GADSS in depth

Airbus views on Global Aeronautical Distress Safety System

ICAO Regional Preparatory Group / WRC-19 Workshop

Claude PICHAVANT

March 2017

AIRBUS

ICAO UNITING AVIATION HLSC2015

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

ITU International Telecommunication Union

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).”

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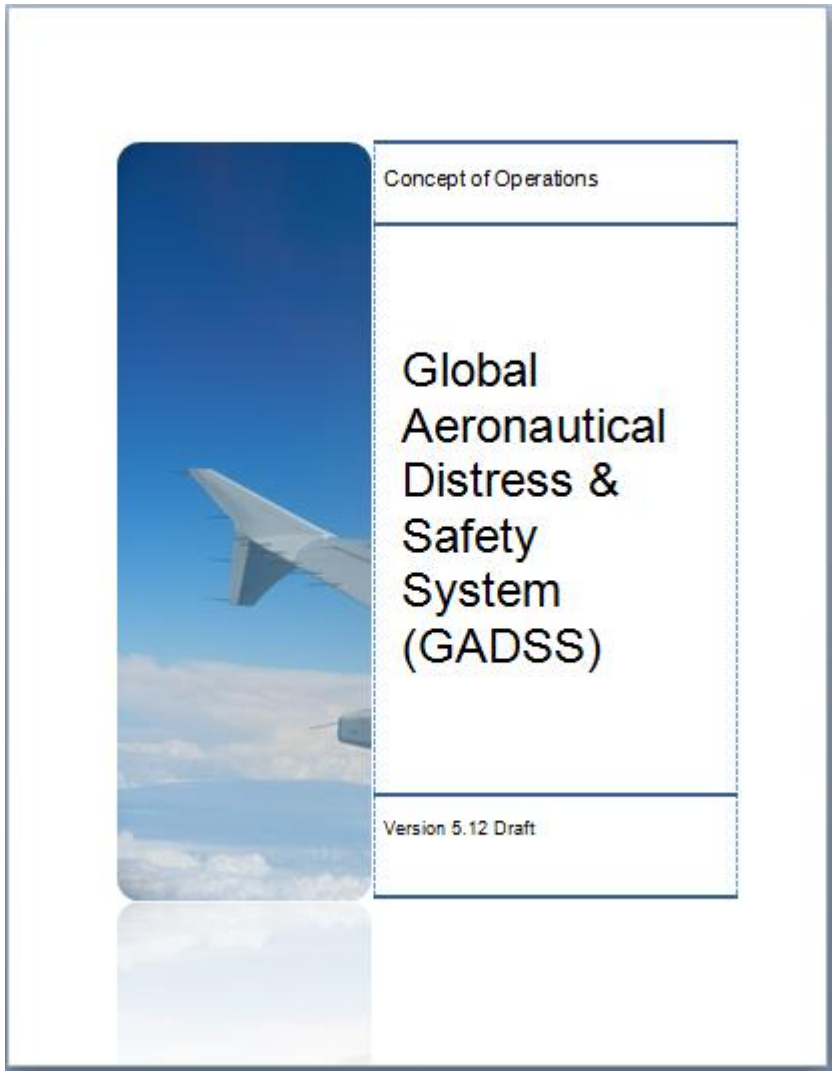

This Concept of Operations document specifies the high-level requirements and objectives for the GADSS.

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.**

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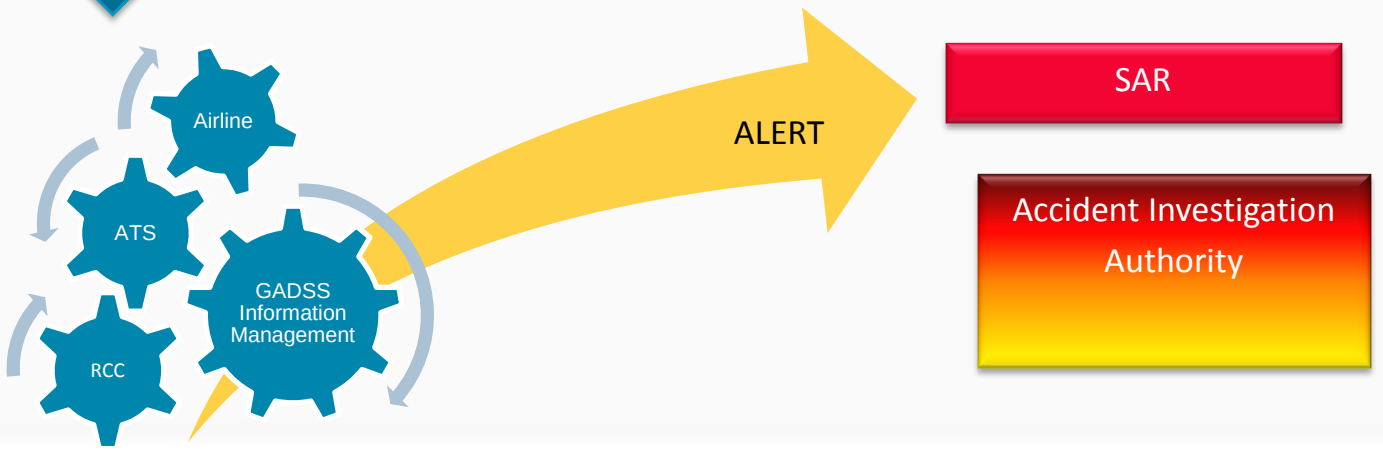
Global Aeronautical Distress Safety System

AT
- Aircraft Tracking

ADT
- Autonomous Distress Tracking

PFLR
- Post Flight Localization & Recovery



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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**

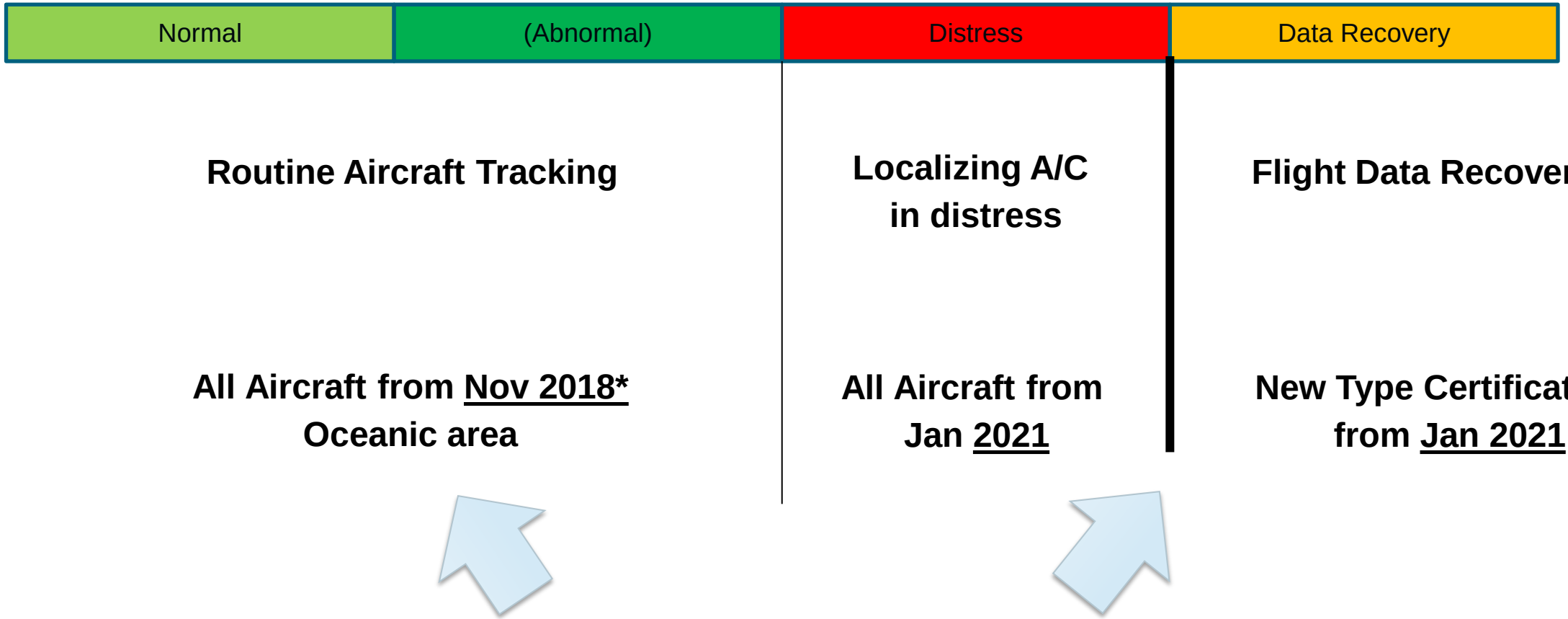
- Location and tracking of an Airplane in Distress

  >>>>> **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



Recommendations into ICAO SARPS

Refer to Annex 6, 10, 11, 12

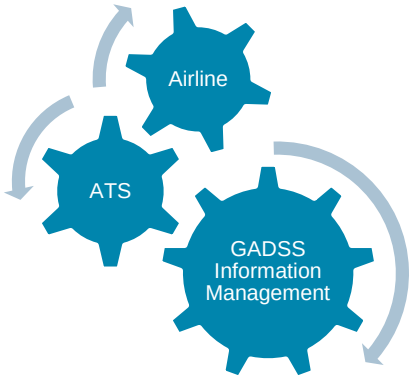
*: *implementation date can be different according to regional or national regulations*

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

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Aircraft Tracking –REGULATIONS

EUROPEAN COMMISSION

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

CAAS
Civil Aviation Authority of Singapore

“ 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

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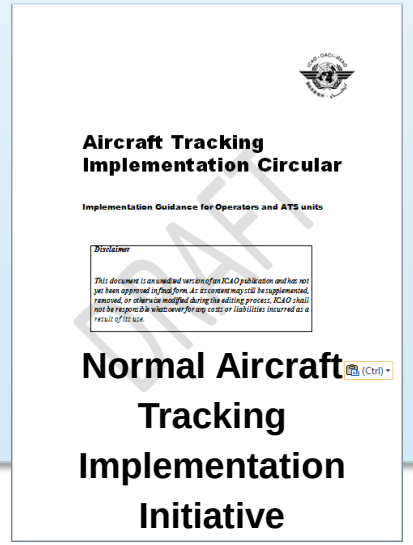
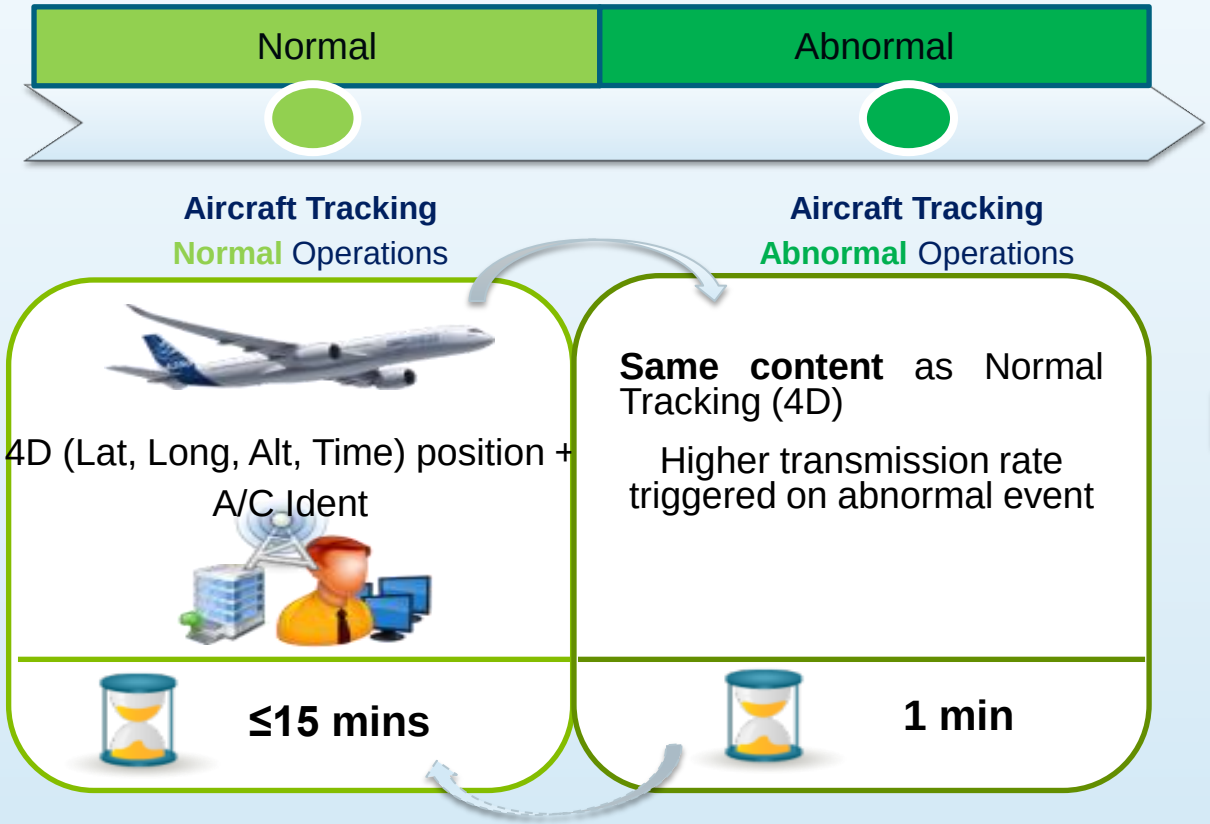
Aircraft tracking supported by existing technologies

ICAO Global Aeronautical Distress and Safety System

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 define their regulation in accordance with ICAO recommendations (Ex CAAS July 2016 or EU after 2021, reporting rate increases to 3 minutes, unless equipped for distress tracking)

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

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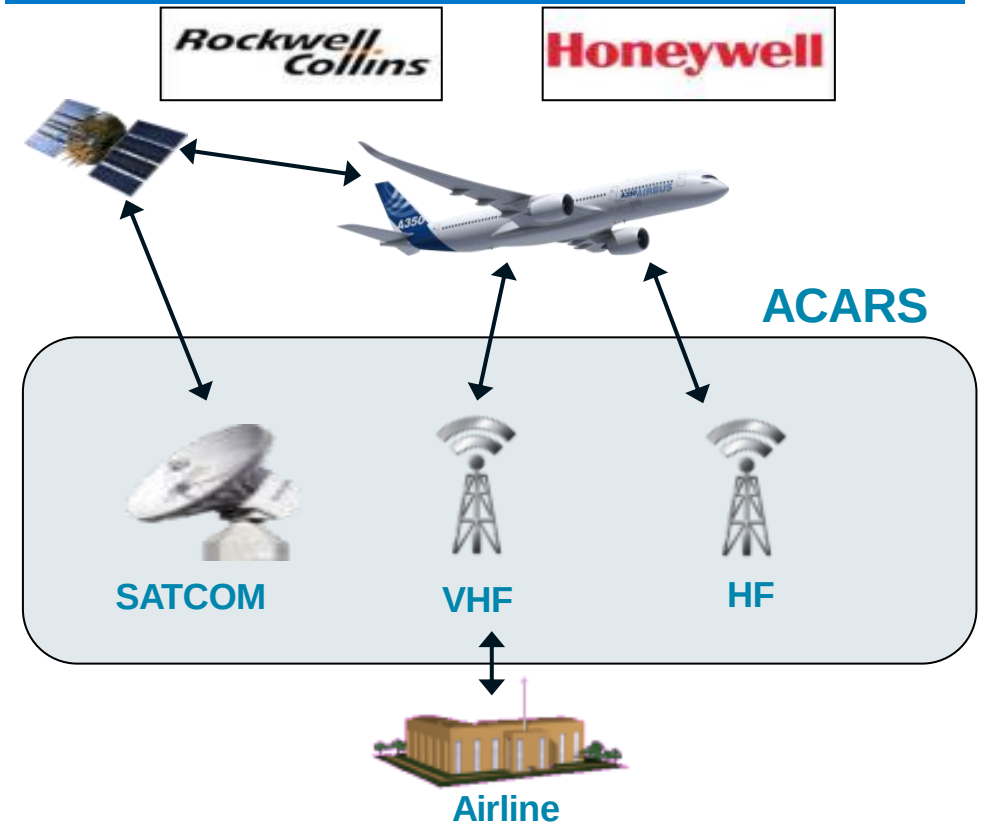
Airbus way forward for implementing Aircraft Tracking function

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

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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

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Datalink communication means on Airbus Aircraft

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

<u>Note</u>: 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.

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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, HFDL)		
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)		

Aircraft Tracking – Other solutions -Navblue N-Tracking

N-TRACKING

More than just a flight and fleet tracker

N-Tracking goes above and beyond simply meeting all current and future ICAO flight tracking requirements efficiently.

Extra features include personalised alerts, real-time information on destination airports, analysis of past operations, as well as a replay function to help optimize future flight plans..

N-Track can be integrated with N-Flight Planning to monitor whether flight operations are developing according to plan or whether specific actions should be expected.

NAVBLUE
AN AIRBUS COMPANY

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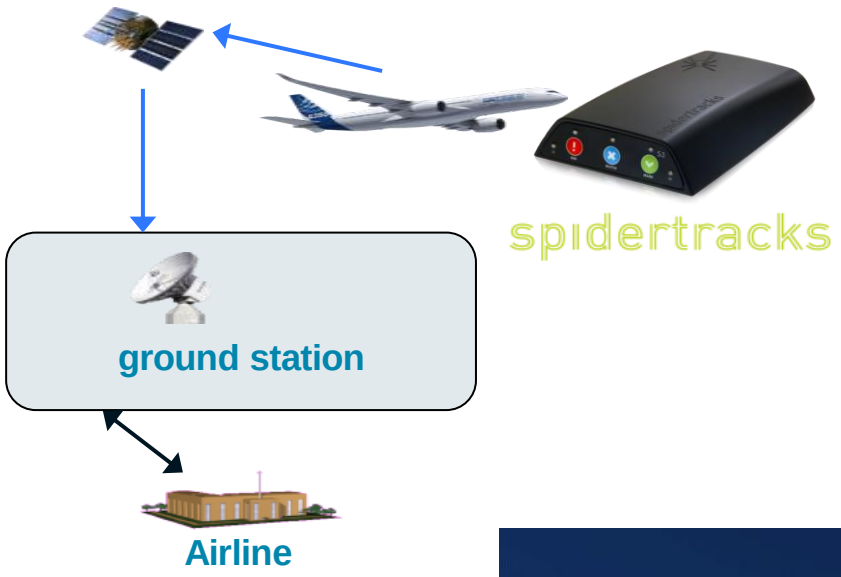
Aircraft Tracking – Other solutions



Other existing technology installed by STC

Standalone solutions like :

- Spidertracks using Iridium constellation
- Globalstar
- …

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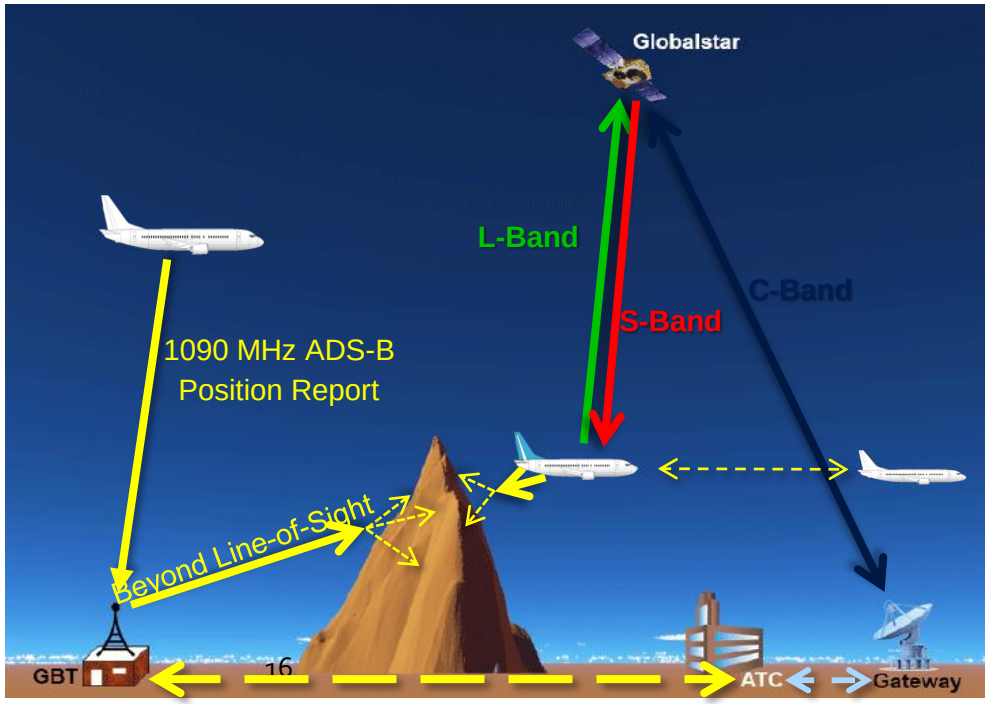
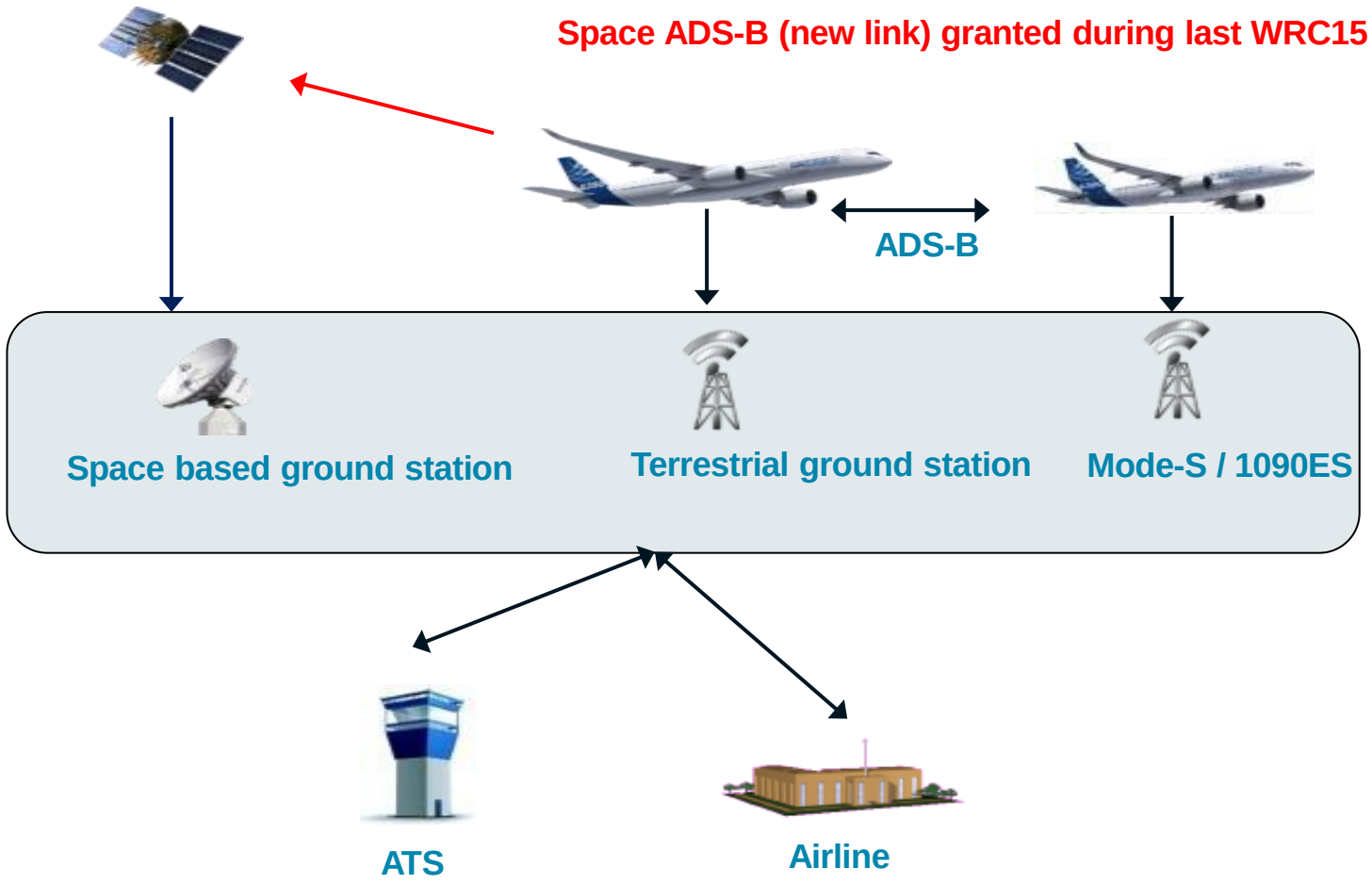


Aircraft Tracking – Other solutions



Future technology

Automatic Dependent Surveillance –Broadcast (ADS-B) space based.
Iridium Next constellation / Aireon service should be available 2018

No expected change on aircraft, neither on ADS-B out avionics / architecture

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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

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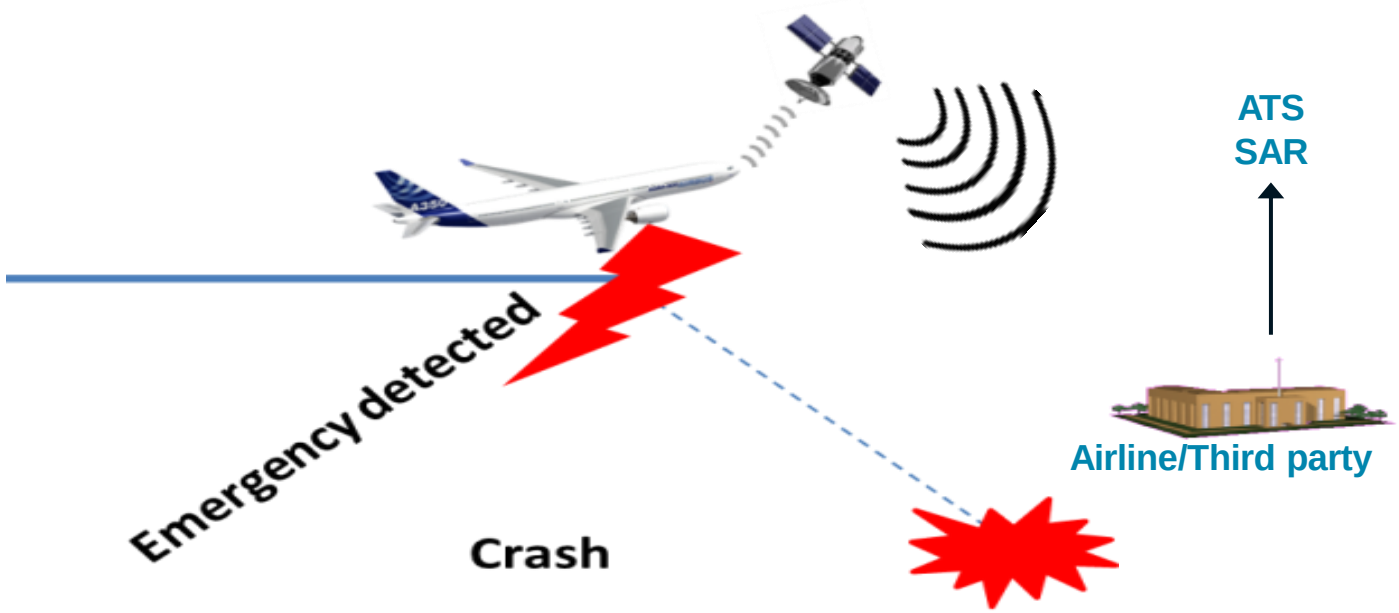
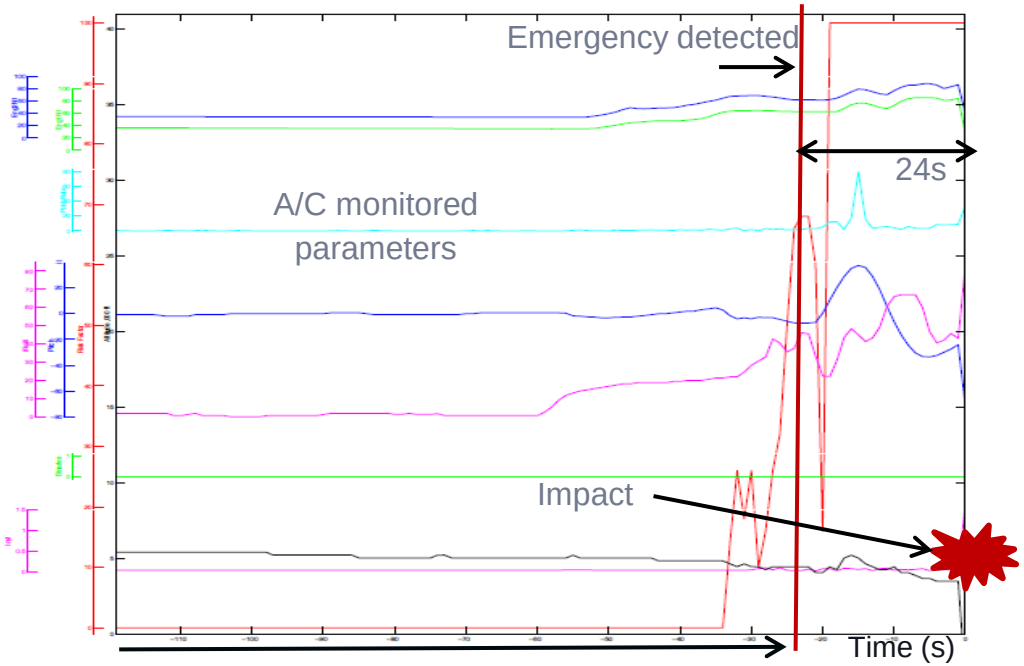
ADT -Autonomous Distress Tracking

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 4D 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 (Tamper proof)
- Could be remotely activated





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

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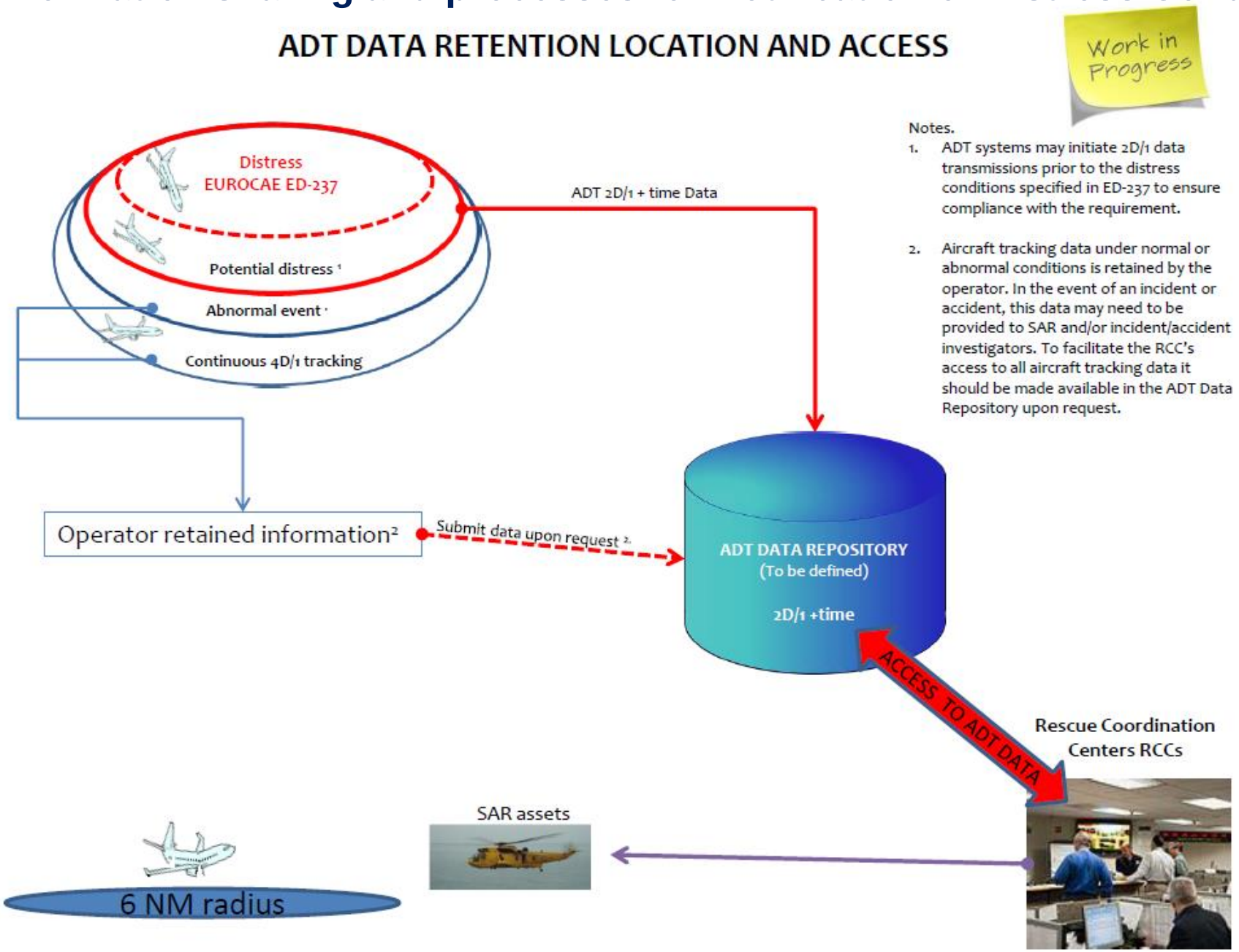
ADT –GADSS information sharing and processes for Notification of Distress Condition

GADSS Extract



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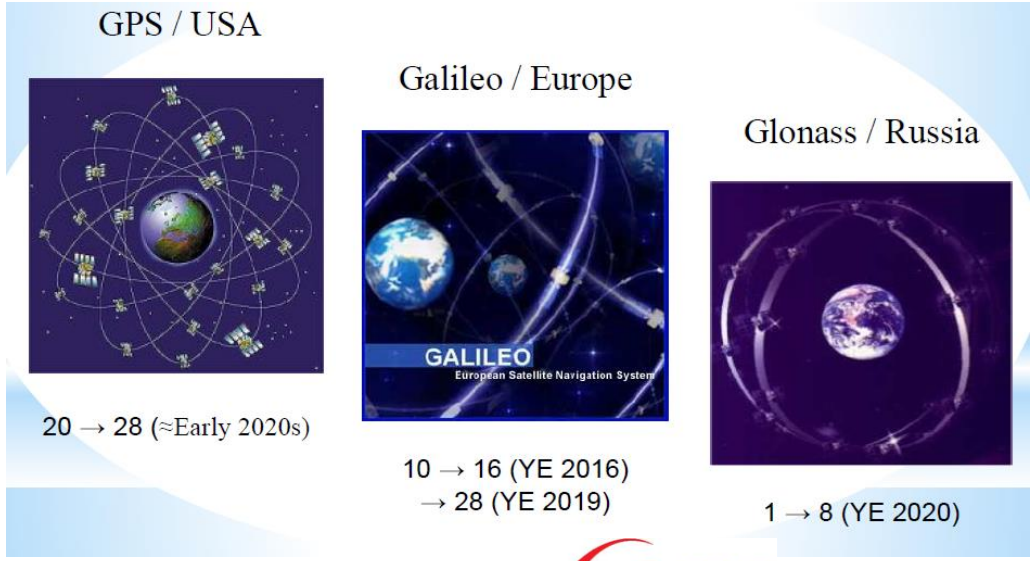
ADT- Autonomous Distress Tracking
2nd Generation ELT- Main new features

- 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



COSPAS SARSAT

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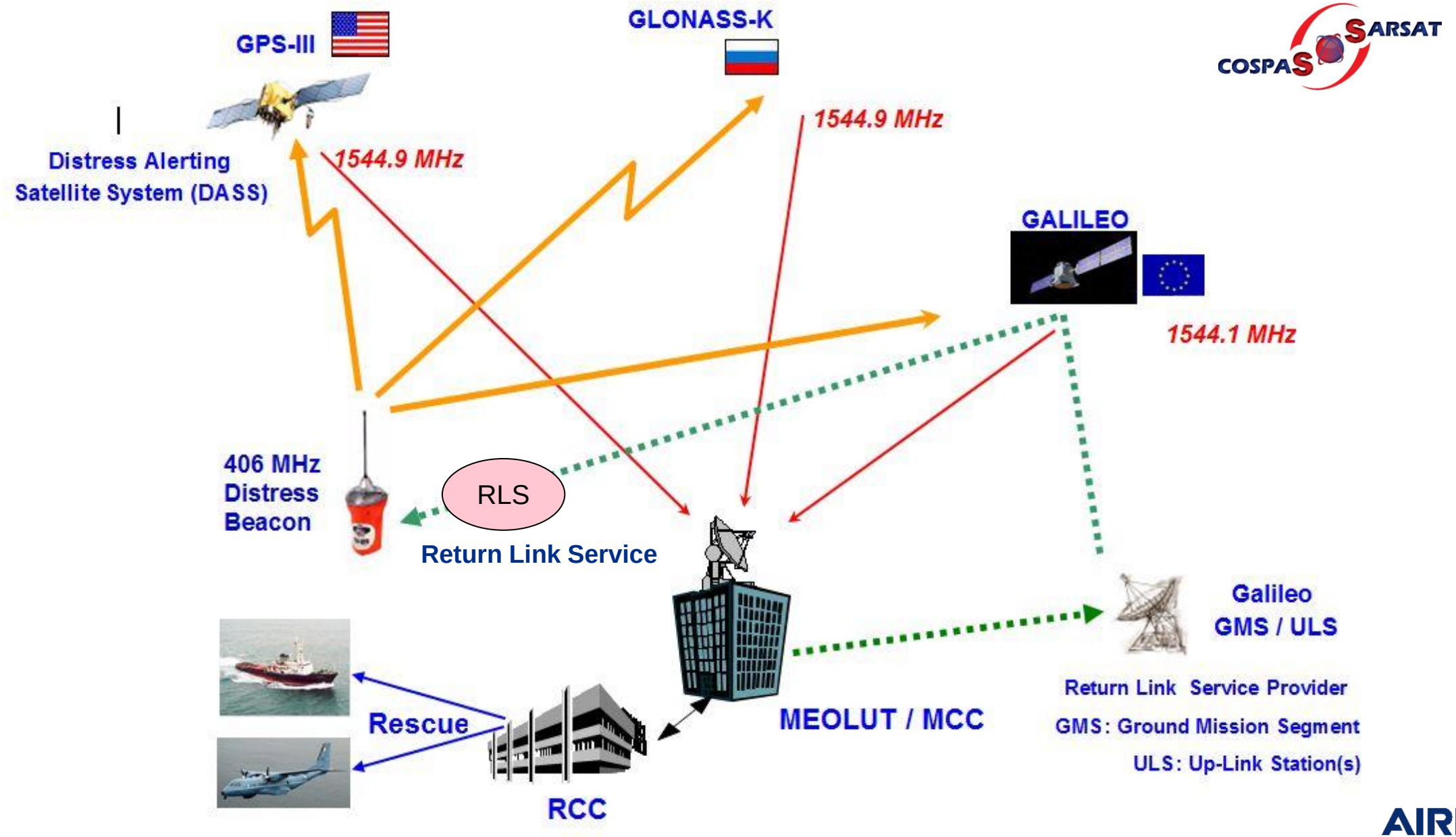
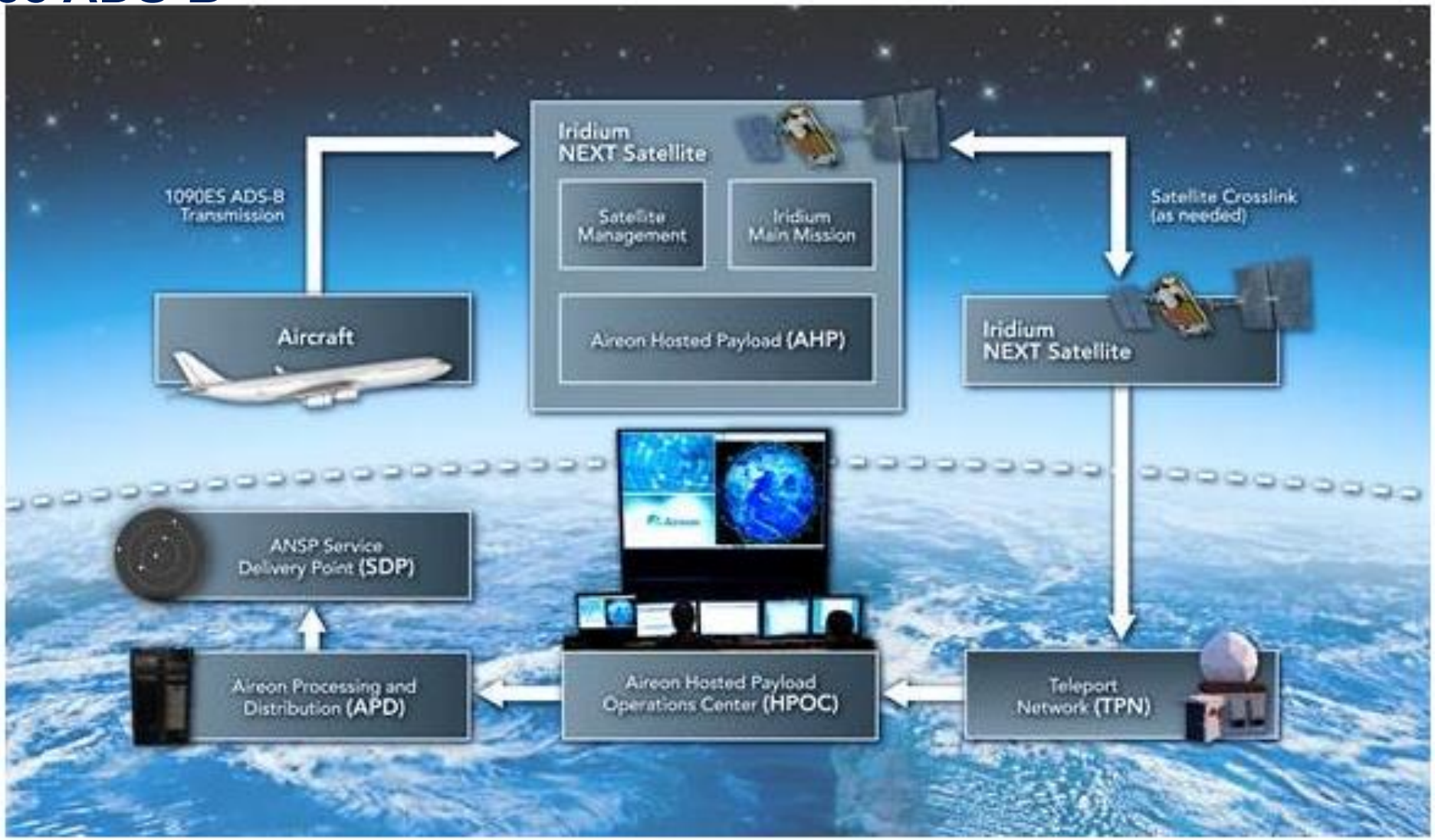
Typical MEOSAR System- Configuration with RLS



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)

ARINC INDUSTRY ACTIVITIES℠
An SAE ITC Program

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

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

- Definition of requirements and main functional block diagrams (Report)
- Proposition of candidate architectures (both at the aircraft-level and on-ground systems) /choose architecture(s) and develop detailed equipment and aircraft installation requirements (Report)
- Develop detailed equipment, interface, and aircraft installation requirements, as well as ground system requirements if applicable, for selected architecture(s) (New ARINC or updated Characteristics)

>>> Completed work expected Jan 2019

APIM need to be approved during next AEEC General Session in May 2017

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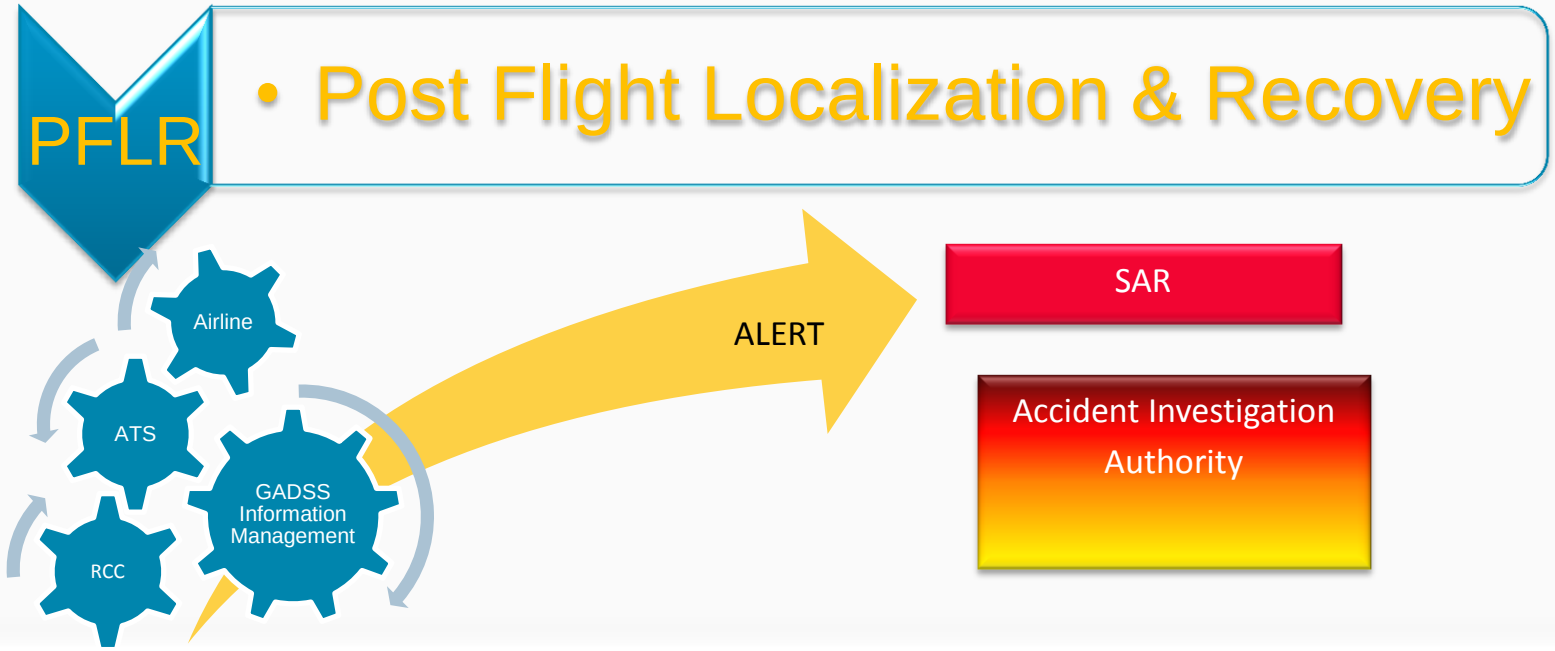
Global Aeronautical Distress Safety System

Use of any type of spectrum properly allocated, for the function being performed, to be confirmed according to ICAO Manual Location of Aircraft in Distress and Flight Recorder Data Recovery (10054)

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**



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PFLR: 1) Deployable Combined Recorder with ELT

1. Sensors detect the start of a crash

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

Source: DRS

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. Deployable acts as homing device for rescue crews, essential for accidents over water or in remote locations.

6. SAR personnel recover survivors and Deployable Recorder Quickly allowing same day accident analysis

Airbus plan: Forward- fit application on all long range operations A/C (A380, A350, A330, A321)

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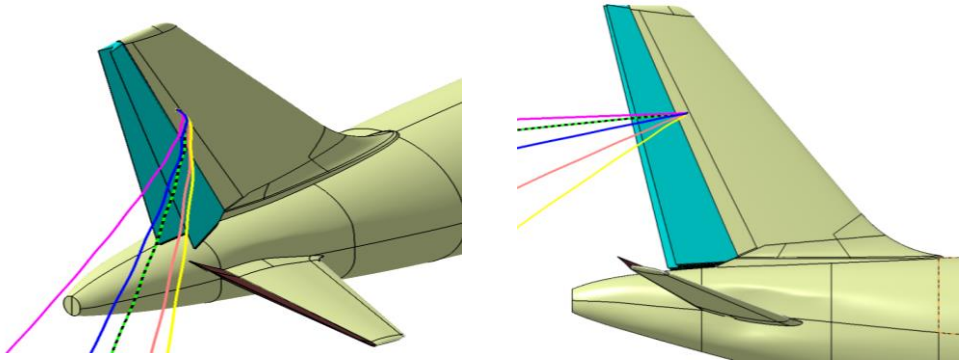
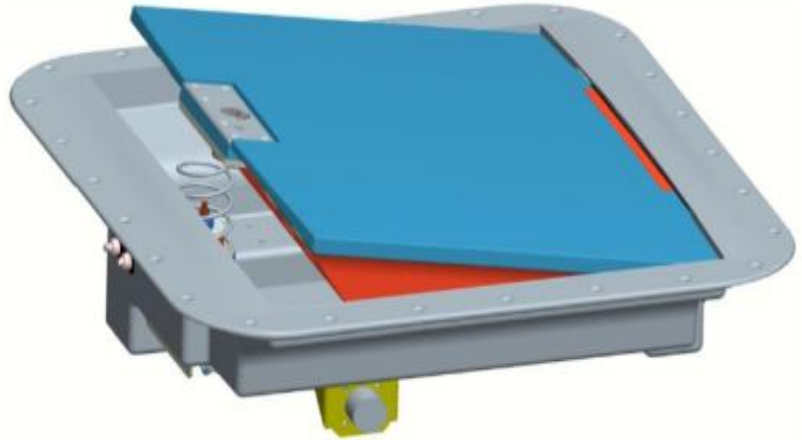
PFLR: 1) Deployable Combined Recorder with ELT

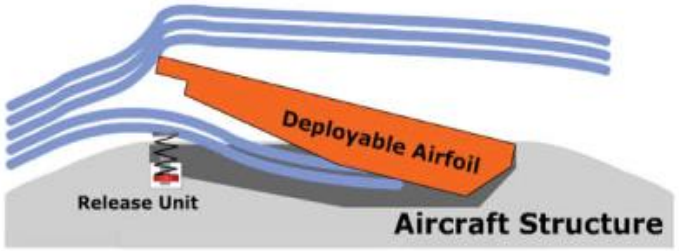
Technology:

- Dual Combination Recording System with:
  - ADFR with integrated ELT installed in Vertical Fin (mean for ADT)
  - 2 Crash detection circuits
  - CVDR installed in Avionics Bay
  - 25 hours recording
  - Common system across A350, A380, A330, A321
  - Individual installation per Program
- 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

L3 communications

DRS TECHNOLOGIES a LEONARDO company

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PFLR: 1) Deployable Combined Recorder Architecture

Main Architecture/ locations

Dual combination recording with ADFR and CVDR

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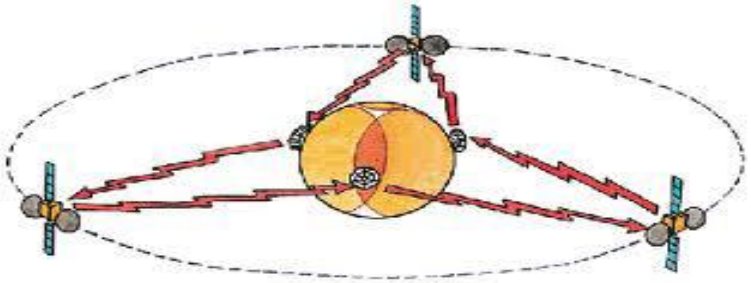
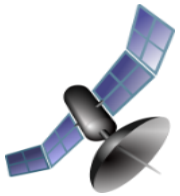
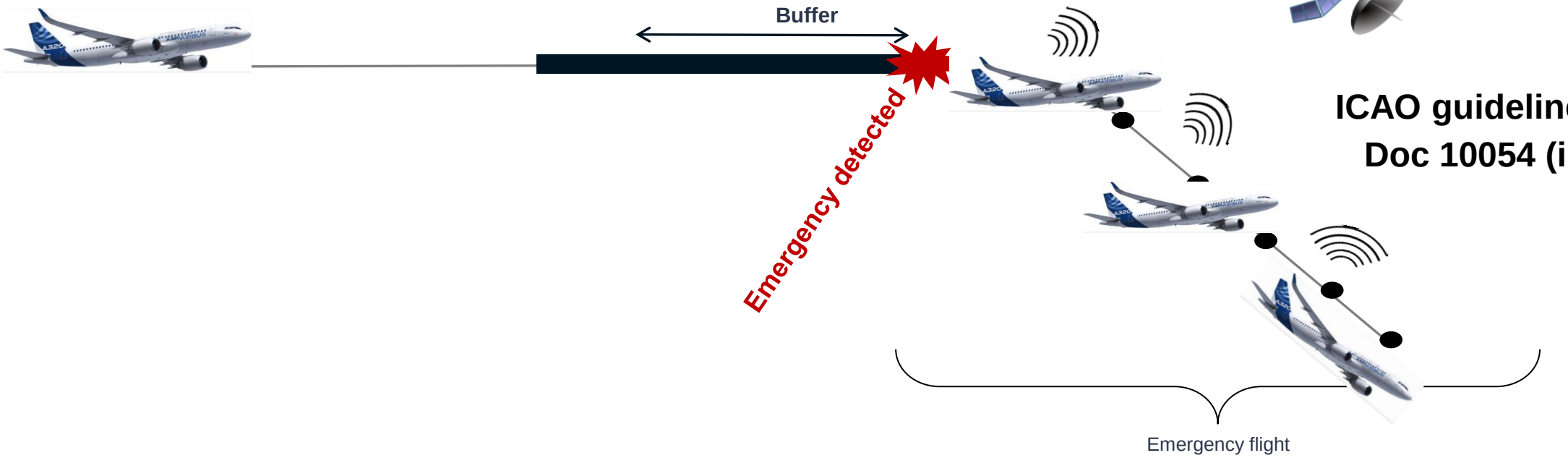
PFLR: 2) Flight Data Streaming



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





ICAO guidelines defined by Doc 10054 (in progress)

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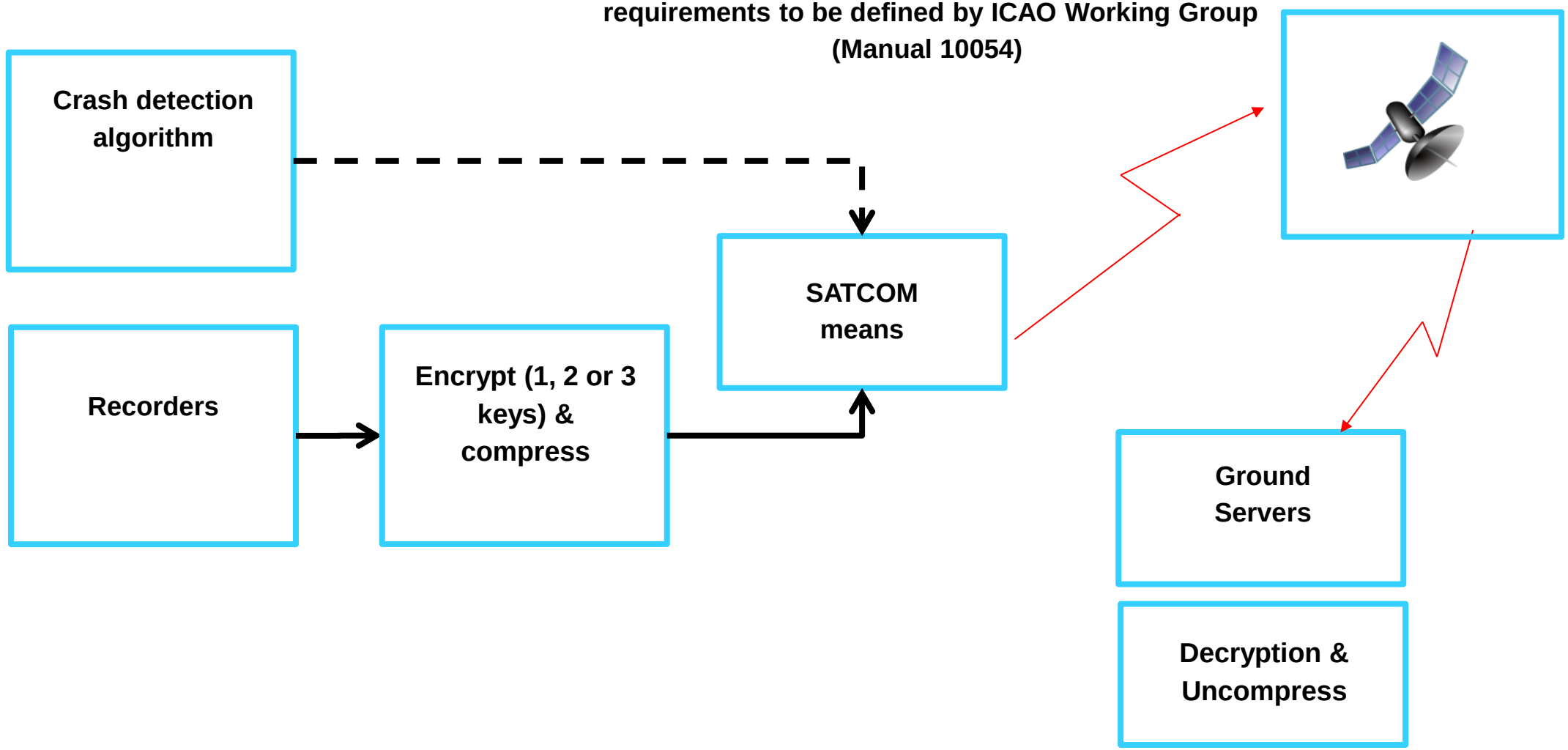
PFLR: 2) Flight Data Streaming -Functional description

Performances (Coverage, bandwidth..) & Spectrum requirements to be defined by ICAO Working Group (Manual 10054)



Standardization of Timely Recovery of Flight Data (TRFD)

ARINC INDUSTRY ACTIVITIES℠
An SAE ITC Program

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.

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

- Document the end to end system (both at the aircraft-level and on-ground systems) and Data Security and privacy requirements, develop System Functional Block Diagram (Report)
- Develop candidate architectures (both at the aircraft-level and on-ground systems) / choose architecture(s) and develop detailed equipment and aircraft installation, as well as ground system requirements (Report)
- Develop detailed equipment, interface, and aircraft installation requirements, as well as ground system requirements for selected architecture(s) (New ARINC or updated Characteristics)

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Standardization of Timely Recovery of Flight Data (TRFD)

ARINC INDUSTRY ACTIVITIES℠
An SAE ITC Program

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)) 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

APIM need to be approved during next AEEC General Session in May 2017

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

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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

- 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)

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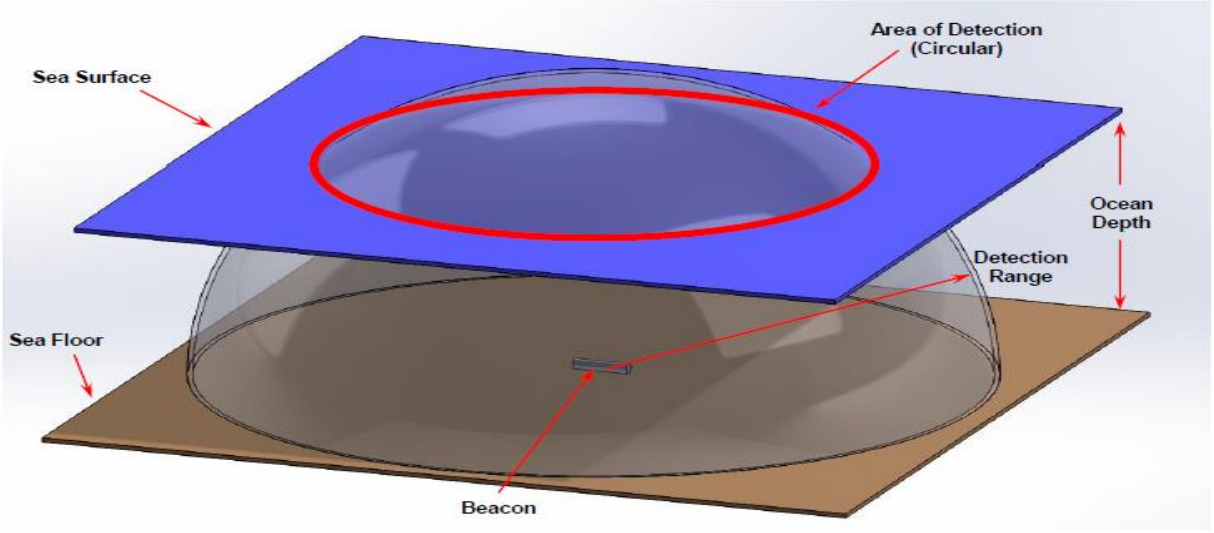
Underwater Locator Devices-Low Frequency Underwater Locator Beacons (LF-ULB)

- Compliance with ARINC 677 specification to harmonize the LF-ULB footprint to aircraft interface

- Guidance manual was published by EASA in December 2015, which led to:
  - Define the installation position on the fuselage (Attached to the aircraft structure)
  - Define the applicable means for fixation (aircraft bracket)
  - Select suppliers having **(E)TSO c200a** qualification
  - Retrofitability (zone not modified after A/C Type Certification)



Independent LF-ULB on A/C structure

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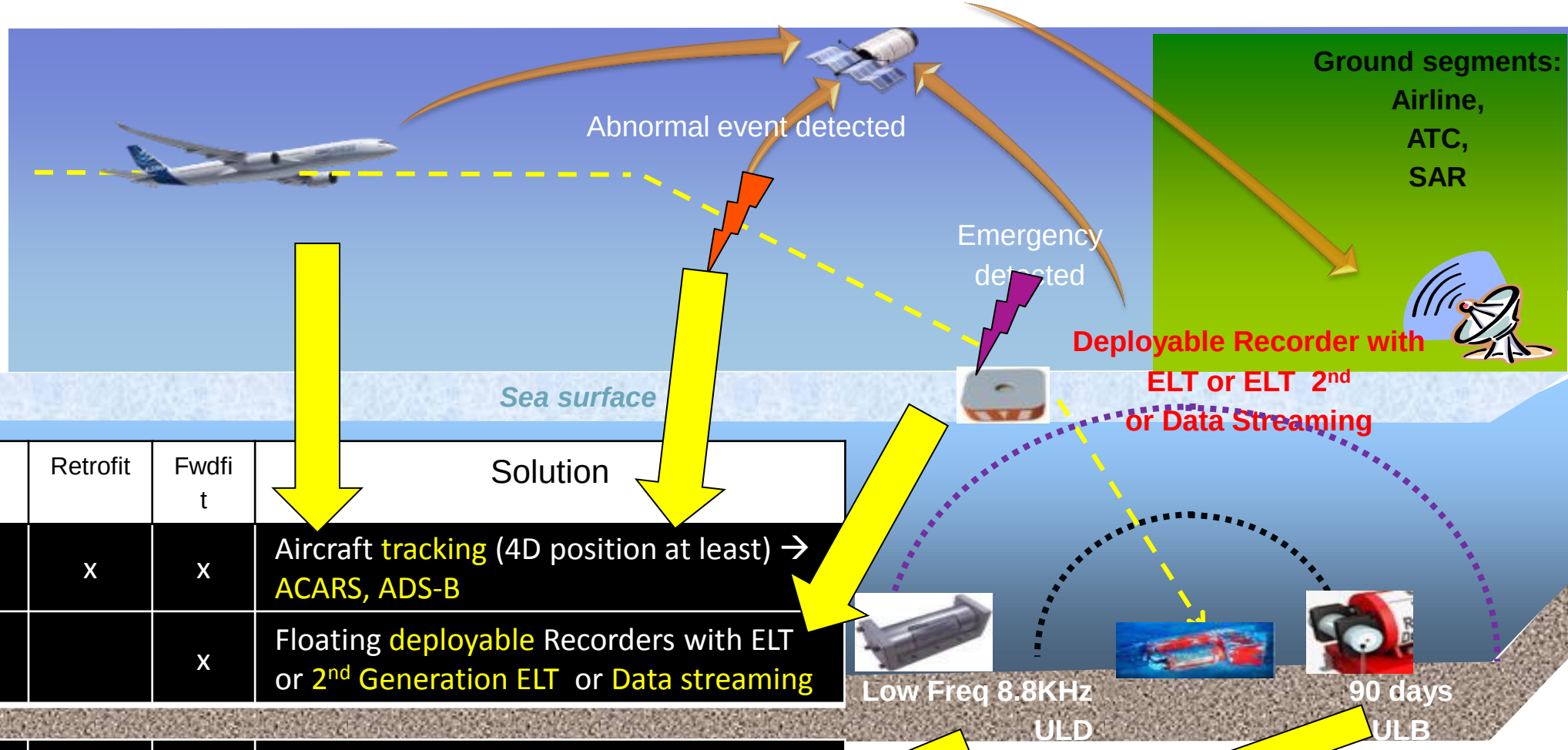
Summary of A/C Tracking , ADT and Flight Data Recovery



Aim	Retrofit	Fwdfit	Solution
Track and alert	x	x	Aircraft tracking (4D position at least) → ACARS, ADS-B
Locate, retrieve data		x	Floating deployable Recorders with ELT or 2nd Generation ELT or Data streaming
Locate wreckage	x	x	Low Freq 8.8KHz ULD, airframe attached
Locate Recorders	x	x	90days 37.5KHz ULB, fix recorders attached

AIRBUS

LOTS OF WORK AHEAD !

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 AdministratFANS: 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