Under discussion
- November 2014 -

ASSOCIATION OF
PROFESSIONAL WIRELESS
PRODUCTION TECHNOLOGIES
Post Box 68, D-91081 Baiersdorf, Germany
www.apwpt.org info@apwpt.org

Matthias Fehr / Norbert Hilbich / Alan March

What are the real spectrum needs of IMT?

The following is the presentation given by LS telcom on the CEPT CPG Meeting[1] in Marseilles on September 25th in short form with some extensions.

The LS telcom consultancy team is often asked by regulators to calculate the future demand for IMT spectrum for mobile communication. This is a common question in preparation for WRC-15[2]. So far, all the calculations for the IMT spectrum demand are based on the ITU-R model (based on M.1768-1).

Projected and actually used spectrum

During their investigation LS telcom found out that the method of the ITU calculation is comprehensible, but that there will be significant discrepancies if unrealistic data is used in the calculation. Results are coming up which are clearly highly questionable (such like total spectrum needs of 240 MHz in 2020). Several other organizations (TMF Associates/USA, EBU, ESOA) identified similar inconsistencies.

The recent ITU-R Report M.2290 presents forecasts for growth in the total amount (any kind of wireless including WLAN) of mobile traffic in the World to 2020 and then models the spectrum demand for IMT services based on the forecast traffic. The model currently forecasts that IMT spectrum of between 1340 (low market setting) and 1960 MHz (high market setting) will be needed for IMT services by 2020.

The same ITU model forecasted that between 760 and 840 MHz of spectrum would be needed for IMT services by 2010. In reality, less than half that amount was available, and was carrying far more traffic than the model forecasted! As already mentioned above: by using unrealistic input data.

---

[1] The European Conference of Postal and Telecommunications Administrations - CEPT - was established in 1959 by 19 countries. Today 48 countries are members of CEPT.
[2] World radiocommunication conferences (WRC) are held every three to four years. It is the job of WRC to review, and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum.
http://www.itu.int/en/ITU-R/conferences/wrc/2015/Pages/default.aspx
In the year 2012 more than 3000 delegates from 165 ITU member states and more than 100 observer discusses over 4 weeks at Geneva.

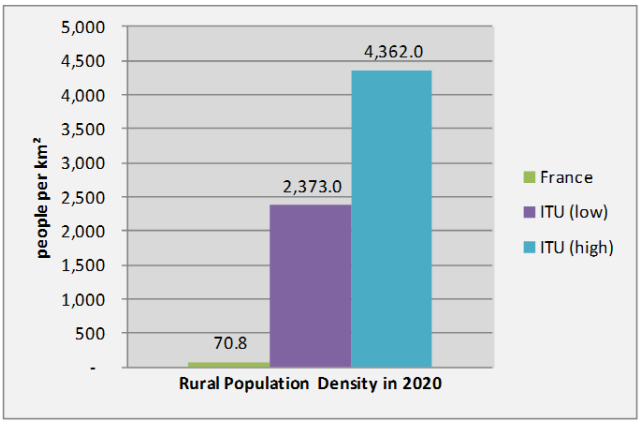
The following table shows the actual available spectrum for mobile operators in the three regions:

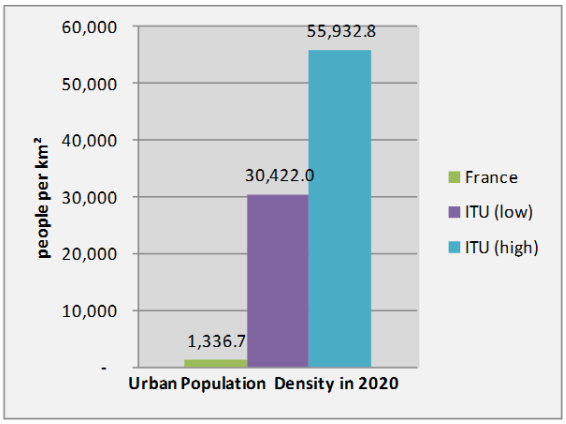
Band	Spectrum	Region 1 (Europe, Middle East, Africa)	Region 2 (The Americas and Caribbean)	Region 3 (Asia and Australasia)
850 MHz (Band 5) 824 – 849 // 869 – 894	50 MHz (2 x 25 MHz)	20 MHz[1]	50 MHz	20 MHz[2]
900 MHz (Band 8) 880 – 915 // 925 – 960 MHz	70 MHz (2 x 35 MHz)	70 MHz	40 MHz[3]	70 MHz
1700 MHz (Band 4) 1710 – 1755 // 2110 – 2155 MHz	90 MHz (2 x 45 MHz)	Not used	90 MHz	Not used
1800 MHz (Band 3) 1710 – 1785 // 1805 – 1880 MHz	150 MHz (2 x 75 MHz)	150 MHz	Some South American Countries	150 MHz
1900 MHz (Band 2) 1850 – 1910 // 1930 – 1990 MHz	120 MHz (2 x 60 MHz)	Rarely used	120 MHz	40 MHz[4]
2100 MHz (Band 1) 1920 – 1980 // 2110 – 2170 MHz	120 MHz (2 x 60 MHz)	120 MHz	Not used	120 MHz
Best Case Assignment		**~360 MHz**	**~360 MHz**	**~400 MHz**

Calculated number of users and data traffic

Why are there these big differences between the forecast and the actual numbers? In the calculation the ITU Urban population density exceeds 220,000 people per sq km in some service categories. According to Wikipedia the world's highest population density is in Monaco with 17.889 inhabitants/km².

The following picture shows the comparison for France in rural and urban population and the corresponding ITU estimation:

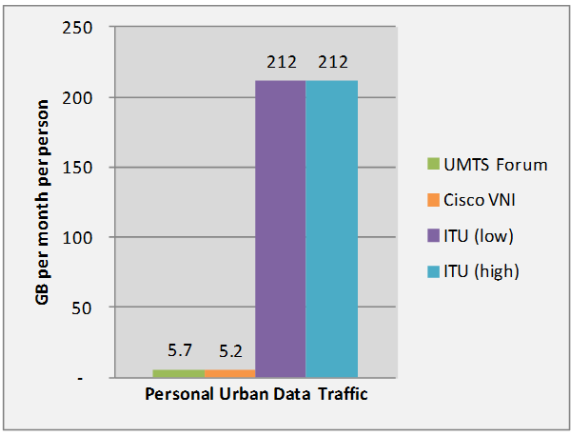




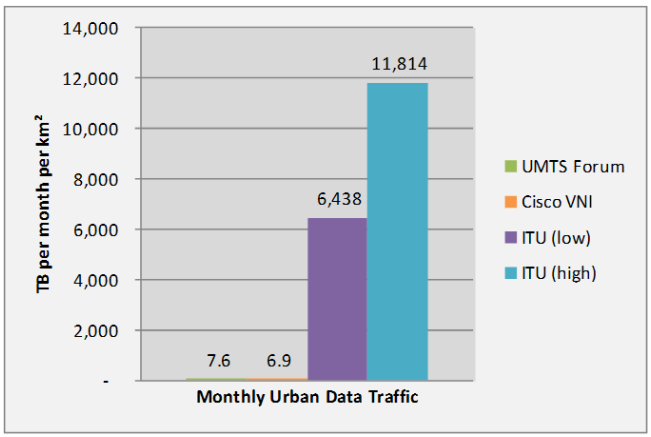
Result: the calculation for rural areas is more than 60 times higher and the one for urban areas about 40 times higher – it does not meet the real world figures.

The following shows realm and the calculated data traffic:

in GB per month and person

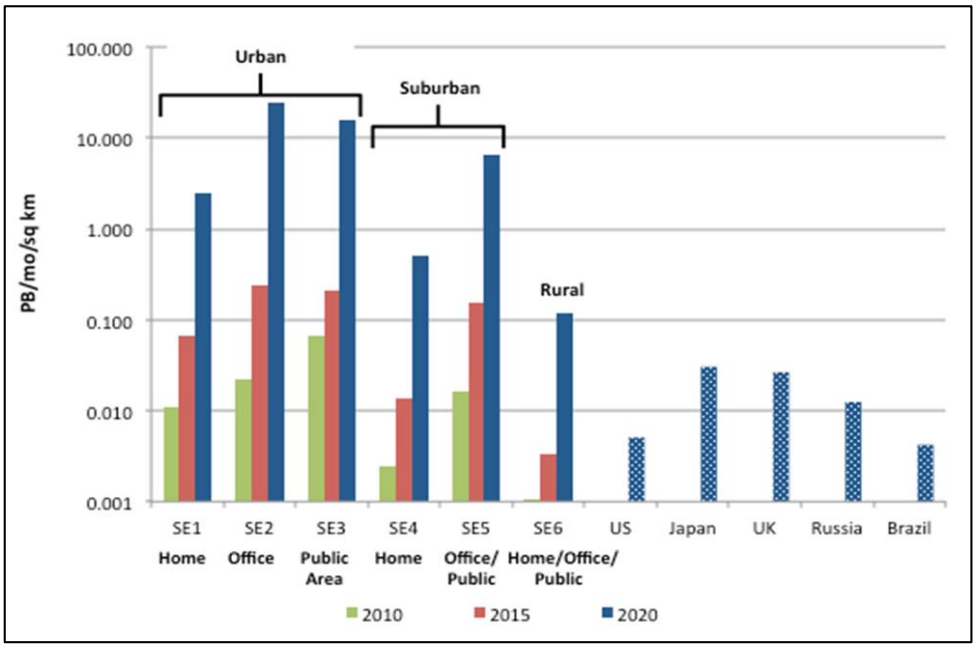


in TB per month and square kilometer



Comparing the Personal Urban Data Traffic per person of the UMTS Forum with that of the ITU shows a difference of factor 37 – picture on the left.

Comparing the monthly Urban Data Traffic per square kilometer of the UMTS Forum with that one of the ITU shows a difference of a factor above 1.500. Result: all of the traffic-related inputs to the model use values that exceed by far any published forecast from any source.



The graph above shows the ITU calculated traffic PByte per month and square kilometer versus international benchmarks taken in the real world. SE1 to SE6 stands for different density of data traffic: SE1 dense urban home usage, SE2 dense urban office, SE3 dense urban public areas, SE4 suburban home, SE5 suburban office and public, SE 6 rural home-office-public. Right to it figures from the real world: US, Japan, UK, Russia, Brazil.

Result: even RURAL traffic values calculated in the ITU model exceed URBAN traffic forecasts for many developed countries.

Other parameters of the ITU calculating model

Other supposed values may also be unrealistic such as spectrum efficiency. The model does not distinguish between different types of spectrum usage. It assumes that mobile traffic is handled in the same spectrum as traffic in an office - in reality they are handled using different solutions and in different bands like WLAN (WiFi) 2400 to 2485 MHz, 5150 to 5350 MHz and 5470 to 5725 MHz[3].

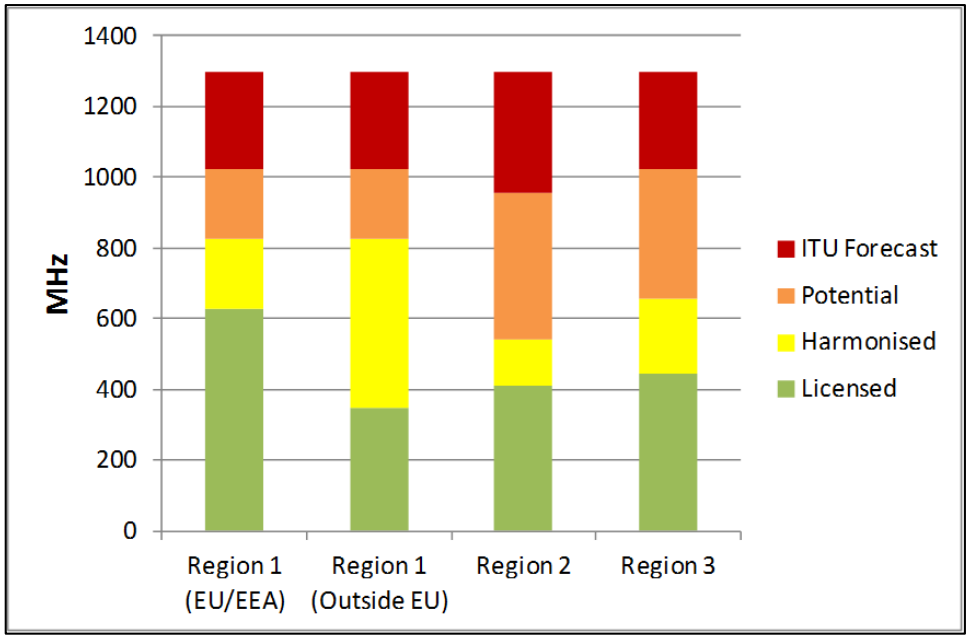
The model also does not differentiate between the demand for spectrum below or above 1 GHz. Example: the LTE ranges vary locally from about 700 to 2.600 MHz and have, depending on the used frequency, very different sizes for their cells.

The model could be improved significantly to produce more valuable results.

The current mobile spectrum use

Not the entire spectrum already identified (harmonized, auctioned) for IMT is yet licensed. The situation is worse if spectrum that could be used for IMT is taken into account (eg. 2300 MHz). Compared to ITU forecasts, less than 50% of forecast spectrum is licensed.

In most regions there is at least 30% of (harmonized) IMT spectrum that is not yet licensed. Of total potential IMT spectrum, typically less than 50% is licensed. It must be monitored if licensed spectrum is also in use.



[3] 1) Worldwide there are different frequency ranges in use:
North America: mainly 700 MHz and 1700/2100 MHz as well as 1900 MHz
South America: 1700 MHz (Band 4), 1800 MHz, 1900 MHz, 2600 MHz
Eastern Europe: 800 MHz, 900 MHz, 1800 MHz, 2300 MHz und 2600 MHz
Asia-Pacific: 850 MHz, 1500 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz
Western Europe, Middle East and Africa: 800 MHz, 900 MHz, 1800 MHz und 2600 MHz
Source: http://de.wikipedia.org/wiki/Long_Term_Evolution

A survey of regulators who were asked to identify:

- which bands are licensed in their country,
- how many licenses have been awarded in each of those bands,
- how many of those licensees have active services in those bands.

These relatively simple questions reveal a significant amount of information on whether licensed spectrum is in use:

Type of IMT Spectrum	Number of licenses awarded	Number of active licenses	Percentage of licenses in-use
FDD	207	180	87%
TDD	85	47	55%
Total	292	227	78%

Result: operators are not yet using the entire spectrum they have been given. Use of TDD spectrum is particularly poor.

APWPT Upshot

The Mobile apparently uses less spectrum, as he needs. According to the ITU the spectrum requirements of mobile phone service is obviously much lower than previously calculated by the ITU.

Spectrum efficiency

The vast majority of operations are using the existing GSM/UMTS technology and have been for about two decades. This technology is written off, but earns money and is inefficient compared to today's standards like LTE[4] or LTE Advanced. Using LTE Advanced instead of UMTS would allow an increase in the data traffic in the given spectrum by a factor of 2.4 without the need for more spectrum. 5G technology, which is expected at 2020, will bring this to a significantly higher level: by a factor of 1.000 compared to today's technology.

Therefore, it could be argued that IMT has its own Digital Dividend here: switching to the available new technology would significantly increase the performance of services within the IMT sectors existing spectrum holdings – if this was the case there would be no need for additional spectrum for the IMT sector.

[4] LTE ist the 3,9G-Standard of 3GPP which does not completely fulfill the 4G definitions of the Telecommunication standardization Sector (ITU-T), but nevertheless for marketing reasons advertised as 4G. Source: http://de.wikipedia.org/wiki/Long_term_Evolution

Results of the investigations:

- the ITU model (with modifications) is a very good basis for IMT spectrum calculations. But the input values currently used need benchmarking, validating and need to be based on real-world values.

- Regulators should not take decisions based on the currently existing ITU model results - as the inputs are unrealistic, so equally are the outputs.

- Spectrum demand should not be based on values representing the most densely populated area(s) in the world as other technical solutions may apply in those areas.

- Any country should be able to apply the model to its own situation and obtain valid results if it is to take a decision based on that model.

- Operators are not yet using the entire spectrum they have been given. Existing licensed spectrum should be used as efficiently as possible by IMT before assigning additional spectrum. „There is therefore clearly a need for regulators to push forward with the licensing of remaining IMT spectrum, and for operators to put all of their licensed spectrum into use before further spectrum is identified for IMT services."

- Switching older GSM/UMTS systems to latest technology would increase the data capacity already minimum by factor 2.4 in certain ranges of the spectrum.

Please see for more details the complete information from LS Telcom:

http://www.lstelcom.com/fileadmin/content/marketing/Press_releases/IMT_Spectrum_Requirements_Final_Report_v107.pdf

http://www.lstelcom.com/fileadmin/content/marketing/Press_releases/Licensing_and_use_of_IMT_Spectrum_version_101.pdf

In addition APWPT suggest to consider this documents:

1) Press Release: PHOENIX CENTER REFUTES CLAIM THAT THERE IS NO "SPECTRUM EXHAUST" http://www.phoenix-center.org/perspectives/Perspective14-06PressReleaseFinal.pdf

2) Have We Got it All Wrong? Forecasting Mobile Data Use and Spectrum Exhaust http://www.phoenix-center.org/perspectives/Perspective14-06Final.pdf

About the APWPT

APWPT is an international non-profit organisation, which is representing the needs of all users of the Programme Making & Special Event ("PMSE") sector.

Members of APWPT include PMSE organisations, users and manufacturers. The APWPT directly and indirectly represents far over 25,000 members of the PMSE community in Europe and beyond. PMSE is crucial on a daily basis for the production of content that has received world-wide acclaim and continues to attract a global audience. A vast array of organisations are reliant on radio spectrum for the production of content for Performing Arts, Broadcasting, News Gathering, Independent Film and TV Production, Corporate Events, Concerts, Night Venues, Sports Events, Churches, etc. In addition, other sectors that utilise the current UHF spectrum include the Health Service, Education, Local Government, Political Programming and Conferencing.

For more information about the goals and achievements of the APWPT please visit our website at www.apwpt.org or contact us at

Association of Professional Wireless Production Technologies e. V.
Post Box 68
D-91081 Baiersdorf / Germany
Tel.: +49 (0) 9191 97 90 554
Fax: +49 (0) 9191 97 90 553
E-Mail: info@apwpt.org