International Civil Aviation Organization

ELEVENTH MEETING OF THE SOUTHEAST ASIA AND BAY OF BENGAL SUB-REGIONAL ADS-B IMPLEMENTATION WORKING GROUP (SEA/BOB ADS-B WG/11)

New Delhi, India 17 – 19 November 2015

Agenda Item 3: **Review implementation and co-ordination activities and sub-regional implementation plans**

3.1) Progress on deployment and implementation planning – Bay of Bengal

OPERATIONAL USE OF ADS-B IN INDIA

(Presented by India)

SUMMARY

This paper presents a status update on the operational use of ADS-B information, in both Radar and Non Radar Airspace(s) in India. The paper also presents the challenges faced by the ANSP and the course charted to succeed in the operational use of ADS-B information, including the way forward.

1. INTRODUCTION

1.1 India has installed 20 ADS-B stations in the mainland and one station in Port Blair, and island in Bay of Bengal.

1.2 ADS-B ground services have been installed at the following locations:

Agartala, Ahmedabad, Amritsar, Calicut, Cochin, Coimbatore, Guwahati, Jaipur, Lucknow, Mangalore, Nagpur, Port Blair, Thriuvananthapuram, Varanasi, Patna, Bhubaneswar, Dibrugarh, Mumbai, Vijayawada, Tiruchirappalli and Jaisalmer. (Refer Annexure – A). The DGCA Certification for the ground receivers installed by the ANSP, has been obtained for 15 of the ground receivers, work is in progress to obtain the approval for 6 ground receivers.

2. DISCUSSION

2.1 The Indian Regulatory Authority, in a special meeting with the ANSP emphasized the need to address the security issues pertaining to the operational use of ADS-B information, especially listed in the ICAO APAC "GUIDANCE MATERIAL: SECURITY ISSUES ASSOCIATED WITH ADS-B". Whereas, the DGCA India was responsible for the Ground Receiver Certification and the Operational Approval of Aircraft. AAI the ANSP was vested with the responsibility of the operational use of ADS-B information after mitigating vulnerabilities.

2.2 AAI issued an Air Traffic Management Circular (ATMC) 15 of 2014 to comprehensively address ADS-B implementation in India, with a special emphasis and exhaustive details on "ADS-B Security related Vulnerabilities and Mitigation Measures". The ATMC also addresses the Performance Monitoring and Reporting Guidelines for ATM and CNS personnel at various ATC Centres and ADS-B ground receiver stations. (Refer Annexure – B).

2.3 The Trial Operations of ADS-B in NRA in both Enroute Airspace at Port Blair and terminal Airspace in Tiruchirapalli has commenced and the results are encouraging. A detailed report on the implementation has been submitted to the DGCA. (Refer Annexure – C).

2.4 The integration of ADS-B data into the ATS Automation systems at Chennai, Kolkata, Nagpur, Ahmadabad, Tribandrum, Varanasi, Cochin, Coimbatore, Calicut, Tiruchirapalli, Lucknow, Guwahati, Agartala, Bhubaneswar and Patna have been completed. The integration of ADS-B sensors in the Delhi FIR is expected to be completed in Q1 2016, when the ATCC migrates to a new ATS Automation system and the integration of ADS-B sensors into the Mumbai ATS Automation system is expected to be completed in near term by the OEM.

2.5 The user benefits have been encouraging and India is now contemplating to plan six additional ADS-B ground receivers at vantage points including Agatti Island in the Arabian Sea and Cambell Bay in the Bay of Bengal, near the FIR boundaries of Chennai, Jakarta and Kuala Lumpur. The installation of an ADS-B receiver at Campbell Bay under the Indian Civil Military Cooperation Programme will enable seamless ATM across the three FIRs.

2.6 The ADS-B data sharing agreement between India and Myanmar has been signed in February 2015 at the CANSO meeting in Japan and India has proactively engaged other States in the BOBASIO/5 meeting held in Delhi in Q2 2015.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

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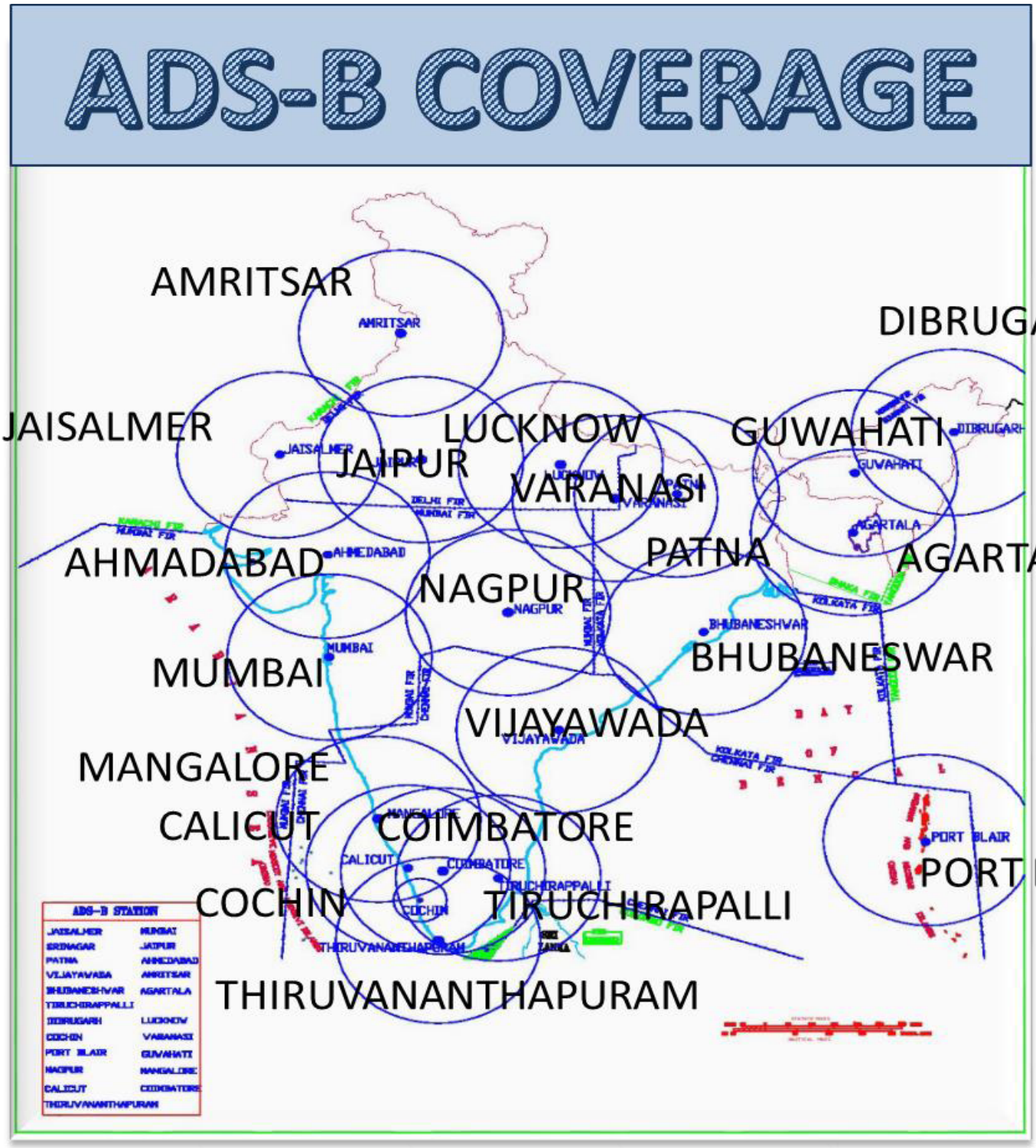
Annexure – A

ADS-B COVERAGE



भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA
DIRECTORATE OF AIR TRAFFIC MANAGEMENT
RAJIV GANDHI BHAWAN, NEW DELHI-110003
[File No. AAI/ATM/OPS/30-68/2014]

Doc. Id: ED/ATM/2014/306801/ATMC/PROC

ATMC

AIR TRAFFIC MANAGEMENT CIRCULAR NO. 15 of 2014

Automatic Dependent Surveillance – Broadcast (ADS-B)

1. Introduction:

1.1 AAI has installed Automatic Dependent Surveillance-Broadcast (ADS-B) ground receivers across India at the following locations:

i.	Agartala	ii.	Ahmedabad	iii.	Amritsar
iv.	Calicut	v.	Cochin	vi.	Coimbatore
vii.	Guwahati	viii.	Jaipur	ix.	Lucknow
x.	Mangalore	xi.	Nagpur	xii.	Port Blair
xiii .	Thiruvananthapuram	xiv.	Varanasi	xv.	Patna
xvi .	Bhubaneswar	xvii.	Dibrugarh	xviii.	Mumbai
xix .	Vijayawada	xx.	Tiruchirappalli	xxi.	Jaisalmer

1.2 ADS-B ground stations at these 21 locations, is envisaged to provide redundancy to existing Radar network and extend ATS surveillance to airports, continental and oceanic airspace currently without radar coverage and facilitate in filling the surveillance gaps in the airspace. The ADS-B surveillance information from any of the many ground stations are integrated with ATS Automation systems serving the ATC Centres at the Airport or Enroute Centres.

1.3 The advanced ATS Automation Systems at major ATC Centres, have the capability of processing ADS-B surveillance input and presenting the information on the Situation Data Display (SDD) as standalone ADS-B tracks or fused with radar position symbols, in a multi surveillance sensor environment.

1.4 ADS-B ground station at Port Blair provides surveillance coverage over the oceanic airspace in the Bay of Bengal Region, thereby converting significantly a remote airspace into a surveilled airspace. The Port Blair ADS-B information is integrated into the ATS Automation Systems at Chennai and Kolkata, to improve the efficiency of Oceanic Control.

1.5 ADS-B data sharing with neighbouring ANSPs is a key enabler to the implementation of Seamless ATM in the ICAO APAC Region.

1.6 ADS-B applications, requirements, functional capabilities are provided in detail in Part VII of Manual of Air Traffic Services Data Link Application (Doc 9694) and the standards and recommended practices pertaining to the use of ADS-B in the provision of ATS Surveillance services is provided in Chapter 8 of PANS – ATM (Doc 4444).

1.7 Procedures in this ATMC are supplementary to the procedures contained in MATS-1 chapter 8 and phraseology contained in Chapter 12. AIP Supplement 18 of 2014 and DGCA OC 17 of 2014 should be read in tandem with this Circular.

2 Purpose:

1.8 Purpose of this ATMC is to provide guidance to Controllers and CNS personnel, on the implementation and use of ADS-B.

3 Scope:

3.1 This ATMC is applicable to all Air Traffic Controllers working at various AAI airports/ATC Centres/ATS Units wherever ADS-B surveillance system is available and CNS personnel working at ADS-B ground receiver stations and ATC Centres wherever ADS-B surveillance system is available.

4 ADS-B system Description

4.1 ADS-B system architecture

4.1.1 The ADS-B system architecture comprises of aircraft avionics and ground infrastructure. On-board avionics determine the position of the aircraft, typically by using the Global Navigation Satellite Systems (GNSS) and transmit this and additional information about the aircraft to ground stations for use by ATC and to aircraft equipped with ADS-B IN capability.

4.2 ADS-B operating Frequency

4.2.1 In accordance with the recommendation made by Eleventh ICAO Air Navigation Planning Conference , India is using 1090MHz Extended Squitter data link for ADS-B data exchange over Indian Airspace.

4.2.2 ADS-B Ground stations shall be capable of detecting, identifying and tracking targets equipped with ADS-B transponders compliant with ICAO SARPS Annex 10. Volume IV and 1090MHz Extended Squitter avionics compliant with Manual on Secondary Surveillance Radar (SSR) Systems (DOC9684) and following RTCA (Radio Technical Commission for Aeronautics)

i) DO-260 (Minimum Operational Performance Standards for 1090 MHz ADS-B),
ii) DO-260A [Minimum Operational Performance Standards for 1090 MHz ADS-B and Traffic Information Services-Broadcast (TIS-B)],
iii) DO-260B (Minimum Operational Performance Standards for 1090 MHz Extended Squitter ADS-B and TIS-B),
iv) DO-259 [Applications Descriptions for Initial Cockpit Display of Traffic Information (CDTI) Applications].

4.3 ADS-B Avionics Operating Modes

4.3.1 **ADS-B OUT:** The transmission of ADS-B information from aircraft is known as ADS-B Out.

4.3.2 **ADS-B IN:** The receipt of ADS-B information by an aircraft is known as ADS-B In.

5 Operational Requirement

5.1 ATS surveillance systems, such as primary surveillance radar (PSR), secondary surveillance radar (SSR) and automatic dependent surveillance — broadcast (ADS-B) may be used either alone or in combination in the provision of Air Traffic Services, including in the provision of separation between aircraft, provided:
a) reliable coverage exists in the area;
b) the probability of detection, the accuracy and the integrity of the ATS surveillance system(s) are satisfactory; and
c) the availability of ADS-B data from participating aircraft is adequate.

5.2 ADS-B may be used alone in the provision of separation between aircraft, provided:
a) identification of ADS-B-equipped aircraft is established and maintained;
b) the data integrity measure in the ADS-B message is adequate to support the separation minimum;
c) there is no requirement for detection of aircraft not transmitting ADS-B; and
d) there is no requirement for determination of aircraft position independent of the position-determining elements of the aircraft navigation system.

5.3 Operation of ADS-B transmitters

5.3.1 To indicate that it is in a state of emergency or to transmit other urgent information, an aircraft equipped with ADS-B might operate the emergency and/or urgency mode as follows:
- emergency;
- communication failure;
- unlawful interference;
- minimum fuel; and/or
- medical emergencies.

***Note**: Some aircraft equipped with first generation ADS-B avionics do not have the capability described above and only have the capability to transmit a general emergency alert regardless of the code selected by the pilot.*

5.3.2 Aircraft equipped with ADS-B having an aircraft identification feature shall transmit the aircraft identification as specified in Item 7 of the ICAO flight plan or, when no flight plan has been filed, the aircraft registration.

5.3.3 Whenever it is observed on the situation display that the aircraft identification transmitted by an ADS-B-equipped aircraft is different from that expected from the aircraft, the pilot shall be requested to confirm and, if necessary, re-enter the correct aircraft identification.

5.3.4 If, following confirmation by the pilot that the correct aircraft identification has been set on the ADS-B identification feature, the discrepancy continues to exist, the following actions shall be taken by the controller:

a) inform the pilot of the persistent discrepancy;

b) where possible, correct the label showing the aircraft identification on the situation display; and

c) notify the next control position and any other unit concerned of the erroneous aircraft identification transmitted by the aircraft.

5.4 ADS-B Identification Procedures

5.4.1 Where ADS-B is used for identification, aircraft may be identified by one or more of the following procedures:

a) direct recognition of the aircraft identification in an ADS-B label;

b) transfer of ADS-B identification;

c) observation of compliance with an instruction to TRANSMIT ADS-B IDENT.

5.5 Separation minima for ADS-B systems

5.5.1 The horizontal separation minimum based on ADS-B shall be as is applicable in the case of radar

a) 5NM within 60 NM of ADS-B ground station
i.e., in the terminal airspace served by the ADS-B receiver.

b) 10NM beyond 60NM of ground station
i.e., in the en route airspace

5.6 ADS-B Phraseology

5.6.1 Phraseologies to be used for ADS-B has been provided in Chapter 12, of MATS Part 1. However, for quick reference phraseologies have been reproduced below:

CIRCUMSTANCES	RADAR PHRASEOLOGY	ADS-B PHRASEOLOGY
Termination of radar and/or ADS-B service	IDENTIFICATION TERMI NATED [DUE (reason)] (instructions)	
Radar or ADS-B ground equipment un-serviceability	SECONDARY RADAR OUT OF SERVICE (appropriate information as necessary) or PRIMARY RADAR OUT OF SERVICE (appropriate information as necessary)	ADS-B OUT OF SERVICE (appropriate information as necessary).
To request the aircraft's SSR or ADS-B capability	ADVISE TRANSPONDER CAPABILITY	ADVISE ADS-B CAPABILITY
To advise the aircraft's SSR or ADS-B capability	TRANSPONDER (ALPHA, CHARLIE or SIERRA as shown in the Flight Plan) or NEGATIVE TRANSPONDER	ADS-B TRANSMITTER (TEN NINETY DATALINK) or ADS-B RECEIVER (TEN NINETY DATALINK) or NEGATIVE ADS-B
To request reselection of FLT ID*	RE-ENTER MODE S AIRCRAFT IDENTIFICATION	RE-ENTER ADS-B AIRCRAFT IDENTIFICATION
To request the operation of the IDENT feature*	SQUAWK [(code)] [AND] IDENT	TRANSMIT ADS-B IDENT
To request termination of SSR transponder or ADS-B transmitter operation*	STOP SQUAWK [TRANSMIT ADS-B ONLY]	STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY]
To request transmission of pressure altitude*	SQUAWK CHARLIE	TRANSMIT ADS-B ALTITUDE
To request termination of pressure altitude transmission due to faulty operation*	STOP SQUAWK CHARLIE WRONG INDICATION	STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION or reason)]

6 Training

6.1 Since ADS-B is one of the surveillance systems and used for the provision of air traffic control service, procedure contained in Chapter 8 of MATS Part 1 shall

also be applicable to ADS-B. ADS-B Training and Rating Endorsement of ATCOs will be governed by AAI/ATM/HRD/29-12/2013 dated 20th June 2013.

7 ADS-B Security-related Vulnerabilities and Mitigation Measures

7.1 All ADS-B technologies are currently defined as **"open systems".** The data, including position and flight identification are broadcast by aircraft and can be received by any airborne or ground based receiver. The signal and transmitted data are fully standardized and those standards are public. This situation is not specific to ADS-B and is very similar for other civil aviation CNS technologies.

7.2 It can also be noted that ADS-B transmission from commercial aircraft is a "fact of life" today. Many commercial aircraft are already equipped with ADS-B and have been transmitting data for some time. DGCA Operational Circular 17/2014 on the subject: "Automatic Dependent Surveillance-Broadcast (ADS-B) Operations and Operational Authorization", states that the intent of this operations circular (OC) is to facilitate operations using Automatic Dependent Surveillance-Broadcast (ADS-B) technology. This OC applies to all Indian aircraft and operators intending to use ADS-B. India does not mandate ADS-B equipage at this time, however ADS-B ground infrastructure has been set up for implementation of ADS-B operations in Indian airspace. ADS-B shall be used for the provision of Air Traffic Services, including 'radar-like' separation. The Automatic Dependent Surveillance Broadcast "(ADS-B) OUT" transmissions on 1090MHz Extended Squitter (1090ES) data link will be used for provision of ATS surveillance services to eligible aircraft within notified portions of Indian airspace(s).

7.3 The nature and complexity of ATC provides for adequate mitigation to the security related issues, for which ICAO APAC has issued "GUIDANCE MATERIAL: SECURITY ISSUES ASSOCIATED WITH ADS- B. The primary objective is uniform adoption of the mitigation measures suggested in the Guidance Material which the ATS Surveillance and Automation Systems are capable of.

7.4 The security related vulnerabilities have been mainly classified as related to Confidentiality, Integrity and Availability. Confidentiality is the property that information is accessible only to those authorized to have access. Integrity is the property that data cannot be created, changed or deleted without authorization. Availability is the property that aircraft information is available to the ATM system/unit when needed.

7.5 Confidentiality

7.5.1 "Confidentiality" needs to be balanced against a significant intent of ADS-B; namely to allow all airspace users have visibility of all other airspace users.

7.5.2 Since the flight number and position of aircraft are available to the public, due to the open architecture of ADS-B, Controllers should be aware that procedures to the open architecture of ADS-B, Controllers should be aware that procedures to support sensitive flights to use different flight identities, may be developed and made applicable by security agencies/DGCA from time to time.

7.5.3 It is also pertinent to note that military flights may use DF19 (Military Extended Squitter) encrypted ADS-B transmissions, in future or DF 22 (Military use only) and Mode 5 [secure/crypto]. Controllers should keep themselves abreast of the regulatory provisions in force, from time to time.

7.5.4 Since, the unique 24 bit code identifies the aircraft and is available to the public, sensitive and military flights, which have the capability to switch off ADS-B may require special handling. Controllers should be aware that military flights may not carry ADS-B on board or switch off ADS-B in order to conceal the unique 24 bit code which uniquely identifies the aircraft. The provisions of PANS ATM (Doc4444) to apply appropriate separation between ADS-B tracks and non-ADS-B tracks, which may be Radar tracks or flight plan tracks, should be ensured by the Controllers.

7.5.5 Due to a threat perception regarding the use of position and aircraft ID data for the coordination of attacks against specific airborne targets (e.g. VIP), the flights operating on special missions, such as carrying VIPs on board may be allowed, by appropriate authority and/or the regulator, the use of different 24 bit codes. ATC Supervisors, Controllers and DBMS Managers should be aware of these provisions.

7.5.5 In order to mitigate the use of position and aircraft ID data for economic intelligence: surveillance of business aircraft or commercial aircraft, DGCA may prescribe procedures to support sensitive flights to use different flight identities. Controllers should be aware of such procedures prescribed, from time to time.

7.6 Integrity

7.6.1 Transmission of false messages from virtual aircraft (spoofing) and the risk of false alarms (STCA), false traffic information, spurious separation manoeuvres, thereof is a vulnerability related to integrity.

7.6.2 However, the fact that ATS Automation Systems (at the ATCCs) are capable of multiple surveillance sensor processing, providing the capability to fuse PSR/SSR and ADS-B tracks. The DBMS Managers/ Operational supervisors shall ensure that the Controllers are suitably updated about the availability/non-availability of PSR/SSR inputs either through systems alerts or through notices or both.

7.6.3 In addition, the ATS Automation systems installed at various ATC Centres are capable of identifying and differentiating a track with an aircraft ID different from that in an FPL.

- identifying and not correlating a FPL track with an ADS-B track if the ADS-B track's position is more than a specified variable parameter (say 10NM).
- After proper correlation provide Route Adherence Monitoring and raising Route offset alert, in case of an ADS-B track outside the lateral clearance limits.
- Providing alerts in case of DUP ID

- Not updating flight plan if the surveillance position report off the route is beyond acceptable parameter(s).
- Providing level burst (LB) alert if the ADS-B track is outside the vertical clearance limits.
- Addressing Positional data "jumps" in a multi sensor surveillance processing environment and thereby providing the "reasonableness check".
- Identifying an ADS-B track which is more than 0.5NM in position from a Radar track and not fusing the same, thus raising an alert.
- Not displaying ADS-B tracks with integrity value (NUCp) less than 5.
- Providing the Controller with the option to choose the associated FPL in case of multiple FPLs with the same callsign, and allow manual correlation.
- Not coupling ADS-B track data to a flight plan if the track arrives into coverage at an unexpected position or arrives into coverage at an unexpected time, or without coordination.

7.6.4 ATC Voice reports, CPDLC position reports, SSR and ADS-C surveillance backup provide a definite method to correlate the ADS-B track. In case of ambiguity regarding an ADS-B track, the Controller shall obtain through voice position reports, similar to identification of PSR tracks, the VOR Radial and distance from the DME to verify the ADS-B derived information. The ADS-B information obtained from the Port Blair ADS-B receiver, should be verified through ADS-C position reports or through CPDLC.

7.6.5 The multiple surveillance environment permits the comparison between PSR/SSR tracks and ADS- B tracks, in case of ambiguity and thus validate the range of the aircraft. The DBMS Managers and the Controllers shall be aware of these features and the Controllers should check the functionalities at least once during their assuming a Controller work position. The Operational Supervisor shall monitor the system for these functionalities and immediately report any anomaly to the DBMS team. Whereas, the automated tools are adequate to warn controllers of potential hazards, it is important to employ the tools effectively to mitigate the threats.

7.6.6 Although the vulnerability of alteration of messages during their transmission between the ground stations and the ATM system, is a theoretical possibility, in India, most of the ADS-B ground receivers are installed within the premises of the ATC Technical Building. The data received by the ADS-B antenna is transferred through physical media (LAN cable) to the equipment room situated in the same building and from there it is transmitted again through physical media to the ATS automation system. The end to end systems are located within the sterile and secure airside area of airports, and the entry to the ATS-Technical building is restricted to authorized personnel. The CNS Engineers are required to secure the ADS-B receivers and the data transmission cables/lines so that the physical access is absolutely restricted to authorized personnel only.

7.6.7 From ADS-B stations such as Port Blair, ADS-B data is transmitted to the ATC Centres (to Chennai or Kolkata) through secure data transmission channels provided by BSNL, which is State owned and provides suitable security to the data transfer, as a service provider. The Technical Supervisor at these ATC

Centres shall perform hourly checks by verifying the ADS-B derived information and SSR data when available, or alternately ADS-C derived position reports.

7.6.8 Although, the chances of alteration of ADS-B messages during their transmission between the ground stations and the ATM system is extremely improbable, the CNS engineers at the ATC Centre(s) should carry out periodic checks to ensure that there is no scope for alteration of ADS-B messages during their transmission.

7.6.9 Another integrity related vulnerability is the possible loss of aircraft visualisation on controller display due deleted messages. Appropriate protections are available for the security of ADS-B transmission network between Ground station and ATC Centre(s) and there is no possibility for deletion of ADS-B data before it reaches the ATS Automation system, which may lead to loss of aircraft visualization on SDD.

7.6.10 Doc 4444 clearly lists the separation to be applied between ADS-B tracks (surveillance separation minima) and between ADS-B and FPL tracks (procedural separation minima). Provision of traffic information to aircraft and use of flight progress strips (manual or electronic) is an additional mitigation measure. The Controllers should strictly adhere to the SARPS in the PANS – ATM (Doc 4444).

7.6.11 Controllers should further ensure that in NRA, there is a proper record of flight progress through paper or electronic strip markings, so as to enable a smooth transition from the application of surveillance based separation minima to procedural separation minima.

7.7 Availability

7.7.1 ATM systems and controllers typically have processes to be used following loss of surveillance and other information. These should take into account possible loss of ADS-B information for both malicious and inadvertent or accidental outages.

7.7.2 The jamming of a receiving ground station has an effect which is somewhat identical to ground station failure. In case of an unusual occurrence of jamming, Radar based surveillance may be continued In RAD environment and procedural control should be resorted to in NRA environment. In the event of jamming of GPS in a particular geographical area, Controllers should be aware that avionics are becoming available that meld GPS with inertial positional data to coast through. However, outages of a longer duration may result in loss of position information which is dependent on GPS.

7.7.3 In the event of spoofing, which has an effect, somewhat identical to ground station failure, ADS-B ground station (if data flooding occurs) should be disconnected.

7.7.4 In summary, from the ATC perspective, if any of the above mentioned events occur, use of ADS-B for ATC purposes shall be discontinued. ADS-B input from the sensor, which is the source of such events, to the ATS automation system

should be disabled immediately. The Controller shall warn aircraft under his/her control about the presence of a spurious ADS-B transmissions in the area and should be discouraged from using ADS-B IN functionalities, if the capability is so recorded in its flight plan.

7.8 Performance Monitoring and Reporting

7.8.1 The ATM and CNS in charge of the ATC Centres shall review the performance of ADS-B and prepare a quarterly report taking into consideration the following parameters:

a) ADS-B ground receivers (each sensor) (serviceability/unserviceability) to provide availability information.
b) The medium used for data transfer and data security
c) Integration of ADS-B data into the ATS Automation system and period disabled, if any.
d) Performance parameters to ensure integrity of ADS-B information in the ATS Surveillance (Automation) System, by verification through comparison with SSR data and/or voice report based on aircraft's VOR/DME derived position information.

7.8.2 In brief, the quarterly report should contain details of downtime, anomalies, occurrence of spoofing, if any and the action taken on observing undesirable occurrences or non-adherence to prescribed performance parameters.

7.8.3 The quarterly reports should be analyzed by the ED (CNS) and ED (ATM) who shall in turn ensure that further measures are employed to mitigate the threats and enhance safe operations while using ADS-B information in providing ATS Surveillance Services.

8 Queries:

8.1 Any queries or further guidance required on the contents of this ATMC should be addressed to:

Executive Director [ATM]
Airports Authority of India
Rajiv Gandhi Bhawan
Safdarjung Airport
New Delhi-110003
E-mail: edatm@aai.aero

9 Validity:

9.1 This ATMC supersedes ATMC 2 of 2012 and will remain in force until further notice.

(P.K. Mishra)
EXECUTIVE DIRECTOR [ATM]
AIRPORTS AUTHORITY OF INDIA
Dated: 24-12-2014.

Annexure – C

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

ADS-B OPERATIONALIMPLEMENTATION REPORT (TRIAL OPERATIONS)

ADS-B OPERATIONALIMPLEMENTATION REPORT (TRIAL OPERATIONS)

The 21 ADS-B ground stations installed by the Indian ANSP are located at the following places:

ADS-B GROUND RECEIVER NETWORK		
AGARTALA	AHMADABAD	AMRITSAR
BHUBANESWAR	CALICUT	COCHIN
COIMBATORE	DIBRUGARH	GUWAHATI
JAIPUR	JAISALMER	LUCKNOW
MANGALORE	MUMBAI	NAGPUR
PATNA	PORT BLAIR	VARANASI
TIRUCHIRAPALLI	THIRUVANANTHAPURAM	VIJAYAWADA

The following ADS-B receivers have been certified by the DGCA:

Agartala, Ahmadabad, Amritsar, Calicut, Cochin, Coimbatore, Guwahati, Jaipur, Lucknow, Nagpur , Port Blair, Vijayawada, Varanasi, Tiruchirapalli (Trichy) and Thiruvananthapuram (Trivandrum).

The following ADS-B receivers are yet to be certified by the DGCA:

Bhubaneswar, Dibrugarh, Mumbai, Mangalore, Patna and Jaisalmer.

ADS-B Operational Trials have been carried out in Chennai FIR, which is the first FIR in which the Upper Airspace Harmonization Plan has been implemented, in 2011, with “multiple surveillance sensor integration” being one of the key enablers in the UAH implementation. Furthermore, the integration of ADS-B sensors into Mumbai and Delhi ATCCs is being negotiated with the OEM, since, software modifications are required. The Operational trials in Kolkata ATCC is yet to

commence due three of the five ADS-B sensors in the FIR are yet to be certified. The certification is a pre-requisite to the operational use of ADS-B information.

The Operational trials of ADS-B in Chennai ATC Centre with the integration of Port Blair ADS-B sensor commenced on 30th June 2015 for a period of 7 hours daily (0430 to 1130 UTC) in the Oceanic Control Centre and has been highly successful. Chennai ATCC has completed the training and rating (ADS-B endorsement) of 105 out of 109 radar controllers (RSR).

The G Series NOTAM and the details of the trial operations of operational use of ADS-B information in Chennai ATCC (Port Blair) is appended as ANNEX-1.

The Operational trial of ADS-B in Trichy ATCC commenced on 27th July, 2015 for a period of 2 hours on week days (MON – FRI between 0830 – 1030 hours). The ADS-B Operational trials in Trichy has been highly successful and the airspace users, especially the international airlines have highly commended the implementation and urged to extend the operations during the entire period of watch. One Controller was rated at Trichy for ADS-B based surveillance services in the approach control phase and other Controllers are undergoing training during the operational trial hours. The Chennai Radar feed has been integrated into the Trichy ATS Automation System as an additional surveillance backup.

The G Series NOTAM and the details of the trial operations of operational use of ADS-B information in Trichy ATCC is appended as ANNEX-1.

Two Controllers have been rated for ADS-B in Calicut and one Controller has been rated for ADS-B in Coimbatore, training of the local Controllers is in progress. The Cochin Radar feed has been integrated into the Coimbatore and Calicut ATS Automation System as an additional surveillance backup. Ten Controllers have been endorsed for ADS-B in Varanasi ATCC. The operational trials at these three stations is likely to commence in the second week of November 2015.

The results of the operational trials are extremely encouraging and the outcomes are positive, with Integrity, Accuracy, Reliability and Availability factors evident from the observations and statistical data.

The integration of ADS-B sensors into various ATS Automations systems in different ATCCs is in progress and the provision of ADS-B surveillance services in both RAD and NRA environments is likely to commence in the first quarter of 2016.

ANNEXURE -1

CHENNAI OCC- PORT BLAIR ADS-B OPERATIONAL TRIALS REPORT

Date of commencement: 30th June 2015 Daily Trial Period: 0430 -1130 UTC

The performance report of ADS-B trial Operations based on random analysis of ADSB data during the first 30 days of trial operations is as below:

S.No	Performance Parameter	Status	Remarks
1	***Integrity (NUC≥ 5)***	>99.995%	• Around 80000 ADS-B broadcast messages were analyzed. NUC values ranged from 5-7. • NUC value was always equal to or more than 5
2	***Flight ID transmission***	99.6%	Out of 15823 broadcast only 62 broad cast did not contain the Flight ID information.
3	***Mismatch of FLTID between ADS-B transmission and FPL call-sign***	0%	Out of 15761 ADS-B broadcasts with FLTID, there was no mismatch observed between ADS-B transmission and FPL call-sign.
4	***Range***	210-270NM	270NM at FL 370 in all sectors except NW sector. 210NM at FL 350 in NW sector.
5	***Vertical Coverage***	A022-F430	Depending on the distance of the aircraft from the ADS-B sensor, ADS-B aircraft were detected from altitude 2200 feet upto FL430
6	***ADS-B equipage***	90%	• 90% of aircraft operating within the VOPB ADS-B coverage are ADS-B equipped. • Around 10% of these aircraft (mostly Indian operators) though ADS-B equipped and detected by the sensor did not have the requisite operational approval.
7	***Availability***	92%	• 8% of the time VOPB ADSB data was not available at Chennai automation system due media. Proposal already initiated for media redundancy.

	ROUTE R457 IS REPLACED BY TANGO- TRACK 034/214 DEG (M) 99NM- MMV VOR. XV. SEGMENT KKP VOR - TRACK 067 DEG(M) 30NM- MMV VOR OF ATS ROUTE W114 IS REPLACED BY KKP VOR - TRACK 067 DEG(M) 29NM- MMV VOR. XVI. SEGMENT TEBAM - TRACK 091 DEG (M) 100NM- MMV VOR OF ATS ROUTE W116 IS REPLACED BY TEBAM- TRACK 091 DEG (M) 99NM- MMV VOR. XVII. SEGMENT MMV VOR - TRACK 286 DEG (M) 75NM-XIVIL OF ATS ROUTE W117 IS REPLACED BY MMV VOR -TRACK 286 DEG (M) 75NM- XIVIL. XVIII.SEGMENT ANIRO - TRACK 127 DEG (M) 111NM- MMV VOR OF ATS ROUTE B211 IS REPLACED BY ANIRO-TRACK 126 DEG (M) 110NM- MMV VOR. XIX. SEGMENT MMV VOR - TRACK 307/127 DEG (M) 111NM- ANIRO OF ATS ROUTE W72 IS REPLACED BY MMV VOR - TRACK 307/126 DEG (M) 110NM-ANIRO. XX. SEGMENT BODEL - TRACK 161 DEG (M) 127NM- MMV VOR OF ATS ROUTE W20 (SOUTH BOUND) IS REPLACED BY BODEL - TRACK 162 DEG (M) 127NM- MMV VOR. AMEND ENR 3.1 ACCORDINGLY.)
G0499/15	1509241151/1512251130 EST BTN 0430-1130 DLY REFER AIP INDIA SUPPLEMENT 18/2014. ADS-B GROUND STATION AT PORTBLAIR IN OPERATION ON TRIAL BASIS. 1. ADS-B BASED ATS SURVEILLANCE SERVICES WILL BE PROVIDED DURING THE TRIAL OPERATIONS WITHIN THE JURISDICTION OF CHENNAI OCEANIC CONTROL TO SUITABLY EQUIPPED AIRCRAFT ON OPPORTUNITY BASIS WITHIN THE COVERAGE AREA OF PORTBLAIR ADS-B SENSOR ON VHF 126.15 MHZ. 2. ADS-B EQUIPPED ACFT FLYING WITHIN CHENNAI OCEANIC CONTROL SHALL COMPLY WITH PROVISIONS CONTAINED IN AIP INDIA SUPPLEMENT 18/2014.)
G0555/15	1510161100/PERM REFER ENR 3.1 OF EAIP INDIA. THE FOLLOWING AMENDMENTS ARE MADE IN ATS ROUTE L896 : 1. SEGMENT "DUGOS - TR 314/133 DEG (M) 368NM - CHENNAI DVOR/DME (MMV)" IS REPLACED BY "DUGOS - TR 314/134 DEG (M) 155NM - ADKIT (103758N 0825122E) -TR 314/133 DEG (M) 213NM - CHENNAI DVOR/DME (MMV)". AMEND ENR 3.1 OF EAIP INDIA ACCORDINGLY.
G0556/15	1510270520/1601251030 EST BTN 0830-1030 DLY EXC SAT, SUN REFER AIP SUPPLEMENT 18/2014. ADS-B GROUND STATION AT TIRUCHIRAPPALLI IN OPERATION ON TRIAL BASIS. 1. ADS-B BASED ATS SURVEILLANCE SERVICES ARE PROVIDED DURING THE TRIAL OPERATIONS WITHIN THE JURISDICTION OF TIRUCHIRAPPALLI APPROACH CONTROL TO SUITABLY EQUIPPED AIRCRAFT ON OPPORTUNITY BASIS WITHIN THE COVERAGE AREA OF TIRUCHIRAPPALLI ADS-B SENSOR ON VHF 124.0 MHZ. 2. ADS-B EQUPPED AIRCRAFT FLYING WITHIN TIRUCHIRAPPALLI APPROACH CONTROL SHALL COMPLY WITH PROVISIONS CONTAINED IN AIP SUPPLEMENT 18/2014.

ANNEXURE -2

TRICHY ATCC - TIRUCHIRAPALLI ADS-B OPERATIONAL TRIALS REPORT

Date of commencement: 27th July 2015 MONDAY-FRIDAY Trial Period: 0830 -1030 UTC

S.No.	PERFORMANCE MONITORING	REPORT
1	ADS-B ground receiver serviceability and availability	
	SENSOR A	Serviceable and available H24
	SENSOR B	Serviceable and available H24
2	Medium used for data transfer and data security	LAN cables are used for data transfer and security is ensured
3	Integration of ADS-B data to automation system	ADS-B data was integrated to automation system on 05/04/2014 0500z
	Period disabled	NIL
4	Integrity check	Copy enclosed

G0231/15	1508200000/PERM REFER EAIP INDIA SECTION ENR 5.1. THE VERTICAL LIMITS OF VOD 177 (KAVALUR) DANGER AREA IS AMENDED AS GND/FL250.)
G0235/15	1508200000/PERM CONSEQUENT UPON CHANGE OF MAGNETIC VARIATION OF THIRUVANANTHAPURAM AIRPORT, FOLLOWING AMENDMENTS ARE MADE:- REFER AIP SUPPLEMENT 23/2013 ON ATS ROUTES Q12 AND Q13. ATS ROUTE Q12 SEGMENT "THIRUVANANTHAPURAM VOR TVM - TRACK 345/ DEG (M) 106NM - COCHIN VOR CIA" IS REPLACED BY "THIRUVANANTHAPURAM VOR TVM - TRACK 344/ DEG (M) 106NM - COCHIN VOR CIA". NO CHANGE IN TRACKS AND DISTANCES OF ATS ROUTE Q13. AMEND AIP SUPPLEMENT ACCORDINGLY.
G0260/15	1507270830/1510261030 EST BTN 0830-1030 DLY EXC SAT, SUN REFER AIP SUPPLEMENT 18/2014. ADS-B GROUND STATION AT TIRUCHIRAPPALLI IN OPERATION ON TRIAL BASIS. 1. ADS-B BASED ATS SURVEILLANCE SERVICES ARE PROVIDED DURING THE TRIAL OPERATIONS WITHIN THE JURISDICTION OF TIRUCHIRAPPALLI APPROACH CONTROL TO SUITABLY EQUIPPED AIRCRAFT ON OPPORTUNITY BASIS WITHIN THE COVERAGE AREA OF TIRUCHIRAPPALLI ADS-B SENSOR ON VHF 124.0 MHZ. 2. ADS-B EQUPPED AIRCRAFT FLYING WITHIN TIRUCHIRAPPALLI APPROACH CONTROL SHALL COMPLY WITH PROVISIONS CONTAINED IN AIP SUPPLEMENT 18/2014.
G0412/15	1510150000/PERM CONSEQUENT UPON THE CHANGE IN MAGNETIC VARIATION OF VIJAYWADA AIRPORT, FOLLOWING AMENDMENTS ARE MADE:- REFER AIP SUPPLEMENT 14/2015 ATS ROUTE L518 1. ATS ROUTE L518 SEGMENT "HYDERABAD VOR HIA - TRACK 109/290 DEG (M) 143NM - VIJAYWADA VOR BBZ - TRACK 121/301 DEG (M) 82NM - GOPNU - TRACK 121/301 DEG (M) 22NM - KASRO - TRACK 121/301 DEG (M) 32NM - SUGAN" IS REPLACED BY "HYDERABAD VOR HIA -TRACK 108/289 DEG (M) 144NM - VIJAYWADA VOR BBZ -TRACK 120/301 DEG (M) 82NM - GOPNU - TRACK 121/301 DEG (M) 22NM - KASRO -TRACK 121/301 DEG(M) 32NM - SUGAN". AMEND AIP SUPPLEMENT 14/2015 ACCORDINGLY.
G0442/15	1510150000/PERM REFER AIP SUPPLEMENT 18/2012. THE ATS ROUTE DESIGNATORS V30 AND V31 ARE RE- DESIGNATED AS T3 AND T4 RESPECTIVELY. AMEND ACCORDINGLY.
G0444/15	1509090720/1510142359 REFER ENR 3.1 OF EAIP INDIA. CONSEQUENT UPON ESTABLISHMENT OF CONNECTOR ROUTES V30

ASSESSMENT OF ADS-B TO SUPPORT AIR TRAFFIC SERVICESIN TRICHY

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ASSESSMENT OF ADS-B SURVEILLANCE

1.1. Introduction

This chapter presents the comparative assessment of ADS-B surveillance for use by the air traffic services. The assessment methodology is explained below, as is the rationale behind its use and the conclusions drawn from it. It has been agreed that if ADS-B can be demonstrated to be as good as radar in the relevant system performance measures, then it can be used to deliver the services that radar currently supports.

1.2. Scope

The Scope of this assessment includes collection of ADS-B and System Track data within the airspace of 200NM around Trichy airport for the comparative assessment of ADS-B surveillance data with that of Radar. For this purpose ADS-B data related to the 200NM around Trichy airport was collected from Trichy ADS_B receiver installed at Trichy and the system track data within the same airspace was collected from the automation system at Chennai.

1.3. Objectives of the assessment

The general objective of this assessment is to demonstrate that ADS-B surveillance can be used to provide a 5 NM separation minimum in an ADS-B only environment or an ADS-B/radar environment.

1.4. Assessment methodology

1.4.1. Analysis was performed using aircraft that used a mode S transponder to reply to both radar interrogations and to transmit ADS-B messages. Data was analyzed to compare system track and ADS-B data. The results of the data analysis for a number of flights are presented in this report. The details provided are typical of the data collected for the aircraft operating in the airspace around

200NM of Trichy airport, and as such is considered representative of the system's performance.

1.4.2. The comparison was performed by analyzing data so collected to determine the positional difference between the two. Also the ASTERIX CAT21 messages of ADS-B and the system track at Chennai were directly recorded. The Terminal Area Route Generation, Evaluation and Traffic Simulation (TARGETS) software produced by the MITRE Corporation and CSSI of USA was used for traffic simulation and comparison of the data.

1.5. TARGETS Software

1.5.1. Terminal Area Route Generation, Evaluation and Traffic Simulation (TARGETS) is a software, that is rich in functionality and designed with a Graphical User Interface (GUI) that is intuitive. Standard AsterixCAT21, CAT48 and CAT62 Track data messages of aircraft can be imported into the TARGETS software using appropriate Track import parser and the imported tracks are displayed in the current View, and the track set is added to the Track Data folder within the Project and View browser folders.

1.5.2. Simulations can be built using the imported track data and the simulation profile for traffic produced by a generator is displayed in the Plan View. The Track sets in the plan view can be exported as images.

1.5.3. Simulations can be run in real time, using the default 4.7/5 seconds update rate of the Automation system. The system can work with large track data sets, multiple image files, and complex simulations. Simulated traffic is displayed in the TARGETS Plan View.

1.5.4. A simulation report can be generated for analyzing the positional information of the track at different timings. Simulations and track data can be exported in the PDARS format which is a CSV format that can be viewed in any spreadsheet program and can be compared.

1.6. Data Collection

The ADS-B of Trichy and the system track data of the following flights recorded on 18th November 01 were analyzed:

a. ALK122
b. AXM10
c. BOX531
d. FDB551
e. KQA860

1.7. Data Analysis

1.7.1. The data was analyzed to compare the ADS-B &system track positions and determine the difference between the two. A comparison of system track and ADS-B altitude data was also undertaken which showed that though the source of barometric altitude, the altitude encoder, is the same for ADS-B and radar, a small difference does occur which is due to the fact that ADS-B data is consistently updated at a higher rate comparedto radar. During an aircraft's climb or descent the radar derived altitude tends to lag the ADS-B reported altitude. Hence during climb ordescent phase a small difference in the altitude is seen which reduces when aircraft reaches the cruising level.

1.7.2. Display of Radar and ADS-B tracks in TARGETS Software Plan view:

a. Figure 1-Combined system and ADS-B Track data image of **ALK122/AXM10/BOX531/FDB551/KQA860**

b. Figure 2- Simulated system and ADS-B Aircraft image of **KQA860**

c. Figure 3- Simulated system and ADS-B Aircraft image of **FDB551**

d. Figure 4- Simulated system and ADS-B Aircraft image of **AXM10**

e. Figure 5- Simulated system and ADS-B Aircraft image of **BOX531**

f. Figure 6- Simulated system and ADS-B Aircraft image of **ALK122**

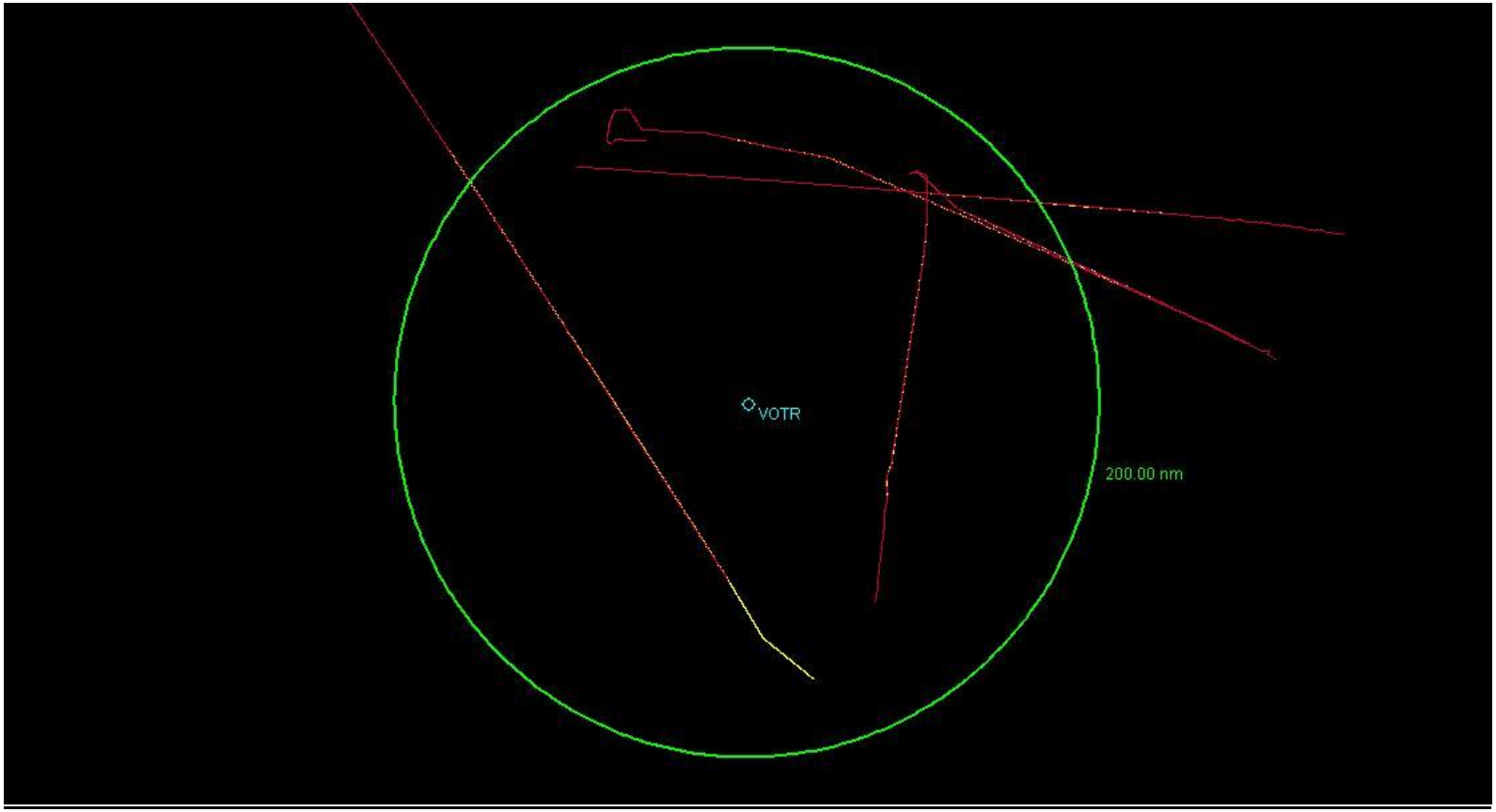


Figure 1-Combined Radar and ADS-B Track data image of ALK122/AXM10/BOX531/FDB551/KQA860

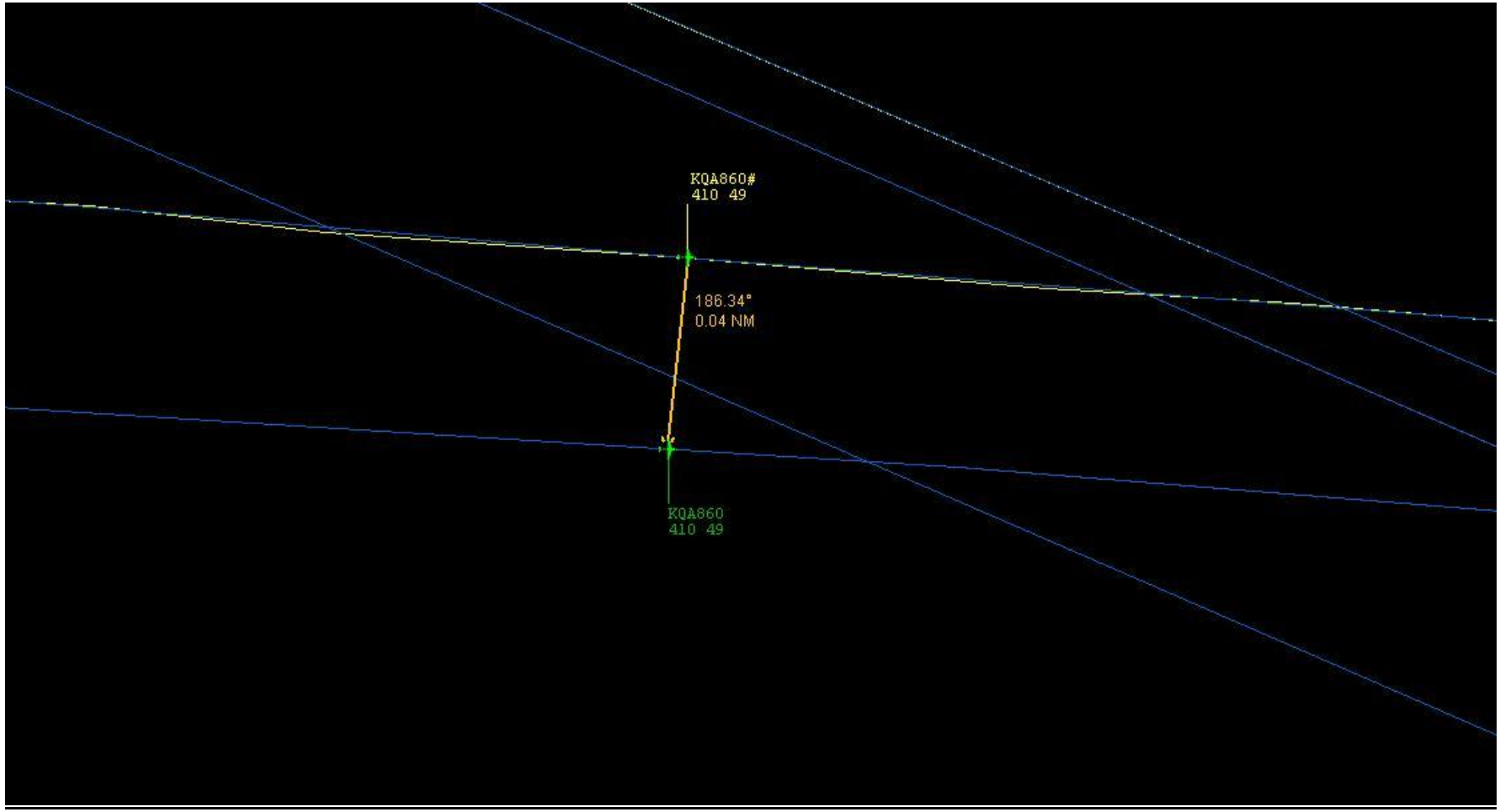


Figure 2- Simulated system and ADS-B Aircraft image of KQA860

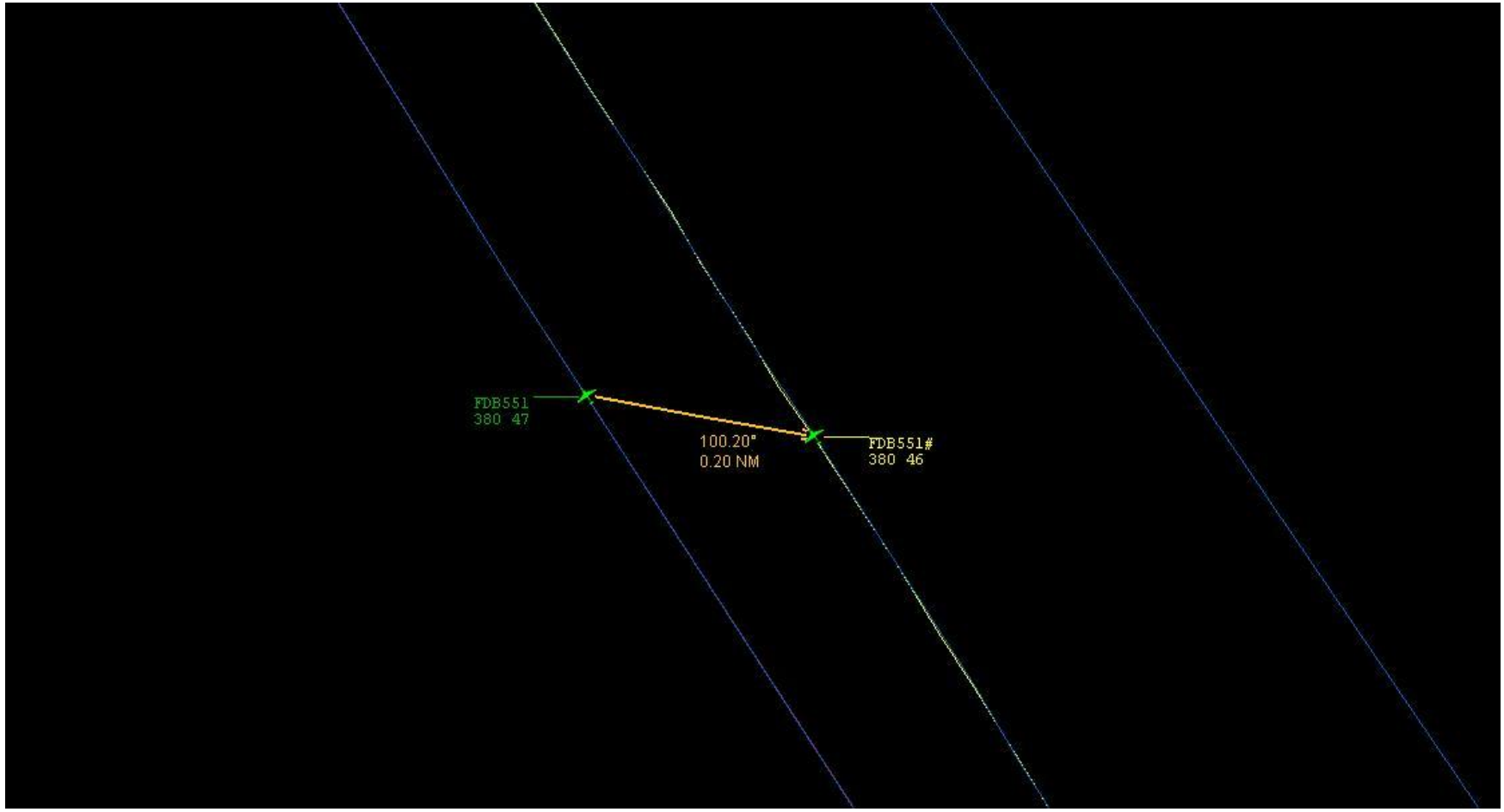


Figure 3 - Simulated system and ADS-B Aircraft image of FDB551

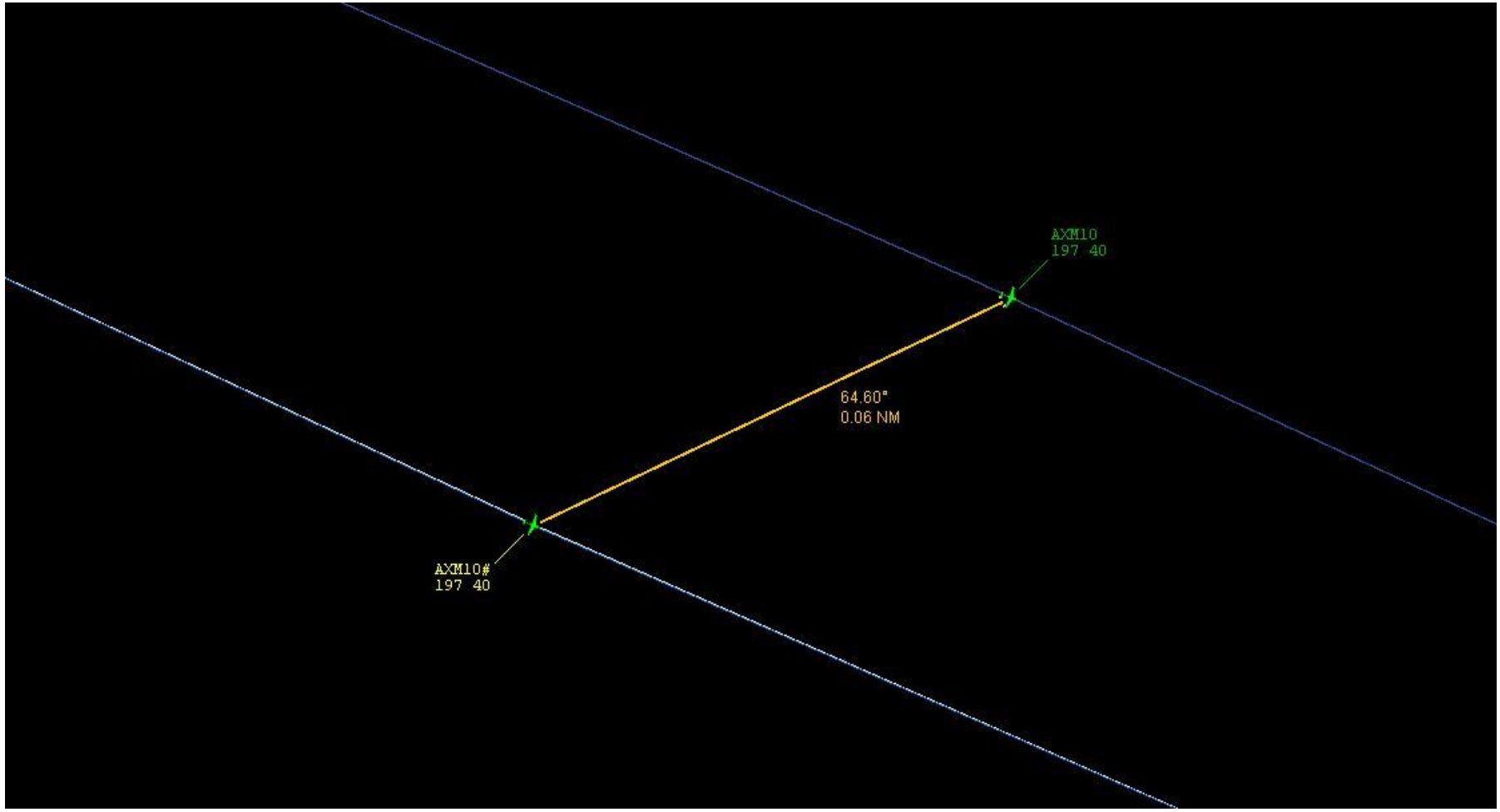


Figure 4- Simulated system and ADS-B Aircraft image of AXM10

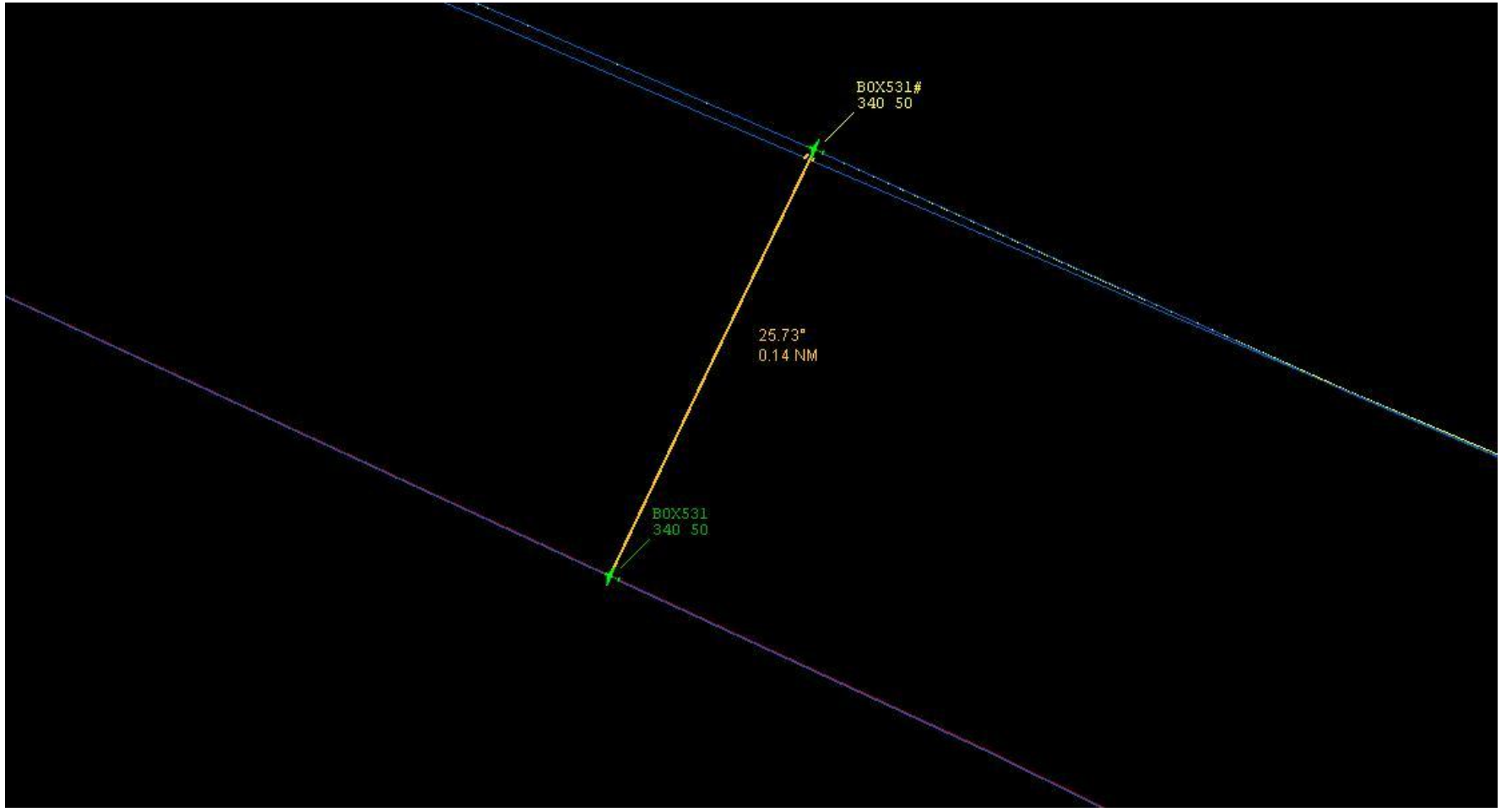


Figure 5- Simulated system and ADS-B Aircraft image of BOX531

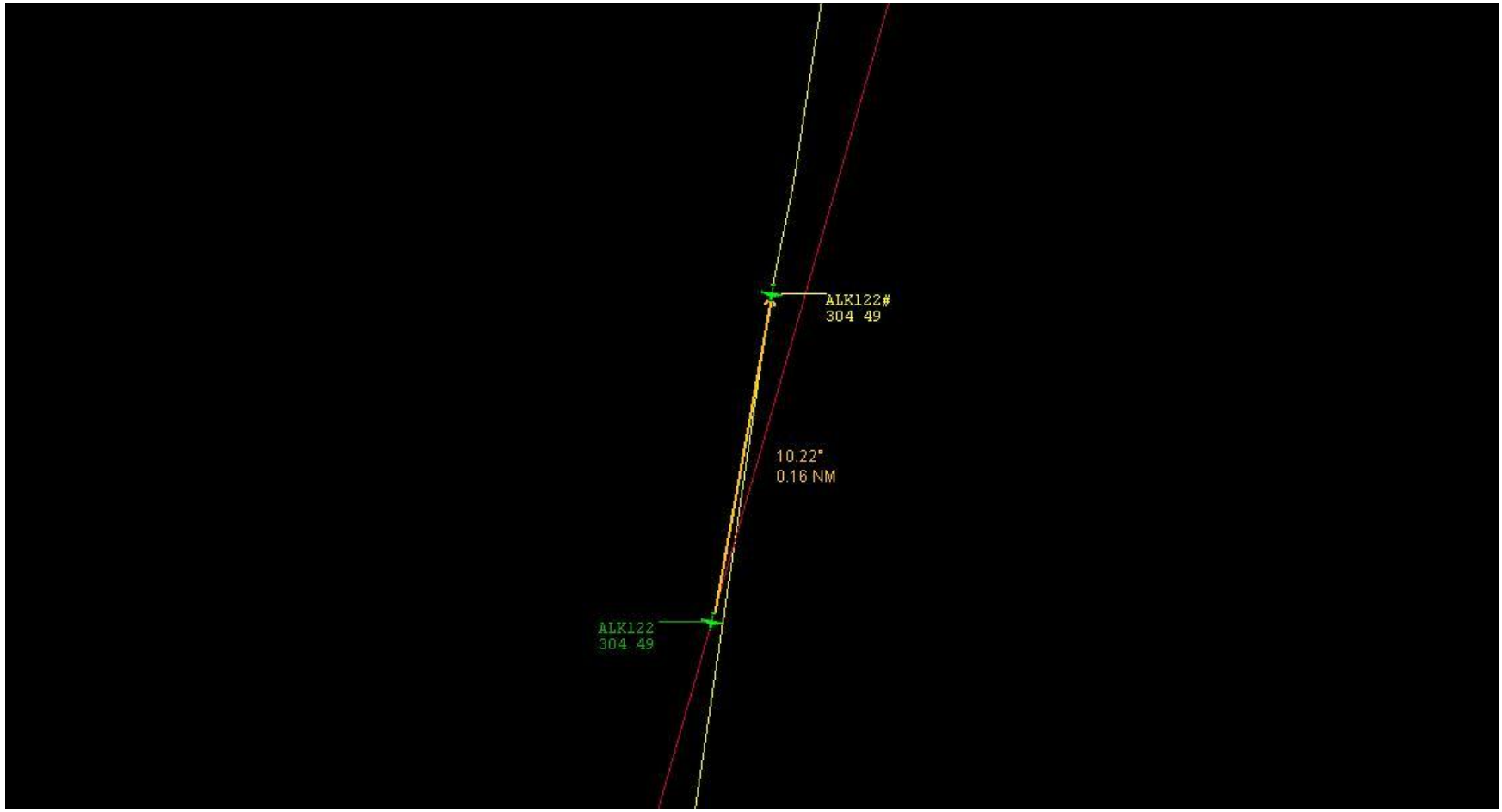


Figure 6- Simulated system and ADS-B Aircraft image of ALK122

Chart Display comparing Radar and ADS-B surveillance information as generated by TARGETS simulation in terms difference in the horizontal position in Nautical Miles as detected by ADS-B and System Track.

a. Chart 1 - Difference in the horizontal position in Nautical Miles as detected by ADS-B and System Track in respect of **ALK122**

b. Chart 2 - Difference in the horizontal position in Nautical Miles as detected by ADS-B and System Trackin respect of **AXM10**

c. Chart 3 - Difference in the horizontal position in Nautical Miles as detected by ADS-B and System Trackin respect of **BOX531**

d. Chart 4 - Difference in the horizontal position in Nautical Miles as detected by ADS-B and System Trackin respect of **FDB551**

e. Chart 5 - Difference in the horizontal position in Nautical Miles as detected by ADS-B and System Trackin respect of **KQA860**

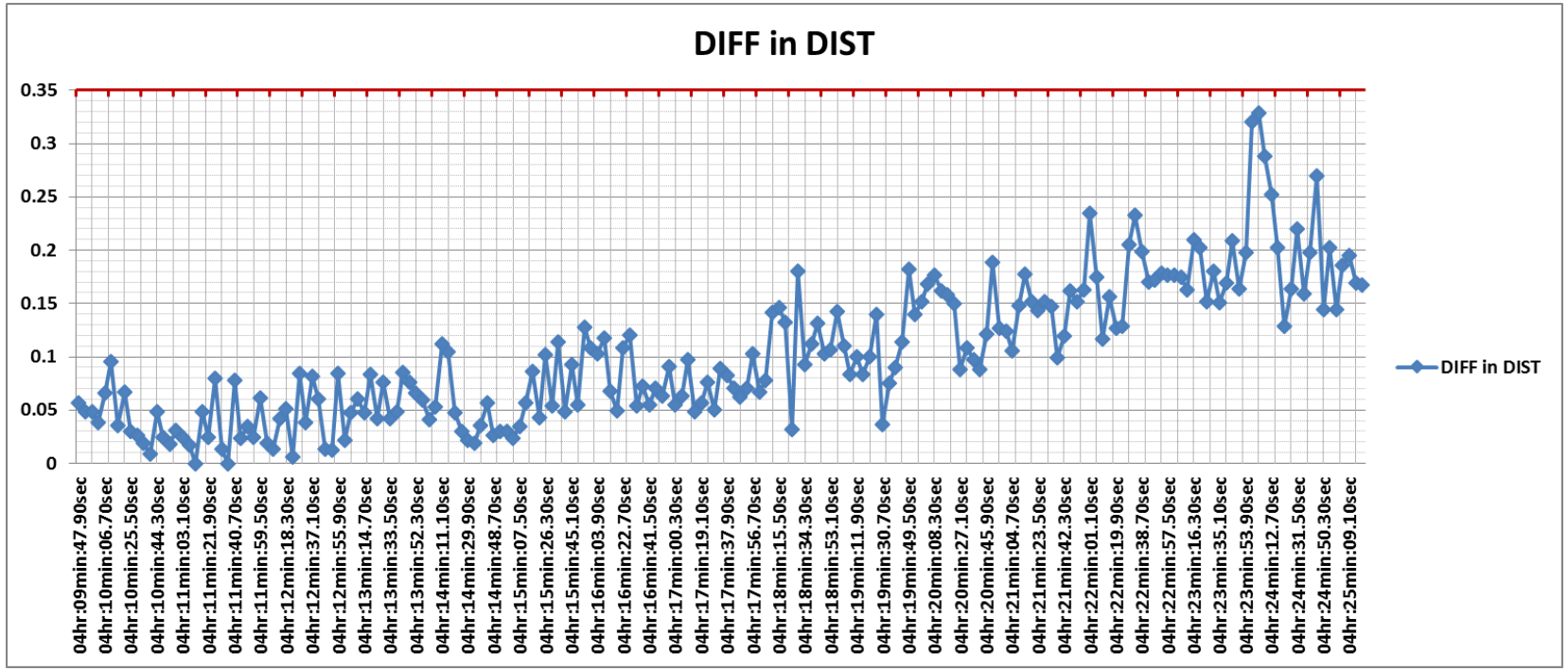


Chart 1 - Difference in the horizontal position in NM as detected by ADS-B and System track in respect of ALK122

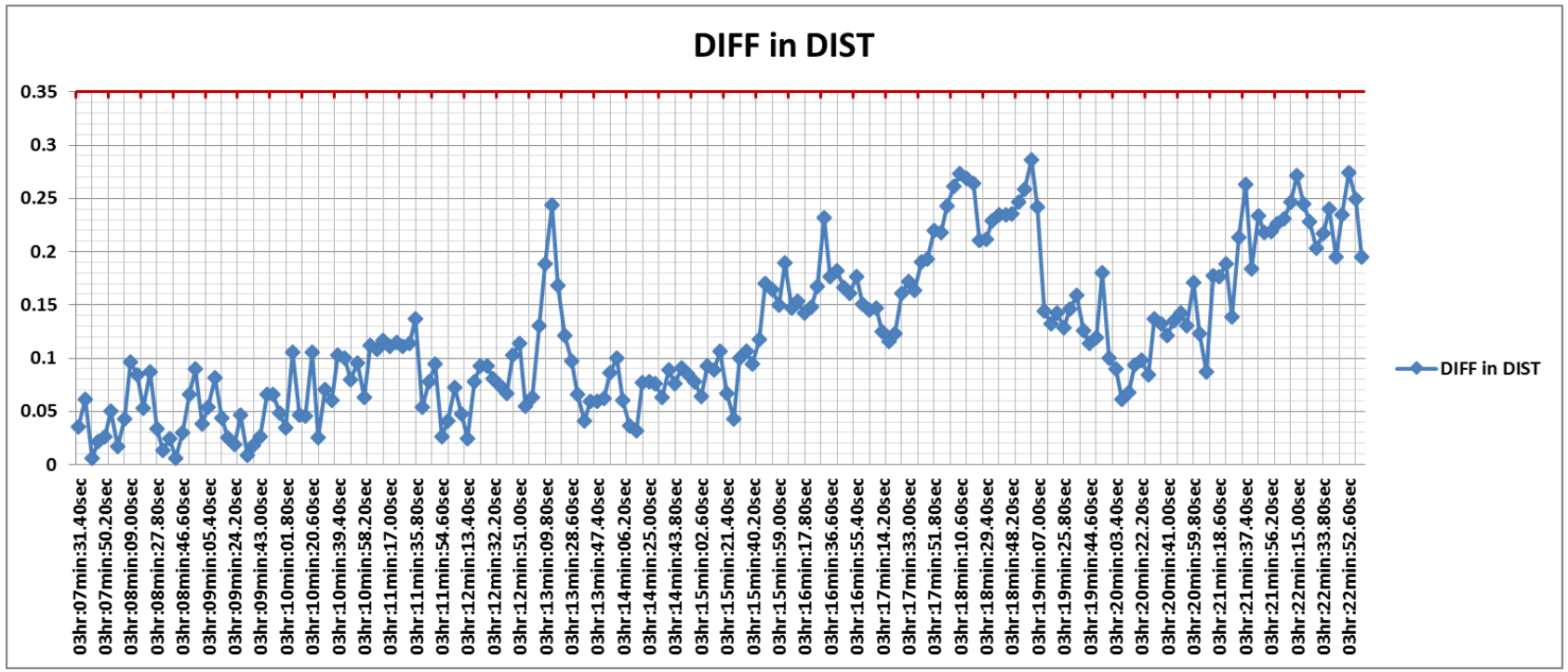


Chart 2 - Difference in the horizontal position in NM as detected by ADS-B and System track in respect of AXM10

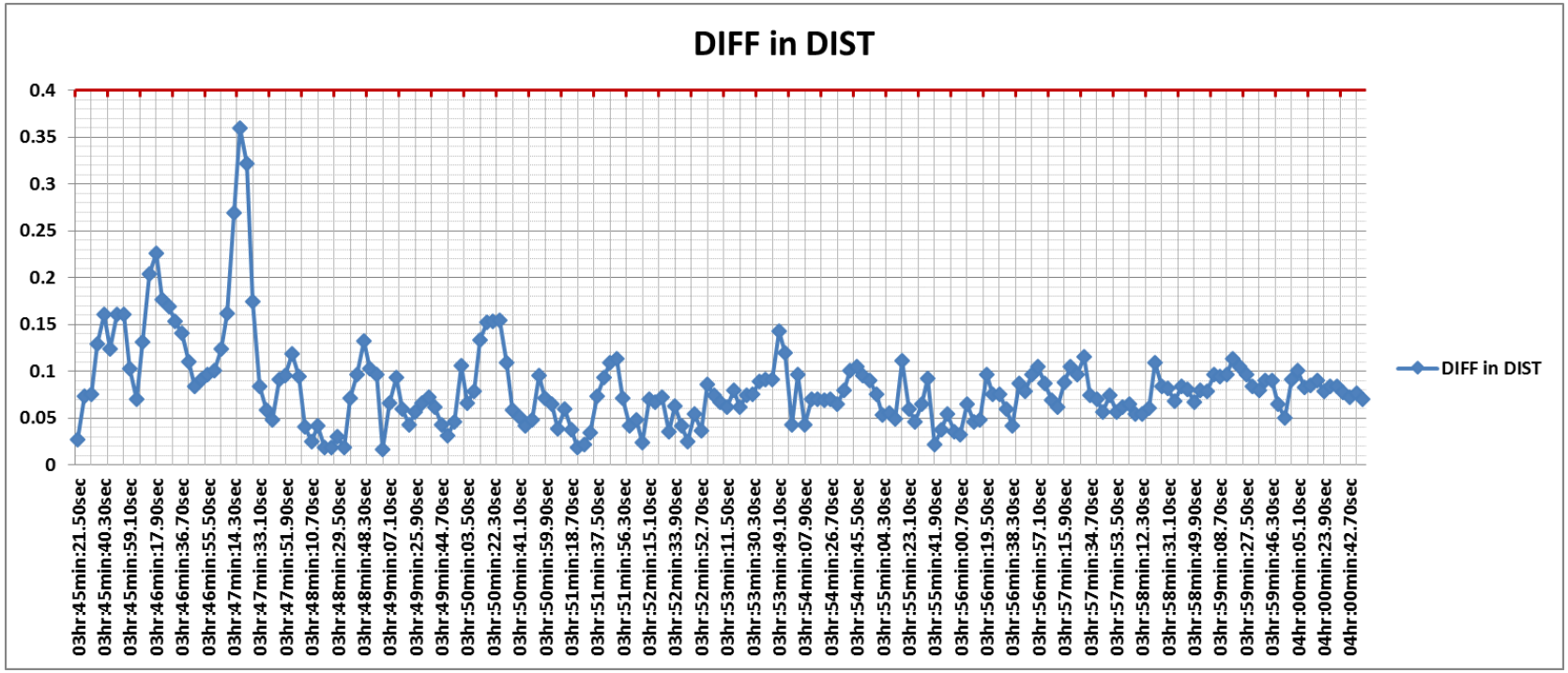


Chart 3 - Difference in the horizontal position in NM as detected by ADS-B and System track in respect of BOX531

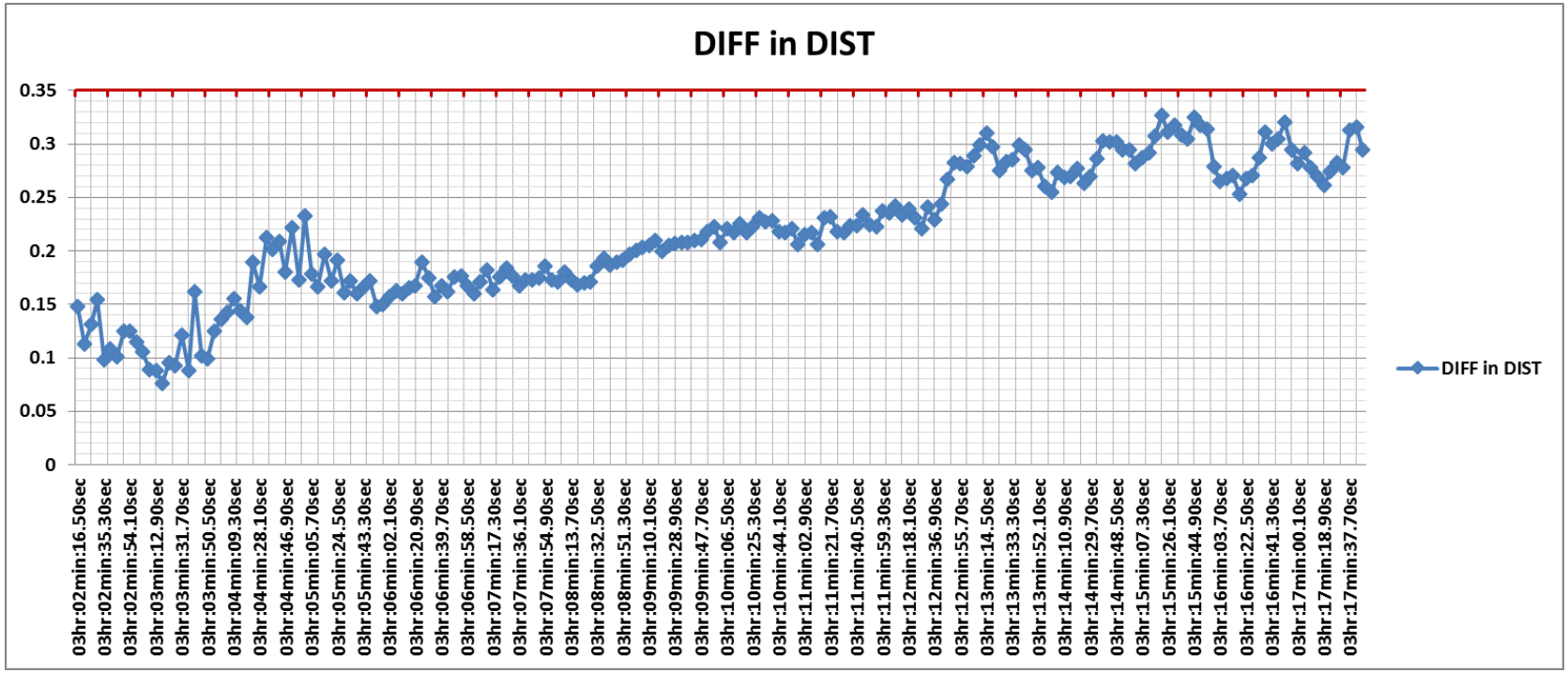


Chart 4 - Difference in the horizontal position in NM as detected by ADS-B and System track in respect of FDB551

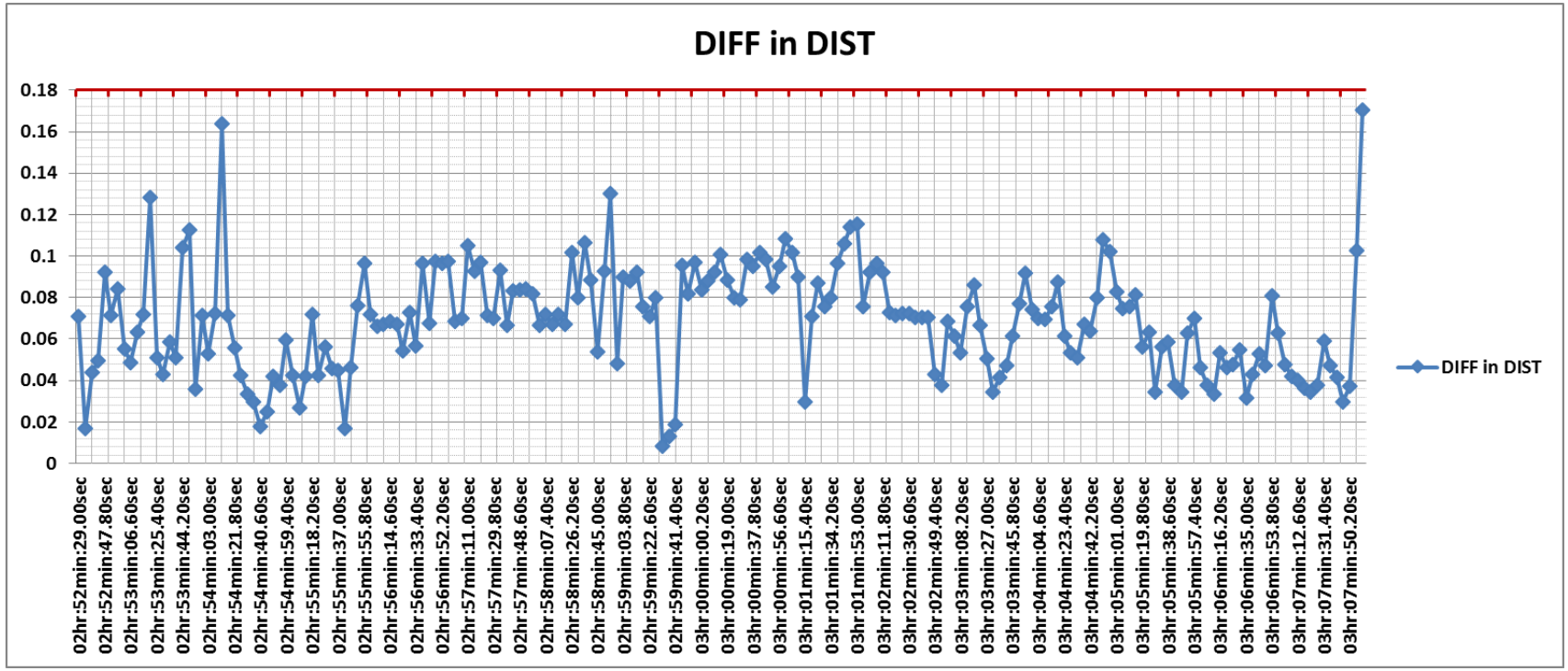
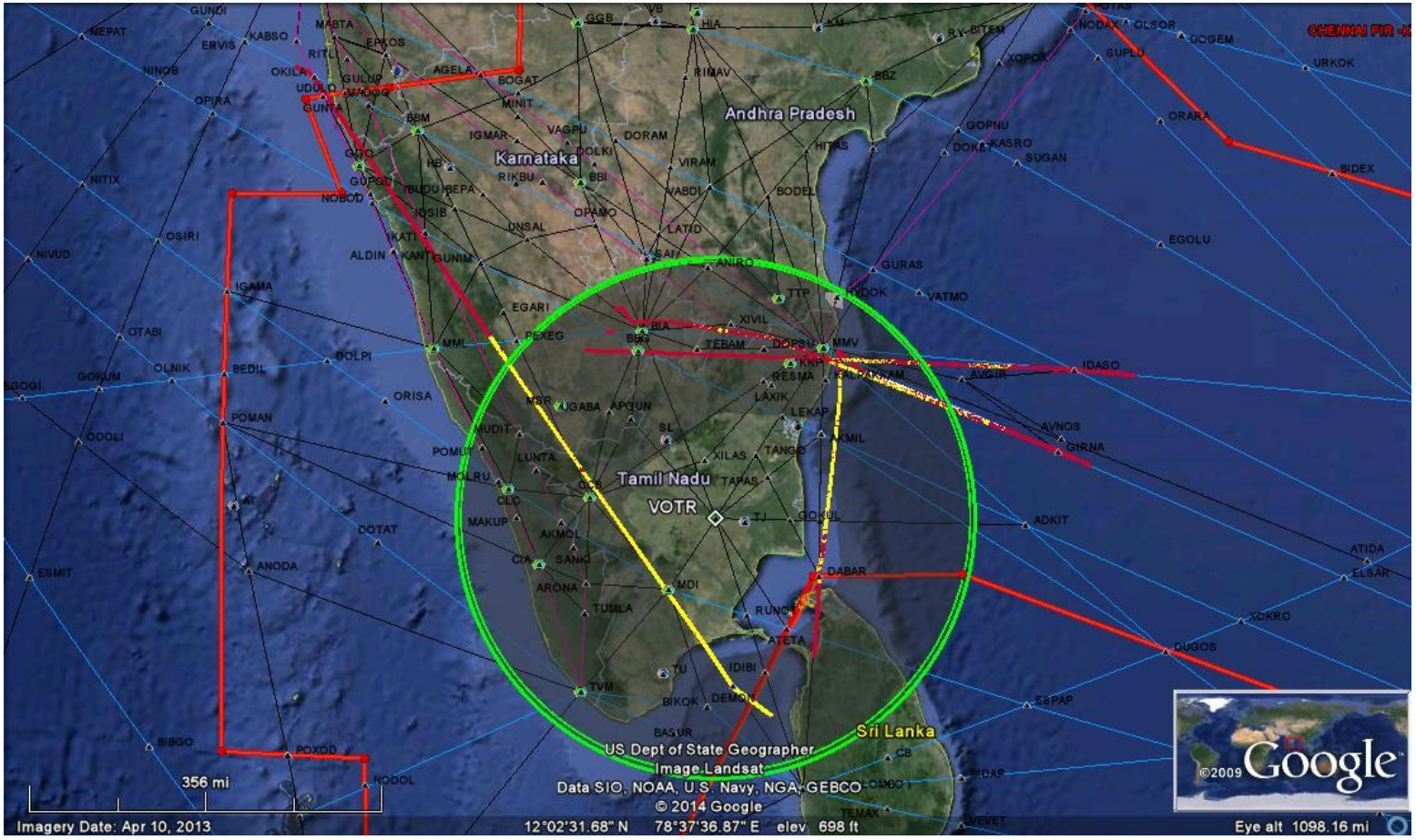


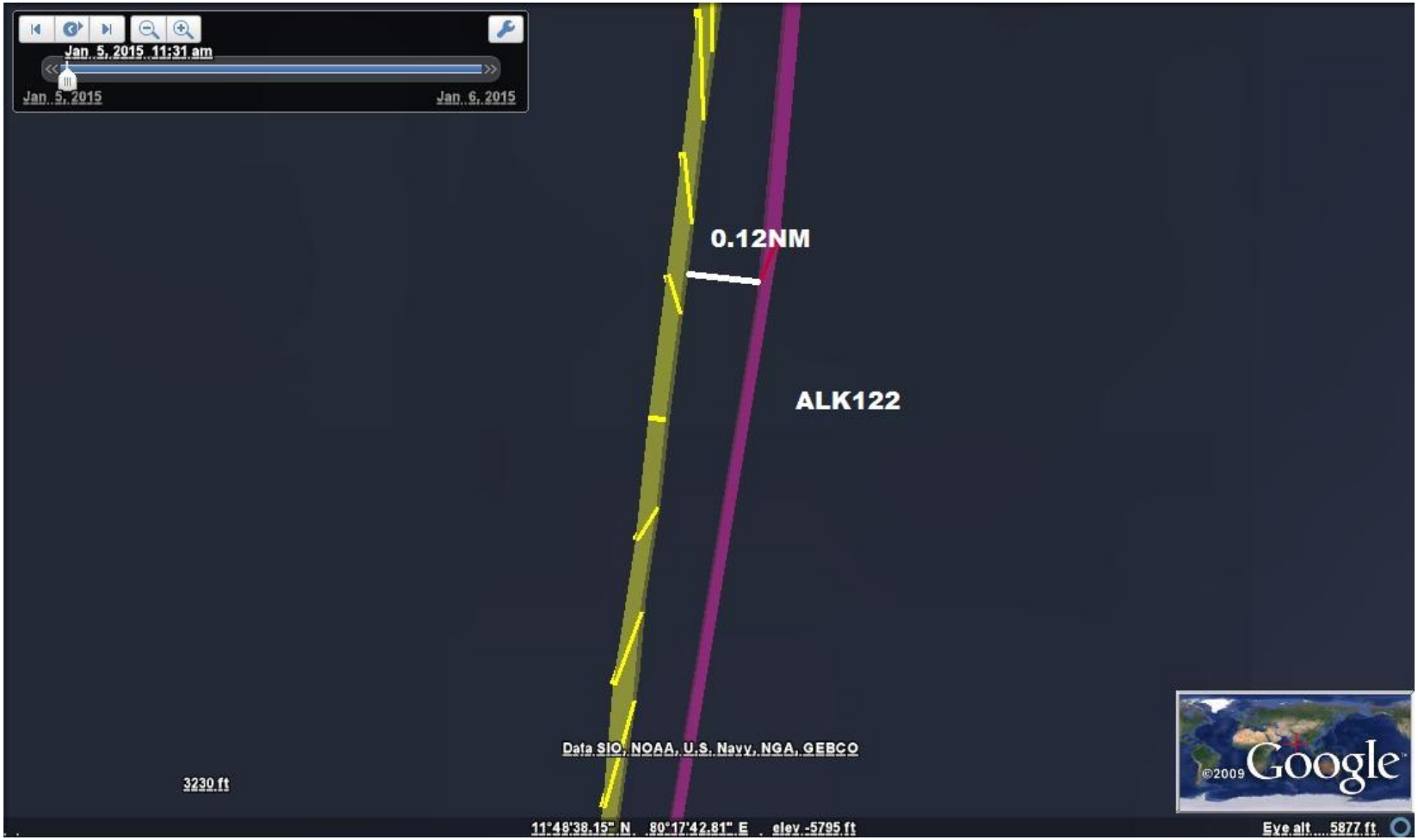
Chart 5 - Difference in the horizontal position in NM as detected by ADS-B and System track in respect of KQA860

1.7.3. The Track data images as captured by the TARGETS Software were exported to Google Earth using the same Software and the images as shown in Google Earth were saved as JPG image and are shown below:

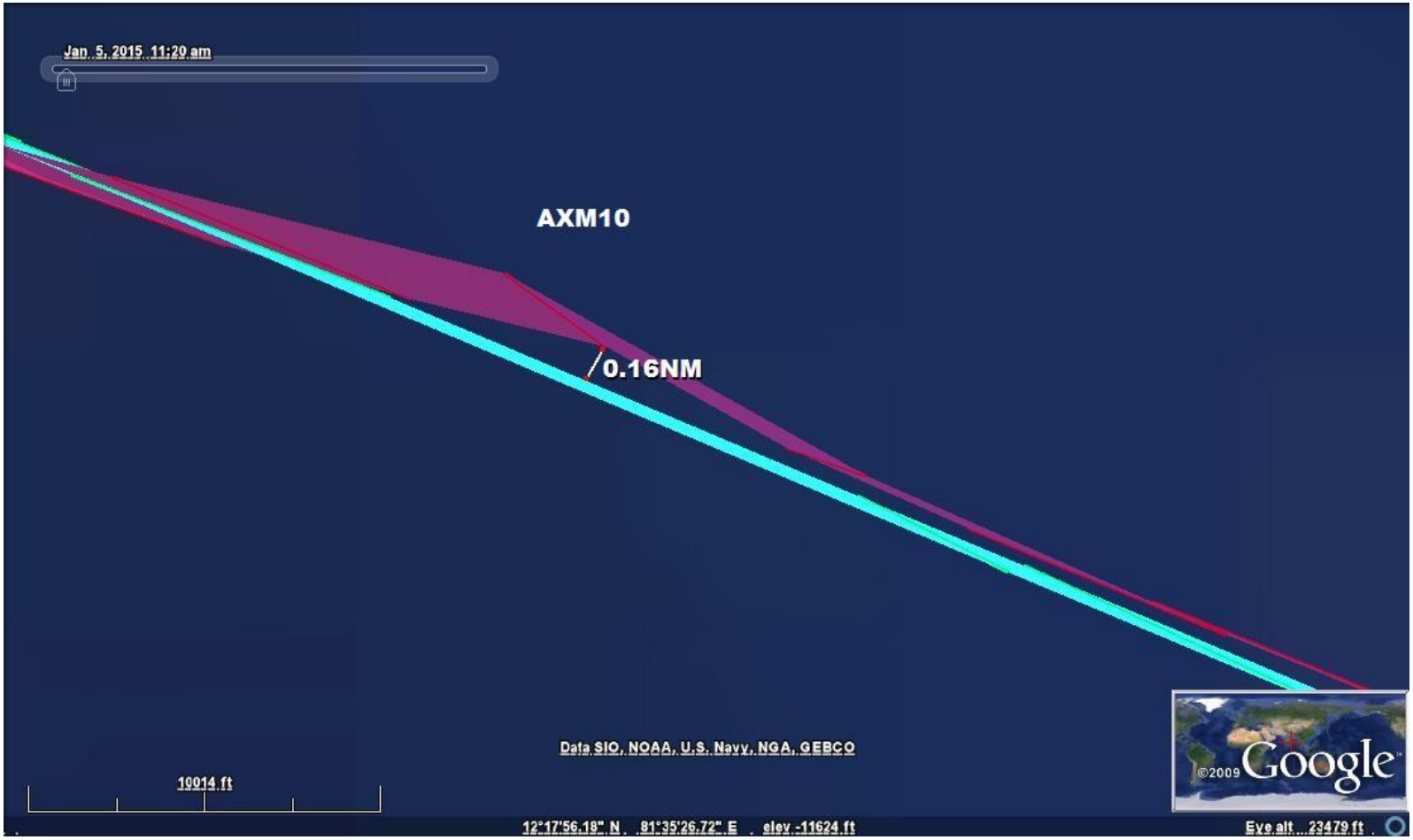
1. GoogleEarth Image 1- Combined Track image of **ALK122/AXM10/BOX531/FDB551/KQA860**
2. GoogleEarth Image 2- Zoomed in Track image of **ALK122**
3. GoogleEarth Image 3- Zoomed in Track image of **AXM10**
4. GoogleEarth Image 4- Zoomed in Track image of **BOX531**
5. GoogleEarth Image 5- Zoomed in Track image of **FDB551**
6. GoogleEarth Image 6- Zoomed in Track image of **KQA860**



Google Earth Image 1- Combined Track image of **ALK122/AXM10/BOX531/FDB551/KQA860**

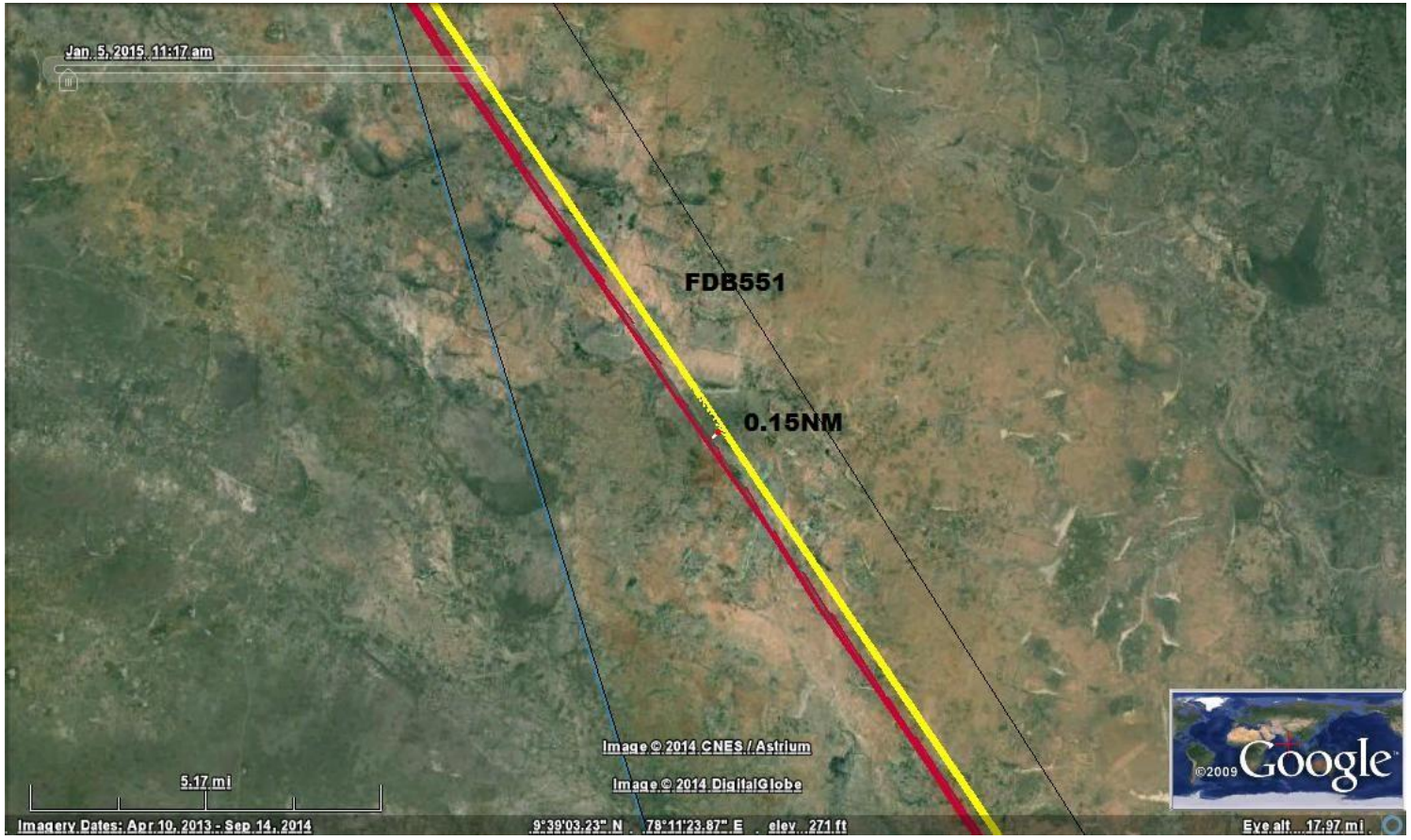


GoogleEarth Image 2- Zoomed in Track image of **ALK122**

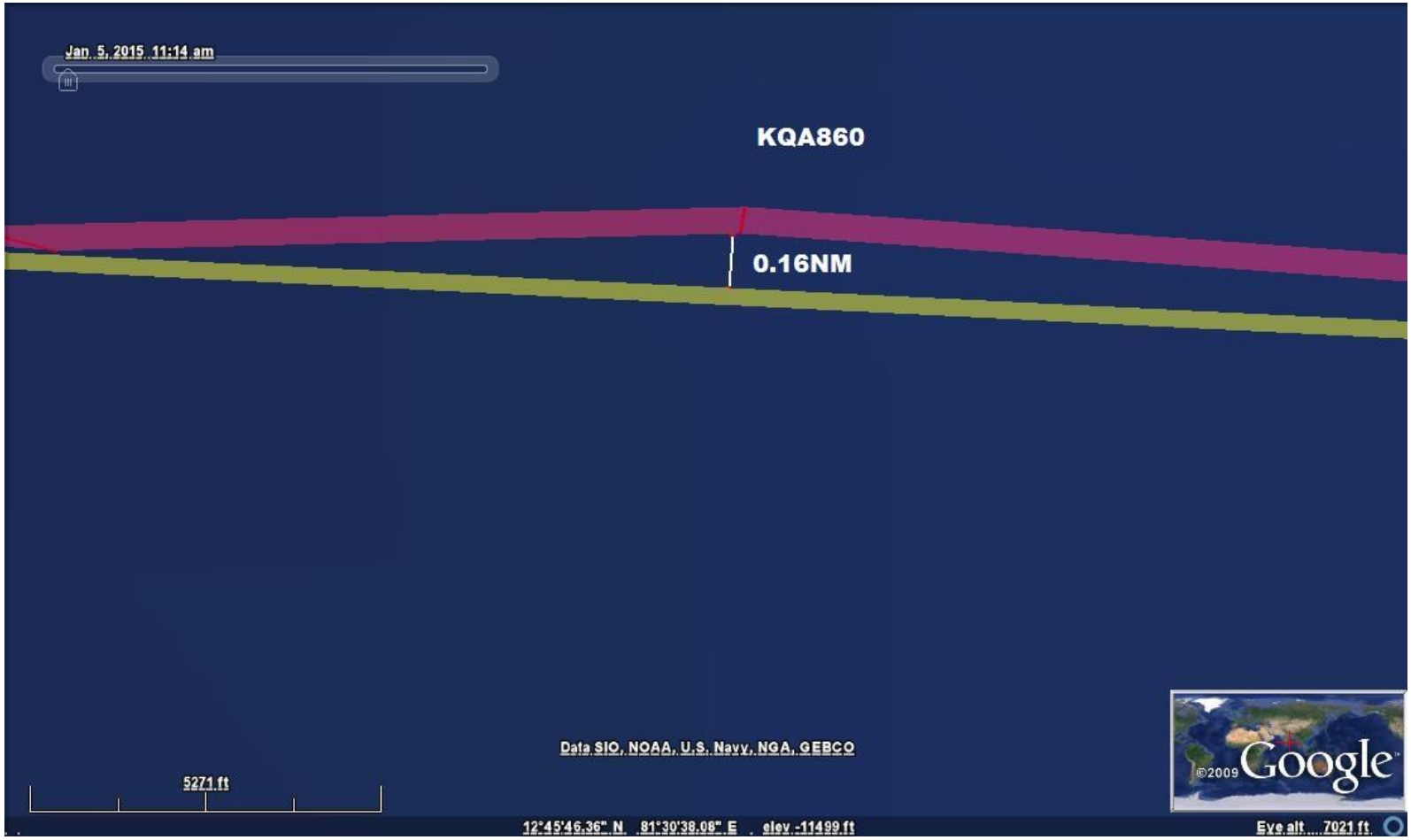


GoogleEarth Image 3- Zoomed in Track image of **AXM10**

GoogleEarth Image 4- Zoomed in Track image of **BOX531**

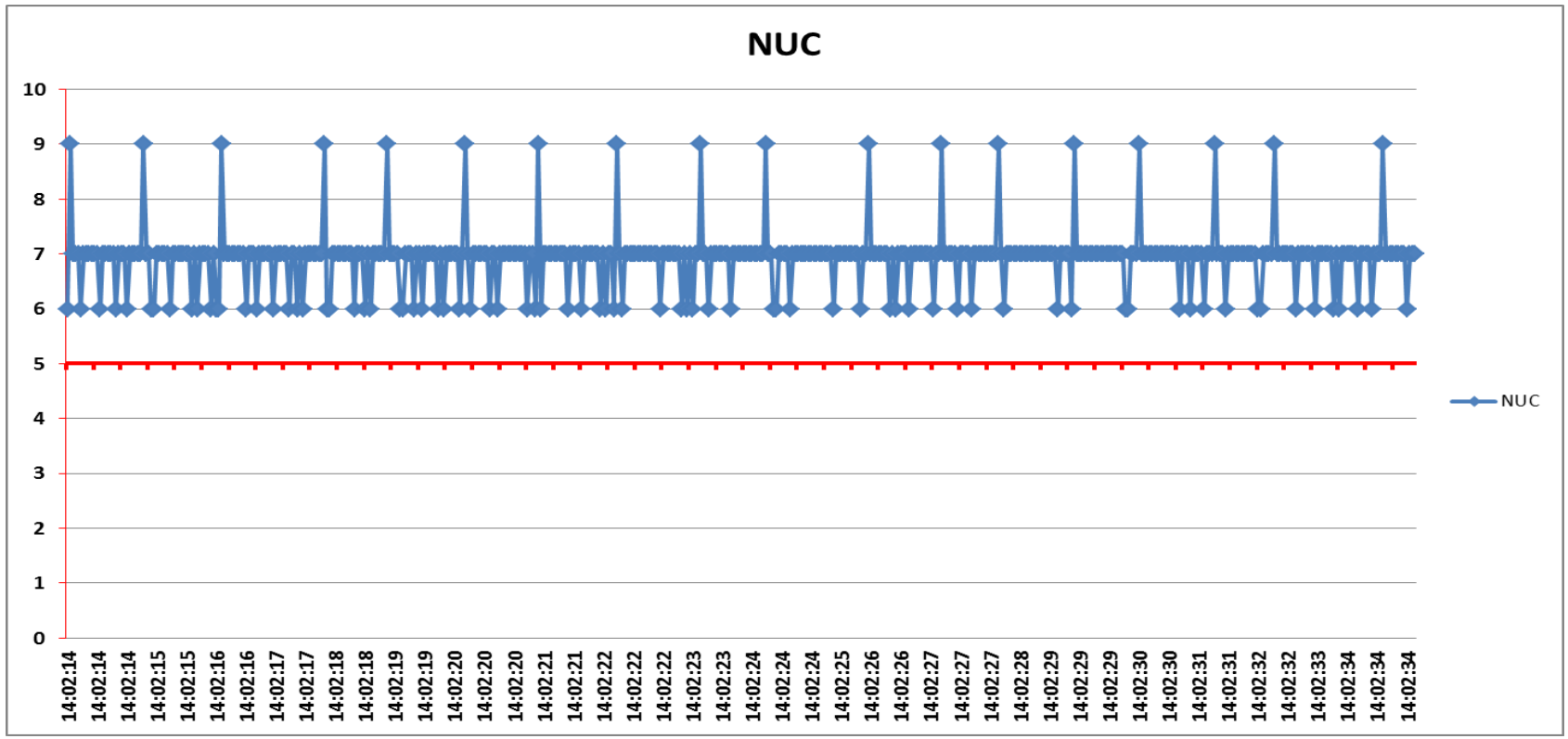


GoogleEarth Image 5- Zoomed in Track image of **FDB551**



GoogleEarth Image 6- Zoomed in Track image of **KQA860**

1.7.4. The Integrity of the ADS-B messages (NUC value) of Trichy ADS-B data was analyzed and the results are as below:



In general there is a demonstrated close agreement between the data displayed to controllers from both radar and ADS-B. The ADS-B tracking performance appears to be better or at least no worse than the reference MSSR.

As such, ADS-B surveillance can be used to provide a 5 NM separation minima for either en route or terminal area operations whether ADS-B is the sole means of ATC surveillance or used together with radar.

Nevertheless, there is a requirement to undertake an implementation safety assessment that demonstrates that the intended safety level will be met using ADS-B surveillance.

ADS-B Training details:

The ADS-B training details in respect of Shri. K. Jebaraj, JGM (ATM) who is having valid ASR and ARSR rating on Mumbai is as follows:-

Sl. No.	ADS-B Theory module	ADS-B simulator training	OJT for ADS-B	ADS-B rating board	Remarks
1	30.10.2013 to 01.11.2013 at Chennai conducted by CATC faculty.	5 days w.e.f. 9.06.2014 to 13.06.2014 at Ahmedabad.	10 days w.e.f. 27.04.2015 to 06.05.2015	ADS-B endorsement rating board conducted by CHQ on 09.06.2015.	CHQ rating board declared that Shri. K. Jebaraj, JGM (ATM) is fit to perform independent duties in approach with ADS-B based surveillance.

(K. JEBARAJ)
JT. GENERAL MANAGER (ATM)
TRICHY AIRPORT

#

Compliance list for ADS-B Security-related Vulnerabilities and Mitigation Measures based on ATMC 15 of 2014

STATION: TIRUCHIRAPPALLI INTERNATIONAL AIRPORT

	Concerns	Mitigation measure	Compliance (yes/no) with comments if any
	Confidentiality		
1	Since the flight number and position of aircraft are available to the public, due to the open architecture of ADS-B, Controllers should be aware that procedures tothe open architecture of ADS-B, procedures to support sensitive flights to use different flight identities, may be developed and made applicable by security agencies/DGCA from time to time.	All ATCOs at Trichy Airport have been briefed in the in-house training on ADS-B on this security issue. As and when the procedures are developed by BCAS / DGCA for sensitive flights to use different flight identities the same will be briefed to the controllers.	Will be complied as and when the procedures are developed by BCAS/DGCA.
2	Military flights may use DF19 (Military Extended Squitter) encrypted ADS-B transmissions, in future or DF 22 (Military use only) and Mode 5 [secure/crypto].	All ATCOs at Trichy Airport have been briefed about the downlink format DF19 for military flights.	
3	24 bit code identifies the aircraft and is available to the public, sensitive and military flights, which have the capability to switch off ADS-B may require special handling.	All ATCOs at Trichy Airport have been briefed about the special handling of sensitive and military flights which will conceal the 24 bit unique code. The provisions of PANS ATM (Doc4444) to apply appropriate separation between ADS-B tracks and non- ADS-B tracks will be complied. The same is included in the SOP.	

4	Due to a threat perception regarding the use of position and aircraft ID data for the coordination of attacks against specific airborne targets (e.g. VIP), the flights operating on special missions, such as carrying VIPs on board may be allowed, by appropriate authority and/or the regulator, the use of different 24 bit codes.	ATC Supervisors, Controllers and DBMS Managers have been briefed about the use of different 24 bit codes by VIP flights during the in-house training for ADSB and the same is included in the SOP.	
5	Use of position and aircraft ID data for economic intelligence: surveillance of business aircraft or commercial aircraft, DGCA may prescribe procedures to support sensitive flights to use different flight identities	All ATCOs at Trichy Airport have been briefed in the in-house training on ADS-B on this security issue. As and when the procedures are developed by DGCA for sensitive flights to use different flight identities the same will be briefed to the controllers	
	Integrity		
1	Transmission of false messages from virtual aircraft (spoofing) and the risk of false alarms (STCA), false traffic information, spurious separation manoeuvres, thereof is a vulnerability related to integrity	Controllers should be aware of these chances and suitable provisions should be made in the automation system for these like • Identifying and not correlating a FPL track with an ADS-B track if the ADS-B track's position is more than a specified variable parameter (say 10NM). • After proper correlation provide Route Adherence Monitoring and raising Route offset alert, in case of an ADS-B track outside the lateral clearance limits. • Providing alerts in case of DUP ID • Not updating flight plan if the surveillance position report off the route is beyond acceptable parameter(s).	

		• Providing level burst (LB) alert if the ADS-B track is outside the vertical clearance limits. • Addressing Positional data “jumps” in a multi sensor surveillance processing environment and thereby providing the “reasonableness check”. • Identifying an ADS-B track which is more than 0.5NM in position from a Radar track and not fusing the same, thus raising an alert. • Not displaying ADS-B tracks with integrity value (NUCp) less than 5. • Providing the Controller with the option to choose the associated FPL in case of multiple FPLs with the same callsign, and allow manual correlation. • Not coupling ADS-B track data to a flight plan if the track arrives into coverage at an unexpected position or arrives into coverage at an unexpected time, or without coordination.	
2	Ambiguity regarding an ADS-B track	The Controller obtain through voice position reports, similar to identification of PSR tracks, the VOR Radial and distance from the DME to verify the ADS-B derived information and the same is included in the SOP. The DBMS Managers and the Controllers shall be aware of these features and the Controllers should check the functionalities at least once during their assuming a Controller work position. The Operational Supervisor shall monitor the system for these functionalities and immediately report any anomaly to the DBMS team.	

3	Vulnerability of alteration of messages during their transmission between the ground stations and the ATM system	ADS-B ground receivers are installed within the premises of the ATC Technical Building . The data received by the ADS-B antenna is transferred through physical media (LAN cable) to the equipment room situated in the same building and from there it is transmitted again through physical media to the ATS automation system. The end to end systems are located within the sterile and secure airside area of Trichy Airport, and the entry to the ATS-Technical building is restricted to authorized personnel. The CNS Engineers are required to secure the ADS-B receivers and the data transmission cables/lines so that the physical access is absolutely restricted to authorized personnel only. From Trichy ADS-B stations, ADS-B data is transmitted to the ATC Centre at Chennai through secure data transmission channels provided by BSNL and provides suitable security to the data transfer, as a service provider.	
4	Chances of alteration of ADS-B messages during their transmission between the ground stations and the ATM system	This is extremely improbable, the CNS engineers at Trichy Airport carry out periodic checks to ensure that there is no scope for alteration of ADS-B messages during their transmission.	
5	Possible loss of aircraft visualisation on controller display due deleted messages.	Appropriate protections are available for the security of ADS-B transmission network between Ground station and ATC Centre(s) and there is no possibility for deletion of ADS-B	

		data before it reaches the ATS Automation system.	
6	Separation methods in mixed(ADS B and NON ADS B) traffic scenario	The provisions of PANS ATM (Doc4444) to apply appropriate separation between ADS-B tracks and non- ADS-B tracks will be complied. The same is included in the SOP.	
	Availability		
1	Jamming of a receiving ground station	As per SOP during an unusual occurrence of jamming, procedural control shall be resorted to in Trichy NRA environment.	
2	Spoofing	As per SOP in the event of spoofing, ADS-B ground station (if data flooding occurs) shall be disconnected and use of ADS-B for ATC purposes shall be discontinued. ADS-B input from the sensor, which is the source of such events, to the ATS automation system should be disabled immediately. The Controller shall warn aircraft under his/her control about the presence of a spurious ADS-B transmissions in the area and should be discouraged from using ADS-B IN functionalities, if the capability is so recorded in its flight plan.	

#

Date: 17.06.2015

Signature:
(K. JEBARAJ)
Jt. GM (ATM)
TRICHY INTL. AIRPORT
#

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 05th AUG,2015 TIME:0840 UTC

AIRPORT	: TRICHY (VOTR)
RUNWAY	: 27
PROCEDURE	: VECTORS FOR ILS RWY 27
PILOT IN COMMAND	: Rishviraj Ivss Fernandopulle
CALL SIGN	: ALK133
SECTOR	: VCBI / VOTR
TYPE OF AIRCRAFT	: A320
REGISTRATION	: 4RABL

COMMENTS ON ADS-B SURVEILLANCE SERVICE :

Vectors on ADS-B very good & comfortable // Interception on LOC was smooth ///

SIGNATURE OF PILOT-IN-COMMAND

Recommendation ⟶ STAR for Rwy 09 & Rwy 27 economically advantageous ///

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 06th AUG,2015 :TIME:0255 UTC

AIRPORT	: TRICHY (VOTR)
RUNWAY	: 27
PROCEDURE	: VECTORS FOR ILS RWY 27
PILOT IN COMMAND	: AGUSTINUS HERMAN W
CALL SIGN	: AXM25
SECTOR	:WMKK / VOTR
TYPE OF AIRCRAFT	: A320
REGISTRATION	: 9MAFB

COMMENTS ON ADS-B SURVEILLANCE SERVICE :

THE NEW SYSTEM PERFOMS VERY WELL. THE VECTORS 2 A/C WITH GOOD SEPARATION. ADS-B PERFORMANCE IS GOOD.

SIGNATURE OF PILOT-IN-COMMAND

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 06th AUG,2015 :TIME:0300 UTC

AIRPORT	: TRICHY (VOTR)
RUNWAY	: 27
PROCEDURE	: VECTORS FOR ILS RWY 27
PILOT IN COMMAND	: Capt. Ruwan Vithanage.
CALL SIGN	: ALK131
SECTOR	:VCBI / VOTR
TYPE OF AIRCRAFT	: A320
REGISTRATION	: 4RABK

COMMENTS ON ADS-B SURVEILLANCE SERVICE : ADS-B Vector's were good minimising the DME arc Procedure and Minimizer's the fuel burn.

Ruwan Vithanage

SIGNATURE OF PILOT-IN-COMMAND

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 12th AUG,2015 :TIME:0302 UTC

AIRPORT : TRICHY (VOTR)

RUNWAY : 27

PROCEDURE : VECTORS FOR ILS RWY 27

PILOT IN COMMAND : ANKISHAD LIYANAGODA.

CALL SIGN : ALK131

SECTOR : VCBI / VOTR

TYPE OF AIRCRAFT : A320

REGISTRATION : 4RABL

COMMENTS ON ADS-B SURVEILLANCE SERVICE :

VERY GOOD - KEEP IT UP.

SIGNATURE OF PILOT-IN-COMMAND

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 12th AUG,2015 :TIME:0312 UTC

AIRPORT : TRICHY (VOTR)

RUNWAY : 27

PROCEDURE : VECTORS FOR ILS RWY 27

PILOT IN COMMAND : MOHAMAD HAFIZ B HAIRUDDIN

CALL SIGN : AXM25

SECTOR : WMKK / VOTR

TYPE OF AIRCRAFT : A320

REGISTRATION : 9MAFD

COMMENTS ON ADS-B SURVEILLANCE SERVICE :

VERY GOOD. FUEL SAVED FOR LANDING VECTORS.

SIGNATURE OF PILOT-IN-COMMAND

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 12th AUG,2015 :TIME:0405 UTC

AIRPORT : TRICHY (VOTR)

RUNWAY : 27

PROCEDURE : VECTORS FOR ILS RWY 27

PILOT IN COMMAND : AMIN NORDIN

CALL SIGN : MXD221

SECTOR : VCBI / VOTR

TYPE OF AIRCRAFT : B739

REGISTRATION : 9MLNK

COMMENTS ON ADS-B SURVEILLANCE SERVICE :

ADSB VECTORS DID WELL ON APPROACH ILS 27
AS SUCH IT WILL SAVE FUEL.

SIGNATURE OF PILOT-IN-COMMAND

DEBRIFEING REPORT ON ADS-B SURVEILLANCE SERVICE AT TRICHY AIRPORT

DATE: 12th AUG,2015 :TIME:0 UTC

AIRPORT : TRICHY (VOTR)

RUNWAY : 27

PROCEDURE : VECTORS FOR ILS RWY 27

PILOT IN COMMAND : Capt. R. NANDKUMAR

CALL SIGN : TGW2662

SECTOR : WSSS/ VOTR

TYPE OF AIRCRAFT : A320

REGISTRATION : 9VTRW

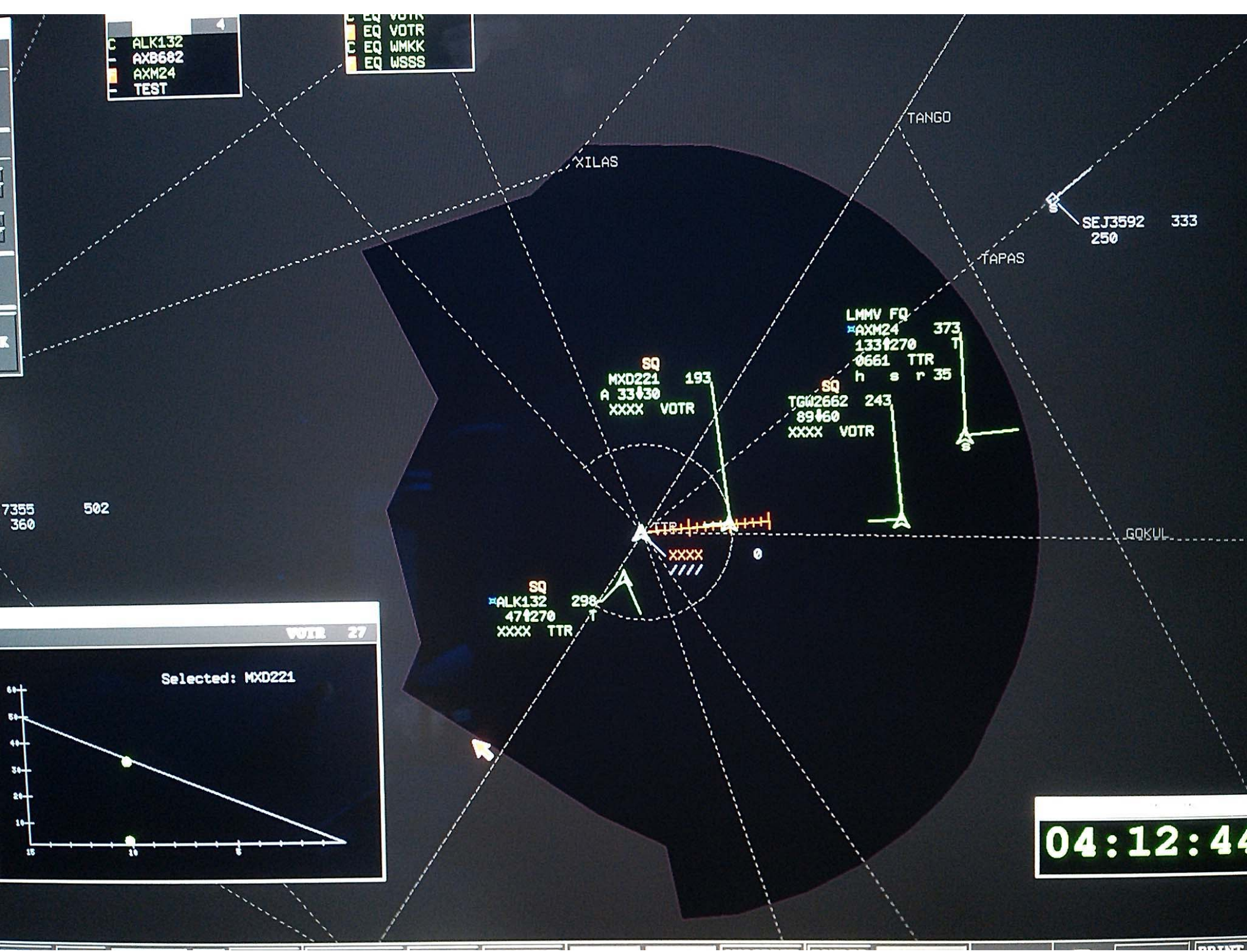
COMMENTS ON ADS-B SURVEILLANCE SERVICE :

Good vectors with ADS-B. Tiger Air is fully compliant with ADS B and welcomes ADSB vectors which will save fuel.

SIGNATURE OF PILOT-IN-COMMAND

12/08/15


XILAS
TAPAS
GOKUL
SEJ3592
365
250
LMMV SQ
AXM24 304
60 60 T
XXXX TTR
h s r 35
TGW2662 398
133 90
2252 VOTR
XXXX
0
58
ALK132
0
SQ
MXD221 238
70
XXXX VOTR
h s r 32
OK
04:08:29


ALK132
AXB682
AXM24
TEST
EQ VOTR
EQ WMKK
EQ WSSS
XILAS
TANGO
TAPAS
GOKUL
SEJ3592 333
250
LMMV FQ
AXM24 373
133↑270 T
0661 TTR
h s r 35
SQ
MXD221 193
A 33↓30
XXXX VOTR
SQ
TGW2662 243
89↓60
XXXX VOTR
7355
360
502
TTR
XXXX
0
SQ
ALK132 298
47↑270 T
XXXX TTR
VOTR 27
Selected: MXD221
04:12:44

Performance monitoring and reporting for the month ending 31 March 2015

Sl no	PERFORMANCE MONITORING	REPORT
1	ADS-B ground receiver serviceability and availability	
	SENSOR A	Serviceable and available H24
	SENSOR B	Serviceable and available H24
2	Medium used for data transfer and data security	LAN cables are used for data transfer and security is ensured
3	Integration of ADS-B data to automation system	ADS-B data was integrated to automation system on 05/04/2014 0500z
	Period disabled	nil
4	Integrity check	Copy enclosed

(K. JEBARAJ)
JT. GM (ATM)
TRICHY AIRPORT

(K. MAHALINGAM)
AGM (CNS)
TRICHY AIRPORT

Performance monitoring and reporting for the month ending 30 April 2015

Sl no	PERFORMANCE MONITORING	REPORT
1	ADS-B ground receiver serviceability and availability	
	SENSOR A	Serviceable and available H24
	SENSOR B	Serviceable and available H24
2	Medium used for data transfer and data security	LAN cables are used for data transfer and security is ensured
3	Integration of ADS-B data to automation system	ADS-B data was integrated to automation system on 05/04/2014 0500z
	Period disabled	nil
4	Integrity check	Copy enclosed

(K. JEBARAJ)
JT. GM (ATM)
TRICHY AIRPORT

(K. MAHALINGAM)
AGM (CNS)
TRICHY AIRPORT

Performance monitoring and reporting for the month ending 31 May 2015

Sl no	PERFORMANCE MONITORING	REPORT
1	ADS-B ground receiver serviceability and availability	
	SENSOR A	Serviceable and available H24
	SENSOR B	Serviceable and available H24
2	Medium used for data transfer and data security	LAN cables are used for data transfer and security is ensured
3	Integration of ADS-B data to automation system	ADS-B data was integrated to automation system on 05/04/2014 0500z
	Period disabled	nil
4	Integrity check	Copy enclosed

(K. JEBARAJ)
JT. GM (ATM)
TRICHY AIRPORT

(K. MAHALINGAM)
AGM (CNS)
TRICHY AIRPORT

SURVEILLANCE EQUIPMENT STATUS FOR ADS B-TRICHY AIRPORT

SL NO.	AIRCRAFT CALL SIGN	OPERATOR	SURVEILLANCE EQPT FILED IN 10B OF FLIGHT PLAN	Whether painting in the SDD scope(90% of time)	REMARKS
01	ALK131	SRILANKAN	H	yes	E-Extended squitter
02	AXM25	AIR ASIA	LB1	yes	H-Enhanced Surveillance
03	AXB682	AIR INDIA EXPRESS	LD1	yes	L-Extended squitter + enhanced surveillance
04	MXD221	MALINDO	S	yes	B1-ADSB 1090 out
05	TGW2662	TIGER	LB1	yes	B2-ADSB 1090 In and Out
06	JAI2750	JET AIRWAYS	H	no	
07	ALK133	SRILANKAN	H	yes	
08	JAI2405	JETAIRWAYS	H	no	
09	AXM27	AIR ASIA	LB1	yes	
10	AXB681	AIRINDIA EXPRESS	LD1	yes	
11	TGW2664	TIGER	LB1	yes	
12	MXD223	MALINDO	S	yes	
13	AXM29	AIR ASIA	LB1	yes	
14	JAI2789	JET AIRWAYS	H	no	
15	AXB612	AIR INDIA EXPRESS	LD1	yes	
16	AXB682	AIR INDIA EXPRESS	LD1	yes	

It is observed that all aircraft except Jet Airways ATR is not ADS-B capable. All the international airlines are ADS-B complaint.

COMPARISON OF ADSB ENABLED AUTOMATION DATA AND AIRCRAFT REPORTED DATA

USING VOR DME- TRICHY AIRPORT

	ADSB DISPLAYED DATA					**AIRCRAFT REPORTED DATA**		
Date	Aircraft	Radial	Level(FL)	distance		Radial	Level	Distance
16.06.15 1139z	AXM27	150	101	40		150	101	40
16.06.15 1250z	AXM26	150	123	26		150	123	26
17.06.15 0310z	ALK131	165	123	37		165	125	37
17.06.15 0329z	AXM25	094	164	55		094	164	55
17.06.15 0422z	TGW2662	094	140	55		094	140	55
17.06.15 0432z	ALK132	165	109	20		165	109	20
17.06.15	AXM24	094	106	20		094	106	20

COMPARISON OF ADSB ENABLED AUTOMATION DATA AND AIRCRAFT REPORTED DATA – TRICHY AIRPORT

	ADSB DISPLAYED DATA					**AIRCRAFT REPORTED DATA**			
Date	Aircraft	Radial	Level	distance		Radial	Level	Distance	
03.10.14 2330z	AXB682	094	F140	33NM		094	F140	33NM	
04.10.14 0330z	AXM25	094	110	35		094	F110	35	
04.10.14 0404z	MXD221	094	188	70		094	188	70	
05.10.14 0805z	AXB612	322	110	30		322	110	30	
05.10.14 0902z	ALK133	165	135	40		165	135	40	
05.10.14 0912z	AXB681	054	110	30		054	110	30	