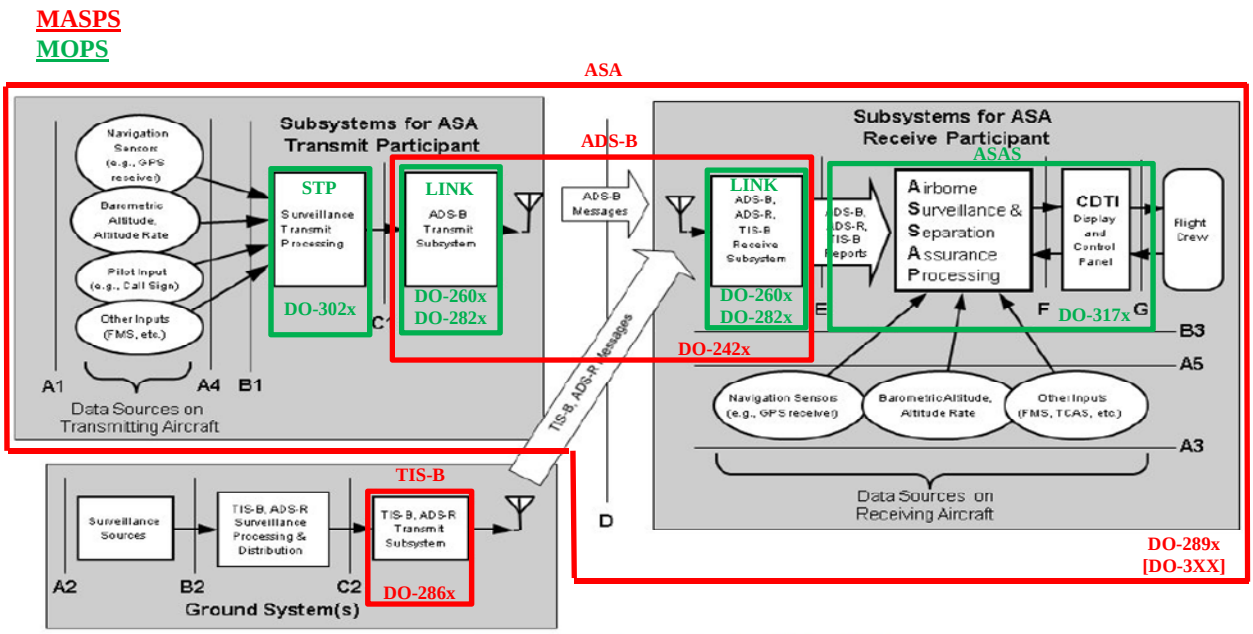
DO-3xx ASSAP Requirements Working Paper [3-23-2011]

UPDATE

The existing document boundaries indicate that there should not be any requirements in DO-242a that propagate to the ASAS MOPS. This is consistent with the initial review of the requirements from DO-242a. Based on this understanding, DO-242a is no longer included in the ASSAP traceability matrix.

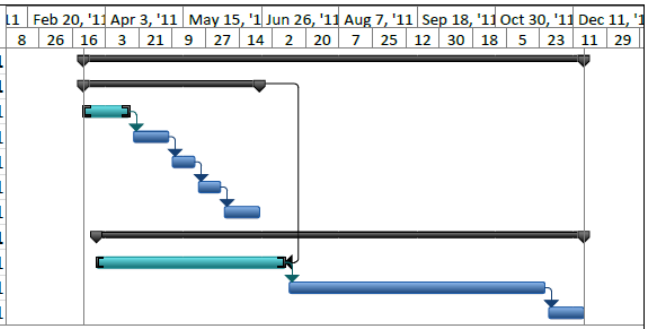
MASPS & MOPS BOUDARIES



TIMELINE

The following timeline reflects the current plan to proceed with the ASSAP requirements section of DO-3xx MASPS. The initial work will be to create the traceability matrix and MASPS sections that are consistent with the current version of DO-289 and DO-317 Draft Version 2.00.

ID	Task Name	Finish
1	**DO-3xx ASSAP Requirements**	**Fri 12/16/11**
2	**Traceability Matrix**	**Fri 6/24/11**
3	Current Document Traceability	Fri 4/15/11
4	Identify and Address Orphans and Inconsistencies	Fri 5/6/11
5	ASSAP / CDTI Review & Reconciliation	Fri 5/20/11
6	WG-4 Review	Fri 6/3/11
7	Next Applications (IM, TSAA, ?)	Fri 6/24/11
8	**DO-3xx ASSAP Documentation**	**Fri 12/16/11**
9	First Draft ASSAP Text	Fri 7/8/11
10	Ongoing WG-6 Review and Update	Fri 11/25/11
11	Final Text	Fri 12/16/11



3.2.1.2 ASSAP [extracted from DO-289 2.3.1.4]

The ASSAP subsystem represents the surveillance and application-specific processing functions of ASA. ASSAP surveillance processing consists of correlation, possible data fusion, and track processing of ADS-B, TIS-B, and TCAS traffic reports. ASSAP application processing provides the application-specific processing for all ASA applications. The extent of ASSAP application processing is dependent upon the aircraft's ASA capabilities, as determined by the ASA Capability Level (ACL) (refer to §2.2.3 for a definition and description of ACLs). ASSAP application processing may be minimal for situational awareness applications (e.g., Enhanced Aid to Visual Acquisition, denoted as a Basic ACL), or may require more significant processing, such as providing speed guidance for ASIA applications, or alerting processing for applications such as ACM or ICSPA. The ASSAP subsystem also monitors and processes flight crew inputs via the interface from the CDTI subsystem, and provides all traffic surveillance data and ASA application-specific data for visual and /or aural display to the CDTI for the flight crew.

The CDTI provides the two-way interface between the flight crew and ASA. The flight crew can select and control the various ASA applications via the CDTI, while the CDTI provides the aural and visual ASA-specific display information to the flight crew.

3.2.1.2.1 ASSAP /CDTI System Boundaries [extracted from DO-289 2.3.5]

Figure 2-4 is based on Figure 2-1, but the dashed line has been changed to represent the system boundaries for the Airborne Surveillance and Separation Assurance Processing (ASSAP) and Cockpit Display of Traffic Information (CDTI) subsystems. The allocated requirements for ASSAP and the CDTI are found in §3.3.2 and §3.3.3, respectively.

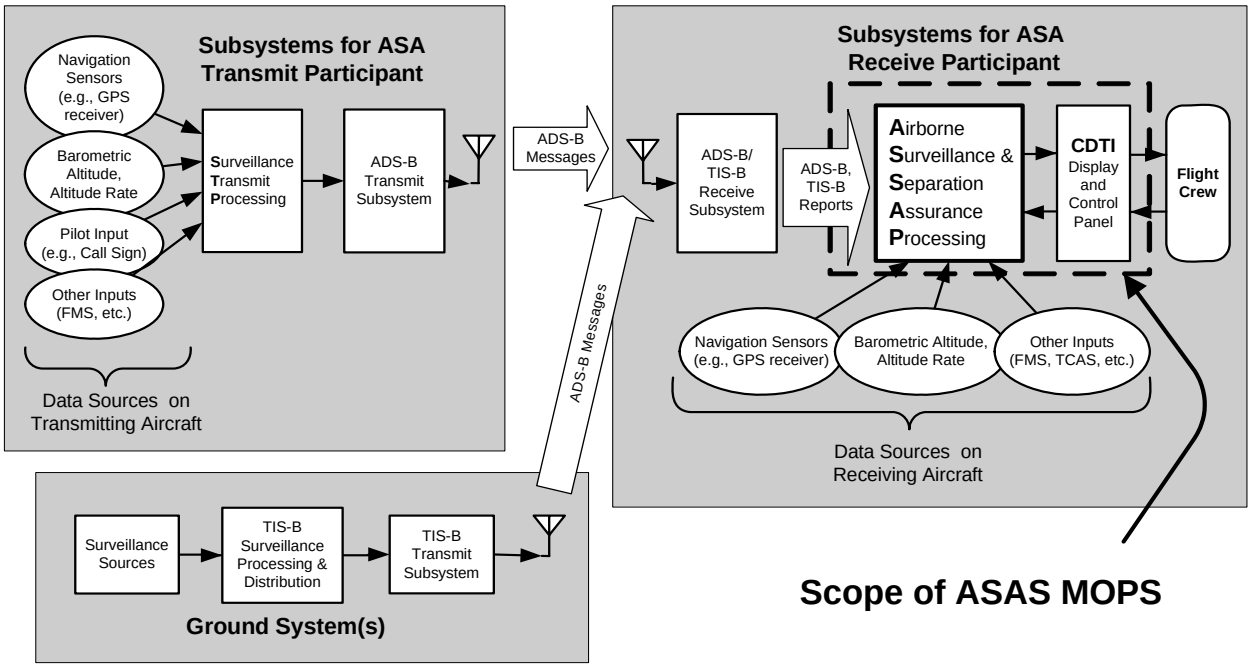


Figure 2-4: Scope of ASAS MOPS

Note for Figure 2-4: *Detailed ASSAP and CDTI performance and subsystem requirements are expected to be addressed in a future standards document, i.e., the ASAS MOPS.*

ASSAP receives surveillance inputs from the ADS-B / TIS-B Receive Subsystem in the form of ADS-B and TIS-B reports. The ASSAP subsystem is integral to ASA application processing, providing surveillance processing on all available surveillance reports, and providing the application-specific processing associated with all ASA applications.

While ASSAP provides all application-specific processing for ASA, it also maintains the interfaces to and from the CDTI Display and Control Panel subsystem. It is due to the close association of the ASSAP and the CDTI and their shared interface, that it was decided to develop a future ASSAP and CDTI MOPS as a single requirements document. The two sub-systems ASSAP and CDTI constitute the "Airborne Separation Assistance System" (ASAS) [ASAS Circular]. The future MOPS for ASSAP and CDTI is to be termed the "ASAS MOPS."

As shown in Figure 2-4, the CDTI subsystem also serves as the ASA interface to the flight crew.

3.2.1.2.2 Requirements for ASSAP [extracted from DO-289 2.4.3.4]

The two major functions of ASSAP are *surveillance processing* and *applications processing.* Requirements for ASSAP are described in §3.3.2.

Surveillance processing:

- Establishes tracks from ADS-B and TIS-B traffic reports
- Cross-references traffic from different surveillance sources (ADS-B, TIS-B, and TCAS)
- Estimates track state (e.g., position, velocity), and track quality
- Deletes tracks that are beyond the maximum allowable coast time for any ASA applications

Applications processing:

- Determines the appropriateness of track information for various applications, and forwards the track data to the CDTI
- Performs alerting functions (e.g., CD, ACM, and ICSPA)
- May derive guidance information for various future applications, e.g., ASIA.

ASSAP is supported by navigation information from own-ship. Each ASA participant **should** input to ASSAP the highest quality state data that is available on-board; this information **should** be the same as that used for ADS-B transmission. See §2.4.2 for guidance on highest quality source selection. ASSAP **shall** (289R2.27) assess the ability of own-ship and traffic targets to support the active applications or applications within an active ACL; this is to be done by ASSAP assessing own-ship performance and transmitted data quality as specified in Table 2-4 and by assessing received traffic-ship data quality as specified in Table 2-1.

3.4.2 Airborne Surveillance and Separation Assurance Processing (ASSAP) Requirements [extracted from DO-289 3.3.2]

ASSAP is the surveillance and separation assurance processing component of ASA. ASSAP processes incoming data from other aircraft/vehicles and derives information for display on the CDTI, as well as alerting and guidance information that will also be displayed. Flight crew command and control inputs that affect application functions are also processed by ASSAP. ASSAP consists of three sub-functions, as illustrated in Figure 3-5:

1. A surveillance processing sub-function that integrates surveillance data from multiple sources, establishes tracks, and determines the surveillance quality of traffic.
2. A function to process coupled applications – deriving specific alert and guidance information to provide to the flight crews.
3. A function to process background applications, deriving required alerts and guidance for conflict detection and airborne conflict management.

Figure 3-6 illustrates the data flow and report structure from the ADS-B receiver to ASSAP and to the CDTI. The discussion in this section will include details on the reports illustrated in the figure and the associated processing.

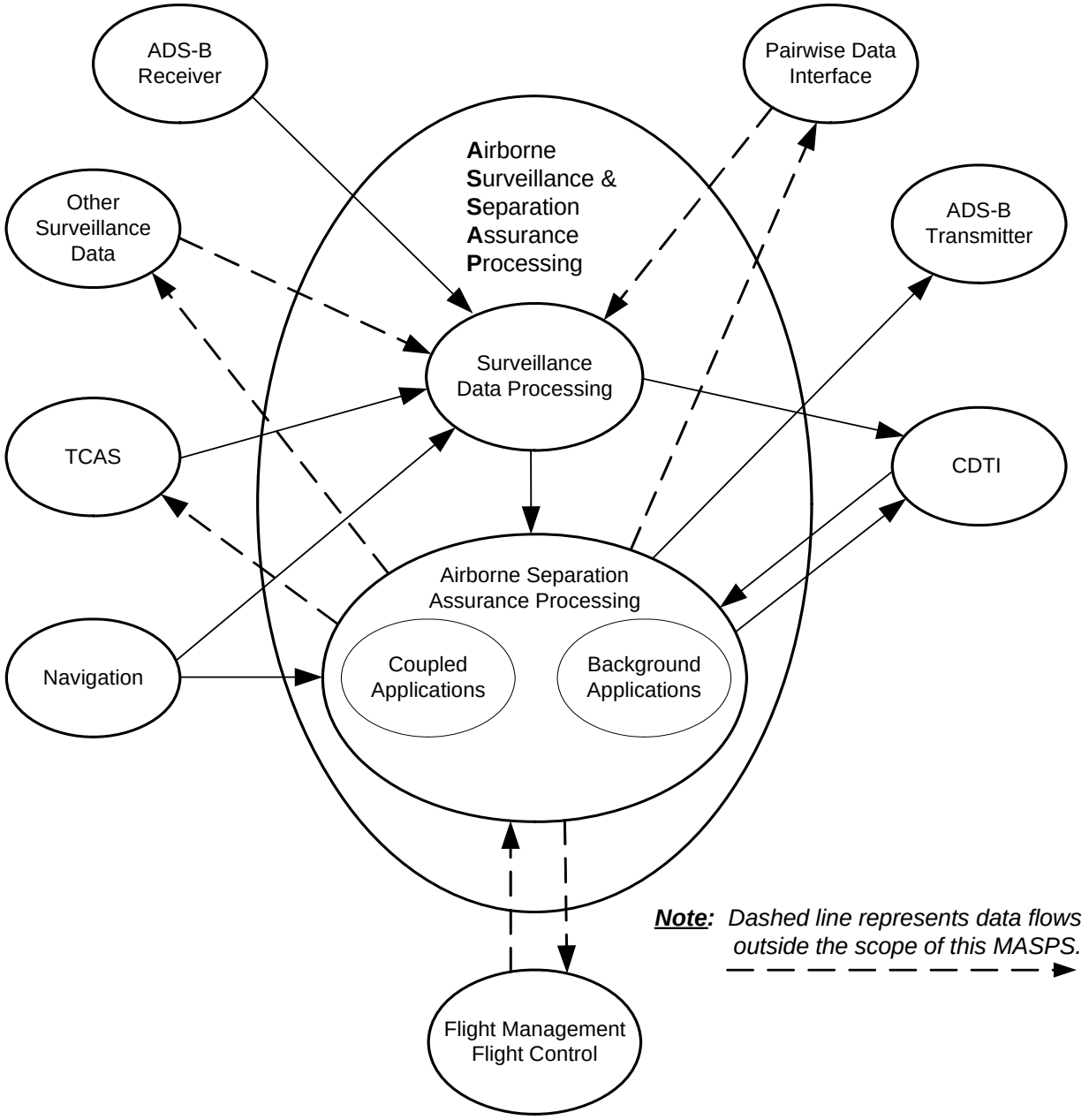


Figure 3-5: ASSAP Components

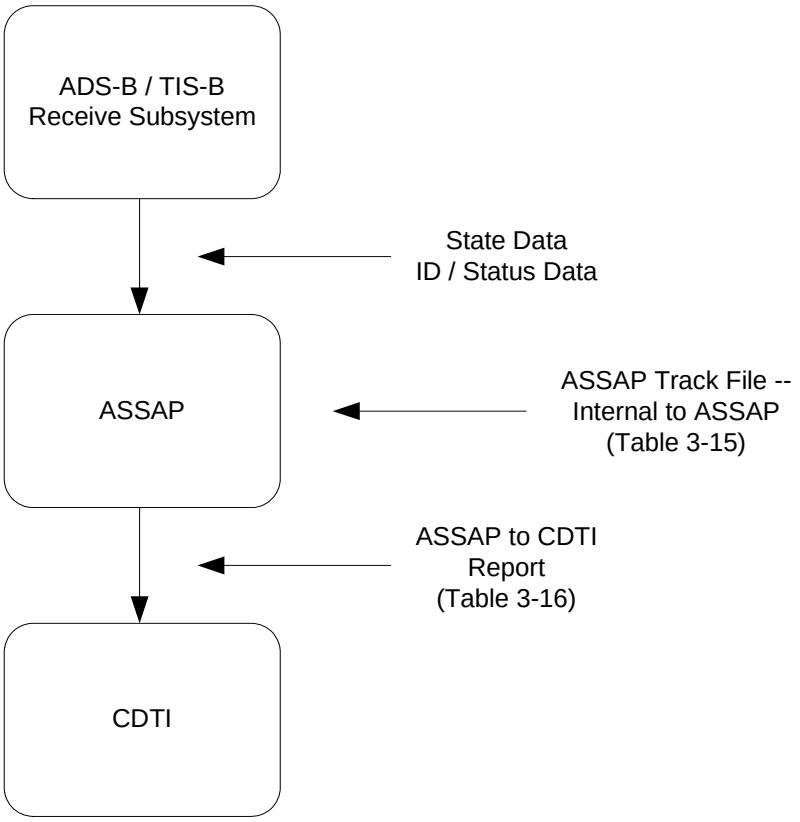


Figure 3-6: ASA: Receive Subsystem Data Flow and Report Structure

3.4.2.1 ASSAP Functional Requirements

ASSAP functional requirements are broken into surveillance processing requirements (§3.3.2.1.1) and applications processing requirements (§3.3.2.1.2).

3.4.2.1.1 ASSAP Surveillance Processing Requirements

The ASSAP surveillance processing as described below is required for all ASA Capability Levels. (See §3.3.2.1.1.1 for definitions of terms.)

ASSAP surveillance processing function receives information for traffic A/V's from various surveillance sources, correlates the data, registers the data, and outputs a track file consisting of state and other information about each A/V under track. Requirements for the surveillance sub-function follow. Note that the tracking and correlation functions make extensive use of the data that is provided in state data (Table 3-18).

1. ASSAP **shall** (289R3.169) provide a tracking function. The tracking function:
    a. **Shall** (289R3.170) maintain, for each A/V under track, a file that contains, at a minimum, the elements listed in Table 3-4.
    b. **Shall** (289R3.171) determine all fields in Table 3-4 that are not directly provided in measurements. The *last measurement* data fields indicated in Table 3-4 are intended to include variables that were obtained with the last valid measurement received for the track.

c. **Shall** (289R3.172) include a correlation function that associates traffic data from different surveillance sources that relate to the same aircraft/vehicle track, i.e., the correlation function is required to associate and cross-reference traffic data from ADS-B traffic, TIS-B traffic, and TCAS traffic. The correlation function **shall** (289R3.173) update traffic cross references when new information is available from the ADS-B/TIS-B receive subsystem or TCAS.

d. **Should** include a registration bias estimation function that estimates systematic biases between surveillance sources (e.g., ADS-B, TIS-B) providing reports on each A/V.

e. **Should** include a registration correction function that registers measurements (including time, position, and velocity) from different surveillance sources.

Note: *Registration bias estimation and correction are needed to align position information from different sensors. These sensors may have systematic biases that could cause data from multiple sources to be misaligned. Since position data from multiple sensors is to be used in common automation algorithms and common displays, an alignment, or registration function, is necessary. Registration estimation and correction functions are likely to be required in the ASAS MOPS.*

f. **Shall** (289R3.174) include an estimation function that estimates track state based on one or more surveillance source inputs. Track state includes time of the state estimate, horizontal position, horizontal velocity, altitude, altitude rate, heading (if possible), and track quality, including accuracy, integrity containment boundary, and integrity containment risk (see §2.4.5.3).

The estimation function may combine information from different data sources in order to improve the track state estimate. ASSAP surveillance processing **shall** (289R3.175) optimize the quality of the information best suited to the applications being run (e.g., accuracy, integrity containment bound, or integrity containment risk). ASSAP may enhance the quality of the track information, using techniques such as Kalman filters. ASSAP **shall** (289R3.176) estimate the quality of the track state information that is maintained in the track file, and maintain quality measures for the track state information, as indicated in Table 3-15.

Note: *The fusion of TCAS measurements with ADS-B or other data is the subject of continuing debate and will be treated in the ASAS MOPS.*

g. **Shall** (289R3.177) initiate a track for each observed A/V when sufficient measurement information is received to form a minimum track state. Required minimum measurement elements are noted in Table 3-15.

h. **Shall** (289R3.178) terminate a track when the maximum coast interval (Table 2-3, row 17) has been exceeded for all of the applications for which the track is potentially being used.

2. Correlation of TCAS data: If TCAS data is to be integrated on the CDTI, ASSAP **shall** (289R3.179) correlate the TCAS tracks with its internal tracks to the extent practicable. For correlated TCAS tracks, ASSAP **shall** (289R3.180) recognize if a track has an active TCAS resolution advisory or traffic advisory, and **shall** (289R3.181) provide that information in the track file (see Table 3-4). The probability of mismatching TCAS/ADS-B tracks, or not matching TCAS/ADS-B tracks, **should** be minimized (the criterion for minimizing **shall** (289R3.182) be defined in the ASAS MOPS).

   Note: *The processing of multiple targets for the same A/V is treated in the tracking section item 1f above.*

3. TIS-B / ADS-B correlation: while it is normally expected that TIS-B and ADS-B information (on a given link) will be mutually exclusive, the possibility exists that an ASA participant will receive TIS-B and ADS-B information on the same aircraft. Therefore, ASSAP surveillance processing **shall** (289R3.183) cross-correlate the traffic from TIS-B and ADS-B reports supplied by the ADS-B receiver. The correlation should make use of all available data that can assist in this process from state data and other information. The probability of mismatching TIS-B/ADS-B tracks, or not matching TIS-B/ADS-B tracks, **should** be minimized (the criterion for minimizing **shall** (289R3.184) be defined in the ASAS MOPS).

   Notes:

   1. *The processing of multiple targets for the same A/V is treated in the tracking section item 1f above.*

   2. *TIS-B may transmit all known surface traffic in part or all of an airport movement area in order to enhance coverage.*

4. ADS-B / ADS-B correlation: if the aircraft ADS-B installation includes multiple ADS-B links, ASSAP surveillance processing **shall** (289R3.185) correlate (cross-reference) traffic from the different links and associate the traffic with the appropriate ASSAP track.

5. The ASSAP **shall** (289R3.185-A) assess the TQL and ACL from all A/Vs to determine the ability of those A/Vs' equipment and broadcast data to support the installed applications. Table 3-14 indicates the required TQL to support the applications in each ACL.

6. ASSAP **shall** (289R3.186) provide current traffic state position information to the interface with the CDTI with at least a 1 Hz rate.

Table 3-14: Minimum TQLs Required to Support ACLs

Transmit Quality Level	ASA Capability Level
1	Basic + CD, ASSA, FAROA
2	Intermediate
3	Advanced 1, 2
4 - 7	reserved

Note for Table 3-14:

Some applications require actual NIC/NAC performance that exceeds the minimum required for the stated TQL. Coupled applications will also require a sufficient ACL.

Table 3-15: Elements of the ASSAP Track File for an Individual Track

Category	Content	Minimum Track Measurement Elements (§3.3.2.1.1 g)	Measured Data	ASSAP Derived Data	Reference Section
ID	Participant (A/V) Address	•	•		§3.1.5.12.1
	Address Qualifier		•		§3.1.5.12.2
	Call Sign / Flight ID		•		§3.1.5.11
Last Measurement Data	Time of Applicability -- Measurement	•	•		§3.1.5.1
	Horizontal Position	•	•		§3.1.5.3
	Geometric Altitude	•	•		§3.1.5.6.1
	Geometric Altitude Valid	•	•		§3.1.5.6.1
	Pressure Altitude	•	•		§3.1.5.6.2
	Horizontal Velocity	•	•[1]		§3.1.5.4
	Vertical Rate (Baro/Geo)	•	•		§3.1.5.7
	Vertical Rate Type (Baro / Geo)	•	•		§3.1.5.7
	Directionality of Surface Participants		•		§3.1.5.8
	Validity of Surface Participant Directionality		•		N/A
Last Measurement Data Quality	Horizontal Integrity Containment Bound	•	•		§2.4.5.3.2.1
	Horizontal Integrity Containment Risk	•	•		§2.4.5.3.2.2
	95% Horizontal Position Accuracy	•	•		§2.4.5.3.1
	95% Horizontal Velocity Accuracy	•	•		§2.4.5.3.1
	95% Vertical Position Accuracy				§2.4.5.3.1
	95% Vertical Velocity Accuracy				§2.4.5.3.1
	Geometric Altitude Containment Bound	•	•		§2.4.5.3.2.1
	Geometric Altitude Containment Risk		•		§2.4.5.3.2.2
	Barometric Altitude Quality (BAQ)	•	•		§3.1.5.18
	Barometric Altitude Integrity Level	•	•		§3.1.5.19
State Vector Estimate (§3.3.2.1.1)	Time of SV Estimate			•	N/A
	Horizontal Position			•	§3.1.5.3
	Geometric Altitude			•	§3.1.5.6.1
	Geometric Altitude Valid			•	§3.1.5.6.1
	Pressure Altitude			•	§3.1.5.6.2
	Horizontal Velocity			•	§3.1.5.4
	Vertical Rate (Baro/Geo)			•	§3.1.5.7
	Vertical Rate Type (Baro / Geo)			•	§3.1.5.7

Table 3-15: Elements of the ASSAP Track File for an individual track (continued)

Category	Content	Minimum Track Measurement Elements (§3.3.2.1.1 g)	Measured Data	ASSAP Derived Data	Reference Section
State Vector Estimate Quality (§3.3.2.1.1)	Horizontal Integrity Containment Bound			•	§2.4.5.3.2.1
	Horizontal Integrity Containment Risk			•	§2.4.5.3.2.2
	Horizontal Position Accuracy			•	§2.4.5.3.1
	Horizontal Velocity Accuracy			•	§2.4.5.3.1
	Vertical Position Accuracy				§2.4.5.3.1
	Vertical Velocity Accuracy				§2.4.5.3.1
	Geometric Altitude Containment Bound			•	§2.4.5.3.2.1
	Geometric Altitude Containment Risk			•	§2.4.5.3.2.2
	Barometric Altitude Quality (BAQ)			•	§3.1.5.18
	Barometric Altitude Integrity			•	§3.1.5.19
Other	Emitter Category		•[2]		§3.1.5.13
	A/V Length and Width Codes		•[2]		§3.1.5.14
	Emergency / Priority Status		•[2]		§3.1.5.25
	ASA Capability Level (ACL)	•	•[2]	•[2]	§2.2.3
TCAS [note 3]	ADS-B / TCAS / TIS-B Correlation Status			•	§3.3.2.1.1.1
	TCAS Traffic Status				§3.3.2.1.1.1

• = Required

Notes for Table 3-15:

1. *On the surface, heading and ground speed must be converted to Cartesian coordinates*
2. *If available.*
3. *The TCAS elements of the track file are only required when the CDTI is also the TCAS Traffic Display (see §2.3.7).*

3.4.2.1.1.1 Definitions

This section contains definitions of terms used above.

ADS-B / TCAS / TIS-B Correlation Status: This field indicates whether the track is being surveilled by ADS-B, TCAS, TIS-B, or a combination thereof.

Correlation: The process of determining that a new measurement belongs to an existing track.

Covariance: A two dimensional symmetric matrix representing the uncertainty in a track's state. The diagonal entries represent the variance of each state; the off-diagonal terms represent the covariances of the track state.

Estimation: The process of determining a track's state based on new measurement information

Extrapolation**:** The process of moving a track's state forward in time based on the track's last estimated kinematic state.

Registration: The process of aligning measurements from different sensors by removing systematic biases.

Time of SV estimate: The time at which the track state estimate is made.

TCAS Traffic status: The status of the TCAS track, if applicable, from the TCAS system. The four states are: Resolution Advisory (RA), Traffic Advisory (TA), proximate, and other.

Track: A sequence of time-tagged measurements and state information relating to a particular aircraft or vehicle.

Track State: The basic kinematic variables that define the state of the aircraft or vehicle of a track, e.g., position, velocity, acceleration.

3.4.2.1.2 ASSAP Applications Processing Requirements

ASSAP **shall** (289R3.187) make *ASSAP track reports* available to the CDTI for all active applications. ASSAP **shall** (289R3.188) deliver track reports to the CDTI for all aircraft of sufficient quality for at least enhanced visual acquisition, extrapolated to a common time that is within 1 second of the time the data is delivered to the CDTI, with at least a 1 Hz rate. In the case where there is no valid velocity data, ASSAP **should** derive velocity from successive position measurements. In this case, ASSAP **shall** (289R3.189) estimate the velocity accuracy, and use the estimated value to determine traffic qualification as appropriate as indicated by Table 2-3.

Note: *Precise conditions under which airborne and surface traffic is to be displayed and filtered is to be developed in the ASAS MOPS. See §3.3.3 for filtering requirements on the CDTI.*

ASSAP track reports elements are listed above in Table 3-15.

Table 3-16: ASSAP to CDTI Report Elements

Category	Contents	Reference Section	Notes
ID	Call Sign / Flight ID	§3.1.5.11	
State Vector Estimate	Time of SV Estimate	§3.3.2.1.1 (bullet 1f)	
	Horizontal Position Relative to Own-ship	This section	
	Geometric Altitude	§3.1.5.6.1	
	Pressure Altitude	§3.1.5.6.2	
	North Velocity	§3.1.5.4	
	East Velocity	§3.1.5.4	
	Vertical Rate (Baro/Geo)	§3.1.5.7	
	Vertical Rate Type (Baro / Geo)	§3.1.5.7	
	Barometric Altitude Integrity	§3.1.5.19	
Other	Selected Target Closure Rate	This section	
	Degraded Data	This section	
Alerts	CAZ Alert [note 1]	§3.3.3.3.2.1, Appendix D, H	
	CDZ Alert [note1]	§3.3.3.3.2.1, Appendix D, H	
Status	Emitter Category	§3.1.5.13	
	A/V Length and Width Codes	§3.1.5.14	
	Emergency / Priority Status	§3.1.5.26	
	Supported Applications	This section	
TCAS [note 2]	Correlated ADS-B / TCAS Target	§3.3.2.1.1	
	TCAS Target Status	§3.3.2.1.1	
Guidance (Examples for Advanced 1 and 2 ACLs)	Break-out	This section	Advanced 2 (ICSPA)
	Recommended speed	This Section	Advanced 2 (ASIA)
	Conflict Resolution Advisory	This Section	Advanced 1 (ACM)

Notes for Table 3-16:

1. *CAZ and CDZ alerts are only required when implementing the CD or ACM applications.*
2. *The TCAS elements of the ASSAP to CDTI report are only required when the CDTI is also the TCAS Traffic Display (see §2.3.7).*

Horizontal Position Relative to Own-ship

The horizontal position of the target track relative to own-ship **shall** (289R3.190) be computed by applying the appropriate coordinate transformations between the track's latitude and longitude and own-ship's latitude and longitude and the display coordinates.

Supported Application

Supported application **shall** (289R3.191) indicate the ASA Capability Level of the target track, and **shall** (289R3.192) indicate any optional applications that are being processed for the track (i.e., CD, ASSA, FAROA).

Degraded Data

The degraded data field **shall** (289R3.193) indicate if the data is considered to be degraded for an active application.

Selected Target Closure Rate

The selected target closure rate **shall** (289R3.194) indicate the radial line of sight closure rate between own-ship and the selected target.

Break Out

The break out command is issued by ICSPA when a blundering intruder poses a threat to own-ship.

Recommended speed

The recommended speed is issued by ASIA to provide a recommended speed to the flight crew during an ASIA based final approach.

Conflict Resolution Advisory

A conflict resolution advisory gives guidance to the flight crew as to a maneuver that will resolve an impending conflict.

Note: *The three elements described above are for future applications, are for illustrative purposes, and are not requirements for this version of this MASPS.*

3.4.2.1.2.1 Basic and Intermediate ASA

Application Eligibility:

- ASSAP track quality (§3.3.2.1.1) **shall** (289R3.195) be compared with acceptable values for basic and intermediate applications, as per Table 2-3.

Note that if the track is being surveilled by multiple sources, the determination of acceptability for applications **should** be based on the track quality as derived by ASSAP, rather than on quality of any individual source. If the sole surveillance source of information is ADS-B or TIS-B, the track quality assessment **shall** (289R3.196) be based on the transmit quality level (TQL) transmitted by the source and, for TQL > 1, the NIC, NAC_P, NAC_V, and SIL requirements specified in Table 2-3.

The ASSAP track report **shall** (289R3.197) be updated to reflect any degraded condition for EVAcq or ASSA/FAROA, as appropriate, as per Table 2-3. The ASSAP track report **shall** (289R3.198) indicate if the track's quality is insufficient for a basic application.

If the installed system has the option for conflict detection (CD), ASSAP **shall** (289R3.199) determine if each track is eligible for CD processing, as per Table 2-3. Each track that is eligible for CD **shall** (289R3.200) be processed by the CD alerting function, and CAZ alerts or CDZ alerts **shall** (289R3.201) be issued as appropriate. ASSAP **shall** (289R3.202) include in the ASSAP track report the status of the CAZ alert and the CDZ alert.

Processing of selected surveillance ID/status elements:

Surveillance status contains information that is of use to various applications, and contains data that must be reported on the CDTI. Required processing of certain elements of surveillance status are indicated below:

a. The ASA MASPS version number (§3.1.5.24) **shall** (289R3.203) be used to coordinate applications processing appropriately for the version combination on own-ship and the target ship.

b. Call Sign / Flight ID **shall** (289R3.204) be included in the ASSAP track file (Table 3-15) and **shall** (289R3.205) be provided to the CDTI in the ASSAP/CDTI report (Table 3-16).

c. ASA Category **shall** (289R3.206) be forwarded to the CDTI.

d. A/V length and width codes **shall** (289R3.207) be forwarded to the CDTI.

e. Emergency / priority status **shall** (289R3.208) be forwarded to the CDTI.

f. ASSAP **shall** (289R3.209) convert heading from true or magnetic heading to the appropriate orientation for consistent display on the CDTI.

3.4.2.1.2.2 Advanced ASA 1

ASSAP **will** process the ACM application based on future algorithms to be determined. ASSAP **will** issue appropriate advisory information to the CDTI. ASSAP will take into account any TCAS resolution advisories issued by the target ship or own-ship; own-ship TCAS resolution advisories **will** take precedence over ASA advisories. Target-ship TCAS resolution advisories **will** limit any ASA resolution advisories to horizontal maneuvers.

3.4.2.1.2.3 Advanced ASA 2

ASSAP **will** process the ASIA and ICSPA applications based on future algorithms to be determined. For the ASIA application, ASSAP **will** derive speed guidance. For the ICSPA application, ASSAP **will** provide path and break-out alerts as required. See the appropriate application appendix for more information on these applications.

3.4.2.2 ASSAP Performance Requirements

General requirements for ASSAP are as follows:

Latency for the combination of ASSAP and the CDTI (interface E to interface G in Figure 2-7) **shall** (289R3.210) be less than 400 ms for targets that are used by coupled applications, targets against which there is an alert, and the 10 highest priority targets. For all other targets, data latency **shall** (289R3.211) be less than 1 second.

Note: *The prioritization of targets is application-specific and is to be specified in the ASAS MOPS. The specific allocation of latency to ASSAP and CDTI is also to be specified in the MOPS, including bus latencies.*

ASSAP **shall** (289R3.212) achieve the subsystem integrity risk and continuity risk requirements listed in Table 3-17.

Table 3-17: ASSAP Availability, Continuity, and Integrity Requirements (Failure rate per flight hour)

	ASA Capability Level			
Feature	**Basic**	**Intermediate**	**Advanced 1**	**Advanced 2**
Subsystem Continuity Risk	10^{-3}	10^{-3}	10^{-4}	10^{-4}
Subsystem Integrity Risk	10^{-3}	10^{-3}	10^{-5}	10^{-5}

3.4.2.3 ASSAP Interface Requirements

ASSAP provides the central processing for ASA and interfaces with many other avionics subsystems. Table 3-18 indicates the required data interfaces to ASSAP. All data indicated by a dot (•) **shall** (289R3.213) be provided to the ASSAP function, with the exception of those items labeled "future." All data in Table 3-18 indicated by the letter "d" are optional, desired interfaces.

Each data item listed in the Table is described in detail below.

Note: *Some of these data item names are re-used from earlier requirements tables; the definitions will not be repeated for items with identical names and definitions. Reference sections are provided for the applicable definitions in the table.*

Table 3-18: Interfaces to ASSAP

				ASA Capability Level					
Source	**Info Category**	**Information Element**	**Reference Section for Definition**	**Basic**	**Basic with CD option**	**Basic with ASSA & FAROA option**	**Intermediate**	**Advanced 1**	**Advanced 2**
ADS-B / TIS-B Receiver	**Aircraft State Data**	Time Of Applicability	§2.4.5.3.1	•	•	•	•	•	•
		Latency	§2.4.5.3.3.4	•	•	•	•	•	•
		Latitude (WGS-84)	§3.1.5.3	•	•	•	•	•	•
		Longitude (WGS-84)	§3.1.5.3	•	•	•	•	•	•
		Horizontal Position Valid	§3.1.5.3	•	•	•	•	•	•
		Geometric Altitude	§3.1.5.6.1	•	•	•	•	•	•
		Geometric Altitude Valid	§3.1.5.6.1	•	•	•	•	•	•
		Air / Ground State	§3.1.5.10			•		•	•
		North Velocity While Airborne	§3.1.5.4	•	•	•	•	•	•
		East Velocity While Airborne	§3.1.5.4	•	•	•	•	•	•
		Airborne Horizontal Velocity Valid	§3.1.5.4	•	•	•	•	•	•
		Ground Speed While on the Surface	§3.1.5.4			•		•	•
		Surface Ground Speed Valid	§3.1.5.4			•		•	•
		Heading While on the Surface (true / mag)	§3.1.5.8			•		•	•
		Heading Valid	§3.1.5.8.1			•		•	•
		Pressure Altitude	§3.1.5.6.2	•	•	•	•	•	•
		Pressure Altitude Valid	§3.1.5.6.2	•	•	•	•	•	•
		Vertical Rate	§3.1.5.7	•	•	•	•	•	•
		Vertical Rate Type (baro / geo)	§3.1.5.7	•	•	•	•	•	•
		Vertical Rate Valid	§3.1.5.7	•	•	•	•	•	•
		Navigation Integrity Category	§3.1.5.9	•	•	•	•	•	•
ADS-B / TIS-B Receiver (continued)	**ID / Status**	ADS-B Version Number	§3.1.5.24	•	•	•	•	•	•
		Participant Address	§3.1.5.12	•	•	•	•	•	•
		Address Qualifier	§3.1.5.12	•	•	•	•	•	•
		Call Sign / Flight ID	§3.1.5.11	d	d	d	d	•	d
		ASA Capability Level (ACL)	§3.1.5.23	•	•	•	•	•	•
		A/V Length and Width Codes	§3.1.5.14			•		•	•
		Emitter Category	§3.1.5.13	•	•	•	•	•	•
		Transmit Quality Level	§3.1.5.22	•	•	•	•	•	•
		TCAS Installed and Operational						•	•
		TCAS Target Status	§3.3.2.1.1					•	•
		Navigation Accuracy Category for Position (NAC_P)	§3.1.5.15	•	•	•	•	•	•
		Navigation Accuracy Category for Velocity (NAC_V)	§3.1.5.16	•	•	•	•	•	•
		Surveillance Integrity Level (SIL)	§3.1.5.17	•	•	•	•	•	•
		Barometric Altitude Quality (BAQ)	§3.1.5.18	•	•	•	•	•	•
		SIL_{BARO}	§3.1.5.19	•	•	•	•	•	•
		True/Magnetic Heading	§3.1.5.20			•		•	•

Table 3-18: Interfaces to ASSAP (continued)

Source	Info Category	Information Element	Reference Section for Definition	ASA Capability Level					
				Basic	Basic with CD option	Basic with ASSA & FAROA option	Intermediate	Advanced 1	Advanced 2
TCAS	TCAS related data [notes 1,7]	TCAS Target Status	§3.3.2.1.1	•	•	•	•	•	•
		Range [note 1]	§3.3.2.3.2.3	•	•	•	•	•	•
		Bearing [note 1]	§3.3.2.3.2.4	•	•	•	•	•	•
		Pressure Altitude [note 2]	§3.3.2.3.2.5	•	•	•	•	•	•
		TCAS Altitude Rate [note 3]	§3.3.2.3.2.6	•	•	•	•	•	•
		Mode S Address [notes 2, 5]	3.3.2.3.2.7	•	•	•	•	•	•
		TCAS Track ID [note 1]	§3.3.2.3.2.8	•	•	•	•	•	•
		TCAS Report Time	§3.3.2.3.2.9	•	•	•	•	•	•
Navigation	Own-ship state data	Time of Applicability	§3.1.5.1	•	•	•	•	•	•
		Horizontal Position	§3.1.5.3	•	•	•	•	•	•
		Horizontal Velocity	§3.1.5.4	•	•	•	•	•	•
		Geometric Altitude	§3.1.5.6.1	•	•	•	•	•	•
		Geometric Altitude Rate	§3.1.5.7	•	•	•	•	•	•
		Pressure Altitude	§3.1.5.6.2	•	•	•	•	•	•
		Pressure Altitude Rate [note 4]	§3.1.5.7	•	•	•	•	•	•
		Ground Speed (on surface)	§3.1.5.4			•		•	•
		Heading (on surface) [note 5]	§3.1.5.8			•		•	•
	Own-ship quality	Integrity Containment Region	§3.1.5.9	•	•	•	•	•	•
		Integrity Containment Risk	§3.1.5.17	•	•	•	•	•	•
		Position Accuracy	§3.1.5.15	•	•	•	•	•	•
		Velocity Accuracy	§3.1.5.16	•	•	•	•	•	•
CDTI	Flight Crew Inputs	Application Selection	§3.3.2.3.4.1	•	•	•	•	•	•
		Coupled Target	§3.3.2.3.4.2				•		•
		Selected Target	§3.3.2.3.4.3				•	•	•
		ANSD	§3.3.3.1.1.3.3		•			•	•
		Low Level Alert Selection	§3.3.3.1.1.3.4		•			•	•
		Future: Own-ship Planned Final Approach Speed	Appendix I						•
	Ownship ID	Own-ship Category	§3.3.3.1.4.3						•

• = Required; d = desired

Notes for Table 3-18:

1. *Required if TCAS is present in the configuration and an integrated TCAS/ASA traffic display is used. These outputs are expected to be supplied by current TCAS installation.*
2. *This information requires a change to the standard TCAS bus outputs defined in ARINC 735A that currently does not provide the Mode S address code, nor does it necessarily output pressure altitude.*
3. *For display of up/down arrow if there is no ADS-B track that correlates with the TCAS track.*
4. *If Available. If altitude rate is unavailable, altitude rate should be computed by ASSAP.*
5. *If available.*
6. *Range rate and range acceleration may be required in the future.*

Table 3-18: Interfaces to ASSAP (continued)

3.4.2.3.1 Interfaces to ASSAP from the ADS-B/TIS-B Receive Subsystem

The interface from the ADS-B/TIS-B receive subsystem provides information elements identified in Table 3-18.

3.4.2.3.1.1 Future: Special Data

Planned final approach speed will need to be communicated to ASSAP from both own-ship and the lead-ship if the ASIA application is implemented. Planned final approach speed is the speed input to the ASIA application for the lead ship and is an indicated airspeed.

3.4.2.3.2 Interfaces to ASSAP from TCAS

For initial ASA applications, TCAS data is needed specifically to support configurations with integrated ASA / TCAS traffic displays. For these configurations, the data items in the following subparagraphs **shall** (289R3.214) be provided to ASSAP for each TCAS track that is to be displayed. These items are required to allow the correlation of TCAS tracks with ASA tracks for traffic display integration. These items also allow the display of an indication of an active Resolution Advisory (RA), or Traffic Advisory (TA).

3.4.2.3.2.1 RA Active

The RA Active flag indicates that a TCAS Resolution Advisory is currently in progress for the track; ASSAP **shall** (289R3.215) accept an RA active flag from the TCAS equipment.

3.4.2.3.2.2 TA Active

The TA active flag indicates that a Traffic Advisory is currently in progress for the track; ASSAP **shall** (289R3.216) accept a TA active flag from the TCAS equipment.

3.4.3.2.3 Range

The range of the TCAS track from own-ship.

3.4.2.3.2.4 Bearing

The bearing of the TCAS track from own-ship relative to the ship's heading.

3.4.2.3.2.5 Altitude

The pressure altitude of the track as reported by TCAS.

3.4.2.3.2.6 Altitude Rate

The rate of change of altitude with respect to time.

3.4.2.3.2.7 TCAS Target Aircraft Address

The 24-bit aircraft address (i.e., Mode S address) for the TCAS track (if available to TCAS).

3.4.2.3.2.8 TCAS Track ID

The internal track ID of the TCAS track.

Note: *The scheme for identifying TCAS track ID is not standardized.*

3.4.2.3.2.9 TCAS Report Time

Table 3-18: Interfaces to ASSAP (continued)

The time of the TCAS report.

Note: *This time may be derived, rather than a specific parameter.*

3.4.2.3.3 Interfaces to ASSAP from Own-ship Navigation

3.4.2.3.3.1 Own-ship State Data

Own-ship state data is defined identically to that of the target ship state data, see Table 3-18 for appropriate reference sections.

3.4.2.3.3.2 Own-Ship Quality

Own-ship quality is very similar to target ship quality; however, as the information comes directly from the navigation system it is not yet categorized into NIC, NAC and SIL values.

An integrity containment radius for position and associated no-alarm probability are assumed to be available from the navigation system. A 95% accuracy bound on both position and velocity are also assumed to be available. ASSAP **shall** (289R3.217) provision for the acceptance of these parameters.

3.4.2.3.4 Flight Crew Inputs

A flight crew input may be required to display desired target parameters. For certain applications, the flight crew must select a specific target.

3.4.2.3.4.1 Application Selection

An application selection is the selection of a desired application that is to be run.

3.4.2.3.4.2 Coupled Target

A coupled target is a target upon which a coupled application is to be conducted.

3.4.2.3.4.3 Selected Target

A selected target is a target for which additional information is requested by the flight crew.

3.4.2.3.4.4 Alert Zone Selection

The alert zone specifies the horizontal and vertical criteria for a CD alert or ACM alert and resolution.

3.4.2.3.4.5 Future: Own-ship Planned Final Approach Speed

3.4.2.3.5 Future: Own-Ship ID

Own-ship ID includes own-ship category that is needed for supporting the ASIA application. Both own-ship and lead-ship categories are needed to determine wake vortex separation minimums.