Functional Specification - **DRAFT**

Location of an Aircraft in Distress Repository (LADR)

Draft Version 2.0

Status of this document

The LADR functional Specification has been developed by the Autonomous Distress Tracking Repository Task Force (ADTR-TF) of ICAO. This document remains draft and subject to further changes as the work progresses.

Version 2.0 incorporates the outcomes of the *DTR Functional Workshop* held at ICAO, Montreal, 9-11 April 2019. As part of the discussion at that workshop, a proposed change to the name of the repository was discussed. Subsequently this has been revised and the document re-titled to refer to the Location of an Aircraft in Distress Repository.

EXECUTIVE SUMMARY

ICAO Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* requires that, as of 1 January 2021, all new production aeroplanes of a maximum certificated take-off mass of over 27 000 kg shall autonomously transmit information from which a position can be determined by the operator at least once every minute when an aircraft is in a state that, if the aircraft behaviour event is left uncorrected, it can result in an accident. Annex 6 also recommends that this requirement be applicable to all new aeroplanes after 1 Jan 2021 of a maximum certificated take-off mass of over 5 700 kg. The operator is responsible to make that position information of a flight in distress available to Air Traffic Services Units (ATSUs), Rescue Coordination Centres (RCCs) and any additional entity as established by the State of the Operator.

The ICAO Global Aeronautical Distress and Safety System (GADSS) - Concept of Operations (CONOPS) identified a need to collect, store and provide access to Autonomous Distress Tracking (ADT) position information to aid appropriate stakeholders in locating an aircraft in distress, and enhance Search and Rescue (SAR) and recovery capabilities. When an operator detects a potential problem with an aircraft such as a missed position report or suspected distress situation, it will need to inform the appropriate ATSU and other stakeholders.

A centrally managed position data repository was considered the preferred means to provide access to the required distress tracking data.

The repository, a secure web-based storage facility, will house position/location information of aircraft in distress or potentially in distress and will be the means to make the last known position of an aircraft in distress available to stakeholders in a timely manner.

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DEFINITIONS

All terms used in this document are consistent with the *GADSS – Concept of Operations*, Version 6.0.

REFERENCE DOCUMENTS

Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*

Annex 10 — *Aeronautical Telecommunications*

Annex 11 – *Air Traffic Services*

Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services (Doc 8585)

Location Indicators (Doc 7910)

Manual on System Wide Information Management (SWIM) Concept (Doc 10039)

Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery (Doc 10054)

ICAO *Global Aeronautical Distress Safety System – Concept of Operations (GADSS - CONOPS)*, Version 6.0

1. 0 BACKGROUND

1.0.1 On 2 March 2016, the ICAO Council adopted Amendment 40-A to Annex 6, Part I which included, among other elements, Standards and Recommended Practices (SARPs) related to the location of an aeroplane in distress (Chapter 6, 6.1.8, refers). These SARPs address the Global Aeronautical Distress Safety System (GADSS) Autonomous Distress Tracking (ADT) concept and became effective on 11 July 2016, with an applicability date of 1 January 2021. Amendment 40-A was issued in July 2016.

1.0.2 The SARPs are applicable to aeroplanes with take-off mass greater than 27 000 kg for which the certificate of airworthiness is first issued as of 1 January 2021, and establish the requirement to autonomously transmit information from which a position can be determined by the operator at least once every minute when in a distress condition. The same is recommended for new aeroplanes for which the certificate of airworthiness is first issued as of 1 January 2021with take-off mass greater than 5 700 kg. An aircraft is considered in distress when it is in a state that can, if the behaviour event is left uncorrected, result in an accident.

1.0.3 The SARPs state that autonomous transmission of position information needs to be active when an aircraft is in a distress condition. This will provide a high probability of locating an accident site to within a 6 NM radius. Annex 6, Part I, Appendix 9, also specifies that this transmission can be activated manually. Annex 6 is not technology-specific and will allow for various solutions, including triggered transmission systems. The autonomous transmission of position information needs to be capable of occurring in the event of aircraft electrical power loss, at least for the expected duration of the entire flight. For further details regarding the requirements for an ADT system, refer to the *Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery* (Doc 10054).

1.0.4 The SARPs also establish the requirement for making this information available to authorities such as: Rescue Coordination Centres (RCCs); Air Traffic Services Units (ATSUs); and others as determined by the State of the Operator.

1.0.5 Performance-based standards for ADT systems allow industry to come up with different degrees of innovation. The challenge, however, is to make the ADT position information available in a standard format for the primary intended audience, the RCCs and ATSUs. To accomplish this, the GADSS CONOPS identified a need to store and provide access to ADT position information by means of a centrally managed repository, originally referred to as the Distress Tracking Data Repository and now referred to at the Location of an Aircraft in Distress Repository (LADR), and implemented in accordance with the guidelines provided in the *Manual on System Wide Information Management (SWIM) Concept* (Doc 10039).

1.1 SCOPE

1.1.1 The scope of this document is to provide details on a solution to meet the requirement of making the last known position of an aircraft in distress situation available to stakeholders in a timely manner applying a global standard.

1.1.2 The proposed Location of an Aircraft in Distress Repository (LADR) is intended to serve as a central location for storing and accessing the last known position of an aircraft in distress. This position may be made available from a number of different proprietary systems which meet the requirements of the Standards in Annex 6. The LADR will provide a single point of access and standard format for this information. Additional functionality, for example the

issuing of a notification to accredited users of the arrival of new data, may also be included but are not considered fundamental to the basic function of the LADR.

1.1.3   The LADR does not provide alerting of distress conditions, this will be done by operators and Air Traffic Service Units (ATSUs) using the existing provisions of Annex 6 and Annex 11.

1.1.4   In due course the LADR may host or serve as a SWIM-based conduit for additional information that may be of use to SAR. This specification identifies the minimum dataset required to make the location of an aircraft in a distress condition (aircraft identification details, latitude, longitude and time) available to ATSUs, RCCs and others as established by the State of the Operator. Additional elements which may optionally be provided by an ADT are also defined in order to ensure the information is received in a standard format.

1.1.5   The LADR scope is limited to position data from an activated ADT device caused by the aircraft reporting a *distress condition*. This should not be confused with an aircraft being designated as in a *distress phase* by ATC, as described in Annex 11, Chapter 5 (Alerting Service).

2.0   HIGH LEVEL OBJECTIVES OF THE DOCUMENT

2.0.1   To ensure that ATSUs, RCCs and others, as established by the State of the Operator, have available timely access to the last known location of an aircraft in distress, as described in the GADSS - CONOPS, Section 3.4. The system should be capable of processing the position information such that it is available for use within a few minutes after transmission from the aeroplane

2.0.2   This paper defines the general LADR profiles for contributors and users of the system.

2.0.3   The LADR functionality begins when data, submitted by a contributor, is received by the LADR and ends after a period when the data is no longer held in the repository. Users, based on their profile and selections, may have access to the data and be notified when a new source of data commences data transfer to the LADR.

3.0   OPERATIONAL FRAMEWORK FOR THE USE OF THE LADR

3.0.1   The LADR is a system that will allow accredited contributors, as defined in Section 6, to submit position information of an aircraft in distress or potentially in distress. The system will store information (i.e. data that meets the input format guidelines) and provide filters allowing users to access information based on their profile.

3.0.2   The available filters will be presented as flags to be selected in the user profile.

3.0.3   The system will allow users, based on the selected flags, to be notified when submitted information is stored in the LADR.

4.0   LADR PERFORMANCE

4.0.1   The LADR will be subject to a quality/maintenance process that ensures that when data is submitted, it is accurately processed.

4.1   Database capacity

4.1.1   The repository should have sufficient capacity to accommodate all distress events and potential events where activation of the ADT occurs. In order to estimate storage requirements for the LADR, Table 1 provides an indication of the storage needed under the following scenario:
- i.   ADT message size of 200 bytes, uncompressed;
- ii.   LADR is receiving information at one-minute intervals from an aircraft through a LADR contributor; and
- iii. data is retained for the duration specified in the header.

Message size (bytes)	200			
No. Aircraft	**Minute (Kb)**	**Hour (Mb)**	**Day (Gb)**	**Month (Tb)**
1	2	0.12	0.003	0.0001
10	20	1.20	0.03	0.001
50	100	6.00	0.14	0.004
100	200	12.00	0.29	0.01
500	1,000	60.00	1.44	0.04
1000	2,000	120.00	2.88	0.09

Table 1

4.1.2   Although 1 minute reporting is defined as the *minimum* reporting rate and many systems may in practice use a higher rate, the figures in Table 1 also provide estimates for substantially higher numbers of aircraft in a distress condition than is considered likely. They can therefore be used to determine the maximum capacity needed regardless of transmission rate.

4.1.3   Using as a basis the ATS data retention requirements in Annex 10 — *Aeronautical Telecommunications*, the LADR will retain ADT data for a period of at least thirty days from its submission. When ADT data is pertinent to inquiries or investigations, it will be retained for longer periods until it is evident that it is no longer required. A mechanism would need to be included to permit such data to be identified and subsequently preserved.

4.1.4   If sufficient capacity is available consideration should be given to retention of all ADT data, as this will facilitate review and analysis of the performance of the system.

4.1.5   The intent is that the repository will be continuously available, within reasonable limits. Operation of the LADR will also be supported by adequate technical support to provide assistance and meet the requirements of the administrator role defined in section 6.1.

4.2   Maximum response time

4.2.1   The maximum response time for return of data requested by a user will not exceed thirty seconds.

4.3 Database security

4.3.1　　　The LADR will provide the appropriate level of security, and only allow approved contributors to submit information and approved users to access read-only information based on their profile. The security requirements will also keep contributor and user profiles secure.

4.3.2　　　Details of accreditation for approved users can be found in Section 6.

4.4 Denial of service protection

4.4.1　　　The repository will provide protection from malicious attempts to interfere with normal operation and authorized access (e.g. high volume repetitive access).

4.5 Virus protection

4.5.1　　　The repository will be designed to minimize the threat posed by computer viruses.

4.6 Password encryption

4.6.1　　　Password information received or transmitted by the repository over the Internet will be protected using standard Internet encryption technology.

4.7 Intrusion detection

4.7.1　　　The LADR will detect and report on intrusions. Intrusion attempts will be:

a) successfully detected;
b) reported in such a way that LADR operator personnel are immediately alerted; and
c) terminated whenever possible.

4.7.2　　　Reports on attempted intrusions will be generated and made available to the originators of the data stored in the LADR.

5.0

5.0.1　　　As described in above Section 1.1, the LADR is a means to make the last known position of an aircraft in distress available to relevant stakeholders in a timely manner applying a global standard. The required information, per Annex 6, Part I, is the latitude and longitude with a time stamp.

5.0.2　　　The provisions in Annex 6 specify that the position of an aircraft in a distress condition needs to be made available to ATSUs, RCCs and others as established by the State of the Operator (Stakeholders). The LADR needs to provide functionalities to make that information available to the appropriate Stakeholders. To allow for this functionality the LADR needs additional fields.

5.1 Required Data

5.1.1　　　Table 2 provides an overview of the minimum data set with information for each field with regards to the LADR functionality.

Field	Format	LADR Functionality	Example
Latitude	N/S DD° MM.M'	Establish domain by geo referencing	N45°30.1'N
Longitude	E/W DDD° MM.M'	Establish domain by geo referencing	W073°33.9'W
Date of Transmission	DD/MM/YYYY	Sequencing of messages and data retention	07/12/2017
Date of Receipt	DD/MM/YYYY	Sequencing of messages and data retention (for corrupted/incomplete data)	07/12/2017
Time of Transmission	HH:MM:SS	Sequencing of messages	10:25:45
Time of Receipt	HH:MM:SS	Sequencing of messages (for corrupted/incomplete data)	10:26:43
3LD	TTT	Establish State of the Operator domain	MXA
Aircraft Registration (with Nationality Mark)	TTTTTTT	Particular aircraft identification: (Completion of at least one field from the possible options to identify the aircraft is required)	XA-BJH
Aircraft 24-bit address	TTTTTT		AC82EC
Selcall	TTTTTT (TTTT)		ABCDEF (ABCD)
Flight callsign and flight #	TTTTTTT		Speedbird1234
ELT Hex ID	HHHHHHHHHHHHHHH		1234567890ABCDE
Contributor Code	NNN	Establish contributor domain for data validation.	001
Data Source	TBD	Enable identification of the source of data (Manufacturer, type of ADT)	TBD

Table 2

5.1.2   For aircraft identification data, where more than one identification means is supplied (24-bit address, 3LD and registration etc.) the LADR should have a means to provide positive disambiguation of events to ensure that multiple reports are not generated based on a single aircraft in distress.

5.2   Optional Data

5.2.1   An ADT system may be configured to provide additional data which could be of use to SAR or post flight location and recovery. The following fields should be available for use in the LADR but remain optional. Where used, the format of the data supplied must match the indicated format to ensure consistency and usability of the data.

Field	Format	LADR Functionality	Example
Altitude (ft)	NNNNN	Optional field – either Altitude in m or ft (Recommended)	35000
Altitude (m)	NNNNN		10000

Altitude source	XXXX	Required if *Altitude* data supplied	BARO GNSS
Indicated Airspeed (kt)	NNN	Optional field	350
Indicated Airspeed (km/h)	NNN	Optional field	550
Heading	DDD^o	Optional field	090
Tracking data from other sources	Free text	Optional field	4D/15 position report
Identification of other data source		Required field if *tracking data from other sources* is used	
ADT Cancellation message	TBD	Records cancellation signal from ADT (where provided) to distinguish between end transmission from end of flight	TBD
Validated distress event flag	True/False	Operator editable to indicate their process has determined the aircraft is in a genuine distress state	

5.3   SWIM compliance for information exchanges

5.3.1   The LADR needs to accept and store LADR data and exchange it with users as a SWIM information service. In a SWIM environment, information services are the means through which organizations provide and consume information via "publish/subscribe" or "request/reply" messaging patterns. More information on SWIM can be found in ICAO Doc 10039.

5.4   LADR data source – reliability of data/source

5.4.1   The LADR will accept and store any data that is appropriately formatted in conformance with the specifications and will notify the relevant contributor for appropriate action when:

a) the message is not complete;

b) the LADR is incapable of processing all submitted data in the message; and

c) the LADR suspects duplication of submitted data or messages.

5.4.2   Transmissions which are incomplete or corrupted should be identified and a flag attached. This data should be retained in the LADR in a 'quarantined' area. Users viewing data transmitted from an ADT should be made aware that 'quarantined' data exists which is associated with this ADT data, and should be able to view such data to determine if there is anything which may be useable in the corrupted or incomplete submission.

5.4.3   The LADR will flag suspected duplication of submitted data, as "possible duplicate data" when stored.

5.4.4   Contributors and users will be aware that incomplete messages may hinder the LADR notification functionality.

5.4.5   Contributors will be responsible for the data they submit to the LADR. They will need to have policy and procedures in place to verify the integrity of submitted data and to take action, as appropriate, when receiving a message from LADR regarding a message or data submitted.

5.4.6   Initial verification will be done as art of the accreditation process (see Section 6). Changes to the ADT system subsequently will need to be validated to ensure that they still meet the requirements of the LADR.

5.4.7   The LADR will have a development area so that LADR submitting tests can be run without interfering with the LADR functionality.

5.4.8   The development area is intended to be used by developmental submitters (see 6.2.2) to become accredited for LADR access, and for changes to existing ADT systems by accredited users.

5.5   LADR access restrictions

5.5.1   The data will be physically stored at least at two geographically independent sites to provide redundancy in case of natural disasters or other factors adversely impacting the operational readiness.

5.5.2   Access to the repository will be provided through a dedicated user interface and granted to authorized individuals only. Sufficiently safe and secure access control mechanisms will be put in place to prevent unauthorized access.

5.6 Export of Data

5.6.1   The data held in the LADR should be able to be exported such that it could be integrated with local systems.

6.0   LADR STAKEHOLDERS

6.0.1   There will be three main categories of LADR stakeholders:
   i.   LADR administrator;
  ii.   contributors (data providers to LADR);
                a)   to include *developmental submitters, see 6.2.2*; and
 iii.   LADR data users.

6.0.2   An individual entity may fit into one or more of the above stakeholders (e.g. an airline may be a contributor and also a LADR data user).

6.1   LADR administrator

6.1.1   The LADR administrator will be ICAO. Effective daily activities for accreditation, monitoring, maintenance and any other working aspects may be delegated to an

organization authorized by ICAO which will "host" all above activities on the organization's behalf.

6.1.2　　　　The LADR administrator, or delegated responsible organization, will be contactable 24/7 and be required to address issues related to availability of the repository and access by accredited users.　Actual response times for issues and database unavailability will need to be defined in a service level agreement with the delegated responsible organization, once this has been decided.

6.1.3　　　　The LADR administrator will establish criteria to approve contributors and determine the information available to each user profile.

6.1.4　　　　The repository should allow for feedback of issues experienced to be sent to the administrator for review and action.

6.2　　　　LADR contributors

6.2.1　　　　Criteria for becoming a LADR contributor

6.2.1.1　　　　Contributors for LADR will be those organizations which:

a)　have ADT solutions which have been approved for use by a Contracting State;

b)　are able to provide data to the LADR in accordance with the requirements defined by the LADR administrator; and

c)　have been properly accredited.

6.2.1.2　　　　Potential contributors will be designated as *developmental submitters* until they can demonstrate that appropriate quality systems ensure verification of accuracy and integrity of provided data.

6.2.1.3　　　　Contributors will need to have policies and procedures to ensure that the data they submit is received and processed by the LADR. These include appropriate actions when notification of a "rejected", "incomplete" or "duplicate" message is received from the LADR. The policies and procedures will also include periodic verification that submitted information is being processed correctly by the LADR.

6.2.2　　　　Contributor accreditation

6.2.2.1　　　　　A LADR contributor will need to provide evidence that it supports an ADT system approved by a Contracting State and that it meets the LADR requirements. The accreditation process may follow the following sequence of events:

a)　a Member State informs ICAO that it is in the approval process of an ADT system and wishes that the LADR establishes the organization as a developmental submitter;

b)　the LADR administrator provides all necessary documentation to fully specify the required data, formats and procedures for ADT data submissions;

c) the LADR administrator runs a verification test to ensure that the contributor, in developmental submitter mode, meets the LADR requirements for data submissions;

d) once the verification tests are successfully completed, the LADR administrator will set the system up to allow the contributor to submit data and monitor data submissions; and

e) once all requirements are met to the satisfaction of the LADR administrator, it informs the respective Member State of the suitability of the ADT system. The LADR administrator will also issue an accreditation to the ADT provider as a contributor.

6.2.2.2   Contributors will automatically have User Status.

6.2.3   Contributor ongoing accreditation

6.2.3.1   Initial accreditation is granted based on meeting the requirements of the LADR and successful testing and verification. Subsequent changes to an ADT system that impact the connection to the LADR would need to be documented and submitted for re-accreditation, demonstrating the results of testing that has been conducted to ensure ongoing compatibility.

6.3   LADR data users

6.3.1   Criteria for becoming a LADR user

6.3.1.1   Users are individuals that are associated with a LADR accredited entity. All user access to the LADR will be read-only. User access and available information will be subject to the entity type profile (see Table 3) and the privileges granted by the particular accredited entity.

6.3.1.2   For the purpose of the LADR, all boundaries used for geo-referencing will have an 80 NM buffer to define the particular area. For example, the area for an FIR or a State will be considered from 80 NM outside of the published boundary.

Entity (user) type profile	Domain of data available to users
Air Operator	All ADT data for aircraft, identified by the operators three letter designator
Air navigation services provider (ANSP)	All ADT data for aircraft within the flight information region (FIR) managed by the ANSP. Additionally any event that starts, is active or terminates within the FIR should be fully visible to the ANSP responsible for the FIR (including the data points that are outside of the FIR)

RCC	All ADT data in the LADR
Others, as established by the State of the Operator	Partial or all ADT data for aircraft associated with air operators of the particular State of the Operator
Contributor	All ADT data submitted by the particular contributor

Table 3

6.3.1.2   An accredited entity will have one or more Super Users and as many users as deemed appropriate. Super Users will manage their own users and will be able to establish criteria, within the domain of the entity type profile, and options that their users can flag to get notifications (see section 7).

6.3.1.3   An accredited entity will need to have at least one Super User that will act as the focal point for the LADR administrator.

6.3.1.4   Users will be approved and registered in the LADR by the Super User. Users will be able to see the ADT data based on the corresponding entity type profile.

6.3.1.5   When submitted data is stored in the LADR, the data will be subject to the filters established by user flags to be acted upon by the LADR accordingly.

6.3.1.6   The LADR will have the functionality to issue a notification to the user when ADT data that meets a user's criteria, as defined with flags in the user's profile, is stored in the LADR. This notification should be triggered on the first entry from an activated ADT and should not subsequently send notifications for each position report received from the device. The functionality is optional and a user may choose to either receive or not receive such notifications.

6.3.1.7   The LADR will have the following options for the delivery of flagged notifications to users:

- email

- SMS

- Automated SWIM notification (to be defined)

6.3.1.8   There is no requirement at this moment for a push-pull message exchange pattern for LADR notifications (i.e. "pushing data"). However, based on comments from the ATS community, there may be a requirement in this regard in the near future.

6.3.2   User (entity) accreditation

6.3.2.1   ICAO will accredit entities that will, in turn, accredit users. When an entity seeks ICAO accreditation to access the LADR, it will need to nominate at least one Super User that will serve as the LADR focal point.

6.3.2.2   The table 4 below contains the entities that are eligible for accreditation by the LADR administrator and the eligibility requirements for each entity.

Entity	Requirement
Air Operator	• Be listed in ICAO Doc 8585 - *Designators for Aircraft Operating*

	Agencies, Aeronautical Authorities and Services • Maintain updated agency (operator) operational control contact information with ICAO
ANSP	• Manage at least one ATSU • Have ATSUs listed in ICAO Doc 7910 - *Location Indicators* • Maintain updated ATSU operational control contact information with ICAO
RCC	• Be listed in the Cospas-Sarsat RCC database • Maintain updated RCC operational control contact information with ICAO
Others, as determined by the State of the Operator	• The State of the Operator will coordinate with the Air Operator. • Other users within the Air Operator will be managed by a single focal point within the Air Operator. • Additional users which the State of the Operator requires to have access will need to be specifically identified by the State of the Operator

Table 4

6.3.2.3   An entity, which meets the requirements in Table 4, seeking ICAO LADR accreditation, will need to submit an official request to the LADR administrator. The request will indicate the contact details of the Super User (focal point) and as applicable, assurance that the relevant ICAO operational contact database is up to date.

6.3.2.4   An entity and all users associated with that entity will retain accreditation for as long as the eligibility requirements in Table 4 remain valid.

7.0   NOTIFICATIONS

7.1   Notification Options

7.1.1   Notification options will be limited depending on the type of user account, according to the following table:

User Account Type	Notification options
Air Operator	Limited to operators aircraft
Air Navigation Service Provider	Events which start are active or terminate within the FIR managed by the ANSP *Note – Data for an event which originated outside of the FIR but terminated within the FIR will still be accessible, according to 6.3.1.1*
RCC	No limitation

7.1.2   Notifications are optional and a user may decide not to receive them.

7.1.3   Additional options related to notifications should also include:

7.1.3.1 Receive all notifications allowed but exclude individual aircraft (to allow fro intermittent /recurrent fault)

7.1.3.2 Option to block some/all notifications for a given time (e.g. block notifications from an individual aircraft for 10 minutes)

7.2   Sending of Notification

7.2.1   Notifications should only be sent once for an event. Successive transmissions at one minute intervals do not generate additional notifications.

7.2.2   In the event that a transmission stops, and subsequently re-starts, this should be considered as a separate event and a new notification sent.

7.2.3   There should be a clear means to determine which stakeholders associated with an event have opted to receive notifications. This will allow other parties to know whether or not they are likely to be informed about the distress condition of the aircraft.