

ASAS MOPS Appendix H: (Draft Revision)

H1.0 Introduction:

H1.1 Background:

The Ground system will provide a TIS-B/ADS-R Service Status message on the 1090ES and UAT links to indicate to clients whether they are receiving TIS-B and ADS-R services. The 1090ES and UAT approaches are similar.

H1.2 Operational Concept

The Service Status indication will be designed to indicate to the pilot when an incomplete traffic picture exists on the CDTI. A single "Traffic Incomplete" message will tell the pilot that TIS-B or ADS-R service has been lost. Optionally, the "Traffic Incomplete" message can also be implemented to indicate that an ADS-B target within a certain proximity has been removed from the CDTI, usually for insufficient data quality. The ground system will provide much of the Service Status functionality.

H2.0 Service Status Approach:

The TIS-B/ADS-R Service Status message can be an airborne TIS-B/ADS-R Service Status message or a surface TIS-B/ADS-R Service Status message.

H2.1 TIS-B/ADS-R Service Status Message (Airborne)

The ground system communicates airborne service status to individual aircraft by encoding the aircraft's 24-bit ICAO address onto the airborne service status message. Each address is preceded by an in-service or out-of-service qualifier. The in-service qualifier indicates that the 24-bit ICAO address is within TIS-B/ADS-R Service Status, the out-of-service qualifier is sent to indicate the aircraft has left the TIS-B or ADS-R service area.

When the aircraft is within the service area it will continuously receive TIS-B/ADS-R Service Status messages with their 24-bit ICAO address at a rate sufficient to ensure receipt at least every 20 seconds (95%).

When the aircraft leaves the service area it will receive the Service Status message with its 24-bit ICAO address and the out-of-service designator at a rate sufficient to ensure receipt within 20 seconds (95%). The out-of-service message does not continue after the initial 20 seconds. If an aircraft misses the out-of-service message it will rely on a timeout to determine loss of status.

Aircraft that have been receiving in-service Service Status messages that stop receiving in-service messages and do not receive an out-of-service message will timeout after 40 seconds and indicate a loss of TIS-B/ADS-R or "Traffic Incomplete."

Up to three 24-bit addresses can reside on each 1090ES airborne Service Status message. Over 100 addresses can reside on a UAT airborne Service Status message.

Table H1 provides more details of how to set airborne service status when the CDTI is running the EVAcq, CD, and EVApp applications.

Table H1: Airborne TIS-B/ADS-R Service Status

Airborne/ Surface Bit	Service Status Bit (In Svc/ Out of Svc)	TCAS on Ownship	Ownship 24-bit Address Present	Time since reception	ASSAP Indication to CDTI (note 3)
Airborne	In-Service	No	Yes	< 40 sec ≥ 40 sec	Traffic Complete Traffic Incomplete
Airborne	In-Service	No	No	Any	No Change
Airborne	Out-of- Service	No	Yes	Any	Traffic Incomplete ¹
Airborne	Out-of- Service	No	No	Any	No Change
Airborne	N/A	Yes ²	N/A	N/A	No Change

Note 1: Receipt of an out-of-service message supersedes the traffic complete message.

Note 2: Aircraft with an operational TCAS will not consider TIS-B/ADS-R Service Status

Note 3: The system default is “Traffic Incomplete”

H2.2 TIS-B/ADS-R Service Status Message (Surface)

A separate surface service status is required to support applications such as ASSA and FAROA.

The ground system communicates surface service status to all aircraft by encoding the airport’s three letter identifier onto the surface service status message. Each three letter identifier is preceded by an in-service or out-of-service qualifier. The in-service qualifier indicates that the airport has an operational surface service volume and the TIS-B and ADS-R services are operational. The out-of-service qualifier indicates that the airport’s surface service volume is not providing TIS-B or ADS-R services.

The ground system transmits the Surface Service Status message such that all aircraft within 20nm of the designated airport will receive the message within 20 seconds (95%).

Aircraft that have been receiving the in-service Surface Service Status messages that stop receiving the in-service message and do not receive an out-of-service message will indicate a loss of TIS-B/ADS-R service at the applicable airport within 40 seconds.

Up to four airport three-letter-identifiers can be encoded per 1090 message. Many more can be encoded on a UAT message. The reason the message supports multiple airports is for areas such as New York where JFK, EWR, and LGA could all have proximate surface service volumes.

Table H2 provides more details of how to set surface service status when the CDTI is running the ASSA/FAROA applications.

Table H2: Surface TIS-B/ADS-R Service Status

Airborne/ Surface Bit	Service Status Bit (In Svc/ Out of Svc)	TCAS on Ownship	Selected Airport 3-letter Identifier Present	Time since reception	ASSAP Indication to CDTI(note 3)
Surface	In-Service	N/A ²	Yes	< 40 sec ≥ 40 sec	Traffic Complete Traffic Incomplete
Surface	In-Service	N/A ²	No	Any	No Change
Surface	Out-of- Service	N/A ²	Yes	Any	Traffic Incomplete ¹
Surface	Out-of- Service	N/A ²	No	Any	No Change

Note 1: Receipt of an out-of-service message supersedes the traffic complete message.

Note 2: All aircraft, TCAS equipped and not equipped, must display surface service status

Note 3: The system default is “Traffic Incomplete”

H3.0 Previous UAT Approach:

Initial versions of the UAT ground system implementation provided a TIS-B service status that encoded the 24-bit ICAO address onto the service status message. The ground system service status indication is being changed to include Airborne and Surface service status messages, ADS-R as well as TIS-B coverage, adding an in-service/out-of-service designator to more quickly identify loss of service, and support for both UAT and 1090.

H4.0 General Issues:

H4.1 Boundary Awareness:

The ground system is going to attempt to design a system that provides awareness of the TIS-B/ADS-R service boundaries. This boundary awareness would allow aircraft to know that they are close to a TIS-B/ADS-R service boundary, and thus don't have a complete traffic picture. The ground system communicates boundary awareness by indicating loss of service when the boundary is exceeded.

Optimally the ground system will indicate loss of service when the client:

- Is within 15 nm laterally of the service boundary, all altitudes
- Descends within 500 feet of the service floor while under 3000 feet AGL
- Descends within 1500 feet of service floor while at or above 3000 feet AGL

H4.2 TCAS Equipped Aircraft:

ACAS equipped aircraft will display a target as a ACAS symbol even if ADS-B/ADS-R/TIS-B are unavailable, thus it is unnecessary and possibly misleading for an ACAS equipped aircraft to indicate that the traffic picture is incomplete. Thus, ACAS equipped aircraft 24-bit addresses will not be included on the 1090ES TIS-B/ADS-R airborne Service Status messages. All aircraft, regardless of ACAS equipage, will need to process the Surface Service Status message for ASSA/FAROA applications.

Airborne system ACAS Status requirements are unchanged from DO-185A.

H4.3 RF Mitigation:

ACAS equipped aircraft 24-bit ICAO addresses will not be encoded on TIS-B/ADS-R Service Status messages. Thus the only 1090ES aircraft that are enrolled are aircraft without ACAS. This should help reduce the number of TIS-B/ADS-R Service Status messages. Also, Aircraft will not receive targeted (24-bit ICAO address) on the surface at airports with an operational Surface Service Volume. They receive the Surface Service Volume Status message instead. Finally, update rates are limited. The ground system requirement is to deliver the message such that message receipt occurs in 20 seconds with a 95% probability. Additionally, the ground system is considering only sending TIS-B/ADS-R service status to aircraft that indicate they are capable of ADS-B In.

H4.4 Combined TIS-B/ADS-R Service Status:

The avionics will display a single "Traffic Incomplete" message regardless of whether TIS-B or ADS-R is unavailable, thus the ground system only needs to indicate one combined TIS-B/ADS-R Service Status message. If the client is outside either TIS-B or ADS-R the client is considered Out-of-Service.

H4.7 Nuisance Status Changes near boundaries

Aircraft flying near boundaries, such as near a vertical boundary in the vicinity of an airport could enter and exit coverage repeatedly. To avoid nuisance transitions of Traffic Status in the cockpit, the ground system is making provisions to prevent continuous transitions between In-Service and Out-of-Service Status. Transitions from Out-of-Service to In-Service should be inhibited until 30 seconds has elapsed from the previous transition to Out-of-Service.

H4.9 International Harmonization

Most countries will not have ADS-R or TIS-B. Manufacturers can create an installation method to disable TIS-B/ADS-R service status. This lock-out will disable the “Traffic Incomplete” message generated by the TIS-B/ADS-R service status. Note, flight manual supplements would have to address this international option.

H5.0 Display Concept Example:

The following is one example ASAS status indication concept. This concept is not required and does not include application status. TCAS status requirements are unchanged from DO-185A, and must also be displayed. The overarching requirement is for all status indications to be displayed in a manner consistent with the overall flight deck design philosophy.

Table H-3: CDTI Display Concept Example

CDTI Display	Meaning
ADS-B	<ul style="list-style-type: none"> ▪ ASSAP and CDTI are functioning <ul style="list-style-type: none"> • Ownship is receiving TIS-B/ADS-R Service • Ownship Position Source information meets the requirements in Table 2.X
ADS-B Or ADS-B Fail	<ul style="list-style-type: none"> ▪ ADS-B System is Failed (ASSAP or CDTI monitor indicates a failure) ▪ Ownship position is invalid or does not meet the requirements in Table 2.X
ADS-B Incomplete Or Traffic Incomplete	<ul style="list-style-type: none"> ▪ TIS-B or ADS-R is unavailable or outside TIS-B/ADS-R Service* ▪ Optionally: An ADS-B target within 15 nm and 3000 feet has been dropped from the display (typically for data quality) <p>* TCAS equipped installations may choose to not show this annunciation when running airborne applications. These aircraft are not relieved from this requirement when running surface applications. (i.e. ASSA/FAROA)</p>
ADS-B TEST	ADS-B System is in Test Mode
ADS-B OFF	The ADS-B System has been turned off or the transponder has been turned to off or to standby in transponder based systems.

H6.0 Limitations of Approach:

There are several limitations which should be documented in the AIM and Flight Manuals:

- Boundary Awareness: When near boundaries of TIS-B/ADS-R coverage the system may not depict all traffic.
- Non Transponder/ADS-B Equipped aircraft: Aircraft not equipped with a transponder or ADS-B Out system will not be depicted on the ownship’s CDTI.
- The System won’t account for targets outside of radar coverage or ground station coverage.
- The System won’t show all surface traffic unless there is TIS-B/ADS-R capability for that surface service volume

H7.0 1090ES TIS-B/ADS-R Service Status Management Message

Tables H-4 and H-5 outline the 1090ES TIS-B/ADS-R Service Status Management Message. DO-260A Change 2 allocates CF=4 of DF=18 for this purpose.

Table H4: 1090 TIS-B/ADS-R Airborne Service Status Message

Bit	TIS-B/ADS-R Management Message (Airborne Status Message)
1-5	Downlink Format (DF=18)
6-8	CF=4
9-10	Airborne/Surface Service Status Type ¹
11	Service Status ²
12-35	ICAO Address #1
36	Service Status ²
37-60	ICAO Address #2
61	Service Status ²
62-85	ICAO Address #3
86-88	Available/Reserved

Table H5: 1090 TIS-B/ADS-R Surface Service Status Message

Bit	TIS-B/ADS-R Management Message (Surface Service Message)
1-5	Downlink Format (DF=18)
6-8	CF=4
9-10	Airborne/Surface Service Status Type ¹
11	Service Status ²
12-29	3-Letter Airport Identifier #1
30	Service Status ²
31-48	3-Letter Airport Identifier #2
49	Service Status ²
50-67	3-Letter Airport Identifier #3
68	Service Status ²
69-86	3-Letter Airport Identifier #4
87-88	Available/Reserved

Note 1: Airborne/Surface Service Status Type is 0 for surface, 1 for airborne

Note 2: Service status is 1 for an In-Service Message, 0 for an out-of-service message

Each character of the 3-letter airport identifier will be coded as a six-bit subset of the ICAO 7-unit coded character set (ICAO annex 10, Vol. IV, 3.1.2.10, Table 3-6. This format was selected to match the DO-260A Aircraft Identification coding.

H8.0 UAT TIS-B/ADS-R Service Status Management Message

The UAT Service Status message is part of the FIS-B Ground Uplink message. The frame type is 14. The data frame content is broken down into 32 bit sections. There can be up to 105 of these 32 bit sections in each message. The 32 bit section is outlined in Table H-4.

Bit	TIS-B/ADS-R Management Message (Airborne Status Message)
1	Surface / Airborne
2-4	Reserved
5	Signal Type
6-8	Address Qualifier
9-32	24-bit ICAO Address or 3 Letter airport identifier

Table H-4

H8.1 Surface/Airborne: This one bit field indicates whether bits 9-32 contain an aircraft 24-bit ICAO address or an airport 3-letter identifier. One indicates in airborne. Zero indicates surface.

H8.2 Signal Type (Sig): This one bit field indicates whether the aircraft 24-bit ICAO address or airport 3-letter identifier is in-service or out-of-service. One indicates in service. Zero indicates leaving service or out-of-service.

H8.3 Address Qualifier:

H8.4 Aircraft 24-bit ICAO Address or 3-Letter airport identifier: For airborne service status this 24-bit field will include aircraft 24-bit ICAO addresses indicating which aircraft are within service or leaving service. For surface service status the first 18 bits of the 24-bit field will be populated with the alpha-numeric three letter identifiers for applicable airports. The remaining 6 bits for the surface service status will be zeros.

H8.5 Each character of the 3-letter airport identifier will be coded as a six-bit subset of the ICAO 7-unit coded character set (ICAO annex 10, Vol. IV, 3.1.2.10, Table 3-6. This format was selected to match the DO-260A Aircraft Identification coding.