ADS-B Implementation Workshop (ADS-B Workshop)
(Bangkok, Thailand, 14 – 16 August 2024)

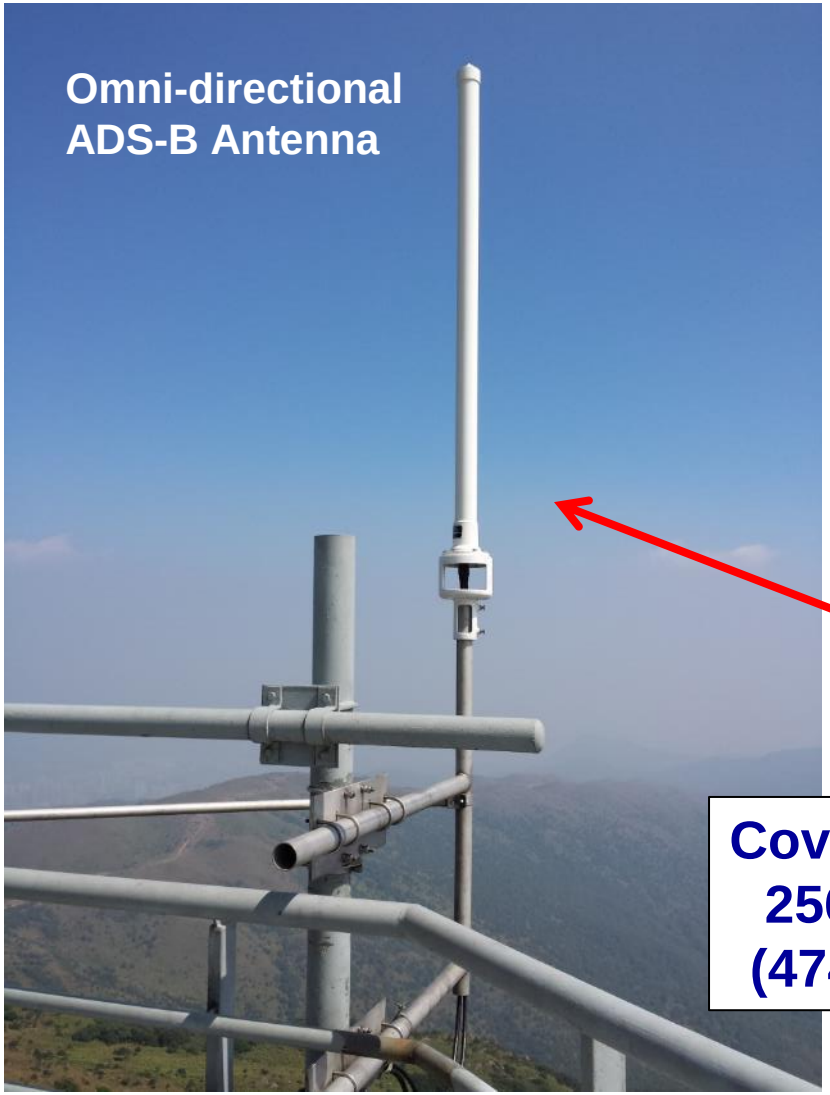
ADS-B Implementation in Hong Kong, China

Presented by Hong Kong, China

Agenda

- **Benefits of ADS-B Implementation**
- **ADS-B Implementation in Hong Kong, China**
- **Evaluation and Safety Assessment**
- **Issues / Challenges**

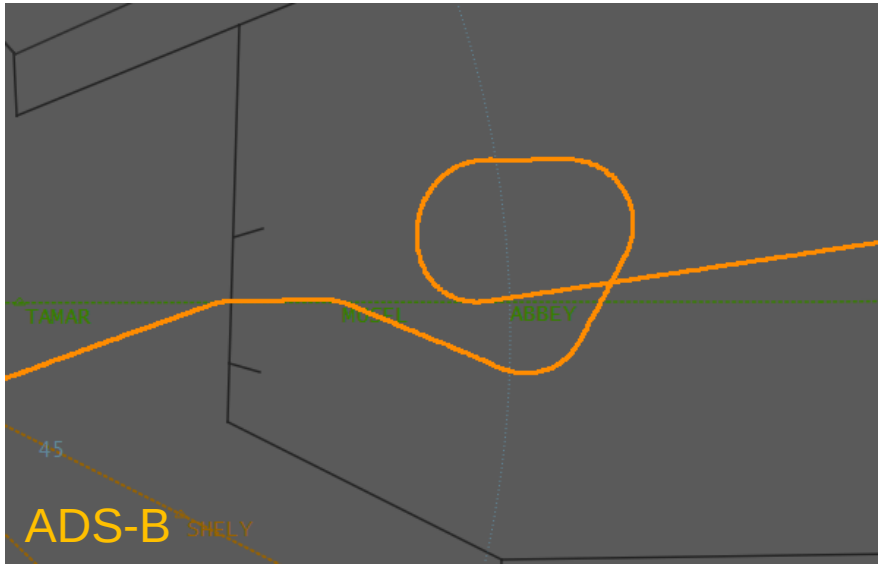
Scale of Ground Equipment

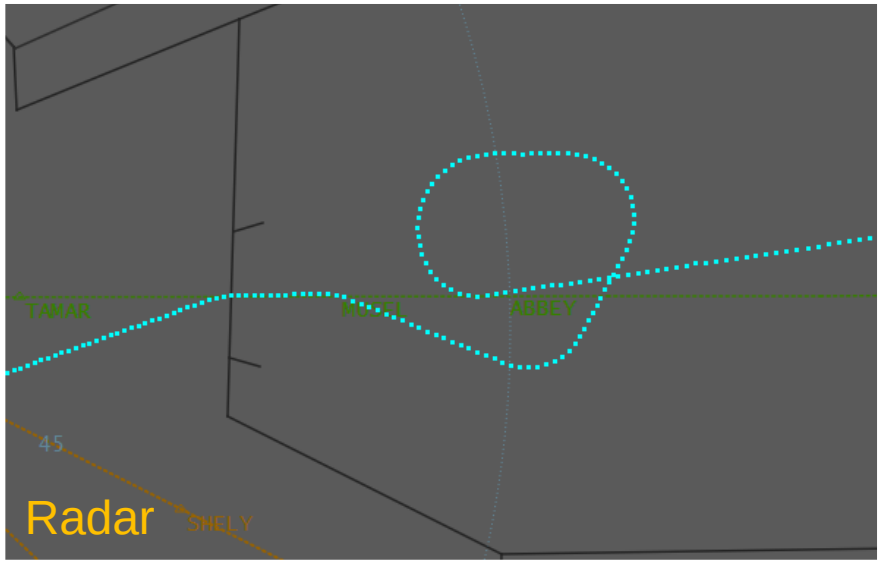


Coverage 256NM (474km)

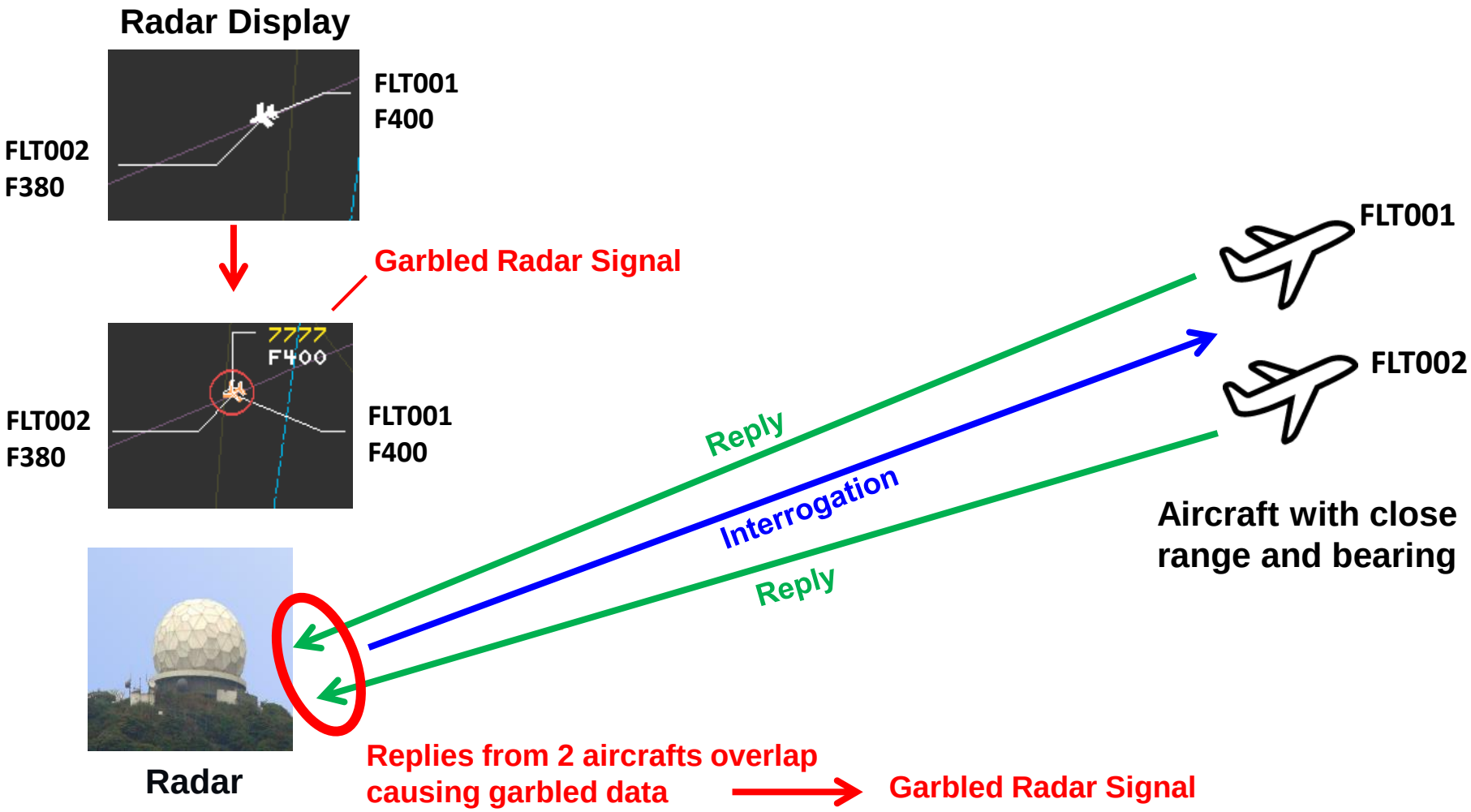
Advantage of ADS-B over Radar

- Accurate position information
  - From GNSS(GPS) signals
- Easy to maintain
  - No mechanical movement
  - No transmitter
- Cost effective
  - Less expensive to setup/maintain
- Fast update rate
  - Typically every 1 second
- Able to provide low-level surveillance coverage





Limitation in Radar Technology (Signal Garbling)



Handling of Signal Interference in ADS-B

- ADS-B information broadcast in an omni-directional manner randomly from aircraft without the need of interrogation
  - Lower chance of overlapping signals from aircraft at close range

- ADS-B verification done at ADS-B ground station
  - Ensure data integrity of received ADS-B information

Minimize the possibility of causing nuisance to ATC due to signal interference on the surveillance data

ADS-B Implementation in Hong Kong

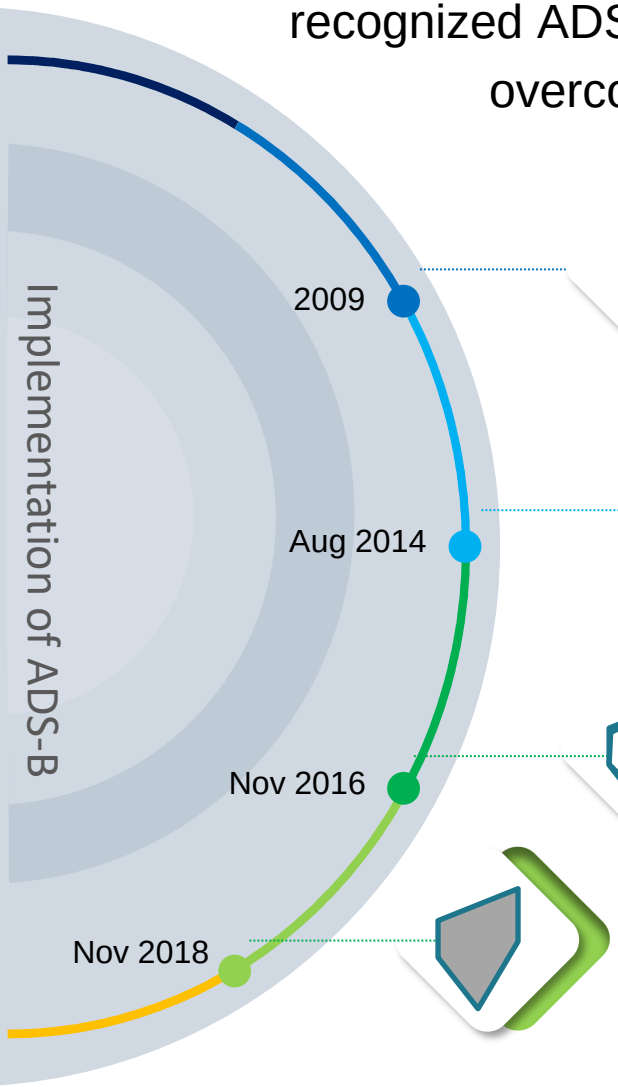
- ADS-B mandate for aircraft flying FL290+ within HKFIR effective on 8 December 2016

- ADS-B Equipage
  - More than 96% aircraft are ADS-B equipped with accurate position report transmission

- Adopted phased implementation approach in accordance with the ICAO's Safety Management System (SMS) to manage changes/risks and ensure safe and smooth ADS-B implementation

ADS-B Implementation Roadmap in Hong Kong

Surveillance Implementation Coordination Group (SURICG) of APANPIRG recognized ADS-B as a cost-effective solution to fundamentally overcome limitations of radar surveillance technology



Collaboration

Hong Kong China collaborated closely with IATA and updated the ICAO in 2009 to mandate ADS-B in phases

Mandate

Published mandate on ADS-B equipage for aircraft flying within HKFIR since Aug 2014

Initial Phases

ADS-B integrated with ATMS for operational use in southern portion of HKFIR in November 2016

Remaining Phases

ADS-B progressively integrated with ATMS for the entire HKFIR by Nov 2018

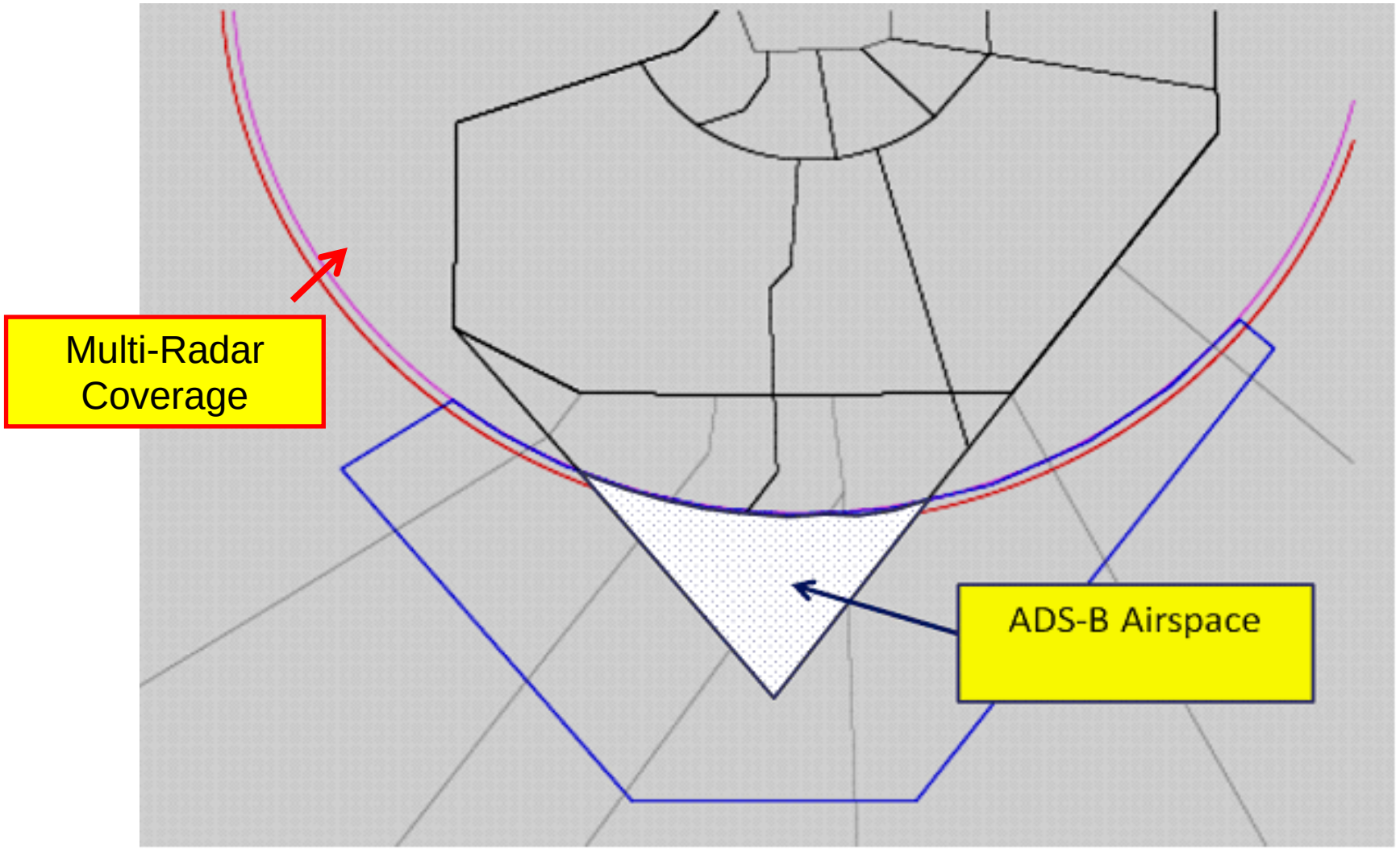
Gradual Phased Implementation of ADS-B Data into Hong Kong FIR

- Gradual and prudent phased implementation approach to ensure safe and smooth integration of ADS-B with existing radar sources into ATMS

Phase	Airspace	Complexity	Separation Minima	Status
1	Non-Radar Airspace (NRA). Minimum overlap with radar (5NM max)	Non-complex	10NM	Implemented from 14 Nov 2016
	Non-radar + partial radar airspace. Triangular portion of FIR	Non-complex	10NM	Implemented from 17 Jan 2017
2	Enhanced SDP volumes around Inner Holding Patterns + ELATO area	Non-complex	5NM	Implemented from 30 Mar 2017
3	Enhanced SDP volume at outer edge of South/Southeast TMA	Non-complex	5NM	Implemented from 7 Jun 2017
4	Whole of Area + TMC airspace	Complex	5NM	Implemented from 17 Aug 2017
5	Final Approach / Initial Departure Phases	Non-complex	3/2.5NM	Implemented from 2 May 2018
6	APP / DEP airspace	Complex	3/2.5NM	Implemented from 1 Nov 2018

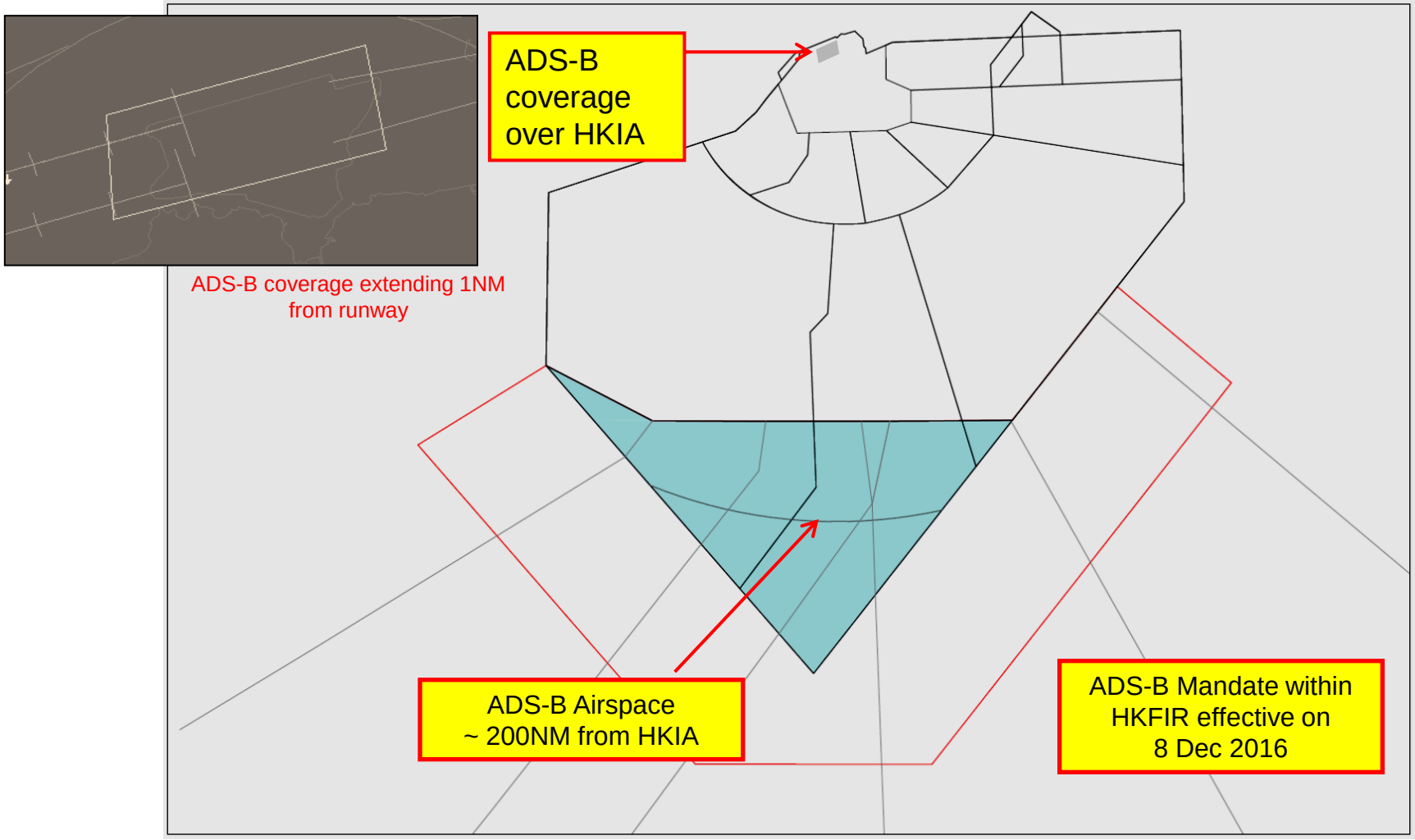
Phased Implementation of ADS-B in Hong Kong

1. ADS-B Coverage after 14 November 2016



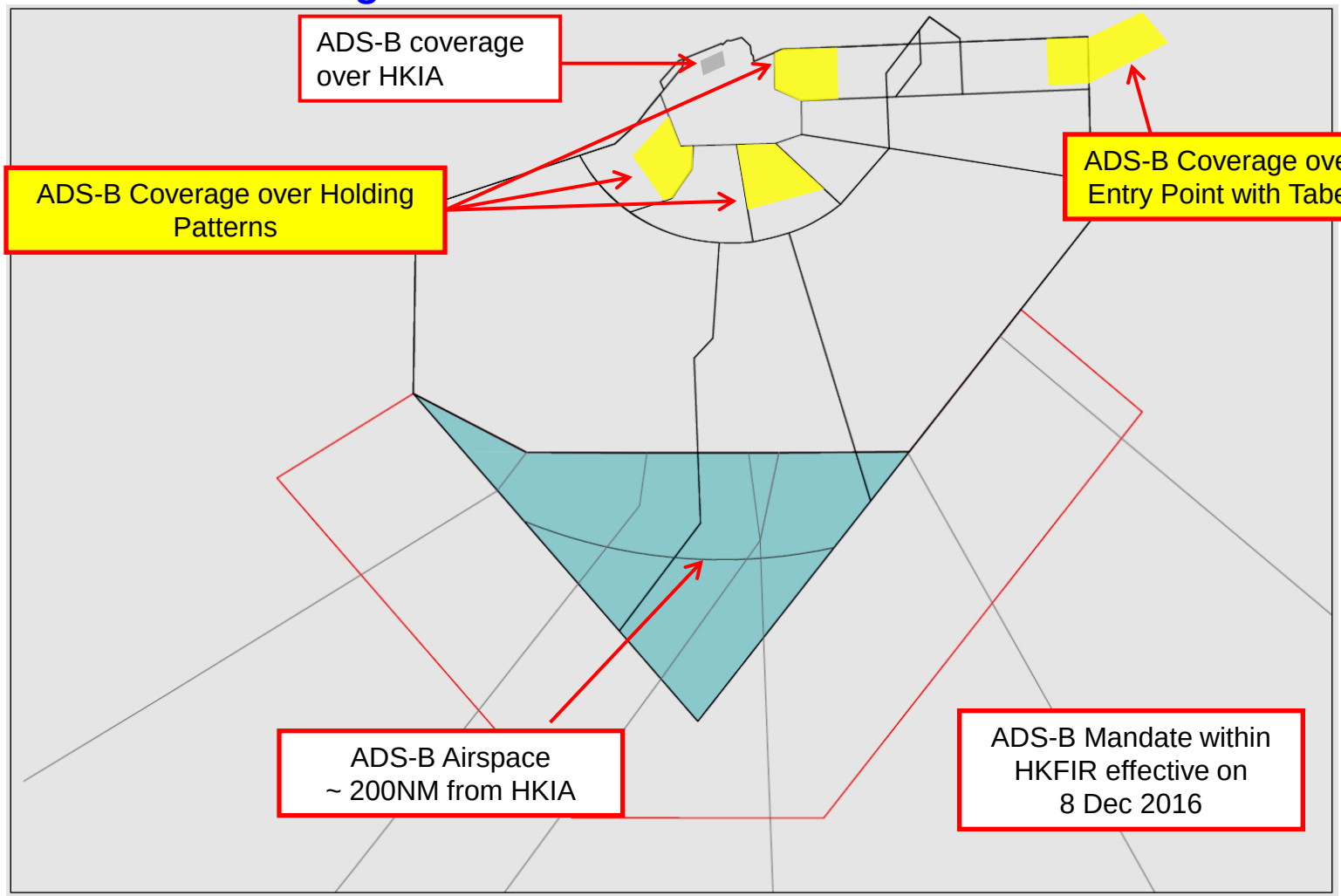
Phased Implementation of ADS-B in Hong Kong

2. ADS-B Coverage after 17 January 2017



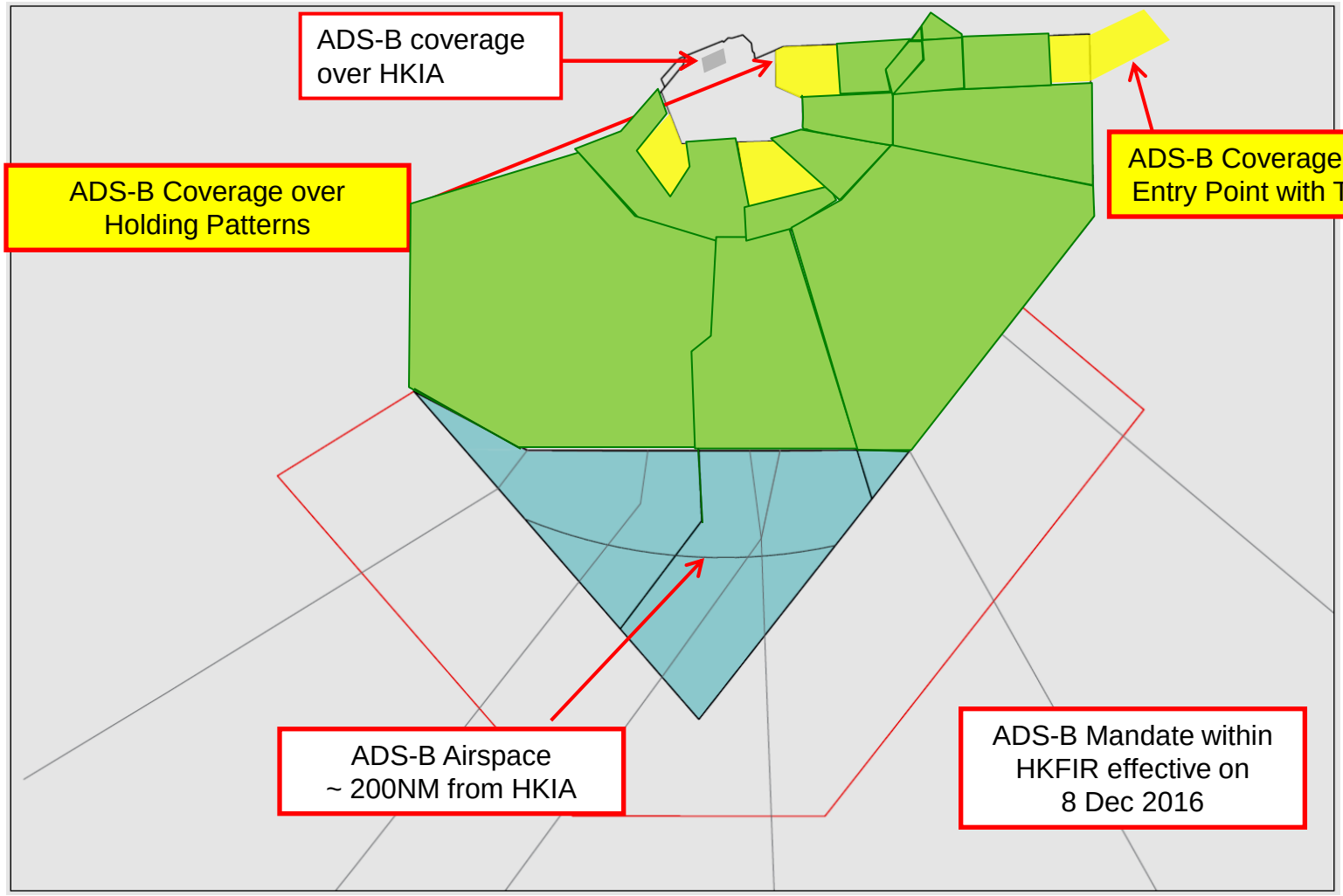
Phased Implementation of ADS-B in Hong Kong

3. ADS-B Coverage after 30 March 2017



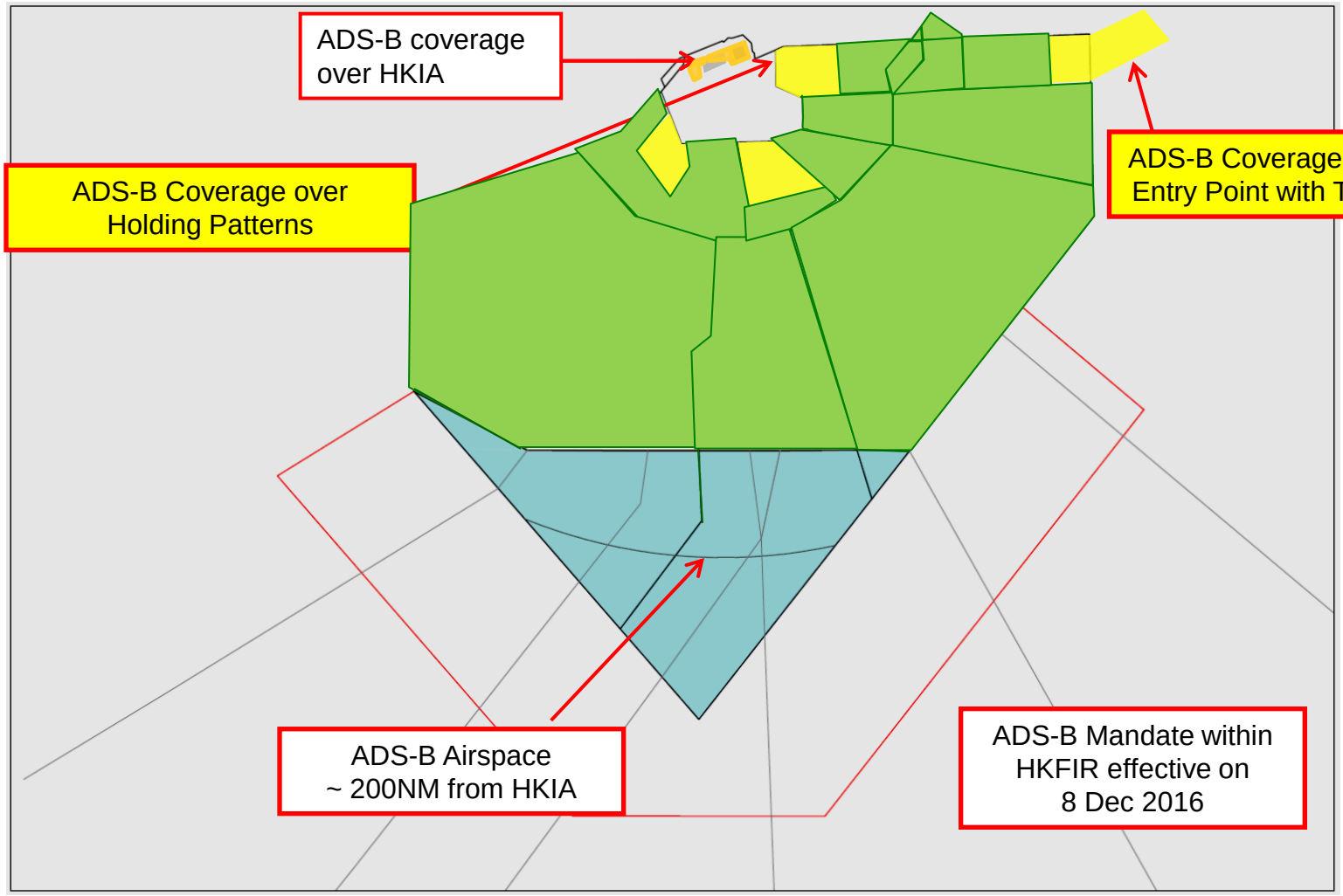
Phased Implementation of ADS-B in Hong Kong

4. Full ADS-B Coverage in Terminal and Area Airspace after 17 August 2017



Phased Implementation of ADS-B in Hong Kong

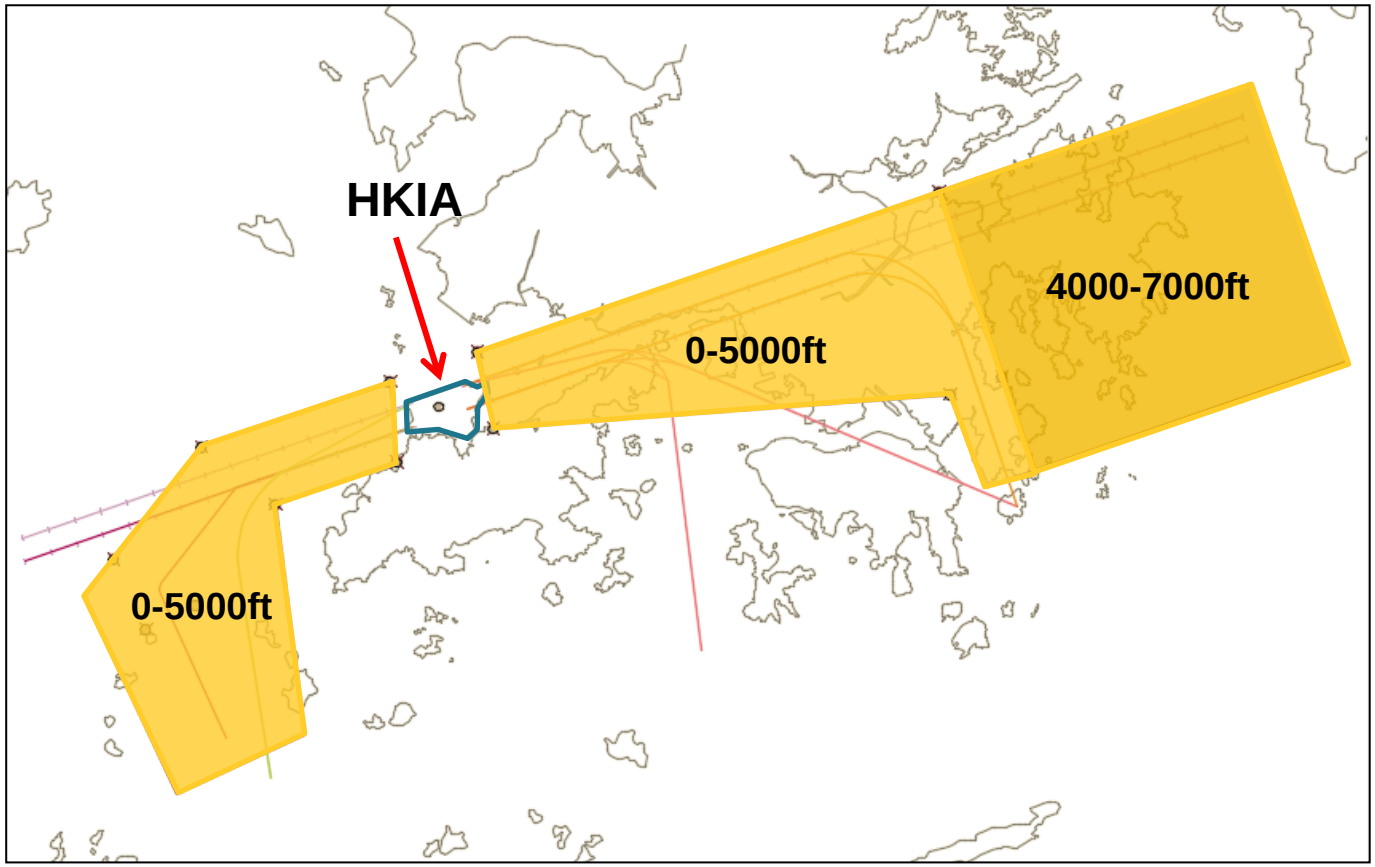
5. Full ADS-B Coverage in Final Approach Path after 2 May 2018



Phased Implementation of ADS-B in Hong Kong

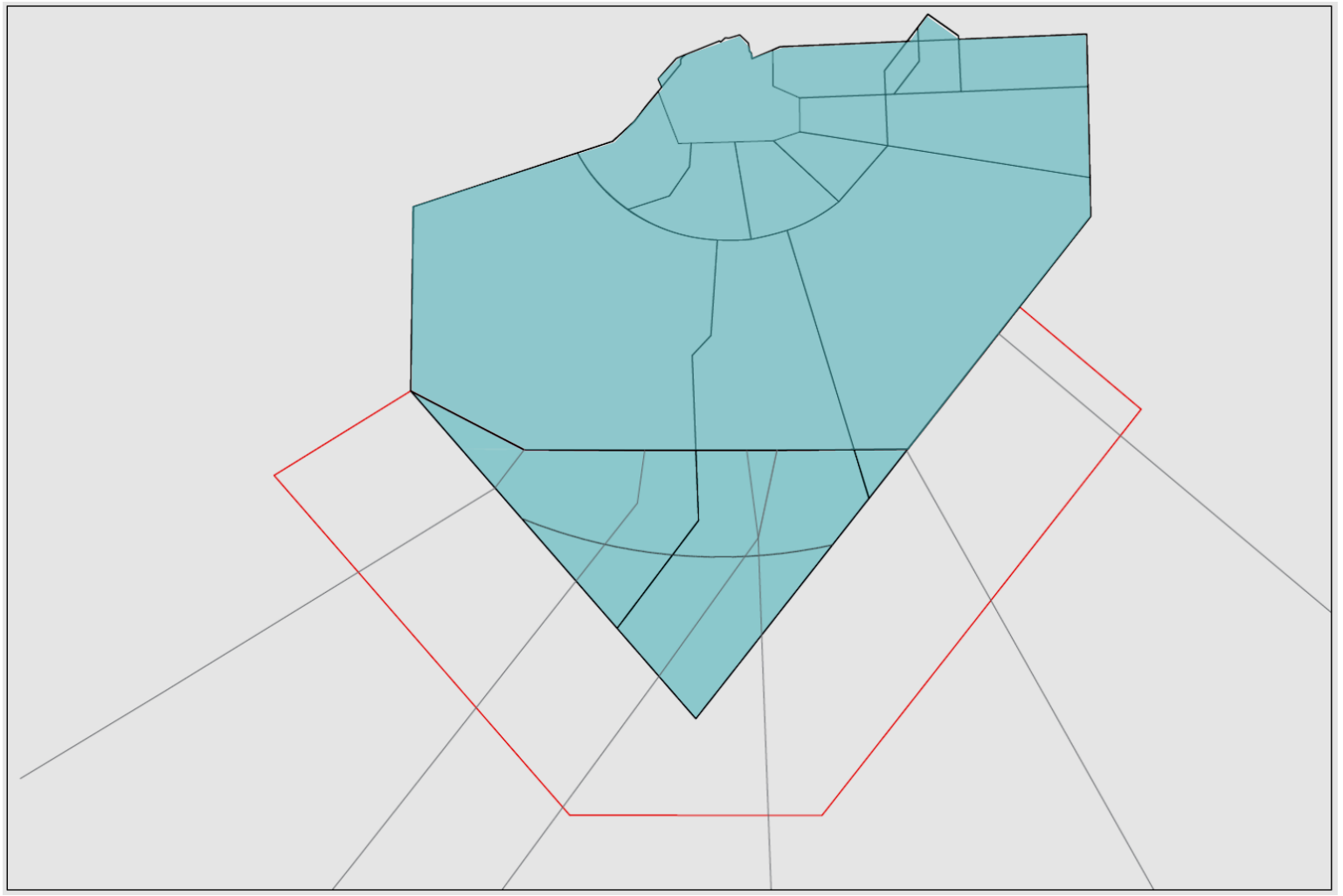
ADS-B Implementation: Final Approach Path

- Aims at improving positional accuracy and response of speed changes of aircraft in the final approach path using ADS-B



Phased Implementation of ADS-B in Hong Kong

6. Full ADS-B Coverage in whole HKFIR Airspace after 1 November 2018



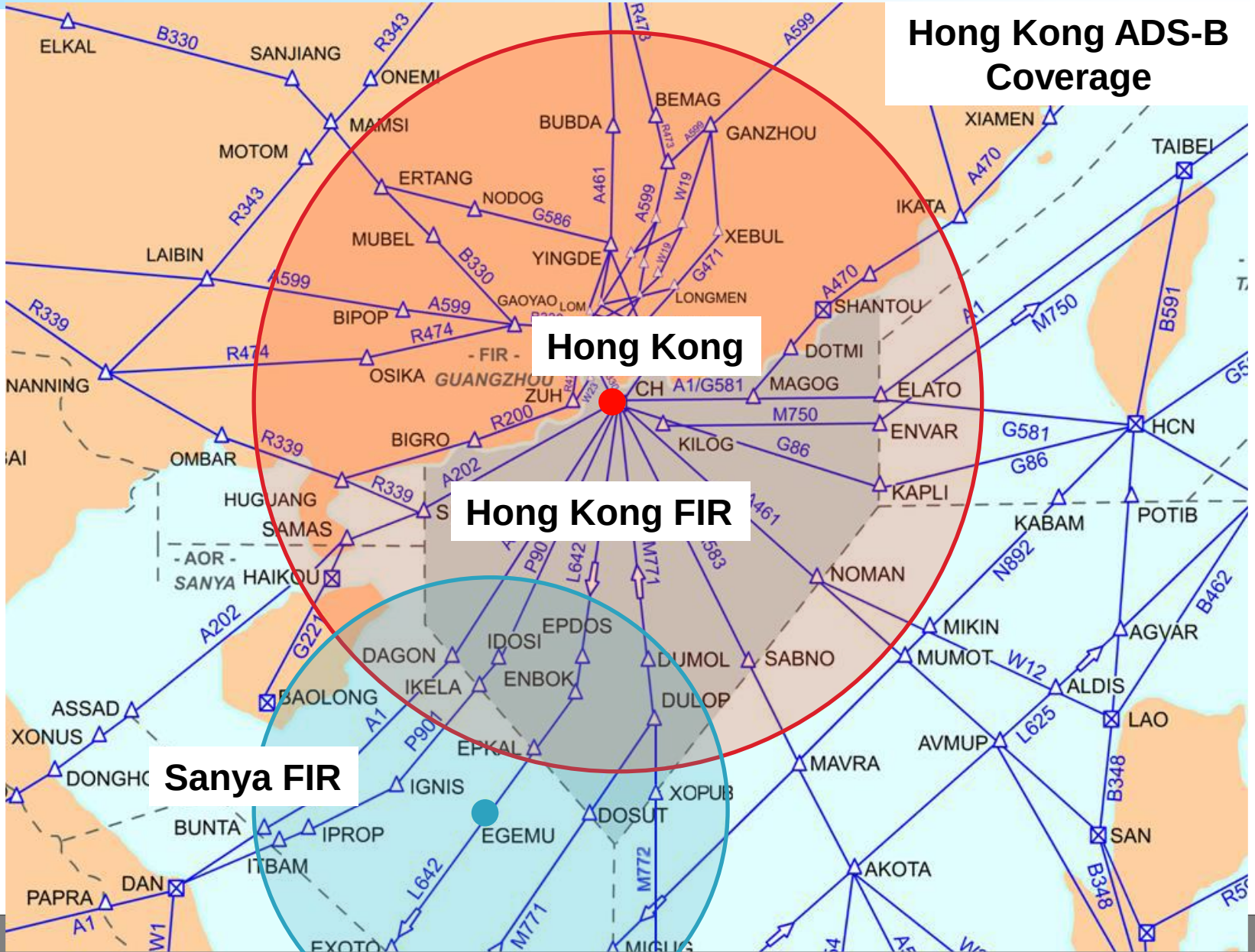
ADS-B Ground Infrastructure in Hong Kong

ADS-B Ground Stations

- ✓ Capable to detect DO260/DO260A/DO260B aircraft
- ✓ ASTERIX CAT21 Edition 2.1
- ✓ Install at 8 sties to provide optimum coverage for both high level aircraft (250NM) and low level GA/helicopters within Hong Kong territories
- ✓ Designed for inter-connection through redundant paths via optical fibres and wireless links

ADS-B Ground Station Sites in HK

Combined ADS-B Coverage of HKFIR



ADS-B Ground Infrastructure in Hong Kong

- ADS-B Central Data Processors
  - ✓ Deign followed AIGD latest version.
  - ✓ Fusion of ADS-B data fed from 8 sites in Hong Kong and ADS-B data shared by China
  - ✓ Real-time conversion for different ASTERIX CAT 21 editions (0.23/0.26/2.1)
  - ✓ Cater for both external data sharing and internal feeding to ATM automation systems
  - ✓ Filtering capabilities – pass data that meet certain criteria
  - ✓ ADS-B “Black List”

ADS-B Ground Infrastructure in Hong Kong

- Air Traffic Management System (ATMS)
  - ✓ Supports SSR and ADS-B data fusion
  - ✓ Shows different symbols for ADS-B only, ADS-B/SSR fused and SSR only targets
  - ✓ Not display ADS-B to controllers when integrity is below configurable threshold value
  - ✓ Supports monitoring of low level target from 8,000ft down to 50ft AMSL within 50NM of HKIA

Evaluation and Safety Assessment

- Basis of Assessments
  - ICAO PANS-ATM
  - ICAO APAC Regional AIGD
  - ICAO Circular 326
    Assessment of ADS-B and Multi-lateration Surveillance to Support Air Traffic Services and Guidelines for Implementation
  - ICAO APAC Regional Baseline ADS-B Service Performance Parameters
  - Eurocontrol Specification for ATM Surveillance System Performance
- Ground Conditions
  - Comms and Navigational capability remains unchanged with respect to introduction of ADS-B into the airspace

Evaluation and Safety Assessment

- AIGD
  - Describes complex airspace as having the following characteristics:
    - Higher aircraft density
    - Higher route crossing point density
    - A higher mixture of different aircraft performance levels
    - A higher rate of aircraft manoeuvring
- Circular 326
  - Technical assessment required if complex airspace involved
- Certain Phases of Implementation involved complex airspace
  - Complex airspaces have existing multi-radar coverage into MST

Evaluation and Safety Assessment

- Proof
  - No degradation of MST accuracy in the presence of ADS-B

- Methodology for Technical Assessment in Complex Airspace
  - Statistical approach by checking the actual performance of MST tracks using targets of opportunity
  - Calculate Root-Mean-Square (RMS) Error between
    - MST positions of ATMS
    - GPS positions of raw ADS-B data
  - Accuracy Analysis
    1. Benchmarking with international standards required for that airspace
    2. Comparison between multi-radar tracks and multi-surveillance tracks

Evaluation and Safety Assessment

Key Areas

- Reliability, Maintainability, Availability of ADS-B ground infrastructure
- The probability of detection, the accuracy and the integrity of the ATS surveillance system(s) are satisfactory
- Early publication of mandate to ensure adequate equipage
- Operational Separation Standards
  - Able to meet Positional Accuracy and Integrity requirements in Cir 326
- Verification
- Continuous monitoring of avionics and mechanism in place to address bad avionics
- Transition of Phases, Notification to Frontline, AIP etc

ADS-B Low Level Surveillance

- Cooperates with Government Flying Service (GFS) for design and modification of helicopter for mounting on-board ADS-B transponder

- Launched flight trials in 2013 with GFS to assess actual low-level surveillance coverage using ADS-B

ADS-B Low Level Surveillance

Low-Level Coverage Check by GFS Helicopter

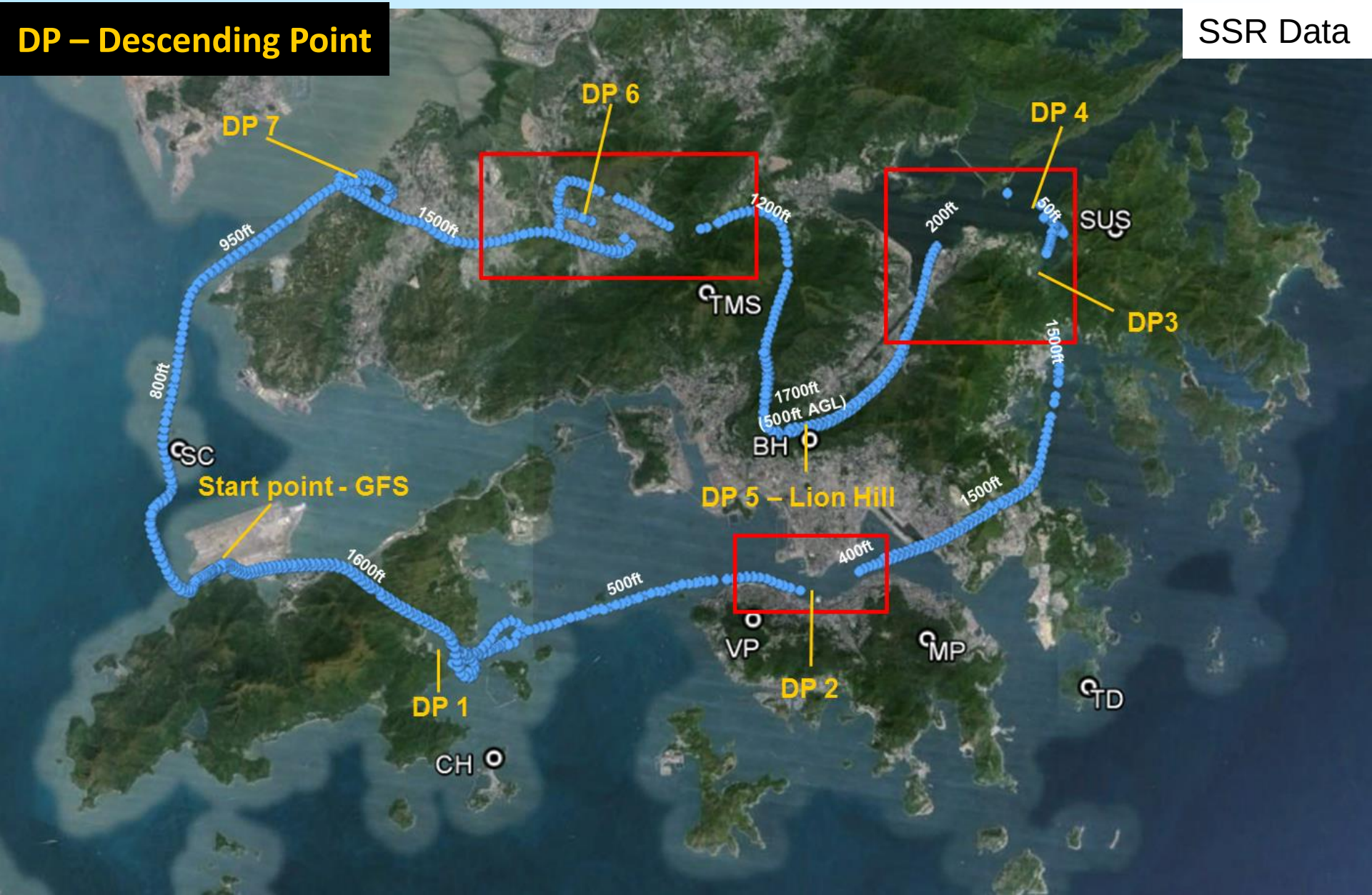
- 1st Coverage Check - Oct 2013
- 2nd Coverage Check - Jan 2014
- 3rd Coverage Check - Feb 2014

ADS-B Low Level Coverage Check Route on 22 Feb 2014

ADS-B Low Level Coverage Check Route on 22 Feb 2014

DP – Descending Point

SSR Data



ADS-B Low Level Coverage Check Route on 22 Feb 2014

Engineering Challenges

- Highly complicated safety assessment on the integration of new surveillance technologies to provide safe and efficient ATC operation

- Identify and isolate Radio Frequency Interference (RFI) from External Sources

Avionics Issues

- Not all aircraft equipped with GPS receiver and ADS-B avionics
  - “Invisible” for Non-equipped aircraft

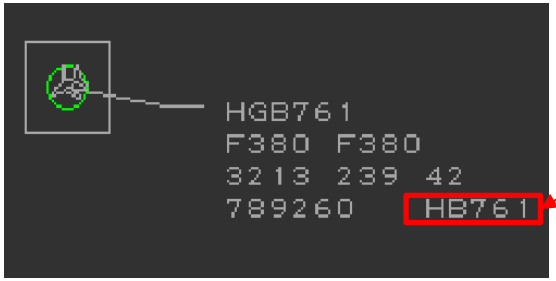
- Required close monitoring on the performance of ADS-B avionics
  - Problematic ADS-B avionics leads to incorrect aircraft position reports
  - Need to “Blacklist” aircraft with problematic transmission
  - Need to follow up with airlines or manufacturers for rectification

Position Data Integrity

- Data display with no quality checking or filtering on the ADS-B data from aircraft
  - ICAO requires ADS-B data with **Navigation Uncertainty Category NUC > 4** for 3NM separation

AD/ID Discrepancies between Surveillance Data and Flight Plan

- Surveillance Data (ADS-B)



Inconsistent ID

- Flight Plan

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Y742 SALMI Q11 DRAKE A1 ELATO V522 ABBEY-VHHH 0326 VMMC-0-PBN/A1B1C1D1L1O1S2
NAV/RNP2 SUR/260B DOF/231219 REG/BKJB EET/RJJJ0114 RCAA0132 VHHK0248 SEL/BHMR
CODE/789260 OPR/GREATER BAY AIRL RMK/WTGM TCASII EQUIPPED CALLSIGN GREATER
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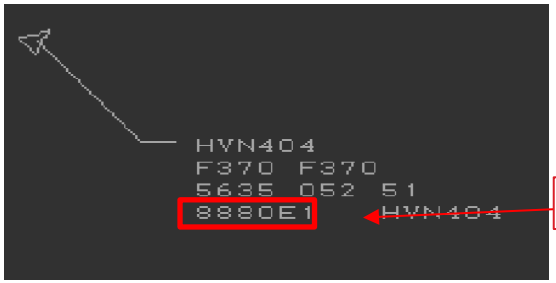

Inconsistent AD

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KADUM DCT PATMA W12 PCA G221 BUNTA/N0487F390 A1 LENKO/N0485F410 A1 IKELA DCT
MORTU DCT NOBAD DCT KAPLI G86 ANDRE A577 TNN W4 ANLOT B1 APU A1 DRAKE Q11 WP900
L4 LIPLO Y741 ATOTI Y722 OLMEN OLME2E-RKSI 0433 RKSS RKPC-0-PBN/A1B1C1D1L1O1S2
NAV/RNP2 SUR/RSP180 DOF/231219 REG/VNA867 EET/VVHN0048 ZJSA0057 VHHK0121
RCAA0200 RJJJ0307 RKRR0322 SEL/BJEM CODE/8880F7 PER/D RALT/VVDN VHHH RCTP RKPC
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Root Cause

- Input errors by pilots on the Target Identification (ID)
- Wrong/outdated entries in the database of flight management system
- Last minute change of aircraft due to maintenance

AD/ID Discrepancies between Surveillance Data and Flight Plan

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

GUIDELINE ON

CONSISTENCY OF ICAO AIRCRAFT ADDRESS AND TARGET IDENTIFICATION BETWEEN SURVEILLANCE DATA AND FLIGHT PLAN

Edition 0.0 – May 2024

Conclusion CNS/SG/28/11 (SURICG/9/2) - Guideline on addressing inconsistencies of Aircraft Address (AD) and Target Identification (ID) between Surveillance Data and Flight Plan	
What: APAC guideline on addressing inconsistencies of ICAO Aircraft Address (AD) and Target Identification (ID) between Surveillance Data and Flight Plan provided in Appendix G is adopted	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The guideline consolidated the outcomes of the Workshop on ICAO ICAO Aircraft Address and Target Identification between Surveillance Data and Flight Plan held in June 2023.	Follow-up: ☐Required from States
When: 05-July-24	Status: Adopted by Subgroup
Who: ☒Sub groups ☐APAC States ☒ICAO APAC RO ☐ICAO HQ ☐Other: XXXX	


Q
&
A
QUESTION
ANSWER

Thank you


• Safe • Orderly • Efficient
• Airworthy • Teamwork
Committed to a Safe, Efficient and Sustainable Air Transport System