

**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**



Reference

REN/TM-04124

Keywords

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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 ETSI standards One-step Approval Procedure.

The present document contains the minimum technical requirements to ensure compatibility of products and conformance with radio regulations across ETSI member states. Radio equipment from different manufacturers are not required to interwork at radio frequency (i.e. no common air interface).

The present document defines the requirements for radio-relay equipment and associated interfaces.

The present document is intended to cover a variety of systems designed for a variety of services, applications, performance objectives and deployment conditions. Therefore it is necessary if applicable to include in the present document different sets of system parameters. In the present document these set of parameters are referred to as "system types".

The present document is part 1 of a multipart deliverable covering 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, 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, 3, 4 and 5 are intended to be used in conjunction with the present document, describing the basic parameters common to all access methods.

References in EN 301 213 parts 2 [4], 3 [5], 4 [6] and 5 [7] to technical parameters for P-MP systems apply equally to MP-MP systems.

A basic description of the different access methods and a comparison among them are provided in TR 101 274 [8].

The present version differs from the previous one for editorial up-dating consequent to the publication of new ERC Recommendations for FWA in these bands, to publication of EN 301 213-4 [6] and EN 301 213-5 [7] and to recent terminology used in the other parts of the present document. Moreover, alignment to the recent status of EMC ENs harmonized under R&TTE Directive [57] has been introduced without specific technical requirements change.

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

Introduction

The main field of application of Multipoint (MP) systems using the Fixed Service (FS) is to provide access to both public and private networks (PSTN, PDN, etc.). By means of MP systems the network service area may cover scattered subscriber locations. The systems may be applied to build new access networks by means of a multi cellular architecture, covering both suburban, urban and regional areas.

Subscribers are offered the full range of services by the particular public or private network. Subscribers have access to these services by means of the various standardized user network interfaces (e.g. 2-wire loop and ISDN ranging from basic rate to $n \times$ primary rate).

Point-to-multipoint systems provide standard network interfaces and transparently connect subscribers to the appropriate network node. These systems allow a service to be connected to a number of subscribers ranging from a few to several thousand, and over a wide range of distances.

P-MP systems are generally configured as Pre-Assigned Multiple Access Systems (PAMA) or as Demand Assigned Multiple Access (DAMA) Radio Systems.

The essential features of a typical MP Radio Systems are:

- efficient use of the radio spectrum;
- concentration;
- transparency.

Radio is often the ideal way of obtaining communications at low cost and almost independent of distance, and difficult topography. Moreover, a small number of sites are required for these installations, thus facilitating rapid implementation and minimizing maintenance requirements of the systems.

Concentration means that m subscribers can share n radio channels (m being larger than n), allowing a better use to be made of the available frequency spectrum and at a lower equipment cost. The term "multi-access" derives from the fact that every subscriber has access to every channel (instead of a fixed assignment as in most multiplex systems). When a call is initiated one of the available channels is allocated to it. When the call is terminated, the channel is released for another call. Concentration requires the use of distributed intelligent control which in turn allows many other operations and maintenance functions to be added.

Transparency means that the exchange (service node) and the subscriber equipment communicate with each other without being aware of the radio link.

1 Scope

The present document specifies the minimum requirements for system parameters of Point-to-Multipoint (P-MP) Radio and Multipoint-to-multipoint (MP-MP) Systems in the terrestrial Fixed Services (FS) operating in the bands 24,5 GHz to 29,5 GHz.

Multipoint (MP) Radio-Relay Systems use in principle three different access methods, taking into account the basic physical parameters of the frequency, the code and the time. This leads to the three basic access methods of:

- Frequency Division Multiple Access (FDMA);
- Code Division Multiple Access (CDMA);
- Time Division Multiple Access (TDMA).

In addition, in particular for wide-band applications, a multi-carrier transmission implementation may be applied, where each sub-carrier uses one of the above access methodologies.

It should be noted that MP-MP systems differ from P-MP systems in that Terminal Stations may be connected directly to one another in a series of short links and generally act as repeaters for traffic carried on to other stations. The arrangement of links varies over time to accommodate changes in propagation characteristics and changes in the subscriber base.

The MP system in the band 24,5 GHz to 29,5 GHz (ERC/REC T/R 13-02 [1]) will provide access to both public and private networks (PSTN, PDN, etc.) by means of the various standardized network interfaces (e.g. 2-wire loop and ISDN ranging from basic rate to $n \times 2$ Mbit/s as well as local area to wide area data networks interfaces).

The system may be applied to build new access networks by means of a multi cellular architecture, covering urban and suburban areas.

MP systems are generally configured as Pre-Assigned Multiple Access (PAMA) or as Demand Assigned Multiple Access (DAMA) Radio Systems.

The present document covers the following MP applications:

- voice;
- fax;
- voice band data;
- telex;

related to analogue interfaces; and

- 64 kbit/s;
- ISDN;
- digital video;
- digital audio;
- Internet access;

related to digital interfaces;

- further applications like ATM, Frame Relay, LAN, WAN may also be provided.

The equipment covered by EN 301 213 should be designed to be able to meet the network performance requirements foreseen by ITU-R Recommendations F.696-2 [9] and F.697-2 [10], for medium and local grade portion or ITU-R Recommendation F.1189 [11] for the national portion (access or short haul) of the digital connection following the criteria defined in ITU-T Recommendation(s) G.821 [12] and/or G.826 [13].

The availability requirements are under further study by the relevant bodies.

Network operators may choose different performance and availability requirements in order to extend the possible area of application thus fitting to their network needs.

Radio terminals from different manufacturers are not intended to interwork at radio frequency (i.e. no common air interface).

Regulatory bodies should take into account the inband coexistence between MP systems using differing access methods.

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

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

- [1] ERC/REC T/R 13-02, annex B and annex C: "Preferred channel arrangements for fixed services in the range 22,0 - 29,5 GHz".
- [2] ERC/REC 00-05: "Use of the band 24.5 - 26.5 GHz for fixed wireless access".
- [3] ERC/REC 01-03: "Use of parts of the band 27.5 - 29.5 GHz for Fixed Wireless Access (FWA)".
- [4] 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".
- [5] 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".
- [6] ETSI EN 301 213-4: "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".
- [7] 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".
- [8] 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".
- [9] ITU-R Recommendation F.696-2: "Error performance and availability objectives for hypothetical reference digital sections forming part or all of the medium-grade portion of an ISDN connection at a bit rate below the primary rate utilizing digital radio-relay systems".
- [10] ITU-R Recommendation F.697-2: "Error performance and availability objectives for the local-grade portion at each end of an ISDN connection at a bit rate below the primary rate utilizing digital radio-relay systems".
- [11] 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 the national portion of a 27 500 km hypothetical reference path".

- [12] ITU-T Recommendation G.821: "Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network".
- [13] ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".
- [14] ETSI ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [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 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".
- [17] 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".
- [18] ITU-T Recommendation G.773: "Protocol suites for Q-interfaces for management of transmission systems".
- [19] ITU-T Recommendation G.810: "Definitions and terminology for synchronization networks".
- [20] ITU-T Recommendation G.812: "Timing requirements of slave clocks suitable for use as node clocks in synchronization networks".
- [21] ITU-T Recommendation G.823: "The control of jitter and wander within digital networks which are based on the 2 048 kbit/s hierarchy".
- [22] ITU-T Recommendation G.813: "Timing characteristics of SDH equipment slave clocks (SEC)".
- [23] ITU-T Recommendation G.825: "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".
- [24] ETSI ETS 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".
- [25] ETSI EN 301 215-1: "Fixed Radio Systems; Point to Multipoint Antennas; Antennas for point-to-multipoint fixed radio systems in the 11 GHz to 60 GHz band; Part 1: General aspects".
- [26] ETSI EN 301 215-2: "Fixed Radio Systems; Point to Multipoint Antennas; Antennas for point-to-multipoint fixed radio systems in the 11 GHz to 60 GHz band; Part 2: 24 GHz to 30 GHz".
- [27] IEC 60154-2: "Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".
- [28] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".
- [29] ITU-T Recommendation G.131: "Control of talker echo".
- [30] ITU-T Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".
- [31] ITU-T Recommendation G.726: "40, 32, 24, 16 kbit/s adaptive differential pulse code modulation (ADPCM)".
- [32] ITU-T Recommendation G.728: "Coding of speech at 16 kbit/s using low-delay code excited linear prediction".
- [33] ITU-T Recommendation G.729: "Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear-prediction (CS-ACELP)".

- [34] ITU-T Recommendation O.151: "Error performance measuring equipment operating at the primary rate and above".
- [35] ITU-T Recommendation O.181: "Equipment to assess error performance on STM-N interfaces".
- [36] ITU-R Recommendation F.1249-1: "Maximum equivalent isotropically radiated power of transmitting stations in the fixed service operating in the frequency band 25,25 - 27,5 GHz shared with the inter-satellite service".
- [37] ETSI EN 301 390: "Fixed Radio Systems; Point-to-point and Point-to-Multipoint Systems; Spurious emissions and receiver immunity at equipment/antenna port of Digital Fixed Radio Systems".
- [38] ITU-T Recommendation Q.552: "Transmission characteristics at 2-wire analogue interfaces of digital exchanges".
- [39] ITU-T Recommendation Q.553: "Transmission characteristics at 4-wire analogue interfaces of digital exchanges".
- [40] ITU-T Recommendation R.20: "Telegraph modem for subscriber lines".
- [41] ITU-T Recommendation V series: "Data communication over the telephone network".
- [42] ITU-T Recommendation X series: "Data networks and open system communication".
- [43] ITU-T Recommendation G.961: "Digital transmission system on metallic local lines for ISDN basic rate access".
- [44] ETSI ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface; Layer 1 specification and test principles".
- [45] ETSI ETS 300 011: "Integrated Services Digital Network (ISDN); Primary rate user-network interface; Layer 1 specification and test principles".
- [46] ITU-T Recommendation G.962: "Access digital line section for ISDN primary rate at 2 048 kbit/s".
- [47] ITU-T Recommendation G.707: "Network node interface for the synchronous digital hierarchy (SDH)".
- [48] ITU-T Recommendation G.964: "V-Interfaces at the digital local exchange (LE) - V5.1 interface (based on 2 048 kbit/s) for the support of access network (AN)".
- [49] ITU-T Recommendation G.965: "V-Interfaces at the digital local exchange (LE) - V5.2 Interface (based on 2 048 kbit/s) for the support of access network (AN)".
- [50] ITU-T Recommendation G.957: "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- [51] ETSI ETS 300 324: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN)".
- [52] ETSI ETS 300 347: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN)".
- [53] ERC/REC 74-01: "Spurious emissions".
- [54] 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".
- [55] ETSI ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [56] ITU-R Radio Regulations, Article S21 (1998): "Terrestrial and space services sharing frequency bands above 1 GHz".

- [57] 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 (R&TTE Directive).

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

round trip delay: sum of the delay between point SNI to UNI plus UNI to SNI in figure 1 including any repeaters as appropriate

Full Capacity Load (FCL): maximum number of 64 kbit/s signals or the equivalent which can be transmitted and received by a single CRS within a specified RF-bandwidth, fulfilling a given performance and availability objectives in respect to fading conditions

Multi-carrier system: system where more than one modulated sub-carrier is radiated from the same transmitter

NOTE 1: A system that uses several transmitters into a non-active antenna is not considered as a multi-carrier system. Systems using FDM/OFDM modulation formats are also not considered multi-carrier unless more that one separate FDM/OFDM signal set is transmitted from the same transmitter.

NOTE 2: FDMA systems are intrinsically multicarrier, because any single sub-carrier may be easily discriminated at RF level (unlike OFDM modulations) and activated according to the traffic requirements. However, for the purpose of the present document, a FDMA system are also considered as a whole (fully loaded) single signal set, unless more that one FDMA signal set is transmitted from the same transmitter.

3.2 Symbols

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

dB	decibel
dBm	decibel relative to 1 mW
GHz	GigaHertz
kbit/s	kilobit per second
km	kilometre
Mbit/s	Megabit per second
MHz	MegaHertz
ms	millisecond
ppm	parts per million
S/I	Signal to Interference ratio

3.3 Abbreviations

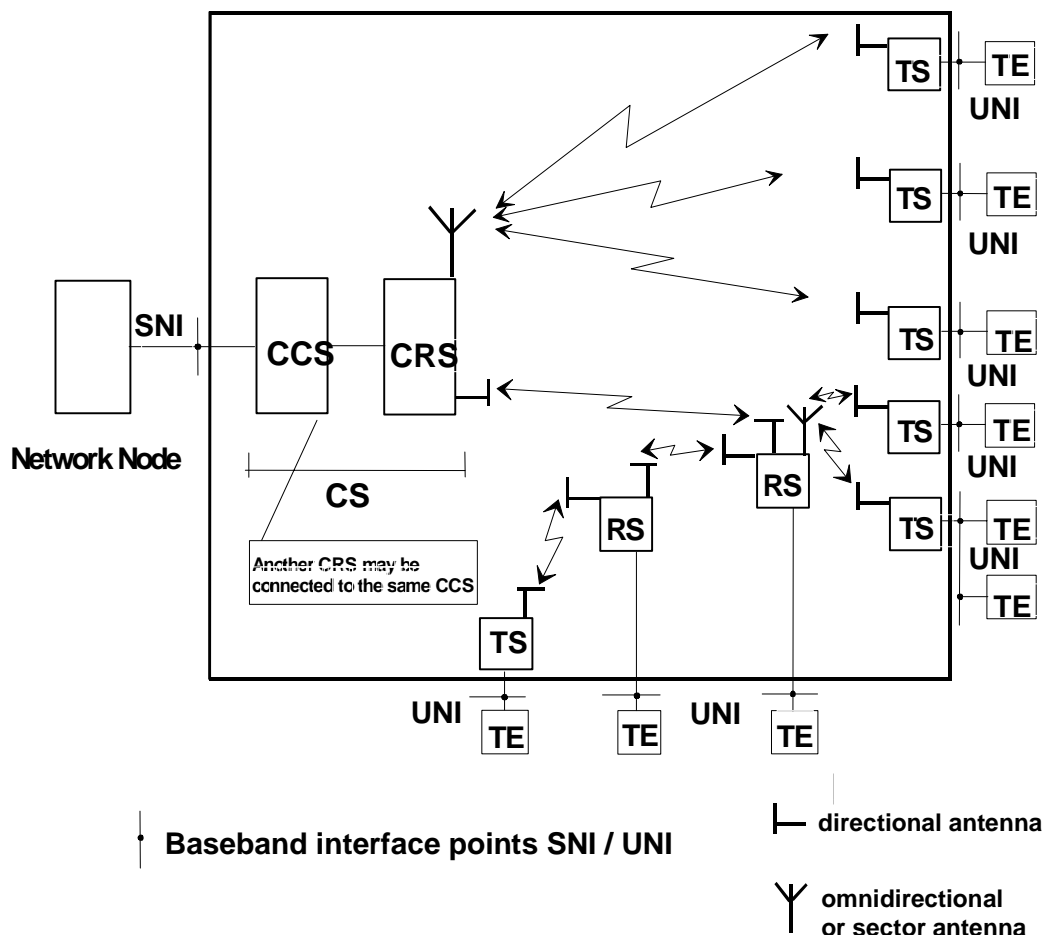
For the purposes of present document the following abbreviations apply:

ATM	Asynchronous Transfer Mode
ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
CCS	Central Controller Station
CDMA	Code Division Multiple Access
CRS	Central Radio Station
CS	Central Station
CW	Continuous Wave
DAMA	Demand Assigned Multiple Access
DS-CDMA	Direct Sequence Code Division Multiple Access
EMC	ElectroMagnetic Compatibility

FCL	Full Capacity Load
FDMA	Frequency Division Multiple Access
FS	Fixed Service
IF	Intermediate Frequency
ISDN	Integrated Service Digital Network
LAN	Local Area Network
LO	Local Oscillator
MP	MultiPoint
MP-MP	MultiPoint-to-MultiPoint
PAMA	Pre-Assigned Multiple Access
PDH	Plesiochronous Digital Hierarchy
PDN	Public Data Network
P-MP	Point-to-MultiPoint
PSTN	Public Switched Telephone Network
RF	Radio Frequency
RFC	Remote Frequency Control
RS	Repeater Station
RSL	Receiver Signal Level
RTPC	Remote Transmit Power Control
Rx	Receiver
SDH	Synchronous Digital Hierarchy
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TMN	Telecommunications Management Network
TS	Terminal Station
Tx	Transmitter
WAN	Wide Area Network

4 General characteristics

4.1 General system architecture



- CS:** Central Station which may be subdivided into two or more units.
- CCS:** Central Controller Station which provides the interface to the network node.
- CRS:** Central Radio Station containing at least the radio transceiver equipment providing the interface to the terminal station or to repeater stations via the air. Each transceiver is connected to a separate antenna. This is used e.g. in P-MP systems if sectored cells are applied to increase the capacity of each cell and in MP-MP systems to connect to other repeater stations or terminal stations within radio line of sight of the central radio station.
- TS:** Terminal station which provides the interfaces to the terminal subscriber equipment.
- RS:** Repeater Station which may also provide the interfaces to the subscriber, if applicable. A RS may serve one or more TSs or other RSs.
- SNI:** Point of connection to the Network Node.
- UNI:** Point(s) of connection to the subscriber equipment.
- TE:** Terminal (Subscriber) Equipment.

NOTE 1: Central Controller Station (CCS) may control more than one Central Radio Station (CRS).

NOTE 2: A TS may serve more than one TE.

Figure 1: General system architecture

The general system architecture (see figure 1) includes the system elements and interfaces for different types of multipoint systems (both P-MP and MP-MP). Not all system elements are necessarily deployed in any particular network. Although a single Central Station is possible, as shown, a typical architecture will deploy several Central Stations, each with connection to the core network(s). The interconnection at point SNI of Central stations to core networks may be by means of radio links, optical fibre or other means not covered by the present document.

In the MP system, the connection to a TS may be via a single radio path or via one or more RS with or without the TS functionality.

4.2 Frequency bands and channel arrangements

4.2.1 Channel plan

Bands allocated to the Fixed Service in the range 24,5 GHz to 29,5 GHz shall be used according to ERC/REC T/R 13-02 [1] annex B and annex C.

Regulatory bodies may choose appropriate parts of the above mentioned frequency bands for the application of MP systems and follow the assignment criteria given in ERC/REC 00-05 [2] and ERC/REC 01-03 [3]. The manufacturer shall declare the particular sub-band for which the system is designed.

4.2.2 Channel arrangements

The system shall operate on one or more of the channel spacing 3,5 MHz, 7 MHz, 14 MHz, 28 MHz, 56 MHz and 112 MHz.

The minimum transport capacities achievable within the above channel spacing with each of the different access methods are defined in the relevant parts of EN 301 213-2 [4], EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7].

The channel spacing appropriate to the MP system envisaged, depends on the necessary customer transport capacity, the overall number of customers connected to one CS in a serving area and the access method used. Details are given in the parts of EN 301 213-2 [4] EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7], addressing the access methods applied.

4.3 Compatibility requirements

There is no requirement to operate the CRS/CS, TS or RS from one manufacturer with the CRS/CS, TS or RS from another manufacturer.

4.4 Environmental conditions

The equipment shall be required to meet the environmental conditions set out in ETS 300 019 [14] which defines weather protected and non-weather protected locations, classes and test severity.

The manufacturer shall state which class the equipment is designed to withstand.

4.4.1 Equipment within weather protected locations (indoor locations)

The equipment intended for operation within temperature controlled locations or partially temperature controlled locations shall meet the requirements of ETS 300 019 [14] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [14] classes 3.3 (Non-temperature controlled locations), 3.4 (Sites with heat trap) and 3.5 (Sheltered locations) may be applied.

4.4.2 Equipment for non-weather protected locations (outdoor locations)

Equipment intended for operation within non-weather protected locations shall meet the requirements of ETS 300 019 [14] class 4.1 or 4.1E. Class 4.1 applies to many European countries and class 4.1E applies to all European countries.

For systems supplied within a specific radio cabinets which gives full protection against precipitation, wind, etc. the ETS 300 019 [14] classes 3.3, 3.4 and 3.5 may be applied also for equipment intended for operation in non-weather protected locations.

4.5 Power supply

The power supply interface shall be in accordance with the characteristics of one or more of the secondary voltages foreseen in parts 1 and 2 of ETS 300 132-1 [54] and ETS 300 132-2 [55].

NOTE: Some applications may require a power supply voltage range that is not covered by ETS 300 132-1 [54] and ETS 300 132-2 [55].

4.6 Electromagnetic compatibility conditions

Fixed Service equipment shall operate under the conditions specified in the relevant parts 1 and 4 of the EMC multipart harmonized standard EN 301 489, part 1 [16] and part 4 [17] or to the equivalent harmonized EN 300 385 [15]; both are base for presumption of conformity to article 3.1b of the R&TTE Directive [57], however the latter will cease this role by the date reported in the Official Journal of the European Community.

The CS and the TS locations have both to be considered with respect to the characteristics of the severity parameters related to EMC. The RS will be regarded as a TS if not co-located with a CRS.

4.7 TMN interfaces

TMN interface, if any, should be in accordance with ITU-T Recommendation G.773 [18].

4.8 Synchronization of interface bit rates

Systems employing digital interfaces shall include methods enabling internal and external synchronization to the network. The principles for synchronization shall be met according to ITU-T Recommendation G.810 [19]. Tolerances shall be in accordance to ITU-T Recommendations G.812 [20] and G.823 [21] for systems providing PDH interfaces and/or ITU-T Recommendations G.813 [22] and G.825 [23] for systems providing SDH interfaces.

4.9 Branching/feeder/antenna requirements

If high gain antennas are required for the Terminal Stations or Repeater Stations to cover longer hop length they shall comply with ETS 300 833 [24]. For other hop lengths the antennas for the TS or RS shall comply with EN 301 215-1 [25] and EN 301 215-2 [26].

Different types of antennas are envisaged for the CRS depending on the type of system (MP-MP or P-MP) and in the case of P-MP systems on the cell structure of the radio cell covered by the CS. Those antennas shall also comply with EN 301 215-1 [25] and EN 301 215-2 [26].

4.9.1 Wave guide flanges

If flanges (or other connector types) are required at reference point(s) B, B', C, C' of the RF-system block diagram (see figure 2) the following types according to IEC 60154-2 [27] shall be used:

- UBR/PBR/CBR 260, for the complete frequency range 24,5 GHz to 29,5 GHz;
- UBR/PBR/CBR 220, for the lower part of the frequency range;
- UBR/PBR/CBR 320, for the higher part of the frequency range.

The upper frequency limit for waveguide R 220 is 26,5 GHz, according to IEC 60154-2 [27].

The lower frequency limit for waveguide R 320 is 26,5 GHz, according to IEC 60154-2 [27].

4.9.2 Return loss

Where antennas are an integral part of the TS, RS and the CRS radio equipment, there are no requirements to be defined at reference point C'/C in the direction to the transceiver of the CRS, TS and RS respectively. When separate antennas are used the return loss referred to C'/C shall be better than 18 dB.

4.9.3 Intermodulation products

No requirements are necessary to be defined because MP systems do not generally use RF branching networks at the same antenna.

5 System parameters

NOTE: Where a reference is made to the number of states of a modulation scheme, an equivalent modulation scheme may be applied, provided that the system parameters are met.

5.1 System capacity

The system capacity considered in the present document for a P-MP system is the transmission capacity of the CRS, which consists of the maximum number of TSs simultaneously connected to the CRS and transporting their maximum payload bit rate each utilizing interfaces according to table 2 in clause 6.

In the case of an MP-MP system, the system capacity is the transmission capacity of the CRS (if available) as defined above for the P-MP systems plus the transmission capacity (if applicable) of the TS and/or RS with TS functionality transported to the same SNI via other links (e.g. P-P links) transporting their maximum payload bitrate each using interfaces according to table 2 in clause 6.

The maximum number of TSs simultaneously connected to a CRS shall be declared by the manufacturer.

The minimum payload (expressed either as the number of 64 kbit/s signals or an aggregate bit rate) which a CRS shall be capable of transporting will be defined in the parts of the present document related to the different access methods. Where the equipment can carry alternative traffic types (e.g. ISDN circuits or ATM cells) the CRS shall be capable of carrying at least this minimum payload with at least one type of traffic.

5.2 Round trip delay

The round trip delay for a 64 kbit/s traffic channel shall not exceed 20 ms.

Longer round trip delays may result at other bit rates and when using speech coding at rates lower than 64 kbit/s. In order to guarantee that the delay introduced by the system into the transmission network does not degrade the quality of the telephone communication, compliance to ITU-T Recommendation G.131 [29] shall be ensured.

5.3 Transparency

The system shall be fully transparent. The network node and the subscriber equipment (points SNI and UNI in figure 1) communicate with each other without being aware of the radio link.

5.4 Voice coding methods

One of the following coding methods should be used:

- 64 kbit/s ITU-T Recommendation G.711 [30];
- 32 kbit/s ITU-T Recommendation G.726 [31];
- 16 kbit/s ITU-T Recommendation G.728 [32];
- 8 kbit/s ITU-T Recommendation G.729 [33].

Other voice coding methods may be employed if the quality for voice transmission is adequate. The used coding method shall be declared by the manufacturer.

5.5 Transmitter characteristics

All transmitter characteristics are referred to a system under any load conditions.

The values and measurements are referred to point B' or C' of figure 2.

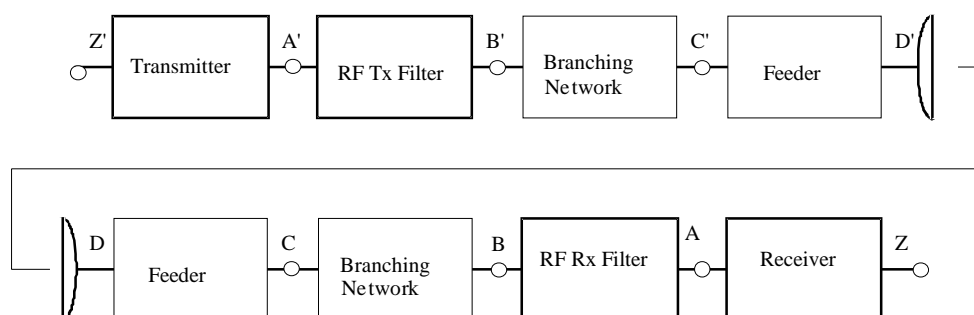
For P-MP systems measurements shall be made when the CRS (at least one transceiver equipment) is under full load conditions, to be declared by the manufacturer.

For a MP-MP system, measurement shall be made when the transmitting CRS (if applicable), the RS and/or TS are under full load conditions, to be declared by the manufacturer.

A BER lower than or equal to 10^{-6} shall be achieved at a receive level stated in clause 5.7.2.

The specified transmitter characteristics shall be met with the appropriate input signals applied at point A or B of figure 1. For the PDH interface this shall be in accordance with ITU-T Recommendation O.151 [34] and for SDH interfaces in accordance with ITU-T Recommendation O.181 [35].

The RF-system block diagram, illustrated in figure 2, shows the point to point connection of a MP transceiver between the CRS and one TS and vice versa, as illustrated in figure 2.



NOTE: The points shown above are reference points only; points B, C and D, B', C' and D' may coincide.

Figure 2: RF system block diagram

5.5.1 Transmitter output power

The maximum mean transmitter output power (average, for CRS, RS and TS) shall not exceed +35 dBm. Care shall be taken that the system EIRP defined in article S.21 of the ITU-R "Radio Regulations" [56] is not exceeded and ITU-R Recommendation F.1249 [36] is fulfilled.

5.5.2 Transmitter nominal output power

The transmitter nominal mean output power shall be in the range +5 dBm to +33 dBm. The nominal value shall be declared by the manufacturer.

A capability for output power level adjustment may be required for regulatory purposes, in which case the range of adjustment, either by fixed or automatic attenuators, should be in increments of 5 dB or less.

5.5.3 Transmit power and frequency control

5.5.3.1 Automatic Transmit Power Control (ATPC)

ATPC is an optional feature. The use of the ATPC may depend on the access scheme. Equipment with ATPC will be subject to manufacturer declaration of the ATPC ranges and related tolerances. Testing shall be carried out with output power level corresponding to:

- ATPC set manually to a fixed value for system performance;
- ATPC set at maximum provided output power for Tx spectral emissions.

5.5.3.2 Remote Transmit Power Control (RTPC)

RTPC is an optional feature. The use of the RTPC may depend on the access scheme. Equipment with RTPC will be subject to manufacturer declaration of the RTPC ranges and related tolerances. Testing shall be carried out with output power level corresponding to:

- RTPC set manually to the maximum and to the minimum values for system performance;
- RTPC set at maximum provided output power for Tx spectral emissions.

5.5.3.3 Remote Frequency Control (RFC)

RFC is an optional feature. The use of the RFC may depend on the access scheme. Equipment with RFC will be subject to manufacturer declaration of the RFC ranges and related tolerances.

RFC setting procedure shall not produce emissions outside the previous and the final centre frequency spectrum masks required in clause 5.5.4.

The tests, carried out to generate the test report and/or declaration of conformity, required to fulfil any Conformity assessment procedure foreseen by the R&TTE Directive [57], shall be carried for RFC setting procedure for three frequencies (i.e. frequencies settings from lower to centre, centre to higher and back in the covered range). The test shall be carried-out at reference climatic conditions.

5.5.4 RF spectrum mask

The 0 dB level shown on the spectrum masks is the maximum of the modulated spectrum disregarding residual of the carriers (eventually due to modulation imperfection).

The masks do not include frequency tolerance.

The spectrum masks used for the different access methods and the spectrum analyser settings for measuring the RF spectrum mask are detailed in EN 301 213-2 [4] for the FDMA access method, in EN 301 213-3 [5] for the TDMA access method, in EN 301 213-4 [6] for the DS-CDMA access method and in EN 301 213-5 [7] for the MC-TDMA access method.

NOTE: RF spectrum mask shall be verified at three channels (lowermost, centre, and uppermost channel) of the frequency band envisaged.

5.5.5 Tx Local Oscillator frequency arrangements

There shall be no requirement on transmitter LO frequency arrangement.

5.5.6 Spurious emissions (external)

According to ERC/REC 74-01 [53] the external spurious emissions are defined as emissions at frequencies, which are separated from the nominal carrier frequency more than $\pm 250\%$ of the relevant channel separation.

Outside the exclusion band of $\pm 250\%$ of the relevant channel separation, the Fixed Service radio systems spurious emission limits, defined by ERC/REC 74-01 [53] together with the frequency range to consider for conformance measurement, shall apply.

Moreover, in the frequency range 21,2 GHz to 43,5 GHz, the more stringent EN 301 390 [37] shall apply.

5.5.7 Radio frequency tolerance

Radio frequency tolerance shall not exceed ± 15 ppm. This limit includes both short-term factors and long-term ageing effects. For the purpose of type testing the manufacturer shall state the guaranteed short-term part and the expected ageing part.

5.6 Receiver characteristics

5.6.1 Rx Local Oscillator frequency arrangements

There shall be no requirement on LO frequency arrangement.

5.6.2 Spurious emissions

ERC/REC 74-01 [53] shall apply.

Moreover, in the frequency range 21,2 GHz to 43,5 GHz, the more stringent EN 301 390 [37] shall apply.

5.6.3 Receiver IF

No IF interfaces are required.

5.7 System performance

The parameters stated below shall be met under any system load condition.

All parameters are referred to reference point B or C of the RF system block diagram (see figure 2).

5.7.1 Dynamic level range

The dynamic level range may depend on the access method utilized. Detailed parameters are given in EN 301 213-2 [4] for the FDMA access method, in EN 301 213-3 [5] for the TDMA access method, in EN 301 213-4 [6] for the DS-CDMA access method and in EN 301 213-5 [7] for the MC-TDMA access method.

5.7.2 BER as a function of Receiver input Signal Level (RSL)

The BER as functions of the input levels are defined in the parts relevant to the various access methods (see EN 301 213-2 [4], EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7]).

5.7.3 Equipment Background BER

The Equipment Background BER under simulated operating conditions shall be measured with a signal level which is 6 dB above the specified level for BER = 10^{-6} in clause 5.7.2 taking into account the actual test load conditions.

For different payload bit rates the measurement time and the maximum number of errors allowed are given in table 1.

Table 1: Maximum number of errors allowed, measuring the Equipment Background BER

Payload bit rate (kbit/s)	Recording time (h)	Maximum number of errors
≤ 64	20	5
64 to 2 048	(see note)	(see note)
≥ 2 048	15	10
NOTE: For bit rates between 64 kbit/s to 2 048 kbit/s the values for the recording time and the maximum number of errors shall be linearly derived from the value for ≥ 2 048 kbit/s in applying the next higher integer value.		

5.7.4 Interference sensitivity

All receive signal levels and S/I measurements are defined in the parts relevant to the various access methods (see EN 301 213-2 [4], EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7]).

5.7.4.1 Co-channel interference sensitivity (external)

The limits of co-channel interference (external) shall be as defined in the parts relevant to the various access methods (see EN 301 213-2 [4], EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7]).

5.7.4.2 Adjacent channel interference

The limits of adjacent channel interference shall be as defined in the parts relevant to the various access methods (see EN 301 213-2 [4], EN 301 213-3 [5], EN 301 213-4 [6] and EN 301 213-5 [7]).

5.7.4.3 Continuous Wave (CW) interference

For a receiver operating at the RSL specified in clause 5.7.2 for 10^{-6} BER threshold, the introduction of a CW interferer at a level of +30 dB (provisional) with respect to the wanted signal and at any frequency up to 60 GHz, excluding frequencies either side of the centre frequency of the wanted RF channel by up to 500 % of the co-polar channel spacing, shall not cause a degradation of more than 1 dB of the BER threshold as specified in clause 5.7.2.

This test is designed to identify specific frequencies at which the receiver may have a spurious response, e.g. image frequency, harmonics of the receive filter, etc. The actual test range should be adjusted accordingly. The test is not intended to imply a relaxed specification at all out of band frequencies elsewhere specified in the present document.

5.7.5 Distortion sensitivity

Outage from multipath phenomena is not considered relevant to the systems subject to the present document.

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

Table 2 lists a range of interfaces for various voice and data services.

The equipment covered by the present document shall use one or more of the ETSI, ITU, ISO/IEC (JTC1) or IEEE standardized interfaces, the more common of which are listed in table 2.

Table 2: Types of interfaces

Interface	Proposed Standards
Subscriber Equipment Interfaces	
Analogue (2 wires)	ITU-T Recommendation Q.552 [38]
Analogue (4 W + E & M)	ITU-T Recommendation Q.553 [39]
Telex	ITU-T Recommendation R.20 [40] and ITU-T Recommendation V series [41]
Digital data port (electrical)	ITU-T Recommendation G.703 [28], ITU-T Recommendation X series [42] and ITU-T Recommendation V series [41]
ISDN basic rate U; S	ITU-T Recommendation G.961 [43]; ETS 300 012 [44]
ISDN primary rate U; S	ITU-T Recommendation G.962 [46]; ETS 300 011 [45]
SDH interfaces	ITU-T Recommendation G.707 [47]
Network Interfaces	
2 Mbit/s	ITU-T Recommendation G.703 [28]
Analogue (2 wires)	ITU-T Recommendation Q.552 [38]
Analogue (4 W + E & M)	ITU-T Recommendation Q.553 [39]
Telex	ITU-T Recommendation R.20 [40] and ITU-T Recommendation V series [41]
Digital data port (electrical)	ITU-T Recommendation G.703 [28], ITU-T Recommendation X series [42] and ITU-T Recommendation V series [41]
Digital data port (optical)	ITU-T Recommendation G.957 [50]
ISDN + Analogue subscribers + Leased lines 2 Mbit/s Interface	ITU-T Recommendation G.703 [28] ITU-T Recommendation G.964 [48] ITU-T Recommendation G.965 [49] ETS 300 324 [51] ETS 300 347 [52]
ISDN U interface	ITU-T Recommendation G.961 [43]
PDH/SDH interfaces	ITU-T Recommendations G.703 [28]; G.707 [47] and G.957 [50]
NOTE: Further ETSI, ITU, ISO/IEC or IEEE standardized interfaces may be implemented.	

Annex A (informative): Bibliography

- ITU-T Recommendation G.861: "Principles and guidelines for the integration of satellite and radio systems in SDH transport networks".

History

Document history		
V1.1.1	November 1999	Publication
V1.1.2	October 2001	One-step Approval Procedure OAP 20020208: 2001-10-10 to 2002-02-08