Duncan Aviation ADS-B and FANS 1/A + Seminar

Minneapolis, MN
7/13/2016

ADS-B and Mandates Overview
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UASC NextGen Solutions
Bruce Bunevich, Universal Avionics

FDF and FANS
John Salame, Satcom Direct

NextGen Solutions for Business Aircraft
Jeff Gauger, L-3 Aviation Products

Garmin NextGen Solutions
James Laster, Garmin

Mandates Compliance
David Ufen, Rockwell Collins

Mandates Made Easy
Tim Kelly, Honeywell

DUNCAN AVIATION

ADS-B

Automatic Dependent Surveillance-Broadcast

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Get the latest NextGen developments at
www.duncanaviation.aero/nextgen

Affected Aircraft

- The FAA estimates that [redacted] aircraft still need to be equipped for the mandate
- There are approximately [redacted] corporate aircraft (jets & turboprops--AMSTAT May 2015) that will require this equipment to fly in their best performance range.

FAA Asserts

[redacted] Deadline

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Benefits

ADS-B Solutions

Duncan Aviation and SAFRAN Engineering are developing an AML STC on the following models:

- Challenger 601-3A/3R, Learjet 60, Gulfstream G100 & G200 and the Textron 800-Series aircraft

Mandates

ADS-B Out DO-260/260A Dec 12, 2013
- Hudson Bay, Hong Kong, Australia & Singapore

LINK 2000+ Europe date moved to Feb 5, 2020

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Originally ADS-B Out DO-260A Europe changed to DO-260B and moved to June 8, 2020

ADS-B Out DO-260B United States & Worldwide Jan 1, 2020

FANS 1/A+
- ICAO North Atlantic (NAT) region
- FL360-390, two tracks in OTS Feb 7, 2013
- FL350-390, all tracks in OTS Feb 5, 2015
- FL350-390, NAT region Dec 7, 2017
- FL290 & above, NAT region Jan 30, 2020

Three Levels of DO-260?

Acronyms

- **ADS-B** Automatic Dependent Surveillance-Broadcast
- **ARINC** Aeronautical Radio Inc
- **CASA** Civil Aviation Safety Authority
- **GNSS** Global Navigation Satellite System
- **FDE** Fault Detection and Exclusion
- **NAC** Navigation Accuracy Category
- **NAC (p)** Navigation Accuracy for Position
- **NIC** Navigation Integrity Category
- **NUC** Navigation Uncertainty Category
- **SA** Selective Awareness
- **SPI** Special Position Indication (Ident)
- **LOA** Letter of Approval

Do I have ADS-B?

Approved Systems

Part Number Specific
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United States ADS-B

- STCs are being revised daily, including those by Rockwell Collins, Freeflight, CMO Flight Solutions & L-3 Business Aviation Services. Garmin has an AML for Part 23 aircraft that are approved for DO-260B out
- The FAA mandates in AC 20-165A that all ADS-B systems require an STC
- Rockwell Collins has the TDR-94D system (-500/-501) that meets all of the US mandates for ADS-B out

Benefits

- Aircraft with ADS-B get priority over non-ADS-B-equipped aircraft
- No need for position reports
- More flexible continuous routes to flight levels
- Reduced runway incursions
- Improved safety in areas that previously had no surveillance coverage

History & Development

- Developed to fit multiple aircraft in a fixed position **horizontally**
- RVSM established a baseline by providing highly accurate separation **vertically**

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Documents

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- Singapore CAAS Advisory Circular AC AOC-21(0)
- Hong Kong AIC 09/11
- Australia CAO 20.18-2009
- United States AC-90-114, AC20-165a, AC20-172a, 14CFR91.225
- EASA AMC20-24, ETSO-2C112a

Three Levels of DO-260?

DO-260
- Tested but position accuracies did not meet predicted forecast

DO-260A
- Developed to add accuracy missing from DO-260. It usually incorporates upgraded GPS WAAS receivers. Installed & tested by airlines, but the results were still outside the range of desired accuracies

DO-260B
- Incorporates GPS accuracies from DO-260A but adds position forecast (from position & velocity) to predict and broadcast position. Adds cockpit annunciators and procedures

DO-260

- Hudson Bay, now in effect
- Australia, Dec 12, 2013. Any flight operating at or above FL290 in or through Australian airspace
- Hong Kong, Dec 12, 2013 for ATS routes M771 and L642 and by Dec 2014 for entire Hong Kong FIR
- Indonesia, Dec 12, 2013. Any flight operating at or above FL290.
- Singapore, Dec 12, 2013. Any flight operating at or above FL290.

DO-260B

- Europe, June 8, 2016 for new production aircraft*
- Europe, June 8, 2020 for all retrofit aircraft*

*** Amendment to regulation No 1207/2011 approved Aug 6, 2014**

DO-260B

- United States, Jan 1, 2020

- Is the world-wide standard
- Uses the advantages of ADS-B DO-260 and DO-260A but requires parameters and addresses latency and annunciation issues

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LEARN WHAT'S NEXT WITH
NEXTGEN
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FAA NextGen

The FAA began implementing **NextGen** in 2009, starting with ADS-B, and plans to have the infrastructure operational by the end of 2014. The mandate for ADS-B Out compliance is Jan. 1, 2020. On May 27, 2010, the FAA published new rules (14 CFR §92.225 and §91.227) mandating airspace and avionics performance requirements after Jan. 1, 2020. AC 20-165A (Nov. 2012) provides guidance for the installation and airworthiness approval of ADS-B Out systems in aircraft. The mandated avionics perform the ADS-B Out function, which transmits the precise location and other information about the aircraft to ground stations and ADS-B-In-equipped aircraft.

FAA NextGen

The mandate does not require ADS-B In equipment, which would enable other services available with ADS-B. Flight decks of aircraft outfitted with ADS-B In can take advantage of data broadcast services for graphical and text-based weather, traffic advisories and other aeronautical information.

The ADS-B mandate requires ADSB-Out avionics when operating in designated airspace, and aircraft owners have less than 5 years to equip their aircraft. The ADS-B rule, like current transponder operating requirements, specifies that operators have ADS-B Out avionics installed and operating in order to fly their aircraft in the busiest airspace.

Transponder Evolution

Used as a baseline for ADS-B upgrades

- Mode A transponder
- Mode C transponder
- Mode S transponder
- Flight ID transponder/system
- EHS transponder/system
- ADS-B (DO-260, DO-260A, DO-260B)

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ADS-B Specifics

- Class A, B & C airspace
- All airspace at and above **10,000 feet** Mean Sea Level (MSL) over the contiguous United States and the District of Columbia
- Within **30 nautical miles** of airports listed in 14 CFR §91.225, from the surface up to **10,000 ft MSL**.
- For Class E airspace over the Gulf of Mexico from the U.S. coastline out to **12 nautical miles**, at and above **3,000 ft MSL**.
- Neither current transponder nor RVSM maintenance requirements have changed or been affected by the ADS-B rule.
- FAA Technical Service Orders (TSOs) describe the equipment specifications approved for ADS-B operations. The ADS-B rule states that avionics must meet the standards of either TSO-C166b (for **1090MHz ES** link equipment) or TSO-C154c (for **978MHz UAT** link equipment). TSO-C166b is required in Class A airspace and either link can be used in all other airspace.

DO-260B ADS-B Parameters

A. Position
- Latitude and longitude

B. Horizontal velocity
- Set from the position source in the air
- Set from HDG, ground speed or track in ground mode

C. Source Integrity Level (SIL)
- Set at installation from the position source
- Can change if alternate source is selected

D. SIL Supplement
- Programmed at the transponder during installation
- Based on source sampling rate from the position source

E. Navigation Integrity Category (NIC)
- Defines the error integrity of the position source

F. Navigation Accuracy Category for Position (NACp)
- Defines the accuracy of the position source

G. Navigation Accuracy Category for Velocity (NACv)
- Defines the velocity accuracy of the position source

H. Geometric Altitude
- Defines the geometric altitude of the position source

DO-260B ADS-B Parameters

I. Geometric Vertical Accuracy (GVA)

- Sets the vertical accuracy of the position source

J. Heading Source

- True of magnetic heading from the aircraft source

K. Ground Track Angle

- Used for systems that do not have a heading source

L. Altitude Source

Can be derived from the following:

- Pressure Altimeter (TSO-C10)
- Air Data Computer (TSO-C106)
- Encoder or digitizer (TSO-C88)

This source must be from the same source that is sent to the transponder & if the aircraft is RVSM-certified, this altitude source must be used

M. Barometric Altitude

- Set from the aircraft barometric source

N. TCAS Status

- Set from TCAS II source
- TCAS I system not required for this status message

DO-260B ADS-B Parameters

O. System Annunciation

- Must visually display the status of the ADS-B system
- Must use **at least two** annunciators
    - A. ADS-B failure
    - B. Position source or interface failure

P. ICAO Address

- Programmed from **the tail number** of the aircraft through the 24-bit address

Q. Flight ID

- Set as **the aircraft registration** or the **Flight ID code**

R. Vertical Rate

- Set from **the source** at installation
    - A. No accuracy status message required
    - B. Hybrid, blended, GNSS or barometric

S. Air vs. Ground mode

- Aircraft **length and width** code
- Air or ground status

Flight Manual Changes

- Must describe the annunciators used for ADS-B and how to respond to malfunctions
- Explain how to disable ADS-B equipment
- Leave on ADS-B systems in taxi operations to facilitate ground movements

Operators who meet the **Australian** requirements for ADS-B operations must indicate ADS-B capability in the flight notification (ATS flight plan) of all approved ADS-B-equipped aircraft when planning to operate in **Australian** airspace.

Do I have ADS-B?

GNSS TSO

- Other systems can be approved but must show FDE, SA, barometric confirmation and must be approved through ground and/or flight test.
- C-145a, C-146a, or C196 or later versions

Message Format

- ICAO Annex 10, Volume III & IV Amendment 85
- DO-260, DO-260A or TSO C188 or TSO-C166a
- DO-260B or TSO C166b

Do I have ADS-B?

Transmitter Characteristics

- ATSO-C1004b
- ATSO-1C74c
- TSO-C112d and compliant with RTCA/DO-181e
- ETSO-C112b
- ED73B or DO-181e
- ATSO C1005b

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Do I have ADS-B?

- HPL to ADS-B transmitter on same interface as GNSS position data
- Suitable barometric encoder
- Flight ID installed and tested
- Tested with results to verify

Do I Have ADS-B?

- Do I have a statement of compliance in my AFM or POH?
- Do I have flight crew training?
- Has my MEL been revised to show ADS-B system dispatch capability?
- Has it been tested recently?

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Transponder Compliance

- ARINC 718A
- TSO-C112
- EUROCAE ED-73B
- JTSO-2c112a
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Approved Systems

Part Number Specific

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Non-Approved Systems

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SB503 must be added to fix Flight ID reporting, 737-400 only

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- Aircraft w
  aircraft
- No need
- More flex
- Reduced
- Improve
  surveilla

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FAA Exceptions For ADS-B

- Reference regulatory document #FAA-2015-0971
- Allows air carriers an exception for implementation for up to 4 years (December 31, 2024) from 14 CFR 91.227
- The exception is meant to help with the scheduling of the aircraft and to allow the manufacturers time to develop new sensors for the air carrier fleet
- Each air carrier must apply and be approved under this program prior to August 1, 2018
- ADS-B transponders must still be installed and operational by January 1, 2020
- Each GPS sensor or MMR must be evaluated by its TSO under the program to see if it qualifies

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Universal Avionics NextGen Solutions

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

Discussion

- NextGen Implementation Plan
- UASC SBAS FMS
- UASC UniLink 80X for FANS 1/A, DataComm
- UASC CVFDR
- UASC Incentives for upgrades
- Bonus Depreciation Tax Incentive

NextGen FAA Implementation Plan

- **NextGen Plan includes**
  - Automatic Dependent Surveillance–Broadcast Out (ADS-B Out)
  - Performance Based Navigation (PBN)
  - CPDLC – DCL (Departure Clearance)
  - International
    - CPDLC FANS 1/A, LINK 2000+ and DataComm

SBAS Flight Management System

- **Today -** All Universal Avionics SBAS Flight Management Systems exceed position input sensor interface requirements for ADS-B Out capable transponders
  - Collins and Honeywell capable ADS-B Out Transponders
- Universal Avionics /Rockwell Collins TDR-94 Transponders incentive packages available through approved dealers
- SBAS FMS Installation or upgrading enables Performance Based Navigation operations in the upcoming NextGen road map
- **SBAS FMS IS THE CORRECT CHOICE** to meet the ADS-B position source sensor and integrated SBAS navigation

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NextGen FAA Implementation Plan

Performance Based Navigation (PBN)

- The FAA is funded to develop PBN
- PBN Increases
  - Air Traffic Capacity
  - Air Traffic Efficiency Using RNAV and RNP with much tighter accuracy requirements such as RNP 1 / RNP .3
- Implements Direct Route RNAV SIDS and STARS
- Implements Time Based Metering Using RNAV and RNP
- Integrated SBAS Flight Management System meets PBN requirements

NextGen FAA Implementation Plan

FANS 1/A, LINK 2000+ AND DataComm

- FANS 1/A is operational and mandated.
- LINK 2000+ is mandated in European Airspace
- FAA is funded and is testing and developing DataComm for the Continental United States utilizing proven Controller Pilot Data Link Communications (CPDLC).
- CPDLC-DCL is operational today

NextGen FAA Implementation Plan

- **ADS-B Out is FAA mandated**
  - ADS-B Out AND Performance Based Navigation (PBN) required
  - FAA is currently certifying and implementing Performance Based Navigation (PBN) procedures
  - ADS-B Out and PBN is simultaneous consideration when evaluating best aircraft solution for ADS-B Out, future requirements and aircraft value
  - Integrated SBAS Flight Management System is **ONLY** solution satisfying both of these operational capabilities

NextGen FAA Implementation Plan

DataComm Operational Value

- DataComm is direct link between ground automation and flight deck avionics
  - Safety-of-flight clearances
  - Navigation instructions
  - Traffic flow management
  - Flight crew requests and reports

- DataComm enhances safety
  - Reducing communication errors
  - Increase controller productivity by reducing communication time between controllers and pilots
  - Increase airspace capacity and efficiency reducing delays, fuel burn, and carbon emissions

NextGen FAA Implementation Plan

DataComm Operational Value

- FAA commits DataComm program Segment 1 Phase 1 to deliver departure clearances at 56 airports
- DataComm commissioning projects completion2019
- Operation Challenge Date end of CY2016 at all 56 locations

SBAS Flight Management System

- SBAS FMS is the foundation to build NextGen Operational Capability and DataComm

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

UNILINK 80X.X Communications Management Unit (CMU)

- NextGen solution architecture is WAAS/SBAS FMS and UL-80X.X CMU for CPDLC FANS 1/A, LINK 2000+ and DataComm

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

UNILINK 80X.X Communications Management Unit

- The UL-801 when integrated with the UASC SBAS FMS provides integrated solution for FAN 1/A, LINK 2000+ and DataComm CPDLC, CPDLC-DCL.

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

Cockpit Voice/Data Recording

Complying with CPDLC FANS 1/A and DataComm requires the recording of data transmitted to and from the aircraft

A CVR capable of meeting these requirements must be installed

Universal Avionics NextGen Solution

- **Solution Summary**

➢The installation of the Universal Avionics SBAS FMS, UniLink 80X.X a CVR and associated annunciators WILL make your aircraft capable of operating in NextGen airspace for 2020 and beyond.

➢SBAS FMS SCN 1001.1 and 1101.1 eliminates the need for additional Transponder fail annunciators in the instrument panel for ADS-B out.

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

Universal Financial Solution

- Universal is offering significant FMS exchange credits to upgrade existing Non-SBAS FMS or Non-Universal FMS to meet mandates

- Additional information about NextGen and Universal solutions at **www.uasc.com**

UNIVERSAL® AVIONICS SYSTEMS CORPORATION

NextGen Financial Solution

- According to Advocate Consulting Legal Group, PLLC
- Congress extended the Bonus Depreciation rules
- Bonus Depreciation includes NEW equipment installations and installation labor cost
- Potentially claim up to 50% tax credits for same year installation is completed with specific stipulations
- Contact your Professional Tax Representative for details

Questions?

Thank You

www.uasc.com

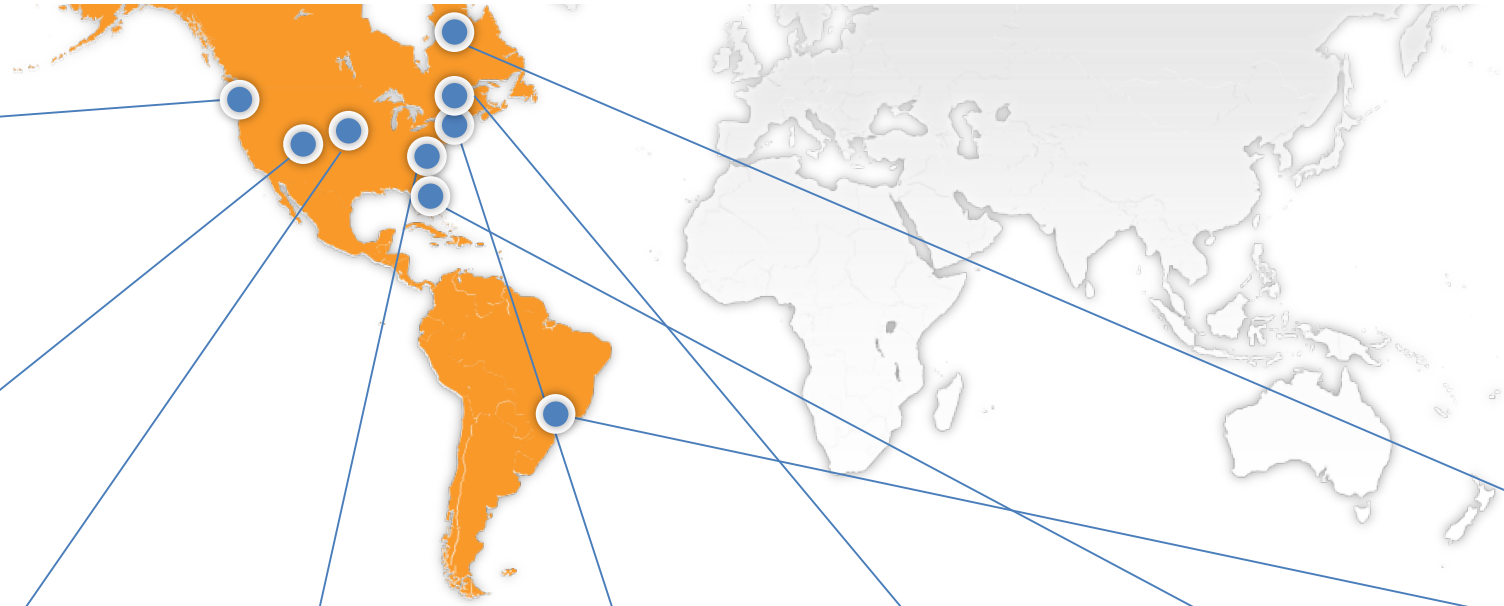
UNIVERSAL® AVIONICS
SYSTEMS CORPORATION

Satcom Direct

- Datalink (FDF) – FANS / CPDLC Compliant

John Salame – Great Lakes Regional Sales Manager

Global Sales, Support and Training – 24/7



Seattle, WA
FlightDeck Freedom
Ops
Sales
Support
+1 321.777.1435

Denver, CO
Sales
Support
Product Development Center
+1 720.328.7205

Little Rock, AR
Dassault Programs
Sales
Support
+1 321.525.4620

Savannah, GA
FlightSafety/ Gulfstream Lab
Sales
Support
+1 912.508.1661

Alexandria, VA
US Government Contracting
Acct Mgt
Support
+1 703.549.3009

Ottawa, Canada
Bombardier Programs
Sales
Support
+1.613.800.0926

Melbourne, FL
World HQ
Training Lab, NOC
SD Store
Sales
Secured Data Ctr.
+1 321.777.3000

Sao Paulo, Brazil
Embraer Programs
Sales
Support
+55.11.2538.9068

Montreal, Canada
Sales
Support
+1.514.900.3009

Global Sales, Support and Training – 24/7

Upcoming location

Farnborough, UK
Training Lab
Sales
Support
+44.1252.554.460

Geneva, Switzerland
Sales
Support
+41225180345

Moscow, Russia
Sales
Support
+1.321.626.3545

Dubai, UAE
Sales
Support
+971.442.11991

Hong-Kong, PRC
Sales
Support
+852.5364.0279

Melbourne, Australia
Sales
Support
+44 7738 717 938

Jakarta, Indonesia
Sales
Support
TBA

Cape Town, South Africa
Sales
Support
+27.282.368.6983

Available Connections

inmarsat

Inmarsat – I3, I4
Classic Services

- Voice / Fax
- Datalink
- Swift64 (internet)

inmarsat

Swift Broadband

- Internet
- Voice
- Streaming

inmarsat

GX Jet ConneX

- Internet
- Voice
- Streaming

Iridium

- Voice
- Fax
- Datalink

iridium

SITA

VHF Datalink

SMARTSKY NETWORKS

- Internet, Voice, Streaming
- CONUS

DIRECTV Now part of the AT&T family
FOR BUSINESS
AUTHORIZED DEALER

ViaSat

Yonder
Ku-Band

- Internet
- Voice
- Streaming

Fit the Aircraft and Mission

NARROW BODY ⟷ WIDE BODY

3000 NM

SD Wi-Fi Hub

- Shorter mission
- Installation less challenging
- 1 bearer typical
- Email, voice and text most important
- Streaming media
- Operators only want to ‘buy what they use’

SDR

- Extended mission
- Installation: Avionics Cabinet
- Forced Air
- 2+ bearers typical
- Onboard content
- Imbedded Modules
  - Wi-Fi / LTE / SSD
- Operators want aircraft ‘provisioned’ for the future

Our New Brand

- Represents our evolution as a company over the past 18 years
- Beyond SATCOM
- Global Connectivity
- Company name is unchanged
- Customer and solutions focus is unchanged
- Call us SD

We've become more than SATCOM

Flightdeck datalink

3G / LTE private data network

GSM MNVO

Air to ground

Hardware

Industry training and **aeroIT** certification

Most comprehensive offerings to passengers

	Value Added Services
aeroV	Business Aviation's first VoIP service. Enables any smartphone as an extension of the aircraft phone system
globalVT	Your phone number and your phone anywhere in the world coupled with less latency and higher bandwidth
ACCELERATED BY aeroXR	Accelerates data through compression and caching, maximizing bandwidth performance
global ONE IP	A single IP address for your aircraft, allowing better security and seamless network transitions worldwide
SkyShield	Filters unwanted data to maximize bandwidth
SkyTicket	Flexible billing for individual onboard data usage

Most comprehensive offerings to flight operations

	Value Added Services
Plane Simple	Online SD account management. Provides detailed usage data to select the best rate plans to actual consumption
unity	Remotely see into LRU and pull logs or update configurations
SD Flight Tracker	Global, real-time fleet tracking Precise flight coordinates
SD FlightLogs	The first automated flight logs solution Real time, accurate data to operations reducing pilot workload and operating costs
FlightDeck freedom	Advanced datalink communications, bridging the flight deck and cabin

Mobile Training and Hospitality Lab

SD

MORE THAN JUST SATCOM

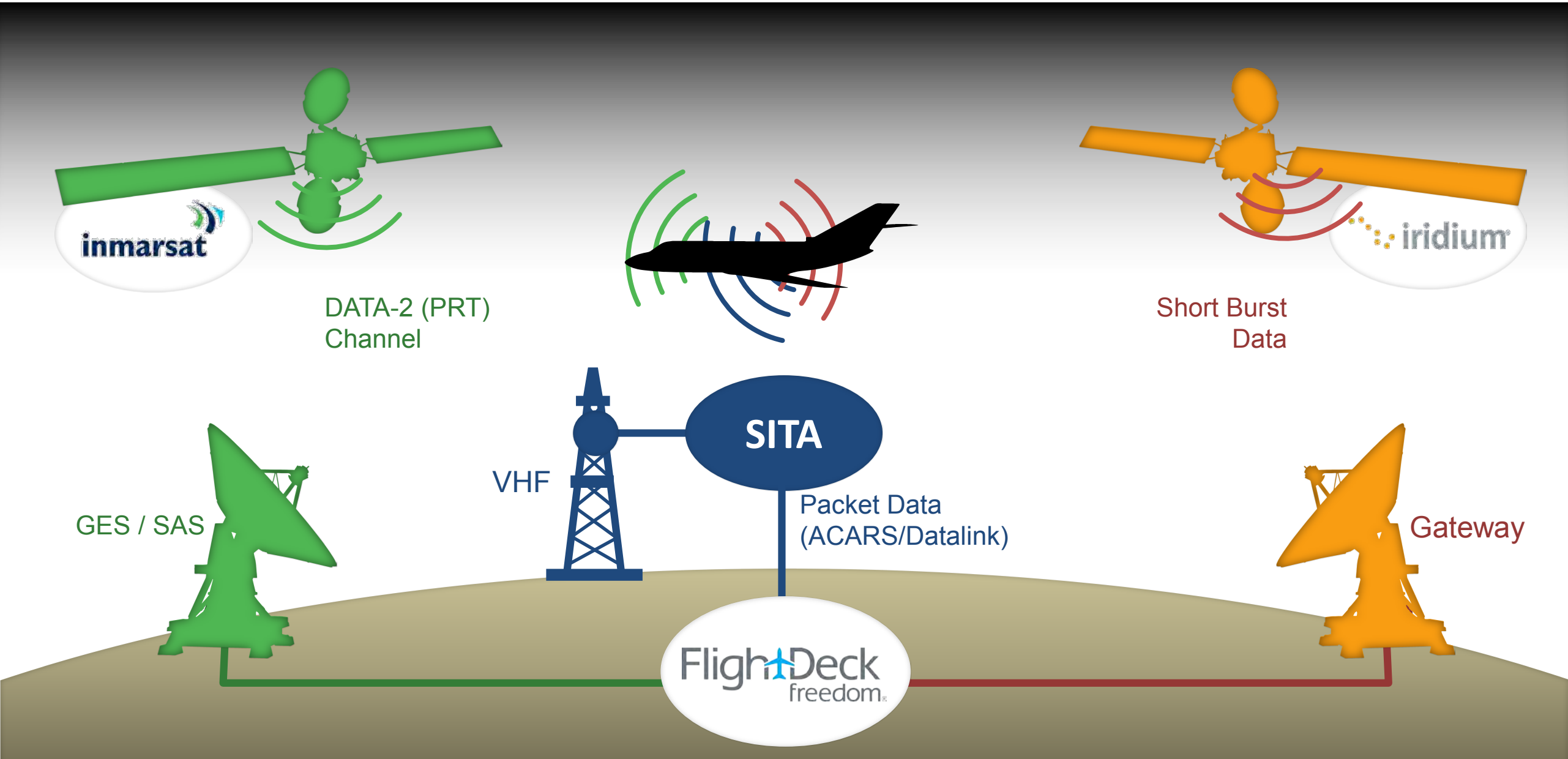
- LEED certified
- 24/7 Network Operations Center
- Testing and Validation Lab
- Research and Development Center
- Customer events
- Private Tours

SD World Headquarters

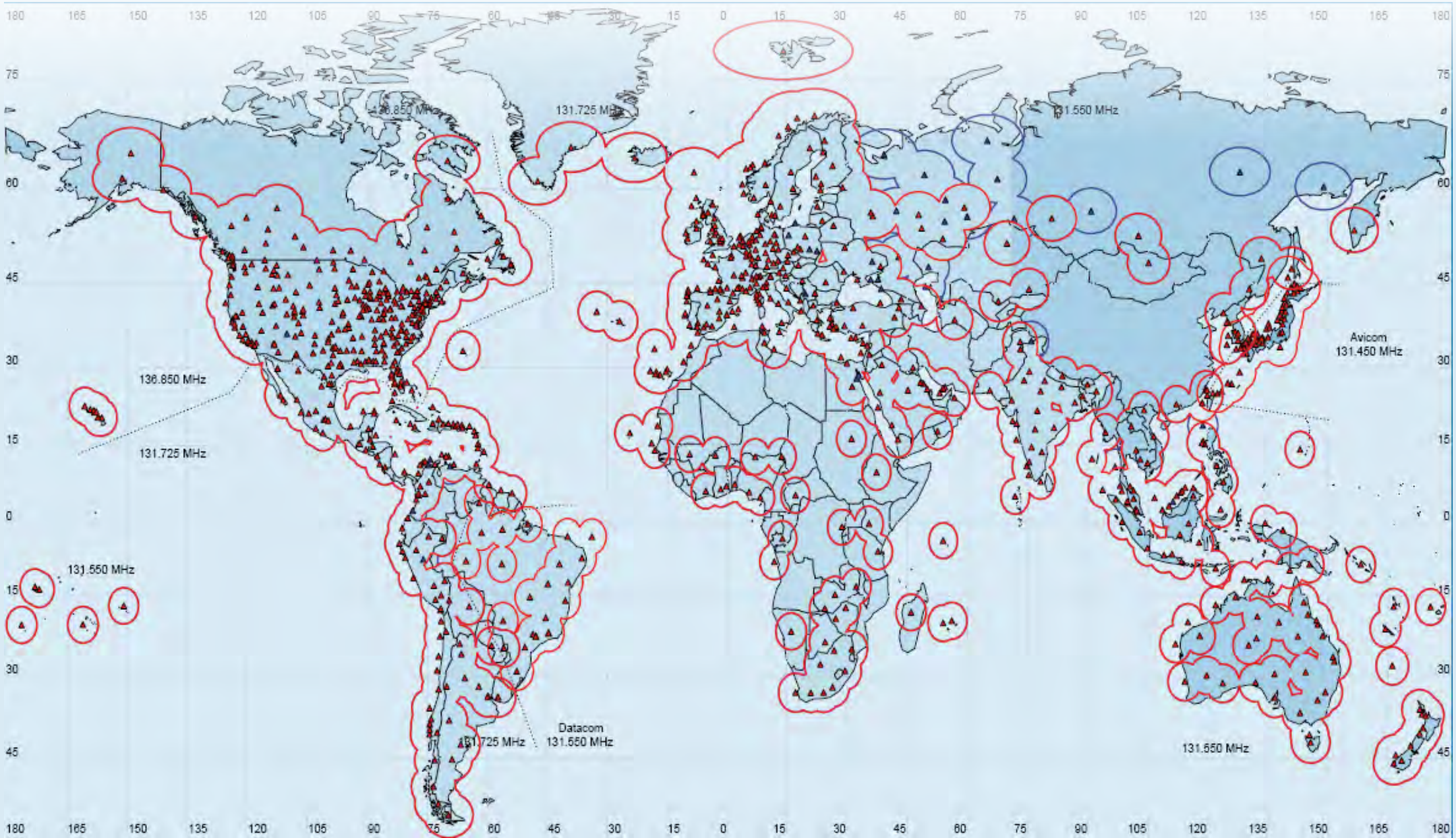
SD Secure Datacenter

FlightDeck freedom®

FlightDeck Freedom Communication Network



SITA VHF Coverage



Satellite Datalink

In addition to VHF, SATCOM is a reliable way to transmit and receive datalink communications

Transmitting or receiving over SATCOM provides:

- No additional costs to the user
- Global coverage
- Cannot be intercepted over the air

Iridium

- Supports datalink through the use of Short Burst Data (SBD)

Inmarsat

- Currently supported with I3 and I4 satellite networks
- Datalink messages go through SAS and will arrive at SD

Included Services

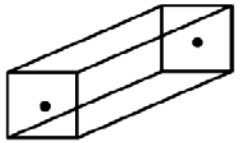
FDF Datalink Capabilities

Flight Plan Uplink to FMS	• 20+ trip planners supported • Flight plan winds
Weather	• Terminal weather • SIGMETS • Winds aloft • Graphical weather
Air Traffic Control	• Digital ATIS • Pre-departure clearances • Oceanic clearances
Movement Reports	• Takeoff / landing times
Text Messages	• To email addresses, fax • Aircraft unique email address, i.e. **N321SD@FDFMail.com**
Flight Tracking	• Weather overlay • VHF and sat coverage • Tracking via mobile device • GeoFence
Cabin Services Status	• Satellite network updates • Phone / internet usage • Outage notifications
FANS & Link 2000+	• ADS – C • CPDLC

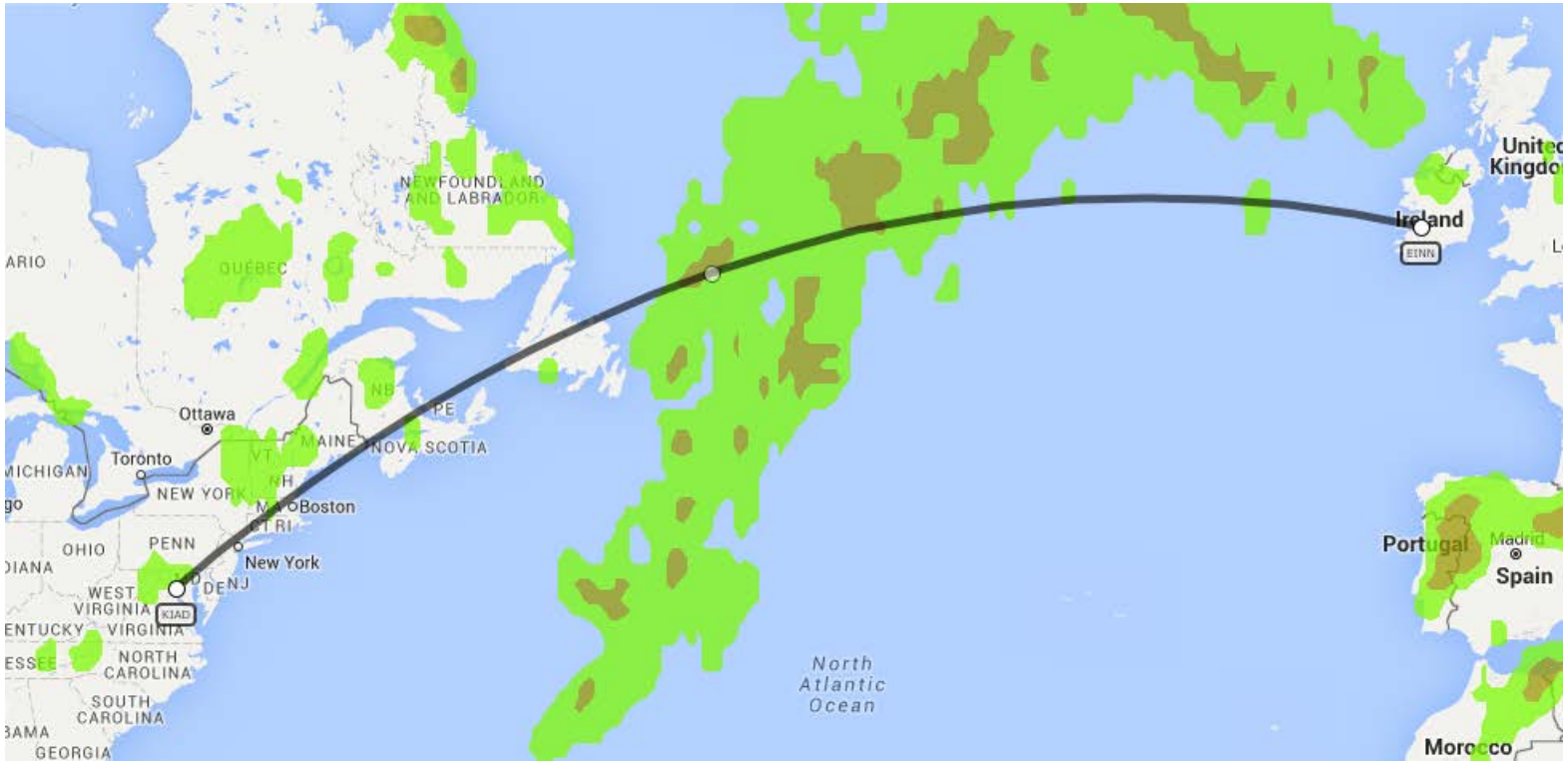
Trip Planning Providers

SD GeoServices - Route Alerts

- 3D flight route
  - +/- 1000’
  - +/- 50 miles



- Route evaluated
  - When flight plan received
  - At takeoff
  - Every 5 minutes
  - Landing ends WX monitoring

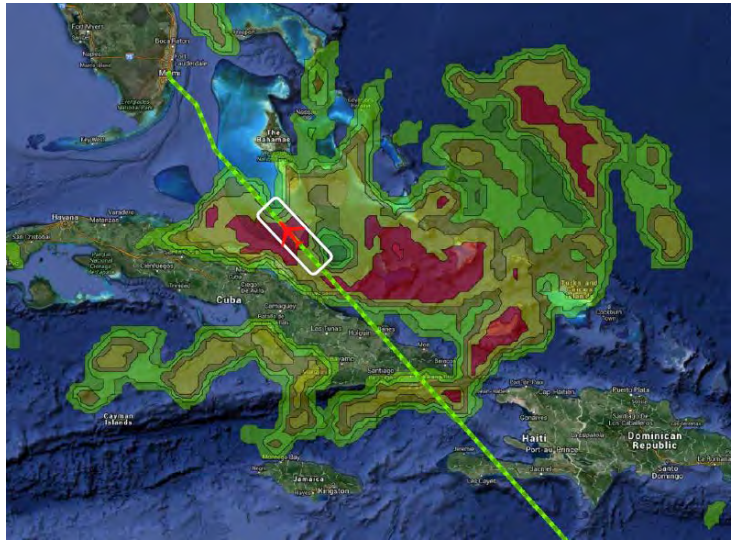


SD GeoServices - Route Alerts

ROUTE	AIRPORT	EXAMPLE

- Turbulence
- Thunderstorms
- Volcanic ash / eruption
- Convective SIGMET
- Icing
- USA TFR

- Tornado
- Severe hail
- Lightning
- Ceiling, visibility, fog
- Wind gusts



Tracking Data Sources

FAA & UK Radar Data

Coverage
- FAA radar-controlled airspace
- Canadian radar-controlled airspace

Types of data
- Takeoff / landing reports
- Filed flight plans
- Position reports every minute
- Diversions & ETA updates

FlightDeck freedom

Coverage
- VHF
- Inmarsat I3 / I4 / SwiftBroadband
- Iridium

Types of data
- Takeoff / landing reports
- Filed flight plans
- Position reports every minute
- Diversions & ETA updates

ViaSat Ku-band

Coverage
- Within Ku coverage areas

No delay in data transmission
All transmissions secure

Types of data
- Position reports every minute
- Planned route and ETE
- ETA may not be provided
- Unique SD algorithms used for takeoff / landing reports

inmarsat SwiftBroadband

Coverage
- Worldwide

No delay in data transmission
All transmissions secure

Types of data
- Position reports
- Unique SD algorithms used for takeoff / landing reports

Movement report updates

Landing Report For EASY

EASY@fdfmail.com

Sent: Mon 2/23/2015 11:37 AM

To: Nicholas Cook

Landing Report

On Time: 23-Feb-2015 1432 UTC / 23-Feb-2015 0932 LCL (9:32 AM)
23-Feb-2015 0432 (4:32 AM) Hawaii

Departure Airport: KSTP - ST PAUL DOWNTOWN-HOLMAN

Destination Airport: KIND - INDIANAPOLIS INTL

OUT: 1324
OFF: 1328
ON: 1432

FLIGHT TIME: 1+04
FUEL BURNED: 2300

In Report For EASY

EASY@fdfmail.com

Sent: Mon 2/23/2015 11:38 AM

To: Nicholas Cook

In Report

In Time: 23-Feb-2015 1437 UTC / 23-Feb-2015 0937 LCL (9:37 AM)
23-Feb-2015 0437 (4:37 AM) Hawaii

Departure Airport: KSTP - ST PAUL DOWNTOWN-HOLMAN

Destination Airport: KIND - INDIANAPOLIS INTL

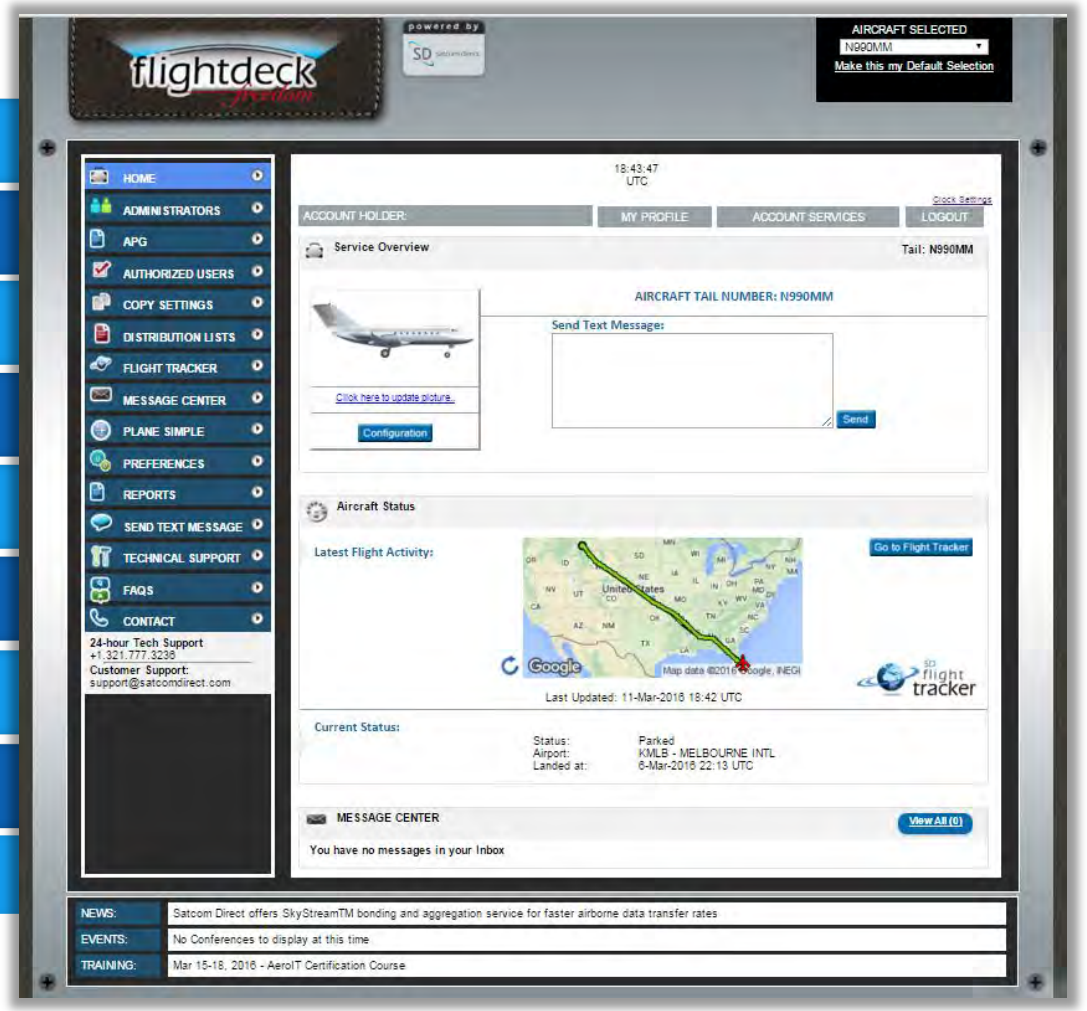
Fuel Quantity: 5400

OUT: 1324
OFF: 1328
ON: 1432
IN: 1437

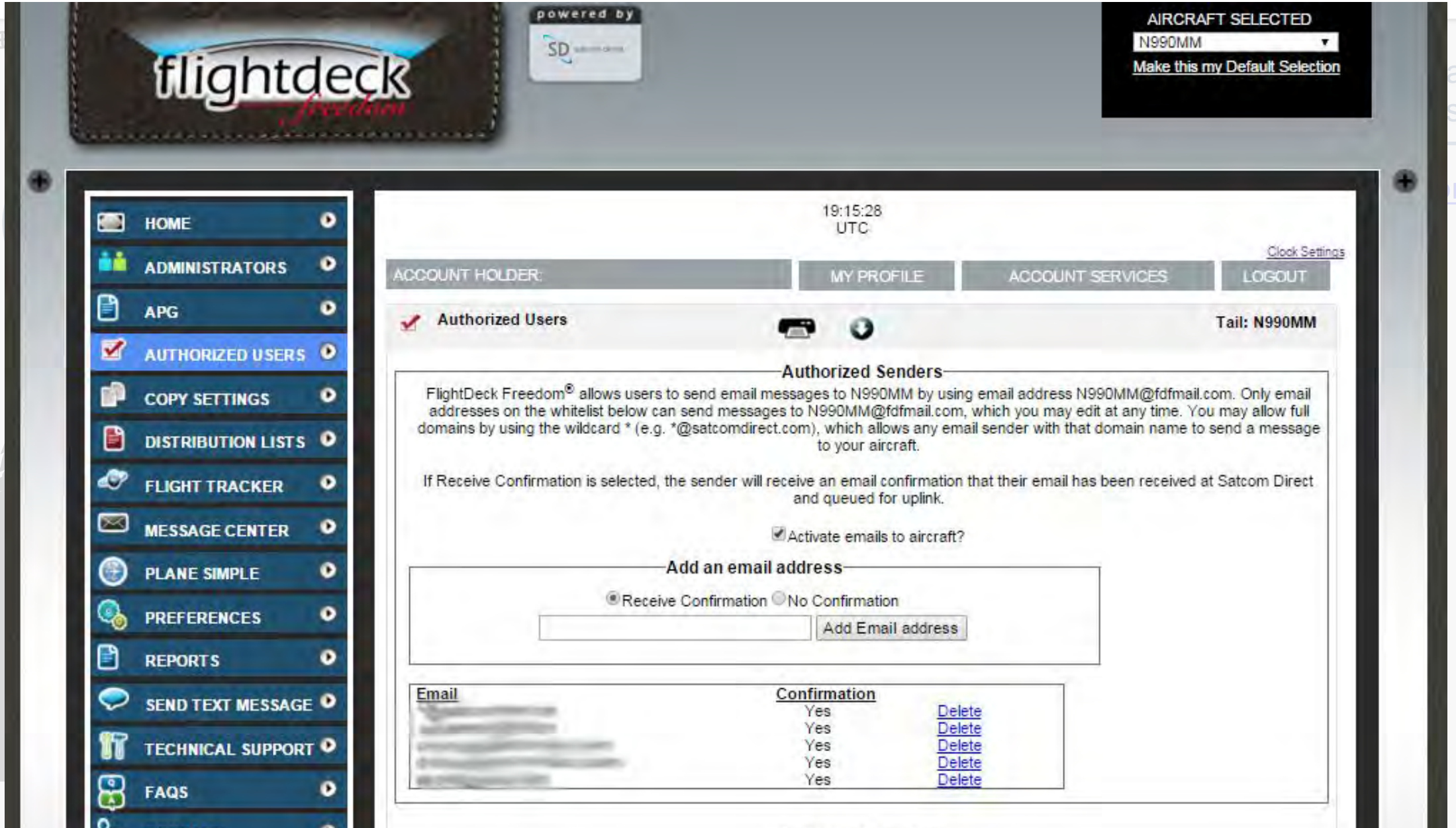
FLIGHT TIME: 1+04
BLOCK TIME: 1+13
FUEL BURNED: 2400

FlightDeck Freedom Portal

- Send message to / from aircraft
- Manage aircraft distribution lists
- Manage takeoff / landing reports
- Copy settings for fleet of aircraft
- Access to SD Global Flight Tracker
- Setup short codes
- Designate authorized users
- Specify message preferences
- Access network service notifications



Communicating with the Aircraft



SD Flight Tracker

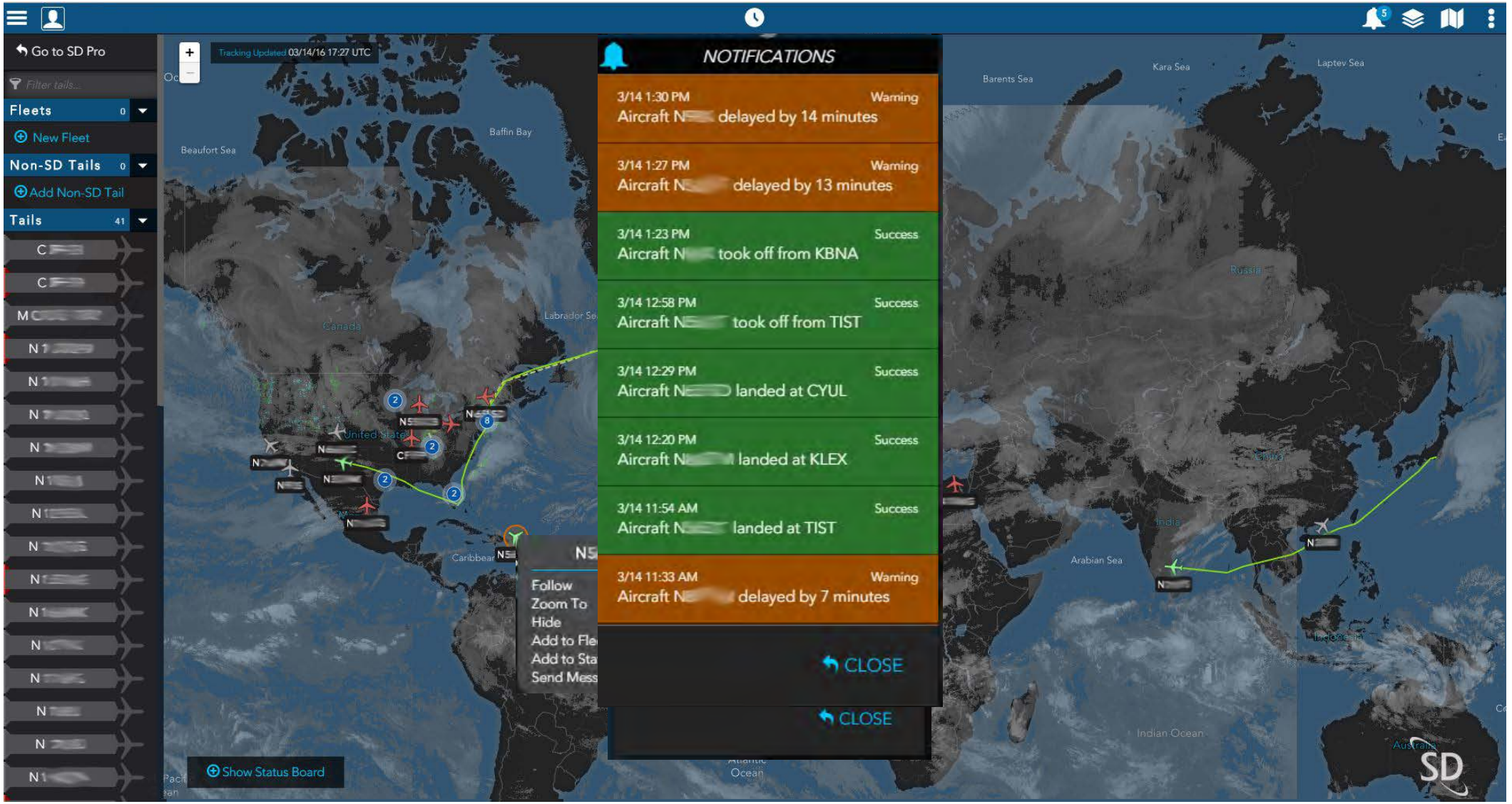
Tracking

Weather

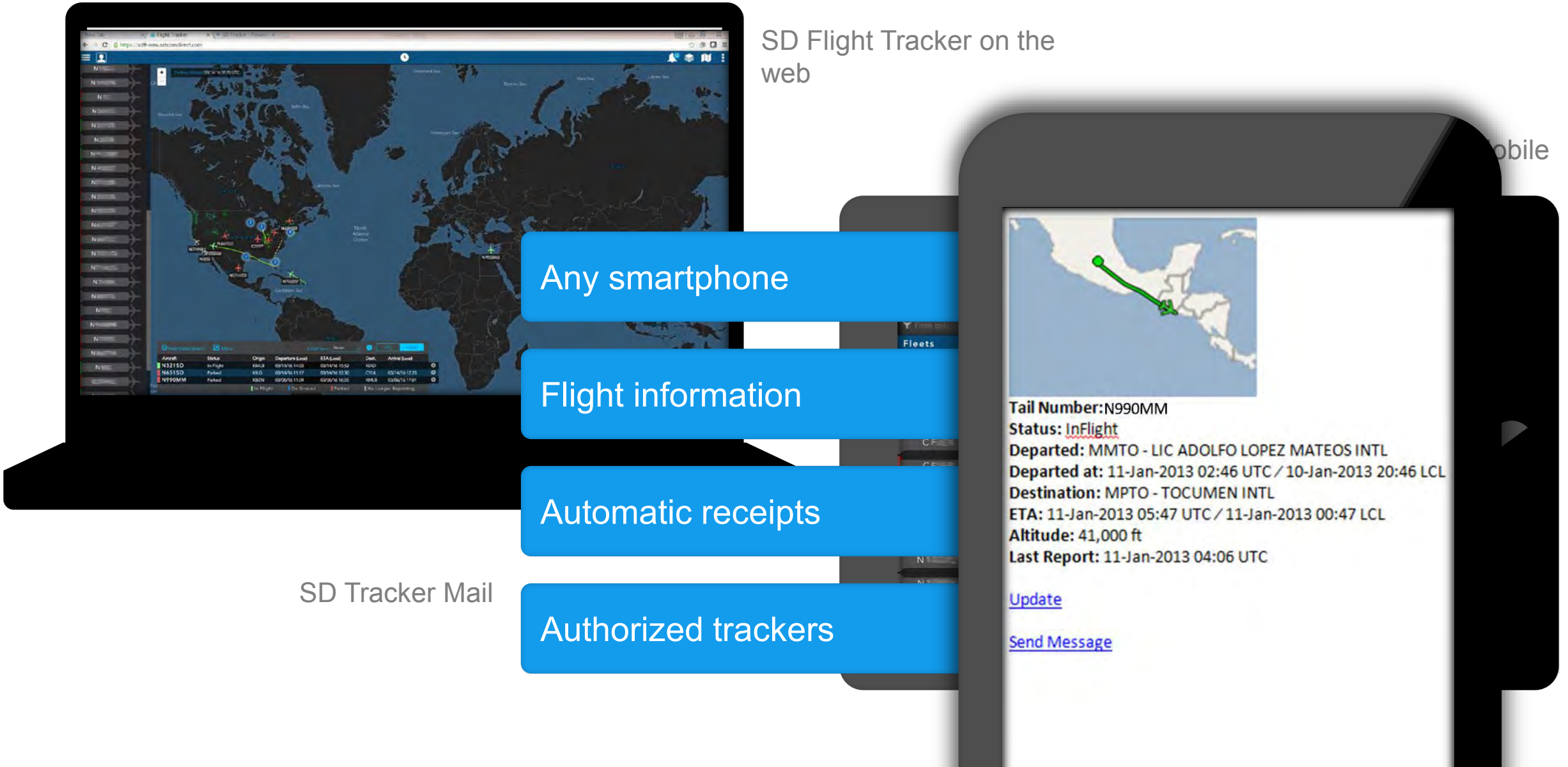
Messages

Layers

Reports

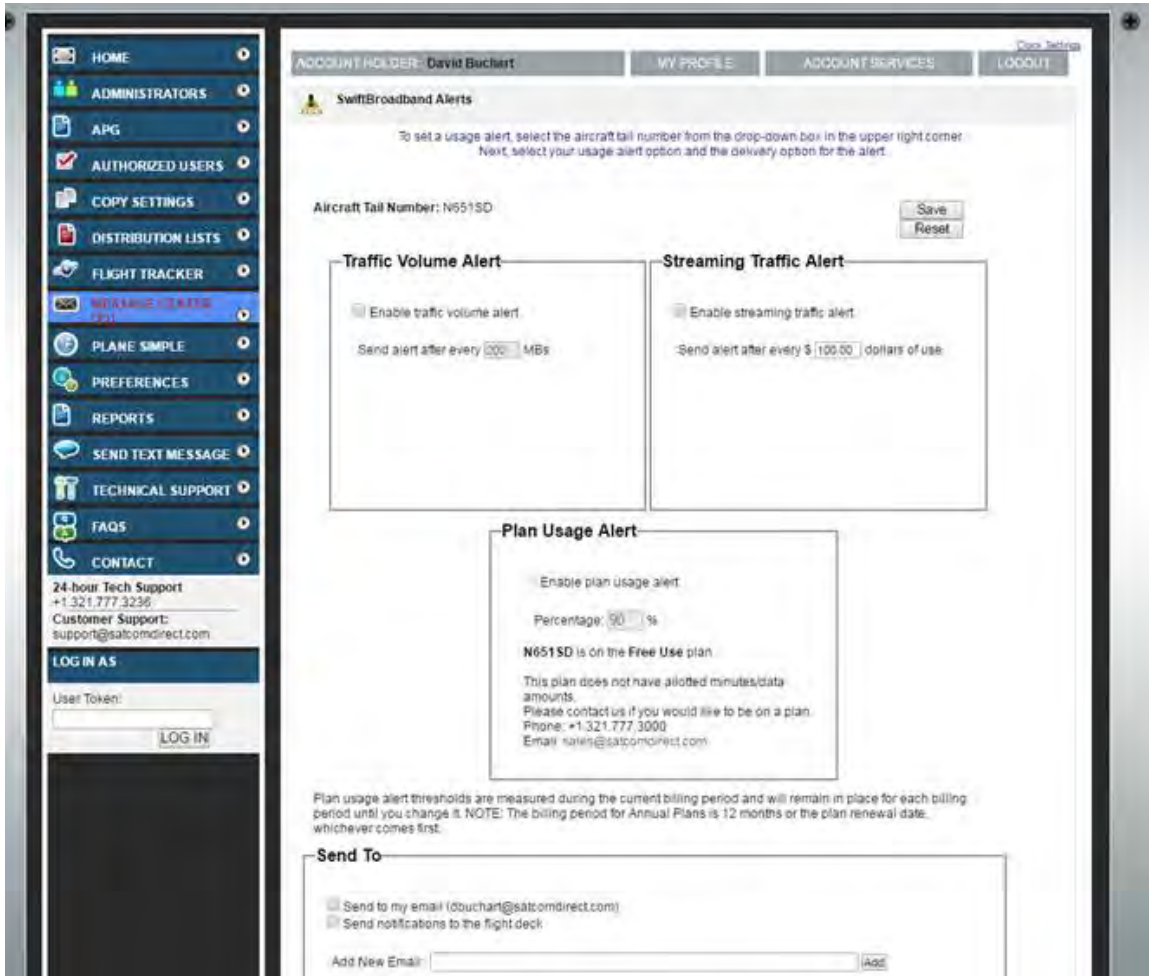


Flight Tracker Options



Monitor Cabin Services

- Monitor Cabin Services with Ops Center selections
  - Notify flight deck when a certain number of SBB MB are used
  - Notify flight deck when a certain percentage of plan is used
- Helps control cost

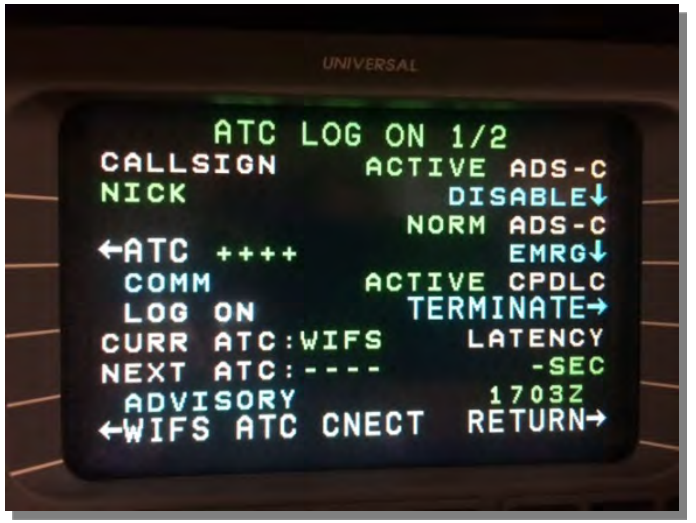


Future Air Navigation System

ADS	Allows ATC to automatically query information from FMC
CPDLC	Text messages exchange between controller and pilot

FANS Test

- System verification
- Crew familiarization
- AFN, ADS-C, CPDLC free-text messages, Altitude request
- No coordination required



FANS Reference Card

satcom direct.

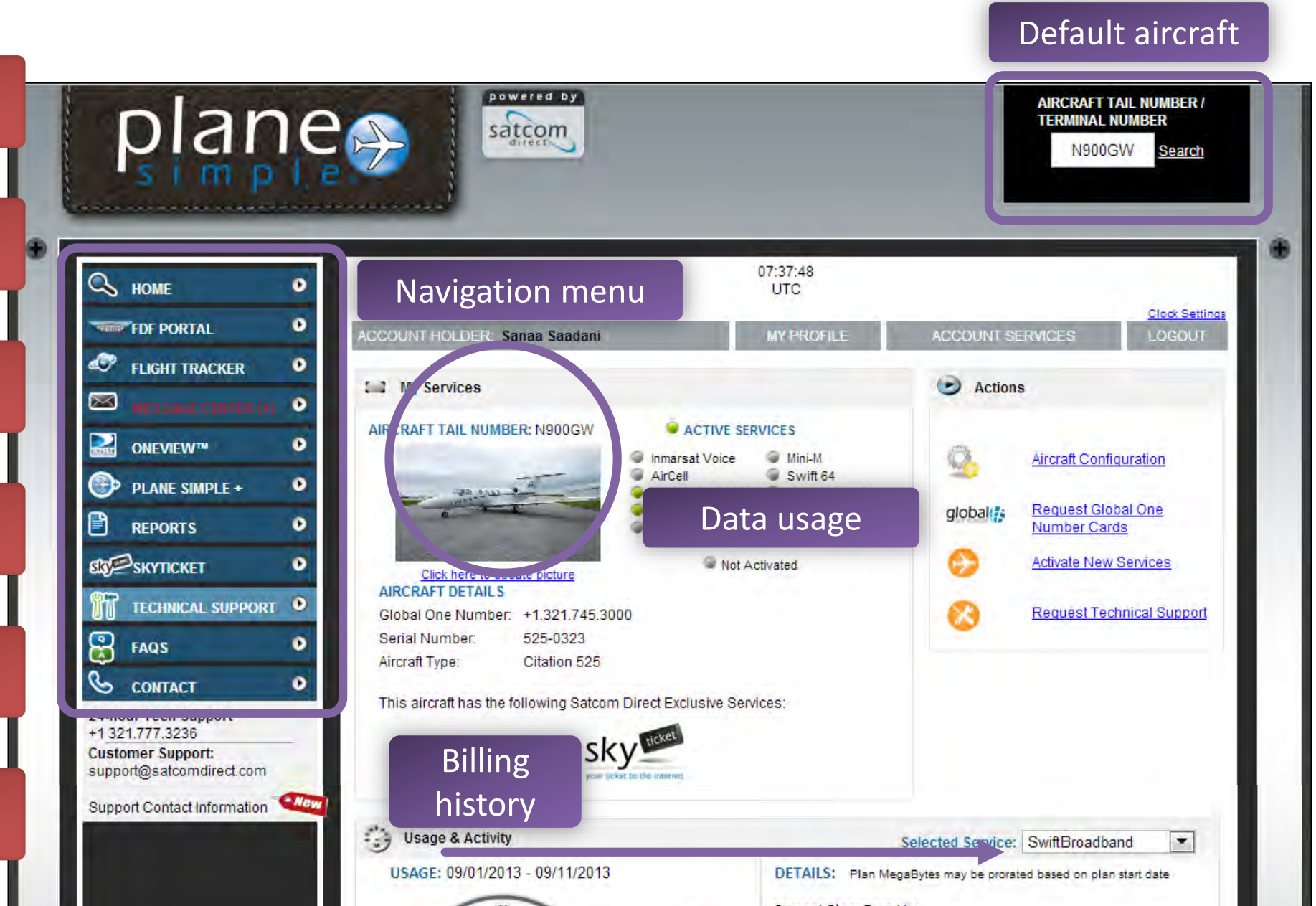
FANS/CPDLC Reference Guide

FlightDeck freedom

Country/Administration	FIR / OCA / CTA	Log On Code	FANS	ATN/CPDLC	Remarks
Algeria	Alger ACC	DAAA	Trial		8
Angola	Luanda	FNAN	Trial		8
Australia	Brisbane	YBBB	Y		3, 18
Australia	Honiara	YBBB	Y		
Australia	Melbourne	YMMM	Y		3, 18
Australia	Nauru	YBBB	Y		18
Austria	Wien ACC	LOVV		Y	
Brazil	Atlântico	SBAO	Y		
Cabo Verde	SAL Oceanic	GVSC	Y		
Canada	Edmonton FIR/CTA	CZEG	Y		
Canada	Gander OCA	CZQX	Y		1, 9
Canada	Gander FIR/CTA (Domestic)	CDQX	CPDLC Only		
Canada	Moncton FIR/CTA	CZQM	CPDLC Only		
Canada	Montreal FIR/CTA	CZUL	CPDLC Only		
Canada	Toronto FIR/CTA	CZYZ	CPDLC Only		
Canada	Vancouver FIR/CTA	CZVR	CPDLC Only		
Canada	Winnipeg FIR/CTA	CZWG	CPDLC Only		
Chad	N'Djamena	FTTT	Y		
Chile	All FIRs (SCFZ, SCEZ, SCTZ, SCIZ, SCCZ)	SCEZ	Y		
China	Beijing	ZBAB	Y		

Plane Simple

- Customer web portal
- Logon / logoff notifications
- Global One Number® configuration reports
- Call records for Inmarsat and Iridium
- Technical support tools
- Plane Simple® Plus



Outage Notifications

Service Notifications (Planned/Unplanned Outages, Service Impacts)

Automatically send service notifications to the aircraft for the following services:

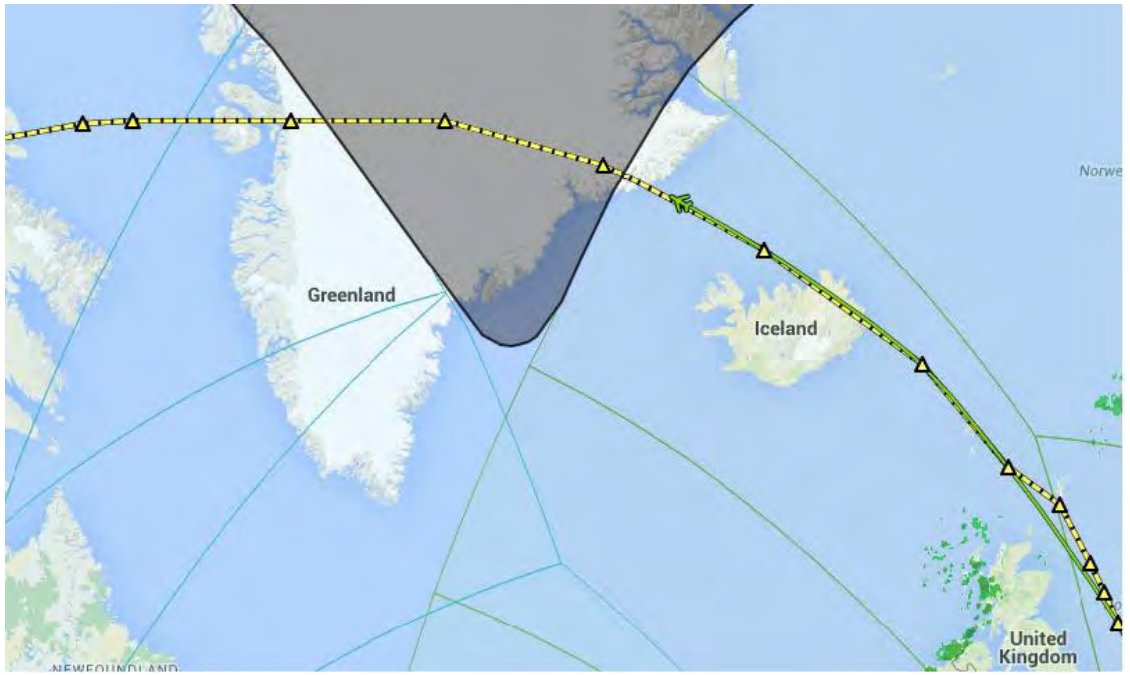
- [x] FlightDeck Freedom
- [x] Inmarsat Voice
- [ ] Iridium
- [x] MPDS
- [ ] OneView
- [x] SwiftBroadband
- [ ] Swift 64
- [ ] Yonder

SD GeoServices - GeoFence

- Uplink messages to aircraft when A/C enters a defined geographic region
  - Exit message
- Areas of VHF restriction
- Comm security issues
- Customer defined regions

Example: I4 Coverage “Greenland Gap” alert

SUBJECT: SATCOM DIRECT ALERT FOR N1234
I4 GREENLAND GAP
APPROACHING BOUNDARY OF I4 COVERAGE AREA.
SBB WILL BECOME UNAVAILABLE. ENSURE SATCOM
IS LOGGED ON TO I3 SATELLITES FOR CONTINUED
DATALINK/CPDLC USE.



John Salame – Great Lakes Regional Sales Manager
Email: jsalame@satcomdirect.com
Mobile: (321) 243-6053

AS DIVERSE AS AVIATION ITSELF

L3 Aviation Products

ACSS • Aviation Recorders • Avionics Systems • Display Systems • Electronic Systems Services

Aviation Products Sector

L-3 Aviation Products
NextGen Solutions for Business Aviation

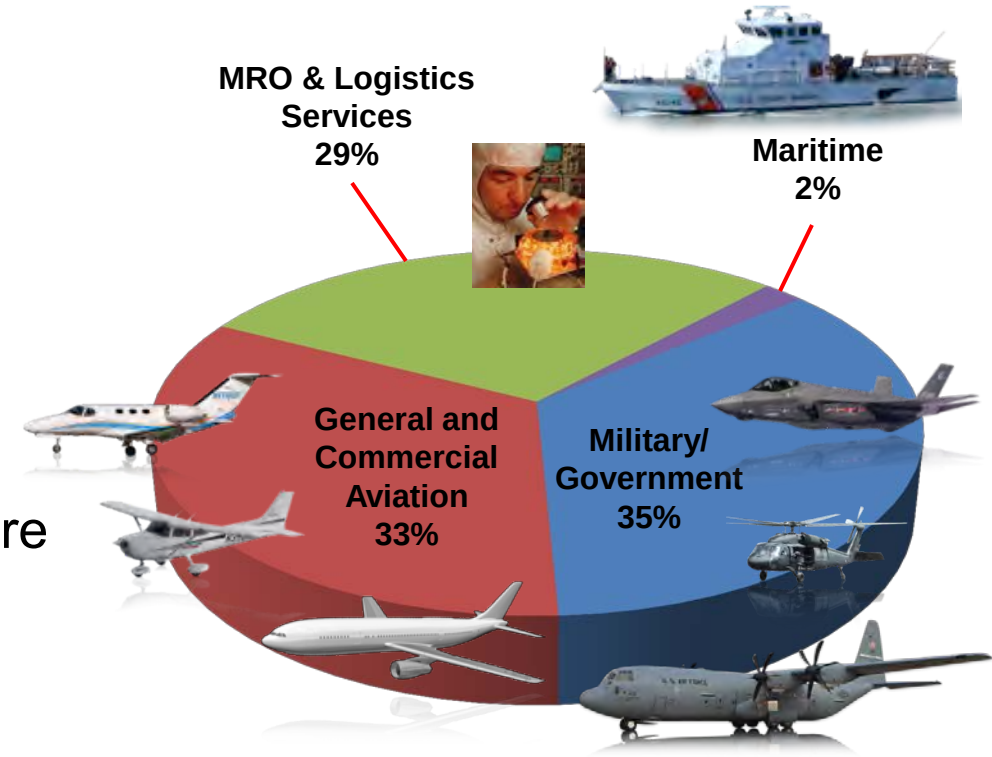
Kim Stephenson
L-3 Aviation Products
Manager, Aftermarket Programs
616-340-1093 Mobile
616-285-4458 Office
Kim.stephenson@L-3com.com

Presentation Agenda

1. L-3 Aviation Products Sector Overview
2. ADS-B/DO-260B
3. TCAS II Change 7.1
4. FANS/CPDLC Data Link Recording
5. Q & A

Aviation Products At A Glance

- Comprised of five aerospace focused business units:
  - Aviation Communication & Surveillance Systems (ACSS)
  - Avionics Systems
  - Aviation Recorders
  - Display Systems
  - Electronic System Services
- ~1,500 employees
- 13 locations worldwide
- Market Diverse
- Actively investing for the future

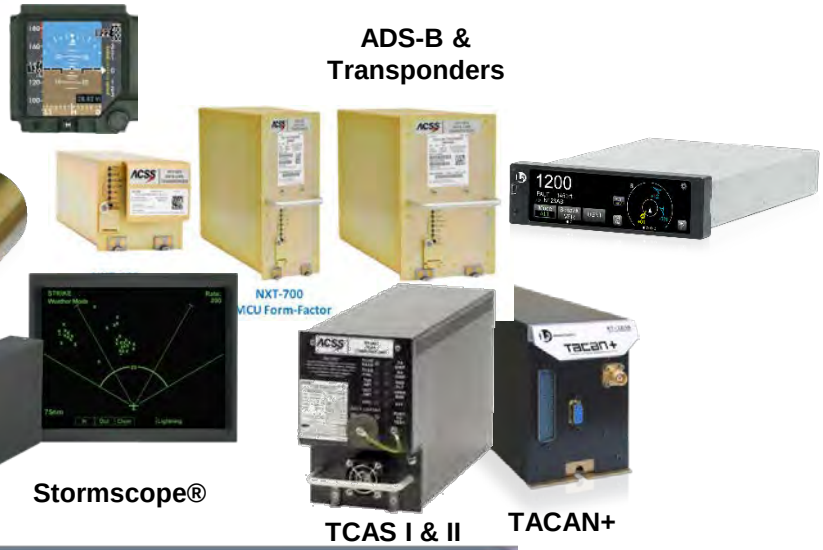


Aviation Products Sector

Commercial and Military Aviation Solutions.

Aviation Products At A Glance

Aviation Products Sector



Integrated Avionics

Flight Displays / Processors

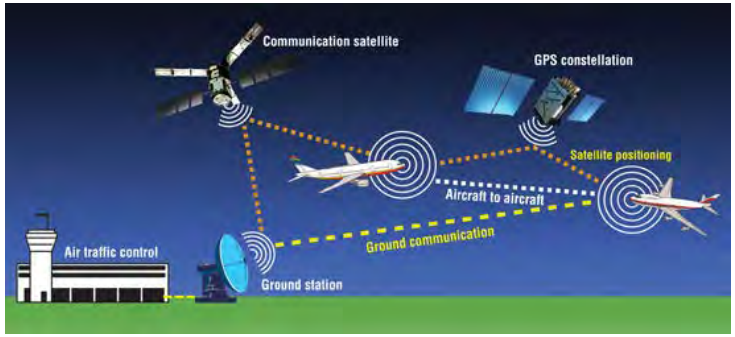
Flight Data & Cockpit Voice Recorders

Avionics/Electronics Repair & Overhaul

LRUs & Controllers

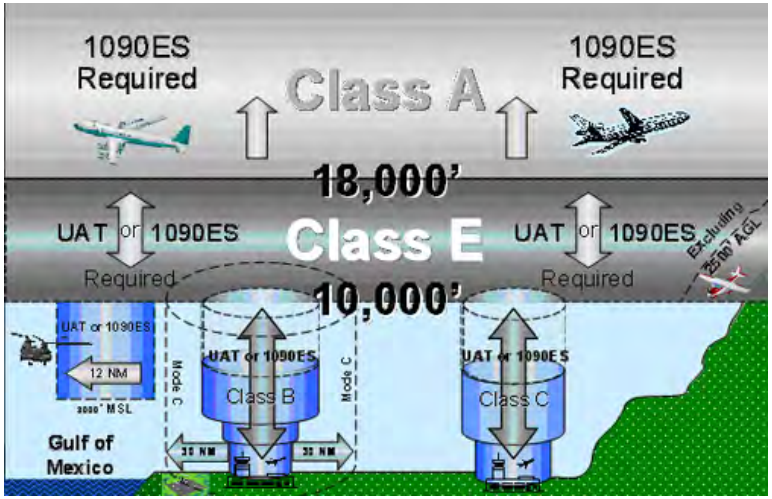
ADS-B Overview

- ADS-B, which consists of two different services, "ADS-B Out" and "ADS-B In", will be replacing radar as the primary surveillance method for controlling aircraft worldwide. In the United States, ADS-B is an integral component of the NextGen national airspace strategy for upgrading/enhancing aviation infrastructure and operations. Mandated equipage date of January 1, 2020.
  - ***Automatic*** - Periodically transmits information with no pilot or operator input required
  - ***Dependent*** - Position and velocity vector are derived from the Global Positioning System (GPS)
  - ***Surveillance*** - A method of determining position of aircraft, vehicles, or other asset
  - ***Broadcast*** - Transmitted information available to anyone with the appropriate receiving equipment



ADS-B Mandate Schedule

- DO-260B Mandates
  - Australia - December 2013 (Operating above FL 290)
  - Europe – June 8, 2016 New production aircraft*
  - Europe – June 8, 2020 Retrofit aircraft*
    - *Amendment to regulation No 1207/2011, approved Aug 6, 2014
  - United States, Jan 1, 2020
- Current Deployments
  - Australia (Operating above FL 290)
  - Indonesia (Operating above FL 290)
  - Singapore (Operating above FL 290)
  - Canada – Hudson Bay
  - USA - Gulf Of Mexico



ADS-B Benefits

- Improved safety and efficiency for ADS-B equipped aircraft operating within the worldwide airspace system (reduced runway incursions, continuous routes to flight levels, reduced separation)
- No subscription fees for ADS-B, ADS-R, TIS-B, or FIS-B services
- See what ATC sees with access to traffic information from TIS-B, ADS-R, and ADS-B
- Flight Information Service - Broadcast (FIS-B) transmits flight information and weather information such as:
  - NEXRAD
  - METARs
  - TAFs
  - Winds Aloft Forecasts
  - Temps Aloft Forecasts
  - TFRs
  - NOTAMs
  - AIRMETs
  - SIGMENTs

L-3 ADS-B Solutions

NXT-600
"RCZ" Form-Factor

NXT-700
2MCU Form-Factor

NXT-800
4MCU Form-Factor

Model	NGT-9000	NXT-600	NXT-700	NXT-800
Market	Business and Military	Business, Regional, and Military	Business, Regional, and Military	Air Transport
Size	5.75"X1.5"X8.5"	RCZ-852 and XS-950	¼ ATR Short	4MCU
Weight	3.0 lbs	5.0 lbs	5.5 lbs	8.6 lbs (AC) 7.8 lbs (DC)
ADS-B Compliance	DO-260B MOPS DO-282B MOPS (UAT)	DO-260B MOPS	DO-260B MOPS	DO-260B MOPS

Aviation Products Sector

Commercial and Military Aviation Solutions.

L-3 Lynx ADS-B Solution

LYNX
MULTILINK SURVEILLANCE SYSTEM

- In February 2015, L-3 introduced an affordable, innovative ADS-B and transponder product line to address the current and future needs of Part 23, 25, 27, and 29 aircraft.
  - Solutions address ADS-B needs across the market
  - FAA TSO authorized
  - AML/STC is in place for Part 23 Class I, II, and III aircraft and Part 27 Helicopters
  - Presently working on STCs for Part 25 and 29 aircraft (although STC may not be needed per FAA memo and approved pairing is in one box)
    - Sub-TCAS II aircraft
  - Solutions meet the FAA's 2020 ADS-B Out mandate and provide ADS-B users with valuable ADS-B in capabilities

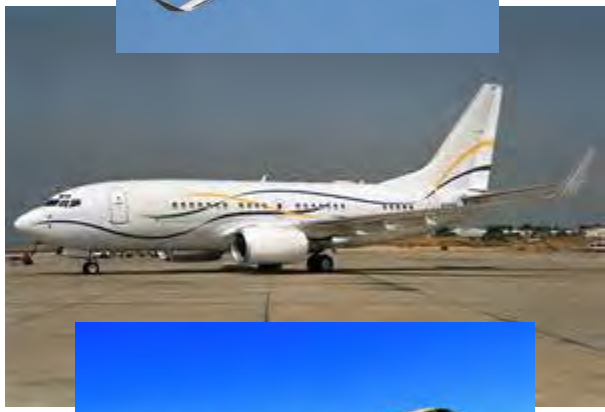
Lynx - One Box Solution

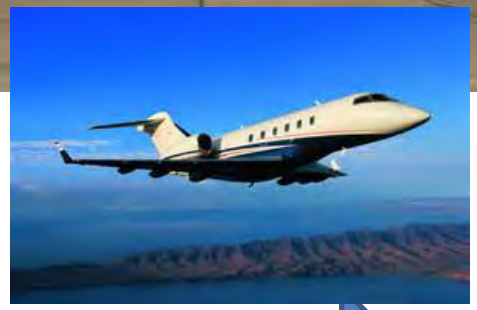
- Integrates key elements for easy installation
  - ADS-B In & Out
  - Mode S ES
  - UAT In
  - Embedded GPS
- Reduced Weight
- Lower Cost

L-3 Lynx ADS-B Solution

- NGT-9000 and NGT-9000R
  All in one approach:
  - Internal GPS/WAAS module
  - Mode S ES In/Out module
  - UAT In/Out module
  - Resistive touch screen interface
  - Options
    - Active Traffic TAS
    - Remote mount
    - Diversity capable
    - WiFi Capable
    - Class B TWAS
    - ATAS (ADS-B TAS)

Replaces many SkyWatch and Landmark TWAS Processors saving weight





Lynx® and NXT Capability

NGT-9000
ADS-B Wx & Traffic Display

NGT-9000 +
Active Traffic (TAS), TWAS, Diversity, ATAS

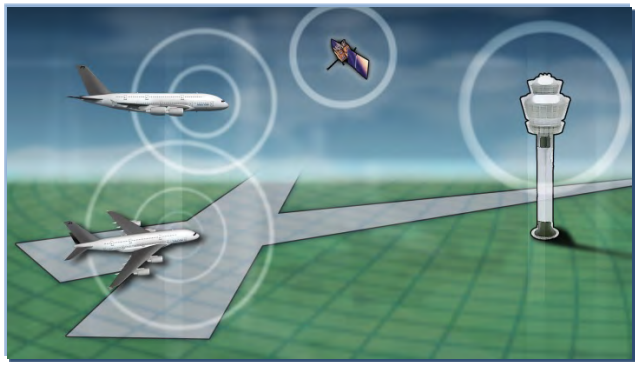
NXT-600
"RCZ" Form-Factor

NXT-700
2MCU Form-Factor

NXT-800
4MCU Form-Factor

ADS-B Out Mode S Transponders

- Certified DO-260B ADS-B Out Transponder
  - Meets 2020 Mandate for ADS-B Out capability
  - Elementary & enhanced surveillance
  - Interfaces with all ARINC 735 standard TCAS II
- Commercial Mode S Transponder with IFF for Military applications
  - Modes 1, 2 and 4
- Available as stand-alone product or integrated with other functions



NXT-600
"RCZ" Form-Factor

NXT-700
2MCU Form-Factor

NXT-800
4MCU Form-Factor

Ready for Worldwide ADS-B Mandate

NXT-600 & 700

- ADS-B Compliant - The higher level of ADS-B Out (DO-260B) transmission includes precise flight data, including position, speed and intent of the aircraft.
  - DO-260B (FAA) and DO-181E (EASA) compliant
  - The NXTs are ICAO Level III transponders, delivering the latest functionality required for ICAO ACAS II mandate compliance; European Elementary Surveillance (ELS) and Enhanced Mode S Surveillance (EHS), Downlink of Aircraft Parameters (DAPs) and ADS-B 1090ES extended squitter.
- Software upgrades to the NXTs are performed through on-wing software loads.
- This configuration is compatible with current retrofit Traffic Collision Avoidance System II, 7.1 (TCAS II) systems.

NXT-600 & 700

- Key Features & Benefits
  - DO-260B compliant to meet FAA/EASA NextGen mandates, transmitting more precise position, speed and intent data
  - Elementary & Enhanced Mode S surveillance compliant
  - Maximum reliability with built-in test and self-test capabilities
  - Compatible with all ARINC 735B/735A/735 TCAS II systems.
  - Interoperability testing to date include the following…
    - ACSS TCAS 3000SP™, TCAS 2000™, T2CAS® and T3CAS™
    - RCI TTR-920/921, TTR-2100, TTR-4000
    - HI TPU-67A & B, TPA-100B, TPA-100 A and B
  - Interfaces with TPU-67A & B TCAS II Processors (KFS-578A/PS-578A/PS-550 Control)
    - Or CD-674C control
    - Or CTA-81A/81D Control
    - Or RMS-555 Radio Management System

NXT-600

- NXT-600 Compatible Platforms
  - Currently, Dash-8, Q-400
  - Others….

NXT-700

- Designed to be a form-fit replacement for the MST-67A
  - ¼ ATR short form
  - Operator can utilize existing tray
  - Compatible with current retrofit TCAS II, 7.1 systems
  - Can use existing mounting rack and connectors
  - No additional control head required

NXT-700

- Features
  - Interfaces with TPU-67A TCAS II Processors (KFS-578A/PS-578A/PS-550 Control)
  - Or CD-674C control
  - Or CTA-81A/81D Control
  - Or RMS-555 Radio Management System
  - Interfaces with Rockwell Collins TTR-921, TTR-2100 TCAS II Processors

NXT-700

- An approved Model List Supplemental Type Certificate (AML STC) with the FAA, TCCA and EASA will be offered as a certification path.
- NXT-700 Compatible Platforms
  - Beechcraft Hawker 125-400/600/700, Early Series
  - Beechcraft Hawker 400 SP/ (Beechjet), Early 400 Series only
  - Bombardier CL601-3A/R
  - Dassault Aviation Falcon 50, 20, 900, 900B and Falcon 10
  - Gulfstream III and IIB
  - Hawker Beechcraft 750/950
  - IAI Westwind 1124
  - Learjet 35, 36, 35A and 36A
  - Textron Aviation Inc. Citation Jet, Ultra, VII and 550
  - Others….


NOW
IS A
GOOD TIME
FOR TCAS
CHANGE
7.1
Our TCAS Platforms:
Citation Mustang
Citation Sovereign
Citation X
Citation XLS
Embraer Legacy
Embraer Phenom
Falcon 2000
Falcon 7X
Falcon 900
Global 5000
Gulfstream 350
Gulfstream 450
Gulfstream 500
Gulfstream 550
Hawker Horizon
Learjet 40
Learjet 40XR
Learjet 45
Learjet 45XR
L3
Aviation Products

TCAS II Change 7.1 Overview

- Change 7.1 provides specific, clear and concise RA commands resulting in faster reaction time improving avoidance performance.
  - Changes the current TCAS II aural warning from "Adjust Vertical Speed, Adjust" to "Level Off, Level Off."
  - Introduces improvements to the current reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RA's.
- Change 7.1 reduces the probability of a mid-air collision in European Airspace from 1 in every 3 years to 1 in every 12 years
- Easy Installation - Change 7.1 is most likely a wing loadable software upgrade for most
- Change 7.1 Mandates - If you intend to fly your aircraft in European or Hong Kong Airspace, you must comply with the Change 7.1 Mandate.
  - ***Retrofit* Dates To Remember…**
    - **Europe (EASA) – December 1, 2015 – NOW REQUIRED**
    - **ICAO Countries- January 1, 2017**
    - All civil turbine powered transport aircraft with more than 19 passenger seats (or MTOW above 5,700 kg/12,566 lbs)

Deployment & Part Numbers

Description	Change 7.1 Part Number
TCAS II	4066010-914
TCAS 2000	7517900-10020, -55020, -71020
TCAS 2000 (Military Version)	7517900-56120
TCAS 2000 +MASS	7517900-20003, -65003
T2CAS (Non-Airbus)	9000000-10309, -55309, -20309
T2CAS (Airbus)	9000000-11414
T2CAS + MASS	9000000-TBD
TCAS 3000	9003000-10005, -55005, -65005
TCAS 3000 SP	9003500-10905, -55905, -65905
TCAS 3000 SP with A3 Sensitivity	9003500-12907, -58907, -68907

FANS (CPDLC) Overview

- CPDLC “Controller Pilot Data Link Communication”
  - A component of Future Air Navigation System (FANS)
  - Digital text-based communication between Air Traffic Control and Pilots
  - Currently used in areas where VHF and HF communications are unavailable or unreliable
    - Specific Oceanic Routes
    - Isolated Land Routes
  - Works with different datalink networks, equipment types, and service providers:
    - Iridium, Inmarsat, VHF Data Link (VDL Mode 2)
  - When a FDR & CVR is required and when CPDLC capable data link systems are installed, message-set data must recorded

CPDLC Data Recording Requirements

- When is data link recording required?
  - FAA
    - "All airplanes or rotorcraft required by this section to have a cockpit voice recorder and a flight data recorder, that install datalink communication equipment on or after December 6, 2010 (FAR 135.151h) or April 6, 2012 (FAR 91.609j), must record all datalink messages as required by the certification rule applicable to the aircraft."
      - If datalink system is installed on or after the above dates, the CVR is required to perform recording of datalink messages
      - Reference Advisory Circular AC20-160 for means of compliance and message-set requirements
      - Rule clarification - FAA Info Document # 10016

CPDLC Data Recording Requirements

- When is data link recording required?
  - EASA
    - Airplanes first issued with an individual certificate of airworthiness (C of A) on or after April 8th, 2014 that have the capability to operate data link communications and are required to be equipped with a CVR, shall record data link communications on a recorder, as defined by EASA CAT.IDE.A.195
    - Helicopters first issued with an individual certificate of airworthiness (C of A) on or after April 8th, 2014 that have the capability to operate data link communications and are required to be equipped with a CVR, shall record data link communications on a recorder, as defined by EASA CAT.IDE.H.195
    - Rules apply to forward-fit only, no current requirement for retrofit

L-3 CPDLC Data Recording Solutions

The FA 2100 and FA5000 series solid state recorders are capable of OMS and CPDLC data link recording:

Model	FA2100 Series SSCVR	FA5000 Series SSCVDR
Type	Solid State Cockpit Voice Recorder	Solid State Cockpit Voice and Data Recorder
Recording Time	120 minutes audio 120 minutes data link	120 minutes audio 120 minutes data link
Channels	4 channels audio	4 channels audio
Data Link Capability	**ARINC 429 OMS/CPDLC**	**ARINC 429 OMS/CPDLC**
Regulatory	EUROCAE MOPS ED-56A	EUROCAE MOPS ED-112
Certification	TSO-C123a	TSO-C123b
Power	115 VAC / 28 VDC	115 VAC / 28 VDC

L-3 Recorders on Commercial and BGA Platforms

CUSTOMER	AIRFRAME
AIRBUS	A300 / A330 / A340 A320 Family, A350 A380
ATR	42 / 72
AVIC	ARJ 21
BEECHCRAFT	**C 90 / 200 / 350 /** **B1900** **400 / PREMIER** **HAWKER**
BOEING	737 / 757 / 767 / 747 / 777 / BBJ
BOMBARDIER **CRJ**	100 / 200 / 700 / 900 CONTINENTAL / **604** **LEAR 31 / 45 / 60 / 85**

CUSTOMER	AIRFRAME
CESSNA	**ALL TYPES** **CITATION X**
DORNIER	DO 228/328
EMBRAER	135 / 145 / 170 /190 **PHENOM / MLJ**
GULFSTREAM	**G IV / G V**
HARBIN	Y-12
PIAGGIO	**P-180**
PILATUS	**PC 7 / 9 / 12 / 21**
SUKHOI	SUPERJET 100

90 Day Under Water Locator Beacons

- The FAA implemented TSO C-121b and is expected to withdraw TSO C-121 and 121a at the end of 2015
  - This change requires all newly manufactured Underwater Locating Beacons/Devices (ULB/Ds) to comply with a 90-day minimum duration.

- EASA is considering a Notice of Proposed Amendment that would require operators to transition to the 90-day variant as well.
  - We believe EASA will adopt the recommendation in 2016, and require compliance by 2018.

- L-3 has already implemented the 90 day beacon for Forward Fit Recorder Solutions

- L-3 has developed a 90-day retrofit kit for each of our fielded products which enable customers to transition their recorders to the new standard in the field.
  - Service Information Letter **SIL L-3AR 2015-0005**

Questions?

Garmin Next Gen Solutions

GARMIN®

Special Thanks

Duncan Aviation

DUNCAN AVIATION®

Today's Agenda

- Garmin Overview
- Current Garmin Overview
- Garmin Part 25 Solutions
  - New Policy Memo changes
- Questions
- Closing Thoughts

Aviation

Research & Development

Garmin International
Olathe, KS

Garmin AT
Salem, OR

Garmin Corporation
Taipei, Taiwan

Garmin
Chandler, AZ

Garmin DCI
Chanhassen, MN

Garmin
Wichita, KS

GARMIN

Compliance for Garmin Flight Decks

- **G5000**
  - Cessna Citation X+ (FANS 1/A, CPDLC, ADS-B)
  - Cessna Citation Sovereign+ (FANS 1/A, CPDLC, ADS-B)
  - Cessna Citation Latitude (FANS 1/A, CPDLC, ADS-B)
  - Bombardier Learjet 75 (CPDLC, ADS-B)
  - Bombardier Learjet 70 (CPDLC, ADS-B)
  - Beechjet 400A/Hawker 400XP (ADS-B)

- **G3000**
  - Citation CJ3+ (CPDLC, ADS-B)
  - Citation CJ2+ Alpine Edition (CPDLC, ADS-B)
  - Honda HA420 "HondaJet" (CPDLC, ADS-B)
  - Embraer Phenom 300 (CPDLC, ADS-B)

- **G1000**
  - Cessna Citation CJ (ADS-B)
  - Cessna Citation Mustang (ADS-B)
  - Embraer Phenom 100 (ADS-B)
  - Beechcraft King Air C90, B200, B300/350 (ADS-B)

GARMIN

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Garmin Part 25 ADS-B Solutions

Program Goals

- Address market need for minimally invasive, lower-cost ADS-B solution for Part 25 aircraft.
- Leverage existing TSO'd/STC'd equipment from Garmin's ADS-B product portfolio.
- Minimize cost and installation time through integration with existing non-Garmin avionics where able.

GARMIN

Garmin Part 25 ADS-B Solutions

Flight Stream 210

- TargetTrend™
- AHRS information
- Safe Taxi
- Nexrad

Garmin Part 25 ADS-B Solutions

- **Gulfstream G150 and G200**
  - Available now from Gulfstream Factory Service Centers
  - Available soon from Duncan Aviation

Garmin Part 25 ADS-B Solutions

- Hawker 750, 800A/XP, 850/900XP, 1000 (Elliott Aviation)
  - Certification Complete
  - Collins equipped aircraft are initial certification aircraft, including Pro Line 21
    - Honeywell-equipped aircraft to follow immediately

Garmin Part 25 ADS-B Solutions

- Cessna Citation 550/560 (SPZ-500 only) (Columbia Avionics)
  - STC currently available for non-TCAS II aircraft.
  - STC covers non-Primus aircraft (no Ultra, no Encore)

Garmin Part 25 ADS-B Solutions

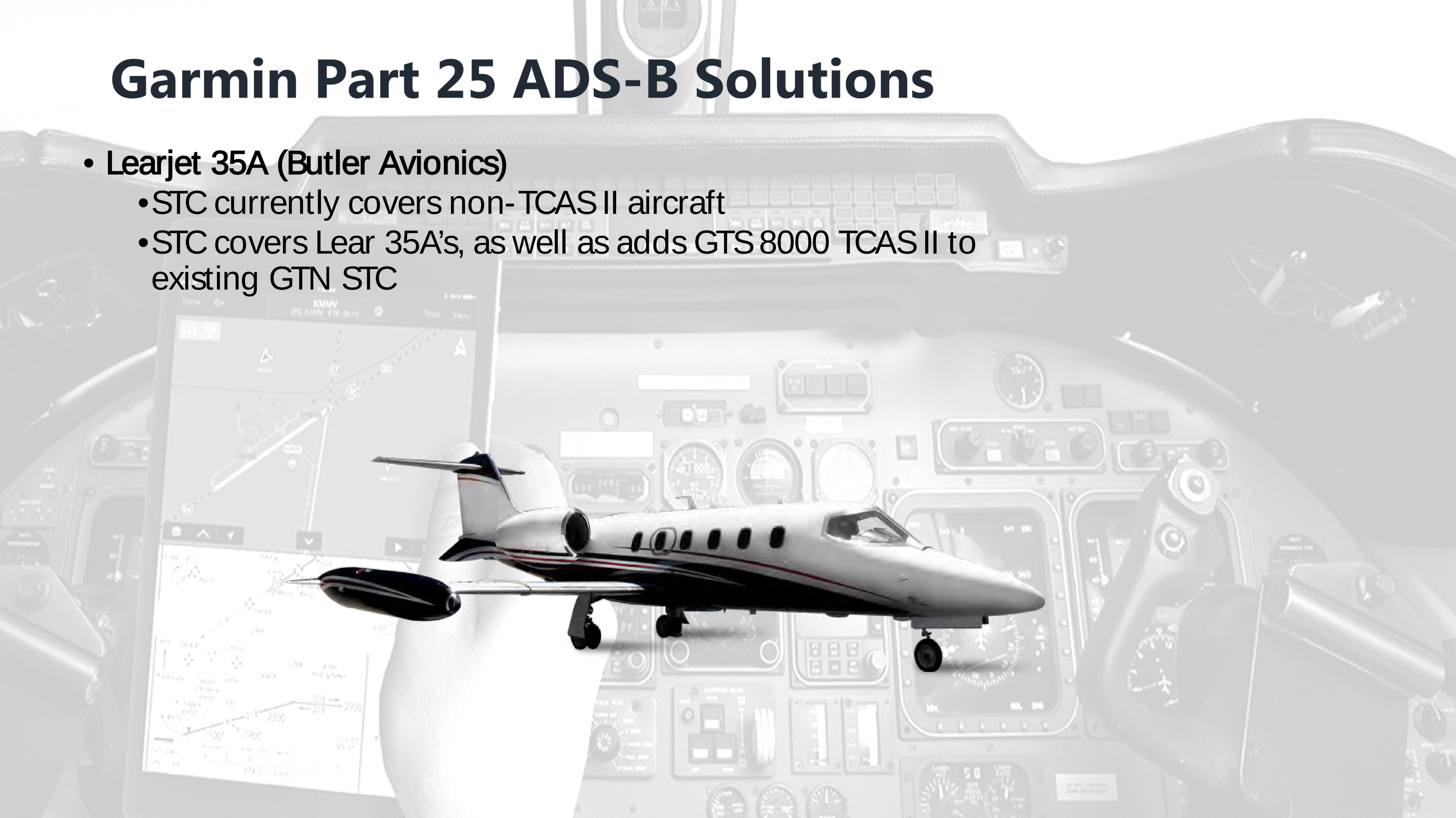
- **Cessna Citation 560XL (Columbia Avionics)**
  - STC currently available for non-TCAS II aircraft.
  - STC covers Primus aircraft
  - GMA-35 audio panel, GDL-69A data link, GTX-3000 transponders and the GTS-855 TCAS I

Garmin Part 25 ADS-B Solutions

- **Learjet 60 (Butler Avionics)**
  - Certification Complete
  - STC covers the Pro Line 4 Lear 60's, no coverage for Lear 60XR's
    - Provisions for Lear 60's with WAAS/LPV upgrade.

Garmin Part 25 ADS-B Solutions

- **Learjet 35A (Butler Avionics)**
  - STC currently covers non-TCAS II aircraft
  - STC covers Lear 35A's, as well as adds GTS 8000 TCAS II to existing GTN STC



Garmin Part 25 ADS-B Solutions

- **Premier I/IA (Elliott Aviation)**
  - Certification expected Q3
  - STC covers both Premier I and I/A aircraft

Garmin Part 25 ADS-B Solutions

- **Falcon 50 (Chicago Jet Group)**
  - Certification expected Q4
  - Collins equipped aircraft are initial certification aircraft, including Pro Line 21

Garmin Part 25 ADS-B Solutions

Beechjet 400A/Hawker 400XP

- STC expected with in 30 Days
  - Early Adopter closing soon

GARMIN

Garmin Part 25 ADS-B Solutions

Approved Pairings

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8900.362

National Policy

Effective Date:
5/9/16

Cancellation Date:
5/9/17

SUBJ: Policy for Installation of ADS-B OUT Systems

Federal Aviation Administration

Memorandum

Date: MAR – 2 2016

To: See Distribution List

From: Margaret Gilligan, Associate Administrator for Aviation Safety, AVS-1
THRU: John S. Duncan, Director, Flight Standards Service, AFS-1
FOR THRU: Dorenda Baker, Director, Aircraft Certification, AIR-1

Prepared by: James Marks, ADS-B Focus Team Lead, AFS-360, (202) 267-1707

Subject: Installation Approval for ADS-B OUT Systems

GARMIN


GARMIN®
Questions?

Mandates Compliance

David Ufen
Regional Sales Manager
Midwest U.S.

July 13, 2016

The information provided herein indicates the expected mandates and air navigation services in global airspace. This information is intended to be accurate, however, the appropriate civil aviation authorities and air navigation service providers (ANSPs) should be consulted for current regulatory requirements and status.

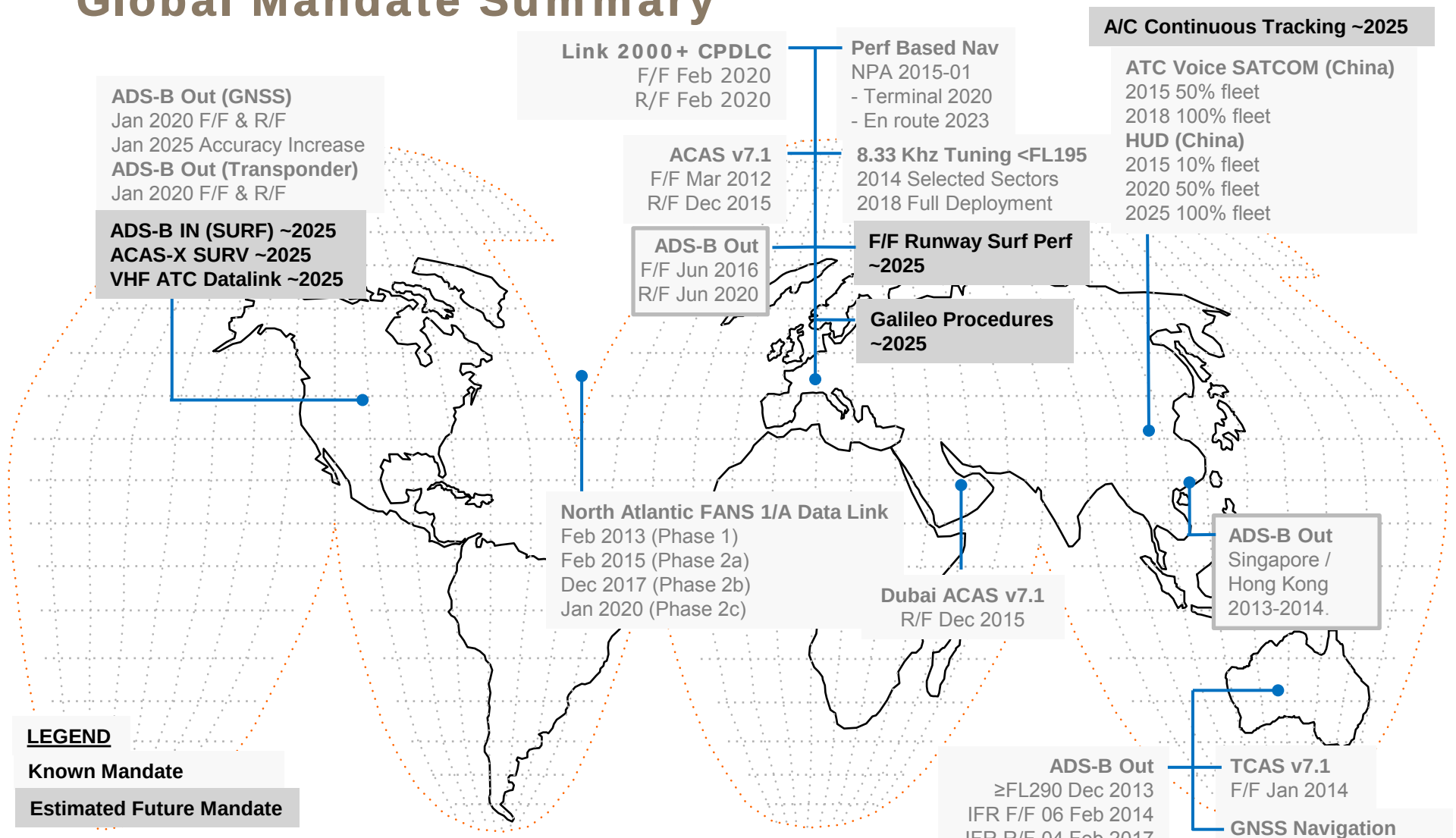
Rockwell Collins
Building trust every day

Mandate Agenda

- WAAS
- Data Communication
  - FANs 1/A
  - Link 2000+
- ADS-B
- TCAS 7.1
- Planning

NextGEN is restructuring how airspace is managed

Global Mandate Summary



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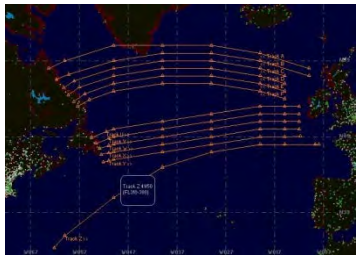
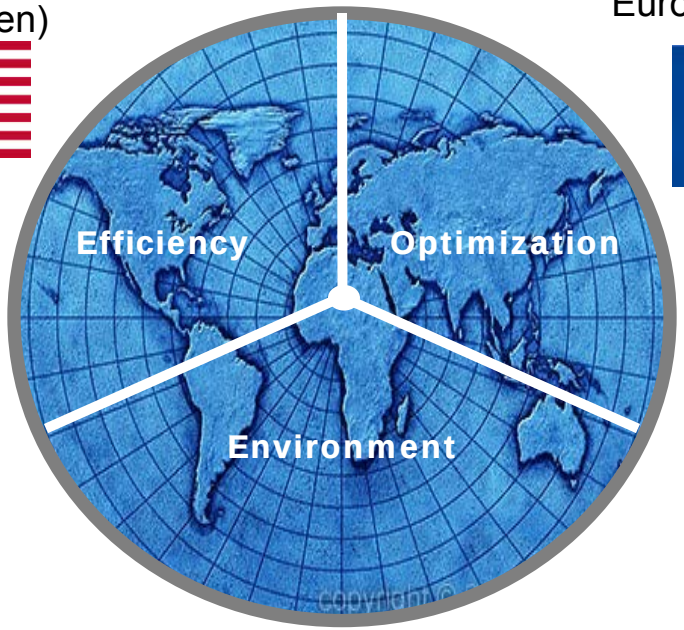
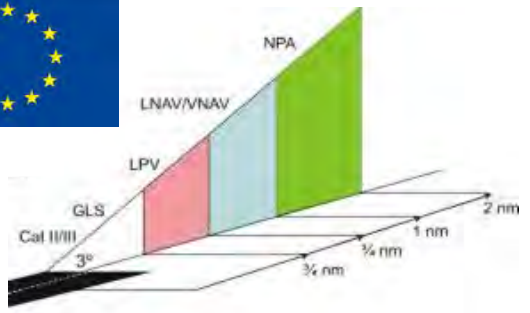
2015	2016	2017	2018	2019	2020	2021+
RNP WAAS/LPV	FANS 1/A TCAS 7.1	FANS Phase 2b	LAAS GLS	FANS Phase 2c ADS-B-Out Link 2000+	PBN ADS-B in ATC Datacom	

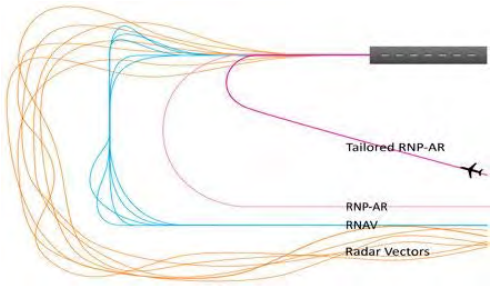
USA (NexGen)

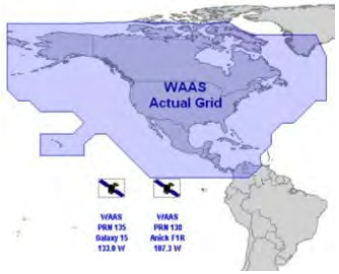


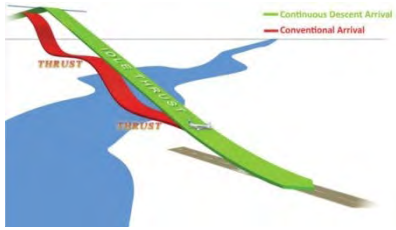


Europe (SESAR)









Airspace Management - Best Equipped/Best Served

Rockwell Collins WAAS LPV Solution

GPS-4000S

Equips Airplane for SBAS

GPS Primary Means Navigation

Value in advance of FMS v 4.0

Simpler RNAV Procedures

(no preflight RAIM check)

Better Availability

Enhanced Mission Flexibility and Efficiency

+

Enables LPV Approaches

Improved Airport Access

Additional Value

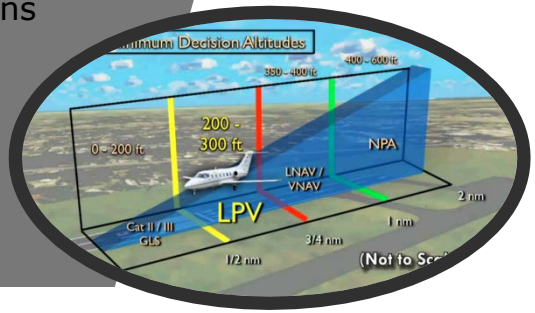
Faster Data Loading

Increase Database Mem.

GPS Primary Means

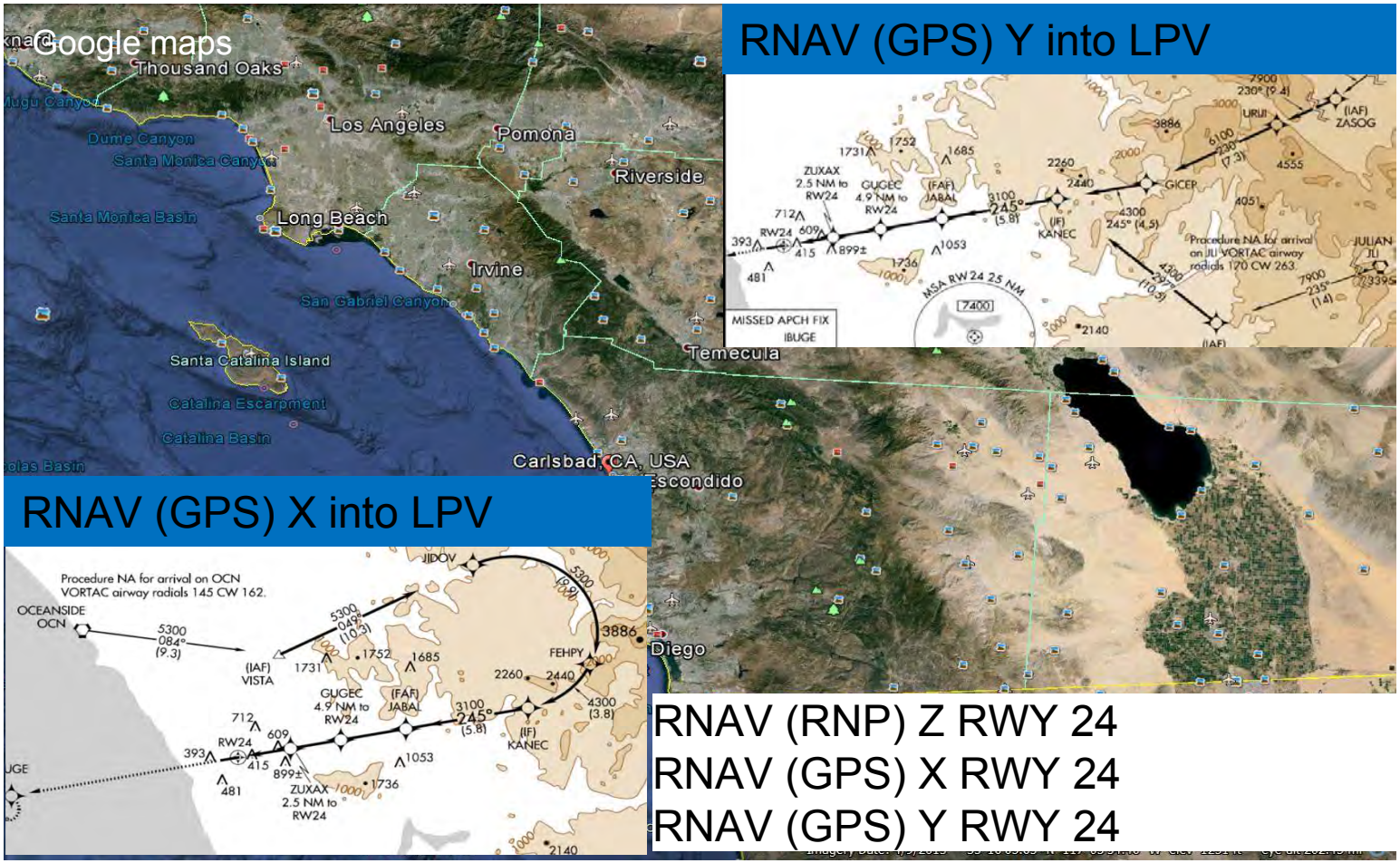
XYZ Approaches

Step Down Fixes



Package of Upgrades for the NextGen / SESAR Space Based Navigation and Air Traffic Management

With FMS 4.x there is more than just LPV, Primary means, RNP, RF Legs and expanded database that includes access to more approaches and runway ends then ever before



Benefits of FMS 4.x and WAAS GPS

- Faster Data loading
  - FMS database loads faster. You can load multiple FMC's simultaneously.
- Increase Mem
  - Doubles the available memory. New Type 7 "accuracy enhanced" database.
- XYZ Approach
  - Multiple approaches of the same type into a single runway end. Older FMS software is not capable of handling multiple procedures.
- GPS Primary Means
  - GPS no longer supplemental to VOR/DME/ILS. FMS 4.0 RNP capabilities baseline to NEXTGEN.
- Step Down Fixes
  - Allows for VNAV path adjustments to between the FAF and the runway end. Efficient routing when obstacles are a factor.
- No RAIM checks
  - Mitigates the need for pre flight RAIM checks. Enhanced GPS fault detection and exclusion.
- Improved Accuracy and Availability (GPS)
  - FMS lateral and vertical position accuracy greatly improved. Augmentation reduces odds of a "NO GPS" situation.
- Localizer Precision with Vertical Guidance (LPV)
  - WAAS FMS 4.0 enables a precision GPS approach capability. ILS equivalent minima and available at a large number of airports.

WAAS FMS & LPV Certification list

- Available on all Rockwell Collins Pro Line 4 and 21 platforms with the exception of the Premier 1
  - Evaluating best path forward on the Premier 1
- Pricing will vary by platform, Single FMS/Dual FMS, Single GPS or Dual GPS etc.
- Pretty much everything moving forward will assume WAAS FMS capable for road map

Datalink

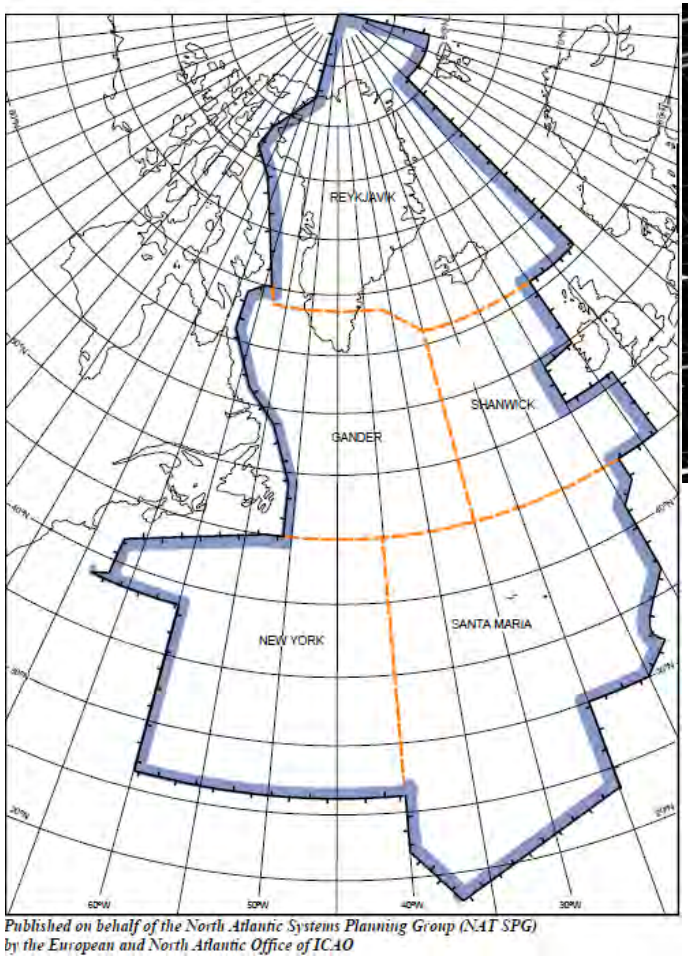
FANs 1/A

- FANS 1/A = CPDLC + ADS-C
- Crew to ATC text messaging via satellite communications (CPDLC)
- Automatic aircraft position & heading reporting via satellite communications (ADS-C)
- Oceanic Airspace
- U.S. testing departure clearance using FANS 1/A

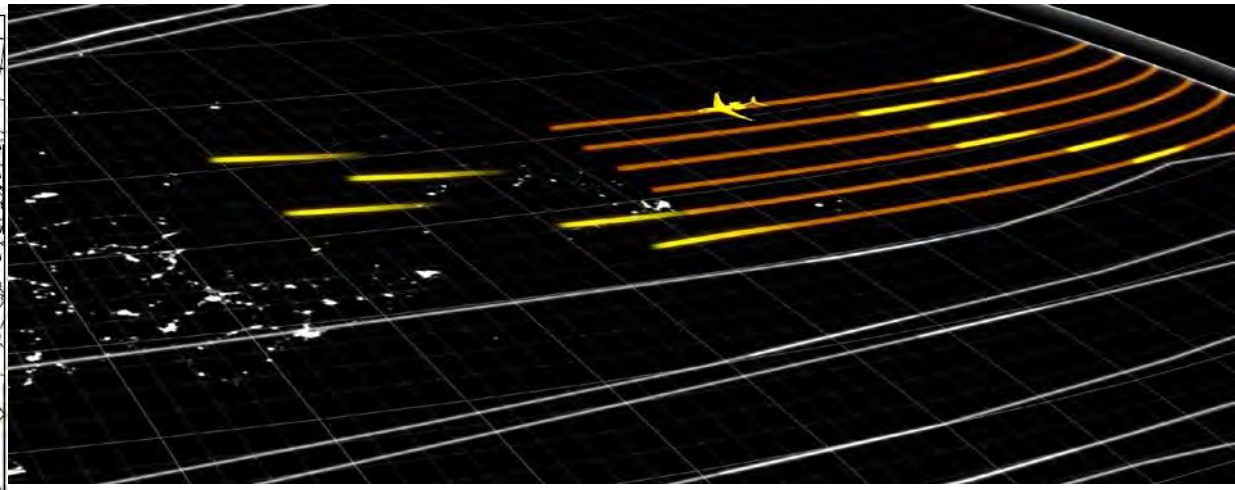
ATN Link 2000+

- Eurocontrol's program that address's ATC congestion issue in Europe.
- Provide controllers and pilots with a second communication channel: air/ground data link.
- Implements a Protected Mode CPDLC for data integrity

Airspace Crossing the Atlantic



Published on behalf of the North Atlantic Systems Planning Group (NAT SPG) by the European and North Atlantic Office of ICAO



North Atlantic Tracks (NAT) FANS 1/A Data Link

Feb 2013 NAT OTS FL360 to FL390 (Phase 1) ✓

Feb 2015 NAT OTS FL350 to FL390 (Phase 2a) ✓

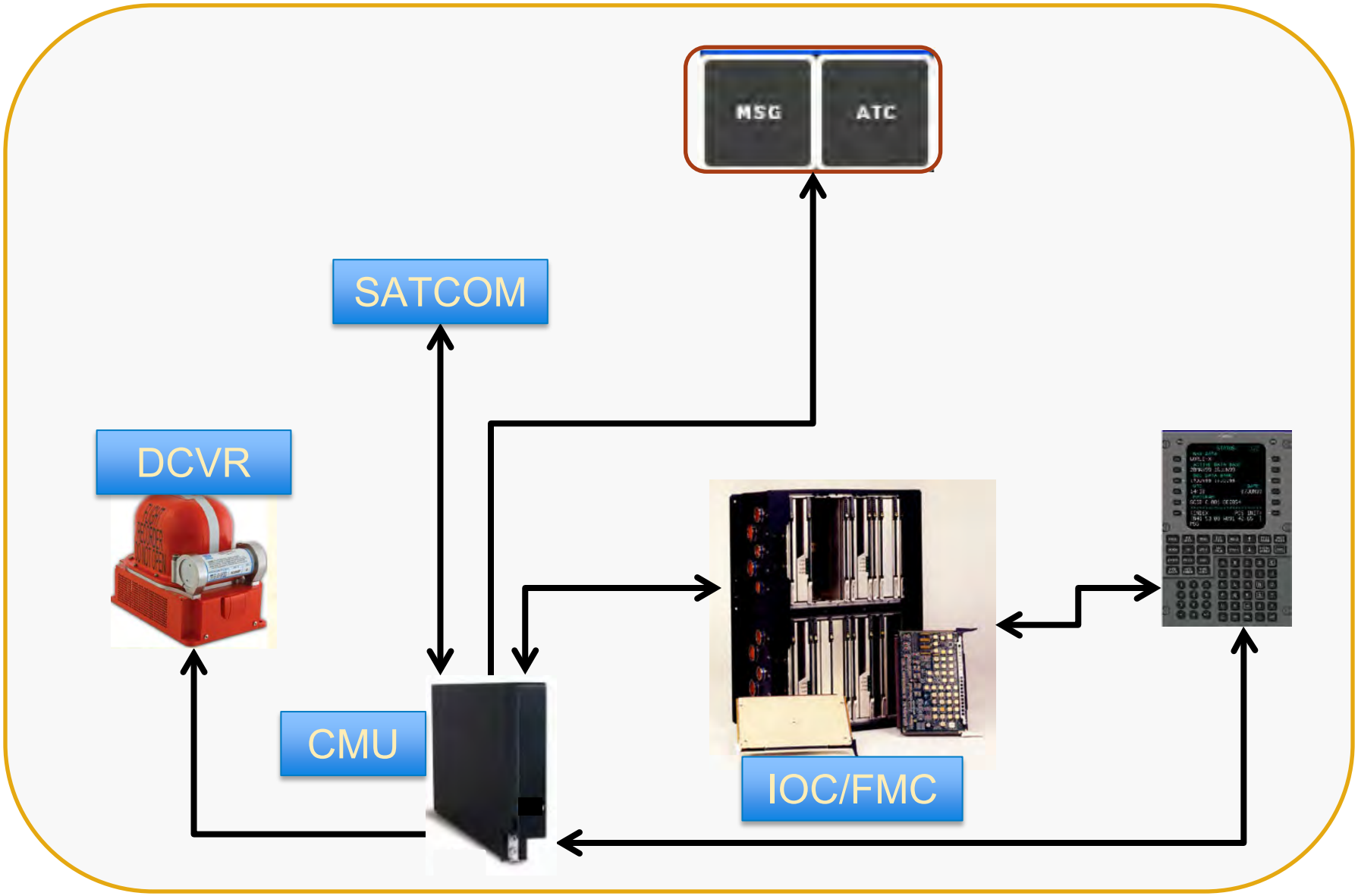
Dec 2017 NAT Region FL350 to FL390 (Phase 2b)

Jan 2020 NAT Region FL290 & Above (Phase 2c)

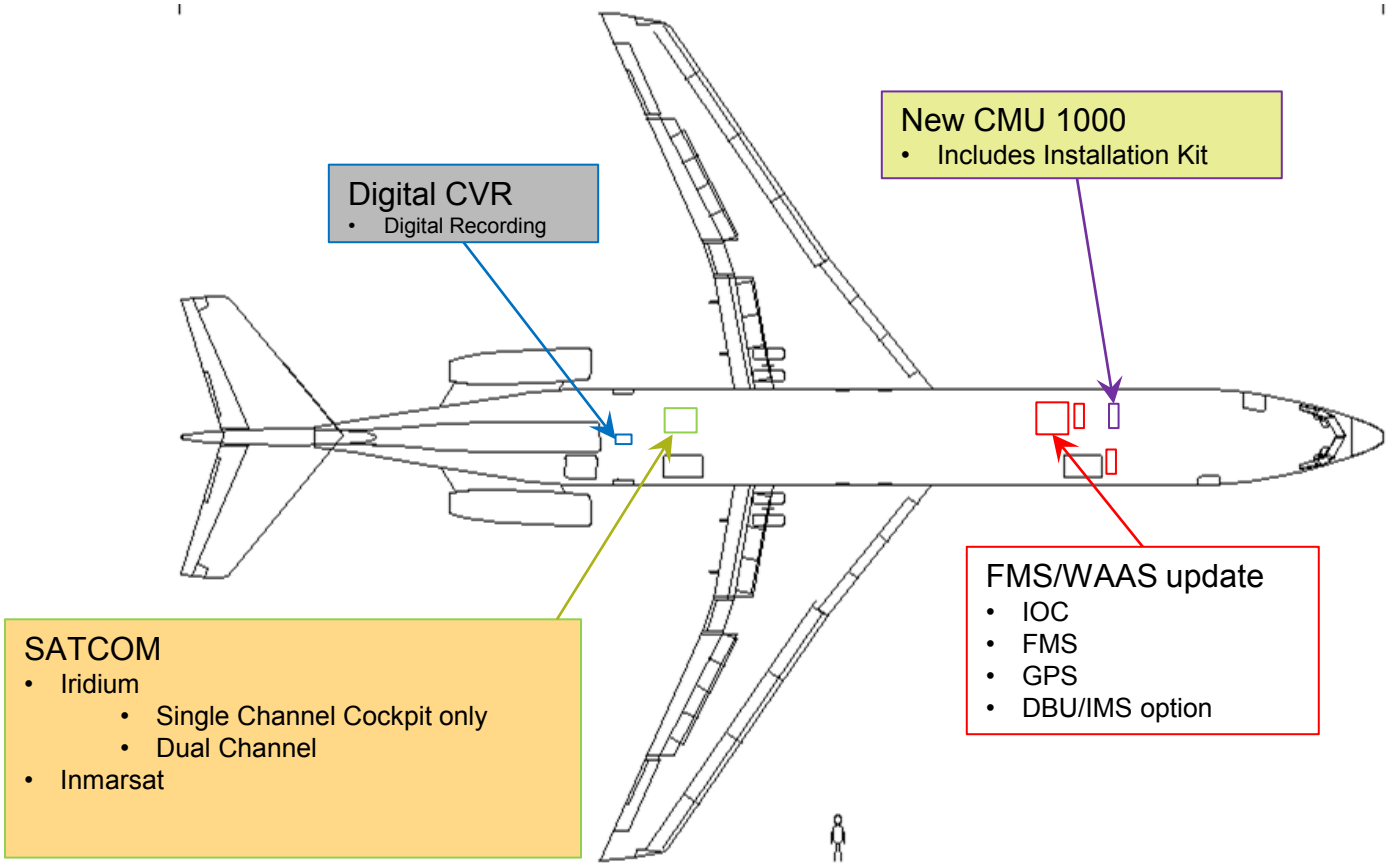
Phase 2b/2c will progressively close North Atlantic airspace to non-FANS 1/A'' aircraft

Rockwell Collins

Rockwell Collins Aftermarket FANS Solution



The basic component involved in a FANS 1A update on Pro Line 4 or 21 include, CMU 1000 Data link unit, minimum of FMS 4.0. DCVR to record CPDLC message and SATCOM qualified for ICAO safety service and FANS 1/A.



FANS Certification list

Aircraft Type	Certification Path	Availability
Challenger 300	Bombardier SB	Mid 2016 (Pro Line 21 Advance)
Challenger 605	Bombardier SB	Available (Pro Line 21 Advance)
Challenger 604	Rockwell Collins FAA STC BA SB	Available
Falcon 50EX	Dassault STC / Rockwell Collins Product	Available – Just Completed
Falcon 2000/2000EX	Dassault STC / Rockwell Collins Product	Available – Just Completed
Challenger 850	Partner identified	Mid 2016 for TC STC.
Gulfstream G200	Offer Submitted	TBD
Gulfstream G150	Offer submitted	TBD
Hawker 900/800	Evaluating	TBD

Link 2000+ Aftermarket Certification list

Fusion Platforms

- Global 5000/6000, Legacy 500/450, G280
  - Available through Aircraft OEM Service bulletins

Pro Line 4 and 21 platforms

- Put on hold due to mandate slip
- Continue to evaluate by platform

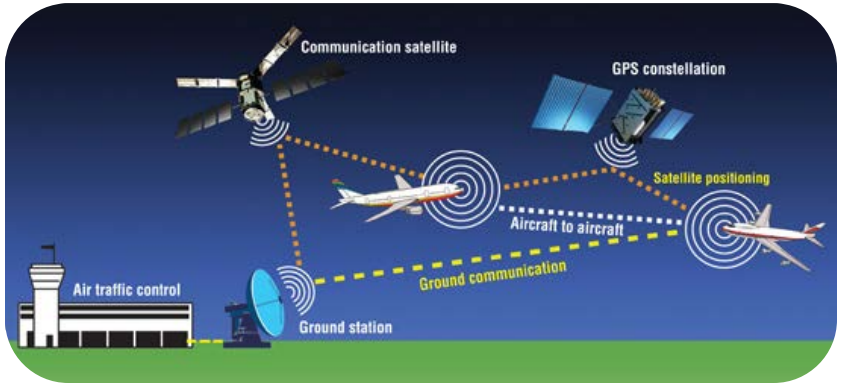
ADS-B Out

ADS-B is a vital enabler of the NextGen plan

Why Automatic Dependent Surveillance- Broadcast (ADS-B)?

- Enabler of air traffic control procedures to increase airspace capacity and efficiency
- Allows surveillance deployment where previously not possible. i.e.: Gulf of Mexico
- Lower cost, more accurate and more frequently updating surveillance infrastructure
- Provides vehicle for safety services to the cockpit
- Provides widespread unprecedented pilot situational awareness

U.S. Mandate Jan 1, 2020



Courtesy FAA.gov

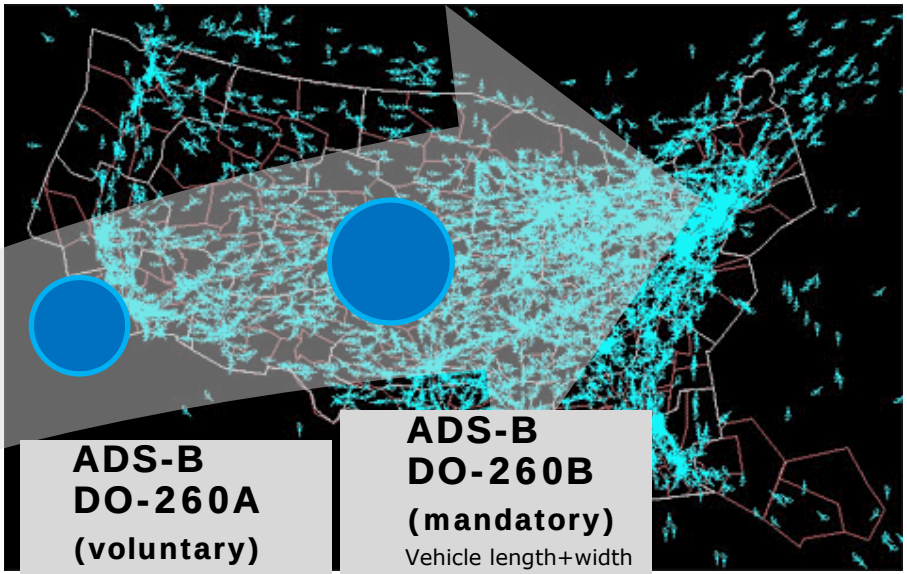
Rockwell Collins

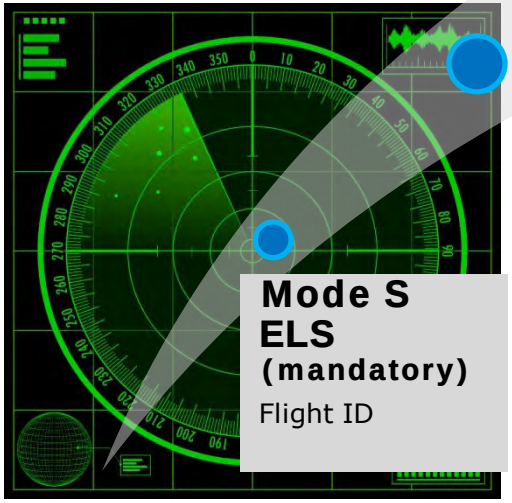
With the increase of air traffic in ADS-B out is a critical function enabling aircraft to be tracked with more accuracy than ever before providing the tools to increase traffic density through tighter spacing, without compromising safety.

TDR-94(D)
-501

GPS-4000S

FLT ID/EhS





Mode S ELS
(mandatory)
Flight ID

Mode S EHS
(mandatory)
Hdg, Roll
TAS/IAS/GS/VS
TK, TKE, Mach
Sel ALT

ADS-B DO-260
(voluntary)
24bit ID
Position and quality
Baro Altitude
Velocities
Flight ID

ADS-B DO-260A
(voluntary)
24bit ID
Position and quality
Baro Altitude
Velocities
Flight ID
Emer code
SPI / GS

ADS-B DO-260B
(mandatory)
Vehicle length+width
GPS Antenna offset
Velocity accuracy
System Design Assurance
UAT/1090ES capability
Aircraft category
Emerg code
NIC / NACp / NACv
GPS altitude
TCAS status

EASA Retrofit Mandate is June 2020

ADS - B Certification List

- Textron; Cessna Pro Line 21, Hawker Pro Line 21, Beechcraft Pro Line 21
  - Releases happening throughout the upcoming year.
  - Premier 1/1A still being planned

- Bombardier
  - Challenger 300, 350, 605, 650 via OEM service bulletin
  - Challenger 604
  - CL 850 third party or Rockwell Collins
  - Lear 60XR; Evaluation
  - Lear 60; Third party STC

- Gulfstream
  - G200 & G150 OEM Service Bulletin
  - GIV with Pro Line 4 Radios, Gulfstream STC
  - G100 and Astra will be third party STC

- Dassault Falcon
  - Falcon 900, 50, 50EX, 2000, 2000EX and more will be available through the upcoming year via Dassault STC.

- Fusion platforms will have OEM service bulletin available
- Significant number of additional dealer STC are being developed

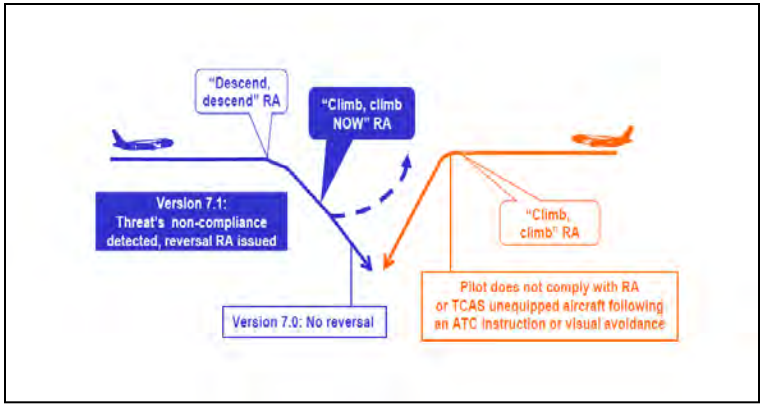
TCAS 7.1- Address Safety Issues

An airliner near-collision over Japan in 2001 and an actual airliner at FL350 over Germany in 2001 led efforts to update TCAS II

Resolution Advisory (RA) Reversal capability:

Crew of one A/C involved in TCAS RA fails to comply "Traffic! Climb!"

- TCAS of other A/C can issue reversal RA command to avert collision

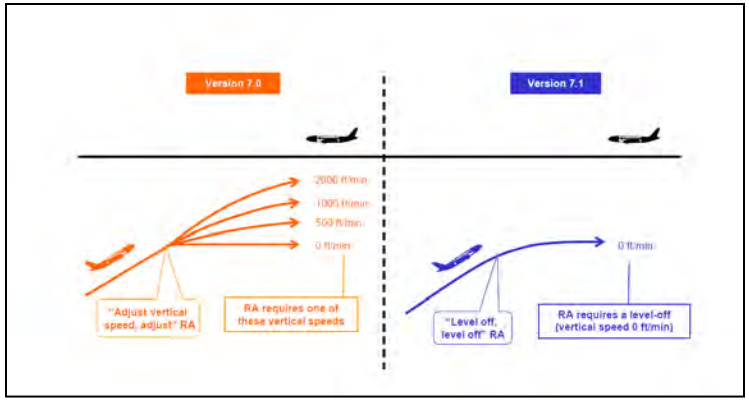


Courtesy of Eurocontrol Website

Level off Callout

Issue a "level off" callout in lieu of "Adjust Vertical Speed-adjust"

- Mitigates ambiguous aural cue to climb or descend



Courtesy of Eurocontrol Website

No published U.S mandate to date

TCAS 7.1 Certification

Aircraft Type	Certification Path	Availability
Challenger 300	TCAS Service Bulletin / AML	Now
Challenger 605	TCAS Service Bulletin / AML	Now
Challenger 604	TTR 2100 AML STC	Now
Falcon 50EX	TTR 4100 AML STC	Now
Falcon 2000 / 2000EX	TTR 4100 AML STC	Now
Challenger 850 / CRJ 200	TTR 2100 AML STC	Now
Gulfstream G200	TTR 921 AML STC	Now
Gulfstream G150	TCAS Service Bulletin / AML	Now
Hawker 800	TCAS Service Bulletin / AML	Now
Lear 60XR	TCAS Service Bulletin / AML	Now
Lear 60	TTR 921 AML STC	Now

* There is a very limited number of TTR 921s available.

Airspace Modernization NextGen

Making the aircraft and airspace more efficient, from taxi, take off through to arrival

5 major areas to focus on

- GPS (Global Positioning System)
  - **WAAS (SBAS)**
  - *LAAS*
- FMS (Flight Management System)
  - RNP (Required Navigation Performance)
  - PBN (Performance Based Navigation)
  - LPV
- CMU (Data Link)
  - FANS (Fans Domestic trials are scheduled to start)
  - Link 2000+
- TDR/TTR (Transponder/TCAS for ADS-B)
  - Of the estimated 20,000 TDRs to update it would take more than 300 units a week starting Jan 2015
- AFD/EFD (Displays)
  - Map Data display
  - RNP/PBN

- ADS-B In

Obsolescence & Maintenance Management

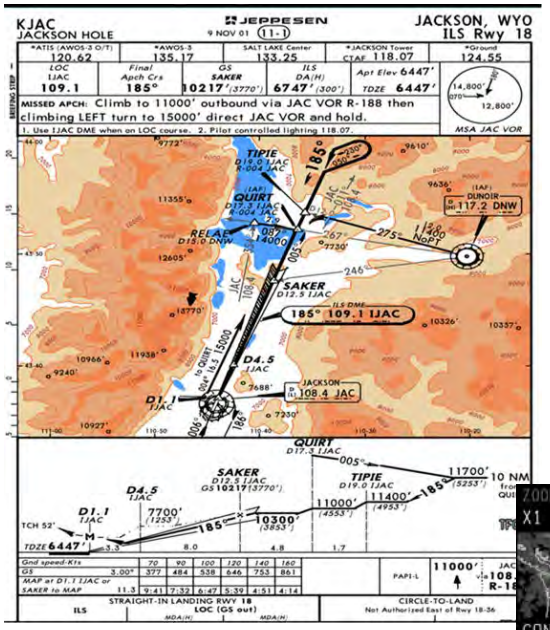
Providing proactive obsolescence management to help operators manage maintenance budgets through life cycle

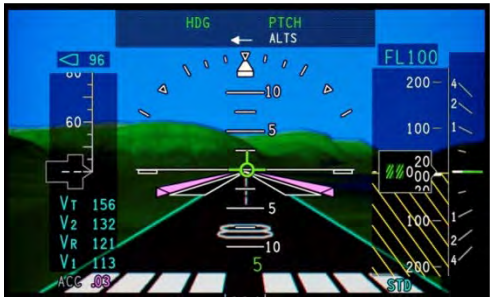
- AHRS
- CRT Display
  - PFD/MFD **(Flight plan)**
  - RTU
  - RMIs
  - Etc.
- 1st generation computers
  - FMS/Database
  - DBU (Floppy Drives)

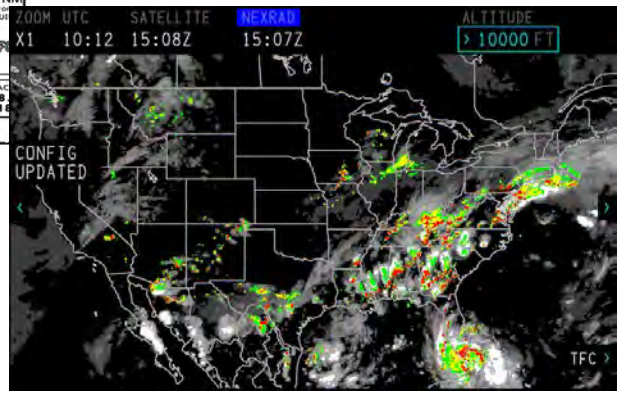
- Equipment life Cycles will Continue to get shorter

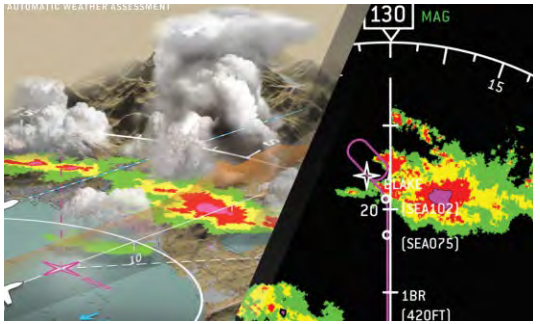
Operational Efficiencies & Safety Enhancements

SVS, Airport moving map, Weather Radar create a safer and more efficient environment









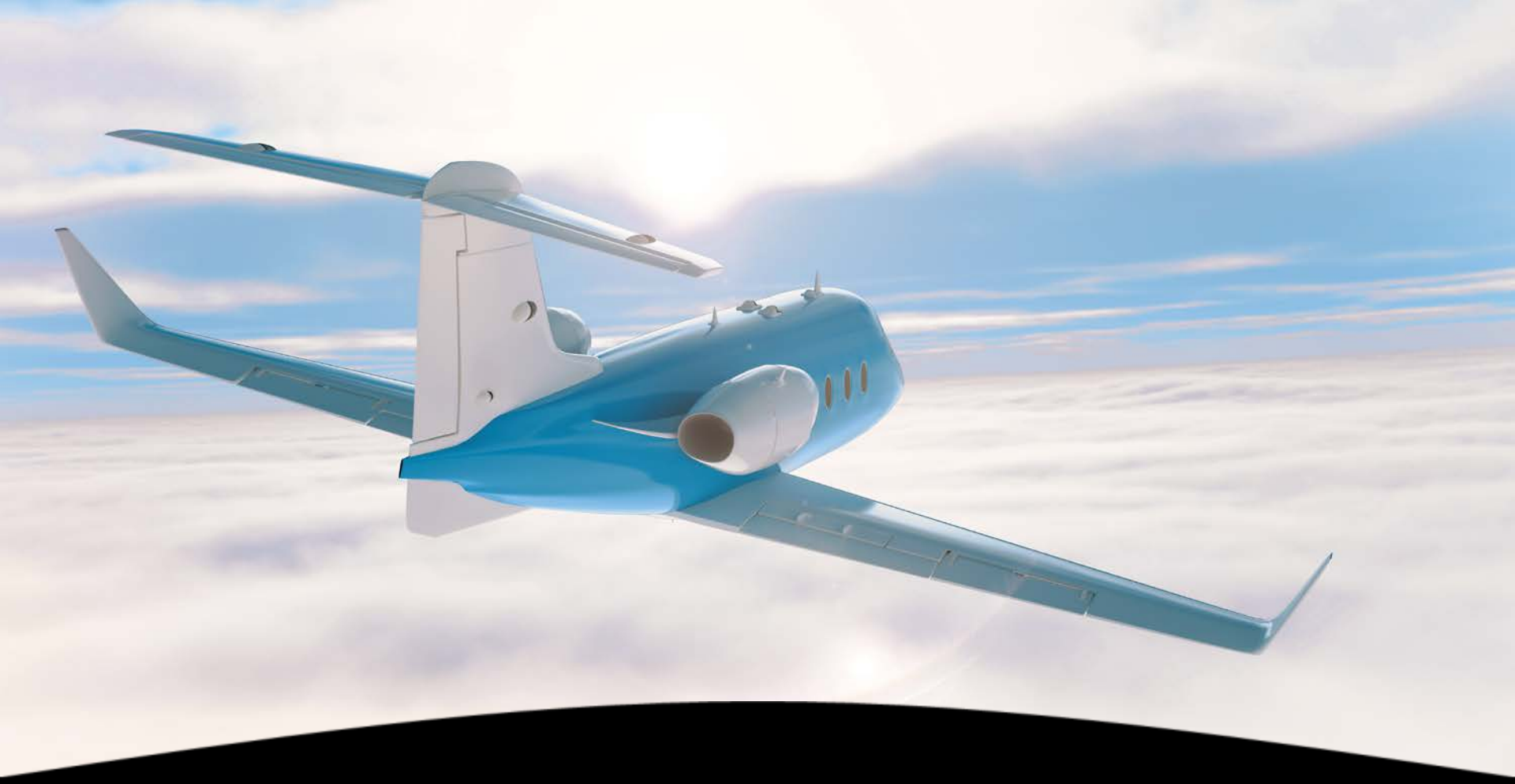
Mandate Compliance

David Ufen
Regional Sales Manager
Midwest U.S.

July 13, 2016

The information provided herein indicates the expected mandates and air navigation services in global airspace. This information is intended to be accurate, however, the appropriate civil aviation authorities and air navigation service providers (ANSPs) should be consulted for current regulatory requirements and status.

Rockwell Collins
Building trust every day



Possibilities of Mandates….
Made Easy

July 13, 2016
Minneapolis/St. Paul

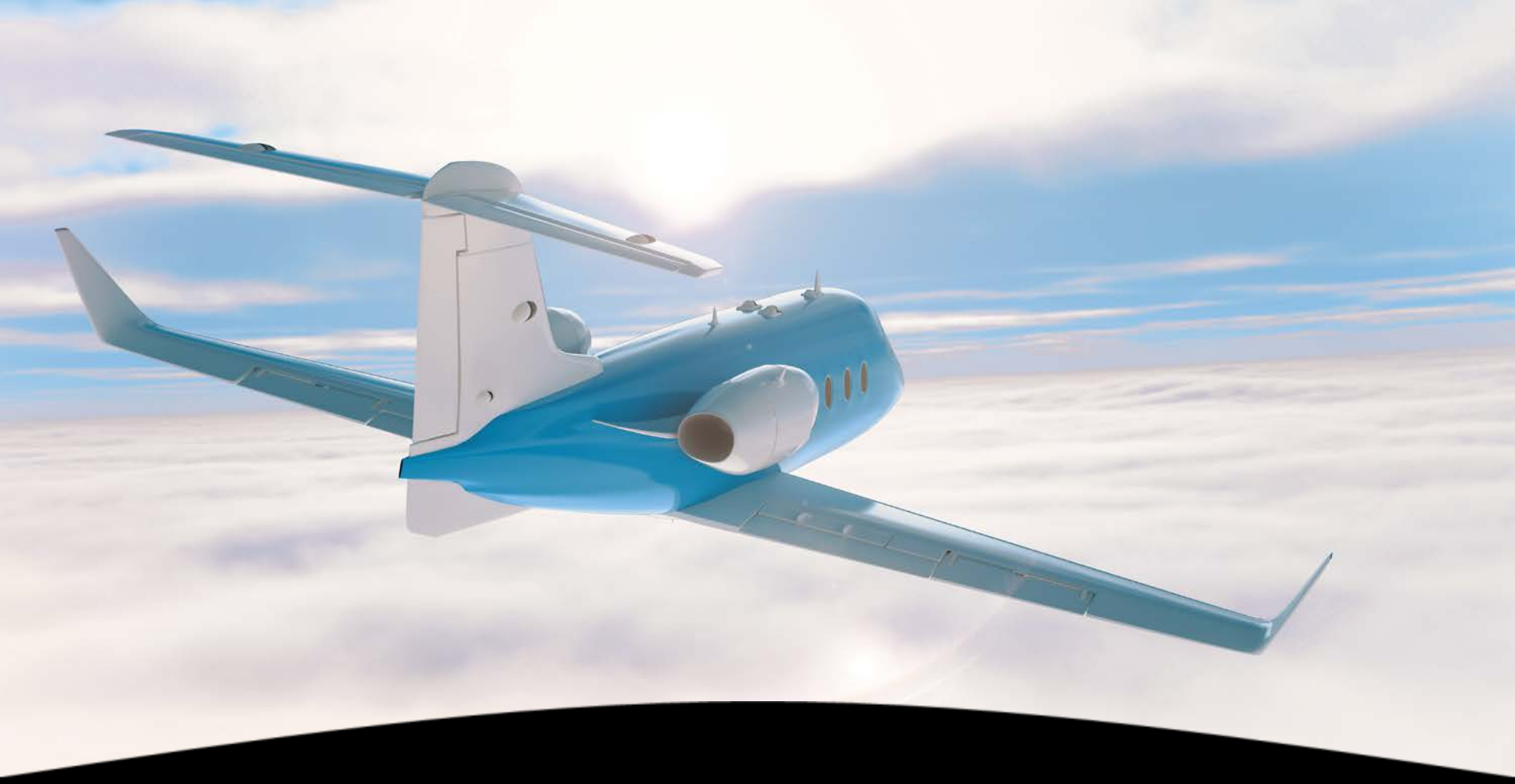
Honeywell

Overview

Honeywell

- **What can you expect today?**
  - Solutions for FANS, PM-CPDLC, ADS-B & TCAS on Honeywell equipped aircraft.
  - Most of us know about these, but staying on top of the various implementation deadlines, geographical requirements and aircraft exemptions can be confusing.

- **Agenda:**
  - Datalink
    - FANS 1/A+
    - PM-CPDLC
    - Datalink Recording
  - ADS-B
  - TCAS 7.1
  - Q&A



Datalink Overview

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What is Datalink - Overview

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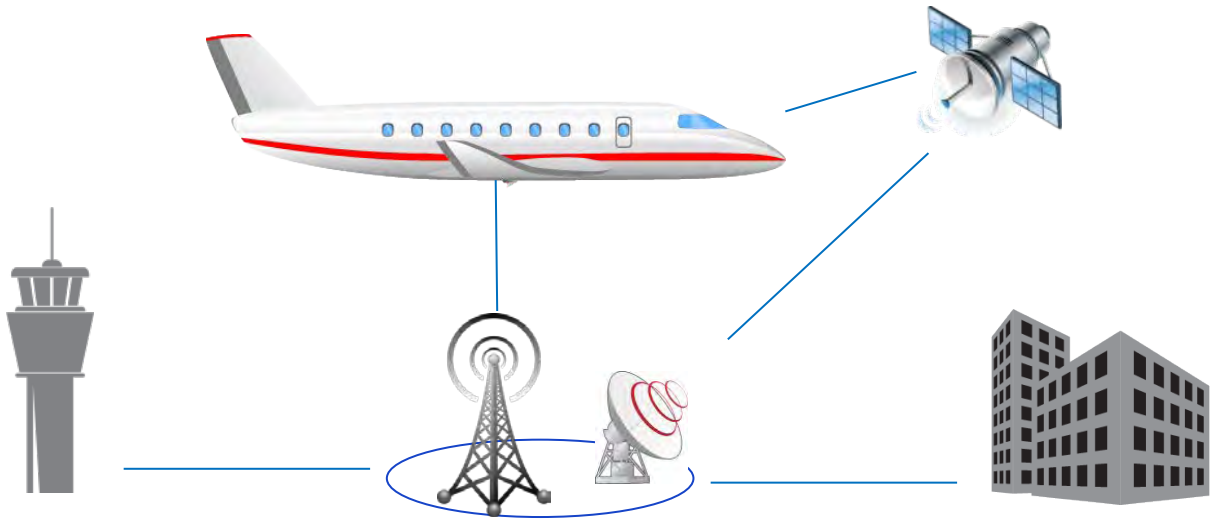


Air Traffic Control (ATC)

- Controller Pilot Datalink Communications (CPDLC) is “text messaging” pilot and ATC for aircraft control instead of using voice communication
- Pilot can request and/or acknowledge changes to aircraft speed, altitude and route using standard ATC phraseology
- Functionality contained in Flight Management Computer and/or Communications Management Unit

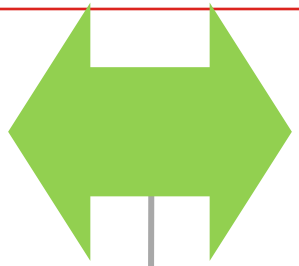
Aircraft Operation Center (AOC)

- Automated Messages / Reports
  - OOOI Information
- Weigh and Balance
- Weather Services
- Flight Plan Uplink
- Gate Information, etc.

CPDLC is “text messaging” between the pilot and ATC

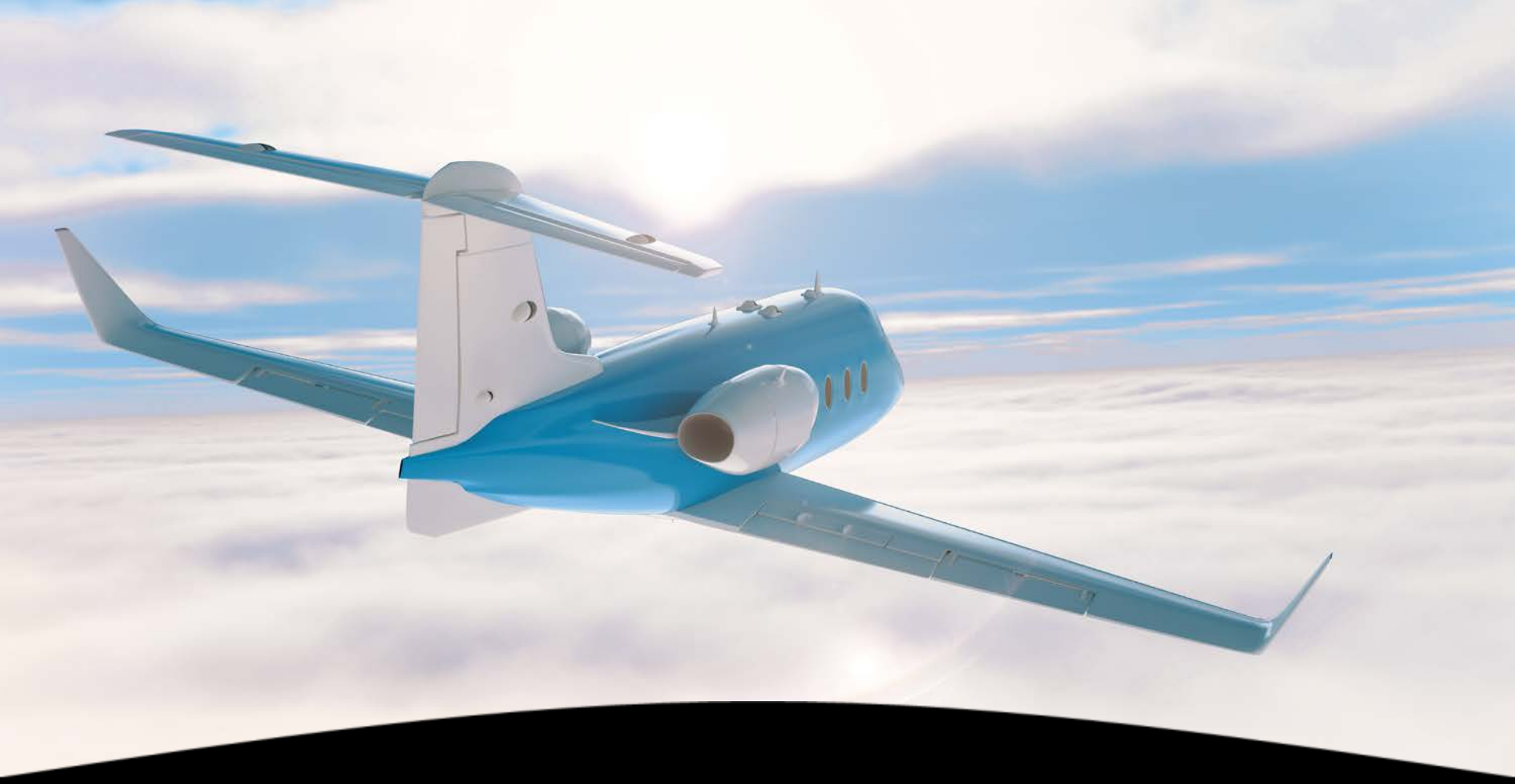
FANS 1/A+ vs. PM-CPDLC

Honeywell



FANS 1/A+	PM-CPDLC
• Future Air Navigation System (FANS1/A+)	• Link2000+ ATN B1 PM-CPDLC (FANS B)
• Oceanic regions and Remote regions: North Atlantic, Canada, NextGen-CONUS	• European Airspace
• Existing ACARS Network	• Newer ATN Network protocol
• VHF, HF and Satellite sub-networks	• VHF VDL Mode 2 radios
• Supports Automatic Dependant Surveillance – Contract (ADS-C)	• European Mandate for FL 285+ (unless exempt)

2 Versions of CPDLC



FANS 1/A+

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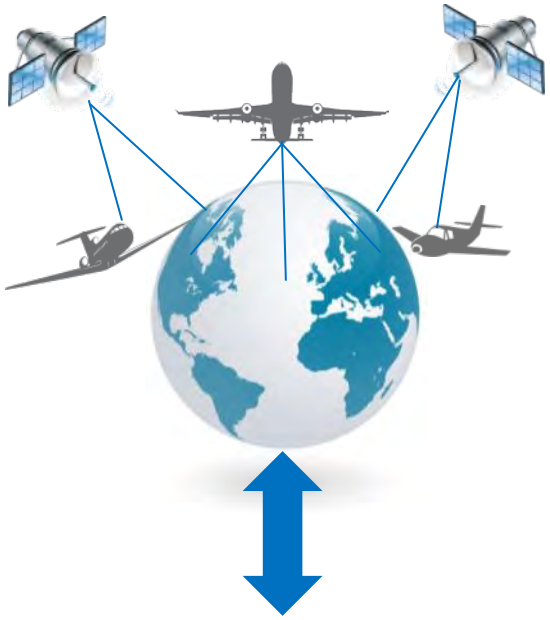
FANS 1/A+ Benefits

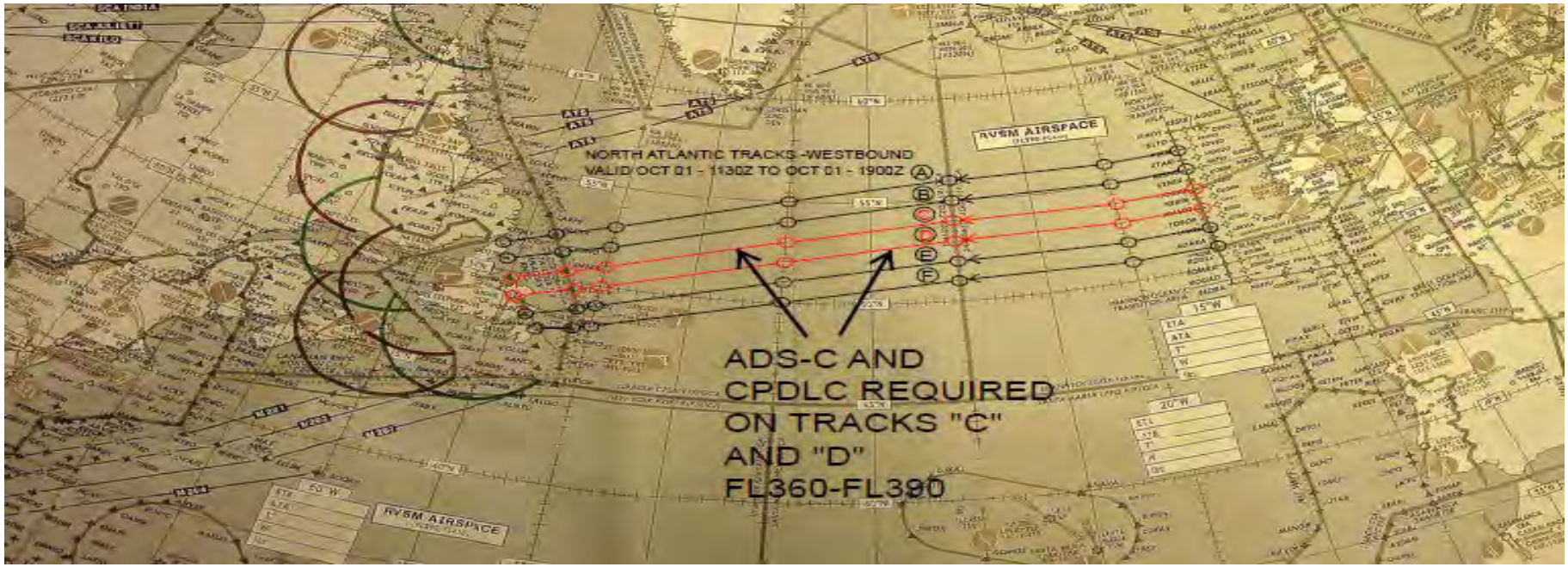
Honeywell

- Preferred, more direct oceanic routing
- Fewer delays on the ground while awaiting clearance
- Fully automated oceanic position reporting (ADS-C)
- Increased safety - improved controller awareness of aircraft position
- Reduced separation allowing more aircraft in the NATS Airspace
- Reduction in gross navigational errors (GNE)
- Route clearances automatically made in flight plan



FANS 1/A+ North Atlantic Tracks

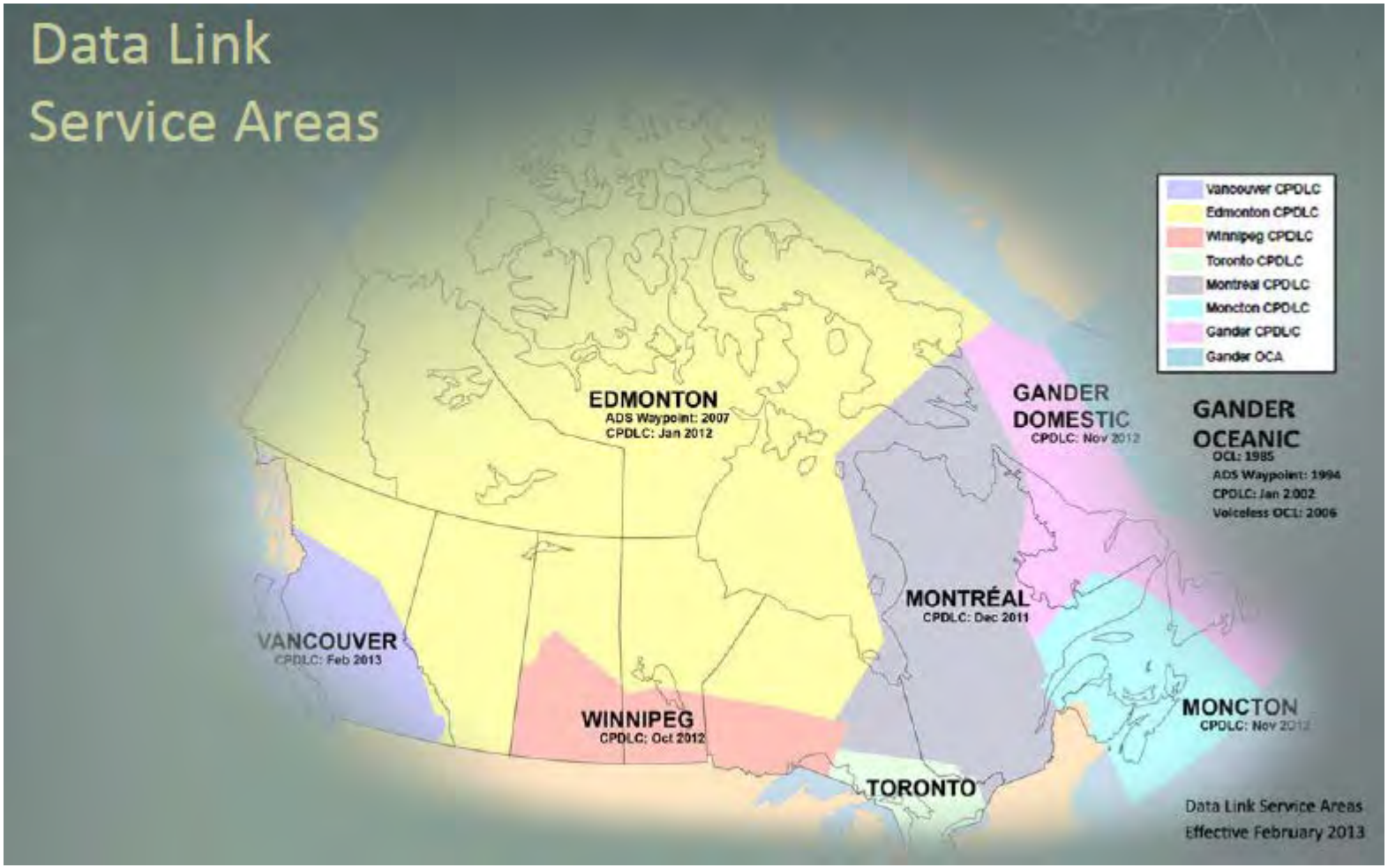
Honeywell



Phase	Dates	Region	Flight Levels
Phase 1	Feb 2013	Center 2 Tracks	FL 360-390
Phase 2A	5 Feb 2015	NATS Tracks OTS	FL 350-390
Phase 2B	7 Dec 2017	ICAO NAT Region	FL 350-390
Phase 2C	30 Jan 2020	ICAO NAT Region	Above FL 290

Nav Canada – FANS 1/A+ Operational

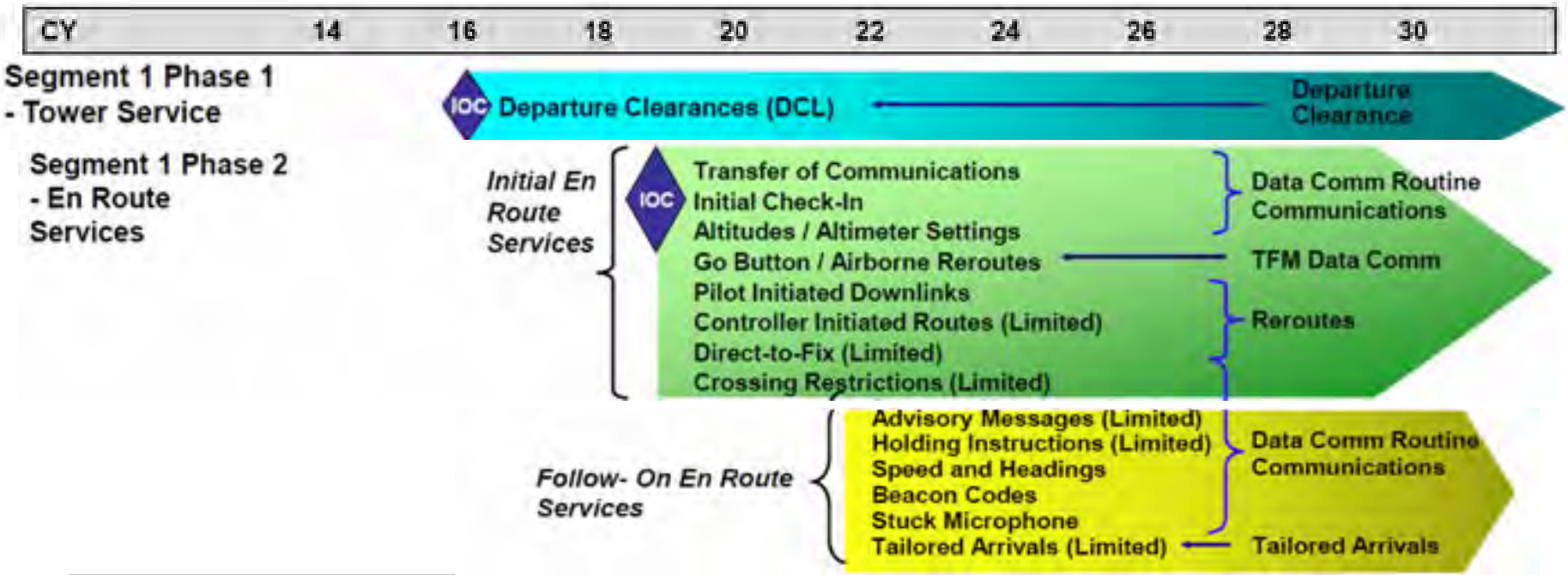
Honeywell



FANS Fully Operational in Canada

FAA NextGen FANS 1/A+ Deployment

Honeywell



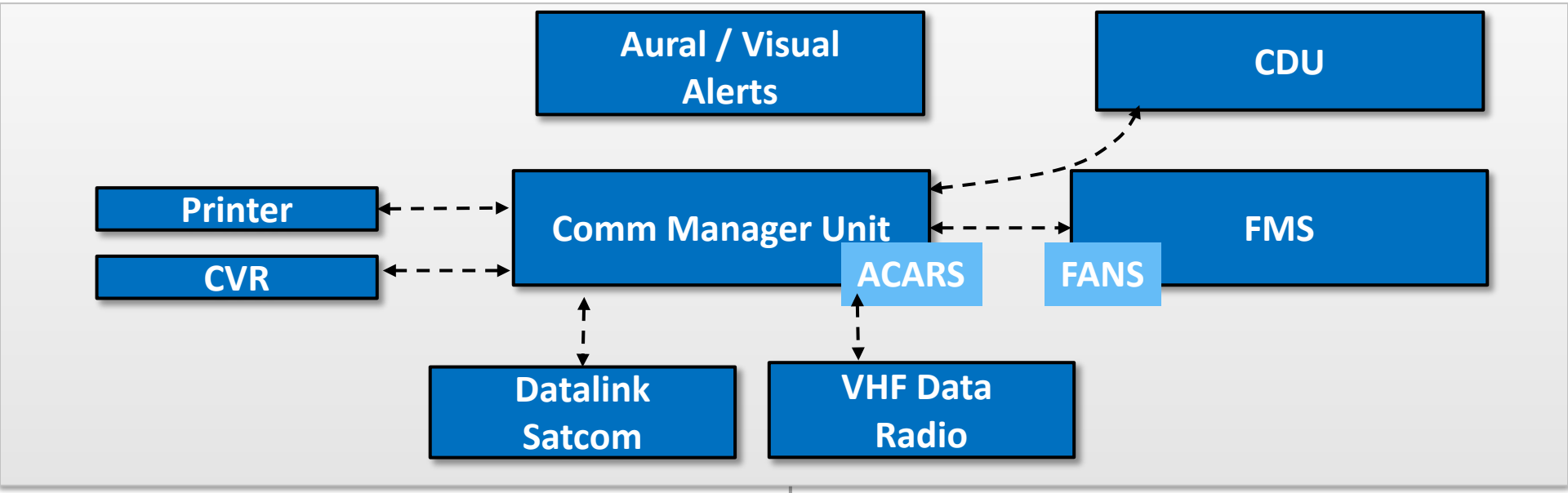
- **Segment 1 Phase 1: DCL**
  - Trial Sites – Newark & Memphis
  - 51 Airports from 2016-18
- **Incentive Program**
  - Goal: 80% Equipage
  - 8 Airlines signed up

- **Radios**
  - VDL Mode 2
  - Mode 0, A Accommodated
- **Segment 1 Phase 2: En Route**
  - Timing decision in process

FANS 1/A+ CPDLC Coming to a US Airport

FANS Solution

Honeywell



- Fully Integrated System tested end to end
- Integrates with existing Flight Management Computers
- Integrates with Existing Control Display Units

- FMS providing aircraft guidance is same FMS providing navigation
- FANS operation available if either FMS 1 or FMS 2 fail
- Forward Front view using the CDU

FANS is an Integrated System Solution

Honeywell Integrated System Solution

Honeywell

CVR-DLR

Printer

CD-810/ 820/830

VDRm2

SATCOM

Mark III CMU

FMS

Product	Required/Option	Model
Flight Management System	Required	FMS6.1 based on A/C type
FMS 6.1 FANS Upgrade	Required	FANS “mini” load
Cockpit Display	Required	CD-810/820/830
Mark III - Communication Management Unit Aircraft Personality Module	Required	7519200-921 964-0465-001
SATCOM Level D	Required	MCS3000/6000/7000/HD710
VHF Data Radio Mode 2	Required	7026201-803/804
Aural and Visual Alerting	Required	External Discretes
Cockpit Voice Recorder with DLR	Required	LW: 980-6044-003 HFR5: 680-6032-001
Printer – TW5	Recommended Option	42904111

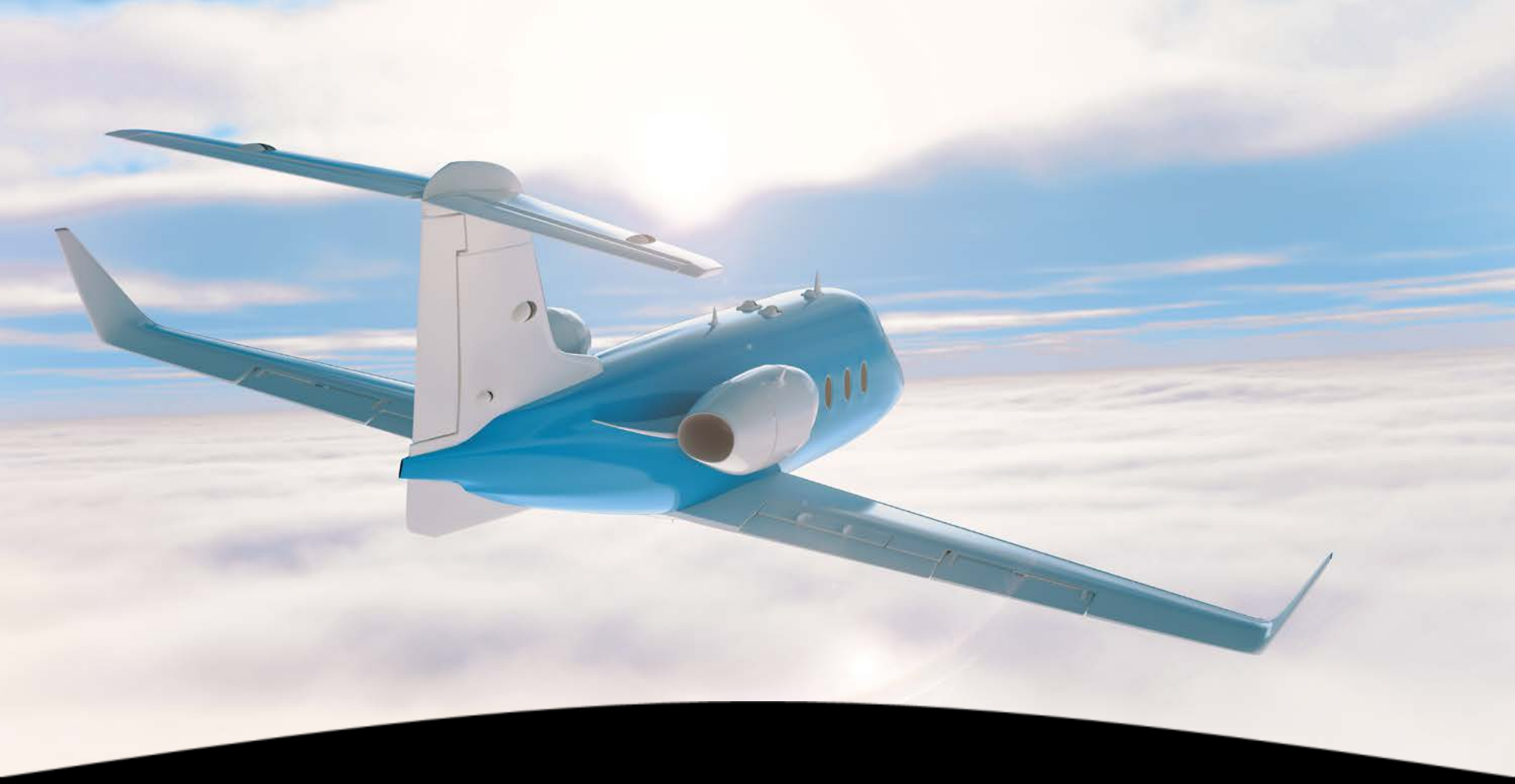
Honeywell FANS solutions

Honeywell

- **EPIC**
  - Available
- **Honeywell FANS solutions:**
  - Using integrated CMU MK III / FMS solution :

Aircraft	Planned Availability
Gulfstream G-V	Available
Gulfstream G-IV	Available
Gulfstream G-IVSP	Available
Falcon 900EX	Available
Falcon 900C	Available
Falcon 900 A/B	Available
CL601	Available

- **Other A/C upon request**
- **Check with your OEM for specific certification dates**



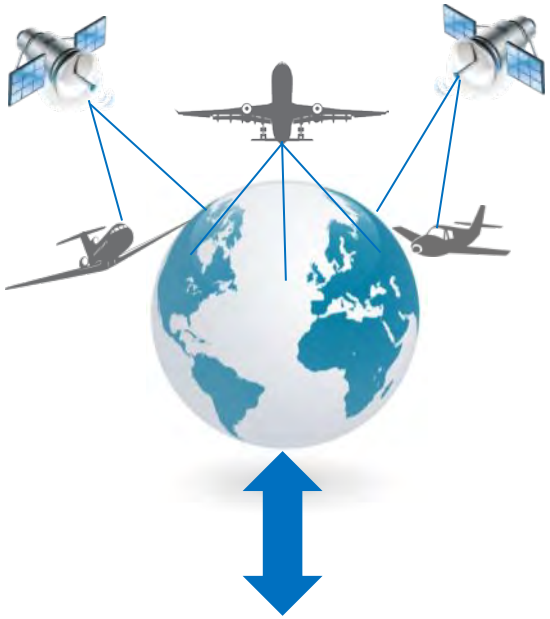
PM-CPDLC / Link 2000+

Honeywell

PM-CPDLC (Link 2000) Benefits

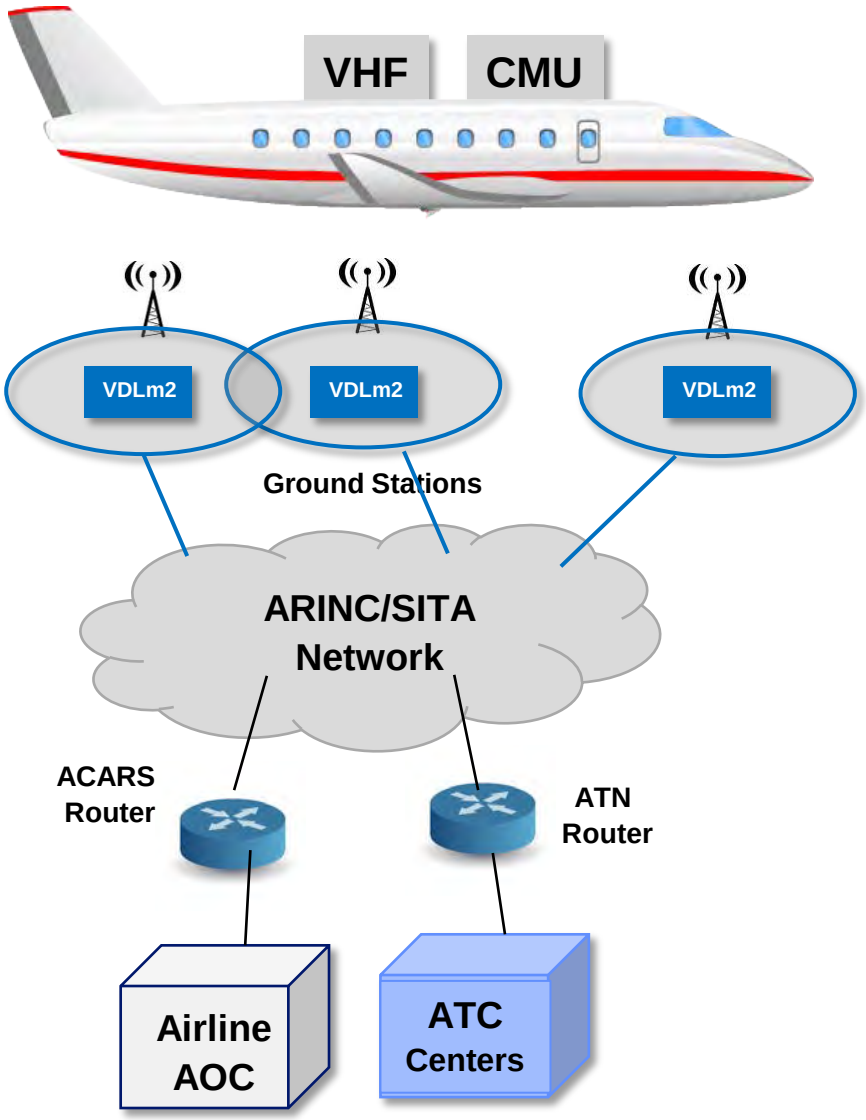
Honeywell

- Increased safety - improved controller awareness of aircraft position
- Reduced separation allowing more aircraft in the Airspace
- Reduction in errors
- Route clearances automatically made in flight plan



PM-CPDLC Overview

Honeywell



- **Automates Routine tasks**
  - Microphone checks
  - Clearances, handoffs
- **Avionics**
  - Radios –VHF VDL mode 2 only
  - Comm Mgt Unit (CMU), FMS
- **Network / Ground Stations**
  - VDL mode 2
  - ATN network
- **Service Agreements**
  - ATC ←→ARINC/SITA

New Network and Avionics Deployment

Why the Extension

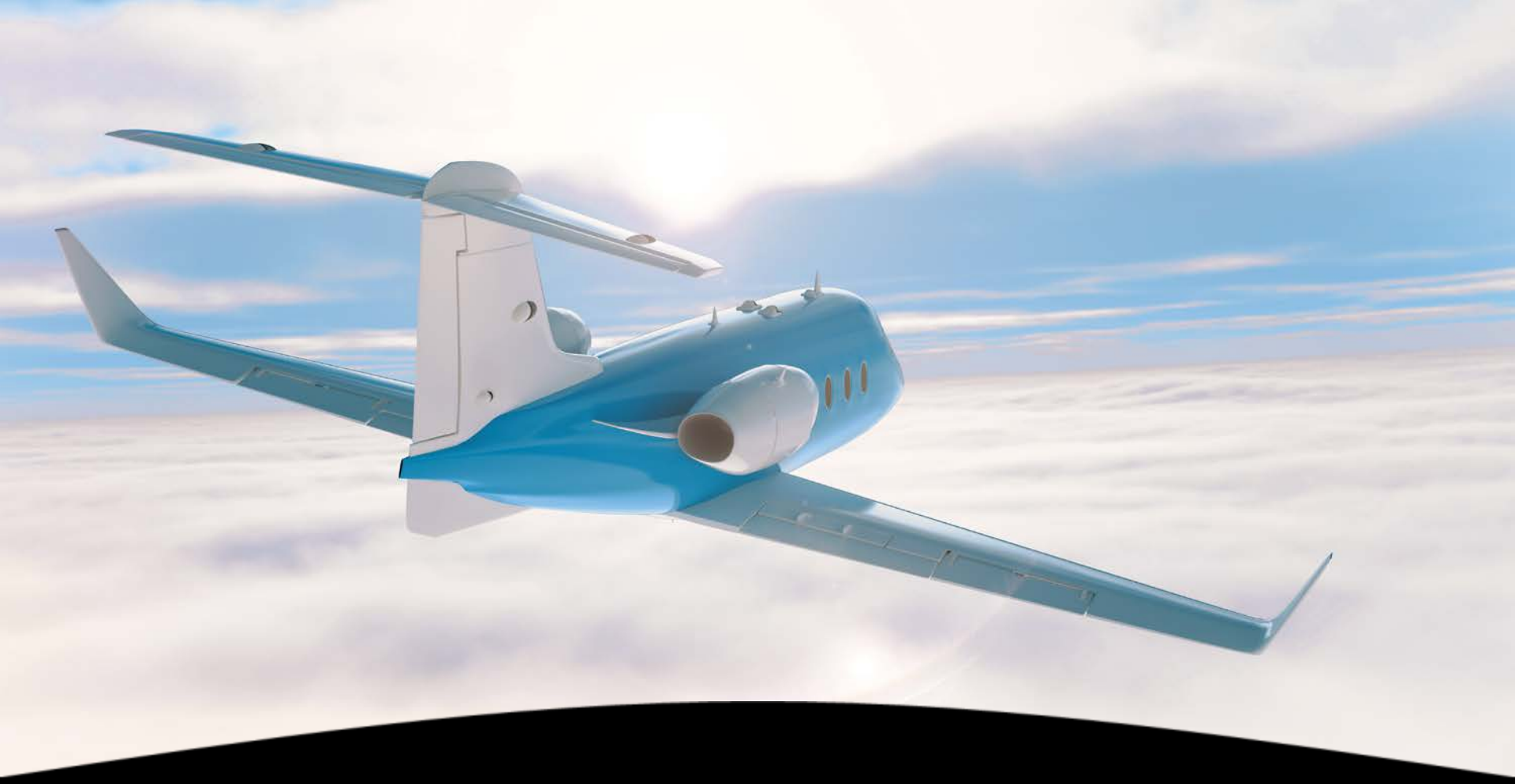
Honeywell

- **Unresolved Issues within PM-CPDLC / ATN Network**
  - Delays in Ground Station Network Roll-out
  - Technical Issues
  - Interference, coverage
  - Channel Congestion
  - Radio Issues/Lost Connections → *Provider Aborts and Network Delays*

http://ec.europa.eu/transport/modes/air/single_european_sky/doc/implementing_rules/2014-04-23-easa-datalink-report.pdf

- **Loss of confidence Pilots and Controllers –**
  - Many Major Airlines have stopped Avionics upgrades

- **EASA / SESAR / European Commission Engaged**
  - SESAR JU VDL mode 2 study launch in January 2015
  - Honeywell Consortium Partner



Crash Protected Recorders

Honeywell

Crash Protected Recorders

Honeywell

- **Data Link Recording**
  - Records CPDLC Messages on the Cockpit Voice Recorder
- **FAA Mandate**
  - CVR is required to perform recording of datalink messages *if datalink system is installed on or after* the below dates:
    - Part 135: December 2010
    - Part 91: April 2012
- **EASA – Europe**
  - new delivered aircraft with CVR, operating in the EC
    - 8 Apr 2014
  - Unclear - retrofit proposed for 2016 (ICAO)
- **90 Day Beacons**
  - Forward Fit: March 2015
  - Retrofit: 2018-20 proposed

6518883

Crash Protected Recorders

Honeywell

- Models:
- LW-CVFDR-717 Combi (A717)
- LW-CVFDR-429 Combi (A429)
- LW-FDR FDR
- LW-CVR CVR

LW RECORDERS FAMILY

- Replaces Legacy HON AR FDR /CVR/Combi(s)
- CVR – Data Link Recording - 2hrs
- FDR – 25Hrs @1024words/sec
- Platforms:
- Dassault
- Other BGA
- Helo

90 Day Beacon Forward Fit
March 2015

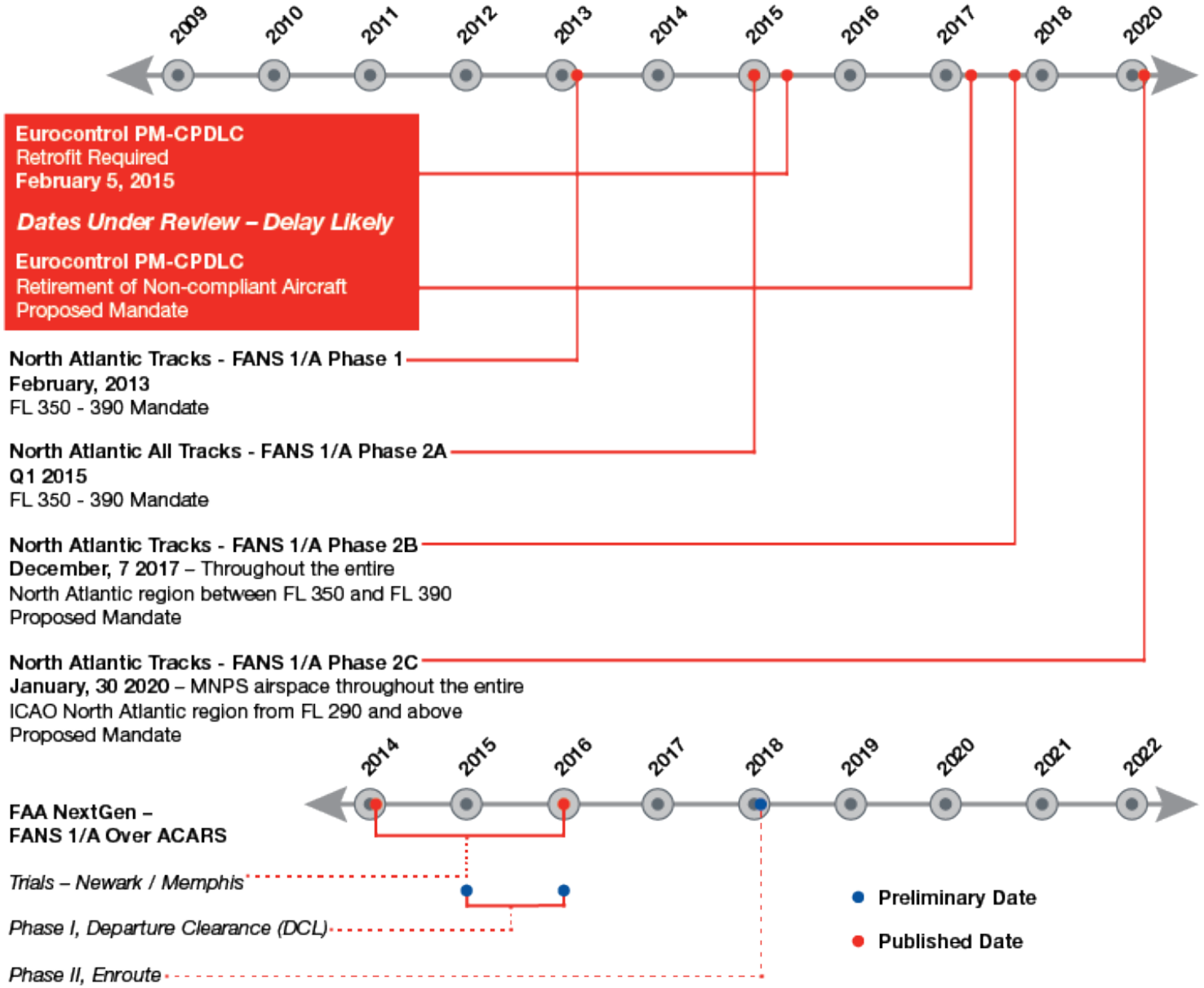
HFR5 FDR & CVR

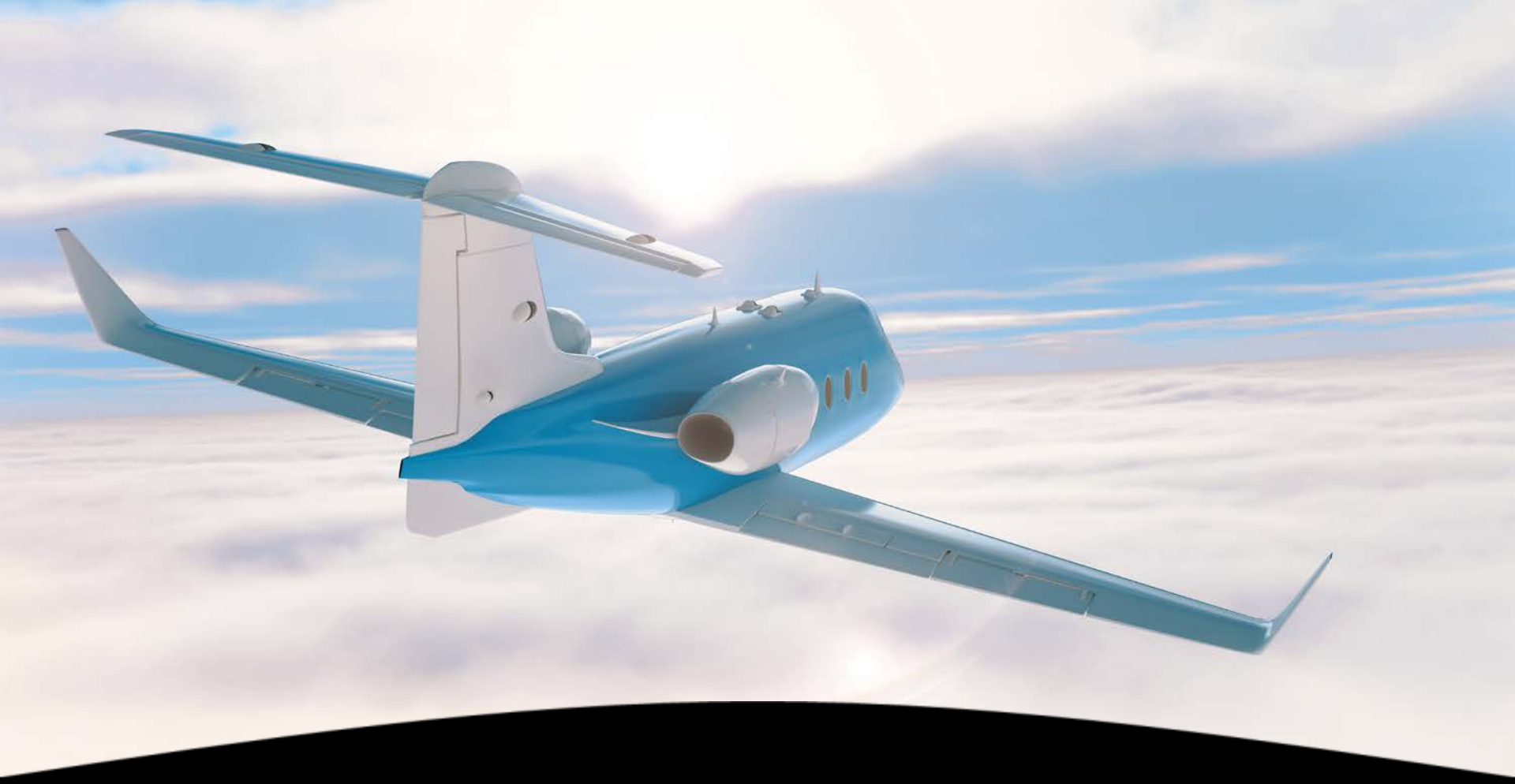
- Airbus SA-A318,A319,A320,A321 Airbus LR-A330, A340
- All Boeing (except 787)
- UAL installing HFR5-V via STC
- Global Express HFR5-V

90 Day Beacon (FF)
March 2015

FANS-1/A, PM-CPDLC Timeline Summary

Honeywell





ADS-B Overview

Honeywell

Why ADS-B

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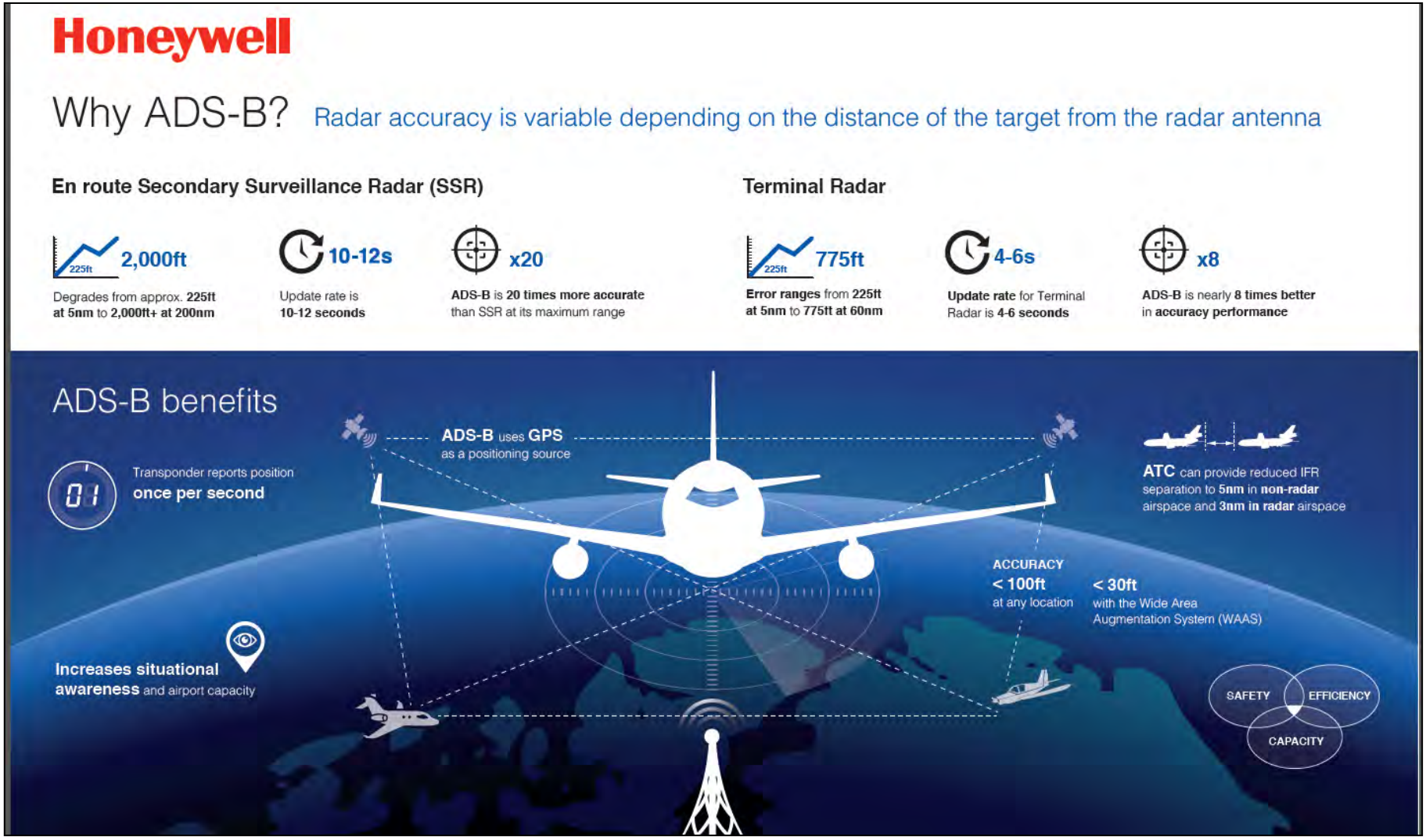


For ADS-B Upgrade

Honeywell

- **XPNDR Upgrade**
  - **TSO-C166b, TSO-C112d, and TSO C169a**
  - **DO-260B**
- **GNSSU Upgrade**
  - **TSO-C145b or TSO-C146b**
  - **GPS "Selective Availability Aware" (GPS SA)**
    - WAAS receiver meets this requirement
  - **Requires Active Antenna**
  - **Wired directly to XPNDR**
- **"ADS-B FAIL" and "ADS-B DGR" indications**
  - **CAS, display or independent lights**
- **Controller Upgrade**
  - **ADS-B Out "ON" or "OFF"**
- **FMS Upgrade**
  - **Require true heading, magnetic heading, magnetic heading status, vertical speed parameters delivered to XPNDR**

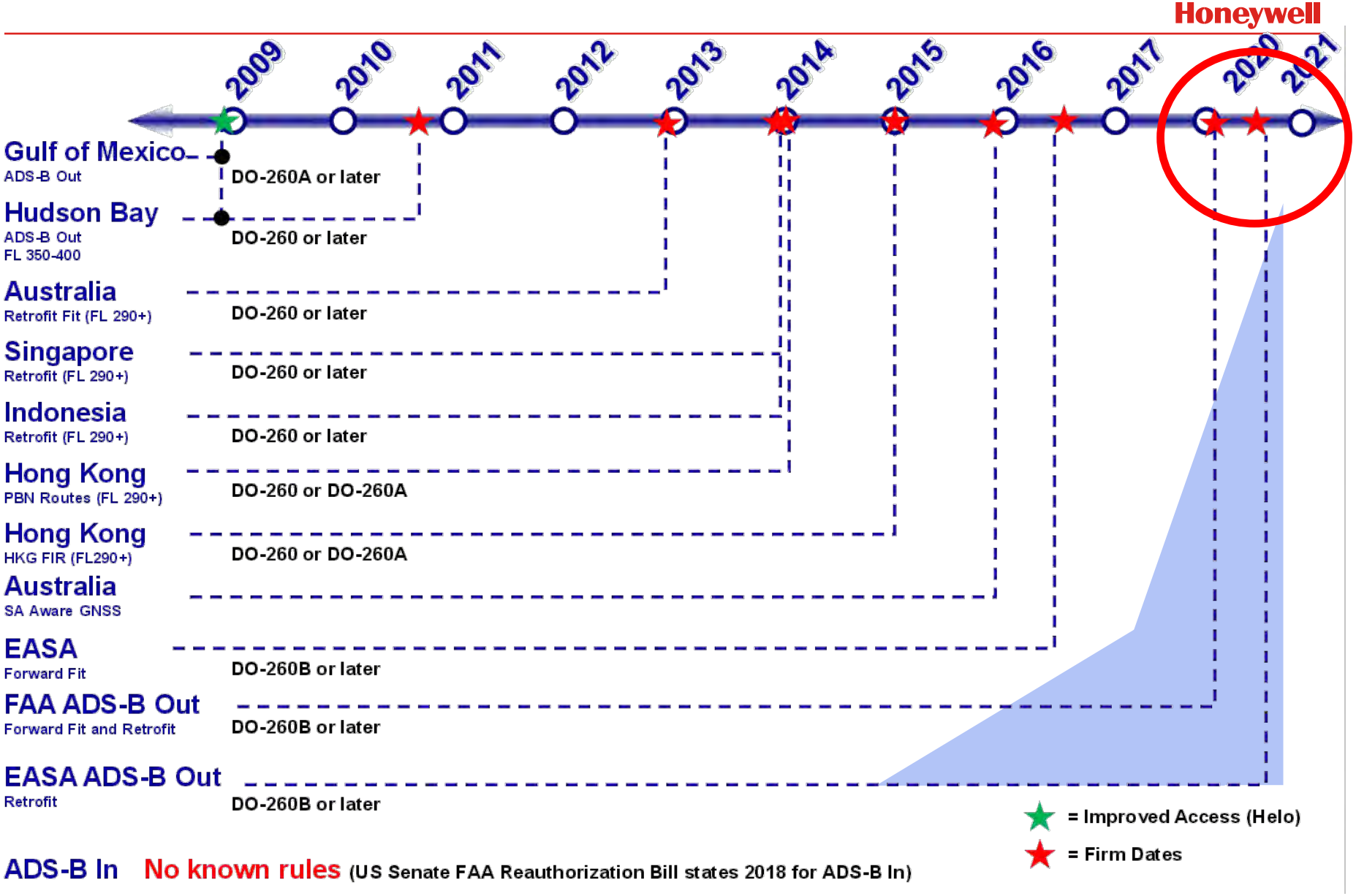
ADS-B is an Integrated System Solution

Honeywell – Epic and PII

Honeywell

- **XPNDR Upgrade (Epic and PII)**
  - ✓ TSO-C166b, TSO-C112d, and TSO C169a (DO-260B)
- **GNSSU Upgrade – TSO-C145b or TSO-C146b (RA Aware)**
  - ✓ Epic - VIDLG upgrade or MAU GPS Module Upgrade
  - ✓ Primus II – Honeywell older HG2101 GNSSUs – replace; Later HG2101GNSSU firmware upgrade; many systems utilize 3rd party GPS
  - ✓ Require Active Antenna
- **Controller Upgrade**
  - ✓ Epic – Display Software
  - ✓ Primus II Radio Management Unit – CRT Units have to be replaced / LCD Units software upgradeable
- **Primus II Communication Unit Upgrade**
  - ✓ Comm Module - Upgrade
  - ✓ Cluster Module - Upgrade
  - ✓ Strap Module - replace
- **FMS Upgrade**
  - ✓ Require true heading, magnetic heading, magnetic heading status, vertical speed parameters delivered to XPNDR
  - ✓ Epic – Version 7.1
  - ✓ NZ-2000 (IC600/800) – Version 6.1
  - ✓ 3rd Party FMS

Timeline



Note – Australia and FAA Mandates Also Require "SA Aware" GPS Receiver (i.e. WAAS)

Honeywell Mode S Transponders ADS-B Out Status

Honeywell

AESS

TRA-100B

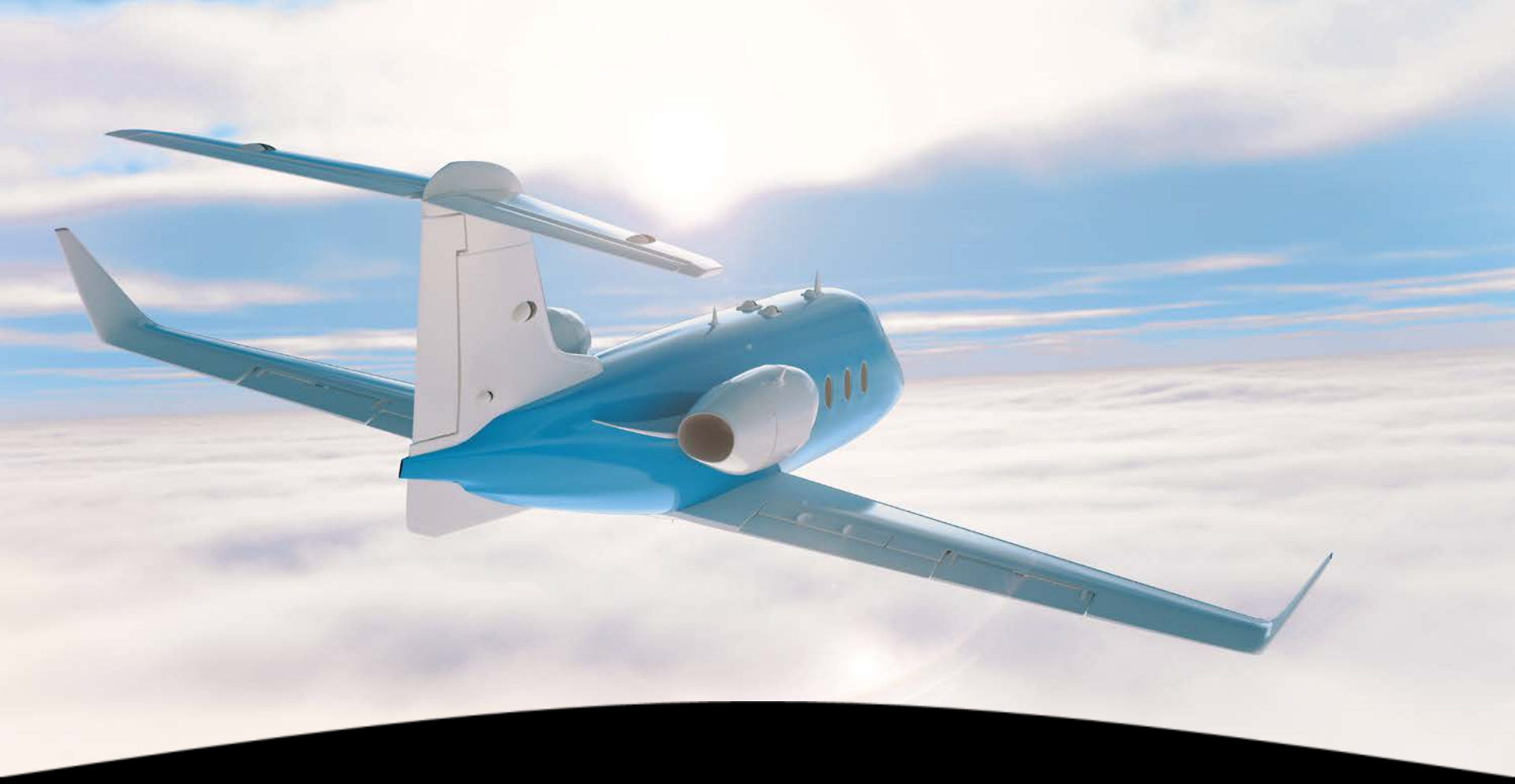
MST-100B

Epic Module

Primus II

Apex Module
KXP-2290

KT-73 Panel Mount



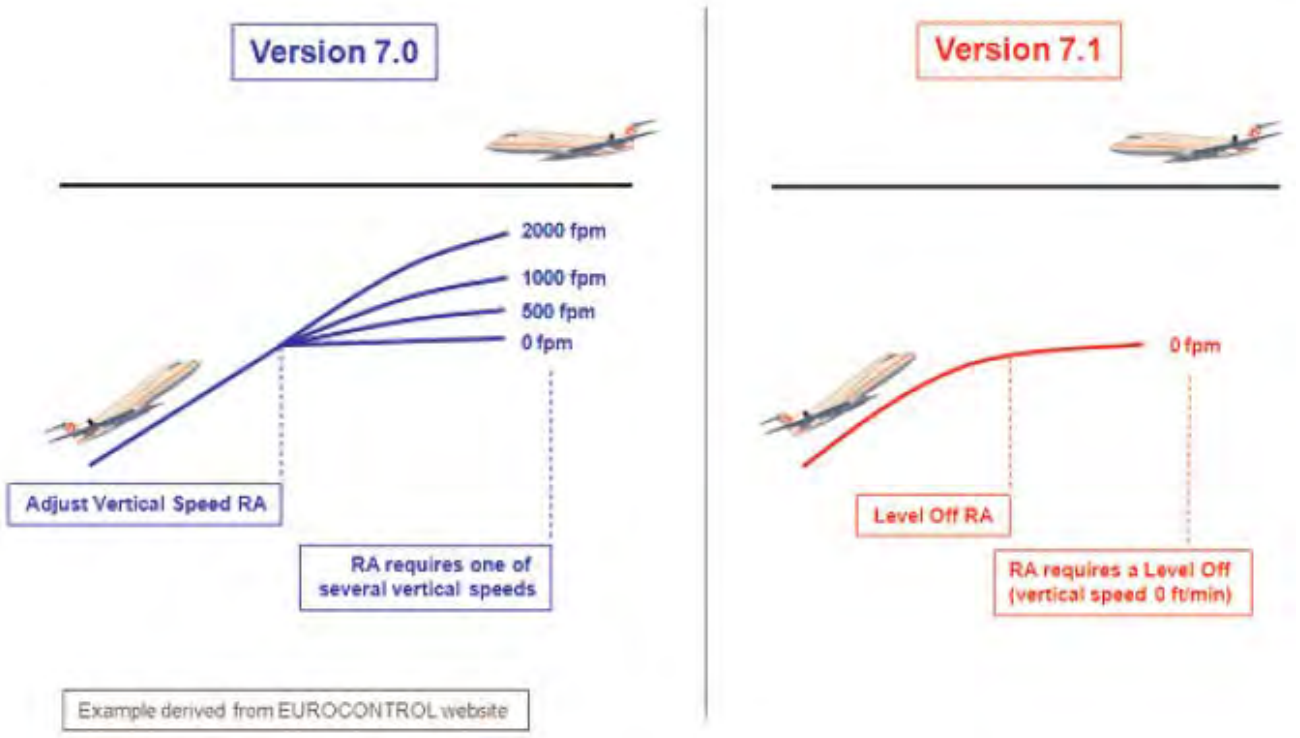
TCAS Overview

Honeywell

TCAS Change 7.1 – Adjust Vertical Speed

Honeywell

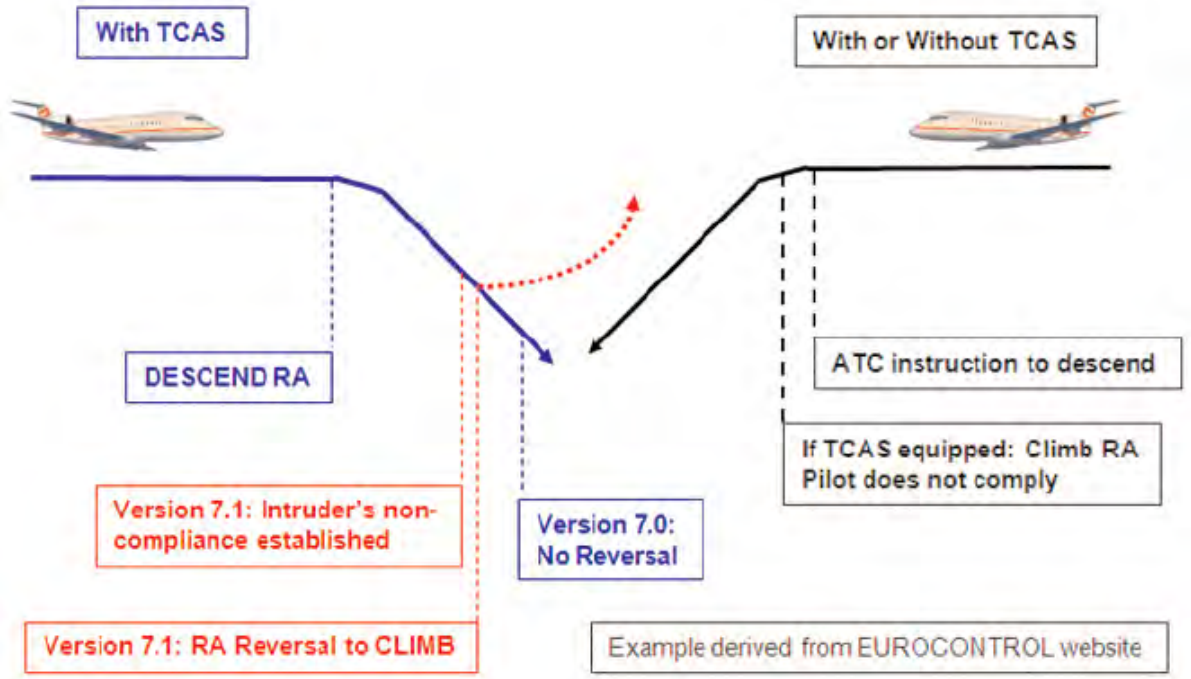
- **"Adjust Vertical Speed, Adjust" (AVSA) Resolution Advisory (RA) was determined to be confusing, and there is a history of some pilots not responding as intended**
- **The solution in Change 7.1 is to replace the four AVSA RAs with a single "Level Off, Level Off" RA.**



TCAS Change 7.1 – TCAS Reversals

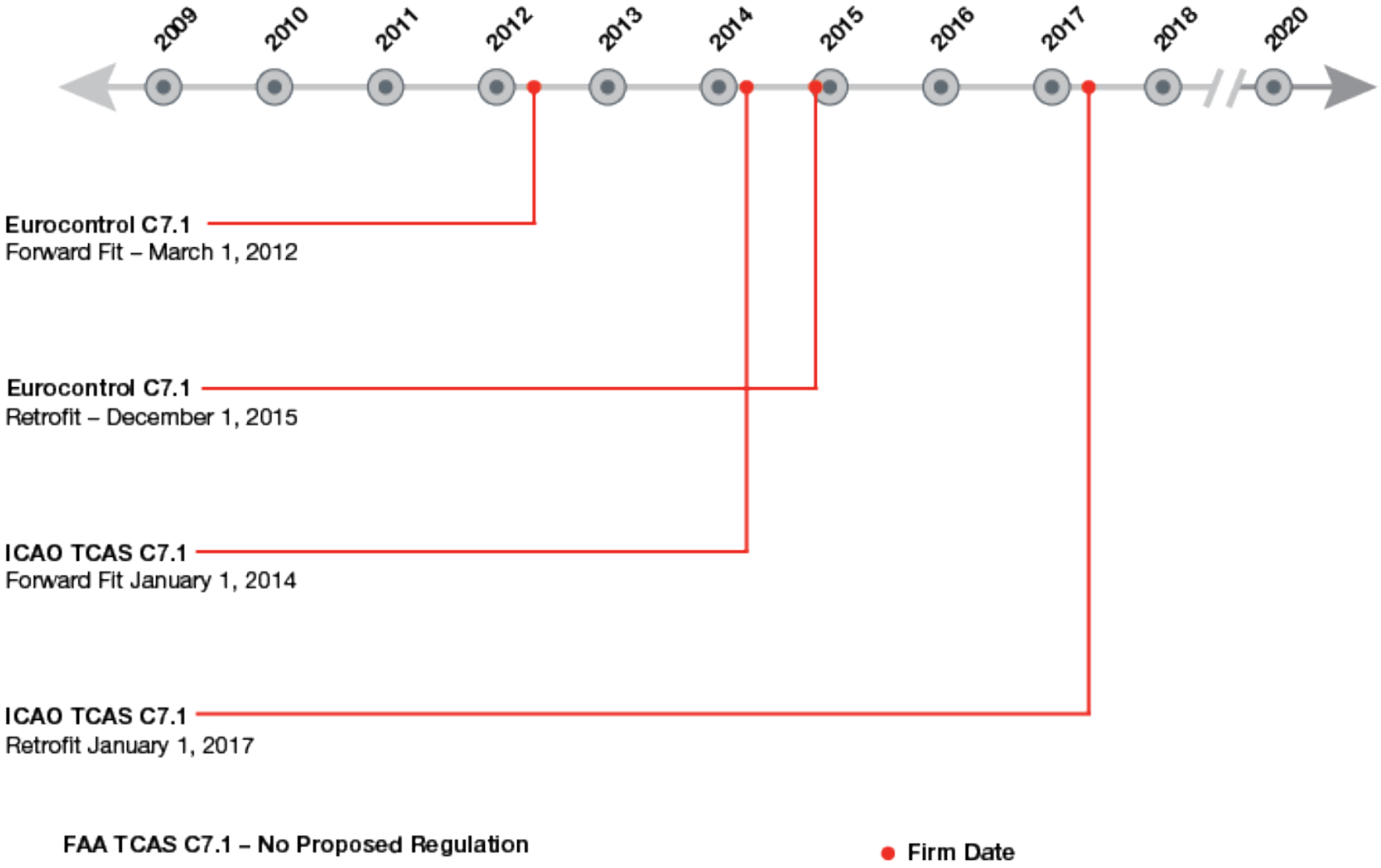
Honeywell

- **TCAS reversals were introduced in 7.0 to adapt to changing situations where the original guidance became the wrong thing to do if one of the pilots did not follow the RA or was instructed by ATC to perform a particular maneuver**
- **Change 7.1 improves this reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RAs**



TCAS Change 7.1 Regulatory Timeline

Honeywell



TCAS 7.1 Honeywell Solutions

Honeywell

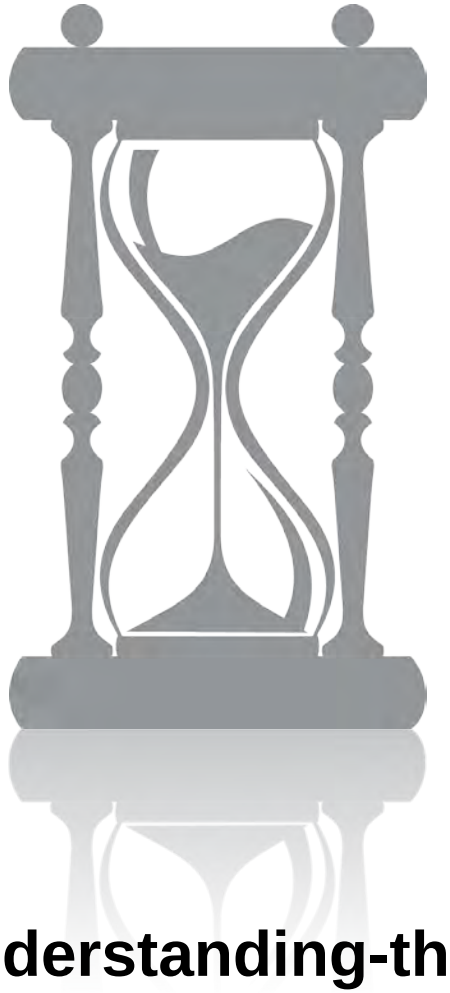
Product	Old PN	New PN	Availability
TPA-100B (6MCU)	940-0300-001	940-0351-001	Available Now
TPA-100B (4MCU)	940-0400-001	940-0451-001	Available Now
TPA-81	066-50000-XXXX	940-0351-001	Upgrade to TPA-100B
TPU-67	066-01146-1111	066-01146-2121	Available Now
TPU-67	066-01146-1211	066-01146-2221	Available Now

Sales Bulletins Currently in place 2016

TPU 67 is not ADS-B 'IN' capable

Time is running out….. Don’t be late to Mandates.

Questions?



Visit:
http://aerospace.honeywell.com/news/understanding-the-mandates-landscape