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Fixed Radio Systems;
Representative values for transmitter power and antenna gain to support inter- and intra-compatibility and sharing analysis;
Part 1: Digital point-to-point systems

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

Major variants with respect to previous published version:

- alignment of terminology and system identification method to latest version of EN 302 217-2-2 [i.4];
- introduction of typical parameters also for bands above 55 GHz (i.e. 60 GHz and 71 GHz to 86 GHz);
- updating due to technology evolution.

Introduction

As a consequence of the development of the multipart EN 302 217 [i.2] to [i.7], which was intended to supersede a number of older point-to-point equipment and antenna ENs, hereby referenced as "source ENs", all previous requirements have been reconsidered in the light of Directive 1999/5/EC (R&TTE Directive) [i.1] in order to clearly split them between those that are relevant to article 3.2 of R&TTE Directive [i.1] and other requirements of normative nature (as in previous regime before R&TTE Directive coming into force) or even considered informative for the EN users.

In particular EN 302 217-2-2 [i.4] and EN 302 217-3 [i.5] recognized that, besides frequency band around 60 GHz, where oxygen absorption becomes very high, and cases specifically mentioned in Radio Regulations [i.13], limits for TX output power do not fall in any of the above categories. Regulatory bodies are generally fixing limits for the licensing but no ECC common view is expressed in any ECC Decision; on the other hand it is not ETSI's role to impose limits to technology evolution and market demands.

As a consequence the "maximum" power figures, historically fixed in those older "source ENs", have been removed from the requirements in EN 302 217-2-2 [i.4] and EN 302 217-3 [i.5], which ask for "supplier declaration" of actual TX power and its tolerance to be used as limits for assessment against R&TTE Directive [i.1], article 3.2 requirements.

However, those values were often used as a basis for intra and inter-services coexistence and sharing studies. It was therefore considered that information about "typical-maximum" TX power (i.e. those coming from practical technology and practical system deployment constraints) would still be usefully maintained in the present document for any such purpose.

Having removed them from regulatory HEN "hard-limits", the present document gives information more close to actual reality of Fixed Service (FS) currently deployed; this would lead to much more balanced sharing studies and planning assumptions, leaving only very few cases, potentially exceeding those values to real "special cases" to be treated on a case-by-case basis according the principles of "proportionality" introduced by the "New Approach" set of EU Directives.

Together with TX power information, it was considered necessary to also give similar antenna gain information for the definition, of "typical-maximum" E.I.R.P. that, in the same fashion, would give the complete information needed for the mentioned sharing/planning studies.

In the band 57 GHz to ~ 64 GHz the peak value of the O_2 ray absorption results in very specific propagation conditions with a high potential of frequency reuse; for this reason CEPT has approved ECC/REC(09)01 [i.9] (superseding previous ERC Recommendation 12-09 [i.8] limited to 57 GHz to 59 GHz band only) for an uncoordinated use of the band or with simplified link notification procedures. No additional regulatory requirements have been set for P-P applications; however, as frequency optimization mechanism, EN 302 217-3 [i.5] considers in its scope only equipment that fulfils minimum E.I.R.P./Antenna gain joint profiles. In addition, manufacturers are free to implement other network optimization features (e.g. automatic channel selection).

The bands 71 GHz to 76 GHz and 81 GHz to 86 GHz have also been open to P-P applications. Here the oxygen absorption attenuation nullifies again and the band use might be considered similar to 38 GHz and 42 GHz bands when taking into account the obvious increasing impact of rain attenuation; however, standing the very wide bandwidth available and for stimulating the band deployment, different policies might be applied in different CEPT countries.

From the ETSI standards point of view, the band is considered to be either conventionally coordinated or with simplified coordination (self coordinated with simple notification in the links data-base) or even fully uncoordinated. Manufacturers and/or administrations can refer either only to EN 302 217-3 [i.5] (i.e. for the minimum requirements when the band is not conventionally coordinated) or also to EN 302 217-2-2 [i.4] (i.e. for the additional requirements needed for link-by-link coordination).

1 Scope

The present document summarizes, in relation to the various frequency bands and sub-system types given in the multipart EN 302 217 [i.2] to [.i.7], information in relation to current practical bounds coming from technology and deployment practice about:

- Typical-maximum TX power (see note).
- Typical-maximum antenna size and gain.
- Exceptional antenna size and gain.

NOTE: This should not be intended as the power delivered by equipment currently on the market; it indicates the level that is reasonably achievable by FS technology in each band and might be rendered available standing suitable market opportunities justifying the cost/benefit trade off.

Antenna gain is also related to its expected typical antenna size, which nowadays, for its ambient impact, is another important factor limiting, in practice, most of FS deployments.

The above values are here reported here due to a lack of any ECC harmonized regulations. In the event that such ECC regulations would come into force, it would supersede any less restrictive information given in the present document.

In the band 57 GHz to 64 GHz CEPT promotes an uncoordinated or simplified use of the band as outlined in ECC Recommendation (09)01 [i.9]. Also in the band 64 GHz to 66 GHz ECC Recommendation (05)02 [i.10] provides for simplified channel arrangement suitable for simplified regulatory approach (e.g. light licensing/notification).

In the bands 71 GHz to 76 GHz and 81 GHz to 86 GHz ECC Recommendation (05)07 [i.11] provides flexible arrangements suitable for both simplified regulatory approach (e.g. light licensing/notification) or conventional coordination; CEPT administrations would freely select the approach best fitting their policy for the bands.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] 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).

[i.2] ETSI EN 302 217-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview and system-independent common characteristics".

[i.3] ETSI EN 302 217-2-1 "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-1: System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied".

[i.4] ETSI EN 302 217-2-2 "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Digital systems operating in frequency bands where frequency co-ordination is applied; Harmonized EN covering the essential requirements of Article 3.2 of the R&TTE Directive".

[i.5] ETSI EN 302 217-3: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Equipment operating in frequency bands where both frequency coordinated or uncoordinated deployment might be applied; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.6] ETSI EN 302 217-4-1 "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-1: System-dependent requirements for antennas".

[i.7] ETSI EN 302 217-4-2 "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-2: Antennas; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.8] CEPT/ERC/REC 12-09 (withdrawn): "Radio frequency channel arrangement for fixed service systems operating in the band 57,0 - 59,0 GHz which do not require frequency planning".

[i.9] ECC/REC(09)01: "Use of the 57 - 64 GHz frequency band for point-to-point fixed wireless systems".

[i.10] ECC/REC(05)02: "Use of the 64-66 GHz frequency band for fixed service".

[i.11] ECC/REC(05)07 (2009): "Radio frequency channel arrangements for fixed service systems operating in the bands 71-76 GHz and 81-86 GHz".

[i.12] Recommendation ITU-R F.746-10: "Radio-frequency arrangements for fixed service systems".

[i.13] ITU Radio Regulations (2008).

[i.14] Recommendation ITU-T G.708: "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

absolute maximum transmitter power: maximum permitted power requested in point-to-point ENs, which constitute the "source ENs" for the multipart EN 302 217 series (see summary in annex C of EN 302 217-1 [i.2])

NOTE: It was judged as "not relevant" to "essential parameters" under article 3.2 of the R&TTE Directive [i.1], and removed from the requirements in the Harmonized EN 302 217-2-2 [i.4]. It is assumed that no system in the past might have exceeded that value.

exceptional size/gain: maximum antenna dish size and its practical associated gain that are still found in most antenna supplier standard catalogues (at the date of publication of the present document)

NOTE: It then excludes any possible special design dedicated to a specific link.

typical maximum output power: typical current (i.e. only for recent and new deployment of systems potentially available on the market) maximum power achievable in point-to-point FS technology

NOTE: In the present document it is separately indicated for the various systems defined in EN 302 217-2-2 [i.4].

typical maximum antenna size/gain: typical current (i.e. only for recent and new deployment of systems currently on the market) maximum antenna dish size and its practical associated gain in point-to-point FS technology (e.g. limited in many cases by ambient and tower infrastructures constraints)

NOTE: In the present document it is separately indicated for the various systems defined in EN 302 217-2-2 [i.4].

3.2 Symbols

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

dB	deciBel
dBi	deciBels relative to an isotropic radiator
dBm	deciBels relative to 1 milliWatt
dBW	deciBels relative to 1 Watt
GHz	GigaHertz
kbit/s	kilo-bits per second
m	meter
Mbit/s	Mega-bits per second
MHz	MegaHertz
O_2	Oxygen

3.3 Abbreviations

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

ACAP	Adjacent Channel Alternate Polarization
ACCP	Adjacent Channel Co-Polarization
ATPC	Automatic Transmit Power Control
AU	Administrative Unit
CCDP	Co-Channel Dual Polarized
CEPT	Conférence des administrations Européennes des Postes et Télécommunications
E.I.R.P.	Equivalent Isotropically Radiated Power
EC	European Community
ECC	Electronic Communication Committee of the CEPT
ERC	European Radiocommunications Committee of the CEPT, presently become ECC
FDD	Frequency Division Duplex
FS	Fixed Service
FSK	Frequency Shift Keying
HEN	Harmonized European Standard
L6	Lower 6 GHz (5,925 GHz to 6,425 GHz) band
OOK	On-Off Keying
PDH	Plesiochronous Digital Hierarchy
R&TTE	Radio equipment and Telecommunications Terminal Equipment
RF	Radio Frequency
RTPC	Remote Transmit Power Control
RX	Receive
SDH	Synchronous Digital Hierarchy
sSTM-1k	Synchronous Transport Module of k times VC-12 equivalent payload (k=1, 2, 4, 8, 16)
sSTM-2n	Synchronous Transport Module of n times VC-2 equivalent payload (n=1, 2, 4)
STM-0	Synchronous Transport Module Level 0 (51,840 Mbit/s AU-3 equivalent payload)
STM-1	Synchronous Transport Module Level 1 (155,520 Mbit/s)
STM-4	Synchronous Transport Module Level 4 (622,080 Mbit/s)
Sub-STM-0	Generic term for a number of low capacity SDH transport modules (sSTM-1k or sSTM-2n) defined by Recommendation ITU-T G.708 [i.14]
TDD	Time Division Duplex
TX	Transmit or Transmitter
U6	Upper 6 GHz (6,425 GHz to 7,125 GHz) band
VC	Virtual Container

4 Parameters to be used in sharing and compatibility analyses

4.1 Technology/Application limited maximum transmit power

4.1.1 Introduction and systems subdivisions

Systems in the EN 302 217-2-2 [i.4] and/or EN 302 217-3 [i.5] are roughly subdivided by operating bands from 1,4 GHz to 2,6 GHz, from 3 GHz to 11 GHz (with channel separations up to about 56 MHz, but excluding 40 MHz case), from 3 GHz to 11 GHz (40 MHz channels), from 13 GHz to 18 GHz, from 23 GHz to 55 GHz, from 57 GHz to 66 GHz and from 71 GHz to 86 GHz.

The system capacities, originally tailored to hierarchical PDH or SDH rate, are now considered generically covering any signal including packet data rates (e.g. Ethernet as most common one).

According Recommendation ITU-R F.746 [i.12], system capacity is roughly subdivided into:

- Small capacity (payload $\leq$ 10 Mbit/s)
- Medium capacity (payload $\leq$ 100 Mbit/s)
- High capacity (payload > 100 Mbit/s)

The system requirements further detailed in EN 302 217-2-2 [i.4] and/or EN 302 217-3 [i.5] are hereby summarized.

4.1.1.1 Systems in frequency bands 1,4 GHz to 2,6 GHz

Annex A of EN 302 217-2-2 [i.4] covers the following different system typologies:

- Low capacity point-to-point digital radio systems operating in the 1,4 GHz frequency band.
- Low and medium capacity point-to-point digital radio systems operating in the frequency range 2,1 GHz to 2,6 GHz.

4.1.1.2 Systems in frequency bands from 3 GHz to 11 GHz with ~ 30 MHz or lower channel separations and ~ 60 MHz channel separation)

Annex B of EN 302 217-2-2 [i.4] covers the following different system typologies:

- Low and medium capacity digital radio systems.
- High capacity digital radio systems (e.g. carrying up to 1 or 2 × STM-1 or equivalent packet data capacity signals) in frequency bands with about 30 MHz or about 60 MHz channel separation and using Adjacent Channel Co- Polar arrangements (ACCP) or doubled capacity (up to STM-4 or equivalent packet data capacity) with Co-Channel Dual Polar (CCDP) operation.
- High capacity digital radio systems (e.g. carrying 1 or 2 × STM-1 or equivalent packet data capacity signals) and operating in frequency bands with about 30 MHz or about 60 MHz channel separation with alternated arrangements (ACAP).

4.1.1.3 Systems in frequency bands from 3 GHz to 11 GHz with 40 MHz channel separations

Annex C of EN 302 217-2-2 [i.4] covers the following different system typologies:

- High capacity fixed radio systems (e.g. carrying up to 2 × STM-1 or equivalent packet data capacity signals) in frequency bands with 40 MHz channel separation and using Adjacent Channel Co-Polar arrangements (ACCP); or doubled capacity (up to STM-4 or equivalent packet data capacity) with Co-channel Dual Polarized (CCDP) operation.

- High capacity digital radio systems (e.g. carrying up to 2 × STM-1 or equivalent packet data capacity signals) in a 40 MHz channel with alternate channel arrangements (ACAP).

4.1.1.4 Systems in frequency bands 13 GHz, 15 GHz and 18 GHz

Annex D of EN 302 217-2-2 [i.4] covers the following different system typologies:

- Low and medium capacity digital radio systems.
- Radio systems for the transmission of Sub-STM-0 digital signals operating in the 18 GHz frequency band.
- High capacity digital radio systems (e.g. carrying up to 1 or 2 × STM-1 or equivalent packet data capacity signals) in frequency bands with about 28 MHz or about 56 MHz channel separation and using Adjacent Channel Co-Polar arrangements(ACCP) or doubled capacity (up to STM-4 or equivalent packet data capacity) with Co-Channel Dual Polarized (CCDP) operation.
- High capacity digital radio systems (e.g. carrying up to 1 or 2 × STM-1 or equivalent packet data capacity signals) and operating in frequency bands with about 28 MHz or about 56 MHz channel separation and alternated arrangements (ACAP).

4.1.1.5 System in frequency bands from 23 GHz to 55 GHz

Annex E of EN 302 217-2-2 [i.4] covers the following different system typologies:

- Low and medium capacity digital radio systems.
- High capacity digital radio systems (e.g. carrying up to 1 or 2 × STM-1 or equivalent packet data capacity signals) in frequency bands with about 28 MHz or about 56 MHz channel separation and using Adjacent Channel Co-Polar arrangements (ACCP) or doubled capacity (up to STM-4 or equivalent packet data capacity) with Co-Channel Dual Polarized (CCDP) operation.
- High capacity digital radio systems (e.g. carrying up to 1 or 2 × STM-1 or equivalent packet data capacity signals) and operating in frequency bands with about 28 MHz or about 56 MHz channel separation and alternated arrangements (ACAP).

4.1.1.6 Systems in frequency bands from 57 GHz to 66 GHz

In these bands P-P systems are standardized for typical uncoordinated or with simply registration deployment. Specific channel arrangements are not defined in these bands, only basic 30 MHz or 50 MHz contiguous slots are provided, without predefined duplex, for TDD or FDD free use; therefore, EN 302 217-3 [i.5] provides only "parametric" limits for E.I.R.P. and antenna gain relationship in the following frequency ranges:

- Range 57 GHz to 59 GHz: Annex UA provides limits for relatively narrow bandwidth (50 MHz and 100 MHz) systems.
- Range 64 GHz to 66 GHz: Annex UB provides limits for any system with bandwidths from 30 MHz to about 1 000 MHz or more (in principle up to the whole 2 000 MHz) allowing high E.I.R.P. (being the band is specifically designated for FS high density applications).
- Range 57 GHz to 66 GHz: Annex UBa provides limits for any system with bandwidths from 50 MHz to 2 500 +MHz with relatively low (max 55 dBm) E.I.R.P. because the larger portion of the range, 59 GHz to 64 GHz, is also designated for a large number of other non fixed applications that need to coexist without coordination.

4.1.1.7 Systems in frequency bands from 71 GHz to 86 GHz

In these bands only high capacity systems are covered, typically carrying packet data (e.g. Ethernet up to 1 or 2 × 1000BaseT data interfaces). Deployment is mostly related to ECC channel arrangements based on N × 250 MHz channels or other channel size eventually defined by ECC and, in principle, any channel size might be possible when the ECC/REC(05)07 [i.11] arrangement is not applied.

Maximum power output and E.I.R.P. of systems is still considered relevant to "essential requirements" under article 3.2 of R&TTE Directive [i.1] and high level limits, with conditional relationship to the actual antenna gain and/or permanent ATPC implementation, are reported in Annex UC of Harmonized EN 302 217-3 [i.5] for easing a generic compatibility with fixed and other applications for which the band is designated.

In addition, when conventional link-by-link coordination is considered, additional "essential requirements" (for relative spectrum masks and RX parameters needed in the coordination process) are further reported in Annex Ea of Harmonized EN 302 217-2-2 [i.4].

4.1.2 Tables of typical transmit power

The following tables provide technology/application limited maximum transmit power to be used in sharing and compatibility analyses. These maximum transmit powers, expressed in dBm, are defined at reference point C' (see figure 1 of EN 302 217-1 [i.2]), including the transmitter power tolerance and, if applicable, ATPC/RTPC influence.

In addition typical feeder loss, if any are considered of typical use in that application, are also indicated.

The essential requirements of article 3.2 of R&TTE Directive [i.1] in term of Transmit power are given in clause 4.2.1 of EN 302 217-2-2 [i.4].

NOTE: The transmitter power tolerance is defined in clause 4.2.3 of EN 302 217-2-2 [i.4] depending on the considered frequency range.

Table 1: Power parameters in frequency bands from 1,4 GHz to 2,7 GHz (Channel separation less than 3,5 MHz in 1,4 GHz and 1,75 to 14 MHz in higher 2,1 GHz and 2,6 GHz)

Power parameters	1,4 GHz band	2,1 GHz and 2,6 GHz bands
Typical transmitter highest power for real equipment	+33 dBm	+33 dBm
Typical feeder loss (coaxial 7/8 inch)	2,8 dB/50 m	3,3 dB/50 m

Table 2: Power parameters in the frequency bands from 3 GHz to 11 GHz (channel separation up to 30 MHz or 60 MHz)

Power parameters	Low and medium capacity Systems	High capacity systems
Typical transmitter highest power for real equipment	+27 dBm	+32 dBm (notes 2, 3)
Typical feeder loss (elliptical waveguide) (See note 1)	4 GHz: 3 dB/100 m L6 GHz: 4 dB/100 m 7 GHz: 6 dB/100 m 8 GHz: 7 dB/100 m 11 GHz: 9,5 dB/100 m	
Feeder length	Typical 50 m	
NOTE 1: Reported feeder losses are generally applicable to trunk systems; however, full outdoor systems (i.e. with no or minimal feeder loss) are also becoming more and more popular for mobile networks backhauling. NOTE 2: Full outdoor systems usually provide less power (e.g. 3 dB or more). NOTE 3: Radio Regulations [i.13] 5.482 (i.e. maximum transmitter power -3 dBW) applies to systems operating in the band 10,6 GHz to 10,68 GHz.		

Table 3: Power parameters frequency bands from 3 GHz to 11 GHz (High capacity with channel separation 40 MHz)

Power parameters	All systems
Typical transmitter highest power for real equipment	+32 dBm (notes 2, 3)
Typical feeder loss (elliptical waveguide) (see note 1)	4 GHz: 3 dB/100 m U6 GHz: 6 dB/100 m 11 GHz: 9,5 dB/100 m
Feeder length	Typical 50 m
NOTE 1: Reported feeder losses are generally applicable to trunk systems; however, full outdoor systems (i.e. with no or minimal feeder loss) are also becoming more and more popular for mobile networks backhauling. NOTE 2: Full outdoor systems usually provide less power (e.g. 3 dB or more). NOTE 3: Radio Regulations [i.13] 5.482 (i.e. maximum transmitter power -3 dBW) applies to systems operating in the band 10,6 GHz to 10,68 GHz.	

Table 4: Power parameters in the frequency bands 13 GHz, 15 GHz and 18 GHz

Power parameters	sub-STM-0 systems (18 GHz only)	Low and medium capacity	High capacity (indoor Systems)	High capacity (full outdoor Systems)
Typical transmitter highest power for real equipment	+25 dBm	+27 dBm	+25 dBm	+25 dBm
Typical feeder loss (elliptical waveguide)	0 dB	0 dB (see note 1)	13 GHz: 12,5 dB/100 m 15 GHz: 15 dB/100 m 18 GHz: 20,5 dB/100 m	0 dB
Feeder length	Full indoor systems; typically: - Up to 40 m at 13 GHz; - Up to 25 m at 15 GHz; - Up to 15 m at 18 GHz.			
NOTE 1: A number of systems are also deployed in full indoor configuration with feeder losses similar to those of high capacity systems. NOTE 2: Radio Regulations [i.13] 5.522A (i.e. maximum transmitter power -3 dBW) applies to systems operating in the band 18,6 GHz to 18,8 GHz.				

Table 5: Power parameters in the frequency bands from 23 GHz to 55 GHz

Power parameters	23 GHz Systems	26 GHz and 28 GHz Systems	31 GHz, 32 GHz, 38 GHz and 42 GHz Systems	50 GHz Systems	52 GHz Systems	55 GHz Systems
Typical transmitter highest power for real equipment	+25 dBm	+25 dBm	+23 dBm	+15 dBm	+15 dBm	+15 dBm (note 2)
Typical feeder loss (elliptical waveguide)	23 GHz: 29 dB/100 m 26 GHz/28 GHz: 33 dB/100 m 32 GHz: 46 dB/100 m 38 GHz: 60 dB/100 m					
Feeder length	Most common applications are fully outdoor radio systems with integrated antennas: no feeder is used present (0 dB loss) Very few non integrated antenna systems with flexible waveguide are also present; typical feeder length: 5 m to 10 m at 23 GHz 5 m at 26 GHz/28 GHz/32 GHz/38 GHz)					
NOTE 1: The old "source ENs" for 52 GHz and 55 GHz bands are the only examples of limits lower than what considered achievable (i.e. the same power of system E.5 in 50 GHz band). NOTE 2: Radio Regulations [i.13] 5.557A (i.e. maximum transmitter power density -26 dBW/MHz) applies to systems operating in the band 55,78 GHz to 56,26 GHz.						

Table 6: Power parameters in the frequency bands from 57 GHz to 66 GHz

Power parameters	57 GHz to 64 GHz Band	64 GHz to 66 GHz Band
Absolute maximum transmitter power considered in the scope of EN 302 217-3 [i.5]	+10 dBm and -10 dBm/MHz	+35 dBm
Typical transmitter highest power for real equipment	+10 dBm and -10 dBm/MHz (note)	+15 dBm
Typical feeder loss (elliptical waveguide)	No applications with significant feeder are known.	
NOTE: Maximum transmitter power limited by ECC/REC(09)01 [i.9]; current technology might permit about 5 dB more.		

Table 7: Power parameters in the frequency bands from 71 GHz to 86 GHz

Power parameters	71 GHz to 86 GHz Band
Absolute maximum transmitter power considered in the scope of EN 302 217-3 [i.5]	+30 dBm (+35 dBm with at least 5 dB permanent ATPC range)
Typical transmitter highest power for real equipment	+18 dBm (see note)
Typical feeder loss (elliptical waveguide)	No applications with significant feeder are known.
NOTE: This is the power typically delivered by RF devices on the market, corrected by typical duplexer losses, at the date of the publication of this version of the present document, when the market for this band is just started. Output power close to this value is available only for the simplest, less efficient modulation formats (e.g. OOK, FSK). It is expected that from one side the RF component technology will improve, while the need for more efficient modulations (requiring more back-off) would substantially maintain stable (or slightly lower for most efficient systems) this highest value.	

4.2 Typical application limited antenna gain and diameter to be used in sharing or compatibility analyses

Table 8: Antenna parameters in frequency bands from 1,4 GHz to 2,7 GHz

Antenna parameter	1,4 GHz band	2,1 GHz and 2,6 GHz bands
Typical maximum antenna diameter/gain	2,4 m/29 dBi 4 m/34 dBi (exceptional)	2,4 m/34 dBi 4 m/38 dBi (exceptional)

Table 9: Antenna parameters in the frequency bands from 3 GHz to 11 GHz (channel separation up to 30 MHz)

Frequency range	Antenna parameter	Low and medium capacity Systems	High capacity Systems
3 GHz to 5 GHz	Typical maximum antenna size/gain	3 m/41 dBi 4,6 m/45 dBi (exceptional)	3,7 m/43 dBi 4,6 m/45 dBi (exceptional)
5 GHz to 8,5 GHz	Typical maximum antenna size/gain	2,4 m/44 dBi 4,6 m/49 dBi (exceptional)	3 m/46 dBi 4,6 m/49 dBi (exceptional)
8,5 GHz to 11 GHz	Typical maximum antenna size/gain	2,4 m/46 dBi 3 m/48 dBi (exceptional)	2,4 m/46 dBi 3 m/48 dBi (exceptional)
NOTE: The practice for full outdoor systems no longer used for long trunk networks implies that smaller size antennas are used; therefore, the percentage of lower gain antennas might significantly increase.			

Table 10: Antenna parameters in the frequency bands from 3 GHz to 11 GHz (channel separation 40 MHz)

Frequency band	Antenna parameter	High capacity systems
4 GHz and 5 GHz	Typical maximum antenna size/gain	3,7 m/43 dBi 4,6 m/45 dBi (exceptional)
U6 GHz	Typical maximum antenna size/gain	3 m/44 dBi 4,6 m/48 dBi (exceptional)
11 GHz	Typical maximum antenna size/gain	3 m/48 dBi 3,7 m/50 dBi (exceptional)
NOTE: The practice for full outdoor systems no longer used for long trunk networks implies that smaller size antennas are used; therefore, the percentage of lower gain antennas might significantly increase.		

Table 11: Antenna parameters in the frequency bands 13 GHz, 15 GHz and 18 GHz

System	Low and medium capacity Systems	Sub-STM-0 Systems	High capacity Systems
Frequency band	13 GHz, 15 GHz, 18 GHz	18 GHz	13 GHz, 15 GHz, 18 GHz
Typical maximum antenna size/gain	13 GHz 3 m/50 dBi 15 GHz 2,4 m/49 dBi 18 GHz 1,8 m/48 dBi	0,6 m/40 dBi	13 GHz 3 m/50 dBi 15 GHz 2,4 m/49 dBi 18 GHz 1,8 m/48 dBi
Exceptional size/gain	13 GHz: 3,7 m/51 dBi 15 GHz: 3 m/51 dBi 18 GHz: 2,4 m/51 dBi		

Table 12: Antenna parameters in the frequency bands from 23 GHz to 55 GHz

Antenna parameter	23 GHz Systems	26 GHz/28 GHz Systems	31 GHz/32 GHz/38 GHz/42 GHz Systems	50 GHz/52 GHz systems	55 GHz/57 GHz to 66 GHz Systems
Typical maximum antenna size/gain	1,2 m/47 dBi	26 GHz 0,6 m/42 dBi 28 GHz 0,6 m/42,5 dBi	31 GHz/32 GHz 0,6 m/43 dBi 38 GHz 0,6 m/45 dBi	0,3 m/41 dBi	0,3 m/42 dBi
Exceptional size/gain	1,8 m/51 dBi	26 GHz 1,2 m/47,5 dBi 28 GHz 1,2 m/48 dBi	31 GHz/32 GHz 1,2 m/48,5 dBi 38 GHz 1,2 m/51 dBi	0,6 m/47 dBi	0,6 m/48 dBi

Table 13: Antenna parameters in the frequency bands from 71 GHz to 86 GHz

Antenna parameter	All systems
Typical maximum antenna size/gain	0,3 m/44 dBi
Exceptional size/gain	0,6 m/50 dBi

History

Document history		
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