CEPT ECC
Electronic Communications Committee

ECC Decision (15)03

The harmonised use of broadband Direct Air-to-Ground Communications (DA2GC) systems in the frequency band 5855-5875 MHz

Approved 3 July 2015

EXPLANATORY MEMORANDUM

1 INTRODUCTION

This ECC Decision aims at harmonising implementation measures for broadband Direct Air-to-Ground Communications (DA2GC) systems in the frequency band 5855-5875 MHz.

Consumers increasingly expect to be connected everywhere, all the time, e.g. with all kinds of mobile devices. This includes the ability to access broadband services while on-board aircraft and European airlines have expressed an interest in offering internet services to their flight passengers in their continental fleets as soon as possible.

Direct-Air-to-Ground Communications (DA2GC) systems provide a bi-directional radio link between an Aircraft Station (AS) and a Ground Station (GS). The aircraft station is mounted on-board aircraft and is under the control of a network of ground stations which provide control and telecommunication functionalities for DA2GC.

Broadband DA2GC systems may operate in national airspace or international airspace.

This ECC 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.

2 BACKGROUND

Broadband DA2GC systems constitute an application for various types of telecommunications services, such as internet access and mobile multimedia services. Such systems aim to provide access to broadband communication services during continental flights on a Europe-wide basis. The connection with the flight passengers' user terminals within an aircraft is already available using a wired or wireless on-board connectivity network.

The broadband DA2GC systems under consideration in this Decision ("the systems") are intended to provide connectivity between a network of ground stations and appropriately equipped aircraft. The aircraft stations will only transmit during certain phases of the flight and will not be operated while the aircraft is on the ground or during take-off and landing.

The allocation or designation of frequency bands under specified conditions in CEPT member countries is laid down by law, regulation or administrative action. The ECC also recognises that for broadband DA2GC systems on-board aircraft to be introduced successfully throughout Europe, confidence must be given on the one hand to manufacturers to make the necessary investments and on the other hand to users of existing services that their protection will be ensured.

This is particularly needed for broadband DA2GC in order 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 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 typically of short duration. An agreed regulatory approach is required to ensure that the spectrum utilised by the systems can be used in any national airspace that the aircraft is crossing, provided that the systems conform to agreed limits in order to prevent harmful interference.

Airworthiness certification of the systems' aircraft components is the separate responsibility of the relevant aviation authorities for the country of registration of the aircraft.

The wireless link between the aircraft and the worldwide broadband network (e.g. Internet) can be established either by means of broadband DA2GC systems or via satellites. Broadband DA2GC systems

and satellites can be seen as alternative technical solutions which are in competition. On the other hand, both solutions could also be seen as complementary to each other.

MSS systems (1980-2010 MHz / 2170-2200 MHz) are being developed and such systems may include a Complementary Ground Component (CGC). In Europe, MSS CGC systems might also be used to provide communication to aircraft.

3 REQUIREMENT FOR AN ECC DECISION

Broadband DA2GC systems are planned to be deployed in Europe by 2017.

There is a need for an ECC Decision to allow for the harmonised use of the 5855-5875 MHz frequency band for broadband DA2GC.

A commitment by CEPT member countries to implement an ECC Decision will provide a clear indication that this frequency range will be made available on time and on a Europe-wide basis and that the means to ensure protection of existing services will be applied.

ECC DECISION OF 3 JULY 2015 ON THE HARMONISED USE OF BROADBAND DIRECT AIR-TO-GROUND COMMUNICATIONS SYSTEMS IN THE FREQUENCY BAND 5855-5875 MHz

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that the introduction of broadband DA2GC enables broadband communications services during continental flights over wide territories in the CEPT;

b) that aviation passengers can be offered connectivity on European continental and intercontinental flights for aircraft equipped for terrestrial and/or satellite communications systems;

c) that broadband DA2GC systems are likely to be used also for non-safety airline operational communications;

d) that harmonised conditions across CEPT help to establish an effective single market for these applications, with consequent economies of scale and benefits to passengers, and avoid difficulties in enforcing divergent national regulations;

e) that every state has sovereignty over the airspace[1], as well as the radio spectrum, above its territory;

f) that the use of a broadband DA2GC AS requires authorisation by the relevant national administration of the country of registration of the aircraft;

g) that for ASs, different authorisation regimes may be established in each country where the DA2GC is allowed to operate (see ECC Report 214);

h) that DA2GC GS are operated under the control of a network and are licensed individually (see ECC Report 214);

i) that appropriate measures should be taken to ensure that the broadband DA2GC aircraft and ground stations do not cause harmful interference to terrestrial and space systems;

j) that ECC adopted ECC Report 214 "Broadband Direct-Air-to-Ground Communications (DA2GC)", ECC Report 210 "Compatibility/sharing studies related to Broadband Direct- Air-to-Ground Communications (DA2GC) in the frequency bands 5855-5875 MHz, 2400-2483.5 MHz and 3400-3600 MHz" and CEPT Report 57: "(Report A) from CEPT to the European Commission in response to the Mandate 'To study and identify harmonised compatibility and sharing conditions for Wireless Access Systems including Radio Local Area Networks in the bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for the provision of wireless broadband services" ;

k) that the frequency band 5850-5925 MHz is allocated to the mobile service, the fixed service and the fixed-satellite service on a primary basis in the European Common Allocation Table (ERC Report 25) and in the ITU Radio Regulations;

l) that the frequency band 5725-5875 MHz is also designated for industrial, scientific and medical (ISM) applications according to footnote 5.150 of the RR, and that radiocommunication services operating within this frequency band must accept harmful interference which may be caused by these applications;

m) that within Europe the frequency band 5855-5875 MHz has been designated for the fixed satellite service, broadband fixed wireless access (BFWA), intelligent transport systems (ITS) and short range devices (SRD);

[1] 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.

n) that two different DA2GC systems based on a TDD (Time Division Duplex) spectrum access method have been developed and system reference documents have been provided by ETSI for the 5855-5875 MHz frequency band (see ECC Reports 210 and 214) ;

o) that the installation and use of a specific system or systems within the aircraft will be subject to regulation, including airworthiness certification, by the relevant aviation authority and the system cannot be put into operation until it complies with these requirements;

p) that ECC Reports 210 and 214 identify certain technical conditions for broadband DA2GC systems to ensure that they do not cause harmful interference to other services;

q) that co-existence measures or coordination is required between DA2GC GS and BFWA stations both operating in the frequency band 5855-5875 MHz;

r) that coordination is required between DA2GC GS and FSS (E-s) earth stations both operating in the frequency band 5855-5875 MHz;

s) that it is envisaged that the locations of ITS infrastructure units can be established, even in those cases where ITS infrastructure units are exempted from individual licences, and this information could be used, in order to ensure co-existence with DA2GC GS;

t) that additional mitigation measures could be required for the DA2GC AS in order to avoid interferences into operational BFWA systems in the frequency band 5855-5875 MHz;

u) that the protection of the radiolocation service is ensured by a limitation of the unwanted emissions from DA2GC into the frequency band below 5850 MHz;

v) that no additional measures are required to protect road tolling systems within the frequency band 5795-5815 MHz;

w) that the protection of the fixed satellite service is enhanced because only half of the DA2GC TDD beamforming ground stations transmit at any instant due to the use of synchronisation across the DA2GC network;

x) that Decision ECC/DEC/(15)02 designates the frequency band 1900-1920 MHz for broadband DA2GC systems on a non-exclusive basis;

y) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the R&TTE Directive. Conformity with the essential requirements of the R&TTE Directive may be demonstrated by compliance with the applicable harmonised European standard(s) or by using the other conformity assessment procedures set out in the R&TTE Directive.

DECIDES

1. that the **purpose of this ECC Decision** is to:
   - harmonise the use of the frequency band 5855-5875 MHz for broadband Direct-Air-to-Ground Communications (DA2GC) systems;
   - establish a common framework for facilitating implementation of a Broadband DA2GC system in the frequency band 5855-5875 MHz;
2. that CEPT **administrations shall**:
   - designate the frequency band 5855-5875 MHz for Broadband DA2GC on a non-exclusive basis;
   - apply the technical and operational requirements for the harmonised frequency arrangement for TDD in the band 5855-5875 MHz according to Annex 1;
   - ensure co-existence between DA2GC GS as described in Annex 1 and other fixed terrestrial stations and FSS earth stations by taking into account the guidelines as provided in Annex 2;
3. that CEPT administrations shall exempt from individual licensing and shall allow free circulation and use of DA2GC AS operating under the control of a network;
4. that CEPT administrations shall notify the coordinates of the DA2GC GS to the Office;
5. that this Decision shall be subject to review by the end of 2017;
6. that this Decision **enters into force** on 3 July 2015;
7. that the preferred **date for implementation** of the Decision shall be 3 January 2016;
8. that CEPT administrations shall communicate the **national measures** implementing this Decision to the ECC Chairman and the Office when the Decision is nationally implemented."

Note:

Please check the Office documentation database http://www.ecodocdb.dk for the up to date position on the implementation of this and other ECC Decisions.

ANNEX 1: TECHNICAL AND OPERATIONAL REQUIREMENTS FOR DA2GC SYSTEMS IN THE BAND 5855-5875 MHz WITH TDD OPERATION MODE

A1.1 TDD ARRANGEMENT WITHOUT BEAMFORMING

A DA2GC ground station may use multiple sector antennas with fixed azimuth and elevation patterns. For such a GS, a fixed elevation up-tilt is introduced to maximise reception at normal cruising altitudes of a commercial aircraft.

The aircraft station antenna may be based on an existing commercial aircraft antenna, which has been enhanced to support operation in the allocated frequency band, and so facilitates retrofit while not creating any additional drag for the aircraft.

Power control is used in both directions, to maintain the required receive power level at the GS and AS receivers.

ECC Reports 210 and 214 provide detailed technical information.

Table 1: Main parameters for ground station and aircraft station

Parameter	Value
Maximum channel bandwidth	20 MHz
Transmitter maximum output power spectral density for GS	28 dBm/MHz
Transmitter maximum output power spectral density for AS	26 dBm/MHz
Transmitter maximum e.i.r.p. spectral density (GS – Sector Antenna with 4 x 90° sectors, 90° half power beam width)	41 dBm/MHz
Transmitter maximum e.i.r.p. spectral density (GS – Directional Antenna) (see Note)	50 dBm/MHz
Transmitter maximum e.i.r.p. spectral density for AS	29 dBm/MHz
Max out-of-band e.i.r.p. spectral density for GS and AS	-38 -10log (20/BW) dBm/MHz below 5850 MHz -8 dBm/MHz above 5875 MHz and 5850-5855 MHz BW = transmitter bandwidth (MHz)

Note:
The directional antenna will only be used where maximum range is required. This will be mainly over sea. To protect any systems located near the coast, the main beam shall not illuminate any landfall within 4 km. The directional antenna may be used in remote areas, such as desert regions, subject to agreement by the regulatory administration(s).

Table 2: Peak e.i.r.p. spectral density levels as a function of the elevation angle for the GS

Elevation Angle	Peak e.i.r.p. spectral density level (dBm/MHz)
Θ < 4°	21
4°≤ Θ < 10°	41
10°≤ Θ < 11°	41 to 36 straight line interpolation
11°≤ Θ ≤ 14°	36
Θ > 14°	30

The AS introduces additional transmitter attenuation according to its height above ground as follows for decreasing e.i.r.p.:

Table 3: AS transmitter attenuation

Height above ground (metres)	Attn (dB)
3 000 to 4 999	8
5 000 to 5 999	6
6 000 to 6 999	4
7 000 and above	0
Minimum operational AS height above ground: 3 000 m	

Table 4: Further co-existence requirements for GS

Ground Station operating in the 5855-5875 MHz band
Coordination with BFWA stations
Co-existence with ITS fixed infrastructure units
Coordination with FSS earth stations (for the protection of DA2GC GS)
The usage of directional antenna is subject to agreement by the regulatory administration(s)
See Annex 2 with guidelines for CEPT administrations to ensure co-existence with other services

Table 5: Further co-existence requirements for AS

Aircraft Station operating in the 5855-5875 MHz band
Additional reduction in maximum e.i.r.p. by 4 dB for aircraft height above ground up to 7 km, in airspace above those regions where co-channel BFWA is used and is to be afforded protection.

A1.2 TDD ARRANGEMENT WITH BEAMFORMING

A beamforming system can be implemented which uses advanced phased array and signal processing technology on the aircraft and at the ground station, to produce shaped and steerable beams. This enables dynamic beam pointing at both ends of the link such that the ground station and the aircraft mutually track each other. The use of beamforming helps to reduce co-channel interference and improves both the DA2GC link performance and its frequency sharing capabilities.

Power control is used in both directions, to maintain the required receive power level at the GS and AS receivers.

ECC Reports 210 and 214 provide detailed technical information.

Table 6: Main parameters for the ground station and aircraft station

Parameter	Value
Maximum channel bandwidth	20 MHz
Max e.i.r.p. spectral density per beam for GS (see note) and AS	32 dBm/MHz
Minimum elevation angle for the beam between GS and AS	5 degrees for all azimuths
Minimum AS operational height above ground	3 000m
Max out-of-band e.i.r.p. spectral density for GS and AS	-38 -10log (20/BW) dBm/MHz below 5850 MHz -8 dBm/MHz above 5875 MHz and 5850-5855 MHz BW = transmitter bandwidth (MHz)
NOTE: For the GS: the e.i.r.p. level in in this table represents the maximum operational level at all times for a single beam in the direction of the aircraft.	

Table 7: e.i.r.p. spectral density mask as a function of elevation angle for the GS

Elevation Angle	Average e.i.r.p. spectral density level (dBm/MHz)
$\Theta < 2°$	4.3
$2° \leq \Theta \leq 16°$	24.3
$\Theta > 16°$	16.3

This average e.i.r.p. spectral density mask represents the sum of the powers generated by all beams of the DA2GC Ground Station in any given azimuth direction.

Any measurement of the average power for enforcement purposes will need to be performed over a significantly long duration to ensure that a true average is obtained.

Peak e.i.r.p. levels can exceed the average values in Table 7 for small percentages of time.

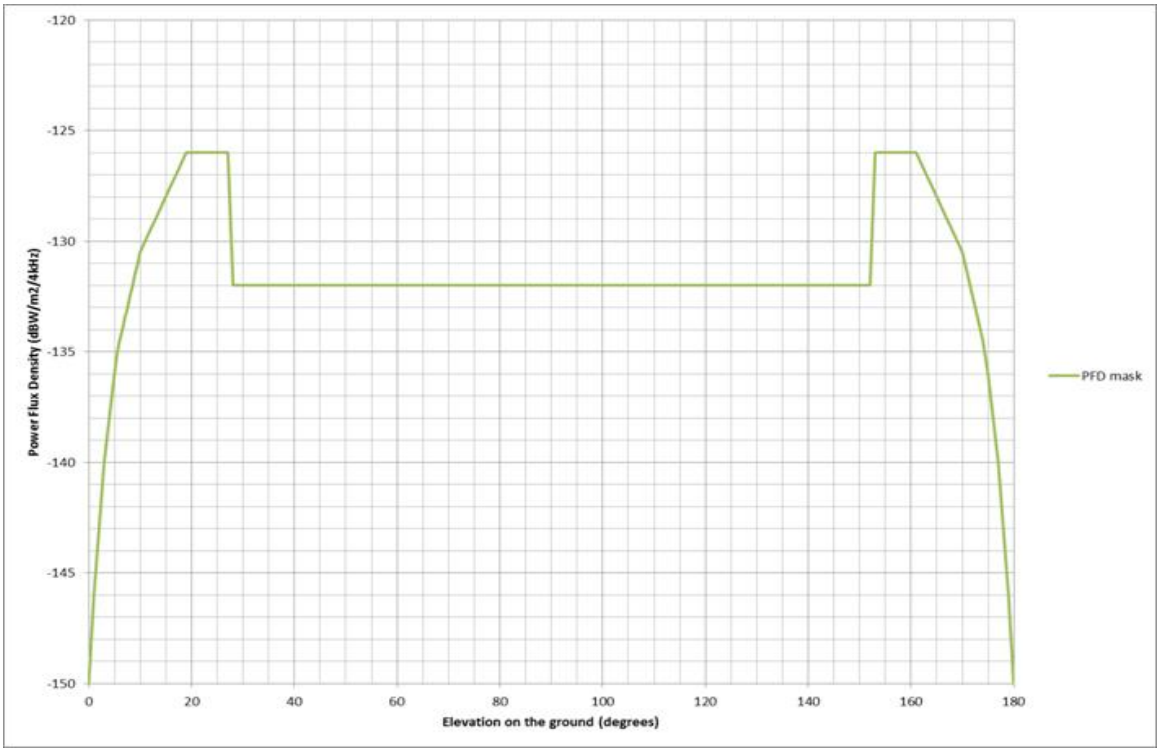

Figure 1: Aircraft station power flux density (p.f.d.) limits

The power flux density limits per AS set out in Figure 1 can be transferred to an e.i.r.p. mask for the AS conformance measurements, see Table 8 below.

Table 8: Aircraft station maximum e.i.r.p. spectral density mask

Elevation at ground (degrees)	Aircraft e.i.r.p. spectral density (dBm/MHz)	Note
$\Theta < 5°$	29.5-C	
$5° \leq \Theta \leq 27°$	29.5-C to 27.0-C	Straight line interpolation
$27° \leq \Theta \leq 28°$	27.0-C to 19.5-C	Straight line interpolation
$28° \leq \Theta \leq 90°$	19.5-C to 13.0-C	Straight line interpolation
C = 20*log(10 000/h) with h is the height above ground of the aircraft in metres and with h ≥3 000		

Table 9: Further co-existence requirements for GS

Ground Station (GS)
Coordination with BFWA stations when necessary
Co-existence with ITS fixed infrastructure units
Coordination with FSS earth stations (for the protection of DA2GC GS)
See Annex 2 with guidelines for CEPT administrations to ensure co-existence with other services

Table 10: Further co-existence requirements for AS

Aircraft Station (AS)
DAA (detect and avoid) mitigation measure is required to protect BFWA

ANNEX 2: GUIDELINES FOR CEPT ADMINISTRATIONS TO ENSURE CO-EXISTENCE WITH OTHER SERVICES THAN BROADBAND DA2GC

BACKGROUND

Coordination is required for DA2GCS GS operating in the frequency band 5855-5875 MHz with BFWA stations, where locations are known. Compatibility studies between BFWA CS (Central Station) and BDA2GC GS have been carried out (see ECC Report 210) and separation distances for all possible cases have been calculated. Compatibility is achieved using minimum separation distances of between a few hundred metres and a few kilometres.

For the protection of ITS, close proximity should be avoided to main roads. Compatibility is achieved using minimum separation distances of between a few hundred metres and a few kilometres when level ground is considered. Therefore the DA2GC GS antenna should be higher than roads in its vicinity to avoid the need for greater separation distances. ITS fixed infrastructure units can always be identified since all ITS stations periodically broadcast their positioning information on the ITS control channel.

In some cases, national considerations concerning co-existence of DA2GC and radiolocation systems operating below 5850 MHz may be needed. With suitable mitigation measures, separation distances can be reduced to 0.03 – 3.5 km depending on the type of radar. The separation distances will increase in the event of the radar site being higher than the DA2GC GS (e.g. this could occur in mountainous areas).

Separation distances up to several tens of kilometres may be required between DA2GC GS and fixed-satellite service earth station uplinks, depending on terrain, ability of DA2GC GS receiver to cancel interference or adopt other mitigation such as site shielding.

GUIDELINES

Coordination with services in adjacent bands - either within a country or between neighbouring countries should be carried out.

These guidelines primarily relate to co-ordination within national boundaries. For the situation where stations are within the territories of different administrations, the use of these guidelines within bilateral agreements may help to expedite cross border co-ordination.

In deploying new stations, administrations and operators should be cognisant of the need to minimise constraints on other services and this should be ensured by the coordination process. This information would also support that a pan-European Broadband DA2GC service would not be subject to operational restrictions at border areas in the future.

The information available at the Office about the DA2GC GS locations can be used to decide whether coordination actions should be triggered.

COORDINATION PRINCIPLES

Coordination between BFWA central stations and FSS earth stations with DA2GCS GS should be carried out on a case-by-case basis, since no single separation distance, guard band or signal strength limit can be provided. The ITU-R P.452 model should be used for more detailed coordination purposes.

The following key principles related to the coordination should be considered at national level or between neighbouring countries in order to ensure co-existence between these systems:

1. Coordination is primarily about national implementation, local propagation conditions and national licensed use, which is best dealt with by national administrations;
2. The principle should be that the operator who introduces changes to his network has to trigger a coordination process (e.g. addition of new BFWA central station or FSS earth station);
3. The implementation of these guidelines is at the discretion of the national administrations to the extent this may help them;
4. Coordination processes and associated protection should only apply to registered/licensed spectrum users;
5. The coordination process should be both accurate and fast to enable all operators to efficiently plan spectrum utilisation and network deployments.