Radiocommunication Study Groups

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Annex 4 to Joint Task Group 4-5-6-7 Chairman's Report

DRAFT CPM TEXT FOR WRC-15 AGENDA ITEM 1.2

CHAPTER 1

Mobile and Amateur issues
(Agenda items 1.1, 1.2, 1.3 and 1.4)

Agenda item 1.2
(**JTG 4-5-6-7 / WP 4A, WP 5A, WP 5B, WP 5D, WP 6A** (WP 3K, WP 3M))[1]

1.2 to examine the results of ITU R studies, in accordance with Resolution ***232 (WRC-12)****, on the use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and take the appropriate measures;*

Resolution **232 (WRC-12)**: *Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and related studies.*

1/1.2/1 Executive summary

Section 1/1.2/2 contains a general description for background information on WRC-15 agenda item 1.2 (AI 1.2) according to Resolution **232 (WRC-12).**

Section 1/1.2/3 contains a summary of technical and operational studies and relevant ITU-R Recommendations. This summary assesses:

- Spectrum requirements for the broadcasting service (BS) and the mobile service (MS)
- Sharing and compatibility studies between the BS and MS
- Sharing and compatibility studies between the aeronautical radionavigation service (ARNS) and MS
- Solutions for SAB/SAP.

Section 1/1.2/4 contains the analysis of the results of studies, in particular:

- The analysis of studies between BS and MS

[1] See the CPM15-1 Decision on the establishment and Terms of Reference of Joint Task Group 4-5-6-7 (Annex 10 to Administrative Circular CA/201).

- The analysis of studies between the ARNS and the MS
- The analysis of solutions for SAB/SAP.

Section 1/1.2/5 contains the methods to satisfy the agenda item for the following issues:

- Issue A: Option for the refinement of the lower band edge
- Issue B: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and BS
- Issue C: Technical and regulatory conditions applicable to MS concerning the compatibility between the MS and the ARNS for the countries listed in RR No. **5.312**
- Issue D: Solutions for accommodating the requirements for applications ancillary to broadcasting.

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Section 1/1.2/6 contains regulatory and procedural considerations for Issues A, B, C and D mentioned above.

1/1.2/2 Background

WRC-12 adopted Resolution **232 (WRC-12)** relating to the allocation of the frequency band 694-790 MHz in Region 1 to MS except aeronautical mobile service (AMS) (see also RR No. **5.312A**). This frequency band is already allocated to the MS in Regions 2 and 3. The frequency band 694-790 MHz is also allocated to BS on a primary basis in all three ITU Regions. In Region 1, it is also allocated to ARNS on a primary basis in some countries under RR No. **5.312**, the land mobile service (LMS) on a secondary basis intended for applications ancillary to broadcasting in some countries under RR No. **5.296**, the fixed service (FS) and mobile except aeronautical MS on a secondary basis in several countries of Africa and Middle East under RR No. **5.300** and the broadcasting satellite service (BSS) under RR No. **5.311A** and in accordance with Resolution **549 (WRC-07)**.

It should be noted that the GE06 Agreement applies in all of Region 1 countries (except Mongolia), and including the Islamic Republic of Iran in Region 3. Compatibility between MS and other primary services to which the frequency band is allocated and in adjacent bands (in particular BS and ARNS) needs to be ensured.

There is a demand by many developing countries in Region 1 to use International Mobile Telecommunications (IMT) systems in the 700 MHz frequency band in order to meet their needs, and in order to assist them to “bridge the gap” between their communication capabilities and those of developed countries considering, to a certain extent, possibilities of new technologies to provide various radiocommunication services.

The 700 MHz frequency band allows for cost effective implementation of IMT in particular for large areas with low population densities. Terrestrial BS provides a cost-efficient solution for high-quality media delivery in particular to populations in rural areas. It is an evolving service that has adapted and continues to adapt to new consumer demands in terms of content and technology, such as three dimensional television (3DTV) and ultra-high definition television (UHDTV).

ITU-R studies have been conducted on spectrum requirements for MS and BS and on the channelling arrangements for MS, adapted to the 700 MHz frequency band.

Furthermore, WRC-15 agenda item 1.2 refers to several issues:

- Issue A: Options for the refinement of the lower edge
- Issue B: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and BS

- Issue C: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and ARNS
- Issue D: Solutions for accommodating applications ancillary to broadcasting requirements.

Resolution **232 (WRC-12)** also invites the ITU-R to study solutions for accommodating applications ancillary to broadcasting requirements. These applications are deployed in a number of countries of Region 1 on a secondary basis in accordance with RR No. **5.296**.

The allocation of the frequency band 694-790 MHz in Region 1 to MS except aeronautical MS will be effective immediately after WRC-15 and therefore fully available for national use, as required, for mobile applications.

Taking into account the desire of harmonization across Regions, ITU-R has developed an IMT channelling arrangement based on a common baseline arrangement: 2x30 MHz frequency division duplexing (FDD) (uplink (UL): 703-733 MHz, and downlink (DL): 758-788 MHz), which is the lower duplexer of A5 channelling arrangement in Recommendation ITU-R M.1036-4 and with maximum possible utilisation of centre gap for IMT.

With regard to possible additions to the baseline arrangement, no consensus was reached and two views were expressed:

View 1: Some administrations are of the view that:

ITU-R is also studying possible additions to the baseline arrangement, which may be reflected in the new revision of Recommendation ITU-R M.1036.

These administrations proposed the following additions to the baseline arrangement:

a) Up to 20 MHz supplemental down-link (SDL) within the centre gap (738-758 MHz);

b) 2x3 MHz FDD (UL: 733-736 MHz, DL: 788-791 MHz), which could be used for IMT applications;

c) 2x5 MHz FDD (UL: 698-703 MHz, DL: 753-758 MHz), which could be used for IMT applications subject to protection of BS below 694 MHz in Region 1.

View 2: Some other administrations are of the view that:

These possible additions have not been studied in ITU-R and some of them are out of the scope of AI 1.2.

In general, it should be noted that another frequency arrangement related to this frequency range is already included in Recommendation ITU-R M.1036-4 (A5 "UL: 703-748 MHz, DL: 758-803 MHz").

1/1.2/3 Summary of technical and operational studies and relevant ITU-R Recommendations

1/1.2/3.1 Spectrum requirements

1/1.2/3.1.1 Spectrum requirements for the broadcasting service

In 2012/13 ITU-R conducted a survey to ascertain the spectrum requirements for digital terrestrial television broadcasting (DTTB) of administrations in Region 1 and 86 responses from administrations were received.

A summary of the responses is given in the following tables.

TABLE 1/1.2/3-1

Proportion of population using terrestrial television

Population using terrestrial TV	<25%	≥25 and <50%	≥50 and <75%	≥75%	No reply
Number of administrations	16	10	14	25	21

TABLE 1/1.2/3-2

Number of DTTB multiplexes required in the future in the band 470-862 MHz

Number of multiplexes	0-3	4-6	7-8	>8	Still to be determined
Number of administrations	4	57	9	4	12

TABLE 1/1.2/3-3

Amount of spectrum required in the band 470-862 MHz for DTTB in the future

Spectrum requirement (MHz)	<224	= 224	> 224 and < 320	= 320	>320	Still to be determined
Required band IV/V 8 MHz TV channels	**Fewer than 28**	**28**	**Between 28 and 40**	**40**	**More than 40**	**–**
Number of administrations	4	39	8	16	3	16

Full details of the results of the ITU-R survey can be found in Report ITU-R BT.2302-0.

Following the allocation of the frequency bands 790-862 MHz and 694-790 MHz to MS at WRC-07 and WRC-12 respectively, forty-seven (47) Sub-Saharan countries in Africa plus Egypt reached an agreement on the principle of harmonizing the use of the frequency band 470-694 MHz for terrestrial television broadcasting and the frequency band 694-862 MHz for MS. The African Telecommunication Union (ATU), with the assistance of the ITU, concluded an 18-month negotiation and coordination process to complete the GE06 modification activities to satisfy all or most of each nation’s broadcasting frequency requirements. These activities have been very successful with a target number of four multiplexes per site largely attained, showing that the broadcasting spectrum needs of these administrations can be covered in the UHF frequency band 470-694 MHz. These administrations have started with the process of formal submission of official GE06 Plan modification notice files to the ITU BR in order that the modifications to the Plan could officially take effect and be reflected in the GE06 Plan.

The result of studies carried out indicates that the lower edge of the frequency band under consideration in WRC-15 agenda item 1.2 should be set at 694 MHz.

1/1.2/3.1.2 Spectrum requirements for the mobile service

Noting that ITU-R studies on spectrum requirements for IMT were focused on the total requirements, therefore no spectrum requirement studies were carried out for MS in the frequency band 694-790 MHz for Region 1.

1/1.2/3.2 Sharing and compatibility studies between IMT and BS

1/1.2/3.2.1 Co-channel studies

1/1.2/3.2.1.1 Mobile service base stations as an interferer into broadcast reception

A generic study showed that the cumulative effect of interference can exceed 20 dB and that a separation distance of more than 200 kilometres is needed to meet the field strength threshold of 23 dB(μV/m) which equivalents to an *I/N* of –10 dB (95% locations, 16 dB antenna discrimination) at the lower end of the frequency band 694-790 MHz compared to 61 kilometres for a single base station of MS.

The results of another generic study showed that the excess of the cumulative interference from an MS network (from IMT to broadcast) over the single interferer can be up to 21 dB. This causes a corresponding increase of separation distance of up to 274 kilometres on land and up to 1 000 kilometres for land/sea paths (warm), when using the same field strength threshold for cumulative interference as for single entry interference.

A case study showed that excess of the cumulative interference from MS network over the single interferer can be up to 21 dB (using the receiving antenna).

A generic study showed that even without accumulation of interfering field strength, a single IMT base station will need to be positioned 53 kilometres (for land path) from the DTTB service edge, i.e. from the border of the affected administration, in order not to exceed 23 dB(μV/m). This field strength is equivalent to an *I/N* of –10 dB (95% locations, 16 dB antenna discrimination) at the input of the DTTB receiver at the lower end of the frequency band 694-790 MHz. Including multiple interfering base stations would increase the interfering field strength at the DTTB service edge by up to 20 dB which corresponds to a separation distance of up to 200 kilometres based on the parameters used in this particular study, when using the same field strength threshold for cumulative interference as for single entry interference.

A case study showed that IMT base stations in one country which are not individually subject to coordination, i.e. meeting the trigger threshold of GE06 (25 dB(μV/m)), will not interfere with the TV receivers in the neighbouring country, even if the cumulative effect of those base stations is taken into account.

1/1.2/3.2.1.2 Broadcasting service as an interferer into mobile service base stations

A generic study showed that separation distances up to 427 kilometres and 269 kilometres, for high power (HP) and medium power (MP) DTTB transmitters respectively, would be required to protect the IMT base station receiver (uplink) for 99% time, a target *I/N* of –6 dB and with no additional discrimination by cross-polarization or receive antenna directivity. The relaxation of the protection level to 90% time, a target *I/N* of 0 dB and mitigation by full receive antenna polarization and/or discrimination would reduce the separation distances to 159 kilometres for HP and 76 kilometres for MP.

A case study showed that co-channel sharing between DTTB transmitters and an IMT uplink receiver positioned at 30 metres height, will require separation distances of the order of 200 kilometres on land paths even with antenna cross polarization and a relaxation of the percentage of time for the interfering signal from 1 to 10%.

A generic study showed that the maximum permissible interfering field strength threshold for the protection of IMT base stations from DTTB stations based on an *I/N* = –10 dB is higher than the GE06 trigger field strength threshold of 13 dB(μV/m) (generic case, code NB).

1/1.2/3.2.2 Adjacent channel studies

1/1.2/3.2.2.1 IMT base station interference into DTTB

One study showed that the separation distances needed for different adjacent channel cases in order to protect DTTB from IMT base stations, considering the accumulative effect would vary from 15 to 35 kilometres.

The study of the interference situation between LTE base station downlinks and fixed roof-top digital terrestrial television (DTT) reception in the adjacent band (in the 800 MHz band) in France shows that the distance between the interfering IMT base station and the fixed roof-top DTT receiving location is, in 99% of cases, below 1.3 kilometres. This interfering situation is essentially a national matter and does not require any provision in the RR. Almost all reported interference cases observed so far were identified as the LTE base station provoking DTT receiver saturation (active systems like amplifiers or DTT television / set-top box). All these cases had been successfully resolved by the administration and operators by introduction of an LTE 800 filter (either head-end filters or user filters). Regarding the saturation effects, the situation is likely to be similar in the 800 MHz and 700 MHz frequency bands.

1/1.2/3.2.2.2 IMT user equipment interference into DTTB

1/1.2/3.2.2.2.1 Minimum coupling loss calculations

One study showed that the minimum coupling loss (MCL) technique establishes known everyday configurations for study. This study showed the television (TV) fixed reception critical distance is around 22 metres to the areas outside a house with a larger distance spread within a few dB. Using the adjacent channel selectivity (ACS) and out-of-block (OOB) / adjacent channel leakage ratio (ACLR) values provided by the working parties, the actual separation distance required between a user equipment (UE) and the fixed TV antenna is a lot greater. There would be no compatibility at maximum UE power in lower TV reception signal strength areas at a separation distance of 22 metres. The potential improvement in compatibility with higher TV ACS values, as found in newer TV sets, were investigated plus additional external filter mitigation. To achieve compatibility, the calculated required UE OOB level is –56 dBm/8 MHz for 23 dBm UE power, for a 10 MHz LTE signal, and given a TV receiver plus an extra filter combined ACS of 80 dB.

A study showed that in a typical European suburban area there is a high probability, over 70% in the example provided, that the path loss between an IMT UE and a DTTB receiver using a fixed receive aerial will be within 6 dB of MCL.

One study based on a MCL method derived the level of out-of-block emissions (OOBE) required to limit the degradation in sensitivity of a DTTB receiver, with fixed roof top antenna, to 0.41 dB; this degradation corresponds to an *I/N* of –10 dB. The results derived a minimum coupling distance of 22 metres and suggest an OOBE limit of –56 dBm/8 MHz would be appropriate to manage the interference into a typical DVB-T2 receiver. The calculations assumed the DTT receiver ACS would be enhanced by using an external filter to give a total ACS value of 79 dB.

One study showed the following, with measurements of the performance of three independent new design TV receivers on sale in the United Kingdom, in the presence of LTE interference. The results also showed that the improved ACS values capabilities of these receivers could not be utilised unless improvements were also made to the ACLR of the UE. The studies showed the additional benefits that were possible with external TV receiving filters. Bandpass transmit filters on the UE were used to vary the OOB emissions. The achieved TV receiver ACS values were between 64 dB to 65 dB unaided and from nearly 74 dB to 80 dB with the aid of an external receiving filter. The TV receiver overload thresholds were improved from around –10 dBm to above +10 dBm with the external receive filter.

1/1.2/3.2.2.2.2 Monte Carlo simulations

A generic study on the impact of IMT UE into DTT reception at the coverage edge showed that the less favourable interference scenario from IMT/LTE uplink to DTT is found in an urban environment for smaller cell size (higher active user density). In a rural environment the probability of interference is mainly dominated by UE in-band (IB) power, and this power can only be attenuated by the DTT receiver ACS. It also showed that the total probability of interference decreases with the increase of DTT receiver ACS, and the increase of IMT UE ACLR (decrease of UE OOBE level). Furthermore, for a given DTT receiver ACS, the total probability of interference will not decrease with the increase of IMT UE ACLR (decrease of UE OOBE level) above a certain level, since it is limited by DTT receiver ACS. When considering several UE (e.g. 10) the probability of interference is mainly dominated by the UE IB power.

Another study indicated that imposing more stringent OOBE values of up to –35 dBm/8 MHz, will lead to a minimal reduction in interference probability (IP) of 0.10% at most. On the basis of this minimal reduction in IP, the adoption of stricter OOBE limits is not warranted. In view of the above results, and taking into account the potential benefits of harmonisation, it is proposed that an OOBE limit of –25 dBm/8 MHz be adopted as a suitable value

Another study indicated that in the whole DTT coverage area, for a given IMT UE transmitter blocking mask or ACLR which are based on the APT OOBE value that are recommended not to exceed –34 dBm/MHz (ACS values of 25, 38, 50 and 60 dB were taken into account) below 694 MHz, the results of the simulations for different DTT receiver ACS values show that the total interference probability (IP) is less than 1% in all cases.

Another study indicated a very low IP for its worst case (urban environment, one user with full resource block allocation, low ACS of DTT receiver) and almost zero potential of IP in the majority of scenarios and parameter combinations. It was also observed that the IP is more sensitive to the DTT ACS than to the LTE UE OOBE level, so that means that after certain breaking point, more stringent OOBE does not decrease the IP anymore. For example, in the urban scenario (worst case found) and with ACS values 55, 60 and 65 dB, the breaking point for OOBE is somewhere between –33 and –38 dBm/8 MHz (for the 10 MHz IMT channel).

Based on previous work testing input parameters, one study calculated the IP for a DTTB receiver ACS of 65, 70 and 75 dB and a range of UE ACLR from 48 to 79 dB. These studies were conducted using the TPC values and network configuration specified by ITU-R for studies and 10 000 000 simulations in the Monte Carlo calculations. IP results for urban, suburban and rural environments, for the ACS and ACLR ranges mentioned are presented.

Another study was carried out to calculate the probability of interference into portable outdoor DTTB reception. Its results indicate that this probability is slightly higher than it is for fixed reception, for the same parameters, and that it increases significantly with the number of active UE’s. The results also indicate that the probability of interference increases by a factor of 2 if no body loss is taken into account or the UE has a higher antenna gain by 4 dB (+1 dB in total). Furthermore, the study indicates that more than 100 000 events should be used in order to get converging/reliable results.

1/1.2/3.2.2.2.3 Monte Carlo simulations with post-processing

One study based on Monte Carlo statistical simulations of the probability of interference into the DTTB reception in a pixel (100x100 m^2) at the coverage edge during an observation time (TW) of one hour indicated that, while the values of IMT UE ACLR and DTT receiver ACS should be similar in order to achieve the best performance configuration with respect to interference into DTTB reception, above a certain level of ACS (e.g. 65 dB, which is the average ACS of recent DTTB receivers), a further improvement of the IMT UE ACLR above a certain level (e.g. a value higher than 67 dB) there is no significant reduction of the overall probability of interference. This leads to a range of IMT UE OOBE limit values between –40 and –44 dBm/8 MHz for a 10 MHz IMT channel. Further simulations showed that the OOBE of IMT UE operating in the frequency band 694-790 MHz should not exceed –42 dBm/8 MHz for a 10 MHz LTE channel bandwidth in the frequency band 470-694 MHz for the protection of BS in this frequency band.

Another study used Monte Carlo analysis to generate the IP which was then post-processed to give the probability of interference to a DTTB receiver occurring in a specified time window (TW). This post-processing used a number of independent events generated based on the user density and UE movement. The results of this post processing have been used to derive the OOB emissions for IMT UE required to limit interference of DTTB reception to 1%. The study concludes that to limit the interference into channel 48 and below, from IMT UE operating in the 700 MHz band, DTTB receiver ACS should be in the range 70 dB to 75 dB. IMT UE out-of-band emissions should be limited to the range –47 dBm/8 MHz to –52 dBm/8 MHz (an ACLR range of 70 dB to 75 dB).

1/1.2/3.2.2.2.4 Monte Carlo simulation with time element

One Monte Carlo study investigated adjacent band sharing between DTTB and IMT UE based on Δ_{RLP}, the degradation of reception location probability (RLP). This method was developed to deal with the time element of mobile transmission (e.g. movement of UE during a DTTB viewer’s time frame) and to take into account RLP which is the basis of broadcast planning. The Monte Carlo methodology used to calculate Δ_{RLP} is described. The results cover a range of ACS values (55-80 dB) and ACLR values (40-80 dB) and UE density (1-10 UE/sector). It is shown that unacceptable interference from UE results, unless both improved OOBE filtering in the UE and increased ACS at the point of DTTB reception are implemented. Based on the results, an ACS of 80 dB, a set of OOBE limits for 10 MHz IMT UEs are proposed: the OOBE shall not exceed a value of –55 dBm/8 MHz for an resource block usage of 33%; a value of –49 dBm/8 MHz for an resource block usage of 50%; and a value of –46 dBm/8 MHz for an resource block usage of 100%.

1/1.2/3.2.2.2.5 Monte Carlo sensitivity studies

Another set of studies were carried out to test how the results of Monte Carlo simulations varied for different input parameters. One study concluded that the number of simulations in a Monte Carlo analysis needed to provide confidence in the derived IP, should use more than 100 000 trials —ideally being between 1 000 000 and 10 000 000. Another study investigated the impact of omitting the standard deviation associated with building entry loss. This study concluded that doing so would result in an under-estimation of the IP of up to 50% and that such values of IP calculated without taking into account a standard deviation associated with building entry loss, should be adjusted appropriately. As the power control settings are key to determining the level of interference of IMT UE to DTTB reception, a further study was carried out to ensure settings are aligned with advice from ITU-R. Values were derived for urban, suburban and rural environments and used in studies to derive the IP.

Another set of studies were carried out to test how the results of MC simulations varied for different input parameters (“sensitivity studies”). With respect to other studies based on “standard” parameters, the probability of interference into fixed DTTB reception increased by a factor of 2 in case that no body loss applies or the UE antenna gain is by 4 dB higher, as well as if 30% of mobile traffic generated from indoor and 70% generated from outdoor. The probability will increase by a factor of 3 if 30% of traffic is generated indoor, 35% is generated outdoor with body loss and an antenna gain of –3 dBi and the remaining 35% is generated outdoor without body loss and an antenna gain of 0 dBi. The studies also concluded that the number of active devices usually is much higher than the number of users triggered this activity, and that the probability of interference increases significantly with the number of active UEs. This set of studies indicates that more than 100 000 events should be used in order to get converging/reliable results.

1/1.2/3.2.2.2.6 Field Trials

One field trial study with a particular wireless broadband access system (non-3GPP LTE system) indicated that necessary line-of-sight separation distance ranges from 180 to 995 metres for specified technical parameters in this study (depending on the OOBE limit in the range from –56 to –25 dBm/8 MHz and the frequency separation) in the frequency range until at least 112 MHz (N-14) offset, when no mitigation technique for BS is applied. With a rejection filter at the broadcast receiver antennae input, separation distances decrease from a range of 180 to 995 metres to the range from 38 to 713 metres for a 15 dB rejection, and to the range from 22 metres to 703 metres for a 25 dB rejection.

Considering protection ratios for a DVB-T2 system interfered with by LTE, it's shown that to keep the number of households affected by interference at a manageable level (lower than 2%), it is necessary to limit UE OOBE to a level no higher than –52 dBm/8 MHz or –56 dBm/8 MHz (better, 0.5% households affected), with a guard band not less than 9 MHz, 30..40 dB rejection filters and UE maximum power not exceeding 23 dBm.

1/1.2/3.2.2.3 Measurements

A measurement study showed that the tested DTTB receivers (ACS 62 to 65 dB) behave similarly in the presence of a continuous IMT UE signal, and behaved differently in the presence of a discontinuous (time varying) signal. The IMT UE ACLR tested was between 60 and 70 dB. Modern DVB-T2 receivers behave better in the presence of a discontinuous IMT UE signal than in the presence of a continuous IMT UE signal, while the performance of DVB-T receivers was reduced by about 20 dB. The impact of discontinuous IMT UE emissions on DTTB reception can only be efficiently combated by improving DTTB receivers' AGC circuits, including the overall ACS of the receivers. It was confirmed that improving the IMT UE ACLR (i.e. above around 60 dB) does not improve the protection ratio. For these reasons, when determining the IMT UE OOBE limits, only the impact of a continuous IMT UE signal on DTTB reception should be considered.

1/1.2/3.2.2.4 Results adjacent channel studies - IMT UE interference into DTTB

Studies were performed in order to obtain an OOBE limit from IMT UE into the DTTB reception below 694 MHz. These studies were performed under the assumption of 9 MHz between the upper channel edge of the DTTB and the lower channel edge of IMT uplink. The required OOBE limits for IMT UE resulting from these studies are the following:

- MCL studies indicate a value of –56.25 dBm/8 MHz for an ACS of 79.25 dB based on *I/N* and an IMT channel of 10 MHz;
- MC IP based studies indicate a range of –25 to –38 dBm/8 MHz for a range of ACS between 55 and 65 dB based on C/(N+I) and an IMT channel of 10 MHz;
- MC IP based studies indicate a value of –25 dBm/8 MHz for a range of ACS between 25 and 60 dB based on C/(N+I) and an IMT channel of 10 MHz;
- MC IP based studies with post-processing to account for time indicate:
  - in one study, a range of –40 to –44 dBm/8 MHz for a range of ACS between 60 and 70 dB based on C/(N+I) and an IMT channel of 10 MHz;
  - in another study, a range of –47 to –52 dBm/8 MHz for a range of ACS between 70 and 75 dB based on C/(N+I) and an IMT channel of 10 MHz;

- MC Δ_{RLP} based study with time element indicate a range of –46 to –55 dBm/8 MHz for an ACS value of 80 dB based on C/(N+I) and an IMT channel of 10 MHz;
- A field trial study indicates a range of –46 to –56 dBm/8 MHz for an ACS range of between 75 and 80 dB based on C/(N+I) and an IMT channel of 10 MHz;
- A measurement study indicates an OOBE limit of –55 dBm/8 MHz (portable indoor reception) based on *I/N* and an IMT channel of 10 MHz.

1/1.2/3.3 Sharing and compatibility studies between IMT and ARNS

Several sharing and compatibility studies have been carried out with diverging results using different assumptions and methodologies. No agreement however could be reached as to the parameters and methodology that should be used and hence on a single conclusion. The required coordination distance between MS and ARNS ranges from 15 to 565 kilometres. The results are contained in section 1/1.2/4.2.

Further material on current compatibility studies between MS and ARNS in the frequency band 694-790 MHz in Region 1 can be found in in Annex 23 of Document 4-5-6-7/715.

1/1.2/3.4 Solutions for SAB/SAP

RR No **5.296** allocates the band 470-790 MHz to the LMS on a secondary basis for 60 countries and the frequency band 470-698 MHz for another 12 countries and limits its use to applications ancillary to broadcasting (SAB/SAP). Studies within JTG 4-5-6-7 (see draft new Report ITU-R BT.[SAB_SAP]) indicate that this spectrum is intensively used by these applications.

This Report contains a summary of the studies on SAB/SAP, including the following:

- Technical parameters required for a reliable operation of SAB/SAP
- The impact of OOBE from IMT devices in the duplex gap of MS, showing that parts of the duplex gap may not be usable for some SAB/SAP applications
- Service requirements for SAB/SAP at large events, including examples of the number of wireless audio links used in major events in recent years. In most cases the whole spectrum available for SAB/SAP in the 470-790 MHz range was required
- The impact of the loss of the 700 MHz band on SAB/SAP use, assuming that DTT transmitters that currently operate in this band will be moved below 694 MHz[2].

1/1.2/4 Analysis of the results of studies

1/1.2/4.1 Analysis of studies between IMT and BS

1/1.2/4.1.1 Co-channel studies between IMT and BS

Several sharing studies, generic and case studies, on the co-channel compatibility between IMT and DTTB were performed. Some of the generic sharing studies indicated ranges of geographic separation distances required for sharing between DTTB systems and IMT systems. The ranges of geographic separation distances differ significantly depending on different technical conditions, assumptions and methodology used in these studies. The calculated separation distances in these generic studies ranged from 53 to 1 000 km to meet the different protection criteria in each study.

[2] In a case study on the Eurovision Song Contest 2011 it has been demonstrated that out of 175 wireless audio links used, it would have been possible to accommodate only 77 links in the remaining spectrum (470-694 MHz) while respecting the required production quality demands.

Based on these ranges, the conclusion of these studies emphasized constraints on the planning, implementation and sharing of the two services regarding the use of the same or overlapping frequencies in neighbouring geographic areas.

Some other studies have shown that the excess of the cumulative interference from MS network over the single interferer can be up to 21 dB above the value of 23 dB(μV/m), which causes a significant increase in the required separation distance when using the same GE06 field strength threshold for cumulative interference as for single entry interference.

Another case study using existing network configurations showed an increase from 5 to 15 dB of the cumulative effect. For this case study where the cumulative interference is calculated from all IMT stations which individually comply with the GE06 trigger value, it was concluded that the protection of BS was also ensured against cumulative interference in terms of the C/(N+I) criterion.

Another generic study showed that the GE06 trigger value for the protection of the MS is sufficient to protect IMT.

1/1.2/4.1.2 Adjacent channel studies between IMT and BS

Studies on interference from IMT base stations into DTTB receivers were performed in order to assess the requirement for compatibility between MS and BS in an adjacent channel situation. One study showed separation distances of several kilometres (15 to 35 km).

An experience based on an actual implementation of IMT in the 800 MHz band in one country showed that the effective separation distance is lower than 1.3 km in 99% of cases and that interference can be resolved by introducing mitigation techniques such as appropriate band rejection filters in the DTTB receiving installation. Further information can be found in Report ITU-R BT.2301. Several studies have been performed in order to derive IMT UE OOBE limits that would achieve the following objectives:

a) to manage the risk of interference between mobile use and BS below 694 MHz;

b) to be technically feasible from the point of view of practical implementation of IMT UE in order to avoid unnecessarily stringent limits that may lead to an increase in size or in complexity of IMT radio equipment;

c) to aim to a global harmonization of IMT UE.

Compatibility studies were based on the lower duplexer of A5 channelling arrangement in Recommendation ITU-R M.1036 (i.e. uplink in 703-733 MHz) and a maximum output power of 23 dBm.

Having in mind the objectives mentioned above, there were diverging views on the way to meet them in a balanced way. Different IMT UE OOBE values into frequency bands below 694 MHz were proposed, including:

- –25 dBm/8 MHz
- –42 dBm/8 MHz
- –56 dBm/8 MHz

It was found difficult to meet the three objectives mentioned above in a balanced way, as they received different consideration among the proponents of the studies from which the proposed OOBE limits were derived, considering the protection of the broadcasting reception and global harmonisation. It should also be noted that these proposed IMT UE OOBE limits reflect that there are different technical conditions for coexistence with BS between different parts of Region 1, taking into account the differences in broadcasting characteristics, deployments, scenarios and protection criteria for broadcasting reception.

In summary, considering the three objectives mentioned above, it was not possible to reach a consensus on a single OOBE to provide sufficient protection of BS from IMT UE OOBE for the whole Region 1.

Some views were expressed that there are possible measures to meet both the objectives of protection of DTTB reception below 694 MHz and harmonization such as implementing different OOBE limits in the IMT UE for different IMT channel bandwidths in 3GPP specifications.

Some other views were expressed that a possible measure to meet these two objectives while using an IMT channel bandwidth greater than 10 MHz, which has a less stringent OOBE limit, is to implement this IMT channel starting from 713 MHz, therefore the emissions levels from IMT UE below 694 MHz may decrease. It was recognized that a too stringent OOBE limit may result in a more difficult or delayed implementation of IMT UE until the point of time where the technical feasibility meets the OOBE limit specifications, or could lead to no implementation of IMT UE. On the other hand, a less stringent OOBE limit may result in a need for additional measures to satisfy protection requirements of BS operating below 694 MHz and appropriate mitigation techniques in order to avoid possible constraints that this less stringent OOBE limit might cause.

Different OOBE limits might be applied in order to meet the requirements for the protection of the broadcasting reception under certain conditions.

Supplementary information

Sensitivity studies, case studies and measurements were performed. In particular a measurement study of current TV set ACS indicated an unaided ACS between 64 and 65 dB and with an additional external filter of 74 dB to 80 dB with an IMT channel of 10 MHz. A separate field trial study also indicated ACS figures between 54 and 60 dB.

1/1.2/4.2 Analysis of the results for the compatibility studies between MS and ARNS for the countries listed in RR No. 5.312

In the studies, two different interference impact scenarios from MS to ARNS were considered:

1) Interference from MS to ARNS without interference from BS.

2) Interference from MS to ARNS with interference from BS.

1/1.2/4.2.1 Results of compatibility studies of MS with ARNS without interference from BS

The results of the various studies carried out as detailed in Annex 23 to Document 4-5-6-7/715 are given below. No agreement was reached on any study.

Views of administrations with respect to the various studies are contained in Appendix 7 to Attachment 2 of the referenced document.

Based on **Study A1** the coordination distances between MS and ARNS shown in Table 1/1.2/4-1 below can be concluded.

TABLE 1/1.2/4-1

Coordination threshold values of MS stations with ARNS

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)[1]
RSBN	AA8	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 15/19*[2] Suburban: 17/25*[2] Urban: 5/7*[2] Mixed: 15/20*[2]
RLS 2 (type 1) (airborne receiver)	BD	Rural: <1 Suburban:<1 Urban: <1	Rural: >RH[4] Suburban/urban: >RH[4] Mixed: >RH[4]
RLS 2 (type 1) (ground receiver)	BA	Rural: <1 Suburban:<1 Urban: N/A[5]	Rural: 31/42* Suburban: 70/112* Urban: 13/18* Mixed: 40/61*
RLS 2 (type 2) (airborne receiver)	BC	Rural: <1 Suburban:<1 Urban: <1	Rural: 251 Suburban/urban: 403 Mixed: 373
RLS 2 (type 2) (ground receiver)	AA2	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 45/65* Suburban: 124/167* Urban: 18/29* Mixed: 69/111*
RLS 1 (types 1 and 2) (ground receiver)	AB	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS ground stations	Not applied	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS airborne stations	Not applied	Rural: <1 Suburban:<1 Urban: <1	Rural: >RH[4] Suburban/urban: >RH[4] Mixed: >RH[4]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area. MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area.

Note 3: All UE with antenna height 1.5 m use average transmit power of 2 dBm for macro rural scenario, –9 dBm for macro urban/suburban scenario and densities of UE in active mode are: rural: 0.17 UE per km^2/5 MHz, suburban/urban: 2.16 UE per km^2/5 MHz, as specified by ITU-R. Typical body loss of 4 dB was taken into account.

Note 4: RH = radio horizon (The radio horizon for 30 m and 10 000 m antenna heights are 431 km).

Note 5: Recommendation ITU-R P.1546 is not applicable for the urban case since both transmitter and receiver antenna heights are below the clutter height.

Note 6: Base station density in the mixed scenario: 0.0274 base stations/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base stations/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base stations/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base stations/km^2/5 MHz = 0.0080).

Note 7: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters, and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 8: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

It can be concluded that only the coordination distances between MS base stations and ARNS need to be considered, since the coordination distances between MS UE and ARNS in all cases are considerably smaller than the coordination distances between MS base stations and ARNS.

Further analysing which frequencies the different ARNS systems use, it can also be concluded that only the ground stations of the RSBN system and the ground station of the RLS2 type 2 needs to be taken into account and it could be concluded that the coordination distance between MS and BS, and ground ARNS receivers in the 694-790 MHz band vary from 15 to 111 kilometres, depending on scenario.

TABLE 1/1.2/4-2

Coordination distance required between MS and ARNS in 694-790 MHz if only RLS 2 (type 2) ground and RSBN receivers of the ARNS system are concerned

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to RLS 2 (Type 2)	Land path	69 km	45 km	124 km	18 km
MS base station to RLS 2 (Type 2)	Mixed: 50% sea/ 50% land path	111 km	65 km	167 km	29 km
MS base station to RSBN	Land path	15 km	15 km	17 km	5 km
MS base station to RSBN	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: all below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in the direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base station/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters, and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

For the case that only RSBN ground receivers are concerned (e.g. if lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036-4 is used for the MS implementation) the distances shown in Table 1/1.2/4-3 below applies.

TABLE 1/1.2/4-3

Coordination distance required between MS and ARNS in 694-790 MHz if only RSBN ground receivers of the ARNS system are concerned

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to ARNS	Land path	15 km	15 km	17 km	5 km
MS base station to ARNS	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km
General note: all below notes apply to all of the values in this table. Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in the direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336 If lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036-4 is used for the MS implementation. Note 2: Base stations density in the mixed scenario: 0.0274 base stations/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base stations/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base stations/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base stations/km^2/5 MHz = 0.0080). Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters, and ARNS receiver are placed in the same type of area (rural/suburban/urban). Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.					

In Study A.2 and Study A.3 the interference scenario from MS to ARNS in the absence of interference caused by BS is feasible when the BS stations operate in the frequency band 694-790 MHz at a large distance (more than 450 kilometres) from ARNS stations and in this case they will not cause interference to ARNS stations.

Under the considered scenario two studies were conducted. The results of the **Study A.2** are given in Table 1/1.2/4-4.

TABLE 1/1.2/4-4

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	75[2] / 90[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	185[2] / 200[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	400[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	250[2] / 275[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base stations is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from ARNS with the protection criteria of I/N = –6 dB.

Note 4: Propagation environment between MS base stations and ARNS receiver is rural for all deployment areas (rural, suburban, urban) in mixed scenario.

Note 5: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree was used.

The results of the **Study A.3** are given in Table 1/1.2/4-5.

The conducted studies showed that the ARNS systems, that are the same than those that were considered in the frequency band 790-862 MHz under the studies on WRC-12 agenda item 1.17, operate in the frequency band 694-790 MHz. The MS system characteristics in the frequency band 694-790 MHz are also close to the MS systems characteristics which were used in the studies on WRC-12 agenda item 1.17.

Therefore in the frequency band 694-790 MHz in absence of interference from BS the results previously obtained (at WRC-12) for the frequency band 790-862 MHz reflected in Resolution **749 (WRC-12)** and given in Table 1/1.2/4-5 can be applied for protection of ARNS from MS.

TABLE 1/1.2/4-5

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Minimum separation distance between receiving MS base stations and ARNS stations (km)	Minimum separation distance between transmitting MS base stations and ARNS stations (km)
RSBN	AA8	50	125/175*
RLS 2 (type 1) (airborne receiver)	BD	410	432
RLS 2 (type 1) (ground receiver)	BA	50	250/275*
RLS 2 (type 2) (airborne receiver)	BC	150	432
RLS 2 (type 2) (ground receiver)	AA2	50/75*	300/325*
RLS 1 (types 1 and 2) (ground receiver)	AB	125/175*	400/450*
Other ARNS ground stations	Not applied	125/175*	400/450*
Other ARNS airborne stations	Not applied	410	432

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 60 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 1470 km^2) and 0.5 km (S = 490 km^2) for urban area, power of MS base stations is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. The results are not based on the updated IMT parameters specified by ITU-R, but used the results in Resolution **749 (Rev.WRC-12)**.

Note 2: Tropospheric scattering effect in propagation model Recommendation from ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

The difference in the obtained results in Table 1/1.2/4-4 and Table 1/1.2/4-5 is explained mainly by the fact that the Study A.2 option addresses the base stations with antenna height of 50 metres and urban area of 30 square kilometres and suburban area of 90 square kilometres. The Study A.3 option addresses base stations with antenna height from 30 m to 60 m and urban area of 490 square kilometres and suburban area of 1 470 square kilometres. For example Moscow area is 1 081 square kilometres, Berlin area is 900 square kilometres, Helsinki area is 680 square kilometres and Prague is 500 square kilometres.

1/1.2/4.2.2 Results of compatibility studies of MS with ARNS with interference from BS

Currently the frequency band 694-790 MHz is widely used by BS. Therefore interference to ARNS stations from the MS stations was considered taking into account interference caused by the existing and future stations of BS.

In practice in the frequency band 694-790 MHz the most likely is the interference scenario from MS to ARNS with interference caused by BS when broadcasting stations operate at the distance of less than 450 kilometres from ANRS stations. It is confirmed by a large number of BS assignments implemented in the frequency band 694-790 MHz.

Under the considered scenario three studies were conducted:

– First study (Study B.1) is based on application of protection criteria for ARNS as the permissible aggregate threshold field strength

– Second study (Study B.2) is based on application of protection criteria for ARNS as the permissible interference-to-noise ratio I/N = –6 dB

– Third study (Study B.3) is based on application of protection criteria for ARNS as the permissible interference-to-noise ratio I/N = –6 dB to obtain coordination protection distances.

In the **first** study the permissible aggregate threshold field strength given in Table 1/1.2/4-6 is used as protection criteria for ARNS. It was assumed that in the territory of neighbouring countries different services can operate (in one country –BS, in another –MS and in the third –ARNS).

TABLE 1/1.2/4-6

Protection criteria for ARNS stations

ARNS type	**Predetermined aggregate trigger field-strength values (dB(µV/m))**
RSBN	42 at 10 m in a 3 MHz reference bandwidth
RLS 2 (Type 1) (aircraft receiver)	52[1] at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (Type 1) (ground receiver)	29[1] at 10 m in a 4 MHz reference bandwidth
RLS 2 (Type 2)	73 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (Type 2) (ground receiver)	24[1][2] at 10 m in a 8 MHz reference bandwidth
RLS 1 (Type 1 and 2)	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS ground stations	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	52 at 10 000 m in a 4 MHz reference bandwidth
Note 1: The values provided in this table refer to the permissible aggregate co-channel interference field strength values provided for the necessary emission bandwidth (from all services).	

The performed studies showed that compatibility of MS stations of one country with ARNS stations of another country with BS in the third country is feasible. With this restrictions to MS stations from ARNS are not so significant as it was expected. In practice the minimum distance between MS stations and the country border operating ARNS does not exceed several tens of kilometres. These restrictions mostly depend on implementation features of BS stations and MS networks in the neighbouring countries.

In the **second** study interference-to-noise *I/N* = –6 dB given in the Table 1/1.2/4-7 was used as protection criteria for ARNS. It was assumed that in the territory of neighbouring countries different services can operate (in one country –BS, in another country –MS and in the third country –ARNS). However, unlike the first study, the protection criterion for ARNS as interference-to-noise ratio allows to estimate interference to ARNS stations from MS stations not accounting for interference from BS even notwithstanding their real existence.

TABLE 1/1.2/4-7

Protection criteria of ARNS stations

ARNS system type	Permissible ratio interference-to-noise*, *I/N* (dB)
RSBN	–6 at 10 m in a 3 MHz reference bandwidth
RLS 1 (types 1 and 2) (ground receiver)	–6 at 10 m in a 6 MHz reference bandwidth
RLS 2 (type 1) (aircraft receiver)	–6 at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (type 1) (ground receiver)	–6 at 10 m in a 4 MHz reference bandwidth
RLS 2 (type 2) (aircraft receiver)	–6 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (type 2) (ground receiver)	–6 at 10 m in a 8 MHz reference bandwidth
Other type ARNS ground stations	–6 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	–6 at 10 000 m in a 4 MHz reference bandwidth
* Values of interference-to-noise, presented in the table relate to the total permissible level of interference-to-noise (from MS) in a common frequency band. For earth stations the propagation model is used in accordance with Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.	

The conducted studies showed that compatibility of MS stations in one country with ARNS stations in the other country with operation of BS in the third country is feasible.

The **third** study is based on application of protection criteria for ARNS as the permissible interference-to-noise ratio *I/N* = –6 dB to obtain coordination distances. The approach indicated in this study allows one to estimate interference to ARNS stations from MS stations not accounting for interference from BS even notwithstanding their real existence.

The conducted studies showed that compatibility of MS stations in one country with ARNS stations in another country with operation of BS in a third country is feasible. The obtained separation distances between the transmitting MS and BS, and ARNS stations in the frequency band 694-790 MHz are given in Table 1/1.2/4-8.

TABLE 1/1.2/4-8

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	455[2]/480[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	400[2]/425[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	441[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	530[2]/550[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	545[2]/565[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	545[2]/565[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from ARNS with the protection criteria of *I/N* = –6 dB.

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/4.2.3 Conclusions

Results of compatibility Study A.1 show that for the ARNS stations operating in the 694-790 MHz band, i.e. ground stations of the RSBN system and the ground station of the RLS2 type 2 system, the coordination distance between MS and BS, and ground ARNS receivers in the 694-790 MHz band vary from 15 to 111 kilometres, depending on the scenario. Coordination distances for other types for ARNS systems are contained in Table 1/1.2/4-1 above.

Results of compatibility Study A.2 show that coordination distances for ARNS stations range from 90 kilometres to 441 kilometres, depending on scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-4 above.

Results of compatibility Study A.3 show that coordination distances for ARNS stations are in the range from 125 kilometres to 450 kilometres, depending on scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-5 above.

Results of compatibility Study B.1 show that as coordination trigger may be used the field strength contained in Table 1/1.2/4-6 for ARNS stations, depending on the scenario. Calculation with the proposed methodology is presented in the section 4.2.2.2 of Annex 23 to Document 4-5-6-7/715.

Results of compatibility Study B.2 show that as coordination trigger may be used the *I/N* value contained in the Table 1/1.2/4-7 for ARNS stations, depending on the scenario. Calculation with the proposed methodology is presented in the section 4.2.3.2 of Annex 23 to Document 4-5-6-7/715.

Results of compatibility Study B.3 show that coordination distances for ARNS stations range from 130 to 565 kilometres, depending on the scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-8 above.

1/1.2/4.3 Analysis of solutions for SAB/SAP

It should be noted that, in the frequency band 694-790 MHz, applications ancillary to broadcasting will be able to operate under a new primary mobile allocation. However the studies referred to in section 1/1.2/3.4 show that co-channel and co-location operation between SAB/SAP and IMT is not feasible and therefore an identification for and use by IMT of the 694-790 MHz band under certain circumstances may imply a loss of frequencies available for SAB/SAP.

Although the envisaged channelling arrangement recommended for IMT would allow Region 1 countries to use all or portion of the guard band and/or duplex gap in 694-790 MHz for these applications, taking into account the increasing demand for SAB/SAP and the need to maintain existing production quality, the frequency band 470-790 MHz will not be sufficient.

Some SAB/SAP applications, which can operate under certain interference conditions, could use IMT duplex gaps and guard bands. However, the duplex gaps of all spectrum currently identified for IMT below 2 GHz may not alleviate the loss of the band 694-790 MHz for SAB/SAP applications. That is why suitable frequency bands below 2 GHz, in addition to bands already allocated to MS, may need to be found for SAB/SAP. Further studies are needed to find additional bands for SAB/SAP, on a regionally harmonised basis.

To this effect, it is considered preferable that the need for additional frequency bands to be used for SAB/SAP in Region 1 could be addressed by a future competent conference, as appropriate.

Recognising that non-broadcasting production teams use the same kind of equipment as broadcasting teams and many productions are conducted exclusively by external production teams or in cooperation with broadcasting teams, adding the term “and programme making” in addition to “applications ancillary to broadcasting” into RR No. **5.296** will increase flexibility in the use of the spectrum.

1/1.2/5 Methods to satisfy the agenda item

1/1.2/5.1 Issue A: Option for the refinement of the lower edge

Method A:

– Modification of RR Article **5** to insert the allocation to the mobile, except aeronautical mobile, service in the frequency band 694-790 MHz in Region 1 on a primary basis, technical and regulatory conditions apply as in one of the methods for Issue B and in the Method(s) of Issue C, to be decided by WRC-15, based on the results of the studies performed by JTG 4-5-6-7.

– Modification of RR No. **5.317A** to extend the identification of IMT in Region 1 down to 694 MHz.

– Consequential modification of RR No. **5.312A** to reflect the decisions of WRC-15 for Issues B and C, as appropriate.

Note: Additional provisions related to Resolutions are addressed under Issues B and C.

Reasons: The lower edge of allocation under agenda item 1.2 is proposed to be set at 694 MHz.

1/1.2/5.2 Issue B: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and BS.

1/1.2/5.2.1 Method B1

No change, see section 1/1.2/6.2.1.

The GE06 Agreement contains the necessary provisions to provide protection to BS in neighbouring countries.

Administrations may take measures to provide a set of technical conditions applicable to IMT UE to protect BS below 694 MHz, on a local, national or regional basis. Based on the results of the studies, ITU-R may develop the following Recommendation(s) to ensure their harmonisation, including:

- Revision of Recommendation ITU-R M.1036-4 so as to include harmonised channelling arrangements for 700 MHz in Region 1.
- New ITU-R Recommendation to specify the limit of OOBE of UE in the 700 MHz band, as appropriate.

View from some administrations supporting Method B1:

> The protection of BS below 694 MHz from MS can be ensured through applying the technical and regulatory provisions of the GE06 Agreement. Case studies of interference have shown that the single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect BS from cumulative interference. A new recommendation may be developed, as appropriate, to specify the OOBE limits of the IMT UE below 694 MHz. Accordingly, this method should be adopted in WRC-15.

View from some administrations not supporting Method B1:

> This method does not provide compatibility between MS and BS for several reasons:
>
> – Development of MS or BS in a country could be blocked by neighbouring countries due to different country interests and large separation distances as justified by ITU-R study.
>
> – Recommendation ITU-R M.1036 does not determine the frequency plan for all possible applications in MS and accordingly does not provide the guard band necessary for protection of BS below 694 MHz.
>
> – Coordination trigger of the GE06 Agreement does not take into account aggregated interference from MS IMT networks.
>
> – This method does not define the limits for the variation of technical parameters within the MS, allowing changes in future without decisions by a competent WRC.

1/1.2/5.2.2 Method B2

The GE06 Agreement applies.

The ITU-R has developed Recommendation(s) which specify a set of technical conditions applicable to MS stations and protection to BS below 694 MHz based on the results of the studies.

- Revision of Recommendation ITU-R M.1036-4 so as to include harmonised channelling arrangements for 700 MHz in Region 1.
- New Recommendation ITU-R to specify the limit of unwanted emissions of UE in the 700 MHz band in Region 1.

Method B2 may be applied by referencing to the Recommendation(s) in a footnote to the allocation in the RR.

View from some administrations supporting Method B2:

> Following ITU-R studies, a possible new ITU-R Recommendation may be developed which defines limits for out-of-band emissions for IMT UE. The provisions of this Recommendation can only be guaranteed by incorporating it by reference in the RR.

View from some administrations not supporting Method B2:

> Some administrations are of the view that ITU-R studies show that the adjacent channel interference from IMT base stations into DTT reception can occur for distances below 1 – 3 km, as confirmed by practical experience, while distances are less than a few hundred of metres for IMT UE. Therefore, this is a national issue which does not require any provisions in the RR. If an ITU-R Recommendation is to be incorporated by mandatory reference in the RR, this cannot be modified outside a WRC. It will be also counter-productive by not reflecting any technology developments that could provide better protection to BS.
>
> Some other administrations are of the view that this method does not provide compatibility between BS and MS, because Recommendation ITU-R M.1036 does not determine frequency arrangements, for all applications of MS, which are not limited to IMT; the GE06 Agreement coordination trigger does not take into account aggregated interference from a network of MS stations; variation of limits for MS technical parameters are not established, allowing for possible changes in future without a decision by a competent WRC.

1/1.2/5.2.3 Method B3

The GE06 Agreement applies together with additional technical conditions and regulatory mechanisms for the protection of BS.

To this effect, a new or a revised WRC-15 Resolution is required which specifies a consistent set of technical conditions and regulatory mechanisms applicable to MS stations for protection of BS with respect to co-channel and adjacent channel interference, based on the results of studies.

For example, this Resolution may include:

− OOBE level of UE in the frequency band below 694 MHz

− Guard band above 694 MHz

− A complementary value to the existing GE06 trigger in order to take into account cumulative interference.

View from some administrations supporting Method B3:

> The method contains the minimum restrictive but necessary conditions to be set in the Radio Regulations, which will ensure sharing between MS and BS.

View from some administrations not supporting Method B3:

> ITU-R studies show that adjacent channel interference from IMT base stations into DTT reception can occur for distances below 1-3 km, as confirmed by practical experience, while distances are less than a few hundreds of metres for IMT UE. Therefore, this is a national issue which does not require any provisions in the RR.
>
> Also, this method does not provide any clear regulatory procedure. The application of two different triggers (GE06 trigger and the additional coordination trigger for cumulative interference) will increase the burden of administrations and the BR and

lead to a contradiction between the results of the two procedures. In addition, case studies of interference have shown that a single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect BS from cumulative interference. Therefore, Method B3 should not be adopted by WRC-15.

1/1.2/5.2.4 Method B4

The GE06 Agreement applies and for the operation of MS in relation to the protection of BS, RR No. **9.21** shall apply.

Affected administrations are identified by application of RR No. **9.21** using trigger criteria, as contained in Annex 1 of Resolution **232 (Rev.WRC-15)** or of a possible new WRC-15 Resolution, resulting from the studies carried out by the JTG 4-5-6-7 through Resolution **232 (WRC-12)**.

View from some administrations supporting Method B4:

The application of the procedure of RR No. **9.21** is necessary due to the following facts:

- Provision of RR No. 9.21 is applied when the sharing criteria are not clearly defined and included in the relevant coordination procedure. The protection of BS from IMT is not ensured by applying GE06 Agreement since the triggering criteria for coordination of that agreement is only based on a single entry and does not take into account the cumulative effect of interference from IMT.
- Studies carried out by ITU-R under JTG 4-5-6-7 demonstrated that the cumulative effect of interference from MS/IMT into a DTTB station is significantly high (up to 21 dB).
- There is no contradiction between RR No. **9.21** and GE06 Agreements. Those assignments which do not obtain the agreement under RR No. **9.21** are not in conformity with the Radio Regulation and therefore are not eligible to enter in that Plan.

View from some administrations not supporting Method B4:

The application of the procedure of RR No. **9.21** is not relevant to this issue under agenda item 1.2 due to the following reasons:

- The protection of BS from IMT can be ensured by applying the GE06 Agreement as shown by case study that a single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect BS from cumulative interference.
- This will contradict with the application of the GE06 Agreement and applying two different triggers will increase the burden on administrations and the BR.
- RR No. **9.21** was never used in cases where a regional agreement exists. However, it applies in cases where no other agreements prevail, such as the application of RR No. **9.21** on MS for protecting ARNS in countries listed in RR No. **5.312**.
- Applying RR No. **9.21** with the GE06 Agreement may lead to non-equitable access to the MS in this frequency band.

1/1.2/5.3 Issue C: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and ARNS for the countries listed in RR No. 5.312

1/1.2/5.3.1 Method C1

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.1) in accordance with a modification of Resolution **232** at WRC-15 or a possible new WRC-15 Resolution.

View from some administrations not supporting Method C1:

> Some administrations are of the view that Method C1 is not applicable, because results obtained in the Study A.1 are based on an incorrect methodology and unrealistic interference scenario. In particular, this view is proven by the fact that coordination distances calculated in Study A.1 for the case of aggregate interference for the urban scenario are shorter than distances for the case of one source of interference for the rural scenario and therefore cannot be applied to provide protection for ARNS. Detailed explanations can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.2 Method C2

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the ARNS coordination trigger as specified in section 1/1.2/4.2.2 above (derived from Study B.2) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C2:

> Some administrations are of the view that: Multiservice interference from BS and MS does not occur and should not be taken into account. ECC Recommendation T/R 25-08 used for the derivation of the MS field strength protection criteria, used for the justification of the multiservice interference, is not applicable to IMT. The methodology proposed is not appropriate due to the dynamic deployment of IMT networks. The $I/N = -6$ dB protection criterion leads to overprotection of ARNS stations. Given these comments Method C2 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.3 Method C3

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.2) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C3:

> Some administrations are of the view that some of the parameters used deviate from the agreed parameters provided by WP 5D. The rural attenuation from Recommendation ITU-R P.1546 has been used also for urban and sub-urban environments. The proposed coordination distances are not the distances required for protecting ARNS; they are derived from the calculation of protection of MS from ARNS. No terrain database has been used as required by Recommendation ITU-R P.1546, when determining the effect of tropospheric scattering. Given these comments Method C3 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.4 Method C4

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.3) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C4:

> Some administrations are of the view that the results are not based on the agreed parameters provided by WP 5D. The coordination threshold values presented in Resolution **749 (Rev.WRC-12)** were agreed upon only on the basis that all affected CEPT countries obtained coordination agreement with the relevant countries in RR No. **5.312**. No terrain database has been used as required by Recommendation ITU-R P.1546, when determining the effect of tropospheric scattering. Given these comments Method C4 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.5 Method C5

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.2 above (derived from Study B.3) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C5:

> Some administrations are of the view that some of the parameters used deviate from the agreed parameters provided by WP 5D. The rural attenuation from Recommendation ITU-R P.1546 has been used also for urban and sub-urban environments. The proposed coordination distances for the receiving base stations do not correspond to the distances needed to protect the ARNS systems; they are derived from the calculation of protection of MS from ARNS. The $I/N = -6$ dB protection criterion leads to overprotection of ARNS stations. No terrain database has been used as required by Recommendation ITU-R P.1546, when determining the effect of tropospheric scattering. Given these comments Method C5 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.6 Method C6

RR No. **9.21** still applies to MS in relation to ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of ARNS, shall use the ARNS coordination trigger as specified in section 1/1.2/4.2.2 above (derived from Study B.1) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C6:

> Some administrations are of the view that multiservice interference from BS and MS does not occur and should not be taken into account. ECC Rec T/R 25-08 used for the derivation of the MS system field strength protection criterion, used for justification of the multiservice interference, is not applicable to IMT. The cumulative effect of broadcasting assignments is taken into account both in the country hosting ARNS as well as in countries within a certain radius from the ARNS station, regardless of the fact that these assignments may not be in operation. The methodology proposed is not appropriate due to the dynamic deployment of IMT networks. Given these comments Method C6 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.4 Issue D: Solutions for accommodating applications ancillary to broadcasting requirements

1/1.2/5.4.1 Method D1

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme making.

To accommodate the operability of the frequency band for applications ancillary to broadcasting and programme making, an identification of the band 694-790 MHz should be done by a new footnote.

1/1.2/5.4.2 Method D2

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme making.

In order to accommodate the operability of the frequency band 694-790 MHz for applications ancillary to broadcasting and programme making, a WRC Resolution needs to address the issue taking into account the process described in Resolution ITU-R 59.

1/1.2/5.4.3 Method D3

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme making.

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1/1.2/6 Regulatory and procedural considerations

1/1.2/6.1 Issue A: Options for the refinement of the lower edge

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD

460-890 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
...		

470-~~790~~694 BROADCASTING 5.149 5.291A 5.294 MOD 5.296 5.300 5.304 5.306 5.311A 5.312 ~~5.312A~~	**470-512** BROADCASTING Fixed Mobile 5.292 5.293	**470-585** FIXED MOBILE BROADCASTING 5.291 5.298
	512-608 BROADCASTING 5.297	**585-610** FIXED MOBILE BROADCASTING RADIONAVIGATION 5.149 5.305 5.306 5.307
	608-614 RADIO ASTRONOMY Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)	**610-890** FIXED MOBILE 5.313A 5.317A BROADCASTING 5.149 5.305 5.306 5.307 5.311A 5.320
	614-698 BROADCASTING Fixed Mobile 5.293 5.309 5.311A	
694~~470~~-790 BROADCASTING MOBILE except aeronautical mobile MOD 5.312A MOD 5.317A ~~5.149 5.291A 5.294 5.296~~ 5.300 ~~5.304 5.306~~ 5.311A 5.312 ~~5.312A~~	**698-806** MOBILE 5.313B 5.317A BROADCASTING Fixed 5.293 5.309 5.311A	
790-862 FIXED MOBILE except aeronautical mobile 5.316B 5.317A BROADCASTING 5.312 5.314 5.315 5.316 5.316A 5.319	**806-890** FIXED MOBILE 5.317A BROADCASTING 5.317 5.318	
862-890 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 5.319 5.323		

Note: For MOD 5.296, see Section 1/1.2/6.4 below (Issue D).

MOD

5.312A In Region 1, the use of the band 694-790 MHz by the mobile, except aeronautical mobile, service is subject to the provisions of Resolution **232 (Rev.WRC-1~~2~~5)**. See also Resolution **224 (Rev.WRC-12)**. (WRC-1~~2~~5)

MOD

5.317A Those parts of the band 698-960 MHz in Region 2 and the band 694-790 MHz in Region 1 and 790-960 MHz in Regions 1 and 3 which are allocated to the mobile service on a primary basis are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) – see Resolutions **224 (Rev.WRC-12)**, **232 (Rev.WRC-15)** and **749 (Rev.WRC-12)**, as appropriate. This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-1~~2~~5)

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MOD

RESOLUTION 232 (Rev.WRC-1225)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and related studies

The World Radiocommunication Conference (Geneva, 20125),

…

resolves

1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this band is allocated on a primary basis and to identify it for IMT;

2 that the allocation in *resolves* 1 is effective immediately after WRC-15;

Note: Depending on the outcome of the WRC-15, this resolves 1 hereafter is to be modified with text from one of the methods of Issue C.

31 that use of the frequency band 694-790 MHz by the mobile service allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. A methodology for identification of the affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in countries listed in No. **5.312** in the 694-790 MHz frequency band *[text from one of the methods of Issue C]*;

4 that the lower edge of the allocation is subject to refinement at WRC-15, taking into account the ITU-R studies referred to in invites ITU-R below and the needs of countries inRegion 1, in particular developing countries;

Note: Depending on the outcome of the WRC-15, this resolves 2 hereafter is to be deleted or to be modified with text from one of the methods of Issue B.

[52] that WRC-15 will specify the technical and regulatory conditions applicable to the mobile service in the frequency band 694-790 MHz with respect to BS *[text from one of the methods of Issue B, if any]*allocation referred to in resolves 1, taking into account the ITU-R studies referred to in invites ITU-R below,

invites ITU-R

1 to study the spectrum requirement for the mobile service and for the broadcasting service in this frequency band, in order to determine as early as possible the options for the lower edge referred to in resolves 4;

2 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 and defined in the last version of Recommendation ITU-R M.1036, in order to ensure coexistence with the networks operated in the new allocation and the operational networks in the band 790-862 MHz;

…

Note: The numbering is provisional and would depend on the amount of resolves to be decided by WRC-15.

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1/1.2/6.2 Issue B: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and BS

1/1.2/6.2.1 For Method B1

No modifications to the RR and no new WRC Resolution or WRC Recommendation in response to Issue B.

1/1.2/6.2.2 For Method B2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD

460-890 MHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>460-470</td><td colspan="2">FIXED
MOBILE 5.286AA
Meteorological-satellite (space-to-Earth)
5.287 5.288 5.289 5.290</td></tr>
<tr><td rowspan="4">470-~~790~~694
BROADCASTING

5.149 5.291A 5.294 MOD 5.296 5.300 5.304 5.306 5.311A 5.312 ~~5.312A~~</td><td>470-512
BROADCASTING
Fixed
Mobile
5.292 5.293</td><td>470-585
FIXED
MOBILE
BROADCASTING

5.291 5.298</td></tr>
<tr><td>512-608
BROADCASTING
5.297</td><td rowspan="2">585-610
FIXED
MOBILE
BROADCASTING
RADIONAVIGATION
5.149 5.305 5.306 5.307</td></tr>
<tr><td>608-614
RADIO ASTRONOMY
Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)</td></tr>
<tr><td rowspan="2">614-698
BROADCASTING
Fixed
Mobile
5.293 5.309 5.311A</td><td rowspan="4">610-890
FIXED
MOBILE 5.313A 5.317A
BROADCASTING

5.149 5.305 5.306 5.307 5.311A 5.320</td></tr>
<tr><td rowspan="2">694~~470~~-790
BROADCASTING
MOBILE except aeronautical mobile ADD 5.A12

~~5.149 5.291A 5.294 5.296~~ 5.300 ~~5.304 5.306~~ 5.311A 5.312 5.312A MOD 5.317A</td></tr>
<tr><td>698-806
MOBILE 5.313B 5.317A
BROADCASTING
Fixed

5.293 5.309 5.311A</td></tr>
<tr><td>790-862
FIXED
MOBILE except aeronautical mobile 5.316B 5.317A
BROADCASTING
5.312 5.314 5.315 5.316 5.316A 5.319
862-890
FIXED
MOBILE except aeronautical mobile 5.317A
BROADCASTING 5.322
5.319 5.323</td><td>806-890
FIXED
MOBILE 5.317A
BROADCASTING

5.317 5.318</td></tr>
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Notes:

– for MOD 5.296, see Section 1/1.2/6.4 below (Issue D);

– for MOD 5.317A, see Section 1/1.2/6.1 above (Issue A).

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ADD

5.A12 International Mobile Telecommunications (IMT) networks in the frequency band 694-790 MHz shall be deployed in accordance with Section [the relevant Section to be referenced] of Recommendation ITU-R M.1036[-5]. In addition, the unwanted emissions of the IMT user equipment shall conform to those specified in [the relevant part of] Recommendation ITU-R M.[BSMS700]. (WRC-15)

1/1.2/6.2.3 For Method B3

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

NOC

5.312A

MOD

RESOLUTION 232 (Rev.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

Note: The text under resolves 2 hereafter is to complete the resolves 2 under Issue A, depending on the outcome of WRC-15, i.e, if this Method B3 is adopted by WRC-15.

[2] that to ensure compatibility with the broadcasting service, the use of allocation to the mobile service in the frequency band 694-790 MHz shall be carried out under the following conditions:

– IMT stations shall not use frequencies below 703 MHz;

– out-of-band emissions of user equipment (UE) shall not exceed [xx] dBm / 8 MHz in the frequency bands below 694 MHz;

– out-of-band emissions of base stations shall not exceed [yy] dBm / 8 MHz in the frequency bands below 694 MHz;

– specifications of IMT base stations and UE shall meet the requirements of Recommendations ITU-R M.1457-11 and ITU-R M.2012-0;~~.~~

– field strength from a mobile service station at the border should not exceed the values given in Annex 1, unless otherwise agreed with affected administrations.

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invites ITU-R

…

Note: The numbering is provisional and would depend on the amount of resolves to be decided by WRC-15.

ANNEX 1

Field strengths limits for the protection of the terrestrial broadcasting services

Service to be protected	Field strength limit (dB(μV/m))[(1)]	
	703-718 MHz	718-790 MHz
Terrestrial broadcasting	2	4

[(1)] The trigger field-strength values are related to an 8 MHz bandwidth and a height of 10 m above ground level.

1/1.2/6.2.4 For Method B4

MOD

RESOLUTION 232 (Rev.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

…

[2] that to ensure compatibility with the broadcasting service, the use of allocation to the mobile service in the frequency band 694-790 MHz in Region 1 is subject to agreement obtained under No. **9.21**. A methodology for identification of the affected administrations under No. **9.21** for the mobile service with respect to broadcasting service in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution.

Note: The text under resolves 2 above is to complete the resolves 2 under Issue A, depending on the outcome of WRC-15, i.e., if this Method B4 is adopted by WRC-15. The numbering in provisional and would depend on the amount of resolves to be decided by WRC-15.

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ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Criteria for identifying potentially affected administrations with respect to the broadcasting service

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service in the frequency band 694-790 MHz with respect to the broadcasting service, the trigger field strength for the mobile service indicated below should be used.

These trigger values are derived from the GE06 Agreement trigger values corrected for the cumulative effect of interference, which is considered to be 20 dB.

All the examinations under the GE06 Agreement for the case of adding or modifying an assignment to the mobile service shall be repeated with these new trigger values and affected administrations shall be identified under No **9.21**.

When submitting a notice to BR for assignments of the mobile service, notifying administrations may indicate in the notice the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

Trigger field strength (dB(µV/m))

694-718 MHz	718-790 MHz
3	5

1/1.2/6.3 Issue C: Technical and regulatory conditions applicable to MS concerning the compatibility between MS and ARNS

1/1.2/6.3.1 Main body of Resolution 232 for all Methods under Issue C (C1-C6)

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this band is allocated on a primary basis and to identify it for IMT;

2 that the allocation in *resolves* 1 is effective immediately after WRC-15;

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For Method C1

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. The coordination distance for the identification of affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution;

or

For Method C2 and Method C6

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. A methodology for the identification of affected administrations under No. **9.21** for the mobile service with respect to ARNS in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution;

or

For Method C3, Method C4 and Method C5

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. The criteria for the identification of affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in the 694-790 MHz frequency band are provided in Annex 1 to this Resolution;

invites ITU-R

…

Note: The numbering in provisional and would depend on the amount of resolves to be decided by WRC-15.

1/1.2/6.3.2 New Annex 1 to Resolution 232 for the different Methods C1 to C6

Note for the preparation of proposals to WRC-15: The different versions of Annex 1 provided under this section correspond to the Methods described in section **1/1.2/5.3**. *These Annexes are shown without revision marks below and, if supported, should be presented as a modification to Resolution* ***232*** *with track changes.*

1/1.2/6.3.2.1 For Method C1

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identifying potentially affected administrations in the frequency band 694-790 MHz with respect to the aeronautical radionavigation service countries listed in No. 5.312

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312**, the coordination distances (between a base station in MS and a potentially affected ARNS station) indicated below should be used.

When notifying, administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

Case where the mobile service is operated according to the frequency arrangement where the base stations transmit only in the band 758-788 MHz and receive only in the band 703-733 MHz

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to ground ARNS station	Land path	15 km	15 km	17 km	5 km
MS base station to ground ARNS station	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: All below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base station operates with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336. If lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036-4 is used for the MS implementation.

Note 2: Base stations density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base station /km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters, and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

Case where the mobile base stations transmit within the band 733-758 MHz

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to ground RLS 2 (Type 2) station	Land path	69 km	45 km	124 km	18 km
MS base station to ground RLS 2 (Type 2) station	Mixed: 50% sea/ 50% land path	111 km	65 km	167 km	29 km
MS base station to ground RSBN station	Land path	15 km	15 km	17 km	5 km
MS base station to ground RSBN station	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: all below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base station/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations, and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters, and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

Other cases

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)[1]
RSBN	AA8	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 15/19*[2] Suburban: 17/25*[2] Urban: 5/7*[2] Mixed: 15/20*[2]
RLS 2 (type 1) (airborne receiver)	BD	Rural: <1 Suburban: <1 Urban: <1	Rural: >RH[4] Suburban/urban: >RH[4] Mixed: >RH[4]
RLS 2 (type 1) (ground receiver)	BA	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 31/42* Suburban: 70/112* Urban: 13/18* Mixed: 40/61*
RLS 2 (type 2) (airborne receiver)	BC	Rural: <1 Suburban: <1 Urban: <1	Rural: 251 Suburban/urban: 403 Mixed: 373
RLS 2 (type 2) (ground receiver)	AA2	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 45/65* Suburban: 124/167* Urban: 18/29* Mixed: 69/111*
RLS 1 (types 1 and 2) (ground receiver)	AB	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS ground stations	Not applied	Rural: <1 Suburban: <1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS airborne stations	Not applied	Rural: <1 Suburban: <1 Urban: <1	Rural: >RH[4] Suburban/urban: >RH[4] Mixed: >RH[4]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area. MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area

Note 3: All user equipment (UE) with antenna height 1.5 m use average transmit power of 2 dBm for macro rural scenario, –9 dBm for macro urban/suburban scenario and densities of UE in active mode are: rural: 0.17 UE per km^2/5 MHz, suburban/urban: 2.16 UE per km^2/5 MHz, as specified by ITU-R. Typical body loss of 4 dB was taken into account.

Note 4: RH = radio horizon (The radio horizon for 30 m and 10 000 m antenna heights are 431 km)

Note 5: Recommendation ITU-R P.1546 is not applicable for the urban case since both transmitter and receiver antenna heights are below the clutter height

Note 6: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7x0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2x0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1x0.0796 base station/km^2/5 MHz = 0.0080).

Note 7: Propagation environment between MS base stations, and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario of MS base stations, that means MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 8: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

1/1.2/6.3.2.2 For Method C2

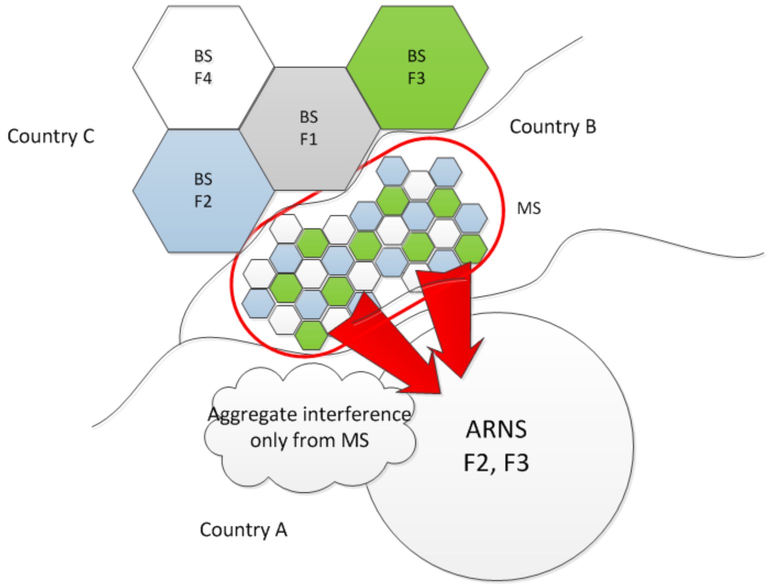
ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Methodology for identification of the affected administrations under No. 9.21 for mobile service in the 694-790 MHz frequency band

Protection criteria *I/N* = –6 dB for aeronautical radionavigation service (ARNS) stations give possibility to estimate interference from the mobile service (MS) to ARNS without taking into account interference caused by stations of the broadcasting service. A typical scenario of the aggregate interference impact from MS to the ARNS is shown in Figure 1.

FIGURE 1

Typical scenario for aggregate interference to ARNS from MS in the frequency band 694-790 MHz



To identify affected administrations when applying No. **9.21** for MS with respect to ARNS in the 694-790 MHz frequency band the criteria specified in Table 1 should be used.

TABLE 1

Protection criteria for ARNS stations

ARNS system type	Permissible ratio «interference-to-noise»*, *I/N* (dB)
RSBN	–6 at 10 m in a 3 MHz reference bandwidth
RLS 1 (types 1 and 2)(ground receiver)	–6 at 10 m in a 6 MHz reference bandwidth
RLS 2 (type 1) (aircraft receiver)	–6 at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (type 1) (ground receiver)	–6 at 10 m in a 4 MHz reference bandwidth
RLS 2 (type 2) (aircraft receiver)	–6 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (type 2) (ground receiver)	–6 at 10 m in a 8 MHz reference bandwidth
Other type ARNS ground- stations	–6 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	–6 at 10 000 m in a 4 MHz reference bandwidth
* Values of interference-to-noise, presented in the table relate to the total permissible level of interference-to-noise (from MS) in a common frequency band. For the earth stations the propagation model is used in accordance with Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.	

This methodology considers that interference to ARNS stations can be caused by MS base stations as well as user equipment (UE). In case of the implementation of an FDD mode by MS, interference would be calculated in each channel from base station or from UE in accordance to the scenario.

1 Consideration of MS base stations impact to ground and aircraft ARNS stations

In applying criteria proposed in Table 1 the estimation of interference caused by newly notified MS stations to ARNS shall be performed taking into account interference from previously notified MS stations.

Assignments of MS base stations recorded in the Master International Frequency Register (MIFR) or earlier notified for coordination under No. **9.21**, that have frequency overlap with ARNS stations, in the frequency band 694-790 MHz shall be taken into account.

Depending on the considered ARNS stations two interference scenarios are possible:

1) interference to airborne ARNS receiver;

2) interference to ground ARNS receiver.

Interference evaluation for each scenario is given below.

1.1 MS base station impact to ARNS aircraft receiver

The typical airborne ARNS receiver is at the altitude of 10 000 metres and can be located at any point of the service area of the associated transmitting ground station (which is notified in ITU).

The visibility zone for the airborne ARNS station is determined in accordance with the equation:

$$Dvi = 4.1 \times (\sqrt{H1i} + \sqrt{H2}) \quad (1)$$

where:

$H1i$ is antenna altitude of ARNS *i*-receiver;

$H2$ is transmitter antenna altitude of the notified MS base station.

The height of the MS base station transmit antenna is taken from the notice. If this value is not available in the notice, the height of the MS base station transmitter antenna should be considered as 50 metres.

In consideration of the interference impact of the notified MS base station to ARNS airborne stations the following algorithm to determine the affected ARNS assignments is proposed:

1) The distance ***Dci*** is determined from the notified MS base station in the direction of ARNS ground stations which are previously notified or recorded in ITU in the frequency band of a new MS base station (see Fig. 2).

2) To condition to be checked:

$$Dci > Rzi + Dvi, \qquad (2)$$

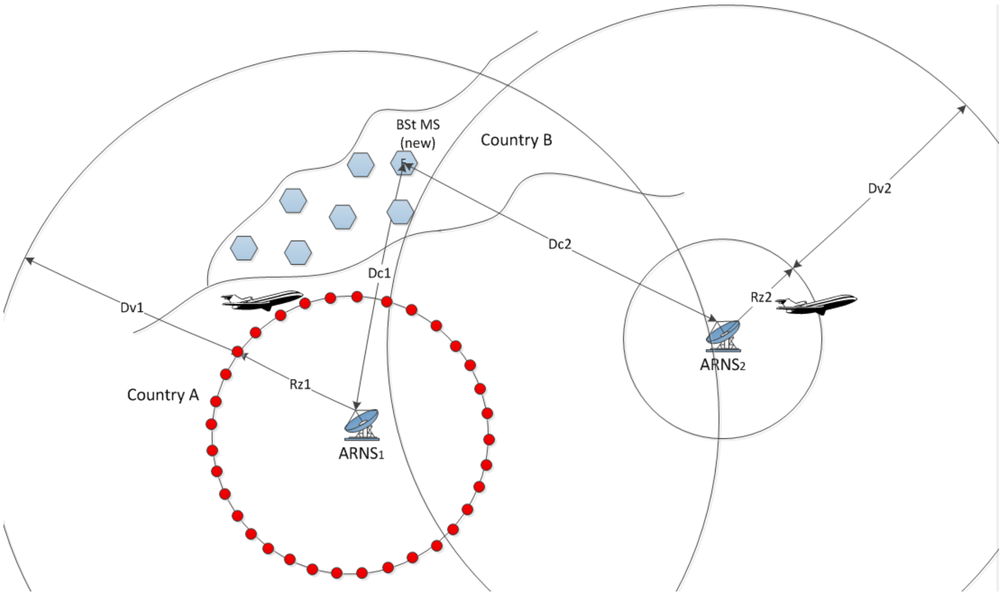
where:

Rzi – the service area radius of the ARNS ground *i*-th station, where the associated receiving airborne ARNS station can be located (indicated in the filing of the ARNS station).

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required (Figure 2 with respect to ARNS2 station).

FIGURE 2

How to determine affected frequency assignments of ARNS airborne receivers



3) For each ARNS *i*-th station located at the distance less or equal to $D_{vi}+R_{zi}$ the following is determined the MS base station assignments recorded in the MIFR or earlier notified to obtain agreement under No. **9.21** which completely or partially fall into the line-of-sight area of the ARNS airborne receiver (these assignments are highlighted in blue in Figure 2)

4) The interference level I_{ijk} is calculated at the *k*-th boundary point of the service area of *i*-th ARNS ground receiver (these are red points in Fig. 2) from each *j*-th interference source identified in item 3 above including the new notified MS base station

assignment. The calculation is performed by application of Recommendation ITU-R P.525-2.

Interference level $\boldsymbol{I_{ijk}}$ is calculated taking into account the overlapping frequency band ratios. *N*– index, that takes into account interference power portion, entering the ARNS receiver, in dB:

$$N = \begin{cases} 10\log(B_I / B_W), B_I < B_W \\ 0, B_I = B_W \end{cases} \quad (3)$$

B_W – interferer's bandwidth, MHz;

B_I – bandwidth overlap of the interferer and the ARNS receiver, MHz.

It should be noted that the test points (where calculations are performed) are chosen at the boundary of the service area of *i-th* ARNS ground receiver with a defined interval (for example 1 degree) (currently used under the GE06 Agreement) (the points on the service area boundary of ARNS1 receiver are highlighted in red in Fig. 2).

5) The aggregate interference level $\boldsymbol{I_{ik}}$ is calculated at each *k*-th point of the service area of *i*-th ARNS ground receiver by application of the data obtained in item 4 above and in accordance with the equation:

$$\mathrm{I}_{ik} = 10\log\left(\sum_{j=1}^{n} 10^{0.1 I_{ijk}}\right) \quad (4)$$

6) The aggregate interference level $\boldsymbol{I_{ik}}$ in each *k*-th boundary point is compared with the protection criteria $\boldsymbol{Ereq_i}$ of *i*-th ARNS airborne receiver. If the condition $\boldsymbol{I_{ik} > Ireq_i}$ is met then obtaining agreement for new notified MS base station under No. **9.21** with regard to the specific *i*-th ARNS station is required. $\boldsymbol{Ireq_i}$ calculation is based on ***I/N*** = –6 dB criterion. Based on $\boldsymbol{N_i}$ for certain type of ARNS system, then $\boldsymbol{Ireq_i} = \boldsymbol{N_i} – 6$.

1.2 MS base station impact on ARNS ground based receiver

In consideration of MS base station impact on a ground based ARNS receiver it is required to take into account the fact that ARNS ground station antennas are directional. Therefore in the compatibility estimation MS assignments which fall in the main lobe of the ARNS station antenna pattern are taken into account. It should be noted, that the parameter for the –3 dB beam width of the main lobe of the ARNS ground based station's antenna should be added to Appendix **4** as a mandatory parameter for notification. In the absence of this parameter in the notification the –3 dB beam width of the main lobe of the ARNS ground based station antenna should be assumed equal to 8 degrees.

Interference outside the ARNS station antenna pattern main lobe was taken into account by adding 4 dB to the interference which will be calculated in the angle sector of the ARNS station antenna pattern main lobe.

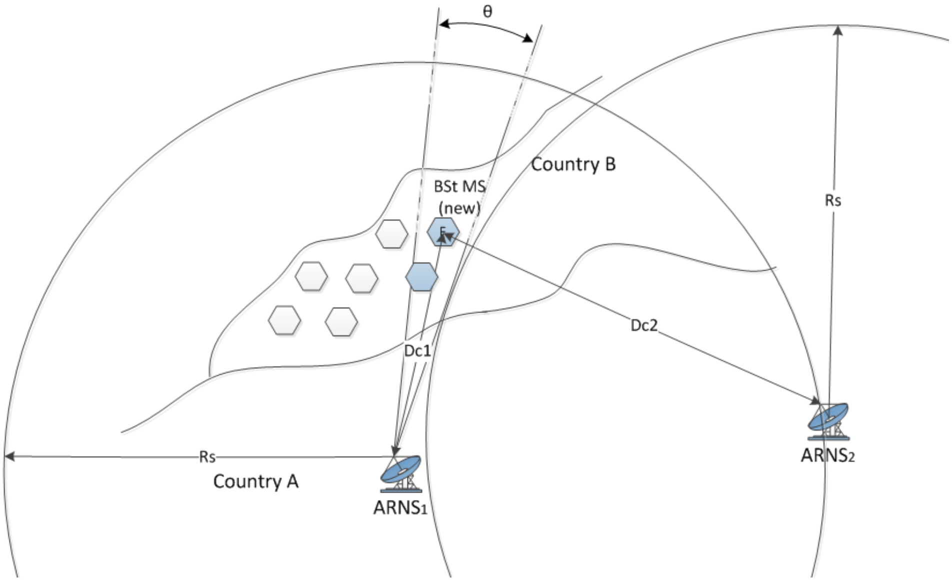
Depending on location of the affected ARNS station the sector radius is determined where interference sources should be taken into account. In the GE06 Agreement and Recommendation ITU-R P.1546-4 the distance of 1 000 kilometres is taken as this sector radius. The same distance is used by BR for checking the notices for the modification of GE06 Plan with respect to ARNS stations.

However, taking into account that Recommendation ITU-R P.1546-4 is applied for different climatic areas and a wide frequency range therefore the sector radius $\boldsymbol{R_s}$ where interference sources are taken into account, is limited up to distance of 600 kilometres —for ARNS stations located above 48 degrees north latitude and up to 800 kilometres for ARNS stations located below or on 48 degrees north latitude (The Black Sea region).

Therefore if the MS base station is located in the main beam of ARNS station antenna pattern, but at the distance $\boldsymbol{R_s}$ of more than 600 kilometres or 800 kilometres (as the case may be) then it is proposed not to take into account such station in the interference calculation for ARNS stations (see Fig. 3).

FIGURE 3

How to determine affected frequency assignments of ARNS ground based receivers



Taking into account the above mentioned while considering the interference impact of the notified MS base station to the ARNS ground based stations the following procedure to determine the affected ARNS is applied:

1) Around the notified new MS base station towards the ARNS ground based stations which are notified/recorded in ITU in the new MS base station frequency band the distance $\boldsymbol{D_{ci}}$ is determined (see Fig. 3).

2) The condition to be checked:

$$Dci > Rs, \quad (5)$$

where:

Rs = 600 kilometres or = 800 kilometres depending on latitude of ARNS *i*-th station.

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required. (This relates to ARNS2 station in Fig. 3.)

3) With respect to each ARNS *i*-th station which is located nearer than $\boldsymbol{Dci} \leq \boldsymbol{Rs}$ the MS base station assignments recorded in MIFR or earlier notified to obtain agreement under No. **9.21** are determined which completely or partially fall into the main beam sector of ARNS ground station directed to a new notified MS base station. This sector is limited by the distance ***Rs*** (in Fig. 3 these assignments and allotments are highlighted in blue).

4) The interference level ***Iij*** is calculated at the location of *i*-th ARNS ground based receiver (in Fig. 3 this is ARNS1) from each *j*-th MS base station assignment recorded in MIFR or earlier notified to obtain agreement under No. **9.21** including the new notified MS base station assignment.

Interference level ***Iij*** shall be calculated with account of overlapping frequency band ratio. *N*– index, that takes into account interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log\left(B_I / B_W\right), B_I < B_W \\ 0, B_I = B_W \end{cases} \quad (6)$$

B_W – interferer's bandwidth, MHz;

B_I – bandwidth overlap of the interferer and the ARNS receiver, MHz.

The calculation is performed by application of Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

5) The aggregate interference level ***Ii*** is calculated at the *i*-th ARNS ground based receiver location by application of the data obtained in item 4 above and in accordance with the following equation:

$$I_i = 10\log\left(\sum_{j=1}^{n} 10^{0.1 I_{ij}}\right) + 4 \quad (7)$$

6) The aggregate interference level ***Ii*** is compared with the protection criteria $\boldsymbol{I_{reqi}}$ of *i*-th ARNS ground based receiver. If the requirement $\boldsymbol{I_i > I_{reqi}}$ is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the *i*-th ARNS station is required. $\boldsymbol{Ireq_i}$ calculation is based on the ***I/N*** = –6 dB criterion. Based on $\boldsymbol{N_i}$ for certain type of ARNS system, then $\boldsymbol{Ireq_i} = \boldsymbol{N_i} - 6$.

2 Consideration of MS user equipment impact on ARNS ground based and aircraft stations

In case of CDMA or TDD MS systems, it is expected that interference caused by MS UE to ARNS stations will not exceed the interference from MS base stations. Therefore, in these cases it is sufficient to use the methodology specified in section 1 above.

In case of frequency division duplex (FDD) MS systems, the interference caused by UE to ARNS stations will impact in other frequency bands than interference form MS base stations. Therefore in this case other approaches are required to be applied to determine the affected ARNS assignments.

In case of notifications of MS systems with FDD when a notifying administration indicates in the notice that the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station does not exceed 21 dBm per 1 MHz (this corresponds to the coordination distance of 70 kilometres specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) then this value should be used in the interference calculation.

Otherwise, the value of 31 dBm per 1 MHz (this corresponds to the coordination distance of 150 kilometres specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) can be used as the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station or to use another e.i.r.p. value as notified by the administration.

Using these aggregate values of UE (21 dBm per 1 MHz or 31 dBm per 1 MHz, as appropriate) operating with one MS base station one can determine the affected ARNS assignments by applying the methodology presented in Section 1 above. However, the receiving MS base station should be considered instead of the transmitting MS base station, and the aggregate e.i.r.p. of all UE operating simultaneously with the notified MS base station should be considered instead of the e.i.r.p. of the MS base station (see above).

1/1.2/6.3.2.3 For Method C3

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for the identification of affected administrations under No. 9.21 for mobile service in the 694-790 MHz frequency band

To identify affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	75[2] / 90[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	185[2] / 200[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	400[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	250[2] / 275[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.
Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.
Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.
Note 3: The figures given are based on the estimated distance to protect the IMT base stations from ARNS with the protection criteria of I/N = –6 dB.
Note 4: Propagation environment between MS base station transmitters, and ARNS receiver is rural for all deployment areas (rural, suburban, urban) in mixed scenario.
Note 5: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/6.3.2.4 For Method C4

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identification of affected administrations under No. 9.21 for mobile service in the 694-790 MHz frequency band

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	**System type code**	**Minimum separation distance between receiving MS base stations and ARNS stations (km)**	**Minimum separation distance between transmitting MS base stations and ARNS stations (km)**
RSBN	AA8	50	125/175*
RLS 2 (type 1) (airborne receiver)	BD	410	432
RLS 2 (type 1) (ground receiver)	BA	50	250/275*
RLS 2 (type 2) (airborne receiver)	BC	150	432
RLS 2 (type 2) (ground receiver)	AA2	50/75*	300/325*
RLS 1 (types 1 and 2) (ground receiver)	AB	125/175*	400/450*
Other ARNS ground stations	Not applied	125/175*	400/450*
Other ARNS airborne stations	Not applied	410	432
* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.			

ARNS station	System type code	Minimum separation distance between receiving MS base stations and ARNS stations (km)	Minimum separation distance between transmitting MS base stations and ARNS stations (km)
Note 1: Result based on conditions that MS base stations operate with antenna height 60 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 1 470 km^2) and 0.5 km (S = 490 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. The results are not based on the updated IMT parameters specified ITU-R, but used the results in Resolution **749 (Rev.WRC-12)**.			
Note 2: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.			

1/1.2/6.3.2.5 For Method C5

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identification of affected administrations under No. 9.21 for mobile service in the 694-790 MHz frequency band

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	455[2]/480[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	400[2]/425[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	441[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	530[2]/550[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	545[2]/565[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	545[2]/565[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from ARNS, with the protection criteria of $I/N = -6$ dB.

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/6.3.2.6 For Method C6

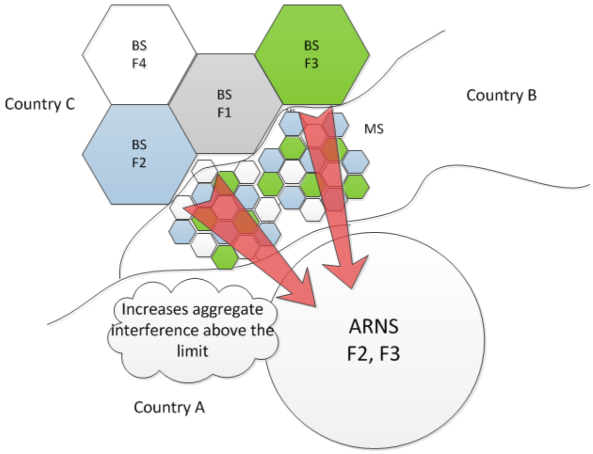
ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Methodology for identification of affected administrations under No. 9.21 for mobile service in the 694-790 MHz frequency band

Protection criteria of field strength values for the aeronautical radionavigation service (ARNS) stations can be used to estimate interference from the mobile service (MS) to ARNS by taking into account interference caused by stations of the broadcasting service (BS). A typical scenario of the aggregate interference impact from MS to the ARNS is shown in Figure 1.

FIGURE 1

Typical scenario for aggregate interference to ARNS from BS and MS in the frequency band 694-790 MHz



To identify affected administrations when applying No. **9.21** for MS with respect to ARNS in the 694-790 MHz frequency band the criteria specified in Table 1 should be used.

TABLE 1

Protection criteria for ARNS stations

ARNS type	**Predetermined aggregate trigger field-strength values (dB(μV/m))**
RSBN	42 at 10 m in a 3 MHz reference bandwidth
RLS 2 (Type 1) (aircraft receiver)	52[1] at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (Type 1) (ground receiver)	29[1] at 10 m in a 4 MHz reference bandwidth
RLS 2 (Type 2)	73 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (Type 2) (ground receiver)	24[1,2] at 10 m in a 8 MHz reference bandwidth
RLS 1 (Type 1 and 2)	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS ground stations	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	52 at 10 000 m in a 4 MHz reference bandwidth
Note 1: The values provided in this table refer to the permissible aggregate co-channel interference field strength values provided for the necessary emission bandwidth (from all services).	

This methodology considers that interference to ARNS stations can be caused by MS base station as well as user equipment (UE). In case of implementation FDD mode by MS, interference would be calculated in each channel from base station or from UE in accordance to scenario.

1 Consideration of MS base stations impact to ground based and aircraft ARNS stations

In applying criteria proposed in Table 1 the estimation of interference caused by newly notified MS stations to ARNS shall be performed by taking into account interference from the previously notified MS stations and also from BS assignments, recorded in the Master International Frequency Register (MIFR) or notified under Article **11**.

The following shall be taken into account:

1) BS assignments, recorded in MIFR or notified under Article **11** which can potentially cause interference to ARNS;

2) assignments of MS base station recorded in MIFR or earlier notified for coordination under No. **9.21**, that have frequency overlap with ARNS stations, in the frequency band 694-790 MHz.

Depending on the considered ARNS stations two interference scenarios are possible:

1) interference to an airborne ARNS receiver;

2) interference to a ground based ARNS receiver.

Interference evaluation for each scenario is given below.

1.1 MS base station impact on ARNS aircraft receiver

The typical airborne ARNS receiver is at the altitude of 10 000 metres and can be located at any point of service area of an associated transmitting ground station (which is recorded in ITU).

The visibility zone for the airborne ARNS station is determined in accordance with the equation:

$$Dvi = 4.1 \times (\sqrt{H1i} + \sqrt{H2}), \quad (1)$$

where

$H1i$ is antenna altitude of ARNS *i*-receiver;

$H2$ is transmitter antenna altitude of the notifying MS base station.

The height of the MS base station transmit antenna is taken from the notice. If this value is not available in the notice, the height of the MS base station transmitter antenna should be considered as 50 metres.

In consideration of interference impact of the notified MS base station to ARNS airborne stations the following algorithm to determine the affected ARNS assignments is proposed:

1) The distance ***Dci*** is determined from the notified MS base station in the direction of ARNS ground stations which are recorded in ITU in the frequency band of a new MS base station (see Fig. 2).

2) To condition to be checked:

$$Dci > Rzi + Dvi, \quad (2)$$

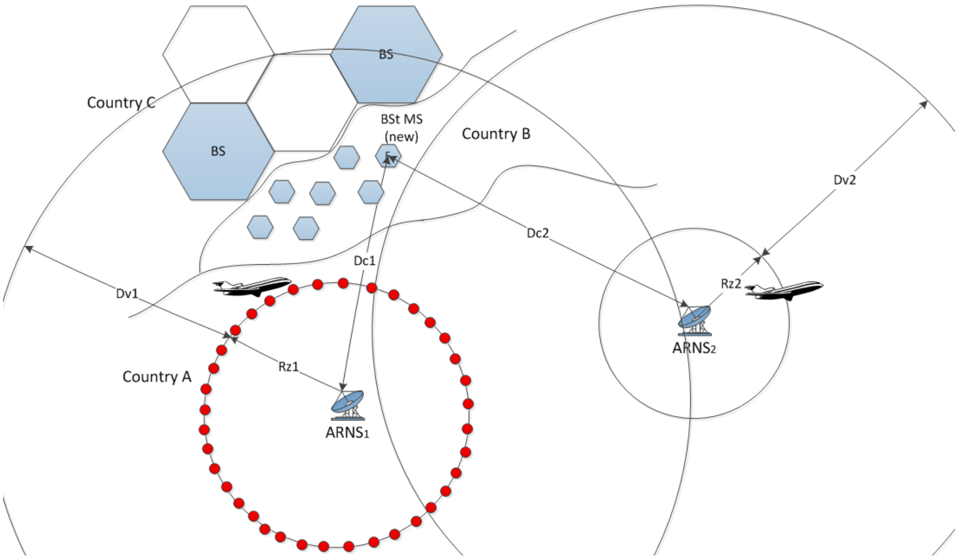
where

Rzi – service area radius of ARNS ground *i*-th station, where the associated receiving airborne ARNS station can be located (indicated in the notice for ARNS station).

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required (Fig. 2 with respect to ARNS2 station).

FIGURE 2

How to determine affected frequency assignments of ARNS airborne receivers



3) For each ARNS *i*-th station located at the distance less or equal to $\boldsymbol{D_{vi}+R_{zi}}$ the following is determined:

a) the MS base station assignments recorded in MIFR or earlier notified to obtain agreement under No. **9.21** which completely or partially fall into the line-of-sight area of ARNS airborne receiver (these assignments are highlighted in blue in Fig. 2);

b) the broadcasting assignments, recorded in MIFR or notified under Article **11**, or which notified for inclusion in the GE06 Plan which completely or partially fall into the line-of-sight area of the ARNS airborne receiver (Fig. 2 these assignments and allotments are highlighted in blue.)

4) The field strength $\boldsymbol{E_{ijk}}$ is calculated at the *k*-th boundary point of the service area of *i*-th ARNS ground based receiver (these are red points in Fig. 2) from each *j*-th interference source identified in item 3 above including the new notified MS base station assignment. The calculation is performed by application of Recommendation ITU-R P.525-2.

Field strength $\boldsymbol{E_{ijk}}$ is calculated taking into account the overlapping frequency bands ratio. *N*– index, that takes into account the interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log(B_I / B_W), B_I < B_W \\ 0, B_I = B_W \end{cases} \quad (3)$$

B_W – interferer's bandwidth, MHz;

B_I – bandwidth overlap of the interferer and the ARNS receiver, MHz.

It should be noted that the test points (where calculations are performed) are chosen at the boundary of the service area of *i*-th ARNS ground receiver at defined intervals (for example 1 degrees) (currently used under the GE06 Agreement) (the points on the service area boundary of ARNS1 receiver are highlighted in red in Fig. 2).

5) The aggregate field strength ***Eik*** is calculated at each *k*-th point of the service area of *i*-th ARNS ground based receiver by application of the data obtained in section 4 above and in accordance with the equation:

$$E_{ik} = 10\log\left(\sum_{j=1}^{n} 10^{0.1\,E_{ijk}}\right) \quad (4)$$

6) The aggregate field strength $\boldsymbol{E_{ik}}$ at each *k*-th boundary point is compared with the protection criteria $\boldsymbol{Ereq_i}$ of *i*-th ARNS airborne receiver. If the condition $\boldsymbol{E_i > Ereq_i}$ is met then obtaining agreement for new notified MS base station under No. **9.21** with regard to the specific ARNS station is required.

1.2 MS base station impact to ARNS ground based receiver

In consideration of MS base station impact on a ground based ARNS receiver it is required to take into account the fact that ARNS ground based station antennas are directional. Therefore in the compatibility estimation MS assignments and BS assignments which fall in the main lobe of the ARNS station antenna pattern are to be taken into account. It should be noted, that the parameter for the –3 dB beam width of the main lobe of the ARNS ground based station antenna should be added to Appendix **4** as a mandatory parameter for notification. In the absence of this parameter in the notification the –3 dB beam width of the main lobe of the ARNS ground based station antenna should be assumed to be 8 degrees.

Interference outside the ARNS station antenna pattern main lobe was taken into account by adding 4 dB to the interference which will be calculated in the angle sector of the ARNS station antenna pattern main lobe.

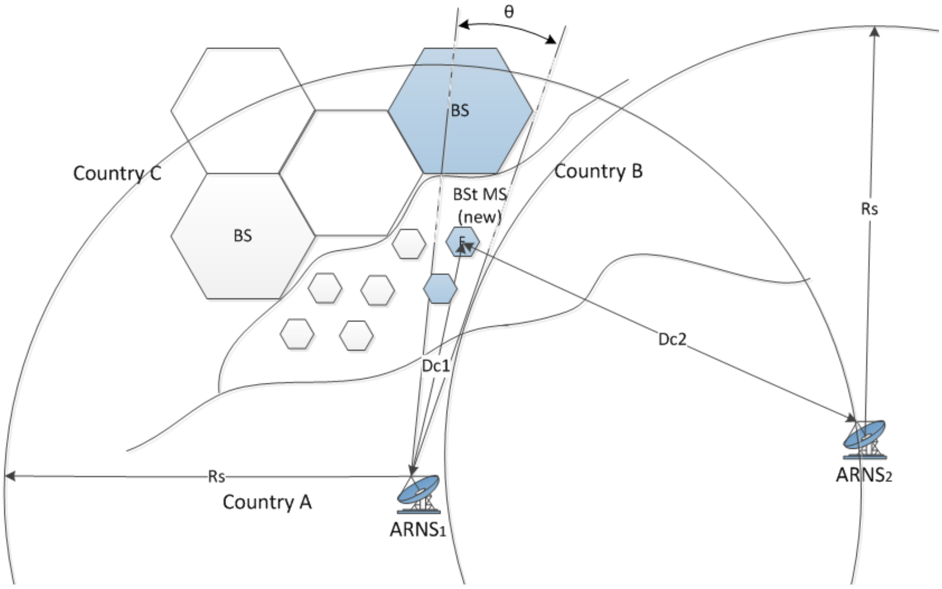
Depending on the location of the affected ARNS station the sector radius is determined where interference sources should be taken into account. In the GE06 Agreement and Recommendation ITU-R P.1546-4 the distance of 1 000 kilometres is taken as this sector radius. The same distance is used by BR for checking the notices for the modification of the GE06 Plan with respect to ARNS stations.

However, taking into account that Recommendation ITU-R P.1546-4 is applied for different climatic areas and a wide frequency range, therefore the sector radius $\boldsymbol{R_s}$ where interference sources are taken into account, is limited up to a distance of 600 kilometres –for ARNS stations located above 48 degrees north latitude and up to 800 kilometres for ARNS stations located below or at 48 degrees north latitude (The Black Sea region).

Therefore if the MS base station is located in the main beam of ARNS station antenna pattern, but at the distance $\boldsymbol{R_s}$ of more than 600 kilometres or 800 kilometres (as the case may be) then it is proposed not to take into account such stations in the interference calculation for ARNS stations (see Fig. 3).

FIGURE 3

How to determine affected frequency assignments of ground ARNS receivers



Taking into account the above mentioned when considering the interference impact of the notified MS base station on the ARNS ground based stations, the following procedure is applied to determine the affected ARNS:

1) Around the notified new MS base station towards the ARNS ground based stations which are recorded in ITU in the new MS base station frequency band the distance $\boldsymbol{D_{ci}}$ is determined (see Fig. 3).

2) The condition to be checked:

$$Dci > Rs, \qquad (5)$$

where *Rs* = 600 km or = 800 km depending on latitude of ARNS *i*-th station.

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required. (This relates to ARNS2 station in Fig. 3.)

3) With respect to each ARNS *i*-th station which is located closer than $\boldsymbol{D_{ci} \leq R_s}$ the MS base station assignments recorded in MIFR or earlier notified to obtain agreement under No. **9.21** and also broadcasting assignments of the GE06 Plan are determined which completely or partially fall into the main beam sector of the ARNS ground based station directed to a new notified MS base station. This sector is limited by the distance *Rs* (in Fig. 3 these assignments and allotments are highlighted in blue).

4) The field strength ***Eij*** is calculated at the location of each *i*-th ARNS ground receiver (in Fig. 3 this is ARNS1) from each *j*-th MS base station assignment entered in MIFR or earlier notified to obtain agreement under No. **9.21** and GE06 Plan assignment including the new notified MS base station assignment. The field strength E_{ij} shall be calculated taking account of the overlapping frequency band ratio.

N– index, that takes into account interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log(B_I / B_W), B_I < B_W \\ 0, B_I = B_W \end{cases} \quad (6)$$

B_W – interferer's bandwidth, MHz;

B_I – bandwidth overlap of the interferer and the ARNS receiver, MHz.

The calculation is performed by application of Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

5) The aggregate field strength $\boldsymbol{E_i}$ is calculated at the *i*-th ARNS ground receiver location by application of the data obtained in section 4 above and in accordance with the following equation:

$$E_i = 10\log\left(\sum_{j=1}^{n} 10^{0.1E_{ij}}\right) + 4 \quad (7)$$

6) The aggregate field strength $\boldsymbol{E_i}$ is compared with the protection criteria $\boldsymbol{E_{reqi}}$ of *i*-th ARNS ground receiver (see. Table 1). If the requirement $\boldsymbol{E_i > E_{reqi}}$ is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the *i*-th ARNS station is required.

2 Consideration of MS user equipment impact on ARNS ground based and aircraft stations

In case of CDMA or TDD MS systems, it is expected that interference caused by MS UE to ARNS stations will not exceed the interference from MS base station. Therefore, in these cases it is sufficient to use the methodology specified in Section 1 above.

In case of frequency division duplex (FDD) MS systems, the interference caused by UE to ARNS stations will impact in other frequency bands than interference form MS base stations. Therefore in this case other approaches are required to be applied to determine the affected ARNS assignments.

In case of the notification of MS systems with FDD when a notifying administration indicates in the notice that the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station does not exceed 21 dBm per 1 MHz (this corresponds to the coordination distance of 70 kilometres specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) then this value should be used in the interference calculation.\

Otherwise, the value of 31 dBm per 1 MHz (this corresponds to the coordination distance of 150 kilometres specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) can be used as the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station or to use another e.i.r.p. value as notified by the administration.

Using these aggregate values of UE (21 dBm per 1 MHz or 31 dBm per 1 MHz, as appropriate) operating with one MS base station one can determine the affected ARNS assignments by applying the methodology presented in Section 1 above. However, the receiving MS base station should be considered instead of a transmitting MS base station, and the aggregate e.i.r.p. of all UE operating simultaneously with the notified MS base station should be considered instead of the e.i.r.p. of the MS base station (see above).

1/1.2/6.4 Issue D: Solutions for accommodating applications ancillary to broadcasting requirements

1/1.2/6.4.1 For Method D1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD

5.296 *Additional allocation:* in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia ~~and~~ , Turkey, ~~the band 470-790 MHz, and in~~ Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-69~~8~~48 MHz ~~are~~ is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-1~~2~~5)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

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ADD

5.B12 In Region 1, the band or part of the frequency band 694-790 MHz is intended for applications ancillary to broadcasting and programme making within the land mobile service. Stations of the land mobile service providing applications ancillary to broadcasting and programme making shall not cause harmful interference to nor claim protection from existing or planned stations operating on a primary basis in accordance with the Radio Regulations. (WRC-15)

1/1.2/6.4.2 For Method D2

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD

5.296 *Additional allocation:* in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia ~~and~~ , Turkey, ~~the band 470-790 MHz, and in~~ Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-69~~4~~8 MHz ~~are~~ is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-1~~2~~5)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

*Note: Depending on the outcome of WRC-15, i.e., if this Method D2 is adopted by WRC-15, only one of the options below (modification of Resolution **232** or addition of two considerings in a new WRC-15 Resolution) should to be retained.*

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

considering

aaa) that in Region 1, a number of countries have deployments of applications ancillary to broadcasting and programme making operating on a secondary basis, which provide tools for the daily content production for the broadcast service;

bbb) that further harmonization of spectrum for applications ancillary to broadcasting and programme making in the frequency band 694-790 MHz is subject to ITU-R studies regarding possible solutions for global/regional harmonization of frequency bands and tuning ranges for electronic news gathering (ENG) use in accordance to Resolution ITU-R 59;

or

ADD

DRAFT NEW RESOLUTION [A12-METHOD-D2] (WRC-15)

…

The World Radiocommunication Conference (Geneva, 2015),

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considering

aaa) that in Region 1, a number of countries have deployments of applications ancillary to broadcasting and programme making operating on a secondary basis, which provide tools for the daily content production for the broadcast service;

bbb) that further harmonization of spectrum for applications ancillary to broadcasting and programme making in the frequency band 694-790 MHz is subject to ITU-R studies regarding possible solutions for global/regional harmonization of frequency bands and tuning ranges for electronic new gathering (ENG) use as in accordance to Resolution ITU-R 59;

…

1/1.2/6.4.3 For Method D3

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD

5.296 *Additional allocation:* in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia ~~and~~ , Turkey, ~~the band 470-790 MHz, and in~~ Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-69~~4~~8 MHz ~~are~~ is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-1~~2~~5)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

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