



ITU-APT Foundation of India

## ITU-APT Foundation of India

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18 December 2017

**Advisor (Networks, Spectrum and Licensing),**

Telecom Regulatory Authority of India  
Mahanagar Doorsanchar Bhawan,  
Jawahar Lal Nehru Marg,  
New Delhi-110002

**Subject: Comments / counter-comments to Consultation Paper on  
Next Generation Public Protection and Disaster Relief (PPDR)  
communication networks**

**Kind Attention: Mr S. T. Abbas,**

Dear Sir,

ITU-APT Foundation of India (ITU-APT) is a non-profit, non-political registered society, is working for last 10 years in India with the prime objective of encouraging involvement of professionals, corporate, public/private sector industries, R&D organizations, academic institutions, and such other agencies engaged in development of Indian Telecom sector in the activities of the International Telecommunication Union (ITU) and the Asia Pacific Telecommunity (APT). The society has been registered with the registrar of the societies with its secretariat working at New Delhi. ITU-APT Foundation of India (ITU-APT) is sector Member of the ITU Development Bureau (ITU-D) and ITU Telecommunication Standardization Bureau (ITU-T) which manifests its usefulness of the Indian Telecom industry.

ITU-APT would like to add one counter comment to the comments already submitted. The same is enclosed

Bharat Bhatia  
President

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**ITU-APT counter comments to the response submitted by Dr. Abhay Karandikar to Consultation Paper on Next Generation Public Protection and Disaster Relief (PPDR) communication networks**

In response to Question no. 5 on the candidate bands for PPDR operations in India, the response from Dr. Abhay Karandikar has recommended to designate the band 440 - 470 MHz as the nationally harmonized spectrum dedicated for Broadband PPDR operations.

***It may be noted that this proposal is based in the Resolution 646 from WRC-12 and does not take into account the decisions taken by WRC-15 where the harmonized band for broadband PPDR is 694-894 MHz. Following WRC-15, APT has already recommended 700 MHz (3GPP band 28) and 800 MHz (3GPP bands 5, 26, 27) as the harmonized bands for broadband PPDR under APT Report 73 (see enclosed) and the same have been incorporated into ITU-R Recommendation M.2015 (see enclosed)***

*Enclosed –.*

- 1 Recommendation ITU-R M.2015 as approved at SG5 meeting in November 2017
- 2 Report APT 73

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## RECOMMENDATION ITU-R M.2015-1

### **Frequency arrangements for public protection and disaster relief radiocommunication systems in accordance with Resolution 646 (Rev.WRC-15)**

(2012-2015)

#### **Summary of the revision**

In accordance with Resolution 646 (Rev.WRC-15), harmonized and country-specific frequency arrangements have been incorporated into Annex 1 (aligning with *resolves* 2 and 3 of the Resolution) and Annex 2 (aligned with *resolves* 4 of the Resolution). A number of additions and other changes have been made to the *considerings*, *notings*, *recognizings* and *recommends*.

#### **Scope**

This Recommendation is intended to promote global and regional harmonization of frequency bands for public protection and disaster relief (PPDR). It provides guidance on frequency arrangements for PPDR 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.

#### **Keywords**

PPDR, frequency arrangements, harmonization

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## Abbreviations/Glossary

3GPP – Third Generation Partnership Project

APT – Asia-Pacific Telecommunity

ATU – African Telecommunications Union

CEPT – European Conference of Postal and Telecommunications Administrations

CITEL – Inter-American Telecommunication Commission

**IMT – International Mobile Telecommunications**

**LRTC - Least Restrictive Technical Conditions**

**PPDR – Public Protection and Disaster Relief**

### **Related ITU Recommendations, Reports**

Recommendation ITU-R M.1826 – Harmonized frequency channel plan for broadband public protection and disaster relief operations at 4 940-4 990 MHz in Regions 2 and 3

Recommendation ITU-R M.2009 – Radio interface standards for use by public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution **646 (Rev.WRC-12)**

Report ITU-R M.2291 – The use of International Mobile Telecommunications (IMT) for broadband public protection and disaster relief (PPDR) applications

Report ITU-R M.2377 – Radiocommunication objectives and requirements for Public Protection and Disaster Relief (PPDR)

Report ITU-R M.[PPDR Spectrum] – Spectrum needs for Public Protection and Disaster Relief (PPDR)

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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)** resolves to include in this Recommendation harmonized PPDR frequency arrangements within the frequency ranges specified in *resolves* 2 and 3 of that Resolution, as well as, as specified in *resolves* 4, countries' frequency arrangements for PPDR;
- 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 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 common frequency bands will enable administrations to achieve the benefits of , 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 administrations have the flexibility:
- to determine, at the national level, how much spectrum to make available for PPDR 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,

*recognizing*

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

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- b)* that administrations may be using other frequency arrangements 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 neighboring 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)* that Resolution **647 (Rev.WRC-15)** addresses radiocommunication aspects, including spectrum management guidelines, for early warning, disaster prediction, detection, mitigation and relief operations relating to emergencies and disasters, and also addresses the need to coordinate activities under Resolutions **646 (Rev.WRC-15)** and **647 (Rev.WRC-15)** in order to minimize any possible overlap;
- g)* that Recommendation ITU-R M.2009 provides appropriate for use in these frequency arrangements;
- 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;
- i)* that Report ITU-R M.2377 contains the radiocommunication objectives and requirements for PPDR;

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j) that Report ITU-R M.[PPDR Spectrum] addresses the estimation of spectrum needs for PPDR;

k) 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 frequency arrangements in Annex 1, in the harmonized frequency ranges in *resolves* 2 and 3 of Resolution **646 (Rev.WRC-15)**, should be used by administrations as guidance when making spectrum available for PPDR applications;

2 that administrations implementing the frequency arrangements in the Annexes should make all necessary efforts to ensure compatibility between PPDR and stations of other services in neighbouring countries.



## ANNEX 1

### Recommended arrangements for public protection and disaster relief operations in the frequency ranges listed in *resolves 2* and *3* of Resolution 646 (Rev.WRC-15)

Section 1: Arrangements in parts of the frequency range 694-894 MHz (as per <i>resolves 2</i> of Resolution 646 (Rev.WRC-15))		
Region / Sub-section	Frequency Arrangement(s)	Page
1	Harmonized frequency arrangements within the frequency range 698 to 791 MHz in accordance with the CEPT harmonization measure ECC/DEC/(16)02 for broadband PPDR	xx
1	Harmonized frequency arrangements within the bands 694 to 791 MHz in accordance with the Arab States harmonized measures for broadband PPDR	xx
1	Frequency arrangements within the bands 791 to 862 MHz in some countries of Region 1 for broadband PPDR	xx
1	Harmonized frequency arrangements within the frequency range 694 to 894 MHz in accordance with ATU harmonization measures for broadband PPDR	xx
1	Frequency arrangements within the frequency range 723 to 788 MHz in some countries of Region 1 for broadband PPDR	xx
1	Frequency arrangements within the frequency range 703 to 768 MHz in some countries of Region 1 for broadband PPDR	xx
2	Harmonized frequency arrangements within the frequency range 703 to 869 MHz in accordance with the CITEL harmonization measures for broadband PPDR	xx
2	Harmonized frequency arrangements within the frequency range 764 to 806 MHz in accordance with the CITEL harmonization measures for PPDR applications	xx

<b>Section 1:</b> <b>Arrangements in parts of the frequency range 694-894 MHz</b> <b>(as per <i>resolves 2</i> of Resolution 646 (Rev.WRC-15))</b>		
<b>Region / Sub-section</b>	<b>Frequency Arrangement(s)</b>	<b>Page</b>
2	Frequency arrangements within the frequency range 806 to 869 MHz in some countries of Region 2 for narrowband PPDR	xx
3	Harmonized frequency arrangements within the frequency range 694 to 894 MHz in accordance with the APT harmonization measures for broadband PPDR	xx
3	Frequency arrangements within the frequency range 694 to 894 MHz in some countries of Region 3 for narrowband and/or broadband PPDR	xx

<b>Section 2:</b> <b>Frequency Arrangements in parts of the frequency range 380-470 MHz</b> <b>(as per <i>resolves 3</i> of Resolution 646 (Rev.WRC-15))</b>		
<b>Region / Sub-section</b>	<b>Example Frequency Arrangement(s)</b>	<b>Page</b>
1	Frequency arrangements for the band 380 to 470 MHz in some countries of Region 1 for narrowband and wideband PPDR in accordance with CEPT harmonization measure ECC/DEC/(08)05	xx
1	Harmonized frequency arrangements within the frequency range 450.5 to 467.5 MHz in accordance with CEPT harmonization measure ECC/DEC/(16)02 for broadband PPDR	xx
1	Frequency arrangements within the frequency range 380 to 399.99 MHz in some countries of Region 1 for narrowband PPDR	xx
1	Harmonized frequency arrangements within the frequency range 380 to 470 MHz in accordance with the ATU harmonization measures for narrowband and/or wideband PPDR	xx
2	There are no bands listed for Region 2 in <i>resolves 3</i> of Resolution <b>646 (Rev.WRC-15)</b>	xx
3	Frequency arrangements within the frequency range 406.1 to 430 MHz in some countries of Region 3 for narrowband PPDR	xx
3	Frequency arrangements within the frequency range 440 to 470 MHz in some countries of Region 3 for narrowband PPDR	xx

<b>Section 3:</b> <b>Frequency Arrangements in parts of the frequency range 4 940-4 990 MHz</b> <b>(as per <i>resolves 3</i> of Resolution 646 (Rev.WRC-15))</b>		
<b>Region</b>	<b>Example Frequency Arrangement(s)</b>	<b>Page</b>
3	Harmonized frequency arrangements within the frequency band 4 940 to 4 990 MHz in some countries of Region 3 for broadband PPDR	xx

## Section 1 – Arrangements in parts of the frequency range 694 to 894 MHz

### Sub-Section 1: Region 1

#### Harmonized frequency arrangements within the frequency range 698 to 791 MHz in accordance with the CEPT harmonization measure ECC/DEC/(16)02 for broadband PPDR

Frequency arrangements for broadband PPDR in the 698-791 MHz frequency range

Frequency arrangement (options)	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	698-703	50	753-758	55	LRTC specified in Annex 1 of ECC/DEC/(16)02
b)	703-733	25	758-788	55	LRTC specified in ECC/DEC/(15)01
c)	733-736	52	788-791	55	LRTC specified in Annex 1 of ECC/DEC/(16)02

#### Detailed description of the frequency arrangement

698-703 MHz	703 -	708 -	713 -	718 -	723 -	728 -	733-736 MHz	736-753	753-758 MHz	758 -	763 -	768 -	773 -	778 -	783 -	788-791 MHz
PPDR a) uplink	PPDR b) uplink (MFCN)					PPDR c) uplink		PPDR a) downlink	PPDR b) downlink (MFCN)					PPDR c) downlink		
5 MHz	30 MHz (6 blocks of 5 MHz)					3 MHz		5 MHz	30 MHz (6 blocks of 5 MHz)					3 MHz		

#### Channelling arrangement for option b):

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 6$	$f_N = 703 - 2.5 + N \times 5$	$f_N = 758 - 2.5 + N \times 5$	5

Administrations requiring 2x10 MHz for broadband PPDR, as calculated in Report ITU-R M.2377-0 and ECC Report 199, and authorizing the full 2x30 MHz

in option b) for commercial mobile/fixed communications networks (MFCN) can no longer identify 2x10 MHz for dedicated broadband PPDR networks within the 700 MHz band. These administrations may therefore need to use the remaining part as shown in option a) and c) and additionally use the 400 MHz range.

For further information on broadband PPDR usage in CEPT please see ECC/DEC/(16)02 (“Harmonised technical conditions and frequency bands for the implementation of Broadband Public Protection and Disaster Relief (BB-PPDR) systems”) and the relevant ECC Reports mentioned therein. For international coordination Resolution 749 (Rev.WRC-15) and Resolution 760 (WRC-15) are applied as appropriate. For the frequency range 698-791 MHz ECC/REC/(16)03 (“Cross-border coordination for Broadband Public Protection and Disaster Relief (BB-PPDR) systems in the frequency band 698 to 791 MHz”) is relevant within CEPT.

### **Harmonized frequency arrangements within the frequency range 694 to 791 MHz in accordance with the Arab States harmonized measures for broadband PPDR**

The following frequency arrangements are possible options of harmonized bands for implementation of broadband PPDR based on IMT technology in Arab States with bandwidth of 2x5 MHz starting at 698 MHz, which has the potential to be harmonized in Region 1.

This arrangement is in line with 3GPP Band 68 with OOB of -25 dBm/8 MHz

**Frequency arrangements for broadband PPDR in the 694-791 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	698-703	50	753-758	55	2 x 5 MHz
b)	698-708	45	753-763	55	2 x 10 MHz
c)	698-713	40	753-768	55	2 x 15 MHz

d)	698-718	35	753-773	55	2 x 20 MHz
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**Detailed description of the frequency arrangement**

698-703	703-708	708-713	713-718	718-723	723-728	728-733	733-736	736-752	753-758	758-763	763-768	768-773	773-778	778-783	783-788	788-791
PPDR a) uplink									PPDR a) downlink							
PPDR b) uplink									PPDR b) downlink							
PPDR c) uplink									PPDR c) downlink							
PPDR d) uplink									PPDR d) downlink							
5 MHz	30 MHz (6 blocks of 5 MHz)						3 MHz		5 MHz	30 MHz (6 blocks of 5 MHz)						3 MHz

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 4$	$f_N = 698 - 2.5 + N \times 5$	$f_N = 753 - 2.5 + N \times 5$	5

Administrations wishing to implement wider channel bandwidth up to 2x20 MHz starting from (UL: 698-703 MHz, DL: 753-758) MHz can combine multiple blocks of 5 MHz based on 3GPP Band 68 to meet their national broadband PPDR requirements (e.g. UL: 698–718, DL: 753-773 MHz).

**Frequency arrangements within frequency range 791 to 862 MHz  
in some countries of Region 1 for broadband PPDR**

Frequency arrangements for broadband PPDR in the 791-862 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX	Centre gap (MHz)	Base station TX (MHz)	Duplex separation	

	(MHz)			(MHz)	
a)	832-862	11	791-821	41	3GPP band 20

**Detailed description of the frequency arrangement**

790-791	791-796	796-801	801-806	806-811	811-816	816-821	821-832	832-837	837-842	842-847	847-852	852-857	857-862
		PPDR downlink							PPDR uplink				
		30 MHz (6 blocks of 5 MHz)					11 MHz		30 MHz (6 blocks of 5 MHz)				

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (CBW) (MHz)
$N = 1 \text{ to } 6$	$f_N = 832 - 2.5 + N \times 5$	$f_N = 791 - 2.5 + N \times 5$	5

The frequency range 791-821/832-862 MHz has been identified for broadband PPDR operations in Qatar. Part of this frequency range is used for PPDR operations in Qatar.

**Harmonized frequency arrangements within the frequency range 694 to 894 MHz in accordance with the ATU harmonization measures for broadband PPDR**

**Frequency arrangements for broadband PPDR in the 694-894 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	698-703	50	753-758	55	Core band broadband PPDR Based on 3GPP LTE Band 68 for broadband PPDR
b)	703-733	25	758-763	55	Broadband PPDR for CBW = 10, 15 MHz Assumes 3GPP LTE Band 68 or Band 28A specs for $F_c < 723$ MHz @ CBW 10 MHz

					Band 28 for $f_c > 723$ MHz @ CBW > 10 MHz
c)	733-736	52	788-791	55	Assumes 3GPP LTE Band 28B CBW: 1.5, 3 MHz

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 0$ to 5	$f_N = 703 - 2.5 + N \times 5$	$f_N = 758 - 2.5 + N \times 5$	5
$N = 1$ to 3	$f_N = 703 - 5 + N \times 10$	$f_N = 758 - 5 + N \times 10$	10
$N = 1$	$f_N = 734.5$	$f_N = 789.5$	3
$N = 1$ to 2	$f_N = 733 - 0.75 + N \times 1.5$	$f_N = 788 - 0.75 + N \times 1.5$	1.5

Administrations requiring parts of the 2x30 MHz for broadband PPDR, may, as a national matter, implement a combination of options b) and c) above.

## Frequency arrangements within the frequency range 723 to 788 MHz in some countries of Region 1 for broadband PPDR

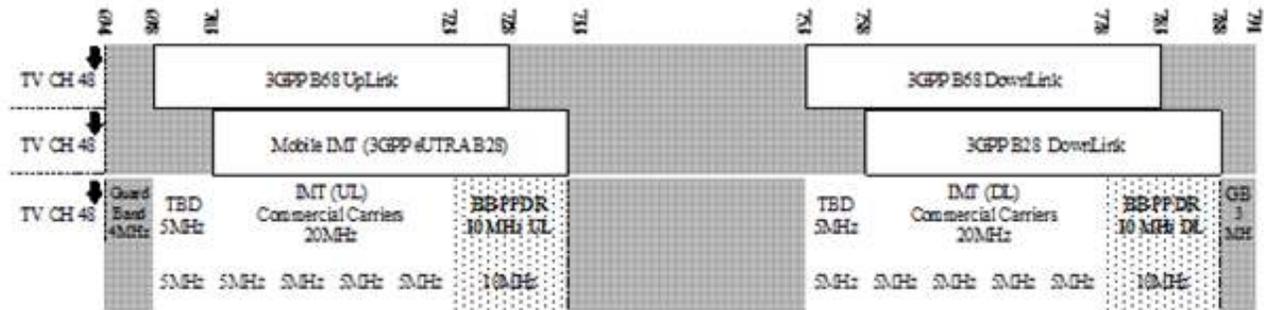
### Frequency arrangements for broadband PPDR in the 723-788 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	723-733	45	778-788	55	2x10 MHz Based on 3GPP LTE Band 28

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$ to 2	$f_N = 723 - 2.5 + N \times 5$	$f_N = 778 - 2.5 + N \times 5$	5
$N = 1$	$f_N = 723 - 5 + N \times 10$	$f_N = 778 - 5 + N \times 10$	10

### Detailed description of the frequency arrangement



## Frequency arrangements within the frequency range 703 to 768 MHz in some countries of Region 1 for broadband PPDR

Frequency arrangements for broadband PPDR in the 703 to 768 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	703-713	45	758-768	55	2×10 MHz FDD based on IMT specifications

### Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$	$f_N = 703 - 5 + N \times 10$	$f_N = 758 - 5 + N \times 10$	10

### Detailed description of the frequency arrangement



## Sub-Section 2: Region 2

### Harmonized frequency arrangements within the frequency range 703 to 869 MHz in accordance with the CITEL harmonization measures<sup>1</sup> for broadband PPDR

#### Frequency arrangements for broadband PPDR in the 703-869 MHz frequency range

Frequency arrangement	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	Notes
a) <sup>1</sup>	703-748	10	758-803	55	
b)	788-798	20	758-768	30	Reverse duplex
c)	807-824	28	852-869	45	
d)	807-814	45	859-869	52	

Note 1: PCC.II/REC.49 (XXVII-16) recommends that administrations that wish to define a particular frequency range for PPDR within this frequency range preferably use the lower portion of this band.

### Harmonized frequency arrangements within the frequency range 764 to 806 MHz in accordance with the CITEL harmonization measures<sup>2</sup> for PPDR applications<sup>3</sup>

#### Frequency arrangements for PPDR applications in the 764-806 MHz frequency range

Frequency arrangement	Base station transmit (MHz)	Centre gap	Mobile station transmit (MHz)	Duplex separation	Notes
a) <sup>4</sup>	764-768	26	794-798	30	
b) <sup>5</sup>	768-776	22	798-806	30	

<sup>1</sup> PCC.II/REC. 18 (VII-06) and PCC.II/REC.49 (XXVII-16)

<sup>2</sup> PCC.II/REC. 18 (VII-06).

<sup>3</sup> PCC.II/REC.18 (VII-06) does not specify broadband, wideband, or narrowband. It refers only to PPDR applications.

<sup>4</sup> 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>).

<sup>5</sup> 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

c) <sup>6</sup>	769-775	24	799-805	30	Note 1
NOTE 1 – This frequency block is used for PPDR applications that provide narrowband voice and low-speed data services. In the context of PPDR, narrowband was 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.					

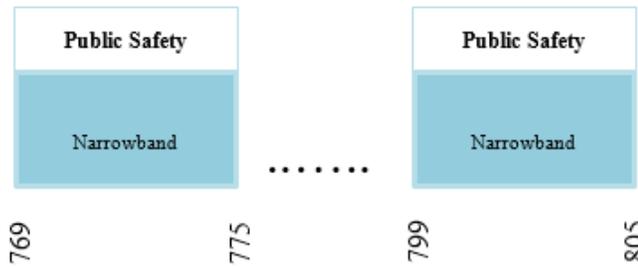
**Detailed description of the frequency arrangement for a) and b)**



\* Block A will be subject to a future consultation.  
 \*\* The amount of narrowband (NB) and wideband (WB) spectrum will be set out in the relevant standard

M.2015-A1-01

**Detailed description of frequency arrangement c)**



**Frequency arrangements within the frequency range 806 to 869 MHz in some countries of Region 2 for narrowband PPDR**

**Frequency arrangements for narrowband PPDR in the 806-869 MHz frequency range**

Frequency arrangement	Mobile station/ Control	Centre gap	Base station transmit (MHz)	Duplex separation	Notes
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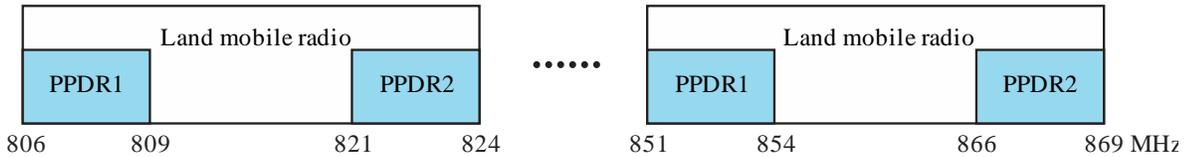
Radiocommunication Systems in the bands 768-776 MHz and 798-806 MHz

(<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09553.html>).

<sup>6</sup> This band plan is from the United States’ FCC Rules. For more details, see Part 90 of the FCC Rules at <https://www.fcc.gov/general/rules-regulations-title-47>

	station transmit (MHz)				
a)	806-809	42	851-854	45	PPDR1 <sup>7</sup>
b)	821-824	42	866-869	45	PPDR2 <sup>8</sup>

Detailed description of the frequency arrangement for a) and b)



M.2015-A3-0

Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (kHz)
$n = 1$ to 600	$f_n = 806.0125 + (0.025) \times (n - 1)$	$f_n = 851.0125 + (0.025) \times (n - 1)$	25
$n = 602$ to 790 except 639, 677, 715, 753	$f_n = 821.0375 + 0.0125 \times (n - 602) + 0.025 \times \text{floor}((n - 601) / 38]$	$f_n = 866.0375 + 0.0125 \times (n - 602) + 0.025 \times \text{floor}((n - 601) / 38]$	12.5
$n = 601, 639, 677, 715, 753$	$f_n = 821.0125 + 0.5 \times \text{floor}((n - 601) / 38]$	$f_n = 866.0125 + 0.5 \times \text{floor}((n - 601) / 38]$	25
$n = 791$ to 830	$f_n = 823.5 + (0.0125) \times (n - 791)$	$f_n = 868.5 + (0.0125) \times (n - 791)$	25

PPDR channels may be assigned throughout this band and specific blocks may be designated exclusively for PPDR applications. 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, neighboring administrations could implement complementary frequency arrangements, an example being shown in the figure above.

### Sub-Section 3: Region 3

<sup>7</sup> This frequency arrangement is from the United States' FCC Rules. For more details, see Part 90 of the FCC Rules at <https://www.fcc.gov/general/rules-regulations-title-47>.

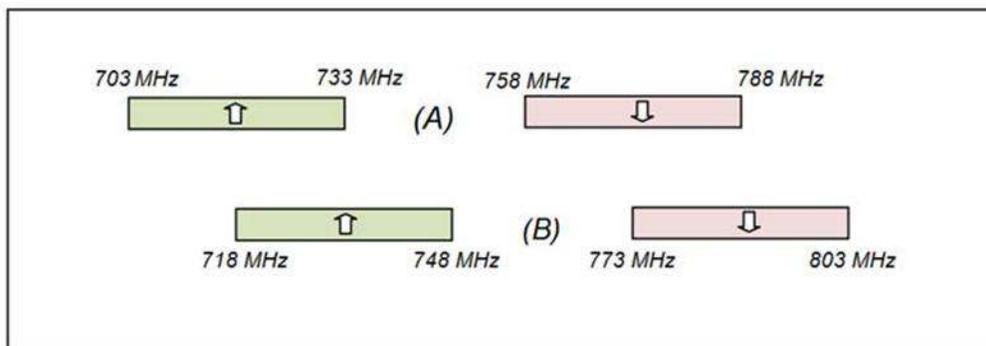
<sup>8</sup> This frequency arrangement is from the Canadian rules. For more details, see Standard Radio System Plan 502 at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00050.html>.

## Harmonized frequency arrangements within the frequency range 694 to 894 MHz in accordance with the APT harmonization measures<sup>9</sup> for broadband PPDR

**Frequency arrangements for broadband PPDR in the 694-894 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	703-748	10	758-803	55	3GPP Band 28 (note 1)
b)	824-849	17	869-894	45	3GPP Band 5
c)	814-849	27	859-894	45	3GPP Band 26
d)	807-824	28	852-869	45	3GPP Band 27

Note 1: 3GPP Band 28 consists of a dual-duplexing arrangement as shown in the figure below.



For frequency arrangements a) to d) in Region 3, any one or two 5+5 MHz or one 10+10 MHz channels can be used for broadband PPDR.

### Detailed description of the frequency arrangement for a)

703-748 MHz	748-758	758-803 MHz
PPDR uplink		PPDR downlink

<sup>9</sup> APT/AWG/REP-73 Edition: April 2017 – “Harmonization of frequency ranges for use by wireless PPDR applications in Asia-Pacific region”.

45 MHz (9 blocks of 5 MHz)		45 MHz (9 blocks of 5 MHz)
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The channelling plan for frequency arrangement a) is based on a channel bandwidth of 5 MHz or 10 MHz.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 9$	$f_N = 705.5 + (5) \times (N - 1)$	$f_N = 760.5 + (5) \times (N - 1)$	5

**Detailed description of the frequency arrangement for b)**

824-849 MHz	849-869	869-894 MHz
PPDR uplink		PPDR downlink
25 MHz (5 blocks of 5 MHz)		25 MHz (5 blocks of 5 MHz)

The channelling plan for frequency arrangement b) is based on a channel bandwidth of 5 MHz or 10 MHz.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 5$	$f_N = 826.5 + (5) \times (N - 1)$	$f_N = 871.5 + (5) \times (N - 1)$	5

**Detailed description of the frequency arrangement for c)**

814-849 MHz	849-859	859-894 MHz
PPDR uplink		PPDR downlink
35 MHz (7 blocks of 5 MHz)		35 MHz (7 blocks of 5 MHz)

The channelling plan for frequency arrangement c) is based on a channel bandwidth of 5 MHz or 10 MHz.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 7$	$f_N = 816.5 + (5) \times (N - 1)$	$f_N = 861.5 + (5) \times (N - 1)$	5



The channelling plan for frequency arrangement e) is based on a channel bandwidth of 5 MHz or 10 MHz.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$ to 2	$f_N = 720.5 + (5) \times (N - 1)$	$f_N = 775.5 + (5) \times (N - 1)$	5
$N = 1$	$f_N = 723$	$f_N = 778$	10

**Detailed description of the frequency arrangement for f)**

806-813 MHz	814-824 MHz	824-851 MHz	851-858 MHz	859-869 MHz
	Broadband uplink			Broadband downlink
Narrowband downlink	10 MHz (2 blocks of 5 MHz)		Narrowband downlink	10 MHz (2 blocks of 5 MHz)

The channelling plan for frequency arrangement f) is based on a channel bandwidth of 25 kHz for the narrowband component and 5 MHz or 10 MHz for the broadband component.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth
$N = 1$ to 280	$f_N = 806.0125 + (0.025) \times (N - 1)$	$f_N = 851.0125 + (0.025) \times (N - 1)$	25 kHz
$N = 1$ to 2	$f_N = 816.5.5 + (5) \times (N - 1)$	$f_N = 861.5 + (5) \times (N - 1)$	5 MHz
$N = 1$	$f_N = 819$	$f_N = 864$	10 MHz

**Detailed description of the frequency arrangement for g) - option 1**

806-809	809-824 MHz	824-851 MHz	851-854	854-869 MHz
NB up	15 MHz (3 blocks of 5 MHz) uplink		NB down	15 MHz (3 blocks of 5 MHz) downlink

**Detailed description of the frequency arrangement for g) - option 2**

807-822 MHz	822-824	824-852 MHz	852-867 MHz	867-869
15 MHz (3 blocks of 5 MHz) uplink	NB up		15 MHz (3 blocks of 5 MHz) downlink	NB down

**Detailed description of the frequency arrangement for h)**

806-823 MHz	824-834 MHz	834-851 MHz	851-868 MHz	869-879 MHz
	PPDR uplink			PPDR downlink
Narrowband uplink	10 MHz (2 blocks of 5 MHz)		Narrowband downlink	10 MHz (2 blocks of 5 MHz)

The channelling plan for frequency arrangement h) is based on a channel bandwidth of 25 kHz for the narrowband component and 5 MHz or 10 MHz for the broadband component.

**Channelling arrangement**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth
$N = 1$ to 680	$f_N = 806.0125 + (0.025) \times (N - 1)$	$f_N = 851.0125 + (0.025) \times (N - 1)$	25 kHz
$N = 1$ to 2	$f_N = 826.5.5 + (5) \times (N - 1)$	$f_N = 871.5 + (5) \times (N - 1)$	5 MHz
$N = 1$	$f_N = 829$	$f_N = 874$	10 MHz



**Detailed description of the frequency arrangement for j)**

806-812 MHz	812-813	813-819 MHz	819-857 MHz	857-858	858-864 MHz	864-868.100	868.100-869.025
N/A	NB up	Narrowband uplink	N/A	NB down	Narrowband downlink	N/A	Simplex

The channelling plan for frequency arrangement j) is for trunked mobile services in three sub-bands.

**Channelling arrangements in the sub-band 868.100-869.025 MHz**

Channel number	Simplex channel centre frequency (MHz)	Channel bandwidth
$N = 1 \text{ to } 37$	$f_N = 868.1125 + (0.025) \times (N - 1)$	25 kHz

**Channelling arrangements in the sub-band 813-819/858-864 MHz**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth
$N = 1 \text{ to } 240$	$f_N = 813.0125 + (0.025) \times (N - 1)$	$f_N = 858.0125 + (0.025) \times (N - 1)$	25 kHz

**Channelling arrangements in the sub-band 812-813/857-858 MHz**

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth
$N = 1 \text{ to } 79$	$f_N = 812.00625 + (0.0125) \times (N - 1)$	$f_N = 857.00625 + (0.0125) \times (N - 1)$	12.5 kHz
$N = 1 \text{ to } 39$	$f_N = 812.0125 + (0.025) \times (N - 1)$	$f_N = 857.0125 + (0.025) \times (N - 1)$	25 kHz

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## SECTION 2 – 380-470 MHz

### Sub-Section 1: Region 1 380-470 MHz

#### **Frequency arrangements within the frequency range 380 to 470 MHz in some countries of Region 1 for narrowband and wideband PPDR in accordance with CEPT harmonization measure ECC/DEC/(08)05**

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, preferably in 380-430 MHz.

Additionally, certain channels have been identified for DMO (direct mode operation) and AGA (air-ground-air operation) purposes.

#### **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.

#### **AGA (air-ground-air operation)**

Duplex channels within the frequency bands 384.800-385 MHz/394.800-395 MHz should be used as the core band for harmonized channels for AGA. Duplex channels within the frequency bands 384.750-384.800 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.

#### **Centre frequencies**

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

$$F_{CH} = \text{band edge} - (\text{channel bandwidth}/2) + n \times \text{channel bandwidth}$$
where:

$F_{CH}$  = 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.

### **Harmonized frequency arrangements within the frequency range 450.5 to 467.5 MHz in accordance with the CEPT harmonization measure ECC/DEC/(16)02 for broadband PPDR**

#### **Frequency arrangements for broadband PPDR in the 450-467.5 MHz frequency range**

<b>Alternative frequency arrangements</b>	<b>Mobile station TX (MHz)</b>	<b>Centre gap (MHz)</b>	<b>Base station TX (MHz)</b>	<b>Duplex separation (MHz)</b>	<b>Notes</b>
a)	450.5-456	4.5	460.5-466	10	LRTC specified in Annex 2 of ECC/DEC/(16)02
b)	452-457.5	4.5	462-467.5	10	LRTC specified in Annex 2 of ECC/DEC/(16)02

#### **Detailed description of the frequency arrangement option a)**

<b>Alternative frequency arrangements (MHz)</b>	<b>450.5-456</b>	<b>456-460.5</b>	<b>460.5-466</b>	<b>466-467.5</b>
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Option a)	PPDR uplink		PPDR downlink	
	5.5 MHz	4.5 MHz	5.5 MHz	1.5 MHz

**Detailed description of the frequency arrangement option b)**

<b>Alternative frequency arrangements (MHz)</b>	<b>450.5-452</b>	<b>452-457.5</b>	<b>457.5-462</b>	<b>462-467.5</b>
Option b)		PPDR uplink		PPDR downlink
	1.5 MHz	5.5 MHz	4.5 MHz	5.5 MHz

The exact channelling arrangements for broadband PPDR in the 450.5-467.5 MHz frequency range are left to the individual decision of each CEPT administration. These can use channels of 1.4 MHz, 3 MHz or 5 MHz.

For further information on broadband PPDR in CEPT please see ECC/DEC/(16)02 and the relevant ECC Reports mentioned therein.

**Frequency arrangements within the frequency range 380 to 399.99 MHz in some countries of Region 1 for narrowband PPDR**

**Frequency arrangements for narrowband PPDR in the 380-399.99 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	380.0125-389.9875	0	390.0125-399.9875	10	Duplex

**Detailed description of the frequency arrangement**

	380.0125-389.9875 MHz		390.0125-399.9875 MHz	
	Narrowband uplink		Narrowband downlink	
	399 channels of 25 kHz		399 channels of 25 kHz	

### Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (kHz)
N = 1 to 399	$f_N = 380.025 + (N - 1) \times 0.025$	$f_N = 390.025 + (N - 1) \times 0.025$	25

The frequency range 380-399.9 MHz has been identified for narrowband PPDR operations in Qatar. Part of this frequency range is used for PPDR operations in Qatar.

### Harmonized frequency arrangements within the frequency range 380 to 470 MHz in accordance with the ATU harmonization measures for narrowband and/or wideband PPDR

#### Frequency arrangements for narrowband and wideband PPDR in the 380-470 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	380-385	5	390-395	10	Core PPDR band for NB 25 kHz CBW
b)	385-389.99	5	395-399.99	10	Expansion band for PPDR 25 kHz CBW
c)	410-420	5	420-430	10	Expansion Band for PPDR 12.5/25 kHz CBW

### Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
N = 1 to 396 380-400MHz	$FCH_n = \text{Band Edge} - (\text{Channel Spacing} / 2) + n \times \text{Channel Spacing}$	$FCH_n = \text{Band Edge} + \text{Duplex Separation} - (\text{Channel Spacing} / 2) + n \times \text{Channel Spacing}$	25 kHz
N = 0 to n 410-430MHz n= 1 to 400 @25kHz n= 1 to 800@12.5kHz	$FCH_n = \text{Band Edge} - (\text{Channel Spacing} / 2) + n \times \text{Channel Spacing}$	$FCH_n = \text{Band Edge} + \text{Duplex Separation} - (\text{Channel Spacing} / 2) + n \times \text{Channel Spacing}$	12.5/25 kHz

## Sub-Section 2: Region 2

There are no bands listed for Region 2 in *resolves* 3 of Resolution 646 (Rev.WRC-15).

## Sub-Section 3: Region 3

### Frequency arrangements within the frequency range 406.1 to 430 MHz in some countries of Region 3 for narrowband PPDR

Frequency arrangements for narrowband PPDR in the 406.1-430 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	410-420	0	420-430	10	Narrowband
b)	414.0125-414.1000	N/A	414.0125-414.1000	N/A	Narrowband
c)	406.1125-411.5875	2.525	414.1125-419.5875	8	Narrowband
d)	457.50625-459.9875	7.51875	467.50625-469.9875	10	Narrowband 12.5 kHz
e)	408.6375-410.5375	7.55	418.0875-420.0000	9.45	Narrowband 12.5 kHz
f)	420.0000-430.0000	-	-	-	

#### Detailed description of the frequency arrangement for a)

410-420 MHz	420-430 MHz
Narrowband PPDR uplink	Narrowband PPDR downlink
800 channels of 12.5 kHz	800 channels of 12.5 kHz

The channelling plan for frequency arrangement a) is used in some countries for narrowband PPDR and digital trunked radio systems. The channelling plan is based on 12.5 kHz channel spacing, providing a total of 800 pairs of physical

radio channels. Although the standard channel spacing is 12.5 kHz, there is flexibility to assign two or more contiguous channels (i.e. 25 kHz, 50 kHz or 100 kHz) as required.

#### Channelling arrangements

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (kHz)
$N = 1$ to 800	$f_N = 410.006125 + (N - 1) \times 0.0125$	$f_N = 420.00625 + (N - 1) \times 0.0125$	12.5

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.

#### Channelling arrangement

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=	$2 \times A - 1 + 20 \times (X - 1)$ and $2 \times A + 20 \times (X - 1)$	$2 \times B + 199 + 20 \times (X - 1)$ and $2 \times B + 200 + 20 \times (X - 1)$	$2 \times C + 399 + 20 \times (X - 1)$ and $2 \times C + 400 + 20 \times (X - 1)$	$2 \times D + 599 + 20 \times (X - 1)$ and $2 \times D + 600 + 20 \times (X - 1)$

#### Detailed description of the frequency arrangement for b)

414.0125-414.1000 MHz
Simplex
8 channels of 12.5 kHz

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The channelling plan for frequency arrangement b) is based on channel arrangements currently used in New Zealand for simplex services.

**Channelling arrangement**

<b>Channel number</b>	<b>Mobile station transmit Channel centre frequency (MHz)</b>	<b>Base station transmit Channel centre frequency (MHz)</b>	<b>Channel bandwidth (kHz)</b>
$N = 1 \text{ to } 8$	$f_N = 414.01250 + ((N - 1) \times 0.0125)$	$f_N = 414.01250 + ((N - 1) \times 0.0125)$	12.5 kHz



## SECTION 3 – REGION 3

### Harmonized frequency arrangements within the frequency band 4 940 to 4 990 MHz in some countries of Region 3 for broadband PPDR

#### Frequency arrangements for broadband PPDR in the 4940-4990 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a)	4940-4990	N/A	4940-4990	N/A	

The channelling plan for frequency arrangement a) supports channel widths from 5 MHz to 20 MHz, to provide the flexibility needed for Administrations to support a variety of PPDR operational requirements.

#### Channelling arrangement

Channel number (n <sub>ch</sub> )	Channel centre 5 MHz	Channel centre 10 MHz	Channel centre 20 MHz
1	4942.5		
2		4945.0	
3	4947.5		
4		4950.0	4950.0
5	4952.5		
6		4955.0	4955.0
7	4957.5		
8		4960.0	4960.0
9	4962.5		
10		4965.0	4965.0
11	4967.5		
12		4970.0	4970.0
13	4972.5		
14		4975.0	4975.0
15	4977.5		
16		4980.0	4980.0
17	4982.5		

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18		4985.0	
19	4987.5		

Because these channels overlap one another, Administrations may take precautions in their assignment procedures to ensure that overlapping channels do not occur in close enough proximity to cause conflicts between multiple PPDR users. Note that not all of the channels are available in some countries.

## ANNEX 2

### Country frequency arrangements for public protection and disaster relief as per *resolves* 4 of Resolution 646 (Rev.WRC-15)

[Editor's note: Page numbers requested to be inserted by the secretariat.]

Annex 2 Country-Specific Frequency Arrangements (as per <i>resolves</i> 4 of Resolution 646 (Rev.WRC-15))		
Region of country(ies) / Section	Frequency Arrangement(s)	Page
1	Frequency arrangements within the frequency range 4940 to 5250 MHz in some countries of Region 1 for Broadband Disaster Relief radio applications in accordance with CEPT harmonization measure ECC/REC/(08)04	
2	Harmonized frequency arrangements within the frequency range 4 940 to 4 990 MHz in some countries of Region 2 in accordance with CITEL harmonization measures for PPDR	
3	Frequency arrangements within the frequency range 138 to 144 MHz in some countries of Region 3 for narrowband PPDR	
3	Frequency arrangements within the frequency range 351 to 370 MHz in some countries of Region 3 for narrowband PPDR	
3	Frequency arrangements within the frequency range 170 to 205 MHz in some countries of Region 3 for broadband PPDR	
3	Frequency arrangements within the frequency range 1 447 to 1 467 MHz in some countries of Region 3 for broadband PPDR	
3	Frequency arrangements within the frequency range 403 to 413.4375 MHz in some countries of Region 3 for narrowband PPDR	
3	Frequency arrangements within the frequency range 405.0125 to 415.4375 MHz in some countries of Region 3 for narrowband PPDR	
3	Frequency arrangements within the frequency range 380 to 399.9 MHz in some countries of Region 3 for narrowband PPDR	

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## SECTION 1 – REGION 1 COUNTRY-SPECIFIC FREQUENCY ARRANGEMENTS

### **Frequency arrangements within the frequency range 4940 to 5250 MHz in some countries of Region 1 for Broadband Disaster Relief radio applications in accordance with CEPT harmonization measure ECC/REC/(08)04**

Spectrum within the frequency band 5150-5250 MHz should be the preferred option for the deployment of Broadband Disaster Relief (BBDR) radio applications within CEPT. Spectrum within the frequency band 4940-4990 MHz should be the optional band in CEPT countries, which do not foresee incompatibilities with active radio astronomy sites, fixed service or mobile service usage in this band. At least 50 MHz of spectrum should be made available for digital BBDR radio applications by administrations. Spectral power density should not exceed the values of 26 dBm/MHz e.i.r.p. for a BBDR Base Station (BS) and 13 dBm/MHz e.i.r.p. for BBDR User Equipment (UE).

## SECTION 2 – REGION 2 COUNTRY-SPECIFIC FREQUENCY ARRANGEMENTS

### **Harmonized frequency arrangements within the frequency range 4 940 to 4 990 MHz in some countries of Region 2 in accordance with CITEL harmonization measures<sup>10</sup> for PPDR**

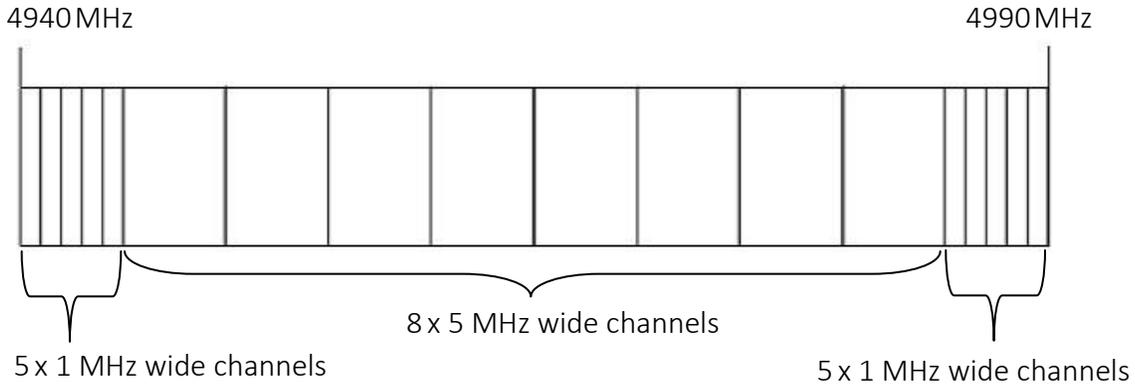
Frequency arrangements for broadband PPDR in the 4 940-4 990 MHz frequency range

Frequency arrangement	Notes
a)	4 940-4 990 Pairing unspecified

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<sup>10</sup> PCC.II/REC. 16 (VII-06): Use of the 4940-4990 MHz band in the Americas for Public Protection and Disaster Relief.

**Detailed description of the frequency arrangement for a)**



**Channelling arrangements**

Channel	Lower frequency (MHz)	Upper frequency (MHz)
1	4 940	4 941
2	4 941	4 942
3	4 942	4 943
4	4 943	4 944
5	4 944	4 945
6	4 945	4 950
7	4 950	4 955
8	4 955	4 960
9	4 960	4 965
10	4 965	4 970
11	4 970	4 975
12	4 975	4 980
13	4 980	4 985
14	4 985	4 986
15	4 986	4 987
16	4 987	4 988
17	4 988	4 989
18	4 989	4 990

The CITEL PCC.II recommended frequency channelling plan for the 4 940-4 990 MHz band for PPDR consists of ten 1 MHz channels and eight 5 MHz channels as

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above. Channels may be aggregated for higher capacity or higher bandwidth applications to allow maximum flexibility and implementation of future broadband technologies. Some countries may also choose to partition the 5 MHz channels.

## SECTION 3 – REGION 3 COUNTRY-SPECIFIC FREQUENCY ARRANGEMENTS

### Frequency arrangements within the frequency range 138 to 144 MHz in some countries of Region 3 for narrowband PPDR

Frequency arrangements for narrowband PPDR in the 138-144 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
a1)	138.00625-140.50625		141.00625-143.50625	3	Duplex
a2)	140.50625-141.00625	N/A	140.50625-141.00625	N/A	Simplex
a3)	143.50625-143.99375	N/A	143.50625-143.99375	N/A	Simplex

#### Detailed description of the frequency arrangement for a1), a2) and a3)

138.00625-140.50625	140.50625-141.00625	141.00625-143.50625	143.50625-143.99375
Narrowband duplex uplink	Narrowband simplex	Narrowband duplex downlink	Narrowband simplex

The channelling plan for frequency arrangement a1) is a duplex arrangement.

#### Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (kHz)
N = 1 to 200	$f_N = 138.0125 + (0.0125) \times (N - 1)$	$f_N = 141.0125 + (0.0125) \times (N - 1)$	12.5

The channelling plan for frequency arrangement a2) is a simplex arrangement.

**Channelling arrangement**

Channel number	Channel centre frequency (MHz)	Channel bandwidth (kHz)
$N = 1$ to 40	$f_N = 140.51250 + (0.0125) \times (N - 1)$	12.5

The channelling plan for frequency arrangement a3) is a simplex arrangement.

**Channelling arrangement**

Channel number	Channel centre frequency (MHz)	Channel bandwidth (kHz)
$N = 41$ to 79	$f_N = 143.51250 + (0.0125) \times (N - 41)$	12.5

**Frequency arrangements within the frequency range 351 to 370 MHz in some countries of Region 3 for narrowband PPDR**

The frequency range 351-370 MHz has been identified by the Ministry of Industry and Information Technology of the People’s Republic of China for narrowband PPDR operations. And a number of PPDR radio communication systems have been deployed on the frequency range 351-370 MHz in the People’s Republic of China.

**Frequency arrangements within the frequency range 170 to 205 MHz in some countries of Region 3 for broadband PPDR**

**Frequency arrangements for broadband PPDR in the 170-205 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
b)	172.5-202.5	N/A	172.5-202.5	N/A	TDD

**Detailed description of the frequency arrangement for b)**

170-172.5	172.5-202.5	202.5-205
	Broadband PPDR	

Guard band	6 blocks of 5 MHz	Guard band
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## Frequency arrangements within the frequency range 1 447 to 1 467 MHz in some countries of Region 3 for broadband PPDR

Frequency arrangements for broadband PPDR in the 1 447-1 467 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
c)	1447-1467	N/A	1447-1467	N/A	TDD

### Detailed description of the frequency arrangement for c)

1447-1467
Broadband PPDR
4 blocks of 5 MHz, 2 blocks of 10 MHz or 1 block of 20 MHz

The channelling plan for frequency arrangement c) may be assigned throughout this band and specific blocks may be designated exclusively for government applications.

### Channelling arrangement

Channel number	Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$ to 4	$f_N = 1449.5 + (5) \times (N - 1)$	5
$N = 1$ to 2	$f_N = 1452.0 + (5) \times (N - 1)$	10
$N = 1$	$f_N = 1457.0$	20

The frequency range 1 447-1 467 MHz has been identified by the Ministry of Industry and Information Technology of the People's Republic of China for PPDR. It is noticed that a number of broadband trunking system trial networks have

been deployed on the 1 447-1 467 MHz band, for example in Beijing, Nanjing, and Tianjin.

### **Frequency arrangements within the frequency range 403 to 413.4375 MHz in some countries of Region 3 for narrowband PPDR**

**Frequency arrangements for narrowband PPDR in the 403-413.4375 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
d)	403.0000–403.9875	-	412.4625–413.4375	9.4625	12.5 kHz

### **Example of frequency arrangements within the frequency range 405.0125 to 415.4375 MHz in some countries of Region 3 for narrowband PPDR**

**Frequency arrangements for narrowband PPDR in the 405.0125-415.4375 MHz frequency range**

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
e)	405.0125–406.0000	-	414.4625–415.4375	9.45	12.5 kHz

## Frequency arrangements within the frequency range 380 to 399.9 MHz in some countries of Region 3 for narrowband PPDR

### Frequency arrangements for narrowband PPDR in the 380-399.9 MHz frequency range

Frequency arrangement	Paired arrangements				Notes
	Mobile station TX (MHz)	Centre gap (MHz)	Base station TX (MHz)	Duplex separation (MHz)	
f)	380.0125-389.8875	-	390.0125-399.8875	10	Duplex

### Channelling arrangement

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (kHz)
$N = 1$ to 395	$f_N = 380.025 + (N - 1) \times 0.025$	$f_N = 390.025 + (N - 1) \times 0.025$	25

The frequency range 380-399.9 MHz has been identified for narrowband PPDR operations in Malaysia. Part of this frequency range is used for PPDR operations in Malaysia.



APT REPORT ON

HARMONIZATION OF FREQUENCY RANGES FOR USE BY WIRELESS PPDR  
APPLICATIONS IN ASIA-PACIFIC REGION

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No. APT/AWG/REP-73  
Edition: April 2017

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*(Source: AWG-21/OUT-22Rev.1)*

## APT REPORT ON HARMONIZATION OF FREQUENCY RANGES FOR USE BY WIRELESS PPDR APPLICATIONS IN ASIA-PACIFIC REGION

### 1. Introduction

Resolution **646 (Rev.WRC-15)** (copy attached at Annex 3) identifies a global frequency range and regional frequency ranges to encourage harmonized spectrum for PPDR solutions. Benefits of spectrum harmonization include: increased potential for interoperability, a broader manufacturing base and increased volume of equipment resulting in economies of scale and expanded equipment availability, improved spectrum management and planning and enhanced cross-border coordination and circulation of equipment.

More specifically, administrations are encouraged 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.

Administrations are further encouraged to also consider parts of the following regionally harmonized frequency ranges, for their PPDR applications

- Region 1: 380-470 MHz

- 
- Region 3: 406.1-430 MHz, 440-470 MHz and 4 940-4 990 MHz

Resolution ITU-R **646 (Rev.WRC-15)** also resolved 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.

Additionally, the Resolution recognized<sup>11</sup> that some countries in Region 3 have 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

This Report provides guidance on the frequency arrangements for PPDR radiocommunications in Region 3 in accordance with Resolution **646 (Rev.WRC-15)**.

## **2. Important considerations for the use of various frequency bands for PPDR applications:**

This Report provides guidance on the frequency arrangements for PPDR radiocommunications in Region 3 in accordance with Resolution 646 (Rev.WRC-15).

Annex 1 of this Report contain frequency arrangements based on *resolve 2* and *resolve 3* of the Resolution and are recommended to administrations as guidance when making spectrum available for PPDR operations.

The frequency arrangements of Annex 1 are categorized into three sections:

- Section 1 contains frequency arrangements in parts of the frequency range 694-894 MHz.
- Section 2 contains frequency arrangements in parts of the frequency range 406.1-470 MHz
- Section 3 contains frequency arrangements in parts of the frequency range 4940-4990 MHz

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<sup>11</sup> recognizing I, footnote 2

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Annex 2 of this Report contains frequency arrangements for PPDR operations on a national basis, in parts of frequency ranges described in the *recognizing* <sup>12</sup> of the Resolution as listed below:

a) for narrowband PPDR applications

- 138-174 MHz
- 351-370 MHz
- 380-400 MHz
- 400-406 MHz

b) for broadband PPDR applications

- 174-205 MHz
- 1 447-1 467 MHz

(Note: Annexes 2 will be further developed and updated in the next Revision of this Report)

The Annexes to this Report may also assist proposed updates to Recommendation ITU-R M.2015

Annex 4 illustrates the alternative band structures defined by 3GPP and falling within the PPDR frequency range designated by Resolution 646 (Rev.WRC-15) – and is specifically aimed at encouraging increased harmonisation amongst APT Members considering PPDR band options.

### **3. Important considerations for the use of various frequency bands for PPDR applications:**

3.1 APT administrations should consider using parts of the following frequency ranges for PPDR to the maximum extent possible when undertaking their national planning for their PPDR operations:

a) 694-894 MHz, as described in Annex 1, Section 1

b) 406.1-430 MHz and 440-470 MHz, as described in Annex 1, Section 2

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<sup>12</sup> *Recognizing I*, Resolution 646 (Rev.WRC-15)

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d) 4 940-4 990 MHz, as described in Annex 1, Section 3

3.2 When using parts of the following frequency ranges the APT administrations should take due regard to any needed consultation and cooperation with other concerned neighbouring countries:

a) for narrowband PPDR applications as described in Annex 2, Section 1

- 138-174 MHz
- 351-370 MHz
- 380-400 MHz
- 400-406 MHz

b) for broadband PPDR applications as described in Annex 2, Section 1

- 174-205 MHz
- 694-894 MHz
- 1 447-1 467 MHz
- 4 940-4 990 MHz

**Guide to Annexes:**

**ANNEX 1 contains Frequency arrangements and related information for PPDR frequency ranges in Asia Pacific Region (Region 3)**

Annex1 - Section 1 contains Frequency arrangements and other technical characteristics of frequency ranges for PPDR in 694-894 MHz

Annex 1 - Section 2 contains Frequency arrangements and other technical characteristics of frequency ranges for PPDR in 406.1-430 MHz and 440-470 MHz

Annex 1 - Section 3 contains Frequency arrangements and other technical characteristics of frequency ranges for PPDR in 4 940-4 990 MHz

**Annex 2 contains Frequency arrangements and other technical characteristics of the following frequency ranges:**

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For narrowband PPDR applications in some APT countries

- 138-174 MHz
- 351-370 MHz
- 380-400 MHz

For broadband PPDR applications in some APT countries

- 174-205 MHz
- 1 447-1 467 MHz

Annex 3 contains a copy of Resolution 646(Rev. WRC-15)

Annex 4 contains 3GPP Frequency arrangements within 694-894 MHz

**Annex 1**  
**Harmonized Frequency Arrangements in Region 3**

Section 1:  
Arrangements in parts of the frequency range 694-894MHz  
(as per *resolves 2* of Resolution 646 (Rev.WRC-15))

Arrangement Number <sup>13</sup> .	Band (MHz)
G3-1-1	703-748 / 758-803
G3-1-2	806-824 / 851-869
G3-1-3	806-824 / 851-869
G3-1-4	806-824 / 851-869
G3-1-5	806-824 / 851-869
G3-1-6	806-834 / 851-879

Section 2:  
Frequency Arrangements in parts of the frequency ranges 406.1-430 MHz and 440-470 MHz  
(as per *resolves 3* of Resolution 646 (Rev.WRC-15))

Arrangement Number.	Band (MHz)
R3-2-1	414.0125-414.1000
R3-2-2	406.1125-411.5875 / 414.1125-419.5875
R3-2-3	410-430

Section 3:  
Frequency Arrangements in parts of the frequency range 4940-4990 MHz (as per *resolves 3* of Resolution 646 (Rev.WRC-15))

Arrangement Number	Band (MHz)
R3-3-1	4940-4990

<sup>13</sup> 1st = Letter; 2nd = Region; 3rd=Section; 4th = Arrangement No.

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**Annex 2**  
**Country Frequency Arrangements**  
(as per *resolves* 4 of Resolution 646 (Rev.WRC-15))

Annex 2 - Section1:  
Country Frequency Arrangements in the ranges 138-174 MHz, 351-370 MHz and 380-400 MHz for narrowband PPDR applications and the frequency ranges 174-205 MHz and 1447-1467 MHz for broadband PPDR applications

Country	Arrangement Number	Band (MHz)
Japan	C3-1-1	170-205 MHz (TDD)
China	C3-1-2	1447-1467 MHz (TDD)

**Annex 1**  
**Harmonized Frequency Arrangements**

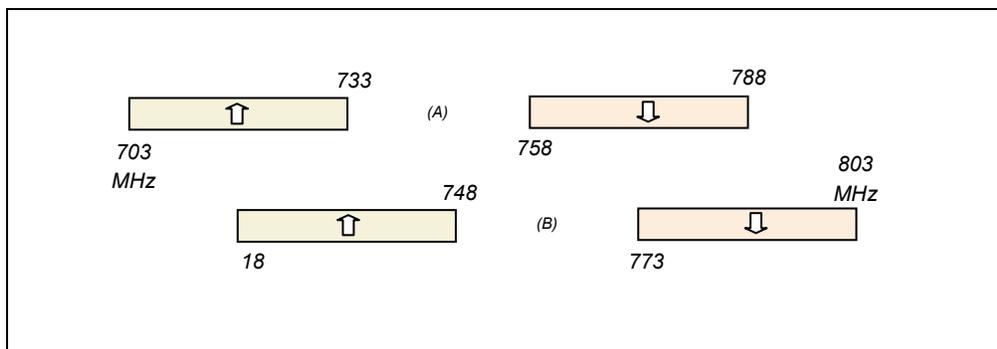
**Section 1:**  
**Arrangements in parts of the frequency range 694-894MHz**  
**(as per resolves 2 of Resolution 646 (Rev.WRC-15))**

Regional Organisation	Frequency Arrangement Number	Paired arrangements			Usage type
		Mobile station transmitter (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
APT	G3-1-1	703-748	758-803	55	Broadband
APT	G3-1-2	806-824	851-869	45	Narrowband -25kHz
APT	G3-1-3	806-824	851-869	45	Narrowband- 25kHz; 12.5 kHz & 6.25 kHz
APT	G3-1-4	806-824	851-869	45	Broadband & Narrowband
APT	G3-1-5	806-824	851-869	45	Broadband & Narrowband
APT	G3-1-6	806-834	851-879	45	Broadband & Narrowband

## A1.1 Example 1

### G3-1-1: 700 MHz Broadband PPDR

Following channel arrangements in the band 703-748/758-803 MHz are used for Broadband public safety LTE systems. In the APT 700 MHz band, which is 45+45 MHz, any one or two 5+5 MHz channels or any one 10+10 MHz channel can be used for Broadband PS LTE system. As an example Korea plans to deploy Broadband PS LTE system in 718-728/773-783 MHz band with one 10+10 MHz Channel.



Example of frequency arrangement for broadband PPDR systems in 703-748/758-803 MHz

Mobile station transmit (MHz)	Base station transmit (MHz)	Frequency block
703-748	758-803	Broadband PPDR
748-758		Duplex Gap

### Channelization for broadband

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

The centre frequency ( $f_N$ ) of the Nth channel is given by:

### Broadband with 5 MHz channels

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$ to 9	$f_N = 705.5 + (5) \times (N - 1)$	$f_N = 760.5 + (5) \times (N-1)$	5



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## A1.2 Example 2

### G3-1-2: 800 MHz Narrow band systems

Following channel arrangements in the band **806-824/851-869 MHz** are used for various narrowband and wideband fixed and mobile systems

#### 806-824/851-869 MHz

The sub-bands 806 – 812 MHz paired with 851 – 857 MHz are used to accommodate wideband bi-directional, fixed, point-to-point links and are unavailable for land mobile.

The sub-band 819 – 824 MHz is used to accommodate the ubiquitous deployment of short-range devices and is unavailable for land mobile use.

The sub-band 849 – 851 MHz is allocated for uni-directional, fixed, point-to-point links in support of radio broadcasting (studio to transmitter linking) and is also unavailable for land mobile use.

The sub-band 845 – 849 MHz provides an alternative pairing for 890 – 894 MHz sub-band potentially available for cellular telephony, and is not available for land mobile use.

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The sub-bands 825.015 – 849 MHz band paired with 870.015 – 890 MHz have been allocated as private rights and are used for the provision of cellular telephony services.

#### 868.100 – 869.025 MHz

This sub-band has been used to accommodate commercial narrowband analogue, simplex, land mobile systems for many years. Spectrum efficient digital technologies are expected to be introduced in this sub-band in the near future.

Simplex services are accommodated within a 25 kHz channel raster on the following centre frequencies (Fn):

$$F_n = 868.1125 + ((N-1) * 0.025) \quad N = 1, 2, 3, \dots 37$$

A 12.5 kHz channel raster is expected to be introduced in the near future.

#### 813 – 819 MHz/858 – 864 MHz

This sub-band has been used to accommodate commercial narrowband analogue trunked land mobile systems for many years and aligns with a number of other countries. Spectrum efficient digital technologies are expected to be introduced in these sub-bands in the near future.

Duplex services are accommodated within a 25 kHz channel raster as follows:

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

$$F_n = 858.01250 + ((N-1) * 0.025) \quad N = 1, 2, 3, \dots 239$$

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

$$F_n = 813.01250 + ((N-1) * 0.025) \quad N = 1, 2, 3, \dots 239$$

#### 812 – 813 MHz / 857 – 858 MHz

This sub-band is identified specifically for Public Protection and Disaster Relief use. These sub-bands are candidates for 12.5 kHz and 25 kHz channel plans. Even though there has not been demand to utilize these sub-bands to date potential demand has been identified by PPDR agencies.

Use of this sub-band by PPDR agencies will be characterized by flexibility including a mix between narrowband voice and data applications as well as wideband data applications such as those involving video, mapping data or high resolution scans and surveillance.

PPDR applications in this sub-band will also range from long term or permanent applications to short term uses set up in response to a specific emergency event.

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### A1.3 Example 3

#### G3-1-3: 800 MHz Narrow band systems

Channel arrangements in the band **806-824/851-869 MHz for trunked Mobile Services.**

The entire band may normally be used with channel bandwidths of 25 kHz for digital trunked radio system. This section describes an example case of channeling. Three channeling schemes can be considered in this band. In sub-band of 806-811/851-856MHz the channel bandwidth is 25 kHz, in sub-band of 811-813.5/856-858.5MHz the channel bandwidth is 12.5 kHz and in sub-band 813.5-816/858-861MHz the channel bandwidth is 6.25 kHz.

Formulas to calculate frequency center of each channel are as follows:

+ In sub-band of 806-811/851-856 MHz:

The band is divided into 25 kHz channels.

Center frequency of Nth base station transmitting channel (MHz):

$$F_N = 851.0125 + (N-1) \times 0.025 \quad N= 1,2, 3,\dots, 200$$

Center frequency of Nth base station receiving channel (MHz):

$$F'_N = 806.0125 + (N-1) \times 0.025 \quad N= 1,2, 3,\dots, 200$$

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

This sub-band is divided into 12.5 kHz channels.

Center frequency of Nth base station transmitting channel (MHz):

$$F_N = 856.00625 + (N-1) \times 0.0125 \quad N= 1,2, 3,\dots, 200$$

Center frequency of Nth base station receiving channel (MHz):

$$F'_N = 811.00625 + (N-1) \times 0.0125 \quad N= 1,2, 3,\dots, 200$$

---

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

This sub-band is divided into 6.25 kHz channels.

Center frequency of Nth base station transmitting channel (MHz):

$$F_N = 858.503125 + (N-1) \times 0.00625 \quad N= 1,2, 3,\dots, 400$$

Center frequency of Nth base station receiving channel (MHz):

$$F'_N = 813.503125 + (N-1) \times 0.00625 \quad N=1,2,3,400$$

#### A1.4 Example 4

##### G3-1-4 – 800 MHz narrow band and Broadband

##### Example Channel arrangements for a combination of narrowband PPDR and broadband PPDR in the band 806-824/851-869 MHz

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

##### Example of frequency arrangement for a combination of 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

### Channelization for narrowband

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

The centre frequency ( $f_N$ ) of the Nth 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	$f_N = 806.0125 + (0.025) \times (N - 1)$	$f_N = 851.0125 + (0.025) \times (N - 1)$	25

### Channelization for broadband

The channeling plan for broadband is based on a channel bandwidth of 5 MHz or 10 MHz as shown below: The centre frequency ( $f_N$ ) of the Nth channel is given by:

#### Broadband with two 5 MHz channels

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 2$	$f_N = 816.5 + (5) \times (N - 1)$	$f_N = 861.5 + (5) \times (N-1)$	5



### Broadband with a single 10 MHz channel

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



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## A1.5 Example 5

### G3-1-5 800 MHz – Broadband and narrow band systems

This example shows channel arrangements in the band 806-824/851-869 MHz for a wider broadband tuning range

To ensure maximum flexibility for administrations in accommodating particular local circumstances, needs and licensing arrangements (including whether or not the band 698-803 MHz is used in whole or in part) the following *minimum* tuning range is suggested for all PPDR systems and user terminal equipment intended for deployment in the band 807-824/852-869 MHz:

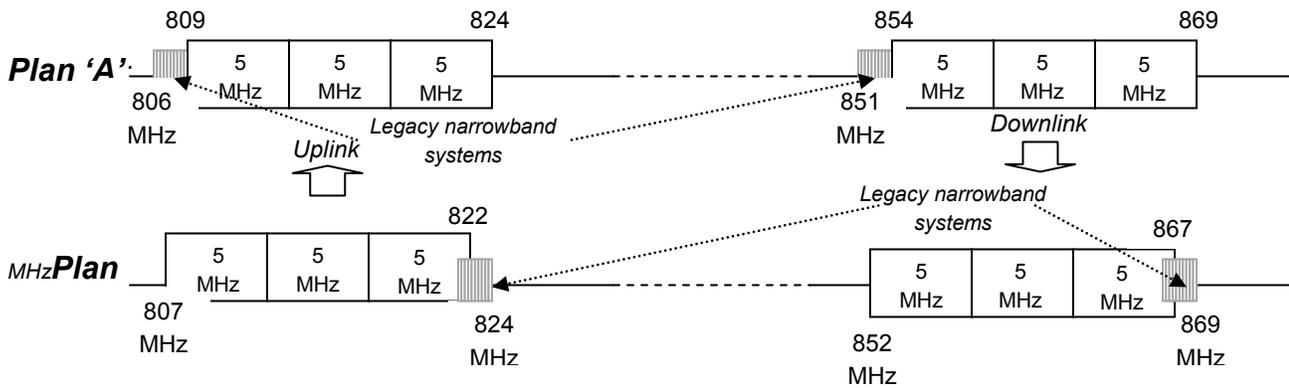


An example of this flexibility is illustrated in the following broadband channel plan, based on

paired frequency blocks with mobile station transmitters in the frequency range 806-824 MHz (uplink) and base station transmitters in the frequency range 851-869 MHz (downlink).

To allow for possible co-existence with legacy narrowband systems and adjacent broadband

channel arrangements, administrations could consider either:



The raster for the broadband channels is 100 kHz, which allows for channel center frequencies to be 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 in accordance with the above Plans 'A' or 'B', or some subset thereof, to suit specific national circumstances. Some administrations may wish to use different amounts of broadband and narrowband spectrum than the examples in Plan 'A' or 'B' to allow for transition.



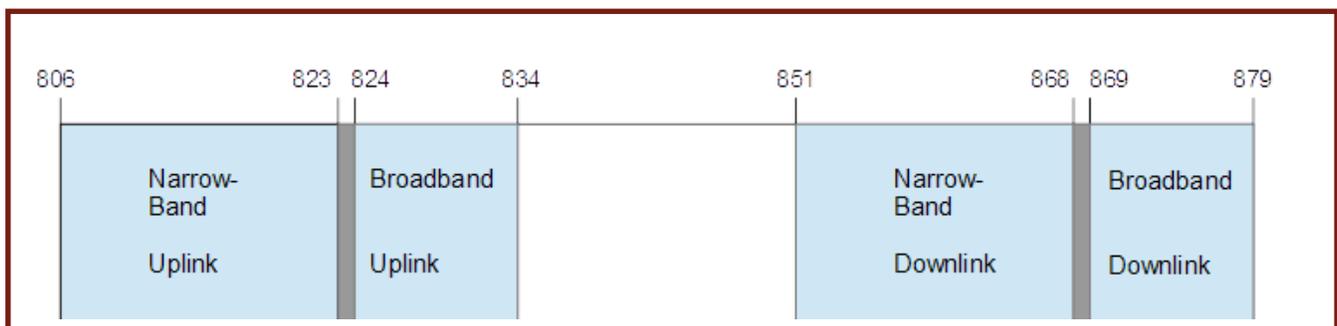
## A1.6 Example 6

### G3-1-6: 800 MHz Narrow band and Broadband systems

Example channel arrangements for a combination of narrowband PPDR and broadband PPDR in the band 806-834/851-879 MHz.

This example shows how narrowband and broadband systems can be deployed in the band 806-834/851-879 MHz. The sub-band 806-823/ 851-868 MHz is used for narrowband systems with a channel bandwidth of 25 kHz; the sub-band 824-834/ 859-879 MHz is used for broadband PPDR (LTE) systems using carrier bandwidths of 5 or 10 MHz. The sub-band 821/823-824/ 866/868-869 MHz acts as guard band between narrowband and broadband systems or is used for legacy SRD devices such as RFID

#### Example of frequency arrangement for a combination of narrowband and broadband systems in 806-834/ 851-879



Mobile station/Control station transmit (MHz)	Base station transmit (MHz)	Frequency block
806-821/823	851-866/868	Narrowband PPDR
821/823-824	866/868-869	Guard band /SRD
824-834	869-879	Broadband PPDR

### Channelization for narrowband

The channeling plan for the sub-band 806-823/ 851-868 MHz is based on the channel spacing of 25 kHz.

The centre frequency ( $f_N$ ) of the Nth 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 680	$f_N = 806.0125 + (0.025) \times (N - 1)$	$f_N = 851.0125 + (0.025) \times (N - 1)$	25

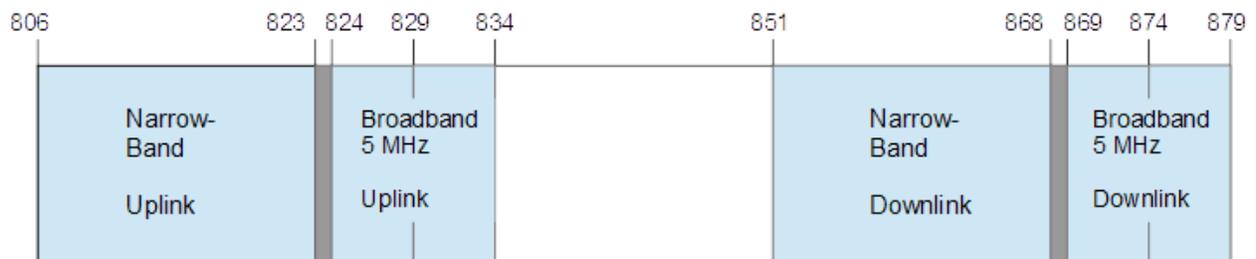
### Channelization for broadband

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

The centre frequency ( $f_N$ ) of the Nth channel is given by:

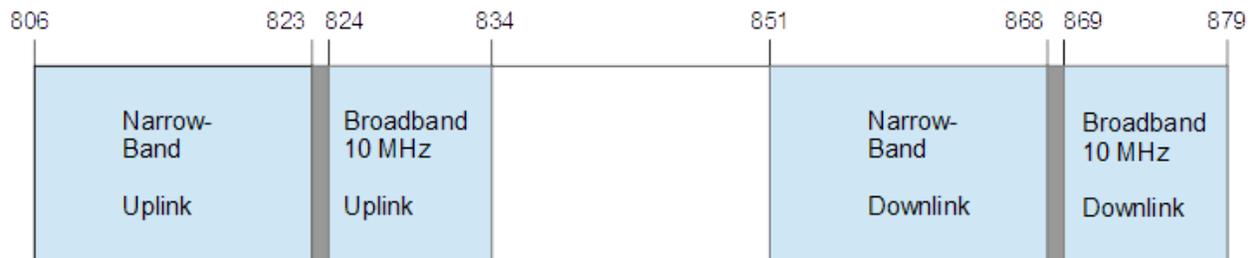
#### Broadband with two 5 MHz channels

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1 \text{ to } 2$	$f_N = 826.5 + (5) \times (N - 1)$	$f_N = 871.5 + (5) \times (N - 1)$	5



Broadband with a single 10 MHz channel

Channel number	Mobile station transmit Channel centre frequency (MHz)	Base station transmit Channel centre frequency (MHz)	Channel bandwidth (MHz)
$N = 1$	$f_1 = 829$	$f_1 = 874$	10





**Annex 1  
Harmonized Frequency Arrangements**

**Section 2:  
Arrangements in parts of the frequency ranges 406.1-430 and 440--470 MHz  
(as per *resolves* 3 of Resolution 646 (Rev.WRC-15))**

Regional Organisation	Frequency Arrangement Number	Paired arrangements			Usage type
		Mobile station transmitter (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
APT	R3-2-1	414.0125-414.1000	414.0125-414.1000	N/A	Narrowband
APT	R3-2-2	406.1125-411.5875	414.1125-419.5875	8	Narrowband
APT	R3-2-3	410-420	420-430	10	Narrowband
APT	R3-2-4	408.6375–410.5375	418.0875–420.0000	9.45	Narrowband 12.5 kHz
APT	R3-2-5	420.0000–430.0000	-	-	-
APT	R3-2-6	457.50625–459.9875	467.50625–469.9875	10 MHz	Narrowband 12.5 kHz

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R3-2-1 and R3-2-2:

Example channel arrangements in the band 406.1 – 430 MHz for information only

Example A: Following channel arrangements are currently used for narrowband wireless systems in New Zealand.

#### 406.1 – 420 MHz

Parts of the band 406.1 – 420 MHz sub-band are used to accommodate commercial analogue trunked land mobile systems for many years, and is a candidate for the introduction of spectrum efficient digital land mobile systems in the future. Current channel arrangements for this spectrum are shown below.

##### (R3-2-1)

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

$$F_n = 414.01250 + ((N-1) * 0.0125) \quad N = 1, 2, 3, \dots 8$$

##### (R3-2-2)

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Duplex services are accommodated within a 12.5 kHz channel raster as follows:

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

$$F_n = 414.11250 + ((N-1) * 0.0125) \quad N = 1, 2, 3, \dots 439$$

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

$$F_n = 406.11250 + ((N-1) * 0.0125) \quad N = 1, 2, 3, \dots 439$$

### **420 – 430 MHz**

The 420 – 430 MHz sub-band is used to accommodate bi-directional fixed point to point links and is not considered as a candidate band for land mobile applications.

**R3-2-3**: The following channel arrangements are used in some APT countries for narrowband PPDR and digital trunked radio systems

### **410-430 MHz**

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The frequency band 410 to 430 MHz provides a total bandwidth of 20 MHz for digital trunked radio Systems. The channelling plan is based on 12.5 kHz channel spacing, providing a total of 800 pairs of physical radio channels. Although the standard channel spacing is 12.5 kHz, there is flexibility to assign two or more contiguous channels (i.e. 25 KHz, 50 KHz or 100 KHz) as required.

Administrations normally assign one or more channels based on channel width of 12.5 kHz or 25 KHz. The channelling plan based on a raster of 12.5 KHz is shown below:

CHANNELLING PLAN (12.5 kHz)

CHANNEL NUMBER	FREQUENCY (MHz)	
	Base Tx	Base Rx
N ( N= 1 to 800)	$420.00625 + (N-1)*0.0125$	$410.006125 + (N-1)*0.0125$

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.

CHANNEL ALLOTMENT PLAN

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 $2*D+600+20*(X-1)$
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**Annex 1  
Harmonized Frequency Arrangements**

**Section 3:  
Arrangements in parts of the frequency range 4940-4990 MHz  
(as per *resolves 3* of Resolution 646 (Rev.WRC-15))**

Regional Organisation	Frequency Arrangement Number	Paired arrangements			Usage type
		Mobile station transmitter (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
APT	R3-3-1	4940-4990	4940-4990	N/A	Broadband

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### Annex 1 – Section 3

Frequency arrangements and other technical characteristics of regionally harmonized frequency range for PPDR in 4 940-4 990 MHz

The frequency range 4940-4990 MHz or parts thereof may be used to support broadband networks designed for PPDR high rate data and video information transfer. Such networks will need to be highly reliable, secure, and designed with coverage capabilities based on PPDR agency requirements. These networks are expected to include both pre-deployed hotspots throughout a PPDR agency's operational area and temporary ad hoc systems deployed at an incident scene as needed for incident scene management. Example detailed channeling plans, emission masks and power limits for use of this band for PPDR applications are given below:

**a) Channel Plan:** The following channeling plan (see Table 1) , which supports channel widths from 5 MHz to 20 MHz, to provide the flexibility needed for Administrations to support a variety of PPDR operational requirements. Because these channels overlap one another, Administrations may take precautions in their assignment procedures to ensure that overlapping channels do not occur in close enough proximity to cause conflicts between multiple PPDR users. Note that not all of the channels are available in some countries.

**b) Emission Masks:** The recommended emission masks for 4.9 GHz for low power devices is similar to the mask defined in the IEEE 802.11a standard and a tighter mask for higher power transmitters which provides better adjacent

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channel protection. The low-to-high power breakpoint, that is, the point at which the high power mask is required, varies by channel bandwidth: 20 dBm (100 milliwatts) for 20 MHz channels, 17 dBm for 10 MHz channels, and 14 dBm for 5 MHz channels. The less stringent mask for transmitting devices at lower power levels below these points allows existing 5 GHz commercial-off-the-shelf (COTS) wireless LAN equipment to be easily modified to operate in the 4.9 GHz band, thereby reducing costs for PPDR users. At the same time, the tighter mask used for powers above these levels provides additional adjacent channel protection needed to help reduce interference and increase the reliability for PPDR users. Manufacturers should also have the option to use the tighter mask for lower power transmitters as well, but would not be required to do so.

**c) Power Limits:** Power limits should be stipulated as a function of channel bandwidth. “High power” transmitters would require the use of a tighter mask to help prevent adjacent channel interference. “Low power” transmitters would have the option to operate with a less stringent mask. Example power limits are given in Table 2. Transmitters under the “High power” category which meet the tighter emission mask should be allowed to use transmit antennas with a directional gain up to 26 dBi at maximum transmit power output. Directional antenna gain could exceed 26 dBi, if both power transmit power and power spectral density are reduced dB-per-dB by the amount that directional antenna gain exceeds 26 dBi.

In some cases, Administrations may wish to impose lower power limits due to tighter frequency-sharing environment. An example set of such power limits is given in Table 3. The parameters are taken from a Broadband Wireless Access (BWA) system that has capability to accommodate broadband PPDR applications.

**Table 1**

Example channeling plan for 4940-4990 MHz

Channel Numbers * (n..)	Channel Center 5MHz	Channel Center 10MHz	Channel Center 20MHz
1	4942.5		
2		4945.0	
3	4947.5		
4		4950.0	4950.0
5	4952.5		
6		4955.0	4955.0
7	4957.5		
8		4960.0	4960.0
9	4962.5		
10		4965.0	4965.0
11	4967.5		
12		4970.0	4970.0
13	4972.5		
14		4975.0	4975.0
15	4977.5		
16		4980.0	4980.0
17	4982.5		
18		4985.0	
19	4987.5		

**Table 2**

Example power limits for transmitters in 4940-4990 MHz by PPDR applications

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Channel Bandwidth (MHz)	Low power peak transmitter power (dBm)	High power peak transmitter power (dBm)
5	14	27
10	17	30
15	18.8	31.8
20	20	33

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**Table 3**

Example parameters of BWA system to support PPDR applications

<u>Channel Spacing</u>	<u>Occupied bandwidth</u>	<u>Peak transmitter power</u>	<u>Peak equivalent isotropic radiated power</u>
<u>5 MHz</u>	<u>4.5 MHz</u>	<u>24 dBm and 17 dBm/MHz</u>	<u>37 dBm</u>
<u>10 MHz</u>	<u>9.0 MHz</u>		
<u>20 MHz</u>	<u>19.7 MHz</u>		

\* Listen-before-transmit protocol is used to avoid interference.

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**Annex 2**  
**Country Frequency Arrangements**  
**(as per resolves 4 of Resolution 646 (Rev.WRC-15))**

**Annex 2 - Section1:**  
**Country Frequency Arrangements in the ranges 138-174 MHz, 351-370 MHz and 380-400 MHz for narrowband PPDR applications and the frequency ranges 174-205 MHz and 1447-1467 MHz for broadband PPDR applications**

Country	Frequency Arrangement Number	Paired arrangements			Usage type
		Mobile station transmitter (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
Japan	C3-1-1	170-205	170-205	NA (TDD)	Broadband
China	C3-1-2	1447-1467	1447-1467	NA (TDD)	Broadband
Australia	C3-1-3	403.0000– 403.9875	412.4625– 413.4375	9.4625 MHz	Narrowband 12.5 kHz
Australia	C3-1-4	405.0125– 406.0000	414.4625– 415.4375	9.45	Narrowband 12.5 kHz

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## Annex 3

### RESOLUTION 646 (REV.WRC-15)

#### **Public protection and disaster relief**

The World Radiocommunication Conference (Geneva, 2015),

*considering*

- a) that the term “public protection radiocommunication” refers to radiocommunications used by responsible agencies and organizations dealing with maintenance of law and order, protection of life and property and emergency situations;
  - b) that the term “disaster relief radiocommunication” refers to radiocommunications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether developing suddenly or as a result of complex, long-term processes;
  - c) the growing telecommunication and radiocommunication needs of public protection agencies and organizations, including those dealing with emergency situations and disaster relief, that are vital to the maintenance of law and order, protection of life and property, disaster relief and emergency response;
  - d) that many administrations wish to promote interoperability and interworking between systems used for public protection and disaster relief (PPDR), both nationally and for cross-border operations in emergency situations and for disaster relief;
  - e) that existing systems for PPDR applications mainly support narrowband/wideband voice and data applications;
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- f) 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, and appropriate spectrum may need to be made available on a national basis to meet these growing needs;
- g) that new technologies for broadband PPDR applications are being developed in various standards organizations, e.g. International Mobile Telecommunications (IMT) technologies that support higher data rates and higher capacity for PPDR applications, and these technologies are also being used to meet the needs of PPDR agencies and organizations;
- h) that continuing development of new technologies and systems, such as IMT and Intelligent Transportation Systems (ITS), may be able to further support or supplement advanced PPDR applications;
- 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;
- j) that administrations may have different operational needs and spectrum requirements for PPDR applications depending on the circumstances;
- k) that an approach based on global and/or regional frequency ranges<sup>1</sup> may enable administrations to benefit from harmonization while continuing to meet national planning requirements,

*recognizing*

- a) the benefits of spectrum harmonization such as:
- increased potential for interoperability;

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<sup>1</sup> In the context of this resolution, the term “frequency range” means a range of frequencies over which radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements.

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- clear guidance for standardization;
  - increased volume of equipment resulting in economies of scale, more cost-efficient equipment and expanded equipment availability;
  - improved spectrum management and planning;
  - more effective international aid during disasters and major events; and
  - enhanced cross-border coordination and circulation of equipment;
- b)* that the organizational distinction between public protection activities and disaster relief activities are matters for administrations to determine at the national level;
- c)* that national spectrum planning for PPDR needs to have regard to cooperation and bilateral consultation with other concerned administrations, which should be facilitated by greater levels of spectrum harmonization;
- d)* that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998), an international treaty deposited with the United Nations Secretary-General and related United Nations General Assembly resolutions and reports are also relevant in this regard;
- e)* that Resolution 36 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference urges Member States Parties to the Tampere Convention to take all practical steps for the application of the Tampere Convention and to work closely with the operational coordinator as provided for therein;
- f)* that Recommendation ITU-R M.1637 offers guidance to facilitate the global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations;
- g)* that Recommendation ITU R M.2009 identifies radio interface standards applicable to PPDR operations;

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- h)* that Report ITU-R M.2291 provides details of the capabilities of IMT technologies to meet the requirements of applications supporting broadband PPDR operations;
- i)* that Report ITU-R M.2377 provides details of systems and applications supporting PPDR operations in narrowband, wideband and broadband use;
- j)* that PPDR agencies and organizations have an initial set of requirements, including but not limited to interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in the use of non-dedicated systems, fast response times, ability to handle multiple group calls and the ability to cover large areas, as described in Reports ITU-R M.2377 and ITU-R M.2291;
- k)* that Report ITU-R BT.2299 provides a compilation of supporting evidence to the effect that terrestrial broadcasting plays an important role in disseminating information to the public in times of emergencies;
- l)* that Recommendation ITU-R M.2015 contains regionally harmonized PPDR frequency arrangements, as well as frequency arrangements of individual administrations<sup>2</sup>;
- m)* that in times of disasters, if most terrestrial-based networks are destroyed or impaired, amateur, satellite and other non-ground-based networks may be available to provide communication services to assist in PPDR efforts;
- n)* that the amount of spectrum needed for public protection on a daily basis differs significantly between countries, and that certain amounts of spectrum are already in use in various countries for PPDR applications;
- o)* that in response to a disaster or emergency, access to additional spectrum on a temporary basis may be required for PPDR operations;

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<sup>2</sup> For example, some countries in Region 3 have 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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- p)* that not all frequencies within an identified common frequency range will be available for PPDR use within each country;
- q)* that the identification of common frequency ranges within which equipment could operate may ease interoperability and/or interworking, with mutual cooperation and consultation, especially in national, regional and cross-border emergency situations and disaster relief operations;
- r)* that when a disaster occurs, the PPDR agencies and organizations are usually the first responders on the scene using their day-to-day communication systems and, additionally, other agencies and organizations may also become involved in disaster relief operations;
- s)* that some countries in Region 1 have identified certain parts of the frequency range 694-791 MHz for broadband PPDR deployment;
- t)* that some countries in Region 1 have identified certain parts of the frequency range 790-862 MHz for broadband PPDR deployment;
- u)* the provisions contained in Nos. **5.266** and **5.267**, and Resolution **205 (Rev.WRC-15)**;
- v)* that Metajds and Metsat services operate on a globally harmonized basis in the frequency band 400.15-406 MHz;
- w)* that the radio astronomy service operates on a primary basis in the frequency band 406.1-410 MHz and there may be PPDR operations adjacent to that frequency band,

*noting*

- a)* that many administrations will continue to use different frequency bands below 1 GHz for narrowband systems and applications supporting PPDR and may decide to use the same range for future PPDR systems;
- b)* that some administrations also use certain frequency bands above 1 GHz for broadband PPDR applications;
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- c) that applications requiring large coverage areas and providing good signal availability would generally be accommodated in lower frequency bands;
  - d) that many administrations have made significant investments in PPDR systems;
  - e) that flexibility allows disaster relief agencies and organizations to use current and future radiocommunications, so as to facilitate their humanitarian operations;
  - f) that disasters and emergency events require response not only from PPDR agencies and organizations but also from humanitarian agencies and organizations;
  - g) that broadband PPDR can be realized and deployed in the frequency bands identified for IMT;
  - h) the benefits of cooperation between countries for the provision of effective and appropriate humanitarian assistance in case of disasters, particularly in view of the special operational requirements of such activities involving multinational response;
  - i) the needs of countries, particularly the developing countries<sup>3</sup>, for cost-efficient communication equipment;
  - j) that the use of technologies based on Internet protocols is well established,

*emphasizing*

- a) that the frequency ranges that are covered by the *resolves* part of this resolution are allocated to a variety of services in accordance with the relevant provisions of the Radio Regulations and are currently used intensively by the fixed, mobile, mobile-satellite and broadcasting services;

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<sup>3</sup> Taking into account, for example, the latest version of the ITU-D Handbook on disaster relief.

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b) that PPDR applications in the ranges listed in *resolves* 2 and 3 are intended to operate in the mobile service allocated on a primary basis according to the provisions of the Radio Regulations;

c) that flexibility must be afforded to administrations

to determine:

- how much spectrum to make available at a national level for PPDR from the ranges in the *resolves* part of this resolution in order to meet their particular national requirements;
- the need and timing of availability as well as the conditions of usage of the bands used for PPDR, including those covered in this resolution and Recommendation ITU-R M.2015, in order to meet specific regional or national situations<sup>4</sup>;

d) that the provisions of Nos. **1.59** and **4.10** of the Radio Regulations do not apply to PPDR;

e) that administrations can adopt their frequency arrangements for the terrestrial component of IMT, from those detailed in Recommendation ITU-R M.1036,

*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;

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,

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<sup>4</sup> For example, some countries in Region 1 have identified certain parts of the frequency range 694-862 MHz for broadband PPDR applications.

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in particular broadband, in order to achieve harmonization, taking into account *emphasizing c) and e)* above;

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;

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;

5 that the use of the frequency ranges for PPDR in *resolves* 2 and 3 above, as well as the use of the countries' frequency arrangements for PPDR, as described in the most recent version of Recommendation ITU-R M.2015, must not cause unacceptable interference, nor constrain the use of these frequency ranges by applications of the services to which these ranges are allocated in the Radio Regulations;

6 to encourage administrations, in emergency and disaster relief situations, to satisfy temporary needs for frequencies in addition to what may be normally provided for in agreements with the concerned administrations;

7 to encourage administrations to facilitate cross-border circulation of radiocommunication equipment intended for use in emergency and disaster relief situations through mutual cooperation and consultation without hindering national legislation;

8 that administrations encourage PPDR agencies and organizations to utilize relevant ITU-R Recommendations in planning spectrum use and implementing technology and systems supporting PPDR;

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9 to encourage administrations to continue to work closely with their PPDR community to further refine the operational requirements for PPDR activities,

*invites the ITU Radiocommunication Sector*

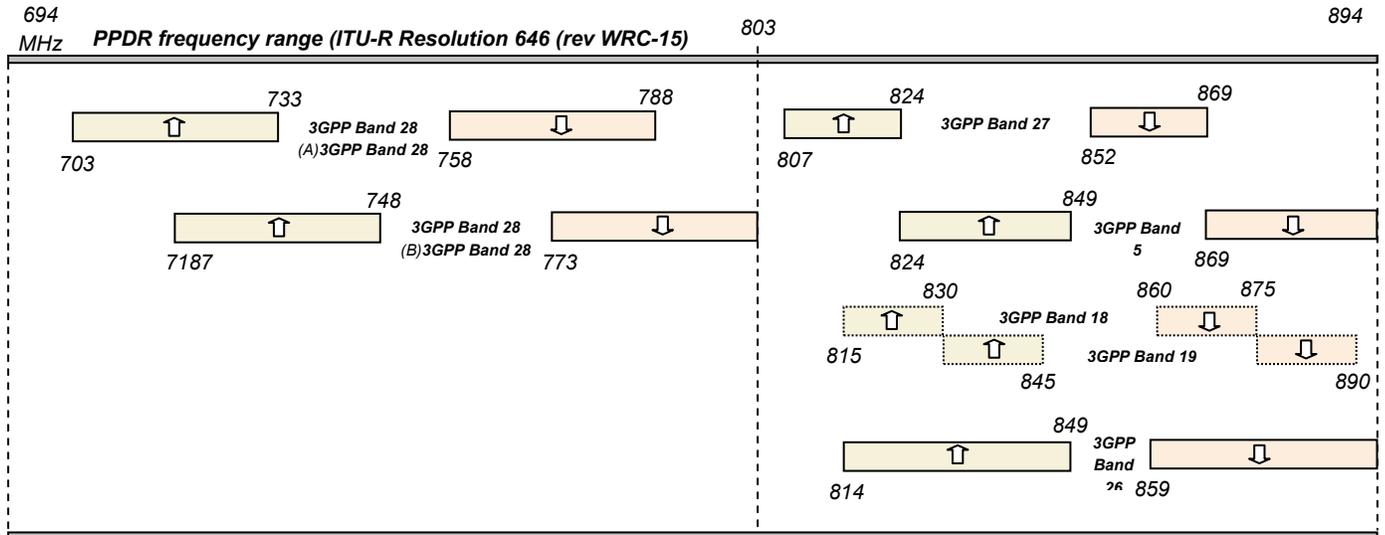
1 to continue its technical studies and to make recommendations concerning technical and operational implementation, as necessary, to meet the needs of PPDR radiocommunication applications, taking into account the capabilities, evolution and any resulting transition requirements of the existing systems, particularly those of many developing countries, for national and international operations;

2 to review and revise Recommendation ITU-R M.2015 and other relevant ITU-R Recommendations and Reports, as appropriate.

## Annex 4

### 3GPP frequency arrangements that may be suitable for deployment of broadband wireless PPDR systems

Resolution **646 (Rev.WRC-15)** encourages administrations to consider parts of the frequency range of 694-894 MHz for meeting their PPDR requirements. The following 3GPP frequency arrangements (applicable to Region 3) fall within the PPDR frequency range designated by ITU-R Resolution **646 (Rev.WRC-15)**, and could therefore be considered for use by administrations in relation to deployment of broadband wireless PPDR systems:



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Figure: 3GPP bands falling within the PPDR frequency range 694-894 MHz