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EUROCONTROL

Data link Network Operational Status Report

June 2023 – Developed 18/07/2023

This report is the monthly 'Data link Network Operational Status Report' as identified in the DPMF Report Catalogue available from the DPMF OneSky team web site. It provides a summary of the operational status and technical performance of data link in Europe covering a rolling 12 month period for monthly statistics ending in June 2023.

The report covers three main areas of the datalink operations in Europe:

1. Operational Status
2. Technical Performance
3. VDL Mode 2 Performance

For each of the three areas above different metrics are presented. A detailed definition of the metrics used in this report is available in the DPMF Report Catalogue. In this report, the identifier for each metric used in the DPMF Report Catalogue is shown in angled brackets e.g. <N-1>.

Notes:

- When ANSPs are providing new LISAT logs to DPMF, the metrics are updated accordingly (retroactively, when data for previous periods are provided). Therefore, some values presented in this report might evolve from past reports.
- Due to a LISAT formatting issue from DSNA, statistics computed for LFBB, LFEE, LFFF, LFMM, LFRR are presented for information only, as statistics might not represent real performance.
- For the month of June there is no data for EISN, LIRR, LIBB, LIMM, LIPP and LOVV (as shown in Appendix A).
- As from May 2023, this report includes data from LZBB (Slovakia).
- As from January 2023, this report includes data from EETT (Estonia).
- As from December 2022, this report includes data from EISN (Ireland).
- As from November 2022, this report includes data from LPPC (Portugal).
- This report assess the technical performance of data link above the level from which each ATSU provides the data link service, using a single level for each Centre as described in https://ext.eurocontrol.int/WikiLink/index.php/Implementation_Status_Table

1. Operational Status

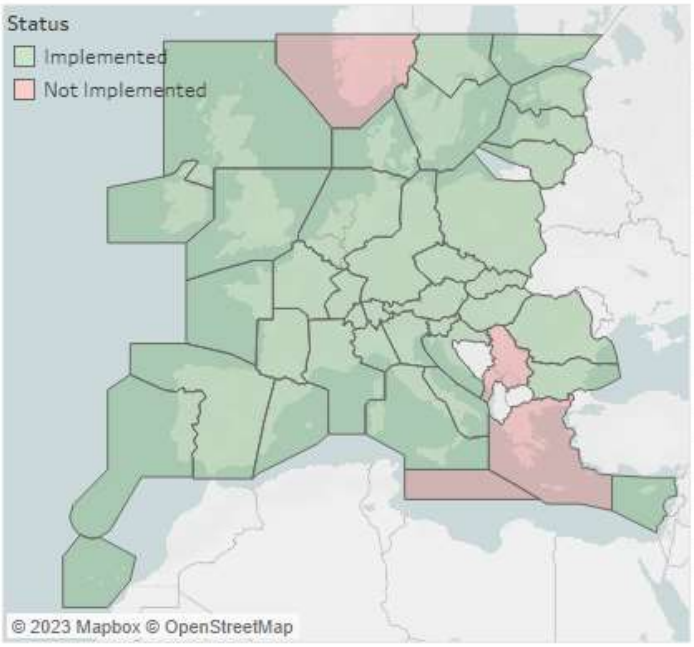
Figure 1-1 on the following page provides a status for each FIR/UIR covered by the DLS IR with a status as of the end of the reporting month. The top map shows the operational status of each centre (<N-4>). The map below shows which centres are providing LISAT data to NM. The table on the right shows per centre for the reporting month: i) the number of flights operating above FL285, ii) The Provider Abort rate (only for those centres providing LISAT data to NM), iii) what percentage of flights indicate that they are capable of performing CPDLC over the ATN (i.e. file 'J1') and iv) what percentage of the flights operating above FL285 are actually seen using CPDLC over the ATN (based on the available LISAT data).

ANSPs with service limitations and operational restrictions

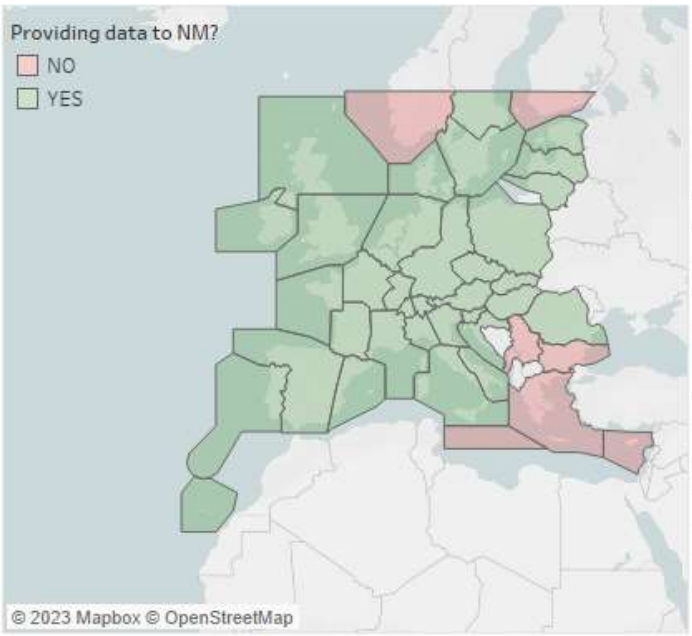
The table below identifies the current service limitations and operational restrictions. The are no changes in this table compared to previous reports.

Centre	Datalink service operational restrictions
France (LFFF, LFRR)	All datalink services are provided but flight crew clearance requests are not supported and a systematic controller response "Unable" is uplinked.
Germany (EDUU)	Airspace control in the south-eastern part of Germany below FL315 is delegated to Munich ACC (EDMM). In this airspace, datalink services are available only after prior coordination (i.e., when EDUU agrees to take or maintain control of flight). Datalink services are provided only to Logon-List a/c
MUAC (EDYY)	Datalink services are provided only to Logon-List a/c
Switzerland (LSAG, LSAZ)	Datalink services are provided only to Logon-List a/c

Implementation Status



Providing Data to NM



Statistics

ATSU Code	Total Flights	% J1 Capable	% Using..
EDUU	172745	84%	49%
EDYY	146238	84%	63%
EETT	11681	83%	27%
EFIN	8928	81%	
EGPX	53379	78%	29%
EGTT	146702	80%	68%
EISN	45102	53%	
EKDK	34406	86%	55%
ENOR	22970	85%	
EPWW	52986	90%	48%
ESMM	35136	89%	64%
ESOS	16657	87%	49%
EVRR	15681	84%	44%
EYVC	11702	85%	32%
GCCC	18554	90%	11%
LBSR	90053	81%	
LCCC	36663	77%	
LDZO	78208	89%	46%
LECB	83374	89%	41%
LECM	106975	88%	54%
LFBB	81744	88%	50%
LFEE	91710	85%	50%
LFFF	52783	80%	42%
LFMM	92435	85%	50%
LFRR	94525	86%	52%
LGGG	89038	85%	
LHCC	96353	83%	45%
LIBB	41146	85%	
LIMM	64889	86%	
LIPP	69098	87%	
LIRR	70476	86%	
LJLA	37723	89%	52%
LKAA	51391	85%	52%
LMMM	10436	66%	
LOVV	99434	86%	
LPPC	47923	88%	60%
LRBB	67189	80%	41%
LSAG	40629	85%	47%
LSAZ	49693	85%	44%
LZBB	49923	84%	41%

Figure 1-1: Current operational status of data link over the ATN

CPDLC / ATN Flights

Figure 1-2 presents data only for flights operating above FL285 in the DLS airspace. It shows what percentage of flights in that airspace file 'J1' in their flight plan <N-1> and what percentage indicate in the flight plan that the aircraft is exempt. For this month, 83,0% of flights indicated the capability to perform CPDLC over ATN/VDL Mode 2. 13,7% (shown in red) indicate they are exempt. Considering the known exemptions, NM estimates that about 1.2% of the filed FPLs are likely contravening the DLS IR (shown in green).

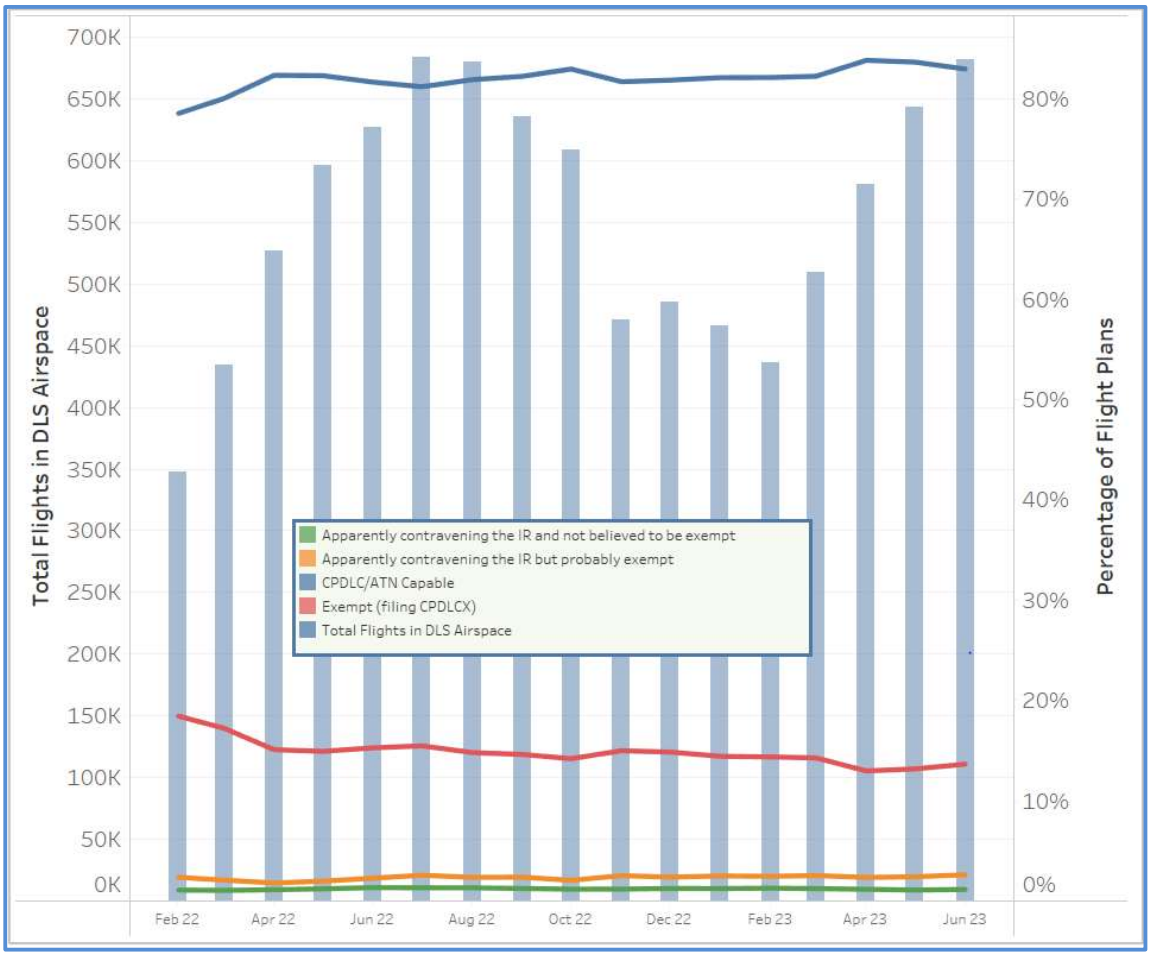


Figure 1-2: Proportion of flights capable of using CPDLC over ATN/ VDL Mode 2

2. Technical Performance

Overall Monthly Provider Abort Rate

Figure 2-1 below shows the monthly PA rate <O-23> aggregated for all ANSPs providing LISAT data to NM. The target value is 1 PA per 100 hours CPDLC (shown as a dashed line on the graph below). The overall average rate for the month was 4.2 PAs per 100 hours.

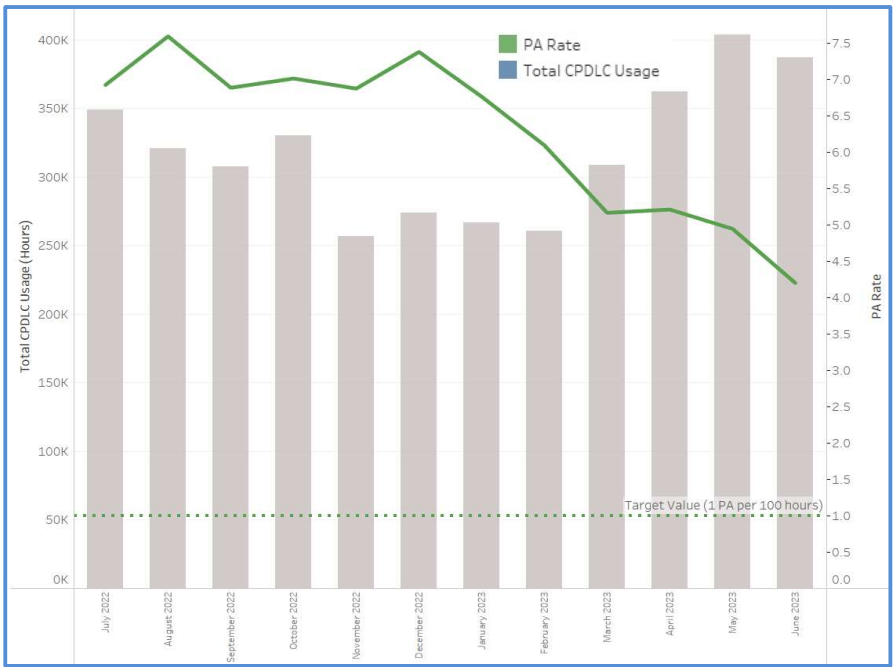


Figure 2-1: PA rate

Figure 2-2 below shows the monthly PA rate of aircraft on the Logon List against aircraft not on the Logon List, using only data from centers that do not support the Logon List.

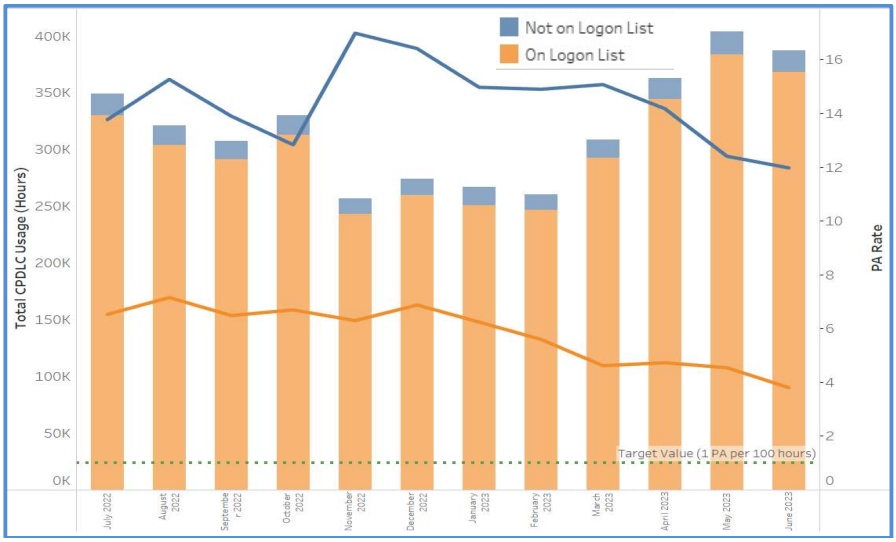


Figure 2-2: Logon Listed Aircraft PA rate

Monthly PA rate per Centre

The PA rate for each of the centers providing data to NM is shown in the table in Figure 2-3 below for the last 12 month period for the months LISAT data are available.

Atsu Code	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
EDUU	2,5	2,0	2,4	1,9	1,4	1,6	1,1	1,5	2,0	2,5	2,4	2,4
EDYY	3,0	2,7	3,2	2,8	2,4	2,7	1,9	2,1	2,1	3,0	3,7	3,4
EETT							2,5	3,6	2,7	4,0	3,4	3,0
EGPX	5,7	7,0	7,1	6,0	5,5	5,8	4,9	5,1	5,7	7,0	6,9	6,5
EGTT	4,0	4,1	4,9	3,7	3,4	4,3	3,6	3,7	3,9	4,8	5,6	5,6
EISN						41,2	55,2	51,8	57,2	73,5		
EKDK	6,3	6,6	6,6	7,8	7,3	7,7	8,4	8,6	9,7	8,4	7,4	7,4
EPWW	3,6	2,6	3,1	2,7	3,6	3,3	5,7	3,2	4,0	4,1	3,7	3,5
ESMM	2,8	2,4	2,2	2,8	2,5	2,7	2,3	2,8	3,1	2,6	2,0	1,9
ESOS	3,8	4,1	5,9	8,9	4,9	5,2	3,6	4,2	4,5	4,2	3,8	2,9
EVRR	2,8	4,5	3,3	3,5	3,5	5,3	3,2	3,0	3,2	4,5	3,4	3,5
EYVC	3,4	1,8	2,8	2,2	3,3	2,3	2,4	1,5	1,6	3,0	1,2	1,5
GCCC	45,1	47,6	44,0	18,2	40,3	44,9	48,1	49,0	46,7	43,6	53,1	43,1
LDZO	19,3	12,2	11,4	10,6	7,3	6,5	5,2	5,3	5,7	7,4	7,2	9,9
LECB	4,9	7,8	10,7	3,8	3,5	2,6	2,7	2,8	2,7	3,0	3,6	3,5
LECM	4,9	5,3	5,4	4,8	7,3	6,5	4,9	6,6	5,9	5,6	5,2	4,9
LFBB	1,6	2,8	3,7	1,4	1,5	1,9	1,2	1,3	1,5	2,0	1,8	1,8
LFEE	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
LFFF	2,9	4,2	4,3	4,7	4,5	4,7	4,2	4,4	4,0	6,5	5,0	3,0
LFMM	13,1	10,3	7,5	7,1	6,3	1,0	0,0	0,0	0,0	0,0	0,0	0,0
LFRR	1,4	1,7	1,4	1,6	1,7	1,9	1,9	1,8	2,0	2,6	2,5	1,9
LHCC	4,9	4,0	4,2	3,2	3,7	3,8	4,6	4,0	4,2	4,7	3,4	3,7
LIBB	143,1	167,5	156,3	122,3	76,9	74,1	65,1	49,2	31,6	32,0	32,6	
LIMM	158,4	216,9	181,3	319,8	204,1	237,0	234,8	105,9	18,1	63,1	57,6	
LIPP	95,3	425,6	357,4	518,8	311,4	429,0	442,1	270,1	76,6	72,2	63,7	
LIRR	152,0	61,2	52,3	66,0	51,3		56,4	29,5	29,1	40,5	45,5	
LJLA	7,6	8,6	7,9	9,8	4,2	5,2	5,2	5,1	5,4	8,8	10,1	11,1
LKAA	5,2	4,2	3,8	4,1	4,2	4,4	5,0	4,6	5,4	5,0	4,5	4,7
LOVV	7,0	6,1	5,3	5,2	4,3	4,2	4,3	4,5	6,7	6,2	5,8	
LPPC				25,1	33,8	50,6	31,9	24,7	14,8	1,6	13,9	13,6
LRBB	4,1	3,9	4,5	3,1	3,7	3,4	3,5	3,8	3,6	3,8	3,1	3,4
LSAG	16,2	5,0	4,6	4,4	4,7	2,3	3,4	3,2	3,2	3,1	3,7	4,2
LSAZ	15,5	4,2	4,1	4,5	3,2	2,8	2,1	2,2	2,6	3,2	4,3	5,3
LZBB											2,5	2,5

Figure 2-3: Monthly PA Rate per Centre

PA Rate for Major Aircraft Operators

Figure 2-4 below shows the PA rate for the top 30 aircraft operators in terms of usage of CPDLC/ATN over the month. The column "Total CPDLC" displays the total CPDLC session duration in hours while the column "Total Flights" displays the total amount of flights performed during the month.

Aircraft Operator (from FL)	Total CPDLC Usage	Total Flights	PA Rate Top30 AOs
RYR	64482,45	54.361	3,0
EZY	26442,08	20.074	2,2
EXS	19126,66	10.494	4,6
EJU	13351,34	14.944	2,0
DLH	13305,54	15.673	2,0
WZZ	12452,98	11.011	2,4
BAW	12076,79	10.178	6,0
EWG	11670,91	12.475	3,6
THY	10594,33	7.168	5,2
TOM	9632,40	6.073	3,4
SAS	9219,60	8.432	3,6
KLM	8993,11	11.292	4,3
TAP	8687,81	7.591	8,1
VLG	8018,40	10.565	4,8
AFR	7814,29	10.438	4,0
PGT	7698,11	5.221	1,8
NSZ	6873,90	4.116	2,4
FIN	6157,44	3.343	4,7
WMT	5520,63	5.703	2,6
TRA	5119,62	3.517	2,6
EIN	4938,37	4.486	3,4
NOZ	4859,12	3.525	1,6
AUA	4134,62	6.369	3,6
SWR	4028,10	5.152	4,3
BEL	3979,50	4.480	2,6
IBE	3830,24	4.298	2,2
CFG	3396,27	2.825	5,1
EZS	2692,75	3.780	1,6
VOE	2553,98	3.552	1,6
LOT	2373,56	2.930	7,9

Figure 2-4: PA Rate for the top 30 Aircraft Operators (CPDLC/ATN use)

Monthly PA Rate for various avionics configurations

The figure below shows the monthly PA rate for various avionics configurations for aircraft on the logon list based on the information declared by the airline operators.

Vdr Make	Vdr Model	Cmu Make	Cmu Model	Jun 22	Jul 22	Aug 22	Sept 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	Jun 23
Garmin	GDR66	Garmin	GIA64E	13.45	17.18	14.44	15.77	8.58	6.03	6.94	3.32	2.75	8.18	7.42	11.91	11.90
			GIA63W	12.19	18.90	14.65	12.27	8.57	7.08	9.58	7.69	8.92	9.53	13.20	17.99	15.24
Honeywell	EPIC VDR	Honeywell	EPIC CMF	11.45	12.27	11.04	9.38	7.23	4.91	4.47	4.88	5.18	4.79	6.82	6.82	7.03
	KTR2280A	Honeywell	EPIC CMF	6.82	6.69	12.76	10.49	5.39	10.75	5.10	4.74	7.79	1.80	5.80	11.11	
	RTA44D	Airbus	FANS-B+	6.96	7.95	8.16	7.25	8.14	5.27	6.17	5.25	4.10	3.27	3.99	3.45	2.82
		Honeywell	Mk2+	2.63	2.83	1.66	1.68	1.60	2.65	4.96	3.09	3.30	2.34	2.59	2.80	1.95
		Rockwell Collins	CMU900	9.08	13.12	7.39	7.10	3.39	4.75	5.67	4.04	3.59	4.72	4.02	4.73	2.69
	RTA50D	Airbus	FANS-C	6.05	7.45	7.67	6.50	7.04	7.49	8.85	7.18	5.69	5.04	3.94	3.11	2.94
			FANS-B+	6.51	7.63	8.78	6.69	7.68	6.09	6.66	5.54	4.59	3.67	3.62	3.25	2.10
			FANS-A+B				2.14	0.83	0.00	5.37	3.36		9.35	18.40	18.99	15.58
		Honeywell	Mk2+	4.61	4.95	4.73	5.29	6.00	6.25	6.29	6.02	5.99	4.91	5.46	4.65	3.26
			777 AIMS2	35.18	32.04	16.89	31.69	17.71	23.65	18.62	30.52	65.61	44.32	43.38	27.41	18.81
		Rockwell Collins	CMU900	9.24	30.76	3.94										2.77
Rockwell Collins	920	Airbus	FANS-B+	9.44	9.07	11.51	8.84	8.29	6.78	7.98	7.82	7.25	5.25	4.92	6.10	6.86
		Honeywell	Mk2+	4.57	3.73	9.84	10.41	9.69	5.83	6.48	9.30	7.97	1.16	1.58	3.02	3.97
		Rockwell Collins	CMU900	11.72	11.10	7.28	7.53	16.07	3.13	4.20	7.34	7.47	5.02	5.83	5.16	4.38
	2100	Airbus	FANS-C	3.77	6.29	2.40	2.46	3.11	4.79	7.89	5.55	4.93	4.91	5.16	4.75	2.80
			FANS-B+	6.59	7.26	9.60	7.54	8.01	6.34	6.21	5.47	4.35	2.88	3.50	3.58	2.70
			FANS-A+B	6.93	5.82	7.46	6.95	6.10	6.36	5.08	4.32	4.60	4.13	3.84	3.60	3.65
		Honeywell	Mk2+	2.25	2.83	1.57	1.48	1.26	1.91	2.20	2.26	2.07	1.77	2.63	3.30	2.48
			787 CMF	5.67	5.89	5.44	5.83	4.52	5.03	6.09	9.50	9.47	10.22	9.62	6.53	5.64
		Rockwell Collins	CMU900	4.02	4.04	3.82	4.05	3.93	7.10	8.44	7.20	5.69	4.82	4.22	4.32	3.84
	2200	Airbus	FANS-C	4.51	4.29	5.64	5.74	6.54	12.75	16.58	14.33	10.01	7.77	5.69	6.26	5.17
			FANS-B+	6.01	5.32	10.19	9.23	7.70	5.98	7.49	5.43	4.84	3.24	2.70	3.35	2.80
			FANS-A+B	3.60	3.92	4.72	5.25	3.99	4.22	5.07	5.09	4.94	3.84	3.59	3.76	3.47
	4000	Rockwell Collins	RIU-4010	10.60	12.72	9.68	10.64	10.67	10.73	10.70	9.18	10.68	10.60	10.72	9.82	11.15
			RIU-4000	12.02	13.72	14.83	7.08	11.03	9.64	5.54	6.13	7.01	8.20	5.31	8.09	6.96
			CMU900	9.13	10.45	10.57	10.38	8.54	8.00	5.65	7.61	2.90	5.69	4.38	6.11	4.66
			CMU4000	6.49	10.26	5.65	4.72	5.99	3.99	3.40	4.32	3.47	4.28	5.14	5.58	5.32
Spectralux	Dlink+	Spectralux	Dlink+	9.78	9.10	11.22	11.49	12.31	17.68	20.81	22.17	18.41	15.59	11.38	17.97	15.47
Thales	EVR750	Airbus	FANS-B+	10.59	8.37	10.02	9.79	9.17	6.80	7.50	6.65	6.47	5.23	5.86	6.85	7.11
			FANS-A+B									3.50				
UASC	UL801	UASC	UL801						14.35							

Figure 2-5: Monthly PA rate for various avionics configurations for aircraft on the logon list.

Note: A sample size of at least 250 hours of CPDLC use has been considered for recommendations/decisions for the Logon List aircraft. In the table above, PA rates computed from less than 250 hours of CPDLC session are displayed in grey.

Overall Technical Round Trip Delay

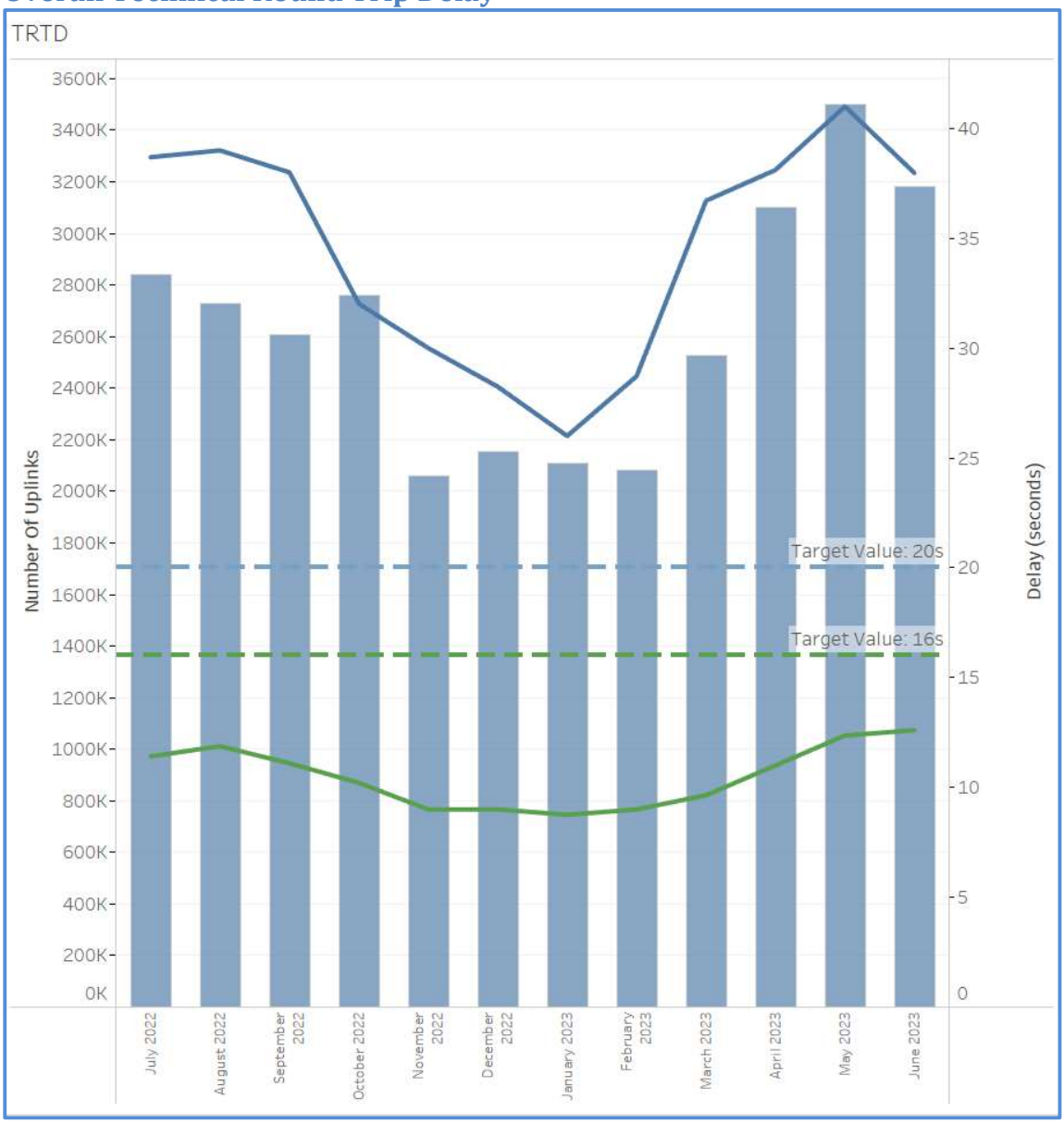


Figure 2-6 below shows the 95th and 99th percentiles of the technical round trip delay <O-2> and <O-3>. It represents the delay between the time when a message is uplinked and the time when the ground system receives the corresponding application level acknowledgement (aggregated for all systems providing data to LISAT). As agreed during DPMG8 (May 2020), the TRTD is now computed taking into account downlinked ERROR messages (DM62). This has resulted in an increase of the 99th percentile value.

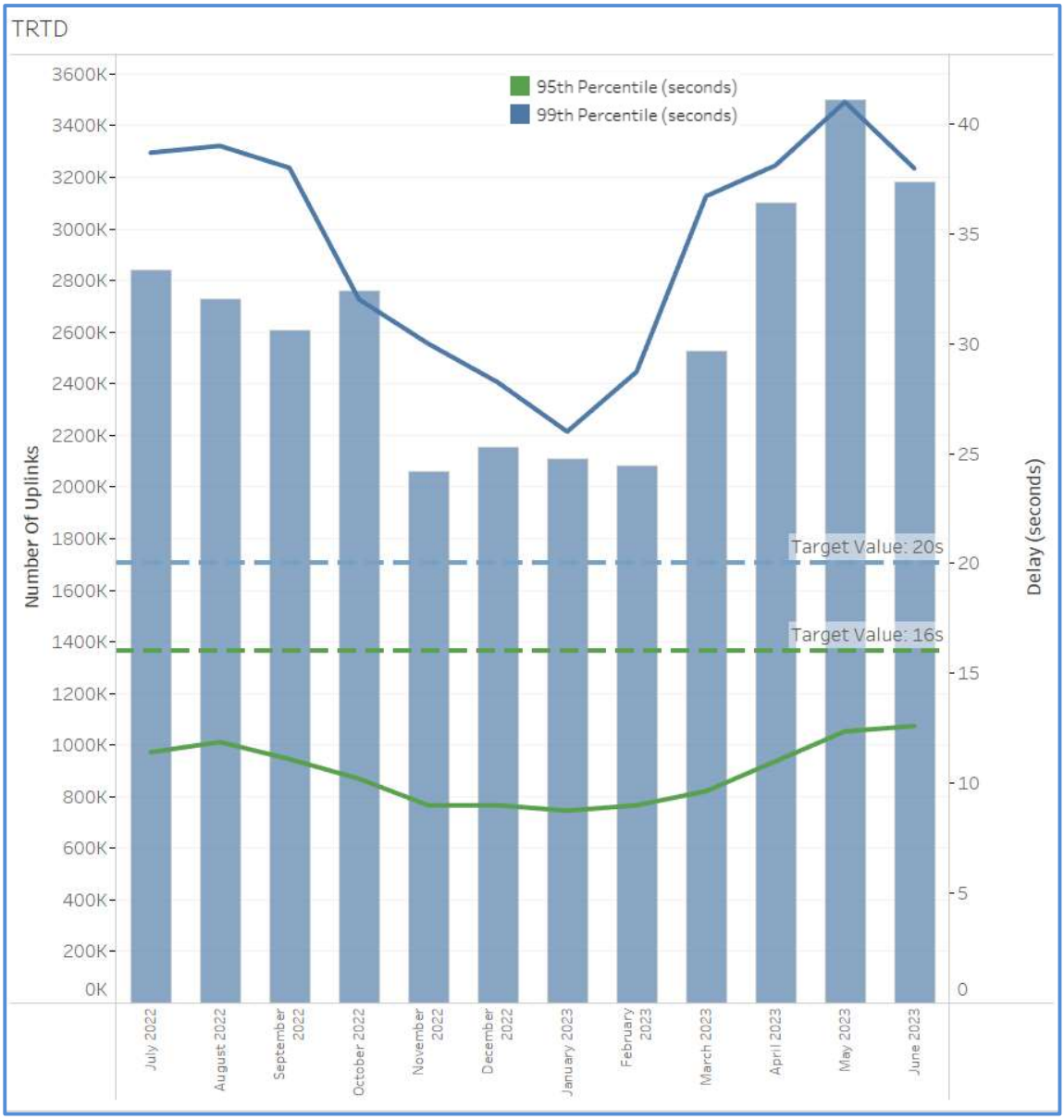


Figure 2-6: Technical Round Trip Delay

Monthly 95th percentile of TRTD per Centre

TRTD 95th

Atsu Code	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
EDUU	11,3	11,1	10,8	10,2	8,3	8,4	8,1	8,4	9,6	11,1	12,8	13,3
EDYY	10,2	10,1	10,2	9,9	8,2	8,3	7,9	8,3	8,8	10,2	12,4	12,6
EETT							6,0	6,0	5,0	6,0	6,0	6,0
EGPX	10,0	9,8	10,0	9,1	7,9	8,1	7,7	8,0	8,2	8,9	10,3	11,2
EGTT	9,7	9,6	9,9	9,4	8,1	8,2	7,9	8,5	8,7	9,8	10,9	11,6
EISN						38,0	19,6	20,7	18,2	18,6		
EKDK	10,0	10,0	10,0	10,0	9,0	9,0	9,0	8,0	9,0	10,0	11,0	11,0
EPWW	6,8	6,8	7,2	6,7	6,6	6,4	6,6	6,4	6,5	6,9	7,4	7,5
ESMM	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	7,0	7,0
ESOS	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0
EVRR	9,0	9,0	8,0	8,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	8,0
EYVC	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0
GCCC	22,8	31,1	22,4	7,9	12,2	14,2	14,2	11,6	11,6	11,3	14,6	10,2
LDZO	13,0	14,0	14,0	12,0	11,0	10,0	10,0	10,0	11,0	13,2	14,1	15,3
LECB	9,4	9,5	9,2	8,3	7,8	7,7	7,8	8,1	8,0	8,6	9,2	9,2
LECM	8,3	8,4	8,2	8,2	8,8	8,5	8,5	9,0	8,6	9,0	9,2	9,2
LFBB	8,0	8,0	8,0	7,0	7,0	7,0	6,0	7,0	7,0	8,0	8,0	10,0
LFEE	10,0	10,0	10,0	9,0	8,0	8,0	8,0	8,0	8,0	10,0	12,0	14,0
LFFF	15,0	15,0	15,0	14,0	12,0	12,0	11,0	11,0	12,0	15,0	18,0	19,0
LFMM	11,0	11,0	10,0	9,0	8,0	6,0	6,0	6,0	6,0	8,0	9,0	13,0
LFRR	9,0	9,0	9,0	8,0	7,0	8,0	7,0	8,0	8,0	9,0	10,0	12,0
LHCC	10,0	11,0	10,0	9,0	8,0	9,0	9,0	8,0	9,0	10,0	11,2	12,1
LIBB	17,9	24,6	29,8	23,7	14,9	14,0	13,6	13,6	14,3	18,7	21,9	
LIMM	87,6	79,6	54,6	73,5	41,6	37,6	29,8	37,7	82,5	85,3	85,4	
LIPP	85,4	67,5	49,7	59,0	40,9	37,7	36,8	84,9	86,5	73,8	53,6	
LIRR	39,5	45,7	37,6	24,5	15,7		14,6	15,5	19,0	30,2	35,3	
LJLA	18,9	18,9	17,9	16,3	13,4	12,9	12,8	13,4	14,5	17,0	19,2	22,1
LKAA	12,0	11,0	11,0	11,0	10,0	10,0	9,0	9,0	10,0	10,0	11,0	12,0
LOVV	13,0	13,0	13,0	12,0	10,0	10,0	10,0	10,0	10,0	12,0	13,7	
LPPC				33,5	37,9	56,4	33,6	19,2	36,9	19,5	20,3	20,0
LRBB	8,2	8,3	8,4	7,5	7,3	7,1	7,6	7,3	7,5	8,0	8,5	9,3
LSAG	13,8	15,1	14,3	11,9	10,2	10,5	10,5	10,5	11,1	14,1	17,0	18,6
LSAZ	16,1	16,7	16,1	14,4	11,7	11,6	11,0	12,0	12,2	15,1	19,0	21,2
LZBB											11,0	12,0

Figure 2-7: Monthly 95th percentile of TRTD per Centre

Monthly 99th percentile of TRTD per Centre

TRTD

Atsu Code	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
EDUU	42,2	40,5	39,6	27,7	21,3	21,7	21,5	21,6	27,8	43,8	55,1	54,0
EDYY	27,1	27,1	27,2	25,5	21,5	21,8	20,9	21,2	22,0	27,0	48,5	50,0
EETT							14,0	14,2	14,0	14,0	14,4	14,0
EGPX	29,1	37,5	35,5	23,3	19,6	20,1	18,5	19,8	20,7	21,2	24,2	27,3
EGTT	23,2	23,3	24,8	22,6	21,7	21,9	21,5	21,9	22,1	23,8	28,6	39,5
EISN						184,7	152,4	108,6	96,0	100,3		
EKDK	21,0	21,0	21,0	20,0	18,0	19,0	18,0	18,0	18,0	21,0	23,0	23,0
EPWW	21,9	21,3	22,0	16,0	21,1	16,6	21,4	15,2	17,9	21,1	22,0	20,6
ESMM	13,0	14,0	14,0	13,0	13,0	13,0	13,0	12,0	13,0	13,0	14,0	14,0
ESOS	13,0	15,0	14,0	13,0	12,0	13,0	12,0	12,0	12,0	13,0	13,0	13,0
EVRR	31,0	37,0	36,1	17,0	16,0	15,0	16,0	16,0	14,0	15,0	16,0	16,0
EYVC	17,2	11,9	12,0	9,0	9,0	10,0	9,0	10,0	9,0	9,0	10,0	11,0
GCCC	64,1	91,7	89,2	35,5	88,0	107,6	65,9	87,1	116,3	62,4	81,1	43,6
LDZO	34,0	37,0	37,0	32,0	28,0	27,0	25,0	28,0	27,0	32,5	33,7	37,0
LECB	22,7	24,6	23,2	21,1	19,8	18,7	21,8	24,0	19,3	21,9	22,4	22,0
LECM	29,0	28,3	29,7	27,8	43,4	39,8	38,6	44,3	39,7	38,7	38,2	30,1
LFBB	18,0	18,0	17,0	15,0	14,0	14,0	14,0	15,0	15,0	18,0	20,0	24,0
LFEE	22,0	21,0	22,0	20,0	17,0	17,0	17,0	17,0	20,0	26,0	33,0	35,0
LFFF	39,0	37,0	38,0	34,0	30,0	29,0	25,0	26,0	31,0	38,0	56,0	55,5
LFMM	37,0	38,0	36,0	30,0	24,0	15,0	15,0	17,0	16,0	21,0	24,0	34,0
LFRR	23,0	21,0	21,0	20,0	18,0	18,0	18,0	18,0	20,0	24,0	29,0	31,0
LHCC	26,0	26,0	26,0	19,0	16,0	17,0	18,0	17,0	17,0	20,0	21,9	24,2
LIBB	87,1	133,7	181,6	106,0	86,4	85,7	78,4	85,1	86,5	97,9	119,3	
LIMM	194,2	191,7	185,5	190,1	184,2	182,3	181,0	182,2	181,8	183,9	186,0	
LIPP	187,6	191,9	183,2	189,4	183,9	186,4	181,8	184,6	186,5	199,6	184,3	
LIRR	182,5	185,8	181,8	181,5	94,0		90,7	100,5	120,3	181,4	181,5	
LJLA	60,5	64,1	57,6	55,2	35,2	28,3	31,4	37,6	41,5	51,7	74,0	87,2
LKAA	38,0	33,0	35,0	32,0	29,0	26,2	29,0	25,0	26,0	28,0	30,0	29,0
LOVV	37,0	37,0	37,0	32,0	23,0	28,0	28,0	25,0	27,0	33,0	35,5	
LPPC				181,1	183,0	186,8	181,9	112,2	181,0	115,4	107,8	103,4
LRBB	25,0	29,9	35,9	21,9	22,4	22,7	22,8	25,1	23,0	27,4	22,7	22,4
LSAG	43,5	52,3	46,1	32,7	26,5	28,5	27,3	28,3	32,1	44,4	68,9	71,8
LSAZ	62,1	62,9	54,1	47,7	30,8	31,6	27,2	33,0	32,9	60,9	76,5	80,9
LZBB											23,0	25,0

Figure 2-8: Monthly 99th percentile of TRTD per Centre

Overall RCTP Technical Continuity

The graph below shows the Required Communications Technical Performance Technical Continuity [RCTP_TC(32) and RCTP_TC(20)]. This is the probability that a LACK/ERROR is received for an uplink message within 32 seconds or 20 seconds.

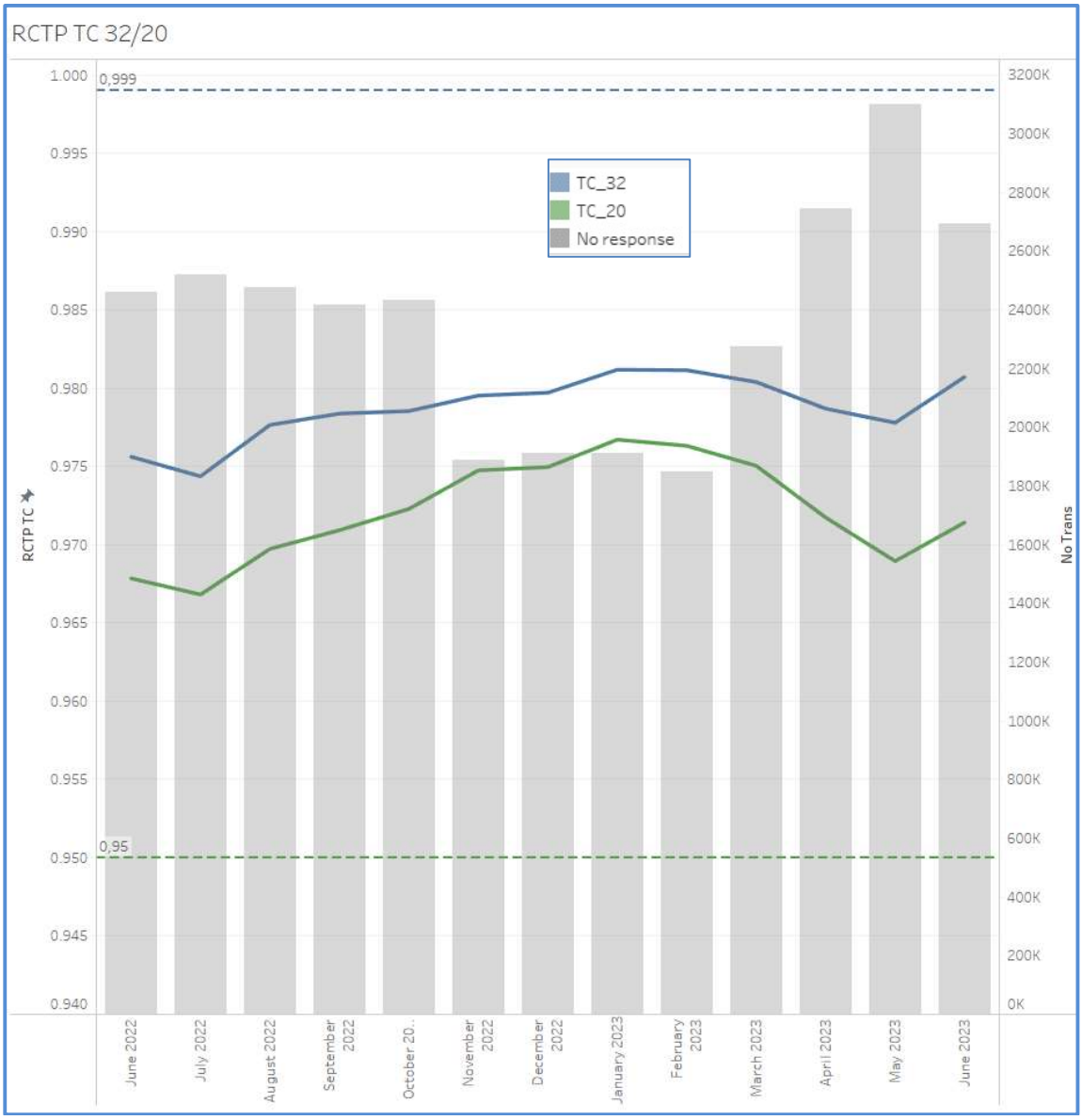


Figure 2-9: Technical Continuity

Note: the graph above does not include DSNA data due to LISAT format issues

RCTP Technical Continuity per Centre

The table below shows the RTCP TC at 32s per Centre and per month.

RCTP TC 32 ANSP Table

Atsu	June 2022	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
EDUU	0,982	0,982	0,984	0,984	0,988	0,991	0,990	0,991	0,990	0,987	0,983	0,981	0,981
EDYY	0,985	0,987	0,986	0,986	0,988	0,990	0,990	0,991	0,989	0,990	0,987	0,981	0,980
EETT								0,993	0,994	0,993	0,991	0,991	0,990
EGPX	0,983	0,985	0,983	0,983	0,988	0,991	0,991	0,991	0,991	0,991	0,989	0,987	0,985
EGTT	0,988	0,989	0,989	0,987	0,990	0,991	0,990	0,991	0,991	0,991	0,989	0,986	0,983
EISN							0,842	0,876	0,875	0,883	0,883		
EKDK	0,986	0,987	0,987	0,987	0,987	0,989	0,987	0,989	0,988	0,987	0,987	0,985	0,982
EPWW	0,989	0,989	0,990	0,989	0,991	0,989	0,990	0,987	0,990	0,989	0,990	0,988	0,989
ESMM	0,991	0,992	0,992	0,991	0,994	0,993	0,992	0,994	0,993	0,993	0,993	0,993	0,991
ESOS	0,985	0,988	0,986	0,988	0,990	0,991	0,990	0,990	0,989	0,990	0,989	0,989	0,989
EVRR	0,977	0,980	0,980	0,978	0,986	0,987	0,988	0,986	0,989	0,985	0,984	0,984	0,985
EYVC	0,993	0,992	0,995	0,993	0,994	0,994	0,994	0,994	0,992	0,993	0,992	0,994	0,994
GCCC	0,865	0,888	0,879	0,876	0,965	0,916	0,903	0,906	0,913	0,903	0,909	0,914	0,910
LDZO	0,968	0,965	0,963	0,965	0,970	0,976	0,978	0,981	0,978	0,980	0,974	0,970	0,967
LECB	0,986	0,987	0,985	0,983	0,990	0,990	0,990	0,990	0,987	0,990	0,990	0,988	0,989
LECM	0,981	0,983	0,982	0,982	0,984	0,978	0,980	0,981	0,979	0,980	0,981	0,981	0,983
LFBB	0,913	0,867	0,864	0,862	0,868	0,865	0,871	0,871	0,863	0,872	0,875	0,875	0,947
LFEE	0,894	0,891	0,890	0,890	0,893	0,898	0,892	0,892	0,886	0,894	0,891	0,889	0,971
LFFF	0,850	0,773	0,778	0,780	0,777	0,817	0,889	0,888	0,886	0,888	0,886	0,886	0,925
LFMM	0,891	0,843	0,845	0,842	0,848	0,847	0,864	0,864	0,855	0,865	0,869	0,869	0,967
LFRR	0,907	0,866	0,867	0,868	0,874	0,875	0,883	0,885	0,881	0,882	0,883	0,881	0,944
LHCC	0,987	0,985	0,986	0,985	0,991	0,993	0,992	0,991	0,992	0,992	0,991	0,990	0,989
LIBB	0,938	0,902	0,945	0,941	0,945	0,960	0,965	0,961	0,967	0,970	0,961	0,956	
LIMM	0,927	0,857	0,927	0,927	0,857	0,886	0,890	0,898	0,923	0,938	0,930	0,929	
LIPP	0,912	0,880	0,912	0,921	0,827	0,844	0,812	0,804	0,893	0,921	0,930	0,933	
LIRR	0,933	0,838	0,932	0,938	0,940	0,952		0,959	0,962	0,958	0,943	0,947	
LJLA	0,964	0,962	0,961	0,964	0,970	0,984	0,984	0,986	0,982	0,980	0,971	0,961	0,956
LKAA	0,983	0,983	0,987	0,986	0,988	0,989	0,989	0,989	0,988	0,990	0,990	0,990	0,990
LOVV	0,965	0,968	0,969	0,968	0,975	0,982	0,979	0,978	0,977	0,977	0,973	0,970	
LPPC					0,928	0,920	0,902	0,937	0,953	0,941	0,955	0,954	0,955
LRBB	0,985	0,985	0,985	0,984	0,988	0,987	0,987	0,985	0,986	0,987	0,985	0,988	0,988
LSAG	0,981	0,980	0,980	0,980	0,986	0,988	0,988	0,988	0,987	0,986	0,981	0,977	0,974
LSAZ	0,975	0,974	0,977	0,980	0,983	0,989	0,988	0,990	0,988	0,987	0,981	0,973	0,970
LZBB												0,988	0,986

Figure 2-10: RCTP Technical Continuity per Centre at 32s

RCTP TC 20 ANSP Table

Atsu	June 2022	July 2022	August 2022	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
EDUU	0.9726	0.9735	0.9752	0.9757	0.9803	0.9868	0.9857	0.9866	0.9852	0.9808	0.9747	0.9699	0.9694
EDYY	0.9769	0.9784	0.9782	0.9778	0.9798	0.9846	0.9839	0.9860	0.9835	0.9836	0.9783	0.9695	0.9686
EETT								0.9904	0.9912	0.9904	0.9873	0.9885	0.9886
EGPX	0.9764	0.9778	0.9767	0.9766	0.9826	0.9864	0.9871	0.9870	0.9865	0.9862	0.9843	0.9797	0.9762
EGTT	0.9807	0.9814	0.9812	0.9796	0.9824	0.9848	0.9840	0.9852	0.9840	0.9835	0.9806	0.9759	0.9718
EISN							0.8340	0.8705	0.8694	0.8773	0.8782		
EKDK	0.9820	0.9836	0.9830	0.9834	0.9840	0.9861	0.9849	0.9870	0.9850	0.9843	0.9832	0.9807	0.9775
EPWW	0.9845	0.9849	0.9859	0.9844	0.9877	0.9847	0.9866	0.9832	0.9873	0.9856	0.9857	0.9833	0.9847
ESMM	0.9894	0.9913	0.9903	0.9895	0.9927	0.9923	0.9910	0.9926	0.9919	0.9921	0.9916	0.9913	0.9899
ESOS	0.9837	0.9875	0.9853	0.9865	0.9894	0.9904	0.9887	0.9895	0.9883	0.9895	0.9879	0.9886	0.9881
EVRR	0.9732	0.9754	0.9768	0.9750	0.9843	0.9855	0.9866	0.9850	0.9864	0.9837	0.9819	0.9820	0.9834
EYVC	0.9901	0.9892	0.9932	0.9923	0.9941	0.9934	0.9935	0.9934	0.9917	0.9926	0.9922	0.9930	0.9934
GCCC	0.8548	0.8804	0.8726	0.8642	0.9605	0.9111	0.8979	0.9000	0.9067	0.8955	0.8994	0.9048	0.9043
LDZO	0.9578	0.9553	0.9519	0.9543	0.9618	0.9700	0.9728	0.9762	0.9730	0.9736	0.9650	0.9594	0.9534
LECB	0.9807	0.9815	0.9783	0.9770	0.9848	0.9853	0.9858	0.9848	0.9813	0.9858	0.9844	0.9821	0.9831
LECM	0.9762	0.9781	0.9768	0.9776	0.9790	0.9729	0.9753	0.9762	0.9729	0.9754	0.9757	0.9757	0.9769
LFBB	0.9099	0.8646	0.8615	0.8595	0.8661	0.8633	0.8693	0.8696	0.8613	0.8701	0.8730	0.8714	0.9422
LFEE	0.8880	0.8848	0.8841	0.8841	0.8876	0.8943	0.8884	0.8888	0.8828	0.8904	0.8860	0.8814	0.9598
LFFF	0.8411	0.7639	0.7692	0.7709	0.7690	0.8108	0.8832	0.8826	0.8806	0.8815	0.8777	0.8737	0.9083
LFMM	0.8859	0.8374	0.8402	0.8366	0.8443	0.8441	0.8621	0.8621	0.8529	0.8630	0.8660	0.8648	0.9596
LFRR	0.9036	0.8613	0.8634	0.8646	0.8709	0.8715	0.8803	0.8824	0.8780	0.8785	0.8787	0.8752	0.9370
LHCC	0.9815	0.9797	0.9800	0.9802	0.9866	0.9892	0.9883	0.9874	0.9885	0.9885	0.9864	0.9844	0.9818
LIBB	0.9267	0.8946	0.9344	0.9314	0.9358	0.9556	0.9608	0.9578	0.9631	0.9664	0.9544	0.9482	
LIMM	0.9157	0.8462	0.9165	0.9158	0.8500	0.8806	0.8850	0.8932	0.9171	0.9307	0.9193	0.9161	
LIPP	0.8987	0.8680	0.8953	0.9074	0.8176	0.8376	0.8058	0.7995	0.8867	0.9119	0.9181	0.9191	
LIRR	0.9240	0.8272	0.9197	0.9291	0.9340	0.9476		0.9548	0.9573	0.9517	0.9338	0.9359	
LJLA	0.9485	0.9449	0.9438	0.9489	0.9581	0.9777	0.9778	0.9797	0.9739	0.9712	0.9565	0.9434	0.9336
LKAA	0.9806	0.9797	0.9839	0.9835	0.9864	0.9878	0.9879	0.9878	0.9872	0.9882	0.9876	0.9870	0.9870
LOVV	0.9570	0.9601	0.9608	0.9598	0.9687	0.9778	0.9749	0.9746	0.9730	0.9722	0.9663	0.9607	
LPPC					0.9222	0.9135	0.8947	0.9311	0.9479	0.9343	0.9498	0.9486	0.9495
LRBB	0.9796	0.9797	0.9797	0.9790	0.9839	0.9826	0.9827	0.9807	0.9808	0.9823	0.9796	0.9827	0.9825
LSAG	0.9707	0.9705	0.9680	0.9686	0.9786	0.9821	0.9825	0.9829	0.9812	0.9798	0.9712	0.9633	0.9580
LSAZ	0.9627	0.9623	0.9637	0.9668	0.9730	0.9820	0.9819	0.9847	0.9812	0.9796	0.9706	0.9575	0.9507
LZBB												0.9812	0.9777

Figure 2-11: RCTP Technical Continuity per Centre at 20s

3. VDL Mode 2 Performance

The following metrics are computed based on the available data from the VGS logs provided to NM by ARINC and SITA. ENAV is currently evaluating how to also provide to NM their VGS logs.

Before April 2022, the logs contained the AVLC traffic recorded at each VGS during the 24hrs of the first Friday[1] of each month (one dataset per month).

From April 2022, the logs now contain AVLC traffic recorded at each VGS during the 24hrs of each Fridays[2] (one dataset per week). The aggregated number of AVLC frames taken into account per month for the metrics below has then increased compared to the data provided before April 2022. The increase in the number of AVLC frames used to compute the metrics improves the confidence in the metric value (narrower confidence interval) and any possible observed changes in the metric values before/after April 2022 should not be accounted to the increase of data.

To keep the trend of the AVLC traffic volume comparable with previous reports (prior to April 2022) it is now expressed as a daily average traffic volume for each month.

From April 2022, the statistics are no longer filtered on aircraft on the logon-list. This filtering measure was set up before April 2021 when VGS logs from ACSPs were incomplete.

[1] Friday is observed to have the highest flight traffic of the week.
[2] The frequency of log provision has been increased from one day per month to one day per week.

AVLC Round Trip Time

The graph below shows the cumulative distributions per frequency (and per CSP) for the AVLC Round Trip Time (RTT) of acknowledged AVLC INFO frames conveying ATN packet considering all the VGS logs. The 95th and the 99.9th percentile of CSP allocation from ED-120 and ED-228A are also provided for information (red and blue dashed lines). Please note the logarithmic scale of the delays.

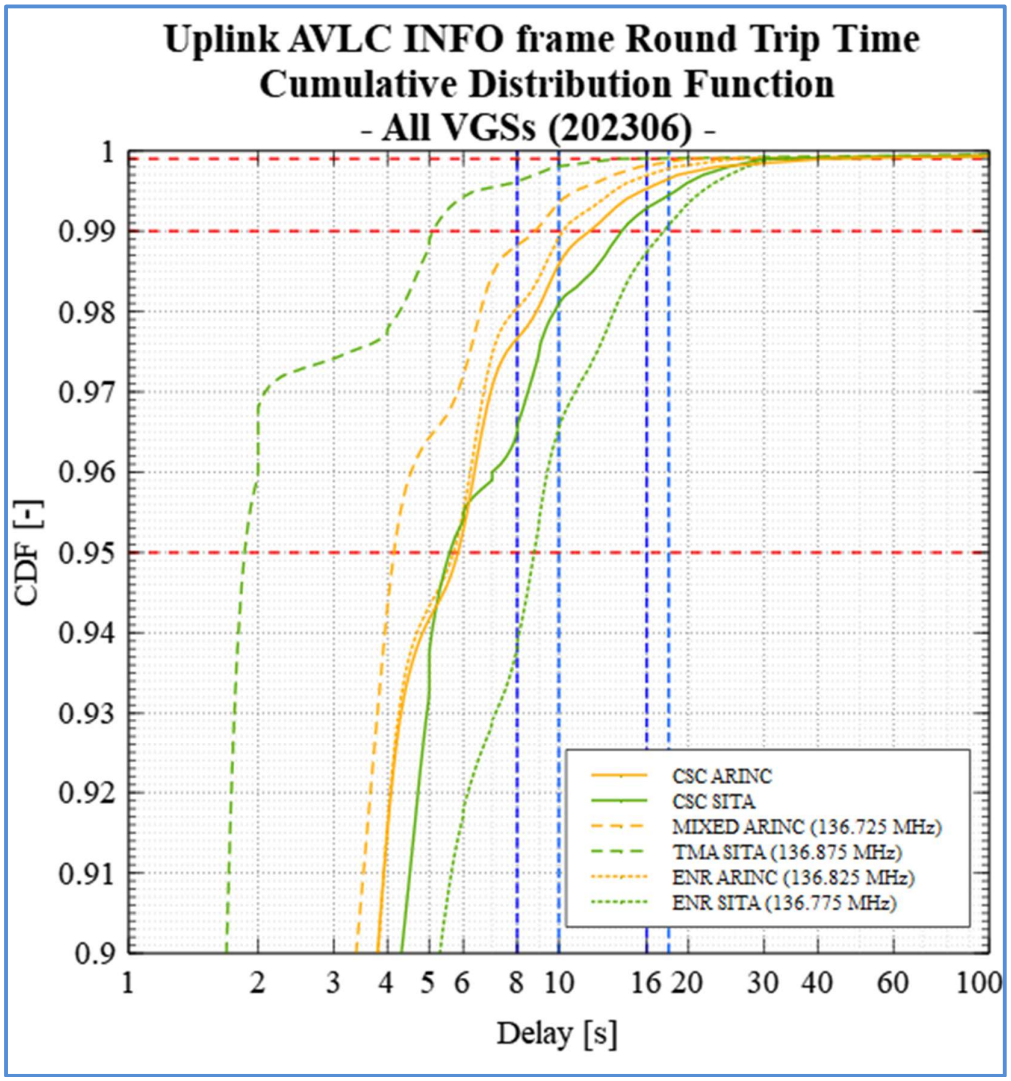


Figure 3-1: AVLC Round Trip Time

AVLC Reliability

The graph below shows the cumulative distributions per frequency (and per CSP) for the AVLC Reliability[3] of AVLC INFO frames conveying ATN packet considering all the VGS logs. The 95th and the 99.9th percentile of CSP allocation from ED-120 and ED-228A are also provided for information (red and blue dashed lines). Please note the logarithmic scale of the delays.

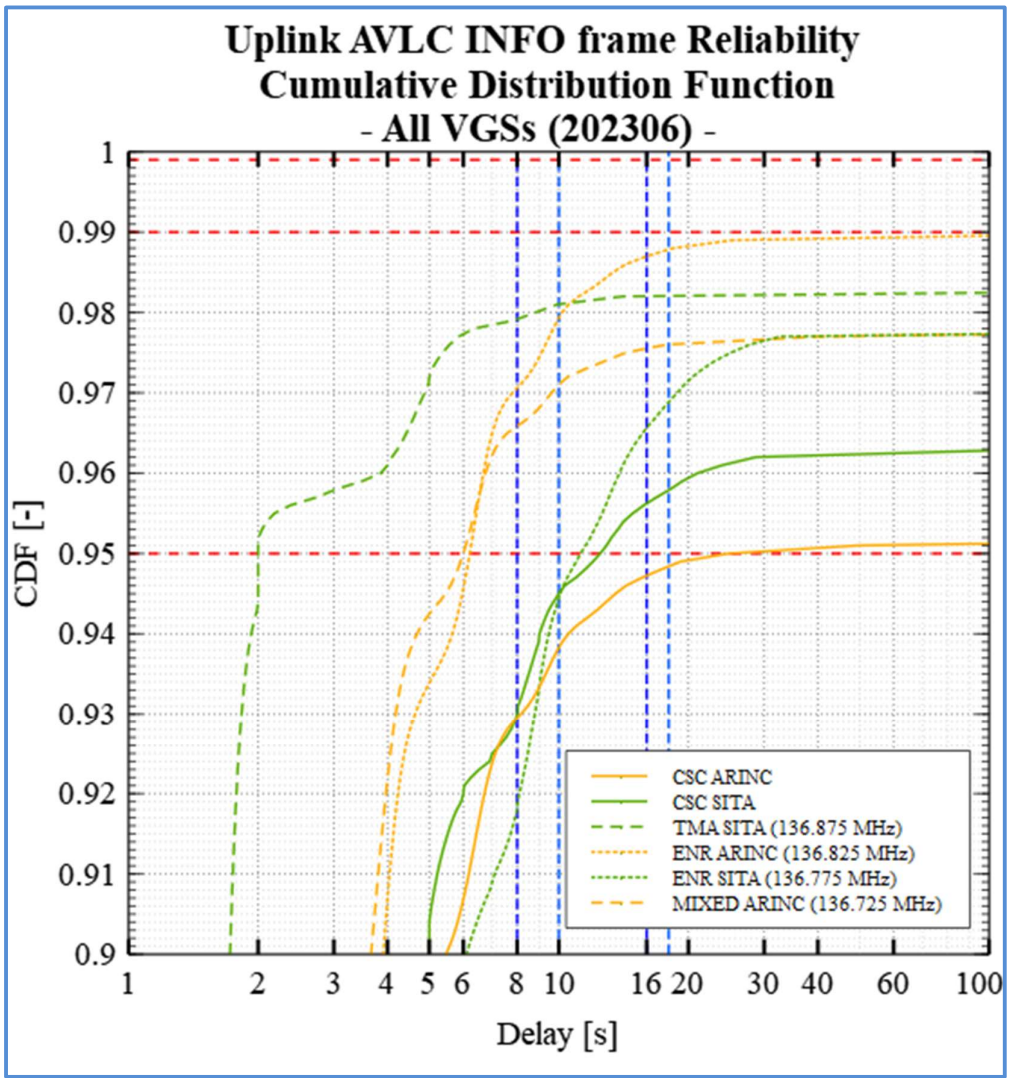


Figure 3-2: AVLC Reliability

Note: AVLC RTT and Reliability are related to each other in the following way: AVLC RTT only consider acknowledged AVLC frames while Reliability consider non-acknowledged ones (lost frames).

[3] Reliability is defined as the probability that an AVLC frame is acknowledged before a specific time. An "infinite" duration is taken for AVLC frames not acknowledged.

Number of retransmissions

The graph below shows the cumulative distributions per frequency (and per CSP for the CSC) for the number of retransmissions needed before acknowledgement of uplink AVLC INFO frames conveying ATN packet considering all the VGS logs. N=0 represents successes on the first attempt, N=1 to N=5 represent successes on the first to the fifth retransmissions and N>5 represents N2T1 events.

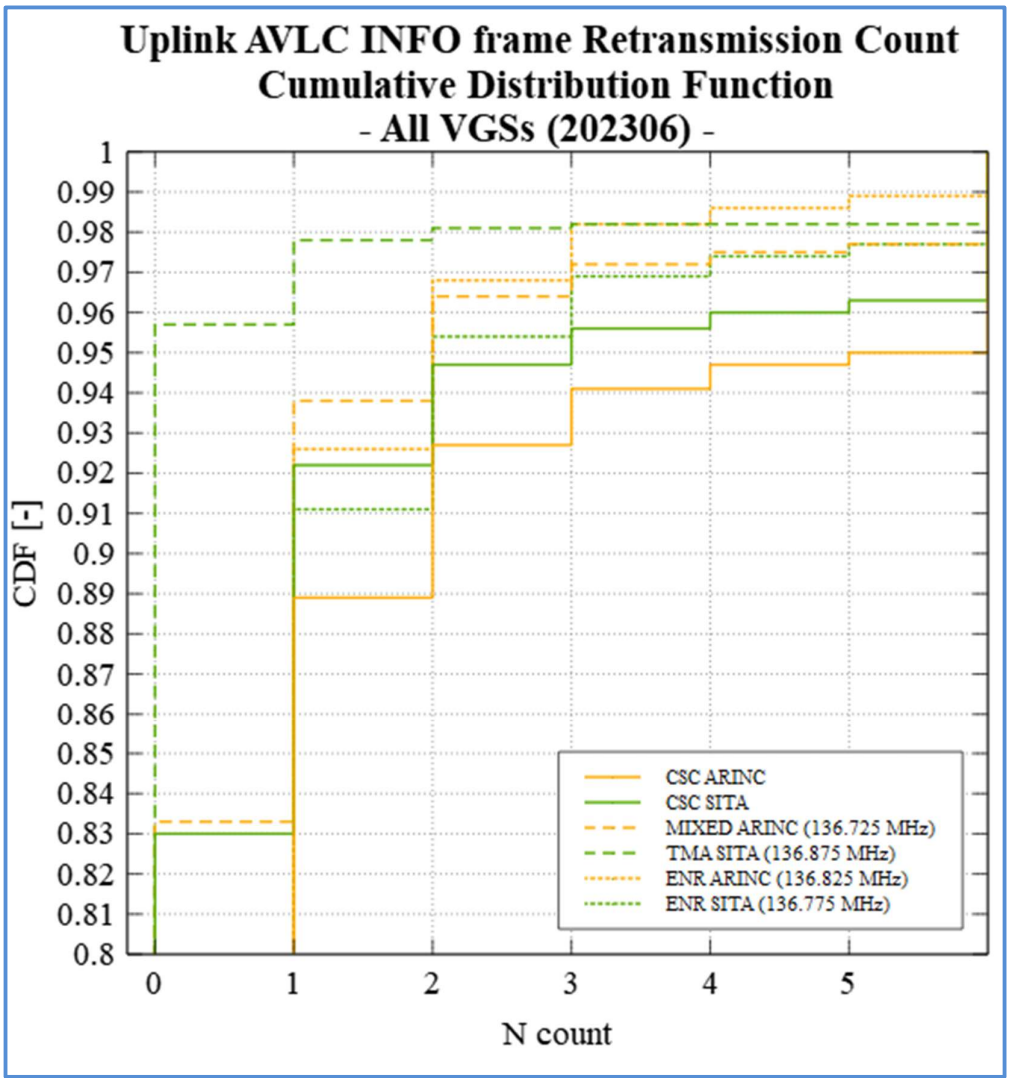


Figure 3-3: AVLC Uplink INFO frame retransmission count

AVLC Round Trip Time per frequency trend

The following set of graphs show the 95th ,99th and the 99.9th percentiles of the AVLC RTT (in seconds) of acknowledged AVLC INFO frames conveying ATN packet for each month and for each frequency with the CSC split over the two CSPs. The RTT axis has a logarithmic scale with the same range for the different frequencies. The graphs also shows the number of AVLC frames taken into account in the percentiles calculations (Frame count in linear scale) and the 95% confidence interval (gray area).

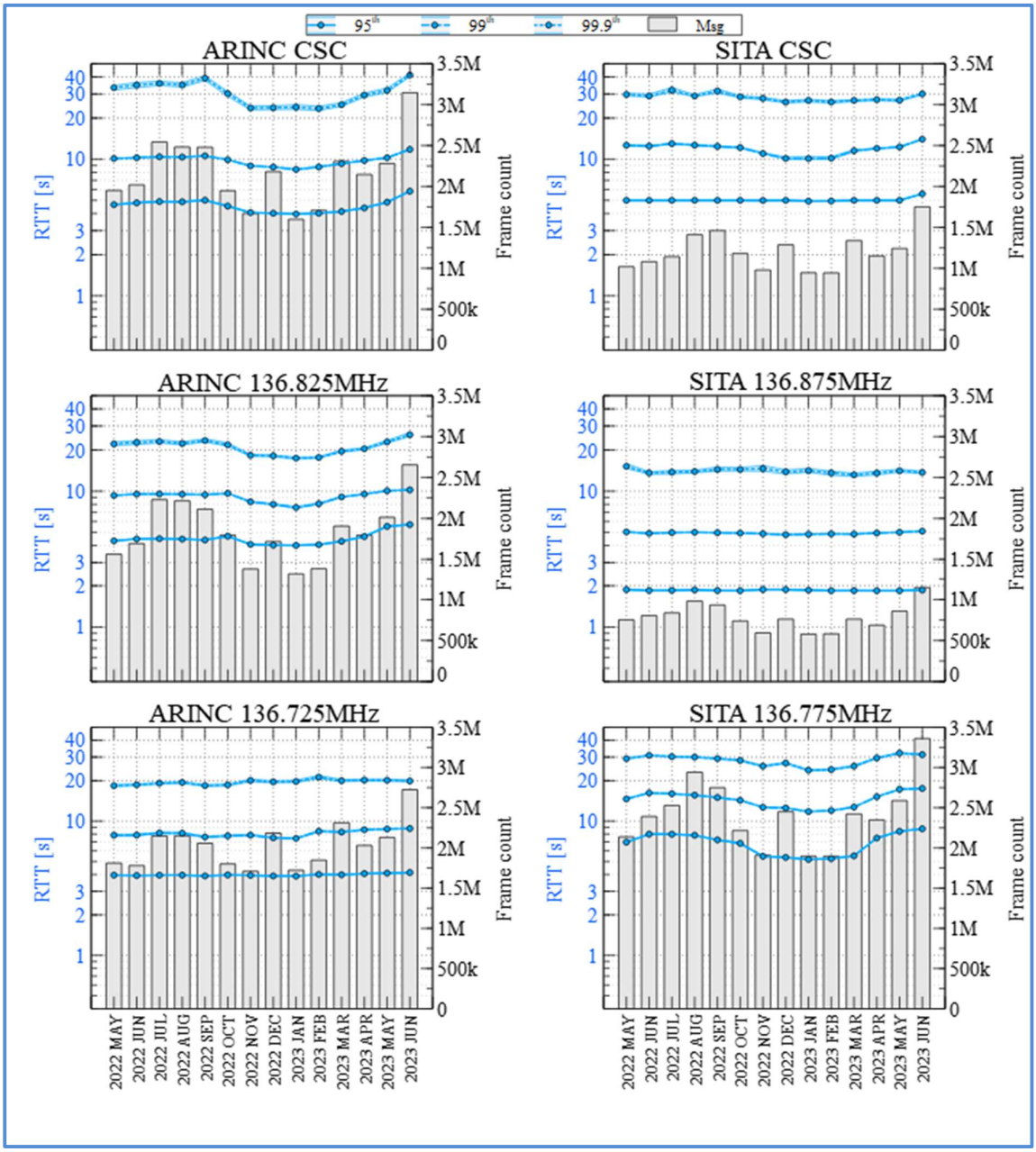


Figure 3-4: AVLC Uplink INFO Round Trip Time per Frequency

Uplink delivery success rate

The following set of graphs show the uplink delivery rate of AVLC INFO frames conveying ATN packet for each month and for each frequency with the CSC split over the two CSPs. It is the probability that an AVLC uplink INFO frame is correctly delivered to the aircraft (ACK received). The graphs also show the number of AVLC frames taken into account in the calculations (Msg count in linear scale = AVLC frame count sent on first attempt) and the 95% confidence interval (gray area).

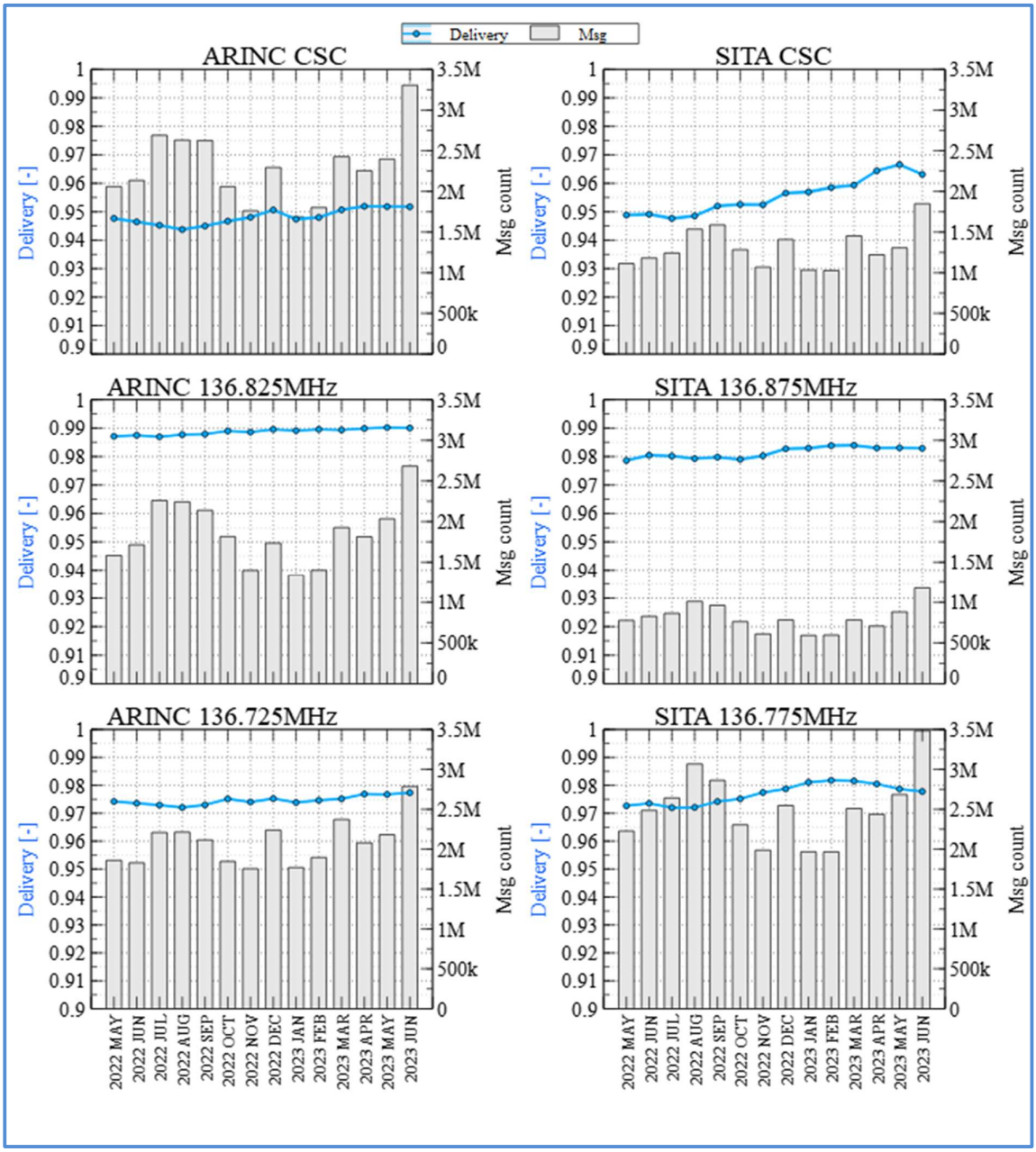


Figure 3-5: AVLC successful delivery rate per frequency

Reliability

The following set of graphs show the uplink reliability of AVLC INFO frames conveying ATN packet for each month and for each frequency with the CSC split over the two CSPs. It is the probability that an AVLC uplink INFO frame is correctly delivered to the aircraft (ACK received) within a specific duration (10 and 18 seconds). The graphs also show the number of AVLC frames taken into account in the calculations (Msg count in linear scale = AVLC frame count sent on first attempt) and the 95% confidence interval (gray area).

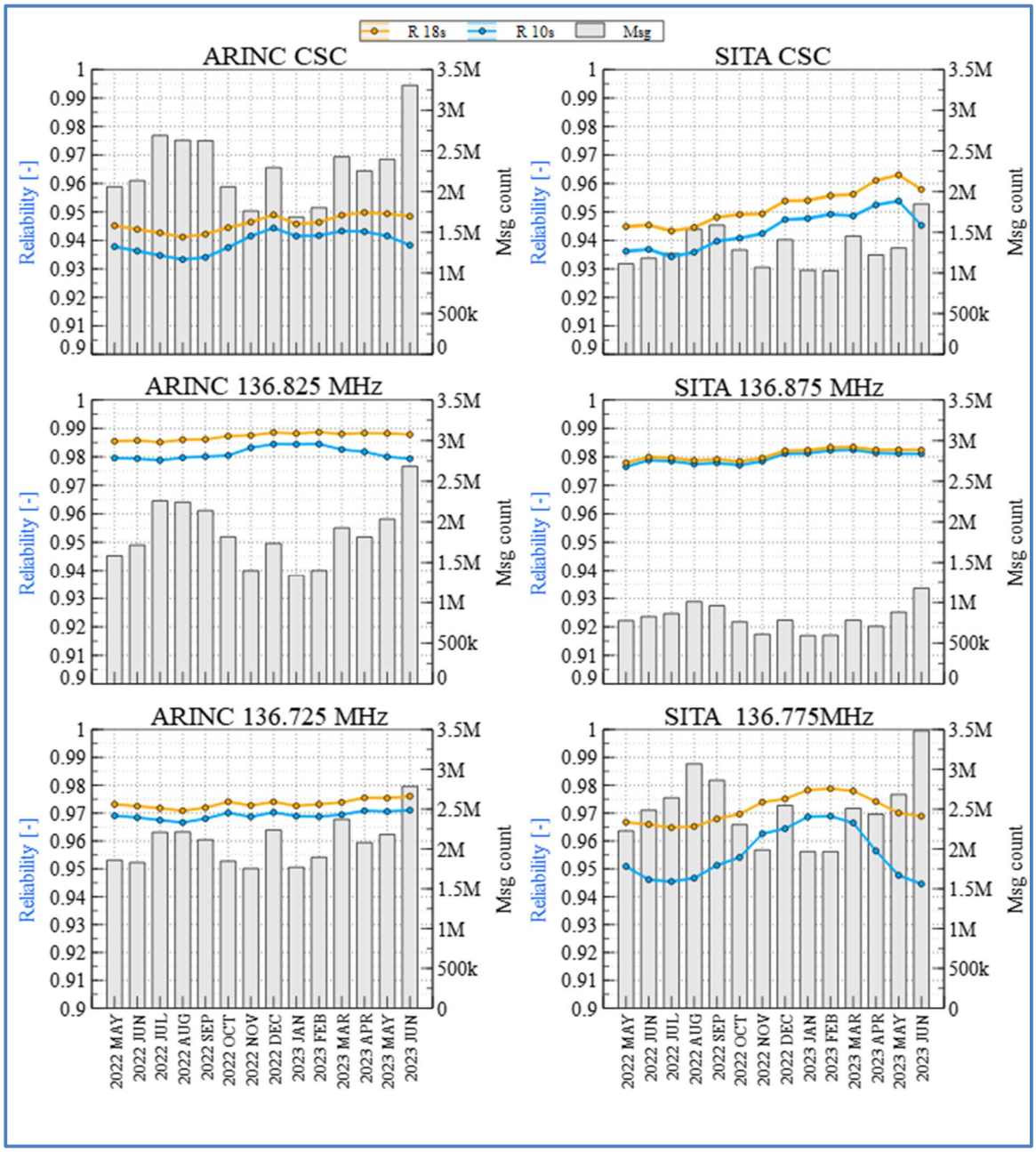


Figure 3-6: AVLC Reliability per frequency

Daily average channel load per frequency trend

The following set of graphs show the daily average channel load per AVLC payload type (ATN, AOA and AVLC protocol related frames[4]) for each month and for each frequency. An additional graph split the traffic on the CSC between ACSPs. The channel load is expressed in megabytes with the same range for the different frequencies.

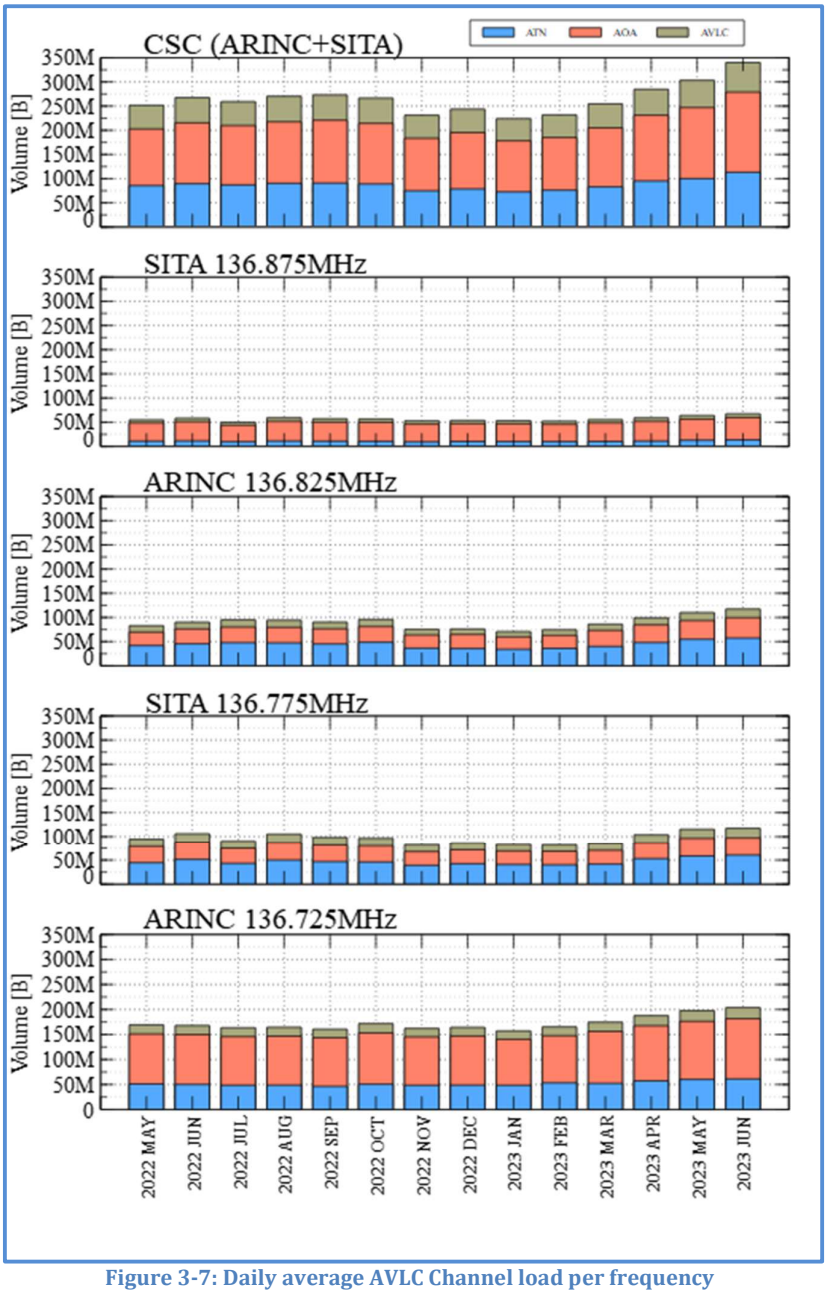


Figure 3-7: Daily average AVLC Channel load per frequency

[4] i.e. RR, SREJ, XID, …

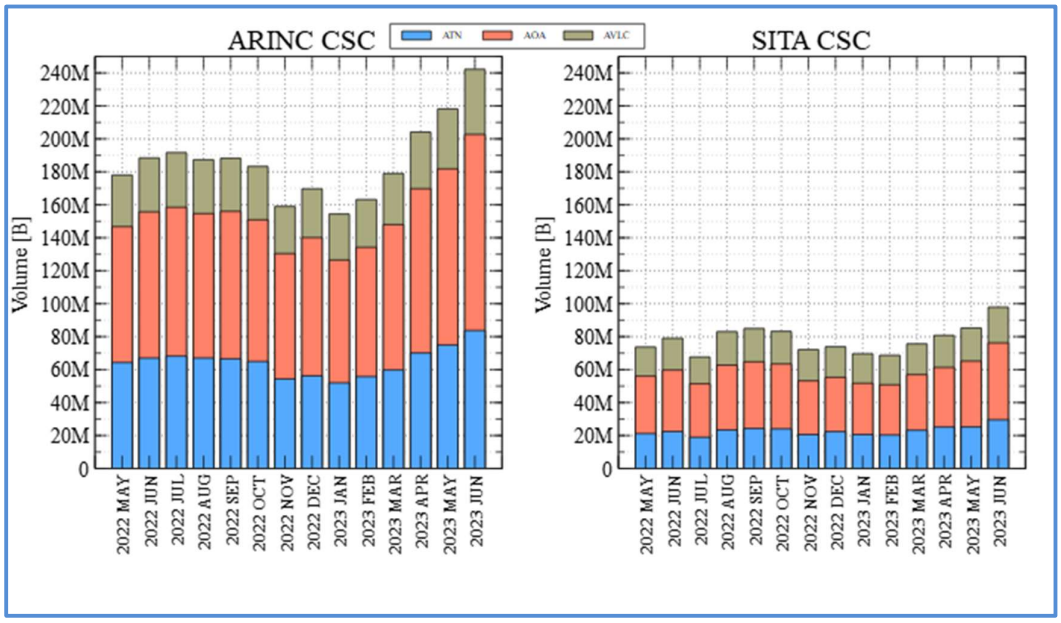


Figure 3-8: Daily average AVLC load on the CSC

Appendix A: LISAT Data Available

The table below shows the number of CPDLC flights in the LISAT database per day, per Centre for the month when this report was created. The data available for this month, computed on the 17 June 2023, may be different in subsequent months if additional data is uploaded by the ANSPs.

	Null	01/06/23	02/06/23	03/06/23	04/06/23	05/06/23	06/06/23	07/06/23	08/06/23	09/06/23	10/06/23	11/06/23	12/06/23	13/06/23	14/06/23	15/06/23	16/06/23	17/06/23	18/06/23	19/06/23	20/06/23	21/06/23	22/06/23	23/06/23	24/06/23	25/06/23	26/06/23	27/06/23	28/06/23	29/06/23	30/06/23
EDUU		3,220	3,253	3,099	3,192	3,168	3,447	3,205	3,089	3,230	3,122	3,287	2,974	2,972	3,035	3,023	3,068	3,197	3,337	3,074	2,953	2,959	2,895	3,169	3,178	3,252	3,195	3,154	3,197	3,241	3,242
EDYY		3,327	3,363	3,193	3,359	3,456	3,413	3,397	3,358	3,444	3,208	3,362	3,195	3,184	3,285	3,193	3,240	3,296	3,252	3,267	3,007	3,189	3,163	3,467	3,363	3,430	3,354	3,359	3,397	3,429	3,352
EETT		147	151	168	163	156	150	156	142	172	181	163								44	149	149	144	159	170	164	138	148	147	150	153
EFIN																															
EGPX		941	1,006	861	909	917	868	878	845	864	775	868	886	889	909	967	1,000	890	836	964	980	881	1,005	953	881	1,048	935	886	859	888	856
EGTT		4,302	4,247	4,206	4,356	4,365	4,202	4,282	4,421	4,536	4,273	4,246	4,198	4,322	4,197	4,419	4,499	4,213	4,178	4,413	4,246	4,377	4,531	4,508	4,313	4,293	4,405	4,371	4,447	4,418	4,438
EISN																															
EKDK		895	907	805	871	894				894	775	901	902	900	887	916	879	851	896	918	870	906	956	940	889	982	993	978	964	951	959
ENOR																															
EPWW		1,083	1,148	1,250	1,197	1,109	1,071	1,032	1,083	1,084	1,257	1,196	1,127	1,114	1,151	1,166	1,223	1,275	1,297	1,182	1,135	1,151	1,187	1,179	1,230	1,258	1,185	1,133	1,146	1,158	1,226
ESMM		780	800	789	818	759	718	750	795	792	773	800	803	765	810	844	840	821	859	858	763	821	836	792	804	837	842	774	824	822	829
ESOS		388	399	354	387	371	354	382	382	395	332	385	405	370	383	389	402	328	381	382	349	391	412	314	345	370	387	356	365	376	365
EVRR		250	267	252	267	250	261	262	246	254	263	270	255	261	248	245	253	246	265	229	247	236	234	242	229	252	245	249	225	221	252
EYVC		213	235	219	238	213	229	214	192	229	235	236	205	227	199	211	216	227	222	208	215	202	199	210	195	208	212	215	194	168	205
GCCC		104	98	125	92	80	101	117	105	80	123	92	79	98	98	89	80	109	94	87	100	117	93	80	121	102	75	95	104	89	87
LBSR																															
LCCC																															
LDZO		1,251	1,243	1,482	1,379	1,253	1,320	1,217	1,365	1,402	1,514	1,475	1,346	1,373	1,341	1,305	1,348	1,586	1,492	1,361	1,311	1,253	1,245	543	963	741	1,408	1,426	1,439	1,359	1,344
LECB		1,850	1,917	1,991	1,884	1,864	1,782	1,833	1,793	1,897	2,052	1,886	1,819	1,839	1,791	1,921	2,023	1,483	1,937	1,957	1,929	1,390	1,147	1,485	1,483	1,453	1,341	998	1,349	1,331	1,410
LECM		2,214	2,180	2,270	2,337	2,215	2,096	2,243	2,297	2,282	2,463	2,345	2,218	2,204	2,288	2,372	2,329	2,465	2,351	2,294	2,281	2,308	2,429	2,304	2,477	2,412	2,381	2,332	2,380	2,435	2,334
LFBB		1,689	1,778	1,852	1,770	1,701	1,413	1,690	1,699	1,747	1,930	1,701	1,656	1,696	1,659	1,719	1,776	1,924	1,702		1,642	1,705	1,657			1,831	1,716	1,792	1,753		
LFEE		1,581	1,669	1,720	1,699	1,620	1,079	1,574	1,596	1,710	1,712	1,559	1,631	1,536	1,646	1,605	1,730	1,744	1,384	1,572	1,379	1,556	1,575	1,733	1,783	1,729	1,634	1,589	1,667	1,563	1,599
LFFF		1,232	1,313	1,184	1,263	1,284	942	1,203	1,282	1,294	1,167	1,127	1,244	1,193	1,247	1,223	1,278	1,143	1,063		1,125	1,191	1,134			1,238	1,274	1,275	1,244		
LFMM		1,704	1,797	1,822	1,685	1,681	1,511	1,646	1,693	1,713	1,895	1,822	1,727	1,634	1,642	1,733	1,861	1,907	1,893	1,844	1,685	1,746	1,652	1,791	1,939	1,882	1,860	1,776	1,767	1,736	1,759
LFRR		2,006	2,004	2,131	2,118	2,019	1,619	2,050	2,093	2,088	2,186	1,927	1,926	2,008	1,980	2,047	2,069	2,191	1,912		2,028	1,955	2,021			2,108	2,038	2,088	2,063		
LGGG																															
LHCC		4	1,653	1,770	1,746	1,630	1,508	1,542	1,529	1,583	1,771	1,631	1,557	1,582	1,610	1,639	1,617	1,766	1,773	1,711	1,640	1,651	1,638	1,732	1,774	1,790	1,751	1,735	1,704	1,733	1,849
LIBB																															
LIMM																															
LIPP																															
LIRR																															
LJLA		691	690	759	681	665	728	590	716	777	820	770	717	733	674	671	626	798	798	677	679	570	589	565	790	758	684	724	735	712	668
LKAA		932	957	943	983	908	900	919	984	973	982	997	894	915	958	992	1,002	987	1,007	955		951	980	1,077	1,000	1,060	1,022	959	1,071	1,012	1,086
LMMM																															
LOVV		2,075	2,026	2,121	2,106	2,079	2,016	1,997	2,045	2,084	2,138	2,152	2,042	2,069	2,029	2,079	2,049	2,131	2,155	2,145	2,055	1,990	1,976	1,957	2,203	2,174	2,097	2,104	2,083	2,123	2,044
LPPC		1,058	1,078	1,145	1,188	1,117	996	1,150	1,161	1,161	1,268	1,195	1,077	1,124	1,159	1,134	1,135	1,298	1,208	1,135	1,110	1,193	1,159	1,121	1,259	1,194	1,186	1,135	1,197	1,179	
LRBB		1,149	1,124	1,242	1,208	1,209	1,068	1,129	1,082	1,052	1,183	1,166	1,136	1,106	1,194	1,236	1,126	1,215	1,186	1,228	1,229	1,134	1,150	1,169	1,291	1,216	1,191	1,231	1,196	1,195	1,307
LSAG		807	982	919	875	849	792	804	885	925	945	908	852	845	850	819	973	955	957	960	835	866	770	935	975	981	947	869	914	866	836
LSAZ		1,037	1,113	1,110	1,092	1,061	915	1,053	1,077	1,126	1,156	1,129	1,039	1,008	1,028	1,094	1,167	1,176	1,138	1,093	951	1,110	1,042	1,132	1,135	1,120	1,086	1,031	1,089	1,001	1,083
LZBB		780	802	906	829	763	730	749	752	786	941	835	765	1	793	805	814	946	939	818	806	790	832	807	885	908	884	859	925		977