Twenty Second Meeting of the
Informal South Pacific ATS Co-ordinating Group (ISPACG/22)
FANS Interoperability Team Meeting (FIT/15)

Papeete, Tahiti, 11-12 March 2008

Agenda Item 9: Other business

Analysis of ADS-C Reports Containing Incorrect and/or "default" ETI Information

Presented by Airservices Australia

SUMMARY

This working paper presents information from a study into apparent errors in ADS-C reports received by Brisbane Centre

1.   Introduction

1.1   In February 2008, Airways New Zealand identified that a significant number of ADS-C reports containing ADS-C default [time] data were being received by Auckland Oceanic. After becoming aware of the problem, the FAA and Airservices Australia found that they were also receiving relatively large numbers of ADS-C reports containing default data.

1.2   In response to this finding, Airservices Australia conducted a more in-depth analysis of ADS-C reports. In addition to ADS-C default data it was discovered that a number of ADS-C Periodic and Waypoint Change Event (WCE) reports contained time intervals that appeared to be erroneous.

2.   Description of Analysis

2.1   This analysis was based on ADS-C reports received by Brisbane Centre (YBBB) during Dec 2007, and was an attempt to determine the number of ADS-C reports containing default or apparently erroneous ETI (Estimated Time Interval) information.

2.2   To determine the number of reports containing ADS-C default ETI data, the ADS-C database was simply scanned for occurrences of ETIs of 16383 seconds.

2.3   To determine the number of reports containing "incorrect" ADS-C ETI data, a "projected groundspeed" was calculated using information in the basic and PRG ADS-C Groups. Projected groundspeeds outside a certain range were deemed to be invalid, or "incorrect".

2.4   The methodology used was as follows:

- ADS-C reports below F250 were excluded from any further analysis, to allow for reduced groundspeeds for aircraft on climb (or still sitting at the gate!);

- ADS-C reports where the distance between the Basic and the Next positions were less than 5NM were excluded, to cater for errors associated with "small distance processing" (In reality, only distances of less than 1nm should really cause problems);

- From the remaining ADS-C reports, the latitude and longitudes for the current and Next waypoint were extracted from the ADS-C Basic and Predicted Route Group(s); and then

- the distance between the two lat/longs was calculated, and based on the ETI contained in the PRG, a projected groundspeed between the two lat/longs was calculated.

2.5   The range of groundspeeds < 300kts and greater than 650kts were deemed to be "invalid", and these reports were extracted for further processing. The format of the final data output permitted correlations between aircraft type, aircraft company and the number (and type) of discrepant ADS-C reports.

3.   Analysis

3.1   The analysis is in its very early stages, and has generated a large amount of data which is still being studied. Several trends have been identified, but not investigated fully. A breakdown of the numbers of ADS-C reports containing default or incorrect ETI data is included in Table 1.

Type of report	Total	%
No of ADS-C Periodic reports	51741	
No of ADS-C Periodic reports containing default ETI data	1276	2.47%
No of ADS-C Periodic reports containing incorrect ETI data	431	0.83%
No of ADS-C WCE reports	28567	
No of ADS-C WCE reports containing default ETI data	1342	4.70%
No of ADS-C WCE reports containing incorrect ETI data	81	0.28%

Table 1.   Breakdown of ADS-C reports

3.2   The first analysis looked at the relationship between erroneous ETIs (not including ADS-C default data) and the distance between the Basic and Next positions. The results are depicted in the following graphs (the dashed line is a linear trend-line):
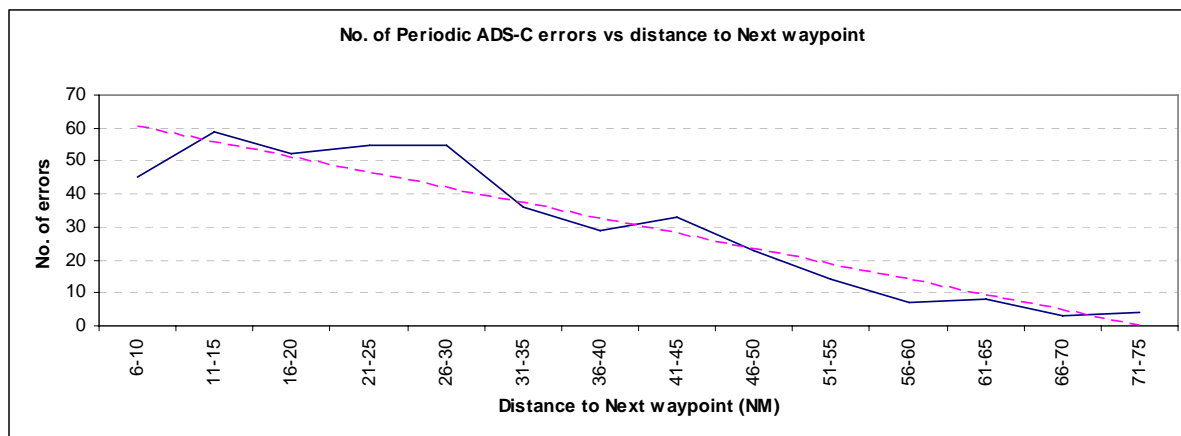
Figure 1. **Relationship between number of errors and distance to Next waypoint (Periodic reports)**
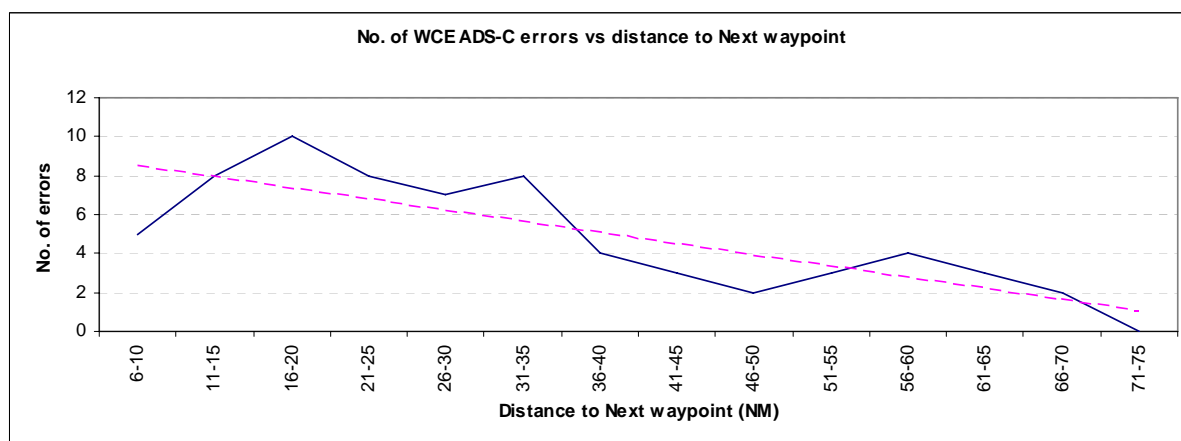

Figure 2. **Relationship between number of errors and distance to Next waypoint (WCE reports)**

3.3 The information in the graphs indicates that:

- the number of errors is inversely related to the distance between the Basic and Next waypoints. As the distance increases, the number of errors decreases.

- there are significantly more incorrect estimates contained in Periodic reports compared to WCE reports. This could be due to:

  ➢ more Periodic reports are received than WCE reports; and
  ➢ the distance between positions in regular WCE report would typically be larger than the distances in Periodic reports - see first bullet (above)

3.4 The second analysis compared relative numbers of default and incorrect ADS-C Periodic and WCE reports per airline per aircraft type. Due to the amount of data, this analysis is quite complex - the graphs in Attachment 1 attempt to provide a pictorial representation.

3.5 A number of similarities between different aircraft types appear to be apparent in the graphs. Of more interest, however are the differences in results between some aircraft types and/or operators. Some of these anomalies indicate that some proportion of the errors identified may be as a result of aircraft configuration and/or pilot procedures.

3.6   Similarities between aircraft types/airlines include:

- **Boeing** aircraft (B744, B772 - refer Figures 3 and 4):

  ➤   The most prolific error is the default ETI in the WCE report;
  ➤   There are only a small percentage of incorrect ETIs in WCE reports.

- **MD11** (refer Figure 5):

  ➤   The most prolific error is the default ETI in the WCE report.

- **Airbus** (A332, A343 - refer Figures 6 and 7):

  ➤   The most prolific error is the default ETI in the Periodic report (compare this with B744, B772 data);
  ➤   There is only a small percentage of incorrect ETIs in WCE reports.

3.7   A number of interesting discrepancies were observed in the data. For example:

- **B744** (refer Figure 3):

  ➤   UAL and JAL have relatively large proportions of Periodic reports containing default data which are not seen for other airlines.

  ➤   FJI has a much smaller proportion of WCE reports containing default data than other airlines.

- **B772** (refer Figure 4):

  ➤   ANZ has almost no WCE reports containing default data, compared to between 3 and 7% for other airlines

  ➤   KAL has almost double the rate of Periodic reports containing incorrect ETIs compared to other airlines

- **MD11** (refer Figure 5):

  ➤   UPS and FDX have nearly identical WCE default errors (15.7% and 15.1% respectively). However, the periodic default rate for UPS (9.7%) is nearly double that for FDX (5.1%)

- **A343** (refer Figure 7):

  ➤   There is a wide range of WCE reports containing default data:- LAN (0%), THT (2.4%) and CPA (7.7%)
  ➤   CPA has no Periodic reports containing default ETI data compared to LAN (9.3%) and THT (7.4%)

4. Effect of Incorrect ETIs on Ground Systems

4.1   The effect of receipt of these ADS-C reports may vary from ATSU to ATSU depending on the ground system automation. An ATSU may reject the report, partially process the report (possibly with error messages), or process without error.

4.2   If an ADS-C report containing incorrect ETI information was processed, it is possible that the ground system would use this incorrect information to extrapolate the displayed position of the ADS-C position symbol, as well as to erroneously update the ATS flight plan data.

5. Action by the Meeting

5.1   a)   ATSUs should be aware that ADS-C reports containing incorrect information are being regularly received;

      b)   The FIT CRA is requested to work in conjunction with aircraft manufacturers and airlines in an attempt to identify the cause of these errors.
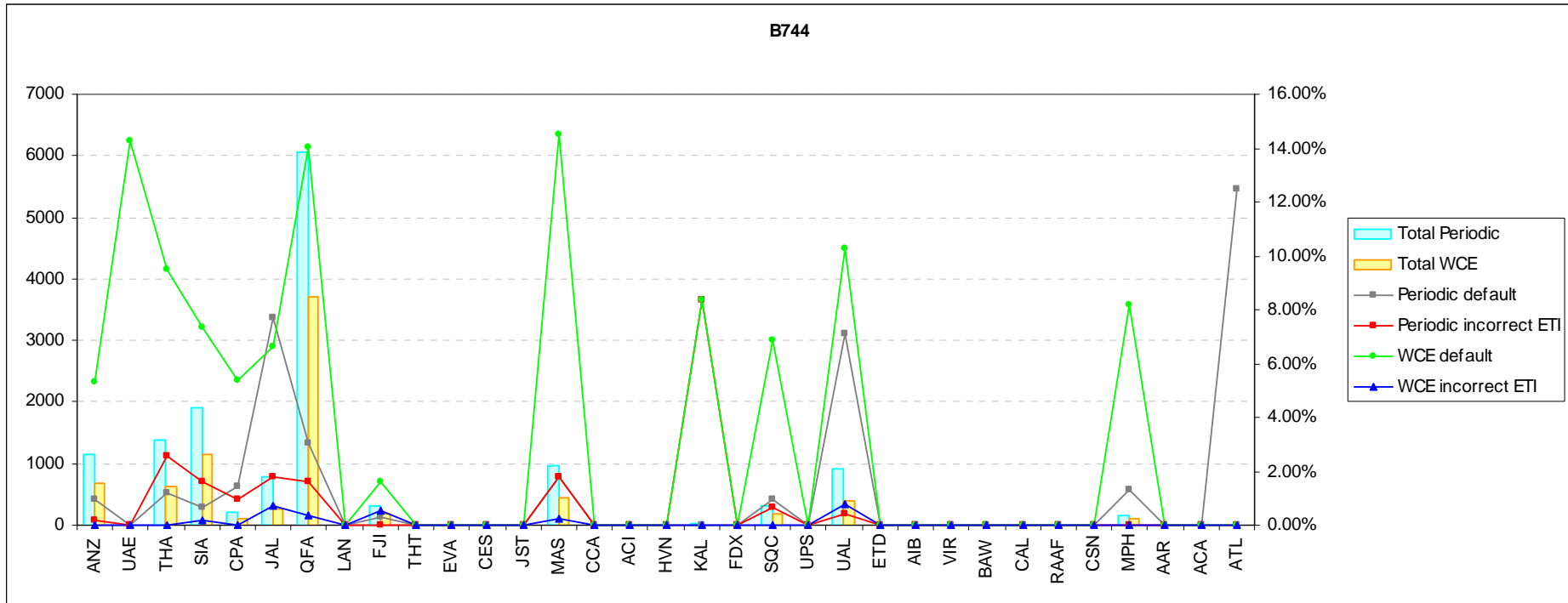
Figure 3   Graph of ADS-C reports from B744
Note. Columns depict the number of ADS-C reports received per airline (refer left hand axis), and lines depict the percentage of erroneous ETIs
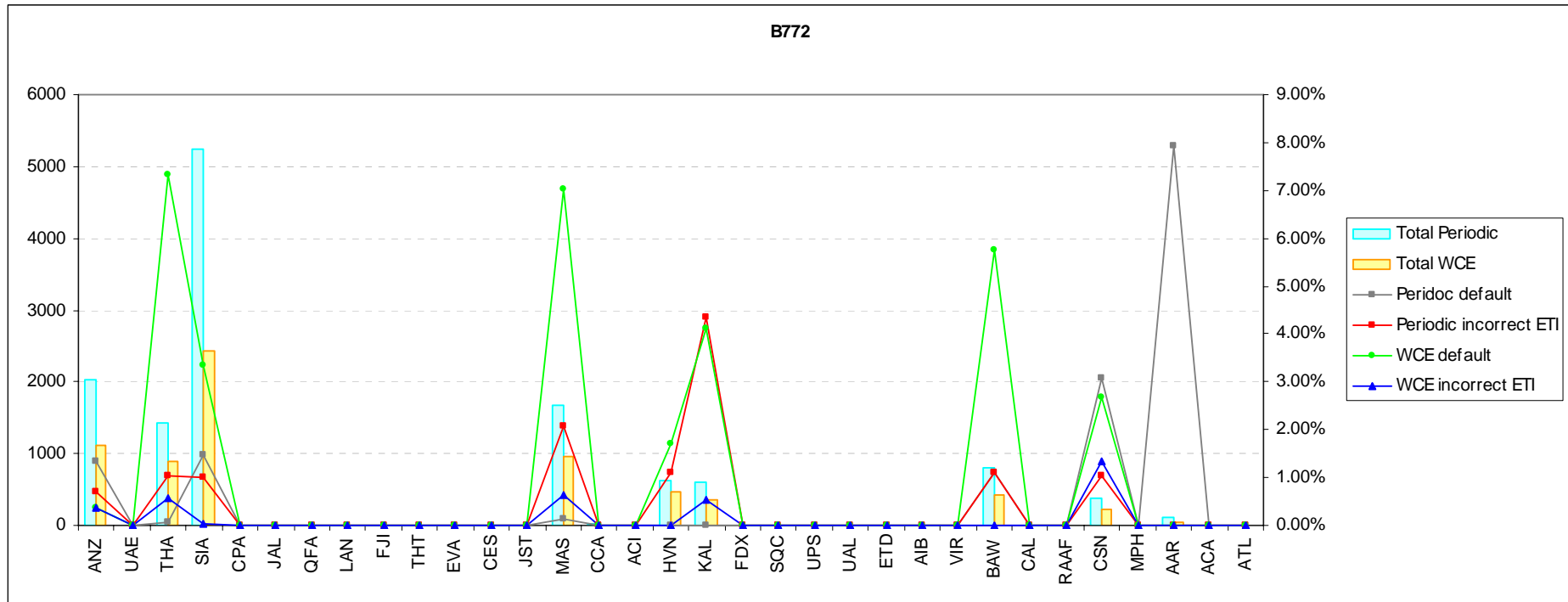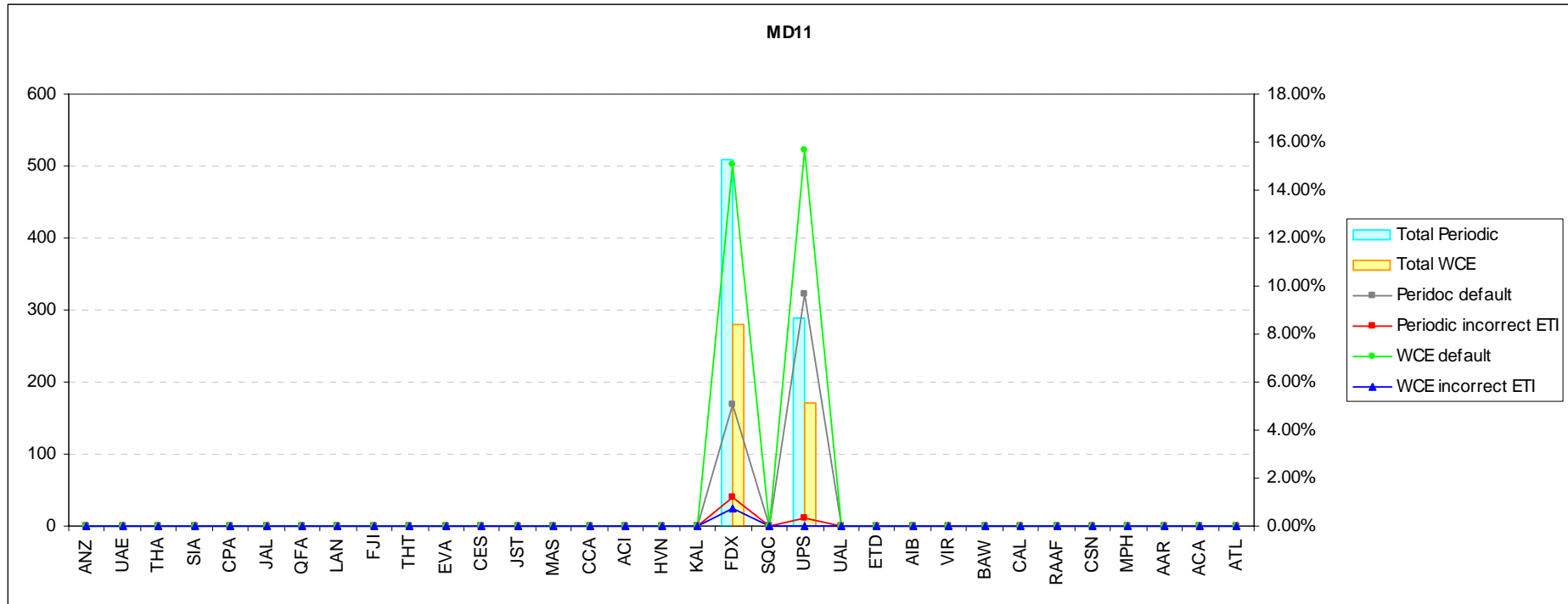
Figure 4   **Graph of ADS-C reports from B772**

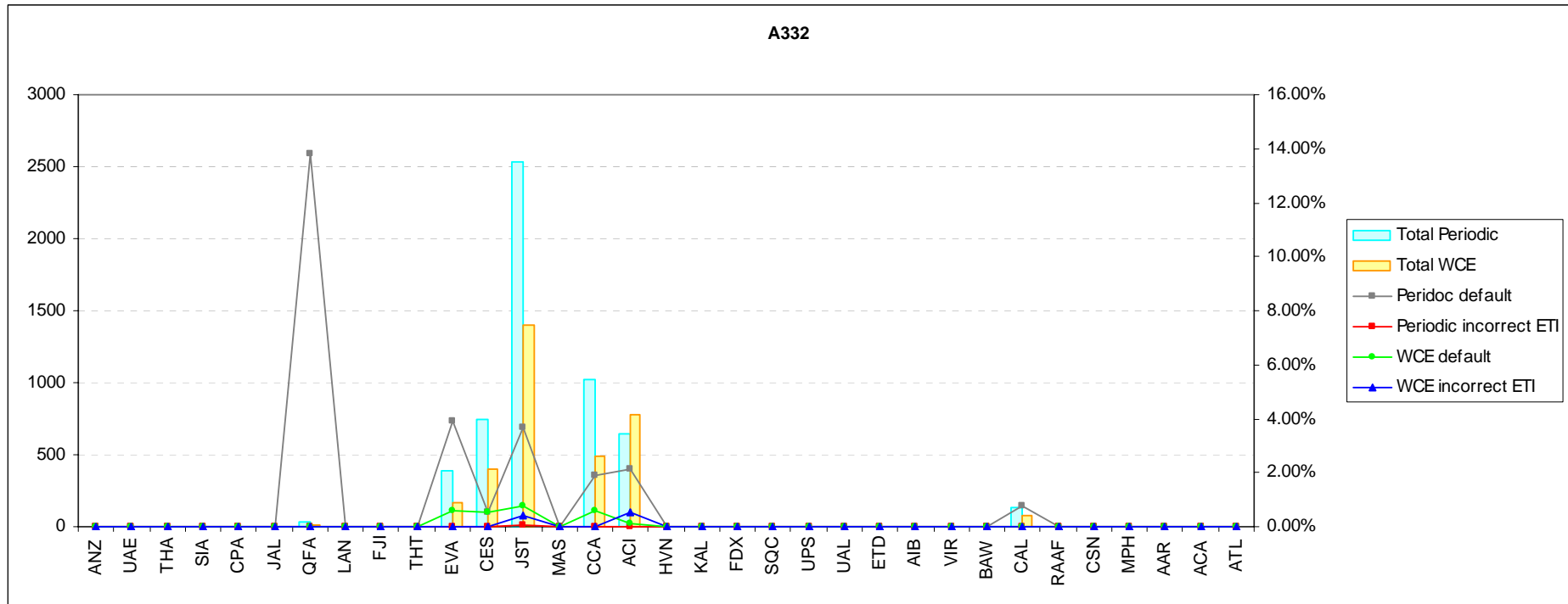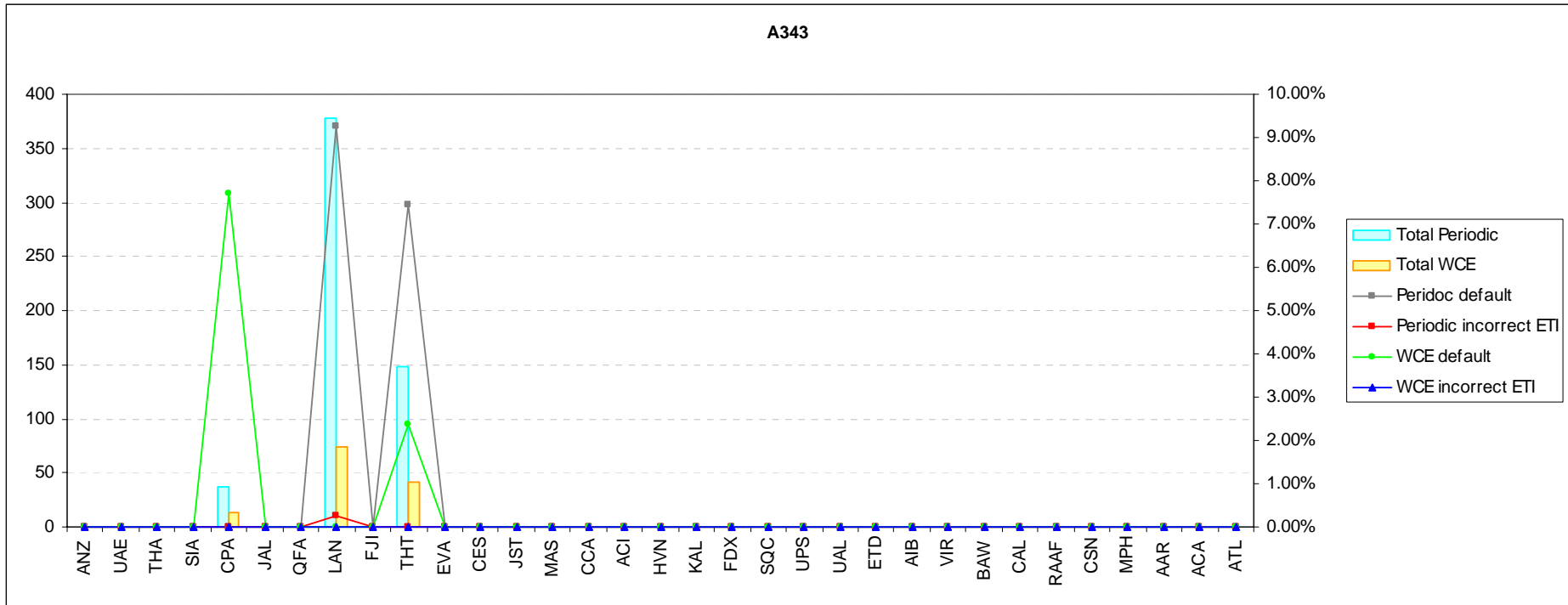**Figure 5**   **Graph of ADS-C reports from MD11**

Figure 6   Graph of ADS-C reports from A332

Figure 7 **Graph of ADS-C reports from A343**