# ADS-B Overview

# *Choosing a Traffic System*

- **Automatic Dependent Surveillance-Broadcast (ADS-B)**
  - ADS-B is an essential part of the planned NextGen airspace upgrade
  - Designed to create better aircraft visibility at a lower overall cost
  - "ADS-B Out" sends aircraft position via digital datalink along with groundspeed, altitude, and intent (aircraft is turning, climbing, or descending, etc).
  - ADS-B Out mandated for 2020 in Class A, B, C and some E airspace

- **A**utomatic
  - Messages are sent out periodically without interrogation (unlike transponder)

- **D**ependent
  - Position and velocity derived from the Global Positioning System (GPS)

- **S**urveillance-
  - Primary purpose is for ATC to know where aircraft are

- **B**roadcast
  - Messages are broadcast to everyone not just sent to specific receivers
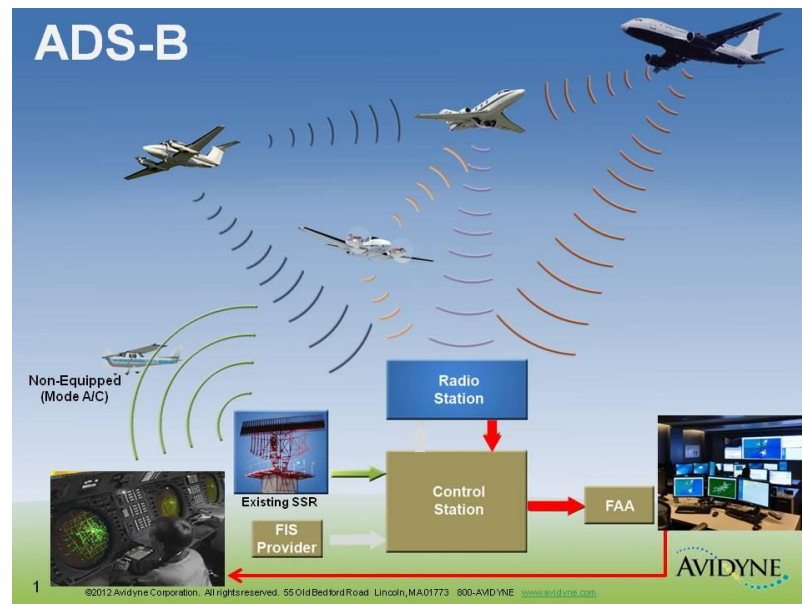
# *Choosing a Traffic System*

## ADS-B Acronyms You Should Know

- ADS-B  ("A, D, S, B")
  - Automatic Dependent Surveillance - Broadcast
- ADS-R ("A, D, S, R")
  - Automatic Dependent Surveillance - Rebroadcast
- TIS-B ("Tizz B")
  - Traffic Information Service – Advisory Broadcast (Not Mode-S TIS)
- FIS-B ("Fizz B")
  - Fight Information Service – Broadcast  (Free Weather)
- CDTI ("C, D, T, I")
  - Cockpit Display of Traffic Information  (MFD)
- 1090ES ("Ten-Ninety Eee Ess")
  - Extended Squitter Mode S Transponder (1090MHz ADS-B Datalink)
- UAT ("U.A.T.")
  - Universal Access Transceiver (978MHz ADS-B datalink)
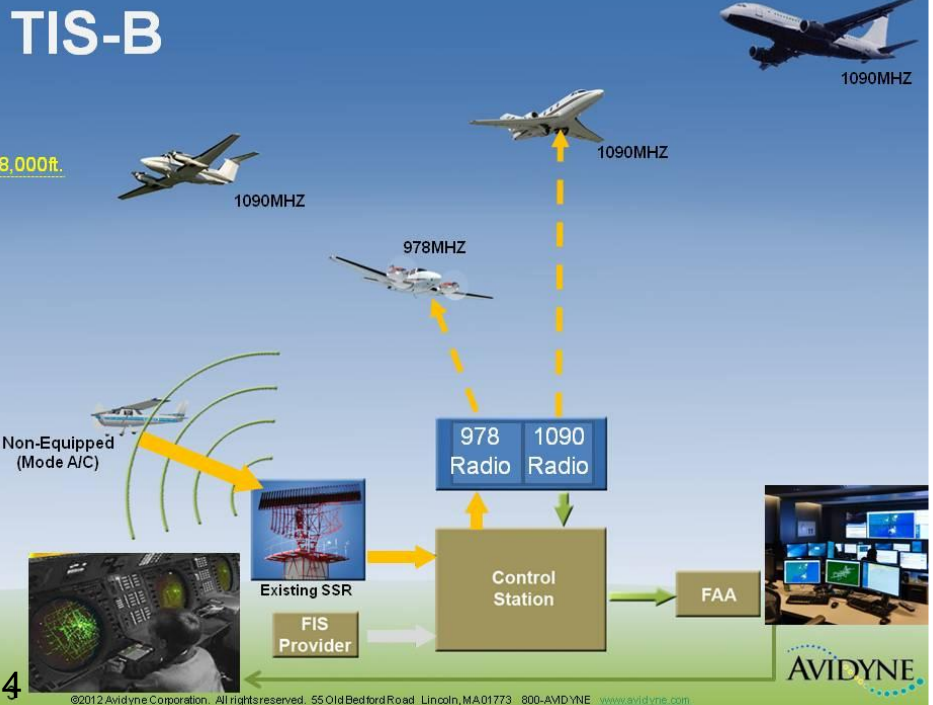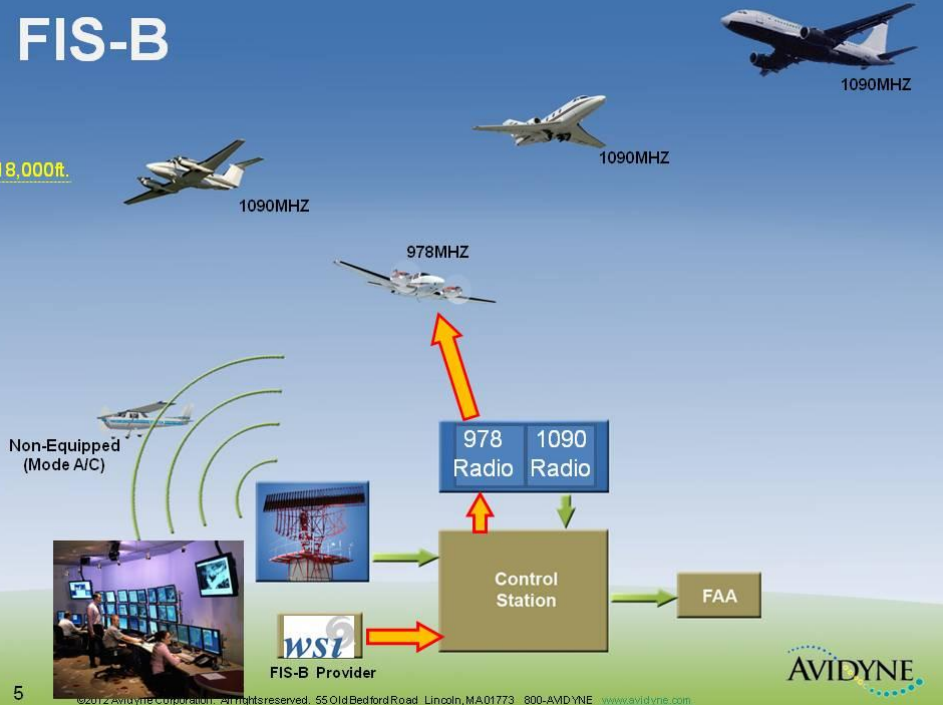
**A**VIDYNE

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ADS-B
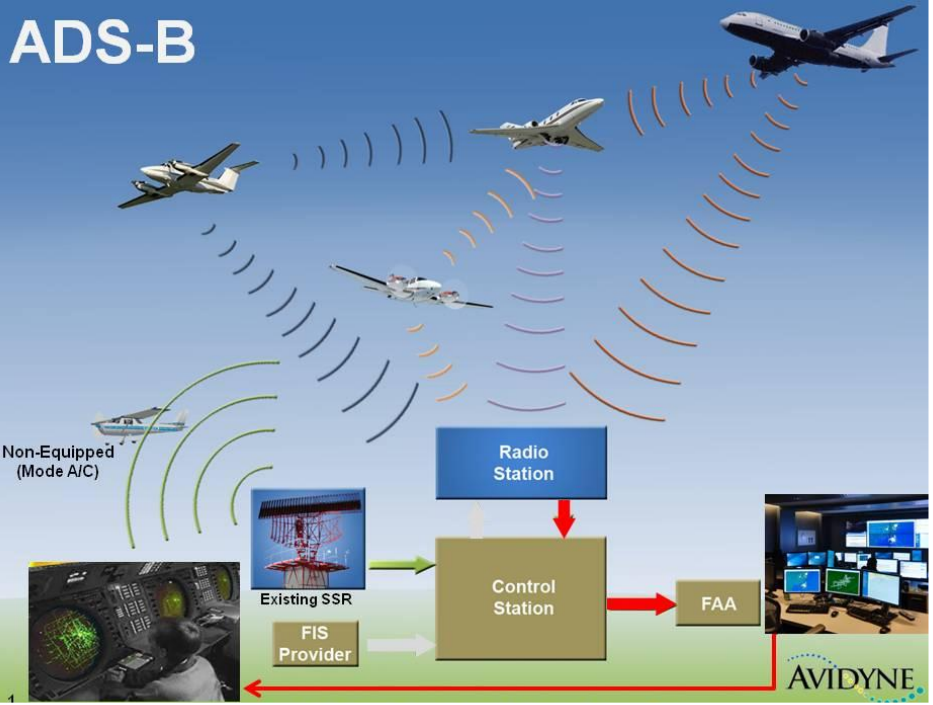
ADS-R
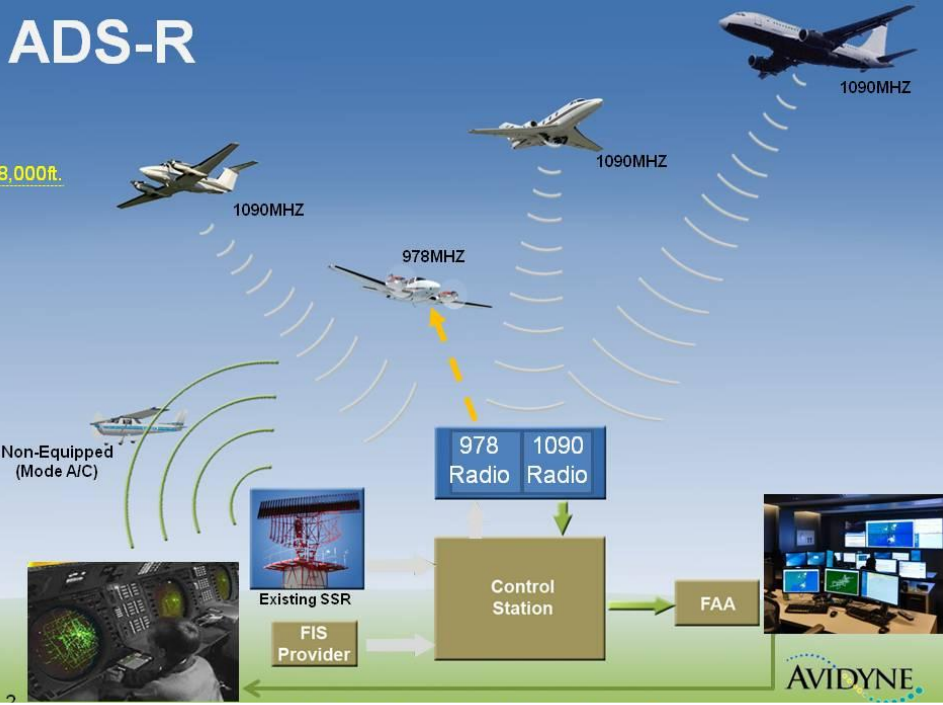
TIS-B

FIS-B

# Current Ground-Based Surveillance Radar interrogates aircraft Transponders to provide aircraft identification and position information to ATC.
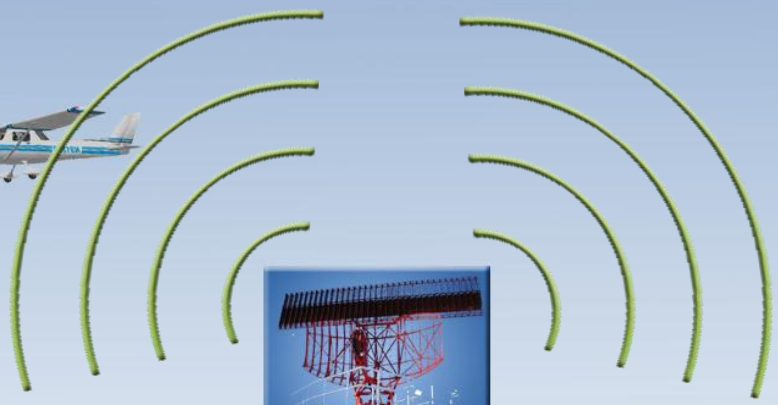
**Existing SSR**

**Ground Radars Transmit on 1030MHz**

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# Current Ground-Based Surveillance Radar interrogates aircraft Transponders to provide aircraft identification and position information to ATC

**Airborne Transponders Receive the 1030MHz interrogations & Reply (Transmit) on 1090MHz**

**Existing SSR**

**Ground Radars Transmit on 1030MHz & Receive on 1090MHz**

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# TCAS & TAS systems allow aircraft to interrogate the transponders of nearby aircraft for on-board Traffic Awareness & Collision Avoidance

**20 nm**

**+02**

**00**

**-05**

**NORM**

**1013mb**

**2700 ft**

Just like Ground Radar, Airborne TCAS & TAS systems interrogate (Transmit) on 1030MHz & receive Transponder replies on 1090MHz.

**Existing SSR**

**Ground Radars Transmit on 1030MHz & Receive on 1090MHz**

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**Traffic Information Service (TIS) is a transmission of all traffic from a Terminal Radar Site out to those aircraft with a TIS-capable Mode S Transponder. TIS is being <u>phased out</u>.**
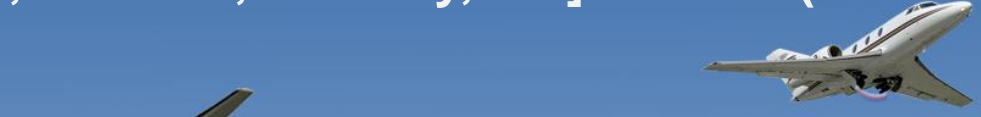


The legacy TIS Traffic signal is transmitted on 1030MHz. TIS is already being phased out in many areas in lieu of ADS-B.

**Existing SSR**

**Ground Radars Transmit on 1030MHz & Receive on 1090MHz**

# With ADS-B, each aircraft automatically transmits its unique aircraft I.D. and position information [Lat/Lon, Altitude, Velocity, etc] to ATC (ADS-B OUT)

**Non-ADS-B aircraft are identified using existing Secondary Surveillance Radar. (i.e. Transponder is still required)**

**Non-Equipped (Mode A/C)**

**ADS-B Out allows ATC to identify and separate all participating aircraft with greater precision. ADS-B does not require interrogation signal from ground station.**

Radio Station

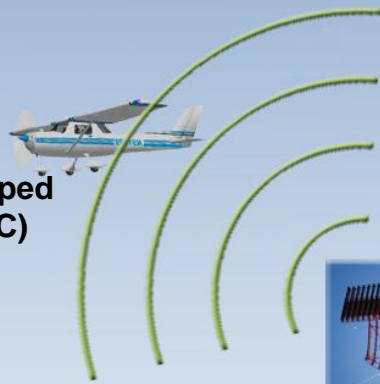Existing SSR

Control Station

FIS Provider

FAA

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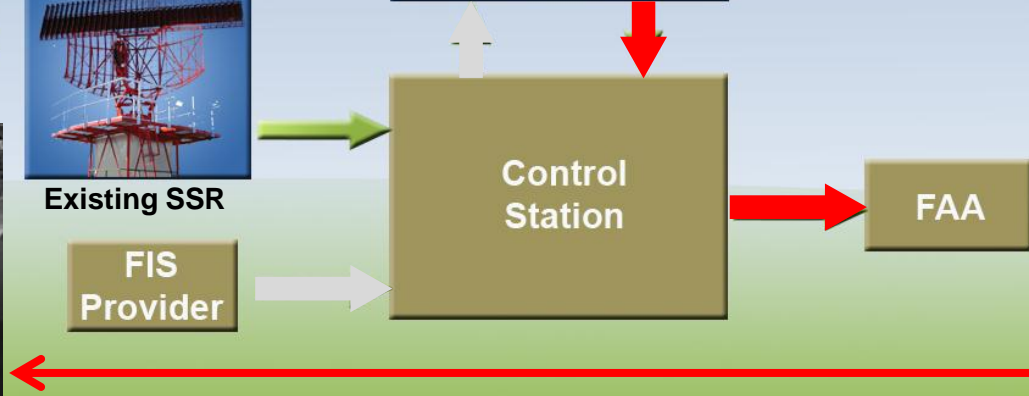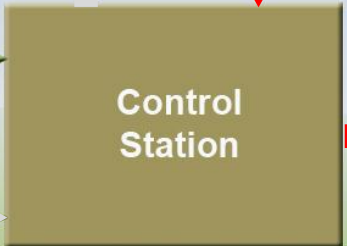
# Aircraft with ADS-B IN can receive the ADS-B OUT signals of nearby aircraft



**Non-Equipped (Mode A/C)**

Radio Station

Existing SSR

Control Station

FIS Provider
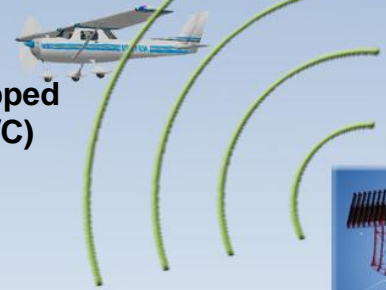
FAA

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**However, in the U.S., the ADS-B OUT mandate can be met using 1090MHz Extended Squitter at all altitudes, or via 978MHz Universal Access Transceiver (UAT) below 18,000ft.**

1090MHZ ES

1090MHZ ES

18,000ft.

1090MHZ ES

978MHZ UAT

Non-Equipped
(Mode A/C)

978 Radio | 1090 Radio

Existing SSR

Control Station

FAA

FIS Provider

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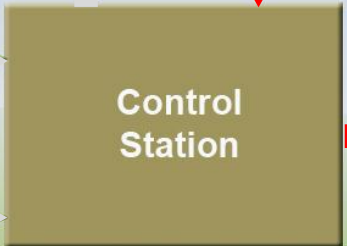
This is where ADS-B becomes more complicated.

1090MHZ

1090MHZ

18,000ft.

1090MHZ

978MHZ

Non-Equipped
(Mode A/C)

978 Radio | 1090 Radio

Existing SSR

Control Station

FIS Provider

FAA

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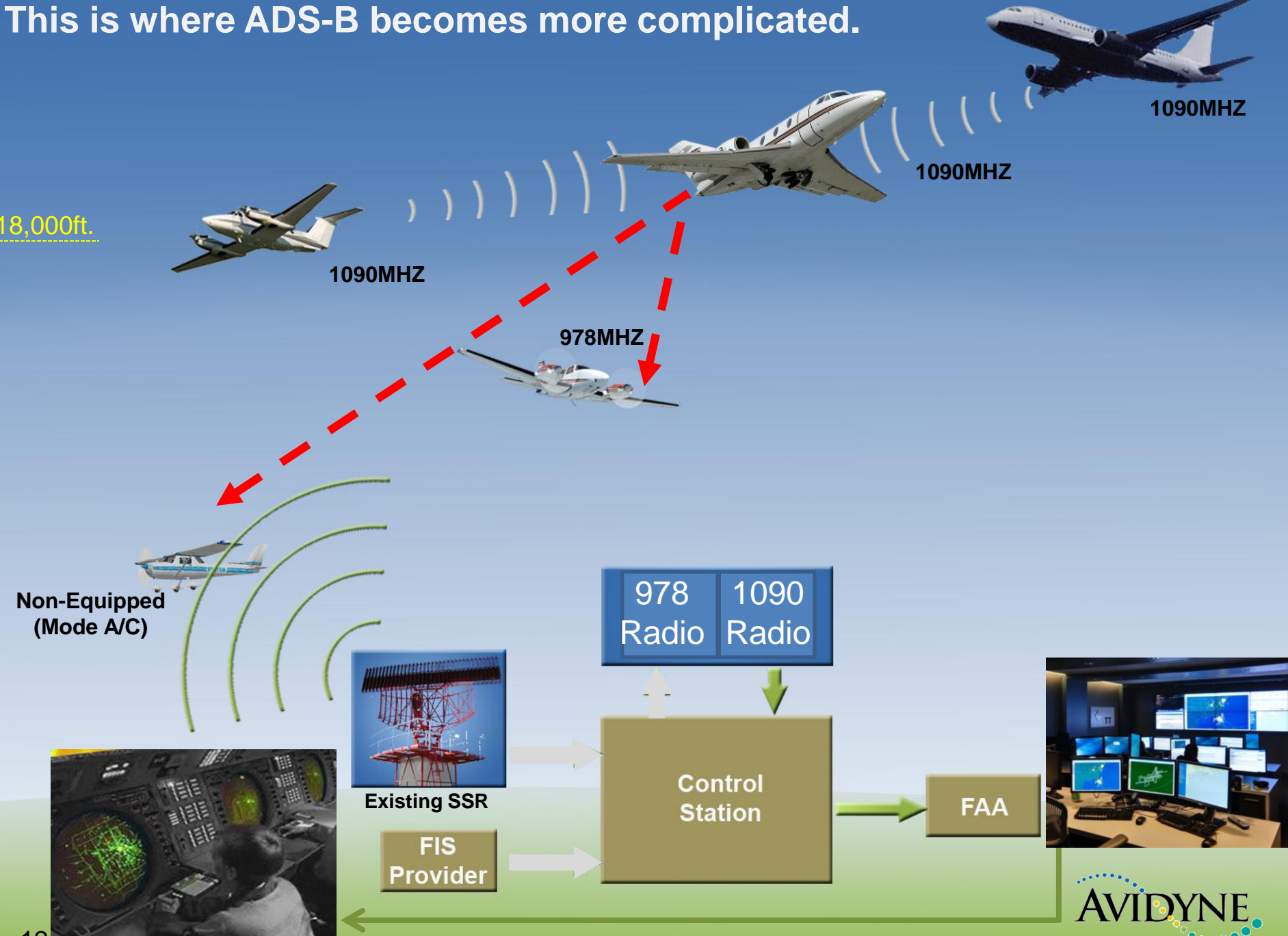
The use of two different ADS-B frequencies (1090MHz or 978MHz) can restrict communication between different aircraft.

18,000ft.

1090MHZ

1090MHZ
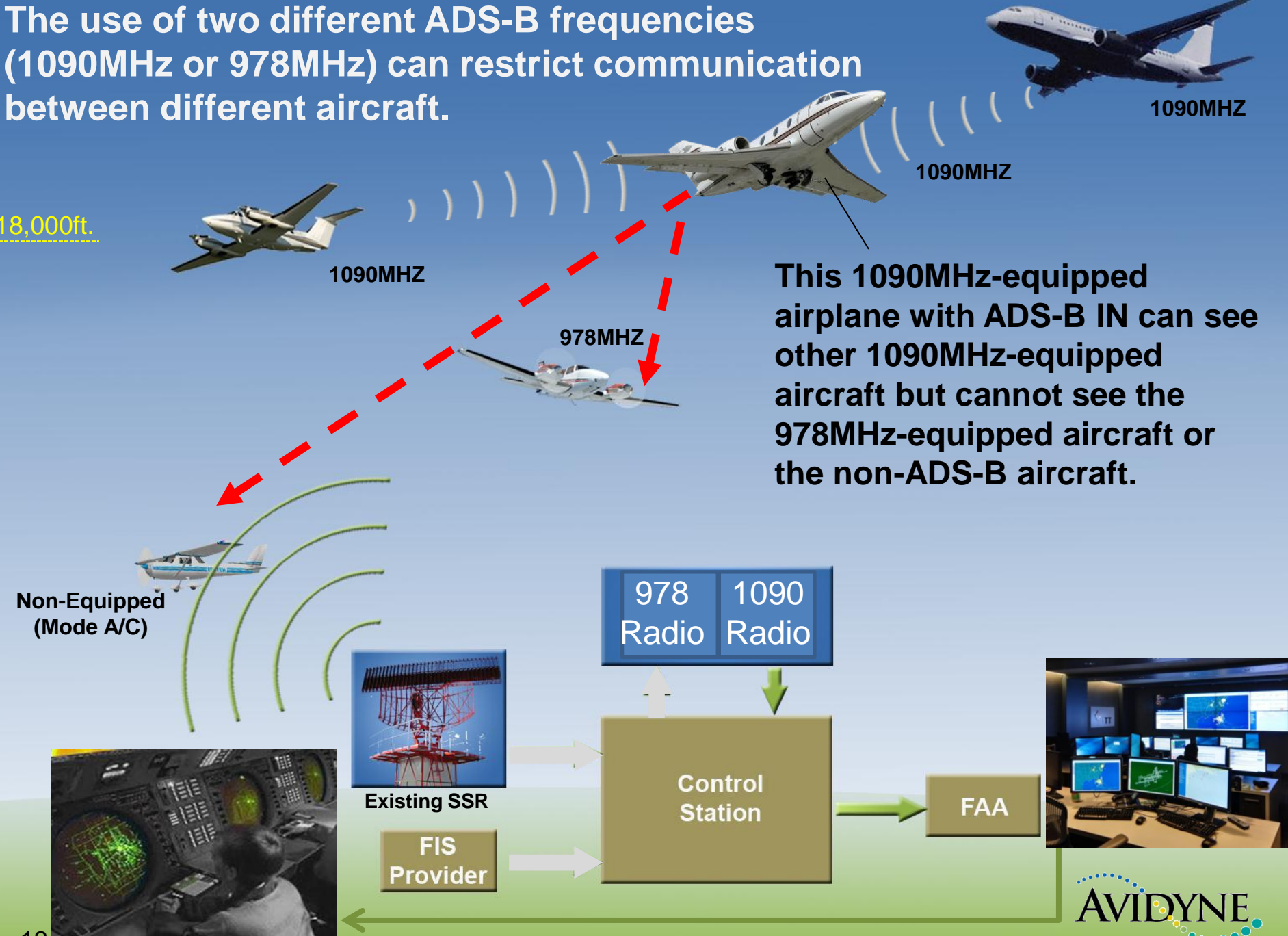
1090MHZ

978MHZ

This 1090MHz-equipped airplane with ADS-B IN can see other 1090MHz-equipped aircraft but cannot see the 978MHz-equipped aircraft or the non-ADS-B aircraft.

Non-Equipped (Mode A/C)

978 Radio | 1090 Radio

Existing SSR

FIS Provider

Control Station

FAA

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# ADS-R solves this communication issue by Rebroadcasting the info from each frequency onto the other frequency.

1090MHZ

18,000ft.
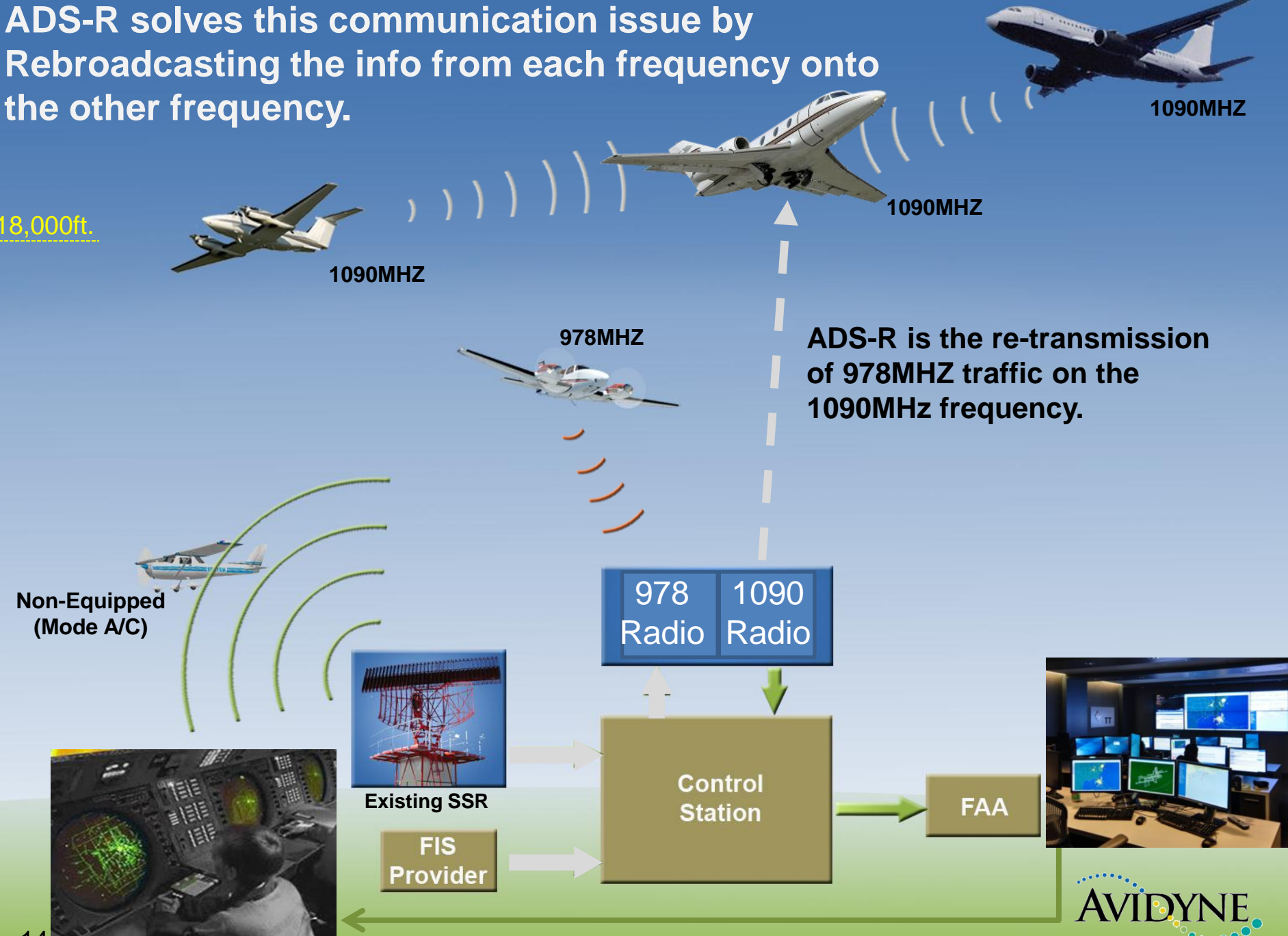
1090MHZ

1090MHZ

**ADS-R is the re-transmission of 978MHZ traffic on the 1090MHz frequency.**

978MHZ

Non-Equipped (Mode A/C)

| 978 Radio | 1090 Radio |
| --- | --- |

Existing SSR

**Control Station**

FIS Provider

FAA

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# ADS-R solves this communication issue by Rebroadcasting the traffic info from each frequency onto the other frequency.

1090MHZ

1090MHZ

18,000ft.

978MHZ

**ADS-R also rebroadcasts all the 1090MHz traffic over the 978MHz frequency.**

Non-Equipped (Mode A/C)

| 978 Radio | 1090 Radio |

Existing SSR

Control Station

FIS Provider

FAA

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**TIS-B solves the problem of displaying non-ADS-B equipped aircraft by broadcasting non-participating traffic to ADS-B equipped aircraft over both frequencies.**
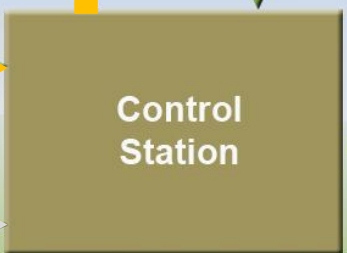
1090MHZ

18,000ft.

1090MHZ

978MHZ

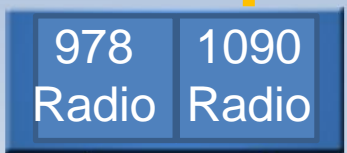**Non-ADS-B traffic data is sent via 1090MHz and 978MHz to TIS-B receivers.**

**TIS-B is different than the old TIS** (which was on 1030MHz.)
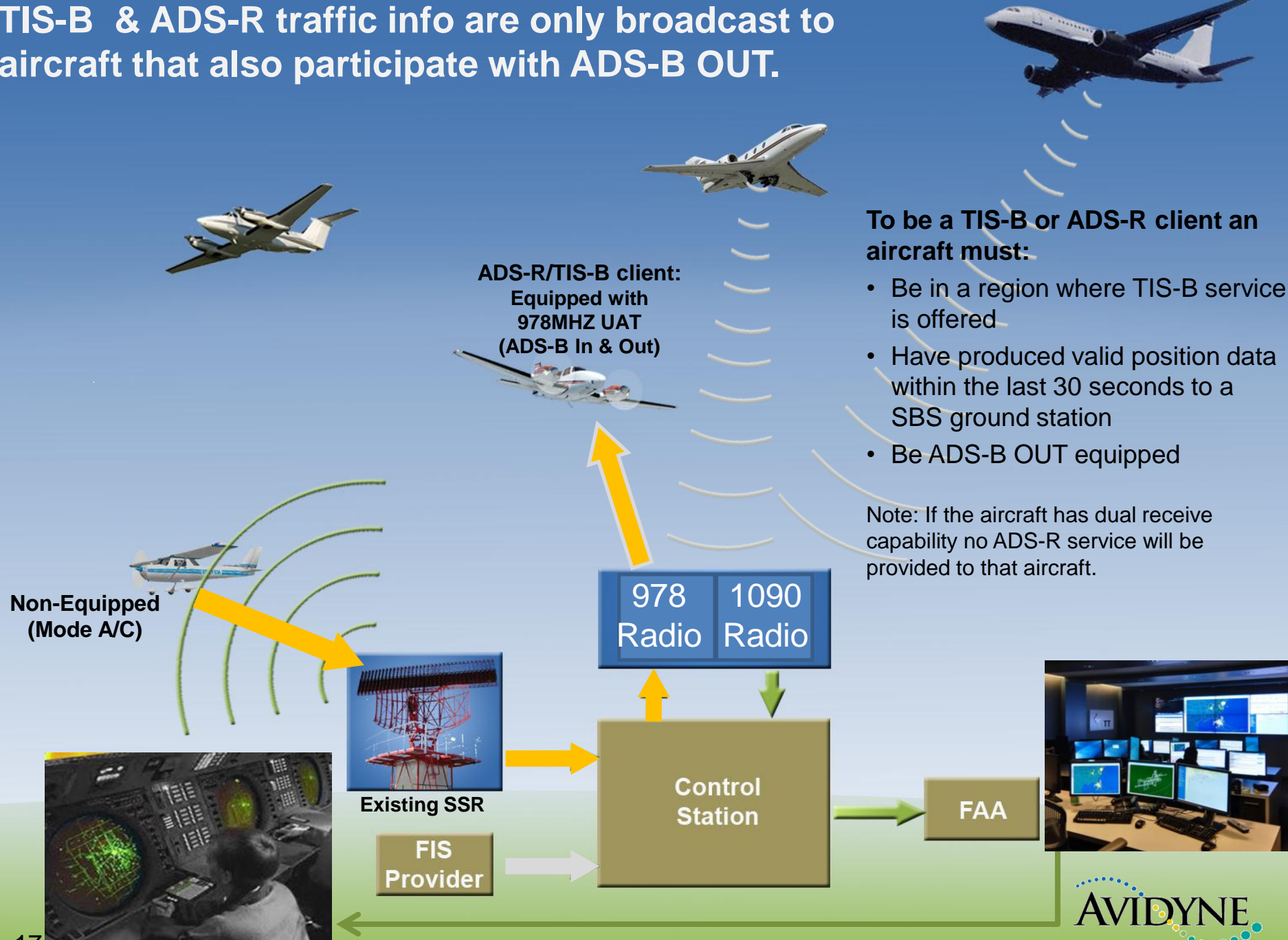
Non-Equipped
(Mode A/C)

978 Radio | 1090 Radio

Existing SSR

Control Station

FIS Provider

FAA

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# TIS-B & ADS-R traffic info are only broadcast to aircraft that also participate with ADS-B OUT.

ADS-R/TIS-B client:
**Equipped with
978MHZ UAT
(ADS-B In & Out)**

**To be a TIS-B or ADS-R client an aircraft must:**

- Be in a region where TIS-B service is offered
- Have produced valid position data within the last 30 seconds to a SBS ground station
- Be ADS-B OUT equipped

Note: If the aircraft has dual receive capability no ADS-R service will be provided to that aircraft.

**Non-Equipped
(Mode A/C)**

| 978 Radio | 1090 Radio |
|---|---|

**Existing SSR**

**Control Station**

**FIS Provider**

**FAA**

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# ADS-R sends information on 'other-frequency' ADS-B aircraft within a 15 NM radius and ±5,000 ft of client aircraft (hockey puck).

**± 5,000 feet**

15mi radius

ADS-R client: equipped with (ADS-B In & Out)

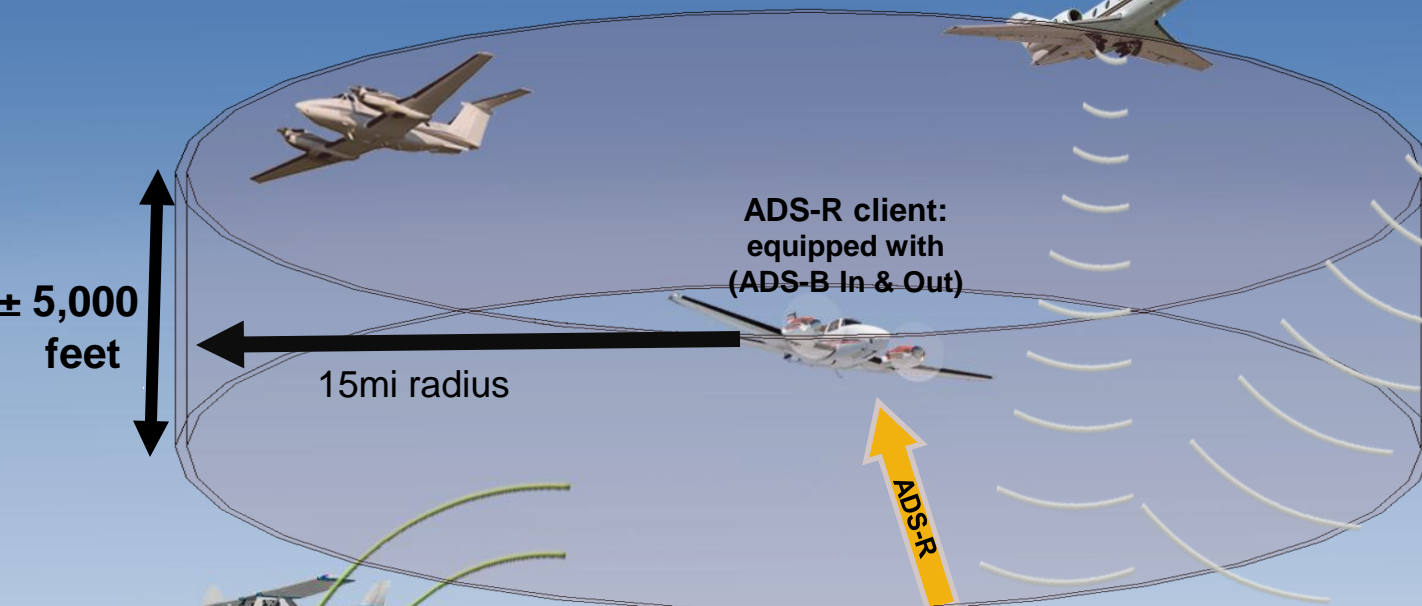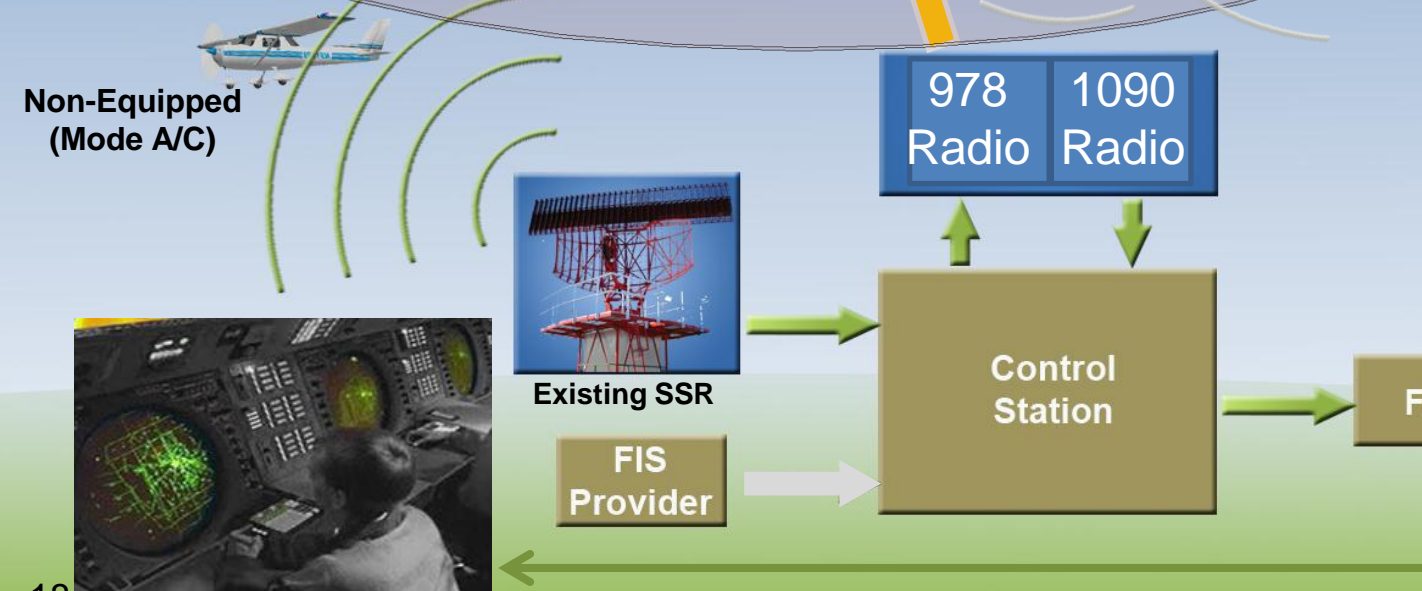**ADS-R**

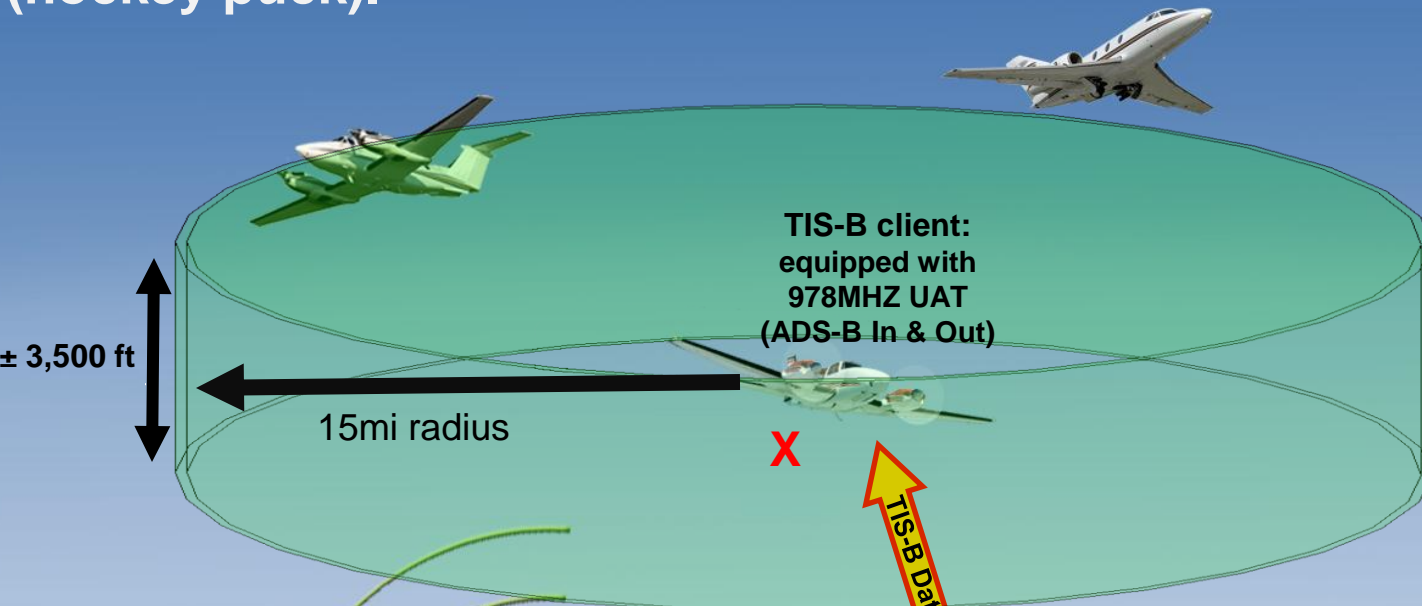**Non-Equipped (Mode A/C)**

978 Radio | 1090 Radio

**To be a ADS-R client an aircraft must:**

- Be in a region where ADS-R service is offered
- Have produced valid position data within the last 30 seconds to a SBS ground station
- Be ADS-B OUT equipped
- **Only receiving ADS-B In on one link (978 OR 1090)**

Note: If the aircraft has dual receive capability no ADS-R service will be provided to that aircraft.

**Existing SSR**

**FIS Provider**

**Control Station**

**FAA**

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# TIS-B sends information on all non-ADS-B aircraft within a 15 NM radius and ±3,500 ft of client aircraft (hockey puck).

**TIS-B client:**
**equipped with**
**978MHZ UAT**
**(ADS-B In & Out)**

**± 3,500 ft**

**15mi radius**

**X**

**TIS-B Data**

**Non-Equipped**
**(Mode A/C)**

**978 Radio**  |  **1090 Radio**

**Existing SSR**

**Control Station**
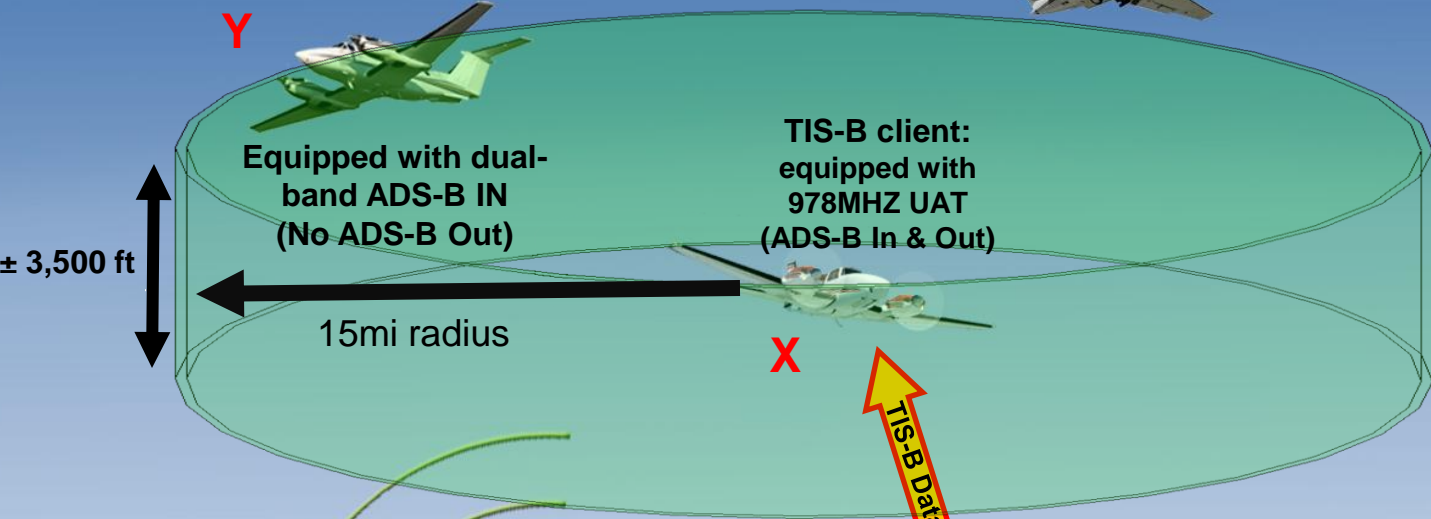
**FIS Provider**

**FAA**

**To be a TIS-B client an aircraft must:**

- Be in a region where TIS-B service is offered
- Have produced valid position data within the last 30 seconds to a SBS ground station
- Be ADS-B OUT equipped
- ADS-B In on only **one** link

Note: If the aircraft has dual receive capability no ADS-R service will be provided to that aircraft.
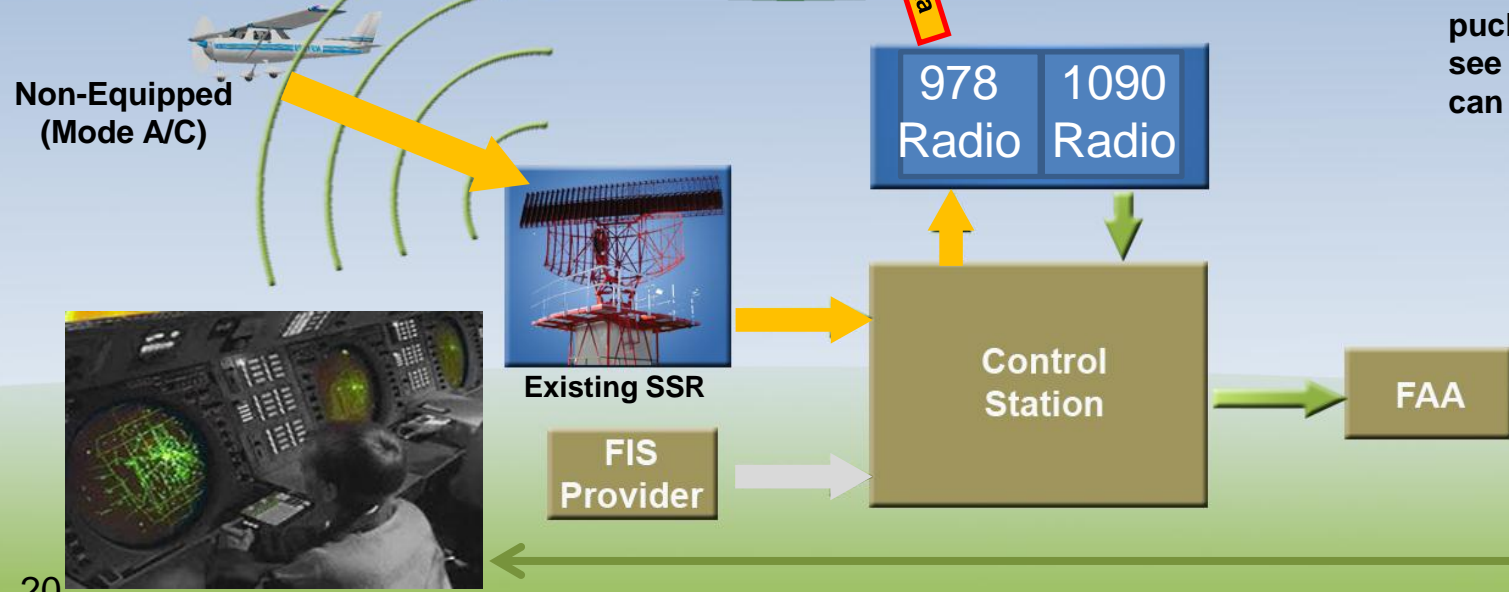
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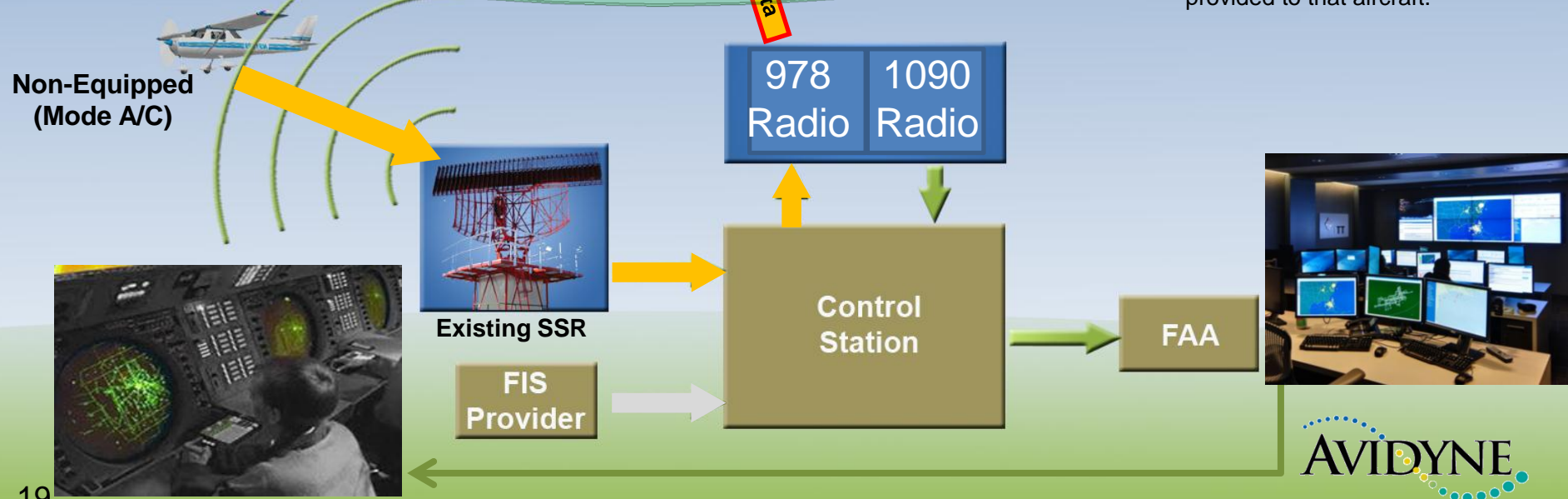
# "Piggybacking" - When an aircraft with only ADS-B IN (Y) is within range of a client aircraft (X) and eavesdrops on the information specific to the client aircraft "hockey puck".

**Y**

Equipped with dual-band ADS-B IN (No ADS-B Out)

**± 3,500 ft**

15mi radius

TIS-B client: equipped with 978MHZ UAT (ADS-B In & Out)

**X**

TIS-B Data

Non-Equipped (Mode A/C)

In this example, Aircraft Y has a dual band (1090MHz & 978MHz) receive-only (i.e. Stratus or GDL39) and no ADS-B out.

Aircraft Y can receive TIS-B (non-ADS-B) traffic info only when within Aircraft X's "hockey puck".

When outside this hockey puck, aircraft Y will only see air-to-air traffic, which can be fairly limited.

| 978 Radio | 1090 Radio |
|---|---|

Existing SSR

**Control Station**

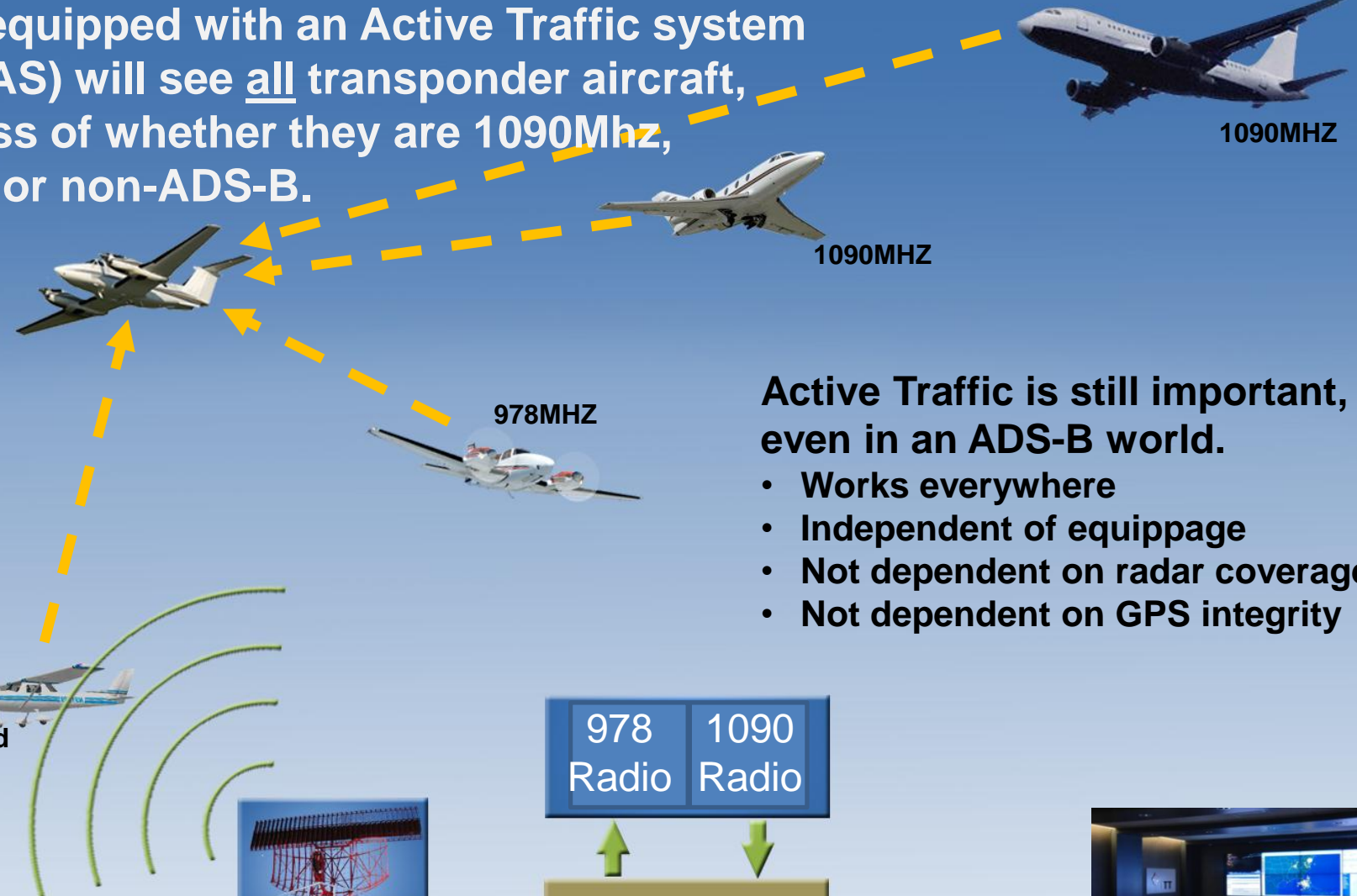**FIS Provider**

**FAA**

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**Aircraft equipped with an Active Traffic system (TAS/TCAS) will see <u>all</u> transponder aircraft, regardless of whether they are 1090Mhz, 978MHz, or non-ADS-B.**
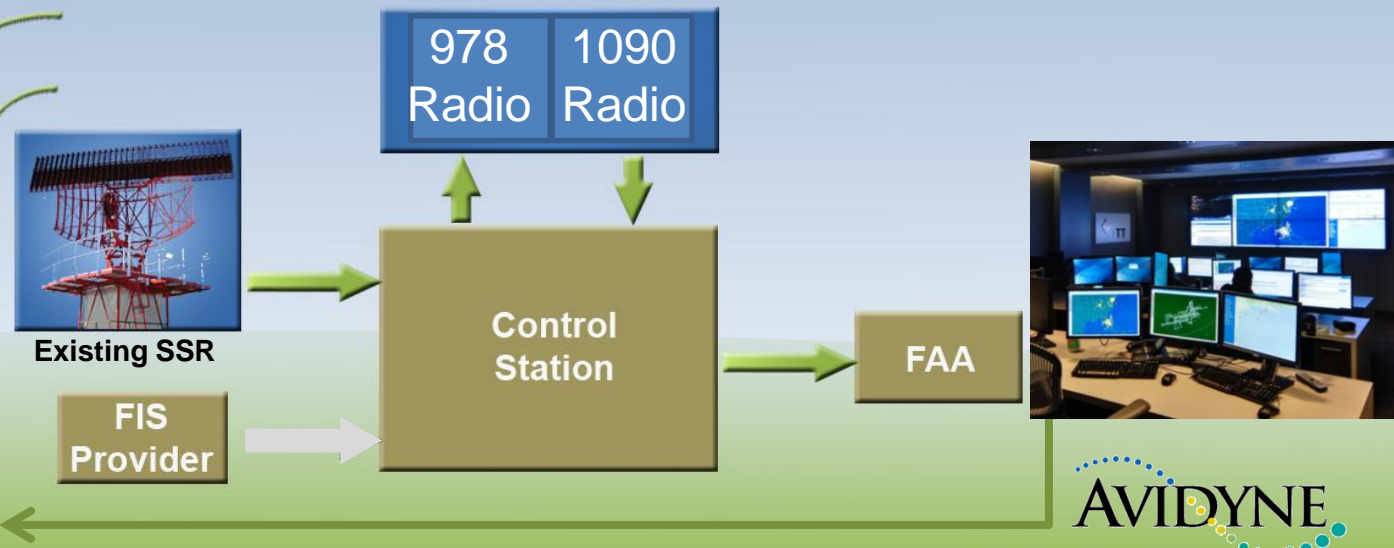
1090MHZ

1090MHZ

18,000ft.

978MHZ

**Active Traffic is still important, even in an ADS-B world.**

- **Works everywhere**
- **Independent of equippage**
- **Not dependent on radar coverage**
- **Not dependent on GPS integrity**

**Non-Equipped (Mode A/C)**

978 Radio | 1090 Radio

**Existing SSR**

**Control Station**

**FAA**

**FIS Provider**

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# FIS-B provides "Free Weather" to 978MHz UAT-equipped aircraft.

**1090MHZ**

**1090MHZ**

18,000ft.

**1090MHZ**

**978MHZ**
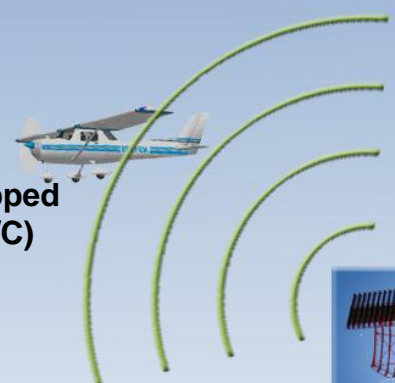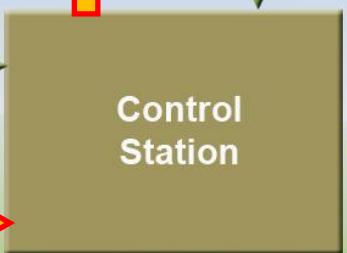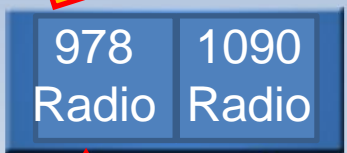
**FIS-B is not available via the 1090MHz channel.**

**FIS-B is a ground based service, which may have line of site limitations not found with current satellite-based systems..**

**FIS-B Wx products have range and resolution restrictions not found with current satellite-based systems.**

**Non-Equipped (Mode A/C)**

| 978 Radio | 1090 Radio |
|---|---|

**Control Station**

**FAA**

**wsi**

**FIS-B Provider**

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# Do I have to equip with ADS-B?

**Canada**
**1090 MHz** ADS-B Out
Mandated as of Jan 15, 2009, over Hudson Bay region between FL350 and FL400.

**Europe**
**1090 MHz** ADS-B Out
Mandated 1090ES ADS-B Out with a Diversity Mode-S transponder for aircraft >12,500lbs or max cruise >250kts TAS by Jan 8, 2015 for new aircraft and Dec 7, 2017 for retrofits.

**United States**
**978 MHz or**
**1090 MHz** ADS-B Out
Mandate January 1, 2020

**Australia**
**1090 MHz** ADS-B Out
Mandate above FL290 after December 12, 2013

**No Mandate for ADS-B IN**

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# *Choosing a Traffic System*
## ADS-B Summary

- U.S. Mandate for ADS-B 'OUT' is 2020 (Affects GA Aircraft)
  - 1090MHZ ES required Above FL180
  - 978MHZ UAT or 1090MHZ ES required below FL180
- All international mandates are for 1090MHz only
- Currently No Mandates for ADS-B 'IN'
  - 978MHZ Req'd for FREE Weather services
  - Provides longer-range traffic advisory with greater precision
  - Has limitations during mixed-equippage period
  - Has limitations due to altitude and line of sight.
- All Avidyne TAS600-Series systems are fully upgradeable for ADS-B 'IN'

- Active-surveillance TAS is viable even in ADS-B world.

- Expect additional ADS-B Announcements will be forthcoming.