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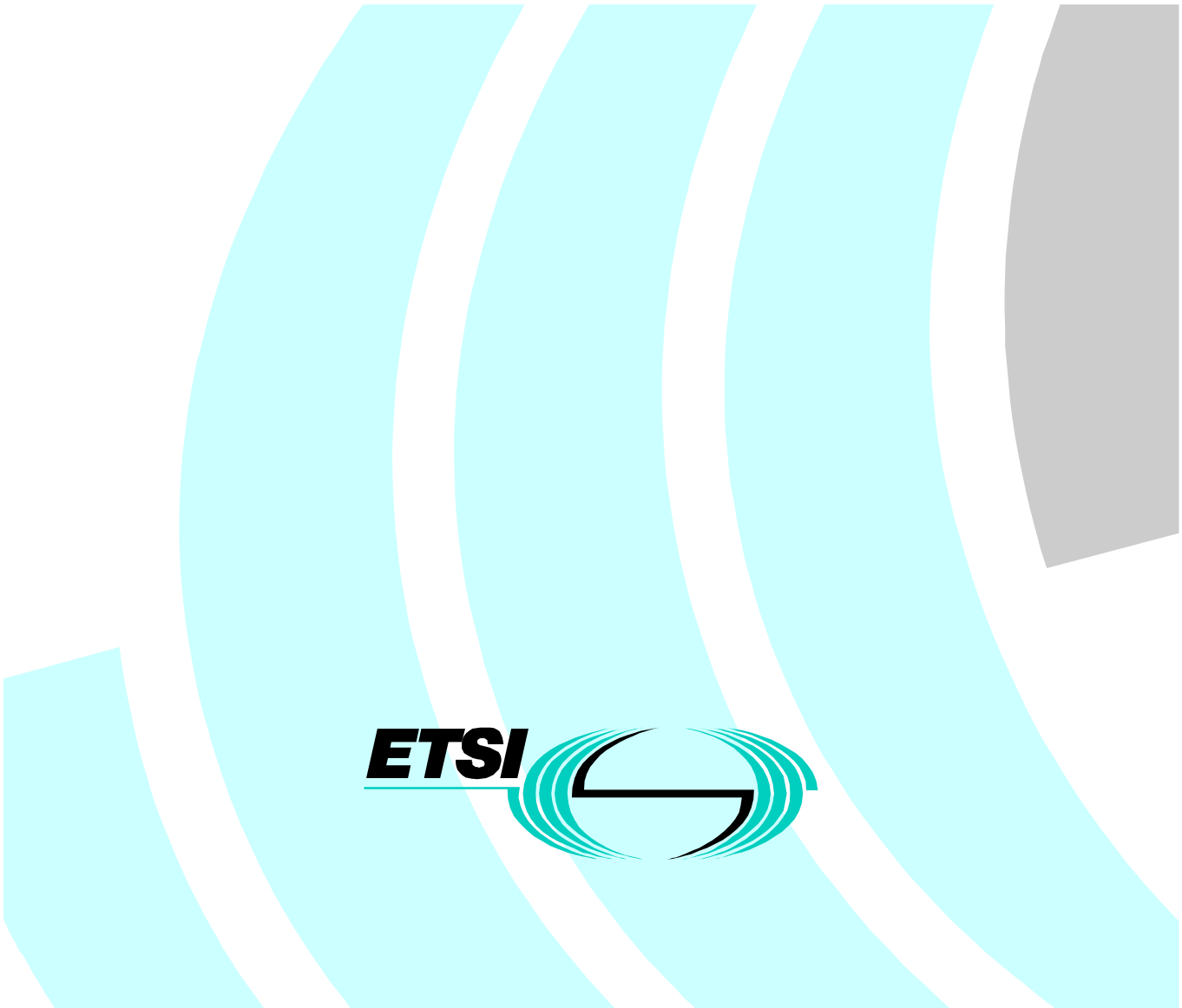
European Standard (Telecommunications series)

Fixed radio systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods; Part 4: Direct Sequence Code Division Multiple Access (DS-CDMA) methods



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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

The present document is part 4 of a multi-part deliverable covering the Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods, as identified below:

Part 1: "Basic parameters";

Part 2: "Frequency Division Multiple Access (FDMA) methods";

Part 3: "Time Division Multiple Access (TDMA) methods";

Part 4: "Direct Sequence Code Division Multiple Access (DS CDMA) methods";

Part 5: "Multi-Carrier Time Division Multiple Access (MC-TDMA) methods".

Parts 2 to 5 are intended to be used in conjunction with part 1, describing the basic parameters common to all access methods.

A basic description of the different access methods and a comparison among them are provided in TR 101 274 [5].

The present document specifies the minimum requirements for system parameters of Direct Sequence - Code Division Multiple Access (DS-CDMA) Point-to-Multipoint (P-MP) Radio Systems in terrestrial fixed services operating in the band 24,5 GHz to 29,5 GHz. Only sections specific to DS-CDMA are described in respect to the paragraphs stated in Part 1 of the present document.

The DS-CDMA Central Radio Station (CRS) transmits simultaneously and continuously to all active Terminal Stations (TS) within its coverage area information utilizing a specific set of codes allocated to each active Terminal Station. The terminal stations use the same, or a different, set of codes when transmitting to the CRS. Transmissions from CRS to TS are distinguished from transmissions on the other directions by using different frequency channels (FDD mode) or different times (TDD mode). Repeater stations (RS) may be placed for cell coverage enhancing.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

1 Scope

The present document (Direct Sequence - Code Division Multiple Access Methods, DS-CDMA) is to be used in conjunction with part 1, describing the basic parameters common to all access methods. The present document specifies the minimum requirements for system parameters of Direct Sequence - Code Division Multiple Access (CDMA) Point-to-Multipoint (P-MP) Radio Systems in the terrestrial fixed services operating in the band 24,5 GHz to 29,5 GHz. Only sections specific to CDMA are described in respect to the paragraphs stated in EN 301 213-1 [1].

Point-to-Multipoint Radio Relay Systems (P-MP) may use different access methods. As some technical parameters are different for the various access methods, the standard is divided in five parts. A basic description of the different access methods and a comparison among them is provided in TR 101 274 [5].

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 301 213-1: "Fixed Radio Systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods; Part 1: Basic parameters".

[2] ETSI EN 301 213-2: "Fixed Radio Systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods; Part 2: Frequency Division Multiple Access (FDMA) methods".

[3] ETSI EN 301 213-3: "Fixed Radio Systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods; Part 3: Time Division Multiple Access (TDMA) methods".

[4] ETSI EN 301 213-5: "Fixed Radio Systems; Point-to-multipoint equipment; Point-to-multipoint digital radio systems in frequency bands in the range 24,25 GHz to 29,5 GHz using different access methods; Part 5: Multi-Carrier Time Division Multiple Access (MC-TDMA) methods".

[5] ETSI TR 101 274: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Point-to-multipoint DRRS in the access network: Overview of different access techniques".

[6] CEPT Recommendation T/R 13-02: "Preferred Channel Arrangements for the Fixed Services in the range 22,0 - 29,5 GHz".

[7] ETSI EG 202 306 (V1.2.1): "Transmission and Multiplexing (TM); Access networks for residential customers".

3 Definitions, symbols and abbreviations

See EN 301 213-1 [1], clause 3.

3.1 Definitions

For the purposes of the present document, in addition to those given in clause 3 of EN 301 213-1 [1], the following terms and definitions apply:

chip: unit of modulation used in Direct Sequence Spread Spectrum (DSSS) modulation

chip rate: number of chips per second, e.g. Mchip/s

chip sequence: sequence of chips with defined length and chip polarities

direct Sequence Spread Spectrum: scheme where the data to be transmitted is combined with a fixed code sequence (chip sequence)
This can be used to modulate a carrier

single DS-CDMA signal: single traffic channel and any associated signalling and synchronization overhead

system loading: number of simultaneous traffic channels at 64 kbit/s in a given radio channel

maximum system loading: number of simultaneous 64 kbit/s traffic channels in a given radio channel for the class of operation declared by the manufacturer

round trip delay: Sum of the delays between Baseband interface reference points F (SNI) to G (UNI) and G (UNI) to F (SNI) in figure 1 of EN 301 213-1 [1], including any repeaters if appropriate.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

dB	decibel
dBm	decibels relative to one milliwatt
kbit/s	kilobits per second
GHz	Gigahertz
Mbit/s	Megabits per second
MHz	Megahertz

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ATPC	Automatic Transmission Power Control
BER	Bit Error Ratio
BW	Bandwidth
CRS	Central Radio Station
CS	Central Station
CSmin	Minimum practical channel separation (for a given radio-frequency channel arrangement)
CW	Continuous Wave
DSSS	Direct Sequence Spread Spectrum
DS-CDMA	Direct Sequence Code Division Multiple Access
EN	European Norm
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
ISDN	Integrated Services Digital Network
MC-TDMA	Multiple Carrier Time Division Multiple Access
MSL	Maximum System Loading
P-MP	Point-to-Multipoint

RBER	Residual BER
RF	Radio Frequency
RS	Repeater Station
SNI	Service Node Interface (EG 202 306 [7])
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TMN	Telecommunication Management Network
TS	Terminal Station
UNI	User Network Interface (EG 202 306 [7])

4 General characteristics

4.1 General System Architecture

See EN 301 213-1 [1], clause 4.1.

4.2 Frequency bands and channel arrangements

4.2.1 Channel Plan

See EN 301 213-1 [1], clause 4.2.1.

4.2.2 Channel Arrangement

In DS-CDMA systems the required channel spacing is determined by the chip rate. For the purposes of the present document, the following example channel spacings have been defined (see table 1).

Table 1: Channel Spacing

Channel spacing (MHz)	3,5	7,0	14,0	28	56	112

Other channel spacings may also be employed. Further channel spacings are available by scaling proportionally all channel-related parameters in the present document.

4.3 Compatibility requirements

See EN 301 213-1 [1], clause 4.3.

4.4 Environmental Conditions

See EN 301 213-1 [1], clause 4.4.

4.5 Power Supply

See EN 301 213-1 [1], clause 4.5.

4.6 Electromagnetic compatibility

See EN 301 213-1 [1], clause 4.6.

4.7 TMN interfaces

See EN 301 213-1 [1], clause 4.7.

4.8 Synchronization of interface bit rates

See EN 301 213-1 [1], clause 4.8.

4.9 Branching/feeder/antenna requirements

See EN 301 213-1 [1], clause 4.9.

5 System Parameters

5.1 System Capacity

The system capacity parameter considered in the present document is the transmission capacity of the CS, which is the maximal payload bit rate transmitted over the air between a given CS and its associated remote terminal and repeater stations (TSs and RSs).

Due to particular features of DS-CDMA, the system capacity is a free design parameter. However in order to define the performance of the system in the present document a maximum system loading shall be used. The manufacturer shall declare which class the equipment meets. The class will define the number of 64 kbit/s traffic channels that can co-exist within a single allocated radio channel with a Bit Error Ratio (BER) lower than or equal to 10^{-6}. Different classes of equipment against maximum system loading are given in tables 7 to 12.

Systems shall use orthogonal code sequences.

NOTE: orthogonal code sequences are referred to as "Class A" in some other DS-CDMA standards to distinguish them from "Class B" (non-orthogonal or pseudo random chip sequences). The BER for a single traffic channel will degrade as the number of simultaneous traffic channels increases.

5.1.1 Maximum System Loading (MSL)

Manufacturers shall declare the MSL for a system. The system performance shall equal or exceed that given in tables 7 to 12 at the declared MSL class of operation.

The minimum number of simultaneous traffic channels is given in table 2.

Table 2: Minimum number of simultaneous 64 kbits/s traffic channels

Channel Spacing →	3,5 MHz	7 MHz	14 MHz	28 MHz	56 MHz	112 MHz
minimum number of simultaneous 64 kbit/s traffic channels	20	40	80	160	320	640

NOTE 1: The nomenclature used for class of operation in tables 7 to 12 is derived from the declared number of 64 kbit/s users that can be supported under maximum loading conditions. Thus, for example, class "A20" denotes "MSL of 20 x 64 kbit/s channels" with orthogonal code sequences.

NOTE 2: For systems that do not support exact multiples of 64 kbit/s traffic, the system must support at least the equivalent total traffic in bit/s e.g. a Class A20 system must support at least 1,28 Mbit/s total traffic. When performing tests to verify the performance against tables 7 to 12 the total traffic carried by the system must not be less than the equivalent to the appropriate number of 64 kbit/s channels or users. E.g. an A20 system may be considered to be operating at its declared loading when carrying 9 × 144 kbit/s ISDN calls.

5.2 Round Trip Delay

See EN 301 213-1 [1], clause 5.2.

5.3 Transparency

See EN 301 213-1 [1], clause 5.3.

5.4 Voice Coding Methods

See EN 301 213-1 [1], clause 5.4.

5.5 Transmitter Characteristics

5.5.1 Transmitter Output Power

See EN 301 213-1 [1], clause 5.5.1.

5.5.2 Transmitter Nominal Power

See EN 301 213-1 [1], clause 5.5.2.

5.5.3 Transmit Power and Frequency Control

See EN 301 213-1 [1], clause 5.5.3.

The use of ATPC is mandatory for the TS transmitters (and for RS transmitters facing CS).

5.5.4 RF Spectrum Mask

5.5.4.1 RF Spectrum density mask (all stations)

The spectrum mask is given in figure 1 and table 4. No allowance is made for frequency tolerance.

The transmitted output power spectrum is defined as the spectrum when modulated with a test data signal that simulates a system operating under maximum system loading conditions.

The spectrum measurement shall be performed at point C' of the RF system block diagram figure 2 of [1]. It shall be performed with the maximum hold function and settings in table 3 on the spectrum analyser selected.

The reference level of the output spectrum means that the 0 dB level is the top of the modulated spectrum, disregarding residual carrier.

Table 3: Spectrum Analyzer Settings

Resolution IF BW	Video BW	Sweep time
30 kHz	300 Hz	Auto

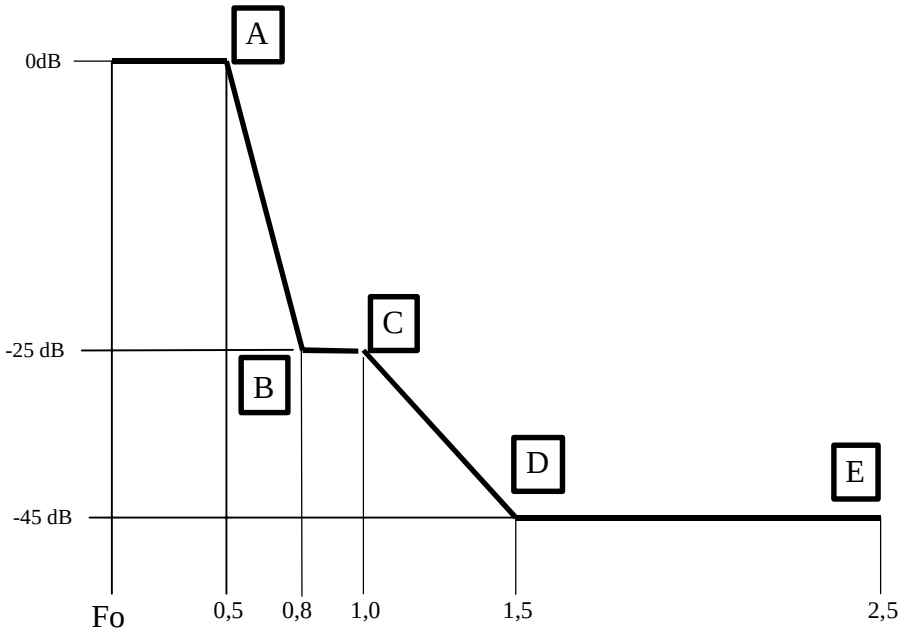


Figure 1: DS-CDMA spectrum mask normalized for channel spacing

Table 4: Channel spacing against spectrum mask reference points

Relative Level→	**Point A 0 dB**	**Point B -25 dB**	**Point C -25 dB**	**Point D -45 dB**	**Point E -45 dB**
Channel Spacing (MHz)↓	**0,5 × Channel Spacing**	**0,8 × Channel Spacing**	**1,0 × Channel Spacing**	**1,5 × Channel Spacing**	**2,5 × Channel Spacing**
3,5	1,75 MHz	2,8 MHz	3,5 MHz	5,25 MHz	8,75 MHz
7	3,5 MHz	5,6 MHz	7 MHz	10,5 MHz	17,5 MHz
14	7 MHz	11,2 MHz	14 MHz	21 MHz	35 MHz
28	14 MHz	22,4 MHz	28 MHz	42 MHz	70 MHz
56	28 MHz	44,8 MHz	56 MHz	84 MHz	140 MHz
112	56 MHz	89,6 MHz	112 MHz	168 MHz	280 MHz

5.5.4.2 Discrete CW components exceeding the spectrum density mask limit (all stations)

In case some CW components exceed the spectrum mask, an additional allowance is given.

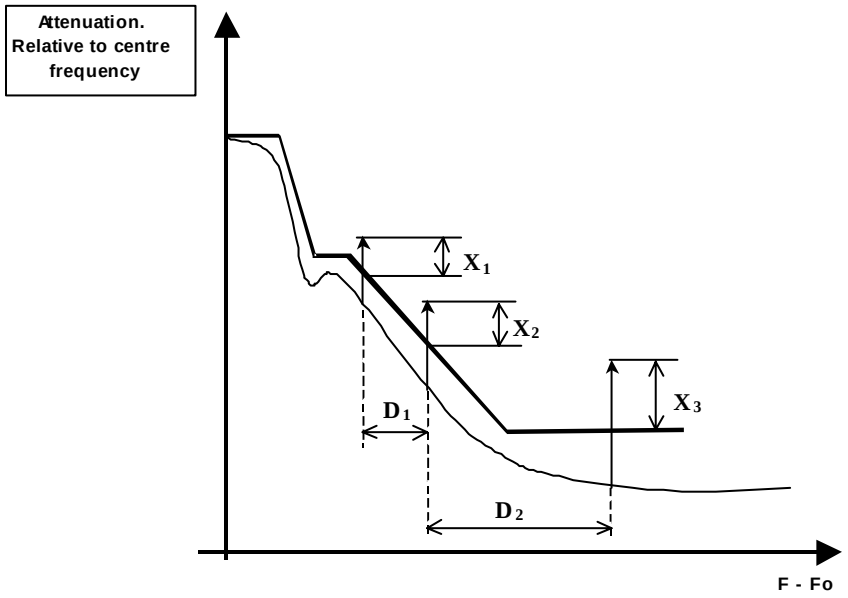
Those lines shall not:

- exceed the mask by a factor more than {10 log (CSmin/IFbw) - 10} dB;
- be spaced each other in frequency by less than CSmin.

Where:

- CSmin is the minimum practical channel separation for the given radio-frequency channel arrangement;
- CSmin = 1 750 kHz for both 26 GHz and 28 GHz bands;
- IFbw is the recommended resolution IF bandwidth, expressed in kHz, reported in table 3.

Figure 2 shows a typical example of this requirement.



X_1, X_2, X_3 [dB] $\leq$ 10log(CSmin/ IFbw) -10

$D_1, D_2 \geq$ CSmin

Figure 2: CW lines exceeding the spectrum mask (typical example)

5.5.5 Tx Local Oscillator Frequency Arrangements

See EN 301 213-1 [1], clause 5.5.5.

5.5.6 Spurious Emissions (external)

See EN 301 213-1 [1], clause 5.5.6.

5.5.7 Radio Frequency Tolerance

See EN 301 213-1 [1], clause 5.5.7.

5.6 Receiver Characteristics

5.6.1 RF Local Oscillator Frequency Arrangements

See EN 301 213-1 [1], clause 5.6.1.

5.6.2 Spurious Emissions

See EN 301 213-1 [1], clause 5.6.2.

5.6.3 Receiver IF

See EN 301 213-1 [1], clause 5.6.3.

5.6.4 Input level range (dynamic range)

Table 5 defines, for the appropriate receiver type and a single DS-CDMA signal, the dynamic range above the receiver threshold level defined in table 6 or in the relevant tables 7 to 12 for the declared system loading, for which the BER shall be 10^{-3} or less.

Table 5: Dynamic range

Terminal Station	60 dB
Repeater Station (facing Central Station)	60 dB
Repeater Station (facing Terminal Station)	20 dB
Central Station	20 dB

NOTE: The dynamic range for CS and RS receivers facing terminal stations is lower because ATPC is mandatory for the corresponding transmitters.

5.7 System Performance

5.7.1 Dynamic Level Range

Not applicable.

5.7.2 BER as a function of RSL

For a single DS-CDMA signal receiver BER thresholds (dBm) referred to point C of the RF block diagram (see EN 301 213-1 [1], figure 2) for a BER of 10^{-3} and 10^{-6} shall be equal to or lower than those stated in table 6. These values do not include any contribution due to the necessary signalling and synchronization overhead.

Table 6: BER performance thresholds

User Bit Rate	**RSL for BER 10^{-3}**	**RSL for BER 10^{-6}**
(kbit/s)	**(dBm)**	**(dBm)**
64	-103	-101

For different system loading, as declared by the manufacturer, the RSL shall be according tables 7 to 12 for the relevant channel bandwidth.

NOTE 1: Tables 7 to 12 extend below the minimum allowed class of operation for information about performance under light loading conditions.

NOTE 2: The RSL in tables 7 to 12 are the power per 64 kbit/s user and do not include any contribution due to the necessary signalling and synchronization overhead.

Table 7: Maximum System Load - 3,5 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	2	-103	-101
	4	-103	-101
	6	-103	-101
	8	-102	-100
	10	-102	-100
	12	-102	-100
	14	-101	-99
	16	-101	-99
	18	-101	-99
A20	20	-100	-98
A22	22	-100	-98
A24	24	-99	-97
A26	26	-98	-96
A28	28	-98	-96
A30	30	-97	-95

Table 8: Maximum System Load - 7 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	4	-103	-101
	8	-103	-101
	12	-103	-101
	16	-102	-100
	20	-102	-100
	24	-102	-100
	28	-101	-99
	32	-101	-99
	36	-101	-99
A40	40	-100	-98
A44	44	-100	-98
A48	48	-99	-97
A52	52	-98	-96
A56	56	-98	-96
A60	60	-97	-95

Table 9: Maximum System Load - 14 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	8	-103	-101
	16	-103	-101
	24	-103	-101
	32	-102	-100
	40	-102	-100
	48	-102	-100
	56	-101	-99
	64	-101	-99
	72	-101	-99
A80	80	-100	-98
A88	88	-100	-98
A96	96	-99	-97
A104	104	-99	-96
A112	112	-98	-96
A120	120	-97	-95

Table 10: Maximum System Load - 28 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	16	-103	-101
	32	-103	-101
	48	-103	-101
	64	-102	-100
	80	-102	-100
	96	-102	-100
	112	-101	-99
	128	-101	-99
	144	-101	-99
A160	160	-100	-98
A176	176	-100	-98
A192	192	-99	-97
A208	208	-99	-96
A224	224	-98	-96
A240	240	-97	-95

Table 11: Maximum System Load - 56 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	32	-103	-101
	64	-103	-101
	96	-103	-101
	128	-102	-100
	160	-102	-100
	192	-102	-100
	224	-101	-99
	256	-101	-99
	288	-101	-99
A320	320	-100	-98
A352	352	-100	-98
A384	384	-99	-97
A416	416	-99	-96
A448	448	-98	-96
A480	480	-97	-95

Table 12: Maximum System Load - 112 MHz channels

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user)	
		for BER = 10^{-3}	for BER = 10^{-6}
	64	-103	-101
	128	-103	-101
	192	-103	-101
	256	-102	-100
	320	-102	-100
	384	-102	-100
	448	-101	-99
	512	-101	-99
	576	-101	-99
A640	640	-100	-98
A704	704	-100	-98
A768	768	-99	-97
A832	832	-99	-96
A896	896	-98	-96
A960	960	-97	-95

5.7.3 Equipment Residual BER

See EN 301 213-1 [1], clause 5.7.3.

5.7.4 Interference sensitivity

5.7.4.1 Co-channel interference

All receive signal levels and interference level measurements are referred to point C of the system block diagram, given in EN 301 213-1 [1], figure 2.

The limits of co-channel interference for uncorrelated, like-modulated signals shall be as in table 13.

For a declared loading of N signals applied to the receiver each at a level greater by 1 dB or 3 dB than the relevant level specified in tables 7 to 12 an applied additional co-channel interferer with uncorrelated, like-modulation in the same bandwidth at the relevant level specified in table 13 shall not cause the BER to exceed the relevant specified figure.

Table 13: Co-channel sensitivity

	BER 10^{-6}	
Threshold degradation	**1 dB**	**3 dB**
Channel spacing MHz ↓	**Interference level (dBm)**	**Interference level (dBm)**
3,5	-112	-106
7	-109	-103
14	-106	-100
28	-103	-97
56	-100	-94
112	-97	-91

5.7.4.2 Adjacent Channel Interference

All receive signal levels and interference level measurements are referred to point C of the system block diagram, given in EN 301 213-1 [1], figure 2.

The limits of adjacent channel interference for an uncorrelated, like-modulated signal shall be as in table 14. For a declared loading of N signals applied to the receiver, each at a level greater by 1 dB or 3 dB than the relevant level specified in tables 7 to 12 an applied additional adjacent channel interferer with uncorrelated like-modulation in the same bandwidth at the relevant signal level specified in table 14 shall not cause the BER to exceed the relevant specified value.

Table 14: Adjacent channel sensitivity

	BER 10^{-6}	
Threshold degradation→	**1 dB**	**3 dB**
Channel spacing MHz ↓	**Interference level (dBm)**	**Interference level (dBm)**
3,5	-96	-90
7	-93	-87
14	-90	-84
28	-87	-81
56	-84	-78
112	-81	-75

5.7.4.3 CW Interference

See EN 301 213-1 [1], clause 5.7.4.3.

5.7.5 Distortion Sensitivity

See EN 301 213-1 [1], clause 5.7.5.

6 Types of interfaces at the subscriber equipment and the network exchange

See EN 301 213-1 [1], clause 6.

History

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