CEPT ECC
Electronic Communications Committee

ECC Recommendation (25)02

Cross-border coordination for Railway Mobile Radio (RMR) in the 900 MHz frequency band excluding GSM-R vs. GSM-R

approved 17 October 2025

Edition 17 October 2025

INTRODUCTION

This Recommendation contains provisions for cross-border coordination between Railway Mobile Radio (RMR) networks in border areas in the frequency band 900 MHz (874.4-880 MHz / 919.4-925 MHz). RMR encompasses GSM-R and its successors, including the Future Railway Mobile Communication System (FRMCS).

This Recommendation covers the following cross-border scenarios:

1) wideband systems vs. wideband systems;
2) narrowband systems vs. wideband systems;
3) narrowband systems vs. narrowband systems (except GSM-R vs. GSM-R since this case is covered in ECC Recommendation (05)08 [1]).

where:

- Narrowband (NB) systems include:
  - GSM-R and standalone NB-IoT (Narrowband IoT) (≤200 kHz);
- Wideband (WB) systems include:
  - 5G NR (New Radio);
  - 5G NR with NB-IoT in-band operation mode without power boost.

ECC RECOMMENDATION (25)02 OF 17 OCTOBER 2025 ON CROSS-BORDER COORDINATION FOR RAILWAY MOBILE RADIO (RMR) IN THE 900 MHZ FREQUENCY BAND EXCLUDING GSM-R VS. GSM-R

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that the ECC Recommendation (05)08 [1] addresses "Frequency planning and cross-border coordination between GSM Land Mobile Systems (GSM 900, GSM 1800 and GSM-R)";

b) that Railway Mobile Radio (RMR) systems use the frequency bands 874.4-880 MHz / 919.4-925 MHz in accordance with ECC Decision (20)02 [7] and Commission Implementation Decision (EU) 2021/1730 [8];

c) that RMR encompasses GSM-R and its successor(s), including the Future Railway Mobile Communication System (FRMCS);

d) that coordination is necessary between countries operating RMR Networks in the same frequency band;

e) that in the context of RMR, channel bandwidths of 3 MHz and 5 MHz and ≤ 200 kHz (e.g. NB-IoT) are covered by this Recommendation. 5.6 MHz channel bandwidth may be considered in future;

f) that in the context of RMR, only non-AAS base stations are covered by this Recommendation;

g) 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;

h) that, for the purpose of this Recommendation, the following definitions as per ECC Report 353 [9] 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.

i) that planning for frequency (GSM-R and NR) and Physical-layer Cell Identity (PCI) (only for NR) in border areas will be based on coordination between national administrations in cooperation with their operators;

j) that PCI coordination is necessary for NR systems to avoid unnecessary signalling load and handover failures;

k) that many agreements for GSM-R cross-border coordination have been signed between administrations and the operation and development of GSM-R networks is continued;

l) that the coordination procedure depends on a number of parameters (technical, operational or topographical);

m) that administrations may diverge from the technical parameters, propagation models and procedures described in this Recommendation subject to bilateral/multilateral agreements;

n) that in the case of operator arrangements approved by national administrations it is possible to deviate from this Recommendation;

o) that existing bilateral/multilateral agreements for GSM-R systems should be updated or additional agreements should be concluded in order to include NR systems;

p) that frequency coordination in border areas should be based on the concept of equitable spectrum access probability by systems on each side of a border and should take into consideration the need for cross-border rail interoperability;

recommends

1. that frequency coordination between RMR systems in neighbouring countries should be based on bilateral/multilateral agreements between administrations;

2. that administrations should encourage and facilitate the establishment of RMR arrangements between RMR operators of different countries with the aim to enhance the efficient use of the spectrum, to optimise the coverage and/or capacity in their respective border areas and/or to provide coverage across the border to ensure railway interoperability;

3. that frequency coordination for narrowband technologies should be based on the same requirements as for GSM-R;

4. that, if the levels in Annex 1 are exceeded, coordination is required and the procedure detailed in Annex 3 should be used;

5. that interference field strength level predictions should be made using the appropriate propagation models defined in Annex 2 for NR systems and in ECC Recommendation (05)08 for GSM-R systems [1]. If it is agreeable to administrations concerned, the same interference field strength level predictions may be applied for all systems;

6. that coordination in coastal and large lake areas are based on prediction of field strength levels at the coastline of the neighbouring country. Other principles for coordination in coastal and large lake areas may be agreed between the administrations concerned;

7. that cross-border coordination between neighbouring NR systems in border areas should be based on the PCIs provided in Annex 4 when synchronisation signal centre frequencies are aligned."

Note:

Please check the ECO 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-FDD SYSTEMS IN THE FREQUENCY BAND 919.4-925 MHZ

In this annex, field strength levels are given for RMR using Frequency-Division Duplex (RMR-FDD) systems for cross-border scenarios of WB vs. WB, NB vs. WB and NB vs. NB. The field strength levels are applicable to non-AAS base stations.

Preferential and non-preferential PCIs for NR are provided in Annex 4.

Administrations/operators may agree on other values of field strength and preferential frequency usage based on bilateral/multilateral agreements/arrangements.

Synchronisation signal means Synchronisation Signal Block (SSB) for NR systems.

Field strength values provided in this Annex refer to non-preferential frequency usage.

The field strength values are given for 3 MHz and 5 MHz frequency block sizes. In cases of frequency block sizes other than 3 MHz or 5 MHz, a factor of 10 × $\log_{10}$ (channel bandwidth[1] / (3 MHz or 5 MHz)) should be added to the field strength values.

A1.1 FIELD STRENGTH LEVELS FOR WB VS. WB CASE

A1.1.1 Base stations of RMR WB systems using the same technology on both sides of the borderline with synchronisation signal centre frequencies not aligned for all PCIs or with synchronisation signal centre frequencies aligned and for preferential PCIs

Base stations of WB systems using the same technology on both sides of the borderline with synchronisation signal centre frequencies not aligned for all PCIs or with synchronisation signal centre frequencies aligned and for preferential PCIs may be used without coordination with a neighbouring country if the mean field strength of each cell produced by base station does not exceed the values of:

for 5 MHz bandwidth

59 dBµV/m/5 MHz at a height of 3 m above ground at the borderline between countries and 41 dBµV/m/5 MHz at a height of 3 m above ground at a distance of 6 km inside the neighbouring country.

for 3 MHz bandwidth

57 dBµV/m/3 MHz at a height of 3 m above ground at the borderline between countries and 39 dBµV/m/3 MHz at a height of 3 m above ground at a distance of 6 km inside the neighbouring country.

A1.1.2 Base stations of RMR WB systems using the same technology on both sides of the borderline with synchronisation signal centre frequencies aligned and for non-preferential PCIs

Base stations of WB systems using the same technology on both sides of the borderline with synchronisation signal centre frequencies aligned and for non-preferential PCIs may be used without coordination with a neighbouring country if the mean field strength of each cell produced by base station does not exceed the values of:

for 5 MHz bandwidth

41 dBµV/m/5 MHz at a height of 3 m above ground at the borderline between neighbouring countries.

[1] not occupied bandwidth

for 3 MHz bandwidth

39 dBµV/m/3 MHz at a height of 3 m above ground at the borderline between neighbouring countries.

A1.1.3 Base stations of RMR WB systems using different technologies on both sides of the borderline

If different technologies are deployed on both sides of the borderline, base stations of WB systems may be used without coordination in the neighbouring country following the same field strength level as mentioned in A1.1.1 for all PCIs irrespective of whether the synchronisation signal centre frequencies are aligned or not.

A1.2 FIELD STRENGTH LEVELS FOR NB VS. WB CASE

A1.2.1 Option 1

GSM-R systems can continue their operation based on the field strength levels defined in ECC Recommendation (05)08 [1] or existing agreement/arrangement between administrations/operators, and in that case base stations may be used without coordination with a neighbouring country if:

- **for NB systems**: the mean field strength of each carrier produced by a base station does not exceed the values according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators;
- **for 5 MHz WB systems**: the mean field strength of each cell produced by a base station does not exceed the values of 59 dBµV/m/5 MHz at a height of 3 m above ground at the borderline and 41 dBµV/m/5 MHz at a height of 3 m above ground at a distance of 6 km for all PCIs;
- **for 3 MHz WB systems**: the mean field strength of each cell produced by a base station does not exceed the values of 57 dBµV/m/3 MHz at a height of 3 m above ground at the borderline and 39 dBµV/m/3 MHz at a height of 3 m above ground at a distance of 6 km for all PCIs.

RMR operators in neighbouring countries may seek an arrangement for redistributing the preferential frequencies of GSM-R system to facilitate the introduction of wideband technologies if needed.

A1.2.2 Option 2

Alternatively, new bilateral or multilateral agreements could be established for cross-border coordination between GSM-R systems and WB systems, and in that case base stations may be used without coordination with a neighbouring country if:

- **for NB systems**: the mean field strength of each carrier produced by a base station does not exceed the value of 45 dBµV/m/200 kHz at a height of 3 m above ground at the borderline between neighbouring countries for all frequencies;
- **for 5 MHz WB systems**: the mean field strength of each cell produced by a base station does not exceed the values of 59 dBµV/m/5 MHz at a height of 3 m above ground at the borderline and 41 dBµV/m/5 MHz at a height of 3 m above ground at a distance of 6 km for all PCIs;
- **for 3 MHz WB systems**: the mean field strength of each cell produced by a base station does not exceed the values of 57 dBµV/m/3 MHz at a height of 3 m above ground at the borderline and 39 dBµV/m/3 MHz at a height of 3 m above ground at a distance of 6 km for all PCIs.

A1.3 FIELD STRENGTH LEVELS FOR NB VS. NB CASE

A1.3.1 Option 1

GSM-R systems can continue their operation based on the field strength levels defined in ECC Recommendation (05)08 [1] or existing agreement/arrangement between administrations/operators and the other NB systems may operate following the same principles.

A1.3.2 Option 2

Base stations may be deployed without coordination with a neighbouring country if the mean field strength of each carrier produced by the base station does not exceed the values of 45 dBµV/m/200 kHz at a height of 3 m above ground at the borderline between neighbouring countries for preferential frequencies and 19 dBµV/m/200 kHz at a height of 3 m above ground at the borderline between neighbouring countries for non-preferential frequencies.

A1.4 OVERVIEW OF FIELD STRENGTH LEVELS

A1.4.1 WB vs. WB

Table 1: Field strength levels at a height of 3 m above ground between wideband systems in 919.4-925 MHz

	Synchronisation signal centre frequencies aligned		Synchronisation signal centre frequencies not aligned	Channel
	Preferential PCIs	Non-preferential PCIs	All PCIs	
Between same technologies	59 dBµV/m/5 MHz @ 0 km and 41 dBµV/m/5 MHz @ 6 km (see A1.1.1)	41 dBµV/m/5 MHz @ 0 km (see A1.1.2)	59 dBµV/m/5 MHz @ 0 km and 41 dBµV/m/5 MHz @ 6 km (see A1.1.1)	5 MHz
Between different technologies	59 dBµV/m/5 MHz @ 0 km and 41 dBµV/m/5 MHz @ 6 km for all PCIs (see A1.1.3)			
Between same technologies	57 dBµV/m/3 MHz @ 0 km and 39 dBµV/m/3 MHz @ 6 km (see A1.1.1)	39 dBµV/m/3 MHz @ 0 km (see A1.1.2)	57 dBµV/m/3 MHz @ 0 km and 39 dBµV/m/3 MHz @ 6 km (see A1.1.1)	3 MHz
Between different technologies	57 dBµV/m/3 MHz @ 0 km and 39 dBµV/m/3 MHz @ 6 km for all PCIs (see A1.1.3)			
@ stands for “at a distance inside the neighbouring country”				

A1.4.2 NB vs. WB

Table 2: Field strength levels at a height of 3 m above ground for narrowband vs. wideband systems in 919.4-925 MHz

Narrowband system	Wideband system	Channel
Option 1 (see A1.2.1)		
according to ECC Recommendation (05)08 [1] or existing agreement/arrangement between administrations/operators	59 dBµV/m/5 MHz @ 0 km and 41 dBµV/m/5 MHz @ 6 km for all PCIs	5 MHz
according to ECC Recommendation (05)08 [1] or existing agreement/arrangement between administrations/operators	57 dBµV/m/3 MHz @ 0 km and 39 dBµV/m/3 MHz @ 6 km	3 MHz

Narrowband system	Wideband system	Channel
	for all PCIs	
Option 2 (see A1.2.2)		
45 dBµV/m/200 kHz@ 0 km	59 dBµV/m/5 MHz @ 0 km and 41 dBµV/m/5 MHz @ 6 km for all PCIs	5 MHz
45 dBµV/m/200 kHz@ 0 km	57 dBµV/m/3 MHz @ 0 km and 39 dBµV/m/3 MHz @ 6 km for all PCIs	3 MHz

A1.4.3 NB vs. NB

Table 3: Field strength levels at a height of 3 m above ground between narrowband systems in 919.4-925 MHz

Preferential Frequency	Non-Preferential Frequency
Option 1 (see A1.3.1)	
according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators	
Option 2 (see A1.3.2)	
45 dBµV/m/200 kHz @ 0 km	19 dBµV/m/200 kHz @ 0 km

ANNEX 2: PROPAGATION MODEL

The following methods are proposed for assessment of anticipated interference inside neighbouring country based on established the field strength levels. Due to 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 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 those 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.

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 [2]. For the relevant transmitting terminal, 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 station shall be required to be coordinated.

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

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 [3], “Method for point to area predictions for terrestrial services in the frequency range 30 to 4000 MHz”. This model is to be employed for 50% locations, 10% time and using a receiver 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 consent[2].

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 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 between the 6 km (including also 6km 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.

[2] e.g. as used by members of the HCM-Agreement [4]

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 [3] 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 [5]).

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 [6] 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: COORDINATION PROCEDURE

When requesting coordination, all of the following characteristics should be included:

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

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.

If 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 station 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 NR

PCI coordination is only needed when synchronisation signal centre frequencies are aligned independent of the channel bandwidth.

ETSI TS 138 211, section 7.4.2 [10] defines 336 “unique physical-layer cell-identity groups for NR”, numbered 0…335, hereafter called “PCI groups”. Within each PCI group there are three separate PCIs giving 1008 PCIs in total.

Administrations should agree on a repartition of these PCIs on an equitable basis when synchronisation signal centre frequencies are aligned as shown in Table 4.

As shown in Table 4, the PCIs 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.

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.

For each type of country, the following table describes the sharing of the PCIs with its neighbouring countries, with the following conventions of writing:

■	Preferential PCI
	Non-preferential PCI

Table 4: PCI sub-sets for NR for use in border areas when the synchronisation signal centre frequencies are aligned

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

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

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

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

Notes

1. 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), it may be necessary to address the situation in bilateral/multilateral coordination agreements as necessary, and may include further subdivision of the allocated codes in certain areas.

2. Country type map is shown in Figure 1.

3. Non-preferential PCIs can be used in areas away from the borderline on the sites within a country under the condition that the field strength produced by those sites does not exceed the limit defined for non-preferential PCIs in Annex 1.

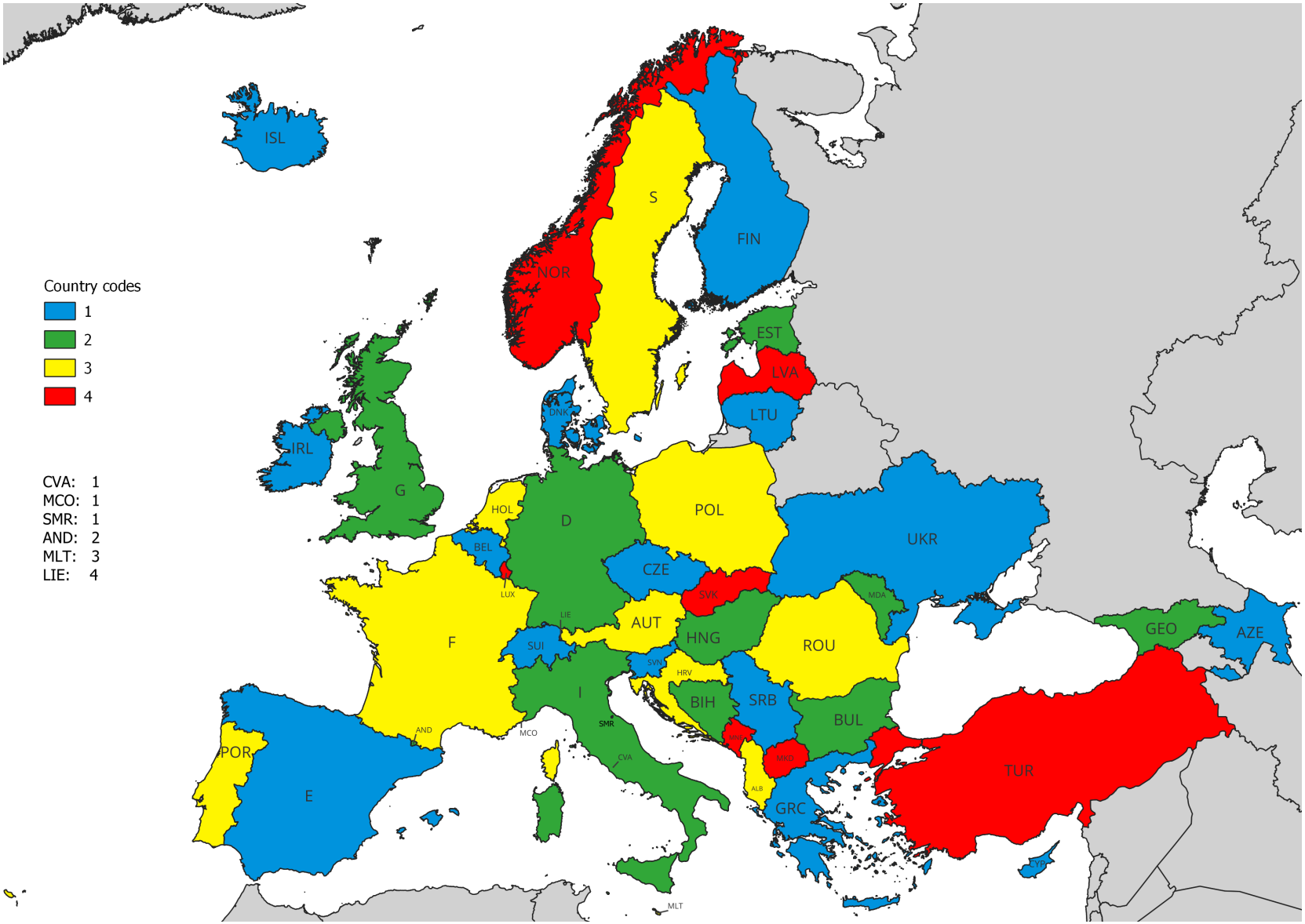


Figure 1: Country type map

ANNEX 5: LIST OF REFERENCES

[1] 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 and latest amended October 2021

[2] 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”

[3] Recommendation ITU-R P.1546: “Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 4000 MHz”

[4] HCM Agreement: https://hcm.bundesnetzagentur.de/http/englisch/verwaltung/index_europakarte.htm

[5] Recommendation ITU-R P.1812: “A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands”

[6] Recommendation ITU-R P.1406: “Propagation effects relating to terrestrial land mobile and broadcasting services in the VHF and UHF bands”

[7] 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, latest amended June 2024

[8] Decision (EU) 2021/1730: “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”

[9] ECC Report 353: “Cross-border coordination and synchronisation for Railway Mobile Radio (RMR) networks in the 1900-1910 MHz TDD frequency band”, approved June 2023

[10] ETSI TS 138 211: “5G; NR; Physical channels and modulation”