International Civil Aviation Organization

**AUTOMATIC DEPENDENT SURVEILLANCE –
BROADCAST SEMINAR AND ELEVENTH MEETING
OF AUTOMATIC DEPENDENT SURVEILLANCE –
BROADCASR (ADS-B) STUDY AND
IMPLEMENTATION TASK FORCE (ADS-B SITF/11)**

Jeju, Republic of Korea, 24 - 27 April 2012

Agenda Item 5:   **Report and updates by the leading member of the Task Force on Tasks Assigned**

DIFFERENCE BETWEEN DO-260, DO-260A AND DO-260B

(Presented by Hong Kong, China and Singapore)

SUMMARY

During the tenth meeting of the ADS-B Study and Implementation Task Force, it was noted that the difference between DO-260, DO-260A and DO-260B may perhaps provide additional useful functionalities in the ATM automation system. This paper analyses the difference between DO-260, DO-260A and DO-260B, and discusses some of the potential uses of the additional information available under DO-260A/B.

1. **INTRODUCTION**

1.1   During the tenth meeting of the ADS-B Study and Implementation Task Force, it was noted that the difference between DO-260/DO-260A and DO-260B may perhaps provide additional useful functionalities in the ATM automation system.

1.2   This paper compares and analyses the technical difference between the various standards. To go further, it also discusses some of the potential uses of the additional information available under DO-260A/B and readiness of the major suppliers for ATM automation systems in the APAC Regions in making use of the additional information.

2. **DIFFERENCE BETWEEN DO-260, DO-260A AND DO-260B**

2.1   Introduction of Navigation Integrity Category (NIC) as quality indicator (Appendix 1)

2.1.1   The NIC is introduced in DO-260A to replace the Navigation Uncertainty Category (NUC$_P$) used in DO-260 as the quality indicator. This has allowed more breakdowns in the levels of integrity of the positions. NIC is only displayed in Asterix CAT21 v1.0 or higher. The NIC Supplement information is only used in Asterix CAT21 v2.1, where the Position Integrity Category

(PIC) is calculated for the aircraft position. In the event that versions lower than v1.0 is used, NUC_P will be used as the quality indicator. Another subtle difference is that the vertical component of the containment radius (VPL) will not be taken into account for DO-260B.

2.2   Quality Indicator for Velocity (Appendix 2)

2.2.1   The Navigation Uncertainty Category for Velocity (NUC_R) in DO-260 is renamed as Navigation Accuracy Category for Velocity (NAC_V) in DO-260A. The definitions of the NUC_R and NAC_V are basically the same. However in DO-260B, the vertical component is removed from the NAC_V, the NAC_V only provides the quality indication for the horizontal component of the velocity.

2.3   Surveillance Integrity Level and Source Integrity Level (Appendix 3)

2.3.1   The Surveillance Integrity Level (SIL), which is the probability of exceeding the Integrity Containment Radius (RC) reported in the NIC without detection, is originally not available in DO-260. It is introduced in DO-260A. SIL is only displayed in Asterix CAT 21 v1.0 or higher.

2.3.2   In DO-260B, the Surveillance Integrity Level is redefined as Source Integrity Level, which is the probability of the reported horizontal position exceeding R_C, without alerting, assuming no avionics fault. A SIL supplement is introduced to indicate whether the SIL is based on per fight hour or per sample. The SIL supplement is only displayed in Asterix CAT 21 v2.1. The probability of avionics fault causing the reported horizontal position to exceed R_C, without alerting, is defined by the System Design Assurance.

2.4   System Design Assurance (SDA) (Appendix 4)

2.4.1   In DO-260B, the SDA is introduced to indicate the probability of undetected fault causing transmission of false or misleading information. The SDA is only displayed in Asterix CAT21 v2.1.

2.5   Navigation Accuracy Category for Position (NAC_P) (Appendix 5)

2.5.1   The NAC_P is introduced in DO-260A to show the accuracy of the position. This is different from the NUC_P (or NIC) which depends on Horizontal Protection Limit (HPL) or RC. The NAC_P will instead be derived from the 95% Horizontal and Vertical Accuracy Bounds (or commonly known as HFOM and VFOM). The NAC_P is displayed in Asterix CAT 21 v1.0 and above. In DO-260B, the vertical component of the NAC_P is removed. The vertical accuracy is indicated by the Geometric Vertical Accuracy (GVA). The GVA is only displayed in Asterix CAT 21 v2.1.

2.6   Barometric Altitude Integrity Code (NIC_{BARO}) (Appendix 6)

2.6.1   The NIC_{BARO} is introduced in DO-260A and DO-260B to indicate whether or not the barometric pressure altitude being reported has been crosschecked against another source of pressure altitude. The NIC_{BARO} is displayed in ASTERIX CAT 21 v1.0 or higher.

2.7   Length and width of aircraft (Appendix 7)

2.7.1.   The length and width of aircraft is introduced in DO-260A and DO-260B. The information is displayed in ASTERIX CAT 21 v 1.0 or higher.

2.8   Indication of capabilities (Appendix 8)

2.8.1   In DO-260A and DO-260B, the transponder is able to report more of the aircraft's

capabilities, as compared to DO-260. These items (with the exception on the availability of 1090ES/UAT in and GPS antenna offset) are displayed in ASTREIX CAT 21 v1.0 or above. The availability of 1090ES/UAT in and GPS antenna offset are yet to be included in the ASTERIX CAT 21.

2.9   Intention

2.9.1   In DO-260A and DO-260B, the transponder is able to report the intended altitude and the intended heading. The intended altitude is displayed in ASTERIX CAT 21 v0.23 or above. The intended heading is yet to be included in the ASTERIX CAT 21 message.

2.10   Target Status

2.10.1   In DO-260B, the transponder is able to indicate whether various modes are applied. These modes include Autopilot Mode, Vertical Navigation (VNAV) Mode, Altitude Hold Mode, Approach Mode and Lateral Navigation (LNAV) Mode. Vertical Navigation Mode, Altitude Hold Mode and Approach Mode are available in ASTERIX CAT 21 v0.23 and above. LNAV Mode is available in ASTERIX CAT 21 v2.1. The Autopilot Mode is yet to be included in the ASTERIX CAT 21 message.

2.11   Resolution Advisory

2.11.1   In DO-260B, the transponder is able to report the following information on the threat:

    a)   Active Resolution Advisories;
    b)   Resolution Advisory complement record;
    c)   Resolution Terminated;
    d)   Multiple Threat encounter;
    e)   Threat Type indicator; and
    f)   Threat Identity data;

2.11.2   The above information is shown in ASTERIX CAT21 v1.0 or higher.

2.12   Mode A

2.12.1   In DO-260 and DO-260A, Mode A information can be broadcasted using a test message. The Mode A information is to be broadcasted only in USA airspace (i.e. Latitude from 18°N to 75°N, Longitude from 65°W to 179°W). The transmission rate is once every 11.8 to 12.2s. In DO-260B, Mode A becomes part of the regularly transmitted information. Mode A is displayed in ASTERIX CAT 21 v0.26 and above. The transmission rate is changed to once every 0.7 – 0.9s (with Mode A change) or 4.8 – 5.2s (No Mode A change).

2.13   A summary of the difference between DO-260, DO-260A and DO-260B is provided in Appendix 9.

3.   POTENTIAL USES FOR THE ADDITIONAL INFORMATION

3.1   The additional quantum levels of NIC would allow the ANSPs more flexibility in deciding whether the NIC is considered as 'good'. For example, if it is decided that Rc<0.6NM can be used for radar separation, instead of Rc<0.5NM, more aircraft can be able to enjoy the ADS-B services. (Note that in DO-260, the level immediately after HPL<0.5NM is HPL<1.0NM).

3.2   The SIL will allow the user to further assess the integrity of the reported position.

3.3   The SDA will indicate the robustness of the system. ANSPs may decide on a minimum SDA for ADS-B services.

3.4   The NIC_{BARO} indicates the integrity of the barometric height. New ATM tools may be developed based on this feature.

3.5   The width / length indicate the size of the aircraft. This information may be used as an input for generating alerts on airport surface movement control.

3.6   Indication on GPS offset may be one of the inputs for generating alerts on airport surface movement control. Indication on the availability of 1090ES in / UAT in will allow the controller to anticipate a potential request for in-trail procedure clearance. Indication of the resolution advisory status allows the controller to know whether the pilots were alerted about the potential conflict.

3.7   The intended heading and flight level can be used as an input to the trajectory prediction algorithm in the Short-Term Conflict Alert.

3.8   The target status allows the controller to know the mode that the aircraft is in.

3.9   The Resolution Advisory will help the controller know the advisories that are provided to the pilots by the ACAS. This helps prevent the controller from giving instructions that are in conflict with the ACAS.

3.10   The Mode A allows flight plans to be coupled with the ADS-B tracks.

4.   READINESS OF ATM AUTOMATION SYSTEMS ON THE USE OF ADDITIONAL INFORMATION

4.1   Upon checking with major equipment suppliers providing ATM automation systems for majority of CAAs/ANSPs in the APAC Regions on potential uses of additional information available under DO-260A/B for enhanced surveillance functions to ATC controllers, the results indicate that some suppliers have plans to make use of NIC, NAC and SIL available under DO-260A/B to improve checking on integrity of ADS-B position data. Uses of other additional information available under DO-260A/B are not yet considered as standard features by most suppliers (see Appendix 9) and might need further system development.

5.   TYPE OF ASTERIX CATEGORY TO ADOPT

5.1   With ASTERIX CAT 21 v0.23, v1.0 and v2.1 substantially incorporated DO-260, DO-260A and DO-260B standards respectively, States/Administrations may adopt the version for the ASTERIX CAT 21 according to their needs as follows :

a)   to adopt v0.23 or above, if ATM automation systems only need to access to basic data available under DO-260;

b)   to adopt v1.0 or above, if ATM automation systems need to access to additional data available under DO-260A;

c)   to adopt v2.1 or above, if ATM automation systems need to access to additional data available under DO-260A & DO-260B.

5.   ACTION BY THE MEETING

5.1   The meeting is invited to:

a)   note the contents in the paper;

b)   discuss the potential uses of the additional information provided by DO-260A and DO-260B;

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Appendix 1

Airborne Position

Horizontal Protection Limit in DO-260	NUC$_P$ in DO-260	Containment Radius in DO-260A	NIC in DO-260A and DO-260B	NIC Sup in DO-260A	Containment Radius in DO-260B	NIC Sup in DO-260B	PIC
HPL<7.5m	9	R$_c$<7.5m and VPL<11 m	11	0	R$_c$<7.5m	0, 0	14
HPL<25m	8	R$_c$<25m and VPL<37.5m	10	0	R$_c$<25m	0, 0	13
	7	R$_c$<75m and VPL<112m	9	1	R$_c$<75m	1, 1	12
HPL<0.1NM	7	R$_c$<0.1NM	8	0	R$_c$<0.1NM	0, 0	11
HPL<0.2NM	6	R$_c$<0.2NM	7	0	R$_c$<0.2NM	0, 0	10
	5		6	0	R$_c$<0.3NM	0, 1	9
HPL<0.5NM	5	R$_c$<0.5NM	6	0	R$_c$<0.5NM	0, 0	8
	4	R$_c$<0.6NM	6	1	R$_c$<0.6NM	1, 1	7
HPL<1.0NM	4	R$_c$<1.0NM	5	0	R$_c$<1.0NM	0, 0	6
HPL<2.0NM	3	R$_c$<2NM	4	0	R$_c$<2NM	0, 0	5
	2	R$_c$<4NM	3	0	R$_c$<4NM	1, 1	4
	2	R$_c$<8NM	2	1	R$_c$<8NM	0, 0	3
HPL<10NM	2		1			0, 0	2
HPL<20NM	1	R$_c$<20NM	1	0	R$_c$<20NM	0, 0	1
HPL≥20NM	0	R$_c$≥20NM	0	0	R$_c$≥20NM	0, 0	0

Surface Position

Horizontal Protection Limit in DO-260	NUC$_P$ in DO-260	Integrity Containment Radius in DO-260A	NIC in DO-260A and DO-260B	Integrity Containment Radius in DO-260B	NIC Sup in DO-260B	PIC
HPL<7.5m	9	R$_c$<7.5m	11	R$_c$<7.5m	0, 0	14
HPL<25m	8	R$_c$<25m	10	R$_c$<25m	0, 0	13
	7	R$_c$<75m	9	R$_c$<75m	1, 0	12
HPL<0.1NM	7	R$_c$<0.1NM	8	R$_c$<0.1NM	0, 0	11
			7	R$_c$<0.2NM	1, 1	10
			6	R$_c$<0.3NM	1, 0	9
			6	R$_c$<0.6NM	0, 1	7
HPL≥0.1NM	6	R$_c$≥0.1NM	0	R$_c$≥0.6NM	0, 0	0

Appendix 2

NUC$_R$ or NACv	HFOM$_R$ and VFOM$_R$ for DO-260 and DO-260A	HFOM$_R$ for DO-260B
4	HFOM$_R$ < 0.3m/s and VFOM$_R$ < 0.46m/s	HFOM$_R$ < 0.3m/s
3	HFOM$_R$ < 1m/s and VFOM$_R$ < 1.5m/s	HFOM$_R$ < 1m/s
2	HFOM$_R$ < 3m/s and VFOM$_R$ < 4.6m/s	HFOM$_R$ < 3m/s
1	HFOM$_R$ < 10m/s and VFOM$_R$ < 15.2m/s	HFOM$_R$ < 10m/s
0	HFOM$_R$ $\geq$ 10m/s or VFOM$_R$ $\geq$ 15.2m/s or unknown	HFOM$_R$ $\geq$ 10m/s or unknown

Appendix 3

SIL	Probability of exceeding the R$_c$
3	$\leq 1 \times 10^{-7}$ per flight hour or per sample
2	$\leq 1 \times 10^{-5}$ per flight hour or per sample
1	$\leq 1 \times 10^{-3}$ per flight hour or per sample
0	$> 1 \times 10^{-3}$ per flight hour or per sample or unknown

SIL supplement	Probability of exceeding the R$_c$
0	Based on per hour
1	Based on per sample

Appendix 4

SDA Value	Probability of Undetected Fault causing transmission of False or Misleading Information
3	$\leq 1 \times 10^{-7}$ per flight hour
2	$\leq 1 \times 10^{-5}$ per flight hour
1	$\leq 1 \times 10^{-3}$ per flight hour
0	$> 1 \times 10^{-3}$ per flight hour or unknown

NAC$_P$	95% Horizontal and Vertical Accuracy Bounds (EPU and VEPU) for DO-260A	95% Horizontal Accuracy Bounds (EPU) for DO-260B	Comment
0	EPU ≥ 10NM	EPU ≥ 10NM	Unknown accuracy
1	EPU < 10NM	EPU < 10NM	RNP-10 accuracy
2	EPU < 4NM	EPU < 4NM	RNP-4 accuracy
3	EPU < 2NM	EPU < 2NM	RNP-2 accuracy
4	EPU < 1NM	EPU < 1NM	RNP-1 accuracy
5	EPU < 0.5NM	EPU < 0.5NM	RNP-0.5 accuracy
6	EPU < 0.3NM	EPU < 0.3NM	RNP-0.3 accuracy
7	EPU < 0.1NM	EPU < 0.1NM	RNP-0.1 accuracy
8	EPU < 0.05NM	EPU < 0.05NM	e.g. GPS (with SA on)
9	EPU < 30m and VEPU < 45m	EPU < 30m	e.g. GPS (SA off)
10	EPU < 10m and VEPU < 15m	EPU < 10m	e.g. WAAS
11	EPU < 3m and VEPU < 4m	EPU < 3m	e.g. LAAS
12-15	Reserved	Reserved	

GVA	Meaning
0	Unknown or > 150m
1	≤150m
2	≤45m
3	Reserved

NIC$_{BARO}$ in DO-260A and DO-260B	Meaning
0	Barometric altitude has not been crosschecked/ No data received in past 2 seconds
1	Barometric altitude has been crosschecked

Appendix 7

L/W code	Length Category	Width Category
0	L<15m	W < 11.5m
1		W < 23m
2	L<25m	W < 28.5m
3		W < 34m
4	L<35m	W < 33m
5		W < 38m
6	L<45m	W < 39.5m
7		W <45m
8	L<55m	W < 45m
9		W < 52m
10	L<65m	W < 59.5m
11		W < 67m
12	L<75m	W < 72.5m
13		W < 80m
14	L<85m	W < 80m
15		W > 80m

Appendix 8

Capabilities reported in DO-260	Capabilities reported in DO-260A	Capabilities reported in DO-260B
Operational Status of TCAS	Operational Status of TCAS	Operational Status of TCAS
Operational Status of CDTI Traffic Display	Operational Status of CDTI Traffic Display	Availability of 1090ES In Availability of UAT In
	Capability of sending messages to support Air Referenced Velocity reports	Capability of sending messages to support Air Referenced Velocity reports
	Capability of sending Target State reports	Capability of sending Target State reports
	Capability of sending Trajectory Change report	Capability of sending Trajectory change report
	Status of TCAS/ACAS Resolution Advisory	Status of TCAS/ACAS Resolution Advisory
	Status of Ident switch	Status of Ident switch
	Whether position offset is applied (whether it shows the ADS-B reference point or the position of antenna)	GPS antenna offset (by how much)

<div align="right">**Appendix 9**</div>

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information	Whether additional information is being used/planned to be used by some suppliers of ATM automation systems (Yes/No)
Introduction of Navigation Integrity Category (NIC) to replace Navigation Uncertainty Category (NUC$_P$)	NUC$_P$ is used	NIC is used to replace NUC$_P$	More level of NIC available. Vertical component removed	NIC is shown in v1.0 and above. More level of NIC (shown as PIC) is available in v2.1	The additional quantum levels of NIC would allow the ANSP more flexibility in deciding whether the NIC is considered as 'good'	Yes
Quality Indicator for Velocity (NUC$_R$ and NAC$_V$)	NUC$_R$ is used	Replaced with NAC$_V$. Definition remains the same	Vertical component removed	Available in v0.23 and above		No
Surveillance Integrity Level and Source Integrity Level (SIL)	Not available	Surveillance Integrity Level is used	Renamed as Source Integrity Level. Definition is changed to exclude avionics fault.	Available in v1.0 and above	The SIL will allow the user to further assess the integrity of the reported position	Yes

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information	Whether additional information is being used/planned to be used by some suppliers of ATM automation systems (Yes/No)
System Design Assurance (SDA)	Not available	Not available	To address probability of avionics fault	Available in v2.1	The SDA will indicate the robustness of the system. ANSPs may decide on a minimum SDA for ADS-B services	No
Navigation Accuracy Category (NAC$_P$)	Not available	Derived from HFOM and VFOM	Relies only on HFOM	Available in v1.0 and above		Yes
Geometric Vertical Accuracy (GVA)	Not available	Not available	Derived from VFOM	Available in v2.1		No
Barometric Altitude Integrity Code (NIC$_{BARO}$)	Not available	To indicate integrity of barometric altitude	Same as DO-260A	Available in v1.0 and above	The NIC$_{BARO}$ indicates the integrity of the barometric height. New ATM tools may be developed based on this new feature	No
Length / Width	Not available	Provide an	Same as DO-260A	Available in v1.0 and	The width / length	No

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information	Whether additional information is being used/planned to be used by some suppliers of ATM automation systems (Yes/No)
of Aircraft		indication of aircraft size		above	indicate the size of the aircraft. This information may be used as an input for generating alerts on airport surface movement control	
Indication of capabilities	Only show status of TCAS and CDTI	More information available including capability to send Air Reference Velocity, Target State and Trajectory Change reports. Status of Identity Switch	Additional information on type of ADS-B in (i.e. 1090ES in or UAT in)	Available in v1.0 and above, except availability of 1090ES/UAT in and information on GPS antenna offset	Indication on the availability of 1090ES in / UAT in will allow the controller to anticipate a potential request for in-trail procedure clearance	No
Status of Resolution Advisory		Information on whether Resolution Advisory is	Same as DO-260A	Available in v1.0 and above	Indication of the resolution advisory status allows the controller to know whether the pilots	No

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information	Whether additional information is being used/planned to be used by some suppliers of ATM automation systems (Yes/No)
		active			were alerted about the potential conflict.	
GPS offset		Indication on whether GPS offset is applied	Information on GPS antenna offset is provided	GPS offset status is available in v1.0 and above. Information on GPS offset is not available in ASTERIX	Indication on GPS offset may be one of the inputs for generating alerts on airport surface movement control	No
Intention	Not available	Able to indicate intended altitude and heading	Same as DO-260A	Intended altitude is available in v0.23. Intended heading is not available in ASTERIX	The intented heading and flight level can be used as an input to the trajectory prediction algorithm in the Short-Term Conflict Alert	No
Target Status	Not available	Not available	Indication of Autopilot mode, Vertical Navigation mode, Altitude Hold mode, Approach Mode and LNAV Mode	Vertical Navigation mode, Altitude Hold mode and Approach Mode are available in v 0.23 and above LNAV Mode is available in in v2.1	The target status allows the controller to know the mode that the aircraft is in	No

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information	Whether additional information is being used/planned to be used by some suppliers of ATM automation systems (Yes/No)
Resolution Advisory	Not available	Not available	Availability of Active Resolution Advisories; Resolution Advisory complement record, Resolution Terminated; Multiple Threat encounter; Threat Type indicator; and Threat Identity data	Available in v1.0 and above	The Resolution Advisory will help the controller know the advisories that are provided to the pilots by the ACAS. This helps prevent the controller from giving instructions that are in conflict with the ACAS	No
Mode A	Broadcasted using test message in USA only	Broadcasted using test message in USA only	Broadcasted worldwide as a regular message	Available in v0.26 and above	The Mode A allows flight plans to be coupled with the ADS-B tracks (supports legacy ATM automation system)	No