



International Civil Aviation Organization

The Sixth Meeting of the Future Air Navigation Systems Interoperability Team-Asia (FIT-Asia/6)

Bangkok, Thailand, 03 – 05 July 2017

Agenda Item 3: Review of ADS/CPDLC Operations

DATA LINK PERFORMANCE REPORT FOR CHINA (L888 ROUTE)

(Presented by China)

SUMMARY

This paper presents data link performance data for 2016 for the Urumqi, Lanzhou, Chengdu and Kunming FIR for the period of Jan. 2016 to Dec. 2016.

- Urumqi FIR (ZWWW)
- Lanzhou FIR (ZLLL)
- Chengdu FIR (ZUUU)
- Kunming FIR (ZPPP)

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 Urumqi, Lanzhou, Chengdu and Kunming FIR for the period of Jan. 2016 to Dec. 2016.

Performance Measure	Percentage of Messages Required to Meet Criteria	ADS-C		CPDLC	
		RSP180 Criteria(sec)	RSP400 Criteria(sec)	RCP240 Criteria(sec)	RCP400 Criteria(sec)
ASP	95%	90	300		
	99.90%	180	400		
ACTP	95%			120	260
	99.90%			150	310
ACP	95%			180	320
	99.90%			210	370

PORT	95%			60	60
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1.4 The performance data observed from the CPDLC and ADS-C systems are measured against the Required Communication Performance (RCP) 400 specification and Required Surveillance Performance (RSP) 400 (please refer to the table above and the criteria highlighted in red) to demonstrate that safety objectives which rely on the communications infrastructure can be met by the aircraft and ground systems. The provision of the data-link performance is presented in the reporting template revised in WP/05 of FIT-ASIA/4 meeting, 2015.

1.5 For the operational status of data link application along L888 route and the improvement that China made in promoting the problem reporting mechanism, please refer to the other working papers that China submitted to this FIT-Asia meeting.

2. DISCUSSION

2.1 This section presents a summary of the data link performance monitoring. Further analysis is provided in **Attachment A**.

2.2 The following analysis are provided in the discussion:

- ACP for Urumqi and Lanzhou FIR
- ACTP for Urumqi and Lanzhou FIR
- ACP per Operator (de-identified) for Urumqi and Lanzhou FIR
- ADS-C Downlink Latency for Urumqi, Lanzhou, Chengdu and Kunming FIR

CPDLC Actual Communications Performance (ACP)

2.3 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.

2.4 **Table 1** and **Figure 1** present overall CPDLC Actual Communications Performance (ACP) for messages sent within Urumqi FIR (ZWWW) by media type (Satellite, VHF, HF and the combined total), for the period Jan. 2016 to Dec. 2016. The ACP for CPDLC messages sent via satellite, Satellite and VHF meet the 95 percentage, but fall below the 99.9 percentage criteria.

Urumqi FIR CPDLC ACP				
Messages		%< 320 sec (Target 95%)	%< 370 sec (Target 99.9%)	Remarks
Satellite	4,816	97.94%	98.55%	-
VHF	4,577	99.16%	99.21%	-
HF	-	-	-	-
Total	9,393	98.53%	98.86%	-

Table 1: Urumqi FIR (ZWWW) CPDLC ACP per Media Type

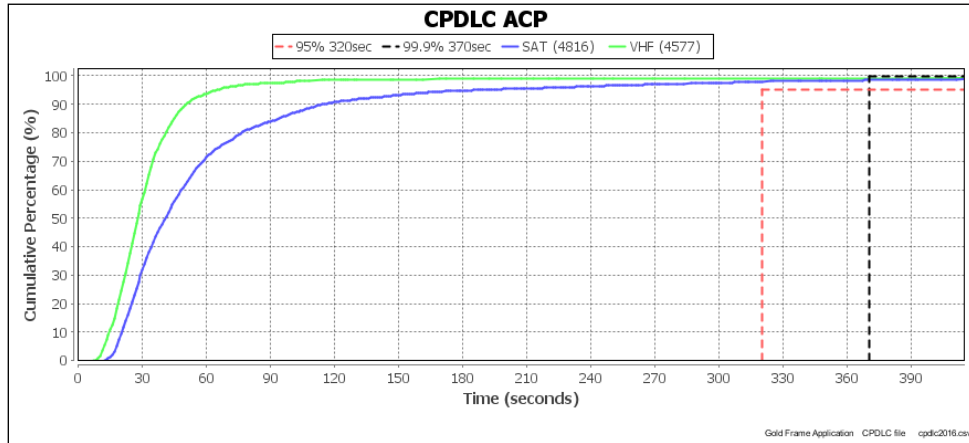


Figure 1: Urumqi FIR ACP per Media Type

2.5. **Table 2** and **Figure 2** present overall CPDLC Actual Communications Performance (ACP) for messages sent within Lanzhou FIR (ZLLL) by media type (Satellite, VHF, HF and the combined total), for the period Jan. 2016 to Dec. 2016. The ACP for CPDLC messages sent via satellite, VHF and HF meet the 95 percentage, but messages sent via satellite and VHF fall below the 99.9 percentage criteria.

Lanzhou FIR CPDLC ACP				
Messages		% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Satellite	7,565	98.62%	99.17%	-
VHF	670	98.59%	98.90%	-
HF	3	100.00%	100.00%	-
Total	8,238	98.61%	99.13%	-

Table 2: Lanzhou FIR CPDLC ACP per Media Type

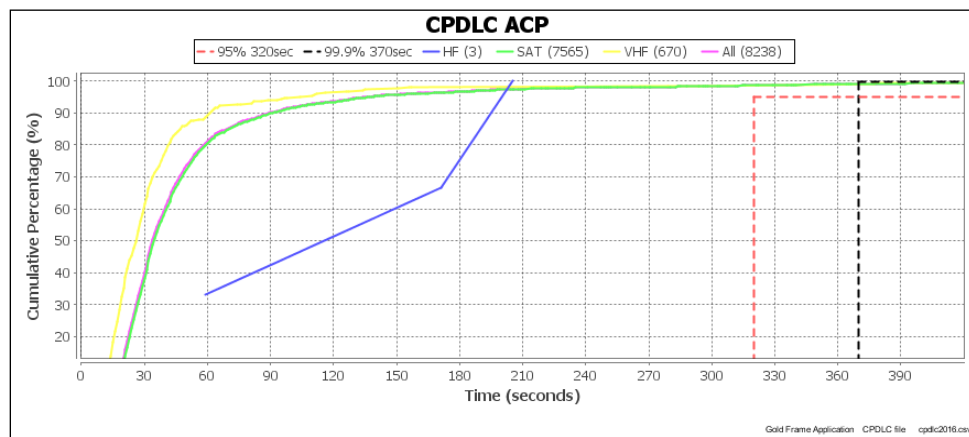


Figure 2: Lanzhou FIR ACP per Media Type

CPDLC Actual Communications Technical Performance (ACTP)

2.6. 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.

2.7. **Table 3** and **Figure 3** present overall CPDLC Actual Communications Technical Performance (ACTP) for messages sent within Urumqi FIR (ZWWW) by media type (Satellite, VHF, HF and the combined total), for the period Jan. 2016 to Dec. 2016. The ACTP for CPDLC messages sent via satellite and VHF meet the 95 percentage, but fall below the 99.9 percentage criteria.

Urumqi FIR CPDLC ACTP				
Messages		% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Satellite	4,816	98.90%	99.36%	-
VHF	4,577	99.74%	99.75%	-
HF	-	-	-	-
Total	9,393	99.31%	99.55%	-

Table 3: Urumqi FIR CPDLC ACTP

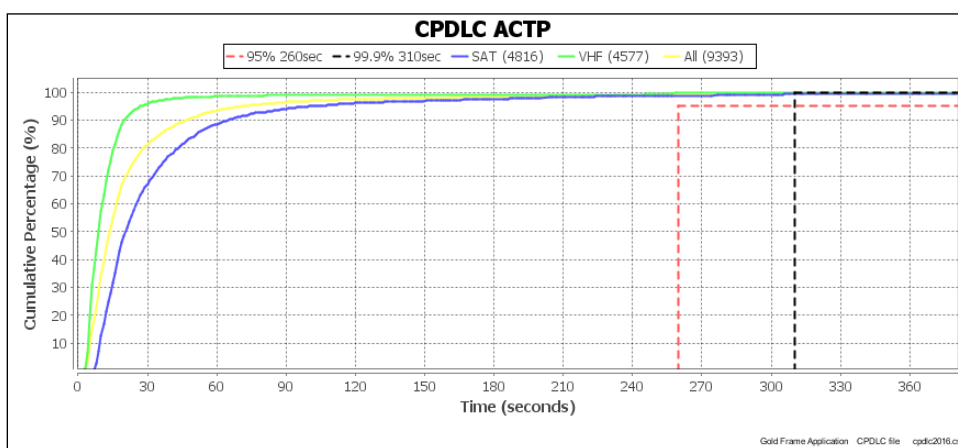


Figure 3: Urumqi FIR ACTP by Data Link Media Type

2.8. **Table 4** and **Figure 4** present overall CPDLC Actual Communications Technical Performance (ACTP) for messages sent within Lanzhou FIR (ZLLL) by media type (Satellite, VHF, HF and the combined total), for the period Jan. 2016 to Dec. 2016. The ACTP for CPDLC messages sent via satellite, VHF and HF all meet the 95 percentage, but CPDLC messages sent via satellite fall below the 99.9 percentage criteria.

Lanzhou FIR CPDLC ACTP				
Messages		% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Satellite	7,565	99.73%	99.81%	-
VHF	670	99.74%	100.00%	-
HF	3	100.00%	100.00%	-
Total	8,238	99.73%	99.83%	-

Table 4: Lanzhou FIR CPDLC ACTP

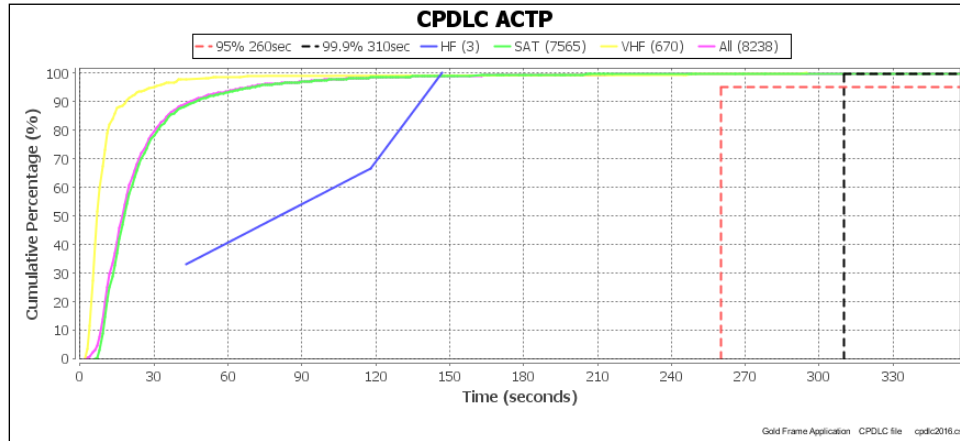


Figure 4: Lanzhou FIR ACTP by Data Link Media Type

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

2.9. **Table 5 and Figure 5** present CPDLC Actual Communications Performance per Operator for messages sent within Urumqi FIR (ZWWW) for the period Jan. 2016 to Dec. 2016. It is observed that the parts of operators fall below the 95 and 99.9 percentage criteria.

Urumqi FIR CPDLC ACP per Operator (de-identified)				
Operator (de-identified)	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
AAA	4,751	99.38%	99.44%	-
ABD	1	100.00%	100.00%	-
ABE	47	96.64%	96.99%	-
BBB	1,035	95.17%	96.24%	-
CCC	862	99.36%	99.43%	-
DDD	470	99.50%	100.00%	-
EEE	38	96.26%	97.38%	-
FFF	212	99.12%	99.32%	-
GGG	101	100.00%	100.00%	-
HHH	1,451	99.82%	99.90%	-
III	1	100.00%	100.00%	-
JJJ	290	96.93%	97.59%	-
KKK	308	100.00%	100.00%	-
LLL	1	100.00%	100.00%	-
MMM	281	90.11%	90.67%	-
NNN	420	98.10%	99.77%	-
OOO	44	100.00%	100.00%	-
PPP	10	90.27%	90.47%	-
QQQ	12	100.00%	100.00%	-
RRR	27	98.20%	98.68%	-
SSS	6	100.00%	100.00%	-
VVV	1	100.00%	100.00%	-
WWW	4	100.00%	100.00%	-
XXX	39	93.75%	94.87%	-
YYY	18	100.00%	100.00%	-
Total	10,430	98.56%	98.87%	-

Table 5: Urumqi FIRCPDLC ACP per Operator

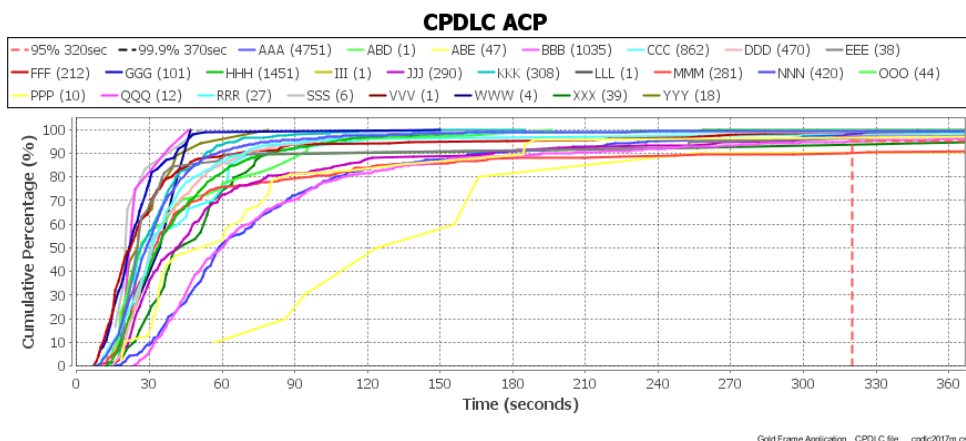


Figure 5: Urumqi FIRCPDL ACP per Operator

2.10. Table 6 and Figure 6 present CPDLC Actual Communications Performance per Operator for messages sent within Lanzhou FIR (ZLLL) for the period Jan. 2016 to Dec. 2016. It is observed that all of the operators meet the 95 percentage, but parts of operators fall below the 99.9 percentage criteria.

Lanzhou FIR CPDLC ACP per Operator (de-identified)				
Operator (de-identified)	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
UNK	115	99.18%	99.66%	-
AAA	2,517	100.00%	100.00%	-
ABA	1	100.00%	100.00%	-
ABC	4	100.00%	100.00%	-
ABD	1	100.00%	100.00%	-
ABE	73	96.76%	100.00%	-
BBB	1,257	98.34%	98.74%	-
CCC	929	99.34%	99.53%	-
DDD	736	99.77%	99.82%	-
EEE	32	100.00%	100.00%	-
FFF	307	98.94%	99.75%	-
GGG	99	100.00%	100.00%	-
HHH	2,571	99.13%	99.29%	-
III	53	100.00%	100.00%	-
JJJ	499	95.31%	98.62%	-
KKK	691	99.45%	99.47%	-
LLL	1	100.00%	100.00%	-
MMM	376	97.37%	97.44%	-
NNN	801	97.67%	98.64%	-
OOO	23	100.00%	100.00%	-
PPP	4	100.00%	100.00%	-
QQQ	4	100.00%	100.00%	-
RRR	10	100.00%	100.00%	-
SSS	6	100.00%	100.00%	-
UUU	1	100.00%	100.00%	-
VVV	2	100.00%	100.00%	-
XXX	116	100.00%	100.00%	-
YYY	44	100.00%	100.00%	-
ZZZ	4	100.00%	100.00%	-
Total	11,277	98.94%	99.32%	-

Table 6: Lanzhou FIRCPDLC ACP per Operator

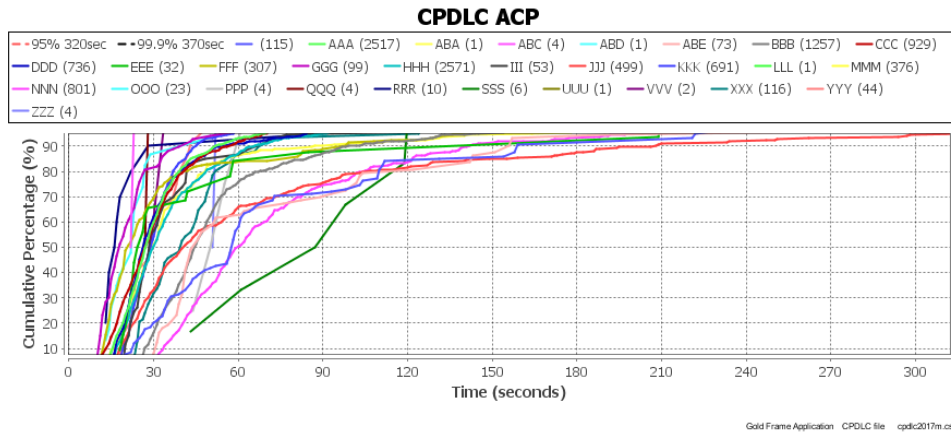


Figure 6: Lanzhou FIR CPDLC ACP per Operator

ADS-C Downlink Latency

2.11. Table 7 and Figure 7 present ADS-C Downlink Latency for messages sent within Urumqi FIR per media type (Satellite, VHF, HF and combined total), for the period for the period Jan. 2016 to Dec. 2016. It is observed that the RSP ADS-C data link messages sent via HF fall below the 95 percentage, and messages sent via satellite and HF fall below the 99.9 percentage criteria.

Urumqi FIR ADS-C Downlink Latency				
Messages		% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Satellite	210,617	99.72%	99.83%	-
VHF	204,065	99.88%	99.91%	-
HF	554	87.31%	91.23%	-
Total	415,236	99.78%	99.86%	-

Table 7: Urumqi FIR ADS-C Downlink Latency per Media Type

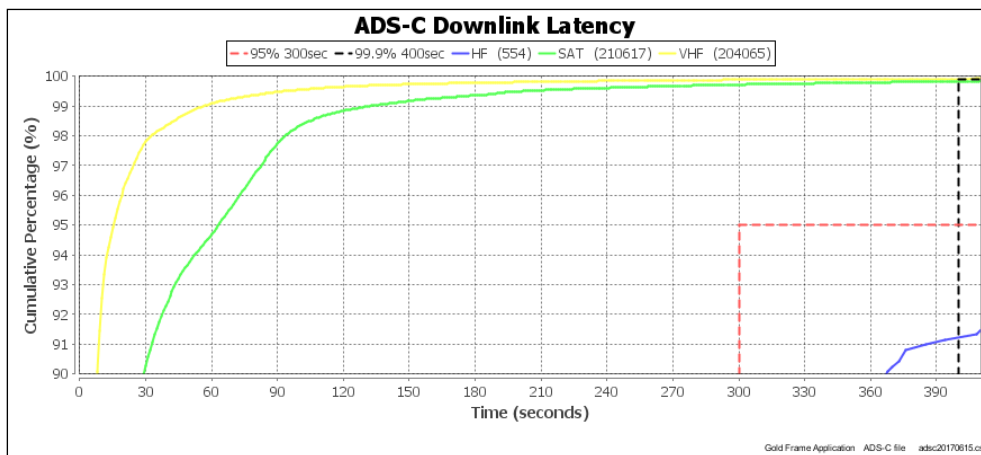


Figure 7: Urumqi FIR ADS-C Downlink Latency

2.12. **Table 8 and Figure 8** present ADS-C Downlink Latency for messages sent within Lanzhou FIR per media type (Satellite, VHF , HF and combined total), for the period for the period Jan. 2016 to Dec. 2016. It is observed that the RSP ADS-C data link messages sent via HF fall below the 95 percentage, and messages sent via satellite and HF fall below the 99.9 percentage criteria.

Lanzhou FIR ADS-C Downlink Latency				
Messages		% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Satellite	392,564	99.72%	99.83%	-
VHF	440,721	99.88%	99.92%	-
HF	894	86.52%	91.26%	-
Total	834,179	99.79%	99.87%	-

Table 8: Lanzhou FIR ADS-C Downlink Latency per Media Type

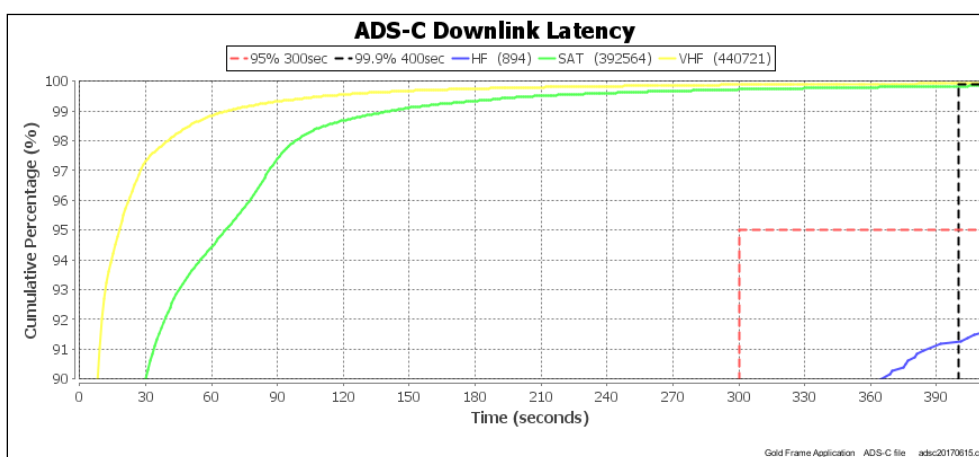


Figure 8: Lanzhou FIR ADS-C Downlink Latency

2.13. **Table 9 and Figure 9** present ADS-C Downlink Latency for messages sent within Chengdu FIR per media type (Satellite, VHF , HF and combined total), for the period for the period Jan. 2016 to Dec. 2016. It is observed that the RSP ADS-C data link messages sent via HF fall below the 95 percentage, and messages sent via all media types fall below the 99.9 percentage criteria.

Chengdu FIR ADS-C Downlink Latency				
Messages		% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Satellite	387,683	99.62%	99.77%	-
VHF	208,302	99.81%	99.88%	-
HF	755	82.05%	90.01%	-
Total	596,740	99.66%	99.79%	-

Table 9: Chengdu FIR ADS-C Downlink Latency per Media Type

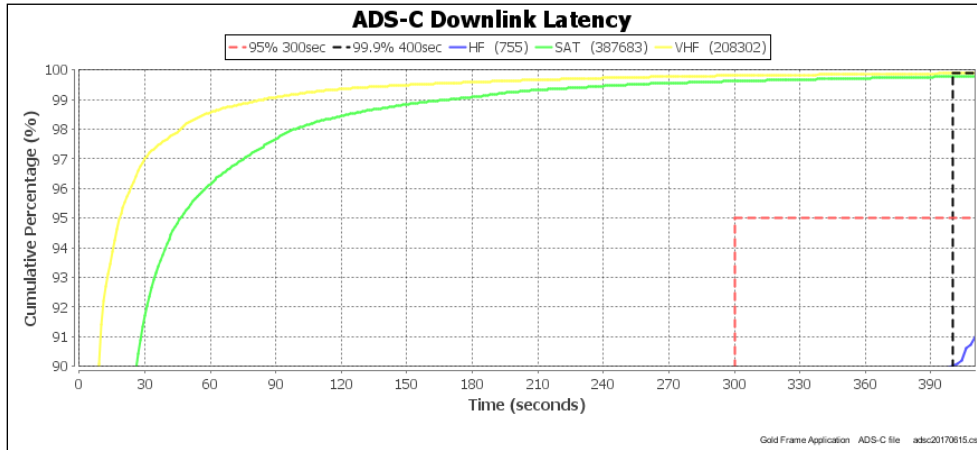


Figure 9: Chengdu FIR ADS-C Downlink Latency

2.14. **Table 10 and Figure 10** present ADS-C Downlink Latency for messages sent within Kunming FIR per media type (Satellite, VHF, HF and combined total), for the period for the period Jan. 2016 to Dec. 2016. It is observed that the RSP ADS-C data link messages sent via HF fall below the 95 percentage, and messages sent via all media types fall below the 99.9% percentage.

Kunming FIR ADS-C Downlink Latency				
Messages		% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Satellite	46,107	99.69%	99.79%	-
VHF	50,397	99.77%	99.84%	-
HF	146	93.20%	94.28%	-
Total	96,650	99.72%	99.81%	-

Table 10: Kunming FIR ADS-C Downlink Latency per Media Type

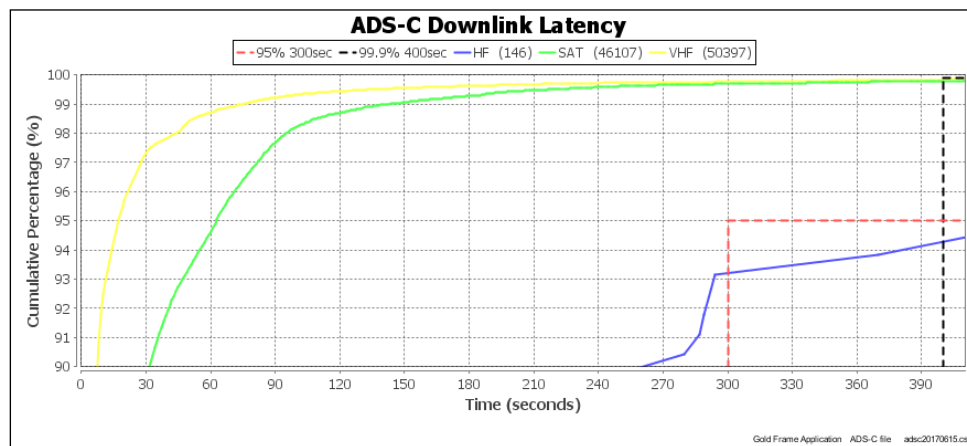


Figure 10: Kunming FIR ADS-C Downlink Latency

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.

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ATTACHMENT A – ADDITIONAL ANALYSIS

1. CPDLC ACTUAL COMMUNICATION PERFORMANCE(ACP)

CPDLC Actual Communications Performance (ACP) per Month – Satellite

1.1 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.

1.2 **Table 1** and **Figure 1** present CPDLC ACP per month for messages sent within the Urumqi FIR (ZWWW) by Satellite data link, for the period Jan. 2016 to Dec. 2016. The ACP for CPDLC messages sent via satellite, VHF and HF all meet the 95% percentage, but messages sent via all media types fall below the 99.9% percentage criteria.

Urumqi FIR CPDLC ACP per Month - Satellite				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Jan.	370	97.76%	97.95%	-
Feb.	281	97.59%	97.89%	-
Mar.	352	98.92%	99.16%	-
Apr.	347	98.71%	98.85%	-
May	354	98.72%	99.18%	-
Jun.	426	96.40%	97.89%	-
Jul.	349	98.87%	99.15%	-
Aug.	338	97.24%	97.96%	-
Sep.	379	98.80%	98.99%	-
Oct.	746	97.45%	98.72%	-
Nov.	517	98.69%	98.79%	-
Dec.	357	98.09%	98.43%	-
Total	4,816	97.94%	98.55%	-

Table 1: Urumqi FIR CPDLC ACP per Month - Satellite

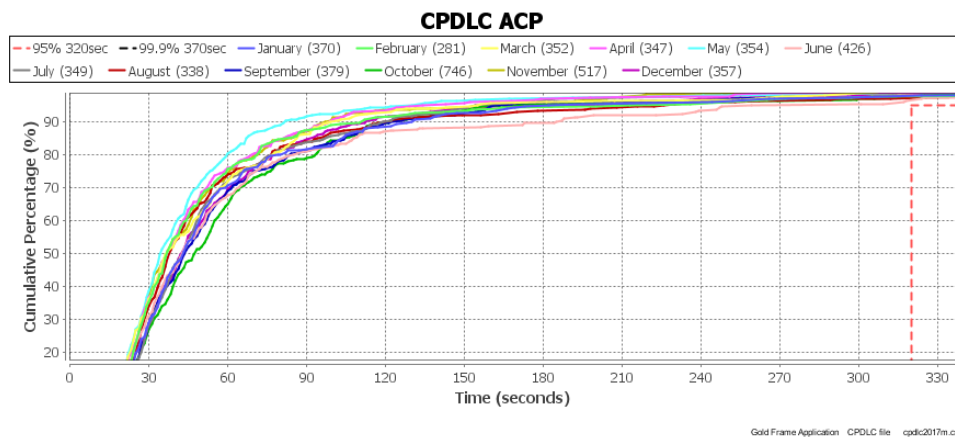


Figure 1: Urumqi FIR ACP per Month - Satellite

1.3 **Table 2** and **Figure 2** present CPDLC ACP per month for messages sent within the Lanzhou FIR (ZLLL) by Satellite data link, for the period Jan. 2016 to Dec. 2016. The ACP for CPDLC messages sent via satellite, VHF and HF all meet the 95% percentage, but parts of messages fall below the 99.9% percentage criteria.

Lanzhou FIR CPDLC ACP per Month - Satellite				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Jan.	411	97.91%	99.30%	-
Feb.	269	98.99%	99.15%	-
Mar.	341	99.50%	99.55%	-
Apr.	358	99.44%	99.47%	-
May	393	99.06%	99.29%	-
Jun.	589	99.06%	99.11%	-
Jul.	364	98.94%	99.75%	-
Aug.	1,042	99.26%	99.62%	-
Sep.	1,562	98.82%	99.33%	-
Oct.	765	96.64%	97.14%	-
Nov.	335	99.76%	99.93%	-
Dec.	1,136	98.32%	99.59%	-
Total	7,565	98.62%	99.17%	-

Table 2: Lanzhou FIR CPDLC ACP per Month – Satellite

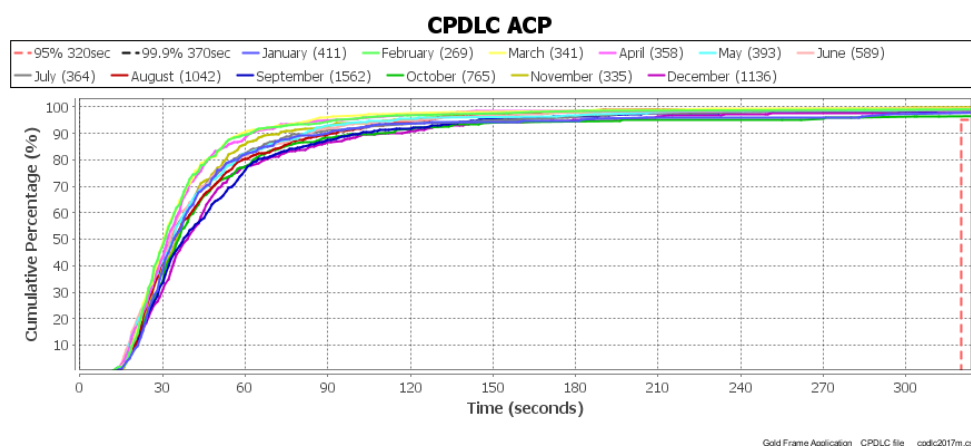


Figure 2: Lanzhou FIR ACP per Month - Satellite

CPDLC Actual Communications Performance (ACP) per Month – VHF

1.4 **Table 3** and **Figure 3** present CPDLC ACP (VHF) per month for messages sent within the Urumqi FIR (ZWWW) by VHF data link, for the period Jan. 2016 to Dec. 2016. The ACP for CPDLC messages sent via satellite, VHF and HF all meet the 95% percentage, but parts of messages fall below the 99.9% percentage criteria.

Urumqi FIR CPDLC ACP per Month - VHF				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Jan.	442	97.38%	97.42%	-
Feb.	273	98.39%	98.44%	-
Mar.	307	99.80%	99.83%	-
Apr.	276	98.13%	98.27%	-
May	261	99.49%	99.59%	-
Jun.	418	99.85%	99.87%	-
Jul.	348	99.80%	99.84%	-
Aug.	247	98.47%	98.57%	-
Sep.	408	99.81%	99.85%	-
Oct.	760	99.45%	99.49%	-
Nov.	477	100.00%	100.00%	-
Dec.	360	99.77%	99.85%	-
Total	4,577	99.16%	99.21%	-

Table 3: Urumqi FIR CPDLC ACP per Month - VHF

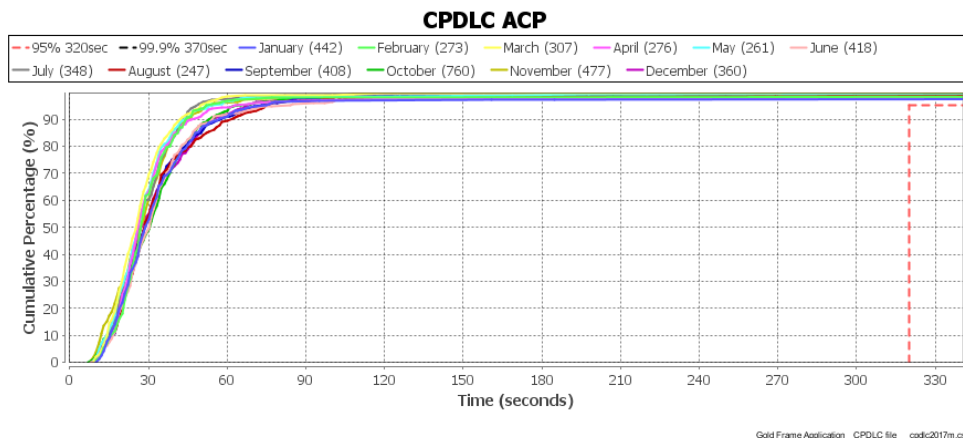


Figure 3: Urumqi FIR ACP per Month - VHF

1.5 **Table 4** and **Figure 4** present CPDLC ACP (VHF) per month for messages sent within the Lanzhou FIR (ZLLL) by VHF data link, for the period Jan. 2016 to Dec. 2016. Parts of messages sent via satellite, VHF and HF fall below the 95% and 99.9% percentage criteria.

Lanzhou FIR CPDLC ACP per Month - VHF				
Month	Messages	% < 320 sec (Target 95%)	% < 370 sec (Target 99.9%)	Remarks
Jan.	19	92.66%	93.25%	-
Feb.	15	99.50%	100.00%	-
Mar.	13	100.00%	100.00%	-
Apr.	13	100.00%	100.00%	-
May	23	98.26%	98.73%	-
Jun.	23	100.00%	100.00%	-
Jul.	24	100.00%	100.00%	-
Aug.	75	100.00%	100.00%	-
Sep.	201	98.78%	98.98%	-
Oct.	105	98.55%	98.64%	-
Nov.	47	100.00%	100.00%	-
Dec.	112	100.00%	100.00%	-
Total	670	98.59%	98.90%	-

Table 4: Lanzhou FIR CPDLC ACP per Month - VHF

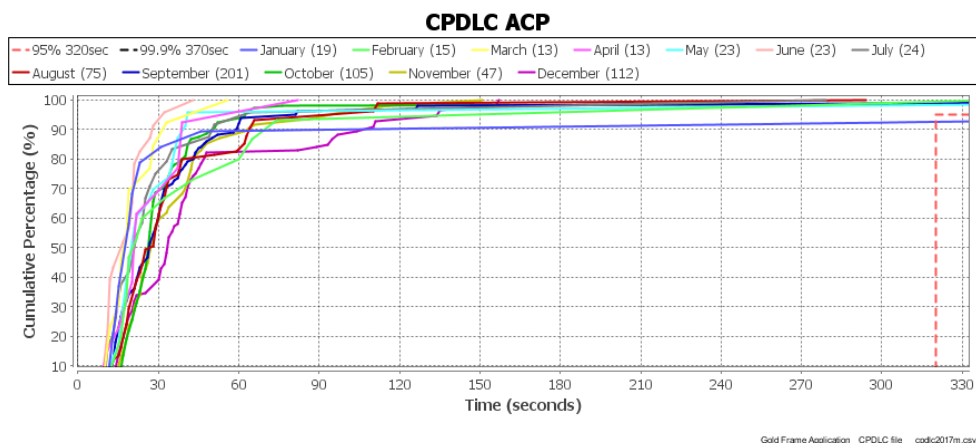


Figure 4: Lanzhou FIR ACP per Month - VHF

2. CPDLC ACTUAL COMMUNICATION TECHNICAL PERFORMANCE (ACTP)

CPDLC Actual Communications Technical Performance (ACTP) per Month – Satellite

2.1 Table 6 and Figure 6 present CPDLC ACTP per month for messages sent within the Urumqi FIR (ZWWW) by Satellite data link, for the period Jan. 2016 to Dec. 2016.

Urumqi FIR CPDLC ACTP per Month – Satellite				
Month	Messages	% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Jan.	370	98.20%	98.92%	-
Feb.	281	98.80%	98.91%	-
Mar.	352	99.46%	99.64%	-
Apr.	347	99.48%	99.53%	-
May	354	100.00%	100.00%	-
Jun.	426	99.19%	99.77%	-
Jul.	349	99.40%	100.00%	-
Aug.	338	97.42%	98.88%	-
Sep.	379	99.68%	99.80%	-
Oct.	746	98.55%	99.41%	-
Nov.	517	98.86%	98.94%	-
Dec.	357	99.34%	99.53%	-
Total	4,816	98.90%	99.36%	-

Table 6: Urumqi FIR CPDLC ACTP per Month - Satellite

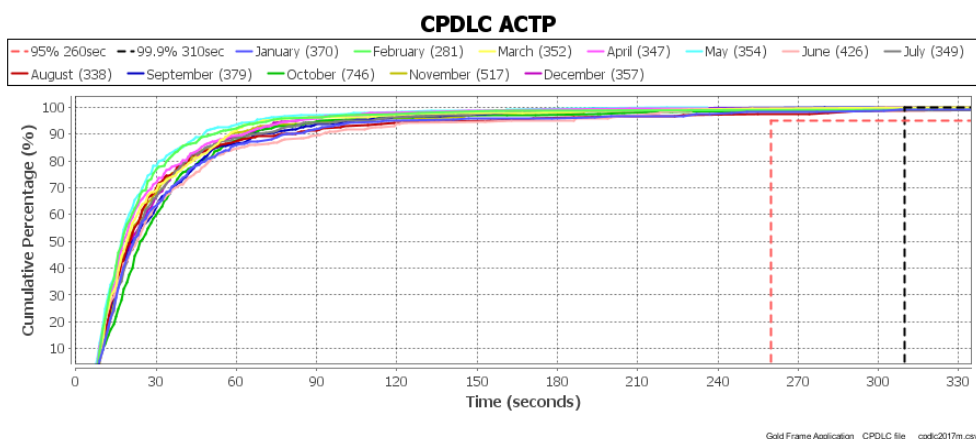


Figure 6: Urumqi FIR ACTP per Month - Satellite

2.2 **Table 7** and **Figure 7** present CPDLC ACTP per month for messages sent within the Lanzhou FIR (ZLLL) by Satellite data link, for the period Jan. 2016 to Dec. 2016.

Lanzhou FIR CPDLC ACTP per Month - Satellite				
Month	Messages	% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Jan.	411	100.00%	100.00%	-
Feb.	269	100.00%	100.00%	-
Mar.	341	100.00%	100.00%	-
Apr.	358	99.97%	100.00%	-
May	393	100.00%	100.00%	-
Jun.	589	99.55%	99.60%	-
Jul.	364	98.78%	98.87%	-
Aug.	1,042	100.00%	100.00%	-
Sep.	1,562	99.85%	100.00%	-
Oct.	765	99.34%	99.43%	-
Nov.	335	99.86%	99.98%	-
Dec.	1,136	99.92%	99.94%	-
Total	7,565	99.73%	99.81%	-

Table 7: Lanzhou FIR CPDLC ACTP per Month - Satellite

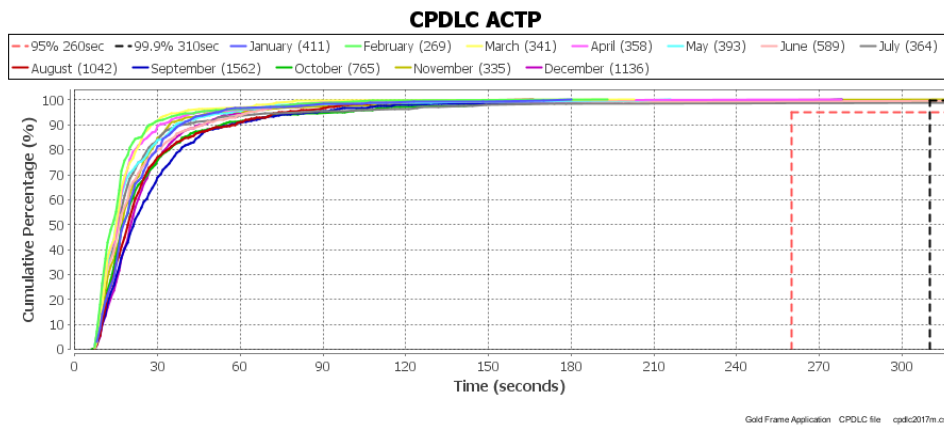


Figure 7: Lanzhou FIR ACTP per Month - Satellite

CPDLC Actual Communications Technical Performance (ACTP) per Month – VHF

2.3 **Table 8** and **Figure 8** present CPDLC ACTP per month for messages sent within the Urumqi FIR (ZWWW) by VHF data link, for the period Jan. 2016 to Dec. 2016.

Urumqi FIR CPDLC ACTP per Month - VHF				
Month	Messages	% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Jan.	442	98.87%	98.92%	-
Feb.	273	100.00%	100.00%	-
Mar.	307	99.80%	99.83%	-
Apr.	276	99.69%	99.90%	-
May	261	99.28%	99.44%	-
Jun.	418	99.82%	99.84%	-
Jul.	348	100.00%	100.00%	-
Aug.	247	100.00%	100.00%	-
Sep.	408	99.79%	99.82%	-
Oct.	760	99.87%	99.88%	-

Nov.	477	100.00%	100.00%	-
Dec.	360	100.00%	100.00%	-
Total	4,577	99.74%	99.75%	-

Table 8: Urumqi FIR CPDLC ACTP per Month - VHF

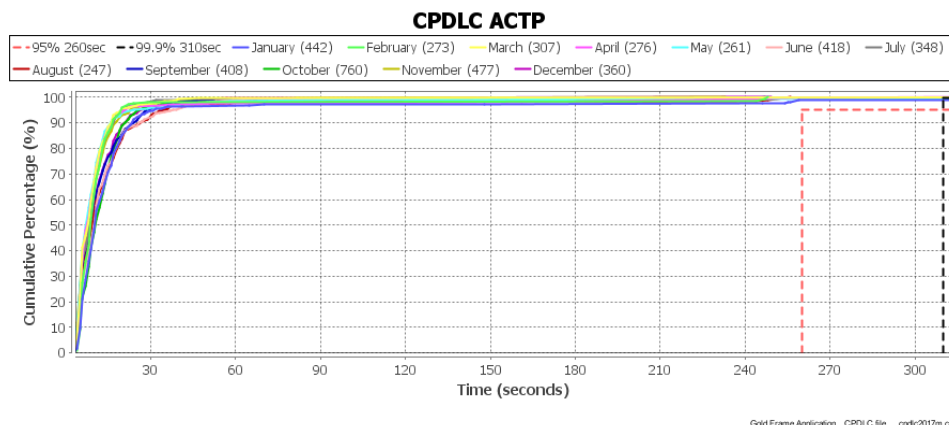


Figure 8: Urumqi FIR ACTP per Month - VHF

2.4 **Table 9** and **Figure 9** present CPDLC ACTP (VHF) per month for messages sent within the Lanzhou FIR (ZLLL) by VHF data link, for the period Jan. 2016 to Dec. 2016.

Lanzhou FIR CPDLC ACTP per Month - VHF				
Month	Messages	% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
Jan.	19	100.00%	100.00%	-
Feb.	15	100.00%	100.00%	-
Mar.	13	100.00%	100.00%	-
Apr.	13	100.00%	100.00%	-
May	23	100.00%	100.00%	-
Jun.	23	100.00%	100.00%	-
Jul.	24	100.00%	100.00%	-
Aug.	75	100.00%	100.00%	-
Sep.	201	100.00%	100.00%	-
Oct.	105	98.93%	100.00%	-
Nov.	47	100.00%	100.00%	-
Dec.	112	100.00%	100.00%	-
Total	670	99.74%	100.00%	-

Table 9: Lanzhou FIR CPDLC ACTP per Month - VHF

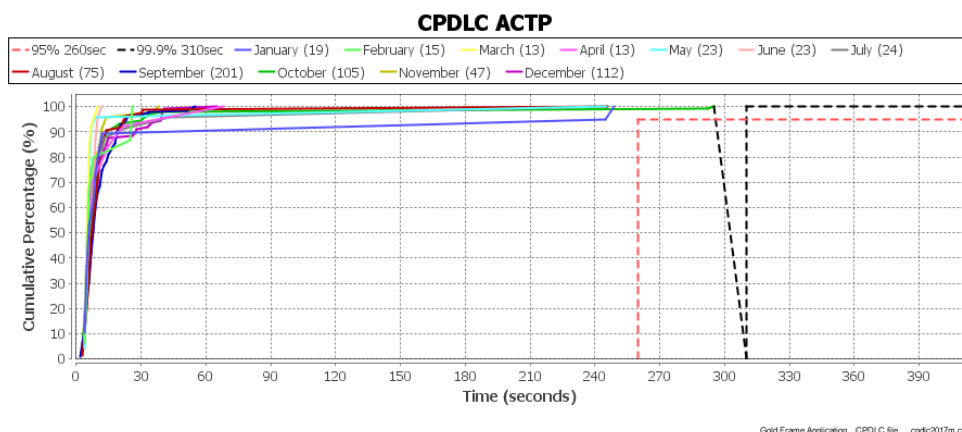


Figure 9: Lanzhou FIR ACTP per Month - VHF

3. CPDLC COMMUNICATION PERFORMANCE PER OPERATOR

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

3.1 **Table 11** and **Figure 11** present CPDLC Actual Communications Technical Performance per Operator (de-identified) for messages sent within Urumqi FIR (ZWWW), for the period Jan. 2016 to Dec. 2016.

Urumqi FIR CPDLC ACTP per Operator(de-identified)				
Operator (de-identified)	Messages	% < 260 sec (Target 95%)	%< 310 sec (Target 99.9%)	Remarks
UNK	103	100.00%	100.00%	-
AAA	4,751	99.58%	99.61%	-
ABD	1	100.00%	100.00%	-
ABE	47	99.07%	99.53%	-
BBB	1,035	96.44%	98.11%	-
CCC	862	99.91%	99.92%	-
DDD	470	100.00%	100.00%	-
EEE	38	98.02%	98.28%	-
FFF	212	100.00%	100.00%	-
GGG	101	98.27%	98.33%	-
HHH	1,451	99.73%	99.78%	-
III	1	100.00%	100.00%	-
JJJ	290	99.82%	100.00%	-
KKK	308	100.00%	100.00%	-
LLL	1	100.00%	100.00%	-
MMM	281	98.22%	98.31%	-
NNN	420	99.22%	99.78%	-
OOO	44	100.00%	100.00%	-
PPP	10	100.00%	100.00%	-
QQQ	12	100.00%	100.00%	-
RRR	27	100.00%	100.00%	-
SSS	6	100.00%	100.00%	-
VVV	1	100.00%	100.00%	-
WWW	4	100.00%	100.00%	-
XXX	39	100.00%	100.00%	-
YYY	18	100.00%	100.00%	-
ZZZ	1	100.00%	100.00%	-
Total	10,534	99.28%	99.49%	-

Table 11: Urumqi FIRCPDLC ACTP per Operator(de-identified)

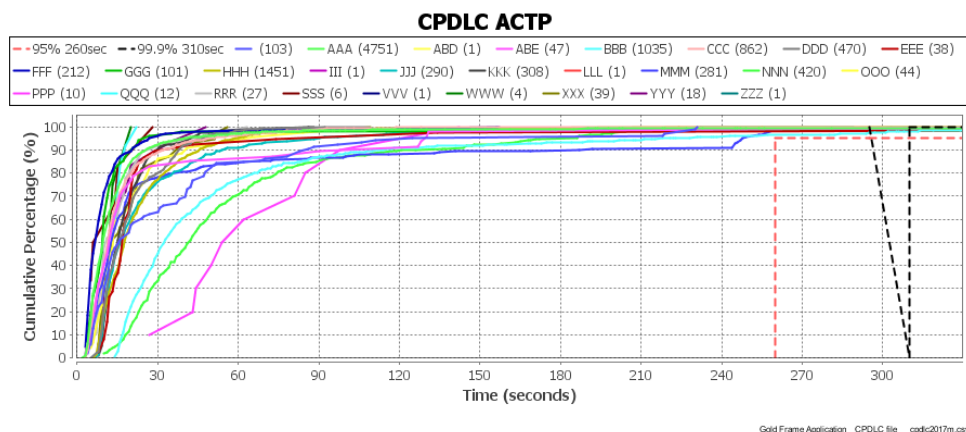


Figure 11: Urumqi FIRCPDLC ACTP per Operator(de-identified)

3.2 **Table 12** and **Figure 12** present CPDLC Actual Communications Technical Performance per Operator (de-identified) for messages sent within Lanzhou FIR (ZLLL), for the period Jan. 2016 to Dec. 2016.

Lanzhou FIR CPDLC ACTP per Operator(de-identified)				
Operator (de-identified)	Messages	% < 260 sec (Target 95%)	% < 310 sec (Target 99.9%)	Remarks
UNK	115	100.00%	100.00%	-
AAA	2,517	100.00%	100.00%	-
ABA	1	100.00%	100.00%	-
ABC	4	100.00%	100.00%	-
ABD	1	100.00%	100.00%	-
ABE	73	100.00%	100.00%	-
BBB	1,257	99.44%	99.91%	-
CCC	929	100.00%	100.00%	-
DDD	736	100.00%	100.00%	-
EEE	32	100.00%	100.00%	-
FFF	307	98.56%	98.66%	-
GGG	99	100.00%	100.00%	-
HHH	2,571	100.00%	100.00%	-
III	53	100.00%	100.00%	-
JJJ	499	99.89%	99.92%	-
KKK	691	100.00%	100.00%	-
LLL	1	100.00%	100.00%	-
MMM	376	99.54%	100.00%	-
NNN	801	99.17%	99.23%	-
OOO	23	100.00%	100.00%	-
PPP	4	100.00%	100.00%	-
QQQ	4	100.00%	100.00%	-
RRR	10	100.00%	100.00%	-
SSS	6	100.00%	100.00%	-
UUU	1	100.00%	100.00%	-
VVV	2	100.00%	100.00%	-
XXX	116	100.00%	100.00%	-
YYY	44	100.00%	100.00%	-
ZZZ	4	100.00%	100.00%	-
Total	11,277	99.80%	99.87%	-

Table 12: Lanzhou FIRCPDLC ACTP per Operator(de-identified)

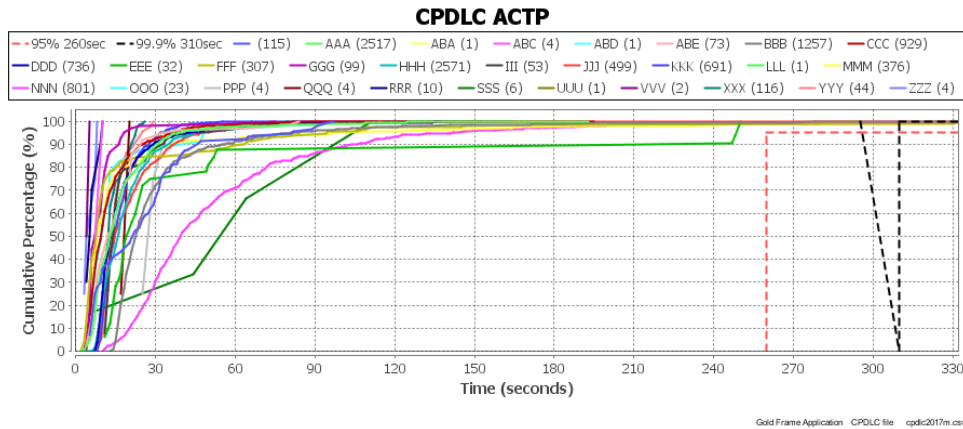


Figure 12: Lanzhou FIR CPLC ACTP per Operator

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

3.3 **Table 13** and **Figure 13** present CPDLC Pilot Operational Response Time per Operator for messages sent within Urumqi FIR (ZWWW), for the period Jan.2016 to Dec. 2016.

Urumqi FIR CPDLC PORT per Operator (de-identified)			
Operator (de-identified)	Messages	% < 60 sec (Target 95%)	Remarks
UNK	103	74.62%	
AAA	4,751	97.75%	
ABD	1	100.00%	-
ABE	47	75.32%	-
BBB	1,035	91.59%	-
CCC	862	97.22%	-
DDD	470	96.84%	-
EEE	38	92.90%	-
FFF	212	92.61%	-
GGG	101	99.16%	-
HHH	1,451	95.80%	-
III	1	100.00%	-
JJJ	290	85.40%	-
KKK	308	98.51%	-
LLL	1	100.00%	-
MMM	281	83.27%	-
NNN	420	91.43%	-
OOO	44	87.36%	-
PPP	10	38.89%	-
QQQ	12	100.00%	-
RRR	27	92.70%	-
SSS	6	100.00%	-
VVV	1	100.00%	-
WWW	4	100.00%	-
XXX	39	89.07%	-
YYY	18	100.00%	-
ZZZ	1	0.00%	-
Total	10,534	95.21%	-

Table 13: Urumqi FIR PORT per Operator

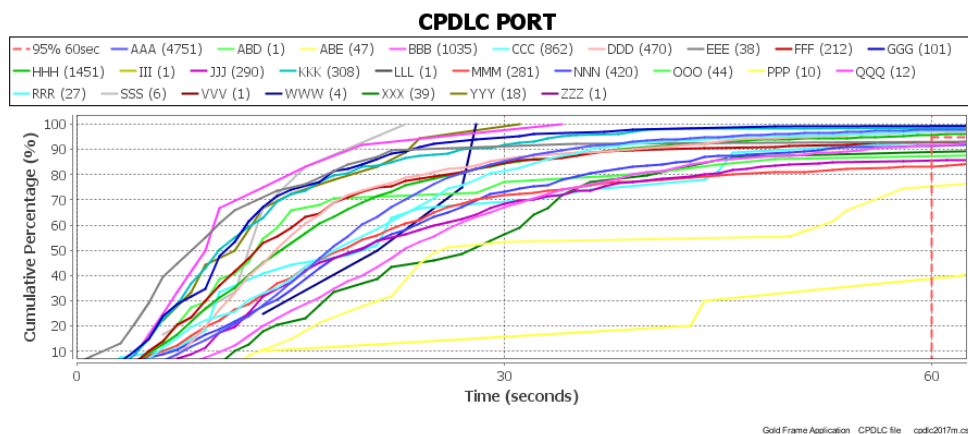


Figure 13: Urumqi FIR PORT per Operator

3.4 Table 14 and Figure 14 present CPDLC Pilot Operational Response Time per Operator for messages sent within Lanzhou FIR (ZLLL), for the period Jan.2016 to Dec. 2016.

Lanzhou FIR CPDLC PORT per Operator (de-identified)			
Operator (de-identified)	Messages	% < 60 sec (Target 95%)	Remarks
UNK	100	76.17%	-
AAA	2,517	98.05%	-
ABA	1	100.00%	-
ABC	4	100.00%	-
ABD	1	100.00%	-
ABE	73	68.84%	-
BBB	1,257	93.56%	-
CCC	929	96.34%	-
DDD	736	97.39%	-
EEE	32	99.56%	-
FFF	307	94.97%	-
GGG	99	98.38%	-
HHH	2,571	96.62%	-
III	53	96.30%	-
JJJ	499	77.23%	-
KKK	691	98.28%	-
LLL	1	100.00%	-
MMM	376	93.88%	-
NNN	801	93.13%	-
OOO	23	100.00%	-
PPP	4	100.00%	-
QQQ	4	100.00%	-
RRR	10	93.28%	-
SSS	6	100.00%	-
UUU	1	100.00%	-
VVV	2	100.00%	-
XXX	116	93.18%	-
YYY	44	100.00%	-
ZZZ	4	100.00%	-
Total	11,277	95.06%	-

Table 14: Lanzhou FIR PORT per Operator

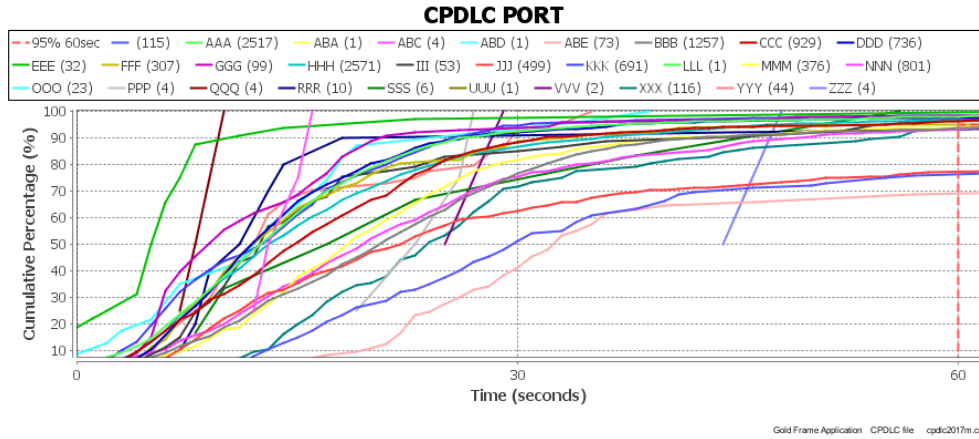


Figure 14: Lanzhou FIR PORT per Operator

4. ADS-C DOWNLINK LATENCY

ADS-C Downlink Latency per Month - Satellite

4.1 Table 15 and Figure 15 present ADS-C Downlink Latency per month for messages sent within Urumqi FIR (ZWWW) by Satellite data link, for the period Jan.2016 to Dec. 2016.

Urumqi FIR ADS-C Downlink Latency – Satellite				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	17,229	99.72%	99.83%	-
Feb.	15,047	99.74%	99.85%	-
Mar.	16,210	99.80%	99.87%	-
Apr.	17,365	99.79%	99.87%	-
May	19,009	99.73%	99.82%	-
Jun.	17,576	99.81%	99.90%	-
Jul.	18,312	99.69%	99.81%	-
Aug.	17,939	99.76%	99.88%	-
Sep.	17,392	99.43%	99.59%	-
Oct.	19,665	99.74%	99.82%	-
Nov.	17,941	99.73%	99.85%	-
Dec.	16,932	99.70%	99.82%	-
Total	210,617	99.72%	99.83%	-

Table 15: Urumqi FIR ADS-C Downlink Latency per month – Satellite

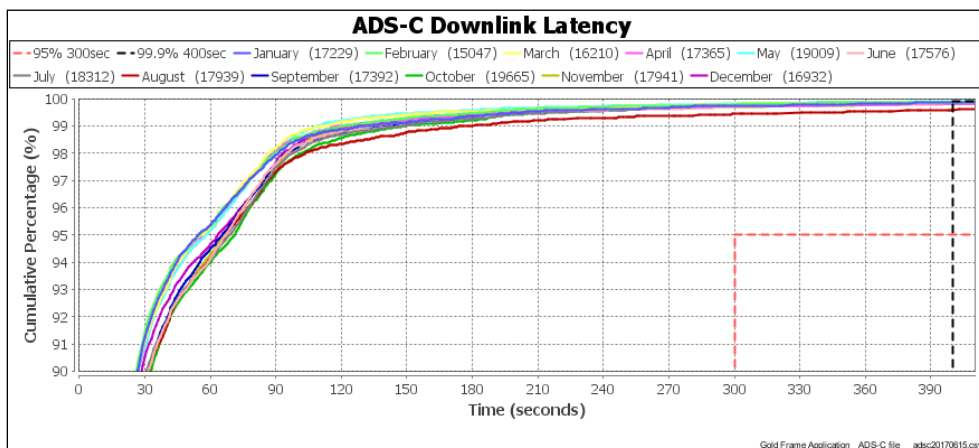


Figure 15: Urumqi FIR ADS-C Downlink Latency per month - Satellite

4.2 **Table 16** and **Figure 16** present ADS-C Downlink Latency per month for messages sent within Lanzhou FIR (ZLLL) by Satellite data link, for the period Jan.2016 to Dec. 2016.

Lanzhou FIR ADS-C Downlink Latency – Satellite				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	32,783	99.78%	99.86%	-
Feb.	29,750	99.75%	99.87%	-
Mar.	33,026	99.80%	99.92%	-
Apr.	33,161	99.78%	99.88%	-
May	35,234	99.80%	99.87%	-
Jun.	31,526	99.64%	99.80%	-
Jul.	32,976	99.72%	99.83%	-
Aug.	29,241	99.23%	99.41%	-
Sep.	27,741	99.72%	99.83%	-
Oct.	35,474	99.84%	99.93%	-
Nov.	36,123	99.76%	99.86%	-
Dec.	35,529	99.75%	99.87%	-
Total	392,564	99.72%	99.83%	-

Table 16: Lanzhou FIR ADS-C Downlink Latency per month - Satellite

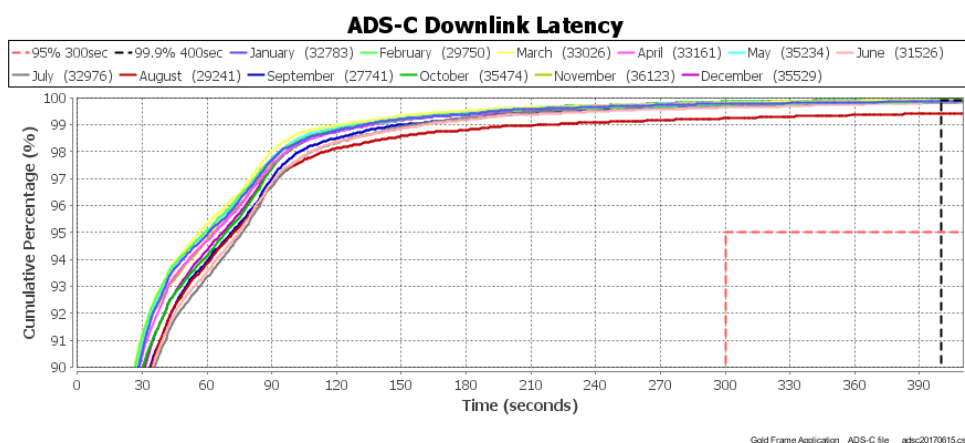


Figure 16: Lanzhou FIR ADS-C Downlink Latency per month - Satellite

4.3 **Table 17** and **Figure 17** present ADS-C Downlink Latency per month for messages sent within Chengdu FIR (ZUUU) by Satellite data link, for the period Jan.2016 to Dec. 2016.

Chengdu FIR ADS-C Downlink Latency – Satellite				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	28,652	99.60%	99.76%	-
Feb.	26,888	99.48%	99.65%	-
Mar.	30,088	99.70%	99.83%	-
Apr.	31,429	99.73%	99.87%	-
May	30,590	99.70%	99.81%	-
Jun.	31,642	99.65%	99.80%	-
Jul.	32,409	99.70%	99.85%	-
Aug.	34,160	99.22%	99.40%	-
Sep.	33,990	99.59%	99.79%	-
Oct.	35,633	99.77%	99.88%	-
Nov.	38,016	99.56%	99.75%	-
Dec.	34,186	99.73%	99.87%	-

Total	387,683	99.62%	99.77%	-
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Table 17: Chengdu FIR ADS-C Downlink Latency per month - Satellite

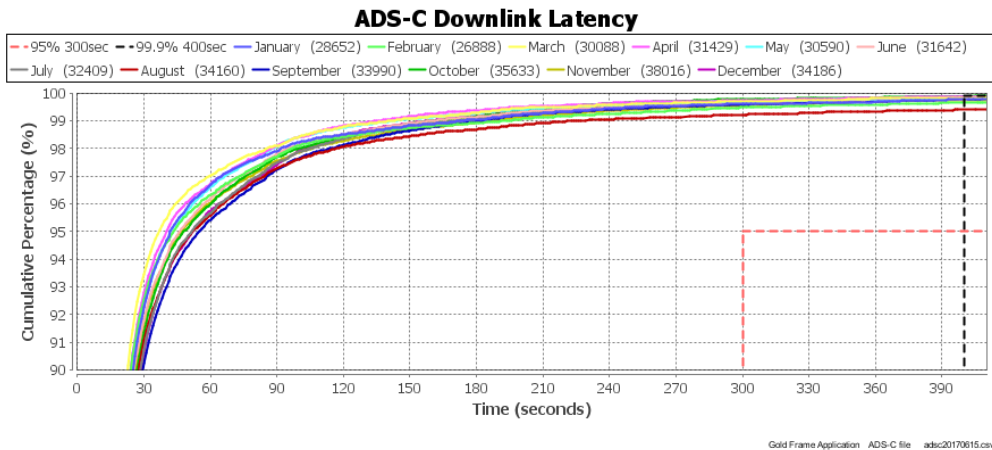


Figure 17: Chengdu FIR ADS-C Downlink Latency per month - Satellite

4.4 **Table 18** and **Figure 18** present ADS-C Downlink Latency per month for messages sent within Kunming FIR (ZPPP) by Satellite data link, for the period Jan.2016 to Dec. 2016.

Kunming FIR ADS-C Downlink Latency – Satellite				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	672	100.00%	100.00%	-
Feb.	524	100.00%	100.00%	-
Mar.	4,315	99.78%	99.82%	-
Apr.	5,858	99.73%	99.83%	-
May	5,291	99.63%	99.71%	-
Jun.	5,110	99.68%	99.84%	-
Jul.	5,460	99.73%	99.78%	-
Aug.	4,383	99.71%	99.83%	-
Sep	5,087	99.62%	99.75%	-
Oct.	3,729	99.76%	99.83%	-
Nov.	1,829	99.58%	99.75%	-
Dec.	3,849	99.60%	99.80%	-
Total	46,107	99.69%	99.79%	-

Table 18: Kunming FIR ADS-C Downlink Latency per month - Satellite

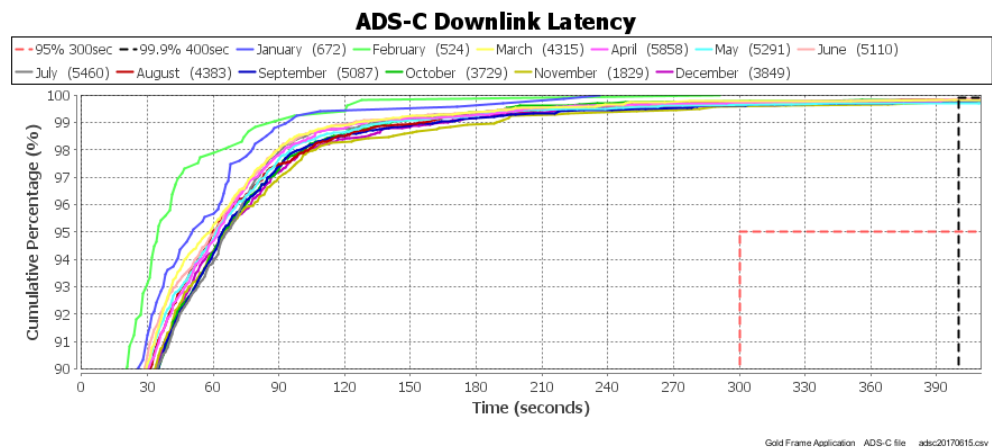


Figure 18: Kunming FIR ADS-C Downlink Latency per month - Satellite

ADS-C Downlink Latency per Month - VHF

4.5 **Table 19** and **Figure 19** present ADS-C Downlink Latency per month for messages sent within Urumqi FIR (ZWWW) by VHF data link, for the period Jan.2016 to Dec. 2016.

Urumqi FIR ADS-C Downlink Latency –VHF				
Month	Messages	% < 300 sec (Target 95%)	%< 400 sec (Target 99.9%)	Remarks
Jan.	16,222	99.84%	99.87%	-
Feb.	13,902	99.90%	99.93%	-
Mar.	14,980	99.93%	99.95%	-
Apr.	15,456	99.85%	99.90%	-
May	17,625	99.91%	99.93%	-
Jun.	18,017	99.80%	99.85%	-
Jul.	19,382	99.89%	99.94%	-
Aug.	17,486	99.85%	99.90%	-
Sep.	17,866	99.93%	99.94%	-
Oct.	19,773	99.85%	99.89%	-
Nov.	17,581	99.90%	99.92%	-
Dec.	15,775	99.91%	99.94%	-
Total	204,065	99.88%	99.91%	-

Table 19: Urumqi FIR ADS-C Downlink Latency per month - VHF

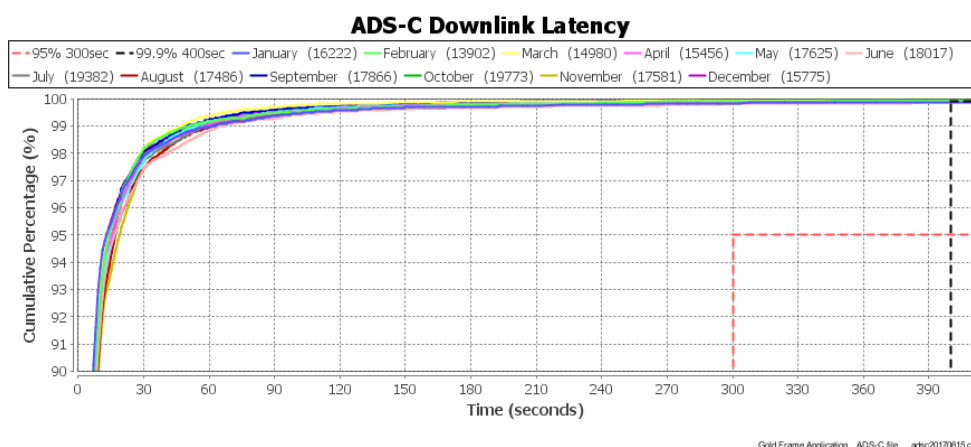


Figure 19: Urumqi FIR ADS-C Downlink Latency per month - VHF

4.6 **Table 20** and **Figure 20** present ADS-C Downlink Latency per month for messages sent within Lanzhou FIR (ZLLL) by VHF data link, for the period Jan.2016 to Dec. 2016.

Lanzhou FIR ADS-C Downlink Latency – VHF				
Month	Messages	% < 300 sec (Target 95%)	%< 400 sec (Target 99.9%)	Remarks
Jan.	38,555	99.90%	99.92%	-
Feb.	34,116	99.91%	99.95%	-
Mar.	36,058	99.92%	99.94%	-
Apr.	34,317	99.86%	99.91%	-
May	38,880	99.85%	99.91%	-
Jun.	39,784	99.80%	99.87%	-
Jul.	43,526	99.90%	99.93%	-
Aug.	30,673	99.81%	99.86%	-
Sep.	30,957	99.87%	99.92%	-
Oct.	39,631	99.91%	99.94%	-
Nov.	37,453	99.89%	99.93%	-

Dec.	36,771	99.90%	99.93%	-
Total	440,721	99.88%	99.92%	-

Table 20: Lanzhou FIR ADS-C Downlink Latency per month - VHF

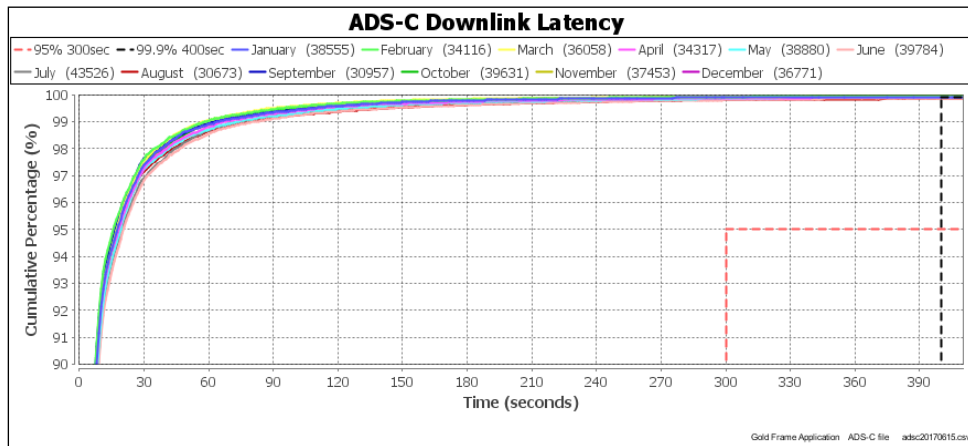


Figure 20: Lanzhou FIR ADS-C Downlink Latency per month - VHF

4.7 **Table 21** and **Figure 21** present ADS-C Downlink Latency per month for messages sent within Chengdu FIR (ZUUU) by VHF data link, for the period Jan.2016 to Dec. 2016.

Chengdu FIR ADS-C Downlink Latency – VHF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	15,796	99.58%	99.66%	-
Feb.	16,545	99.88%	99.95%	-
Mar.	13,408	99.72%	99.81%	-
Apr.	14,140	99.71%	99.79%	-
May	16,419	99.82%	99.88%	-
Jun.	16,658	99.82%	99.91%	-
Jul.	20,242	99.90%	99.95%	-
Aug.	18,738	99.75%	99.81%	-
Sep.	17,563	99.87%	99.94%	-
Oct.	18,267	99.88%	99.92%	-
Nov.	21,658	99.86%	99.93%	-
Dec.	18,868	99.86%	99.92%	-
Total	208,302	99.81%	99.88%	-

Table 21: Chengdu FIR ADS-C Downlink Latency per month - VHF

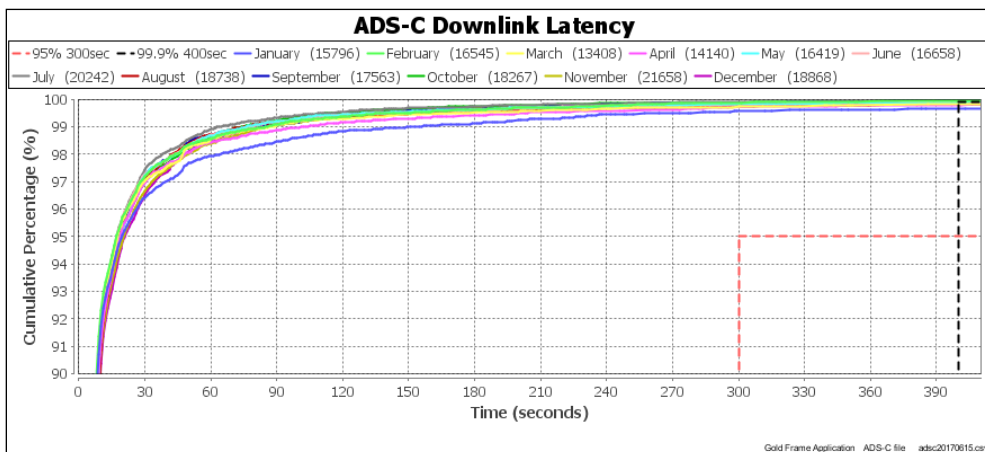


Figure 21: Chengdu FIR ADS-C Downlink Latency per month - VHF

4.8 **Table 22** and **Figure 22** present ADS-C Downlink Latency per month for messages sent within Kunming FIR (ZPPP) by VHF data link, for the period Jan.2016 to Dec. 2016.

Kunming FIR ADS-C Downlink Latency – VHF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	746	99.90%	99.94%	-
Feb.	350	100.00%	100.00%	-
Mar.	4,261	99.88%	99.90%	-
Apr.	5,916	99.78%	99.84%	-
May	5,648	99.81%	99.86%	-
Jun.	5,858	99.71%	99.87%	-
Jul.	6,351	99.76%	99.81%	-
Aug.	4,515	99.74%	99.86%	-
Sep.	5,723	99.64%	99.73%	-
Oct.	4,724	99.75%	99.81%	-
Nov.	2,275	99.88%	99.89%	-
Dec.	4,030	99.84%	99.93%	-
Total	50,397	99.77%	99.84%	-

Table 22: Kunming FIR ADS-C Downlink Latency per month – VHF

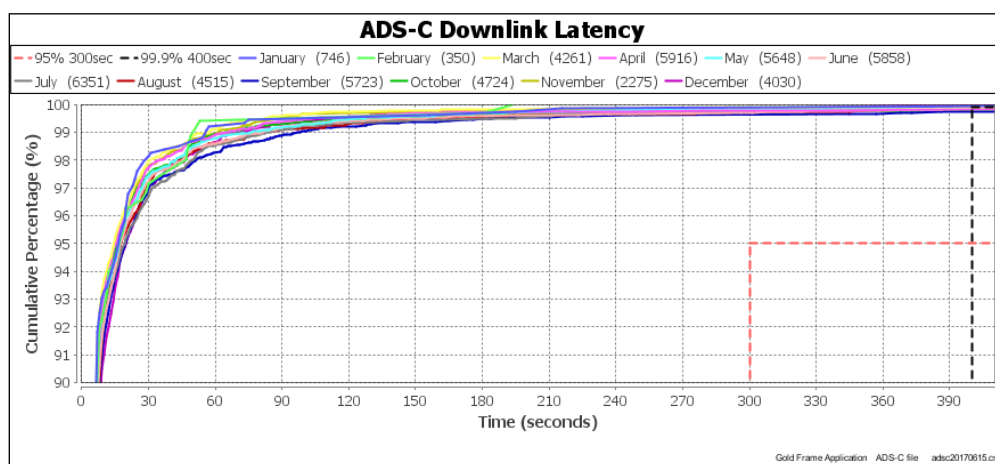


Figure 22: Kunming FIR ADS-C Downlink Latency per month - VHF

ADS-C Downlink Latency per Month - HF

4.9 **Table 23** and **Figure 23** present ADS-C Downlink Latency per month for messages sent within Urumqi FIR (ZWWW) by HF data link, for the period Jan.2016 to Dec. 2016.

Urumqi FIR ADS-C Downlink Latency –HF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	56	85.67%	93.27%	-
Feb.	40	92.89%	96.09%	-
Mar.	61	85.59%	86.47%	-
Apr.	50	83.33%	87.50%	-
May	74	75.99%	81.68%	-
Jun.	49	93.97%	95.77%	-
Jul.	61	91.12%	98.63%	-
Aug.	34	96.52%	100.00%	-
Sep.	29	91.82%	93.45%	-
Oct.	31	98.54%	100.00%	-
Nov.	30	93.39%	94.24%	-

Dec.	39	86.44%	89.36%	-
Total	554	87.31%	91.23%	-

Table 23: Urumqi FIR ADS-C Downlink Latency per month – HF

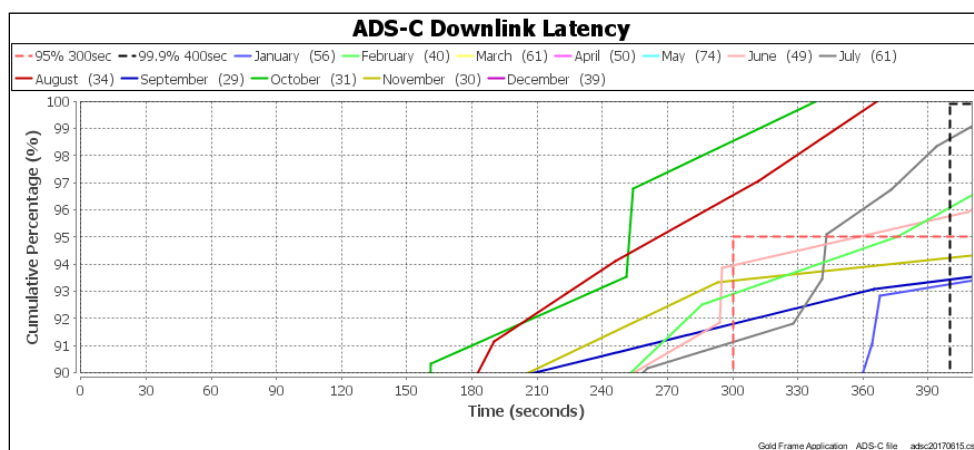


Figure 23: Urumqi FIR ADS-C Downlink Latency per month - HF

4.10 **Table 24** and **Figure 24** present ADS-C Downlink Latency per month for messages sent within Lanzhou FIR (ZLLL) by HF data link, for the period Jan.2016 to Dec. 2016.

Lanzhou FIR ADS-C Downlink Latency – HF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	90	88.31%	93.61%	-
Feb.	79	87.28%	92.25%	-
Mar.	81	91.38%	92.38%	-
Apr.	92	81.23%	87.62%	-
May	105	82.29%	89.90%	-
Jun.	81	89.42%	93.71%	-
Jul.	69	86.34%	94.16%	-
Aug.	72	87.10%	90.09%	-
Sep.	42	95.75%	97.74%	-
Oct.	61	85.42%	90.77%	-
Nov.	63	89.66%	95.34%	-
Dec.	59	87.18%	88.80%	-
Total	894	86.52%	91.26%	-

Table 24: Lanzhou FIR ADS-C Downlink Latency per month - HF

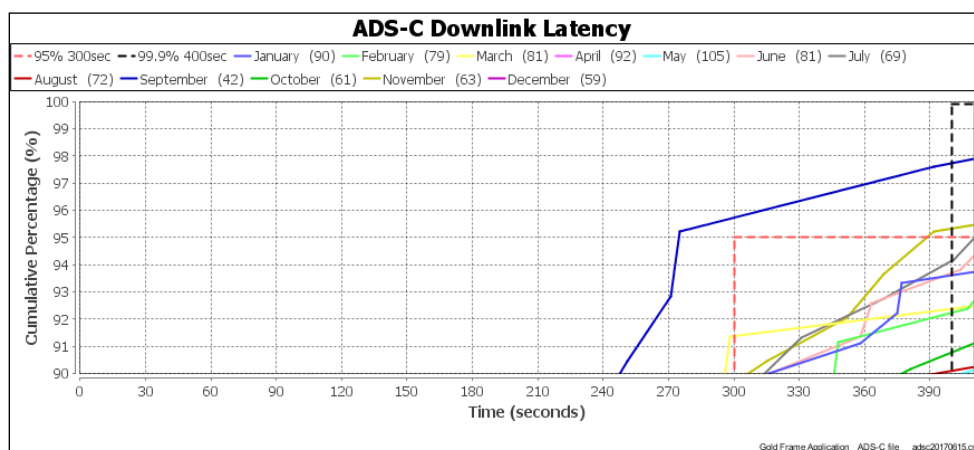


Figure 24: Lanzhou FIR ADS-C Downlink Latency per month - HF

4.11 **Table 25** and **Figure 25** present ADS-C Downlink Latency per month for messages sent within Chengdu FIR (ZUUU) by HF data link, for the period Jan.2016 to Dec. 2016.

Chengdu FIR ADS-C Downlink Latency – HF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	60	77.67%	91.90%	-
Feb.	73	81.85%	87.52%	-
Mar.	93	83.92%	86.47%	-
Apr.	68	82.26%	90.99%	-
May	61	69.34%	88.59%	-
Jun.	60	83.24%	94.56%	-
Jul.	46	91.22%	93.07%	-
Aug.	51	80.91%	88.39%	-
Sep.	63	85.19%	91.62%	-
Oct.	39	95.21%	97.31%	-
Nov.	76	84.30%	91.85%	-
Dec.	65	84.21%	93.30%	-
Total	755	82.05%	90.01%	-

Table 25: Chengdu FIR ADS-C Downlink Latency per month - HF

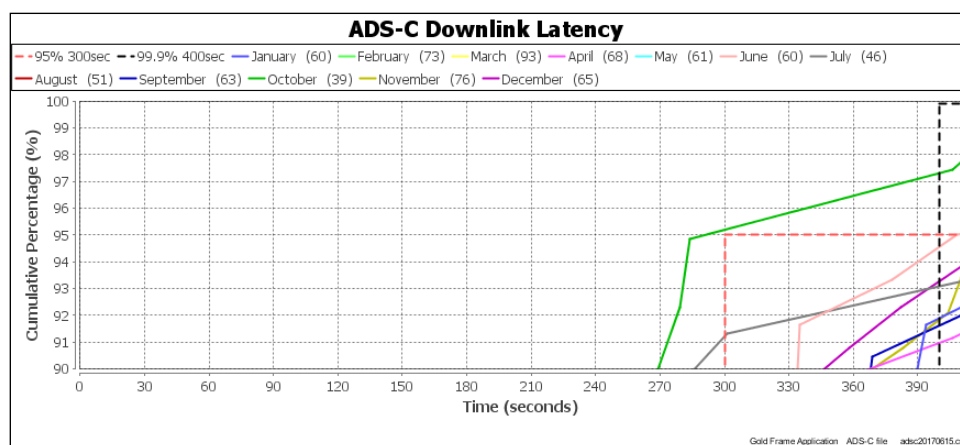


Figure 25: Chengdu FIR ADS-C Downlink Latency per month - HF

4.12 **Table 26** and **Figure 26** present ADS-C Downlink Latency per month for messages sent within Kunming FIR (ZPPP) by HF data link, for the period Jan.2016 to Dec. 2016.

Kunming FIR ADS-C Downlink Latency – HF				
Month	Messages	% < 300 sec (Target 95%)	% < 400 sec (Target 99.9%)	Remarks
Jan.	-	-	-	-
Feb.	3	100.00%	100.00%	-
Mar.	12	100.00%	100.00%	-
Apr.	17	91.65%	93.49%	-
Jun.	17	94.39%	96.47%	-
Jul.	13	100.00%	100.00%	-
Aug.	23	87.07%	88.88%	-
Sep.	16	88.04%	92.96%	-
Oct.	21	91.53%	97.88%	-
Nov.	7	100.00%	100.00%	-
Dec.	10	100.00%	100.00%	-
Total	146	93.20%	94.28%	-

Table 26: Kunming FIR ADS-C Downlink Latency per month - HF

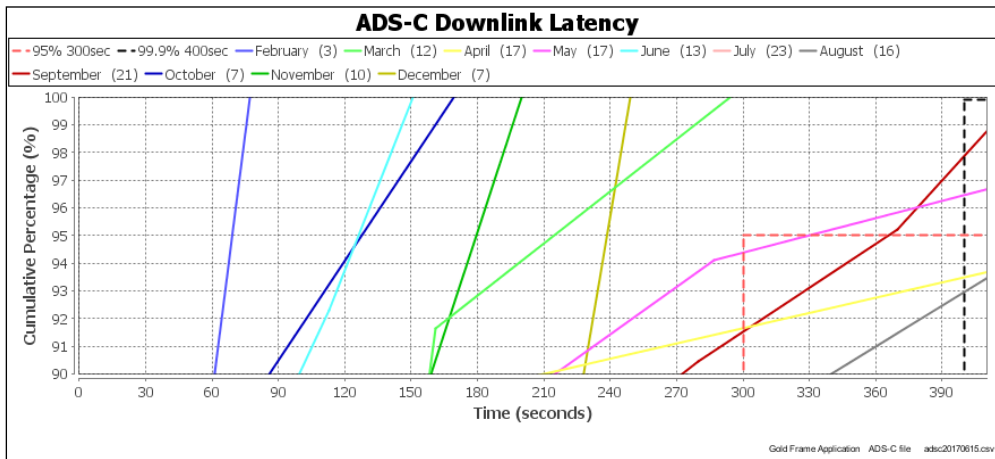


Figure 26: Kunming FIR ADS-C Downlink Latency per month - HF

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