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Recommendation ITU-R F.1497-2
(02/2014)

Radio-frequency channel arrangements for fixed wireless systems operating in the band 55.78-66 GHz

F Series

Fixed service

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

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RECOMMENDATION ITU-R F.1497-2

Radio-frequency channel arrangements for fixed wireless systems operating in the band 55.78-66 GHz

(Question ITU-R 247/5)

(2000-2002-2014)

Scope

This Recommendation specifies radio-frequency channel arrangements for fixed wireless systems (FWS) using TDD (time division duplex) or FDD (frequency division duplex) with channel separations of 3.5, 7, 14, 28, 30, 50 and 56 MHz in the range 55.78-66 GHz, the portions of which have been identified for use for high-density applications in the fixed service (HDFS).

Keywords

Fixed service, radio-frequency channel arrangement, oxygen absorption, frequency division duplex (FDD), time division duplex (TDD), guard band.

The ITU Radiocommunication Assembly,

considering

a) that the frequency range 55.78-66 GHz is allocated worldwide to the fixed service and to a number of other services sharing different portions of that band on a co-primary basis;

b) that the bands 55.78-59 GHz and 64-66 GHz are as being available for high-density applications in the fixed service (FS);

c) that in the frequency range 55.78-66 GHz high antenna directivity is achievable even with small size antenna, increasing the density of equipment and further reducing the risk of interference with the same and other radio services;

d) that the propagation characteristics in this frequency range are significantly affected by additional attenuation due to oxygen absorption and, in particular, the central 57-64 GHz portion of the band exhibits the higher attenuation, which facilitate the deployment of a large number of short-range digital fixed links also in an uncoordinated manner;

e) that ITU-R should develop radio-frequency channel arrangements in order to make the most effective use of the spectrum available;

f) that differing applications licensed by various administrations may require different radio-frequency channel arrangements;

g) that the applications in this frequency range may require differing channel bandwidths;

h) that several radio services with various transmission signal characteristics and capacities may be in simultaneous use in this frequency range;

j) that, due to different propagation behaviour and different sharing conditions, different portions of the whole 55.78-66 GHz may require different regulatory considerations for their use;

k) that a high degree of compatibility between radio-frequency channels of different arrangements can be achieved by selecting channel centre frequencies within a homogeneous basic pattern,

recognizing

that, in the band 55.78-56.26 GHz, in order to protect stations in the Earth exploration-satellite service (passive), the maximum power density delivered by the transmitter to the antenna of a fixed service station is limited to –26 dB(W/MHz) in the Radio Regulations,

noting

a)   that frequency division duplex (FDD) and time division duplex (TDD) systems may be used simultaneously in the same geographical area providing sufficient measures are put in place to allow successful coordination;

b)   that the high additional attenuation due to oxygen absorption, effectively limits the achievable path length and interference level;

c)   that, also in absence of coordination, equipment may listen for a free channel before transmission to recognize existing transmissions in order to minimize interference problems and to ensure continued operation of existing transmissions,

recommends

1   that administrations should consider the channel arrangement given in Annex 1, § 1 for TDD FS system deployment in the frequency range 55.78-57 GHz (see Note 1);

2   that administrations should consider the channel arrangement given in Annex 1, § 2 for FDD FS system deployment in the frequency range 55.78-57 GHz (see Note 1);

3   that administrations wishing to implement a specific radio-frequency plan should consider the channel arrangement given in Annex 2 for FS systems deployment, either FDD or TDD, in the frequency range 57-64 GHz (see Note 2);

4   that administrations wishing to implement a specific radio-frequency plan should consider the channel arrangements given in Annex 3 for FS systems deployment, either FDD or TDD, in the frequency range 64-66 GHz;

5   that administrations may consider the channel arrangements in Annexes 2 and 3 for a combined use of the bands 57-64 GHz and 64-66 GHz utilizing a 50-MHz channel separation;

6   that the following Notes are considered as part of this Recommendation.

NOTE 1 – The channel arrangements in Annex 1 provide the same centre frequencies for both TDD and FDD operation.

NOTE 2 – The channel arrangement in Annex 2 can also be used in any portion of the 57-64 GHz range, due to different national needs.

Annex 1

Radio-frequency channel arrangement in the band 55.78-57 GHz

1 For FS systems using TDD

Let:

f_r be the reference frequency of 55 786 MHz

f_n be the centre frequency of a radio-frequency channel in the band 55.78-57 GHz,

then the centre frequencies of individual channels are expressed by the following relationships:

a) for systems with a channel separation of 56 MHz:

$$f_n = f_r + 28 + 56\,n \qquad \text{MHz}$$

where:

$$n = 1, 2, 3, \dots 20$$

b) for systems with a channel separation of 28 MHz:

$$f_n = f_r + 42 + 28\,n \qquad \text{MHz}$$

where:

$$n = 1, 2, 3, \dots 40$$

c) for systems with a channel separation of 14 MHz:

$$f_n = f_r + 49 + 14\,n \qquad \text{MHz}$$

where:

$$n = 1, 2, 3, \dots 80$$

d) for systems with a channel separation of 7 MHz:

$$f_n = f_r + 52.5 + 7\,n \qquad \text{MHz}$$

where:

$$n = 1, 2, 3, \dots 160$$

e) for systems with a channel separation of 3.5 MHz:

$$f_n = f_r + 54.25 + 3.5\,n \qquad \text{MHz}$$

where:

$$n = 1, 2, 3, \dots 320.$$

TABLE 1

Calculated parameters according to Recommendation ITU-R F.746

XS (MHz)	*n*	f_1 (MHz)	f_{nmax} (MHz)	Z_1S (MHz)	Z_2S (MHz)
56	1, ... 20	55 870	56 934	90	66
28	1, ... 40	55 856	56 948	76	52
14	1, ... 80	55 849	56 955	69	45
7	1, … 160	55 845.5	56 958.5	65.5	41.5
3.5	1, … 320	55 843.75	56 960.25	63.75	39.75

XS: separation between centre frequencies of adjacent channels

Z_1S: separation between the lower band edge and the centre frequency of the first channel

Z_2S: separation between centre frequencies of the final channel and the upper band edge.

2 For FS systems using FDD

The radio-frequency channel arrangement for channel separations of 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz shall be derived as follows:

Let:

f_r be the reference frequency of 55 814 MHz

f_n be the centre frequency (MHz) of the radio-frequency channel in the lower half of the band

f_n' be the centre frequency (MHz) of the radio-frequency channel in the upper half of the band

Tx/Rx separation = 616 MHz

band separation = 112 MHz

then the frequencies (MHz) of individual channels are expressed by the following relationships:

a) for systems with a channel separation of 56 MHz:

lower half of the band: $f_n = f_r + 56\,n$

upper half of the band: $f_n' = f_r + 616 + 56\,n$

where:

$n = 1, 2, … 9$

b) for systems with a channel separation of 28 MHz:

lower half of the band: $f_n = f_r + 14 + 28\,n$

upper half of the band: $f_n' = f_r + 630 + 28\,n$

where:

$n = 1, 2, 3, … 18$

c) for systems with a channel separation of 14 MHz:

lower half of the band: $f_n = f_r + 21 + 14\,n$

upper half of the band: $\qquad f'_n = f_r + 637 + 14\,n$

where:

$$n \;=\; 1, 2, 3, \dots 36$$

d)   for systems with a channel separation of 7 MHz:

lower half of the band: $\qquad f_n = f_r + 24.5 + 7\,n$

upper half of the band: $\qquad f'_n = f_r + 640.5 + 7\,n$

where:

$$n \;=\; 1, 2, 3, \dots 72$$

e)   for systems with a channel separation of 3.5 MHz:

lower half of the band: $\qquad f_n = f_r + 26.25 + 3.5\,n$

upper half of the band: $\qquad f'_n = f_r + 642.25 + 3.5\,n$

where:

$$n \;=\; 1, 2, 3, \dots 144.$$

TABLE 2

Calculated parameters according to Recommendation ITU-R F.746

XS (MHz)	n	f_1 (MHz)	f_{nmax} (MHz)	f'_1 (MHz)	f'_{nmax} (MHz)	$Z_1 S$ (MHz)	$Z_2 S$ (MHz)	YS (MHz)	DS (MHz)
56	1, ... 9	55 870	56 318	56 486	56 934	90	66	168	616
28	1, ... 18	55 856	56 332	56 472	56 948	76	52	140	616
14	1, ... 36	55 849	56 339	56 465	56 955	69	45	126	616
7	1, …72	55 845.5	56 342.5	56 461.5	56 958.5	65.5	41.5	119	616
3.5	1, …144	55 843.75	56 344.25	56 459.75	56 960.25	63.75	39.5	115.5	616

XS: separation between centre frequencies of adjacent channels

YS: separation between centre frequencies of the closest go and return channels

$Z_1 S$:   separation between the lower band edge and the centre frequency of the first channel

$Z_2 S$:   separation between centre frequencies of the final channel and the upper band edge

DS: duplex spacing $(f'_n - f_n)$.

Annex 2

Radio-frequency channel arrangement in the band 57-64 GHz

This Annex gives basic frequency channel arrangements for both FDD and TDD applications.

Let:

f_r be the reference frequency of 56 950 MHz

f_n be the centre frequency of a radio-frequency channel in the band 57-59 GHz,

then the centre frequencies of individual basic 50 MHz channel are expressed by the following relationship:

$$f_n = f_r + 25 + 50\,n \qquad \text{MHz}$$

where:

n = 1, 2, 3, ... 140.

Figure 1 shows the basic channel arrangement.

Wider channel operation, up to 2 500 MHz, either TDD or FDD, may be derived by basic channels aggregation. FDD duplex separation is not specifically identified; it may be either left free or defined at national level according to the needs.

Channels n = 1, 2 may be considered as guard-band (GB) towards lower band 55.78-57 GHz (see Annex 1), possibly subject to different coordination conditions; in this case they should only be used for e.g. temporary purposes or equipment alignment and propagation tests.

In the upper band edge, there is no need for guard band because the same system might appropriately operate also in the adjacent 64-66 GHz band.

FIGURE 1

Basic channel arrangement 57-64 GHz

Bands limits (GHz) → (see Note 1)	57-59							59-63						63-64			
50 MHz channel number	1	2	3	4	→→→	39	40	41	42	→→→	119	120	121	→→→	140		
	G	B			→→→					→→→				→→→			

NOTE 1 – The separation into three major frequency ranges is indicative only. Regulatory considerations at national level may differ. Based on these national considerations, the administrations may choose to deploy radio systems within channels overlapping these boundaries as well as be paired within these bands.

NOTE 2 – Administrations may wish to combine the use of PP radio systems in the 57-64 GHz band with the 64-66 GHz band according to Annex 3 of this Recommendation. If circumstances allow, these radio systems may also be deployed within a channel overlapping the boundary with the 57-64 GHz band as well as being paired within these bands. Different regulatory provisions between these bands are to be taken into account at national level.

TABLE 3

Calculated parameters according to Recommendation ITU-R F.746

XS (MHz)	n	f_1 (MHz)	f_{140} (MHz)	$Z_1 S$ (MHz)	$Z_2 S$ (MHz)
50	1, ... 140	57 025	63 975	25	25

XS: separation between centre frequencies of adjacent channels

$Z_1 S$: separation between the lower band edge and the centre frequency of the first channel

$Z_2 S$: separation between centre frequencies of the final channel and the upper band edge.

Annex 3

Radio-frequency channel arrangements in the band 64-66 GHz

This Annex gives examples of frequency channel arrangements for both FDD and TDD applications. The 30 MHz or 50 MHz basic channels for both types of applications can be aggregated to form larger blocks/channels as required by the national administration.

Administrations may also wish to combine the use of point-to-point radio systems in the 64-66 GHz band with the contiguous 57-64 GHz band according to Annex 2 of this Recommendation. These radio systems may also be deployed within a channel overlapping the boundary with the 64-66 GHz band as well as being paired within this band, using either:

a) a number of 30 MHz basic channels and the lower 10 MHz guard band from the arrangement of Fig. 3 or;

b) a number of 50 MHz basic channels according to the arrangement of Fig. 6.

It should be noted that the different amount of oxygen absorption in the 57-64 GHz band and in the 64-66 GHz band may suggest, at a national level, different regulatory provisions between these bands.

1 FDD and TDD arrangements with 30 MHz basic channels

Let:

f_r be the reference frequency of 56 950 MHz;

f_n be the centre frequency of a radio-frequency channel in the band 64-66 GHz,

then the centre frequencies of individual channels are expressed by the following relationships:

a) for FDD arrangements:

$$f_n = f_r + 7\,045 + 30\,n \qquad \text{MHz}$$

$$f'_n = f_r + 8\,035 + 30\,n \qquad \text{MHz}$$

where:

$n = 1, 2, 3, ... 33$

b)   for TDD arrangements:

$$f_n = f_r + 7\,045 + 30\,n \qquad \text{MHz}$$

where:

$$n \quad = \ 1, 2, 3, \dots 66$$

Figure 2 shows the basic FDD arrangement consisting of 33 paired 30 MHz basic channels, which can be aggregated to form paired FDD channels/blocks consisting of several contiguous 30 MHz basic channels.

FIGURE 2

Basic 30 MHz channels FDD arrangement 64-66 GHz
(duplex separation: 990 MHz)

Figure 3 shows the basic TDD arrangement consisting of 66 basic channels of 30 MHz, which can be aggregated to form TDD channels/blocks consisting of several 30 MHz basic channels.

FIGURE 3

Basic 30 MHz channel TDD arrangement 64-66 GHz

NOTE – When used in conjunction with a contiguous lower band (from 57-64 GHz range in Annex 2 of this Recommendation), this guard band may also be used.

2   Arrangement with 50 MHz basic channels (64-66 GHz only)

Let:

f_r be the reference frequency of 56 950 MHz

f_n be the centre frequency of a radio-frequency channel in the frequency band 64-66 GHz,

then the centre frequencies of individual channels are expressed by the following relationships:

a)   for FDD arrangements:

$$f_n = f_r + 7\,075 + 50\,n \qquad \text{MHz}$$

$$f'_n = f_r + 8\,025 + 50\,n \qquad \text{MHz}$$

where:

$$n \quad = \ 1, 2, 3, \dots 19$$

b)   for TDD arrangements:

$$f_n = f_r + 7\,075 + 50\,n \qquad \text{MHz}$$

where:

$$n \quad = 1, 2, 3, \dots 38$$

Figure 4 shows the basic FDD channel arrangement consisting of 19 paired basic channels of 50 MHz and Fig. 5 shows the basic TDD channel arrangement consisting of 38 unpaired basic channels of 50 MHz, which can be aggregated to form paired FDD or TDD channels/blocks consisting of several contiguous 50 MHz basic channels. These arrangements are valid when not used in conjunction with the arrangement in lower 57-64 GHz band (Annex 2 of this Recommendation).

FIGURE 4

Basic 50 MHz channels FDD arrangement 64-66 GHz
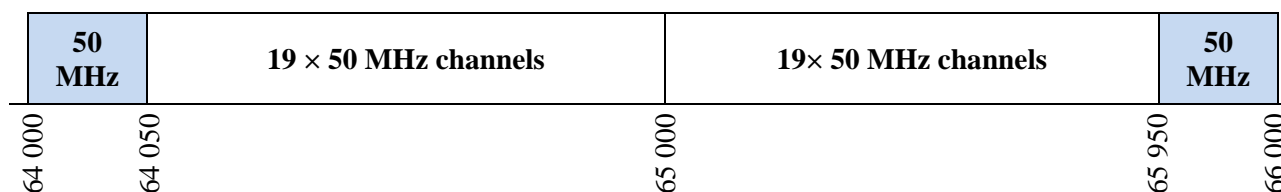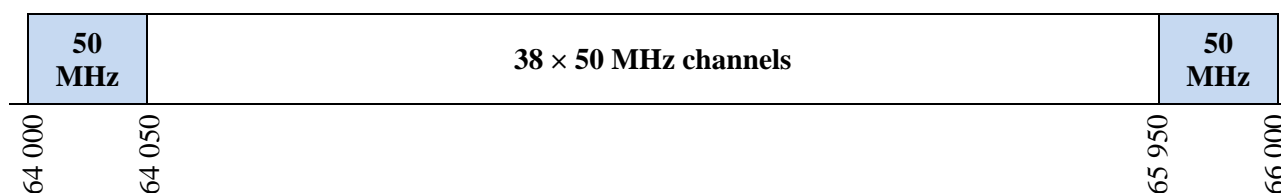**(duplex separation: 950 MHz)**

FIGURE 5

Basic 50 MHz channels TDD arrangement 64-66 GHz

3   Arrangement with 50 MHz basic channels (64-66 GHz in conjunction with lower band)

Centre frequency of the basic 50 MHz channels is considered as extension, with higher n, of that in Annex 2 of this Recommendation.

Let:

f_r be the reference frequency of 56 950 MHz

f_n be the centre frequency of a radio-frequency channel in the frequency band 64-66 GHz,

then the centre frequencies of individual channels are expressed by the following relationships:

$$f_n = f_r + 25 + 50\,n \qquad \text{MHz}$$

where:

$$n \quad = 141, 142, 143, \dots 179.$$

Figure 6 shows the channel arrangement consisting of 39 basic channels of 50 MHz when used in conjunction with the arrangement and 50 MHz basic channel aggregation method in lower

57-64 GHz band described in Annex 2 of this Recommendation; there is no need for a lower guard band of 50 MHz. The arrangement is valid for both TDD and FDD deployment, as appropriate.

FIGURE 6

Basic 50 MHz channel arrangement 64-66 GHz
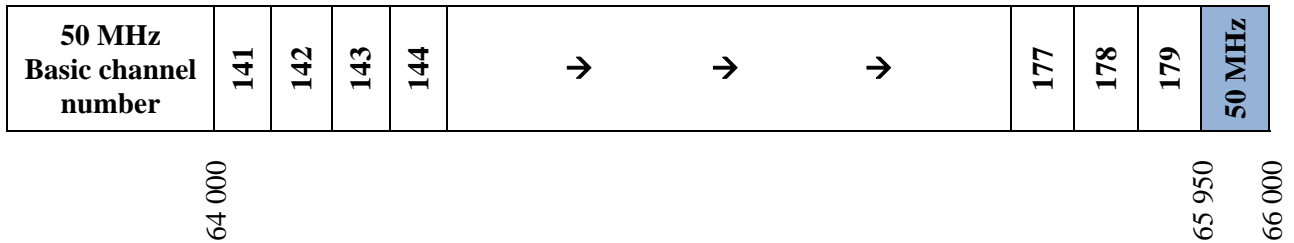**(used in conjunction with arrangement in lower band)**

50 MHz Basic channel number	141	142	143	144	→	→	→	177	178	179	50 MHz

64 000   65 950   66 000

TABLE 4

Calculated parameters according to Recommendation ITU-R F.746

XS (MHz)	n	f_1 (MHz)	f_{nmax} (MHz)	f'_1 (MHz)	f'_{nmax} (MHz)	Z_1S (MHz)	Z_2S (MHz)	YS (MHz)	DS (MHz)
30	1, ... 33 (FDD)	64 025	64 985	65 015	65 975	25	25	30	990
30	1, ... 66 (TDD)	64 025	65 975	–	–	25	25	–	–
50	1, ... 19 (FDD)	64 075	64 975	65 025	65 925	75	75	50	950
50	1, …38 (TDD)	64 075	65 925	–	–	75	75	–	–
50 (Note)	141, …179	64 025	65 925	–	–	25	75	–	–

XS: separation between centre frequencies of adjacent channels

YS: separation between centre frequencies of the closest go and return channels

Z_1S: separation between the lower band edge and the centre frequency of the first channel

Z_2S: separation between centre frequencies of the final channel and the upper band edge

DS: duplex spacing $(f'_n - f_n)$.

NOTE – Extension of the channel arrangement in Annex 2.