SatNavNews

FAA Navigation Programs AJM-32
http://gps.faa.gov

Yes to Avionics Upgrades During a Pandemic

Universal Avionics used to rely on big trade shows like Oshkosh, Sun 'n Fun and NBAA's annual to demonstrate its latest new cockpits. Since all of them were cancelled in 2020, Universal turned a crisis into an opportunity. Rather than staging cockpit demonstrators on the floor of major aero exhibitions, the merged organization decided to pack the equipment up in a trailer and take it on the road direct to prospective customers.

"We realized there was no way that we could exhibit and meet with our customers unless we did something different," said Dror Yahav who became Universal Avionics' chief executive officer after it was bought by the Israeli defense electronics company Elbit Systems Ltd. The two combined Elbit's military and Universal's commercial products to offer more complete cockpit systems for business and commercial aircraft.

It only took 40 days for Universal to create a Mobile Demo Unit and put it on the road in 2020. Since then the demonstrator has travelled 9,000 miles to 16 different states. The Universal crew has had to navigate a variety of state quarantine and COVID-19 regulations to move the unit from A to B and set up for visitors.

The mobile demonstrator worked so well that the company plans to continue employing it even as trade shows are reopening as the pandemic eases. Demonstrations are turning up new customers who like to have the cockpit display driven to their location. Some of these aircraft owners didn't attend trade shows on a regular basis even when they were being held before the pandemic hit.

SatNav News saw the demonstrator in action at Manassas Regional Airport in Virginia at DeltaFox Aviation, an FAA Part 145 Airframe, Powerplant, Radio, & Instrument repair shop. DeltaFox is one facility that will be doing Universal cockpit upgrades for jet and turboprop operators.

Souce:Universal Avionics

The demonstrator features an integrated flight deck with a Universal InSight™ Display System that features embedded synthetic vision, advanced mapping capability, a runway display for situational awareness while taxiing, electronic charts that show the aircraft position and radio control. The rectangular electronic flight instrument displays measure 9.86 by 7.86 inches and are larger than the square displays offered by Universal in the past.

Universal's strategy on the InSight Display System is to provide an avionics suite for retrofit that doesn't require all of the existing avionics systems to be removed and replaced. InSight can connect to many types of existing attitude/heading sensors, data computers, radars, traffic systems, radios and autopilots already aboard the aircraft.

The InSight Display System can interact with a variety of Flight Management Systems (FMS) made by Universal and ones made by other avionics companies including Honeywell. When Universal was founded in the early 1980s by Hubert Naimer, he invented the first flight management system in the industry. In 2007 the company received the first certification of an FMS capable of satellite navigation with WAAS/SBAS.

Universal field service engineers showed *SatNav News* how the InSight Display System with a Universal FMS can depict an RNAV approach procedure with WAAS LPV and LP minimums. The display of the holding pattern with the position of the aircraft marked makes it easy to enter holding either with a teardrop, parallel or direct entry. The system can fly the approach coupled to an autopilot.

These types of advanced displays are also available from other avionics manufacturers in the United States and Europe. Universal aims to provide one of the best systems by combining Elbit's military avionics expertise with Universal's experience in the commercial retrofit market.

Universal also shows in the demonstrator how the company's ClearVision™ Enhanced Flight Vision System (EFVS) works. This can combine the view from an enhanced vision infrared camera with a synthetic vision 3D display of terrain for commercial aircraft. These views can be displayed to the pilot in a helmet-mounted display (HMD) or a head-wearable display (HWD). In addition, ClearVision for Helicopters works with rotorcraft platforms for day and night applications including with night vision goggles.

Souce:Universal Avionics

The Universal SkyLens™ Head-Wearable Display shows the pilot both enhanced vision infrared imagery and a synthetic vision view of the runway and terrain in 3D as the pilot looks ahead out the windscreen. This system can be retrofitted into small cockpits. The SkyLens also provides aircraft flight path vector, attitude, visual glideslope and runway aim point so the pilot can execute stabilized approaches in low visibility while reducing the risk of controlled flight into terrain.

Souce:Universal Avionics

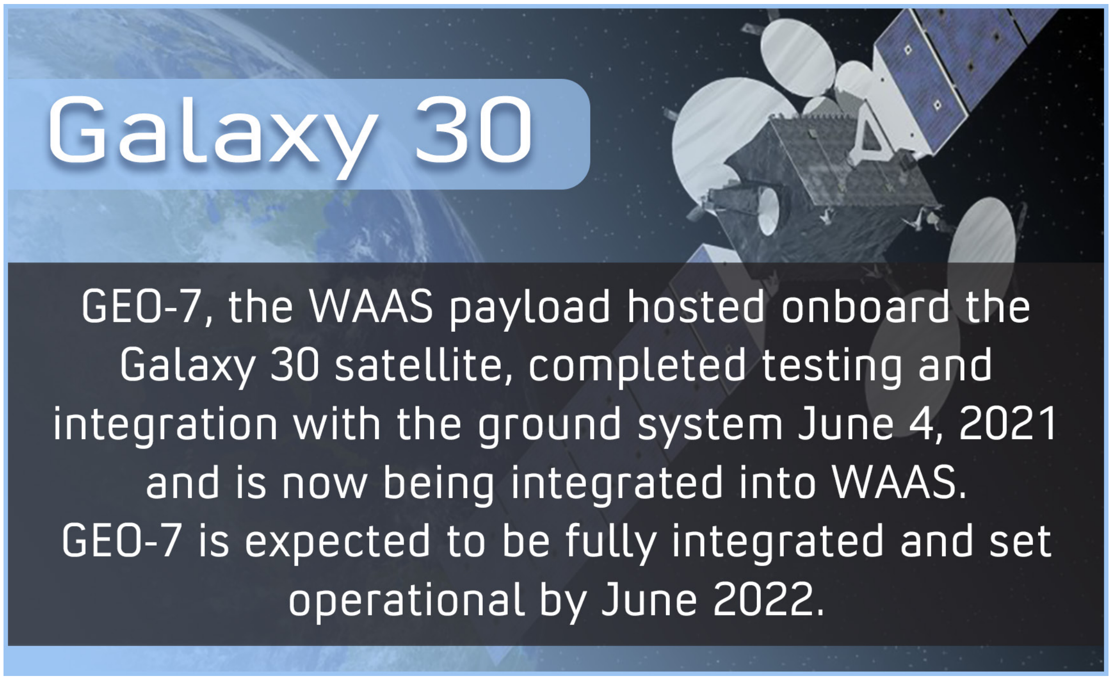
While a pilot uses SkyLens to execute an RNAV approach, the Universal navigation system can safely guide the aircraft down to LPV minimums as low as 200 feet above the airport when the procedure allows. This is the same minimums as for a Category 1 ILS. If the pilot sees the approach lights he can continue to descend below 200 feet and at 100 feet if he sees the threshold or runway features he can continue down to land using the head-wearable display and enhanced vision system. This is as long as visibility is 1000 feet RVR which is close to zero ceiling and visibility and covers 99.9% of situations, notes Yahav.

"The FAA allows flights using EFVS to land based on an 'additional credit' provided to some configurations, including on some Gulfstream, Dassault Falcon and Bombardier Global Express jets," said Yahav. Manufacturers who provided additional supportive data have been granted this 'EFVS to land' credit as long as the RVR is at least 1000 feet. Part 91 operators can conduct this operation based on their current standard operating procedure while part 135 operators will require a letter of agreement.

"Modern fighters do not have head-updisplays any longer," said Yahav. "Instead, they are using HUDs with a high-end tracker to stabilize the 'virtual HUD' image. SkyLens does the same for commercial aviation. The pilot gets a full HUD experience on a wearable display with additional information while looking outside. Panoramic synthetic vision is a unique and additional feature.
- David Hughes

David Hughes is a freelance aviation writer. He worked as a writer and the Managing editor of ***Aviation Week and Space Technology*** magazine and as an FAA writer.

Update: GEO 7



Talking About EGNOS with... Isavia ANS

Reprint from EGNOS BULLETIN Issue 35, Spring'21 Edition

Credit: Isavia ANS

"Isavia ANS Is the Air Navigation Services Provider (ANSP) for Iceland and the surrounding oceanic areas (BIRD). The company has about 235 professionals and experts in air traffic control services, AIS, MET, flight procedure design, flight inspection and validation, communications, surveillance and navigation. The airspace served reaches from the south of Iceland (61°N), includes Iceland's domestic area, and provides services over Greenland and around the Faroe Islands. The service volume is around 5.4 million square kilometres in size and reaches the North Pole. Isavia ANS is very active in international cooperation and follows closely new technologies and methods being developed for aviation, from both sides of the North Atlantic, with the benefits to our customers in mind."

The implementation of LPV procedures is very recent in Iceland, having published the first LPV procedure in 2019 at Husavik Airport. Tell us about ISAVIA's decision and process to implement EGNOS procedures in Iceland.

"Iceland is on the boundary of EGNOS' service volume and, therefore, additional steps were needed for the validation of EGNOS for approach navigation in Iceland. For several months, Isavia ANS collected data to be used for the validation, in locations close to target airports from the first implementation. This data was then handled and processed cooperatively by Isavia ANS and ESSP being the results presented in a report to the Icelandic Transport Authority (ICETRA). Isavia ANS additionally went through the steps of safety analysis with local airlines and ICETRA. The result was the authorisation to design and publish EGNOS approaches east of 19°W, essentially splitting the island in the middle, covering the eastern part of Iceland.

Husavik Airport was chosen as the pilot project because of its closeness and sensitivity to the boundary of EGNOS APV-1 service volume and its location on the north coast, resulting in an interesting research case on EGNOS satellite's footprints".

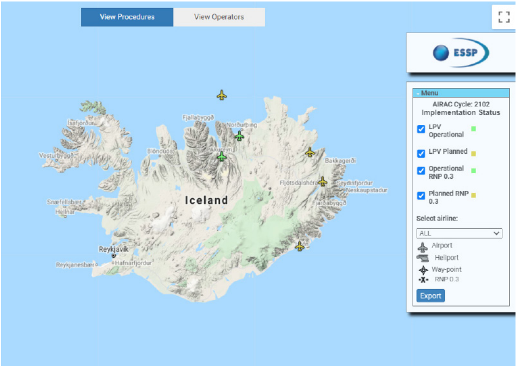


Figure 1. LPV Implementation Status at Iceland: Source: EGNOS User Support Website

Our readers would like to know more about the singular aspects affecting Iceland's airspace configuration, such as meteorology, terrain and/or types of traffic. What are the main challenges you faced when implementing LPV procedures?

"Iceland is a country of elevated terrain, where airports are often located in valleys between mountains and the North Atlantic weather can often be quite unpredictable, resulting in quick change in visibility and wind. These elements present a unique navigation challenge, especially for domestic traffic in the country. Isavia ANS looked into adding EGNOS-based LPV to the stable of navigation means early on and, in cooperation with the EGNOS Program, deployed EGNOS ground stations. LPV availability makes navigation with vertical guidance possible, improving safety where the ground infrastructure is not available for such precise navigation. And in other cases, LPV can reduce minimas where conventional navaids have difficulties due to terrain features".

> "It can save operators up to 40 NM flying not having to make the approach to runway 01"

Akureyri Airport (ICAO code BIAR) was second in receiving LPV procedures. What particularities make Akureyri special, and how did you implement LPV procedures?

"Akureyri Airport (BIAR) is an airport located in a tight valley in the northern part of Iceland, which has the second-highest traffic volume of all domestic airports in Iceland, only behind Reykjavik Airport (BIRK). The traffic there can range from private propeller aircraft to class D wide-bodies such as B767, which results in a unique navigation challenge. A variety of navigation solutions have been used in the past, such as the high approach angle ILS or the LOC approach supplemented by ASR final. More recently, the GNSS RNP approach, which allows designing procedures with an as-low-as-possible decision height that increases landing capability in reduced visibility conditions.

EGNOS LPV is an appropriate addition to these methods; it avoids costly investment in ground infrastructure and allows procedure designs with narrower design surfaces while being an equally safe, or safer, navigation than before. Aside from finding the best fit for the design criteria, we also had to consider possible TAWS/GPWS warnings when flying so close to the ground and checking if the geostationary EGNOS satellites were visible during the LPV part of the procedure. Furthermore, in terms of surveillance, Isavia ANS increased the ADS-B coverage in the fjords to cover the approach area".

What are the main benefits of LPV procedures with RF legs: Environmental, fuel consumption, airspace flexibility...? Was LPV the only type of approach that suited your requirements?

"The main benefits at Akureyri are shorter routings when arriving from Reykjavik, constant width design criteria during the turn, and less required airspace than a normal fly-by turn. When flying in a narrow fjord/valley, all aircraft follow the same path, making TAWS warnings more predictable. RF turns are used for LNAV and LNAV/VNAV as well, but LPV offers much smaller design criteria, especially in the missed approach".

Why develop two different LPV solutions -with and without RF legs-? Is it to suit various operators' needs or even avionics?

"We can say yes to both. As said earlier, during the first turn in the missed approach, RF turns offer us shorter approach legs and smaller criteria. Most of the domestic fleet is RF capable, but this is not so for other traffic. RF capability offers slightly lower minima".

Credits: Isavia ANS

Figure 2. Flying view approaching the final segment of the LPV procedure to RWY19 at Akureyri.

Which traffic types or airlines are operating at Akureyri? Do you have any feedback from them after flying the LPV procedure?

"The major domestic airline using Akureyri Airport is Air Iceland Connect, operating DHC8 400/200, the regional airline, Norlandair, operating DHC6 and BE20 and Myflug, the ambulance operator, utilising BE20´s. Operators are very happy with the new approaches, especially the LPV option. We also have occasional international flights flying larger aircraft landing at Akureyri Airport, where LPV may help. However, we have received less feedback from these operators than from the domestic flight operators, indicating that domestic airlines may benefit the most".

Credits: Isavia ANS

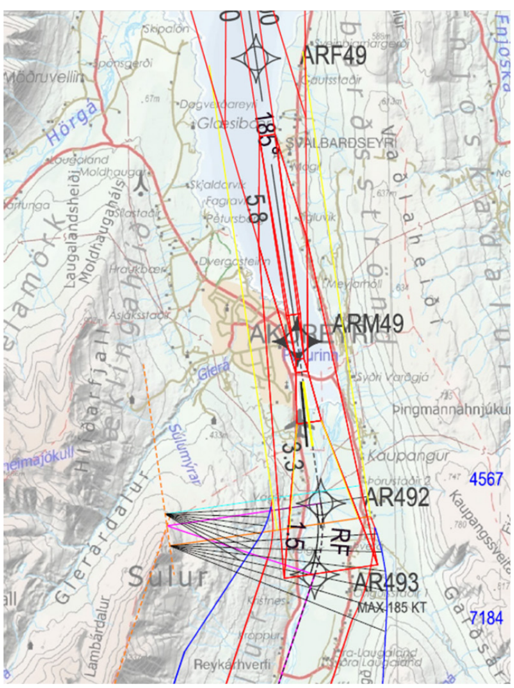


Figure 3. LPV design surfaces.

We have noticed that the LPV minima for runway 19 at Akureyri –both for X and Y LPV procedures is between 140ft – 450 ft lower than the ILS CAT I depending on the aircraft type and the missed approach climb gradient. What are the main reasons at Akureyri that allow lower minima for LPV than for ILS CAT I?

"The main difference is that, in the first missed approach leg, LPV offers track guidance with narrow criteria up until the first turn. Although a similar criterion is available for the ILS, the track guidance is missing, so for safety reasons, we decided not to publish the lower minima for the ILS against that calculated for ILS with the RNP 1 missed approach".

Even if it is just a small difference, does this lower minimum avoid any disruptions throughout the year? Are there other benefits?

"The LPV minima is very beneficial, especially during the winter when it is snowing or in low ceiling mornings. It can save operators up to 40 NM flying not having to make the approach to runway 01 and help to avoid a re-route to an alternative airport with the complexity of delivering their passengers to their destination by other logistical means".

> "Operators are very happy with the new approaches, especially the LPV option"

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

Share your thoughts with our readers about EGNOS' contribution to air navigation in Iceland and your future plans with EGNOS.

"EGNOS provides opportunities thanks to the increased accuracy and integrity for en-route navigation and, especially in domestic approach navigation (LPV). Isavia ANS wants to utilize this new technology to best serve our customers. Isavia ANS looks for the best opportunities to apply EGNOS LPV in domestic airfields, starting with designs that maximise benefits regarding landing minimas, terrain or difficulty in applying procedures based on ground infrastructure. Due to EGNOS' actual service volume distribution, Isavia ANS only has the option of doing this eastwards from 19°W. In the future, Isavia ANS would like to see EGNOS' service volume expand westwards to open up further opportunities towards an increasing country-wide EGNOS LPV approach in Iceland. The biggest and busiest international (BIKF) and domestic (BIRK) airports in Iceland are located on the west coast, and there are also opportunities at smaller airfields in the west. Isavia ANS would like to work towards the widespread use of EGNOS LPV in Iceland with EGNOS' stakeholders, considering the navigation performance and safety benefits this includes. Isavia ANS hopes to see a general support towards this goal within the EGNOS Consortium in the future.

In addition, RNP approaches with LPV are planned for 5 aerodromes this year: BIGR and BIVO in late April, and BITN, BIEG and BIHN later this year".

> "The LPV minima is very beneficial, especially during the winter when it is snowing or in low ceiling mornings"

Credits: Isavia ANS

Snaebjorn Gudbjornsson (left) is a chief flight procedure designer at Isavia ANS and has ten years of experience in the field. Snaebjorn has ATPL licenses and is a flight validation pilot at Isavia ANS, flying the company's BE20. In addition, Snaebjorn has a background in air traffic control.

Arnór Bergur Kristinsson (right) holds a MSc. in Electrical Engineering, with a focus on GNSS, from the University of Iceland. He has been working with Isavia ANS as a project leader in various satellite navigation fields for twenty years and acts as a consultant for the government and authorities on the subject. For most of this time, Arnor has been involved with EGNOS leading EGNOS' ground segment deployment and operations in Iceland and the domestic SBAS services implementation.

Serial Aircraft Builder Favors WAAS LPV

Clark Schadle is building an RV 14 with his kit plane partner Tommy Turner and he looks forward to flying it using RNAV GPS approach procedures.

The RV14 has a bubble canopy and a wide cockpit for two people sitting side by side. The two kit plane builders are installing dual Dynon Skyview HDX touch screen avionics displays. The aircraft has a top speed of 207 miles per hour and can cruise at 70 percent power at 190 miles per hour. It has a 939-mile range with 50 gallons of fuel and about 500 pounds for people and baggage.

The RV 14 kit costs about $36,000 and the cost to complete a project like this can run as high as $140,000. Schadle and his partner, both retired, will complete the aircraft in 16 months while most people take four or five years. During the pandemic they could show up for work every day just like they were working at a factory. They sold an RV-6 they built together to start work on the RV-14. Now they will hang the engine in the next few months and get to first flight by the fall.

Schadle said it is unbelievable what the avionics on new kit plane like the RV 14 can do with navigation displays and an autopilot. The aircraft has better equipment for air navigation than some earlier generation airline aircraft still flying today. He will be able to fly coupled to climb, cruise, descend at a set speed or rate in feet per minute. “It is really amazing what these systems can do,” he said.

When it comes to flying an RNAV (GPS) approach with LPV or LP minimums it is easy to set up an extended runway centerline for situational awareness while being vectored onto the straight in approach course. Or the display can show the procedure turn and the aircraft position and allow the pilot to make a tear drop, direct or parallel entry automatically. “Easy peasy,” said Schadle.

Schadle has logged 17,000 flying hours in his career as an airline pilot and an aircraft commander of military transport aircraft. His flying includes 6,500 hours in general aviation as the owner of a Beech Baron and then of experimental aircraft. He also visits Alaska twice a year where he flies his brother’s bush plane on skis or floats.

> “I’m not flying a back course in the mountains and with the RNAV (GPS) you just follow the yellow brick road and it runs you down to final and you’re done”

Schadle said his faith in RNAV approaches was demonstrated some years back when he was flying a Sabreliner private jet into Cold Bay Airport (PACD) in (Alaska). The weather was 400 feet overcast and a couple of miles visibility.

His choice was whether to fly the RNAV (GPS) to Runway 33 down a mountain valley or a localizer back course. “I’m not

Vans RV8 cockpit

flying a back course in the mountains and with the RNAV (GPS) you just follow the yellow brick road and it runs you down to final and you're done." The vertical guidance is welcome because there is a 1,500-foot mountain close to the airport which sits at an elevation near sea level. The LPV decision altitude is 200 ft., 127 feet lower than the localizer back course provides.

Schadle also likes the way the sensitivity works on an RNAV GPS approach versus how it works on an ILS. An ILS gets more and more sensitive the closer you get to the runway. But RNAV works a little differently. Beyond 30 miles from the runway a full-scale deflection represents five miles. Inside 30 miles it scales to one mile. "You know where the scaling is starting, you know when it's going to get more sensitive and then it stays that way for a while before it scales down again for final approach. The scaling makes it easy for me because I know when it is going to scale down and I know it will be that way for five or six miles so I can get used to it and then when it scales down again, I'm ready for it."

- David Hughes

WAAS LPV Instructor Pilot

Pilots who want to go to school on WAAS LPV often read one of Max Trescott's handbooks on glass cockpits or go fly with him if they live in Silicon Valley where his home drome is Half Moon Bay airport.

Cirrus SR22

Max is a certified flight instructor who was logging 600 hours of instruction a year before the pandemic hit and cut his flying with students in half. A lot of the instruction involves showing new owners of Cirrus aircraft how to set up the avionics for a WAAS LPV approach. He prefers satellite navigation approaches to ILS.

With his flying time reduced last year, he managed to write another book. The latest volume is Max Trescott's G3000 and G5000 Glass Cockpit Handbook. Max's handbook for the G1000 and Perspective written years ago is now in its fifth printing.

As we talked Trescott had to take time out so he could reply to an email from the owner of a Cirrus Vision Jet who was looking for a pilot to ferry his jet from the West to East Coast. Max didn't want to delay his answer and miss out on the opportunity. He has flown the 345 mile per hour Vision Jet with a G3000 glass

Cirrus Vision Jet

cockpit several times. This is a single engine jet aircraft which can carry six passengers and has a range of about 1,200 miles.

The G3000 has a touch screen that is fast and easy to use when loading approaches and modifying flight plans. It is lighter so it is suitable for Part 23 aircraft while the G5000 is designed for Part 125 air transport aircraft.

"A big change with all of these systems is it really requires more knowledge than previous GPS systems required for operation. I think it pays to do some review between flights." But (avionics) systems are so similar it is possible to move from one type of aircraft to another and to find similarities in loading data. "It is amazing that you can retrofit a Cessna 172 nowadays with the kind of capability that you would have found in an airliner just a few years ago," he said.

> "... fewer things you have to check and verify when you are setting up for the approach"

In the Cirrus piston powered aircraft Max instructs with Avidyne glass cockpits and in newer aircraft with enhanced Garmin 1000 systems called Perspective or Perspective Plus. "You can put up a chart such as a Jeppesen or an FAA chart and see the aircraft superimposed on the chart. Or you can have the normal map up and it will show the lines that you are to follow for that (RNAV) approach," he said.

The reason Trescott prefers RNAV with WAAS LPV to ILS is that there are "fewer things you have to check and verify when you are setting up for the approach," he said,. "For example, you don't have to verify the Morse code identification for the localizer which you would need to do for an ILS. And you don't have to switch the Course Deviation Indicator needle from GPS to the navigation radio when you join the localizer. We just use GPS for the entire approach, so there is no switching required with the CDI."

One important aspect of his instruction on how to fly RNAV approaches is that they are a little bit more complex because there are different types of minimums including LPV, LP, LNAV/VNAV and LNAV. The FAA publishes approaches with LP (localizer precision) when terrain or obstructions prevent vertically guided LPV procedures. "LP is really handy at airports that have challenging terrain such as Monterey Regional Airport. The nearby mountains get up to about 6,000 feet and the airport is nearly at sea level," he said. He added there is one approach with LP minimums that comes in at an angle and has lower minimums than any other approach to that runway.

"I love the technology (such as GPS) and figuring it out so that I understand it really well and then I like sharing it with other people," he said.

- David Hughes

Instructor Max Trescott (left) and Vision Jet owner Donald Storer are thumbs up after ground training on how to fly WAAS LPV approaches. Credit: Max Trescot

WAAS is Working Episode 5: Modernizing Miss Virginia NOW SHOWING! (click watch to view)

Did You Know . . .

What is Dual Frequency (DF), and what will it mean to aviation users?

Recently, we received a question about DF; what it is and what does it mean to aviation users. We thought this would be a good place to give a light overview of dual frequency as it pertains to the future of aviation.

While the GPS system has broadcast ranging signals on at least two frequencies since its inception, only the L1 Coarse / Acquisition (LA C/A) code signal had an open format available for civil use. The L1 C/A signal provides good ranging accuracy but relies on a model of the ionosphere to correct for ionosphere delay. WAAS measures and broadcasts the ionosphere delay for given Ionospheric Grid Points (IGP) **(see note below)**. When the ionosphere is fairly uniform, users can determine and apply the ionosphere delay to the GPS ranges to improve their position accuracy. In certain conditions there can be ionosphere anomalies that are inconsistent with this approach. During ionosphere anomalies, current aviation receivers account for more ionosphere error via correction messages from WAAS to protect the airplane, which might result in an inability to conduct some operations, such as vertically guided approach operations using WAAS. When people refer to DF in satellite navigation, they are referring to aviation equipment that uses two aviation protected GPS frequencies to determine position – L1 C/A and L5. The GPS constellation will provide a minimal set of L5 capable satellites for WAAS use around 2028. The DF aviation receiver will combine range measurements from the two aviation-protected GPS frequencies to directly remove the ionosphere delay from the position computation, thereby removing the largest error source. Dual frequency equipment can continue to operate during many ionosphere anomalies and can operated in regions in which WAAS is unable to provide ionosphere information. This will extend WAAS approach service to areas that currently do not have such services, such as Hawaii and U.S. Caribbean Islands.

What changes in GPS satellites enable Dual Frequency aviation equipment?

Aviation dual frequency will use the GPS L5 signal (1176 MHz) with the L1 C/A signal. Both L1 and L5 signals are transmitted in frequencies identified for aviation radio navigation. GPS L5 is the third signal introduced for civilian use after L1 C/A and L2C. L2C is not used by aviation receivers for safety-of-life applications since it is not in a frequency band with protection for aviation use. GPS satellites starting with Block IIF and continuing with Block III broadcast the L5 signal. The first Block IIF satellite with the L5 signal was launched in 2010. As of January 9, 2021, 16 satellites are broadcasting the L5 signal. As identified in the 2019 Federal Radionavigation Plan, the Department of Defense anticipates having a full complement of 24 satellites broadcasting the L5 signal some time in 2027. A new GPS operational control system, called the Next Generation Operations Control System, or OCX, is required as well, with control capability expected to be available in 2023.

What is WAAS doing to provide a dual-frequency service and when will the service be available?

The WAAS program has been working for several years for the Dual Frequency Operations (DFO) phase of WAAS (called Phase 4) which will provide a dual-frequency service. WAAS Phase 4 maintains the approach capability to Localizer Performance with Vertical guidance (LPV) minima available in the coterminous United States, Canada, and Alaska with the current L1 service while developing the dual-frequency service. Due to the extended implementation of the DFO phase, Phase 4 is divided into three segments, Phase 4A, Phase 4B, and Phase 4C. DFO Phase 4A is nearing completion. Under DFO Phase 4A, WAAS introduced infrastructure required to support the dual frequency service using the GPS L5 signal and replaced obsolescent infrastructure. In particular, WAAS replaced the G-II WAAS reference receiver with the G-III model, upgraded safety computer capacity, and replaced Signal Generators. WAAS also replaced aging GEO satellites with three new satellites, extending GEO services until about 2028 and beyond. WAAS DFO development continues in Phase 4B, with planned introduction of WAAS Limited Operational Capability (non-aviation use) in 2025 and an Initial Operational Capability aviation service around 2026. The WAAS DFO Full Operation Capability is planned for circa 2030. WAAS Phase 4C will continue to improve the WAAS L1 and Dual Frequency services post 2030.

When will Dual Frequency aviation equipment be available?

During Phase 4A, the FAA participated in the development of the DFMC SBAS concept through the SBAS Interoperability Working Group. The FAA supported the development of the associated DFMC SBAS Standard and Recommended Practice (SARPs) at the International Civil Aviation Organization. The FAA is working within the joint RTCA/EUROCAE standards bodies to development the associated aviation receiver Minimum Operational Performance Specifications (MOPS). RTCA and EUROCAE plan to release two generations of MOPS, in summer of 2022 and fall of 2023. These will support development of user equipment, with FAA projections of equipment being available for production aircraft by 2026.

What is WAAS doing to provide a dual-frequency service and when will the service be available?

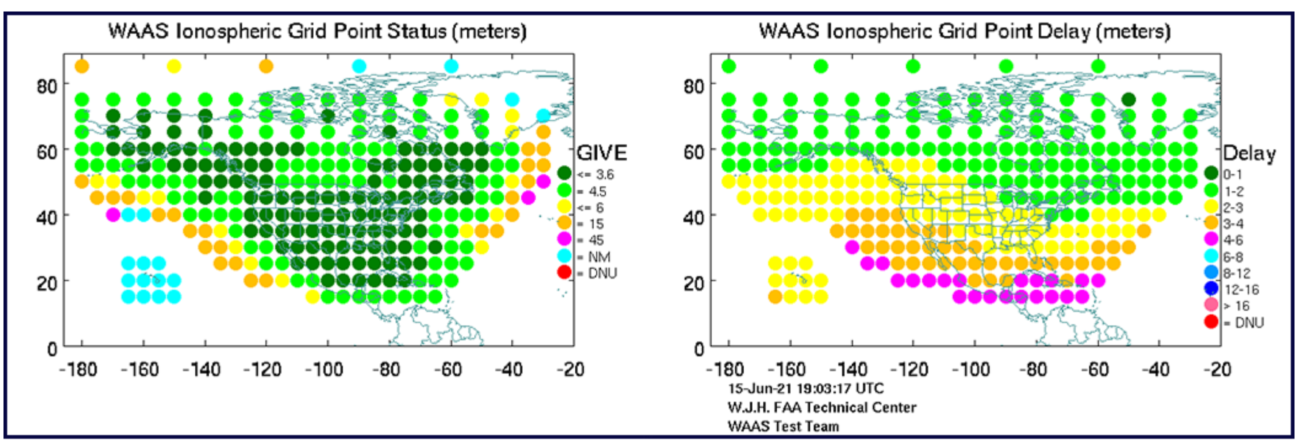
The start of DFO Phase 4B is right around the corner in FY 2022. Phase 4B will consist of continuation of WAAS SF service with technical refresh and the development, fielding and certification of the WAAS DFO services. Some of the technical refresh activities, such as updates to the communications infrastructure and changing computer processors, will happen in parallel with the dual frequency modifications. Current plans introduce a non-operational LOC service earlier to support overall development of dual frequency capability. The WAAS program is targeting the certification of the dual frequency IOC service with reduced performance in 2026. Performance will increase as DoD provides more L5 capable satellites, with the complete dual-frequency FOC service available by the end of Phase 4B. Several ideas are under investigation in the WAAS Technology Evolution area. The global SBAS community is experimenting with high-accuracy Precise Point Position Services and several SBAS providers plan to introduce dual-frequency multiple constellation services. WAAS will continue to explore these capabilities for consideration of future extensions of WAAS.

With continued planning and development of standards to support DFO as it becomes available, the future looks more accurate for the aviation world.

- Joseph Dennis, FAA AJM-32/NAVTAC

Note:

An Ionospheric Grid Point (IGP) is the location described by a latitude and longitude associated with a broadcast ionosphere delay. Typical IGPs are 5 degrees apart.



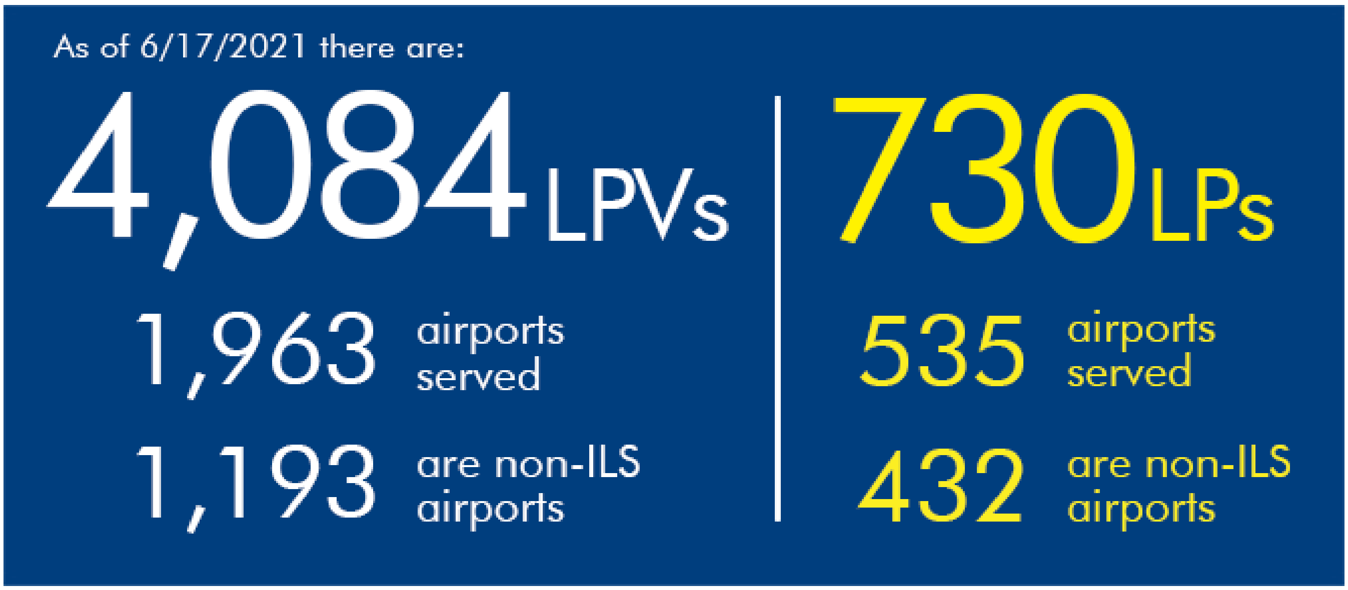
Click to see charts: https://www.nstb.tc.faa.gov/RT_WaasSIGPStatus.htm

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

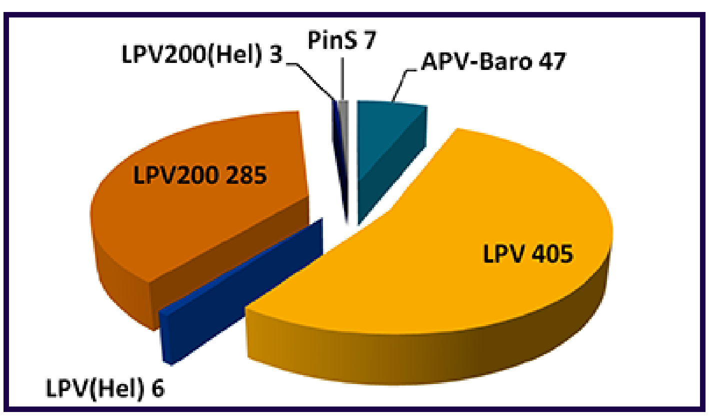
WAAS

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 25, 2021, as included in the EGNOS Bulletin Spring'21 (Source: EGNOS Bulletin, Issue 35, Spring'21 Edition): *http://egnos-user-support.essp-sas.eu/new_egnos_ops/content/quarterly-bulletin*



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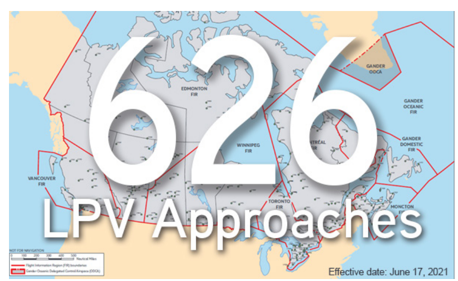

Numbers provided by NAV CANADA
as of June 17, 2021
(click for map)