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| **Radiocommunication Study Groups** |  |
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| Source: Document 5A/TEMP/343 | **Annex 6 to****Document 5A/788-E** |
| **21 November 2011** |
| **English only** |
| Annex 6 to Working Party 5A Chairman’s Report |
| PRELIMINARY DRAFT NEW REPORT ITU-R M.[LMS.PPDR.UHF CHANNELS] |
| Channelization scenarios for public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution 646 (WRC-03) |

**Scope**

This Report provides channelization scenarios that could be used in the range 746-806 MHz and 806‑869 MHz for public protection and disaster relief (PPDR) radiocommunications.

**1 Introduction**

This Report provides examples of channelization scenarios for broadband PPDR in the band 746‑806 MHz and narrow-band PPDR in the bands 746-806 MHz and 806-824/851-869 MHz.

**2 Relevant Recommendations and Reports**

The existing Recommendations and Reports that are considered to be of importance in the development of this particular Report are as follows:

Draft new Recommendation ITU-R M.[LMS.PPDR.UHF TECH] “Radio interface standards for use by public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution 646 (WRC-03)”

Draft new Recommendation ITU-R M.[LMS.PPDR.UHF] “Frequency arrangements for public protection and disaster relief radiocommunication systems in UHF bands in accordance with Resolution 646 (WRC‑03)”.

Report ITU-R M.2014 – “Digital land mobile systems for dispatch traffic”.

Report ITU-R M.2033 – “Radiocommunication objectives and requirements for public protection and disaster relief”.

**3 Acronyms and abbreviations**

BCG – Band Class Group

CDMA-DS – Code Division Multiple Access – Direct Spread

CDMA-MC – Code Division Multiple Access – Multi-Carrier

CDMA TDD – Code Division Multiple Access Time Division Duplex

DL – Downlink

DMR – Digital Mobile Radio

E-UTRA – Evolved Universal Terrestrial Radio Access

FDD – Frequency Division Duplex

I/O – Interoperability

kHz – kilohertz

LTE – Long-Term Evolution

MBit/s – Megabits per section

MHz – Megahertz

OFDMA TDD WMAN – Orthogonal Frequency Division Multiple Access Time Division Duplex Wireless Metropolitan Area Network

PPDR –Public Protection and Disaster Relief.

PSTN – Public Switched Telephone Network

RF – Radio Frequency

TDD –Time Division Duplex

TDMA-SC – Time Division Multiple Access – Single Carrier

TETRA – TErrestrial Trunked RAdio

UL – Uplink

UHF – Ultra High Frequency

{Editor’s note: To be expanded as the document progresses}

**4 PPDR user requirements**

PPDR is defined in Resolution 646 (WRC-03) through a combination of the terms “public protection radiocommunication” and “disaster relief radiocommunication”. The first term refers to radiocommunications used by responsible agencies and organizations dealing with maintenance of law and order, protection of life and property and emergency situations, and the second term 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.

In addition, Resolution 646 and Report ITU-R M.2033 describe a range of requirements for PPDR. It is recognized that there is a need for narrow-band, wideband and broadband applications, and Resolution 646 and Report ITU-R M.2033 provide general definitions of these terms applicable for PPDR. It is recognized, however, that other definitions of these terms exist in other ITU texts (such as Recommendation ITU-R F.1399) or in the rules of various individual administrations.

PPDR requirements from a user perspective are described in detail in Report ITU-R M.2033, specifically in Section 3.2 of Annex 1. These user requirements include priority access, grade of service/quality of service, coverage, a variety of capabilities (including push-to-talk, fast call set-up, hardened equipment that is capable of operating in harsh environments, interconnection to the PSTN, one touch broadcasting/group call capabilities), secure communications, interoperability and regulatory compliance. It is noted thatindividual administrations or PPDR organizations may have their own requirements for PPDR that go beyond those described herein, and that each standard would need to be evaluated on a case-by-case basis against those requirements.

**5 Radio interface standards that could be used for PPDR in the range 746-806 MHz**

[Preliminary draft new] Recommendation ITU-R M.[LMS.PPDR.UHF] details the frequency arrangements for PPDR operations in some parts of the UHF band. [Preliminary draft new] Recommendation ITU-R M.[LMS.PPDR.UHF TECH] outlines the radio interface standards for PPDR operations in some parts of the UHF band.

Annex 1

**Examples of channelization scenarios that could be used for broadband[[1]](#footnote-1) public protection and disaster relief operations in the 746-806 MHz band**

**1 Technology “A”**

Technology “A” corresponds to the IMT-2000 CDMA-MC technology.

**1.1 Example channelization scenario “A” for Technology A**

This channelization scenario uses paired frequencies with base station transmitters in the frequency band 758-768 MHz and mobile station transmitters in the frequency band 788-798 MHz. Certain channels have also been identified for interoperability purposes. The scenario includes only wideband channels for public protection and disaster relief operations with two channelling plans (“A1” and “A2”).

For systems corresponding to channelization scenario “A1”, a total of 200 channels are defined. Each channel raster is 50 kHz wide, while the carrier bandwidth of the technology is 1.25 MHz, composed of 25 50 kHz channels. The centre frequencies for channelling plan “A1” are defined in Table A-1 below, where *n* is the channel number:

Table A-1

**Channel raster for channelization scenario A1**

|  |  |  |
| --- | --- | --- |
| **Transmitter** | **Channelnumber** | **Centre frequency forchannel (MHz)** |
| Access terminal | 20 ≤ *n* < 220 | 787.000 + 0.050 *n*1 |
| Access network | 20 ≤ *n* < 220 | 757.000 + 0.050 *n* |
| 1 For example, for channel number 45, the centre frequency of the 50 kHz wide channel is 757 + 0.05 × 45 = 759.25 MHz (access network) and 787 + 0.05×45 = 789.25 MHz (access terminal). |

Table A-1A shows the valid, invalid and, conditionally valid channels for the “PPDR A” and PPDR broadband, “PPDR B”, blocks. The transmit frequency band is composed of the centre frequencies of the relevant valid channels. For example, for PPDR A the transmit frequency band 789.250‑791.750 MHz (access terminal) corresponds to the centre frequencies of channel numbers 45 and 95 respectively.

Table A-1a

**Possible channels for different channel bandwidths for channelization scenario A1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Blockdesignator** | **Channel validity1** | **Channelnumber** | **Transmit frequency band (MHz)** |
| **Access terminal** | **Access network** |
| PPDR A(5 MHz) | Not validValidCond. valid | 20-4445-9596-119 | 788.000-789.200789.250-791.750791.800-792.950 | 758.000-759.200759.250-761.750761.800-762.950 |
| PPDR B broadband(5 MHz) | Cond. validValidNot valid | 120-144145-195196-219 | 793.000-794.200794.250-796.750796.800-797.950 | 763.000-764.200764.250-766.750766.800-767.950 |
| 1 Channel validity based on 1.25 MHz bandwidth. Different bandwidths would imply different valid channels. Note that certain channel assignments are not valid and others are conditionally valid. Transmission on “conditionally valid channels” is permissible if the adjacent block is allocated to the same licensee or if other valid authorization has been obtained. |

For channelling plan “A2”, the centre frequencies of the channels are defined in Table A-2 below, where *n* is the channel number. Each channel raster is 50 kHz wide, while the carrier bandwidth of the technology is 1.25 MHz, composed of 25 50 kHz channels.

Table A-2

**Channel raster for channelization scenario A2**

|  |  |  |
| --- | --- | --- |
| **Transmitter** | **Channelnumber** | **Centre frequency forchannel (MHz)** |
| Access terminal | 8 192 ≤ *i*1 < 8 432 | 787.0384 +( ⎣((0.050 (i – 8 192))/0.0096) + 0.5⎦ × 0.0096) |
| Access network | 0 ≤ *n* < 240 | 757.0384 +( ⎣((0.050 n)/0.0096) + 0.5⎦ × 0.0096) |
| 1 *i = n*+ 8 192, where *n* is the access network channel number. |

Table A-2A shows the possible channels for different channel bandwidths of “PPDR A” and PPDR broadband, “PPDR B”, blocks for channelization scenario A2.

Table A-2A

**Possible channels for different channel bandwidths for channelization scenario A2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Blockdesignator** | **Channel validity1** | **Centre frequency carrier channelnumber** | **Centre frequency and transmit frequency band (MHz)** |
| **Access terminal** | **Access network** |
| PPDR A(5 MHz) | Preferred | 45 | 789.293(788.668-789.918) | 759.293(758.668-759.918) |
| 70 | 790.543(789.918-791.168) | 760.543(759.918-761.168) |
| 95 | 791.793(791.168-792.418) | 761.793(761.168-762.418) |
| PPDR B broadband(5 MHz) | Preferred | 120 | 793.043(792.418-793.668) | 763.043(762.418-763.668) |
| 145 | 794.293(793.668-794.918) | 764.293(763.668-764.918) |
| 170 | 795.543(794.918-796.168) | 765.543(764.918-766.168) |
| 195 | 796.793(796.168-797.418) | 766.793(766.168-767.418) |
| 1 Channel validity based on 1.25 MHz bandwidth. Different bandwidths would imply different preferred set channels. |

Interoperability channels provide for coordination of tactical communications between different PPDR agencies or within the same PPDR agency, or for other similar emergency communications.

Table A-3 shows the wideband paired channels have been identified as PPDR interoperability channels only, in support of the associated designation.

Table A-3

|  |
| --- |
| **Interoperability channel number1** |
| 45, 70, 95, 120, 145, 170 |
| [1] For channelling plan “A2”, these channel numbers specify the base station transmit channels. For base station transmit channel *n*, the corresponding mobile station transmit channel is 8 192 + *n*. |

**2 Technology “B”**

Technology “B” corresponds to IMT-2000 CDMA-DS, specifically UTRA FDD.

**2.1 Example channelization scenario “B” for Technology B (FDD)**

This broadband channelization scenario uses paired frequencies with base station transmitters in the frequency band 758-768 MHz and mobile station transmitters in the frequency band 788-798 MHz[[2]](#footnote-2).

The channel raster is 200 kHz, for all bands which means that the centre frequency must be an integer multiple of 200 kHz. In addition a number of additional centre frequencies are specified according to table 5.1A, which means that the centre frequencies for these channels are shifted 100 kHz relative to the general raster.

The carrier frequency is designated by the UTRA Absolute Radio Frequency Channel Number (UARFCN). For each operating Band, the UARFCN values are defined as follows:

Uplink: NU =5 \* (FUL - FUL\_Offset), for the carrier frequency range FUL\_low FUL  FUL\_high

Downlink: ND =5 \* (FDL - FDL\_Offset), for the carrier frequency range FDL\_low FDL  FDL\_high

For each operating Band, FUL\_Offset, FUL\_low FUL\_high, FDL\_Offset,, FDL\_lowand FDL\_high are defined in Table 5.1 for the general UARFCN. For the additional UARFCN, FUL\_Offset, FDL\_Offset and the specific FUL and FDL are defined in Table 5.1A.

TABLE [B-1: UARFCN definition (general)

| Band | UPLINK (UL)UE transmit, Node B receive | DOWNLINK (DL)UE receive, Node B transmit |
| --- | --- | --- |
| UARFCN formula offsetFUL\_Offset [MHz] | Carrier frequency (FUL) range [MHz]  | UARFCN formula offsetFDL\_Offset [MHz] | Carrier frequency (FDL) range [MHz] |
| FUL\_low | FUL\_high | FDL\_low | FDL\_high |
| - | - | - | - | - | - | - |
| XIV | 12 | 790.4 | 795.6 | -63 | 760.4 | 765.6 |
| - | - | - | - | - | - | - |

TABLE [B-2]: UARFCN definition (additional channels)

| Band | UPLINK (UL)UE transmit, Node B receive | DOWNLINK (DL)UE receive, Node B transmit |
| --- | --- | --- |
| UARFCN formula offsetFUL\_Offset [MHz] | Carrier frequency [MHz](FUL) | UARFCN formula offsetFDL\_Offset [MHz] | Carrier frequency [MHz](FDL) |
| = | **-** | **-** | **-** | **-** |
| XIV | 2.1 | 790.5, 795.5 | -72.9 | 760.5, 765.5 |
| = | - | - | - | - |

The following UARFCN range shall be supported for each paired band

TABLE [B-3]: UTRA Absolute Radio Frequency Channel Number

|  |  |  |
| --- | --- | --- |
| Band | Uplink (UL)UE transmit, Node B receive | Downlink (DL)UE receive, Node B transmit |
| General | Additional | General | Additional |
| - | - | - | - | - |
| XIV | 3892 to 3918 | 3942, 3967 | 4117 to 4143 | 4167, 4192 |
| - | - | - | - | - |

**3 Technology “C”**

Technology “C” corresponds to OFDMA TDD WMAN.

**3.1 Example channelization scenario “C” for Technology C (FDD)**

This broadband channelization scenario uses paired frequencies with base station transmitters in the frequency band 758-768 MHz and mobile station transmitters in the frequency band 788-798 MHz as detailed in Table C-1[[3]](#footnote-3).

Table C-1

Band Class Group (BCG) information for different channel bandwidths of Technology C

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Band Class Group (BCG) | Frequency range UL (MHz) | Frequency range DL (MHz) | Channel bandwidth (MHz) | Duplex mode | Comments |
| 7.C | 788-793, 793-798 | 758-763, 763-768 | 2 × 5 | FDD | The bandwidths are applicable to both the MS and BS. |
| 7.D | 788-798 | 758-768 | 2 × 10 | FDD |

Table C-2 specifies the channel raster corresponding to the Band Class groups of Table C-1. More specifically, Table C-2 provides the set of RF channel centre frequency numbers for the Band Class Groups. From Table C-2, the RF channel centre frequencies can be derived as a function of RF channel centre frequency numbers using the following equation.

  (1)

In equation (1) the RF channel centre frequency () is in MHz. The RF channel centre frequency number () is a number corresponding to the channel centre frequencies. In Table C-2, for each combination of band class group and channel bandwidth size, the RF channel centre frequency number sets are specified using the following triple:

 (,, )

where  is the starting RF channel centre frequency number assigned to the first RF channel centre frequency in the BCG,  is the ending RF channel centre frequency number assigned to the last RF channel centre frequency in the BCG and  is the RF channel centre frequency number step size between  and .

Table C-2

RF channel centre frequency numbers for the band class groups in Table C-1

|  |  |  |  |
| --- | --- | --- | --- |
| Band class group | Channel BW (MHz) | Frequency range (MHz) | RF channel centre frequency number set |
| Uplink  | Downlink | Uplink | Downlink |
| 7.C | 2 × 5 | 788-793, 793-798 | 758-763, 763-768 | (15 810, 15 910, 2)(15 910, 15 910, 2) | (15 210, 15 310, 2)(15 310, 15 310, 2) |
| 7.D | 2 × 10 | 788-798 | 758-768 | (15 910, 15 910, 2) | (15 310, 15 310, 2) |

**4 Technology “D”**

Technology “D” corresponds to TDMA-SC.

This broadband channelization scenario uses paired frequencies with base station transmitters in the frequency band 747-763 MHz and mobile station transmitters in the frequency band 777-793 MHz.

The carrier spacing is 200 kHz with a duplex distance of 30 MHz.

The carrier frequency is designated by the absolute radio frequency channel number (ARFCN). If we call Fl(n) the frequency value of the carrier ARFCN n in the lower band (base station transmit), and Fu(n) the corresponding frequency value in the upper band (mobile station transmit), we have for the dynamically mapped ARFCNs:

TABLE [D-1] Dynamically mapped ARFCN

|  |  |  |  |
| --- | --- | --- | --- |
| GSM 750 | Fl(n) = 747.2 + 0.2\*(n-x+y) | x ≤ n ≤ x+z  | Fu(n) = Fl(n) + 30 |

where the applicable band is indicated by the GSM\_Band parameter, x = ARFCN\_FIRST, y = BAND\_OFFSET and z = ARFCN\_RANGE (See 3GPP TS 44.018). Parameters defining carrier frequencies not belonging to the indicated band shall not be considered erroneous.

**5 Technology “E”**

Technology “E” corresponds to IMT-2000 CDMA TDD.

There are no TDD frequency arrangements defined in ITU-R Recommendation M.[LMS.PPDR.UHF], “Frequency arrangements for public protection and disaster relief

radiocommunication systems in UHF bands in accordance with Resolution 646 (WRC-03)”. Therefore there are no PPDR channelization scenarios defined for CDMA-TDD in this Report.

**6 Technology “F”**

Technology “F” corresponds to E-UTRA (LTE) technology.

**6.1 Example channelization scenario “F” for Technology F (FDD)**

This broadband channelization scenario uses paired frequencies with base station transmitters in the frequency band 758-768 MHz and mobile station transmitters in the frequency band 788-798 MHz[[4]](#footnote-4).

The channel raster is 100 kHz for all bands, which means that the carrier centre frequency must be an integer multiple of 100 kHz.

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 - 65535. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where FDL\_low and NOffs-DL are given in table 5.7.3-1 and NDL is the downlink EARFCN.

 FDL = FDL\_low + 0.1(NDL – NOffs-DL)

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where FUL\_low and NOffs-UL are given in table 5.7.3-1 and NUL is the uplink EARFCN.

 FUL = FUL\_low + 0.1(NUL – NOffs-UL)

TABLE [F-1] E-UTRA channel numbers

|  |  |  |
| --- | --- | --- |
| E-UTRA OperatingBand | Downlink | Uplink |
| FDL\_low (MHz) | NOffs-DL | Range of NDL | FUL\_low (MHz) | NOffs-UL | Range of NUL |
| - | - | - | - | - | - | - |
| 14 | 758 | 5 280 | 5 280-5 379 | 788 | 23 280 | 23 280-23 379 |
| - | - | - | - | - | - | - |
| NOTE - The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 5 and 10 MHz respectively. |

Annex 2

**Example channelization scenarios that could be used for narrow-band[[5]](#footnote-5)
public protection and disaster relief operations in the 746-806 MHz and 806-824/851-869 MHz bands**

**1 Technology “A”**

Technology “A” corresponds to Project 25.

Within the narrow-band frequency block in the frequency band 746-806 MHz, Project 25 is mandated for the narrow-band paired channels (shown in Table A-1) that have been identified as PPDR interoperability channels only, in support of the associated designation[[6]](#footnote-6).

TABLE A-1

| **Narrow-band interoperability channel pairing** |
| --- |
| **Base/mobile** | **to** | **Base/mobile** | **Designation** |  | **Base/mobile** | **to** | **Base/mobile** | **Designation** |
| 23/983 | to | 24/984 | Interoperability(I/O) |  | 641/1 601 | to | 642/1 602 | I/O |
| 39/999 | to | 40/1 000 | I/O Calling |  | 657/1 617 | to | 658/1 618 | I/O |
| 63/1 023 | to | 64/1 024 | I/O |  | 681/1 641 | to | 682/1 642 | I/O Calling |
| 79/1 039 | to | 80/1 040 | I/O |  | 697/1 657 | to | 698/1 658 | I/O |
| 103/1 063 | to | 104/1 064 | I/O |  | 721/1 681 | to | 722/1 682 | I/O |
| 119/1 079 | to | 120/1 080 | I/O |  | 737/1 697 | to | 738/1 698 | I/O |
| 143/1 103 | to | 144/1 104 | I/O |  | 761/1 721 | to | 762/1 722 | I/O |
| 159/1 119 | to | 160/1 120 | I/O |  | 777/1 737 | to | 778/1 738 | I/O |
| 183/1 143 | to | 184/1 144 | I/O |  | 801/1 761 | to | 802/1 762 | I/O |
| 199/1 159 | to | 200/1 160 | I/O |  | 817/1 777 | to | 818/1 778 | I/O |
| 223/1 183 | to | 224/1 184 | I/O |  | 841/1 801 | to | 842/1 802 | I/O |
| 239/1 199 | to | 240/1 200 | I/O |  | 857/1 817 | to | 858/1 818 | I/O |
| 263/1 223 | to | 264/1 224 | I/O |  | 881/1 841 | to | 882/1 842 | I/O |
| 279/1 239 | to | 280/1 240 | I/OLow-speed data |  | 897/1 857 | to | 898/1 858 | I/O |
| 303/1 263 | to | 304/1 264 | I/O |  | 921/1 881 | to | 922/1 882 | I/OLow-speed data |
| 319/1 279 | to | 320/1 280 | I/O |  | 937/1 897 | to | 938/1 898 | I/O |

These channel numbers correspond to the channelling arrangement of the narrow-band frequency block. Narrow-band channels are based on a 6.25 kHz grid for a total of 1 920 6.25 kHz channels[[7]](#footnote-7). The frequencies corresponding to the lower and upper band edge of the channel number are defined in Table A-2 by the following formulas, where *n* is the channel number:

TABLE A-2

|  |  |  |
| --- | --- | --- |
| Channel number | Lower channel edge (MHz) | Upper channel edge (MHz) |
| *n* = 1 to 960 | *fn* = 769.0 + (0.00625) × (*n* − 1) | *fn* = 769.0 + (0.00625) × (*n*) |
| *n* = 961 to 1 920 | *fn* = 799.0 + (0.00625) × (*n* − 961) | *fn* = 799.0 + (0.00625) × (*n* − 960) |

In the frequency band 806-824/851-869 Mhz, the narrow-band paired channels for P25 are as shown in Table A-3. The frequencies corresponding to the centre frequency of the channel number are defined by the following formulas, where *n* is the channel number:

Table A-3

|  |  |  |
| --- | --- | --- |
| Channel number | Mobile station transmitChannel centre frequency (MHz) | Base station transmitChannel centre frequency (MHz) |
| *n* = 1 to 600 | *fn* = 806.0125 + (0.025) × (*n* − 1) | *fn* = 851.0125 + (0.025) × (*n*) |
| *n* = 602 to 790 but not 601, 639, 677, 715, 753 | *fn* = 821.0125 + 0.125 × int(*n* − 602) + 0.025 × int[(*n* − 601) / 38] | *fn* = 866.0125 + 0.125 × int(*n* − 602) + 0.025 × int[(*n* − 601) / 38] |
| *n* = 794 to 830 | *fn* = 823.5375 + (0.0125) × (*n* − 794) | *fn* = 868.5375 + (0.0125) × (*n* − 794) |

Channels 601, 639, 677, 715 and 753 are to be 25 kHz wide and adjacent channels will not be assigned closer than 25 kHz.

**2 Technology “B”**

Technology “B” corresponds to the TErrestrial Trunked RAdio (TETRA) system.

*[Editor’s Note: To be completed based on input received from External Organizations or deleted if no input is received.]*

**3 Technology “C”**

Technology “C” corresponds to the Digital Mobile Radio (DMR) system.

*[Editor’s Note: To be completed based on input received from External Organizations or deleted if no input is received.]*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The use of the term “broadband” in this Annex means indicative data rates in the order of 1‑100 Mbit/s with channel bandwidths dependent on the use of spectrally efficient technologies (from Resolution 646 (WRC‑03) and Report ITU‑R M.2033). It is recognized that other definitions of this term exist in other ITU texts (such as Recommendation ITU‑R F.1399) or in the rules of various administrations. [↑](#footnote-ref-1)
2. Editorial note: This information for UTRA is taken from 3GPP TS 25.101 V10.2.0 (2011-06) (“3rd generation partnership project; technical specification group radio access network; evolved universal terrestrial radio access (E-UTRA); user equipment (UE) radio transmission and reception (Release 10)”). [↑](#footnote-ref-2)
3. Editorial note: This information is taken from WiMAX Forum mobile radio specification
(“WMF-T23-005-R015v04”). [↑](#footnote-ref-3)
4. Editorial note: This information for E-UTRA is taken from 3GPP TS 36.101 V10.3.0 (2011-06) (“3rd generation partnership project; technical specification group radio access network; evolved universal terrestrial radio access (E-UTRA); user equipment (UE) radio transmission and reception (Release 10)”). [↑](#footnote-ref-4)
5. In the context of PPDR, narrow-band is defined in Resolution 646 (WRC‑03) as “supporting voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less”. [↑](#footnote-ref-5)
6. Interoperability channels provide for coordination of tactical communications between different PPDR agencies or among the same PPDR agency, or for other similar emergency communications. [↑](#footnote-ref-6)
7. Channel aggregation of contiguous channels into 12.5 kHz or 25 kHz wide channels is allowed. Narrow-band channels may also be consolidated into wider channels of 50 to 150 kHz. The latter, however, requires a limited waiver process in some administrations. [↑](#footnote-ref-7)