

**For information
on 13 December 2016**

Legislative Council Panel on Economic Development

Full Commissioning of the New Air Traffic Management System

Purpose

This paper supplements the information paper on the new air traffic control (ATC) system originally prepared for the meeting of the Legislative Council Panel on Economic Development (ED Panel) on 28 November 2016 (LC Paper No. CB(4)154/16-17(04)), which has been postponed to 13 December 2016. An account of an incident relating to the new air traffic management system (ATMS), one of the eight systems of the ATC system, which happened on 29 November 2016 is also provided for Members' information.

Follow-up Work on the Occurrences which Warranted Operational Optimisation

2. As mentioned in (LC Paper No. CB(4)154/16-17(04)), since its full commissioning on 14 November 2016, the new ATMS has been providing, safe, smooth and orderly air traffic services to flights operating in and out of the Hong Kong International Airport (HKIA) and through the Hong Kong Flight Information Region (HKFIR).

3. Like all large-scale change/upgrading of complicated computer systems and the introduction of all complex air traffic management systems in other airports, there were occurrences which warranted operational optimisation during the inaugural stage of the new ATMS operation. These occurrences did not affect aviation safety. For example, as CAD explained in public, the occurrences of “split tracks”, “false targets” and “aircraft positions not displayed temporarily” were caused by, among other external factors, the limitations of radar technology. The ATMS' developer, Raytheon, will undertake optimisation work in the light of the actual operations of the system. To fundamentally overcome the limitations of ground-based radar technology, the International Civil Aviation Organization (ICAO) advocates the implementation of satellite-based surveillance technology.

CAD has already built in a plan in its master schedule for migration to the new ATMS to extend the satellite-based “Automatic Dependent Surveillance - Broadcast (ADS-B)” system to cover the entire HKFIR. In fact, with effect from 14 November 2016, the first phase of the ADS-B implementation has been completed with ADS-B signal fed into the new ATMS for operational use, covering the southern portion of the HKFIR which has no radar coverage (under both the old and the new systems). The extension of the ADS-B coverage to the entire HKFIR is expected to be completed by end 2017, by which time the surveillance performance of the new ATMS will be further improved.

Incident Involving the Flight Data Processor (FDP) on 29 November 2016

4. On 29 November 2016, an incident occurred during which the radar screens of the new ATMS were unable to display some of the flight information temporarily (such as flight callsigns and flight speed) for about 26 seconds. Subsequent investigation showed that the issue was primarily caused by the number one Flight Data Processor (FDP#1) of the Main system which encountered a file access anomaly when it tried to access certain archived playback data. The system then activated an auto-protection mechanism as per design and initiated an auto-switchover to the number two FDP (FDP#2) of the ATMS’ Main System while putting the FDP#1 offline temporarily. After confirming the normal operation of the FDP#1, the technical staff restarted the FDP#1 promptly in accordance with the established procedures to make it serve as the standby FDP. During this process, the two data processors started to synchronise flight information. The data synchronisation process took priority and the flight plan association process was expected to take place shortly afterwards, resulting in the momentary flight plan dis-association.

5. During the entire occurrence, there was no loss or corruption of flight plan data, and that all other functions of the ATMS were functioning normally. Neither air traffic management nor aviation safety were affected. The Fallback System and the Ultimate Fallback System of the new ATMS, though not activated, were both operating normally and available for use at all times. CAD’s professional air traffic controllers are also well-prepared to handle different situations, including the situation concerned in which certain flight information could not be displayed temporarily, to maintain direct communications with the pilots at all times to ensure smooth and effective air traffic control services. For

the sake of prudence, CAD suspended the handling of departure flights at HKIA for 15 minutes during the incident, which affected 9 flights scheduled to depart during that period.

Further Actions to Enhance ATMS Performance

Follow up with Raytheon

6. Immediately after the incident on 29 November 2016, CAD tasked Raytheon to submit an incident report and propose the necessary fix within 48 hours. Raytheon submitted a report to CAD on 1 December 2016. To prevent recurrence, Raytheon proposed the necessary fix in the report through optimising operating procedures and system software. CAD has already put in place the refined operational procedures to minimise the risk of recurrence.

7. At the request of the Director-General of Civil Aviation (DGCA), the senior management of Raytheon met DGCA in Hong Kong on 6 December to follow up on the 29 November occurrence. Raytheon undertook to make the fix available within the week of 12 December, which would then be tested in accordance with the ICAO safety management process. Raytheon also agreed to carefully review all teething issues and conduct a comprehensive assessment, with a view to identifying effective solutions to speed up the optimisation of the new ATMS. Moreover, Raytheon will hold regular meetings and teleconferences with CAD, and take appropriate follow-up actions in a timely manner to ensure smooth operation of the system. The senior management of Raytheon has also agreed to co-operate with the expert panel set up by CAD (see paragraph 9 below) in order to rectify the teething issues of the system.

Seeking Comment from THB's Independent Consultant

8. Meanwhile, THB has approached its independent overseas consultant, the UK-based National Air Traffic Services (NATS), for expert advice on what follow-up actions should be taken with a view to ensuring the highest level of aviation safety based on international experiences and best practices. NATS is reviewing the incident.

Setting up an Independent Expert Panel

9. To benefit from independent advice from local and international experts, CAD has set up a panel comprising experts in the aviation and engineering fields to offer objective advice to the DGCA on the teething issues identified since the commissioning of the new ATMS. The expert panel members, appointed for a one-year term, will meet from time to time in the coming year to receive updates on the latest operations of the new ATMS and to provide independent professional advice to the DGCA. The expert panel will also gauge the views of other stakeholders, including frontline air traffic controllers. The first meeting of the expert panel is scheduled for mid-December 2016.

10. For detailed background of the 29 November incident and follow-up actions taken, please see at **Annexes A - C**, respective press releases issued by CAD and THB on 29 November, and CAD's press release issued on 1 December (with Raytheon's incident report and membership of the expert panel enclosed).

Conclusion

11. THB and CAD will continue to closely monitor the operation of the new ATMS. The public and all stakeholders can rest assured that THB and CAD will keep them informed of key developments, and will spare no effort in ensuring the safety of the new ATMS. Aviation safety will not be compromised under any circumstance.

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

CAD to set up expert panel to offer advice to CAD on new ATMS

The radar screens of the new Air Traffic Management System (ATMS) of the Civil Aviation Department (CAD) today (November 29) were unable to display some of the flight information temporarily, and the information eventually reappeared automatically. Aviation safety was not affected by the incident. The CAD has requested the contractor to submit an incident report within 48 hours and is going to set up an expert panel to offer advice to the CAD on the teething issues identified since the new ATMS' commissioning.

"At around 1pm today, the radar screens were unable to display some of the flight information (such as flight callsigns and flight speed) for about 26 seconds. Nevertheless, positions and altitudes of the flight targets were still available on the radar screens. The flight information eventually reappeared automatically. To safeguard aviation safety, air traffic control officers (ATCOs) have suspended the handling of departure flights for 15 minutes during the incident," the Director-General of Civil Aviation, Mr Simon Li, said.

"Other flights within the Hong Kong Flight Information Region were operating smoothly and aviation safety was not affected by the incident. Other functionalities of the new ATMS have also been operating smoothly. Although the radar screens were unable to display some of the flight information, positions and altitudes of the flight targets were still available. ATCOs, who have undergone professional training, can keep direct communications with the pilots at all times to ensure the flight position and altitude, and provide effective air traffic control services according to the information," he added.

According to a preliminary analysis of the contractor's on-site engineer, the incident was primarily caused by number one Flight Data Processor (FDP#1) of the main system. It encountered a problem when it was archiving data automatically. According to system design, the system automatically switched over to the main system's number two FDP (FDP#2). Upon fixing and restarting the FDP#1, the two data processors started to synchronise data. As a result, the flight data could not associate with radar data.

"Although aviation safety was not affected by the incident, it is not satisfactory as the above circumstance should not have occurred due to data archiving of the FDP. The CAD has asked the senior management of the system's contractor to come to Hong Kong to follow-up on the incident. The system's contractor has also been asked to submit an incident report and propose the necessary fix within 48 hours to prevent recurrence in future," Mr Li said.

In view of the incident, the CAD will set up an expert panel comprising academics, electronics engineers and representatives of ATCOs to offer objective advice to the CAD on the teething issues identified since the new ATMS' commissioning.

Ends/Tuesday, November 29, 2016
Issued at HKT 21:43

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Statement of Transport and Housing Bureau on New Air Traffic Management System

The Civil Aviation Department (CAD) reported to the Transport and Housing Bureau (THB) on an incident concerning the new Air Traffic Management System (ATMS) today (November 29). The incident involves the Flight Data Processor (FDP), which is one of the sub-systems of the new ATMS. The Director-General of Civil Aviation (DGCA) conducted a media stand-up this evening to explain the incident to the public. The DGCA confirmed that aviation safety was not affected by the incident.

Aviation safety is of utmost importance. The incident, which appears to relate to the new ATMS' performance, is of concern to the THB. The Secretary for Transport and Housing, Professor Anthony Cheung Bing-leung, has instructed the CAD to thoroughly review the incident and its causes. The THB noted that the CAD had asked Raytheon, the system's contractor, to submit an incident report and propose the necessary fix within 48 hours. The senior management of Raytheon had also been requested to meet the DGCA in Hong Kong over this incident and other teething issues identified since the system's commissioning, with a view to identifying effective solutions to further optimise the system. An expert panel involving those with expertise in the fields of, among others, electronics engineering and air traffic management control will be set up to offer expert advice to the CAD on its on-going efforts in optimising the operation of the new ATMS. At the same time, the THB is approaching its independent overseas consultant, the UK-based National Air Traffic Services (NATS), for expert advice on what follow-up actions should be taken with a view to ensuring the highest level of aviation safety based on international experiences and best practices.

The CAD will continue to closely report to the THB on the operation of the new ATMS, and the THB will closely monitor the situation. The public and all stakeholders can rest assured that the THB and the CAD will keep them informed of key developments, and will spare no effort in ensuring the safety of the new ATMS. Aviation safety will not be compromised under any circumstance.

Ends/Tuesday, November 29, 2016
Issued at HKT 20:10

Press Releases

Update on New Air Traffic Management System operations

Regarding the occurrence on Tuesday (November 29) involving the Flight Data Processor (FDP), which is one of the sub-systems of the new Air Traffic Management System (ATMS), the system's contractor, Raytheon, earlier today (December 1) has complied with a request made by the Civil Aviation Department (CAD) to submit an investigation report within 48 hours and proposed the necessary fix.

On the cause of the issue, the report is consistent with the preliminary analysis made by the contractor's on-site engineer on that day. The issue was primarily caused by the number one Flight Data Processor (FDP#1) of the Main system which encountered a file access anomaly when it tried to access certain archived playback data. The system then activated an auto-protection mechanism as per design and initiated an auto-switchover to the Main system's number two FDP (FDP#2) while putting the FDP#1 offline temporarily. During the auto-switchover, all the radar and flight information was displayed at radar screens in a continuous and seamless manner. After confirming the normal operation of the FDP#1, the technical staff restarted the FDP#1 promptly in accordance with the established procedures to make it serve as the standby FDP. During this process, the two data processors started to synchronise flight information. The data synchronisation process took priority and the flight plan association process was expected to take place shortly afterwards, resulting in the momentary flight plan dis-association.

There had been no loss or corruption of flight plan data during the occurrence. All other functions of the ATMS were functioning normally. Neither air traffic management, nor aviation safety were affected. The Fallback system and the Ultimate Fallback System of the new ATMS were operating normally and available for selection at all times.

In preventing recurrence, Raytheon has proposed the necessary fix in the report, through optimising operating procedures and system software.

To prevent the switchover to the FDP#2 of the Main system when conducting playback sessions, as an expedient measure, playback sessions will be conducted on the Fallback system to avoid impacting the Main system operation. In the long run, unnecessary auto-switchover of the FDP can be avoided through optimising system software to strengthen monitoring and management of playback sessions, especially handling the situation when the FDP encountered a file access anomaly.

To prevent flight plan dis-association, in the short run, if a switchover is needed from the FDP#1 to the FDP#2 in case of problem, the restoration of the FDP#1 and the synchronisation process should not be carried out during a period of high traffic. In the long run, there will be system optimisation. When the FDPs carry out data synchronisation, the established associations between targets and flight plans would be protected to ensure that flight plan association will not be affected.

For details of the report, please refer to Annex I.

Furthermore, in view of the teething issues since the new ATMS' commissioning, the CAD previously announced that it would set up an expert panel to offer objective advice to the CAD.

The CAD today announced the membership of the expert panel. The Director-General of Civil Aviation (DGCA), Mr Simon Li, is the Chairman. Other members comprise of local representatives, including Ir Warren Chim, Mr Albert Lam, Dean Mr Man Hau-chung; and overseas representatives, including President of National School of Civil Aviation in France, Mr Marc Houalla; and Chairman of International Civil Aviation Organization Regional Air Traffic Management Sub-Group, Mr Kuah Kong Beng. The expert panel will meet from time to time in the coming year to receive updates on the latest operations of the new ATMS and to provide objective professional advice to the DGCA. The expert panel will also gauge views of other stakeholders when necessary. The expert panel will convene its first meeting in December. For brief profiles of the expert panel members and terms of reference of the expert panel, please refer to Annex II. The members are appointed for a one-year term.

Ends/Thursday, December 1, 2016

Investigation Report on Flight Data Processor (FDP) Switchover and Momentary Flight Plan Dis-association on 29 November 2016

1. Observation

1.1 The Air Traffic Management System (ATMS) has commenced full operations since 14 November 2016 and Air Traffic Control (ATC) operation has been smooth in general. CAD reported an observation of FDP switchover from primary server to secondary server and momentary deferring and restoration of flight plan associations for aircraft targets on 29 November 2016 while running in Main System. Details of the abnormalities are given in the ensuing paragraphs. Given the undesirable impact on ATC operations, Raytheon's urgent investigation, by Raytheon's support on-site and factory personnel on the observation was engaged and relevant system logs and recorded data were immediately sent to Raytheon factory at Marlborough, USA.

1.2 Description of Occurrence

Date/Time: 29 November 2016/13:15 (Local Time)

Description: At 13:15, automatic switchover of FDP from the primary to the secondary server was indicated on the Control and Monitoring Display (CMD) due to activation of the auto-protection mechanism of the primary FDP server. External links with interfacing systems were not affected during the switchover. At 13:20, per standing procedures, the offline FDP server was manually restarted to restore fully hot-standby of server. During the restoration process, at 13:25, the screen refreshed with momentary flight plan dis-association for currently associated targets at all logged-on workstations. Display of information was affected for about 26 seconds.

2. Detailed Investigation and Findings

2.1 Raytheon was requested to promptly investigate into occurrence. There were two parts that were relevant to the occurrence:-

Part 1 – Switchover of FDP Server

Cause of the issue – after detailed analysis of the system log and fault signature, it was confirmed that switchover of the FDP server was triggered by an on-going Interactive Playback session. In serving the Interactive Playback session, the primary FDP had encountered a file access anomaly during the process of determining the availability of the network file system that maintains the automatically archived playback data. With the anomaly detected in the primary FDP and its associated data transferring modules, the system then activated an auto-protection mechanism to initiate an auto-switchover of FDP server to the secondary FDP while putting primary FDP offline, as per design. During the switchover, all the radar and flight information was displayed at all workstations in a continuous and seamless manner.

Part 2 – Momentary FPL Dis-association

Cause of the issue - the automatic FDP server switchover initiated and completed successfully. The offline FDP was then restored manually per procedures. Towards the end of the restoration process, auto flight information synchronization between the FDP servers took place at a high priority to ensure both the primary FDP and secondary FDP could be paired up to make ready hot-standby operation. During such time, the FDP processed traffic in parallel with a temporary data transfer for server-server synchronization and providing FPL association. The data synchronization process took priority over the FPL association process, resulting in the momentary FPL dis-association.

2.2 There had been no loss or corruption of flight plan data during the occurrence. The Surveillance Data Processor (SDP) and all other functions were also functioning normally.

Moreover, the Fallback system and the Ultimate Fallback System (UFS) were operating normally and available for selection at all times.

3. Permanent Fix being implemented and Available Workarounds

3.1 Part 1 - Switchover of FDP Server

Fix – the proposed mechanism for a change is already available and the strategy of the change would be the monitoring and management of Interactive Playback sessions such that the automatic switch-over mechanism would be optimized to allow for graceful ending of an anomalous playback session instead of triggering an automatic switch-over of FDP.

Workarounds – before the change is delivered, the following workarounds would be effective in preventing recurrence:

- (a) Interactive Playback sessions to be conducted on the Fallback system without inducing any risk on the operational system or impacting Main system operation.

3.2 Part 2 - Momentary FPL Dis-association

Fix – the proposed mechanism for the optimization would be such that during the restoration of a previously off-line FDP server, the established associations between targets and flight plans would be protected, such that server-server synchronization could be handled in parallel with the other tasks that FDP server is processing, thus inhibiting recurrence of FPL dis-association event.

Workaround – before the change is delivered, the following workaround would be effective in preventing recurrence:

(a) to reduce the impact of data synchronization on flight plan associations, the restoration and maintenance work of an offline FDP server should be carried out during a period of low traffic.

4. Availability of Fix

The fix would be available in 2 weeks.

Raytheon Company

November 2016

Air Traffic Management System

Expert panel members

Terms of Reference

- To provide objective expert advice to the Director-General of Civil Aviation on the teething issues arising from the commissioning of the new Air Traffic Management System (ATMS) by the Civil Aviation Department (CAD) and the necessary optimisation work; and
- To share with the CAD international experience and best practices in relation to long-term optimisation of ATMS.

Term of appointment

- From December 1, 2016 to November 30, 2017

Background of Expert Panel Members

Ir Warren Chim is a professional aircraft engineer and Deputy Chairman of the Hong Kong Institution of Engineers' Aircraft Division. He has over 30 years of professional aviation experience at executive and operational level in Aviation Consulting, Aircraft Hangar Design, Airworthiness, Business Aviation, Business Development, Corporate Planning, Fleet Planning, Base Maintenance, Line Maintenance, Learning & Development, Technical Training, Quality Assurance & Management, Safety & Risk Management in Hong Kong, Macau and Mainland.

Mr Marc Houalla is the President of Ecole Nationale de l'Aviation Civile (National School of Civil Aviation). He commenced as an engineer specialised in software and telecommunications applications to air transportation at the Civil Aviation Authority of Canada. In early 2000s, he was the Marseilles Airport Director. From 2004 to 2007, he was director of the French Air Navigation Service Provider in South East region. In 2007, he became CEO of service d'exploitation de la formation aéronautique (SEFA, former National School of Civil Aviation).

Mr Kuah Kong Beng is the Chairman of International Civil Aviation Organization (ICAO) Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) Air Traffic Management Sub-Group.

Mr Albert Lam assumed the post of Director of Civil Aviation in October 1998 and retired in April 2004. During his service, he has made significant contribution to the development of Hong Kong as an international and regional aviation centre and actively promoted Hong Kong in the international civil aviation arena. He was responsible for coordinating the relocation of the Airport from Kai Tak to Chek Lap Kok. Mr Lam was elected as the Chairman of the International Civil Aviation Organization 11th Air Navigation Conference, which was the first time that such a significant international aviation conference has been chaired by a Chinese. He was awarded the Silver Bauhinia Star in 2004.

Professor Man Hau-chung is the Dean of the Faculty of Engineering of the Hong Kong Polytechnic University. He graduated with a BSc(Eng) in Polymer Science and Engineering from Queen Mary College, University

of London, an MSc in Plant Engineering in the Process Industries from the University of Technology, Loughborough, UK, and a PhD in Laser Materials Processing from Imperial College of Science, Engineering and Medicine, University of London.
