9M-MRO Satellite Phone Connections

Summary

9M-MRO's flight may be regarded as comprising three phases:

1. Departure to 17:21UTC;
2. 17:21 to 18:22 – the “dark” phase; and
3. 18:22 to end.

This analysis reviews the 3 satphone call attempts and concludes that their failure was a direct consequence of events in phase 2.

The failure to complete two of the three outbound satellite phone calls was the result of degraded function of the HGA antenna system.

Analysis

Three outbound call attempts to the aircraft were recorded in the signalling log: two at 18:39 and one at 23:13. The call attempts were categorized as concerning 'regularity' – airline dispatch communications. Regularity is assigned the third priority after Emergency and Safety, but higher than passenger communications.

- Call A, 18:39: Channel IOR-3730-21000;
- Call B, 18:39: Channel IOR-373E-21000; and
- Call C, 23:13: Channel IOR-3737-21000.

The signalling unit log shows sub-channel frames being exchanged as preparation to establish the voice circuit but excludes detail of the payload data carried by the frames. However, the AMS(R)S Manual[1] details the possible logic conditions carried by the specific sub-channel signalling units. The signalling evidenced in the log shows the GES requesting the AES to:

- check the aircraft “forward circuit”, from the SDU, is ready to complete the call: the “continuity test”;
- participate in an exchange to optimise EIRP and so minimise BER (threshold is $1{:}10^{3}$ errors): the “power management” test.

The outcomes of the call attempts are as follows:

- Calls A and C failed as a consequence of the “power management” test;
- Call B as a consequence of the “continuity test”.

1 URL for AMS(R)S manual

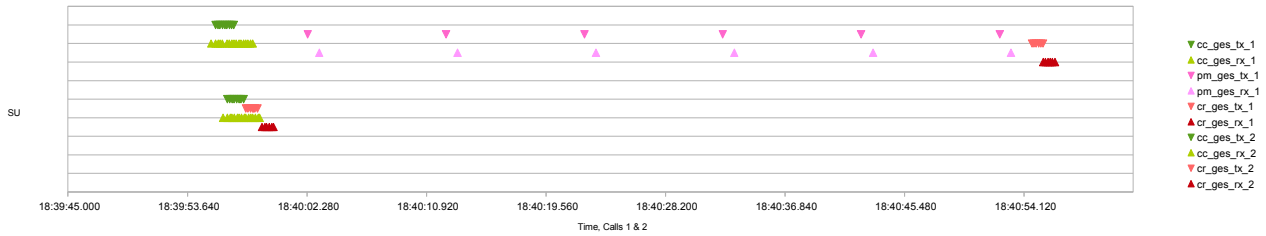

Illustration 1: Sub-channel signalling, Calls A and B

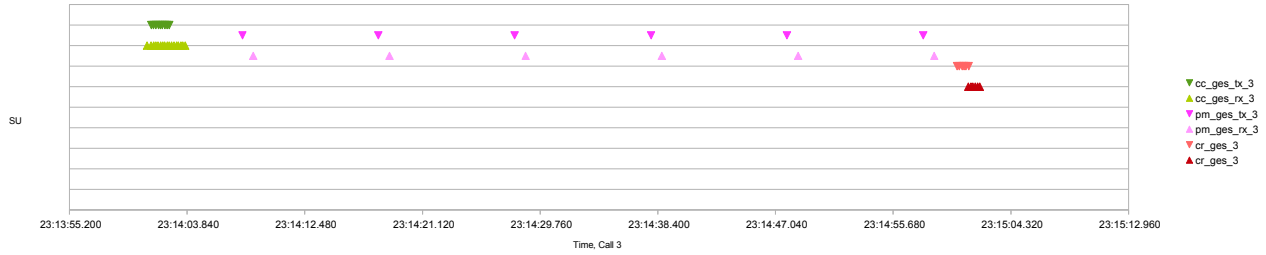

Illustration 2: Sub-channel signalling, Call C

Key to Illustration 2 and Illustration 3 above:

- cc_ges_tx: Continuity Check - GES transmitted SU;
- cc_ges_rx: Continuity Check - GES received SU;
- pm_ges_tx: Power Management – GES transmitted SU;
- pm_ges_rx: Power Management – GES received SU;
- cr_ges_tx: Channel Release – GES transmitted SU;
- cr_ges_rx: Channel Release – GES received SU

In each sequence illustrated above, note where the Channel Release is initiated.

An assumption is that Calls A and C were routed to the flight deck audio system and Call B to the cabin crew station. The Call B failure may be linked to the ABC 'Four Corners' commentary that the IFE (i.e., the cabin communications system - CCS) was “interfered with”. The cabin crew satphone would be connected via the CCS whereas the flight deck circuit terminates in the flight deck audio system.

The assumption remains that the AES was unable to communicate with the GES between 17:07, the time of final inbound ACARS message from the aircraft, and 18:03, the time of failed outbound ACARS message to the aircraft.

The SDU achieved a successful GES log-on at 18:25. Two events may have initiated log-on, those events are:

- an SDU re-boot subsequent to power re-applied after “dark phase”; or
- the SDU re-acquired I3-F1's P_{smc} signal after losing sync with its allocated P_d (IOR-P10500-0-3859) in immediate period after 17:21.

The AES comprises the Honeywell SDU, HPA and SM-HGA set plus an HPA and LGA for AES Class 1 packet data backup. The SDU log-on at 18:25 included it identifying AES Class 3 operation, for voice and packet data. That the GES forwarded voice call attempts during the log-on session confirms Class 3 registration.

The aircraft position at 18:39[2] (7.74ºN, 94.35ºE) places it for good elevation and azimuth range to I3-F1 and within the Ball Airlink 13dB gain boundary as depicted in Illustration 3. Similarly, the aircraft positions at 22:41 and 00:10 indicate that the estimated position at 23:13 affords a good signal.

Conclusion

The SDU recovered service with a log-on at 18:25, however, the HGA Beam Steering Unit did not recover operation successfully with the consequence that voice service could not be sustained.

Two calls, one at 18:39 and one at 23:13, did not complete successfully due to sub-optimal HGA performance.

One call attempt, at 19:39, failed due to the Cabin Communication System unavailable to a receive voice call.

The BSU normally receives steering data over an ARINC 429 bus interface from the SDU, in turn the SDU receives inertial reference data via the AIMS.

Further information is necessary to understand the beam steering performance of the Ball Aerospace Airlink antenna when reinitialised in flight.

2 Richard Godfrey, email 30th Sep 2014

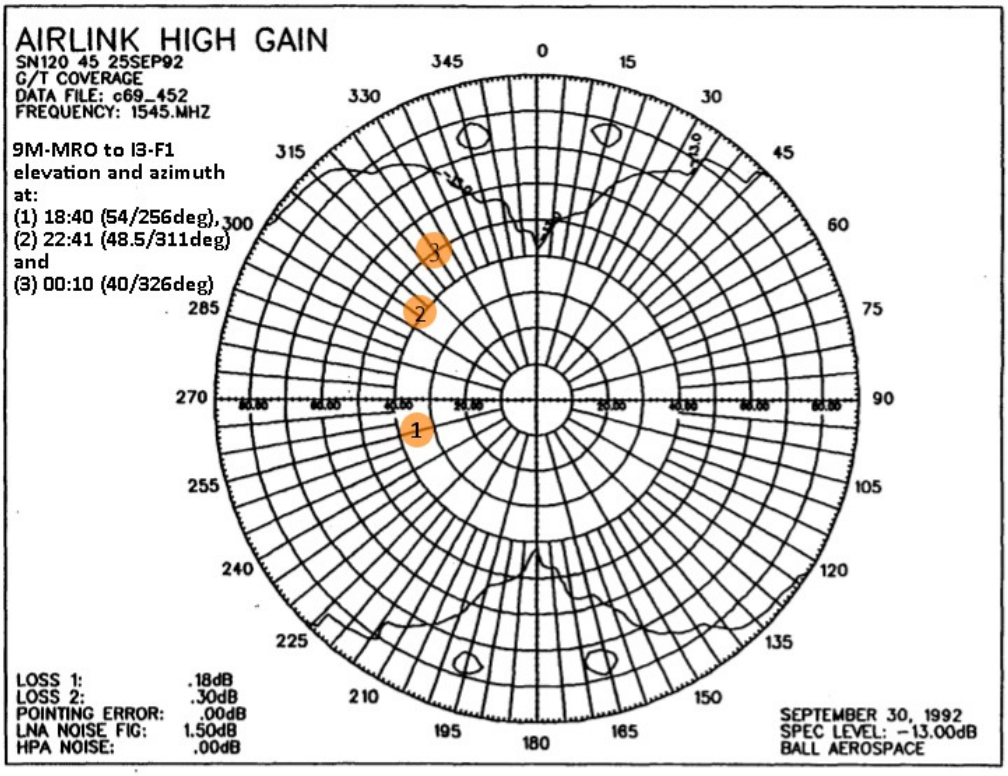

Fig. 11. AIRLINK® -13.0 dB/K° CONTOUR IN AIRCRAFT COORDINATES

Illustration 3: Airlink Antenna Gain vs 9M-MRO position

Appendix A

Excerpt from AMS(R)S Manual Part III related to “power management” negotiated with “0x30 Call Progress - Status Report“ Signalling Units.

4.10.4.4.3.1.2 For the C channel, the initial EIRP value shall be assigned by the GES management on a per-call basis and shall be sent to the AES via the circuit-mode services in the C channel assignment LIDU.

4.10.4.4.3.2 C channel power adjustment

4.10.4.4.3.2.1 For the to-aircraft C channel, the GES management shall adjust the GES EIRP according to the BER value received from the AES management in the channel status report LIDU. The adjustment EIRP shall be required to maintain a BER of no more than 10^3.

4.10.4.4.3.2.2 For the from-aircraft C channel, the GES management shall determine the AES EIRP adjustment required to maintain a BER of no more than 10^3 based on the BER value measured at the GES. The adjustment shall be sent to the AES management in the channel status report LIDU.