



Designation: F3623 – 23

Standard Specification for Surveillance Supplementary Data Service Providers¹

This standard is issued under the fixed designation F3623; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification defines minimum performance requirements for Surveillance supplemental data service providers (SDSPs) and associated equipment and services. This specification also defines requirements on users of the Surveillance SDSP's services. Surveillance SDSPs may provide aircraft track information to Detect and Avoid (DAA) systems and situational awareness tools to enable beyond visual line of sight (BVLOS) UAS operations and support VLOS operations.

1.2 The expected operating environment is low- to medium-risk airspace (equivalent to Joint Authorities for Rulemaking of Unmanned Systems Specific Operations Risk Assessment (JARUS SORA) ARC-b and ARC-c airspace, respectively). It is generally intended to cover operations below 10 000 ft AGL, and specifically operations below 1200 ft AGL.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Relationships Between Standards

2.1 This specification is one of several developed within ASTM International that, when taken together, endeavor to provide a robust and scalable set of DAA solutions to enable BVLOS operations for UAS. Therefore, the reader is also encouraged to consider Specification for Detect and Avoid System Performance Requirements (F3442/F3442M), Specification for Remote ID and Tracking (F3411), and Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability (F3548). There are several ways that these standards may be used collectively.

2.2 Specification F3442/F3442M specifies high-level risk ratios that the overall system must achieve. Many components and factors go into determining and verifying a given risk ratio. These include elements such as the vehicle's speed and maneuverability; the level of human interaction required to respond to an alert; the quality, accuracy, latency and completeness of traffic surveillance information; and the performance, availability and latency of command and control (C2) links. The applicant seeking approval (which could be an operator, integrator, service provider or manufacturer) should be able to verify that the required risk ratios can be achieved. Each element to be used in an integrated DAA solution is expected to provide documentation such that risk ratios may be determined.

2.3 The latencies between the sensors and Surveillance SDSPs are important variables to be included in any risk ratio calculations.

2.4 A successfully implemented Surveillance SDSP may use this specification to define its operational requirements to verify that it is fulfilling the detect function, whether partially or fully, in a way that meets the DAA performance requirements of Specification F3442/F3442M. The Surveillance SDSP alone cannot demonstrate whether the risk ratios are achieved, since this depends on many factors controlled by each operator's integration with the SDSP, and each operator's avoidance concept.

2.4.1 The Surveillance SDSP entity writes a test plan, taking into account its system and limitations/assumptions associated with its expected users (for example, types of vehicles and on-board/ground-based DAA systems).

2.4.2 The Surveillance SDSP entity conducts a series of tests (for example, live flights, simulated encounter datasets, or a combination), documenting each test (for example, through test cards) as well as its results (for example, through collection and analysis of data).

2.4.3 The Surveillance SDSP entity uses the results of its tests as part of its documentation to users and competent authorities, demonstrating that its capabilities are as described.

2.4.4 The Surveillance SDSP entity will also conduct an interference test to determine the level at which interference adversely affects the required accuracy of the surveillance systems and set an alert level in the surveillance monitoring system to notify the pilot of degraded DAA performance.

¹ This specification is under the jurisdiction of ASTM Committee F38 on Unmanned Aircraft Systems and is the direct responsibility of Subcommittee F38.01 on Airworthiness.

Current edition approved Nov. 1, 2023. Published December 2023. DOI: 10.1520/F3623-23.

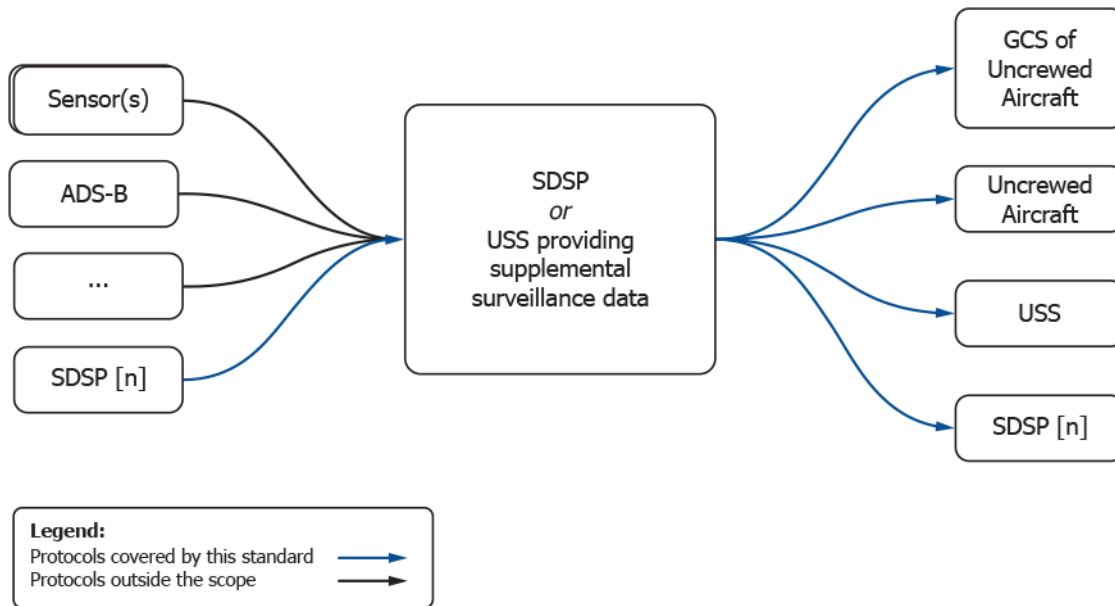


FIG. 1 Scope of Standard and Flow of Data

3. Referenced Documents

3.1 When this specification references external standards, documents or studies, the latest revision applies unless otherwise stated herein. Standards referenced should not be considered normative unless explicitly stated.

3.2 ASTM Standards:²

F3060 Terminology for Aircraft

F3341/F3341M Terminology for Unmanned Aircraft Systems

F3411 Specification for Remote ID and Tracking

F3442/F3442M Specification for Detect and Avoid System Performance Requirements

F3548 Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability

3.3 JARUS Documents:³

JARUS Specific Operations Risk Assessment Package, V2.0, 30 January, 2019. <http://jarus-rpas.org/content/jar-doc-06-sora-package>

3.4 EUROCAE Documents:⁴

EUROCAE Safety and Performance Requirements Standards for a Generic Surveillance System, GEN-SUR SPR (ED-261), Draft Volumes 1 and 2, 2020

3.5 EUROCONTROL Standards:⁵

EUROCONTROL Specification for ATM Surveillance System Performance (ESASSP) Edition 1.2, Volumes 1 and 2, 20 April 2021

3.6 RTCA Standards:⁶

RTCA SC-228 DO-381A Ground-based surveillance system MOPS

3.7 FAA Standards:⁷

FAA Unmanned Aircraft System (UAS) Traffic Management (UTM) Concept of Operations, Version 2.0, 2020

FAA RMA-HDBK-006C V1.1 Reliability, Maintainability, and Availability (RMA) Handbook, Version 3.1, 2015

3.8 ITU Standards:⁸

ITU-R Report M.2204 Characteristics and Spectrum Considerations for Sense and Avoid Systems use on Unmanned Aircraft Systems (UAS), November 2010

3.9 EASA Documents:⁹

Easy Access Rules for Standardised European Rules of the Air (SERA) February 2023

4. Terminology

4.1 *Use of Shall, Should, and May*—The use of shall indicates a requirement, should indicates a recommendation, and may is used to indicate that something is permitted.

4.2 *Unique and Common Terminology*—Terminology used in multiple standards is defined in F3341/F3341M, Terminology for Unmanned Aircraft Systems and F3060, Terminology for Aircraft. Terminology that is unique to this specification is defined in this section.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Joint Authorities for Rulemaking on Unmanned Systems (JARUS), <http://jarus-rpas.org/>.

⁴ Available from EUROCAE, 9-23 rue Paul Lafargue, "Le Triangle" building, 93200 Saint-Denis, France, <https://www.eurocae.net/>.

⁵ Available from EUROCONTROL, Rue de la Fusée 96, 1130 Brussels, Belgium, <https://www.eurocontrol.int/>.

⁶ Available from Radio Technical Committee for Aeronautics (RTCA), 1150 18th NW, Suite 910, Washington, D.C., 20036, <https://www.rtca.org/>.

⁷ Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, <http://www.faa.gov>.

⁸ Available from the International Telecommunication Union (ITU), International Telecommunication Union, Place des Nations, 1211 Geneva 20, Switzerland, <https://www.itu.int/en/Pages/default.aspx>.

⁹ Available from European Union Aviation Safety Agency (EASA), Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, <https://www.easa.europa.eu/>.

4.3 This specification uses terminology contained within Specifications **F3442/F3442M** and **F3548**. These terms are not duplicated within this document.

4.3.1 The following terms, among others, are defined in Specification **F3442/F3442M**: detect and avoid (DAA); NMAC risk ratio (RR) measurement; operational volume (OV); loss of well clear risk ratio (LR) measurement; mid-air collision (MAC); near mid-air collision (NMAC) function; remain well clear (RWC) function; and well-clear (WC) boundary.

4.3.2 The following terms, among others, are defined in Specification **F3548**: operational intent, UAS service supplier (USS), UAS traffic management (UTM) and USS service.

4.4 The following terms, among others, are defined in RTCA DO-381A: declaration volume (DV); and surveillance volume (SV).

4.5 Abbreviations and Acronyms:

4.5.1 *ADS-B*—automatic dependent surveillance – broadcast

4.5.2 *AGL*—above ground level

4.5.3 *AMSL*—above mean sea level

4.5.4 *ATC*—air traffic control

4.5.5 *BVLOS*—beyond visual line of sight

4.5.6 *DAA*—detect and avoid

4.5.7 *EPU*—estimated position uncertainty

4.5.8 *LIDAR*—light detection and ranging

4.5.9 *MOR*—mandatory occurrence report

4.5.10 *MTBF*—mean time between failures

4.5.11 *MTTR*—mean time to recovery

4.5.12 *RMS*—root mean square

4.5.13 *SLA*—service level agreement

4.5.14 *SDSP*—supplemental data service provider

4.5.15 *UA*—unmanned aircraft

4.5.16 *UAS*—unmanned aircraft system

4.5.17 *USS*—UAS service supplier

4.5.18 *UTM*—UAS traffic management

4.5.19 *VLOS*—visual line of sight

5. Service-Level Agreement (SLA)

5.1 Surveillance SDSP Responsibilities:

5.1.1 The Surveillance SDSP shall have a service-level agreement (SLA) or other form of agreement in place with each end user that explains, among other things, how this specification is implemented. An optional outline of relevant SLA provisions can be found in **Appendix X1**. The SLA shall, at a minimum, include the following:

5.1.1.1 A statement declaring the Surveillance SDSP's adherence to applicable provisions of this specification,

5.1.1.2 A summary of the Surveillance SDSP's performance and quality metrics as defined in Section 7, Performance Requirements,

5.1.1.3 A description of how the Surveillance SDSP's surveillance volume is calculated or measured, or both,

5.1.1.4 Applicable limitations or restrictions on aircraft classes and data usage,

5.1.1.5 An indication as to whether the Surveillance SDSP supports Class 1 DAA systems, Class 2 DAA systems per Specification **F3442/F3442M**, or situational awareness systems.

5.1.1.6 The required notification time prior to scheduled service changes (14 days unless stated otherwise),

5.1.1.7 Post-processing applied to the raw data feed (for example, extrapolation, interpolation, fusion, correlation, validation), and

5.1.1.8 Any additional services provided.

5.1.2 The Surveillance SDSP may also include the following in the SLA:

5.1.2.1 An overview and definition of its system and processes, and

5.1.2.2 Information pertaining to the commercial agreement with its End User (for example, penalties for service failures, rules on sharing/reselling of data).

5.1.3 The Surveillance SDSP shall provide timely and accurate updates about its coverage and performance, especially when its service is degraded or otherwise nonconformant to the SLA. The Surveillance SDSP shall notify Users of unplanned service degradation or non-conformance with the SLA as soon as practicable but no later than within 24 hours of discovery unless stated otherwise. The Surveillance SDSP shall routinely confirm that its current status meets or exceeds the minimum performance agreed upon in the SLA.

5.1.4 The Surveillance SDSP shall define and calculate surveillance and declaration volumes.

5.1.5 The Surveillance SDSP shall provide the altitude of tracks with its reference (above mean sea level (AMSL), above ground level (AGL), uncorrected barometric pressure altitude, or GPS altitude) when capable of reporting altitude.

5.1.6 The Surveillance SDSP should convert between altitude reference frame values.

5.2 The User's Responsibilities:

5.2.1 The User shall identify the system performance needed to support their operations and safety requirements. The User shall determine whether the data characteristics (for example, quality, reliability, availability, coverage area) provided by the Surveillance SDSP and detailed in the SLA are sufficient.

5.2.2 The User shall define their operational volume and verify that the associated volume(s) is (are) appropriately encapsulated by the Surveillance SDSP surveillance and declaration volumes.

5.2.3 The User shall determine the appropriate contingency action upon notification of degradation or failure of the Surveillance SDSP's service(s).

5.2.4 The User shall comply with training and system limitations documentation provided by the Surveillance SDSP. The User should distribute this documentation to personnel or participants, or both, in a manner consistent with their safety and operational requirements.

5.2.5 The User shall make any necessary conversions of reference frames to support their safety and operational requirements.

5.2.6 The User may limit the ingested surveillance volume to a predetermined area.

5.2.7 The User shall verify that the information received from the Surveillance SDSP supports the system-level risk ratios for a given set of operations.

5.2.8 While the User is ultimately responsible for the above items, they may delegate the underlying/implied tasks described above to another entity, including the Surveillance SDSP.

6. Roles and Functions of the Surveillance SDSP

6.1 The Surveillance SDSP uses input data from one or more sensors or other surveillance SDSPs. Sensors can be provisioned by any combination of public or private entities, as allowed by applicable regulation. There are many possible types of sensors, but they generally fall into three types:

6.1.1 Independent or primary, which detects aircraft with no assistance from the aircraft (for example, primary radar, LIDAR, optical, acoustic);

6.1.2 Cooperative or secondary, which detects aircraft with assistance from the aircraft (for example, secondary radar, Transponder Modes A, C, or S); or

6.1.3 Dependent, is a passive sensor that depends on the aircraft to provide location and identification information (for example, ADS-B, FLARM, passive multilateration).

6.2 The Surveillance SDSP may provide validated track data to its users, meaning that the position of a given track is known with a degree of certainty to represent an actual aircraft at that location. This can be achieved by comparing two or more sources.

6.3 Surveillance is an important input to a number of other functions outside of a UTM setting. For example, it can support DAA safety functions, which can be used in a variety of ways by the operator/UAS itself or by an intermediate service.

6.3.1 From a system-level view, the Surveillance SDSP and its underlying sensors contribute to the target NMAC risk ratio (RR) and loss of well clear risk ratio (LR) for a given operation. Calculating whether a given surveillance configuration satisfies the operation's requirements must be done by the operator or its USS, or another entity that has access to detailed information about the operator's and vehicle's contribution to the risk ratios. The quantitative performance requirements for a given intruder's equipage can be found in Specification [F3442/F3442M](#).

7. Performance Requirements

7.1 Users of the Surveillance SDSP data feed will require varying data quality and performance depending on their intended operation. This section provides the minimum required data metrics and values. This section also specifies how those metrics and values should be measured wherever necessary. These metrics and values may be improved upon in the SLA.

7.2 The Surveillance SDSP shall update all track data sent to users at the rate specified in the SLA. The rate shall be at least once every 4 seconds. This rate is considered one update cycle. If the sensor measurement rate is less frequent than the specified update rate, extrapolation may be used to achieve the

specified update rate. A track is considered coasted (and shall be tagged as such) if none of the sensors detected the track in its respective last update cycles.

NOTE 1—This value is used for ATC for 3NM separation and is considered the minimum acceptable threshold.

7.3 The Surveillance SDSP shall send heartbeat messages to all users at the rate specified in the SLA. This rate shall not be less frequent than twice the update rate (for example, for an update rate of 4 seconds, the heartbeat rate shall not be less frequent than 8 seconds).

7.4 The Surveillance SDSP shall measure the probability of track updates. This is to ensure that tracks are updated statistically consistently and that misses (no update) are not concentrated in time and on any particular track. This shall be done using the methodology¹⁰ described in [7.5](#).

7.5 After each track update, the next update is expected within a specified measurement interval (typically 5 s for ATC 4 s update rate). A gap is the time between the end of the measurement interval and the next track update.

7.5.1 Probability of update is calculated by:

$$1 - \frac{\text{total duration of all gaps}}{\text{total duration of all tracks}}$$

NOTE 2—One duration is the first time a sensor captures a track to the last time a sensor captures a track. The total duration of all tracks is the summation of all track durations for each 24 hour operational period.

7.5.2 Probability of update shall be greater than 97 %¹¹ for each 24-hour operational period.

7.5.3 Long gaps (larger than 3 times the measurement interval + 10 %) shall be less than 0.5 %¹² for each 24-hour operational period.

7.6 The accuracy of a track is a function of the underlying sensors detecting the object and the methods, if any, used for tracking. The Surveillance SDSP's track accuracy shall be specified in the SLA, in accordance with the limits set in this specification.

7.7 The actual track trajectory can be reconstructed and the received track data can be measured against the reconstructed trajectory. The difference between the reconstructed trajectory and the received track data should be measured at the time of update. An RMS (root mean square) average of this distance is measured for each track across all track updates. Actual track trajectory can be reconstructed using a variety of methods. This is typically based on adjacent air traffic and mathematical reconstruction over the entire life of the track.

7.8 The horizontal accuracy class shall be stated¹³ by keeping into account the 95 % of horizontal accuracy bound and the following EPU (estimated position uncertainty) categories:

EPU ≥ 926 m (0.5 NM)

EPU < 926 m (0.5 NM)

EPU < 555.6 m (0.3 NM)

¹⁰ This methodology is derived from ESASSP Ed. 1.2.

¹¹ R2 of ESASSP Ed. 1.2.

¹² R3 of ESASSP Ed. 1.2.

¹³ Appendix 1 to AMC1 SERA.6005(c).

EPU < 185.2 m (0.1 NM)
 EPU < 92.6 m (0.05 NM)
 EPU < 30 m
 EPU < 10 m
 EPU < 3 m

7.9 Vertical accuracy follows the same determination method as horizontal accuracy. Vertical accuracy requirements are only applicable for systems that are capable of reporting altitude. The Surveillance SDSP shall provide the reference frame for the reported altitude.

7.10 The vertical accuracy shall be stated according to the following categories¹³ by keeping into account 95 % geometric altitude accuracy:

Unknown or > 150 m
 ≤ 150 m
 ≤ 45 m
 ≤ 15 m

7.11 Latency is the measure of time delay. Several latencies are relevant to the use of surveillance data. Latency is expressed in the time delay from the time of applicability to the sensor; from the sensor to the Surveillance SDSP; in the internal processing time of the Surveillance SDSP itself; and from the Surveillance SDSP to the user (including network latencies). See [Appendix X2](#) for Surveillance SDSP system latency design considerations.

7.12 The Surveillance SDSP shall define its nominal and maximum latencies in milliseconds from the time of applicability to the Surveillance SDSP's dissemination endpoint. The Surveillance SDSP shall indicate nominal latency in its heartbeat messages, including alerts if latencies exceed those specified by SLA.

7.13 The Surveillance SDSP may report which functions its latency includes (DF, A1F, A2F) as per Specification [F3442/F3442M](#).

7.14 The User shall monitor the network and latency between the Surveillance SDSP and the user and shall respond to diminished network and latency performance in a manner consistent with their safety management system and standard operating procedures, if defined. This can be achieved by measuring the delay between timestamped messages and their reception time at the user's.

7.15 For Surveillance SDSPs where track capacity is a limiting operational factor, the Surveillance SDSP shall report the maximum number of tracks the system is capable of handling to its users.

7.16 When information about the type of object being tracked is provided by the sensor, that information shall be provided by the Surveillance SDSP to its users. The Surveillance SDSP may report false tracks delineated by classification in addition to the requirements outlined in [7.20](#).

NOTE 3—This information can be presented in various ways. It may be an indication of type of aircraft, or that an object is a UA or birds. It may also be one or more expressions of the certainty that a given object fits one or more classification categories. This behavior is set by the sensor provider.

7.17 If the Surveillance SDSP provides extrapolation as a service, it shall offer all track data within a given surveillance volume at the current time or with a difference between timestamps of no more than 200 ms. The user shall have access to the non-extrapolated track feed should their use case require it. The age of the last measured information, compared to the timestamp of the message, shall be provided.

7.18 A coasted track shall be terminated after no more than 16 seconds. The number of track updates associated with a coasted track shall be specified in the SLA and may vary depending on aircraft classification. The Surveillance SDSP shall identify coasted tracks in the track message.

7.19 The termination of a track shall be explicitly stated. Information about the reason for termination may also be provided, if available (for example, ADS-B equipped aircraft landed, operation finished for a UAS, track obscured by a physical obstacle). The user of the Surveillance SDSP data may choose to keep dropped tracks displayed if beneficial to their situational awareness.

7.20 False tracks are non-real tracks within a declaration volume. False tracks do not correspond to an aircraft or to its actual position. If the Surveillance SDSP is capable of identifying false tracks for a specific surveillance volume, it shall report the false track at the time of discovery. The Surveillance SDSP shall report false track statistics for a given surveillance volume that persists for more than three update cycles (for example, as a percentage of total encounters or as the number of alerts per hour) alongside the date on which the statistic was gathered.

7.21 For the purposes of setting limits on instances of dropped tracks and false tracks, the Surveillance SDSP shall indicate geographic areas that constitute a single declaration volume, regardless of the number and types of sensors that lie within that region. A single declaration volume should not be smaller than the declaration volume of a single sensor. For a network of sensors, the declaration volume shall not be smaller than the contiguous declaration volume of the network. The Surveillance SDSP may change, add, remove, enlarge or shrink its surveillance volumes but shall provide prior notification of those changes to its users. Adherence to chart revision cycles or similar intervals is encouraged but ultimately is at the discretion of the competent authority.

7.22 Because the Surveillance SDSP is an important component in helping the UAS operator or USS ensure that the UA does not collide with manned air traffic, it is expected to meet high availability metrics, as defined in this section. The differentiator between Class 1 and Class 2 Surveillance SDSPs is in the achievement of these metrics, which necessarily influences overall robustness. The Surveillance SDSP shall meet the requirements in [Table 1](#) for MTTR (mean time to recovery), automatic recovery time, and MTBF (mean time between failures). The Surveillance SDSP is expected to employ automatic recovery, but there may be instances of unsatisfactory operation of the automatic recovery mechanism where human intervention may be required. To allow for that, two MTBF intervals are specified.