ASSEMBLY — 40TH SESSION

TECHNICAL COMMISSION

Agenda Item 30: Other issues to be considered by the Technical Commission

PROGRESS IN THE APPLICATION OF INTEGRATED COCKPIT AND CABIN COMMUNICATION

(Presented by China)

EXECUTIVE SUMMARY

This paper presents the recent progress in China in the application of integrated cockpit and cabin air-ground communication. Relevant developments include the work of Civil Aviation Administration of China (CAAC) to promote the development of operation specifications and facilitate pilot tests and experiments in airlines. It will be decided whether CAAC request to amend the Doc 9925, *Manual on the Aeronautical Mobile Satellite (Route) Service* and add a description of the use of high-throughput satellite systems to transmit non-safety application data in the cockpit.

Strategic Objectives:	This working paper relates to Strategic Objective of Air Navigation Capacity and Efficiency.
Financial implications:	
References:	Doc 9925, *Manual on the Aeronautical Mobile Satellite (Route) Service*

1. INTRODUCTION

1.1 As defined in Doc 9925, airborne data communications are divided into air traffic services (ATS), aeronautical operational control (AOC) communications, aeronautical administrative communications (AAC), and aeronautical passenger communications (APC), where ATS and AOC are classified as safety data applications, and AAC and APC non-safety data applications. Currently, ICAO only specifies the use of narrow-band (L band, VHF, HF) systems to transfer safety data.

1.2 AOC applications can improve operation efficiency without affecting flight safety. ARINC 791 classifies AAC, APC and part of AOC as non-safety related communications, and Ka/Ku satcom system may be used to support non-safety related communications.

1.3 In order to improve the operational efficiency and operational safety margin of airlines, CAAC has been actively exploring cockpit data transmission and application mode in the broadband communication scenario.

[1] English and Chinese versions provided by China.

2. DISCUSSION

2.1 Currently, the narrow-band (L band, VHF, HF) systems are mostly used for communications in cockpit, providing voice and data communication services; and the Ku/Ka band is mostly used for cabin communications, providing Internet access services for cabin passengers. With the development and maturing of the new generation of broadband satellite technology represented by Ka/Ku high-throughput satellites, the capacity of cabin communications has increased significantly, which has led to a speed as high as 100 Mbps in one single aircraft, and significant reduction in traffic cost (currently about 1/100 of the cost in the cockpit or lower than 1/100). Next-generation Connected Airplane featuring broadband connectivity in the cockpit will help improve airlines' operation, maintenance and control service capabilities, and will embrace the explosive development in future. In recent years, many countries and organizations, including Inmarsat, are vigorously developing and deploying high-throughput satellites. The rapid development of HTS service network provides favourable conditions and opportunities for the large-scale application of integrated cockpit and cabin air-ground interconnection via broadband.

2.2 ARINC (Aeronautical Radio, Incorporated) has also been promoting work related to the development and application of airborne broadband satellite systems, including how to safely and reliably use the cabin satellite broadband system to transmit non-safety data in the cockpit. Technical specifications such as ARINC 791 have incorporated a description of the use of the Ka/Ku broadband satellite communication system to support the Airline Operational Communication (AOC) and Airline Administrative Communication (AAC) data communications in the airline information services domain (AISD) in the cockpit. Part 5 of ARINC 664 clearly defines the specification for the division of airborne data service domains; ARINC 848 defines a protocol specification for a secure network interface. By utilizing a virtual private network technology on different aircraft system domains, it provides criteria for secure communications including non-safety services between each on-board LAN and Enterprise LANs on the ground while not impacting secure segregation between on-board LANs. The promotion of ARINC industry standards ensures the safety and reliability of integrated cockpit and cabin air-ground interconnection enabled by high-throughput satellites.

2.3 Based on the significant progress in the application of network in both the cockpit and cabin, CAAC believes that using the in-flight network in the cabin for the transmission of non-safety data in the cockpit is a feasible option in terms of both efficiency and cost, and the time is ripe. In July 2018, a pilot project was launched in airlines to test integrated cockpit and cabin air-ground interconnection based on high-throughput satellites. In addition to providing internet access services to passengers, it can also realize real-time transmission of relevant operational data through cockpit wifi. The project will explore cockpit applications based on broadband satellites, mainly including electronic flight bag (EFB) and Aircraft Communication Addressing and Reporting System (ACARS) OVER IP and Quick Access Recorder (QAR) real-time transmissions, to support digital innovations in airlines' flight, operations control, aircraft maintenance and safety supervision departments so as to further enhance operational safety and efficiency. At present, the project's program research and system design has been completed. Equipment installation and certification will be carried out by the end of the year. An introduction to the project is contained in the appendix. It will be decided whether CAAC request to amend the Doc 9925 and add a description of the use of high-throughput satellite systems to transmit non-safety application data in the cockpit .

3. CONCLUSION

3.1 The Assembly is invited to be informed of the progress of CAAC in the integrated cockpit and cabin air-ground communication.

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APPENDIX

INTRODUCTION TO THE PILOT APPLICATION OF HTS-BASED INTEGRATED COCKPIT AND CABIN AIR-GROUND INTERCONNECTION IN DONGHAI AIRLINES

Air-ground instant communications: Taking advantage of EFBs, ground-based operational control personnel can directly transmit meteorological data, flight plan data, aeronautical information data, maintenance troubleshooting information, operation supporting decision data, etc. in the forms of text, photos, voice and videos to hand-held EFBs of pilots on-board aircraft, to support the crew in making operational decisions during flights. The crew can also send real-time data in text, photo, voice and video forms to operation control personnel through EFBs so that the latter can help them make more reasonable and accurate flight operational decisions in the air.

Real-time monitoring of aircraft: Real-time transmission can be realized through ACARS (Aircraft Communications Addressing and Reporting System) OVER IP and QAR (Quick Access Recorder), and ground decoding stations can decode and analyze core indicators and parameters in real time, enabling real-time monitoring of flights by airlines which can learn about the status of flights and aircraft timely, and provide forecast and warning of flight operation risks or abnormal conditions. Real-time monitoring includes the following elements:

- Position monitoring: the latitude and longitude of the current position of the aircraft.
- Trajectory monitoring: to obtain flight path of aircraft from the continuous display of QAR historical data.
- Height monitoring: the height of the current position of aircraft.
- Fuel monitoring: real-time monitoring of fuel consumption.
- Flight state: to get information about aircraft's operations and identify key phase such as push-back, taxi, take-off, landing, and taxi-in.
- Abnormal maneuvers: to identify deviations from the flight plan such as yaw, diversion, turn-back, go-around, and emergency descent.
- Aircraft failures: to perform dynamic monitoring and analysis of aircraft's operating conditions and performance, define monitoring parameters according to the characteristics of the various components of aircraft and set red lines and fitting models for the parameters to provide early warnings when abnormalities occur, so as to improve the operation monitoring effectiveness of the maintenance department. To monitor fault information that affects aircraft safety during flight, which includes but is not limited to engine parameters, cabin height, hydraulic system parameters, fuel system parameters, and various types of warning lights.
- Maneuver monitoring: to monitor the maneuvering of the aircraft by the crew, assist pilots in making more accurate maneuvering decisions in emergency situations, and use trend analysis to remind

flight crew to avoid further escalation of safety incidents; to perform 3D restoration of maneuvering in the cockpit and aircraft's aerial attitude by using real-time data.

- Meteorological monitoring: to collect aircraft or crew data in a real-time manner, and share data on dangerous weather phenomena such as turbulence, thunderstorms and low-altitude wind shears and abnormalities of related facilities that have occurred during flight, to provide strong support for air crews of subsequent flights.

- Safety monitoring: to monitor and manage air safety incidents. Consideration is taken to install cameras in both the cockpit and cabin to enable one-click real-time downlink transmission of video data in the event of safety incidents, or even emergencies such as hijacking, fire, sudden sickness of passengers, aircraft failure and illegal interference, so that joint emergency response can be initiated to ensure better execution of the flight with support from ground-based experts.

Ground-air coordinated response: to establish a data-driven coordinated work platform based on air-ground interconnection, and monitor real-time data of aircraft through enhanced AOC application system, so as to get information about special circumstances in a timely manner and offer support to pilots through uplink transmission of disposal instructions, video and voice illustrations, and reference documents, to help ease the psychological burden that may be caused to pilots as a result of the occurrence in the air.

- Before aircraft departure, the system will automatically create a online collaborative support group which will include personnel from relevant departments such as operation control, maintenance and safety inspection. Each person will perform instant communications in the forms of text, photos, voice and small videos to help the flight crew make more reasonable and accurate flight operational decisions in the air.

- The system's emergency plan bank sets disposal plans and the rules for coordination among different posts according to different scenarios. Data and videos from emergency safety incidents are timely transmitted back to the ground emergency command center which will offer support for rapid disposal decisions, so as to improve emergency response capabilities.

- The flight crew communicates with the ground-based maintenance personnel in real time through EFBs by means of photographs, text, audio/video communication, etc., to improve the accuracy of troubleshooting and the efficiency of problem solving. When the equipment onboard fails in the air, the maintenance department on the ground can quickly develop maintenance tools and prepare materials to save time in support of flight.

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