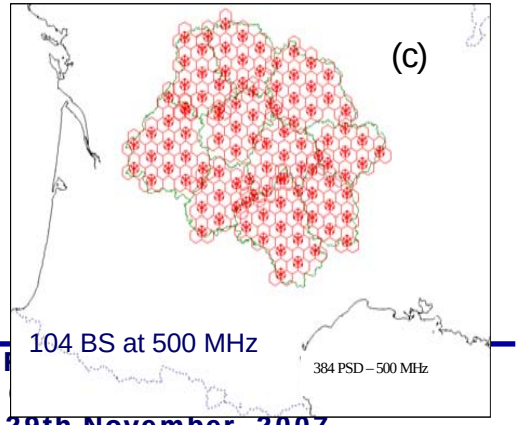
- Detailed studies by UMTS Forum confirm clear advantages for UMTS/IMT-2000 and providing extended propagation range

- Larger cell sizes and lower number of base stations to cover low density populated areas (Forum Report #38))
  - –5 times more Node B at 2GHz compared to 500MHz
  - –3 times more Node B at 2GHz compared to 900MHz

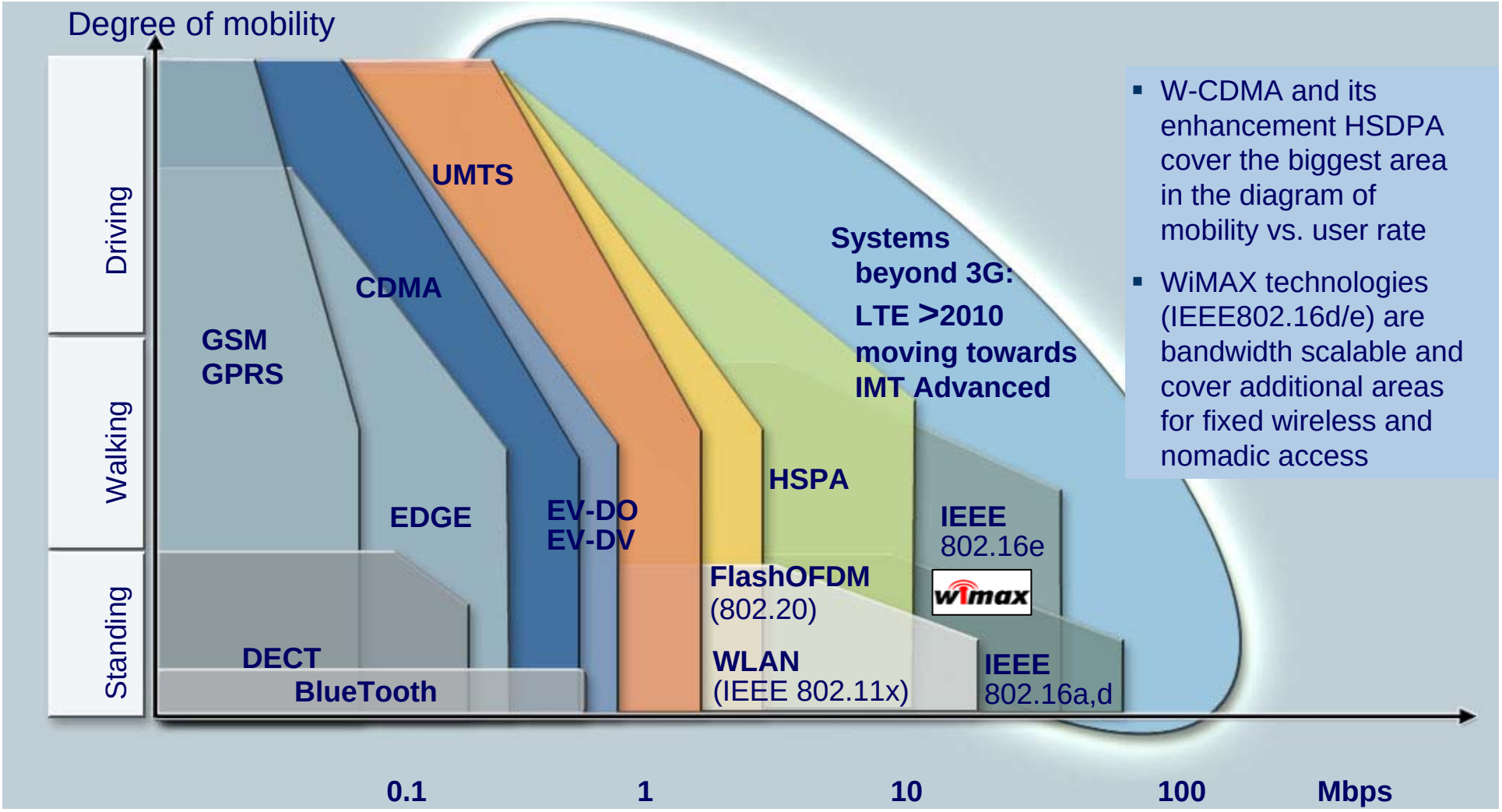
- Cost savings of 80% for BSs at 500 MHz compared to 2GHz
  - –Remarkable cost savings in network investments, since base stations subsystem and transmission costs play a vital role in determining up-front and downstream capital costs as well as ongoing operating costs







Different systems/technologies offer different features but compete about the same frequency bands



- W-CDMA and its enhancement HSDPA cover the biggest area in the diagram of mobility vs. user rate
- WiMAX technologies (IEEE802.16d/e) are bandwidth scalable and cover additional areas for fixed wireless and nomadic access

Wide area vs short range communication

- UWB at 6 – 10 GHz range is a good solution satisfying short range high-bit-rate communications (e.g. 480 Mbit/s @ 3m or 110 Mbit/s @ 10m). Bluetooth and UWB provide same kind of functionality.
- WLAN at 2.4 GHz and 5 GHz provides solutions for high-bit-rate local area networking (e.g. 50 Mbit/s @ tens of meters)
- Below 5 GHz spectrum is most suitable (technical reasons like propagation) for wide area mobile communication and its evolution. Coverage can best be built using frequencies below 1 GHz.

Harmonization vs multimode/multiband equipment

- Harmonization of frequency bands, keeps the number of bands and technologies low and is a benefits the mobile community. Supported multi-band multi-mode combinations should be Market and use-case driven.
- Support of several modes and bands i.e. GSM/UMTS/Bluetooth/WLAN and bands 900MHz/1800MHz/… 2.1GHz/2.4GHz are no issue.
- Additional modes/bands add complexity, testing (time to market), size and price of equipment.
- Similar modes (when capabilities of the modes are the same) are invisible for the end users and do not add value to them
  - The modes should offer different capabilites, e.g. GSM/UMTS for coverage& mobility, WLAN for local high capacity and UWB (or Bluetooth) for short range very high bit rates.

WRC2007 Outcome

- ITU-R estimated a minimum of 700 MHz new spectrum needed to fulfill the spectrum needs for IMT-Advanced.
- ITU-R had chosen a number of candidate bands but none of these were supported by the majority of countries.
- In addition, some of the bands that where supported by regional groups (like CEPT in Europe) were heavily opposed by other Regions.
- The compromise solution is that most of the supported bands identified for IMT leaves it open to each country to decide which band(s) they will take into use.

  This means that IMT identification does not mandate any country to actually make these bands available for IMT.

WRC2007 Conclusion

- *The agenda of WRC-2011 does not give possibility for identification of news bands for IMT. In addition, there will be studies in the UHF bands that might have an impact on the result of WRC-2011. Resolution 228 has been suppressed and replaced by a Recommendation ONLY*
- *Although the estimated spectrum demand was not fulfilled, especially, the identification of 72 MHz from the UHF band was a good outcome.*
- *The* Identification *of 3.4-3.6 GHz band in Regions 1& 3 had a high number of supporting countries, and as such is most likely to become a basis for IMT-Advanced.*

SUMMARY

- The existing frequency bands, GSM and IMT-2000 bands, will satisfy the capacity needs of GSM and UMTS and its evolutions for the next decade.
- About 1 GHz more spectrum will be needed for IMT-Advanced below 5 GHz around 2020

  -The spectrum demand is due to the increasing use of data services: it is expected that all services available via ADSL/fixed networks will be required in mobile environment.
- Coverage will be an issue for mobile networks, as the trend is to designate higher bands from the range of 2 – 5 GHz for mobile networks

  - New bands below 1 GHz should be made available for mobile use also in Europe. 470 – 600 MHz could have the best potential for a global band, if it could be freed from the broadcasting use.
- Harmonization of spectrum and standards remain beneficial for the mobile industry and the end user.

For more information…

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