



ICAO

International Civil Aviation Organization

**THE THIRD MEETING OF MODE S DOWNLINKED
AIRCRAFT PARAMETERS WORKING GROUP
(MODE S DAPs WG/3)**

Web-conference, 12 – 15 May 2020

Agenda Item 4: Mode S monitoring and analysis

EMPTY RA MESSAGE HANDLING AT ATM SYSTEM

(Presented by Korea, Republic of/Incheon Int'l Airport Corporation)

SUMMARY

Asterix message “I048/260, ACAS Resolution Advisory Report” indicates that airplane is in ACAS RA condition. But in some cases, all zero I048/260 reports are received through Mode-s radar. This paper gives brief information about all zero I048/260 handling at ATM system

1. INTRODUCTION

1.1 Main differences between Mode-S radar and SSR radar are the features related to the vertical intension message handling and ACAS Resolution advisory message handling. ATM controller can receive active ACAS RA message through “Data Item I048/260, ACAS Resolution Advisory Report” from the airplane.

1.2 Because ACAS message started from a transponder, flows to Mode-S Radar and finally feeds to CWP screens at ATM server system, some radar or ATM system rejects I048/260 Item, the controller cannot instantaneously check active RA situation at an airplane. It can be cause of, a situation which can lead to aircraft incidents. So, Data Item I048/260 message handling feature must be checked in case of installation of new ATM system or new radars.

1.3 This IP provides the ATM system with operation experience about “False ACAS alarm from Empty RA message”.

2. DISCUSSION

2.1 All zero ACAS RA message received through MODE-S radar.

In 2017, Incheon Int'l Airport Corporation (IIAC) completed the construction of new ATM system with two Mode-S radar including Mode-S Dap functionality. After completion of the project, controllers experienced some ACAS alarm messages at their CWP screen several times a month. IIAC engineers checked whether or not those ACAS reports are real, and analyzed Asterix CAT048/260 message.

ACAS RA message. This can be also applied to real aircraft traffic situations. When radar receives all zero RA message from an aircraft, it signifies that the aircraft does not have any adjacent aircraft traffic near its flight boundary.

2.3. BDS-30 Content

2.3.1. TSO-C119A format

2.3.1.1. TSO format is used by TCAS v6.04 and by TCAS v7.0 coupled with a TSO-C119A Mode-S transponder. TSO format contains only the ARA and the RAC part.

2.3.1.2. Below are the field positions within BDS-30. Item 260 of Asterix category 48 contains only these 7 bytes.

Bit 33-40		41-54	55-58	59-88
BDS1=3	BDS2=0	ARA	RAC	empty

<ACAS RA specification>

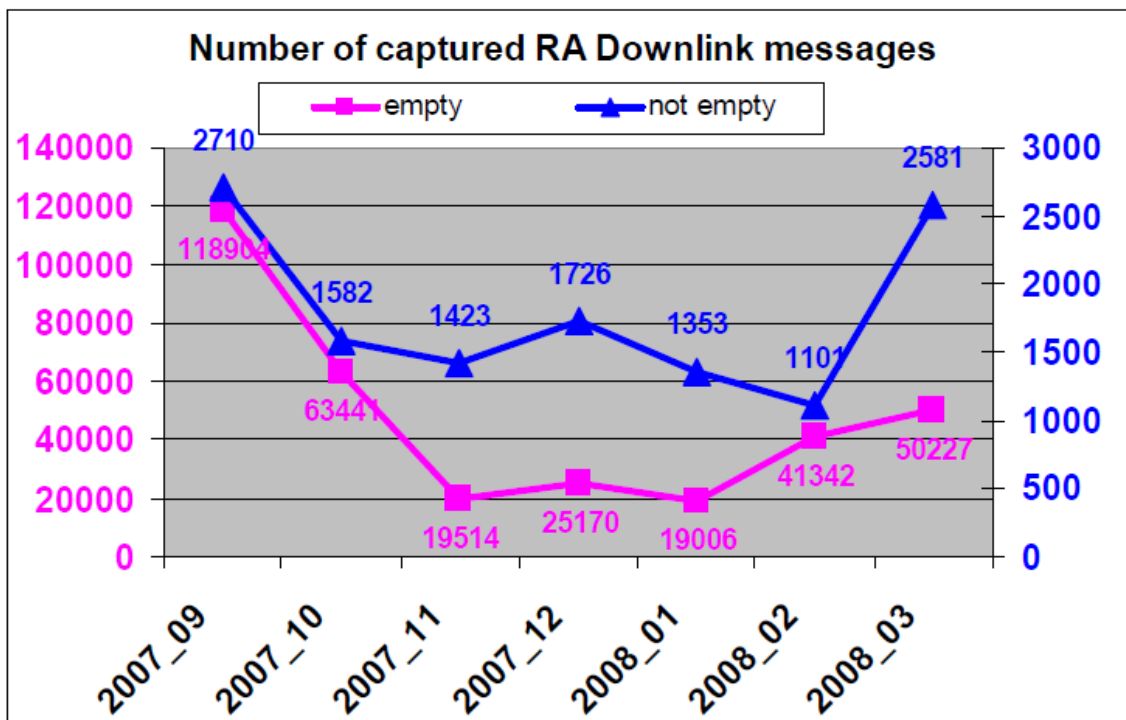
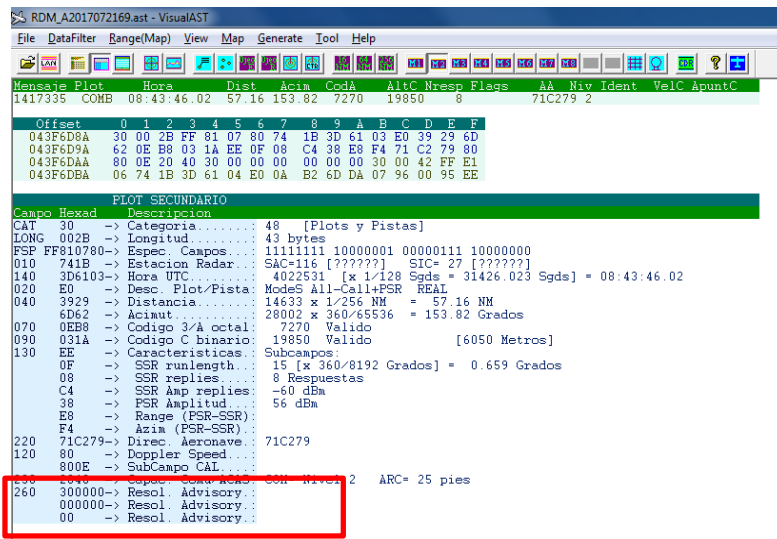


Figure 15: Number of collected RA downlink messages

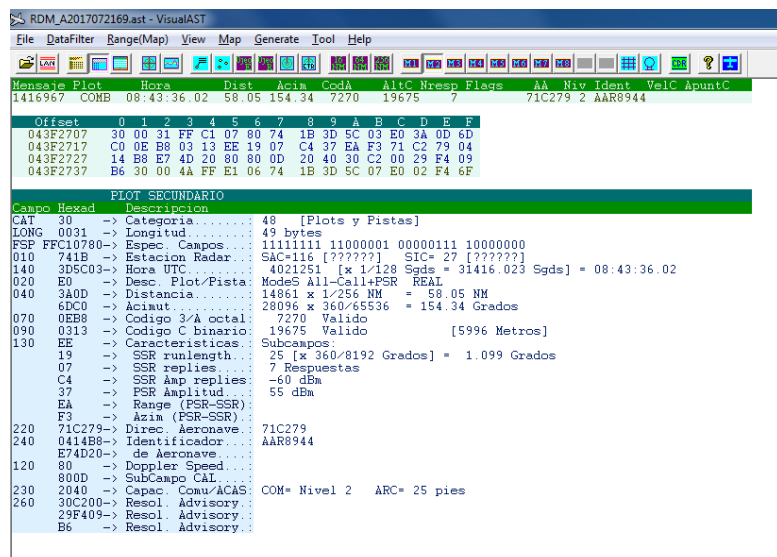
<Eurocontrol research result at “Analysis of RA downlink data”>

The following picture is the example of all zero ACAS RA message. All zero ACAS RA message is discovered seldom at the 24 7 radar data recordings. Even for ACAS RA situation, real ACAS RA messages, which start with all zero RA message, will be followed by real ACAS RA message and finishes with all zero RA message.



<Empty RA message case (I048/260 ACAS)>

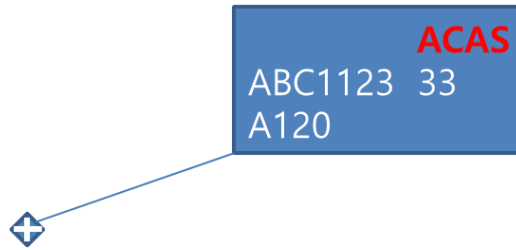
2.2 Real ACAS message receiving case



<Real RA message case (I048/260 ACAS)>

In the following Real RA message case, I048/260 message is received as “C200 29F4 09B6”. ATM system at Incheon Airport labeled the target as ACAS alarm marker through CWP screen.

If Radar system misses or rejects BDS30 message and ATM system cannot handle ACAS message, a ATM controller cannot check real RA situation at the aircraft and will not be able to respond appropriately to fix ACAS situation at the controlled aircraft.



<Target labeling scheme for ACAS situation (Incheon airport ATM system) >

3. DISCUSSION

If there is more information about Empty RA message handling, we would like to hear and share at the Working Group.

ACAS message handling feature at ATM system must be checked on at its installation stage following the ACAS message flow.

IP/10 Empty RA message handling at ATC system

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INTRODUCTION

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2. Because ACAS message started from a transponder, flows to Mode-S Radar and finally feeds to CWP screens at ATM server system, some radar or ATM system rejects I048/260 Item, the controller cannot instantaneously check active RA situation at an airplane. It can be cause of, a situation which can lead to aircraft incidents. So, Data Item I048/260 message handling feature must be checked in case of installation of new ATM system or new radars.
3. This IP provides the ATM system with operation experience about “False ACAS alarm from Empty RA message”.



Example of Empty RA ACAS message

```

RDM_A2017072169.ast - VisualAST
File DataFilter Range(Map) View Map Generate Tool Help
[Icons]
Mensaje Plot Hora Dist Acim CodA AltC Nresp Flags AA Niv Ident VelC ApuntC
1417335 COMB 08:43:46.02 57.16 153.82 7270 19850 8 71C279 2

Offset 0 1 2 3 4 5 6 7 8 9 A B C D E F
043F6D8A 30 00 2B FF 81 07 80 74 1B 3D 61 03 E0 39 29 6D
043F6D9A 62 0E B8 03 1A EE 0F 08 C4 38 E8 F4 71 C2 79 80
043F6DAA 80 0E 20 40 30 00 00 00 00 00 00 30 00 42 FF E1
043F6DBA 06 74 1B 3D 61 04 E0 0A B2 6D DA 07 96 00 95 EE

PILOT SECUNDARIO
Campo Hexad Descripcion
CAT 30 -> Categoria..... 48 [Plots y Pistas]
LONG 002B -> Longitud..... 43 bytes
FSP FF810780-> Espec. Campos... 11111111 10000001 00000111 10000000
010 741B -> Estacion Radar... SAC=116 [??????] SIC= 27 [??????]
140 3D6103-> Hora UTC..... 4022531 [x 1/128 Sgds = 31426.023 Sgds] = 08:43:46.02
020 E0 -> Desc. Plot/Pista: ModeS All-Call+PSR REAL
040 3929 -> Distancia..... 14633 x 1/256 NM = 57.16 NM
6D62 -> Acimut..... 28002 x 360/65536 = 153.82 Grados
070 0EB8 ->Codigo 3/A octal: 7270 Valido
090 031A ->Codigo C binario: 19850 Valido [6050 Metros]
130 EE -> Caracteristicas: Subcampos:
0F -> SSR runlength... 15 [x 360/8192 Grados] = 0.659 Grados
08 -> SSR replies... 8 Respuestas
C4 -> SSR Amp replies: -60 dBm
38 -> PSR Amplitud... 56 dBm
E8 -> Range (PSR-SSR):
F4 -> Azim (PSR-SSR):
220 71C279-> Direc. Aeronave: 71C279
120 80 -> Doppler Speed...
800E -> SubCampo CAL...
230 2040 -> Capas. Comu/ACAS: COM- Nivel 2 ARC= 25 pies
260 300000-> Resol. Advisory...
000000-> Resol. Advisory...
00 -> Resol. Advisory...
    
```

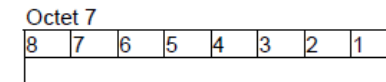
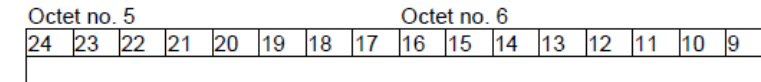
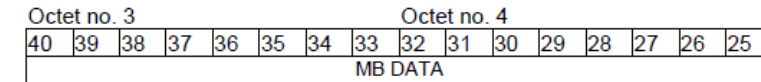
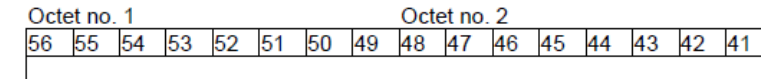
5.2.26

Data Item I048/260, ACAS Resolution Advisory Report

Definition: Currently active Resolution Advisory (RA), if any, generated by the ACAS associated with the transponder transmitting the report and threat identity data.

Format: Seven-octet fixed length Data Item.

Structure:



bits-56/1

(MB Data)

56-bit message conveying Mode S Comm B message data of BDS Register 3,0.

Encoding Rule:

This item shall be present when a Resolution Advisory has been generated in the last scan.

NOTES

1. Refer to ICAO Draft SARPs for ACAS for detailed explanations.

Research about All zero RA message

2.3. BDS-30 Content

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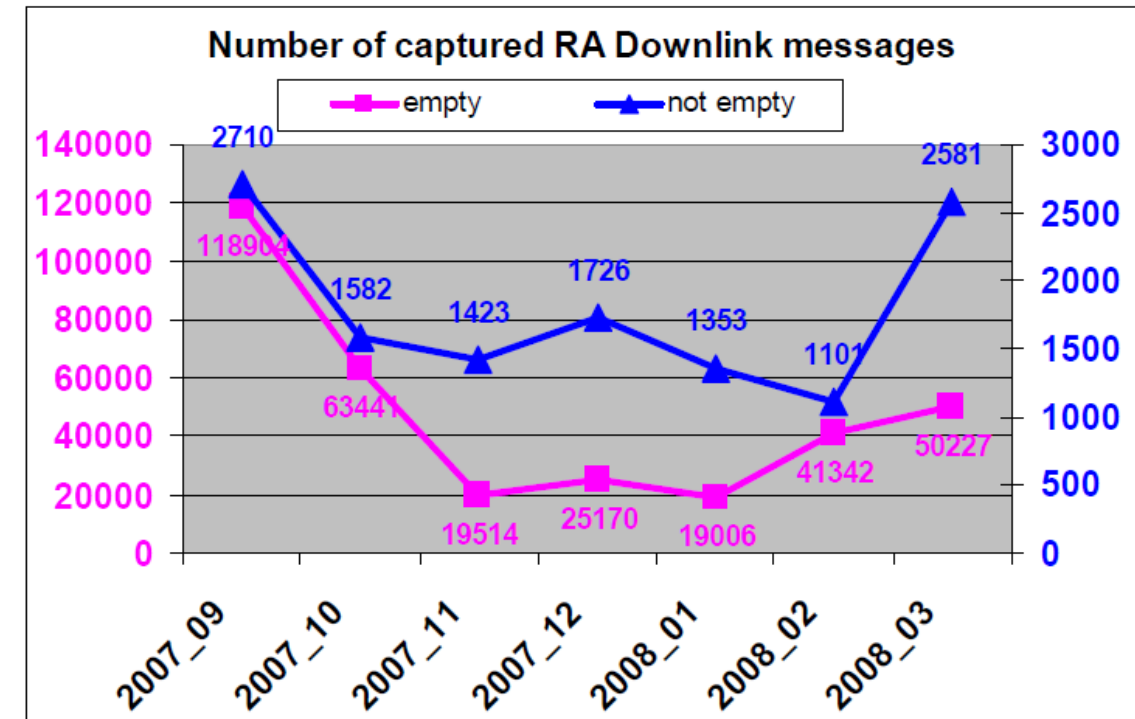


Figure 15: Number of collected RA downlink messages

- Information about Empty RA message at Eurocontrol Document.
- According to the Eurocontrol document (Analysis of RA Downlink data), BDS30 empty RA message is a well-known bug which has not been fixed yet. It means that all zero I048/260 message is wrong ACAS RA message. This can be also applied to real aircraft traffic situations. When radar receives all zero RA message from an aircraft, it signifies that the aircraft does not have any adjacent aircraft traffic near its flight boundary.
- Eurocontrol working paper, Analysis of RA downlink data, Performance and safety aspects of short-term conflict alert – full study pass project. 30-03-2009, pass/wa1/wp4/38

"Real" ACAS case

RDM_A2017072169.ast - VisualAST

File DataFilter Range(Map) View Map Generate Tool Help

Mensaje	Plot	Hora	Dist	Acim	CodA	AltC	Nresp	Flags	AA	Niv	Ident	VelC	ApuntC
1416967	COMB	08:43:36.02	58.05	154.34	7270	19675	7		71C279	2	AAR8944		

Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
043F2707	30	00	31	FF	C1	07	80	74	1B	3D	5C	03	E0	3A	0D	6D
043F2717	C0	0E	B8	03	13	EE	19	07	C4	37	EA	F3	71	C2	79	04
043F2727	14	B8	E7	4D	20	80	80	0D	20	40	30	C2	00	29	F4	09
043F2737	B6	30	00	4A	FF	E1	06	74	1B	3D	5C	07	E0	02	F4	6F

PLOT SECUNDARIO

Campo	Hexad	Descripcion
CAT	30	-> Categoria..... 48 [Plots y Pistas]
LONG	0031	-> Longitud..... 49 bytes
FSP	FFC10780	-> Espec. Campos... 11111111 11000001 00000111 10000000
010	741B	-> Estacion Radar... SAC=116 [??????] SIC= 27 [??????]
140	3D5C03	-> Hora UTC..... 4021251 [x 1/128 Sgds] = 08:43:36.02
020	E0	-> Desc. Plot/Pista: ModeS All-Call+PSR REAL
040	3A0D	-> Distancia..... 14861 x 1/256 NM = 58.05 NM
6DC0		-> Acimut..... 28096 x 360/65536 = 154.34 Grados
070	0EB8	->Codigo 3/A octal: 7270 Valido
090	0313	->Codigo C binario: 19675 Valido [5996 Metros]
130	EE	-> Caracteristicas: Subcampos:
19		-> SSR runlength... 25 [x 360/8192 Grados] = 1.099 Grados
07		-> SSR replies..... 7 Respuestas
C4		-> SSR Amp replies: -60 dBm
37		-> PSR Amplitud... 55 dBm
EA		-> Range (PSR-SSR)
F3		-> Azim (PSR-SSR)
220	71C279	-> Direc. Aeronave... 71C279
240	0414B8	-> Identificador... AAR8944
E74D20		-> de Aeronave....
120	80	-> Doppler Speed...
800D		-> SubCampo CAL...
230	2040	-> Capac. Comu/ACAS: COM= Nivel 2 ARC= 25 pies
260	30C200	-> Resol. Advisory..
29F409		-> Resol. Advisory..
B6		-> Resol. Advisory..



ACAS
ABC1123 33
A120

Discussion

- If there is more information about Empty RA message handling, we would like to hear and share at the Working Group.
- ACAS message handling feature at ATM system must be checked on at its installation stage following the ACAS message flow.
- <Thanks Very much...>