INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC OFFICE

REPORT OF THE SECOND MEETING OF ICAO SOUTH-EAST ASIA REQUIRED NAVIGATION PERFORMANCE IMPLEMENTATION TASK FORCE (RNP-SEA/TF/2)

SINGAPORE

4 – 7 March 2008

The views expressed in this report should be taken as those of the Task Force and not of the Organization

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1.1 Introduction

1.1.1 The second meeting of ICAO South-East Asia Required Navigation Performance Implementation Task Force (RNP-SEA/TF/2) was held at Singapore Aviation Academy, Singapore from 4 to 7 March 2008.

1.2 Attendance

1.2.1 RNP-SEA/TF/2 was attended by 38 participants from China, Hong Kong China, Malaysia, Singapore, Thailand, United States, Viet Nam, IATA and IFALPA. A complete list of participants is at **Appendix A** to this Report.

1.3 Officers and Secretariat

1.3.1 Mr. Peter E. Rabot, Head (School of ATS), Singapore Aviation Academy, Civil Aviation Authority of Singapore (CAAS), Singapore continued as the Chairperson of the Task Force. Mr. Kyotaro Harano, Regional Officer, Air Traffic Management (ATM), ICAO Asia and Pacific Office served as the Secretary for the meeting.

1.4 Opening of RNP-SEA/TF/2

1.4.1 Mr. Rosly Bin Md. Saad, Head (Air Traffic Control Operations), Singapore Air Traffic Control Centre, CAAS, opened the meeting. On behalf of Director General and Chief Executive Officer CAAS, he welcomed all the participants to the meeting. He remarked that the traffic over the South China Sea had continued to grow and it became urgent to continue to work towards the successful implementation of RNP 10 operations on airways L642 and M771. He expressed appreciation to the assistance and guidance provided by ICAO. He wished all a fruitful meeting.

1.4.2 Mr. Peter Rabot extended a warm welcome to all the participants. He also remarked that it was acknowledged at the 15th Meeting of the ATM/AIS/SAR Sub-Group (ATM/AIS/SAT/SG/15, July 2005) that there was a need to implement RNP 10 operations in Southeast Asia due the significant increase in traffic volume over the South China Sea.

1.4.3 Mr. Rabot recalled that the Task Force developed its Terms of Reference (TOR) at the inaugural meeting, which was subsequently reviewed and adopted by the 13th meeting of Southeast Asia ATS Coordination Group (SEACG/13, May 2006). Although this meeting was focusing on the implementation of RNP 10 operations, he believed that this Task Force should also start looking and thinking about further enhancements to airspace capacity such as RNP 4 operations.

1.4.4 Mr. Rabot hoped to achieve at this meeting some concrete steps to implement RNP10 operations on L642 and M771 through the joint efforts. He wished all a fruitful meeting, and a pleasant stay at Singapore Aviation Academy and to his overseas delegates and a pleasant stay in Singapore.

1.4.5 On behalf of Mr. Mokhtar A. Awan, Regional Director, ICAO Asia and Pacific Office, Mr. Kyotaro Harano welcomed all the participants to the meeting. He expressed sincere appreciation to CAAS for their warm welcome and generous support in hosting the significant meeting at the excellent facility of Singapore Aviation Academy. Singapore kindly hosted the first meeting in March 2006, and he was very grateful for Singapore to host again the second meeting.

1.4.6 Mr. Harano also recalled that the first meeting developed the TOR for the Task Force. This second meeting should ensure that all the key factors were covered to facilitate the reduction of the longitudinal separation. Also, it was necessary to address all the requirements for reducing longitudinal separation such as communication requirement, navigation performance and safety assessment.

1.4.7 Mr. Harano wished all concerned to continue cooperating and working closely so that the critical elements of reduced separation can be addressed to allow for the implementation as soon as possible. He wished everyone a fruitful meeting, and a pleasant stay at Singapore.

1.5 Documentation and Working Language

1.5.1 The working language of the meeting as well as all documentation was in English.

1.5.2 Ten Working Papers and eight Information Papers were presented to RNP-SEA/TF/2. A list of papers is included at **Appendix B** to this Report.

Agenda Item 1: Adoption of Agenda

Adoption of Agenda

1.1 The meeting reviewed the provisional agenda proposed by the Secretariat. The meeting agreed to exchange Agenda Items 3 and 4, and adopted the following revised agenda.

Agenda Item 1: Adoption of Agenda

Agenda Item 2: Review Outcomes of Related Meetings

Agenda Item 3: ~~Develop a Coordinated Plan for Implementation of Actions Agreed by the Task Force~~ Safety Analysis and Airspace Monitoring Issues

Agenda Item 4: ~~Safety Analysis and Airspace Monitoring Issues~~ Develop a Coordinated Plan for Implementation of Actions Agreed by the Task Force

Agenda Item 5: Update RNP-SEA/TF Task List

Agenda Item 6: Any Other Business

Agenda Item 7: Date and Venue for the Next Meeting

Review of the Terms of Reference for RNP-SEA/TF Adopted by SEACG

1.2 The meeting recalled that the first meeting of the RNP Implementation Task Force (RNP/TF/1, subsequently renamed as *Southeast Asia RNP Implementation Task Force* by SEACG/13) agreed that as a first step, the Task Force would focus on L642 and M771, and eventually address other routes in the region. Consequently, RNP/TF/1 developed the draft TOR for the Task Force. SEACG/13 reviewed and adopted the TOR for the Task Force as developed by RNP/TF/1.

Suggestion to the Terms of Reference for RNP-SEA/TF by RASMAG

1.3 The fifth meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/5, June 2006) felt that the safety implications were particularly pertinent in respect to Conclusion 16/5 of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG), under which implementation of reduced separation minima could only proceed where implementing States could demonstrate an ability to comply with Annex 11 – *Air Traffic Services*, Chapter 2 provisions. Accordingly, RASMAG/5 requested that the Regional Office draw this to the attention of the next meeting of the Task Force and propose the inclusion of a work item in the terms of reference (TOR) that would ensure that formal safety assessments were carried out in accordance with the Annex 11 provisions.

1.4 After reviewing the proposal from RASMAG/5, the meeting agreed to add the text to item g) and to change the subsequent item numbers accordingly, as follows:

Terms of Reference of the South-East Asia RNP Implementation Task Force

The objective of the Task Force is to:

Develop strategic, benefits-driven implementation plans in collaboration with stakeholders, to improve en-route airspace efficiency by means of reduced horizontal separation based on RNP operations within the Southeast Asia area, ensuring inter-regional harmonization.

To meet this objective the Task Force shall:

a) Review the current South China Sea route structure and examine its suitability for application of reduced horizontal separation based on RNP operations.

b) Identify routes where the application of reduced horizontal separation would bring immediate operational efficiency

c) Determine the reduced horizontal separation required, taking into account the aircraft approval status of the traffic operating on the relevant routes, capacity increase desired, and communication and surveillance capability of ATS providers.

d) Examine the possibility of a phased implementation of reduced horizontal separation based on RNP operations and to detail the phases required and the areas/routes concerned.

e) Develop the necessary strategic plans to implement the agreed horizontal separation taking into account airspace user requirements, the need for inter-regional harmonization, and ICAO Standard and Recommended Practices.

f) Explore the possibility of further harnessing operational efficiency of the routes through re-reconfiguration and enhanced surveillance.

g) Ensure the conduct of Annex 11 compliant pre-implementation safety assessments and make arrangements for States to conduct ongoing post-implementation safety monitoring in accordance with ICAO provisions.

~~g)~~h) Consider setting up appropriate teams/groups which might but not necessarily, include the entire Task Force, to address and implement specific agreed measures within their airspace; and

~~h)~~i) Cooperate with other Task Forces and groups which are involved with similar work in the adjacent airspace in order to achieve harmonized inter-regional solutions.

Scope of Initial Work

The Task Force shall adopt a phase-by-phase approach, beginning with the 50 lateral/50 longitudinal separations based on RNP 10 operations on RNAV routes L642 and M771 as Phase 1.

The Task Force reports to the South East Asia ATS Coordination Group (SEACG).

1.5 The Secretariat undertook to report this proposed amendment to TOR at SEACG/15 in May 2008 for consideration and adoption by the Group.

Agenda Item 2: Review Outcomes of Related Meetings

Review Outcomes of the 14th Meeting of Southeast Asia ATS Coordination Group

2.1 The meeting reviewed the outcomes of SEACG/14 (May-June 2007, Hanoi), which was held in conjunction with the sixth meeting of FANS Implementation Team, South-East Asia (FIT-SEA/6). SEACG/14 updated the table of the Status of Application of Radar Handover Procedures as in Appendix E to the Report of SEACG/14. The meeting reviewed and updated the table as in **Appendix C** to this report.

Consideration of Radar Coverage along L642 and M771

2.2 Subsequent to the review of the table of the Status of Application of Radar Handover Procedures, the meeting also reviewed the radar coverage chart for the South China Sea area, which was developed by SEACG/10 (March 2002, Bangkok) and reviewed by SEACG/13. IATA observed that the chart be updated with the latest information. The Secretariat requested States to provide the data of coordinates of radar sites and coverage distances to update the chart.

Review Outcomes of the Seventh Meeting of FANS Implementation Team, South-East Asia (FIT-SEA/7)

2.3 The meeting reviewed outcomes of FIT-SEA/7 (January-February 2008, Fukuoka).

Review South China Sea ADS/CPDLC Operational Trial

2.4 FIT-SEA/7 concluded that the result of the downlink performance in the Ho Chi Minh Flight Information Region (FIR) during the Phase 2 was acceptable from ATC operational point of view and would not impose an immediate adverse effect on the data link services. Consequently, it was agreed that Viet Nam could complete the Phase 2 trial and commence the regular operation on 10 April 2008 as proposed.

2.5 However, FIT-SEA/7 concluded that it would be required that the ADS/CPDLC performance fully meet the criteria in the *FANS Operations Manual* (FOM) to reduce the longitudinal separation using the data link. In this regard, FIT-SEA/7 considered it more prudent that FIT-SEA/8 in May review the situation of performance improvement and the results of remedial actions taken by Viet Nam to ensure that the FOM criteria are met.

Summary of Discussions from the Special Coordination Meeting Held in Singapore

2.6 Singapore presented the meeting the summary of discussions from the Special Coordination Meeting (SCM, September 2007) held in Singapore to progress the implementation of RNP 10 (50 NM/50 NM) operations on RNAV routes L642 and M771. SCM had agreed to the target date of implementation of 3 July 2008. SCM had noted that a safety assessment should be conducted before the reduced separation could be implemented, and Singapore had informed SCM that they would engage an external consultant to assist in the establishment of the Safety Monitoring Agency (SMA) and the conduct of the safety assessment for the implementation of 50 NM/50 NM horizontal separations on L642 and M771.

2.7 Singapore also updated the meeting that at the fourth meeting of the Western Pacific/South China Sea RVSM Scrutiny Group (WPAC/SCS RSG/4, February 2008), the implementation date of the new flight level orientation scheme (FLOS) had been targeted on 2 July 2008 at 2100 UTC. The meeting then considered whether the target date of RNP 10 operations should be delayed to allow for the stabilization of the new FLOS or to proceed as planned.

2.8 IATA queried the need to wait for the new flight level assignment to stabilize and felt that the required actions to implement the RNP 10 operations should be considered before deciding on the implementation date. The Secretariat commented that the target date for implementation should be subject to the completion of the safety assessment for these two routes and requested for an estimated timeline for the completion on the safety assessment. Singapore informed the meeting that the presentation of the two papers on the preliminary safety assessment and the "Know your Airspace analysis" would give the meeting an insight into the decision process that led to the determination of the estimated date of completion for the safety assessment. The meeting agreed to re-visit this item under Agenda Item 4.

2.9 The Summary of Discussions of SCM presented by Singapore is attached in **Appendix D** to this report.

The Fourth Meeting of the Western Pacific/South China Sea RVSM Scrutiny Group

2.10 The meeting reviewed outcomes of the fourth meeting of the Western Pacific/South China Sea RVSM Scrutiny Group (WPAC/SCS RSG/4, February 2008).

Model AIP Supplement for FLOS/FLAS Implementation

2.11 Hong Kong, China informed WPAC/SCS RSG/4 that despite strong attempts to meet the June target, the high workload resulting from a number of changes in the ATC operations as well as limited simulator capacity meant that training for the new flight level allocation arrangements could not be completed in time for a June implementation. As such, Hong Kong, China was limited to an early July implementation. WPAC/SCS RSG/4 thanked Hong Kong, China for their attempts to meet an earlier implementation but recognized that the additional time would be useful to all States in making preparations and considered the 3 July 2008 AIRAC cycle for implementation of the new flight level arrangements. Accordingly, WPAC/SCS RSG/4 adopted a switchover date/time of 2100 UTC on 2 July 2008 to implement the new flight level arrangements in the WPAC/SCS area.

Outcomes of 18th Meeting of APANPIRG

2.12 The meeting reviewed outcomes of the 18th meeting of APANPIRG (August 2007, Bangkok) regarding the monitoring of the gross navigational errors (GNE), conduct of an Air Traffic Flow Management (ATFM) seminar and the speed variation of Annex 2 – *Rule of the Air*.

Asia/Pacific Air Navigation – Review of APANPIRG Activities

2.13 ATM/AIS/SAR/17 (July 2007, Bangkok) had agreed to an initiative from Singapore that, in order to facilitate the implementation of RNP 10-based separations, i.e. 50 NM lateral/50 NM longitudinal, Singapore would monitor GNE in the Singapore FIR on the appropriate route segments. This was essential to enable any further horizontal safety assessments to be structured to assess RNP 10 (50 NM/50 NM) operations as it was anticipated that this necessary step to RNP 10 configuration would be taken in the foreseeable future.

2.14 With regard to ATFM, APANPIRG/18 considered that a useful way forward in bringing existing ATFM provisions, techniques and procedures to the attention of States in the Asia/Pacific Region would be to conduct an ATFM seminar.

2.15 There were a number of potential interpretations of the terminology "inadvertent changes" as used in paragraph 3.6.2.2 of Annex 2 and that, in the case of speed variations, the differing interpretations could lead to potentially unsafe outcomes, particularly where reduced longitudinal separation standards are implemented. APANPIRG/18 agreed that clarification of the intent of paragraph 3.6.2.2 b) of Annex 2 in relation to the 5 % parameter was also necessary noting, for example, a 5 % variation in speed meant the difference between, for example, M.080 and M.084, APANPIRG/18 adopted Conclusion 18/10.

Summary of the First Meeting of Asia/Pacific Performance Based Navigation Task Force

Develop Task List and Action Plan

2.16 The First Meeting of Asia/Pacific Performance Based Navigation (PBN) Task Force noted that two sub-groups of the PBN Task Force could consider adapting the two model documents that had been provided (PBN Implementation Plan for States and the CAR/SAM Roadmap for PBN) after necessary changes/amendments to meet the regional requirements.

Role of RASMAG

2.17 In fulfilling its objectives for facilitating the safe implementation of reduced separation minima and CNS/ATM applications within the Asia/Pacific Region in the context of airspace safety assessment and monitoring responsibilities, RASMAG offered support to the PBN Task Force to assist with the oversight of airspace safety and monitoring matters relevant to PBN implementations as the work of the Task Force progressed.

Review of the Eighth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/8)

2.18 The meeting reviewed the discussion of RASMAG/8 (December 2007, Bangkok), and noted that Singapore would provide a copy of the safety assessment to the next RASMAG meeting and RASMAG would continue to assist Singapore towards achieving SMA capability.

Agenda Item 3: Safety Analysis and Airspace Monitoring Issues

Engaging CSSI, Inc. to Assist Singapore to be Established as SMA and to Conduct Safety Assessment for the Implementation of RNP 10 (50 NM/50 NM) Operations

3.1 Singapore presented the meeting on their efforts to implement RNP 10 operations on L642 and M771 in the South China Sea area to enhance safety, increase capacity and efficiency. Singapore informed the meeting that they had engaged CSSI, Inc to assist in the establishment of SMA and to conduct the safety assessment for the implementation of 50 NM/50 NM horizontal separations on L642 and M771.

3.2 CSSI, Inc. had an established record of supporting the works of the United States Federal Aviation Administration (FAA) to reduce separation minima within international airspace. The record included the support of Reduced Vertical Separation Minimum (RVSM) implementation activities within the Asia/Pacific, North American, Caribbean/South American and North Atlantic Regions. The meeting was informed that CSSI, Inc had assisted the FAA in the implementation of the 50 NM lateral separation minimum over the Pacific and the introduction of 30 NM horizontal separation standards in a portion of the Oakland FIR. Services provided to the FAA included separation standards requirements and implementation, safety assessment and collision risk modeling, airspace analysis, operational ATC system maintenance and upgrades, air traffic modeling and simulation, system acquisition, and life-cycle management.

3.3 The safety assessment by CSSI, Inc was currently in progress and a preliminary safety assessment was presented at the meeting. Singapore had also informed RASMAG that it would undertake to provide the safety monitoring services for reduced horizontal separation in the South China Sea area when the requirements for the establishment of the SMA are fulfilled.

3.4 The meeting thanked Singapore for the initiatives taken to assist the Task Force in moving forward to achieve the goal of implementing RNP 10 (50 NM/50 NM) operations on L642 and M771.

Revised Operational Letter of Agreement (LOA) for Monitoring of Aircraft Gross Navigational Errors (GNE) in the South China Sea Area

3.5 In 2001, an LOA was signed by States concerned for the monitoring of aircraft GNE in the South China Sea area for the implementation of the revised South China Sea route structure on 1 November 2001.

3.6 At the 17th meeting of the ATM/AIS/SAR Sub-Group (ATM/AIS/SAR/SG/17, July 2007), Singapore expressed willingness to monitor traffic movement data and GNE reports on two additional RNAV routes, namely N884 and N892, in the South China Sea area to facilitate the implementation of RNP 10 operations. With the additional traffic movement data to be collected and the implementation of reduced horizontal separation, Singapore was tasked by the Sub-Group to revise the current Operational LOA for the monitoring of aircraft GNE in the South China Sea area and the collection of data for the conduct of safety assessment to implement 50 NM/50 NM and 30 NM/30 NM reduced horizontal separations in the South China Sea area.

3.7 Singapore presented the meeting with the draft of an updated Operational LOA for monitoring of aircraft GNE in the South China Sea area and the collection of data for the conduct of safety assessment to implement 50 NM/50 NM and 30 NM/30 NM reduced horizontal separations in the South China Sea area.

3.7 The Sub-Group had noted that implementation of 50 NM/50 NM horizontal separation was imperative in the short term to manage the increased traffic movements in this area, and that the implementation of 30 NM/30 NM separation should be considered as the medium term goal. As such, incorporating these amendments in the Operational LOA would mean that suitable data would be available in the future as required.

3.8 To ensure the successful implementation of RNP 10 horizontal separation by July 2008 and RNP 4 implementation by 2010 by Singapore, there was a need to amend the Operational LOA to reflect the changes accordingly. The amended Operational LOA was presented at RASMAG/8. RASMAG/8 had accepted the amendments in the Operational LOA and urged Singapore to circulate the amended Operational LOA to the States concerned for their concurrences. As there were no objections from States, Singapore would proceed to coordinate with the Regional Office for the circulation of the Operational LOA to be signed by States concerned. The amended Operational LOA for the monitoring of aircraft GNE is attached as **Appendix E** to this report.

Examination of Operations Conducted on RNAV Routes L642 and M771

3.9 Singapore presented to the meeting the analysis of operations conducted on South China Sea RNAV routes L642 and M771 based on December 2007 traffic sample data sets (TSD) from the Hong Kong and Singapore FIRs. The analysis reviewed the operators, aircraft types, origin-destination pairs, flight level (FL) use and operator/aircraft-type combinations observed in the TSD in light of the planned introduction of 50 NM lateral and longitudinal separation standards on these routes. Using published information about data link use in other portions of Asia/Pacific Region airspace, the analysis noted the possible aircraft types and operators which might qualify for application of the reduced separation minima using data link.

3.10 The meeting also noted that TSD contained, for each flight operating during the month, the following information:

(1) date;

(2) call sign;

(3) aircraft type;

(4) origin aerodrome;

(5) destination aerodrome;

(6) on entry into the RVSM airspace of the FIR, the entry fix, entry time, entry flight level and route followed after the entry fix;

(7) on exit from RVSM airspace, the exit fix, corresponding time and flight level, and route followed after the exit fix; and

(8) optionally, for fixes internal to RVSM airspace, the fix name, corresponding time and flight level and routing after the fix.

3.11 It was noted that these data contributed to the conduct of an annual assessment of the safety of continued RVSM use. With proper treatment, the data were also useful to support assessment of the safety of 50 NM lateral and longitudinal separation minima.

3.12 Two TSD, those collected by Hong Kong China and Singapore, were available for analysis in advance of the meeting. Records of flights operating on L642 and M771, and common to both TSD, were merged through a software process to avoid duplicate counts of flights and other items. A significant number of L642 and M771 flights in each of the TSD failed to match a corresponding flight in the other TSD. This outcome was due, almost entirely, to flight operations which originated outside of one of the FIRs and did not pass through the airspace of the other. For example, flights between Tan Son Nhat International Airport (VVTS) and Singapore Changi Airport (WSSS) did not appear in the Hong Kong TSD.

3.13 From the comparison of the number of flights from the two TSD which should have matched during the merging process, it was concluded that the quality of data-entry in each of the TSD samples was very high, and that, as a consequence, the combined Hong Kong and Singapore TSD provided a highly reliable basis for gaining insight into the airspace characteristics of flight operations on L642 and M771. After processing and merging, a total of 5 743 flight operations were observed on L642 and M771 in December 2007. Flights operating on L642 and M771 in the merged

Hong Kong and Singapore TSD were examined to identify and quantify several important characteristics of airspace use.

3.14 Each traffic movement in the merged Hong Kong and Singapore TSD was examined to determine the operator conducting the flight. Table 1 of **Appendix F** to this report presents the counts, ordered from largest to smallest, of each of the 61 three-letter ICAO operator designators observed in the merged TSD. Table 1 below presents the top 25 of these operator-designator counts, which accounted for nearly 97 percent of the operations in the December merged TSD. It was noted that the top four operators accounted for nearly half of the operations in the merged TSD, while the top 10 accounted for about three operations in four.

Number	**Operator**	**Count**	**Proportion**	**Cumulative Count**	**Cumulative Proportion**
1	SIA	1045	0.1820	1045	0.1820
2	CPA	839	0.1461	1884	0.3281
3	AXM	439	0.0764	2323	0.4045
4	MAS	393	0.0684	2716	0.4729
5	CES	334	0.0582	3050	0.5311
6	CSN	328	0.0571	3378	0.5882
7	TGW	327	0.0569	3705	0.6451
8	CCA	248	0.0432	3953	0.6883
9	CXA	191	0.0333	4144	0.7216
10	GIA	159	0.0277	4303	0.7493
11	SLK	157	0.0273	4460	0.7766
12	CAL	142	0.0247	4602	0.8013
13	SQC	139	0.0242	4741	0.8255
14	HVN	139	0.0242	4880	0.8497
15	JSA	125	0.0218	5005	0.8715
16	UAL	99	0.0172	5104	0.8887
17	CSZ	97	0.0169	5201	0.9056
18	HKE	62	0.0108	5263	0.9164
19	SHQ	58	0.0101	5321	0.9265
20	AHK	46	0.0080	5367	0.9345
21	TSE	42	0.0073	5409	0.9418
22	CRK	41	0.0071	5450	0.9490
23	VVM	39	0.0068	5489	0.9558
24	KAL	31	0.0054	5520	0.9612
25	CSH	31	0.0054	5551	0.9666

Table 1. Top 25 Operator Designators Observed in December 2007 Merged TSD

3.15 Table 2 of Appendix F to this report presents information on the observed frequencies of the 37 unique ICAO four-letter aircraft-designators found in the December 2007 merged TSD. The top 15 aircraft types, accounting for 97 percent of the December 2007 operations, are shown in table 2 below.

Number	**Type**	**Count**	**Proportion**	**Cumulative Count**	**Cumulative Proportion**
1	A320	1083	0.1886	1083	0.1886
2	B772	900	0.1567	1983	0.3453
3	A333	791	0.1377	2774	0.4830

Number	Type	Count	Proportion	Cumulative Count	Cumulative Proportion
4	B773	557	0.0970	3331	0.5800
5	B738	554	0.0965	3885	0.6765
6	B744	465	0.0810	4350	0.7574
7	A319	314	0.0547	4664	0.8121
8	A306	148	0.0258	4812	0.8379
9	B737	147	0.0256	4959	0.8635
10	A321	145	0.0252	5104	0.8887
11	B752	125	0.0218	5229	0.9105
12	B742	108	0.0188	5337	0.9293
13	MD11	90	0.0157	5427	0.9450
14	B763	82	0.0143	5509	0.9593
15	A343	62	0.0108	5571	0.9701

Table 2. Top 15 Aircraft-Type Designators Observed December 2007 Merged TSD

3.16 It was noted that the most frequently occurring aircraft type, A320, accounted for nearly 19 percent of the operations. This may be significant if controller-pilot data link communications (CPDLC) the contract mode of automatic dependent surveillance (ADS-C) are to be the communication and surveillance bases for application of 50 NM longitudinal separation standards, since A320 has not been observed, in Pacific applications of reduced separation minima, to be equipped with the Future Air Navigation System – A (FANS-A) package, i.e. with data link capability. Likewise, types 5, 7, 8, 9, 10, 11, 12 and 14 (B738, A319, A306, B737, A321, B757, B742 and B763, respectively) – which accounted for an additional 19 percent of the operations in the December 2007 sample – were not known to be equipped, typically, with FANS packages.

3.17 It was further noted that a total of 46 aerodromes appeared as either origins or destinations of flights in the December 2007 merged TSD. These are shown in Table 3 of Appendix F to this report, with four-letter designators and descriptions as they appear in ICAO *Location Indicators* (Doc 7910). These aerodromes gave rise to a total of 106 origin-destination pairings. These are shown in Table 4 of Appendix F to this report along with the counts of operations between each pair. The top 20 origin-destination pairs, in terms of operations, are shown in table 3 below. From the table, nearly one in five operations in the December 2007 sample flew between Hong Kong International Airport and Singapore International Airport.

Number	Origin/ Destination	Count	Proportion	Cumulative Count	Cumulative Proportion
1	WSSS VHHH	549	0.0956	549	0.0956
2	VHHH WSSS	509	0.0886	1058	0.1842
3	ZSPD WSSS	297	0.0517	1355	0.2359
4	WSSS ZSPD	271	0.0472	1626	0.2831
5	VHHH WMKK	221	0.0385	1847	0.3216
6	WMKK VHHH	207	0.0360	2054	0.3577
7	VVTS WSSS	177	0.0308	2231	0.3885

Number	Origin/ Destination	Count	Proportion	Cumulative Count	Cumulative Proportion
8	ZBAA WSSS	174	0.0303	2405	0.4188
9	WSSS ZBAA	174	0.0303	2579	0.4491
10	ZSPD WMKK	159	0.0277	2738	0.4768
11	WSSS ZSAM	156	0.0272	2894	0.5039
12	VHHH VVTS	143	0.0249	3037	0.5288
13	WMKK ZSPD	142	0.0247	3179	0.5535
14	WSSS ZGGG	133	0.0232	3312	0.5767
15	VMMC WMKK	130	0.0226	3442	0.5993
16	ZGGG WSSS	128	0.0223	3570	0.6216
17	WMKK VMMC	127	0.0221	3697	0.6437
18	VHHH WIII	124	0.0216	3821	0.6653
19	WIII VHHH	119	0.0207	3940	0.6861
20	ZSAM WSSS	115	0.0200	4055	0.7061

Table 3. Top 20 Origin-Destination Pairs

3.18 Also, the meeting noted the examination of the December 2007 merged TSD with regard to route use as table 4 below. The proportion of operations on the two routes was not balanced.

Number	Route	Count	Proportion	Cumulative Count	Cumulative Proportion
1	L642	3067	0.5340	3067	0.5340
2	M771	2676	0.4660	5743	1.0000

Table 4. Count of Operations on L642 and M771

3.19 Table 5 below presents the FL and associated frequencies observed in the December 2007 merged TSD. FL 360, 380 and 340 were the preferred altitudes in this order on the routes, and accounted for 77 percent of the operations. The one observation at FL 220 was very likely due to a minor error in data interpretation.

Number	FL	Count	Proportion	Cumulative Count	Cumulative Proportion
1	360	1738	0.3026	1738	0.3026
2	380	1442	0.2511	3180	0.5537
3	340	1244	0.2166	4424	0.7703

4	400	565	0.0984	4989	0.8687
5	320	459	0.0799	5448	0.9486
6	390	93	0.0162	5541	0.9648
7	300	90	0.0157	5631	0.9805
8	310	36	0.0063	5667	0.9868
9	410	29	0.0050	5696	0.9918
10	330	24	0.0042	5720	0.9960
11	370	9	0.0016	5729	0.9976
12	350	7	0.0012	5736	0.9988
13	290	6	0.0010	5742	0.9998
14	220	1	0.0002	5743	1.0000

Table 5. Flight-Level Use on L642 and M771

3.20 Table 5 of Appendix F to this report provides detail on all 107 combination of operator and aircraft type observed in the December 2007 merged TSD. Table 6 below shows the top 21 of 107 combination of operator and aircraft type observed in the December 2007 merged TSD. The top 21 accounted for 70 percent of the operations in the merged TSD.

PAIR NUMBER	**OPERATOR-AIRCRAFT TYPE**	**Count**	**PROPORTION**	**Cumulative Count**	**Cumulative Proportion**
1	SIA-B772	611	0.1064	611	0.1064
2	AXM-A320	439	0.0764	1050	0.1828
3	CPA-A333	336	0.0585	1386	0.2413
4	TGW-A320	327	0.0569	1713	0.2983
5	SIA-B773	312	0.0543	2025	0.3526
6	CPA-B773	245	0.0427	2270	0.3953
7	MAS-A333	193	0.0336	2463	0.4289
8	CXA-B737	144	0.0251	2607	0.4539
9	SQC-B744	139	0.0242	2746	0.4781
10	JSA-A320	125	0.0218	2871	0.4999
11	CES-A333	124	0.0216	2995	0.5215
12	CES-A319	122	0.0212	3117	0.5427
13	SIA-B744	122	0.0212	3239	0.5640
14	CSN-A320	103	0.0179	3342	0.5819
15	MAS-B772	103	0.0179	3445	0.5999
16	UAL-B744	99	0.0172	3544	0.6171
17	CSN-A319	99	0.0172	3643	0.6343
18	CSZ-B738	97	0.0169	3740	0.6512
19	CPA-B772	95	0.0165	3835	0.6678
20	SLK-A319	93	0.0162	3928	0.6840
21	GIA-B738	92	0.0160	4020	0.7000

Table 6. Top 21 Operator/Aircraft-Type Combinations

3.21 The overall PowerPoint presentation on the safety assessment by Singapore is in **Appendix G** to this report. The meeting was then invited to inspect the summary information concerning the December 2007 merged TSD presented and also compare the likelihood of data link equipage, presented in connection with aircraft-type summary information, with the experience gained in recent trial use of data link in South China Sea FIRs.

Preliminary Safety Assessment of the Implementation of 50 NM Lateral and Longitudinal Separation Standards on RNAV Routes L642 and M771

3.22 Singapore presented the preliminary safety assessment on introducing 50 NM lateral and longitudinal separation standards on South China Sea RNAV routes L642 and M771. The assessment employed internationally agreed collision risk methodology, using mathematical models to estimate the risk of collision due to the loss of properly established horizontal-plane separation minima and evaluates the acceptability of the risk in light of the Target Level of Safety (TLS) established for the Asia/Pacific Region. The safety assessment made use of December 2007 TSD collections from the Hong Kong and the Singapore FIRs. All risk model parameters and related material were estimated from the results of processing these TSD: no navigational performance data or other information normally applied in collision risk methodology was available for the assessment. The outcome of the assessment suggested that the TLS would be satisfied. It was noted, however, that this preliminary finding must be confirmed using additional data sources in order to increase confidence that the forecast of risk after implementation of the reduced separation standard values would satisfy the TLS.

3.23 The meeting was advised that the requirements for implementation of a 50 NM lateral separation standard were described in the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc 9689), Appendix 13. The requirements for introduction of a 50 NM longitudinal separation standard based on ADS/CPDLC were presented in section 5.2.6.4 ("Longitudinal Distance-Based Separation Minima in an RNP RNAV Environment Using ADS-C") of the *Procedures for Air Traffic Services Air Traffic Management* (PANS-ATM, Doc 4444). Both references emphasize the need for a safety assessment prior to implementing the respective separation minima. This is in keeping with the general provisions of Annex 11.

Overview of Collision Risk Models

3.24 The meeting noted that detailed descriptions of the assumptions underlying the lateral and longitudinal risk models, as well as their mathematical derivations, may be found in the Manual on Airspace Planning Methodology. Statement of a few principal assumptions and definition of a few key concepts, however, assisted the meeting in understanding the safety assessment.

3.25 One simplifying assumption used in development of the risk models was that aircraft shapes could be represented as rectangular parallelepipeds (that is, as blocks or slabs) with length, width and height equal, respectively, to a typical aircraft's metallic length, wingspan and height from the underside of the fuselage – with landing gear retracted – to the top of the vertical tail. Loss of separation in a dimension (longitudinal, lateral or vertical) is then equivalent to the centers of mass of two slabs (representing two aircraft under the simplifying assumption) being closer together than the corresponding size of the slab in that dimension (length, width or height).

3.26 The meeting was informed that when two aircraft were closer together than the size of the slab in a dimension, they were said to be in ***overlap*** in that dimension. Overlap corresponded to the loss of all planned separation in a dimension, but not necessarily to a collision (two aircraft could be 100 NM apart along a common route, and have lost all planned lateral separation). Thus, from the standpoint of collision risk modeling, two aircraft collide only when they are, at the same time, closer together by less than the size of the slab in each dimension. Two aircraft in such a condition is said to be in ***simultaneous overlap***.

3.27 If P is the proportion of time that an aircraft pair is in simultaneous overlap in airspace and if t is the average time for a simultaneous overlap, then the rate of collisions, CR, between a typical pair of aircraft is:

$$CR = P/t$$

3.28 Another assumption used in the modeling was that navigational errors were independent in each dimension (that, the occurrence of a lateral error is not influenced by the occurrence of a longitudinal or vertical error). Under this assumption of independence, if P_x, P_y and P_z are the proportions of time that a typical pair of aircraft is in overlap in the longitudinal, lateral and vertical dimensions, then

$$P = P_x \bullet P_y \bullet P_z$$

3.29 That is, the proportion of time that a typical pair of aircraft is in simultaneous overlap is the product of the probabilities that the pair is in overlap in the longitudinal, lateral and vertical dimensions.

3.30 The meeting also noted that if t_x, t_y and t_z were, respectively, the average duration of a longitudinal, lateral and vertical overlap, the effect of other initiating assumptions was that:

$$t = t_x + t_y + t_z$$

3.31 That is, the average of duration of a simultaneous overlap is the sum of the average durations of longitudinal, lateral and vertical overlap.

3.32 It is then possible to express CR, the rate of collisions between a typical pair of aircraft in the airspace, as

$$CR = P_x \bullet P_y \bullet P_z / (t_x + t_y + t_z)$$

3.33 Multiplication of the collision rate, CR, which represents the rate of collision of pairs of aircraft, by a factor of 2 results in the rate of aircraft accidents, which are assumed to be always fatal. This multiplication then permits comparison of model-estimated risk expressed in fatal accidents per flight hour to the TLS, which was derived originally from worldwide fatal accident data reported to ICAO annually, and is also expressed in fatal accidents per flight hour.

3.34 It was noted that another of the assumptions underlying risk modeling was that, in a collision, one aircraft slab passes through the other completely. Although not consistent with the actual mechanism of a collision, this assumption simplified the mathematics of deriving a risk model and had been shown to be an adequate means of estimating collision risk. If, for example, $\overline{|\dot{x}|}$ represents the average speed of a pair of aircraft as they lose all planned longitudinal separation and λ_x is the length of the slab representing the aircraft in the longitudinal dimension, then t_x in the expression for the collision rate, CR, becomes $\lambda_x/\overline{|\dot{x}|}$ (recall that distance = speed • time, or time = distance/speed).

3.35 The separation planned for an aircraft in a dimension, r, is represented by the symbol S_r in risk model expressions. Thus, for example, S_y represents planned lateral separation. Depending upon the separation standard being examined, there may or may not be ATC-planned separation in a dimension. For example, in the case of lateral separation, there is no planned longitudinal separation between two aircraft on laterally adjacent tracks. Likewise, in the application of vertical separation, there is no planned longitudinal separation between pairs of aircraft at adjacent flight levels on the same route.

3.36 It was noted that there was a significant difference between no planned separation and planned separation of 0 NM or 0 ft. Thus, two aircraft on the same route at the same flight level are separated longitudinally by at least the minimum longitudinal separation standard, but have planned separation of 0 ft vertically and 0 NM laterally (which may be considered to be another way of saying "on the same route, at the same flight level). Using the symbols presented here, $P_y(0)$ and $P_z(0)$ are the mathematical representations of the probabilities of vertical and lateral overlap for two co altitude aircraft on the same route, with planned longitudinal separation at least equal to the longitudinal separation standard.

3.37 Having provided with this general explanation of assumptions and terms, the meeting noted that the mathematical form of the collision risk model applicable to the assessment of the safety a lateral separation standard was:

$$N_{ay} = P_y(S_y)P_z(0)\frac{\lambda_x}{S_x}\left\{E_y(same)\left[\frac{\overline{|\dot{x}|}}{2\lambda_x}+\frac{\overline{|\dot{y}|}}{2\lambda_y}+\frac{\overline{|\dot{z}|}}{2\lambda_z}\right]+E_y(opp)\left[\frac{\overline{V}}{2\lambda_x}+\frac{\overline{|\dot{y}|}}{2\lambda_y}+\frac{\overline{|\dot{z}|}}{2\lambda_z}\right]\right\} \quad (1)$$

and the form of the longitudinal risk model was:

$$N_{ax} = P_y(0)P_z(0)\frac{2\lambda_x}{\overline{|\dot{x}|}}\left[\frac{\overline{|\dot{x}|}}{2\lambda_x}+\frac{\overline{|\dot{y}|}}{2\lambda_y}+\frac{\overline{|\dot{z}|}}{2\lambda_z}\right]\times\int_m^M\left(\int_s^M f(s,l)\,dl\right)ds \quad (2)$$

The terms on the left side of these two equations, N_{ay} and N_{ax}, were the estimated lateral and longitudinal collision risks, respectively.

3.38 It is possible to see evidence of the "$P_x \bullet P_y \bullet P_z$" term in the collision rate expression above in each of the model forms, although some explanation below should make the three proportions, or probabilities, more evident. The term in "[ ]" in each model form is actually the "$1/(t_x + t_y + t_z)$" term in the expression for the collision rate, CR, above. The specifics of the derivation which results in the sum of the three terms, each of which is the ratio of a relative speed to an aircraft dimension, are found in *Manual on Airspace Planning Methodology for the Determination of Separation Minima*.

Explanation of Model Parameters and Values of Their Estimates Used In the Preliminary Safety Assessment

Parameters Common to the Lateral and Longitudinal Risk Models

Aircraft Length, Wingspan and Height: λ_x, λ_y and λ_z

3.39 These are the dimensions of the slab discussed above. Although not immediately obvious from the model forms shown above, it is a well established result that model-estimated risk increases in proportion to the increase in the size of the aircraft dimensions chosen for λ_x, λ_y and λ_z.

3.40 From the December 2007 Hong Kong and Singapore TSD, the most frequently occurring type was A320, accounting for 18.9 percent of the observations. The second most frequently observed type was B777-200. Of the four most frequently observed types – accounting for 58 percent of the aircraft recorded in the TSD, three were wide-body aircraft, including both B777-200 and B777-300. Based on the results concerning aircraft types presented, the safety assessment used B777-300 as the typical aircraft. The length, wingspan and height of this aircraft type were 0.0399 NM, 0.0329NM and 0.0099 NM, respectively.

Probability That Two Aircraft Assigned to the Same Flight Level Are at the Same Geometric Height: $P_z(0)$

3.41 The meeting noted that the value of this parameter depended on the accuracy of the height-keeping in the airspace under analysis and, also, on the height of the aircraft type chosen to represent the typical aircraft. Since a value for $P_z(0)$ using B-777-300 as the typical aircraft was not readily available, the safety assessment proceeded with the commonly used value of this parameter associated B747-400. The value used in this safety assessment, 0.538, has been used previously for other Asia/Pacific Region risk assessments and reflects the positive effect of compliance with RVSM performance requirements on height-keeping accuracy.

The Average Relative Vertical Speed of Two Aircraft Assigned to the Same Flight Level: $|\dot{\bar{z}}|$

3.42 The meeting recalled that the value used was 1.5 knots in all recent safety assessments conducted to support separation changes in Asia and Pacific Region. This value also reflected the effect of compliance with RVSM requirements on height-keeping performance.

Parameters Used Only in Estimation of Lateral Risk

Same- and Opposite-Direction Lateral Occupancies: E_y(same) and E_y(opp)

3.43 The meeting recognized that there was no planned longitudinal separation between two aircraft operating on parallel routes at the same flight level. As a result, the proportion of time spent in longitudinal overlap, P_x, for such aircraft pairs was the result of the relative aircraft density at the available flight levels on the routes, as opposed to loss or maintenance of a separation standard. A measure of this relative density is termed “occupancy,” and provides quantitative insight into the likelihood that two co altitude aircraft on laterally adjacent routes will be in the same relative along-track position.

3.44 Since these parameters measure the density of aircraft pairs in the airspace, they are the means whereby risk modeling reflects differences in risk as the result of traffic-flow differences among different portions of airspace. It should be noted that occupancy is not expressed in a unit of traffic flow, such as the number of aircraft per year using a route. Rather, occupancy is a dimensionless number, like a probability, and increases with an increase in the number of pairs of aircraft on laterally adjacent routes which are at or near the same along-track positions. Insofar as an increase in airspace traffic volume results in an increase in these proximate aircraft pairs, occupancy increases with increasing flights using the airspace.

3.45 The meeting also noted that in the general airspace system, it was possible to have two co altitude aircraft on parallel tracks flying identical or reciprocal headings. These two possibilities for the headings of an aircraft pair operating on adjacent tracks were referred to as “same- and opposite and opposite-direction flight” in documentation on collision risk modeling. In the expression of the lateral risk model (equation (1), above), there are two parameters, representing the relative density of same- and opposite-direction pairs on adjacent routes, E_y(same) and E_y(opp), to account for these differences in headings.

3.46 Since L642 and M771 are each unidirectional-flight routes, with flights on the two routes in opposite directions, E_y(same) has the value zero. Because of this, the expression for lateral risk reduces to:

$$N_{ay} = P(S_y) \bullet P_z(0) \bullet (\lambda_x/S_x) \bullet E_y(opp) \bullet [\ ]$$

where the “[ ]” refers to the sum of ratios of relative speeds to aircraft dimensions in equation (1).

3.47 Availability of traffic movement data containing times reported by flights at fixes allows estimation of occupancy values for a volume of airspace. In the case of a pair of parallel routes, the basic estimation process is to:

(1) count the number of proximate co altitude aircraft pairs on the routes at each pair of laterally adjacent fixes on the two routes, where “proximate” means that the reported times of a pair over the adjacent fixes are within some interval (usually, -15 minutes to +15 minutes) of each other,

(2) for each pair of adjacent fixes, multiply the count of pairs by 2 to produce the number of proximate aircraft,

(3) divide the number of proximate of aircraft by the total number of aircraft reporting times over the adjacent fixes, producing an estimate of occupancy for each fix-pair in the traffic movement data and

(4) averaging the occupancy estimates for each fix-pair to produce overall occupancy estimates for the airspace HERE which are, based on reported times over adjacent fixes on the two routes. The number of such pairs at each fix is multiplied by 2 to obtain a count of proximate aircraft, and then divided by the total number of aircraft on the two routes reporting times

3.48 It was noted that the December 2007 TSD provided these traffic movement data for the preliminary safety assessment. Each flight’s time reported over EPKAL was compared to the times reported at DOSUT by co altitude flights operating on M771. Whenever the difference of EPKAL and DOSUT times were within the range +15 minutes to -15 minutes of each other, the two aircraft were counted as a pair. The same pair-counting process was applied at the ESPOB-DUDIS fix-pair.

3.49 The results of examining 5 743 flights in the merged December 2007 Hong Kong and Singapore TSD showed some flights in the merged TSD operated in only one of the FIRs, and reported times over only one of the two fixes (EPKAL or ESPOB for L642 flights and DOSUT or DUDIS for M771 flights) were available for the occupancy analysis. Table 7 below presents the pair-counts by flight level resulting from the TSD analysis.

	Flight Levels													
Fix Pairs	290	300	310	320	330	340	350	360	370	380	390	400	410	Total
EPKAL-DOSUT	0	1	0	19	0	190	0	483	0	401	0	49	0	1143
ESPOB-DUDIS	0	1	0	4	0	138	0	411	0	394	0	119	0	1067
Total	0	2	0	23	0	328	0	894	0	795	0	168	0	2210

Table 7. Counts of Laterally Proximate Pairs from Merged December 2007 TSD

3.50 It was further noted that table 7 contains no pairs at odd flight levels as expected from the flight level allocation scheme used on L642 and M771. Comparison of this table with table 5 shows that the highest number of proximate pairs occurs at the most heavily used flight levels, again consistent with expectations.

3.51 Multiplying the pair-counts by 2 and dividing by the number of flights used in the analysis at each fix-pair results in the estimates of occupancy shown in table 8 below.

Fix Pairs	Numbers of Flights		Numbers of Laterally Adjacent Pairs		Opposite-Direction Lateral Occupancy Estimates
EPKAL-DOSUT	4996		1143		0.4576
ESPOB-DUDIS	4718		1067		0.4523
Total	9714		2210		0.455

Table 8. Opposite-Direction Lateral Occupancy Estimates Derived From Merged December 2007 TSDs

3.52 The Monitoring Agency for Asia Region (MAAR) presented a safety assessment of the South China Sea RNAV routes at RASMAG 7. The value for opposite-direction lateral occupancy used in that assessment was 0.78, which was based on the entire December 2006 TSD for the South China Sea FIRs. The safety assessment presented employed the MAAR-derived value of opposite-direction lateral occupancy, since it came from a larger TSD sample than that available for this analysis.

Speed of the Typical Aircraft in the System: $\overline{V}$

3.53 Also, the meting noted that this parameter represented the relative speed of two aircraft as they lose all planned separation while operating on parallel tracks at the same flight level on reciprocal headings. There is no planned separation between co altitude aircraft on adjacent parallel tracks, therefore aircraft operations on parallel tracks are independent of application of Mach number technique or any other actions by ATC to regulate the relative speed between aircraft. As a result, the relative speed between a typical pair of co-altitude aircraft on adjacent tracks reflects the range of speeds of individual aircraft in the airspace.

3.54 The meeting was advised that the merged Hong Kong and Singapore TSD provided information to estimate the value of this parameter. All flights on L642 with reported times over both EPKAL and ESPOB and all M771 flights with reported times over both DUDIS and DOSUT were used to produce separate estimates of the parameter for the two routes. The results are shown in table 9 below.

Route	Fix-Pair	Distance Between Fix-Pair (NM)	Number of Flights Used to Compute $\overline{V}$	Estimate of $\overline{V}$ (kts.)	Standard Deviation of Estimate (kts.)
L642	EPKAL – ESPOB	783.6	1970	470.0	17.6
M771	DUDIS – DOSUT	725.5	2125	483.9	17.6

Table 9. Average Aircraft Speeds on L642 and M771 Estimated From December 2007 TSD

Relative Across-Track Speed of Two Aircraft on Parallel Tracks As They Lose All Planned Lateral Separation: $|\overline{\dot{y}}|$

3.55 The meeting noted that this parameter described the relative speed of two aircraft as they lose all planned lateral separation. Since global experience had shown that the basic track-keeping accuracy of aircraft approved for RNP 10, as is required for operation on L642 and M771, precludes the loss of 50 NM lateral separation due to normal navigational performance, the most reasonable circumstance associated with such a separation-loss event is a waypoint insertion error. Monitoring of lateral navigation performance on the South China Sea RNAV routes since their November 2001 introduction has not recorded one such event.

3.56 Nevertheless, a cautious approach to lateral risk estimation should include use of a value for $|\overline{\dot{y}}|$ which corresponds to the loss of 50-NM lateral separation. Safety assessment by MAAR for the 60 NM lateral separation contains such a value, 75 kts., which has been used in the preliminary safety assessment.

Probability of Lateral Overlap: $P_y(50)$

3.57 The meeting recalled that this parameter described the chance that two aircraft assigned to laterally adjacent routes which are separated by 50 NM would lose all planned lateral separation. Two approaches to treating $P_y(50)$ were possible in lateral collision risk assessment:

(1) Collecting sufficient lateral navigational performance to estimate the value of $P_y(50)$ directly and then using this value in equation (1) with the other necessary parameter values to estimate lateral risk and then comparing the risk estimate to the TLS in order to demonstrate that the safety goal is satisfied, and

(2) Using all the other necessary parameters in risk model, determining that value of $P_y(50)$ which will satisfy exactly the TLS and then demonstrating that this value is satisfied.

3.58 The meeting recognized that the first approach required, typically, many years of recording lateral errors in a parallel-track system in order to demonstrate with high statistical confidence that the TLS is satisfied.

3.59 The second approach takes advantage of the fact that there is a well-established relationship between the probability that two aircraft with planned 50-NM separation will lose all planned separation, $P_y(50)$, and the probability that an individual aircraft will commit a lateral error of 25 NM or more in magnitude. Table B-1 of Attachment B to Annex 11 is an example of this approach for the case of planned 30 NM lateral separation between parallel routes.

3.60 In applying this second approach, a competent authority organizes a program to monitor lateral errors and employs a statistical decision-making process to evaluate the monitoring results. The decision-making process incorporates a predetermined level of statistical confidence that the TLS is met and uses the observed frequency of 25-NM or greater lateral errors to signal, at any time in the monitoring program, one of three decisions:

(1) the TLS is satisfied,

(2) lateral navigational performance is not at the level required to meet the TLS, or

(3) there is not yet sufficient monitoring data available to conclude that the TLS has been satisfied

3.61 This approach to demonstrating compliance with the lateral TLS has been applied successfully in parallel-track systems in several portions of worldwide airspace and has been adopted in the preliminary safety assessment. Details will be provided after review of the lateral risk model parameter values used in the preliminary safety assessment.

Summary of Parameter Values Used in the Preliminary Assessment of the Safety of a 50-NM Lateral Separation Standards on L642 and M771

3.62 Table 10 below summarizes the details of parameters used in the preliminary safety assessment for the lateral collision risk model.

Model Parameter	**Description**	**Value Used in Preliminary Safety Assessment**	**Source for Value**
N_{ay}	Risk of collision between two aircraft with planned 50-NM lateral separation	5.0×10^{-9} fatal accidents per flight hour	TLS adopted by APANPIRG as safety goal for changes in separation minima
S_y	Lateral separation minimum	50 NM	Goal of RNP-SEA Task Force
$P_y(50)$	Probability that two aircraft assigned to parallel routes with 50-NM lateral separation will lose all planned lateral separation	2.69×10^{-9}	Value required to meet exactly the TLS value of 5×10^{-9} fatal accidents per flight hour, given other parameters used in the preliminary safety assessment.
λ_x	Aircraft length	0.0399 NM	Merged December 2007 TSDs
λ_y	Aircraft wingspan	0.0329 NM	

Model Parameter	Description	Value Used in Preliminary Safety Assessment	Source for Value
λ_z	Aircraft height	0.0099 NM	
S_x	Length of the interval, in NM, used to count proximate aircraft at adjacent fix for occupancy estimates	+120 NM to -120 NM, equivalent to the +15-minute to -15-minute pairing criterion used in the preliminary safety assessment, for aircraft operating at 480 kts.	Arbitrary criterion which does not affect the value of risk
E_y(same)	Same-direction lateral occupancy	0.0	Result of opposite-direction uses of L642 and M771
E_y(same)	Opposite-direction lateral occupancy	0.78	MAAR estimate based on entire December 2006 TSD (reference 8)
$\overline{V}$	Aircraft along-track speed	483.9 kts.	Merged December 2007 TSDs
$\lvert\dot{\overline{y}}\rvert$	Average relative speed of a pair of aircraft as they lose all planned 50-NM lateral separation	75 kts.	Reference 8
$\lvert\dot{\overline{z}}\rvert$	Average relative vertical speed of a co altitude aircraft pair assigned to the same route	1.5 kts.	Conservative value commonly used in safety assessments

Table 10. Summary of Risk Model Parameters Used in Lateral Safety Assessment

Outcome of the Lateral Safety Assessment

3.63 The meeting recalled that the monitoring of lateral deviations had been continuous since the November 2001 introduction of the South China Sea RNAV routes, with the criterion to identify a GNE set at 30 NM in magnitude. In anticipation of the planned introduction of 50 NM lateral separation and future use of a 30 NM standard, the LOA among South China Sea air traffic service providers now established the GNE criterion as 25 NM.

3.64 Singapore had acted as a reporting agency in this monitoring program, collecting records of GNEs from all FIRs where monitoring takes place. To date, there had been no reports of GNEs for aircraft operating on either L642 or M771. This record of no 30 NM GNE occurrences during more than six years of monitoring indicates that lateral navigational performance on the routes clearly supports introduction of a 50 NM lateral separation standard.

3.65 The number of flights observed in the merged December 2007 TSD from Hong Kong and the Singapore FIRs was 5 743. Assuming that December 2007 was a month representative of the traffic counts on L642 and M771, it was reasonable to conclude that there would be, in a year, about 70 000 flights available for monitoring on the two routes. The value of required value of $P_y(50)$ shown in table 10 above, 2.69 x 10^{-9} , implied that it would be necessary to have many years of navigational performance observations from the monitoring program in order to show with high confidence that the TLS is being met.

3.66 Taking the approach outlined in the section, which addressed demonstration of compliance with the TLS through analysis of GNEs, could shorten this time considerably. The approach is based on a statistical technique known as sequential sampling and employs a control chart of the type that is used in monitoring manufacturing quality in many industrial processes. In such an environment, a manufacturer always wants to know if the product manufactured meets the company's standards for quality. As proposed for application in the case of introducing the 50 NM lateral separation standard on L642 and M771, the product is system safety, as demonstrated by compliance of risk with the TLS, and the standard for quality is an acceptably low rate of occurrence of GNEs.

3.67 Figure 1 below shows a control chart which mechanizes the sequential sampling process using the parameter values shown in table 10, with the assumption that decision-makers want to have 95 percent statistical confidence that the TLS is met. The chart permits plotting of GNEs on the vertical axis against numbers of observations from the monitoring program on the horizontal axis.

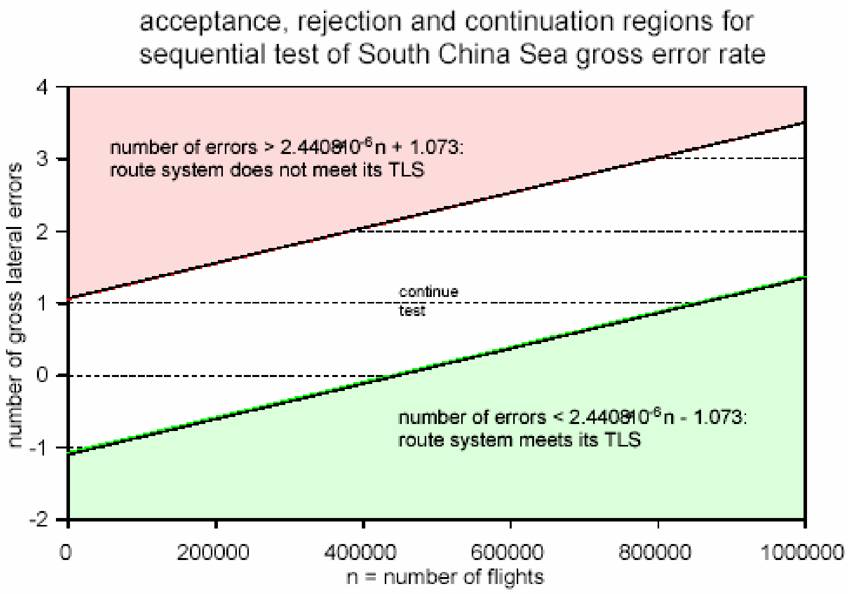

Figure 1. Sequential Sampling Approach to Demonstrating That Lateral Collision Risk for 50-NM Lateral Separation Standard Applied to L642/M771 Complies With TLS

3.68 The meeting also noted that the two straight lines of identical slope in the figure divided the chart into three regions, corresponding to the three decisions possible after entering each monitoring observation onto the chart:

(1) the number of GNEs recorded during observation of the total number of flights monitored lead to the conclusion that the TLS is met (the plot of GNEs versus number of monitored flights enters the region below the lower sloped line),

(2) the total number of flights monitored is not yet sufficient to conclude that the TLS is met (the plot of GNEs versus number of monitored flights is between the two sloped lines), or

(3) navigational performance, as measured by the number of GNEs recorded for the number of flights monitored, is not adequate to meet the TLS and, therefore, investigations must be done to look for any sources of systematic error which, if found, must be eliminated (the plot of GNEs versus number of monitored flights enters the region above the upper sloped line).

3.69 If navigational performance on L642 and M771 follows the record of no 30 NM GNE occurrences when the new GNE criterion of 25 NM is applied, the chart indicates that the plot of GNEs versus number of monitored flights will enter the "meets the TLS" region of the chart roughly six years after the start of monitoring against the 25-NM criterion. In the interim, unless the plot of GNEs versus monitored flights enters the uppermost region of the chart, use of the 50 NM lateral separation standard is justified, in the sense that system operation has not yet produced enough monitoring observations to conclude that the TLS is met – but there is no indication that the TLS will not be satisfied eventually.

Conclusions and Recommendations from the Preliminary Safety Assessment Concerning Introduction of the 50 NM Lateral Separation Standard on L642 and M771

3.70 The meeting noted that analysis of available data provided the basis for developing a sequential-sampling approach to demonstrating that the TLS will be satisfied after introduction of the 50 NM lateral separation standard on L642 and M771.

3.71 The combination of the record of no 30 NM GNEs on these routes in more than six years of monitoring and the intent to continue the monitoring program with adjustments for the 50 NM lateral standard justified going forward with the implementation. Because the availability of navigational performance data plays such an important role in conducting a safety assessment, it was recommended that some observations of navigational performance on L642 and M771 be made available for the final safety assessment preceding the planned 2 July 2008 introduction of the 50 NM lateral separations standard between L642 and M771.

Parameters Used Only in Estimation of Longitudinal Risk

Background Information from the Merged Hong Kong and Singapore December 2007 TSD Useful for the Estimation of Longitudinal Collision Risk

3.72 The meeting was informed that all flights on L642 with reported times over EPKAL and ESPOB and all flights on M771 with reported times over DUDIS and DOSUT were examined to estimate the relative along-track speed of aircraft pairs on the two routes. A pair of aircraft was included in the examination of relative along-track speed if the two aircraft were at the same flight level and passed over the entry fix (EPKAL for M642 flights and DUDIS for M771 flights) within 60 minutes of each other. The same-altitude/close-in-time criteria were intended to minimize the effects of wind on the estimation of relative speeds. Application of these criteria resulted in 650 L642 pairs and 742 M771 pairs available for the examination of relative speed. For any pair, the computed difference in speeds was assigned a positive value if the lead aircraft in the pair was faster, and a minus sign if the faster aircraft were the trailing aircraft in the pair. The examination involved computing the average of these signed speeds as well as the average of the speed differences without regard to sign, or average of the absolute value of the speeds.

3.73 All flights on L642 with times reported over both EPKAL and ESPOB and all M771 flights with reported times over both DUDIS and DOSUT were used to estimate the average transit time between the fix-pairs. There were 1970 such flights identified on L642 and 2125 flights on M771. Table 11 below shows the results of this investigation.

Route	Fix-Pair	Average Signed Speed (kts.)	Standard Deviation of Signed Speed (kts.)	Average Absolute-Value Speed (kts.)	Standard Deviation of Absolute-Value Speed (kts.)	Average transit Time (mins.)
L642	EPKAL - ESPOB	-3.34	2.39	16.74	2.40	100.0
M771	DUDIS - DOSUT	-5.89	2.45	14.27	2.51	90.1

Table 11. Average Speeds and Transit Times on RNAV Routes L642 and M771

3.74 The average along-track signed speed for each route was negative, indicating that, on the average, a faster aircraft was following a slower one in the pairs used in the examination.

Probability That Two Aircraft Assigned to the Same Route and Flight Level Are in Lateral Overlap: $P_y(0)$

3.75 The meeting noted that from inspection of the longitudinal collision risk model presented in equation (2) above, risk was directly proportional to the value of this parameter. That is, as the value of this parameter increases, longitudinal risk increases.

3.76 Experience had shown that use of the Global Positioning System (GPS) in determining aircraft position produced highly accurate results. In turn, these accurate position estimates produce smaller lateral errors from course. Smaller lateral errors produce higher values of $P_y(0)$, thus increasing the risk of losing longitudinal separation, all other things being equal. This "navigation paradox" – improvements in navigation in one dimension increase collision risk in another – is well known.

3.77 The meeting recalled that ICAO RVSM Implementation Task Force initiated work to introduce RVSM into Pacific FIRs in November 1998. At its Third Meeting, the Task Force was presented with reference 10 which described analysis of cross track errors exhibited by B-747-400 aircraft known to be using GPS for position-determination. Based on analysis of these errors, reference 10 reported that, if all Pacific operations were conducted by B-747-400 aircraft equipped with GPS, the estimated value of $P_y(0)$ would be 0.3868. In contrast, if there were no GPS-equipped aircraft in the airspace, the value would be only 0.019. Reference 10 provided evidence that about 27 percent of Pacific operations at the time of the RVSM/TF/3 meeting were conducted by GPS-equipped aircraft. The corresponding value of $P_y(0)$ adopted by the Task Force was 0.052.

3.78 Table 2 presented the 15 aircraft types which, taken together, accounted for 97 percent of the operations on L642 and M771 found in the merged December 2007 TSD. From this table, it was concluded that at least 50 percent of the operations on L642 and M771 were conducted by aircraft types known to be equipped with GPS. Based on this percentage of GPS equipage, the preliminary safety assessment used a value of 0.20 for $P_y(0)$, with the intent that the percentage of GPS-equipped operations on L642 and M771 be determined prior to completion of the final pre-implementation safety assessment.

Relative Across-Track Speed of Two Aircraft Assigned to the Same Route and Flight Level - $|\bar{\dot{y}}|$

3.79 The effect of GPS in the navigation solution is to reduce aircraft cross-track velocity.

Probability of Longitudinal Overlap: P_x

3.80 The remaining terms in the longitudinal risk model address the estimation of P_x, the probability of that a pair of same-route, co-altitude aircraft loses all planned longitudinal separation. While the estimation of this probability is a complex mathematical form in equation (2), involving a double integral, the concept behind the form is relatively straightforward.

3.81 If Q(s) is the proportion of aircraft pairs separated initially by s in the longitudinal dimension and P(S ≥ s) is the probability of losing at least the separation s, then the probability of losing all longitudinal separation between a pair of aircraft, Px , can be represented by:

P_x = (factor dependent on initial separation s) •
summation of [Q(s) · P(S ≥ s)] for all values of s.

3.82 The term in "( )" (factor dependent on initial separation) is represented in equation (2) above by $(2\lambda_x / |x|)$, where the relative speed is that necessary for two aircraft to lose longitudinal separation, s, within a time T. The value of T is usually taken to be the time between successive waypoint reports, under the assumption that air traffic control will intervene to correct the case of a serious loss of longitudinal separation at the next waypoint. In oceanic airspace such as the Pacific, T is roughly 60 minutes.

3.83 As noted in table 11, the average transit time on M771 between DUDIS and DOSUT was 90 minutes and roughly 100 minutes on L642 between EPKAL and ESPOB. The principal fixes on each route are on the order of 200 NM apart. Assuming three required reporting points between EPKAL and ESPOB and between DUDIS and DOSUT, T for L642 and M771 would be on the order of 30 minutes. If two aircraft were separated longitudinally by 50 NM at a required reporting point, the relative speed difference required to lose exactly 50 NM within 30 minutes is 100 kts. The data on relative speeds presented in table 5 suggest that such an overtake speed is highly unlikely.

3.84 In longitudinal risk estimation, the term Q(s) is, typically, the distribution of initial separations between co-altitude same-route aircraft pairs on entering the airspace. The term P(S ≥ s), the chance of losing all planned longitudinal separation of s or more, is usually is estimated from data on longitudinal separation erosion available from airspace records.

3.85 The meeting recognized that it was not possible to know in advance how co-altitude aircraft would be spaced longitudinally when a 50 NM longitudinal separation minimum is applied. It was, however, possible to infer something about capacity demand and air traffic control response by examining actual system performance.

3.86 The merged December 2007 TSDs were used to gain insight into both the initial distribution of along-track separation and also separation decrease or increase during operations on L642 and M771. The term "separation loss or gain" was used to describe the decrease or increase in initial separation, but, in using this term, there should be no misunderstanding that "separation loss" means loss of all initial longitudinal separation between an aircraft pair.

3.87 The TSD data were processed to determine pairs of co altitude aircraft on L642 passing over EPKAL within 60 minutes of each other. Similarly, pairs of aircraft passing over DUDIS no more than 60 minutes apart were identified. The pair-separations for the L642 pairs passing over ESPOB and the M771 pairs passing over DOSUT were then computed and the data summarized as counts of initial-separation/separation-change. The combined total of L642 and M771 pairs which contributed to the initial-separation/separation-change analysis was 1 392. The results of the pairing are shown in **Appendix H** to this report. The table is organized with the various values of observed initial inter-aircraft separation in minutes (over EPKAL for L642 flights and DUDIS for M771 flights) as the leftmost column and the observed separation loss or gain at the exit fix (ESPOB for L642 flights and DOSUT for M771 flights) as column headings in sequence from -12 minutes to +12 minutes. If the initial separation between the two aircraft of a pair was 15 minutes and the final observed separation was 16 minutes, the pair would have contributed a count of one to the table entry at the intersection of 15 minutes initial separation and 1 minute gain in separation.

3.88 The meeting noted from the table that the smallest initial separation between two aircraft in pair was 4 minutes. The exit-fix change in separation between the members of the pair was 12 minutes, indicating that the pair was cleared into the system was the faster aircraft in the lead and the anticipation that inter-aircraft separation would increase.

3.89 The cumulative totals of aircraft pairs for each value of initial separation are shown in the column headed “Total” on the right of the table. From the table, there was no initial separation less than 4 minutes.

Outcome of the Preliminary Longitudinal Safety Assessment

3.90 The meeting noted that the longitudinal safety assessment process determined the value of P_x in a manner similar to the discussion of the lateral safety assessment, which exactly satisfies the TLS, given the necessary parameter values from table 4, the value of 100 kts for $|x|$ and the values stated for $P_y(0)$ and $|\bar{\dot{y}}|$ of 0.20 and 1 kt, respectively. The value was 2.22×10^{-6}. It would be necessary to take observations on many pairs of aircraft in order to demonstrate that this value of P_x is met.

3.91 Examination of the loss or gain in separation showed that there was no reason to be concerned about either the current longitudinal separation minimum of 80 NM, or 10 minutes with application of Mach number techniques. That examination also showed that there was no evidence of the loss of 6 minutes or more separation, the equivalent of 50 NM separation given the average speed determined for the flights in the December 2007 TSD, for aircraft with smaller values of initial longitudinal separation.

3.92 The meeting reviewed the conclusions and recommendations from the preliminary safety assessment concerning introduction of the 50 NM lateral and 50 NM longitudinal separation standards on L642 and M771. IATA commented that from the user’s point of view, the implementation of RNP 10 (50 NM/50 NM) operations on these 2 routes was timely. IATA complimented the good work of the air traffic controllers in the region and felt that some of the 9 minutes separation recorded between 2 aircraft on these 2 routes could be due to the rounding up of 30 seconds at position reports. Singapore added that it had a bilateral agreement with Ho Chi Minh ACC to use Mach number technique on these 2 routes to reduce separation. Singapore added that it would work closely with CSSI, Inc and would provide them with the necessary radar plot data captured on these 2 routes for the safety assessment.

Review of RASMAG List of Competent Airspace Safety Monitoring Organizations

3.93 The meeting reviewed the 'RASMAG List of Competent Airspace Safety Monitoring Organizations'.

Agenda Item 4: Develop a Coordinated Plan for Implementation of Actions Agreed by the Task Force

Operational Concept and Implementation Requirements for RNP 10 50 NM/50 NM Horizontal Separations on L642 and M771 (Operational Plan)

4.1 Singapore provided the meeting with a table on Understanding the Operational Concept and Implementation Requirements for RNP 10 operations on L642 and M771. The table showed the communications, navigation and surveillance (CNS) capabilities in the four FIRs and the proposed operational plan for the implementation of RNP 10 (50 NM/50 NM) operations. States concerned were invited to comment on the table presented.

4.2 Hong Kong, China advised the meeting that the separation used on these 2 routes was 10 minute time separation and radar was used for monitoring. Mach number technique was also applied on these two routes.

4.3 China informed the meeting that radar separation was applicable within the Sanya FIR but Sanya Area Control Centre (ACC) applied 10 minute time separation on L642 and M771 in accordance with the LOA with the neighboring ACCs.

4.4 Viet Nam updated the meeting that it used radar as the primary means of control and ADS-C for monitoring in the Ho Chi Minh FIR.

4.5 IATA commented that the table should also indicate the basic requirements for the implementation of RNP 10 operations and felt that the use of radar monitoring was only an additional tool as it was not a requirement in RNP 10 operations.

4.6 The meeting accepted the table as shown below as the Operational Concept for the implementation of RNP 10 operations on L642 and M771.

FIR	Existing CNS Infrastructure and RNP 10 50 NM/50 NM Requirements			Additional Information on Current Mode of Operation on L642 and M771	Adequate for RNP 10 50/50 Operation ?
	RNP 10 Communications Requirements Direct controller-pilot communication in voice/CPDLC	**RNP 10 Navigation Requirements** RNP10 Approval	**RNP 10 Surveillance Requirements** Procedural position reports at least every 24 minutes		
	Communication Means	**Navigation Specification**	**Surveillance in Place**		
Hong Kong	VHF direct communication between ATC and pilots	RNP10 Approval	Frequent position update by radar	Use of Radar to monitor RNP 10 operation	Yes
Sanya	VHF direct communication between ATC and pilots	RNP10 Approval	Frequent position update by radar	Use of Radar to monitor RNP 10 operation	Yes
Ho Chi Minh	VHF direct communication between ATC and pilots, CPDLC available as secondary communication means	RNP10 Approval	Frequent position update by radar	Use of Radar as primary means of separating aircraft, ADS-C for monitoring FANS 1/A aircraft as added surveillance	Yes
Singapore	CPDLC as primary communication between ATC and pilots for FANS 1/A aircraft, direct HF as secondary communication	RNP10 Approval	Procedural position reporting, intervals between successive waypoints less than 24 minutes	ADS-C surveillance on FANS 1/A aircraft	Yes

4.7 Singapore informed the meeting that the safety assessment would be completed and presented at RASMAG/9 in May 2008 subject to the timely provision of data required to complete the safety assessment. The meeting agreed that the required data be provided to Singapore as soon as available from the Ho Chi Minh, Hong Kong, Kuala Lumpur and Sanya FIRs. The meeting discussed and agreed that the implementation time/date should be 2100 UTC, 2 July 2008. The Secretariat agreed that the Go/No/Go meeting could be held in the first week of June.

4.8 The meeting confirmed that the ATS route re-alignment would be not be considered for the implementation of RNP 10 50 NM/50 NM separations. The current spacing of 60 NM between the trunk routes would be kept as it is until the next step of RNP 4 is introduced. This would allow for simply establishing additional routes between the current routes.

Readiness of States

4.9 The meeting noted the four FIRs involved in the implementation of RNP 10 operations on L642 and M771 were ready for implementation at 2100 UTC, 2 July 2008.

4.10 States were requested to submit their amendment proposals to the *Regional Supplementary Procedures* (Doc 7030) as shown in **Appendix I** to this report by end of March 2008 to allow the Secretariat sufficient time to process the proposal amendment.

Agenda Item 5: Update RNP-SEA/TF Task List

5.1 The meeting reviewed and updated the RNP-SEA/TF Task List as in **Appendix J** to this Report.

Agenda Item 6: Any Other Business

Large Scale Weather Deviations

6.1 Hong Kong, China and IFALPA requested clarification of the large scale weather deviation procedures with regard to the implementation of RNP 10 operations. The meeting was informed by Singapore that WPAC/SCS RSG/4 requested that this matter would be discussed at the upcoming SEACG/14 in May.

Equipage of Aircraft for RNP Operations

6.2 The meeting noted IATA's concerns regarding the data provided in the safety analysis which indicated relatively large proportion of new aircraft types operating in the South China Sea area that were not fully capable of data link communications. IATA noted that future work of the Task Force and ICAO's plans on implementation of PBN would be hampered if the situation is not addressed. IATA urged States to take early cognizance of this problem and put in place incentives to encourage early adoption of data link equipage to support implementation of RNP 4 30/30 NM horizontal separation standards and to assist in reduction in ATC workload and encourage operators to support these regional ATM measures.

Use of HF for DCPC

6.3 IATA requested clarification from Singapore with regard to the operational use of HF as a means of communications for application of RNP 10 operations. Singapore confirmed that the primary means of communication would be CPDLC, however direct HF would be used for non-FANS-1/A equipped aircraft.

Data Link Implementation Table for Capacity Planning

6.4 It was noted that if the actual message traffic that the aircraft using the SITA satellite service are generating is more than predicted, customers would face severe degradation. SITA wished to obtain from customer airlines and air navigation service providers their planned FANS activities and to feed traffic forecast model to assist themselves to provide the required level of performance for their customers.

Agenda Item 7: Date and Venue for the Next Meeting

7.1 The meeting agreed tentatively on the future work programme of the Task Force as follows:

RNP-SEA/TF/3 (Go/No-go meeting)	4-6 June 2008	Singapore
RNP-SEA/TF/4 (90 days review meeting)	November 2008	TBD

7.2 The 90-day review meeting will include a review of the safety assessment after the implementation of the 50 NM horizontal separations. When the review meeting finds that the 50 NM longitudinal separation is successfully implemented on L642 and M771, the Task Force will continue its work to address other routes in the region as agreed at RNP/TF/1.

Closing of the Meeting

8.1 Mr. Rabot thanked all the participants for their active participation, cooperation and valuable inputs throughout the meeting that made his role as chairman much easier. He believed that this meeting had achieved a great deal and as a Task Force, we can be proud of the work done over the last few days.

8.2 Mr. Rabot expressed that the implementation of RNP 10 50/50 NM horizontal separation on L642 and M771 was but the first step toward a more comprehensive use of RNP operations on the South China Sea routes. He was sure the meeting looked forward to the implementation of RNP 10 operations on 2 July 2008 at 2100UTC.

8.3 On behalf of the participants, Mr. Rabot thanked Singapore for hosting this meeting. He also thanked the Regional office for the invaluable support of the work of this Task Force.

8.4 On behalf of the RNP-SEA/TF, Mr. Harano thanked all delegates for their participation. He was very grateful to the meeting for their excellent job contributed to the meeting.

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LIST OF PARTICIPANTS

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
CHINA		
Ms. Zhang Ying	Engineer of Airspace Management Division Air Traffic Management Bureau, CAAC No.12 East Sanhuan Road Middle Chaoyang District, Beijing 100022 People's Republic of China	Tel: +86-10-8778 6837 Fax: +86-10-8778 6830 E-mail: zhangying@atmb.net.cn
Mr. Chen Wenyi	Deputy Director of ATC Division Middle South Regional Air Traffic Management Bureau, CAAC People's Republic of China	Tel: +86-020-8613 0736 E-mail: atcguy@163.com
Mr. Yu Peng	Director, Sanya Area Control Centre Middle South Regional Air Traffic Management Bureau, CAAC People's Republic of China	Tel: +86-898-6575 2698 E-mail: ccatcyp@263.net
HONG KONG, CHINA		
Mr. Kermit Yuen Ka Fai	Area Supervisor Air Traffic Management Division Civil Aviation Department 4/F, ATC Complex 1 Control Tower Road Hong Kong International Airport Lantau Hong Kong, China	Tel: 852-2910 6808 Fax: 852-2910 0186 E-mail: kkfyuen@cad.gov.hk
Mr. Mike Wai-kan Tam	Evaluation Officer Air Traffic Management Division Civil Aviation Department 4/F, Air Traffic Control Complex 1 Control Tower Road Hong Kong International Airport Lantau Hong Kong, China	Tel: 852-2910 6451 Fax: 852-2910 0186 E-mail: mwktam@cad.gov.hk
MALAYSIA		
Mr. Tan Jee Leng	Deputy Director, KL ATCC Department of Civil Aviation Sultan Abdul Aziz Shah Airport 47200 Subang Malaysia	Tel: 603-78465233 Fax: 603-78456590 E-mail: tanjl@dca.gov.my
Mr. Chars Wong	Centre Superintendent KK ATCC Department of Civil Aviation 88618 Kota Kinabalu Sabah Malaysia	Tel: 088-224404 Fax: 088-219170 E-mail: chars@dca.gov.my

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
Capt. Wee Yeng Chor	Flight Ops Manager (Technical B747/B777) Malaysia Airlines Fleet Management B747/B777 Flight Ops Division 4/F, Admin Building, Southern Support Zone Kuala Lumpur Int'l Airport 64000 Supang, Selangor Malaysia	Tel: 603-8777 9666 Fax: 603-8783 3109 E-mail: weeyc@mas.com.my
SINGAPORE		
Mr. Rosly Bin Md Saad	Head (Air Traffic Control Operations) Singapore Air Traffic Control Centre 60 Biggin Hill Road Singapore 509950	Tel: 65 6541 2685 Fax: 65 6545 6252 E-mail: rosly_saad@caas.gov.sg
Mr. Sebastian Lim Kim Chuan	Chief Singapore Air Traffic Control Centre Singapore Air Traffic Control Centre 60 Biggin Hill Road Singapore 509950	Tel: 65 6541 2430 Fax: 65 6545 6252 E-mail: sebastian_lim@caas.gov.sg
Mr. Peter Edward Rabot	Head (School of ATS) Singapore Aviation Academy 1 Aviation Drive Singapore 499867	Tel: 65 6540 6247 Fax: 65 6542 9890 E-mail: peter_rabot@caas.gov.sg
Mr. Vincent Hwa Teck Pheng	Air Traffic Control Manager (Airspace) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2774 Fax: 65 6545 6516 E-mail: hwa_teck_pheng@caas.gov.sg
Mr. Heng Cher Sian Edmund	Project Officer (Air Traffic Management) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2457 Fax: 65 6545 6516 E-mail: edmund_heng@caas.gov.sg
Mr. Tan Yean Guan	Project Officer (Airspace) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2709 Fax: 65 6545 6516 E-mail: tan_yean_guan@caas.gov.sg
Mr. Loke Chee Yong Jeffrey	Project Officer (Air Traffic Management) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2463 Fax: 65 6545 6516 E-mail: loke_chee_yong@caas.gov.sg
Mr. Lim Kheng Leong Harrison	Air Traffic Control Officer Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2868 Fax: 65 6545 6516 E-mail: harrison_lim@caas.gov.sg

STATE/NAME	**DESIGNATION/ADDRESS**	**CONTACT DETAILS**
Mr. Hermizan M Jumari	Project Officer (Air Traffic Management) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2464 Fax: 65 6545 6516 E-mail: Hermizan_jumari@caas.gov.sg
Mr. Robert L. Miller	Operations Analysis and Implementation Team CSSI, Inc. 400 Virginia Ave, SW, Suite 210 Washington DC 20024 USA	Tel: 1-202-484-3359 Fax: 1-202-863-2398 E-mail: rmiller@cssiinc.com
Mr. Brian Colamosca	Technical Lead CSSI, Inc. 400 Virginia Ave, SW, Suite 210 Washington DC 20024 USA	Tel: 1-609-569-0122 Fax: 1-609-407-9356 E-mail: bcolamosca@cssiinc.com
THAILAND		
Dr. Jaroon Meesomboon	Director Airport Standards and Air Navigation Facilitating Division Department of Civil Aviation 71 Soi Ngarmduplee, Tungmahamek Rama IV Rd, Bangkok 10120 Thailand	Tel: 66-2-287 0320 ext 1133 Fax: 66-2-286 1013 E-mail: mjaroon@aviation.go.th
Mr. Yoottakarn Niewpant	Air Traffic Control Specialist Airport Standards and Air Navigation Facilitating Division Department of Civil Aviation 71 Soi Ngarmduplee, Tungmahamek Rama IV Rd, Bangkok 10120 Thailand	Tel: 66-2-287 8629 Mobile: 081-7014909 Fax: 66-2-286 8159 E-mail: niewpant@aviation.go.th
Mr. Watee Arthakamol	Air Traffic Control Manager Aeronautical Radio of Thailand Ltd. 102 Ngarmduplee, Tungmahamek Sathorn, Bangkok 10120 Thailand	Tel: 66-2-285 9660 Fax: 66-2-285 9406 E-mail: watee.ar@aerothai.co.th
Mr. Bancha Kingbualuang	Air Traffic Control Manager Aeronautical Radio of Thailand Ltd. 102 Ngarmduplee, Tungmahamek Sathorn, Bangkok 10120 Thailand	Tel: 66-2-287 8024-5 Fax: 66-2-287 8026-7 E-mail: bancha.ki@aerothai.co.th
Capt. Choompol Soodla	Manager, Operations Specification Division Operations Support Department Thai Airways International Public Company Ltd 89 Vibhavadee Rangsit Rd Bangkok Thailand	Tel: 66-2-545 2669 Fax: 66-2-545 3849 E-mail: choompol.s@thaiairways.com

STATE/NAME	**DESIGNATION/ADDRESS**	**CONTACT DETAILS**
Mr. Pairat Wonganan	Manager, Operations Control Support Bangkok Airways Company Limited 999 Mu 4, Bangna-Trad Rd. Bangchalong, Bangplee Samutprakarn Bangkok 10540 Thailand	Tel: 66-2-328 3353 Fax: 66-2-325 0664 E-mail: pairat@bangkokair.com
UNITED STATES		
Mr. Dan Hanlon	ATO Representative, Asia Pacific Region US Federal Aviation Administration American Embassy Singapore 27 Napier Road Singapore 258508	Tel: 65-6543 1466 E-mail: dan.hanlon@faa.gov
VIETNAM		
Mr. Doan Khac Manh	Deputy Director of AND Civil Aviation Administration of Viet Nam 119 Nguyen Son, Long Bien Hanoi The Socialist Republic of Viet Nam	Tel: +84-4-8731611 Fax: +84-4-8274194 E-mail: manhdoankhac@caa.gov.vn
Mr. Nguyen Thanh Trung	Vice Chief of Hanoi ACC ATS Northern Regional Centre Nobai Airport, Civil Aviation Administration of Viet Nam Hanoi The Socialist Republic of Viet Nam	Tel: +84-4-8860958 Fax: E-mail: nguyenthanhtrunghanoiacc@yahoo.com.vn
Mr. Dang Dang Van	ATC Instructor of SORAT ATS Southern Regional Centre Vietnam Air Traffic Management Civil Aviation Administration of Viet Nam Ho Chi Minh City The Socialist Republic of Viet Nam	Tel: +84-9-84733758 Fax: +84-4-8443774 E-mail: dangvanaacc@hcm.fpt.vn
Mr. Tran Xuan Son	ATS Specialist Viet Nam Air Traffic Management Civil Aviation Administration of Viet Nam Gialam Airport, Long Bien Dist Hanoi The Socialist Republic of Viet Nam	Tel: +84-4-8725271 Fax: +84-4-8725281 E-mail: stats8668@yahoo.com
IATA		
Mr. Soon Boon Hai	Assistant Director – Safety, Operations & Infrastructure – Asia/Pacific International Air Transport Association 111 Somerset Road Singapore Power Building Singapore 238164	Tel: +65-6499 2251 Fax: +65-6233 9286 E-mail: soonbh@iata.org
Mr. Douglas K. Michael	Assistant Director – Safety, Operations & Infrastructure – Asia/Pacific International Air Transport Association 111 Somerset Road Singapore Power Building Singapore 238164	Tel: +65-6499 2254 Fax: +65-6233 9286 E-mail: michaeld@iata.org

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
Capt. Aric Oh	Deputy Chief Pilot (Technical) Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-6540 3694 Fax : +65-6490 0601 E-mail: aric_oh@singaporeair.com.sg
Mr. YS Tang	Asst Manager, Flight Ops Technical, Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-6540 7942 Fax : +65-6490 0601 E-mail: ys_tang@singaporeair.com.sg
Capt. R. Saravanan	Management Pilot (Special Duties) – Technical Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-6548 1677 Fax : +65-6490 0601 E-mail: r_saravanan@singaporeair.com.sg
Mr. Yusuke Chaki	Assistant Manager Operations Standards Section Nippon Cargo Airlines Co., Ltd. NCA Global Operations Center Narita International Airport Terminal 2 Narita-shi, Chiba 282-0004 Japan	Tel : 81-476-32 9739 Fax : 81-476-32 9788 E-mail: yusuke.chaki@nca.aero
IFALPA		
Capt. Cheong Kah Seng	IFALPA Representative ALPA-S 720 Upper Changi Road East SIA Training Centre (SIN-STC-02A) Singapore 486852	Tel: +65-91392102 E-mail: cheongkahseng@alpas.org, cheongkahseng@yahoo.com
ICAO		
Mr. Kyotaro Harano	Regional Officer, ATM ICAO Asia & Pacific Office 252/1 Vibhavadi Rangsit Road Ladyao, Chatuchak Bangkok 10900 Thailand	Tel: 66-2-5378189 Fax: 66-2-5378199 E-mail: kharano@bangkok.icao.int

LIST OF WORKING PAPERS (WPs) AND INFORMATION PAPERS (IPs)

WORKING PAPERS

NUMBER	AGENDA	WORKING PAPERS	PRESENTED BY
WP/1	1	Provisional Agenda RNP-SEA/TF/2	Secretariat
WP/2	1	Terms of Reference of the Task Force Adopted by the 13th Meeting of South-East Asia ATS Coordination Group (SEACG/13)	Secretariat
WP/3	2	Review Outcomes of the 14th Meeting of Southeast Asia ATS Coordination Group (SEACG/14)	Secretariat
WP/4	2	Radar Coverage Chart for the South China Sea	Secretariat
WP/5	2	Review Outcomes of the Seventh Meeting of FANS Implementation Team, South-East Asia (FIT-SEA/7)	Secretariat
WP/6	2	Summary of Discussions for the Special Coordination Meeting Held in Singapore from 25 to 27 September 2007	Singapore
WP/7	3	Engaging CSSI, Inc. to Assist Singapore to Be Established as the Safety Monitoring Agency and Conduct of Safety Assessment for the Implementation of RNP10 (50/50NM) Operations on L642 and M771 in the South China Sea Area	Singapore
WP/8	3	Revised Operational Letter Of Agreement (LOA) for Monitoring of Aircraft Gross Navigational Errors in the South China Sea Area	Singapore
WP/9	1	RASMAG Review of the Terms of Reference of the Task Force	Secretariat
WP/10	3	Preliminary Assessment of the Safety of Implementing 50-NM Lateral and Longitudinal Separation Standards on RNAV Routes L642 and M771	Singapore

INFORMATION PAPERS

NUMBER	AGENDA	INFORMATION PAPERS	PRESENTED BY
IP/1	-	List of Working Papers (WPs) and Information Papers (IPs)	Secretariat
IP/2	2	Outcomes of APANAPIRG/18	Secretariat
IP/3	2	Summary of the First Meeting of Asia/Pacific Performance Based Navigation Task Force	Secretariat
IP/4	2	The Fourth Meeting of the Western Pacific/South China Sea RVSM Scrutiny Group	Secretariat
IP/5	3	Review of the Eighth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/8)	Secretariat

NUMBER	AGENDA	INFORMATION PAPERS	PRESENTED BY
IP/6	3	Review of RASMAG List of Competent Airspace Safety Monitoring Organizations	Secretariat
IP/7	6	Data Link Implementation Table for Capacity Planning	Secretariat
IP/8	3	Examination of Operations Conducted on RNAV Routes L642 And M771	Singapore

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Status of Application of Radar Handover in South East Asia

Yes: Implemented
No: Not Implemented
N/A: Not Applicable (radar converages not overlap,thus impossbile)

FIR/AOR	Bangkok	Guangzhou	Hanoi	Ho Chi Minh	Hong Kong	Jakarta	Kota Kinabalu	Kuala Lumpur	Manila	Fukuoka	Phnom Penh	Sanya	Singapore	Taibei	Ujung Pandang	Vientiane
Bangkok		N/A	N/A	YES	N/A	N/A	N/A	YES	N/A	N/A	YES	N/A	N/A	N/A	N/A	YES
Guangzhou	N/A		YES	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	TBD	N/A	N/A	N/A	N/A
Hanoi	N/A	YES		YES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	YES	N/A	N/A	N/A	YES
Ho Chi Minh	YES	N/A	YES		N/A	N/A	N/A	N/A	N/A	N/A	YES	YES	~~NO~~N/A	N/A	N/A	NO
Hong Kong	N/A	NO	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	YES	N/A	N/A
Jakarta	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	N/A	N/A
Kota Kinabalu	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kuala Lumpur	YES	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	YES	N/A	N/A	N/A
Manila	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	NO	N/A	N/A
Fukuoka	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NO		N/A	N/A	N/A	YES	N/A	N/A
Phnom Penh	YES	N/A	N/A	YES	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	NO
Sanya	N/A	NO	YES	YES	NO	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
Singapore	N/A	N/A	N/A	~~NO~~N/A	N/A	N/A	NO	YES	N/A	N/A	N/A	N/A		N/A	N/A	N/A
Taibei	N/A	N/A	N/A	N/A	YES	N/A	N/A	N/A	YES	YES	N/A	N/A	N/A		N/A	N/A
Ujung Pandang	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A
Vientiane	YES	N/A	YES	NO	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	N/A	N/A	N/A	

CIVIL AVIATION AUTHORITY OF SINGAPORE

SUMMARY OF DISCUSSION

SPECIAL COORDINATION MEETING FOR THE IMPLEMENTATION OF REDUCED HORIZONTAL SEPARATION BASED ON RNP10 OPERATIONS ON ATS ROUTES L642 AND M771 IN THE SOUTH CHINA SEA AREA

(SCM/RNP10)

SINGAPORE, 25 SEPTEMBER TO 27 SEPTEMBER 2007

SPECIAL COORDINATION MEETING FOR THE IMPLEMENTATION OF REDUCED HORIZONTAL SEPARATION BASED ON RNP10 OPERATIONS ON ATS ROUTES L642 AND M771 IN THE SOUTH CHINA SEA AREA (SCM/RNP10)

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PART I – HISTORY OF THE MEETING

1. Introduction

1.1 The Special Coordination Meeting for the Implementation of Reduced Horizontal Separation based on RNP10 Operations on ATS Routes L642 and M771 in the South China Sea Area (SCM/RNP10) was held in Singapore from 25 September to 27 September 2007 at the premises of the Singapore Aviation Academy.

2. Attendance

2.1 The meeting was attended by 23 participants from China, Malaysia, Singapore, Thailand, Viet Nam and IATA. A list of participants is at **Appendix A** to this report.

3. Opening of the Meeting

3.1 In his opening remarks Mr Rosly Saad, Head of Air Traffic Control Operations, welcomed all the delegates to the SCM/RNP10. The SCM/RNP10 was convened by the RNP-SEA/TF to implement reduced horizontal separation based on RNP10 operations on ATS routes L642 and M771 as a start due to the significant increase in traffic volume on the two routes. At the last ATM/AIS/SAR/SG/17, IATA requested Singapore to host a special coordination meeting among the relevant States to progress on the implementation of RNP10 operations. As such, Singapore accepted IATA's proposal and hosted this meeting to increase capacity and enhance efficiency in our region.

3.2 Mr Peter Rabot, Chairman of RNP-SEA/TF acted as the moderator for this meeting.

4. Language and Documentation

4.1 All discussions were conducted in English. Documentation was issued in English. A total of 6 Working Papers were considered by the meeting. A list of the Working Papers is at **Appendix B.**

SPECIAL COORDINATION MEETING FOR THE IMPLEMENTATION OF REDUCED HORIZONTAL SEPARATION BASED ON RNP10 OPERATIONS ON ATS ROUTES L642 AND M771 IN THE SOUTH CHINA SEA AREA (SCM/RNP10)

PART II – SUMMARY OF DISCUSSION ON THE SCM/RNP10

Agenda Item 1: Adoption of Agenda

1.1 The meeting adopted the following agenda for the meeting:

Agenda Item 1:	Adoption of Agenda
Agenda Item 2:	Review RNP-SEA/TF/1 Report including the Terms of Reference
Agenda Item 3:	Discuss the Coordinated Plan for Implementation of RNP10 Operations on ATS Routes L642 and M771
Agenda Item 4:	Review of Task List developed at RNP-SEA/TF 1
Agenda Item 5:	Any Other Business
Agenda Item 6:	Date and Venue for the Next Meeting

Agenda Item 2: Review RNP-SEA/TF/1 Report including the Terms of Reference

2.1 The meeting noted the RNP-SEA/TF/1 report and the Terms of Reference of the Task Force which were as follows:

TERMS OF REFERENCE OF THE RNP-SEA IMPLEMENTATION TF

The objective of the Task Force is to:

Develop strategic, benefits-driven implementation plans in collaboration with stakeholders, to improve en-route airspace efficiency by means of reduced horizontal separation based on RNP operations within the Southeast Asia area, ensuring interregional harmonization.

To meet this objective the Task Force shall:

a) Review the current South China Sea route structure and examine its suitability for application of reduced horizontal separation based on RNP operations.

b) Identify routes where the application of reduced horizontal separation would bring immediate operational efficiency.

c) Determine the reduced horizontal separation required, taking into account the aircraft approval status of the traffic operating on the relevant routes, capacity increase desired, and communication and surveillance capability of ATS providers.

d) Examine the possibility of a phased implementation of reduced horizontal separation based on RNP operations and to detail the phases required and the areas/routes concerned.

e) Develop the necessary strategic plans to implement the agreed horizontal separation taking into account airspace user requirements, the need for interregional harmonization, and ICAO Standard and Recommended Practices.

f) Explore the possibility of further harnessing operational efficiency of the routes through re-reconfiguration and enhanced surveillance.

g) Consider setting up appropriate teams/groups which might but not necessarily, include the entire Task Force, to address and implement specific agreed measures within their airspace; and

h) Cooperate with other Task Forces and groups which are involved with similar work in the adjacent airspace in order to achieve harmonized interregional solutions.

Scope of Initial Work

The Task Force shall adopt a phase-by-phase approach, beginning with the 50 lateral/50 longitudinal separations based on RNP 10 operations on RNAV routes L642 and M771 as Phase 1.

The Task Force reports to the South East Asia ATS Coordination Group (SEACG).

2.2 The meeting noted the decision of the Task Force to implement 50/50NM reduced separation on L642 and M771 for the initial phase before proceeding to other areas.

2.3 This meeting report will be submitted to the RNP-SEA Task Force and SEACG.

Agenda Item 3: Discuss the Coordinated Plan for Implementation of RNP10 Operations on ATS Routes L642 and M771

3.1 At ATM/AIS/SAR/SG/15 (July 2005, Bangkok), Singapore reported the significant increase in traffic volume that had been experienced on ATS routes L642 and M771 in the South China Sea area. In light of the increasing traffic volumes forecasted for Asia and Pacific Region, the route capacity would be reached during the peak periods. The meeting considered it essential to implement reduced horizontal separation to increase airspace capacity in the whole of South China Sea area and, as a start, reduction in the longitudinal separation on ATS routes L642 and M771 from 80 NM to 50 NM based on RNP 10 operations should be considered as these routes had seen the largest increase in traffic volumes.

Year	2002	2003	2004	2005	2006	2007 (Jan to Aug)
Number of Flights	33026	28776	41441	46256	51882	33823

3.2 At APANPIRG/16 (August 2005, Bangkok), the Regional Office confirmed that as a result of resource limitations, it would be unable to assist with the establishment and operation of such a Task Force. In light of this, Singapore generously offered to provide a Chairman for this Task Force and would assist its operation in terms of leadership and meeting arrangements. Singapore undertook to coordinate arrangements to establish the Task Force and would keep the Regional Office apprised of developments.

3.3 IATA agreed with the issues raised by Singapore and thanked them for their leadership in chairing and coordinating Task Force arrangements. IATA considered that the problem was much bigger than just the two routes previously mentioned, involving the majority of the routes in the South China Sea parallel route structure and general implementation of RNP 10, and agreed to work off line with Singapore to draft suitable objectives and terms of reference for the Task Force and an agenda for the first meeting.

3.4 Singapore had hosted the first RNP-SEA Task Force Meeting in March 2006. At that meeting, it was agreed that the implementation of 50/50nm separations based on RNP 10 operations on L642 and M771 would be a good start, but that the Task Force should have the whole region in mind as a long term goal.

3.5 The meeting discussed how the Task Force could be operated. In the regard, ATM/AIS/SAR/SG/15 agreed that affected States should collaborate to form a task force, which would operate with minimal resources from the Regional Office and provide reporting to ICAO via the SEACG. The meeting noted that the participation of all States concerned was vital to the successful implementation of RNP10 operations and agreed that if the Task Force was to operate outside the auspices of ICAO, some States might find it difficult to participate in meetings, thereby rendering the work of the Task Force ineffective.

3.6 The meeting was of the opinion that it would be beneficial if the work of the Task Force is supported by the Regional Office and considered the support of the Regional Office was of utmost importance for the success of the Task Force. Therefore, the meeting urged the Regional Office to provide the level of support commensurate to the scope of the work of the Task Force.

3.7 As informed by the Secretariat, the Second RNP-SEA Task Force would only be scheduled in first half of 2008. Given the increase in number of flights on L642 and M771, any delay in the work of the Task Force would reduce the efficiency on the two routes and caused delays to flights. Hence, at the ATM/AIS/SAR/SG/17 meeting held from 2 to 6 July 2007, IATA highlighted the need to implement 50NM/50NM separation based on RNP10 operations on ATS routes L642 and M771 due to the significant increase in air traffic movements on these two routes. IATA requested Singapore to host a special coordination meeting among the relevant States to progress on the implementation of RNP10 operations.

3.8 States concerned and International Organisations had expressed a willingness to participate at the special coordination meeting. As such, Singapore agreed to host a special coordination meeting to proceed with the implementation of reduced horizontal separation based on RNP10 operations on L642 and M771.

3.9 IATA informed the meeting that the increasing traffic volumes on the parallel routes had caused some saturation during the peak periods. It had resulted in ground delays and/or aircraft operating at less uneconomical flight levels thus increasing operating costs as well as contributing to environmental issues. In IATA's view, the time had come to implement the reduction in longitudinal separation from 80NM to 50NM to enhance the route capacity.

3.10 IATA also extended its appreciation for the efforts of the meeting to achieve a reduced longitudinal separation for the two busiest routes namely, L642 and M771 in the immediate term. It also urged the meeting to take a longer term view to address the issue on increasing the capacity and enhance the efficiency in the remaining pairs of parallel routes by applying a 50/50NM horizontal separation as well as a reduction in the route lengths through minor route re-alignment.

3.11 The meeting noted IATA's concerns and agreed that the RNP-SEA Task Force should also identify other areas whereby the application of reduced 50/50NM horizontal separation could bring about increase in capacity and enhancement of efficiency.

Future Direction and Arrangements

3.12 The meeting reviewed the position of affected States in relation to the implementation of RNP10 50/50NM reduced horizontal separation on L642 and M771, as follows:

China

3.13 China reported that they were ready and supported the implementation of 50/50NM reduced horizontal separation. However, a safety assessment should be conducted before the implementation of reduced separation.

Malaysia

3.14 Malaysia informed the meeting that they supported the implementation of 50/50NM reduced horizontal separation.

Singapore

3.15 Singapore informed the meeting that they were ready and supported the implementation of reduced horizontal separation based on RNP 10 operations.

Thailand

3.16 Thailand reported that they supported the implementation of reduced horizontal separation and highlighted that the safety assessment was important for the implementation of reduced separation to be carried.

Viet Nam

3.17 Viet Nam reported that they were ready and supported the implementation of 50/50NM reduced horizontal separation.

IATA

3.18 IATA noted that all States present at the meeting were ready for the implementation of 50/50NM reduced horizontal separation on L642 and M771. IATA also agreed that the safety assessment was an important process for the implementation to take place. However in view of the need for 50/50NM horizontal separation to be implemented in the South China Sea area in the near future and if it does not delay the implementation of reduced horizontal separation on L642 and M771, the safety assessment should also encompass the other four parallel RNP10 routes.

3.19 The meeting noted the absence of Hong Kong, China who was also one of the affected States for the implementation of 50/50NM reduced horizontal separation on L642 and M771. The meeting was informed that Hong Kong, China had advised Singapore that they were unable to attend this meeting due to work commitments and had requested that they be kept informed of the outcome of this meeting.

3.20 The meeting agreed that the report would be forwarded to Hong Kong, China for their comments on their readiness to implement RNP10 50/50NM reduced horizontal separation on L642 and M771 in the near future.

Safety Assessment

3.21 At RASMAG/7 in June 2007, MAAR had presented the safety assessment of 60NM Lateral Separation Minimum for the South China Sea parallel route structure which was a follow-up to APANPIRG Conclusion 17/6 urging concerned States to complete the safety assessment by 30 June 2007.

3.22 Although the safety assessment was inconclusive and upon reviewing the results of the safety assessment, RASMAG/7 agreed that the situation was stable and that there was no evidence to justify any concern. However, due to the need of more traffic data to achieve the conclusive results, RASMAG agreed that the safety assessment should be repeated within about 18 months to formally demonstrate that the TLS was being met, and then again periodically or when a significant change was likely to impact the traffic volume and/or disposition.

3.23 At ATM/AIS/SAR/SG/17 in July 2007, Singapore expressed its appreciation to MAAR for their contribution in conducting the safety assessment of the South China Sea parallel routes in accordance with APANPIRG Conclusion 17/6. MAAR was also requested to conduct the next safety assessment for the parallel route structure in the South China Sea based on 50/50NM horizontal separation. This would assist in the implementation of RNP10 operations based on 50/50NM separation in the near future.

3.24 At the ATM/AIS/SAR/SG/17, the ICAO Secretariat also noted that the implementation of 50NM lateral and longitudinal separation was imperative in the short term to manage the increasing traffic levels in this area and that implementation of 30NM/30NM separation should be considered as the medium term goal.

3.25 IATA requested the meeting to consider the safety assessment for all the six parallel routes instead of only two routes and also for MAAR to provided advice on the way forward, time required and also the data required to complete the safety assessment.

3.26 Thailand had previously conducted the safety assessment based on the 60NM lateral separation for the South China Sea parallel route structure as requested by RASMAG. In this regard, Thailand informed the meeting that the data required for reduced lateral separation were the traffic sample data that was collected every December of each year and the gross navigation error reports. Thailand suggested that FAA/PARMO or Airservices Australia had the expertise and experience in conducting the horizontal safety assessment and the insight to the time frame and any additional requirements could be sought from them in order for the longitudinal safety assessment to be completed.

3.27 Singapore informed the meeting that they would engage a safety assessment expert to assist in the completion of the safety assessment so that the implementation of RNP10 50/50NM horizontal separation would not be delayed.

3.28 The meeting requested MAAR to provide any previously collected data that could be critical for the safety assessment. MAAR agreed to assist in order for the safety assessment to be completed without delay.

3.29 The meeting also agreed to provide data that would be required to complete the safety assessment for the reduced horizontal separation as identified by the safety assessment expert.

3.30 IATA extended its appreciation to States for their readiness to progress the implementation of 50/50NM horizontal separation in the near future as it would increase capacity and enhance efficiency and also Singapore's willingness to undertake the task of coordinating for the completion of the safety assessment by a safety assessment expert so that the implementation would not be delayed.

Agenda Item 4: Review of Task List developed at RNP-SEA/TF 1

4.1 The meeting reviewed the Task List that was developed at the RNP-SEA TF/1. The meeting agreed that not all the items captured in the Task List were applicable to the implementation of 50/50NM horizontal separation on L642 and M771 as RNP10 requirements for aircraft operating on the six parallel routes had been established since the implementation of the Revised South China Sea Route Structure.

4.2 The meeting identified the key items and adopted the revised Task List as shown in **Appendix C** for the implementation of 50/50NM horizontal separation on L642 and M771.

Agenda Item 5: Any Other Business

5.1 The meeting discussed the need to amend the ICAO DOC 7030 to include the application of 50/50NM horizontal separation in Ho Chi Minh, Hong Kong, Kuala Lumpur, Sanya and Singapore FIRs.

5.2 The meeting agreed on the Amendment Proposal for ICAO DOC 7030 as shown in **Appendix D,** which would be forwarded to Hong Kong, China for their comments before forwarding it to ICAO Regional Office for their comments and circulation.

Agenda Item 6: Date and Venue for the Next Meeting

6.1 The meeting acknowledged that the safety assessment would be important to the implementation of 50/50NM horizontal separation and Singapore to update the States concerned on the progress of the safety assessment as well as any follow-up actions related to the implementation. If the safety assessment could be completed by the next RNP-SEA TF meeting which has been tentatively scheduled in March 2008, Singapore would present the safety assessment at the Task Force meeting. However, if the safety assessment could be completed earlier, Singapore would consider hosting another special coordination meeting for States and stakeholders concerned to finalise the implementation date and plan for the 50/50NM horizontal separation implementation on L642 and M771.

Closing Remarks

6.2 Mr Peter Rabot expressed his sincere appreciation to the participants at this meeting for their valuable inputs, cooperation and discussion on issues in an open and candid manner. The active participation would definitely hasten the process to implement reduced horizontal separation on L642 and M771.

6.3 Mr Peter Rabot hoped that the meeting arrangements and facilities provided for this meeting were to the satisfaction of every delegate and wished all delegates a safe homeward journey.

LIST OF PARTICIPANTS

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
CHINA (3)		
Mrs. Zhang Ying	Engineer of Airspace Management Division Air Traffic Management Bureau, CAAC No.12 East San-huan Road Middle Chaoyang District, Beijing 100022 China	Tel: +86-010-8778 6837 Fax: +86-010-8778 6830 E-mail: zhangying@atmb.net.cn
Mr. Chen Wenyi	Engineer of Air Traffic Control Division Middle South Regional ATMB, CAAC New Baiyun International Airport Guangzhou, Guangdong Province China	Tel: +86-020-8613 0736 Fax: +86-020-3622 9685 E-mail: atcguy@163.com
Mr. Yu Peng	Chief of Sanya Area Control Centre Sanya Area Control Centre, CAAC Meilan International Airport Haikou, Hainan Province China	Tel: +86-0898-6575 2698 Fax: +86-0898-6575 2698 E-mail: ccatcyp@263.net
MALAYSIA (2)		
Mr. Balasubramaniam A/L Muttaya	Director of KL ATCC Air Traffic Control Centre Department of Civil Aviation Sultan Abdul Aziz Shah Airport 47200 Subang Malaysia	Tel: 603-78465233 ext 200 Fax: 603-76456590 E-mail: balaatc@gmail.com
Mr. Lim Chee Tat	Air Traffic Controller Department of Civil Aviation Senai Airport Johor Bahru Malaysia	Tel: 607-5994789 Fax: E-mail:
SINGAPORE (9)		
Mr. Kuah Kong Beng	Chief Air Traffic Control Officer Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2405 Fax: 65 6545 6516 E-mail: kuah_kong_beng@caas.gov.sg
Mr. Rosly Bin Md Saad	Head (Air Traffic Control Operations) Singapore Air Traffic Control Centre 60 Biggin Hill Road Singapore 509950	Tel: 65 6541 2685 Fax: 65 6545 6252 E-mail: rosly_saad@caas.gov.sg
Mr. Sebastian Lim Kim Chuan	Chief Singapore Air Traffic Control Centre Singapore Air Traffic Control Centre 60 Biggin Hill Road Singapore 509950	Tel: 65 6541 2430 Fax: 65 6545 6252 E-mail: sebastian_lim@caas.gov.sg

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
Mr. Peter Edward Rabot	Head Air Traffic Services Singapore Aviation Academy 1 Aviation Drive Singapore 499867	Tel: 65 6540 6247 Fax: 65 6542 9890 E-mail: peter_rabot@caas.gov.sg
Mr. Heng Cher Sian Edmund	Project Officer (Air Traffic Management) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2457 Fax: 65 6545 6516 E-mail: edmund_heng@caas.gov.sg
Mr. Tan Yean Guan	Project Officer (Airspace) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2709 Fax: 65 6545 6516 E-mail: tan_yean_guan@caas.gov.sg
Mr. Loke Chee Yong Jeffrey	Project Officer (Air Traffic Management) Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2463 Fax: 65 6545 6516 E-mail: loke_chee_yong@caas.gov.sg
Mr. Kathirvelu s/o Krishnan	Air Traffic Control Officer Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2668 Fax: 65 6545 6516 E-mail: kathirvelu_krishnan@caas.gov.sg
Mr. Lim Kheng Leong Harrison	Air Traffic Control Officer Air Traffic Services Division Civil Aviation Authority of Singapore PO Box 1 Singapore Changi Airport Singapore 918141	Tel: 65 6541 2668 Fax: 65 6545 6516 E-mail: harrison_lim@caas.gov.sg
THAILAND (2)		
Dr. Paisit Herabat	Engineering Manager ATS Planning Department Aeronautical Radio of Thailand Ltd. 102 Ngarmduplee, Tungmahamek Sathorn, Bangkok 10120 Thailand	Tel: 66-2-285 9191 Fax: 66-2-285 9406 E-mail: paisit@aerothai.co.th
Mr. Watee Arthakamol	Air Traffic Control Manager Aeronautical Radio of Thailand Ltd. 102 Ngarmduplee, Tungmahamek Sathorn, Bangkok 10120 Thailand	Tel: 66-2-285 9532 Fax: 66-2-285 9406 E-mail: watee.ar@aerothai.co.th

STATE/NAME	DESIGNATION/ADDRESS	CONTACT DETAILS
VIETNAM (2)		
Mr.Phan Tat Thanh	Chief, Ho Chi Minh ACC Southern Region ATS Vietnam Air Traffic Management CAAV	Tel: 84-9-03817361 Fax: 84-4-8443774 E-mail: phanthanhats@hcm.vnn.vn
Mr. Ngo The Vinh	Officer of ATS-AIS Division Vietnam Air Traffic Management No 6 Lane 200 Nguyen Son Street Long Bien District - Hanoi CAAV	Tel: 84-9-12440319 Fax: 84-4-8725281 E-mail: ngothevinh71@vnn.vn
IATA (5)		
Mr. Soon Boon Hai	Assistant Director – Safety, Operations & Infrastructure – Asia/Pacific International Air Transport Association 77 Robinson Road #05-00 SIA Building Singapore 068896	Tel: +65-62397267 Fax: +65-65366267 E-mail: soonbh@iata.org
Mr. Owen Dell	Manager International Operations Cathay Pacific Airways Limited International Affairs Department 9/F Central Tower, Cathay Pacific City 8 Scenic Road Hong Kong International Airport Lantau, Hong Kong, China	Tel : +852 2747 8829 Fax : +852 2141 8829 E-mail: owen_dell@cathaypacific.com
Capt. Aric Oh	Deputy Chief Pilot (Technical) Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-6540 3694 Fax : +65-6490 0601 E-mail: aric_oh@singaporeair.com.sg
Capt. R. Saravanan	Management Pilot (Special Duties) – Technical Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-6548 1677 Fax : +65-6490 0601 E-mail: r_saravanan@singaporeair.com.sg
Mr. Tan Cheng Yeow	Flight Operations Technical Executive Singapore Airlines Limited Flight Operations Technical SIA Training Centre, SIN-STC-04C 720 Upper Changi Road East Singapore 486852	Tel : +65-65402913 Fax : +65-6490 0601 E-mail: chengyeow_tan@singaporeair.co m.sg

LIST OF WORKING PAPERS (WPs)

WORKING PAPERS

NUMBER	AGENDA	TITLE	PRESENTED BY
WP/1	1	Provisional Agenda	Singapore
WP/2	2	RNP-SEA/TF/1 Report Including The Terms Of Reference	Singapore
WP/3	3	Need For RNP10 Operations On L642 And M771	Singapore
WP/4	3	Need For RNP10 (50/50NM) Safety Assessment To Be Conducted For The Parallel Routes In The South China Sea	Singapore
WP/5	4	Task List Developed At RNP-SEA/TF/1	Singapore
WP/6	3	RNP10 Longitudinal Separation For L642 And M771	IATA

Appendix C

SN	Activity	Start	Complete	Present Status	Group Responsible
1	**Identify Operational Need**				
2	Agree that an operational needs for a 50 NM longitudinal separation in South China Sea area	13-Mar-06	13-Mar-06	Completed	RNP-SEA TF
3	For the near term, the implementation of 50NM longitudinal separation on L642 and M771	25-Sep-07	25-Sep-07	Subject to Hong Kong, China comments	SCM
4	**Safety Assessment**				
5	Engage a qualified Horizontal Safety Assessment Expert	25-Sep-07	Dec-07	On-going	SINGAPORE
6	States to continue to collect and provide traffic data	25-Sep-07		On-going	STATES
7	States to provide additional data as required by the Horizontal Safety Assessment Expert	25-Sep-07		On-going	STATES
8	Examine history of navigational errors and assess possible impact on safety	Jan-08			RNP-SEA TF
9	Confirm collision risk model assumptions/parameters are consistent with airspace where the 50 NM longitudinal separation is to be applied	Jan-08			RNP-SEA TF
10	Conduct simulations to predict occupancy after the 50 NM longitudinal separation implementation	Jan-08			SINGAPORE
11	Collect weather and turbulence data for analysis	Jan-08			STATES

SN	Activity	Start	Complete	Present Status	Group Responsible
12	Report monthly navigational errors (including operational errors) to Monitoring Authority (Singapore)	13-Mar-06		On-going	STATES
13	Collect additional data if required by the Safety Assessment Expert for the safety assessment for the 50 NM longitudinal separation implementation	Jan-08			STATES
14	**Feasibility Analysis**				
15	Examine the operational factors and workload associated with the 50 NM longitudinal separation implementation in South China Sea	13-Mar-06		On-going	STATES
16	Complete feasibility analysis on the 50NM longitudinal separation implementation on L642 and M771	13-Mar-06	25-Sep-07	Completed	NA
17	**Determination of Requirements (airborne & ground systems)**				
18	States assess the impact of the 50 NM longitudinal separation implementation on controller automation systems and plan for upgrades/modifications	13-Mar-06	25-Sep-07	Completed	NA
19	**Aircraft & Operator Approval Requirements**				
20	Promulgate the operational approval process of RNP 10	13-Mar-06	13-Mar-06	Completed	NA

SN	Activity	Start	Complete	Present Status	Group Responsible
21	**Perform Rulemaking (if required)**				
22	Recommend State airspace regulatory documentation	13-Mar-06	13-Mar-06	Completed	NA
23	**Perform Necessary Industry & International Co-ordination**				
24	Establish target implementation date on the 50NM longitudinal separation on L642 and M771	25-Sep-07	25-Sep-07	Completed (Target Date of Implementation is 3 July 2008)	SCM
25	Report to RNP-SEA TF and SEACG			On-going	SINGAPORE
26	Prepare draft amendment proposal to amend Doc 7030	25-Sep-07	26-Sep-07	Completed	SCM
27	Submit draft amendment proposal to amend Doc 7030 to ICAO	26-Sep-07		On-going	SINGAPORE
28	Assess need to publish AIP Amendment containing the 50 NM longitudinal separation policy/procedures	26-Sep-07		On-going	SINGAPORE
29	Assess need for Trigger NOTAM	13-Mar-06	Jun-08	On-going	RNP-SEA TF
30	Review inter-facility coordination procedures	26-Sep-07		On-going	STATES
31	Finalize changes to Letters of Agreement	26-Sep-07	Jun-08	On-going	STATES

SN	Activity	Start	Complete	Present Status	Group Responsible
32	**Approval of Aircraft & Operators**				
33	Establish approved operations readiness targets	13-Mar-06	13-Mar-06	Completed	NA
34	Assess operator readiness	13-Mar-06	13-Mar-06	Completed	NA
35	**Develop ATC Procedures**				
36	Develop procedures for handling non-compliant aircraft in ATS documentation	13-Mar-06	13-Mar-06	Completed	NA
37	**ATC Training**				
38	Complete training on the application of 50 NM longitudinal separation training for air traffic controllers	13-Mar-06	Jun-08	On-going	STATES
39	**Complete Safety Assessment**				
40	Review and accept safety assessment	13-Mar-06	Jun-08	On-going	RNP-SEA TF
41	**Final Implementation Decision**				
42	Go/No Go Decision		Jun-08		RNP-SEA TF/ SCM
43	**Post Implementation Review**		Oct-08		RNP-SEA TF

Proposal for Amendment of
Regional Supplementary Procedures – Doc 7030/4
(Serial No. APAC-XXXXXX - MID/ASIA RAC/X)

a) **Regional Supplementary Procedures:** MID/ASIA

b) **Proposing State(s):** China, Malaysia, Singapore and Viet Nam

c) **Proposed Amendment:** Editorial note: Amendments are arranged to show deleted text using strikeout (~~text to be deleted~~), and added text with grey shading (text to be inserted).

On page MID/ASIA/RAC-9 dated 28/1/05

Add "Ho Chi Minh", "Hong Kong", "Kuala Lumpur", "Sanya" and "Singapore" to Paragraph 7.1.5.

7.1.5 For flights on designated controlled oceanic routes
or areas within the Auckland Oceanic, Brisbane, Honiara, Ho Chi Minh, Hong Kong, Kuala Lumpur, Melbourne, Naha, Nauru, New Zealand, Port Moresby, Sanya, Singapore and Tokyo FIRs, a lateral separation minimum of 93 km (50 NM) may be applied provided that the aircraft and the operator have been approved by the State of Registry or the State of the Operator, as appropriate, to meet the following requirements (or equivalent):

On page MID/ASIA/RAC-11 dated 2/6/06

Add "Ho Chi Minh", "Hong Kong", "Kuala Lumpur", "Sanya" and "Singapore" to Paragraph 7.2.2.1.

7.2.2.1 For flights on designated controlled oceanic routes or areas within the Auckland Oceanic, Brisbane, Honiara, Ho Chi Minh, Hong Kong, Kuala Lumpur, Melbourne, Naha, Nauru, New Zealand, Port Moresby, Sanya, Singapore and Tokyo FIRs, a longitudinal separation minimum of 93 km (50 NM) derived by RNAV may be applied between RNAV-equipped aircraft approved to RNP 10 or better, in accordance with the provisions of
PANS-ATM, 5.4.2.6.

d) **Proposer's Reason For Amendment:**	RNP 10 (50/50) operations will be implemented on RNAV routes L642 and M771 in the Ho Chi Minh, Hong Kong, Kuala Lumpur, Sanya and Singapore FIRs on 3 July 2008 to increase capacity and enhance efficiency.
e) **Proposed Implementation Date of the Amendment:**	3 July 2008
f) **Proposed Circulated to the Following States and international organisations:**	*...states in MID/AISA...* IATA IFALPA IFATCA
g) **Secretariat comments:**	

OPERATIONAL LETTER OF AGREEMENT
BETWEEN

General Administration of Civil Aviation of China	China
Civil Aviation Department	Hong Kong, China
Directorate General of Civil Aviation	Indonesia
Department of Civil Aviation	Malaysia
Air Transportation Office	Philippines
Civil Aviation Authority	Singapore
Aeronautical Radio of Thailand Ltd	Thailand
Civil Aviation Administration	Viet Nam

FOR

MONITORING OF AIRCRAFT NAVIGATION ERRORS

IN THE

SOUTH CHINA SEA ***AREA***

Operational Letter of Agreement

Document Management

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Checklist of Effective Pages

Subject	Pages	Issue Date
Letter of Agreement	1 – 10	DD MMM YYYY
Appendix A-Navigation Error Report	A1 – 6	DD MMM YYYY

Operational Letter of Agreement

Overview

Introduction

The following document is a Letter of Agreement (LOA) between those Air Traffic Service (ATS) authorities shown on page one of this document. The letter of agreement details monitoring procedures between the following ATS units:

Bangkok ACC	Hanoi ACC
Ho Chi Minh ACC	Hong Kong ACC
Jakarta ACC	Kota Kinabalu ACC
Kuala Lumpur ACC	Manila ACC
Sanya ACC	Singapore ACC

Objective

The objective of this LOA is to define agreed procedures for the monitoring, notification, investigation, analysis and reporting of aircraft navigation errors in respect of aircraft to which ~~60NM lateral separation standard and a 10 minute or 80NM RNAV longitudinal~~ *reduced horizontal separation minima* is applied when operating on the following designated RNAV routes:

L642	M771	N892
L625	M767	N884

Scope

The procedures contained in this LOA implement the performance monitoring requirements associated with the introduction of the ~~60NM lateral~~ *reduced horizontal* separation standard, and for the reporting and monitoring of gross lateral and longitudinal navigational errors.

For the purposes of this LOA, the term ‘Service Providers’ refers to organisations which are responsible for the provision of Air Traffic Control (ATC) services.

The term ‘Regulatory Authority’ refers to those organizations responsible for the investigation of navigational errors. In some cases, the Regulatory Authority may be the same as the Service Provider.

Effective Date

This letter of agreement becomes effective on *DD MMMM YYYY.*

Operational Letter of Agreement

Overview, continued

Background

The use of these ~~lateral and longitudinal~~ *horizontal* separation standards is restricted to aircraft which meet the requirements detailed in the respective States' AIP Supplements. This includes a requirement for Required ~~Navigation Performance (RNP) 10~~ *RNP 10 / RNP 4 Performance Based Navigation (PBN)* approval and it is the responsibility of the operator to ensure that such requirements are satisfied when so declared.

~~RNP 10~~ *PBN* approval includes operators meeting certain requirements with regard to crew training and in-flight operating procedures. The responsibility for approval for such operations rests with the State of Registry of the Operator.

Monitoring navigation errors is a joint responsibility between the aircraft operators, the States of Registry, and the ATC providers. There are established requirements for the operators to monitor navigation performance under the terms of their ~~RNP~~ *PBN* Approval. This document sets out the responsibilities and procedures to be followed by staff of the signatory organizations to this LOA.

Area of Applicability

The procedures outlined in this LOA shall be applied to all aircraft operating on the following designated RNAV routes:

L642	M771	N892
L625	M767	N884

Operational Letter of Agreement

Monitoring Procedures

Lateral Deviations

Monitoring shall be based on radar observations.

When the radar controller observes a lateral deviation of 15NM or more, the controller shall:

- Immediately advise the pilot in command; and
- Provide the 'Duty Supervisor' with the necessary information to enable Part 1 of the Navigation Error Investigation Form (as shown in **Appendix A**) to be completed.

Where an aircraft is off-track as the result of ATC approved diversion (e.g. due weather), no notification under the terms of this Letter of Agreement need be submitted.

Longitudinal Deviations

Monitoring of longitudinal errors shall be accomplished by reporting occurrences where the observed longitudinal separation, following a check, is either less or more than the expected longitudinal separation as detailed below.

Where a time standard is being used, this check will follow the receipt of a routine position report. Notification, in accordance with **Appendix A**, shall be submitted in all cases where:

- The separation standard is infringed; or
- The expected time between two aircraft varies by 3 minutes or more, even if the applicable separation standard is not infringed; or
- A pilot estimate varies by 3 minutes or more from that advised in a routine position report.

Where a distance standard is being used, the check may be based on ADS, radar observations, or it may be the result of a specific request for RNAV distance reports. Notification, in accordance with **Appendix A**, shall be submitted in all cases where:

- The separation standard is infringed; or

- The expected distance between two aircraft varies by 10NM or more, even if the applicable separation standard is not infringed.

Operational Letter of Agreement

Notification Procedures

Action by ATC Unit

The duty supervisor, when advised of the deviation, shall be responsible for completion and submission of a Navigation Error Investigation Form.

A copy of the aircraft's flight plan shall be attached to the Navigation Error Investigation Form, and forwarded to the Chief of ATC.

The Chief of ATC shall forward copies of the Navigation Error Investigation Form (Parts 1 to 4) to the aircraft operator and the State of Registry of the aircraft or the State of the Operator, as considered appropriate.

In addition, the copy for the aircraft operator shall be sent with a covering letter (as provided in **Appendix A**) requiring the operator to complete the Navigation Error Investigation Form and to provide reasons for the error.

Operational Letter of Agreement

Investigation Procedures

Investigation Procedures

The investigation of errors notifiable under this Letter of Agreement is a joint responsibility of the operator, the ~~ATC~~ *Regulatory* Authority of the airspace in which the error occurred, and the State of Registry or State of the Operator of the aircraft involved.

The initial investigation shall be undertaken by the aircraft operator, who is responsible for supplying all data and comments needed to complete the form at **Appendix A**. The completed reports are to be returned by the operator to the originating ~~ATC~~ *Regulatory* Authority. For aircraft registered in States not included in this LOA, these reports are also to be forwarded to the State of Registry of the aircraft or the State of the operator.

Further action by States other than signatories to this LOA is outside the scope of this agreement, and shall be at the discretion of that State.

On receipt of the completed report from the aircraft operator, the relevant ~~ATC~~ *Regulatory* Authority will first check that all information required has been supplied and, if necessary, the ~~ATC~~ *Regulatory* Authority shall request and further information from either the operator, the State of the Operator, or the State of Registry of the aircraft.

If the completed form from the aircraft operator is not received within 14 days of the date of dispatch, the ~~ATC~~ *Regulatory* Authority will contact the operator and request the completed form.

Once the completed information has been received, the ~~ATC~~ *Regulatory* will complete Part 5 of the Navigation Error Investigation Form as detailed in **Appendix A**. The cause of the error is to be classified in accordance with the criteria specified in Part 5.

The decision as to whether any further investigation is warranted will be taken by the ~~ATC~~ *Regulatory* Authority based on their assessment of the seriousness of the error.

Operational Letter of Agreement

Analysis of Errors & Reporting

At the end of each month, Service Providers shall forward to the Operations Division, Civil Aviation Authority of Singapore (CAAS), a copy of all completed Navigation Error Investigation Forms (Parts 1 to 5) covering reported errors or nil reports for that month, together with data on the number of movements on the routes being monitored as recorded by the relevant Flight Data Processing System, or other auditable means.

CAAS shall be responsible for calculation of the frequency of the errors, in accordance with Doc 7030.

Each six months, the Monitoring Authority should prepare an assessment schedule setting out the results of the monitoring for the preceding six-month period and forward a copy of this schedule to:

a. All signatory States to the Monitoring Letter of Agreement; and

b. The Chairman of the APANPIRG ATS/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

Permitted Error Rate Exceeded

Where the summary statistics show a long term trend which could result in the Permitted Error Rate being exceeded, ATC Authorities of the States concerned, in conjunction with the ICAO Regional Office, will jointly consider the causes, to determine if the problems can be eliminated, and to take appropriate remedial action.

Revision

This LOA shall remain in force until it is cancelled or superseded.

For any reason, which might make it advisable to change this agreement and its associated attachments, the interested State shall propose the pertinent revision.

Operational Letter of Agreement

Authority

China	Name Designation Department
Hong Kong, China	Name Designation Department
Indonesia	Name Designation Department
Malaysia	Name Designation Department

Continued on next page

Operational Letter of Agreement

Authority, Continued

Philippines	Name Designation Department
Singapore	Name Designation Department
Thailand	Name Designation Department
Viet Nam	Name Designation Department

Operational Letter of Agreement

Appendix A

NAVIGATION ERROR REPORT

Dear

Air Traffic Control service providers are monitoring traffic on routes in the South China Sea Area, as part of the implementation of reduced separation minima on those routes.

These procedures require the reporting and investigation of:

i) Lateral tracking errors of 15NM or more;

ii) Variations of longitudinal separation of three minutes or more; or

iii) Variations of longitudinal separation of 10NM or more.

A Navigation Error Investigation Form relating to one of your aircraft is enclosed.

An investigation of this occurrence is required. A detailed explanation should be provided within 10 days, using the attached Navigation Error Investigation Form. In your reply, you are also requested to indicate any corrective action taken to prevent future occurrences.

Yours faithfully,

NAVIGATION ERROR NVESTIGATION FORM

Instructions for Service Provider responsible officer: Please ensure that Part 1 of this form has been completed to the maximum extent possible, and distribute according to the requirements of the Letter of Agreement on monitoring of aircraft navigation errors in the South China Sea *Area* ~~airspace~~.
Instructions for aircraft owner/operator: Please supply any details required in Part 1 of this form which have not already been completed, together with the information requested in Parts 2, 3 and 4 (if applicable), and return to: [*Appropriate Regulatory Authority*]
Instructions for Investigating Agency (Regulatory Authority): Please complete Part 5 of this form and return to: [*Appropriate Service Provider*]

NAVIGATION ERROR INVESTIGATION FORM

PART 1 - To be completed by responsible officer in the Service Provider (and aircraft owner/operator if need)		
ATC Unit Observing Error:		
Date/Time (UTC):		
Type of Error: (tick one) ☐ LATERAL ☐ LONGITUDINAL		
Details of Aircraft		
	First Aircraft	**Second Aircraft (when longitudinal deviation observed)**
Aircraft Identification:		
Name of owner/Operator:		
Aircraft Type:		
Departure Point:		
Destination:		
Route Segment:		
Cleared Track:		
Position where error was observed: (BRG/DIST from fixed point or LAT/LONG)		
Extent of deviation – magnitude and direction: (NM for lateral, min/NM for longitudinal)		
Flight Level:		
For All Errors		
Action taken by ATC:		
Other Comments:		

**** (Please Attach ATS Flight Plan)**

NAVIGATION ERROR INVESTIGATION FORM

PART 2 - Details of Aircraft, and Navigation and Communications Equipment Fit (To be completed by aircraft owner/operator)			
LRNS	**Number of Systems (0, 1, 2 etc.)**	**Make**	**Model**
INS			
IRS			
GNSS			
FMS			
Others (please Specify)			
COMS			
HF			
VHF			
SATCOM			
CPDLC			
Which navigation system was coupled to the autopilot at the time of observation of the error?			
Which NAV MODE was selected at the time of observation of the error?			
Which comms system was in use at the time of observation of the error?			
Aircraft registration and model/series			
Was the aircraft operating according to ~~RNP~~ *PBN* requirements?	☐Yes ☐ No		

NAVIGATION ERROR INVESTIGATION FORM

PART 3 – Detailed description of incident **(To be completed by owner/operator – use separate sheet if required)**
Please give your assessment of the actual track flown by the aircraft, and the cause of the deviation:
Corrective action proposed:

PART 4 – To be completed by owner/operator, only in the event of partial or total navigation equipment failure.			
Nav System Type	**INS**	**IRS/FMS**	**Others (Please specify)**
Indicate the number of units of each type which failed			
Indicate position at which failure(s) occurred			
Give an estimate of the duration of the equipment failure(s)			
At what time were ATC advised of the failure(s)?			

NAVIGATION ERROR INVESTIGATION FORM

PART 5 – To be completed by investigating agency		
Have all required data been supplied?	□ Yes	□ No
Is further investigation warranted?	□ Yes	□ No
Will this incident be the subject of a separate report?	□ Yes	□ No
General comments:		
Classification: (please circle) A B C D E F G H I		

CLASSIFICATION OF GROSS NAVIGATION ERRORS	
Class	**Cause**
A	Aircraft not approved to ~~RNP~~ *PBN requirements*
B	ATC system loop error
C	Waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position
D	Other navigation errors, including equipment failure notified to ATC in time for action
E	Other navigation errors, including equipment failure notified to ATC too late for action
F	Other navigation errors, including equipment failure of which notification was not received by ATC
G	Mode select error
H	Weather deviation (other than approved)
I	Other (please specify):

Procedures for the Assessment of Aircraft Navigation Errors In Support of the Implementation of *Reduced Horizontal Separation Minima* ~~A Revised ATS Route Structure (60NM Route Spacing)~~ In the South China Sea Area

1. Introduction

1.1 This document provides guidance on the methodology to be adopted in the assessment of navigation errors associated with the implementation of *reduced horizontal separation minima* ~~a revised route structure, and a revised lateral separation minimum of 60NM~~, in the South China Sea *Area*.

1.2 This document should be read in conjunction with the Letter of Agreement between States of the South China Sea Area, entitled "*Letter of Agreement for the Monitoring of Aircraft Navigation Errors in the South China Sea Area*".

2. Data Gathering Responsibility

2.1 The States responsible for the gathering and onwards forwarding of data relating to the monitoring letter of agreement, and the monitoring areas identified in paragraph 4, shall be Hong Kong China, the Philippines, and Singapore.

2.2 Data gathering requirements are detailed in paragraph 5.

3. Monitoring Authority

3.1 ~~Until such time as a permanent monitoring authority is established by APANPIRG, the organization responsible for the collection and reporting of navigation error data will be the~~ Civil Aviation Authority of Singapore (CAAS) *shall be responsible for the collection and reporting of navigation error*.

4. Designated Monitoring Areas

4.1 In order to validate the monitoring requirements supporting the reduction in *horizontal separation minima* ~~lateral separation to 60NM~~, it is necessary to assess the track keeping ability of aircraft operating on the route structure, whilst they have been using on-board RNAV navigation systems only, for a maximum period of time, relative to the route being flown.

4.2 It is also essential that observation of the navigation of the aircraft, using radar, occurs before the on-board navigation systems have been able to "up-date" using ground-based navigation aids, such as DME/DME, or VOR/VOR.

4.3 In assessing navigation errors on the 6 core routes – ie L642, M771, N892, L625, N884 and M767 – there are only four appropriate areas at which the required monitoring may be undertaken, given the extensive ground-based navigation aid coverage in the South China Sea *Area*.

4.4 These areas are the route segments between:

a) DULOP and DUMOL on M771
b) AKOTA and AVMUP on L625
c) LULBU and LEGED on N884
d) MELAS and MABLI on N892
e) ESPOB and ENREP on L642
f) TEGID and BOBOB on M767

4.5 Monitoring of aircraft on these route segments should be undertaken as soon as possible after the aircraft enters radar coverage.

4.6 It should be noted that navigation error reports relating to areas other than those stated above, should also be processed and reported on, in order to support data gathering for future reductions in lateral and longitudinal separation. Details on the processing of these reports are given at paragraph 7.

5. Collection and Forwarding of Data

5.1 Those States identified in Paragraph 2, are required, at the end of each month, to collect the following data:

a) Recorded navigation errors at the required monitoring areas, by way of the "Navigation Error Investigation Form", as detailed in the Letter of Agreement on the Monitoring of Navigation Errors; and

b) Total monthly movement statistics relating to air traffic passing the designated monitoring areas within the designated monitoring height band.

Note: The recording of monthly traffic movement statistics in the monitoring areas should be auditable – in other words, some formal method of recording the movements – eg copies of flight progress strips or data from Flight Data Processing Systems – should be available for audit if required.

5.2 After collection, the required data should be forwarded to the Monitoring Authority (CAAS), for assessment, to arrive not later than 15 days from the end of the month within which the data was collected. This will allow time for the Navigation Error Investigation Forms relating to occurrences near the end of a month, to be processed and returned as detailed in that form.

5.3 In respect of paragraph 5.1.a), if there have been no error reports submitted, a "Nil Return" should be submitted to the Monitoring Authority.

6. Assessing of Navigation Errors

6.1 The monitoring requirements associated with the introduction of the reduced *horizontal separation minima* ~~lateral separation minima of 60NM~~ will be in accordance with the requirements for *RNP10 / RNP4 PBN* ~~RNP 10 navigation performance~~, i.e. aircraft navigation performance shall be such that the standard deviation of lateral track errors *shall be in accordance with the PBN requirement.* ~~shall be less than 8.7km (4.7NM)~~.

6.2 The requirements will be met, if the number of navigation errors by approved flights, measured in the monitoring area, divided by the total number of approved flights over those monitoring points, is less than the required parameters, over a period of time for *the PBN requirement*. ~~RNP 10 navigation performance~~. (See Appendix B).

6.3 The assessments for each month should be recorded separately, and also cumulatively, on a month-to month basis. If the assessment in any particular month exceeds the required parameter, a check should be made to ensure that the cumulative assessment does not also exceed the required parameter.

6.4 If a trend is identified, which indicates that the required parameter is being exceeded regularly, or the cumulative assessment indicates a upwards trend, the Monitoring Authority should notify, though the ICAO Bangkok Office, the APANPIRG ATS/AIS/SAR Sub-Group, which should then investigate the need for a review of the applicable procedures.

6.5 An example of an assessment schedule is shown at Appendix B.

7. Processing of Navigation Error Reports Relating to Areas Other Than Required Monitoring Areas

7.1 The Letter of Agreement on the Monitoring of Navigation Errors required all participating States to notify all appropriate navigation errors to the Monitoring Authority. This data should be collated and assessed in the following manner.

7.2 If the navigation error report relates to aircraft tracking on RNAV routes L625, L642, M767, M771, N884, or N892, the error should be assessed and processed in accordance with paragraph 6 above.

7.3 If the report relates to aircraft tracking on other routes, the errors should be assessed, and recorded separately. This information should be assessed by the APANPIRG ATS/AIS/SAR Sub-Group meeting, for appropriate action.

8. Reporting Procedures

8.1 The Monitoring Authority should prepare an assessment schedule (refer to Appendix B), and forward a copy of this schedule, at least every 6 months, to:

a) All signatory States to the Monitoring Letter of Agreement; and

b) The Chairman of the APANPIRG ATS/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

8.2 In addition, a report should be prepared on those errors reported in accordance with paragraph 7.3 above.

9. Attachments

Appendix A – Assessment Schedule Process
Appendix B – Sample Assessment Schedule

Appendix A

Assessment Schedule Process For Designated Monitoring Areas

STEP 1.

Hong Kong, Philippines and Singapore carry out a total monthly traffic count for approved traffic at FL290 and above, over the points:

a) DULOP and DUMOL on M771
b) AKOTA and AVMUP on L625
c) LUBLU and LEGED on N884
d) MELAS and MABLI on N892
e) ESPOB and ENREP on L642
f) TEGID and BOBOB on M767

STEP 2.

Hong Kong, Philippines and Singapore collate all Navigation Error Investigation Forms.

STEP 3.

Not later than the 15th day of each month, send the statistics gathered in Steps 1 and 2, to the Monitoring Authority (CAAS).

STEP 4.

The Monitoring Authority collates the information into an assessment schedule.

STEP 5.

Each 6 months, the assessment schedule is sent to:

a) All signatory States to the Monitoring Letter of Agreement; and

b) The Chairman of the APANPIRG ATS/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

STEP 6 (if required).

If the trend in errors is increasing, notify, through the ICAO Bangkok Office, the APANPIRG ATS/AIS/SAR Sub-Group, for appropriate action.

Appendix B

Example of Navigation Error Assessment Schedule For Designated Monitoring Areas

a. Example of Monthly Total – Single Area

Month/ 1997	Total traffic at DULOP/DUMOL	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	3105	1	0	3.22×10^{-4}	0
May	3042	2	0	6.57×10^{-4}	0
June	2810	0	0	0	0
July	2995	1	1	3.34×10^{-4}	3.34×10^{-4}

Category 1 => 30NM Category 2 = 50 – 70NM

b. Example of Cumulative Monthly Total – Single Area

Month/ 1997	Total traffic at DULOP/DUMOL	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	3105	1	0	3.22×10^{-4}	0
May	6147	3	0	4.88×10^{-4}	0
June	8957	3	0	3.35×10^{-4}	0
July	11952	4	1	3.34×10^{-4}	8.36×10^{-3}

Category 1 => 30NM Category 2 = 50 – 70NM

c. Example of Monthly Total – All ~~Four~~ *Six* Areas

Month/ 1997	Total traffic at Areas	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	7852	2	0	2.55×10^{-4}	0
May	8311	2	0	2.41×10^{-4}	0
June	8263	1	0	1.21×10^{-4}	0
July	7678	1	1	1.30×10^{-4}	1.30×10^{-4}

Category 1 => 30NM Category 2 = 50 – 70NM

d. Example of Cumulative Monthly Total – All ~~Four~~ *Six* Areas

Month/ 1997	Total traffic at Areas	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	7852	2	0	2.55×10^{-4}	0
May	16163	4	0	2.47×10^{-4}	0
June	24426	5	0	2.05×10^{-4}	0
July	32104	6	1	1.87×10^{-4}	3.11×10^{-3}

Category 1 => 30NM Category 2 = 50 – 70NM

Table 1

Counts of 61 Operator Designators Observed in
Merged Hong Kong/Singapore
December 2007 Traffic Sample Data

Number	Operator	Count	Proportion	Cumulative Count	Cumulative Proportion
1	SIA	1045	0.1820	1045	0.1820
2	CPA	839	0.1461	1884	0.3281
3	AXM	439	0.0764	2323	0.4045
4	MAS	393	0.0684	2716	0.4729
5	CES	334	0.0582	3050	0.5311
6	CSN	328	0.0571	3378	0.5882
7	TGW	327	0.0569	3705	0.6451
8	CCA	248	0.0432	3953	0.6883
9	CXA	191	0.0333	4144	0.7216
10	GIA	159	0.0277	4303	0.7493
11	SLK	157	0.0273	4460	0.7766
12	CAL	142	0.0247	4602	0.8013
13	SQC	139	0.0242	4741	0.8255
14	HVN	139	0.0242	4880	0.8497
15	JSA	125	0.0218	5005	0.8715
16	UAL	99	0.0172	5104	0.8887
17	CSZ	97	0.0169	5201	0.9056
18	HKE	62	0.0108	5263	0.9164
19	SHQ	58	0.0101	5321	0.9265
20	AHK	46	0.0080	5367	0.9345
21	TSE	42	0.0073	5409	0.9418
22	CRK	41	0.0071	5450	0.9490
23	VVM	39	0.0068	5489	0.9558
24	KAL	31	0.0054	5520	0.9612
25	CSH	31	0.0054	5551	0.9666
26	EVA	20	0.0035	5571	0.9701
27	UPS	19	0.0033	5590	0.9734
28	AZW	18	0.0031	5608	0.9765
29	FDX	18	0.0031	5626	0.9796
30	MAU	18	0.0031	5644	0.9828
31	JEC	11	0.0019	5655	0.9847
32	DER	10	0.0017	5665	0.9864
33	ANA	10	0.0017	5675	0.9882
34	NWA	9	0.0016	5684	0.9897
35	VHP	6	0.0010	5690	0.9908
36	UAE	6	0.0010	5696	0.9918
37	MKA	6	0.0010	5702	0.9929
38	CLX	5	0.0009	5707	0.9937
39	AS6	5	0.0009	5712	0.9946

Number	Operator	Count	Proportion	Cumulative Count	Cumulative Proportion
40	N68	3	0.0005	5715	0.9951
41	PKR	3	0.0005	5718	0.9956
42	N78	2	0.0003	5720	0.9960
43	N50	2	0.0003	5722	0.9963
44	N72	2	0.0003	5724	0.9967
45	VPB	2	0.0003	5726	0.9970
46	N77	2	0.0003	5728	0.9974
47	RMF	1	0.0002	5729	0.9976
48	INJ	1	0.0002	5730	0.9977
49	GTI	1	0.0002	5731	0.9979
50	VTN	1	0.0002	5732	0.9981
51	JAL	1	0.0002	5733	0.9983
52	N60	1	0.0002	5734	0.9984
53	SBI	1	0.0002	5735	0.9986
54	N81	1	0.0002	5736	0.9988
55	N11	1	0.0002	5737	0.9990
56	GOM	1	0.0002	5738	0.9991
57	SE3	1	0.0002	5739	0.9993
58	BMA	1	0.0002	5740	0.9995
59	UAA	1	0.0002	5741	0.9997
60	SE8	1	0.0002	5742	0.9998
61	N28	1	0.0002	5743	1.0000

Table 2

Counts of 37 Aircraft-Type Designators Observed in
Merged Hong Kong/Singapore
December 2007 Traffic Sample Data

Number	Type	Count	Proportion	Cumulative Count	Cumulative Proportion
1	A320	1083	0.1886	1083	0.1886
2	B772	900	0.1567	1983	0.3453
3	A333	791	0.1377	2774	0.4830
4	B773	557	0.0970	3331	0.5800
5	B738	554	0.0965	3885	0.6765
6	B744	465	0.0810	4350	0.7574
7	A319	314	0.0547	4664	0.8121
8	A306	148	0.0258	4812	0.8379
9	B737	147	0.0256	4959	0.8635
10	A321	145	0.0252	5104	0.8887
11	B752	125	0.0218	5229	0.9105
12	B742	108	0.0188	5337	0.9293
13	MD11	90	0.0157	5427	0.9450
14	B763	82	0.0143	5509	0.9593
15	A343	62	0.0108	5571	0.9701
16	B762	49	0.0085	5620	0.9786
17	A332	31	0.0054	5651	0.9840
18	B733	28	0.0049	5679	0.9889
19	A310	17	0.0030	5696	0.9918
20	H25B	9	0.0016	5705	0.9934
21	GLF4	7	0.0012	5712	0.9946
22	B734	6	0.0010	5718	0.9956
23	LJ45	4	0.0007	5722	0.9963
24	LJ60	3	0.0005	5725	0.9969
25	CL60	3	0.0005	5728	0.9974
26	LJ35	2	0.0003	5730	0.9977
27	G4	2	0.0003	5732	0.9981
28	E135	2	0.0003	5734	0.9984
29	F2TH	1	0.0002	5735	0.9986
30	B743	1	0.0002	5736	0.9988
31	B735	1	0.0002	5737	0.9990
32	FK10	1	0.0002	5738	0.9991
33	A330	1	0.0002	5739	0.9993
34	GLF5	1	0.0002	5740	0.9995
35	GL5T	1	0.0002	5741	0.9997
36	IL76	1	0.0002	5742	0.9998
37	GLEX	1	0.0002	5743	1.0000

Table 3

Forty-Six Aerodromes Observed in
Merged Hong Kong/Singapore
December 2007 Traffic Sample Data

Number	ICAO 4-Letter Designator	Airport Name	State
1	VHHH	HONG KONG/INTERNATIONAL	Hong Kong, China
2	WMKK	SEPANG/KL INTERNATIONAL AIRPORT	Malaysia (Peninsular)
3	ZBAA	BEIJING/CAPITAL	China
4	ZSPD	SHANGHAI/PUDONG	China
5	ZGGG	GUANGZHOU/BAIYUN	China
6	ZGSZ	SHENZHEN/BAO'AN	China
7	ZSFZ	FUZHOU/CHANGLE	China
8	ZSAM	XIAMEN/GAOQI	China
9	VMMC	MACAOU/INTL AIRPORT	Macao, China
10	WMSA	SUBANG/SULTAN ABDUL AZIZ SHAH	Malaysia (Peninsular)
11	WSSS	SINGAPORE/CHANGI	Singapore
12	WMKJ	JOHOR BAHRU/SULTAN ISMAIL	Malaysia (Peninsular)
13	ZSNJ	NANJING/LUKOU	China
14	WSSL	SELETAR	Singapore
15	WIII	JAKARTA/SOEKARNO HATTA (COMM CENTER)	Indonesia
16	HTDA	DAR ES-SALAAM APP,TWR, MET, NOF, COM, CI	United Republic of Tanzania
17	WSAP	PAYA LEBAR (RSAF)	Singapore
18	VVTS	HO CHI MINH/TAN SON NHAT	Viet Nam
19	YSSY	SYDNEY/SYDNEY (KINGSFORD SMITH) INTL	Australia
20	YMML	MELBOURNE/MELBOURNE INTL	Australia
21	RPLC	CLARK AB, PAMPANGA	Philippines
22	VVNB	HA NOI/NOI BAI	Viet Nam
23	VVDN	DA NANG	Viet Nam
24	ZJHK	HAIKOU/MEILAN	China
25	ZHHH	WUHAN/TIANHE	China
26	WIDD	BATAM/HANG NADIM	Indonesia
27	WIHH	JAKARTA/HALIMPERDANA KUSUMA	Indonesia
28	RCTP	TAIBEI CITY/TAIBEI INTL AP	China
29	RPLB	SUBIC BAY,SUBIC BAY INTL, OLONGAPO CITY,	Philippines
30	RKSI	INCHEON	Republic of Korea
31	ZGNN	NANNING/WUXU	China

Number	ICAO 4-Letter Designator	Airport Name	State
32	VDPP	PHNOM PENH	Cambodia
33	ZSJN	JINAN/YAOQIANG	China
34	WIMM	MEDAN/POLONIA	Indonesia
35	RJBB	KANSAI INTL	Japan
36	RJAA	NARITA INTL	Japan
37	ZPSD	TAIBEI CITY/TAIBEI INTL AP	China
38	WMKP	PENANG/INTL	Malaysia (Peninsular)
39	WARR	SURABAYA/JUANDA	Indonesia
40	OMDB	DUBAI INTERNATIONAL	United Arab Emirates
41	FIMP	SIR SEEWOOSAGUR RAMGOOLAM INTERNATIONAL	Mauritius
42	VOMM	CHENNAI	India
43	OMSJ	SHARJAH INTERNATIONAL	United Arab Emirates
44	VTBD	BANGKOK/BANGKOK INTL AIRPORT	Thailand
45	WMKL	PULAU LANGKAWI/INTL	Malaysia (Peninsular)
46	WBGB	BINTULU	Malaysia

Table 4

One Hundred Six Unique Origin-Destination Aerodrome Pairings
Observed in Merged Hong Kong/Singapore
December 2007 Traffic Sample Data

NUMBER	ORIGIN/ DESTINATION	COUNT	PROPORTION	Cumulative Count	Cumulative Proportion
1	WSSS VHHH	549	0.0956	549	0.0956
2	VHHH WSSS	509	0.0886	1058	0.1842
3	ZSPD WSSS	297	0.0517	1355	0.2359
4	WSSS ZSPD	271	0.0472	1626	0.2831
5	VHHH WMKK	221	0.0385	1847	0.3216
6	WMKK VHHH	207	0.0360	2054	0.3577
7	VVTS WSSS	177	0.0308	2231	0.3885
8	ZBAA WSSS	174	0.0303	2405	0.4188
9	WSSS ZBAA	174	0.0303	2579	0.4491
10	ZSPD WMKK	159	0.0277	2738	0.4768
11	WSSS ZSAM	156	0.0272	2894	0.5039
12	VHHH VVTS	143	0.0249	3037	0.5288
13	WMKK ZSPD	142	0.0247	3179	0.5535
14	WSSS ZGGG	133	0.0232	3312	0.5767
15	VMMC WMKK	130	0.0226	3442	0.5993
16	ZGGG WSSS	128	0.0223	3570	0.6216
17	WMKK VMMC	127	0.0221	3697	0.6437
18	VHHH WIII	124	0.0216	3821	0.6653
19	WIII VHHH	119	0.0207	3940	0.6861
20	ZSAM WSSS	115	0.0200	4055	0.7061
21	WMKK ZGSZ	95	0.0165	4150	0.7226
22	ZGSZ WMKK	92	0.0160	4242	0.7386
23	VVTS VHHH	91	0.0158	4333	0.7545
24	VVNB WSSS	70	0.0122	4403	0.7667
25	ZGGG WMKK	60	0.0104	4463	0.7771
26	ZGGG VVTS	60	0.0104	4523	0.7876
27	ZBAA WMKK	59	0.0103	4582	0.7978
28	ZGSZ WSSS	58	0.0101	4640	0.8079
29	WSSS ZGSZ	58	0.0101	4698	0.8180
30	WSSS VMMC	56	0.0098	4754	0.8278
31	VMMC WSSS	49	0.0085	4803	0.8363
32	ZSPD VVTS	43	0.0075	4846	0.8438
33	VVTS ZGGG	37	0.0064	4883	0.8503
34	WMKK ZBAA	35	0.0061	4918	0.8563
35	ZGGG WIII	35	0.0061	4953	0.8624
36	WMKK ZGGG	34	0.0059	4987	0.8684
37	WMKJ VMMC	34	0.0059	5021	0.8743
38	VMMC WMKJ	31	0.0054	5052	0.8797
39	ZJHK WSSS	31	0.0054	5083	0.8851

NUMBER	ORIGIN/ DESTINATION	COUNT	PROPORTION	Cumulative Count	Cumulative Proportion
40	WMKK RKSI	31	0.0054	5114	0.8905
41	ZSAM WMKK	30	0.0052	5144	0.8957
42	WMKP ZGGG	30	0.0052	5174	0.9009
43	ZGGG WMKP	29	0.0050	5203	0.9060
44	ZSFZ WSSS	28	0.0049	5231	0.9108
45	WMKP VHHH	28	0.0049	5259	0.9157
46	VHHH WMKP	27	0.0047	5286	0.9204
47	WMKK ZSAM	26	0.0045	5312	0.9250
48	WSSS ZSFZ	23	0.0040	5335	0.9290
49	ZSFZ WMKK	22	0.0038	5357	0.9328
50	VHHH WMSA	22	0.0038	5379	0.9366
51	WMKK ZSFZ	20	0.0035	5399	0.9401
52	WIII ZGGG	20	0.0035	5419	0.9436
53	WSSS RJAA	19	0.0033	5438	0.9469
54	WMSA VHHH	18	0.0031	5456	0.9500
55	WSSS ZSNJ	18	0.0031	5474	0.9532
56	VVTS YSSY	18	0.0031	5492	0.9563
57	WMKK RPLB	18	0.0031	5510	0.9594
58	WMKK RCTP	17	0.0030	5527	0.9624
59	VMMC WIII	16	0.0028	5543	0.9652
60	WIII VMMC	15	0.0026	5558	0.9678
61	WSSS RCTP	14	0.0024	5572	0.9702
62	ZGSZ VVTS	14	0.0024	5586	0.9727
63	ZSNJ WSSS	13	0.0023	5599	0.9749
64	VVTS YMML	13	0.0023	5612	0.9772
65	VVTS ZGSZ	13	0.0023	5625	0.9795
66	VVDN WSSS	10	0.0017	5635	0.9812
67	FIMP VHHH	9	0.0016	5644	0.9828
68	VHHH FIMP	9	0.0016	5653	0.9843
69	WIII ZGNN	8	0.0014	5661	0.9857
70	VMMC VVTS	8	0.0014	5669	0.9871
71	VHHH OMDB	7	0.0012	5676	0.9883
72	ZSPD WMKP	7	0.0012	5683	0.9896
73	WMSA ZSNJ	6	0.0010	5689	0.9906
74	WSSL ZGSZ	5	0.0009	5694	0.9915
75	VMMC VOMM	5	0.0009	5699	0.9923
76	ZGSZ WSSL	3	0.0005	5702	0.9929
77	VHHH WMKJ	3	0.0005	5705	0.9934
78	VVTS WSSL	3	0.0005	5708	0.9939
79	VHHH WMKL	3	0.0005	5711	0.9944
80	WMKJ VHHH	2	0.0003	5713	0.9948
81	WIHH VMMC	2	0.0003	5715	0.9951
82	WSSL VVTS	2	0.0003	5717	0.9955
83	WIHH VHHH	2	0.0003	5719	0.9958
84	WMKL VHHH	2	0.0003	5721	0.9962
85	VHHH WSSL	1	0.0002	5722	0.9963
86	HTDA VHHH	1	0.0002	5723	0.9965
87	WSAP VHHH	1	0.0002	5724	0.9967

NUMBER	ORIGIN/ DESTINATION	COUNT	PROPORTION	Cumulative Count	Cumulative Proportion
88	WSSL VHHH	1	0.0002	5725	0.9969
89	RPLC WMKK	1	0.0002	5726	0.9970
90	ZJHK WSSL	1	0.0002	5727	0.9972
91	VVNB WSSL	1	0.0002	5728	0.9974
92	ZHHH WSSL	1	0.0002	5729	0.9976
93	VVTS WIDD	1	0.0002	5730	0.9977
94	VHHH WIDD	1	0.0002	5731	0.9979
95	WIHH VDPP	1	0.0002	5732	0.9981
96	WMSA ZSJN	1	0.0002	5733	0.9983
97	WIMM RJBB	1	0.0002	5734	0.9984
98	WSSS ZPSD	1	0.0002	5735	0.9986
99	WSSL VVNB	1	0.0002	5736	0.9988
100	WARR VMMC	1	0.0002	5737	0.9990
101	VMMC OMSJ	1	0.0002	5738	0.9991
102	VMMC VTBD	1	0.0002	5739	0.9993
103	VVTS VMMC	1	0.0002	5740	0.9995
104	WMSA RJAA	1	0.0002	5741	0.9997
105	VMMC WIHH	1	0.0002	5742	0.9998
106	VHHH WBGB	1	0.0002	5743	1.0000

Table 5

One Hundred Seven Unique Operator/Aircraft-Type Combinations
Observed in Merged Hong Kong/Singapore
December 2007 Traffic Sample Data

Pair Number	Operator-Aircraft Type	Count	Proportion	Cumulative Count	Cumulative Proportion
1	SIA-B772	611	0.1064	611	0.1064
2	AXM-A320	439	0.0764	1050	0.1828
3	CPA-A333	336	0.0585	1386	0.2413
4	TGW-A320	327	0.0569	1713	0.2983
5	SIA-B773	312	0.0543	2025	0.3526
6	CPA-B773	245	0.0427	2270	0.3953
7	MAS-A333	193	0.0336	2463	0.4289
8	CXA-B737	144	0.0251	2607	0.4539
9	SQC-B744	139	0.0242	2746	0.4781
10	JSA-A320	125	0.0218	2871	0.4999
11	CES-A333	124	0.0216	2995	0.5215
12	CES-A319	122	0.0212	3117	0.5427
13	SIA-B744	122	0.0212	3239	0.5640
14	CSN-A320	103	0.0179	3342	0.5819
15	MAS-B772	103	0.0179	3445	0.5999
16	UAL-B744	99	0.0172	3544	0.6171
17	CSN-A319	99	0.0172	3643	0.6343
18	CSZ-B738	97	0.0169	3740	0.6512
19	CPA-B772	95	0.0165	3835	0.6678
20	SLK-A319	93	0.0162	3928	0.6840
21	GIA-B738	92	0.0160	4020	0.7000
22	HVN-A321	83	0.0145	4103	0.7144

Pair Number	Operator-Aircraft Type	Count	Proportion	Cumulative Count	Cumulative Proportion
23	CAL-A333	71	0.0124	4174	0.7268
24	CES-A306	64	0.0111	4238	0.7379
25	CCA-B763	64	0.0111	4302	0.7491
26	SLK-A320	64	0.0111	4366	0.7602
27	CSN-B738	64	0.0111	4430	0.7714
28	MAS-B742	63	0.0110	4493	0.7823
29	CAL-B738	62	0.0108	4555	0.7931
30	CCA-B752	62	0.0108	4617	0.8039
31	HKE-B738	62	0.0108	4679	0.8147
32	CCA-B738	62	0.0108	4741	0.8255
33	CSN-A321	62	0.0108	4803	0.8363
34	CCA-B772	60	0.0104	4863	0.8468
35	CPA-B744	59	0.0103	4922	0.8570
36	SHQ-B752	58	0.0101	4980	0.8671
37	AHK-A306	46	0.0080	5026	0.8752
38	CPA-A343	44	0.0077	5070	0.8828
39	CXA-B738	43	0.0075	5113	0.8903
40	TSE-MD11	42	0.0073	5155	0.8976
41	CRK-B738	40	0.0070	5195	0.9046
42	CPA-A306	38	0.0066	5233	0.9112
43	GIA-A333	36	0.0063	5269	0.9175
44	HVN-B772	31	0.0054	5300	0.9229
45	KAL-A333	31	0.0054	5331	0.9283
46	CSH-B738	31	0.0054	5362	0.9337

Pair Number	Operator-Aircraft Type	Count	Proportion	Cumulative Count	Cumulative Proportion
47	VVM-B762	31	0.0054	5393	0.9391
48	GIA-B733	28	0.0049	5421	0.9439
49	MAS-B744	26	0.0045	5447	0.9485
50	HVN-A320	25	0.0044	5472	0.9528
51	CES-MD11	24	0.0042	5496	0.9570
52	CPA-B742	22	0.0038	5518	0.9608
53	AZW-B762	18	0.0031	5536	0.9640
54	UPS-MD11	18	0.0031	5554	0.9671
55	MAU-A343	18	0.0031	5572	0.9702
56	FDX-A310	17	0.0030	5589	0.9732
57	EVA-A332	13	0.0023	5602	0.9754
58	JEC-B742	11	0.0019	5613	0.9774
59	ANA-B763	10	0.0017	5623	0.9791
60	DER-H25B	9	0.0016	5632	0.9807
61	NWA-A332	9	0.0016	5641	0.9822
62	CAL-B744	9	0.0016	5650	0.9838
63	VVM-B763	8	0.0014	5658	0.9852
64	MAS-B734	6	0.0010	5664	0.9862
65	UAE-A332	6	0.0010	5670	0.9873
66	MKA-B742	6	0.0010	5676	0.9883
67	CLX-B744	5	0.0009	5681	0.9892
68	AS6-B742	5	0.0009	5686	0.9901
69	CXA-B752	4	0.0007	5690	0.9908
70	VHP-LJ45	4	0.0007	5694	0.9915
71	EVA-B744	4	0.0007	5698	0.9922

Pair Number	Operator-Aircraft Type	Count	Proportion	Cumulative Count	Cumulative Proportion
72	EVA-MD11	3	0.0005	5701	0.9927
73	N78-GLF4	2	0.0003	5703	0.9930
74	GIA-B744	2	0.0003	5705	0.9934
75	N50-LJ60	2	0.0003	5707	0.9937
76	VHP-LJ35	2	0.0003	5709	0.9941
77	N77-GLF4	2	0.0003	5711	0.9944
78	PKR-E135	2	0.0003	5713	0.9948
79	N68-GLF4	2	0.0003	5715	0.9951
80	RMF-B737	1	0.0002	5716	0.9953
81	DER-GLF4	1	0.0002	5717	0.9955
82	MAS-A332	1	0.0002	5718	0.9956
83	INJ-F2TH	1	0.0002	5719	0.9958
84	GIA-A332	1	0.0002	5720	0.9960
85	GTI-B742	1	0.0002	5721	0.9962
86	VTN-CL60	1	0.0002	5722	0.9963
87	N72-CL60	1	0.0002	5723	0.9965
88	JAL-B743	1	0.0002	5724	0.9967
89	UPS-B752	1	0.0002	5725	0.9969
90	N60-LJ60	1	0.0002	5726	0.9970
91	VPB-B738	1	0.0002	5727	0.9972
92	SBI-B735	1	0.0002	5728	0.9974
93	N68-G4	1	0.0002	5729	0.9976
94	PKR-FK10	1	0.0002	5730	0.9977
95	FDX-MD11	1	0.0002	5731	0.9979
96	MAS-A330	1	0.0002	5732	0.9981
97	VPB-GLF5	1	0.0002	5733	0.9983
98	N81-GL5T	1	0.0002	5734	0.9984
99	N11-G4	1	0.0002	5735	0.9986
100	GOM-IL76	1	0.0002	5736	0.9988

Pair Number	Operator-Aircraft Type	Count	Proportion	Cumulative Count	Cumulative Proportion
101	SE3-MD11	1	0.0002	5737	0.9990
102	BMA-CL60	1	0.0002	5738	0.9991
103	N72-B737	1	0.0002	5739	0.9993
104	UAA-A332	1	0.0002	5740	0.9995
105	SE8-MD11	1	0.0002	5741	0.9997
106	N28-GLEX	1	0.0002	5742	0.9998
107	CRK-B737	1	0.0002	5743	1.0000

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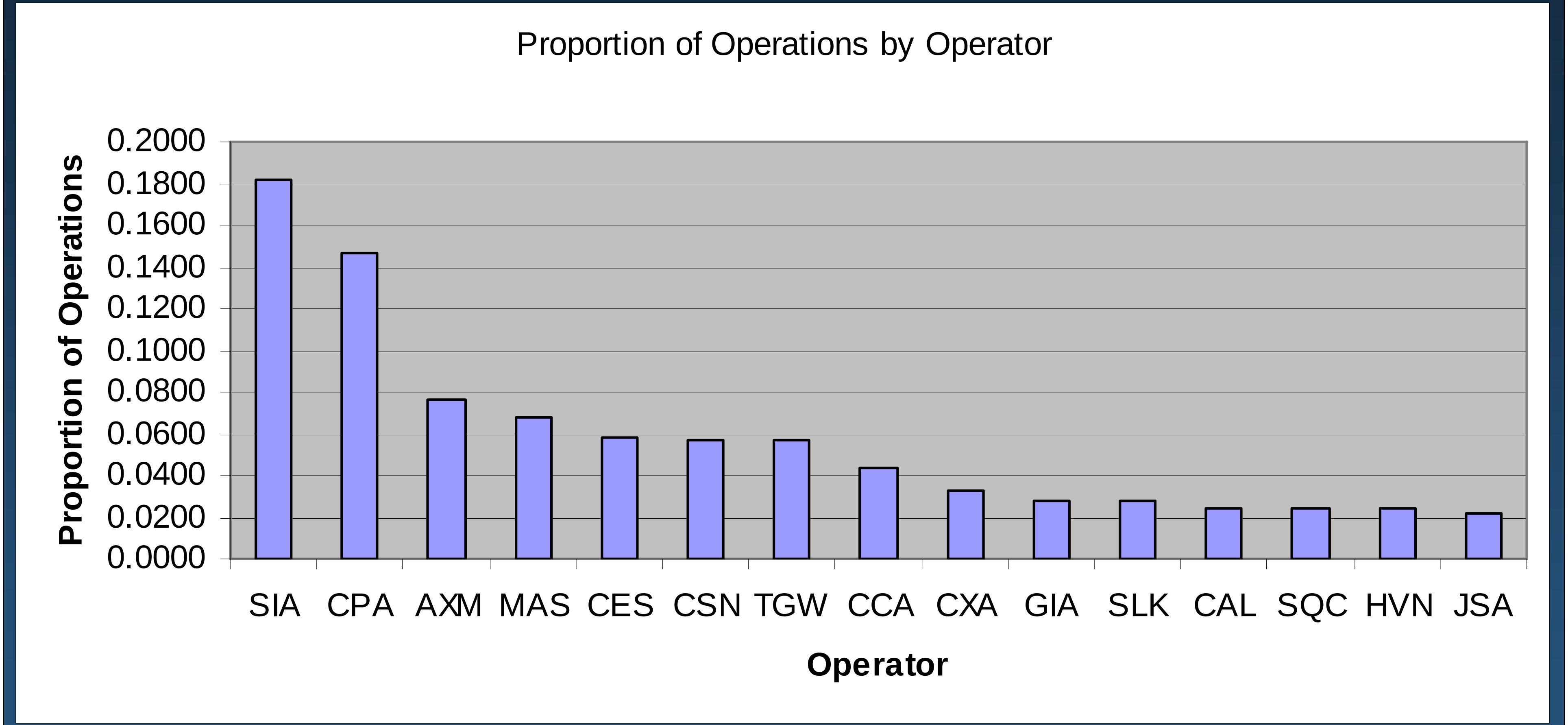
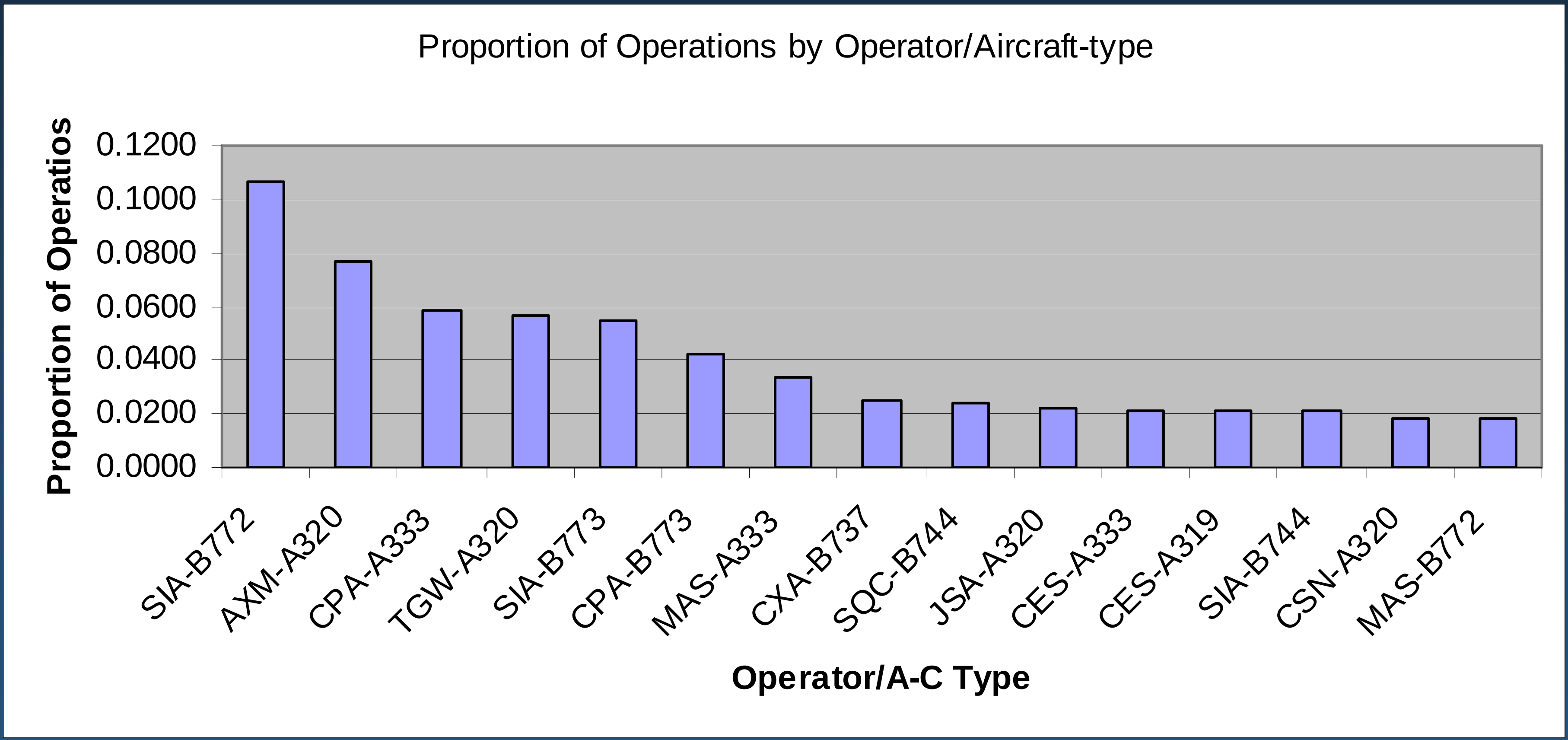
4 March 2008

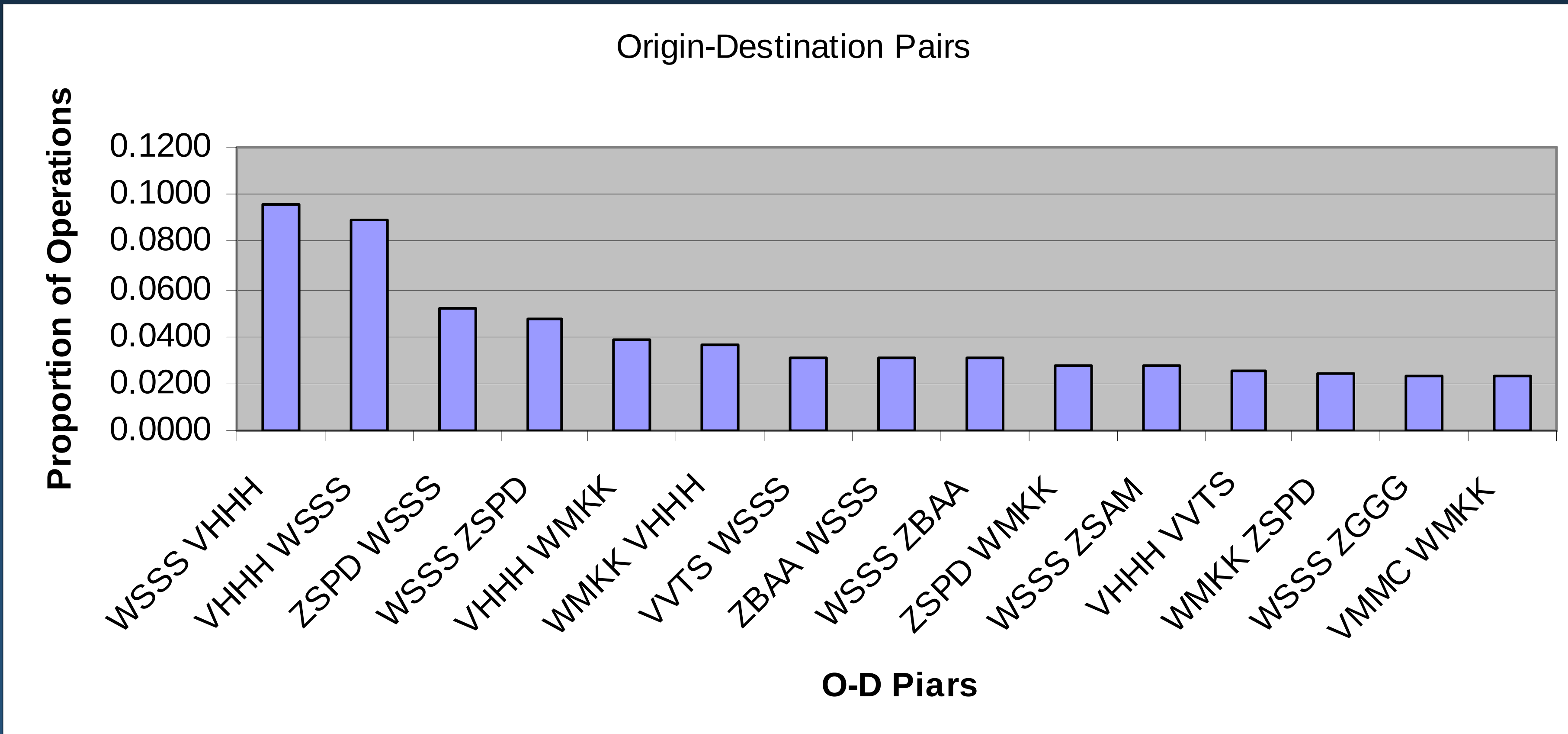
Operations By Operator



Operations By Operator/Aircraft Type



Origin-Destination Pairs



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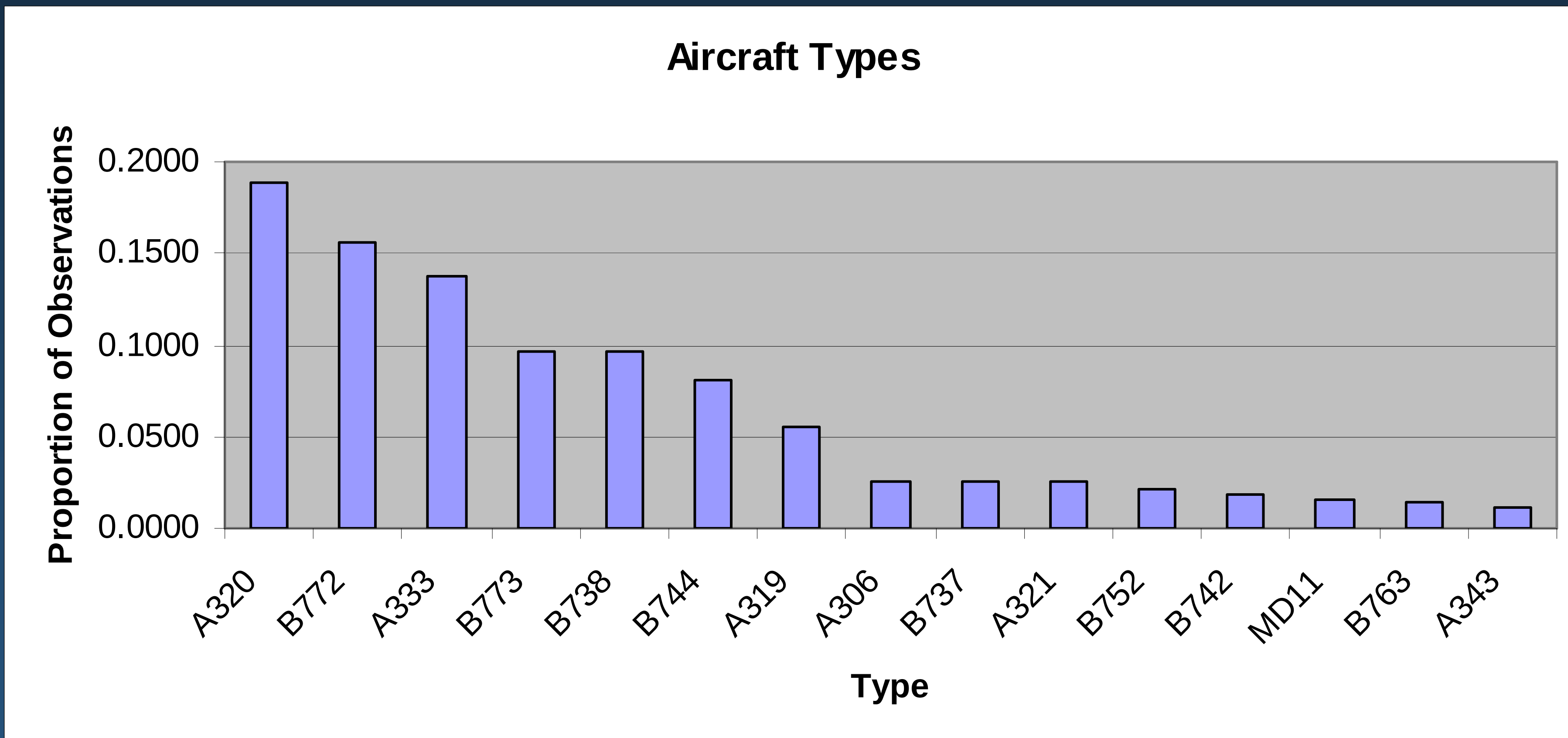
Aircraft Types



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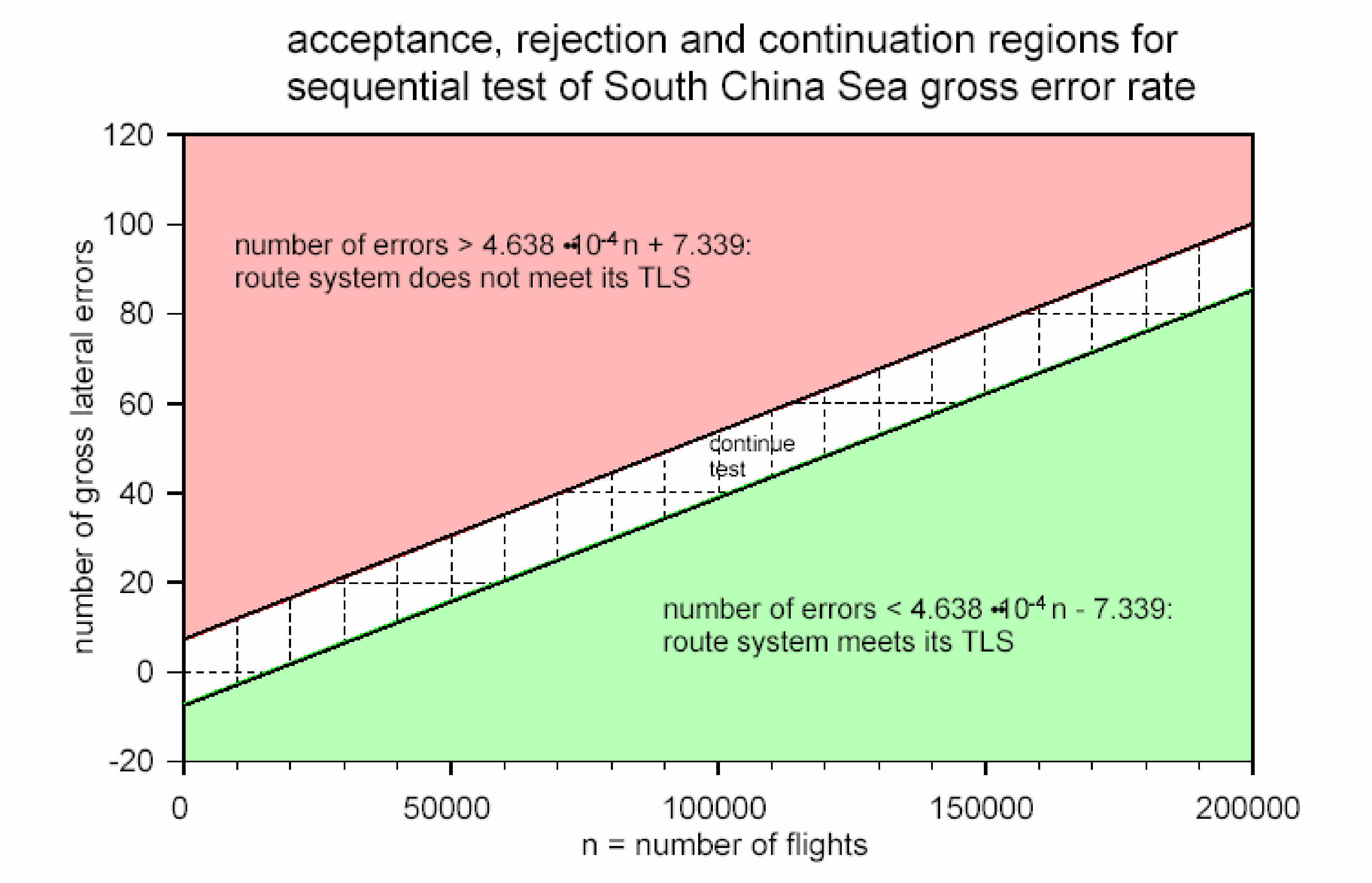

acceptance, rejection and continuation regions for
sequential test of South China Sea gross error rate
number of errors > 4.638 •10-4 n + 7.339:
route system does not meet its TLS
continue
test
number of errors < 4.638 •10-4 n - 7.339:
route system meets its TLS
number of gross lateral errors
n = number of flights
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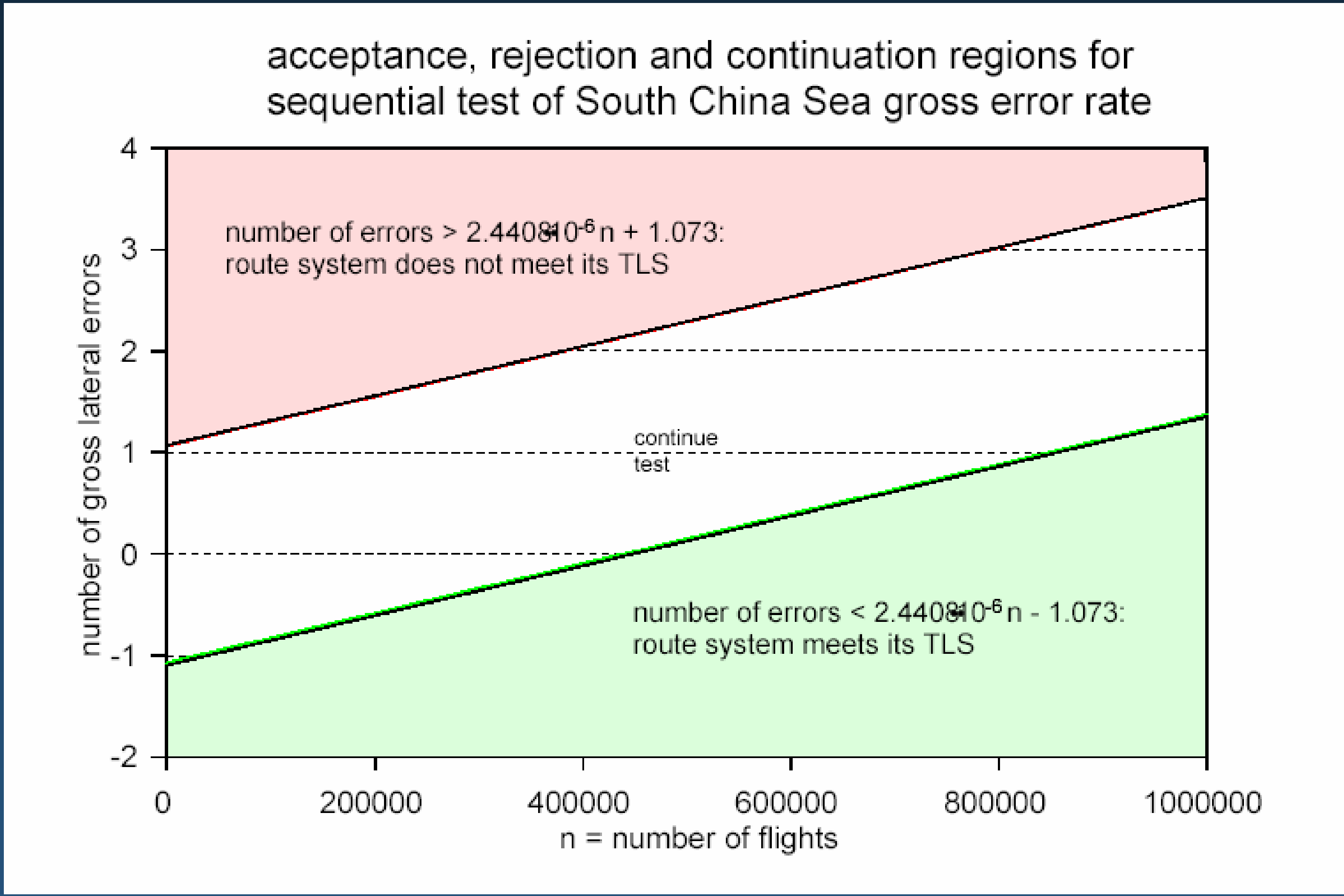
80
60
40
20
0
-20
0
50000
100000
150000
200000

30 NM



Moving Research to Reality

Frequency Table on Change as a Function of Initial Pair Separation for 1392 Pairs

Separation Loss (-) or Gain At Exit Fix (Minutes)

Initial Separation at Entry Fix (Minutes)	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	Total	Relative Frequency	Cumulative Frequency
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	7E-04	0.0007
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0007
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	7E-04	0.0014
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	7E-04	0.0022
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	1	1	0	0	0	6	0.004	0.0065
9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2	1	0	0	0	0	7	0.005	0.0115
10	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4	3	0	0	1	1	0	0	0	0	0	13	0.009	0.0208
11	0	0	0	0	0	0	0	0	0	0	0	2	8	3	5	4	2	0	1	2	2	1	0	0	0	30	0.022	0.0424
12	0	0	0	0	0	0	0	0	1	0	1	2	8	4	0	2	1	1	0	1	1	1	1	0	0	24	0.017	0.0596
13	0	0	0	0	0	0	0	0	1	2	6	3	4	4	3	1	1	0	1	1	1	0	1	0	0	29	0.021	0.0805
14	0	0	0	0	0	0	0	0	1	1	4	7	4	5	0	2	2	5	3	1	0	0	1	0	0	36	0.026	0.1063
15	0	0	0	0	0	0	1	0	1	4	2	4	8	8	4	0	4	2	1	1	1	0	0	0	0	41	0.029	0.1358
16	0	0	0	0	0	0	1	1	1	1	3	3	6	2	2	2	7	3	0	1	2	1	0	0	0	36	0.026	0.1616
17	0	0	0	0	1	2	0	0	1	3	3	7	6	3	1	1	4	2	1	0	1	0	0	0	0	36	0.026	0.1875
18	0	0	0	0	0	0	0	2	0	1	4	5	4	3	2	4	1	0	1	6	1	1	0	0	0	35	0.025	0.2126
19	0	0	0	0	0	0	1	1	2	2	3	8	6	5	2	3	2	1	2	1	2	0	1	0	0	42	0.03	0.2428
20	0	0	0	1	1	2	1	1	2	5	6	2	4	2	3	1	2	3	1	0	0	1	1	0	0	39	0.028	0.2708
21	0	0	0	0	2	1	1	1	2	1	4	7	6	7	5	2	2	3	1	2	0	1	0	0	0	48	0.034	0.3053
22	0	0	0	1	0	1	0	0	1	3	3	5	3	2	1	3	1	5	2	2	0	0	0	0	0	33	0.024	0.329

23	0	0	0	0	0	1	2	0	1	1	4	5	1	4	3	2	2	0	3	1	0	1	0	0	0	31	0.022	0.3513
24	0	0	0	0	1	0	0	0	2	1	2	5	5	4	1	0	3	1	0	1	0	1	0	0	0	27	0.019	0.3707
25	0	0	0	1	0	1	0	1	1	3	1	2	5	5	2	2	2	3	1	2	1	0	0	0	0	33	0.024	0.3944
26	0	0	1	1	1	1	1	1	2	2	2	5	2	1	2	1	0	1	3	0	0	0	0	1	0	28	0.02	0.4145
27	0	0	0	0	1	0	0	0	1	1	2	2	3	3	2	0	1	0	0	0	0	0	0	0	0	16	0.011	0.426
28	1	0	0	0	0	2	0	0	4	2	3	5	4	x	2	3	1	0	1	1	0	0	0	0	0	32	0.023	0.449
29	0	0	0	0	0	1	0	1	1	0	4	4	5	1	5	1	2	2	0	1	1	0	0	0	0	29	0.021	0.4698
30	0	0	1	0	2	2	0	0	3	2	3	1	1	5	2	1	1	0	2	0	2	0	0	0	0	28	0.02	0.4899
31	0	0	0	0	0	1	0	1	2	0	2	1	6	2	1	2	3	1	1	0	2	0	0	0	0	25	0.018	0.5079
32	0	1	0	0	1	2	0	3	0	0	2	6	6	1	2	1	1	3	1	1	2	0	0	0	2	35	0.025	0.533
33	0	0	0	1	1	1	1	0	3	0	3	1	3	5	5	1	2	0	0	0	1	0	0	0	0	28	0.02	0.5532
34	0	0	0	0	0	0	0	2	3	4	2	4	3	3	3	0	1	1	2	1	0	0	0	0	0	29	0.021	0.574
35	0	0	0	1	0	0	1	3	4	1	4	0	5	4	1	2	2	0	0	1	0	1	1	0	0	31	0.022	0.5963
36	0	0	0	0	1	0	3	0	0	0	0	6	2	6	2	1	0	0	0	0	0	1	0	0	0	22	0.016	0.6121
37	0	0	0	0	1	0	1	3	1	3	3	2	7	4	1	1	1	1	1	1	1	0	0	0	0	32	0.023	0.6351
38	0	0	0	0	1	1	1	2	0	0	1	4	1	1	1	1	2	1	1	1	0	1	0	0	0	20	0.014	0.6494
39	0	0	0	0	1	2	1	0	1	0	2	1	2	3	2	2	2	1	2	0	1	1	0	0	0	24	0.017	0.6667
40	0	0	0	0	1	0	2	1	0	0	2	3	5	1	1	0	0	0	1	0	1	1	1	0	0	20	0.014	0.681
41	0	0	0	0	0	0	0	0	3	4	3	5	2	6	1	2	0	1	0	2	0	0	0	0	0	29	0.021	0.7019
42	0	0	0	0	1	1	3	2	1	1	5	1	2	2	2	4	1	0	0	3	0	0	0	0	0	29	0.021	0.7227
43	0	0	2	1	0	0	0	0	0	3	1	2	3	2	1	3	1	1	0	2	0	0	0	0	0	22	0.016	0.7385
44	0	0	0	0	0	0	2	1	1	3	2	1	7	2	1	0	1	1	1	3	0	0	1	0	0	27	0.019	0.7579
45	0	0	0	0	0	1	3	1	0	2	2	3	2	2	3	6	2	0	0	1	0	1	0	0	0	29	0.021	0.7787
46	0	0	0	0	1	0	3	1	1	4	1	8	2	6	3	1	0	2	1	0	0	0	0	0	0	34	0.024	0.8032
47	0	0	0	0	1	0	3	1	1	3	1	2	0	3	0	1	0	1	0	1	0	0	0	0	0	18	0.013	0.8161
48	0	0	0	0	1	0	1	3	0	0	3	5	0	2	2	5	1	0	0	2	1	0	0	0	0	26	0.019	0.8348
49	0	0	0	0	0	0	1	0	5	3	3	4	2	0	0	1	0	0	0	1	1	0	1	0	0	22	0.016	0.8506
50	0	0	0	0	1	2	0	0	0	0	3	0	2	3	1	1	0	0	1	0	1	0	0	0	1	16	0.011	0.8621
51	0	0	0	0	0	2	0	0	0	2	2	4	2	3	2	1	0	1	0	0	0	0	0	0	0	19	0.014	0.8757
52	0	0	0	1	1	0	0	0	0	1	2	5	3	0	2	1	2	0	1	1	2	0	1	0	1	24	0.017	0.893
53	0	0	0	0	1	1	1	0	4	0	0	2	4	1	2	0	0	1	0	1	0	0	0	0	0	18	0.013	0.9059
54	0	0	0	0	0	0	0	0	1	1	0	2	2	2	2	1	1	1	0	0	2	0	0	0	0	15	0.011	0.9167

55	0	0	0	1	1	0	0	1	1	0	1	4	3	4	1	1	0	1	0	0	0	0	0	0	0	19	0.014	0.9303
56	0	0	0	1	0	0	0	0	3	1	3	3	1	2	3	0	1	3	0	1	0	0	0	0	0	22	0.016	0.9461
57	0	0	0	1	0	0	0	1	1	3	2	1	3	2	2	2	1	0	0	1	0	0	0	0	0	20	0.014	0.9605
58	1	0	0	0	1	2	1	0	0	3	0	3	3	1	2	0	0	2	0	1	1	0	0	0	0	21	0.015	0.9756
59	0	0	0	0	0	1	0	2	2	0	2	2	2	1	1	0	2	1	0	0	0	0	0	0	0	16	0.011	0.9871
60	0	0	0	0	1	0	2	1	2	0	1	5	3	2	0	0	0	0	0	1	0	0	0	0	0	18	0.013	1
																											0	
TOTAL	2	1	4	11	26	31	38	38	68	77	118	174	183	150	103	81	70	56	40	53	33	16	10	1	5	1392	1	
Relative Frequency	0	0	0	0.01	0.02	0.02	0.03	0.03	0.05	0.06	0.08	0.13	0.13	0.11	0.07	0.06	0.05	0.04	0.03	0.04	0.02	0.01	0.01	0	0	1		
Cumulative Relative Frequency	0	0	0.01	0.01	0.03	0.05	0.08	0.11	0.16	0.21	0.3	0.42	0.55	0.66	0.74	0.79	0.84	0.88	0.91	0.95	0.97	0.99	0.99	0.99	1			

Proposal for Amendment of
Regional Supplementary Procedures – Doc 7030/4
(Serial No. APAC-XXXXXX - MID/ASIA RAC/X)

a)	**Regional Supplementary Procedures:**	MID/ASIA
b)	**Proposing State(s):**	China, Hong Kong China, Malaysia, Singapore and Viet Nam
c)	**Proposed Amendment:**	Editorial note: Amendments are arranged to show deleted text using strikeout (~~text to be deleted~~), and added text with grey shading (text to be inserted).

On page MID/ASIA/RAC-9 dated 28/1/05

Add "Ho Chi Minh", "Hong Kong", "Kuala Lumpur", "Sanya" and "Singapore" to Paragraph 7.1.5.

7.1.5 For flights on designated controlled oceanic routes or areas within the Auckland Oceanic, Brisbane, Honiara, Ho Chi Minh, Hong Kong, Kuala Lumpur, Melbourne, Naha, Nauru, New Zealand, Port Moresby, Sanya, Singapore and Tokyo FIRs, a lateral separation minimum of 93 km (50 NM) may be applied provided that the aircraft and the operator have been approved by the State of Registry or the State of the Operator, as appropriate, to meet the following requirements (or equivalent):

On page MID/ASIA/RAC-11 dated 2/6/06

Add "Ho Chi Minh", "Hong Kong", "Kuala Lumpur", "Sanya" and "Singapore" to Paragraph 7.2.2.1.

7.2.2.1 For flights on designated controlled oceanic routes or areas within the Auckland Oceanic, Brisbane, Honiara, Ho Chi Minh, Hong Kong, Kuala Lumpur, Melbourne, Naha, Nauru, New Zealand, Port Moresby, Sanya, Singapore and Tokyo FIRs, a longitudinal separation minimum of 93 km (50 NM) derived by RNAV may be applied between RNAV-equipped aircraft approved to RNP 10 or better, in accordance with the provisions of PANS-ATM, 5.4.2.6.

d)	**Proposer's Reason For Amendment:**	RNP 10 (50NM/50NM) operations will be implemented on RNAV routes L642 and M771 in the Ho Chi Minh, Hong Kong, Kuala Lumpur, Sanya and Singapore FIRs on 2 July 2008 to increase capacity and enhance efficiency.
e)	**Proposed Implementation Date of the Amendment:**	2 July 2008
f)	**Proposed Circulated to the Following States and international organisations:**	…states in MID/AISA… IATA IFALPA IFATCA
g)	**Secretariat comments:**	

SN	Activity	Start	Complete	Present Status	Group Responsible
	Identify Operational Need				
1	Agree that an operational needs for a 50 NM ~~longitudinal~~horizontal separation in South China Sea area	13-Mar-06	13-Mar-06	Completed	RNP-SEA TF
2	~~For the near term, the implementation of 50NM lonigtudinalhorizontal separation on L642 and M771~~ Seek agreement from Hong Kong China for the implementation of 50 NM horizontal separation on L642 and M771	25-Sep-07	25-Sep-07	~~Subject to Hong Kong, China comments~~Completed	SCM
	Safety Assessment				
3	Engage a qualified Horizontal Safety Assessment Expert	25-Sep-07	Dec-07	~~On-going~~Completed	SINGAPORE
4	States to continue to collect and provide traffic data	25-Sep-07		On-going	STATES
5	States to provide additional data as required by the Horizontal Safety Assessment Expert	25-Sep-07		On-going	STATES
~~6~~	~~Examine history of navigational errors and assess possible impact on safety~~	~~Jan-08~~		~~NA~~	~~RNP-SEA TF~~
7	Confirm collision risk model assumptions/parameters are consistent with airspace where the 50 NM ~~longitudinal~~horizontal separation is to be applied	Jan-08	6-Mar-08	Completed	RNP-SEA TF
8	Conduct simulations to predict occupancy after the 50 NM ~~longitudinal~~horizontal separation implementation	Jan-08	5-Mar-08	Completed	SINGAPORE
9	Collect weather and turbulence data for analysis	Jan-08		On-going	STATES
10	Report monthly navigational errors (including operational errors) to Monitoring Authority (Singapore)	13-Mar-06		On-going	STATES
11	Collect additional data if required by the Safety Assessment Expert for the safety assessment for the 50 NM ~~longitudinal~~horizontal separation implementation	Jan-08		On-going	STATES
	Feasibility Analysis				
12	Examine the operational factors and workload associated with the 50 NM ~~longitudinal~~horizontal separation implementation in South China Sea	13-Mar-06		On-going	STATES
13	Complete feasibility analysis on the 50NM ~~longitudinal~~horizontal separation implementation on L642 and M771	13-Mar-06	25-Sep-07	Completed	NA

SN	Activity	Start	Complete	Present Status	Group Responsible
	Determination of Requirements (airborne & ground systems)				
14	States assess the impact of the 50 NM ~~longitudinal~~horizontal separation implementation on controller automation systems and plan for upgrades/modifications	13-Mar-06	25-Sep-07	Completed	NA
	Aircraft & Operator Approval Requirements				
15	Promulgate the operational approval process of RNP 10	13-Mar-06	13-Mar-06	Completed	NA
	Perform Rulemaking (if required)				
16	Recommend State airspace regulatory documentation	13-Mar-06	13-Mar-06	Completed	NA
	Perform Necessary Industry & International Co-ordination				
17	Establish target implementation date on the 50NM ~~longitudinal~~horizontal separation on L642 and M771	25-Sep-07	25-Sep-07	Completed (Target Date of Implementation is ~~3~~2 July 2008)	~~SCM~~ RNP SEA TF
18	Report to ~~RNP-SEA TF and~~ SEACG			On-going	~~SINGAPORE~~ REGIONAL OFFICE
19	Prepare draft amendment proposal to amend Doc 7030	25-Sep-07	26-Sep-07	Completed	SCM
20	Submit draft amendment proposal to amend Doc 7030 to ICAO	26-Sep-07		On-going	~~SINGAPORE~~ STATES
21	Assess need to publish AIP Amendment/Supplement, if necessary, containing the 50 NM ~~longitudinal~~horizontal separation policy/procedures	26-Sep-07		On-going	~~SINGAPORE~~STATES
22	Assess need for ~~Trigger~~ NOTAM	13-Mar-06	Jun-08	On-going	~~RNP-SEA TF~~STATES
23	Review inter-facility coordination procedures	26-Sep-07		On-going	STATES
24	Finalize changes to Letters of Agreement	26-Sep-07	Jun-08	On-going	STATES
	Approval of Aircraft & Operators				
25	Establish approved operations readiness targets	13-Mar-06	13-Mar-06	Completed	NA
26	Assess operator readiness	13-Mar-06	13-Mar-06	Completed	NA

SN	Activity	Start	Complete	Present Status	Group Responsible
	Develop ATC Procedures				
27	Develop procedures for handling non-compliant aircraft in ATS documentation	13-Mar-06	13-Mar-06	Completed	NA
	ATC Training				
28	Complete training on the application of 50 NM longitudinalhorizontal separation training for air traffic controllers	13-Mar-06	Jun-08	On-going	STATES
	Complete Safety Assessment				
29	Review and accept safety assessment	13-Mar-06	Jun-08	On-going	RNP-SEA TF
	Final Implementation Decision				
30	Go/No Go Decision	Jun-08		On-going	RNP-SEA TF/ SCM
31	Implementation	Jul-08		On-going	
	Post Implementation Review				RNP-SEA TF
32	RNP-SEA/TF/3	Jun-08		On-going	RNP-SEA TF
33	RNP-SEA/TF/4	Nov-08		On-going	RNP-SEA TF