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Safety and Performance Requirements Document for CDTI Assisted Visual Separation (CAVS)

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Prepared by: SC-186
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FOREWORD

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1. INTRODUCTION

This document provides the minimum operational, Safety and Performance Requirements (SPR) for the implementation of the "CDTI (Cockpit Display of Traffic Information) Assisted Visual Separation" (CAVS) application. CAVS is fully defined in the Operational Services and Environment Definition (OSED) found in Annex A.

This document does not provide any Interoperability Requirements (INTEROP) as they are identical to those defined for the "Enhanced Visual Separation on Approach" (VSA) application (DO-314/ED-160 [10]).

All material in this document was developed jointly by EUROCAE Working Group 51 and RTCA Special Committee 186. This document was developed based on the criteria for SPR documents set forth in DO-264/ED-78A, "Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications" [4]. It provides the minimum CAVS requirements - and allocations thereof - based on the results of a coordinated requirements determination process.

The requirements contained in this document are necessary to provide adequate assurance that the appropriate aspects of the relevant Communication Navigation Surveillance and Air Traffic Management (CNS/ATM) system, when operating together, will perform their intended function in an acceptably safe manner for the operations defined in the OSED.

Whilst all detailed SPR related assessments are found in Annexes to this document, CHAPTER 3 presents the results of reconciling all of these assessment results into a single set of underlying Safety and Performance Requirements. This process retains the most stringent requirement for those attributes or parameters commonly treated by both the safety and performance assessments. Traceability of those requirements back to the corresponding assessment(s) is provided.

1.1 PURPOSE OF THE DOCUMENT

This document defines and allocates the set of minimum requirements for the end-to-end operational, safety and performance aspects for implementations of the CAVS application. This SPR allocates these requirements to the necessary domains of the CNS/ATM system (i.e. at aircraft and ground domain levels).

These requirements can be used as a component for approval processes including aircraft type design approval, aircraft operator operational approval, and Air Traffic Services (ATS) provider operational approval. This SPR document is also written to support system-specific standards (e.g. MOPS, TSOs, etc.) which will be required for many airspace regulators.

In addition, this document also provides guidance to determine the levels of design assurance and performance that are needed for each element (aircraft, operator, and Air Navigation Service Provider - ANSP) to support the CAVS application.

The CAVS SPR is also envisaged to be used along with those from other surveillance applications based on Automatic Dependent Surveillance-Broadcast (ADS-B) to develop minimum standards for avionic systems to assure that all subsystems perform their intended functions adequately for these applications

1.1.1 CAVS application

To increase runway capacity, operations at some airports are based on a flight crew maintaining own separation from the Preceding Aircraft. The "Enhanced Visual Separation on Approach" application (VSA) [10] has been developed and standardised

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to enhance this type of operation. CAVS is intended to further enhance the VSA application.

The fundamental difference between VSA and CAVS is that the flight crew of the flight crew of the CAVS Aircraft is authorized to use the information provided by the CDTI when OTW visual contact on the Preceding Aircraft is lost (e.g. lost in the lights of the night) to continue maintaining own separation in VMC from this aircraft on the approach.

Before starting CAVS, the flight crew will have achieved OTW visual contact on the Preceding Aircraft and will have verified the consistency of the information on the CDTI with what they can see Out-The-Window (OTW), and with traffic information provided by the controller when available.

CAVS mainly applies to visual approaches but can also be applied to when the CAVS Aircraft is flying an instrument approach, in some conditions, and provided flight visibility conditions are VMC. The task of maintaining own separation from the Preceding Aircraft is the same for both types of approaches. CAVS does not change any requirements for visual or instrument approaches. Throughout CAVS, the CAVS Aircraft must remain in VMC and VMC must exist at the airport. The weather conditions to conduct CAVS during an instrument approach must still be VMC. CAVS does not aim to modify Visual Meteorological Conditions (VMC) minima as defined by ICAO.

The application is mainly intended for air transport aircraft arriving into capacity-limited airports but it can be used by all suitably equipped aircraft during approach to any airports where clearances for maintaining own separation from the Preceding Aircraft are used. CAVS does not change any pilot and controller procedures related to wake vortex limitations or runway occupancy time.

To achieve the CAVS objectives, the flight crew will be provided with additional features in comparison with VSA. The flight crew has the capability to designate one of the depicted traffic on the CDTI for which two additional parameters are displayed:

- the horizontal range to the designated traffic; and
- the differential ground speed at the minimum when the aircraft are in-trail of each other.

Additionally three types of alerts can be triggered for the designated traffic:

- an advisory alert when the designated traffic is no longer qualified to support CAVS;
- an advisory “Range Indication” alert when the horizontal range to the designated traffic falls below a value selected by the flight crew; and
- a caution “CAVS Minimum Range” alert when the CDTI can no longer be used as the only source of information to maintain own separation from the designated traffic at this distance (i.e. the horizontal range to the designated traffic becomes less than 1.4 NM).

1.1.2 Use of document for approvals

This document is intended to support the approval of all elements of the CNS/ATM system relating to CAVS.

The corresponding safety and performance assessments are based on the detailed specification of the OSED. States or regions implementing an application different to that specified in the OSED must take into account those differences in the operations or environment in supporting analysis and must analyse the impact of these differences on the requirements.

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The assessments and specifications in this document are not intended to be the sole basis for operational and airworthiness approval. However, this material can be used as an important component for establishing minimum design and system performance standards for ANSP, aircraft operator and aircraft certification approvals for the CAVS application.

Aircraft and avionics system designers should consider any additional specifications that may enhance the system supporting the CAVS application in view of other future Airborne Surveillance Applications (ASA) so that systems designed for CAVS will easily accommodate more demanding ADS-B enabled operations in the future.

1.2 SCOPE OF THE DOCUMENT

This document includes the definition of the services and the Environmental Conditions relevant to the implementation of the CAVS application and the operational, safety and performance requirements for using the application.

***NOTE**: Requirements that provide protection against intentional behaviour causing harm or sabotage are beyond the scope of this document.*

***NOTE**: Requirements related to the recording of ADS-B data for accident or incident investigation purposes are beyond the scope of this document.*

1.2.1 CAVS context

CAVS is one application in a suite of planned applications based on an ADS-B "IN" function that relies on airborne surveillance information (e.g. ADS-B "OUT") being available from other aircraft. ADS-B OUT is mandated for most aircraft (including GA) in rule-defined airspace in the United States by 2020 [15] [16], and for most aircraft over 5.7 tonnes or 250 kts in Europe from 2017 [17].

***NOTE**: Full details of ADS-B OUT mandates are beyond the scope of this document.*

To support CAVS operations, this document places specific requirements on the quality of surveillance information which has been developed to be consistent with ADS-B OUT mandates wherever possible.

While defined and assessed as a separate, stand-alone application, CAVS will be implemented as part of a larger ASA System in which it is integrated with other applications (at least AIRB [12] which is the underlying application for CAVS). This standard, however, does not consider the interaction, interoperability and transition between CAVS and other ADS-B IN applications and systems. Nevertheless, as CAVS can be considered as an extension of VSA, the OSED, OPA and OSA for CAVS are developed starting from those for VSA and many requirements are identical to both applications.

Separate publication of the SPR/INTEROP documents for ADS-B applications will allow Sovereign States, ANSPs and airspace users to select those applications that are best suited to their operations and needs. However, to ensure seamless growth and global interoperability, any new installation of ADS-B should meet the full minimum requirements for the given data link as specified in the published ADS-B link MOPS [5] and [7].

1.2.2 Assumed airborne & ground generic surveillance functional architecture

Figure 1.1 presents the generic surveillance functional architecture considered by the RTCA/EUROCAE to support Airborne Surveillance Applications. The figure identifies the airborne domains and the ground domain associated with Airborne Surveillance Applications enabled by ADS-B. The airborne domains consist of the ASA Transmit Participant and the ASA Receive Participant. The ASA Transmit Participant represents the functions associated with providing the ADS-B OUT

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capability needed to support ground-based or aircraft-based surveillance applications. The ASA Receive Participant provides the ADS-B IN capability to host Airborne Surveillance Applications. The Ground Domain represents the capability to host ground-based surveillance applications in support of Air Traffic Services.

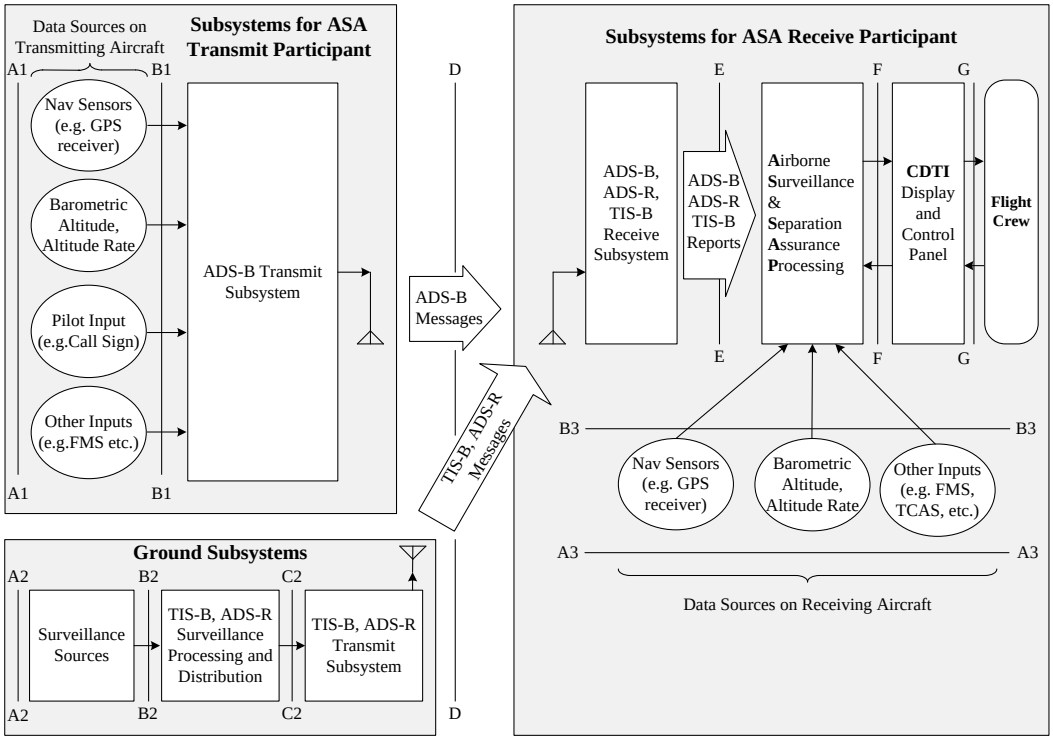


FIGURE 1.1: SURVEILLANCE FUNCTIONAL ARCHITECTURE FOR AIRBORNE SURVEILLANCE APPLICATIONS

Figure 1.1 also identifies the system functions and functional interfaces (small lines with associated letters and numbers, e.g. B1) associated with the aircraft domains and the ground domain. The figure identifies the functional interfaces (e.g. D, G1) to which the Safety and Performance Requirements are allocated. These interfaces are referenced throughout the document where requirements are provided.

***NOTE**: In this document, the ASA Receive Participant is referred to as the CAVS Aircraft and the ASA Transmit Participant as the Preceding Aircraft, i.e. the aircraft from which the flight crew of the CAVS Aircraft is cleared to maintain own separation.*

General functional capabilities and key aspects of the architecture are specified below.

For the CAVS Aircraft:

- The minimum surveillance functional architecture includes:
    - reception of ADS-B messages (represented by the ADS-B Receive Function);
    - ownship sensor data processing;

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- where applicable, surveillance data processing, and applications-specific processing (represented by the Airborne Surveillance and Separation Assurance Processing Function, ASSAP); and
- where applicable, the provision of necessary information to the flight crew by the CDTI Function and its associated control interface.

- Requirements allocated to the CAVS Aircraft are measured
  - from the time of transmission or reception (interface D) of the ADS-B information;
  - at the time of measurement of sensor data (interface A3) or at the output of the aircraft sensors and systems (interface B3);
  - through the conveyance of needed information to the flight crew (interface G).

***NOTE**: TIS-B (Traffic Information Service - Broadcast) and ADS-R (Automatic Dependent Surveillance – Rebroadcast) data are shown in Figure 1.1 as potential other sources of surveillance data that may be used for some Airborne Surveillance Applications. ADS-R can support CAVS operations if available and compliant with CAVS safety, performance and interoperability requirements. However, At this point there is insufficient data to show whether the reported TIS-B velocity has the quality required during in-trail acceleration/deceleration in order to display traffic ground speed and to compute differential ground speed when sourced by terminal radars or multilateration. Until data collection and analysis is completed TIS-B is not approved for use with CAVS. Investigation is also under way for using TCAS range rate to validate or possibly substitute for TIS-B velocity. That possibility is not discussed in this document. Manufacturers have the option of using an issue paper if they have sufficient data to show that TIS-B and/or other data sources can be safely used to provide velocity for CAVS until the next version of this document is published.*

For the Preceding Aircraft:

- The minimum surveillance functional architecture includes on-board aircraft sensors and the ADS-B Transmit Function.
- Assumptions placed on the Preceding Aircraft are measured:
  - from the time of measurement of sensor data (interface A1 for positioning data);
  - from sensor outputs and flight crew control panel inputs, e.g. Aircraft Identification (interface B1); and
  - at the point of transmission of ADS-B OUT (interface D).

For the Ground Domain:

- The minimum functional architecture for the generic ASA systems includes a Surveillance Function, a Processing and Distribution Function and a TIS-B/ADS-R Transmit Function.
- Assumptions placed on the Ground Domain are measured:
  - from the time of reception of surveillance data (interface A2
  - through the transmission of the TIS-B/ADS-R messages (interface D).

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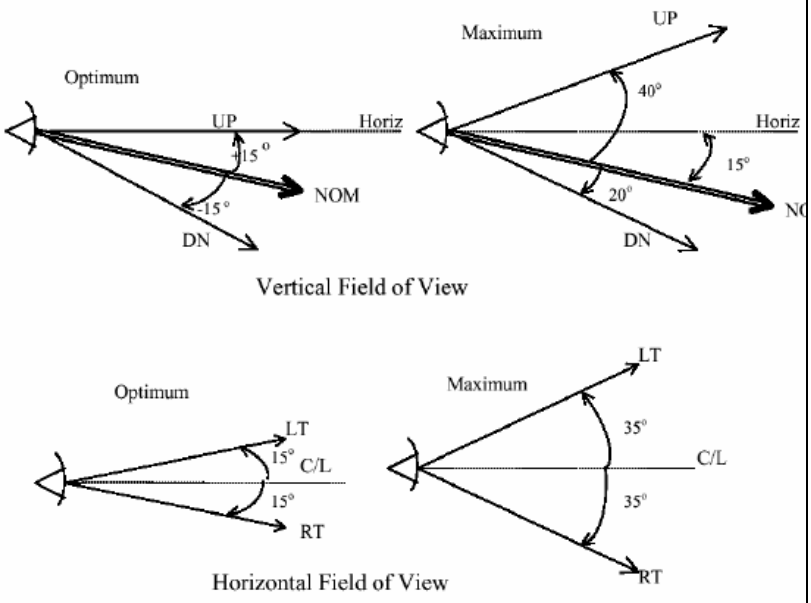
1.3 DEFINITION OF TERMS

This section provides a definition of the main terms used in the document. Some additional definitions are provided in the OPA (B.1.3) and the OSA (C.1.3) for terms more specific to these assessments.

TABLE 1.1: DEFINITION OF TERMS

Term	Definition	Source
Advisory	The level of alert for conditions that require flight crew awareness and may require subsequent flight crew response. ***NOTE**: Advisories may or may not contain an auditory message. Advisories are associated with any colour but red or green and preferably not yellow or amber.*	AC 25.1322-1 / CS-25
Alert	A generic term used to describe a flight deck indication meant to attract the attention of and identify to the flight crew a non-normal operational or airplane system condition. Alerts are classified at levels or categories corresponding to Warnings, Cautions, and Advisories.	AC 25.1322-1 / CS-25
ASSAP	The processing subsystem that accepts surveillance inputs (e.g. ADS-B reports), performs surveillance processing to provide reports and tracks, and performs application-specific processing.	ED-194 / DO-317A
Caution	The level of alert for conditions that require immediate flight crew awareness and subsequent flight crew response. ***NOTE**: Cautions are associated with an auditory signal and the colour yellow/amber.*	AC 25.1322-1 / CS-25
CAVS Aircraft	The aircraft that is equipped with CAVS Equipment and is operating the CAVS application.	-
CAVS Equipment	All avionics which perform functions needed to support or perform the CAVS application, i.e. the receive subsystem, ASSAP and CDTI.	-
Cockpit Display of Traffic Information (CDTI)	The pilot interface portion of the Aircraft Surveillance Applications System. This interface includes traffic display(s) and all the controls that interact with such a display. At a minimum, CDTI includes a graphical plan-view (top down) traffic display. Additional graphical and non-graphical display surfaces may also be included. The CDTI receives position information of traffic and ownship from the Airborne Surveillance And Separation Assurance Processing (ASSAP) function. The ASSAP receives such information from the surveillance sensors and ownship position sensors.	ED-194 / DO-317A
Designated traffic	The traffic designated by the flight crew on the CDTI that they identify as being the Preceding Aircraft.	-
Horizontal range	Direct horizontal distance between the CAVS Aircraft and the designated traffic.	-
In-trail aircraft	Two aircraft are in-trail when the relative track angle between these aircraft is less than 20 degrees	-

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Term	Definition	Source
Preceding Aircraft	The aircraft to be visually acquired and from which the flight crew of the CAVS Aircraft is cleared to maintain own separation	Based on ICAO 4444 section 6.5.3
Primary Field of View (PFOV)	Primary Field-of-View is based on the optimum vertical and horizontal visual fields from the design eye reference point that can be viewed with eye rotation only using foveal or central vision. The description below provides an example of how this may apply to head-down displays. With the normal line-of-sight established at 15 degrees below the horizontal plane, the values for the vertical (relative to normal line-of-sight forward of the aircraft) are +/-15 degrees optimum, with +40 degrees up and -20 degrees down maximum.  **Figure A3-1 Primary Field of View**	AC 25-11A
Traffic Display	The graphical plan-view (top down) traffic display of the CDTI.	ED-194 / DO-317A

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1.4 STRUCTURE OF THE DOCUMENT

- CHAPTER 1 (the current chapter) explains the purpose and scope of this document and introduces the CAVS application and the SPR document and process.
- CHAPTER 2 describes the approach and methodology aspects applied for the development of this application and the safety and performance assessments.
- CHAPTER 3 provides the consolidated Safety and Performance Requirements applicable to the CAVS application. It also includes the key assumptions made for the CAVS application.
- Annex A is the Operational Services and Environment Definition (OSED) for CAVS. This describes the services, intended functions and associated procedures of the CAVS application and the assumptions about the environment in which the application is specified to operate. It also contains phase diagrams that give an illustrative (flow chart) description of the steps of the fundamental procedures applied and which are used as part of the analysis process. It includes three appendices; providing the definition of key terms used in the OSED, the relevant ICAO provisions and an illustration of possible CAVS operations.
- Annex B is the Operational Performance Assessment (OPA). This determines minimum Performance Requirements for the surveillance data (received and from the CAVS Aircraft), associated processing and the display of traffic for the CAVS Aircraft. The OPA also derives a set of assumptions on the Preceding Aircraft needed for the application.
- Annex C is the Operational Safety Assessment (OSA). This Annex explains in detail the methodology used for this assessment, which is based on ED-78A/DO-264 [4] The Annex also presents the detailed tables of results of the Safety Assessment itself. It includes an appendix, providing the Hazard Classification matrix.
- Annex D is the CAVS Spacing Error Analysis deriving requirements on the horizontal position measurement integrity and accuracy (which have to be reconciled with respective OSA and OPA requirements), as well as the CAVS surveillance quality driven alert threshold (i.e. caution “CAVS Minimum Range” alert). It also provides consideration of the “coasting” of ADS-B horizontal position quality indicators.
- Annex E provides the list of acronyms used in this document.
- Annex F provides a list of participants who have contributed to the development of this document.

1.5 REFERENCES

1.5.1 ICAO

[1] “Air Traffic Management”, ICAO, Procedures for Air Navigation Services, Document 4444, Fifteenth edition-2007

[2] Annex 2, Rules of the Air, 10th Edition, Amendment No. 39, 23 November 2006

[3] Annex 10, Volume 4, Volume IV, Surveillance Radar and Collision Avoidance Systems, Fourth Edition, July 2007

1.5.2 EUROCAE/RTCA

[4] ED-78A/DO-264: Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications, March 2002

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[5] ED-102A/DO-260B, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B), December 2009

[6] DO-260A, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B), April 2003

[7] DO-282B, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance – Broadcast, December 2009

[8] ED-125, Process Specification for Performing Risk Assessment and Mitigation in ATM in Compliance with ESARR 4, November 2009

[9] ED-126/DO-303, Safety, Performance and Interoperability Requirements Document For ADS-B-NRA application, December 2006

[10] ED-160/DO-314, Safety, Performance and Interoperability Requirements Document for Enhanced Visual Separation on Approach (ATSA-VSA), December 2008

[11] ED-161/DO-318, Safety, Performance and Interoperability Requirements Document for ADS-B-RAD application, September 2009

[12] ED-164/DO-319, Safety, Performance and Interoperability Requirements Document for Enhanced Traffic Situational Awareness during Flight Operations (ATSA-AIRB), March 2010

[13] ED-165/DO-322 Safety, Performance and Interoperability Requirements Document for ATSA-SURF application, December 2010

[14] ED-194/DO-317A, Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications (ASA) System, December 2011

1.5.3 Other

[15] 14 CFR 91.225 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment and use

[16] 14 CFR 91.227 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment performance requirements

[17] Commission Implementing Regulation (EU) No 1207/2011 of 22 November 2011 697 laying down requirements for the performance and the interoperability of 698 surveillance for the single European sky Text with EEA relevance (OJ L 305, 699 23.11.2011

[18] AC 25.1322-1, Flight crew alerting, FAA, 13 December 2010

[19] CS 25.1322-1, Flight crew alerting, EASA, 13 July 2012

[20] AC 25.1302-1, Installed Systems and Equipment for Use by the Flight crew , FAA, 3 May 2013

[21] AMC 25.1302, Installed Systems and Equipment for Use by the Flight crew, EASA, Amendment 14, 19 December 2013.

[22] AC 25-11A, Electronic Flight Deck Displays, 21 June 2007

[23] EUROCONTROL Safety Regulatory Requirement – ESARR 4: Risk Assessment and Mitigation in ATM, Edition 1.0

© 2014, RTCA, Inc.

[24] System Safety for the 21st Century", Updated and Revised Edition of System Safety 2000, Richard A. Stephans, 2004

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