CEPT ECC
Electronic Communications Committee

ERC Recommendation 12-11

Radio frequency channel arrangements for Fixed Service systems operating in the bands 48.5 to 50.2 GHz / 50.9 to 52.6 GHz

Approved 29 October 1999

Editorial update May 2015

INTRODUCTION

The channel arrangements in ERC/REC 12-10 (for band 48.5 to 50.2 GHz) and ERC/REC 12-11 (for the band 51.4 to 52.6 GHz) were originally developed in late ’90 years, having in mind a possible emerging FS market for private small business broadband wireless access to core networks for internet and data connections and entertainment purpose.

The relatively short hops achievable, when broadband high G.826 quality links were considered, were not attractive, at that time, for the mobile backhauling market, which needed link length characteristics typically achievable by 23 and 38 GHz bands.

The rapid advent of XDSL broadband connections, as well as of mobile wireless access, made fruitless also the original intent for these bands use; actually, in 2011 ECC Report 173 reported no fixed links present or planned use in CEPT area for theses band.

ECC Report 173 also reported that in nearly all case conventional link-by-link planned license conditions apply; however, in the only case where significant deployment is achieved in 51.4 to 52.6 GHz band, block assignment licensing was established.

However, with the advent of new generation of mobile networks, the issue of the deployment of “small cells” in highly populated areas (i.e. with expected “micro/pico base stations” density up to about 100/km^2). Part of them might benefit of easy fibre backhauling, but a significant number would need wireless backhauling resulting in many tens of links per km^2 with typical length less than 1 km spread in a relatively large number of different channels of medium/high bandwidth (i.e. perfectly matched to the 50/52 GHz frequency range,).

Consideration is also given to the band 50.9 to 51.4 GHz, presently not considered in any recommendation, but also allocated to FS in all countries; this band, also mentioned as unused in ECC Report 173, could be profitably merged with the present 51.4 to 52.6 GHz creating a total of 1700 MHz that perfectly match the size of the 48.5 to 50.2 GHz band and would permit a common go/return arrangements between the two bands.

For being attractive to the mass backhauling market these links needs to be cost effective, quickly deployable and; these requirements call for unlicensed or other very simple planning/licensing procedure, either as link-by-link or in as block assignment.

ERC RECOMMENDATION 12-11 OF 29 OCTOBER 1999 ON RADIO FREQUENCY CHANNEL ARRANGEMENTS FOR FIXED SERVICE SYSTEMS OPERATING IN THE BANDS 48.5 - 50.2 GHz / 50.9 - 52.6 GHz, REVISED 10 OCTOBER 2001, AMENDED 30 JANUARY 2015, EDITORIAL UPDATE 8 MAY 2015

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that the bands 48.5 to 50.2 GHz, 50.9 to 51.4 GHz and 51.4 to 52.6 GHz are allocated on a primary basis for Fixed and other services;

b) that the bands in considering a) can also be jointly used for same fixed point-to-point applications within a common channel arrangement and CEPT administrations may consider allocating whole these bands nationally for FS;

c) that the propagation characteristics of the range 48.5 to 52.6 GHz are ideally suited for use of short range, medium and high capacity digital radio links in high density networks;

d) that the evolution of mobile network technology requires more and more capacity and link density to the backhauling infrastructure;

e) that ETSI EN 302 217-2-2 provides characteristics and limits of Point-to-Point equipment in these bands, to be applied when link-by-link coordination procedure is applied;

f) that very dense short links backhauling network in urban areas requires simple licensing and deployment procedures;

g) that ECC/REC(01)04, developed specifically for the 42 GHz band, gives general technical guidelines for the assignment of frequency blocks to Fixed Service applications;

h) that as an alternative to conventional coordination, a simple form of coordination, similar to that described by ECC Report 80 as "light licensing", could maintain spectrum efficiency and availability for FS avoiding harmful interference among the users

i) that the adjacent band 50.2 to 50.4 GHz, allocated to EESS (passive), is subject to RR 5.340. (all emissions prohibited); however, RR 5.340.1 says it should not impose undue constraints on the use of the adjacent bands by the primary allocated services;

j) that the adjacent band 52.6 to 54.25 GHz, allocated to EESS (passive), is subject to RR 5.340 (all emissions prohibited) and WRC Resolution 750 provides the limits for unwanted emissions from fixed service stations operating in the 51.4 to 52.6 GHz into that EESS band;

k) that RR 5.555 allocates the band 48.94 to 49.04 GHz to the Radio Astronomy Service on a primary basis for spectral line observations and RR 5.149 applies.

recommends

1. that the administrations wishing to use point-to-point links the band 51.4 to 52.6 GHz within stands alone channel arrangement should follow the recommended channel arrangements in the frequency range 51.4 to 52.6 GHz given in ANNEX 1:;

2. that administrations wishing to use point-to-point links the band 48.5 to 50.2 GHz within stands alone channel arrangement should follow the recommended radio frequency arrangements for the band 48.5 to 50.2 GHz given in ANNEX 2:;

3. that administrations wishing to use high/medium capacity point-to-point links band 48.5 to 50.2 GHz paired with 50.9 to 52.6 GHz should follow the recommended radio frequency arrangements given in ANNEX 3:;

4. that administrations wishing to use high/medium capacity point-to-point links in the central portion of band 48.5 to 50.2 GHz paired with 51.4 to 52.6 GHz should follow the recommended radio frequency arrangements given in Annex 4 - A4.1;

5. that administrations using the arrangement in recommend 4 may also use for small/medium capacity point-to-point links the frequency arrangement in the outermost portion of the band 48.5 to 50.2 GHz given in Annex 4 - A4.2;

6. that administrations wishing to assign frequency in blocks, should consider blocks of N x 28 MHz size, either with channels self-managed among the licensed operators or following the block assignment general guidelines given in ECC/REC(01)04;

7. that administrations who wish to implement a self-coordination mechanism similar to “light licensing” may refer to the example 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 ARRANGEMENT IN THE BAND 51.4 - 52.6 GHz

The radio frequency channel arrangement for channel separations of 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz shall be derived as follows:

Let

Fr be the reference frequency of 51412 MHz;

fn be the centre frequency (MHz) of the radio-frequency channel in the lower half of the band;

fn' be the centre frequency (MHz) of the radio-frequency channel in the upper half of the band.

TX/RX separation = 616 MHz

Figure 1 shows the spectrum occupancy.

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

a) for systems with a channel separation of 112 MHz:

lower half of the band:	$fn = fr - 28 + 112\ n$	
upper half of the band:	$fn' = fr + 588 + 112\ n$	where n = 1, 2, … 4

b) for systems with a channel separation of 56 MHz:

lower half of the band:	$fn = fr + 56\ n$	
upper half of the band:	$fn' = fr + 616 + 56\ n$	where n = 1, 2, … 9

c) for systems with a channel separation of 28 MHz:

lower half of the band:	$fn = fr + 14 + 28\ n$	
upper half of the band:	$fn' = fr + 630 + 28\ n$	where n = 1, 2, 3, … 18

d) for systems with a channel separation of 14 MHz:

lower half of the band:	$fn = fr + 21 + 14\ n$	
upper half of the band:	$fn' = fr + 637 + 14\ n$	where n = 1, 2, 3, … 36

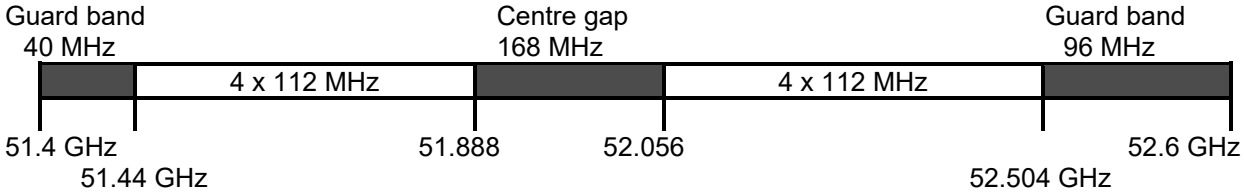
e) for systems with a channel separation of 7 MHz:

lower half of the band:	$fn = fr + 24.5 + 7\ n$	
upper half of the band:	$fn' = fr + 640.5 + 7\ n$	where n = 1, 2, 3, … 72

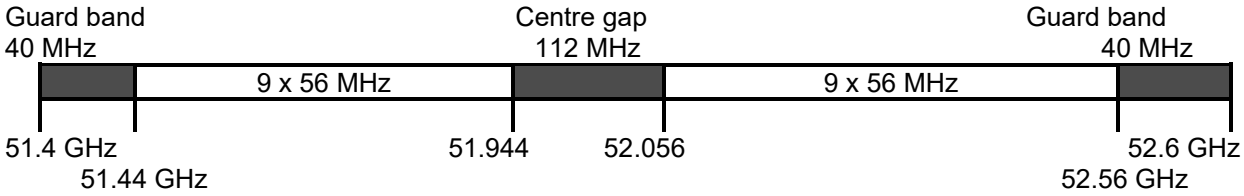
e) for systems with a channel separation of 3.5 MHz:

lower half of the band:	$fn = fr + 26.25 + 3.5\ n$	
upper half of the band:	$fn' = fr + 642.25 + 3.5\ n$	where n = 1, 2, 3, … 144

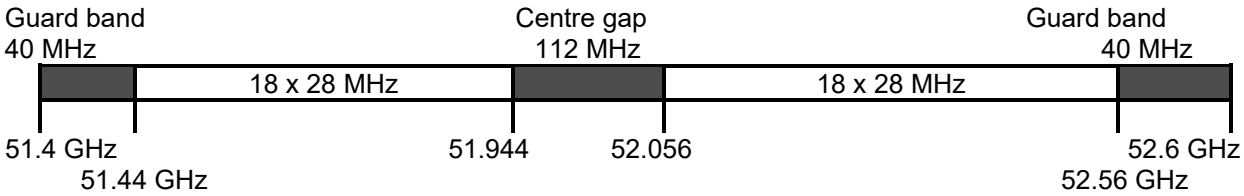
a) 112 MHz channels



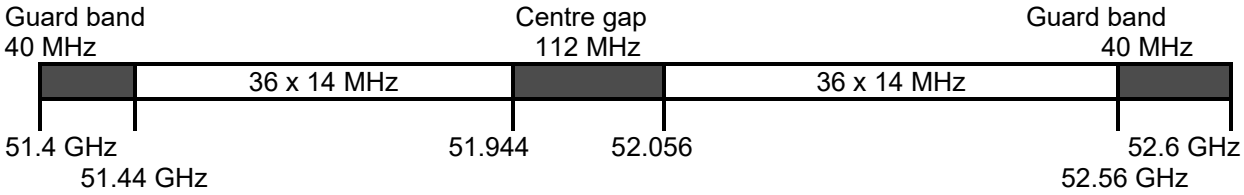
b) 56 MHz channels



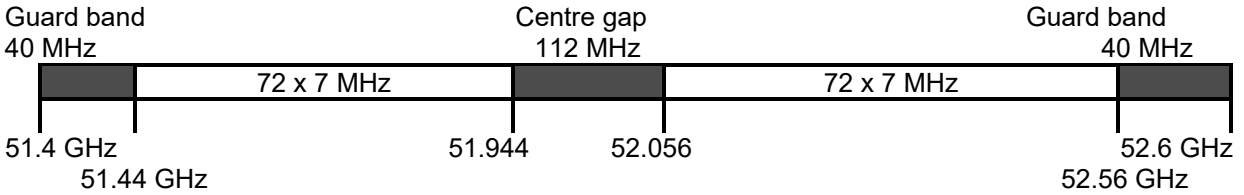
c) 28 MHz channels



d) 14 MHz channels



e) 7 MHz channels



f) 3.5 MHz channels

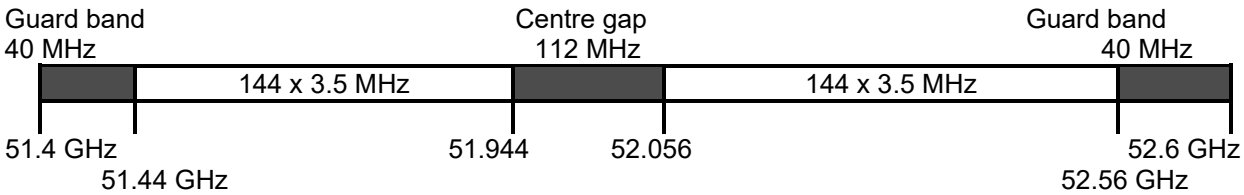


Figure 1: Occupied spectrum: 51.4 to 52.6 GHz Band

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

XS MHz	n	f1 MHz	fn MHz	f'1 MHz	f'n MHz	Z1S MHz	Z2S MHz	YS MHz	DS MHz
112	1,…4	51496	51832	52112	52448	96	152	280	616
56	1,...9	51468	51916	52084	52532	68	68	168	616
28	1,...18	51454	51930	52070	52546	54	54	140	616
14	1,...36	51447	51937	52063	52553	47	47	126	616
7	1,…72	51443.5	51940.5	52059.5	52556.5	43.5	43.5	119	616
3.5	1,…144	51441.75	51942.25	52057.75	52558.25	41.75	41.75	115.5	616

XS Separation between centre frequencies of adjacent channels;

YS Separation between centre frequencies of the closest go and return 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;

DS Duplex spacing (f'n - fn).

ANNEX 2: RADIO-FREQUENCY CHANNEL ARRANGEMENT IN THE BAND 48.5 - 50.2 GHz

The radio frequency channel arrangement for channel separations of 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz shall be derived as follows:

Let

fr be the reference frequency of 49350 MHz;

fn be the centre frequency (MHz) of the radio-frequency channel in the lower half of the band;

fn' be the centre frequency (MHz) of the radio-frequency channel in the upper half of the band.

TX/RX separation = 884 MHz

Figure 2 shows the spectrum occupancy.

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

a) for systems with a channel separation of 112 MHz:

lower half of the band:	fn = fr - 862 + 112 n	
upper half of the band:	fn' = fr + 22 + 112 n	where n = 1, 2, 3, … 6

b) for systems with a channel separation of 56 MHz:

lower half of the band:	fn = fr - 834 + 56 n	
upper half of the band:	fn' = fr + 50 + 56 n	where n = 1, 2, 3, … 13

c) for systems with a channel separation of 28 MHz:

lower half of the band:	fn = fr - 848 + 28 n	
upper half of the band:	fn' = fr + 36 + 28 n	where n = 1, 2, 3, … 28

d) for systems with a channel separation of 14 MHz:

lower half of the band:	fn = fr - 841 + 14 n	
upper half of the band:	fn' = fr + 43 + 14 n	where n = 1, 2, 3, … 56

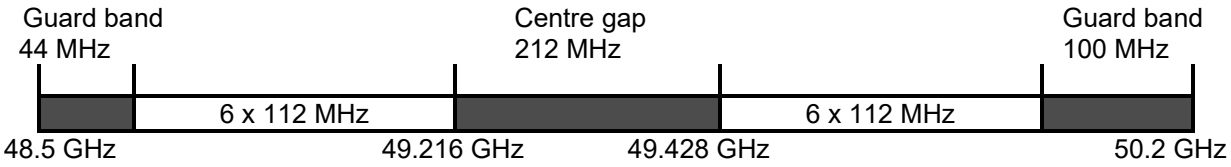
e) for systems with a channel separation of 7 MHz:

lower half of the band:	fn = fr - 837.5 + 7 n	
upper half of the band:	fn' = fr + 46.5 + 7 n	where n = 1, 2, 3, … 112

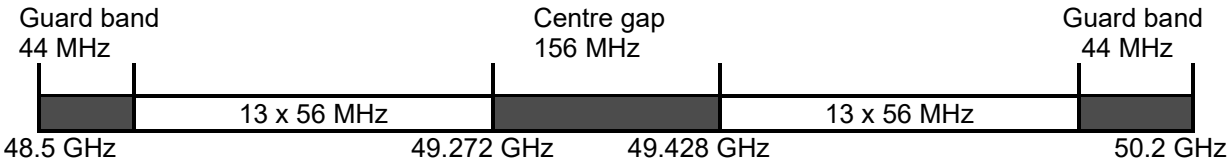
f) for systems with a channel separation of 3.5 MHz:

lower half of the band:	fn = fr - 835.75 + 3.5 n	
upper half of the band:	fn' = fr + 48.25 + 3.5 n	where n = 1, 2, 3, … 224

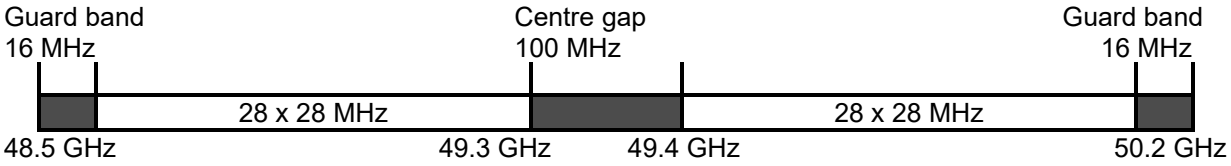
a) 112 MHz channels



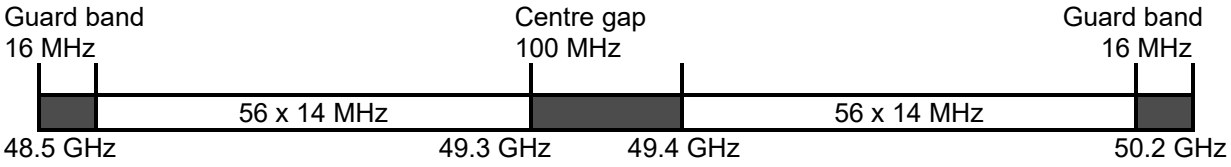
b) 56 MHz channels



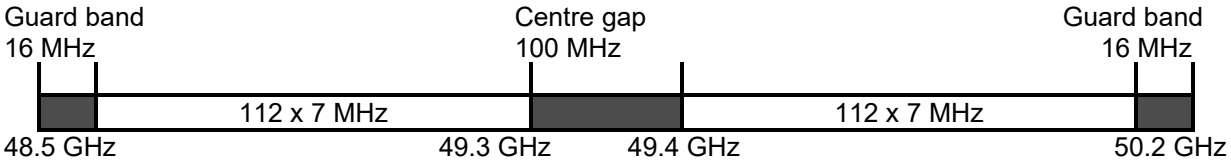
c) 28 MHz channels



d) 14 MHz channels



e) 7 MHz channels



f) 3.5 MHz channels

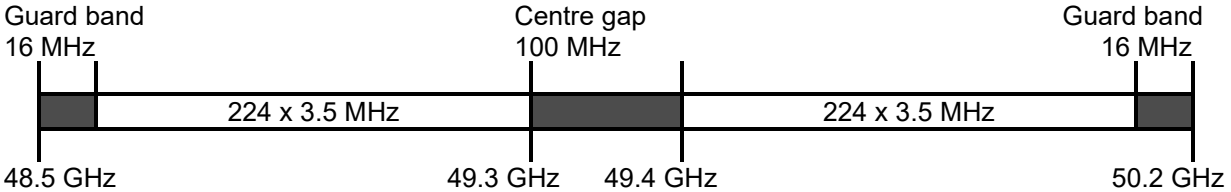


Figure 2: Occupied spectrum: 48.5 to 50.2 GHz band

Table 2: Calculated parameters according to Recommendation ITU-R 746

XS MHz	n	f1 MHz	fn MHz	f'1 MHz	f'n MHz	Z1S MHz	Z2S MHz	YS MHz	DS MHz
112	1,…..6	48600	49160	49484	50044	100	156	324	884
56	1,…13	48572	49244	49456	50128	72	72	212	884
28	1,….28	48530	49286	49414	50170	30	30	128	884
14	1,….56	48523	49293	49407	50177	23	23	114	884
7	1,...112	48519.5	49296.5	49403.5	50180.5	19.5	19.5	107	884
3.5	1,...224	48517.75	49298.25	49401.75	50182.25	17.75	17.75	103.5	884

XS Separation between centre frequencies of adjacent channels;

YS Separation between centre frequencies of the closest go and return 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;

DS Duplex spacing (f'n - fn).

ANNEX 3: RADIO-FREQUENCY CHANNEL ARRANGEMENT FOR HIGH AND MEDIUM CAPACITY IN THE BANDS 48.5 - 50.2 GHz PAIRED WITH 50.9 - 52.6 GHz

When these bands are available for Point-to-point use they can be profitably paired for wide band systems. The radio frequency channel arrangement for channel separations of 224 MHz, 112 MHz, 56 MHz, 28 MHz 14 MHz, shall be derived as follows:

Let

frL be the reference frequency of 49350 MHz for the lower 48.5 - 50.2 GHz band;

frH be the reference frequency of 51412 MHz for the higher 50.9 - 52.6 GHz band;

fn be the centre frequency (MHz) of the radio-frequency channel in the lower 48.5 - 50.2 GHz band;

fn' be the centre frequency (MHz) of the radio-frequency channel in the upper 50.9 - 52.6 GHz band.

TX/RX separation = 2392 MHz

Figure 3 shows the spectrum occupancy.

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

a) for systems with a channel separation of 224 MHz:

lower 48.5 - 50.2 GHz band:	fn = frL – 918 + 224 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 588 + 224 n	where n = 1, 2, … 7

b) for systems with a channel separation of 112 MHz:

lower 48.5 - 50.2 GHz band:	fn = frL – 862 + 112 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 532 + 112 n	where n = 1, 2, … 14

c) for systems with a channel separation of 56 MHz:

lower 48.5 - 50.2 GHz band:	fn = frL – 834 + 56 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 504 + 56 n	where n = 1, 2, … 29

d) for systems with a channel separation of 28 MHz:

lower 48.5 - 50.2 GHz band:	fn = frL – 848 + 28 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 518 + 28 n	where n = 1, 2, 3, … 59

e) for systems with a channel separation of 14 MHz:

lower 48.5 - 50.2 GHz band:	fn = frL – 841 + 14 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 511 + 14 n	where n = 1, 2, 3, … 118

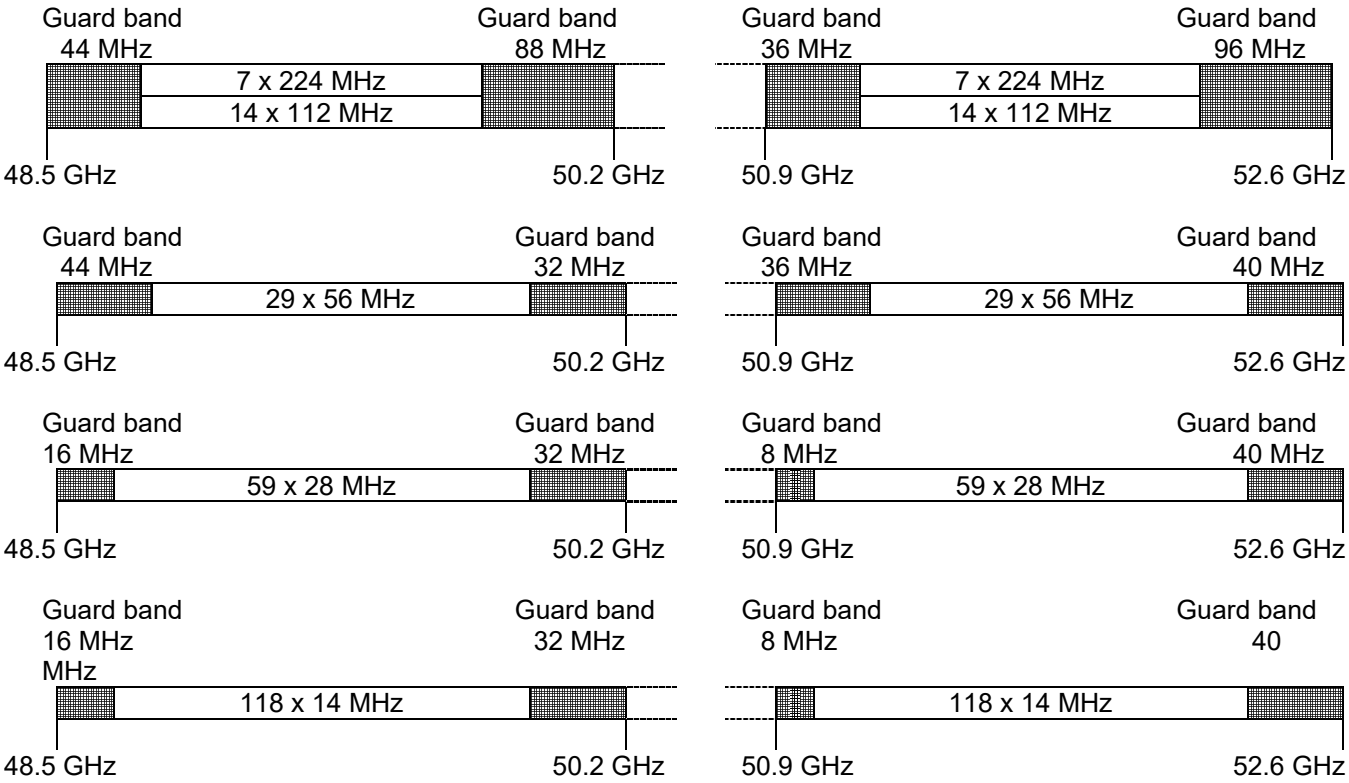


Figure 3: Occupied spectrum: 48.5 to 50.2 GHz paired with 50.9 to 52.6 GHz band

Table 3: Calculated parameters according to Recommendation ITU-R 746

XS MHz	n	f1 MHz	fn MHz	f'1 MHz	f'n MHz	Z1S MHz	Z1Si MHz	Z2Si MHz	Z2S MHz	YS MHz	DS MHz
224	1,…7	48656	50000	51048	52392	156	200	148	208	1048	2392
112	1,…14	48600	50056	50992	52448	100	144	92	152	936	2392
56	1,…29	48572	50140	50964	52532	72	60	64	68	824	2392
28	1,…59	48530	50154	50922	52546	30	46	22	54	768	2392
14	1,…118	48523	50161	50915	52553	23	39	15	47	754	2392

XS Separation between centre frequencies of adjacent channels;

YS Separation between centre frequencies of the closest go and return channels;

Z1S Separation between the lower edge of the lower band and the centre frequency of the first channel;

Z1Si Separation between centre frequencies of the nth channel and the upper edge of the lower band;

Z2Si Separation between centre frequencies of the first' channel and the lower edge of the upper band;

Z2S Separation between centre frequencies of the n'th channel and the upper edge of the upper band;

DS Duplex spacing (f'n - fn).

ANNEX 4: RADIO-FREQUENCY CHANNEL ARRANGEMENTS FOR JOINT USE OF THE BANDS 48.5 - 50.2 GHz AND 51.4 - 52.6 GHz

When the band 50.9 - 51.4 GHz is not available for FS applications the bands 48.5 - 50.2 and 51.4 - 52.6 GHz are not of the same size. Nevertheless, the central portion of the lower band may still be paired with the higher one within an arrangement suitable for high and medium capacity applications shown in section A4.1; the unused outermost parts of the lower bands may be used for small capacity applications within the arrangement shown in section A4.2.

A4.1 WIDEBAND HIGH AND MEDIUM CAPACITY ARRANGEMENT

When Pairing the central portion (48.768 - 49.888 GHz) of the lower band with the 51.4 - 52.6 GHz, the radio frequency channel arrangement for channel separations of 224 MHz, 112 MHz, 56 MHz, 28 MHz 14 MHz, shall be derived as follows:

Let

frL be the reference frequency of 49350 MHz for the lower 48.5 - 50.2 GHz band;

frH be the reference frequency of 51412 MHz for the higher 51.4 - 52.6 GHz band;

fn be the centre frequency (MHz) of the radio-frequency channel in the lower 48.768 - 49.888 GHz band;

fn' be the centre frequency (MHz) of the radio-frequency channel in the upper 51.4 - 52.6 GHz band.

TX/RX separation = 2672 MHz,

Figure 4 shows the spectrum occupancy.

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

a) for systems with a channel separation of 224 MHz:

lower 48.768 - 49.888 GHz band:	fn = frL – 694 + 224 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 84 + 224 n	where n = 1, 2, … 5

b) for systems with a channel separation of 112 MHz:

lower 48.768 - 49.888 GHz band:	fn = frL – 638 + 112 n	
upper 50.9 - 52.6 GHz band:	fn' = frH – 28 + 112 n	where n = 1, 2, … 10

c) for systems with a channel separation of 56 MHz:

lower 48.768 - 49.888 GHz band:	fn = frL – 610 + 56 n	
upper 50.9 - 52.6 GHz band:	fn' = frH + 56 n	where n = 1, 2, … 20

d) for systems with a channel separation of 28 MHz:

lower 48.768 - 49.888 GHz band:	fn = frL – 596 + 28 n	
upper 50.9 - 52.6 GHz band:	fn' = frH + 14 + 28 n	where n = 1, 2, 3, … 40

e) for systems with a channel separation of 14 MHz:

lower 48.768 - 49.888 GHz band:	fn = frL – 589 + 14 n	
upper 50.9 - 52.6 GHz band:	fn' = frH + 21 + 14 n	where n = 1, 2, 3, … 80

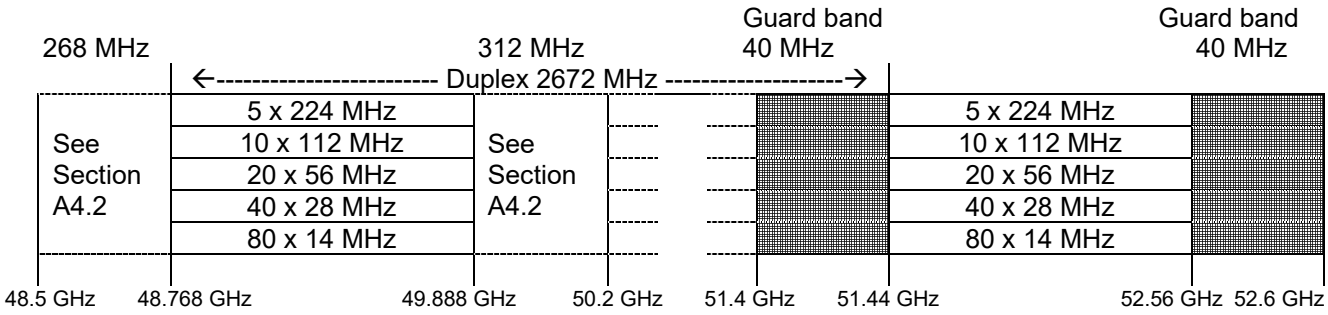


Figure 4: Occupied spectrum: 48.5 to 50.2 GHz paired with 51.4 to 52.6 GHz band

Table 4: Calculated parameters according to Recommendation ITU-R 746

XS MHz	n	f1 MHz	fn MHz	f'1 MHz	f'n MHz	Z1S MHz (*)	Z1Si MHz (*)	Z2Si MHz	Z2S MHz	YS MHz	DS MHz
224	1,…5	48880	49776	51552	52448	380	424	152	152	1776	2672
112	1,…10	48824	49832	51496	52504	324	368	96	96	1664	2672
56	1,…20	48796	49860	51468	52532	296	340	68	68	1608	2672
28	1,…40	48782	49874	51454	52546	282	326	54	54	1580	2672
14	1, 80	48775	49881	51447	52553	275	319	47	47	1566	2672

(*) With respect to the 48.5 - 50.2 GHz band edges;

YS Separation between centre frequencies of the closest go and return channels;

Z1S Separation between the lower edge of the lower band and the centre frequency of the first channel;

Z1Si Separation between centre frequencies of the n^{th} channel and the upper edge of the lower band;

Z2Si Separation between centre frequencies of the first (') channel and the lower edge of the upper band;

Z2S Separation between centre frequencies of the n^{th} (') channel and the upper edge of the upper band;

DS Duplex spacing (f'n - fn).

A4.2 NARROWBAND LOW CAPACITY ARRANGEMENT

Pairing the lowermost portion (48.5 - 48.768 GHz) with higher most portion (49.888 - 50.2 GHz) of the band, left free by the arrangement in section A4.1 above, for narrow channels, the radio frequency channel arrangement for channel separations of 14 MHz, 7 MHz and 3.5 MHz shall be derived as follows:

Let

fr be the reference frequency of 49 350 MHz;

fn be the centre frequency (MHz) of the radio-frequency channel in the lower half of the band;

fn' be the centre frequency (MHz) of the radio-frequency channel in the upper half of the band.

TX/RX separation = 1505 MHz

Figure 5 shows the spectrum occupancy.

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

a) for systems with a channel separation of 14 MHz:

lower half of the band: $fn = fr - 841 + 14\ n$
upper half of the band: $fn' = fr + 664 + 14\ n$ where n = 1, 2, 3, … 11

b) for systems with a channel separation of 7 MHz:

lower half of the band: $fn = fr - 837.5 + 7\ n$
upper half of the band: $fn' = fr + 667.5 + 7\ n$ where n = 1, 2, 3, … 22

c) for systems with a channel separation of 3.5 MHz:

lower half of the band: $fn = fr - 835.75 + 3.5\ n$
upper half of the band: $fn' = fr + 669.25 + 3.5\ n$ where n = 1, 2, 3, … 44

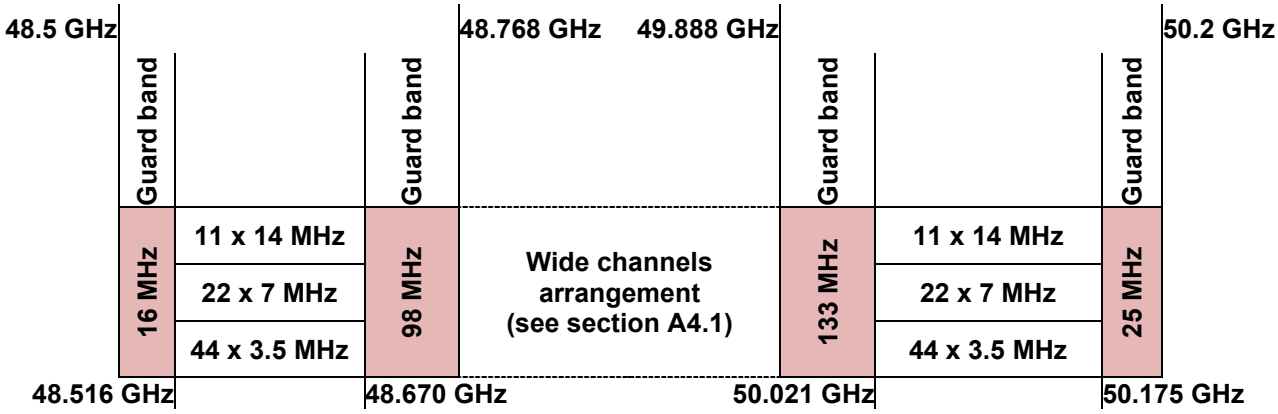


Figure 5: Occupied spectrum: 48.5 to 48.768 GHz paired with 50.021 to 52.6 GHz band

Table 5: Calculated parameters according to Recommendation ITU-R 746

XS MHz	n	f1 MHz	fn MHz	f'1 MHz	f'n MHz	Z1S MHz (*)	Z1Si MHz (*)	Z2Si MHz	Z2S MHz	YS MHz	DS MHz
14	1,…11	48523	48663	50028	50168	23	105	140	32	1365	1505
7	1,…22	48519.5	48666.5	50024.5	50171.5	19.5	101.5	136.5	28.5	1358	1505
3.5	1, 44	48517.75	48668.25	50022.75	50173.25	17.75	99.75	134.75	26.75	1354.5	1505

(*) With respect to the inner band portion used for wide band channels;

YS Separation between centre frequencies of the closest go and return channels;

Z1S Separation between the lower edge of the lower band and the centre frequency of the first channel;

Z1Si Separation between centre frequencies of the nth channel and the upper edge of the lower band;

Z2Si Separation between centre frequencies of the first (') channel and the lower edge of the upper band;

Z2S Separation between centre frequencies of the nth (') channel and the upper edge of the upper band;

DS Duplex spacing (f'n - fn).

ANNEX 5: 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, keeping that analysis available for any dispute resolution. 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, licenses 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). Consideration of a maximum time frame between the link registration and its effective operational start is a matter for Administrations at national level.