

Estimated Future Spectrum Needs for IMT

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- WRC-15 Agenda item 1:1:
 - To consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution 233 (WRC-12)



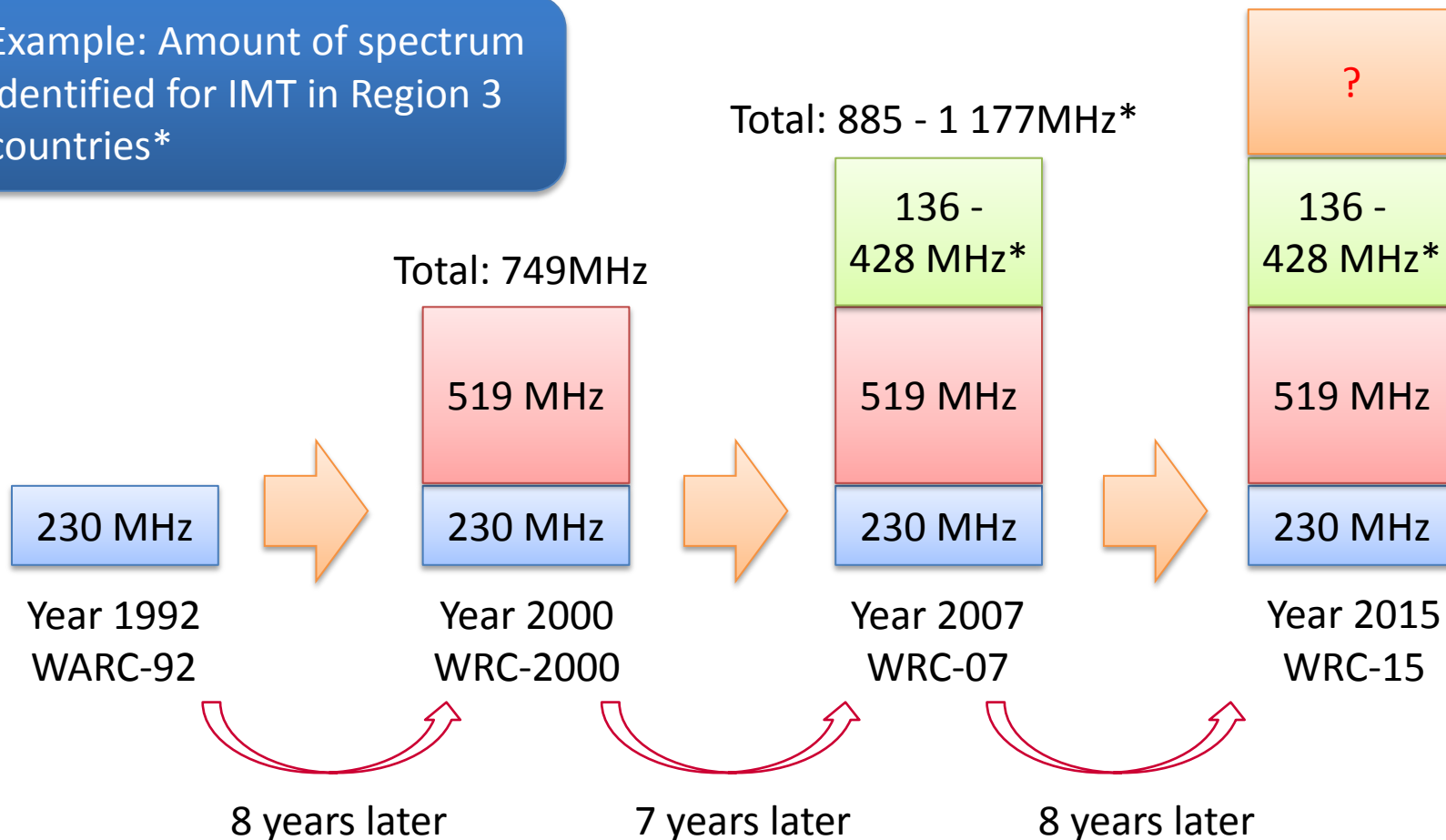
Resolution 233 (WRC-12) is calling for studies on future spectrum requirements and potential candidate bands for IMT and other terrestrial mobile broadband applications

resolves to invite ITU R

- 1 **to study additional spectrum requirements**, taking into account:
 - technical and operational characteristics of IMT systems, including the evolution of IMT through advances in technology and spectrally-efficient techniques, and their deployment;
 - the bands currently identified for IMT, the technical conditions of their use, and the possibility of optimizing the use of these bands with a view to increasing spectrum efficiency;
 - the evolving needs, including user demand for IMT and other terrestrial mobile broadband applications;
 - the needs of developing countries;
 - the time-frame in which spectrum would be needed;
- 2 to study potential candidate frequency bands, taking into account the results of the studies under resolves to invite ITU R 1, protection of existing services and the need for harmonization;

- Previous WARC/WRCs identified spectrum for IMT

Example: Amount of spectrum identified for IMT in Region 3 countries*



* Amount of spectrum identified for IMT has some countries deviations in accordance with the different footnotes in ITU Radio Regulations

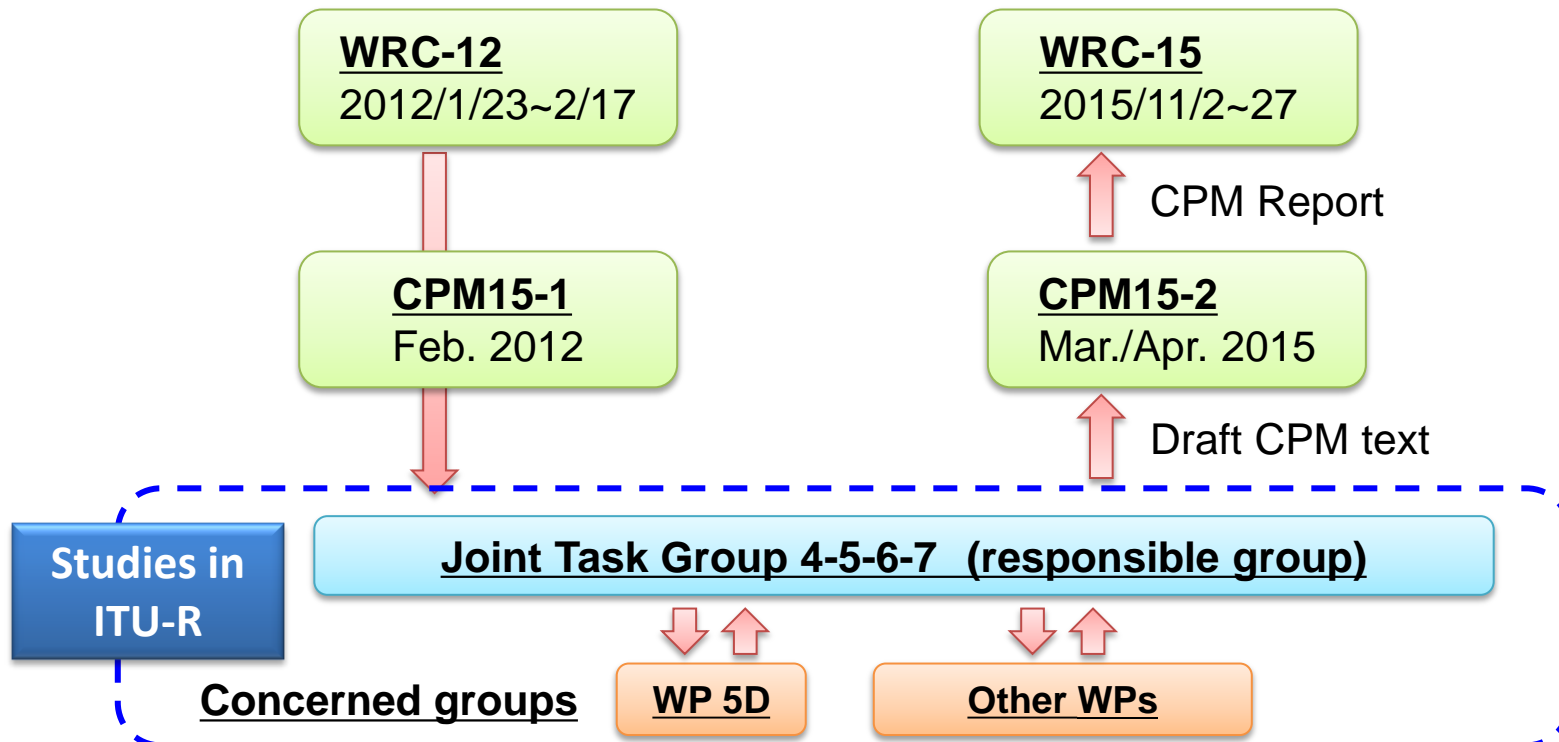
IMT spectrum in ITU Radio Regulations (2)

Amount of spectrum identified for IMT in ITU Radio Regulations

Band (MHz)	Footnotes identifying the band for IMT	Region 1	Region 2	Region 3
450-470	5.286AA	20 MHz	20 MHz	20 MHz
694/698-960	5.313A, 5.317A, 5.312A*	170 MHz + 96 MHz*	236 MHz	170 MHz + 92 MHz (for 10 countries)
1 710-2 025	5.384A, 5.388	315 MHz	315 MHz	315 MHz
2 110-2 200	5.388	90 MHz	90 MHz	90 MHz
2 300-2 400	5.384A	100 MHz	100 MHz	100 MHz
2 500-2 690	5.384A	190 MHz	190 MHz	190 MHz
3 400-3 600	5.430A, 5.432A, 5.432B, 5.433A	200 MHz (for 81 countries)	–	200 MHz (for 9 to 10 countries)
	Total	981 / 1 181MHz	951 MHz	885 / 1 177 MHz

* Based on the assumption that the lower edge of the frequency band identified in RR No 5.312A remains at 694 MHz.

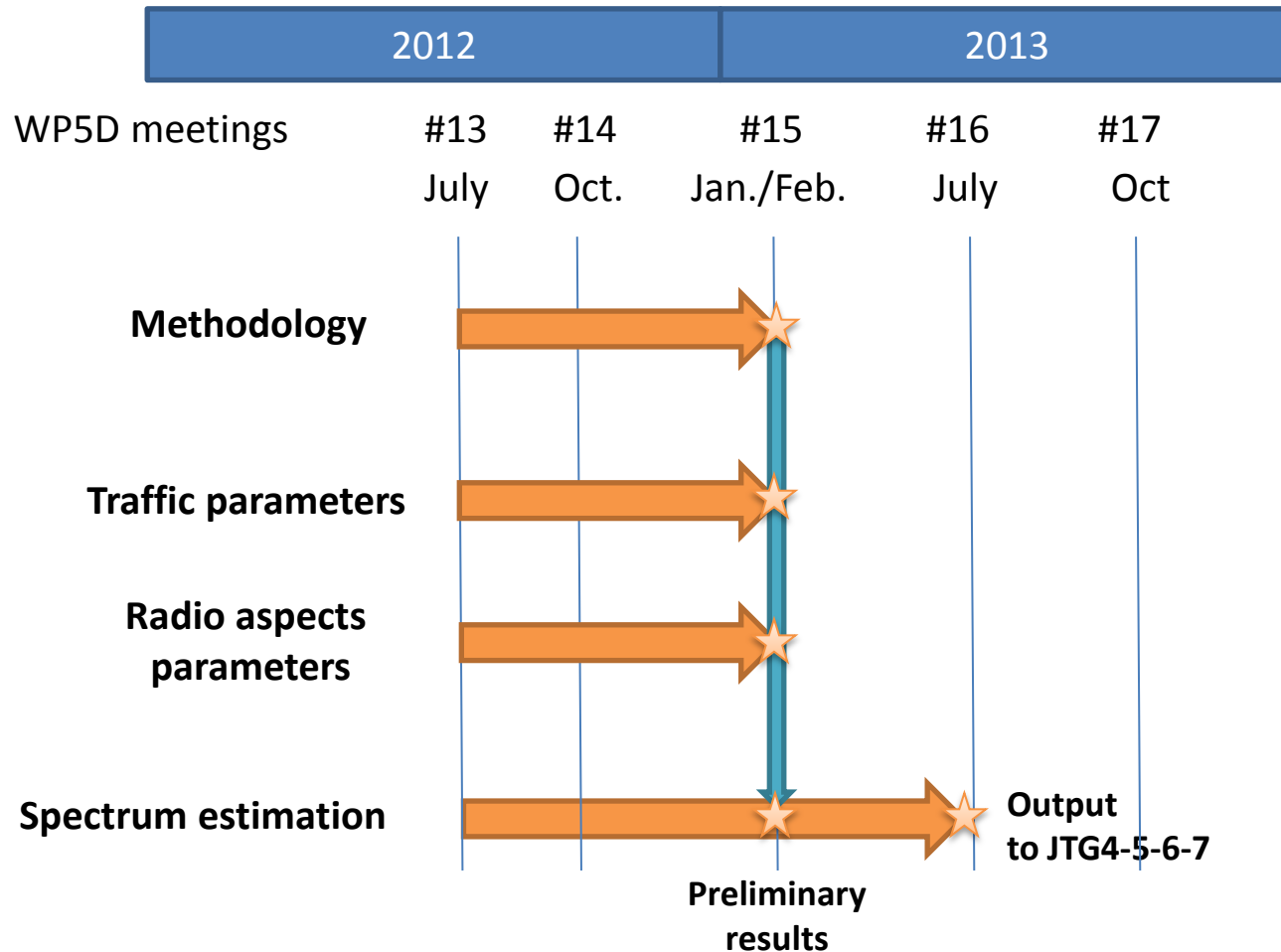
- In ITU-R, Joint Task Group 4-5-6-7 (JTG) is a responsible group to conduct preparatory studies for WRC-15 agenda item 1.1
- To assist the studies of the JTG, Working Party 5D (WP 5D) was tasked to provide the JTG with results of studies on future spectrum requirements for IMT



- From the 13th meeting of WP 5D in July, 2012, WP 5D initiated studies on future spectrum requirements for IMT
- The following ITU-R deliverables, in particular, were reference documents that were reviewed in the studies
 - [Recommendation ITU-R M.1768 \(March 2006\)](#)
 - Methodology for calculation of spectrum requirements for the future development of the terrestrial component of IMT-2000 and systems beyond IMT-2000
 - [Report ITU-R M.2078 \(2006\)](#)
 - Estimated spectrum bandwidth requirements for the future development of IMT-2000 and IMT-Advanced
 - [Report ITU-R M.2243 \(November 2011\)](#)
 - Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications

Work plan in WP 5D

- Considering the deadline for the studies requested by the JTG, WP 5D conducted the studies

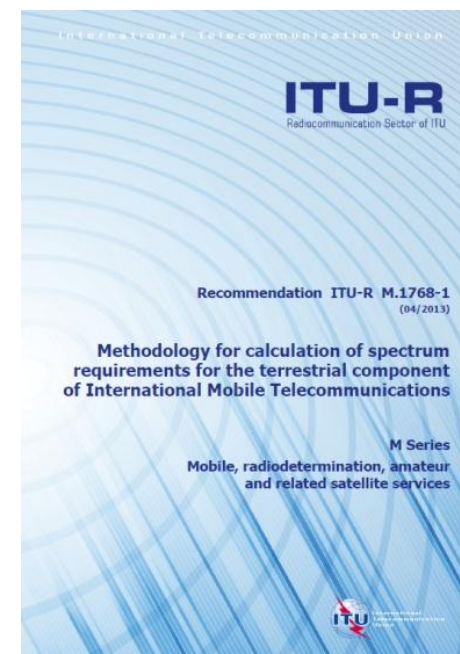


- In order to reflect the advances in technologies and the deployments of IMT networks, Recommendation ITU-R M.1768 was updated



- [Recommendation ITU-R M.1768-1 \(April 2013\)](#)

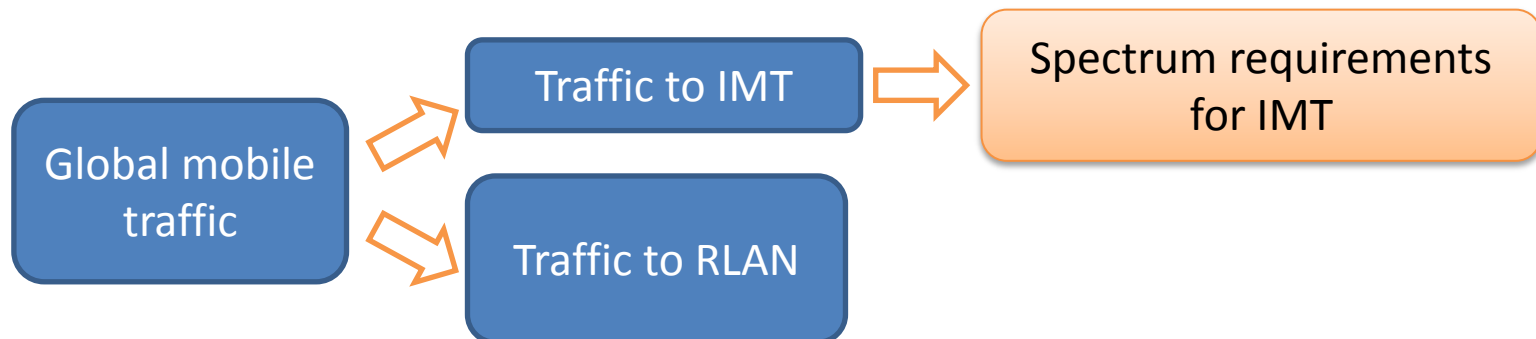
- “Methodology for calculation of spectrum requirements for the terrestrial component of International Mobile Telecommunications”



- To avoid overestimating the IMT spectrum requirements, the following two aspects are taken into account in the revised Recommendation:
 - Spectrum sharing between the macro and micro cell layers in IMT Advanced networks
 - A new parameter “Granularity of deployment per operator per radio environment” is defined

Traffic off-loading considerations (1)

- Two offloading approaches are taken into account in Recommendation ITU-R M.1768-1
 - From IMT networks to RLAN
 - Within IMT networks from larger cells to smaller cells
- The methodology takes into account the global mobile telecommunications traffic carried by different mobile systems such as IMT and RLAN, nevertheless the spectrum requirements are calculated only for IMT



Traffic off-loading considerations (2)

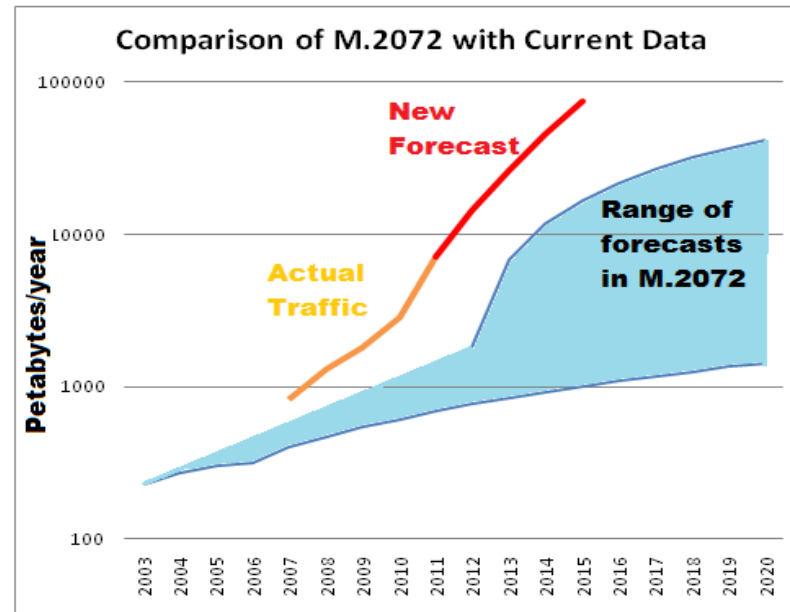
- Traffic offloading algorithm from IMT networks to RLAN is defined in Section 3.6 of Rec. M.1768-1

Distribution ratios among available RAT groups employed for the spectrum estimates

Available RAT groups	Distribution ratio (%)		
	RATG 1	RATG 2	RATG 3
1	100	–	–
2		100	
3	–	–	100
1, 2	10	90	-
1, 3	10	–	90
2,3	-	50	50
1,2,3	10	50	40
	Pre-IMT, IMT-2000 and its enhancement	IMT-Advanced	RLAN

Traffic parameters for spectrum estimates (1)

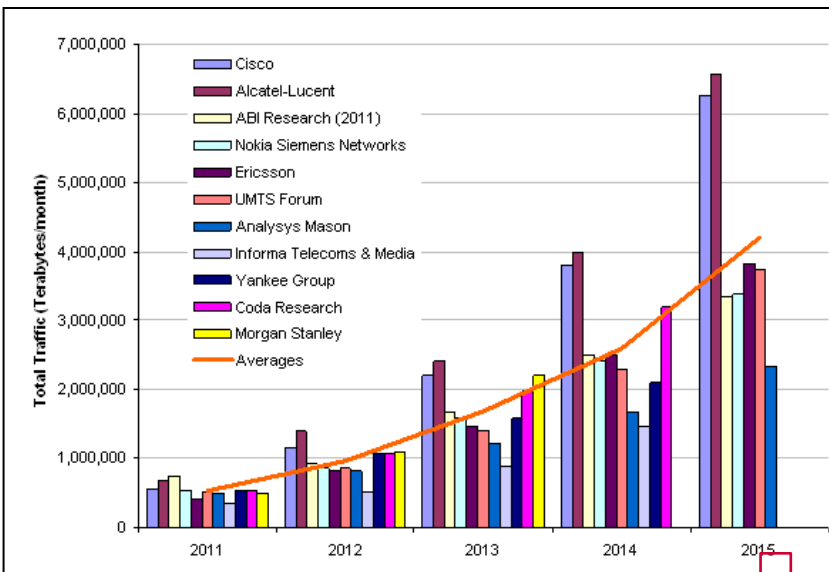
- [Report ITU-R M.2243](#)
 - Recent mobile telecommunication market developments indicate that the great majority of the market forecasts prior to WRC-07 had underestimated the actual market developments



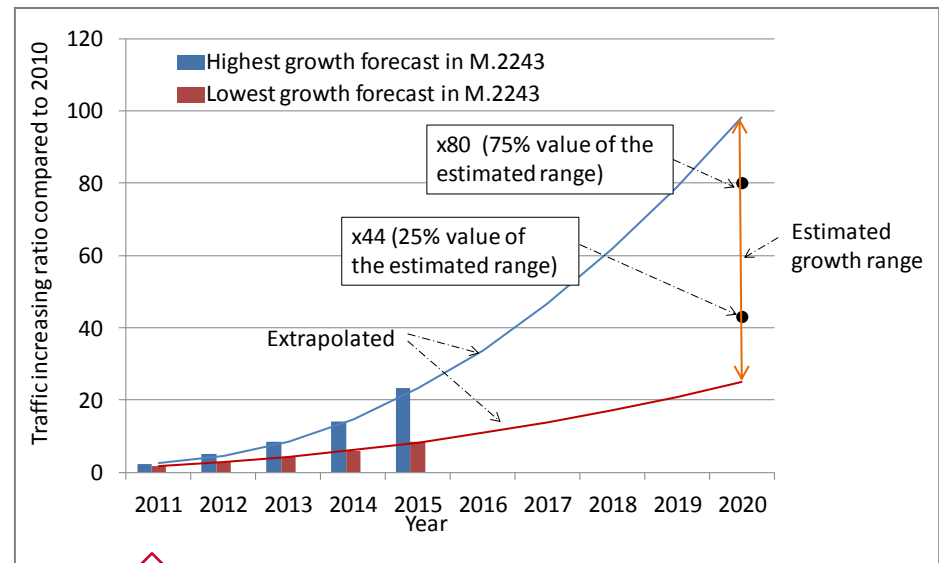
- The updated market-related parameters that were adopted characterize a larger amount of mobile traffic than those used in Report ITU-R M.2078

Traffic parameters for spectrum estimates (2)

- Traffic growth ratios towards 2020 were obtained through extrapolating the traffic forecasts for the years 2011-2015 based on the studies by different organizations in Report ITU-R M.2243
- The 25% and the 75% values of the estimated growth range are selected to define input traffic parameters



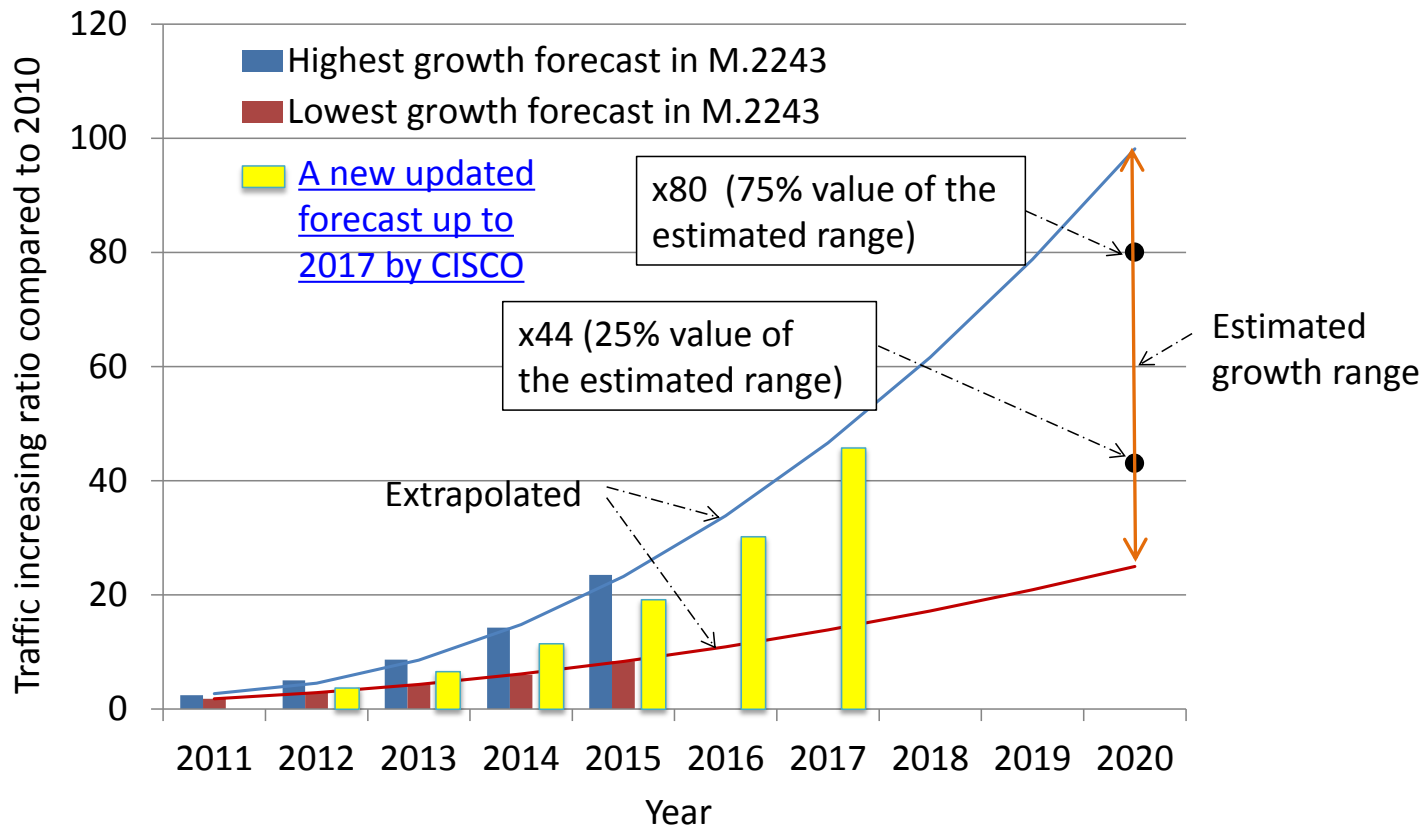
Traffic forecasts in M.2243



Extended towards 2020

Validity of ITU-R's extrapolation

- A new updated forecast by CISCO up to 2017 falls in between these two curves in Report ITU-R M.2290



Results: Total spectrum requirements based on global traffic

- There are differences in the markets and deployments and timings of the mobile data growth in different countries
- Therefore, two settings are developed to characterize lower and higher user density settings

	Traffic growth ratio in 2020 compared to 2010	Total spectrum requirements for IMT in 2020
Lower user density settings	44-fold	1 340 MHz
Higher user density settings	80-fold	1 960 MHz

- The above results were derived in 2012 based on the available forecasts at that point

Additional spectrum requirements

- Calculation of additional spectrum requirements:
 - The amount of spectrum already identified for IMT in the Radio Regulations is subtracted from the total spectrum requirements

User density settings	Total spectrum requirements (MHz)	Region 1		Region 2		Region 3	
		Already identified (MHz)*	Additional spectrum requirements (MHz)*	Already identified (MHz)	Additional spectrum requirements (MHz)	Already identified (MHz)*	Additional spectrum requirements (MHz)*
Low	1 340	981-1 181	159-359	951	389	885-1 177	163-455
High	1 960	981-1 181	779-979	951	1 009	885-1 177	783-1 075

Note *: The values in these columns have ranges since some of the frequency bands are identified for IMT only in some countries in Regions 1 and 3 as per RR Nos. **5.317A**, **5.430A**, **5.432A**, **5.432B**, and **5.433A**.

Note **: The values for Region 1 are based on the assumption that the lower edge of the frequency band identified in RR No **5.312A** remains at 694 MHz.

Importance of employing high user density settings in spectrum estimation

- Many countries are now experiencing huge demand of mobile data, primarily due to video consumption via mobile networks
 - Speed of changing from low user density to high user density will be rapid due to urbanization and user behavior
- Spectrum estimation using high user density settings in 2020 should be adopted to achieve the following:
 - Larger amount of globally harmonized spectrum
 - Mobile broadband in the situation of concentration of population in large cities
 - Machine-to-machine communication and Internet of Things

- The results of ITU-R studies indicate that the estimated total spectrum requirement for IMT has a range of 1 340-1 960 MHz for year 2020
 - The results of studies are now approved as Report ITU-R M.2290
- Adequate and timely availability of spectrum with appropriate regulatory provisions as well as improved technologies are essential to support the future growth of IMT
- Spectrum estimation using high user density settings in 2020 should be adopted