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Detect and Avoid (DAA)
White Paper Phase 2

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- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
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1 INTRODUCTION

This White Paper contains the description and plan for development, verification and validation of Phase 2 Minimum Operational Performance Standards (MOPS) for Unmanned Aircraft System (UAS) Detect and Avoid (DAA) systems. The standards will specify performance standards that should be useful to designers, manufacturers, installers and users of the equipment. Emphasis for Phase 2 will be development of standards for UAS equipped to conduct extended Beyond-Visual-Line-of-Sight (BVLOS) operations in the National Airspace System (NAS) as outlined in Section 3 and Section 4.

Compliance with the to-be-developed standards is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all foreseeable operating conditions as described in the RTCA Special Committee (SC-228) Terms of Reference (TORs) and this document for DAA Phase 2. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

Early sections of this document provide information needed to understand the rationale for development of equipment characteristics and work to be performed in the remaining sections. The paper describes typical operations and operational goals as envisioned by the members of SC-228 and establishes the basis for the work plan and standards that will be developed. Definitions and assumptions essential to proper understanding of this document are also provided.

The MOPS to be developed will specify the required DAA performance under standard environmental and operational conditions that will be defined as described in Section 4 of this document. Also included in the MOPS will be recommended test procedures necessary to demonstrate equipment compliance with the minimum requirements. Tests for the DAA installed equipment are to be included in the MOPS when performance cannot be adequately determined through bench testing.

The MOPS will describe the performance required of the DAA equipment. To the maximum extent possible, required Command and Control (C2) data link performance will be included by reference to the existing C2 MOPS (RTCA DO-362) and the Phase 2 C2 MOPS concurrently under development by the SC-228 C2 Working Group.

The word “DAA equipment” as used in this document includes all components and units necessary for the DAA system to properly perform its intended function(s). For example, the equipment may include ground-based DAA radar, active surveillance and Automatic Dependent Surveillance – Broadcast (ADS-B) cooperative sensors, electro-optical, infrared and radar non-cooperative sensors, computer processors, data links (e.g., the Command and Control (C2) link system), and pilot displays. In the case of this example, all of the foregoing components and units comprise the “DAA equipment.” It should not be inferred from this example that each DAA design will necessarily include all of the foregoing components or units, or that this is a complete list of equipment for a satisfactorily operational system. This will depend on the specific design chosen by the manufacturer.

The MOPS will describe the operational performance characteristics for DAA equipment installations and will define conditions that will assure the equipment user that operations can be conducted safely and reliably in the expected operational environment.

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The MOPS will consider a DAA equipment configuration consisting of: sensors, processors, software/firmware, communication data links, and displays and controls that will allow the Pilot in Command (PIC) of a UAS to conduct extended Beyond Radio Line-of-Site (BRLOS) operations as described in Section 3, Scope, and Section 4, Operational Environment. Operational performance standards for functions or components that refer to equipment capabilities that exceed the stated minimum requirements will be identified as optional scope. Performance requirements and associated test procedures would need to be developed for these optional features, but schedule and other resource constraints may limit the identification and specification of optional features.

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2 BACKGROUND

The requirement to "see and avoid" other aircraft is part of the regulations governing the general operation of aircraft in the NAS under Title 14 of the Code of Federal Regulations (14 CFR), Part 91, §91.111, §91.113(b), and §91.181(b). Although the requirements stated in the regulations are described as collision hazard, right-of-way rules, and well-clear, respectively, the intent of these regulations when taken together is to avoid collisions, remain well clear from other aircraft, and comply with right-of-way rules.

While these operating regulations are specific, the concept of well-clear is non-specific in nature and requires a pilot's subjective assessment when performing maneuvers for this purpose. This is problematic for designing an engineering solution to meet the "see and avoid" requirement. To set performance requirements for an equipment standard, quantitative descriptions for Loss of Well Clear (LoWC) and Near Mid-Air Collision (NMAC) will be used. Furthermore, thresholds that determine when action is needed to avoid these boundaries may be required to ensure interoperability and compatibility with other Air Traffic Management (ATM) functions. These thresholds may not necessarily be fixed boundaries in space, but may be dynamic and dependent on the time to Closest Point of Approach (CPA), closure rate, maneuverability, and other factors. These thresholds may be different and dynamic for each aircraft being tracked in the vicinity of the UAS, dependent on the phase of flight, and may change over time as an encounter progresses. The NMAC volume is a well-established definition for Collision Avoidance at 500' horizontal and +/-100' vertical and will be used for the Phase 2 MOPS effort.

A DAA system is designed to provide the capability to remain well clear and avoid collisions with other aircraft. The DAA system notionally consists of a surveillance sensor (or suite of sensors), trackers and/or surveillance data fusion/correlation logic, threat detection and avoidance logic, the display/annunciation of traffic information and maneuver guidance, and controls. The system and its architectural components must be designed to an appropriate level of system performance and design assurance to be acceptably safe for use in the United States (U.S.) NAS and similar airspace internationally. The DAA Working Group will develop, verify and validate DAA equipment MOPS for UAS operating in the NAS. Phase 1 focused on Unmanned Aircraft (UA) transit and operations as described in detail in the Phase 1 DAA MOPS, RTCA DO-365 and the Phase 1 Air-to-Air Radar MOPS, RTCA DO-366. The focus of the Phase 1 MOPS was UAS transitioning to and from Class A or special use airspace (higher than 500' above ground level), traversing Class D, E, and G airspace. The Phase 1 MOPS requires a fairly powerful radar to detect non-cooperative aircraft and thus cannot apply to UAS with reduced Size, Weight, and Power (SWaP) capabilities.

The Federal Aviation Administration (FAA) UAS Operational Concept document includes assumptions, constraints, requirements, and high level operational considerations for UAS and is intended to provide the foundation for the DAA system MOPS.[1] The scope and functionality of the Phase 2 DAA MOPS may require specific restrictions, operating limitations and/or supplemental operational controls or provisions to achieve an acceptable level of collision risk mitigation for use of compliant equipment in the NAS and similar airspace internationally. Any such restrictions or operating limitations and/or supplemental

[1] Integration of Unmanned Aircraft Systems into the National Airspace System Concept of Operations V2.0, 28 September 2012

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