

## RECOMMENDATION ITU-R F.497-7

**Radio-frequency channel arrangements for fixed wireless systems operating in the 13 GHz (12.75-13.25 GHz) frequency band**

(Question ITU-R 136/9)

(1974-1978-1982-1990-1992-1995-1999-2007)

**Scope**

This Recommendation provides RF channel arrangements for fixed wireless systems (FWS) operating in the 13 GHz band. The main text of this Recommendation presents an RF arrangement with a channel separation of 28 MHz in the frequency range 12.75-13.25 GHz. Methodologies are provided for subdividing the main 28 MHz wide channels into smaller channels of 14, 7 and 3.5 MHz, as well as for extending the use to  $2 \times 28$  MHz adjacent channels.

The ITU Radiocommunication Assembly,

*considering*

- a) that the 12.75 to 13.25 GHz band is allocated *inter alia* to the fixed and mobile terrestrial services;
- b) that, at these frequencies, fixed wireless systems (FWS) for digital transmission are feasible with repeater spacings and other features chosen according to rainfall and multipath conditions;
- c) that the homogeneous frequency pattern based on an interval of 14 MHz (see Recommendation ITU-R F.636) may also be adapted for this frequency band;
- d) that high capacity digital FWS in the synchronous digital hierarchy (SDH) are required in the 13 GHz RF band;
- e) 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 rainfall or multipath propagation-induced depolarization;
- f) 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,

*noting*

- a) that it may no longer be practical, because of the bandwidth of the modulated carrier, to use interleaved frequencies<sup>1</sup>,

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<sup>1</sup> Additional RF channels had been recommended for analogue systems, interleaved between those of the main pattern, their centre frequencies being 14 MHz above those of the corresponding main channel frequencies. They have possibly been maintained for their migration to digital systems; these channels may still be in use.

*recommends*

1 that the preferred RF channel arrangement for FWS with a capacity of 34 Mbit/s or higher capacity up to 140 Mbit/s or the synchronous bit-rates, operating in the 13 GHz band, should be derived as follows:

Let  $f_0$  be a reference frequency near the centre of the 12.75 to 13.25 GHz band (MHz),

$f_n$  be the centre frequency of a 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 of individual channels are expressed by the following relationship:

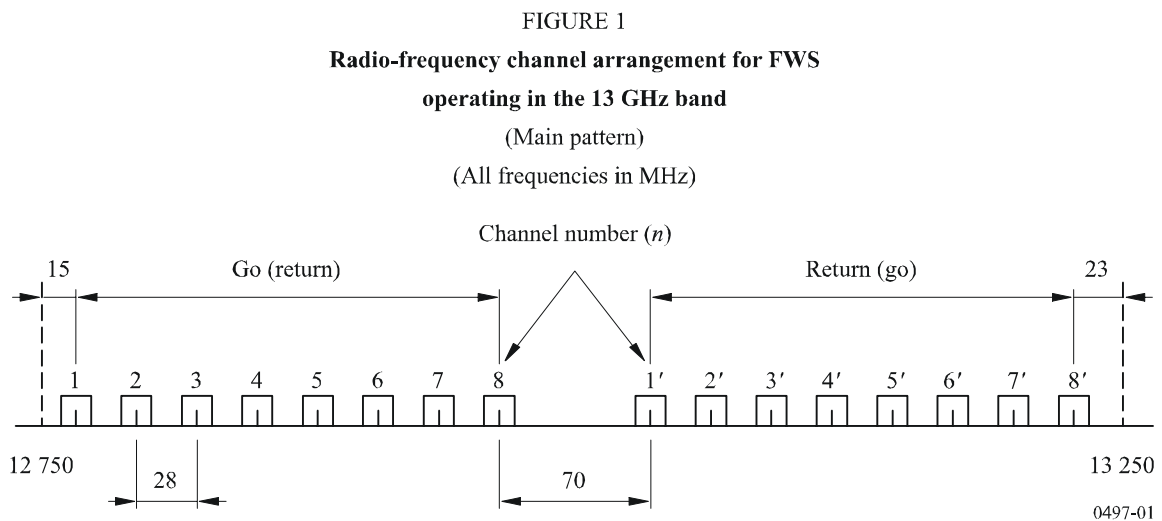
$$\text{lower half of the band: } f_n = f_0 - 259 + 28n \quad \text{MHz}$$

$$\text{upper half of the band: } f'_n = f_0 + 7 + 28n \quad \text{MHz}$$

where:

$$n = 1, 2, 3, 4, 5, 6, 7 \text{ or } 8.$$

The frequency arrangement is illustrated in Fig. 1;



2 that, in the section through which an international connection is arranged to pass, 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, in digital systems both horizontal and vertical polarization should be used, where possible, for each RF channel;

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 MHz channels specified in *recommends* 1 is possible, for a wider bandwidth system, with the centre frequency lying in the central point of the distance between the two 28 MHz adjacent channels;

**5** that, when common transmit-receive antennas are used and no more than four channels are accommodated on a single antenna, it is preferred that the channel frequencies be selected by making either:

$$n = 1, 3, 5 \text{ and } 7 \quad \text{or} \quad 2, 4, 6 \text{ and } 8;$$

**6** that, for international connections, the reference frequency should preferably be 12 996 MHz. Other values may be used by agreement between the administrations concerned;

**7** that, in cases where smaller capacity radio channels are required, the following channel arrangements (which occupy some of the bi-directional radio channels of the basic channel arrangement) should be used (see Note 2):

– *Alternative I (7 MHz channels):*

$$\text{lower half of the band:} \quad f_m = f_0 - 276.5 + 28 n + 7 m \quad \text{MHz}$$

$$\text{upper half of the band:} \quad f'_m = f_0 - 10.5 + 28 n + 7 m \quad \text{MHz}$$

where:

$$m = 1, 2, 3 \text{ or } 4$$

$n$ : channel number of the basic channel arrangement.

When  $n = 1$ , the channel arrangement of Fig. 2a) is obtained.

Additional channels may be obtained by choosing  $n = 2$ .

By agreement between the administrations concerned,  $n$  may be greater than 2.

– *Alternative II (7 MHz channels):*

$$\text{lower half of the band:} \quad f_m = f_0 - 66.5 + 7 m \quad \text{MHz}$$

$$\text{upper half of the band:} \quad f'_m = f_0 + 3.5 + 7 m \quad \text{MHz}$$

where:

$m$  is preferably 3, 4, 5 or 6.

When additional channels are required, channel values of  $m = 1, 2, 7$  or  $8$ , may be used. This arrangement is illustrated in Fig. 2b).

– *Alternative III (3.5 MHz or 14 MHz channels):*

To achieve low capacity channels of 3.5 MHz or 14 MHz width using paired channels of the basic plan as in Alternative I:

a) 3.5 MHz option:

$$\text{lower half of the band:} \quad f_m = f_0 - 274.75 + 28 n + 3.5 m \quad \text{MHz}$$

$$\text{upper half of the band:} \quad f'_m = f_0 - 8.75 + 28 n + 3.5 m \quad \text{MHz}$$

Some administrations have already implemented and may decide to continue to apply the following formulae:

$$\text{lower half of the band:} \quad f_m = f_0 - 273 + 28 n + 3.5 m \quad \text{MHz}$$

$$\text{upper half of the band:} \quad f'_m = f_0 - 7 + 28 n + 3.5 m \quad \text{MHz}$$

where:

$$m = 1, 2, 3, 4, 5, 6, 7 \text{ or } 8$$

$n$ : number of the basic channel arrangement.

When  $n = 1$ , the channel arrangement of Fig. 2c) is obtained.

b) 14 MHz option:

$$\text{lower half of the band: } f_m = f_0 - 280 + 28n + 14m \quad \text{MHz}$$

$$\text{upper half of the band: } f'_m = f_0 - 14 + 28n + 14m \quad \text{MHz}$$

where:

$$m = 1 \text{ or } 2$$

$n$ : number of the basic channel arrangement.

When  $n = 1$ , the channel arrangement of Fig. 2d) is obtained.

Additional channels may be obtained by choosing  $n - 2$ .

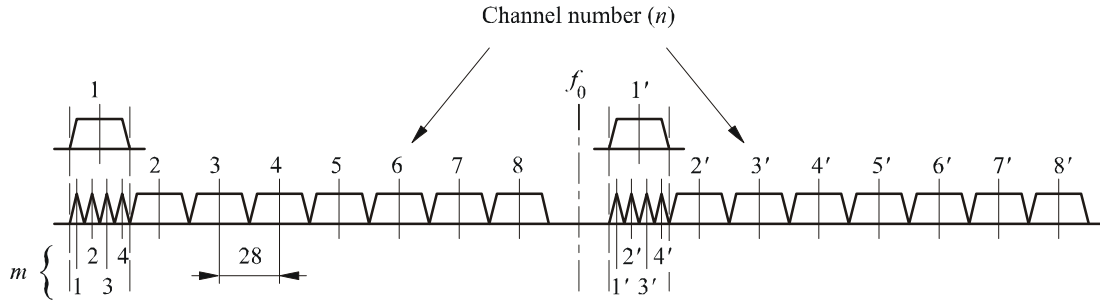
By agreement between the administrations concerned,  $n$  may be greater than 2.

NOTE 1 – In some countries in Region 1, the basic channel spacing of this frequency pattern may be suitable for extension to adjacent frequency bands in the range 11.7 to 15.35 GHz, taking into account the appropriate provisions of the Radio Regulations.

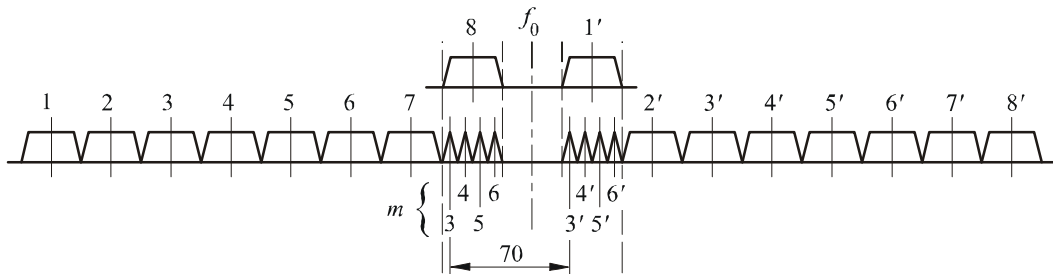
NOTE 2 – In order to reduce the possibility of an unacceptable degradation in performance occurring, care should be exercised in using mixed channel arrangements in a fixed wireless network. This would especially apply if low capacity links operating within the channel arrangements described in *recommends 7* are mixed with medium and high capacity links, operating in accordance with the main channel arrangements when both are present in the same network.

FIGURE 2  
**Examples of radio-frequency channel arrangements  
 for smaller capacity digital systems**

(As described in *recommends 7*)  
 (All frequencies in MHz)

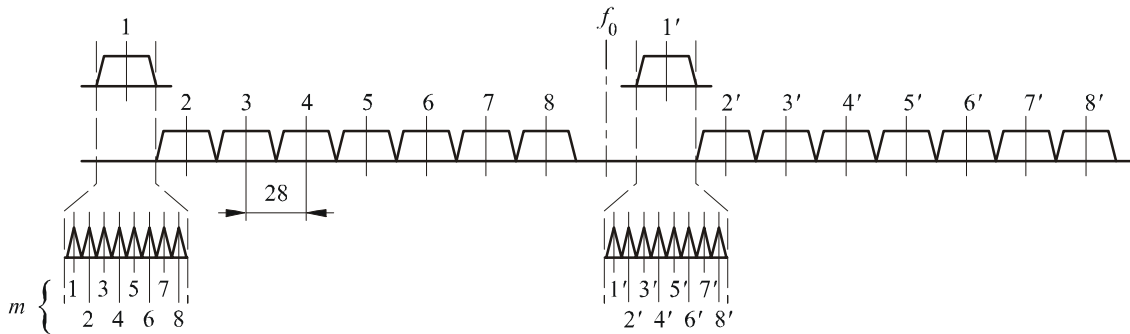


a) 7 MHz channel Systems using channel Nos. 1 and 1' of the basic plan

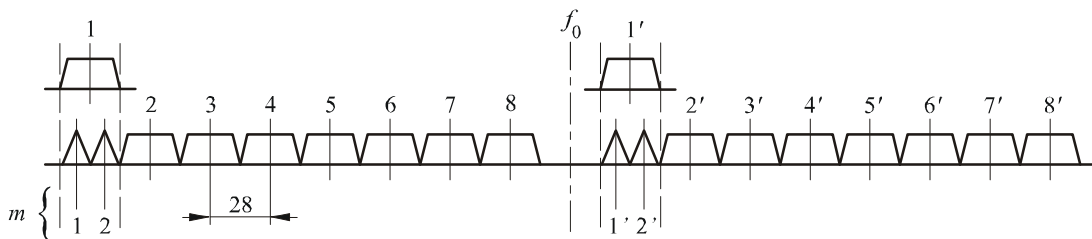


Preferred values for  $m$ ,  $m = 3, 4, 5, 6$   
 Additional values  $m = 1, 2, 7, 8$

b) 7 MHz channel Systems having 70 MHz frequency separation between the send and receive directions



c) 3.5 MHz channel Systems using channel Nos. 1 and 1' of the basic plan



d) 14 MHz channel Systems using channel Nos. 1 and 1' of the basic plan