



# ECC Decision (06)07

The harmonised use of airborne GSM, LTE and 5G NR non-AAS systems in the frequency bands 1710-1785 MHz and 1805-1880 MHz, and airborne UMTS systems in the frequency bands 1920-1980 MHz and 2110-2170 MHz<sup>1</sup>

**approved 1 December 2006**

latest corrected 18 November 2022

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<sup>1</sup> Comparable technical specifications to those given in this ECC Decision are given in Commission Decisions 2008/294/EC [1], 2013/654/EU [2] and 2016/2317/EU [3], as well as Commission Recommendation 2008/295/EC [4]. EU Member States and, if so approved by the EEA Joint Committee, Iceland, Liechtenstein and Norway are obliged to implement the EC Decision.

## EXPLANATORY MEMORANDUM

### 1 INTRODUCTION

There is increasing demand to use mobile communications from wherever you are located, including the use of mobile communications terminals 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 and 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 Mobile communications pico-cell<sup>2</sup> system onboard an aircraft based on GSM, UMTS, LTE or 5G NR non-AAS technology 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 mobile communications terminals providing the full range of services normally provided on a mobile communications 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, mobile communications network operators and aircraft operators.

Frequently, an aircraft will travel through the airspace of more than one country with the duration spent in the airspace of any individual country being comparatively short. 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.

On 24 September 2014, the European Aviation Safety Agency (EASA) adopted Decision 2014/029/R [5] which makes it possible for European airlines to allow passengers to use their Portable Electronic Devices in transmitting mode (TPEDs) during all phases of flight i.e. without the need to be in "airplane mode", on non-equipped aircraft with the System. In the context of this Decision PEDs are ac-UE (Mobile Network User Equipment on-board aircraft). However this EASA Decision is focused only on the aeronautical safety considerations with the use of the PED onboard aircraft, and does not consider radio frequency compatibility

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<sup>2</sup> Pico-cells are cells, mainly used indoors and in this case within the aircraft.

issues with other applications or services. ECC Decision (06)07 applies to operation of the System at a minimum height of 3000 m above ground.

CEPT noted that the use of a NCU is not mandatory in all CEPT administrations and investigated how to simplify the regulatory framework in 2015/16 and again in 2021 further to a request from an operator of mobile communication services on board aircraft (MCA).

CEPT studies in response to EC Mandates on MCA (see CEPT Report 63 [6] and CEPT Report 81 [7]) have concluded that MCA operations without an NCU are sufficient to guarantee a reasonable protection against resulting interference and signalling issues to and from terrestrial GSM and/or LTE wireless as well as 5G NR telecommunication systems. For UMTS systems, the studies conclude that an NCU is necessary to prevent connection of User Equipment onboard to mobile communications networks on the ground, and that without an NCU or sufficient aircraft attenuation the resulting connection could cause a partial and temporary reduction in capacity for the connecting and neighbouring ground based cells.

#### **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 1800 MHz and 2100 MHz frequency bands.

This ECC Decision initially designated only the 1800 MHz band for GSM systems. However subsequent to a request to study the possibility to use UMTS and LTE technologies for onboard aircraft mobile communications, the ECC decided to update this ECC Decision on 14 March 2014. The technical conditions for the use of the added cellular technologies are detailed in ECC Report 187 [8] whose results are included in the Annex of this ECC Decision.

The European Commission mandated CEPT to undertake studies to determine whether the installation of a NCU onboard MCA equipped aircraft may be made optional as well as to determine the possibility to use 5G non-AAS for MCA in the 1800 MHz (1710-1785 MHz and 1805-1880 MHz) band. CEPT Report 63 [6] and CEPT Report 81 [7] contain the results of these work and form the basis for the update to this ECC Decision.

**ECC DECISION OF 1 DECEMBER 2006 ON THE HARMONISED USE OF AIRBORNE GSM, LTE AND 5G NR NON-AAS SYSTEMS IN THE FREQUENCY BANDS 1710-1785 MHZ AND 1805-1880 MHZ, AND AIRBORNE UMTS SYSTEMS IN THE FREQUENCY BANDS 1920-1980 MHZ AND 2110-2170 MHZ (ECC DECISION (06)07), AMENDED 13 MARCH 2009, 14 MARCH 2014 AND 18 NOVEMBER 2016, UPDATED ON 30 JUNE 2017, AMENDED 1 JULY 2022 AND CORRECTED 18 NOVEMBER 2022**

“The European Conference of Postal and Telecommunications Administrations,

*considering*

- a) that every state has sovereignty over the airspace<sup>3</sup>, including the radio spectrum, above its territory;
- b) that ECC adopted its Report 093 [8] “Compatibility between GSM equipment on board aircraft and terrestrial networks” and complementary ECC Report 187 [9] “Compatibility study between mobile communication services on board aircraft (MCA) and ground based systems” as well as CEPT Report 63 [6] and CEPT Report 81 [7] in response to the EC Mandates on MCA;
- c) that the frequency bands 1710-1785 and 1805-1880 MHz, 1920-1980 MHz and 2110-2170 MHz are allocated to the mobile service on a co-primary basis in the ITU Radio Regulations [10];
- d) that within Europe the frequency bands 1710-1785 MHz and 1805-1880 MHz have been designated for Mobile/Fixed Communications Networks on a technology neutral basis, and are used by GSM, LTE and 5G NR systems at the time of the adoption of this Decision;
- e) that within Europe the frequency bands 1920-1980 MHz and 2110-2170 MHz have been designated for Mobile/Fixed Communications Networks on a technology neutral basis, and are used by UMTS, LTE and 5G NR at the time of the adoption of this Decision;
- f) that a system (i.e. the equipment necessary to establish an MCA pico-cell system onboard an aircraft and to prevent a direct connection of the onboard mobile communications terminals with mobile networks on the ground, “the System”) can enable the use of mobile communications terminals onboard an aircraft during flight;
- g) that appropriate measures should be taken to ensure that there is no harmful interference from the System to the ground mobile networks. In particular CEPT Report 63 [6] and CEPT Report 81 [7] conclude that a Network Control Unit (NCU) should be implemented in the frequency bands where UMTS ground networks are in operation unless it is demonstrated that there is sufficient aircraft fuselage attenuation;
- h) that existing NCUs operating in frequency bands other than those where UMTS is deployed respect the maximum e.i.r.p. limits, set in ECC Report 93 [8] and ECC Report 187 [9]. 2.6 GHz NCU operations, are no longer necessary under the terms of this Decision and should be deactivated as soon as possible;
- i) that for the protection of terrestrial GSM, LTE and 5G NR networks no NCU is needed;
- j) that compared to CEPT Report 63, CEPT Report 81 took into consideration 1800 MHz AAS ground base stations parameters and updated accordingly the applicable e.i.r.p. limits from the onboard terminal outside the aircraft for 5G NR operating in the 1800 MHz frequency band;
- k) that there is no fundamental difference between non-AAS LTE and 5G NR technologies;
- l) 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;

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<sup>3</sup> 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 <https://www.britannica.com/eb/topic?idxStructId=435589&typeId=13> Outer Space Treaty of 1967, is declared to be free and not subject to national appropriation.

- m) that the effect of the System can be confined within the aircraft, facilitating the efficient use of spectrum;
- n) that, without prejudice to the minimum height requirements set out in Annex 1, 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;
- o) 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;
- p) 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;
- q) 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;
- r) 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;
- s) that the communication link between the System and the ground is outside the scope of this Decision;
- t) that all necessary measures should be taken to monitor that the System and its installation conform to the relevant technical parameters given in Annex 1;
- u) that, despite measures to ensure avoidance of harmful interference referred to in considering j), k), l) and r) 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;
- v) that the System provides an electronic communication service to mobile communications terminals inside the aircraft during flight;
- w) 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 airborne GSM, LTE and 5G NR non-AAS systems in the frequency bands 1710-1785 and 1805-1880 MHz, and airborne UMTS systems in the frequency bands 1920-1980 MHz and 2110-2170 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 n);
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 Annex 1; the provisions in A1.1, A1.2 and A1.3 regarding the protection of UMTS networks in the 900 MHz and 2.1 GHz bands are applicable until 1 January 2026, after which point these provisions are optional;
4. that this Decision **enters into force** on 1 July 2022;
5. that the preferred date for implementation of the Decision shall be 1 January 2023;
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 ECO any additional national measures supplementing this Decision in accordance with considering n), which shall be then made publicly available on the Office web site (<https://www.cept.org/ecc>).

*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 Decisions.*

## ANNEX 1: TECHNICAL AND OPERATIONAL REQUIREMENTS FOR AIRBORNE MOBILE COMMUNICATIONS SYSTEMS

### A1.1 DESCRIPTION OF THE AIRBORNE MOBILE COMMUNICATIONS SYSTEM

The onboard mobile communications system (the System) enables airline passengers to use their personal mobile terminals during approved stages of flight. Mobile communications access onboard aircraft is provided by one or more pico-cell base stations (aircraft-BTS).

In cases where terrestrial GSM, LTE and 5G NR systems are deployed, intra-network interference will prevent onboard mobile terminals from attempting to register with mobile networks on the ground.

Onboard mobile communications terminals must be prevented from attempting to register with UMTS mobile 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 mobile communications terminals is controlled by the aircraft-BTS. The following frequency bands and associated technologies:

- GSM 1800: 1710-1785 MHz and 1805-1880 MHz;
- LTE 1800: 1710-1785 MHz and 1805-1880 MHz;
- 5G NR 1800 non-AAS<sup>4</sup>: 1710-1785 MHz and 1805-1880 MHz;
- UMTS2100 (FDD): 1920-1980 MHz and 2110-2170 MHz;

could be used for the provision of mobile communication service onboard aircraft.

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.

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

### A1.2 PREVENTION OF MOBILE TERMINALS FROM ATTACHING TO NETWORKS ON THE GROUND

If terrestrial UMTS systems are deployed in a certain frequency band and if the aircraft fuselage to attenuate the signal entering and leaving the fuselage is not sufficient to prevent from attempting to access networks on the ground, an NCU is needed (see A1.1 above). Therefore, currently the NCU shall operate in the following frequency bands:

- 925-960 MHz  
and
- 2110-2170 MHz

and the noise power radiated by the NCU must be sufficient to prevent onboard terminals from receiving and connecting to UMTS networks on the ground, while also meeting the requirement, described in the section A1.3, for maximum power radiated from the aircraft in mobile receive bands<sup>5</sup>.

<sup>4</sup> complying with the 5G NR Standards as published by ETSI EN 301 908-24 and ETSI EN 301 908-25.

<sup>5</sup> 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.

### A1.3 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<sup>6</sup>:

**Table 1: Maximum e.i.r.p. produced by the System**

Height above ground (m)	Maximum e.i.r.p. produced by the System outside the aircraft in dBm/channel			
	Band: 900 MHz	Band: 1800 MHz		Band: 2.1 GHz
	NCU (note 1)	Aircraft BS		Aircraft BTS (UMTS) and NCU
		GSM and LTE	5G NR	
	Channel Bandwidth= 3.84 MHz	Channel Bandwidth= 200 kHz (note 2)	Channel Bandwidth= 5 MHz (note 3)	Channel Bandwidth= 3.84 MHz
3000	-6.2	-13.0	10	1.0
4000	-3.7	-10.5	13	3.5
5000	-1.7	-8.5	15	5.4
6000	-0.1	-6.9	16	7.0
7000	1.2	-5.6	18	8.3
8000	2.3	-4.4	19	9.5

Note 1: The aircraft BTS is not in operation at 900 MHz, however, an NCU is needed to prevent terminals using other MCA channels from connecting to the 900 MHz UMTS terrestrial networks.

Note 2: For channel bandwidth other than 200 kHz, a correction, calculated by the formula  $10 \times \log_{10}(\text{channel bandwidth}/(200 \text{ kHz}))$  dB, shall be added to the e.i.r.p. values. The reference is CEPT Report 63 [6].

Note 3: For channel bandwidth other than 5 MHz, a correction, calculated by the formula  $10 \times \log_{10}(\text{channel bandwidth}/(5 \text{ MHz}))$  dB, shall be added to the e.i.r.p. values. The reference is CEPT Report 81 [7].

It should be noted that the limits, defined in the Table 1, are dependent 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.

### A1.4 E.I.R.P. FROM THE ONBOARD TERMINAL OUTSIDE THE AIRCRAFT

The e.i.r.p., defined outside the aircraft, resulting from the GSM 1800 mobile terminal transmitting at 0 dBm shall not exceed<sup>7</sup>:

<sup>6</sup> The values quoted in Table 2 correspond to a maximum increase of the receiver noise floor 1 dB (i.e.  $I/N \leq -6$  dB) with a high statistical confidence using the most sensitive types of base stations and terminals.

<sup>7</sup> The values quoted in Table 3, Table 4 and Table 5 correspond to a maximum increase of the receiver noise floor 1 dB (i.e.  $I/N \leq -6$  dB) with a high statistical confidence using the most sensitive types of base stations and terminals.

**Table 2: Maximum e.i.r.p. from GSM terminal operating on board at 1800 MHz**

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

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

In the 2100 MHz connectivity band — UMTS technology, FDD:

- the transmit power of the UMTS terminal must not exceed -6 dBm/(3.84 MHz) and the maximum number of users should not exceed 20;
- the e.i.r.p. of the ac-UE defined outside the aircraft must not exceed the following values as shown in Table 3:<sup>8</sup>

**Table 3: Maximum e.i.r.p. from UMTS terminal operating on board at 2.1 GHz**

Height above ground (m)	Maximum e.i.r.p., defined outside the aircraft, resulting from the ac-UE in dBm/3.84 MHz
	2100 MHz
3000	3.1
4000	5.6
5000	7
6000	7
7000	7
8000	7

In the 1800 MHz connectivity band - LTE and 5G NR non-AAS:

- The e.i.r.p. defined outside the aircraft resulting from the LTE and 5G NR terminals transmitting at 5 dBm/channel inside the aircraft must not exceed the values as provided in Table 4.

<sup>8</sup> The values quoted in Table 3, Table 4 and Table 5 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.

**Table 4: Maximum e.i.r.p. from LTE and 5G NR terminal operating on board at 1800 MHz**

Height above ground (m)	Maximum e.i.r.p., defined outside the aircraft, resulting from the LTE and 5G NR mobile terminal in dBm/channel 1800 MHz
3000	0
4000	2
5000	4
6000	6
7000	7
8000	8
The reference is CEPT Report 81 [7] where 5G NR non-AAS MCA systems were considered together with both 5G AAS and 5G non-AAS ground based BS as well as other non-AAS terrestrial systems (GSM, LTE). See also considering j) and k)	

For ac-UE, the e.i.r.p. is specified per channel regardless of the used channel bandwidth due to the fact that multiple ac-UE could be operated.

**A1.5 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;
- depending on the terrain and related network deployments in a country.

**A1.6 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, UMTS or LTE 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.

The aircraft base station, during operation, must limit the transmit power of all 5G NR mobile terminals transmitting in the 1800 MHz band to a nominal value of 5 dBm/channel at all stages of communication, including initial access.

**A1.7 E.I.R.P. OUTSIDE THE AIRCRAFT FROM NCUS OPERATING IN OTHER FREQUENCY BANDS**

If NCUs operate in frequency bands other than those where UMTS is deployed they shall respect the maximum e.i.r.p. limits set in ECC Report 93 [8] and ECC Report 187 [9]. The maximum e.i.r.p., defined outside the aircraft, resulting from the NCU shall not exceed:

**Table 5: Maximum e.i.r.p. produced by NCUs operating in frequency bands other than those where UMTS is deployed**

Height above ground (m)	Maximum e.i.r.p. outside the aircraft produced by NCU			
	Band: 450 MHz	Band: 800 MHz	Band: 1800 MHz	Band: 2.6 GHz
	Channel	Channel Bandwidth= 10 MHz	Channel Bandwidth= 200 kHz	Channel Bandwidth= 4.750 MHz
3000	-17.0	-0.87	-13.0	1.9
4000	-14.5	1.63	-10.5	4.4
5000	-12.6	3.57	-8.5	6.3
6000	-11.0	5.15	-6.9	7.9
7000	-9.6	6.49	-5.6	9.3
8000	-8.5	7.65	-4.4	10.4

## **ANNEX 2: IMPLEMENTATION CONSIDERATIONS**

### **A2.1 CONSIDERATIONS FOR DESIGN/INSTALLATION OF SYSTEMS**

The requirements for operation of an MCA 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 A1.3 and A1.4) 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 MCA system (e.g. whether system uses NCU or not, what type of antennas are used for aircraft-BTS, etc);
- The manufacturers and operators of MCA 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 authorise the operation of MCA systems may require that documentation describing the evaluation of installation be provided as part of the authorisation of the MCA system. Additionally, administrations authorising the MCA systems should also consider various mitigation factors such as the distribution of the carriers over the authorised band.

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

Further detailed information on these issues is available in ECC Report 093 [8].

### **A2.2 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 MCA 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 dependent 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 MCA 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 093 [8] and ECC Report 187 [9] demonstrate that the limits for maximum radiation from MCA 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 Annex 1.

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 ECC Report 093 [8] and ECC Report 187 [9].

### ANNEX 3: LIST OF REFERENCES

- [1] Commission Decisions (2008/294/EC) of 7 April 2008 on harmonised conditions of spectrum use for the operation of mobile communication services on aircraft (MCA services) in the Community
- [2] Commission implementing Decision (2013/654/EU) of 12 November 2013 amending Decision 2008/294/EC to include additional access technologies and frequency bands for mobile communications services on aircraft (MCA services)
- [3] Commission Implementing Decision (EU) (2016/2317) of 16 December 2016 amending Decision 2008/294/EC and Implementing Decision 2013/654/EU, in order to simplify the operation of mobile communications on board aircraft (MCA services) in the Union
- [4] Commission Recommendation (2008/295/EC) of 7 April 2008 on authorisation of mobile communication services on aircraft (MCA services) in the European Community
- [5] Decision 2014/029/R of the executive director of the Agency of 24 September 2014 on amending Decision 2014/015/R of the Executive Director of the Agency of 24 April 2014 on adopting Acceptable Means of Compliance and Guidance Material to Part-CAT of Regulation (EU) No 965/2012 'AMC and GM to Part-CAT – Issue 2, Amendment 1'
- [6] [CEPT Report 63](#): "To undertake technical studies regarding the possibility of making the usage of the network control unit (NCU) optional onboard MCA enabled aircraft", approved November 2016
- [7] [CEPT Report 81](#): "Report from CEPT to the European Commission in response to Task 1 of the Mandate "Study and assess conditions to operate 5G non-AAS connectivity for MCA in the 1800 MHz (1710-1785 MHz and 1805-1880 MHz) frequency band" and Task 2 of the Mandate "Study and assess whether, and under what conditions, the usage of an NCU in MCA operations could be made optional", approved November 2021
- [8] [ECC Report 093](#): "Compatibility between GSM equipment on board aircraft and terrestrial networks. Revised ECC Report with Annex G (May 2008), approved October 2006
- [9] [ECC Report 187](#): "Compatibility study between mobile communication services on board aircraft (MCA) and ground-based systems", approved February 2013
- [10] ITU Radio Regulations, Edition of 2020