RTCA SC-186 WG-3 and Eurocae WG-51, SG-1

1090ES MOPS Maintenance Meeting

Chicago, 12 – 15 May 2009

1090ES Event Driven Squitter Transmit Rates

in discussion of Action Item 25-14

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Version 2 Event Driven Squitter Message Required Timing

- Concurrent Messages have tight timing tolerances but cannot adhere to the timing when limited by the hard limit of 2 messages per second for the Event-Driven squitter
  - A2 and A3 Class with Mode A Change Timing
    - Target State and Status (TSS) - 1.2 - 1.3 seconds
    - Operational Status (OS) - 2.4 - 2.6 seconds
    - Emergency/Priority (E/P) - 0.7 - 0.9 seconds

			Version 1 1090ES Broadcast Rates		
Register	**Event-Driven Message Priority**	**1090ES ADS-B Message**	**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	1	Aircraft Status (Emergency/Priority Status, Subtype=1)	0.7 – 0.9 seconds	0.7 – 0.9 seconds	TSS not broadcast 0.7 – 0.9 seconds
					TSS being broadcast 2.4 – 2.6 seconds
BDS 6,2	5	Target State and Status (TSS)	N/A	N/A	1.2 – 1.3 seconds
BDS 6,5	7 (nominal) 4 (info change)	Aircraft Operational Status	4.8 – 5.2 seconds	4.8 – 5.2 seconds	TSS being broadcast or not No change TCAS/NAC/SIL 2.4 – 2.6 seconds
					TSS being broadcast Change in TCAS/NAC/SIL 2.4 – 2.6 seconds
					TSS not broadcast Change in TCAS/NAC/SIL 0.7 – 0.9 seconds
	4	TEST Message (for Mode A Code) (TYPE=23, Subtype=7)	N/A	N/A	1 / 12 seconds (11.8 – 12.2 sec)

Version 2 Message Event-Driven Transmit Rates

Condition	TSS Rate	OS Rate	E/P Rate	Event Driven Rate	Total Squitter Rate
A2 – A3 Steady State	0.8	0.4	0.2	1.4	5.6
A2 – A3 Emergency	0.8	0.4	0.4	1.6	5.8
A2 – A3 Mode A Change	0.8	0.4	1.25	2.45	6.65
A2 – A3 TCAS RA	0.8	0.4	1.0	2.2	6.4
Class A1 Steady State	X	0.4	0.2	0.6	4.8
Class A1 Mode A Change	X	0.4	1.25	1.65	5.85
Class A1 High Rate OS	X	1.25	0.2	1.45	5.65
Class A1 High Rate OS + Mode A Change	X	1.25	1.25	2.5	6.7

Options Presented to the ICAO ASP Working Group Meeting @ Louisville, 20 – 24 April 2009

1. Eliminate the hard limit of 2 Event-Driven Squitters per second to achieve the proper transmit rates.
   - Overall average of 6.2 messages per second is achieved since normal rate of Event Driven squitter is less than 2 per second and exceeds 2 only in temporary exception conditions (e.g., Mode A Code change, emergency declared, or TCAS RA)
   - Requires SARPs and Transponder MOPS Changes
2. Maintain the hard limit and accept that the required performance cannot be achieved.
3. Remove Target State and/or Operational Status Messages from the Event-Driven protocol so that proper transmit rates can be achieved.

Resultant Decisions

- During the ICAO ASP Working Group meeting, a small subgroup of ICAO ASP Technical Subgroup (TSG) members reviewed and discussed the previous slides.
- The resultant agreement was to separate the TSS and OS Messages out of the Event-Driven protocol and to craft proposed changes to the ICAO SARPs, 1090ES and Transponder MOPS to agree to the language dealing with the maximum squitters per second and transmit rates from:
  - 2 squitters per second maximum for Event-Driven Messages, to
  - 2 squitters per second maximum, averaged over any 60 second period for a combination of Periodic Status and Event-Driven Messages:

    6.2 average = 2 P + 2 V + 0.2 ID + [2 Periodic Status and Event-Driven]

Version 2 Message Structure

Periodic Status Messages:	**Broadcast Interval:**	**Contribution to Msg/second:**
1. Target State and Status	1.2 to 1.3 seconds	0.8 squitters per second
2. Operational Status	2.4 to 2.6 seconds	0.4 squitters per second

Event-Driven Messages:

1. Emergency/Priority (Emergency declarations, and Mode A Code – Subtype 0, and TCAS RA – Subtype 1)
   (0 or 0.2 or 1.25 or 1.45 messages per second)

   0 For no transmission of Emergency, Mode A Code or TCAS RA
   (cases were the Mode A Code is set to a "no-transmit" code)

   0.2 For transmission of E/P with only Mode A Code without a rate change

   1.25 For transmission of E/P with Mode A Code after a Code change

   1.45 For transmission of E/P with TCAS RA and nominal Mode A Code broadcast

Going Forward

- One of the criteria for acceptance of this concept by the ICAO ASP is for the equipment standard to show that it is meeting the 6.2 squitter average over any 60 second period. This will be verified by analysis of operational scenarios and included as a new Appendix to DO-260B, performed by Eric Potier of Eurocontrol. This will not require any new protections to be implemented in the transponder, since conformance will be shown by analysis.
- Obtain WG-3/SG-1 agreement.
- Craft proposed changes for DO-260B.
- Craft proposed changes to DO-181D, ICAO SARPs and ICAO Doc 9871 during ICAO ASP TSG meeting in Paris.