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FANS Interoperability Team Meeting (FIT/18)
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Agenda Item 7: INMARSAT, Iridium

CPDLC and ADS-C Data Link Performance 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 Communications (CPDLC) and Automatic Dependent Surveillance - Contract (ADS-C) systems are measured against the appropriate Required Communication Performance (RCP) and Required Surveillance Performance (RSP) specification to demonstrate that safety objectives which rely on the communications infrastructure can be met by the aircraft and ground systems.

1.3 This paper presents the data link performance by media type and by operator. In addition, the accompanying MS power point presentation contains various analyses for data link performance by GES and VHF/SAT transitions. The accompanying MS power point presentation also includes data link performance from the Anchorage and New York FIRs for comparison purposes.

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 Observed Data Link Performance by Media Type

2.2.1 Figure 1 presents the ACP measurement for the messages sent within the Oakland FIR by media type (Satellite, VHF, and HF) during the collection period of February 2010 to January 2011. The numbers of CPDLC messages included in the analysis are shown in the legend of Figure 1, there were 185,765 satellite, 3,357 VHF, and 1,068 HF messages. 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.

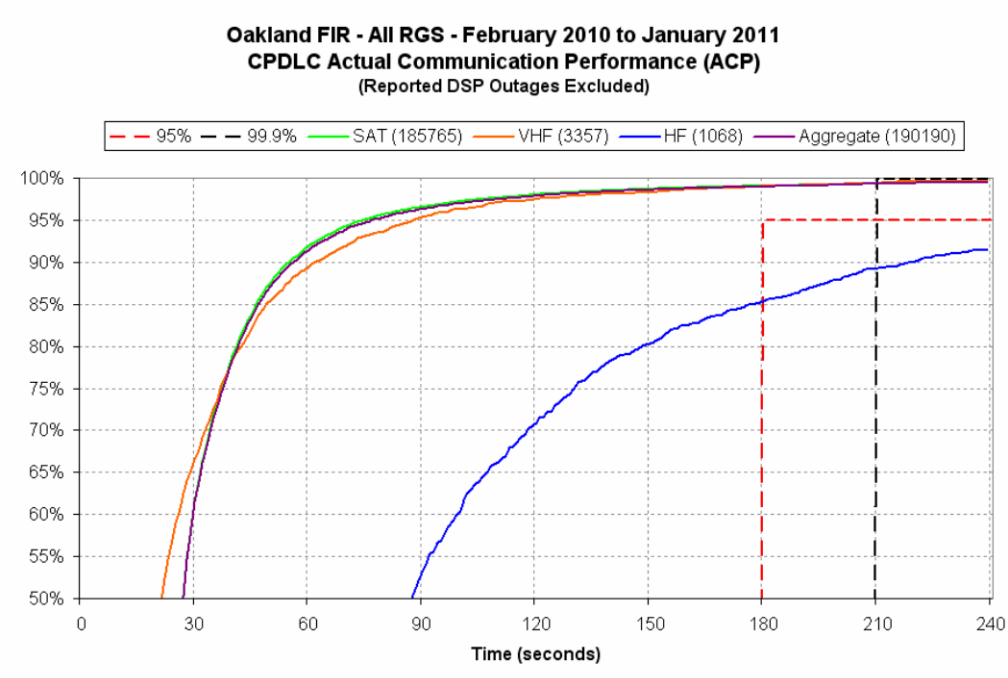

Figure 1. ACP – Oakland FIR by Data Link Media Type

2.2.2 Figures 2 and 3 presents the ACTP and ADS-C measurements, respectively, for messages sent within the Oakland FIR by media type (Satellite, VHF, and HF) during the time period February 2010 to January 2011. Again, the numbers of CPDLC and ADS-C messages used for each measurement are shown in the legend key of the figure. Figure 2 shows that data link messages sent via VHF and satellite meet the 95 percent ACTP criteria.

2.2.3 The HF data link performance is included in Figures 1 through 3 for comparison purposes only. The RCP240 and RSP240 criteria shown in Figures 1 through 3 are used to measure the performance of VHF and satellite data link only. The RCP400 and RSP400 criteria are used to measure the performance of HF data link.

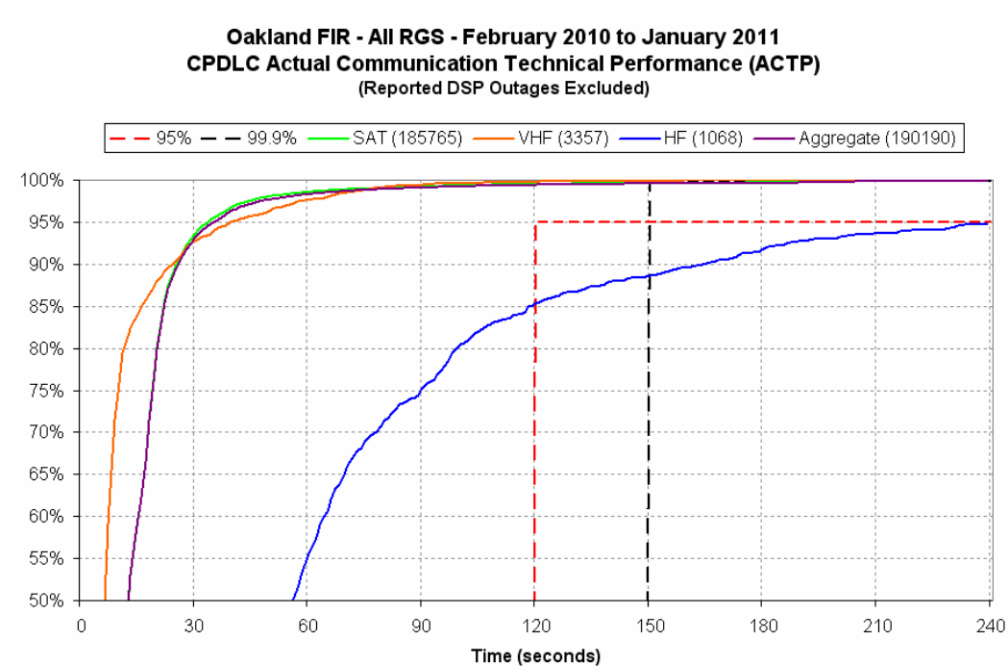

Figure 2. ACTP – Oakland FIR by Data Link Media Type

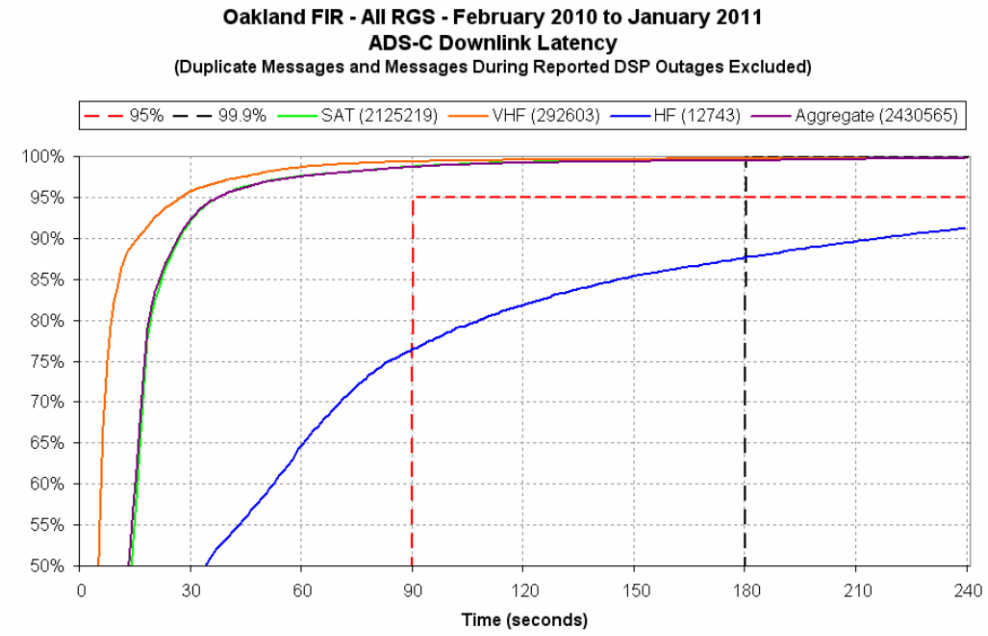

Figure 3. ADS-C Downlink Latency – Oakland FIR by Data Link Media Type

2.2.4 Figures 4 through 6 present the ACP, ACTP and ADS-C performance by month for the February 2010 through January 2011 time period. Figures 4 through 6 include message performance from by satellite only (VHF and HF were excluded). The numbers of messages observed during each month are shown in the legend key of each figure.

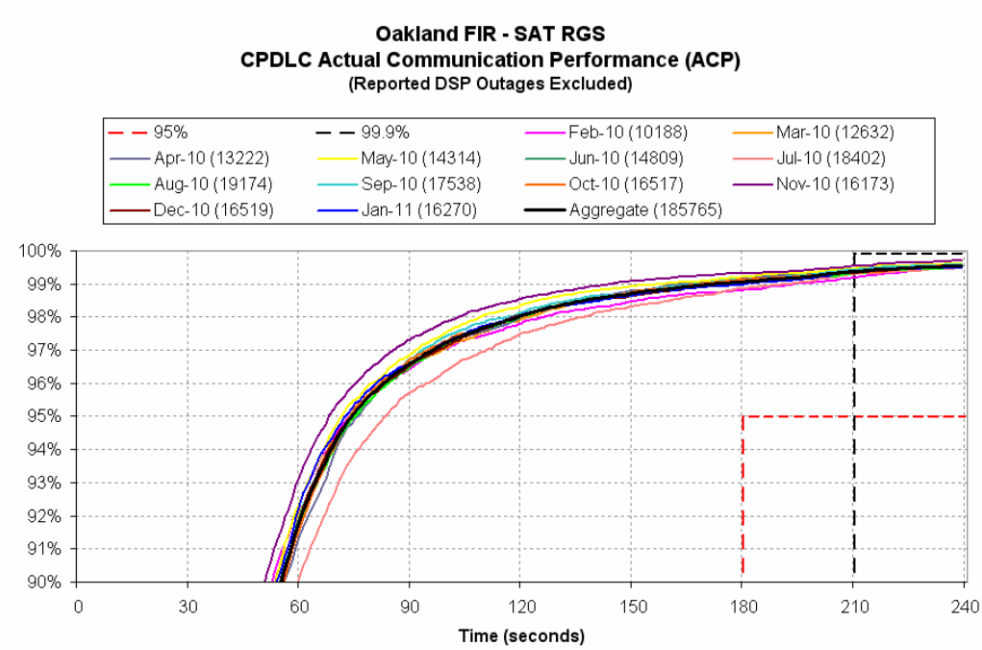

Figure 4. ACP – Oakland FIR by Month (Satellite Remote Ground Stations (RGS) Only)

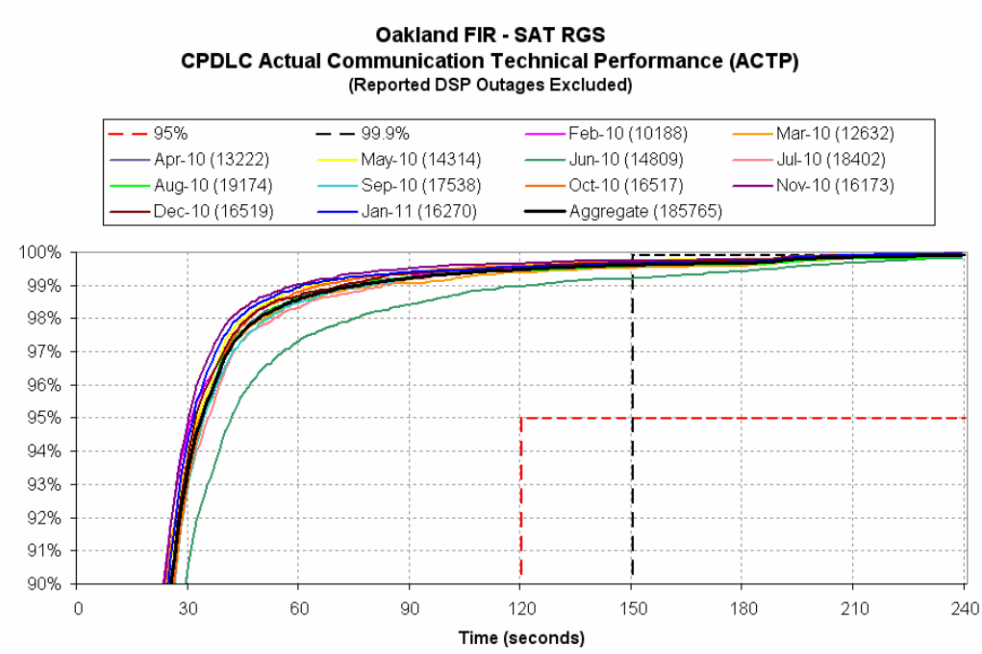

Figure 5. ACTP – Oakland FIR by Month (Satellite RGS Only)

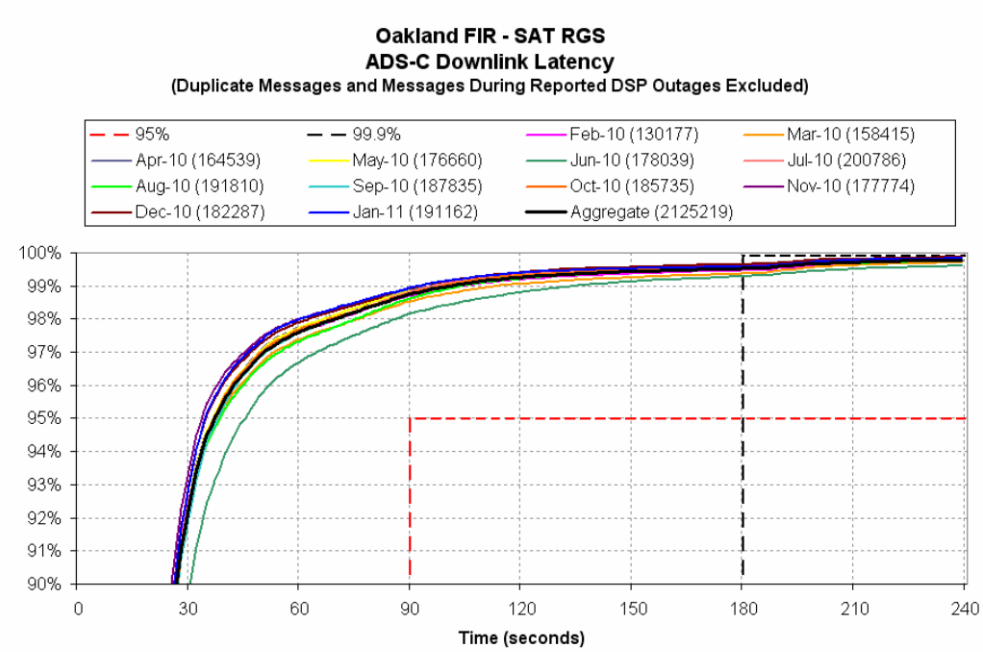

Figure 6. ADS-C Downlink Latency – Oakland FIR by Month (Satellite RGS Only)

2.2.5 Figures 7 through 9 present the ACP, ACTP and ADS-C HF data link performance by month for the February 2010 through January 2011 time period. The RCP 400 and RSP 400 criteria are used in Figures 7 through 9 for the HF data link performance targets. The numbers of messages observed during each month are shown in the legend key of each figure.

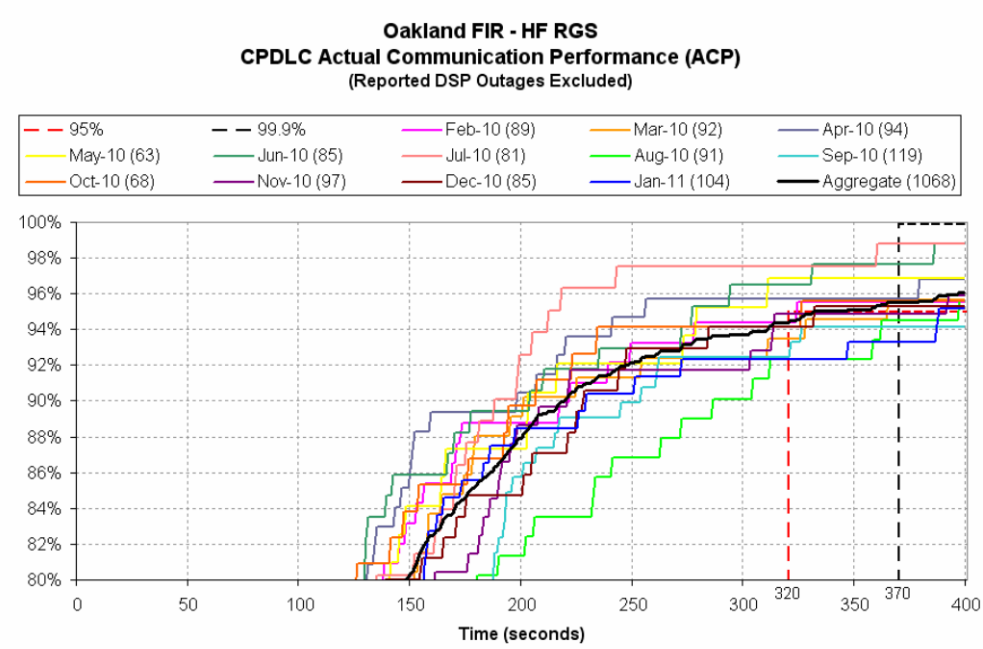

Figure 7. ACP – Oakland FIR by Month (HF RGS Only)

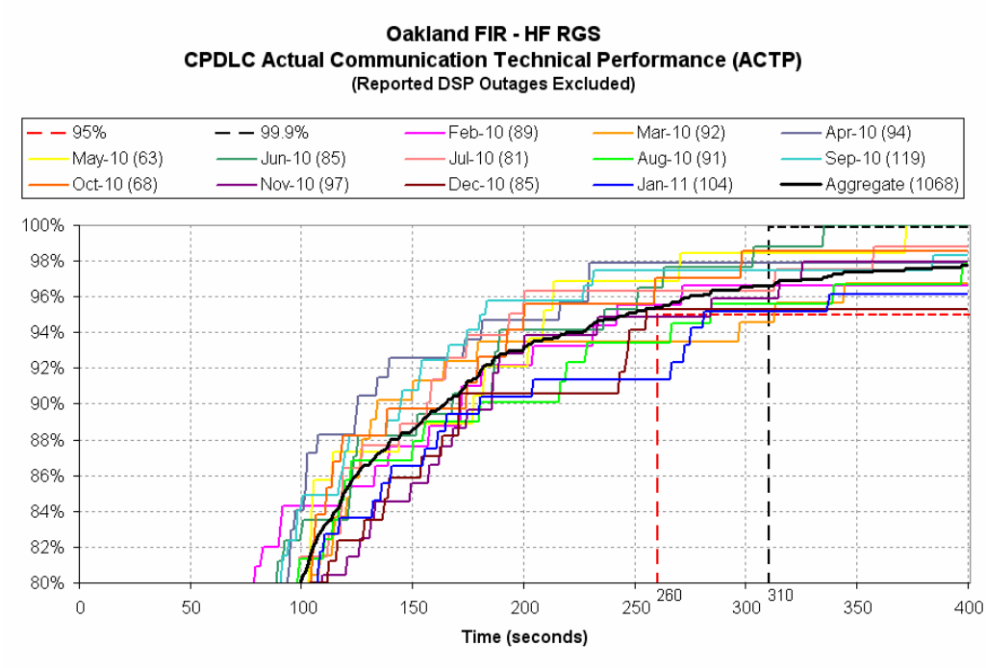

Figure 8. ACTP – Oakland FIR by Month (HF RGS Only)

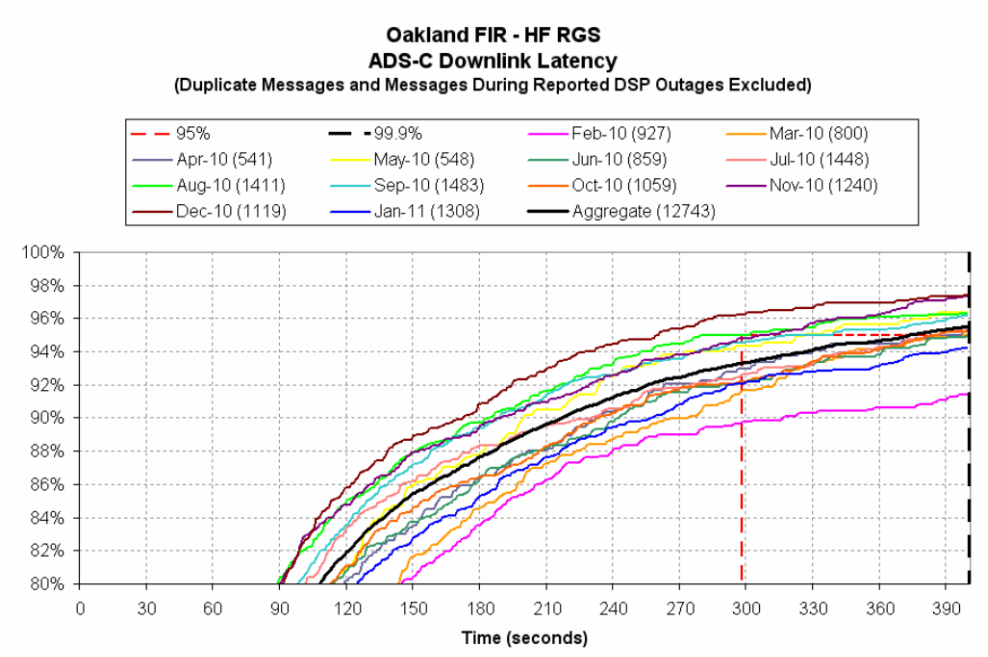

Figure 9. ADS-C Downlink Latency – Oakland FIR by Month (HF RGS Only)

2.2.6 Figures 1 through 6 show that the observed satellite and VHF data link performance for ACP, ACTP and ADS-C (Type 180) meet the 95 percent criteria for RCP240. In addition, the observed HF data link performance for ACP, ACTP, and ADS-C does

not meet the 95 percent criteria for RCP400 in most of the months shown in Figures 7 through 9.

2.3 Observed Data Link Performance by Operator

2.3.1 Figures 10 through 13 show the ACP, ACTP, PORT and ADS-C downlink latency charts by operator for the time period August 2010 through January 2011. Figures 10 through 13 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 operators contributing the top 80 percent in terms of message counts were chosen for the charts. The identifying information for the operators is desensitized in the figures.

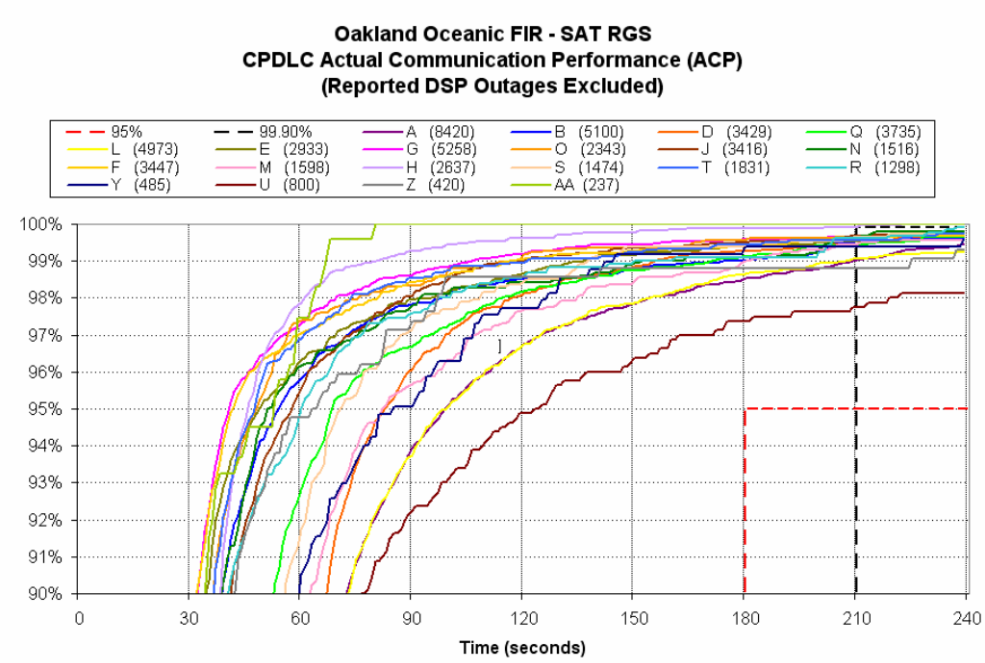

Figure 10. ACP – Oakland FIR by Operator (SAT RGS Only)

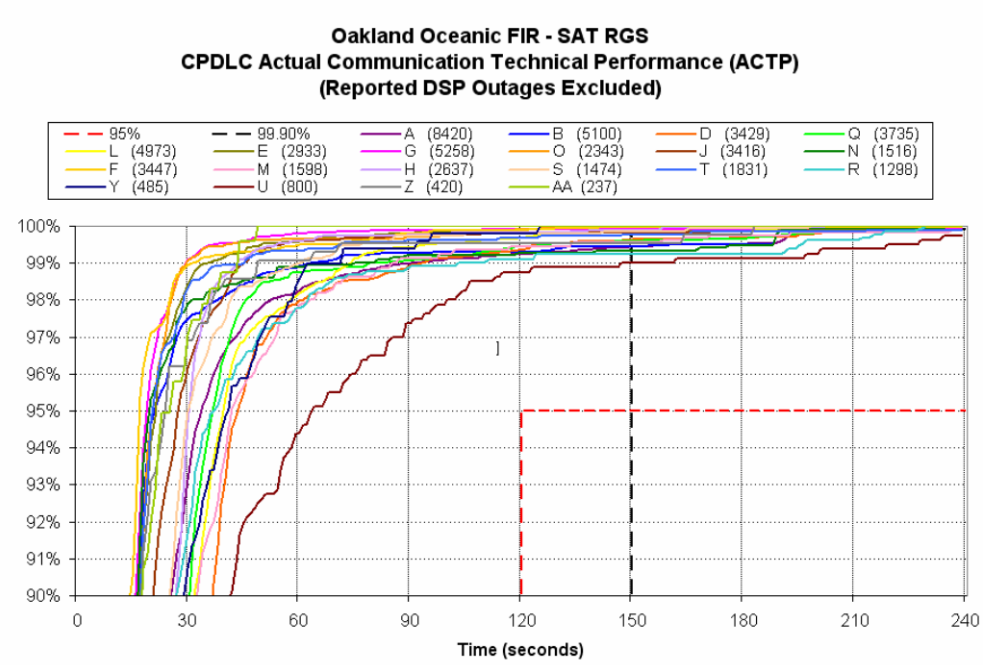

Figure 11. ACTP – Oakland FIR by Operator (SAT RGS Only)

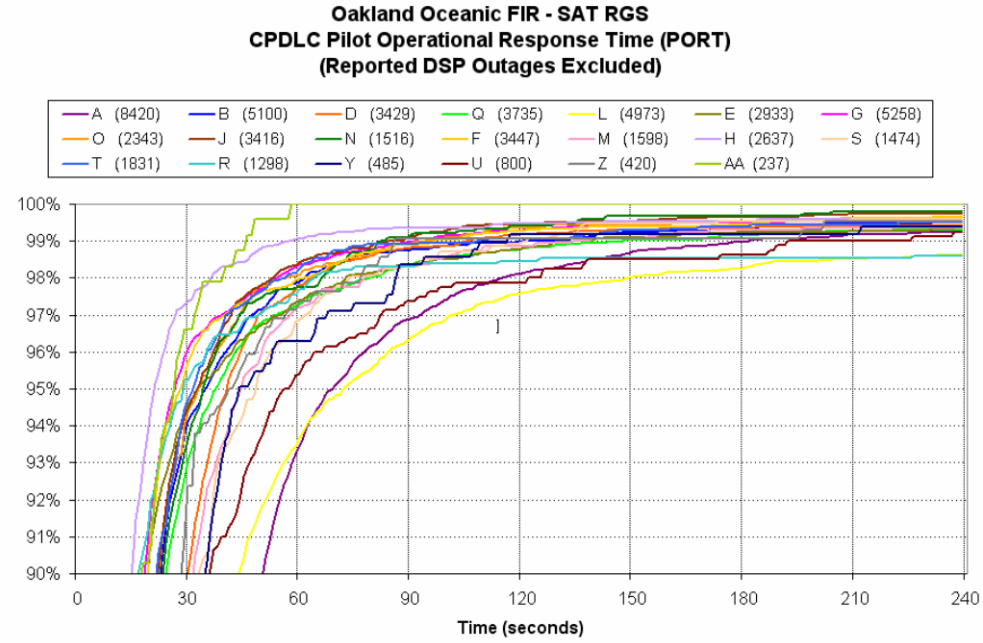

Figure 12. PORT – Oakland FIR by Operator (SAT RGS Only)

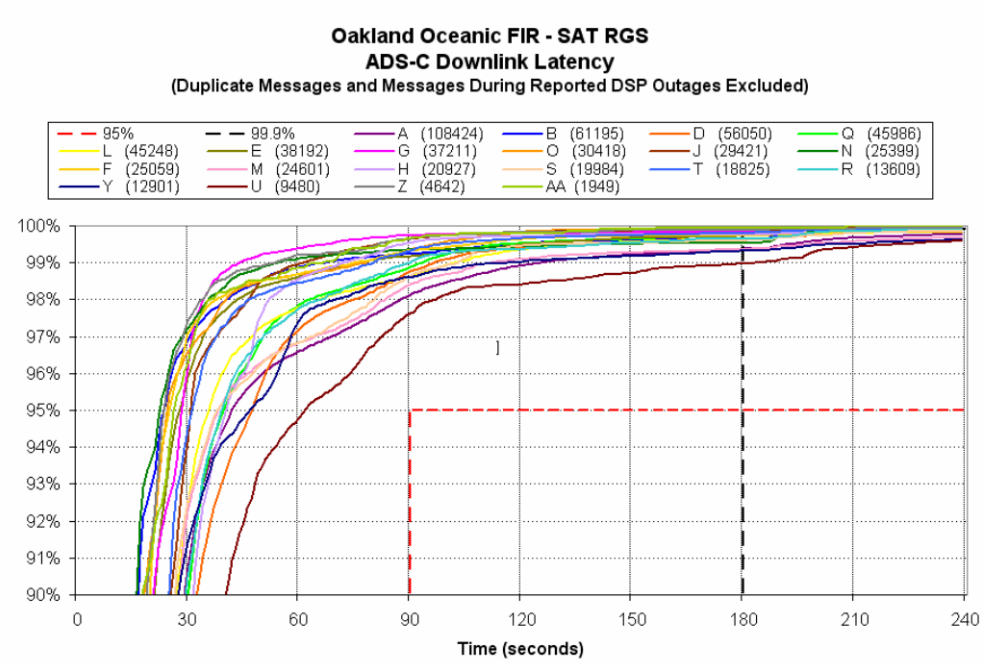

Figure 13. ADS-C Downlink Latency – Oakland FIR by Operator (SAT RGS Only)

2.3.2 Figures 10 through 13 show that the ACP and ACTP for the data link messages from the operators presented in the charts meet the 95 percent RCP240 criteria. The ACP from five of these operators meets the 99.9 percent criteria for RCP240. The ACTP from fourteen of these operators meets the 99.9 percent criteria for RCP240.

2.3.3 The accompanying presentation contains the observed data link performance for operator 'A' from all three US oceanic FIRs; Anchorage, New York, and Oakland. These comparisons help to demonstrate the differences in observed data link performance within different regions.

2.4 Observed Data Link Performance by GES

2.4.1 The charts presented in the accompanying presentation show that the observed performance appears to be degraded for one GES. The estimated message loading for this particular GES showed a decreased in the number of data link messages transmitted by approximately 16% from May 2010 to January 2011.

2.4.2 A small number of data link messages transmitted for operations conducted in the Pacific oceanic region utilize GESs that are typically designated for the Atlantic oceanic region. The data link performance for these messages are noticeably lower when compared to other messages transmitted from operations conducted within the Pacific oceanic region and utilizing GESs that are designated for the Pacific region. The accompanying presentation shows the aircraft locations associated with some of these messages. There are a small number of these cases, but the associated delays are significant.

2.4.3 The accompanying presentation also provides comparisons of data link performance before and after the R15 GES upgrade at the Eik GES (XXE), Aussaguel GES (AOW2), Santa Paula GES (XXC), Perth GES (POR1).

2.5 Observed Data Link Performance Contributes Associated with VHF/SAT Transitions

2.5.1 ADS-C satellite data link reports sent from operations conducted within the Anchorage, New York, and Oakland FIRs during November 2010 were examined. To determine whether the aircraft was operating within an area of possible VHF/SAT transition, the closest ADS-C, CPDLC, or AFN message in terms of time that was sent using VHF data link was matched to each satellite data link ADS-C report (within one hour). This message along with the corresponding VHF ground station is used to estimate the great circle distance between the aircraft location (given in the ADS-C report sent via satellite data link) and the VHF ground station.

2.5.2 The presentation file contains charts showing the observed ADS-C latency against the estimated great circle distance between ADS-C reported position and the closest VHF station.

2.5.3 The analyses show an increase in the number of ADS-C reports, sent via satellite data link, with large delay times and corresponding aircraft locations approximately 200nm from the closest VHF ground station. A similar trend was observed for operations traveling from/toward VHF coverage.

2.5.4 The analyses show a larger number of significant delay times associated with transitions from VHF to SAT rather than transitions from SAT to VHF.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Review and comment on the information contained within this paper and the accompanying power point presentation file.