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Fixed Radio Systems;
Characteristics and requirements for point-to-point equipment and antennas;
Part 1: Overview, common characteristics and system-dependent requirements

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REN/ATTM-04028

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Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document is part 1 of a multi-part deliverable covering the Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas, as identified below (see note):

Part 1: "Overview, common characteristics and system-dependent requirements";

Part 2: "Digital systems operating in frequency bands from about 1,3 GHz to 86 GHz; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU";

Part 4: "Antennas".

NOTE: In previous regulatory regime of harmonised standards under Directive 1999/5/EC more parts were published, which have been superseded since Directive 2014/53/EU repealed Directive 1999/5/EC; they are:
- Part 2-1: which technical content merged in the present document (Part 1)
- Part 2-2: which technical content is merged in Part 2
- Part 3: which technical content is merged in Part 2 (with addition of a complete set of receiver parameters)
- Part 4-1: which technical content is merged in Part 4
- Part 4-2: which technical content is merged in Part 4

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):	18 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

(i) Generality and historical background

Digital Fixed Radio Systems (DFRS), used in European countries, had been historically specified in a relatively large number of specific European Norms produced by ETSI.

Those previous documents, already superseded by first publication of this ETSI EN 302 217 series, contained both essential requirements and other requirements that, even if not considered essential under Directive 2014/53/EU [i.1] of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC, may still be applicable.

For the correct understanding and application of the requirements in the whole ETSI EN 302 217 multipart series, the definitions summarized in clause 3.1 of the present document are also relevant; those definitions are generally hereby identified with the use of *italic characters* (e.g. *mixed-mode*).

Standards for point-to-point systems, including antennas, cover a very large range of traffic capacities, channel separations (CS), modulation formats and applications over a very wide range of frequency bands that are summarized in table 1.

Table 1: Digital Fixed Radio Systems (DFRS) parameters

Parameter	Range
Frequency bands	from 1 GHz to 86 GHz (see note)
Traffic capacities	from 9,6 kbit/s to 622 Mbit/s and to Gbit/s and above in the highest bands
Channel separations	from 25 kHz to 112 MHz and to GHz and above in the highest bands
Modulation formats	from 2 states to 2 048 states (amplitude and/or phase and/or frequency modulated states)
Typical applications	**POINT-TO-POINT (P-P) CONNECTIONS:** rural and urban low/medium/high capacity links for mobile access infrastructure (backhaul), transport/trunk (long haul), FWA/BWA/ access, fixed LAN extensions (FLANE) governmental (non-military) links, private fixed networks, SAP/SAB P-P audio and video links with *integral* or *dedicated antenna*. ***STAND ALONE* ANTENNAS:** for all of the above applications when *integral* or *dedicated antennas* are not employed
NOTE: Market demand will likely extend the upper limits.	

The regulatory framework for placing radio systems on the market, established by Directive 2014/53/EU [i.1] also requires the availability of Harmonised Standards covering the essential requirements under article 3.2 of Directive 2014/53/EU [i.1]. ETSI EN 302 217 series meet this demand by providing a rational subdivision of technical characteristics into:

- general system independent parameters, defined in the present document;
- system dependent "main" parameters relevant to the "essential" requirements of art 3.2 of Directive 2014/53/EU [i.1], briefly summarized in the present document but specifically defined in ETSI EN 302 217-2 [18];
- system dependent "complementary" parameters NOT relevant to the "essential" requirements of art 3.2 of Directive 2014/53/EU [i.1]. Nevertheless they have been commonly agreed for proper system operation and deployment when specific deployment conditions or compatibility requirements are present; they are also defined in the present document.

ETSI EN 302 217-4 [19] includes electrical and mechanical characteristics for development of any kind of DFRS P-P antenna and represent relevant reference in ETSI EN 302 217-2 [18] defining directional parameters of P-P radio relevant to essential requirements under article 3.2 of Directive 2014/53/EU [i.1] for *integral* and *dedicated antennas*.

In the present document, equipment is grouped into families of either similar frequency bands or applications. Nine families are identified for frequency bands corresponding, in ETSI EN 302 217-2 [18], to annexes referenced from annex B to annex J and one family associated with applications of packet data and combination of other signals mapped into proprietary transport modules, detailed in annex N.

B frequency bands from 1,4 GHz to 2,4 GHz;

C frequency bands from 3 GHz to 11 GHz (channel separation around 60 MHz and from 1,75 MHz up to around 30 MHz);

D frequency bands from 3 GHz to 11 GHz (channel separation 40 MHz);

E frequency bands 13 GHz, 15 GHz and 18 GHz;

F frequency bands from 23 GHz to 42 GHz;

G frequency bands from 50 GHz to 55 GHz;

H frequency bands from 57 GHz to 66 GHz;

I frequency bands from 64 GHz to 66 GHz;

J frequency bands from 71 GHz to 76 GHz and 81 GHz to 86 GHz;

N definition of equivalent data rates for packet data, PDH/SDH and other signals on the traffic interface.

(ii) Cross references to previously relevant ENs and TSs

The ETSI EN 302 217 series replaced and superseded a number of older standards (frequency and/or capacity oriented), which remained, only as "historical" documents, in the ETSI data base. Provided that they may still be referenced in some documentation, previous version of the present document (ETSI EN 302 217-1 V2.1.1 [i.12]) provides their list.

(iii) Summary of system options provided

A number of options for equipment implementation are identified in ETSI EN 302 217 series; the set of characteristics applicable to each option is uniquely identified through three parameters:

- operating frequency band;
- operating radio frequency channel separation (CS);
- spectral efficiency class (as defined in ETSI EN 302 217-2 [18]).

Each option so identified has a "nominal" payload requirement in term of minimum RIC (Radio Interface Capacity) to be fulfilled when packet payloads are used (e.g. Ethernet, ATM, etc.); in case PDH/SDH traffic are alternatively provided, annex N of ETSI EN 302 217-2 [18] gives the translation from the minimum RIC to the minimum hierarchic interfaces.

Table 2 and table 3 summarize the relevant cross-references between channel separation in various Fixed Service frequency bands and the available options of equipment provided in ETSI EN 302 217 series. They are shown in term of the minimum RIC payload, which, depending on the channel separation, correspond to a specific spectral efficiency class detailed in clause 1.2 of ETSI EN 302 217-2 [18] (identified, with increasing spectral efficiency, as classes 1, 2, 3, 4L, 4H, 5L, 5H, 6L, 6H 7 and 8). In classes from 5L to 8, two further sub-classes suffix (i.e. A and B) are provided for the same channel separation depending on whether ACAP or CCDP operation is, respectively, considered for the equipment use.

The minimum RIC payload in table 2 and table 3 are the minimum required for conformance to the present document and are based on the "minimum RIC density" defined, for each spectral efficiency class, in clause 1.2 of ETSI EN 302 217-2 [18] (see note).

NOTE: In ETSI EN 302 217-2 [18] only some cases of systems in annex B, due to the smaller channel separation provided, are (exceptionally) labelled with typical *gross bit rate* rather than minimum RIC capacity rates.

However, equipment may offer a variety of base band interfaces, e.g. typical hierarchical rates PDH or SDH, ISDN, Ethernet as well as mixture of these or other standardized interfaces. Mapping/multiplexing of the various base-band interfaces into common frame(s) suitable for radio transmission may be done using standardized higher hierarchical frames or other proprietary methods.

Table N.1a through table N.1h in annex N of ETSI EN 302 217-2 [18] summarize the "minimum RIC" considered in the present document and, when only PDH or SDH interfaces are provided, give the equivalent capacity in term of number of 2 048 Mbit/s streams provided as multiple or single multiplexed PDH or SDH interfaces. These minimum capacities are associated to the relevant channel separation and spectral efficiency classes defined.

The cells in table 2 and table 3 are filled only on the basis of available physical single equipment transmission capacity (up to a minimum RIC of 862 Mbit/s for class 8 systems in conventional channel arrangements with CS up to 112 MHz or even up to about 3 Gbit/s in bands above 57 GHz where larger CS are possible), which is relevant for Directive 2014/53/EU [i.1] article 3.2 assessment. Doubled capacity is, in principle, possible for any option using CCDP operation or, more in general, subdividing the payload over two channels; however, specific test procedures are provided in ETSI EN 302 217-2 [18] only for STM-4 interface or other high speed data interfaces when their payload is split over two or more equipment or on *channels-aggregation* equipment.

Table 2: Cross reference of available equipment and antenna requirements in parts and annexes of ETSI EN 302 217 series: bands from 1,4 GHz to 18 GHz

ETSI EN 302 217 series															
General requirements⇨		**Part 1 (present document) (System common characteristics and system-independent requirements)**													
Antenna requirements⇨		**Part 4 [19] (Antenna general and complementary requirements)**													
Equipment main requirements⇨		**Part 2 [18] (HS for equipment characteristics relevant to article 3.2 of Directive 2014/53/EU [i.1])**													
Relevant annex in Part 2 [18]⇨		**B**					**C or E**								**D**
Frequency band (GHz)⇨		1,4; 2,4	2,1	1,4; 2,1	2,1		**Annex C** : 3,5 ; 4 ; U4 ; L6 ; U6 ; 7 ; 8 ; 10,5 ; 11 **Annex E** : 13 ; 15 ; 18							**Annex C :** U6	4, U4, U6, 8, 11
Minimum RIC (Mbit/s) provided with relevant equipment characteristics — **Channel separation (MHz) ⇨** / **Spectral efficiency ⇩**		CS < 1,75 and 2	1,75	3,5	7	14	1,75	3,5	7	13,75 / 14 / 15	27,5 / 28 / 29 / 29,65 / 30	55 / 56 / 58 / 59,3 / 60	110 (note 1)	20	40
Reference index ⇩	**Class ⇩**														
1	**1**	(note 2)		2											
2	**2**	(note 2)	2	4	8	16	2	4	8	16	32	64	128		
3	**3**						3	6	12	24	48	96	191		
4	**4L**	(note 2)	4	8	16	32	4	8	16	32	64	128	256	45	
5	**4H**							12 (a)	24	49	98	196	392		
6	**5L**								29	58					
6	**5LA, 5LB**										117	235	470		168
7	**5H**							17 (a)	34	68					
7	**5HA, 5HB**										137	274 (b)	548		137 (c) / 196
8	**6L**								39	78					
8	**6LA, 6LB**										156	313	627		224
9	**6H**									88					
9	**6HA, 6HB**										176	352	705		252 (b)
10	**7**									98					
10	**7A, 7B**										196	392	784		280
11	**8**									107					
11	**8A, 8B**										215	431	862		308
Equivalent capacity for hierarchic-only systems		Annex D of the present document and annex N of Part 2 [18]													

NOTE 1: CS 110 MHz available only in 18 GHz band.
NOTE 2: For channel separations of 2 MHz and other various smaller than 1,75 MHz, only typical "gross bit rates" are defined.
(a): These systems are intended only for the transport of subSTM-0 capacities only in 18 GHz band.
(b): STM-4 capacity as combination of two 2 × STM-1 equipment operating on two channels in ACAP or CCDP or even non adjacent operation is also described.
(c): Minimum RIC 137 Mbit/s option is special provision only for commonality of use of 5HB/28 MHz like equipment modulation also into 40 MHz channel arrangements.

Table 3: Cross reference of available equipment and antenna requirements in parts and annexes of ETSI EN 302 217 series: bands from 23 GHz to 80 GHz

ETSI EN 302 217 series																								
Common requirements ⇨			Part 1 (present document) (System common characteristics and system-independent requirements)																					
Antenna requirements ⇨			Part 4 [19] (Antenna general and complementary requirements)																					
Equipment requirements ⇨			Part 2 [18] (HS for equipment characteristics relevant to article 3.2 of Directive 2014/53/EU [i.1])																					
Relevant annex Part 2 [18]⇨			F						G					J										I	H
Frequency band (GHz) ⇨			23, 26, 28, 31, 32, 38, 42						50, 52, 55					71 to 76 and 81 to 86 (note)										64 to 66	57 to 66 (note)
Minimum RIC (Mbit/s) provided with relevant equipment characteristics	Spectral efficiency ⇩		Channel separation (MHz)						Channel separation (MHz)					Channel separation (MHz)										Channel size free or multiple of predefined slots from 30/50 MHz to 2 000 MHz	
	Reference index ⇩	Class ⇩	3,5	7	14	28	56	112	3,5	7	14	28	56	62,5	125	250	500	750	1 000	1 250	1 500	1 750	2 000		
	1	1							2	4(c)	8(c)	16(c)	32	35	71	142	285	427	570	712	855	997	1 140	See minimum spectral efficiency reported in Tables H.2 and I.2 of the relevant annexes.	
	2	2	4(b)	8	16	32	64	128	4	8	16	32	64	71	142	285	570	855	1 140(a)	1 425	1 710	1 995	2 280		
	3	3	6(b)	12	24	48	96	191	6	12	24	48	96	106	212	425	850	1 275	1 700	2 125(a)	2 550	2 975	3 400		
	4	4L	8(b)	16	32	64	128	256		16	32	64	128	142	285	570	1 140(a)	1 710	2 280(a)	2 850					
	5	4H		24	49	98	196	392						219	438	875	1 750	2 625							
	6	5L		29	58																				
	6	5LA, 5LB				117	235	470						262	525	1 050(a)	2 100(a)	3 150(a)							
	7	5H		34	68																				
	7	5HA, 5HB				137	274(c)	548						306	612	1 225	2 450								
	8	6L		39	78																				
	8	6LA, 6LB				156	313	627						350	700	1 400	2 800								
	9	6H			88																				
	9	6HA, 6HB				176	352	705																	
	10	7			98																				
	10	7A, 7B				196	392	784																	
	11	8			107																				
	11	8A, 8B				215	431	862																	
Equivalent capacity for hierarchic only systems			Annex D of the present document and annex N of Part 2 [18]																					

NOTE: Alternative, in overlapping band, to annex I.
(a): RIC rounded down to closest N × 1 Gbit/s rate are also considered valid.
(b) Not provided in 42 GHz band.
(c): STM-4 capacity as combination of two 2 × STM-1 equipment operating on two channels in ACAP or CCDP or even non adjacent operation is also described.

(iv) User's guide

The symbols abbreviations and definitions, which apply to the whole ETSI EN 302 217 series, are listed in the present document. In particular, correct understanding of the definitions is necessary for the correct application of all the requirements.

The requirements applicable to a specific point to point digital fixed radio systems (including its antenna) are summarized in table 4 showing the major structure of the whole ETSI EN 302 217 series. The requirements are subdivided across the three parts of the EN series corresponding to their four major categories.

The first category (the present document) corresponds to "common" system independent characteristics which are either common to the whole family of equipment, i.e. performance and availability, environmental profiles, power supply, system block diagram, mechanical characteristics and baseband interfaces and parameters. The present document defines those requirements and characteristics set out in the other parts of ETSI EN 302 217 series.

The second category (also described in the present document) corresponds to "complementary" characteristics and requirements, which are NOT relevant to article 3.2 of Directive 2014/53/EU [i.1] but may guarantee better performance to the actual deployed links. Therefore, the manufacturer may wish to claim compliance to all or some of these requirements for showing enhanced characteristics of its product.

Complementary requirements are requirements that are not related to essential requirements under article 3.2 of Directive 2014/53/EU [i.1]. Nevertheless they are considered, having been commonly agreed for proper system operation and deployment when specific deployment conditions or compatibility requirements are present. Compliance to all or some of these requirements is made on a voluntary basis.

The limits for main and complementary requirements that are not common or parameterized for all of the equipment covered by one part, but specific to one frequency range, one RIC or PDH/SDH capacity, etc., are located in annexes.

The third category (summarized in the present document and detailed in ETSI EN 302 217-2 [18]) is for equipment in any frequency bands; it corresponds to essential characteristics, with respect to article 3.2 of Directive 2014/53/EU [i.1] and are consequently defined in a harmonised standard. A complete set of TX and RX parameters is retained essential. The limiting values associated with the essential requirements which are not common to all of the equipment covered by one part, but specific to one frequency range, one RIC or PDH/SDH capacity, etc., are located in annexes. In annex A of ETSI EN 302 217-2 [18] a correspondence table between the technical requirements and article 3.2 of Directive 2014/53/EU [i.1] summarizes those requirements to be addressed in order to claim compliance.

The fourth category (ETSI EN 302 217-4 [19]) provides the antenna characteristics to be used for any P-P system in all operating bands; some of these characteristics are also referenced in ETSI EN 302 217-2 [18] as being "essential parameters" for radio equipment with *integral* or *dedicated antenna*. These latter characteristics might also be used by the manufacturer of radio equipment placed on the market with external *dedicated antenna* or other *stand-alone* antenna (possibly independently substituted or purchased by the user itself), for respecting obligations in other articles of Directive 2014/53/EU [i.1] (e.g. article 10 recital 8 of Directive 2014/53/EU [i.1]), ETSI EN 302 217-2 [18] provides suitable guidelines for the description in the user instruction of the antenna characteristics "*information required to use radio equipment in accordance with its intended use*".

To conclude, ETSI EN 302 217 series is used as a comprehensive document that, starting from the present document down to the relevant annexes of parts ETSI EN 302 217-2 [18] and ETSI EN 302 217-4 [19]. Table 4 shows the major clauses and annexes of the series.

Table 4: Structure of the ETSI EN 302 217 series

ETSI EN 302 217-1 (present document) Overview, common characteristics and system-dependent requirements	
3	Definitions, symbols and abbreviations
4	General characteristics
5	Baseband interfaces and parameters
6	Main requirements
7	Complementary requirements
Annex A(normative)	Spectrum masks and receiver selectivity when mixed manufacturer compatibility is required
Annex B (normative)	Definition of equivalent data rates for packet data, PDH/SDH and other signals on the traffic interface
Annex C (informative)	Additional information:
C.1	Residual Bit Error Ratio (RBER) and Residual Frame Error Ratio (RFER)
C.2	Measurement test set for XPI characteristics
C.3	Differential delay compensation range
C.4	FER/BER equivalence and FER performance measurement
C.5	Automatic Transmitter Power Control (ATPC)
Annex D (informative)	Information on Multi-channel and Channel-aggregation differences and operation
Annex E (informative)	Mechanical characteristics

ETSI EN 302 217-4 Antennas	
4	Technical requirements specifications
4.3	Environmental profile
4.4	Radiation Pattern Envelope (RPE)
4.5	Cross-Polar Discrimination (XPD)
4.6	Antenna gain
5	Testing for compliance with technical requirements
Annex A (informative)	Additional information
A.1	Mechanical characteristics
A.2	Antenna input connectors
A.3	Return loss at the input ports
A.4	Inter-port isolation
Annex B (informative)	Antenna gain and radiation pattern information
B.1	Impact of antenna gain on the frequency planning
B.2	Gain and typical radiation pattern for circular symmetric antennas

ETSI EN 302 217-2 [18] (Harmonised Standard) Digital systems operating in frequency bands from 1,3 GHz to 86 GHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU	
4	Technical requirements specifications
4.1	General requirements
4.1.1	Requirements framework
4.1.2	System identification and traffic loading
4.1.3	Environmental profile
4.2	Transmitter requirements
4.3	Receiver requirements
4.4	Antenna characteristics
5	Testing for compliance with technical requirements
Annex A (normative)	Relationship between the present document and the essential requirements of Directive 2014/53/EU
Annex B (normative)	Frequency bands 1,4 GHz to 2,6 GHz
Annex C (normative)	Frequency bands from 3 GHz to 11 GHz (CS up to 30 MHz and 56/60 MHz)
Annex D (normative)	Frequency bands from 3 GHz to 11 GHz (CS 40 MHz)
Annex E (normative)	Frequency bands 13 GHz, 15 GHz and 18 GHz
Annex F (normative)	Frequency bands from 23 GHz to 42 GHz
Annex G (normative)	Frequency bands from 50 GHz to 55 GHz
Annex H (normative)	Frequency band 57 GHz to 66 GHz
Annex I (normative)	Frequency band 64 GHz to 66 GHz
Annex J (normative)	Frequency bands 71 GHz to 86 GHz
Annexes K, L and M	Void (for future use)
Annex N (normative)	Definition of equivalent data rates for packet data, PDH/SDH and other signals on the traffic interface
Annex O (normative)	Test report in relation to flexible systems applications
Annex P (informative)	Impact of power control (ATPC and/or RTPC), mixed mode and bandwidth adaptive operation on spectrum mask and link design requirements
Annex Q (informative)	Typical interference sensitivity behaviour for frequency planning purpose
Annex R (informative)	Receiver selectivity evaluation