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Editorial

Forecasted air traffic growth is being seriously hampered by frequency channel congestion in the current Air Traffic Management (ATM) communications infrastructure using the VHF frequency band. This underpins the need to alleviate saturation by means of additional capacity in congested regions on the one side, and the need for improved operational efficiency in oceanic and remote airspace on the other side. Satellite communications is considered in this context as a potentially valuable resource and shall be hence regarded at as an integral part of the foreseen long term solution providing global ATM service availability [1].

This approach is also in line with the final conclusions and recommendations of the Future Communication Study [2], carried out by Eurocontrol and the Federal Aviation Agency, where a set of candidate technologies for the provision of future safety critical communications services for the aeronautical domain was selected (see Table 1).

The study team recognized the unique capabilities of satellite communication systems to provide adequate coverage over large and/or remote geographic areas. It is important to note, however, that the defined operational concept for the Future Communications Infrastructure (FCI) is beyond the service horizon of current satellite offerings for aeronautical mobile satellite services. The potential of next generation satellite systems, particularly those systems customized to meet the specific needs of aviation was also recognized. Last but not least, future satellite systems shall be also investigated as a complement of the terrestrial infrastructure to jointly meet the future capacity and availability requirements in high-density continental airspaces.

Aviation's regulatory bodies place stringent requirements on safety critical communications to/from aircraft in terms of performance and existence of a protected spectrum, in order to ensure highest availability and integrity. Any satellite system wishing to provide safety critical services must develop technical manuals that prove the SARPS (Standards and Recommended Practices) compliance (ICAO certification). As of today, Inmarsat, Iridium and MTSAT are the only satellite systems certified to provide aeronautical safety services.

ATM communications currently includes 2 services categories: Air Traffic Services (ATS), namely communications between aircraft and air traffic controllers and safety critical Aeronautical Operational Control (AOC), namely communications for aircraft operations (flight infos, aircraft operational parameters). For both, currently analogue voice communications predominate. However, a gradual movement towards digital data communications can be clearly identified. Eventually, from 2020 voice will be more and more reduced to serve as backup or as complement in emergency situations. The foreseen increase of air traffic has hence a double impact on capacity requirements: on the one side the communications load per aircraft shall be multiplied by an increasing number of aircraft in operation, on the other side ATM methods must be replaced by more sophisticated ones, data-intensive techniques, resulting in higher traffic load per aircraft.

The Aeronautical Mobile Satellite (Route) Service (AMS(R)S) defines the worldwide spectrum allocation for aeronautical safety services via satellite, namely 1545.0–1555.0 MHz (Space-to-Earth) and 1646.5–1656.5 MHz (Earth-to-Space).

At the 1997 World Radio Communications Conference, these two bands became part of the generic Mobile Satellite Service (MSS) bands, allowing other mobile users to use these bands, with priority to aeronautical services. This implies that satellite systems that use this band for different services must be able to implement priority and pre-emption for aeronautical safety services; if different satellite systems share this band and no solution for real-time priority and pre-emption has been found, coordination must occur in advance.

Table 2 summarises the main strengths, weaknesses, opportunities and threads related to the usage of satellite communications for ATM services. A suitable candidate satellite communications technology should be able to provide convincing solutions to the weaknesses and threads mentioned in the table. In particular, optimised radio resource management solutions, tailored to the specific features of the ATM traffic in order to optimise performance and reduce bandwidth usage, shall be an integral part of any proposed solution.

Table 1
Evaluated technologies in [2]

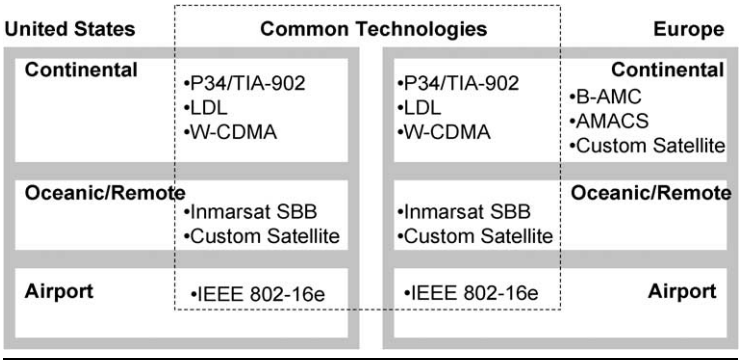

Table 2
SWOT analysis of satellite communications for ATM

Strengths	Weaknesses
• Global coverage • Ideal for broadcast and multicast services • Rapid deployment • Synergies with satellite-based navigation and surveillance systems • Support of IP-based services	• Demanding service requirements esp. vs. inherently large delay (mainly for GEO) • High cost of bandwidth and terminals • Critical failure point
Opportunities	**Threads**
• Scarcity of radio spectrum resources in the VHF band • Envisaged ATM paradigm shift (voice-based → data-based)	• Suitable frequency allocation • Lack of full acceptance by part of civil aviation entities

This special issue contains a collection of papers covering several key aspects related to the provision of safety critical ATM services via satellite.

The present volume contains the following contributions:

- an overview of the Eurocontrol activities and involvement in relation to the usage of satellite communications to support the aviation requirements in the future aeronautical communications infrastructure;
- the European Space Agency's rationale for initiating a new programme line dedicated to ATM communications under the umbrella of the Advanced Research in Telecommunications Systems (ARTES) programme, its objectives, and its workplan of activities;
- a methodology devised in the framework of the ANASTASIA project to estimate the capacity in terms of communication bit rate requirements for ATM services in a constellation of geostationary (GEO) satellites with spot beams;
- the reviews of candidate satellite communications systems and a detailed competitive analysis carried out in the framework of the ANASTASIA project, aiming at assessing their suitability to support aeronautical services;
- a summary of the design of an IPv6-based network for air–ground communications currently ongoing in the NEWSKY project. NEWSKY pursues the vision of "Networking the Sky" by integrating different radio link technologies, including satellite, and different applications into a single IP-based aeronautical network;
- a more general overview of the ANASTASIA project, where research on future technologies and system architectures for navigation is being carried out, resulting in the development of a new generation of airborne Global Navigation Satellite System (GNSS) receivers for all phases of flight;
- an analysis of the potential role that satellite technologies may play in future CNS/ATM systems with a special focus on the operational, legal and political issues, as well as potential challenges to be encountered along the way.

Guest Co-Editors' biographies

Sandro Scalise graduated in electronic engineering specialising in telecommunications (with honours) from University of Ferrara (Italy) in 1999 and received his PhD (summa cum laude) from University of Vigo (Spain) in 2007. Since 2001, he is scientific researcher at the Institute of Communications and Navigation of DLR Oberpfaffenhofen, where, since October 2004, he is leading the Mobile Satellite Systems Group. His research activity deals with forward error correction and synchronization schemes for mobile satellite applications, land mobile satellite channel modelling and link performance evaluation. He has been involved in several national and international projects in the area of mobile satellite communications. Dr. Scalise is co-author of more than 40 international publications, including 10 journal papers, he was editor of a chapter devoted to satellite channel impairments in the framework of the book "Digital Satellite Communications" published by Springer in 2007, he is IEEE member and, since June 2006, he is leading the R&D Working Group of ISI European Technology Platform.

Markus Werner received the Dipl.-Ing. degree from Darmstadt Technical University in 1991, and the PhD degree from Munich Technical University in 2002, both in electrical engineering. He is with TriaGnoSys GmbH, a satellite and aeronautical communications company, as managing director since 2002. From 1991 to 2005, he was with the Institute of Communications and Navigation of the German Aerospace Center (DLR) as research scientist, project manager and group leader. His project experience includes several national and ESA studies and various projects in the framework of European research programs. He has been national delegate to the COST Actions 227, 252 and 272. In 2004 and 2005, he was project coordinator of the European Network of Excellence in Satellite Communications (SatNEx). His main R&D activities cover the broad range of modern satellite system design, including technical and business aspects, with some focus on multiservice traffic engineering, capacity dimensioning, and satellite-based systems and solutions for aeronautical and maritime services. Dr. Werner is a Lecturer at the Carl-Cranz-Gesellschaft (CCG), Oberpfaffenhofen, Germany, teaching satellite communications courses for telecommunications professionals. He is co-author of the textbook "Satellite Systems for Personal and Broadband Communications" published by Springer in 2000, a Senior Member of IEEE and a member of AIAA and VDE/ITG.

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