

TECHNICAL RECOMMENDATIONS FOR COMPATIBILITY OF DIGITAL TERRESTRIAL TELEVISION (DTT) BROADCASTING SERVICE IN THE UHF BAND BELOW 698 MHZ WITH LAND MOBILE SERVICE IN THE 698 MHZ-806 MHZ BAND

The XXV Meeting of Permanent Consultative Committee II: Radiocommunications (PCC.II),

CONSIDERING:

- a) That it is imperative to increase the penetration of broadband services in the region's countries, especially in rural and currently underserved areas, with a view to maximizing the social and economic benefits of the digital age while upholding existing and future digital television broadcasting services;
- b) That the 470 MHz–608 MHz and 614 MHz–698 MHz bands are allocated on a primary basis to the broadcasting service in Regions 1 and 2 on a co-primary basis in Region 3 and are used mainly by this service in most places of the world;
- c) That many countries are using the 470 MHz–608 MHz and 614 MHz–698 MHz frequency bands for high-definition television and other higher definition modes;
- d) That the television digitalization process is an opportunity for countries to redeploy the radio spectrum in order to provide their inhabitants with more social and economic benefits;
- e) That it is imperative to guarantee protection to the broadcasting service in the UHF band below 698 MHz;
- f) That the deployment of high-speed land mobile services in the 698 MHz–806 MHz frequency bands shall enable the region's broadband coverage to increase substantially, facilitating penetration and, as a result, increasing each country's productivity and competitiveness;
- g) That some of the region's countries have started, or are currently in the process of, granting licenses to use the 698 MHz-806 MHz frequency bands for mobile services;
- h) That various studies conducted worldwide have shown that there is interference between the international mobile telecommunication systems (IMT) being deployed in the 698 MHz-806 MHz frequency band and television services in the UHF band below 698 MHz, because of which mitigation measures must be adopted depending on the specific conditions of the networks deployed in each country;
- i) That land mobile systems currently deployed in the 698 MHz–806 MHz band include IMT and trunking systems, among others;
- j) That various of the region's countries have conducted technical studies that enable optimal use of the 698 MHz–806 MHz band and the proper operation of mobile broadband services, while protecting broadcasting service in the UHF band below 698 MHz;
- k) That the results of these studies are of the utmost importance, to be used by all of the region's countries as a reference,

¹ CCP.II-RADIO/doc. 3849/15 cor.1

RECOGNIZING:

- a) That, in the International Telecommunication Union (ITU) Radio Regulations, the 698 MHz–806 MHz band is allocated on a primary basis to Region 2 and identified for International Mobile Telecommunications (IMT);
- b) That Resolution 224 (Rev. WRC-12) resolves, among other issues, that the Administrations that are implementing or planning to implement IMT consider using bands identified for IMT below 1 GHz;
- c) That ITU-R Recommendation M.1036, “Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR),” provides frequency arrangements for IMT in the 698 MHz–806 MHz band;
- d) That Recommendation PCC.II-REC. 30 (XVIII-11), “Frequency arrangements of the 698 MHz–806 MHz Band in the Americas for broadband mobile services,” provides frequency arrangements for IMT in the 698 MHz–806 MHz band in the Americas;
- e) That ITU-R Report M.2241 “Compatibility studies in relation to Resolution 224 (Rev. WRC-12) in the bands 698-806 MHz and 790-862 MHz,” provides compatibility studies with respect to Resolution 224 in the 698-806 MHz and 790-862 MHz bands;
- f) That ITU-R Report BT.2247, “Field measurement and analysis of compatibility between DTTB and IMT,” refers to the review of compatibility between the systems considered in the present recommendation;
- g) That ITU-R Recommendation M.1767 establishes a protection criterion of land mobile systems from interference caused by terrestrial digital video and audio broadcasting systems in the VHF (174-230 MHz) and UHF (470-862 MHz) shared bands allocated on a primary basis. It provides the methodology and formulas to assess the maximum allowable field strength of digital terrestrial broadcasting signals into the land mobile system bandwidth, also taking into account the case of potential partial overlap in frequencies between both systems;
- h) That ITU-R Report M.2264 provides guidance on the development of frequency arrangements for systems operating in large contiguous bandwidths in the mobile service, with a view to assisting Administrations on spectrum planning issues;
- i) That, according to Decision PCC.II/DEC. 167 (XXIII-14), technical studies concerned with the subject addressed in the present recommendation are available in the CITEL Virtual Community’s Discussion Group on the Digital Dividend Spectrum, established by Decision PCC.II/DEC. 118 (XVII-11),

RECOMMENDS:

1. That the Administrations consider the mitigation techniques identified in the studies concerning compatibility of the digital terrestrial television service (DTT) in the UHF band below 698 MHz with land mobile service systems in the 698 MHz–806 MHz frequency band compiled in Annex A, in accordance with their particular needs;
2. That the Administrations, as deemed advisable, carry out the technical and administrative activities to guarantee the compatibility of the digital terrestrial television service (DTT) in the UHF band below 698 MHz with land mobile service systems in the 698 MHz–806 MHz frequency band in border areas;

3. That the Administrations that conduct new studies concerning compatibility of the digital terrestrial television (DTT) broadcasting service in the UHF band below 698 MHz with land mobile service systems in the 698 MHz–806 MHz band, present the studies at the successive meetings of PCC.II for the purposes of incorporating them into Annex hereto.

ANNEX TO RECOMMENDATION PCC.II/REC. 47 (XXV-15)

TECHNIQUES TO BE CONSIDERED TO FACILITATE COMPATIBILITY OF DIGITAL TERRESTRIAL TELEVISION SERVICE (DTT) IN THE UHF BAND BELOW 698 MHz WITH LAND MOBILE SERVICE IN THE 698 MHz-806 MHz BAND

Section I presents the description of the broadcasting service reception systems, as well as the description of the land mobile reception systems. Section II describes the possible interference cases and section III describes the mitigation techniques to facilitate the compatibility of the mentioned services.

I. Reception systems²³

First, it is important to identify the reception systems in each country subject to interference; each reception system will be a specific case:

1. Possibilities of DTT reception systems:
 - a) TV reception with an external antenna;
 - b) TV reception with an internal antenna;
 - c) reception of the TV antenna amplifier with a collective antenna; and
 - d) TV reception at mobile terminals (One-seg). (In case of ISDB).
2. Possibilities of radio broadcasting reception systems:
 - a) reception of base station, repeater or node; and
 - b) reception of the mobile station (terminal).

II. Types of interference²³

Types of harmful interference caused by radiocommunication system transmitters in DTT reception are as follows:

- a) reception saturation;
- b) TV reception degradation;
- c) image channel interference; and
- d) interference from unwanted emissions.

Types of harmful interference caused by DTT transmitters in radiocommunication systems are as follows:

- e) reception saturation; and
- f) interference from unwanted emissions.

² CCP.II-RADIO/doc. 3661/14 – “Information document regarding Brazilian tests on the coexistence of IMT (LTE) in the 700 MHz band with DTV (ISDB-T)” (Information document submitted by the delegation of Brazil)

³ CCP.II-RADIO/doc. 3512/14 – “Report on laboratory tests on the interference of the LTE mobile broadband in the 700 MHz band into Digital TV in 470 - 698 MHz band” (Document submitted by ABERT - Brazilian Radio and TV Broadcasters Association),

III. Mitigation techniques

1. Organization of the spectrum intended for land mobile service so as to minimize interferences with DTT

1.1 DVB-T2 - LTE⁴

Based on one of the included studies, it can be observed that, as interference increases (protection margin worsens) so does the bandwidth of the LTE signals. Because of that, those studies consider that, in band distribution by blocks, the LTE block with the lesser bandwidth should be in the channel adjacent to the DTT in the digital dividend band.

2. Limitation of power emissions in high broadcasting channels.

The establishment of adequate transmission power, according to specific location, address and channels, may guarantee compatibility and minimize mutual harmful interferences.⁵

2.1. ISDB-T - LTE⁶

Limiting power emissions using planning that avoids high-power broadcasting stations in high channels (48-51) helps to reduce out-of-band interference, especially blocking interference experienced by the LTE base station. Setting power limits in broadcasting signals in channels immediately adjacent to the receiver of the LTE base station is highly beneficial and could reduce the separation distance required when combined with other mitigation techniques.

2.2. DVB-T2 - LTE⁷

In the studies being reviewed, the technical conditions of the potential use of channel 51 of DTT (692 to 698 MHz) were closely assessed, which made it possible to conclude that the protection margin that was measured does not significantly change when the guard band is greater than 9 MHz.

For example, as for the analysis for reception of portable DTT indoors, results show that the minimum distance between the LTE mobile terminal and DTT receiver for a LTE bandwidth of 15 MHz must be 10 meters when in the same room and 4 meters when in different rooms. By applying a domestic filter of 8 dB of minimum rejection, it was possible to reduce minimum distance problems by a half.

It is up to each Administration to decide whether or not to use channel 51 to increase the guard band between services. If channel 51 is chosen, the studies conducted by Colombia suggest it be used in rural areas, where the DTT signal level received is designed to meet the conditions of fixed reception on rooftop using a directional antenna. Likewise, using a robust DTT transmission mode is helpful in these cases.

3. Use of RF filters at base stations of the land mobile service to block signals from broadcasting stations

⁴ CCP.II-RADIO/doc. 3545/14 - "Study results of compatibility between Digital TV services with DVB-T2 standard and IMT and P25 systems" (Document submitted by the delegation of Colombia)

⁵ CCP.II-RADIO/doc. 3661/14 - "Information document regarding Brazilian tests on the compatibility of IMT (LTE) in the 700 MHz band with DTV (ISDB-T)" (Information document submitted by the delegation of Brazil)

⁶ PCC.II RADIO/doc. 3635/14 - "Interference studies in 700MHz in Brazil" (Document submitted by GSMA/Brazil)

⁷ CCP.II-RADIO/doc. 3545/14 - "Study results of compatibility between Digital TV services with DVB-T2 standard and IMT and P25 systems" (Document submitted by the delegation of Colombia)

3.1. ISDB-T – LTE⁸⁹

One way to reduce the separation distances required between the broadcasting and base stations to prevent blocking of the latter, by inserting additional attenuation, is using a filter in the LTE base station to reduce the interfering signal.

4. Use of RF filters in DTT receivers¹⁰

- Downlink: Using filters in television receivers and in the emission at LTE base stations makes it possible to mitigate LTE downlink interference.
- Uplink: The LTE uplink interference level towards the television receivers depends on the existing guard band between DTT and LTE, as well as on the bandwidth of said link.

4.1. DVB-T2 – LTE¹¹

The use of low-pass RF filters for DTT receivers, either domestic for television sets or professional for facilities with a collective antenna, makes it possible to lower interference. Necessary attenuation of the filters increases as the bandwidth of the adjacent LTE signal increases. The results of the studies show that the necessary attenuation of the filters for blocks from 10 MHz to 20 MHz ranges from 17dB to 20dB. It is must be highlighted that filters introduce insertion losses of about 3 dB in the high portion of the DTT band.

4.2. ISDB-T – LTE¹²

In those cases where interference with the ISDB-T receiver has been proven, a low-pass filter in that receiver may be used to decrease the interference.

5. Establishment of minimum separation distances between DTT antennas and land mobile service devices¹³

Establishment of a minimum distance between the transmitters of one system and the receivers of the other, so that protection ratios are met and can coexist without any mutual harmful interference, is a solution to be considered.

6. Selection of orthogonal polarizations

6.1. ISDB-T – LTE¹⁰

Most ISDB-T emissions have horizontal polarization. Using vertically polarized LTE signals may increase discrimination with the horizontally polarized broadcasting antennas and make the receiver less vulnerable

⁸ CCP.II RADIO/doc. 3635/14 – “Interference studies in 700MHz in Brazil” (Document submitted by GSMA/Brazil)

⁹ CCP.II-RADIO/doc. 3661/14 – “Information document regarding Brazilian tests on the compatibility of IMT (LTE) in the 700 MHz band with DTV (ISDB-T)” (Information document submitted by the delegation of Brazil)

¹⁰ CCP.II-RADIO/doc. 3512/14 – “Report on laboratory tests on the interference of the LTE mobile broadband in the 700 MHz band into Digital TV in 470 - 698 MHz band” (Document submitted by ABERT - Brazilian Radio and TV Broadcasters Association),

¹¹ CCP.II-RADIO/doc. 3545/14 - “Study results of compatibility between Digital TV services with DVB-T2 standard and IMT and P25 systems” (Document submitted by the delegation of Colombia)

¹² CCP.II RADIO/doc. 3635/14 – “Interference studies in 700MHz in Brazil” (Document submitted by GSMA/Brazil)

¹³ CCP.II-RADIO/doc. 3661/14 – “Information document regarding Brazilian tests on the compatibility of IMT (LTE) in the 700 MHz band with DTV (ISDB-T)” (Information document submitted by the delegation of Brazil)

to interfering signals. According to the studies submitted, the use of orthogonal polarizations would offer supplementary discrimination.

7. Promoting the use of high-quality TV receivers¹⁰

Administrations may specify minimum performance and quality criteria for digital television receivers in their equipment homologation and user protection policies.

The possibility that receiver quality may be supported by some of the previously mentioned interference mitigation techniques and that a high-quality receiver alone does not guarantee the adequate reception of DTT signals in the presence of interfering signals must be taken into consideration.