International Civil Aviation Organization
North American, Central American and Caribbean Office
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Nassau, Bahamas, 02-04 July 2003

Agenda Item 7: Other business

STATUS OF THE U.S. WIDE AREA AUGMENTATION SYSTEM (WAAS)

(Presented by United States)

SUMMARY

This information paper provides the most recent status of the United States Federal Aviation Administration's (FAA) Wide Area Augmentation System, or WAAS, and its current and future operational capability.

1. The Future of Navigation

1.1 Satellite navigation technology is already in use in the United States and around the globe as a navigation aid for en route, oceanic and remote airspace, and non-precision approach operations. The U.S. Global Positioning System (GPS) provides this service as an integral part of the International Civil Aviation Organization's (ICAO) envisioned seamless Global Navigation Satellite System (GNSS).

1.2 Satellite navigation, represented by GPS and its various augmentation systems under development today, provides significant flight safety and system capacity and efficiency benefits by making precision approaches possible at thousands of airports worldwide where no such capability exists today. The introduction of new, straight-in GPS approach procedures has reduced the need for procedure turns and circling approaches, thus providing a very reliable and accurate navigation system that dramatically improves safety over a Non-directional Beacon (NDB) approach or a VHF Omni-directional Range (VOR) approach when the VOR is not collocated with the runway.

1.3 The United States continues to aggressively work towards the operational implementation of GPS and its Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS) to complete the transition to satellite-based navigation.

2. Wide Area Augmentation System (WAAS) Commissioning Status

2.1 The WAAS uses a network of ground reference stations (WRS), master stations (WMS), geostationary communication satellites (GEO), and GEO uplink stations (GUS) to augment the basic GPS service and provide increased accuracy, availability, integrity, and continuity of service to all properly equipped users in the U.S. National Airspace System (NAS).

2.2 The WAAS program has progressed significantly over the past several years. The initial system stability test was completed in July 2000 and demonstrated total system accuracy to be much better than originally anticipated or required. The accuracy requirement for WAAS initial operating capability (IOC) is 7.6 meters (horizontal and vertical) and these preliminary test results showed that total system accuracy was 2-3 meters (horizontal and vertical).

2.3 Following these successful tests, the FAA announced in August 2000 that the WAAS signal-in-space would be continuously available for aviation users to increase situational awareness during visual flight rules (VFR) and non safety of life flight applications, as well as for non-aviation users for recreational, maritime, agricultural, surveying, and other applications requiring precise positioning and time. The most recent user data shows that at the end of 2002, over 1 million non-aviation users were already using the WAAS signal in space as part of their daily routines.

2.4 The WAAS program achieved another significant milestone in September 2002 when the FAA successfully completed the 60-day stability test. This test, which ran from July 19 through September 6, 2002, had a goal of proving WAAS to be a stable system that met or exceeded all performance requirements. The results demonstrated continuous operation of the WAAS in support of required coverage, accuracy and integrity requirements.

2.5 After the 60-day stability test, the next major hurdle for the WAAS program was the contractor acceptance inspection (CAI) milestone. CAI is the official hand-off of the WAAS system from the contractor (Raytheon) to the FAA. This can only be accomplished if the contractor successfully demonstrates that WAAS meets or exceeds all system, reliability, and performance requirements and guidelines set forth by the FAA. This milestone was completed on January 24, 2003 and thus positioned the FAA to commission the WAAS for widespread operational use by July 2003.

2.6 With the commissioning of WAAS now in the FAA's hands, several key activities remain to be accomplished before the FAA can commission WAAS for operational use. Between January and July 2003, the FAA will complete the Operational Test and Evaluation (OT&E), continue to develop WAAS-based instrument flight procedures for use in the U.S. National Airspace System (NAS), complete training programs for FAA equipment and system operators, maintainers, and air traffic control personnel, provide ample guidance to the pilot community and airlines on impending WAAS use, and obtain executive authorization to commission WAAS as a public use system in the U.S. NAS. Currently, the FAA's goal is to have all of these activities completed in time for a July 2003 WAAS commissioning.

3. WAAS Post-IOC Implementation Strategy

3.1 WAAS IOC will provide users with a lateral navigation/vertical navigation (LNAV/VNAV) capability throughout the U.S. NAS. LNAV/VNAV is an approach procedure with vertical guidance with nominal minimums of a 350' decision height, 1½mile visibility, 556m horizontal alert limit (HAL), and 50m vertical alert limit (VAL). This initial WAAS capability will also provide improved guidance to users in the en route and departure domains as well. The FAA is expecting to have over 300 LNAV/VNAV procedures published and ready for use at WAAS IOC in mid 2003. LNAV/VNAV procedures will continue to be developed at a rate of 300 per year.

3.2 In the six (6) months after WAAS commissioning, the FAA will improve the precision approach capability provided by WAAS through terminal approach procedures (TERPS) optimization. This improvement, expected by December 2003, will provide a new approach procedure with vertical guidance called Lateral Precision with Vertical Guidance, or LPV. LPV provides more lateral precision over LNAV/VNAV resulting in lower approach minima for most runways. LPV procedures have nominal minimums of a 250' decision height, ¾mile visibility without proper lighting (½mile visibility with proper lighting), 40m HAL, and 50m VAL.

3.3 LPV and LNAV/VNAV approaches do not require any equipment beyond standard WAAS Technical Standard Order (TSO) avionics, and will make vertical guidance safety benefits accessible to the general aviation community, thus directly affecting flight safety for general aviation aircraft and other WAAS users.

3.4 The FAA also plans to complete several other WAAS service/system enhancements in the post-IOC time frame.

3.5 Due to the long lead-time necessary to plan for and secure GEO satellite services, the FAA has been working for the past couple of years to ensure that WAAS IOC and FOC are supported with redundant GEO services. The initial and critical goal is to provide a third GEO satellite on orbit as soon as possible after WAAS IOC to mitigate the single thread failure of the existing INMARSAT-III AOR-W and POR satellite solution. The FAA also wants to improve WAAS system availability (during GUS switchovers) and improve overall system coverage through more optimized GEO orbital locations.

3.6 In support of the GEO initiatives, the FAA awarded a contract to Lockheed Martin Air Traffic Management on March 5, 2003 to provide additional satellite services for the WAAS. This contract provides for a 24-month development of ground earth stations with the flexibility for the FAA to procure up to three (3) payloads on satellite-leased communication services. Designed to support both the initial and final operating capabilities of WAAS, this contract also provides the FAA with flexibility in acquiring additional GEO assets to ensure uninterrupted GEO service and system reliability for all WAAS users.

3.7 The FAA's goal is to have additional GEOs (at least one) on orbit by 2006/07. Beyond this time frame, the FAA will continue to develop a GEO constellation sustainment strategy to ensure the required redundancy in WAAS broadcast over the U.S. National Airspace.

3.8 WAAS Full Operating Capability (FOC) is expected in the late 2007 time frame. At this time, the U.S. Government plans to incorporate a second civil frequency (L5 @ 1176.45 MHz) will be more solidified. When available for use, WAAS will incorporate L5 into its operation to upgrade the LPV capability available at FOC to a GPS Landing System (GLS) capability. GLS is the Category I precision approach equivalent for GPS systems with aviation minimums of 200' decision height and ½ mile visibility (with proper lighting).

4. Conclusion

4.1 The meeting is requested to note the material presented in this information paper, and consider its contribution to the implementation of a global satellite-based navigation capability to support safety-of-life operations within the Central Caribbean region.

4.2 Attendees are invited to visit the FAA's GPS Product Team's website at http://gps.faa.gov for up-to-date WAAS program information, or contact Mr. David S. Burkholder in the FAA for additional information on WAAS and other FAA Communications, Navigation, and Surveillance (CNS) programs.

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