Autonomous Distress Tracking (ADT)
Architecture Studies
SATCOM - Iridium

ARINC REPORT 6XX

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FOREWORD
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ARINC Industry Activities organizes and provides the secretariat for international aviation organizations (AEEC, AMC, FSEMC) which coordinate the work of aviation industry technical professionals and lead the development of technical standards for airborne electronic equipment, aircraft maintenance equipment and practices, and flight simulator equipment used in commercial, military, and business aviation. The AEEC, AMC, and FSEMC develop consensus-based, voluntary standards that are published by SAE-ITC and are known as ARINC Standards. The use of ARINC Standards results in substantial technical and economic benefit to the aviation industry.

There are three classes of ARINC Standards:

a) ARINC Characteristics – Define the form, fit, function, and interfaces of avionics and other airline electronic equipment. ARINC Characteristics indicate to prospective manufacturers of airline electronic equipment the considered and coordinated opinion of the airline technical community concerning the requisites of new equipment including standardized physical and electrical characteristics to foster interchangeability and competition.

b) ARINC Specifications – Are principally used to define either the physical packaging or mounting of avionics equipment, data communication standards, or a high-level computer language.

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In order to facilitate the continuous product improvement of this ARINC Standard, two items are included in the back of this volume:

An Errata Report solicits any corrections to existing text or diagrams that may be included in a future Supplement to this ARINC Standard.

An ARINC IA Project Initiation/Modification (APIM) form solicits any proposals for the addition of technical material to this ARINC Standard.

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1.0 INTRODUCTION

1.1 Purpose of this Document

This document documents the architectural options to support an Autonomous Distress Tracking (ADT) System that are being levied by the International Civil Aviation Organization (ICAO) and individual Civil Aviation Authorities (CAAs) (both at the aircraft-level and on-ground systems). All derived system-level requirements are also documented within this report.

In addition, a System Functional Block Diagram, allocating the requirements to each functional block, is also documented.

COMMENTARY

The difficulty in locating the crash sites of Air France Flight 447 in June 2009 and Egypt Air Flight 804 in May 2016, and the disappearance of Malaysia Airlines Flight 370 in March 2014, has prompted significant international effort to provide means for a global aircraft tracking capability. Since 2015, ICAO has worked to amend ICAO Annex 6 standards to include requirements for tracking commercial planes during all flight phases, including functionality of autonomous identification and reporting of distress situations (Autonomous Distress Tracking). In addition, the European Commission has published Commission Regulation (EU) 2015/2338 with similar, but in some cases differing, requirements.

1.2 Scope

The scope of this document is limited to documenting the system-level requirements for an Autonomous Distress Tracking (ADT) System and a survey of potential architectures to support these requirements.

Requirements associated with Normal or Abnormal Tracking, as identified in ICAO or CAA documents, are not part of the ADT requirements.

1.3 Objectives

The objective of this ARINC report is to:

1. Capture all documented ICAO and regulatory system-level requirements for an ADT system
2. Integrate these and derive a requirements set to use in evaluating a range of potential ADT architectures.
3. Perform a study of applicable ADT architectures to support the following characteristics development work.

1.4 Related Documents

These documents provide source requirements for the ADT system.

COMMISSION REGULATION (EU) 2015/2338 of 11 December 2015 amending Regulation (EU) No 965/2012 as regards requirements for flight recorders, underwater locating devices and aircraft tracking systems

EU No. 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No. 216/2008 of the European Parliament and of the Council

Annex II to Executive Director (ED) Decision 2015/XXX/R 'AMC and GM to Part-CAT — Issue 2, Amendment X' (DRAFT dated Feb. 2016)

ICAO Annex 6, "Operation of Aircraft", Part I, "International Commercial Air Transport – Aeroplanes"

ICAO Annex 11, "Air Traffic Services"

ICAO Document, "Concept of Operations – Global Aeronautical Distress & Safety System" (Ver 6.0, 7 June 2017)

ICAO Document 10054, "Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery" *(Not yet released)*

2.0 Autonomous Distress Tracking (ADT) Architecture Study

2.1 Architecture x Study

2.1.1 Description of Architecture

As part of the iridium ADT architecture study, these are the options:

(a) Independent Event & trigger block (ie, ADT) and Iridium transceiver

(b) Integrated Event & trigger block (ADT) and Iridium transceiver and

(c) Separate Event & trigger block (ADT) and Iridium Transceiver with a builtin ADT capability (offering certain level of redundancy for the ADT function).

See attached diagrams.

2.1.2 Architecture Mapped to the Architecture Frame Work

Key components and capabilities mapped to the architecture framework described in Appendix A.

Functional Block 1- Aircraft state --- Included in Architecture (Input to D & T function)

Functional Block 2- Distress Detection logic --- Included in Architecture (D & T function)

Functional Block 3- Triggering Criteria logic --- Included in Architecture (D & T function) and Airlines AOC function

Functional Block 4- Distress tracking transmission --- Included in Architecture (AES function)

Functional Block 5- Distress Report --- Included in Architecture (Airlines AOC)

Functional Block 6- Flight crew Feedback --- Included in Architecture (ADT status annunciation to Flight Deck)

Discussion, in terms of architecture framework components, of the architectures' functionality that supports the component.

TBD

Discussion of key assumptions and dependencies for the architecture.

Assumption 1: ADT function includes independent sensor input and independent power (including builtin battery).

Assumption 2: It is recommended the link A/C systems → ADT is unidirectional diode to prevent potential security breach from Ground systems and/or AISD domain. The only exception shown is ADT status going to flight deck (A/C systems domain). This exception will have to be reviewed as a team on how the potential security risk from AISD domain will be addressed.

Assumption 3: Ground based trigger can be used in the case of non-cooperative crew (malicious or incapacitated). This is coupled with the capability to cancel the trigger.

Assumption 4: No forced air cooling is required.

Assumption 5: These architectural block diagrams are applicable to new aircraft deliveries starting from Jan 2012 per the anticipated mandate.

Assumption 6: The objective is Architecture diagram does not require to be modified to meet the retrofit market needs.

Assumption 7: Security requirements for airborne segment and ground segment are TBD.

Discussion of key airplane infrastructure support and changes required to support architecture.

- **Antenna Installation requirements**
- **Continuous power to ADT function and transceiver function**
- **Size requirements**
- **Harness routing requirements from ADT to Transceiver**
- **Other installation requirements TBD**
- **Tamper proof requirements**

Discussion of key network support and changes required to support architecture.

Performance requirements for transceiver to transmit the distress signal TBD

Message definition TBD

Discussion of key ground segment support and changes required to support architecture.

Performance requirements for Ground segment (Gateway and AOC) to process the distress signal and uplink ground based triggerTBD

2.1.3 Compliance with Requirements

Evaluate the architectures support for the minimum and optional requirements described in Appendix B (minimum requirement set spreadsheet) and for the GADSS CONOPS (Ver 6.0) State of the Operator Approval Criteria Recommendations (section 3.2.10) using the matrices in Appendix C.

Identify and provide textual/graphic descriptions and discussions of any major shortcomings and if and how they are expected to be addressed.

Provide textual/graphic descriptions and discussions of any additional capabilities or opportunities for improved distress capabilities and services not addressed in the requirements.

Identify and discuss requirements that potentially impose a significant cost or impact for the architecture and discuss where changes in requirements or alternative could potentially provide similar capabilities at a significantly reduced cost or impact.

Identify and discuss requirements where there is potential opportunity for the architecture to significantly exceed or improve on the required levels with minor impact and cost.

2.1.4 Support for Related Services and Capabilities

Provide textual/graphic descriptions and discussions of any additional capabilities or opportunities for improved distress capabilities and services not addressed in the requirements. In particular address support for

1. Normal tracking
2. Abnormal and potential distress tracking
3. Implications for timely recovery of flight data
4. Post Flight Localization and Recovery

Appendix A. Architectural Framework

Adobe Acrobat Document

Figure A-1 Architectural Framework

(embedded file:

Global Tracking_Emb_2017_ARINC_Seattle_reve.pdf

from August 2017 Seattle Meeting)

Appendix B. Minimum Requirements Set

Microsoft Excel 97-2003 Worksheet

Figure B-2 Minimum Requirements Set

(embedded file: SAI GAT Architecture Study Requirements Tables_REV_NEW.xls)

Appendix C. Architecture Compliance/Support Matrix

Microsoft Excel 97-2003 Worksheet

Figure C-3 Architecture Compliance/Support Matrix

(embedded file:

SAI GAT Architecture Study Requirements Compliance Matrices _REV_NEW.xls)