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Flimsy ASP03-02

Extracted assumptions from ADS-B-RAD OSED

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This paper is generated to provide the common assumption on ADS-B-RAD operational environment between ASA/GSA-RFG and ASP/WG.

The application summary of ADS-B-RAD and its assumptions on surveillance means are extracted as follows from the OSED of ADS-B-RAD version 1.7, which has been used for RFG GSA meeting in Boston on July 2007.

Z.3 APPLICATION SUMMARY

The ADS-B-RAD application will support, and in some cases enhance, Air Traffic Services through the addition of ADS-B surveillance, in areas where radar surveillance currently exists. It will apply to the en-route and terminal phases of flight in airspace classes (A to D). The application is designed to support the following ICAO Air Traffic Services.

- Air Traffic Control Service
  - Area Control Service and
  - Approach Control Service
- Flight Information Service
- Alerting Service,
- Air Traffic Advisory Service

The introduction of ADS-B may enhance these services by improving the overall quality of surveillance (i.e. radar + ADS-B). Examples of operational benefits may include:

- A reduction in separation standards applied to the ICAO minima (e.g. 10nm to 5nm), and
- Provision of additional surveillance data (such as identity information in environments that do not provide it today such as in PSR environments)

Although not explicitly covered by the OSED (see Z.4.1.3), in the longer term, surveillance infrastructure costs are expected to be reduced by replacing radars with ADS-B which are cheaper to install and cheaper to maintain than current radar installations.

Z.4 ENVIRONMENT DEFINITIONS

The following section contains details about the various environments (termed 'Scenarios') within which the ADS-B-RAD application will be applied. The level of granularity of the descriptions balances the need to provide enough guidance for an adequate safety and performance assessment, without over prescribing the environment in such a way as to unnecessarily restrict implementation options and impose excessive requirements.

This section also aims at highlighting differences that exist between the baseline (Termed 'Reference') environment and a post implementation (termed 'Target') environment.

Reference Environment

A comparative assessment methodology has been chosen for the ADS-B-RAD application description. The baseline for the comparison are the procedures as detailed in PANS ATM (Ref: 3) as these define, at an internationally agreed ICAO level, the concept of operations for providing air traffic services in a surveillance environment. As a consequence a definition of the reference radar environment used to determine appropriate ADS-B requirements is necessary for each chosen environment scenario (see Z.4.1).

Target Environment

The target environment description focuses on the post-implementation environment (i.e after ADS-B has been deployed) and is used during the safety requirements derivation process (in particular during the OHA). In conducting a hazard analysis, the target environment is used to determine the severity of hazards taking into account any available environment mitigations.

The target environment does not concern itself with implementation transitional issues (see Z.4.1.3.2 and Z.4.1.3.3).

Z.4.1 Surveillance Environment Scenarios

Z.4.1.1 Scoping the environments

As there are multiple variations of radar environments (PSR, SSR, Mode S) and consequently multiple combinations of radar plus ADS-B (e.g. PSR + SSR, SSR + Mode S etc), it is necessary to limit the scope and the number of environments to be analysed in this document. For this purpose the most demanding environments that

allow the derivation of the minimum airborne requirements were selected and analysed. This scoping process is not intended to limit the possible deployment by local authorities of ADS-B ground surveillance together with other combinations of radar surveillance infrastructures, but merely to focus the effort for this document.
The surveillance environment scenarios which will be analysed in this OSED have been selected based on three criteria:

- Scenarios estimated as providing the most demanding environments that will derive the minimum airborne requirements for the use of ADS-B surveillance data in radar environments.
- Scenarios assessed as most likely to gain operational benefits through the introduction of ADS-B data into the ground surveillance system, and
- Scenarios that represent the largest proportion of current environments and therefore the most likely for deployment of this application in the near term.

Z.4.1.2 Selected Environment Scenarios

As already stated above this OSED is not intended to create or limit a deployment case for other scenarios, such as adding ADS-B to multiple SSR layers, but to enable the minimum global requirements to be derived from the most demanding environments. There are three environment scenarios that will be analysed in this application description that cover the three different radar technologies of PSR, SSR and Mode S and each has a different assumption regarding traffic densities (traffic number assumptions can be found 0). Additionally each scenario has a different reference baseline to which a comparison is made against the relevant ATS procedures. This is necessary as procedures often differ between surveillance sources (i.e. identification procedures for aircraft under PSR differ for aircraft under SSR surveillance).

RAD 1. Single Primary Surveillance Radar (PSR) with ADS-B surveillance in medium density TMA

This scenario assumes ADS-B ground surveillance is added to the surveillance provided by a single PSR. From an operational perspective the analysis will take as its baseline PSR with SSR as this is the most useful comparison to be made from a procedures point of view

Reference Surveillance baseline for procedure analysis: PSR with a single co-mounted SSR covering a medium density TMA

RAD 2a. A Single Monopulse Secondary Surveillance Radar (SSR) with ADS-B

surveillance in high density Enroute

This scenario assumes ADS-B ground surveillance is added to the surveillance provided by a single SSR (detection using Mode A/C transponder).

Reference Surveillance baseline for procedure analysis: Two SSR's providing coverage for a high density en-route sector

RAD 2b. Single Mode S Radar with ADS-B surveillance in Enroute

This is seen as an iteration of the single SSR plus ADS-B in en-route. However it ensures the OSA and OPA pick up any requirements that relate to the use of aircraft identification data that would not be picked up in 2a above.

Reference Surveillance baseline for procedure analysis: Two Mode S radars providing coverage to a high density en-route sector

RAD 3. Single Primary Surveillance Radar (PSR) with a collocated single SSR together with ADS-B surveillance in high density TMA

This scenario assumes ADS-B ground surveillance is added to the surveillance provided by a single primary radar and a single SSR in a high density TMA. This scenario includes the use of dependant and independent parallel runway operations (as per PANS ATM/Annex 14 Volume 1 requirements) but does not include precision runway monitoring operations.

Reference Surveillance baseline for procedure analysis: Single PSR plus Dual SSR's (one of them co-mounted) covering a high density TMA.

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Z.4.2 Generic Environment Assumptions

The following section provides details on the assumptions made for the environment within which ADS-B RAD will be deployed. This description is aimed at providing sufficient detail to enable the safety and performance assessment.

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Z.4.2.4 Transponder Equipage:

In general, transponder equipage requirements in radar environments are established by local authorities (Ref: 7: Chapter 2 section 2.25). However, ICAO airspace classifications also impose requirements on transponder equipage through the ATS services that are applied for each airspace class (Ref: 7: Chapter 2 section 2.6). For classifications A to D and some sections of class E (i.e. in various regions of the world

only class E above certain flight levels) all flights are separated from each other, and hence all aircraft are required to be detected by the surveillance system.
As this OSED does not consider the transitional deployment scenarios (Z.4.1.3) and is focussed on the target environment, there is no desire to assess partial equipage scenarios. Additionally, solutions to operational issues surrounding partial airborne equipage for ground surveillance applications are normally resolved by the ground domain (systems or procedures) which are not the focus of this OSED (Z.4.1.1)

Environment Assump. 10 All aircraft in the ADS-B RAD airspace are equipped with suitable ADS-B and radar transponder equipment and systems.

Z. 4.2.5 Ground system functionality

The following items relate to the minimum functionality that has been assumed in the ground system. These assumptions are related to the ability of the ATCO to provide an air traffic control service and are also necessary to provide a baseline for the safety assessment. These do not limit local implementers from utilising different or more advanced ground systems and conducting their own safety assessment to account for these differences.

Environment Assump. 11 Flight Data Processing is capable of supporting and performing Mode A code to call sign (Field 7 of the ICAO Flight plan) automatic correlation. This includes controller access to a manual correlation function (Ref: 3- 8.6.2.3.1a)

Environment Assump. 12 Surveillance automation and display functions as a minimum shall display position targets with a constant refresh cycle (i.e. same as radar) and display targets that are time synchronised (Ref:3 – 8.2.2)

Environment Assump. 13 Radar data shall be available as a backup during loss of ADS-B data is an important assumption as it implies that there will not be a simultaneous failure of the ADS-B and Radar system . This is a reasonable and necessary assumption for two reasons: (1) ADS-B safety and performance requirements (particularly the airborne ones) should not have to carry the burden of failures in the radar system which should be as robust as the ADS-B system, and (2) It is necessary to enable the safety assessment to be confined to failures of the ADS-B system so as to produce appropriate ADS-B requirements.

Environment Assump. 14 As no assumption is made regarding position data ‘fusion’ or other advanced tracker functionality, if the ground system detects a

difference in position information between two different surveillance sources (that is greater than a defined parameter) such that it cannot be confident that either source is suitable for the application of the relevant separation minima for the airspace, the ground system is assumed to present the separate position symbols on the CWP for each source. (Ref: 3– 8.2.5)

Environment Assump. 15 Similar to Environment Assump. 14 it is assumed that either (1) the ground system performs consistency checks between different surveillance sources for the same identification data item (e.g. between Mode A code received from radar compared to Mode A received from ADS-B), or (2) the ADS-B transmitter conveys the same identification data as the radar transponder.

Environment Assump. 16 It is assumed that the ATS system in the RAD environments described in this document support procedures that enable the use of automated transfer of identification between ATS units (8.6.3.2 a-d).

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Z.8 REFERENCES

Ref: 1. “Air Traffic Services”, ICAO, Annex 11 to the convention on International Civil Aviation, Thirteenth edition, July 2001.

Ref: 2. “Air Traffic Management”, ICAO, Procedures for Air Navigation Services, Document 4444, Fourteenth edition, 2001, Amendment 4.

Ref: 3. ICAO State Letter 28th April 2006 Ref “Air Traffic Management”, ICAO, Procedures for Air Navigation Services, Document 4444, Fourteenth edition - proposal to update Amendment 4 to include ADS-B procedures in Chapter 8 ‘Surveillance Services’

Ref: 4. “Package 1 Operational Services and Environmental Definition (OSED)”, RFG internal document.

Ref: 5. ICAO PANS-OPS Volume 1 ‘Flight Procedures’ Document 8168.

Ref: 6. ICAO Doc 9689 ‘manual on Airspace Planning Methodology for the Determination of Separation Minima’, First Edition 1998.

Ref: 7. ICAO Annex 11 –Air Traffic Services, 13th Edition (July 2001) Amendment 42 (November 2003)

Ref: 8. ICAO Annex 14 - Aerodromes, Volume 1 4th Edition (July 2004) , incorporating amendments 1-6.

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