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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

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European Standard (Telecommunications series)

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Contents

Intellectual Property Rights	5
Foreword	5
1 Scope	6
2 References	7
3 Symbols and abbreviations	9
3.1 Symbols	9
3.2 Abbreviations	9
4 General characteristics	10
4.1 Frequency bands and channel arrangements	10
4.1.1 Channel arrangements	10
4.2 Compatibility requirements between systems	10
4.3 Performance and availability requirements	10
4.4 Environmental conditions	11
4.4.1 Equipment within weather protected locations (indoor locations)	11
4.4.2 Equipment for non-weather protected locations (outdoor locations)	11
4.5 Power supply	11
4.6 Electromagnetic compatibility	11
4.7 System block diagram	12
4.8 Telecommunications Management Network (TMN) interface	12
4.9 Branching/feeder/antenna characteristics	12
4.9.1 Antenna radiation patterns	12
4.9.2 Antenna cross-Polar Discrimination (XPD)	12
4.9.3 Antenna Inter-Port Isolation (IPI)	12
4.9.4 Waveguide flanges (or other connectors)	12
4.9.5 Return loss	13
5 System Parameters	13
5.1 Transmission capacity	13
5.2 Baseband parameters	13
5.2.1 Plesiochronous interfaces	13
5.2.2 SDH baseband interface	13
5.3 Transmitter characteristics	13
5.3.1 Transmitter power range	14
5.3.2 Transmit power and frequency control	14
5.3.2.1 Automatic Transmit Power Control (ATPC)	14
5.3.2.2 Remote Transmit Power Control (RTPC)	14
5.3.2.3 Remote Frequency Control (RFC)	15
5.3.3 Transmitter output power tolerance	15
5.3.4 Transmit Local Oscillator (LO) frequency arrangements	15
5.3.5 RF spectrum mask	15
5.3.6 Discrete CW components exceeding the spectrum mask limit	21
5.3.7 Spectral lines at the symbol rate	21
5.3.7.1 Additional CW components	21
5.3.8 Spurious emissions	22
5.3.8.1 Spurious emissions - external	23
5.3.8.2 Spurious emissions - internal	23
5.3.9 Radio frequency tolerance	23
5.4 Receiver characteristics	23
5.4.1 Input level range	23
5.4.2 Receiver image rejection	24
5.4.3 Spurious emissions	24
5.4.3.1 Spurious emissions - external	24
5.4.3.2 Spurious emissions - internal	24
5.4.4 Innermost channel receiver selectivity for L6 GHz	25

5.5	System performance without diversity	26
5.5.1	BER as a function of Receiver input Signal Level (RSL)	26
5.5.2	Equipment Residual BER.....	26
5.5.3	Interference sensitivity	26
5.5.3.1	Co-channel interference sensitivity.....	27
5.5.3.2	Adjacent channel Interference.....	27
5.5.3.3	CW Spurious Interference.....	27
5.5.4	Distortion sensitivity	28
5.6	System characteristics with diversity.....	28
5.6.1	Differential delay compensation	28
5.6.2	BER performance	28
Annex A (informative): Additional information		29
A.1	Cross-Polar Discrimination (XPD).....	29
A.2	Branching/feeder/antenna requirements.....	29
A.2.1	Return loss	29
A.2.2	Intermodulation products.....	29
A.2.3	Interport isolation	29
A.3	Automatic Transmit Power Control (ATPC)	29
A.4	RBER.....	30
A.5	Co-channel and adjacent channel interference	31
Annex B: Void		34
Annex C (normative): System type codes for regulatory procedures		35
Annex D (informative): Bibliography.....		36
History		37

SIST EN 300 234 V1.3.1:2003

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Foreword

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

The present document contains the minimum technical requirements to ensure compatibility of products and conformance with radio regulations across ETSI member states. Radio terminals from different manufacturers are not required to interwork at radio frequency (i.e. no common air interface). However, terminals may be combined with other manufacturers' equipment on a Radio Frequency (RF) branching network for operation on different polarizations.

The present document defines the requirements of radio terminal and radio relay equipment and associated interfaces. The requirements for multiplex, network management and antenna/feeder equipment may be addressed elsewhere.

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1 Scope

The present document specifies parameters for high capacity STM-1 digital radio-relay systems designed to operate in defined bands up to 15 GHz. The channel spacing between adjacent cross-polar channels is generally approximately 30 MHz. Operation in the Adjacent Channel alternated cross-polar mode is foreseen. The present document specifies the minimum performance parameters for terrestrial fixed service radio communications equipment operating in the frequency bands up to 15 GHz and contains a revision from the previous version, in the area of:

- modification of the RF spectrum masks taking into account the compatibility requirements.

Recognizing that in some geographical areas there is a high demand for spectrum two different grades of system has been defined.

- Class 5 Grade A: equipment spectral efficiency based on typically 64 or 128-states modulation scheme (e.g. 64-QAM, 128-QAM, or equivalent) to be deployed, on parallel routes, with cross-polar adjacent channel with less stringent adjacent channel performance (see table 8) or for trunked multi-channel applications;
- Class 5 Grade B: equipment spectral efficiency based on typically 64 or 128-states modulation scheme (e.g. 64-QAM, 128-QAM, or equivalent) to be deployed, on parallel routes, with cross-polar adjacent channel with more stringent adjacent channel performance (see table 9).

The above classes are indicative only and do not imply any constraint to the actual modulation format, provided that all the requirements in the present document are met.

- Introduction of unique system type codes for regulatory reference to the various system types detailed in the present document, refer to new annex C (normative) and related categories of equipment classes of spectral efficiency.
- Additional specification for CW spectral lines exceeding the spectrum mask.

The applications of these digital radio-relay systems are anticipated to be in the trunk, regional and access networks, at data rates of Synchronous Transport Module, level 1 (STM-1). The parameters to be specified fall into two categories:

- a) those that are required to provide compatibility between channels from different sources of equipment on the same route connected either to separate antennas or separate polarizations of the same antenna. This category also includes parameters providing compatibility with the existing radio-relay network;
- b) parameters defining the transmission quality of the proposed system.

The standardization deals with RF and baseband characteristics. Antenna/feeder system requirements are covered in EN 300 833 [29].

Two possible baseband interfaces for SDH systems have to be considered: one for STM-1 and another for 140 Mbit/s signals.

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 [27].

Safety aspects are outside the mandate of ETSI and they will not be considered in the present document. However compliance to EN 60950 [43] will be required to comply with Directive 1999/5/EC [44] (R&TTE Directive).

Technical background for most of the parameters and requirements referred in the present document may be found in TR 101 036-1 [28].

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] ITU-R Recommendation F.382-7: "Radio-frequency channel arrangements for radio-relay systems operating in the 2 and 4 GHz bands".
- [2] ITU-R Recommendation F.635-5: "Radio-frequency channel arrangements based on a homogeneous pattern for radio-relay systems operating in the 4 GHz band".
- [3] ITU-R Recommendation F.385-6: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".
- [4] ITU-R Recommendation F.383-6: "Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band".
- [5] ITU-R Recommendation F.386-6 (Annex I): "Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band".
- [6] ITU-R Recommendation F.497-6: "Radio-frequency channel arrangements for radio-relay systems operating in the 13 GHz frequency band".
- [7] ITU-R Recommendation F.636-3: "Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band".
- [8] CEPT/ERC Recommendation 12-08: "Harmonized radio frequency channel arrangements and block allocations for low, medium and high capacity systems in the band 3 600 MHz to 4 200 MHz".
- [9] CEPT/ERC Recommendation 14-01: "Radio-frequency channel arrangements for high capacity analogue and digital radio-relay systems operating in the band 5 925 MHz to 6 425 MHz".
- [10] CEPT/ERC Recommendation 12-02: "Harmonized radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 12,75 GHz to 13,25 GHz".
- [11] CEPT/ERC Recommendation 12-07: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 15,23 GHz to 15,35 GHz".
- [12] ITU-R Recommendation F.750-3: "Architectures and functional aspects of radio-relay systems for synchronous digital hierarchy (SDH) based networks".
- [13] ITU-R Recommendation F.751-2: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".
- [14] ITU-R Recommendation F.1189-1: "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".
- [15] ITU-R Recommendation F.1092-1: "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".
- [16] ETSI ETS 300 019 (all parts): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

- [17] 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".
- [18] ETSI ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [19] ITU-T Recommendation G.703 (1998): "Physical/electrical characteristics of hierarchical digital interfaces".
- [20] ITU-T Recommendation G.707 (1996): "Network node interface for the synchronous digital hierarchy (SDH)".
- [21] ITU-T Recommendation G.773 (1993): "Protocol suites for Q-interfaces for management of transmission systems".
- [22] ITU-T Recommendation G.784 (1999): "Synchronous digital hierarchy (SDH) management".
- [23] ITU-T Recommendation G.826 (1999): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".
- [24] ITU-T Recommendation G.827 (2000): "Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate".
- [25] ITU-T Recommendation G.957 (1999): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- [26] ETSI EN 300 385: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment".
- [27] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment - Definitions, general requirements and test procedures".
- [28] ETSI TR 101 036-1: "Fixed Radio Systems; Point-to-point equipment; Generic wordings for standards on digital radio systems characteristics; Part 1: General aspects and point-to-point equipment parameters".
- [29] 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".
- [30] ETSI ETS 300 635: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of M x STM-N".
- [31] ETSI EN 300 645: "Telecommunications Management Network (TMN); Synchronous Digital Hierarchy (SDH) radio relay equipment; Information model for use on Q interfaces".
- [32] ETSI EN 300 417 (all parts): "Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment".
- [33] ETSI EN 301 167: "Transmission and Multiplexing (TM); Management of Synchronous Digital Hierarchy (SDH) transmission equipment; Fault management and performance monitoring; Functional description".
- [34] CEPT/ERC Recommendation 74-01: "Spurious emissions".
- [35] ITU-T Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".
- [36] ITU-T Recommendation O.181 (1996): "Equipment to assess error performance on STM-N interfaces".
- [37] IEC Publication 154-2: "Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".
- [38] CEPT/ERC Recommendation T/L 04-04: "Harmonization of 140 Mbit/s digital radio relay systems for operation below 10 GHz utilizing 64 QAM at about 30 MHz spacing".

- [39] 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".
- [40] 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".
- [41] ETSI TR 101 035 (V1.1.2): "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".
- [42] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.
- [43] EN 60950: "Safety of information technology equipment".
- [44] 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.

3 Symbols and abbreviations

3.1 Symbols

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

dB	decibel
dBc	decibel relative to mean carrier power
dBm	decibel relative to 1 milliWatt
GHz	GigaHertz
kHz	kiloHertz
Mbit/s	Mega-bits per second
MHz	MegaHertz
ppm	parts per million

3.2 Abbreviations

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

ATPC	Automatic Transmit Power Control
BBER	Background Block Error Ratio
BER	Bit Error Ratio
BWe	evaluation BandWidth (resolution bandwidth in which spectrum components are measured)
C/I	Carrier to Interference ratio
CEPT	Conférence des Administrations Européennes des Postes et Télécommunications
CMI	Coded Mark Inversion
Csmin	Minimum practical channel separation (for a given radio-frequency channel arrangement)
CW	Continuous Wave
DC	direct current
DRRS	Digital Radio Relay Systems
EMC	ElectroMagnetic Compatibility
ESR	Errored Seconds Ratio
ERC	European Radiocommunications Committee
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IPI	Inter-Port Isolation
ITU-R	International Telecommunication Union-Radiocommunications standardization sector
ITU-T	International Telecommunication Union-Telecommunications standardization sector
LO	Local Oscillator

PDH	Plesiochronous Digital Hierarchy
PRBS	Pseudo Random Binary Sequence
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RFC	Remote Frequency Control
RBER	Residual BER
RSL	Receive Signal Level
RTPC	Remote Transmit Power Control
SDH	Synchronous Digital Hierarchy
SOH	Section OverHead
STM-N	Synchronous Transport Module, level N
TM	ETSI TC-Transmission and Multiplexing
TMN	Telecommunications Management Network
XPD	cross-Polar Discrimination

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 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 Recommendation 12-08 [8] annex A, Part 2 or ITU-R Recommendations F.382-7 [1] or F.635-5 [2].
6L GHz	The channel plan shall be in accordance with CEPT/ERC Recommendation 14-01 [9] or ITU-R Recommendation F.383-6 [4].
7 GHz	The channel plan shall be in accordance with ITU-R Recommendation F.385-6 [3].
8L GHz	The channel plan shall be in accordance with ITU-R Recommendation F.386-6 [5].
13 GHz	The channel plan shall be in accordance with CEPT/ERC Recommendation 12-02 [10] or ITU-R Recommendation F.497-6 [6].
15 GHz	The channel plan shall be in accordance with CEPT/ERC Recommendation 12-07 [11] or ITU-R Recommendation F.636-3 [7].

4.2 Compatibility requirements between systems

The compatibility requirements between systems are as follows:

- there shall be no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another;
- there may be a requirement to multiplex different manufacturers equipment on the same polarization of the same antenna;
- there may be a requirement to multiplex different manufacturers equipment on different polarization of the same antenna. This will not apply to systems with integral antenna.

4.3 Performance and availability requirements

Equipment shall be designed in order to meet network performance and availability requirements foreseen by ITU-T Recommendations G.826 [23] and G.827 [24] following the criteria defined in ITU-R Recommendations F.1092-1 [15] and F.1189-1 [14] for international or national portion of the digital path.