



AUTONOMOUS DISTRESS TRACKING

TCCA Delegates Conference

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BOMBARDIER

Agenda



TIMELINE – ICAO AND EASA RULEMAKING



ICAO STANDARD AND EASA MANDATE – AUTONOMOUS DISTRESS TRACKING



ANALYSIS/SYSTEM REQUIREMENTS



TYPES OF SOLUTIONS

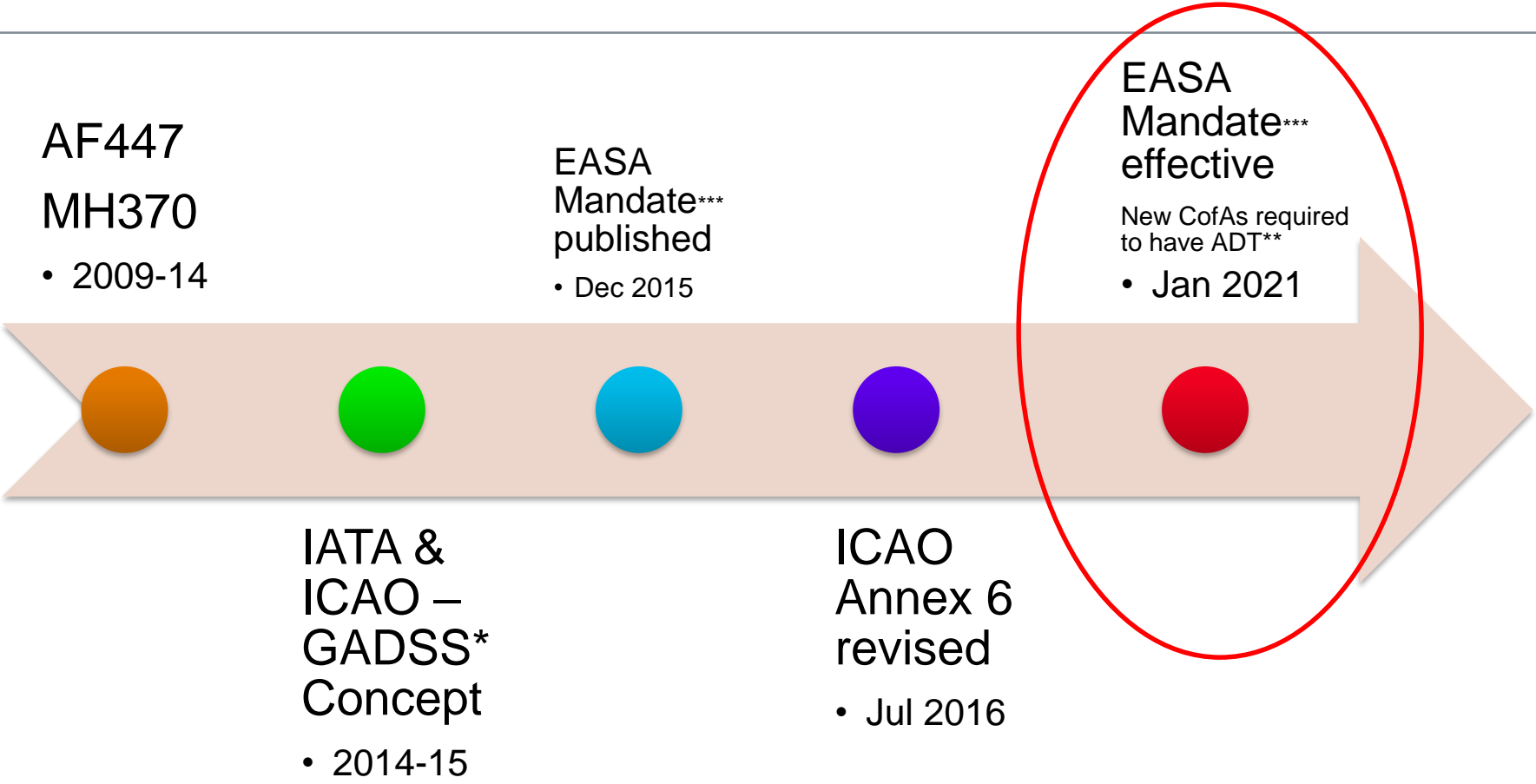


ELT-DT PROPOSED AIRBORNE SYSTEM ARCHITECTURE



RELIABILITY AND SAFETY CONSIDERATIONS

Timeline – Distress Tracking - ICAO & EASA Rulemaking



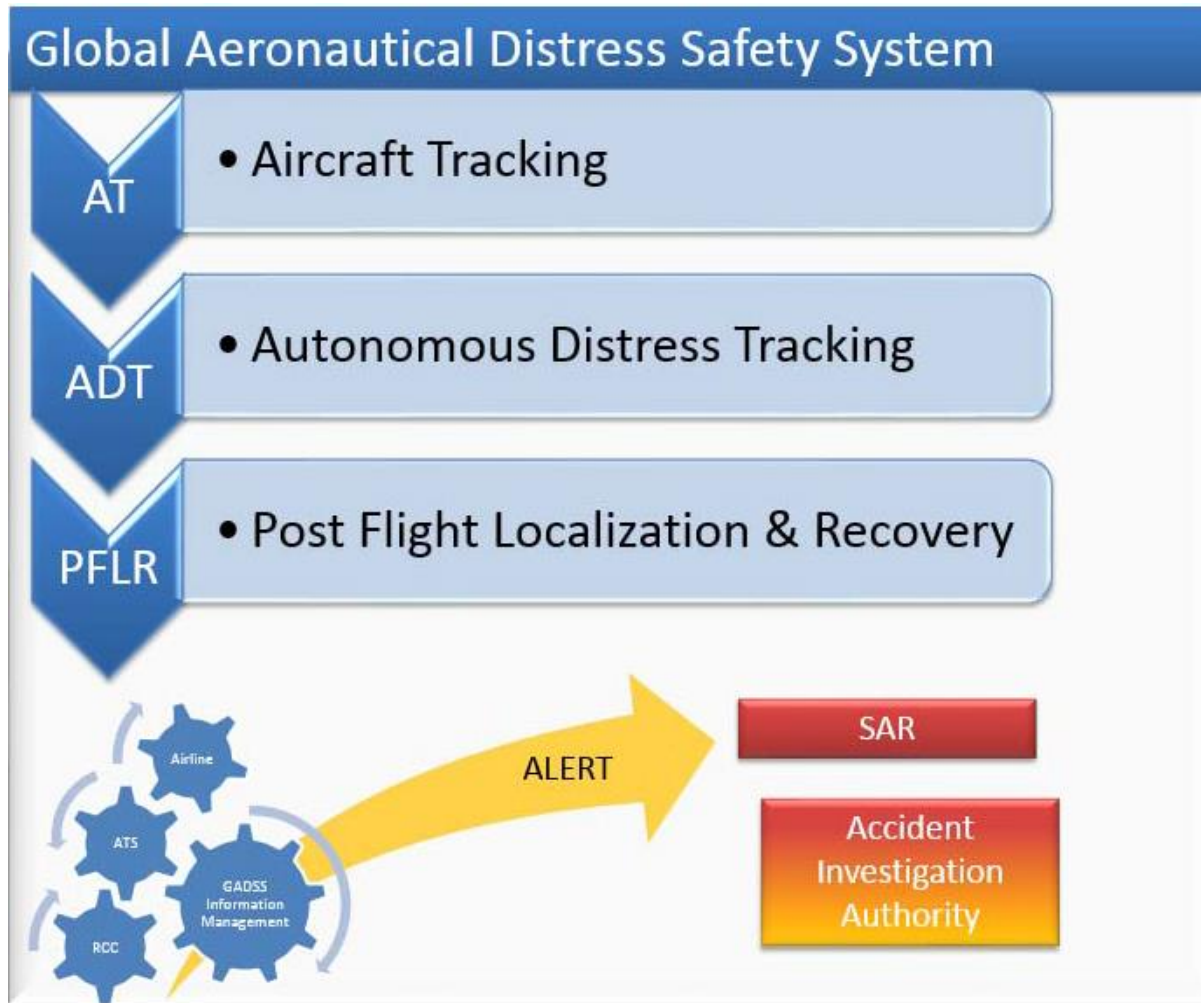
*Global Aeronautical Distress and Safety System concept of operations (ICAO)
** ADT: Autonomous Distress Tracking
*** EASA mandate: COMMISSION REGULATION (EU) 2015/2338 of 11 December 2015 amending Regulation (EU) No 965/2012 as regards requirements for flight recorders, underwater locating devices and aircraft tracking systems

Bombardier designs aircraft that comply with regulations applicable in states where operators operate



GLOBAL AERONAUTICAL DISTRESS SAFETY SYSTEM

CONCEPT OF OPERATIONS



ICAO Annex 6 part I
Equipage required

2018

2021

New types >2021

GLOBAL AERONAUTICAL DISTRESS SAFETY SYSTEM

CONCEPT OF OPERATIONS



ICAO Annex 6 part I
Equipage required

2021

Autonomous Distress Tracking Analysis of ICAO Standard

■ ICAO Annex 6, Part I – Commercial Air Transport

“6.18.1 All aeroplanes of a maximum certificated take-off mass of over 27 000 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2021, shall autonomously transmit information from which a position can be determined by the operator at least once every minute, when in distress, in accordance with Appendix 9.”

- Autonomous
- Transmission
- When in Distress

EASA ADT Mandate for 2021

The EASA mandate also affects 25 hour CVR and airframe ULB

Affected
Bombardier
Aircraft

System / Equipment	Effect. date	Requirement summary	Affected Platforms
Location of an aircraft in distress	1-Jan-21	CAT.GEN.MPA.210 The following aeroplanes shall be equipped with robust and automatic means to accurately determine , following an accident where the aeroplane is severely damaged, the location of the point of end of flight :	[A220] Global 7500 Q400 CRJ700-900-1000
		CAT.GEN.MPA.210(1) All aeroplanes with MCTOM > 27 000 kg, with MOPSC > 19 and CofA on or after 1 January 2021; and	<ul style="list-style-type: none"> Commercial Air Transport Aircraft (CAT) registered in EASA member states or flying in/out of EU airports¹ Note: Other ICAO member states may mandate ADT compliant with ICAO annex 6, and some have done so.
		CAT.GEN.MPA.210(2) All aeroplanes with MCTOM > 45 500 kg and CofA on or after 1 January 2021.	

¹Fleet operators (e.g. Netjets) are considered CAT in Europe

The EASA regulation is the EC regulation implementing ICAO standards

- Aligned with ICAO standard – GADSS concept

Autonomous Distress Tracking

Analysis of ICAO Standard

Autonomous

Transmission

When in Distress

- Independent from:
 - Flight crew action (automatic arm/disarm/activation/reset)
 - Aircraft systems & power after activation
- Continues to transmit required data while the aircraft is in distress
- Self cancelling if no longer in distress
- May include manual activation in addition to automatic
 - Cannot manually turn off automatic activation
- May include remote activation if available

Autonomous Distress Tracking

Analysis of ICAO Standard

Autonomous

Transmission

When in Distress

- What to transmit (minimum)
 - 2D position*
 - Time stamp
 - Aircraft identification
 - Other parameters if available (e.g. altitude**)
- 1st transmission within 5 sec of distress detection
- 1 min update rate or better
- Continue to transmit for duration of remaining flight
- Transmission from any geographic location

*or signal allows 2D position to be determined

** Note that altitude is a required parameter for Normal Tracking, but not for distress tracking

Autonomous Distress Tracking

Analysis of ICAO Standard

Autonomous

Transmission

When in Distress

- Distress condition: event may result in accident if left uncorrected
- Eurocae ED-237 – defines 4 top level conditions

• Unusual attitude	• Collision with terrain
• Unusual speed	• Total loss of thrust

- Robust trigger logic
 - Minimize nuisance triggers
 - Maximize availability of function, esp. in distress scenarios
 - loss of wiring, trigger information, electrical power,, etc.
- Airborne equipment qualification: ambient temperature, pressure, high vibration etc.

Autonomous Distress Tracking – 2 Types of Physical Architecture

- The industry has proposed two possible approaches to meet ADT requirements:
 1. **ELT-Based Solutions**
 - Onboard detection of distress condition with automatic pre-crash activation of the ELT. An ELT meeting such requirements is referred to as ELT-DT
 2. **Continuous or triggered transmission of data from the aircraft**
 - Enabling on-ground/in air/combined detection of distress condition and location of the point of end of flight

Autonomous Distress Tracking - Physical Architectures

Two types of ELT-Based Solutions

1. Onboard detection of distress condition with automatic pre-crash activation of the ELT

- ELT-Distress Tracking (ELT-DT); MOPS are in RTCA DO-204b/Eurocae ED-62b (in work)
- EASA: ELT-DT can replace ELT-AF if it is crash-survivable
- Location of survivors with 121.5 Mhz homing signal in addition to DT functionality
- Potentially higher cost of change (vs. continuous or triggered transmission) for distress detection logic depending how implemented

2. Automatic Deployable Flight Recorder (ADFR)

- Addresses equipage requirements for ELT-DT and one of two flight recorders
- Detects structural deformation and deploys during crash
- Floats to facilitate data recovery when crash is over water
- Requires structural modification to install
- Addresses ICAO Annex 6 requirement for timely recovery of flight data (new types 2021+)

3. Both use existing Cospas-Sarsat infrastructure to notify ATSU and RCC

4. No data fees for operator

Autonomous Distress Tracking - Physical Architectures

Continuous or Triggered Transmission-Based Solutions

- Continuous or triggered transmission of aircraft data/position with on ground/air detection of distress
 - Aircraft continually transmits or triggered to transmit position and aircraft state data
 - On-ground detection of distress condition (or a mix of air-ground detection)
 - Needs SATCOM Transceiver on the aircraft – for some aircraft types (e.g. CRJ) this may be the sole driver for a SATCOM on the aircraft
 - System including SATCOM, needs to meet to meet the robustness and autonomous requirements
 - If detection is on-ground, potentially lower cost of change to distress detection logic
 - ELT-AF (post-crash) may still be required
 - Potential data fees for operator
 - Requires more operator involvement to notify RCC and ATSU of distress condition:

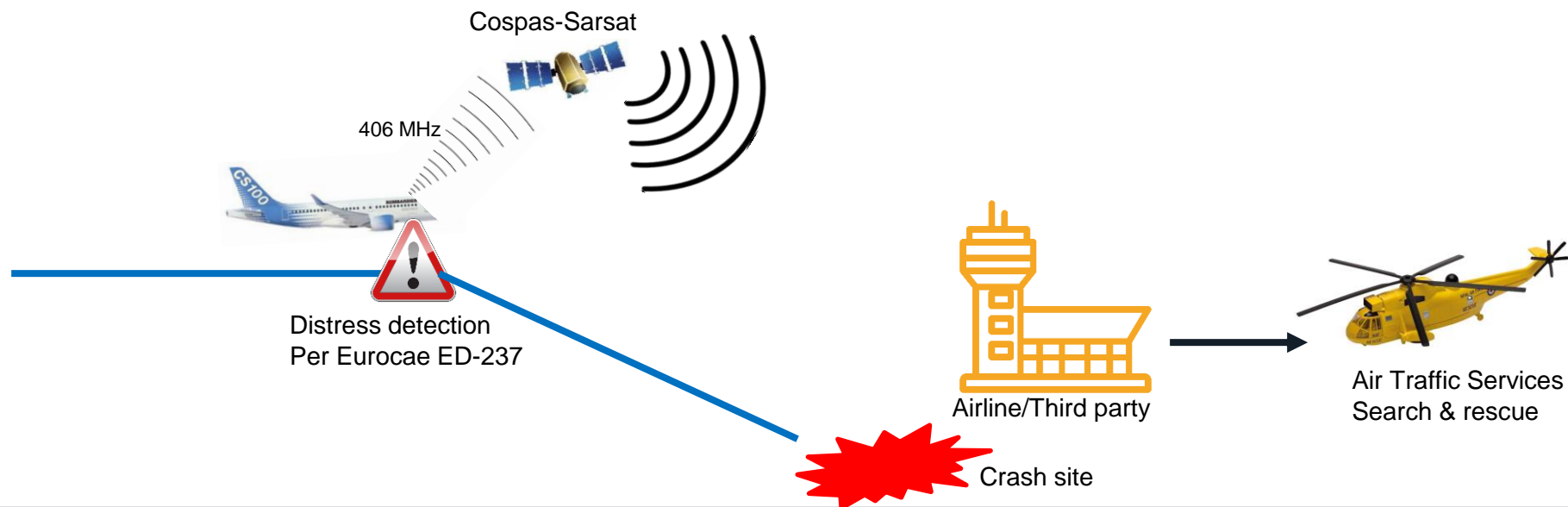
From ICAO doc 10054 The minimum requirements would be for the information to be made available to Air Traffic Service Units (ATSUs) and Search and Rescue (SAR) Rescue Coordination Centers (RCCs), as described in Appendix 9 para 2.4.

Emergency Locator Transmitter – Distress Tracking

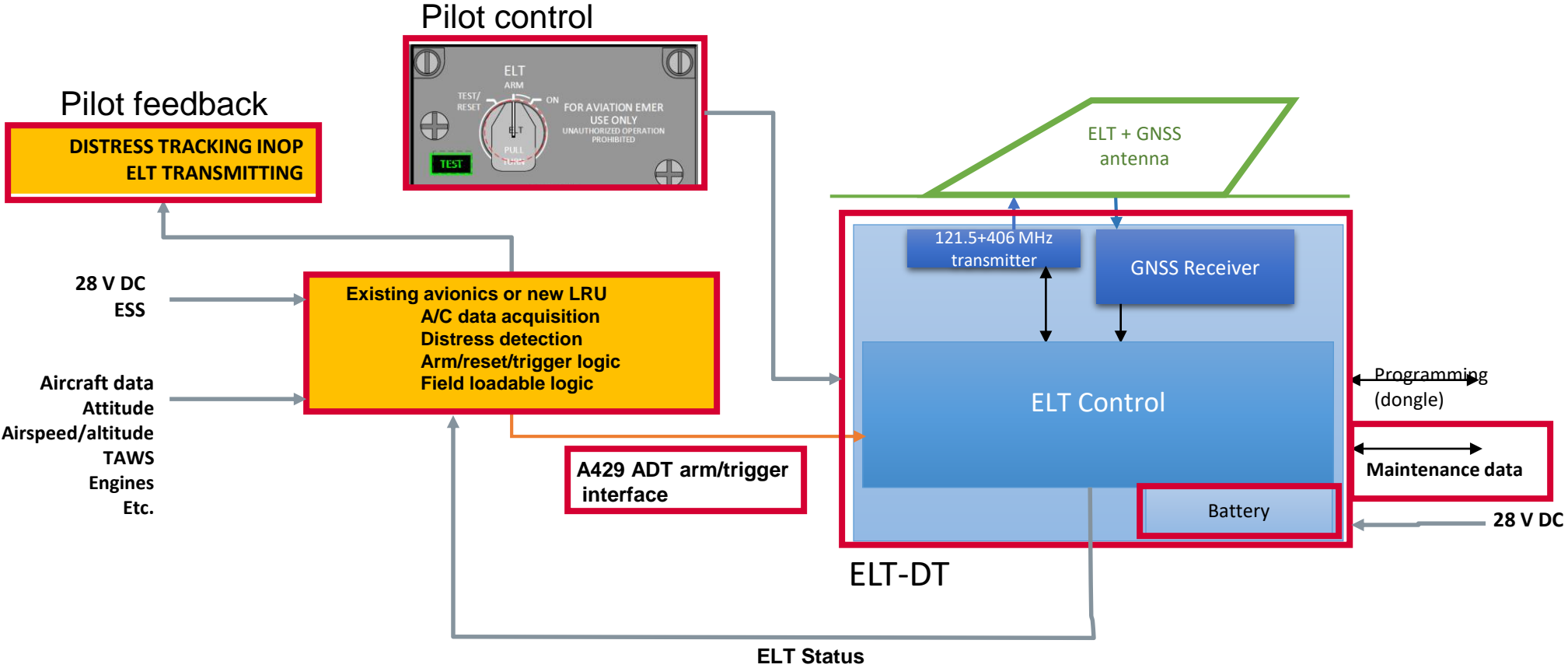
Typical Operation with ELT-DT

ELT-DT* (pre-crash trigger)

- Replaces current ELT
- Onboard distress detection & auto trigger/first transmission within 5 s
- Transmission of position and ID at 1 min interval
 - From aircraft GNSS if available, otherwise from built-in GNSS receiver
- Once triggered, is independent of aircraft power & sensors
- Activation can be manual; cannot be manually turned off if auto-triggered
- Location of accident site within 6 NM



Possible ELT-DT Airborne Architecture



Reliability and Safety Considerations

ICAO Doc 10054 (final draft – April 2018)

- The rate of nuisance alerts that are passed to Search and Rescue should be $< 2E-5$ /hour
- Validation of the distress event by the operator is required

EASA draft CS-ACNS requirements (Sep 2018 Workshop, Cologne)

- The loss of the system is at least classified as a minor failure condition
- **Erroneous activation is at least classified as a major failure condition.**
- Transmission of signals containing erroneous information is classified at least as a minor failure condition.

Bombardier: Could erroneous transmission of ADT alert by the aircraft be a **minor condition but have a probability target consistent with the ICAO guidance for end-to-end rate of nuisance alerts passed to Search and Rescue, which includes validation of the alert by the operator?**

In case of erroneous transmission the flight crew action would be to communicate with their airline operational control to advise/confirm that the alert is erroneous, which would be “well within their capabilities”

Minor: Failure Conditions which would not significantly reduce aeroplane safety, and which involve crew actions that are well within their capabilities



Q&A

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