CEPT ECC
Electronic Communications Committee

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

Approved 21 February 2008

latest amended 8 October 2021

INTRODUCTION

This Recommendation contains provisions for cross-border coordination between Mobile/Fixed Communications Networks (MFCN) in border areas in the frequency bands 900 MHz (880-915 MHz/925-960 MHz) and 1800 MHz (1710-1785 MHz/1805-1880 MHz).

This Recommendation also 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), noting that RMR systems use the same radio access technologies as MFCN.

This Recommendation covers the following cross-border scenarios, but it does not deal with GSM vs. GSM nor GSM-R vs. GSM-R cases in detail because it is covered in ECC Recommendation (05)08 [1]:

1) Wideband systems vs. Wideband systems;

2) Narrowband systems vs. Wideband systems;

3) Narrowband systems vs. Narrowband systems.

Where

- Narrowband (NB) systems include:
    - GSM, EC-GSM-IoT (Extended Coverage GSM IoT) and standalone NB-IoT (Narrowband IoT);
- Wideband (WB) systems include:
    - UMTS, LTE, LTE-MTC (LTE Machine Type Communication), LTE-eMTC (evolved MTC), LTE in-band NB-IoT, LTE guard-band (GB) NB-IoT and NR (New Radio).

ECC RECOMMENDATION (08)02 ON CROSS-BORDER COORDINATION FOR MOBILE/FIXED COMMUNICATIONS NETWORKS (MFCN) IN THE FREQUENCY BANDS 900 MHZ AND 1800 MHZ EXCLUDING GSM VS. GSM AND FOR RAILWAY MOBILE RADIO (RMR) IN THE 900 MHZ FREQUENCY BANDS EXCLUDING GSM-R VS. GSM-R, AMENDED 8 FEBRUARY 2019 AND AMENDED 8 OCTOBER 2021

"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 the Radio Regulations identify the frequency bands 880-915 MHz / 925-960 MHz (RR 5.317A) and 1710-1785 MHz / 1805-1880 MHz (RR 5.384A) for terrestrial IMT;

c) that ERC Decision (94)01 [2], ERC Decision (97)02 [3] and ERC Decision (95)03 [4] designate the frequency bands 880-915 MHz / 925-960 MHz and 1710-1785 MHz / 1805-1880 MHz for GSM systems;

d) that ECC Decision (06)13 [5] designates the frequency bands 880-915 MHz / 925-960 MHz and 1710-1785 MHz / 1805-1880 MHz for terrestrial UMTS/LTE/NR and IoT cellular systems;

e) that ECC Decision (06)13 also indicates that administrations shall take all necessary measures to ensure the protection of continued operation of GSM systems in the 900 MHz and 1800 MHz bands;

f) that the amending Decision 2009/766/EC [6] (modified by (EU) 2018/637) on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community has included the technical conditions for UMTS/LTE and M2M Cellular IoT (Extended Coverage GSM IoT (EC-GSM-IoT), LTE Machine Type Communication (LTE-MTC), evolved MTC (LTE-eMTC) and Narrowband IoT (NB-IoT) in its annex;

g) that EC-GSM-IoT systems operate following the technical conditions applicable to GSM;

h) that LTE-MTC, LTE-eMTC, NB-IoT in-band and guard-band systems operate following the technical conditions applicable to LTE;

i) 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 [12] and where applicable the relevant EU Decision and Regulation, in the context of the railway interoperability principle;

j) that RMR encompasses GSM-R and its successor(s), including the Future Railway Mobile Communication System (FRMCS), noting that FRMCS may use LTE, NR or NB-IoT technologies;

k) that standalone NB-IoT for MFCN should operate following the technical conditions in ECC Decision (06)13 and that standalone NB-IoT for RMR should operate following the technical conditions in ECC Decision (20)02;

l) that frequency (GSM/GSM-R and UMTS/LTE/NR) and code (only for UMTS) and PCI (only for LTE/NR) planning in border areas will be based on coordination between national administrations in cooperation with their operators;

m) that Physical Cell Identifier (PCI) coordination is necessary for LTE/NR systems to avoid unnecessary signalling load and handover failures;

n) that other radio parameters may need to be coordinated for LTE/NR systems on a bilateral/multilateral basis;

o) that coordination is necessary between countries operating GSM/GSM-R, UMTS/LTE/NR systems in the same frequency band;

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

q) that GSM/GSM-R and UMTS/LTE/NR systems use frequency arrangements with different channel bandwidths;

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

s) that where practicable and only for UMTS systems soft-handover between neighbouring networks may provide an option to facilitate coordination in border areas and to enhance efficiency of spectrum usage;

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

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

v) that in many CEPT member countries there are multiple operators for GSM and UMTS/LTE/NR systems;

w) that a frequency coordination procedure is necessary both between countries operating GSM and UMTS/LTE/NR systems and between those countries and countries operating other systems in accordance with the ITU-R Radio Regulations;

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

y) that this Recommendation does not consider TDD systems;

z) that frequency coordination in border areas should be based on the concept of equal spectrum access probability by systems on each side of a border.

recommends

in general:

1. that frequency coordination between UMTS/LTE/NR systems and other systems in neighbouring countries should be based on bilateral/multilateral agreements between administrations;

2. that administrations should encourage and facilitate the establishment of arrangements between operators of different countries with the aim to enhance the efficient use of the spectrum and the coverage in the border areas;

3. that frequency coordination for LTE-MTC/LTE-eMTC, in-band and guard-band NB-IoT systems should be based on the same requirements as for LTE;

4. that frequency coordination for EC-GSM-IoT and standalone NB-IoT systems should be based on the same requirements as for GSM/GSM-R;

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

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

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

between WB systems:

8. that bilateral/multilateral agreements should be established for cross-border coordination between WB systems based on the principles provided in paragraph A1.1;

9. that cross-border coordination between WB systems may also use preferential frequencies based on bilateral/multilateral agreements;

10. that cross-border coordination between neighbouring UMTS systems in border areas should be based on the code groups provided in ANNEX 3;

11. that cross-border coordination between neighbouring LTE/NR systems in border areas should be based on the PCI's provided in ANNEX 5 when channel centre frequencies are aligned;

12. that other radio parameters for LTE may need to be coordinated on a bilateral/multilateral basis based on the guidance provided in ANNEX 6;

between NB and WB systems:

13. that GSM/GSM-R systems can continue their operation based on the field strength levels defined in ECC Recommendation(05)08 or existing agreement/arrangement between administrations/operators (see paragraph A1.2.1);

14. that, alternatively, new bilateral/multilateral agreements may be established for cross-border coordination between GSM/GSM-R systems and WB systems according to paragraph A1.2.2;

15. that bilateral/multilateral agreements should be established for cross-border coordination between NB systems (other than GSM/GSM-R) and WB systems based on the principles provided in paragraph A1.2.2;

between NB systems:

16. that cross-border coordination between NB systems (GSM, GSM-R, EC-GSM-IoT and standalone NB-IoT) should be in accordance with paragraph A1.3."

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 FDD MFCN SYSTEMS AT 900 MHZ AND 1800 MHZ AND BETWEEN FDD RMR SYSTEMS AT 900 MHZ

In this Annex, field strength levels are given for FDD systems for cross-border scenarios of WB vs. WB, NB vs. WB and NB vs. NB.

Preferential codes for UMTS and preferential PCIs for LTE and NR are given in ANNEX 3 and ANNEX 5 respectively.

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

All the field strength values provided in this Annex refer to non-preferential frequency usage.

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

A1.1.1 Base stations of WB systems in the frequency bands of 919.4-960 MHz and 1805-1880 MHz using the same technology on both sides of the borderline with centre frequencies not aligned for all codes/PCIs or with centre frequencies aligned and for preferential codes/PCIs

Base stations of WB systems in the frequency bands of 919.4-960 MHz and 1805-1880 MHz using the same technology on both sides of the borderline with centre frequencies not aligned for all codes/PCIs or with centre frequencies aligned and for preferential codes/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:

in the frequency band of 919.4-960 MHz

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

in the frequency band of 1805-1880 MHz

65 dBµV/m/5MHz at a height of 3 m above ground at the borderline between countries and 47 dBµV/m/5MHz at a height of 3 m above ground at a distance of 6 km inside the neighbouring country.

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

Base stations of WB systems using the same technology on both sides of the borderline with centre frequencies aligned and for non-preferential codes/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:

in the frequency band of 919.4-960 MHz

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

in the frequency band of 1805-1880 MHz

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

A1.1.3 Different technologies deployed on both sides of the borderline

If different technologies are deployed on both sides of the borderline, base stations of WB systems in the frequency bands of 919.4-960 MHz and 1805-1880 MHz may be used without coordination in the neighbouring country following the same field strength level as mentioned in paragraph A1.1.1 for all codes/PCIs irrespective of whether the centre frequencies are aligned or not.

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

A1.2.1 Option 1

GSM/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 a base stations may be used without coordination with a neighbouring country if:

in the frequency band of 919.4-960 MHz:

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

in the frequency band of 1805-1880 MHz:

- **for NB systems**: the mean field strength of each carrier produced by base station does not exceed the values of according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators;
- **for WB systems**: the mean field strength of each cell produced by base station does not exceed the values of 65 dBµV/m/5MHz at a height of 3 m above ground at the borderline and 47 dBµV/m/5MHz at a height of 3 m above ground at a distance of 6 km for all codes/PCIs.

Mobile network operators in neighbouring countries may seek an arrangement for redistributing the preferential frequencies of GSM/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/GSM-R systems and WB systems, and in that case a base stations may be used without coordination with a neighbouring country if:

in the frequency band of 919.4-960 MHz:

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

in the frequency band of 1805-1880 MHz

- **for NB systems**: the mean field strength of each carrier produced by base station does not exceed the value of 51 dBµV/m/200kHz at a height of 3 m above ground at the borderline between neighbouring countries for all frequencies;
- **for WB systems**: the mean field strength of each cell produced by base station does not exceed the values of 65 dBµV/m/5MHz at a height of 3 m above ground at the borderline and 47 dBµV/m/5MHz at a height of 3 m above ground at a distance of 6 km for all codes/PCIs.

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

A1.3.1 Option 1

GSM/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:

in the frequency band of 919.4-960 MHz:

45 dBµV/m/200kHz at a height of 3 m above ground at the borderline between neighbouring countries for preferential frequencies and 19 dBµV/m/200kHz at a height of 3 m above ground at the borderline between neighbouring countries for non-preferential frequencies

in the frequency band of 1805-1880 MHz:

51 dBµV/m/200kHz at a height of 3 m above ground at the borderline between neighbouring countries for preferential frequencies and 25 dBµV/m/200kHz 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

	Wideband system vs. Wideband system		
	Centre frequencies aligned		**Centre frequencies not aligned**
	Preferential codes/PCIs	Non-preferential codes/PCIs	All codes/PCIs
900 MHz			
Between same technologies	59 dBµV/m/5MHz @ 0 km and 41 dBµV/m/5MHz @ 6 km (paragraph A1.1.1)	41 dBµV/m/5MHz @ 0 km (paragraph A1.1.2)	59 dBµV/m/5MHz @ 0 km and 41 dBµV/m/5MHz @ 6 km (paragraph A1.1.1)
Between different technologies	59 dBµV/m/5MHz @ 0 km and 41 dBµV/m/5MHz @ 6 km (paragraph A1.1.3)		
1800 MHz			
Between same technologies	65 dBµV/m/5MHz @ 0 km and 47 dBµV/m/5MHz @ 6 km (paragraph A1.1.1)	47 dBµV/m/5MHz @ 0 km (paragraph A1.1.2)	65 dBµV/m/5MHz @ 0 km and 47 dBµV/m/5MHz @ 6 km (paragraph A1.1.1)
Between different technologies	65 dBµV/m/5MHz @ 0 km and 47 dBµV/m/5MHz @ 6 km (paragraph 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 the case of narrowband and wideband systems

	Narrowband system	Wideband system
	Option 1 (paragraph A1.2.1)	
900 MHz	according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators	59 dBμV/m/5MHz @ 0 km and 41 dBμV/m/5MHz @ 6 km for all codes/PCIs
1800 MHz	according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators	65 dBμV/m/5MHz @ 0 km and 47 dBμV/m/5MHz @ 6 km for all codes/PCIs
	Option 2 (paragraph A1.2.2)	
900 MHz	45 dBμV/m/200 kHz@0 km	59 dBμV/m/5MHz @ 0 km and 41 dBμV/m/5MHz @ 6 km for all codes/PCIs
1800 MHz	51 dBμV/m/200 kHz@0 km	65 dBμV/m/5MHz @ 0 km and 47 dBμV/m/5MHz @ 6 km for all codes/PCIs
@ stands for “at a distance inside the neighbouring country”		

A1.4.3 NB vs. NB

Table 3: Field strength levels at a height of 3 m above ground between narrowband systems

	Narrowband system vs. Narrowband system	
	Preferential Frequency	**Non-Preferential Frequency**
	Option 1 (paragraph A1.3.1)	
900 MHz	according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators	
1800 MHz	according to ECC Recommendation (05)08 or existing agreement/arrangement between administrations/operators	
	Option 2 (paragraph A1.3.2)	
900 MHz	45 dBμV/m/200kHz @ 0 km	19 dBμV/m/200kHz @ 0 km
1800 MHz	51 dBμV/m/200kHz @ 0 km	25 dBμV/m/200kHz @ 0 km
@ stands for “at a distance inside the neighbouring country”		

A1.5 CALCULATION EXPLANATION

For field strength predictions, the calculations should be made according to Annex 2. In the case of channel bandwidth other than the reference one, a factor of 10 x Log10 (channel bandwidth[1] /reference bandwidth in the same units) should be added to the field strength levels.

[1] not occupied bandwidth

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 [7]. 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 [8], "Method for point to area predictions for terrestrial services in the frequency range 30 to 3000 MHz". This model is to be employed for 50% locations, 10% time and using a receiver height of 3m.

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 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 3m 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 [9]

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 with the terrain clearance angle correction factor TCA, HCM method with the terrain clearance angle correction factor or Recommendation ITU–R P.1812 [10]).

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 [11] 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: PREFERENTIAL CODES FOR UMTS (UTRA FDD)

The code groups defined for the FDD modes have no particular correlation properties and no particular organisation of the repartition is required.

Administrations should agree on a repartition of these code groups on an equitable basis.

In border areas, the codes will be divided into 6 "code sets" containing each one sixth of the available code groups. Each country is allocated three code sets (half of the codes) in a bilateral case, and two code sets (one third of the codes) in a trilateral case.

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, BLR, BUL, D, EST, G, GEO, HNG, I, MDA and RUS (Exclave),

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

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

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

(black)	Preferential code
(white)	Non-preferential code

For the FDD mode; 3GPP TS 25.213 defines 64 «scrambling code groups» in §5.2.3, numbered {0…63}, hereafter called «code groups».

Table 4: Code group sub-sets for use in border areas when the carrier frequencies are aligned

	Set A	Set B	Set C	Set D	Set E	Set F
Country 1	0..10	11..20	21..31	32..42	43..52	53..63
Border 1-2	■	■				■
Zone 1-2-3	■	■				
Border 1-3	■	■	■			
Zone 1-2-4	■					■
Border 1-4	■		■			■
Zone 1-3-4	■		■			

	Set A	Set B	Set C	Set D	Set E	Set F
Country 2	0..10	11..20	21..31	32..42	43..52	53..63
Border 2-1			■	■	■	
Zone 2-3-1			■	■		
Border 2-3		■	■	■		
Zone 2-1-4			■	■		
Border 2-4			■	■		■
Zone 2-3-4			■	■		

	Set A	Set B	Set C	Set D	Set E	Set F
Country 3	0..10	11..20	21..31	32..42	43..52	53..63
Border 3-2	■				■	■
Zone 3-1-2					■	■
Border 3-1				■	■	■
Zone 3-1-4					■	■
Border 3-4			■		■	■
Zone 3-2-4					■	■

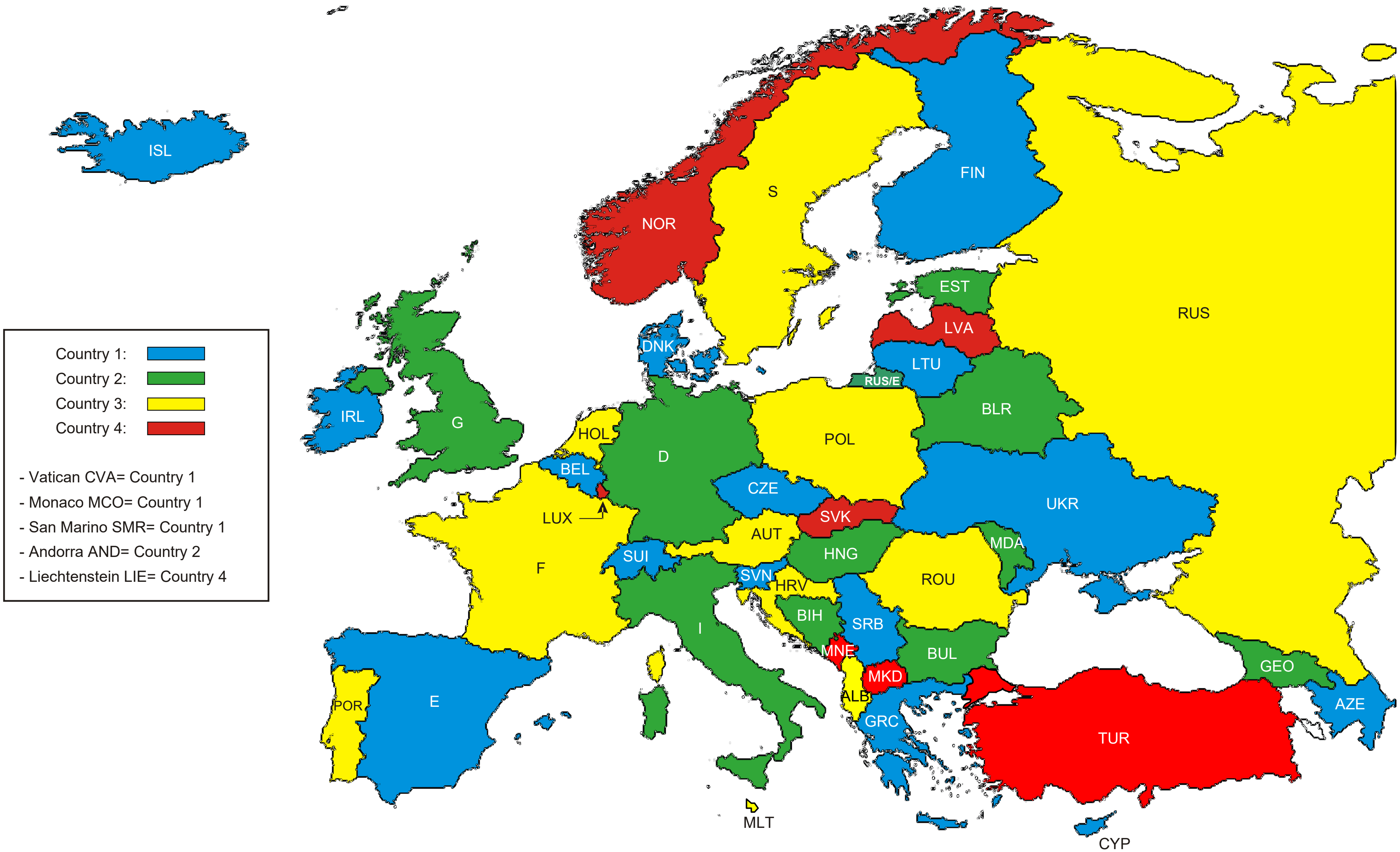
	Set A	Set B	Set C	Set D	Set E	Set F
Country 4	0..10	11..20	21..31	32..42	43..52	53..63
Border 4-1		■		■	■	
Zone 4-1-2		■			■	
Border 4-2	■	■			■	
Zone 4-2-3	■	■				
Border 4-3	■	■		■		
Zone 4-3-1		■		■		

Notes

1. A two country code sharing should be applied or used by base stations that exceed the relevant field strength values (Annex 1) of only one neighbouring country. A three country code sharing should be applied or used by base stations that exceed the relevant field strength values (Annex 1) of two neighbouring countries.

2. 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.

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


Country 1:
Country 2:
Country 3:
Country 4:
- Vatican CVA= Country 1
- Monaco MCO= Country 1
- San Marino SMR= Country 1
- Andorra AND= Country 2
- Liechtenstein LIE= Country 4
ISL
NOR
S
FIN
RUS
EST
LVA
LTU
RUS/E
DNK
IRL
G
HOL
BEL
LUX
D
POL
BLR
CZE
SVK
UKR
AUT
F
SUI
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AZE
TUR
POR
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MLT
CYP

ANNEX 4: EXCHANGE OF INFORMATION

When requesting coordination the relevant characteristics of the base station, the code group number and the PCI numbers should be forwarded to the Administration affected. All of the following characteristics should be included:

a) channel centre frequency (MHz)

b) channel bandwidth (MHz)

c) name of transmitter station

d) country of location of transmitter station

e) geographical coordinates (W/E, N; WGS84)

f) effective antenna height (m)

g) antenna polarisation

h) antenna azimuth (deg)

i) directivity in antenna systems or antenna gain (dBi)

j) effective radiated power (dBW)

k) expected coverage zone

l) date of entry into service (month, year).

m) code group number used only for UMTS

n) PCI numbers used (only for LTE/NR)

o) antenna electrical and mechanical tilt (deg)

p) antenna pattern or envelop.

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 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 5: PREFERENTIAL PHYSICAL-LAYER CELL IDENTITIES (PCI) FOR LTE/NR

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

Administrations should agree on a repartition of these PCI's on an equitable basis when channel centre frequencies are aligned as shown in the Table below. It has to be noted that dividing the PCI groups or PCI's is equivalent.

As shown in the table below, the PCI's should be divided into 6 sub-sets containing each one sixth of the available PCI's. Each country is allocated three sets (half of the PCI's) in a bilateral case, and two sets (one third of the PCI's) in a trilateral case.

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:

7Type 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, BLR, BUL, D, EST, G, GEO, HNG, I, MDA and RUS (Exclave),

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

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

(Note: Country type map can be found in Annex 3).

For each type of country, the following tables describe the sharing of the PCI's with its neighbouring countries, with the following conventions of writing:

	Preferential PCI
	Non-preferential PCI

3GPP TS 36.211 defines 168 "unique physical-layer cell-identity groups" in §6.11, numbered 0…167, hereafter called "PCI groups". Within each PCI group there are three separate PCIs giving 504 PCIs in total.

3GPP TS 38.211 defines NR Physical channels and modulation, in NR 2-step identification using PSS/SSS detection of the Physical Cell ID (same as LTE), the number of different cell IDs has been increased to 1008 from 504 in LTE.

Table 5: PCI sub-sets for LTE for use in border areas when the carrier frequencies are aligned

PCI	Set A	Set B	Set C	Set D	Set E	Set F
Country 1	0..83	84..167	168..251	252..335	336..419	420..503
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	84..167	168..251	252..335	336..419	420..503
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	84..167	168..251	252..335	336..419	420..503
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	84..167	168..251	252..335	336..419	420..503
Border 4-1		■		■	■	
Zone 4-1-2		■			■	
Border 4-2	■	■			■	
Zone 4-2-3	■	■				
Border 4-3	■	■		■		
Zone 4-3-1		■		■		

Table 6: PCI sub-sets for NR for use in border areas when the carrier 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 can be found in Annex 3.
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.

ANNEX 6: GUIDANCE ON THE CONSIDERATION OF LTE RADIO PARAMETERS FOR USE IN BILATERAL AND MULTILATERAL AGREEMENTS

This Annex is provided for guidance purposes for use in bilateral/multilateral discussions. For LTE, it may be beneficial to co-ordinate other radio parameters besides PCI (which is covered by the previous Annex) in order to minimise deteriorating effects of uplink interference.

The parameters described in this Annex are usually optimised during LTE radio network planning of an operator's network. The idea of optimisation is to plan the parameters taking into account specific correlation properties of the uplink control signals which enable more stable and predictable operation of the network. In the cross-border scenario the optimisation of parameters among neighbouring operators could provide better control of uplink interference. However because of the difference between intra-network and inter-network interference and due to limited experience in the LTE cross-border deployment, it is difficult to assess the benefits of such optimisation. The following guidance provides the basis for operators to consider in border areas in case of high levels of uplink interference.

1. Demodulation Reference Signal (DM RS) coordination

Demodulation Reference Signals (DM RS) are transmitted in the uplink and used for channel estimation. There is a risk of intercell interference between neighbouring cells even in case of no frame synchronisation. That is why special measures for DM RS allocation between networks in neighbouring countries occupying the same channel may need to be applied.

The case of partial channel overlap has not been studied but due to DM RS occupying resource blocks of separate users there is a risk of DM RS collisions between neighbouring networks when the subcarriers positions coincide (the frequency offset between central carriers of neighbouring networks is multiple of 300 kHz). Some minor benefits from DM RS coordination in these particular cases could be expected.

There are a number of possible approaches to the coordination of DM RS:

- In basic planning procedure only 30 DM RS sequence groups with favourable correlation characteristics are available, numbered {0…29}. In this case, each cell could be assigned one of the 30 DM RS sequence groups providing cluster size of 30;
- It is possible to extend each DM RS sequence group to generate up to 12 time shifted sequence groups by applying the cyclic shift parameter stated in 3GPP TS 36.211. For example each tri-sector site could be assigned one DM RS sequence group with each co-sited cell having its own cyclic shift of 2π/3 which provides cluster size 30 only with 10 DM RS sequence groups. The latter case corresponds well to the case of DM RS sequence groups repartition between neighbouring countries when only limited number of groups is available for network planning. The drawback of DM RS sequence group cyclic shift is a loss of orthogonally of DM RS due to fading channels which has been found only recently during first trials of LTE and caused throughput loss as well as time alignment problems;
- Another approach for DM RS coordination is to implement dynamic DM RS sequence group allocation also called pseudo-random group hopping. In this method nearby cells are grouped into clusters up to 30 cells and within each cell cluster the same hopping-pattern is used. At the border of two clusters inter-cell interference is averaged since two different hopping patterns are utilised. There are 17 defined hopping patterns, numbered {0…16}, which leads to some minor unfairness in case of apportioning these patterns between neighbouring countries. Even in a trilateral case each operator will have at least 5 hopping patterns available near the border which should be enough for planning purposes. It should be noted the pseudo-random group hopping option could be absent in the first generations of LTE equipment.

The decision of which of these methods to use in cross-border coordination should be agreed by the interested parties. Specific DM RS sequence groups or hopping patterns repartition is not provided in the text of this Recommendation but could be deduced in a similar manner to the PCI repartition shown in the previous annex.

2. Physical Random Access Channel (PRACH) coordination

Another radio network parameter which is considered during radio network planning is PRACH configuration which is needed to distinguish random access requests addressed to different cells. PRACH resources are allocated by specifying the PRACH Resource Blocks time positions within the uplink frame, their frequency position within the LTE channel bandwidth and by apportioning cell-specific root sequences. During radio network planning these parameters are usually used in the following way:

- time positions for PRACH resource allocations are usually used to create time collision of PRACH resources of co-sited/frame synchronised cells because PRACH-to-PRACH interference is usually less severe than PUSCH-to-PRACH interference;
- frequency positions within the LTE channel bandwidth is usually the same for all cells, again because PRACH-to-PRACH interference case is more favourable one.
- cell-specific root sequences are used to distinguish between PRACH requests addressed to different cells.

For cross-border coordination it is proposed to use frequency position offsets to exclude the possibility of so-called “ghost” PRACH requests caused by neighbouring networks. The PRACH is configured in LTE to use only 6 Resource Blocks or 1.08 MHz of the LTE channel bandwidth except in regions used by PUCCH. In case of overlapping or partially overlapping channel bandwidths of neighbouring networks it is enough to establish non-overlapping PRACH frequency blocks to perform coordination. Because it is difficult to establish an implementation dependent procedure for such allocation it will be the responsibility of operators to manage such frequency separation during coordination discussions.

In early implementation, it is possible that very limited number of frequency positions will be supported by LTE equipment which will not be enough to coordinate in the trilateral case. In such cases, root-sequence repartition could be used. There are 838 root sequences in total to be distributed between cells, numbered {0..837}. There are two numbering schemes for PRACH root sequences (physical and logical) and that only logical root sequences numbering needs be used for coordination. Unfortunately the process of root sequences planning doesn’t involve direct mapping of root sequences between cells because the number of root sequences needed for one cell is dependent on the cell range. The table showing such interdependency is presented below:

Table 7: Interdependency of PRACH root sequences with cell range

PRACH Configuration	Number of root sequence per cell	Cell Range (km)
1	1	0.7
2	2	1
3	2	1.4
4	2	2
5	2	2.5
6	3	3.4
7	3	4.3
8	4	5.4
9	5	7.3
10	6	9.7
11	8	12.1
12	10	15.8
13	13	22.7
14	22	38.7
15	32	58.7
0	64	118.8

Thus in the case of root sequence repartition, it will be the responsibility of radio network planners to assign the correct number of root sequences in order to not to overlap with the root sequence ranges of other operators. It also should be noted that different root sequences have different cubic metrics and correlation properties which affect PRACH coverage performance and planning of so-called high-speed cells. For simplicity of cross-border coordination, it is proposed to ignore these properties.

In summary, it should be stipulated that frequency separation of PRACH resources should be used as the main coordination method. PRACH root sequences repartition should be avoided and used only in exceptional cases. Specific PRACH root sequences repartition is not provided in the text of Recommendation but could be deduced in a similar manner to the PCI repartition shown in the previous annex.

ANNEX 7: LIST OF REFERENCES

This annex contains the list of relevant reference documents.

[1] ECC Recommendation (05)08 : "Frequency planning and cross-border coordination between GSM Land Mobile Systems (GSM 900, GSM 1800, and GSM-R)", amended October 2021

[2] ERC Decision (94)01: "The frequency bands to be designated for the coordinated introduction of the GSM digital pan-European communications system", approved October 1994

[3] ERC Decision (97)02: "The extended frequency bands to be used for the GSM Digital Pan-European Communications System", approved by March 1997

ERC Decision (95)03: "The frequency bands to be designated for the introduction of DCS 1800", approved December 1995

[4] ECC Decision (06)13: "Designation of the bands 880-915 MHz, 925-960 MHz, 1710-1785 MHz and 1805-1880 MHz for terrestrial UMTS, LTE and WiMAX and IoT cellular systems", amended March 2019

[5] Commission Decision of 16 October 2009 on the harmonisation of the 900 MHz and 1 800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community (2009/766/EC)

[6] 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"

[7] Recommendation ITU-R P.1546: "Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz"

[8] HCM Agreement: http://www.hcm-agreement.eu/

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

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

[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