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# SatNavNews

FAA Navigation Programs AJM-32



The *SatNav News* is produced by the Navigation Programs AJM-32 branch of the Federal Aviation Administration (FAA). This newsletter provides information on the Global Positioning System (GPS), the Wide Area Augmentation System (WAAS) and the Ground Based Augmentation System (GBAS).

## IGWG Meeting Reflects Continuing GBAS Momentum

The 15th International Ground Based Augmentation System (GBAS) Working Group (IGWG) was hosted by EUROCONTROL at the Experimental Centre (EEC) on June 3-6, 2014 in Brétigny, France. The meeting was co-chaired by the FAA and EUROCONTROL. The IGWG addresses relevant issues for the development and implementation of GBAS. It also provides a forum for the exchange of data and information, which can effectively be used by the participants in formulating their business strategies and implementation plans. About one hundred (100) participants from twelve (12) nations, international service providers, industry, airlines and aircraft manufacturers attended the meeting and working sessions.

In the meeting welcome, the progress made since the first meeting of the group, also held at the EEC in 2004, was emphasized. Today, it is evident that GBAS has achieved multinational support, significant operational experience, and is well poised to remain a key element of the aviation navigation mix.

The recent operational approval of GBAS in Sydney by Airservices Australia and in Malaga by Aeropuertos Españoles y Navegación Aérea (AENA), the Spanish service provider, were

examples of the expansion of GBAS capability throughout the world. Also, fifteen (15) GBAS locations in Russia have been flight checked and are awaiting publication of the approach charts in the Aeronautical Information Publication (AIP) before starting regular operations by regional air carriers. An increasing number of GBAS acquisition plans also were reported for locations including Zurich, Switzerland; Oslo, Norway; London (Heathrow), United Kingdom; and Dubai, United Arab Emirates. GBAS installations are also being considered for Frankfurt, Germany and for multiple locations in Australia.

Boeing and Airbus remain strongly committed to GBAS Landing System (GLS) capability and reported an increasing GLS customer base and increased number of GLS equipped aircraft sales. The number of GLS-equipped aircraft has nearly doubled since 2013.

Airline operations are steadily increasing. United Airlines flies an average of 70 GBAS operations per month at the Houston, Texas and Newark, New Jersey facilities (with a total of 784 approaches as of July 2014). Delta is in the process of receiving 112 GLS-certified aircraft and participated in the IGWG for the first time. TUIfly and Air Berlin

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### Tell Us Your WAAS Story

We're collecting testimonials about the benefits of Wide Area Augmentation System (WAAS) navigation from users. If you are a pilot, passenger, airport manager, airline employee, or are involved in aviation in any capacity - whether you fly fixed-wing or vertical flight aircraft - we want to hear from you! Please send your stories and contact information to Mary Ann Davis at [maryann.ctr.davis@faa.gov](mailto:maryann.ctr.davis@faa.gov)

fly GLS at Bremen, Germany and Malaga, Spain. In Sydney, Qantas is flying an average of 40 approaches daily since operational approval of the Sydney system. Lufthansa is expected to be the first to fly GLS approaches to Frankfurt when that station becomes operational in August 2014. Swiss Airlines is planning to do the same in Zurich. A EUROCONTROL flight plan analysis shows over 3% of European traffic is now GBAS equipped.

Presentations and discussions at the meeting demonstrated a strong and continuing commitment to the implementation of GBAS Category (CAT) I, GBAS CAT II/III validation activities, and increased research in the potential impact of the future multi-constellation and dual-frequency environment. Plans and status reports from service providers, users, and manufacturers were informative. Technical and operational sessions provided a key value to the GBAS working group. At these sessions, data collection and evaluation results, siting experience and interference mitigation studies, ionospheric activities, current operational plans, and future operations plans were not only exchanged, but actively coordinated. More than two thirds of the participants attended the operational working sessions. The presence of representatives from regulatory organizations was beneficial to these discussions. All nations represented at the meeting have GBAS related activities in one form or another -- from concept development, research prototype activities, to actual implementation.

A few highlights from the operational and technical sessions:

- ❖ A recurring topic was the Required Navigation Performance (RNP)-GLS transition. This is important for addressing operational improvements and the needs of airports and operators flight efficiency and environment while maintaining the precision approach capability.



IGWG Meeting Participants

- ❖ Two topics from a previously-developed value chart received the most attention -- Extended Service Volume (ESV) and CAT II operations on a GAST-C system. For ESV, joint operational and technical teleconferences and a common working session were conducted after last year's discussions. Concepts and a working paper were presented to the International Civil Aviation Organization (ICAO) Navigation Systems Panel (NSP) in early 2014.
- ❖ Several presenters underscored the need to go beyond Instrument Landing System (ILS) capabilities rapidly to exploit GBAS potential in noise reduction and shorter approach paths. The capability to provide steeper and multiple approach paths for runway ends, possible with GBAS, can be immediately beneficial for noise reduction and wake turbulence avoidance.
- ❖ The Data and Testing, Ionosphere, Siting, Interference and Ground Monitoring session focused on the ongoing improvements in the technical understanding of GBAS implementation and the advances in the tools used for GBAS performance assessment.
- ❖ The investigation into the effects of ionospheric events was an important subject with intense discussion of GBAS approach service type D (GAST-D)

ionospheric monitoring and Standards And Recommended Practices (SARPs) validation.

- ❖ In several areas, work will continue between IGWG sessions to continue progress on the exchange of methods and experience for more detailed subject matter.

All participants were extremely satisfied with the outcome of the working group meeting. First-time participants noted the high quality of work presented and the significant amount of ongoing projects. The IGWG fulfills a recognized function in GBAS implementation and its format seems well adapted to the participants' needs. The exact location of the next meeting is still open. Multiple options are being reviewed and need to be confirmed, but the meeting is targeted for March 2015.

More on this meeting, including video interviews with the participants, is available at <https://www.eurocontrol.int/news/moving-towards-gbas-implementation>.

- Dieter Guenter (FAA AJM-321/NAVTAIC)

### Where is GBAS Today?

Latest information on GBAS activities can be monitored on <http://flygls.net>, which is hosted by Airbus with information from air navigation service providers, industry, and users. The goal of the site is to provide

Home Screen of FlyGLS.net

public information on GBAS. The site contains several sections which include:

- ❖ Map of GBAS locations
- ❖ Latest news
- ❖ GBAS benefits
- ❖ Useful links
- ❖ Latest GLS charts
- ❖ Articles dealing with GLS

- Dieter Guenter (FAA AJM-321/NAVTAC)

## WAAS and PBN

WAAS, RNAV, LPV, LP, RNP, PBN, NextGen - Aviation Acronyms Galore...AYKM (Are you kidding me?)

If you've been around aviation for a while, likely you've learned to speak in a unique and sometimes confusing language. And there are a lot of acronyms – sometimes acronyms in acronyms! As technology evolves, so does the language and the acronyms. All of the examples here are related to navigation technologies or capabilities in aviation. How they fit together can be hard to understand, so here are a few basics to help you feel more fluent.

**WAAS, or Wide Area Augmentation System** was developed by the FAA for civil aviation, WAAS is an extremely accurate, satellite-based navigation system. WAAS provides horizontal and vertical navigation capability

for all phases of flight, including approaches, departures, and en route operations. Before WAAS, the U.S. National Airspace System (NAS) did not have this potential. With WAAS, this capability exists.

**RNAV, or Area Navigation (RNAV)** is a method of navigation that permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids, or a combination of both. Many Instrument Flight Rules (IFR) pilots are familiar with RNAV (GPS) approach procedures. These procedures can include a line of minima for Localizer Performance with Vertical guidance (LPV) or a line of minima for Localizer Performance (LP). Both LPVs and LPs are flown using WAAS.

- ❖ **LPVs** take advantage of the remarkable lateral and vertical guidance accuracy of WAAS and are very similar to a Category I Instrument Landing System (ILS) approach. Like an ILS, an LPV provides vertical guidance and is flown to a Decision Altitude (DA). Today, there are almost three times as many LPVs as there are ILS approaches.
- ❖ **LPs** provide an alternative for runways that cannot qualify for

an LPV due to obstacles. LPs provide only lateral guidance. In that sense, LPs are the WAAS-enabled equivalent to Localizer (LOC) procedures.

**RNP, or Required Navigation Performance** is another method of navigation. RNP is RNAV with the addition of onboard performance monitoring and alerting capability. RNP capability is defined in levels. Examples include, but are not limited to, 0.1, 0.3, 1, 2, 4 and 7. The RNP value represents the accuracy requirement for lateral navigation for a particular operation. For example, RNP 1 requires that an aircraft stay within a path that deviates no more than 1 nautical mile from the centerline of the intended procedure, route, or path. WAAS can support RNP 0.3 and higher RNP levels.

**PBN, or Performance Based Navigation** includes both RNAV and RNP. It is a way of navigating not associated with a particular navigation aid, but instead with the ability of an aircraft to maintain a certain level of performance. In contrast, traditional navigation capability has been associated with the use of a particular navigation system – such as an Instrument Landing System (ILS), Very High Frequency Omnidirectional Range (VOR), Distance Measuring Equipment (DME) or Non Directional Beacon (NDB). PBN initiatives are allowing the FAA to transition the U.S. NAS navigation infrastructure from one that was previously constrained upon the locations of existing ground-based navigation aids to one that supports more efficient routes and procedures. Satellite navigation systems like GPS, WAAS, and the Ground Based Augmentation System (GBAS) are enablers of PBN.

**NextGen, or Next Generation Air Transport System** is the FAA's wide-ranging transformation of the NAS. Through the introduction of satellite-based and digital technologies and new procedures, NextGen is increasing efficiency, reducing

delays and improving aviation's environmental footprint through decreased fuel burn and lower aircraft exhaust emissions. NextGen is much broader than just navigation, but many NextGen initiatives are related to improvements in navigation. PBN is an important part of NextGen. The FAA is implementing new PBN routes and procedures that take advantage of satellite navigation and improvements in aircraft navigation capabilities. Although WAAS is not a NextGen program (WAAS was commissioned for aviation use in 2003), it does provide important value as an enabling technology for a range of NextGen initiatives. For example, in support of NextGen, WAAS improves the accuracy, availability, and integrity needed to support continuous all-weather use of GPS as a primary means of navigation. WAAS also provides a navigation solution which supports the most demanding levels of navigation sensor requirements associated with the use of Automatic Dependent Surveillance - Broadcast (ADS-B) within the NAS.

As you navigate through the new language of aviation, we hope this article provides a few helpful waypoints during your journey. Happy and safe flying!

- Mary Ann Davis (FAA AJM-321/NAVTAC)

### Summit Fosters Collaboration on Support Services for GPS Users

The 2014 Global Positioning System (GPS) Operations Summit was hosted by the United States Coast Guard (USCG) at their Navigation Center (NAVCEN), located in Alexandria, Virginia, on June 4, 2014. The GPS Operations Summit, referred to as the Ops Summit, is an annual event that brings together the managers responsible for providing support services to GPS users worldwide.

The annual Ops Summit is coordinated by the Office of the Assistant Secretary of Transportation for Research and Technology. Participating organizations included

the FAA National Operations Control Center (NOCC), the USCG NAVCEN, and the United States Air Force 2nd Space Operations Squadron (2SOPS). The principle attendees included:

- ❖ Mr. John Lopresti, Manager, National Operations Control Group
- ❖ CAPT Bill Burns, Commander, Navigation Center
- ❖ Lt Col Thomas Ste. Marie, Commander, 2nd Space
- ❖ Mr. Hank Skalski, DOT Liaison to Air Force Space Command

#### The Triad

These three organizations, commonly known as the 'Triad', provide essential support services to GPS users around the world. Cooperatively working together since the GPS Initial Operating Capability was declared in 1993, the working relationships of the Triad were formally documented in separate Support Agreements beginning in 1999. Since then, a single Memorandum of Agreement (MOA), encapsulating the three support agreements, was crafted and approved in 2010. This trilateral, interagency MOA titled, "Support to Users of the Navstar Global Positioning System" improved standardization and brought preeminent unity to the working relationship of the Triad. The capstone of this year's Ops Summit was the approval and signing of an

updated 2014 version of the trilateral MOA.

Mandated by various statutes and national policy, the services provided by the Triad supports air, land, maritime and Department of Defense users of the GPS Standard Positioning Service (SPS). The Triad embraces an interagency partnership of 24/7 operations/support centers which provide a point of contact for any world-wide GPS user, Critical Infrastructure and Key Resources (CIKR) sector, or other Global Navigation Satellite System (GNSS) operator. These services include:

- ❖ Provide for timely distribution of GPS constellation related information, data files, and messages to the civil community as outlined by applicable documents,
- ❖ Accept and coordinate responses to requests for general or technical information from respective GPS user segments and support requests or problem reports from interagency partners related to the GPS constellation, service outages, or interference affecting GPS-provided PNT services to user segments or CIKR sectors,
- ❖ Coordinate and cooperate with other GNSS service providers on matters affecting compatibility and interoperability



of PNT services, international user support, and international interference activities, as defined in Department of State approved Bi-lateral Agreements.

In addition to these services, the Triad contributes to a broader web of mutual and individual department/agency/center responsibilities for real-time coordinated information-sharing and support for a coordinated U.S. government response to interference affecting GPS-provided PNT services within the Homeland, in order to better protect critical national infrastructure and interests.

### Why Three Organizations?

Each of the Triad organizations has their unique set of roles and responsibilities as defined in public law, detailed in organizational missions and emphasized in national policy. In addition to operating, maintaining and sustaining the GPS constellations, 2SOPS provides user support activities for the military users. The USCG operates the National Differential GPS and other maritime navigation systems. The NAVCEN is responsible for supporting the maritime and other civil GPS users, with exception of the aviation users segment. Likewise, the FAA operates the Wide Area Augmentation System and other National Airspace System navigation systems; and thus provides GPS user support to the aviation community. Organizational roles and responsibilities for providing GPS user support include:

#### USAF/2SOPS

- ❖ Provide a 24/7 operations center for technical questions or requests for information related to: (a) operational status of the GPS constellation; and (b) service outages or interference affecting GPS-provided PNT services to the military user segment within the Homeland, and with respect to event classification.
- ❖ Inform NAVCEN of all civil/non-aviation and NOCC of all civil aviation GPS service interruption events.

- ❖ Provide technical analysis to support interagency inquiries and source location of interference affecting GPS-provided PNT services.
- ❖ Participate in interagency teleconferences to: (1) gain situational awareness related to service outages or interference affecting GPS-provided PNT services; and (2) perform PNT interference-related tasks specified in established orders and directives.

#### USCG/NAVCEN

Disseminate GPS unclassified, publically releasable operational data files and messages provided by the GPS Control Segment.

- ❖ Provide a 24/7 operations center for technical questions or requests for information related to: (a) operational status of the Nationwide Differential GPS augmentation system and Nationwide Automatic Identification System; (b) Notice Advisory to Navstar Users (NANU) messages and status of GPS constellation inquiries; and (c) service outages or interference affecting GPS-provided PNT services to civil/non-military/non-aviation user segments, nationally and internationally.
- ❖ Inform NOCC of all civil aviation and GPSOC of all military related GPS service interruption events.
- ❖ Provide technical analysis of interruptions to Differential GPS and/or Nationwide Automatic Identification System to support source location of interference affecting GPS-provided PNT services.

#### FAA/NOCC

- ❖ Disseminate GPS unclassified, publically releasable operational data files and messages provided by the GPS Control Segment.
- ❖ Provide a 24/7 operations center for technical questions or requests for information related to: (a) operational status of timing-dependent space and ground-based GPS local and

wide area augmentation services used in the National Airspace System; (b) civil aviation GPS service interruptions nationally and internationally; (c) service outages or interference affecting or disrupting GPS-provided PNT services to the civil and commercial aviation user segment within the NAS.

- ❖ Provide technical analysis through the use of the Automated Frequency Manager (AFM) to support source location of interference affecting GPS-provided PNT services to any user segment or CIKR sector.
- ❖ Support interagency efforts to characterize, locate, attribute, identify and resolve instances of interference affecting GPS-provided PNT services affecting user segments or CIKR sectors.
- ❖ Provide status of any investigations or coordinated field efforts to resolve interference disrupting or affecting GPS-provided PNT services to the aviation user segment.
- ❖ Inform interagency partners, the Department of State (DOS) and international Aeronautical Navigation Service Provider (ANSP) civil entities of reports of interference to GPS-provided PNT services affecting the international aviation user segment.

### 2014 GPS Operations Summit

Each Ops Summit opens with "Organizational Update Reports". These reports provide the opportunity for each of the Triad organizations to inform the others of their recent activities that include, but are not limited to, operational procedures; organizational/personnel changes; process improvements; identified issues or concerns; change recommendations; and other areas of mutual concern and interest.

There were two prominent topics at this year's summit:

1. **Trilateral MOA Update** - As referenced above, the update to the Trilateral MOA had been

through an extensive review and was ready for the final approval and signatures. The update consisted primarily of organizational configuration revisions and an increase emphasis on the roles and responsibilities related to GPS interference reporting procedures. Additionally, there will be an addition of an Annex A titled, "Interagency Procedures for the Reporting of GPS Interference Affecting User Segments and CIKR Sectors within the Homeland". This annex will focus on the detailed roles, responsibilities and procedures of GPS interference reporting and define the cooperation and interaction with other agencies.

**2. Interference Reporting and Training Exercises** - With the inclusion of Annex A in the MOA, the summit's discussion centered on the Triad's relationship with other federal agencies and participation in training exercise related to GPS

interference reporting. Training exercises, from small functional table top venues to large scale national level exercises, have been beneficial and vital for the constant evolution and improvement in the identification, detection and mitigation of real world GPS interference events.

In addition to the two topic areas identified above, other Ops Summit discussions focused on:

- ❖ **International User Support Activities:** Through unilateral and multilateral forums sponsored by the State Department, the other providers of Global Navigation Satellite Systems have expressed interest in cooperating and developing User Support Services. The Triad organizations will have various roles in supporting these efforts.
- ❖ **OCX Interface Requirements:** The implementation of the Next Generation GPS Control Segment (OCX) will bring changes to the internet protocol

formats used to distribute GPS operational information and increase Information Assurance requirements. Discussion centered on the Triad's readiness for implementing these upcoming changes.

- ❖ **GPS Classification Guide:** Air Force Space Command is preparing to conduct a review of the GPS Classification Guide. The Triad members were encouraged to review the document and be prepared to participate in the upcoming review.
- ❖ **Information Coordination Dissemination Team (IDCT):** The IDCT, organized in 1995, developed and documented the processes and procedures used to formulate today's GPS user support services. Restructuring of the IDCT was discussed by the Triad principles.
- ❖ **GPS Civil Signal Operations Interface and Command Authority:** With the launching of the modernized GPS satellites with new civil signals and the impending OCX command and control improvements, the new GPS civil signals will have expanded capabilities, unlike the legacy SPS GPS signal (L1 C/A) used over the last two decades. The Triad members will participate in developing the new procedures required to command and control these new capabilities.

The 2014 Ops Summit closed with mixed emotions as this summit marked the final participation by key members as they prepare to move on to new jobs and challenges. Best wishes and gratitude for years of support go out to: Lt Col Thomas "Steamer" Ste. Marie; Mr. John Lopresti and Mr. Mark Miner.

- Hank Skalski (FAA AJM-3211)

### CNAV Announcement

In March, the Department of Transportation issued a Federal Register Notice (FRN) - "Global Positioning System Pre-Operational



Civil Navigation; Message Continuous Broadcast". The purpose of this notice was to seek comment from the public and industry regarding plans by the United States Air Force to broadcast pre-operational L2C and L5 civil navigation (CNAV) messages from certain Global Positioning System (GPS) satellites. This broadcast began in April 2014.

For more information on the Civil Navigation (CNAV) broadcast, please see the associated Federal Register Notice.

- Mary Ann Davis (FAA AJM-321/NAVTAC)

### Satellite Navigation Approach Procedures Update

The Satellite-based Approach Procedures table reflects the continuing growth of all types of satellite navigation approach procedures. For comparison purposes, we also include a table noting the recent inventory of Instrument Approach Procedures Based on Conventional NAVAIDS. More detailed information about satellite based instrument approach procedures, please visit our GPS/WAAS Approach Procedures page.

- Mary Ann Davis (FAA AJM-321/NAVTAC)

### On the Web

Where can you find FAA Satellite Navigation Program information in between editions of the SATNAV News? Please visit our website - <http://gps.faa.gov>. Recently, we have updated GPS/WAAS Approaches and GBAS News. Also, on our website, you can find information about how GPS, WAAS, and GBAS work; an archive of past SATNAV News editions; and fact sheets. We are always looking for ways to improve the website and love your suggestions, so please feel free to send them to [MaryAnn.CTR.Davis@faa.gov](mailto:MaryAnn.CTR.Davis@faa.gov). In the meantime, we continue to make updates to existing pages.

- Mary Ann Davis (FAA AJM-321/NAVTAC)

Satellite-based Approach Procedures (by Procedure Type)			
	Procedures (Part 139 Airports)	Procedures (Non-Part 139 Airports)	Total Number of Procedures
LNAV Procedures	1,760	4,115	5,875
LNAV/VNAV Procedures	1,354	1,955	3,308
LPV Procedures (LPV w/200' HAT)	1,356	2,074	3,430 (866)
LP Procedures	79	476	555
GLS Procedures	11	0	11
GPS Stand-Alone Procedures	11	117	128

Note: Number of GPS Stand-Alone will continue to decrease as they are replaced by RNAV procedures  
(Data as of July 24, 2014)

Instrument Approach Procedures (IAPs) Based on Conventional NAVAIDS	
ILS	1,268
ILS (CAT II)	152
ILS (CAT III)	117
NDB	746
VOR	1,259
VOR / DME	936

(Data as of July 24, 2014)

[Click for more information on the FAA Inventory Flight Procedures \(IFP\) Inventory Summary](#)