FAA Navigation Programs AJM-32
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SatNav News

San Francisco International Airport (SFO) Ground Based Augmentation System (GBAS) Commissioned

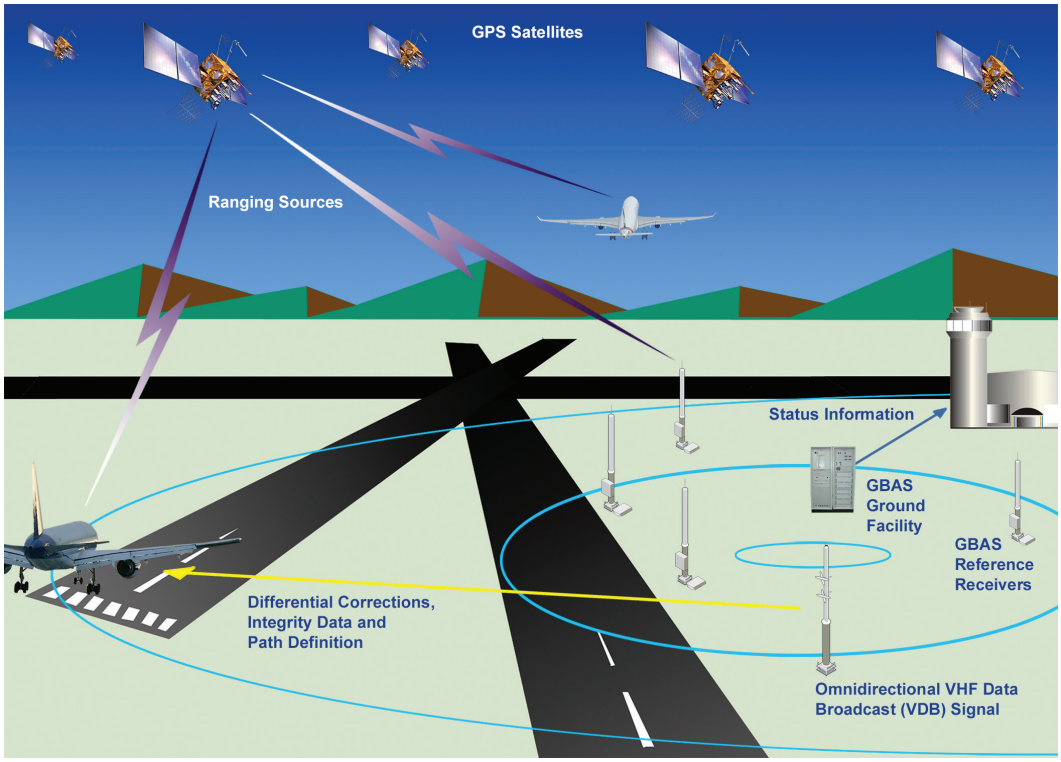
The FAA commissioned the third public GBAS in the National Airspace System (NAS) March 14, 2022 at SFO. SFO joins Newark Liberty International (EWR) and George Bush Intercontinental (IAH) airports, commissioned in 2012 and 2013, respectively, in offering GBAS services to their customers.

What is GBAS?

GBAS is a non-federal navigational aid that supports precision approach operations. While the FAA does not own or operate GBAS, the agency does have regulatory responsibilities to approve these systems and provide ongoing oversight. Honeywell's SLS-4000 GBAS is the only such system to have received FAA approval to be installed and operated by non-federal entities in the NAS.

GBAS ground facilities receive, process, and monitor Global Positioning Satellite (GPS) measurement data. They provide GPS correction and integrity parameters, as well as precision approach path data to GBAS equipped aircraft via a Very High Frequency (VHF) broadcast from an omnidirectional antenna.

GBAS offers several advantages over traditional ILS. GBAS ground facility broadcast data is not subject to the VHF beam bends and transient multipath reflections from taxiing



GBAS Architecture

aircraft that can affect ILS signals, which can lead to autopilot disconnects. GBAS also has a level of resiliency to environmental factors, such as snow buildup that the ILS lacks, and can remain functional in conditions that may remove an ILS from service. Another benefit GBAS provides is the flexibility to install the system at airports confined by their layout, as it is not fixed by function. This can allow for instrument approaches to runways where an ILS cannot be installed. For instance, at SFO, there is now a published GBAS Landing System (GLS) procedure to RWY 19R, which was previously served only by RNAV/GPS approaches, including LPV. The GLS offers reduced minima when compared to these options, and can be utilized by commercial aircraft that are not currently equipped for LPV.

Boeing and Airbus offer GBAS equipage as either standard or an option on all new mainline airframes. Several major airlines, including Delta and United, have been increasing orders for and receiving GBAS equipped aircraft. These same airlines have been key players in encouraging their primary airports to establish non-federal GBAS facilities.

FAA Support for GBAS

Over the past five years, the FAA has worked with the City and County of San Francisco to plan and implement the establishment of the SFO GBAS. During initial discussions, the FAA's Mission Support Services (AJV) Western Service Center (WSC) provided SFO with guidance and policy for establishing a non-federal system, creating a reimbursable agreement for FAA support and developing Instrument Approach Procedures (IAPs).

As the project matured, the local Technical Operations (AJW) offices started to engage in activities necessary to commission the system. The San Francisco NAV/COMM/RAD System Support Center (SSC), along with support from the Oakland Technical Support Center (TSC) and Northern California TRACON's (NCT) Service Operations Center (SOC), worked diligently with SFO to develop an operations

and maintenance manual that documented site-specific operational requirements for the system. In addition, FAA Airway Transportation Systems Specialists (ATSS) from the San Francisco NAV/COMM/RAD SSC attended the GBAS manufacturer's training course to gain the appropriate knowledge to provide oversight of non-federal maintainers. The Oakland Operations Support Services (OSS) Training Specialists reviewed training records for and issued verification authority to the non-federally employed maintenance technicians hired by SFO. These non-federal maintenance technicians will maintain and verify the operational status of the SFO GBAS.

Prior to commissioning the SFO GBAS, Air Traffic Services (AJT) conducted a local Safety Risk Management (SRM) assessment via an SRM Panel with facilitation support from the WSC Quality Control Group (QCG). GBAS stakeholders, internal and external to the FAA, reviewed the proposed changes to the NAS (i.e., addition of the GBAS and the associated IAPs) and documented their no hazard findings.

Commissioning activities included a ground inspection by the San Francisco NAV/COMM/RAD SSC's ATSS and a flight inspection by Flight Program Operations (AJF). The long endeavor to establish the SFO GBAS was successful because of all the contributions made by SFO and the FAA, and their ability to work together towards this goal.

The Port Authority of New York and New Jersey (PANY/NJ) has plans in place to install GBAS facilities at John F. Kennedy International Airport (JFK/New York, NY) and LaGuardia Airport (LGA/New York, NY) in the 2023-2024 timeframe. Lessons learned during the SFO project will be applied to ensure that the installation and commissioning of these additional systems goes as smoothly as possible.

Non-federal Systems in the NAS

In addition to approving non-FAA equipment for use in the NAS comes the challenge with credentialing and managing non-federally employed technicians that maintain those systems and the FAA inspectors that provide oversight for equipment without an FAA equivalency. The training and oversight processes used for GBAS have demonstrated to be successful and will set the precedence with other systems in the future.

Lessons learned from the SFO GBAS project will assist the FAA in evaluating its existing processes and identifying areas that require improvements. This work will become increasingly essential as industry pushes forward with interest in other non-FAA technologies, including Remote Towers and UAS/UAM Traffic Management support tools.

- ASDS Team, FAA AJW-121

Angels in the Air

Dr. Steve Minton at controls

It's hard to know what Dr. Steve Minton is more passionate about; medicine, or flying, but with Angel Flight, he has combined the two. As a practicing internist in Northern Virginia for 30+ years, he spends his spare time flying his Cessna Caravan 675. Many of his flights are for Angel Flight Mid-Atlantic. Angel Flight looks to marry up those in need of a flight to specialized medical care. Often these flights are from rural areas where finding a flight would take time and be quite costly to the patient, not to mention anxiety provoking when you are ill.

Dr. Minton's Cessna Caravan 675

All Angel Flight pilots are volunteers as is Dr. Minton. They volunteer their time, aircraft and resources to serve those in need. Dr. Minton's Cessna Caravan is outfitted with a Garmin avionics suite, with a WAAS-GPS navigator. And, over the years it has come in handy when flying into some of the smaller airports to pick-up or drop off patients and experiencing IFR conditions. All Angel Flight pilots are IFR certified. Dr. Minton confirms the added benefit of IFR with WAAS, "the ability to fly a precision approach to some of these municipal airports that are close to the people who we're flying, … made the need to go to a large airport, non-existent. So it just adds a level of simplicity and lack of worry, having a precision type approach." Sure, Dr. Minton could fly an ILS to many of these runway ends, but he prefers WAAS LPV. "On a couple of occasions, I've had to fly an ILS to circle-to-land, and that procedure in marginal VFR conditions is one of the most anxiety-provoking legal procedures I've had to do" stated Minton.

> "...it just adds a level of simplicity and lack of worry, having a precision type approach"

Flying patients, or sometimes even live organs, is a weekend job for Dr. Minton as he

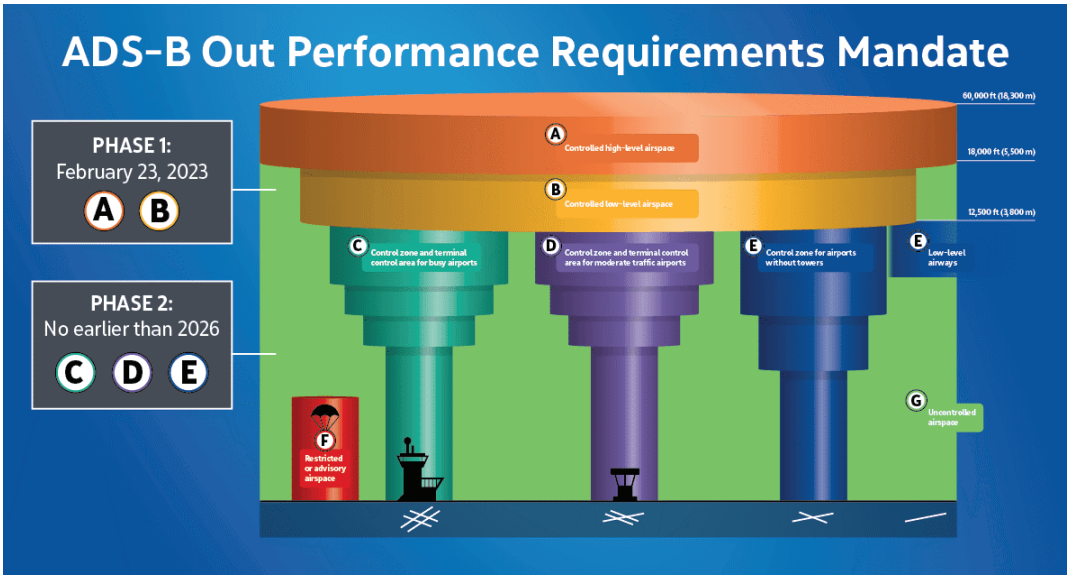
gets an email every day and looks for one that fits into his schedule. It is clear that the relief he sees on the patient's faces, recognizing one issue has been taken off their plate, is more than enough reason to keep doing what he does. Knowing that he has vertical guidance and access to many airport runway ends with WAAS LPV, Dr. Minton has the confidence to give back to this community in need. "Sometimes it's not just the patient we are helping but the whole family….it's a very rewarding experience"

- Amy Trevisan, FAA AJM-32/NAVTACII

WAAS LPV approach

NAV Canada to Implement New ADS-B Airspace Mandate in 2023

Reprinted from *Avionics International*
by Woodrow Bellamy III, February 15, 2022



Nav Canada will implement its new ADS-B Out airspace mandate starting next year. (Nav Canada)

Canadian air navigation service provider (ANSP) NAV Canada will require aircraft operators flying in Class A and B airspace to meet their new Automatic Dependent Surveillance – Broadcast (ADS-B) Out performance requirements beginning Feb. 23, 2023.

According to a Feb. 11 announcement on the new mandate from Nav Canada, the new policy requires aircraft flying above 12,500 feet to be equipped with ADS-B Out transponders that meet the applicable standard of Radio Technical Commission for Aeronautics (RTCA) DO-260B.

Although Canada has been providing ground-based ADS-B surveillance to aircraft flying above 29,000 feet since 2008, the new mandate clarifies what type of ADS-B equipment is required and where.

In an emailed statement to Avionics International, a representative for Nav Canada said the mandate will come into effect through updates being added to Transport Canada's Standards in Airworthiness Manual Chapter 551. There is an aeronautical information circular being developed on the new mandate, while Nav Canada is directing aviation stakeholders to their Service Notice on the new policy in the interim.

The representative also explained how there are very small differences between the ADS-B Out mandate that became effective in U.S. airspace on Dec. 31, 2019, and the one taking effect in Canada next year. Nav Canada wants to ensure that aircraft flying in Class A and B airspace will be broadcasting their aircraft position updates to the satellite space-based ADS-B receivers operated by Aireon.

Appropriately equipped aircraft flying below 29,000 feet in the Montreal Flight Information Region (FIR) were first linked to space-based ADS-B surveillance by Nav Canada in December 2021, with plans to expand that surveillance to operators in the Edmonton and Winnipeg FIRs later this year.

"The ADS-B Out avionics performance standards required is RTCA DO-260B or newer. This requirement can be met either through antenna diversity (the use of a top and bottom antenna) or with a single antenna that is capable of transmitting both towards the ground and up towards satellites," the representative said. "In the U.S., aircraft that operate in airspace that required a Mode C or Mode S transponder needed to be equipped with ADS-B Out by December 31, 2019. This includes most controlled airspace (Class A, B, C and parts of E). Outside U.S. airspace, almost all ADS-B systems operate on 1090 MHz."

The Canadian ADS-B Out airspace mandate was delayed in 2019 to address concerns about the cost of equipage that the antenna diversity aspect of the policy requires. Originally, Nav Canada had proposed a five-year phased approach to its policy that included a requirement for antenna diversity—antennas mounted to the top and bottom of the fuselage—that would help support its goal of achieving a five nautical mile aircraft separation through space-based ADS-B surveillance. The DO-260B standard incorporates improved Wide Area Augmentation System (WAAS)/GPS accuracies, latency, and position forecasting developed from position and velocity to predict aircraft position, as well as additional cockpit failure annunciators among other performance requirements.

> "The Canadian equipage mandate—when combined with NAV CANADA's space-based surveillance capabilities—will enhance safety and service"

Nav Canada estimates that approximately 95% of aircraft currently operating in Class A airspace are equipped with DO-260B compliant ADS-B Out transponders, while approximately 65% of those in Class B airspace are properly equipped. Raymond G. Bohn, President and CEO of Nav Canada describes ADS-B as "a foundational building block for our future airspace and operations."

"The Canadian equipage mandate—when combined with NAV CANADA's space-based surveillance capabilities—will enhance safety and service," Bohn said. The agency plans on expanding the mandate to Class C, D, and E airspace with a phased approach beginning in 2026.

NOTE: Canada's airspace designations are not identical to those in the USA.

An Instrument Flight Instructor's View on WAAS

Vince Massimini

The approval of GPS in 1995 spurred a revolution in navigation for general aviation (GA) aircraft. After a few years, GA had direct-to-destination navigation for VFR and IFR flights and a straight-in non-precision LNAV instrument approach at almost every Instrument Flight Rules (IFR) runway. But GPS alone was only supplemental navigation—IFR flights still had to carry a VOR (and/or an NDB), pilots still had to plan for a non-GPS approach at the alternate airport, pilots had to train for VOR non-precision and ILS precision approaches, and there were no vertically-guided approaches at most runways. Also, the flight instructor had to find an ILS runway to train students for precision approaches and a VOR or NDB for non-GPS non-precision approaches to get them ready for their instrument check rides.

Then the FAA commissioned WAAS in 2003. With WAAS, nearly every runway now has a vertically-guided LPV approach in addition to a non-precision LNAV approach. Importantly, using WAAS IFR flights can file for an LNAV approach at the alternate—no ILS, VOR or NDB approach is required at the alternate. And the FAA modified the Airmen Certification Standards to recognize that LNAV and LPV approaches can be used for obtaining an instrument rating.

WAAS is not without costs, however. The avionics are more complex for WAAS. With a VOR or ILS receiver, one simply tunes the frequency, identifies the Morse ID signal, sets in the course, and flies. Even us old guys can do that. With WAAS, however, the setup for an approach involves multiple selections on the avionics—menu levels, selections, knobs, buttons, and touch screens on a complex avionics box. That's a challenge for us older pilots that still have the 12:00 flashing on our Betamax video players.

But WAAS has been a boon in many ways that make up for the difficulties above. With the widespread availability of LNAV non-precision approaches and

Vince and student Jack Trevisan performing flight check

LPV approaches, instructors do not have to search for VOR and ILS approaches since there are LNAV and LPV approaches at most close-by airports. Also, the

Vince and Jack preparing for take off

FAA modified the Airmen Certification Standards and FAA legal opinions for gaining an instrument rating so that LNAV and most LPVs can be used for training and check rides. Yes, a good instructor will teach the student to be proficient in VOR and ILS, but the focus can be on GPS and WAAS.

The real payoff with WAAS is not training, however, it is capability and safety. WAAS gives the pilot a robust area navigation system that can provide straight-in vertically-guided instrument approaches to nearly every IFR-capable airport in the conterminous United States, and the system is sufficiently robust to also use for alternate airport planning and filing. Vertical guidance has been shown to provide a stabilized approach and reduce Controlled Flight Into Terrain (CFIT) accidents—a big safety benefit. Almost all of the WAAS approaches are straight in—no weird procedure turns to get on final. Also, most WAAS avionics have or can connect to a moving map that assists the pilot with spatial orientation.

"...The real payoff with WAAS is not training, however, it is capability and safety."

WAAS has another big plus in addition to navigation improvements—it enables ADS-B, which provides traffic information and traffic alerts in most avionics. Traffic awareness and alerts are a big safety enhancer all the time, but especially when the student is using a vision-restricting device and the instructor is focusing on instructing (and perhaps not looking outside as much as s/he should).

WAAS is a winner for aviation—especially GA. And remember that only a small percentage of WAAS receivers are used by aviation—WAAS benefits far more users of maritime, automotive, farming, and cell phones than aviation users. Overall, it's a great system.

- Vince Massimini, NAVTACII/DSc, CFI, CFII

EGNOS Workshop December 2021

The WAAS team was able to participate in the EGNOS Workshop, held virtually on December 2, 2021. To view our presentation on SBAS Global Status and the variouspresentations on EGNOS presented at the workshop, follow this link:

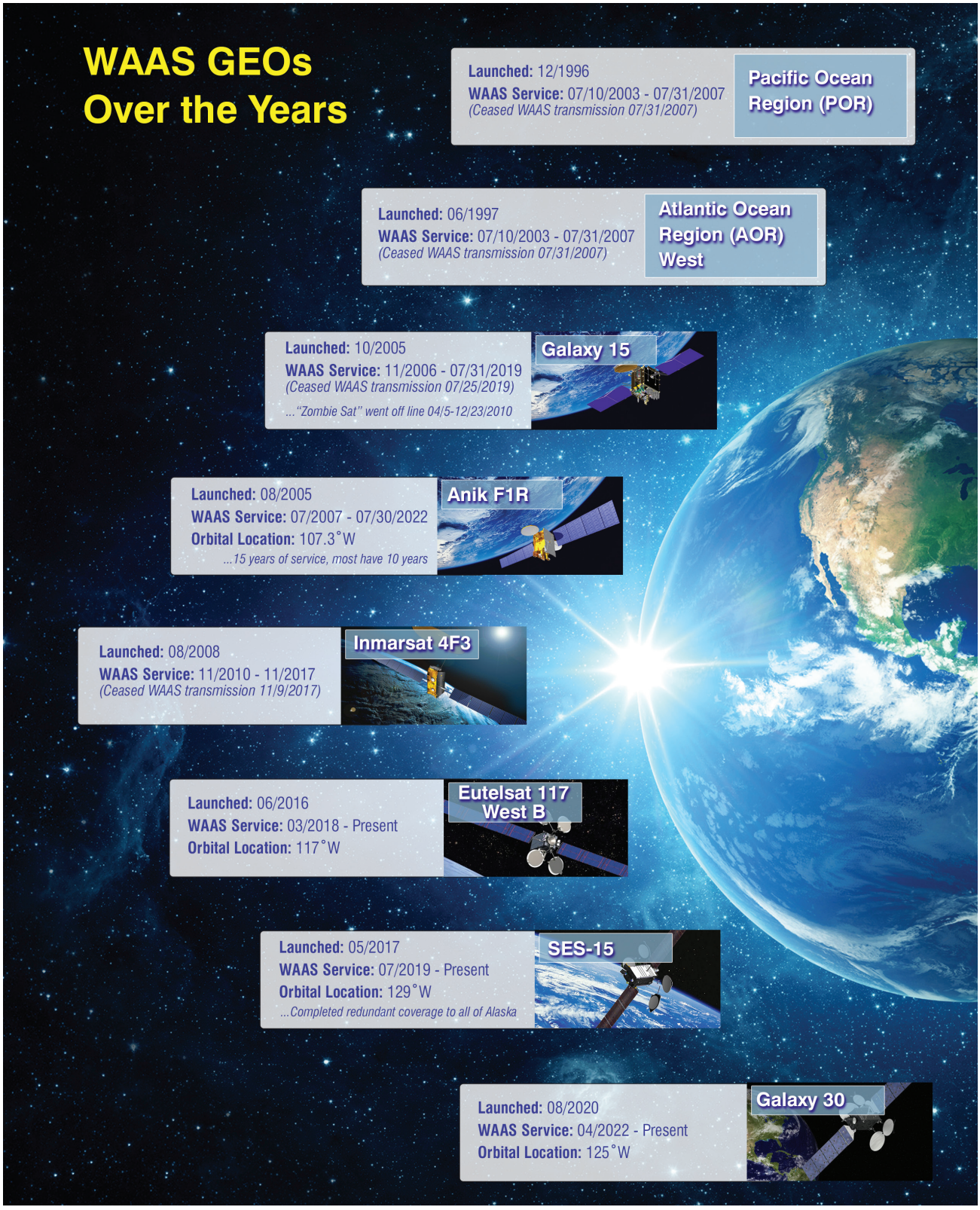
EGNOS WORKSHOP AGENDA 2021 | EGNOS User Support (essp-sas.eu)

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, controller, dispatcher, 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 Amy Trevisan at: amy.ctr.trevisan@faa.gov

Did You Know . . .

A few readers were curious about how many GEO satellites there have been in the 18+ years of WAAS and how long each one was used along with other interesting facts. This graphic shows everything in one place.

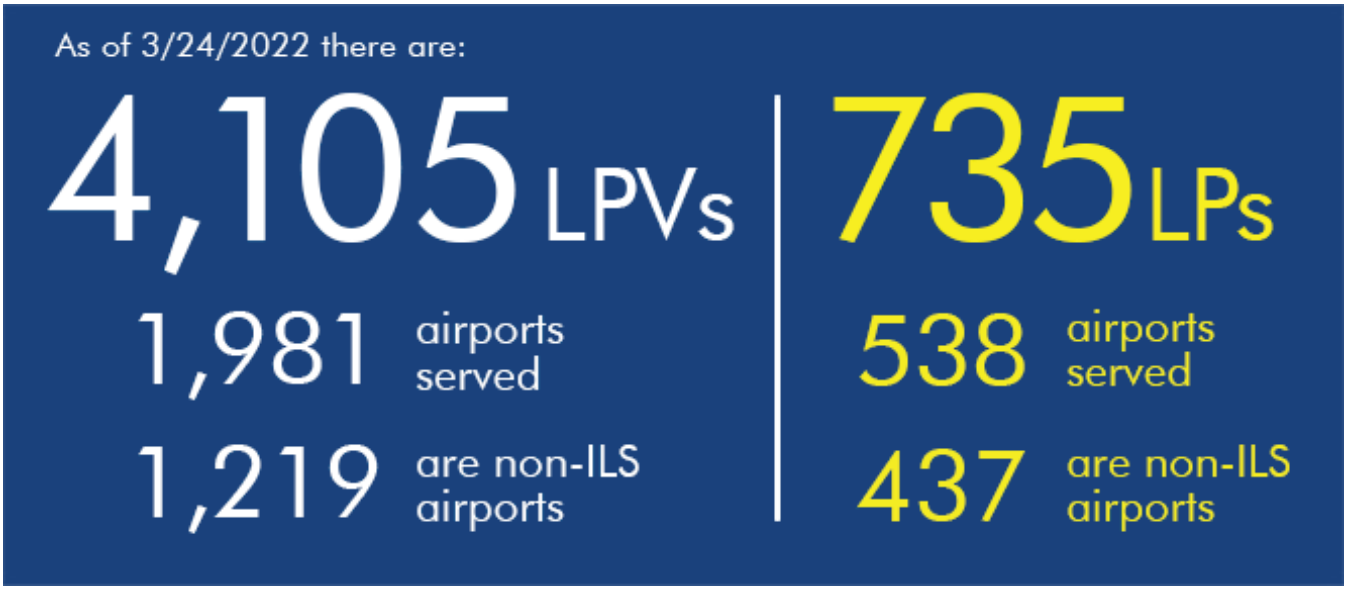


The SatNav News is produced by the Navigation Programs AJM-32 branch of the Federal Aviation Administration (FAA). This newsletter provides information on the Global Positioning System (GPS), the Wide Area Augmentation System (WAAS) and the Ground Based Augmentation System (GBAS).

Satellite Navigation Approach Procedures

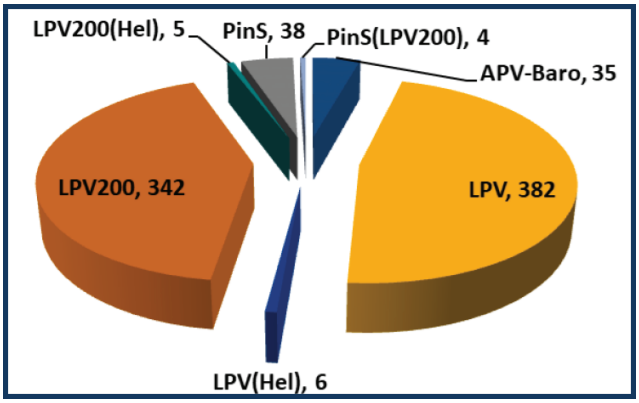
WAAS

The charts below reflect the continuing growth of satellite-based approach procedures. For more detailed information about satellite-based instrument approach procedures, please visit our GPS/WAAS Approach Procedures web page. *http://www.faa.gov/about/office_org/ headquarters_offices/ato/service_units/techops/navservices/gnss/ approaches/ index.cfm*

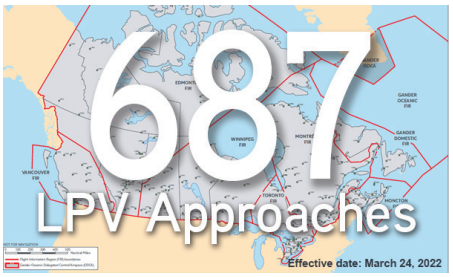


EGNOS

The number of LPVs in Europe is also growing. The chart below shows LPV procedures in Europe as of February 24, 2022. https://egnos-user-support.es-sp-sas.eu/new_egnos_ops/news-events/egnos-bulletin



Canada



Numbers provided by NAV CANADA
as of March 24, 2022
(click for map)

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