International Civil Aviation Organization

FIRST MEETING OF THE SURVEILLANCE IMPLEMENTATION COORDINATION GROUP (SURICG/1)

Bangkok, Thailand, 21 - 22 April 2016

Agenda Item 6: **Review of Regional Requirements for Surveillance in the eANP, Seamless ATM Plan and ASBU**

REGIONAL SURVEILLANCE ELEMENTS OF THE SEAMLESS ATM PLAN

(Presented by the Secretariat)

SUMMARY

This paper presents information on current and proposed ATS Surveillance elements, including performance objectives, of the Asia/Pacific Seamless ATM Plan.

1. INTRODUCTION

1.1 The Asia/Pacific Seamless ATM Plan ('the Plan'), adopted by the 24th Meeting of the Asia/Pacific Planning and Implementation Regional Group (APANPIRG/25, Bangkok, Thailand, 24 – 26 June 2013). The Plan defines goals and the means of meeting State planning objectives for a Regional seamless ATM performance framework, with a focus on technological and human performance.

1.2 The Plan is due for review by APANPIRG/27, scheduled for September 2016. New or amended information in draft is currently being reviewed by relevant contributory bodies of APANPIRG.

1.3 Existing performance objectives in the current version of the Plan include the implementation of surveillance technologies that may be considered within the work program of the Surveillance Implementation Coordination Group (SURICG). The current draft of the updated version of the Plan includes information and performance objectives for the implementation and use of Mode S SSR surveillance, also for consideration by SURICG.

2. DISCUSSION

2.1 The Plan states that the ICAO *Manual on Global Performance of the Air Navigation System* (ICAO Doc 9883) provides guidance on implementing a performance-oriented ATM System. It further states that The *Manual on ATM System Requirements* (ICAO Doc 9882) contains eleven Key Performance Area (KPA) system expectations, as well as a number of general performance-oriented requirements. In accordance with the expectations of these documents, the Plan was developed with the following performance objectives to facilitate Seamless ATM operations:

a) Preferred Aerodrome/Airspace and Route Specifications (PARS); and

b) Preferred ATM Service Levels (PASL).

2.2 The PARS/PASL introduced two Performance Objectives, which incorporate system expectations, such as general performance-oriented requirements. Each performance objective is composed of a list of expectations of different aspects of the aviation system.

2.3 Prior to implementation, each State should verify the applicability of PARS and PASL by analysis of safety, ATM capacity requirements to meet current and forecast traffic demand, efficiency, predictability, cost effectiveness and environment to meet the expectations of stakeholders. The PARS/PASL elements would be either:

a) not applicable; or

b) already implemented; or

c) not implemented.

2.4 The PARS and PASL were expected to be implemented in two phases, Phase I by 12 November 2015 and Phase II by 08 November 2018.

Note: The draft updated Plan will include a change to the Phase II implementation date to 07 November 2019, to align with the new ASBU Block 0/Block 1 timeframe.

2.5 The PARS contain the expectations for airspace and ATS routes, including aircraft equipage to facilitate Seamless ATM operation, and is therefore a matter for the State regulator or the airspace authority, and is of primary interest to airspace planners, flight procedure designers and aircraft operators.

2.6 The PASL contain the expectations for Air Navigation Service Providers (ANSP), and is therefore a matter for the State regulator or the ATS authority. The PASL is of primary interest to ANSPs and aircraft operators. The PARS and PASL together form the foundation of Seamless ATM development, and as such should be enabled by national regulations, rules and policies wherever applicable to enable a harmonised effort by all stakeholders.

2.7 In accordance with the operational concept that air navigation services should be provided commensurate with the capability of the communications, navigation and surveillance (CNS) equipment, the Plan categorizes airspace by reference to its CNS capability as:

a) Category R: remote en-route airspace within Air Traffic Services (ATS) communications and surveillance coverage dependent on a third-party Communication Service Provider (CSP); or

b) Category S: serviced (or potentially serviced) en-route airspace – by direct (not dependent on a CSP) ATS communications and surveillance; or

c) Category T: terminal operations serviced by direct ATS communications and surveillance.

2.8 The Plan currently includes a number of performance objectives of interest to SURICG. **Attachment A** provides relevant excerpts from the current version of the Plan

Draft Updated Seamless ATM Plan

2.9 The draft updated version of the Plan incorporates further ATS surveillance information and performance objectives of interest to SURICG. **Attachment B** provides relevant excerpts from the draft.

2.10 The meeting is invited to note in particular the proposed performance objectives relating to Mode S SSR. These are in part supported by the following APANPIRG Conclusion:

Conclusion APANPIRG/26/11 – Implementation of FPL 2012 Capability

That, noting the relevant aircraft separation and track spacing minima specified in ICAO Doc 4444 PANS-ATM, and the performance objectives of the Asia/Pacific Seamless ATM Plan;

States are urged to include in ATM automation system specifications the processing and presentation in ATC human-machine interfaces and decision support and alerting tools, the communications, navigation and approach aid indicators received in items 10 and 18 of FPL and ATS messages, where applicable, and the following Mode S SSR or Automatic Dependent Surveillance – Broadcast (ADS-B) downlinked aircraft parameters as a minimum:

- *Aircraft Identification, magnetic heading and indicated airspeed or Mach Number; and*
- *Pilot selected altitude.*

3. ACTION REQUIRED BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this papers;

b) note surveillance-related performance objectives of Version 1.0 of the Asia/Pacific Seamless ATM Plan;

c) note, review and provide feedback on the proposed surveillance-related information and performance objectives of the draft updated version of the Asia/Pacific Seamless ATM Plan;

d) consider how the current and proposed performance objectives of the Seamless ATM Plan should be included in the SURICG work program; and

b) discuss any relevant matters as appropriate.

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Attachment A: Current Surveillance-Related Performance Objectives of the Asia/Pacific Seamless ATM Plan

*Note: ** indicates current non-ADS-B surveillance-related objectives*

PARS Phase I (expected implementation by 12 November 2015)

Aerodrome Operations

7.1 ** All high density international aerodromes (100,000 scheduled movements per annum or more) should:

a) provide electronic surface movement guidance and control.

Note 1: the 100,000 movement benchmark must not be viewed as lessening more stringent existing requirements and criteria established by the State, or superseding ICAO Annex 14 Volume I requirements, especially with regard to aerodrome certification.

Note 2: the provision of A-SMGCS should be subject to economic analysis.

7.2 ** All high density aerodromes should operate an A-CDM system serving the MTF and busiest city pairs, with priority implementation for the busiest Asia/Pacific aerodromes [1].

En-route Operations

7.6 All Category S upper controlled airspace and Category T airspace supporting high density aerodromes should be designated as non-exclusive or exclusive as appropriate ADS-B airspace requiring operation of ADS-B using 1090ES with DO-260/260A and 260B capability, with priority implementation for the following high density FIRs (**Figure 9**) supporting the busiest Asia/Pacific traffic flows (APANPIRG Conclusion 22/8 and 23/5 refer):

b) South Asia: Delhi, Mumbai;

c) Southeast Asia: Bangkok, Hanoi, Ho Chi Minh, Jakarta, Kota Kinabalu, Manila, Sanya, Singapore, Vientiane; and

d) East Asia: Beijing, Fukuoka, Guangzhou, Hong Kong, Kunming, Incheon, Shanghai, Shenyang, Taibei, Wuhan.

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[1] Based on 2012 ICAO data, the 21 busiest Asia/Pacific aerodromes were:

- Australia (Sydney, Melbourne);
- China (Beijing, Shanghai Pudong and Hong Jiao, Guangzhou, Hong Kong, Xi'an, Shenzhen, Chengdu, Kunming);
- India (New Delhi, Mumbai);
- Indonesia (Jakarta);
- Japan (Haneda, Narita);
- Malaysia (Kuala Lumpur);
- Philippines (Manila);
- Republic of Korea (Incheon);
- Singapore (Changi); and
- Thailand (Suvarnabhumi).

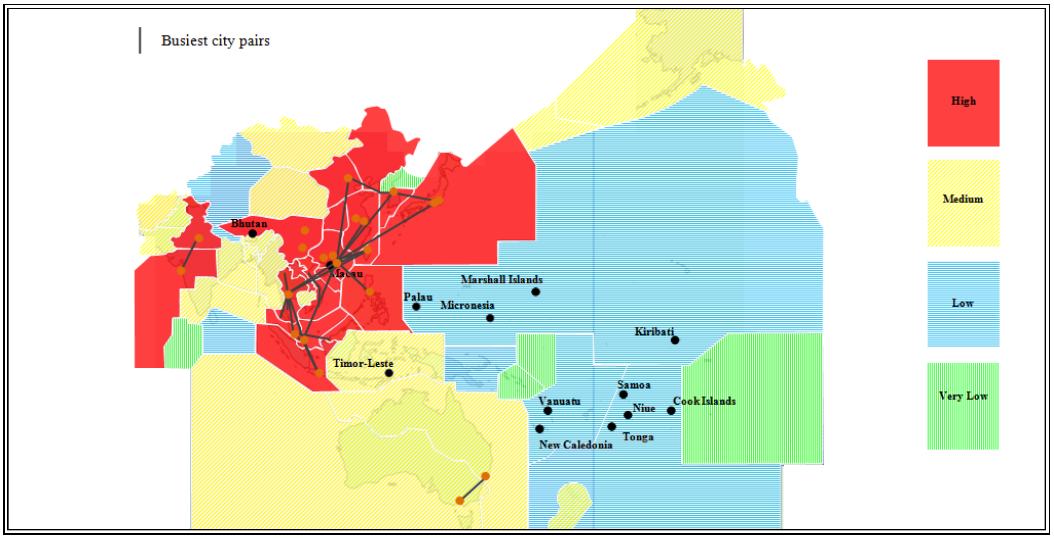

Figure 9: High Density FIRs

Note 1: in areas where ADS-B based separation service was provided, the carriage of ADS-B OUT using 1090ES with DO260/60A and 260B is recommended.

Note 2: States should refer to the ADS-B implementation in the ICAO ADS-B Implementation and Guidance Document (AIGD).

7.7 ** All <u>Category R and S</u> upper controlled airspace, and <u>Category T</u> airspace supporting high density aerodromes should require the carriage of an operable mode S transponder within airspace where Mode S radar services are provided.

PARS Phase II (expected implementation by 08 November 2018)

<u>En-route Airspace</u>

7.23 All <u>Category S</u> upper controlled airspace and <u>Category T</u> airspace should be designated as non-exclusive or exclusive as appropriate ADS-B airspace requiring operation of ADS-B using 1090ES with DO-260/260A and 260B capability.

7.24 In areas where ADS-B based separation service is provided, the mandatory carriage of ADS-B OUT using 1090ES with DO260/60A and 260B should be prescribed (ASBU Priority 2).

Preferred ATM Service Levels (PASL)

Note: prior to the implementation, the applicability of PASL should be verified by analysis of safety, current and forecast traffic demand, efficiency, predictability, cost effectiveness and environment to meet expectations of stakeholders.

PASL Phase 1 (expected implementation by 12 November 2015

ATM Systems

7.32 ADS-B (using 1090ES) or MLAT or radar surveillance systems should be used to provide coverage of all Category S-capable airspace as far as practicable (ASBU Priority 1). Data from ATS surveillance systems should be integrated into operational ATC aircraft situation displays (standalone displays of ATS surveillance data should not be used operationally).

7.34 Subject to appropriate filtering, ATS surveillance data, particularly from ADS-B, should be shared with neighbouring ATC units within high density FIRs (refer **Figure 5** of the Plan). Direct speech circuits and appropriate handoff procedures should be implemented between controllers providing ATS surveillance in adjacent airspace.

7.37 ATM systems, including communication and ATS surveillance systems and the performance of those systems, should support the capabilities of PBN navigation specifications and ATC separation standards applicable within the airspace concerned.

Note: guidance on the performance of ATS communication and surveillance systems is available in the Global Operational Data-link Document.

PASL Phase II (expected implementation by 08 November 2018)

Aerodrome Operations

7.43 ATM system design (including ATS surveillance, ATS communication systems, ATC separation minimum, aircraft speed control and ATC training) should be planned and implemented to support optimal aerodrome capacity expectations for the runway(s) concerned.

Enroute Operations

7.47 All FIRs supporting Major Traffic Flows should implement ATFM incorporating CDM to enhance capacity, using bi-lateral and multi-lateral agreements (ASBU Priority 1).

7.48 Subject to appropriate filtering, ATS surveillance data, particularly from ADS-B, should be shared with all neighbouring ATC units.

Attachment B: Proposed Surveillance-Related Performance Objectives of the Asia/Pacific Seamless ATM Plan

(Section 5 - Background Information)

Surveillance strategy. The Asia/Pacific Seamless ATM Plan should be aligned with the Asia/Pacific Surveillance Strategy:

http://www.icao.int/APAC/Documents/edocs/APX.%20J%20%20Revised%20Surveillance%20Strategy.pdf

(Section 6 – Current Situation)

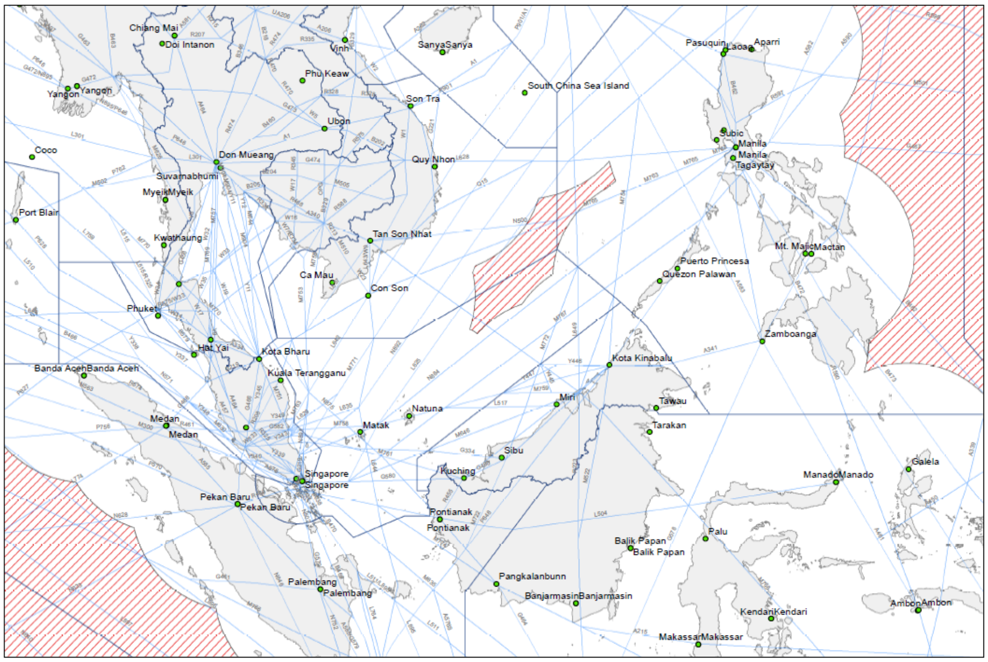

Figure x: South China Sea ATS surveillance gaps (as at October 2015)

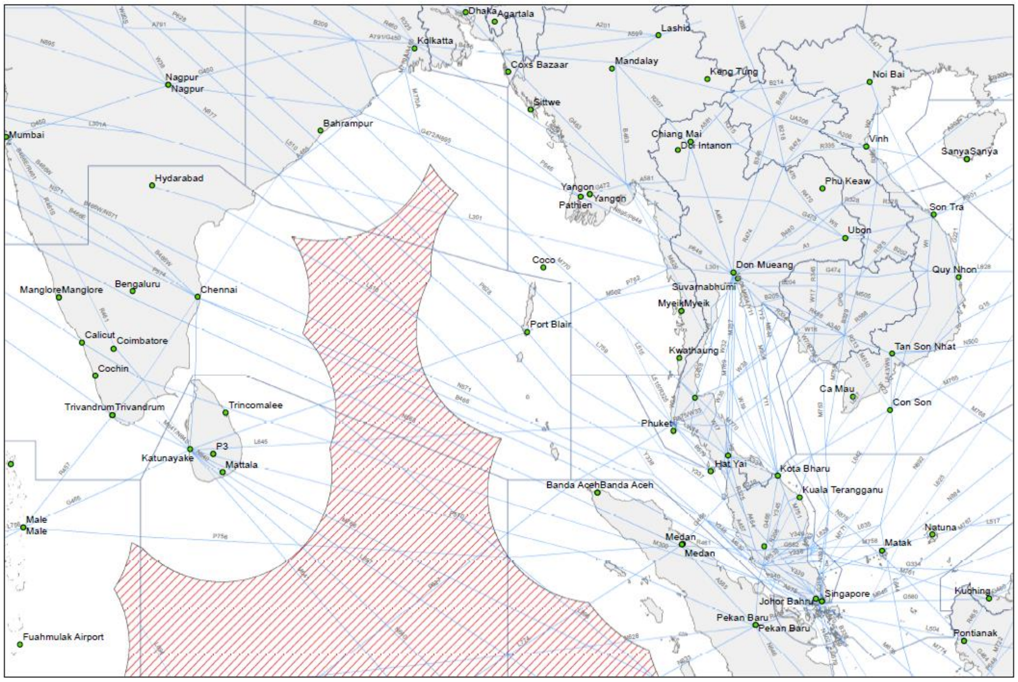

Figure x: Bay of Bengal ATS surveillance gaps (as at December 2015)

<u>ADS-B South China Sea Cost-Benefit Study Summary</u>

In 2009 CANSO and IATA agreed to conduct a cost-benefit study for the initial phase of the ADS-B project (**Figure 6**) over the South China Sea involving two trunk routes L642 and M771 (See Fig 6). . The study concluded that there was a strong business case for the project taking into account the economic savings in fuel burnt, carbon emissions, Aircraft Direct Operating Costs (ADOC) and Passenger Value of Time (PVT). The project involved the sharing of the ADS-B data and VHF communications among Indonesia, Vietnam and Singapore to cover gaps in radar surveillance and VHF communications over the two trunk routes L642 and M771. . The initial phase of ADS-B implementation over South China Sea has since been completed. Aircraft longitudinal separation was reduced from 80-50 NM to 40NM when the ADS-B mandated became effective in Dec 2013 followed by further reduction to 30NM in July 2014. (Note to be removed later - based on DGCA DP 2015)

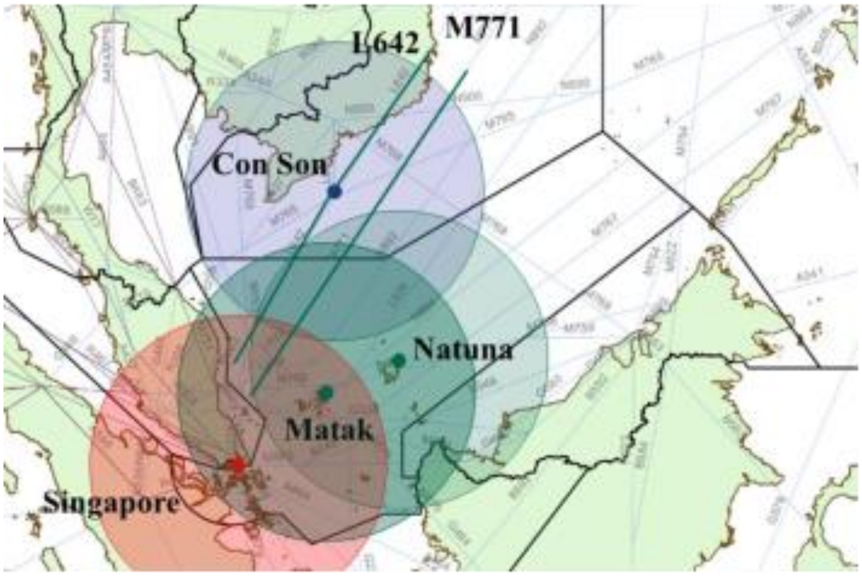

Figure x: Initial Phase of ADS-B collaboration project over the South China Sea

Airborne Efficiency Savings

The implementation of the ADS-B exclusive airspace has led to enhancement in the allocation of cruising levels for flights that operate on the two trunk routes. Statistical samples of flight level allocation after implementation of ADS-B showed that approximately 5% of the flights achieved a more optimum level of between 1,000 to 5,000 feet above their assigned cruising levels prior to ADS-B implementation.

With the use of the ICAO Fuel Savings Estimation Tool (IFSET), the projected fuel savings achieved by these flights over the period of 1 year in 2014 amounts to 1.5 million kilograms of fuel. At an average fuel price of S$2.72 per US gallon, this amounts to about $2 million worth of fuel savings for the airlines.

In addition to fuel saved from the optimum cruising level allocation, the previous study also took into account benefits from reduction of airborne delay from cruising at the optimum flight level. This equates to savings in passenger value of time (PVT) and aircraft direct operating cost (ADOC). The total PVT and ADOC savings is about $1 million. Overall the benefit yield amounts to about $3 million. Please see Table 1.

Airborne Efficiency – Savings 2014	**12 months**
Fuel Burn Savings (kg)	1,567,920 kg
Fuel Burn Savings (2014 US$)	$1,966,694
Flight time savings (hours)	138
Airborne ADOC w/o fuel savings (2014 US$)	$411,499
PVT savings (2014 US$)	$576,513
CO2 Emissions Savings (kg)	4,938,948 kg
CO2 Savings (2014 US$)	$44,451
Total Economic Savings (2014 US$)	**$2,999,156**

Table 1: ADS-B Airborne Efficiency

Ground Delay Savings

The previous study also took into account potential reduction in ground delays arising from the elimination of queuing time for optimum levels. However, in reality the estimation of ground delay savings is complicated by many other factors contributing to ground delays at the airport. If we exclude these other factors the estimated economic benefits from ground delay savings is about to $1 million from savings in PVT, ADOC and fuel burn. Please see Table 2.

Ground Delay –Savings 2014	
Fuel Burn Savings (kg)	275,700 kg
Fuel Burn Savings (2014 US$)	$345,820
Time savings (hours)	128
Ground ADOC w/o fuel savings (2014 US$)	$95,236
PVT savings (2014 US$)	$534,737
CO2 Emissions Savings (kg)	868,455 kg
CO2 Savings (2014 US$)	$7,816
Total Economic Savings (2014 US$))	**$981,992**

Table 2: Ground Delay Savings

<u>Costs</u>

The cost incurred in 2014 is based on the depreciation and recurrent cost of equipment used to support the ADS-B operations but excludes sunk costs of existing facilities prior to the project. These include the ADS-B stations in Singapore and Con Son, VHF radios in Con Son, Matak and Natuna, as well as the various telecommunications links. As with the original Cost Benefit Analysis, the costs exclude the ATC system cost and the ADS-B stations in Matak and Natuna which were already installed prior to the project and therefore considered as sunk cost. Avionics and aircraft equipage were also not included as the aircraft operate beyond the airspace concerned. The total cost incurred in 2014 amounts to about $3.5m.

Cost Items – Savings 2014	
Facilities	Cost incurred in 2014
ADS-B stations in Singapore and Vietnam	$310,000
VHF radios in Indonesia and Vietnam	$1,030,000
Communication links to bring the ADS-B signals from Con Son and Jakarta to Singapore	$1,000,000
Communication links to bring the VHF signals from Con Son, Matak and Natuna to Singapore	$1,110,000
Total Cost	**$3,450,000**

Table 3.: Cost Savings

Overall, the economic savings in 2014 exceeded the total cost by about $0.5m. In the 2009 cost benefit study, it was assumed that aircraft separation in the airspace concerned would be reduced to 5NM with the commencement of ADS-B operations. Based on this current study, it can be seen that even with 30NM separation, the annual benefits in 2014 alone already outweigh the cost. According to ACI, air traffic has been growing strongly in the region with Singapore and Hong Kong chalking up average growth rates of 9.1% and 7.4% per annum over the period 2009-2013. For the region as a whole, the average growth rate during the same period is 6.4%. Clearly, as air traffic continues to grow coupled with further reduction in aircraft separation one can expect the overall economic benefits to increase further.

Other benefits

It should also be noted that there are other benefits apart from economic savings and these include improved safety with enhanced tracking of aircraft and safer and more efficient weather deviations; enhanced aircraft surveillance with increased situational awareness for ATC and the facilitation of search and rescue as well as enhanced flight data collection for better analysis and planning

Other Areas for ADS-B Collaboration

The successful implementation of the initial phase of the South China Sea should provide a strong impetus for similar collaborative arrangements in the Bay of Bengal and the rest of the South China Sea and indeed for the region as a whole. Potential projects highlighted in the past include ADS-B data sharing between Myanmar and India over the Bay of Bengal and among Singapore, Brunei Darussalam and the Philippines in the eastern part of the South China Sea.

In May 2015 the ANSPs of India and Myanmar signed an ADS-B data sharing agreement at the sidelines of the CANSO Asia Pacific Conference in Fukuoka, Japan thus establishing the collaborative framework for ADS-B data sharing involving ADS-B stations in India (Port Blair and Agartala) and ADS-B stations in Myanmar (Coco Island and Sittwe). The objective is to provide end to end surveillance for several busy airways over the Bay of Bengal similar to that accomplished over the South China Sea

ADS-B collaboration over the eastern part of the South China Sea has also been making good progress recently. Singapore is working closely with the Philippines and Brunei Darussalam to share ADS-B data and VHF communications to plug surveillance gaps on the trunk routes M767 and N884. When completed, these airways will have end to end surveillance coverage similar to that achieved in the initial phase of the South China Sea.

http://www.icao.int/APAC/Documents/edocs/APX.%20J%20%20Revised%20Surveillance%20Strategy.pdf

(Section 7 - PERFORMANCE IMPROVEMENT PLAN)

All high density aerodromes should operate an A-CDM system serving the MTF and busiest city pairs, with priority implementation for the busiest Asia/Pacific aerodromes[1].

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[1] Based on 2015 ICAO data, the 51 busiest Asia/Pacific aerodromes were:

- Australia (Sydney, Melbourne, Brisbane);
- China (Beijing, Shanghai Pudong and Hong Jiao, Guangzhou, Hong Kong, Xi'an, Shenzhen, Chengdu, Kunming, Hangzhou, Chongqing, Xiamen, Wuhan, Zhengzhou, Changsha, Nanjing, Qingdao, Urumqi, Dalian, Guiyang, Tianjin, Haikou, Sanya);
- India (New Delhi, Mumbai, Chennai, Bangalore);
- Indonesia (Jakarta, Surabaya, Bali, Makassar);
- Japan (Haneda, Narita, Fukuoka, Osaka, Sapporo, Naha);
- Malaysia (Kuala Lumpur);
- New Zealand (Auckland)
- Philippines (Manila);
- Republic of Korea (Incheon, Jeju, Seoul);
- Singapore (Changi);
- Thailand (Suvarnabhumi, Don Mueang);and
- Viet Nam (Ho Chi Minh, Hanoi).

PARS Phase II (expected implementation by 07 November 2019)

All high density international aerodromes should integrate arrival/departure management (AMAN/DMAN) with the surface management systems: A-SMGCS with SMAN or ASDE-X.

High density international (ICAO codes 3 and 4) aerodromes and aircraft operator operating from there aerodromes should implement the EVS and runway safety alerting logic (SURF-1A) in accordance with EUROCAE document EUROCAE/RTCA documents ED-159/DO-312/ ED-165.

In areas where ADS-B based separation service is provided, the mandatory carriage of ADS-B OUT using 1090ES with DO260/60A or 260B should be prescribed do we need to add reference to ICAO Circular 326 and RTCA DO-303 (NRA) 5NM separation performance 95% 0.5 NM , DO260 avionics NUC≥4 , DO260A/B NAC≥5, Integrity requirement (Containment radius) Performance 2 NM, DO260 NUC≥4 , DO260A/B NIC≥4

PASL Phase I (expected implementation by 12 November 2015)

Mode S SSR surveillance and the use of Mode S Downlinked Aircraft Parameters (DAPS) should be enabled in all upper level Category S airspace and all Category T airspace servicing high density city pairs. ATM automation system specifications should include the processing and presentation in ATC human-machine interfaces and decision support and alerting tools, the communications, navigation and approach aid indicators received in items 10 and 18 of FPL and ATS messages, where applicable, and the following Mode S SSR or ADS-B downlinked aircraft parameters as a minimum:

- Aircraft Identification;
- Aircraft magnetic heading;
- Aircraft indicated airspeed or Mach Number; and
- Pilot selected altitude.

All Category S upper controlled airspace, and Category T airspace supporting high density city pairs and wholly served by Mode S SSR and/or ADS-B surveillance should implement the use of a standard non-discrete Mode A code XXXX for Mode S transponder equipped aircraft to reduce the reliance on assignment of discrete Mode A SSR codes and hence reduce the incidences of code bin exhaustion and duplication of code assignment.