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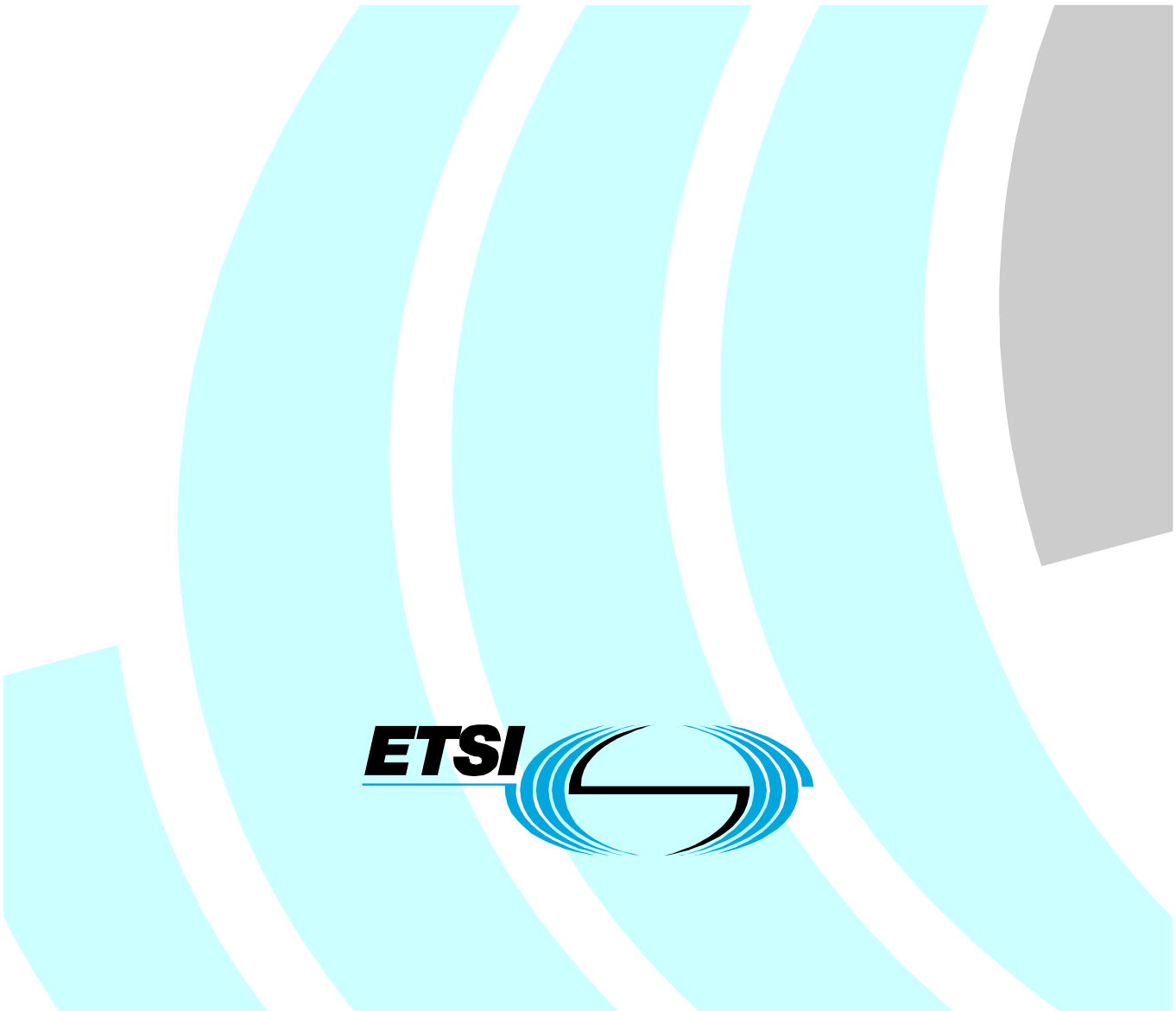
Technical Specification

Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D);
Part 15: TETRA frequency bands,
duplex spacings and channel numbering



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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

1 Scope

The present document defines TETRA frequency bands, duplex spacings and channel numbering for the Terrestrial Trunked Radio (TETRA) system supporting Voice plus Data (V+D).

The informative annex A gives an example of the radio channel definition.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions in EN 300 392-2 [1] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations defined in EN 300 392-2 [1] apply.

4 Carrier frequencies and radio channel numbers

TETRA can support multiple carrier frequency requirements such as different offsets from multiples of 25 kHz. If the same frequency band will be allocated in different countries using different variants, the same base frequency of the frequency band is used and the migrating MS shall carefully study SYSINFO broadcast to find out the applied offset and duplex spacing values.

In the clause 21.4.4.1 in EN 300 392-2 [1] the main carrier frequency is defined as:

- downlink main carrier frequency = base frequency + (main carrier × 25 kHz) + offset kHz; and

in the clause 21.5.2 in EN 300 392-2 [1] the carrier number is defined as:

- downlink carrier frequency = base frequency + (carrier number × 25 kHz) + offset kHz.

For the purpose of the TETRA carrier frequency definition the base frequency shall be equal to the reference frequency for the band. The reference frequency need not coincide with the band edge frequency. The main carrier (or carrier number) is the carrier number (N).

The carrier frequency offsets defined in clause 21.4.4.1 in EN 300 392-2 [1] allow values:

a) -6,25 kHz;

b) 0 kHz;

c) +6,25 kHz; and

d) +12,5 kHz.

With those values up to four different radio carrier frequency allocations are possible as shown in figure 1. The number of the first whole radio channel is always "1". The radio channel numbers for different allocations are marked by a letter A, B, C or D. That marking of radio channels by additional letter allows to keep channel numbers running 1,2,3… If there is only one region (country) wide allocation variant in use, as for the band 380 MHz to 400 MHz in Europe, then the letter can be left out.

The possible variants are shown in the figure 1 where the band edge frequency is the reference frequency + the band position. Both the reference frequency and the band position values are assumed to be even numbers of form XXX,000 MHz. The band position is not transferred over the air interface protocol as a separate information element but it is included into the carrier number N.

NOTE: The radio channel number is intended for human purposes and it normally starts with value "1" for the lowest radio channel. The main carrier (carrier number) is defined for the MAC layer protocol purposes to be used in the air interface signalling. The numerical values of the radio channel number and the carrier number are normally different for the same radio channel. The radio channel number values are outside the scope of the present document.

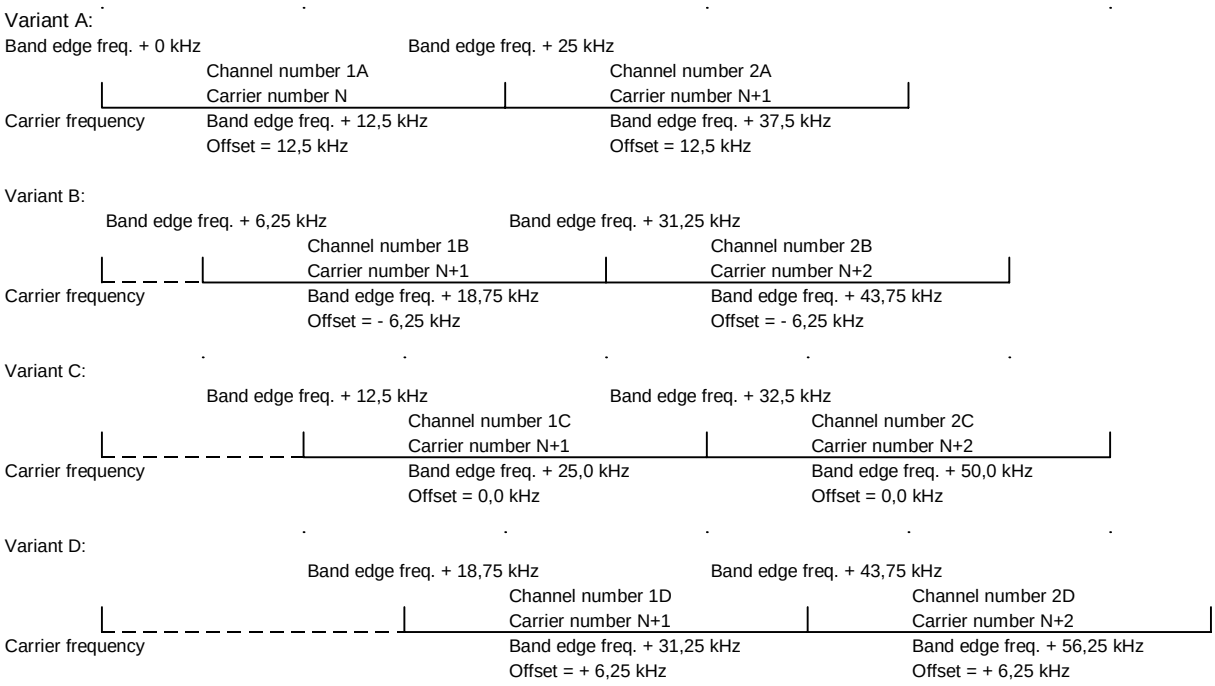

Figure 1: Channel allocation possibilities

The radio channel number is what a user may see especially in direct mode operation and may be defined in the frequency band allocation documentation. It is proposed to define radio channel numbers starting from the band edge independently whether radio channels allocated for TETRA usage starting from band edge so that the radio channel numbers will be same in all countries.

The carrier number N is a TETRA radio protocol internal number, which is used in the radio carrier definition. Both the radio channel number and the associated carrier number are the same for both base station and mobile station and the difference in transmitter frequencies is defined by the duplex spacing and the normal/reverse information elements.

Most probably only variants A and B will be applied for TETRA frequency allocations in Europe. As a regulatory issue the radio channel centre frequency (offset) allocations are outside the scope of the present document.

5 TETRA frequency bands

The frequency band information element values generally and for the current defined bands for TETRA in Europe shall be encoded as defined in table 1. The frequency band information element value is valid for the whole indicated frequency range although it may not be allocated totally for TETRA service. The reference and base frequency is defined by the frequency band of the BS transmitter.

As a regulatory issue the frequency band allocations are outside the scope of the present document and the indicated band pairs are for information to indicate the information element encoding for those bands.

Table 1: TETRA frequency bands

Frequency band of the MS transmitter	Frequency band of the BS transmitter	Reference and base frequency	Value of the Frequency band element	Value of the Reverse operation element
100 MHz (see note 1)	100 MHz (see note 1)	100,000 MHz	0001_2	0_2 (Normal) (see note 2)
200 MHz (see note 1)	200 MHz (see note 1)	200,000 MHz	0010_2	0_2 (Normal) (see note 2)
300 MHz (see note 1)	300 MHz (see note 1)	300,000 MHz	0011_2	0_2 (Normal) (see note 2)
380 MHz to 390 MHz	390 MHz to 400 MHz	300,000 MHz	0011_2	0_2 (Normal)
400 MHz (see note 1)	400 MHz (see note 1)	400,000 MHz	0100_2	0_2 (Normal) (see note 2)
410 MHz to 420 MHz	420 MHz to 430 MHz	400,000 MHz	0100_2	0_2 (Normal)
450 MHz to 460 MHz	460 MHz to 470 MHz	400,000 MHz	0100_2	0_2 (Normal)
500 MHz (see note 1)	500 MHz (see note 1)	500,000 MHz	0101_2	0_2 (Normal) (see note 2)
600 MHz (see note 1)	600 MHz (see note 1)	600,000 MHz	0110_2	0_2 (Normal) (see note 2)
700 MHz (see note 1)	700 MHz (see note 1)	700,000 MHz	0111_2	0_2 (Normal) (see note 2)
800 MHz (see note 1)	800 MHz (see note 1)	800,000 MHz	1000_2	0_2 (Normal) (see note 2)
870 MHz to 876 MHz	915 MHz to 921 MHz	900,000 MHz	1001_2	0_2 (Normal)
900 MHz (see note 1)	900 MHz (see note 1)	900,000 MHz	1001_2	0_2 (Normal) (see note 2)

NOTE 1: For this frequency band only the reference frequency is defined and the actual band limits will be defined by regulatory bodies. It is preferred that the lowest possible radio channel in all areas where this band is available is numbered to be "1" independently whether it is actually available for TETRA usage.
NOTE 2: Also reverse operation may be used in some frequency allocation.

NOTE 1: The air interface protocol is independent of the actual frequency bands as the reference/base frequency (a multiple of 100 MHz) and the carrier number with the offset, duplex spacing and reverse operation information elements alone define as a mathematical equation the real carrier frequency.

NOTE 2: In future more frequency bands may be defined or more details added to the TETRA frequency bands.

6 Duplex spacing

The duplex spacing values are defined without any mathematical rule. The duplex spacing shall be reference/base frequency dependent as defined in table 2. The 0,000 MHz duplex value may be needed for direct mode operation and is included here for completeness.

Table 2: Duplex spacing as function of the reference/base frequency

		Duplex spacing information element value (next row) and corresponding duplex spacing (other rows; in MHz)							
Frequency band	**Base/reference frequency**	**000_2**	**001_2**	**010_2**	**011_2**	**100_2**	**101_2**	**110_2**	**111_2**
0000_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
0001_2	100 MHz	1,6	4,5	0	note 1	note 1	note 1	note 1	note 1
0010_2	200 MHz	10	note 1	0	note 1	note 1	note 1	note 1	note 1
0011_2	300 MHz	10	note 1	0	8, (see note 2)	18, (see note 2)	note 1	note 1	note 1
0100_2	400 MHz	10	7, (see note 2)	0	8, (see note 2)	5 (see note 2)	note 1	note 1	note 1
0101_2	500 MHz	10	note 1	0	note 1	note 1	note 1	note 1	note 1
0110_2	600 MHz	10	note 1	0	note 1	30, (see note 2)	note 1	note 1	note 1
0111_2	700 MHz	note 1	note 1	0	note 1	30, (see note 2)	note 1	note 1	note 1
1000_2	800 MHz	note 1	45	0	18, (see note 2)	note 1	note 1	note 1	note 1
1001_2	900 MHz	note 1	45	0	18, (see note 2)	39, (see note 2)	note 1	note 1	note 1
1010_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1011_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1100_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1101_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1110_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1
1111_2	note 1	note 1	note 1	0	note 1	note 1	note 1	note 1	note 1

NOTE 1: The value is reserved for future standardization.
NOTE 2: These values are intended to be used only outside Europe.

Annex A (informative): Examples

A.1 Frequency band 380 MHz to 400 MHz

CEPT/SE has defined for TETRA frequency band 380 MHz to 400 MHz channel numbers as shown in figure A.1, which shows only two first radio channels of that frequency band. The reference/base frequency is 300 MHz and for base station transmitter the band position value is 90 MHz so that the base station band starts from 390 MHz. The duplex spacing is 10 MHz with normal band allocation (no reverse operation) so that that the mobile station transmitter is 10 MHz below the base station transmitter. The offset is +12,5 kHz so that the band edge frequency and the lower edge of the first radio channel coincide. The lowest possible base station radio channel 1 has carrier number 3 600, refer to table A.1.

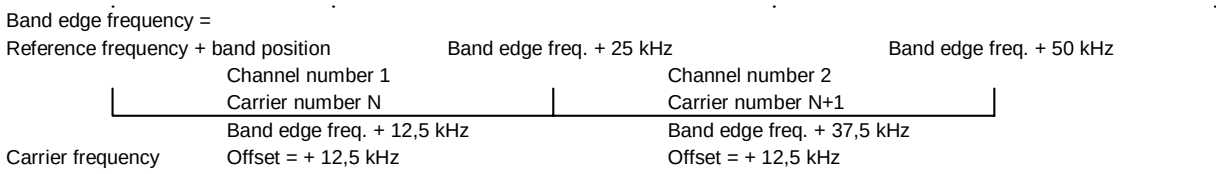

Figure A.1: Radio channel arrangement and radio channel numbering on 380 MHz to 400 MHz

As an example the carrier frequencies 380,0125 MHz to 390,0125 MHz of the first radio channel on the 380 MHz to 400 MHz band are indicated in the TETRA protocol by information elements as shown in table A.1.

Table A.1: The first radio channel on the band 380 MHz to 400 MHz

Information element	Value of the information element	Remark
Radio channel number	-	1
Frequency band	0011_2	300 MHz reference frequency
Main carrier/Carrier number	3 600	(390 000 - 300 000)/25
Offset	11_2	+12,5 kHz
Duplex spacing	000_2	10 MHz
Reverse operation	0_2	normal

History

Document history		
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