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## India (Republic of)

### INTERFERENCE CRITERIA OF PUBLIC PROTECTION AND DISASTER RELIEF (PPDR) SYSTEMS

#### 1 Background

Working Party (WP) 5A is responsible for Land mobile service above 30 MHz\*(excluding IMT); wireless access in the fixed service; amateur and amateur-satellite services and is expected to provide inputs on various agenda items to other Working Parties which are responsible for those agenda items that could impact Land mobile services. Two key agenda items which could potentially impact these services are WRC-27 agenda item 1.13 and 1.15:

WRC-27 agenda item 1.13 will *"consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution 253 (WRC-23);"*

Under the resolves of Resolution **253 (WRC-23)**;"the ITU Radiocommunication Sector is invited to complete in time for the 2027 world radiocommunication conference studies on possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU-R M.1036; *and to conduct studies on sharing and compatibility between incumbent services, including in adjacent frequency bands, ensuring the protection of incumbent services in accordance with the Radio Regulations. A number of frequency bands included in Recommendation ITU-R M.1036 are used for broadband PPDR services and are also included in Resolution 646 (Rev.WRC-19). In addition, some of these bands are also used for narrow band PPDR in India and many other countries around the world.*

WRC-27 agenda item 1.15 *considers studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface, in accordance with Resolution 680 (WRC-23).*

*Resolves 4 of Resolution 680 (WRC-23) invites the ITU Radiocommunication Sector to conduct studies of sharing and compatibility related to systems in the SRS that are planned for operation in the frequency ranges identified in resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference to ensure protection of radiocommunication services, as specified in recognizing g) to n), and the RAS on the Earth and in the SZM in the same, adjacent or nearby bands; Among the frequency ranges listed in recognizing k): 390-399.9 MHz, 400.05-401 MHz, 420-430 MHz and 440-450 MHz.*

These frequency ranges overlap the frequency ranges of *resolves 3* of Resolution **646 (Rev.WRC-19)** and are used by PPDR service in India and many other countries around the world.

## **2 ITU regulations for PPDR**

### **2.1 Resolution 646- Public protection and disaster relief**

Resolution **646 (Rev.WRC-19)** has the following resolves:

*resolves 1:* to encourage administrations to use harmonized frequency ranges for PPDR to the maximum extent possible, taking into account the national and regional requirements and also having regard to any needed consultation and cooperation with other concerned countries;

*resolves 2:* to encourage administrations to consider parts of the frequency range 694-894 MHz, as described in the most recent version of Recommendation ITU-R M.2015, when undertaking their national planning for their PPDR applications, in particular broadband, in order to achieve harmonization, taking into account and above;

*resolves 3:* to further encourage administrations to also consider parts of the following regionally harmonized frequency ranges for their PPDR applications:

- in Region 1: 380-470 MHz;
- in Region 3: 406.1-430 MHz, 440-470 MHz and 4 940-4 990 MHz;

*resolves 4:* that PPDR frequency arrangements within the frequency ranges specified in (resolves) 2 and 3, as well as countries' frequency arrangements for PPDR, should be included in Recommendation ITU-R M.2015

### **2.2 Recommendation ITU-R M.2015**

Annex 1 of this recommendation contain regional and country frequency arrangements for PPDR.

- Annex 1, Section 1 contains frequency arrangements in parts of the frequency range 694-894 MHz (as per resolves 2 of Resolution **646 (Rev.WRC-15)**).
- Annex 1, Section 2: Frequency Arrangements in parts of the frequency range 380-470 MHz (as per resolves 3 of Resolution **646 (Rev.WRC-15)**).

## **3 WRC-27 agenda items that can affect operation of PPDR systems**

### **3.1 WRC-27 agenda item 1.13**

*to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution **253 (WRC-23)**.*

Under the resolves of Resolution **253 (WRC-23)** the ITU Radiocommunication Sector is invited to complete in time for the 2027 world radiocommunication conference:

- studies on possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU-R M.1036;
- to conduct studies on sharing and compatibility between incumbent services, including in adjacent frequency bands, ensuring the protection of incumbent services in accordance with the Radio Regulations.

In Recommendation ITU-R M.1036, Section 3, there is a frequency arrangement (Table 2, Frequency Arrangement A1) with mobile station transmit at 824-849 MHz, paired with base station transmit at 869-894 MHz.

This arrangement is adjacent to a frequency arrangement for narrowband PPDR in Region 2, with mobile station transmit in 821-824 MHz and base station transmit in 866-869 MHz, as indicated in Section 1-2.3 of Recommendation ITU-R M.2015.

In Section 1-3.2 of Recommendation ITU-R M.2015, Region 3, frequency arrangement (h) has a frequency arrangement for narrowband PPDR, with mobile station transmit in 806-823 MHz and base station transmit in 851-868 MHz.

In the same section (1-3.2), frequency arrangement (j) has indicated that the band 868.1-869.025 MHz is used for simplex operation using 25 kHz<sup>1</sup> channel bandwidth.

By now, PPDR radios employing channel bandwidths of 12.5kHz or 6.25 kHz have replaced most of the radios using 25 kHz channel bandwidth.

Indian Administration, through National Frequency Allocation Plan (NFAP-2022) has permitted part of the frequency range 806-894 MHz for PPDR applications. This frequency range being adjacent to frequency ranges recommended in Recommendation ITU-R M.1036, Indian Administration wishes to protect PPDR applications adjacent to bands being considered under WRC-27 agenda item 1.13.

### 3.2 WRC-27 agenda item 1.15

*to consider studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface, in accordance with Resolution 680 (WRC-23);*

*resolves 4 of Resolution 680 (WRC-23) invites the ITU Radiocommunication Sector to conduct studies of sharing and compatibility related to systems in the SRS that are planned for operation in the frequency ranges identified in resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference 1 to ensure protection of:*

- radiocommunication services, as specified in *recognizing g) to n)*, and
- the RAS on the Earth and in the SZM in the same, adjacent or nearby bands.

Among the frequency ranges listed in *recognizing k)*: 390-399.9 MHz, 400.05-401 MHz, 420-430 MHz and 440-450 MHz; these frequency ranges overlap the frequency ranges of *resolves 3 of Resolution 646 (Rev.WRC-19)*, viz:

- in Region 1: 380-470 MHz;
- in Region 3: 406.1-430 MHz, 440-470 MHz.

In addition, footnote 2 of *recognizing l)* of Resolution 646 (Rev.WRC-19) has the following text:

*For example, as of November 2015 some countries in Region 3 had adopted parts of the frequency ranges 138-174 MHz, 351-370 MHz and 380-400 MHz for narrowband PPDR applications and the frequency ranges 174-205 MHz and 1 447-1 467 MHz for broadband PPDR applications.*

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<sup>1</sup> Currently, most of the PPDR radios use channel bandwidths of 12.5 kHz or 6.25 kHz.

## **4 Radio interface standards and technical and operational characteristics of PPDR systems**

### **4.1 Recommendation ITU-R M.2009 – Radio interface standards for use by public protection and disaster relief operations in accordance with Resolution 646 (Rev.WRC-15)**

This Recommendation contains the radio interface standards that should be used for PPDR operations. Annex 2 of the Recommendation provides information on narrow-band standards for use by PPDR operations:

- Project 25 (also known as APCO P25)
- Terrestrial Trunked Radio (TETRA)
- Digital Mobile Radio (DMR)

It should be noted that abovementioned standards (P25, TETRA and DMR) are used as (trunked radio) digital dispatch systems, as well as conventional systems.

### **4.2 Report ITU-R M.2014 – Digital land mobile systems for dispatch traffic**

This Report provides the technical and operational characteristics for spectrum efficient digital dispatch systems and also provides details of systems being introduced throughout the world.

### **4.3 Recommendation ITU-R M.1808 - Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies in bands below 960 MHz**

This Recommendation provides technical and operational characteristics of (digital and analogue) conventional and trunked land mobile systems to be used in sharing studies.

## **5 Interference criteria for PPDR**

Recommendation ITU-R M.1808 contains a section on interference criteria, section 2.1, reproduce below:

### **2.1 Interference criteria**

There are many methodologies used to ensure coexistence between conventional and trunked land mobile systems e.g. field-strength contours, carrier-to-interference, etc. For simplicity, an  $I/N$  of  $-6$  dB could be used to determine the impact of interference. For applications with greater protection requirements, such as public protection and disaster relief (PPDR), an  $I/N$  of  $-10$  dB may be used to determine the impact of interference.

Although an  $I/N$  of  $-6$  dB could be used, a  $I/N$  of  $-10$  dB is permitted (may be used) for PPDR. The interference criteria of  $I/N = -6$  may be acceptable to some land mobile radio systems provided the receivers of such radio systems can tolerate the  $C/N$  degradation due to the  $I/N$  of  $-6$  dB. An  $I/N$  of  $-6$  dB represents an increase in the receiver effective noise by 1 dB, causing a degradation in the carrier-to-noise ratio ( $C/N$ ) of 1 dB.

In a noise-limited land mobile radio system, the transmission range of a base station is limited by the thermal noise in the receiver. An increase in receiver effective noise of 1 dB would result in significant degradation in communication range<sup>2</sup>.

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<sup>2</sup> Recommendation ITU-R M.2116, section 4.

The C/N degradation can be mitigated by reducing the propagation loss by 1 dB. This achievable by reducing the distance between transmitter and receiver. That is, moving the mobile station closer to the base station.

A 1-dB degradation to the C/N can be mitigated by reducing the original transmission range by 89%<sup>3</sup>.

For example, if the original transmission range is 20km, then the range has to be reduced to 17.8km (20 x 0.89) to restore the C/N ratio to its original value.

## **6 Proposal on interference criteria for the protection PPDR radio systems**

To ensure the protection to PPDR land mobile radio system it is proposed that an I/N of -10 dB (as recommended in Recommendation [ITU-R M.1808](#)) be used in sharing and compatibility studies to protect stations of PPDR land mobile radio systems from aggregate interference, in WRC-27 agenda items 1.13 and 1.15.

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<sup>3</sup> Assuming free space propagation loss.