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European Standard (Telecommunications series)

**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**



Reference

REN/TM-04109

Keywordsantenna, DRRS, multipoint, radio, RLL,
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Foreword

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

The present document is part 1 of a multi-part deliverable covering requirements for antennas in conjunction with multipoint (MP) systems necessary to facilitate frequency co-ordination between services in the frequency bands 11 GHz to 60 GHz, as identified below:

- Part 1: "General aspects";**
- Part 2: "24 GHz to 30 GHz";
- Part 3: "Multipoint Multimedia Wireless system in 40,5 GHz to 43,5 GHz";
- Part 4: "Multipoint Multimedia Wireless system in 30 GHz to 40,5 GHz".

The present document is organized in the following way. Part 1 gives general information about the scope, normative references, definitions, classification, normative and informative electrical and mechanical characteristics. Part 1 is the framework for further parts, where distinct values of normative characteristics for a given frequency sub-band are defined. Consequently, Part 1 in combination with another part forms the EN for a given sub-band.

| National transposition dates | |
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1 Scope

The present document specifies the essential electrical requirements for linear polarization, fixed beam antennas to be utilized with new multipoint (P-MP and MP-MP) Multimedia Wireless Systems (MWS) [1], including central station, repeater and terminal station applications, operating in frequency bands from 11 GHz to 60 GHz. These systems use various multiple access schemes. Antennas may be pointed by manual or electro-mechanical means or by switching between different fixed antennas. Electronically steerable antennas, and circularly polarized antennas are not considered in the present document.

A Regulatory Authority may impose tighter requirements than the minimum values given in the present document, in order to maximize the use of scarce spectrum resources.

For some high gain, multipoint requirements, antennas may be used having performance as per the appropriate point-to-point antenna standard. For these antennas, minimum requirements are given in EN 300 833 [2].

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, subsequent revisions do apply.

- [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 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".
- [3] CEPT Recommendation T/R 13-02: "Preferred channel arrangements for fixed services in the range 22.0-29.5 GHz".
- [4] ITU-R Recommendation F.746-1: "Radio-frequency channel arrangements for radio-relay systems".
- [5] Final Acts of the World Radiocommunications Conference (WARC-95), Geneva 1995.
- [6] ETSI EN 301 126-3-2: "Fixed Radio Systems; Conformance testing; Part 3-2: Point-to-Multipoint antennas - Definitions, general requirements and test procedures".
- [7] 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".
- [8] ETSI EN 301 215-3: "Fixed Radio Systems; Point-to-multipoint Antennas; Antennas for point-to-multipoint fixed radio systems in the 11 GHz to 60 GHz band; Part 3: Multipoint Multimedia Wireless system in 40,5 GHz to 43,5 GHz".
- [9] ETSI ETS 300 019-1-4: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".
- [10] Void.

- [11] ETSI EN 301 215-4: "Fixed Radio Systems; Point to Multipoint Antennas; Antennas for point-to-multipoint fixed radio systems in the 11 GHz to 60 GHz band; Part 4: Multipoint Multimedia Wireless system in 30 GHz to 40,5 GHz".
- [12] CEPT ERC/DEC(99)15: "ERC Decision of 1 June 1999 on the designation of the harmonised frequency band 40.5 to 43.5 GHz for the introduction of Multimedia Wireless Systems (MWS) including Multipoint Video Distribution Systems (MVDS)".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

antenna: part of the transmitting or receiving system that is designed to radiate and/or receive electromagnetic waves

boresight: axis of the main beam in a directional antenna

Central Station (CS): base station which communicates with Terminal Stations and in some cases Repeater Stations

co-polar pattern: diagram representing the radiation pattern of a test antenna when the reference antenna is similarly polarized, scaled in dBi or dB relative to the measured antenna gain

cross-Polar Discrimination (XPD): difference in dB between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle measured within a defined region

cross-polar pattern: diagram representing the radiation pattern of a test antenna when the reference antenna is orthogonally polarized, scaled in dBi or dB relative to the measured antenna gain

fixed beam: radiation pattern in use is fixed relative to a defined mechanical reference plane

gain: ratio of the radiation intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna was radiated isotropically

half power beamwidth: angle, relative to the main beam axis, between the two directions at which the measured copolar pattern is 3 dB below the value on the main beam axis

input port(s): flange(s) or connector(s) through which access to the antenna is provided

inter-port isolation: ratio in dB of the power level applied to one port of a multi-port antenna to the power level received in any other port of the same antenna as function of frequency

isotropic radiator: hypothetical, lossless antenna having equal radiation intensity in all directions

main beam axis: direction for which the radiation pattern intensity is the maximum

main beam: radiation lobe containing the direction of maximum radiation

mechanical tilt: fixed angular shift in elevation of the antenna main beam axis by a change to the physical mounting

radiation pattern envelope: envelope below which the radiation pattern shall fit

radiation pattern: diagram relating power flux density at a constant distance from an antenna to direction relative to the antenna main beam axis

radome: cover of dielectric material, intended for protecting an antenna from the effects of the physical environment

Repeater Station (RS): radio station providing the connection via the air to a Central Station, Terminal Station(s) and/or other Repeater Stations. The Repeater Station may also provide the interfaces to the subscriber equipment, if applicable.

sector angle: declared angle of coverage in azimuth of a sectored antenna, defined as 2α in the present document

Terminal Station (TS): remote (out) station, which communicates with a Central Station or Repeater Station

tilt: fixed, angular shift of the antenna main beam axis (boresight) in the elevational plane by either electrical, electronic or mechanical means

zero degree (0°) reference direction: declared direction as referenced to the antenna mechanical characteristics, used as reference for RPE

3.2 Symbols

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

| | |
|----------|--|
| dB | Decibel |
| dBi | Decibels relative to an isotropic radiator |
| GHz | Gigahertz |
| α | Alpha (= half of the sector angle) |

3.3 Abbreviations

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

| | |
|-------|-----------------------------|
| CS | Central Station |
| HPBW | Half power beamwidth |
| MP-MP | Multipoint to Multipoint |
| MWS | Multimedia Wireless Systems |
| P-MP | Point-to-Multipoint |
| RPE | Radiation pattern envelope |
| RS | Repeater Station |
| TS | Terminal Station |
| VSWR | Voltage standing wave ratio |
| XPD | cross-Polar Discrimination |

4 Frequency bands

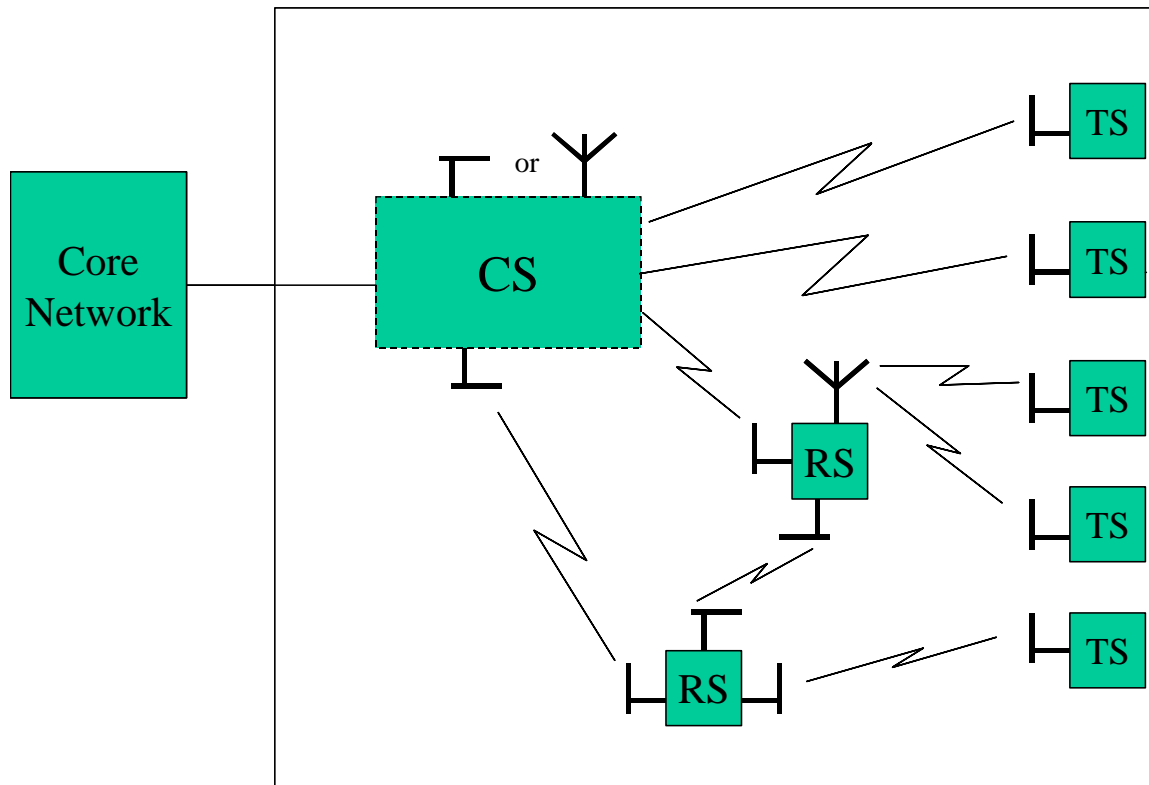
The present document applies to a number of frequency ranges within the 11 GHz to 60 GHz frequency bands as considered within CEPT/ERC and ETSI for allocation to the fixed services [3], [4], [5] and [12].

For the purpose of the present document the overall frequency band 11 GHz to 60 GHz is divided into a number of frequency ranges, each of which are addressed in parts 2 onwards.

5 Types and classification of antennas

5.1 Antenna types

The standard addresses fixed beam antennas used in the Central (CS) and Terminal (TS) Stations including repeaters (RS). The antennas are used in a system which can be described as in figure 1.



- CS:** Central Station, which is linked to remote stations (repeater or terminal stations) by microwave transmission paths.
- TS:** Terminal Station (outstation with subscriber interfaces).
- RS:** Repeater Station (radio repeater outstation with or without subscriber interfaces). An RS may serve one or more TSs.

Figure 1: General multipoint system architecture

The antennas shall be grouped into the following types:

- Central and Repeater Stations:
 - Omni-directional;
 - Sectored;
 - Directional as per Terminal Stations;
- Terminal Stations:
 - Directional.

5.2 Antenna classifications

5.2.1 CS classes

With respect to the azimuthal radiation pattern envelope (RPE), a number of Classes may be identified in different frequency sub-ranges for CS sectorized antennas:

- Class CS 1;
- Class CS 2;
- Class CS 3;
- other classes.

These Classes allow flexibility for a variety of different systems, and may be generally appropriate for lower and higher density deployments. If appropriate, the definition of antenna Classes is given in subsequent parts of the present document.

With respect to the azimuthal RPE for omnidirectional CS antennas, no requirement for separate Classes has been identified.

5.2.2 TS classes

With respect to the radiation pattern envelope (RPE), a number of Classes may be identified in different frequency sub-ranges for TS directional antennas:

- Class TS 1;
- Class TS 2;
- Class TS 3;
- other classes.

These Classes allow flexibility for a variety of different systems and deployment conditions. If appropriate, the definition of antenna Classes is given in subsequent parts of the present document.

6 Electrical characteristics

For the purpose of the present document, an antenna is specific to a Type, Class, Range, Gain Category (if applicable), the frequency range of operation and the mid-band gain. An antenna, which employs a radome, shall meet the requirements of the present document with the radome in place.

A 0° reference direction shall be defined for each antenna. The radiation characteristics in the present document are all referred to this 0° reference direction.

RPE(s) and gains of defined antenna Types and Classes are described in the relevant subsequent parts of the present document.

The copolar and crosspolar radiation patterns for both azimuth and elevation shall not exceed the RPE(s) defined in the distinct parts of the present document.

Specific requirements for multipoint antennas operating in various frequency bands can be found in the following parts of the present document:

- Part 2 for the frequency band 24 GHz to 30 GHz [7];
- Part 3 for the frequency band 40,5 GHz to 43,5 GHz [8];
- Part 4 for the frequency band 30 GHz to 40,5 GHz [11].

7 Conformance tests

EN 301 126-3-2 [6] shall apply.

Additional parameters appropriate to system implementation may be subject to agreement between the equipment purchaser and supplier. Further guidance is provided in annex A.

Annex A (informative): Additional information

A.1 Mechanical characteristics

A.1.1 Environmental characteristics

The antennas should be designed to operate within a temperature range of -45°C to $+45^{\circ}\text{C}$ with a relative humidity up to 100 % for environmental conditions specified in ETS 300 019-1-4 [9].

The temperature range could be divided in two parts where at least one of the following ranges should be covered:

- 1) -33°C to $+40^{\circ}\text{C}$;
- 2) -45°C to $+45^{\circ}\text{C}$.

The antennas should be designed to meet wind survival ratings specified in table A.1:

Table A.1: Wind survival ratings

| Antenna type | Wind velocity m/s (km/h) | Ice load (density 7 kN/m^3) |
|--------------|-----------------------------|---|
| Normal duty | 55 (200) | 25 mm radial ice |
| Heavy duty | 70 (252) | 25 mm radial ice |

A.1.2 Antenna stability

The antenna equipment should be stable under the most severe operational conditions at the site of intended application.

For installation purposes, the deviation of the antenna main beam axis should not be more than 0,3 times the smaller of the two azimuthal and elevation HPBW, as a general guide, under the conditions specified in table A.2:

Table A.2: Antenna stability

| Antenna type | Wind velocity m/s (km/h) | Ice load (density 7 kN/m^3) |
|--------------|-----------------------------|---|
| Normal duty | 30 (110) | 25 mm radial ice |
| Heavy duty | 45 (164) | 25 mm radial ice |

Further guidance can be obtained from ETS 300 019-1-4 [9].

A.2 Antenna input connectors

When flanges are provided at the input port of the antenna they should be in accordance with IEC 60154 (see annex B).

For antennas which are integrated to the radio equipment proprietary connection designs may be utilized.

For antennas using coaxial input ports the connectors should conform to IEC 60169 (see annex B).

Other interconnection design should be agreed between the equipment supplier and purchaser in line with the overall system design requirements, in such a case a suitable test fixture should be agreed and used for test purposes.

A.3 VSWR at the input ports

The maximum VSWR should be agreed between the equipment supplier and purchaser in line with the overall system design requirements. For guidance antennas with a VSWR in the range of 1.9 to 1.1 are typical.

A.4 Inter-port isolation

The isolation between the input ports of a dual polarized antenna should be agreed between the equipment supplier and purchaser in line with the overall system design requirements. For guidance inter-port isolation better than 25 dB is typical.

A.5 Antenna labelling

Antennas should be clearly identified with a weather-proof and permanent label(s) showing the manufacturers name, antenna type, serial number(s) and type approval reference number where appropriate. It should be noted, that integrated antennas may share a common label with the outdoor equipment.

A.6 Passive Intermodulation (PIM) performance

For some P-MP access methods the minimum Passive Intermodulation (PIM) performance of the antenna may need to be taken into account. In such cases a passive intermodulation performance should be agreed between the equipment supplier and purchaser in line with the overall system design requirements. For guidance PIM product limits can often exceed -100 dBc.

Annex B (informative): Bibliography

- IEC 60050-712: "International Electrotechnical Vocabulary - Chapter 712: Antennas".
- IEEE Standard 145: "Definitions of Terms For Antennas".
- ITU-R Recommendation F.699: "Reference radiation patterns for line-of-sight radio-relay system antennas for use in coordination studies and interference assessment in the frequency range from 1 GHz to about 70 GHz".
- DIN 5030-1: "Spectral measurement of radiation; terminology, quantities, characteristic values".
- DIN 5030-2: "Spectral measurement of radiation; radiation sources; selection criteria".
- EN 60835-2-2: "Methods of Measurement for Equipment Used in Digital Microwave Radio Transmission Systems Part 2: Measurements on Terrestrial Radio- Relay Systems Section 2: Antenna (IEC 835-2-2:1994)".
- IEEE Standard 149: "Test Procedures for Antennas".
- IEC 60154-1: "Flanges for waveguides; Part 1: General requirements".
- IEC 60154-2: "Flanges for waveguides; Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".
- IEC 60169: "Radio-frequency connectors".
- EIA-195-C: "Electrical and mechanical characteristics for terrestrial microwave relay system antennas and passive reflectors errata".
- MIL-DTL-24211: "Gasket, waveguide flange".
- Draft DEN/TM-04097: "Fixed Radio Systems; Radio equipment for use in Multimedia Wireless Systems (MWS) in the band 40,5 GHz to 43,5 GHz".

History

| Document history | | |
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| V1.1.1 | June 2000 | Publication |
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