ADS-B Workshop – SP/12

Rockwell Collins Surveillance / Traffic / ADS-B / GPS Overview

Bombardier CSeries
Rockwell Collins Pro Line Fusion
Flight Deck

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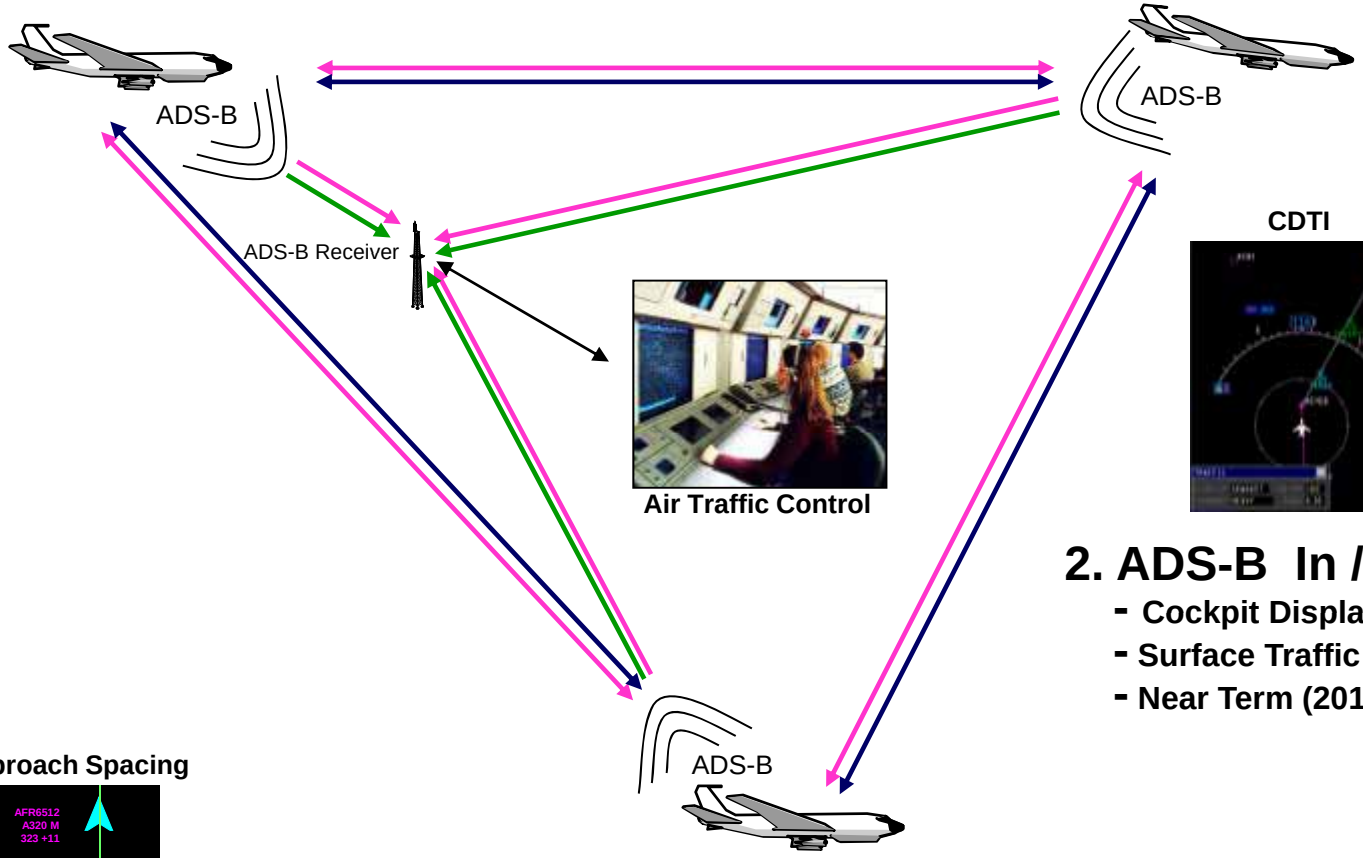
Uses of ADS-B (Short Reminder)

1. ADS-B Out

- Ground Surveillance Systems
- Current use (DO 260/DO26A/DO260B)



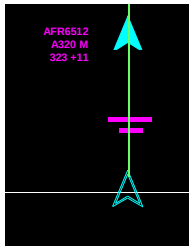
CDTI

Surface Ops

2. ADS-B In / Traffic Computer

- Cockpit Display of Traffic Information
- Surface Traffic Display
- Near Term (2010), Accelerates beyond 2012

Approach Spacing



3. Advanced ADS-B Procedures

- Closely Parallel Approaches, Approach Spacing, etc.
- Future (Beyond 2020)

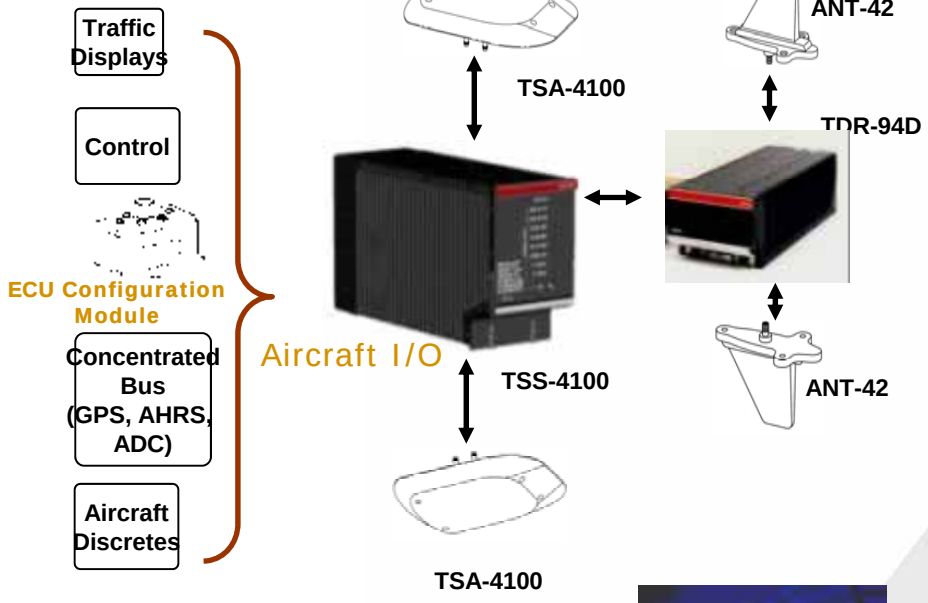
Phase 1 ADS-B IN Applications Summary

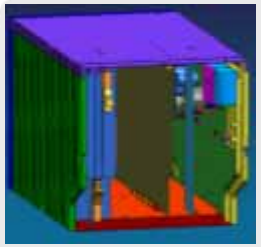
US Name	European Name	Applicable MOPS and Requirements	Description
Enhanced Visual Acquisition (EVAcq)	ATSA-AIRB	DO-289 MASPS, DO-317 MOPS	This application uses a cockpit display to enhance visual acquisition of air traffic. Provides the flight crew with the relative range, altitude, and bearing of other aircraft.
Enhanced Visual Approach (EVApp)	ATSA-VSA	DO-289 MASPS, DO-317 MOPS, DO-314 SPR	This application will enhance visual separation from other aircraft on approach. This will allow visual approach procedure operation arrival rates to be maintained, even during periods of reduced visibility (haze, fog, sunlight, etc).
Oceanic In Trail Procedure (ITP)	ATSA-ITP	DO-312, in service trials are expected in 2010,	A procedure employed by an aircraft that desires to change its flight level to a new flight level by climbing or descending in front of or behind an aircraft on the same track. Assists in maintainignthe standard longitudinal separation minimums.
Airport Surface Situational Awareness (ASSA)	ATSA-SURF	DO-289 MASPS, DO-317 MOPS	This application will reduce the potential for deviations and collisions through an increase in flight crew situational awareness while operating an aircraft on the ground. Display may be used to determine position of ground vehicles.
Final Approach and Runway Occupancy Awareness (FAROA)	[ATSA-SURF]	DO-289	This application will depict the runway environment and display traffic from the surface up to approximately 1,000 feet above ground level on final approach. It will help determine runway occupancy and detect ATC errors.

Requirements for Traffic Applications are being defined and published.

Rockwell Collins Status

Transponder and TCAS Product Lines



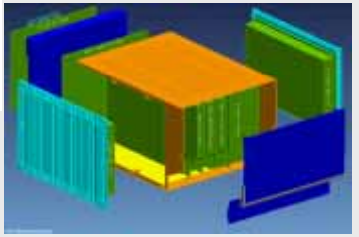


TTR-2100

TSS-4100

TPR-901

ISS-2100



TDR-94D

Rockwell Collins

Federated Transponder and TCAS Systems

TDR-94D Transponder – Design Features

Functionality

- Elementary and Enhanced Surveillance Compliant
  - RTCA DO-181C
- ADS-B Extended Squitter (Today)
  - DO-260A Change 2

Hardware

- RTCA DO-160D Compliant

Software

- DO-178B Level B Software Design

TDR-94D

TPR-901 Transponder – Design Features

Functionality

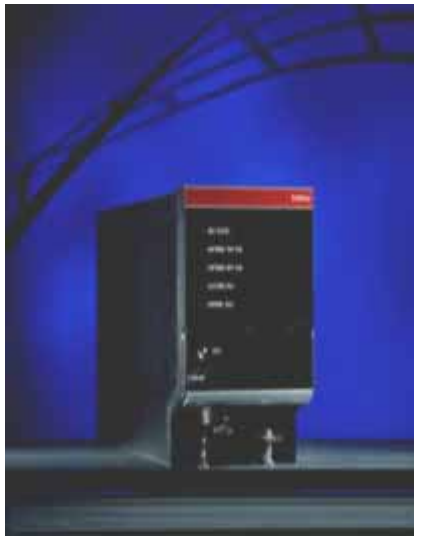
- Elementary and Enhanced Surveillance Compliant
  - RTCA DO-181C
- ADS-B Extended Squitter (today)
  - DO-260
- ARINC 615 Data Loadable Software

Hardware

- DO-160D Compliant Hardware
- Rear Interconnect - ARINC 718A - 3
- Dual Use Pins Allow Full Backwards Compatibility With ARINC 718-4 installations
  - Backward Compatible with TPR-720/900

Software

- Change 2.0 (DO-181A) Baseline Software
  - DO-178B Level B Software Design



TPR-901

TTR-921 / TTR-2100 TCAS – Design Features

- TTR-921
  - TCAS Change 7.1 TSOed – December 2010
  - Not Traffic Computer Enabled

- TTR-2100 in development for forward fit and retrofit
  - Plug and Play for TTR-921 and TTR-920
    - Uses existing TRE-920 Antenna
  - Traffic Computer Enabled
    - ARINC 735B Traffic Computer TCAS System
  - TCAS Change 7.1 compliant at entry into service

Parameter Description	Existing TTR-921	New TTR-2100
Interface Standard	A735A	A735B
Size	6 MCU	6 MCU
TSO types	C112 and C119	C112 and C119
TSO Complete	1999	May 2012
Availability Date	2000	July 2012
Part Number	822-1293-XXX	822-2911-XXX
Estimated Weight	17.7 lbs	<14
Input Power	115VAC	115VAC
TCAS 7.1 Compliant	December 2010	Yes
Traffic Capable	No	Yes
Antenna Type	Phase (TRE-920)	Phase (TRE-920)
Qualifcation Levels	DO160D	DO160F

Rockwell Collins

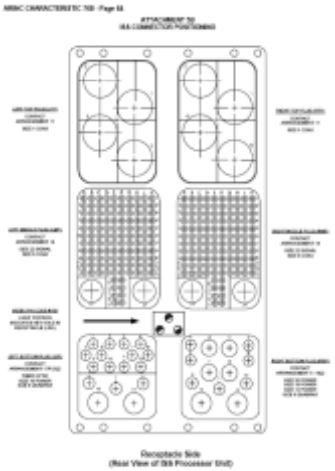
Integrated Transponder and TCAS Systems

TSS-4100 Integrated TCAS/Transponder - Design Features

- Transponder function
  - TSO C112/TSO 166
  - DO-181C Change 1 compliant mode A, C, S
    - Eurocontrol elementary surveillance, enhanced surveillance
    - 1090 MHz extended squitter certified to DO 260A Change 2
  - Antenna diversity operation, allowing automatic use of the upper or lower aircraft antenna based on signal strength
  - DO-178B Level B Software Design
- TCAS function
  - Transmit on 1030 MHz; Receive on 1090 MHz
  - TSO C119b and DO-185A Change 7
  - Traffic Computer Enabled

TSS-4100

PHYSICAL CHARACTERISTICS	
Connector	ARINC 768
Size	4 MCU
Weight	18 lbs maximum
Power	28VDC @ 95 watts



ARINC 768 Interconnect

ISS-2100 Integrated Surveillance System – Design Features

WFA-701X

DRV-2120

RTM-2100

8 MCU

ISS-2100

4 Functions Integrated

Weather Radar

Pedestal

8 MCU

TCAS

6 MCU

Mode S

4 MCU

TAWS

2 MCU

ISS-2100 Integrated Surveillance System – Design Features

- Transponder function
  - TSO C112/TSO 166
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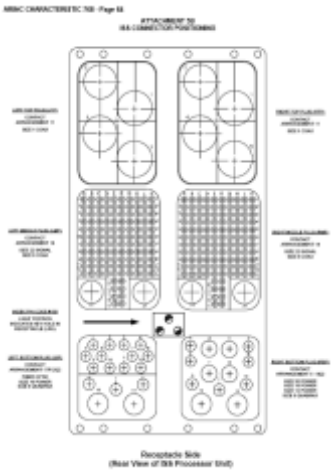
- TCAS function
  - Transmit on 1030 MHz; Receive on 1090 MHz
  - TSO C119b and DO-185A Change 7
  - Traffic Computer Enabled

PHYSICAL CHARACTERISTICS	
Connector	ARINC 768
Size	8 MCU
Weight	28 lbs maximum
Power	115VAC @ 200 watts (Max)



ARINC 768 Interconnect

- TAWS function
  - TAWS Map modes
    - Extended Map Mode, Centered Map Mode, Vertical Situation Display (VSD) Mode
  - TAWS Alert annunciations
    - Forward Looking Terrain Alerting, Terrain Floor Alerting,
  - Ground Proximity Alerting
  - TAWS Display Alert
    - Terrain colors Red = Warning Terrain, Yellow = Caution Terrain
- Weather Radar function
  - Weather Radar Drive Unit provides the mechanical mounting for a flat plate antenna
  - Weather Radar Receiver-Transmitter
    - Provides the RF transmit signals and down converts the received signals for processing
  - Fully Automatic MultiScan™ Weather Radar System
    - MultiScan™ features and function set
    - TSO C-63C Weather Radar, with Predictive Windshear and Turbulence Detection

TCAS Federated and Integrated Product Line History

2000-2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015+

End of new Production

TTR-921/4000

- Legacy Federated TCAS II

Production – Air Transport and Business Regionals → Service & Support

TTR-2100/4100

- Federated TCAS II
- Traffic Computer

Production

TSS-4100

- TCAS/Traffic Computer
- Transponder

Production – Business Regionals

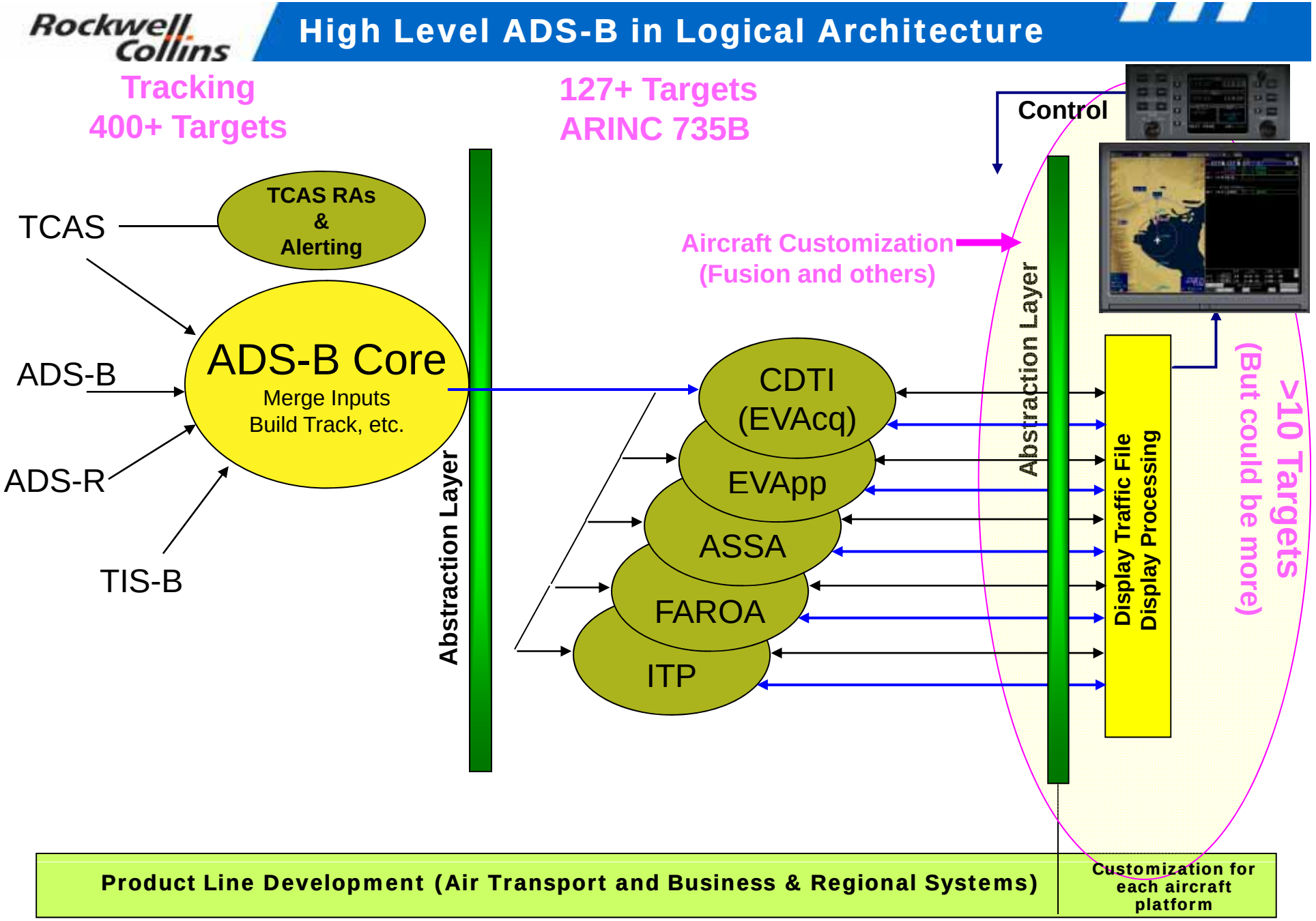
ISS-2100

- TCAS function/Traffic Computer
- Transponder function
- Weather Radar function
- Terrain Warning function

Production – Boeing 787

Common Traffic Computer and Traffic Apps.

High Level ADS-B in Logical Architecture



TSO Status

- Transponder DO 260B TSO
  - ISS-2100 (B787)
    - Coordination with Boeing
  - TSS-4100 (Integrated TCAS and Transponder)
    - Mid 2012
  - TDR-94D (Business and Regional Transponder)
    - Mid 2012
  - TPR-901
    - Mid 2012
- TCAS Change 7.1 TSO
  - ISS-2100
    - Coordination with Boeing
  - TTR-921 / 4000
    - November 2010
  - TSS-4100
    - January 2012

Multi Mode Receivers (MMRs)
GPS Sensors

Collins MMR Heritage and Leadership

Heritage

- Involved in GPS since late 1970s
- Championed MMR concept development in airlines industry since early 1990s
- Space shuttle flies with Rockwell Collins GPS.
- First to design and produce an MMR
- First to field operational GPS receivers in each segment: Ground, Airborne, Ship, Space
- Designed more versions of MMRs than any other company
- Produced more MMRs than any other company
- Collins was first to certify MMR with GPS, ILS, MLS, FMS, GLS and Marker Beacon
- Obtained first TSO and certification on Boeing 737 NG
- Preferred supplier to Airbus (Basic SFE on all platforms)

Leadership

- First TSO and certification for LAAS GLS. Currently CAT I capable and FAA plans to certify GLS to support CAT II and CAT III. Growth path in the roadmap.
- CAT I GLS operated by Qantas on B737NG in Sydney since December 2005
- Developed flight inspection MMR for FAA
- Provided AirServices Australia and ATMB MMR for flight inspection
- Deeply involved in next generation GNSS industry activities Galileo, GPS L5). RC is responsible for Galileo receiver task.
- FAA flight inspection aircraft using Rockwell Collins MMR for approach procedure development
- Preferred supplier to Airbus. Basic SFE on all platforms
- CAT I GLS operated by Qantas on B737NG in Sydney since December 2005. QF completed 2000 GLS approach in revenue service at SYD on September 2009.
- Sole source on B747-8, A350XWB and Basic on A380

Multimode Receivers – GPS + Landing Receivers

GLU-920

- Highest installed digital MMR
- GPS + Cat IIIB ILS
- Tracks 24 Satellites
- Intermixable with GLU-925
  - On Boeing A/C
- TSO c129
  - RAIM, FDE, Baro Aiding
- Certified on
  - Airbus: A300, A310, A320 Family and A330/A340,
  - Boeing: 737NG, 747-400, 757/767, 777
- "SA Aware" Available via Service Bulletin and new units in 4 Qtr 2010
- End of 2011 end of production expected

GLU-925

- Updated Version of the GLU-925
- GPS + Cat IIIB ILS + Cat I GLS (Option)
- Tracks 24 Satellites, RAIM, FDE, Baro Aiding, "SA Aware"
- TSO c129a
- Intermixable with GLU-920 (on Boeing A/C)
- Certified on
  - Airbus: A320, A330/A340; standard on the A350XWB and A380
  - Boeing: 737NG, 747-400, 757/767, 777; Standard on 747-8
- Planned Updates:
  - GLS Cat II/III
    - TBD – Based on Trials Programs / Market Demand
  - SBAS
    - Under evaluation / Market demand

Certification Status

	Part Number	Functionality				Certification Available
		ILS	GNSS	GLS	FLS	
GLU-910 Boeing & Airbus	822-1151-001					Available
GLU-920 Boeing & Airbus	822-1152-xxx					
GLU-925 Boeing / Airbus	822-1821-001 822-1821-430					737NG, 777 , 747-400 - Available 767 – TBD Airbus SA and LR - Available
GLU-925 Boeing	822-1821-330					737NG – Available 747-8 – At Entry into Service 777 – TBD GLS included in Block 16 upgrade, 767, 747-400 – TBD
GLU-925 Airbus	822-1821-430					A380 - Available A320 – Awaiting Approval (FLS) A340-500/-600 –4Q11 (FLS) A330 – 1Q11 (FLS) A340 Basic – 2011 (FLS)
GLU-925 Airbus	822-1821-430					A380 – Available A320 – Available (GLS) A330 – 1Q11 (GLS) A340-500/-600/Basic – 2011

Analog and Stand-Alone GPS Receivers

GNLU-930

- Analog Version of the GLU-920
- Replaces the 51RV-4B
- GPS + ILS + VOR + MB
- 24 Satellites, TSO c129, RAIM
- Certified on
  - Boeing: 737 Classics, MD-80/-90 Series
- SA Aware
  - TBD – As Market Dictates

GPS-4000S

- Common GPS Receiver / chip set with GLU-925
- GPS and SBAS Sensor
- 24 Satellites, RAIM, FDE, Baro Aiding, SBAS, “SA Aware”
- TSO c129 and c145a
- Certified on
  - Boeing: 737 Classics
  - Bombardier CRJ Series
  - Other business and regional aircraft
- Basic on aircraft with Rockwell Collins flight deck’s

Thank You