

Bangkok-Singapore CDM Journal



Bangkok – Singapore Collaborative Decision Making (CDM)



Record of Amendments

Number	Date of Issue	Date of Applicability	Pages Affected
1	Jan 2013	Jan 2013	-

As the CDM project is on-going, this journal will be periodically updated by the project members.

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Abbreviations and Acronyms

As used in this report, the following abbreviations have the meanings indicated:

Acronyms	Definition	Explanation
AIBT	Actual In-Block Time	The time that an aircraft arrives in-blocks. (Equivalent to Airline/Handler ATA –Actual Time of Arrival)
ALDT	Actual Landing Time	The time that an aircraft lands on a runway. (Equivalent to ATC ATA –Actual Time of Arrival = landing)
AOBT	Actual Off-Block Time	Time the aircraft pushes back / vacates the parking position. (Equivalent to Airline / Handlers ATD – Actual Time of Departure)
EXOT	Estimated Taxi-Out Time	The estimated taxi time between off-block and take off. This estimate includes any delay buffer time at the holding point prior to take off
SIBT	Scheduled In-Block Time	The time that an aircraft is scheduled to arrive at its first parking position
SOBT	Scheduled Off-Block Time	The time that an aircraft is scheduled to depart from its parking position
TIBT	Target In-Block Time	The time that an aircraft estimates to arrive at its parking position
TLDT	Target Landing Time	Targeted Time from the Arrival management process at the threshold, taking runway sequence and constraints into account. It is not a constraint but a progressively refined planning time used to coordinate between arrival and departure management processes. Each TLDT on one runway is separated from other TLDT to represent vortex and/or SID separation between aircraft
TOBT	Target Off-Block Time	The time that an Aircraft Operator or Ground Handler estimates that an aircraft will be ready, all doors closed, boarding bridge removed, push back vehicle available and ready to start up / push back immediately upon reception of clearance from the Tower
TSAT	Target Start Up Approval Time	The time provided by ATC taking into account TOBT and/or the traffic situation that an aircraft can expect start up / push back approval
TTOT	Target Take-Off Time	The Target Take Off Time taking into account the TOBT/TSAT plus the EXOT.

Project Team Members

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1. Preface

Despite the on-going economic woes in Europe and North America, the Asia-Pacific region has continued to experience strong annual air traffic growth of over 10 percent. In fact the Asia-Pacific is already the world's largest aviation market.

Continuing air traffic growth in the region is putting pressure on current air navigation service infrastructure and new and innovative solutions are urgently needed. Today, some aviation stakeholders view each other as "customers" On the other hand, under the Collaborative Decision Making (CDM) model, aviation stakeholders view each other as "partners" collaborating towards a common goal of delivering a safe, efficient and sustainable air transport services for the public and the economy. The CDM concept is a key element of the ICAO Aviation System Block Upgrade (ASBU) and a number of airports have Airport CDM (A-CDM) systems. However to fully exploit the capabilities of CDM it is essential that all aviation stakeholders are involved in the CDM process.

The adoption of such a CDM model would contribute to enhancements in many of ICAO KPAs such as predictability, flexibility, cost-effectiveness, participation of aviation community and the environment.

With CDM, everyone wins – airlines, airport operators, air traffic control (ATC), ground handlers and the air transport network as a whole.

Recognizing the potential benefit that CDM can bring about, CANSO introduced the CDM city pair concept to maximise the predictability and efficiency of flights between major city pairs.

The idea which arose from a CANSO Asia Pacific ATM Best Practices Workshop in Singapore resulted in the aviation partners of Singapore and Thailand launching a pilot "Bangkok - Singapore CDM Project" in June 2011. The objective is to use CDM to improve air traffic management for flights between Bangkok's Suvarnabhumi Airport and Singapore's Changi Airport. The pilot project aims to demonstrate the efficiency gains achievable through the integration of airport and en-route CDM and to establish best practices for other city pairs in the region.

The project team comprising of representatives from the ANSPs, airports and airlines met several times to develop the operational concept and key performance indicators (KPIs) and to plan for operational trials to validate the concept. Operational trials were held over a 2 week period in 2012 to gather feedback and operational flight data. A post-trial review meeting was held to review and evaluate outcomes from the trials. The results presented in this report were based on the agreed key performance indicators (KPIs).

2. Description of CDM

2.1. General

From a global perspective, CDM is an initiative aimed at building system synergy for the aviation community through increased information exchange among stakeholders. CDM comprises of representatives from air navigation service providers, airport operations (e.g. stand and gate management), ground handling services, aircraft operators, military and other stakeholders who work together to create technological and procedural solutions to the ATFM challenges faced by the network stakeholders.

The goal of CDM is a safe, efficient, secure and sustainable air navigation system that provides flight operators the flexibility to operate within their own capabilities and economic objectives. While supported by a variety of tools and technologies, collaboration transcends specific programs and fosters a more efficient and reliable way to achieve system goals by including ATFM stakeholders in the decision-making process. By sharing information, values and preferences, stakeholders learn from each other and build a common pool of knowledge, resulting in Air Traffic Management decisions and actions that are most valuable to the system.

Under the CDM principle, aviation stakeholders view each other as “partners” collaborating with the common goal of delivering high-quality air transport products or services that are attuned to the needs of the flying public and the overall economy.

2.2. Expected Results

The expectations the partners have of CDM are to a large extent identical, but they also include explicit requirements.

2.2.1. General

- Automated and timely data exchange
- Optimised use of available capabilities in all conditions
- Reduced engine run times
- Transparency concerning sequence for all users
- Higher planning accuracy and planning reliability of operational processes
- Increase efficiency from improved punctuality

2.2.2. Airline/ground handling

- Optimised turn-around times
- Taking into account preferences and priorities (start-up sequence)
- More efficient use of airline and/or handling resources
- Reduced waiting times at the runway
- Minimised impact of delayed arrival on the punctuality of the subsequent departure

Airlines will benefit most from the implementation of CDM. Fewer missed connections for passengers will mean a decrease in compensation paid. And there are reduced fuel costs due to shorter taxi times and shorter turn-around times. This has another major benefit to the environment in terms of emission and noise abatement. Increased predictability also means schedule buffering can be reduced, which has a positive impact on airline operating costs. Ground handlers will find that increased predictability enables better planning, leading to more

efficient use of existing manpower and equipment with subsequent reduction in operating costs.

2.2.3. Airport

- Improved adherence to airport slots
- Optimised consideration of customer wishes
- Better utilisation of infrastructure, e.g. aircraft stand/gate management
- Improve public information data quality

Airports will achieve better use of airport resources and infrastructure (manpower, equipment, or stands and gates) through having the right information at the right time for the right people.

2.2.4. Air Navigation Service Providers

- Optimisation of pre-departure sequence and departure flows
- Increase and optimise runway throughput
- Optimised restart after interruptions
- Reduced engine run times

ANSPs will benefit from better use of resources (e.g. maximise runway capacity) and this will possibly lead to cost avoidance. ATC may see the smaller quantifiable benefit but will see major qualitative improvements in work processes.

2.3. Bangkok – Singapore CDM Project

Under the auspices of CANSO, the aviation partners in Malaysia, Singapore and Thailand agreed to launch a pilot “Bangkok – Singapore CDM Project” in June 2011 with the aim of improving air traffic management efficiency between the two major cities in the Asia-Pacific region

The pilot CDM project seeks to demonstrate potential efficiency gains from implementation of CDM on all phases of flight (Figure 1) in the Bangkok – Singapore city pair from scheduling, flight planning, surface movement at airports, integration with en-route CDM processes and post-operational reviews in order to enable seamless ATM operations from all partners’ perspectives.

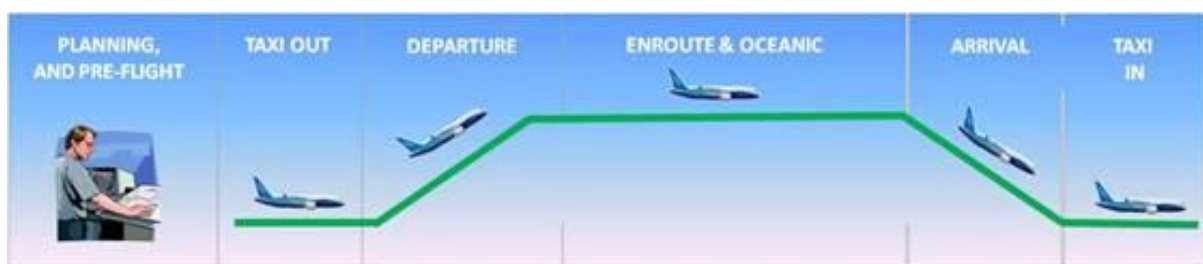


Figure 1 – Phases of a Flight

3. Scope and Objective of Bangkok-Singapore CDM Project

The project team, co-led by Aeronautical Radio of Thailand Ltd (AEROTHAI) and Civil Aviation Authority of Singapore (CAAS) and supported by CANSO, comprises members from Department of Civil Aviation of Malaysia (DCA Malaysia), Airports of Thailand (AOT), Changi Airport Group (CAG), Singapore Airlines (SQ) and Thai Airways (TG). The Concept of Operations developed by the project team involved data sharing over a secured public internet connection among the relevant aviation partners (Figure 2).

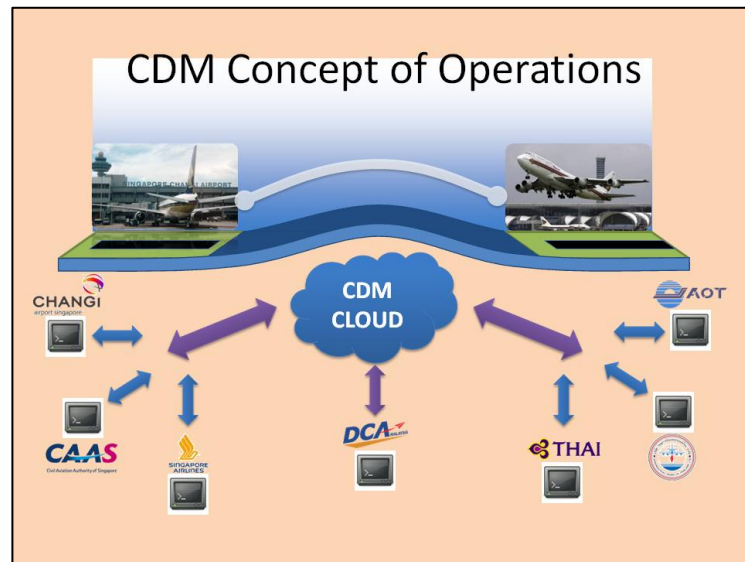


Figure 2 – Concept of Operations

The CDM project’s inaugural trial was held from 23 Jul – 29 Jul 2012 involving eight daily return flights operated by Singapore Airlines and Thai Airways. The information on the flights was shared using an information sharing template (Figure 3) on an Excel Spreadsheet hosted on Microsoft SkyDrive™.

ID	Carrier	Flight No.	Aircraft Type	ADEP	ADES	STD Date	STD	STA Date	STA	SOBT	STOT	SLDT	SIBT	WMFC TCP Entry EET	WMFC TCP Exit EET	Total Flight Time	TOBT	ADEP Stand	ADEP RWY
S1	SIA	972	B772	WSSS	VTBS	18-Aug	1:40	18-Aug	4:05	1:40	2:00	3:55	4:05	0:23	0:46	2:02	1:40	F58	R20C
S2	SIA	975	B772	VTBS	WSSS	18-Aug	5:30	18-Aug	7:55	5:30	5:50	7:45	7:55	1:06	1:29	1:55	5:30	0	19L
S3	SIA	974	B772	WSSS	VTBS	18-Aug	4:55	18-Aug	7:20	4:55	5:15	7:10	7:20	0:23	0:46	2:02	4:55	F58	R20C
S4	SIA	977	B772	VTBS	WSSS	18-Aug	8:30	18-Aug	10:55	8:30	8:50	10:45	10:55	1:06	1:29	1:55	8:30	0	19L
T1	THA	403	B773	VTBS	WSSS	18-Aug	1:00	18-Aug	3:15	1:00	1:20	3:05	3:15	1:01	1:23	1:59	1:00	0	19L
T2	THA	404	B773	WSSS	VTBS	18-Aug	4:25	18-Aug	6:45	4:25	4:45	6:35	6:45	0:24	0:44	2:04	4:25	C20	R20C
T3	THA	413	AB6	VTBS	WSSS	18-Aug	4:15	18-Aug	6:30	4:15	4:35	6:20	6:30	1:06	1:29	2:03	4:15	0	19L
T4	THA	414	AB6	WSSS	VTBS	18-Aug	7:55	18-Aug	10:15	7:55	8:15	10:05	10:15	0:24	0:46	2:03	7:55	C24	R20C

	TTOT	WMFC Entry	WMFC Planned Entry	WMFC Exit	WMFC Planned Exit	TLDT	ADES RWY	ADES Stand	TIBT	WMFC Actual Entry	WMFC Actual Exit	ALDT	AIBT
S1	2:20	VPK	2:44	VKB	4:45	4:21	19R	0	4:31	2:41	3:03	4:22	0:00
S2	5:50	VKB	6:49	VPK	7:11	8:12	R20R	F40	8:22	6:46	7:08	7:41	7:46
S3	5:13	VPK	5:30	VKB	5:50	7:10	19R	0	7:20	5:30	5:53	7:12	0:00
S4	8:50	VKB	9:50	VPK	10:12	11:06	R20R	F40	11:16	9:47	10:09	10:54	10:40
T1	1:20	VKB	2:28	VPK	2:54	3:59	R20R	C20	4:09	2:26	2:49	3:17	3:23
T2	4:40	VPK	4:57	VKB	5:18	6:40	19R	0	6:50	4:57	5:19	6:37	0:00
T3	4:35	VKB	5:29	VPK	6:41	6:59	R20R	C24	7:09	5:27	5:49	6:18	6:25
T4	8:19	VPK	8:29	VKB	8:50	10:12	19L	0	10:22	8:31	8:53	10:16	0:00

Figure 3 – Information Sharing Template

The information sharing template contained constantly updated information for all phases of flight in terms of scheduled, targeted, and actual times and is divided into the following worksheets:

Worksheet	Partner(s)	Description
ANSP-Departure	AEROTHAI, CAAS	Information worksheet for departure ANSPs (Tower and ACC)
ANSP-En Route	DCA Malaysia	Information worksheet for Kuala Lumpur ACC
ANSP-Arrival	AEROTHAI, CAAS	Information worksheet for arrival ANSPs (Tower and ACC)
Airport Operator-Departure	AOT, CAG	Information worksheet for Airport Operators for departures
Airport Operator-Arrival	AOT, CAG	Information worksheet for Airport Operators for arrivals
Airline-TG	Thai Airways	Information worksheet for Thai Airways
Airline-SQ	Singapore Airlines	Information worksheet for Singapore Airlines
Master Data		Common Information Worksheet shared by all based on information from other worksheets
Variable Taxi-Out		Taxi-Out Time Database for Singapore Changi Airport and Suvarnabhumi International Airport
Variable Taxi-In		Taxi-In Time Database for Singapore Changi Airport and Suvarnabhumi International Airport
Configuration		Configuration worksheet for defaults such as default taxi-out and taxi-in times

The following data are shared through the information sharing template:

Partner(s)	Data Provided
Aircraft Operators	<ul style="list-style-type: none"> - Flight Schedule: call sign, aircraft type, departure and arrival schedule - Flight Plan Information: Elapsed Time information when aircraft control expected to be handed over to Kuala Lumpur ACC, Elapsed Time information when aircraft control expected to be handed over from Kuala Lumpur ACC to final destination ACC, total elapsed time - Target Off-Block Time (TOBT): expected time aircraft will be in position to push back from departure aircraft stand; updated 40 minutes, 10 minutes prior to schedule departure and when significant changes occur
Airport Operators	<ul style="list-style-type: none"> - Aircraft Stand / Gate Allocation of aircraft in question: initial plan, updated 40 minutes, 10 minutes prior to schedule departure and arrival
Departure ANSPs	<ul style="list-style-type: none"> - Runway Allocation of participating aircraft on departure - Actual time at Transfer of Control Point to Kuala Lumpur ACC
En Route ANSP	<ul style="list-style-type: none"> - Actual time at Transfer of Control Point to final destination ACC
Destination ANSPs	<ul style="list-style-type: none"> - Runway Allocation of participating aircraft on arrival - Target Landing Time (TLDT): updated 40 minutes, 10 minutes prior to schedule arrival and when significant changes occur

The participating stakeholders involved in the different phases of Bangkok-Singapore flight were required to provide and input data into the “interim” platform for CDM information sharing. Figure 4 illustrates the sequence of events and the required inputs.



Figure 4 – Sequence of events

The trial which allowed partners to familiarize themselves with the CDM concept of operations showed that the data sharing platform and the information template had enabled all stakeholders to share a common picture of the flights in progress. The issues encountered during the trial and lessons learnt were used to fine-tune processes for a second trial.

The second trial took place from 13 Aug – 19 Aug 2012 incorporating process enhancements based on lessons learnt from the first trial. This included the use of operational journals to capture the observations and operational outcomes from the CDM process.

A Post-Trial Review meeting was held to review and evaluate outcomes from the trials. The Post-Trial review also marked the first CDM meeting attended by International Air Transport Association (IATA) and Airports Council International (ACI). Both industry partners voiced strong support for the project in enhancing cooperation among aviation partners in the region.

From the trial data and journals, the project team identified several qualitative benefits from the project which could potentially be quantified. An over-arching benefit was the ability of the stakeholders to better plan the operational execution of the participating flights.

4. Analysis of Trial Data

A total of 112 flights were involved in the 2 weeks trial with 8 daily flights from SQ and TG. During the second trial conducted in August, daily operational journals were kept by stakeholders participating in the trial for monitoring and planning purposes. A comparison of the following parameters of the trial data was made;

	Predictability KPIs	Punctuality KPIs
Off-Block Time	TOBT vs AOBT	SOBT vs AOBT
Landing Time	TLDT vs ALDT	
In-Block Time	TIBT vs AIBT	SIBT vs AIBT

It was expected that CDM information sharing among aviation partners would provide benefit in flight operations predictability as operations center on shared target times rather than operations based on schedules. Therefore, comparison was made between predictability KPIs (how close shared target times are to actual operations) and punctuality KPIs (how close scheduled times are to actual operations).

Initially, KPI analysis was taken with 5-minute window, i.e. for Off-Block Time Predictability, comparison of TOBT being within 5 minutes before or after AOBT. The following KPIs were observed while not including data points where AOBT and AIBT were not recorded:

	Week 1: 23 – 29 Jul 2012		Week 2: 13 – 19 Aug 2012	
	5-minute Window Predictability KPIs	5-minute Window Punctuality KPIs	5-minute Window Predictability KPIs	5-minute Window Punctuality KPIs
Off-Block Time	52.27%	45.45%	60.00%	55.56%
Landing Time	56.36%		60.71%	
In-Block Time	56.10%	48.78%	36.84%	34.21%

Increasing time window specified from 5-minute window to 15-minute window provided the following results (not including data points where AOBT and AIBT were not recorded):

	Week 1: 23 – 29 Jul 2012		Week 2: 13 – 19 Aug 2012	
	15-minute Window Predictability KPIs	15-minute Window Punctuality KPIs	15-minute Window Predictability KPIs	15-minute Window Punctuality KPIs
Off-Block Time	84.09%	77.27%	84.44%	75.56%
Landing Time	90.91%		87.50%	
In-Block Time	90.24%	80.49%	73.68%	73.68%

It can be observed from trial data that the effort of the airlines in updating Target Off-Block Time (TOBT) pays off in increasing predictability KPIs both with 5-minute window and 15-minute window beyond traditional information provided by comparison of actual information against schedule (punctuality KPI for the purpose of CDM trial). Meanwhile, In-Block Time predictability was also better when compared to operations solely based on schedule (punctuality KPI for the purpose of the trial).

The trial results were encouraging and showed that quantifying benefits and measuring performance from the trial data may be feasible. Two examples of benefits that resulted from the trial are as follows;

- a. Although a flight from Bangkok to Singapore had departed 30 minutes late, the airport operator in Singapore was able to make use of the flight's up-to-date arrival time in Changi to better resource manage their ground handlers and airport operators. There was no requirement to allocate a new gate to the arriving flight. With improved predictability the airline could also reduce its built-in time buffer for the arriving flight.
- b. By having knowledge of the TOBT of airlines, ATC Ground Controllers in Changi Tower were able to better plan the push-back sequences of aircraft at departure gates and minimise the flights' departure delay.

With CDM, pre-departure sequencing was collaborative. ATC had a complete picture of when each flight would be ready based on TOBTs published by airlines or ground handlers. Taking into account additional constraints such as TTOTs and the current traffic situation tower controllers were able to optimise the pre-departure sequence and set the TSATs accordingly. This optimised pre-departure sequence led to more accurate TTOTs.

These qualitative benefits showed that CDM was beneficial and desirable. Other examples include better working environment (ATC), improved customer satisfaction (Ground Handlers), improved overall image (Airport) and higher quality of service (ATC). Even when they cannot be easily quantified at this stage of the project, these benefits may still be very important to decision makers.

The resulting improvements in resource usage, schedule maintenance and flexibility in reacting to events benefit airspace users, airport operators, handling agents as well as air navigation service providers. With CDM, the local benefits expand into the ATM network as a whole, thus further increasing the positive impact.

5. Conclusions

While benefits should be expressed in monetary terms in order to be compared against CDM implementation costs, it should be noted that a benefit need not always be quantifiable to be recognized as a real benefit.

In the trials conducted during the CDM project, several benefits could not be quantified. There were several reasons for this (availability of time and resources, difficulty in finding a consensus yardstick for measurement, etc.) In such cases, effort was placed on assessing the benefit in qualitative terms. While intangible benefits cannot be quantified, they are still important for decision makers, hence the need to recognize and document them.

Nevertheless it is clear from this pilot project that a system wide approach to CDM will deliver significant benefits to all stakeholders in terms of enhanced predictability, greater flexibility and better use of resources.

From the perspective of CDM, it is significant that cost benefit analyses should be carried out to date shows a compelling case, for all the partners, to implement CDM as a very cost effective operational efficiency enabler. Taking into account the fact the analyses have been based on very conservative assumptions, the results can lead to only one recommendation, namely to start and if possible, to expand or to accelerate the implementation of CDM, as this will increase the overall benefit, including Network Benefits.

The review of the trials also noted the information updates by airport stakeholders were not consistent. While there was great enthusiasm in the build-up of the project, the anticipated actions during the trials were not immediately carried out. This could be due to a perception that the reliability of the information from CDM did not contribute to the potential benefits mentioned previously. The project team concluded that it would be essential for the relevant staff of all stakeholders to 'buy in' to the CDM concept so that CDM behavior is properly exhibited by the parties involved. CDM implementations have been 'tool-driven' rather than process driven and information sharing tools are clearly important.

6. Beyond Bangkok – Singapore Whole – Flight CDM Trial

The next phase of the CDM project will be to conduct trials encompassing automated linking of information updates. This will relieve the burden on operators of having to enter information manually thus leaving them to concentrate on analyzing the information coming in to make operational changes or decisions.

As of January 2013, AEROTHAI and CAG, in cooperation with all partners involved, are continuing to explore automated information exchange to enable operators to concentrate more on using information provided to enhance operations. In the initial stage, EUROCONTROL message DPI and FUM used to communicate between Airport CDM and EUROCONTROL Network Manager are being considered along with utilization of existing AFTN/ATN network in order to speed up data exchange setup.

It is envisaged that these messages may have to be further tailored and extended to contain appropriately required information.

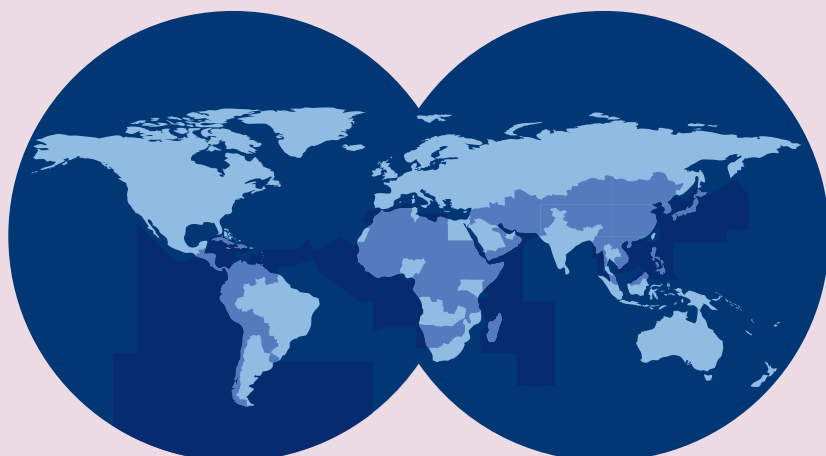
Once automated data exchange is setup, it is envisaged that a semi-automated trial with more Bangkok – Singapore flights as well as expansion to include Hong Kong would be feasible.

In accordance to ICAO Flight and Flow – Information for Collaborative Environment concept (FF-ICE, Doc 9965), information exchange would eventually transition to exchange based on Flight Information Exchange Model (FIXM) with System-Wide Information Management (SWIM) as underlying communications link.

CANSO Members

CANSO – The Civil Air Navigation Services Organisation – is the global voice of the companies that provide air traffic control, and represents the interests of Air Navigation Services Providers worldwide.

CANSO members are responsible for supporting over 85% of world air traffic, and through our Workgroups, members share information and develop new policies, with the ultimate aim of improving air navigation services on the ground and in the air. CANSO also represents its members' views in major regulatory and industry forums, including at ICAO, where we have official Observer status. For more information on joining CANSO, visit www.canso.org/joiningcanso.



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- ENANA-EP ANGOLA
- ENAV S.p.A: Società Nazionale per l'Assistenza al Volo
- Entidad Pública Aeropuertos Españoles y Navegación Aérea (Aena)
- Estonian Air Navigation Services (EANS)
- Federal Aviation Administration (FAA)
- Finavia Corporation
- GCAA United Arab Emirates
- General Authority of Civil Aviation (GACA)
- Hellenic Civil Aviation Authority (HCAA)
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- NATA Albania
- National Airports Corporation Ltd.
- National Air Navigation Services Company (NANSC)
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- NAV CANADA
- NAV Portugal
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- LAIC Aktiengesellschaft
- LEMZ R&P Corporation
- LFV Aviation Consulting AB
- Micro Nav Ltd
- The MITRE Corporation – CAASD
- MovingDot
- New Mexico State University Physical Science Lab
- NLR
- Northrop Grumman
- NTT Data Corporation
- Project Boost
- Quintiq
- Rockwell Collins, Inc.
- Rohde & Schwarz GmbH & Co. KG
- RTCA, Inc.
- Saab AB
- Saab Sensis Corporation
- Saudi Arabian Airlines
- SENASA
- SITA
- STR-SpeechTech Ltd.
- TASC, Inc.
- Tetra Tech AMT
- Washington Consulting Group
- WIDE