

**SURVEILLANCE AND CONFLICT RESOLUTION SYSTEMS PANEL (SCRSP)
FIRST MEETING**

Montreal, 8th to 19th November, 2004

Agenda Item 3: Review of Implementation Issues

**Analytical Results of Unauthorized Address Aircraft
Measured by Aircraft Address Monitoring System**

INFORMATION PAPER

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SUMMARY

This paper describes the analytical result to detect the unauthorized aircraft address by Aircraft Address Monitoring System installed at the New Tokyo and Kansai international airports.

1. Introduction

- 1.1 The Aircraft Address Monitoring System (AAMS), which is the detection system for unauthorized aircraft addresses, began to operate from July 17th in 1996 at New Tokyo International Airport and from June 1st in 1997 at Kansai International Airport.
- 1.2 It was already introduced by several WPs at WG1 (SICASP), WGB (SCRSP) and SICASP/7. And the latest WP is WPB7-45 at Montreal in April 2004.
- 1.3 This paper introduce the results of detected aircraft with unauthorized address to SCRSP/1.

2. System Overview

2.1 This section describes briefly the AAMS. The system concept of the AAMS is shown in Fig.-1. The AAMS consists of three remote stations with both mode A/C receiver and mode S receiver, and the center station with data processing system. The data processing system is installed at New Tokyo and Kansai International Airports. They employ tri-lateration method in detecting target position, which is calculated by arrival time difference of SSR reply signals among three receivers. Therefore, it is a passive system, which does not require transmitting any signals. The three receivers utilize GPS clock to synchronize accurately each others. The system receives mode S squitter to obtain an aircraft address and receives mode A/C replies to identify flight plan data. The data processing system is consisted of a UNIX workstation and I/O units. The flight plan data in FDP (Flight Data Processing) system contain registration numbers, airlines, call signs, aircraft types etc. The aircraft radiating the mode S squitter is correlated with the aircraft radiating mode A/C replies by the positioning determined as intersection point of hyperbolas calculated from the arrival time difference among three receiving station. The aircraft address is checked with the registration number using FDP data with the off-line process.

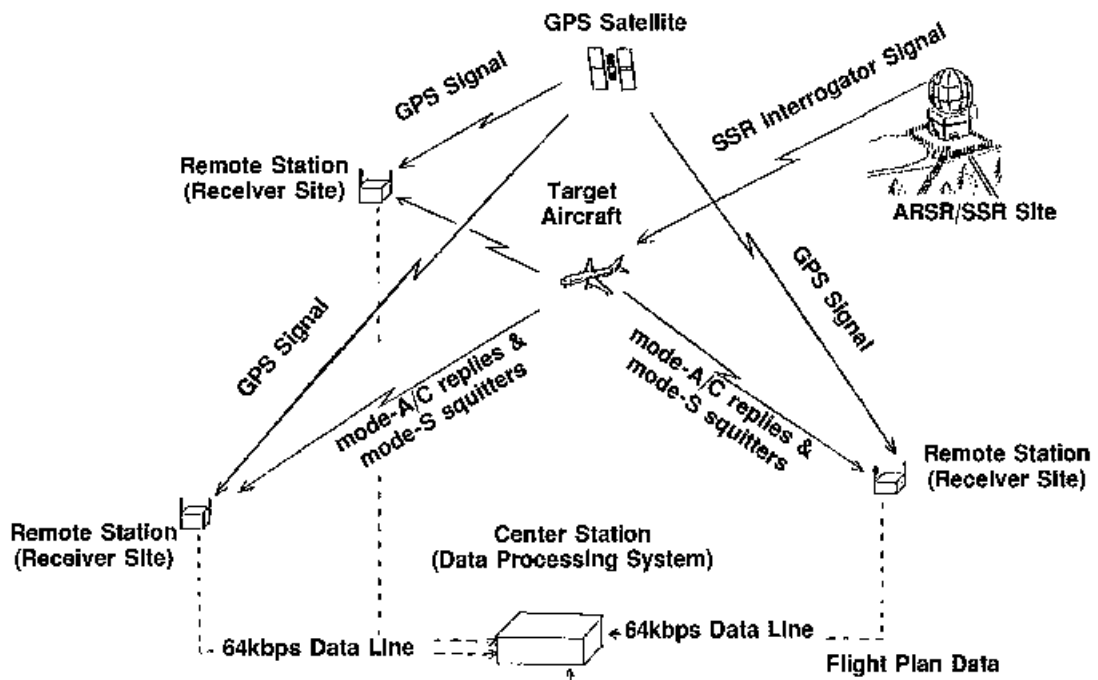


Fig.- 0 Concept of Aircraft Address Monitoring System

2.2 The summary of the characteristic of receivers equipped with AAMS is shown in Table-1. The conversion decode level at antenna is -81 dBm.

Table-1 Summary of Characteristic of Receiver

Item	Characteristics	Remarks
(1) Coverage (nominal)	50 NM	
(2) Antenna Gain (typical)	7.5 dBi	peak direction
(3) Antenna Front Back Ratio (typical)	4.5 dB	
(4) Receiver Sensitivity (typical)	-88.3 dBm	tangential
(5) Receiver Decode Level (typical)	-82.5 dBm	
(6) Cable Loss (typical)	8.9 dB	
(7) ATRBS Plot Extractor Plot Capacity	100 aircraft / 10 s	(nominal)
(8) Mode S Plot Extractor Plot Capacity	50 aircraft / 1 s	(nominal)

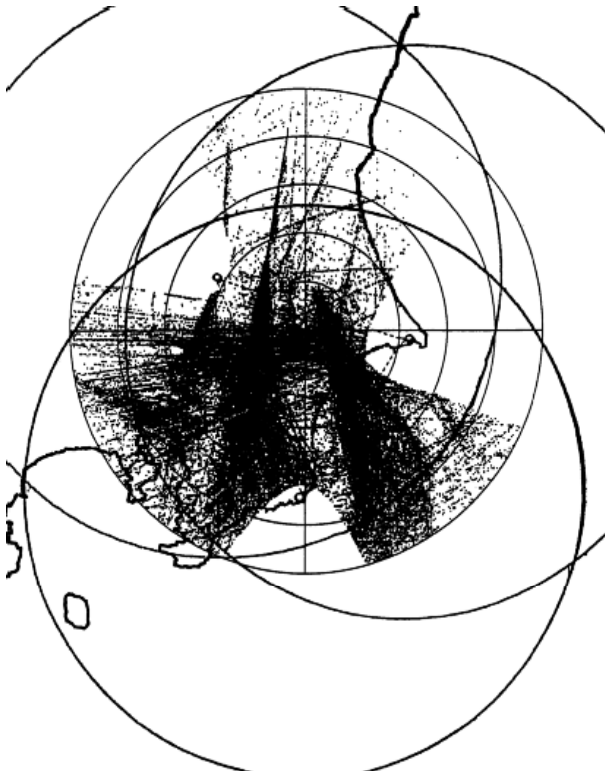


Fig.-2. Actual Coverage of AAMS at New Tokyo

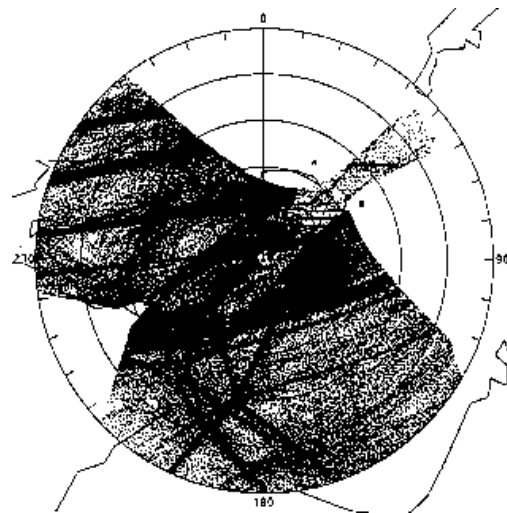


Fig.-3. Actual Coverage of AAMS at Kansai

2.3 The actual coverage of AAMS are shown in Fi.-2 and Fig.-3. Fig.-2 is drawn by points of mode-S 5,000 tracks, which are detected by AAMS installed at New Tokyo in 5 days. Fig.-3 is drawn by points of mode-S 15,000 tracks, which are also detected by AAMS installed at Kansai in 5 days. The number of detected point by Kansai AAMS is about three times the detected point by New Tokyo AAMS, because the over flight above Kansai area is greater than above New Tokyo area.

The three notches in the shape of a hyperbola are undetectable area of AAMS, because existing multiple solutions using tri-lateration method in these area. The nominal coverage area is overlapped with 3 cycles with 50 NM radius from the receiver sites and small dots. The 5-cocentric circles of

radius of 10 to 50 NM stepped by 10 NM show range from the airport at center in Fig.-2 and Fig.-3. The data out of 50 NM radius from center are cut off by the data processing system. Both actual coverages are wider than nominal coverage.

3. Information

- 3.1 The analytical results measured by the AAMS are listed in Table-2, and the transition of unauthorized address aircraft is shown in Fig-4.
- 3.2 Considering the analytical results in Table-2, most of unauthorized address aircraft are estimated by the differences between the nationality of their registration numbers and the nationality of their aircraft addresses. Some unauthorized address aircraft are estimated by their aircraft addresses having only their nationality codes.
- 3.3 From more consideration, most of unauthorized address aircraft are caused by some error in setting their address and to forget to set their address.
- 3.4 The number of unauthorized address aircraft have been decreasing since AAMS started to operate in the second half of 1997, therefore we believe that this activity is effectively to reduce the unauthorized address aircraft.
- 3.5 This activity will be continued even after implementation of SSR mode S sensors in Japan.

Table-2 List of Unauthorized Mode S Aircraft

Registration Country	Registration Number	Operation Airline	Operation Airline Country	Mode S Address	Mode S Address country	Code (*1)	2000 1st half	'00 2nd half	'01 1st half	'01 2nd half	'02 1st half	'02 2nd half	'03 1st half	'03 2nd half	Total	Remarks
Aruba?	P4GJC	OPR/PV	-	48412E	Netherlands	1					2	2			4	Aruba belongs to Netherlands.
Australia	VNA764	Vietnam Airlines	Vietnam	000000	No assignment	3		12							12	Valid Mode S address is not still setup.
No assignment	70400	OPR/DOD	-	AE010D	United States	1					2				2	US Department of Defense/Military call sign.
Germany	DABVT	Deutsche Lufthansa, A.G.	Germany	BC4AD4	No assignment	1			6	5	6				17	'MSB is incorrect bit. '3C4AD4' is assigned to Germany.
Italy	IDEIC	Alitalia-Linee Aeree Italiane, S.P.A.	Italy	340089	Spain	1				2					2	6SB is incorrect bit. '300089' is assigned to Italy.
Japan	JA8498	Japan Air System CO.LTD.	Japan	02DDCA	Tunisia	1					2				2	MSB & 6SB are incorrect bits. '86DDCA' is assigned to Japan.
Japan	JA8930	Japan Transocean Air	Japan	3C618D	Germany	1	1	25							26	Former Registered in Germany as DAHLM. New Mode S address is not still setup.
Korea	HL7465	Korean Air Lines CO. LTD.	Korea	38DC65	France	1					4	14	13	9	40	Upper 12 bits are right shifted. '71BC65' is assigned to South Korea.
Korea	HL7281	Korean Air Lines CO. LTD.	Korea	713A81	Saudi Arabia	1		1							1	9SB is incorrect bit. '71BA81' is assigned to South Korea.
Malaysia	9MMHL	Malaysian Airlines System	Malaysia	750000	Malaysia	2	6	10	2	7					25	Discrete part is not still setup.
Malaysia	9MMPI	Malaysian Airlines System	Malaysia	7D0034	Australia	1				4	2	1			7	5SB is incorrect bit. '750034' is assigned to Malaysia.
Malaysia	9MMPM	Malaysian Airlines System	Malaysia	F7007A	No assignment	1	5	9	6	1					21	MSB & 7SB are incorrect bits. '75007A' is assigned to Malaysia.

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Registration Country	Registration Number	Operation Airline	Operation Airline Country	Mode S Address	Mode S Address country	Code (*1)	2000 1st half	'00 1st half	'01 1st half	'01 2nd half	'02 1st half	'02 2nd half	'03 1st half	'03 2nd half	Total	Remarks
Russian Federation	RPC3223	Philippine Air Lines Inc.(PAL)	Philippine	77801D	Syria	1						5	5	1	11	7SB is incorrect bit. '75801D' is assigned to Philippines.
United Kingdom?	MM62173	Private?	-	33FFF8	Italy	1					2				2	Italian Air Force/Military call sign.
China	BHXA	Cathay Pacific Airways LTD.	China	70015B	Afghanistan	1	3								3	5SB is incorrect bit. '78015B' is assigned to China.
China	B16103	EVA Airlines Corporation	China	81908B	India	1		1							1	5SB is incorrect bit. '89908B' is assigned to Taiwan.
United States	N201YT	Private?	-	E1A484	Argentina	1				2					2	Former Registered in Argentina as LVZRD. Correct Mode S address was not setup.
United States	N527MC	China Airlines	Taiwan	000005	No assignment	1	1	4							5	Correct Mode S address is not still setup.
United States	N213MT	Private?	-	E19242	Argentina	1				2					2	Former Registered in Argentina as LVYIB. Correct Mode S address was not setup.
United States	N307FV	Private?	-	000000	No assignment	3				2					2	Valid Mode S address is not still setup.
United States	N496AN	Private	-	04C034	Kenya	1						2			2	Former Registered as Kenya Air 5YRAB. Correct Mode S address was not setup.
United States	N526MD	World Airlines	United States	44B24D	Belgium	1						4			4	Former Registered in Belgium as OOLRM. Correct Mode S address was not setup.
United States	N660US	Northwest Orient Airlines INC.	United States	E83F8F	No assignment	1							3		3	2SB is incorrect bit. Correct Mode S address is 'A83F8F'.(*2)

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Registration Country	Registration Number	Operation Airline	Operation Airline Country	Mode S Address	Mode S Address country	Code (*1)	2000 1st half	'00 1st half	'00 2nd half	'01 1st half	'01 2nd half	'02 1st half	'02 2nd half	'03 1st half	'03 2nd half	Total	Remarks	
United States	N666US	Northwest Orient Airlines INC.	United States	88CC56	Japan	1	21	16								37	3SB is incorrect bit. Correct Mode S address is 'A8CC56'.(*2)	
United States	N142SW	Northwest Orient Airlines INC.	United States	780009	China	1	2									2	Former Registered in China as B-2454. Correct Mode S address was not setup.	
United States	N881Q	Private?	-	C7DC05	No assignment	1					2					2	Wrong Mode S address is set. Correct Mode S address is 'AC22EA'.(*2)	
China	BHLC	Cathay Pacific Airways LTD.	China	F80126	No assignment	1									7	7	MSB is incorrect bit. '780126' is assigned to China.	
Japan	JA190A	ORANGE CARGO Inc.	Japan	A0D020	United States	1									29	29	Correct Mode S address is not still setup.	
United States	N641NW	Northwest Orient Airlines INC.	United States	886A33	Thailand	1							1	1		2	3SB is incorrect bit. Correct Mode S address is 'A86A33'.(*2)	
Total number							39	65	27	25	14	37	22	46	275			
No. of Unauthorized aircraft							7	6	5	8	6	9	4	4	49			

(*1)code

1 : The nationality of the Registration Number differs from that of Mode-S address.

2 : The bits for individual assignments are all zeroes.

3 : All bits are zeroes.

(*2) "Aircraft Registration Database", FAA web(<http://registry.faa.gov/ardata.asp>)

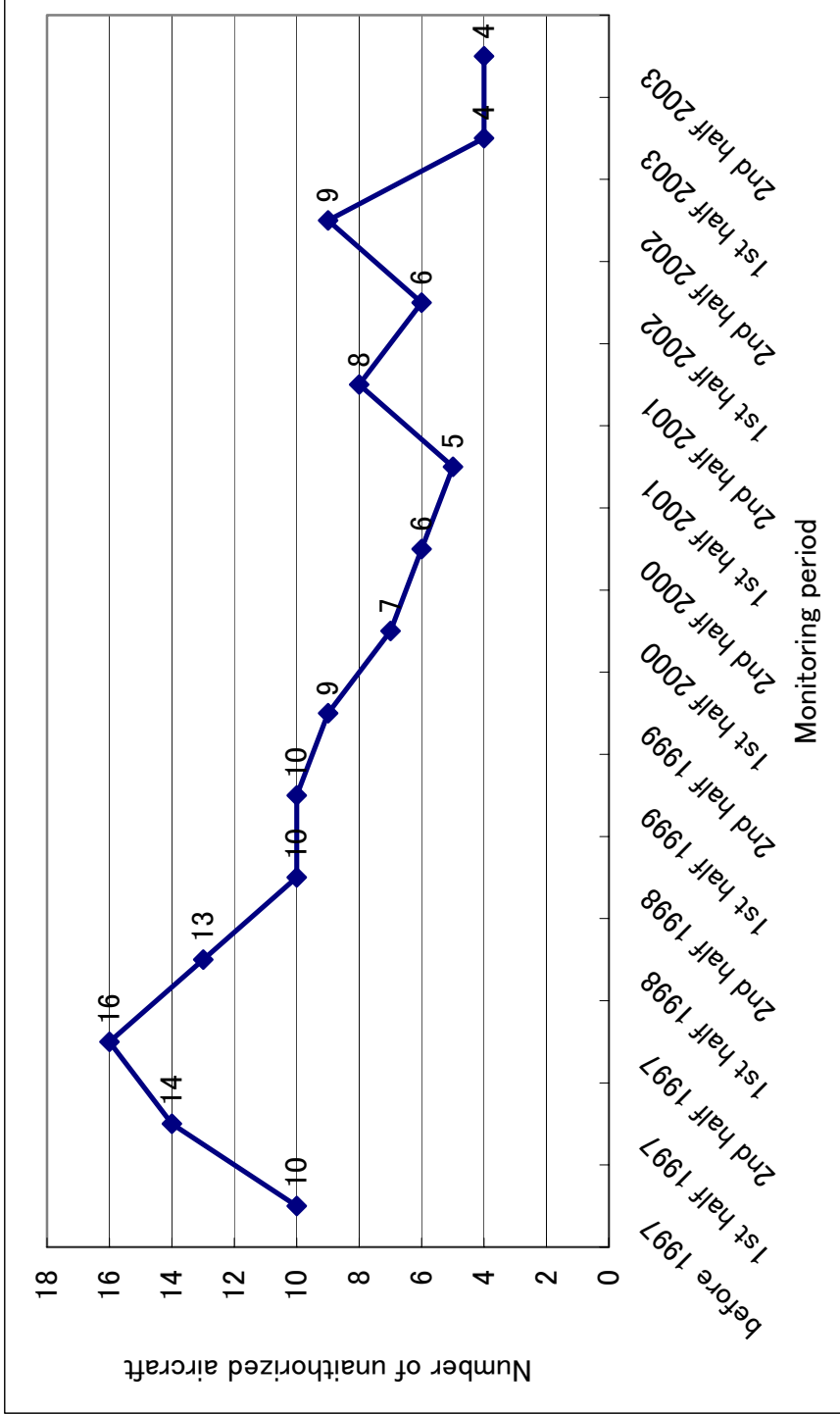


Fig-4: Transition of number of unauthorized address aircraft