International Telecommunication Union



Recommendation ITU-R F.2006 (03/2012)

Radio-frequency channel and block arrangements for fixed wireless systems operating in the 71-76 and 81-86 GHz bands

> F Series Fixed service



International Telecommunication Union

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <u>http://www.itu.int/ITU-R/go/patents/en</u> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

	Series of ITU-R Recommendations
	(Also available online at <u>http://www.itu.int/publ/R-REC/en</u>)
Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
Μ	Mobile, radiodetermination, amateur and related satellite services
Р	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

Electronic Publication Geneva, 2012

© ITU 2012

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

RECOMMENDATION ITU-R F.2006

Radio-frequency channel and block arrangements for fixed wireless systems operating in the 71-76 and 81-86 GHz bands

(2012)

Scope

This Recommendation provides radio-frequency channel and block arrangements for fixed wireless systems (FWS) operating in the 71-76/81-86 GHz range, which may be used for broadband applications and other high-speed networks. The preferred arrangements are based on common homogeneous pattern with elementary slots of 125 MHz. The preferred radio-frequency block arrangements are based on 5 GHz sub-band or block possibly subdivided to form smaller blocks. The preferred channel arrangement provides flexible identification of channel sizes from 250 MHz to 4 500 MHz and duplex frequency either of 2.5 GHz (single sub-band, 71-76 GHz or 81-86 GHz, arrangement) or 10 GHz (joint sub-bands, 71-76 GHz and 81-86 GHz together, arrangements).

The ITU Radiocommunication Assembly,

considering

a) that there is a particular need for fixed wireless systems (FWS) for large data capacity transport, e.g. for uncompressed high-definition television (HDTV) signal transmission or for mobile networks applications, the deployment of which is expected to rapidly grow;

b) that the frequency bands 71-76 GHz and 81-86 GHz are allocated to the fixed service;

c) that the propagation characteristics in these bands are ideally suited for use of short-range high capacity digital radio links in high-density networks;

d) that in these frequency bands high directivity antennas are achievable even with small size antennas, increasing the density of equipment and further reducing risk of interference with same and other services;

e) that several services with various transmission signal characteristics and capacities may be in simultaneous use in this frequency band;

f) that the applications in this frequency band may require different channel bandwidths;

g) that, in some cases, a flexible sub-band or block arrangement, can accommodate various FWS technologies, whilst remaining consistent with good spectrum management principles, including provision for inter-systems/services operation and overall spectrum efficiency;

h) that, when link-by-link frequency coordination is applied, the definition of radio-frequency channel arrangements is preferable;

j) that careful frequency planning permits accommodation of frequency division duplex (FDD) and time division duplex (TDD) applications;

k) that different applications licensed by various administrations may require different radiofrequency channel arrangements;

1) that, in some countries, only limited portions of the two bands may be available for civil applications;

m) that some countries may wish to or already have made these bands available through a flexible simplified approach without any specific channel plan,

noting

a) that Recommendation ITU-R F.1519 provides guidance on frequency arrangements based on frequency blocks for systems in the fixed service;

b) that Report ITU-R F.2107 provides characteristics and applications of fixed wireless systems operating in frequency ranges between 57 GHz and 134 GHz,

recommends

1 that administrations wishing to implement a radio-frequency channel or block arrangement for the 71-76 GHz and 81-86 GHz bands should consider the following homogeneous pattern of 125 MHz slots:

$$fn = 71.0625 + 0.125 (n - 1) \text{ GHz}$$

where:

fn:centre frequency of the *n*-th slotn =1 to 40 for the band 71-76 GHz

81 to 120 for the band 81-86 GHz;

2 that administrations wishing to use specific radio-frequency channels or blocks should have size multiple of 250 MHz and should be composed by aggregating 2 or a higher even number of frequency slots from the homogeneous pattern;

3 that administrations wishing to assign sub-bands or frequency blocks for FWS in the frequency bands 71-76/81-86 GHz, should consider the sub-bands or block arrangements presented in Annex 1;

4 that administrations should consider the adoption of carrier centre frequencies, within the preferred frequency blocks, from the channel slots of 250 MHz, as derived in *recommends* 2;

5 that administrations wishing to assign pre-defined channels of 250 MHz, or multiples thereof, either paired or unpaired, should consider the flexible channel arrangements illustrated in Annex 2.

Annex 1

Radio-frequency sub-band or block arrangements in the band 71-76/81-86 GHz

This arrangement is based on the use of the basic 5 GHz sub-bands, which can be subdivided to form smaller paired blocks, as shown in the examples of Fig. 1. According to the needs, other block subdivisions are possible, including blocks of different size.

FIGURE 1

		Exa	amples	s of frequ	ency block	arranger	nent f	or the ra	nges 71-7	6/81-8	86 GHz		
71 G	Hz				76 (GHz	81 0	GHz				86	6 GHz
			5.0 GH	łz						5.0 GH	Iz		
	2.5	5 GHz		2.5 0	Hz			2.5	5 GHz		2.5 0	GHz	
	1.25 GHz			1.25 GHz	1.25 GHz			1.25 GHz	1.2 GH	-	1.25 GHz	1.25 GHz	
	1 GHz	1 GHz	1 GHz	z 1 GHz	1 GHz			1 GHz	1 GHz	1 GHz	z 1 GHz	z 1 GHz	

F 2006-01

Annex 2

Radio-frequency channel arrangements in the band 71-76/81-86 GHz

1 Basic 250 MHz channels in the 71-76 GHz and 81-86 GHz bands

Let

fr

- be the reference frequency of: 71 000 MHz for the band 71-76 GHz, 81 000 MHz for the band 81-86 GHz
- *fn* be the centre frequency of a radio-frequency channel in the band 71-76 GHz or 81-86 GHz band,
- *n* be the channel number in each band,

then the centre frequencies of individual channels with 250 MHz separation, are expressed by the following relationship:

$$fn = fr + 250 \cdot n$$
 MHz

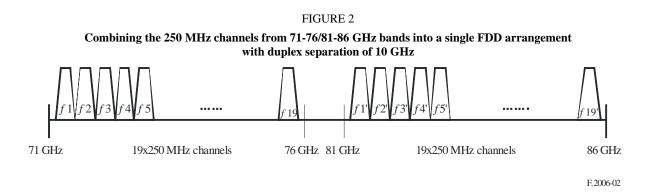
where:

n = 1, 2, 3, ..., 19 for each band

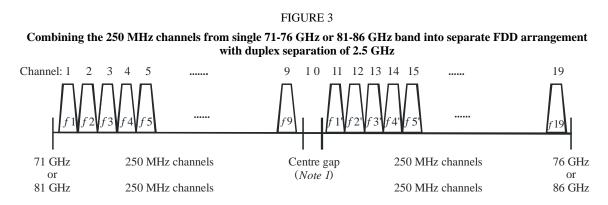
The 19 basic 250 MHz channels derived as above maintain 125 MHz guardband (i.e. ZS = 250 MHz as defined in recommendation ITU-R F.746) at each four band edges.

2 Pairing and aggregating basic channels in frequency bands 71-76/81-86 GHz

The principle of using the 2×19 basic channels from within the bands 71-76 GHz and 81-86 GHz jointly in a single duplex FDD arrangement with 10 GHz duplex separation is described in the Fig. 2.



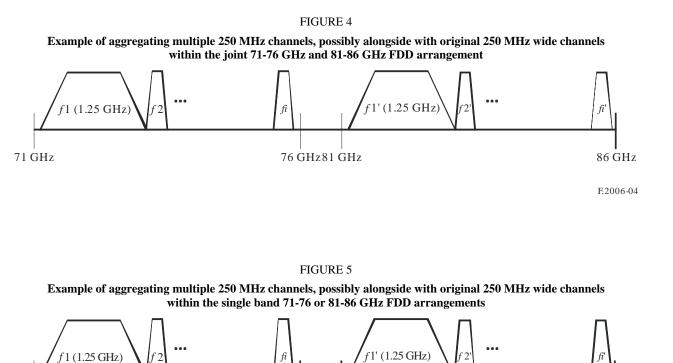
The principle of using the 2×19 basic channels within a single band 71-76 GHz or 81-86 GHz with two separate FDD arrangement with duplex separation of 2.5 GHz is shown in Fig. 3.



Note 1 – Wider centre gap may be obtained with wider duplex separation (e.g. centre gap made by basic channels 9, 10 and 11 resulting in 2.75 GHz duplex separation).

F.2006-03

When wider channels are needed, e.g. for very high bitrate and high system gain applications (e.g. employing frequency shift keying modulation and/or gigabit/s or higher capacity), then a flexible number of consecutive 250 MHz channels may be aggregated into FDD channels, as illustrated in Fig. 4, for duplex separation equal or more than 10 GHz, or in Fig. 5, for duplex separation of 2.5 GHz. Administrations that prefer to use of multiple sizes channels in predefined positions may refer to the arrangements in section 4 of this Annex.



3 Specific channel arrangements for multiple size FDD/TDD aggregated channels in frequency bands 71-76/81-86 GHz

Centre gap

Centre gap

A multiple sizes channel arrangement for these bands depends on the basic assumptions that an administration makes for the deployment, e.g.:

– TDD, FDD or their mixed use of the band;

71 GHz

81 GHz

- Paired FDD assignments with fixed duplex;
- FDD channels paired either in each single band or in cross-band pairing, or both contemporarily;

For maximum flexibility all possible channel size of N \times 250 MHz are described in the arrangements.

 $N = 1, 2, \dots$ 9 resulting in channel size from 250 MHz to 2 250 MHz as described in Fig. 6 for the separate arrangements in 71-76 GHz or 81-86 GHz sub-bands with duplex separation 2.5 GHz.

 $N = 1, 2, \dots 18$ resulting in channel size from 250 MHz to 4 500 MHz as described in Fig. 7 for the joint arrangement in both 71-76 GHz and 81-86 GHz sub-bands with 10 GHz duplex separation. In this case channels from 250 MHz to 2 250 MHz maintain the same centre frequency of the corresponding channels in previous separate arrangements; this makes easier, when necessary, the contemporary coordination of systems with 2.5 GHz and 10 GHz duplex separation.

76 GHz

86 GHz

F.2006-05

		(Thannel r	umberin	ig scheme	(TDD ar	nd single-	band FD	D)		
Ch. size (I	MHz)		250	500	750	1 000	1 250	1 500	1 750	2 000	2 250
Channel boundary (MHz)↓											
Lower		Upper		Sin	gle-band	FDD: du	plex spac	sing = 2.5	00 MHz		
71 125		81 125			1						
71 375	1	81 375	1	1							
71 625		81 625	2		1	1					
71 875		81 875	3	2			1	1			
72 125		82 125	4						1	1	
72 375	500 MHz	82 375	5	3	2						1
72 625	= 2 50	82 625	6			2					
72 875	DS = 2	82 875	7	4	3		2 (unpaired) or paired/unpaired channels of lower size	mels			
73 125		83 125	8				unpaired inpaired f lower s	l/unpaired char of lower size	ired ze		
			9	aired) er size npair		aired/unpaired channels of lower size	2 (paired/u	Paired/unpaired channels of lower size	Paired/unpaired channels of lower size	Paired/unpaired channels of lower size	
73 375		83 375	10 (unpaired)	5 (unpaired) or lower size pair/unpair	Unpaired (channel 10/250 MHz)	Paired/unpaired channels of lower size		Pair	Pair	Paired/unpaire channels of lower size	Unpaired (channel 10/250 MHz
73 625		83 625	11(1')								
73 825		83 875	12(2')	6(1')	4(1')						
74 125		84 125	13(3')			3(1')	3(1')				
74 375		84 375	14(4')	7(2')				2(1')	2(1')		
74 625		84 625	15(5')		5(2')					2(1')	2(1')
74 875		84 875	16(6')	8(3)							_(_)
75 125		85 125				4(2')	thannels				
75 375		85 375	17(7')	9(4')			Paired/unpaired channels of lower size	npaired nels rr size	e ed		
75 625		85 625	18(8')	Pair/unp.	6(3')	Pair/unp.	Paired/ur of 1	Paired/unpaired channels of lower size	Paired/unp aired channels of lower size	Pair/unp.	
75 875		85 875	19(9')	(ch.19(9')/ 250 MHz)		(ch.19(9')/ 250 MHz)	H		Paire cf of 1	(ch.19(9')/ 250 MHz)	

FIGURE 6
Channel positions for TDD and single-band FDD applications (2.5 GHz fixed duplex for all channels)

Legend:	
n	Paired (go) or unpaired "n" channel in each band
m (n')	Paired "n" or unpaired "m" channel in each band
	Unpaired channel of same size or paire/unpaired channel(s) of lower size(s) in each band
	Unpaired channel 10 of basic 250 MHz pattern in each band
	Paired or unpaired channel 19(9') of basic 250 MHz pattern in each band
	Paired or unpaired channel(s) of lower size(s) in each band

F.2006-06

FIGURE 7

Channel positions for TDD and joint cross-bands FDD applications (10 GHz fixed duplex for all channels)

					Char	nnel nu	mberir	ng sche	me (Tl	DD and	l cross-	-bands	s FDD)						
	$(MHz) \Rightarrow$	250	500	750	1 000	1 250	1 500	1 750	2 000	2 250	2 500	2 750	3 000	3 250	3 500	3 750	4 000	4 250	4 500
	boundary z)↓																		
Lower	Upper							Cro	ss-hand	· dunle	x spacin	σ – 10 C	Hz						
71 125	81 125			_				010	55 build	n uupic	x spacin	<u>g = 10 (</u>							
		1(1')																	
71 375	81 375	2(2')	1(1')	1(1')															
71 625	81 625			1(1)	1(1')														
71 875	81 875	3(3')	2(2')			1(1')	1(1')												
		4(4')	2(2)				1(1)	1(1')											
72 125	82 125	5(5')		2(2')					1(1')	1(1')									
72 375	82 375		3(3')	-(-)						-(-)	1(1')	1/10							
72 375 HD 01 =	82 625	6(6')			2(2')							1(1')	1(1')						
0	8	7(7')	4740		-(-)		Paired/unpaired channels of lower size						-(-)	1(1')	1/10				
72 875 🏛	82 875	8(8')	4(4')	3(3')		2(2')	l cha size	R							1(1')	1(1')			
73 125	83 125	. ,		-(-)	e gq	-(-)	o ai rec ow er	npaire nels r size	e red							-(-)	1(1')	1/10	
73 375	83 375	9(9')	5(5')	Dain (una	Paired/unpaired channels of lower size		d/unj of lo	Paired/unpaired channels of lower size	Paired/unpairex channels of lower size	Dain (una								1(1')	1(1')
		10(10')		Pair./unp. (ch. 10(10')/ 250 MHz)	Paired/unpaire channels of lower size		Paire	Pai of	Paired. ch: of low	Pair./unp. (ch. 10(10')/ 250 MHz)									, í
73 625	83 625	11(11')		200 1111)						250 1111.)									
73 875	83 875	10(10)	6(6')	4(4')															
74 125	84 125	12(12')		4(4')	3(3')														
74 375		13(13')	7(7')			3(3')	2(2')				sla								
14 315	84 375	14(14')	(/)		1		2(2)	2(2')			anne	nels			1				
74 625	84 625	15(15')		5(5')	<u> </u>				2(2')	2(2')	ed cl er siz	dh an ize	nnel	se		1			
74 875	84 875		8(8')	5(5)		s				2(2)	inp air lo we	aired wer s	d cha size	hanne	nds	~			
75 125	85 125	16(16')			4(4')	Paired/unpaired channels of lower size					Paired/unp aired channels of lower size	Paired/unpaired channels of lower size	Paired/unpaired chan nels of lower size	Paired/unpaired channels of lower size	Pai red/u npaired channels of lower size	Paired/unpaired channels of lower size			
		17(17')			4(4)	od cha size	ed a				Pai	aired	of 1	inp ai f lo w	aired wer s	od cha size	e eq		
75 375	85 375	18(18')	9(9)	6(6')		ipaire	mpair nels er s iz	ired s ize				-	Paire	ired/t	funp of lo	ipaire	mpair nels er s iz	paul az	
75 625	85 625		Pair./unp.	0(0)	Pair./unp.	of of	Paired/unpaired channels of I ower size	Paired/unpaired channels of lower size	Pair./unp.					Pa	Aireo	of u	Paired/unpaired channels of I ower s ize	ired'unpairec channels of lower size	Pair./unp.
75 875	85 875	19(19')	Pair./unp. (ch. 19(19')/ 250 MHz)		(ch. 19(19)/ 250 MHz)	Pain	Pa	Paire cl of le	(ch. 19(19')/ 250 MHz)							Pain	Pa	Paired'u chan of lowe	(ch. 19(19')/ 250 MHz)
15 075	05 075																		
Legend:																			
n (n')	Paired chann																		
	Channels 10(Lower size(s)												return/up	per band)	or unpair	ed (i.e. "1	0" and/or	"19" in e	ach band)
								11. 00	, .										

F.2006-07

4 Specific channel arrangements for multiple size FDD/TDD aggregated channels in the reduced frequency bands 74-76/84-86 GHz

In case only these reduced portions of the whole bands are available, only the joint arrangement with 10 GHz duplex separation is retained appropriate. It is shown in Fig. 8.

FIGURE 8

Channel positions for TDD and cross-bands FDD applications (Limited to 74-76 GHz and 84-86 GHz bands with 10 GHz duplex separation)

Chan	Channel numbering scheme (TDD and cross-bands FDD)								
Ch. size ($MHz) \Rightarrow$	250	500	750	1 000	1 250	1 500	1 750	
Channel l									
(MHz	z) ↓								
Lower	Upper	Cr	oss-ban	d FDD:	duplex	spacing	= 10 G	Hz	
74 125	84 125			-					
		1(1')							
74 375	84 375		1(1')						
臣		2(2')		1(1')					
74 625 ² H9 01	84 625				1(1')				
<u> </u>		3(3')				1(1')			
74 875	84 875		2(2')				1(1')		
1 17		4(4')					1(1)	1(1')	
75 125	85 125				<u>s</u>				
		5(5')		2(2')	unnel				
75 375	85 375		3(3')		l cha	p			
		6(6')			/unpaired cha of lower size	Pai red/unpaired channels of lower size			
75 625	85 625				unp f lo	ed/unpai hannels lower si			
		7(7')	Pair./unp. (ch. 7(7')/	Pair./unp. (ch. 7(7')/	Paired/unpaired channels of lower size	Paire d of J	Pair./unp. (ch. 7(7')/		
75 875	85 875	Ĺ	250 MHz)	250 MHz)	Pai		250 MHz)		
	00 010								

	Legend:	
[n (n')	Paired (i.e. "n" go/lower band and "n' " return/upper band) or unpaired channel (i.e. "n" in each ba nd)
[Channels 7(7') of basic 250 MHz pattern: paired ("7" go/lower band and "7" return/upper band) or u npaired "7" channel in each band)
I		Lower size(s), paired ("n" go/lower band and "n'" return/upper band) or unpaired "n" channel(s) in each band)

F.2006-08