ADS-B SITF/12

SP/12

Rockwell Collins ADS-B Out, In and GNSS Product Update

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ADS-B OUT

Rockwell Collins

Typical ADS-B Out Equipage Summary

Transponder

DO-260 / DO-260B Standard

+

GPS/GLU

GPS Input wired to Transponder

+

Minor Aircraft

718A-3/4 Standard

- Transponder update to DO260B
  - Newer Transponders can be updated via SB (SW + minor HW SB)
  - –Replacement transponder units for older aircraft
- GPS equipment update to ADS-B Out position accuracy and "SA OFF/aware"
  - –Most GPS units can be updated via SB (SW + minor HW SB)
  - –GPS unit replacements for a smaller quantity of older aircraft
  - –Some older aircraft without any type of GPS unit
- Aircraft wiring impact
  - –GPS inputs to transponder
  - –718A-3/4 interface definition wiring

Mandate Summary (DO-260, DO-260B)

- Europe (DO-260B)
  - Forward Fit Mandate Jan 2015, Retrofit Mandate now Dec 2017
- Australia Upper Airspace (DO-260)
  - 12 December 2013 for Class A aircraft above FL290
  - All IFR capable aircraft
- Canada Hudson Bay & areas with limited SSR coverage (DO-260)
  - November 2010 Exclusionary Airspace
    - 5 NM separation services being offered
  - No plans for a 260B mandate
- US DO-260B mandated by 2020
  - No FF to RF segmentation – 100% equipped rule
- Hong Kong (DO-260)
  - 12 Dec 2013 on PBN routes L642 or M771 ≥ FL290
  - 31 Dec 2014 all aircraft within HK FIR ≥ FL290
- Singapore (DO-260)
  - 12 Dec 2013 all aircraft within Singapore FIR ≥ FL290

GPS Requirements for DO-260B Mandate

- **Europe**
  - The European Rule asks for (E)TSO-129A as a minimum
  - SA=ON is acceptable
    - Though SA=OFF (Aware) is preferred

- **Canada**
  - SA=ON is acceptable
    - Though SA=OFF (Aware) is preferred

- **United States**
  - A GPS receiver that is SA Aware will be necessary
    - FAA requirement is for a NACp of 8
    - 100% availability along enroute will determine GPS requirements

- **The quick summary of SA=Off/AWARE or SA=ON**
  - Australian rule will require SA Aware for forward fit (December 2016)
  - FAA rule will require SA Aware at a minimum
  - Europe recommends SA aware (doesn't require)
  - Canada recommends SA aware (doesn't require)

ARINC 718A-3/4 Update - An indication of the changes

- The development of DO-260B has required additional changes and more inputs into the transponder
  - GPS Antenna Position to support POA
    - Requires about 32 states for ~ 2 meter accuracy
  - Other installation related issues are being addressed in the A718-4 work

Function	# Pins	States
Aircraft Length/Width	4	16
SIL	2	3
NACv	3	8
Aircraft Category	3	8
POA	1	2
Total	13	37

Current 718A-2 Program Pin Utilization

Function	# Pins	Required States (Available States)
Aircraft Length/Width	3	16 (27)
SIL	1	3
NACv	2	8 (9)
Aircraft Category	2	8 (9)
GPS Antenna / POA	4	32 (81)
Spare	1	3
Total	13	

Compatible with

Minimum Subset
(ARINC 718A -2 attachment 2B-1)

AND

Minimum TIF
(ARINC 718A-2 Attachment 2C-1)

Function	# Pins	States
Spare	5	243

Additional program pins available with Minimum Subset
(ARINC 718A -2 attachment 2B-1)

Note: Estimates of states assumes 3 state program pins.

Minor changes are being incorporated in 718A-4

Federated Transponder – TDR-94D

For business/regional aircraft

Functionality

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

Hardware

- RTCA DO-160D Compliant

Software

- DO-178B Level B Software Design

TDR-94D

Federated Transponder – TPR-901

- For Air Transport aircraft

- 822-1338-021 (Airbus) 822-1338-003 (Boeing)
  - Elementary Surveillance & Enhanced Surveillance
  - ADS-B Out DO-260 (Extended Squitter)
  - DO-181C and JTSO 2C112b
  - Interface standard ARINC 718A or 718-4
  - DO-160D

- 822-1338-004 (B747-8 Only)
  - Elementary Surveillance & Enhanced Surveillance
  - ADS-B Out DO-260A Change 2 (Extended Squitter)
  - TSO C166
  - Updated to DO-181D (ED-73C) and TSO C112c (ETSO C112c)
  - DO-160D

- 822-1338-225 (Airbus) and -205 (Boeing)
  - Elementary Surveillance & Enhanced Surveillance
  - ADS-B Out DO-260B
  - TSO C166b
  - DO-181E (ED-73C) and TSO C112d (ETSO C112c)
  - Interface standard 718A-4
  - **DO-160G**

DO-260B Certification planned for 3rd Qtr 2013

TPR-901 Position Jumping Fix

- Previous reports of some Boeing aircraft with TPR-901 flying ADS-B routes in Australian airspace whose position reports have either disappeared or have been erratic.
  - This condition has been referred to as position jumping

- SB503 was released in March 2011 to create more robust filtering to eliminate position jumping issue
  - P/N -003 updated to -005
  - Results is satisfactory

Integrated Transponder

- Business and Regional Aircraft

TSS-4100
- 4 MCU
TCAS, Traffic Computer, Transponder

DO-260B Certification planned for 4th Quarter 2013

- Air Transport Aircraft

ISS-2100
- 8 MCU
TCAS function/Traffic Computer
Transponder, Weather Radar and
Terrain Warning functions

DO-260B Certification planned for 3rd Quarter 2014

ADS-B In (Traffic Computer)

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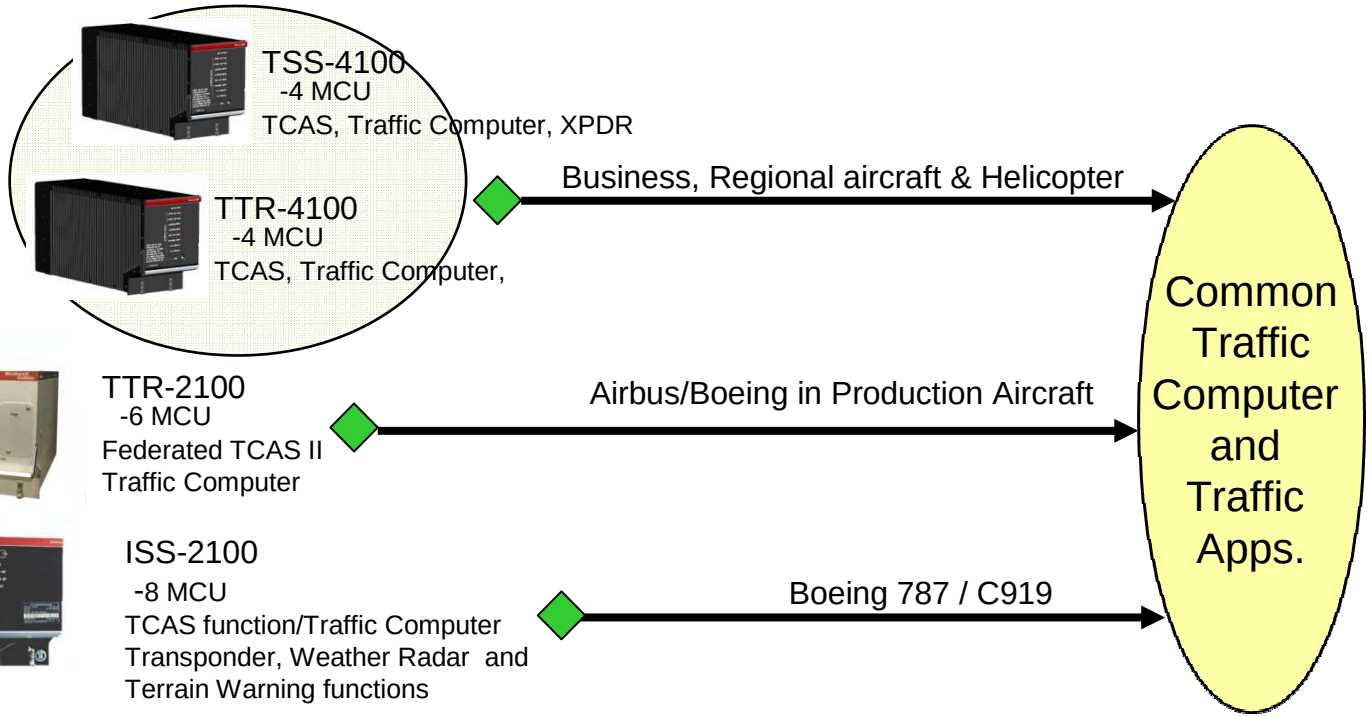
TCAS with Traffic Computer Summary

Next Generation TCAS and Traffic Computer Product Line Developments

- TTR-2100 is Plug and Play with the TTR-921
- All products are Traffic Computer Capable
- Using a common traffic computer architecture
- Product line ADS-B In applications development
  - Though will require display customization for each aircraft type



Common Traffic Computer Design enables re-use of ADS-B In Applications

ADS-B In Airborne Traffic Apps. Fully Developed Standards

Application Category	US Original Name	Harmonized Name	System Rqmts. (MASPS/SPR)	Applicable MOPS	Brief Description	RCI Role in Standards Development
Situational Awareness	Enhanced visual Acquisition (EVAcq)	ATSA-AIRB	DO-289 DO-319	DO-317A	Situational awareness for airborne traffic.	Review
	Enhanced Visual Approach (EVApp)	ATSA-VSA	DO-289 DO-314	DO-317A	Assist the flight crew in acquiring and maintaining visual contact during visual seperation on approach.	Active Participant
	Oceanic In-Trail Procedure	ATSA-ITP	DO-312	DO-317A	Assist flight crew to determine whether the initition criteria for oceanic climb or descend through are satisfied.	Review
	Airport Surface Situational Awareness (ASSA)	ATSA-SURF	DO-289 DO-322	DO-317A	Situational awareness for surface traffic.	Lead
	Final Approach and Runway Occupancy Awareness (FAROA)	ATSA-SURF	DO-289 DO-322	DO-317A	Situational awareness for near runway traffic.	Lead

Note: MASPS = Minimum Aviation System Performance Standards
MOPS = Minimum Operational Performance Standards
SPR = [Operational,] Safety and Performance Requirements

ADS-B: DO-317A Traffic Symbology

DO-317A Traffic

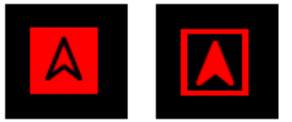


Figure 2-21 Directional TCAS RA Symbols (Examples)

Figure 2-20 Directional TCAS TA Symbols (Examples)

Figure 2-18 Directional and Non-directional Proximate Traffic Symbols (Example)

2.3.4.2.3.2 Traffic Symbols and Variations

The "basic" traffic symbol is used to depict general airborne traffic, including TCAS Other traffic. Traffic symbols can be modified from the basic symbols to provide special status information, such as on ground, selected, designated and alerted.

Figure 2-14 Basic Directional Traffic Symbol (Example)

Figure 2-15 Basic Non-directional Traffic Symbol (Example)

Non-directional symbol use TCAS RA

Non-directional symbol use TCAS TA

Non-directional symbol same as TCAS

Non-directional symbol same as TCAS

TCAS

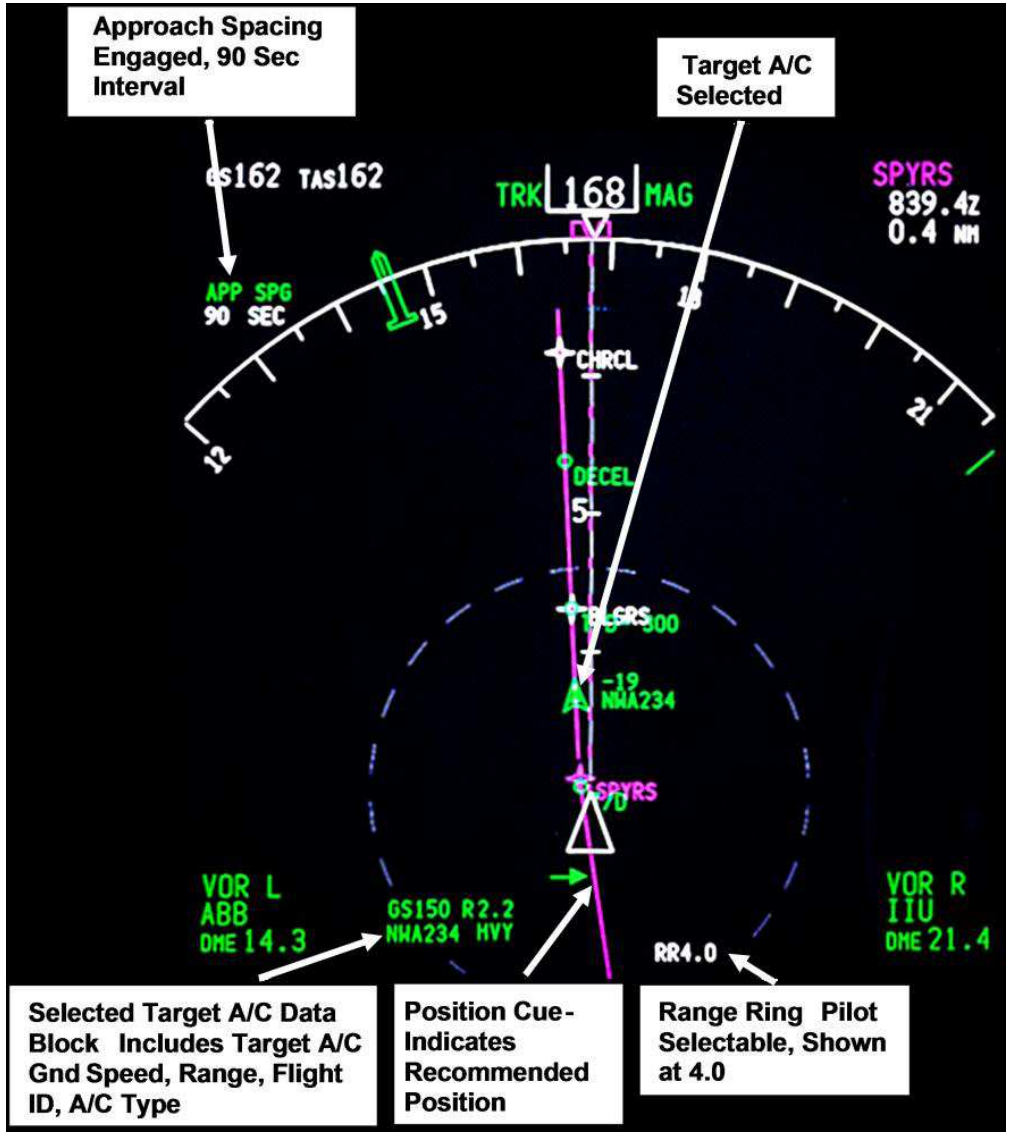
RA

TA

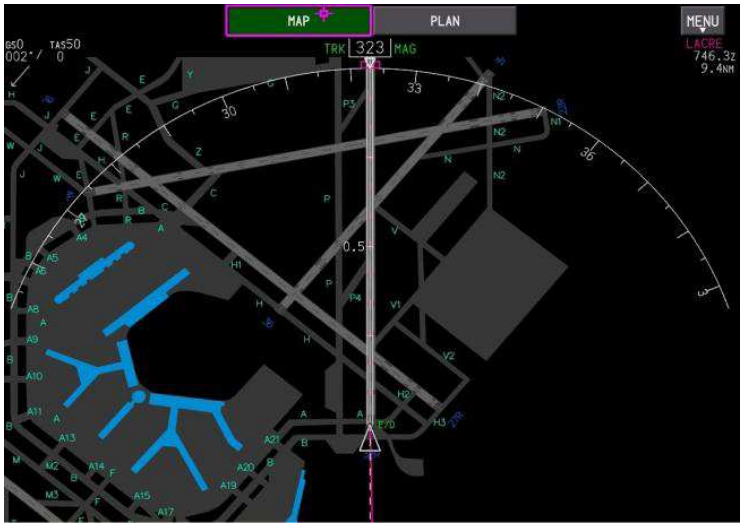
Proximate

Other

Airport Surface with Traffic



Merging & Spacing



Airport Moving Maps and SURF-IA

ADS-B IN Summary

- Today, no mandate exists for ADS-B IN.

- ADS-B IN is a function of ADS-B Out.
  - Hence, mandate exists for ADS-B Out. All aircraft worldwide must be ADS-B Out before benefits of ADS-B IN can be realized.

- Rockwell Collins TTR-2100 is ARINC 735B Traffic Computer, and certified forward fit by both Boeing (by end of 2013) & Airbus (mid 2014).

- Once final MOPS & Standards are completed by FAA, Rockwell Collins will develop all approved ADS-B IN applications.

GNSS Requirements

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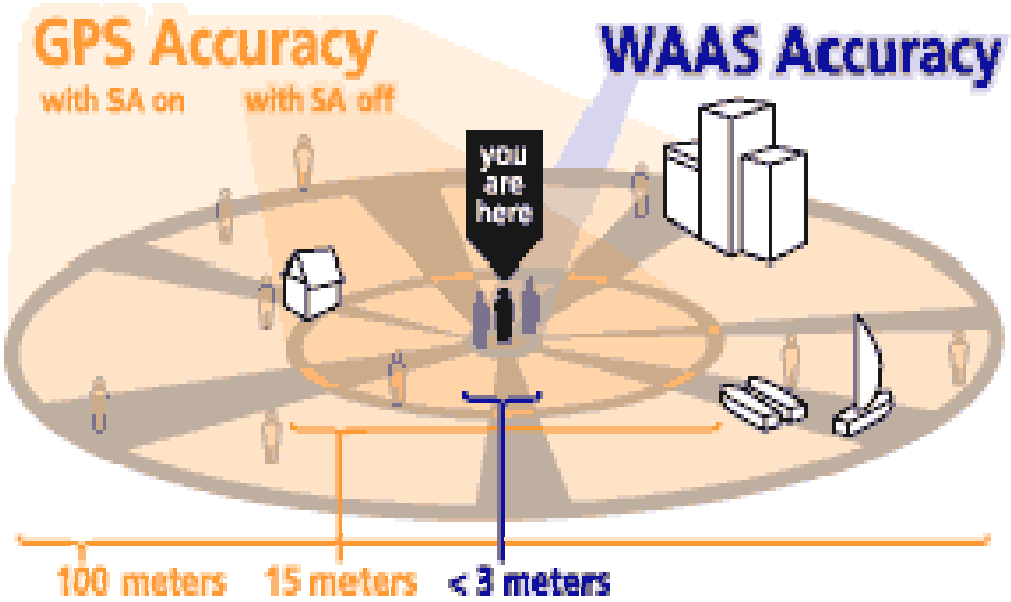
GLU Status

- **Current GLU-925 (SA = Aware)**
  - ILS (Category IIIB)
  - Compliant with DO-229D (without SBAS)
    - TSO 145A without SBAS
  - Provides NIC ≥ 7 (99.9% availability)
  - Accommodates Category I GLS
    - GLS Category I Certified on Airbus & Boeing aircraft
  - Supports SIL = 3 for ADS-B Out
    - System Integrity Limit
  - FLS (FMS Landing System) Capability
    - Airbus platforms only
- **Current GLU-920 (SA = On)**
  - ILS (Cat IIIB)
  - Compliant with TSO-C129A
    - SA=On
  - SA=Off Service Bulletin available today (Boeing)
    - Compliant with TSO-C129A
    - Will provide NIC ≥ 7 (99.9% availability)
    - Will not accommodate SBAS, GLS, or Galileo
- **Upgrade of GLU-920 to GLU-925**
  - SB 503 converts 920 to GLS 925 (Boeing)
  - SB 504 converts 920 to Non-GLS 925 (Boeing)
  - SB 505 converts the 920 to SA=Off (Aware)

GLS = GNSS Landing System
GLU = GNSS Landing Unit
SA = Selective Availability
SB = Service Bulletin
TSO = Technical Standard Order

A350 Will Integrate SBAS (WAAS) Capability into the MMR

Benefits Of SA Aware (SA OFF)



- 100 meters: Accuracy of the original GPS system, which was subject to accuracy degradation under the government-imposed Selective Availability (SA) program.
- 15 meters: Typical GPS position accuracy without SA.
- 3-5 meters: Typical LAAS (SBAS) position accuracy.
- < 3 meters: Typical WAAS (GBAS) position accuracy.

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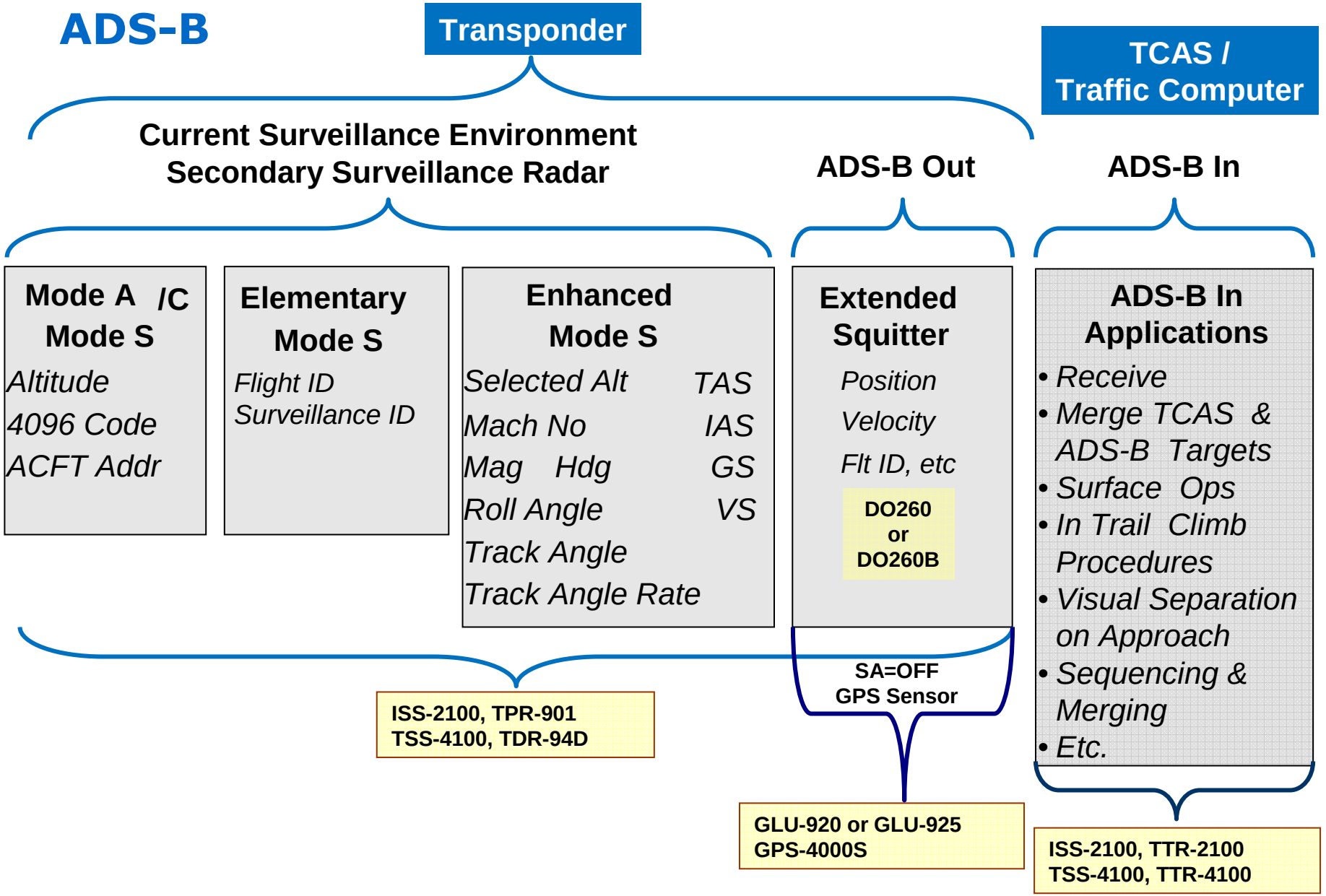
ADS-B



THANK YOU

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