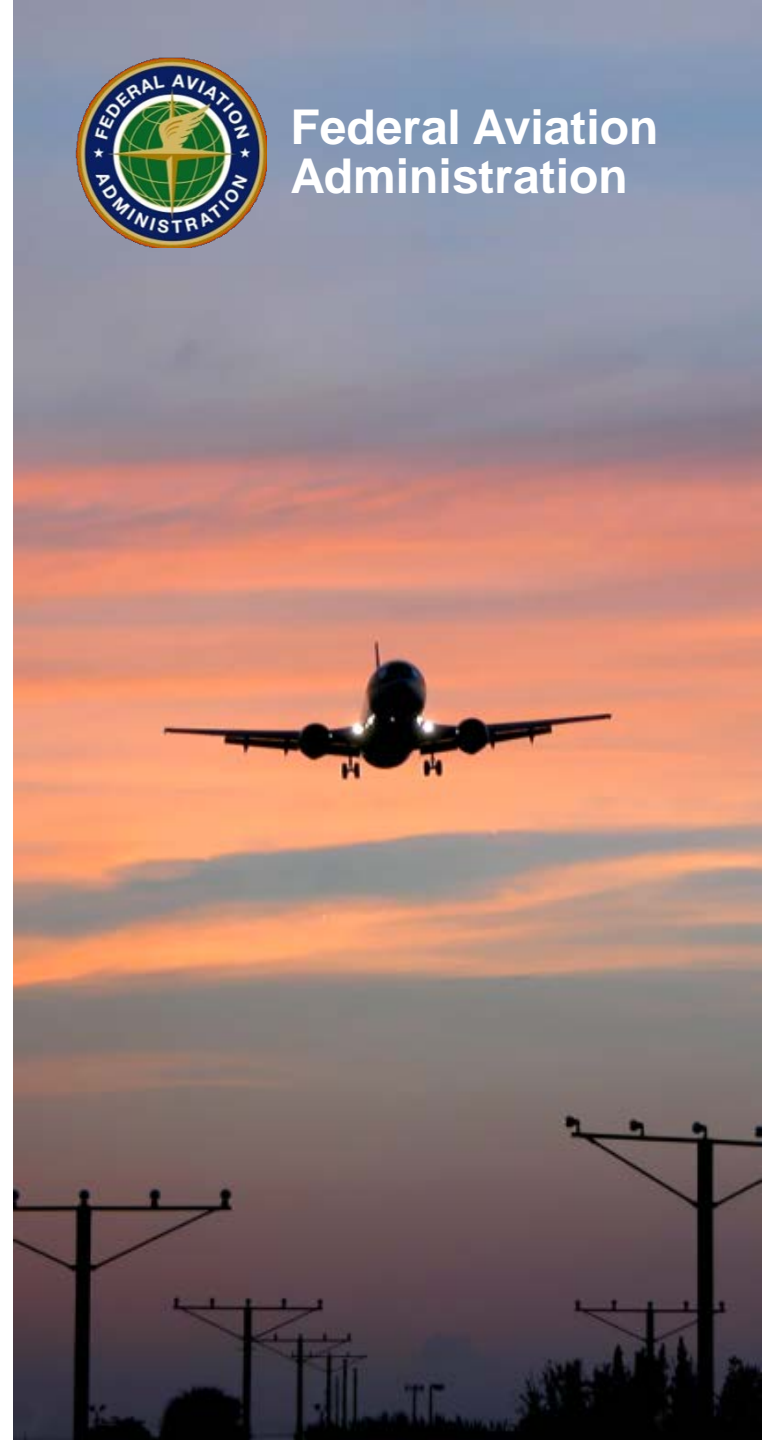




Federal Aviation
Administration

Differences of ADS-B Version 0, 1, and 2

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Outline

- **Background of Version 0, 1, and 2.**
- **Differences between ADS-B Versions.**
- **Transition of Quality Parameters**
- **Conclusion**



Background of Version 0, 1, and 2

- During the fourth ANI/WG meeting in Miami, the Surveillance Task Force noted the need for States to understand the differences between the various versions of ADS-B.
- There currently exists three versions of ADS-B:
 - Version 0 = DO-260/ED-102
 - Version 1 = DO-260A
 - Version 2 = DO-260B/ED-102A
- The purpose of this presentation and accompanying Information Paper is to outline the technical differences between the various standards of ADS-B.
 - Primarily, the focus is on the changes made to the quality parameters of both Airborne and Surface messages.

Background of Version 0, 1, and 2

- DO-260/ED-102 provided the initial standardization for ADS-B messages.
 - In the initial standard, the Navigation Uncertainty Category for Position (NUCp) was the only means to indicate the accuracy or integrity of the horizontal position data being used by the ADS-B system.
- DO-260A recognized the limitations imposed by only using NUCp. This led to the following changes in formats and protocols:
 - Allow the accuracy and integrity to be reported separately under the Navigation Accuracy Category for Position (NACp), Navigation Integrity Category (NIC), and Surveillance Integrity Level (SIL).
 - Addition of status parameters and ADS-B messages (e.g. Target State and Status) for Traffic Information Service – Broadcast (TIS-B) and Automatic Dependent Surveillance – Rebroadcast (ADS-R). Note that currently, the FAA is the only ANSP providing TIS-B and ADS-R services.

Background of Version 0, 1, and 2

- DO-260B/ED-102A was modified based on experience gained through the operational use of ADS-B data. Some of the important changes in DO-260B/ED-102A were:
 - Separation of position source and system integrity reporting.
 - Additional levels of NIC to better support airborne and surface applications.
 - Incorporation of the Broadcast of Mode A code into the emergency/priority message, increased transmission rates after a Mode A code change, and the broadcast of the Mode A code on the surface.
 - Including additional parameters in the Target State and Status Message.
 - Removed the ability to use the vertical component when calculating the NIC and NAC parameters.
 - Transition of specific Event-Driven Messages to Periodic Messages:
 - Target State and Status
 - Aircraft Operational Message
 - Aircraft Status Message
 - ADS-R formats were modified to be compatible with the changes introduced in Version 2.

Interoperability and Regulations

- The delivery of critical data (e.g. position, velocity, etc.) between Version 0, 1, and 2 are interoperable.
- Minor differences with non-critical data exists between Version 2 and previous Versions of ADS-B.
 - Table 4-1 in ICAO Doc 9871 outlines a list of differences.
- The United States and Europe have published a mandate requiring aircraft flying into specified airspace be equipped with ADS-B Version 2 avionics.
- Although similar, the published regulations differ slightly on the required parameters to be transmitted by the aircraft.
 - *Refer to Section 2.6 of the associated submitted IP/02.*

ADS-B Parameters

Parameters	U.S.	E.U.
Length and width of the aircraft	R	R
Latitude and longitude	R	R
Barometric pressure altitude	R	R
Velocity	R	R
TCAS II or ACAS is installed & operating in a mode that can generate resolution advisories	R	R
If a resolution advisory is in effect when an operable TCAS II or ACAS is installed	R	R
Mode 3/A transponder code	R	R
Aircraft Identification (the aircraft's call sign)	R	R
An emergency, radio, communication failure, or unlawful interference indication	R	R
“IDENT” indication (SPI)	R	R
Assigned ICAO 24-bit address	R	R
Emitter category	R	R
ADS-B In capability	R	O

Parameters	U.S.	E.U.
Geometric altitude	R	R
Navigation Accuracy Category for Position (NAC _p)	R (≥8)	R (≥7)
Navigation Accuracy Category for Velocity (NAC _v)	R (≥1)	R (≥1)
Navigation Integrity Category (NIC)	R (≥7)	R (≥6)
System Design Assurance (SDA)	R (≥2)	R (≥2)
Source Integrity Level (SIL)	R (=3)	R (=3)
Version number	R (=2 ⁴)	R (=2 ⁵)
Geometric Vertical Accuracy (GVA)	O	R
Vertical rate	O	R
GNSS antenna offset	O	R
Selected altitude	O	R
Barometric pressure setting	O	R

Differences between Versions of ADS-B

- As operational knowledge was gained, a transition occurred from event-driven messages to periodic messages.
- The following tables outline the version of ADS-B and the associated event-driven vs periodic messages:

DO-260/ED-102: Introduced periodic and event-driven messages.

Transponder Register	Event-Driven Message	1090ES ADS-B Message
BDS 0,5	No	Airborne Position
BDS 0,6	No	Surface Position
BDS 0,8	No	Aircraft Identification and Category
BDS 0,9	No	Airborne Velocity
BDS 6,1	Yes	Aircraft Status
BDS 6,5	Yes	Aircraft Operational Status

DO-260A: Added Target State and Status to the list of event-driven messages. BDS 6,2 was modified to represent both Emergency/Priority Status and ACAS RA Broadcast.

Transponder Register	Event-Driven Message	1090ES ADS-B Message
BDS 0,5	No	Airborne Position
BDS 0,6	No	Surface Position
BDS 0,8	No	Aircraft Identification and Category
BDS 0,9	No	Airborne Velocity
BDS 6,1	Yes	Aircraft Status / ACAS RA
BDS 6,2	Yes	Target State and Status Information
BDS 6,5	Yes	Aircraft Operational Status

Note: The fields in the Aircraft Operational Status Message were completely re-defined.

Differences between Versions of ADS-B

Transponder Register	Event-Driven Message Priority	1090ES ADS-B Message	Broadcast Rate		
			On-the-Ground, not moving	On-the-Ground and moving	Airborne
BDS 0,5	N/A	Airborne Position	N/A	N/A	2 / 1 second (0.4 – 0.6 sec)
BDS 0,6	N/A	Surface Position	LOW RATE 1 / 5 seconds (4.8 – 5.2 sec)	HIGH RATE 2 / 1 second (0.4 – 0.6 sec)	N/A
BDS 0,8	N/A	Aircraft Identification and Category	LOW RATE 1 / 10 seconds (9.8 – 10.2 sec)	HIGH RATE 1 / 5 seconds (4.8 – 5.2 sec)	HIGH RATE 1 / 5 seconds (4.8 – 5.2 sec)
BDS 0,9	N/A	Airborne Velocity	N/A	N/A	2 / 1 second (0.4 – 0.6 sec)
BDS 6,1	TCAS RA = 1 Emergency = 2	Aircraft Status (Emergency/Priority Status, Subtype=1) (TCAS RA Broadcast, Subtype=2)	TCAS RA or Mode A Code Change 0.7 – 0.9 seconds		
			No TCAS RA, No Mode A Change 4.8 – 5.2 seconds		
BDS 6,2	N/A	Target State and Status (TSS)	N/A	N/A	1.2 – 1.3 seconds
BDS 6,5	N/A	Aircraft Operational Status	4.8 – 5.2 seconds	No change NIC _{SUPP} /NAC/SIL 2.4 – 2.6 seconds	TSS being broadcast or not No change TCAS/NAC/SIL/NIC _{SUPP} 2.4 – 2.6 seconds
				Change in NIC _{SUPP} /NAC/SIL 0.7 – 0.9 seconds	TSS being broadcast Change in TCAS/NAC/SIL/NIC _{SUPP} 2.4 – 2.6 seconds
					TSS not broadcast ² Change in TCAS/NAC/SIL/NIC _{SUPP} 0.7 – 0.9 seconds

N/A = Not Applicable

Notes:

1. Transmitters are limited to no more than 2 Event Driven messages per second. Therefore, the average of 2 Airborne Position, 2 Airborne Velocity, 0.2 Identification, and 2 Periodic Status and Event Driven messages per second, averaged over any 60 second interval, yields the required 6.2 messages per second.
2. Not all aircraft broadcast the Target State and Status Message (see [Table 2-3](#)).

- In addition, it is important to note that Mode A code information was added to the Aircraft Status Message.

Differences between Versions of ADS-B

Parameter	ADS-B Message	DO-260	DO-260A	DO-260B	US	EU
NUC _p	Airborne Position	X			N/A	N/A
NUC _r	Airborne Velocity	X			N/A	N/A
NIC	Airborne Position Aircraft Operational		X	X	R	R
NAC _v	Airborne Velocity		X	X	R	R
SIL	Target State and Status Aircraft Operational		X	X	R	R
SDA	Aircraft Operational			X	R	R
NAC _p	Aircraft Operational		X	X	R	R
NIC _{BARO}	Target State and Status		X	X	N/A	N/A
L/W Code	Aircraft Operational		X	X	R	R
GVA	Aircraft Operational			X	O	R
Antenna Offset	Aircraft Operational			X	O	R
Selected Altitude	Target State & Status		X	X	O	R
Baro Pressure Setting	Target State and Status			X	O	R
TCAS II/ACAS Op	Aircraft Operational (DO-260B Only) Target State & Status	X	X	X	R	R
TCAS II RA	Aircraft Operational		X	X	R	R
Mode 3/A	Aircraft Status		X	X	R	R
ADS-B IN	Aircraft Operational			X	R	O

Conclusion

- As noted in the presentation and associated IP, differences exist between the different versions of ADS-B.
- It is important that each state determine the appropriate version of ADS-B Out required to meet their operational needs.
- In addition, each State should take into consideration the ASTERIX version required to process the desired version of ADS-B:
 - v0.23 for DO-260/ED-102
 - v1.0 or later for DO-260/ED-102 & DO-260A
 - v2.1 or later for DO-260/ED-102, DO-260A, and DO-260B/ED-102A