THE FORTY-SIXTH MEETING OF THE
INFORMAL PACIFIC ATC CO-ORDINATING GROUP
(IPACG/46)
THE THIRTY-THIRD MEETING OF THE
FANS INTEROPERABILITY TEAM (FIT/33)

(Virtual, 14 & 15 October 2020)

Presented by: Federal Aviation Administration

Federal Aviation Administration

Performance-based Communication and Surveillance (PBCS) Monitoring Report

Overview

- Data link performance – airspace level evaluation
  - Summary for aggregate airspace and by media type
  - By SATCOM path identifier
  - FANS over Iridium
  - FANS over SwiftBroadband
- Data link performance – aircraft level evaluation

PERFORMANCE BY MEDIA TYPE

Performance by Media Type

81,362 data link flights

January – June 2020

Oakland

Media Type	ADS-C			CPDLC				
	Count of ADS-C Downlink Messages	ADS-C 95%	ADS-C 99.9%	Count of CPDLC Transactions	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%
Performance Criteria		RSP 180			RCP 240			
Aggregate	3,177,308	98.9%	99.6%	306,146	99.3%	99.6%	99.2%	99.5%
SAT	2,776,704	98.9%	99.6%	283,954	99.5%	99.7%	99.4%	99.6%
VHF	393,275	98.9%	99.6%	16,731	99.9%	99.9%	99.7%	99.8%
HF	7,290	63.2%	76.6%	158	59.5%	67.7%	67.1%	71.5%
SAT-VHF				1,836	94.1%	95.8%	89.9%	90.8%
VHF-SAT				1,364	95.7%	97.9%	96.7%	97.9%
SAT-HF				984	82.5%	86.8%	85.4%	87.9%
HF-SAT				987	97.6%	98.6%	97.5%	98.7%
VHF-HF				61	80.3%	88.5%	85.3%	85.3%
HF-VHF				71	90.1%	94.4%	94.4%	94.4%

Performance by Media Type

34,443 data link flights

January – June 2020

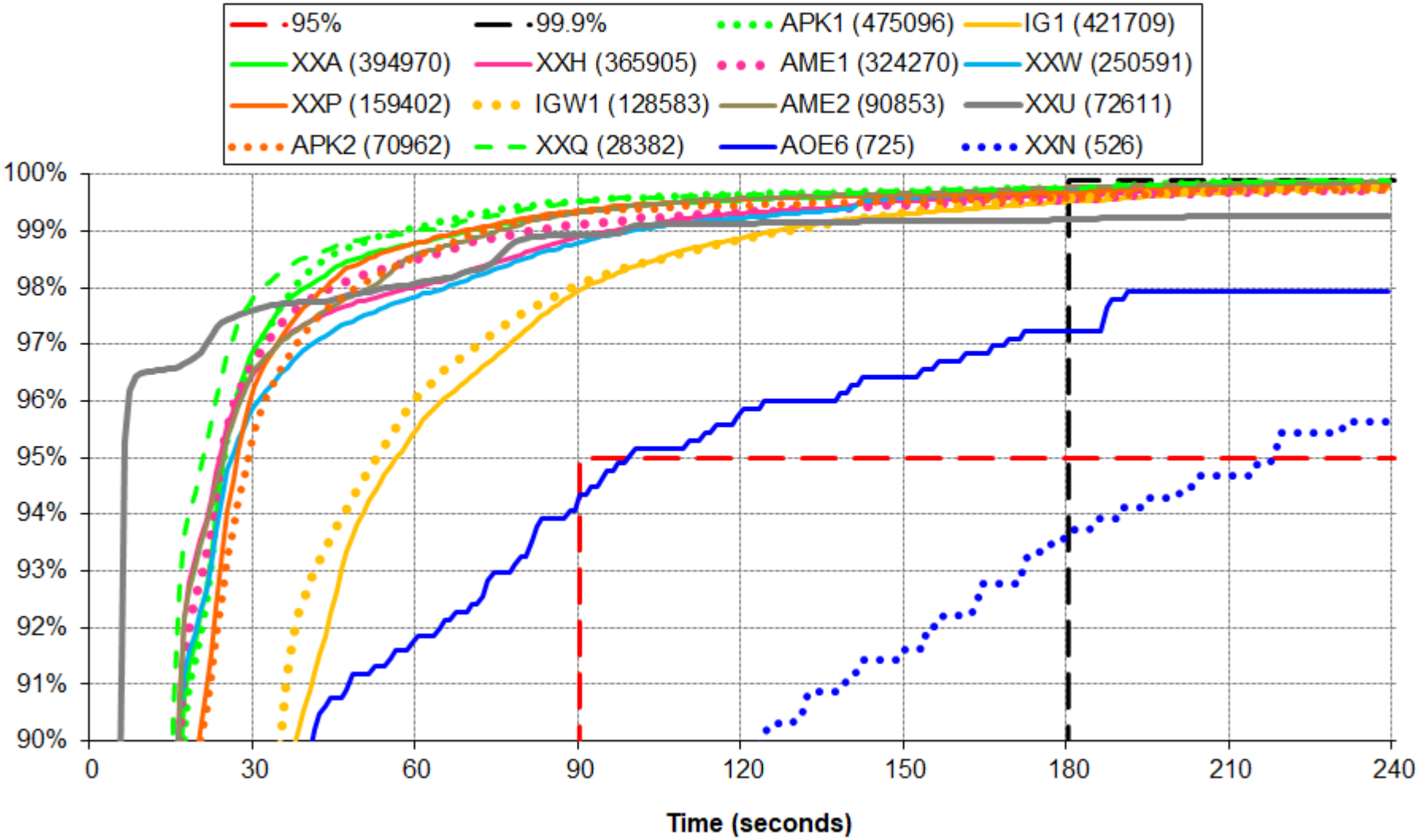
Anchorage

Media Type	ADS-C			CPDLC				
	Count of ADS-C Downlink Messages	ADS-C 95%	ADS-C 99.9%	Count of CPDLC Transactions	ACTP 95%	ACTP 99.9%	ACP 95%	ACP 99.9%
Performance Criteria		RSP 180			RCP 240			
Aggregate	1,118,605	98.7%	99.6%	70,739	99.2%	99.5%	99.1%	99.3%
SAT	704,825	98.4%	99.6%	48,431	99.4%	99.6%	99.1%	99.3%
VHF	408,865	99.7%	99.9%	19,992	99.9%	100.0%	99.8%	99.9%
HF	4,878	69.9%	82.2%	131	43.5%	49.6%	35.9%	43.5%
SAT-VHF				795	98.7%	99.1%	98.5%	99.1%
VHF-SAT				913	87.0%	95.7%	96.9%	97.6%
SAT-HF				122	78.7%	85.3%	83.6%	86.9%
HF-SAT				323	97.5%	98.1%	96.6%	97.5%
VHF-HF				18	88.9%	88.9%	88.9%	94.4%
HF-VHF				14	92.9%	100.0%	85.7%	92.9%

PERFORMANCE FOR SATCOM PATHS

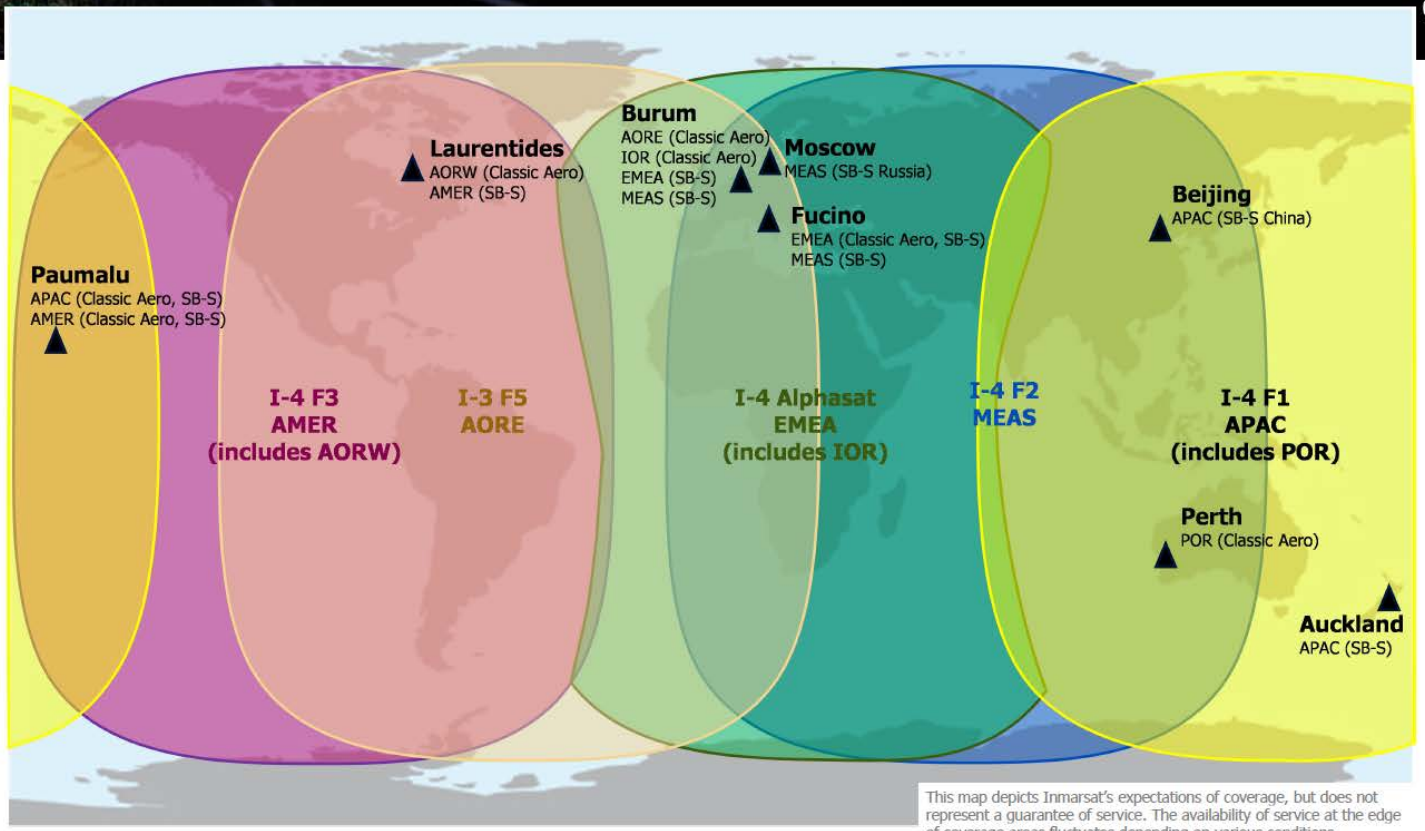
Satellite Service Provider (SSP)	Satellite	Service	Ground Station Location	ARINC ACARS Identifiers	SITA ACARS Identifiers
Iridium	All	Short Burst Data	Primary: Tempe, Arizona, US Secondary: None	IG1	IGW1
Inmarsat	AORE (3F5 at 54°W)	Classic Aero	Burum, Netherlands	XXN	AOE6
		Swift Broadband-Safety	N/A	N/A	N/A
	EMEA (AF1 at 25°E)	Classic Aero over I-4	Primary: Fucino, Italy Secondary: Burum, Netherlands	XXF	EUA1
		Classic Aero over I-4 (virtual I-3 IOR)	Burum, Netherlands	XXI	EUA2
		Swift Broadband-Safety	Primary: Burum, Netherlands Secondary: Fucino, Italy	XXB	EUA9
	APAC (4F1 at 143.5°E)	Classic Aero over I-4	Primary: Paumalu, Hawaii, US Secondary: Auckland, New Zealand	XXA (XXQ temporarily for maintenance)	APK1
		Classic Aero over I-4 (virtual I-3 POR)	Perth, Australia	XXP	APK2
		Swift Broadband-Safety	Primary: Paumalu, Hawaii, US Secondary: Auckland, New Zealand	XXS	APK9
	AMER (4F3 at 98°W)	Classic Aero over I-4	Primary: Paumalu, Hawaii, US Secondary: Auckland, New Zealand	XXH	AME1
		Classic Aero over I-4 (virtual I-3 AORW)	Laurentides, CA	XXW	AME2
		Swift Broadband-Safety	Primary: Paumalu, Hawaii, US Secondary: Laurentides, CA	XXU	AMR9
	MEAS (4F2 at 64°E)	Swift Broadband-Safety	Primary: Burum, Netherlands Secondary: Fucino, Italy	XXM	MEA9

Oakland FIR - Jan-Jun 2020
Actual Surveillance Performance (ASP)



Operational Coverage Map

inmarsat aviation

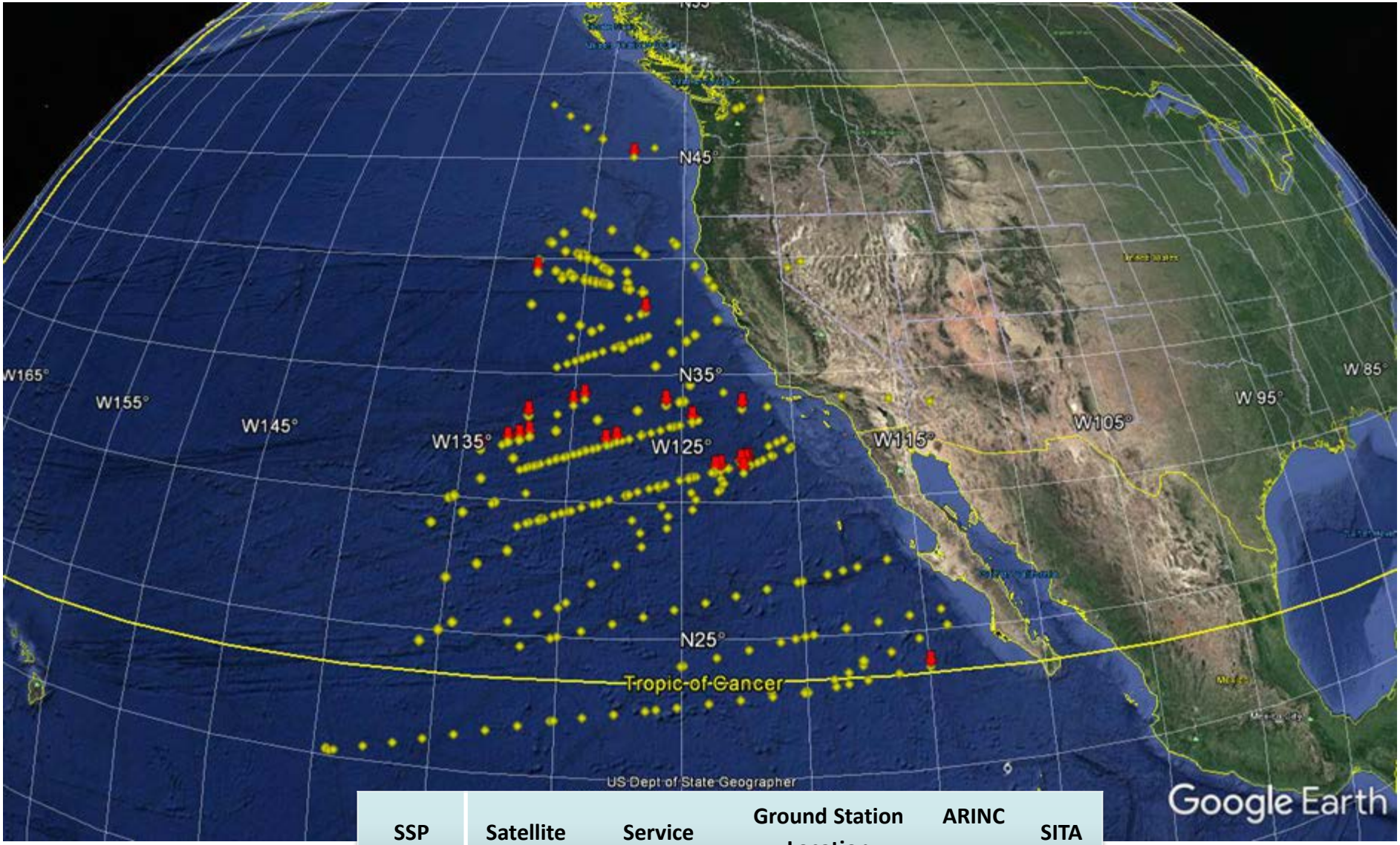


This map depicts Inmarsat's expectations of coverage, but does not represent a guarantee of service. The availability of service at the edge of coverage areas fluctuates depending on various conditions.

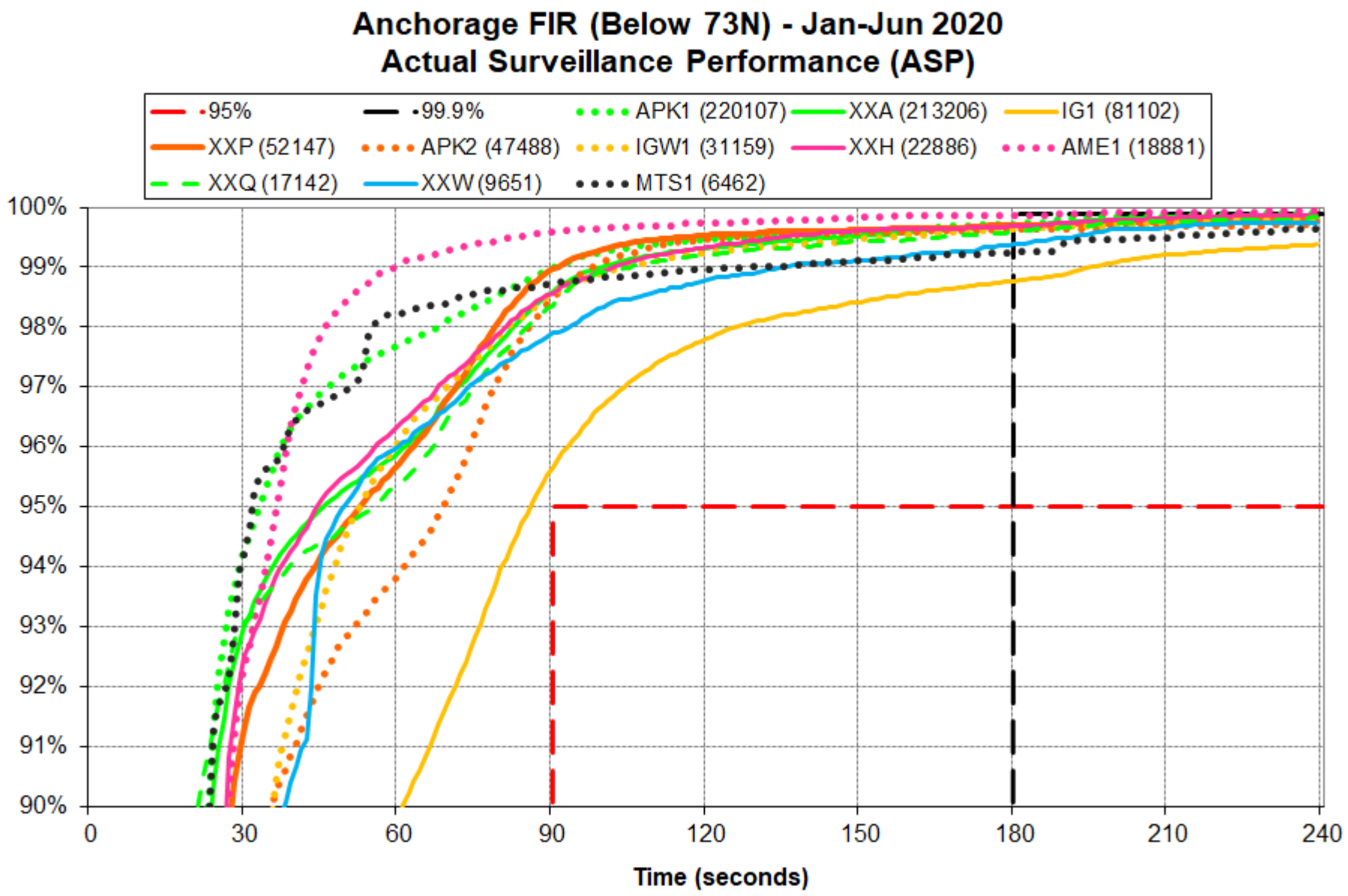
Inmarsat Update ICAO NAT TIG/08 7-11 Oct 2019

4

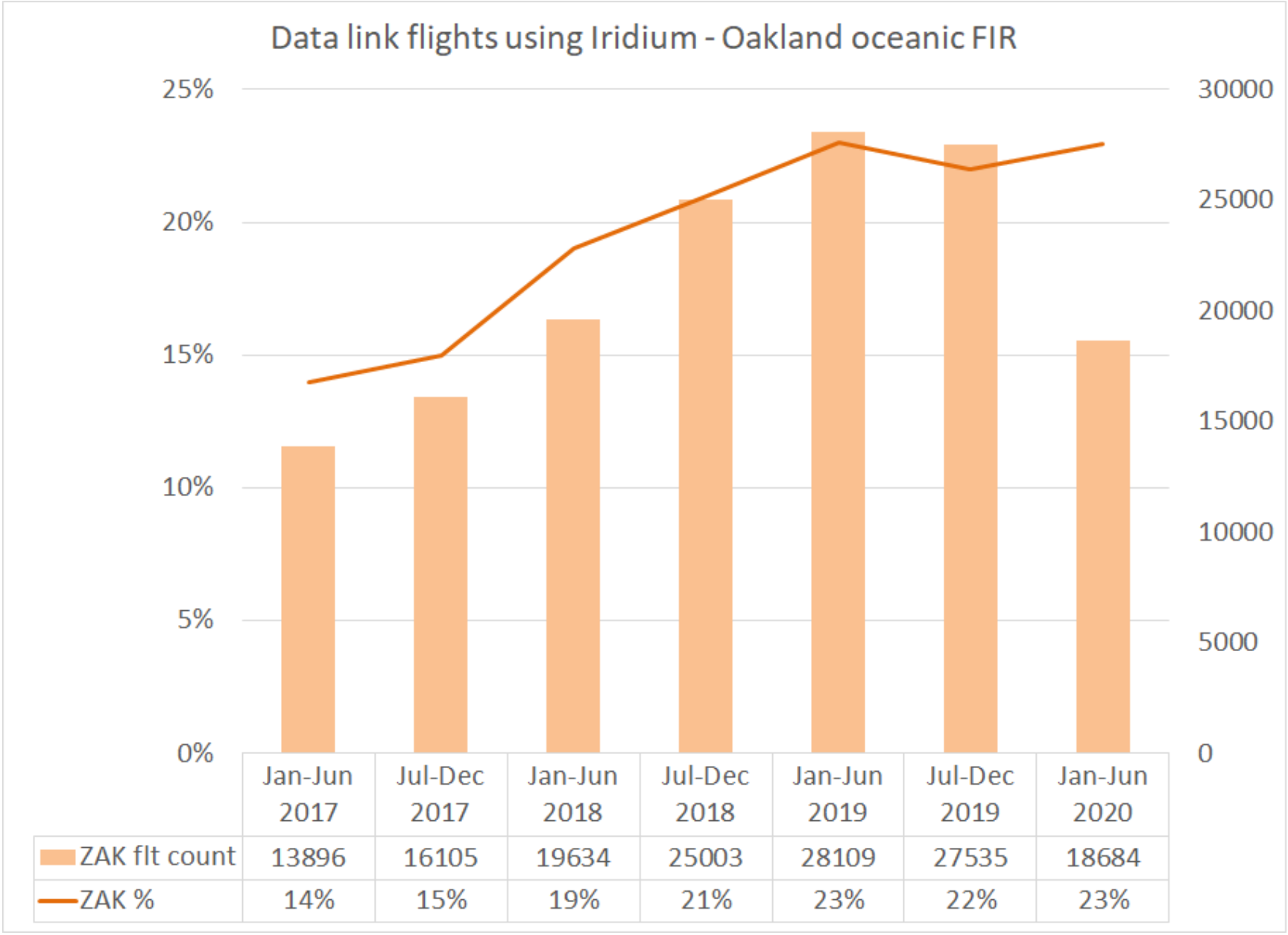
AOE6/XXN ADS-C position reports – Dec 2019

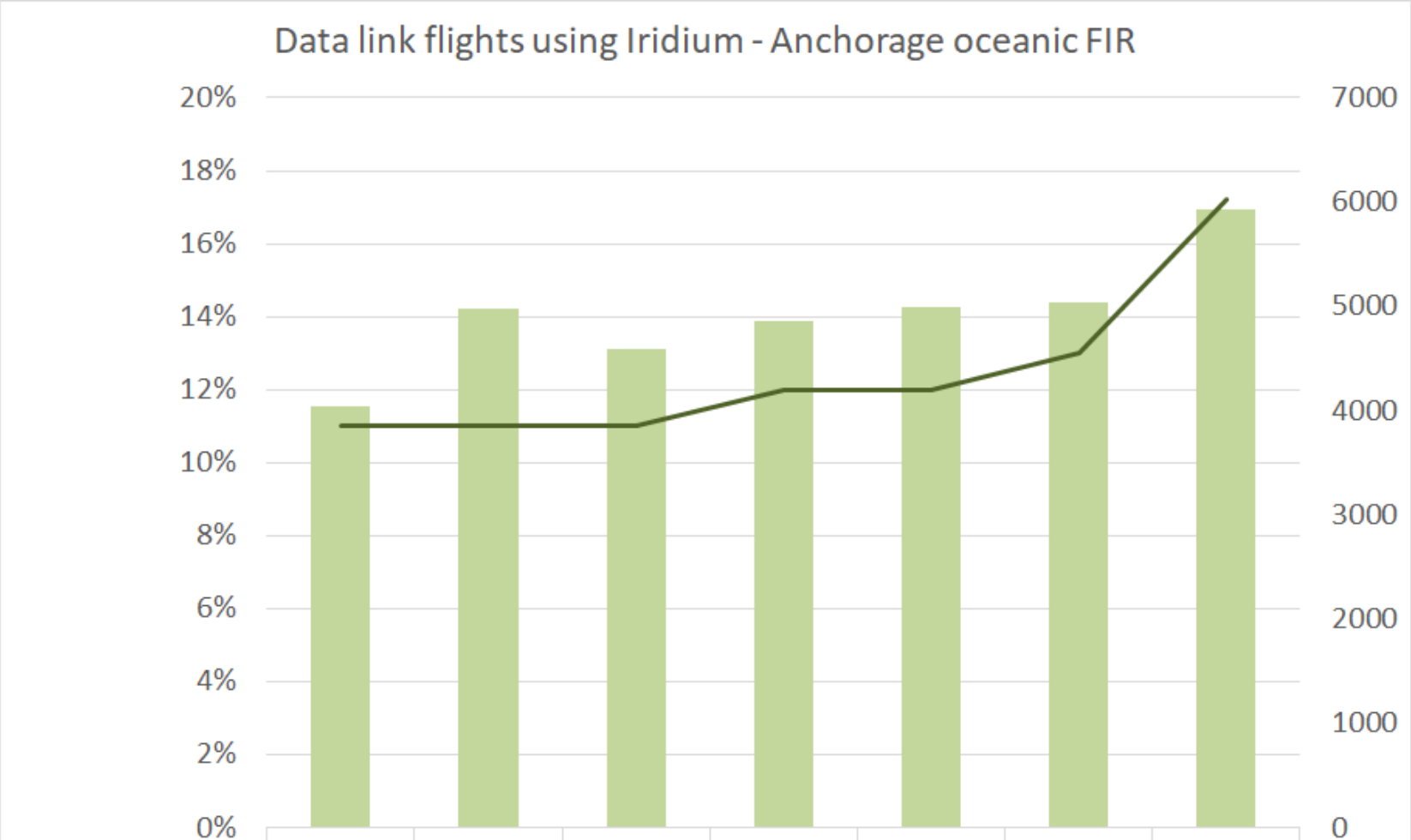


SSP	Satellite	Service	Ground Station Location	ARINC	SITA
Inmarsat	AORE (3F5 at 54°W)	Classic Aero	Burum, Netherlands	XXN	AOE6


Anchorage FIR (Below 73N) - Jan-Jun 2020
Actual Surveillance Performance (ASP)
95%
99.9%
APK1 (220107)
XXA (213206)
IG1 (81102)
XXP (52147)
APK2 (47488)
IGW1 (31159)
XXH (22886)
AME1 (18881)
XXQ (17142)
XXW (9651)
MTS1 (6462)
100%
99%
98%
97%
96%
95%
94%
93%
92%
91%
90%
0
30
60
90
120
150
180
210
240
Time (seconds)

FANS OVER IRIDIUM


Data link flights using Iridium - Oakland oceanic FIR
25%
20%
15%
10%
5%
0%
30000
25000
20000
15000
10000
5000
0
Jan-Jun 2017
Jul-Dec 2017
Jan-Jun 2018
Jul-Dec 2018
Jan-Jun 2019
Jul-Dec 2019
Jan-Jun 2020
ZAK flt count 13896 16105 19634 25003 28109 27535 18684
ZAK % 14% 15% 19% 21% 23% 22% 23%

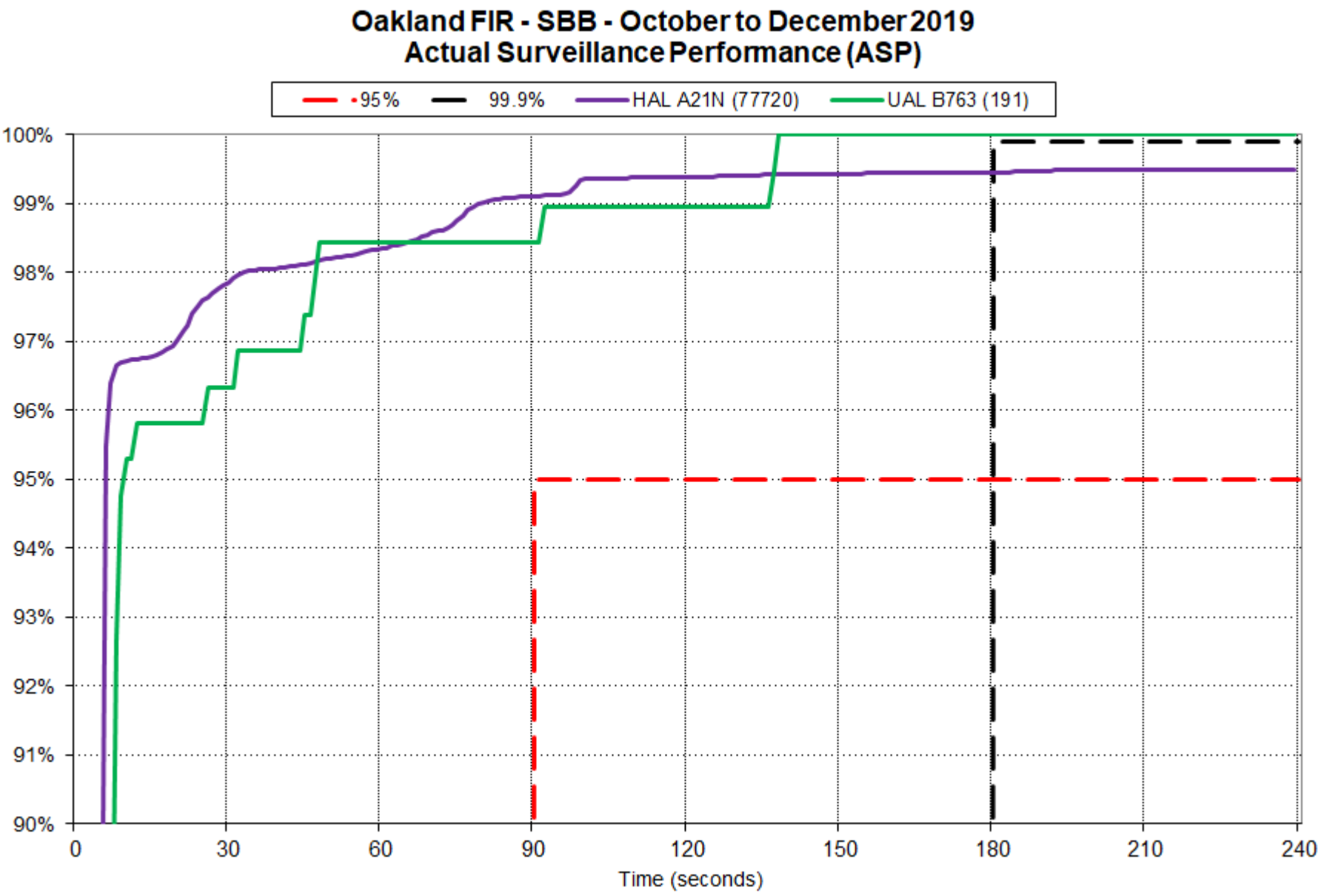


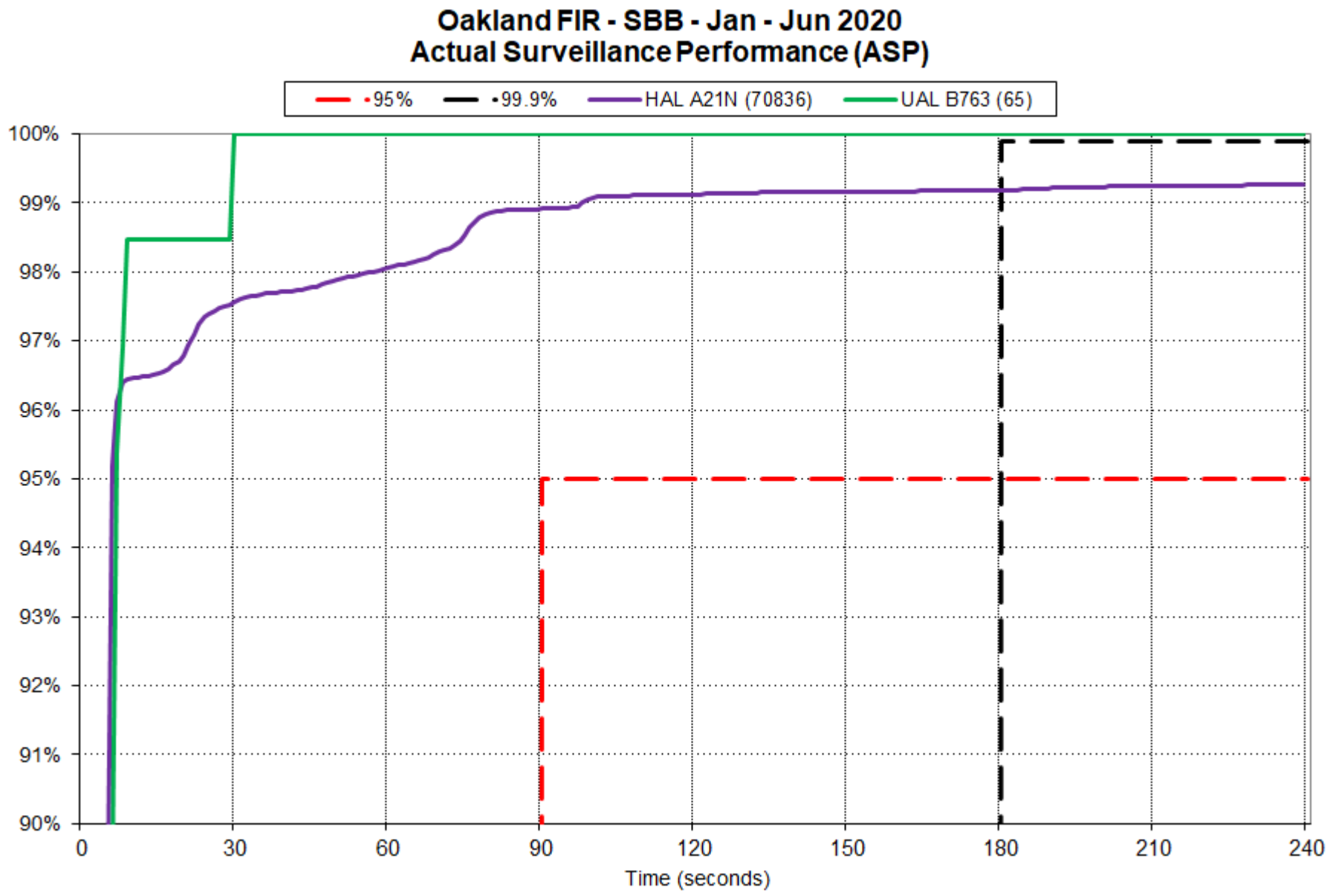
	Jan-Jun 2017	Jul-Dec 2017	Jan-Jun 2018	Jul-Dec 2018	Jan-Jun 2019	Jul-Dec 2019	Jan-Jun 2020
ZAN flt count	4033	4976	4586	4862	4996	5032	5929
ZAN %	11%	11%	11%	12%	12%	13%	17%

FANS OVER SWIFT BROADBAND

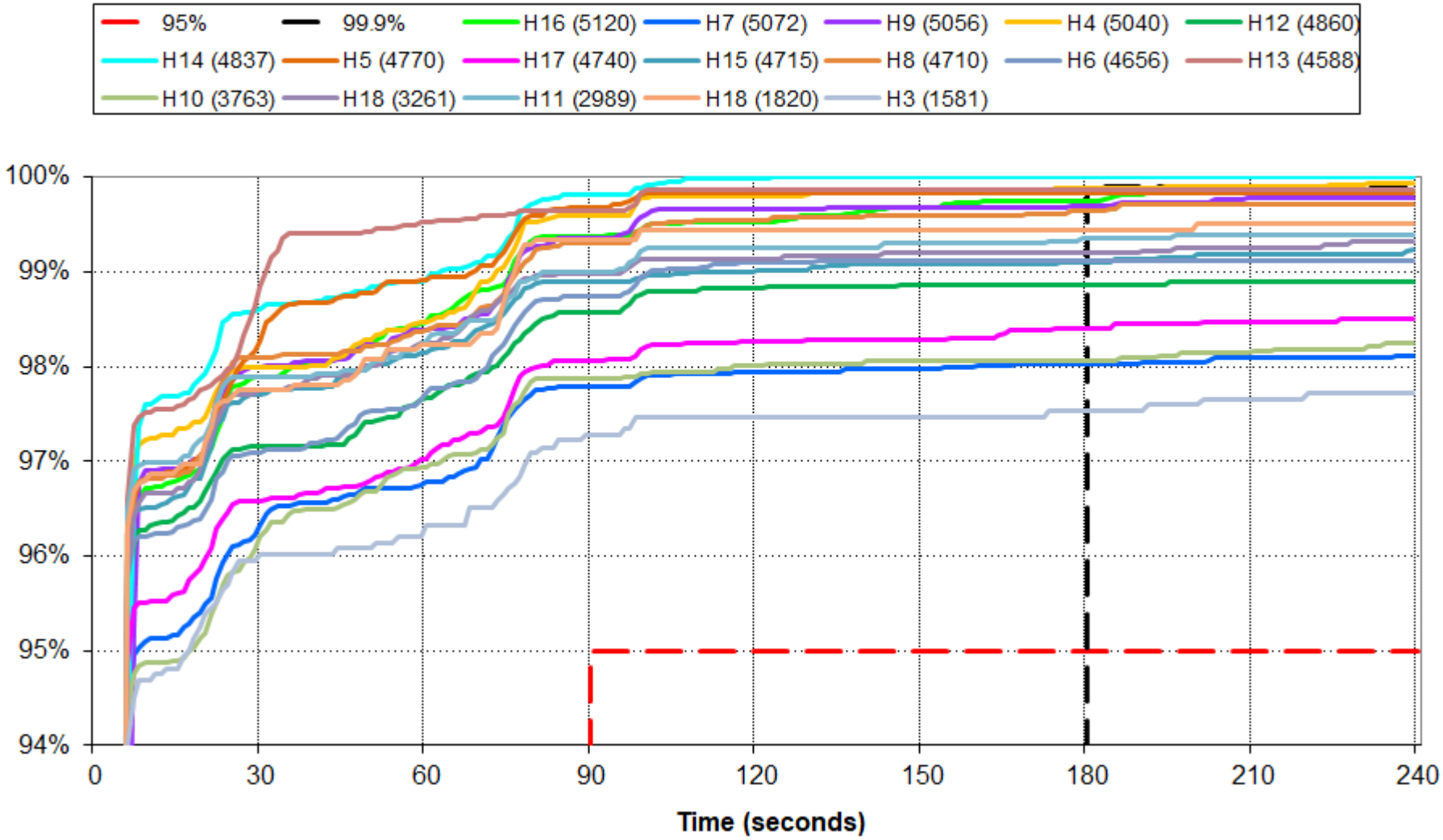
FANS over SBB Data Link Usage

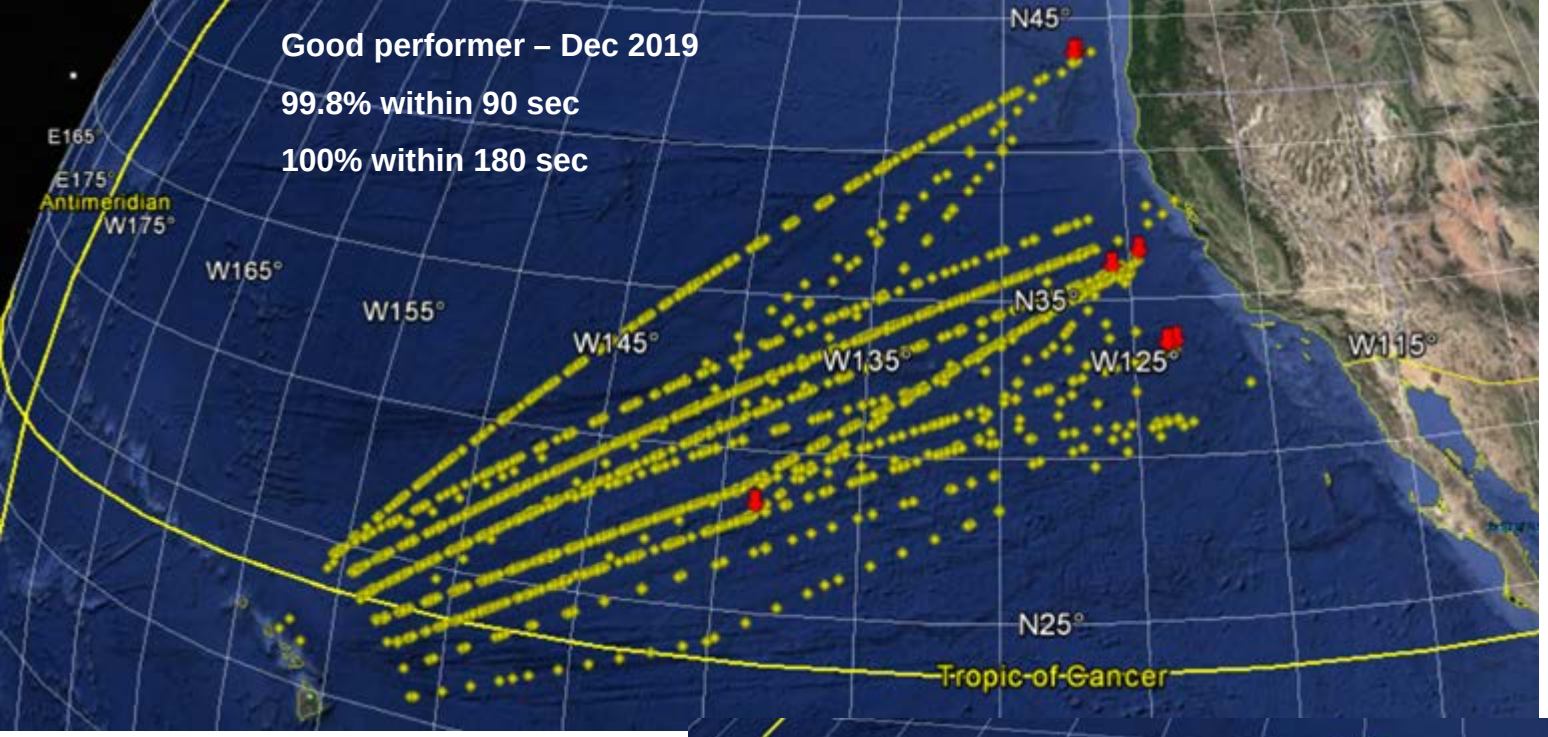
Jan-Jun 2020	KZAK
FANS data link airframes using SBB	23
Total flights observed	2418

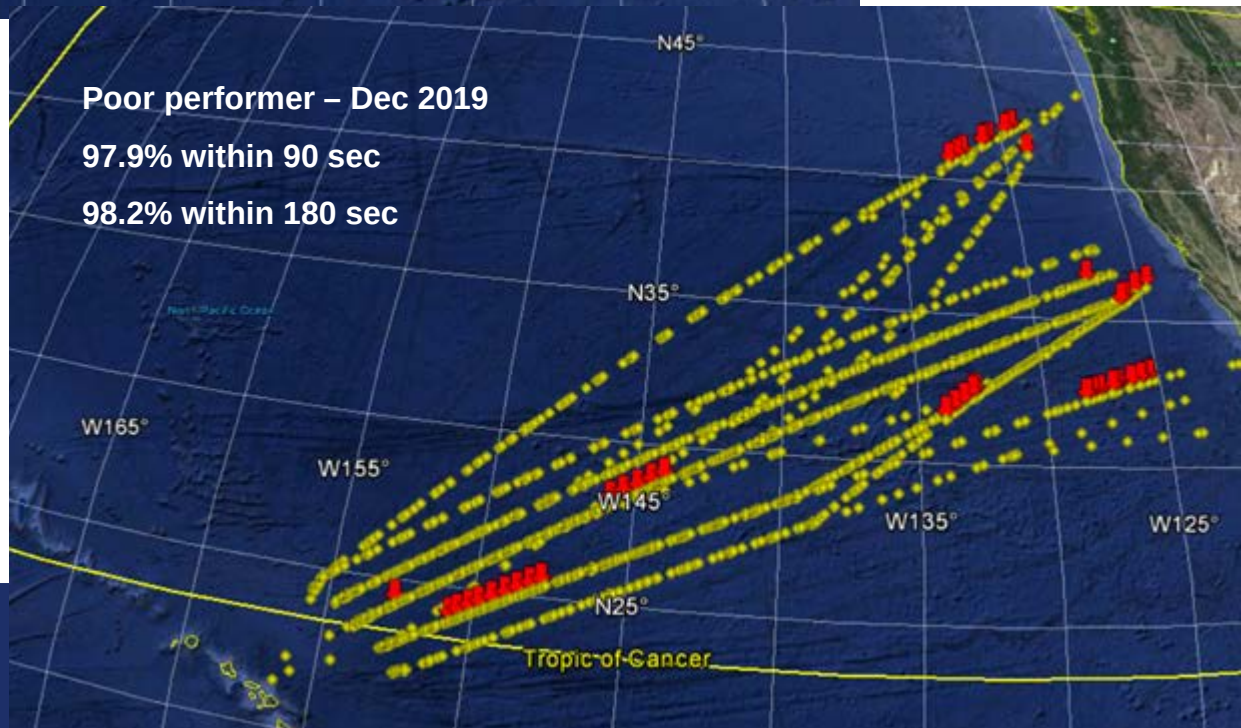

Oakland FIR - SBB - October to December 2019
Actual Surveillance Performance (ASP)
95%
99.9%
HAL A21N (77720)
UAL B763 (191)
100%
99%
98%
97%
96%
95%
94%
93%
92%
91%
90%
0
30
60
90
120
150
180
210
240
Time (seconds)


Oakland FIR - SBB - Jan - Jun 2020
Actual Surveillance Performance (ASP)
95%
99.9%
HAL A21N (70836)
UAL B763 (65)
100%
99%
98%
97%
96%
95%
94%
93%
92%
91%
90%
0
30
60
90
120
150
180
210
240
Time (seconds)

Oakland - HAL A321N - SBB - Jan-Jun 2020
Actual Surveillance Performance (ASP)



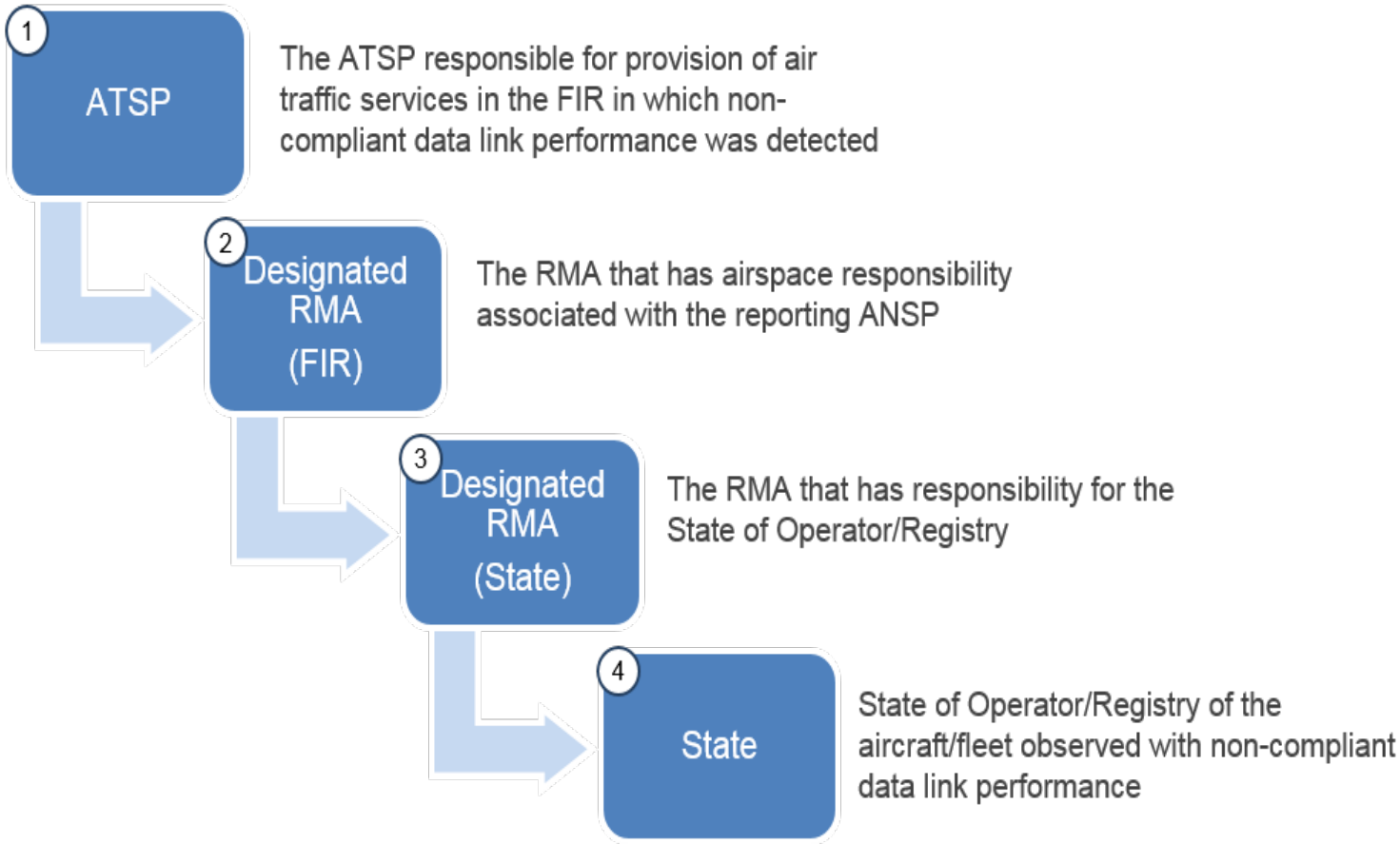

Good performer – Dec 2019
99.8% within 90 sec
100% within 180 sec
N45°
E165°
E175°
Antimeridian
W175°
W165°
W155°
W145°
W135°
N35°
W125°
W115°
N25°
Tropic-of-Cancer


Poor performer – Dec 2019
97.9% within 90 sec
98.2% within 180 sec
N45°
N35°
W165°
W155°
W145°
W135°
W125°
N25°
Tropic-of-Cancer

PBCS Aircraft Performance Monitoring Programs
Monthly reporting

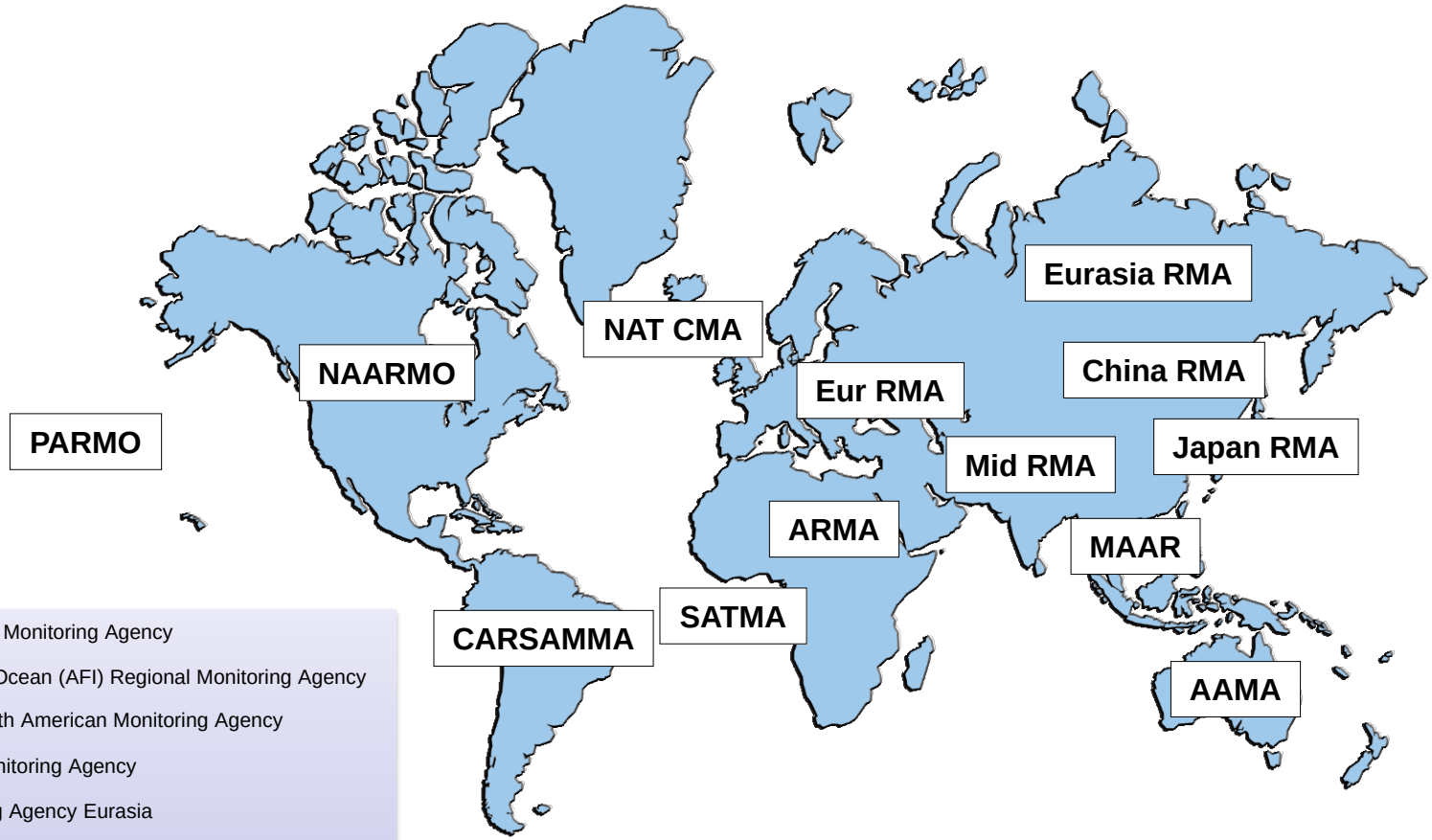
- Monthly monitoring processes being coordinated for ATSPs to compile and send reports for cases of airframe non-compliance to the relevant Regional Monitoring Agencies (RMAs)
- Focuses more on timely identification and investigation of non-compliant airframes
- To be effective, will rely on well defined processes and clear coordination between ATSPs, RMAs, State regulators, Operators

Non-compliance reporting



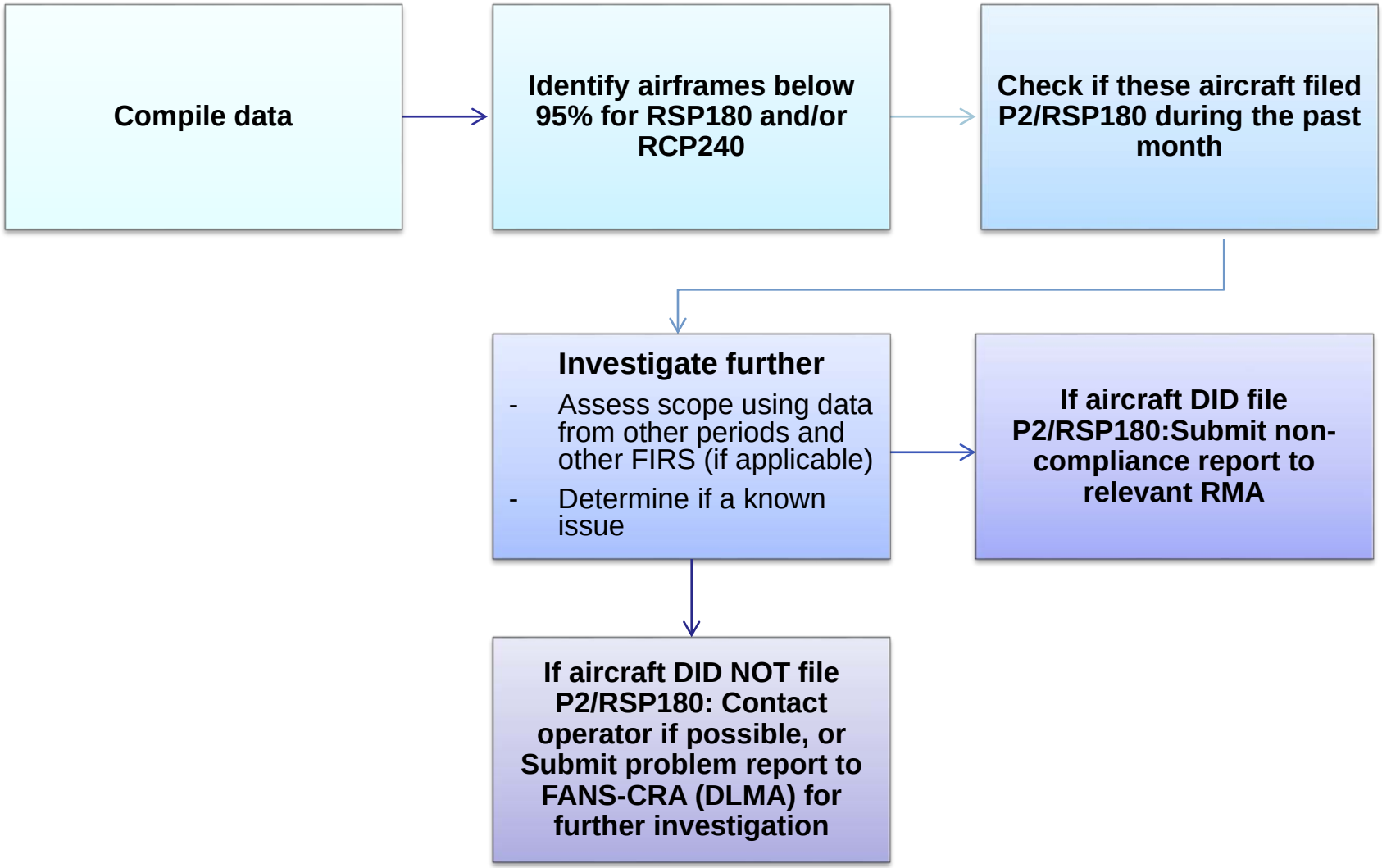
RMA: regional monitoring agency

ICAO Endorsed Regional Monitoring Agencies (RMAs)



AAMA	Australian Airspace Monitoring Agency
ARMA	African and Indian Ocean (AFI) Regional Monitoring Agency
CARSAMMA	Caribbean and South American Monitoring Agency
China RMA	China Regional Monitoring Agency
EurAsia RMA	Regional Monitoring Agency Eurasia
Eur RMA	European Regional Monitoring Agency
Japan RMA	Japan Regional Monitoring Agency
MAAR	Monitoring Agency for Asia Region
Mid RMA	Middle East Regional Monitoring Agency
NAARMO	North American Approvals Registry and Monitoring Org
NAT CMA	North Atlantic Central Monitoring Agency
PARMO	Pacific Approvals Registry and Monitoring Organization
SATMA	South Atlantic Monitoring Agency

ATSP monthly monitoring process



Non-compliance reporting

Monitoring period: June-August 2020	
Airspace:	Oakland
Total aircraft observed using data link	1,829
Have 100 or more ADS-C downlink reports and/or CPDLC transactions	1,346
Observed below 95% for RSP180 and/or RCP240	42
Filed P2/RSP180	6
Reported to PARMO	4

Non-compliance reporting

Monitoring period: June-August 2020	
Airspace:	Anchorage
Total aircraft observed using data link	1,264
Have 100 or more ADS-C downlink reports and/or CPDLC transactions	888
Observed below 95% for RSP180 and/or RCP240	18
Filed P2/RSP180	11
Reported to PARMO	8

ATSP Investigation…

- **Check if performance issue occurred on one leg during monitoring period and was subsequently resolved**
- **Check media types of reports > 90 seconds (and reports before and after)**
  - Helps identify or confirm HF data link problems, media transition problems, specific media/path problem
- **Plot position reports and check locations of reports > 90 seconds**
  - Helps identify if delays occur in VHF/SAT or SAT/SAT transition areas, FIR boundaries
- **Check performance in 2 previous months**
  - Helps identify ongoing vs. new problems, scope of problem
- **Check estimated PORT if ACP < 95%**
  - *May* help identify abnormal pilot response behavior

FAA PBCS Analysis Tool

- **Platforms used**
  - Front end: Tableau
  - Data processing: Python
    - Input data: PBCS-formatted ACP and ASP files
- **Used to support investigations of non-compliant aircraft to determine cause, when possible, and whether a report should be generated**

Select Menu
ADS-C airframe report under 95%

Select a View 2
- ADS-C Performance Und...
- Filed ADS-C Performance

FIR Boundaries
(Multiple values)

Select a View 1
- CPDLC performance by oper/actype
- ADS-C by Path ID
- Data

Select a (Map) View
- Density Map
- Lat/Long Points

DATE
2/1/2020 — 3/31/2020

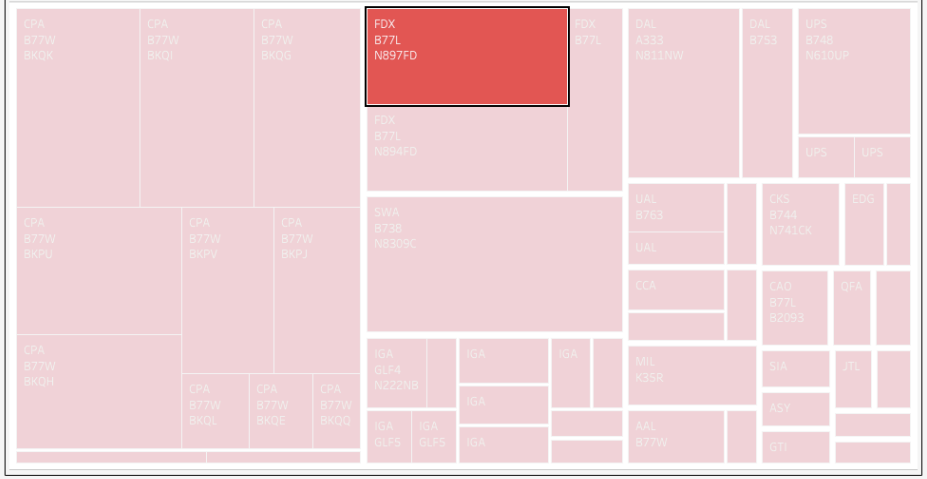
All airframes by media type

COMTYPE	ADS-C message downlink counts	95% RSP 180 benchmark ASP < 90 secs	99.9% RSP 180 benchmark ASP <= 180 sec
Aggregate	1,063	94.45%	96.14%
SAT	907	96.36%	97.91%
VHF	119	99.16%	100.00%
HF	37	32.43%	40.54%

COMTYPE	CPDLC Transaction counts	95% RCP 240 benchmark ACP <= 180 sec	99.9% RCP 240 benchmark ACP <= 210 sec
Aggregate	1,604	98.69%	98.94%
SAT	1,457	99.25%	99.38%
VHF	66	100.00%	100.00%
HF	13	53.85%	53.85%
HF-SAT	57	92.98%	96.49%
SAT-VHF	6	100.00%	100.00%
VHF-SAT	5	100.00%	100.00%

All Airframes Map

ADS-C airframe report under 95% by operator/aircraft type



Data of airframe report under 95% by operator/aircraft type

DATE	STIME	DEL (bin)	ACID	LAT	LONG	RGS	TYP	COMTYPE	ITV
2/7/2020	8:11:11 AM	3	FDX802	21.9717	-153.6817	ITOV	PER	VHF	9999
	8:19:20 AM	3	FDX802	22.2369	-152.4139	ITOV	PER	VHF	9999
	8:20:47 AM	283	FDX802	22.2831	-152.1878	H05	PER	HF	9999
	8:22:45 AM	392	FDX802	22.3503	-151.8828	AME1	WCE	SAT	9999
	8:24:00 AM	317	FDX802	22.4314	-151.7067	AME1	PER	SAT	9999
	8:27:44 AM	111	FDX802	22.6839	-151.1883	AME1	PER	SAT	9999
	8:30:23 AM	8	FDX802	22.8633	-150.8167	AME1	PER	SAT	9999
	8:40:00 AM	705	FDX802	23.5	-149.4739	H05	PER	HF	9999
	8:44:11 AM	582	FDX802	23.7742	-148.8833	H05	PER	HF	9999
	8:59:12 AM	771	FDX802	24.7261	-146.7756	H02	PER	HF	9999
	9:07:45 AM	463	FDX802	25.2447	-145.5842	H02	PER	HF	9999
	9:08:18 AM	430	FDX802	25.2772	-145.5078	H02	WCE	HF	9999
	9:08:48 AM	507	FDX802	25.3069	-145.4386	AME1	PER	SAT	9999
	9:18:24 AM	63	FDX802	25.865	-144.115	AME1	PER	SAT	9999
	9:28:00 AM	375	FDX802	26.4061	-142.7903	H02	PER	HF	9999
	9:32:23 AM	134	FDX802	26.6458	-142.1894	H02	PER	HF	9999
	9:37:37 AM	12	FDX802	26.9244	-141.4794	H02	PER	HF	9999
	9:47:13 AM	7	FDX802	27.4217	-140.1814	AME1	PER	SAT	9999
	9:56:49 AM	517	FDX802	27.8969	-138.8972	H02	PER	HF	9999
	9:57:09 AM	780	FDX802	27.9128	-138.8531	H02	WCE	HF	9999
	10:01:36 AM	513	FDX802	28.1247	-138.2658	H02	PER	HF	9999
	10:06:25 AM	719	FDX802	28.3472	-137.6392	H02	PER	HF	9999
	10:16:01 AM	608	FDX802	28.7811	-136.3839	H02	PER	HF	9999
	10:25:37 AM	847	FDX802	29.1994	-135.1294	H02	PER	HF	9999

Sample PBCS ATSP Non-compliance Report Form	
Report Date:	7/27/2020
Period of observed non-compliance:	Jan-Mar 2020
Reporting Air Traffic Service Provider (ATSP):	FAA - Oakland
Contact email address(es) at Reporting ATSP:	FAAPBCSmonitoring@faa.gov
Reporting to Regional Monitoring Agency (RMA):	PARMO
ICAO CODE:	XXX
Airline Operator:	XXX Inc.
State of Operator/Registry:	United States

PBCS Data

FIR	4-letter ICAO Aircraft Type	Registration	ADS-C downlink Message Counts	95% RSP 180 Benchmark	CPDLC Transaction Counts	95% RCP 240 benchmark	Issue code
				ASP		ACP	
				<=90 sec		<=180 sec	
KZAK	B772	Reg 1	410	93.41%	25	96.00%	(*1)(*3)
KZAK	B772	Reg 2	290	94.48%	21	95.24%	(*1)

Issue code	Explanation	Recommendation(s)
(*1) Delayed reports around VHF/SAT transitions.	This note is used when ADS-C or CPDLC reports are observed with delays when there is mixed media usage in the sequence of reports before, at or after the delayed reports (ex.: VHF/VHF/SAT/VHF/SAT).	- Review "NAT OPS Bulletin 2019_003: Data Link Performance Improvement Options" and recommended solutions/actions (Problem/Issue #2).
(*2) Delayed reports via HF media.	This note is used when delayed ADS-C or CPDLC reports are observed to be delivered via HF data link (HFDL) or near reports delivered via HFDL. Check whether this appears to be a SATCOM failure with one flight or a period during the flight, or more continuous, intermittent use of HFDL. Potential issue with aircraft media priority settings.	- Review "NAT OPS Bulletin 2019_003: Data Link Performance Improvement Options" and recommended solutions/actions (Problem/Issue #1, #4, #9). - Review all Service Information Letters (SILs) and Software Bulletins (SBs) released from Satcom avionics manufacturers, particularly advice on Operator Requirement Table (ORT) set-up. - Operator should be aware that HFDL DOES NOT meet the RCP/RSP criterias for PBCS operations.
(*3) Delayed reports due to Inmarsat satellite to satellite transition (aircraft) or satellite problems (network).	This note is used when ADS-C or CPDLC reports are observed with delays and its noticed that there is a switch sequence between different or same Inmarsat satellite paths (Ex.: XXF/XXH/XXF/XXH). One known area where this occurs in the NAT is at 30W longitude. If multiple aircraft observed with same issue around same time, may be a network-related issue and ATSP may want to report to FANS-CRA/DLMA.	- Review all Service Information Letters (SILs) and Software Bulletins (SBs) released from Satcom avionics manufacturers, particularly advice on Operator Requirement Table (ORT) set-up. - Check with contracted Data Link Service Provider and Satellite Service Provider for possible coverage problems.
(*4) Delayed reports due to Iridium avionics (aircraft) or satellite problems (network).	This note is used when ADS-C or CPDLC reports are observed with delays via Iridium satellite paths (IG1, IGW1). If multiple aircraft observed with same issue around same time, may be a network-related issue and ATSP may want to report to FANS-CRA/DLMA.	- Check for SATCOM radio/unit problems.
(*5) Reported only on VHF and/or HF.	This note is used when delayed ADS-C reports or CPDLC messages are observed via VHF and/or HF only (no SATCOM). This might indicate that SATCOM unit is defective or became unavailable during flight. Check if this issue is observed during one flight or part of one flight only, or whether it is an ongoing problem. If not observed on subsequent flights, the issue may have been addressed.	- Operator should not declare PBCS if SATCOM not available. - Check for SATCOM radio/unit problems. - Flight crew should inform ATC if SATCOM becomes unavailable during flight.
(*6) Poor ACP due to high PORT.	This note is used when its found that the delayed CPDLC transactions are caused by high pilot operational response time (PORT).	- Review "NAT OPS Bulletin 2019_003: Data Link Performance Improvement Options" and recommended solutions/actions (Problem/Issue #6). - Review procedures to reduce pilot operational response time (PORT) to CPDLC messages.
(*7) Aircraft data link connection problems detected.	This note is used when we can identify that delays happened on periods that disconnections and reconnections have been performed. Check whether this appears to be a problem with one flight or a period during one flight, or whether it is an ongoing problem. If problem is not observed on later flights, the issue may have been addressed.	- Review "NAT OPS Bulletin 2019_003: Data Link Performance Improvement Options" and recommended solutions/actions (Problem/Issue #8 unknown cause).
(*8) Delays related to specific VHF station.	This note is used when the delayed ADS-C reports and CPDLC messages are observed via a specific VHF ground station. If multiple aircraft observed with same issue, ATSP may want to report to FANS-CRA/DLMA as a VHF station issue.	- Review "NAT OPS Bulletin 2019_003: Data Link Performance Improvement Options" and recommended solutions/actions (Problem/Issue #2).
(*9) FMS time before ATC uplink time. Clock setting not syncronized with GPS.	This note is used when its found that the FMS response time is earlier than the ATC uplink time. According to aircraft manufacturers this happens when clock is set manually and not being set by synchronization with GPS source.	- Review procedures for clock settings to be set to GPS clock instead of manual set of clock.

Top cause for non-compliance: VHF/SAT transition areas

- **Aircraft flying on routes with higher concentrations of VHF/SAT transition areas typically observed with lower performance**
- **Mitigations have been provided by OEMS – important to consult for solutions available for specific aircraft types**
  - Some aircraft have software updates available that have implemented changes to timer values that improve media transition performance

Data link performance improvement options

- **<u>VHF-to-SATCOM transitions</u>** Transitions from using VHF to using SATCOM, especially when they occur repeatedly in a short period of time, reduce datalink performance because the ACARS protocols are generally designed to minimize cost (by persistently attempting to use less-costly VHF), not maximize performance.
- Solutions:
  1. ***Disable VHF datalink just prior to entering oceanic airspace*** Implement flight crew procedures to disable VHF datalink (usually by placing the VHF radio used for VHF datalink into voice mode) just prior to entering oceanic airspace in order to proactively force SATCOM use. (Conversely, enable VHF datalink when exiting oceanic airspace.)
  2. ***Implement more precise VHF region definitions*** In avionics that offer the capability to prefer specified subnetworks in defined geographic regions, implement more precise VHF region definitions that exclude areas of the world with only intermittent VHF subnetwork coverage in order to force SATCOM use in those areas.
  3. ***Implement ARINC 618 RAT1 timer*** Upgrade ACARS router avionics (CMU or equivalent) software to include the new ARINC 618 RAT1 timer when it becomes available. This timer is intended to improve performance for FANS downlink messages during VHF-to-SATCOM transitions by additionally attempting to send a message via SATCOM when attempts to send it via VHF have not been successful for 60 seconds (such as when exiting land-based VHF coverage).

Data link performance improvement options (2 of 3)

- **<u>HF datalink – next-on-busy</u>** Airbus ATSU and Rockwell Collins CMU-900 avionics may implement a feature called “next-on-busy” by which those avionics send a new downlink message via HF datalink if SATCOM is busy sending a previous downlink, instead of waiting for SATCOM to finish sending the previous downlink. This is a good design idea in theory, but in practice it reduces datalink performance because the avionics can actually deliver the new downlink more quickly if they wait for SATCOM to finish sending the previous downlink.
- ***Solution:*** Work with Airbus and Rockwell Collins to disable the next-on-busy feature. (For the Rockwell Collins CMU-900 with recent software, this can be done with a database update.)

Data link performance improvement options (3 of 3)

- **<u>HF datalink – general</u>** HF datalink performance has not been demonstrated to meet the RCP240 and RSP180 specifications, although for various reasons the avionics may send FANS downlink messages via HF datalink.
- *Solutions:*
  - ***Manually prevent HF datalink use*** Prevent HF datalink use manually by implementing flight crew procedures to disable HF datalink.
  - ***Automatically prevent HF datalink use*** Prevent HF datalink use automatically with capable avionics (for example, by deselecting HF datalink as an allowed subnetwork for FANS downlink messages in the 777 DCMF AMI or 787 CMF AMI).

Questions