Northern Air Cargo to Use WAAS to Fly More Efficient Routes and Gain Greater Airport Access

Northern Air Cargo, an air freight carrier based in Anchorage, Alaska, has been certified to begin flying with the Federal Aviation Administration’s Wide Area Augmentation System (WAAS). Using the extremely accurate navigation service provided by WAAS, Northern Air Cargo can now take advantage of WAAS localizer performance with vertical (LPV) approach procedures, utilize low and high altitude routes throughout Alaska that require WAAS equipage, and take advantage of other WAAS-enabled benefits. Northern Air Cargo is the first Boeing 737-200 in the U.S. to apply for and acquire supplemental type certification to fly with full WAAS capability. Northern Air Cargo worked closely with ARC Avionics of Miami, Florida to upgrade their Universal Avionics UNS-1F to the WAAS UNS 1-Fw that led to the approval of the Supplemental Type Certificate (STC). This installation of WAAS on a Northern Air Cargo B 737-200 is a much anticipated milestone for Northern Air Cargo, but it is also a major benefit to other B 737-200/300 operators interested in WAAS. With the completion and approval of this installation by Northern Air Cargo, the same process for other operators will now be much abbreviated. As a result of this initiative being taken by Northern Air Cargo, the potential for this becoming a catalyst for WAAS installation in hundreds of similar Boeing 737 airframes is a distinct possibility.

Benefits of WAAS Equipage
Northern Air Cargo will now be able to take advantage of the benefits of WAAS Localizer Performance with Vertical (LPV) approach procedures. WAAS LPVs improve access to airports by supporting approach minimums as low as 200 feet without the need for any navigation equipment at the airport — a capability especially beneficial at runway ends without an Instrument Landing System (ILS). In Alaska, there are currently 40 WAAS LPVs to 23 different locations. Many of these locations are very remote with no ILS, and some with gravel runways. With WAAS, Northern Air Cargo will have better access to these airports, gaining the ability to land in conditions that were before prohibitive. Nationwide, there are over 1,500 WAAS LPVs already in place and the FAA has committed to publish WAAS approach procedures to all qualifying runway ends, estimated to be about 6,000, by 2018.
Additionally, Northern Air Cargo will now be able to fly “T” and “Q” routes. In Alaska, WAAS is required to fly T routes (enroute FL180 and below) and GNSS is required to fly Q routes (above FL180). T and Q routes are beneficial because they provide more direct routing as opposed to the less direct Victor and Jet routes which are predicated on the ground-based locations of Very High Frequency Omnidirectional Ranging (VOR) navigation systems. T routes are beneficial because they will permit aircraft to fly lower minimum enroute altitudes (MEAs) than Victor routes, increasing safety through aircraft’s ability to fly below icing levels.

This NAC upgrade to WAAS capability will also mitigate the requirement for departure, terminal, and en route Receiver Autonomous Integrity Monitoring (RAIM) checks that will go into effect this summer in accordance with requirements in AC 90-100A. These RAIM checks will not be required for WAAS-equipped aircraft as long as the WAAS signal is available to the aircraft since the WAAS signal includes built-in integrity.

Next Steps
Now that the first installation is in place for a commercial transport category operator, Northern Air Cargo will work closely with the FAA to begin flight evaluation of proposed data collection routes. These activities will support the collection and reporting of the operational benefits that can be derived from WAAS-equipped air carrier aircraft operating in the NAS environment. This data will assist the FAA in the technical evaluation of WAAS utilization (especially in Alaska) to include the assessment of environmental benefits, economic savings, and cost avoidance related to such flight operations as would be normally flown by an air carrier. This economic information will be shared with the JPDO and NextGen organizations as part of the evaluation of these NextGen capabilities. This data will be collected as part of Northern Air Cargo’s normal revenue flight operations to airports within their system. Northern Air Cargo has already started collecting operational data prior to WAAS equipage to help to establish a baseline for comparison purposes. In addition to operational benefits accrued by the air carrier, other benefits are expected to be validated, such as environmental benefits resulting from more direct routes and less fuel burn. While benefit analyses have been projected, the FAA WAAS program seeks to measure actual benefits and evaluate operational issues in order to support more effective use of WAAS in meeting FAA and NextGen goals and objectives.

More on Northern Air Cargo
Northern Air Cargo has been providing service to Alaska for over 50 years. They connect Anchorage with destinations throughout Alaska and beyond with scheduled, charter, and flag stop service - carrying up to 30,000 pounds per trip.

More on WAAS
The Wide Area Augmentation System was originally commissioned in July 2003 and provides service to the continental United States, Alaska, Canada and Mexico. WAAS can provide vertical guidance down to as low as 200 feet height above touchdown (HAT).

This series of upgrades coincided with the rise in the number of WAAS LPV approaches. As of May 2009, the FAA has published over 1,500 LPV approach procedures, and over 100 of these LPV procedures have a decision height as low as 200 feet. The upgrades to the WAAS and the rapid increase in the number of LPV approach procedures together have been integral to the FAA strategy to increase the usage of WAAS for aviation.

This article shows the resultant WAAS performance after the series of upgrades. Specifically, the WAAS coverage for different service levels is shown. The service levels are based on horizontal and vertical alert limits (HAL and VAL). Though these service levels do not correlate directly to an approach procedure, the service levels define performance levels for WAAS.

WAAS Performance Continues to Improve with Latest Set of Upgrades
In October 2008, the WAAS completed a series of upgrades, in part to improve the availability of the LPV service. These upgrades began in 2004 and included the addition of reference stations in Alaska, the establishment of international reference stations in Canada and Mexico, and the improvement of operational WAAS algorithms to increase the availability and reliability of the WAAS navigation service. Other changes were made during this timeframe that improved the operation and maintenance of the WAAS.

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- Mary Ann Davis, FAA AJW-43/GPS TAC
WAAS receivers, as specified in RTCA DO-229, calculate horizontal and vertical protection levels (HPL and VPL). HPL and VPL are calculated once per second. As long as the HPL is less than the HAL and the VPL is less than the VAL, then a particular service level is available. LPV service is available when the HPL is less than 40 meters and the VPL is less than 50 meters. LPV-200 service is available when the HPL is less than 40 meters and the VPL is less than 35 meters.

Figure 1 shows the Continental U.S. (CONUS) LPV service from October to December 2008. In this figure (and the other figures in this article) availability is determined by calculating the HPL and VPL each second. When the HPL and VPL both meet the criteria of a particular service level, then the service is available. The statistics based on this HPL/HAL and VPL/VAL calculation determines the service availability over the timeframe. For comparison, the coverage in CONUS from July to September 2008 is shown in Figure 2. The main difference in the coverage of these two figures is that in Figure 2 there are no locations in CONUS that had WAAS available 100% of the time.

Figure 3 shows the LPV-200 coverage from October to December 2008 and Figure 4 shows the LPV-200 coverage from July to September 2008. Because of the latest WAAS upgrades the WAAS LPV-200 coverage is better in the October to December figure.
Figures 5 and 6 show the Alaska LPV coverage during October to December 2008 and July to September 2008, respectively.

The latest upgrade to WAAS improved LPV and LPV-200 service in Alaska. The upgrade in LPV-200 service in Alaska can be seen in Figures 7 and 8.

The performance shown in the October to December figures will be the typical performance of WAAS for the next several years.

The next major upgrade to WAAS will be when the GPS constellation is upgraded to include a second civilian frequency. When that WAAS upgrade occurs, the FAA anticipates near 100% LPV-200 availability for users that utilize both civilian frequencies.

- Bill Wanner, FAA ATO-P/AJP-7A1
Worldwide SBAS Coverage is Growing

The availability of Satellite Based Augmentation System (SBAS) coverage throughout the world continues to grow. To date, the Wide Area Augmentation System (WAAS), the European Geostationary Navigation Overlay System (EGNOS), and Multi-function Transport Satellite (MTSAT) Satellite-based Augmentation System (MSAS) are all up and running. The service areas of these three systems cover a significant part of the world and additional systems are under development. Collectively, these SBASs support RNP 0.3 operations in broad areas of the world.

- Mary Ann Davis, FAA AJW-43/GPS TAC

8th International GBAS Working Group Hosted in Palermo

The 8th International Ground Based Augmentation System (GBAS) Working Group was hosted by Ente Nazionale di Assistenza al Volo (ENAV), Italy's Air Navigation Service Provider on March 3-6, 2009. The goal of the International GBAS Working Group (IGWG) is to provide a forum for the exchange of technical and operational topics and coordination of research and implementation activities that will help accelerate the implementation of GBAS capability worldwide. The meeting was chaired by the FAA GBAS Program Office and Eurocontrol.

Over 55 participants, representing international service providers, industry, airlines and aircraft manufacturers, attended the meeting and working sessions. Participants included:

- Honeywell, Thales, ENRI/Japan, KARI/Korea, NEC/Japan, SELEX/US, Indra/Spain, and NPPF Spectr/Russia

The meeting was opened by the Director General of ENAV, Mr. Nadio Di Rienzo, who stressed the importance of satellite navigation. He also emphasized the need to reduce lead times from definition to implementation, increasing the ability to achieve a cost effective transition, especially in the present financial critical situation for airlines and service providers. He noted that ENAV has invested in satellite research and development activities and will continue as demonstrated by the GBAS prototype project at Palermo airport.

The national updates and briefings clearly indicated increased activities and focus on implementation of GBAS CAT I; but, there was also significant activity on planning for GBAS CAT II/III due to SESAR ATM master plan activities. The Single European Sky ATM Research Programme (SESAR) ATM research and development (R&D) program in Europe has a budget of 2.1 B Euros of which the GBAS funding is approximately 63 M Euros. The R&D program consists of several work packages that include GBAS embedded under “Airport Operations”, “Aircraft”, and “GND CNS”. The GBAS packages focus on GBAS CAT III development and validation.

EUROCONTROL expects initiation of the projects by summer 2009.

The effect of the SESAR ATM master plan activities was visible in both increased and new attendance of industry and service providers at this IGWG. New plans for GBAS development and implementation were presented by NAV of Portugal, SELEX of the U.S. and Indra of Spain. The U.S., Spain, Germany, Australia, and Russia are leading GBAS implementation activities. Germany and Australia have already granted approval for the use of GBAS for airlines under revenue operations. This approval will have a VFR operational restriction until certification is received.

In the U.S., the biggest GBAS implementation project is the Newark project, a cooperative effort between the FAA, the New York and New Jersey Port Authority, and Continental Airlines. In Russia, a Russian-built (NPPF SPECTR) GPS and GLONASS based version of GBAS is operational at several locations. EUROCONTROL and NPPF SPECTR are performing interoperability research on these Russian systems in coordination with the German DFS and the University of Braunschweig. Many of the other service providers have ongoing GBAS validation projects with near-term to mid-term implementation plans. For example, the Chilean DGAC is engaged in an ongoing study for GBAS implementation at Santiago and other suitable airports.
Airbus and Boeing continue their support for GBAS and provided an outline on their plans for fleet equipage. All new Airbus aircraft will eventually include the option for GBAS capability. Today, 62 percent of all current A 380 aircraft ordered are requested with the GBAS option, also referred to as GLS-equipped. For Boeing, the Boeing 737-800, Boeing 787, and Boeing 747-8 will all be GLS-capable. (GLS will be standard on B787 and the B747-8 aircraft.)

Both Airbus’ and Boeing’s concept of airborne implementation is GNSS RNAV/RNP to a GLS final. Boeing demonstrated this procedure by presenting the results of a joint Alaskan Airlines, Qantas, and Boeing flight demonstration in Juneau. This included a combination of RNP to a short GBAS final with autoland (demonstration only). Airbus is also in the process of implementing a similar capability through a fully automated process (FMS selection, automatic capture, and transition to GLS).

Avionics and ground station manufacturers provided updates on the status of their system developments. At this time, the Honeywell system is the only one being certified by the FAA. Thales is working directly with their individual customers on system certification. NPPF SPECTR achieved certification in Russia.

The technical working sessions held as a part of this meeting included detailed discussions on a number of related activities. These discussions provided a good forum for information and data exchange and the participation in cooperative projects vital to the international implementation of GBAS.

The meeting exceeded the co-chairing organizations expectations and all participants were extremely satisfied with the outcome of the working group meeting. This working group addresses relevant issues for the development and implementation of GBAS, and exchanges data and information, which can effectively be used by the participants in formulating their business strategies and implementation plans.

The next working group meeting is planned for October 2009 in the U.S.

WAAS Designed for Continuous Enhancements

The Wide Area Augmentation System (WAAS) is composed of four distinct phases, each bringing its own set of enhancements which will maintain the viability of WAAS well into the future. Perhaps the most notable of these phases is Phase 1, or Initial Operational Capability (IOC), which was reached in July 2003 as WAAS was commissioned into the National Airspace System (NAS). However, there are three more phases for WAAS, each bringing a round of enhancements to further extend the popular navigation system’s capabilities.

Here is a summary of the phases:

**Phase 1 - Initial Operational Capability (IOC)**

**Phase 2 - Full Localizer Performance with Vertical Guidance [LPV] Performance (FLP)**

**Phase 3 - Full LPV-200 Performance (WAAS is currently within Phase 3)**

**Phase 4 - Dual Frequency Operations**

**Phase 2 - Full Localizer Performance with Vertical Guidance [LPV] Performance (FLP)**

After WAAS commissioning, the FAA embarked upon increasing system availability, coverage, and performance. Through a series of meticulously-planned and tightly-executed operational upgrades, the WAAS team increased availability and performance of service throughout the NAS even while the WAAS was operational for users. Upgrades included increased performance to support LPV procedures to lower minimums, additional wide-area reference stations (WRSs) in Alaska for improved WAAS performance over Alaska’s airspace, additional WRSs in Mexico and Canada to increase WAAS coverage across the NAS and across North America, WAAS software algorithmic improvements for increased performance and system robustness, and the addition of two well-placed, high-power WAAS navigation payloads (onboard commercial geostationary earth orbit (GEO) satellites) to replace the original navigation payloads. The FLP Phase series of upgrades was completed and FLP was achieved in 2008.

**Phase 3 - Full LPV-200 Performance**

Subsequent to the achievement of FLP, the WAAS team started the development of Phase 3. In Phase 3, WAAS upgrades will be incrementally added to expand LPV-200 coverage and availability, increase WAAS performance during the upcoming Solar Max period (2011 - 2014), ensure WAAS availability and coverage via the addition of a third WAAS navigation payload, and provide technical refresh of system components. A further major
component of Phase 3 is to transition system maintenance capabilities from the WAAS prime contractor to the FAA’s Safety Operations Support group (SOS) at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma.

Phase 3 started in October 2008 and will be complete in 2014. The first Phase 3 upgrade will occur in November 2009 and will include software changes for increased operational availability and the technical refresh of near obsolete processing hardware. The second upgrade will occur in the winter of 2010 and will add a short-term ‘Gap Filler’ GEO, software improvements, and WAAS telecommunications network infrastructure upgrades. The Gap Filler GEO will allow WAAS to meet operational availability requirements using a temporary navigation transponder solution. An additional upgrade is planned for Fall 2011. This upgrade will include WAAS algorithm improvements to increase WAAS availability and performance during the peak of the solar cycle.

Phase 4 - Dual Frequency Operations
WAAS Phase 4, Dual Frequency Operations, will begin in 2014. Phase 4 will focus on two major areas: 1) the introduction of dual-frequency operation into the WAAS and 2) WAAS lifecycle maintenance. During Phase 4 the WAAS team plans modifications to the WAAS to take advantage of planned improvements in the GPS program – specifically the introduction of the second civilian aviation signal (L5). With L1 and L5 broadcast by the GPS constellation, dual-frequency users (both L1 and L5) can compute ionospheric corrections directly, allowing for increased accuracy and performance. WAAS modifications will include the integrity monitoring of L5 signals for broadcast to dual-frequency users. These modifications will not affect legacy single-frequency (current) users. Dual-frequency WAAS development will begin in 2014 and will continue with WAAS system enhancements that will be ready to take advantage of the L5 GPS constellation. A usable L5 GPS constellation is currently scheduled to be available in 2018. WAAS lifecycle maintenance will be an important component of this phase, including the replenishment of WAAS GEO assets. Phase 4 will continue until at least 2028, the earliest planned retirement of the WAAS.

- Ed Sigler, FAA AJW-43/GPS TAC

GPS/WAAS Approaches Page - Every 56 days, new procedures are published for use in the National Airspace System (NAS) through the Terminal Procedures Publication (TPP) process. Additionally, procedures can also be published during the interim months through the Operations Change Notice (OCN) process. Data on this page is derived from National Aeronautical Charting Office (NACO) Flight Information Publications. This page gives the most current list of available localizer performance with vertical guidance (LPV) approaches, as well as related data about each published LPV, to include airport identifier and airport census information and a graphic of the current LPVs in the U.S. The page also includes a helpful link to the FAA’s Instrument Flight Procedures (IFP) Production Plan web page which contains information on projected IFP production by region or fiscal year and links to how to apply for an IFP at your airport.

Library Page - We have a number of briefings, fact sheets, and other documents with information to keep our readers in the know on the GNSS and all its aviation applications.

In each edition of the SATNAV News, we will highlight different information that can be found on our website. In the coming months, stay logged in for new and exciting additions and upgrades to our website.

- Gretchen Adragna, FAA AJW-43/GPS TAC

LPV Watch: LPVs Continue to Grow
The number of WAAS LPVs continues to rapidly increase.

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<tr>
<th>Total LPVs Published as of 7/02/09</th>
<th>1668</th>
</tr>
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<tbody>
<tr>
<td>To Runways Also Served by ILS</td>
<td>709</td>
</tr>
<tr>
<td>To Runways Not Served by ILS</td>
<td>959</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Number of Airports with LPVs</th>
<th>908</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Airports Served by ILS</td>
<td>520</td>
</tr>
<tr>
<td>To Airports Not Served by ILS</td>
<td>388</td>
</tr>
</tbody>
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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.

- Mary Ann Davis, FAA AJW-43/GPS TAC

GNSS in the News
Below are a few select articles that have appeared in the news since the last publication of SATNAV News. Some of these same links can also be found on the WAAS News page of our website.

What’s on the Web
In our efforts to bring the aviation community the best and most accurate information, the GNSS website content is regularly updated. Here are some highlights of our site that are already a mainstay for those in need of this knowledge.


In Future Editions

Future issues of SATNAV News will be expanded to become “Navigation News”. The Navigation News will include articles on legacy ground-based navigation aids (GBNA) and lighting systems, as well as on satellite navigation topics. Although satellite navigation plays an important role in the transition to NextGen; it is a collective mix of our existing legacy navigation technologies, as well as the supporting lighting systems, that will provide the bridge to the future. Satellite navigation, GBNA transition planning and sustainment, and lighting technology improvements will collectively provide the path to and foundation for the future navigation services planned for the NextGen system.

We hope to provide our readers with the latest information on these initiatives to support decisions they will make as they transition from the use of legacy navigation systems to the navigation system architecture of the future.

- Mary Ann Davis, FAA AJW-43/GPS TAC

FAA SATNAV News will soon become the FAA Navigation News! ”Covering the Navigation Transformation from Now to NextGen.” Look for the change in our next edition!