



GADSS in depth

Airbus views on Global Aeronautical Distress Safety System
ICAO Regional Preparatory Group / WRC-19 Workshop

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Sept 2017, Paris

AIRBUS

Emerging Issue

Global Aircraft Tracking Initiatives



SECOND HIGH-LEVEL SAFETY CONFERENCE 2015 (HLSC 2015)



“ICAO should encourage States and the International Telecommunication Union (ITU) to discuss allocation requirements at the World Radio Communication Conference in 2015 (WRC 15) to provide the necessary spectrum allocations for global air traffic services surveillance as a matter of urgency; “

WORLD RADIO CONFERENCE 2015

Resolution 425 (WRC-15)

“Use of the frequency band 1 087.7-1 092.3 MHz by the Aeronautical Mobile-Satellite (R) Service (Earth-to-space) to facilitate global flight tracking for civil aviation.”

>>> “Space ADS-B “



New Agenda Item 1.10

“To consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution 426 (WRC15).”





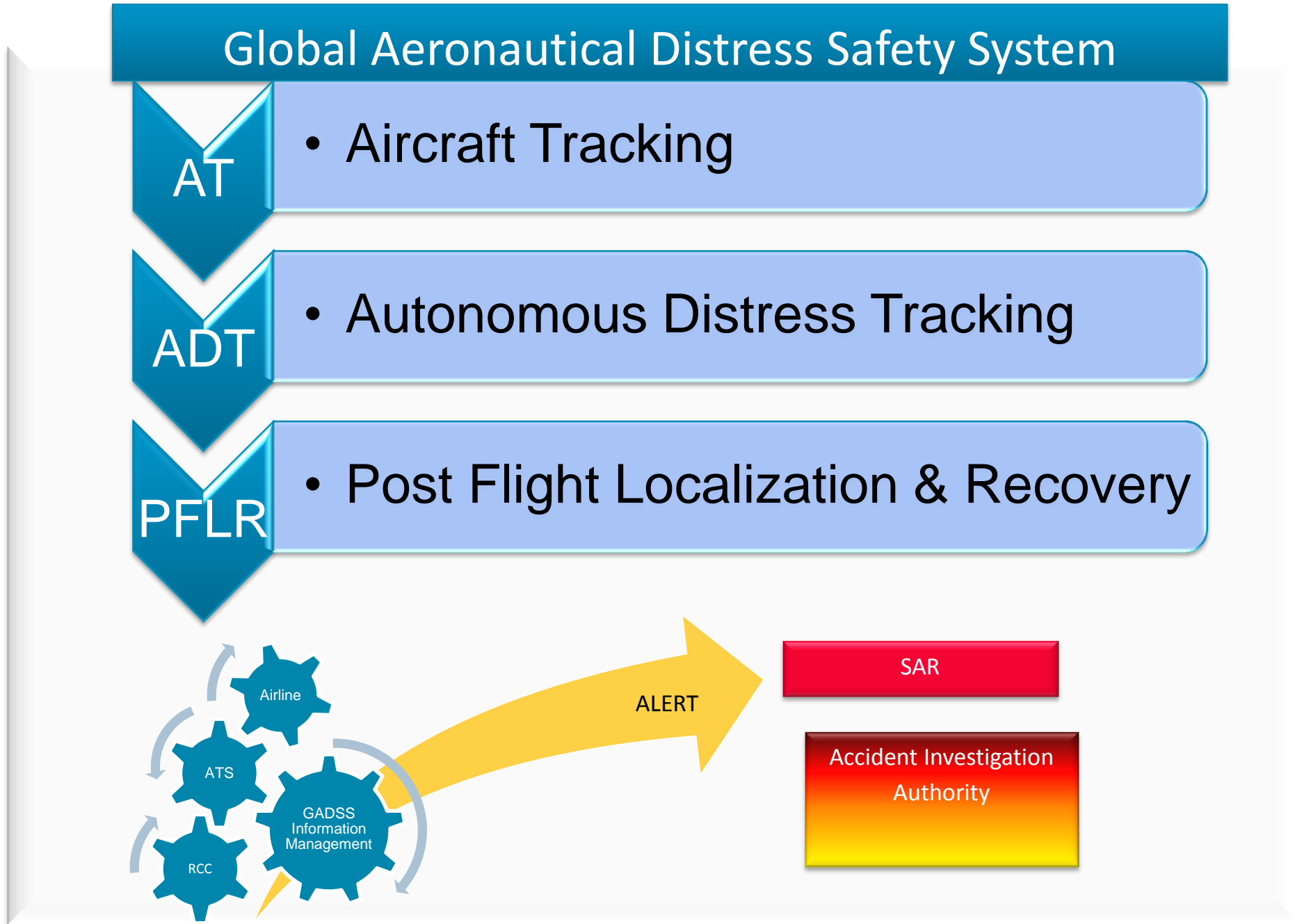
Concept of Operations

Global
Aeronautical
Distress &
Safety
System
(GADSS)

Version 6.0

This Concept of Operations document specifies the high-level requirements and objectives for the GADSS.

Responding to the requirements and objectives, the ConOps specifies the high-level functions needed, with a description of users and usages of **aircraft position information, in all airspaces, during all phases of flight, both normal and distress flight conditions including the timely and accurate location of an aircraft accident site and recovery of flight data.**



ICAO Recommendations

- 90 days ULB “Underwater Locator Beacons” (37,5Khz) attached to recorders CVR and DFDR (replacement of 30 days ULB)
>>>>> January 2018 Forward fit & Retrofit.
- 90 days Low Frequency ULD “Underwater Locating Devices” (8,8Khz) attached to the aircraft for long-range over-water flights
>>>>> 2019 Forward fit & Retrofit
(ICAO: Not later than 1 January 2018 ; EASA: By 1 January 2019)
- 25 hours CVR
>>>>> Jan 2021 -Forward fit

ICAO Recommendations

- Aircraft Tracking Normal (& Abnormal) Conditions
 >>>>> **Nov or Dec 2018 Forward fit & Retrofit**

- Location and tracking of an Airplane in Distress
 >>>>> **Jan 2021 - Forward-fit**

- Flight Data Recovery , two alternative means:
 - Data streaming (CVR and FDR data content)
 - or ADFR “Automatic Deployable Flight Recorders” (with integrated ELT).
 >>>>> **Jan 2021 - new Type Certificate**



Current ICAO Recommended Practices



Routine Aircraft Tracking

**Localizing A/C
in distress**

Flight Data Recovery

**All Aircraft from Nov 2018*
Oceanic area**

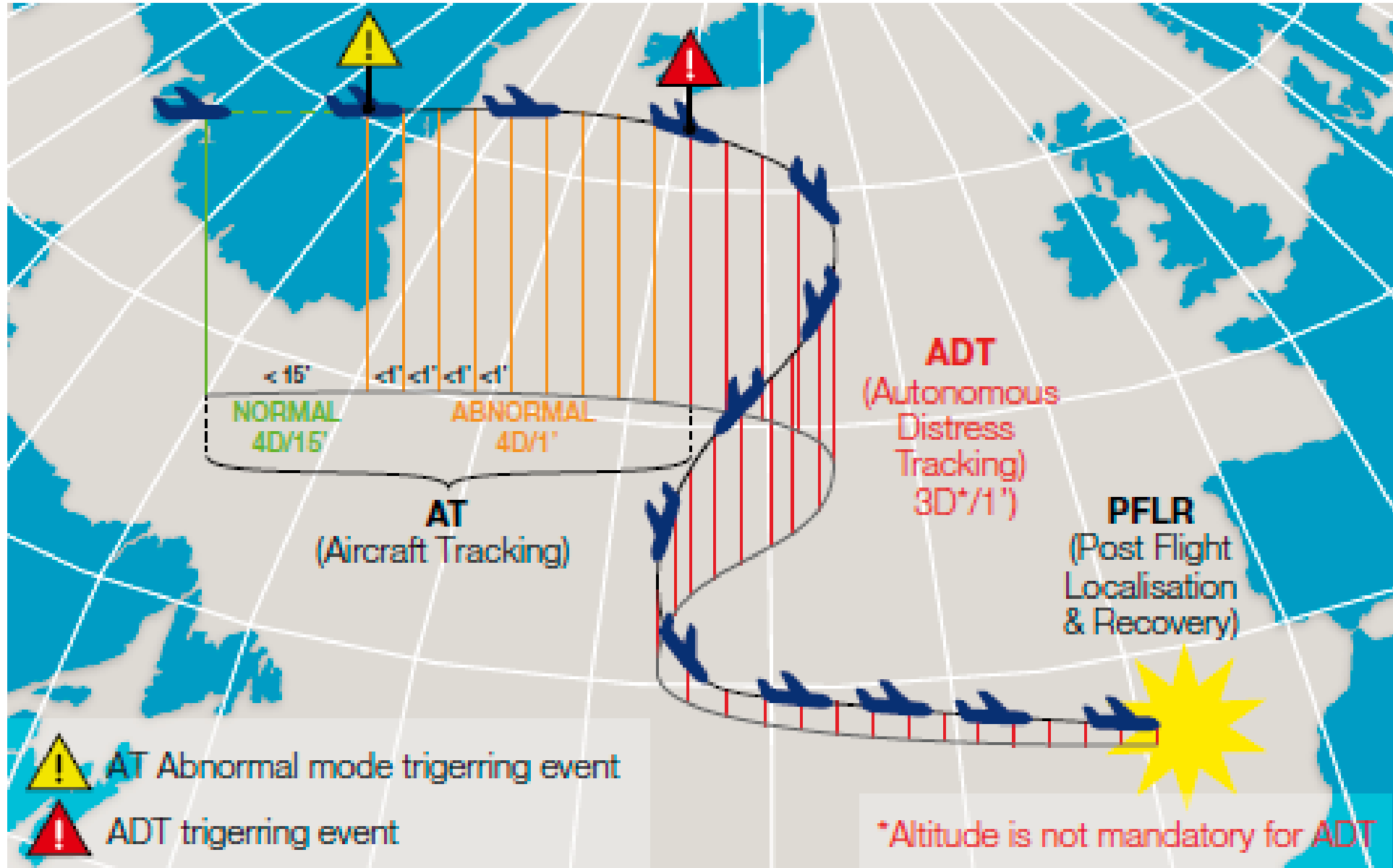
**All new manufactured
Aircraft from
Jan 2021**

**New Type Certification
from Jan 2021**



**Recommendations into ICAO SARPS
Refer to Annex 6, 10, 11, 12**

**: implementation date can be different according to regional or national regulations*

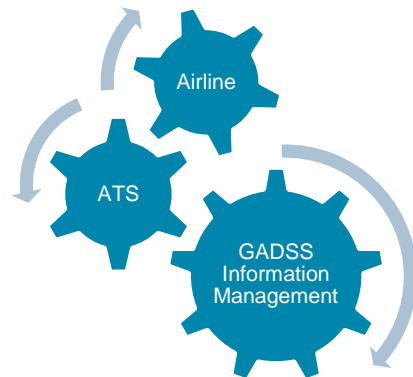


Global Aeronautical Distress Safety System

AT

• Aircraft Tracking

- Provides automatic A/C position at least once every 15 minutes
- ATS Surveillance may be utilized
- Can be isolated by Flight crew
- Multiple solutions
- May have airline defined triggers for abnormal operations with higher reporting rate



Use of any type of spectrum properly allocated, on a primary basis

Aircraft Tracking –REGULATIONS



Commission Regulation (EU) 2015/2338

- + AIR OPERATIONS GM1 and GM2 CAT.GEN.MPA.205
- “ Aircraft tracking system - Aeroplanes” introduced
- + Published in December 2015
- + **Applicable from December 2018**
- EASA agency has published Draft Decision titled: ‘Acceptable means of compliance and guidance material to implementing rules related to flight recorders, underwater locating devices and aircraft tracking systems (third set)’” for consultation up to September 7th

“ Aircraft Operator Certificate Requirements ” issue 3 rev 30

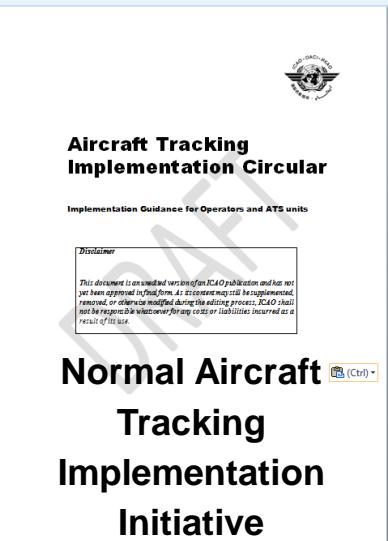
- + “Aircraft Tracking” introduced
- + Published in December 2015
- + Applicable from July 2016 (possible by voice reporting, except HF)
- + **Automated Reporting required from November 2018**

What is 4D (4 dimensions) ?

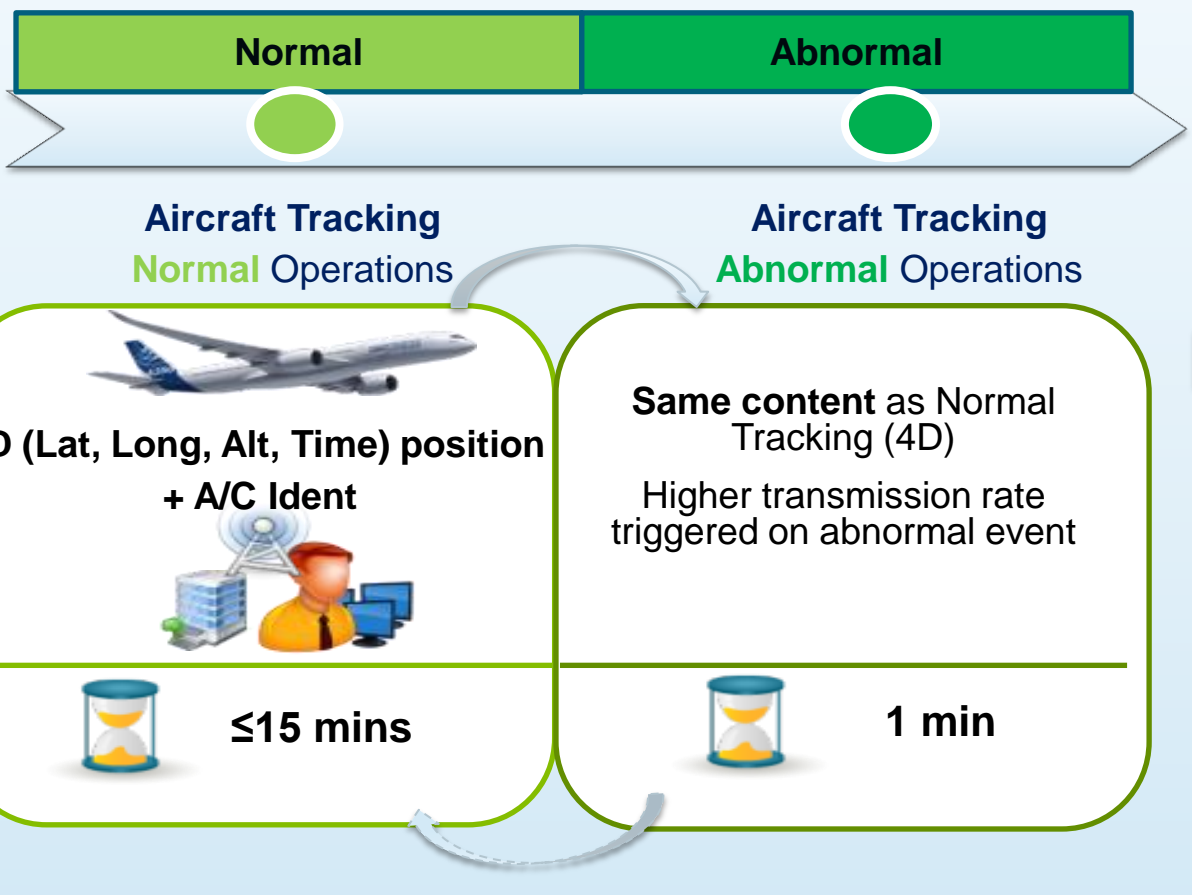


Aircraft tracking supported by existing technologies

Applicability
November 2018
 (Recommended in all areas of operations and mandatory over Oceanic areas)



Normal Aircraft Tracking Implementation Initiative (NATII)






National Aviation Authorities (NAA) regulations

NAA are able to define their own regulation in accordance with ICAO recommendations

Operators will have to check with their local NAA what is the relevant applicable regulation regarding Aircraft Tracking

AIRCRAFT TRACKING IS PLACED UNDER OPERATORS RESPONSIBILITY

Datalink communication means on Airbus Aircraft

Communication systems <i>Geographical Coverage</i>			
VHF Datalink <i>Continental areas</i>	Basic	Basic	Basic
SATCOM Inmarsat <i>Worldwide except polar area</i>	Option	Basic	Basic
SATCOM Iridium <i>Worldwide</i>	Option	Option	Not yet available
HF Datalink <i>Worldwide</i>	Option	Basic	Basic

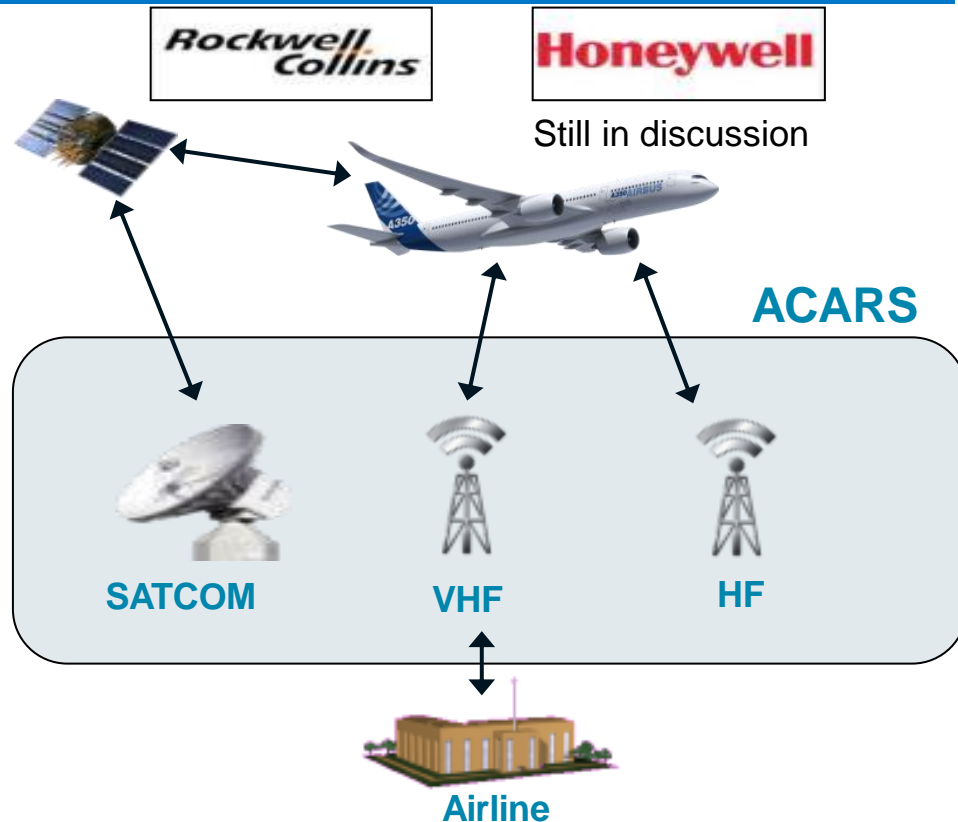
Note: Operators will need to make sure that the A/C are equipped with the proper Datalink communication means (VDL / Satcom / HFDL) with regards to their operated routes and that coverage is ensured for these routes.

Aircraft Tracking – Airbus Solutions synthesis

	AOC Airbus recommendation for A320/A330/A340/A350/A380	ACMS Aircraft Condition Monitoring System	ADS-C Automatic Dependent Surveillance- Contract
Normal tracking	AOC DB customization	ACMS DB customization	ADS-C periodic contract (from 1 to 15 min)
Abnormal tracking	Through AOC DB customization (Access to many avionics parameters) (Airbus recommended solution)	Through ACMS DB customization (Access to many avionics parameters)	ADS-C event contract + ADS-C periodic contract of 1 min
Avionics impacts	Software only	Software only	Requires FANS A/ A+ or A+B
ACARS network access	Contract with Datalink Service Provider required + Communication means selected with regards to operated routes (VDL, SATCOM, HF DL)		
Airline Costs	ACARS messages cost + AOC DB customization cost	ACARS messages cost + ACMS DB customization cost	ACARS messages cost
Ground impacts	On Airline ground systems side, an access to ACARS Server and ground tools are necessary to receive and manage Aircraft positions. Since mid-2015, Airbus has been offering its AirFlight web-based tool for OCC as part of “Services by Airbus” (airflight@airbus.com)		

Airbus way forward for implementing Aircraft Tracking function

AOC Application Airline Operational Control



- Airbus recommendation for A320/ A330 /A350/ A380: A/C tracking solution based on **existing** AOC datalink applications (ACARS network) and **without any additional flight crew action**
- Partnership was established between Airbus and AOC suppliers, in order to provide generic solution for normal and abnormal tracking conditions through **AOC customized database**
 - Activation/Deactivation of abnormal tracking will be done **automatically** through the monitoring of specific sets of A/C parameters that will trigger the emission of the A/C information at least every 1mn. Ground Airline center will also be able to activate abnormal mode **upon uplink request** if necessary.

Supported by existing technologies

Fast and simple solutions available in most of Airbus fleet
Already implemented by some Airlines

Reference
ISI 23.21.00007

Airbus implementation of A/C abnormal tracking

Airbus offers and promotes implementation **of triggers for abnormal operations** with an automatic reporting every minute :

- A higher reporting frequency will enable to reduce the uncertainty phase and will also improve the **accuracy of A/C position** in case of incident.
- Airbus A/C option for abnormal tracking is **available**, using an AOC customisation to ease implementation.

Abnormal triggers can be incorporated in the Aircraft Tracking function as an option for forward fit and retrofit

Aircraft Tracking – Other solutions

Other existing technologies installed by Supplemental Type Certification (STC).

A wide variety of Standalone solutions using various Satcom constellations are available on the market.

spidertracks

SKYTRAC

Panasonic

FlightAware

Globalstar

N-TRACKING

NAVBLUE
AN AIRBUS COMPANY

Aireon

Blue Sky Network

Rockwell Collins

LATITUDE
Optimize every flight.

FLYHT
INSIGHT • ACTION • CONTROL

Smart GADSS™

inmarsat
The mobile satellite company

Thompson Aerospace

SITAONAIR

...

Implementation aspects

Airbus Aircraft Tracking solution is used by a first set of customers, but we do not yet have sufficient return of experience to share.

As a first general feedback, the need for Airlines to check every 15 minutes « the good » reception of A/C routine tracking messages may highlight some communication delays .

Note: Transmission rate in normal mode can be modified to answer to some regulations or to anticipate some delays in ACARS network depending on Aircraft routes (e.g over polar zones which are only covered by HF)

Cost Aspects;

Costs of communication will depend on contracts that Airlines have negotiated with their Service Providers (Fees, Volume, Package...) .

Based on a 10 hours long range flight , the following amount of data is expected :

Routine / normal mode:	3ko
Abnormal mode:	40ko

Aircraft Tracking – Conclusion

Today

- Fast and simple solutions available: AOC, ACMS, ADS-C, other...
- No additional workload for the flight crew
- Already implemented by some operators.

In the Future

- New enhancements based on new technologies (IP communications ...).

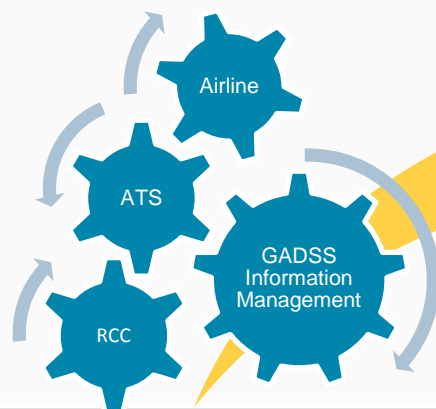
Global Aeronautical Distress Safety System

ADT

• Autonomous Distress Tracking

- Provides automatic A/C position at least once every minute
- Must be active prior to accident event
- Location of an accident site within 6 NM
- Operates autonomously of aircraft power
- Results in Distress signal to appropriate SAR FIR
- May be manually activated
- Cannot be isolated

Only protected aeronautical safety spectrum, or protected distress spectrum (e.g., 406.1 MHz), can be used



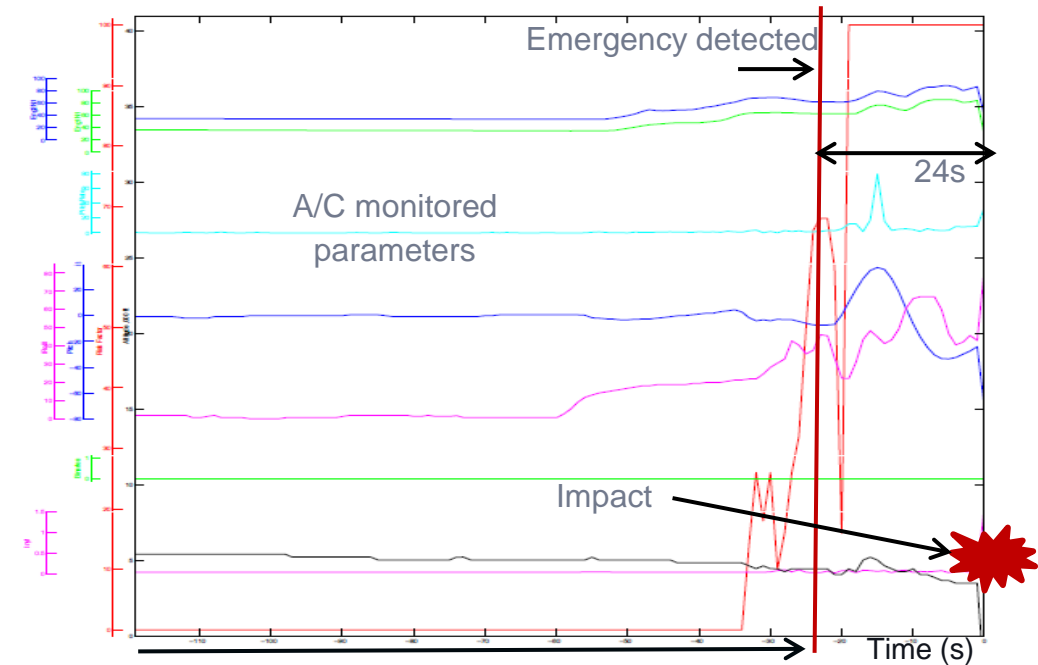
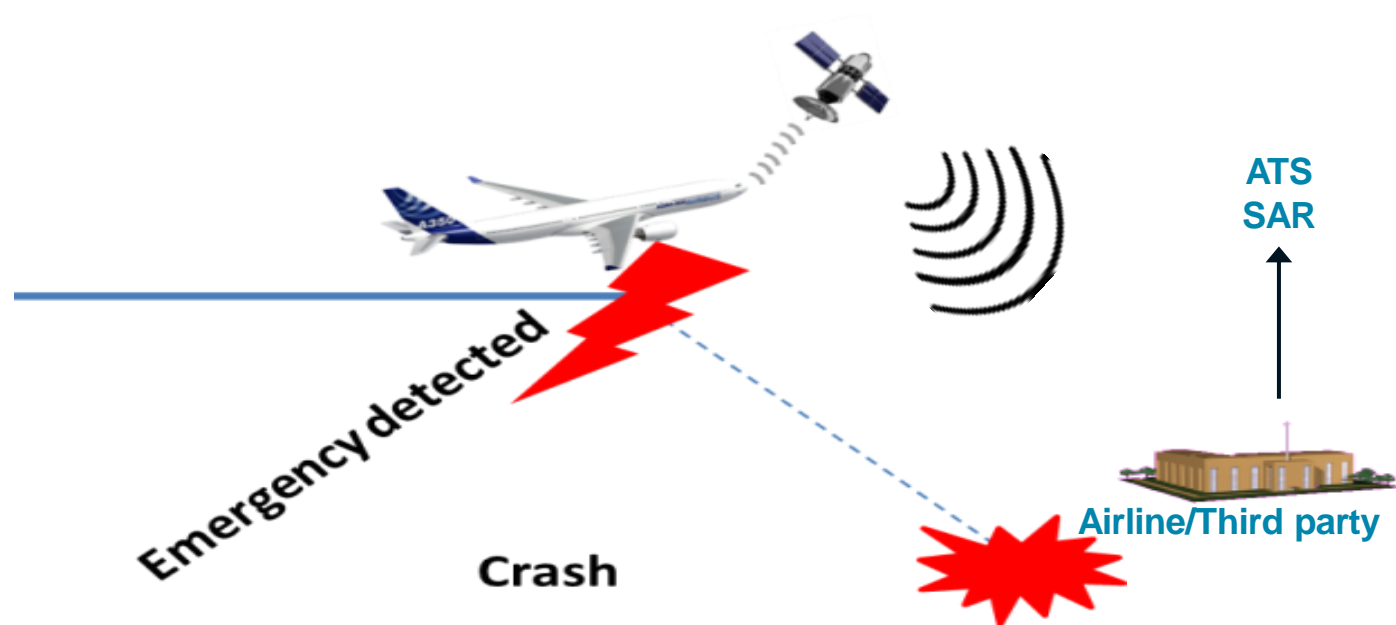
SAR

Accident Investigation
Authority

ADT -Autonomous Distress Tracking

Need new equipment on board like ELT 2nd Generation (pre-crash triggered)

- Location of an accident site within a 6 NM radius,
- Automatic transmission of 3D position +ID at a rate of 1 minute
- First burst no later than 5 seconds
- Distress will only be able to be de-activated using the same mechanism that activated it
- Standalone powered and autonomous controlled
- Could be remotely activated



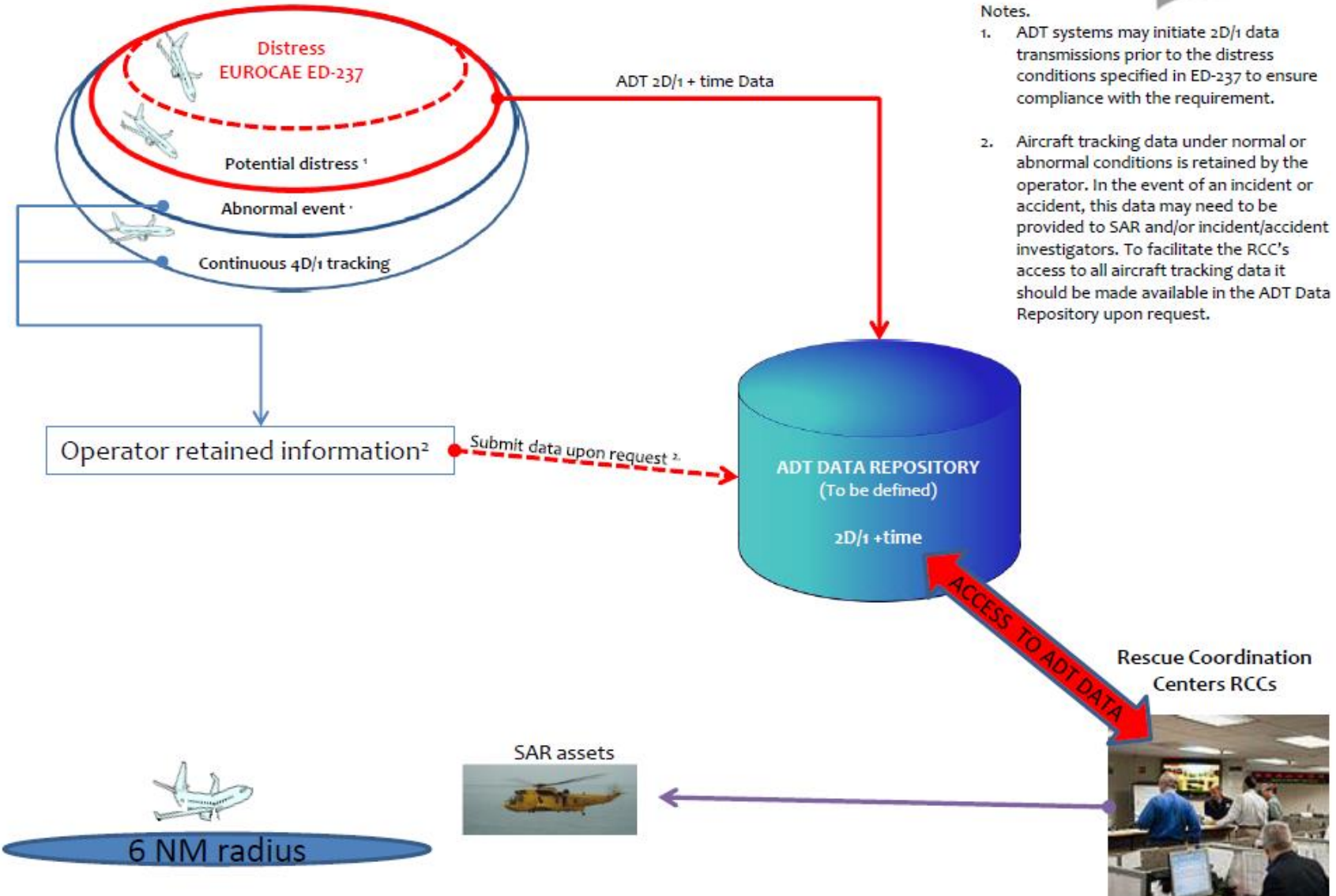
Triggers for Distress Tracking are defined by EUROCAE MASPS ED-237

Note: ADFR with integrated ELT could be an alternative equipment for ADT. Focus is on the « end of flight location » which is primary concern due to the very short duration of « In distress flight »

ADT –GADSS information sharing and processes for Notification of Distress Condition

ADT DATA RETENTION LOCATION AND ACCESS

Work in Progress



Notes.

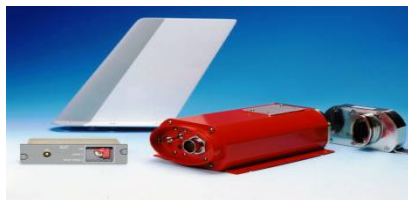
1. ADT systems may initiate 2D/1 data transmissions prior to the distress conditions specified in ED-237 to ensure compliance with the requirement.
2. Aircraft tracking data under normal or abnormal conditions is retained by the operator. In the event of an incident or accident, this data may need to be provided to SAR and/or incident/accident investigators. To facilitate the RCC's access to all aircraft tracking data it should be made available in the ADT Data Repository upon request.

**GADSS
Extract**

ADT- Autonomous Distress Tracking

2nd Generation ELT- Main new features

- Pre-Crash-Activation according to defined triggers e.g. Unusual attitudes, Unusual speed conditions, Unusual altitudes, Loss of power on all engines...
- GPS position information embedded in distress signal
- Use of new COSPAS-SARSAT -MEOSAR constellation based on payloads on GPS, Glonass and Galileo satellites
- 100% worldwide coverage reached
 - **first burst will be spotted by satellite anywhere in the world, at any time**
- Potential Return Link Service
- Availability expected 2018-20



GPS / USA

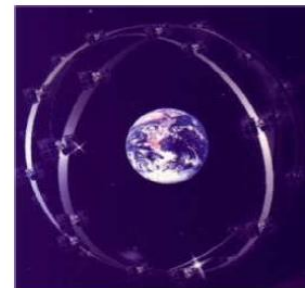


20 → 28 (≈Early 2020s)

Galileo / Europe

10 → 16 (YE 2016)
→ 28 (YE 2019)

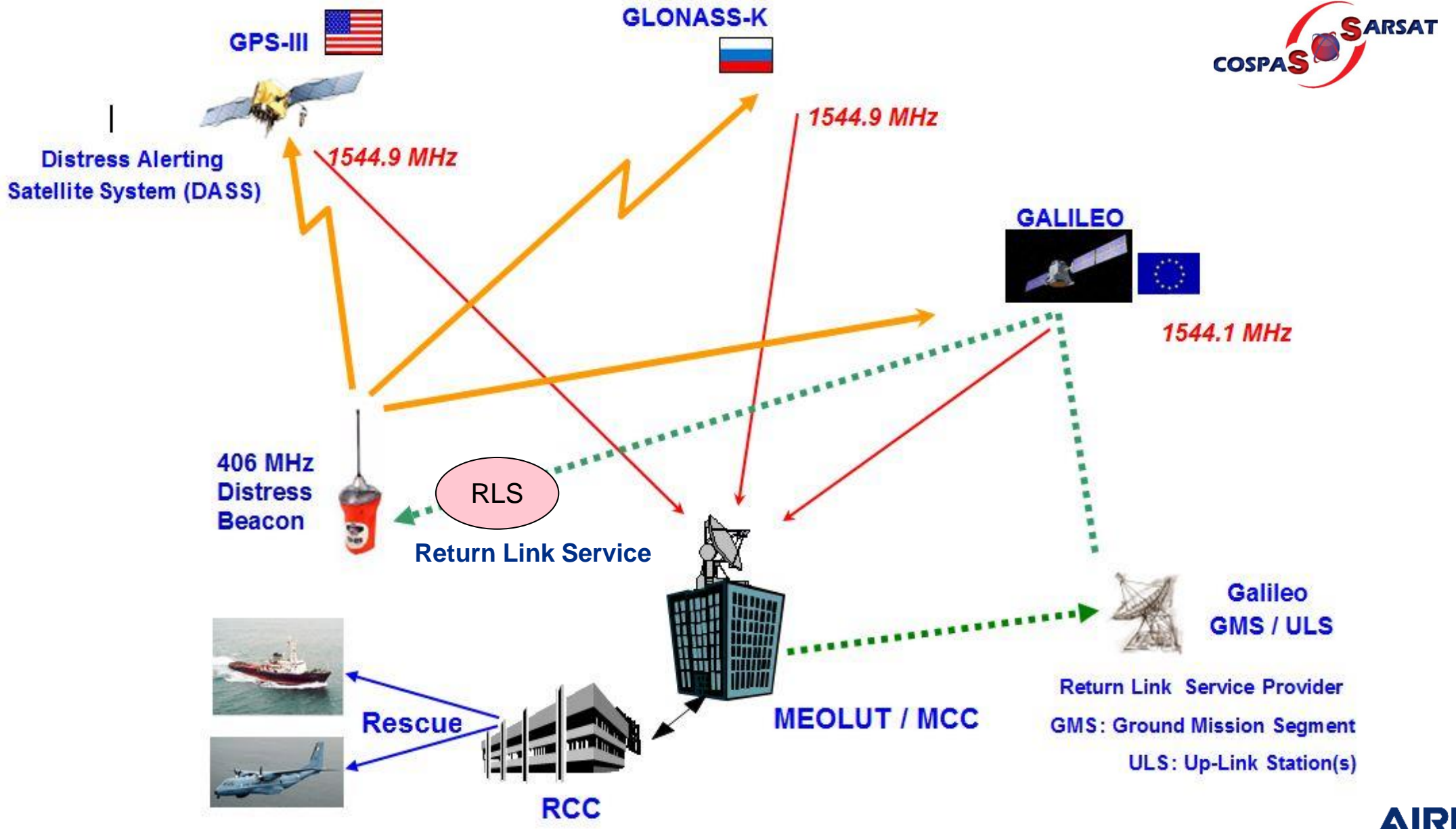
Glonass / Russia



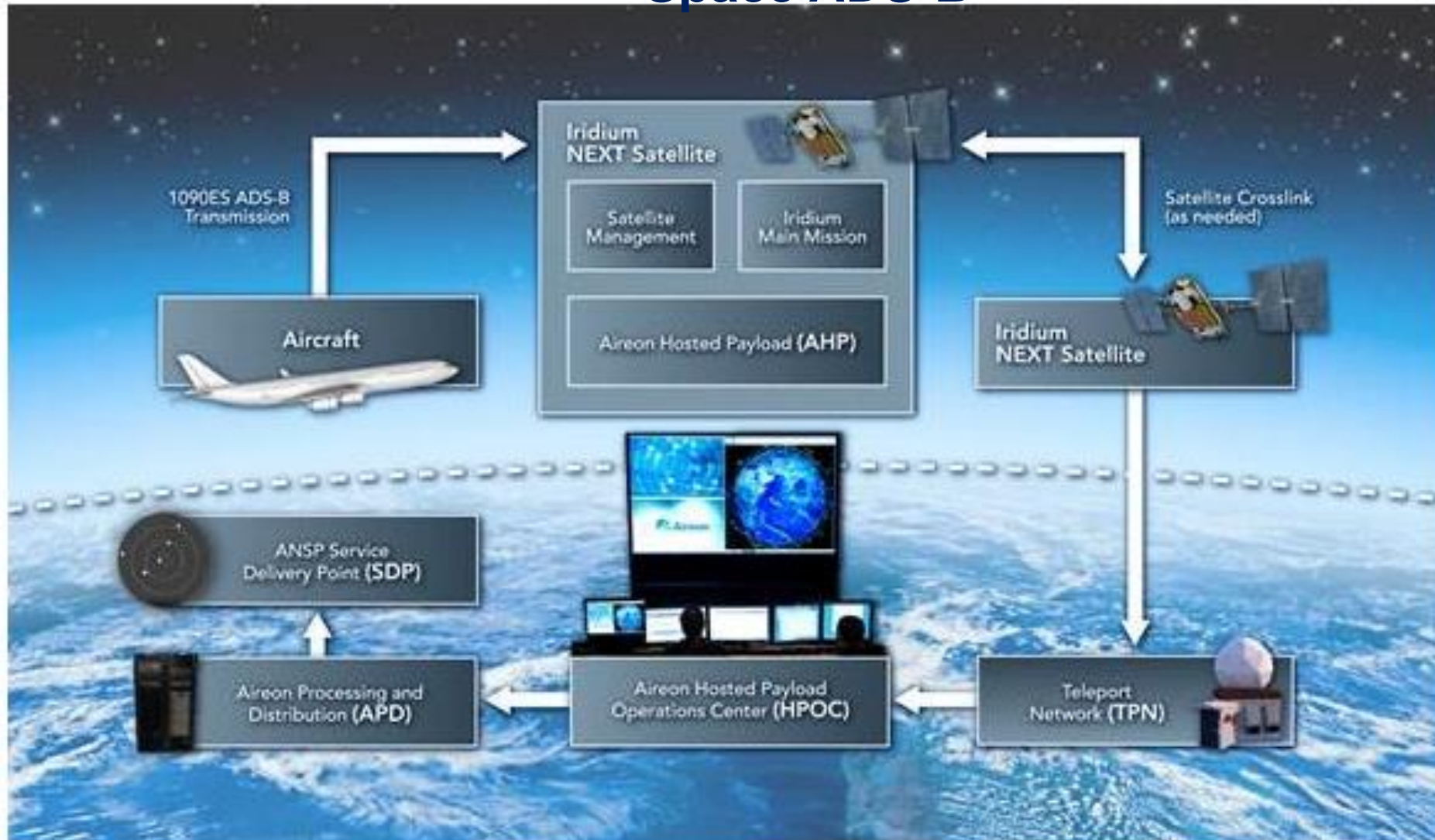
1 → 8 (YE 2020)



Typical MEOSAR System- Configuration with RLS



Autonomous Distress Tracking (ADT) - Example of other proposed solutions: Space ADS-B



Aireon ALERT solution will provide GPS location and real-time tracking data to assist rescue coordination centers in emergency situations.

Standardization of Autonomous Distress Tracking (ADT)



In order to specifically address expected, forthcoming ADT mandate in the most effective way (accounting for system complexity, cost, schedule, risk, etc.), the aviation industry proposed an ARINC Project Initiation/Modification (APIM) through the Systems Architecture and Interfaces (SAI) Subcommittee to standardize **ADT on board part**.

APIM was approved during AEEC General Session in May 2017

The work is structured in 3 main phases:

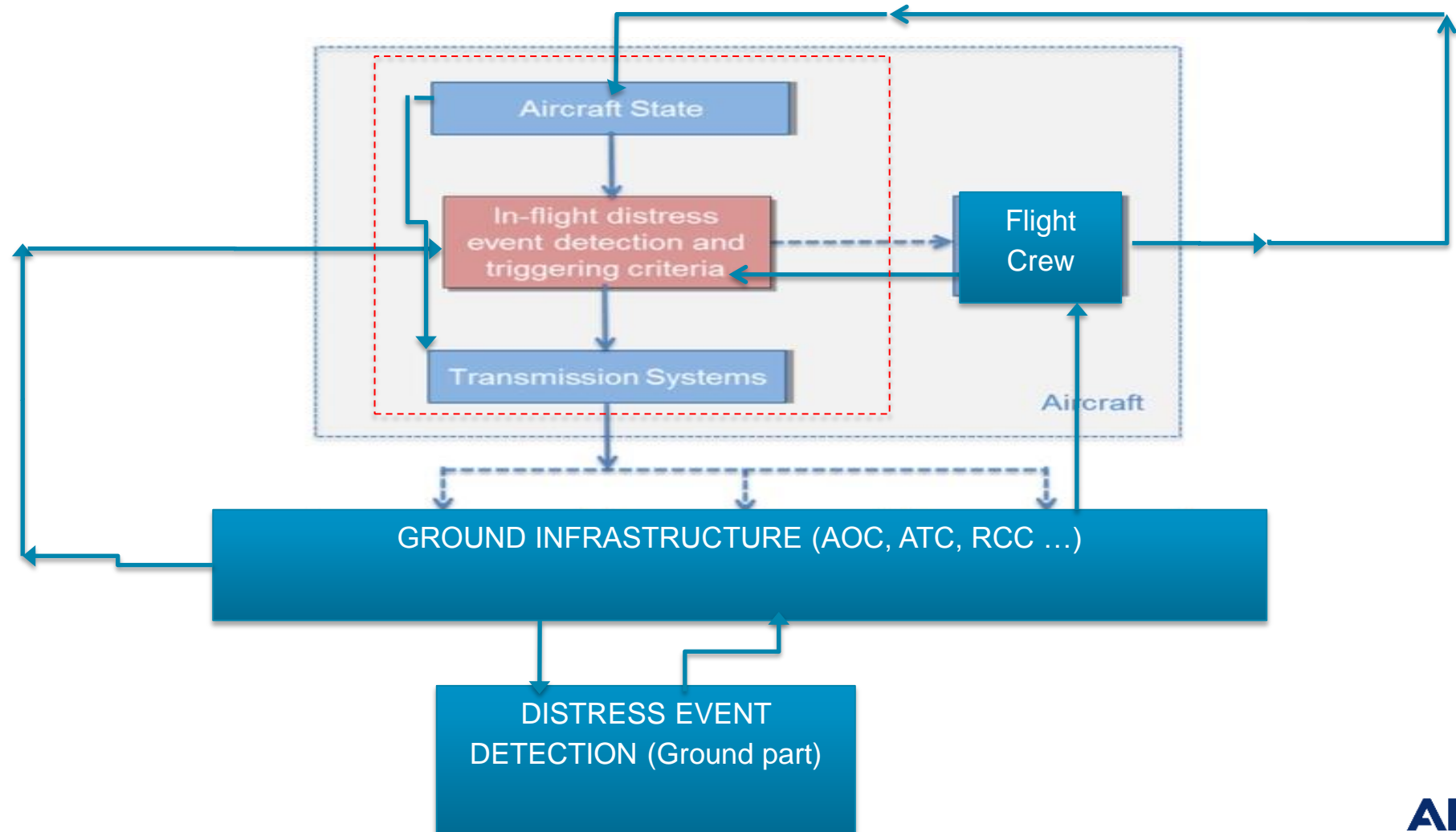
- Definition of requirements and main functional block diagrams (Firs Draft Report available)
- Proposition of candidate architectures (Report) . Activity has started
- Develop detailed equipment, interfaces, and aircraft installation requirements, for selected architecture(s). Define accordingly new ARINC or updated Characteristics.

Global Aircraft Tracking Working Group at full speed...

>>> Completed work expected Jan 2019

Outcome of AEEC GAT group, scope of ADT

1st Phase: 1st Draft report concerning Definition of requirements and main functional block diagrams is on going.

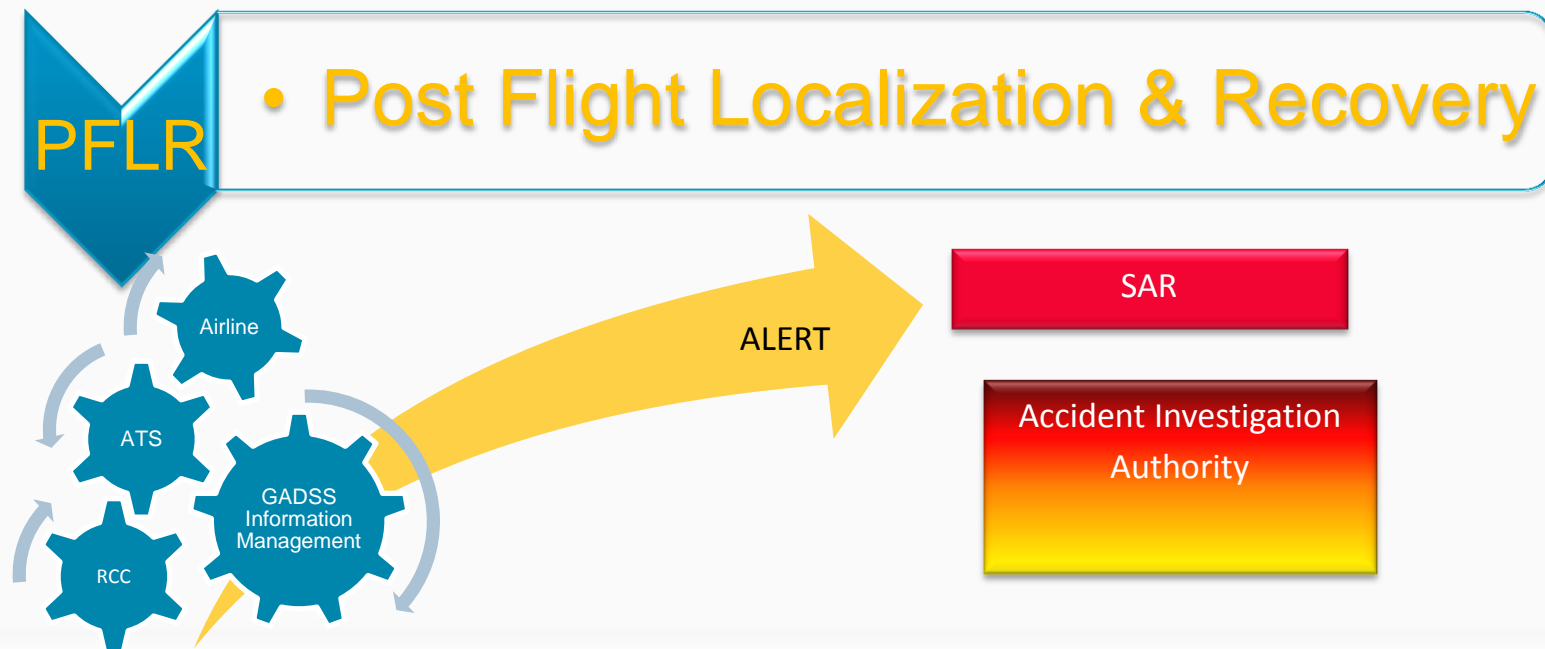


Global Aeronautical Distress Safety System

Use of any type of spectrum properly allocated, [on a primary basis], for the function being performed,
To be confirmed according to ITU and ICAO on going discussions (ConOps, CPM text...)

Performance Based Solutions (Not technology-specific)

- Make it available in a timely manner
- approved by the State of the Operator
 - Data Streaming
 - Ensures a minimum dataset of CVR and DFDR information
 - ADFR (Automatic Deployable Flight Recorder)
 - Floatable
 - Contains ELT to aid location



Main ICAO activities

ICAO GADSS-Advisory Group activities are on going, a work programme has been establish related to the GADSS implementation .

ICAO is also working on Manual Doc 10054 on Location of Aircraft in Distress and Flight Recorder Data Recovery.

This document 10054 is a Manual of Guidelines /Requirements of the various means of compliance for both Autonomous Distress and Post Flight Localization & Recovery.

This document is currently defined by an ICAO “Flight Recorder” Working Group.

>>> First draft of ICAO Doc 10054 is expected to be ready for end October 2017

PFLR: Deployable Combined Recorder with integrated ELT

1. Sensors detect the start of a crash



2. Deployable **combined** recorder releases from aircraft



3. Deployable lands safely and floats on water ensuring quick recovery.



4. **Integrated ELT** in the deployable recorder transmits Location and ID of the Aircraft via satellite to SAR authorities.



5. SAR personnel recover survivors and Deployable Recorder quickly allowing accident analysis



Source: DRS

Airbus Official Announcement

On June 21st 2017, during Paris Air Show, AIRBUS announced a new Recording System architecture

This new architecture is composed of:

- A combined Cockpit Voice and Data Recorder (CVDR)
- An Automatic Deployable Flight Recorder (ADFR)
- A Recorder Interface Unit (RIU)



PFLR: Deployable Combined Recorder with integrated ELT

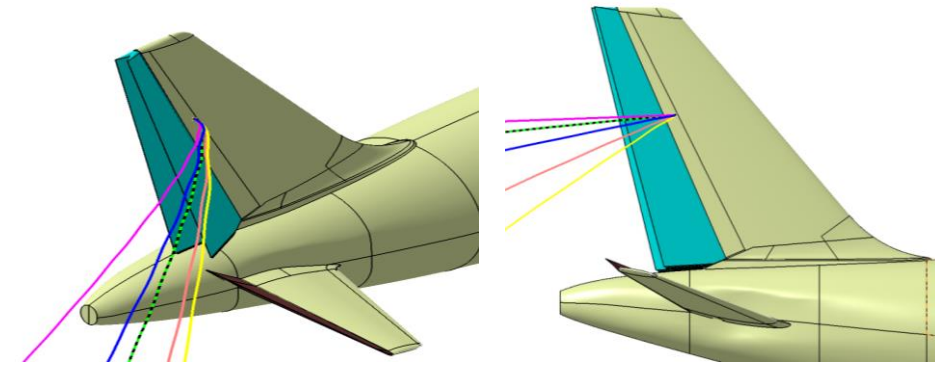
**Airbus plan: Forward-fit application of ADFR (Automatic Deployable Flight Recorder) on all long range operations aircraft:
A380, A350, A330, and A321LR**



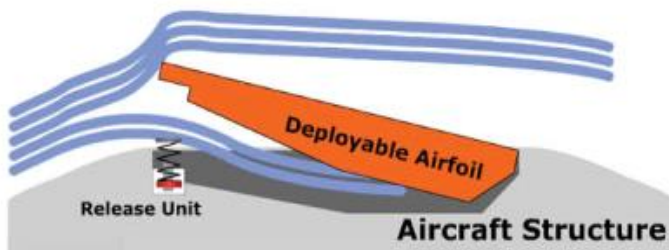
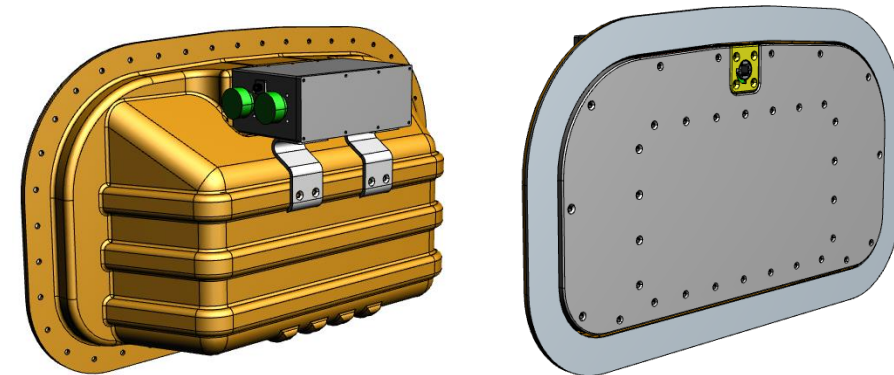
PFLR: Deployable Combined Recorder with ELT

Technology:

- Dual Combination Recording System with:
 - ADFR with integrated ELT installed in Vertical Fin
 - Crash detection circuits (significant structural deformation or water submersion)
 - CVDR installed in Avionics Bay
 - 25 hours recording
 - Common system across Airbus fleet A350, A380, A330, A321
- **Entry Into Service expected before mandate date**



Ejection principle



- » Airfoil releases from aircraft within milliseconds
- » Aerodynamic force "lifts" airfoil away from the aircraft
- » Floats on water indefinitely

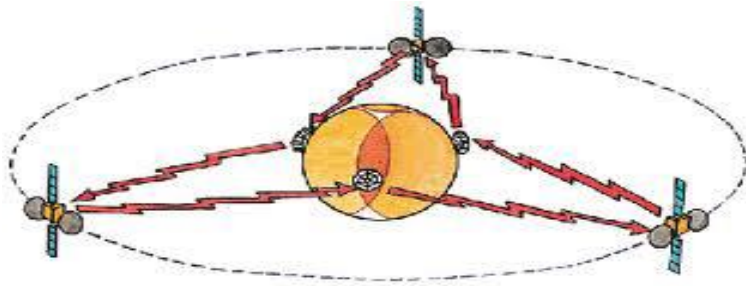
PFLR: Deployable Combined Recorder Architecture

Main Architecture/ locations



Dual combination recording with ADFR and CVDR

PFLR: Flight Data Streaming

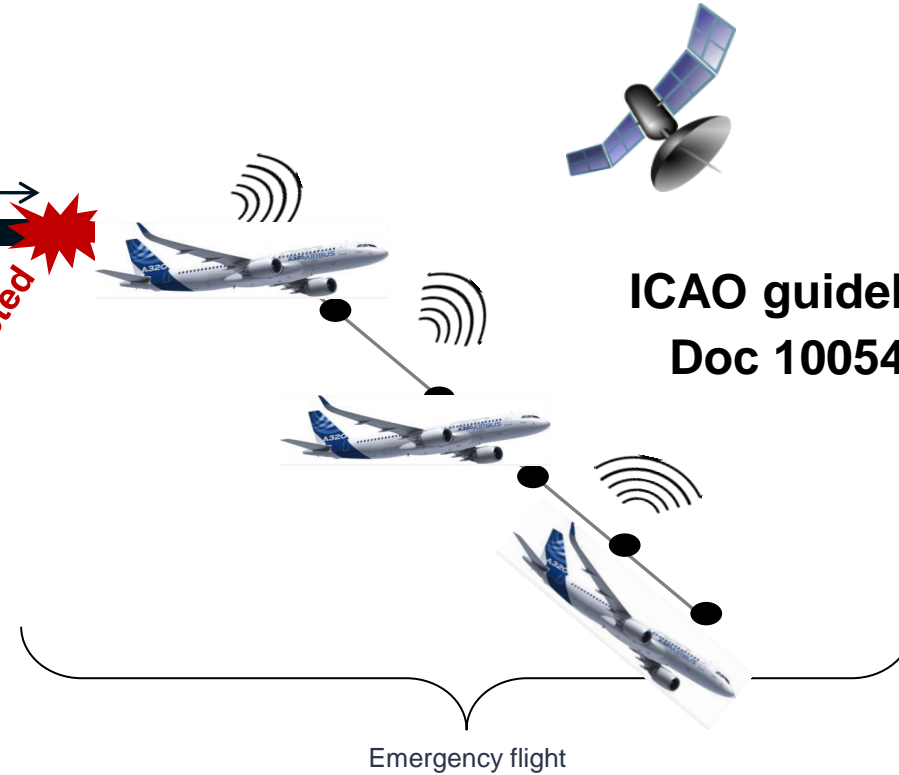


SATCOM GSO or LEO coverages
(L / Ku / Ka bands...)



← Buffer →

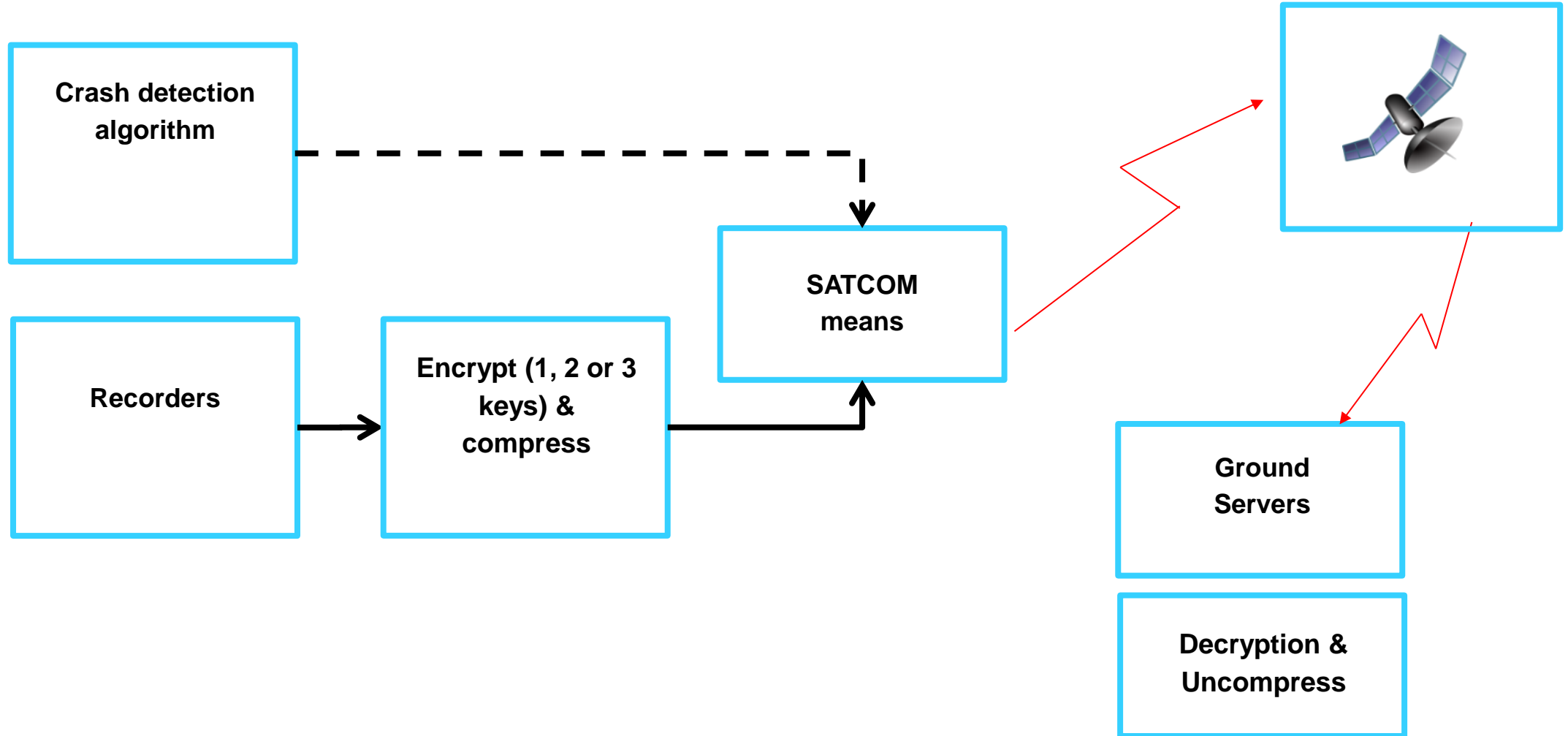
Emergency detected



ICAO guidelines defined by
Doc 10054 (in progress)

PFLR: Flight Data Streaming -Functional description

Performances & Requirements (Coverage, bandwidth, triggers, continuous transmission ...)
are in definition by ICAO Working Group (Manual 10054)



Standardization of Timely Recovery of Flight Data (TRFD)



In order to specifically address expected, forthcoming PLFR mandate in the most effective way (accounting for system complexity, cost, schedule, risk, etc.), the aviation industry then propose an ARINC Project Initiation/Modification (APIM) through the Systems Architecture and Interfaces (SAI) Subcommittee to standardize TRFD (Timely Recovery of Flight Data) solutions.

APIM was approved during AEEC General Session in May 2017

The APIM propose to structure the work in 3 main phases:

- Document the end to end system , Data Security and privacy requirements, develop System Functional Block Diagram (Report)
- Develop candidate architectures) / choose architecture(s) (Report)
- Develop detailed equipment, interface, and aircraft installation requirements, as well for selected architecture(s). Define accordingly new ARINC or updated Characteristics

Standardization of Timely Recovery of Flight Data (TRFD)



There are two potential TRFD architectures that are expected to be evaluated, including (but not limited to) the following:

- Automatic Deployable Flight Recorder (ADFR) - a combination flight recorder (Cockpit Voice Recorder (CVR)/Flight Data Recorder (FDR)) with integrated ELT installed on the aircraft which is capable of automatically deploying from the aircraft
- Flight Data Streaming (FDS) – the ability to stream flight data from the airplane while in flight

>>> Completed work expected Sept 2020

Flight Data Streaming –Spectrum aspects



PRELIMINARY CEPT POSITION (Issued from last CPG march 17th)

CEPT recognises that the implementation of the GADSS concept would contribute to increasing the effectiveness of the current alerting of search and rescue services for civil aviation transportation.

CEPT is of the view;

- that systems contributing to the GADSS have to be identified in accordance with ICAO requirements or recommendations provided in SARPs, manuals or guidance material;
- that any changes to the Radio Regulations should be determined on the basis of the GADSS concept developed by ICAO;
- that systems identified to contribute to the GADSS may not necessarily require any additional frequency allocation nor any new or revised regulatory provisions;
- that additional regulatory actions for the introduction and use of GADSS, if any, should be identified ensuring sharing and compatibility with systems in incumbent radiocommunication services in the frequency bands proposed for GADSS introduction and in the adjacent frequency bands without imposing any additional constraints on the existing and planned systems.
- that according to the process to implement the GADSS concept an extension of activities towards WRC-23 may need to be considered

Next PT-C is planned end September

Underwater Locator Devices

- Aircraft are equipped with flight recorders with Underwater Locator Beacons (ULBs) attached. The detectable acoustic range of the currently used Flight Recorder ULBs is limited due to the transmit frequency of **37.5 kHz**. Duration time has been increased to 90 days (from 30 days) .



ULB attached on CVR / DFDR

**Airbus plan: already installed
basically on all Airbus programs
Service Bulletins available for retrofit**

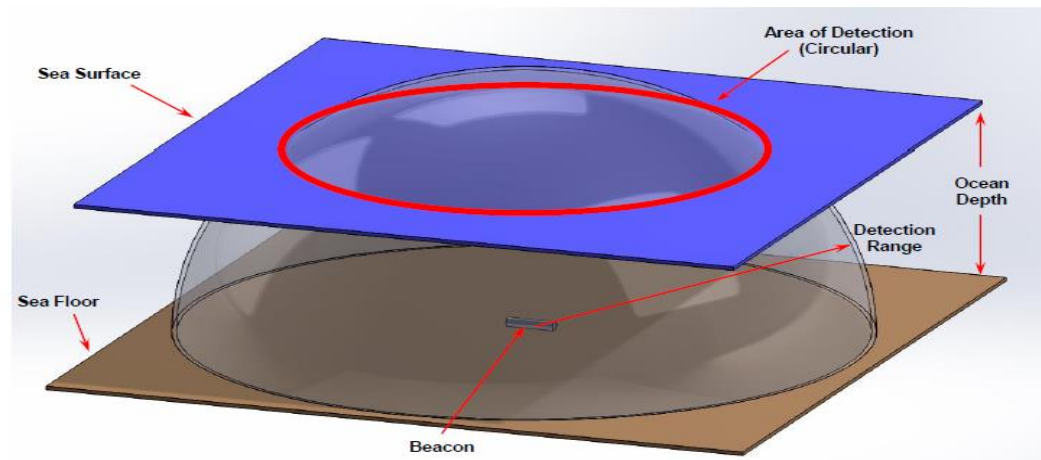
- 90 days Low Frequency ULB “Underwater Locating Beacons ” (8,8Khz) attached to the aircraft for long-range over-water flights

Transmission range is increased by a factor 4 using lower frequency.

ULB Type	Frequency	Transmission Range
Conventional ULB	37,5 kHz	5km (~2,5NM)
LF-ULB	8,8 kHz	22km (~12NM)

Underwater Locator Devices-Low Frequency Underwater Locator Beacons (LF-ULB)

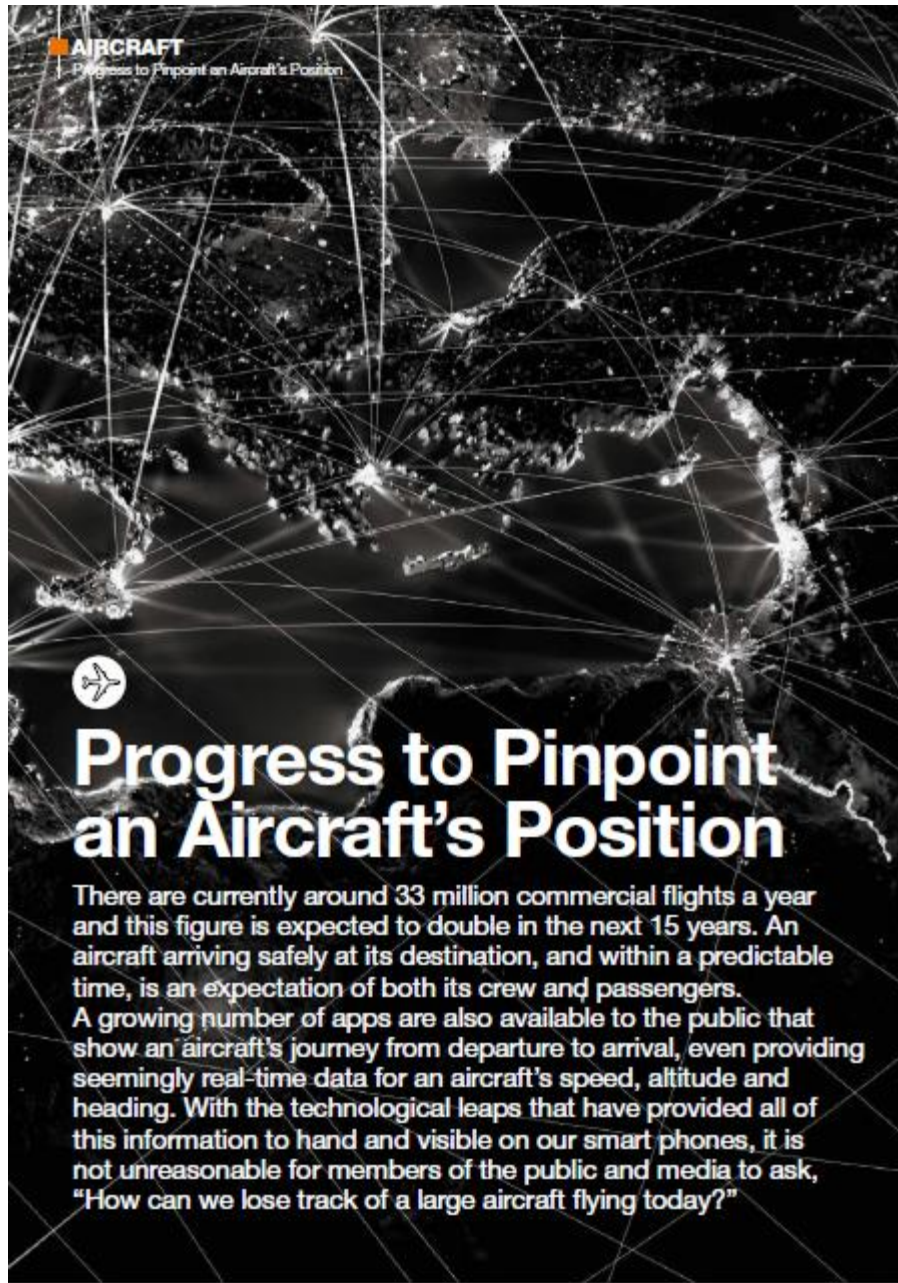
- Compliance with ARINC 677 specification to harmonize the LF-ULB footprint to aircraft interface
- Guidance manual published by EASA in December 2015:
 - Define the installation position on the fuselage (Attached to the aircraft structure)
 - Define the applicable means for fixation (aircraft bracket)
 - (E)TSO c200a qualification
 - Retrofitability (zone not modified after A/C Type Certification)



*Independent LF-ULB
on A/C structure*

**Airbus plan: Forward-fit application on all Airbus programs :
A380, A350, A330, and A320 families
Service Bulletins available soon for retrofit**

**Lot of Working Groups
are active, Airbus is
involved in majority of
them...**



Aircraft Tracking article in Safety First Airbus Magazine

Claude PICHAVANT
Senior Expert Communications & Surveillance
Manage Flight Systems

Geraldine VALLEE
Director of Flight Safety
Safety Enhancement

Article available on demand



Glossary

ACARS: Aircraft Communication Addressing and Reporting System

ACMS: Aircraft Condition Monitoring System

ACR: Avionics Communication Router

A/C: Aircraft

ADFR: Automatic Deployable Flight Recorder

ADS-B: Automatic Dependent Surveillance-Broadcast

ADS-C: Automatic Dependent Surveillance-Contract

ADT: Autonomous Distress Tracking

AEEC: Airlines Electronic Engineering Committee

A/L: Airlines

AOC: Airlines Operational Control

APC: Airlines Passenger Communications

APIM: ARINC Project Initiation/Modification

AT: Aircraft Tracking

ATC: Air Traffic Control

AtG: Air to Ground

ATM: Air Traffic Management

ATS: Air Traffic Services

ATSU :Air Traffic Service Unit

ATTF: Aircraft Tracking Task Force

CAAS : Civil Aviation Authority of Singapore

CEPT: Conférence Européenne des administrations des Postes et Télécommunications

CONOPS: CONcept of OPerationS

CVR: Cockpit Voice Recorder

CVDR: Cockpit Voice Data Recorder

DAR: Digital Access Recorder

DB: Data Base

DFDR: Digital Flight Data Recorder

DLK: Data Link

DSP: Datalink Service Provider

EASA: European Aviation Safety Agency

ELT: Emergency Locator Transmitter

EU: European Union

FAA: Federal Aviation Administration FANS: Future Air Navigation System

FDR: Flight Data Recorder

FDS: Flight Data Streaming

FMS: Flight Management System

GADSS : Global Aeronautical Distress and Safety System

GEO: Geostationary Earth Orbit

GPS: Global Positioning System

GSO: Geo Stationary Orbit

HF: High Frequency

HFDL:HF Data Link

HFDR : HF Data Radio

HLSC: High Level Safety Conference

IATA: International Air Transport Association

ICAO: International Civil Aviation Organisation

ID: Ident

IP: Internet Protocol

ITU: International Telecommunication Union

LEO: Low Earth Orbit

MASPS: Minimum Aviation System Performance Specification

MCC :Mission Control Center

NAA: National Aviation Authorities

NATII: Normal Aircraft Tracking Implementation Initiative

NM: Nautical Miles

Glossary

OCC = Operational Control Center

OEM: Original Equipment Manufacturer

OPS: Operations

PFLR: Post Flight Localization & Recovery

QoS: Quality of Service

RCC: Rescue Coordination Center

RLS : Return Link Service

RTCA: Radio Technical Commission for Aeronautics

SAI : System Architectures and Interfaces

SAR: Search And Rescue

SARPs: Standards And Recommended Practices

SSCVR: Solid State Cockpit Voice Recorder

STC: Supplemental Type Certification

TRFD: Timely Recovery of Flight Data

ULB: Underwater Locator Beacon

ULD: : Underwater Locating Device

VDR: VHF Data Radio

VDL: VHF Data Link

VHF: Very High Frequency

VTP: Vertical Tail Plane

WRC: World Radio Conference

Thank you