

ADS-B For Beginners



- **ADS-B is an Air Traffic Management (ATM) Surveillance system that replaces traditional radar based systems**
- **ADS-B is like a large wireless network - the ground stations are Wireless Access Points and the aircraft are Clients**
- **Aircraft report their own position via the network and receive back, from the ground system, traffic and other information**
- **Computers on the ground integrate all the information and provide controllers with timely warnings of problems**

*The Acronym "ADS-B" stands for "Automatic Dependent Surveillance - Broadcast"

- **The Air Traffic Management System needs ADS-B because**
 - Radars are large, expensive and old
 - Radar coverage is limited by distance, terrain and atmospheric conditions
- **Aircraft Operators need ADS-B because**
 - It will be mandated
 - It improves safety by providing flight following, improved separation services and useful cockpit data such as traffic and graphical weather
 - It enables more efficient routing

Accident Prevention

Weather is directly responsible for around 5% of General Aviation accidents - and around 15% of General Aviation fatalities. Weather is a contributing factor in many more accidents and incidents. Up to date awareness of weather is a real factor. Studies have shown that many incidents and accidents start with limited weather briefings and / or with weather conditions that changed in flight. Having real time, graphical, aviation specific weather available in the cockpit helps pilots make good decisions and avoid weather related difficulties. With ADS-B, this information is available from the FAA, subscription free

Traffic related accidents have received a lot of attention in the past couple of years. Operations close to busy airfields bring airplanes close together and provide controllers with very high workloads - a dangerous combination. ADS-B equipped aircraft provide a higher quality signal to ATC - making integration of the overall traffic picture more automated and less dependent on human processing. An ADS-B equipped aircraft will also receive a tailored traffic picture - giving the pilot a simple, reliable, comprehensive picture of traffic around him - enhancing his “see and avoid” capability

Accident Survival

ADS-B makes you visible to ATC - with reports once a second. The FAA makes this information available to search and rescue teams which can in turn dramatically shorten rescue time. If you are unfortunate enough to go down in a remote area this can literally be the difference between life and death.

We also believe in the value of a reliable ELT. Units are available now with integral GPS and antennas - so they work even if they are disconnected from the aircraft. Current, accurate position reports from the FAA and a robust ELT means you will be found fast, even in difficult locations.

Airplane Wreckage can be hard to find



- **Each aircraft automatically transmits information about itself and its position - there is a message sent every second**
- **The ground system integrates that information and uses it to provide “smart” data to air traffic controllers**
- **The ground system rebroadcasts this integrated information (and legacy radar targets) back to the sky once a second - any aircraft in range can receive the data. This data broadcast is usually called “TIS-B”. Aircraft can also see each other if they are within line of sight**
- **The ground system also broadcasts additional flight information such as graphical weather and NOTAMS. This data is called “FIS-B”**

Which aircraft will need to be ADS-B capable?

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Pretty much anybody who, today, is required to have a transponder

Out

- **ADS-B “Out” is the broadcast by aircraft of ADS-B data**
- **When the FAA talks mandated equipage, they are referring to ADS-B “Out”**

In

- **ADS-B “In” is the reception by aircraft of FIS-B and TIS-B data and other ADS-B data such as direct communication from nearby aircraft**
- **ADS-B “In” is optional**

- **For ADS-B “Out”**

- A precision GPS source

GPS Source:

Standards vary worldwide but an enhanced (TSO-C145 or TSO-C146) GPS will work anywhere

- A transmitting radio

***Transmitting Radio:**

An ADS-B qualified Mode-S transponder (1090 MHz)

- or -

[US only, below 18K Ft only] a dedicated ADS-B data radio (978 MHz)

- Simple controls

Simple Controls:

Some way to enter a mode 3/A code and verify that ADS-B is working

*1090 MHz Data Link is commonly referred to as “Mode S”

978 MHz data link is commonly referred to as “UAT”

(Neither is very descriptive or accurate - we will call them “1090” or “978”)

ADS-B Position Sources



FreeFlight Systems 1201 SBAS/GPS receiver



FreeFlight Systems 1203 SBAS/GPS receiver



ADS-B Data Radios

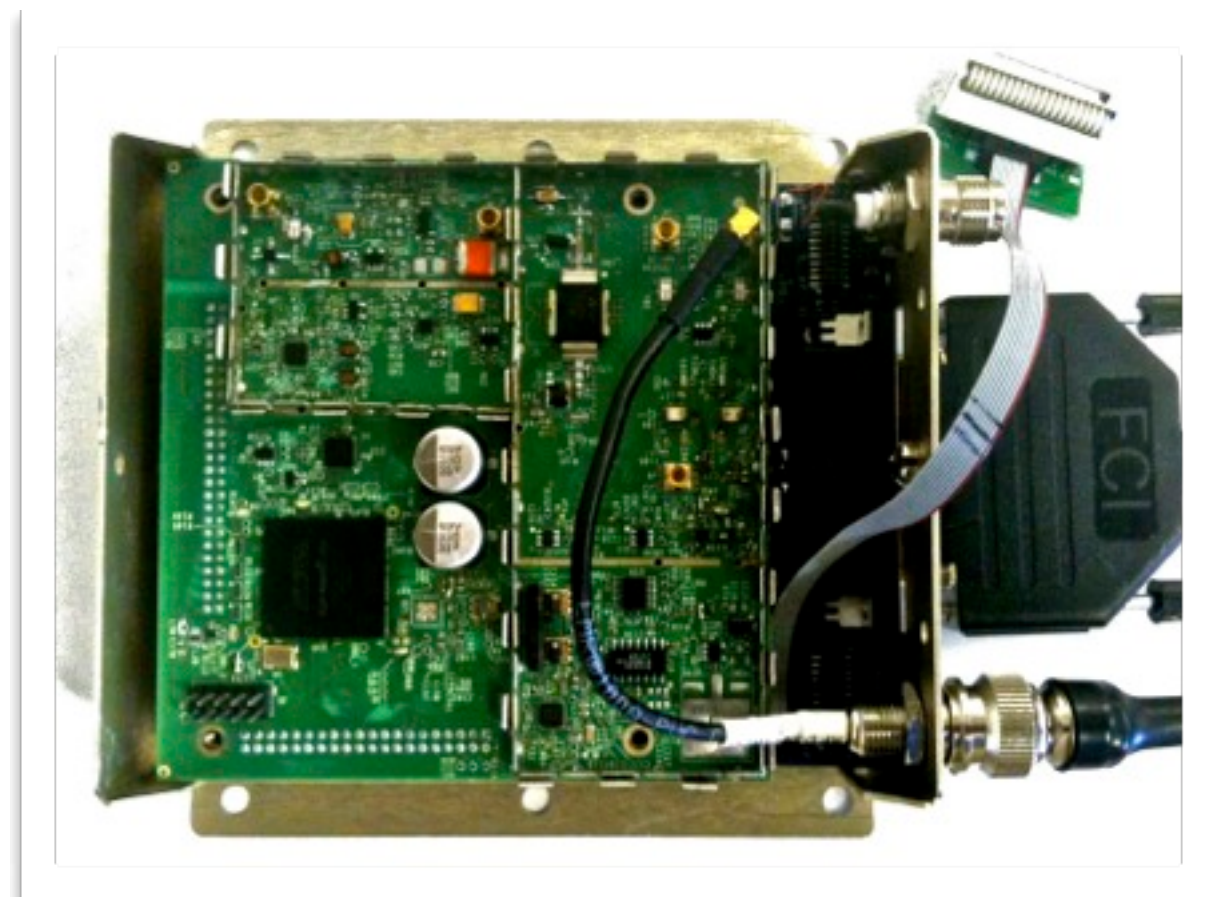


FreeFlight Systems "RANGR" 978 MHz ADS-B Transmitter with Control Head



1090 MHz ADS-B Transponders

- **TSO-C154c Class B1 / B1S Data Radio**
 - Diversity capable
 - Internal or external GPS
 - Transmitter only or transceiver configurations
 - Weight 0.8 lbs
 - Nominal 60W output power
 - Supports “GDL-90” protocols
 - Design assurance level C



Naked RANGR-T



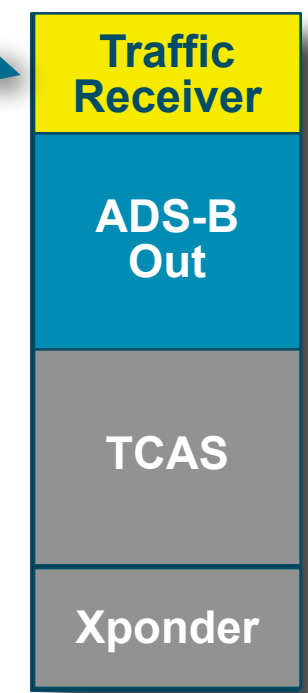
RANGR-T ADS-B Datalink Radio

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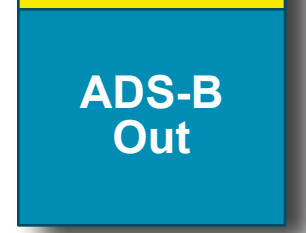
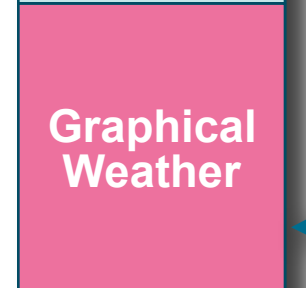
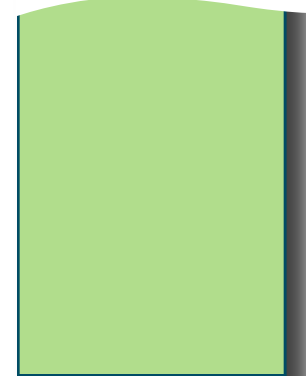
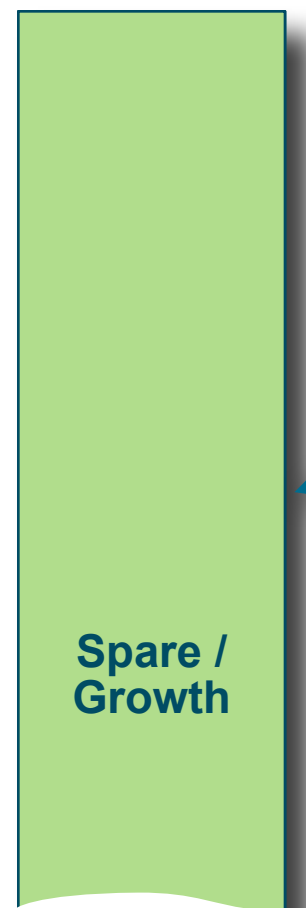
Datalink Capacity

1090 MHz datalink is transponder based. It is used by TCAS and is already very crowded. Addition of ADS-B Data takes this datalink to the limit of its capacity

Zero growth capacity



1090 MHz



978 MHz

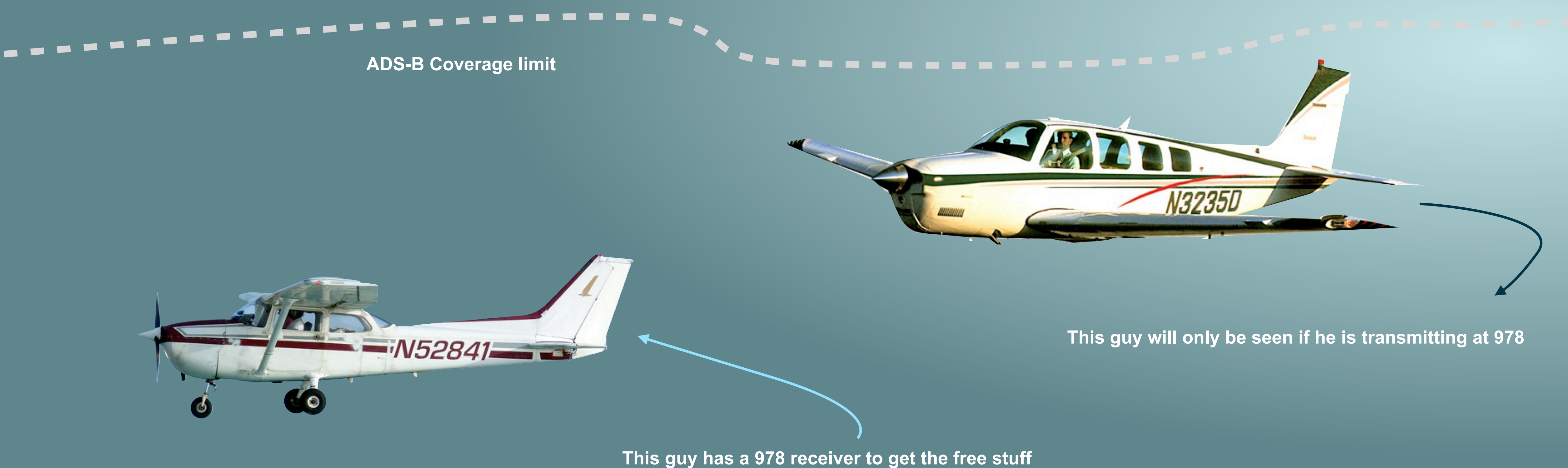
High Data Content Services

Capacity for Future Products and Services



The 978 MHz datalink is dedicated to ADS-B and carries no other data giving it enormous growth capacity - over and above the high data content services already offered

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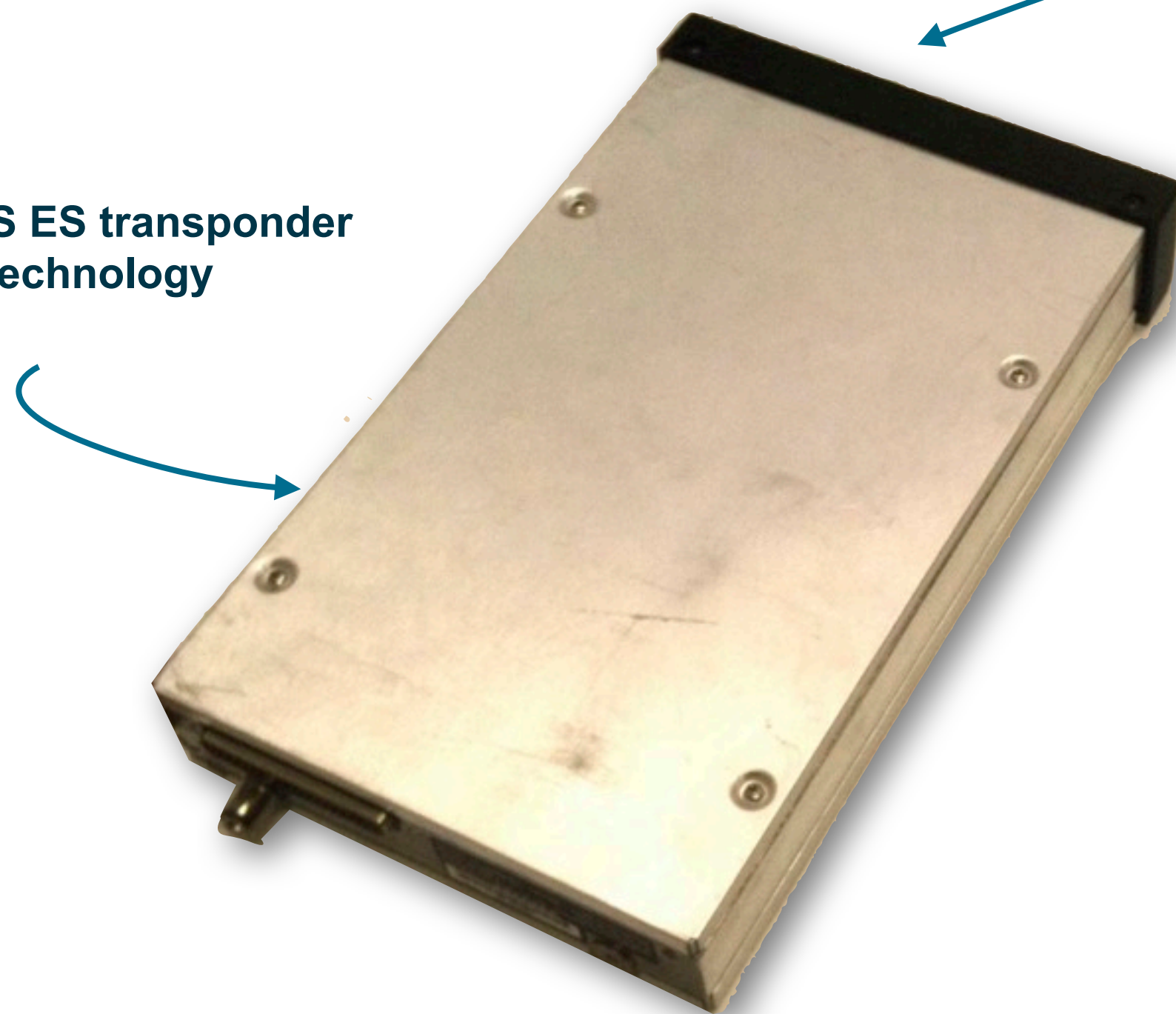
ADS-B Coverage limit

This guy will only be seen if he is transmitting at 978

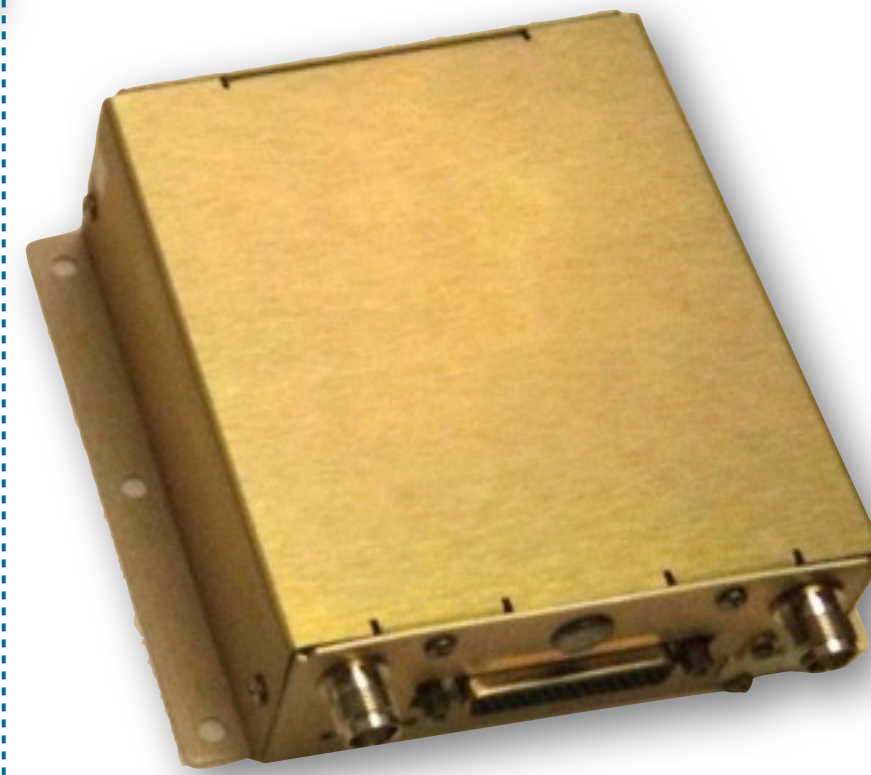
This guy has a 978 receiver to get the free stuff

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1090 MHz Mode S ES transponder
Not 2011 technology



To Scale



978 MHz ADS-B Transceiver
Weight ~ 0.8 lbs
Tested To DO-160G
Meets DO 282B MPOS
Meets TSO-C154c

2011 technology

Transponder technology was introduced in WW2
"Mode S ES" technology was introduced in the early 1990's with TCAS

First generation 978 MHz radio was introduced in 2003
Current generation is 100% "today" technology

"Its Like VHS vs Blue Ray"
John DeBusk, VP Engineering, FreeFlight Systems

1090 MHz

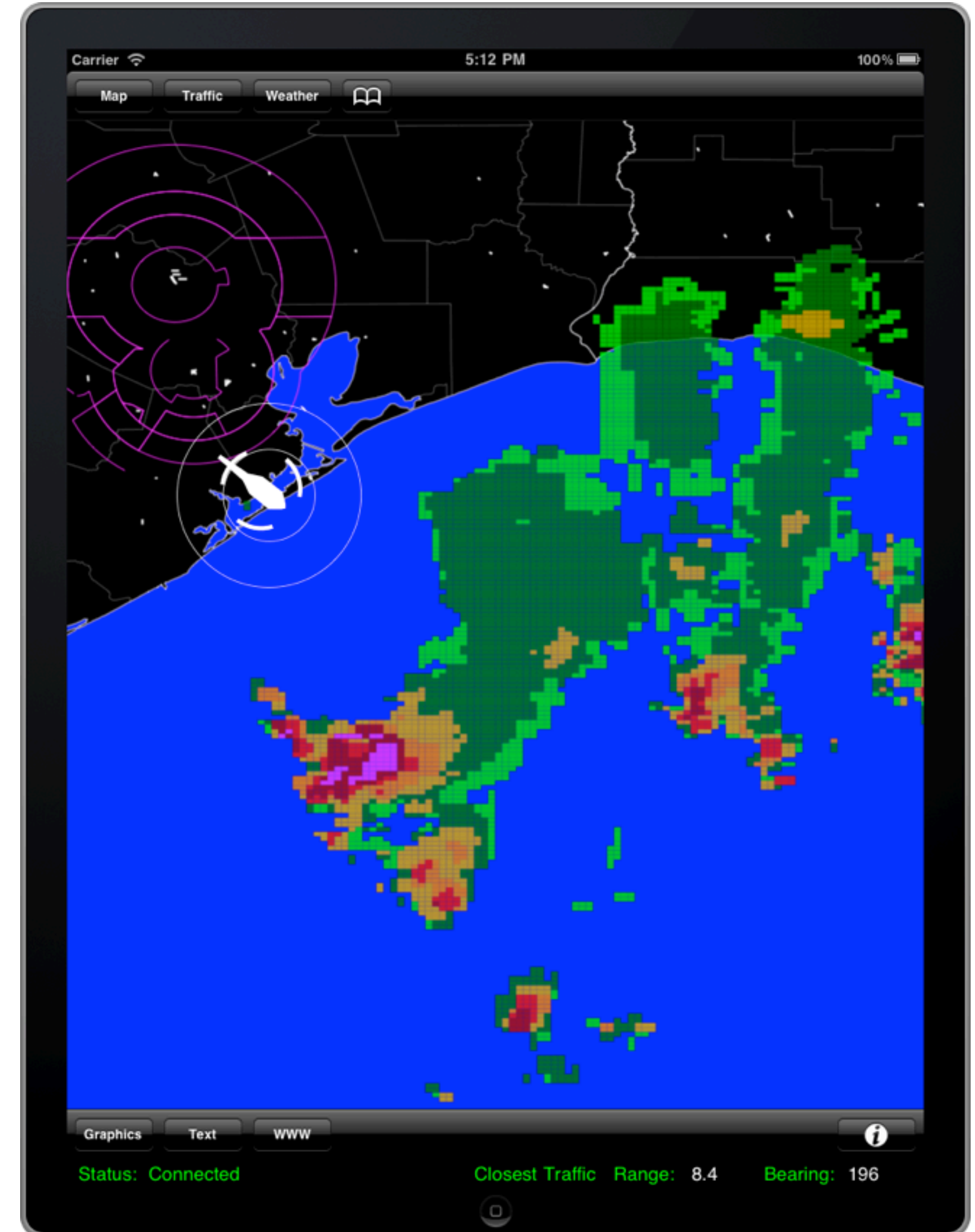
978 MHz

FreeFlight Systems Proprietary Information

- **Prerequisite - you must have a valid ADS-B “Out” system**
- **TIS-B traffic data is transmitted at both 1090 MHz and 978 MHz**
- **FIS-B graphical weather and other data is transmitted only at 978 MHz**
- **At either frequency you can use a dedicated receiver or a transmitter that has “In” Capability. Displaying the ADS-B “In” data requires an ADS-B capable display. This sounds obvious but different manufacturers have different approaches. In general:**
 - 978 TIS-B / FIS-B data can be displayed on any surface that accepts the standard interface. This includes most Chelton products and a few Garmin displays such as the MX 20/ GMX 200. For other Garmin products or other manufacturers we recommend that you call them to discuss TIS-B/FIS-B interfaces

Or

ADS-B Traffic and Weather shown on iPad



USA

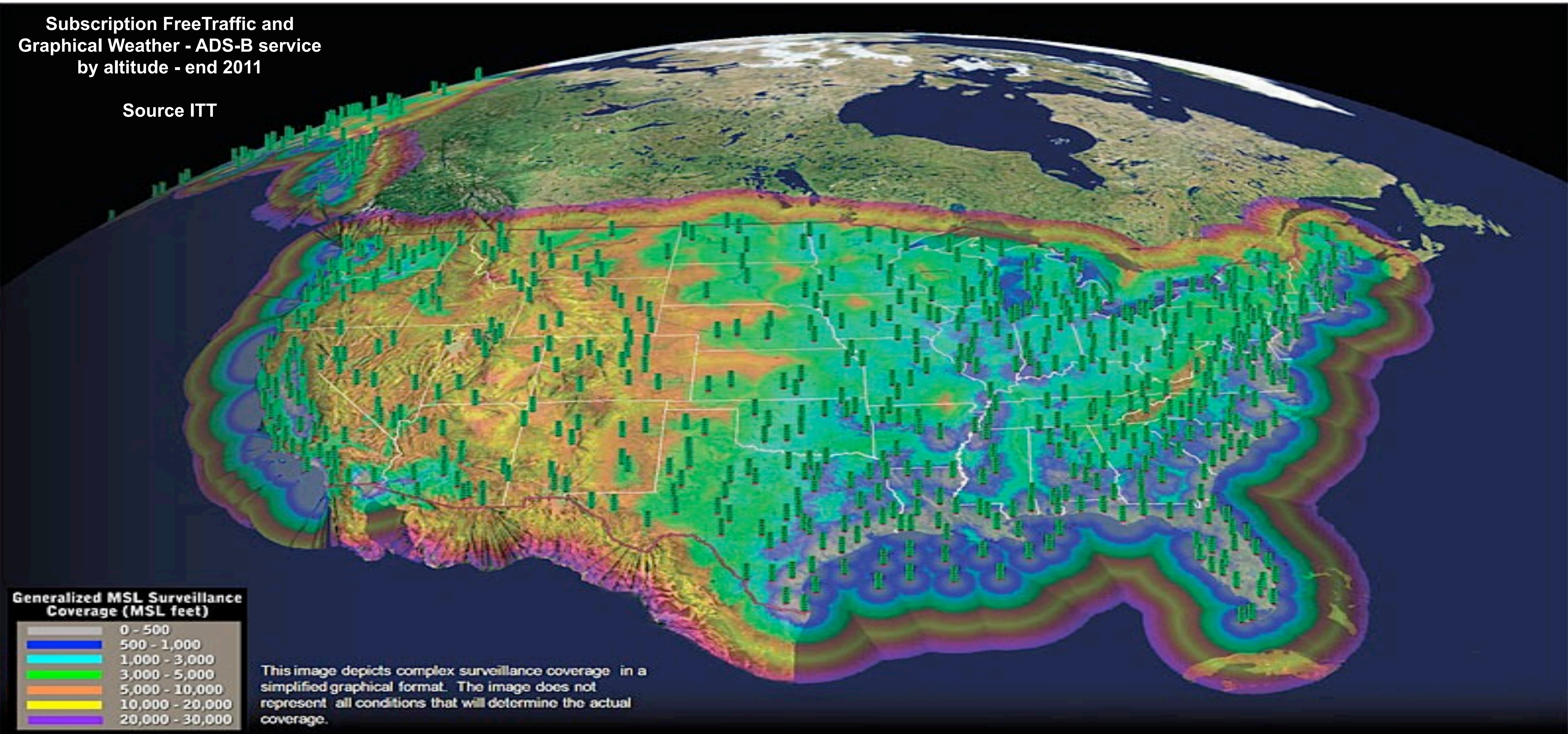
- **Over 80% coverage by the end of 2011**
- **All USA (at least the same coverage as radar today) by the end of 2013**

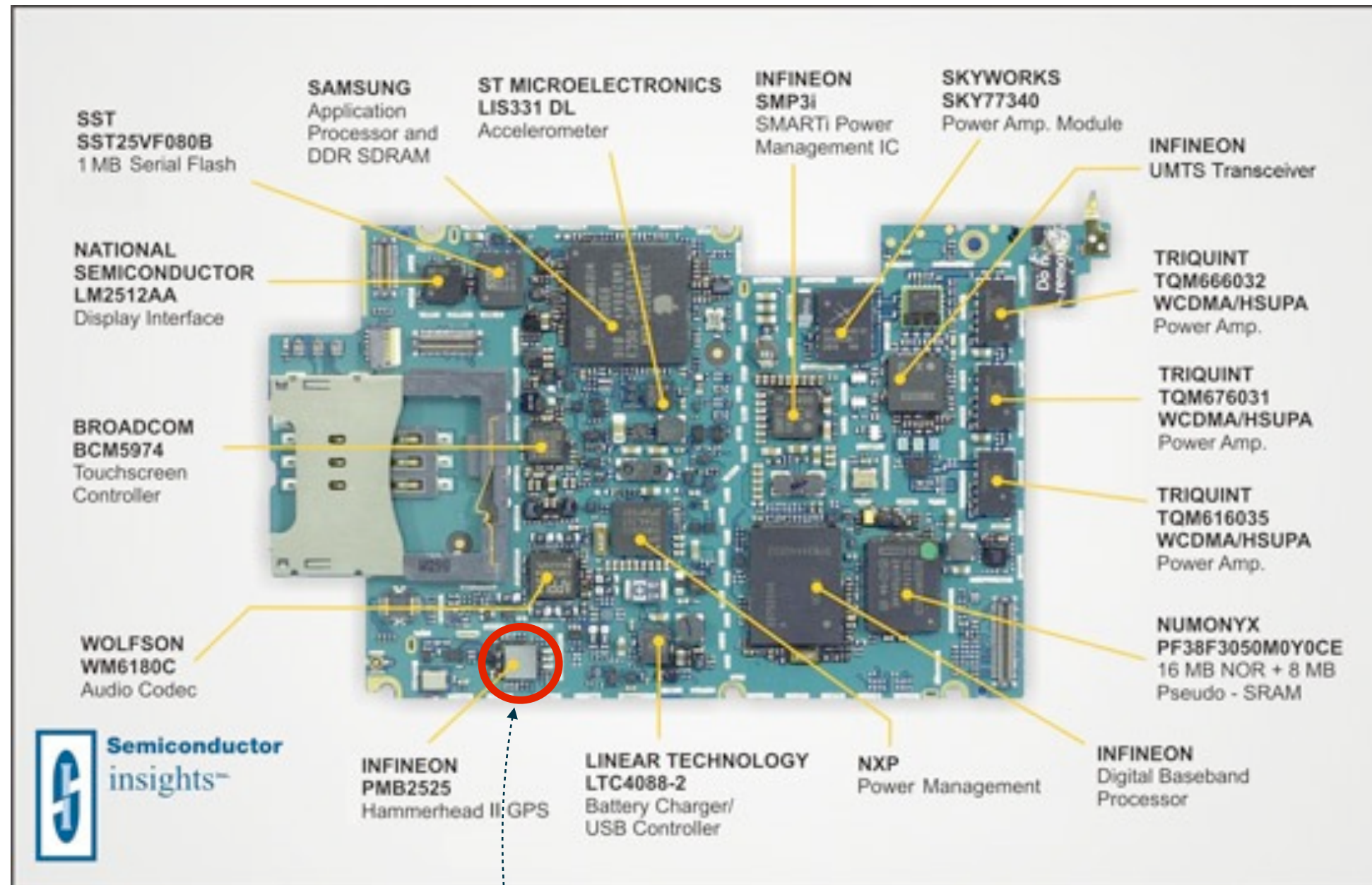
Non USA

- **ADS-B “Out” at 1090 MHz will be required in most non-US airspace by 2014 - 2017**

Subscription FreeTraffic and
Graphical Weather - ADS-B service
by altitude - end 2011

Source ITT

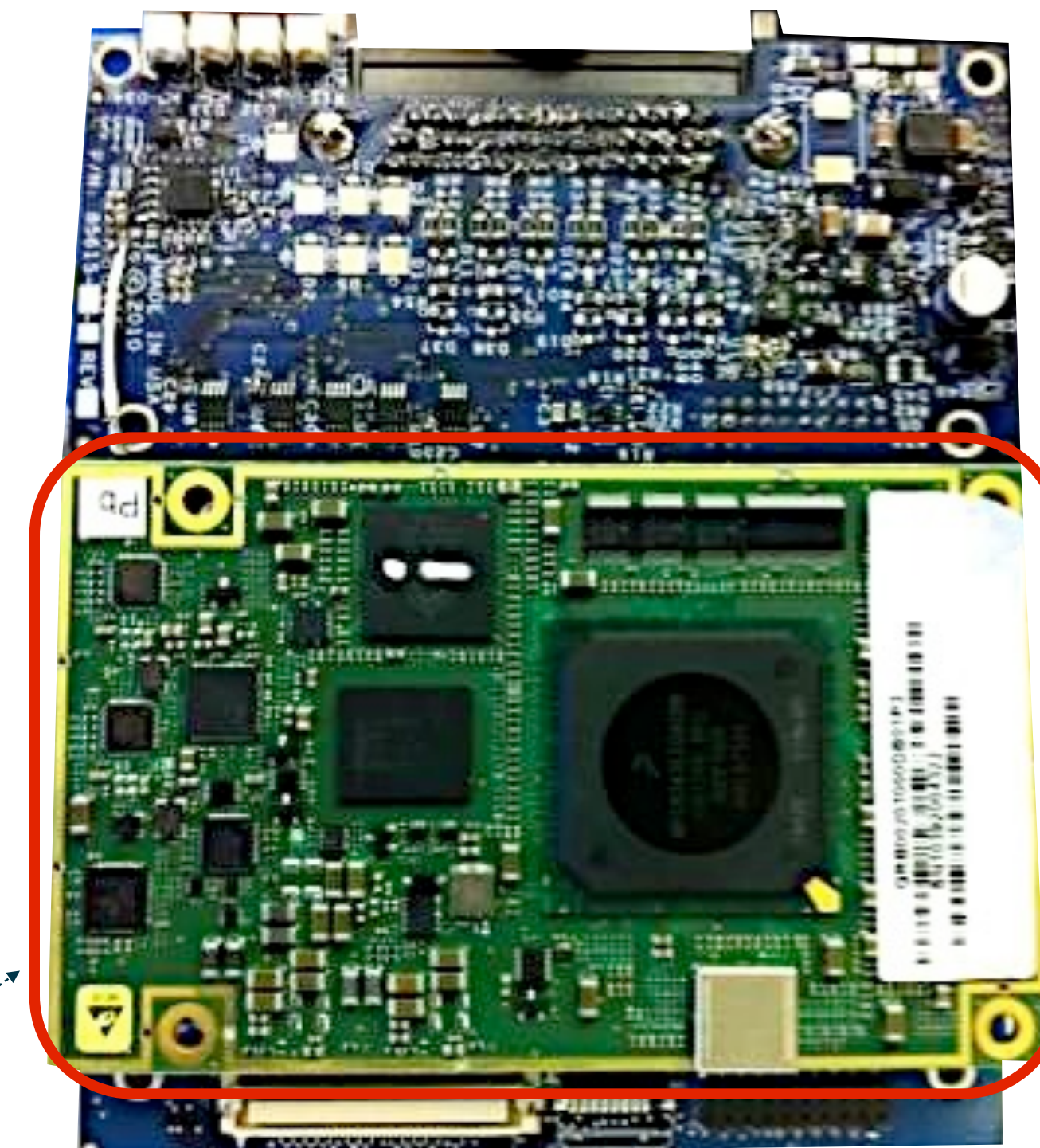




State Of The Art
Portable Device GPS
Circuitry

Often Right

State Of The Art
Aviation GPS Circuitry






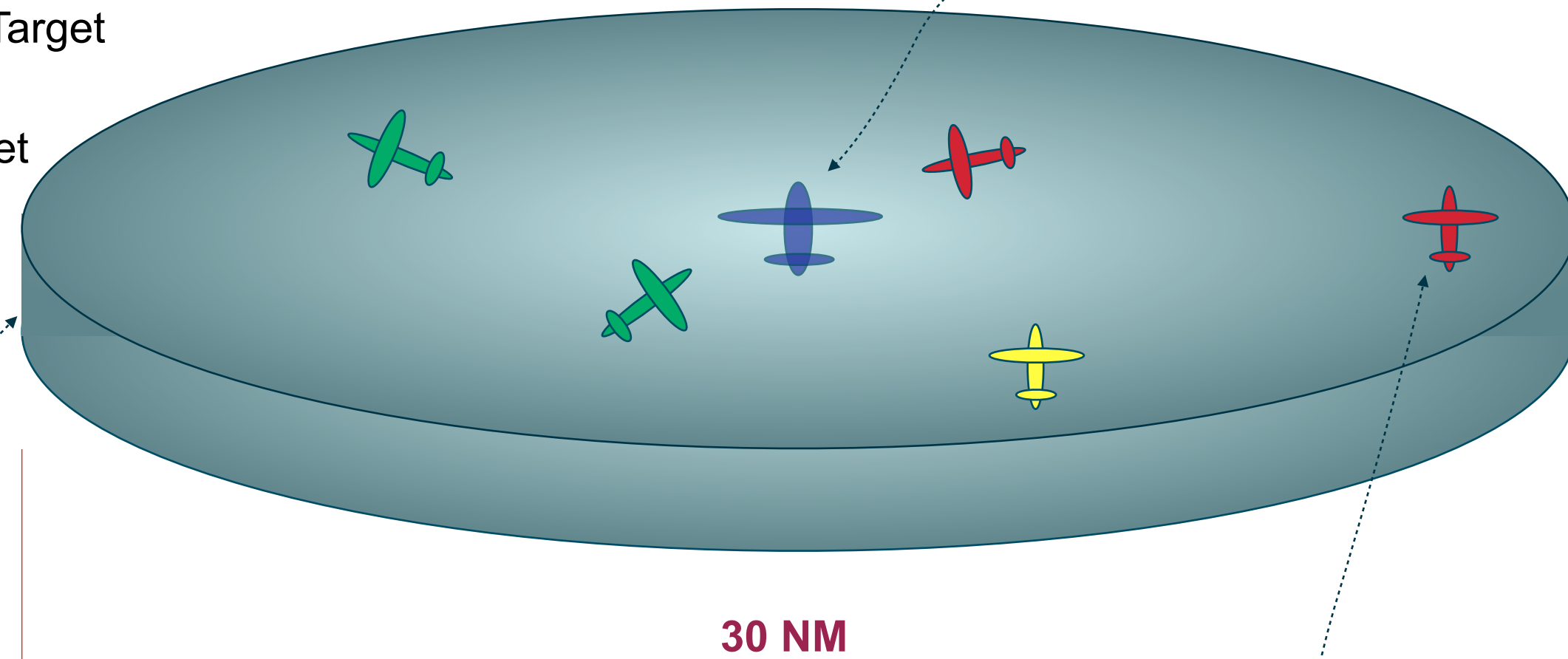
Right
Knows if its right
Knows if the satellites are right and excludes bad ones
Knows it is going to know if it is right

Only gives bad information once in every 1,000,000,000 Hours
(One hundred and forty one thousand years)

The basic, free FIS-B service transmits graphical and textual weather, as well as other aeronautical products. These include:

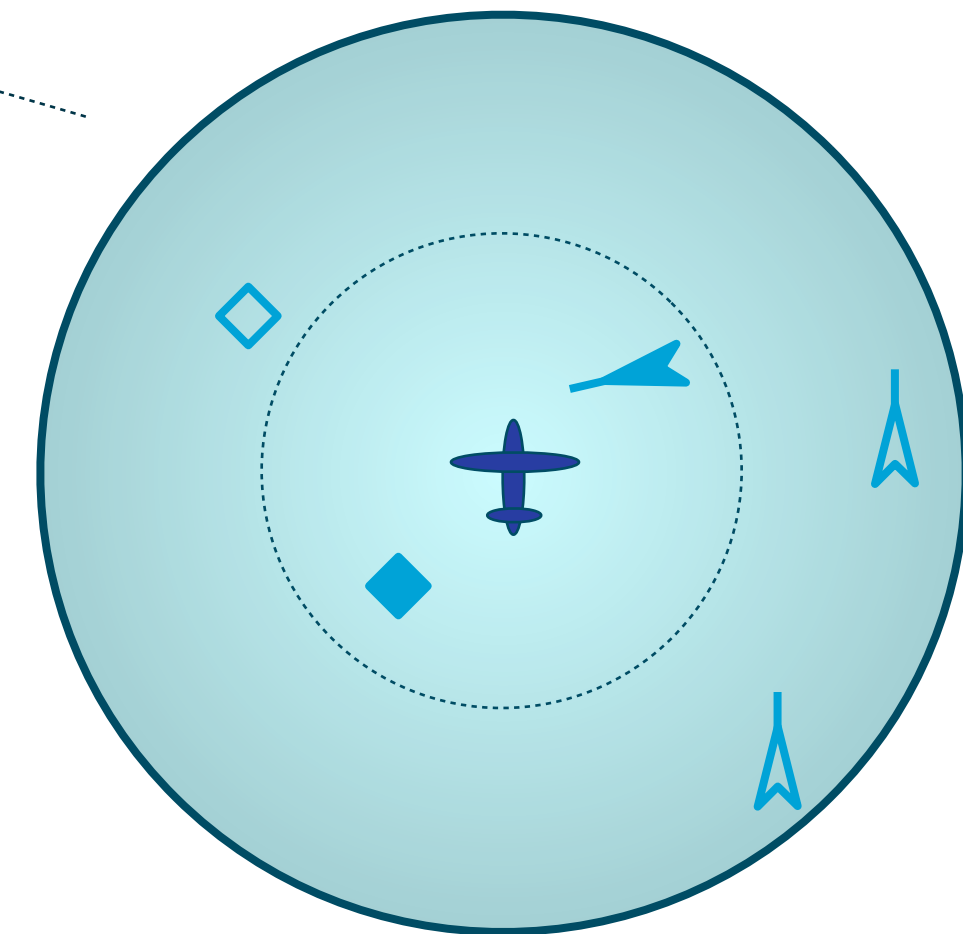
- Aviation Routine Weather Reports (METARs).
- Non-Routine Aviation Weather Reports (SPECIs).
- Terminal Area Forecasts (TAFs) and their amendments.
- NEXRAD (regional and CONUS) precipitation maps.
- Notice to Airmen (NOTAM) Distant and Flight Data Center.
- Airmen's Meteorological Conditions (AIRMET).
- Significant Meteorological Conditions (SIGMET) and Convective SIGMET.
- Status of Special Use Airspace (SUA).
- Temporary Flight Restrictions (TFRs).
- Winds and Temperatures Aloft.
- Pilot Reports (PIREPS).
- TIS-B service status.

-  978 ADS-B Target
-  1090 ADS-B Target
-  Xponder Target



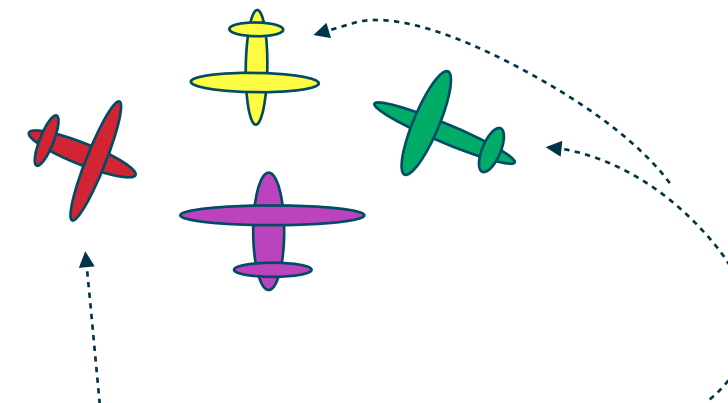
Ground System sends hockey puck of traffic info centered around a valid ADS-B client

Properly equipped aircraft (978)



3500 ft
3500 ft

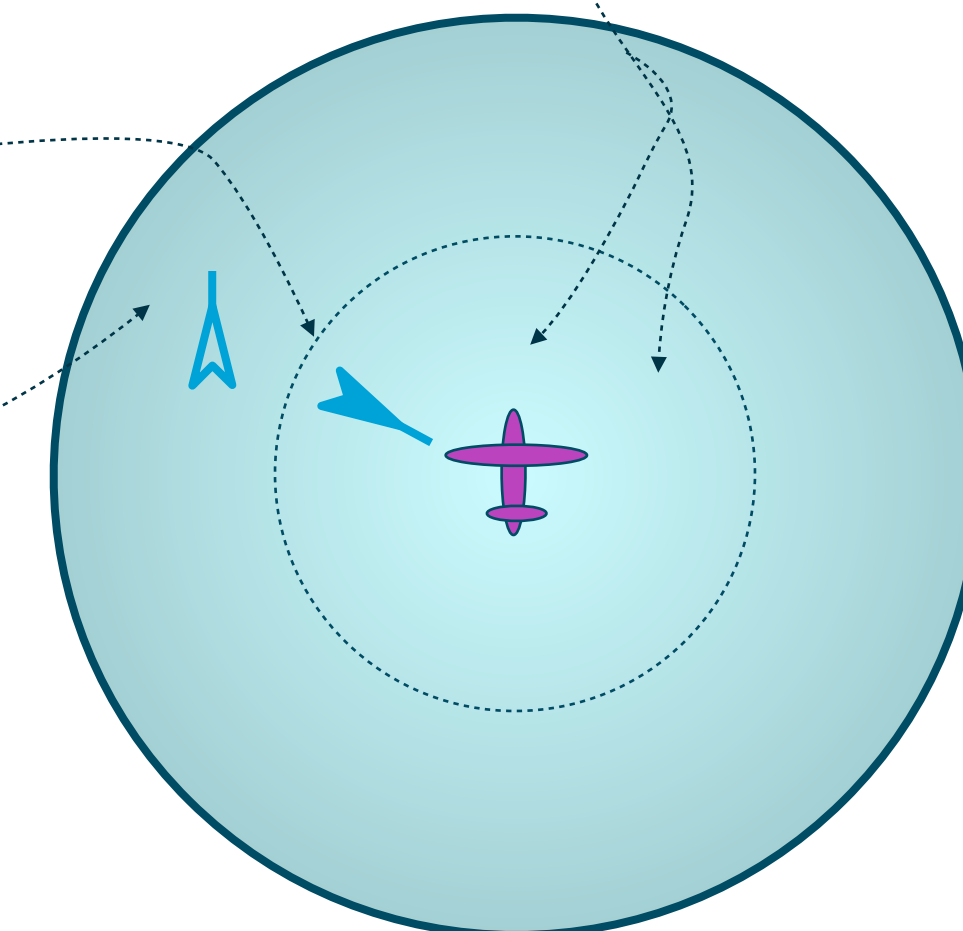
30 NM



He does not see these

He sees this one air to air

Improperly equipped aircraft sees this target from FAA re-broadcast



Improperly equipped aircraft (978) sees some targets but misses others

Receive only (traffic) or uncertified ADS-B "out" installs with traffic receivers lead to dangerous conditions and are not allowed

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Backup Slides

1090 MHz

Pro

- **Required above 18K Ft or outside of the US**
- **Integrated with Mode-S ES Transponder**
- **Integrated transponder and ADS-B Control**

Con

- **Older aircraft will require new transponder or a significant upgrade to installed equipment**

978 MHz

Pro

- **Coexists peacefully with existing transponder**
- **Inexpensive**
- **FAA preferred solution for light aircraft**

Con

- **Limited to US below 18K feet**
- **Requires additional squawk control**