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Fixed Radio Systems; Point-to-point equipment; High capacity digital radio systems carrying SDH signals (up to 2 x STM-1) in frequency bands with about 30 MHz channel spacing and using co-polar arrangements or Co-Channel Dual Polarized (CCDP) operation

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European Standard (Telecommunications series)

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document modifies only class 5b spectrum mask giving more allowance for practical implementations without modifying any other requirement.

National transposition dates	
Date of adoption of this EN:	12 July 2002
Date of latest announcement of this EN (doa):	31 October 2002
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 April 2003
Date of withdrawal of any conflicting National Standard (dow):	30 April 2003

1 Scope

The present document specifies the minimum performance parameters for a high capacity digital radio-relay system operating in frequency bands with about 30 MHz channel spacing in the 4 GHz, 6L GHz, 7 GHz, 8L GHz, 13 GHz and 15 GHz bands. The channel capacity is $1 \times \text{STM-1}$ on each polarization that allows to transmit up to $2 \times \text{STM-1}$ signals at the same frequency by using both polarizations in co-channel dual polarized (CCDP) mode of operation with cross-polar interference canceller techniques (XPIC).

The present document is also applicable to $1 \times \text{STM-1}$ systems operating only with co-polar arrangement of about 30 MHz for which the CCDP operation with XPIC is considered a non mandatory options; for those systems the clauses relevant to XPIC operation (i.e. co-channel "internal" interference) are not applicable. These systems are intended for local high capacity links (e.g. mobile infrastructure connections) where few channels may be used by different operators) and the crowded environment could require co-polar operation on adjacent channels.

It has to be noted that STM-1 systems can be grouped in order to offer an SDH interface higher than STM-1.

The area of application of these digital radio-relay systems is foreseen to be in regional and trunk networks forming part of an SDH-network including optical rings.

Systems considered in the present document shall be able to respect ITU-R and ITU-T performance objectives.

The systems considered shall operate in these networks having regard for existing hop length, which are considered to be normally up to about 30 km to 40 km for regional and about 60 km for trunk networks, respectively. Hop lengths greater than this latter length are used in special applications.

The systems considered in the present document are intended to operate in the same network with existing, Alternate Polarization (AP), SDH and PDH systems reported in EN 300 234 [14] and in CEPT/ERC Recommendation T/L 04-04 [7], respectively.

NOTE 1: Adjacent channel co-polar operation on the same route between digital systems designed according these older standards and digital systems defined by the present document, is not feasible.

The parameters specified fall into two categories:

- a) Parameters that are required to provide compatibility between channels connected to the same antenna via multichannel branching system, or channels on the same route connected to separate antennas.

NOTE 2: Due to the internal functionality of the XPIC, equipment operating on both polarization of the same channel is considered to form a single CCDP system.

- b) Parameters defining the transmission quality of the proposed system.

The standardization deals with baseband, IF and RF characteristics relevant to SDH. Antenna/feeder system requirements are also considered for information to the reader, however antenna characteristics are generally covered in EN 300 833 [17].

Baseband interfaces have to be considered for STM-1 signals in accordance with ITU-T Recommendation G.707 [36] and ITU-T Recommendation G.957 [42].

PDH interfaces according ITU-T Recommendation G.703 [35] for signals mapped into STM-1 signal according to ITU-T Recommendation G.707 [36] could be used.

The present document does not contain aspects related to test procedures and test conditions, however they are to be found in EN 301 126-1 [18].

Safety aspects are outside the mandate of ETSI and they will not be considered in the present document. However compliance to EN 60950 [1] will be required to comply with Directive 1999/5/EC (R&TTE) [8].

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] EN 60950: "Safety of information technology equipment".
- [2] CEPT ERC/REC 12-02: "Harmonised radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 12,75 GHz to 13,25 GHz".
- [3] CEPT ERC/REC 12-07: "Harmonised radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 14,5 - 14,62 GHz paired with 15,23 - 15,35 GHz".
- [4] CEPT ERC/REC 12-08: "Harmonised radio frequency channel arrangements and block allocations for low, medium and high capacity systems in the band 3 600 MHz to 4 200 MHz".
- [5] CEPT ERC/REC 14-01: "Radio-frequency channel arrangements for high capacity analogue and digital radio-relay systems operating in the band 5 925 MHz - 6 425 MHz".
- [6] CEPT ERC/REC 74-01: "Spurious emissions".
- [7] CEPT ERC/REC T/L 04-04: "Harmonisation of 140 Mbit/s digital radio relay systems for operation below 10 GHz utilising 64 QAM at about 30 MHz spacing".
- [8] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
<http://standards.iteh.ai/catalog/standards/sist/6fbd9be4-cbd1-4418-8fac-6aef0f63e8a6/sist-en-301-127-v1-3-1-2003>
- [9] ETSI TR 101 035: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".
- [10] ETSI EN 300 019 (all parts): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".
- [11] ETSI ETS 300 119 (all parts): "Equipment Engineering (EE); European telecommunication standard for equipment practice".
- [12] ETSI ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".
- [13] ETSI EN 300 132-2: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [14] ETSI EN 300 234: "Fixed Radio Systems; Point-to-point equipment; High capacity digital radio systems carrying 1 x STM-1 signals and operating in frequency bands with about 30 MHz channel spacing and alternated arrangements".
- [15] ETSI EN 300 385: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment".
- [16] ETSI ETS 300 635: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of M x STM-N".
- [17] ETSI EN 300 833: "Fixed Radio Systems; Point-to-point Antennas; Antennas for point-to-point fixed radio systems operating in the frequency band 3 GHz to 60 GHz".

- [18] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-point equipment - Definitions, general requirements and test procedures".
- [19] ITU-R Recommendation F.382: "Radio-frequency channel arrangements for radio-relay systems operating in the 2 and 4 GHz bands".
- [20] ITU-R Recommendation F.383: "Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band".
- [21] ITU-R Recommendation F.385: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".
- [22] ITU-R Recommendation F.386: "Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band".
- [23] ITU-R Recommendation F.497: "Radio-frequency channel arrangements for radio-relay systems operating in the 13 GHz frequency band".
- [24] ITU-R Recommendation F.557: "Availability objective for radio-relay systems over a hypothetical reference circuit and a hypothetical reference digital path".
- [25] ITU-R Recommendation F.635: "Radio-frequency channel arrangements based on a homogenous pattern for radio-relay systems operating in the 4 GHz band".
- [26] ITU-R Recommendation F.636: "Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band".
- [27] ITU-R Recommendation F.695: "Availability objectives for real digital radio-relay links forming part of a high-grade circuit within an integrated services digital network".
- [28] ITU-R Recommendation F.750: "Architectures and functional aspects of radio-relay systems for synchronous digital hierarchy (SDH)-based networks".
- [29] ITU-R Recommendation F.752: "Diversity techniques for radio-relay systems".
- [30] ITU-R Recommendation F.1092: "Error performance objectives for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part of the international portion of a 27 500 km hypothetical reference path".
- [31] ITU-R Recommendation F.1093: "Effects of multipath propagation on the design and operation of line-of-sight digital radio-relays systems".
- [32] ITU-R Recommendation F.1101: "Characteristics of digital radio-relay systems below about 17 GHz".
- [33] ITU-R Recommendation F.1189: "Error performance objectives for constant bit rate digital paths at or above the primary rate carried by digital radio-relay systems which may form part or all of the national portion of a 27 500 km hypothetical reference path".
- [34] ITU-R Recommendation F.1191: "Bandwidths and unwanted emissions of digital fixed service systems".
- [35] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".
- [36] ITU-T Recommendation G.707: "Network node interface for the synchronous digital hierarchy (SDH)".
- [37] ITU-T Recommendation G.773: "Protocol suites for Q-interfaces for management of transmission systems".
- [38] ITU-T Recommendation G.783: "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".
- [39] ITU-T Recommendation G.784: "Synchronous digital hierarchy (SDH) management".

- [40] ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".
- [41] ITU-T Recommendation G.827: "Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate".
- [42] ITU-T Recommendation G.957: "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- [43] ITU-T Recommendation O.151: "Error performance measuring equipment operating at the primary rate and above".
- [44] ITU-T Recommendation O.181: "Equipment to assess error performance on STM-N interfaces".
- [45] ITU-R Recommendation SM.329-9: "Spurious emissions".
- [46] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".
- [47] ETSI EN 301 489-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services".
- [48] ITU-T Recommendation G.828: "Error performance parameters and objectives for international, constant bit rate synchronous digital paths".
- [49] ETSI Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".

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3 Symbols and abbreviations

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3.1 Symbols

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

dB	decibel
dBm	decibel relative to 1 mW
GHz	GigaHertz
km	kilometre
Mbit/s	Megabit per second
MHz	MegaHertz
ppm	parts per million
ns	nanosecond

3.2 Abbreviations

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

6L	Lower 6 (GHz frequency band)
AP	Alternate Polarization
ATPC	Automatic Transmit Power Control
BB	Base Band
BER	Bit Error Rate
C/I	Carrier to Interference (ratio)
CCDP	Co-Channel Dual Polar
CMI	Code Mark Inversion
CSmin	minimum practical Channel Separation (for a given radio-frequency channel arrangement)
CW	Continuous Wave

DRRS	Digital Radio Relay System
FDM	Frequency Division Multiplexing
IF	Intermediate Frequency
LO	Local Oscillator
NFD	Net Filter Discrimination
ppm	parts per million
RF	Radio Frequency
RFCOH	Radio Frame Complementary OverHead
RX	Receiver
SDH	Synchronous Digital Hierarchy
SOH	Section OverHead
STM-1	Synchronous Transport Module Level 1 (155,52 Mbit/s)
TMN	Telecommunication Management Network
TX	Transmitter
XPD	Cross Polar Discrimination
XPI	Cross Polar Interference
XPIC	Cross Polar Interference Canceller

4 General characteristics

4.1 Frequency bands and channel arrangements

The equipment shall operate on one or more of the channels as defined below.

4 GHz	The channel plan shall be in accordance with CEPT ERC/REC 12-08, annex A, part 2 [4] or ITU-R Recommendations F.382 [19] or F.635-5 [25].
6L GHz	The channel plan shall be in accordance with CEPT ERC/REC 14-01 [5] or ITU-R Recommendation F.383 [20].
7 GHz	The channel plan shall be in accordance with ITU-R Recommendation F.385 [21].
8L GHz	The channel plan shall be in accordance with ITU-R Recommendation F.386 [22].
13 GHz	The channel plan shall be in accordance with CEPT ERC/REC 12-02 [2] or ITU-R Recommendation F.497 [23].
15 GHz	The channel plan shall be in accordance with CEPT ERC/REC 12-07 [3] or ITU-R Recommendation F.636 [26].

It is recognized that, particularly in bands 7 GHz and 8 GHz there might be a number of national channel arrangements that are not referenced in the above recommendations, however the provision of the present document are valid also for them, provided that the channel separation is contained between 28 MHz and 30 MHz.

4.2 Modes of operation

The mode of operation is Co-Channel Dual Polar (CCDP) for all frequency bands.

The actual exploiting of both polarization is considered optional; in particular, for the case of partially outdoor systems, the XPIC and frequency reuse may even not be applicable, while compatibility with other systems, that fully exploiting the CCDP frequency reuse, is maintained.

In defining system characteristics for CCDP systems the additional losses introduced by the branching networks should be taken into account. Depending on the implementation (split branching for even and odd channels followed by a 3 dB loss hybrid put at reference points C and/or C', narrow band RF filters concept or others implementation) additional losses ranging from 3 dB to 6 dB should be considered in evaluating the available net system gain.

When narrow-band RF filters are used losses affect directly receiver thresholds at reference point B. As a consequence this should be taken into account in specifying receiver threshold limits.