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| **INTERNATIONAL TELECOMMUNICATION UNION** | |  | |
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| Annex 20 to Working Party 5A Chairman’s Report | | | |
| Working document toward a preliminary draft revision of RECOMMENDATION ITU-R M.2015-1 | | | |
| Frequency arrangements for public protection and disaster relief radiocommunication systems in accordance  with Resolution 646 (Rev.WRC-15) | | | |

(2012-2014)

Summary of the revision

[TBD]

Scope

This Recommendation is intended to promote global and regional harmonization of frequency bands for public protection and disaster relief. It provides guidance on frequency arrangements for public protection and disaster relief radiocommunications, in particular within the frequency ranges specified in resolves 2 and 3 of the Resolution 646 (Rev.WRC-15), as well as countries’ frequency arrangements.

[The combination of Resolution **646** **(Rev.WRC-15)** and other relevant ITU-R Recommendations and Reports are to be considered as a package in relation to the provision of PPDR services and applications, therefore the considering, noting and recognizing below will only mention information pertinent for this ITU-R Recommendation. All other important information is covered by related sections of Resolution **646 (Rev.WRC-15)** other relevant ITU-R Recommendations and Reports**.]**

Keywords

PPDR, frequency arrangements[TBD]

The ITU Radiocommunication Assembly,

considering

*a)* that Resolution **646 (Rev.WRC-15)** encourages administrations to use harmonized frequency ranges for PPDR to the maximum extent possible when undertaking their national planning for their PPDR applications;

*b)* that Resolution 646 (Rev.WRC-15) resolved to include harmonized PPDR frequency arrangements within the frequency ranges specified in *resolves* 2 and 3 of that Resolution*,* as well as countries’ frequency arrangements for PPDR, in this Recommendation;

*c)* that addressing the growing telecommunication and radiocommunication needs of PPDR agencies and organizations is vital to the maintenance of law and order, protection of life and property, disaster relief and emergency response;

*d)* that many administrations wish to facilitate interoperability and interworking between systems used for PPDR radiocommunication, both nationally and for cross-border operations in emergency situations and for disaster relief;

*e)* that, although narrowband and wideband systems will continue to be used to meet PPDR requirements, there is a growing need for broadband applications to support improved data and multimedia capabilities, which require higher data rates and higher capacity;

*f)* that, over time, narrowband public protection and disaster relief (PPDR) applications, for example mission critical voice and low-data rate applications, may be provided by broadband systems;

*g)* that administrations may have different operational needs and spectrum requirements for their PPDR agencies and organizations depending on their policy objectives and organizational structures;

*h)* that usage of the same frequency bands will enable administrations to achieve the benefits of harmonization, such as:

– increased potential for interoperability;

– clear guidance for standardization;

– increased volume of equipment resulting in economies of scale, more cost-efficient and affordable equipment and expanded equipment availability, which is of particular benefit to developing countries;

– improved spectrum management and planning;

– more effective international aid during disasters and major events; and

– enhanced cross-border coordination and circulation of equipment;

*i)* that some commercial terrestrial and satellite systems are complementing the dedicated systems in support of PPDR, and that the use of commercial solutions will be in response to technology development and market demands,

noting

*a)* that spectrum planning for PPDR radiocommunications is performed at the national level, taking into account the need for interoperability and benefits of neighbouring administrations using harmonized or common frequency bands;

*b)* that flexibility must be afforded to administrations:

– to determine, at the national level, how much spectrum to make available for PPDR from the ranges in the resolves part of Resolution **646 (Rev.WRC-15)** taking into account the existing applications and their evolution, in order to meet their particular national requirements;

– to determine the need and timing of availability, as well as the conditions of usage, of the bands for PPDR in order to meet specific regional or national situations,

[Moved to recognizings and revised there] [Moved to recognizings and revised there][moved to recognizing and revised there]

recognizing

*a)* that Resolution **646 (Rev.WRC-15)** encourages administrations to consider the identified frequency bands/ranges or parts thereof in *resolves* *2 & 3* when undertaking their national planning for the purposes of achieving harmonized frequency bands/ranges for advanced PPDR systems and applications;

*b)* that administrations may be using other frequency bands for the provision of PPDR, as listed in Annex 2 and there is a need for administrations using these frequency arrangements to ensure compatibility between PPDR applications and stations of other services in neighbouring countries operating in accordance with the Radio Regulations;*c)* the continuing need for development of regionally harmonized frequency arrangements for the purposes of implementing advanced PPDR solutions;

*d)* that the frequency arrangements in the Annexes are provided for PPDR applications in the mobile service;

*e)* that compatibility of stations using these frequency arrangements with other services operating in other countries is studied in the ITU at the service level and not at the application level;

*f)* the relationship between Resolution **646 (Rev.WRC-15)** on public protection and disaster relief, which invites to review and revise of this Recommendation, and Resolution **647 (Rev.WRC-15)** on radiocommunication aspects, including spectrum management guidelines, for early warning, disaster prediction, detection, mitigation and relief operations relating to emergencies and disasters, which also addresses the need to coordinate activities under these Resolutions in order to minimize any possible overlap[moved from noting i and revised]

*g)* that Recommendation ITU‑R M.2009 provides information on technologies that may be appropriate for use in these frequency arrangements; [moved from noting g and revised]

*h)* that Report ITU-R M.2291 addresses the current and possible future use of international mobile telecommunications (IMT), including the use of long term evolution (LTE), in support of broadband PPDR communications; [moved from noting h and revised]

*i)* that Report ITU-R M.2377 contains the radiocommunication objectives and requirements for PPDR;

*j)* that some of the bands addressed in this Recommendation have been identified by World Radiocommunication Conferences for use by administrations wishing to implement IMT,

recommends

1 that the harmonized frequency arrangements in Annex 1 should be used by administrations as guidance when making spectrum available for PPDR applications;[moved from recommends 2 and revised]

2 that administrations implementing the harmonized frequency arrangements in the Annex 1 should make all necessary efforts to ensure compatibility between PPDR applications and stations of other services in neighbouring countries operating in accordance with the Radio Regulations. [moved from recommends 1 and revised]

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Agreed structure for Annexes

Annex 1 – recommended arrangements based on resolves 2 and 3 of the Resolution

Section 1 694-894 MHz harmonized plans

Section 2:

Region 1 380-470 MHz

Region 3 406.1-430 MHz

Region 3 440-470 MHz

Section 3:

Region 3 4 940-4 990 MHz

Annex 2 – ‘countries’ frequency arrangements’ – mentioned in recognizing

[Editor’s Note: There is a conceptual guidance document for the structure of the Annexes attached to the WG Chairman’s report that could provide guidance for future contributions on the organization of the Annexes.]

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Annex 1

Examples of frequency arrangements for the band 380-470 MHz   
in certain countries in Region 1 for narrowband and wideband   
public protection and disaster relief operations

# 1 Region 1

The frequency range 380-470 MHz has been identified as a tuning range for PPDR in Region 1. The frequency band 380-385 MHz (uplink)/390-395 MHz (downlink) is the harmonized core band for permanent use for PPDR. For more information relating to countries within Europe, see ECC/DEC/(08)05 and ECC Report 102.

Wideband PPDR applications use channels within available parts of the frequency range 380‑470 MHz.

Additionally certain channels have been identified for DMO (Direct mode operation) and AGA (Air‑ground-air operation) purposes.

## 1.1 DMO (Direct mode operation)

Simplex channels within the frequency bands 380-380.150 MHz and 390-390.150 MHz should be used as harmonized channels for DMO. For more information relating to countries within Europe see ERC/DEC/(01)19.

## 1.2 AGA (Air-ground-air operation)

Duplex channels within the frequency bands 384.800 MHz-385 MHz/394.800-395 MHz should be used as the core band for harmonized channels for AGA. Duplex channels within the frequency bands 384.750 MHz-384.800 MHz/394.750-394.800 MHz may be used as the preferred extension band for AGA when additional channels are required. For more information relating to countries within Europe, see ECC/DEC/(06)05.

## 1.3 Centre frequencies

*a) For systems with a channel bandwidth of up to 150 kHz*

*FCH* = band edge – (channel bandwidth/2) + *n* \* channel bandwidth

where:

*FCH* = centre frequency;

*n* = channel number (1, 2, 3, ...);

band edge: is lower edge of frequency band.

*b) For systems with a channel bandwidth of 200 kHz*

The centre frequencies should be selected according to the formula under *a)* with an option to offset these centre frequencies by 100 kHz.

*c) For systems with a channel bandwidth of 1.25 MHz*

The centre frequencies should be selected according to the formula under *a)* with an option to offset these centre frequencies by multiples of 12.5 kHz, in order to provide flexibility to locate the centre frequencies in the optimum position within the band.

Annex 2

Examples of frequency arrangements within the bands 763 to 776 MHz   
and 793 to 806 MHz in certain countries in Region 2  
for narrowband, wideband and broadband public  
protection and disaster relief operations

# 1 Region 2

The frequency range 764-776 MHz and 794-806 MHz has been identified for PPDR in the CITEL PCC.II/REC. 18 (VII-06). Within this frequency range, administrations could consider a number of possible frequency arrangements examples as indicated below.

## 1.1 Example frequency arrangement “A”[[1]](#footnote-5)

|  |  |  |
| --- | --- | --- |
| Base station transmit (MHz) | Mobile station transmit (MHz) | Frequency block |
| 764-768 | 794-798 | PPDR 1 |
| 768-776 | 798-806 | PPDR 2 |



## 1.2 Example frequency arrangement “B”[[2]](#footnote-6)

|  |  |  |
| --- | --- | --- |
| Base station transmit (MHz) | Mobile station transmit (MHz) | Frequency block |
| 758-768 | 788-798 | PPDR 11 |
| 769-775 | 799-805 | PPDR 22 |
| 768-769 | 798-799 | PPDR internal guardband |
| NOTE 1 – This frequency block is used for broadband PPDR applications[[3]](#footnote-7). Broadband PPDR applications include web browsing, tactical video, surveillance video, high resolution imaging, database access, and virtual private networks.  NOTE 2 – This frequency block is used for PPDR applications that provide narrowband voice and low-speed data services. In the context of PPDR, narrowband is defined in Resolution **646 (Rev.WRC‑12)** as “supporting voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less”. Narrowband channels may also be consolidated into wideband channels (50 to 150 kHz) if approval by the licensing administration is obtained through a limited waiver process. | | |





Annex 3

Examples of frequency arrangements for the band 806 to 869 MHz in   
certain countries in Region 2 for narrowband public protection   
and disaster relief operations

# 1 Region 2

In a number of countries in the Region 2, the band 806-824/851-869 MHz is allocated to the mobile service, and designated for Land Mobile Radio (LMR) applications. The duplex spacing is 45 MHz, with the base stations transmitting in the 851-869 MHz, and the mobile stations in the 806‑824 MHz range. PPDR channels may be assigned throughout this band and specific blocks may be designated exclusively for PPDR applications. (See § 1.1) Radio equipment is capable of tuning to all channels in the band ensuring interoperability. To simplify cross-border coordination and to ensure that public safety agencies have access to a stable and predictable pool of radio frequency channels, neighbouring administrations could implement complementary frequency arrangements, an example being shown in the figure below.



## 1.1 Example frequency arrangement

### 1.1.1 Designation of frequency blocks

|  |  |  |
| --- | --- | --- |
| Mobile station/ Control station transmit (MHz) | Base station transmit  (MHz) | Frequency block |
| 806-809 | 851-854 | PPDR1[[4]](#footnote-8) |
| 821-824 | 866-869 | PPDR2[[5]](#footnote-9) |

### 1.1.2 Channelization

The frequencies corresponding to the centre frequency of the channel number are defined by the following formulas, where *n* is the channel number:

|  |  |  |  |
| --- | --- | --- | --- |
| Channel number | Mobile station transmit Channel centre frequency (MHz) | Base station transmit Channel centre frequency (MHz) | Channel bandwidth (kHz) |
| *n* = 1 to 600 | *fn* = 806.0125 + (0.025) × (*n* − 1) | *fn* = 851.0125 + (0.025) × (*n* − 1) | 25 |
| *n* = 602 to 790 except 639, 677, 715, 753 | *fn* = 821.0375 + 0.0125 × (*n* − 602) + 0.025 × floor[(*n* − 601) / 38] | *fn* = 866.0375 + 0.0125 × (*n* − 602) + 0.025 × floor[(*n* − 601) / 38] | 12.5 |
| *n* = 601, 639, 677, 715, 753 | *fn* = 821.0125 + 0.5 × floor[(*n* − 601) / 38] | *fn* = 866.0125 + 0.5 × floor[(*n* − 601) / 38] | 25 |
| *n* = 791 to 830 | *fn* = 823.5 + (0.0125) × (*n* − 791) | *fn* = 868.5 + (0.0125) × (*n* − 791) | 25 |

Annex 4

Examples of frequency arrangements for the range 406.1-430 MHz  
in certain countries in Region 3 for narrowband public protection   
and disaster relief operations

# 1 Region 3

## 1.1 Example frequency arrangement – 406.1-410 MHz

Parts of the band 406.1-410 MHz are used in certain Region 3 countries to accommodate trunked land mobile systems. Frequency arrangements for this spectrum are shown below.

Simplex services are accommodated within a 12.5 kHz channel raster on the following centre frequencies (MHz):

*Fn* = 406.01250 + ((*N* – 1) \* 0.0125) *N* = 1, 2, 3,…

## 1.2 Example frequency arrangement for digital PPDR within 410-430 MHz

The band 410-430 MHz is used in certain Region 3 countries to accommodate digital trunked land mobile systems.

The frequency band 410 to 430 MHz provides a total bandwidth of 20 MHz for Digital Trunked Radio Systems. The 12.5/25 kHz channelling plan is the standard channelling plan for this band giving a total of 800 physical radio channels (or equivalent trucked radio system analogue traffic channel of 1 600 noting possibility of two time slots per physical channel). Although the standard channel spacing is 12.5/25 kHz, it provides flexibility to operate two or more contiguous channels (i.e. 50 kHz or 100 kHz) if needed. Administrations normally assign one or more channel based on channel spacing 12.5 kHz or 25 kHz.

The channelling plan based on a raster of 12.5 kHz and 25 kHz is shown below:

### 1.2.1 Frequency arrangements for 25 kHz channel spacing

Centre frequencies of the base station transmitting channel are (MHz):

*Fn* = 420.0125 + (*N* – 1)\*0.025 *N* = 1, 2, 3,… 400

The centre frequencies of the base station receiving channel is (MHz):

*Fn* = 410.0125 + (*N* – 1)\*0.025 *N* = 1, 2, 3,… 400

### 1.2.2 Frequency arrangements for 12.5 kHz channel spacing

Centre frequencies of the base station transmitting channel are (MHz):

*Fn* = 420.00625 + (*N* – 1)\*0.0125 *N* = 1, 2, 3,… 800

The centre frequencies of the base station receiving channel is (MHz):

*Fn* = 410.00625 + (*N* – 1)\*0.0125 *N* = 1, 2, 3,… 800

### 1.2.3 Channel allotment plan

The channel arrangements are divided into 4 pairs of frequency blocks (blocks A/A’, blocks B/B’, blocks C/C’, and blocks D/D’) with transmit/receive separation of 10 MHz. The channel allotment plan is designed to minimize inter-modulation and frequency interference problems by assigning co‑sited channels that are 250 kHz apart. The frequency blocks A, B, C and D, which contain 200 channels each, are divided into ten (10) channel groups (i.e. A01-A10, B01-B10, C01-C10 and D01-D10) respectively.

The numbers of channels/channel groups assigned are based on the service requirement of the user agency based among others on the area covered, grade of service (GOS), capacity and services provided.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Block | A | B | C | D |
| Group Nos. 01 to 10 | X=1 to 10  A=1 to 10 | X=1 to 10  B=1 to 10 | X=1 to 10  C=1 to 10 | X=1 to 10  D=1 to 10 |
| Channel Number N= | 2\*A-1+20\*(X−1) and  2\*A+20\*(X−1) | 2\*B+199+20\*(X−1) and  2\*B+200+20\*(X−1) | 2\*C+399+20\*(X−1) and  2\*C+400+20\*(X−1) | 2\*D+599+20\*(X−1) and  2\*D+600+20\*(X−1) |

Annex 5

Examples of frequency arrangements for the bands 806 to 824 MHz and  
851 to 869 MHz in certain countries in Region 3 for narrowband   
and broadband public protection and disaster relief operations

# 1 Region 3

## 1.1 Example narrowband plan – 806-824/851-869 MHz

The entire band could be used for channel bandwidths of 25 kHz for digital trunked radio systems. However some administrations may want to use different channel bandwidths according to their policy. This sub-section provides examples of three channelling schemes. In the sub-band of   
806-811/851-856 MHz the channel bandwidth is 25 kHz, in the sub-band of   
811-813.5/856-858.5 MHz the channel bandwidth is 12.5 kHz and in sub-band   
813.5-816/858-861 MHz the channel bandwidth is 6.25 kHz. The lower block 806‑824 MHz is used for mobile station transmitters (uplink) and the upper block is used for base station transmitters (downlink).



Formulas to calculate the centre frequency of each channel are as follows:

– In sub-band of 806-811/851-856 MHz:

The band is divided into 25 kHz channels.

Centre frequency of *N*‑th base station transmitting channel (MHz):

*FN* = 851.0125 + (*N* − 1) × 0.025 *N* = 1, 2, 3, …, 200

Centre frequency of *N*-th base station receiving channel (MHz):

*FN*′ = 806.0125 + (*N* − 1) × 0.025 *N* = 1, 2, 3, …, 200

– In sub-band of 811-813.5/856-858.5 MHz:

This sub-band is divided into 12.5 kHz channels.

Centre frequency of *N*‑th base station transmitting channel (MHz):

*FN* = 856.00625 + (*N* − 1) × 0.0125 *N* = 1, 2, 3, …, 200

Centre frequency of *N*‑th base station receiving channel (MHz):

*FN*′ = 811.00625 + (*N* − 1) × 0.0125 *N* = 1, 2, 3, …, 200

– In sub-band of 813.5-816/858.5-861 MHz:

This sub-band is divided into 6.25 kHz channels.

Centre frequency of *N*‑th base station transmitting channel (MHz):

*FN* = 858.503125 + (*N* − 1) × 0.00625 *N* = 1, 2, 3, …, 400

Centre frequency of *N*‑th base station receiving channel (MHz):

*FN*′ = 813.503125 + (*N* − 1) × 0.00625 *N* = 1, 2, 3, …, 400.

## 1.2 Example broadband plan – 806-824/851-869 MHz

The broadband channel plan is based on paired frequencies with mobile station transmitters used in the frequency band 806-824 MHz (uplink) and base station transmitters used in the frequency band 851-869 MHz (downlink).

To allow for possible co-existence with legacy narrowband systems and adjacent broadband channel arrangements, administrations could consider the examples below:



The raster for the wideband channels is 100 kHz, which means that the channel center frequencies are an integer multiple of 100 kHz. The broadband channel bandwidth is an integer multiple of 5 MHz. This provides flexibility for administrations to implement appropriate channel arrangements in accordance with the above Plans ‘A’ or ‘B’, or some subset thereof, to suit specific national circumstances. Some administrations may want to use different amounts of broadband and narrowband spectrum than the examples in Plan ‘A’ or ‘B’ to allow for transition.

## 1.3 Example narrowband and broadband in 806-824/851-869 MHz

In Region 3 some countries, in accordance with Resolution **646 (WRC-12)**, have identified the band 806-824/ 851-869 MHz for PPDR in their national plans. With the regional adoption of the APT 700 MHz band plan, these countries wish to deploy broadband PPDR within the band 806‑824/ 851‑869 MHz and at same time a) provide the necessary spectrum for narrow band PPDR and b) ensure that the downlink of the APT 700 MHz band is protected from adjacent band interference from the uplink transmission of broadband systems operating in the band 806‑824/851‑869 MHz, particularly in cases where channel sizes of 10+10 or higher bandwidth are used in the APT 700 MHz band.

This example shows how narrowband and broadband systems can be deployed in the band 806‑824/851-869 MHz while ensuring the necessary protection of the APT 700 MHz band from adjacent band interference. The sub-band 806-813/851-858 MHz is used for narrowband systems with a channel bandwidth of 25 kHz; the sub-band 814-824/859-869 MHz is used for broadband (LTE) systems using carrier bandwidths of 5 to 10 MHz. The sub-band 813-814/ 858-859 MHz acts as guard band between narrowband and broadband systems.

### 1.3.1 Example of frequency arrangement for narrowband and broadband systems



|  |  |  |
| --- | --- | --- |
| Mobile station/ Control station transmit (MHz) | Base station transmit  (MHz) | Frequency block |
| 806-813 | 851-858 | Narrowband PPDR |
| 813-814 | 858-859 | Guard band |
| 814-824 | 859-869 | Broadband PPDR |

### 1.3.2 Example channelization for narrowband

The channelling plan for the sub-band 806-813/851-858 MHz is based on the channel spacing of 25 kHz.

The centre frequency (*fN*) of the *N*th channel is given by:

|  |  |  |  |
| --- | --- | --- | --- |
| Channel number | Mobile station transmit Channel centre frequency (MHz) | Base station transmit Channel centre frequency (MHz) | Channel bandwidth (kHz) |
| *N* = 1 to 280 | *fN* = 806.0125 + (0.025) × (*N* − 1) | *fN* = 851.0125 + (0.025) × (*N –* 1) | 25 |

### 1.3.3 Example channelization for broadband

The channelling plan for broadband is based on a channel bandwidth of 5 MHz or 10 MHz as shown below:

The centre frequency (*fN*) of the *N*-th channel for two 5 MHz channels is given by:

|  |  |  |  |
| --- | --- | --- | --- |
| Channel number | Mobile station transmit Channel centre frequency (MHz) | Base station transmit Channel centre frequency (MHz) | Channel bandwidth (MHz) |
| *N* = 1 to 2 | *fN* = 816.5 + (5) × (*N* − 1) | *fN* = 861.5 + (5) × (*N −* 1) | 5 |



The centre frequency (*fN*) of the *N-*th channel for one 10 MHz channels is given by:

|  |  |  |  |
| --- | --- | --- | --- |
| Channel number | Mobile station transmit Channel centre frequency (MHz) | Base station transmit Channel centre frequency (MHz) | Channel bandwidth (MHz) |
| *N* = 1 | *f*1 = 819 | *f*1 = 864 | 10 |



1. This frequency arrangement is from the Canadian rules. For more details, see Industry Canada’s Gazette Notice No. DGTP-007-09 – Narrowband and Wideband Public Safety Radiocommunication Systems in the bands 768-776 MHz and 798-806 MHz (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09553.html>). [↑](#footnote-ref-5)
2. This band plan is from the United States’ FCC Rules. For more details, see Part 90 of the FCC Rules at <http://wireless.fcc.gov/index.htm?job=rules_and_regulations>. [↑](#footnote-ref-6)
3. The use of the term “broadband” in this Annex means indicative data rates in the order of 1‑100 Mbit/s with channel bandwidths dependent on the use of spectrally efficient technologies (from Resolution 646 (Rev.WRC‑12) and Report ITU‑R M.2033). It is recognized that other definitions of these terms exist in other ITU texts (such as Recommendation ITU‑R F.1399) or in the rules of various individual administrations. [↑](#footnote-ref-7)
4. This frequency arrangement is from the United States’ FCC Rules. For more details, see Part 90 of the FCC Rules at <http://wireless.fcc.gov/index.htm?job=rules_and_regulations>. [↑](#footnote-ref-8)
5. This frequency arrangement is from the Canadian rules. For more details, see Standard Radio System Plan 502 at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00050.html>. [↑](#footnote-ref-9)