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COMMITTEE A

Agenda Item 2: Enabling the global air navigation system
2.2: Integrated CNS and spectrum strategy

4G/5G MOBILE TECHNOLOGY APPLICATION IN CIVIL AVIATION

(Presented by China)

EXECUTIVE SUMMARY

This paper presents the experimental verification of the application of 4G/5G mobile communication technology in civil aviation, expounds the prospects and advantages of the technology for the development and application of civil aviation operation service, and some suggestions and expectations of CAAC.

1. INTRODUCTION

1.1 Introduction to Technology

The ground-air broadband data communication based on 4G/5G ATG-LTE mobile communication technology has great development and application space in the fields of civil aviation, transportation flight, general aviation, UAV monitoring and so on. Compared with the widely used aviation communication data link technology, the ATG-LTE technology has the advantages of large data bandwidth and low service cost. It can provide Reliable signal coverage on the land and variety altitude in the air space. 4G/5G based technology is expected to be an ideal broadband data communication solution.

1.2 Experimental Test of Ground-air Broadband Data Communication Based on Mobile Communication Network in Civil Aviation of China

Civil Aviation Administration of China has organized an experimental verification project for the ATG-LTE technology in civil aviation applications. CAAC has approved the technical verification of 10 routes in China，Beijing -Guangzhou/Shenzhen, Beijing -Shanghai, Beijing -Chengdu -Chongqing -Kunming. At present, China Mobile has completed the reconstruction of ATG ground base stations in three routes，Beijing to Chengdu, Beijing to Guangzhou, and Beijing to Shanghai, and has modified around ten test flights of Boeing 737NG series, Airbus A320 series, Cessna 525, Cessna 680,

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etc. Air China airline has completed the modification of two aircrafts, in addition, more than 400 flight trails were performed. The results of the flight test proved that: The experimental system of ground-air broadband communication with ATG-LTE and satellite communication is stable and reliable.

2. DISCUSSION

2.1 Fundamental Architecture and Planning of China Mobile's Wireless Broadband Data Communication Network Based on Mobile Communication Network

In March 2018, China Mobile released an Internet of Aircraft plan to build a three-dimensional layered air network coverage. Based on satellite and 4G/5G ATG(Air to Ground) networks, China Mobile builds an open space network to provide broadband data communication services for civil aviation airports, UAVs, general aviation and transportation airlines.

2.1.1 Aeronautical ground-air data communication

China Mobile will continuously deploy ground-air networks to improve access experience. It is planned to complete smooth upgrade from ground communication 1.0 to ground communication 2.0 by the end of 2022 and provide ultra-fiber access experience. China Mobile will adopt the hybrid networking of the coverage of ground base stations and satellite coverage. At present, the ground-air communication backbone network has been established, and the technical verification is mature. There are 52 ground base stations in the routes of Beijing-Shanghai, Beijing-Guangzhou, and Beijing-Chengdu, with more than 400 flight trails and a total bandwidth of 45-75Mbps/flight. In the next five years, China Mobile will complete the verification and deployment of China's domestic air routes with airlines and related partners, so that they can be put into commercial use.

2.1.2 Unmanned Aircraft

China Mobile has established China's first low-altitude digital application innovation Hub with Huawei and Shanghai General Aviation Industry Alliance. It has also set up a UAV cloud platform to test low-altitude coverage and security Supervision solutions..

2.1.3 Smart Airport Operation

The smart airport solution will promote 4G wireless digital apron services firstly. Currently, China Mobile has cooperated with CAAC in Haikou Meilan Airport, Chengdu Shuangliu Airport and Urumqi International Airport to provide secure and efficient information connection services for airports.

2.2 Current Progress of 5G Mobile Communications Technology Standards and Projects

On June 14, 2018, the 3rd Generation Partnership Project (3GPP) approved the first standard R15 of the 5G NR independent networking function. In December 2017, the NR standard for non-independent networking was completed. The 5G mobile communications technology has completed the first phase of full-function standardization. By the end of 2019, the 3GPP R16 standard will be approved. With the launch of independent 3GPP R15 networking standards, 5G communications spectrum has been distributed in some countries, and 5G communications will enter the large-scale deployment phase.

The 3GPP R15 standard focuses on the commercial requirements of enhanced mobile broadband and provides basic requirements for low-latency and multi-connection services. In the case of 100 MHz bandwidth, the peak rate of 10 Gbit/s can be achieved by 5G technology, and the peak rate of 20Gbps can be achieved by 200MHz bandwidth. 3GPP R16 and later versions will completely resolve problems such as massive connections and low latency, and take on the historical mission of digitalization in various industries.

Compared with 4G, 5G mobile communication technology uses the same network architecture, introduces stronger privacy protection and authentication mechanisms, and enhances security mechanisms. 5G technology provides faster communication, lower latency, and more connections.

2.3 Application Prospects and Advantages of 4G/5G Mobile Communication Technology in Civil Aviation Services

2.3.1 Civil transport aviation, general aviation ground air broadband data communication service

Based on the 4G/5G mobile communication technology, low-cost and reliable ground-air broadband data communication services can be provided for transportation and general flight, which solves the bottleneck problems such as low data bandwidth, high service cost, and long delay of the ground-air data communication service in the current ATN network, for air traffic control services, aeronautical operational control, SWIM services, airport surface operational communication surveillance, and more, especially for airborne surveillance and free interval，TBO, real-time high-precision weather information services, flight information services, QAR Real-time data download and global aircraft tracking. It will provide powerful basic communication network support.

2.3.2 Internet Services for Civil Aviation Airlines

Compared with the civil aviation nose cabin data service, the 4G/5G mobile communications technology has more flexibility in solving the passenger entertainment demand service in the rear compartment, which brings passengers a good experience of big data bandwidth, ultra-low latency, and cheap service. CAAC plans to implement broadband interconnection services in the rear cabin of the civil aviation passenger plane by using the100% 4G/5G technology before 2022.

2.3.3 Unmanned Aircraft Management

China, the US, and Europe have released the UAV supervision plan, US UTM, Europe U-Space, and China UOMS. Recently, China Civil Aviation CAAC and European EASA cooperated with telecom operators to verify the feasibility of using cellular network monitoring and tracking UAV. (http://www.caac.gov.cn/en/HYYJ/NDBG/201802/P020180227616856973062.pdf, http://www.caac.gov.cn/en/XWZX/201802/t20180207_49252.html). Global standards are required for UAV electronic licenses and online security flight management based on 5G cellular technologies.

2.3.4 4G/5G mobile communication has the following advantages in civil aviation applications

a) Good user experience, high bandwidth, low delay, and low tariff. Based on the 4G technology, a single sector can provide 45-75Mbps broadband wireless data transmission channels in the uplink and downlink. With the maturity of the 5G communications technology industry chain, the bandwidth can reach 1 Gbit/s. The mobile communication technology-based ground-to-air communication delay can be controlled at 50-200ms.

b) The terminal cost is low and the airborne antenna is small. The aviation mobile

communication terminal can share the technical achievements with the public service terminal. The popularization of the technology is high and the development period is short. The airspace communication antenna is small in size to facilitate aircraft modification.

c) Network construction and O&M costs are low and benefits are high. According to the measured coverage radius of a single ATG pilot site 150km, the scale of the mobile communication base station that implements reliable signal coverage is limited. Based on the existing terrestrial base station resources of the operator, the comprehensive cost of constructing the networking and operation and maintenance is less than the current satellite communication system.

3. CONCLUSION

3.1 The 4G/5G mobile communication technology has a bright prospect and great potential for the application in civil aviation. The representatives and institutions of the Conference please pay attention to the development and application of the technology actively.

3.2 CAAC hopes to strengthen cooperation with ICAO, all Member States and other international organizations, to jointly study and develop civil aviation broadband data communication services. We promote the construction of relevant technical standards all together.

3.3 CAAC will actively cooperate with mobile operators and industry institutions to study and practice the application of civil aviation broadband data communication based on 5G mobile communications technologies, and continuously improve related technical systems.

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