Electronic Communications Committee (ECC)
within the Conference of Postal and Telecommunications Administrations (CEPT)

ECC RECOMMENDATION (05)07

RADIO FREQUENCY CHANNEL ARRANGEMENTS FOR FIXED SERVICE SYSTEMS OPERATING IN THE BANDS 71-76 GHz AND 81 - 86 GHz

Recommendation approved by the Working Group "Spectrum Engineering" (WGSE)

INTRODUCTION

The millimetre wave spectrum above 70 GHz is of increasing interest to service providers and systems designers because of the wide bandwidth available for carrying communications at this frequency range. These wide bandwidths are valuable in supporting applications such as extremely-high-speed data transmission. Because of the unique nature of the propagation in the millimetre bands and possibility to employ highly directional (pencil-sized) beams, multiple services and applications can be implemented without interference concerns, thus ensuring highly efficient re-use of the frequency band.

The use of the 71 - 76 GHz and/or 81 - 86 GHz bands provides an inviting opportunity to cope with the future market demands for increasingly high bandwidth access, in particular for Internet-bases applications. Fixed radio links may be deployed much quicker and in certain cases are more cost efficient than the wired networks, and as such the millimetre waves provide sufficient bandwidth for terrestrial fixed links to compete or complement the fiber optic based access networks. The competing FSO (Free space optics) systems are also emerging as a possible solution that on short distances can support broadband capabilities (1-10 Gbit/s) with reasonable availability and reliability.

In the proposed scenario of using the 71 - 76 GHz and/or 81 - 86 GHz band for fixed services, it appears possible to implement very high capacity (up to 10 Gbit/s) links with some 1-2 km hop lengths (line-of-sight conditions); these systems would allow a rapid and effective deployment of broadband capacity in areas where fibre optic cables are not available or are not cost-effective.

The main features of operating fixed radio systems in this region of spectrum may be summed up as follows:

- Availability of wide bandwidths, allowing for the low cost of traffic in terms of bit/sec/Hertz/Euro;
- Possibility of multiple channel frequency re-use, thanks to the unique propagation conditions, highly directional pencil-sized beams; this will also enable implementation of multiple services and applications without interference concerns, obviating the need for coordination;
- Radio links are much easier to install comparing to alternative wire-bound solutions like fiber optical links;
- Ability to ensure high security because of low possibility of interference/capture of signals.

Use of the spectrum above 70 GHz is the only viable solution for fixed links to achieve the above objectives. The lower FS band at around 52 GHz (28/56 MHz channels) has similar propagation conditions but does not provide sufficient space for truly wide band links.

Therefore the bands 71 - 76 GHz and 81 - 86 GHz may be considered suitable for high speed data FS links.

It should be noted that the bands 71 - 76 GHz and 81 - 86 GHz are used in some countries by other services or applications than FS civil links. In particular the bands 71 - 74 GHz and 81 - 84 GHz have been identified as NATO Type 3 bands, i.e. for possible military use in NATO Europe. This should be taken into account by administrations wishing to use whole or parts of the frequency bands 71 - 76 GHz and/or 81 - 86 GHz for civil FS links.

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that ITU Radio Regulations (RR) and the European Table of Frequency Allocations and Utilisations (CEPT/ERC Report 25) allocate the bands 71 - 76 GHz and 81 - 86 GHz on a primary basis to Fixed Service as well as other co-primary services;

b) that the European Table of Frequency Allocations and Utilisations in ERC Report 25 identifies the bands 71 - 74 GHz and 81 - 84 GHz as harmonised military bands for defence systems, but recognises that these bands can be shared between civil and military users according to national requirements and legislation (see ECA footnote EU27);

c) that ITU RR No. 5.340 prohibits all emissions, *inter alia*, in the band 86 - 92 GHz, and care should be taken to limit FS out-of-band emissions into that band;

d) that ITU RR No.5.149 applies to the frequency range 81- 86 GHz which urges administrations to take all practicable steps to protect the radio astronomy service from harmful interference;

e) that the propagation characteristics of the 71 - 76 GHz and 81 - 86 GHz are ideally suited for use of short range FS links in high density networks;

f) that, as the propagation loss difference in the bands 71 - 76 GHz vs. 81 - 86 GHz is within the range of 1 dB for the hop lengths of up to 2 km, this also suggests the possibility of using these two bands together for FDD links with large duplex separation, if necessary;

g) that the FS uses envisaged in this band include various transmission digital systems with different modulation schemes, system gains and providing high data rate capacities;

h) that a large number of new FS systems could be deployed in the range of 71 - 76 GHz and 81 - 86 GHz, relieving congestion in the lower frequency bands;

i) that the 79 GHz frequency band (77 - 81 GHz) has been designated to the SRR equipment in accordance with ECC/DEC(04)03;

recommends

1) that administrations wishing to use whole or parts of the frequency bands 71 - 76 GHz and/or 81 - 86 GHz for civil FS links should consider the channel arrangements given in Annex 1 and Annex 2 respectively;

2) that administrations wishing to assign duplex channels, may use the bands 71 - 76 GHz and 81 - 86 GHz as paired bands, or as a separate single bands containing internal duplex separation, as illustrated in Annex 3;

3) that when extremely high bit rate system with high system gain is required, administrations may allow flexible aggregation of any number of 250 MHz channels, as illustrated in Annex 3;

4) that until the relevant ETSI technical specifications for FS in these frequency bands are developed, administrations may find examples of technical parameters for civil FS links in these bands in Annex 4.

Note:
Please check the Office web site (http//:www.ero.dk) for the up to date position on the implementation of this and other ECC Decisions.

Annex 1

RADIO-FREQUENCY CHANNEL ARRANGEMENTS IN THE BAND 71 - 76 GHz

Let f_r be the reference frequency of 71000 MHz,
f_n be the centre frequency of a radio-frequency channel in the band 71 - 76 GHz,
n be the channel number,

then the centre frequencies of individual channels with 250 MHz separation are expressed by the following relationship:

$$f_n = f_r + 250 \cdot n \quad \text{MHz}$$

where:

n = 1, 2, 3, ..., 19

Note, that the specified channels may be used to form either TDD or FDD systems within the single band, or in combination with other band specified in this recommendation.

Calculated parameters according to ITU-R Rec. 746

XS MHz	n	f1 MHz	fn MHz	Z1S MHz	Z2S MHz
250	1,...19	71250	75750	250	250

TABLE A1.1

XS Separation between centre frequencies of adjacent channels
Z1S Separation between the lower band edge and the centre frequency of the first channel
Z2S Separation between centre frequencies of the final channel and the upper band edge

Annex 2

RADIO-FREQUENCY CHANNEL ARRANGEMENTS IN THE BAND 81 - 86 GHz

Let f_r be the reference frequency of 81000 MHz,
f_n be the centre frequency of a radio-frequency channel in the band 81 - 86 GHz,
n be the channel number,

then the centre frequencies of individual channels with 250 MHz separation are expressed by the following relationship:

$$f_n = f_r + 250 \cdot n \quad \text{MHz}$$

where:

n = 1, 2, 3, ..., 19

Note, that the specified channels may be used to form either TDD or FDD systems within the single band, or in combination with other band specified in this recommendation.

Calculated parameters according to ITU-R Rec. 746

XS MHz	n	f1 MHz	fn MHz	Z1S MHz	Z2S MHz
250	1,...19	81250	85750	250	250

TABLE A2.1

XS Separation between centre frequencies of adjacent channels
Z1S Separation between the lower band edge and the centre frequency of the first channel
Z2S Separation between centre frequencies of the final channel and the upper band edge

Annex 3

EXAMPLES OF PAIRING AND AGGREGATING CHANNELS IN FREQUENCY BANDS 71 -76 / 81 - 86 GHz

The principle of using the channels from within the bands 71 - 76 GHz and 81 - 86 GHz in a single duplex FDD arrangement is described in the Fig. A3.1.

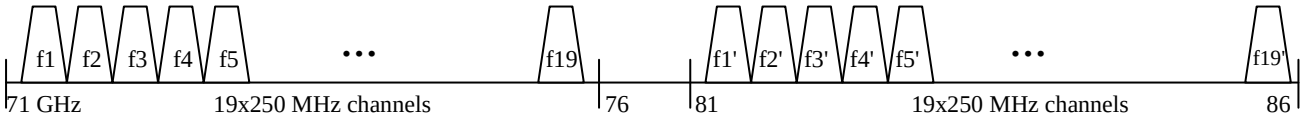

Fig. A3.1. Combining the channels from 71 - 76 / 81 - 86 GHz bands into a single FDD arrangement with duplex separation of 10 GHz

The principle of duplex channels within a single band 71 - 76 GHz or 81 - 86 GHz with duplex separation of less than 5 GHz is shown in Fig. A3.2.

Fig. A3.2. Combining the channels from single 71 - 76 GHz or 81 - 86 GHz band into an FDD arrangement with duplex separation of less than 5 GHz

When the wider channels are needed, e.g. for very high bitrate and high system gain applications (e.g. employing FSK modulation), then a flexible number of consecutive 250 MHz channels may be aggregated into FDD channels, as illustrated in Fig. A3.3 for duplex separation of 10 GHz or in Fig. A3.4 for duplex separation of less than 5 GHz.

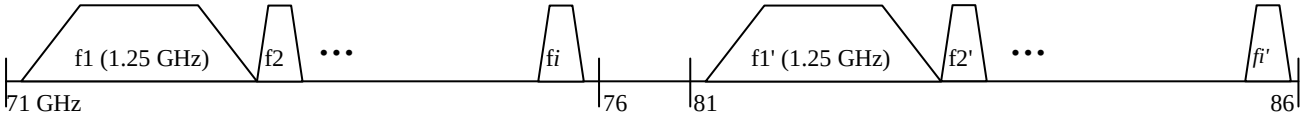

Figure A3.3: Example of aggregating multiple 250 MHz channels, possibly alongside with original 250 MHz wide channels

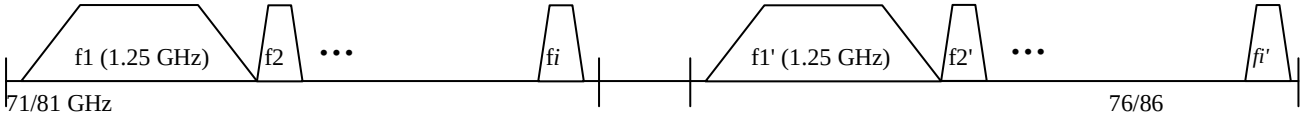

Figure A3.4: Example of aggregating multiple 250 MHz channels, possibly alongside with original 250 MHz wide channels within the single band 71 - 76 or 81 - 86 GHz

Annex 4

PRELIMINARY EXAMPLES OF FS TECHNICAL PARAMETERS CONSIDERED IN FREQUENCY BANDS 71 - 76 / 81 - 86 GHz

This annex provides examples of the key FS radio system parameters, which may be used by administrations as a guidance for interference evaluation and calculations for frequency sharing with other services in frequency bands 71 - 76 GHz and 81 - 86 GHz. These parameters should not be understood as regulatory limits.

The following tables set out the basic parameters for FS system, suited to transmit 1Gbit/s payload but exploiting different number of 250 MHz channels in 71 - 76 GHz frequency band and/or in 81 - 86 GHz frequency band, according to the arrangements given in Annexes 1-3 of this recommendation.

Frequency bands	GHz	71 - 76	81 – 86
Channel Bandwidth (MHz)	MHz	250	
Payload rate (Gbit/s)	Gbit/s	1	
Modulation scheme		128QAM	
Receiver Noise bandwidth	MHz	190	
Noise Figure @ Antenna Port	dB	12	13
Receiver signal power for BER 10^{-6}	dBm	-56	-55
Antenna gain	dB	50	
Maximum output power level @ antenna port	dBm	5	4
Additional feeder losses	dB	0	
Antenna radiation pattern		ITU-R F.699 and 1245	

Table A4.1: Parameters for 1Gb/s FS link using one 250 MHz channel

Frequency bands	GHz	71 - 76	81 – 86
Channel Bandwidth (MHz)	MHz	500	
Payload rate (Gbit/s)	Gbit/s	1	
Modulation scheme		16QAM	
Receiver Noise bandwidth	MHz	350	
Noise Figure @ Antenna Port	dB	12	13
Receiver signal power for BER 10^{-6}	dBm	-61	-60
Antenna gain	dB	50	
Maximum output power level @ antenna port	dBm	7-14	6-14
Additional feeder losses	dB	0	
Antenna radiation pattern		ITU-R F.699 and 1245	

Table A4.2: Parameters for 1Gb/s FS link using two aggregated 250 MHz channels

Frequency bands	GHz	71 - 76	81 – 86
Channel Bandwidth (MHz)	MHz	1250	
Payload rate (Gbit/s)	Gbit/s	1	
Modulation scheme		FSK	
Receiver Noise bandwidth	MHz	1000	
Noise Figure @ Antenna Port	dB	12	13
Receiver signal power for BER 10^{-6}	dBm	-64	-63
Antenna gain	dB	50	
Maximum output power level @ antenna port	dBm	14-20	14-20
Additional feeder losses	dB	0	
Antenna radiation pattern		ITU-R F.699 and 1245	

Table A4.3: Parameters for 1Gb/s FS link using five aggregated 250 MHz channels