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A UN SPECIALIZED AGENCY
RECONNECTING THE WORLD

ADS-B IMPLEMENTATION IN FIJI

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FIJI AIRPORTS

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PRESENTATION OVERVIEW

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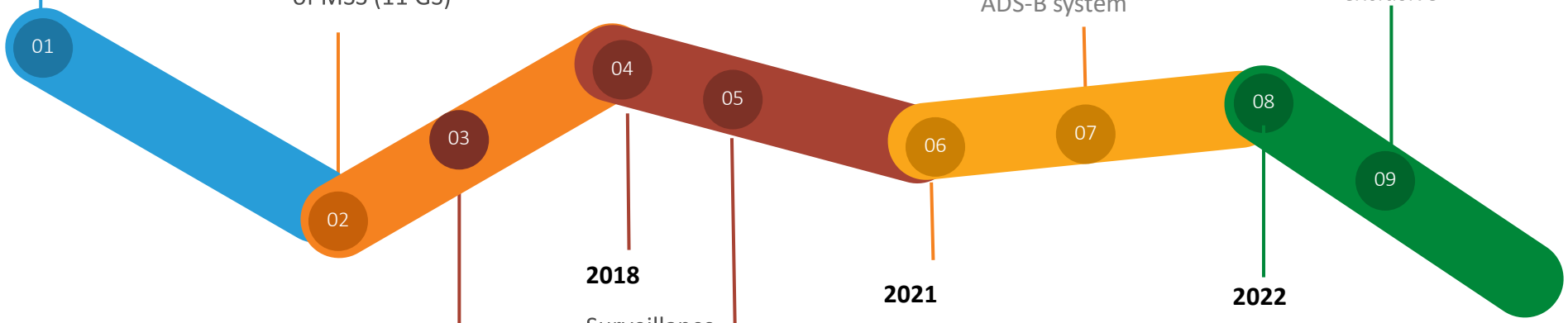
01

INTRODUCTION

- Approach and Area Control Services within Fiji's domestic controlled airspace were provided using procedural control.
- As air traffic volumes increased within the domestic airspace, the number of air safety occurrences also increased, thus necessitating the introduction of surveillance control services.
- Fiji selected the ADS-B system to facilitate the introduction of surveillance control services within the domestic controlled airspace.
- Fiji did not have any Primary Surveillance Radar (PSR) or Secondary Surveillance Radar (SSR) previously and Fiji Airports as the ANSP was the first to migrate directly to surveillance from Procedural control without RADAR experiences.

02

TIMELINES



2008

Industry Consultation

2011

Commissioning of MSS (11 GS)

2013

CAAF mandated all domiciled aircraft to have ADSB transponders for Mode S for DO-260, DO-260A & DO-260B (Extended Squitter 260-B preferred in upgrading the fitment).

2018

Surveillance training commenced

2020

Completion of Airspace redesign

2021

ATM System Upgrade and commissioning

2022

Installation of new ADSB sites and Upgrade of the old ADS-B sites for a total of 10 GS and commissioning of ADS-B system

2022

Rollout of Surveillance Service

2023

FA proposed and CAAF mandated Fiji's Domestic airspace to be ADSB-Out exclusive

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ADS-B IMPLEMENTATION

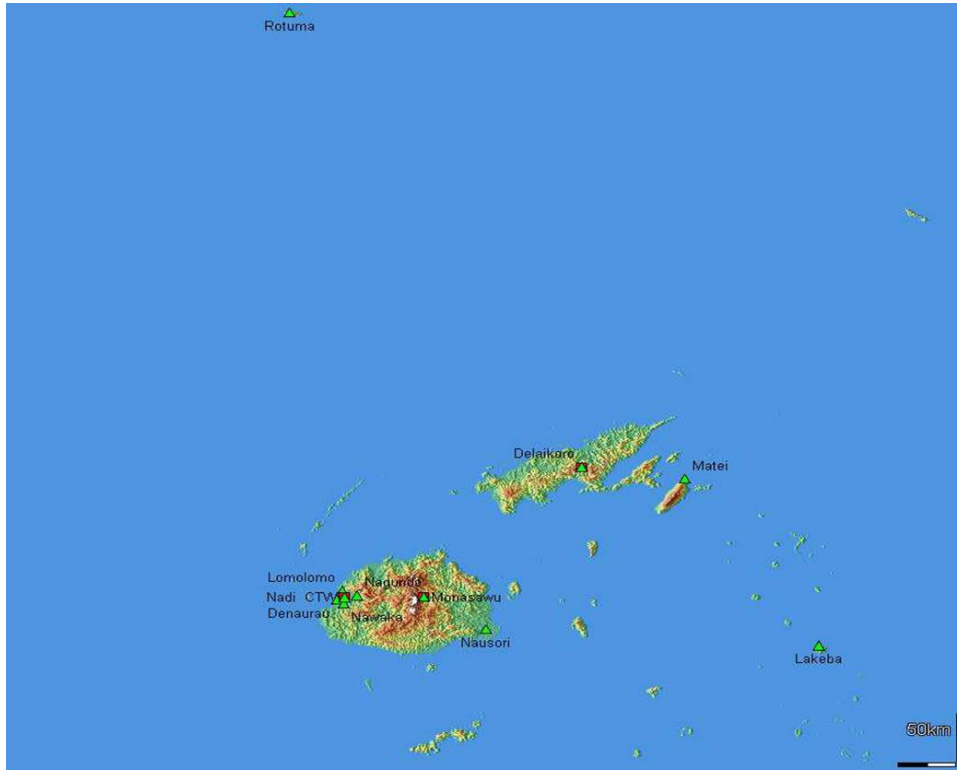
- MSS DEPLOYMENT IN FIJI
- ADS-B GROUND STATION INSTALLATION
- ADS-B DATA VALIDATION

MSS DEPLOYMENT IN FIJI – 2011

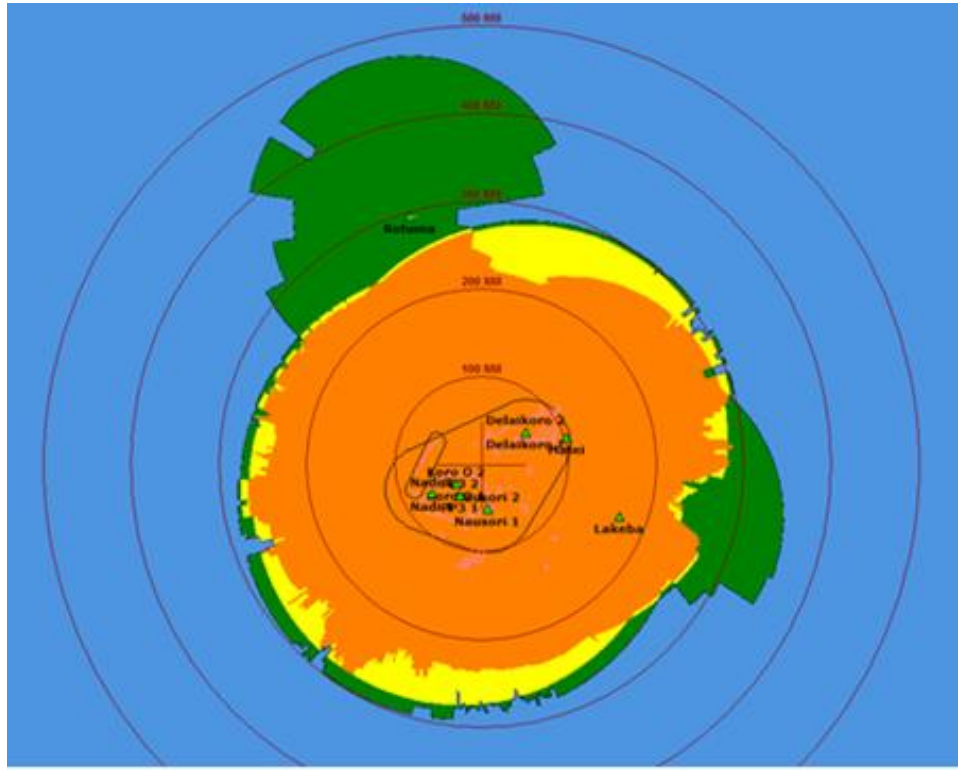
- MSS for ATM Fiji (MSS FIJI) was designed as an active multilateration system based on distributed timing architecture with the ADS-B functionality using the centralized architecture.
- MSS FIJI consisted of the following four main subsystem sections
  - Ground Stations (GS00 to GS10)
  - Central Processing Station (CPS)
  - Remote Control & Management Terminal (RMT)
  - Communication Network links

MSS 11 GS site

Fiji MSS Ground Station Locations 2011



Simulated ADSB coverage at 2,500ft MSL .
Orange > 2 stations
Yellow = 2 stations
Green = 1 station



Simulated MLAT coverage at 10,000ft MSL from the same ground station network to provide en-route surveillance

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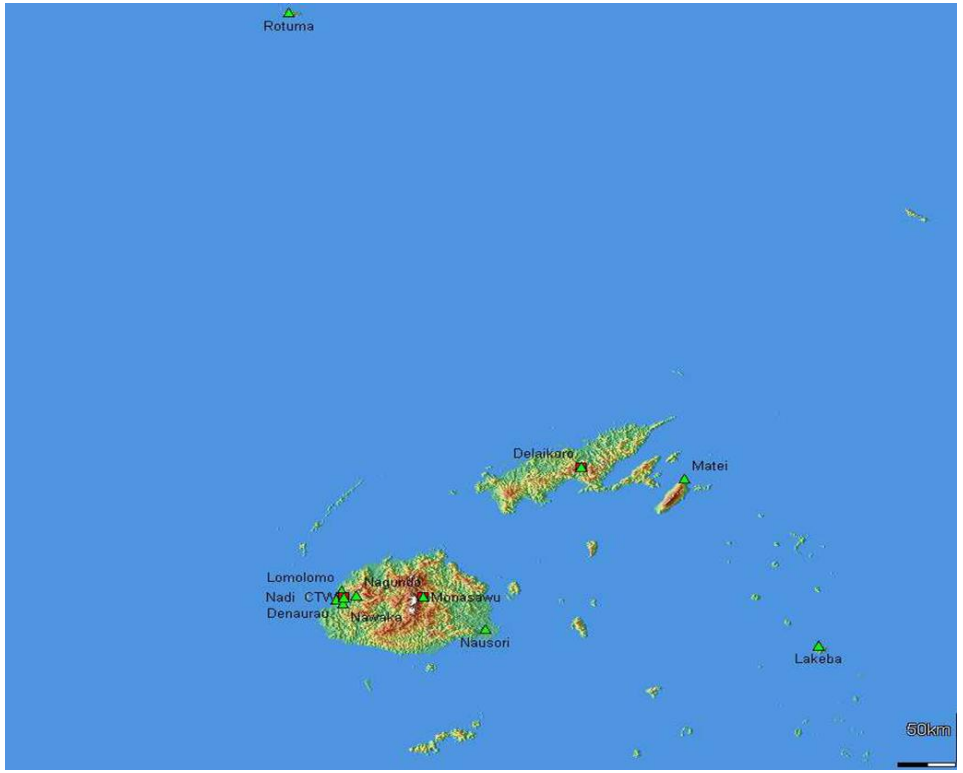
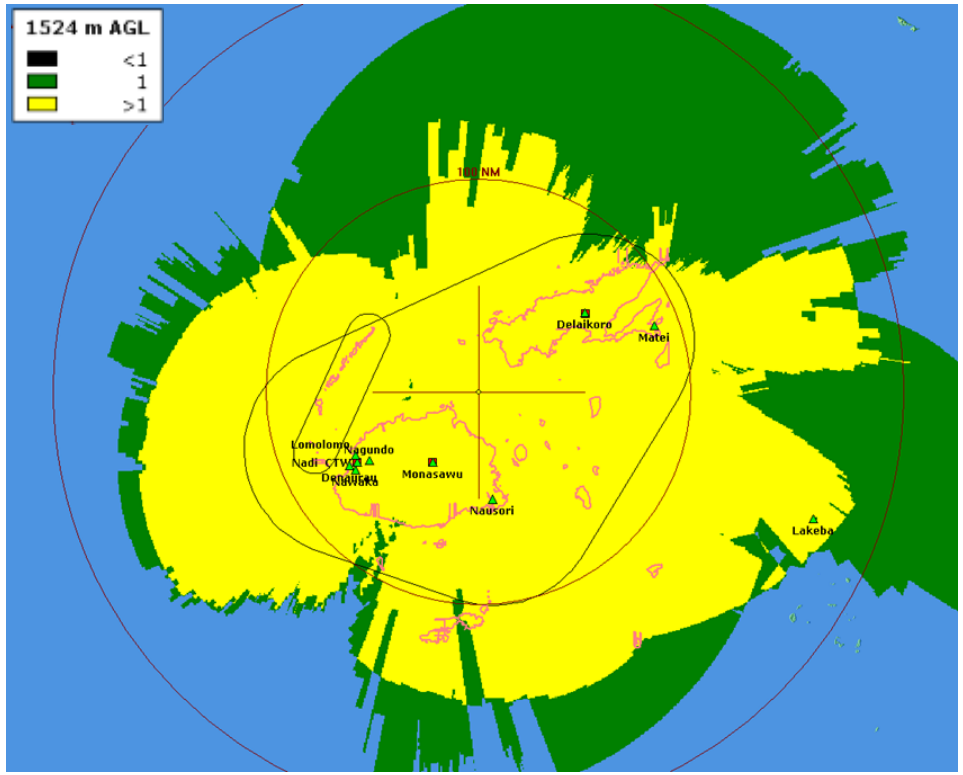
Fiji MSS Ground Station Locations 2011



11 ADS-B RX Ground Stations Deployment



Simulated ADS-B coverage at 5,000ft AGL

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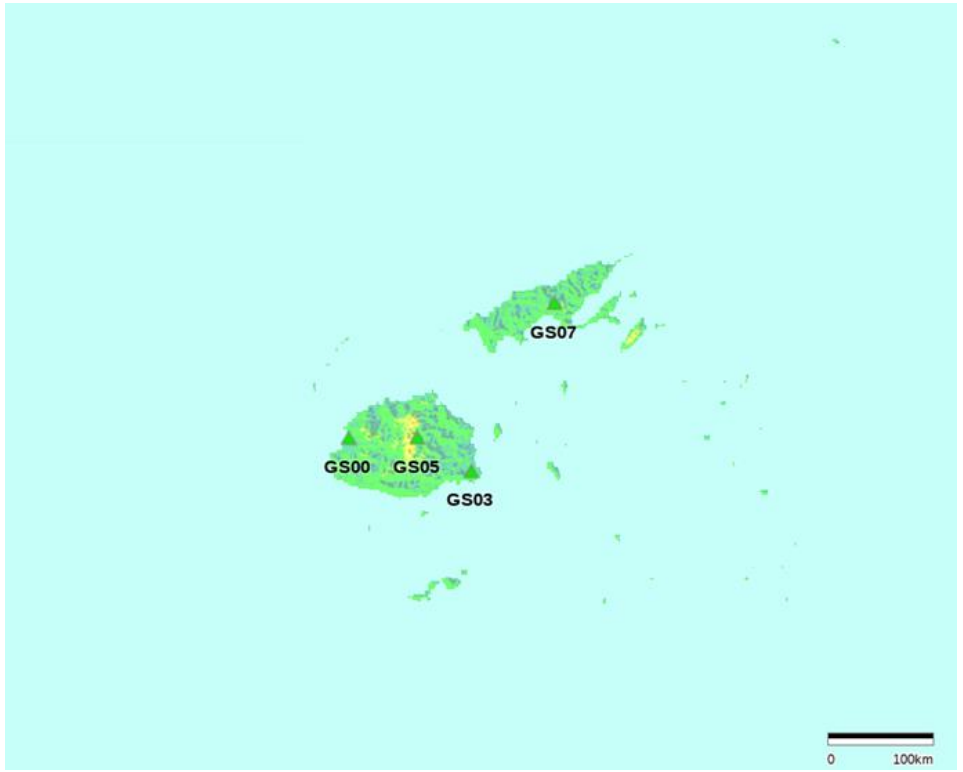
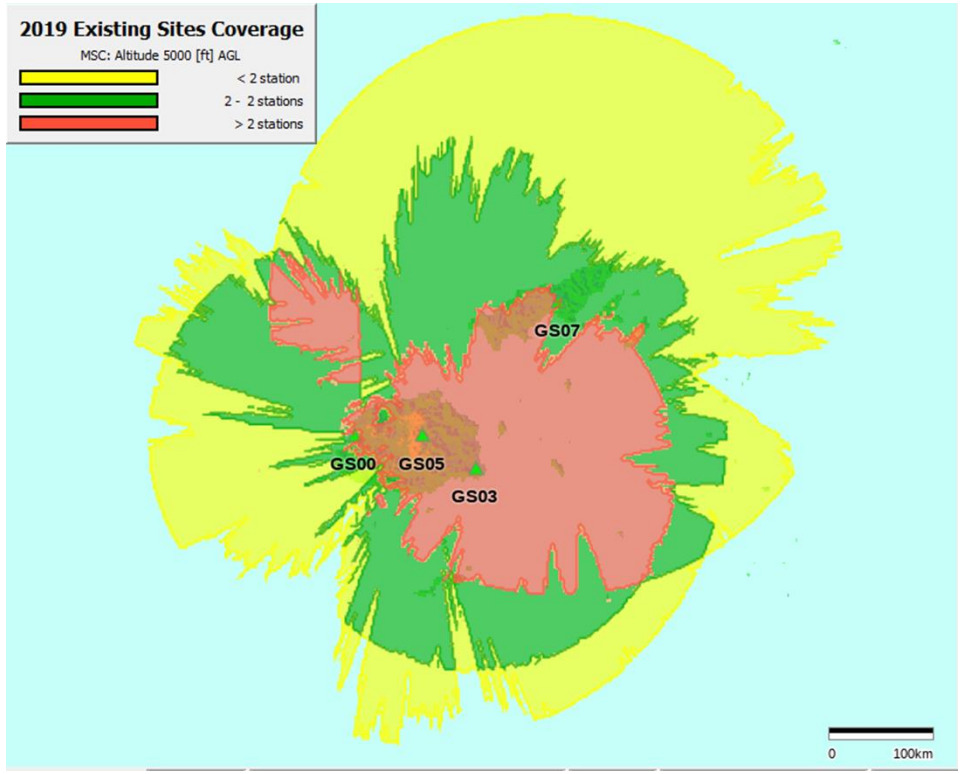
ADS-B PHASED IMPLEMENTATION

- 10 UPGRADE AND REPLACEMENT ADS-B GROUND STATIONS WERE INSTALLED IN TWO PHASES
- PHASE 1 – INSTALLATION OF SEVEN (7) NEW SITES WHICH WERE SOUTH RIDGE, SABETO HILL, EMURI HILL, DOGOWALE, NAUSORI, AND DEVOUX PEAK
- PHASE 2 – REPLACEMENT OF THREE (3) EXISTING SITES WHICH WERE NADI, DELAIKORO AND MONASAVU

Fiji MSS Ground Station Locations 2019



4 ADS-B RX Ground Stations



Simulated ADS-B coverage at 5,000ft AGL

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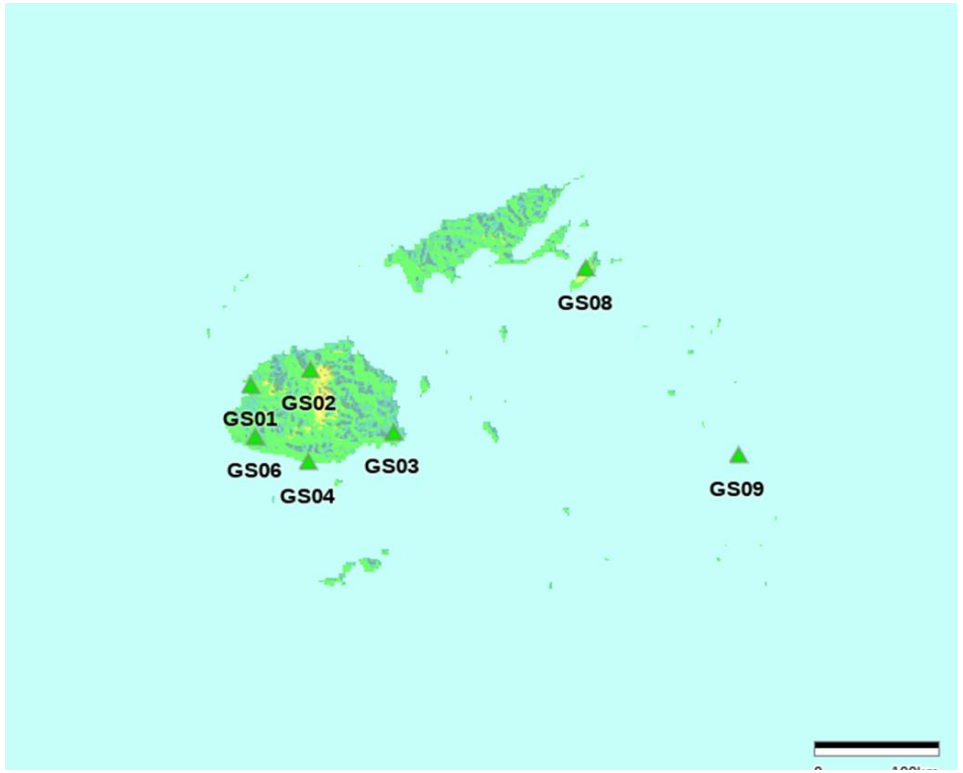
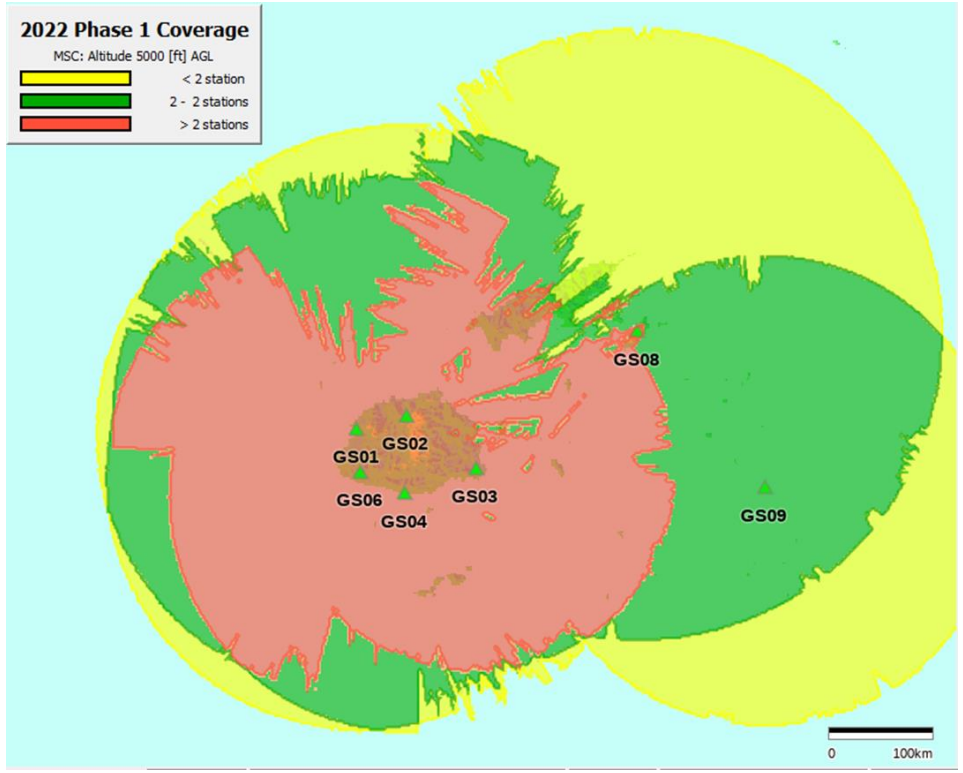
Fiji ADS-B RX Ground Stations Location 2022 Phase 1



6 new ADS-B RX Ground Stations Location
1 Replacement Ground Station



Simulated ADS-B coverage at 5,000ft AGL

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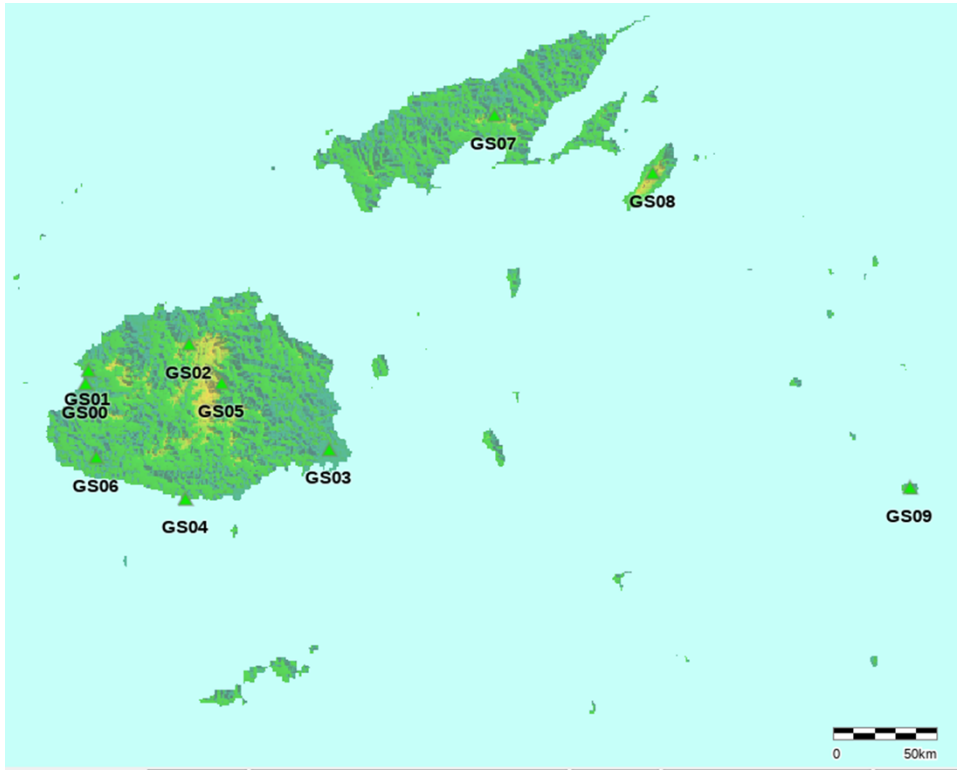
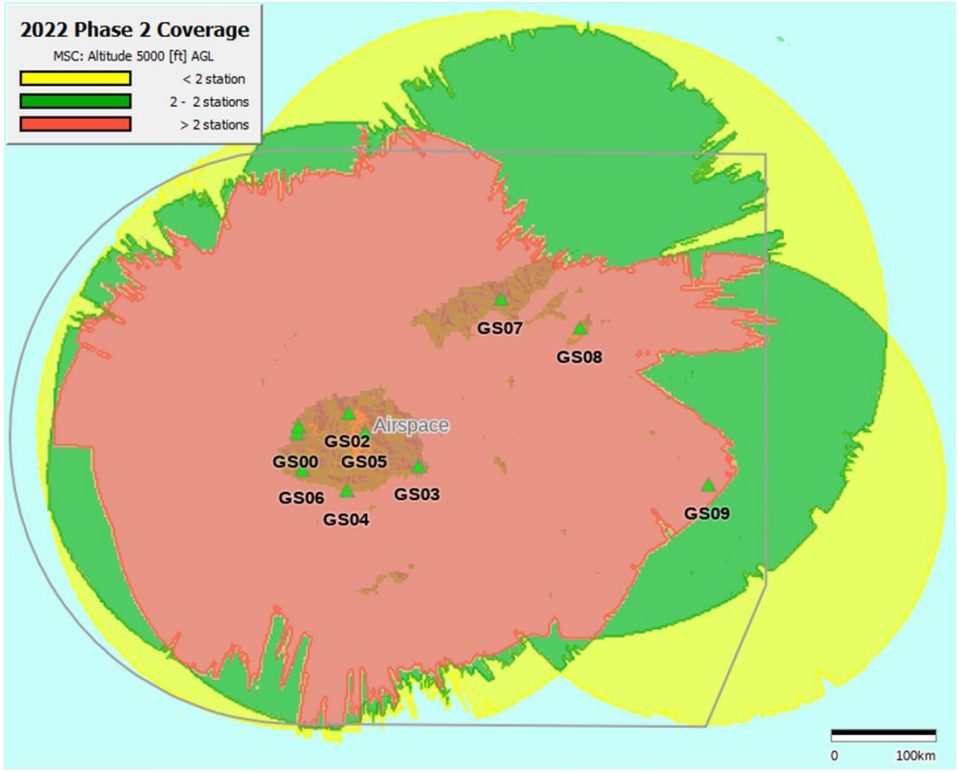
Fiji ADS-B RX Ground Stations Location 2022 Phase 2



6 new ADS-B RX Ground Stations Location
4 Replacement Ground Stations



Simulated ADS-B coverage at 5,000ft AGL

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TECHNICAL VALIDATION FOR TIER 2 & 1

- Is per ADS-B Implementation and Operations Guidance Document (AIGD)
- CAAF - AIC 06/20

	Characteristic	CATEGORY 1 (TIER 1) 5NM Separation Capable Commensurate with Radars (Separation/Vectoring/High Performance with Reliability, Integrity & Latency)	CATEGORY 2 (TIER 2) Situational Awareness Similar to ADS-C (Safety-Net Alerts, SAR, Supports Procedural Separation Without Voice, Not 5nm Separation)	CATEGORY 3 (TIER 3) Position Reporting With Enhanced Flight Operation
1.	Position: Accuracy	A 95-percentile accuracy of 0.5NM This can be represented by either: a) NACp ≥ 5 or b) NUC ≥ 4		
2.	Position: Integrity	A containment radius of < 2 NM a) NUC ≥ 4; or b) NIC ≥ 4 and SIL ≥ 2		
3.	Aircraft Updates	12 secs	0.5 second < Interval < 20 seconds as Operationally required	0.5 second < Interval < 60 seconds as Operationally required
4.	Network Latency	95% < 2 secs of receiver-station output	95%:< 15 secs of receiver-station output	95%: < 60 secs of receiver-station output
5.	Reliability 1	2 autonomous receiver-stations including antenna, each providing data, no common point of failure	1 unduplicated receiver-station including antenna	1 unduplicated receiver-station including antenna
6.	Reliability 2 – MTBF	Each receiver-station including antenna to have MTBF > 10,000hrs	Each receiver-station including antenna to have MTBF >10,000 hrs	Each receiver-station including antenna to have MTBF >10,000 hrs
7.	Reliability – Communications Infrastructure	Completely duplicated, no common point of failure	Unduplicated, MTBF > 400 hrs	Unduplicated, MTBF > 200 hrs
8.	Reliability – Total ADS-B Service	Total Service MTBF > 50,000 hrs	Total Service MTBF > 400hrs	Total Service MTBF > 200 hrs
9.	Availability – Total ADS-B Service	Total Service Availability > 0.999	Total Service Availability >.95	Total Service Availability >.90
10	Integrity – Ground Station	Site monitor System Monitoring	Site monitor System Monitoring	System Monitoring
11	Integrity – Data & Communications & Processing	All systems up to ATM systems, errors < 1 X 10E-6	All systems up to ATM system, errors < 1 x 10E-6	All systems up to ATM system, errors < 1 x 10E-6

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OPERATIONAL VALIDATION FOR TIER 2 & 1

- BCST PLATFORM WAS USED TO VALIDATE TIER 2 ADS-B DATA
  - ADSB Data validation focused on
    - ✓ Avionics monitoring such as track consistency, valid flight ID
    - ✓ Performance monitoring such as accuracy, barometric height, monitoring position jumps etc.
    - ✓ Display on ATC ASD such as coupling failure, duplicate ICAO code, split tracks etc.
  - Flight validation checks were not done on the new 10 GS However, 'targets of opportunity' were used to validate the ADS-B data and check the ADS-B coverage area.

SAMPLE OF TIER 2 & 1 DATA COLLECTION

Tier 2 Validation Data

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ADS-B (NEW TRANSMITTER INSTALLATIONS) TIER 2 DATA VALIDATION STATISTICS

	DATE DD/MM/YYYY		16 MAY 22	TIME (UTC):	FROM 0200	TO	ADS-B COVERAGE SELECTED (✓/X)	SELECTED – RANGE RING ON CURRENT ADAPTATION		UPPER LIMIT	000	LOWER LIMIT	600
					ASD DATA BLOCK DISPLAY (✓/X)					CONTROLLER WORK-STATION			
										BCST CWP 2 – NEW GS			
	ACFT CALLSIGN	ACFT TYPE	DEP-DEST	ALT/FL	ADSB TARGET	TARGET COUPLED (AUTO/ MANUAL)	SPEED	ADS-B LEVEL	POOR QUALITY / YELLOW TARGET	TIME	REMARKS		
1	DQ WPG	C208	NFFN-NFSW	A085	✓	✓	✓	✓	X		RBL DRAWN – 15s DELAY BEFORE DISPLAY		
2	DQ WPG	C208	NFFN-NFSW	A045	✓	✓	✓	✓	X		TARGET XED TMA/B ON DESCENT		
3	FJA153	DHC6	NFFN-NFNM	A110	✓	✓	✓	✓	X		NIL ISSUED OBSERVED		
4	DQTAA	DHC2	NFUL-NFFN	A010	✓	✓	✓	✓	X		ABLE TO SEE THE TARGET ON THE GND @ NFUL ON START		
5	FJA153	DHC6	NFFN-NFNM	A100	✓	✓	✓	✓	X		ACCURATE READINGS OBSERVED		
6	FJA83	AT46	NFFN-NFNL	A085	✓	✓	✓	✓	X		ACFT ON CLIMB TO FL150. ACCURATE READINGS OBSERVED		
7	FJA153	DHC6	NFFN-NFNM	A007	✓	✓	✓	✓	X		TARGET STILL SEEN WHILE ON DESCENT INTO NFNM		
8	DQWPG	C208	NFFN-NFND	A055	✓	✓	✓	✓	X		ACCURATE READINGS OBSERVED		
9	DQWPG	C208	NFFN-NFND	A040	✓	✓	✓	✓	X		TARGET STILL SEEN WHILE ON DESCENT INTO NFND		
10	DQFTI	C152	NFSW-NFFN	A034	✓	✓	✓	✓	✓		ACFT TRACKED TOWARDS THE YASAWA GROUP & BACK TO NADI. TARGET SEEN ALL THE WAY		
11	DQJJS	EN2	NFKD-NFNA	A055	✓	✓	✓	✓	X		NIL TARGET OBSERVED UPON DEPARTURE. ADS-B TARGET DISPLAYED ON THE ASD WHEN ACFT PASSED S.SOOFT		
12	DQWPG	C208	NFFN-NFND	A008	✓	✓	✓	✓	X		TARGET STILL SEEN WHILE ON DESCENT INTO NFND		
13													

Legend: **FL** – Flight Level; **DEP** – Departure; **ARR** – Arrival; **OVERFLT** – Over flight; **ACFT** – Aircraft; **ASD** – Air Situation Display; **IDENT** – Identification

Tier 1 Validation Data

ADS-B TIER 1 DATA COLLECTION

DATE 8/06/2022 TIME PERIOD 0200z - 0400z CWP# 4 AIRSPACE: NADI CTA

ACFT C/SIGN	ACFT TYPE	MODE-S CODE	DEP - DEST	ALT/FL	CONSISTENCY	TRACK	FLIGHT ID VALID	VALUE (>/=4) NUCp	VALUE (>/=4) NUCr	VALUE (>/=5) NACp	SIL (>/=2)	ADS-B LEVEL	COUPLING FAILURE	TARGET YELLOW	ADDRESS ICAO ACFT	DUPLICATED	DATA BLOCK DISPLAY
FJA83	AT46	C88060	NFFN-NFNL	F130	Y		Y	7	0	0	0	Y	N	N	N		Y
DQYYT	C172	C88030	NFFN-NFFN	A035	Y		Y	8	1	10	3	Y	N	N	N		Y
FJA142	DHC6	C88080	NFKD-NFNA	A60	Y		Y	8	2	9	3	Y	N	N	N		Y
DQFTI	C152	C8807	NFFN-NFFN	A020	Y		Y	8	2	9	0	Y	N	Y	N		Y
JST119	A320	7C6B0D	YSSY-NFFN	F350	Y		Y	7	0	0	0	Y	N	N	N		Y
FJA127	DHC6	C88080	NFFN-NFNM	A090	Y		Y	8	2	9	3	Y	N	N	N		Y

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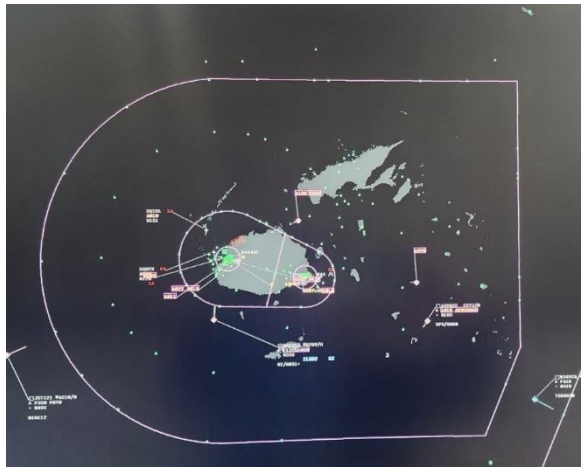
The 10 ADS-B Ground Station Sites

Operational ADS-B 10 GS site

Comparison of the ADSB coverage



Nadi CTA

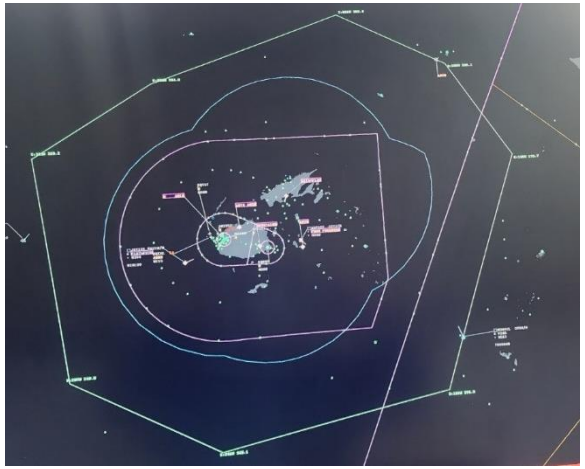
Dimension: Centered on the FN ARP to approx. 150nm to the North, West, and South &approx. 260nm to the East, joined by a common arc.

Vertical Limits: A065 to F600

Classification: Class D

OLD ADSB Coverage area

Centered on FN ARP to approx. 180nm to the West & South and approx. 300nm to the North and East



New ADSB Coverage area

Centered on FN ARP to approx. 280nm to the West & South and approx. 440nm to the North & East

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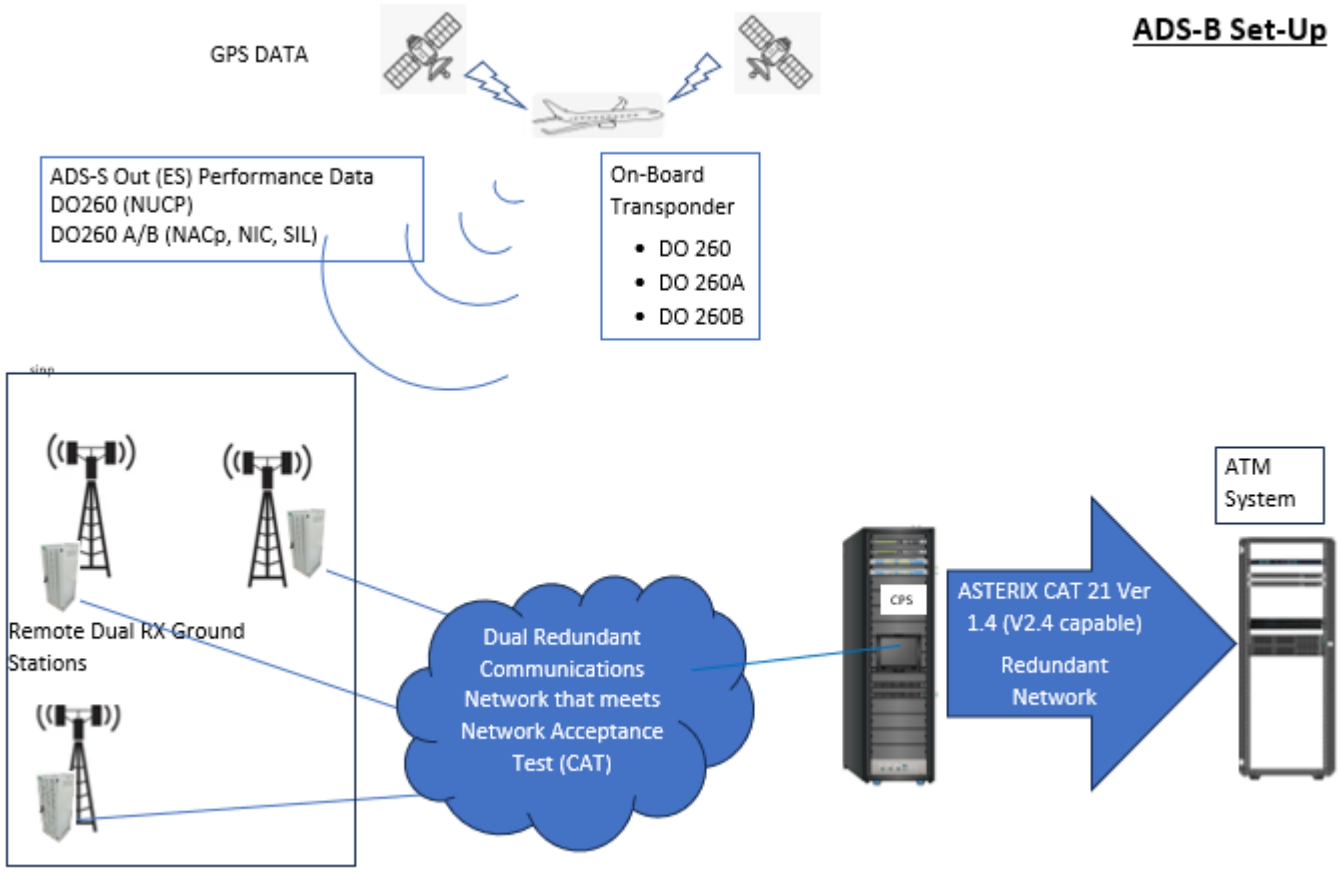
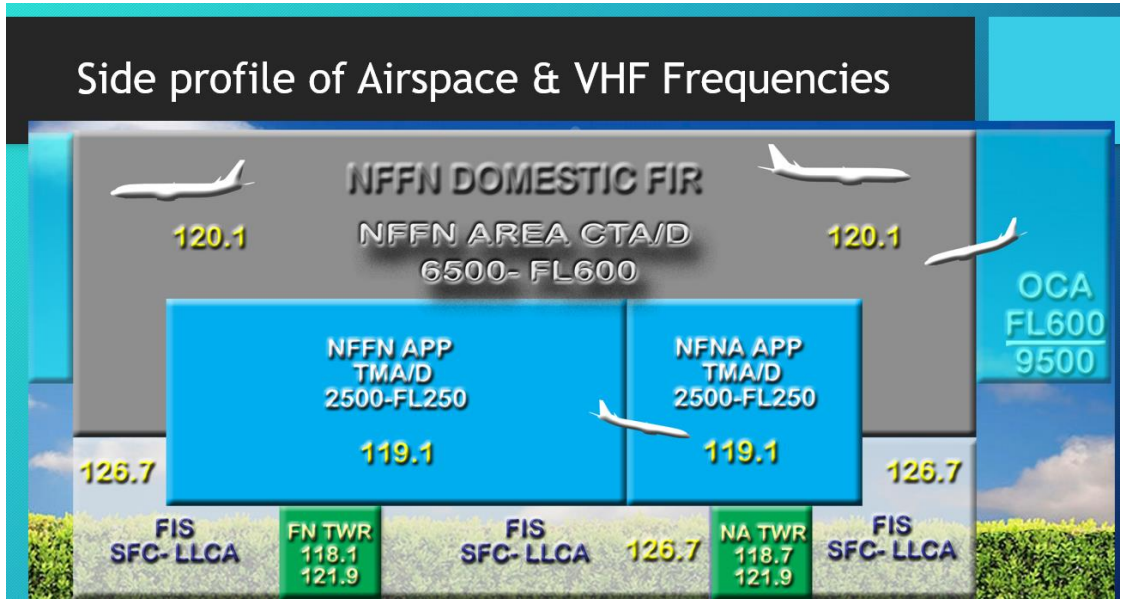
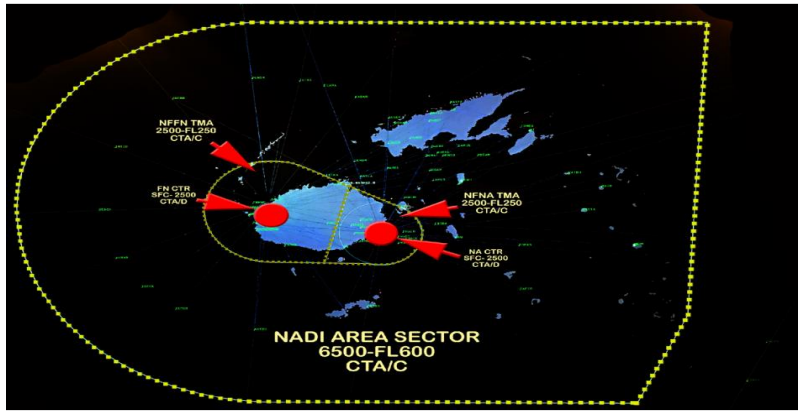
FIJI ADS-B COMMUNICATION NETWORK



VHF Radio Communication Sites and Coverage





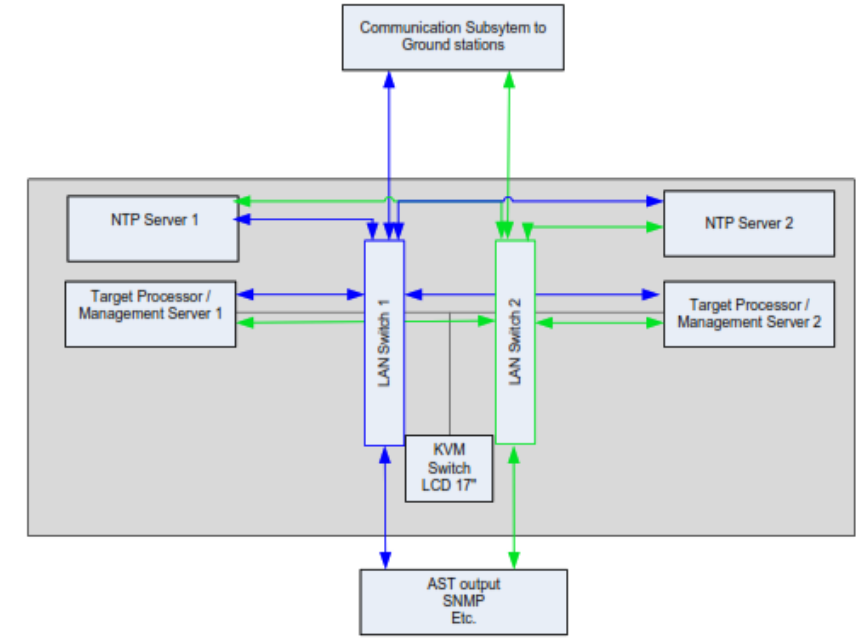
The VHF coverage area is just as good as the ADSB coverage area due to the strategic location of our VHF transceivers.

Centered on FN ARP the coverage area is approximately 250nm to the East & South and West and approximately 300nm to the North & Northeast

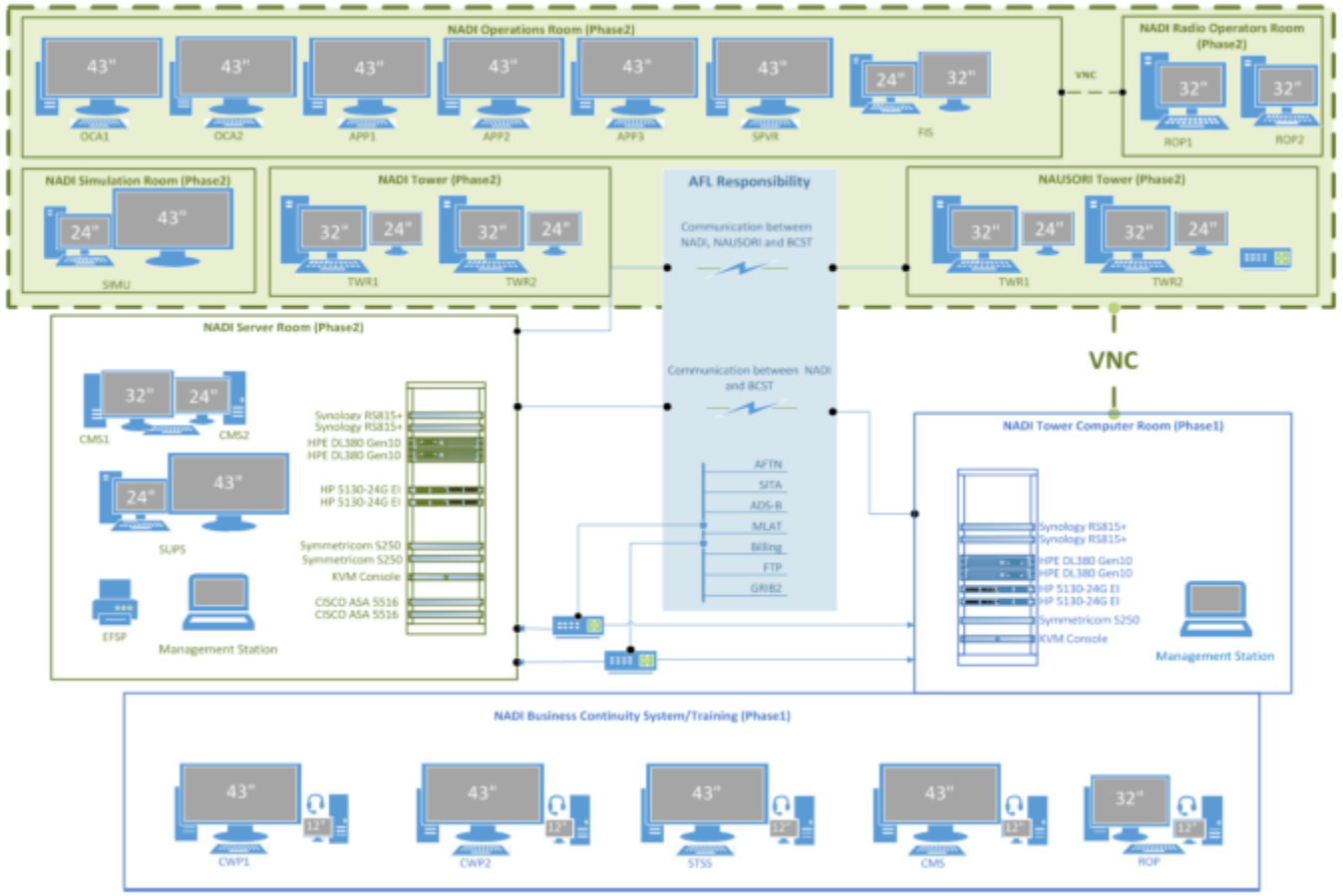
ADS-B & ATM System Supplier & Resource Agency

- ADS-B - ERA, Czech Republic
- ATM System – Adacel, Montreal Canada
- Technical Assistance -Greg Dunstone (Aireon & former Air Services Australia ADS-B Expert) – Radar, ADS-B and ATC Automation SME
- Airways NZ ATC Surveillance Operational Experts – Operational procedures, Training & Rating

Block Diagram of the ERA ADS-B & Aurora ATM System



ERA ADS-B System



AURORA ATM System & Simulator Training System (STSS)

04

SURVEILLANCE ROLLOUT

SURVEILLANCE ROLLOUT

The Civil Aviation Authority of Fiji (CAAF) mandated all aircraft domiciled in Fiji to have ADS-B transponders by December 2013. Mode S (Extended Squitter 260-B preferred).

CAAF mandated the Fiji Domestic airspace to be Automatic Dependent Surveillance Broadcast (ADS-B) Out Exclusive Airspace from 13 July 2023. Fiji does not have PSR or SSR previously.

Surveillance theoretical training for Batch 1 commenced in June 2019 and In the height of the COVID-19 pandemic, an application was submitted to CAA Fiji for the majority of the on-the-job training to be conducted on the BCST platform.

CAAF approved for on-the-job training to commence in the BCST from September 2020 for a total of 144 hours with the remaining 36 hours is to be completed on the Live platform.

Live training together with the delivery of surveillance control service commenced in the Operational platform on the 6th of October 2022 and was being provided from 0000 – 0800utc, Thursday to Monday. Outside those hours, procedural control services were being provided.

On the 20th of October, Surveillance control services were provided from 1800UTC to 0600UTC.

On the 8th of December 2022, the hours of watch were revised to 1800UTC to 0800UTC, Thursday to Monday.

From the 28th of December 2023 till today, the surveillance control is provided daily from 1800UTC till 0800UTC.

CAA FIJI CERTIFICATION PROCESS

As per CAAF Form GS 409

- ✓ PLANNING
  - Safety Case – 14 days before implementation
  - Facility specification
  - Operational user requirements
  - System design review and contractual project deliverables
  - Project schedule and key milestones
  - Contractual agreement signed
- ✓ FACTORY ACCEPTANCE TEST
- ✓ SITE ACCEPTANCE TEST
- ✓ COMMISIONING
  - Transition plan – Ghosting, Mimicking, Cut-over and decommission of the Legacy system
  - Commissioning report signed by ATM and ANES
  - Training reports with instructors cv
  - Rating Assessment plan
  - Documentation
    - OEM Technical Manual
    - OEM Installation Manual
    - OEM Operation Manual
    - OEM Maintenance Manual
    - OEM Training Manual etc.
    - Fiji Airports -Commissioning Report
    - Fiji Airports -Route Schematics etc.
    - Fiji Airports Maintenance Procedures.
    - Records of Hand-over of Project to the Maintenance Unit
    - ATC Operational workstation to have its Operators/User's Manual, if applicable.
    - Fiji Airports Local Contingency procedures.

05

BENEFITS

BENEFITS

- Reduced separation using 5nm within the Surveillance coverage area which includes the domestic airspace
- Positive feedback from domestic operators as well as national airlines with significant fuel savings due to CCO and CDO and track shortening.
- Improved SAFETY
- Consistency and predictability
- Less controller interruption in the cockpit.
- Significantly reduced RTF workload
- Less airborne delays and holding
- SAR assistance
- Enhanced traffic information in Class G Airspace
- In alignment to the ICAO ASBU & the APAC ATM Seamless plan

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06

LESSON LEARNT

LESSON LEARNT

- Importance of VHF coverage to realize the full benefits of Surveillance control
- Importance of performance data collation
- ADS-B Ground System needs to be supported by Space ADS-B for redundancy and SAR function
- Contingency System for loss of surveillance control
- Consideration of Data fusion and priority for surveillance operation
- Airspace mandate plan in alignment with Aircraft equipage

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THE FUTURE

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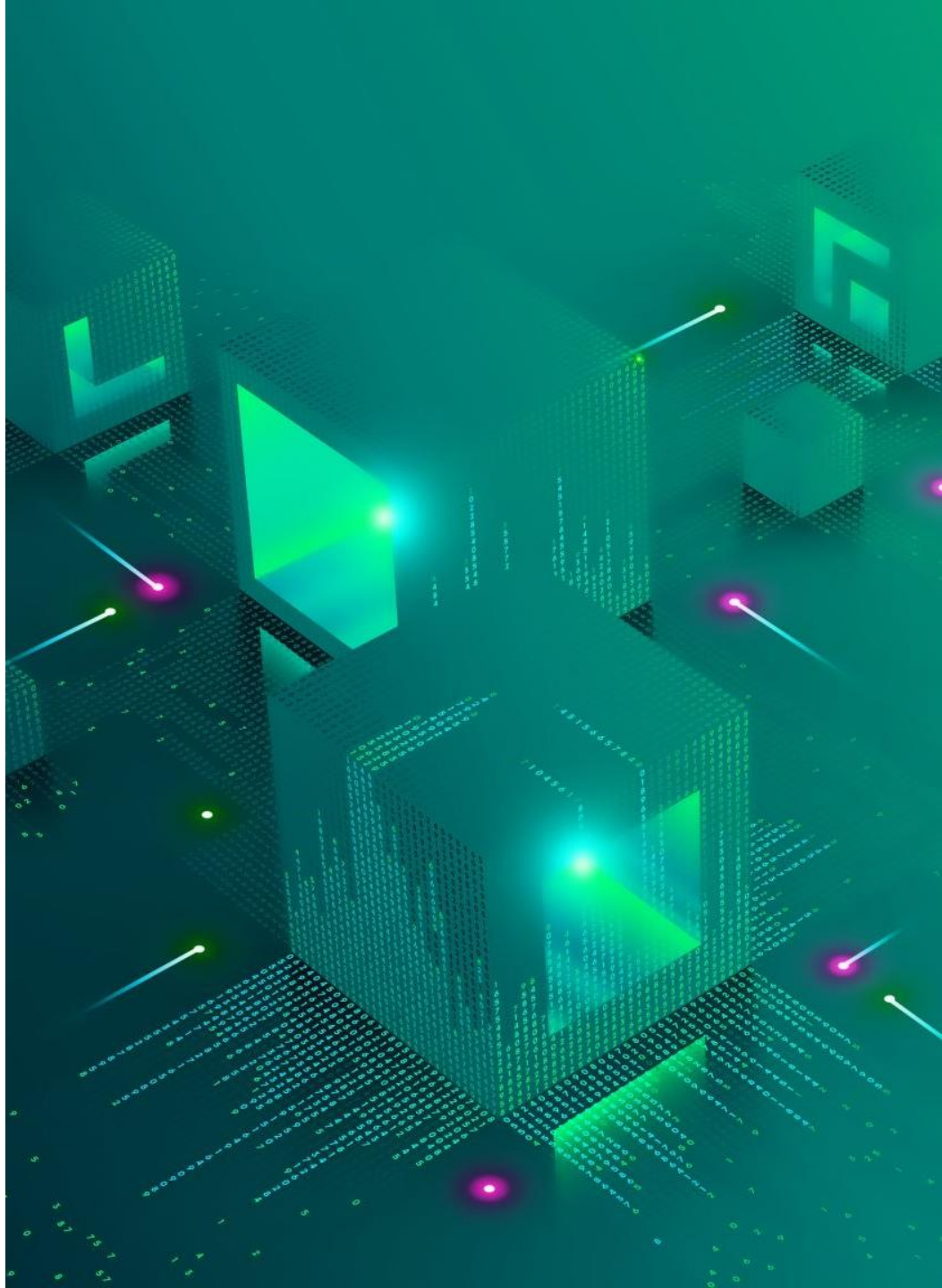
THE FUTURE

- Use of 3nm separation in the Domestic airspace
- Space-Based ADSB to complement surveillance source – ensure continuity of the service
- Space-Based ADSB within Nadi FIR for application of reduced separation
- Implementation of DAPs in the surveillance control airspace
- Revised airspace mandate for ADS-B DO 260B fitment
- Migrating from Voice to Data communication in the control domestic airspace using VDL mode.
- Use of Satellite VHF Radio in the Nadi FIR to support data communication using VDL mode.



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Thank You

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