RECOMMENDATION ITU-R F.386-5

RADIO-FREQUENCY CHANNEL ARRANGEMENTS FOR MEDIUM AND HIGH CAPACITY ANALOGUE OR DIGITAL RADIO-RELAY SYSTEMS OPERATING IN THE 8 GHz BAND

(Question ITU-R 136/9)

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

The ITU Radiocommunication Assembly,

considering

a) that it may be desirable to be able to interconnect radio-relay systems on international circuits at radio frequencies in the 8 GHz band;

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

c) that it may be desirable to interconnect in such a band up to six systems with a capacity of 960 channels, or the equivalent;

d) that such a frequency arrangement should also be suitable for 300-channel systems;

e) that for reasons of frequency economy, it is desirable to interleave additional radio-frequency (RF) channels between those of the main pattern;

f) that economy may be achieved, if at least three go and three return channels can be interconnected between systems using common transmit-receive antennas;

g) that many interfering effects can be minimized by a carefully planned frequency arrangement for systems employing several RF channels,

recommends

1 that the preferred RF channel arrangement in the 8 GHz band should be 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 (MHz) of the individual channels are expressed by the following relationships:

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

upper half of the band: $f'_n = f_0 + 11.662\, n$

where for systems with a capacity of 960 telephone channels, or the equivalent:

$n = 1, 3, 5, 7, 9$ and 11;

for systems with a capacity of 300 telephone channels:

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

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 shall be used alternately;

4 that, when common transmit-receive antennas are used and three RF channels are accommodated on a single antenna, it is preferable that for systems with a capacity of 960 telephone channels, or the equivalent, channel frequencies be selected by making:

$$\left.\begin{array}{l} n = 1, 5 \text{ and } 9 \\ \text{or} \\ n = 3, 7 \text{ and } 11 \end{array}\right\} \text{in both halves of the band;}$$

when using systems with a capacity of 300 telephone channels it is preferable to select:

$$\left.\begin{array}{l} n = 1, 5 \text{ and } 9 \text{ or} \\ n = 2, 6 \text{ and } 10 \text{ or} \\ n = 3, 7 \text{ and } 11 \text{ or} \\ n = 4, 8 \text{ and } 12 \end{array}\right\} \text{in both halves of the band;}$$

5 that, when additional RF channels are required for 960-channel systems, or the equivalent, interleaved between those of the main pattern, the frequencies of the individual channels shall be obtained by making:

$n = 2, 4, 6, 8, 10$ and 12;

6 that for international connections the centre frequency should preferably be:

$f_0 = 8\,350$ MHz,

this value corresponds to the band 8 200-8 500 MHz. Other values may be taken by agreement between the administrations concerned;

7 that due regard be taken of the fact that, in some countries, another RF channel arrangement for systems with capacities of up to 1 800 telephone channels, or the equivalent, as well as 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 1.

NOTE 1 – The RF channel arrangement described in § 1 to 6 permits all local oscillator frequencies to be derived from the common oscillator frequency 11.662 MHz. The frequency pattern allows for economical use of the frequency band, but since the intermediate frequency of 70 MHz is a multiple of the channel spacing, adequate system selectivity will have to be provided to avoid undue interference.

NOTE 2 – Due regard should be taken of the fact that in parts of Region 2 a different RF channel arrangement is in use for digital systems with a capacity of about 90 Mbit/s. This arrangement is described in Annex 2.

NOTE 3 – Due regard should be taken of the fact that in some countries the RF channel arrangement described in Annex 3 is in use for medium and low capacity digital systems operating in the band 8 275 to 8 500 MHz.

ANNEX 1

Description of the RF channel arrangement referred to in *recommends* 7

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 up to 1 800 telephone channels, or the

equivalent, as well as 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. 1 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 (MHz) of the individual channels are expressed by the following relationships:

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

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

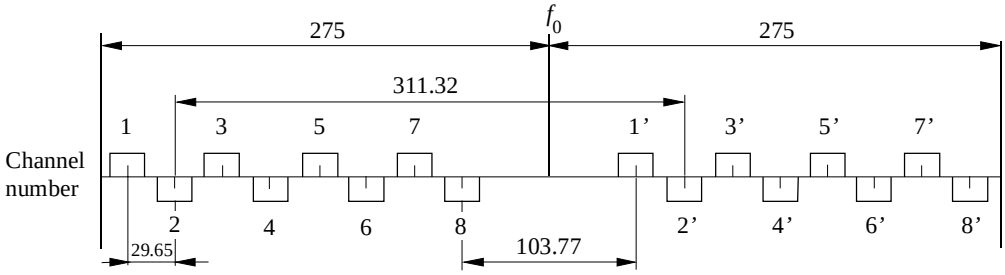
where:

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

FIGURE 1

RF channel arrangement for systems with capacities up to 1 800 telephone channels or digital radio systems up to 140 Mbit/s or synchronous digital hierarchy bit rates operating in the 7 725-8 275 MHz band

(All frequencies in MHz)



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2 That, 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 That 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′

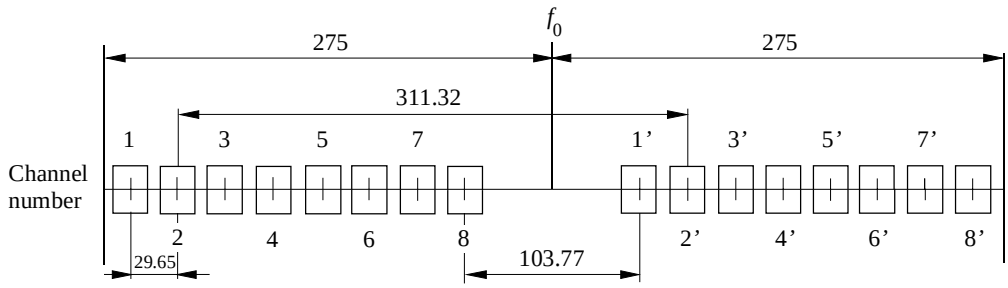
4 That, when additional RF channels, interleaved between those of the main pattern, are required, the values of the centre frequencies of these RF channels should be 14.825 MHz below those of the corresponding main channel frequencies; in systems for 1 800 channels, or the equivalent, it may not be practical to use interleaved frequencies, because of the bandwidth of the modulated carrier.

5 That, in the case of digital radio-relay systems with a co-channel arrangement, the plan as shown in Fig. 2, should be used.

FIGURE 2

Co-channel arrangement for digital radio-relay 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 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 for eight go and eight return channels, shown in Fig. 1, is suitable for use with the preferred intermediate frequency of 70 MHz (see Recommendation 403 (Volume IX, Part 1) (Düsseldorf, 1990)). It is also suitable for use with an intermediate frequency of 74.13 MHz, which enables a common oscillator (14.82 MHz) to be used for generating all the local oscillations for the system, if desired.

NOTE 2 – The RF channel arrangement shown in Fig. 1 overlaps that of this Recommendation by 75 MHz, between 8 200 MHz and 8 275 MHz, and 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 radio-relay systems using these channel arrangements.

ANNEX 2

Description of the RF channelling arrangement referred to in Note 2

This Annex describes a digital RF channelling arrangement for the 8 GHz band. The arrangement provides for up to 12 go and 12 return channels each accommodating about 90 Mbit/s. The use of a quadrature partial-response signal (QPRS) modulation scheme allows for the possibility of cross-polar operation.

In implementing the cross-polar option the co-channel centre frequencies have been offset by 5.56 MHz to allow for simplified hardware to detect the loss of one of the orthogonal signals. It is also possible to operate an interleaved channel arrangement however with the loss of one RF channel pair.

1 The RF channel arrangement for the co-channel arrangement is shown in Fig. 3 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 (MHz) of the individual channels are expressed by the following relationships:

lower half of the band: $f_n = f_0 - 275 + 20.37\,n$

upper half of the band: $f_n' = f_0 + 30.56 + 20.37\,n$

where:

$n = 1, 3, 5, 7, 9, 11,$

and lower half of the band: $f_n = f_0 - 295.37 + 20.37\,n + 5.56$

upper half of the band: $f_n' = f_0 + 10.19 + 20.37\,n - 5.56$

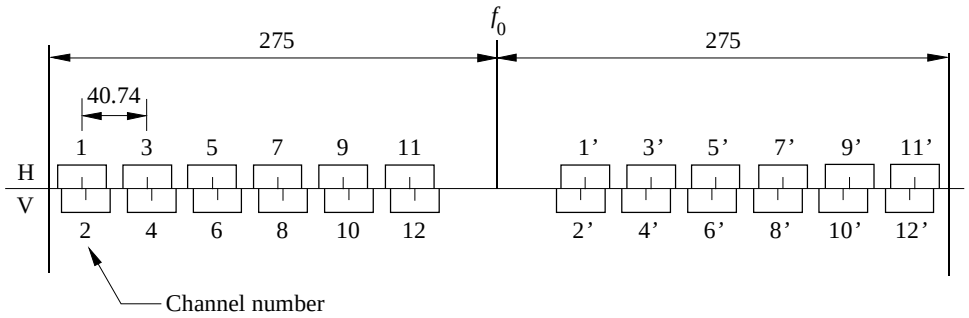
where:

$n = 2, 4, 6, 8, 10, 12.$

FIGURE 3

RF channel arrangement for the 8 GHz band co-channel plan

(All frequencies in MHz)



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2 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 growth beyond 6 go and 6 return channels, orthogonal polarizations are used on a co-channel basis.

ANNEX 3

A RF channel arrangement for medium and small capacity digital radio-relay systems operating in the 8 GHz band

1 This Annex describes a 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. 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 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: $f_n = f_0 - 108.5 + 14\,n$

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

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: $f_n = f_0 - 108.5 + 7n$

upper half of the band: $f'_n = f_0 + 17.5 + 7n$

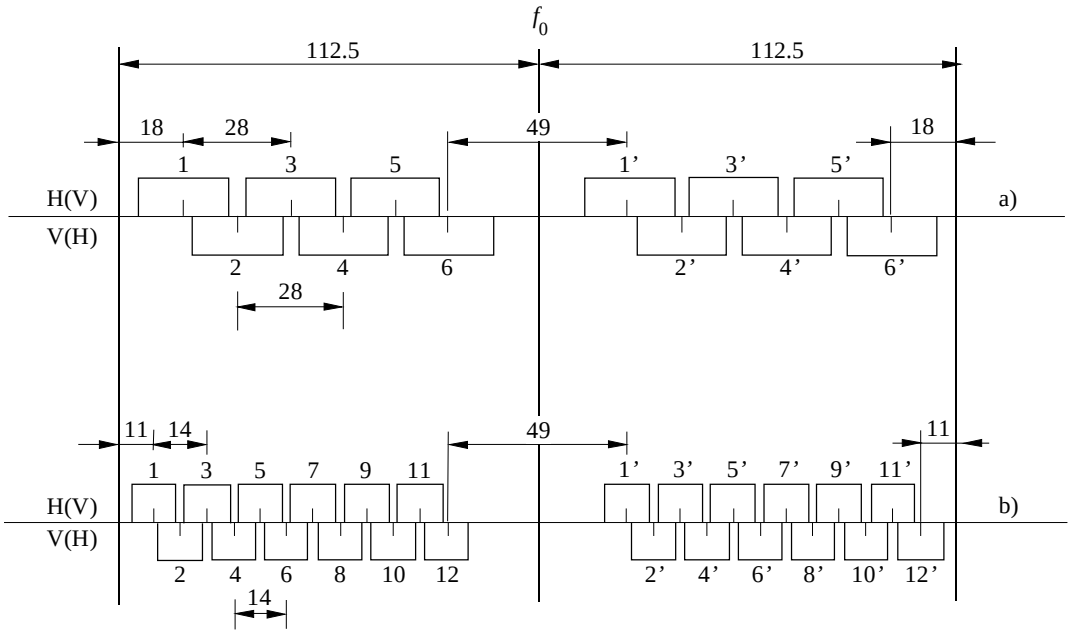
where:

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

FIGURE 4

RF channel arrangement for medium- and small-capacity digital radio-relay systems operating in the 8 275-8 500 MHz band

(All frequencies are in MHz)



a) For systems with a capacity of 34 Mbit/s
b) For systems with a capacity of 2×8 Mbit/s 0386-04

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 small-capacity systems (2×8 Mbit/s), RF channel arrangements may be adopted in conformity with the pattern shown in Fig. 4, 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. 4.

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