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Fixed Radio Systems;
Generic definitions, terminology and applicability of essential requirements covering article 3.2 of Directive 2014/53/EU to Fixed Radio Systems

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Foreword

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

Modal verbs terminology

In the present document "**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).

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1 Scope

The present document, is intended for complementing the ETSI EG 203 336 [i.1] for specific guidance related to *Digital Fixed Radio Systems* (DFRS) in the production of candidate harmonised standards covering Directive 2014/53/EU [i.2]. Consequently the present document should always be used in conjunction with ETSI EG 203 336 [i.1] whenever DFRS are concerned.

NOTE: The previous versions of the present document were developed for similar purpose related to the now superseded ETSI EG 201 399 [i.10] V2.1.1 and Directive 1999/5/EC [i.11] repealed in June 2016 by Directive 2014/53/EU [i.2].

The present document identifies, among the generic technical parameters, relevant for the article 3.2 of the Directive, presently quoted by ETSI EG 203 336 [i.1], those which are relevant and applicable and those that are considered not applicable, for the various typologies of DFRS. Taking also into account the general principle of avoiding overregulation, they are justified through specific peculiarities of the DFRS technologies employed.

Moreover it gives the cross reference from the generic terminology used in ETSI EG 203 336 [i.1] and that currently used within the Fixed Radio technical community.

Considerations about technical parameters related to article 3.1 (health, safety and EMC) and article 3.3 (interworking and other special requirements) of Directive 2014/53/EU [i.2] are outside the scope of the present document.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative 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 referenced document (including any amendments) applies.

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

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] ETSI EG 203 336 (V1.2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.2] Directive 2014/53/EU of the European Parliament and of the Council 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.

[i.3] ITU Radio Regulations.

[i.4] Recommendation ITU-R F.1191: "Necessary and occupied bandwidths and unwanted emissions of digital fixed service systems".

[i.5] Recommendation ITU-R F.1399: "Vocabulary of terms for wireless access".

[i.6] ETSI EN 301 390: "Fixed Radio Systems; Point-to-point and Multipoint Systems; Unwanted emissions in the spurious domain and receiver immunity limits at equipment/antenna port of Digital Fixed Radio Systems".

[i.7] CEPT/ERC Recommendation 74-01 (May 2019): "Spurious Emissions".

[i.8] ETSI EN 302 217-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview, common characteristics and system-independent requirements".

[i.9] ETSI EN 302 217-4: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4: Antennas".

[i.10] ETSI EG 201 399 (V2.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".

NOTE: Version under Directive 1999/5/EC [i.11], superseded, for use under Directive 2014/53/EU [i.2], by preliminarily version V3.1.1 and finally by ETSI EG 203 336 [i.1].

[i.11] 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.

NOTE: Repealed by Directive 2014/53/EU [i.2].

[i.12] ETSI EN 302 326-3: "Fixed Radio Systems; Multipoint equipment and antennas; Part 3: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for Multipoint Radio Antennas".

NOTE: HS under Directive 1999/5/EC [i.11] and no longer needed for covering Directive 2014/53/EU [i.2]. At the moment of publication of the present document, the EN is under revision as a not HS EN.

[i.13] Electronics Notes: "What is Reciprocal Mixing: measurement & specification".

NOTE: Available at https://www.electronics-notes.com/articles/radio/radio-receiver-sensitivity/reciprocal-mixing.php.

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

NOTE: The definitions hereby identified are generally used in the present document with the use of *italic characters* (e.g. *dedicated antenna*).

active antenna: antenna that contains active electronic components independently from their directional characteristics

air interface interoperability: capability of DFRS terminals from different manufacturers can be connected as terminals of the same P-P radio link or the same P-MP cell

NOTE: It requires standardization of the physical radio layer (e.g. modulation format, digital codings, synchronization procedures, etc.) and part or all of the higher network layers protocols.

backhauling network: part of fixed network interconnecting the Base Stations (BS) of a mobile network, collecting/distributing data traffic from/to those BS to/from core network access points

NOTE 1: In various mobile systems standardization organization terminologies, specific links in the backhauling networks can be identified with different terms (e.g. backhaul, midhaul or fronthaul) depending on the specific structure of the mobile BSs.

NOTE 2: Various backhauling network structures are possible (e.g. links interconnected in chains, trees or rings).

bandwidth adaptive systems: From ETSI EN 302 217-1 [i.8]: *"System, the capacity of which may be dynamically changed by means of bandwidth reduction during adverse propagation conditions"*.

dedicated antenna: From ETSI EN 302 217-1 [i.8]: "*Antenna specifically designed for being attached to the radio equipment (i.e. with special mechanical fixing to the antenna port of the specific radio supplied), but can be separated from the equipment (typically for transport purpose) using normal tools"*.

Digital Fixed Radio Systems (DFRS): Point-to-Point (P-P) or Point-to-MultiPoint (P-MP) or MultiPoint-to-MultiPoint (MP-MP) radio equipment, which may be used in fixed locations as part of public or private networks in the core, backhauling or access segments

NOTE 1: It is equivalent to the ITU-R definition of Fixed Wireless Systems (FWS) and comprises Fixed Wireless Access (FWA) systems and, in specific cases, their optional extension to Nomadic Wireless Access (NWA) (see note 3).

NOTE 2: The two latter generically identified as MultiPoint (MP) systems.

NOTE 3: NWA systems are defined in Recommendation ITU-R F.1399 [i.5] as (quoting from it) *"Wireless access application in which the location of the end-user termination may be in different places but it must be stationary while in use"*.

essential parameter: radio frequency characteristic related to the essential requirements under article 3.2 of Directive 2014/53/EU [i.2] capable of being expressed in terms of quantifiable technical parameters

frequency tolerance: From Radio Regulations [i.3] article 1.151: *"The maximum permissible departure by the centre frequency of the frequency band occupied by an emission from the assigned frequency or, by the characteristic frequency of an emission from the reference frequency"*.

harmonized radio frequency band: commonly referred as a portion of the frequency spectrum that CEPT/ECC and/or European Commission (EC) allocates to a specific service through CEPT/ECC and/or European Commission (EC) Decision

NOTE: It should be noted that, presently, no radio frequency band allocation to Fixed Service is harmonized.

integral (integrated) antenna: From ETSI EN 302 217-1 [i.8]: *"Antenna which is declared as part of the radio equipment by the manufacturer; it is not physically separable from the equipment, unless it is returned to the manufacturer premises"*.

mixed-mode system: From ETSI EN 302 217-1 [i.8]: *"System having the capability for stations to operate, according network and operator needs (e.g. according propagation variations), on different modulation orders and/or different error correction coding, switching dynamically between them within the same assigned radio frequency channel, adapting the system capacity accordingly (multirate operation)"*.

Out-Of-Band (OOB) domain: From Radio Regulations [i.3] article 1.146A: *"The frequency range, immediately outside the necessary bandwidth but excluding the spurious domain, in which out-of-band emissions generally predominate. Out-of-band emissions, defined based on their source, occur in the out-of-band domain and, to a lesser extent, in the spurious domain. Spurious emissions likewise may occur in the out-of-band domain as well as in the spurious domain"*.

radio equipment: From Article 2 of Directive 2014/53/EU [i.2]: *"Radio equipment means an electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination"*.

reference mode (reference spectral efficiency class and *channel separation*): From ETSI EN 302 217-1 [i.8]: *"In mixed-mode systems, it identifies the operative mode, which characteristics (i.e. system capacity, spectral efficiency class over a given channel separation) are used (i.e. declared in the licensing process) in the link per link coordination analysis (see note)"*.

NOTE: It provides the reference availability objective commonly used for the whole network (i.e. the typical 99,99 % or any other generally used by the administration concerned for the frequency coordination of licensed P-P links). When also *bandwidth adaptive* operation is active, the *reference mode* is always related to the widest *channel separation* used.

spurious domain: From Radio Regulations [i.3] article 1.146B: *"The frequency range beyond the out-of-band domain in which spurious emissions generally predominate"*.

stand-alone antenna: From ETSI EN 302 217-1 [i.8]: *"Antenna designed independently from the fixed radio equipment, by the same or a different manufacturer and connected to the radio equipment in the field through standard cables or waveguide"*.

unwanted emissions: From Radio Regulations [i.3] article 1.146: *"Consist of spurious emissions and out-of-band emissions"*.

3.2 Symbols

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

dBi	deciBels relative to isotropic radiator
GHz	GigaHertz

3.3 Abbreviations

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

ACM	Adaptive Code and Modulation
ATPC	Automatic Transmission Power Control
BEM	Bloch Edge Mask
BER	Bit Error Ratio
CEPT	Conférence Européenne des administrations des Postes et des Télécommunications (European Conference of Postal and Telecommunications administrations)
CS	Channel Separation
CW	Continuous Wave
DFRS	Digital Fixed Radio Systems
EC	European Commission
ECC	European Communication Committee
EIRP	Effective Isotropic Radiation Power
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunication Committee

NOTE: Now renamed ECC.

EU	European Union
FDMA	Frequency Division Multiple Access
FH	Frequency Hopping
FS	Fixed Service
FWA	Fixed Wireless Access
FWS	Fixed Wireless Systems
GSM	Global System Mobile
HS	Harmonised Standard
LBT	Listen Before Talk
LO	Local Oscillator
MP	MultiPoint

NOTE: Term including both P-MP and MP-MP.

MP-MP	MultiPoint-to-MultiPoint
NWA	Nomadic Wireless Access
OOB	Out-Of-Band
P-MP	Point-to-MultiPoint
P-P	Point-to-Point
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
R&TTE	Radio equipment and Telecommunications Terminal Equipment
RF	Radio Frequency
RFC	Remote Frequency Control
RPE	Radiation Pattern Envelope
RSL	Received Signal Level
RTPC	Remote Transmit Power Control
TCAM	Telecommunication Conformity Assessment and Market surveillance committee
TDMA	Time Division Multiple Access
TPC	Transmission Power Control

WG TM4	Working group TM4 of ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (TC ATTM)
XPD	X(cross) Polar Discrimination

4 General principles

The objective of a harmonised standard covering Directive 2014/53/EU [i.2] for DFRS is to define clear and unambiguous provisions for fulfilling the essential requirements referred in that Directive, which are applicable to the system concerned.

To aid the ETSI Technical Bodies in the production of candidate harmonised standards, ETSI produced the ETSI EG 203 336 [i.1] that expands the general concepts of essential requirements into a more detailed subdivision and gives guidance for identifying the technical parameters relevant to the essential requirement under consideration.

However, particularly in the parts that refer to article 3.2 *"… effectively uses and supports the efficient use of radio spectrum …"* of the Directive 2014/53/EU [i.2], ETSI EG 203 336 [i.1] uses terminology and concepts that, when applied to a specific family of radio systems such as the Fixed Radio, proves to be still too generic; therefore further guidance, more technically based on the technology and terminology used by the relevant technical community, is reported in the present document. Therefore the present document should always be used in conjunction with the ETSI EG 203 336 [i.1] whenever Fixed Digital Radio Systems (DFRS) are concerned.

Whenever a technical parameter mentioned in ETSI EG 203 336 [i.1] is partially or not applicable for DFRS, technical justifications is also given.

5 Application of technical parameters in ETSI EG 203 336 to DFRS

5.0 Introduction

The content of the present document follows the guidance structure of ETSI EG 203 336 [i.1], clause 5. For each technical parameter considerations are given on the applicability, DFRS based requirement identification (terminology) and other useful background is given.

5.1 DFRS which do not require *air interface interoperability*

From the guidance given by the ETSI EG 203 336 [i.1], a more detailed applicability to DFRS of transmitter, receiver and other parameters related to essential requirements may be derived as shown in table 1.

Table 1: Essential requirements and parameters relevant to DFRS which do not require *air interface interoperability*; related background and terminology for parameters reported in ETSI EG 203 336 [i.1]

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
3.2 (transmitting)	(A) 5.2.2) Transmitter Power limits and (B) 5.2.3) Transmitter Power accuracy	Transmitter power have different impact on the use of the spectrum depending on the regulatory regime in the operating band (e.g. link-by-link licensing, block assignment, light licensing or license exempt) and type of DFRS systems permitted (e.g. P-P and/or P-MP). According to these distinctions different approaches to the relevant technical parameters should be adopted: **1) LINK-BY-LINK LICENSED BANDS:** **Requirement:** From Directive 2014/53/EU [i.2] assessment point of view, harmonised standards define only the maximum output power, in terms of either EIRP or power density (usually that in articles 21.3 and 21.5 of Radio Regulations [i.3]). Other specific bands limitations in other articles and some footnotes of Radio Regulations [i.3] (sometimes implying antenna azimuth angles limitation are generally fixed on link-by-link license. **Rationale:** In practice, a radio system, within those limits, may be designed in order to transmit, with suitable power setting methods, the appropriate transmission power to fulfil the performance, availability and interference requirements for which it is designed. In actual links deployment, the link-by-link planning process would define the actual power needed for that specific link (in terms of nominal EIRP, based on the needed antenna gain) for fulfil the required QoS and maintain the planned interference levels to nearby links. Therefore from the essential requirements point of view, relevant is the power variation on the nominal activation (licensed) value (including ATPC effects), within Remote and/or Automatic Transmit Power Control (RTPC/ATPC) ranges, if any, to guarantee stable frequency co-ordination. **2) BLOCK ASSIGNMENT:** **Requirement:** From Directive 2014/53/EU [i.2] assessment point of view, equipment operating in this regulatory regime is not different from the previous case. **Rationale:** It should be noted that, in most cases, the block assignment, for P-P, is used in some countries as alternative to link by link licensing, while for P-MP is the most common method. In this case there is no link-by-link power limitation, which will eventually be decided by the block owner itself; however, the block usage rules may define maximum in-block and out-of-block (e.g. BEM) power limitations; these are not intended "technical requirements" for Directive 2014/53/EU [i.2] assessment, but "licensing conditions".	A1) Transmitter maximum power and EIRP A2) Transmitter combined power output and EIRP limits B) Transmitter output power environmental variation	Y NOTE: Requirements A1) and B) in all cases. A2) Additional requirement only in bands where link by link planning is not the unique licensing method

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
		3) LICENSE EXEMPT OR LIGHT LICENSING: **Requirement:** From Directive 2014/53/EU [i.2] assessment point of view, harmonised standards define the maximum output power, in terms of either EIRP or power density generally defined by the applicable regulatory instruments (European Commission (EC) Decision and/or ECC Decision or ECC Recommendations). Moreover, ETSI WG TM4 may define additional limitations (e.g. in terms of power and antenna directivity) necessary for improving, in average, the efficient use of the band in dense network deployment. **Rationale:** These band access methods are typically used in some specific bands. In general, those bands, when harmonisation is sought, are regulated through EC Decisions and/or ECC Decisions or ECC Recommendations, which give emission limits and other requirements for accessing the band; no further specific coordination is applied among different users. NOTE: However, in some bands, different licensing conditions are applied by different EU administrations.		
3.2 (transmitting)	5.2.4) Transmitter Spectrum mask	Common practice for DFRS is to define a mask for spectral density relative to actual centre frequency ranging up to 2,5 times of the actual radio-frequency channel separation (see note 2 in last column), from which adjacent channel interference may be derived in conjunction with the receiver sensitivity to like-interference. Spectrum mask is the main tool to control interference to other like systems operating in adjacent channels as well as, when deployed close to the band boundary, to other systems in adjacent bands. For this reason also other factors possibly affecting the interfering potential should be considered as follows: • interfering power from discrete spectral lines additional to the integrated density power of the mask; • potential impact on spectrum mask due to automatic controls on the output frequency and power.	1) Transmitter Radio Frequency spectrum mask 2) Transmitter discrete CW components at the symbol rate 3) Transmitter (other) discrete CW components exceeding the transmitter spectrum mask limit 4) Transmitter power and frequency control (RTPC/ATPC and RFC)	Y NOTE 1: The spectrum mask for DFRS is extended over the whole *OOB domain*; therefore, it is alternative to limits of *unwanted emissions* in the *OOB domain.* NOTE 2: In cases where channel separation is not defined, the Occupied Bandwidth (defined for FS systems in Recommendation ITU-R F.1191 [i.4]) is used as CS alternative. NOTE 3: Possibly covered also by alternative spectrum mask method

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
		Adjacent allocated band(s) emission limitations. In bands where no specific channel arrangements are defined, or guards bands at the band edges are not provided or are of very limited size; wide band emissions at the band edge might generate sensible *unwanted emission* spill-over into adjacent bands; it should be suitable limited. In some cases, EC Decisions or ECC Decisions or Recommendations directly provide limits of all *unwanted emissions* (either in *OOB domain* only or also in the *spurious domain*) that falls in adjacent bands for the protection of particularly sensitive systems with primary allocation in that adjacent band. These limits are also considered relevant from Directive 2014/53/EU [i.2] point of view.	Transmitter emissions limitations outside the allocated band	Y NOTE: When the need is identified.
3.2 (transmitting)	5.2.5) Transmitter Frequency stability	Frequency deviation from the nominal assigned/selected channel centre frequency. NOTE: The Radio Regulations [i.3] defines this parameter as "*Frequency tolerance*"; it is assumed that Radio Regulations terminology prevails on the ETSI one.	Transmitter Radio Frequency tolerance	Y
3.2 (transmitting)	5.2.6) Transmitter Inter-modulation attenuation	DFRS commonly use non-reciprocal passive circuits (e.g. isolators) at transmitter output for guaranteeing the required return loss and for preventing intermodulation phenomena on the final active power devices of transmitter. The output power of DFRS is commonly rather low, therefore also any intermodulation produced by these non-reciprocal devices is irrelevant. Moreover DFRS antennas are passive and usually highly directive; the expected interference from other DFRS systems sharing the same network area re-entering from the antenna port is very low. Therefore this parameter has never been considered relevant. However in case of systems that will eventually adopt *active antennas* this parameter may become relevant and should be further studied and eventually defined to comply with Directive 2014/53/EU [i.2].	To be defined whenever necessary	Y (*active antennas* only N (all other cases)
3.2 (transmitting)	5.2.7.2) Transmitter Unwanted emissions in the out-of-band domain	Emission limitations in the *OOB domain*. When relevant, also the "Emissions limitations outside the allocated band" is retained relevant.	See row 5.2.4 (see note) for Transmitter Spectrum mask	NOTE: The 5.2.4 refers to the cell in the second column of the present table. All OOB emissions are covered within that row; no need to repeat again.
3.2 (transmitting)	5.2.7.3) Transmitter Unwanted emissions in the Spurious domain	They are relevant as defined by CEPT/ERC Recommendation 74-01 [i.7].	Transmitter unwanted emissions in the spurious domain	Y

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
3.2 (transmitting)	5.2.8) Transmitter Time domain characteristics	Time domain characteristics are e.g. the duty cycle, turn-on and turn-off, frequency hopping cycle, dynamic changes of modulation scheme and others of a transmitter. When relevant, EC Decisions or ECC Decisions or ECC Recommendations may specify such limits. At the time of publication of the present document, no other cases are identified for DFRS operations. NOTE: Dynamic changes of modulation are regulated in DFRS HS through the use of the definitions of "*reference modes*" and the consequent behaviour of "*mixed-mode*" system (see next "transmitter transients").	None	N
3.2 (transmitting)	5.2.9) Transmitter Transients	Transmitters can have dynamic variation in power (e.g. ACM, ATPC, TDMA operation, etc.), frequency (e.g. RFC, FH or FDMA with dynamic "channel" allocation, etc.) or modulation format (adaptive modulation in *mixed-mode* and *bandwidth-adaptive* operation) it is relevant that during these transition the required spectrum parameters (Licensed power, Spectrum mask, frequency tolerance, etc.) should not be exceeded or should be controlled by specific requirements.	– Automatic Transmit Power Control (ATPC) – Transmitter Remote Frequency Control (RFC) – Transmitter dynamic Change of Modulation Order	Y
3.2 (receiving)	5.3.2) Receiver Sensitivity	This parameter is the base on which, through proper frequency co-ordination techniques to assure the efficient use of the spectrum, the required QoS and availability for DFRS in public core and access networks, offering high network performance (e.g. for leased lines), may be assessed and calculated in presence of interference. This parameter is the only system parameter at the receive site, which enables to assess the co-channel rejection and the adjacent selectivity (see below). Also in license exempt bands, this parameter, would affect the level of transmitted power for keeping suitable QoS; better values would permit, in average, reduction of interference situation with consequent improved efficiency in the use of the band.	BER as a function of receiver input signal level (RSL)	Y
3.2 (receiving)	5.3.2.3) Desensitization	Desensitization is a degradation of the receiver sensitivity caused by the presence of an unwanted signal. As such, it is considered the "gauge", on which basis the interference performances of receiver are defined. In DFRS desensitisation is a fixed quantity (e.g. 1 dB or 3 dB) in each C/I test; therefore, it is not considered a receiver parameter in itself.	NONE	N

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
3.2 (receiving)	5.3.3) Receiver Co-channel rejection	In link-by-link licensed bands this parameter is required to define the amount of frequency reuse still assuring the required QoS for fixed radio in communication networks (e.g. in a nodal station or in systems on a geographical area). Also in all other cases this parameter defines the ability of the systems to support interference; better values would improve interference situation with consequent improved efficiency in the use of the band. Therefore this parameter is relevant for from Directive 2014/53/EU [i.2] point of view to ensure the efficient use of the spectrum. The actual performance is described in terms of Bit/block Error Ratio (BER) threshold degradation.	Receiver Co-channel interference sensitivity	Y
5.3.4	**Receiver Selectivity**			
3.2 (receiving)	5.3.4.1) General	Receiver selectivity is a generic concept that should be tailored to the specific radio application in order to provide "*efficient use of the spectrum*" and "*protect its level of performance against the risk of harmful interference*". Therefore, the assessment should be based on the "performance" of the radio system, which, for fixed radio systems, is generally based on evaluation of BER under specific propagation situation (through the properly designed link fade margin). Such performance should be maintained under suitable (i.e. representing the expected situation in field) interference scenario. Therefore, all selectivity-related characteristics are described in terms of receiver threshold degradation (desensitization) under specific C/I ratio at various representative frequency offset near and far from the operating frequency. A "selectivity" figure could be extrapolated by the difference between the performances, at the same desensitization degree of threshold degradation, of required co-channel C/I and the C/I required at other representative frequencies.		
3.2 (receiving)	5.3.4.2.1) Receiver Adjacent channel selectivity	In link-by-link licensed bands this parameter is required for frequency co-ordination among different DFRS operated in the same geographical area by network operators (e.g. more than one). It defines the amount of frequency separation (e.g. at P-P nodal stations) or the amount of geographical separation (e.g. in MP systems deployment) for adjacent channel, still assuring the required QoS for DFRS in communication networks. Therefore this parameter is relevant from the Directive 2014/53/EU [i.2] point of view to ensure the efficient use of the spectrum.	1) Receiver first adjacent channel interference sensitivity 2) Receiver second adjacent channel interference sensitivity	Y NOTE: When receiver intermodulation requirement is also identified, the 2nd adjacent channel requirement (2) may be combined with a unique limit.
3.2 (receiving)	5.3.4.2.2) Receiver adjacent band selectivity	This requirement is present when EC or ECC Decisions or Recommendations specify the level of selectivity on interfering signal from transmitters of different service/applications operating in the band(s) adjacent to that allocated to the Fixed Service. At the moment of publication of the present document, no such requirements are present.	To be defined when necessary	N Unless specific requirement is defined by EC or ECC

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
3.2 (receiving)	5.3.4.4) Receiver Spurious response rejection	This parameter is complementary to the next (blocking) dealing only with specific frequency(ies) response that may have been excluded from it due to different sensitivity than the generic rejection capability required under the "blocking". It is "optional" but relevant if there are frequencies specifically identified (e.g. a known interference at a specific frequency and level such as image(s) or harmonic) not respecting the previous "blocking " requirement and mentioned here.	To be defined when necessary	N (unless identified by the relevant EN)
3.2 (receiving)	5.3.4.3) - Receiver Blocking	This parameter is relevant for showing the receiver capability of supporting interference, at any frequencies outside an exclusion bandwidth, with a level reasonably higher than its sensitivity level. Therefore it is relevant also for the Directive 2014/53/EU [i.2]. Clause 7 "Receivers immunity at antenna port" of ETSI EN 301 390 [i.6] contains technical requirements valid for all P-P and MP systems as well as the exclusion bandwidth and the frequency range of assessment.	Receiver Blocking (CW Spurious Interference sensitivity)	Y
3.2 (receiving)	5.3.4.5) Radio frequency Inter-modulation	This parameter covers the receivers capability of rejecting (withstanding) more than one interfering signals, spaced by two or several channels that may possibly create 3rd order intermodulation products which fall in band of the main receive signal. This parameter is not relevant for systems which foresee multichannel branching with relatively narrow RF filters for each channel; it may be relevant only for systems with an RF duplexer pass-band relatively large compared to the RF-channel bandwidth. However, this parameter is understood as derived from mobile systems requirements, where the receivers have to withstand a large amount of unwanted adjacent channel signals (interferer) due to relatively wide band RF-filtering (e.g. in portable terminals) in conjunction with antennas having poor (i.e. lower than about 30 dBi) or no directivity at all, resulting in relatively high interference level into the receiver, and where the interference scenario is continuously changing with possible danger of random blocking because of intermodulation among adjacent carriers. On the contrary, the interference scenario for P-P DFRS is stable in the time and antennas are directive (gain lower than about 30 dBi are not practical), resulting in spatial directivity equivalent to a narrow band RF filter and, therefore, in relatively low level of multiple interference into the receiver (usually confined within assessed levels for blocking requirement) and all possible interference are of different levels, with one of them predominant in level over the others. Therefore, for P-P it is commonly considered not essential unless for specific cases presently not identified.	Receiver radio-frequency intermodulation	N For P-P (Common choice) Y for MP (see note). NOTE: When appropriate combined with second adjacent channel interference sensitivity.

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
3.2 (receiving)	5.3.5) Receiver Unwanted emissions in the spurious domain	They are relevant as defined by CEPT/ERC Recommendation 74-01 [i.7].	Receiver Unwanted emissions in the spurious domain	Y
3.2 (receiving)	5.3.6.1) Receiver dynamic range	The lower end of this range is normally the sensitivity of the receiver. The upper end of a receiver's dynamic range determines how strong a received signal can be before producing degradation due to overloading. P-P receivers are deployed in a manner that results in a situation where it is impossible to receive a wanted signal that is high enough to produce any overloading effect. MP stations receivers might be deployed at random distance from the corresponding transmitter station; therefore, the manufacturer usually establish a minimum practical distance and/or adaptive measures (e.g. RTPC/ATPC) for avoiding such effects.	Receiver dynamic range	N For P-P Y For MP
3.2 (receiving)	5.3.6.2) Reciprocal mixing	Reciprocal mixing occurs when the phase-noise sidebands of the receiver Local Oscillator (LO) mix with an high level interfering signals at distances from wanted signal comparable to the LO offset range where phase noise is higher than the thermal noise (i.e. from few hundreds Hz to few MHz) converting unwanted noise at the frequency of the receiver. See background in the in Electronics Notes [i.13]. In modern DFRS receivers the LO phase noise required for the high QAM formats commonly used is very low; therefore, reciprocal mixing effects are considered negligible. In any case, reciprocal mixing effects is implicitly covered in HS by comprehensive interference requirements in term of C/I tests; in fact, the results of such C/I tests are implicitly affected also by reciprocal mixing effect, if any.	None	N NOTE: Covered by 1st adjacent C/I test.

Essential Requirement	Technical parameters (clause in ETSI EG 203 336 [i.1])	Relevance as standardized parameter for DFRS	Alternative WG TM4 requirements terminology	Essential parameter Y=yes N=no and notes
5.4	**Protocol elements: interference mitigation techniques and type of modulation**			
3.2 (Protocol elements. interference mitigation techniques and type of modulation)	5.4.2) Transmitter Power Control (TPC)	At the time of publication of the present document no EC Decisions or ECC Decisions or Recommendations impose automatic TPC (ATPC) for DFRS systems. Whenever this would happen, or in particular cases where the DFRS experts would consider appropriate for improving spectrum utilization in some bands (typically for uncoordinated use), specific ATPC operation would be relevant and included in the HS. Also, in MP systems ATPC might be implemented for managing the receiver dynamic range requirement derived from the foreseen minimum receiver distance from the corresponding transmitter.	See ATPC in row 5.2.9 (see note) for Transmitter Transients	Y (specifically identified cases) NOTE: The 5.2.4 refers to the cell in the second column of the present table
	5.4.3) Listen Before Talk (LBT)	This parameter may be relevant only in case sharing procedure is required by relevant EC Decisions or ECC Decisions or Recommendations for enabling the transmission in not co-ordinated frequency bands. In other cases may be relevant only in case of standardized radio frequency interface for interoperability of equipment from different manufacturers (e.g. GSM-like *air interface interoperability*), presently not foreseen by TM4 standards. At the time of publication of the present document this is not required by any EC Decisions or ECC Decisions or Recommendations for any DFRS application.	Interference avoidance requirement	Y (for systems requiring sharing procedure) N (all other cases)
	5.4.4) Operation under the control of a network	Only MP systems provides network control protocols for proper terminals operation; however, having no *air interface interoperability* and operating in block assignment to unique user, they are left to manufacturer responsibility only and there is no need to include them in HS.	None	N
3.2 (antennas)	5.5 Antennas	See clause 5.3 in the present document.		

5.2 DFRS which do require *air interface interoperability*

Presently, no such cases are foreseen in any ETSI standard for DFRS.

Whenever required, detailed analysis, beyond the parameters relevant for general frequency co-ordination purpose eventually reported in table 1, is left for future study.

5.3 DFRS Antennas

5.3.1 General

ETSI EG 203 336 [i.1], clause 5.5 states that *"For other equipment that* contains an *integral antenna* or is supplied with a *dedicated antenna*, *the TB should consider whether radiated and/or conducted requirements are appropriate"*.

Where the antenna is supplied separately from the radio equipment, Technical Bodies should not include antenna characteristics in the Harmonised Standard.

If the ETSI Technical Body decides to standardize the characteristics of antennas, these may be included a non-harmonised EN or other ETSI deliverable.

5.3.2 P-P antenna parameters in HS

5.3.2.1 General approach

From the considerations in clause 5.3.1, antenna parameters play a significant role for P-P DFRS conformity to essential requirements under article 3.2 of Directive 2014/53/EU [i.2]. However, in the DFRS market two cases are possible:

1) Radio equipment and antenna are provided by the radio equipment manufacturer as an *integral/integrated* or *dedicated antenna* product.

2) Radio equipment and antennas are produced and placed on the FS market as separate stand-alone products by specialized suppliers; the end user may purchase such antenna and its integration with the radio equipment is directly made on the radio station through RF cables or waveguides, outside the radio equipment manufacturer control.

For analysing the essentiality or not of FS antenna parameters with respect to Directive 2014/53/EU [i.2] article 3.2 requirement, the following consideration apply:

- Following Directive 2014/53/EU [i.2], article 2 definition of radio equipment, a *stand-alone antenna* is considered an "accessory" of the radio equipment.
- Therefore, FS *stand-alone antennas* are not within the scope of Directive 2014/53/EU [i.2]. However, if these antennas do not fulfil the appropriate technical requirements, there could be an increased risk of harmful interference and a reduced level of efficient spectrum use.
- A number of provisions within Directive 2014/53/EU [i.2] (e.g. article 10.8, article 18.2 and Annex VI.8) require that radio manufacturers should define and inform the end user of the relevant technical characteristics of any accessory *"which allow the radio equipment to operate as intended"*.
- Therefore, whenever antennas technical parameters are considered necessary, the HS should also contain the necessary guidelines for *stand-alone antennas*; e.g. listing antennas conforming to ETSI EN 302 217-4 [i.9] as the only possible antenna "accessory" fulfilling essential requirements in article 3.2 of Directive 2014/53/EU [i.2].

5.3.2.2 P-P antenna parameters in HS

In the case where the radio is supplied with either an *integral/integrated* or *dedicated antenna* then the following parameters should be defined within the HS:

- Radiation Pattern Envelope (RPE):
  - RPE describes the directional attenuation with respect to the bore sight direction and is the basis for all DFRS networks planning. Different RPE classes are usually provided.
- Gain (boresight direction):
  - In bands where link-by-link licensing is generally applied, the absolute value of this parameter is not deemed essential under Directive 2014/53/EU [i.2]. However, as antenna gain is required for the frequency co-ordination process in order to evaluate the link EIRP (associated to the absolute transmitter power) the value is usually determined during the link design phase.
- Cross-Polar Discrimination (XPD):
  - XPD is relevant for frequency co-ordination in link-by-link licensed frequency bands, Furthermore this parameter is important, in LoS links operation, to ensure the efficient use of the spectrum because the relatively high XPD of DFRS antennas would permit the crosspolar frequency reuse also for more sensitive high efficient modulation formats. Consequently, in most bands it is considered relevant from Directive 2014/53/EU [i.2] point of view.

5.3.3 MP antenna parameters in HS

Provided that MP systems are predominantly deployed under "block assignment license" to a single operator, the maximization of spectrum usage is left to the owner of the block and might be pursued in various manner, including proprietary passive and active antennas (see note). It will not affect other operators eventually protected at the block edge by the block license rules.

NOTE: It is reminded that when active antenna are used, other requirements (e.g. spectrum masks and spurious emissions should be in any case respected).

Therefore MP antenna parameters are not considered an essential characteristic for the MP system.

However, ETSI EN 302 326-3 [i.12] still contains characteristics of a number of passive MP antennas (directional, sectorial and omnidirectional) that can be used as reference whenever needed for administrative or technical purpose.

Annex A:
Change History

Version	Major variants with respect to previous version
1.1.1	First Publication following the entering into force of Directive 1999/5/EC. Based on ETSI EG 201 399 guidelines.
1.2.1	Revision including clarification on antenna parameters relevance and certification procedure following several TCAM discussion and decision on the antenna treatment under the Directive 1999/5/EC.
2.1.1	Overall updating due to entering into force of Directive 2014/53/EU repealing Directive 1999/5/EC. Based on ETSI EG 203 336 V1.1.1 guidelines.
2.2.1	Further updating for alignment to new version V1.2.1 of ETSI EG 203 336 and resolution to EC comments on poor justification/description for some parameters.

History

Document history		
V1.1.1	January 2000	Publication
V1.2.1	May 2008	Publication
V1.3.1	January 2010	Publication
V2.1.1	July 2016	Publication
V2.2.1	September 2020	Publication