ads-b

CHECK YOUR VISIBILITY

Transitioning from radar to ADS-B in all controlled airspace: rules, facilitation, and guidance for a new surveillance system

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Policy discussion document
February 2019

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

Contents

h.3o7alnkObjectives for this consultation process

The Civil Aviation Authority (CAA) is currently developing policy and rule changes to support the replacement of New Zealand's aviation surveillance radar infrastructure, which will reach the end of its operational life in 2021.

Automatic Dependent Surveillance-Broadcast (ADS-B) will become the main source of surveillance information for air traffic management in New Zealand.

This change will affect all aircraft owners and operators who fly in controlled airspace in New Zealand.

We want to understand the impact of this proposal on operators flying in controlled airspace below flight level 245 (approximately 24,500 feet).

The policy objectives for this work are to:

- **Assess the impact of a rule change that would mandate ADS-B OUT for all aircraft operating in all controlled airspace in the New Zealand flight information region from 31 December 2021.**
- **Identify actions that would best support aircraft owners and operators to move to ADS-B before the mandate comes into force.**
- **Ensure that aviation safety is, at a minimum, maintained during and after the transition period to ADS-B.**

The structure of this document

Section one sets out the background information on the move to ADS-B OUT, including the costs and benefits for operators.

Section two sets out the policy proposal to mandate ADS-B OUT for aircraft operating in controlled airspace below flight level 245, and information about the costs and benefits of an ADS-B mandate.

Section three sets out a series of questions about the proposal to mandate ADS-B OUT and what it will mean for you.

How to make a submission

We want to hear your views about the proposals so that we can maximise the benefits of ADS-B for everyone using the aviation system.

Questions have been provided in Section 3. These questions are a guide, but please feel free to provide your own feedback.

The closing date for feedback is close of business on **5 April 2019.**

Feedback can be provided through channels:

Survey monkey: https://www.research.net/r/ADSB-CAA

Email: consultation@caa.govt.nzmailto:consultation@caa.govt.nz mailto:consultation@caa.govt.nz

Post: Katie Gunatunga
Policy Advisor
Civil Aviation Authority
PO Box 3555
Wellington 6140

If you have any questions about the policy proposal or the consultation process please contact the ADS-B team at adsb@caa.govt.nz

Section One: About ADS-B

1.1 Introduction

New Southern Sky (NSS) is the name of the programme to implement New Zealand's National Airspace and Air Navigation Plan and modernise our aviation system. NSS is a ten-year programme that aligns work by all the key stakeholders to maximise the benefits for the whole aviation sector and improve safety, capacity and efficiency.

NSS gives a clear direction on incorporating new and emerging technologies into the aviation system to ensure the safe, cohesive, efficient and collaborative management of New Zealand's airspace and air navigation to 2023.

NSS includes a pathway for replacing New Zealand's current radar surveillance system with ADS-B.

For more information on NSS, the wider surveillance project and the dependencies between surveillance and navigation modernisation, please visit www.nss.govt.nz.

1.2 Automatic Dependent Surveillance-Broadcast (ADS-B)

Civil Aviation Rules currently require that aircraft be fitted with equipment that is compatible with the secondary surveillance radar (SSR) used by Air Traffic Control. SSR determines the location of aircraft, and can also obtain further identifying information from aircraft that are equipped with the required transponders.

New Zealand's SSR infrastructure will reach the end of its service life in 2021. Rather than replacing this radar equipment, Airways, which owns and operates the equipment, will install Automatic Dependent Surveillance-Broadcast (ADS-B) ground stations.

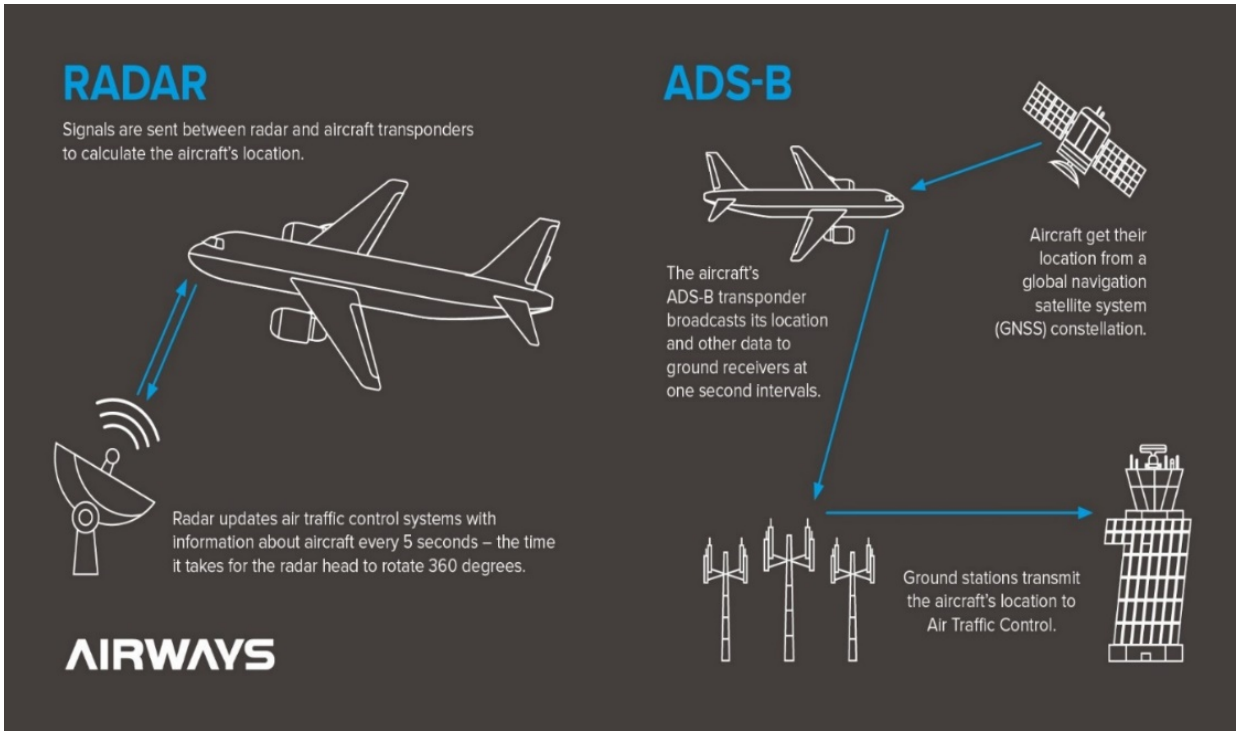
How ADS-B works

ADS-B equipment on board an aircraft uses satellite positioning data to broadcast its identity, location, airspeed, altitude, and other flight parameters every second. The broadcasting equipment on the aircraft is known as known as ADS-B OUT.[1]

ADS-B ground stations pick up the information broadcast by aircraft and feed it through to Airways and to the air traffic controllers. It is used for separation of aircraft in controlled airspace. Controllers can also see, but will not control, ADS-B equipped aircraft operating outside controlled airspace.

[1] ADS-B OUT is the system that transmits information from the aircraft. The information gets broadcast automatically and can be picked up by ground stations for use by air traffic control

Figure 1: how ADS-B works



1.3 ADS-B OUT

ADS-B OUT refers to the equipment on board aircraft that collects and then broadcasts information OUT to ADS-B ground receivers that feed information to the air traffic control system. In effect, aircraft need to be equipped to be 'seen' by air traffic controllers.

An ADS-B OUT system comprises two components:

- An ADS-B OUT extended squitter (Mode ES) transponder operating on 1090 MHz; AND
- A global navigation satellite system (GNSS) position source (e.g. GPS receiver) that is compatible with the transponder

These can be standalone pieces of equipment, OR

- An all-in-one ADS-B OUT system: an ADS-B OUT transponder with a built-in GPS position source.

1.4 ADS-B IN

ADS-B IN technology includes an ADS-B receiver. Aircraft fitted with ADS-B IN can receive data from those transmitting ADS-B OUT, and provide that information to the crew. ADS-B IN can help improve situational awareness.

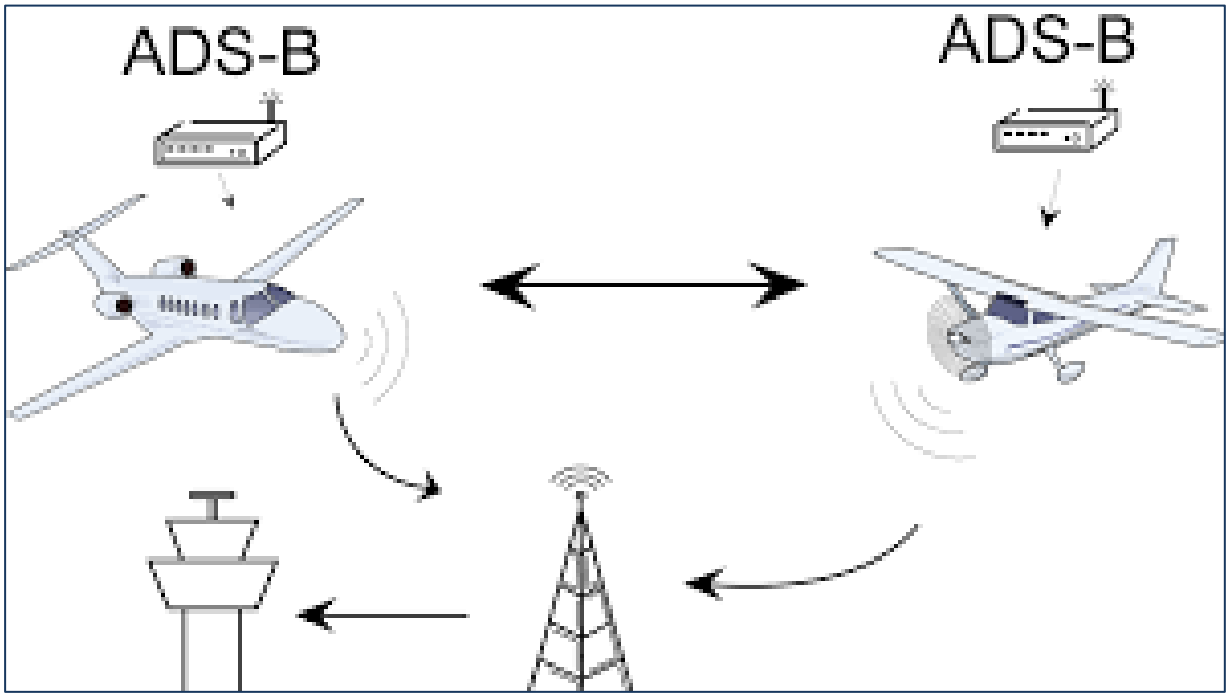
There are no plans to make ADS-B IN mandatory in New Zealand.

ADS-B IN relies on other aircraft having ADS-B OUT, and transmitting accurate ADS-B OUT data. Aircraft that aren't fitted with ADS-B OUT won't be visible to ADS-B IN systems, so not all aircraft will be picked up by the system.

Other ADS-B IN options also include Traffic Information Service (TIS) and Flight Information Service (FIS) as offered in the United States; however, these services require ground infrastructure systems that are not cost-effective for New Zealand.

ADS-B IN can improve situational awareness, however, when flying VFR it's still the pilot's responsibility to see and avoid other aircraft[2].

Figure 2: How ADS-B IN works



Source: AIE Inc

Section Two: The move to ADS-B

New Zealand will be replacing its current secondary surveillance radar network with ADS-B. That decision has been taken and will be brought into effect over the next few years.

This section sets out how we are proposing to enable the move to ADS-B for users of controlled airspace below flight level 245.

2.1 The current rules

At the moment, all aircraft in controlled airspace must be equipped with a transponder that is compatible with the current secondary surveillance radar system.

[2] CAR 91.229

In transponder mandatory airspace, aircraft must be equipped with a transponder as a safety measure to avoid passenger transport aircraft fitted with aircraft collision avoidance systems (ACAS).

The rules mandating ADS-B OUT are being implemented in two stages.

In July 2018, the Minister of Transport introduced rule amendments that did two key things:

- Introduced a mandate requiring ADS-B OUT carriage and use in all aircraft operating in controlled airspace above FL 245; and
- Set the equipment and performance standards for new and existing ADS-B OUT systems in *all* aircraft.

You can see an outline of the current rule requirements in Appendix One and at www.nss.govt.nz/surveillance

2.2 Proposal to mandate ADS-B OUT for all controlled airspace below flight level 245

The second part of the move to ADS-B would involve:

- An amendment to Civil Aviation Rules to:
  - extend the mandate to cover all controlled airspace, effective 31 December 2021; and
  - provide for a transition period to preserve the status quo equipment requirements for aircraft below flight level 245 between the date the rule comes into force, and 31 December 2021.

As per the current rule, all existing and newly fitted ADS-B systems need to comply with the equipment and performance standards set out in CAR Part 91 and CAA Notice (NTC) 91.258.

Who would have to comply with the mandate?

The mandate would apply to all aircraft operating in transponder mandatory controlled airspace in the New Zealand flight information region. It would apply equally to all types of aircraft and all aircraft operations whether operating under instrument (IFR) or visual (VFR) flight rules.

In effect, this proposal would mean that:

- all aircraft operating in controlled airspace will need an ADS-B OUT system fitted by 31 December 2021
- the systems on aircraft must comply with the rule requirements in CAR Part 91 and CAA Notice 91.258
- aircraft not equipped with a compliant ADS-B OUT system will not be permitted to enter controlled airspace after that date unless authorisation is provided from Airways.

If you do not operate in controlled airspace, you will not need to equip.

ADS-B OUT will not be required for transponder mandatory airspace that is not in controlled airspace, designated under CAR Part 71.201. The transponder requirements for that airspace remain unchanged and are set out in CAR Part 91.247.

2.3 Why a mandate?

ADS-B relies on all aircraft having an ADS-B OUT system that makes it visible to air traffic control through the information broadcast from the aircraft and received by the ADS-B ground antennae. The information must contain specific message sets and have sufficient integrity for it to be used to separate aircraft safely in controlled airspace.

Once Airways has decommissioned the radar system, aircraft not fitted with ADS-B OUT will effectively be invisible to the air traffic control system.[3]

Aircraft that broadcast inaccurate or incomplete information may not be visible to air traffic controllers as the system may discard non-compliant information. A worst-case scenario is aircraft systems broadcasting misleading information to air traffic control and other aircraft fitted with ADS-B IN.

Relying on voluntary uptake of ADS-B OUT in controlled airspace instead of a mandatory requirement could compromise safety. There would be no guarantee that all aircraft in controlled airspace would be visible to air traffic control. Alternatively, it could create a need to invest in a second system to provide for aircraft without ADS-B OUT. The cost of that system would fall on airspace users through Airways' charges.

2.4 The benefits of moving to ADS-B

ADS-B offers benefits to aircraft owners and operators in New Zealand, and to the wider aviation system.

The system benefits of ADS-B:

- The surveillance data is more accurate than radar and includes more information. This means controllers have a more accurate and more complete picture of who is where.
- Improved safety, particularly in airspace with more traffic. ADS-B OUT provides more precise position information on a more frequent basis. It refreshes up to twice every second compared to every five seconds for radar.
- Aligning New Zealand's surveillance system with recommendations for system modernisation from the International Civil Aviation Organization (ICAO), and global and regional practice in surveillance system modernisation.
- The ground system components of ADS-B are less expensive to install and maintain when compared to the current secondary surveillance radar system.

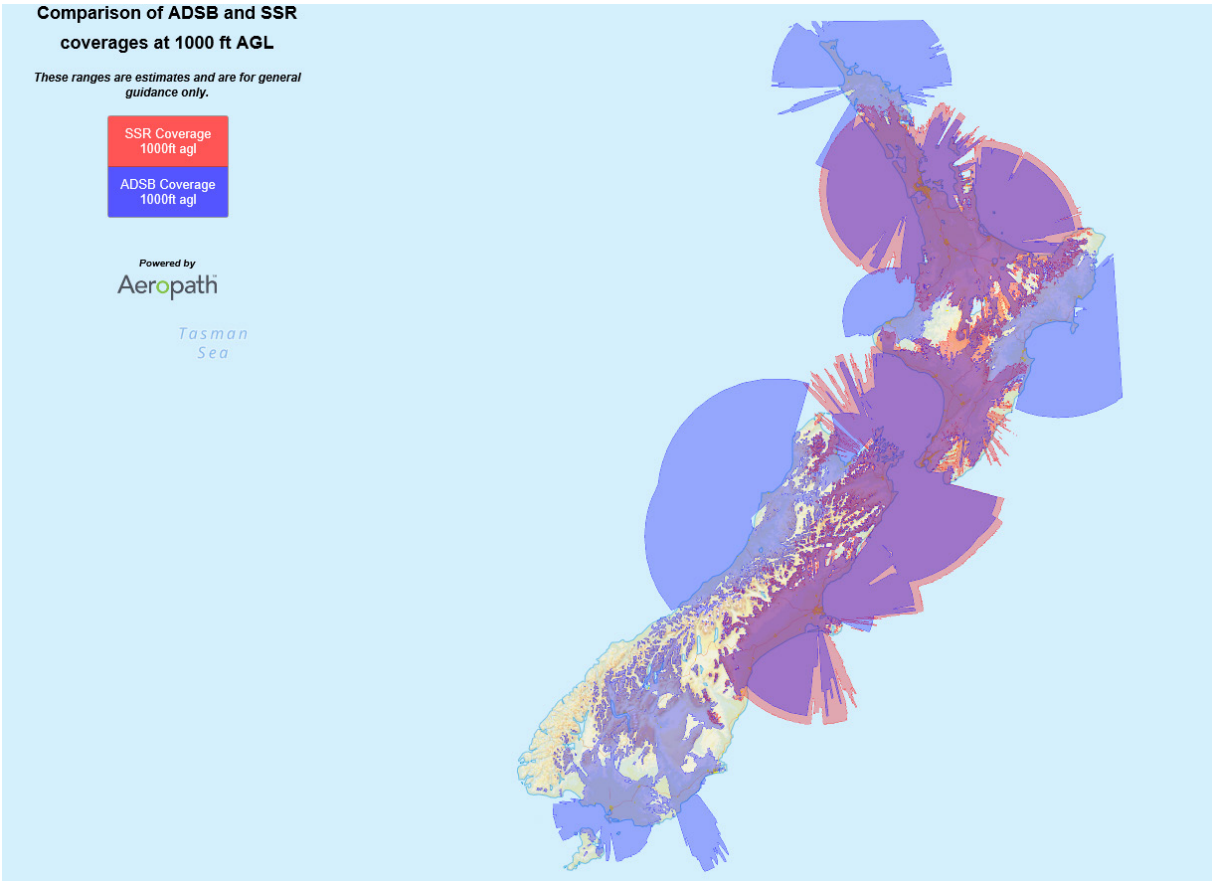
[3] There will be a skeleton contingency surveillance system that is a backup in case New Zealand loses GPS coverage. However, it's a backup for ADS-B, not an alternative.

- Significantly improved surveillance coverage compared to radar: ADS-B will cover 45 percent more of New Zealand's airspace, including coverage to the ground at all controlled aerodromes.
- ADS-B will support the safe integration of new technologies into the aviation system.

The benefits of ADS-B for operators:

- Increased visibility outside controlled airspace which means that controllers may be able to provide assistance or information to aircraft in areas well beyond what is possible with radar.
- In search and rescue situations, ADS-B will provide valuable information to augment emergency location transmitters. Equipping with ADS-B OUT makes ADS-B IN viable. The more aircraft are equipped, the greater the benefit from ADS-B IN. Those benefits apply inside *and* outside controlled airspace.
- ADS-B offers an alternative or supplement to flight tracking systems.
- The greater coverage means some aerodromes that currently use procedural control will be able to move to surveillance control, which is safer and more efficient.
- ADS-B will support the implementation of digital towers. This development may offer safety benefits through extended hours of control or information services at aerodromes.

Figure 1: comparing coverage at 1000 feet with current SSR and ADS-B



2.5 Costs of the proposed mandate

In 2017, the CAA commissioned a cost benefit analysis to help develop policy options for the proposed mandate for ADS-B below FL 245. The analysis found that the greatest burden would fall on owners of aircraft that:

- are older and/or lower value, as the cost of ADS-B would not match the benefits relative to the value of the aircraft are not covered by acceptable technical data (for example a supplemental type certificate (STC))
- fly in controlled airspace relatively infrequently, as the investment in the ADS-B equipment would not be matched by the benefit of ongoing access to controlled airspace
- are not flown often, again related to the return relative to the cost of equipment and installation.

Ernst & Young carried out the review, with support and expert input from the Future Surveillance Implementation Working Group. The group comprises representatives of operator groups, engineers, avionics suppliers, Airways NZ, and the Ministry of Transport.

You can read the full cost benefit analysis here: https://www.nss.govt.nz/dmsdocument/53-cost-benefit-analysis-on-ads-b-below-fl245-proposed-mandate

2.6 Costs to owners and operators

The CAA recognises that the cost of equipping for ADS-B OUT is significant relative to the benefits, particularly for operators of General Aviation (GA) Visual Flight Rules (VFR) aircraft.

Costs of ADS-B OUT equipment have dropped in recent years, particularly with the introduction of certified all-in-one ADS-B OUT systems: a transponder that has an inbuilt GNSS position source. The current cost of an all-in-one ADS-B OUT system is approximately $5,000 NZD (uninstalled).

The cost benefit analysis identified the following costs for ADS-B. We used an average taking into account the range of costs that could apply to aircraft.

Please note: the costs vary considerably depending on the following:

- the equipment the operators chooses for the aircraft
- whether or not the aircraft has an STC or another form of ATD for ADS-B OUT equipment
- The aircraft's existing configuration: some installations are less complicated than others

Table 1 sets out an approximate cost for four scenarios ranging from no equipment and no STC available to aircraft covered by an STC and with a transponder already on board.

Note that these estimates are for certified equipment.

Table 1: cost outline for different STC and equipment scenarios

Scenario	Estimated cost
An aircraft with an existing Mode-ES transponder that can be upgraded to ADS-B with ATD applicable to the relevant aircraft.	$5,500 (including installation)
An aircraft where the equipment has a relevant ATD for the aircraft, but where the aircraft does not have a Mode-ES transponder.	$9,000 Between $500-1500 of this would be for installation
An aircraft with an existing Mode-ES transponder, but no ATD.	$11,000
An aircraft with no Mode-ES transponder and no equipment with an ATD applicable to that aircraft.	$13000 This could break down into: ► $7000-8000 for lightweight unit suitable for installation in aircraft without an STC ► $1000-2000 for installation ► $3000-5000 for certification

2.7 Other issues for owners and operators

In addition to the cost of equipment and installation, the estimates used in the cost benefits analysis show that the costs don't relate to the equipment alone. There are also factors to consider around:

- Access to acceptable technical data
- Access to different equipment options
- Access to LAMEs and maintenance organisations (Parts 66 and 145)
- Information on ADS-B

2.7.1 Access to acceptable technical data (ATD)

All design changes to aircraft must be carried out in accordance with ATD.

ATD can come in the form of supplemental type certificates (STCs) or AML STCs typically issued by manufacturers of the ADS-B OUT equipment.

Operators of aircraft without an applicable STC can commission a Part 146 design organisation to develop ATD for their aircraft. There are costs involved in commissioning tailored design solutions.

The biggest impact of the requirement for ATD falls on aircraft that don't fit in the Standard or Restricted Category due to their type of manufacture, or age. That includes light sports aircraft where the OEM has not released a modification for ADS-B; microlights; amateur-built aircraft; balloons; gliders; and older aircraft.

What about AC43-14?

CAA is proposing to extend AC43-14 to cover all-in-one ADS-B OUT systems.

Advisory Circular (AC) 43-14 *Avionics, Installations—Acceptable Technical Data* provides two things:

- Methods, techniques, and practices that are acceptable to the Director for showing compliance with Part 43-*General Maintenance Rules*; and
- Technical instructions which are 'acceptable technical data' under Part 21, Appendix D(a)(6), for avionics installations.

Aircraft owners can use AC43-14 as ATD for specified modifications if the aircraft types are eligible and providing they do the work in accordance with the technical instructions in AC43-14, Part 21 and Part 43.

2.7.2 Access to different equipment options

Under current the current civil aviation rules (and associated notice) operators have access to different equipment options:

1. ADS-B equipment certified to Technical Standard Orders (TSOs) referred to in the rule and Notice
2. ADS-B equipment that demonstrates performance equivalent to the standards set out in the TSOs but is not certified.

The primary reason for this performance based approach was to provide for new equipment options coming on to the market, in particular, new TSOs, without needing to revise the rule. It also allows for interested parties to demonstrate that a system which is not certified to the relevant TSO can meet the same level of performance as certified equipment. The piece of equipment would need to:

- Consistently operate at an appropriate standard
- Not interfere with other aircraft or aviation systems
- Be durable and fit for purpose
- Be manufactured to an appropriate standard under adequate oversight.

However uncertified equipment will not have associated ATD. Therefore while the cost of uncertified equipment might be lower, the cost of demonstrating that it meets the performance standards, and the cost of design work to enable installation could be more than buying and installing a certified ADS-B OUT system.

The benefits of the uncertified equipment options may include:

- the ability to fit equipment that suits aircraft with specific characteristics, such as low or no power aircraft or weight and space limitations that preclude the use of standard options

- opportunities to use equipment that provides functions in addition to those available on standard options
- lower equipment cost (bearing in mind the costs of design work and installation).

2.7.3 Access to avionics engineers

NTC 91.258 requires that ADS-B transponders must be installed by a Group 3 LAME or an equivalent authorised person, in a maintenance organisation under Part 145.

We are aware that there is a limited number of LAMEs with this rating, and similarly a limited number of Part 145 organisations. There are parts of the country with limited access to Part 145 organisations and Part 66 LAMEs.

2.7.4 Information about ADS-B OUT

Some operators have told us that having access to information about ADS-B OUT, for example, the costs, equipment options, and the process for installation, will help them decide when and what equipment to install.

The NSS website includes information about the current rules and the proposal for mandated ADS-B. Section three in this document includes questions designed to help us understand what information you would like, and how you'd like to receive it.

Questions on how the proposed ADS-B mandate as outlined in the discussion document will affect you

General questions

Question1: What do you think about mandating ADS-B in all controlled airspace?

1. I support the proposal to mandate ADS-B OUT	☐
2. I support the proposal but have concerns about the cost to me / operators below flight level 245	☐
3. I do not support the proposal because of the costs to me / operators below flight level 245	☐
4. I would support the proposal if there were measures to reduce the costs	☐
5. The proposal won't make any difference to me	☐
6. Other: please briefly explain:	

Question 2: what difference will the proposed mandate have on the way you fly?

1. It will not make any difference to me	☐
2. I will not fly in controlled airspace if the mandate comes into effect	☐
3. I will equip in time for the mandate in order to continue flying in controlled airspace	☐
4. I will retire or sell my aircraft	☐
5. Other: please briefly explain:	

Section 2: The move to ADS-B

Question 3: Do you think the section 2 describes the need for a mandate and the associated issues? If not, what have we missed?

Section 2.3: The Benefits of ADS-B

Question 4: Which of the benefits of ADS-B described in section 2.3 are the most important to you?

1. System modernisation: replacing old technology with new	☐
2. The increased coverage of ADS-B compared to radar	☐
3. Potential for improved information to support search and rescue efforts	☐
4. The opportunity to install and use ADS-B IN: improved situational awareness	☐
5. Flight following	☐
6. Other: please briefly explain:	

Section 2.4: The Costs of ADS-B

Please review the costs of equipping, installing, and certification for ADS-B OUT, and consider the questions below.

Question 5: Do you agree that the costs of equipping an aircraft with an existing Mode ES Transponder that can be upgraded to ADS-B with applicable ATD is NZ$5,500 including installation?

1. yes	☐
2. No, these costs look different from what I expect/I have already paid.	☐
3. Not relevant to me	☐
If no, please explain	

Question 6: Do you agree that the cost of equipping an aircraft where the aircraft does not have a Mode ES Transponder using ATD is NZ$9000 (including $500-$1500 for installation)?

1. yes	☐
2. No, these costs look different from what I expect/I have already paid.	☐
3. Not relevant to me	☐
If no, please explain	

Question 7: Do you agree that the cost of equipping an aircraft with an existing Mode ES transponder but no ATD is approximately NZ$11,000?

1. yes	☐
2. No, these costs look different from what I expect/I have already paid.	☐
3. Not relevant to me	☐
If no, please explain	

Question 8: Do you agree that the cost of equipping an aircraft with an aircraft with no Mode-ES transponder and no equipment with ATD to that aircraft is approx. $13,000?

This could break down into:

- **$7,000-8,000 for lightweight unit suitable for installation in aircraft without an STC**
- **$1,000-2,000 for installation**
- **$3,000-5,000 for certification**

1. yes	☐
2. No, these costs look different to what I expect/I have already paid.	☐
3. Not relevant to me	☐
If no, please explain	

Question 9: How big of a concern is the cost of equipment to you? (choose one)

1. I am not concerned about the cost	☐
2. The mandate won't apply to me	☐
3. I am somewhat concerned about the cost	☐
4. The cost is a major concern for me	☐
5. Other: please explain	

Question 10: Would you consider equipping with ADS-B IN as well as OUT?

1. Yes, I will consider adding ADS-B IN	☐
2. No, I wouldn't consider ADS-B IN	☐
Please explain your answer:	

Section 2.5: Barriers to ADS-B uptake

Question 11: Which of the barriers in section 2.5 are the most important for you?

1. Cost of equipment and installation	☐
2. Access to ATD for my ADS-B equipment for my aircraft	☐
3. Being able to fit equipment that best suits my aircraft	☐
4. Access to a qualified Part 66 LAME or Part 145 organisation	☐
5. Other: please explain	

Question 12: Is your aircraft covered by an STC or other Acceptable Technical Data for ADS-B OUT system installation?

1. Yes	☐
2. No	☐
3. I don't know	☐

Question 13: Is obtaining ATD a barrier to equipping your aircraft with ADS-B OUT?

1. No, my aircraft is covered by applicable ATD	☐
2. I don't have ATD for my aircraft but I don't see this as a barrier	☐
3. I don't have ATD for my aircraft and I see this as a barrier.	☐
4. I don't know	☐

Question 14: What would make the most difference to you with regard to access to ATD?

1. Access to an ATD for ADS-B OUT for my aircraft	☐
2. Information about which aircraft are covered by STCs	☐
3. Ability to use AC43-14 to fit ADS-B OUT to my aircraft	☐
4. OEM issues a design solution for my light sport aircraft	☐
5. Other: please explain:	

Question 15: If alternative equipment options (e.g., TABs or uncertified equipment could be safely used in New Zealand, would you consider installing it? (choose all that are relevant)

1. Yes, provided it is a cheap option	☐
2. Yes, provided it is a lightweight option	☐
3. Yes, provided it is a low power solution	☐
4. No, I will be installing standard TSO equipment	☐
5. Other: please explain	

Question 16: What information about ADS-B would be the most helpful for you? Please tick all that apply

1. Do I need ADS-B OUT?	☐
2. Choosing an ADS-B OUT system	☐
3. ATD for ADS-B OUT	☐
4. Planning and budgeting for ADS-B OUT installation	☐
5. The installation process: what you need to know	☐
6. Operating ADS-B OUT	☐
7. ADS-B IN	☐
8. Other: please describe	

Question 17: What would be the best ways for CAA to provide this information to you? Please tick all that apply

1. Websites: NSS, CAA	☐
2. Direct emails	☐
3. Seminars delivering information in a meeting format	☐
4. Training on installing, testing, operating ADS-B OUT systems	☐
5. Written material: booklets, brochures	☐
6. Posters or other display material that many people can see	☐
7. *Vector* magazine articles	☐
8. Other: please describe	

Now some questions about you and your aircraft:

Question 18: Please tick all that apply: are you a...

1. Commercial pilot/owner	☐
2. Recreational pilot/owner	☐
3. Part 66 LAME	☐
4. Part 145 organisation	☐
5. Part 146 organisation	☐
6. Part 149 organisation	☐
7. Part 137 operator	☐
8. General Aviation Organisation	☐
9. Other, please describe	

Question 19: Would you like to be contacted about your feedback? If you please fill in the details below

Name	
Company	
Email Address	
Phone Number	

Question 20: Do you fly/work on:

1. VFR aircraft	☐
2. IFR aircraft	☐
3. Both	☐

Question 21: Do you fly in controlled airspace now?

1. Yes, frequently – at least once a month all year, or when I'm flying (e.g., in the summer months)	☐
2. Sometimes – once every two or three months	☐
3. Occasionally – less than once every two months	☐
4. No, never	☐

Question 22: What type of aircraft do you fly, and does it / do they have ADS-B?

Aircraft	ADS-B		If yes, what ADS-B system do you have?
	No	Yes	

Question 23: If you do not have ADS-B OUT, what transponder do you have on your aircraft?

1. No transponder	☐
2. Current transponder (please describe)	

Question 24: Is there anything else you would like to add to your comments on the proposal to mandate ADS-B OUT below flight level 245?

Official Information Act

Submitters should note that subject to the Official Information Act 1982, any information attached to submissions will become part of the docket file and will be available to the public for examination at the Civil Aviation Authority offices in the Asteron Centre, 55 Featherston Street, Wellington.

Submitters should state clearly if there is any information in their submission that is commercially sensitive or for some other reason the submitter does not want the information to be released to other interested parties. The CAA will consider this in making a decision in respect of any Official Information Act requests. It should be noted that the CAA cannot guarantee confidentiality in respect of any specific submissions.

Thank you for your submission.

Appendix 1: Summary of rule requirements for ADS-B OUT

- All existing ADS-B OUT installations must include transponder certified to TSO-C166 initial issue or TSO-C166a for existing installations (or demonstrate equivalent performance).

- All **new ADS-B OUT installations** must include an ADS-B OUT transponder certified to TSO-C166b.

- GNSS position sources for ADS-B OUT systems need to be certified to TSO-C145 or TSO-C146, or demonstrate equivalent performance (e.g., TSO-C129 with FDE).

- If the GNSS position source is separate to the transponder (i.e., it is not part of an all-in-one ADS-B OUT system), then the transponder and the GNSS position source must be compatible.

- All new ADS-B OUT systems must be installed in accordance with acceptable technical data. If the aircraft is not covered by an STC, you will need to consult a Part 146 organisation.

- Before release to service, all new ADS-B OUT systems must be tested to demonstrate compliance with the system performance requirements set out in NTC 91.258.

- Operators must not transmit ADS-B OUT data that doesn't comply with the standards set out in NTC 91.258.

Appendix 2: Glossary of acronyms and terms

ADS-B	Automatic Dependent Surveillance-Broadcast.
ADS-B OUT and ADS-B-IN	ADS-B OUT refers to information being broadcast *out* by the aircraft's transponder. ADS-B IN refers to information received by the transponder.
AML STC	Approved Model List Supplemental Type Certificate. This allows a single STC to address several different types of certificates. It provides a more efficient process compared to multiple approvals of, for example, installations that are largely similar or identical for several different aircraft models.
ATC	Air Traffic Control
ATD	Acceptable technical data
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule
FIR	Flight Information Region
FIS	Flight Information Service
Flight Level 245 (FL 245)	Flight Level 245 is the boundary between upper and lower airspace in the New Zealand domestic FIR.
FMS	Flight Management System
GA	General Aviation
GNSS	Global Navigation Satellite System. A general term referring to a navigation satellite system including the US GPS network, the Chinese BeiDou, Russian GLONASS and European Galileo systems.
GPS	Global Positioning System. One type of GNSS, owned and operated by the US Government. GPS is the only GNSS used for Aviation in New Zealand.
IFR	Instrument Flight Rules
MLAT	Multilateration. A ground-based surveillance system which is comprised of a network of ground stations interrogate and receive replies from aircraft SSR transponders
Mode A/C transponder	Mode A/C refers to transponders currently mandated in parts of New Zealand airspace. Mode A provides an aircraft identity code; Mode C provides altitude in 100 ft increments.
Mode S transponder	Mode S(elect) transponders are the next generation on from Mode A/C. Mode S provides a much larger number of identification codes, altitude in 25 ft increments, and a range of Downlink Airborne Parameters (DAPs) depending on the aircraft avionics and surveillance system characteristics.
NSS	New Southern Sky

OEM	Original Equipment Manufacturer
PBN	Performance based navigation
PSR	Primary surveillance radar. PSR is a *non-co-operative* surveillance system: it does not rely on information from the aircraft.
SBAS	Satellite-based augmentation system. SBAS measures small variations in the GPS signals and provides regular corrections to aircraft receivers within the specific geographic service areas covered by the system's ground stations. New Zealand is not currently covered by an SBAS service area.
SSR	Secondary surveillance radar. SSR is a *co-operative* surveillance system, meaning that it relies on a response from an aircraft transponder.
STC	Supplemental type certificate
TIS	Traffic Information Service
TSO	Technical Service Order. TSOs are issued by the Federal Aviation Authority in the United States and provides the performance parameters for equipment certification.
UAT	Universal Access Transceiver
VFR	Visual Flight Rules