

PBCS Monitoring in NZZO



Operational Data Link Seminar
ICAO Asia and Pacific Office
Bangkok, Thailand
2-4 May 2016



PBCS - Post Implementation Monitoring

- States participate in planning and implementation regional groups (PIRGs), and most use a regional monitoring agency to facilitate monitoring activities within their respective region.
- Individual states/ANSPs will need to provide the data and information and analysis that will portray regional performance measures.
- All stakeholders, ANSPs, operators, CSPs, airframe manufacturers, all need to actively participate in reporting and resolving problems .



PBCS - Post Implementation Monitoring

- Monitoring of data link performance in terms of RCP and RSP is an important part of the performance based system described in the ICAO global plan.
- To successfully achieve this performance monitoring on a global scale requires the use of a common data set.
- It is only through this common data set that RCP and RSP data can be aggregated from the individual ANSP level through to a regional level and then to a global level.
- This aggregation of performance data is in accordance with the guidelines provided in ICAO Doc 9883 Manual on Global Performance of the Air Navigation System.



PBCS - Post Implementation Monitoring

- Individual ANSP will develop the data collection mechanisms, monitoring tools, and internal reporting requirements best suiting their own environment.
- All ANSP should collect and maintain a database of FANS1/A performance data using the data formats specified in PBCS Manual/GOLD Appendix D.
- These databases will provide the means to aggregate measures of ADS-C Required Surveillance Performance (RSP) and CPDLC Required Communication Performance (RCP) on a regional and global basis.



ADS-C and CPDLC Data Points - .csv files

- Comma separated value .csv files are used for data transfer
- File formats for both CPDLC RCP and ADS-C RSP are defined in Appendix D of the GOLD/PBCS manual.

```
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```



Continuous Performance Improvement

- Monitoring shows that the FANS1/A system is capable of meeting the RCP240 and RSP180 requirements.
- However, not all aircraft meet the requirements.
- For those aircraft not meeting the requirements the aim is to improve their performance by:
 - Identifying the performance problems by monitoring.
 - Reporting performance problems through a Central Reporting Agency that has buy in from all stakeholders.
 - Resolving the identified performance problems.
 - Providing feedback to stakeholders.
- Promote a culture of continuous performance improvement among all stakeholders.



Monitoring methods

- Requires automation to extract required data from the ground ATM system and create the .csv files required for analysis.
- Various methods are employed by ANSP to analyze the PBCS data . These range from:
 - Manual excel spreadsheet based analysis.
 - Analysis tools such as the FAA GPAT tool.
 - System automation.



Current NZZO Monitoring ADS-C Performance - RSP180



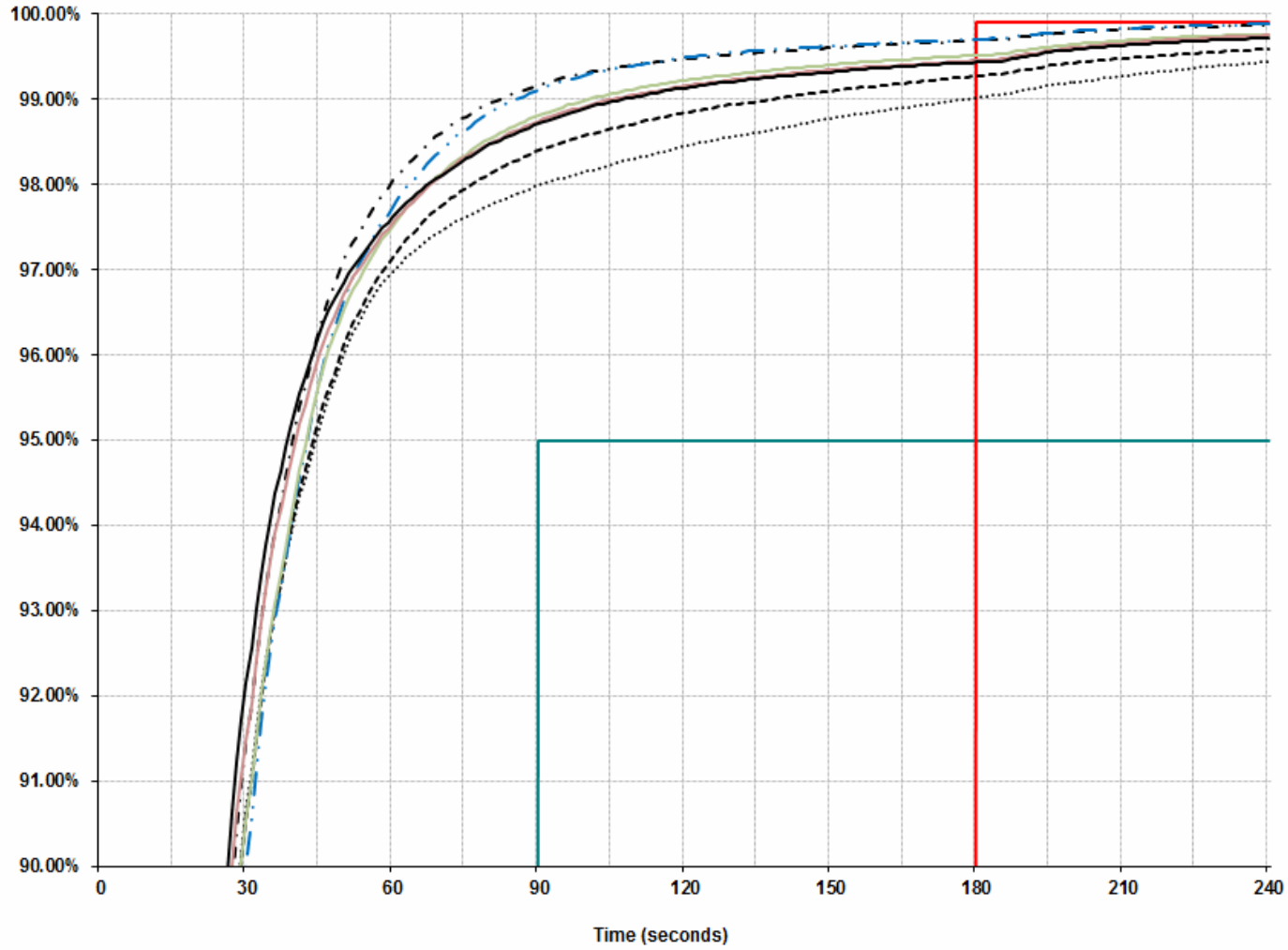
ADS-C Downlink Analysis - NZZO

| Media | | 2013 | | | 2014 | | | 2015 | | | Jan-16 | | | Feb-16 | | |
|---------|--------------|---------------|--------------|--------------|---------------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | | # | % | RSP180 | # | % | RSP180 | # | % | RSP180 | # | % | RSP180 | # | % | RSP180 |
| I3 | POR1 | 122126 | 40.03 | 99.40 | 111474 | 34.23 | 99.41 | 124733 | 29.32 | 99.46 | 11781 | 26.79 | 99.37 | 12055 | 27.42 | 99.29 |
| | XXP/H | 33662 | 11.03 | 99.64 | 48962 | 15.04 | 99.47 | 61425 | 14.44 | 99.38 | 5460 | 12.41 | 99.86 | 7056 | 16.05 | 99.60 |
| | Total | 155788 | 51.06 | 99.47 | 160902 | 49.41 | 99.42 | 186117 | 43.76 | 99.42 | 17241 | 39.20 | 99.62 | 19111 | 43.47 | 99.40 |
| I4 | APK1 | 13954 | 4.57 | 98.97 | 49161 | 15.10 | 99.29 | 73661 | 17.32 | 99.12 | 7258 | 16.50 | 98.86 | 7167 | 16.30 | 99.04 |
| | AME1 | 1254 | 0.41 | 99.76 | 4330 | 1.33 | 99.84 | 6821 | 1.60 | 99.90 | 1320 | 3.00 | 99.62 | 1203 | 2.74 | 99.50 |
| | XXA | 6617 | 2.17 | 99.46 | 14145 | 4.34 | 99.55 | 20599 | 4.84 | 99.70 | 2043 | 4.65 | 99.90 | 2136 | 4.86 | 99.58 |
| | Total | 21825 | 7.15 | 99.17 | 67636 | 20.77 | 99.38 | 101081 | 23.76 | 99.29 | 10621 | 24.15 | 99.15 | 10506 | 23.90 | 99.20 |
| SBB | | | | | | | | 466 | 0.11 | 99.57 | 151 | 0.34 | 100.00 | 156 | 0.36 | 98.73 |
| MTSAT | | 33668 | 11.03 | 99.91 | 32665 | 10.03 | 99.79 | 51253 | 12.05 | 99.78 | 6860 | 15.60 | 99.68 | 5607 | 12.76 | 99.73 |
| Iridium | | 2614 | 0.85 | 96.56 | 2889 | 0.89 | 95.47 | 3604 | 0.85 | 97.84 | 484 | 1.10 | 98.55 | 321 | 0.73 | 99.07 |
| HF DL | | 2655 | 0.87 | 95.25 | 3730 | 1.15 | 94.02 | 5715 | 1.34 | 94.61 | 467 | 1.06 | 91.22 | 485 | 1.10 | 97.73 |
| VHF | | 57096 | 18.71 | 99.91 | 59096 | 18.14 | 99.90 | 77059 | 18.13 | 99.87 | 8159 | 18.55 | 99.75 | 7773 | 17.68 | 99.67 |
| ALL RGS | | 305098 | 100.00 | 99.52 | 325640 | 100.00 | 99.45 | 425336 | 100.00 | 99.44 | 43983 | 100.00 | 99.38 | 43959 | 100.00 | 99.42 |

- No significant changes to overall performance in 2015
- Gradual transition from Inmarsat I3 to I4 continues
- Satellite performance generally good - but:
 - I4 APK1 – 99.12% at 180” is lower than expected. Further analysis later.
 - Iridium – 98.55% below 99.0% at 180” . Further analysis later
- HF DL – 94.61% at 180” is below standard. Further analysis later.
- In 2015 we recorded 425336 downlinks an 85% increase from 2009 when PBCS analysis was implemented

ADS-C RSP180
 ALL RGS 2009-2015
 NZZO Oceanic FIR
 (Duplicates, DSP Outages Excluded)

95% 90sec 99.9% 180sec 2009 #227629 - - - 2010 #247340 - . - 2011 #267818
 2012 #286972 2013 #305098 2014 #325640 2015 #425336



ADS-C performance in NZZO FIR

| Colour Key | | Period 01 Jan 15 - 31 Dec 15 | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|---|---|-------------------------------------|--------------------------|----------------------|-----------------------------|-------------------------------|
| Meets Criteria | 99.0%-99.84% | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 All Media 2015 | | | | | | |
| SATCOM I3 | All | All | All | 186084 | 98.84 | 99.42 |
| SATCOM I4 | All | All | All | 101072 | 98.41 | 99.29 |
| SATCOM SBB | All | All | All | 466 | 98.28 | 99.57 |
| SATCOM MTSAT | All | All | All | 51252 | 99.19 | 99.78 |
| SATCOM Iridium | All | All | All | 3604 | 92.62 | 97.84 |
| VHF All | All | All | All | 77142 | 99.71 | 99.87 |
| HF All | All | All | All | 5697 | 86.01 | 94.63 |
| All | All | All | All | 425317 | 98.71 | 99.44 |

PBCS Certification

How can ANSP help?



ADS-C performance in NZZO FIR

| Colour Key | | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|------------------------------|------|---------------|-------------------|---------------|----------------------|------------------------|
| Period 01 Jan 15 - 31 Dec 15 | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 ANZ B772 SATCOM 2015 | | | | | | |
| SATCOM I4 | APK1 | B772 | ANZ | 114 | 96.49 | 99.12 |
| SATCOM I4 | AME1 | B772 | ANZ | 2853 | 99.68 | 99.89 |
| SATCOM MTSAT | MTS1 | B772 | ANZ | 41363 | 99.49 | 99.81 |

ADS-C performance in NZZO FIR

| Colour Key | | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|------------------------------|------|---------------|-------------------|---------------|----------------------|------------------------|
| Period 01 Jan 15 - 31 Dec 15 | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 ANZ B77W SATCOM 2015 | | | | | | |
| SATCOM I4 | AME1 | B77W | ANZ | 3528 | 99.40 | 99.94 |
| SATCOM I4 | APK1 | B77W | ANZ | 58968 | 98.18 | 99.14 |

ADS-C performance in NZZO FIR

| Colour Key | | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|------------------------------|------|---------------|-------------------|---------------|----------------------|------------------------|
| Period 01 Jan 15 - 31 Dec 15 | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 ANZ B789 SATCOM 2015 | | | | | | |
| SATCOM I3 | POR1 | B789 | ANZ | 27 | 100.00 | 100.00 |
| SATCOM I4 | AME1 | B789 | ANZ | 188 | 99.47 | 100.00 |
| SATCOM I4 | APK1 | B789 | ANZ | 2140 | 93.97 | 97.06 |
| SATCOM MTSAT | MTS1 | B789 | ANZ | 9875 | 97.96 | 99.69 |



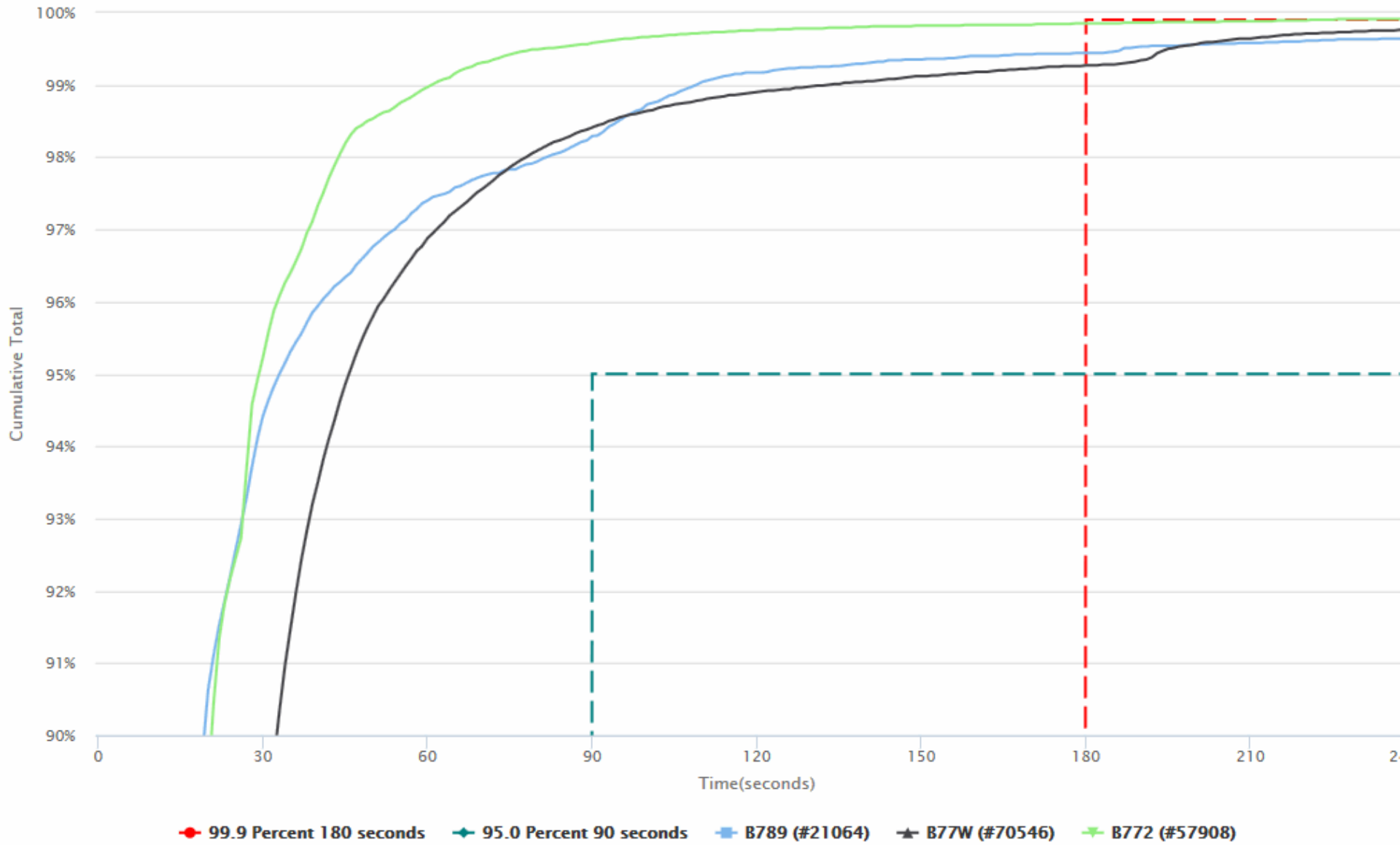
ADS-C performance in NZZO FIR

| Colour Key | | Period 01 Jan 15 - 31 Dec 15 | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|---|------|------------------------------|-------------------|---------------|----------------------|------------------------|
| <p>Meets Criteria</p> <p>99.0%-99.84%</p> <p>Under Criteria</p> | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 Air New Zealand All Media 2015 | | | | | | |
| SATCOM I4 | AME1 | B77W | ANZ | 3528 | 99.40 | 99.94 |
| SATCOM I4 | APK1 | B77W | ANZ | 58968 | 98.18 | 99.14 |
| SATCOM I4 | AME1 | B772 | ANZ | 2853 | 99.68 | 99.89 |
| SATCOM I4 | APK1 | B789 | ANZ | 2140 | 93.97 | 97.06 |
| SATCOM MTSAT | MTS1 | B772 | ANZ | 41363 | 99.49 | 99.81 |
| SATCOM MTSAT | MTS1 | B789 | ANZ | 9875 | 97.96 | 99.69 |
| VHF All | AKL1 | B77W | ANZ | 2420 | 99.79 | 99.96 |
| VHF All | AKL2 | B77W | ANZ | 2568 | 99.53 | 99.96 |
| VHF All | AKL7 | B77W | ANZ | 1635 | 99.82 | 100.00 |
| VHF All | APW1 | B77W | ANZ | 1180 | 99.83 | 99.92 |
| VHF All | AKL1 | B772 | ANZ | 2945 | 99.93 | 100.00 |
| VHF All | AKL2 | B772 | ANZ | 6298 | 99.87 | 100.00 |
| VHF All | APW1 | B772 | ANZ | 1202 | 100.00 | 100.00 |
| VHF All | NLK1 | B772 | ANZ | 2667 | 99.93 | 99.96 |
| VHF All | AKL1 | B789 | ANZ | 872 | 100.00 | 100.00 |
| VHF All | AKL2 | B789 | ANZ | 1174 | 99.74 | 99.74 |
| VHF All | AKL7 | B789 | ANZ | 2840 | 99.79 | 99.86 |
| VHF All | NLK1 | B789 | ANZ | 3797 | 99.53 | 99.63 |



NZZO Air New Zealand

RSP180 All RGS 2015

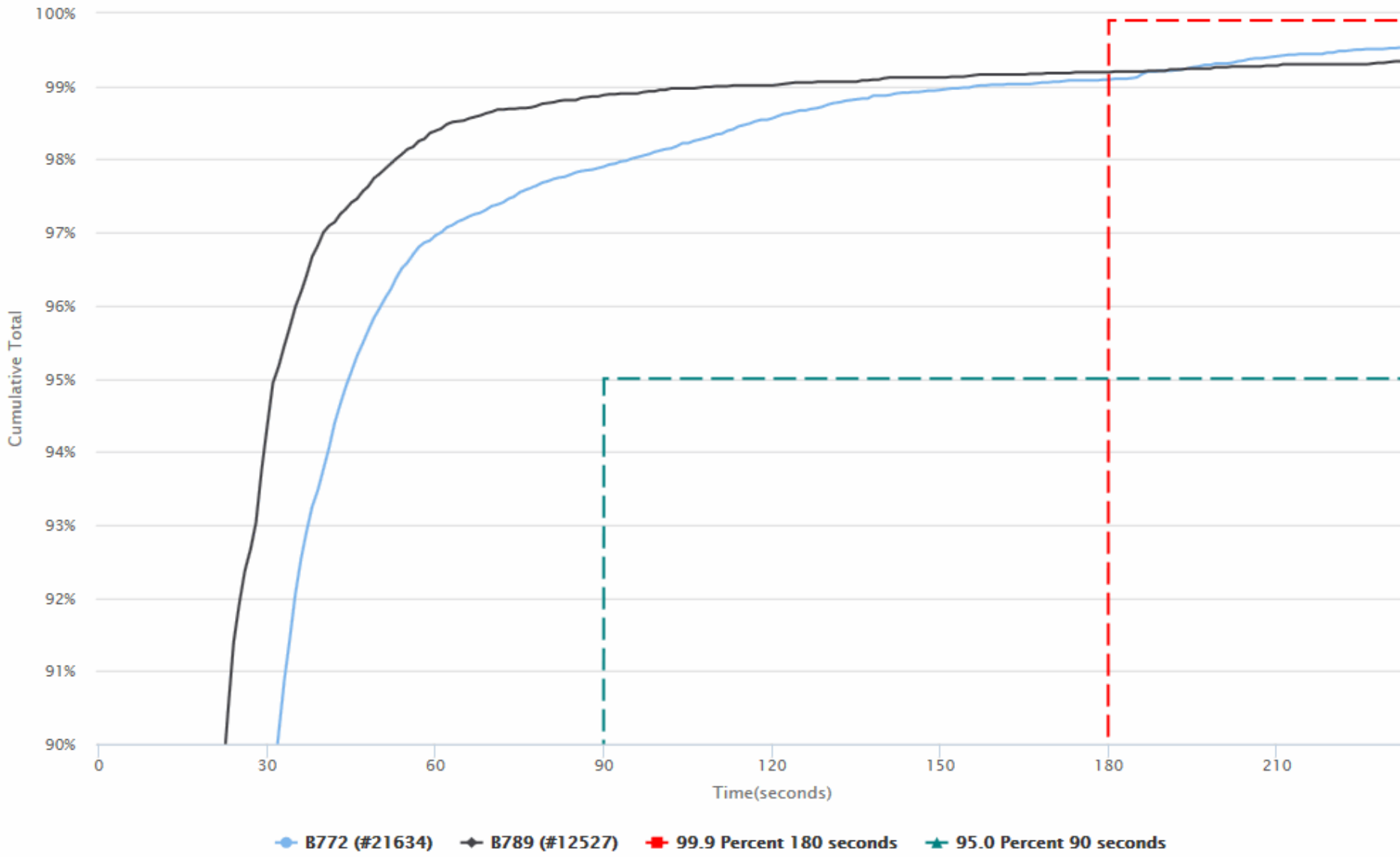


● 99.9 Percent 180 seconds ◆ 95.0 Percent 90 seconds ■ B789 (#21064) ★ B77W (#70546) ◆ B772 (#57908)



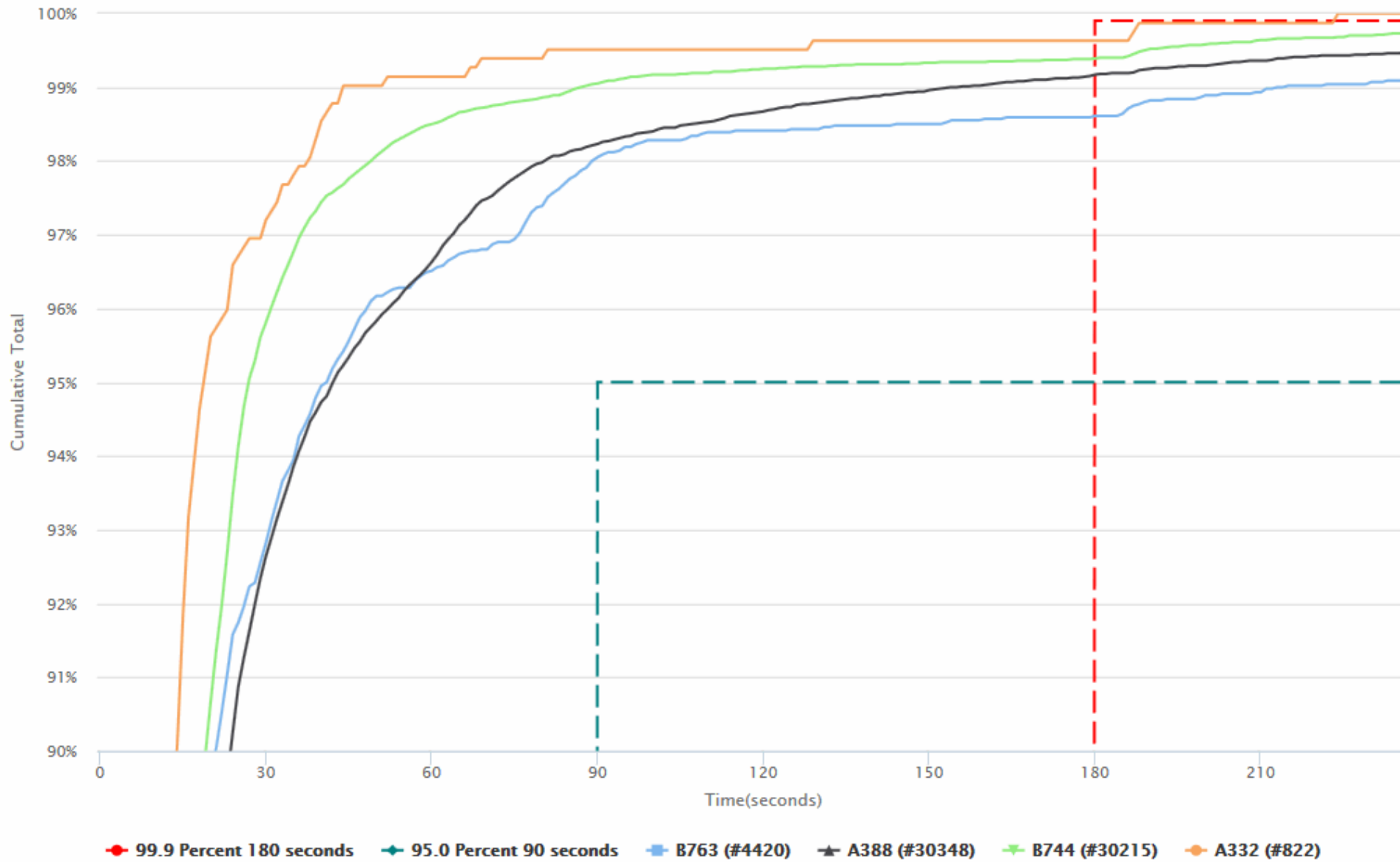
NZZO United Airlines

RSP180 All RGS 2015



NZZO QANTAS

RSP180 All RGS 2015

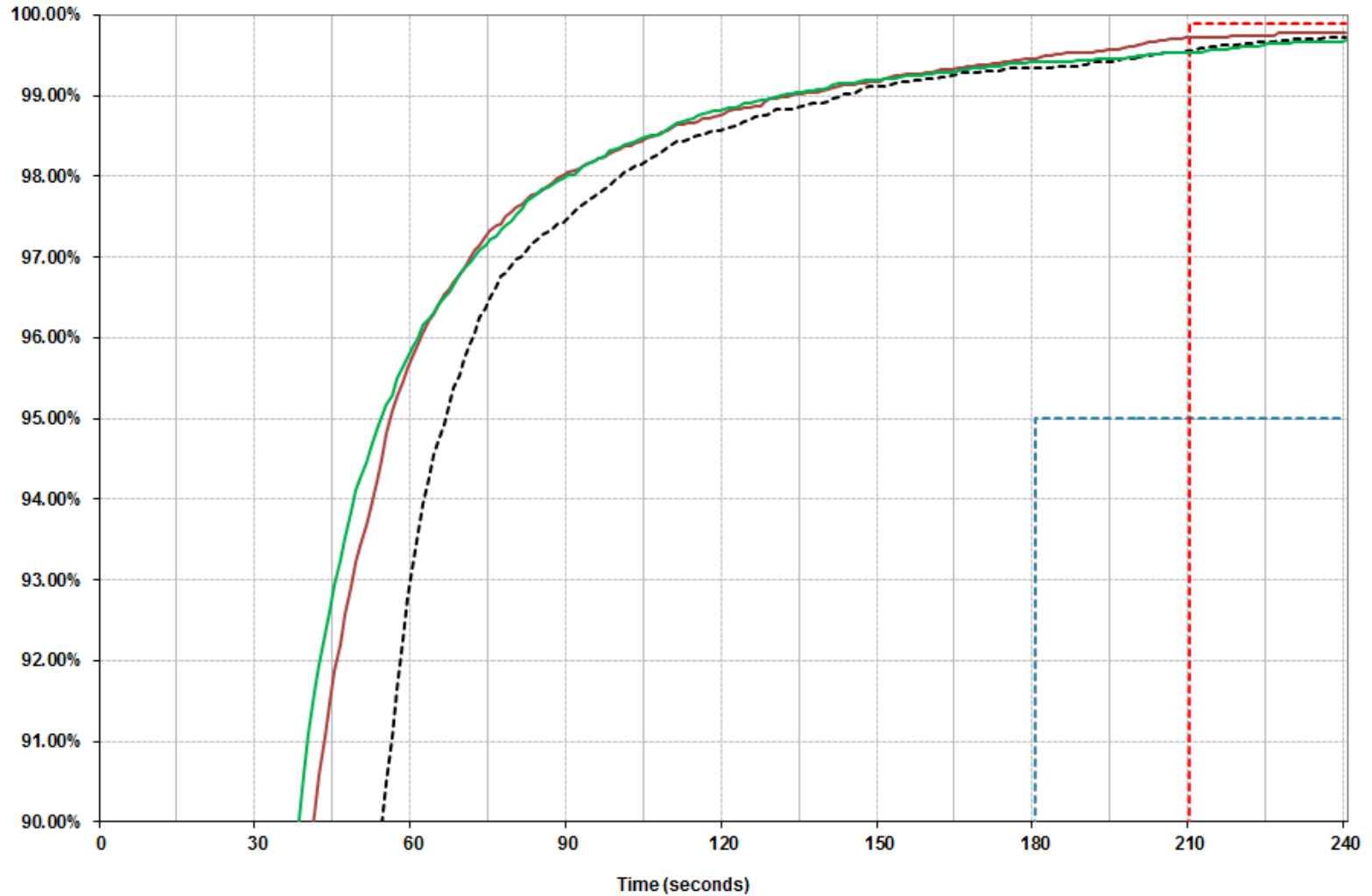


Current NZZO Monitoring CPDLC Performance – RCP240

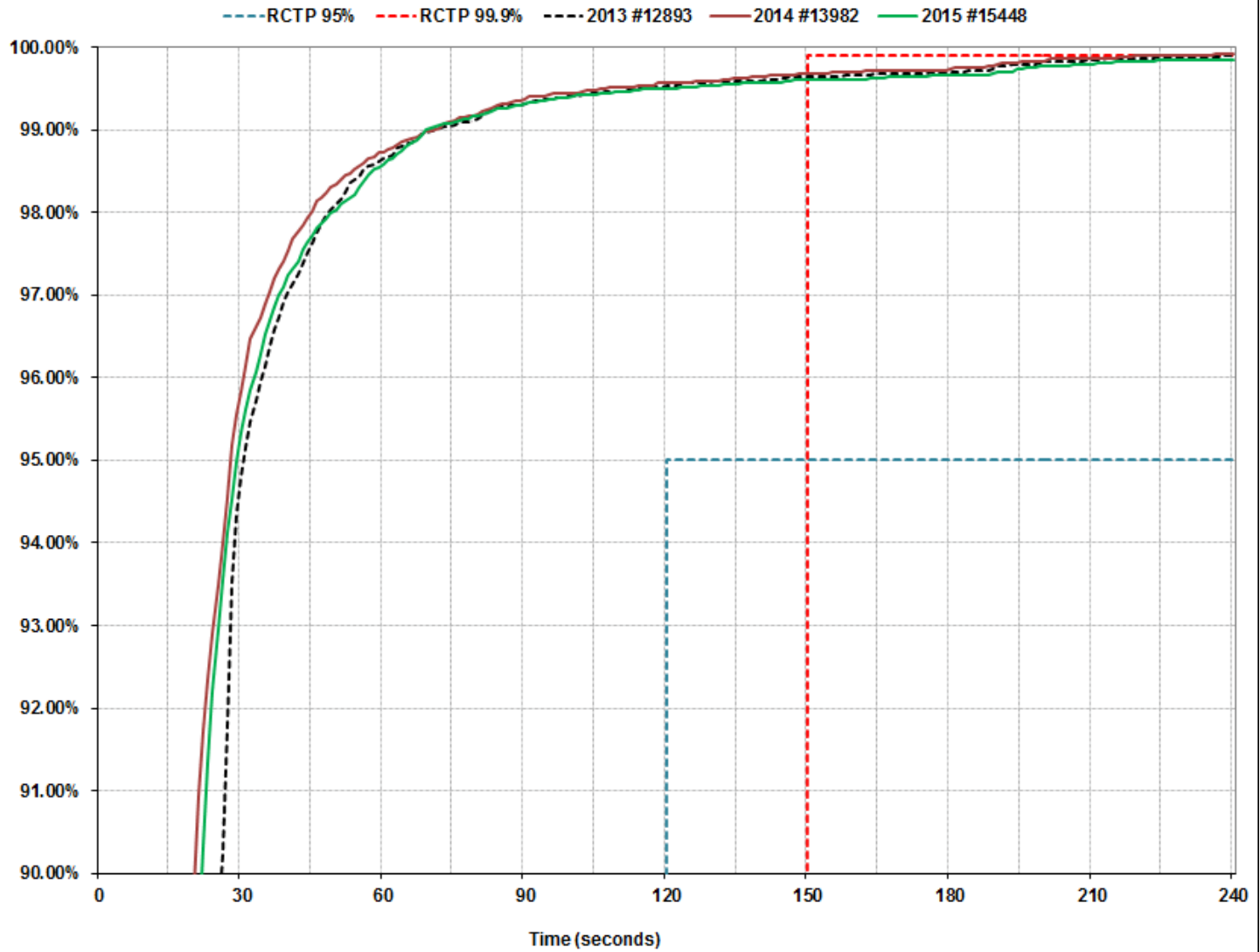


RCP240 CPDLC ACP
All Aircraft (All RGS)
NZZO FIR
(DSP Outages Excluded)

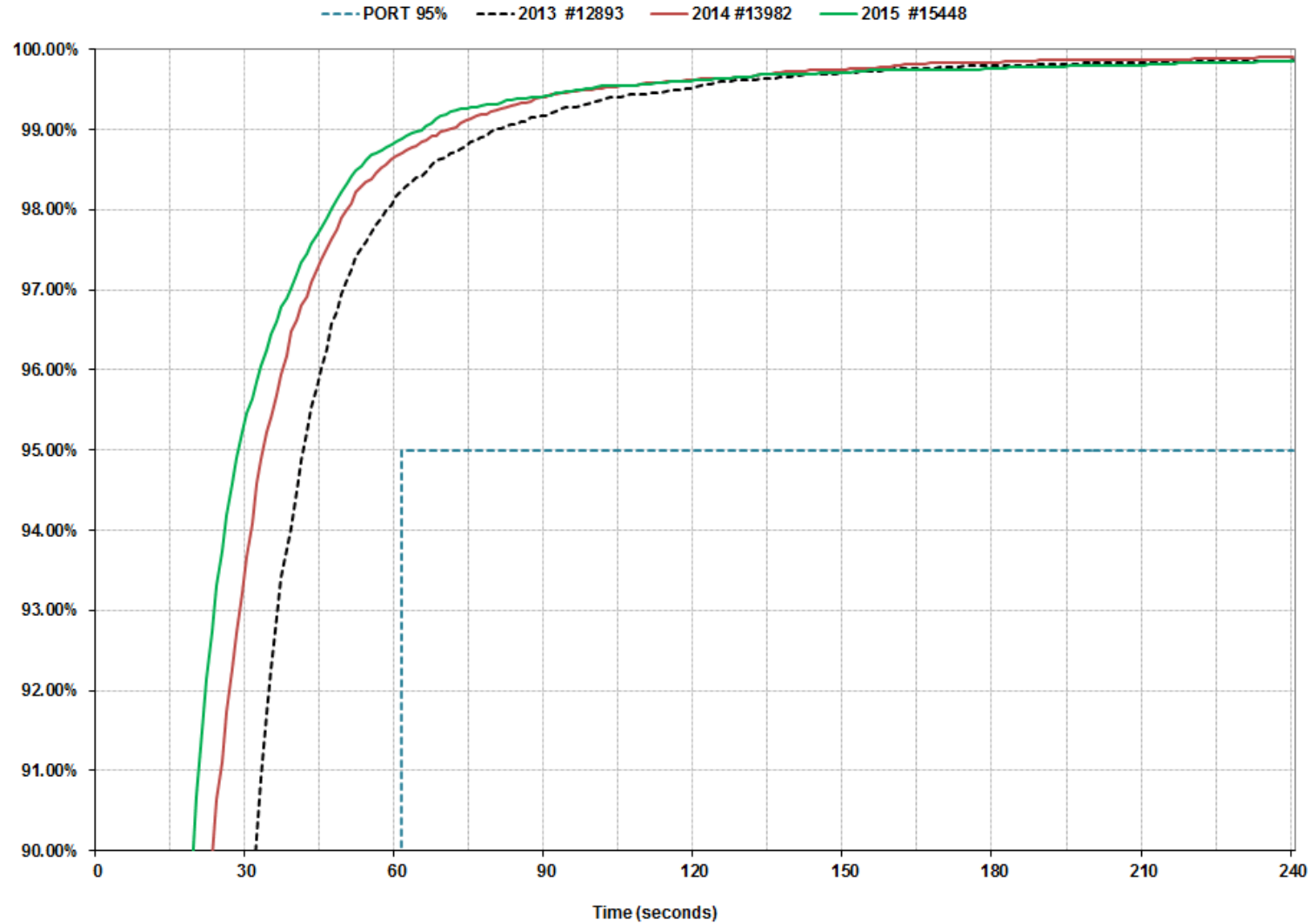
--- TRN 95% - - - TRN 99.9% - - - 2013 #12893 - 2014 #13982 - 2015 #15448



RCP240 CPDLC ACTP
All Aircraft (All RGS)
NZZO FIR
(DSP Outages Excluded)



CPDLC PORT
All Aircraft (All RGS)
NZZO FIR
(DSP Outages Excluded)



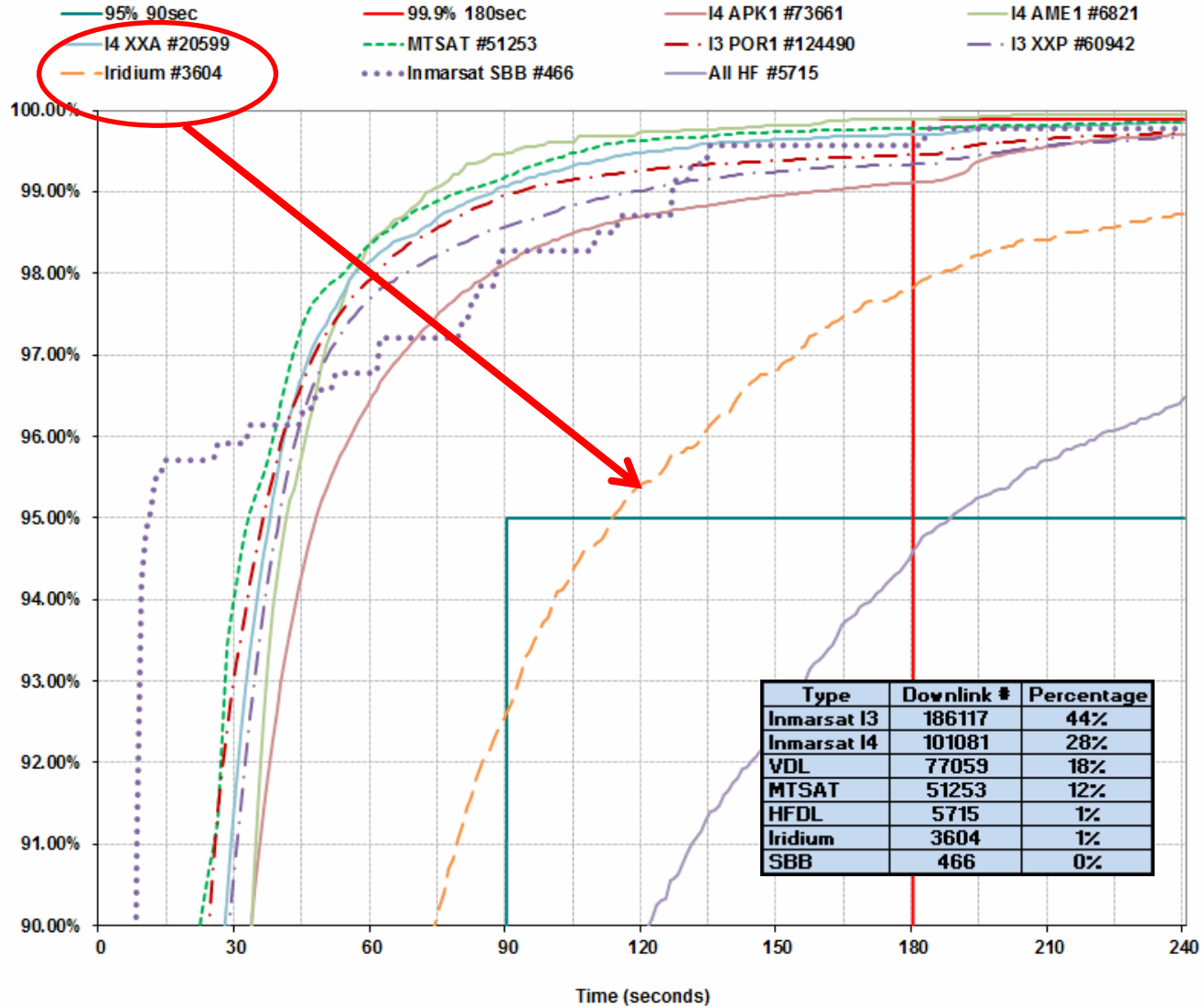
NZZO CPDLC Performance - All Aircraft – All RGS - 2015

| ACTP | | ACP | | PORT |
|----------|------------|----------|------------|---------|
| 95% 120" | 99.9% 150" | 95% 180" | 99.9% 210" | 95% 60" |
| 99.50% | 99.60% | 99.41% | 99.54% | 98.84% |

Current NZZO Monitoring Iridium Performance



ADS-C RSP180
 Performance by Satellite and HF RGS
 NZZO Oceanic FIR 2015
 (Duplicates, DSP Outages Excluded)



ADS-C performance in NZZO FIR

Colour Key

- Meets Criteria
- 99.0%-99.84%
- Under Criteria

Period 01 Jan 15 - 31 Dec 15

95% RSP180
Benchmark

99.9% RSP180
Benchmark

| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
|------------------------------|------|---------------|-------------------|---------------|---------------|----------------|
| RSP180 Iridium Satcom | | | | | | |
| SATCOM Iridium | IG1 | All | All | 2445 | 93.42 | 98.28 |
| SATCOM Iridium | IGW1 | All | All | 1159 | 90.94 | 96.89 |



ADS-C performance in NZZO FIR

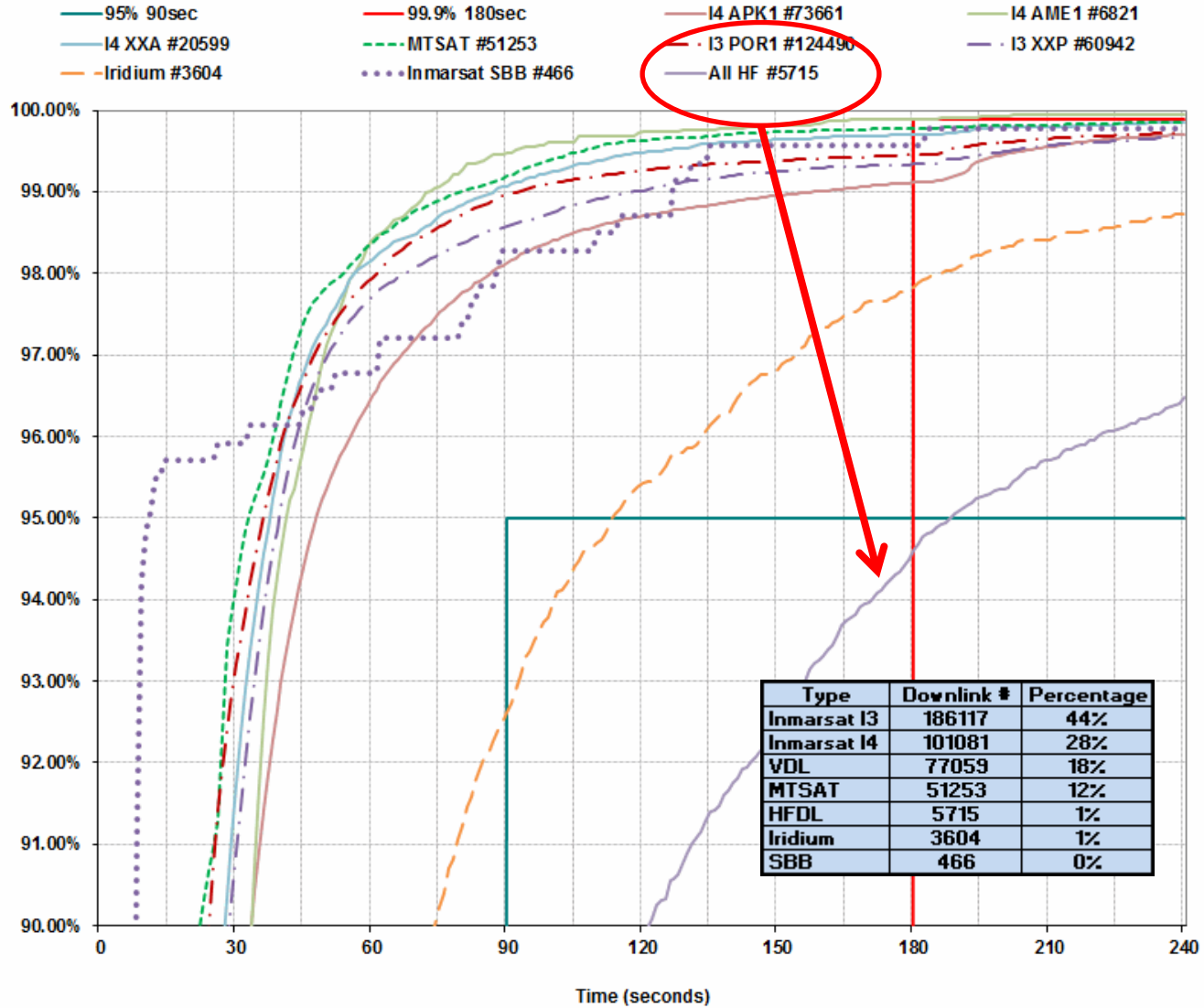
| <u>Colour Key</u> ■ Meets Criteria ■ 99.0%-99.84% ■ Under Criteria | Period 01 Jan 15 - 31 Dec 15 | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|---|------------------------------|------------------|----------------------|------------------|-------------------------|--|
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 Iridium Satcom | | | | | | |
| SATCOM Iridium | IGW1 | A320 | ACI | 987 | 90.37 | 96.35 ★ |
| SATCOM Iridium | IG1 | B744 | CKS | 16 | 93.75 | 93.75 |
| SATCOM Iridium | IG1 | B744 | GTI | 1015 | 98.03 | 99.61 |
| SATCOM Iridium | IG1 | B763 | HAL | 1384 | 90.03 | 97.40 |
| SATCOM Iridium | IG1 | B721 | PVT | 30 | 93.33 | 96.67 |
| SATCOM Iridium | IGW1 | B752 | PVT | 158 | 94.30 | 100.00 |
| SATCOM Iridium | IGW1 | CL60 | PVT | 14 | 92.86 | 100.00 |
| RSP180 All Media | | | | | | |
| All | All | A320 | ACI | 1836 | 94.44 | 97.88 ★ |



Current NZZO Monitoring HFDL Performance






ADS-C RSP180
 Performance by Satellite and HF RGS
 NZZO Oceanic FIR 2015
 (Duplicates, DSP Outages Excluded)



| ADS-C performance in NZZO FIR | | | | | | |
|-------------------------------|-----|---------------|-------------------|---------------|----------------------|------------------------|
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
| | | | | | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 HFDL Operations | | | | | | |
| HF All | All | All | All | 5697 | 86.01 | 94.63 |

| ADS-C performance in NZZO FIR | | | | | | |
|-------------------------------|-----|---------------|-------------------|---------------|----------------------|------------------------|
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
| | | | | | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 HFDL Operations | | | | | | |
| HF All | All | A332 | All | 1260 | 81.59 | 93.02 |
| HF All | All | A388 | All | 4403 | 87.64 | 95.41 |
| HF All | All | B763 | All | 5 | | |
| HF All | All | B788 | All | 3 | 66.67 | 100.00 |
| HF All | All | B789 | All | 22 | 36.36 | 50.00 |
| HF All | All | MD11 | All | 4 | 75.00 | 100.00 |

ADS-C performance in NZZO FIR

| Colour Key | | Period 01 Jan 15 - 31 Dec 15 | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|--|------------|-------------------------------------|--------------------------|----------------------|-----------------------------|-------------------------------|
|  Meets Criteria | | | | | | |
|  99.0%-99.84% | | | | | | |
|  Under Criteria | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 HFDL Operations 2015 | | | | | | |
| HF All | All | A332 | CES | 118 | 88.14 | 97.46 |
| HF All | All | A332 | FJI | 964 | 81.64 | 92.74 |
| HF All | All | A388 | QFA | 2879 | 88.29 | 95.38 |
| HF All | All | A388 | UAE | 1377 | 86.56 | 95.28 |

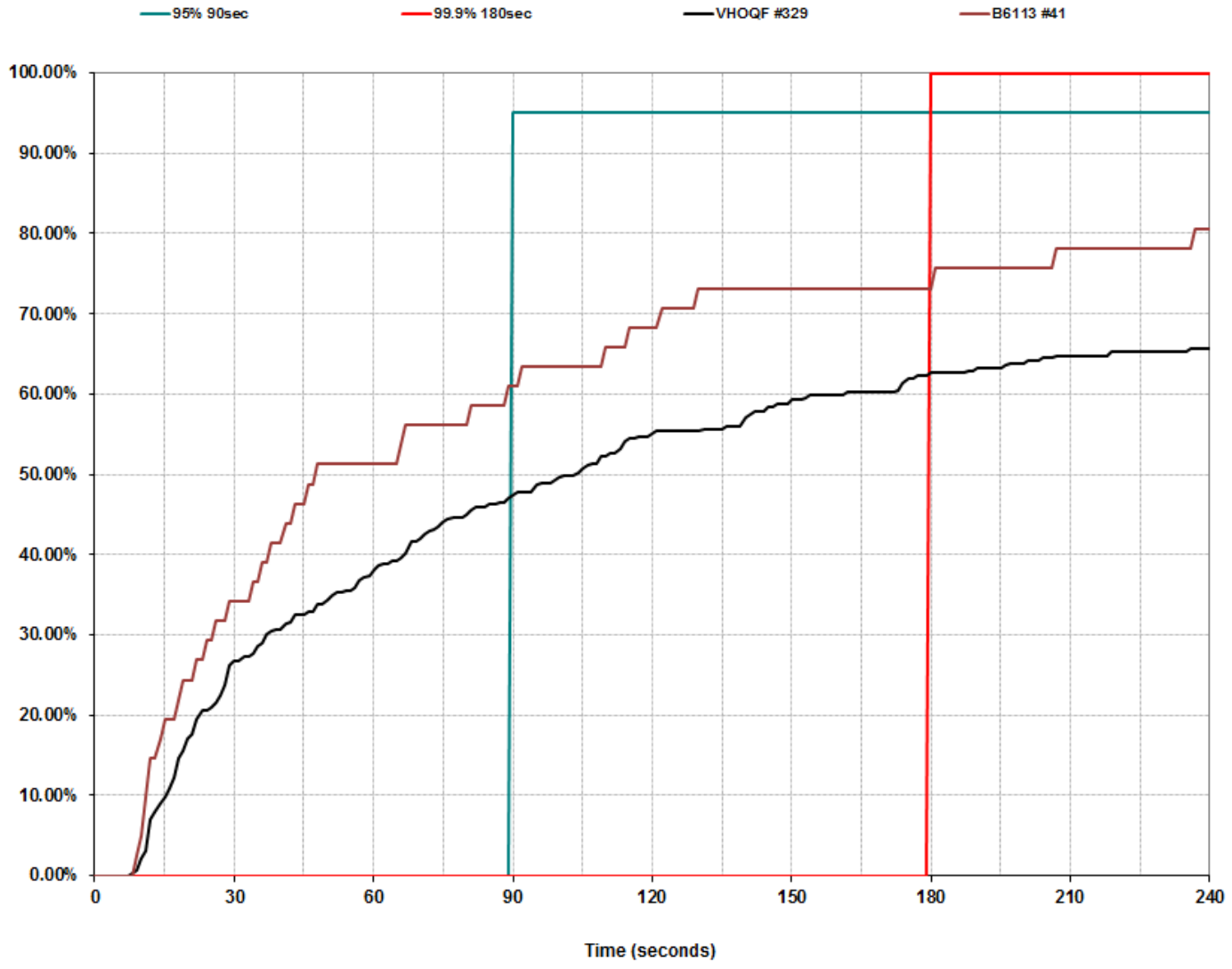
ADS-C performance in NZZO FIR

| Colour Key | | Period 01 Jan 15 - 31 Dec 15 | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark | |
|--|-----|------------------------------|-----|---------------|-------------------|----------------------|------------------------|----------------|
| Meets Criteria 99.0%-99.84% Under Criteria | | Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 Qantas A388 | | | | | | | | |
| SATCOM All | All | A388 | QFA | 24152 | 99.21 | 99.53 | | |
| VHF All | All | A388 | QFA | 3317 | 99.76 | 99.88 | | |
| HF All | All | A388 | QFA | 2879 | 88.29 | 95.38 | | |

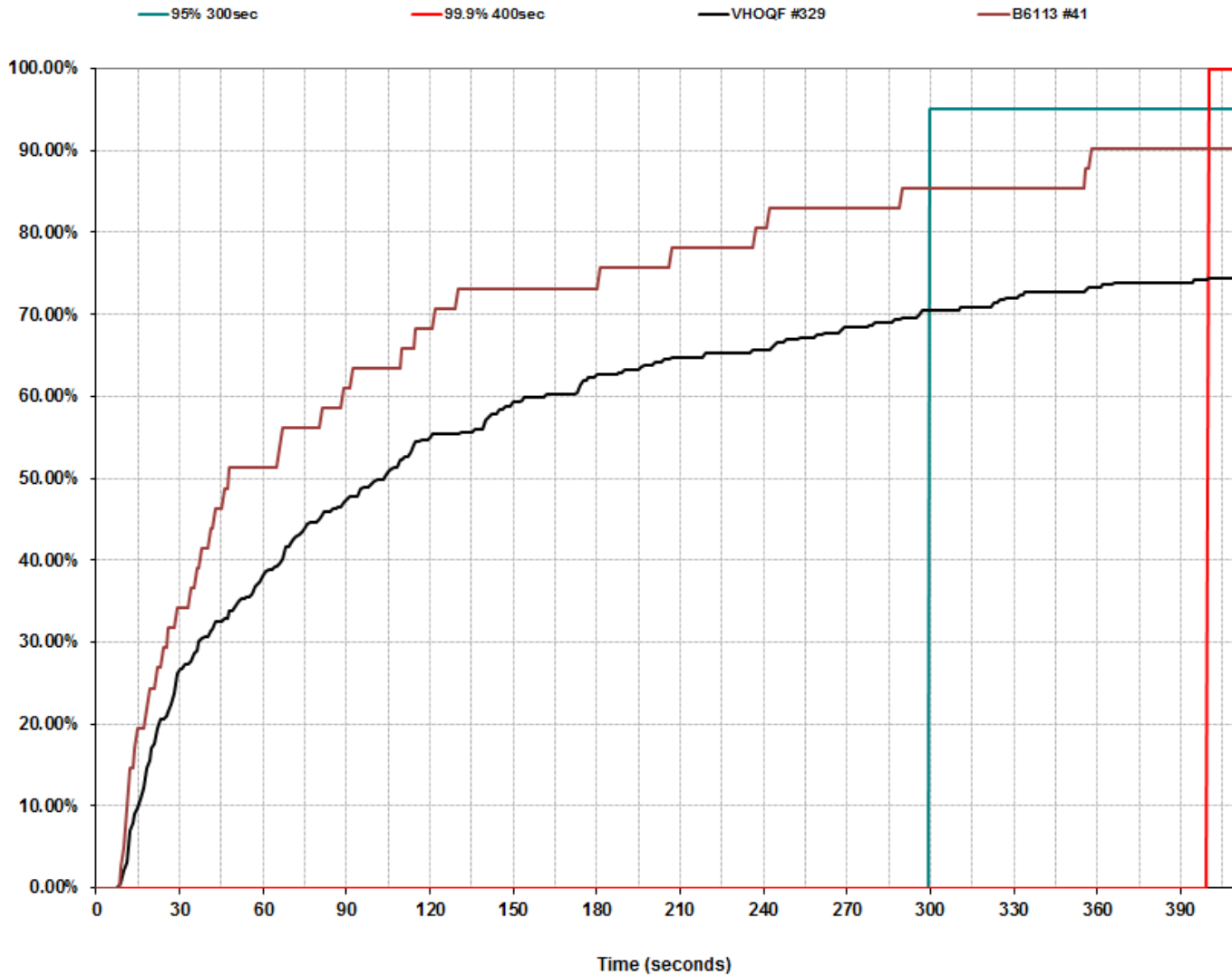
ADS-C performance in NZZO FIR

| Colour Key | | Period 01 Jan 15 - 31 Dec 15 | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark | |
|--|-----|------------------------------|-----|---------------|-------------------|----------------------|------------------------|----------------|
| Meets Criteria 99.0%-99.84% Under Criteria | | Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 UAE A388 | | | | | | | | |
| SATCOM All | All | A388 | UAE | 10791 | 99.36 | 99.68 | | |
| VHF All | All | A388 | UAE | 4585 | 99.98 | 99.98 | | |
| HF All | All | A388 | UAE | 1377 | 86.56 | 95.28 | | |


A388 VHOQF No SATCOM 24 Nov 15 - 14 Dec 15
 A332 B6113 No SATCOM 18 Dec 15
 Actual ADS-C HF DL Performance against RSP180 standard
 KZAK, NZZO, YBBB, YMMM FIR




A388 VHOQF No SATCOM 24 Nov 15 - 14 Dec 15
A332 B6113 No SATCOM 18 Dec 15
Actual ADS-C HF DL Performance against RSP400 standard
KZAK, NZZO, YBBB, YMMM FIR



Individual HFDL performance for each QFA A388 - NZZO 2015

| Tail # | # Message | 95% 90sec | 99.9% 180sec |
|--------|-----------|-----------|--|
| OQC | 288 | 95.13 | 98.26 |
| OQH | 286 | 89.51 | 98.25 |
| OQD | 191 | 91.62 | 97.9 |
| OQB | 282 | 90.42 | 97.51 |
| OQL | 202 | 89.6 | 97.02 |
| OQE | 214 | 91.58 | 96.26 |
| OQI | 310 | 87.74 | 95.48 |
| OQG | 278 | 91.36 | 95.32 |
| OQA | 233 | 73.58 | 94.84 |
| OQJ | 186 | 87.09 | 94.62 |
| OQK | 144 | 82.63 | 93.05 |
| OQF | 265 | 73.58 | 85.28  |

Individual HFDL performance for OQF operating no SATCOM

| Tail # | # Message | 95% 90sec | 99.9% 180sec |
|--------|-----------|-----------|---|
| OQF | 107 | 48.59 | 69.15  |

- With implementation of PBCS and ICAO FPL “P “ codes:
 - Operating with no SATCOM on HF DL will mean that aircraft is not meeting RSP180 or RSP400.
 - ATSP automation systems will place increasing reliance on the accuracy of FPL information.
 - PBCS AOC and crew training will need to capture that if operating with HF DL and no SATCOM then aircraft will not meet RCP or RSP standards.



Current NZZO Monitoring FPL Consistency?



During the period 24 November 2015 – 14 December 2015 Qantas A388 VH-OQF operated with no SATCOM using HFDL and VDL only. This was correctly indicated in the FPL - files HF and VDL.

(FPL-QFA94-IS
-A388/H-SADE2E3FGHIJ2J4RWYZ/LB1

On 18 December 2015 Air China A332 B6113 operated no SATCOM and operated HFDL and VDL only. This was not correctly indicated in the FPL – files HF, VDL , and SATCOM.

(FPL-CCA783-IS
-A332/H-SDE3FGHIJ3J4J5RWYZ/LB1D1

A review of FPL indicates some inconsistency in filing the J codes. For example:

(FPL-CCA784-IS (This flight operates SAT/VHF/HFDL – files OK)
-A332/H-SDE3FGHIJ2J3J4J5RWYZ/LB1D1

(FPL-CES779-IS (This flight operates SAT/VHF/HFDL – files only SATCOM)
-A332/H-SDE2E3FGHIJ5M1RWY/LB1

(FPL-FJI811-IS (This flight operates SAT/VHF/HFDL – files only HF and SATCOM)
-A332/H-SDE3FGHIJ2J5LRWXY/LB1D1

(FPL-KAL129-IS (This flight operates SAT/VHF/HFDL – files only VDL and SATCOM)
-B748/H-SDE2E3FGHIJ3J5M1RWXY/LB1D1

B787 Performance in NZZO

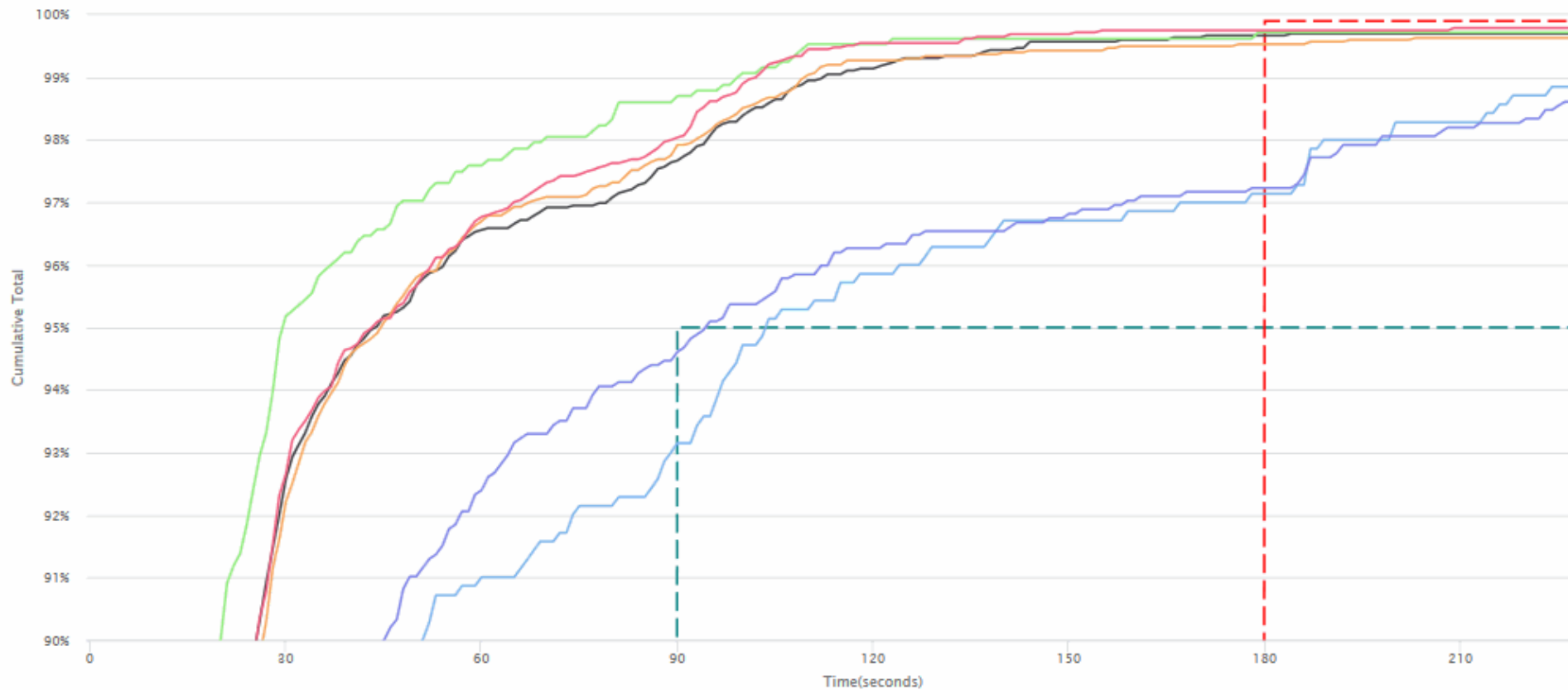
**A case study on identifying, reporting on,
and resolving data link issues through
post-implementation monitoring**



- Reviewing Inmarsat I4 performance in late 2015 shows a significant deterioration in overall performance for Air New Zealand B789 :
 - Investigation shows performance deterioration is caused by two tails ZQ-NZF and ZQ-NZD.
 - These were the last two aircraft delivered to ANZ and commenced operations in late 2015.
 - Analysis shows both aircraft operating on the Inmarsat I4 while the rest of the fleet were operating on MTSAT as programmed in the aircraft software.
 - ANZ advised that all the fleet had identical software loads.
 - After checking with SITA , ANZ advised us that the aircraft had not been setup for operations on MTSAT although they had received positive confirmation of this when the aircraft entered service.
 - This oversight has now been corrected and we expect performance on these two tails to return to normal.
 - Performance impact is shown on following slide.
 - We now have a new example of why monitoring is needed.

NZZO Air New Zealand B789

RSP180 SATCOM 2015



◆ 95.0 Percent 90 seconds
 ◆ 99.9 Percent 180 seconds
 ◆ ZKNZH (#701)
 ◆ ZKNZG (#3057)
 ◆ ZKNZC (#1079)
 ◆ ZKNZF (#3031)
 ◆ ZKNZD (#1449)
 ◆ ZKNZE (#2913)

| ADS-C performance in NZZO FIR | | | | | | |
|-------------------------------|------|---------------|-------------------|---------------|----------------------|------------------------|
| Colour Key | | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
| Period 01 Jan 15 - 31 Dec 15 | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 ANZ B789 SATCOM 2015 | | | | | | |
| SATCOM I3 | POR1 | B789 | ANZ | 27 | 100.00 | 100.00 |
| SATCOM I4 | AME1 | B789 | ANZ | 188 | 99.47 | 100.00 |
| SATCOM I4 | APK1 | B789 | ANZ | 2140 | 93.97 | 97.06 |
| SATCOM MTSAT | MTS1 | B789 | ANZ | 9875 | 97.96 | 99.69 |

ADS-C performance in NZZO FIR

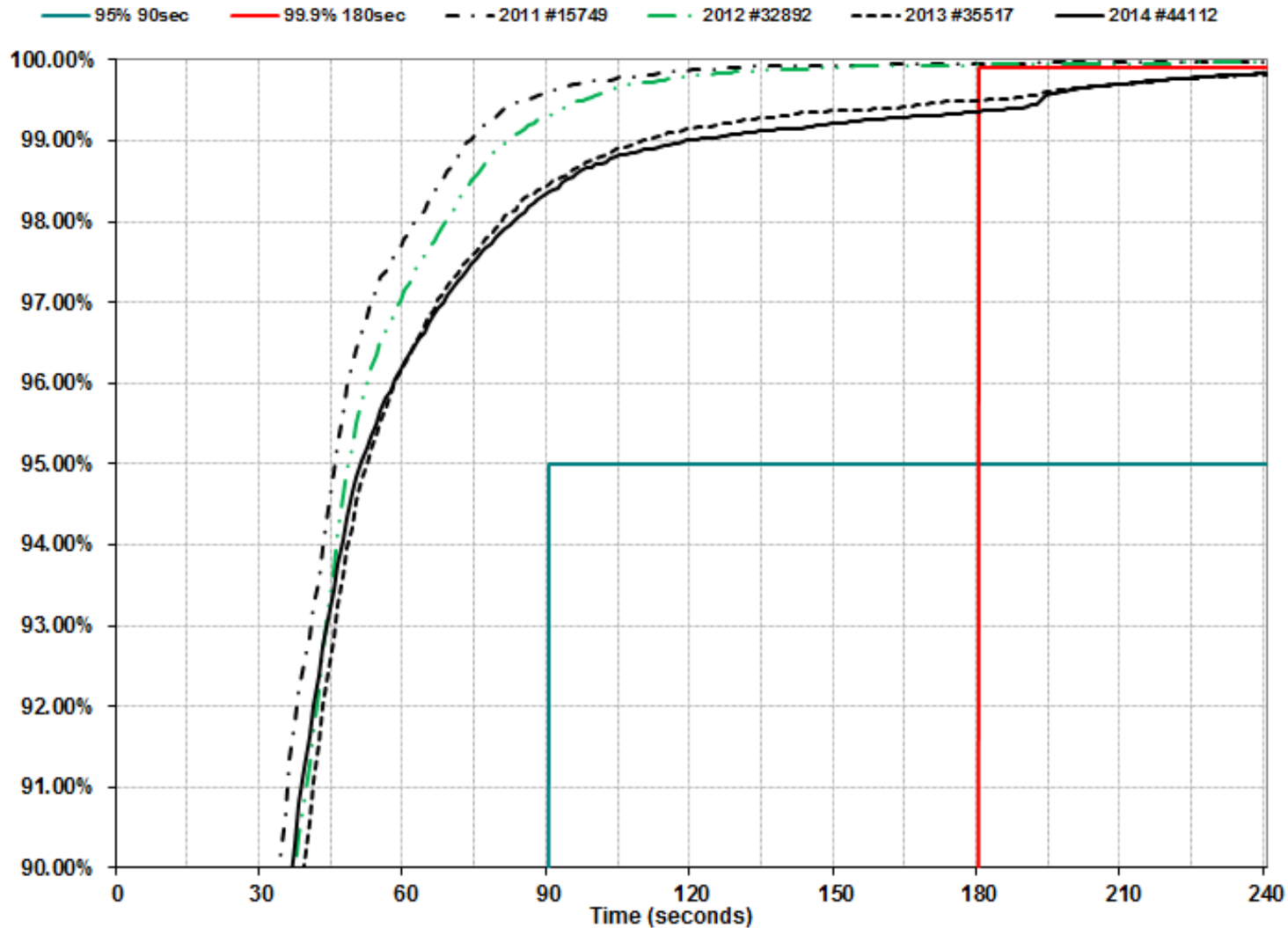
| <u>Colour Key</u> | | | | | 95% RSP180 Benchmark | 99.9% RSP180 Benchmark |
|---|------|------------------------------|-------------------|---------------|----------------------|------------------------|
| ■ Meets Criteria | | Period 01 Jan 15 - 31 Dec 15 | | | | |
| ■ 99.0%-99.84% | | | | | | |
| ■ Under Criteria | | | | | | |
| Media Type | RGS | Aircraft Type | Operating Company | Message Count | RSP <= 90 sec | RSP <= 180 sec |
| RSP180 B788 B789 SATCOM 2015 | | | | | | |
| SATCOM I3 | XXP | B788 | UAL | 139 | 99.28 | 99.28 |
| SATCOM I3 | XXP | B789 | UAL | 12460 | 98.99 | 99.28 |
| SATCOM I3 | POR1 | B788 | LAN | 9801 | 98.83 | 99.35 |
| SATCOM I3 | POR1 | B789 | LAN | 6572 | 99.07 | 99.57 |
| SATCOM I3 | POR1 | B788 | CSN | 2055 | 99.12 | 99.76 |
| SATCOM I3 | POR1 | B789 | ANZ | 27 | 100.00 | 100.00 |
| SATCOM I3 | POR1 | B788 | JST | 41 | 95.12 | 100.00 |
| SATCOM I4 | APK1 | B789 | ANZ | 2140 | 93.97 | 97.06 |
| SATCOM I4 | AME1 | B789 | ANZ | 188 | 99.47 | 100.00 |
| SATCOM I4 | APK1 | B788 | JST | 26 | 96.15 | 100.00 |
| SATCOM MTSAT | MTS1 | B789 | ANZ | 9875 | 97.96 | 99.69 |

B77W on Inmarsat I4 Performance

A case study on identifying, reporting on, and resolving data link issues through post-implementation monitoring



**ADS-C RSP180
SATCOM Downlink Latency
Actual Performance for Air New Zealand B77W
NZZO Oceanic FIR
(Duplicates, DSP Outages Excluded)**



Notes:

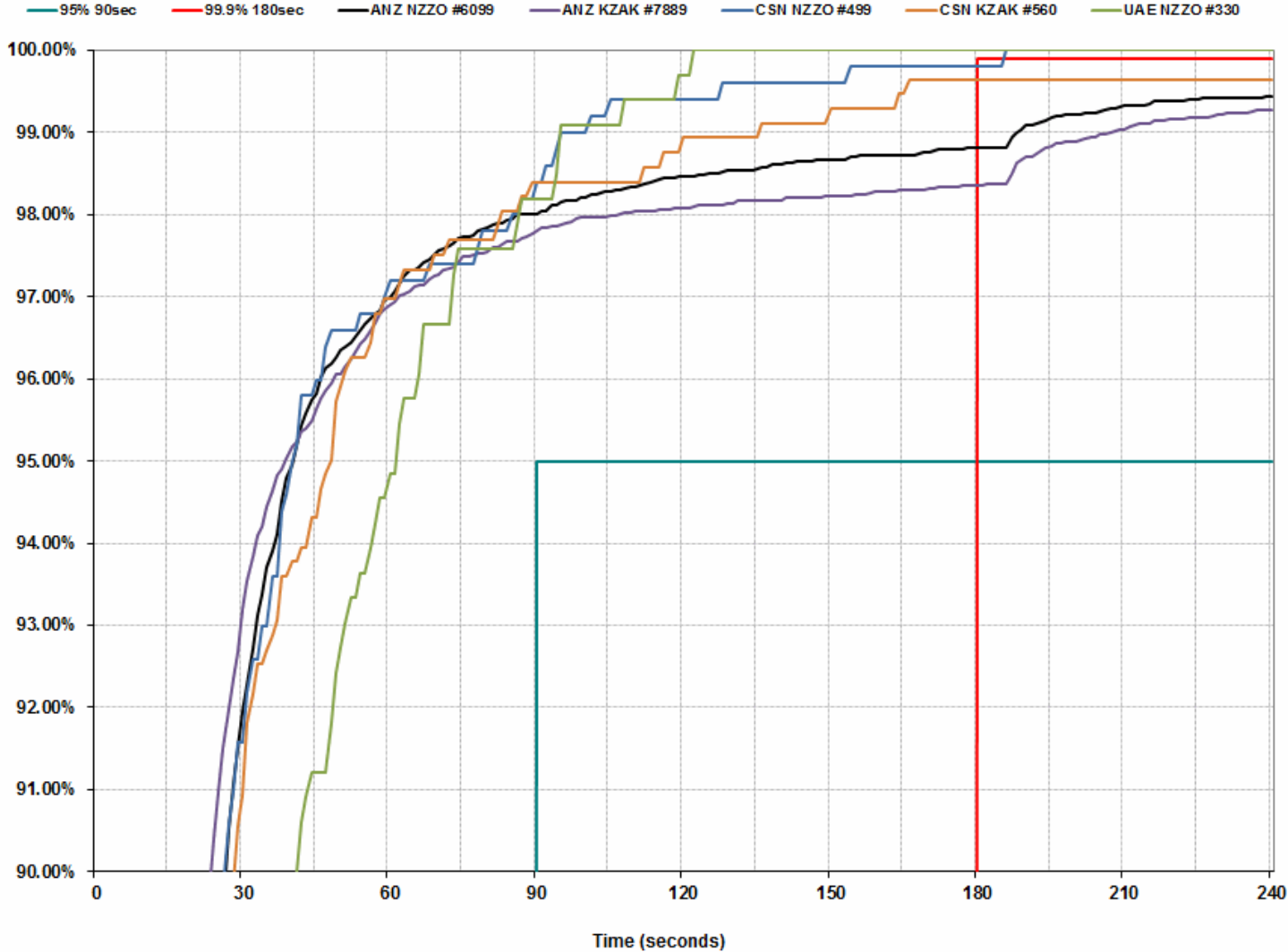
In 2011 and 2912 ANZ B77W fleet was meeting the RSP180 requirements. On Inmarsat I3

In 2013 the fleet started a gradual transition to the Inmarsat I4 which was completed by the end of 2014.

During the transition to the I4 the performance deterioration was noted and a problem report was raised.

Investigation is ongoing and the following slides depict some of the analysis completed by Airways.

RSP180 ADS-C
 SATCOM Downlink Latency
 Actual Performance for B77W on I4
 NZZO and KZAK Oceanic FIR's
 (Duplicates, DSP Outages Excluded)



Notes:

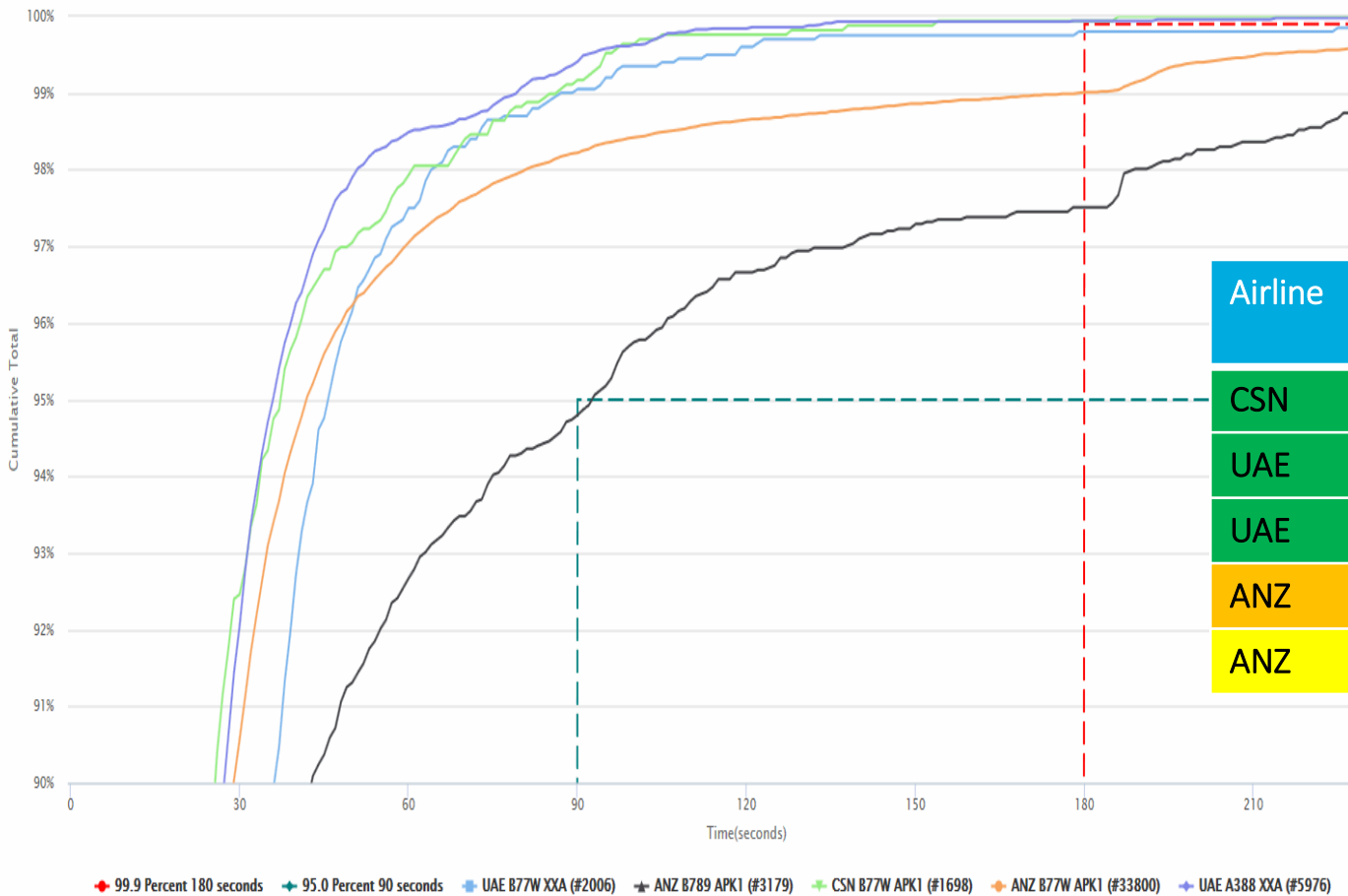
In January KZAK and NZZO both show ANZ B77W performance below 99% 180".

UAE B77W performance in NZZO operating on Tasman Sea routes meets the spec 99.9% 180"

CSN B77W operating on Northern Tasman Sea routes in NZZO nearly meets spec and is well above 99% 180"

CSN B77W operating in KZAK slightly down on performance seen in NZZO.

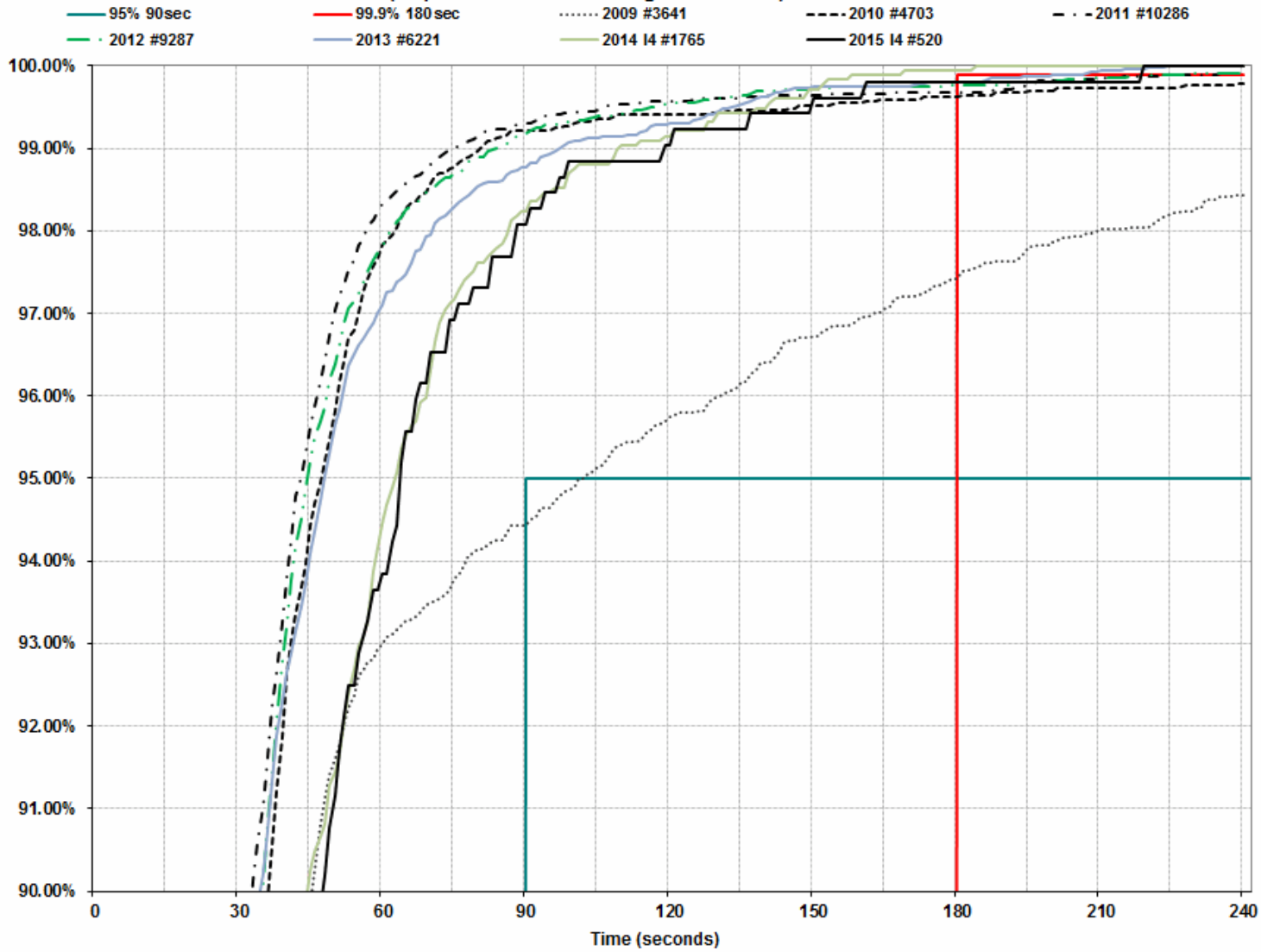




| Airline | Type | RGS | RSP 180 |
|---------|------|------|---------|
| CSN | B77W | APK1 | 99.9 |
| UAE | B77W | XXA | 99.8 |
| UAE | A388 | XXA | 99.9 |
| ANZ | B77W | APK1 | 99.0 |
| ANZ | B789 | APK1 | 97.5 |

- This graph illustrates the difference between three fleets (CSN B77W on SITA APK1, UAE A388 and B77W on Rockwell Collins/ARINC XXA) which meet the RSP180 requirement and the two ANZ fleets operating SITA APK1.
- The CSN and UAE fleets operate on Tasman Sea routes while the ANZ fleets operate mainly on Pacific routes

RSP180 ADS-C
 SATCOM Downlink Latency
 Actual Performance for UAE B77W
 NZZO Oceanic FIR
 (Duplicates and CSP Outages Excluded)



Notes:

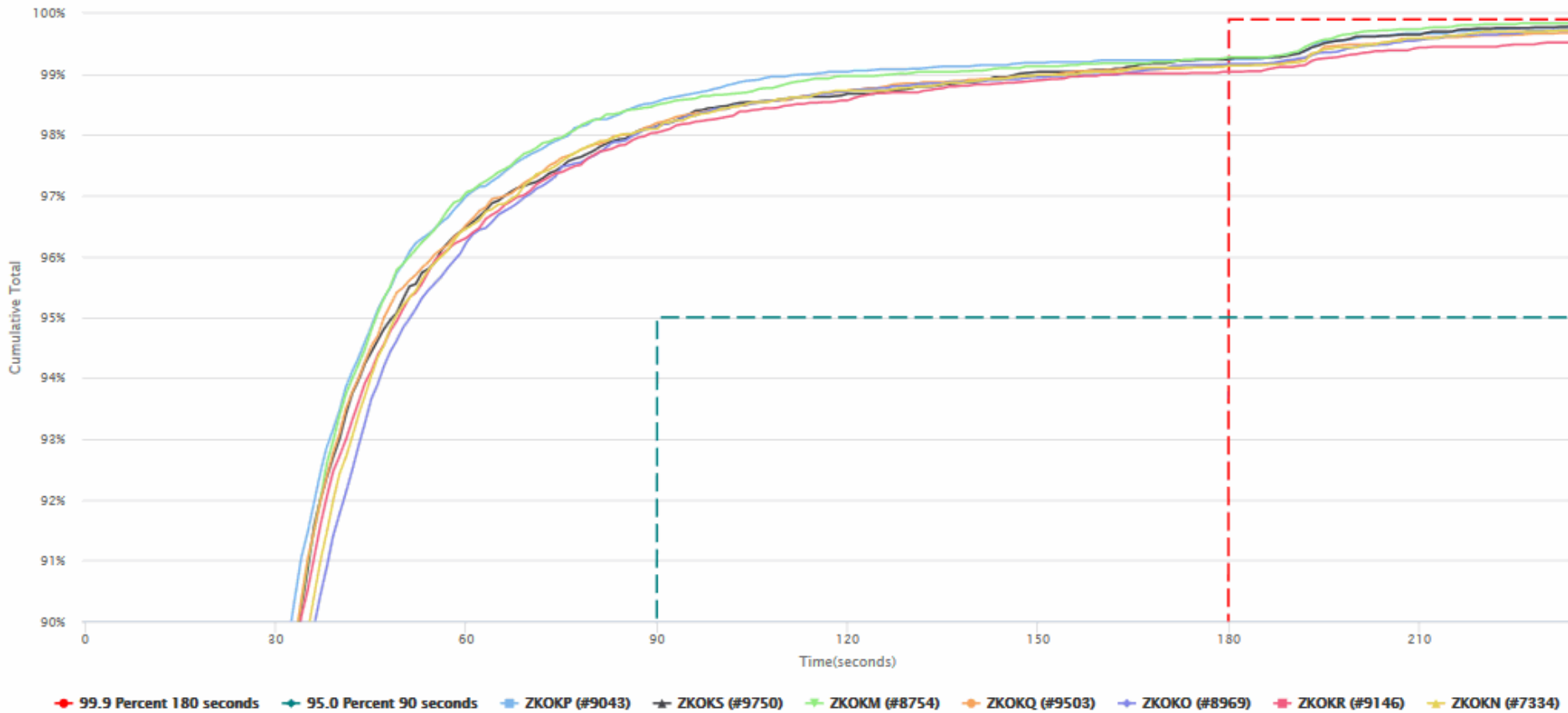
In 2009 the UAE B77W fleet performance was severely impacted by VHF transition issues that were also seen on other fleets and subsequently resolved

Performance of this since 2010 meets the standard.

The UAE fleet is also using the Inmarsat I4.

NZZO Air New Zealand B77W

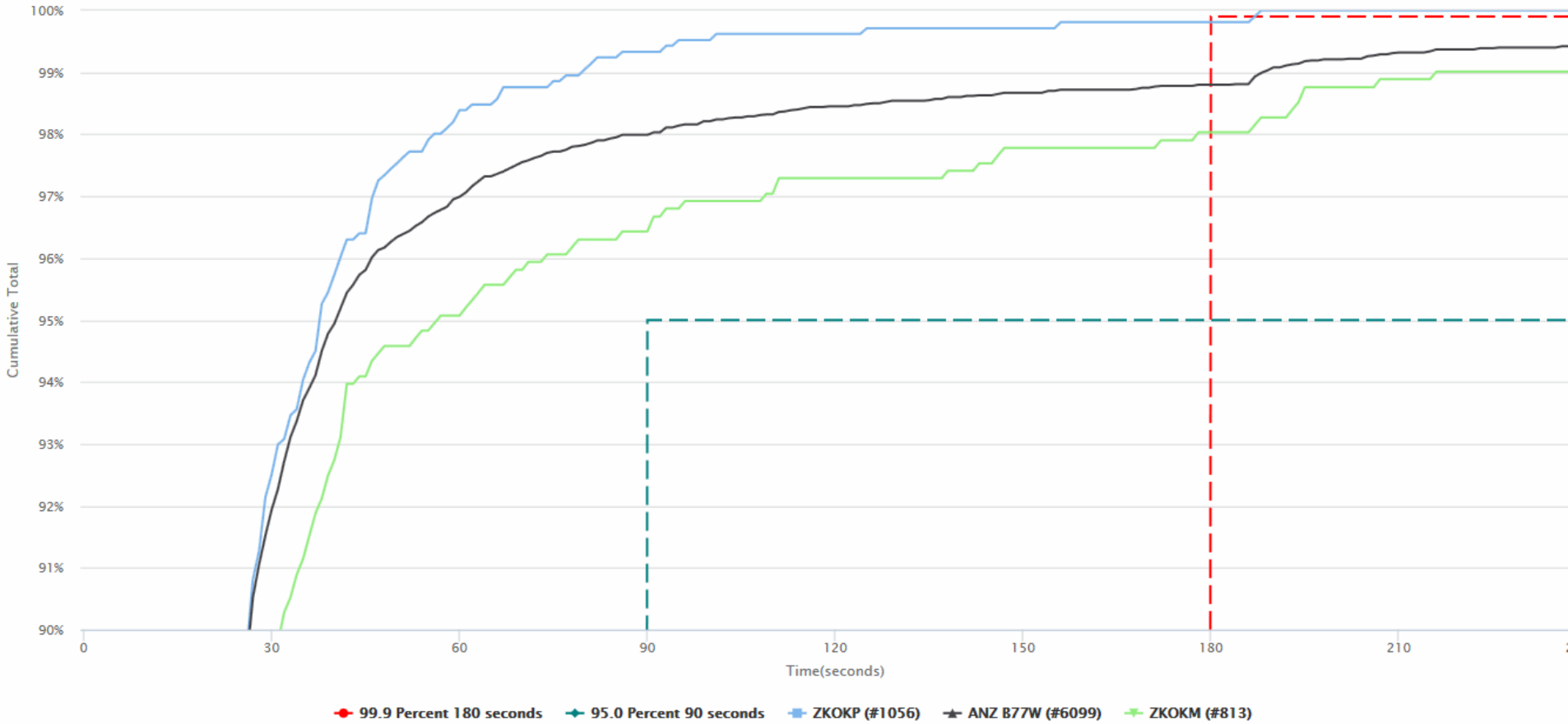
RSP180 SATCOM 2015



Notes: This graph illustrates that no significant difference exists between different tail numbers in the ANZ fleet.

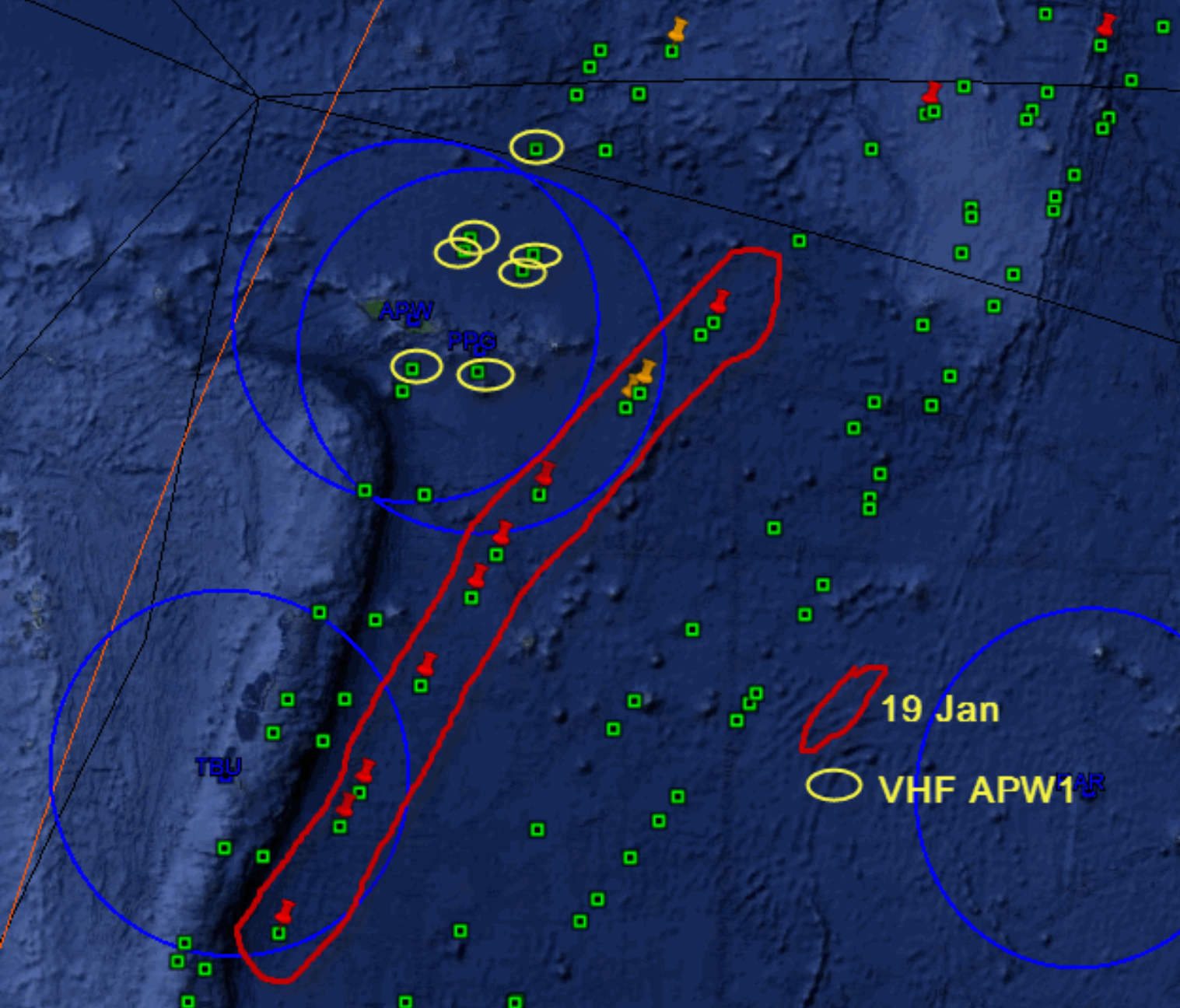
NZZO ADS-C RSP180

ANZ B77W I4 Analysis



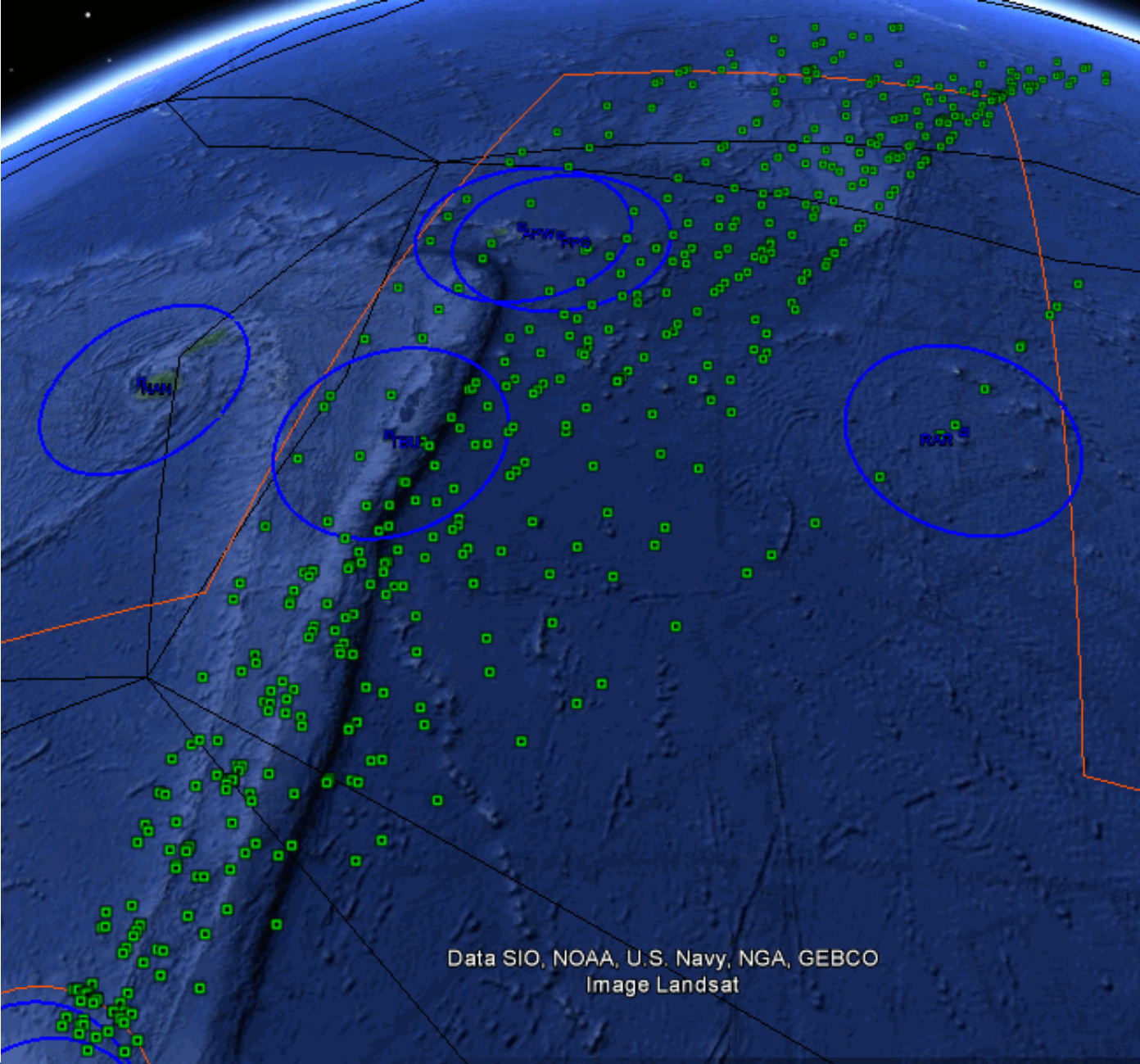
Notes: Analysis for January 2016. Smaller data-set shows wide r variability.

Note: Fleet average is below 99% 180 seconds. Best performing tail (ZKOKP) nearly meets the specification while the lowest performing tail (ZKOKM) just meets 98% 180 seconds.



*Notes: ZK-OKM
January 2016
routes with
delays showing
those reports
using VHF and
the flight on 19
January with
multiple delays
indicated on
consecutive
reports.*





This shows the remaining pacific flights flown by ZKOKM that experienced no ADS-C latency delays in January 2016 These are all UPR routes between NZAA and NAM.



- To date no resolution on reason for performance drop when the fleet switched to the I4 from the I3
- On occasional flights we see numerous consecutive delays. For example 19 January in Pacific and 20 January in Tasman, and most recently 18 March in Pacific with 5 consecutive delayed messages with latency between 10-22 minutes over the period 1357-1455 UTC and 5 consecutive delayed messages between 6-23 minutes over the period 1508-1611 UTC.
- Inmarsat and SITA have carried out independent investigations in addition to the CRA investigation. Some areas for further investigation have been identified. The investigation continues.....

Thank you

