International Civil Aviation Organization

Seventh Meeting of the Communications/Navigation/Surveillance and Meteorology Sub-Group (CNS/MET/SG/7) and Tenth Meeting of Communications/Navigation/Surveillance and Air Traffic Management Implementation Coordination Sub-Group (CNS/ATM IC SG/10) of APANPIRG

Bangkok, Thailand, 15-21 July, 2003

Agenda Item 6: Surveillance
2) review surveillance systems : Analytical Results of Unauthorized Aircraft Address Measured by Aircraft Address Monitoring System in 2002

(Presented by Japan)
(Prepared by Naoki Fujii, ENRI and Toshio Nakamura, NEC)

SUMMARY

This paper describes the analytical results of the unauthorized aircraft addresses in 2002 by Aircraft Address Monitoring System installed at New Tokyo and Kansai international airports.

1. Introduction

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. Aircraft addresses are allocated by the method described in attachment-A of this paper. Analytical results of unauthorized aircraft address measured by AAMS was already presented at Sixth Meeting of CNS/MET Sub-Group of APANPIRG in last year and SICASP/WP1-517 at London in April 1996, SICASP/WP1-579 and SICASP/WP1-580 at Nagoya in October 1996, SICASP/WP1-636 at Honolulu in October 1997, SICASP/WP1-849 at London in March 2000, SCRSP/WPB1-10 at Rio de Janeiro in April 2001, SCRSP/WPB3-17 at Kobe in March 2002, SCRSP/B/4-25-I at Frankfurt in October 2002, SCRSP/WP/B/5-31-I at Stockholm in May 2003, and the results of detected aircraft with unauthorized addresses was already introduced by SICASP/7 WP-7.

This paper presents the analytical results of unauthorized aircraft address from 2000 to 2002.

2. System Overview

This section describes the aircraft address monitoring system briefly. The system concept of the monitoring system is shown in Fig.-1. 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

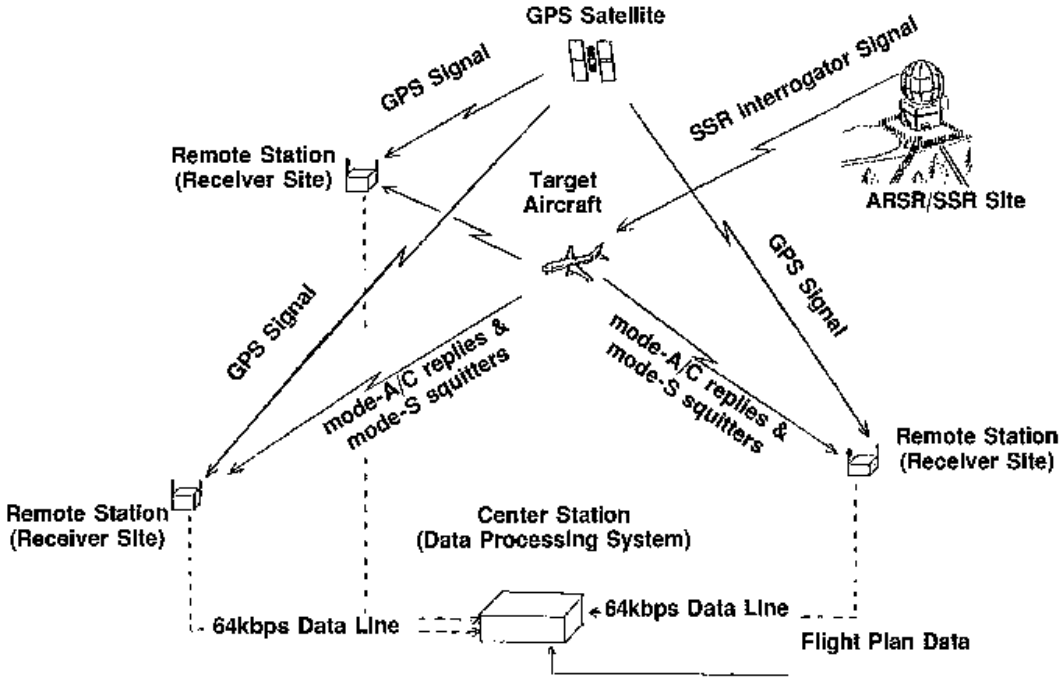

Fig.-1: Concept of Aircraft Address Monitoring System

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.

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) ATCRBS Plot Extractor Plot Capacity	100 aircraft / 10 s	(nominal)
(8) Mode S Plot Extractor Plot Capacity	50 aircraft / 1 s	(nominal)

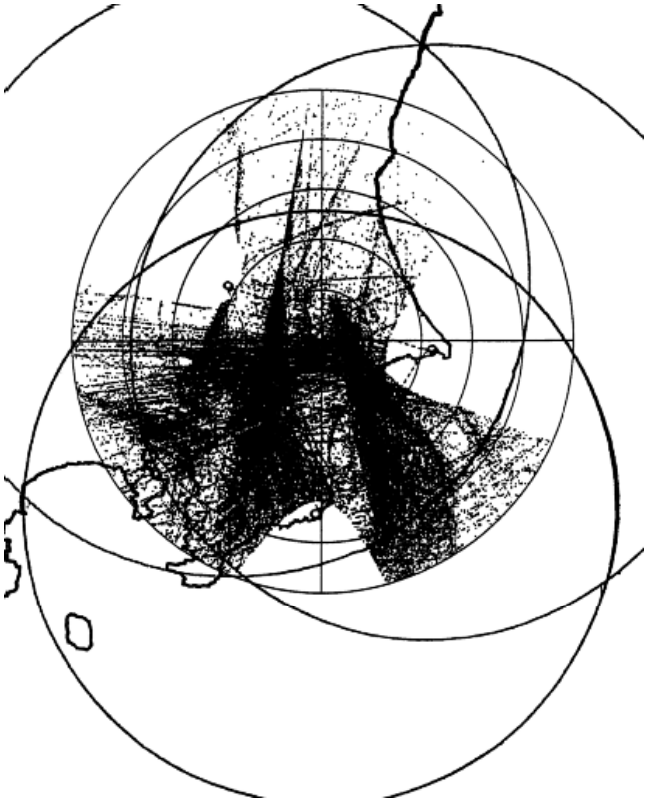

Fig.-2: Actual Coverage of New Tokyo AAMS

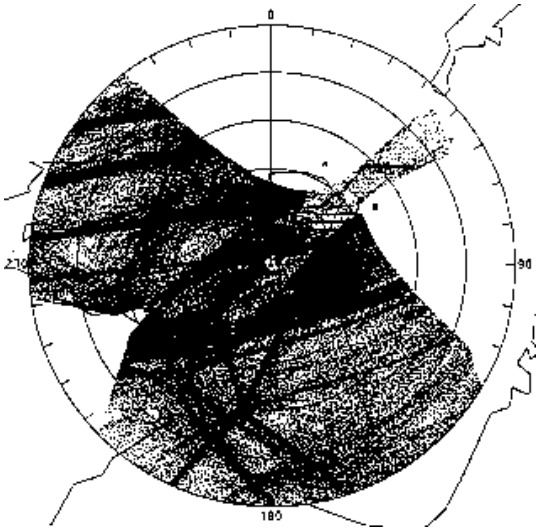

Fig.-3: Actual Coverage of Kansai AAMS

The actual coverage of AAMS are shown in Fig.-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 Narita AAMS, because the over flight above Kansai area is greater than above Narita 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 coverages.

3. Analytical Results and Conclusion

The analytical results of unauthorized aircraft address measured by AAMS from 2000 to 2002 are listed in Table-2, and the transition of the number of unauthorized address aircraft is shown in Fig.-4. Most of unauthorized address aircraft are estimated by the difference between the nationality of the registration number and the nationality of the aircraft address. Some unauthorized address aircraft are estimated by the aircraft address having only the nationality code. The number of unauthorized address aircraft have been decreasing since AAMS started to operate in the second half of 1997, but as the result of this analysis, we can see the increase tendency of the number of unauthorized address aircraft from some developed countries. For a

while, what we need to do in such situation is to keep watch the tendency of the number of unauthorized aircraft from developed countries and analyze it to determine whether the above-mentioned tendency represents only a transient phenomenon or a newly appeared steady state, and this activity will be continued until vanishing all unauthorized address aircraft.

4. Recommendation

It is recommended that the meeting notes this analytical results of unauthorized aircraft address.

Attachment-A ICAO Annex10 Volume III Chapter 9 Aircraft Addressing System

Table-2 List of Detected Unauthorized Mode-S Aircraft

Registration Country	Registration Number	Operation Airline	Operation Airline Country	Mode-S Address	Mode-S Address assignment country	Code*	2000 1st half	2000 2nd half	2001 1st half	2001 2nd half	2002 1st half	2002 2nd half	Total	Remarks
Aruba?	P4GJC	OPR/PV	-	48412E	Netherlands	1					2	2	4	
Australia	VNA764	Vietnam Airlines	Vietnam	000000	No assignment	3			12				12	
No assignment	70400	OPR/DOD	-	AE010D	U. S. A	1						2	2	U. S. governmental?
Germany	DABVT	Deutsche Lufthansa, A.G.	Germany	BC4AD4	No assignment	1			6	5		6	17	3C4AD4? bit 1 error
Italy	IDEIC	Alitalia-Linee Aeree Italiane, S.P.A.	Italy	340089	Spain	1				2			2	300089?
Japan	JA8498	Japan Air System CO. LTD.	Japan	02DDCA	Tunisia	1					2		2	86DDCA, upper 6 bits error
Japan	JA8930	Japan Transocean Air	Japan	3C618D	Germany	1	1	25					26	
Korea	HL7465	Korean Air Lines CO. LTD.	Korea	38DC65	France	1					4	14	18	71B8CA?, 1 bit shift
Korea	HL7281	Korean Air Lines CO. LTD.	Korea	713A81	Saudi Arabia	1		1					1	
Malaysia	9MMHL	Malaysian Airlines System	Malaysia	750000	Malaysia	2	6	10	2	7			25	
Malaysia	9MMPI	Malaysian Airlines System	Malaysia	7D0034	Australia	1				4	2	1	7	750034? , bit 5 error
Malaysia	9MMPM	Malaysian Airlines System	Malaysia	F7007A	No assignment	1	5	9	6	1			21	
Russian Federation	RPC3223	Philippine Air Lines Inc.(PAL)	Philippine	77801D	Syria	1						5	5	
U. K. ?	MM62173	Private?	-	33FFF8	Italy	1					2		2	
China	BHXA	Cathay Pacific Airways LTD.	China	70015B	Afghanistan	1	3						3	
China	B16103	EVA Airlines Corporation	China	81908B	India	1			1				1	
U. S. A	N201YT	Private?	-	E1A484	Argentina	1				2			2	
U. S. A	N527MC	China Airlines	Taiwan	000005	No assignment	1	1	4					5	
U. S. A	N213MT	Private?	-	E19242	Argentina	1				2			2	
U. S. A	N307FV	Private?	-	000000	No assignment	3				2			2	
U. S. A	N496AN	Private?	-	04C034	Kenya	1						2	2	
U. S. A	N526MD	World Airlines	U. S. A	44B24D	Belgium	1						4	4	
U. S. A	N666US	Northwest Orient Airlines INC.	U. S. A	88CC56	Japan	1	21	16					37	
U. S. A	N142SW	Northwest Orient Airlines INC.	U. S. A	780009	China	1	2						2	
U. S. A	N881Q	Private?	-	C7DC05	No assignment	1					2		2	
					Total Number		39	65	27	25	14	36	206	
					No. of Unauthorized aircraft		7	6	5	8	6	8	40	

*code 1 : The nationality of the registration number differs from that of Mode-S address.
*code 2 : The bits for individual assignments are all zeroes.
*code 3 : All bits are zeroes

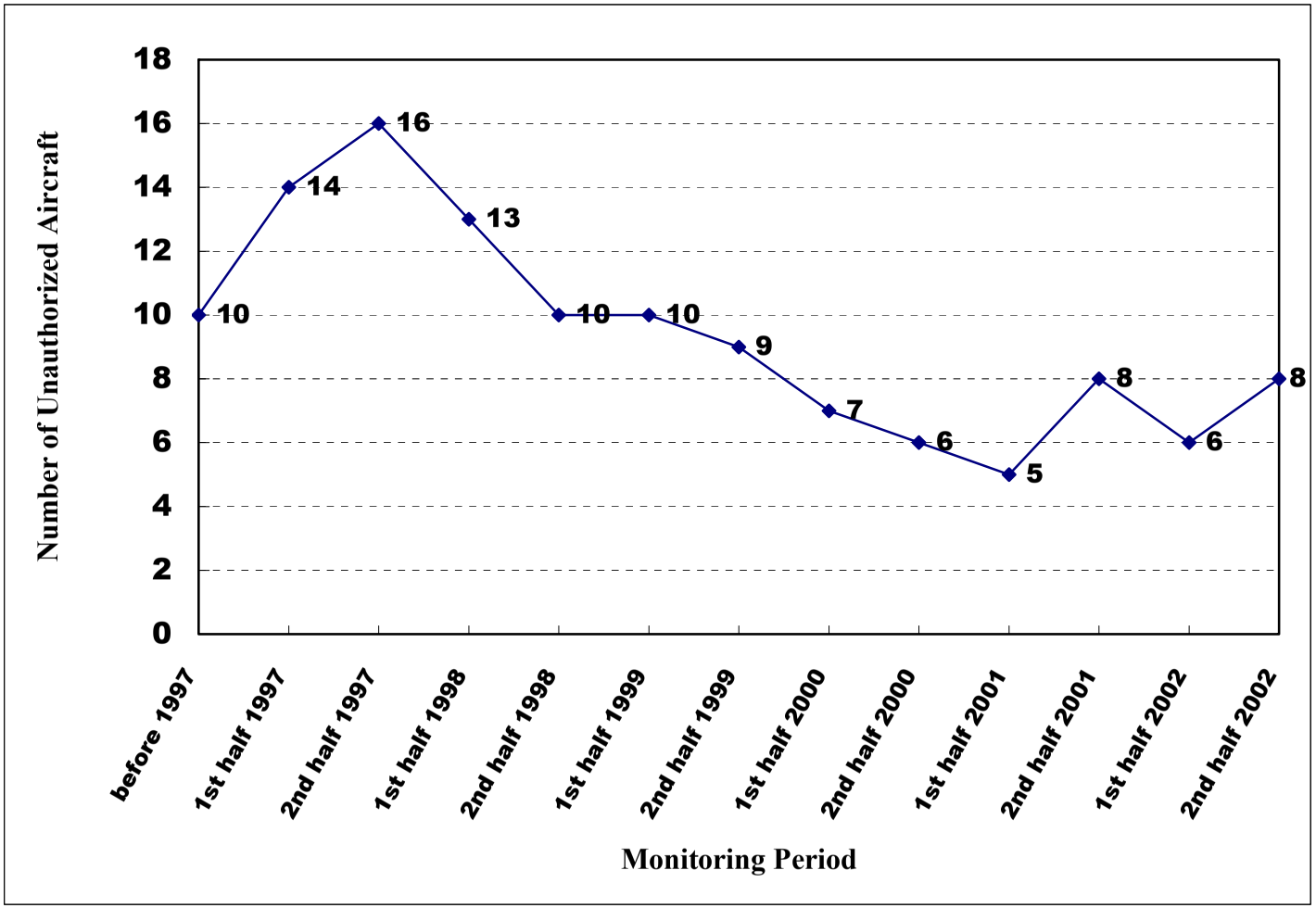

Fig.-4: Transition of Number of Detected Unauthorized Address Aircraft

ICAO Annex10 Volume III
CHAPTER 9. AIRCRAFT ADDRESSING SYSTEM

9.1 The aircraft address shall be one of 16 777 214 twenty-four-bit aircraft addresses allocated by ICAO to the State of Registry or common mark registering authority and assigned as prescribed in the Appendix to this Chapter.

APPENDIX TO CHAPTER 9. A WORLD-WIDE SCHEME FOR THE ALLOCATION, ASSIGNMENT AND APPLICATION OF AIRCRAFT ADDRESSES

1. General

1.1 Global communications, navigation and surveillance systems shall use an individual aircraft address composed of 24 bits. At any one time, no address shall be assigned to more than one aircraft. The assignment of aircraft addresses requires a comprehensive scheme providing for a balanced and expandable distribution of aircraft addresses applicable world-wide.

2. Description of the scheme

2.1 Table 9-1 provides for blocks of consecutive addresses available to States for assignment to aircraft. Each block is defined by a fixed pattern of the first 4, 6, 9, 12 or 14 bits of the 24-bit address. Thus, Blocks of different sizes (1 048 576, 262 144, 32 768, 4 096 and 1 024 consecutive addresses respectively) are made available.

3. Management of the scheme

3.1 The International Civil Aviation Organization (ICAO) shall administer the scheme so that appropriate international distribution of aircraft addresses can be maintained.

4. Allocation of aircraft addresses

4.1 Blocks of aircraft addresses shall be allocated by ICAO to the State of Registry or common mark registering authority. Address allocations to States shall be as shown in Table 9-1.

4.2 A State of Registry or common mark registering authority shall notify ICAO when allocation to that State of an additional block of addresses is required for assignment to aircraft.

4.3 In the future management of the scheme, advantage shall be taken of the blocks of aircraft addresses not yet allocated. These spare blocks shall be distributed on the basis of the relevant ICAO region:
Addresses starting with bit combination 00100: AFI region
Addresses starting with bit combination 00101: SAM region
Addresses starting with bit combination 0101: EUR and NAT regions
Addresses starting with bit combination 01100: MID region
Addresses starting with bit combination 01101: ASIA region
Addresses starting with bit combination 1001: NAM and PAC regions
Addresses starting with bit combination 111011: CAR region
In addition, aircraft addresses starting with bit combinations 1011, 1101 and 1111 have been reserved For future use.

4.4 Any future requirement for additional aircraft addresses shall be accommodated through co-ordination between ICAO and the States of Registry or common mark registering authority concerned.
A request for additional aircraft addresses shall only be made by a registering authority when at least 75 percent of the number of addresses already allocated to that registering authority have been assigned to aircraft.

4.5 ICAO shall allocate blocks of aircraft addresses to non-Contracting States upon request.

5. Assignment of aircraft addresses

5.1 When required for use by suitably equipped aircraft entered on a national or international register, individual aircraft addresses within each block shall be assigned to aircraft by the State of Registry or common mark registering authority.

5.2 Aircraft addresses shall be assigned to aircraft in accordance with the following principles:
a) at any one time, no address shall be assigned to more than one aircraft;
b) only one address shall be assigned to an aircraft, irrespective of the composition of equipment on board;
c) the address shall not be changed except under exceptional circumstances and shall not be changed during flight;
d) when an aircraft changes its State of Registry, the previously assigned address shall be relinquished and a new address shall be assigned by the new registering authority;
e) the address shall serve only a technical role for addressing and identification of aircraft and shall not be used to convey any specific information; and
f) the addresses composed of 24 ZEROs or 24 ONEs shall not be assigned to aircraft.

6. Application of aircraft addresses

6.1 The aircraft addresses shall be used in applications which require the routing of information to or from individual suitably equipped aircraft.

Note 1.— Examples of such applications are the aeronautical telecommunication network (ATN), SSR Mode S and airborne collision avoidance system (ACAS).

Note 2.— This Standard does not preclude assigning the aircraft addresses for special applications associated with the general applications defined therein. Examples of such special applications are the utilization of the 24-bit address in a pseudo-aeronautical earth station to monitor the aeronautical mobile-satellite service ground earth station and in the fixed Mode S transponders (reporting the on-the-ground status as specified in Volume IV, 3.1.2.6.10.1.2) to monitor the Mode S ground station operation. Address assignments for special applications are to be carried out in conformance with the procedure established by the State to manage the 24-bit address assignments to aircraft.

6.2 An address consisting of 24 ZEROs shall not be used for any application.

Table 9-1. Allocation of aircraft addresses to States

Note.— The left-hand column of the 24-bit address patterns represents the most significant bit (MSB) of the address.

State	*Number of addresses in block*					*Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)*
	1024	*4096*	*32768*	*262144*	*1048576*	
Afghanistan		*				0 1 1 1 0 0 0 0 0 0 0 0 – – – – – – – – – – – –
Albania	*					0 1 0 1 0 0 0 0 0 0 0 0 1 0 0 – – – – – – – – – –
Algeria			*			0 0 0 0 1 0 1 0 0 – – – – – – – – – – – – – – –
Angola		*				0 0 0 0 1 0 0 1 0 0 0 0 – – – – – – – – – – – –
Antigua and Barbuda	*					0 0 0 0 1 1 0 0 1 0 1 0 0 0 – – – – – – – – – –
Argentina				*		1 1 1 0 0 0 – – – – – – – – – – – – – – – – – –
Armenia	*					0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 – – – – – – – – – –
Australia				*		0 1 1 1 1 1 – – – – – – – – – – – – – – – – – –
Austria			*			0 1 0 0 0 1 0 0 0 – – – – – – – – – – – – – – –
Azerbaijan	*					0 1 1 0 0 0 0 0 0 0 0 0 1 0 – – – – – – – – – –
Bahamas		*				0 0 0 0 1 0 1 0 1 0 0 0 – – – – – – – – – – – –
Bahrain		*				1 0 0 0 1 0 0 1 0 1 0 0 – – – – – – – – – – – –
Bangladesh		*				0 1 1 1 0 0 0 0 0 0 1 0 – – – – – – – – – – – –
Barbados	*					0 0 0 0 1 0 1 0 1 0 1 0 0 0 – – – – – – – – – –
Belarus	*					0 1 0 1 0 0 0 1 0 0 0 0 0 0 – – – – – – – – – –
Belgium			*			0 1 0 0 0 1 0 0 1 – – – – – – – – – – – – – – –
Belize	*					0 0 0 0 1 0 1 0 1 0 1 1 0 0 – – – – – – – – – –
Benin	*					0 0 0 0 1 0 0 1 0 1 0 0 0 0 – – – – – – – – – –
Bhutan	*					0 1 1 0 1 0 0 0 0 0 0 0 0 0 – – – – – – – – – –
Bolivia		*				1 1 1 0 1 0 0 1 0 1 0 0 – – – – – – – – – – – –
Bosnia and Herzegovina	*					0 1 0 1 0 0 0 1 0 0 1 1 0 0 – – – – – – – – – –
Botswana	*					0 0 0 0 0 0 1 1 0 0 0 0 0 0 – – – – – – – – – –
Brazil				*		1 1 1 0 0 1 – – – – – – – – – – – – – – – – – –
Brunei Darussalam	*					1 0 0 0 1 0 0 1 0 1 0 1 0 0 – – – – – – – – – –
Bulgaria			*			0 1 0 0 0 1 0 1 0 – – – – – – – – – – – – – – –
Burkina Faso		*				0 0 0 0 1 0 0 1 1 1 0 0 – – – – – – – – – – – –
Burundi		*				0 0 0 0 0 0 1 1 0 0 1 0 – – – – – – – – – – – –
Cambodia		*				0 1 1 1 0 0 0 0 1 1 1 0 – – – – – – – – – – – –
Cameroon		*				0 0 0 0 0 0 1 1 0 1 0 0 – – – – – – – – – – – –
Canada				*		1 1 0 0 0 0 – – – – – – – – – – – – – – – – – –
Cape Verde	*					0 0 0 0 1 0 0 1 0 1 1 0 0 0 – – – – – – – – – –
Central African Republic		*				0 0 0 0 0 1 1 0 1 1 0 0 – – – – – – – – – – – –
Chad		*				0 0 0 0 1 0 0 0 0 1 0 0 – – – – – – – – – – – –
Chile		*				1 1 1 0 1 0 0 0 0 0 0 0 – – – – – – – – – – – –
China				*		0 1 1 1 1 0 – – – – – – – – – – – – – – – – – –
Colombia		*				0 0 0 0 1 0 1 0 1 1 0 0 – – – – – – – – – – – –
Comoros	*					0 0 0 0 0 0 1 1 0 1 0 1 0 0 – – – – – – – – – –
Congo		*				0 0 0 0 0 0 1 1 0 1 1 0 – – – – – – – – – – – –
Cook Islands	*					1 0 0 1 0 0 0 0 0 0 0 1 0 0 – – – – – – – – – –
Costa Rica		*				0 0 0 0 1 0 1 0 1 1 1 0 – – – – – – – – – – – –
Côte d'Ivoire		*				0 0 0 0 0 0 1 1 1 0 0 0 – – – – – – – – – – – –
Croatia	*					0 1 0 1 0 0 0 0 0 0 0 1 1 1 – – – – – – – – – –
Cuba		*				0 0 0 0 1 0 1 1 0 0 0 0 – – – – – – – – – – – –
Cyprus	*					0 1 0 0 1 1 0 0 1 0 0 0 0 0 – – – – – – – – – –
Czech Republic			*			0 1 0 0 1 0 0 1 1 – – – – – – – – – – – – – – –
Democratic People's Republic of Korea			*			0 1 1 1 0 0 1 0 0 – – – – – – – – – – – – – – –
Democratic Republic of the Congo		*				0 0 0 0 1 0 0 0 1 1 0 0 – – – – – – – – – – – –
Denmark			*			0 1 0 0 0 1 0 1 1 – – – – – – – – – – – – – – –
Djibouti	*					0 0 0 0 1 0 0 1 1 0 0 0 0 0 – – – – – – – – – –
Dominican Republic		*				0 0 0 0 1 1 0 0 0 1 0 0 – – – – – – – – – – – –
Ecuado		*				1 1 1 0 1 0 0 0 0 1 0 0 – – – – – – – – – – – –

State	Number of addresses in block					Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	1024	4096	32768	262144	1048576	
Egypt			*			0 0 0 0 0 0 0 1 0 – – – – – – – – – – – – – – – –
El Salvador		*				0 0 0 0 1 0 1 1 0 0 1 0 – – – – – – – – – – – –
Equatorial Guinea		*				0 0 0 0 0 1 0 0 0 0 1 0 – – – – – – – – – – – –
Eritrea	*					0 0 1 0 0 0 0 0 0 0 1 0 0 0 – – – – – – – – – –
Estonia	*					0 1 0 1 0 0 0 1 0 0 0 1 0 0 – – – – – – – – – –
Ethiopia		*				0 0 0 0 0 1 0 0 0 0 0 0 – – – – – – – – – – – –
Fiji		*				1 1 0 0 1 0 0 0 1 0 0 0 – – – – – – – – – – – –
Finland			*			0 1 0 0 0 1 1 0 0 – – – – – – – – – – – – – – – –
France				*		0 0 1 1 1 0 – – – – – – – – – – – – – – – – – –
Gabon		*				0 0 0 0 0 0 1 1 1 1 1 0 – – – – – – – – – – – –
Gambia		*				0 0 0 0 1 0 0 1 1 0 1 0 – – – – – – – – – – – –
Georgia	*					0 1 0 1 0 0 0 1 0 1 0 0 0 0 – – – – – – – – – –
Germany				*		0 0 1 1 1 1 – – – – – – – – – – – – – – – – – –
Ghana		*				0 0 0 0 0 1 0 0 0 1 0 0 – – – – – – – – – – – –
Greece			*			0 1 0 0 0 1 1 0 1 – – – – – – – – – – – – – – –
Grenada	*					0 0 0 0 1 1 0 0 1 1 0 0 0 0 – – – – – – – – – –
Guatemala		*				0 0 0 0 1 0 1 1 0 1 0 0 – – – – – – – – – – – –
Guinea		*				0 0 0 0 0 1 0 0 0 1 1 0 – – – – – – – – – – – –
Guinea-Bissau	*					0 0 0 0 0 1 0 0 1 0 0 0 0 0 – – – – – – – – – –
Guyana		*				0 0 0 0 1 0 1 1 0 1 1 0 – – – – – – – – – – – –
Haiti		*				0 0 0 0 1 0 1 1 1 0 0 0 – – – – – – – – – – – –
Honduras		*				0 0 0 0 1 0 1 1 1 0 1 0 – – – – – – – – – – – –
Hungary			*			0 1 0 0 0 1 1 1 0 – – – – – – – – – – – – – – –
Iceland		*				0 1 0 0 1 1 0 0 1 1 0 0 – – – – – – – – – – – –
India				*		1 0 0 0 0 0 – – – – – – – – – – – – – – – – – –
Indonesia			*			1 0 0 0 1 0 1 0 0 – – – – – – – – – – – – – – –
Iran, Islamic Republic of			*			0 1 1 1 0 0 1 1 0 – – – – – – – – – – – – – – –
Iraq			*			0 1 1 1 0 0 1 0 1 – – – – – – – – – – – – – – –
Ireland		*				0 1 0 0 1 1 0 0 1 0 1 0 – – – – – – – – – – – –
Israel			*			0 1 1 1 0 0 1 1 1 – – – – – – – – – – – – – – –
Italy				*		0 0 1 1 0 0 – – – – – – – – – – – – – – – – – –
Jamaica		*				0 0 0 0 1 0 1 1 1 1 1 0 – – – – – – – – – – – –
Japan				*		1 0 0 0 0 1 – – – – – – – – – – – – – – – – – –
Jordan			*			0 1 1 1 0 1 0 0 0 – – – – – – – – – – – – – – –
Kazakhstan	*					0 1 1 0 1 0 0 0 0 0 1 1 0 0 – – – – – – – – – –
Kenya		*				0 0 0 0 0 1 0 0 1 1 0 0 – – – – – – – – – – – –
Kiribati	*					1 1 0 0 1 0 0 0 1 1 1 0 0 0 – – – – – – – – – –
Kuwait		*				0 1 1 1 0 0 0 0 0 1 1 0 – – – – – – – – – – – –
Kyrgyzstan	*					0 1 1 0 0 0 0 0 0 0 0 1 0 0 – – – – – – – – – –
Lao People's emocratic Republic		*				0 1 1 1 0 0 0 0 1 0 0 0 – – – – – – – – – — — –
Latvia	*					0 1 0 1 0 0 0 0 0 0 1 0 1 1 – – – – – – – – – –
Lebanon			*			0 1 1 1 0 1 0 0 1 – – – – – – – – – – – – – – –
Lesotho	*					0 0 0 0 0 1 0 0 1 0 1 0 0 0 – – – – – – – – – –
Liberia		*				0 0 0 0 0 1 0 1 0 0 0 0 – – – – – – – – – – – –
Libyan Arab Jamahiriya			*			0 0 0 0 0 0 0 1 1 – – – – – – – – – – – – – – –
Lithuania	*					0 1 0 1 0 0 0 0 0 0 1 1 1 1 – – – – – – – – – –
Luxembourg	*					0 1 0 0 1 1 0 1 0 0 0 0 0 0 – – – – – – – – – –
Madagascar		*				0 0 0 0 0 1 0 1 0 1 0 0 – – – – – – – – – – – –
Malawi		*				0 0 0 0 0 1 0 1 1 0 0 0 – – – – – – – – – – – –
Malaysia			*			0 1 1 1 0 1 0 1 0 – – – – – – – – – – – – – – –
Maldives	*					0 0 0 0 0 1 0 1 1 0 1 0 0 0 – – – – – – – – – –
Mali		*				0 0 0 0 0 1 0 1 1 1 0 0 – – – – – – – – – – – –
Malta	*					0 1 0 0 1 1 0 1 0 0 1 0 0 0 – – – – – – – – – –
Marshall Islands	*					1 0 0 1 0 0 0 0 0 0 0 0 0 0 – – – – – – – – – –
Mauritania	*					0 0 0 0 0 1 0 1 1 1 1 0 0 0 – – – – – – – – – –
Mauritius	*					0 0 0 0 0 1 1 0 0 0 0 0 0 0 – – – – – – – – – –

Mexico			*			0 0 0 0 1 1 0 1 0 – – – – – – – – – – – – – – –
Micronesia, Federated States of	*					0 1 1 0 1 0 0 0 0 0 0 1 0 0 – – – – – – – – – –
Monaco	*					0 1 0 0 1 1 0 1 0 1 0 0 0 0 – – – – – – – – – –
Mongolia	*					0 1 1 0 1 0 0 0 0 0 1 0 0 0 – – – – – – – – – –
Morocco			*			0 0 0 0 0 0 1 0 0 – – – – – – – – – – – – – – –
Mozambique		*				0 0 0 0 0 0 0 0 0 0 1 1 0 – – – – – – – – – – –
Myanmar		*				0 1 1 1 0 0 0 0 0 1 0 0 – – – – – – – – – – – –
Namibia	*					0 0 1 0 0 0 0 0 0 0 0 1 0 0 – – – – – – – – – –
Nauru	*					1 1 0 0 1 0 0 0 1 0 1 0 0 0 – – – – – – – – – –
Nepal		*				0 1 1 1 0 0 0 0 1 0 1 0 – – – – – – – – – – – –
Netherlands, Kingdom of the			*			0 1 0 0 1 0 0 0 0 – – – – – – – – – – – – – – –
New Zealand			*			1 1 0 0 1 0 0 0 0 – – – – – – – – – – – – – – –
Nicaragua		*				0 0 0 0 1 1 0 0 0 0 0 0 – – – – – – – – – – – –
Niger		*				0 0 0 0 0 1 1 0 0 0 1 0 – – – – – – – – – – – –
Nigeria		*				0 0 0 0 0 1 1 0 0 1 0 0 – – – – – – – – – – – –
Norway			*			0 1 0 0 0 1 1 1 1 – – – – – – – – – – – – – – –
Oman	*					0 1 1 1 0 0 0 0 1 1 0 0 0 0 – – – – – – – – – –
Pakistan			*			0 1 1 1 0 1 1 0 0 – – – – – – – – – – – – – – –
Palau	*					0 1 1 0 1 0 0 0 0 1 0 0 0 0 – – – – – – – – – –
Panama		*				0 0 0 0 1 1 0 0 0 0 1 0 – – – – – – – – – – – –
Papua New Guinea		*				1 0 0 0 1 0 0 1 1 0 0 0 – – – – – – – – – – – –
Paraguay		*				1 1 1 0 1 0 0 0 1 0 0 0 – – – – – – – – – – – –
Peru		*				1 1 1 0 1 0 0 0 1 1 0 0 – – – – – – – – – – – –
Philippines			*			0 1 1 1 0 1 0 1 1 – – – – – – – – – – – – – – –
Poland			*			0 1 0 0 1 0 0 0 1 – – – – – – – – – – – – – – –
Portugal			*			0 1 0 0 1 0 0 1 0 – – – – – – – – – – – – – – –
Qatar	*					0 0 0 0 0 1 1 0 1 0 1 0 0 0 – – – – – – – – – –
Republic of Korea			*			0 1 1 1 0 0 0 1 1 – – – – – – – – – – – – – – –
Republic of Moldova	*					0 1 0 1 0 0 0 0 0 1 0 0 1 1 – – – – – – – – – –
Romania			*			0 1 0 0 1 0 1 0 0 – – – – – – – – – – – – – – –
Russian Federation					*	0 0 0 1 –
Rwanda		*				0 0 0 0 0 1 1 0 1 1 1 0 – – – – – – – – – – – –
Saint Lucia	*					1 1 0 0 1 0 0 0 1 1 0 0 0 0 – – – – – – – – – –
Saint Vincent and the Grenadines	*					0 0 0 0 1 0 1 1 1 1 0 0 0 0 – – – – – – – – – –
Samoa	*					1 0 0 1 0 0 0 0 0 0 1 0 0 0 – – – – – – – – – –
San Marino	*					0 1 0 1 0 0 0 0 0 0 0 0 0 0 – – – – – – – – – –
Sao Tome and Principe	*					0 0 0 0 1 0 0 1 1 1 1 0 0 0 – – – – – – – – – –
Saudi Arabia			*			0 1 1 1 0 0 0 1 0 – – – – – – – – – – – – – – –
Senegal		*				0 0 0 0 0 1 1 1 0 0 0 0 – – – – – – – – – – – –
Seychelles	*					0 0 0 0 0 1 1 1 0 1 0 0 0 0 – – – – – – – – – –
Sierra Leone	*					0 0 0 0 0 1 1 1 0 1 1 0 0 0 – – – – – – – – – –
Singapore			*			0 1 1 1 0 1 1 0 1 – – – – – – – – – – – – – – –
Slovakia	*					0 1 0 1 0 0 0 0 0 1 0 1 1 1 – – – – – – – – – –
Slovenia	*					0 1 0 1 0 0 0 0 0 1 1 0 1 1 – – – – – – – – – –
Solomon Islands	*					1 0 0 0 1 0 0 1 0 1 1 1 0 0 – – – – – – – – – –
Somalia		*				0 0 0 0 0 1 1 1 1 0 0 0 – – – – – – – – – – – –
South Africa			*			0 0 0 0 0 0 0 0 1 – – – – – – – – – – – – – – –
Spain				*		0 0 1 1 0 1 – – – – – – – – – – – – – – – – – –
Sri Lanka			*			0 1 1 1 0 1 1 1 0 – – – – – – – – – – – – – – –
Sudan		*				0 0 0 0 0 1 1 1 1 1 0 0 – – – – – – – – – – – –
Suriname		*				0 0 0 0 1 1 0 0 1 0 0 0 – – – – – – – – – – – –
Swaziland	*					0 0 0 0 0 1 1 1 1 0 1 0 0 0 – – – – – – – – – –
Sweden			*			0 1 0 0 1 0 1 0 1 – – – – – – – – – – – – – – –
Switzerland			*			0 1 0 0 1 0 1 1 0 – – – – – – – – – – – – – – –
Syrian Arab Republic			*			0 1 1 1 0 1 1 1 1 – – – – – – – – – – – – – – –
Tajikistan	*					0 1 0 1 0 0 0 1 0 1 0 1 0 0 – – – – – – – – – –
Thailand			*			1 0 0 0 1 0 0 0 0 – – – – – – – – – – – – – – –

State	*Number of addresses in block*					*Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)*
	1024	*4096*	*32768*	*262144*	*1048576*	
The former Yugoslav Republic of Macedonia	*					0 1 0 1 0 0 0 1 0 0 1 0 0 0 – – – – – – – – – –
Togo		*				0 0 0 0 1 0 0 0 1 0 0 0 – – – – – – – – – – – –
Tonga	*					1 1 0 0 1 0 0 0 1 1 0 1 0 0 – – – – – – – – – –
Trinidad and Tobago		*				0 0 0 0 1 1 0 0 0 1 1 0 – – – – – – – – – – – –
Tunisia			*			0 0 0 0 0 0 1 0 1 – – – – – – – – – – – – – – –
Turkey			*			0 1 0 0 1 0 1 1 1 – – – – – – – – – – – – – – –
Turkmenistan	*					0 1 1 0 0 0 0 0 0 0 0 1 1 0 – – – – – – – – – –
Uganda		*				0 0 0 0 0 1 1 0 1 0 0 0 – – – – – – – – – – – –
Ukraine			*			0 1 0 1 0 0 0 0 1 – – – – – – – – – – – – – – –
United Arab Emirates		*				1 0 0 0 1 0 0 1 0 1 1 0 – – – – – – – – – – – –
United Kingdom				*		0 1 0 0 0 0 – – – – – – – – – – – – – – – – – –
United Republic of Tanzania		*				0 0 0 0 1 0 0 0 0 0 0 0 – – – – – – – – – – – –
United States					*	1 0 1 0 –
Uruguay		*				1 1 1 0 1 0 0 1 0 0 0 0 – – – – – – – – – – – –
Uzbekistan	*					0 1 0 1 0 0 0 0 0 1 1 1 1 1 – – – – – – – – – –
Vanuatu	*					1 1 0 0 1 0 0 1 0 0 0 0 0 0 – – – – – – – – – –
Venezuela			*			0 0 0 0 1 1 0 1 1 – – – – – – – – – – – – – – –
Viet Nam			*			1 0 0 0 1 0 0 0 1 – – – – – – – – – – – – – – –
Yemen		*				1 0 0 0 1 0 0 1 0 0 0 0 – – – – – – – – – – – –
Zambia		*				0 0 0 0 1 0 0 0 1 0 1 0 – – – – – – – – – – – –
Zimbabwe	*					0 0 0 0 0 0 0 0 0 1 0 0 0 0 – – – – – – – – – –
Non-Contracting States						
Yugoslavia			*			0 1 0 0 1 1 0 0 0 – – – – – – – – – – – – – – –
Other allocations						
ICAO [1]			*			1 1 1 1 0 0 0 0 0 – – – – – – – – – – – – – – –
ICAO [2]	*					1 0 0 0 1 0 0 1 1 0 0 1 0 0 – – – – – – – – – –
ICAO [2]	*					1 1 1 1 0 0 0 0 1 0 0 1 0 0 – – – – – – – – – –

1. ICAO or its designate administers this block for assigning temporary aircraft addresses if and when an immediate action is to be taken to avoid the assignment of an unauthorized 24-bit aircraft address. It is intended that the temporary address is to be relinquished as soon as practicable when the 24bit aircraft address is assigned by a State of Registry or common mark registering authority in conformance with the provisions in 4, 5 and 6 of this Appendix. The State concerned is then expected to inform ICAO or its designate regarding the release of the temporary address.
2. Block allocated for special use in the interest of flight safety.