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Transmission and Multiplexing (TM); High capacity digital radio-relay 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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Foreword

This European Telecommunication Standard (ETS) has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS 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 an Radio Frequency (RF) branching network for operation on different polarizations.

This ETS 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.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	31 October 1995
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	30 April 1996
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1 Scope

This European Telecommunication Standard (ETS) specifies parameters for digital radio-relay systems with a channel capacity of 1 x Synchronous Transport Module-level 1 (1 x STM-1) designed to operate in defined bands up to 15 GHz utilising approximately 30 MHz between adjacent cross-polar channels.

The parameters specified fall into two categories:

- a) those required to provide compatibility between channels from different sources of equipment on the same route, connected either to separate antennas, or to 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 systems.

The task of defining compatibility requirements with analogue and digital systems on the same hop and at nodes is made complex by the fact that analogue systems and some digital systems are not standardized. Compatibility requirements are, therefore, limited to allowing the operation of digital and analogue channels on separate ports of the same antenna.

The standardization includes the following specifications:

- transmitter and receiver characteristics;
- baseband and Radio Frequency (RF) interface characteristics;
- diversity system characteristics.

Two possible baseband interfaces have to be considered:

- one for STM-1 signals (electrical and/or optical) in accordance with ITU-R Recommendation 750; and
- one for 140 Mbit/s plesiochronous signals (only electrical), according to ITU-T recommendation G.703.

The 140 Mbit/s signals should be carried "open-port", i.e. in a transparent manner independent of their content. They should be mapped into a 155 Mbit/s STM-1 signal as described in ITU-T Recommendations G.708 and G.709.

As regards the STM-1 signal the Section Overhead (SOH) processing is covered in a separate ETSI STC TM 4 document (a report on Synchronous Digital Hierarchy (SDH) aspects) and in ITU-R Recommendation 750 [7].

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- [1] ITU-R Recommendation 382: "Radio-frequency channel arrangements for medium and high capacity analogue radio-relay systems operating in the 2 and 4 GHz bands, or for medium and high capacity digital radio-relay systems operating in the 4 GHz band".
- [2] ITU-R Recommendation 385: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".
- [3] ITU-R Recommendation 383: "Radio-frequency channel arrangements for radio-relay systems operating in the Lower 6 GHz band".
- [4] ITU-R Recommendation 386, Annex I: "Description of the radio-frequency channel arrangement referred to in recommends 7".
- [5] ITU-R Recommendation 497: "Radio-frequency channel arrangements for low and medium capacity analogue or medium and high capacity digital radio-relay systems operating in the 13 GHz band".
- [6] ITU-R Recommendation 636: "Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band".
- [7] ITU-R Recommendation 750: "Architectures and functional aspects of radio-relay systems for SDH-based networks".
- [8] ITU-R Recommendation 751: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".
- [9] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [10] ETS 300 132: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment".
- [11] CEPT Recommendation T/L 04-04: "Harmonization of 140 Mbit/s digital radio relay systems for operation below 10 GHz utilising 64 QAM at about 30 MHz spacing".
- [12] ITU-T Recommendation G.708 (1990): "Network Node Interface for the Synchronous Digital Hierarchy".
- [13] ITU-T Recommendation G.709 (1990): "Synchronous Multiplexing Structure".
- [14] ITU-T Recommendation G.773: "Protocol Suites for Q-Interfaces for Management of Transmission Systems".
- [15] ITU-T Recommendation G.784: "Synchronous Digital Hierarchy Management".

3 Abbreviations and symbols

3.1 Abbreviations

For the purpose of this ETS the following abbreviations apply.

ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
DRRS	Digital Radio-Relay System
IF	Intermediate Frequency
L6	Lower 6 (GHz band)
PRBS	Pseudo-Random Binary Sequence
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
Rx	Receive (Receiver)
SDH	Synchronous Digital Hierarchy
SOH	Section Overhead
STM-1	Synchronous Transport Module-level 1
TMN	Telecommunications Management Network
Tx	Transmit (Transmitter)
VSWR	Voltage Standing Wave Ratio
XPD	Cross-Polar Discrimination

3.2 Symbols

For the purpose of this ETS the following symbols apply:

dB	decibel
dBm	decibel relative to 1 mW
GHz	GigaHertz
km	kilometre
m/s	metres per second
Mbit/s	Megabit per second
MHz	MegaHertz
ns	nanosecond
ppm	parts per million
W/m ²	Watts per square metre

4 Network and system considerations

The area of application of these digital radio-relay systems is foreseen to be in regional and trunk networks. Consideration shall be given to the special requirement in the case of a regional network, e.g. simpler towers with less space for antenna, different network structures with high density nodes. Application may also be envisaged for local links and unidirectional connections.

Systems considered in this ETS should be able to respect ITU-R high grade performance objectives.

The systems considered should operate in these networks having regard for existing hop lengths, which are considered to be normally up to about 30 km - 40 km for regional and about 60 km for trunk networks, respectively. Hop lengths greater than this latter length, up to about 100 km, are used in special applications.

5 General characteristics

5.1 Frequency bands and channel arrangements

The systems shall be required to operate in the following frequency bands, to the specified ITU-R Recommendation on the quoted channel spacings.

4 GHz

ITU-R Recommendation 382 [1] with 29 MHz channel spacing. The centre gap between transmitters and receivers in ITU-R Recommendation 382 [1] is 68 MHz.

Lower 6 GHz

ITU-R Recommendation 383 [3] with 29,65 MHz spacing and a centre gap of 44,49 MHz. The alternative plan in which channels 8 and 1' operate on opposite polarizations should be utilised.

7 GHz

A number of frequency channelling plans are in use at 7 GHz, including that given in ITU-R Recommendation 385 [2] Annex III. These plans all make use of 28 MHz channel spacing with centre gaps of 56 MHz or 84 MHz.

8 GHz

ITU-R Recommendation 386 [4], Annex 1, with 29,650 MHz spacing and a centre gap of 103,770 MHz.

13 GHz

ITU-R Recommendation 497 [5] with 28 MHz spacing and a centre gap of 70 MHz.

15 GHz

ITU-R Recommendation 636 [6] with 28 MHz spacing. The centre gap shall be equal to $N \times 28$ MHz (N integer) and greater than 84 MHz.

5.2 Modes of operation

The mode of operation shall make use of alternate polarizations for adjacent channels in all frequency bands up to 15 GHz (covered by this ETS).

It should be noted that systems designed for co-frequency cross-polar operation with a 30 MHz channel spacing are also expected to comply at least with the specifications contained in this ETS.

However, more stringent specifications for spectrum masks and interference sensitivity would certainly be required for co-frequency cross-polar operation.

5.3 Types of installation

For frequency bands below 10 GHz mainly indoor installations are foreseen.

For radio-relay systems operating in the 13 GHz and 15 GHz bands both indoor and partially outdoor installations are foreseen.

5.3.1 Environmental conditions

The equipment shall be required to meet either the environmental conditions set out in ETS 300 019-1-3 [9] and ETS 300 019-1-4 [9], which define weatherprotected and non-weatherprotected locations, classes and test severities, or one of the conditions listed in subclause 5.3.1.2.