

**For discussion
on 12 April 2016**

**Legislative Council Subcommittee
to Follow Up Issues Relating to the
Three-runway System at the Hong Kong International Airport**

**Runway Capacity Related Issues
and Pearl River Delta Region Airspace Management**

Introduction

This paper addresses issues relating to (i) the runway capacity of Hong Kong International Airport (HKIA), including the constraints faced by the current two-runway system (2RS); and (ii) the airspace management plan for the Pearl River Delta (PRD) region to ensure the compatibility of the future HKIA three-runway system (3RS) with other airports in the PRD region.

Factors Affecting Airport Handling Capacity

2. The major factors which determine airport handling capacity are runway capacity, airspace¹ management and capacity, and terminal facilities. To enhance the handling capacity of an airport, one could expand the physical infrastructure (such as adding more runways or terminal buildings), or improve flight path design and airspace management, or a combination of both, depending on which factor(s) is /are constraint(s).

¹ “Airspace” is a generic term of any space above the Earth. The global airspace is coordinated and designated by ICAO to various authorities for the purpose of air traffic services provision.

(A) Issues Related to Runway Capacity

3. Runway capacity is defined by the International Civil Aviation Organization² (ICAO) as the number of flight movements which civil aviation authorities determine can be safely operated. It is usually presented as the number of landings and take-offs per hour. The number is affected by various factors such as the required minimum safe distance between aircraft (which may also be expressed in terms of time), terrain, operating environment, airport's infrastructure, aircraft mix, etc.

4. For HKIA, the airport handling capacity is presently constrained by its runway capacity. The capacity of the existing 2RS is, in turn, mainly constrained by two factors about which the ICAO has strict requirements and standards:

- (a) the need for safe distance between aircraft due to the spiral air vortex generated by operating aircraft; and
- (b) the surrounding terrain near the runway.

5. Both factors are related to air traffic control (ATC). A detailed description of ATC is provided in **Annex A**. In very brief terms, the objective of ATC is to keep aircraft separated at safe distance but at the same time, maximise the flow of air traffic through the airport and the airspace to achieve efficiency. In Hong Kong, ATC service is provided by the Civil Aviation Department (CAD) whose main responsibility, among others, is to maximise the runway capacity and air traffic movement (ATM) throughputs at HKIA while ensuring the highest level of aviation safety. The two factors are explained in further detail below.

(a) Requirement for safe distance between aircraft

6. If two aircraft flying along the same trajectory are too close to each other, the one behind may lose balance due to the air vortex generated by the leading aircraft. This is known as wake turbulence and can be very dangerous. Therefore, the ICAO requires that a minimum safe distance be maintained between aircraft during takeoff and landing. The heavier the

² ICAO, a specialised agency of the United Nations, was established in 1944 to promote the safe and orderly development of international civil aviation. It works with its Member States and global aviation organisations to develop international standards and recommended practices.

aircraft, the stronger the wake turbulence will be created thus a larger distance would be required. After one aircraft takes off, the next aircraft has to wait until wake turbulence subsides before taking off. The same rule applies to landing. Consequently, the capacity of a runway is limited by such safety arrangement. More details on this topic are provided in **Annex B**.

(b) Terrain consideration

7. The terrain of Lantau Island is one of the primary constraints to the capacity of HKIA which precludes any aircraft operations to the immediate south of the existing runways. There are misplaced views claiming that HKIA's 2RS should be able to achieve at least 80 movements per hour³, similar to the London Heathrow Airport of the United Kingdom, which also operates as a 2RS. We need to clarify that whereas the topography around Heathrow Airport is generally low, the south of HKIA is barricaded by numerous high terrains particularly the stretch of mountains on Lantau Island such as Lantau Peak, Sunset Peak and other high mountains. As such, HKIA can only adopt either segregated mode⁴ or dependent mixed mode⁵. Currently, the **HKIA is operating under segregated mode⁶. It is unable to adopt other operation modes such as independent mixed mode^{7,8}** notwithstanding

³ As compared with 68 movements per hour which is derived based on "Airspace and Runway Capacity Study" conducted by National Air Traffic Services (NATS) and commissioned by the Airport Authority of Hong Kong.

⁴ At present, the two runways at HKIA are operating on "segregated mode", meaning that one runway is exclusively used for departures, and another exclusively for arrivals. Under normal circumstances, the south runway is exclusively for departures while the north runway exclusively for arrivals.

⁵ Under dependent mixed mode, both runways are used for departures and arrivals. However, for safety reason, arrivals to different runways are required to be staggered as if they are approaching the same runway. Similarly, departures from different runways are required to be staggered as if they are departing from the same runway.

⁶ Dependent mixed mode has not been adopted since it involves more complicated mode of runway operation yet the maximum capacity of the 2RS under this mode of operation would be the same as segregated mode, i.e. no capacity gain.

⁷ Under independent mixed mode, both runways are used for a mixture of departures

that it may result in higher runway capacity. In order to satisfy those ICAO requirements⁹ for independent mixed mode operation, based on preliminary assessment, part of the apex of most peaks on Lantau Island, including Lantau Peak, Sunset Peak, etc, will have to be removed. Hence such operation was neither safe nor practicable.

8. There are also views that if the peaks of Tai Yam Teng (大陰頂) (610 feet) and Fa Peng Teng (花瓶頂) (810 feet) were removed, the runway capacity of 2RS at HKIA could be further increased thus enhancing the runway capacity. A similar suggestion could indeed be found in the New Airport Master Plan (NAMP) report in 1992, but the NAMP report only made this suggestion within the specific context of possible options to lower the climb gradient of **contingency departure procedures** for departures on engine out during initial climb (i.e. to reduce restriction on the aircraft engine out climb performance), **not** as a measure to increase runway capacity. To set the record straight, the NAMP report categorically stated that the terrain in and around Hong Kong precluded constraint-free operations within the low altitude airspace surrounding Chek Lap Kok¹⁰.

and arrivals. Simultaneous approaches to and departures from both runways can be conducted without the requirement of staggering of aircraft.

⁸ The National Air Traffic Services (NATS) reaffirmed findings in previous studies that independent mixed mode could NOT be supported by the two runways owing to the surrounding terrain. On the other hand, NATS stated that while dependent mixed mode can be supported by the existing two runways at HKIA, the maximum capacity of the 2RS under this mode of operation would still be 68 movements per hour.

⁹ The relevant ICAO requirements state that if an aircraft is observed to deviate from the final approach flight path of its landing runway towards that of the adjacent runway, ATC will have to instruct the aircraft on the flight path being intruded to climb and turn away in order to avoid the deviating aircraft. In this regard, since aircraft may need to be turned away from the final approach flight path at any point during the approach, a designated portion of airspace near the runways must be clear of obstacles to safeguard the execution of an immediate climb and turn manoeuvre.

¹⁰ “NAMP, Master Plan and Civil Engineering, First Interim Report” (vol. 1) 1992, para 5.2.3 “Airspace Utilization”.

9. Both NAMP and subsequent consultancy studies confirmed that what really limits HKIA's maximum runway capacity from achieving the high-end hypothesized runway capacity (i.e. 86 air traffic movements (ATMs) per hour) is the entire stretch of North Lantau terrain. In other words, unless most of the high peaks on Lantau Island were levelled, we are unable to operate the existing 2RS at noticeably higher capacity than 68 ATMs per hour while at the same time meeting ICAO safety requirements (see Annex C). If we were to level those high mountains, some crucial infrastructures/landmarks such as the Ngong Ping Cable Car, Big Buddha and Po Lin Monastery would be affected, not to mention that most of these areas fall within the boundaries of the Lantau Country Parks. Hence, the option is not practicable and 3RS is the only way to enhance capacity in a significant manner.

Previous studies on maximum capacity of the existing 2RS

10. To assess the capacity of the 2RS at HKIA, several studies have been conducted in the past, including the 1992 NAMP, the study by the Washington Consultancy Group (WCG) in 1994, and the study by National Air Traffic Services (NATS)¹¹ in 2008. Based on the 2008 study conducted by NATS, **the maximum practical capacity of the 2RS would be 68 ATMs per hour, or 420 000 ATMs per year.** It should be noted that such maximum capacity already represented a leapfrogged increase of ATMs from 55 per hour in 2008, mainly attributed to a basket of optimisation measures adopted by CAD. The details of the technical assessments are summarised in Annex D.

11. In October 2015, the runway capacity reached its practical maximum of 68 ATMs per hour. While both terminal facilities and runway capacities affect the airport handling capacity, in the case of HKIA, the limitation on the runway capacity is much more pressing and beginning to constrain the growth of HKIA. Therefore, developing a 3RS is the only viable means to further expand the capacity of HKIA to cater for future air traffic growth.

¹¹ NATS is the main air navigation service provider in the United Kingdom. It has also conducted similar study for London Heathrow Airport.

(B) Coherent PRD Airspace Development to Support 3RS of HKIA
PRD Region Air Traffic Management Planning and Implementation
Plan (Version 2.0)

12. To maximise the airport handling capacity of the HKIA upon increasing the runway capacity through implementation of 3RS, we also have to ensure compatibility with other major airports in the neighbourhood in terms of airspace management.

13. Within the PRD region, there are five major airports (namely, HKIA, Guangzhou Baiyun Airport, Macau International Airport, Shenzhen Bao'an Airport and Zhuhai Airport) and all have experienced phenomenal growth in air traffic volume. In order to enhance flight safety in the PRD airspace while supporting air traffic growth, the Civil Aviation Administration of China (CAAC), the CAD of Hong Kong SAR and the Civil Aviation Authority of Macao SAR (CAAM) jointly established a Tripartite Working Group (TWG) in 2004 to formulate measures to harmonise air traffic management arrangements in the PRD region. The TWG drew up the “Pearl River Delta Region Air Traffic Management Planning and Implementation Plan (Version 2.0)” (the 2007 Plan) in 2007, based on the principles of joint airspace planning, use of common standards, and harmonised flight procedure design such that the whole PRD airspace is considered as an entity, setting out various ATM enhancement measures to be adopted. In a nutshell, it is a joint effort of the three sides with an aim to ensuring that the use of airspace is optimised and flight procedures of the major airports in the PRD region are compatible with each other. Where necessary, adoption of common operational standards will also be considered. The overarching objective of the 2007 Plan is to optimise the utilization and management of PRD airspace, in a safe and efficient manner, for the mutual benefits the five major airports in the PRD region. Aviation safety is the priority of the TWG and the safety regulations on airspace management set out by the ICAO will be strictly adhered to. Flight safety will never be compromised.

14. The 2007 Plan covers assessments on the future air traffic demand of the PRD region, as well as analyses of the ATC environment and development. It also recommends measures to improve air traffic

management and planning of the PRD region, including a range of short, medium and long term measures to optimise the developmental opportunity and synergy of the five airports in the PRD region. By analysing the historic and projected growth of air traffic in the region, business development plan of individual airports as well as the structure of air space of individual FIRs, the 2007 Plan proposes measures relating to, for example, airspace planning, airspace operation standards, procedures and management. These measures are intended to deal with the growing demand arising from PRD air traffic growth. It also sets out the direction for TWG's future work, including further collaboration among the three civil aviation authorities to augment the strength and role of individual airports with an ultimate aim of achieving a more seamless, effective and optimised regional air space management system.

15. The 2007 Plan is a government-to-government agreement, the content of which has to be kept confidential. However, to balance the need to keep the public, including the aviation sector, posted of key progress made by the TWG, the three governments have announced from time to time the progress made in the successful phased implementation of short to medium term initiatives which have been implemented include the following :

- (a) establishment of two additional handover points and corresponding air routes between Hong Kong and Guangzhou Flight Information Regions ("FIRs")¹² to cater for flights overflying Hong Kong and landing in Guangzhou and Shenzhen;
- (b) establishment of new air routes for the eastern part of the Mainland and an additional handover point between Hong Kong and Guangzhou FIRs for flights operating between Hong Kong, Macao and the eastern part of the Mainland; and
- (c) adjustment of the Zhuhai airspace structure and establishment of peripheral flight paths in the PRD region.

¹² The airspace of the entire globe is divided into numerous Flight Information Regions (FIR); within each FIR, a designated civil aviation authority is responsible for providing ATC service so that aircraft flying anywhere in the world will receive such service to ensure aviation safety.

16. The above measures were announced in the form of press release and navigation charts/diagrams in the Aeronautical Information Publication of the respective civil aviation authority. Apart from the above, the three sides have made considerable progress in the adoption of common operational standards and completed the feasibility studies of some enhancement measures in preparation for the next phase of implementation.

17. The 2007 Plan has taken into account the operational need for 3RS of HKIA, as well as the planned development of other key airports in the PRD (including three runways in Shenzhen and eventually five runways in Guangzhou). The phased implementation of the Plan, which was agreed by all parties concerned, provides the basis for achieving the eventual target maximum capacity of 102 ATMs per hour under the 3RS operation at HKIA.

18. The 2007 Plan has been analysed and studied by technical experts from the Mainland, Hong Kong and Macao with the use of advanced evaluation techniques including fast time simulations, and has incorporated the advice of air traffic control experts of the three sides during its formulation. The CAD believes it is a practicable and feasible plan for mutual benefits, which will achieve a win-win situation for airport expansion on the three sides.

19. The CAD has been maintaining close liaison with the CAAC and the CAAM through the TWG to discuss the phased implementation of the enhancement measures set out in the Plan. Since the establishment of the TWG in 2004, more than 40 meetings at different levels have been held in the Mainland, Hong Kong and Macao, mainly attended by officers responsible for policies and technicalities from the civil aviation authorities of the three sides.

20. In 2015 alone, there were six coordination meetings on the establishment of new air routes for the eastern part of the Mainland. In addition, three high-level meetings were also held in May 2015 as well as January and March 2016 respectively. The high-level meeting held in Hong Kong on 23 March 2016 between CAAC, CAD and CAAM further discussed various PRD airspace enhancement issues on flight procedures

and airspace structure, and optimization of the airspace utilization in the region, and to pave the way for further high-level co-operation in the future. A press release was issued by CAD after the meeting, indicating CAAC's full support of HKIA's 3RS (See [Annex E](#)).

Ongoing implementation of the 2007 Plan

21. Implementation of the 2007 Plan is an ongoing exercise. As mentioned above, over the years a number of short-to-medium-term airspace enhancement measures in the 2007 Plan have been successfully implemented in a step-by-step, incremental manner. The three sides have been maintaining close liaison and will continue to deliberate on the work plans under the TWG platform, taking into account realistic situation at the time, in order to better manage PRD airspace and improve air route efficiency in a progressive manner. Technical details are subject to thorough joint study by the technical personnel from the three sides. The CAD will continue to contribute proactively to the discussions of the TWG in order to take forward the enhancement measures contained in the 2007 Plan in a pragmatic and progressive manner.

22. The 2007 Plan envisages, inter alia, a degree of “shared use” of airspace between Hong Kong SAR and the Mainland by adopting an ICAO-endorsed air traffic management arrangement known as “delegation of airspace”. Due to the close proximity of HKIA and Shenzhen Airport to the FIR boundary, there are lots of flight activities happening close to the boundary. Through “delegation of airspace” arrangement, the scarce airspace resources could be fully utilised by designating a relevant portion of airspace to a particular air traffic control unit handling the flights transiting that particular airspace for a streamlined provision of ATC service in order to enhance air traffic management efficiency. There are concerns about whether such arrangement would be in breach of Article 130 of Basic Law. Members may wish to know that this arrangement, when implemented, will not in any sense involve the allocation or alienation of civil aviation airspace from Hong Kong SAR to other jurisdiction. In fact, to enhance air traffic management efficiency, ICAO has been advocating that air route structure and air traffic management efficiency, rather than national boundaries, should be the prime considerations in planning the airspace. According to Chapter two of Annex 11 of the Convention on International

Civil Aviation promulgated by ICAO – Air Traffic Services, the delineation of airspace, wherein air traffic services are to be provided, should be related to the nature of the route structure and the need for efficient service rather than to national boundaries. Agreements to permit the delineation of airspace lying across national boundaries are advisable when such action will facilitate the provision of air traffic services. This kind of airspace management methodology is also a very common international practice, for instance between Singapore and Malaysia, and between Germany and Switzerland (see **Annex F**).

Full support of the Central People’s Government (CPG) for 3RS

23. The 3RS development receives full support from the relevant Central Authorities at various levels. At ministerial level, the Administrator of CAAC has repeatedly expressed his full support for the 3RS project during meetings with the Secretary for Transport and Housing and the Chairman of the Airport Authority of Hong Kong (AAHK).

24. At the State Council level, in the Guiding Opinion on promoting cooperation within the Pan-Pearl-River Delta region (《國務院關於深化泛珠三角區域合作的指導意見》) (“Guiding Opinion”) issued on 15 March 2016, it supports the development of the 3RS at the HKIA to reinforce Hong Kong's position as an international aviation hub. The CPG also encourages closer cooperation between the HKIA and airports in the nine provinces/regions of the Mainland. The Guiding Opinion clearly supports the coordinated management and utilization of pan-PRD airspace resources, to realise a healthy and orderly development of the cluster of airports in the PRD region.

25. The TWG will continue to conduct regular meetings and expert studies with a view to implementing enhancement measures of the 2007 Plan in a progressive manner. Meanwhile, to provide some temporary relief for improving runway capacity pending the completion of the 3RS, the CAD is exploring the use of incremental improvements such as better runway slot utilisation, new air traffic management technology, etc. Last but not least, the new ATC system which is scheduled for commissioning by CAD within 2016, will also improve the local air

traffic management capacity in phases.

On-going Effort to Enhance HKIA's Existing Capacity

26. To enhance handling capacity of HKIA, AAHK has been taking forward various initiatives including West Apron Expansion and Midfield Development Project. The former consists of 28 new parking stands and other related supporting facilities and has been fully operational since 2015. The latter would be taken in three phases: Phase 1 Project - Midfield Concourse, with 20 additional parking stands, - has come into full operation in March 2016 and will increase airport handling capacity by 10 million passengers per annum, whereas Phase 2 and Remaining Midfield Development would provide an extra 34 full service stands. The entire Midfield Apron is planned to be completed by 2020.

27. Meanwhile, given 3RS would only be completed by 2023, AAHK and CAD will continue to assess whether there are still technically feasible measures to further stretch the runway capacity of existing 2RS. Examples include possible refinement of existing airspace and flight paths. However, to increase HKIA runway capacity substantially, the prompt development of 3RS is absolutely necessary.

Advice Sought

28. Members are invited to note and discuss the issues covered in this paper.

**Transport and Housing Bureau
Civil Aviation Department
April 2016**

Introduction to Air Traffic Control

Objectives of Air Traffic Control

The primary objective of air traffic control (ATC) is to ensure that aircraft are separated with a minimum safe distance in accordance with the requirements specified by the International Civil Aviation Organization (ICAO). At the same time, however, ATC needs to expedite the flow of air traffic in order to minimise delay. These two demands upon ATC are often conflicting in nature because on the one hand, ATC needs to separate aircraft to ensure the minimum safe distance, but on the other hand, ATC needs to pack aircraft as closely as possible so as to maximize the number of aircraft landing and taking-off at the airport as efficiently as possible. At the Hong Kong International Airport one can see nowadays aircraft take-off and landing at the airport every minute during peak hours.

What Causes Aircraft Delay?

2. There is often a misconception that ATC causes delay. In reality, it is because too many aircraft arriving at the same time that exceeds the capacity of the runway so that ATC has to hold some aircraft in the air to await their turns for landing. We can use an analogy of a road system to illustrate the idea. Suppose the runway is compared to a cross-harbour tunnel so that the number of aircraft arriving for landing is similar to the number of vehicles trying to use the tunnel. The “cross-harbour tunnel” has a designed capacity, i.e. the maximum number of vehicles that can travel through the tunnel without delay. If, however, the number of vehicles simultaneously arriving at the tunnel exceeds the designed capacity, then congestion is bound to occur at the entrance of the tunnel so that cars have to queue up awaiting their turn to enter the tunnel. This is exactly what happens to air traffic too – i.e. congestion of aircraft waiting to land or take-off.

Flight Information Region and Airspace Arrangement

3. To understand how ATC works, we need to first understand some basic airspace arrangements. In accordance with ICAO arrangement, the airspace of the entire globe is divided into numerous Flight Information Regions (FIR); within each FIR, a designated civil aviation authority is responsible for providing ATC service so that aircraft flying anywhere in the world will receive such service to ensure aviation safety. In Hong Kong, Civil Aviation Department (CAD) is responsible for providing ATC service within the HK FIR. Figure 1 below depicts the approximate extent of HK FIR.

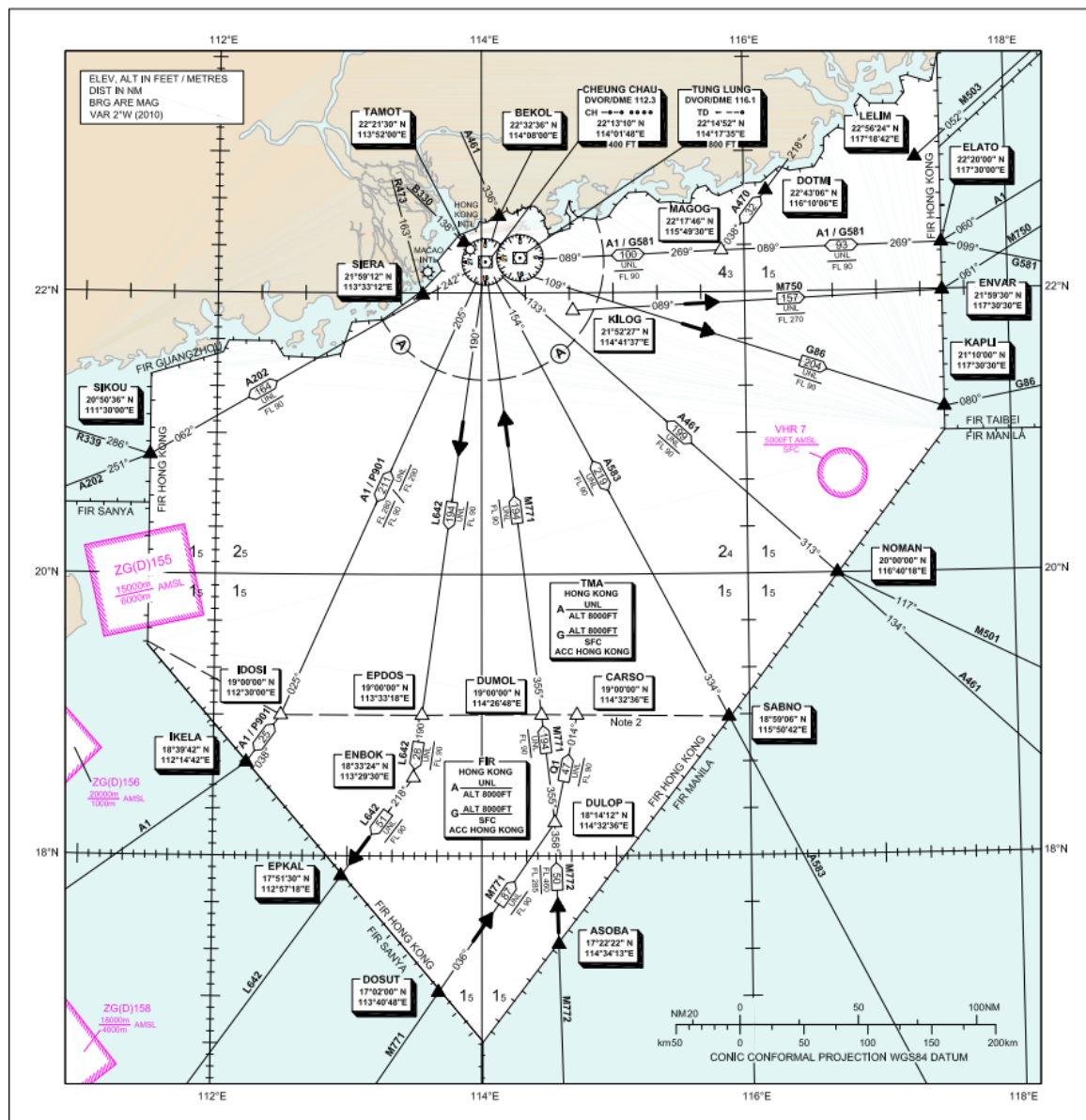


Figure 1

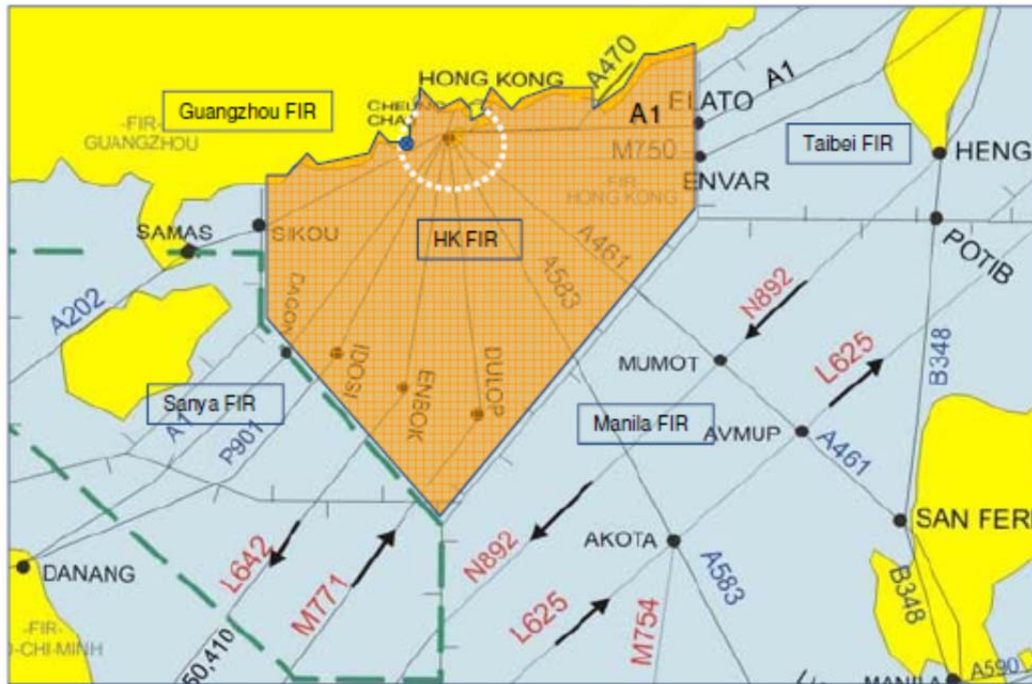


Figure 2

4. All aircraft flying within the FIR have to maintain two-way radio contact with ATC so that air traffic controller and pilot can communicate directly. Also, by making use of radar, ATC can maintain surveillance of the airspace to visualize the positions of aircraft flying within the FIR. Together, radar and radio are the “eyes” and “ears” of ATC.

5. Further, there are a number of airways established according to ICAO arrangement so that aircraft flying from one city to another city can travel on these air routes. These are the “highways” along which aircraft travel. Figures 1 and 2 also show the airways that are within the HK FIR and nearby FIRs respectively. At the FIR boundary, an aircraft will be released to the next ATC authority responsible for that FIR and the pilot will be instructed to change radio frequency accordingly. Using an example of a flight coming to Hong Kong from Taipei, the aircraft travels along Airway A1 within Taipei FIR (shown in Figure 2 as Taipei) until it reaches the boundary with HK FIR, at which point, the pilot changes radio frequency to contact HK ATC. Likewise for a flight departing to the east, HK ATC will release control of the flight to Taipei ATC when it reaches the FIR boundary.

6. As seen in Figure 1, the HK FIR covers a large airspace over the South China Sea, much larger than the territory of Hong Kong Special Administrative Region. To the east, southeast and southwest, the HK FIR extends to approximately 370 km from Hong Kong while the southernmost tip is almost 600 km away. North of HK FIR is the Guangzhou FIR. Apart from aircraft coming in to land at HKIA or departing from it, there are also many aircraft travelling across the HK FIR at high altitudes, these are called overflights. For example, an aircraft travelling from Taipei to Bangkok will enter the HK FIR from the east, overfly the HK FIR and exit to the west. There are also many overflights going into the Mainland or departing from it that overfly the HK FIR in a north-south direction. To have an idea of how busy the airspace is, HK ATC nowadays on average handle approximately 1,150 aircraft landing/take-off at HKIA and another 750 overflights every day. That means in total, HK ATC handles about 1,900 flights each day within our FIR.

Airspace Sectors

7. Due to the number of traffic moving through the airspace continuously, it is necessary to spread the workload amongst a number of air traffic controllers. Consequently, the HK FIR is sub-divided into smaller sectors. Each air traffic control position is responsible for providing ATC service within the airspace of its sector. Figure 3 below shows the different sectors in HK FIR; each sector is given a unique name.

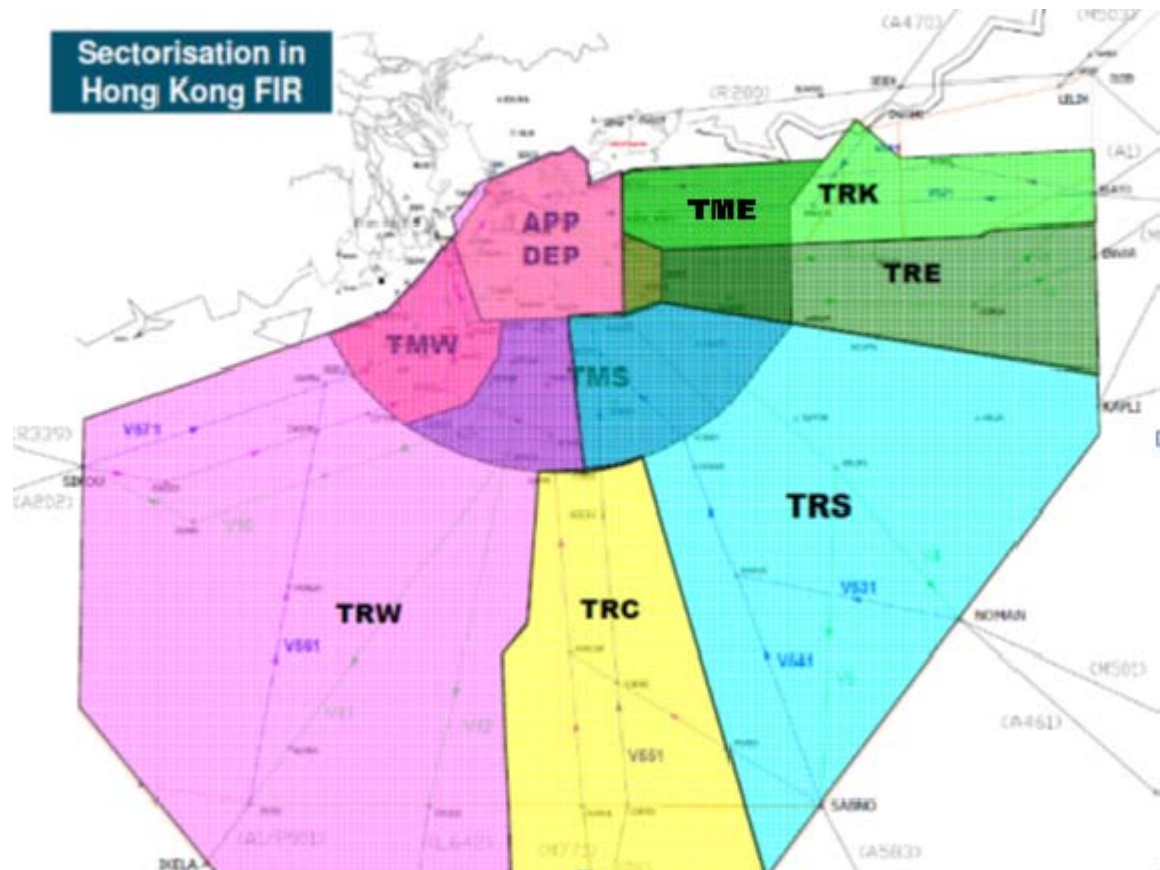


Figure 3

8. Thus, in the example of a flight coming in from Taipei FIR, the pilot first establishes contact with the sector TRK. The controller in this sector is responsible for providing ATC service to this flight until it reaches the boundary with the next sector TME, at which point, the pilot changes frequency to contact the TME controller, so on and so forth until the aircraft has landed and parked at the parking gate at the airport. Therefore, each flight is handled by a number of controllers consecutively once it enters the HK FIR. Such sectorisation arrangement aims to ensure that the workload within each sector is manageable so that the controller can safely handle all flights within his/her sector.

9. Obviously, if the number of aircraft within a particular sector starts to increase to a certain amount, it will eventually overload the sector and exceeds the handling capacity of this sector. As a result, no more flights can enter this sector and have to be held in the upstream sector(s). This can occur, for instance, when bad weather affects the airport so that aircraft cannot land safely and has to hold in the air to wait for weather improvement. This will first affect the APP sector in Figure 3 within

which holding of these arriving aircraft takes place. But at the same time, there are more arriving flights coming in from adjacent sectors, such as TME, TMS and TMW. If the situation continues, it will reach a point when APP cannot hold more aircraft and therefore, those upstream sectors need to start holding further arriving flights. This is analogous to a glass holding water up to a certain limit such that if more water is poured in, it will overflow. This example illustrates that the airspace in each sector has its own capacity limit. If the landing rate at the airport is smaller than the rate of arriving aircraft, such as due to bad weather, holding will occur. There have been a number of occasions in past years when due to the presence of typhoons or bad weather affecting landing at HKIA, holding of aircraft occurred in the upstream sectors to such an extent that HK ATC cannot accept more incoming aircraft. In those cases, we have to implement “flow control measure” – to request our adjacent FIRs, such as Taipei, Guangzhou, Manila and Sanya, to slow down the number of aircraft coming into HK FIR, either by holding these aircraft in their airspaces or to temporarily stop any flights that have not yet departed from their airports coming to HK.

Summary

10. To summarise, we need to separate aircraft safely but at the same time, we need to maximise the flow of air traffic through the airport and the airspace to achieve efficiency. Safety and efficiency are thus always the main concerns of ATC.

Spacing of Aircraft

Not only would the departing and landing rate of the runway at HKIA be affected by bad weather, it would also be limited by another determining factor – the minimum safe distance required between aircraft even under normal conditions. ICAO has currently classified aircraft according to their weight into four categories: Jumbo, Heavy, Medium and Light. The Jumbo category includes A380 and the Heavy category includes B747, B777, B787, A340, A330 etc. which commonly operate at HKIA on longer routes, while smaller aircraft which are in the Medium category such as B737, A310, A320 etc. usually operate on shorter regional routes.

2. Taking arriving aircraft as an example, because arriving aircraft follows one another on the approach path for landing (see Figure 1), the distance between two successive landing aircraft determines the number of landing aircraft the runway can accommodate within a given time – the closer the spacing between all landing aircraft, the more aircraft can land on the runway within any given time; this figure is expressed as the number of landing aircraft movements per hour.



Figure 1

3. As departing and landing aircraft would generate an unstable air vortex known as wake turbulence which may cause the following aircraft to lose balance, ICAO has specific requirements which govern the minimum spacing due to safety consideration. Generally speaking, if the aircraft in front is of a heavier weight category than the following aircraft, a greater spacing should be allowed. The table below illustrates how the weight category affects the landing interval due to greater spacing:-

<u>Weight Category</u>		
<u>Preceding aircraft</u>	<u>Following aircraft</u>	<u>Landing interval (approx.)</u>
Medium	Medium/Heavy	90 seconds
Heavy	Medium	115 seconds

4. At HKIA, the aircraft types that operate frequently contain both Heavy and Medium weight categories. The approximate distributions of these two categories are 60% Heavy aircraft and 40% Medium aircraft. A rough calculation shows that the average arrival spacing is approximately 105 seconds ($0.6 \times 115 + 0.4 \times 90$). In other words, there would be one aircraft landing at HKIA about every 105 seconds, and therefore in one hour, there are about 33-34 landing aircraft. This calculation also applies to departing aircraft because they are equally subject to the ICAO weight category spacing requirements. One could thus see that during the peak hours, our airport is operating at the maximum capacity level with the two runways.

5. The calculations demonstrate how Hong Kong ATC is currently operating at peak level safely and efficiently with the two runways at HKIA due to the need to comply with relevant ICAO requirements on minimum safe distance between aircraft of different weight categories.

Reference:

See ICAO Doc 4444 “Procedures for Air Navigation Services - Air Traffic Management” (15th edition, 2007), para. 8.7.3.4 for details

**Areas/ peaks to be levelled for 2RS to operate
under Independent Mixed Mode**

In order to satisfy the ICAO requirements for Independent Mixed Mode operation, based on preliminary assessment, part of the apex of most peaks on Lantau Island, including Lantau Peak, Sunset Peak, etc, will have to be removed (See Figure 1).

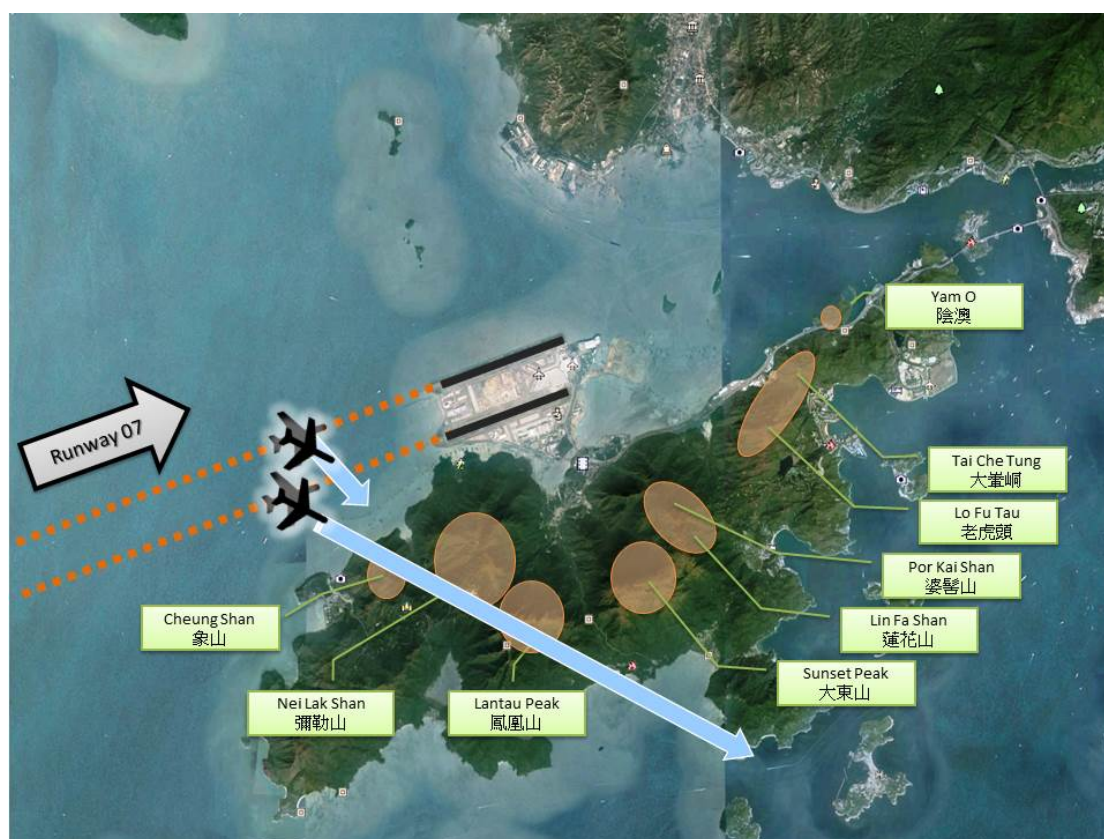


Figure 1

Figure 2 is a vertical cross section to illustrate the safety requirement.

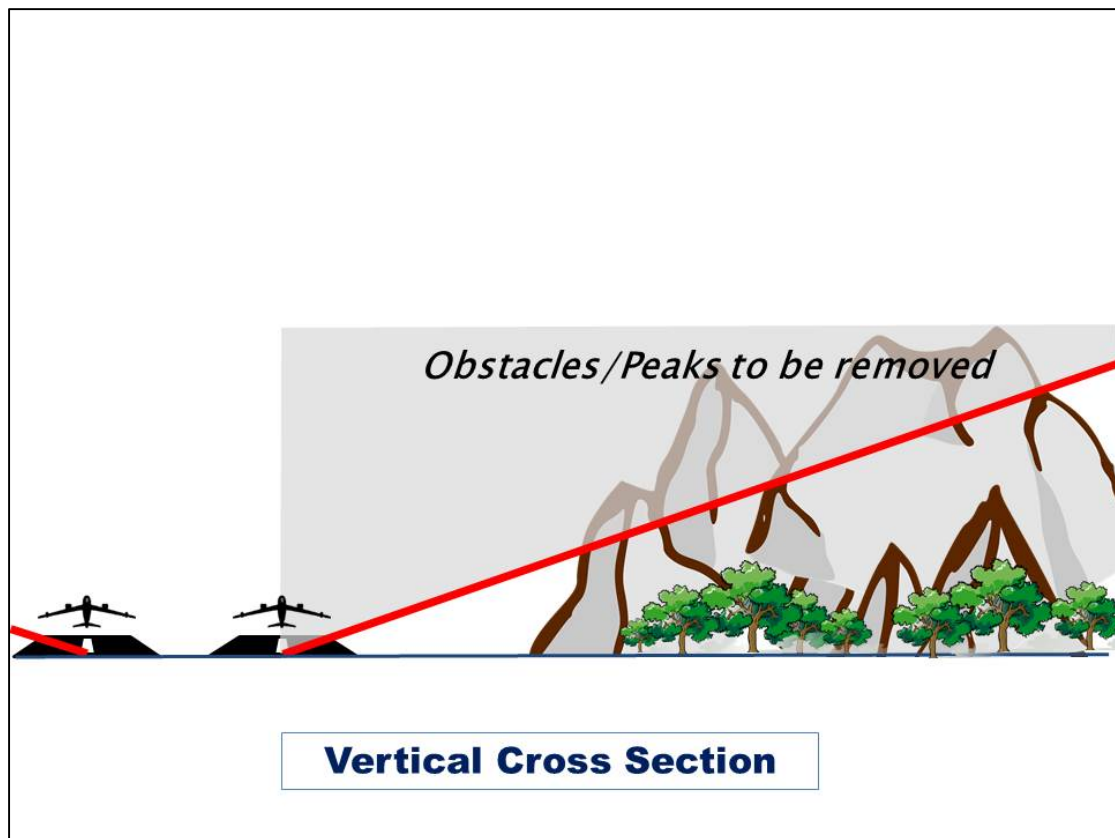


Figure 2

**Consultancy Studies on Capacity of the
Two-Runway System at HKIA**

Various studies [see [table 1](#)] in the past, including the New Airport Master Plan in 1992 (NAMP), the study by the Washington Consultancy Group in 1994 (WCG) and the study conducted by National Air Traffic Services (NATS)¹³ in 2008, have been conducted to assess the capacity of the two-runway system (2RS) at HKIA. According to the latest study conducted by NATS in 2008, the maximum practical capacity of the 2RS, in full compliance with the safety standard/requirements of the International Civil Aviation Organisation (ICAO), would be **68 air traffic movements (ATMs) per hour, or 420 000 ATMs per year**.

Table 1 Capacity study of 2RS

Year	Report	Runway Capacity (Movements per hour)
1992	New Airport Master Plan	52-86 (Theoretically)
1994	Airspace Design Consultancy	63
2008	Airspace and Runway Capacity Study	68

2. The report of NAMP in 1992 by the former Provisional Airport Authority pointed out that a pair of parallel runways under different modes of operation could in theory achieve different capacity ranging from 52 to 86 movements per hour (See table above). However, the NAMP report made clear that due to the mountains on the nearby Lantau Island, in order to achieve higher runway capacity, it would not be possible to operate in compliance with relevant ICAO standards on flight procedure, hence such operation was neither safe nor practicable.

¹³ NATS is the main air navigation service provider in the United Kingdom. It has also conducted similar study for London Heathrow Airport.

3. Following the report of NAMP, Civil Aviation Department (CAD) engaged Washington Consulting Group in 1994 to conduct in-depth study of air traffic control operations, surrounding terrain and airspace conditions etc. to design the flight procedures for HKIA at Chek Lap Kok in accordance with the ICAO standards. The study confirmed that, constrained by the surrounding terrain, **the maximum capacity of the two runways at HKIA was no more than 63 movements per hour.**

4. In 2008, AAHK commissioned the British Aviation expert NATS to conduct the “Airspace and Runway Capacity Study” for HKIA, taking into account the latest Air Traffic Control technology and international standards. NATS confirmed that, **after implementing 46 improvement recommendations** such as “Airfield Infrastructure Improvements”, “Air Traffic Control System Upgrade”, “Air Traffic Control and Flight Procedures Enhancement”, increasing the number of Air Traffic Control staff and enhancement in relevant training, etc., the capacity of the two runways at HKIA under **Segregated Mode** could be increased to **68 movements per hour.**

5. NATS has also studied if there would be capacity gain by changing the mode of operation of the two runways at HKIA from Segregated Mode to Dependent Mixed Mode, or even Independent Mixed Mode. NATS reaffirmed findings in previous studies that **Independent Mixed Mode could NOT be supported by the two runways owing to the surrounding terrain.** On the other hand, NATS stated that while **Dependent Mixed Mode** can be supported by the existing two runways at HKIA, the maximum capacity of the 2RS under this mode of operation would still be **68 movements per hour.**

6. Noting that there would be no capacity gain in switching the mode of operation to Dependent Mixed Mode, as well as the administrative/operational difficulties (including the considerable changes in training and infrastructure requirements e.g. departure management to balance the two runways, the more complex ground movement environment, etc.) arising from such a change, NATS did not recommend it for HKIA. **Currently, the HKIA is operating under Segregated Mode.**

7. Over the past years, CAD has, through various optimization measures of air traffic management, increased the maximum aircraft movements per hour at HKIA under the 2RS from 55 in 2008 to the current 68 which is the hourly maximum practical capacity. Subsequently, room for further increase in the annual air traffic movements would be very limited. The saturation of the 2RS is imminent.

Press Release issued by CAD on 23 March 2016

Meeting held between THB, CAD and Director General of Air Traffic Management Bureau of CAAC

Representatives from the Transport and Housing Bureau and the Director-General of Civil Aviation, Mr Norman Lo, today (March 23) met with the Director General of the Air Traffic Management Bureau (ATMB) of the Civil Aviation Administration of China (CAAC), Mr Che Jinjun, in Hong Kong to exchange views on various issues regarding the Pearl River Delta (PRD) region, including enhancement of flight procedures and airspace structure, and optimisation of the airspace utilisation in the region, and to pave the way for further high-level co-operation in the future on an ongoing basis.

During the meeting, representatives from the Civil Aviation Department (CAD) briefed the participants on the latest developments of the three-runway system (3RS) at the Hong Kong International Airport (HKIA). Mr Che said that the ATMB of the CAAC has all along strongly supported the airspace co-ordination work for the development of a new runway at the HKIA to strengthen Hong Kong's position as an international transport centre and to reinforce the HKIA as an international aviation hub.

With regard to the management and utilisation of the PRD airspace resources, Mr Che noted that the ATMB of the CAAC would continue to promote synergy and foster co-operation through the tripartite co-ordination mechanism, which comprises the Mainland, Hong Kong and Macau, in the aim of pushing forward the implementation of all airspace enhancement measures and achieving the ultimate target of implementing the Pearl River Delta Region Air Traffic Management Planning and Implementation Plan (the Plan) progressively in a gradual and orderly manner. This would bring about healthy and orderly development of the airports in the PRD region and give full play to the unique strengths of the region. This would also enable the 3RS of the HKIA to maximise its potential and to achieve the target runway capacity

of 102 air traffic movements per hour in the long run.

Mr Lo said that the State Council issued a guideline last week on promoting co-operation within the pan-PRD region which clearly stated that the Central People's Government supports the development of the 3RS at the HKIA to reinforce Hong Kong's position as an international aviation hub and for the closer co-operation between the HKIA and its neighbouring airports in the Mainland. The guideline also clearly supports the co-ordinated management and utilisation of pan-PRD airspace resources.

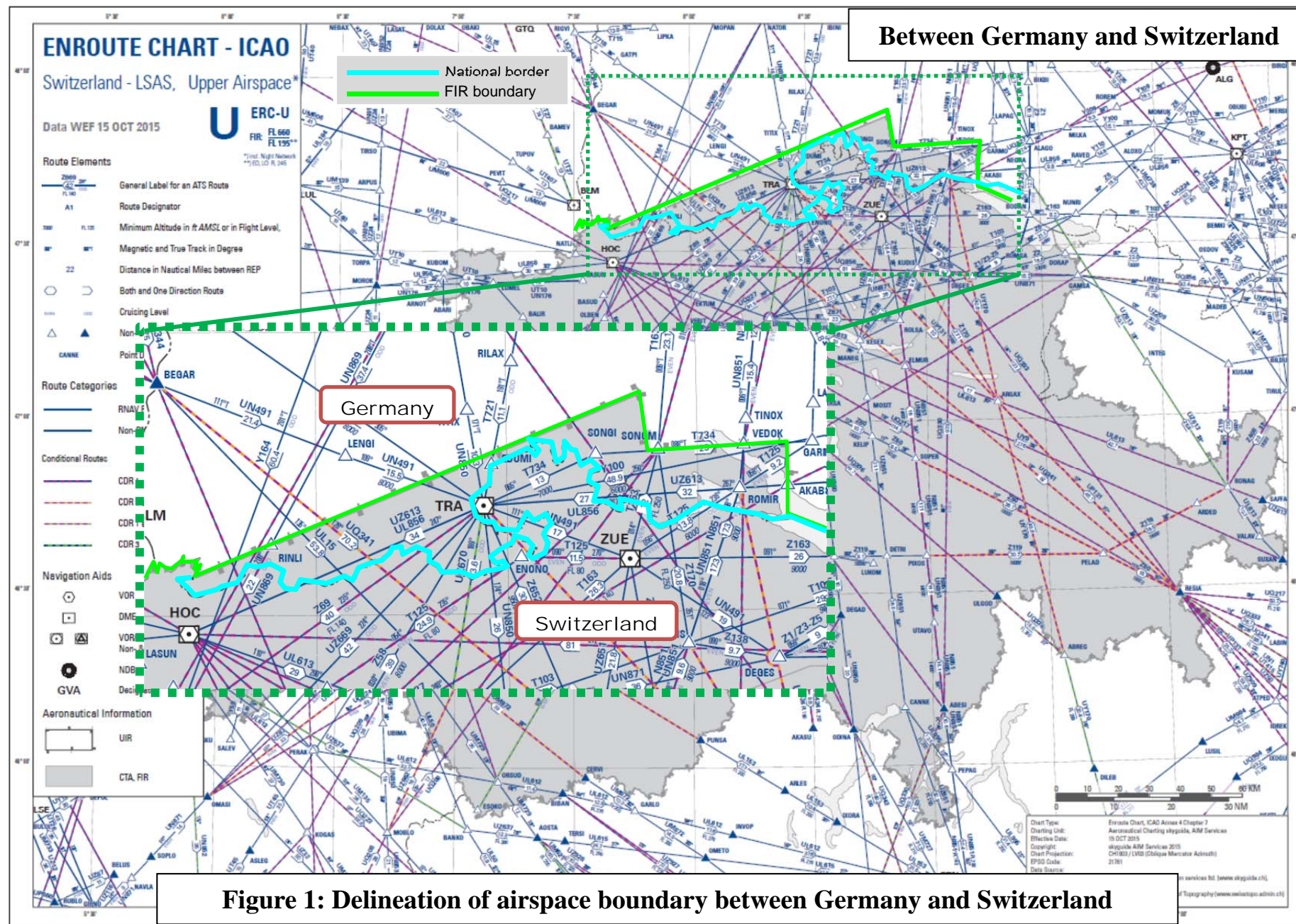
The meeting today also reaffirmed the positive impacts of the new air routes and associated additional handover point for traffic to and from the eastern part of the Mainland which were established in January this year, which have helped to enhance the number of flights between Hong Kong and the Mainland. In addition, the meeting also confirmed the enhanced tripartite high-level co-ordination mechanism. Representatives of the Mainland and Hong Kong also explored ways to improve the on-time performance of airlines.

The CAD, as in the past, will continue to proactively promote exchanges and co-operation on PRD region air traffic management, to pursue via the Tripartite Working Group various air traffic control and airspace enhancement measures as set out in the Plan to cope with the sustained growth of air traffic in the region and to meet the future development needs of all airports in the region.

Ends/Wednesday, March 23, 2016

Issued at HKT 18:55

Examples of delegation of airspace in other places



To ensure the safe and efficient operation of airports in the vicinity, an airspace delegation agreement is made between Singapore and Malaysia. In this example, a portion of airspace in Kuala Lumpur FIR, which is under the Malaysian civil aviation authority is delegated to Singapore air traffic control unit. Under this arrangement, Singapore ATC is responsible for the provision of air traffic control service in that specific portion of airspace. For illustration, see Figure 2 and Figure 3.

Figure 2: Singapore ATC is responsible for the provision of air traffic services in a portion of airspace in Kuala Lumpur FIR

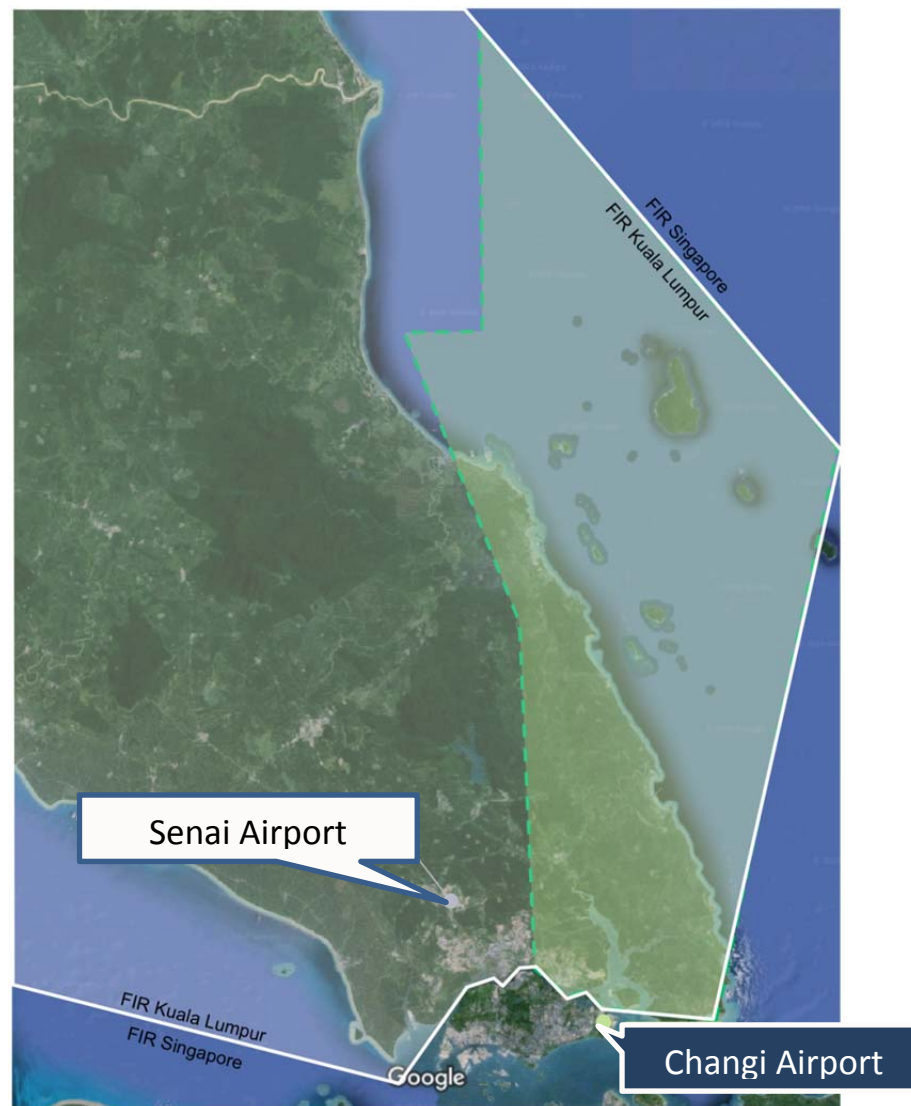


Figure 3: 3-D illustration of shared use of airspace between Malaysia and Singapore

