**Annex 1.2.**

**Available frequency bands and channel arrangements**

**Introduction:**

The channel arrangement can be defined as the subdivision of a “frequency band” into smaller portion called “channel”. Any channel is usually characterised by its centre frequency and by a progressive numeration.

Recommendations for radio-frequency channel arrangements have been developed by the ITU and are in continuous evolution. This Annex of the HANDBOOK examines the general principles adopted by Recommendations for digital radio-relay systems and presents a summary of all the current radio-frequency arrangements.

**Available frequency bands:**

Appendix 1 to Annex 1.2.:

HCM table of frequency allocations and utilisations (1 GHz to 100 GHz)

The Appendix 1 (to this Annex) provides the HCM table of frequency allocations and utilisations (in the frequency range 1 GHz to 100 GHz) for possible extension of HCM Agreement (new frequency bands) and modification of table in (Art. 1.2.3.), which contains only the frequency bands for fixed services with description of shared fixed service and mobile service bands.

**Spectrum related parameters:**

The main parameters that affect the choice of a radio-frequency arrangement are the spectrum elated parameters XS, YS, ZS and DS defined as:

XS: defined as the radio-frequency separation between the centre frequencies of adjacent radio-frequency channels on the same polarization and in the same direction of transmission;

YS: defined as the radio-frequency separation between the centre frequencies of the go and return radio‑frequency channels which are nearest to each other.

ZS: defined as the radio-frequency separation between the centre frequencies of the outermost radio-frequency channels and the edge of the frequency band.

DS: Tx/Rx duplex spacing, defined as the radio-frequency separation between corresponding go and return channels, constant for each couple of i‑th and i'‑th frequencies, within a given channel arrangement.



Figure 1: Radio-frequency channel arrangements for the three possible schemes in the text

The choice of radio-frequency channel arrangement depends on the values of cross-polar discrimination (XPD) and on the net filter discrimination (NFD) where these parameters are defined as:





The *XPD* and *NFD* parameters (dB) contribute to the value of carrier-to-interference ratio.

If *XPDmin* is the minimum value reached for the percentage time required, from this value and from the adjacent channel *NFD*, the total amount of interfering power can be evaluated, and this result must be compared with the minimum value of carrier-to-interference (*C*/*I*)*min* acceptable to the modulation adopted (see Note 4).

Alternated channel arrangements can be used (neglecting the co-polar adjacent channel interference contribution) if:

*XPDmin* + (*NFD* – 3) ≥ (*C*/*I*)*min*                dB

Co-channel arrangements can be used if:

                dB

Interleaved channel arrangements can be used if:

                dB

where:

*NFDa* : net filter discrimination evaluated at *XS* frequency spacing;

*NFDb* : net filter discrimination evaluated at *XS* / 2 frequency spacing;

*XIF* : *XPD* improvement factor of any cross-polar interference countermeasure, if implemented in the interfered receiver;

**3** that the channel arrangements reported in Fig. 1 may be used for digital FWSs either with single carrier or multi-carrier transmission (see Note 5);

**4** that when multi-carrier transmission is employed, the overall number of carriers will be regarded as a single channel whose centre frequency and channel spacing will be that defined according to Fig. 1 disregarding the actual centre frequency of the carriers, which may vary, for technical reasons, according to practical implementations;

**5** that where practicable (e.g. in newly exploited or rearranged bands with comparable width) it is useful to have the same duplex separation in different nearby frequency bands;

**6** that the following categorization with respect to the transmission capacity may be used in ITU-R Recommendations on digital fixed wireless systems (see also Annex 1 to Recommendation ITU-R F.1101):

– “low-capacity fixed wireless systems” for the transmission of digital signals with gross bit rates up to and including 10 Mbit/s;

– “medium-capacity fixed wireless systems” for the transmission of digital signals with gross bit rates ranging from 10 Mbit/s up to about 100 Mbit/s;

– “high-capacity fixed wireless systems” for the transmission of digital signals with gross bit rates greater than 100 Mbit/s;

**7** that Tables 1 and 2 report the summary of presently ITU-R defined radio-frequency channel arrangements with reference to the relevant Recommendation. Some radio-frequency channel arrangements in bands that are not covered by a specific Recommendation, and which are nevertheless used by administrations, are described in Annexes 1 to 8.

Table 1.

Radio-frequency channel arrangements for RR systems in frequency bands above 1 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Band (GHz) | Frequency range (GHz) | Recommendations  ITU-R F Series | Channel separation (MHz) |
| 2 | 1.427-2.69 1.7-2.1; 1.9-2.3 1.9-2.3 1.9-2.3 1.9-2.3 2.3-2.5 2.29-2.67 | ITU-R 701 ITU-R 382 ITU-R 1098 ITU-R 1098, Annexes 1, 2 ITU-R 1098, Annex 3 ITU-R 746, Annex 1 ITU-R 1243 | 0.5 (pattern)  29 3.5; 2.5 (patterns) 14 10 1; 2; 4; 14; 28 0.25; 0.5; 1; 1.75; 2; 3.5; 7; 14; 2.5 (pattern) |
| 3.6 | 3.4-3.8 3.4-3.8 | ITU-R 1488, Annex 1 ITU-R 1488, Annex 2 | 25(1) 0.25(2) |
| 4 | 3.8-4.2 3.7-4.2 3.4-4.2 3.6-4.2 3.4-4.2 | ITU-R 382 ITU-R 382, Annex 1 ITU-R 635 ITU-R 635, Annex 1 ITU-R 635, Annex 1 | 29 28 10 (pattern) 40; 30 80 |
| U4 | 4.4-5.0 4.4-5.0 4.4-5.0 4.54-4.9 | ITU-R 1099 ITU-R 1099, Annex 1 ITU-R 1099, Annex 3 ITU-R 1099, Annex 2 | 10 (pattern) 40; 80 28  40; 20 |
| L6 | 5.925-6.425 5.925-6.425 5.925-6.425 5.925-6.425 | ITU-R 383 ITU-R 383, Annex 1 ITU-R 383, Annex 2 ITU-R 383, Annex 3 | 29.65 40 28 40; 20; 10; 5 |
| U6 | 6.425-7.11 6.425-7.11 6.425-7.11 | ITU-R 384 ITU-R 384, Annex 1 ITU-R 384, Annex 2 | 40; 30; 20; 10; 5 80 30; 14; 7; 3.5 |
| 7 | 7.25-7.55 7.425-7.725 (7.125-7.425)(3) (7.250-7.550)(3) (7.550-7.850)(3) 7 125-7 425 7.425-7.725 7.435-7.75 7.11-7.75 7.425-7.90 | ITU-R 385, Annex 5 ITU-R 385  ITU-R 385, Annex 1 ITU-R 385, Annex 1 ITU-R 385, Annex 2 ITU-R 385, Annex 3 ITU-R 385, Annex 4 | 3.5 7; 14; 28  1.75; 3.5; 7; 14; 28 1.75; 3.5; 7; 14; 28 5; 10; 20 28 28 |
| 8 | 7.725-8.275 7.725-8.275  8.275-8.5 7.9-8.4 7.725-8.275 8.025-8.5 7.725-8.275 | ITU-R 386, Annex 1 ITU-R 386, Annex 2 ITU-R 386, Annex 2 ITU-R 386, Annex 3 ITU-R 386, Annex 4 ITU-R 386, Annex 5 ITU-R 386, Annex 6 | 30; 20; 10; 5; 2.5; 1.25 28; 14; 7 28; 14; 7 28; 14; 7 40; 20; 10; 5 28; 14; 7 29.65 |
| 10 | 10.0-10.68 10.0-10.68 10.15-10.65 10.15-10.65 10.15-10.65 10.5-10.68 10.55-10.68 | ITU-R 747 ITU-R 747, Annex 4  ITU-R 747, Annex 3  ITU-R 1568, Annex 1 ITU-R 1568, Annex 2 ITU-R 747, Annex 1 ITU-R 747, Annex 2 | 1.25 and 3.5 patterns 3.5; 7; 14; 28 (patterns) 3.5; 7; 14; 28 (patterns) 28(1) 30(1) 7; 3.5 (patterns) 5; 2.5; 1.25 (patterns) |
| 11 | 10.7-11.7 10.7-11.7 10.7-11.7 10.7-11.7 10.7-11.7 | ITU-R 387 ITU-R 387, Annex 2 ITU-R 387, Annex 1 ITU-R 387, Annex 3 ITU-R 387, Annex 4 | 40  60 80 5; 10; 20 7; 14; 28 |
| 12 | 11.7-12.5 12.2-12.7 | ITU-R 746, Annex 2, § 3 ITU-R 746, Annex 2, § 2 | 19.18 20 (pattern) |
| 13 | 12.75-13.25 12.7-13.25 | ITU-R 497 ITU-R 746, Annex 2, § 1 | 28; 14; 7; 3.5 25; 12.5 |
| 14 | 14.25-14.5 14.25-14.5 | ITU-R 746, Annex 3 ITU-R 746, Annex 4 | 28; 14; 7; 3.5 7; 14; 28 |
| 15 | 14.4-15.35 14.5-15.35 14.5-15.35 | ITU-R 636 ITU-R 636, Annex 1 ITU-R 636, Annex 2 ITU-R 636, Annex 3 | 56; 28; 14; 7; 3.5 2.5 (pattern) 2.5 5; 10; 20; 30; 40; 50 |
| 18 | 17.7-19.7 17.7-19.7 17.7-19.7 17.7-19.7 17.7-19.7 17.7-19.7 17.7-19.7 17.7-19.7 18.58-19.16 | ITU-R 595 ITU-R 595, Annex 1 ITU-R 595, Annex 2 ITU-R 595, Annex 3 ITU-R 595, Annex 4 ITU-R 595, Annex 5 ITU-R 595, Annex 6 ITU-R 595, Annex 7 ITU-R 595, Annex 7 | 220; 110; 55; 27.5 60 (block) 50; 40; 30; 20; 10; 5; 2.5 7; 3.5 27.5; 13.75; 7.5; 7; 3.5; 1.75 55; 110 55; 27.5; 13.75 60 |
| 23 | 21.2-23.6 21.2-23.6 22.0-23.6 21.2-23.6 21.2-23.6 | ITU-R 637 ITU-R 637, Annex 1 ITU-R 637, Annex 2 ITU-R 637, Annex 3  ITU-R 637, Annex 4 | 3.5; 2.5 (patterns) 112 to 3.5 112 to 3.5 2.5; 5; 7.5; 10; 15; 20; 40; 50 112 to 3.5 |
| 27 | 24.25-25.25 24.25-25.25 25.25-27.5 25.27-26.98 24.5-26.5 27.5-29.5 27.5-29.5 | ITU-R 748 ITU-R 748, Annex 3 ITU-R 748 ITU-R 748, Annex 3 ITU-R 748, Annex 1 ITU-R 748 ITU-R 748, Annex 2 | 3.5; 2.5 (patterns) 40(1) 3.5; 2.5 (patterns) 60(1) 112 to 3.5 3.5; 2.5 (patterns) 112 to 3.5 |
| 31 | 31.0-31.3 31.0-31.3 | ITU-R 746, Annex 5 ITU-R 746, Annex 6 | 25; 50 28; 14; 7; 3.5 |
| 32 | 31.8-33.4 31.8-33.4 | ITU-R 1520, Annex 1 ITU-R 1520, Annex 2 | 3.5; 7; 14; 28; 56; 112 56(1) |
| 38 | 36.0-40.5 36.0-37.0 37.0-39.5 38.6-39.48 38.6-40.0 39.5-40.5 | ITU-R 749 ITU-R 749, Annex 2 ITU-R 749, Annex 1 ITU-R 749, Annex 2 ITU-R 749, Annex 2 ITU-R 749, Annex 3 | 3.5; 2.5 (patterns) 112 to 3.5 112; 56; 28; 14; 7; 3.5 60(1) 50(1) 112 to 3.5 |
| 42 | 40.5-43.5 40.5-43.5 40.5-43.5 | ITU-R F.2005, Annex 1 ITU-R F.2005, Annex 2 ITU-R F.2005, Annex 3 | 112; 56; 28; 14; 7 Variable size blocks Mixed 112 to 7 and blocks |
| 52 | 51.4-52.6 | ITU-R 1496, Annex 1 | 56; 28; 14; 7; 3.5 |
| 62 | 55.78-57.0 57.0-64.0 64.0-66.0 | ITU-R 1497, Annex 1 ITU-R 1497, Annex 2 ITU-R 1497, Annex 3 | 56; 28; 14; 7; 3.5 50 × *n* (*n* = 1, …50) 30 × *n* (*n* = 1, …, 33 for FDD,  *n* = 1, …, 66 for TDD) 50 × *n* (*n* = 1, …, 19 for FDD, *n* = 1, …, 38 for TDD) |
| 70/80 | 71-76 GHz/81-86 GHz 71-76 GHz/81-86 GHz  71-76 GHz/81-86 GHz  74-76 GHz/84-86 GHz | ITU-R F.2006  ITU-R F.2006, Annex 1 ITU-R F.2006, Annex 2 ITU-R F.2006, Annex 2 | 125 MHz (pattern)  n × 250 MHz blocks (n = 1, …, 20)  n × 250 MHz channels  (n = 1, …, 18) n × 250 MHz channels  (n = 1, …, 7) |
| 94 | 92.0-94 / 94.1-95 | ITU-R F.2004 | 50, 100, N × 100 |

**References:**

* Radio Regulations (Edition 2012)
* ITU-R Recommendations (F and SF)
* ITU-R Reports (F)
* ECC Recommendations
* ECC Reports
* ERC REPORT 25 (2015)
* ERC Report 173
* CEPT Report 19