SatNavNews

Volume 77 Winter Edition

http://gps.faa.gov

Inside:

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).

Credits: GPS III, Lockheed Martin

SatNav Days

The GPS program celebrated 50 years on 17 December 2023—the date of the original approval of the system by DOD that now provides worldwide timing and position. That date is also 120 years since Orville and Wilbur Wright flew the first powered, controlled, and sustained flights with a man on board in 1903 at Kill Devil Hills, NC. The Wrights didn't have much fancy navigation aboard the plane (which resides at the National Air and Space Museum in Washington DC), but they did have timing!! The Wrights had a stopwatch to time the duration of their flights.

An interesting tidbit is that GPS was not the first satellite navigation system. That honor goes to Transit, which was developed by the US in the early 1960s. Transit was operated by the U.S. Navy until the mid-1990s when it was replaced by GPS.

Another day to be celebrated is "International GNSS* Day" which has been set at 23 October by the Institute of Navigation (ION). It is a fair question to ask, "Why 23 October?" Most of the math geeks in the world are familiar with 14 March as "Pi Day." With sufficient rounding, Pi is 3.14 which translates to 14 March. But what about 23 October?

First, let's call it 1023. I think most of us understand that our GPS receivers calculate the distance to each of the visible GPS satellites to deduce our position. This is done by a timing measurement of the transmission and reception of a signal from each visible GPS satellite with a conversion of the time duration to a distance using the speed of light. Yes, it is more complicated than the previous one sentence, but our receiver basically converts the time of travel from each of the visible GPS satellites to a distance, and then the receiver uses the distances from each satellite to compute our position.

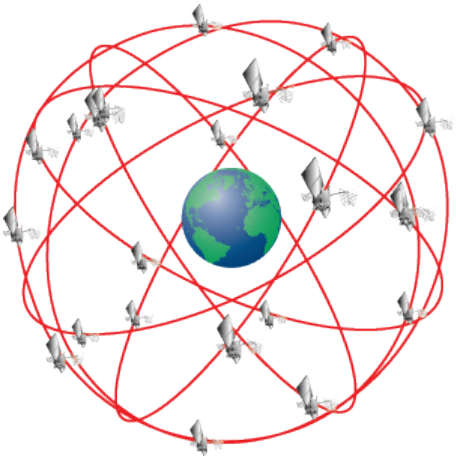
(Continued next page)

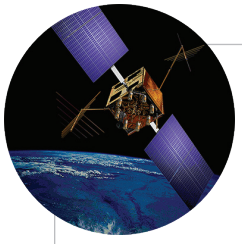
Stay with me—1023 is coming. The way the receiver measures the time from the satellite to the receiver is with a coded sequence of signals generated at 1.023 MHz on the GPS L1 frequency—called the "chipping rate." The Electrical Engineering stuff can get pretty thick, but the 1023 date comes from the chipping rate. Similar rates (or multiples) are used in other GNSS systems and frequencies.

Yes, it would have been simpler if GNSS had used Pi Day—and much easier to explain. But now you know.

-Vince Massimini, NAVTACII/DSc, CFI, CFII

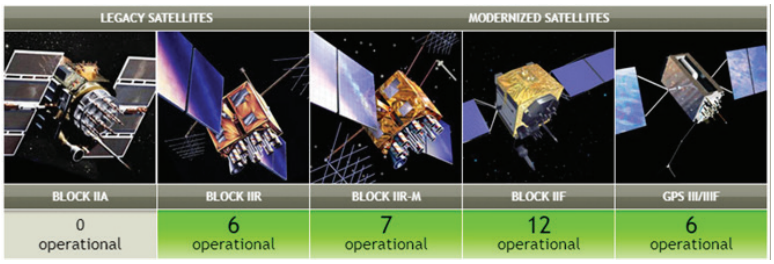
**The Global Navigation Satellite System includes satellite navigation systems from other countries.*





More on GPS

To read more on the anniversary and impacts of GPS click **here** for the December edition of *GPS World* magazine.



For all things GPS go to official website: www.gps.gov

"Another day to be celebrated is "International GNSS* Day" which has been set at 23 October . . .Why 23 October?"

GPS: A celebration of the first 50 years

Reprint from *GPS World*
by Lisa Dyer, Executive Director, GPS Innovation Alliance (GPSIA)
October 23, 2023

This year marks 50 years since the U.S. Department of Defense approved the design for GPS and first funded the program. It is also the 30-year anniversary of an important milestone – initial operational capability of GPS. Please don't let its longevity fool you into thinking it is past its prime! GPS is, and will remain, one of the most innovative systems ever designed, funded and operated by the U.S. government.

Today, GPS represents a highly successful public and private partnership, one in which diverse stakeholders continue to coordinate through fora such as the National Executive Committee for PNT and its Advisory Board and the Civil GPS Service Interface Committee. How did this system become a military, public safety, critical infrastructure, and economic success? The world-class GPS community is made up of the teams and individuals who design, develop and operate these critical technologies as well as the people and organizations that benefit from its applications. From pioneers, scientists, engineers, and Guardians to civil servants, lawmakers, and entrepreneurs, the GPS community has transformed, is transforming, and will continue to transform lives across the globe, and soon, the moon.

GPS World highlighted the important roles played by many early GPS pioneers in a two-part series aptly titled, "Heroes" in the May and June 2010 issues. It has also covered Dr. Gladys West, who is one of the most consequential mathematicians and programmers to contribute to the global success of GPS. Her geodetic models helped refine our understanding of Earth's shape, which proved fundamental to the success of GPS and its myriad applications. In 2021, the Trimble Foundation established the Dr. Gladys West Scholarship Program. Virginia State University (her alma mater), North Carolina A&T State University, and Florida International University award four-year scholarships to one student per year to honor Dr. West's achievements as a woman of science and a woman of color.

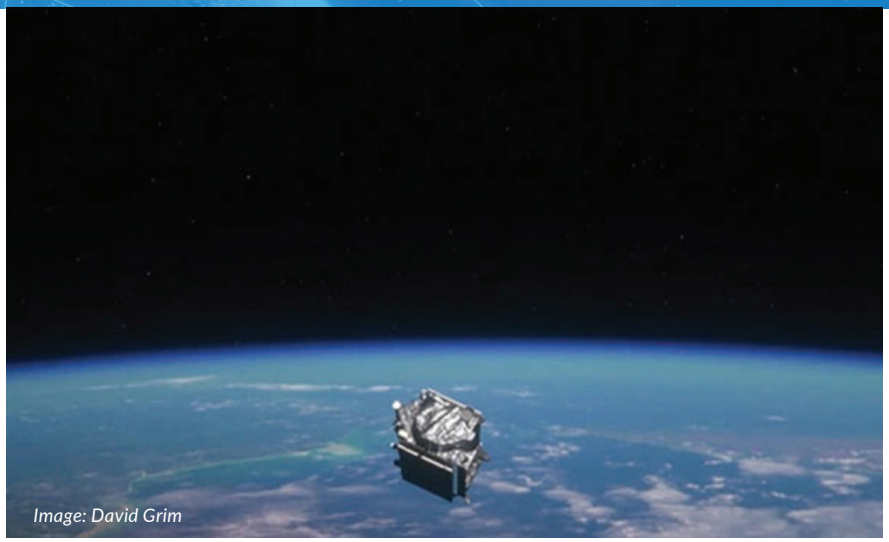


Image: David Grim

A celebration of GPS must also recognize our lawmakers — the people who authorize and appropriate funding for GPS and its augmentation programs. Nearly every U.S. federal department and agency uses these systems to fulfill their missions on behalf of the American people. They also leverage their technical, programmatic, operational, and experiential expertise to ensure that GPS and its augmentation systems remain the best in the world. This work is possible thanks to congressional committees, members of Congress, and staff. The Senate Appropriations and House Appropriations committees, the Senate Armed Services and House Armed Services committees, the Senate Commerce, Science and Transportation and the House Energy and Commerce committees, the GPS Caucus and many more members of Congress, provide critical oversight and funding. Their support ensures that GPS continues to bring $1.7 trillion and counting in economic benefits to the U.S. economy, creating hundreds of thousands of jobs while enhancing national security, public safety and critical infrastructure.

The future is bright for GPS manufacturers and those developing new applications. To realize their success, projects funded by the Infrastructure and Investment Jobs Act and the Inflation Reduction Act will depend on GPS to continue to deliver signals that are accurate, have integrity, and are available and continuous in nature. The next enterprising GPS entrepreneur is waiting in the wings

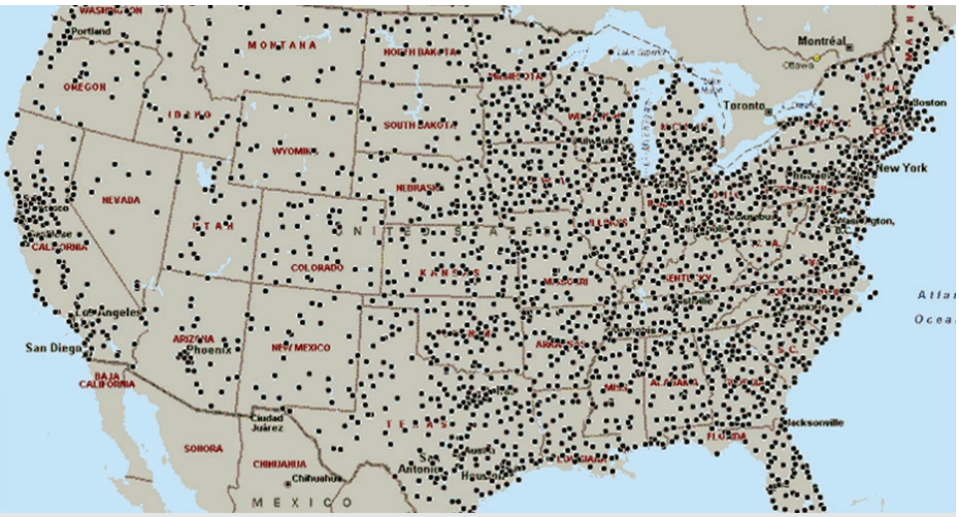
Thanks to a network of determined individuals, GPS-driven technologies — used to support precision agriculture, safe transportation, synchronized global banking, cutting-edge emergency response, elite and amateur sports, and more — are transforming our lives, creating jobs, and promoting growth across the economy.

GPSIA joins other members of the GPS community by celebrating 50 years of GPS and looks forward to the innovations and applications that will shape the next 50 years and beyond.

How WAAS turned into a must-have system

Once the subject of criticism, WAAS is on the majority of general aviation aircraft

by David Hughes, December 4, 2023



The FAA now has nearly 5,000 WAAS LPV and LP approaches. (Image: The FAA)

Twenty years ago, the FAA commissioned the Wide Area Augmentation System (WAAS), opening the door to satellite-based GPS navigation with accuracy, integrity, and consistent availability for an array of business and general aviation aircraft.

Leading up to then, WAAS had come under scrutiny—and criticism—after encountering several years of delays and mushrooming costs. Even so, groups such as the Aircraft Owners and Pilots Association strongly backed it.

And now, if you are a business aviator and not using WAAS, then you can count yourself in a minority. Most business aircraft rolling off the production line now are equipped to fly RNAV approaches with WAAS localizer performance with vertical guidance (LPV) minima.

Avionics repair shops also continue to upgrade aging jets, turboprops, and IFR-capable piston singles and twins with WAAS LPV, often as part of major full panel upgrades. It can cost $20,000 to $30,000 to upgrade a small aircraft with WAAS LPV and more like $200,000 to $300,000 for a business jet, according to several avionics repair shops.

What do general aviation aircraft owners get for the money? They get access to precision-like approaches with more than 4,100 WAAS LPV procedures that can, in many cases, match Category 1 ILS minimums down to 200 feet. LPV serves more than 2,000 airports, including more than 1,200 without ILS.

WAAS provides an accuracy of two to four meters for horizontal position by providing corrections to GPS from more than two dozen precisely surveyed ground stations throughout the U.S., as well as in Canada, Puerto Rico, and Mexico. These corrections are broadcast up to geostationary orbit satellites and then sent from there to avionics aboard aircraft.

The Safety Benefit

According to the FAA, WAAS provides pilots with more stable vertical guidance for approaches and enhances safety in all weather conditions. The Flight Safety Foundation points out that controlled flight into terrain accidents are significantly reduced by vertically guided approaches. ILS approaches can be affected by bends in the signals that can lead to a missed approach, the FAA noted.

There are only 1,290 ILS approaches in the U.S.—just about one for every three LPVs. Thus, many runways now have vertical guidance without having to maintain an ILS at the airport since WAAS approaches require no navigation infrastructure at the airport.

Some runways cannot have vertical guidance due to terrain or obstacles. WAAS localizer performance (LP) procedures provide for lateral accuracy similar to ILS for approaches where terrain or obstructions do not permit the vertically-guided LPV. The FAA says some manufacturers include an advisory glideslope so pilots can fly a stabilized descent to the minimum descent altitude even when the approach does not officially have vertical guidance.

There are 734 WAAS LP approaches to 734 runways at 537 airports—most of which do not have ILS. These RNAV approach procedures without vertical guidance have LP minima that can also be helpful when there is no precision-type approach available at an airport.

NBAA points to the benefits of the lower minimums provided by WAAS. “Our members value the precision-like minimums WAAS technology brings to the table. Many aircraft owners have equipped to take advantage of the capabilities and lower minimums at many airports across the country that aren’t currently served by an ILS,” said NBAA senior director of air traffic services and infrastructure Heidi Williams. . . . *(more)*

Read the complete article here in the December 2023 edition of *AIN* magazine.

Dual-Frequency Multiple Constellation (DFMC) Standards Progress and other technical updates

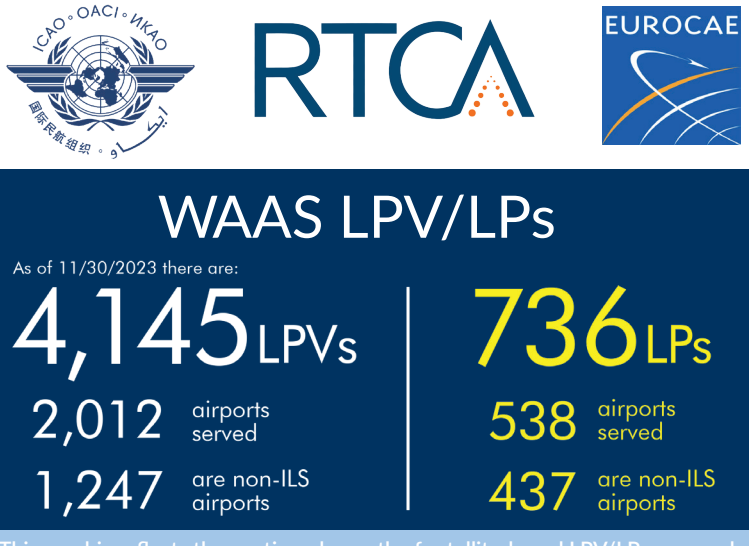
While the production and availability of DFMC equipment remains in the future, standards bodies completed several important milestones in 2023.

The International Civil Aviation Organization (ICAO) update the DFMC Satellite Based Augmentation System (SBAS) standard and made progress in the development of Horizontal Advanced Receiver Autonomous Integrity Monitoring (H-ARAIM) standards. H-ARAIM provides integrity through use of redundant measurements similar to existing RAIM. H-ARAIM however can use either a dual-frequency ranging observation or single frequency ranging observations from either frequency. This will provide some resiliency against interfering signals in only one frequency band. H-ARAIM also provides a safe way to integrate core satellite constellations with different performance characteristics. The ICAO Navigation Systems Panel developed a Standards and Recommended Practices (SARPs) update for Annex 10 – Aeronautical Telecommunications, Volume 1 - Radio Navigation Aids. In October, the Air Navigation Commission authorized the transmission of the update to Contracting States for review, with comments due back to ICAO by April 30, 2024. This will become Amendment 94, with effectivity in November 2025. The SARPs update also includes a change in the DFMC SBAS Vertical Protection Level (VPL) equation. The change officially incorporates a change briefed at prior NSP meetings and at the 37th SBAS Interoperability Working Group (IWG) meeting. The development of Vertical ARAIM standards remains a future NSP task.

RTCA and EUROCAE met jointly four times in 2023. The first two meetings (January and March) progressed the development of the Minimum Operations Performance Standards (MOPS) for DFMC SBAS Airborne Equipment. This enabled release of a version for Final Review and Comment (FRAC). The third meeting in June 2023 reviewed and adjudicated the FRAC comments, and lead shortly thereafter to formal approval by RTCA and EUROCAE. The MOPS, RTCA DO-401 and EUROCAE ED-259A, was published in September 2023 to support validation of requirements. A future revision will be the basis for a Technical Standing Order and the development of DFMC SBAS equipment. This version of the MOPS includes all the requirements for a GPS-RAIM service, and L1 SBAS service, and a DFMC SBAS service. The MOPS adds requirements for detection of interference and spoofing and extends the required GPS satellite tracking to satellites broadcasting PRNs 1-63, in line with the GPS Interface Standards. It includes the updated DFMC SBAS VPL equation. The fourth meeting in October 2023 commenced the development of the next revision. Participants at the meeting discussed capability that may be included in the next version. The meeting agreed to include the H-ARAIM service. Other capabilities are of interest depending on the relative maturity of the capability and market needs. There was interest to at least include forward-fit requirements for V-ARAIM. There was interest to include authentication services, with the SBAS Navigation Message Authentication (NMA) and Galileo Authentication Service under discussion. RTCA did not make any specific decisions regarding implementation of these capabilities and plans to monitor development of both capabilities.

In September, SBAS providers met in Toulouse, France for the 38th SBAS Interoperability Working Group (IWG) meeting. The European Space Agency hosted the meeting at the Cité de l'Éspace. IWG-38 included one and a half days of parallel meetings of the Technology Subgroup (TSG) and the Operations Subgroup (OSG) and a day of plenary meetings. The plenary received briefs from SBAS providers on the status of current SBAS systems and the planned deployment schedules for new SBAS systems. SBAS providers continue to make progress with the deployment of new SBAS systems and services. The TSG reviewed some discussion points that emerged from the DFMC SBAS MOPS FRAC and delved more deeply into aspects of the proposed SBAS NMA scheme. The OSG received updates from SBAS providers on available procedures. Japan provided an update on the trial SBAS approaches to LPV minima. India indicated an increase in promulgated procedures, with procedures now available for 8 runways at 5 airports. India has an additional 16 procedures at 9 airports in development. Two airlines provided updates on their SBAS plans. ASECNA provided an out brief of their Abuja demonstration and outreach event.

- Joseph Dennis, FAA AJM-32/NAVTAC II



This graphic reflects the continued growth of satellite-based LPV/LPs approach procedures. For more detailed information please visit: http://www.faa.gov/about/office_org/ headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/index.cfm

EGNOS Success Stories

KLM goes for LPV on their new A320NEO fleet

Reprint from *EGNOS BULLETIN* Issue 41, Autumn '23 Edition

Credits: KLM

The Netherlands flag carrier expands its fleet by incorporating a large set of new LPV-capable A320NEO and A321NEO, a more efficient aircraft model that will constitute a significant fleet renewal for the company, contributing to its sustainability objective for reducing CO2 emissions.

WAAS is a highly accurate satellite based navigation system developed for civil aviation that augments the basic service provided by GPS through improved accuracy, integrity and availability for all Performance Based Navigation (PBN) operations and vertically guided approaches.

This storyboard demonstrates how WAAS operates within the National Air Space (NAS).

About KLM...

Based in Amsterdam, KLM started operations in 1919, making it the world's oldest airline still operating under its original name. The airline has been evolving since then, reaching more than 92 European cities and 70 intercontinental destinations and carrying 34.1 million passengers and 621,000 tonnes of cargo today. The KLM Group (KLM Royal Dutch Airlines, KLM Cityhopper, Transavia and Martinair) is also part of the Air France-KLM group, being one of the world's largest air carriers. Following this lengthy path, the latest objectives for the company are sustainability and the reduction of the environmental footprint, which requires the acquisition of the latest and best available technologies.

A fleet renewal

The latest outcome of KLM's sustainability corporate objective is acquiring a large set of Airbus 320NEO and 321NEO aircraft. To this purpose, by the end of 2021, the Air France-KLM Group signed an order for 100 aircraft of the NEO family, with the option to extend it up to 160. The new fleet is intended to be operated by KLM, Transavia Netherlands and Transavia France and will replace the current Boeing 737NG, whose face-out is expected in 2030. The Airbus A320NEO family not only produces 50% less noise than the current, older generation of aircraft but also reduces fuel consumption and CO2 emissions to 15%. Alongside their LPV capability, these units will serve KLM to meet more stringent criteria and thus reduce Delays, Diversions and Cancellations (DDCs).

KLM's decision on LPV

As part of this renewal, KLM has decided to equip all of those ordered aircraft with EGNOS and LPV capability, which will

cover the European continental network. Currently, there are more than 800 LPV approaches published in Europe that KLM could benefit from with the new aircraft units, resulting in a safer and more sustainable fleet. As Vicent Hilligers -ATM Regional Manager of KLM- declares, the PBN Implementing Rule and the safety benefits provided by EGNOS were fundamental in the decision-making. The PBN Implementing rule mandates that, for 2024, all European instrument runway ends must implement RNP approaches to the three lines of minima (LNAV, LNAV/VNAV and LPV), and air navigation should transition from conventional to a full PBN environment in 2030, with LPV as normal means for CAT-I approaches. KLM was aware of the expected scenario for 2030, and they saw LPV as a basic need for future operations. In addition, the vertical guidance provided by EGNOS is not affected by temperature or QNH mis-settings, increasing the safety levels compared to barometric vertical guidance.

Credits: KLM

Next steps

The process to be LPV-ready will not be complicated. Since the aircraft comes with LPV from the manufacturing line, they will only have to train the pilots from the beginning. The training will also include other PBN capabilities, such as RNP AR, which can fulfil the use of the parallel RNP AR approaches at their home base, Schiphol, which is foreseen in the Dutch PBN roadmap as part of their sustainability goal.

KLM sees the need to equip its fleet with LPV in the coming years, especially on new orders. Recently, the regional carrier of the KLM Group, KLM Cityhopper, received the first LPV-capable fleet with the acquisition of new Embraer E2 jets. On the other hand, KLM's French partner, Air France, implemented a new company policy to equip all new aircraft with SBAS and LPV. Clearly, EGNOS will play a key role in the future of the Air France-KLM Group.

> "KLM has decided to equip all of those ordered aircraft with EGNOS and LPV capability, which will cover the European continental network"

Did you know...?

Air France will equip all future aircraft with LPV!

In a groundbreaking move for aviation, Air France has taken a monumental step to improve the safety and efficiency of its future fleet. The airline made the bold decision to equip all its future aircraft with LPV (Localizer Performance with Vertical Guidance) capability. This visionary choice means a commitment to providing passengers with unprecedented precision during approaches and landings. LPV technology leverages the power of satellite-based navigation systems, ensuring aircraft can navigate safely even in the most challenging weather conditions. Air France's decision to adopt LPV across its entire future fleet is a major step forward in modern aviation. It sets a new standard of excellence, demonstrating its unwavering commitment to passenger safety, operational efficiency and environmental responsibility.

Codes for filing FAA Domestic Flight Plans using GPS/WAAS

A simplified approach

As the U.S National Airspace System (NAS) transitions to Performance Based Navigation (PBN), the routes and procedures are based on a level of aircraft performance (RNAV-1, -2, etc.), instead of the specific performance of VOR or ILS. Area Navigation (RNAV) en route and terminal procedures can be flown with a variety of satellite and/or radio navigation sensors. For example, RNAV en route procedures (Q/T Routes and direct routing) and terminal procedures (SID/STAR) can be flown using either GPS, WAAS, or DME/DME/IRU navigation. To fly approaches on RNAV(GPS) charts, either GPS or WAAS can meet required performance for non-precision LNAV approaches. Finally, to fly the minima for Localizer Performance with Vertical guidance (LPV) or the non-vertical guidance LP approaches, WAAS is the only solution in the U.S.

The efficiency benefits from PBN come at the cost of more complicated flight plan options and equipment codes. The new ICAO flight plan format for civil domestic flights (FAA Form 7233-4) is a bit more complex in a few areas, but it is mostly the same stuff as the old FAA form (FAA Form 7233-1).

One thing that has proved to be more complex in the ICAO flight plan is the Equipment Codes (Block 10 on the 7233-4 or sometimes just labeled, for example, as "Aircraft Equipment" or "Surveillance Equipment" on tablets or online apps.) Also, Block 18 "Other Information," has required entries that can be bewildering for folks not familiar with the performance levels of PBN.

In the "old days," filing /G (for GPS) got you almost everything you wanted—direct routing, GPS approaches, etc. The truth is, /G will still get you most of what you want. But the FAA relies on the flight plan Equipment Codes and Other Information to understand which services aircraft use so that the FAA can allocate resources more effectively. Analysis of filed flight plans indicates that many users are not completely specifying their capabilities when filing flight plans.

The purpose of this article is to assist users in understanding and correctly filing the Equipment Codes and Other Information in the FAA ICAO flight plan for the General Aviation user. The AIM has an entire appendix with pages and pages of tables dedicated to many obscure codes, and these can be difficult to apply. To simply the process for most GA aircraft, this article does not include filing for international flight plans, aircraft with sophisticated Flight Management Systems (FMSs), nor does it include airline or air taxi users flying under mandated operational specifications. We will try to keep it straightforward and use a minimum of jargon.

So, let us start with the first part of Block 10 or "Aircraft Equipment." This is principally addressing what installed communications and navigation equipment one has aboard. If you do not have a radio or installed electronic navigation equipment, enter "N," and you are done.

- If you have an installed VHF comm radio, hold that thought and go to the next bullet.
- If you have an installed VOR/ILS in addition to the comm radio, enter "S." These can be in a single NAVCOM box, a VHF/VOR/GPS, separate boxes, or a multifunction display. If you do not have an installed VOR/ILS, then enter "V" (only a VHF radio).
- If you have an IFR-approved GPS, enter "GR" in addition to S or V. This GPS capability does not include tablets, handhelds, or an installed VFR GPS. In general, IFR-approved GPSs can conduct LNAV instrument approaches (in addition to other navigation, of course). The G is for GPS and the R is for PBN approval, which all installed and approved IFR GPSs have.
- If your installed IFR GPS has Wide Area Augmentation System (WAAS) capability, enter "GBR" (and not the GR above). WAAS GPSs have the capability to offer LPV or LP approaches—so you can select an RNAV approach, and the avionics will cycle to "LPV" or "LP" if the approach has those lines of minima.

Now, a couple of quick examples. If you have a Garmin 430W or a G750, you can enter SGBR, since you have a VHF radio, a VOR/ILS, and a WAAS GPS. If you have a VHF radio, no VOR/ILS, and King KLN-94 (GPS but not WAAS). Then you enter VGR—a VHF radio, no VOR/ILS, and a GPS (non-WAAS) receiver. Note that some older Garmin G1000s do not have WAAS, so they are SGR, while newer ones have WAAS and would be SGBR.

If you are still with me, there are a few more Equipment Codes. If you have a DME, then add a "D" to what you had above. If you have fancy stuff like an inertial navigation system, FMS, DME/DME RNAV, or a Ground Based Augmentation System (GBAS), go to the AIM. These are not common except in airliners or business jets. Note that an electronic directional gyro (ADHRS) in a multifunction or a round dial display is not an inertial navigation system.

This gets us through the communications and navigation equipment. Surveillance equipment is easier for domestic flight plans.

- If you have no transponder, enter "N."
- If your transponder has no altitude reporting, enter "A."
- If you have a transponder with altitude reporting capability, enter "C."
  Note: For international flight plans, you must identify various capabilities of a Mode S transponder—a bunch more codes. This is not required for domestic flight plans.

ADS-B equipment codes are also required if you have ADS-B. If you do not have ADS-B, just enter the transponder code above. Unfortunately, if you have ADS-B you must look in your ADS-B manual for your equipment type. Here are the codes:

- If you transmit your ADS-B Out information via Mode S (i.e., on 1090 MHz) but do not have an installed ADS-B In receiver, use "B1." If you have an installed ADS-B In receiver and see traffic and weather on your display, use "B2." Portable/non-installed ADS-B In receivers do not count—so file B1 if your ADS-B In is portable.
- If you transmit your ADS-B Out information via UAT (on 978 MHz) but do not have an installed ADS-B In receiver, use "U1." If you have an installed ADS-B In receiver and see traffic and weather on your display, use "U2." Ditto the above for portables/non-installed.

The last task is the "Other Information." If you do not have an installed IFR-approved GPS, leave it blank. If your installed GPS is IFR approved (either WAAS (GBR) or non-WAAS (GR)), then enter "PBN/C2D2O2S1." Ok, here is a bit of an explanation—but your installed IFR GPS will legally do all these PBN operations.

- C2 (RNAV 2 GNSS): This means that you can fly en route GPS routes (i.e., Q and T routes). These meet the RNAV 2 navigation specification.
- D2 (RNAV 1 GNSS): This means that you can do RNAV arrivals (STARS) and departures (SIDS). These meet the RNAV 1 navigation specification.
- O2 (Basic RNP 1 GNSS): This means you can do procedures what require RNP-1 specification, which is part of the RNAV (GPS) approach.
- S1 (RNP APCH): This means you can do RNAV(GPS) approaches.

Now, this discussion leaves out some capabilities you may have read about. Some approaches have curved segments, which are called Radius-to-Fix (RF) segments. Similarly, some procedures are RNAV (RNP) arrivals, departures, and approaches. Unless you have a specifically approved GPS box or an FMS, you will not be able to do these procedures. Generally only airliners and some FMS equipped aircraft have these capabilities. They may come to smaller aircraft someday, but not yet.

Below are two tables for a summary of what will work for almost all non-FMS-equipped aircraft.

ICAO Flight Plan Block 10 "Equipment"

Comm/Nav Equipment		Surveillance Equipment	
N	None	**N**	None
V	VHF Radio Only	**A**	Transponder-No Altitude Reporting
S	VHF Radio, VOR and ILS	**C**	Transponder with Altitude Reporting
GR	IFR GPS (installed)	**B1**	ADS-B: 1090 MHz ADS-B "Out"
GBR	IFR GPS with WAAS (installed)	**B2**	ADS-B: 1090 MHz ADS-B "Out" and "In"
D	DME	**U1**	ADS-B: UAT ADS-B "Out"
		U2	ADS-B: UAT ADS-B "Out" and "In"

ICAO Flight Plan Block 18 "Other Information"

If Block 10 has GR or GBR put:	PBN/C2D2O2S1

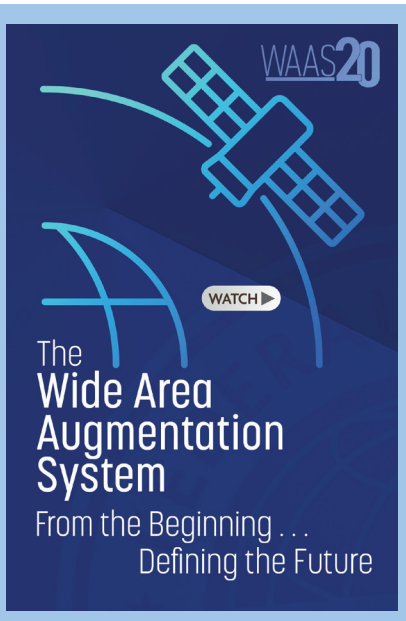
An example. My Maule M7 has a Garmin 430W (VHF radio, VOR/ILS, and WAAS GPS) and a Garmin Mode S transponder that has ADS-B Out and In. Here are my Equipment Section codes:

- **SGBR** (Standard VHF and VOR/ILS plus GPS, WAAS, and RNAV approval)
- **CB2** (An altitude reporting transponder with Mode S ADS-B In and Out)
- And my Comments section codes: PBN/C2D2O2S1 (All the capabilities listed above)

Hope this is helpful. As noted above, there are many more tables in the AIM, but they generally apply to FMS-equipped aircraft or high-end jets and airliners and/or to flight plans filed out of the USA.

-Vince Massimini, NAVTACII/DSc, CFI, CFII

> "In the "old days," filing /G (for GPS) got you almost everything you wanted—direct routing, GPS approaches, etc."



Celebrating twenty years, this video tells the story of the Wide Area Augmentation System, from the program's beginnings to how it is defining the future of satellite navigation

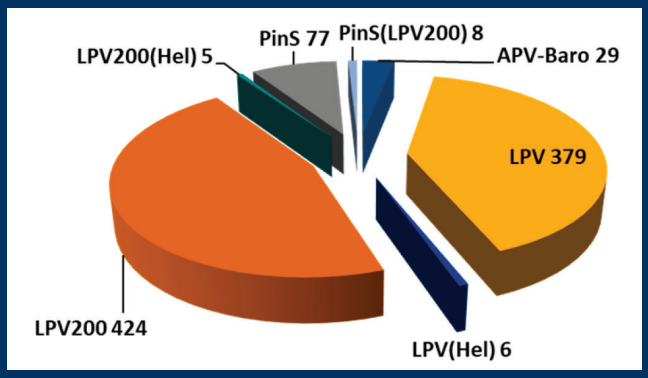
WAAS is Working

A Video Series demonstrating the benefits of WAAS

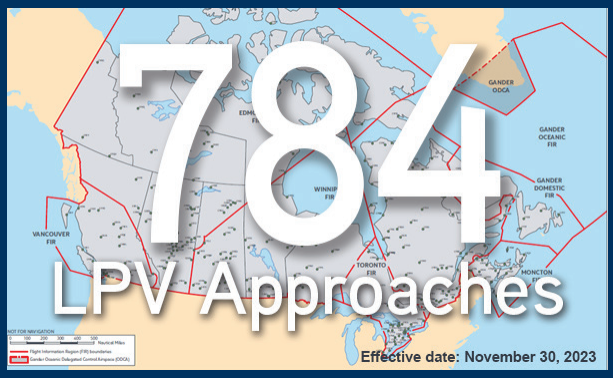
Featuring: Horizon Air, the Goodyear Blimp, MedStar, Miss Virginia, Floatplanes in Alaska, Mid Atlantic Angel Flight and Airports

FLY WAAS

LPVs Internationally



The number of LPVs in Europe is also growing. The graphic shows LPV procedures in Europe as of October 5, 2023. https://egnos-user-support.es-sp-sas.eu/new_egnos_ops/news-events/egnos-bulletin



Canadian WAAS LPVs provided by NAV CANADA
as of November 30, 2023
(click for map)

. . . 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