International Telecommunication Union

ITU-R
Radiocommunication Sector of ITU

Recommendation ITU-R F.748-4
(05/2001)

Radio-frequency arrangements for systems of the fixed service operating in the 25, 26 and 28 GHz bands

F Series

Fixed service

International
Telecommunication
Union

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from http://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

<table>
<tr><td colspan="2" align="center">**Series of ITU-R Recommendations**
(Also available online at http://www.itu.int/publ/R-REC/en)</td></tr>
<tr><td>**Series**</td><td align="center">**Title**</td></tr>
<tr><td>**BO**</td><td>Satellite delivery</td></tr>
<tr><td>**BR**</td><td>Recording for production, archival and play-out; film for television</td></tr>
<tr><td>**BS**</td><td>Broadcasting service (sound)</td></tr>
<tr><td>**BT**</td><td>Broadcasting service (television)</td></tr>
<tr><td>**F**</td><td>**Fixed service**</td></tr>
<tr><td>**M**</td><td>Mobile, radiodetermination, amateur and related satellite services</td></tr>
<tr><td>**P**</td><td>Radiowave propagation</td></tr>
<tr><td>**RA**</td><td>Radio astronomy</td></tr>
<tr><td>**RS**</td><td>Remote sensing systems</td></tr>
<tr><td>**S**</td><td>Fixed-satellite service</td></tr>
<tr><td>**SA**</td><td>Space applications and meteorology</td></tr>
<tr><td>**SF**</td><td>Frequency sharing and coordination between fixed-satellite and fixed service systems</td></tr>
<tr><td>**SM**</td><td>Spectrum management</td></tr>
<tr><td>**SNG**</td><td>Satellite news gathering</td></tr>
<tr><td>**TF**</td><td>Time signals and frequency standards emissions</td></tr>
<tr><td>**V**</td><td>Vocabulary and related subjects</td></tr>
</table>

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

Electronic Publication
Geneva, 2009

© ITU 2009

RECOMMENDATION ITU-R F.748-4*

Radio-frequency arrangements for systems of the fixed service operating in the 25, 26 and 28 GHz bands

(1992-1994-1995-1999-2001)

Scope

This Recommendation provides specifications for radio-frequency channel arrangements for systems in the fixed service with channel separations ranging from 2.5 to 112 MHz in the bands 24.5-26.5 GHz, 27.5-29.5 GHz, 24.25-25.25 GHz and 25.27-26.98 GHz. One Annex (Annex 3) includes block-based arrangements with bandwidths of 40 MHz and 60 MHz in the frequency range 24.25 to 26.98 GHz.

The ITU Radiocommunication Assembly,

considering

a)   that the bands 24.25-25.25 GHz, 25.25-27.5 GHz and 27.5-29.5 GHz are allocated to fixed and other services;

b)   that some administrations use digital systems for point-to-point (P-P) and/or point-to-multipoint (P-MP) applications;

c)   that the bands are used for differing applications by various administrations and that these applications require different frequency plans;

d)   that the bands may also be used for fixed wireless access (FWA) systems;

e)   that several types of service with various capacities may be in simultaneous use in these frequency bands;

f)   that the band allocated to each service or even to each administration may vary from one country to another;

g)   that the applications in these frequency bands may require differing channel bandwidths;

h)   that a high degree of compatibility between different systems and between radio-frequency (RF) channels of different arrangements can be achieved by selecting all channel centre frequencies from a homogeneous basic pattern;

j)   that allocation of frequency blocks to FWA systems allows flexible deployment of various technologies including provision for inter-system/services operation and overall spectrum efficiency,

recommends

1   that the preferred RF channel arrangement for the 24.25-25.25 GHz, 25.25-27.5 GHz and 27.5-29.5 GHz bands should be based on homogeneous patterns;

2   that the homogeneous pattern with a preferred 3.5 MHz interval be defined by the relation:

$$f_p = f_r + 3.5 \, p$$

_____

* Radiocommunication Study Group 5 made editorial amendments to this Recommendation in 2009 in accordance with Resolution ITU-R 1.

where:

$$1 \leq p \leq 285 \qquad \text{for the band 24.25-25.25 GHz}$$

$$287 \leq p \leq 928 \qquad \text{for the band 25.25-27.5 GHz}$$

$$930 \leq p \leq 1\,500 \qquad \text{for the band 27.5-29.5 GHz}$$

f_r: reference frequency of the homogeneous pattern;

3   that the homogeneous pattern with a preferred 2.5 MHz interval be defined by the relation:

$$f_p = f_r + 2 + 2.5\,p$$

where:

$$1 \leq p \leq 399 \qquad \text{for the band 24.25-25.25 GHz}$$

$$401 \leq p \leq 1\,299 \qquad \text{for the band 25.25-27.5 GHz}$$

$$1\,301 \leq p \leq 2\,099 \qquad \text{for the band 27.5-29.5 GHz}$$

f_r: reference frequency of the homogeneous pattern;

4   that the reference frequency of the homogeneous pattern for international connections should be:

$$f_r = 24\,248 \qquad \text{MHz}$$

5   that all go channels should be in one half of any bidirectional band, and all return channels in the other;

6   that the channel spacings, XS, centre gap, YS, and the lower and upper band limits, Z_1S, Z_2S, should be agreed by the administrations concerned, dependent on the application and the channel capacity envisaged (see Recommendation ITU-R F.746 for definitions of XS, YS and ZS);

7   that allocated blocks should result from aggregation of contiguous channels in accordance with the homogeneous pattern.

NOTE 1 – Due regard has to be taken that, in certain countries, a 3.5 MHz homogeneous pattern, interleaved by 1.75 MHz from that referred in *recommends* 2, is used in conjunction with the main pattern.

NOTE 2 – Examples of channel arrangements based on this Recommendation are described in Annexes 1 and 2.

NOTE 3 – Examples of FWA system block (sub-band) arrangements are described in Annex 3.

ANNEX 1

**Radio-frequency channel arrangements for some CEPT administrations
in the band 24.5-26.5 GHz in accordance with *recommends* 2**

An example of the RF channel arrangement based on this Recommendation for carrier spacings of 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz is derived as follows (see Fig. 1):

Let f_0 be the reference frequency of $25\,501$ MHz $= f_r + (358 \times 3.5)$ MHz,

f_n be the centre frequency of a RF channel in the lower half of the band,

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

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

a) for systems with a carrier spacing of 112 MHz:

lower half of band: $f_n = f_0 - 1\,008 + 112\,n$ MHz

upper half of band: $f_n' = f_0 + 112\,n$ MHz

where:

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

b) for systems with a carrier spacing of 56 MHz:

lower half of band: $f_n = f_0 - 980 + 56\,n$ MHz

upper half of band: $f_n' = f_0 + 28 + 56\,n$ MHz

where:

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

c) for systems with a carrier spacing of 28 MHz:

lower half of band: $f_n = f_0 - 966 + 28\,n$ MHz

upper half of band: $f_n' = f_0 + 42 + 28\,n$ MHz

where:

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

d) for systems with a carrier spacing of 14 MHz:

lower half of band: $f_n = f_0 - 959 + 14\,n$ MHz

upper half of band: $f_n' = f_0 + 49 + 14\,n$ MHz

where:

$n = 1, 2, 3, \ldots 64$

(See Note 1)

e) for systems with a carrier spacing of 7 MHz:

lower half of band: $f_n = f_0 - 955.5 + 7\,n$ MHz

upper half of band: $f_n' = f_0 + 52.5 + 7\,n$ MHz

where:

$n = 1, 2, 3, \ldots 128$
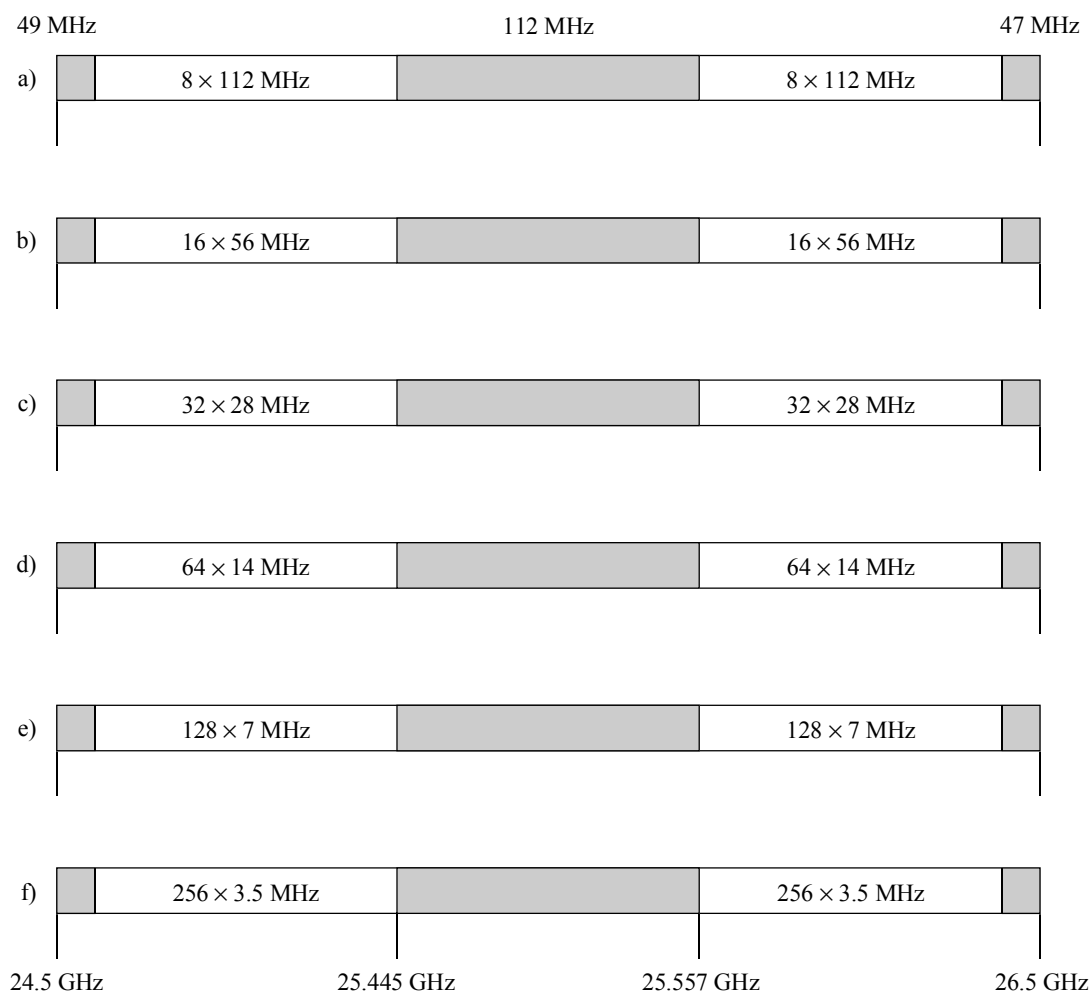
f)   for systems with a carrier spacing of 3.5 MHz:

lower half of band: $f_n = f_0 - 953.75 + 3.5\,n$ MHz

upper half of band: $f'_n = f_0 + 54.25 + 3.5\,n$ MHz

where:

$n = 1, 2, 3, \ldots 256$.

FIGURE 1

NOTE 1 – The RF channel arrangements of § a) to e) of this Annex use channel centre frequencies f_n and f'_n selected from the homogeneous pattern of *recommends* 2. The arrangement of § f) above uses frequencies spaced by 3.5 MHz but interleaved between the homogeneous pattern of *recommends* 2 with an offset of 1.75 MHz.

NOTE 2 – Figure 1 gives occupied spectrum in the 24.5-26.5 GHz band. The centre and edge guardbands may be reduced, by agreement between administrations, to allow the use of an increased number of lower capacity systems, by the addition of extra channels using frequencies derived from the homogeneous pattern of *recommends* 2.

NOTE 3 – The RF channel arrangements of § a) to f) of this Annex may be used in digital systems for P-P and/or P-MP applications.

ANNEX 2

RF channel arrangements for some CEPT administrations in the band 27.5-29.5 GHz in accordance with *recommends* 2

An example of the RF channel arrangement based on this Recommendation for carrier spacings of 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz is derived as follows:

Let f_0 be the centre frequency of $28\,500.5$ MHz $= f_r + (1\,215 \times 3.5)$ MHz,

f_n be the centre frequency of a RF channel in the lower half of the band,

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

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

a) for systems with a carrier spacing of 112 MHz:

lower half of band: $f_n = f_0 - 1\,008 + 112\,n$ MHz

upper half of band: $f_n' = f_0 + 112\,n$ MHz

where:

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

b) for systems with a carrier spacing of 56 MHz:

lower half of band: $f_n = f_0 - 980 + 56\,n$ MHz

upper half of band: $f_n' = f_0 + 28 + 56\,n$ MHz

where:

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

c) for systems with a carrier spacing of 28 MHz:

lower half of band: $f_n = f_0 - 966 + 28\,n$ MHz

upper half of band: $f_n' = f_0 + 42 + 28\,n$ MHz

where:

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

d) for systems with a carrier spacing of 14 MHz:

lower half of band: $f_n = f_0 - 959 + 14\,n$ MHz

upper half of band: $f_n' = f_0 + 49 + 14\,n$ MHz

where:

$n = 1, 2, 3, \ldots 64$

e) for systems with a carrier spacing of 7 MHz:

lower half of band: $f_n = f_0 - 955.5 + 7\,n$ MHz

upper half of band: $f_n' = f_0 + 52.5 + 7\,n$ MHz

where:

$n = 1, 2, 3, \ldots 128$

(See Note 1)
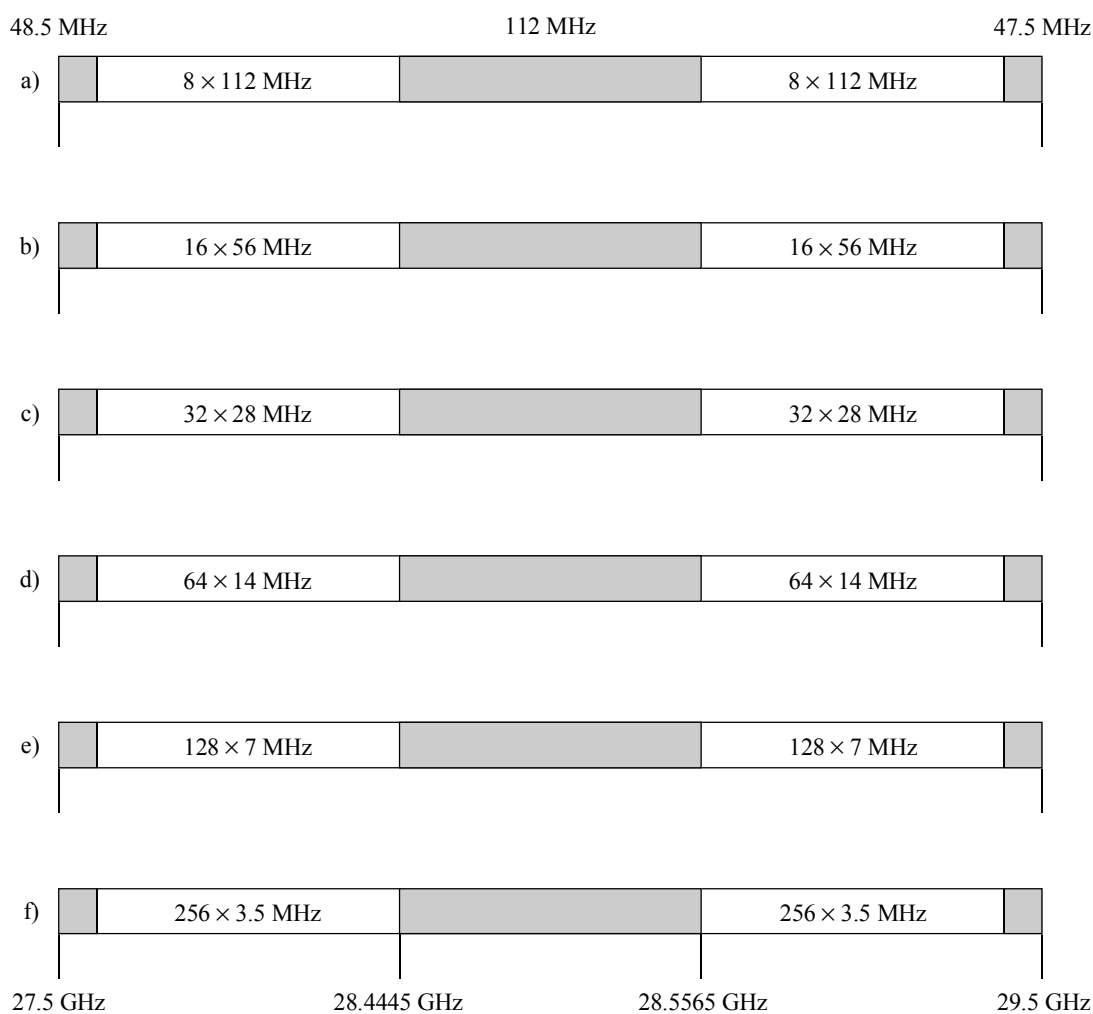
f)   for systems with a carrier spacing of 3.5 MHz:

lower half of band: $f_n = f_0 - 953.75 + 3.5\,n$ MHz

upper half of band: $f'_n = f_0 + 54.25 + 3.5\,n$ MHz

where:

$n = 1, 2, 3, \ldots 256.$

FIGURE 2

NOTE 1 – The RF channel arrangements of § a) to e) of this Annex use channel centre frequencies f_n and f'_n selected from the homogeneous pattern of *recommends* 2. The arrangement of § f) above uses frequencies spaced by 3.5 MHz but interleaved between the homogeneous pattern of *recommends* 2 with an offset of 1.75 MHz.

NOTE 2 – Figure 2 gives occupied spectrum in the 27.5-29.5 GHz band. The centre and edge guardbands may be reduced, by agreement between administrations, to allow the use of an increased number of lower capacity systems, by the addition of extra channels using frequencies derived from the homogeneous pattern of *recommends* 2.

NOTE 3 – The RF channel arrangements of § a) to f) of this Annex may be used in digital systems for P-P and/or P-MP applications.

ANNEX 3

RF block arrangements in the bands 24.25-25.25 GHz and 25.27-26.98 GHz in accordance with *recommends* 7

1 Arrangement based on a 40 MHz frequency block

The following arrangements can be referred to for use by administrations wishing to implement arrangements based on frequency blocks.

1.1 RF block arrangement description

The band 24.25-25.25 GHz is divided into five paired frequency blocks (40 MHz + 40 MHz) as follows:

Paired block	Lower frequency block (MHz)	Upper frequency block (MHz)
A/A'	24 250-24 290	25 050-25 090
B/B'	24 290-24 330	25 090-25 130
C/C'	24 330-24 370	25 130-25 170
D/D'	24 370-24 410	25 170-25 210
E/E'	24 410-24 450	25 210-25 250

1.2 Usage

– The block arrangement is for both P-P and P-MP systems.

– Frequency blocks are paired to facilitate frequency division duplex (FDD) systems. Preference is given to the lower frequency blocks for downlink operation and to the upper frequency blocks for uplink operation. Time division duplex (TDD) systems may operate in either the lower or upper frequency blocks.

– Operators may subdivide the 40 MHz blocks according to their needs.

– Larger frequency blocks can be made available through the aggregation of 40 MHz paired blocks.

2 Arrangement based on a 60 MHz frequency block

2.1 RF block arrangement description

The band 25.27-26.98 GHz is divided into 13 paired frequency blocks (60 MHz + 60 MHz) as follows.

Paired block	Lower frequency block (MHz)	Upper frequency block (MHz)
D1/D'1	25 270-25 330	26 125-26 185
D2/D'2	25 330-25 390	26 185-26 245
D3/D'3	25 390-25 450	26 245-26 305
B1/B'1	25 450-25 510	26 305-26 365
B2/B'2	25 510-25 570	26 365-26 425
B3/B'3	25 570-25 630	26 425-26 485
B4/B'4	25 630-25 690	26 485-26 545
B5/B'5	25 690-25 750	26 545-26 605
B6/B'6	25 750-25 810	26 605-26 665
B7/B'7	25 810-25 870	26 665-26 725
D4/D'4	25 945-26 005	26 800-26 860
D5/D'5	26 005-26 065	26 860-26 920
D6/D'6	26 065-26 125	26 920-26 980

2.2   Usage

–   The block arrangement is for both P-P and P-MP systems.

–   Frequency blocks are paired to facilitate FDD systems. Preference is given to the lower frequency blocks for uplink operation and to the upper frequency blocks for downlink operation. TDD systems may operate in either the lower or upper frequency blocks.

–   Operators may subdivide the 60 MHz blocks according to their needs.

–   Larger frequency blocks can be made available through the aggregation of 60 MHz paired blocks.