Twenty Fourth Meeting of the
Informal South Pacific ATS Co-ordinating Group (ISPACG/24)

FANS Interoperability Team Meeting (FIT/17)
Brisbane, Australia, 9-10 March 2010

Agenda Item 7: ANSP Monitoring

CPDLC COMMUNICATION PERFORMANCE AND ADS-C LATENCY POST IMPLEMENTATION MONITORING FOR THE OAKLAND FLIGHT INFORMATION REGION (FIR)

Presented by the Federal Aviation Administration

SUMMARY

This paper provides observed performance measures as specified in the Global Operational Data Link Document (GOLD) from the operational data collected in Oakland Oceanic airspace. This analysis includes performance of the Controller Pilot Data Link Communication (CPDLC) and Automatic Dependent Surveillance – Contract (ADS-C).

1. INTRODUCTION

1.1 This paper provides observed performance measures from the operational data link system at Oakland Oceanic Center. The purpose of this paper is to present the most recent observed performance of the data link system.

1.2 The performance data observed from the Controller Pilot Data Link Communication (CPDLC) and Automatic Dependent Surveillance - Contract (ADS-C) systems are measured against the Required Communication Performance (RCP) 240 specification to demonstrate that safety objectives which rely on the communications infrastructure can be met by the aircraft and ground systems. The sample period of 1 August 2009 through 31 January 2010 was examined in this paper.

2. DISCUSSION

2.1 The Global Operational Data Link Document (GOLD) provides the guidance material describing the required data points from the FANS 1/A aircraft communications addressing and reporting system (ACARS) messages. The GOLD also describes the calculation process for the actual communication performance (ACP), actual communication technical performance (ACTP), pilot operational response time (PORT), and surveillance latency.

2.2 The ACP is used for monitoring the RCP requirement time allocation for the communication transaction (TRN). The TRN is the portion of the total transaction time that does not include the message composition time or recognition of the operational response. Actual communications technical performance (ACTP) is used to monitor required communication technical performance (RCTP) time allocations, and pilot operational response time (PORT) is used to monitor the flight deck responder element of the transaction.

2.3 As described in the GOLD, this analysis uses the measurement of transit and response times to those CPDLC uplinks that receive a single Will Comply (WILCO) and/or an Unable response. These messages are considered to be intervention messages critical to the communications used when applying reduced separation standards. Other message types, such as free text queries or information requests, are not included in the analysis because the corresponding longer response time from the flight deck would skew the results. All messages with a WILCO and/or Unable response attribute are assessed. These include communications transfer messages in addition to the typical intervention messages such as climb clearances. The ACP is computed by the difference between the time the uplink message is originated at the air traffic service provider (ATSP) and the time the corresponding response downlink is received at the ATSP.

2.4 The ACTP is computed in three steps. The first step is to estimate the downlink time from the difference between the time stamp on the aircraft-originated downlink message and the ATSP received time. Then, the round trip time of the uplink message is estimated from the difference between the time the uplink message was sent from the ATSP and the receipt of the message assurance (MAS) response for the uplink at the ATSP. The last step is to divide the estimated round trip time by two and add the result to the estimated downlink time. Equation 1 provides the estimate of ACTP:

$$((\textit{MAS receipt} - \textit{Uplink transmission time})/2 + \textit{Downlink time}) \qquad (1)$$

2.5 The GOLD also describes the estimation of the PORT latency, which is calculated by the difference between ACP and ACTP. Figure 1, taken from the GOLD, illustrates these measurements.

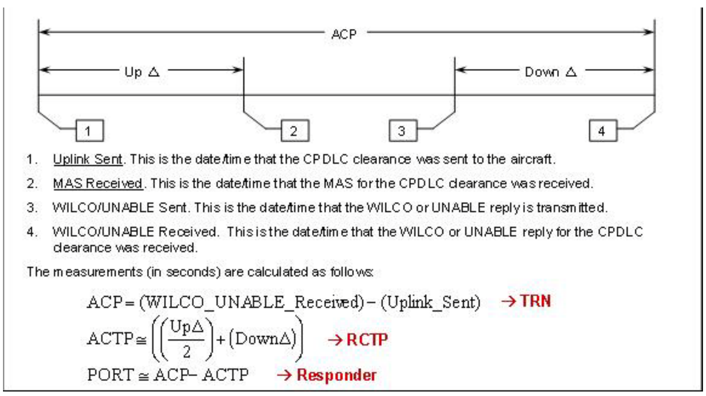

Figure 1. CPDLC transaction calculations (refers GOLD)

2.6 Observed Data Link Performance by Media Type

2.6.1 Figure 2 presents the ACP measurement for the messages sent from the Oakland Oceanic Center by media (Satellite, VHF, and HF) during the collection period from August 2009 to January 2010. The numbers of CPDLC messages included in the analysis are shown in the legend of Figure 2, there were 64,173 Satellite, 2,661 VHF, and 507 HF messages. Figure 2 shows the estimated ACP for the HF messages does not meet either the 95 or 99.9 percent requirement; however the number of HF messages was relatively small. The ACP for CPDLC messages sent via Satellite and VHF messages meet the 95 percent criteria but fall just below the 99.9 percent criteria.

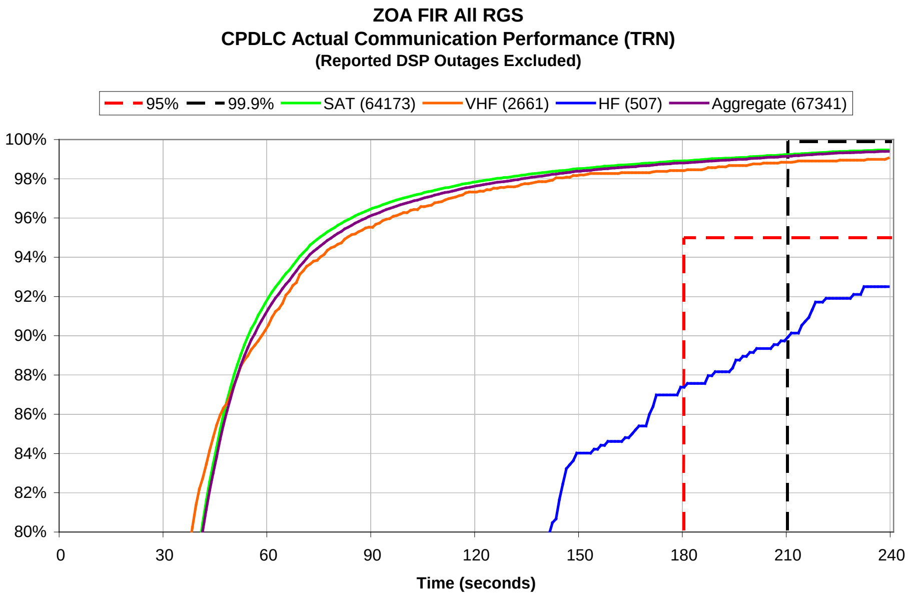

Figure 2. ACP – Oakland Oceanic Airspace by Data Link Media

2.6.2 Figures 3 and 4 presents the ACTP and ADS-C measurements, respectively, for messages sent from the Oakland Oceanic Center by media (Satellite, VHF, and HF) during the collection period from August 2009 to January 2010. Again, the numbers of CPDLC and ADS-C messages used for each measurement are shown in the legend key of the figure. Similar performance by media type is noted for the messages transmitting through HF for the ACTP and ADS-C performance as was noted for the ACP in Figure 2.

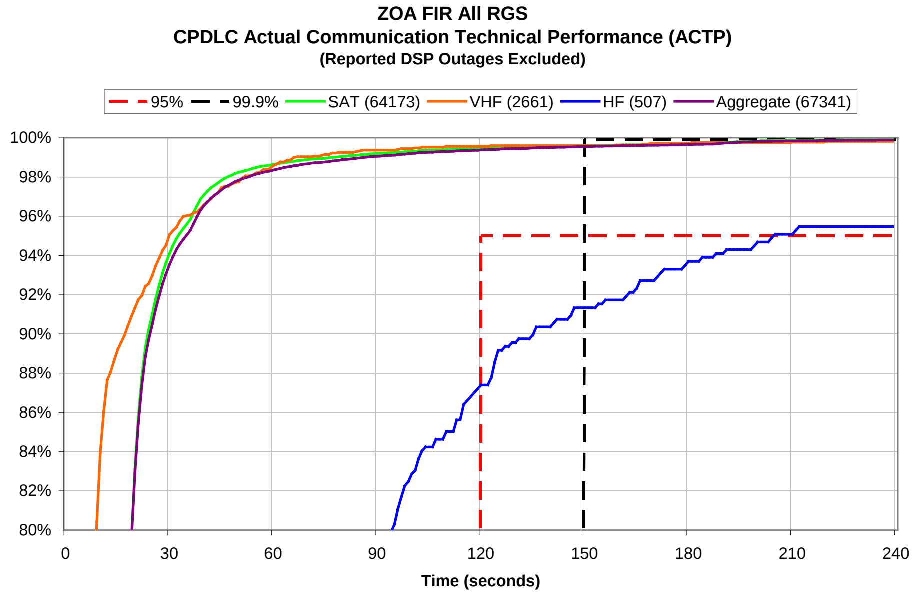

Figure 3. ACTP – Oakland Oceanic Airspace by Data Link Media

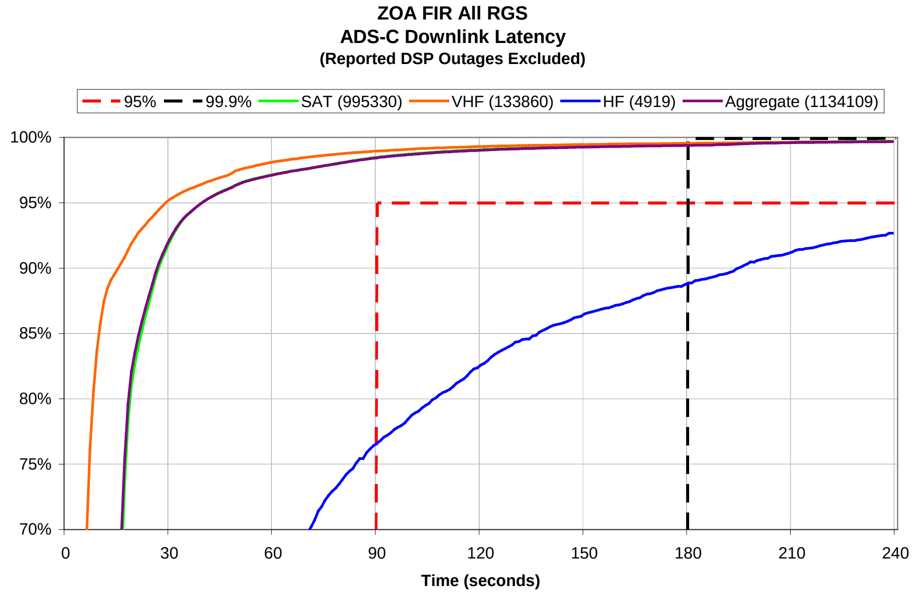

Figure 4. ADS-C Performance – Oakland Oceanic Airspace by Data Link Media

2.7 Figures 5 through 7 present the ACP, ACTP and ADS-C performance by month for the August 2009 through January 2010 time period. Figures 5 through 7 include message performance from by all media (Sat, VHF, and HF). The numbers of messages observed during each month are shown in the legend key of each figure.

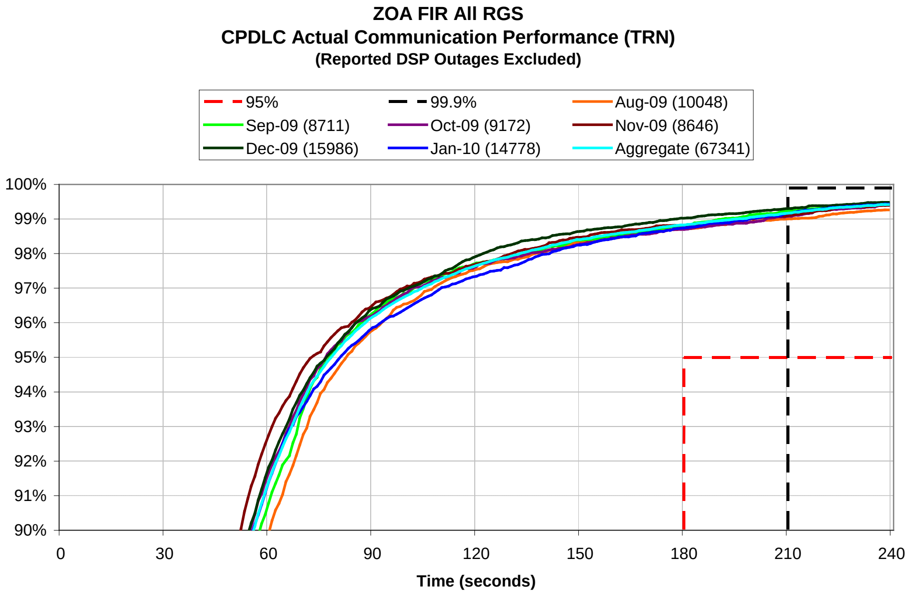

Figure 5. ACP - Oakland Oceanic Airspace by Month

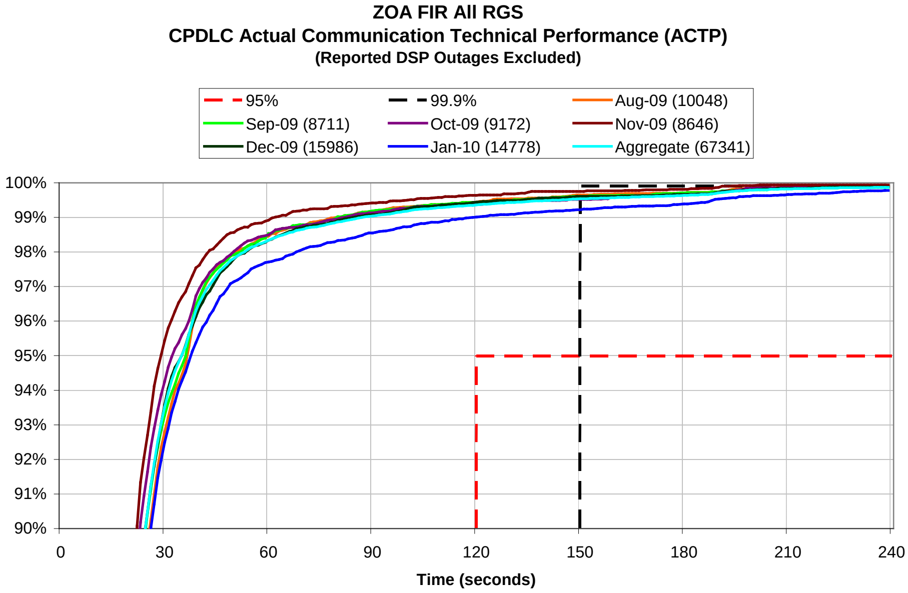

Figure 6. ACTP - Oakland Oceanic Airspace by Month

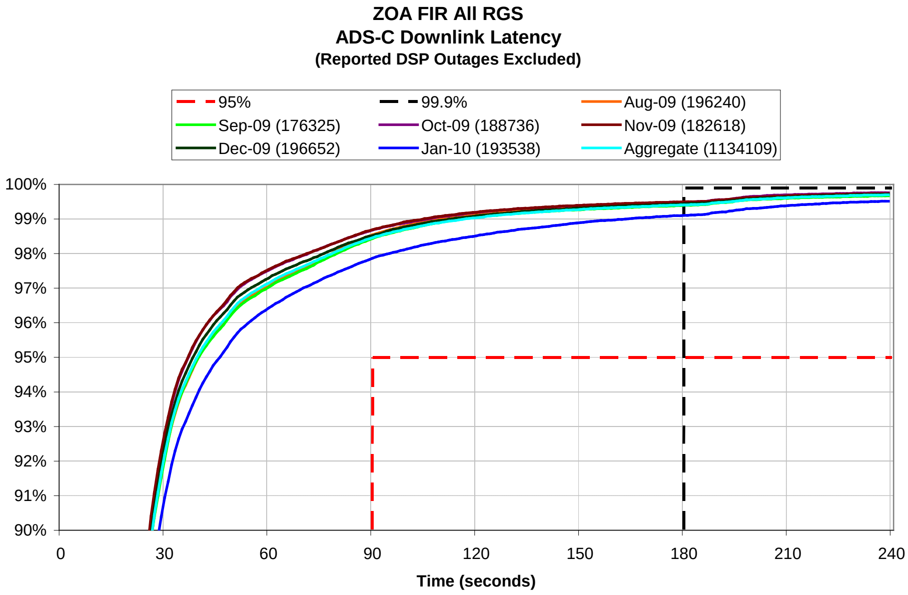

Figure 7. ADS-C Downlink Latency - Oakland Oceanic Airspace by Month

2.8 Observed Data Link Performance by Operator

2.9 Figures 8 through 11 show the ACP, ACTP, PORT and ADS-C Downlink Latency Charts by operator for the time period August 2009 through January 2010. Figures 8 through 11 include only satellite data link communications and represented observed performance in the Oakland FIR. Again, the numbers of messages observed during each month by operator are shown in the legend key of each figure. The top 13 operators in terms of message counts are shown in Figures 8 through 11, the operator information is desensitized in the figures.

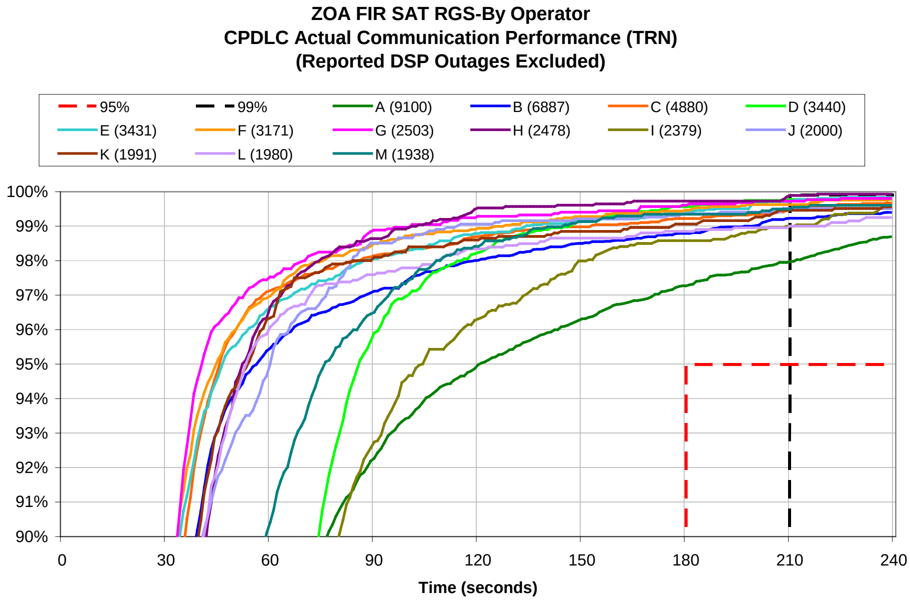

Figure 8. ACP - Oakland Oceanic Airspace by Operator

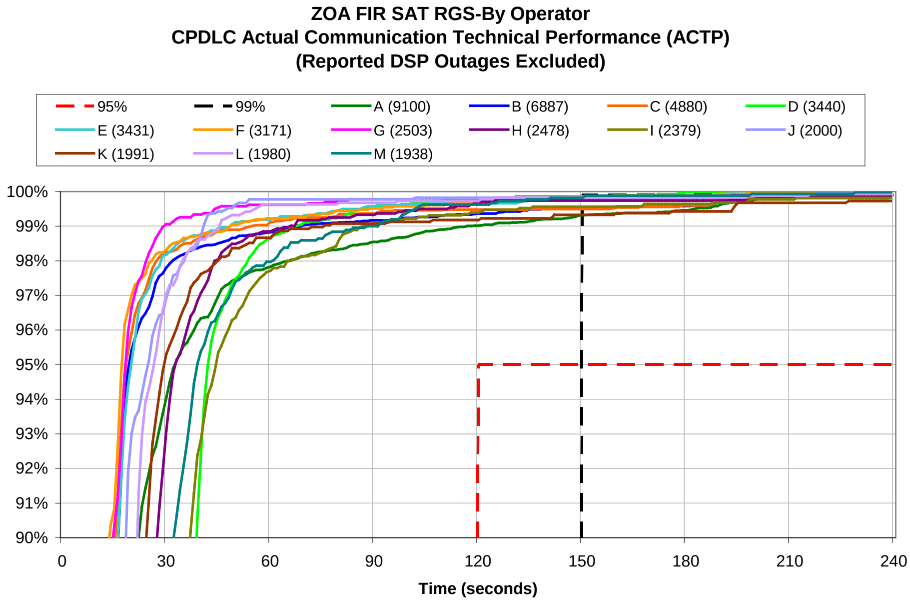

Figure 9. ACTP - Oakland Oceanic Airspace by Operator

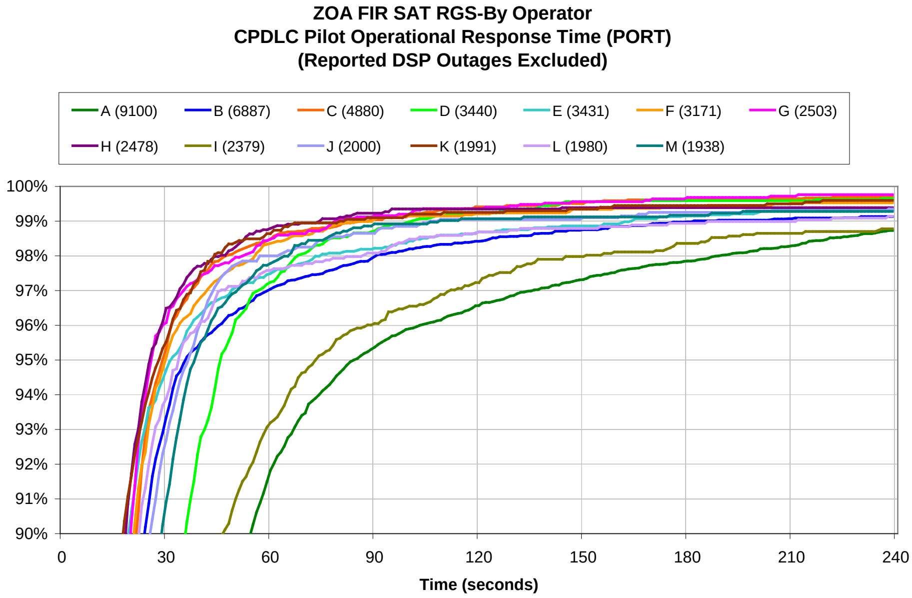

Figure 10. PORT - Oakland Oceanic Airspace by Operator

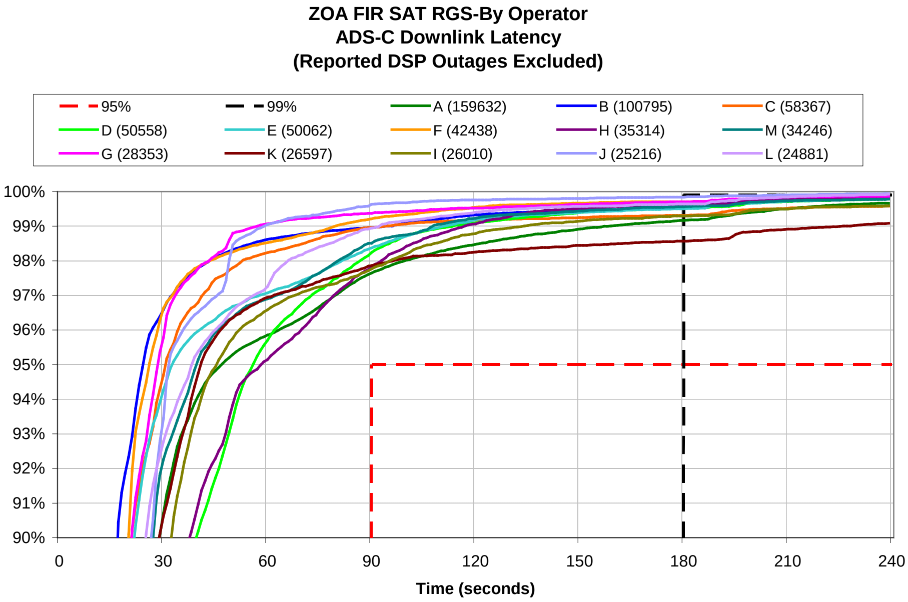

Figure 11. ADS-C Downlink Latency - Oakland Oceanic Airspace by Operator

2.10 All observed performance by operator for the ACP, ACTP and ADS-C shown in Figures 8 through 11 meet the 95 percent criteria.

2.11 Figures 12 through 15 show the observed ACP, ACTP, PORT and ADS-C performance for B744 aircraft by operator. These observations represent only satellite communications (e.g. VHF and HF messages were excluded). The operator information is desensitized in the figures.

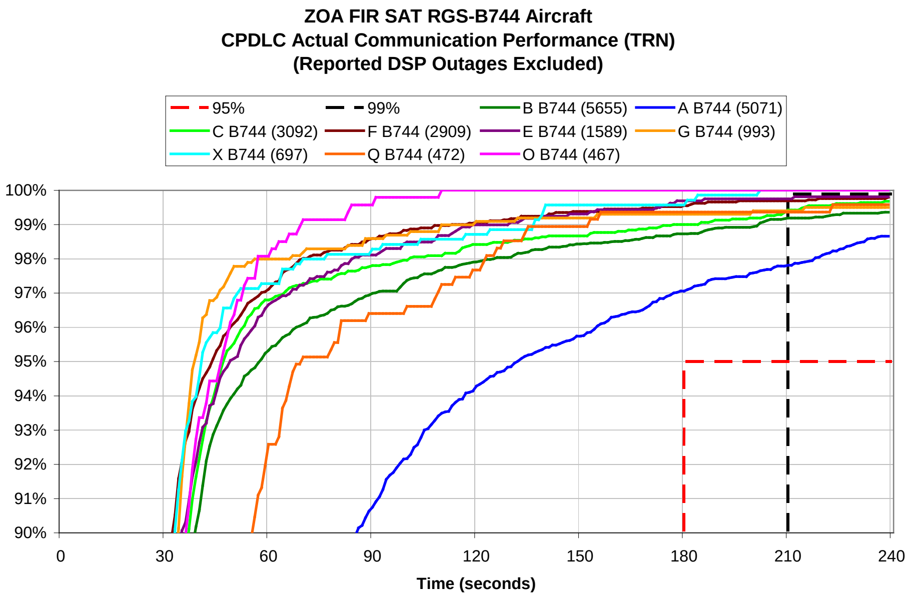

Figure 12. ACP – B744 Operations in Oakland Oceanic Airspace by Operator

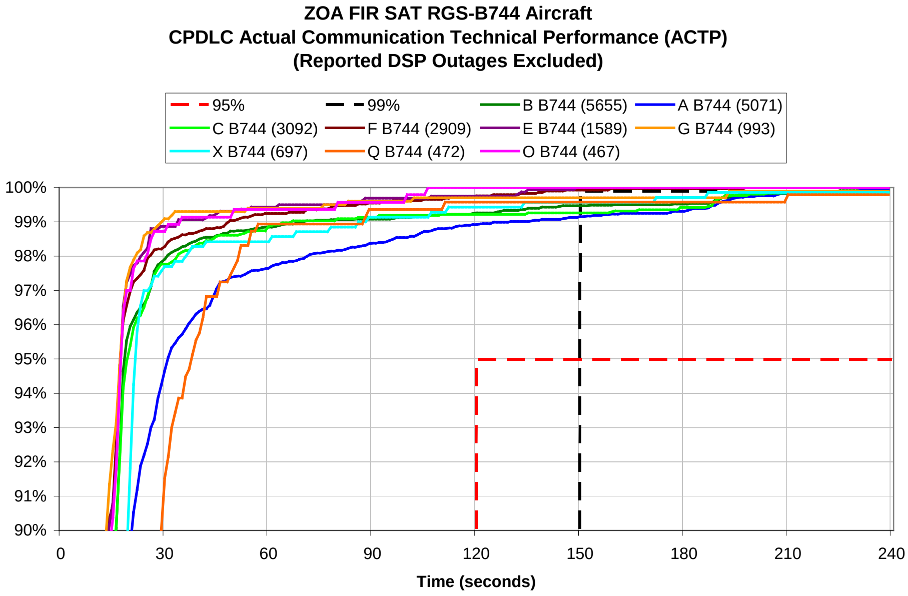

Figure 13. ACTP – B744 Operations in Oakland Oceanic Airspace by Operator

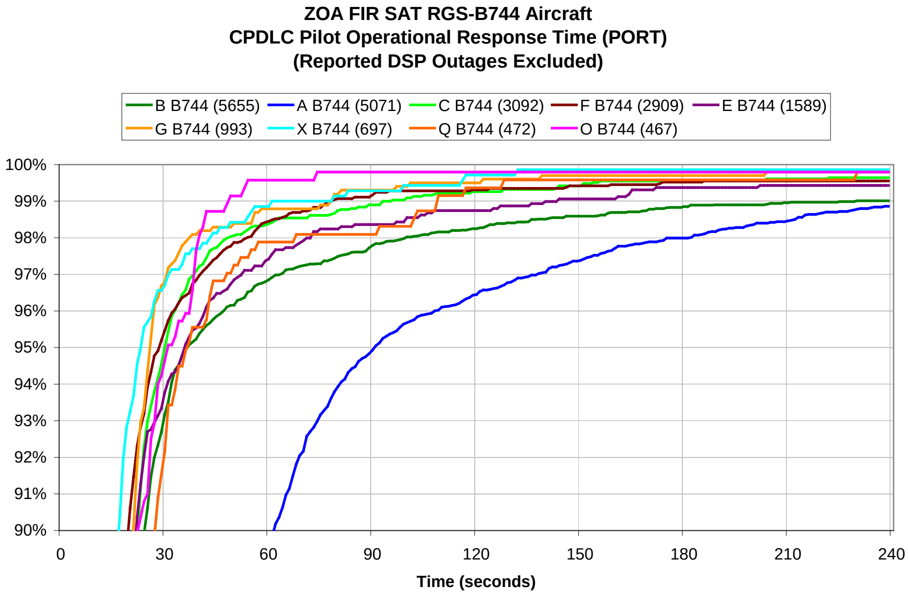

Figure 14. PORT – B744 Operations in Oakland Oceanic Airspace by Operator

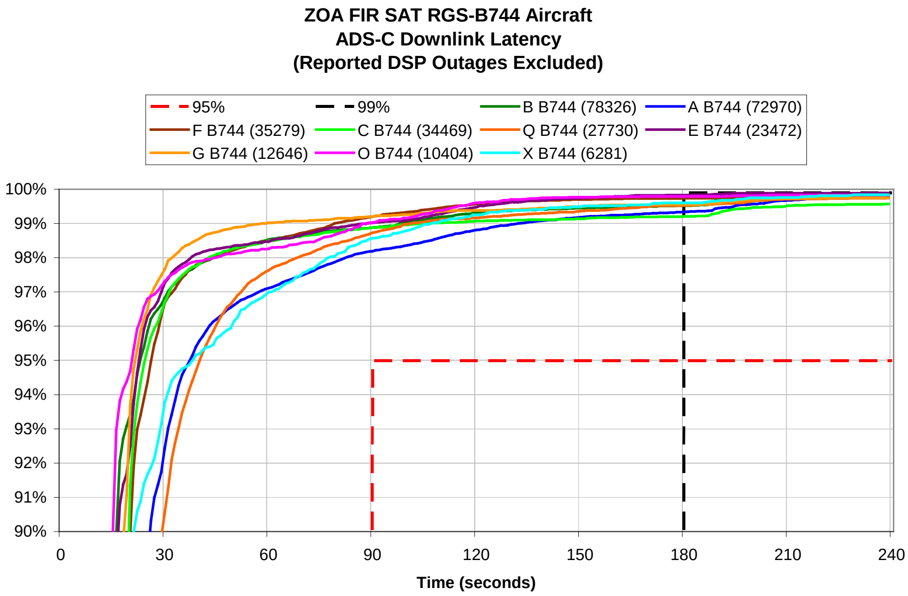

Figure 15. ADS-C Latency – B744 Operations in Oakland Oceanic Airspace by Operator

2.12 All observed performance by operator shown in Figures 12 through 15 meet the 95 percent criteria. Similar charts are presented in Figures 16 through 19 for the B772 aircraft. Again, the operator information is desensitized in the figures.

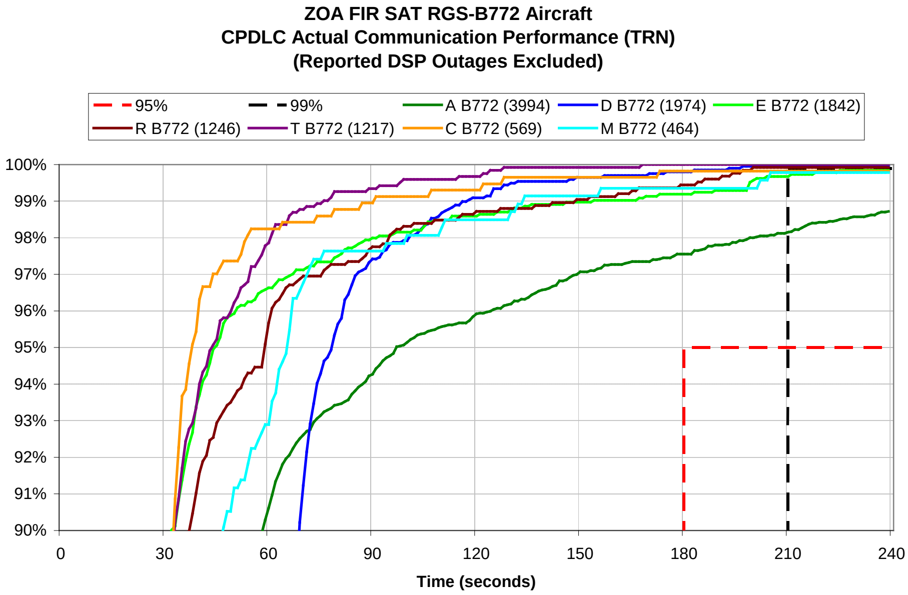

Figure 16. ACP – B772 Operations in Oakland Oceanic Airspace by Operator

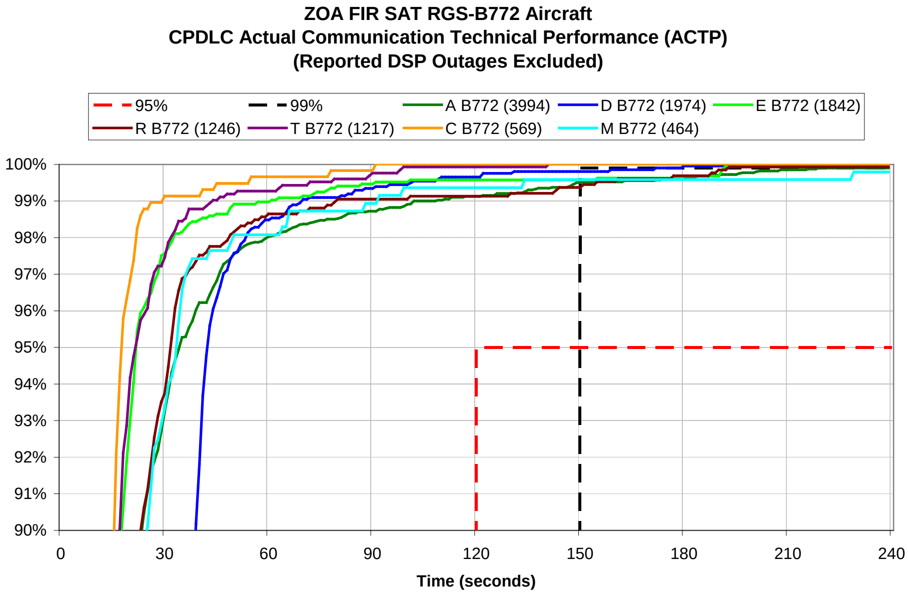

Figure 17. ACTP – B772 Operations in Oakland Oceanic Airspace by Operator

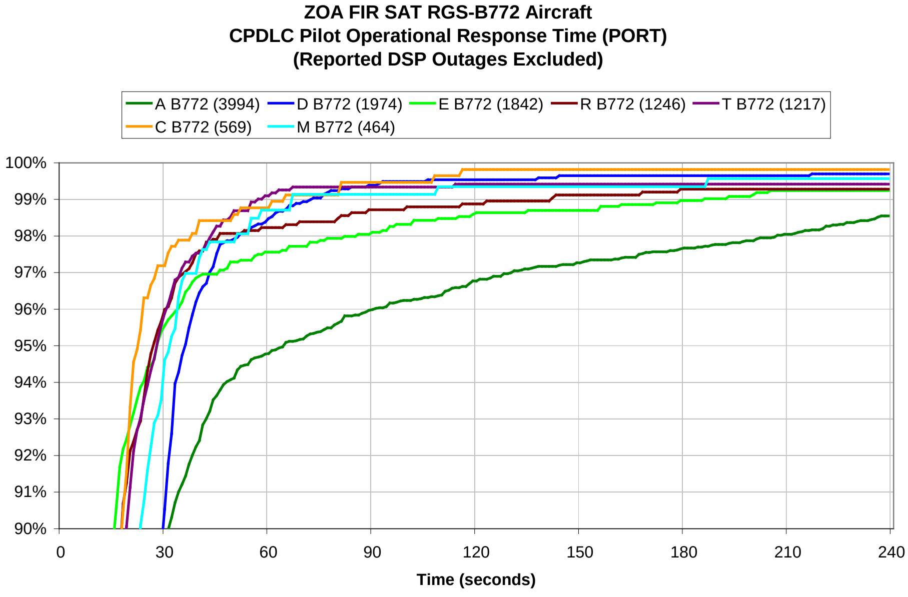

Figure 18. PORT – B772 Operations in Oakland Oceanic Airspace by Operator

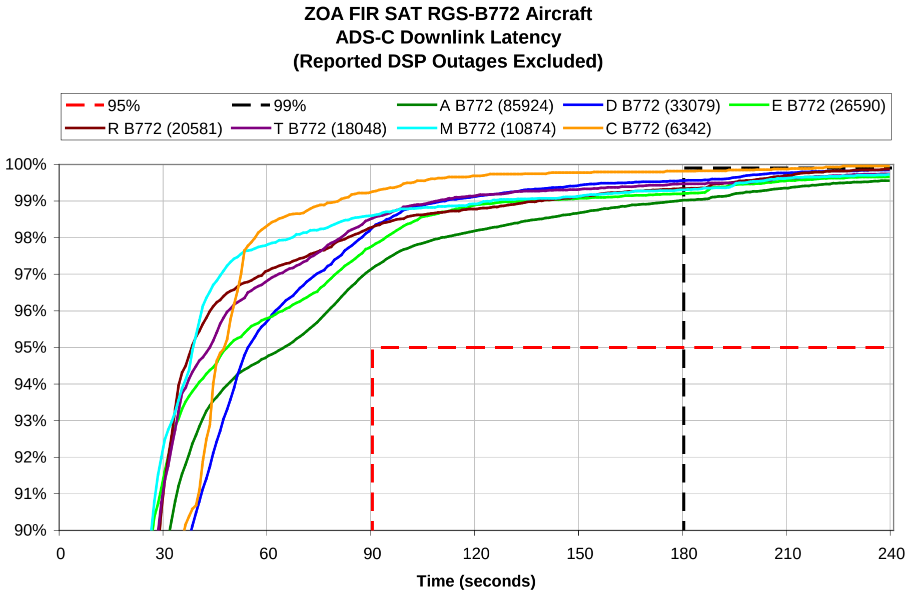

Figure 19. ADS-C Latency – B772 Operations in Oakland Oceanic Airspace by Operator

2.13 All observed performance by operator shown in Figures 16 through 19 meet the 95 percent criteria.

2.14 Additional GOLD charts are produced which show the performance by airframe. Due to the large number of charts of this type, this paper contains only a few of these charts. Figures 20 through 23 show the GOLD charts for the one operator's B772 airframes from satellite messages only. The operator and airframe identifying information are desensitized in the figures.

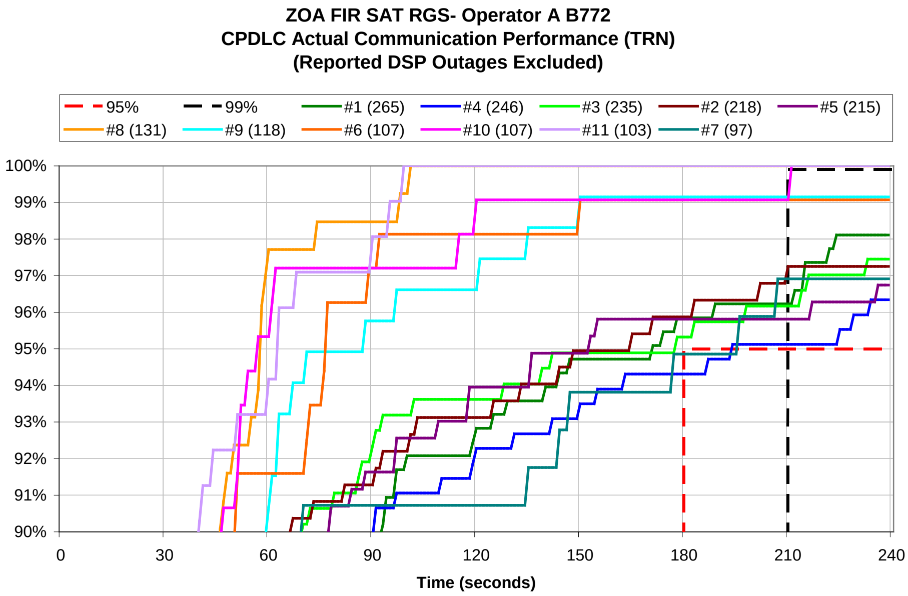

Figure 20. ACP – Operator A B772 Operations in Oakland Oceanic Airspace

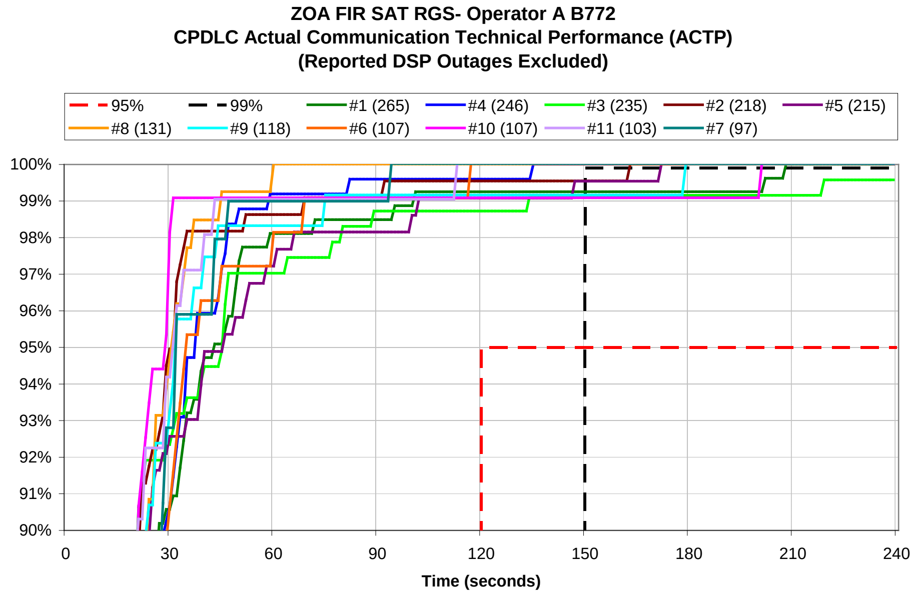

Figure 21. ACTP – Operator A B772 Operations in Oakland Oceanic Airspace

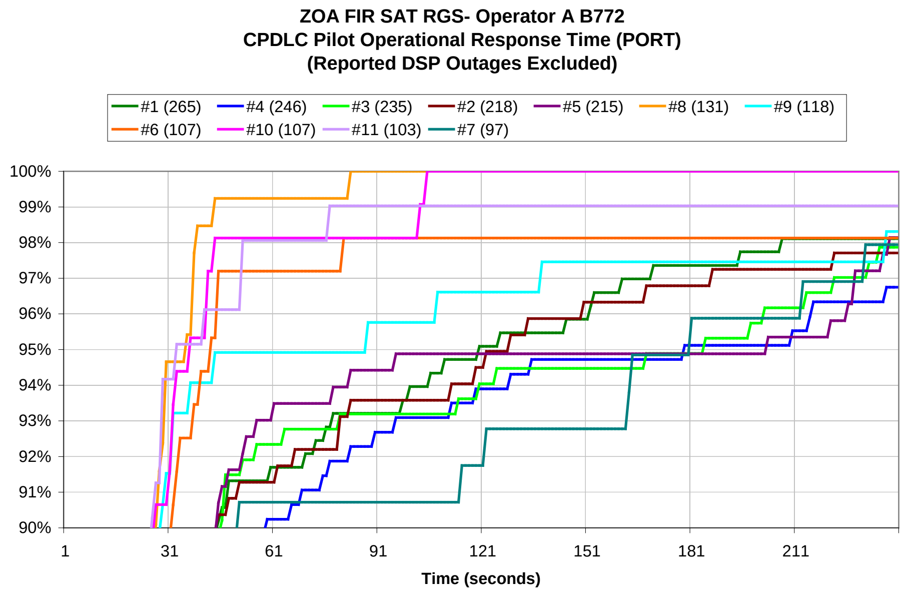

Figure 22. PORT – Operator A B772 Operations in Oakland Oceanic Airspace

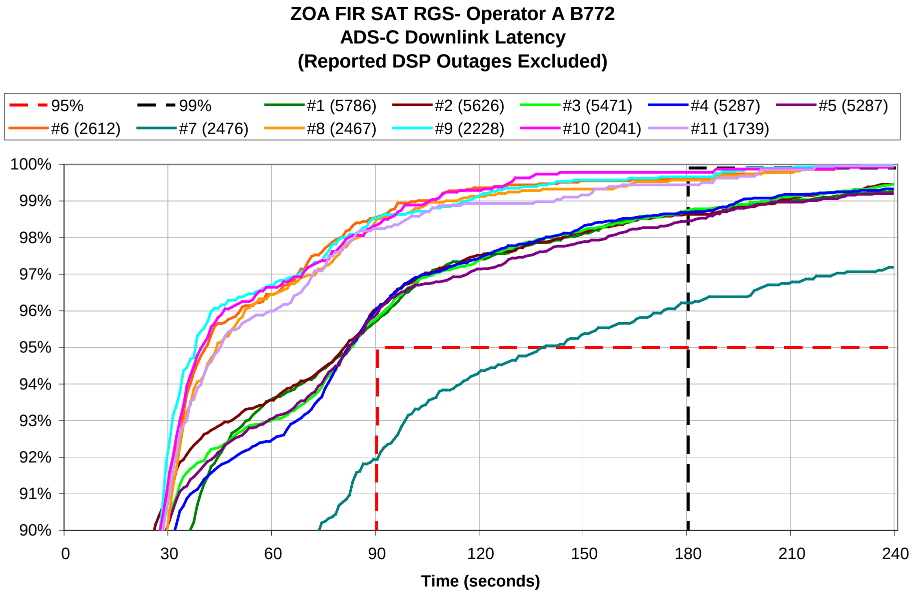

Figure 23. ADS-C Latency – Operator A B772 Operations in Oakland Oceanic Airspace

2.15 Figures 20 through 23 demonstrate a split in data link performance amongst the B772 airframes observed in Oakland oceanic airspace. The FAA plans to further investigate these results with the operator.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the information contained within this paper.