ECC Recommendation (14)01

Radio frequency channel arrangements for fixed service systems operating in the band 92-95 GHz

Approved 31 January 2014

Ammended May 2015

Edition May 2015

INTRODUCTION

The millimetre wave spectrum in the range from 70 to 100 GHz is of increasing interest to service providers and systems designers because of the favourable propagation, nearly free from O_2 absorption attenuation and of the wide bandwidth available for carrying communications. Considering also the possible use of high directional/high gain antennas of relatively small size, these wide bandwidths are valuable in supporting applications such as extremely-high-speed data transmission over significant hop lengths, while offering an inherent reduced interference occurrence probability similar to that experienced in lower FS bands such as the 38 GHz one.

Multiple services and applications can be implemented, with simplified coordination mechanisms, ensuring highly efficient re-use of the frequency band. A simplified coordination mechanism is understood as where the link by link coordination, traditionally under the responsibility of the administration, is still required but would be performed by the license holders (i.e. operators). On this subject, ECC Report 80 describes a "light licensing regime" summarised as: *"Light licensing regime, where the position and characteristics of the stations are recorded on a database on a first-come first-served basis, with responsibility for subsequent users to ensure the compatibility with previously notified stations"*.

The choice of the appropriate assignment method and licensing regime remains a decision for national administrations.

The use of the 92-94 GHz and/or 94.1-95 GHz bands provides an inviting opportunity to cope with the future market demands for increasingly high bandwidth access, in particular for Internet-based applications. Fixed radio links may be deployed much quicker and in certain cases are more cost efficient than the wired networks, and as such these bands provide sufficient bandwidth for terrestrial Fixed links to compete or complement the fiber optic-based access networks.

In the proposed scenario of using the 92-94 GHz and/or 94.1-95 GHz band for Fixed Services, availability objectives in the order of 99.99% with the average European rain rates may be satisfied by very high capacity (up to 10 Gbit/s) links with some 1-2 km hop lengths (line-of-sight conditions); Longer hops may be implemented with reduced availability objectives. Consideration is also given to the slight attenuation variation between the two bands (92-94 GHz and 94.1-95 GHz), which make possible their paired use. 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 part of the spectrum may be summed up as follows:

- Availability of wide bandwidths, allowing for the low cost of traffic;
- Possibility of multiple channel frequency re-use, thanks to highly directional antenna beams;
- Feasibility of deploying radio links is much easier in comparison to alternative wire-bound solutions;
- Ability to ensure high security because of low possibility of interference/capture of signals.

It should be noted that the bands 92-94 GHz and 94.1-95 GHz are used in some countries by other services or applications than FS civil links. In particular the European Table of Frequency Allocations and Utilisations (ECA, ERC Report 25, footnote 5.149)) mentions that ,in making assignments to stations of other services to which this bands is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference.

ECC RECOMMENDATION (14)01 ON RADIO FREQUENCY ARRANGEMENTS FOR FIXED SERVICE SYSTEMS OPERATING IN THE BAND 92-95 GHz AMENDED 8 MAY 2015

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that ITU Radio Regulations (RR) and the ECA allocate the bands 92-94 GHz and 94.1-95 GHz on a primary basis to Fixed Service as well as other co-primary services;

b) that ITU RR No.5.149 applies to the frequency range 92-94 and 94.1-100 GHz which urges administrations to take all practicable steps to protect the radio astronomy service from harmful interference;

c) that ITU RR No. 5.562A indicates that in the bands 94-94.1 GHz, transmissions from space stations of the Earth exploration-satellite service (active) that are directed into the main beam of a radio astronomy antenna have the potential to damage some radio astronomy receivers.Space agencies operating the transmitters and the radio astronomy stations concerned should mutually plan their operations so as to avoid such occurrences to the maximum extent possible.

d) that the use of the band 94-94.1 GHz by the Earth exploration-satellite (active) and space research (active) services is limited to spaceborne cloud radars. (WRC-97) ;

e) that the propagation characteristics of the 92.0-95.0 GHz band are ideally suited for use of short-range digital radio links in high-density networks;

f) that ECC/REC/(01)05 provides information for planning of P-P Fixed Service systems;

g) that in the frequency range a high antenna directivity is achievable even with small-size antennas, increasing the density of equipment and further reducing the risk of interference within the same and other services;

h) that the low end of the frequency band is suitable for the longest-hop radio links because the atmospheric attenuation is less than at the top of the band;

i) that ITU-R Resolution 750 (Rev. WRC-12) provides relevant Recommended maximum level of unwanted emission from FS in the band 92-94 GHz to ensure protection of EESS (passive) in the 86-92 GHz band based on the results of technical studies given in ITU-R Report F. 2239.

recommends

1. that the use of FS in the 92-94 and 94.1-95 GHz bands be mainly intended for Point-to-Point (PP); systems ;

2. that administrations wishing to use whole or parts of the frequency bands 92-94 and 94.1-95 GHz for FS links and preferring to implement channel arrangement should consider the basic channel arrangements given in Annex 1 (for TDD), Annex 2 (for FDD) and Annex 3 (Multiple size TDD/FDD aggregated channels);

3. that administrations wishing to assign pre-defined channels of multiple size, either paired or unpaired, may consider the channel arrangements illustrated in Annex 3;

4. that administrations who wish to implement a self-coordination mechanism similar to "light licensing" may refer to the example provided in Annex 4;

5. that in order to protect the EESS (passive) operations in the band 86-92 GHz, the unwanted emissions at the antenna port of any FS station in that band should respect the mask provided in Annex 5."

Note:

Please check the Office documentation database http://www.ecodocdb.dk for the up to date position on the implementation of this and other ECC Recommendations.

ANNEX 1: RADIO-FREQUENCY CHANNEL ARRANGEMENTS IN THE BAND 92-95 GHz* FOR SYSTEMS USING TDD

Let

f_r : be the reference frequency of 92 000 MHz;
f_n :be the centre frequency of a radio-frequency channel in the band 92-95 GHz;

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

a. for systems with a channel separation of 100 MHz: $f_n = f_r + 100\ n$ MHz

where: n = 1, 2, …, 19, 22, 23, …, 29 (Notes 1 and 2)

b. for systems with a channel separation of 50 MHz: $f_n = f_r + 25 + 50\ n$ MHz

where: n = 1, 2, …, 39, 43, 44, …, 58 (Note 1).

Table 1: Calculated parameters according to Recommendation ITU-R F.746

XS MHz	n	f1 MHz	fn MHz	Z1S MHz	Z1Si	Z2Si	Z2S MHz
50	1,..39,42,...,58 (note1)	92075	94925	75	25	25	75
100	1,..19,22,....29 (note 1)	92100	94900	100	100	100	100

XS Separation between centre frequencies of adjacent channels;
Z1S Separation between the lower band edge and the centre frequency of the first channel;
Z1Si Separation between centre frequency of the innermost channel of the lower band and the center gap edge;
Z1Si Separation between centre frequency of the innermost channel of the higher band and the center gap edge;
Z2S Separation between centre frequency of the final channel and the upper band edge.

Note 1 : Channel with n=20 and 21 of the 100 MHz arrangement and N=40 and 41 of the 50 MHz arrangement are not to be used.
Note 2 : Channel arrangements with carrier spacing of 200,300,...,MHz are possible by channel concatenation (see Annex 3).

* The band 94-94.1 GHz is not allocated to the fixed service in the Radio Regulations.

ANNEX 2: RADIO-FREQUENCY CHANNEL ARRANGEMENT IN THE BAND 92.0-95.0 GHz* FOR SYSTEMS USING FDD

The radio-frequency channel arrangement for channel separations of 100 MHz and 50 MHz shall be derived as follows:

Let

f_r: be the reference frequency of 92 000 MHz;
f_n: be the centre frequency (MHz) of the radio-frequency channel in the lower half of the band;
f'_n: be the centre frequency (MHz) of the radio-frequency channel in the upper half of the band;
TX/RX separation = 1 500 MHz;
band separation = 100 MHz;

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

a. for systems with a channel separation of 100 MHz:

lower half of the band: $f_n = f_r + 100\ n$
upper half of the band: $f'_n = f_r + 1\ 500 + 100\ n$
where n = 1, 2, 3, 4, 7, 8, …, 14 (Notes 1 and 2)

b. for systems with a channel separation of 50 MHz:

lower half of the band: $f_n = f_r + 25 + 50\ n$
upper half of the band: $f'_n = f_r + 1\ 525 + 50\ n$
where n = 1, 2, 3, …, 9, 12, 13, …, 28 (Note 1).

Table 2: Calculated parameters according to Recommendation ITU-R F.2004

XS MHz	n	f1 MHz	fn MHz	f'_1 MHz	f'_n MHz	Z1S MHz	Z2S MHz	YS MHz	DS MHz
50	1,2,3,...,,9	92075	92475	93575	93975	75	10255	1100	1500
	12,13,,,..,,28	92625	93425	94125	94925	625	75	700	1500
100	1,2,3,4	92100	92400	93600	93900	100	1100	1200	1500
	7,8,...,14	92700	93400	94200	94900	700	100	800	1500

XS Separation between centre frequencies of adjacent channels
YS separation between the centre frequencies of the go and return radio-frequency channels which are nearest to each other (also named innermost channels).
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.
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

Note 1 : Channel with n=5' and 6' of the 100 MHz arrangement and n=10' and 11' of the 50 MHz arrangement are not to be used. Unpaired frequency band 92.45-92.65 GHz of the 100 MHz arrangements and 92.5-92.6 GHz of the 50 MHz arrangement, can be used for TDD.
Note 2 : Channel arrangements with carrier spacing of 200,300,...,MHz are possible by channel concatenation (see Annex 3).

* The band 94-94.1 GHz is not allocated to the fixed service in the Radio Regulations.

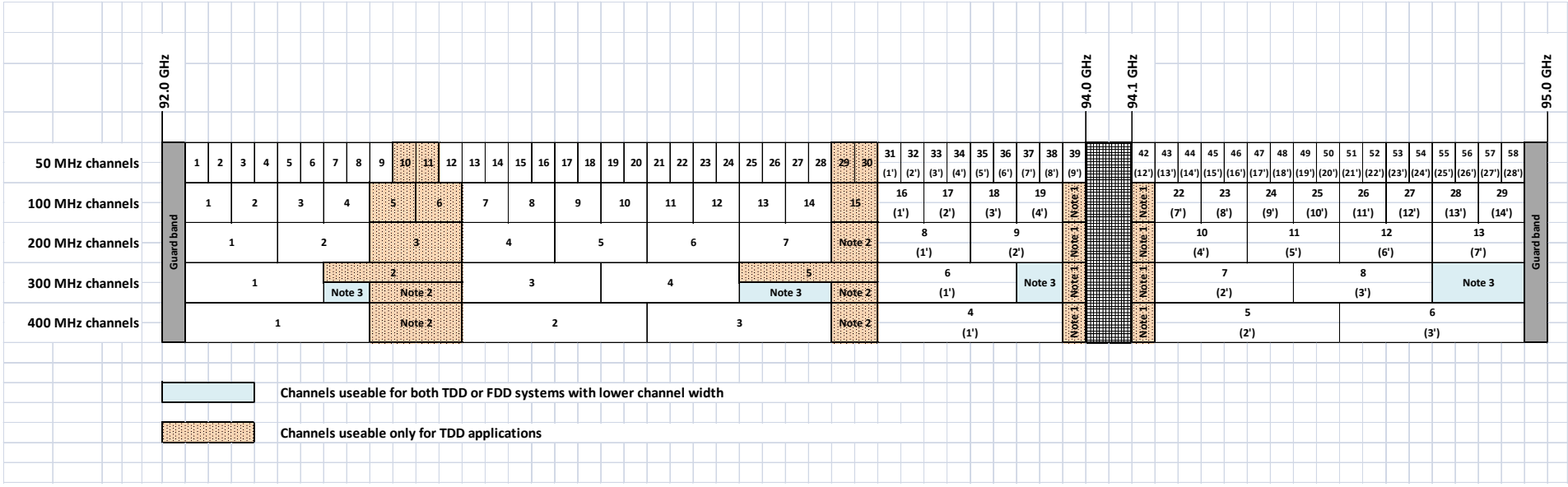
ANNEX 3: CHANNEL ARRANGEMENTS FOR MULTIPLE SIZE TDD/FDD AGGREGATED CHANNELS

A multiple sizes channel arrangement for these bands depends on the basic assumptions that an administration makes for the deployment, e.g.:

- TDD, FDD or their mixed use of the band;
- Paired FDD assignments with fixed duplex;

Figure 1 shows the channel arrangements for various channel width up to 400 MHz.

It is intended that mixed TDD and FDD channels of different width can be deployed together according national needs.



Note 1: Can be used only for 50 MHz TDD systems
Note 2: Can be used only for TDD systems operating in channels from the lower widths arrangements
Note 3: Can be used only for both TDD and FDD systems operating in channels from the lower widths arrangements

Figure 1: Channel positions for TDD and FDD applications

ANNEX 4: EXAMPLE OF TECHNICAL BACKGROUND FOR IMPLEMENTING A SELF-COORDINATION APPROACH FOR PP FS

To assist the planning of PP Fixed links, self-coordination approach, similar to the “light licensing”, described in ECC Report 80, can be considered. Such regimes do not mean “licence exempt” use, but rather using a simplified set of conventional licensing mechanisms and attributes within the scope decided by administration. This planning is delegated to the licensee.

Administrations intervene for protecting a limited number of sensitive sites while giving greater flexibility elsewhere than it could be allowed without the geographical limitation.

This process requires to record for instance the following set of simple criteria for each authorised link and makes the data available publicly to assist in the identification of operational parameters and to conduct interference analyses:

- Date of application (In order to assign priority);
- Transmit, receive centre frequencies and occupied bandwidth;
- Equipment type, specifying relevant transmitter/receiver parameters;
- Link location (geographic coordinates, height/direction of antenna, etc…);
- The antenna gain and radiation pattern.

Subject to the conditions set by the administration, it is left to the operator to conduct any compatibility studies or coordinate as necessary to ensure that harmful interference is not caused to existing links registered in the database. For example, an operator wishing to install a new link could calculate the interference that the new link will create to the existing links in the database. Then it will be possible to determine whether this new link will interfere with existing links. If so, the new link could be re-planned to meet the interference requirements of existing links in the database. Otherwise, the new link may be also co-ordinated with existing operators, who might suffer from the interference.

To assist with the resolution of disputes, licences are issued with a “date of priority”: interference complaints between licensees may therefore be resolved on the basis of these dates of priority (as with international assignments).

ANNEX 5: PROTECTION OF EESS (PASSIVE)

Unwanted emission mask for FS systems operating in the band 92-94 GHz for the protection of EESS (passive)

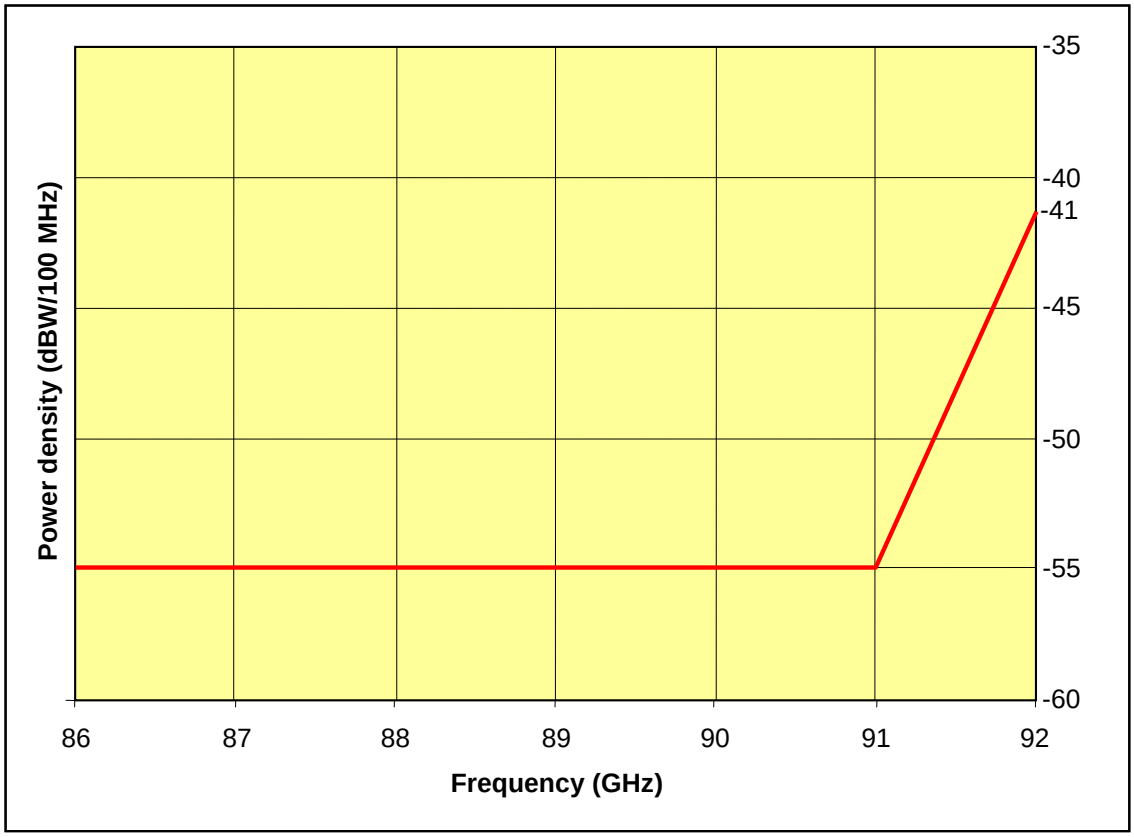


Figure 2: Unwanted emission power density at the antenna port

Note: The last 100 MHz slot is intended to be centered at 91.95 GHz.