Post Implementation Monitoring

Airbus A388 Performance Review

FANS1/A Performance

Version 1.0

4 September 2010

Authorised by: P.L. Radford

Paul Radford

Manager Oceanic Systems

AIRWAYS

making your world possible

Contents

1 Introduction

1.1 Background

The QANTAS and Emirates A388 fleets were introduced into SOPAC operations in late 2008 and early 2009. Since that time FANS1/A performance has been monitored for both fleets and has been observed to be below both that observed from the A340 fleets and more importantly, below that needed to satisfy all of the safety and performance requirements defined in the Oceanic Safety and Performance Standard (Oceanic SPR) for the application of the reduced distance based separation standards.

The Oceanic SPR requires CPDLC performance to meet Required Communications Performance (RCP240) and ADS-C performance surveillance latency (Type 180) for the application of RNP10 50NM longitudinal and RNP4 30NM longitudinal/30NM lateral separations.

Several issues have been identified that may have negatively affected the performance of the A388 aircraft. One of these issues relates to the CSP routing of uplinks via HFDL. The A388 aircraft use HFDL in the Airbus “next on busy” mode to transmit data if the SATCOM channel is busy sending other data. This issue was filed as problem reports with the ISPACG CRA on two occasions.

Another issue relates to the DATA2/DATA3 interaction issue. It was found that some of the FANS1/A aircraft using DATA2 ACARS were occasionally experiencing significant delays on FANS1/A when DATA3 was in use for cabin services. This was also filed as a problem report with the ISPACG CRA, and it is possible that this affected A388 operations.

Additionally, a general problem report on the observed A388 performance was raised in 2009 with the ISPACG CRA.

Conversely, a number of system improvements have been made over the past two years that have positively impacted A388 performance. These include CSP routing changes to ensure that uplinks are not transmitted via HFDL (where possible), as well as significant improvements at the INMARSAT I3 GES to overcome delays to FANS1/A traffic caused by the interaction with DATA3 transmissions from affected aircraft.

With the intention of promoting continued improvements in performance, the following report describes the results of the analysis of current observed performance.

1.2 Form of the Review

This report assesses ADS-C surveillance latency and CPDLC communications performance observed on the QANTAS and Emirates A388 fleets during operations in the NZZO Oceanic FIR over the period May, June, and July 2010.

ADS-C latency and CPDLC communications performance are assessed as per the guidance material contained in Appendix D of the Global Operational Data Link Document (GOLD).

Additional performance graphs are included in Appendix A and referenced in the main body. The data derived from operations within the Auckland Oceanic FIR data has been supplemented with performance data provided by the FAA for QANTAS A388 operations within the Oakland FIR during the review period.

Airways New Zealand acknowledge the assistance provided by FAA staff in the preparation of this report.

2 Observed ADS-C Performance

2.1 QANTAS A388 Aircraft

Performance assessed against the Type 180 specification

Figure 1 plots current SATCOM latency for each QANTAS A388 aircraft (OQA-OQF) for the period May-July 2010. There is very little variation between aircraft at the lower end of the scale with 90% of all messages being received between 30 seconds and 45 seconds after transmission from the aircraft FMS. Figure A1 in Appendix A illustrates this lower end consistency.

To achieve the Oceanic SPR Type 180 requirements 95% of all messages have to be received within 90 seconds and 99.9% of all messages have to be received within 180 seconds.

The aggregate fleet is easily achieving the 95% requirement using SATCOM but does not meet the 99.9% requirement. Half of the individual airframes in this sample are achieving better than 99.5% within 180 seconds, while the poorest performing aircraft, OQD is only delivering 97.4% of messages within 180 seconds. These variations in individual aircraft performance can be indicative of an aircraft avionics problem or a “bad tail” but this conclusion would require consistency between observed performance in different FIR and that has not been observed with this fleet. The FAA data for the Oakland FIR shows the top performer in NZZO, OQA as their lowest performer for the same period. The average ADS-C performance over the QANTAS fleet using SATCOM is 99% of messages delivered within 180 seconds.

Figure 1 also depicts the difference in performance when HFDL latency is included. While the fleet again meets the 95% requirement using SATCOM + HFDL, only 98.3% of ADS-C reports are delivered within 180 seconds. Using SATCOM + HFDL there is a 0.7% performance penalty for messages delivered within 180 seconds. In absolute terms 20 messages out of the total 2, 842 delivered via SATCOM and HFDL during the review period fall outside the Type 180 requirement that 99.9% of messages are to be delivered within 180 seconds.

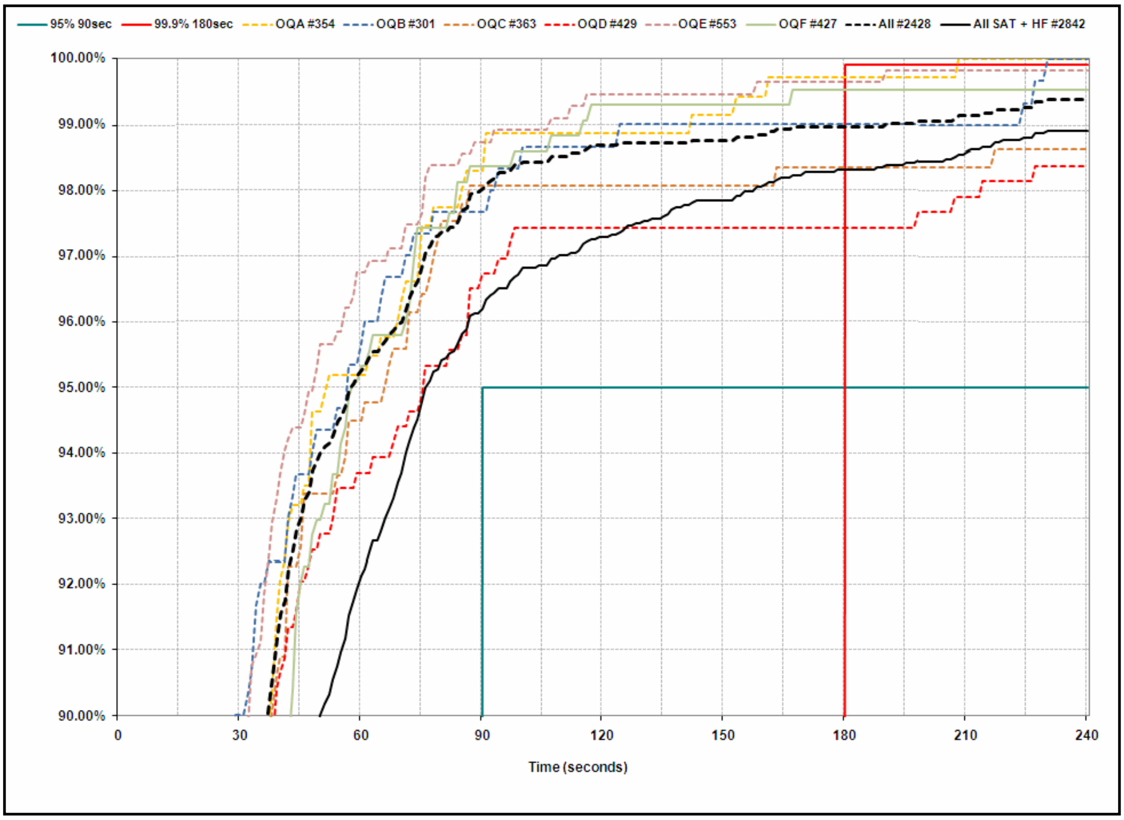

Figure 1: QFA ADS-C SATCOM Latency by aircraft – NZZO – Type 180

In the Oakland data, it is observed that the QFA A388 fleet performance using SATCOM sees 99.68% of messages delivered within 180 seconds while SATCOM + HFDL sees 99.49% of messages delivered. There is only a 0.2% performance penalty using HFDL in the Oakland data compared with the 0.7% penalty observed in the NZZO data. This difference has been investigated further and a reason for the difference discussed in paragraph 2.3.1 below.

Performance assessed against the Type 400 specification

Figure 2 shows plots of SATCOM latency for each aircraft (OQA-OQF), in addition to the overall SATCOM and SATCOM + HFDL latency for all the aircraft for the period May-July 2010 measured against the Type 400 criteria required for HFDL.

Four of the aircraft (2/3 of the fleet) meet the Type 400 requirement with 99.9% of reports delivered within 400 seconds, while the worst performer (OQD) falls short, achieving 99.1% of messages delivered within 400 seconds.

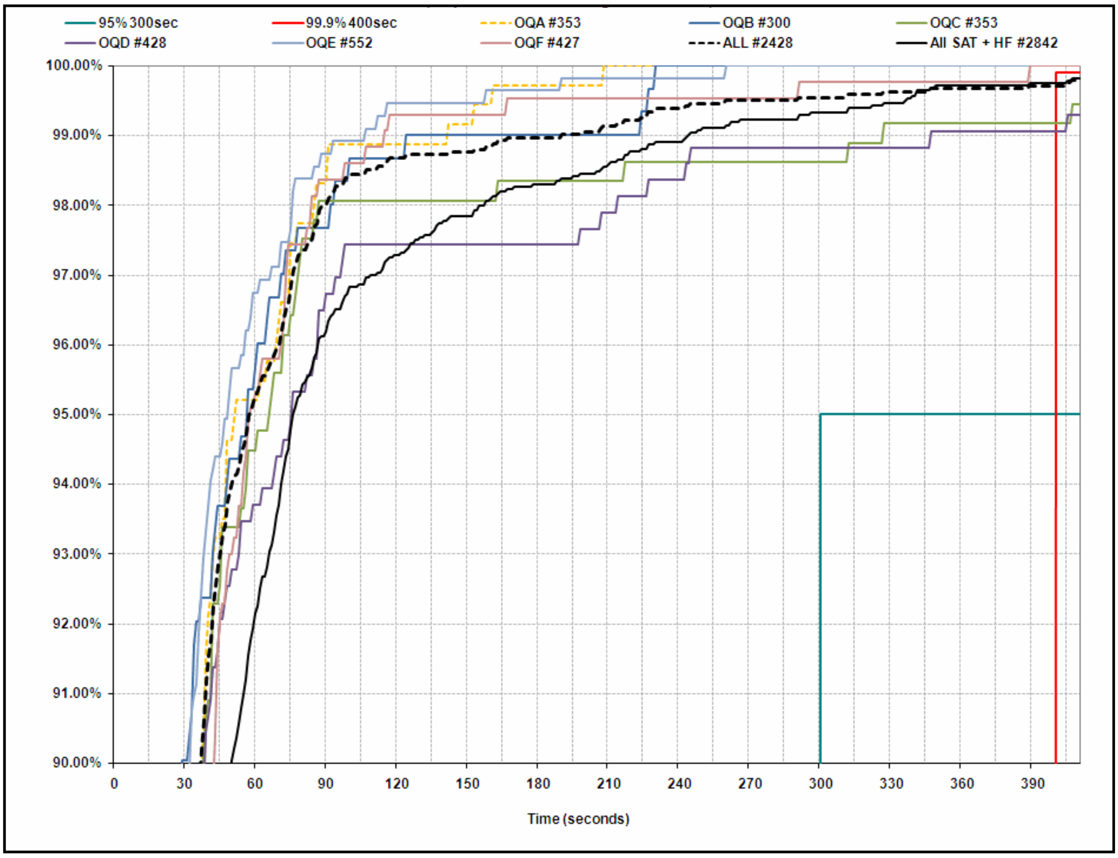

Figure 2: QFA ADS-C SATCOM Latency by aircraft – NZZO – Type 400

There is no significant difference at the 99.9% 400 second level between messages delivered via pure SATCOM and those delivered via SATCOM + HFDL, which is the normal operating mode on the A388. SATCOM delivered 99.7% of reports within 400 seconds, while the combined SATCOM + HFDL media delivered 99.8% of reports within 400 seconds. Performance of this fleet measured in the Oakland FIR also meets the type 400 99.9% requirement.

2.2 Emirates A388 Aircraft

Performance assessed against the Type 180 specification

Figure 3 plots current SATCOM latency for each aircraft in the Emirates A388 fleet (EDA-EDE) for the period May-July 2010. There is very little variation between aircraft at the lower end of the scale with 95% of all messages being received between 24 seconds and 34 seconds after transmission from the aircraft FMS. Please refer to Figure A2 in Appendix A which illustrates this lower end consistency.

The fleet is easily achieving the 95% requirement using SATCOM or SATCOM + HFDL but does not meet the 99.9% requirement. Looking at individual aircraft four out of five aircraft in this sample are better than 99.2% within 180 seconds. The lowest performing aircraft EDB only delivered 98.7% of messages within 180 seconds. The fleet average over SATCOM sees 99.2% of messages delivered within 180 seconds.

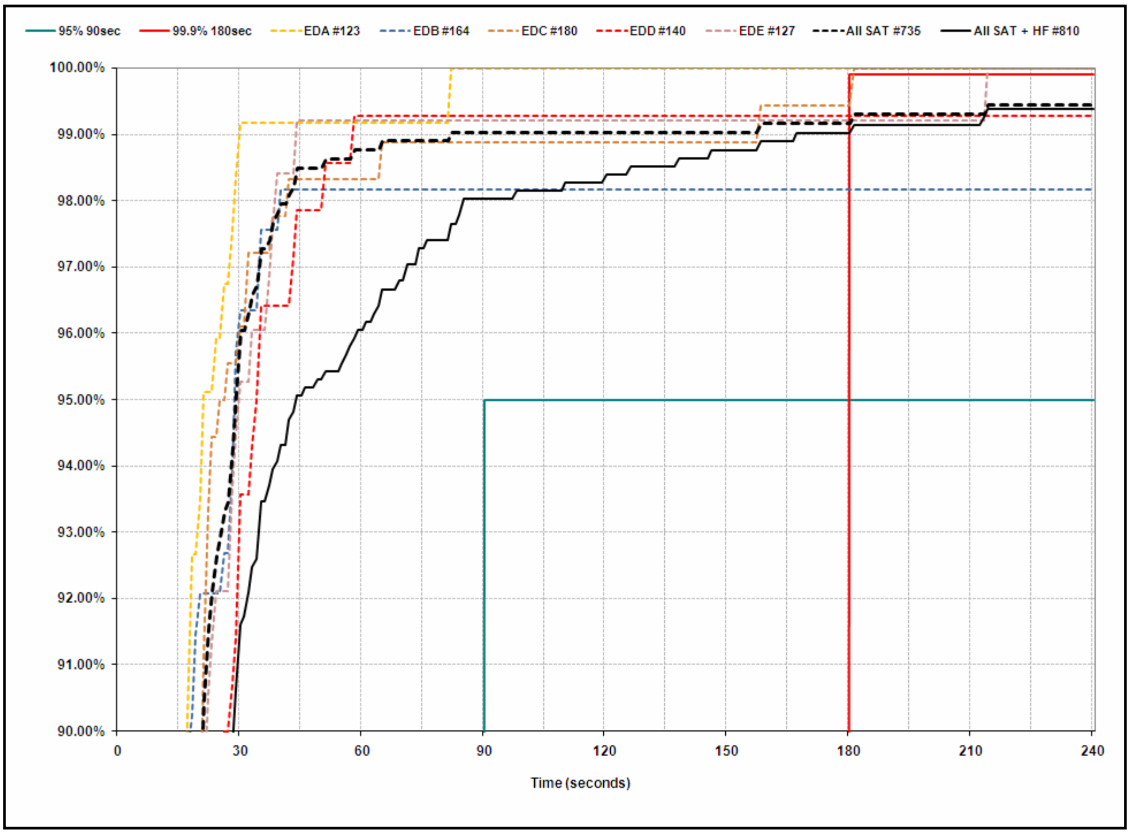

Figure 3: UAE ADS-C SATCOM Latency by aircraft – NZZO – Type 180

Figure 3 also depicts the difference in performance when HFDL latency is incorporated. While the fleet meets the 95% requirement for SATCOM + HFDL, only 99.1% of messages are delivered within 180 seconds. Using SATCOM + HFDL there is only a 0.1% difference from pure SATCOM in messages delivered at 180 seconds. In absolute terms 6 messages out of 810 during the review period fall outside the Type 180 requirement that 99.9% of messages are to be delivered within 180 seconds.

Performance assessed against the Type 400 specification

Figure 4 below plots current SATCOM latency for each aircraft (EDA-EDE), and the overall SATCOM and SATCOM + HFDL latency for all the aircraft for the period May-July 2010 measured against the Type 400 criteria required for HFDL.

All of the aircraft meet the Type 400 requirement of 99.9% of reports delivered within 400 seconds using pure SATCOM or SATCOM + HFDL which is normal operating mode for the A388.

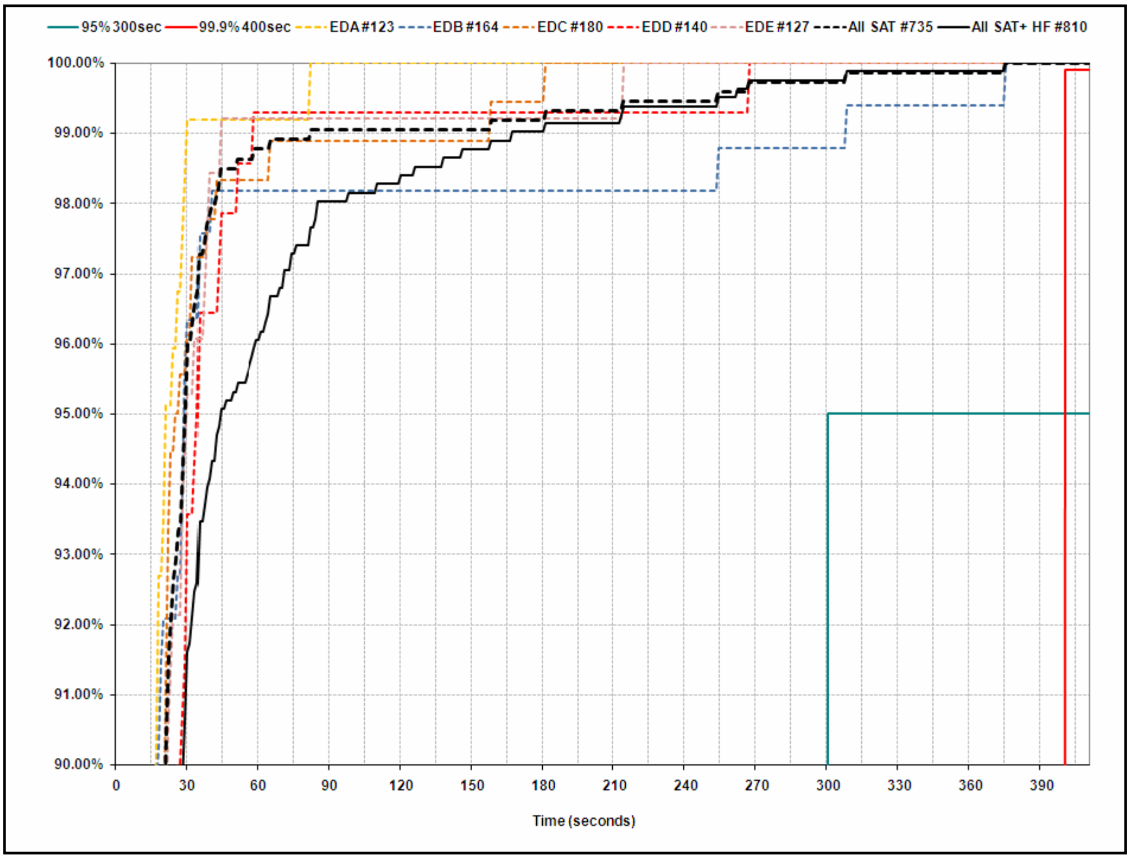

Figure 4: UAE ADS-C SATCOM Latency by aircraft – NZZO – Type 400

2.3 Comparison between QFA and UAE A388 fleets

Figure 5 below illustrates two significant differences between the two fleets: First, the observed QANTAS fleet performance in the Oakland Oceanic FIR is considerably better than that observed in Auckland Oceanic FIR. Second relative frequency distribution of delays for the QANTAS fleet is displaced to the right of the UAE distribution along the X axis.

2.3.1 QANTAS performance difference between Oakland and Auckland FIR

For the QANTAS fleet, there is little difference between the Oakland (ZOA) and Auckland (NZZO) performance distributions up to the 15 second 50% point. As the message times increase above this point, a significant performance drop-off is seen in the Auckland data which is clearly illustrated in Figure 5 below.

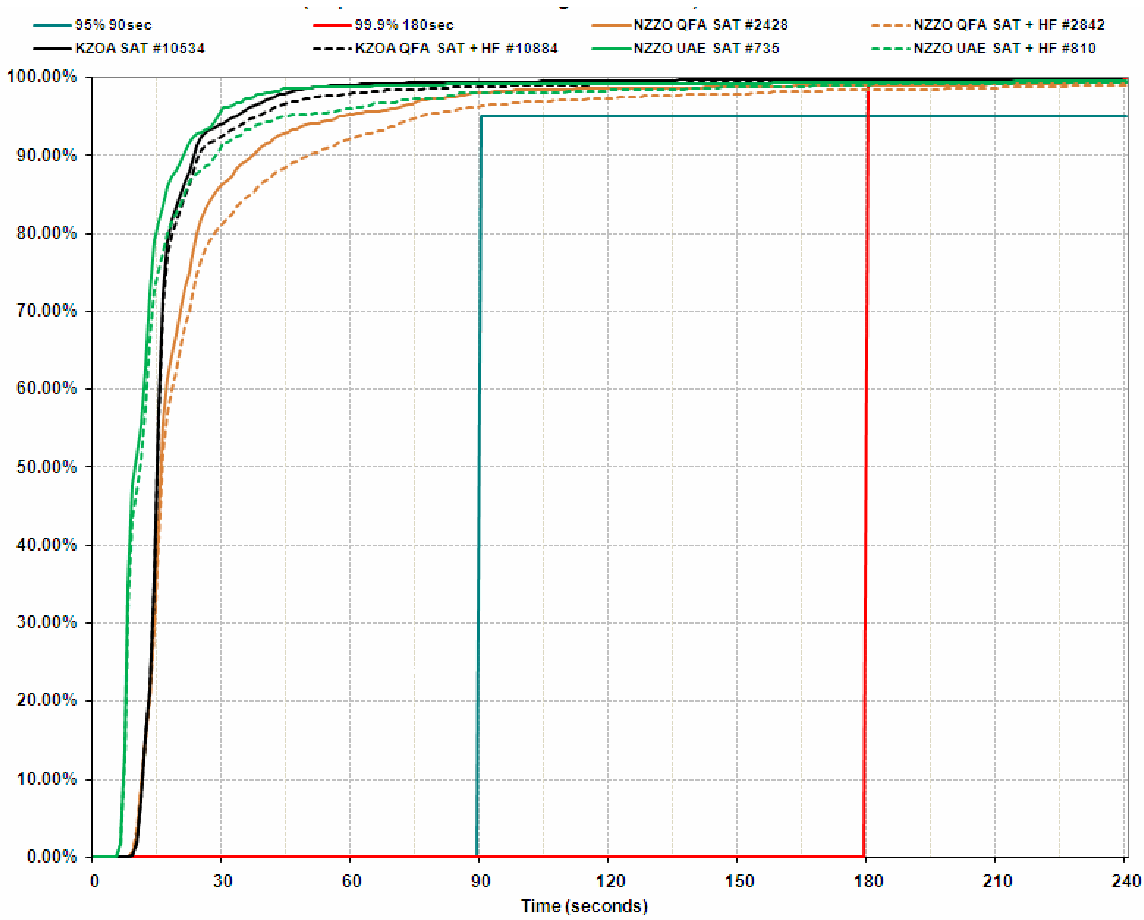

Figure 5: QFA and UAE ADS-C Latency by aircraft – Type 180

Analysis of messages sent via SATCOM and HFDL indicates that there is a significant difference between Oakland and Auckland in the percentage of ADS-C reports being sent via HFDL. This is illustrated in Table 1 below. Thus, if performance is correlated with the percentage of reports sent via HFDL, it is clear that the lower the percentage of reports sent via HFDL the better the observed performance.

FIR	Airline	% of reports
KZOA	QFA	3%
NZZO	QFA	15%
NZZO	UAE	9%

Table 1: Percentage of ADS-C reports sent via HFDL

A plot of all delayed reports with more than 180 seconds latency for the review period is shown in Figure 6. This plot shows a significant number of delays in the area between Norfolk Island (NLK) and Tonga (TBU) just south of the NFFF FIR boundary. Typically, at the time of year corresponding to the review period from May to July 2010, north bound flights on UPR between Sydney and Los Angeles operate around the axis indicated with a number entering into the NFFF FIR between Norfolk Island (NLK) and Tonga (TBU) for a short period before re-entering the NZZO FIR.

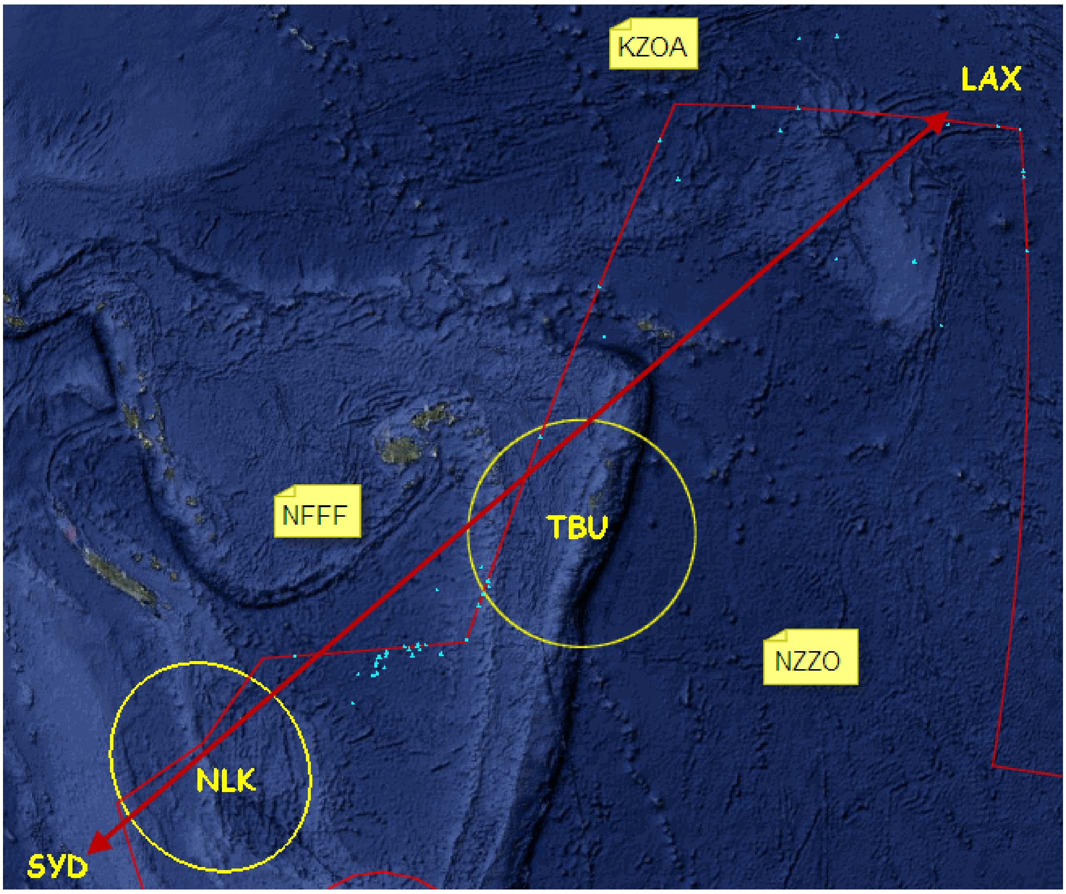

Figure 6: QFA A388 – Geographic distribution of delayed reports >180 seconds

To further investigate these large delays, a particular QANTAS flight on airframe, VH-OQD is analyzed. On 8 June between 0603 and 0618 a normal communications transfer to NFFF and normal CPDLC communications and ADS-C surveillance are observed with this aircraft. However, after this transfer is completed between 0603 and 0619 UTC a total of 5 AFN Contact (FN_CON) messages from the aircraft are received. For each of these AFN Contact messages the NZZO system will re-initialize the communications transfer process and the NZZO ground system will re-establish CPDLC and ADS contracts, and resend the NDA and AFN Contact Advisory to the aircraft for entry to NFFF. Similarly, multiple AFN Contact messages were received following a normal transfer process with NFFF for airframe VH-OQA on 4 July between 0609 and 0630 as well as for VH-OQE on 28 July between 0619 and 0625. In all these cases the aircraft was flight planned with a short sector transit of the NFFF FIR before re-entering NZZO.

This is clearly a ground system problem which is caused by the re-initialisation of the address forwarding process following an AFN logon in both the NZZO OCS and NFFF Aurora ground systems. This establishes a looping of the communications transfer process in these short sector transit situations between the two systems until the aircraft exits NZZO airspace. It is this looping that eventually causes the latency delays observed because of the large number of additional messages being processed on the aircraft. Airways will raise a FANS problem report on these occurrences and implement a software fix as soon as possible. This issue will have started with the introduction of the new Aurora ground system in Nadi.

The other delays seen in Figure 6 are mainly waypoint event reports on the common boundary between NZZO and NFFF, NTAA, and KZOA where multiple contracts are established with different FIR. These boundary delays are also seen on the Emirates fleet where the delayed reports with latency's exceeding 180 seconds are all waypoint event reports with 75% generated on the common boundary between NZZO and YBBB at 163E and the remainder at the NZZC domestic boundary with NZZO.

Airways will look at ways to mitigate these boundary delays. With the Emirates fleet most delays are on the westbound flights where the waypoint report at 163E is not needed by NZZO. One option that will be investigated is to remove the waypoint event contract after the penultimate waypoint has been crossed for all flights leaving NZZO airspace.

2.3.2 Performance difference between Emirates and QANTAS fleets.

The graph in Figure 7 below illustrates the QANTAS distribution shift along the X axis using a relative frequency distribution. This shows the relative frequency distribution observed on the QFA B744 fleet (representing "normal" FANS1/A operations), compared with the UAE A388 fleet in NZZO and the QFA A388 fleets in NZZO and KZOA.

The distribution for the UAE A388 and QFA B744 fleets correspond to the distribution typically observed on other FANS1/A fleets operating in the Auckland Oceanic FIR including A343, A345, B772, and B77W aircraft types. This typical FANS1/A distribution display a bi-modal characteristic with between 20-25% of messages delivered at around the 8 second point and between 5-10% of messages delivered around the 13 second point. The QFA A388 distribution is significantly different from this in both NZZO and KZOA with around 13% of messages delivered at the 15 second point in NZZO and with 22% delivered at the 15 second point in KZOA. The KZOA data also shows a smaller modal point around 12 seconds with around 8% of messages delivered at that time; there is a suggestion of the same smaller modal point in the NZZO data.

The difference in the distributions is similar to the difference seen between A343 fleets where one fleet was operating high speed ACARS channels and one fleet was operating on low speed ACARS channels. The low speed P, R, and T SATCOM channels operate at 600 bps or 1200 bps, the high speed channels at 10500 bps.

Discussions on the ACARS channel issue at a number of ISPACG forums have recommended that operators should use the high speed channels because of the performance improvements gained. This is also documented in the GOLD guidance material.

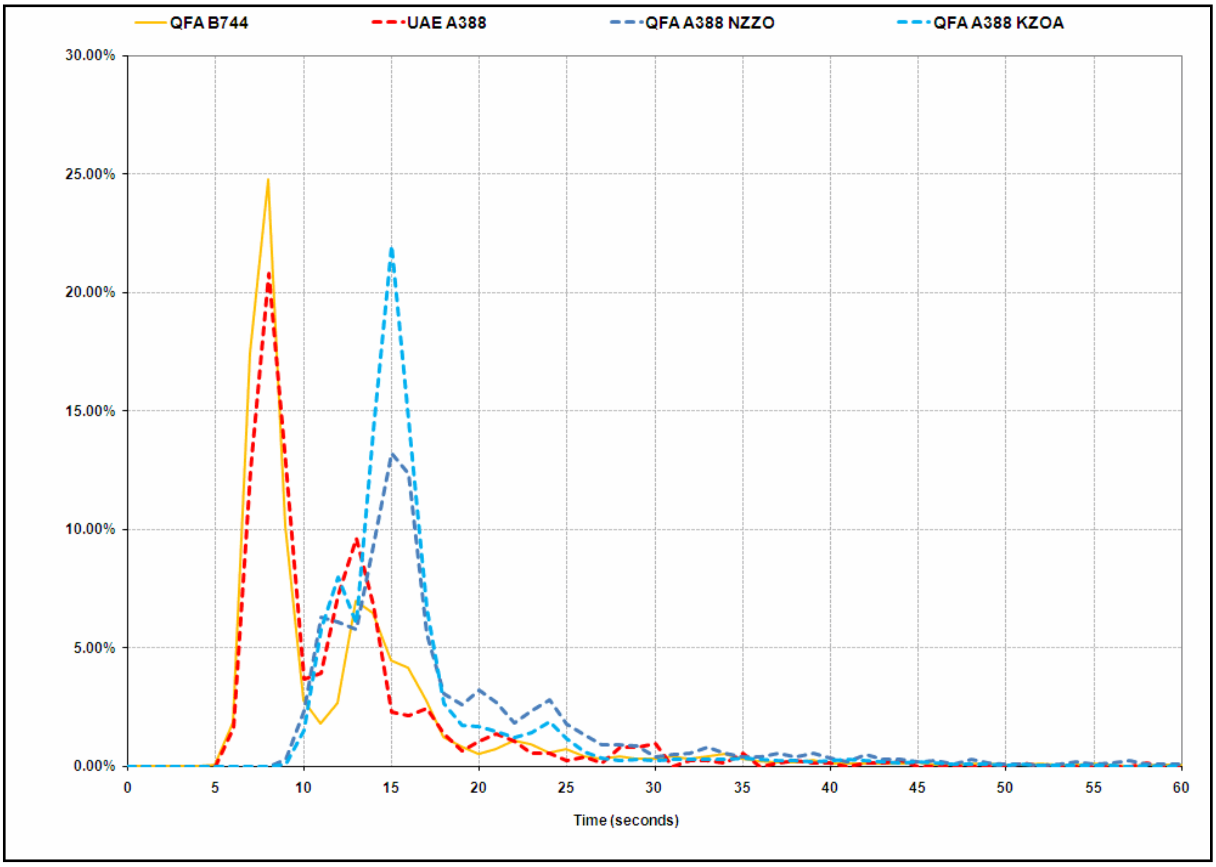

Figure 7: ADS-C Relative Frequency Distribution

The use of different ACARS channel may explain the difference in performance between the Emirates and QANTAS fleets and QANTAS will be asked to verify the current ACARS channel speed setting in use on their A388 fleet.

2.4 Comparison of 2009 performance with current performance

Figure 7 below illustrates the difference in observed performance for the QANTAS and Emirates A388 fleets in NZZO between that measured in 2009 and that measured during this review period (May-July 2010).

The performance of the QFA A388 fleet for May-July 2010 (solid black line) is slightly down on that observed for the entire year of 2009. It is expected that this is due to the delays caused by the NZZO and NFFF ground systems looping the communications transfer process during short sector transits as described in paragraph 2.3.1 above.

The current performance of the UAE A388 fleet (solid brown line) shows a significant improvement on that observed in 2009. The 2009 distribution is similar to that seen on the fleets affected by the DATA3/DATA2 interaction issue which was resolved earlier this year, but we have no data to verify that this is the reason for the observed improvement. Emirates may be able to provide an answer to this by advising if their A388 were using DATA3 for any applications.

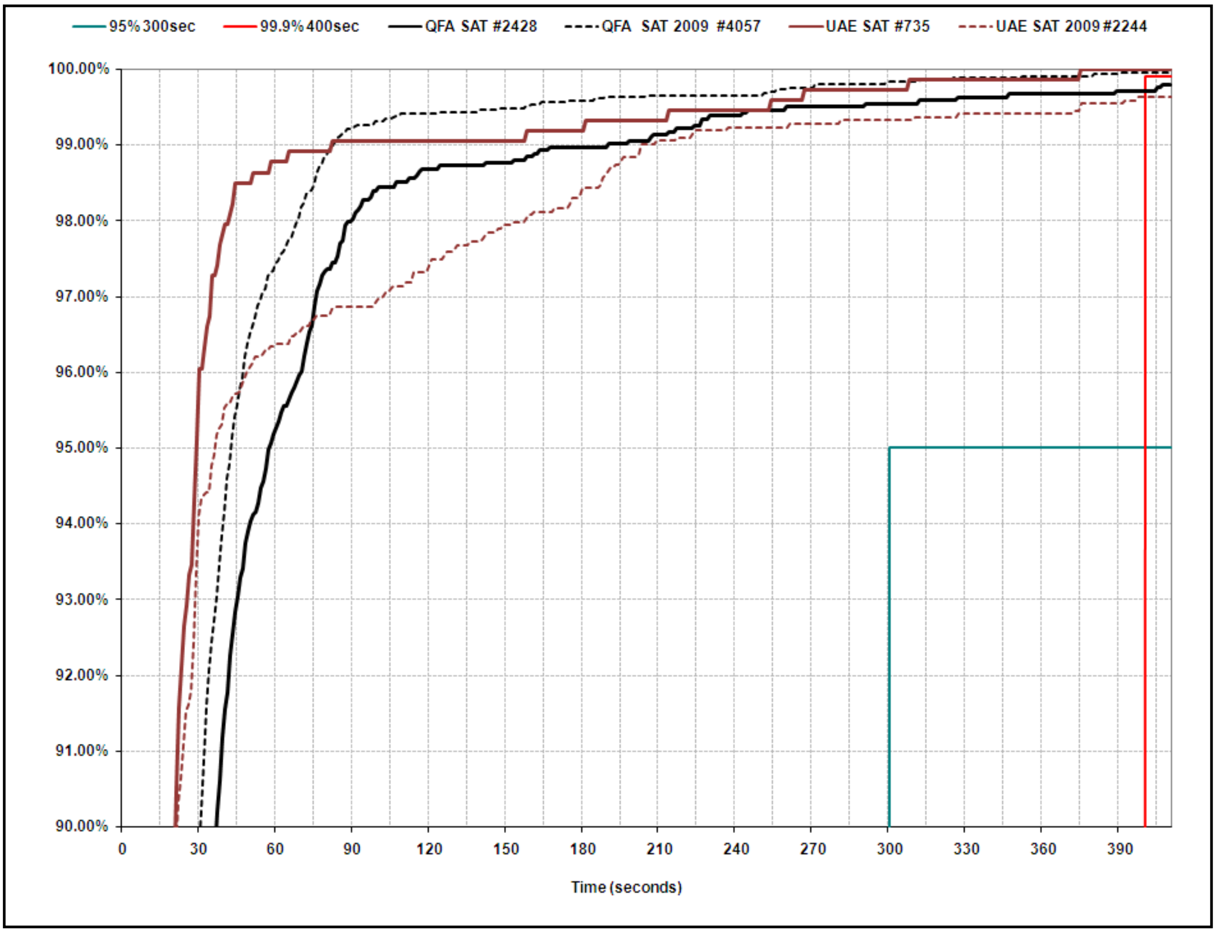

Figure 8: ADS-C latency performance 2009 compared with May-July 2010

2.5 Meeting Type 180 ADS-C latency requirements

In order to qualify for the application of reduced distance based separations, aircraft must meet both of the Type 180 ADS-C latency requirements. Figure 9 below shows the current fleet performance for SATCOM and SATCOM + HFDL. Neither of the A388 fleets reviewed is currently meeting the Type 180 requirement for 99.9% of reports delivered within 180 seconds but all meet the normal operating requirement of 95% delivered within 90 seconds.

Airways have assessed the current ADS-C latency performance in terms of traffic density within the Auckland Oceanic FIR, and the frequency of operations experiencing reduced separation. While neither fleet meet the 99.9% 180 second requirement, it is the view of Airways that the degraded performance is mainly caused by delays concentrated in specific areas, and can thus be managed. Accordingly, Airways is of the opinion that the observed performance level of ADS-C latency does not pose a significant risk when applying reduced distance based separations in the Auckland Oceanic FIR and we will at this stage continue with their application on the A388.

The data presented in this report illustrates that the use of HFDL can significantly degrade performance when trying to meet the Type 180 requirements. Airways will attempt to improve performance by resolving the short sector message looping issue identified in 2.3.1 above, and by taking steps to minimise common boundary multiple contract issues. However, it is unlikely that those steps will improve performance much beyond that observed in the Oakland data as shown in Figure 9. It would be advantageous if the A388 fleets could deliver 99.7% of reports or better within 180 seconds, but this is only being met in Oakland if pure SATCOM is used. The penalty imposed by HFDL use is seeing performance drop to what we consider to be an unacceptable level.

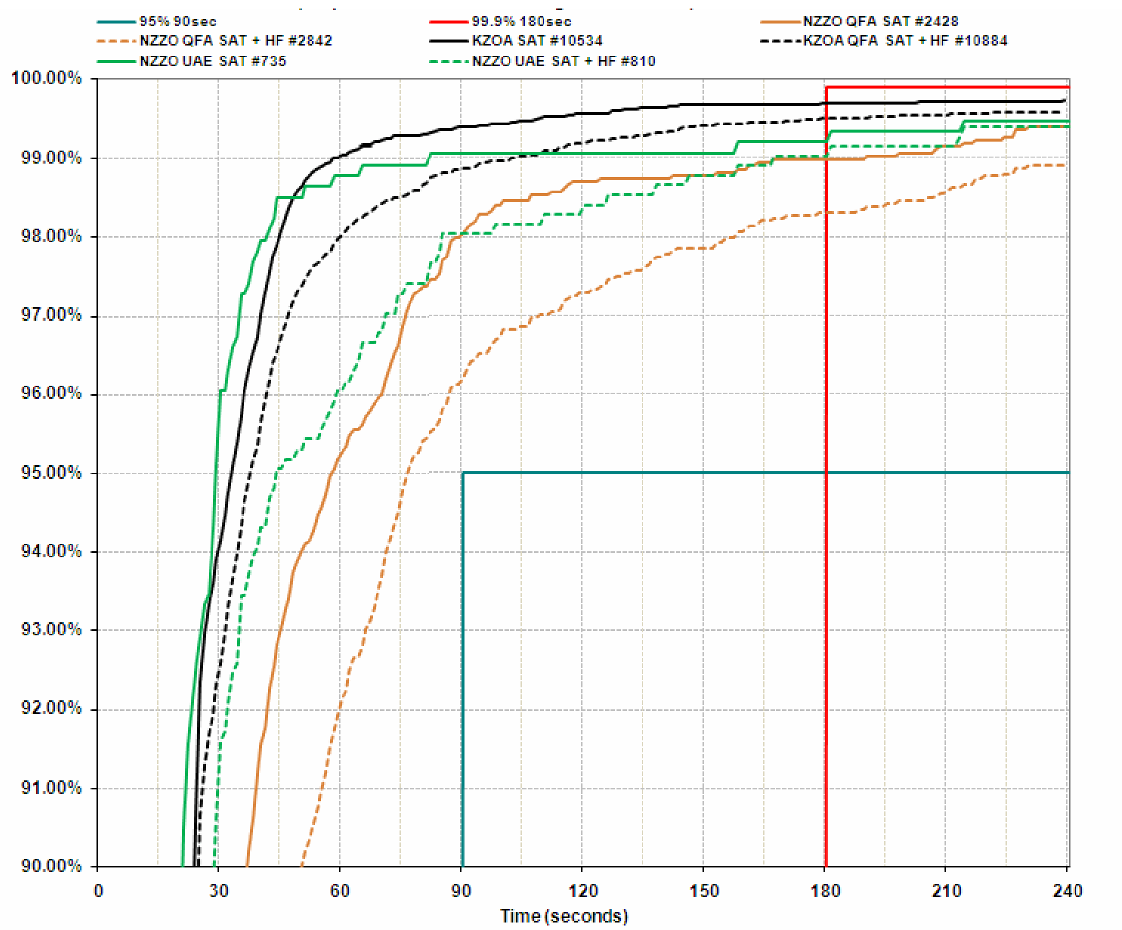

Figure 9: ADS-C Type180 latency requirements

Observation of HFDL performance shows that aircraft using this media will meet the type 400 latency requirements but that fleets will not meet the type 180 requirements. It should be noted that ANSP operating with a higher density of traffic may not be as liberal as Airways in their interpretation of the requirements. Therefore, we suggest that airlines inclined to meet the RCP240 Type 180 requirements for the application of reduced distance based separations re-evaluate their use of HFDL for ATC communications.

The performance observed for A388 using SATCOM only is still below that observed for fleets of B744 and A343 operating in the Auckland Oceanic FIR and meeting the type 180 latency requirements. Figure 10 below illustrates this difference in performance by comparing the KZOA data for the QFA A388 to the NZZO data for the B744 and A343 fleets.

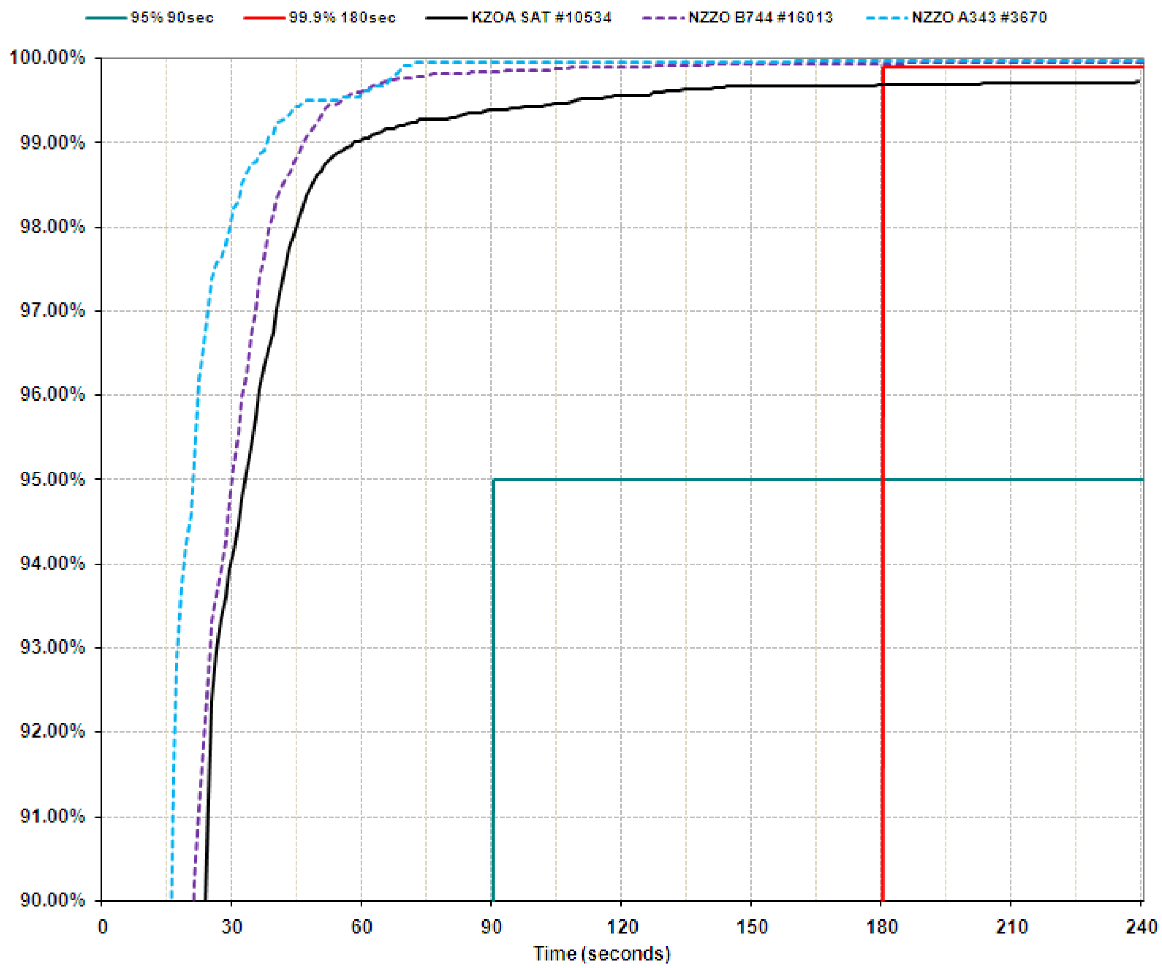

Figure 10: Type 180 performance difference A388 A343 B744

It is unknown whether the QFA A388 is using low or high speed ACARS channels. If the low speed channels are currently being used, it is expected that the distribution would shift to the left if the high speed channel were used instead, thus mimicking the distribution below 99% for the A343 and B744 fleets. However, this would not improve the performance above 99% for the A388, which would still below be the other fleets, with too many messages being delivered with an unacceptably high latency.

A distinct reason for this lower performance is not apparent at this time, but the need for further improvement is clear.

3 Observed CPDLC Performance

3.1 Comparison between QANTAS and Emirates A388 fleets

Performance improvements observed in this review period

Figure 11 illustrates the improvements in performance for the assessment of CPDLC actual communications technical performance (ACTP) during the 2010 review period from May to July as compared with the assessment of the data during the entire year of 2009. It is expected that this is due to the resolution of the CSP routing issues resulting in CPDLC uplinks sent incorrectly via HFDL. While an occasional downlink via HFDL is observed, pure HFDL transactions where both the uplink and downlink are sent via the HFDL media are not. It will be recommended that the FANS problem report covering this issue is closed.

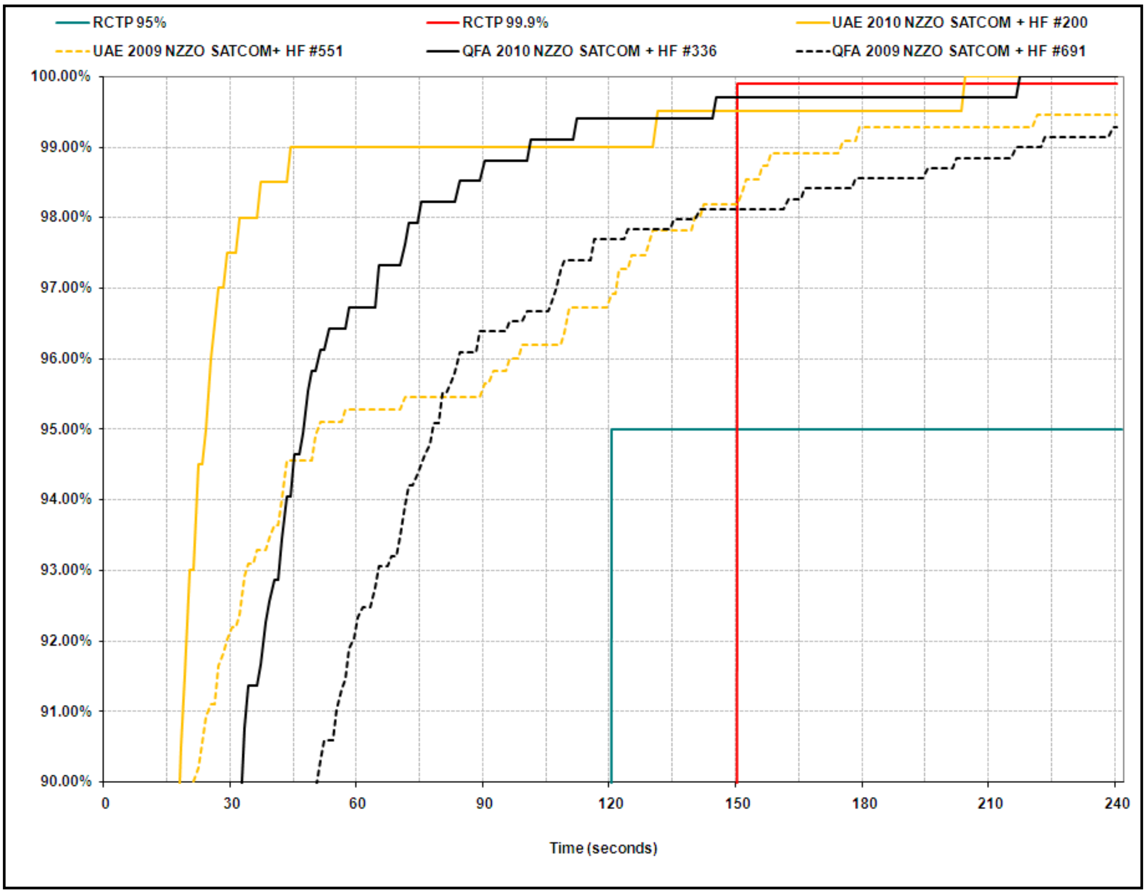

Figure 11: CPDLC ACTP performance improvements

The improvement in performance observed for the UAE distribution may be partially explained by the release of the GES Release 15 software upgrade by ARINC at the Santa Paula GES in early 2010 (prior to this review period). SITA have subsequently released GES release 15 at the Perth GES.

Actual Communications Technical Performance (ACTP)

ACTP measures the technical performance of a CPDLC transaction by adding the uplink latency to the downlink latency thus excluding the flight deck decision time. While the observed ACTP easily meets the normal operations requirement of 95% of the transactions to be completed within 120 seconds neither fleet is meeting the requirement to have 99.9% of the transactions completed within 150 seconds. Figure 12 illustrates the performance of the QANTAS fleet observed in the Auckland and Oakland FIR, and the performance of the Emirates fleet observed in the Auckland FIR.

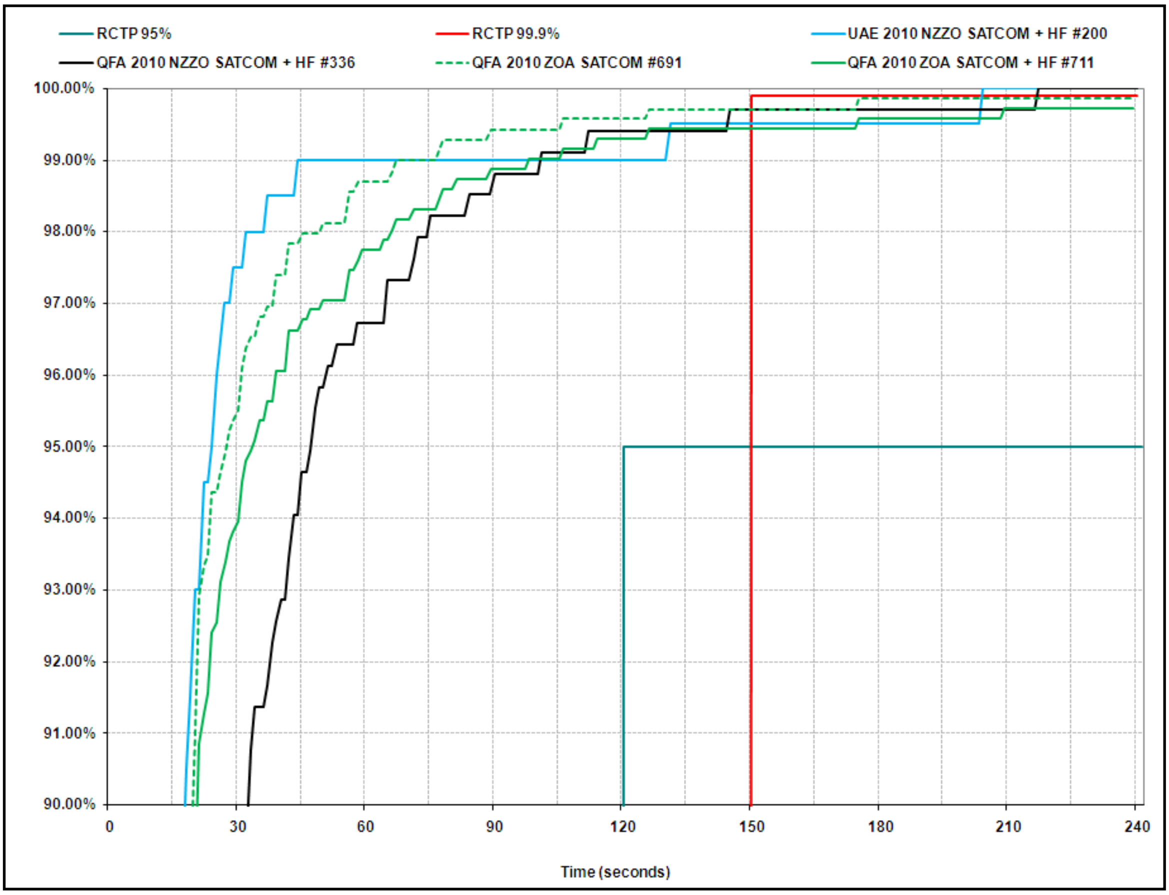

Figure 12: RCP240 ACTP Distribution 90-100%

Based on further analysis of the QANTAS data from the Auckland FIR it has been determined that the removal of the two transactions affected by the ANSP message looping issue results in the QANTAS fleet meeting RCP240 ACTP requirements. Only one Emirates transaction did not meet the RCP240 ACTP requirement. Due to the low count of total transactions for Emirates this has a significant effect even though the transaction was completed less than a minute outside the requirement.

The Oakland data represented in Figure 12 clearly demonstrates the performance penalty experienced when using HFDL while trying to meet RCP240 requirements. This is around a 0.3% at 150 second mark.

Similar to that observed in the ADS-C latency distributions, the QANTAS CPDLC data shows the same shift in the distribution to the right on the X-axis. This is illustrated in Figure 13 below.

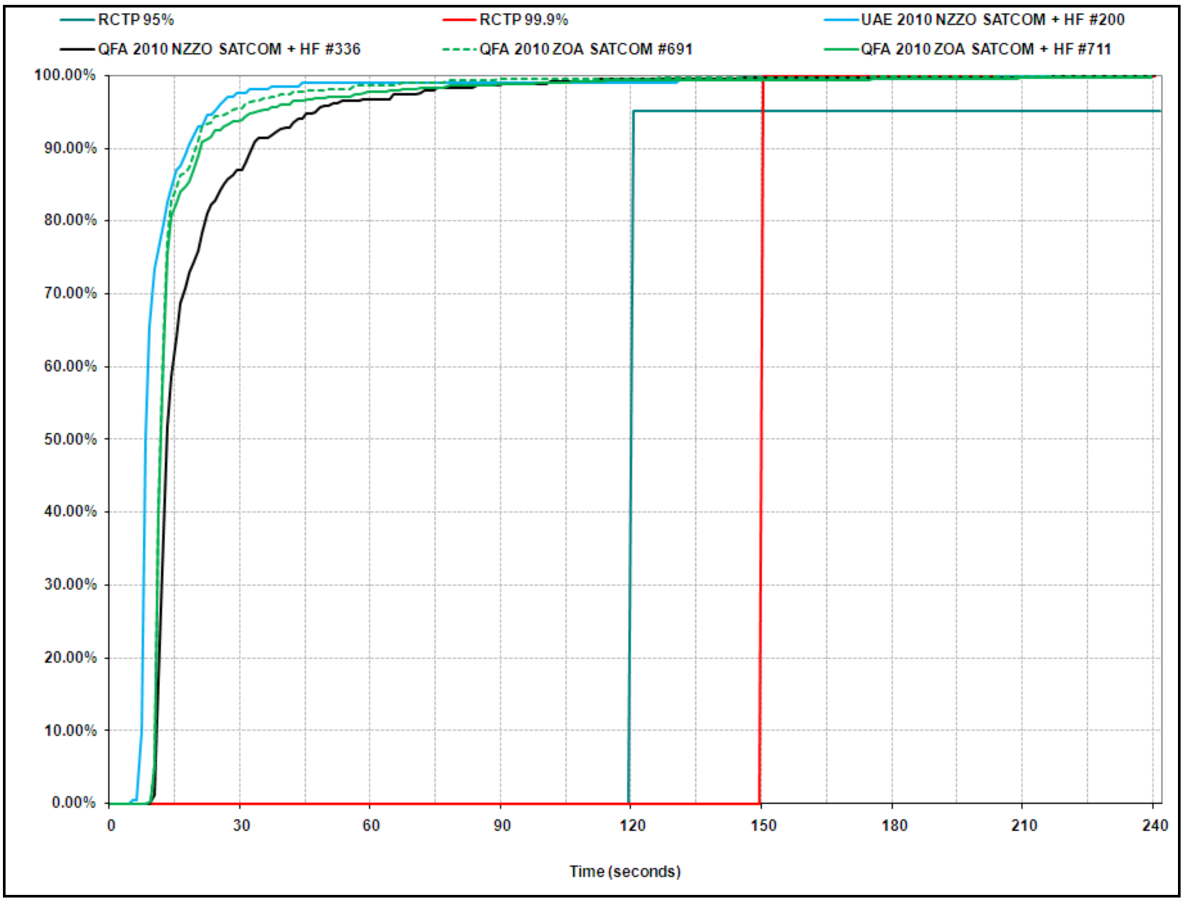

Figure 13: RCP240 ACTP Distribution 0-100%

Pilot Operational Response Time (PORT)

The PORT measures the time it takes for the flight deck to respond to the controller instruction and send the downlink response. The RCP240 specification has an allocation of 60 seconds for PORT and expects that 95% of responses will be sent within this time.

In 2009 the PORT distribution for both fleets just met the 95% 60 second point, but a marked improvement as been observed for the PORT observed in this review period with better than 97% of the messages assessed being processed by the flight deck within 60 seconds as illustrated in Figure 14 below.

However, there remain a small number of messages with an abnormally long response time. Because PORT contributes to the Actual Communication Performance measurement of transaction performance these unusually long response times prevent the fleets from meeting the RCP 240 requirements regardless of the technical performance of the FANS1/A system.

It would be beneficial to remind crews of the need for prompt responses to messages requiring WILCO responses.

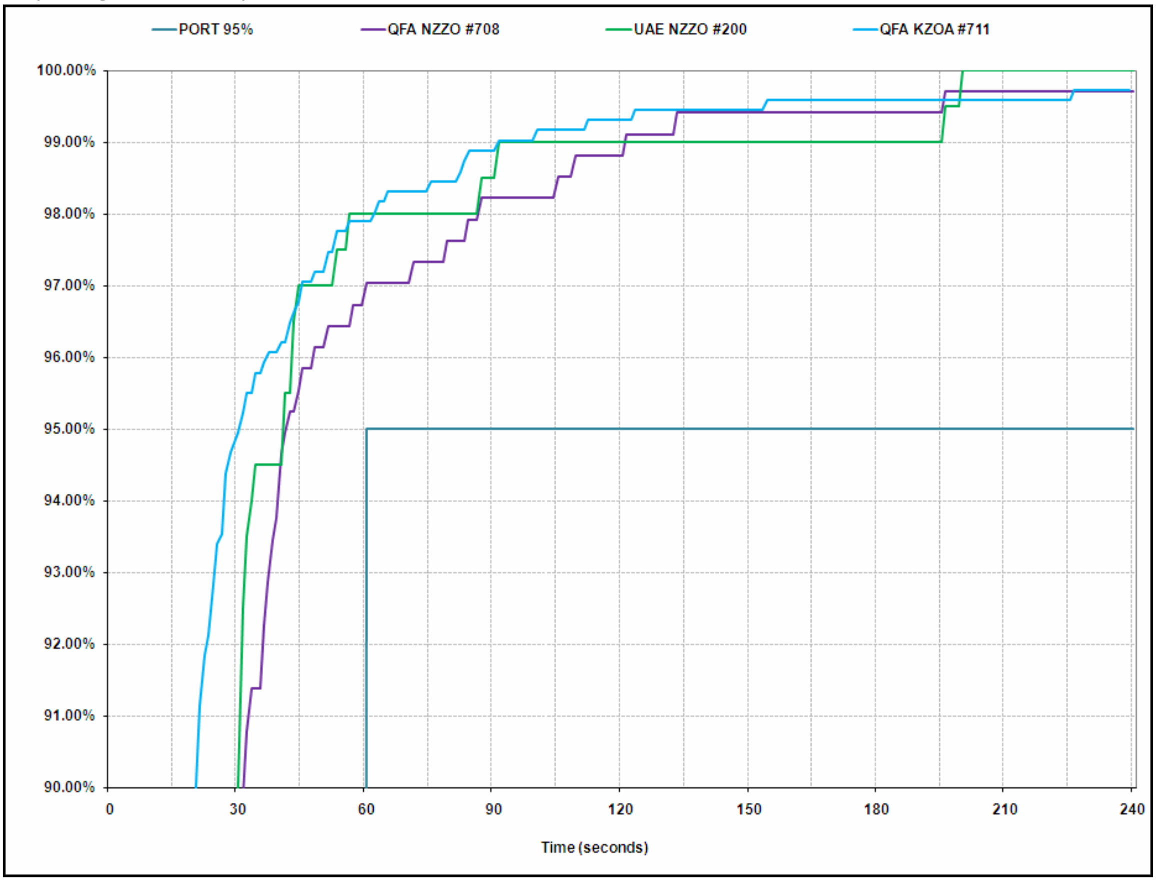

Figure 14: PORT distribution

Actual Communications Performance (ACP)

ACP, also referred to as the transaction time (TRN), measures the performance of the complete CPDLC transaction and is estimated by adding the PORT to the technical latency of the uplink and downlink measured using ACTP. . The ACP observed in this review period is illustrated in Figure 15.

To meet the RCP240 specification 95% of transactions are required to be completed within 180 seconds and 99.9% within 210 seconds. Both fleets easily meet the 95% of transactions completed within 180 second requirement.

The performance related to ACP for the QANTAS fleet is observed to be better in the Oakland FIR than in the Auckland FIR. It is suspected that the Auckland performance is affected by the message looping issue described in paragraph 2.3.1 above.

As illustrated in the Figure below, the observed ACP performance falls below the RCP240 requirement at the 99.9% level in both Oakland and Auckland. However, it can be seen that 100% of the transactions are completed within 240 seconds in Oakland, thus within 30 seconds beyond the 99.9% requirement. The performance penalty using SATCOM + HFDL in Oakland is also illustrated in this Figure, approximately 0.3% at 99.9% and 210 seconds. This is consistent with the penalty observed for the CPDLC ACTP and ADS-C latency.

The Emirates fleet is not meeting the RCP240 99.9% requirement either, although it is not far beyond it with all transactions completed within 220 seconds.

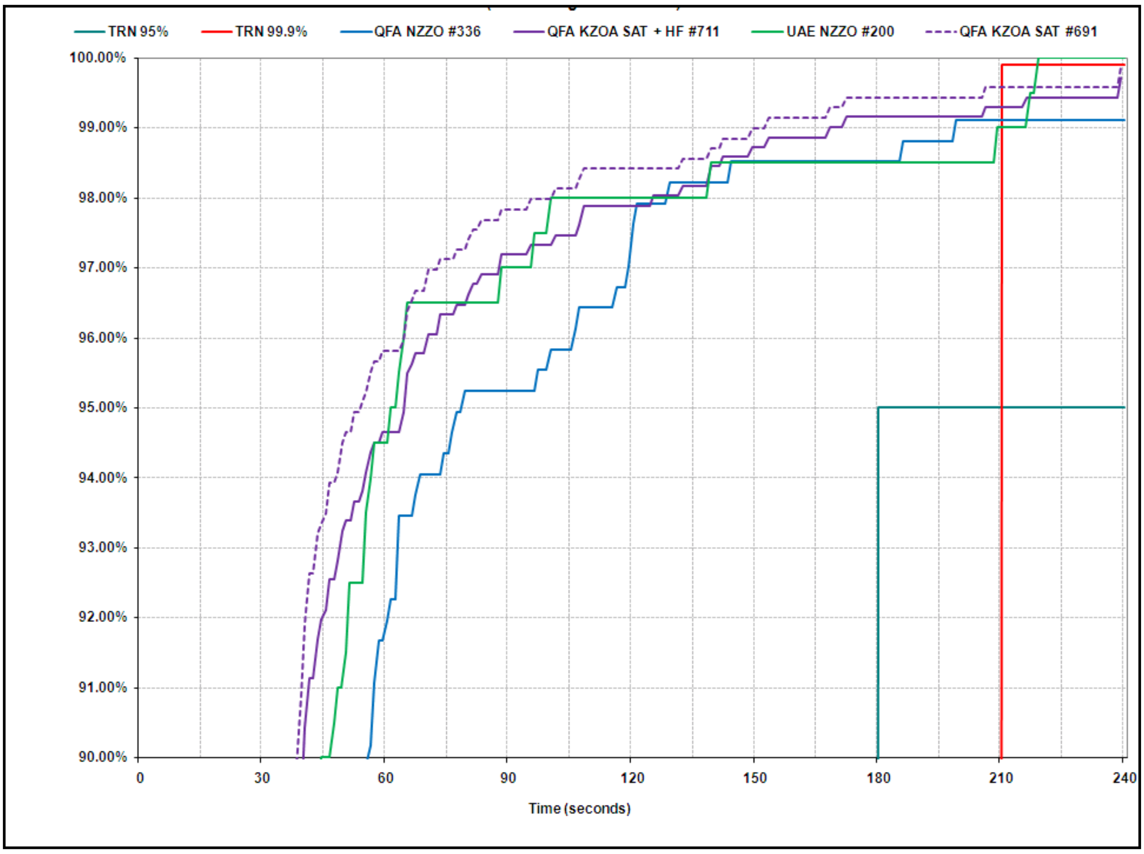

Figure 15: RCP240 ACP distribution 90-100%

4 Conclusions

1. Ground system software. An issue with Airways OCS software design is contributing to the degradation of FANS1/A performance of the QANTAS A388. This degraded performance is the result of latency delays introduced by a significant increase in message traffic caused by looping of the AFN address forwarding process during short sector transits of the Nadi FIR. This is legacy code shared with the Nadi Aurora and FAA ATOP systems. This issue will have been affecting performance since the commencement of operation of the Nadi Aurora system in May this year.

2. Overall performance. Excluding the effects of the ground system software issue, performance has significantly improved across both fleets from 2009 to the review period covered in this report from May through June 2010.

3. ADS-C performance. Both the QANTAS and Emirates A388 fleets easily meet the 95% normal operating requirements for ADS-C type 180 but do not meet the 99.9% requirements. The Emirates fleet meets the type 400 99.9% requirements required for HFDL, but the QANTAS fleet falls just short of meeting it in the Auckland FIR, likely due to the software issue referenced in conclusion 1 above. The QANTAS A388 fleet does meet the type 400 99.9% specification in the Oakland FIR. Performance remains below other FANS1/A aircraft types at the top end of the distribution.

4. CPDLC performance. Both the QANTAS and Emirates A388 fleets easily meet the 95% normal operating requirements for RCP240 when assessing ACTP, PORT, and ACP. Both fleets nearly meet the 99.9% ACTP requirement and the QANTAS fleet would have met the performance requirement if two transactions that we can identify as being affected by the ground system message looping issue in conclusion 1 were removed. PORT performance is meeting RCP240 allocations but there are still a number of significantly delayed responses. Both fleets are just missing the 99.9% ACP requirement.

5. Impact of HFDL. When HFDL is used in the next-on-busy mode as seen on the A388, it imposes a significant penalty towards meeting the 99.9% performance requirements for both Type 180 surveillance and RCP240. It is not likely that these aircraft will meet the specifications with continued use of HFDL for ATC communications. HFDL performance does meet the type400 and RCP400 specification.

6. QANTAS latency. The latency performance of the QANTAS fleet is observed to be lower than that of the Emirates fleet. This is observed as a right shift of the complete distribution and would appear to indicate a slower transmission rate through the selected media.

7. Application of reduced distance based separations. The application of these reduced separations requires the aircraft to meet the Type 180 and RCP240 requirements. While both fleets easily meet the 95% operating requirements they are struggling to meet the 99.9% requirements.

8. Near boundary latency delays. It has been concluded that FANS1/A ADS-C event reports can be delayed when event reports are concurrently established with multiple FIR. These near boundary latency delays are observed with the A388 fleets.

5 Recommendations

1. Ground system software. Airways have initiated a software upgrade that will resolve the short sector message looping issue. The intention is to have this completed and installed by 1 October 2010. The issue is being tracked through the ISPACG CRA using the FANS problem report process.

2. Overall performance. While overall performance has generally improved for the A388 fleets further performance improvements are required to enable these fleets to meet RCP240 and type 180 requirements.

3. ADS-C performance. Airways will complete another performance review in twelve months time. Stakeholders should continue attempts to identify the cause of the top end delays.

4. CPDLC performance. Airways will complete another performance review in twelve months time. Stakeholders should attempt to identify the cause of the top end PORT delays because of their negative impact on ACP.

5. Impact of HFDL. The use of HFDL should be re-evaluated by the A388 airlines if they aim to achieve the RCP240 requirement.

6. QANTAS latency. The specific ACARS channel speed used on the QANTAS A388 fleet should be reviewed. If the fleet is currently using the high speed channels then further investigation is needed to explain the performance difference.

7. Application of reduced distance based separations. Airways have reviewed the performance data and will continue to apply reduced distance based separations in the Auckland FIR at this time.

8. Near boundary latency delays. Airways will investigate ways to reduce the use of waypoint event reports for flights departing NZZO airspace.

Appendix A Additional Data

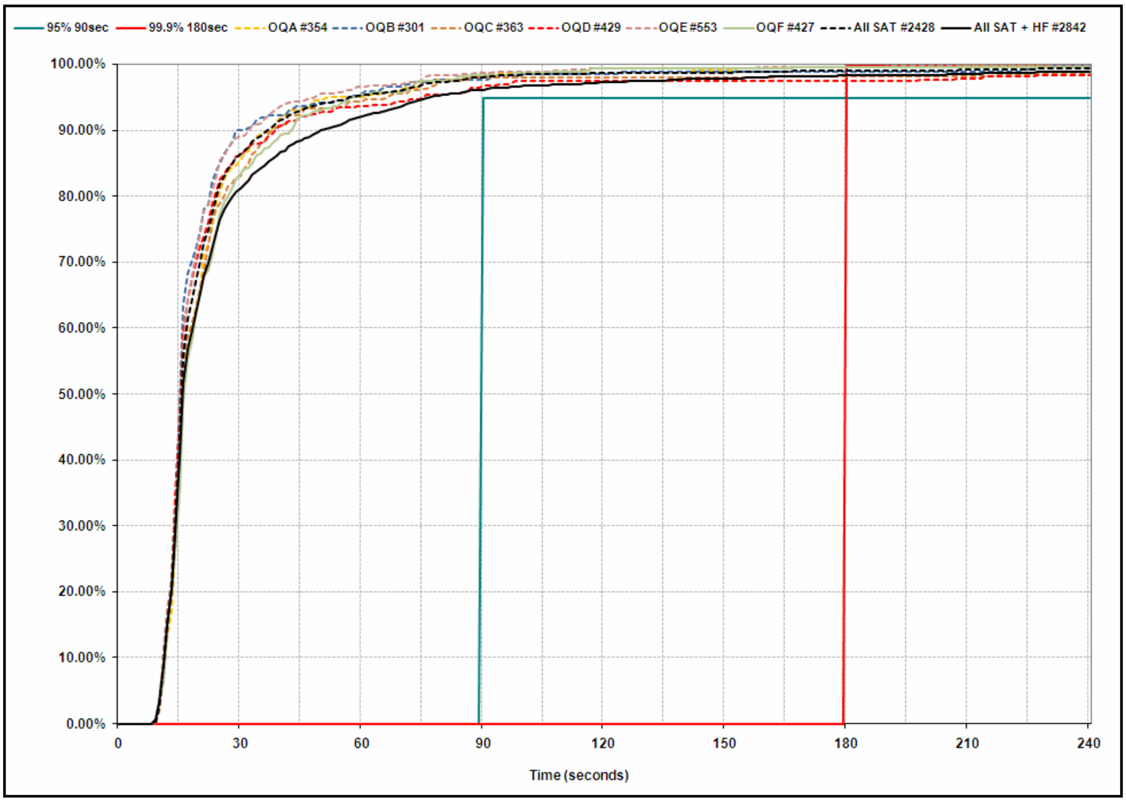

Figure A1: QANTAS Type 180 ADS-C NZZO FIR

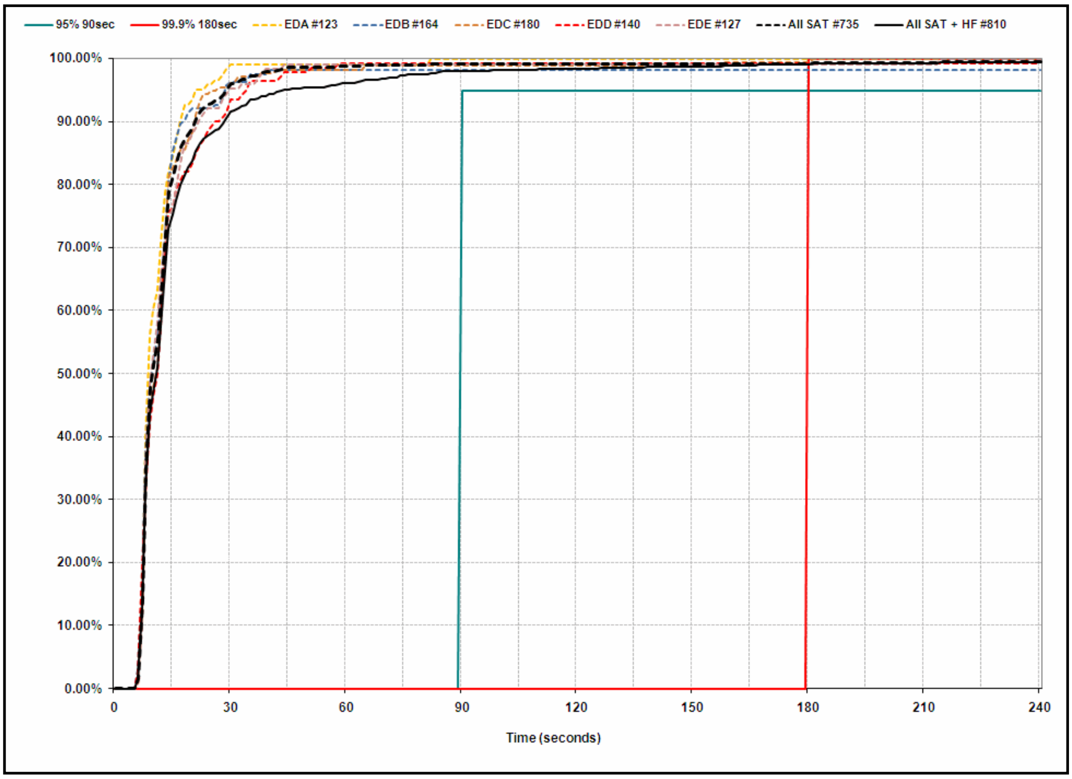

Figure A2: Emirates Type 180 ADS-C NZZO FIR

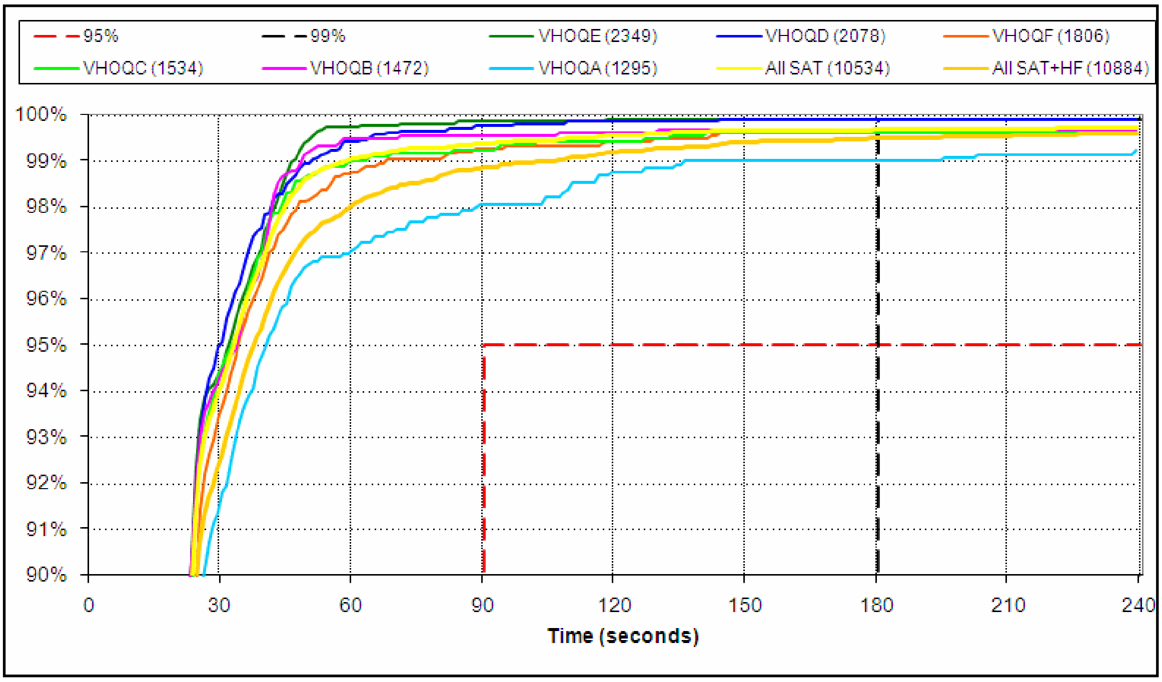

Figure A3: QANTAS Type 180 ADS-C by tail ZOA FIR

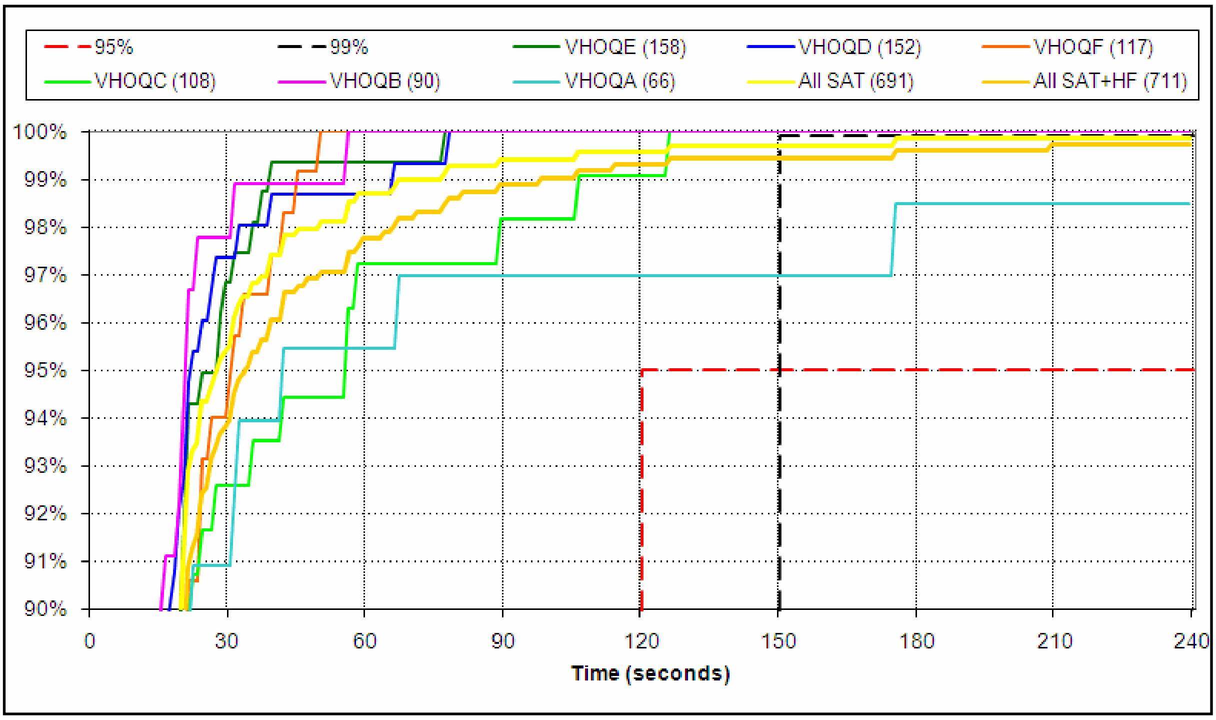

Figure A4: QANTAS ACTP 240 by Tail ZOA FIR

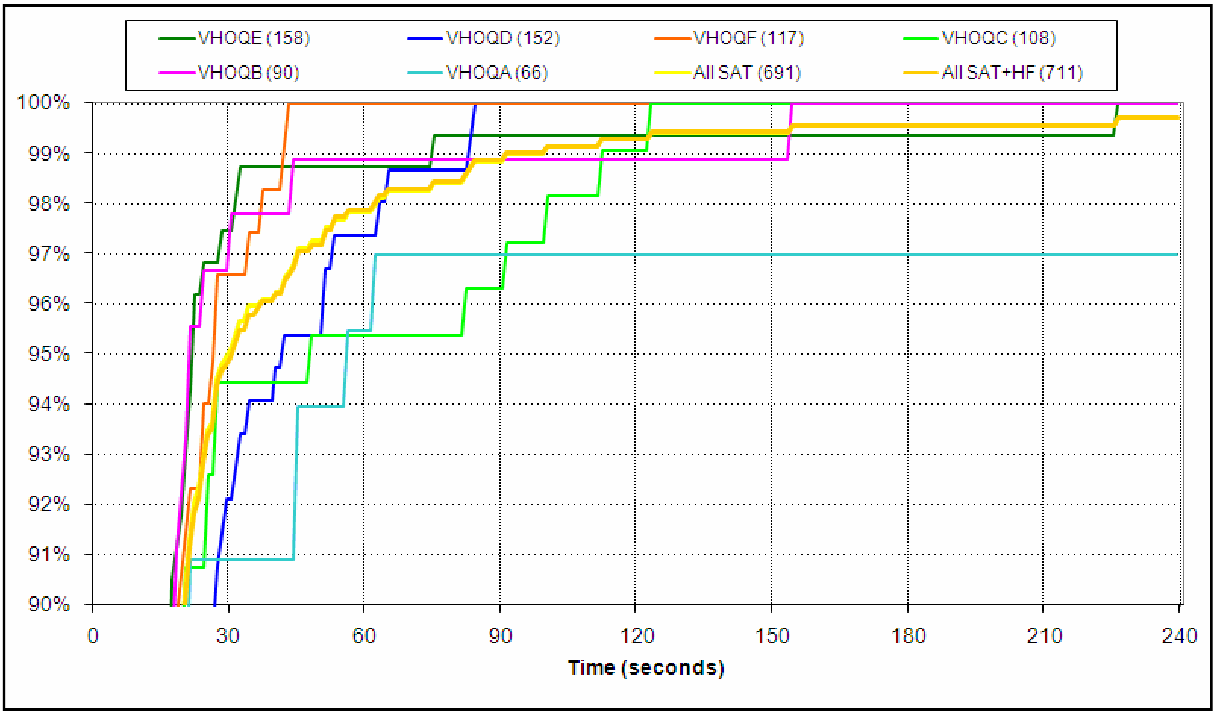

Figure A5: QANTAS PORT 240 by tail ZOA FIR

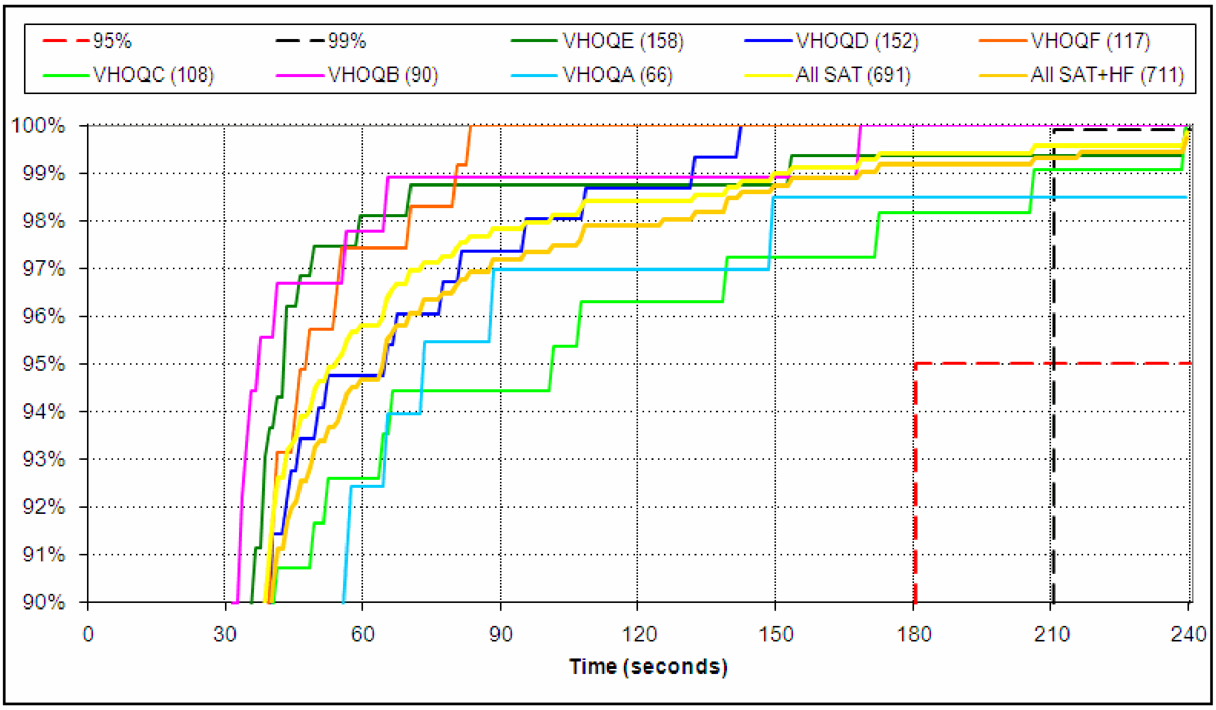

Figure A6: QANTAS ACP by tail ZOA FIR