



International Civil Aviation Organization

The Fourth Meeting of the Future Air Navigation Systems Interoperability Team-Asia (FIT-Asia/4)

Bangkok, Thailand, 25-26 May 2015

Agenda Item 3: Review of ADS/CPDLC Operations

DATA LINK PERFORMANCE REPORT FOR L888 ROUTE

(Presented by China)

SUMMARY

This paper presents data link performance data for Oct. 2014 to Mar. 2015 for Chinese L888 FANS route

1. INTRODUCTION

1.1 Data-link communications have been used for CPDLC and ADS-C for many years, and data-link performance requirements have been established. Specific requirements are published in the Global Operational Data-link Document (GOLD), and reflect those contained in Doc 9869, Manual on Required Communication Performance. States are invited to ensure that the appropriate data link performance monitoring is undertaken and reported to CRAs/FITs, as required, in a timely manner.

1.2 China has officially started providing data link services on FANS-L888 routes in the remote airspace Western China since 2001. The data link system in this airspace comprises a variety of ground systems that may provide data link services to FANS 1/A aircraft.

1.3 This paper provides observed performance of the operational data link system along L888 route, collected from centres of Chengdu ZUUU, Lanzhou ZLLL and Urumqi ZWWW. The purpose of this paper is to present recent observed performance of the data link system.

1.4 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) 400 specification to demonstrate that safety objectives which rely on the communications infrastructure can be met by the aircraft and ground systems.

1.5 The provision of the data-link performance of L888 route in this paper are presented in the Data Link performance reporting template developed in WP 10 of FIT-ASIA/2 meeting, 2013.

2. DISCUSSION

L888 route CPDLC Actual Communications Performance (ACP)

2.1 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.

2.2 **Table 1** summarizes overall CPDLC Actual Communications Performance (ACP) for messages sent within three centres (ZUUU, ZLLL, ZWWW). **Figure 1** graphs ACP measurement by media type (Satellite, VHF and HF) against the 95% 320” and 99.9% 370” requirements for RCP400 using the 4274 CPDLC transactions recorded during the period of Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ACP				
Messages		% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Satellite	1914	100.00%	100.00%	-
VHF	2356	100.00%	100.00%	-
HF	4	100.00%	100.00%	-
Total	4274	100.00%	100.00%	-

Table 1: CPDLC ACP per Media Type of L888 Route

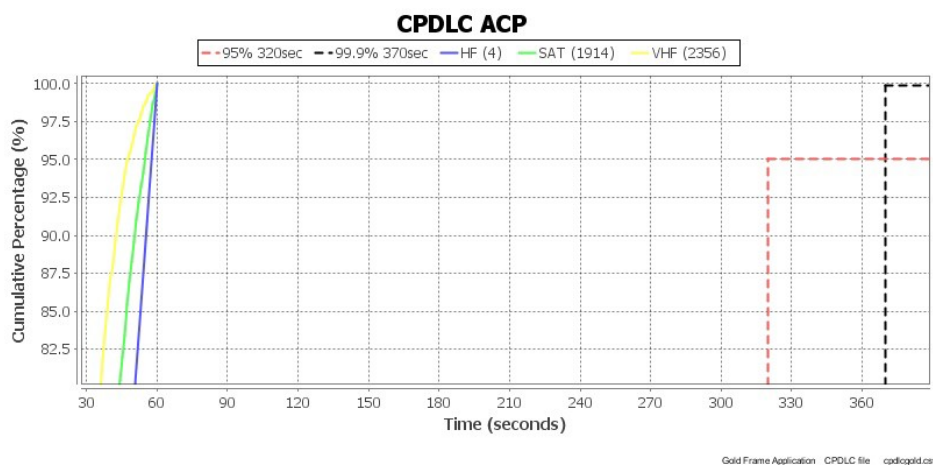


Figure 1: ACP by Data Link Media Type of L888 Route

ADS-C Downlink Latency

2.3 **Table 2** summarizes overall ADS-C Downlink Latency for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 2** graphs ADS-C Downlink Latency measurement by media type (Satellite, VHF and HF) against the 95% 300” and 99.9% 400” requirements for Surveillance performance type 400 specification using 875969 ADS-C messages recorded during the period Oct. 2014 to Mar. 2015. in the three centres.

ADS-C Downlink Latency				
Messages		% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Satellite	528,680	99.55%	99.70%	-
VHF	344,795	99.77%	99.85%	-
HF	2,494	87.89%	93.44%	-
Total	875,969	99.61%	99.74%	-

Table 2: ADS-C Downlink Latency per Media Type of L888 Route

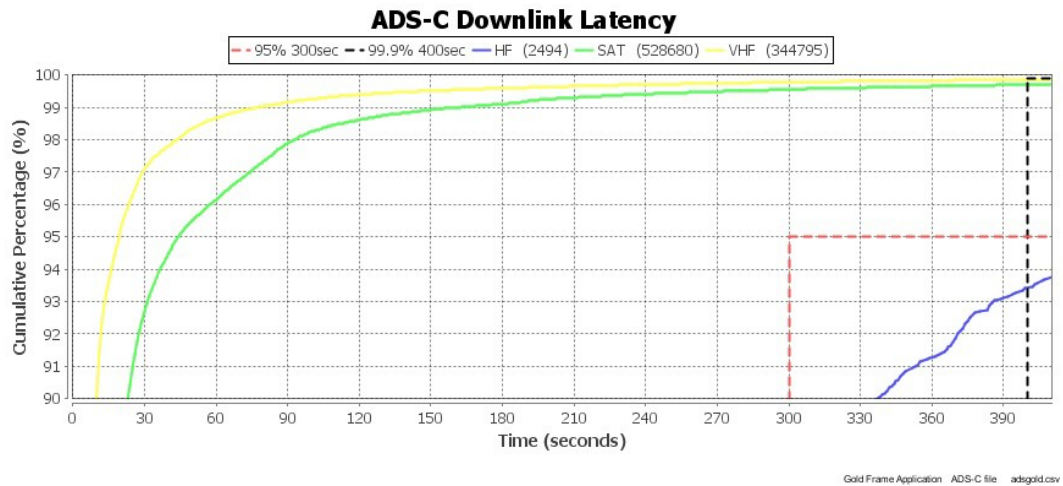


Figure 2: ADS-C Downlink Latency of L888 route.

2.4 From the demonstrations, it can be found that the ADS-C Downlink Latency of HF failed to meet the 95%. The reason is that messages from some HF stations has long Latency (**Figures 2.1 and 2.2**).

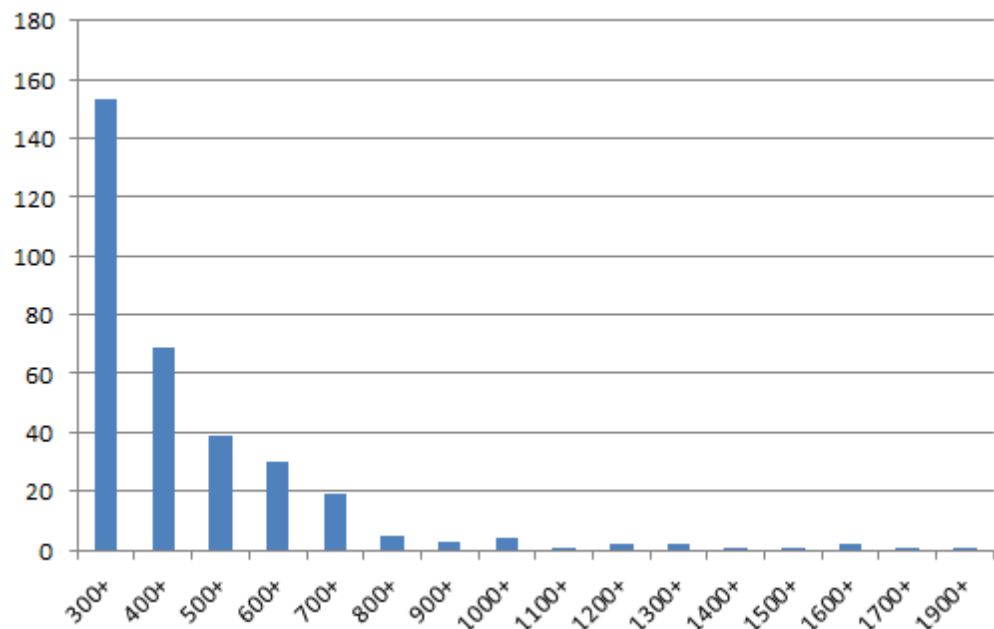


Figure 2.1: Count of ADS-C Downlink Messages Latency over 300 second

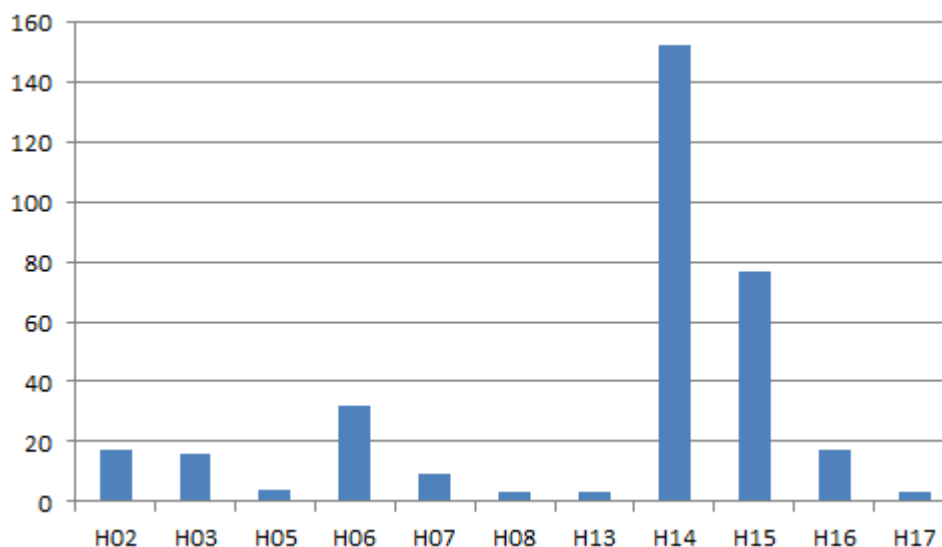


Figure 2.2: Count of ADS-C Downlink Messages Latency over 300 second by HF Station

CPDLC Actual Communications Performance (ACP) per Operator (de-identified)

2.5 **Table 3** summarizes CPDLC Actual Communications Performance per Operator for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 3** presents the CPDLC Actual Communications Performance per Operator for the period Oct. 2014 to Mar. 2015.

CPDLC ACP per Operator				
Operator (de-identified)	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
AA6	1669	100.00%	100.00%	-
AA7	701	100.00%	100.00%	-
AA16	478	100.00%	100.00%	-
AA2	275	100.00%	100.00%	-
AA23	260	100.00%	100.00%	-
AA14	199	100.00%	100.00%	-
AA3	139	100.00%	100.00%	-
AA12	120	100.00%	100.00%	-
AA11	86	100.00%	100.00%	-
AA5	68	100.00%	100.00%	-
AA17	56	100.00%	100.00%	-
AA1	42	100.00%	100.00%	-
AA21	34	100.00%	100.00%	-
AA19	34	100.00%	100.00%	-
AA18	32	100.00%	100.00%	-
AA9	20	100.00%	100.00%	-
AA22	19	100.00%	100.00%	-
AA13	17	100.00%	100.00%	-
AA4	16	100.00%	100.00%	-
AA15	3	100.00%	100.00%	-
AA8	3	100.00%	100.00%	-
AA10	2	100.00%	100.00%	-
AA20	1	100.00%	100.00%	-
Total	4274	100.00%	100.00%	-

Table 3: CPDLC ACP per Operator of L888 Route

CPDLC ACP

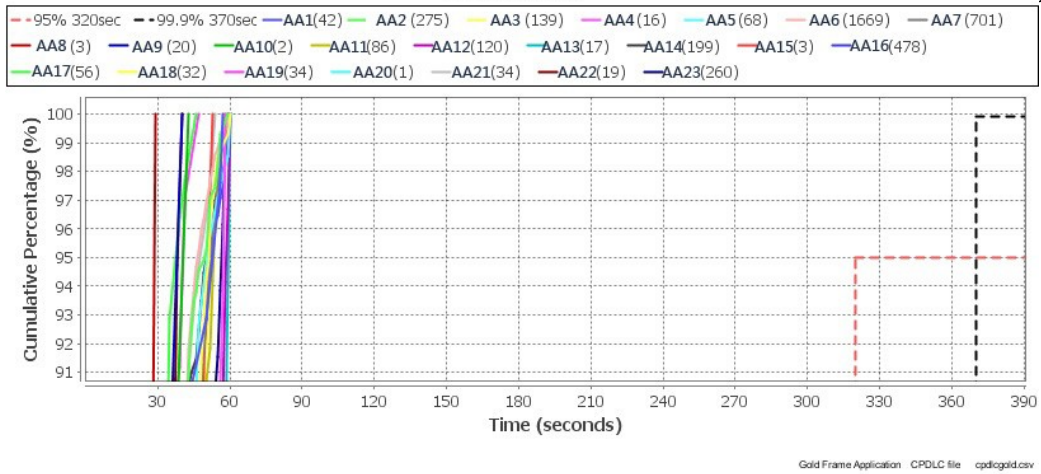


Figure 3: CPCLC ACP per Operator of L888 Route

2.6 **Appendix A** provides further data-link performance analysis.

Other issues concerning data link performance report

2.7 China applies data link ground station information (station identifier and media type) to perform the analysis, but each year it is difficult for China to obtain a complete list containing all the ground stations. China proposed that if it is possible for FIT-ASIA meeting to maintain and publish a complete list of ground station information to assist CRAs and states to conduct data link performance.

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
- a) note the information contained in this paper; and
 - b) discuss any relevant matters as appropriate; and
 - c) discuss the proposal in paragraph 2.7

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Appendix A – Data Link Performance for L888 Route

L888 route Actual Communications Performance (ACP) per Month – Satellite

1.1 **Table 1** summarizes CPDLC ACP (Satellite) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 1** graphs the ACP (Satellite) measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ACP per Month - Satellite				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Oct	595	100.00%	100.00%	-
Nov	599	100.00%	100.00%	-
Dec	542	100.00%	100.00%	-
Jan	769	100.00%	100.00%	-
Feb	785	100.00%	100.00%	-
Mar	984	100.00%	100.00%	-
Total	4274	100.00%	100.00%	-

Table 1: CPDLC ACP (Satellite) per month of L888 route

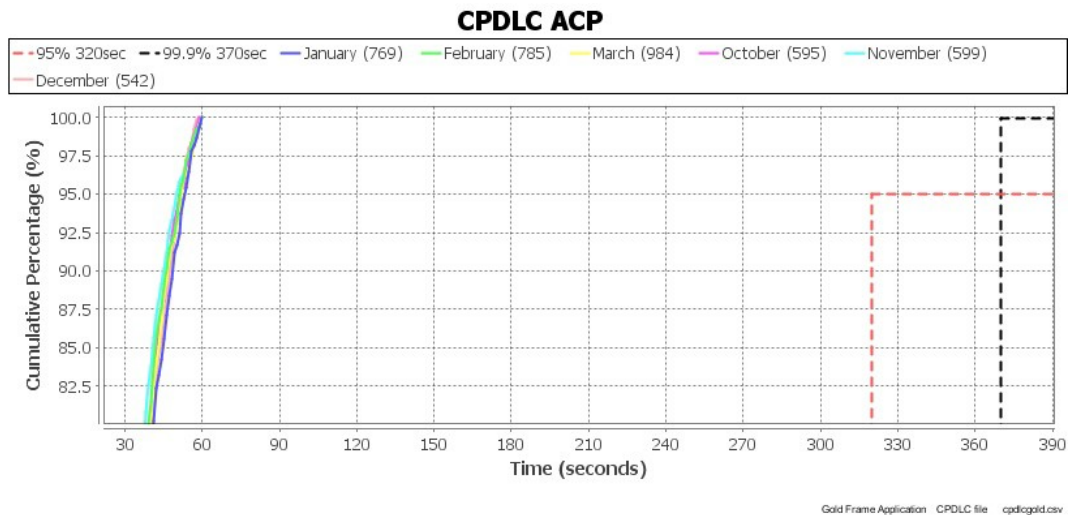


Figure 1: CPDLC ACP (Satellite) per month of L888 route

L888 route Actual Communications Performance (ACP) per Month – VHF

1.2 **Table 2** summarizes CPDLC ACP (VHF) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 2** graphs the ACP (VHF) measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ACP per Month - VHF				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Oct	322	100.00%	100.00%	-
Nov	358	100.00%	100.00%	-
Dec	336	100.00%	100.00%	-
Jan	435	100.00%	100.00%	-
Feb	422	100.00%	100.00%	-
Mar	483	100.00%	100.00%	-
Total	2356	100.00%	100.00%	-

Table 2: CPDLC ACP (VHF) per month of L888 route

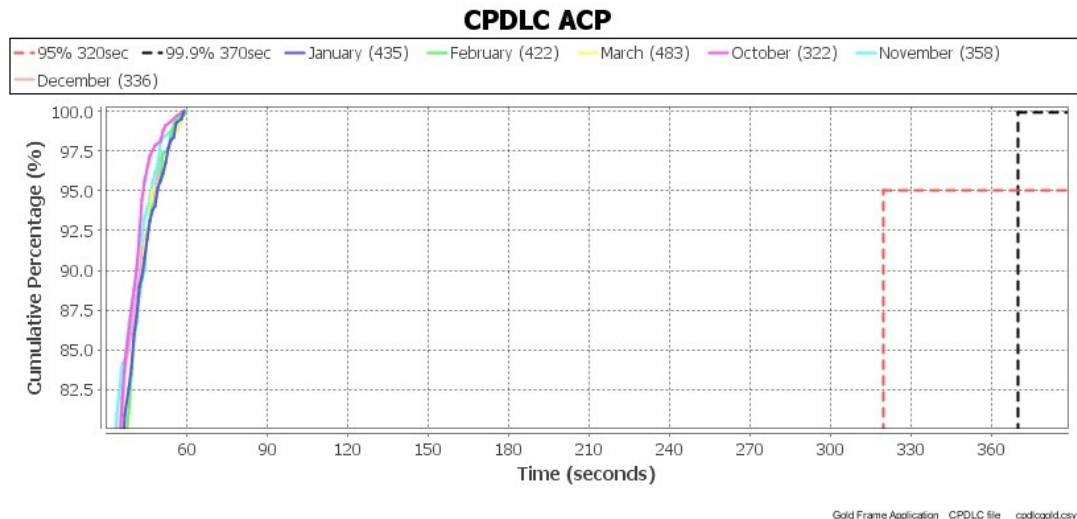


Figure 2: CPDLC ACP (VHF) per month of L888 route

CPDLC Actual Communications Technical Performance (ACTP)

1.3 Actual communications technical performance (ACTP) is used to monitor required communication technical performance (RCTP) time allocations. 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:

$$((MAS\ receipt - Uplink\ transmission\ time)/2 + Downlink\ time) (1)$$

1.4 **Table 3** summarizes overall CPDLC Actual Communications Technical Performance (ACTP) for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 3** graphs ACTP measurement by media type (Satellite, VHF and HF) against the 95% 260” and 99.9% 310” requirements for RCP400 using the 4274 CPDLC transactions recorded during the period Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ATCP				
Messages		% <260 sec (Target 95%)	% <310 sec (Target 99.9%)	Remarks
Satellite	1914	99.83%	99.84%	-
VHF	2356	99.62%	99.64%	-
HF	4	100.00%	100.00%	-
Total	4274	99.70%	99.72%	-

Table 3: CPDLC ATCP per Media Type of L888 Route

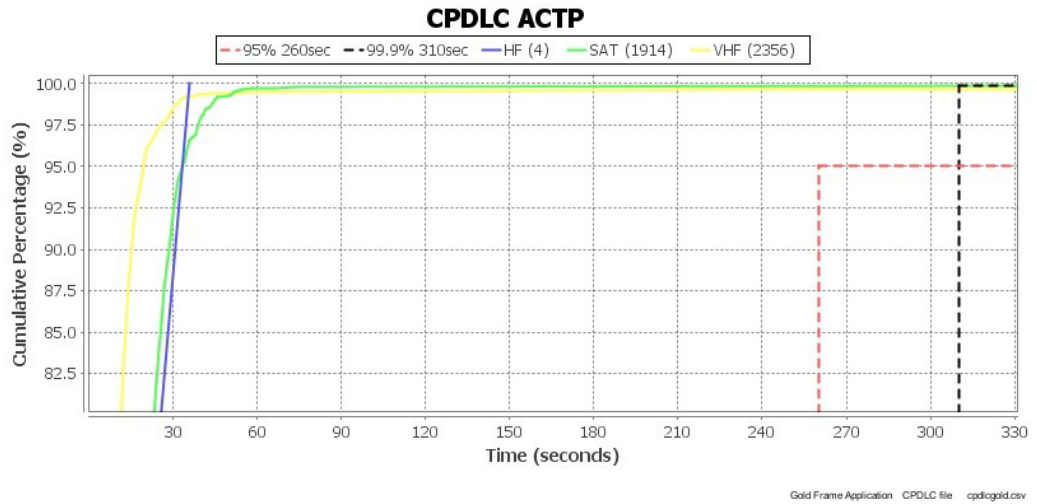


Figure 3: CPDLC ATCP by Data Link Media Type of L888 Route

CPDLC Actual Communications Technical Performance (ACTP) per month - Satellite

1.5 Table 4 summarizes CPDLC ACTP (Satellite) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 4 graphs the ACTP (Satellite) measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ACTP per Month - Satellite				
Month	Messages	% < 260sec (Target 95%)	% < 310sec (Target 99.9%)	Remarks
Oct	272	99.55%	99.62%	-
Nov	241	100.00%	100.00%	-
Dec	206	100.00%	100.00%	-
Jan	334	100.00%	100.00%	-
Feb	362	99.77%	99.78%	-
Mar	499	99.87%	99.89%	-
Total	1914	99.83%	99.84%	-

Table 4: CPDLC ACTP (Satellite) per month of L888 route

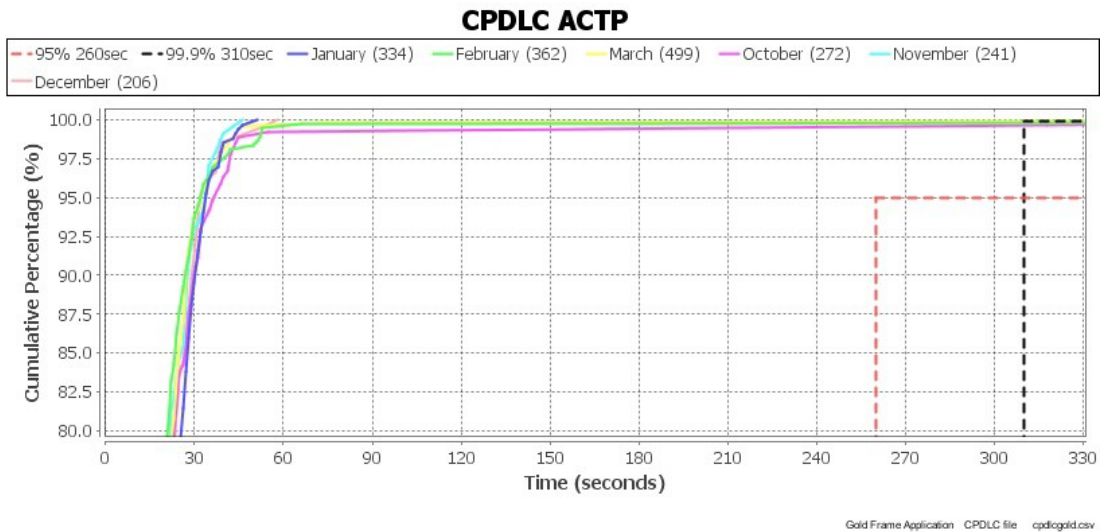


Figure 4: CPDLC ACTP (Satellite) per month of L888 route

CPDLC Actual Communications Technical Performance (ACTP) per month - VHF

1.6 **Table 5** summarizes CPDLC ACTP (VHF) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 5** graphs the ACTP (VHF) measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

CPDLC ACTP per Month - VHF				
Month	Messages	% < 260sec (Target 95%)	% < 310sec (Target 99.9%)	Remarks
Oct	322	99.51%	99.54%	-
Nov	358	99.77%	99.78%	-
Dec	336	100.00%	100.00%	-
Jan	435	99.11%	99.19%	-
Feb	422	100.00%	100.00%	-
Mar	483	99.61%	99.62%	-
Total	2356	99.62%	99.64%	-

Table 5: CPDLC ACTP (VHF) per month of L888 route

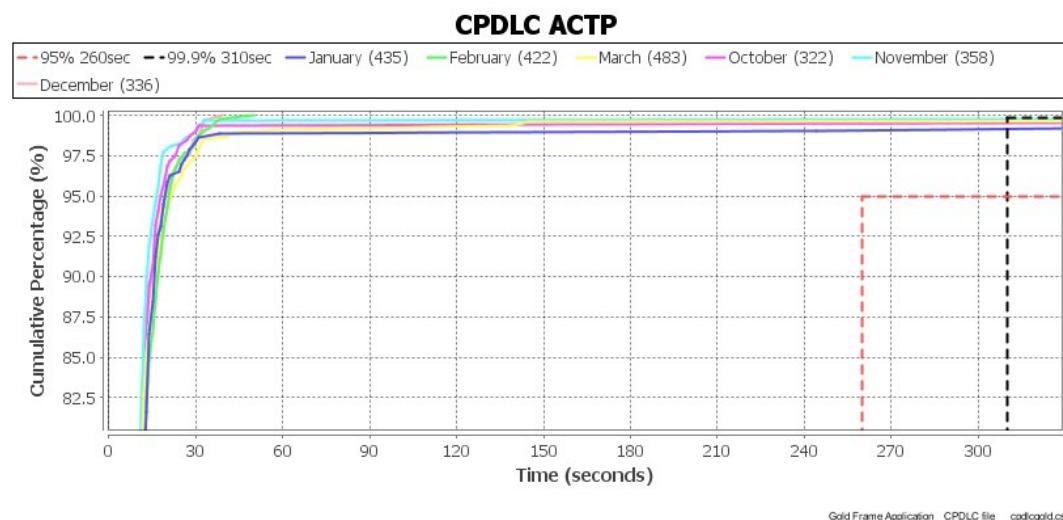


Figure 5: CPDLC ACTP (VHF) per month of L888 route

L888 route ADS-C Downlink Latency per Month - Satellite

1.7 **Table 6** summarizes ADS-C Downlink Latency (Satellite) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). **Figure 6** graphs the ADS-C Downlink Latency (Satellite) per month measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

ADS-C Downlink Latency per Month – Satellite				
Month	Messages	% < 300sec (Target 95%)	% < 400sec (Target 99.9%)	Remarks
Oct	93922	99.67%	99.82%	-
Nov	99255	99.37%	99.54%	-
Dec	85767	99.55%	99.66%	-
Jan	88055	99.49%	99.64%	-
Feb	74564	99.59%	99.77%	-
Mar	87117	99.66%	99.81%	-
Total	528680	99.55%	99.70%	-

Table 6: ADS-C Downlink Latency (Satellite) per month of L888 route

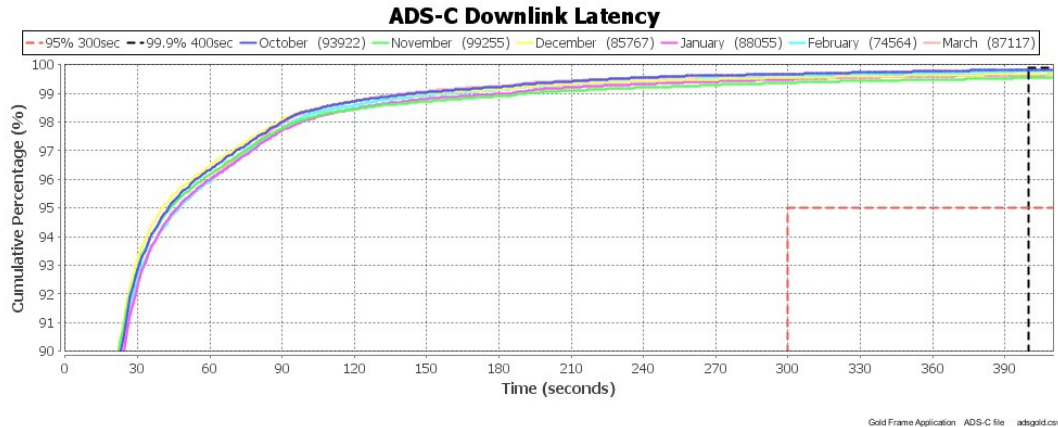


Figure 6: ADS-C Downlink Latency (Satellite) per month of L888 route

L888 route ADS-C Downlink Latency per Month - VHF

1.8 Table 7 summarizes ADS-C Downlink Latency (VHF) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 7 graphs the ADS-C Downlink Latency (VHF) per month measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

ADS-C Downlink Latency per Month – VHF				
Month	Messages	% < 300sec (Target 95%)	% < 400sec (Target 99.9%)	Remarks
Oct	57902	99.86%	99.92%	-
Nov	57468	99.56%	99.66%	-
Dec	52850	99.75%	99.83%	-
Jan	57187	99.75%	99.83%	-
Feb	53975	99.86%	99.93%	-
Mar	65360	99.86%	99.93%	-
Total	344742	99.77%	99.85%	-

Table 7: ADS-C Downlink Latency (VHF) per month of L888 route

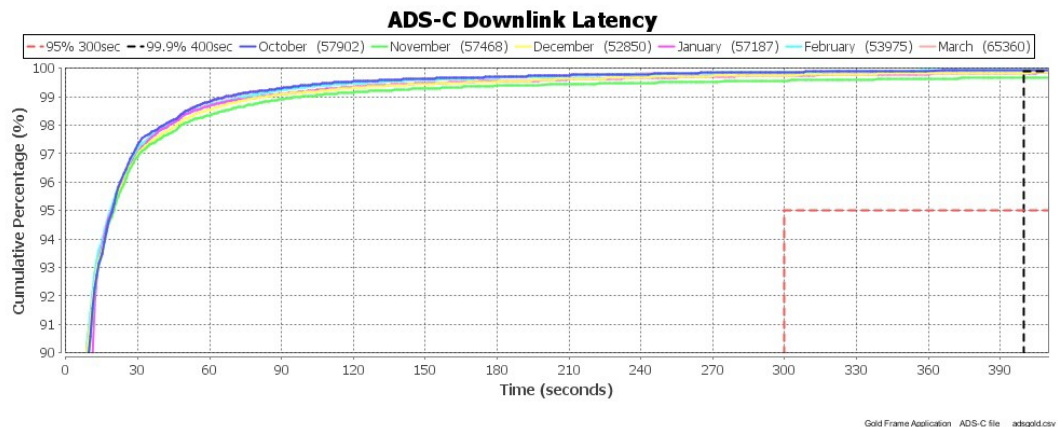


Figure 7: ADS-C Downlink Latency (VHF) per month of L888 route

L888 route ADS-C Downlink Latency per Month - HF

1.9 Table 8 summarizes ADS-C Downlink Latency (HF) per month for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 8 graphs the ADS-C Downlink Latency (HF) per month measurement per month for the period of Oct. 2014 to Mar. 2015. in the three centres.

ADS-C Downlink Latency per Month – HF				
Month	Messages	% < 300sec (Target 95%)	% < 400sec (Target 99.9%)	Remarks
Oct	477	88.47%	93.24%	-
Nov	472	89.09%	95.70%	-
Dec	362	85.82%	92.84%	-
Jan	427	91.80%	95.63%	-
Feb	358	81.98%	87.59%	-
Mar	398	89.20%	94.99%	-
Total	2494	87.89%	93.44%	-

Table 8: ADS-C Downlink Latency (HF) per month of L888 route

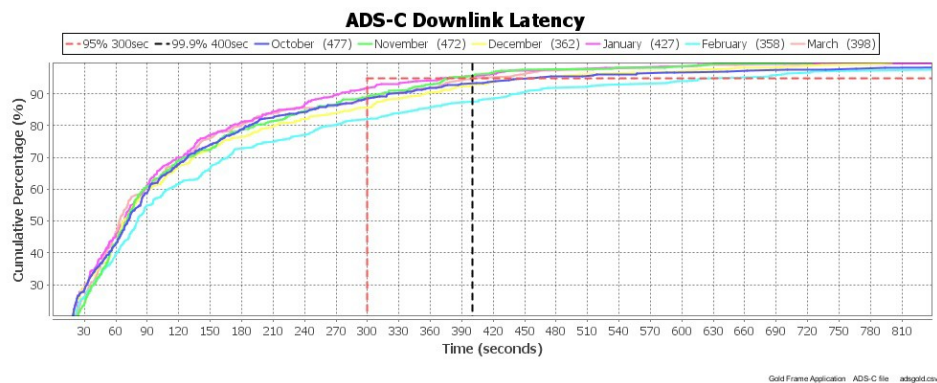


Figure 8: ADS-C Downlink Latency (HF) per month of L888 route

CPDLC Actual Communications Performance (ACP) per Operator (de-identified)

1.10 **Table 9** summarizes CPDLC Actual Communications Performance per Operator for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 9 presents the CPDLC Actual Communications Performance per Operator for the period Oct. 2014 to Mar. 2015.

CPDLC ACP per Operator				
Operator (de-identified)	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
AA6	1669	100.00%	100.00%	-
AA7	701	100.00%	100.00%	-
AA16	478	100.00%	100.00%	-
AA2	275	100.00%	100.00%	-
AA23	260	100.00%	100.00%	-
AA14	199	100.00%	100.00%	-
AA3	139	100.00%	100.00%	-
AA12	120	100.00%	100.00%	-
AA11	86	100.00%	100.00%	-
AA5	68	100.00%	100.00%	-
AA17	56	100.00%	100.00%	-
AA1	42	100.00%	100.00%	-
AA21	34	100.00%	100.00%	-
AA19	34	100.00%	100.00%	-
AA18	32	100.00%	100.00%	-
AA9	20	100.00%	100.00%	-
AA22	19	100.00%	100.00%	-
AA13	17	100.00%	100.00%	-
AA4	16	100.00%	100.00%	-
AA15	3	100.00%	100.00%	-

CPDLC ACP per Operator				
Operator (de-identified)	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
AA8	3	100.00%	100.00%	-
AA10	2	100.00%	100.00%	-
AA20	1	100.00%	100.00%	-
Total	4274	100.00%	100.00%	-

Table 9: CPDLC ACP per Operator of L888 route

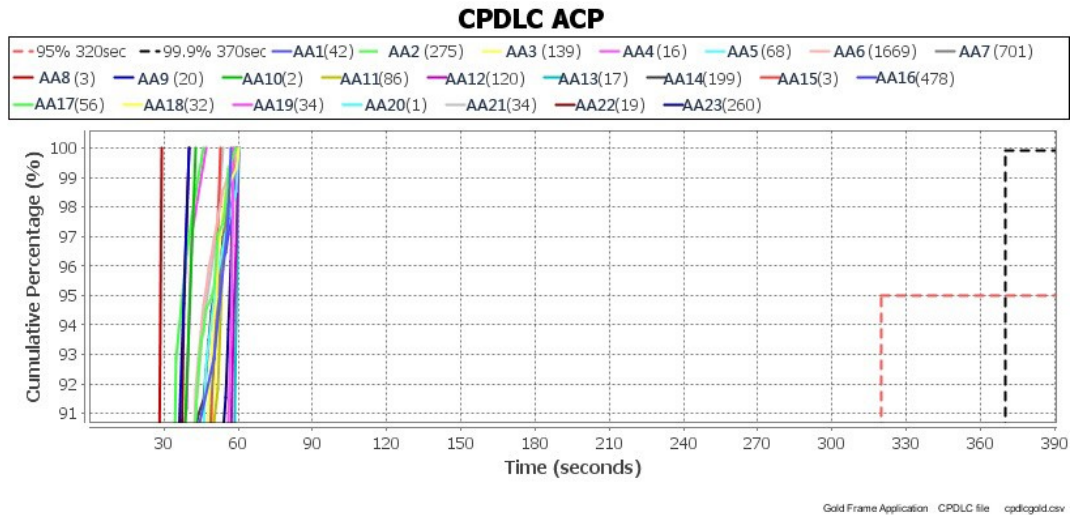


Figure 9: CPLC ACP per Operator of L888 route

CPDLC Actual Communications Technical Performance (ACTP) per Operator (de-identified)

1.11 Table 10 summarizes CPDLC Actual Communications Technical Performance per Operator for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 10 presents the CPDLC Actual Communications Technical Performance per Operator for the period Oct. 2014 to Mar. 2015.

CPDLC ACTP per Operator				
Operator (de-identified)	Messages	% < 260sec (Target 95%)	% < 310sec (Target 99.9%)	Remarks
AA6	1669	99.74%	99.75%	
AA7	701	99.68%	99.71%	
AA16	478	99.61%	99.63%	
AA2	275	100.00%	100.00%	
AA23	260	99.28%	99.29%	
AA14	199	100.00%	100.00%	
AA3	139	100.00%	100.00%	
AA12	120	100.00%	100.00%	
AA11	86	99.06%	99.11%	
AA5	68	100.00%	100.00%	
AA17	56	100.00%	100.00%	
AA1	42	100.00%	100.00%	
AA21	34	100.00%	100.00%	
AA19	34	100.00%	100.00%	
AA18	32	100.00%	100.00%	

CPDLC ACTP per Operator				
Operator (de-identified)	Messages	% < 260sec (Target 95%)	% < 310sec (Target 99.9%)	Remarks
AA9	20	100.00%	100.00%	
AA22	19	100.00%	100.00%	
AA13	17	100.00%	100.00%	
AA4	16	100.00%	100.00%	
AA15	3	100.00%	100.00%	
AA8	3	100.00%	100.00%	
AA10	2	100.00%	100.00%	
AA20	1	100.00%	100.00%	
Total	4274	99.70%	99.72%	

Table 10: ACTP per Operator (de-identified) of L888 route

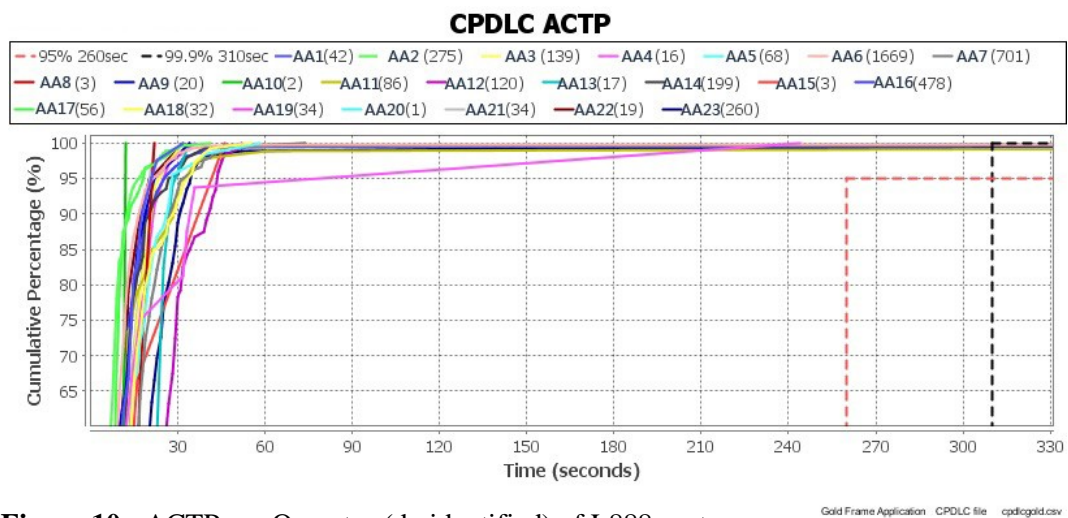


Figure 10: ACTP per Operator (de-identified) of L888 route

Pilot Operational Response Time (PORT) per Operator (de-identified)

1.12 Table 11 summarizes Pilot Operational Response Time (PORT) per Operator (de-identified) for messages sent within three centres (ZLLL, ZUUU, ZWWW). Figure 11 presents the Pilot Operational Response Time (PORT) per Operator (de-identified) for the period Oct. 2014 to Mar. 2015.

CPDLC PORT per Operator			
Operator (de-identified)	Messages	% < 60sec (Target 95%)	Remarks
AA6	1669	100.00%	-
AA7	701	100.00%	-
AA16	478	100.00%	-
AA2	275	100.00%	-
AA23	260	100.00%	-
AA14	199	100.00%	-
AA3	139	100.00%	-
AA12	120	100.00%	-
AA11	86	100.00%	-
AA5	68	100.00%	-
AA17	56	100.00%	-

CPDLC PORT per Operator			
Operator (de-identified)	Messages	% < 60sec (Target 95%)	Remarks
AA1	42	100.00%	-
AA21	34	100.00%	-
AA19	34	100.00%	-
AA18	32	100.00%	-
AA9	20	100.00%	-
AA22	19	100.00%	-
AA13	17	100.00%	-
AA4	16	100.00%	-
AA15	3	100.00%	-
AA8	3	100.00%	-
AA10	2	100.00%	-
AA20	1	100.00%	-
Total	4274	100.00%	-

Table 11: PORT per Operator (de-identified) of L888 route

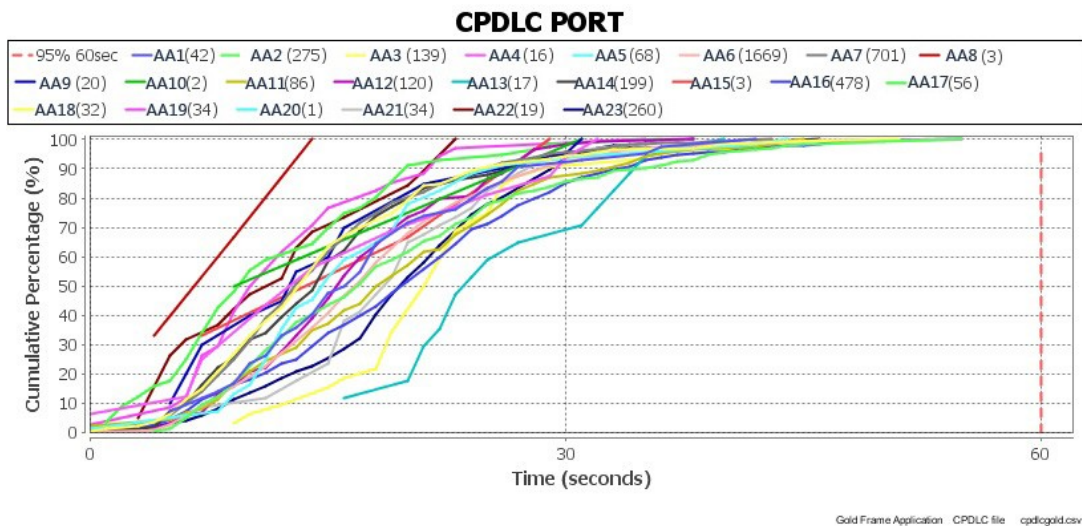


Figure 11: PORT per Operator (de-identified) of L888 route

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