European Radiocommunications Committee (ERC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

BASIC PRINCIPLES FOR SPECTRUM SHARING BETWEEN THE GSM AND RSBN SYSTEMS

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1 BACKGROUND INFORMATION

In 1994 ERC approved the Decision (94)01 on the Harmonised designation of frequency bands 890-915 MHz / 935-960 MHz to the GSM Public Land Mobile Telephony System. The success of this system in Europe has ever since been enormous, which caused the quick exhaustion of the allocated frequency bands.

In order to solve this problem and provide some more room for further development of GSM in Europe, later ERC approved the Decision (97)02, which additionally designated frequency bands 880-890 MHz / 925-935 MHz for extension of GSM system (therefore referred to as Extension- or simply E-GSM system/bands). For the purpose of this Report we shall refer to both GSM and E-GSM systems generally as to GSM system, unless otherwise specifically stated in relevant parts of the text.

In parallel with all these developments of GSM system, parts of the GSM bands are also currently used in some CEPT countries by the Aeronautical Radionavigation System called RSBN/PRMG (later in this Report we shall refer to it generally as RSBN system).

Research into the issues of compatibility between GSM and RSBN systems reveals impossibility of the simultaneous use of both systems in the same parts of a frequency band at the same time in the same place (operation on non-interference basis). The time sharing is also not applicable in this situation.

Assuming that, it appears that the only possibilities to share the spectrum lie in the application of either frequency or geographical separation principles, or both of them [1].

Therefore, this Report addresses relevant necessary provisions for application of these two sharing principles in the case of use of different systems (GSM vs. RSBN) in neighbouring countries.

2 PROVISIONS OF ADMINISTRATIVE NATURE

2.1 Provisions of the ITU Radio Regulations

Allocation of the band 862-960 MHz to “MOBILE except aeronautical mobile” service is made for Region 1 in the Table of Frequency Allocations, Article S5 of the Radio Regulations (RR).

Additional allocation to RSBN is made through the footnote S5.323, stating that in several countries (among them in some CEPT countries) “the band 862-960 MHz is also allocated to the aeronautical radionavigation service on a primary basis. Such use is subject to agreement obtained under Article 14/S9.21 with Administrations concerned and limited to ground-based radiobeacons in operation on 27 October 1997 until the end of its lifetime”.

2.2 Provisions of the European Common Frequency Allocation Table

The European Common Frequency Allocation Table (ECA), contained in the ERC Report 25, allocates the frequency band 862-960 to the primary MOBILE service (secondary allocation to Radiolocation service is made for sub-band 890-942 MHz).

Allocation to RSBN is made through reference to RR footnote S5.323, with additional ECA footnote EU13. ECA footnote EU13 states that “CEPT Administrations are urged to take all practical steps to clear the band 645-960 MHz of the assignments to the aeronautical radionavigation service by the year 2008”.

3 Provisions for application of the principle of frequency separation

The overall comparison of GSM and RSBN frequency bands is presented below in Figure 1 (only those RSBN bands which overlap with the GSM bands are presented in the Figure 1 and further considered in this Report).

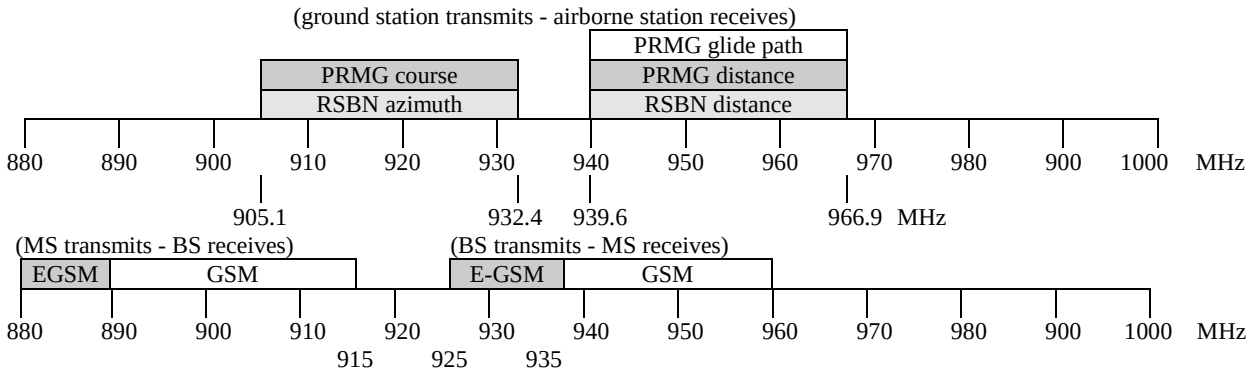

Figure 1. Comparison of overlapping GSM and RSBN frequency bands

It may be noted, that in countries using the RSBN the precise number of RSBN channels from the whole RSBN band, necessary to insure the acceptable quality of the navigation system operation differs from country to country and is dependent on the area of that country and the airfield density on its territory.

However, a number of those CEPT Administrations, which use RSBN system, have estimated possibilities to reduce the number of necessary RSBN channels and agreed, that the essential minimum requirements for operation of RSBN on their territory could be met within the bands 925-933 MHz / 959-967 MHz [2].

In this respect, attention should be also drawn to a fact, that reduction of a number of available channels sometimes may put a higher burden on the RSBN operating authorities to re-plan the RSBN assignments among themselves on the international level.

At the same time, permanent increase of GSM penetration in Europe does not allow to make any assumption on reducing spectrum requirements for GSM system. Therefore, the entire spectrum designated by the ERC Decisions (94)01 and (97)02 has to be considered as essential minimum for GSM system.

Assuming all above, the comparison of the essential minimum spectrum requirements for GSM and RSBN systems is presented below in Figure 2.

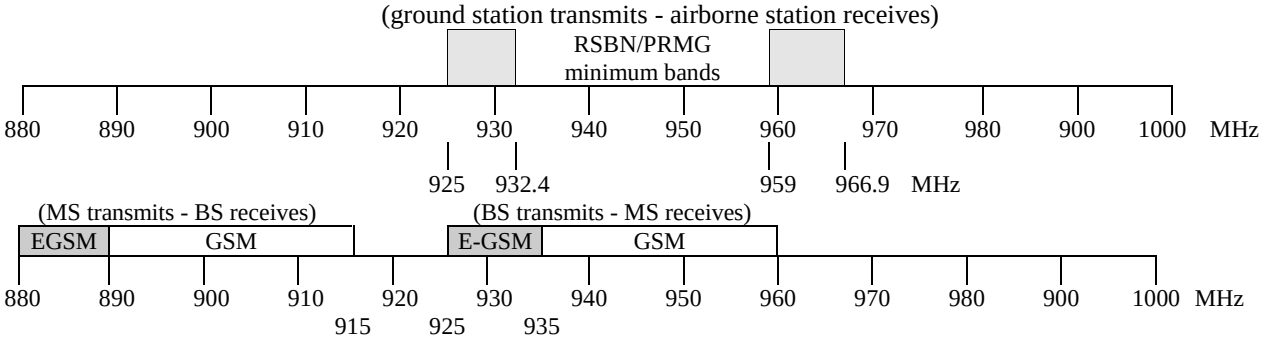

Figure 2. Comparison of essential minimum spectrum requirements for GSM and RSBN systems

From the picture presented in Figure 2, the provisions for possible application of the frequency separation principle may be derived. That is, in the frequency range from the 932.4 MHz to 959 MHz base stations (BS) of the GSM system may operate on a non-restricted basis. Operation of both GSM and RSBN systems on the overlapping channels within the remaining sub-bands 925-932.4 MHz and 959-960 MHz would require solution of the electromagnetic compatibility between GSM and RSBN by other means, e.g. geographical separation.

4 PROVISIONS FOR APPLICATION OF THE PRINCIPLE OF GEOGRAPHICAL SEPARATION

When applying the principle of geographical separation, the risk of potential interference is usually reduced by placing the interfering transmitting station at a safe distance from the victim receiver.

In this case of GSM vs. RSBN spectrum sharing, the assumption can be made that either the RSBN receiver might be flown right along the border line, or the GSM BS may be placed close to the border line. This means that in the case of GSM BS placed close to the border line, the neighbouring country will not be able to use overlapping RSBN channel for operation in the proximity to that BS. And likewise, the operation of particular RSBN channel when flying along the border line would require placement of the BS with overlapping GSM channel at a certain distance from the border. Therefore, neighbouring countries will have to ensure certain safe distance to separate their overlapping frequency assignments.

In order to guarantee in advance that the estimation of such safe distances of geographical separation shall be valid for all possible cases of interference, the worst-case interference scenario must be taken into account for calculation of that distance. In our case, the co-channel (in this case it means the same centre frequencies) interference from a powerful GSM Base Station (BS) into the RSBN receiver is to be considered as a worst-case scenario.

Similarly, the worst-case free space propagation model must be assumed for radio wave propagation calculations for both interfering and wanted signals.

On the basis of the said assumptions, necessary geographical separation distances in the horizontal plane between the GSM BS and RSBN airborne receiver were calculated and verified by the in-flight tests, that were carried out under real operating conditions of GSM and RSBN equipment.

The summarised results of these exercises are presented below in Table 1.

Table 1

Neccessary geographical separation distances in horizontal plane between GSM BS and airborne RSBN receivers, to prevent harmful interference into RSBN receivers

EIRP of the BS in direction of airborne RSBN receiver (see Note 1), W ///Interferred RSBN channel	Necessary separation distance of GSM BS from RSBN receiver, km	Necessary separation distance of E-GSM BS from RSBN receiver, km	
	Glide path (see Note 2)	Azimuth	Course
5	3.5	-	12.6
10	5.0	5.6	17.8
50	11.2	23.7	38.9
100	15.8	34.9	56.2

Note 1: EIRP of the BS should be taken in direction towards the airborne RSBN receiver placed at the maximum height of 10000 m for the case of interference to Azimuth channel (for RSBN navigation mode), and at the height of 600 m for two other cases (for PRMG landing mode);
Note 2: The danger of interference into the RSBN/PRMG distance channels is considerably lower.

Detailed explanation of the methodology, used to derive the values in Table 1, may be found in [3].

Therefore, the values of distances from the Table 1 may be used as guidance when applying the principle of geographical separation for shared use of the same bands by GSM and RSBN systems.

That is, it should be enough to ensure that the geographical separation between the Base Station of the GSM network and the airborne RSBN receiver is greater than that, indicated in Table 1 for relevant power value and interference scenario. Then it may be assumed that operation of such Base Station shall not cause interference to the RSBN receiver in neighbouring country, even if it operates on the same carrier frequency.

5 CONCLUSIONS

This Report briefly outlined the possibilities, which may be considered when deciding on possible shared use of spectrum by GSM/E-GSM and RSBN systems. The need for such sharing is anticipated on the basis of several provisions in the Radio Regulations and European Common Frequency Allocation Table, presented in Section 2 of this Report.

It is shown, that the GSM/RSBN spectrum sharing objective may be achieved through application of either frequency or geographical separation principles, or both of them. Together, these principles present a powerful tool, allowing solution of interference problems in various situations of deployment of GSM and RSBN systems in adjacent countries.

References

1. Principles for sharing between military and civil radio services / ERC Report 59 – Bucharest, 2-5 December 1997.
2. Aeronautical radio navigation system RSBN/PRMG. / Doc. WGFM civ/mil(97)3 – Contribution of Czech Republic to the CEPT WG FM Joint Civil-Military Meeting in Bern, 18-19 June 1997.
3. Compatibility between ARN system RSBN/PRMG and E-GSM. / Doc. WGFM civ/mil(98)16 – Contribution of the Russian Federation to the CEPT WG FM Joint Civil-Military Meeting in Vilnius, 3-4 June 1998.