ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 7 : Aeronautical air-ground and air-to-air communications

STRATEGY FOR GLOBAL INTEROPERABILITY OF AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B)

(Presented by the United States)

SUMMARY

This working paper proposes an approach for achieving globally interoperability in support of the early introduction of ADS-B enabled services.

Action by the conference is in paragraph 4.

1. INTRODUCTION

1.1 Automatic dependent surveillance — broadcast (ADS-B) technologies have been under development for more than a decade and the concepts for the initial use of ADS-B have begun to mature in some States and regions over the past few years. Currently ICAO has Standards and Recommended Practices (SARPs) for two ADS-B link technologies and is developing the SARPs for a third. The United States of America Federal Aviation Administration (FAA) has conducted studies in cooperation with United States industry and has also supported cooperative activities with other States and organizations that have attempted to assess the merits of each ADS-B link technology based on technical and economic factors. No single ADS-B link technology has emerged and been accepted by the international community as the sole long-term ADS-B solution. While recognizing that multiple ADS-B link technologies exist, a global strategy is needed to facilitate the early introduction of ADS-B capabilities.

1.2 In parallel with the link development activity, appropriate ICAO operational bodies should continue development of long-term operational requirements for ADS-B. This work should build on studies performed by regional technical bodies such as RTCA and the European Organisation for Civil Aviation Equipment (EUROCAE) with an eye towards global applications.

2. DISCUSSION

2.1 Over the past several years a number of States and organizations have participated in activities to develop and evaluate ADS-B technologies and the operational applications enabled by those ADS-B technologies. One of these efforts was a cooperative activity between the United States FAA and the European Organisation for the Safety of Air Navigation (EUROCONTROL). This activity has included the evaluation of three candidate ADS-B link technologies (i.e. Mode S extended squitter, VHF digital link (VDL) Mode 4, and universal access transceiver (UAT)). The FAA has also conducted additional technical and economic studies that were focused on the use of ADS-B within the United States. Likewise, EUROCONTROL has sponsored additional studies focused on the European applications for ADS-B. In addition, the United States FAA and EUROCONTROL have jointly sponsored a number of flight evaluations that have utilized single and multiple ADS-B link technologies. Other States, such as Australia and Sweden have conducted ADS-B evaluations using a single ADS-B link technology.

2.2 In July 2002 the United States FAA announced a decision on the ADS-B links for use within the United States for the initial introduction of ADS-B services. Under this decision 1 090 MHz (i.e. Mode S) extended squitter is to be used for air transport and other high performance aircraft while UAT is to be used on the typical general aviation aircraft. No actions have been taken to require ADS-B equipage. The UAT is selected to provide ADS-B and associated services for the general aviation users because of its lower cost and greater uplink capacity, especially for flight information services — broadcast (FIS-B) services. If long range air-to-air applications are validated for use in the long-term that cannot be satisfied by 1 090 ES alone, UAT would be a leading candidate to support these requirements. The United States supports progressing UAT ICAO SARPs so that UAT can be considered an international candidate for ADS-B. A number of technical, integration, and economic issues were identified with the VDL Mode 4 alternative, either by itself or in combination with another link, that precluded its consideration as part of the near-term United States ADS-B strategy.

2.3 The FAA and EUROCONTROL have each undertaken to coordinate strategies for the introduction of the initial ADS-B services within the United States and European airspace respectively. Common to both the United States and the European strategies for the introduction of the initial ADS-B services is the use of Mode S extended squitter as a common link technology for achieving interoperability in support of near-term ADS-B applications. It must be recognized that currently Mode S extended squitter is the only ICAO standardized ADS-B link technology for which global radio frequency spectrum authorization currently exists.

2.4 Simulations for future core Europe and future Los Angles operational environments suggest that Mode S extended squitter is expected to be capable of satisfying the initial requirements for ADS-B services for at least the next decade. There will likely be a point in time beyond which the current Mode S extended squitter system will need to be either augmented with a complementary second ADS-B link or replaced with a higher capacity alternative ADS-B link technology in order to fully satisfy the operational needs for ADS-B services in the most demanding operational environments. At what point in time the Mode S extended squitter technology will no longer be able to satisfy the ADS-B requirements is highly dependent on many factors including the ADS-B applications to be supported, the growth in air traffic and the evolution of the overall secondary surveillance radar environment as it impacts loading of the 1 090 MHz channel. Given the many variables and the uncertainty associated with each, it is not possible today to estimate with any degree of certainty how long into the future the Mode S extended squitter technology alone will be able

satisfy the operational needs. Therefore, though a second ADS-B link may be accommodated by both the United States and the proposed European strategies, it is the intent of both that international air carriers equipping with Mode S extended squitter would not also need to equip with a second ADS-B link in order to benefit from the initially offered ADS-B applications. It is recognized however, that as the requirements mature for the longer-term ADS-B applications, and as the demands placed on the 1 090 MHz link increase over time, a point may be reached when the Mode S extended squitter technology may be unable to fully support the desired ADS-B capabilities. Therefore, air carriers may be encouraged to make provisions for the easy addition of a second ADS-B link in the future.

2.5 Both Airbus and Boeing have announced plans to equip new commercial air transport class aircraft with Mode S transponders supporting the transmission of Mode S extended squitter for ADS-B. The most recent generation of airborne collision avoidance system (ACAS) and Mode S equipment has incorporated support for Mode S extended squitter and given the global use of ACAS in air transport class aircraft the widespread availability of Mode S extended squitter based ADS-B services is becoming possible. The retrofit of commercial air transport aircraft with Mode S extended squitter capability for ADS-B has already begun by some commercial operators.

3. CONCLUSIONS

3.1 The FAA and EUROCONTROL have coordinated on strategies for the introduction of the initial ADS-B services within the United States and European airspace respectively and both have identified the use of Mode S extended squitter as a common link technology for achieving interoperability in support of near-term ADS-B applications.

3.2 Mode S extended squitter is the only ICAO standardized ADS-B link technology for which global radio frequency spectrum allocation and global channel assignments currently exist.

3.3 Mode S extended squitter provides the most straightforward transition path to incorporate ADS-B within the ground air traffic services (ATS) infrastructure and onboard air transport aircraft equipped with Mode S and ACAS avionics.

3.4 As a part of a global plan, in the near term, other link technologies supporting the initial introduction of ADS-B applications may optionally be used on a local or regional basis either in addition to Mode S extended squitter or in lieu of Mode S extended squitter (in support of local or regional operations).

a) the ground infrastructure intended to serve both international air transport operations as well as local domestic operations should support Mode S extended squitter and any additional ADS-B link technology authorized for use in instrument flight rules (IFR) operations in that airspace; and

b) global, local or regional radio frequency spectrum authorization, as appropriate will be required for the additional ADS-B link(s) that are used.

3.5 In the longer-term, it is recognized that the current Mode S extended squitter technology may not be able to fully satisfy all of the requirements for ADS-B services in all airspace. It is therefore important to more fully define: the evolution of the operational requirements for ADS-B; the evolution of the air traffic

environments in which ADS-B must operate; and the evolution of the use of the 1 090 MHz channel. The long-term ADS-B solution will need to be integral with an overall long-term surveillance architecture that supports the required surveillance performance (RSP) associated with a set of internationally standardized ATS applications

3.6 The long-term operational requirements will become the basis for an ICAO technical body to develop SARPs for an internationally standardized set of ADS-B applications, supporting both air-air and air-ground services. Further, the continued development within the appropriate ICAO technical body(ies) of alternative ADS-B link technologies is appropriate. However, it is premature to select any specific long-term ADS-B link architecture (i.e. either a single link or multi-link configuration) for the support of global aviation needs. Studies on such a long-term ADS-B link architecture must consider one alternative where the Mode S extended squitter technology continues to be used but is supplemented with a second ADS-B link specifically chosen to complement the capabilities of Mode S extended squitter. A second ADS-B link architecture that should be considered would be a high performance single global link solution that alone would be capable of satisfying the anticipated long-term global requirements for ADS-B. The two other ADS-B link technologies, the UAT and the VHF data link — Mode 4, should each be considered within the context of complementing Mode S extended squitter. However, technical, integration, and economic issues associated with VDL Mode 4 would need to be resolved before it could become a viable candidate as a complementary second ADS-B link. UAT SARPs will need to be finalized and integration issues addressed in order for UAT to be considered as a complementary second ADS-B link. In addition to considering UAT in combination with Mode S extended squitter, UAT should also be considered as a long-term candidate for serving as a single high performance ADS-B link. Other link technologies, or enhancements to existing ADS-B link technologies, may emerge and need to be considered before any ICAO decision on the preferred long-term ADS-B link architecture.

3.7 Any long-term solution for ADS-B must include radio frequency spectrum authorization for the ADS-B link or links involved. The economic factors associated with the alternative ADS-B link architectures would also need to be considered to ensure that any recommended long-term ADS-B configuration would be economically viable from both a ground infrastructure and airborne systems perspective.

4. ACTION BY THE CONFERENCE

4.1 The conference is invited to agree on the following recommendation:

Recommendation 7/xx — Strategy for global interoperability of ADS-B

That ICAO:

a) accept Mode S extended squitter as the ADS-B link technology for achieving global interoperability in support of the initial introduction of ADS-B enabled services;

b) agree that as part of a global plan, for the near term, that other link technologies supporting the initial introduction of ADS-B applications may optionally be used on a local or regional basis either in addition to

Mode S extended squitter or in lieu of Mode S extended squitter in support of local or regional operations;

c) recognize that in the longer-term the current Mode S extended squitter technology may not be able to fully satisfy all of the requirements for ADS-B services in all airspace;

d) continue development, within the appropriate ICAO operational bodies, of the long-term operational requirements for ADS-B. This work should build on studies performed by regional technical bodies such as RTCA and EUROCAE with an eye towards global applications; and

e) continue with the development of the technical standards for ADS-B link technologies since it is premature to make any decision on the preferred ADS-B link architecture to support the to be developed long-term ADS-B requirements.

— END —