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SPECIAL COMMITTEE FOR THE MONITORING AND CO-ORDINATION OF DEVELOPMENT AND TRANSITION PLANNING FOR THE FUTURE AIR NAVIGATION SYSTEM (FANS PHASE II)

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Agenda Item 2: Air traffic management (ATM)

Agenda Item 3: Research and development programmes, trials and demonstrations in communications, navigation and surveillance (CNS) and air traffic management (ATM)

INTEGRATION OF ADS AND SSR DATA

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SUMMARY

This paper proposes how the integration of automatic dependent surveillance (ADS) and secondary surveillance radar (SSR) data could enhance the SSR surveillance function, increase the level of surveillance redundancy, and allow the integrity of the navigation system to be monitored. The Special Committee on Future Air Navigation Systems (FANS) is invited to recommend the implementation of this feature, especially in areas where reduced separation between aircraft will be applied.

1. Introduction

1.1 The idea of integrating automatic dependent surveillance (ADS) data and secondary surveillance radar (SSR) data with the purpose of enhancing the SSR data surveillance function, increasing the level of surveillance redundancy and monitoring the integrity of the navigation system, was proposed by Spain, at the last FANS II Working Group 3 Meeting held in London on 26 to 28 February 1991. The working group agreed to include it in the list of tasks which need to be undertaken to support the FANS concept, and also agreed that Spain would produce a working paper on this topic for the FANS II Meeting in Montreal.

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2. Enhancement of the SSR system

2.1 One of the features of the future air traffic services (ATS) system is that through application of a separation closer to the minima it will permit the potential density of traffic in the airspace to increase.

2.2 With aircraft operating more frequently at close proximity, there is a need to increase the availability of accurate positional data, and thus increase the reliability of the measurement of the relative separation of aircraft flying close together.

2.3 Monopulse techniques leading to accuracy of azimuth measurement of better than 1/10th of a degree, make it possible to reduce the frequency, the severity, and the consequences of garbling and other shortcomings. They also contribute toward reducing the radar separation minima which are applicable with SSR.

2.4 Integrating ADS data with SSR positional data also offers suitable improvements for better surveillance in a cost-effective manner:

a) permits the ground system to acquire automatically certain airborne data such as heading, rate of climb/descend, speed, etc. which improve the ground tracking of aircraft, thus ensuring that the required level of safety is maintained when lower radar separation minima will be used;

b) the coding of altitude data in 8 ft increments, and the availability of the vertical rate, improve the ability of air traffic control (ATC) to monitor and to make high quality prediction of aircraft trajectories in the vertical plane, thus enhancing the short term conflict alert (STCA) function;

c) when a satellite data link is used to support the ADS function, it would permit the ground system to acquire surveillance data from low altitude and blind areas, where the radar, due to its line-of-sight propagation limitations, is blind; aircraft positional losses will become more critical in high density traffic areas, where reduced separations will be applied;

d) permits the renewal rate of ADS information on each aircraft to be selectively adapted according to instantaneous ATC needs, by simply modifying its ADS polling rate; this rate can be automatically controlled by the tracking algorithm itself (increasing the rate when the aircraft turns, or when radar losses start occurring and, therefore, the figure of merit of the radar track decreases, etc.) and by the short term conflict alert function; and

e) permits the ground system to automatically acquire aircraft call signs, thus overcoming problems connected with SSR code allocation, and with radar identification and transfer procedures.

3. Increase the level of surveillance redundancy

3.1 Reductions in the separation minima, and application of certain types of tactical control, require the surveillance function to have a high availability and reliability because radar system outages will become more critical. For example, as the separation minima is reduced, the impact of certain errors occurring during an outage would become more critical, since the resulting deviations could constitute a collision risk in a shorter period of time than would be the case with larger separations minima.

3.2 In order to provide the required level of surveillance availability and reliability, adequate redundancy should be ensured through the highest possible diversity of systems, since diversity in system types minimizes the risks. Using both SSR and ADS provides this diversity.

3.3 Also, the degree of redundancy and duplication in the provision of the surveillance function should be kept to a minimum consistent with operational efficiency and safety. Satellite ADS permits the degree of surveillance redundancy to be adapted according to instantaneous ATC needs, thus providing redundancy in a very cost-effective manner. This would be done by opening ADS channels when needed and closing them when no longer needed.

4. Navigation integrity monitoring

4.1 Several means of monitoring the integrity of the global-navigation satellite system are under investigation in many places.

4.2 To provide a warning to the pilot within ten seconds when a navigation error occurs might not be sufficient in high density traffic areas where reduced separation will be applied and deviations resulting from a navigation error could constitute a collision risk in a very short period of time.

4.3 Cross-checking positional data derived from the navigation system automatic dependent surveillance (ADS) of each aircraft with its positional data determined by the radar surveillance system (SSR, monopulse SSR, or Mode S SSR) could enable the ground system to detect navigational errors so as to permit the timely intervention of both, the air traffic controller and the pilot, to prevent these errors from growing to such proportions as to constitute a collision risk.

4.4 One of the advantages of this means is that not only errors due to the malfunction of the space segment can be detected, but also due to the malfunction of the airborne equipment.

4.5 Another advantage is that the monitoring interval for each aircraft can be selectively adapted according to its instantaneous relative position with respect to other possible conflicting aircraft or the terrain, by just modifying its ADS polling rate. Some aircraft might not need to be monitored as frequently as others.

4.6 Under certain circumstances, and in areas where the integrity of the SSR surveillance system cannot be monitored by conventional means, like in oceanic areas close to the coast, cross-checking SSR data with ADS data can also provide integrity monitoring of the SSR system.

5. Conclusion

5.1 ADS data when combined with monopulse SSR could enhance the surveillance function to a level of performance similar to that of the Mode S SSR, providing in addition coverage in low altitudes and blind areas when satellite data link is used for ADS. Also, when ADS is combined with any radar surveillance system (SSR, monopulse SSR, or Mode S SSR) provides a flexible diversified redundancy, and a way to timely monitor the integrity of the navigation system.

6. Action required

6.1 The committee is invited to discuss this paper, to adopt its conclusion, and to:

a) recommend that States, regions and organizations related take into account the advantages presented in this paper when developing future surveillance implementation programmes;

b) recommend that States, regions and organizations related investigate "the integration of ADS data and SSR positional data with the purpose of enhancing the SSR surveillance function, increasing the level of surveillance redundancy, and monitoring the integrity of the navigation system"; and

c) take any other action that would be considered appropriate.

Note.- The list of research and development tasks to support the FANS concept should be corrected to include the text in b).

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