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**3.1 BROADBAND DIRECT-AIR-TO-GROUND COMMUNICATIONS**

Different ECC Reports are currently under development within CEPT/ECC describing frequency management related and compatibility/sharing issues.

**3.1.1 Introduction**

A Broadband DA2GC system constitutes an application for various types of telecommunications services, such as internet access and mobile multimedia services. It aims to provide access to broadband communication services during continental flights on a Europe-wide basis. The request for spectrum is related to the direct-air-to-ground radio solution. The connection with the flight passengers’ user terminals on-board aircraft is to be realised by already available fixed or Wi-Fi-based on-board connectivity network and/or via GSMOBA and in the future possibly also via UMTS and/or LTE.

The main application field would be Air Passenger Communications (APC). In addition a Broadband DA2GC system could also support Airline Administrative Communications services (AAC) and thus improving aircraft operation, resulting in particular in reduced OPEX for the airlines. Safety-relevant communications such as Air Traffic Control (ATC) and related services are not intended to be covered.

Currently, there is no spectrum designated for Broadband DA2GC in Europe. In order to allow European citizens and airlines to profit from the social and economic benefits of the implementation of such a radio application (intended to provide broadband connectivity between the aircraft and a terrestrial based network), a harmonised spectrum designation within CEPT would be necessary. In order for the system to be commercially viable it would need to have the potential to provide a pan-European solution.

It should also be noted that in North America an air–to-ground system has been established in the duplex bands 849-851 MHz and 894-896 MHz, since the year 2008, with more than 1 500 commercial aircraft and 5 000 business aircraft equipped so far. An extension of the spectrum in the order of 2 x 1 MHz is going to be realised in the near future. In addition, the FCC is considering a new proposed rulemaking for DA2G Communications at 14.0-14.5 GHz (sharing with the FSS uplink whereby ground stations avoid transmissions into the geostationary arc).

China is currently testing CDMA EV-DO to cover all of China's air routes. The industry is also studying the use of the fourth-generation mobile communications standard LTE, which provides higher download speeds, for route coverage. Trials for DA2G communications are underway under the direction of CAA China and other Chinese Government entities to operate in 1785-1805 MHz band (20 MHz total bandwidth for DA2GC) and using TD-LTE technology. At present, China Telecom has constructed four surface-to-air base stations on the Beijing-Chengdu route, and has a total of 17 base stations completed as of early 2012. Under the plan, China will construct up to a thousand surface-to-air base stations in the next few years. China's Civil Aviation Air-Ground Broadband Communications System will cover all routes of the major domestic airlines.

European companies represent an important force in the aeronautical market. The European aircraft industry holds about 50% of the world market for aircraft manufacturing. In the field of Air Passenger Communications services, however, Europe has room for improvements when compared to other parts of the world.

**3.1.2 Definitions**

For the purpose of the present document the following definitions apply.

| **Term** | **Definition** |
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| Aircraft Station (AS) | Entity on-board aircraft providing the radio, control and telecommunication functionalities for broadband DA2G communication. |
| Direct-Air-to-Ground Communications | Direct radio link between an Aircraft Station (AS) and a Ground Station (GS). |
| Forward Link (FL) | Within the DA2GC system the link from the Ground Station (GS) to the Aircraft Station (AS). |
| Ground Station (GS) | Entity on the ground providing the radio, control and telecommunication functionalities for DA2GC. |
| Reverse Link (RL) | Within the DA2GC system the link from the Aircraft Station (AS) to the Ground Station (GS). |

**3.1.3 Motivation for Broadband DA2GC**

Mobile customers expect to be connected everywhere, every time, with all kind of mobile devices. This includes the provision of broadband services on-board aircraft and European airlines have great interest to offer internet services to their flight passengers in their continental fleets as soon as possible.

The connection link between the aircraft and the ground can be established either via satellites or by means of Direct-Air-to-Ground Communications (DA2GC). For future broadband services, it can be foreseen that the service provision via satellite will be conducted by using Ka-band satellite capacity and a considerable number of Ka-Band satellites are already put into operation or under procurement. Satellite operators also consider mobile platforms such as aircraft and vessels as a considerable part of the addressable market and the ECC has recently adopted and published new ECC Decision (13)01 supporting Earth Stations on Mobile Platforms (ESOMP). Ka-band satellite as well as DA2GC can therefore be seen as alternative technical solutions in competition. On the other side, both solutions could also complement each other.

The establishment of a pan-European regulatory environment for Broadband DA2GC would provide ample benefits for the users - i.e. airline companies and flight passengers - in Europe:

• As an alternative service provision which by fostering competition might lead to a lower cost for the airlines and for the flight passengers;

• The technical implementation of DA2GC and also the stimulus of competition may lead to a provision of services at improved cost structures - including non-safety-relevant administrative communication services - and hence create a benefit to end customers and airlines resulting in higher and earlier service take-up;

• DA2GC avoids the round trip delay that is typical and unavoidable for geostationary satellite service provision and hence can provide low latency services;

• The costs for aircraft installations and maintenance are a key issue for airline companies. Given the fact the DA2GC equipment can be installed overnight to a plane is seen as an advantage by airline operators. In particular with regard to the aircraft antenna, a terrestrial solution has a clear advantage compared to existing satellite usage.

A further motivation arises from the expected growth of the air traffic. A forecast from Eurocontrol published in October 2011 estimates 11.5 million movements under Instrument Flight Rules (IFR) in Europe in 2017. This is 21% more than in 2010.

About 66% of the European air traffic consists of domestic or continental flights, i.e. the main part of the airline business. The addressable market in Europe for DA2GC is currently consisting of about 160 airlines with more than 4 500 aircraft expected in 2014 (without business aviation). In general a strong increase in percentage of aircraft fleet equipped with internet connectivity solutions is expected during the next years. As a result of a market research approximately 50% of the world’s fleet will have been equipped with Wi-Fi connectivity by 2020.

The introduction of Broadband DA2GC would not only increase Europe’s competitive position, but it could also bring Europe into a leading position in this market segment. Studies on air passenger demand for on-board connectivity are currently not publicly available.

The introduction of Broadband DA2GC providing mobile services would contribute to the development of the internal market and enhance competition by increasing the availability of pan-European services and end-to-end connectivity as well as encouraging efficient investment. DA2GC constitutes an innovative alternative platform for various types of pan-European telecommunications services provided to aircraft passengers.

The provision of broadband services including also all kinds of transportation sectors is a declared goal under the European Digital Agenda 2020 plans.

Broadband DA2GC provide such services without the round trip delay that is a feature in the competing geostationary satellite service solutions. In addition, these networks can provide services to airplanes by using aircraft antennas that are considerably efficient in terms of weight, size, aircraft installation costs and air drag considerations when compared to satellite antennas on-board aircraft.

**3.1.4 Spectrum Demand for Broadband DA2GC**

The spectrum demand for Broadband DA2GC is derived from a summary of relevant factors to be essential to cope with future capacity demand as well as from results achieved by system performance evaluations.

Statistical traffic evaluations show that there is an average number of more than 26 aircraft simultaneously within one cell with coverage radius of 100 km in high air traffic areas which are concentrated in Western/Central Europe (mainly Germany, France, Benelux, Switzerland, Austria, United Kingdom, Northern Spain and Northern Italy). It has to be mentioned that there are also areas at the edge of the flight zones, where the cells have only a low traffic density in the range of 1 - 2 aircraft simultaneously, but the spectrum demand for Broadband DA2GC has to be adapted for the high traffic areas. The approach used assumes that about 60% of the fleets are covered.

Based on the calculations which have been carried out and accepted so far within ECC, paired spectrum of 2 x 10 MHz for FDD operation is agreed to be necessary to cope with short- to medium-term demand. Unpaired spectrum for TDD operation (20 MHz) would also be an option..

A future spectrum designation for Broadband DA2GC should be technology neutral.

Bands other than the unpaired 2 GHz bands are also under consideration within ECC, e.g. compatibility and sharing studies are on-going with regard to the band 5855-5875 MHz.