

RECOMMENDATION ITU-R F.382-7^{*,**}**Radio-frequency channel arrangements for radio-relay systems operating in the 2 and 4 GHz bands**

(Question ITU-R 136/9)

(1956-1959-1963-1966-1970-1982-1986-1990-1991-1997)

The ITU Radiocommunication Assembly,

considering

- a) that it is sometimes desirable to be able to interconnect radio-relay systems on international circuits at radio frequencies in the 2 and 4 GHz bands;
- b) that, in a frequency band 400 MHz wide, it may be desirable to interconnect up to six go and six return radio-frequency channels;
- c) that economy may be achieved if at least three go and three return channels can be interconnected between systems each of which uses common transmit-receive antennas;
- d) that many interfering effects can be substantially reduced by a carefully planned arrangement of the radio frequencies in radio-relay systems employing several radio-frequency channels;
- e) that it may sometimes be desirable to interleave additional radio-frequency channels between those of the main pattern;
- f) that the use of bit rates of 34 Mbit/s may be possible in the 2 GHz band;
- g) that the use of bit rates of 2×34 Mbit/s or 2×45 Mbit/s or 140 Mbit/s or synchronous digital hierarchy bit rates is possible in the 4 GHz band;
- h) that for these digital radio systems, further economies are possible by accommodating up to six go and six return channels on a single antenna;
- j) that it is desirable to provide for operation of analogue and digital systems on the same path;
- k) Resolution 716 of the World Radiocommunication Conference (Geneva, 1995) (WRC-95) urges administrations to ensure that frequency assignments to new fixed service systems do not overlap with the 1 980-2 010 MHz and 2 170-2 200 MHz bands in all three Regions and the 2 010-2 025 MHz and 2 160-2 170 MHz bands in Region 2 mobile-satellite service (MSS) allocations,

* This Recommendation applies only to line-of-sight and near line-of-sight radio-relay systems.

** Radiocommunication Study Group 9 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44.

recommends

1 that the preferred radio-frequency channel arrangement for up to six go and six return channels, with capacities from 600 to 1 800 telephone channels, or the equivalent, in the 2 and 4 GHz bands or 34 Mbit/s in the 2 GHz band, or 34 to 140 Mbit/s or synchronous digital hierarchy bit rates in the 4 GHz band, should be as shown in Fig. 3 and 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 radio-frequency channel in the lower half of the band (MHz),
 f'_n be the centre frequency of one radio-frequency channel in the upper half of the band (MHz),

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

$$\text{lower half of the band: } f_n = f_0 - 208 + 29 n$$

$$\text{upper half of the band: } f'_n = f_0 + 5 + 29 n$$

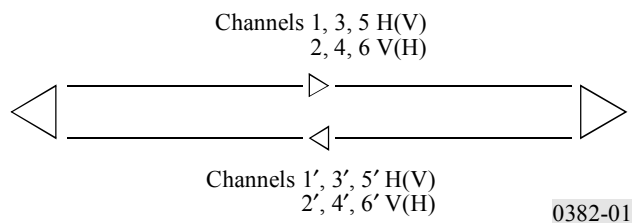
where:

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

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;

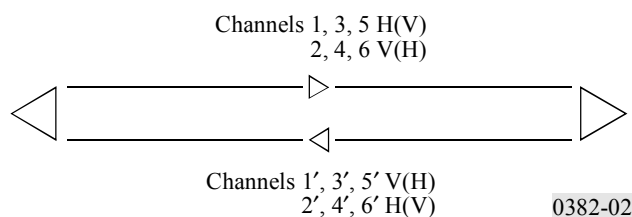
3 that for adjacent radio-frequency channels in the same half of the band, different polarizations should preferably be used alternately; i.e. the odd numbered channels in both directions of transmission on a given section should use H(V) polarization, and the even numbered channels should use V(H) polarization, as shown in Fig. 1 below:

FIGURE 1



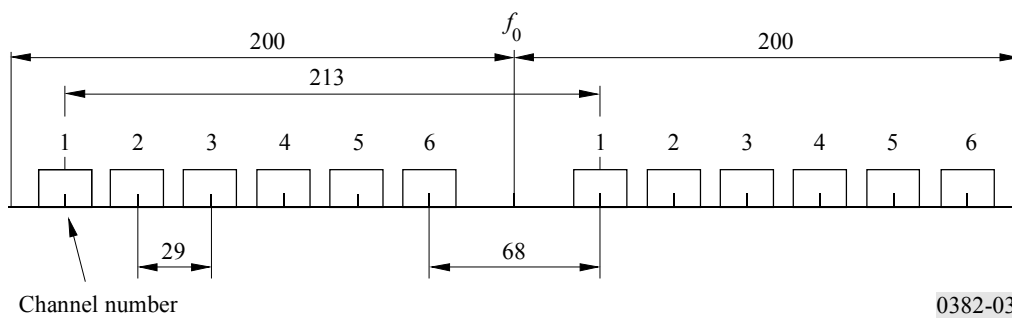
NOTE 1 – When antennas for double polarization are used, the arrangement of channels shown in Fig. 2 may be used by agreement between administrations;

FIGURE 2



4 that, when common transmit-receive antennas are used, and not more than three radio-frequency channels are accommodated on a single antenna, it is preferred that the channel frequencies be selected by either making $n = 1, 3$ and 5 in both halves of the band or making $n = 2, 4$ and 6 in both halves of the band;

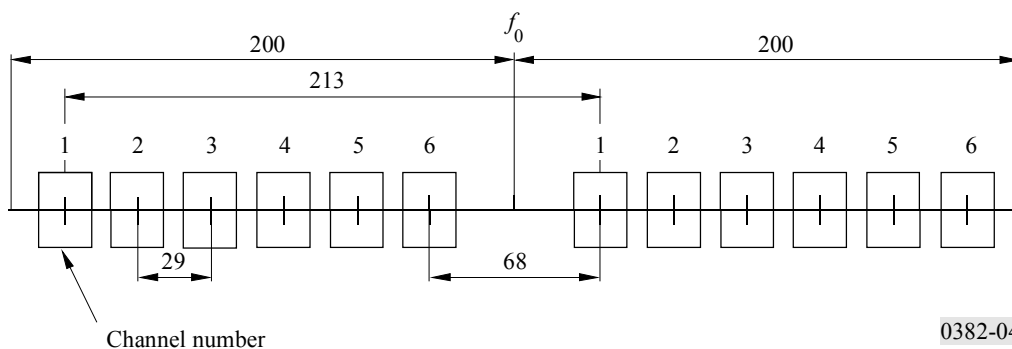
FIGURE 3
Radio-frequency channel arrangement for radio-relay systems with capacities from 600 to 1 800 telephone channels, or equivalent, in the 2 and 4 GHz bands, or 34 Mbit/s in the 2 GHz band, or 34 to 140 Mbit/s or synchronous digital hierarchy bit rates in the 4 GHz band, for use in international connections
 (All frequencies in MHz)



5 that use of frequencies in the 2 GHz band should take into consideration results of ITU-R sharing studies with other services which have a primary allocation with the fixed service. In this regard, alternative channel arrangements given in Recommendation ITU-R F.1098 should be used as appropriate.

6 that in the case of digital radio-relay systems with a co-channel arrangement, the plan as shown in the Fig. 4, should be used;

FIGURE 4
Co-channel arrangement for digital radio-relay systems operating in the 4 GHz band
 (All frequencies in MHz)



7 that when additional radio-frequency channels, interleaved between those of the main pattern, are required, the values of the centre frequencies of these radio-frequency channels should be 14.5 MHz below those of the corresponding main channel frequencies*.

* In analogue radio-relay systems for 1 800 telephone channels, or the equivalent, and in radio-relay systems with digital modulation using a bit rate of 2×34 Mbit/s, 2×45 Mbit/s, 140 Mbit/s or synchronous hierarchy bit rates it may not be practicable to use interleaved frequencies, because of the wide bandwidth occupied by the modulated carrier.

8 that to minimize interference within a system, the centre frequency f_0 should preferably be as given below:

$f_0 = 1\,903$ MHz or $2\,101$ MHz in the 2 GHz band (see Note 1);

$f_0 = 4\,003.5$ MHz in the 4 GHz band.

Other centre frequencies may be used by agreement between the administrations concerned**.

** Interference due to certain harmonics of the shift frequency, which may fall near radio-frequency channel frequencies f_n (MHz) in radio-frequency repeaters, or may fall near $(f_n \pm 70)$ MHz in repeaters using an intermediate frequency of 70 MHz, may in certain cases be serious. Such interference may be reduced by choosing a suitable value for f_0 , such as those given in § 6;

9 that due regard be taken of the fact that in some countries, mostly in a large part of Region 2 and in certain other areas, another radio-frequency channel arrangement for 4 GHz systems is used. A description of this radio-frequency channel arrangement is given in § 4 of Annex 1 to Recommendation ITU-R F.635. Attention is drawn to the problem of interconnection;

10 that if a digital transmission at 2×34 Mbit/s or 2×45 Mbit/s is established in the existing 4 GHz arrangement, there exist modulation systems which ensure compatibility on the same artery between digital and analogue radio-frequency circuits with up to 1 260 analogue telephone channels, provided that the analogue and digital radio-frequency circuits are cross-polarized.

NOTE 1 – In certain countries, particularly in Region 2, it may be preferable to use as centre frequencies:

$f_0 = 1\,932$ MHz instead of 1 903 MHz, and

$f_0 = 2\,086.5$ MHz instead of 2 101 MHz.

NOTE 2 – In the Russian Federation, a radio-frequency channel arrangement conforming to the scheme in Fig. 1 of Recommendation ITU-R F.497 is used in the frequency band 3 700 to 4 200 MHz and for systems with a capacity of 1 800 telephone channels or the equivalent, or for digital radio-relay systems with a capacity of 34 to 140 Mbit/s. The reference frequency f_0 is then 3 947.5 MHz.

NOTE 3 – In the People's Republic of China, the frequency band from 3 400 to 4 200 MHz has been divided into two groups each with a frequency band 400 MHz wide. The radio-frequency channel arrangement is identical to that shown in Fig. 3 of this Recommendation, where $f_0 = 3\,592.0$ MHz and 4 003.5 MHz, respectively.