



**A White Paper Update by NGMN**

# **Next Generation Mobile Networks Spectrum Requirements Update**

**next generation mobile networks**



A White Paper Update by  
the NGMN Alliance

# Next Generation Mobile Networks Spectrum Requirements Update

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## Document Information

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Spectrum is the life blood of the mobile industry. But unfortunately spectrum is a limited and scarce resource that requires careful global, regional and national planning and regulation. The timely availability of sufficient and suitable spectrum for mobile communications is a prerequisite to extending the benefits of mobile broadband to all people, and to furthering the global success story of mobile communications.

To continue to offer benefits to the users and societies, the mobile communication industry requires continued availability of radio spectrum in sufficient quantity within suitable bands and arranged in a consistent and harmonised manner. This will facilitate global roaming and enable economies of scale that produce high cost efficiencies.

In the official WRC preparatory process for the ITU World Radiocommunications Conference 2007 (WRC-07) the future spectrum requirements for IMT were determined after extensive analysis of the expanding wireless marketplace up to the year 2020. The conclusion of this assessment and the basis of the request to the WRC-07 is shown below in the extract from the ITU document “CPM Report on technical, operational and regulatory/procedural matters to be considered by the 2007 World Radiocommunication Conference, Geneva 2007”.

Table 1.4-1 shows the net additional spectrum requirement per ITU Region, beyond that identified for IMT-2000 at both WARC-92 and WRC-2000, taking into account that different amounts of spectrum have been identified for IMT-2000 in each Region.

Table 1.4-1  
Predicted spectrum requirements by the year 2020 for IMT

User demand setting	Predicted total (MHz)	Region 1		Region 2		Region 3	
		Identified (MHz)	Net additional (MHz)	Identified (MHz)	Net additional (MHz)	Identified (MHz)	Net additional (MHz)
Low	1 280	693	587	723	557	749	531
High	1 720	693	1 027	723	997	749	971

NOTE – Prediction based on one network deployment.

As a result of the deliberations in the ITU World Radiocommunications Conference (WRC-07) only approximately 400 MHz of additional spectrum was earmarked for International Mobile Telecommunications (IMT-2000 and IMT-Advanced) in the following bands<sup>1</sup>:

<sup>1</sup> It should be noted that this simple view by band and region does not provide guidance to specific availability and that not all bands are available in all regions or countries.



- Globally: 450 - 470 MHz and 2,300 - 2,400 MHz
- Region 1: 790-862 MHz for Region 1 (Europe)
- Region 2: 698 - 806 MHz for Region 2 (Americas)
- Region 3: 790 - 806 MHz for Region 3 (Asia-Pacific)
- Other: 698 - 790 MHz for nine countries<sup>2</sup> in Region 3  
3,400 - 3,600 MHz (no global allocation, but identified in 82 countries)

While this identification of additional spectrum is important and appreciated, it is evident there is still a shortfall to be addressed. Consequently, the securing of agenda items for IMT in future World Radio Conference deliberations is an important consideration.

As a next step in utilizing the spectrum identified in the WRC-07, the ITU-R and regional bodies are currently developing channelling arrangements for these bands so that they can subsequently be used on a harmonised basis around the world. NGMN members are actively participating in this ongoing work to ensure that the new arrangements will suit the needs of NGMN members. The current status and NGMN views on these bands are provided below. NGMN is continuing to study these bands and may develop additional views in the future.

#### **Generic principles for frequency arrangements for bands identified at WRC-07**

NGMN supports commonly agreed band plans. The benefits of commonly agreed band plans are:

- economies of scale for affordable user equipment,
- wider choice of service providers and brands of devices for consumers,
- minimized risk of radio interference,
- maximized total economic value of spectrum,
- facilitated cross-border coordination and
- global roaming.

ITU-R Recommendation M.1036-3 on frequency arrangements (band plans) is being revised in ITU-R Working Party 5D to incorporate the new bands identified at WRC-07. NGMN supports the inclusion of clear band plans for IMT in this ITU-R Recommendation. NGMN does not support those band plan options in the ITU-R Recommendation that only say “flexible FDD/TDD” as these mixed options do not provide any guidance to industry on how to specify and develop equipment. Arrangements with a fixed band segmentation where some parts of the band are used for FDD and some for TDD are acceptable in some cases, i.e. where the global frequency band is wide enough (since feasibility of such mixed arrangements

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<sup>2</sup> Bangladesh, China, Korea (Rep. of), India, Japan, New Zealand, Papua New Guinea, Philippines and Singapore

will depend on the absolute/relative size of the frequency band concerned) as this would be a “controlled” mix that the industry can implement accordingly.

#### 450-470 MHz

ITU is developing channelling arrangements for this band. So far, a number of different arrangements consisting of exclusively FDD or exclusively TDD or mixed arrangements have been proposed. However, considering the need to develop a limited set of recommended channelling arrangement for the various frequency bands, the current number of channelling arrangements might have to be further reduced. It should be noted that presently mixing of FDD and TDD arrangements (option D9) is not supported by NGMN in this band.

#### 698-806 MHz

WRC-07 identified 108 MHz of UHF spectrum for ITU-R Region 2 and nine countries in Region 3, including China, India, Japan and Korea (Rep. of). This band allows mobile operators to provide a cost-effective, continuous, broadband experience, targeting for expanded rural coverage and better quality coverage in urban areas. This is an important step towards closing the digital divide.

#### ITU-R Region 2 (Americas)

In March 2008, the United States took further steps in implementation of its band plan for the 698-806 MHz band and equipment vendors have already started the work taking advantage of this resource in the provision of wireless broadband. The US band plan is unlikely to change and has an advantage of early deployment of mobile broadband networks as major service providers in the US have started the deployment of LTE in the 2010-2011 timeframe, and it forms the basis of a regional 700 MHz band plan proposal, shown in Figure 1.

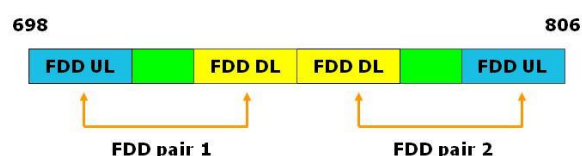


Figure 1 - High-level US 700 MHz band plan

However, with the adoption of the 700 MHz band plan for the Asia-Pacific region (see next section), there are discussions ongoing on whether the Asia-Pacific plan could also be an option for the Americas to facilitate economies of scale for this band. Conclusions on the 700 MHz band plan for Region 2 will depend on discussions within the Inter-American Telecommunication Commission (CITEL).

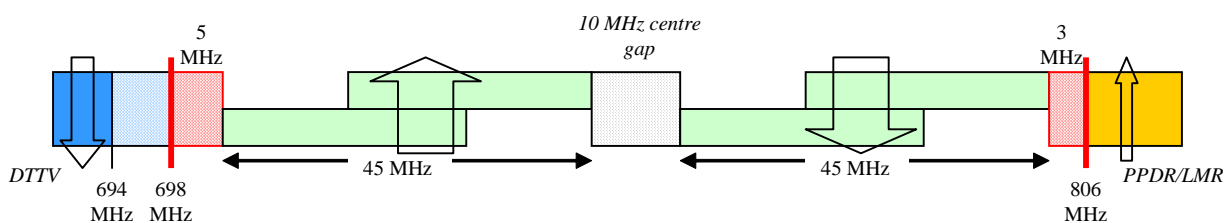
ITU-R Region 3 (Asia-Pacific)

Following WRC-07, AWF, the Wireless Forum of Asia-Pacific Telecommunity (APT), established a group to develop recommended harmonized approaches for the introduction of new wireless technologies, services and applications in released spectrum, including preferred frequency bands and associated technical characteristics.

In September 2010 the AWF reached agreement on two harmonized frequency arrangements for IMT in the 698-806 MHz frequency band in Region 3. This agreement is the result of extensive studies undertaken by Region 3 administrations, network operators and manufacturers of equipment, user devices and electronic components, following the decisions taken by World Radiocommunication Conference 2007 (WRC-07).

Recognizing the need to provide sufficient protection for the services in adjacent bands and based on studies of the various interference mechanisms that may impact services in adjacent bands, it was decided that spectrum should be allocated as follows:

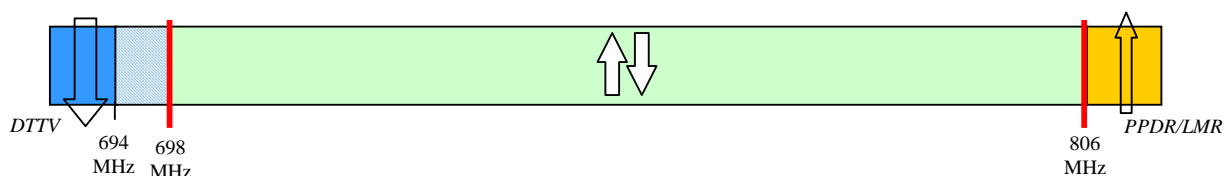
- a lower guard-band of 5 MHz should be allocated between 698-703 MHz; and
- an upper guard-band of 3 MHz should be allocated between 803-806 MHz.



**Figure 2 - AWF harmonized FDD arrangement of 698-806 MHz band**

Taking into consideration the capabilities of state-of-the-art filter technology, and to maximize the amount of FDD spectrum, a 2 x 45 MHz FDD structure with a 10 MHz centre-band gap was decided.

In regard to the ‘duplex direction’ for the FDD arrangement, and recognizing the proliferation of Radio Navigation Satellite Service (RNSS) receivers in pedestrian and vehicular environments and the risk of harmonic interference from user device emissions in the segment 779-805 MHz, it was further decided that the lower block (703-748 MHz) should be allocated for mobile ‘uplink’ transmissions (i.e., a ‘conventional duplex’ arrangement).



**Figure 3 - AWF harmonized all-TDD arrangement of 698-806 MHz band**

Taking into account the external 4 MHz guard band (694-698 MHz), a minimum internal guard-band of 5 MHz at the lower edge (698 MHz) and 3 MHz at the upper edge (806 MHz) needs to be considered.

**790-862 MHz**

Within CEPT the channelling arrangement shown in Figure 4 has been developed under a mandate from the European Commission.

CEPT ECC Project Team 1 has developed a preferred harmonized frequency arrangement for this band, which was finally adopted in October 2009.

The CEPT preferred harmonised frequency arrangement is 2 x 30 MHz with a duplex gap of 11 MHz, based on a block size of 5 MHz, paired and with reverse duplex direction. The FDD downlink starts at 791 MHz and the FDD uplink starts at 832 MHz.

791-796	796-801	801-806	806-811	811-816	816-821	821 - 832	832-837	837-842	842-847	847-852	852-857	857-862
Downlink						Duplex gap	Uplink					
30 MHz (6 blocks of 5 MHz)						11 MHz	30 MHz (6 blocks of 5 MHz)					

**Figure 4 - CEPT preferred harmonized frequency arrangement for the 790-862 MHz band**

**2,300-2,400 MHz**

An unpaired TDD arrangement is considered to be the plan most capable of delivering high bit-rates in this spectrum. Therefore, NGMN supports TDD in this band as reflected in the current draft revision of ITU-R Recommendation M.1036 (see figure 5). Mixing of FDD and TDD arrangements is not supported by NGMN in this band.

MHZ	2300	2325	2350	2375	2400
E1					
	TDD				
	2300				2400

**Figure 5 - TDD frequency arrangement for the 2300-2400 MHz band**

**3,400-3,600 MHz (3,800 / 4,200 MHz)**

CEPT has developed channelling arrangements for the 3,400-3,600 and 3,600-3,800 MHz bands (see figures 6, 7 and 8), for which the TDD options also cover downlink-only operation. Moreover NGMN supports a

band plan which would allow an extension to 3,800 MHz and possibly up to 4,200 MHz for use in countries where terrestrial mobile use is permitted.

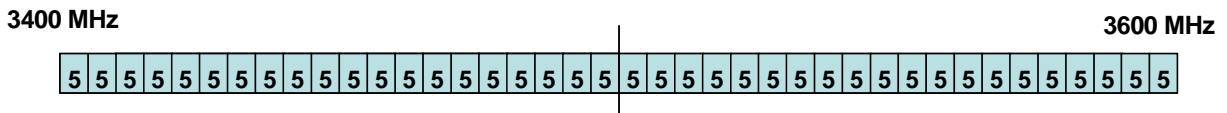


Figure 6 - Frequency arrangement for the 3400-3600 MHz band based on TDD

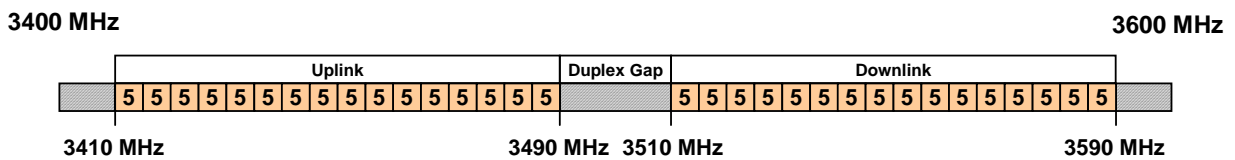


Figure 7 - Frequency arrangement for the 3400-3600 MHz band based on FDD

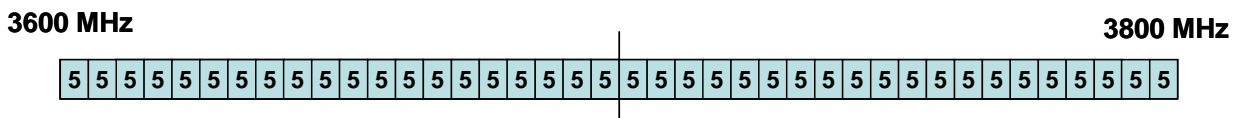


Figure 8 - Frequency arrangement for the 3600-3800 MHz band based on TDD

Given the capabilities and requirements of IMT-Advanced, in particular its data-handling capacity and requirement for larger channel bandwidths (40 ... 100 MHz), this band will be one focus for such usage. All other bands identified or allocated for IMT are relatively limited in their ability to support multi-operator operation of such large carrier bandwidths within one single band. Additional solutions to this requirement include future carrier bandwidth aggregation (see below).

**Generic principles on re-farming of bands identified at earlier WRCs (850 MHz, 900 MHz, 1800 MHz, 1900 MHz, AWS, 2000 MHz, 2600 MHz, etc.)**

- NGMN supports the re-farming of existing IMT bands to enable operators to deploy more advanced IMT technologies in their existing spectrum.
- To enable smooth migration to LTE, existing FDD/TDD arrangements in these bands should be maintained.
- NGMN actively supports the ongoing work to implement the “bandwidth aggregation between different IMT bands” capability in current and future IMT standards. This enables a spectrum efficient usage and provides the possibility to deliver peak user data rates promised by NGMN technologies.

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