ELECTRONIC COMMUNICATIONS COMMITTEE

ECC Decision
of 1 December 2006
on the harmonised use of airborne GSM systems
in the frequency bands
1710-1785 and 1805-1880 MHz

(ECC/DEC/(06)07)

EXPLANATORY MEMORANDUM

1 INTRODUCTION

There is increasing demand to use mobile communications from wherever you are located, including the use of GSM mobile phones onboard aircraft. However, to ensure successful operation of systems which will facilitate this there is a need to establish a basis for the free circulation use of such equipment within Europe and to provide access to the required spectrum and to ensure that all aeronautical safety issues have been addressed.

2 SCOPE

This decision covers the radio regulatory aspects of operation of such systems, not the aviation safety aspects (both technical and human factors related) that are the responsibilities of the relevant aviation authorities.

3 BACKGROUND

It is a general aim of the Electronic Communications Committee (ECC) to facilitate the free circulation and use of radio equipment. An objective of this Decision is to extend the application of this general aim to include the air transportation domain.

The system under consideration in this Decision, (i.e. the equipment necessary to establish a GSM 1800 MHz pico-cell[1] system onboard an aircraft and to prevent direct connection of the onboard mobile terminals with mobile networks on the ground, "the System"), onboard is intended to provide an interface to onboard GSM mobile terminals providing the full range of services normally provided on a GSM network. It is important to ensure that the mobile terminals onboard the aircraft do not attempt to register with terrestrial Base Transceiver Stations ("BTS") and can only register with the onboard System. The link between the onboard System and the ground is out of the scope of this Decision. The link will operate in a different frequency range, probably using satellite links. These satellite links will be operated in accordance with relevant ECC Decisions. The System will only be operated during certain phases of the flight and will not be operated while the aircraft is on the ground or during take-off and landing.

There is a need for a harmonised approach to the System together with its harmonised use to ensure the provision of an uninterrupted service whilst aircraft cross the borders of various countries and to reduce the regulatory requirements placed on administrations, GSM network operators and aircraft operators.

It will frequently be the case that on any one flight an aircraft will travel through the airspace of more than one country with the time spent in the airspace of any individual country being of short duration. An agreed regulatory approach is required to ensure that the spectrum utilised by the System can be used in any national airspace that the aircraft is crossing, provided that the System conforms to agreed limits in order to prevent harmful interference.

For the purposes of this Decision only it is assumed that the responsibility for the authorisation of the spectrum utilised onboard an aircraft as part of the System should be that of the country of registration of the aircraft

Airworthiness certification of the System is the separate responsibility of the relevant aviation authorities for the country of registration of the aircraft.

[1] Pico cells are cells, mainly used indoors and in this case within the aircraft.

4 REQUIREMENT FOR AN ECC DECISION

There is a need for an ECC Decision to allow for the harmonised use of the System in, and to permit access to, the GSM 1800 MHz frequency band.

ECC Decision
of 1 December 2006

on the harmonised use of airborne GSM systems in the frequency bands 1710-1785 and 1805-1880 MHz

(ECC/DEC/(06)07)

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that every state has sovereignty over the airspace[2], including the radio spectrum, above its territory;

b) that ECC adopted its Report 093 "Compatibility between GSM equipment on board aircraft and terrestrial networks";

c) that the frequency bands 1710-1785 and 1805-1880 MHz are allocated to the mobile service on a co-primary basis in the ITU Radio Regulations;

d) that within Europe the frequency bands 1710-1785 and 1805-1880 MHz have been designated for GSM;

e) that a system (i.e. the equipment necessary to establish a GSM 1800 MHz pico-cell system onboard an aircraft and to prevent a direct connection of the onboard GSM mobile terminals with mobile networks on the ground, "the System") can enable the use of GSM mobile terminals onboard an aircraft during flight;

f) that appropriate measures should be taken to ensure that onboard terminals are switched off when the airborne GSM system is not in operation and that mobile terminals not controlled by the System (such as those from professional mobile networks) remain switched off during all the phases of the flight;

g) that, provided the power levels and frequency bands used by the System are suitably controlled and that mobile terminals onboard an aircraft in flight are prevented from attempting to register with mobile networks on the ground, and can only register with the onboard System, it is possible to ensure that there is no harmful interference to systems operating outside the aircraft;

h) that the effect of the System can be confined within the aircraft, facilitating the efficient use of spectrum;

i) that, without prejudice to the minimum height requirements set out in the Annex, administrations may place additional height or geographic restrictions on the operation of the System over their territory, depending on the terrain and related network deployments in a country;

j) that for the purposes of this Decision the aircraft cabin space is considered to be subject to the control of the country of aircraft registration and the System will only be used within the aircraft;

k) that accordingly responsibility for the authorisation of the spectrum utilised onboard an aircraft by the System will be that of the country of registration of the aircraft, in accordance with that country's authorisation regime;

l) that the use of the relevant frequencies will be authorised by one administration but those frequencies could also be used within the airspace of other countries;

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[2] This defined as:- the space above a particular national territory, treated as belonging to the government controlling the territory. It does not include outer space, which, under the Outer Space Treaty of 1967, is declared to be free and not subject to national appropriation.

m) that the installation and use of the System within the aircraft will be subject to regulation, including airworthiness certification, by the relevant aviation authorities and the System cannot be put into operation until it complies with these requirements;

n) that the communication link between the System and the ground is outside the scope of this Decision;

o) that all necessary measures should be taken to monitor that the System and its installation conform to the relevant technical parameters given in the Annex;

p) that, despite measures to ensure avoidance of harmful interference referred to in considering g), h), i) and o), it may remain necessary for administrations to assist each other with the resolution of reports of interference in a timely manner, in accordance with appropriate ITU procedures;

q) that the System provides an electronic communication service to GSM mobile terminals inside the aircraft during flight;

r) that this Decision shall not impede EU/EFTA countries from fulfilling their obligations according to Community laws;

DECIDES

1. that administrations shall allow the use of the System within the frequency bands 1710-1785 and 1805-1880 MHz provided that the System operator is authorised to operate the System (including the right to use the necessary spectrum) by the country of registration of the aircraft and in accordance with the restrictions referred to in considering i);

2. that the System shall not cause harmful interference to, or claim protection from, any other authorised system;

3. that the use of the System shall comply with the technical and operational requirements set out in the Annex;

4. that this Decision enters into force on 1 December 2006;

5. that the preferred date for implementation of the Decision shall be 1 June 2007;

6. that CEPT administrations shall communicate the national measures implementing this Decision to the ECC Chairman and the Office when the Decision is nationally implemented;

7. that CEPT administrations shall communicate to the ERO any additional national measures supplementing this Decision in accordance with considering i), which shall be then made publicly available on the Office web site (http://www.ero.dk)."

Note:
Please check the Office web site (http//:www.ero.dk) for the up to date position on the implementation of this and other ECC Decisions.

ANNEX

TECHNICAL AND OPERATIONAL REQUIREMENTS FOR AIRBORNE GSM SYSTEMS

A.1 DESCRIPTION OF THE AIRBORNE GSM SYSTEM

The onboard GSM mobile system (the System) enables airline passengers to use their personal mobile terminals during approved stages of flight. GSM access onboard aircraft is provided by one or more pico cell BTS (aircraft-BTS). Onboard mobile terminals must be prevented from attempting to access networks on the ground. This could be ensured:

- By the inclusion of a Network Control Unit (NCU), which raises the noise floor inside the cabin in mobile receive bands and/or;
- Through RF shielding of the aircraft fuselage to further attenuate the signal entering and leaving the fuselage.

The power of the onboard GSM mobile terminals is controlled to the minimum value by the aircraft-BTS. The aircraft-BTS operates in the GSM 1800 frequency band. This band has been selected because the minimum transmit power of the mobile terminal is lower than for the GSM 900 band and the path loss is higher for the 1800 MHz band.. The NCU power must be sufficient to remove "visibility" of the networks located on the ground, whilst not being so high as to cause harmful interference to these networks. Similarly the power of the aircraft-BTS should be sufficient to provide a reliable service, without causing harmful interference to networks on the ground.

The terrestrial networks protected are those operating in frequency bands:

- 450-470 MHz
- 876-915 MHz / 921-960 MHz
- 1710-1785 MHz / 1805-1880 MHz
- 1920-1980 MHz / 2110-2170 MHz

Other frequency bands (such as the 2500-2690 MHz band) might need to be addressed in the future.

This decision applies to operation of the System at a minimum height of 3000 m above ground.

A.2 PREVENTION OF MOBILE TERMINALS FROM ATTACHING TO NETWORKS ON THE GROUND

During the period when the use of GSM mobile terminals is authorized on an aircraft, terminals operating within the frequency bands defined in table 1 shall be prevented from attempting to register with networks on the ground.

Frequency band (MHz)	Considered systems on the ground[3]
460-470	CDMA2000, FLASH OFDM
921-960	GSM, WCDMA
1805-1880	GSM, WCDMA
2110-2170	WCDMA

Table 1

If an NCU is used, the noise power radiated by the NCU must be sufficient to prevent terminals from receiving and connecting to networks on the ground, while also meeting the requirement, described in the section A.3, for maximum power radiated from the aircraft in mobile receive bands[4].

[3] The parameters of the considered victim systems were used when defining the limits described in this annex; see ECC report 93 for the values assumed in the studies.

A.3 E.I.R.P FROM THE NCU/AIRCRAFT-BTS, OUTSIDE THE AIRCRAFT

The total e.i.r.p, defined outside the aircraft, resulting from the NCU/aircraft-BTS shall not exceed[5]:

Height above ground (m)	**Maximum e.i.r.p. produced by NCU/aircraft-BTS, outside the aircraft in dBm/channel**			
	Band: 450 MHz	**Band: 900 MHz**	**Band: 1800 MHz**	**Band: 2 GHz**
	Channel Bandwidth=1.25 MHz	**Channel Bandwidth=200 kHz**	**Channel Bandwidth=200 kHz**	**Channel Bandwidth=3.84 MHz**
3000	-17.0	-19.0	-13.0	1.0
4000	-14.5	-16.5	-10.5	3.5
5000	-12.6	-14.5	-8.5	5.4
6000	-11.0	-12.9	-6.9	7.0
7000	-9.6	-11.6	-5.6	8.3
8000	-8.5	-10.5	-4.4	9.5

Table 2

It should be noted that the limits, defined in the table 2, are dependant on the elevation angle at the victim terminal on the ground (see the attachment to this annex). The values contained in the table are for the case where the victim terminal is directly below the aircraft, and are therefore conservative.

A.4 E.I.R.P FROM THE ONBOARD TERMINAL OUTSIDE THE AIRCRAFT

The e.i.r.p, defined outside the aircraft, resulting from the GSM mobile terminal transmitting at 0 dBm shall not exceed[6]:

Height above ground (m)	Maximum e.i.r.p, defined outside the aircraft, resulting from the GSM mobile terminal in dBm/channel
	1800 MHz
3000	-3.3
4000	-1.1
5000	0.5
6000	1.8
7000	2.9
8000	3.8

Table 3

It should be noted that the limits, defined in table 3, are dependant on the elevation angle at the victim base station on the ground (see the attachment to this annex). The values contained in the table correspond to an angle of elevation of 2°, which are conservative.

A.5 MINIMUM HEIGHT FOR OPERATION

The absolute minimum height above ground for any transmission from the system in operation shall be 3000 metres. However, this minimum height requirement could be set higher, in particular:

- in order to comply with the aircraft-BTS and the onboard terminals emission requirements set in previous sections,

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[4] If these two requirements cannot be simultaneously met for a particular aircraft height, the minimum height for the operation of the System must be increased.

[5] The values quoted in the tables 2 and 3 correspond to a maximum increase of the receiver noise floor 1 dB (i.e. I/N ≤ -6 dB) with a high statistical confidence using the most sensitive types of base stations and terminals.

[6] The values quoted in the tables 2 and 3 correspond to a maximum increase of the receiver noise floor 1 dB (i.e. I/N ≤ -6 dB) with a high statistical confidence using the most sensitive types of base stations and terminals.

- depending on the terrain and related network deployments in a country.

A.6 OPERATIONAL REQUIREMENTS

The aircraft-BTS shall control the transmit power of all GSM mobile terminals, transmitting in the GSM 1800 band, to the minimum nominal value of 0 dBm at all stages of communication, including initial access.

It is necessary that appropriate measures are taken to ensure that onboard terminals are switched off when the airborne GSM system is not in operation and that mobile terminals not controlled by the System (such as those from professional mobile networks) remain switched off during all the phases of the flight.

ATTACHMENT TO ANNEX: IMPLEMENTATION CONSIDERATIONS

Considerations for design/installation of systems

The requirements for operation of an Airborne GSM system, which would ensure avoidance of interference into terrestrial networks, are highly dependent on many factors of the System, including the aircraft size and type, its RF isolation characteristics, propagation characteristics within the cabin and the installation of the onboard system.

Defining the emissions requirements outside the aircraft (as given in A.3 and A.4) has the following advantages:

- The limits are independent of the aircraft type and technical characteristics, such as size, fuselage construction and its RF shielding features, etc;
- The limits are technology neutral as they would not assume a specific type of installed Airborne GSM system (e.g. whether system uses NCU or not, what type of antennas are used for aircraft-BTS, etc);
- The manufacturers and operators of Airborne GSM systems have freedom to trade-off different elements of technical system design and choice of installation for achieving compliance with the limits, such as:
    - variation of the output power of NCU/aircraft-BTS inside the cabin depending on the fuselage attenuation;
    - choosing for the NCU/aircraft-BTS an appropriate antenna type, number and their placement so as to achieve the most efficient coverage along the cabin while limiting radiation outside the aircraft;
    - evaluating more precisely the propagation characteristics inside the cabin, e.g. variation of signal strength due to the layout of the cabin, and factoring this into the evaluation of emissions radiated outside the aircraft, and so on.

Administrations wishing to authorize the operation of Airborne GSM systems may require that documentation describing the evaluation of installation be provided as part of the authorization of the Airborne GSM system. Additionally, administrations authorizing the GSM onboard systems should also consider various mitigation factors such as the distribution of the carriers over the authorized band.

Some factors that might be considered as part of a detailed evaluation are briefly summarized in the following sub-sections.

Further detailed information on these issues is available in ECC Report 93.

Attenuation by aircraft fuselage

The aircraft attenuation is a very important factor when considering how the emission limits outside aircraft should relate to the actual parameters of the Airborne GSM system equipment installed onboard an aircraft (notably output power for the NCU/aircraft-BTS and their antenna type and radiation characteristics). However this factor is highly dependant on the individual aircraft features such as its size, fuselage construction and material, number of windows, etc. Therefore it is impractical to find a single precise relationship (analytical or empirical formula), which would be applicable to all aircraft makes/types.

It is envisaged that the manufacturers/operators will be able to evaluate with a reasonable degree of precision the fuselage attenuation of each particular aircraft type where the Airborne GSM system is intended to be used and thus would be able to relate the emissions limits outside aircraft with the equipment parameters and emission limits inside that particular aircraft.

Elevation angle at ground victim receiver

- The studies described in ECC Report 93 demonstrate that the limits for maximum radiation from Airborne GSM system in order to protect ground networks would depend on the elevation angle at which the ground victim receiver sees the interfering aircraft. This is due to the fact that for a given height, two factors vary inversely with the elevation angle to the aircraft: the lower the elevation angle, the higher the distance to the aircraft and the larger the free space path loss; but
- the lower the elevation angle, the higher the victim receiver antenna gain of the ground BTS.

Since the elevation angle will change as the aircraft flies over terrestrial base stations, the worst case elevation angle is assumed when deriving the radiation limits given in the annex.

If the radiation pattern of the aircraft is known, this information could be considered when defining the emission limits for a specific aircraft type and installation (e.g. positioning of NCU/aircraft-BTS antennas in relation to aircraft windows).

More information on this issue (incl. the graphs for emissions limits as a function of elevation angle) can be found in section 8 of ECC Report 93.