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Agenda Item 4: Hyper-connectivity of air navigation system
4.1: Connected aircraft concept and associated challenges

CONNECTED AIRCRAFT VALIDATION ACTIVITIES

(Presented by the United States)

EXECUTIVE SUMMARY

This paper presents information on a series of validation activities completed to better explore and develop the connected aircraft concept.

1. INTRODUCTION

1.1 The draft ICAO connected aircraft concept outlines a framework for the use of performance-based links to accommodate the expected growth in demand for information exchange between the aircraft and relevant aviation stakeholders.

1.2 Using new connectivity solutions as well as existing non-aviation connectivity solutions, the connected aircraft concept enables digital interaction between stakeholders, based on data exchanged with the aircraft. Capturing the value of information available from these digital exchanges enables the operational benefits envisioned through collaborative decision-making (CDM) and emerging air traffic management (ATM) concepts.

2. DISCUSSION

2.1 Over the past four years, the Federal Aviation Administration (FAA) has undertaken multiple connected aircraft validation activities including two live flight demonstration projects. The first was the four-dimensional trajectory (4DT) live flight demonstration project to demonstrate how 4DT-based operations in the United States national airspace system can be implemented with current technologies and to inform future research. The FAA partnered with key industry participants to conduct two live flights in the national airspace system using commercial data link for aircraft and ATM communications to demonstrate negotiations of flight trajectory, delivery of clearances and sharing of aircraft intent information. The 4DT live flight demonstration leveraged a connected aircraft with an Internet Protocol (IP) data link for information exchange as the aircraft traversed the national airspace system. The activity leveraged a Honeywell FMS and an iPad Pro electronic flight bag (EFB) capable of running Jeppesen FliteDeck Pro and Route Maximizer.

2.2 The second and most extensive demonstration thus far has been the multi-regional trajectory-based operations project, which involved a live flight from the United States to Japan, traversing multiple flight information regions (FIRs). Partner organizations included Nav Canada, AEROTHAI, Civil Aviation Authority of Singapore (CAAS) and the Japan Civil Aviation Bureau (JCAB). This project focused on using global information exchange standards and aircraft intent data to enhance trajectory predictions and leveraging various communication services throughout the multi-FIR flight. Specifically, the project included validation of ICAO's flight and flow – information for a collaborative environment (FF-ICE) draft implementation guidance (Volume II of Doc 9965, *Manual of Flight and Flow – Information for a Collaborative Environment (FF-ICE)*), global information exchange models, application of the international aviation trust framework, and analysis of air traffic flow management (ATFM) procedures and information needs. Results from this project were promising, demonstrating the feasibility of the connected aircraft concept in complex operational environments. The demonstration was able to achieve connectivity across the Pacific Ocean and exchange information including the downlinking of aircraft position at regular intervals. The activity leveraged a Boeing 787-10, an iPad Pro running Route Maximizer, and a Honeywell FMS.

2.3 Additionally, the FAA has explored new applications in support flight deck decision-making in a collaborative environment by leveraging EFBs, personal mobile devices, and non-aviation data link connectivity. One collection of applications is the mobile technology for information exchange program, targeted towards the general aviation and business aviation community. The aim of this project is to provide services and capabilities that enable the exchange of information between FAA systems, and in some cases air traffic controllers and pilots in the community using their personal mobile device and their service provider of choice. Services and capabilities include the exchange of instrument flight rules (IFR) clearance, release and cancellation information through text-based interfaces in lieu of voice communications at non-towered airports and airports without electronic clearance delivery services. Another example is a capability that allows a pilot to provide updated departure intent information and negotiate a traffic management departure release time with air traffic control.

2.4 Finally, the connected aircraft concept can be leveraged as one of the foundational pillars for advanced air mobility (AAM) and unmanned aircraft system traffic management (UTM). AAM aircraft and unmanned aircraft systems (UAS) share necessary data using hardware-agnostic solutions over IP networks. The FAA conducted a series of validation activities for AAM aircraft, evaluating whether the non-aviation communication IP links could be utilized to transmit telemetry data to ground control stations and third-party service providers while the aircraft was remotely piloted. This was done to assess whether remotely piloted aircraft are conforming to their flight plans. These activities aimed to evaluate the performance and feasibility of this approach in monitoring aircraft compliance in real-time. These types of real-time data exchanges enhance situational awareness, supporting operators in navigation, efficient airspace management and enabling dynamic aircraft rerouting.

3. CONCLUSION

3.1 Validation activities are beneficial to the development and maturation of a concept. The United States has completed multiple activities for connected aircraft, validating the concept, setting expectations for future implementation, and providing valuable lessons learned. The connected aircraft concept has been found to work across the diverse set of use cases detailed in the sections above. Some of the findings have already been leveraged and incorporated in the maturation of the connected aircraft concept. Additionally, the successful exercises have allowed the FAA to better anticipate requirements of future operations and planned information services. This information will allow the FAA to better meet the needs of users and better plan for advancements in the national airspace system.

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