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# SatNavNews

FAA Navigation Services, AJW-91



## Navigation System Transition Detailed in Federal Register Notice (FRN)

A recent Federal Register Notice (FRN) put forth by the Federal Aviation Administration (FAA) describes a proposed federal rule which would implement a plan to transition the navigation infrastructure of the National Airspace System (NAS) from the conventional ground-based systems to a combination of satellite-based and conventional systems for the Next Generation Air Transportation System (NextGen). A significant capability implemented under the NextGen plan is performance-based navigation (PBN) which consists of area navigation (RNAV) and required navigation performance (RNP), to provide more efficient routes for users, support increased capacity at our Nation's airports, and reduce fuel usage and its associated carbon footprint.

"This FRN sets forth a long awaited transition of our conventional infrastructure to the future based on performance based navigation systems," said Leo Eldredge, Program Manager for the FAA's Global Navigation Satellite Services (GNSS) group.

Key to achieving these goals is the ability of many aircraft to support point-to-point RNAV and RNP routes and procedures unrestricted by the fixed locations of conventional VHF omni-directional range (VOR) facilities and the precise positioning

accuracy provided by the global positioning system (GPS). The plan will significantly reduce the number of VOR facilities. Thanks to the development and deployment of satellite navigation, many aviation users already use RNAV and GPS to fly the existing airways and the Wide Area Augmentation System (WAAS) to fly localizer performance vertical (LPV) instrument approaches..

The FAA is planning to transition to a minimum operating network (MON) of roughly half of the 967 VORs by 2020 to serve as a backup navigation

system in the event of a GPS outage. In the future the FAA may be able to remove all or nearly all of the remaining VORs when sufficient numbers of users have equipped with suitable RNAV or RNP avionics and the FAA provides an alternate positioning, navigation, and timing (APNT) service.



The *SatNav News* is produced by the Navigation Services AJW-91 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).

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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 Scott Speed at [scott.ctr.speed@faa.gov](mailto:scott.ctr.speed@faa.gov)

### Why is the FAA deciding to reduce the number of existing VORs in the NAS?

- FAA is continuing to shift to performance-based navigation (PBN) services that support RNAV and RNP routes and procedures as part of the transition to a satellite-based navigation system that will support NextGen goals. The existing VORs will be used less as primary navigation references because they do not enable PBN.
- The primary navigation source on most aircraft will be satellite-based by 2020, allowing for the discontinuance of a portion of the existing VORs. This stems, in part, from the final rule mandating ADS-B Out equipage by 2020.
- Approximately 85% of the VORs currently operating in the NAS were installed in the 1970's and are well past their 20-year economic service life. They cost nearly \$110 million per year to operate and maintain and recapitalization costs are estimated at over \$1 billion. The FAA can no longer afford to support an entire network of legacy VORs.

### What happens if there is a GPS outage without a suitable network of ground-based navigation aids?

- The FAA will ensure the safety of all NAS users by sustaining a minimum operating network (MON) of roughly half of the VORs to maintain navigation in the unlikely event of a long-term or wide spread GPS outage.
- FAA is also planning to improve a current backup to GPS by enhancing its network of Distance Measuring Equipment (DME) ground stations, which enable RNAV and, in some cases, RNP operations.
- The FAA is developing a long-term alternative to GPS position, navigation, and timing that supports RNAV and RNP required for NextGen operations, which will be operational by 2025. A

VOR-based alternative to GPS is not being considered as one of the options for this system because it does not support RNAV/RNP.

### How will the FAA decide which VORs will be retained in the MON?

- FAA's Navigation Services and Mission Support Services offices are co-chairing a cross-agency working group that will develop a list of candidate VORs for discontinuance using relevant operational, safety, cost, and economic criteria.
- Some VORs are not being considered for discontinuance at this time, such as those outside of the contiguous United States (CONUS), those used to support airways from the Atlantic and Pacific as defined by international agreements, those at the Nation's Core 30 airports<sup>1</sup>, and those in the western mountainous area of the U.S. as defined in 14 USC Part 95. Also, FAA will only consider discontinuing VORs that it currently owns and operates.
- A candidate list will be coordinated with the FAA Eastern, Central, and Western Service Centers and other stakeholders to gain the qualitative knowledge of specific VORs and associated routes, procedures, and operations. This information will be used to develop a final recommended list of VORs for discontinuance.

<sup>1</sup> Core 30 airports are those with significant activity serving major metropolitan areas and also serve as hubs for airline operations, found at [http://aspmhelp.faa.gov/index.php/Core\\_30](http://aspmhelp.faa.gov/index.php/Core_30)

### Who can I contact for more information on the VOR discontinuance program?

- The FAA's point of contact is Mr. Greg Joyner, AJW-911, Navigation Services, Federal Aviation Administration, 800 Independence Avenue, SW, Washington DC 20591; (202)-493-5721.

-Greg Joyner, AJW-911

### FAA Approves First SBAS RNP (AR)

In November 2011, the Federal Aviation Administration (FAA) approved Operations Specifications for Required Navigation Performance (RNP) 0.3 for regional air carrier Horizon Air. This is the first RNP Authorization Required (AR) using a Satellite Based Augmentation System (SBAS) platform, namely the Wide Area Augmentation System (WAAS). On November 22nd, Steve Bush, Horizon's flight operations manager, piloted the first approved RNP (AR) approach in Part 121 revenue service, flight 2064 from Seattle-Tacoma International Airport (SEA) to Pangborn Memorial Airport in Wenatchee, WA (EAT), using a WAAS platform.

Horizon Air, a Part 121 carrier, operates Bombardier Q400 turboprop aircraft, several of which have been equipped with Universal WAAS avionics under an FAA Government Industry Project managed by the WAAS Program Office. The project is designed to provide for flight and data collection activities to evaluate the benefits of WAAS utilization.

"Due to the mountainous terrain near the airport at Wenatchee," said Mr. Bush, "the use of a straight-in approach to Runway 30 was not feasible. However, through the application of Radius-to-Fix (RF) legs to bend the final course around obstacles, we have very good minimums through use of the RNP (AR) approach."

This event demonstrates that WAAS and RNP (AR) combination is a solid performer that belongs in the Performance Based Navigation (PBN) and NextGen "toolbox". Mr. Bush stated, "RNP and the WAAS platform provided by the Universal UNS-1EW Flight Management System provide us with the best of both worlds. It is not necessarily an either/or choice between WAAS or RNP, rather, the two systems are complementary."

Horizon Air's Steve Bush, right, and Perry Solmonson after flying the first RNP (AR) using a SBAS/WAAS platform.



Exploiting the synergy between RNAV RNP (AR) and WAAS-enabled RNAV GPS approaches has been high on the FAA's list of PBN and NextGen objectives. That synergy lies in the combined use of Terminal Procedures (TERPS) criteria in design guidance orders 8260.52A (RNP AR) and 8260.54A (RNAV), where a combination or hybrid of the two orders will produce distinct performance, safety, and operational improvements for air navigation service providers, airspace designers, and aircraft owners and operators of all classes and categories of aircraft. This hybrid of RNP (AR)'s narrower protected air space and RF turn criteria, and the WAAS system's even narrower obstacle clearance areas near the approach end of the runway allow for consistent Category 1 instrument approach minima, that is, a ceiling of 200 feet and a half-mile visibility. This hybrid has the potential to provide greater operational and economic benefits to all but the most terrain- and obstacle-challenged airports.

WAAS is an extremely accurate method of Area Navigation (RNAV) developed for civil aviation that provides augmented GPS navigation service for all classes and categories of aircraft in all phases of flight, including enroute navigation routes such as National Route Plan routes (NRPs) and National Random Routes (NRRs), Q routes, and terminal

instrument flight procedures such as departures, arrivals, and approaches.

RNP, a refinement of RNAV, is part of a collaborative effort by the FAA and the aviation industry to enable development of Performance Based Navigation (PBN) routes and flight procedures

that are not dependent on any specific piece of avionics equipment. Aircraft flying these routes and procedures must demonstrate a required level of performance and be able to meet the operational requirements for the airspace, route, or procedure being flown. RNP enables more flexibility for procedure designers through the use of narrower obstacle clearance areas and RF legs or curved flight paths that exclude more terrain and obstacles along the flight path.

- Scott Speed, FAA AJW-9131/NAV/TAC

### Industry Day for WAAS Phase IV Dual Frequency Operations Contract

On November 21, 2011, the Federal Aviation Administration (FAA) conducted an Industry Day event at FAA headquarters in Washington, DC. The purpose of the well-attended event was to provide information to potential bidders on the Wide Area Augmentation System (WAAS) Program's upcoming Phase IV Dual Frequency Operations Contract.

The following are the objectives of the WAAS Phase IV Dual Frequency Operations effort:

1. Incorporate the GPS L5 civil signal to:
  - Accommodate the L2 semi-codeless Federal Register Notice 'Sunset' date,
  - Introduce the Dual Frequency User Service;

2. Integrate new Geostationary Earth Orbit (GEO) satellites to sustain the WAAS GEO constellation;
3. Perform Technology Refresh.

Under WAAS Phase IV - Dual Frequency Operations, the FAA plans to introduce a new dual frequency navigation service while retaining the current single frequency user service. The use of the two frequencies, L1 (C/A) and L5 - both in the protected Aviation Radio Navigation Service (ARNS) bands - will allow WAAS equipped dual frequency GPS receivers to directly measure the ionospheric delay, allowing more accurate, real-time estimates. Also, during Phase IV, computation of the WAAS ionospheric grid used by current single frequency receivers will be switched from L2 P(Y) to the L5 signal to comply with the Air Force's Federal Register Notice operations sunset of L2 P(Y).

The first operational L5 satellite was launched May 5, 2010 and the second was launched July 16, 2011. A full constellation of L5 capable satellites is estimated to be available in 2018. The FAA plans to initiate WAAS Dual Frequency service in concert with the full L5 capable GPS constellation. The FAA will continue to fully support the current Single Frequency service.



Deborah Lawrence, WAAS Program Manager, delivering a presentation.

Tom McHugh,  
WAAS Technical  
Director, answers  
a question.



The ground segment upgrades needed to implement the dual frequency user service will be applied incrementally, thus maintaining continuous single frequency services. All upgrades, culminating in the Dual Frequency Operations Capability, will first be thoroughly tested within the WAAS Shadow System prior to operational fielding. The WAAS Shadow System is a collection of operational and test hardware and software that emulates the fielded WAAS.

- Ed Sigler, FAA AJW-9131/NAVTAC

### Ground Based Augmentation System (GBAS) Working Group Meets

The 12th International GBAS Working Group (IGWG) was hosted by the Federal Aviation Administration (FAA) at the William J Hughes Technical Center in Atlantic City, NJ, USA. Eighty participants from ten nations, international service providers, airlines, aircraft manufacturers, and other industry firms attended the meeting and working sessions.

The meeting was organized into 3 distinct phases. Day 1 focused on national, airline, and industry updates. Day 2 and 3 were divided into technical and operational working sessions. Day 4 was a summary of the working sessions, special topics, and action item review, including addition of new actions to be addressed before the next meeting.

The national updates and briefings indicated increased activities in implementation of GBAS CAT I including near-term expected operational approvals. All of the attending nations have GBAS related activities in one form or another, from concept development and research prototype activities to actual implementation.

Airbus and Boeing continue their support for GBAS and outlined their plans for fleet equipage. All new Airbus and Boeing aircraft will eventually be GBAS capable. Boeing 787, and Boeing 747-8 will have GBAS capability as standard feature.

While Day 1's service provider plans and user and manufacturer updates are important and informative, the value of the IGWG resides more in the technical and operational sessions, where data collection and evaluation, siting experience, ionospheric activities, and operational plans are not only exchanged but actively coordinated.

The technical sessions (Data and Testing, Ionosphere, Siting, and Ground Monitoring) focused on the ongoing improvements in the technical understanding of GBAS implementation and the advances in the tools used for GBAS performance assessment.

In the operational sessions (CAT I Post Approval Activities, Future Operations, and Cockpit and Avionics Aspects) all aspects of use of the GBAS signals were discussed. Recurring topics were notably the RNP-GLS transition and the GBAS ATC interface for status and control.

An important development was that the subgroups agreed to continue working between meetings on identified actions and use web based teleconferences, technical – operational interchange meetings, and/or the public IGWG website (flygls.net). This coordination will include exchanging information on concept developments, test plans, and flight tests to the point that mutually agreed to activities

can be included in national/organizational plans, when applicable.

On the afternoon of the second day, the group profited from a visit to some of laboratories at the FAA William J. Hughes Technical Center, which is the FAA's premier aviation research and development, and test and evaluation facility. The participants could visit the display area of the NextGen Integration and Evaluation Capability (NIEC), a suite of laboratories through which the Technical Center is helping to shape the future of the U.S. Air Transportation System.

The meeting exceeded the co-chairing organizations expectations and all participants were extremely satisfied with the outcome of the working group meeting. With a constant increase in number of contributions and participants, the IGWG visibly serves a recognized function in GBAS implementation and its format seems well adapted to the participants' needs. This working group addresses relevant issues for the development and implementation of GBAS, and exchanges data and information which can be used by the participants in formulating their business strategies and implementation plans.

- Dieter Guenther, FAA AJW-9132/NAVTAC

### World SBAS Data to be Collected by Evergreen Airlines

In December, under a Federal Aviation Administration (FAA) Government Industry Partnership, Evergreen International Airlines will begin equipping the first of six Boeing 747 freighters with a Universal Avionics Wide Area Augmentation System (WAAS) UNS-1Fw flight management system (FMS), an FMS that enhances the accuracy of the GPS signal by using one of the world's Satellite Based Augmentation Systems (SBAS).

There are currently three SBAS in operation: the WAAS on most of the North American Continent, with its focus on the US, the European Geostationary Navigation Overlay Service (EGNOS) in Europe, and the



Multi-functional Satellite Augmentation System (MSAS) in Japan. A fourth system, the GPS Aided Geo Augmented Navigation (GAGAN), is due to become operational in India in 2013. Through the Evergreen project, the FAA intends to study the global interoperability of all the systems for airborne navigation and instrument approach applications.

Evergreen, based in McMinnville, Oregon, will fly its aircraft equipped with WAAS enabled avionics on its global routes over the next two years, collecting data on how well the aircraft maintain lateral and vertical paths along routes, procedures and approaches

when using each of the four different augmentation systems. Evergreen is currently collecting baseline data along the same routes and procedures with its non-SBAS equipped aircraft.

The WAAS, using a constellation of three geostationary satellites and a network of ground stations, generates corrected signals that are received by the avionics aboard an aircraft, and when combined with the GPS information also received by that aircraft, improves that aircraft's known lateral position accuracy from +/-30 feet to less than 3 feet. Additionally, the WAAS provides increased vertical accuracy when compared to barometric altimetry systems found in many aircraft flying today. An aircraft equipped with the appropriate WAAS avionics will be able to fly RNAV (GPS) approaches to much lower ceiling and visibility approach minimums. For example, an RNAV (GPS) approach

with a Localizer Performance with Vertical guidance (LPV) line of minima will in many cases provide ceiling and visibility equivalent to 200 feet above ground level and one half statute mile, or the equivalent of Category I ILS approach minimums.

- Scott Speed, FAA AJW-9131/NAV-TAC

**What's New on the Web!**

Just type <http://gps.faa.gov> into any web browser to access the best and most accurate information available from the FAA's Navigation Services Global Navigation Satellite System (GNSS) website.

Click on recently posted articles on the "In the News" sliding banner to stay informed of developments in satellite navigation.

**Satellite Navigation Approach Procedures Update**

December 15, 2011 – The number of Wide Area Augmentation System (WAAS)-enabled approach procedures continues to increase. The tables shown here reflect the latest numbers. More information about WAAS approach procedures can be found on our GNSS - GPS/WAAS Approaches web page ([http://www.faa.gov/about/office\\_org/headquarters\\_offices/ato/service\\_units/techops/navservices/gnss/approaches/index.cfm](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/index.cfm)).

- Mary Ann Davis, FAA AJW-9131/NAV-TAC

Satellite-based Approach Procedures (by Procedure Type)			
	Procedures (Part 139 Airports)	Procedures (Non-Part 139 Airports)	Total Number of Procedures
LNAV Procedures	1753	3571	5324
LNAV/VNAV Procedures	1254	1409	2663
LPV Procedures (LPV w/200' HAT)	1220	1526	2746 (574)
LP Procedures	39	194	233
GPS Stand-Alone Procedures	22	253	275

*Note: Number of GPS Stand-Alone will continue to decrease as they are replaced by RNAV procedures (Data as of December 15, 2011)*

Instrumentation Approach Procedures (IAPs) Based on Traditional NavAids	
ILS	1,281
ILS (CAT II)	160
ILS (CAT III)	112
NDB	876
VOR	1,330
VOR / DME	971

*(Data as of December 15, 2011)*

## Federal Agencies State Unanimous Conclusions on LightSquared Proposals

*A January 13, 2012 letter, sent by the National Executive Committee for Space-Based Positioning, Navigation & Timing (EXCOM) to the National Telecommunications and Information Administration (NTIA), states conclusions drawn from recent test findings concerning interference issues raised by LightSquared's plans for its proposed mobile network. EXCOM has representatives from nine federal departments and agencies including the Department of Transportation and the Air Force.*

*The letter, signed by Deputy Defense Secretary Ashton Carter and Deputy Transportation Secretary John Porcari, reads as follows:*

At the request of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), the nine federal departments and agencies comprising the National Space-Based Positioning, Navigation and Timing (PNT) Executive Committee (EXCOM) have tested and analyzed LightSquared's proposals to repurpose the Mobile Satellite Services (MSS) frequency band adjacent to Global Positioning System (GPS) frequencies to permit another nationwide terrestrial broadband service. Over the past year we have worked with LightSquared to evaluate its original deployment plan, and subsequent modifications, to address interference concerns. This cooperative effort included extensive testing and analysis of GPS receivers. Substantial federal resources have been expended and diverted from other programs in testing and analyzing LightSquared's proposals.

It is the unanimous conclusion of the test findings by the National Space-Based PNT EXCOM Agencies that both LightSquared's original and modified plans for its proposed mobile network would cause harmful interference to many GPS receivers. Additionally, an analysis by the Federal Aviation Administration (FAA) has concluded that the LightSquared proposals are not compatible with several GPS-dependent aircraft safety-of-flight systems. Based upon this testing and analysis, there appear to be no practical solutions or mitigations that would permit the LightSquared broadband service, as proposed, to operate in the next few months or years without significantly interfering with GPS. As a result, no additional testing is warranted at this time.

The EXCOM Agencies continue to strongly support the President's June 28, 2010 Memorandum to make available a total of 500 MHz of spectrum over the next 10 years, suitable for broadband use. We propose to draft new GPS Spectrum interference standards that will help inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals and ensure that any such proposals are implemented without affecting existing and evolving uses of space-based PNT services vital to economic, public safety, scientific, and national security needs.

*For further information on this letter, please visit <http://www.gps.gov/news/2012/01/lightsquared/>*