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02 March 2010

Stuart Parker
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Dear Stuart

New Zealand air traffic management radar systems (SSR and PSR) are approaching the end of their operational life. Over the last two years Airways New Zealand has been reviewing the surveillance requirements within New Zealand airspace and researching both the requirement for surveillance and the technology options that are and will be available in the future.

The result of that effort is the attached document "Airways Surveillance Policy and Strategy". Airways is now in the consultation phase with stakeholders following which feedback will be considered, the document finalised and become the blueprint for the replacement of current radar systems between now and 2018.

We request that you review this document in relation to your area of interest and responsibility and provide feedback to Airways. In the interests of making progress to finalising both the surveillance policy and surveillance strategy we request your feedback be submitted by **1700NZDT on Friday 16 April 2010.**

Please send any feedback to:

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Thank you for your participation.

Regards

ROB IRWIN
Airways New Zealand

AIRWAYS
NEW ZEALAND

airways surveillance policy & strategy

a review of future requirements for surveillance within the boundaries of new zealand sovereign airspace.

17 February 2010

contents

introduction

Airways New Zealand has reviewed future requirements for surveillance within the boundaries of New Zealand sovereign airspace. Current ground based surveillance systems (Monopulse Secondary surveillance Radar (MSSR) and Primary Surveillance Radar (PSR)) are approaching the end of their life. A policy specifying future surveillance requirements and a strategy to meet the objectives of those requirements is required to enable consultation with the aviation industry and regulator. It is also required to enable capital planning for the system replacement and allocation of technical and air traffic management resources for implementation.

surveillance policy

Vision 2015 is the Airways project responsible for establishing a road map of how Communication, Navigation and Surveillance system technologies will enable:

- ANS Managers to have a comprehensive framework for decision–making related to Airways surveillance systems and services.
- Aircraft operators to see Airways surveillance policy and strategy, with timeframes that show for relevant information - for example the fitment of avionics that will be needed with future surveillance technology.
- CAA and Transport Policy makers to understand the logic behind ANSP expectations for rule-making that supports the agreed industry timeline for implementation.

By December 2018, Airways New Zealand will have an operational surveillance system utilizing a combination of the most appropriate technologies to provide services at airports, and in controlled airspaces to meet the needs of Airways customers, satisfy regulatory requirements and provide effective, efficient Air Traffic Management.

By that time, the main surveillance system will be ADS-B supported by MLAT, and MLAT will be the main surface surveillance at any location where CATIII ILS is deployed. Current MSSR radar systems will not be replaced at the end of their operational life.

Aircraft operating in controlled airspace will be required to be fitted with appropriately certified Mode S transponders compatible with the ADS-B surveillance system.

New Civil Aviation Rules will be required to support ground based surveillance service provision including modification to minimum aircraft equipment requirements and associated minimum technical functionality.

surveillance strategy

The strategies are included in this document:

- to achieve the objectives of the Surveillance Policy,
- to confirm and publish future intentions in regard to Airways surveillance infrastructure including a view out beyond 2021 that meets enroute, oceanic and approach requirements,
- to show Airways' reasoning for its intentions to review Primary Surveillance Radar within the surveillance infrastructure at Auckland, Wellington and Christchurch airports.
- to provide CAA with information required to support a change in the relevant Civil Aviation Rules to facilitate the introduction of ADS-B as the main surveillance system in New Zealand providing air traffic management services including surveillance based separations. A prerequisite is that ADS-B implementations meet the ICAO assessment that they are not less reliable, available or capable than the generic MSSR radar.
- To educate aircraft owners, operators and providers on the avionic equipment required to operate in an ADS-B surveillance environment with specific dates for appropriate fit out requirements to enable continued operations in controlled airspace.
- To set a timeline for the replacement of the MSSR network and other changes including equipment siting and location.

background

Since the introduction of MSSR in 1990, surveillance methods for New Zealand Airports and Airspace have been evolutionary using a range of various forms of radar and in the case of Oceanic services presenting ADS report predicted positions.

Total coverage has not been required, or provided. Predictions of traffic surveillance requirements - made at the time of each change - drive the surveillance update or change. As the cost of surveillance technology is significant, coverage has usually been provided where it provides the best value for money in contributing to safety and efficiency of the air traffic services. As actual traffic growth can vary over time some non-surveilled areas might then need surveillance. The New Zealand Air Navigation Plan has mostly reflected the status quo, with some forward commitments.

In the past two decades, new surveillance technologies have become available. Airways has maintained a watch on developments and ICAO standards, and gained first-hand experience with technology trials. Where Airways Executive decision-making has been required, it has usually required a full investigation into the context of why it is required, so effort is needed to research and report at each occasion, much of which could have been answered by having a defined, agreed Policy and Strategy document covering all surveillance technologies.

Changes are being driven by stakeholder requirements, using both new technologies and increased coverage. ICAO has declared a vision of Aviation as a 'System of Systems' to indicate the inter-dependent parts of aviation as a whole. This suits Airways view of multiple networks / systems where all influence each other and all parts should be considered holistically in driving support for the goal of global safe and efficient air operations.

This document has been created to provide Airways view of the evolution of surveillance technologies, noting known applicable technologies, especially those that reverse the trend of 'escalating replacement cost'. It supplements the Airways process of dialogue and liaison with customers to communicate systems and process status and intentions. It supports cohesive surveillance planning and implementation for all stakeholders.

Prior to presenting the discussion and specific items of Airways Surveillance Strategy, a general Surveillance Policy is provided.

As a principle, Strategy follows the Policy. Both are subdivided into Airport [surface/local area], and Airspace [Approach, Enroute Domestic and Enroute Oceanic] surveillance.

document structure
(airways surveillance policy & strategy)

The Surveillance POLICY is presented as Part A.

The purpose of the policy is:

- to provide a common point of reference that notes the applicable performance standards, the selected and intended surveillance applications for use in NZ, and to identify which air traffic services are envisaged to use each technology,
- to specify Data recording storage and retrieval requirements, and
- to provide a basis for Corporate guidance such as when ANS Managers and Executive Board consider future change proposals to surveillance services and technologies provided.

Statements of Policy are specified for:

- when surveillance systems should be provided,
- surveillance system types that are acceptable,
- considerations for implementing particular surveillance systems,

The Surveillance STRATEGY is presented in Part B.

The purpose of providing the Surveillance Strategy is:

- to provide Airways intentions including what surveillance options are considered as acceptable, reasonable and available. Also some comment on existing systems, and the conditions for when a change of technology / new technology is appropriate to meet the requirements of the Surveillance Policy.
- As a baseline for future change in regard to surveillance technology.

Introduction

International technology standards are essential building blocks for a global industry and enable a cost effective and seamless method of delivering safe and efficient air navigation services to the international aviation industry. Industry standards are developed concurrently with the development of new technologies that can take several years to reach maturity. These changes are almost always initiated in response to demand for improved performance from aircraft and ground systems. The initial development work is generally conducted by Original Equipment Manufacturers [OEMs] and Avionics manufacturers, supported by industry bodies such as RTCA [FAA Radio Technical Committee for Aeronautics] and EUROCAE [European Organisation for Civil Aviation Equipment]. As new technology and the associated standards gain industry support, regulators at state and international levels are petitioned for approval to utilise the technology within national, regional and global regulatory domains.

ATS Surveillance means the Detection and Display of aviation traffic, in airspace (aircraft in flight) and on the airport surface (aircraft and vehicles on the ground),
Detection is any form of electronic system, including those that calculate interpolated tracks as a result of data input by an ATS operator.
Display means the presentation to the ATS operator as an Air Situation Display (ASD) or Ground Situation Display (GSD), whether interactive (Graphical User Interface) or not.

1 WHEN should ATS Surveillance be provided?

In the Airspace and Airports served by Airways New Zealand, the following surveillance is required, in the following order of priority:

- Oceanic airspace – all operations shall be managed by the responsible controller using an automated ground system which is available at least 99.99% of the time, that provides the performance and accuracy to enable the application of available ICAO oceanic separations.
    - Oceanic airspace services shall also utilise appropriate available ADS-B data obtained by the New Zealand Domestic Surveillance network, and may deploy ADS-B sites at any location within the NZFIR or Auckland FIR, where a Business requirement exists.
    - Oceanic airspace services shall utilise appropriate available ADS-B data available from neighbouring States where that information is able to improve safety or capacity within the Auckland FIR.
- Oceanic / Domestic / Oceanic transition airspace – surveillance coverage of routes to and from Main Trunk airports, plus Hamilton, Dunedin, Rotorua and Queenstown – covering Regular Passenger Transport (RPT) jet operations, to be displayed to the responsible controller on a Situation Display, available at least 99.99%* of the time, with systems performance and accuracy that enables 5nm ATC Separation between flights.

- Domestic Class C Enroute. Airspace surveillance of RPT jet operations along International routes from Main Trunk Airports and between Main Trunk Airports displayed to the responsible controller on a Situation Display, available at least 99.99%* of the time, with systems performance and accuracy that enables 5nm ATC Separation between flights.
- Domestic Terminal Manouvering Area (TMA) airspace surveillance at the Main Trunk Airport Terminal areas, displayed to the responsible controller on a Situation Display, available at least 99.99%* of the time, with systems performance and accuracy that enables 5nm ATC separation between flights at least 99.99%* of the time, and 3nm ATC separation between controlled flights at least 99.99%* of the time in the TMAs affected.
- Domestic Enroute airspace surveillance of all RPT Jet operations, and a majority of other RPT operations above 10,000ft, covering the whole routes linking Domestic airports to the Main Trunk airports (i.e. not essentially between two non-Main Trunk airports). This surveillance shall be displayed to the responsible controller on a Situation Display, available at least 99.99%* of the time, with performance and accuracy that enables 5nm ATC Separation between flights,

Airport Surface surveillance shall be provided for Low Visibility operations (LVO) ground manouvering operations [LVO = visibility < 350m down to minimum Cat IIIB ILS conditions] displayed to the responsible controller on a Situation Display, available at least 99.99% of the time.

Airport surface or local Surveillance at Main Trunk and Domestic airports shall be considered necessary if supported by a satisfactory business case acceptable to customers using technology detection methods available to supplement visual observation. The KPI criteria is that such surveillance will improve safety and capacity, and/or supports an aerodrome control service being provided either at the airport or from a remote facility.

* Where WAM Multilateration is the surveillance source this may be reduced by agreement to 99.8 (for example based on geographical/weather response capability to address faults).

2 *What ATS Surveillance should be provided?*

The types of electronic surveillance considered acceptable include:

- Primary Surveillance Radar
- Monopulse Secondary Surveillance Radar
- Surface Movement Radar
- Multilateration – airport surface Surveillance
- Multilateration – airspace Surveillance (WAM)
- Automatic Dependent Surveillance – Broadcast (Domestic Airspace)
- Automatic Dependent Surveillance – Contract (OCS)
- CCTV systems for Surface and Airspace Surveillance at Aerodromes.

3 *High Reliability and Availability of any system is essential*

All parts of the system end-to-end must be included in the assessment for Reliability and Availability, including Communications Datalinking, Network systems, and Power supply.
Airways understand NZ CAA require that surveillance technologies include a recording of surveillance data obtained.

Ancillary uses of surveillance data include automated collection of operational performance and commercial data.

4 *References for consideration within this policy:*

4.1 Within the Global and Regional Strategies for Surveillance, the following relevant ICAO strategies are noted:

4.1.1 The ICAO Global view: Air Navigation Commission [ANC] –11th Air Navigation Conference, and

4.1.2 Regional ICAO view: Asia-Pacific Air Navigation Planning & Implementation Regional Group "Regional Surveillance Strategy for Asia Pacific" – Adopted by APANPIRG/19 – September 2008

4.2 Within the ICAO Required Performance Standards:
The Required *Communications, Navigation, and Surveillance* Performance Standard is defined in various different ICAO Annexes / Documents.

4.3 Within the New Zealand Civil Aviation Regulations (NZ CAR) requirements and relevant approvals for approved surveillance technologies – CAR Part 172.115

part b – strategy

Introduction

This section contains:

- Airways systems and intentions to alter the Surveillance services and technologies, status of ICAO and other ANSP (Global / Regional) Surveillance experiences, approvals, and implementations,
- the current strategic decisions of Airways for future surveillance technology deployments,
- the supporting logic for each application.

In general, most countries have relied to date on radar (PSR/SSR/SMR/Precision Approach radar), in some form for their various surveillance needs. ADS-B is maturing to a viable sole-means of surveillance for civil aviation in certain areas. Multilateration provides coverage for the interim period until all required flights are equipped with the required advanced transponder types for ADS-B, and is gaining global support as a long-term standalone method in specific locations.

For surface surveillance, combinations of these 'Advanced - Surface Movement Guidance and Control Systems' [A-SMGCS, which may also use Surface Movement Radar] are implemented in several areas, notably the United States, and Europe, with product names such as ASDE-X.

A variation of Multilateration [MLAT] is Wide Area [WAM] which is used to serve approach and enroute airspace.

Since the ICAO ANS 11th Air Navigation Conference statement, many countries express a desire to adopt new technologies as they become capable, to ensure they adequately use aircraft systems and achieve safer, more efficient operations. It is fair to say that globally, implementations will be piecemeal due to each State having different timelines and budget driven by their business needs and justifications for investment.

The Surveillance options either being used or being considered for NZ:

1 Airspace Surveillance

1.1 ADS-C: [Oceanic Airspace]. This technology was introduced operationally to the Auckland FIR in 2001 in the Oceanic Control System [OCS] Phase 2, following an earlier Phase 1 which provided ADS-C and FANS 1/A data link availability from 1995. Phase 2 included non-ADS-C aircraft and introduced Trajectory based Operations.

- The FANS-1/A applications use satellite, VHF, and HF datalink technology for Communications and Surveillance with those aircraft which have the necessary avionics. When an ADS-C contract is active, data is obtained directly from the aircraft Flight Management Systems automatically, checked for validity and conflict detection, then provided to the controller with regular position, level and other information. The FANS-1/A Controller-Pilot Data Link Communication [CPDLC] application is used for communication between the Controllers and Pilots. Currently, both ADS-C and CPDLC are provided by the FANS-1/A

applications which employ ACARS technology. ATN based CPDLC and ADS-C applications will be introduced if necessary when aircraft are ATN fitted.

- FMS-WPR: [Flight Management System – Waypoint Position Reporting] This source of surveillance information was introduced operationally to the Auckland FIR- Oceanic Airspace in 2007. FMS-WPR uses satellite, VHF, and HF datalink to send ACARS position reports to an airline operational control centres (AOC) where the relevant data are converted into a format readable by the oceanic automation, and transmitted on to OCS via AFTN.
- These technologies are considered leading edge globally, suit the large Oceanic expanses involved in the South Pacific, and will be maintained for the foreseeable future.

1.2 Primary Surveillance Radar [PSR] – last upgraded in 2005, with an expected lifecycle of 15 years, producing an expected 'end of life' (Decommissioning) date: 2021.

1.2.1 The current (2010) use for PSR (non-dependant surveillance) is to detect and track 'uncooperative' flights; for example with unserviceable transponders, or inadvertent, even criminal disablement of transponders that consequently prevents detection and tracking. Undetected non-transponding flights were perceived to create risk to controlled flights receiving ATC services within the busier terminal CTA's, although experience has shown that in the lifetime of the current Primary radars, PSR has not 'prevented' unauthorised intrusions into airspace.

1.2.2 PSR can be used individually as a sole-means surveillance for the provision of an Air Traffic Control service (includes radar control service and radar traffic information service).

1.2.3 The PSR range is limited to 80nm, using large amounts of power. Maintenance costs are high, especially with the electromechanical interfaces of the antennae. Each PSR emits a high amount of Radio Frequency energy and is considered unfriendly to the environment for that reason. Attenuation of signal is a relevant issue that results in PSR locations that have short data link distances. Cost of maintaining and/or replacing PSR is now unreasonable for the actual benefits these currently provide.

1.2.4 Airways intend to review the requirement for the remaining PSRs at Auckland Wellington and Christchurch. To that end a safety case will be developed to assess the impact of not providing surveillance for non-cooperative targets at those locations.

1.3 Monopulse Secondary Surveillance Radar [MSSR] – a Mode S upgrade was introduced in 2005, so (as with PSR) with an expected lifecycle of 15 years, produces expected 'end of life' (Decommissioning) date: 2021.

1.3.1 MSSR is the baseline surveillance coverage of Approach (manouvering) areas, and Enroute tracks between large city pairs, International flights, and a selection of regional routes.

1.3.2 The need to decommission MSSR is primarily cost related. This electro-mechanical technology is a high power user, generates significant high Radio Frequency energy, and is expected to become increasingly more

expensive to maintain, while a variety of more cost effective alternatives are available.

1.3.3 MSSR is an approved technology for the provision of an Air Traffic Control service (includes radar control service and radar traffic information service).

1.3.4 A single MSSR can be used for all levels of ATM operations and ATC separations.

1.3.5 It is intended to remove the MSSRs between 2018 and 2021 and the surveillance infrastructure will be mainly ADS-B and/or MLAT sourced.

1.4 Wide Area Multi-Lateration (WAM) – Airways is installing/commissioning various sites, starting with Queenstown in December 2009. The role of WAM is as a standalone means of surveillance, although the main use for the Auckland MLAT system for WAM will be as a supplementary means for MSSR until 2018. Supplementary use can include contingency support situations for other major terminal areas as an extension of the MSSR network. Regional airport WAM evaluations are possible in future depending on the location, geography, traffic and business case aligning in favour of this.

1.4.1 Wide Area Multi-Lateration (WAM) has been selected because it is compatible both backward and forwards in regard to other dependent and non-dependent technologies (based on the aircraft Mode A/C and Mode S transponder equipment standards). It's dispersed array of receivers creates a surveillance system that is capable of delivering higher levels of performance than conventional MSSR at significantly lower installation and operating costs, with the added flexibility of being simply expanded as needs arise.

1.4.2 A WAM system also detects and provides ADS-B data. When the data within the ADS-B message is unacceptable, the signal reception will be included in the Multilateration process, albeit requiring more sensors to determine the position, and therefore applicable in a smaller general area of airspace.

1.4.3 As a new technology for New Zealand in 2009, it should be noted that WAM will follow the company process standard prerequisite steps before being operationally deployed following the completion of:

- Customer needs analysis,
- An Airways safety case.
- CAA approval of the safety case.
- Amendment to the Airways expositions in regard to technologies and the intended use, and
- CAA Rule alignment for use as proposed (either situational awareness or for Separation of flights by ATC).

1.4.4 Prior to integration of WAM and ADS-B with the ATM system (e.g. SkyLine) and the result being deployed for ATC use, the use of WAM will be limited to the provision of a surveillance based traffic information service with increased situational awareness by the ATC.

1.4.5 Following the deployment of WAM surveillance data in the ATM system, and a satisfactory stability test period, a separate safety case will be

conducted to support the use of WAM data to provide an ATC Surveillance [radar-like] control service.

1.5 Automatic Dependent Surveillance – Broadcast (ADS-B OUT; Transmit from Aircraft). Airways intend to use their ability to receive ADS-B signals from WAM Systems to commission various sites, starting with Auckland and Queenstown and apply that data in the National ATM System (SkyLine) by October 2010.

1.5.1 ADS-B has been widely deployed in Australia to cover all the upper airspace. Ground Stations detect ADS-B messages and send them to the ATM system. Two antennae at each site provide redundancy. Australia's system does not include up-linking of data from the Ground Station to the aircraft. Their lower airspace implementation is now scheduled for around 2021. The FAA has committed to deploy ADS-B across the National Airspace, with a more complex system that uplinks weather, traffic and other data to aircraft.

1.5.2 Because ADS-B systems are basically listening devices, they have no mechanical parts, they require less power, emit no RF, do not require substantial building protection, and are environmentally 'friendly'. They are more easily added to the Surveillance toolbox than a traditional MSSR and at a fraction of the price.

1.5.3 ADS-B has been selected by Airways because this technology has been recognised by ICAO as a key enabler of the Global Navigation Plan, and the timing is similar to that of other respected ANSP's. The technology delivers higher levels of performance than MSSR for significantly lower ANS cost. While the lower ANS costs were identified as being offset by increased aircraft equipage costs in the 2005 review, by the declaration of Airways' intent that by 2018 ADS-B will form the backbone of surveillance requirements for New Zealand, this timeframe allows a long period for aircraft operators to select and install a compliant transponder type.

2 Surface Surveillance

2.1 Surface Movement Radar [SMR] is a common surface detection of aircraft and vehicles. As a Primary radar 'skin paint' technology it has been useful at comple major airports where unauthorised manouvering area intrusions have been problematic. These are usually set at high rotation (60/min) limiting coverage. Where considered essential at least two are required, and at complex airports there it becomes very expensive to provide coverage due to siting in relation to existing and future building. For the periods it would be useful, the costs outweigh the benefits predicted. While SMR is a proven technology, it is not expected to be required by Airways when Multilateration offers so much more.

2.2 Advanced Surface Movement Guidance and Control System [A-SMGCS] is the term for application of several levels of Surface Surveillance at airports, each level defining different levels of automation. A full A-SMGCS system would include a combination of Surface movement Radar, Multilateration, (and ADS-B to provide a comprehensive tracking surveillance of aircraft and vehicles on an airport. Generally the cost of a full system is significant, and the need for it is usually based on regular low visibility operations. At present no airport in New Zealand is considered a business candidate for full A-SMGCS, although it can be considered a natural evolutionary upgrade in future from the combinations of Multilateration, ADS-B, and Radar that are present surveillance assets.

2.3 Multilateration Surface Surveillance (MSS) has been selected for use at Auckland International Airport, without SMR. It can be described as the key element of A-SMGCS (Surveillance). It is favoured for the near term as it is a compatible system both backwards and forwards with aircraft Mode A/C and Mode S transponder equipment standards. The Auckland implementation is an example of meeting the market need. The dispersed array of receivers creates a surveillance system that is capable of delivering the high levels of performance needed to support airport surface operations at significantly lower installation and operating costs than the alternative (full A-SMGCS) systems. Other airports will be evaluated for Surface Surveillance systems when WAM systems are likely to provide operational benefits at an affordable cost. For example where a significant reduction in RTF load or improvement in traffic capacity and/or safety are identified. Every month manufacturers are reporting new contracts for Multilateration surface systems, so globally many ANSPs are finding them attractive.

2.4 Airport surface areas and operations may also be surveilled using CCTV surveillance, primarily for visual operation conditions, but also by using light enhancing technology for low visibility and low light situations.

2.4.1 CCTV is in the concept stage for Airways. This technology is another lower cost system that has the potential to increase capacity at busy Low Visibility operations airports, and to provide remote surveillance for secondary or unattended airports to provide safe operations.

3 Other considerations

3.1 Performance Monitoring

3.1.1 The surveillance performance requirements for each surveillance technology deployed by Airways NZ will vary depending on the technology design and it's intended use, however for every Surveillance system deployed operationally, performance monitoring tools must be used that deliver regular performance reports of elemental and system statistics and performance.

3.2 Height Monitoring Facility

3.2.1 Airways plan to evaluate the business case for an independent height monitoring facility to enable aircraft avionics compliance with ICAO / CAA requirements for RVSM height keeping performance. Airways' suggest that the ICAO recommendation is for each ICAO Region to have monitoring, not each State. The recommendation applies to flights above FL290 being monitored. For this reason, Airways will coordinate with NZCAA and neighbouring ANSPs to evaluate how and when this might be achieved, and will review how and when other Domestic aircraft may be monitored.

3.3 Navigation Performance Monitoring

3.3.1 There is no mandate for aircraft navigation performance monitoring by the Surveillance and ATM systems, although the NZCAA PBN draft plan is indicating some level of monitoring may be required.

part c – references

- ICAO Annex 10
- ICAO Annex 11 Chapter 6
- NZ CAA Rules: ATC, Technical, Avionics for all Flight types, Part 172 Airways Expositions on Rules P172, P171, P175
- NZAIP, NZ MATS, ACs, Exemptions, etc

Relevant Papers (Key Points included)

- C:1 Surveillance Strategy for the Asia/Pacific Region – APANPIRG/19 – September 2008
- C:2 Asia pacific APANPIRG ADS-B Implementation & Operations Guideline Documen (2006)
- C:3 Summary of Airways' view regarding ADS-B and MLAT

1 Surveillance Strategy for the Asia/Pacific Region Adopted by APANPIRG/19 – September 2008

Key Point 1:

Considering that:

1. States are implementing CNS/ATM systems to gain safety, efficiency and environmental benefits, and have endorsed the move toward satellite and data link technologies;
2. The future air traffic environment will require increased use of aircraft-derived surveillance information for the implementation of a seamless automated air traffic flow management system;
3. The 11th Air Navigation Conference endorsed the use of ADS-B as an enabler of the global air traffic management concept and encouraged States to support cost-effective early implementation of ADS-B applications;
4. APANPIRG has decided to use the 1090MHz Extended Squitter data link for ADS-B air-ground and air-air applications in the Asia/Pacific Region, noting that in the longer term an additional link type may be required;
5. SSR and ADS-C will continue to meet many critical surveillance needs for the foreseeable future;
6. ACAS acts as situational awareness tool and last resort for safety conflict resolution;
7. SARPs, PANS and guidance material for the use of ADS-B have been developed;
8. ADS-B avionics and ground systems are available; and
9. Multilateration is a technology that can supplement SSR and ADS-B.

Key Point 2:

THE SURVEILLANCE STRATEGY FOR THE ASIA/PACIFIC REGION IS TO:

1. Minimise the reliance upon pilot position reporting, particularly voice position reporting, for surveillance of aircraft;

2. Maximise the use of ADS-B on major air routes and in terminal areas, giving consideration to the mandatory carriage of ADS-B Out as specified in Note 1 and use of ADS-B for ATC separation service;
3. Reduce the dependence on Primary Radar for area surveillance;
4. Provide maximum contiguous ATS surveillance coverage of air routes using 1090Mhz Extended Squitter ADS-B and Mode S SSR based on operational requirements;
5. Make full use of SSR Mode S capabilities where radar surveillance is used and reduce reliance on 4-digit octal codes;
6. Make use of ADS-C where technical constraint or cost benefit analysis does not support the use of ADS-B, SSR or Multilateration;
7. Make use of Multilateration for surface, terminal and area surveillance where appropriate as an alternative or supplement to other surveillance systems;

Key Point 3:
Appendix J to the Report on Agenda Item 3.4 / J- 3 includes the following:

8. Increase the effectiveness of surveillance and collision avoidance systems through andatory use of pressure altitude reporting transponders;
9. Improve safety through sharing of ATS surveillance data across FIR boundaries;
10. Ensure provision of communication, navigation, and data management capabilities necessary to make optimal use of surveillance systems;
11. Enhance ATM automation tools and safety nets through the use of aircraft-derived data such as flight identification, trajectories and intentions; and
12. Ensure civil-military interoperability.

2 Asia Pacific APANPIRG ADS-B Implementation & Operations Guideline Document: 2006 (Key sections)

3.4 SYSTEM PERFORMANCE CRITERIA FOR AN ATC SEPARATION SERVICE

A number of States have started to introduce ADS-B for the provision of Air Traffic Services, including 'radar-like' separation. The ICAO Separation and Airspace Safety Panel (SASP) has been assessing the suitability of ADS-B for various applications using a comparative assessment methodology and, together with the ICAO Operational Data Link Panel (OPLINKP), is drawing on the experience of early implementers to develop operational provisions. It is anticipated that PANS-ATM (Doc 4444) will be amended to include ADS-B separation minima in 2007.

States intending to introduce ADS-B separation minima not published in PANS-ATM or Regional Supplementary Procedures (Doc 7030) should comply with the provisions of Annex 11 paragraph 3.4.1. States should adopt the guidelines contained in this document unless conformance with PANS-ATM specifications requires change.

3.5 ATC SYSTEM VALIDATION

3.5.1 Safety Assessment Guidelines

To meet system integrity requirements, States should conduct a validation process that confirms the integrity of their equipment and procedures. Such processes shall include:

a) A system safety assessment for new implementations is the basis for definitions of system performance requirements. Where existing systems are being modified to utilize additional services, the assessment demonstrates that the ATS Provider's system will meet safety objectives.

b) Integration test results confirming interoperability for operational use of airborne and ground systems; and

c) Confirmation that the ATS Operation Manuals are compatible with those of adjacent providers where the system is used across a common boundary.

3.5.2 System safety assessment

The objective of the system safety assessment is to ensure the State that introduction and operation of ADS-B is safe. This can be achieved through application of the provisions of Annex 11 paragraph 2.26 and PANS-ATM Chapter 2. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

a) Identifying failure conditions;
b) Assigning levels of criticality;
c) Determining risks/ probabilities for occurrence; and
d) Identifying mitigating measures.
e) Categorising the degree of acceptability of risks.
f) Operational hazard ID process

Following the safety assessment, States should institute measures to offset any identified failure conditions that are not already categorized as acceptable. This should be done to reduce the probability of their occurrence to an acceptable level. This could be accomplished through automation or procedures.

3.5.3 Integration test

States should conduct trials with suitably equipped aircraft to ensure they meet the operational and technical requirements. To provide an ATS alternatively, they may be satisfied by test results and analysis conducted by another State or organisation deemed competent to provide such service. Where this process is followed, the tests conducted by another State or organisation should be comparable (i.e. using similar equipment under similar conditions).Reference to Doc968

3.5.4 ATS Operation Manuals

States should coordinate with adjacent States to confirm that their ATS Operation Manuals contain standard operating procedures to ensure harmonization of procedures that impact across common boundaries.

3.5.5 ATS System Integrity

With automated ATM control systems, data changes, software upgrades, and system failures can affect adjacent units. States shall ensure that:

a) A conservative approach is taken to manage any changes to the system.

b) Aircrew, aircraft operating companies and adjacent ATSU(s) are notified of any planned system changes in advance, where that system is used across a common boundary.
c) ATSUs have verification procedures in place to ensure that following any system changes, displayed data is both correct and accurate.
d) In cases of system failures or where upgrades (or downgrades) or other changes may impact surrounding ATS units, ATSUs should have a procedure in place for timely notification to adjacent units. Such notification procedures will normally be detailed in Letters of Agreement between adjacent units.
e) ADS-B surveillance data is provided with equal to or better level of protection and security than existing surveillance radar data.

3.6 SYSTEM MONITORING

During the initial period of implementation of ADS-B technology, routine collection of data is necessary in order to ensure that the system continues to meet or exceed its performance, safety and interoperability requirements, and that operational service delivery and procedures are working as intended. The monitoring program is a two-fold process. First, summarised statistical data should be produced periodically showing the performance of the system. This is accomplished through ADS-B Periodic Status Reports. In addition, as problems or abnormalities arise, they should be identified, tracked, analyzed and corrected and information disseminated as required, utilizing the ADS-B Problem Report.

3.6.1 Problem Reporting System (PRS)

The Problem Reporting System is tasked with the collection, storage and regular dissemination of data based on reports received from ADS-B SITF members. The PRS tracks problem reports and publish information from those reports to ADS-B SITF members. Problem resolution is the responsibility of the appropriate ADS-B SITF members.

The PRS Administrator shall:

a) prepare consolidated problem report summaries for each ADS-B SITF meeting;
b) collect and consolidate ADS-B Problem Reports; and
c) maintain a functional website (with controlled access) to manage the problem reporting function.

3.6.2 The monitoring process

When problems or abnormalities are discovered, the initial analysis should be performed by the organization(s) identifying the problem. In addition, a copy of the problem report should be entered in to the PRS which will assign a tracking number. As some problems or abnormalities may involve more than one organization, the originator should be responsible for follow-up action to rectify the problem and forward the information to the PRS. It is essential that all information relating to the problem is documented and recorded and resolved in a timely manner.

The following groups should be involved in the monitoring process and problem tracking to ensure a comprehensive review and analysis of the collected data:

a) ATS Providers,

b) Organizations responsible for ATS system maintenance (where different from the ATS provider),
c) Relevant State regulatory authorities,
d) Communication Service Providers being used,
e) Aircraft operators, and
f) Aircraft and avionics manufacturers.

3.6.3 Distribution of confidential information

It is important that information that may have an operational impact o other parties be distributed by the authorised investigator to all authorised groups that are likely to be affected, as soon as possible. In this way, each party is made aware of problems already encountered b others, and may be able to contribute further information to aid in the solution of these problems. The default position is that all states agree to provide the data which will be de-identified for reporting and record keeping purposes.

3.6.4 ADS-B problem reports

Problem reports may originate from many sources, but most will fall within two categories; reports based on observation of one or more specific events, or reports generated from the routine analysis of data. The user would document the problem, resolve it with the appropriate party and forward a copy of the report to the PRS for tracking and distribution. While one occurrence may appear to be an isolated case, the receipt of numerous similar reports by the PRS could indicate that an area needs more detailed analysis.

To effectively resolve problems and track progress, the problem repor should be sent to the nominated point of contact at the appropriate organisation and the PRS. The resolution of the identified problems may require:

a) Re-training of system operators, or revision of training procedures to ensure compliance with existing procedures;
b) Change to operating procedures;
c) Change to system requirements, including performance and interoperability; or
d) Change to system design.

3.6.5 ADS-B periodic status report

The ATS Providers should complete the ADS-B Periodic Status Report annually and deliver the report to the regional meeting of the ADS-B SITF. The Periodic Status Report should give an indication of system performance and identify any trend in system deficiencies, the resultan operational implications, and the proposed resolution, if applicable.

Communications Service Providers, if used, are also expected to submi Periodic Status Reports on the performance of the networks carrying ADS-B data at the annual regional meeting of the ADS-B SITF. These reports could also contain the details of planned or current upgrades t the network.

3.6.6 Processing of Reports

Each group in the monitoring process should nominate a single point o contact for receipt of problem reports and coordination with the other

parties. This list will be distributed by the PRS Administrator to all parties to the monitoring process.

Each State should establish mechanisms within its ATS Provider and regulatory authority to:

a) Assess problem reports and refer them to the appropriate technical or operational expertise for investigation and resolution;
b) Coordinate with aircraft operators;
c) Develop interim operational procedures to mitigate the effects of problems until such time as the problem is resolved;
d) Monitor the progress of problem resolution;
e) Prepare a report on problems encountered and their operational implications and forward these to the PRS;
f) Prepare the ADS-B periodic status report at pre-determined times and forward these to the Secretary of the annual meeting of the ADS-B SITF; and
g) Coordinate with any Communication Service Providers used.

3.7 APANPIRG

APANPIRG shall oversee the monitoring process to ensure the ADS-B system continues to meet its performance and safety requirements, and that operational procedures are working as intended. The APANPIRG'S objectives are to:

a) review Periodic Status Reports and any significant Problem Reports;
b) highlight successful problem resolutions to ADS-B SITF members;
c) monitor the progress of outstanding problem resolutions;
d) prepare summaries of problems encountered and their operational implications; and
e) assess system performance based on information in the PRS and Periodic Status Reports.

4. ADS-B DATA

The Eleventh ICAO Air Navigation Planning Conference recommended that States recognize ADS-B as an enabler of the global ATM concept bringing substantial safety and capacity benefits; support the cost-effective early implementation of it; and ensuring it is harmonized, compatible and interoperable with operational procedures, data linking and ATM applications.

APANPIRG has decided to use 1090MHz Extended Squitter data link for ADS-B data exchange in the Asia and Pacific Regions. In the longer term an additional link type may be required.

ADS-B data requirements for aircraft transmissions are contained in Annex 10 Vol IV. ADS-B data requirements for ground-ground messaging shall be determined by States. International exchange of ground-ground messaging should use ASTERIX 21 Version 0.23 format.

3 Summary of Airways' view regarding ADS-B and MLAT

Airways has the capability to receive Automatic Dependent Surveillance – Broadcast [ADS-B] from aircraft transmitting these messages. Currently this is in

the Auckland area where flights are in line-of-sight with any of the Multilateration Surveillance System (MSS) sensors at that location, and also from any Wide Area Multilateration (WAM) sensors that have been provided at Queenstown.

Airways note that globally, ANSPs are adopting ADS-B as a sole-means surveillance for ATC that will replace MSSR. Big players including Australia and the U.S. which are introducing ADS-B over the whole Continental areas, which is also forming the basis of future cooperative systems of air navigation (such as Freeflight in the U.S.). Some Asia-Pacific regional countries introducing ADS-B in part are: China, India, Indonesia, Fiji, Thailand, Singapore, and Taiwan. Australia have installed ADS-B at Lord Howe Island and are in negotiation with Airways for a similar installation at Norfolk Island –that can provide ADS-B detection continuously from Auckland to Brisbane.

The 11th Eleventh ICAO Air Navigation Planning Conference [in 2003] recommended that States recognize ADS-B as an enabler of the global ATM concept bringing substantial safety and capacity benefits; support the cost-effective early implementation of it; and ensuring it is harmonized, compatible and interoperable with operational procedures, data linking and ATM applications.

New Zealand's MSSR sites were upgraded in 2006 a little ahead of end of life. In deciding to upgrade, Airways considered ADS-B as a replacement for MSSR, but it was assessed as too immature on the ICAO and technology fronts, with a critical issue being the lack of the necessary avionics equipage in the NZ fleet, especially amongst General Aviation (GA) in those areas where it would be most useful. The decision to buy an upgrade the radars has given New Zealand the luxury of time until they too reach end-of-life.

MLAT / WAM

MLAT or Multilateration is a term that covers Surface Surveillance and Wide Area Multilateration (WAM). During 2006, Airways introduced a Multilateration system for Airport Surface Surveillance at Auckland (improving safety and capacity in Low Visibility Operations), and another for Airspace Surveillance at Queenstown (WAM – improving safety and capacity overall, but especially beyond the visual range of the Control Tower). The technology is the same, but the WAM system required more sensors to achieve the required airspace coverage. The decision to introduce MLAT was based on a) the need for surveillance in these areas, b) the high cost of Surface Movement or Area Radars, and c) the fact that Multilateration in these places is designed to detect the minimum level transponders almost all New Zealand aircraft have been equipped with (mode A/C) – in spite of Multilateration being more expensive to establish and maintain than an ADS-B site.

These Multilateration systems can establish an accurate position by the receipt of aircraft ADS-B transmissions, or by 'Multilaterating' responses from the ADS-B signal, Mode S interrogation responses, TCAS interrogation responses, or Multilateration Interrogator responses.

Airways will use MLAT-determined tracks for enroute and terminal control airspace surveillance from 2010, and intend to retain the established MLAT systems beyond 2021, using the modular design to expand coverage areas where required. MLAT systems are appropriate in other locations depending on a customer need and valid business case. In future new systems can be 'plugged in' to the ATM system without further software development effort to include them.

ADS-B OUT

In the intervening 3 years since 2006 however, ADS-B has developed across all fronts, and is now able to be adopted in a managed way. Airways wish to take advantage of the ADS-B being received from its MLAT sensors and from separate ADS-B sensors that are added to the NZ Surveillance infrastructure, and will stage the introduction of ADS-B from 2010 as a surveillance source as appropriate. Airways wish to give industry (and aircraft owners) sufficient notice of the impending requirement to plan for their aircraft avionics to be upgraded / replaced as necessary to ensure at least ADS-B OUT functionality by 2018. Airways commitment is to complete the ADS-B infrastructure in 2018, when the radar infrastructure will begin a phase out.

It should be noted that earlier installations can occur, ADS-B OUT is already being used by some aircraft, and by ATC without any adverse impact on other systems. It should also be noted that non-compliant ADS-B equipment (TSO129, or pre-DO260a Mode S, or Mode A/C only) and non-compliant configurations (missing data in an ADS-B message set for example) will not be allowed.

For Airways to rely on ADS-B for ATS monitoring and separation, aircraft must be required to carry and operate:

- A correct method of determining position – with sufficient integrity – TSO 145/146 is the minimum specification that will exclude known issues,
- A Mode S transponder that sends ADS-B OUT with sufficient integrity – minimum DO260a [DO260b agreed and becoming available from 2009] at present. Critically, DO260a can determine if there is a GNS Satellite failure (Failure Detection –FD), and can exclude any information from that satellite Failure Detection & Exclusion [FDE].
- Configuration to ensure all the data is being provided for integrity of the whole system and to allow Safety net alert processing etc.

The Air Traffic Management system has been modified (this work has been done, and was tested offline during 2009):

- ADS-B messages can be received and processed to form a display track using fusion with any other surveillance source(s) for the flight.
  When a track is derived from a single sensor or is a fused combination of sensors (radars, WAM, or ADS-B), the same position indicator icon will be displayed to the controller.
- For ADS-B only tracks, these will be processed through the same safety net alerting as for other surveillance tracks (MSAW, Trajectory compliance, STCA, Restricted Area Warning, etc). Aircraft operators will be afforded these protections when in coverage of an ADS-B sensor from the time they have ADS-B OUT functioning.

As for MLAT, future new ADS-B systems can be 'plugged in' to the ATM system without further software development effort to include them.

acronyms

The following is a list of acronyms used in this document:

ACARS	Aircraft Communications, Addressing and Reporting System
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
AOC	Airline Operations Centre
APANPIRG	Asia-Pacific Air Navigation Planning & Implementation Regional Group
ASD	Air Situation Display
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Service
CAA	Civil Aviation Authority
CAR	Civil Aviation Rules
CCTV	Closed Circuit Television
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CTA	Controlled Airspace
FIR	Flight Information Region
FMS	Flight Management System
GNSS	Global Navigation Satellite System
GSD	Ground Situation Display
HF	High Frequency radio
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
KPI	Key Performance Indicator
LVO	Low Visibility Operations
MLAT	Multilateration
MOT	Ministry of Transport
MSS	Multilateration Surface Surveillance
MSSR	Mono-pulse Secondary Surveillance Radar
OCS	Oceanic Control System
OEM	Original Equipment Manufacturer
PBN	Performance Based Navigation
PSR	Primary Surveillance Radar
RSP	Required Surveillance Performance

RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance Authorisation Required
RPT	Regular Passenger Transport
RTF	Radiotelephony
SkyLine	New Zealand Air Traffic Management system
SMR	Surface Movements Radar
SSR	Secondary Surveillance Radar
TMA	Terminal CTA
VHF	Very High Frequency radio
WAM	Wide Area Multilateration

Consultation List

Organisation	Title
Air New Zealand	Mgr Ops Support – Bob Fletcher
Jetstar	Chief Pilot – Phil Stevenson
Pacific Blue	CEO – Mark Pitt
Qantas Airlines	Mgr Operations – Graham Rennie
CAA NZ	Director – Steve Douglas
AIA	CEO – Irene King
Mount Cook Airlines	Mgr Flight Ops – Alan Brown
Air Nelson	Mgr Flight Ops – Bob Guard
Eagle Air	Mgr Flight Ops – Wayne Taylor
NZALPA	Technical Officer – Ross Gillespie
IFALPA	Executive VP – Asia Pacific – Stu Julian
MOT	Principal Advisor – Nigel Mouat
Gliding NZ	President – George Rogers
Air National	CEO – Jason Gray
JetConnect	Flight Operations Manager – Paul Burton
RNZAC	Executive Secretary – Dave Bishop
CTC Aviation	Acting CEO – Ian Calvert
NZ Aviation Federation	Secretary – Rex Baynes
Sport Aircraft Assn	Admin Officer – Adrienne Fillery
Defence - RNZAF	Air Cdr Gavin Howse, DCAF
AOPA	Secretary & Treasurer – Ian Vercoe
NZ Airports Assn	CEO – Kevin Ward
Met Service	Manager Aviation Services - Ray Thorpe
Air Freight	CEO - Mark Lazenby
Airwork / Airpost	Mgr Flight Ops – Grant Jolley
ACAG	Chairman – Brian Whelan
Vincent Aviation	Managing Director – Peter Vincent
Sport Aviation Corp	CEO – Barry Readman
Recreational Aircraft Assn NZ	Admin Officer – Stuart Parker
BARNZ	CEO – John Beckett
CASA - Australia	Mgr Airways & Aerodromes – Kim Jones
Air Services Australia	GM ATC – Jason Harfield
Airways – Main Trunk	Mgr Main Trunk – Lewis Jenkins
Airways – Oceanic	Mgr Oceanic – Mark Goodall
Airways – Regional	Mgr Regional – Grant Rawstorn
Airways – Systems	Group Manager – Andrew Griffith
Airways – Safety	Mgr Safety – Russell Buckley
Airways – Commercial	Mgr Commercial – Bert Prvanov