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WORKING PAPER

FOURTEENTH AIR NAVIGATION CONFERENCE

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Agenda Item 4: Hyper-connectivity of air navigation system
4.1: Connected aircraft concept and associated challenges

FUTURE AIR-GROUND CONNECTIVITY

(Presented by Hungary on behalf of the European Union[1] and its Member States, the other Member States of the European Civil Aviation Conference[2], the European Organisation for the Safety of Air Navigation (EUROCONTROL) and the United States)

EXECUTIVE SUMMARY

The evolution of the air navigation system is built on access to timely and accurate shared information between airspace users, air traffic management (ATM) and aerodrome operations. It will be enabled by advancements, inter alia, in the use of standardized, interoperable air and ground communication technologies and applications supporting aircraft conducting flights within and between contracting States and regions with a seamless connectivity.

A limited set of communication technologies are currently in use, and several are in the development and standardization phase. These communication technologies support the datalink functions and services defined by the air traffic services baseline 2 (ATS B2) standard. From an interoperability perspective, a harmonized application of a minimum number of available connectivity technologies is required globally to minimize the impact on aircraft equipage and service provision costs, and maximize the benefits of data exchange ensuring a seamless operation between contracting States and regions through the application of a multilink concept. Technology selection should be defined primarily through a performance-based approach, that considers resilience, cost and spectrum efficiency.

Action: The Conference is invited to agree to the recommendation in Paragraph 3.

1. INTRODUCTION

1.1 Air traffic services (ATS) will rely heavily on very high frequency (VHF) voice communications for separation, flow and advisory information exchange until adequate air-ground (A/G) data link (DL) communications will become widely available. Current aviation connectivity supports various A/G services with an increasing use to support safe, sustainable, secure and efficient ATM. At the same time, the need for data and higher data volumes (not only for communication) are expanding, for

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[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Iceland, Republic of Moldova, Monaco, Montenegro, North Macedonia, Norway, San Marino, Serbia, Switzerland, Türkiye, Ukraine, and the United Kingdom

instance, to support trajectory-based operations (TBO), digitized services such as weather information and NOTAMs, and the increasing needs in the field of airline operations. This connectivity is currently enabled by a set of technologies that rely on VHF DL (e.g. VHF DL Mode 2 – VDLM2) and on aeronautical satellite communications (SATCOM) connectivity. Although these technologies have served the aviation community well for decades, they cannot be scaled to accommodate the anticipated data volumes and security needed for the increase in traffic capacity. SATCOM currently use multiple standards and applications that are fragmented and not globally interoperable. The lack of global standards for SATCOM results in high re-equipment costs for operational stakeholder willing to change SATCOM provider and is detrimental for the competition in the market. In addition, the current regional implementation is characterized by the need for multiple aircraft equipment to be installed (for example aeronautical telecommunications network baseline 1 (ATN B1) and future air navigation system (FANS) data communication capability). These characteristics are such that it is unlikely that future service needs can be met without implementation of several significant, internationally coordinated new link technologies. Among those needs, it will be necessary to rely on robust end-to-end secure, scalable and spectrum-efficient A/G communications. This working paper lays out proposals for a future vision of A/G connectivity and identifies areas which would require ICAO intervention to enable a globally coordinated approach.

2. DISCUSSION

2.1 The proposed solutions for an A/G communication infrastructure and operations, supporting ATM, aeronautical information service (AIS) and aeronautical operational control (AOC), comprise of three layers: applications, communication network and (physical) links.

2.2 Applications: The long-term goal is that ATS Baseline 2 (ATS B2) applications shall be the global standard in support of ATM operations. ATS B2 applications have been designed to support all known and foreseen ATS use cases. Their global deployment while providing an equivalent level of service to the existing regional implementations, enables the introduction of new ATM services (e.g., full TBO), supporting efficient operations. AOC applications remain largely under airlines' control and will continue to evolve according to the needs for optimization specific to the aircraft operator. In support of AIS, global standards (including safety, performance and interoperability requirements) should be developed to support those services for which a "required demonstrated performance" would be essential, such as providing urgent situational awareness data for pilot decision (exchange of hazardous and emergency data sharing with the pilot, to ensure tactical decision-making).

2.3 Network: The long-term goal is that ATN/Internet Protocol Suite (IPS) shall be the global network solution for communications subject to required demonstrated performance. ATN/IPS is recognized as a state-of-the-art protocol, with performance, safety and security features, leveraging the guidance developed by the ICAO Trust Framework Panel (TFP), capable of supporting current and future applications with required demonstrated performance. Many aircraft are or will be equipped with avionics solely based on the ATN/ open system interconnection (OSI) protocol; therefore, ground gateways will be necessary in ICAO regions and States to translate between the two protocols during the transition to ATN/IPS.

2.4 Physical links: For safety critical communications, several technologies are currently being evaluated, to complement the VDLM2 and SATCOM Class B. All the new and former technologies will have to coexist in a so-called multilink environment allowing aircraft to use different complementary technologies. In addition, for the long-term, VDLM2 requires replacement with a more secure and spectrum efficient link technology. The choice for the next potential link technologies has not yet been completed and still requires further development and validation. To enhance the overall A/G communication capabilities it is proposed:

2.4.1 For the short-medium term:

a) to extend the life span of the existing VDLM2 by offloading AOC traffic to other complementary technologies; and

b) to promote the use of SATCOM for ATS and AOC communications, also supporting the offload of traffic from VDLM2.

2.4.2 To develop a performance-based "multilink" framework to support a long-term evolution including:

a) DL for ATM and AOC operations over commercial communication systems ("Hyperconnected ATM"). This concept assumes that appropriate safety assessments will be performed and that the aviation protected spectrum will continue to exist, being a key-enabler of the Hyperconnected ATM concept. Precautions must also be taken to avoid any adverse collateral impact on the way the current civil aviation safety spectrum is used; and

b) a new A/G terrestrial communication system.

2.4.3 Acknowledge the need for a future decision to adopt a new A/G terrestrial communication system and/or a DL for ATM and AOC operations over commercial communication systems ("Hyperconnected ATM"), once the technologies have been validated to be mature.

2.5 The long-term future connectivity landscape, comprising the three layers, consists of seven "long-term objectives" which are intended to be descriptors of the important changes for the future vision of A/G connectivity to become a reality:

a) move towards full ATS-B2 (ATM communications, applications level);

b) ensure sufficient availability, performance, capacity and flexibility (i.e. technology agnostic) of safety link(s) through the use of multilink;

c) establish a fully interoperable secure connectivity framework, including ground gateways to enable the transition from OSI to ATN/IPS (ATM communications, network level);

d) offload non safety critical AOC data from the safety links and promote sufficient non-safety connectivity for AOC;

e) develop a performance-based framework to support long-term evolution encompassing: DL for ATM and AOC over commercial communication systems and/or a new A/G terrestrial communication system;

f) continue the development of a terrestrial communications, navigation and surveillance (CNS) system that is scalable, spectrum efficient and secured to face the new aviation coming requirements;

g) ensure safety-of-life aviation spectrum allocation and encourage States to protect it from interferences.

3. CONCLUSION

3.1 The Conference is invited to agree on the following recommendation:

Recommendation 4.1/x – Future air-ground connectivity

That States:

a) note the challenges faced by operational stakeholders in the use of currently standardized A/G DL systems, in particular VDLM2;

b) recognize the urgent need for a secure, scalable, cost-efficient and spectrum-efficient A/G DL that offers a significant increase in capacity and other technical performance; and

c) take advantage of aeronautical SATCOM to deliver incremental operational benefits in continental airspace and encourage related industry implementation;

that ICAO:

d) incorporate the long-term future connectivity strategy in future editions of the *Global Air Navigation Plan* (GANP, Doc 9750), including the need to adopt a new A/G terrestrial communication system and/or a DL for ATM and AOC operations over commercial communication systems ("Hyperconnected ATM"), once the technologies have been validated to be mature;

e) define which types of AOC and AIS applications (if any) require the use of aviation protected spectrum, due to specific performance requirements (reference ICAO *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation including Statement of Approved ICAO Policies* (Doc 9718));

f) develop a performance-based framework to support long-term evolution encouraging the development of emerging secured and spectrum efficient CNS technologies;

g) develop global Standards applicable to SATCOM systems in coordination with standards development organizations (SDOs) to enable interoperability and competition in the market;

h) identify potential opportunities and develop guidance and Standards in coordination with SDOs for sending DL for ATM and AOC operations over commercial communication systems ("Hyperconnected ATM"), without adversely impacting the existence and use of the protected aviation safety spectrum;

i) pursue the development of guidance and Standards in coordination with SDOs for a new A/G terrestrial communication system;

j) define the minimum airborne and ground infrastructure to operate in a multilink environment while maintaining the interoperability; and

k) develop Standards in coordination with SDOs for IPS/OSI gateways to ensure interoperability during the transition.

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