RTCA Special Committee 186, Working Group 3
EUROCAE WG-51, SG-1

ADS-B 1090ES MOPS Maintenance

Meeting #29

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Proposed Appendix on the Analysis for the 6.2 squitters averaged over 60 seconds

In Response to Action Item 28-05

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Summary
This Working Paper proposes an initial draft for an appendix showing that the average number of transmission per second is acceptable for specific scenarios and that there is no need to implement a function to limit the transmission of Extended Squitter.

1 Introduction

This Working Paper contains an initial draft of a new appendix (e.g. R) containing the different transmission rates of Extended Squitters which are met for different scenarios.

2 Proposed new Appendix to explain the Extended Squitter transmission rate

R. Extended Squitter transmission rate analysis for different scenarios

R.1 Purpose and Scope

The purpose of this Appendix is to provide a calculation of Extended Squitter rate for different operational scenario to show that transmission rates achieved over a 60s period meet the required average rate over 60s and that there is no need to implement a function to limit the total number of Extended Squitter transmitted over a certain period of time.

R.2 Background

The 1090 ADS-B MOPS, specifies different types of Extended Squitters with different transmission rates (see table 2.77)

There is no requirement to limit the transmission over a 1s second other than a maximum of 2 event driven messages. The transmission rate averaged over 60 seconds must be less or equal to 6.2 per second.

R.3 Analysis of Extended Squitter rate for specific scenarios

<u>Scenario 1:</u> Airborne Steady State

Conditions:

- Airborne
- TSS available

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Airborne position squitter	0.5	2	2	120	
Airborne velocity squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
TSS	1.25	0.8	1	48	
Aircraft operational Status	2.5	0.4	1	24	
	0.8	1.25		-	
Aircraft Status	5	0.2	1	12	
	0.8	1.25		-	
total number over the period			8	336	
Average /s				5.60	

<u>Scenario2:</u> Airborne, Mode A Code change

Conditions:

- Airborne
- TSS available
- **Mode A code Change**

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Airborne position squitter	0.5	2	2	120	
Airborne velocity squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
TSS	1.25	0.8	1	48	
Aircraft operational Status	2.5	0.4	1	24	
	0.8	1.25		-	
Aircraft Status	5	0.2	2	7	for remaining 36s
	0.8	1.25		30	for 24s after Mode A Code change + 36s RA
total number over the period			9	361	
Average /s				6.02	

<u>Scenario 3:</u> Airborne, TSS, Permanent Alert State (7500, 7600, 7700)

Conditions:

- Airborne
- TSS
- **Permanent Alert State (7500, 7600, 7700)**

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Airborne position squitter	0.5	2	2	120	
Airborne velocity squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
TSS	1.25	0.8	1	48	
Aircraft operational Status	2.5	0.4	1	24	
	0.8	1.25		-	
Aircraft Status	5	0.2		-	
	0.8	1.25	2	75	for 60s
total number over the period			9	399	
Average /s				6.65	

For this scenario the average number of Extended Squitters is greater than 6.2 /s however it can be considered that the occurrence of this scenario is a rare event, and if it happens it will be on a very limited number of aircraft in the coverage.

<u>Scenario 4:</u> Airborne, no TSS, NAC/SIL change

Conditions:

- Airborne
- TSS not available
- **TCAS/NAC/SIL change**

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Airborne position squitter	0.5	2	2	120	
Airborne velocity squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
TSS	1.25	0.8	-	-	
Aircraft operational Status	2.5	0.4	2	14	for 36s
	0.8	1.25		30	for 24s after a NAC/SIL change
Aircraft Status	5	0.2	1	12	
	0.8	1.25		-	
total number over the period			8	308	
Average /s				5.13	

<u>Scenario 5:</u> Airborne, no TSS, TCAS/NAC/SIL change, Mode A code change

Conditions:

- Airborne
- TSS not available
- **Mode A code Change**
- **TCAS/NAC/SIL change**

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Airborne position squitter	0.5	2	2	120	
Airborne velocity squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
TSS	1.25	0.8	-	-	
Aircraft operational Status	2.5	0.4	2	14	for 36s
	0.8	1.25		30	for 24s after a NICsupp/NAC/ SIL change
Aircraft Status	5	0.2	2	7	for 36s
	0.8	1.25		30	for 24s after Mode A Code change
total number over the period			9	333	
Average /s				5.55	

<u>Scenario 6:</u> On the ground, moving, Mode A code change, NICsuppNAC/SIL change

Conditions:

- On the Ground
- Moving
- Mode A code Change
- NICsupp/NAC/SIL Change

	time between 2 transmissions	average number per second	peak number per second	number over 60 seconds	comment
Surface position squitter	0.5	2	2	120	
Aircraft Identification	5	0.2	1	12	
Aircraft operational Status	2.5	0.4	2	14	for 36s
	0.8	1.25		30	for 24s after a NIC/NAC/SIL change
Aircraft Status	5	0.2	2	7	for 36s
	0.8	1.25		30	for 24s after Mode A Code change
total number over the period			7	213	
Average /s				3.55	

Table 2-77: 1090 MHz Extended Squitter ADS-B Message Broadcast Rates

Transponder Register	Event-Driven Message Priority	1090ES ADS-B Message	Broadcast Rate: On-the-Ground, not moving	Broadcast Rate: On-the-Ground and moving	Broadcast Rate: 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)	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 or Emergency 0.7 – 0.9 seconds		
			No TCAS RA, No Mode A Change, No Emergency 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 in NIC_{SUPP}/NAC/SIL 2.4 – 2.6 seconds	TSS being broadcast or not No change TCAS/NAC/SIL 2.4 – 2.6 seconds
				Change in NIC_{SUPP}/NAC/SIL 0.7 – 0.9 seconds	TSS being broadcast Change in TCAS/NAC/SIL 2.4 – 2.6 seconds
					TSS not broadcast[2] Change in TCAS/NAC/SIL 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 (Table 2-3).*