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Architecture Recommendations for Aeronautical Information (AI) and Meteorological (MET) Data Link Services

RTCA DO-349
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Prepared by SC-206

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FOREWORD

This report was prepared by RTCA Special Committee 206 (SC-206) and approved by the RTCA Program Management Committee (PMC) on March 18, 2014.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal advisory committee, and develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- 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
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders and several advisory circulars

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EXECUTIVE SUMMARY

The availability of highly reliable, high-throughput, and low-cost wireless aircraft connectivity is growing rapidly. On the other hand, ground-based technologies and systems have far outstripped airborne capabilities in both speed and shear breadth of available functionality. Certification and approval techniques for airborne systems and capabilities have remained reactionary to the demand rather than leading the way. In some instances, standards and guidance have been created and/or updated, but overall have not evolved appreciably with the breakneck pace of digital data exchange technology.

These Aeronautical Information Services (AIS) and Meteorological (MET) Services Architecture Delivery Recommendations provide industry supported recommendations that will enable greater flexibility for the review and operational approval of systems delivering AIS and MET data services to aircraft cockpits. The delivery recommendations are built upon those applications and uses described in RTCA DO-340, *Concept of Use (ConUse) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services* and RTCA DO-339, *Aircraft Derived Meteorological Data via Data Link for Wake Vortex, Air Traffic Management and Weather Applications Operational Services and Environmental Definition (OSED)*. While these two documents provided the basis for the development of this document, other considerations were included in the development of the recommendations contained herein.

Several of the subjects discussed within this document are considered out of scope to the delivery of AIS and MET data link services to cockpits and aircraft in general; however, this document was developed with the purpose of holistically analyzing all of the issues that could enable or hinder AIS and MET data link services. The analysis revealed four main areas of concern:

- architectural ambiguity;
- information quality;
- cyber security; and
- lack of data link media suitability determination standardization.

This document, while describing these areas of concern and proposing recommended paths to solutions, does not specify the precise manner in which solutions must be defined. The specifics necessary to address these recommendations, in many cases, lie with future efforts. The analysis led to the creation of a set of recommendations detailed in Section 1.7. The recommendations were limited to assessed obstacles to achieving data link services. Further explanation as to the analysis and assessment that allowed the derivation of each recommendation is contained within the relevant sections.

Architecture:

RTCA DO-340 described a clarification of how to think of data link services. That document defined Category 1 and Category 2 data link services. This was an important first step in moving away from earlier concepts of how to differentiate data link services. What it did not provide was the means to apply these new definitions.

- What does it mean practically for a data link service to be classified as Category 1 versus Category 2?
- Is there a difference between a behavior and a required communication performance parameter?
- What functions need to be accomplished for which service?

This document describes a framework that answers the above questions and more. A holistic functional architecture, outlined in Section 3, attempts to capture identified needs. This architecture again does not provide a minimum requirement for all data link systems, but it does provide a structure from which functional choices can be made by implementers, regulators, and standards groups. Included in the architectural discussion are recommendations to achieve flexible development by implementers of data link services. The flexible approach outlined is a recommendation; and if applied correctly, it will allow the greatest amount of innovation, while still allowing for the appropriate amount of regulatory oversight to achieve safe operations.

Information Quality Assurance:

In order to achieve approval for operational use of data link services to aircraft for the purpose of supporting or satisfying the air traffic service function, the information delivered through those services must have some level of assurance as to its quality. The industry and regulatory agencies currently face two challenges to realizing this assurance.

On the one hand, the information delivered to aircraft is largely dependent upon the quality of the information as generated by the source prior to incorporation into the data link service. While various data quality standards exist, there is not a mandated minimum requirement that data producers must abide by for the full breadth of information that is to be dynamically data linked to aircraft in the next generation of aviation.

On the other hand, standards exist to assure the quality of aeronautical data as it moves along the data chain. These standards, while potentially adaptable for information made more contextually rich delivered via data link, their efficiency for information managed on a working and free flowing basis requires further investigations. A standardized process necessary to achieve either certification or operational approval of the developing high bandwidth data link delivery systems does not currently exist. This creates a situation where the industry has developed or is developing capabilities that can assist in the realization of the RTCA DO-340 described uses, but they languish in complex and ambiguous approval processes that are unique to each effort.

Section 4 describes the situation as it relates to information quality assurance and provides specific and timely recommendations. Without clear regulatory oversight and rigorous attention to achieving quality information origination as well as delivery assurance, Category 1 delivery services as well as the uses that they intend to support will not be achievable in the near term.

Security:

The operational use of AIS and MET data link services introduces concerns related to cyber security threats and vulnerabilities. These security concerns are system-wide, which may impact the overall data link service, including aircraft systems. These concerns need to be addressed through both the aircraft system certification process and the aircraft operational approval process. Central to resolving issues surrounding data, data exchange, and data link security is that it be viewed on an end-to-end basis.

While there are several efforts underway to define systems and data security as it relates to aircraft systems and data link technologies, there continues to be a demand for an overarching security architecture set, which may satisfy the needs for safe operations of aircraft well into the future.

Allocation of Use to Data Link:

Underlying all of the above subjects lays the means to provide, via data link, the data that is the foundation of any data link service. The determination of which data link(s) is suitable to provide services for a given use(s) continues to focus frequently on incumbent safety service defined data links instead of broadening the field to other links for consideration. In turn, this causes delays in implementation, unrealized safety, cost, and user benefits and lastly a reduction in vendor competiveness and opportunity.

To begin to address these shortcomings, Section 6 describes and outlines a repeatable process for determining suitable delivery methods for current and future AIS and MET applications, uses, and data link technologies. This recommended and flexible approach provides a structure by which multiple disparate data link technologies may be comparatively analyzed as potential candidates to provide the specified level of service.

The analyses resulting from this process will inform FAA and industry decisions regarding acceptable delivery methods and the relevant architecture given limited spectrum for specific uses and services today. By standardizing the determination of data links' suitability, the recommended process is expected to have the following benefits: future implementation of services will be shortened, safety will be improved, costs will be reduced, and competition will increase.

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1 INTRODUCTION

This Aeronautical Information Services (AIS) and Meteorological (MET) Services Delivery Architecture Recommendations document was developed by RTCA Special Committee (SC-206). The document contains an initial set of industry supported delivery method recommendations for those applications and uses described in RTCA document DO-340, *Concept of Use (ConUse) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services*. A further service defined in RTCA DO-339, *Aircraft Derived Meteorological Data via Data Link for Wake Vortex, Air Traffic Management and Weather Applications Operational Services and Environmental Definition (OSED)* is included in the recommendations. These recommendations cover architectural, information sourcing, security, and allocation processes. The analyses resulting from this process will support the Federal Aviation Administration (FAA) and industry decisions regarding acceptable delivery methods and the relevant architecture given limited spectrum for specific uses and services.

This document has been developed to support the data communications needs of future Air Traffic Management (ATM) concepts (e.g., Next Generation Air Transportation System (NextGen) and potentially provides input for future efforts by the Single European Sky Air Traffic Management Research (SESAR) initiatives). A key objective of these future ATM concepts is to establish the aircraft as a primary participant in collaborative decision making (CDM), and in some cases, establish airspace regions for autonomous operations where the aircraft is primarily responsible for safe separation from other traffic, wake turbulence, weather, and designated/restricted airspace. Timely availability of high quality and reliable electronic AIS and MET information services are necessary to support these global ATM concepts.

1.1 Purpose

This document is to be used by multiple audiences for several purposes: approval authorities and non-regulators. Approval authority entities are the civil or military authorities that authorize the use and/or installation of Data Link Services as defined by RTCA DO-308/European Organisation for Civil Aviation Equipment (EUROCAE) European Document ED-151. The approval authority entity in the United States (U.S.) is the FAA, more specifically the Aviation Safety Services organization within the FAA, which includes Flight Standards Services and Aircraft Certification Services. This document is expected to be used as a decision support document for policy decisions and recommended guidance to FAA for approving AIS and MET data link architectures and systems.

Additionally, this document is being constructed with further standards work in mind. Similar efforts to define, refine, and constrain data delivery to airborne vehicles could