

**RTCA Special Committee 186, Working Group 3**

**ADS-B 1090 MOPS, Revision A**

**Meeting #9**

**Action Item 8-10**

**Draft of MOPS Material for TIS-B Message Processing and Reporting,  
Sections 2.2.17.4 to the end of 2.2.17**

**Presented by William Harman**

SUMMARY

At the previous meeting (December 2001), it was decided to prepare TIS-B material using the concept that much of the TIS-B processing will be done in a separate TIS-B box (an “application”). This working paper presents a draft of the MOPS material for message processing and report generation, when TIS-B messages are received.

Draft of MOPS Material for TIS-B Message Processing and Reporting,  
Sections 2.2.17.4 to the end of 2.2.17

At our previous meeting, we discussed the TIS-B material needed in the MOPS revision. Vince Orlando presented a 3rd draft of TIS-B material, formulated as a new section of requirements, 2.2.17, and a corresponding section of tests, 2.4.17. This draft includes message formats in detail, including both coarse and fine position messages. This draft does not yet include message processing and reporting.

The inclusion of TIS-B material is somewhat difficult because a MASPS for TIS-B is being prepared by a separate group (WG2), and is not yet to a point where its implications on the 1090 MOPS are clear. For example, it is not clear to us what management messages will be required. A number of possible complexities were identified at our meeting, including the fact that both ADS-B and TIS-B tracks may exist for a given target, and the question of whether to report TIS-B information when ADS-B information is being currently reported.

In discussion at our meeting, we formulated an approach in which ADS-B accepts and reports TIS-B information in a direct feed-through manner. I was assigned the action item to prepare a draft of the message processing and report generation, using this approach. Following is a draft of these sections.

In writing this, I have felt increasingly confident that our approach is effective. Tracking of TIS-B information is only needed for CPR decoding, so all other received information can be reported directly, without using tracks.

In this draft, there is a definition of TIS-B tracking, which can be either separate or together with ADS-B tracking. At Vince's suggestion, I included a bubble diagram, similar to what we already have in the MOPS for ADS-B tracking. This one is considerably simpler.

#### **2.2.17.4 TIS-B Message Processing and Report Generation**

The information received in TIS-B messages is reported directly to applications, with one exception. The exception is latitude-longitude position information, which is CPR-encoded when it is received, and must be decoded before reporting. In order to accomplish CPR decoding, it is necessary to track received messages, so that even-format and odd-format messages can be combined to determine the latitude and longitude of the target.

In the most common case, a particular target will result in TIS-B message receptions or ADS-B message receptions, but not both. It is possible, however, for both types of messages to be received for a single target. Therefore TIS-B messages are compared with tracks of previous TIS-B receptions and tracks of ADS-B receptions. The tracking structure within ADS-B can either use separate tracking of TIS-B receptions and ADS-B receptions or combined tracking of the two types of receptions.

##### **2.2.17.4.1 TIS-B Message-to-Track Correlation**

Tracking makes it possible to associate a received message with information previously received about that same target, in the presence of many other intervening messages about other targets. As TIS-B position messages are received, they are compared with existing tracks. If a received TIS-B message correlates with an existing track, the message is decoded (2.2.17.4.2), the track is updated (2.2.17.4.3), and a report is generated (2.2.17.6). If the new message does not correlate, it is used in new-track initiation (2.2.17.4.4).

###### **2.2.17.4.1.1 TIS-B Messages Having a 24-Bit Address**

For a target that has a 24-bit address, that address is used for correlating a new reception with information in the track file. Correlation is successful if the address matches exactly. When a TIS-B position message having a 24-bit address is received, and an existing TIS-B track has the same address, the message shall be correlated with the track. When a TIS-B message having a 24-bit address is received, and an existing ADS-B track has the same address, the message shall be correlated with the track.

###### **2.2.17.4.1.2 TIS-B Messages Having Mode A Code and Track Number**

For a target that does not have a 24-bit address, but instead has a Mode A code and a TIS-B track number, then these are used to correlate with information in the track file. Correlation is successful if the Mode A code and the track number both match exactly. When a TIS-B message having a Mode A code and TIS-B track number is received, and an existing TIS-B track has the same Mode A code and ADS-B track number, the message shall be correlated with the track.

##### **2.2.17.4.2 TIS-B Message Decoding**

When a received TIS-B position message correlates to an existing track, the message and the track are used together to decode the latitude and longitude of the target. If the track is “Complete”, meaning that a global decode has been accomplished, then the new latitude-

longitude information shall be decoded using local decoding, as specified in A.7.4 in Appendix A, taking the previous position of the target as the reference.

If the track is Incomplete, meaning that a global decode has not yet been accomplished prior to this reception, then a global decode may be computed depending on the contents of the track. If the information in the track together with the new position message consist of at least one even format message and at least one odd format message received within 10 seconds, then a global decode shall be computed as specified in A.7.7 of Appendix A. Otherwise the received encoded position, the even/odd format, and the time of applicability, shall be saved in the track file for later use.

For ADS-B tracks, as illustrated in Figure 2-16b, a track is Complete if it is in the Track State or is in the Acquisition State. Otherwise the track is Incomplete.

### 2.2.17.4.3 TIS-B Track Update

When a position message is correlated to a TIS-B track that is Complete, then a new position is computed as specified in 2.2.17.4.2 and the tracked position shall be updated with the new position and time of applicability. The previous position and time need not be saved. Figure 2-xx illustrates the transition from Incomplete track to Complete track and later track drop.

When a position message is correlated with a TIS-B track that is Incomplete, the new information may make it possible for a global decode, as specified in 2.2.17.4.2. If a global decode is accomplished, the track shall be promoted to Complete, and the latitude, longitude, and time of applicability shall be saved in the track. The previous position and time information need not be saved. If a global decode is not accomplished, the even and odd encoded positions shall be saved for future decodes. It is not necessary to save any encoded positions longer than 10 seconds.

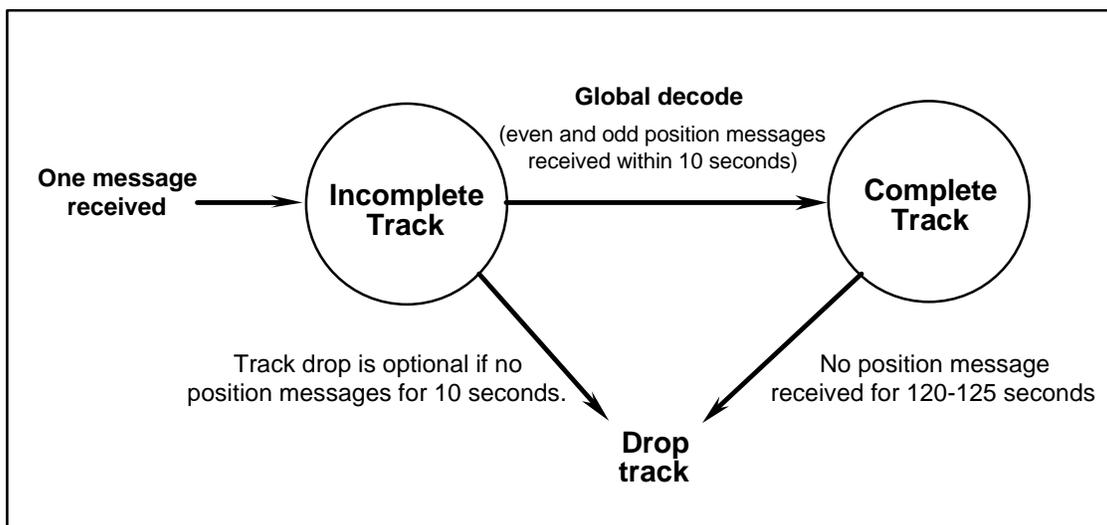


Figure 2-xx. TIS-B Tracks

#### **2.2.17.4.4 TIS-B Track Initiation**

A TIS-B track begins with the reception of one position message. A new Incomplete track shall be created, and the encoded position, even/odd format bit, and time of applicability shall be saved. Upon subsequent receptions, the track may be promoted to Complete as specified in 2.2.17.4.3.

#### **2.2.17.4.5 TIS-B Track Drop**

A TIS-B track that is Complete shall not be dropped within 120 seconds after any TIS-B position message reception. If 125 seconds elapses without any TIS-B message reception, the track shall be dropped.

Note. As specified in 2.2.17.4.3, for an Incomplete TIS-B track, it is not necessary to save any information more than 10 second after reception. Therefore the track can be dropped after 10 seconds.

#### **2.2.17.4.6 TIS-B Report Generation**

As TIS-B messages are received, the information is reported to applications. All received information elements, other than position, shall be reported directly. The reporting format is not specified in detail, except that the information content reported shall be the same as the information content received. The report shall be issued within 0.5 seconds of the message reception.

When a TIS-B position message is received, it is compared with tracks to determine whether it can be decoded into target position, as specified in 2.2.17.4.2. If the message is decoded into target position, a position report shall be generated, within 0.5 seconds of the message reception. The report shall contain the latitude, longitude, altitude, and time of applicability.

Note. In the absence of TIS-B message receptions, it is possible but not required for generation of reports. Such additional reports might be useful as a means of counteracting possible flaws in an on-board data bus between ADS-B and an application.

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*Editorial note. This draft refers to sections in Appendix A. We need to check these section numbers as changed in DO-260A.*