RECOMMENDATION ITU-R F.386-8

Radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band

(Question ITU-R 136/9)

(1963-1966-1982-1986-1992-1997-1999-2007)

Scope

This Recommendation provides radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band, which may be used for high, medium and low capacity systems. The preferred radio-frequency channel arrangements are based on multiples of basic slots either of 3.5 MHz or 2.5 MHz width. Examples in various segments of the 8 GHz band are presented in Annexes 1 to 5. Annex 6 presents an arrangement for high capacity digital systems used in some countries. For migration opportunity, Annex 7 presents a channel arrangement which was considered preferred for the deployment of analogue systems and that may still be used for digital systems.

The ITU Radiocommunication Assembly,

considering

a) that it may be desirable to be able to interconnect fixed wireless systems (FWSs) on international links at radio frequencies in the 8 GHz band;

b) that the availability of frequency bands in the range from 7 725 MHz to 8 500 MHz differs in various countries;

c) that, for some administrations, a frequency band, only 300 MHz wide or less, may be available in the 8 GHz range for such systems;

d) that some channel arrangements have been developed in the past based on analogue system requirements only;

e) that it is desirable to deploy in such a band digital systems of low, medium and/or high capacity. In some countries, analogue systems are still being used;

f) that digital systems are mostly designed to accommodate radio-frequency (RF) channel arrangements based on multiples of 2.5 MHz or 3.5 MHz patterns;

g) that, digital techniques such as cross-polar interference cancellers (XPIC) may significantly contribute to the cross-polar discrimination improvement factor (XIF, defined in Recommendation ITU-R F.746), thus counteracting multipath or rain propagation-induced depolarization;

h) that, when very high capacity links (e.g. twice Synchronous Transfer Mode-1 (STM-1)) are required, further economy may be achieved using system bandwidths wider than the recommended channel separation, associated to high-efficient modulation formats,

recommends

1 that the preferred RF channel arrangements be based on multiples of basic bandwidths of either 3.5 MHz or 2.5 MHz; examples in various segments of the 8 GHz band are shown in Annexes 1 to 5;

2 that, in a section over which the international connection is arranged, all the go channels should be in one half of the band, and all the return channels should be in the other half of the band;

3 that, for adjacent RF channels in the same half of the band, horizontal and vertical polarization may be used alternately, as well as co-channel arrangements, provided that sufficient adjacent channel rejection is provided;

4 that when very high capacity links are required and network coordination permits, with the agreement of the administrations concerned, the use of any two adjacent 28 or 29.65 MHz channels specified in *recommends* 1 is possible, for wider bandwidth system, with centre frequency lying in the central point of the distance between the two 28 or 29.65 MHz adjacent channels;

5 that due regard be taken of the fact that, in some countries, another RF channel arrangement for high capacity digital systems up to 140 Mbit/s or synchronous digital hierarchy bit rates is used. A description of this RF channel arrangement is given in Annex 6.

NOTE 1 – Due regard should be taken that another RF channel arrangement in the 8 GHz band was considered preferred in previous versions of this Recommendation for the deployment of analogue systems with a capacity up to 960 telephone channels; it is no longer recommended for the transmission of traditional analogue systems. However, for migration opportunity, it may still be in use for some digital systems; a description of this RF channel arrangement is given in Annex 7.

Annex 1

RF channel arrangements for the transmission of various digital signals operating in the 7 725-8 275 MHz band, with 300 MHz duplex spacing, based on a 2.5 MHz bandwidth referred to in *recommends* 1

This Annex describes an RF channel arrangement for low, medium and high capacity point-to-point fixed wireless systems using digital modulation and operating in the band 7 725-8 275 MHz. Channel pairs are provided with a common transmit-receive separation of 300 MHz.

1 The RF channel arrangement is shown in Fig. 1 and is derived as follows:

Let f_0 be the frequency at the centre of the band:

$$f_0 = 8\,000 \text{ MHz}$$

f_n be the centre frequency of one RF channel in the lower half of the band (MHz),

f_n' be the centre frequency of one RF channel in the upper half of the band (MHz), then the centre frequencies of the individual channels are expressed by the following relationships:

1.1 for systems with a 30 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 290 + 30\,n$ MHz

upper half of the band: $f_n' = f_0 + 10 + 30\,n$ MHz

where:

$n = 1, 2, 3, \ldots 8;$

1.2 for systems with a 20 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 285 + 20\,n$ MHz

upper half of the band: $f'_n = f_0 + 15 + 20\,n$ MHz

where:

$n = 1, 2, 3, \ldots 12;$

1.3 for systems with a 10 MHz channel bandwidth:

lower half of the band: $f_n = f_0 - 280 + 10\,n$ MHz

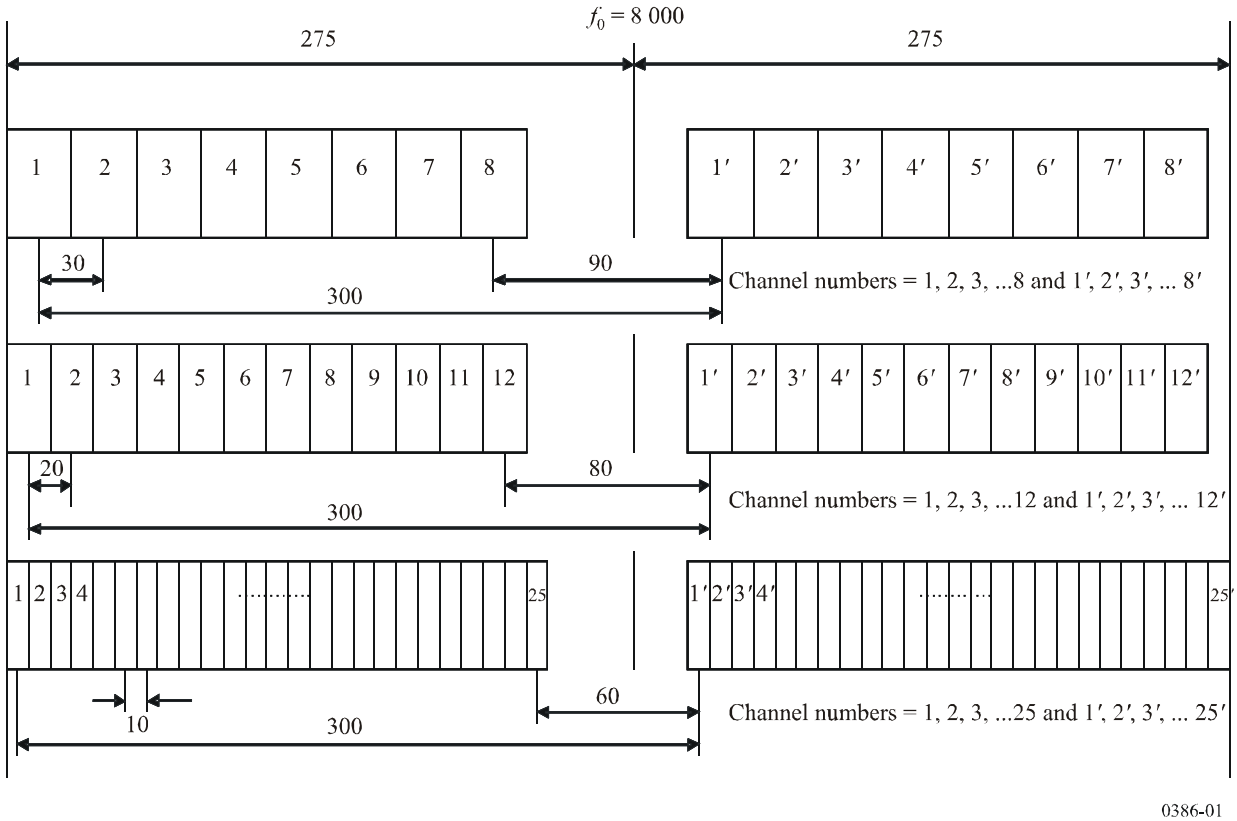
upper half of the band: $f'_n = f_0 + 20 + 10\,n$ MHz

where:

$n = 1, 2, 3, \ldots 25.$

FIGURE 1

RF channel arrangements for the band 7 725-8 275 MHz
(All frequencies in MHz)



2 Low capacity systems with RF channel bandwidths of 1.25 MHz, 2.5 MHz and 5 MHz may also be utilized by subdividing the 10 MHz RF bandwidth pattern shown in Fig. 1.

3 All the go channels should be in one half of the band and all the return channels should be in the other half of the band.

Annex 2

RF channel arrangements for medium and low capacity digital fixed wireless systems operating in the 8 275-8 500 MHz band based on a 3.5 MHz bandwidth referred to in *recommends* 1

1 This Annex describes an RF channel arrangement for digital RF systems with capacities of 34 Mbit/s and 2×8 Mbit/s operating in the band 8 275-8 500 MHz. The RF channel arrangement is shown in Fig. 2 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz),

f_n be the centre frequency of one RF channel in the lower half of the band (MHz),

f_n' be the centre frequency of a RF channel in the upper half of the band (MHz),

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

1.1 for systems with a capacity of 34 Mbit/s:

lower half of the band: $f_n = f_0 - 108.5 + 14\,n$ MHz

upper half of the band: $f_n' = f_0 + 10.5 + 14\,n$ MHz

where:

n = 1, 2, 3, 4, 5, or 6;

1.2 for systems with a capacity of 2×8 Mbit/s:

lower half of the band: $f_n = f_0 - 108.5 + 7\,n$ MHz

upper half of the band: $f_n' = f_0 + 17.5 + 7\,n$ MHz

where:

n = 1, 2, 3, . . . 12.

2 All go channels should be in one half of the band and all the return channels should be in the other half of the band.

3 The centre frequency f_0 is 8 387.5 MHz.

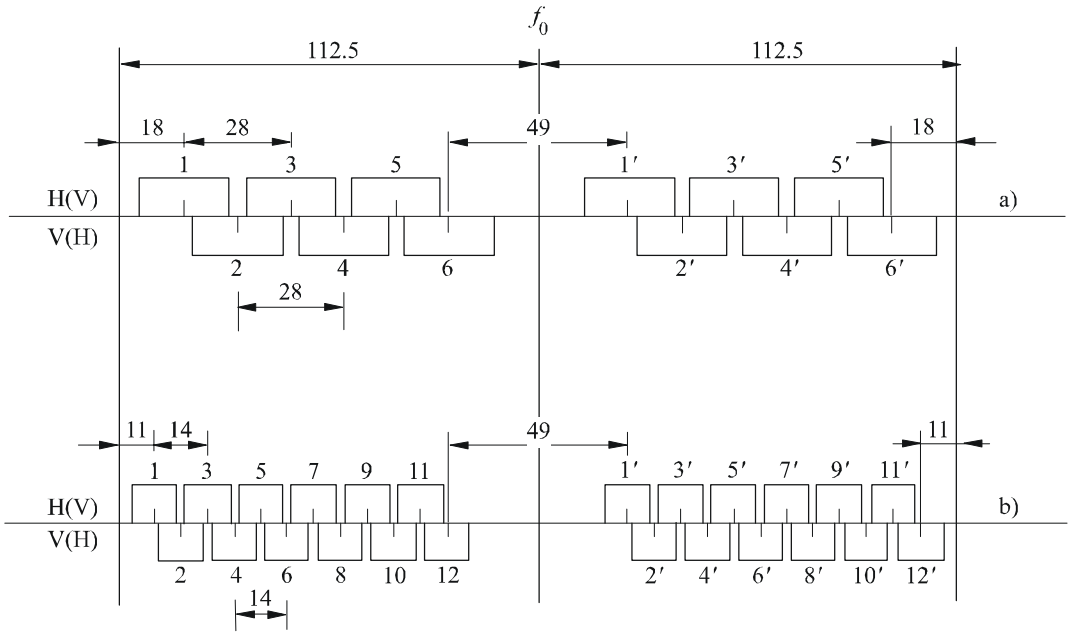
4 For low capacity systems (2×8 Mbit/s), RF channel arrangements may be adopted in conformity with the pattern shown in Fig. 2, by adding interleaved channels at 7 MHz.

5 For adjacent RF channels in the same half of the band, different polarization should be used alternately, in the interleaved channel arrangement of Fig. 2.

6 Both horizontal and vertical polarization should be used for each RF channel in a co-channel arrangement.

FIGURE 2

RF channel arragements for medium- and low-capacity digital fixed wireless systems operating in the 8 275-8 500 MHz band
(All frequencies in MHz)



a) For systems with a capacity of 34 Mbit/s
b) For systems with a capacity of 2 × 8 Mbit/s

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Annex 3

RF channel arrangements for digital fixed wireless systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band, based on a 3.5 MHz bandwidth referred to in *recommends* 1, with a channel separation of up to 28 MHz

1 This Annex describes a RF channel arrangement suitable for digital fixed wireless systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band with a channel separation up to 28 MHz, and makes provision for eight 28 MHz channels.

The RF channel arrangement is shown in Fig. 3 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz),

f_n be the centre frequency of one RF channel in the lower half of the band (MHz),

f_n' be the centre frequency of one RF channel in the upper half of the band (MHz),

then the frequencies of individual 28 MHz channels are expressed by the following relationships,

lower half of the band: $f_n = f_0 - 259 + 28\,n$ MHz

upper half of the band: $f_n' = f_0 + 7 + 28\,n$ MHz

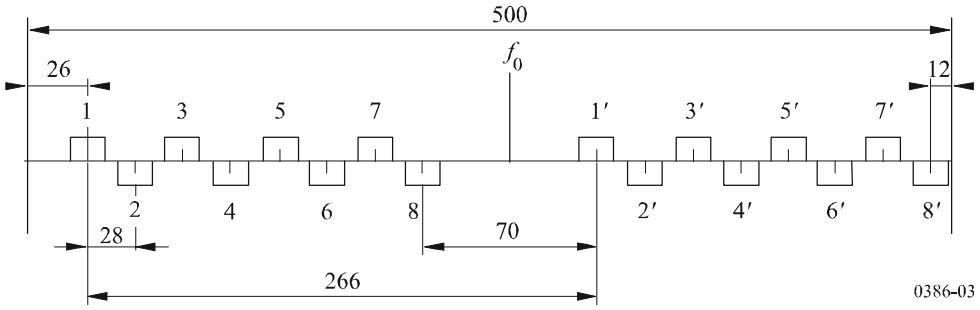
where:

$n = 1, 2, 3, \ldots 8.$

FIGURE 3

RF channel arragement for digital fixed wireless systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 900-8 400 MHz band

(All frequencies in MHz)



2 The eight channels with a separation of 28 MHz can be split to provide 16 channels with a separation of 14 MHz or 32 channels with a separation of 7 MHz.

The frequencies of individual channels are expressed by the following relationships:

2.1 for 14 MHz channels:

lower half of the band: $f_n = f_0 - 259 + 14\,n$ MHz

upper half of the band: $f_n' = f_0 + 7 + 14\,n$ MHz

where:

$n = 1, 2, 3, \ldots 16.$

2.2 for 7 MHz channels:

lower half of the band: $f_n = f_0 - 252 + 7\,n$ MHz

upper half of the band: $f_n' = f_0 + 14 + 7\,n$ MHz

where:

$n = 1, 2, 3, \ldots 32.$

3 All go channels should be in one half of the band and all return channels should be in the other half of the band.

4 The centre frequency f_0 is 8 157 MHz.

Annex 4

RF channel arrangements for the transmission of various digital signals operating in the 7 725-8 275 MHz band referred to in *recommends* 1

1 This Annex describes an RF channel arrangement suitable for the transmission of various digital signals operating in the 7 725-8 275 MHz band with a channel separation of 40, 20, 10 and 5 MHz.

The RF channel arrangement is shown in Fig. 4 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz),

f_n be the centre frequency of one RF channel in the lower half of the band (MHz),

f_n' be the centre frequency of one RF channel in the upper half of the band (MHz),

a) for systems with a channel separation of 40 MHz:

lower half of the band: $f_n = f_0 - 295 + 40\,n$ MHz

upper half of the band: $f_n' = f_0 + 15 + 40\,n$ MHz

where:

$n = 1, 2, 3, \ldots 6$;

b) for systems with a channel separation of 20 MHz:

lower half of the band: $f_n = f_0 - 275 + 20\,n$ MHz

upper half of the band: $f_n' = f_0 + 35 + 20\,n$ MHz

where:

$n = 1, 2, 3, \ldots 11$;

c) for systems with a channel separation of 10 MHz:

lower half of the band: $f_n = f_0 - 275 + 10\,n$ MHz

upper half of the band: $f_n' = f_0 + 35 + 10\,n$ MHz

where:

$n = 1, 2, 3, \ldots 23$;

d) for systems with a channel separation of 5 MHz:

lower half of the band: $f_n = f_0 - 275 + 5\,n$ MHz

upper half of the band: $f_n' = f_0 + 35 + 5\,n$ MHz

where:

$n = 1, 2, 3, \ldots 47$.

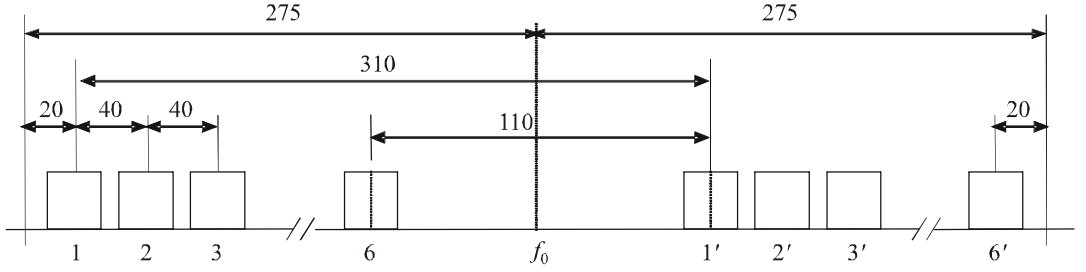
The centre frequency f_0 is 8 000 MHz.

2 Alternatively, an effective RF channel arrangement with 20 MHz, 10 MHz, and 5 MHz may also be used by subdividing the 40 MHz RF bandwidth pattern as shown in Fig. 5.

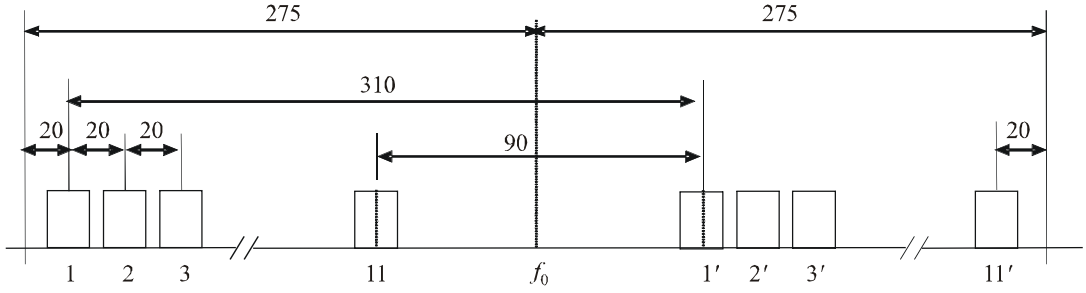
FIGURE 4

RF channel arrangements for transmission of various signals operating with 40 MHz, 20 MHz, 10 MHz and 5 MHz channel spacing in 7 725-8 275 band

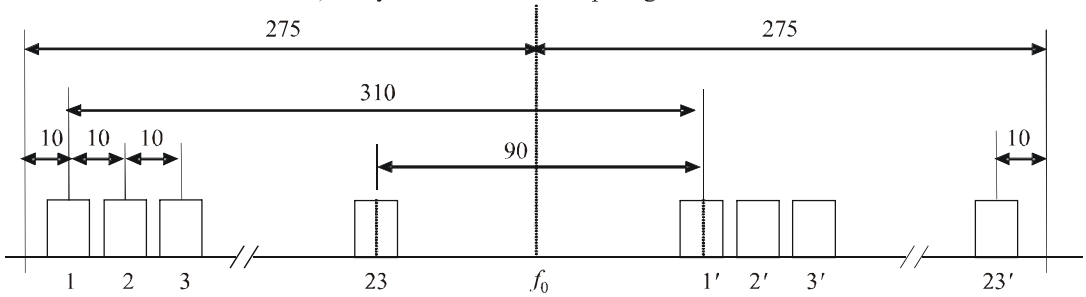
(All frequencies in MHz)



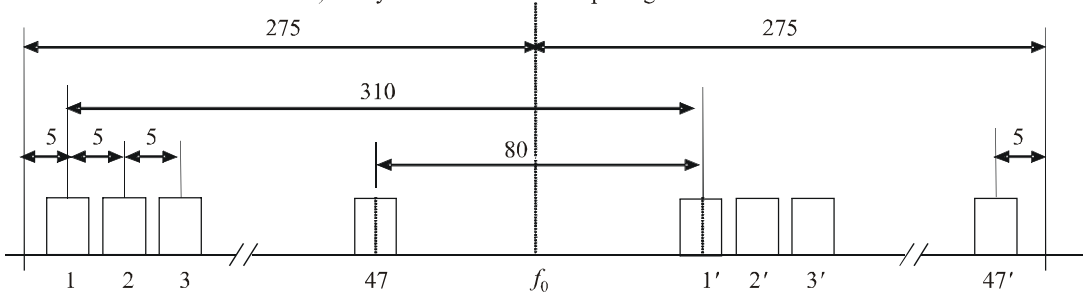
a) for systems with a carrier spacing of 40 MHz



b) for systems with a carrier spacing of 20 MHz



c) for systems with a carrier spacing of 10 MHz



d) for systems with a carrier spacing of 5 MHz

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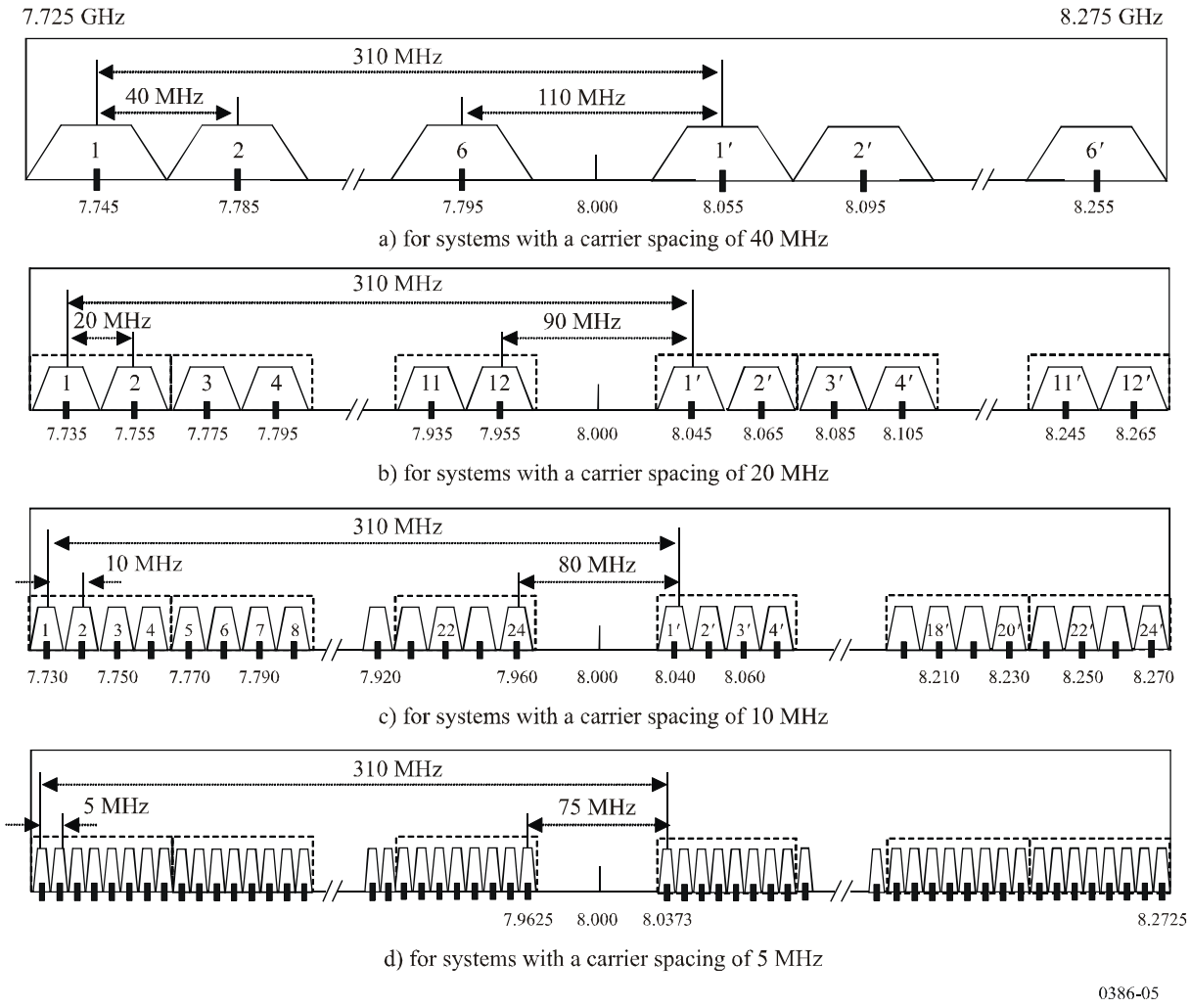
FIGURE 5

Alternative RF channel arrangements for transmission of various digital signals operating with 40 MHz, 20 MHz, 10 MHz and 5 MHz channel spacing in the band 7 725-8 275 MHz



Annex 5

RF channel arrangements for digital fixed wireless systems operating in the 8 025 to 8 500 MHz band based on a 3.5 MHz bandwidth referred to in *recommends* 1

This Annex describes an RF channel arrangement suitable for digital fixed wireless systems operating in the 8 025-8 500 MHz band with a channel separation multiple of 3.5 MHz.

The RF channel arrangement is shown in Fig. 6 and is derived as follows:

Let f_n be the centre frequency of one RF channel in the lower half of the band (MHz),

f'_n be the centre frequency of one RF channel in the upper half of the band (MHz),

f_0 be the reference frequency (MHz),

$$f_0 = 8\,253 \text{ MHz}$$

a) for systems with a channel separation of 28 MHz (32 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 217 + 28\,n$ MHz

upper half of the band: $f'_n = f_0 - 9 + 28\,n$ MHz

where:

$n = 2, 3, \ldots 7$;

b) for systems with a channel separation of 14 MHz (16 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 210 + 14\,n$ MHz

upper half of the band: $f'_n = f_0 - 2 + 14\,n$ MHz

where:

$n = 2, 3, \ldots 14$;

c) for systems with a channel separation of 7 MHz (8 × 2 Mbit/s):

lower half of the band: $f_n = f_0 - 206.5 + 7\,n$ MHz

upper half of the band: $f'_n = f_0 + 1.5 + 7\,n$ MHz

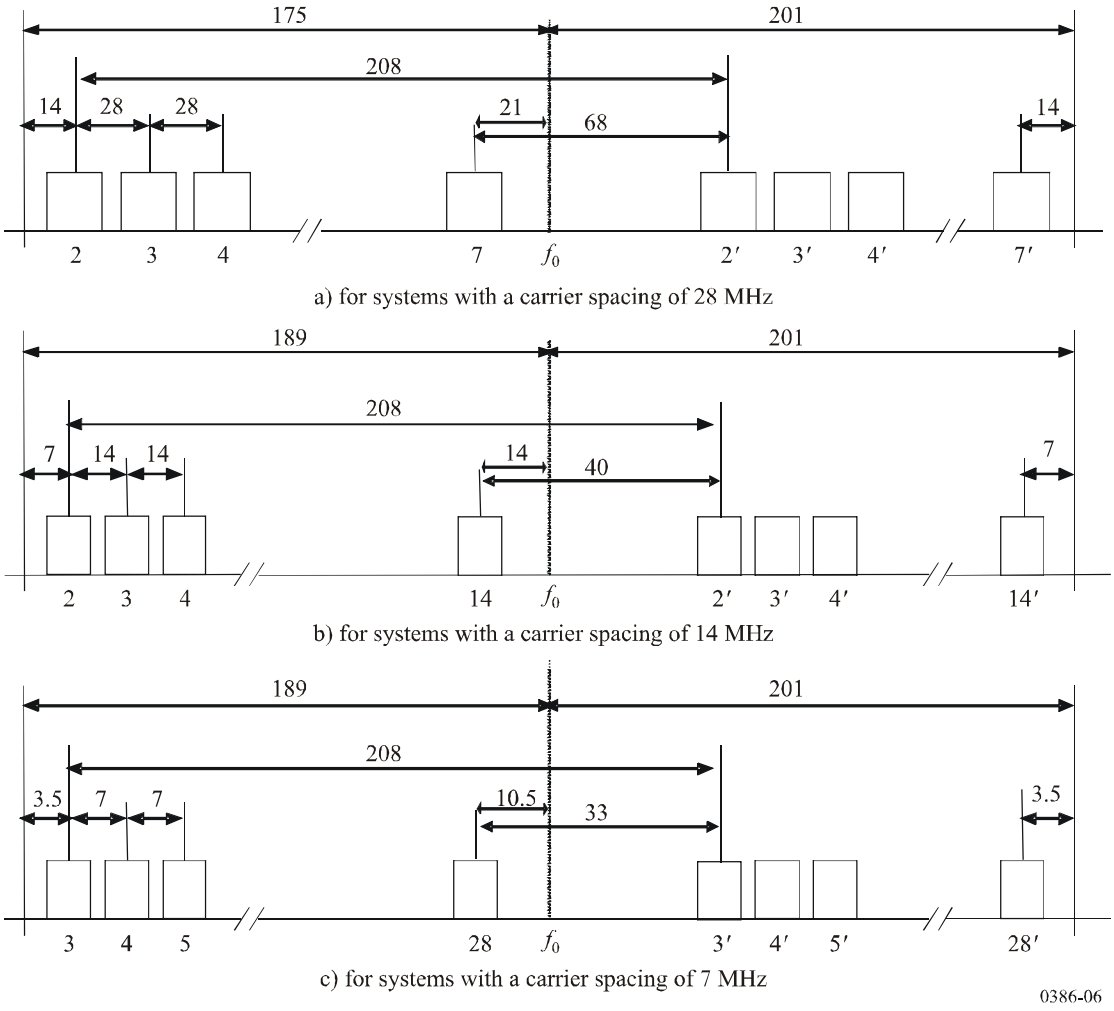
where:

$n = 3, 4, \ldots 28$.

FIGURE 6

RF channel arrangements for transmission of digital fixed wireless systems operating with multiples of 3.5 MHz channel spacing in the band 8 025-8 500 MHz

(All frequencies in MHz)



Annex 6

Description of the RF channel arrangement referred to in *recommends* 5

1 The RF channel arrangement, in a frequency band 250 MHz below 7 975 MHz and 250 MHz above 8 025 MHz for up to eight go and eight return channels, each accommodating high capacity digital systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 8 GHz band, is as shown in Fig. 7 and is derived as follows:

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz),

f_n be the centre frequency of one RF channel in the lower half of this band (MHz),

f_n' be the centre frequency of one RF channel in the upper half of this band (MHz),

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

lower half of the band: $f_n = f_0 - 281.95 + 29.65\,n$ MHz

upper half of the band: $f'_n = f_0 + 29.37 + 29.65\,n$ MHz

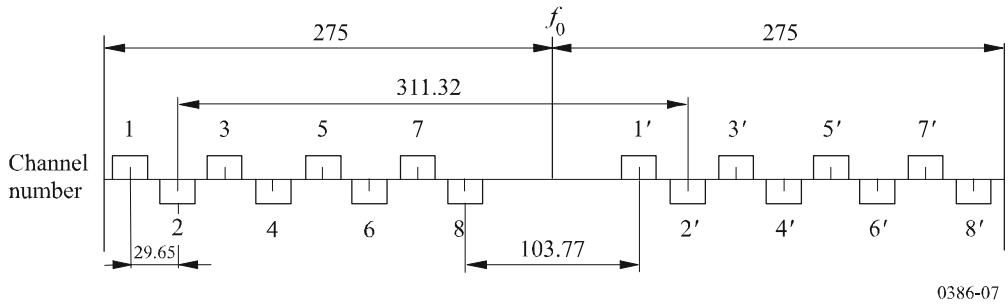
where:

n = 1, 2, 3, 4, 5, 6, 7 or 8.

FIGURE 7

RF channel arrangements for digital fixed wireless systems with capacities up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



2 In a section over which the international interconnection is arranged, all the go channels should be in one half of the band, and all the return channels should be in the other half of the band.

3 The go and return channels on a given section should preferably use the polarizations shown below:

	Go	*Return*
H(V)	1 3 5 7	1′ 3′ 5′ 7′
V(H)	2 4 6 8	2′ 4′ 6′ 8′

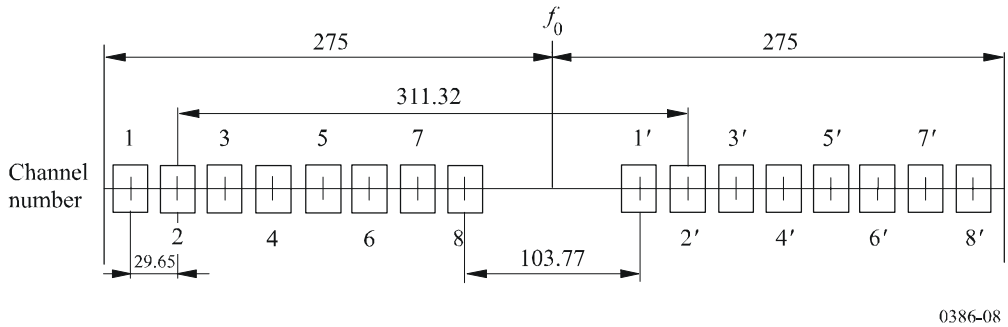
4 When additional RF channels, interleaved between those of the main pattern, are required, the values of the centre frequencies of these RF channels should be 14.825 MHz below those of the corresponding main channel frequencies.

5 In the case of digital fixed wireless systems with a co-channel arrangement, the plan as shown in Fig. 8, should be used.

FIGURE 8

Co-channel arrangement for digital fixed wireless systems operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



6 That, for international connections, the centre frequency should be:

$$f_0 = 8\,000 \text{ MHz}.$$

This value corresponds to the band 7 725-7 975 MHz in the lower half and 8 025-8 275 MHz in the upper half.

NOTE 1 – The RF channel arrangement shown in Fig. 7 overlaps that mentioned in Recommendation ITU-R F.385, for a centre frequency of 7 700 MHz, by 125 MHz between 7 725 MHz and 7 850 MHz. All due precautions to avoid mutual interference must be taken by fixed wireless systems using these channel arrangements.

Annex 7

An RF channel arrangement in the 8 200 to 8 500 MHz band referred to in Note 1 of *recommends*

The RF channel arrangement in the 8 GHz band described in this Annex was considered preferred for the deployment of analogue systems with a capacity of up to 960 telephone channels; however, for migration opportunity, it may still be in use for some digital systems.

1 The radio-frequency channels should be derived as follows (see Note 1):

Let f_0 be the frequency of the centre of the band of frequencies occupied (MHz),

f_n be the centre frequency of one RF channel in the lower half of this band (MHz),

f_n' be the centre frequency of one RF channel in the upper half of this band (MHz),

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

lower half of the band: $f_n = f_0 - 151.614 + 11.662\,n$ MHz

upper half of the band: $f_n' = f_0 + 11.662\,n$ MHz

where $n = 1, 2, 3, 4, 5, \ldots 12$;

2 In a section over which the international connection is arranged, all the go channels should be in one half of the band, and all the return channels should be in the other half of the band.

3 For adjacent RF channels in the same half of the band, horizontal and vertical polarization should be used alternately.

4 For international connections the centre frequency should preferably be:

$$f_0 = 8\,350 \text{ MHz},$$

this value corresponds to the band 8 200-8 500 MHz. In addition, other values might have been used by agreement between the administrations concerned.

NOTE 1 – Historically, the RF channel arrangement described in this Annex permitted all local oscillator frequencies to be derived from the common oscillator frequency 11.662 MHz.