



Federal Aviation Administration

SatNav News

FAA Satellite Navigation Product Teams

What's Next for WAAS?

In 2007, the Wide Area Augmentation System (WAAS) expanded its coverage, transitioned to new GEO satellites, and continued making system enhancements to keep the WAAS momentum moving forward. Additionally, over 300 new LPVs were published, bringing the total number of LPVs at the end of 2007 to nearly 1,000. Equipage also continued to steadily increase as more users embraced the benefits that WAAS provides. With all this accomplished, one might ask, "What's next for WAAS?" The answer is "even more".

The WAAS project consists of four phases. Phase I was completed in 2003 with the initial commissioning of the WAAS. Phase II is currently underway and will be completed this year. At that point, the FAA will embark upon the two final phases of WAAS. Phase III, which will begin in 2009, is referred to as the "Full LPV-200 Performance" phase. This phase will include modifications and enhancements, including technology refresh. During this time, the FAA will be involved in a series of operational initiatives to extend the benefits of the existing service. In particular, emphasis will be placed on the production of WAAS approach procedures that support minimums as low as 200'. The FAA has a jump on this initiative as there are already 12 published WAAS LPVs that go down to 200'. Phase IV, currently expected to start in 2014, is referred to as "Dual Frequency Operations". This final phase will focus on making enhancements to WAAS to take full advantage of future dual frequency GPS. As such, FAA has aligned its WAAS Phase IV project schedule with that of the DoD's GPS modernization program. After Phase IV is complete, the FAA will continue to support single frequency users, but for those interested in dual frequency, there will be added benefit. Availability and continuity during severe solar activity will be greatly improved. Additionally, this capability will provide additional protection against GPS interference. Phase IV is scheduled for completion in 2028.

Development Phases of WAAS

2003 (July)
Phase I: Initial Operational Capability (IOC) - Provided LNAV/VNAV/limited LPV capability
2003 - 2008
Phase II: Full LPV Performance - Improve LPV availability in CONUS and Alaska
2009 - 2013
Phase III: Full LPV-200 Performance - Will include development, modifications, and enhancements, including technical refresh
2014 - 2028
Phase IV: Dual Frequency Operations - Will significantly improve availability and continuity during severe solar activity - Will provide additional protection against GPS interference

Throughout this development, the FAA will continue to work with the International Civil Aviation Organization (ICAO) and other international satellite based augmentation system (SBAS) service providers to ensure interoperability and to help extend the benefits and coverage of the worldwide SBAS network. Additionally, WAAS will be a cornerstone of the FAA's Next Generation (NextGen) Air Transportation System, providing a robust navigation

In this issue:

What's Next for WAAS?.....1

FAA to Publish New Line of Minima for WAAS on RNAV (GPS) Instrument Approach Charts.....2

LPV Watch: WAAS-Based Approach Procedures Surpass 1,000.....3

WAAS Avionics Update.....3

2008 - An Exciting Year for LAAS.....3

GNSS in the News.....4

GNSS on the Road.....5

Subscription Service for GPS/WAAS Approaches Web Page Takes Off.....5

The **SATNAV News** is produced by the Navigation Services (ATO-W) branch of the Federal Aviation Administration. This newsletter provides information on the Wide Area Augmentation System (WAAS) and the Local Area Augmentation System (LAAS), and initiatives associated with the implementation of satellite navigation into the National Airspace System (NAS).



source for ADS-B applications and providing area navigation services for Required Navigation Performance (RNP) and Area Navigation (RNAV) operations. WAAS has already matured into a critical navigation services component for current and future users, but there is much more to come. Stay tuned.

- Mary Ann Davis, FAA ATO-W/GPS TAC

FAA to Publish New Line of Minima for WAAS on RNAV (GPS) Instrument Approach Charts

Soon, some RNAV (GPS) instrument approach procedures (IAPs) will have a new line of minima. Labeled on the charts as 'LP', localizer performance minima will allow operators with appropriately-certified Wide Area Augmentation System (WAAS) navigation systems to fly instrument approaches in potentially lower weather conditions to runways that do not qualify for localizer performance with vertical guidance (LPV) minima. These new approaches are the result of new terminal instrument procedures (TERPS) criteria recently approved by the FAA and will benefit both fixed wing and rotary wing for instrument flight rules (IFR) operations.

For pilots landing at airports in less than optimal weather conditions, IAPs are the key to guiding the pilot through clouds



and low visibility to a point where the runway can be seen and the approach and landing completed visually. A combination of navigation systems, aircraft capabilities, and instrument approach design criteria determine how low the minima for an approach will be.

An LPV procedure has often been referred to as the satellite navigation equivalent of the Instrument Landing System (ILS) as both LPVs and ILSs provide vertical guidance. As the name implies, an LP approach is the equivalent of a localizer-only approach. Like many localizer-only approaches that serve runway ends with obstacles that prevent use of an ILS, LP

approaches are intended to utilize the benefits of WAAS in locations where a vertically-guided LPV approach is not feasible due to obstacles or terrain.

Technically, LP differs from existing LNAV (lateral navigation) minima by allowing approach developers to use a smaller obstacle evaluation area based on localizer-like angular guidance and the much smaller integrity limits of WAAS. Obstacles offset from the approach course that raise the minimum descent altitude (MDA) for an LNAV may not necessarily affect the MDA for LP. This results in potentially lower minimums, and in the case of low instrument meteorological conditions, the difference between landing and diverting to another airport.

There are minimal operational differences between an LP and LNAV approach. On an LNAV approach, full scale deflection is ± 0.3 nautical miles (NM) at the final approach fix (FAF) and continues at this scaling until the runway threshold. An LP procedure is designed similar to a localizer approach with the course narrowing from approximately ± 1400 feet at the FAF to ± 350 feet at the threshold. The LP procedure is not vertically-guided so the minimum is depicted as an MDA, rather than a decision altitude (DA) in the case of an LPV.

The publication of LP procedures will not have any effect on the continuing development of LPV approaches. The FAA has published over 1,000 LPV approaches to date and has committed to publishing an LPV procedure to every runway in the National Airspace System (NAS) that will qualify. As a result, there will never be a need for both LPV and LP minima on the same instrument approach chart—a good thing considering LP certified avionics cannot store both LP and LPV procedures for the same approach in their database.

While the criteria for LP procedures have been approved, it will likely be the fourth quarter of 2008 before LP lines of minima begin to appear on charts. This takes into consideration the time required for training of procedure development specialists, configuration of procedure development tools, and normal timeline for development of a procedure. Further, while WAAS avionics certified under TSO-C145B or TSO-C146B may be configured for LP, avionics certified under prior technical service orders (TSO) may require updates in order to properly depict LP procedures. The flight manual for your avionics should indicate whether your WAAS receiver is LP ready.

While it is too soon to estimate how many LP procedures will be published, LP is further proof that the FAA is committed to utilizing satellite-based navigation to increase safety while providing the lowest minima and IFR accessibility to thousands of airports in the NAS.

- Brad Zeigler, FAA ATO-W/GPS TAC



LPV Watch: WAAS-Based Approach Procedures Surpass 1,000

February 14, 2008 marked a new milestone for the FAA Global Navigation Satellite System (GNSS) Program. As of this latest charting cycle, there were more than 1,000 instrument approach procedures with localizer performance with vertical guidance (LPV) minima.

This charting cycle yielded 33 additional procedures for a total of 1,028 LPV procedures. More than half (58%) of all LPV procedures are to runways without an existing instrument landing system (ILS).

Total LPVs Published as of 2/14/08	1028
To Runways Also Served by ILS	436
To Runways Not Served by ILS	592
Total Number of Airports with LPVs	577
To Airports Served by ILS	350
To Airports Not Served by ILS	227

The LPV utilizes WAAS to provide vertical guidance for satellite-based approaches. The FAA began publishing GPS approaches in 1994 and has published 4,411 GPS and RNAV (GPS) procedures to date. In 2003 the FAA published the first RNAV (GPS) procedure with LPV minima. Today, 23% of all published satellite-based approaches include LPV.

1,275 RNAV (GPS) procedures include lateral/vertical navigation (LNAV/VNAV) minima. Originally intended for aircraft with barometric vertical guidance, WAAS users with avionics certified for LPV can also fly to LNAV/VNAV minima. Between LPV and LNAV/VNAV procedures that do not yet have LPV minima, 33% of all RNAV (GPS) procedures can be flown with published vertical guidance.

Satellite-based procedures represent about 42% of the approximately 10,500 instrument approach procedures maintained by the FAA. As the agency continues to publish new RNAV (GPS) procedures while decommissioning little-used ground-based procedures such as NDB, that percentage will steadily increase.

A listing of current airports and runways served by LPVs can be found on our website. To access this information, go to <http://gps.faa.gov> and select the GPS/WAAS Approaches button from bottom of the front page.



- Brad Zeigler, FAA ATO-W/GPS TAC

WAAS Avionics Update

Garmin recently announced that they will no longer be manufacturing the venerable GNS-480. They will however continue to support the unit and work toward the removal of the IFR GPS operational "primary means of navigation" limitation. This limitation has already been removed from the GNS 400W and 500W avionics family under Garmin's Software Service Bulletin No. 0740 Rev. A, published November 29, 2007. This bulletin describes the process for upgrading the 400W/500W unit's main software to version 3.0 and upgrading the GPS software to version 3.0. This software also includes some 15 new features and capabilities.

Universal Avionics has recently announced that development of their single WAAS flight management system (FMS) capability is progressing on schedule with expected certification early in the second quarter of 2008. These single WAAS FMSs will be available in the UNS-1E, UNS-1Esp, UNS-1F and UNS-1L models and will also include Localizer Performance (LP) approach capability. (For more information on LP capability, please see "FAA to Publish New Line of Minima for WAAS on RNAV (GPS) Instrument Approach Charts" on page 2.) The single FMS installation will be particularly applicable to helicopter and medium-size transport category airplanes where pedestal space and weight are major considerations.

Universal's WAAS products are also seeing many and varied airframe applications both here in the US and Canada. Canadian carrier First Air has equipped Boeing 727-200 series aircraft with UNS-1Fw FMSs while ARC Avionics of Miami, Florida is working toward the integration of a UNS-1Fw FMS in Boeing 737-200 aircraft. Cessna Aircraft is also progressing toward supplemental type certificate (STC) development in the Citation XLS series with UNS-1Espw FMSs.

I'd like to thank those of you who responded to our last update with both comments and questions. Don't hesitate to send a note (thomas.ctr.salat@faa.gov) to either ask a question, or provide feedback or suggestions.

- Tom Salat, FAA ATO-W/GPS TAC

2008 - An Exciting Year for LAAS

2008 is expected to be a big year for LAAS. By the end of 2008, the first Category (CAT) I LAAS is expected to be certified in compliance with the International Civil Aviation Organization's (ICAO) Standards and Recommended Practices (SARPS). This accomplishment will be the much anticipated result of many years of research and development, international cooperation, and strong coordination between government and industry stakeholders. At present, the LAAS program is



finishing work to address LAAS safety requirements and complete a hazardously misleading information (HMI) analysis, expected to be complete by March. The next step will be system design approval. Upon the completion of system design approval, the way will be clear for certification - also referred to as Part 171 non-Federal approval.

Simultaneously with the CAT I LAAS work, the FAA has also continued work toward a CAT II/III LAAS capability. This work includes coordination with RTCA, ICAO, and other industry partners. RTCA is currently reviewing and modifying a joint FAA/Boeing proposal on CAT II/III requirement allocation. Concurrently, ICAO is reviewing and modifying the SARPS proposal. In conjunction with RTCA and ICAO reviews, the FAA Navigation Services group is updating the draft non-Federal ground facility specification. The next major milestone for LAAS CAT II/III is expected in May 2008 when the Category I non-Federal ground system is delivered. The CAT I ground system will provide a platform to begin validating CAT II/III concepts. In September of 2008, the non-Federal ground specification will be updated to reflect recommended changes from RTCA and ICAO.

In the meantime, international interest in LAAS, or GBAS (Ground Based Augmentation System), as the system is referred to internationally, remains high. The International GBAS Working Group (IGWG) continues to meet regularly. The next meeting is scheduled in Brazil in April and will be hosted by DECEA Brazil. This international working group has had strong impact on the proliferation of LAAS technology. With the GBAS technology moving from the development stage to the implementation stage, new participants - especially,



Building momentum for 2008, LAAS closed out 2007 with a successful flight trial in Malaga, Spain. The flight trial was conducted with an Airbus 320 aircraft against a Honeywell SLS-3000 ground station, identical to the one in Memphis. FAA and Spain's Aeropuertos Españoles y Navegación Aérea (AENA) are working closely on implementation of GBAS/LAAS under a cooperative agreement for research and development.

commercial airlines - have joined the working group to monitor the progress and to provide information about their operations and equipage plans. As a part of those plans, new generation Airbus and Boeing aircraft will be GBAS-capable, including the new Boeing Dreamliner which includes GBAS capability as standard equipment.

More and more countries continue to approach the FAA to learn about the development and implementation of LAAS. In the last quarter, the FAA GNSS Program Office has hosted visitors from both Chile and Japan. These international delegations visited the LAAS test prototype in Memphis and also had the opportunity to meet with GNSS team members at FAA headquarters. The certification work underway in Memphis also has an international connection. The FAA's work in Memphis is complemented by that of Air Services Australia in Sydney. The FAA and Australia are working together under an international agreement to achieve LAAS/GBAS certification as soon as possible to the delight of many LAAS enthusiasts. This international cooperation will be the key to achieving the most expeditious path to Part 171 non-Federal approval.

In future editions of the SATNAV News, we will bring you updates on all these activities as the countdown to LAAS certification gains increasing momentum.

- *Mary Ann Davis/Dieter Guenter, FAA ATO-W / GPS TAC*

GNSS in the News

Recently, a few articles related to the FAA's GNSS program have appeared in aviation trade magazines. Here are a couple that we came across in case you are interested in checking them out.

❖ "WAAS Expands" by David Hughes. (December 24/31, 2007). Aviation Week and Space Technology, p. 34.

The web link is: http://www.aviationweek.com/search/AvnowSearchResult.do?reference=xml/awst_xml/2007/12/24/AW_12_24_2007_p34-20425.xml (Access may be limited to Aviation Week subscribers.)

❖ "WAAS-enabled GPS systems support precise navigation" by Barry Rosenberg. (January 2008). Avionics Magazine, pp. 43-46.

The web link is: <http://www.aviationtoday.com/av/categories/bga/18080.html>.



GNSS on the Road

As a part of outreach, representatives of the FAA GNSS Program Office will be participating in several of our stakeholders' conferences this spring. If you plan to attend any of these events, please stop by and say "hello".

Events attended earlier this year:

Northwest Aviation Conference

Puyallup, WA
February 23 - 24, 2008

Helicopter Association International (HAI) - HELI-EXPO

Houston, TX
February 24-26, 2008

2008 ACC/AAAE Airport Planning, Design and Construction Symposium

Denver, CO
February 27-29, 2008

Upcoming events:

Experimental Aircraft Association (EAA)

Sun 'N Fun
Lakeland, FL
April 8-13, 2008

Texas Aviation Conference

Austin, TX
April 15-17, 2008

Alaska State Aviation and Trade Show and Conference

Anchorage, AK
May 3-4, 2008

RAA Annual Convention

Indianapolis, IN
May 5-8, 2008

FAA Western Pacific Regional Airports Conference

Los Angeles, CA
May 5-8, 2008

Subscription Service for GPS/WAAS Approaches Web Page Takes Off

In early October, we began offering an option to our website visitors to subscribe to a few of our web pages, to include the GPS/WAAS Approaches page. As of late January, in just a few short months, over 700 of you have signed up to receive e-mail notifications when the GPS/WAAS approaches information is updated. We are encouraged by this interest and hope you are finding the information posted helpful.

If you haven't yet signed up for this service, but are interested, you can sign up by one of two ways.

❖ Visit <http://gps.faa.gov> and select the GPS/WAAS Approaches button at the bottom of the page. From the GPS/WAAS Approaches page, simply click on the "Subscribe to this page" link in the right margin and follow the online instructions from there. Or...

❖ Visit <http://www.faa.gov/help/subscribe/>. After a quick process (which requires no personal information other than the e-mail address to which you would like the notifications sent), select "GPS/WAAS Approaches" from the list of options. After you have completed either process, you will receive an e-mail notification confirming that you have been added to the service.

- Mary Ann Davis, FAA ATO-W / GPS TAC

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If you have any questions on the e-mail registration process, ideas for future articles, or general feedback on the newsletter, please contact Mary Ann Davis at maryann.ctr.davis@faa.gov.