

ECC Recommendation (23)01

Cross-border coordination for Railway Mobile Radio (RMR)
in the 1900-1910 MHz TDD frequency band

approved 16 June 2023

INTRODUCTION

Following the harmonised technical conditions for the frequency band 1900-1910 MHz for Railway Mobile Radio (RMR) defined in ECC Decision (20)02 [11] and Commission Implementing Decision (EU) 2021/1730 [12], this Recommendation contains provisions for cross-border coordination between RMR networks in this frequency band in order to avoid harmful interference.

RMR encompasses GSM-R and its successor(s), including the Future Railway Mobile Communication System (FRMCS). In the frequency band 1900-1910 MHz, only Wideband systems operate.

This Recommendation covers RMR Wideband (WB) vs. Wideband systems cross-border coordination scenarios but does not address cross-border coordination of RMR vs. other systems in this band.

Cross-border coordination between GSM-R Networks in the 900 MHz frequency band is covered by ECC Recommendation (05)08 [13], while ECC Recommendation (08)02 [14] also deals with cross-border coordination for RMR in the 900 MHz frequency band, but excluding GSM-R vs. GSM-R.

In this Recommendation, Wideband systems include LTE and NR.

ECC RECOMMENDATION (23)01 OF 16 JUNE 2023 ON CROSS-BORDER COORDINATION FOR RAILWAY MOBILE RADIO (RMR) IN THE 1900-1910 MHZ TDD FREQUENCY BAND

“The European Conference of Postal and Telecommunications Administrations,

considering

- a) that Railway Mobile Radio (RMR) encompasses GSM-R and its successor(s), including the Future Railway Mobile Communication System (FRMCS);
- b) that ECC Decision (20)02 [11] and Commission Implementing Decision (EU) 2021/1730 [12] provide the harmonised technical conditions for RMR in the frequency bands 874.4-880 MHz / 919.4-925 MHz and 1900-1910 MHz, in the context of the railway interoperability principle;
- c) that RMR for the purpose of this Recommendation includes IMT technologies;
- d) that ECC Report 353 [15] provides guidelines on “Cross-border coordination and synchronisation for RMR networks in the 1900-1910 MHz TDD band”;
- e) that, for the purpose of this Recommendation, the following definitions as per ECC Report 353 apply:
 - An agreement is a legally binding set of technical conditions that have been concluded between national administrations, with the purpose of avoiding interferences in areas across a national border. It may contain permission to establish operator arrangements;
 - An arrangement is a plan agreed between parties (i.e. RMR operators) covering a set of technical conditions that have the purpose of allowing optimised usage of the radio spectrum by each party for radio coverage across country borders and/or in a border area. Such arrangements may have to be under administrations review. In that case, it is anticipated that those arrangements shared with administrations would not have to systematically be formally approved by them. However, administrations may choose to do so on a case-by-case basis or depending on their national policy. Those arrangements shall be approved by all operators in the area potentially affected by field strengths above the coordination trigger field strength (CTFS) value, as defined in ECC Report 353.
- f) that railway lines may cross borders and need to be operated seamlessly, which may result in the need to extend RMR network coverage within the neighbouring country to assist service continuity;
- g) that synchronised operation means that no simultaneous uplink and downlink transmissions occur between any pairs of cells which may interfere with each other in the same band. It requires stakeholders to agree both on a common primary reference time clock (PRTC) with a given accuracy and on compatible frame structures;
- h) that MFCN cross-border coordination has shown that synchronised operation of TDD networks often enables a higher degree of efficient spectrum utilisation, while unsynchronised operation of TDD networks may imply a need for large separation distances in border areas (ECC Report 296 [2] and ECC Report 331 [1]);
- i) that, compared to MFCN, a RMR network may exhibit more diversity in the traffic patterns and UL/DL needs, therefore a higher degree of spectrum utilisation may be achieved in some cases by enabling some degree of flexibility at the local level provided that an RMR arrangement has been agreed by all involved RMR operators;
- j) that there is a need to define reference TDD parameters for synchronised operation for stakeholders to deploy RMR networks in border areas not covered by an RMR arrangement. RMR networks that are compliant with those reference TDD parameters will be assumed to be in synchronised operation regardless of the deployment status of RMR networks on the other side of the border;
- k) that, in the context of RMR, the purpose of coordination trigger field strength is to identify the relevant RMR radio sites where detailed evaluations of the interference potential need to be performed;
- l) that, in the context of RMR, only non-AAS base stations are covered by this Recommendation;
- m) that different administrations may wish to adopt different approaches to cross border coordination;
- n) that administrations may diverge from the technical parameters, propagation models and procedures described in this Recommendation subject to bilateral / multilateral agreements;
- o) that in the case of operator arrangements, it is possible to deviate from this Recommendation;

- p) that Physical-layer Cell Identity (PCI) coordination is necessary for LTE/NR systems to avoid unnecessary signalling load and handover failures;

recommends

1. that cross-border coordination between RMR networks in border areas should be based on bilateral / multilateral agreements between administrations;
2. that bilateral / multilateral agreements should define coordination methods which encompass all RMR networks present on each side of the border;
3. that a “coordination trigger field strength” (CTFS) is defined in Annex 1, based on results for the required isolation between a victim system at the border and an unsynchronised system on the other side of the border;
4. that in absence of a specific RMR arrangement, the reference TDD parameters for synchronised operation given in Annex 5 shall be used as a fallback;
5. that cross-border coordination between RMR networks not covered by a specific RMR arrangement should be based on the field strength limits provided in Annex 1;
6. that interference field strength predictions for RMR networks should be made using the appropriate propagation models defined in Annex 2;
7. that if the CTFS levels in Annex 1 are exceeded, coordination is required and the procedure detailed in Annex 3 should be used;
8. that coordination between neighbouring RMR networks using LTE/NR technology in border areas should use preferential PCIs provided in Annex 4 when synchronisation signal centre frequencies are aligned;
9. that administrations should encourage and facilitate the establishment of RMR arrangements between RMR operators in their own country and in neighbouring countries with the aim to enhance the efficient use of the spectrum and to optimise the coverage and/or capacity in their respective border areas and/or to provide coverage across the border for the sake of railway interoperability;
10. that this Recommendation should be reviewed within five years of its adoption in the light of practical experience of its application and of the operation of RMR networks.”

Note:

Please check the Office documentation database <https://docdb.cept.org/> for the up to date position on the implementation of this and other ECC Recommendations.

ANNEX 1: FIELD STRENGTH LEVELS FOR THE CROSS-BORDER COORDINATION BETWEEN RMR TDD SYSTEMS

In this annex, field strength values are given for cross-border scenarios of wideband vs wideband RMR networks.

A1.1 UNSYNCHRONISED OPERATION AND COORDINATION TRIGGER FIELD STRENGTH

Base stations of unsynchronised RMR TDD networks (e.g. with non-compatible frame structures and/or without common phase clock reference) on both sides of the borderline in the frequency band 1900-1910 MHz for all PCIs may be used without coordination with a neighbouring country if the field strength of each cell produced by the base station does not exceed a value of:

- 0 dB μ V/m/(5 MHz) at a height of 3 m above ground at the borderline between countries.

Table 1 gives an overview of the field strength value.

Table 1: Field strength values at 3 m height for unsynchronised operation

Unsynchronised operation
All PCIs
0 dB μ V/m/(5 MHz) @ 0 km
@ stands for "at a distance from the borderline into the neighbouring country".

The required isolation and corresponding field strength for unsynchronised operation are used to define the coordination trigger.

A1.2 SYNCHRONISED OPERATION

Base stations of synchronised RMR TDD networks on both sides of the borderline in the frequency band 1900-1910 MHz with synchronisation signal centre frequencies not aligned for all PCIs or with synchronisation signal¹ centre frequencies aligned and for preferential PCIs may be used without coordination with a neighbouring country if the field strength of each cell produced by the base station does not exceed the values of:

- 65 dB μ V/m/(5 MHz) at a height of 3 m above ground at the borderline between countries;
- 47 dB μ V/m/(5 MHz) at a height of 3 m above ground at a distance of 6 km inside the neighbouring country.

Base stations of synchronised RMR TDD networks on both sides of the borderline in the frequency band 1900-1910 MHz with synchronisation signal centre frequencies aligned and for non-preferential PCIs may be used without coordination with a neighbouring country if the field strength of each cell produced by the base station does not exceed the value of:

- 47 dB μ V/m/(5 MHz) at a height of 3 m above ground at the borderline between countries.

Table 2 gives an overview of the field strength values.

¹ In this context, "synchronisation signals" refer to the Synchronisation Signal Block (SSB) for NR and Primary/Secondary Synchronisation Signal (PSS/SSS) for LTE as defined in relevant standards, and should not be confused with the general principle of synchronised/unsynchronised operation that is a different concept.

Table 2: Field strength values at 3 m height for synchronised operation

Synchronised operation		
Synchronisation signal centre frequencies aligned		Synchronisation signal centre frequencies not aligned
Preferential PCIs	Non-preferential PCIs	All PCIs
65 dBµV/m/(5 MHz) @ 0 km and 47 dBµV/m/(5 MHz) @ 6 km	47 dBµV/m/(5 MHz) @ 0 km	65 dBµV/m/(5 MHz) @ 0 km and 47 dBµV/m/(5 MHz) @ 6 km
@ stands for “at a distance from the borderline into the neighbouring country”.		

A1.3 FIELD STRENGTH LEVEL CALCULATION AND MEASUREMENT

All field strengths shall be measured on the downlink part of the frame (otherwise any measurement averaged on the whole frame must then be scaled with a factor of $10 \times \log_{10} ((UL+DL)/DL)$, where “DL” and “UL” are the durations of the downlink and uplink part of the frame respectively).

For field strength predictions, the calculations should be made according to Annex 2. In the case of channel bandwidth other than 5 MHz, a factor of $10 \times \log_{10} (\text{channel bandwidth}^2 / 5 \text{ MHz})$, should be added to the field strength levels.

A1.4 GUIDANCE FOR RMR OPERATORS FOR DEPLOYMENT IN BORDER AREAS

This section lists different techniques as a guidance for operators that can be used to reduce the interference across the border. In the context of TDD systems, while these techniques decrease the interference, they may not be sufficient without other interference mitigation solutions such as synchronisation and/or Downlink Symbol Blanking (DSB).

1. Antenna tilting and restricted beamforming

Tilt optimisation of the base station is applicable, where the downtilt of the base station antennas is adjusted such that there is suppression of all signals towards the horizon, thereby reducing the horizontal component of interference to the base stations.

2. Downlink power reduction

Another possible solution could be to reduce the downlink power on the base station sectors which are facing the border or located at sites near the border. One of the main advantages of this technique is that there is less interference radiated across the border. Moreover, since the difference between the uplink and downlink transmit powers is smaller, there is reduced UL/DL imbalance in a cell. The direct consequence of this technique is that the downlink to uplink interference becomes less problematic as there is a smaller area with vulnerable UEs. Also, smaller cells can be deployed closer to the border, providing stronger uplink. Additionally, the performance degradation due to downlink power reduction can be compensated by link adaptation.

3. Minimum inter-cell interference scheduling

The selection of start Physical Resource Blocks (PRB) or Resource Block Group (RBG) in the scheduler can be enhanced to reduce the inter-cell interference. This can be accomplished through restricted or randomised distributed PRB scheduling in uplink or RBG scheduling in downlink.

² not occupied bandwidth

ANNEX 2: PROPAGATION MODELS

The following methods are proposed for assessment of anticipated interference inside a neighbouring country based on established field strength levels. Due to the complexity of radio wave propagation nature, different methods are proposed to be considered by administrations and are included here for guidance purposes only.

It should be noted that the following methods provide theoretical predictions based on available terrain knowledge. It is practically impossible to recreate these methods with measurement procedures in the field. Therefore, only some approximation of measurements could be used to check compliance with these methods based on practical measurement procedures. The details of such approximation are not included in this Recommendation and should be negotiated between countries based on their radio monitoring practices.

A2.1 PATH SPECIFIC MODEL

Where appropriate detailed terrain data is available, the propagation model for interference field strength prediction is the latest version of Recommendation ITU-R P.452 [3]. For the relevant transmitting base station, predictions of path loss would be made at x km steps along radials of y km at z degree intervals. The values for those receiver locations within the neighbouring country would be used to construct a histogram of path loss – and if 10% of predicted values exceed the threshold, the base station shall be required to be coordinated.

Values for x, y and z are to be agreed between the administrations concerned.

A2.2 SITE GENERAL MODEL

If it is not desirable to utilise detailed terrain height data for the propagation modelling in the border area, the basic model to be used to trigger coordination between administrations and to decide if coordination is necessary, is Recommendation ITU-R P.1546-6 [4]. This model is to be employed for 50% locations, 10% time and using a receiver antenna height of 3 m.

For specific reception areas where terrain roughness adjustments for improved accuracy of field strength prediction are needed, administrations may use correction factors according to terrain irregularity and/or an averaged value of the terrain clearance angle (TCA) parameter in order to describe the roughness of the area on and around the coordination line.

Administrations and/or operators concerned may agree to deviate from the aforementioned model by mutual consent³.

A2.3 AREA CALCULATIONS

In the case where greater accuracy is required, administrations and operators may use the area calculation below.

For calculations, all the pixels of a given geographical area to be agreed between the Administrations concerned in a neighbouring country are taken into consideration.

For the relevant base station, predictions of path loss should be made for all the pixels of a given geographical area from a base station and at a receiver antenna height of 3 m above ground.

For evaluation:

- only 10 percent of the number of geographical area pixels between the borderline (including also the borderline) and the 6 km line itself inside the neighbouring country may be interfered by higher field strength than the values given for the borderline in Annex 1 at a height of 3 m above ground;
- only 10 percent of the number of geographical area pixels between the 6 km (including also 6 km line) and 12 km line inside the neighbouring country may be interfered by higher field strength than the values given for the 6 km line in Annex 1 at a height of 3 m above ground.

³ e.g. as used by members of the HCM-Agreement [5]

It is recommended that during area calculations not only detailed terrain data but also clutter data be taken into account. Use of correction factors for clutter is crucial in particular where the border area is 'open' or 'quasi-open' from the point of view of clutter or where the interfering base station is just a few kilometres from a borderline.

If the distance between a base station and a terrain point of a borderline is closer than or equal to 1 km, free space propagation model needs to be applied. Furthermore, if there is no terrain obstacle within the 1st Fresnel zone," also the free space propagation model should be applied.

If clutter data is not available, it is proposed to extend the usage of free space propagation model to a few kilometres, depending on the clutter situation in border areas.

For area type interference calculations, propagation models with path specific terrain correction factors are recommended (e.g. Recommendation ITU-R P.1546 [4] with the terrain clearance angle correction factor TCA, Harmonised Calculation Method (HCM) method with the terrain clearance angle correction factor or Recommendation ITU-R P.1812 [6]).

As to correction factors for clutters 'open area' and 'quasi-open area', 20 dB and 15 dB should be used respectively. Recommendation ITU-R P.1406 [7] should be used if a finer selection of clutter is required. It must be noted that terrain irregularity factor Δh is not recommended to be used in area calculations. Administrations and/or operators concerned may agree to deviate from the aforementioned models by mutual consent.

ANNEX 3: EXCHANGE OF INFORMATION

When requesting coordination, the relevant characteristics of the base station, the code group number and the PCI (physical-layer cell-identity) numbers (in case of a network, e.g. LTE, uses PCI), should be forwarded to the administration and/or RMR operator affected. All of the following characteristics should be included:

1. channel centre frequency (MHz);
2. channel bandwidth (MHz);
3. Name of transmitter station;
4. country of location of transmitter station;
5. geographical coordinates (W/E, N; WGS84);
6. (effective) antenna height (m);
7. antenna polarisation;
8. antenna azimuth (deg);
9. directivity in antenna systems or antenna gain (dBi);
10. effective radiated power (dBW);
11. expected coverage zone;
12. date of entry into service (month, year);
13. PCI numbers used;
14. antenna electrical and mechanical tilt (deg);
15. antenna pattern or envelope;

For synchronised 5G NR TDD networks in the 1900-1910 MHz band, the following characteristics should be included:

16. Frame structure including the special slot "S" configuration (the format at symbol level for slots between downlink and uplink slots);
17. Clock phase, frequency and time synchronisation;
18. Global Synchronisation Channel Number (GSCN).

The administration affected shall evaluate the request for coordination and shall within 30 days notify the result of the evaluation to the administration requesting coordination.

In the course of the coordination procedure an administration may request additional information.

If no reply is received by the Administration requesting coordination within 30 days it may send a reminder to the administration affected. An administration not having responded within 30 days following communication of the reminder shall be deemed to have given its consent and the code coordination may be put into use with the characteristics given in the request for coordination.

The periods mentioned above may be extended by common consent.

ANNEX 4: PHYSICAL-LAYER CELL IDENTITIES (PCI) FOR LTE AND NR

ETSI TS 138 211 [8] defines NR Physical channels and modulation, and that the Physical Cell ID is determined based on PSS/SSS detection.

Administrations should apply sharing of PCIs in border areas, an equitable distribution of 1008 PCIs, for preferential and non-preferential PCIs as proposed in Table 3.

Each country should only use their own preferential PCIs as a result of sharing of PCIs, depending on cross-border co-ordination scenario and interference field strength.

Sharing of PCIs between operators of neighbouring countries should only be applied:

- where channel centre frequencies used in the neighbouring countries are aligned independent of the channel bandwidth, or
- where it is not known whether or not the channel centre frequencies used in the neighbouring countries are aligned, or
- where there is no network in operation in the neighbouring country,

unless otherwise stated in Annex 1 or administration agreements / operator arrangements.

In addition, the CTFS values given in Annex 1 for non-preferential PCIs should also be examined.

The preferential PCIs of a two country PCI sharing should be applied to a base station if the trigger value of field strength relating to non-preferential PCIs (in Annex 1) could be exceeded at the borderline of only one neighbouring country. The preferential PCIs of a three country PCI sharing should be applied to a base station if the trigger value of field strength relating to non-preferential PCIs (Annex 1) could be exceeded at the borderline of two neighbouring countries.

As shown in Table 3, the PCIs for NR are divided into 6 sub-sets containing each one sixth of the available PCIs. Each country is allocated three sets (half of the PCIs) in a bilateral case and two sets (one third of the PCIs) in a trilateral case, therefore dividing the PCI groups or PCIs is equivalent. For the deployment of NR systems PCIs between 0 to 1007 may be used. Four types of countries are defined in such a way that no country will use the same code set as any one of its neighbours. The following lists describe the distribution of European countries:

Type country 1: AZE, BEL, CVA, CYP, CZE, DNK, E, FIN, GRC, IRL, ISL, LTU, MCO, SMR, SRB, SUI, SVN and UKR

Type country 2: AND, BIH, BUL, D, EST, G, GEO, HNG, I and MDA

Type country 3: ALB, AUT, F, HOL, HRV, MLT, POL, POR, ROU, and S

Type country 4: LIE, LUX, LVA, MKD, MNE, NOR, SVK and TUR

(Note: Country type map can be found in Figure 1).

For each type of country, the following tables and figure describe the sharing of the PCIs with its neighbouring countries, with the following conventions of writing:

	Preferential PCI
	non-preferential PCI

Table 3: PCI sub-sets for LTE and NR for use in border areas

PCI	Set A	Set B	Set C	Set D	Set E	Set F	PCI	Set A	Set B	Set C	Set D	Set E	Set F
Country 1 NR	0..83	84..167	168..251	252..335	336..419	420..503	Country 2 NR	0..83	84..167	168..251	252..335	336..419	420..503
	504-587	588..671	672..755	756..839	840..923	924..1007		504-587	588..671	672..755	756..839	840..923	924..1007
Border 1-2							Border 2-1						
Zone 1-2-3							Zone 2-3-1						
Border 1-3							Border 2-3						
Zone 1-2-4							Zone 2-1-4						
Border 1-4							Border 2-4						
Zone 1-3-4							Zone 2-3-4						

PCI	Set A	Set B	Set C	Set D	Set E	Set F	PCI	Set A	Set B	Set C	Set D	Set E	Set F
Country 3 NR	0..83	84..167	168..251	252..335	336..419	420..503	Country 4 NR	0..83	84..167	168..251	252..335	336..419	420..503
	504-587	588..671	672..755	756..839	840..923	924..1007		504-587	588..671	672..755	756..839	840..923	924..1007
Border 3-2							Border 4-1						
Zone 3-1-2							Zone 4-1-2						
Border 3-1							Border 4-2						
Zone 3-1-4							Zone 4-2-3						
Border 3-4							Border 4-3						
Zone 3-2-4							Zone 4-3-1						

Note

In certain specific cases (e.g. AUT/HRV) where the distance between two countries of the same type number is very small (< few 10s km) and at the same time harmful interference for that distance could occur, it may be necessary to address the situation in bilateral /multilateral coordination agreements as necessary, and further subdivision of the allocated PCIs may be included in certain areas.

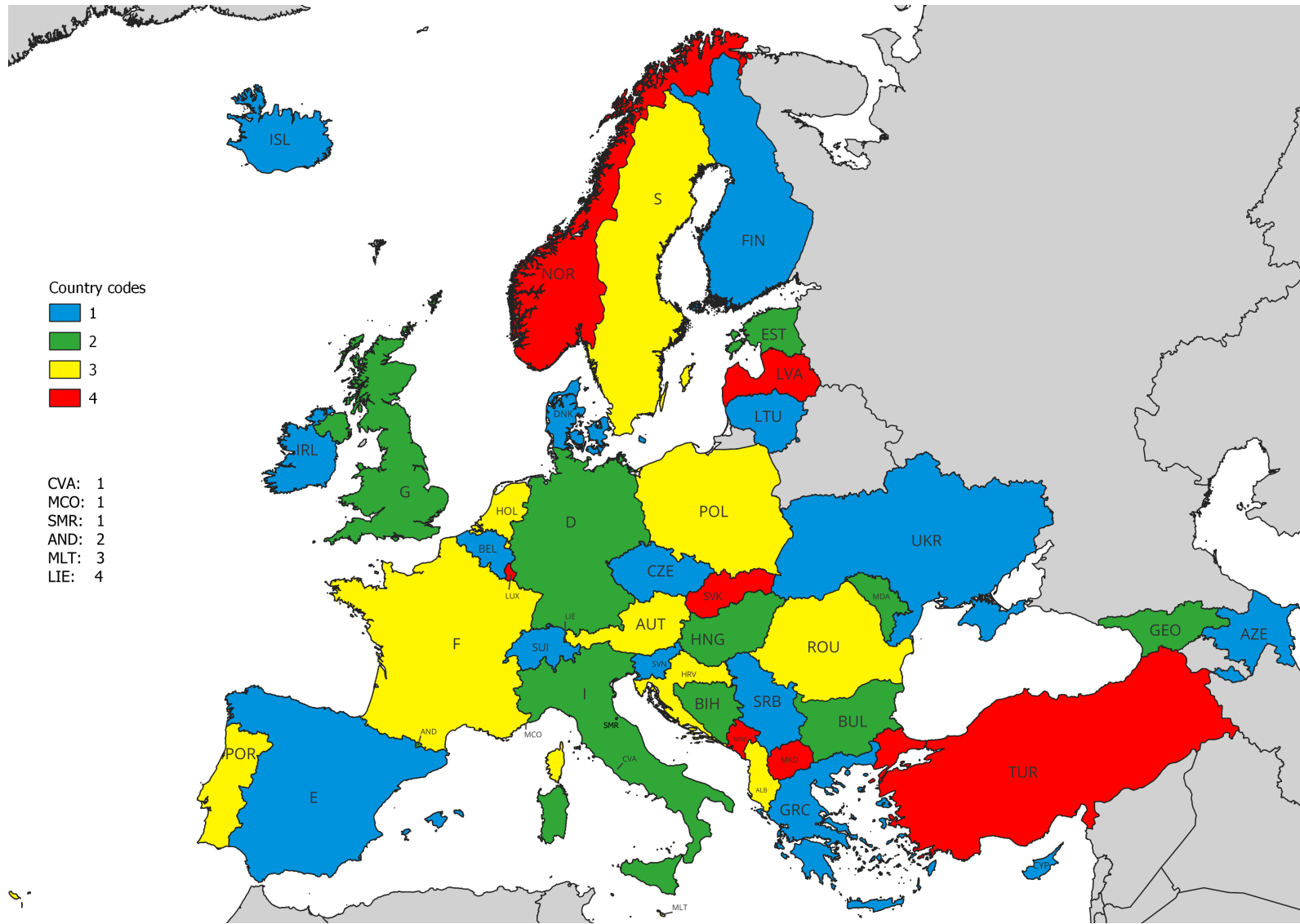


Figure 1: Country type map

ANNEX 5: REFERENCE TDD FRAME

Any deployment subject to coordination, not covered by a specific RMR arrangement shall use the following reference TDD parameters for synchronised operation as a fallback.

Table 4: Reference TDD parameters for synchronised co-channel operation at a border

Parameter	Value
Reference phase / time clock	Aligned with UTC, properly monitored to ensure the local clock drift does not exceed +/- 1.5 μ s in the event of a PRTC outage (Informative note: GNSS (e.g. GPS) is an example of compliant PRTC)
Reference frame	<p>With $T_c := 1/(480000 \cdot 4096)$ seconds (Basic time unit for NR as defined in ETSI TS 138.211, section 4.1 [8]):</p> <ol style="list-style-type: none"> 1. Start-of-frame, aligned with the reference clock 2. Downlink for $3371008 \cdot T_c$ 3. Guard period for $280576 \cdot T_c$ 4. Uplink for $2246656 \cdot T_c$ 5. Downlink for $1685504 \cdot T_c$ 6. Guard period for $280576 \cdot T_c$ 7. Uplink for $1966080 \cdot T_c$ 8. Downlink for $3371008 \cdot T_c$ 9. Guard period for $280576 \cdot T_c$ 10. Uplink for $2246656 \cdot T_c$ 11. Downlink for $1685504 \cdot T_c$ 12. Guard period for $280576 \cdot T_c$ 13. Uplink for $1966080 \cdot T_c$ 14. Back to start-of-frame <p>(Informative note: Those timings correspond to 5G-NR configuration “DS_aUS_bU DS_aUS_bU” with a 15 kHz SCS and S(DL/GP/UL):=(S_a = 10:2:2, S_b = 12:2:0) and 5G NR configuration “DDDS₁UUDS₂UU DDS₁UUDS₂UU” with a 30 kHz SCS and S(DL/GP/UL):=(S₁ = 6:4:4, S₂ = 10:4:0))</p> <p>Note: All SCS are acceptable as long as the frame complies with the above timings. Other frame configurations are also deemed compatible if they do not lead to any downlink/uplink overlap (e.g. if they implement a larger guard period).</p>

ANNEX 6: LIST OF ABBREVIATIONS

Abbreviation	Explanation
AAS	Active Antenna Systems
CEPT	European Conference of Postal and Telecommunications Administrations
CTFS	Coordination Trigger Field Strength
DL	Downlink
DSB	Downlink Symbol Blanking
ECC	Electronic Communications Committee
EU	European Union
FDD	Frequency Division Duplex
FRMCS	Future Railway Mobile Communications System
GNSS	Global Navigation Satellite System
GP	Guard Period
GPS	Global Positioning System
GSCN	Global Synchronisation Channel Number
GSM-R	GSM for Railways
HCM	Harmonised Calculation Method
IMT	International Mobile Telecommunications
ITU-R	International Telecommunication Union, Radiocommunication Sector
LTE	Long Term Evolution
MFCN	Mobile/Fixed Communication Networks
NR	New Radio
PCI	Physical-Layer Cell ID
PRB	Physical Resource Blocks
PRTC	Primary Reference Time Clock
PSS	Primary synchronisation signal
RBG	Resource Block Group
RMR	Railway Mobile Radio
SCS	Subcarrier Spacing
SSB	Synchronisation Signal Block
SSS	Secondary Synchronisation Signal
T_c	Basic time unit for NR
TCA	Terrain Clearance Angle
TDD	Time Division Duplex
UL	Uplink
UTC	Coordinated Universal Time
WB	Wideband

ANNEX 7: LIST OF REFERENCES

- [1] [ECC Report 331](#): "Efficient usage of the spectrum at the border of CEPT countries between TDD MFCN in the frequency band 3400-3800 MHz", approved November 2021
- [2] [ECC Report 296](#): "National synchronisation regulatory framework options in 3400-3800 MHz: a toolbox for coexistence of MFCNs in synchronised, unsynchronised and semi-synchronised operation in 3400-3800 MHz", approved March 2019
- [3] [Recommendation ITU-R P.452](#): "Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz"
- [4] [Recommendation ITU-R P.1546](#): "Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 4 000 MHz"
- [5] HCM Agreement: <http://www.hcm-agreement.eu/>
- [6] [Recommendation ITU-R P.1812](#): "A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands"
- [7] [Recommendation ITU-R P.1406](#): "Propagation effects relating to terrestrial land mobile and broadcasting services in the VHF and UHF bands"
- [8] ETSI TS 138 211 V15.8.0: "5G; NR; Physical channels and modulation"
- [9] [ECC Report 216](#): "Practical guidance for TDD networks synchronisation", approved August 2014
- [10] [ECC Report 281](#): "Analysis of the suitability of the regulatory technical conditions for 5G MFCN operation in the 3400-3800 MHz band", approved July 2018
- [11] [ECC Decision \(20\)02](#): "Harmonised use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio (RMR)", approved November 2020, updated June 2022
- [12] Commission implementing Decision (EU) 2021/1730 of 28 September 2021 on the harmonised use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio
- [13] [ECC Recommendation \(05\)08](#): "Frequency planning and cross-border coordination between GSM Land Mobile Systems (GSM 900, GSM 1800, and GSM-R)", approved February 2006, latest amended October 2021
- [14] [ECC Recommendation \(08\)02](#): "Cross-border coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency bands 900 MHz and 1800 MHz excluding GSM vs. GSM systems, approved February 2008, latest amended October 2021
- [15] [ECC Report 353](#): "Cross-border coordination and synchronisation for RMR networks in the 1900 - 1910 MHz TDD band", approved June 2023