

1. TIS-B REPORT COUNTS VERSUS TRACK CANCELLATION MESSAGES

1.1 Background

In the latest TIS-B Functional Architecture Discussion paper it is proposed that the heartbeat message include a count of the number of TIS-B reports that have been generated for the service since the previous heartbeat message. This functionality is also required by the NUP service description.

This paper discusses the needs for such counters, and the implications of having more than one groundstation per service volume.

1.2 The Reason For Counting TIS-B Target Reports

The counters were introduced to allow the airborne system to check that it had successfully received all the TIS-B reports that it should have, and to determine whether the TIS-B service was of an acceptable quality.

1.3 Counting Tis-B Reports When Using Multiple Groundstations

The functional architecture considers two cases where more than one groundstation may be required for a service volume. Firstly because the coverage of a single groundstation is not large enough to cover the service volume, and secondly when a single groundstation does not have the capacity to broadcast all the targets within the Traffic Information Volume (TIV) of the service.

In the first case, each groundstation would broadcast all the TIS-B reports for the service and the heartbeat message would contain the number of TIS-B reports broadcast. In the areas where the coverage of the two groundstations overlap, the aircraft is likely to receive the TIS-B reports and heartbeat messages from both groundstations. If the aircraft simply counts the number of TIS-B reports received it will not match the contents of the heartbeat message.

In the second case of two groundstations sharing the load for a service, then the TIS-B Server would share the load across the two groundstations. If the heartbeat message contained the total number of TIS-B reports for the TIV then the TIS-B server would have to ensure that the heartbeat message was sent after all the TIS-B reports had been sent from both groundstations. This implies some synchronisation between groundstations which is undesirable as it adds complexity to the design.

A simple solution to these problems would be for each groundstation to generate a heartbeat message containing the number of TIS-B reports sent by that groundstation. To allow the aircraft to correlate the TIS-B report count in the heartbeat message with the corresponding TIS-B reports, it would be necessary to include a groundstation identifier in each TIS-B report and heartbeat message and although the identifier may consist of a few bits the fact that the identifier would need to be sent in each message, it seems too big an overhead for the benefit derived. Also managing the allocation of the groundstation identifiers would add complexity to the overall system.

1.4 An Alternative Method.

An alternative way for the airborne data processing to check the quality of the TIS-B service is for the airborne processing to maintain a track list (i.e. a list of the targets for which it expects to receive a TIS-B report), and to place a requirement on the ground systems to provide regular updates for each track and to indicate when a track is no longer applicable to the service (i.e. a track cancellation message of some kind).

For example, if the ground is required to provide a TIS-B report every 4 seconds the airborne SDPD would check that it receives a TIS-B report for each track every 4 seconds, if it fails to receive a report for one track the airborne SDPD could decide to extrapolate the position etc. for a period of time for example until the next TIS-B report is expected (i.e. another 4 seconds), if no TIS-B report is received for a longer period (e.g. 10 seconds) the SDPD could decide to either delete the track or terminate the TIS-B service temporarily. If the ground system provides a track cancellation message (broadcast several times to ensure it is received) whenever a track is intentionally withdrawn from the TIS-B service, then the airborne SDPD would not extrapolate tracks unnecessarily.

1.5 Conclusion

In the situation where more than one groundstation is required, using the counters would add complexity to the system design and require additional bandwidth for each TIS-B report to contain the groundstation identifier. Alternatively, by providing a track cancellation bit and the regular nature of the TIS-B reports, it will be possible for the airborne SDPD to easily establish whether it has received all the TIS-B reports it should have. The keeping of a track list in the airborne SDPD is almost certainly required irrespective of this issue, so using it to check the quality of TIS-B service should add little or no complexity to the airborne SDPD.