

# **The 700 MHz mobile allocation in Africa: Observations from the battlefield\***

## **Abstract**

The African countries made their voice heard during the last World Radiocommunication Conference of 2012 (WRC-12) when they managed to have an allocation of the 694-790 MHz band to mobile service considering the opposition of the European countries. Following WRC-12, discussions have emerged with regard to setting the lower edge of the 700 MHz allocation, frequency arrangements in the band, out of band emissions (OOBE) of the mobile terminals, and sharing between mobile and broadcasting services.

These discussions has shown that while the African countries were noticeable a majority in region 1 at the last WRC-12, it appears that the African countries' decisions regarding spectrum use are influenced by their neighbouring countries. In particular, while in theory, the African countries are sovereign in terms of spectrum use in their territories; they prefer to align themselves with the other countries in order to gain benefits of global harmonisation.

In addition, the paper has highlighted that several emerging themes regarding spectrum management in Africa including the coordination with the neighbouring countries to the African continent, utilising the large number of the African countries in region 1, flexibility in reaching a compromise. Furthermore, the paper has identified weakness points of the decision making procedures in terms of having few countries blocking the views of the majority as consensus is the basis of discussions at the ITU-R, and of the ITU-R three regions systems in terms of having neighbouring countries from regions 1 and 3 with different spectrum needs.

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\* The authors are solely responsible for the opinions expressed in this paper.

## **1. Introduction**

The African countries made their voice heard during the last World Radiocommunication Conference (WRC-12) when they called for an immediate allocation of the 694-790 MHz band to mobile service to meet growing broadband demand. Even so, the European countries opposed the proposal, arguing that the band is heavily utilised by broadcasters in their countries. Eventually, the conference approved the allocation, which was effective immediately after WRC-15 (El-Moghazi, Whalley, & Irvine, 2013). Following WRC-12, a discussion has emerged with regard to the lower edge of the 700 MHz allocation. Moreover, proposals were discussed so that different technical conditions for the 700 MHz allocation for the African continent than the rest of ITU-R region 1 would result. In addition, the African countries have been quite involved in the issue of the frequency arrangements to be applied in the 700 MHz band. Finally, and perhaps most importantly, there were diverse views between the African and European countries regarding the limits of the out of band emission (OOBE) of mobile devices in the 700 MHz band.

However, while the African countries were noticeable a majority in region 1 of the ITU-R at the last WRC-12, with the consequence that they were able to force European countries to follow their lead, the discussion following WRC-12 has shown that the African countries cannot entirely formulate their decisions regarding spectrum use in their territories separately from the other countries. Investigating such an issue could help African spectrum managers to understand the complex dynamics of the spectrum use decisions that occur at the international level.

Accordingly, the overarching research question of this paper is formulated to be ‘how dependent are the African countries’ decisions regarding the use of spectrum in their territories on the other countries?’ More specifically, while, in theory, countries are sovereign in terms of spectrum use in their territories, the paper will examine such statement in practice in the light of the 700 MHz discussions following WRC-12 from the African perspective while focusing on the interaction between the African and other countries.

In order to answer such question, this paper adopts a qualitative methodology that examines the case study of the African countries regarding the 700 MHz mobile allocation in the period following WRC-12. The paper also traces the different activities of the African countries in the various ITU-R working parties (WPs) and in the African Telecommunication Union (ATU). The paper is based on primary data collected mainly through semi-structured interviews with the several African and European stakeholders that participated in the 700 MHz debate during and after WRC-12. The paper also draws on the observations made by the lead author who attended meetings where the 700 MHz allocation was discussed.

The rest of the paper is organized as follows. Section two explores the discussion during WRC-12 with regard to the mobile allocation in the 700 MHz band and address the development in Africa on the issue. Section three to six examine the 700 MHz allocation refinement, sharing between mobile and broadcasting services in the 700 MHz band, OOBE vales, and frequency arrangements in the 700 MHz. While Section seven discuss the policy implications, Section eight concludes.

## **2. WRC-12: Africa Taking the Lead**

The African countries presence in the ITU-R has significantly changed with time. Firstly, the ITU was controlled prior to 1950 by a small number of developed countries to convey their domestic preferences (Rutkowski, 1979). These countries were using the votes of their overseas

colonies to dominate the ITU activities. For instance, in 1925, France, Great Britain, Italy, and Portugal, each had seven votes in the ITU (Noam, 1989). The situation had changed by the WARC-79 where there were no colonies presented at the conference (U.S. Congress Office of Technology Assessment, 1982).

One significant change in the performance and influence of the African countries at the ITU-R was at the last WRC-12 where they succeeded in acquiring an additional allocation to the mobile service in the 700 MHz band. Historically, most of the UHF band (470-862 MHz) was planned for the analogue terrestrial broadcasting service in region 1<sup>1</sup>. In 2006, the Regional Radiocommunication Conference 2006 (RRC-06) planned the digital terrestrial broadcasting service in region 1 and in the Islamic Republic of Iran, in the frequency bands 174-230 MHz and 470-862 MHz (ITU, 2006). Shortly after that, the WRC-07 approved an additional allocation in the frequency band 790-862 MHz to mobile service effectively from 17 June 2015 (ITU-R, 2007a) while conducting sharing studies between mobile service and other services operating in the bands such as broadcasting (ITU-R, 2007b). These sharing studies showed that no new mandatory regulatory measures are needed to enable sharing between mobile and broadcasting services in neighbouring countries in the 790-862 MHz band (Ofcom, 2012).

Shortly before WRC-12, the ATU 1st African summit on digital switchover recommended to pursue the allocation of the band 694-790 MHz to the mobile service on an equal primary basis with the broadcasting service for the African countries at the WRC-12 (ATU, 2011). In addition, the summit called for evaluating the GE-06 plan while taking into account the short and medium term spectrum needs of broadcasting and mobile industry (ATU, 2011). During WRC-12, The African in addition to the Arab countries called formally for the band 694-790 MHz to be allocated immediately for mobile services in region 1 as it was in ITU-R regions 2 and 3 to meet growing broadband demand (Standeford, 2012a, 2012b).

The argument presented by Arab and African countries was based on the followings (ITU-R, 2012d). Firstly, the spectrum available in the 790-862 MHz band for mobile broadband is only the band 790-816 MHz as the rest of the band is already used by other services. Therefore, the 694-790 MHz band is, for the Arab and African countries, arguably the first digital dividend rather than the second. Secondly, the 694-790 MHz band is already allocated in ITU regions 2 and 3 for mobile and using this band will decrease the cost of deploying such systems. The European countries opposed such proposals because the 694-790 MHz band is mainly used for broadcasting service in their territories and a large investment has already been made to fund the transition to digital television (Sims, 2012).

Eventually, WRC-12 decided in its resolution 232 to allocate the 694-790 MHz frequency band in region 1 to mobile service on a primary basis in addition to the existing primary broadcasting service and to identify the band for IMT (ITU-R, 2012c). The allocation was decided to be effective after WRC-15 upon refinement of the lower edge of the allocated band and upon specifying the technical and regulatory conditions applicable to the mobile service allocation. The WRC-12 invited the ITU-R to study the spectrum requirement for the mobile service and for the broadcasting service in this frequency band, in order to determine the options

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<sup>1</sup> The world is divided in terms of radiocommunication service allocation into three regions where region 1 comprises Europe, Africa, the Middle East west of the Persian Gulf including Iraq, the former Soviet Union and Mongolia. Region 2 covers the Americas, Greenland and some of the eastern Pacific Islands. Region 3 contains most of non-former-Soviet-Union Asia, east of and including Iran, and most of Oceania (ITU-R, 2008).

for the lower edge. The ITU-R was also invited to study the channelling arrangements for the mobile service adapted to the frequency band below 790 MHz taking into account the existing arrangements in region 1 in the bands between 790 and 862 MHz, the harmonization with arrangements across the three regions, and the compatibility with other primary services to which the band is allocated including in adjacent bands.

Most importantly, the ITU-R Bureau (BR) was requested by the WRC-12 to study the compatibility between the mobile service and other services currently allocated in the frequency band 694-790 MHz. Furthermore, the WRC-12 invited the director of the BR to work, in cooperation with the Director of the Telecommunication Development Bureau (TDB), to bring assistance to developing countries wishing to implement the new mobile allocation by determining the modifications of the GE-06 plan necessary to keep sufficient capacity for broadcasting.

Following WRC-12, several developments occurred in region 1. In Africa, motivated by the huge success of Africa at the conference, the ATU established the African Spectrum Working Group (AfriSWoG) at the 1st African Preparatory Meeting for WRC-15 (APM15-1) to act as an advisory group to the general secretariat on matters of the radio spectrum (ATU, 2013). In addition, the 2nd ATU digital migration summit was conducted by end of 2012 and recommended the adoption of the digital terrestrial broadcasting standard DVB-T2 with MPEG-2 or MPEG-4 compression instead of DVB-T which the GE-06 agreement was based on, and to finalise the frequency coordination between the African countries. Moreover, the summit recommended that frequency arrangements for the bands 700 MHz and 800 MHz should be harmonised with other regions such as APT and CEPT (ATU, 2012b).

In particular, it was decided to identify a minimum of 4 coverage layers (multiplexes)<sup>2</sup> for the territories of all sub-Saharan African countries in the band 490-698 MHz (Ghazi, 2013). In general, the number of the layers was significantly reduced after the WRC-12 as a consequence to the 700 MHz allocation. This is due to the fact that the number of TV channels decreased from 49 channels which were planned in the RRC-06 in the band 470-862 MHz to 40 channels after WRC-07 where the 800 MHz band was allocated to mobile service, and finally to 28 channels after the 700 MHz mobile allocation (Mwale, 2013).

By September 2013, the ITU announced that forty seven sub-Saharan African countries have agreed on frequency coordination for a 2015 digital switchover so that these countries can allocate the 700 MHz and 800 MHz bands for mobile service (Standeford, 2013). Moreover, prior to the WRC-15, the ATU announced that it is not in favour of a co-primary allocation of mobile service at the band 470-694 MHz in Region 1 (Youell, 2014a).

At the ITU-R level, the Joint Task Group 4-5-6-7 (JTG 4-5-6-7) was established to address the sharing and compatibility between broadcasting and mobile services IN the 700 MHz band (Stirling, 2012). The group is also responsible of confirming the lower edge of the allocation to the mobile service made at WRC-12 from 694-790 MHz (Obam, 2013). The name of the group indicates the cooperation between four main study groups (SGs) in the ITU-R: SG 4 (satellite services), SG 5 (mobile services), SG 6 (broadcasting services), and SG 7 (science services).

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<sup>2</sup> The total capacity available in the GE06 Plan is often expressed in the number of multiplexes ('layers') that could be provided over the whole national territory. One layer represents a set of channels that can be used to provide one full, or partial, nationwide coverage (EBU, 2009).

In addition, WP 5D was assigned the task of calculating mobile requirements in the band 694-790 MHz while the WP 6A was responsible of broadcasting service requirements (Stirling, 2012). Other responsibilities of WP 5D include participating in the work related to sharing for IMT systems and the frequency arrangements for these systems (WP 5D Chairman, 2012). The chairman of the JTG 4-5-6-7 was assigned from CEPT while the two vice chairman were from ASMG and ATU (ITU, 2014). This reflects the interest of these three regional groups in the 700 MHz issue.

In the following five sections, in the light of discussions at JTG 4-5-6-7 and WP 5D, the paper shall discuss four main issues that were discussed prior to the WRC-15 namely, the refinement of the lower edge of the 700 MHz allocation, sharing between mobile and broadcasting services in the 700 MHz band, OOB values, and frequency arrangements in the 700 MHz in addition to the policy implications of all these discussions. Through these sections, the paper will focus on the African positions and activities in order to examine the paper main question, The four sections are based on the contributions made at the ITU-R by the concerned entities in addition to primary data collected mainly through semi-structured interviews with the several African and European stakeholders that participated in the 700 MHz debate during and after WRC-12. They are also supported by the observations made by the lead author who attended several meetings where the 700 MHz allocation was discussed.

### **3. 700 MHz Allocation Refinement**

Recalling that the WRC-12 decision on the 700 MHz band was conditioned by refinement of the lower edge of the band, several discussions occurred following the WRC-12 that reflect different interpretation to the refinement process. The issue was of importance to the African countries because the refinement process may have decrease the bandwidth available for the mobile service if the lower edge of the band is set above the frequency 694 MHz.

In particular, during the third meeting of the JTG 4-5-6-7, South Africa and Zimbabwe made a contribution pointing to the regional activities in western and central, eastern, southern Africa regions in addition to the Southern African Development Community (SADC) in order to optimise the GE06 Plan in such a way that assignments to the broadcasting service would end at 694 MHz instead of the then upper band edge of 790 MHz (South Africa (Republic of) & Zimbabwe (Republic of), 2012). The two countries recommended that the lower edge of the allocation of the mobile allocation in the 700 MHz to be set at 694 MHz as tentatively set out by WRC-12

During the meeting, there was an objection from countries against the allocation that the SGs studies cannot depend on data that are region dependent where the data is different from region to another. More specifically, it was argued that not all African countries participated in the GE-06 re-planning activities especially northern African countries. In addition, there was an argument that any decision of WRC-15 should not have any influence on the RRC-06 conference. In other words, the re-planning of the Sub-Sahara broadcasting plan should not affect other area containing in the GE 06 plan. However, some countries from northern Africa replied in the meeting that they are coordinating with sub-Sahara countries. One other African country, Egypt, contributed to the debate on the lower edge frequency, and argued that the word refinement limits the change to be plus or minus 2-3 MHz. Accordingly, the lower edge of the allocation should be limited to the range 691-697 MHz. It was also argued that broadcasting services could be provided over other platforms, there are limited terrestrial broadcasting content

and penetration in developing countries, and that not only UHF band is allocated to terrestrial broadcasting (Egypt (Arab Republic of), 2012a).

Regarding the requirements of the broadcasting in the UHF which is also indication of the required lower edge of the 700 band, the ITU-R conducted a survey to collect data regarding spectrum requirements for broadcasting in the UHF band in region 1 where only one response was received from the African countries (ITU-R WP6A, 2013). Accordingly, the JTG 4-5-6-7 send a liaison statement to WP 6A seeking additional and updated information (Chairman ITU-R Joint Task Group 4-5-6-7, 2012b). The JTG 4-5-6-7 received liaison statement from the WP 6A indicating the broadcasting requirements in the band 470-862 MHz where most of the African countries were requiring exactly 224 MHz which indicated that the lower edge of the band should be set to the frequency 694 MHz (ITU-R WP6A, 2013). In general, many contributions were submitted to the JTG 4-5-6-7 supporting a confirmation of the lower edge at 694 MHz and on the usage of GE06 plan and protection of DTT in Channel 48 and below. By the fourth meeting of the JTG, only one method<sup>3</sup> was proposed to the issue of the refinement of the lower edge of the 700 MHz allocation which is to set it at 694 MHz (Chairman ITU-R Joint Task Group 4-5-6-7, 2012a).

The issue of the refinement of the lower edge of the band has raised a question whether it would have been better to decide on the 700 MHz allocation in WRC-15 with more certainty instead of WRC-12. On the one hand, there was a view that it may have been better to put the 700 MHz item on the agenda of the WRC-15, instead of having a conditioned decision at WRC-12 and then revise it at WRC-15. In fact, one of the interviewees argues that what happened is having the 700 MHz band mobile allocation discussed between WRC-12 and WRC-15. However, the final result on the allocation would be decided at WRC-15, which is equivalent to having a new agenda item in WRC-15. As stated by him “there is an allocation but it is inactive till we see what will decide on it after 2015”.

On the other hand, some interviewees from Africa expressed that while every WRC is independent and everything can be questioned at WRCs, the 700 MHz allocation seems stable although the opposition of some countries. One other interviewee argued that while some may argue that the refinement may include the whole band 694-790 MHz, the word refinement should mean plus minus up to 3 MHz. From the European perspective, one interviewee expressed that the WRC-12 decision took into account that Africa wants to utilise the band as fast as possible and allow the views of the European countries to be accommodated by WRC-15.

#### **4. Sharing between Mobile and Broadcasting Services**

A discussion was conducted during the meetings of JTG 4-5-6-7 over whether it is possible to have co-primary allocation for broadcasting and mobile service in the 700 MHz band from the sharing perspective. More specifically, the first primary service in the 700 MHz, which is the broadcasting service, should have protection against the new primary service, which is the mobile service. However, having difficult conditions on the mobile service (e.g. large separation distance between the stations of the two services) may constrain its deployment. On the other hand, allowing the mobile service without coordination may cause harmful interference to the broadcasting service in the neighbouring countries or in the frequency band below 694 MHz.

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<sup>3</sup> A method is a proposed measure to handle an issue by WRCs. Having one method for an issue indicates consensus on such method while having several methods implies difference of views.

Firstly, Egypt pointed out that the studies conducted within ITU-R under WRC-12 A.I. 1.17 in the frequency band 790-862 MHz showed that GE06 provides sufficient protection for broadcasting service from mobile service (Egypt (Arab Republic of), 2012b). On the other hand, Iran pointed out that studies prior to WRC-12 showed that cross-border sharing of the band 790-862 MHz implies that mobile and broadcasting services cannot be fully exploited at the same time on both sides of countries' borders.

In addition, Iran argued that the situation is much more complex for 694-790 MHz band compared to 790-862 MHz due to the extensive use of broadcasting in the former band. Moreover, three issues were highlighted that make the sharing between the two services difficult, namely the issue of cumulative effect of interference from IMT networks into broadcasting service, the lack of studies on the case of interference into adjacent channels prior to WRC-12, and the difference in the characteristics of mobile service used in the development of GE06 agreement than the time being (Iran (Islamic Republic of), 2012b).

Moreover, the Iranian administration suggested that the results of studies to be carried out by JTG 4-5-6-7 to be considered by WRC-15 could result in revision of the decision taken by WRC-12 (Iran (Islamic Republic of), 2012b). In other words, the 700 MHz allocation may need to be reconsidered at the conference. It is worth mentioning that the Iranian administration made an objection to the inclusion of materials to the Conference Preparatory Meeting (CPM)<sup>4</sup> text unless it is agreed by all the meeting (Iran (Islamic Republic of), 2012a). In other words, consensus is needed to propose something to the WRC-15. Moreover, there was also a debate on whether Iran should be concerned with the spectrum requirements of region 1 as Iran lies in region 3. The reply was that Iran is the only country from region 3 that is part of GE-06 and that Iran has several neighbouring countries from region 1.

During the next meetings of JTG 4-5-6-7, countries and organisation in favour and against the 700 MHz allocation started to conduct probabilistic, deterministic and empirical studies showing different results on the sharing between mobile and broadcasting services in the 700 MHz band. On the one hand, the African, European, Arab countries, mobile industries proposed mostly probabilistic studies using Monte Carlo simulations indicating relatively relaxed conditions for sharing between the mobile and broadcasting services (France & Italy, 2013; GSMA, 2013; Nokia Corporation, 2013; South Africa (Republic of) et al., 2013). On the other hand, European broadcasters, Iran and Russia attempted to show difficulty of coexistence between the two services (European Broadcasting Union, 2013a, 2013b).

Most importantly, at the third meeting of the JTG 4-5-6-7, Iran made a contribution that raised a challenge to the African countries (Iran (Islamic Republic of), 2013). In particular, the contribution propose a method to the WRC-15 where the conference can made an unconditional activation of allocation in Africa, while conditioning it in the rest of region 1. These conditions include the application of the article 9.21<sup>5</sup> of the RR by the mobile service in the rest of region 1 except Africa. It was also mentioned that the RR 9.21 has been used for decades as a prerequisite condition of admission to the RR where the sharing criteria is not established or did not ensure

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<sup>4</sup> CPM prepare a consolidated report to be used in support of the work of WRCs

<sup>5</sup> Such article states that before an administration notifies to the ITU-R BR or brings into use a frequency assignment for any station of a service for which the requirement to seek the agreement of other administrations is included in a footnote to the table of frequency allocations, this administration shall effect coordination, as required, with other administrations (ITU-R, 2012a).

the compatibility between services. Russia made also a contribution in the same meeting suggesting a method that having different technical and regulatory conditions that may differ from those applicable to the entire region 1 (Russian Federation, 2013). This was explained by that region 1 covers large area and includes 118 countries out of the 193 ITU-R countries, which implies different spectrum requirements. As a result, there should be different conditions for some countries in region 1.

At the fourth meeting of the JTG 4-5-6-7 meeting, several Arab countries made a contribution clarifying why the article RR 9.21 cannot be applied (Bahrain (Kingdom of), Egypt (Arab Republic of), Kuwait (State of), et al., 2013). In particular, it was argued that the protection of broadcasting service from mobile services could be ensured by applying the technical and regulatory provisions of the GE-06 agreement, and by bilateral and multilateral coordination and agreements between neighbouring countries. Furthermore, it was clarified that the RR 9.21 has been applied in cases where there are no agreed protection criteria. Regarding the application of different conditions for region 1, it was mentioned that this may destroy the basic principle of regional allocation and global harmonisation, and may also lead to cancellation of the already agreed 700 MHz allocation and re-allocation of the band based on non-harmonized allocation across the region where every neighbouring country may ask for a separate conditions to protect existing service (Bahrain (Kingdom of), Egypt (Arab Republic of), Kuwait (State of), et al., 2013).

At the fifth meeting of the JTG 4-5-6-7, still there were attempts to challenge the whole 700 MHz allocation of the WRC-12. In particular, there was an argument that result of sharing and compatibility studies between the broadcasting and mobile service shows that sharing is not possible. Therefore, the decision of WRC-12 needs to be reviewed and properly modified (Iran (Islamic Republic of), 2014). At the same meeting, Egypt and UAE repeated their request to remove methods that include applications of the Article 9.21 as with regard to the protection of broadcasting service from mobile service where GE-06 provisions apply (Egypt (Arab Republic of) & United Arab Emirates, 2014).

At the 6th and last meeting of the JTG 4-5-6-7, several Arab countries, including African ones, presented a contribution supporting having the 700 MHz allocation without additional protection as GE-06 agreement can protect broadcasting from cumulative interference. In addition, it was suggested to have a new ITU-R recommendation specifying the OOB limits of IMT into below 694 MHz (Bahrain (Kingdom of) et al., 2014).

At last, the CPM text was drafted to reflect the different views. More specifically, four methods were drafted in the CPM text in order for the WRC-15 meeting to choose from. Method B1 suggests that the GE-06 Agreement contains the necessary provisions to provide protection to the broadcasting service in neighbouring countries. Method B2 is different than method B1 in having the recommendation on the OOB limits associated with the 700 MHz allocation so that the recommendation would have more obligatory status. Method B3 specifies the additional technical conditions and regulatory mechanisms for the protection of the broadcasting service in an ITU-R resolution that is more obligatory than a recommendation.

Method B4 is the most stringent method in terms of putting additional constraints or conditions on the mobile service operating in the 700 MHz band. In particular, the method states that the article RR No. 9.21 shall apply and that affected administrations are identified using trigger criteria that would be contained in a WRC resolution. Lately, the ATU in its 3rd

preparatory meeting for WRC-15 recommends adopting method B1 (ATU, 2015) upon the recommendation of the AfriSWoG group (ATU, 2014).

The sharing issue has shown diverse views on the use of different technical modelling to assess interference between the mobile and broadcasting services and whether to use probabilistic (e.g. Monte Carlo) or deterministic (e.g. MCL) studies. Furthermore, the issue has also highlighted the different perceptions on the GE-06 plan and whether it is a long term plan that is sufficient to protect the broadcasting service or there is a need for additional protective measures.

In addition, the proposal of Iran and Russia to have different technical and regulatory conditions across regions 1 was perceived to disturb efforts towards harmonization across region 1. Accordingly, there was an argument during the JTG meetings from countries in favour of the harmonised allocation that the method of having the allocation active in Africa only is not valid and cannot be implemented because one African country, Egypt, has land in both of Africa and Asia.

When it was proposed to add the territories of Egypt to the method, some of the attendants raised the issue of the nearby neighbours of Egypt (e.g. Palestine, Jordan), which are far from Iran and still quite close to Africa. Eventually, the meeting did not approve such method. In general, the Arab and African countries did not want to have fragmentation in region 1 by having different technical conditions. Instead, harmonisation along the three regions and not only within region 1 was the target from the beginning.

## **5. Out of Band Emission (OOBE)**

One other issue that was discussed following WRC-12 is the out of band emission (OOBE) values in the band below the frequency 694 MHz, which are required for the protection of the broadcasting service. The issue with the OOBE values is that too stringent OOBE limit would make it more technically challenging for IMT end user devices to meet them without more design complexity and cost increase. On the contrary, a less stringent OOBE limit may imply additional measures to protect the broadcasting service operating below 694 MHz such as filters on the broadcasting receivers (ITU-R, 2014).

One of the first identified OOBE value in the 700 MHz was determined in association with the APT plan in 2011 to be not exceeding -34 dBm/MHz below the frequency 694 MHz which is equivalent to -25 dBm/ 8MHz (APT, 2011). Such value was formally informed to the JTG meeting by the APT (APT, 2013).

At the third meeting of the JTG 4-5-6-7, the ECOWAS region proposed that the technical requirements applicable to the APT plan be adopted in region 1 in particular the OOBE limit (ECOWAS Administrations plus Cameroon (Republic of), 2013). However, such proposal was not based on technical studies. This was also supported by the GSMA and Nokia (GSMA, 2013; Nokia Corporation, 2013, 2014).

At the fourth meeting of the JTG 4-5-6-7, the Arab and African countries made a significant step and maybe the first of its kind by conducting detailed technical studies by themselves supporting their arguments. More specifically, five African countries conducted Monte Carlo simulations and provide evidences that for urban environment, IMT OOBE of -25 dBm/8 MHz represents an appropriate regulatory limit (Cameroon (Republic of), Kenya (Republic of), Lesotho (Kingdom of), South Africa (Republic of), & Zimbabwe (Republic of), 2013). Similarly,

five Arab countries, including Egypt, made similar contribution indicating same result in terms of OOB value (Bahrain (Kingdom of), Egypt (Arab Republic of), Qatar (State of), Kuwait (State of), & Emirates, 2013).

The fifth meeting was a moment of glory for the African countries where 30 African countries present common proposals to a study group meeting maybe for the first time of the history of the ITU-R. These 30 African countries include some Arab countries and they proposed that an OOB limit of  $-25$  dBm/8MHz be adopted as a suitable value for the protection of DTT (Angola (Republic of) et al., 2014). On the other hand, some European broadcasters suggested OOB values in the range  $-47$  dBm/8 MHz to  $-52$  dBm/8 MHz (Broadcast Networks Europe, 2014). At the sixth meeting, Russia made a proposal to establish OOB limits for not higher than  $-52$  dBm/8 MHz, or  $-56$  dBm/8 MHz (better), with guard band not less than 9 MHz (Russian Federation, 2014).

There was a proposal to have a draft recommendation on the suitable values of OOB. After extensive discussion, the recommendation accommodated that that the OOB of an IMT mobile station operating in region 1 in the frequency band 703-733 MHz with an IMT channel bandwidth greater than 10 MHz should not exceed  $-25$  dBm/8 MHz into the frequency band 470-694 MHz and that the out-of-band emission of an IMT mobile station operating in Region 1 in the frequency band 703-733 MHz with an IMT channel bandwidth of 10 MHz or less should not exceed  $-42$  dBm/8 MHz into the frequency band 470-694 MHz (Chairman ITU-R Joint Task Group 4-5-6-7, 2014). From the African countries' perspective, this meant that the  $-25$  dBm/8MHz would be adopted for region 1 in line with the APT and that CEPT countries could achieve the  $-42$  dBm/8MHz by limiting the use of larger channel than 10 MHz to frequencies higher than 713 MHz.

There were two views on that recommendation on the value of OOB. The first is that the recommendation was mature and should be forwarded to the relevant SGs (e.g. SG 5 and SG 6) for adoption and approval. If the recommendation cannot be approved by these SGs then it could be forwarded to the RA. On the other hand, Russia and Iran had the view that the draft recommendation was not mature enough to be agreed. Eventually, the recommendation was not forward to anywhere, which means that all this work on OOB in the JTG meetings is not yet agreed and therefore cannot be approved.

Meanwhile, the CPM text submitted by the JTG accommodated the results of all the studies conducted by the Arab, African, European countries in addition to Russia and Iran. In particular, the CPM text shows variance of recommended OOB values ( $-25$  dBm/8 MHz,  $-42$  dBm/8 MHz,  $-56$  dBm/8 MHz) based on the type of conducted study and whether it is based on MCL or Monte Carlo or have been post processed (ITU-R, 2014).

The OOB issue has revealed that the African and Arab countries had preference towards the value of  $-25$  dBm/8 MHz while the European countries adopted  $-42$  dBm/8 MHz. Furthermore, the paper has shown that although technical studies on sharing between services are supposed to be neutral and result in similar values, the paper has shown how the interest and assumptions of countries conducting the studies may influence the studies output. More specifically, as the European countries are more concerned in protecting their broadcasting service, their OOB values are more conservative and protective. On the other hand, the African countries are keen to aligned with the APT plan in terms of OOB values in order to achieve more harmonization.

In particular, one interviewee from Europe explained that following WRC-12, European countries did have different position where some were keen to promote the use of the 700 MHz band for mobile and others wanted to protect the broadcasting service. Therefore, the -42 dBm/8 MHz OOB value was a compromise between the mobile and broadcasting parties in Europe.

The African and Arab countries tended to reach win-win situation, as having different OOB values for each group of countries will increase the prices of the user terminals and make them more complicated. Therefore, the African, Arab, and European countries reached a compromise to have OOB limit of -25 dBm/8 MHz for up to 20 MHz IMT channel bandwidth and a value of -42 dBm/8MHz for 10 MHz or less IMT channel bandwidth.

## 6. Frequency Arrangements

Another important issue that was related to the 700 MHz is the frequency arrangements or channel planning in the band in region 1 considering harmonisation with the other regions and the compatibility with other services. Channel planning accommodates type of channel duplex mode (Frequency Division Duplex (FDD) and Time Division Duplex (TDD)) and the width of the channel (e.g. 10, 20 MHz). The issue of agreeing on one frequency arrangement in the 700 MHz band was quite important, as having different arrangements in the band would destroy harmonisation within region 1 and with the other two regions (region 2 and 3).

In Europe, CEPT has adopted a plan in the 800 MHz that operates in the bands 791-821 MHz and 832-862 MHz and provides 2x30 MHz for FDD operation of broadband systems. In addition, the USA adopted a more complicated plan that compromises a mix of FDD operation in the bands 698-716 MHz, 728-746 MHz, 746-763 MHz, and 776-793 MHz and TDD operation in the band 716-728 MHz (ITU-R, 2012b). In Asia, the APT has adopted a plan in the 700 MHz in 2010 in the ninth meeting of the APT Wireless Forum (AWF-9) that operates in the bands 703-748 MHz and 758-803 MHz and provides 2x45 MHz for FDD operation of broadband systems (APT, 2010). Figure (1) below shows the APT plan and the guard band between it and the digital terrestrial TV (DTTV) in the UHF band.

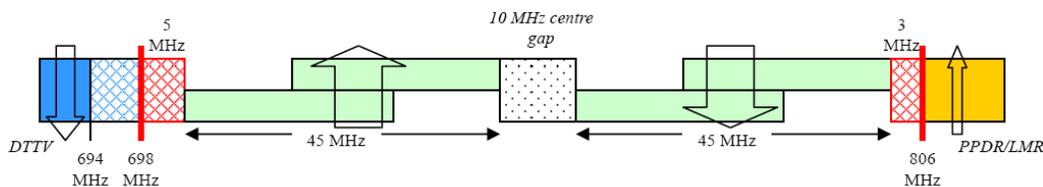


Figure 1. Harmonised FDD Arrangement of 698-806 MHz band (APT, 2010)

The APT plan is different than the other plans because it compromises dual-duplexer arrangement with 2x30 MHz for each one (APT, 2010). The reason for adopting dual-duplexer is that the maximum bandwidth of a duplexer for a terminal at this frequency range is usually around 30-35 MHz (APT, 2009). Therefore, it is difficult to have a user handset that covers the 2x45 MHz of the APT plan with only one duplexer. By 2013, number of countries who decided to adopt the APT 700 MHz plan was 18 countries in region 3 and 8 countries in region 2 with most countries in Latin America except for Bolivia which decided to adopt the US band plan (Bateson, 2014; Migwalla, 2013).

The APT plan overlaps with the CEPT plan in the band 791-803 MHz, which means that countries cannot adopt both of the two plans in the same time and a choice between them has to

be made. If a country adopts the CEPT plan, it will not be able to utilise the large bandwidth of 45 MHz of the APT plan in the 700 MHz. On the other hand, fully adopting of the APT plan would impact the harmonisation with CEPT plan. Figure (2) below shows the overlap between the APT plan in the 700 MHz band and the CEPT plan in the 800 MHz band.

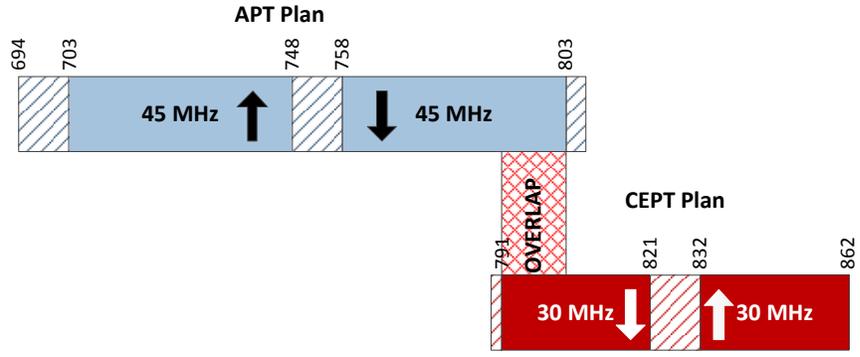


Figure (2): Overlap between the APT Plan in the 700 MHz Band and the CEPT Plan in the 800 MHz Band (Egypt, 2012)

Similarly, adopting the CEPT plan in full would contradict with CDMA or GSM plan in the 850 MHz that is used by many countries in Africa, and using the full plan CDMA 850 or GSM 850 would contradict with the plan of the 900 MHz that is used for systems such as GSM900. The conclusion is that harmonisation between the different plans is difficult and countries cannot adopt them all. Figure (3) below shows the different frequency arrangements in the 700 MHz, 800 MHz, 850 MHz, and 900 MHz bands.

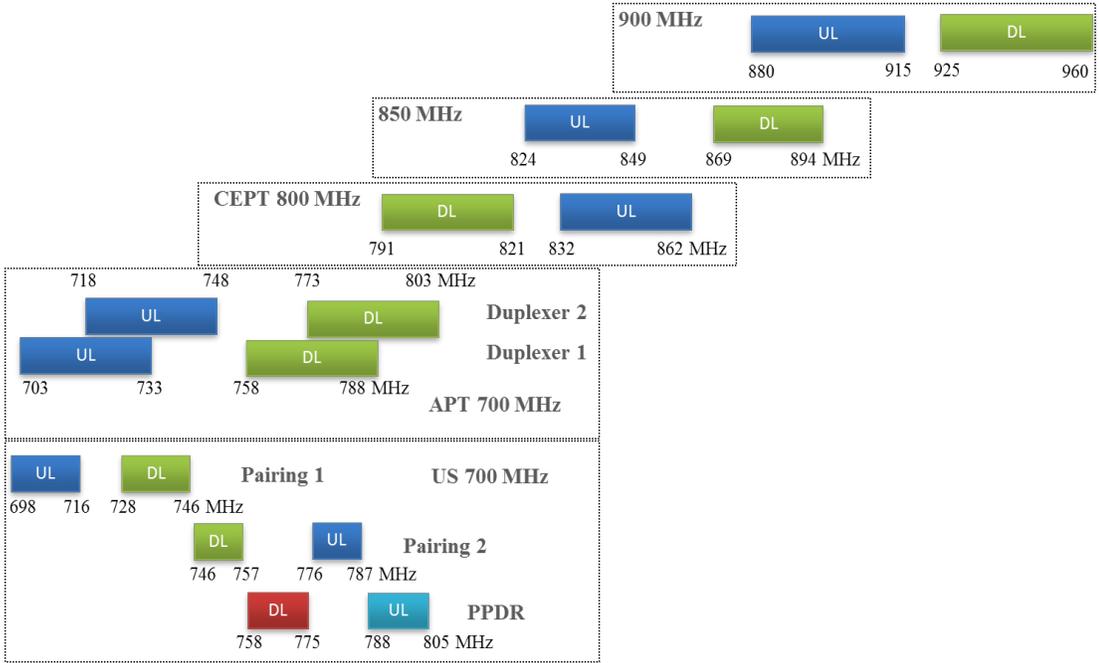


Figure (3): Frequency Arrangements in the 700 MHz, 800 MHz, 850 MHz, 900 MHz (Rancy, 2012)

Having mentioned that, harmonisation between the CEPT 800 MHz plan and the APT 700 plan is possible by adopting the lower duplex of the APT plan of the spectrum bands, 703-733

MHz and 758-788 MHz as shown in Figure (4). This implies that end user equipment can operate according to the APT plan in the 700 MHz band in the Asian countries while being able to roam in Europe on the 800 MHz band using the CEPT plan. The advantages of using the lower duplex of the APT plan include simplifying the equipment design due to the use of the same duplex of the APT plan and having a large duplex gap which reduces self-interference between handset transmitter and receiver (Egypt, 2012).

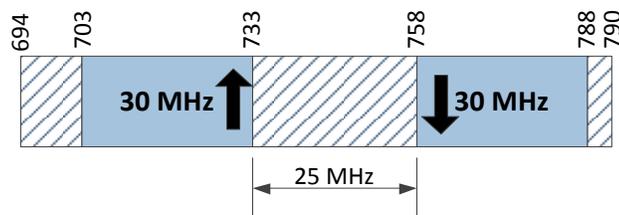


Figure (4): Using the Lower Duplexer of the APT Plan (Egypt, 2012)

The issue of the preferred frequency arrangements in the 700 MHz in region 1 was discussed extensively in the WP 5D where there were 14 different proposals for the 700 MHz band frequency arrangement that are fully or partially harmonised with the APT plan (Migwalla, 2013).

It is useful to focus on the positions of the African countries during the discussion. In particular, at the beginning, the African countries wanted to make the best use of the 700 MHz band by utilising most of the APT plan if not all of it. In other words, some African did not give much attention to the CEPT plan in the 800 MHz band while focusing on making the maximum use of the APT plan. For instance, Kenya made a proposal that was fully harmonised with the APT plan with 2x45 MHz in the two bands 703-748 MHz and 758-803 MHz regardless of the CEPT plan (Kenya (Republic of), 2014). Similarly, Egypt proposed a frequency arrangement of 2x40 MHz that starts at 694 MHz (Egypt, 2012), and of 2x42 MHz which starts at 694 MHz to achieve the highest possible utilisation efficiency of the 700 MHz band (Egypt, 2013).

In early 2013, South Africa and Zimbabwe made a proposal to assess the suitability of proposed channelling arrangements (South Africa & Zimbabwe, 2013). In particular, it was suggested to maximise commonality with the APT plan, as many countries adopted it and to achieve economies of scales. In middle of 2013, some African countries made a proposal to decrease the number of the frequency arrangements discussed at the WP 5D (Angola (Republic of) et al., 2013). In particular, it was proposed that only frequency arrangements that match with the APT plan in the 700 MHz should be kept.

In the 19<sup>th</sup> meeting of the WP 5D which was the last before the sixth and last JTG 4-5-6-7 meeting, the CEPT made a proposal on the frequency arrangements issue indicating that CEPT is focusing its work on a channelling arrangement for IMT in the 694-790 MHz band which consists of 2x30 MHz of the lower edge of the APT plan in addition to up to 20 MHz (738-758 MHz) for supplemental downlink (United Kingdom of Great Britain and Northern Ireland, 2014). Kenya made also a contribution requesting the WP 5D to indicate to the JTG 4-5-6-7 that only two frequency arrangements should be included in the draft CPM text for agenda item 1.2 which is the lower duplex of the APT plan (703-733/758-788 MHz) and the whole APT plan (703-748/758-803 MHz) (Kenya (Republic of), 2014).

Several giants companies from the industry supports having one single frequency arrangements by the WP 5D accommodating the lower duplex of the APT plan in addition to 20 MHz (738-758 MHz) for supplemental downlink (SDL) for IMT (Alcatel-Lucent International et al., 2014). Eventually, WP 5D sent a liaison statement to the JTG 4-5-6-7 indicating that the proposed IMT channelling arrangements consist of a common baseline arrangement: 2x30 MHz FDD (uplink: 703-733 MHz, and downlink: 758-788 MHz), which is the lower duplexer of the APT plan in the 700 MHz band (Working Party 5D, 2014). Such arrangement was included in the draft CPM text to the WRC-15 (ITU-R, 2014).

The analysis of the interviews on the frequency arrangements in the 700 MHz band shows that the APT plan did have an influence on the discussion on the 700 MHz mobile allocation in region 1 in the WRC-12. As explained by one interviewee from the Arab countries, the European countries were not ready at the WRC-12 in terms of the frequency arrangements. More specifically, the Asian and the US already had their frequency arrangements developed. Moreover, adopting the APT band plan was perceived as much more efficient in terms of lowering the cost and achieving roaming. A statement made by an interviewee conveys this *“current reality: much of Africa and Middle East has probably more aligned East to West (region 2 and 3) rather than North and South”*. In fact, several interviewees expressed that there is a market movement in region 1 from Europe towards Asia.

Furthermore, one senior interviewee from the APT region explained that the APT is considering being in line with other regions as much as possible and this is the reason why the APT is keen that other countries from other regions follow their 700 MHz channel arrangements. One other interviewee from APT clarified that APT managed to develop a plan and there is an interest to get momentum for it. In particular, the Asian manufactures have special interest in getting market shares in the Arab and African countries.

However, at the WRC-15, the European countries would be ready by having their frequency arrangements. In fact, this is one of the reasons why the European countries requested to have the allocation activated by the WRC-15. In particular, one interviewee from CEPT explained why the European countries were interested in the discussion following the WRC-12. More specifically, if the Asia, African and Arab countries are interested in that band, Europe cannot miss having cheap handsets produced in Asia. One other interviewee from CITEL commented on the frequency arrangements proposed by the US and how it was expected that Canada and Mexico would follow the US to achieve economies of scales. However, Latin America countries found the APT plan more attractive to them and Mexico decides to adopt it although the pressure from the US government.

One note regarding the frequency arrangements is that at the beginning of the discussion following the WRC-12, some of the African and Arab countries were interested in adopting the APT frequency arrangements fully to maximise spectrum use utilisation even if that would contradict with the CEPT plan in the 800 MHz. This is due to the fact that in several African and Arab countries, the band 800 MHz is already utilized by other services rather than mobile. However, due to the unique nature of the telecom market that is based on harmonization, eventually, countries and the industry were more in favour in achieving harmonization by adopting both of CEPT plan in the 800 MHz while adopting part of the APT plan in the 700 MHz (lower duplexer) that does not contradict with CEPT plan.

## 7. Policy Implication

The 700 MHz mobile in allocation issue in Africa has raised a lot of areas that needs further examination. Firstly, the African countries challenged the decision making procedures and managed to have the 700 MHz allocation in WRC-12 without being on the agenda of the conference considering the severe objections of the European countries in addition to Iran. However, as shown through the paper, the European countries were quite involved in the discussion on the 700 MHz allocation following WRC-12 and were keen to have their views included. So a question that rises is why the situation changed following WRC-12 from the European perspective.

The paper is based on primary data collected mainly through semi-structured interviews with the several African and European stakeholders that participated in the 700 MHz debate during and after WRC-12. The paper also draws on the observations made by the lead author who attended meetings where the 700 MHz allocation was discussed.

Firstly, prior to WRC-12, the need of the 700 MHz band was different between Africa and Europe. More specifically, the European operators were still in the process of utilising the 800 MHz and the 700 MHz band was utilised by the broadcasters (Stirling, 2012). In addition, re-farming the 700 MHz band was perceived to be more difficult than the 800 MHz band as it would affect almost one third of the broadcasting band 470-790 MHz and would negatively influence the programme making and special events (PMSE) services operating in the broadcasting spectrum in Europe (Standeford, 2015). One interviewee from mobile industry explained that due to the severe competition in the European market, Europe was not in rush to use the 700 MHz immediately. In addition, while some European countries have 90% of their population depending on terrestrial broadcasting, this percentage is 5% for some other European countries (Youell, 2014b).

On the other hand, in Africa, the majority of countries have limited analogue TV broadcasting channels and therefore, the broadcasting service does not occupy much spectrum in the UHF band (Balancing Act, 2011). Moreover, the band 790-862 MHz is partially allocated to other services in many African countries which increases the importance of the band 694-790 MHz (ATU, 2012a). Stirling (2012) explains that the reason for the slow development in switching over to digital terrestrial broadcasting comparing to Europe is related to the population density in Africa where over one billion people distributed over a continent of over 30 million square kilometres

Therefore, during WRC-12, there was an immediate need to the 700 MHz mobile allocation in Africa. On the contrary, the 700 MHz may have been part of the long-term plan of the UHF band in Europe. However, the European countries agree to have the allocation in their territories because the alternatives would to have the allocation in the Arab and African countries exclusively. As explained by one of the interviewees from Africa that during the WRC-12, it was proposed that countries objecting to the allocation can simply not join it. In such case, in addition to have region 1 breaking apart, the Arab and African countries would align themselves to the Asian plan of APT and the manufacturing industry in Europe would be the loser.

However, as clarified through the interviews, the European countries refused having the sub-regional allocation by footnotes in the international table of frequency allocation to African countries because they were concerns that some of them would join and the footnote will grow to be regional allocation and they would have lost the control which they have now on determining

how the frequency arrangements take place in the 700 MHz band. It was clarified by one of the interviewees that the JTG 4-5-6-7 which addressed the 700 MHz allocation after the WRC-12 is chaired by chairman from Europe, which indicate that Europe does not want to be separated from the other regions regarding this issue.

Meanwhile, several interviewees indicated that some non-European countries, which were interested in the 700 MHz band allocation were also keen to have the European countries agreeing on the allocation. More specifically, although the African and Arab countries intended initially to have an immediate allocation even on their lands only, they also wanted the European countries to approve the allocation in order to have a regional allocation for region 1 countries. In addition, it was explained that the decision by Europe on the 700 MHz whether to be used for broadcasting or mobile will have an influence on the rest of region 1 because the manufactures of mobile terminals are mainly from Europe.

The second issue that needs close examination is the decision-making procedures of the ITU-R. In particular, the African countries challenged the WRC-12 procedures and used the argument that WRCs are sovereign in their decisions and that the conference agenda should be flexible. As stated by one interviewee who was in favour of the allocation during the conference "*Who serves who, the agenda item serves the world, or the world serves the agenda item?*". However, it seems that the same African countries were not able to impose their views on the others in the period following WRC-12. More specifically, the discussions in the ITU-R WPs and SGs are based on consensus, which means that it is possible for few countries to include their views. In fact, this is what happened regarding the ITU-R recommendation on OOB. While the recommendation had the support of several African, Arab and European countries, it was not possible to get the recommendation agreed.

In fact, consensus is related to one of the most important concepts in the telecom industry: harmonisation. In other words, without having consensus, everyone loses. If consensus is not possible, each group of countries would have their solutions and economies of scales would not have been achieved. Still consensus has the drawback of countries blocking the discussion even on basis related to other issues. What could be concluded on that issue is that countries are not totally independent in their decisions on international spectrum matters. In other words, while each country is sovereign in their territories regarding spectrum use, countries need the others in order to have regional or global harmonised use of spectrum. Otherwise, in most cases, countries do not have the scale to act alone in the telecom industry, and even if they have the scale, they still needs their citizens to be able to having roaming capabilities in the other countries.

The third issue that needs exploration is the three region systems. In particular, while the 700 MHz mobile allocation issue is a region 1 issue, several entities from region 2 and 3 were involved. Firstly, Iran, as part of GE-06 plan which covers region 1 in addition to Iran, was interested in the 700 MHz discussion. And while most of the region 1 countries (Arab, African, European) were keen to have the mobile allocation, Iran was more concerned with the protection of their terrestrial broadcasting service in the 700 MHz from mobile deployment in neighbouring region 1 countries (e.g. UAE). Therefore, it could have been more convenience to have Iran as part of region 1 instead of having this historical division between region 1 and 3 that is geographically unexplained.

In fact, the situation of Iran is complicated as explained by one of the interviewees. On the one hand, Iran is part of region 3, which has already a mobile allocation in the 700 MHz band.

On the other hand, Iran is also against having mobile allocation in the 700 MHz band in region 1 unless their broadcasting service is fully protected. In other words, although the 700 MHz allocation in region 1 is a region 1 decision, still a country from region 3 is involved in the discussion. One other issue that was raised is related to Russia, which is far away geographically from Africa and still is able to oppose decisions related to service allocation in Africa. As stated by one of the interviewees from Africa “*we are on the other side of the earth, we can't cause interference to the Russians*”.

Another issue related to the three regions system that was raised during the interviews is the dynamics of region 1 and how the different four regional organisations including tens of developed and developing countries interact. In particular, it was expressed that region 1 is large and accommodates quite diverse conditions. In addition, it was argued that Europe and Africa have the same need but they are with different development. One interviewee from Africa expressed that region 1 should be divided between Africa and Europe as there is no common ground between them except that Africa used to be the colonies of Europe.

One other interviewee from Africa clarified that the African countries have started re-planning the GE-06 agreement and such process was conducted independently from Europe. Therefore, although Europe and Africa are in the same ITU-R region, region 1, the African countries were able to decide on the use of the spectrum in the UHF spectrum without cooperation with the European countries due to the large separation distance from Europe and most of the African countries. In fact, recently, there have been calls to create a new ITU-R region for Africa (Youell, 2015).

In summary, the paper has shown several emerging themes regarding spectrum management in the African continent. Firstly, the African countries managed to well coordinate their positions with their neighbouring Arab countries in preparation for the WRC-15 following their joint significant success in the WRC-12. This was not reflected only in the large number of countries in favour of or against an issue. Instead, the African countries managed to conduct, maybe for the first time, sophisticated technical studies supporting their views. In fact, the African countries succeeded in several occasions in including their views (e.g. lower band refinement, sharing between broadcasting and mobile services).

Secondly, the large exceptional number of countries from Africa supporting their contributions regarding the 700 MHz allocation discussion (30 countries in two contributions) proves that there is unified position toward some issues on spectrum use on the international level. Such unified position is powerful at the ITU-R meetings and could enforce to a certain extent the African countries' interests. As expressed by several interviewees, the presence of Africa in the ITU-R was not effective before WRC-12. Furthermore, the African countries have showed their flexibility in reaching a compromise with the European countries regarding the OOB values.

In addition, the paper has identified double edges measures in the international spectrum management regime such as the capabilities of few countries to block the whole discussion. Besides, the paper has shown that the three regions system does not accurately reflect the geographical situation where countries in region 1 are quite close to countries in region 3.

Last but not least, with respect to the dependency of the African countries' decisions regarding the use of spectrum in their territories on their neighbouring countries, this paper shows that although in theory, the African countries have the sovereign right to plan and use

their spectrum according to their needs, they prefer to align themselves with the other countries in order to gain benefits of global harmonisation (e.g. roaming, economies of scales). Firstly, with respect with the 700 MHz allocation, the European countries were keen to join the allocation and the African countries were also keen to have the allocation in the European countries. With regard to the frequency arrangements in the 700 MHz band, the African countries aimed at having an arrangements that fits with APT plan in the 700 MHz band but without any contradiction with the CEPT plan in the 800 MHz band. Regarding the OOB values, they African countries agreed to reach a compromise with the European countries that is also in line with the values adopted by APT.

This is also related to one of the main concepts adopted in the ITU-R, which is consensus. As explained by one of the interviewees, consensus does not necessarily means no country object, but it implies that countries do not show such rejection and instead seek compromise. This is the reason why voting has rarely been used in the ITU-R. While this may has the shortcoming of delay in reaching such consensus, it has the advantage of not enabling any country or group of countries to enforce a decision on the others. As clarified by one of the interviewees “Everybody goes home equally happy and equally unhappy”.

This paper argued that, in this era of globalisation, it is not beneficial for a country or a group of countries to act separately from the rest of the world even if they could. Therefore, Until Africa has the manufacturing capabilities and economic resources to have this independent framework of spectrum use, the African countries should closely coordinate with the rest of the world in order to achieve mutual benefits for all.

## **8. Conclusions**

The African countries presence in the ITU-R has significantly changed with time from having their votes used by the European countries to establishing regional organisation and presenting common proposals to WRCs. One significant change in the performance and influence of the African countries at the ITU-R was at the last WRC-12 where they succeeded in acquiring an additional allocation to the mobile service in the 700 MHz band although the opposition of the European countries.

While the band was historically allocated exclusively to the broadcasting service, the African countries perceived the band as their first digital dividend. The WRC-12 allocation was conditioned by refinement of the lower edge of the band, defining technical and regulatory conditions for the mobile service, and studying frequency arrangements in the band.

Regarding the refinement of the lower edge of the 700 MHz band, the African counties requested the lower edge to be set at the frequency 694 MHz considering that most of the African counties managed to re-plan their broadcasting service in the UHF band to be accommodated in the band 470-694 MHz following the WRC-12. Eventually, it was agreed to that.

The discussion on the sharing between mobile and broadcasting services in the 700 MHz band accommodates two views. The first, which is shared by the African countries, is that sharing is possible and that GE-06 provides sufficient protection for the broadcasting service. The second is that constrained technical and regulatory conditions should be imposed on the mobile service. These views will be discussed at the WRC-15 so that the conference would decide on which to apply.

One other issue that was extensively discussed following WRC-12 is the out of band emission (OOBE) values in the band below the frequency 694 MHz, which are required for the protection of the broadcasting service. One of the first identified OOBE value in the 700 MHz was determined in association with the APT plan in 2011 to be not exceeding -34 dBm/MHz below the frequency 694 MHz which is equivalent to -25 dBm/ 8MHz. While the African countries supported the APT value, other countries and broadcasters suggested more stringent values. Eventually, it was not possible to reach consensus on a single OOBE value for the protection of broadcasting service below the frequency 694 MHz.

Another important issue that was related to the 700 MHz band is the frequency arrangements in the band in region 1. The main adopted plan in the band is the APT one which provides 2x45 MHz for FDD operation of broadband systems but overlaps with the CEPT plan in the 800 MHz. While the African countries aimed following the WRC-12 to fully harmonise with the APT plan, they agree eventually to partially harmonise with the APT plan by the adopting the lower duplex of it while being able to harmonise with the CEPT plan in the 800 MHz as well. The industry and the European countries also supported this in order to maximise harmonisation between the ITU-R three regions.

The 700 MHz band issue has shown that although the African and European have different needs with regard to using the band for broadcasting or mobile services, both of these countries are keen to have harmonisation among them to the largest possible extent in order to gain the benefits of economies of scales and international roaming.

The examination of the decision making procedures in the light of the 700 MHz discussion has revealed that although the African countries are sovereign in their territories regarding spectrum use, they are still in need for the others countries in order to have regional or global harmonised use of spectrum. Therefore, discussions in the ITU-R are mostly based upon consensus.

Having this conflict of interest during the 700 MHz discussions between Iran, which is not part of region 1 where Africa lies and has already mobile allocation in the 700 MHz band, and Russia, which is largely separated geographically, on one hand and the African countries on the other hand has raised a big question mark regarding the current ITU-R three regions system. This is in addition to the several differences in terms of spectrum use between the African and European continents.

The frequency arrangements in the 700 MHz has shown that there is a tendency of the African countries to align with the Asian market in instead of the European and American ones to lower the cost of the end user equipment. Meanwhile, the European and Asian manufactures have interest in getting shares of the African market. Furthermore, the issue has revealed that harmonisation among the regions is more important than maximising spectrum use utilisation. On the OOBE issue, the African and Arab countries tended to compromise with the European countries, as having different OOBE values for each group of countries will increase the prices of the user terminals and make them more complicated.

The paper has shown several emerging themes regarding spectrum management in the African continent including the well coordination with the neighbouring countries to the African continent, utilising the large number of the African countries in region 1, flexibility in reaching a compromise. The paper has also examines the weakness points of the ITU-R decision making procedures and the three regions system. In general, although in theory, the African countries are

sovereign, they prefer to align themselves with the other countries in order to gain benefits of global harmonisation (e.g. roaming, economies of scales).

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