Welcome to **WAAS Defined**

Welcome to this special expanded issue of The Universal Flyer featuring a four-page report exploring the many facets of the Wide Area Augmentation System (WAAS). The *WAAS Defined* feature report includes guest columns from NAV CANADA and the Federal Aviation Administration (FAA), presents the benefits of utilizing WAAS for navigation and highlights Universal Avionics’ involvement in this exciting technology.

Satellite-Based Augmentation Systems (SBAS) such as WAAS are an integral part of the worldwide effort to reduce dependency on ground-based infrastructure and leverage the precision and accuracy provided by satellite technologies. The WAAS SBAS was developed by the FAA to augment Global Positioning System (GPS) navigation for properly equipped aircraft operating in the U.S., Canada and Mexico. It was the first SBAS deployed in the world, with systems covering Europe, Japan and India currently in development and expected to be commissioned for navigational use soon.

The *WAAS Defined* feature report serves as a foundation by which an aircraft operator can determine if embracing this new technology will benefit their flight operations, but a seasoned WAAS user just might learn a bit about the WAAS and other SBAS too. Enjoy!

**New Product News**

**New WAAS GPS/XM Antenna Available**

Universal Avionics is pleased to announce the addition of a dual-element GPS/WAAS (SBAS) and XM antenna to its product catalog. Part Number (P/N) 10710 is designed for use with WAAS/SBAS-FMS and XM radio installations. The new antenna is ideal for operators with limited aircraft space for an additional XM antenna.

To allow interchangeability, the GPS/XM antenna has the same footprint as Universal’s single-element GPS/WAAS antenna (P/N 10708). Certain installations may require the aircraft be modified to accept an additional connector used for XM radio signal reception.

**TSO for CVFDR Expected in November**

The FAA Technical Standard Order (TSO) approval for Universal Avionics’ new line of cockpit voice and flight data recorders (CVFDR) is scheduled to occur next month. The CVFDR product line will meet the following certification and safety requirements:

- FAA TSO-C123b, Cockpit Voice Recorder Systems
- FAA TSO-C124b, Flight Data Recorder Systems
- FAA TSO-C155, Recorder Independent Power Supply
- FAA TSO-C177, Data Link Recorder Systems
- EUROCAE ED-112, Minimum Operational Performance
- FAA Revisions to Cockpit Voice Recorder and Digital Flight Data Recorder Regulations; Final Rule

Unique to the CVFDR is the optional no-battery, maintenance-free internal Recorder Independent Power Supply (RIPS) capability. The RIPS provides a backup power source that allows the CVR to record for up to 10 minutes in the event of a main power fail.

The FAA issued Final Rule on Cockpit Voice Recorder and Digital Flight Data Recorder Regulations (FAA-2005-20245) in March 2008 mandating all forward-fit CVR installations in aircraft with more than 10 seats to have RIPS by March 2010. Universal’s CVFDR internal RIPS option allows operators to meet the mandate without the extra weight, cost and maintenance of an external RIPS unit.

Receive The Universal Flyer by mail or email. To update your mailing preferences, email universalflyer@uasc.com or call 1-800-321-5253.
FAA Looks to Cancel VOR and GPS Procedures

As industry-wide support of satellite-based navigation grows, the FAA has embarked on a cost-saving program to cut the number of NDB approaches at airports that also have RNAV approaches. Reducing the number of ground-based procedures that provide redundant capabilities allows more resources to be allocated to the development of satellite-based RNAV (GPS) WAAS procedures.

Now, the FAA is looking to cancel a number of VOR and GPS circle-to-land approaches. Expanding the scope of the program is expected to free up more money for the development of more WAAS procedures. The Aircraft Owners and Pilots Association (AOPA) has posted the 154 procedures being considered for elimination here: [http://download.aopa.org/epilot/2009/ePilot_Approach_Decommissionings.pdf](http://download.aopa.org/epilot/2009/ePilot_Approach_Decommissionings.pdf). Final determination by the FAA is expected sometime after October.

Update: RNP SAAAR vs WAAS LPV

Some compare the minima achieved using RNAV (GPS) LPV procedures to that of RNAV (GPS) Special Aircraft and Aircrew Authorization Required (SAAAR) procedures. Both provide significant benefits to operators, but, as the article in our April 1, 2009 issue summarized, obtaining RNP SAAAR approval tends to be a costly and complex process with limited availability for most business jet operators.

Using navigation data from the FAA, as of July 30, 2009, here is an update to the RNP SAAAR vs RNAV (GPS) LPV statistics first presented in our April 1, 2009 issue.

- Number of runways with RNAV (GPS) approaches containing an LPV minimum (decision height): 1,670
- Number of runways with an RNAV (RNP) SAAAR procedure: 148
- Of the 1,670 runways with an LPV procedure, 961 of them are to non-ILS runways
- Number of RNP approaches to non-ILS runways: 35
- Approaches with LPV with a Decision Height (DH) less than 250’: 146
- RNP approaches with a DH less than 250’: 0
- Of the 148 runways with RNP SAAAR procedures published, 102 (69%) of those RNP approaches are to runways that also have an RNAV (GPS) approach containing an LPV with a lower minimum

Software and Hardware Updates

RCU
SCN 1016.0.5 approved 6/23/09.
This minor change adds support for digital HF radios, a third VHF Comm interface and certain Collins MMR radios.

WAAS GPS/XM Antenna
New WAAS GPS/XM Antenna
P/N 10710 approved 9/2/09.
Dual element antenna provides reception for WAAS (SBAS) GPS and XM radio signals.

FMS
SCN 1000.3/1100.3 approval scheduled for 10/1/09. Minor change incorporates several improvements to the Multi-Missions Management System, adds a high speed transponder bus, support for future FANS requirements and an internal flight data recorder for maintenance purposes.

SSDTU
SCN 10.1 approved 8/24/09.
Minor change adds compatibility for USB devices with non-standard partitioning and formatting.

Universal Expands Sales and Marketing Support in U.S.

Universal Avionics is pleased to welcome Carey Miller as Western U.S. Regional Marketing Manager. Carey assumes this position from Regional Marketing Manager Tom Wright, who is now dedicated to the newly created Southwest U.S. Marketing Region. The addition of this new sales region allows Universal to provide a higher level of sales, marketing and customer support to the Southwest U.S. customer base. This represents the second expansion for Universal, as a Southeast U.S. region was added earlier this year. View Universal’s new regional sales coverage map at: [www.uasc.com/sales/reps.aspx](http://www.uasc.com/sales/reps.aspx).

With over 20 year’s experience, Mr. Miller brings extensive knowledge of aviation sales to his new position. He holds a commercial multi-engine instrument rating with type in the Challenger 604 and Beechjet 400a.

Carey may be contacted at (520) 295-2300 / (800) 321-5253; email: cmiller@uasc.com.
Notes from Product Support

From solving complex avionics integrations to answering simple operational questions, Universal Avionics’ Customer Support and Repair department is available virtually anytime, anywhere. Through a network of field service representatives, Authorized Service Centers and repair stations, the department guides customers through the installation and operation of Universal equipment.

Located in Corporate Headquarters in Tucson, Arizona, Universal’s main facility provides the widest range of services. A second repair station and training office is located in Universal Avionics’ Wichita, Kansas facility.

Day to day technical issues are supported Monday through Friday 0600 to 1700 MST. On site support is available on a case by case basis and with prior scheduling approval and support personnel availability. Field representatives are located worldwide to support on-site technical assistance.

To request assistance for Universal equipment, contact the appropriate center nearest you. See map below for location of services and visit our website to view a complete list of services available by location.

www.uasc.com/support

Service Bulletins and Letters

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All Service Bulletins and Letters are available at: www.uasc.com.
Approach procedures utilizing WAAS technology offer several benefits over traditional GPS procedures for operators and national airspace systems alike. Would your flight operations be more effective or efficient by taking advantage of WAAS?

**Operational Benefits**
- Augmented signal is accurate enough to be considered a “Sole Means” of navigation
- Eliminates RAIM prediction requirement, reducing pilot work load
- Enables more “Direct-To” operations for potential fuel savings
- File WAAS approach as IFR Alternate saving productivity and fuel
- Potential air handling preference at crowded airports
- Eliminates procedural requirements for minimum temperature restrictions
- Electronic glidepath eliminates intermediate step down approaches
- No special training or navigation database requirements
- Allows approaches at smaller municipal airports at night when no local altimeter setting is available
- LPV procedures eliminate cold temperature effects, incorrect altimeter settings and missed landings due to lack of local altimeter source
- Greater opportunity for landing at airports closer to destination

**Airport Benefits**
- WAAS offers a cost-efficient opportunity for airports to gain ILS-like approach capability without installing ground-based nav aids
- No consideration needs to be given to the placement of navigation facility, maintenance of clear zones around the facility or access for maintenance

**System Benefits**
- WAAS supports vertically-guided instrument approaches to all qualifying runways
- Vertically-guided approaches reduce pilot workload and provide safety benefits compared to Instrument Landing System (ILS) precision and non-precision approaches
- Satellite-based navigation is a core element of the FAA’s Next Generation National Airspace System (NAS) and several other airspace agencies worldwide
- Eliminates the need for ground equipment infrastructure, which saves airspace systems money on maintenance and installation
- WAAS signal uses standard ICAO parameters for compatibility with future SBAS systems, including the European Geostationary Navigation Overlay service (EGNOS) and India’s Multi-functional Satellite Augmentation System (MSAS)
- Aircraft equipped with WAAS avionics can use EGNOS and MSAS

**Accuracy**
The WAAS specification requires a position accuracy of 7.6 meters or better for both lateral and vertical measurements 95% of the time. Actual performance measurements of WAAS at specific locations have shown it typically provides better than 1.0 meter laterally and 1.5 meters vertically. With these results, WAAS is capable of achieving the required Category I precision approach accuracy of 16 meters laterally and 4.0 meters vertically for ILS-like performance without ground-based landing aids.

**Integrity**
System integrity refers to the ability to provide timely warnings to users when the system is producing hazardously misleading information and should not be used as a sole means of navigation. WAAS improves the integrity of standard GPS signals by detecting smaller errors more quickly and with a higher probability of success.

The WAAS specification requires the system to detect errors in the network and notify users within 5.2 seconds, which is nearly half the time specified by Differential GPS. WAAS must also maintain an extremely small probability that an error exceeding the requirements goes undetected – a probability equivalent to one error in ten million approaches. This provides integrity information equal to or better than Receiver Autonomous Integrity Monitoring (RAIM).

**Reliability**
The WAAS specification refers to reliability as “Continuity of Function” for the system and is defined as the probability that accuracy and integrity requirements will be supported by the system throughout the flight operation. The stated probability is 99.9945%.

**Availability**
Availability is the probability that the navigation and fault detection functions are operational and meet accuracy, integrity and continuity of function requirements.

The WAAS specification mandates availability as 99.9% throughout the service area, equivalent to a downtime of just over 5 minutes per year.

**Who Benefits from WAAS and How**

The Wide Area Augmentation System is designed to provide the additional accuracy, integrity and reliability necessary to enable sole-means GPS navigation for all phases of light when within the WAAS coverage area.
With the introduction of WAAS/SBAS-FMS over 2 years ago, Universal Avionics was the first to bring a WAAS-capable TSO’d FMS to market for Part 25 aircraft. The GPS WAAS technology of this new generation FMS was in its infancy, and as such posed challenges for some operators seeking installation approval. This was especially true for those seeking approval for WAAS LPV procedures. Standard approval policies had yet to be established by the FAA for this new capability.

Together, Universal and the FAA have developed a solution that provides an affordable and expeditious process for approval of LPV-capable WAAS/SBAS-FMS upgrades. This solution will allow Universal non-WAAS FMS operators currently approved for fully coupled 3D pseudo ILS approaches (non-LPV approaches) to obtain certification approval for a new Universal WAAS/SBAS-FMS with LPV via a specially designed “Engineering Assisted Field Approval Process”.

Candidates for this process must meet certain aircraft, certification and installation-specific qualifications. Operators of aircraft not eligible for this process will need to obtain approval from their certifying agencies by way of standard processes (i.e. FAA STC, TC, Field Approval).

Summary of eligibility requirements:
1. Aircraft is registered in the United States (N-Registered).
2. Aircraft must operate under 14 CFR Part 91 or Part 135.
3. Existing FMS installation approved by FAA TC, STC, or Field Approval.
4. Existing FMS installation must be approved for lateral and vertical coupled operation to the Flight Guidance System (FGS). Interfaces to the FGS using the analog ILS channel inherently meet these scaling requirements as deviation scaling is under the control of the FMS.
5. Existing FMS installation must be laterally and vertically integrated to the flight instruments capable of meeting the scaling requirements of TSO-C146c and RTCA/DO-229D.
6. Existing FMS configuration must be in the “UNS-1 System Installation Upgrade Eligibility Table” list in the FAA/Universal agreement.
7. Aircraft type, flight guidance and display combination must be in the “Aircraft / Flight Guidance / Display Applicability” list in the FAA / Universal agreement.

Universal Avionics has distributed a detailed report outlining the specific eligibility requirements (6 and 7 above) and the approval process to all its Authorized Dealers. Customers interested in gaining WAAS or LPV capabilities should contact their dealer to determine the applicable certification path for their aircraft.

Universal’s Engineering Services Organization is available to answer questions about the Field Approval process at 1-800-321-5253.

Universal Works with FAA for LPV Engineering Assisted Field Approval Process

WAAS on Your Aircraft Type?

Universal Avionics has sold over 19,000 Flight Management Systems. Over 700 of those are WAAS/SBAS-FMSs, which have been installed on over 50 aircraft models...and counting.

Fixed Wing
Bombardier Challenger CL-600
Bombardier Challenger CL-601-3A
Bombardier Challenger CL-601-3R
Beech King Air 200
Beech King Air B200
Beech King Air 350
Beech King Air 300
Beech King Air C90A
Cessna Citation V 560
Cessna Citation Excel 560-XL
Cessna Citation III 650
Cessna Citation Bravo 550
Cessna Citation Encore 560
Cessna Citation II 550
Cessna Citation V Ultra 560
Cessna Citation VII 650
Cessna Citation II 550
Cessna CitationJet 525
Cessna Citation CJ2 525A
Dassault Falcon 10
Dassault Falcon 20
Dassault Falcon 2000
Dassault Falcon 50
Dassault Falcon 50EX
Gulfstream G-100
Gulfstream G-200
Gulfstream GII
Gulfstream GIII
Gulfstream Astra 1125 SP
Gulfstream Astra 1125 SPX
Hawker HS 125-700A
Hawker 800 XP
Hawker Beechjet 400
Hawker 800
IAI Astra 1125
Learjet 31
Learjet 31A
Learjet 35
Learjet 35A
Learjet 36A
Learjet 45 Learjet
Learjet 55 Learjet
Learjet 60 Learjet

Airliners
ATR-42
Boeing 727
Boeing 737
Bombardier DHC-7
Bombardier DHC-8 Q-Series
Cessna 208B Caravan
MD-87
Saab 340B

Military/Government
Gulfstream C-20A/D
Beech RC-12
Learjet C21A

Sikorsky S-76C++

Helicopters
Bell Helicopter Bell 412
Gulfstream S-76

Sikorsky S-76
Canada RNAV LPV Gets a Boost

By Jeff Cochrane, Manager CNS Service Design, NAV CANADA

Aircraft operators around the world have been using the U.S. military’s satellite-based Global Positioning System (GPS) for over a decade. GPS has made it possible for NAV CANADA to provide approaches that increase airport usability without the need for new ground navigation aids and NAV CANADA’s customers have benefited from more accurate approach guidance and direct routings that save time and fuel.

The advent of the Wide Area Augmentation System (WAAS) has provided NAV CANADA with the opportunity to offer even better approaches and the potential to reduce our dependence on ground aids. Today, thanks to the installation of WAAS ground stations at Winnipeg, Iqaluit, Gander and Goose Bay, the WAAS signal coverage area extends into Northern Canada, providing a high availability of en route, terminal and approach guidance. This allows NAV CANADA to increase airport accessibility with the design and publishing of Localizer Performance with Vertical guidance (LPV) procedures.

NAV CANADA is in the process of replacing obsolescent ground-based navigation approach capability, such as Localizer Back-Courses, with RNAV (GNSS) procedures with LNAV/VNAV and LPV minima, wherever possible.

The development of LPV procedures in Canada has been hampered by the availability of the current design criteria (FAA 8260.54A) and by the lack of accurate airport survey data required for design. Consequently, Canada has lagged behind the U.S. in the number of LPV procedures published. However, it is expected that the latest criteria will be approved for use in Canada this year.

NAV CANADA will continue to work with airport authorities to highlight the benefits of LPV approaches in order to encourage provision of the essential survey information. We are confident this will result in a continued growth in the number of LPV published RNAV procedures in Canada.

NAV CANADA is investigating further potential improvements to airport access enabled by WAAS. An ionospheric study into the potential for application of decision altitudes as low as 200 feet above the touchdown zone on LPV approaches in Canada is underway. Results are expected early in 2010 and, if positive, would lead to lower minima on select LPV procedures.

NAV CANADA is Canada’s civil air navigation services provider. With operations coast to coast, NAV CANADA provides air traffic control, flight information, weather briefings, aeronautical information services, airport advisory services and electronic aids to navigation.

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**WAAS** abbr. Wide Area Augmentation System. A Satellite-Based Augmentation System operated by the United States Federal Aviation Administration with coverage in Canada, United States and Mexico.

**SBAS** abbr. Satellite-Based Augmentation System. A navigation service using a combination of Global Positioning System (GPS) satellites and Geostationary satellites with the primary objective of improving GPS navigational service for civil aviation.

**LNAV** abbr. Lateral Navigation. Non-precision RNAV (GPS) approach procedure; uses GPS and/or WAAS for lateral navigation; if vertical guidance is provided, it is barometric; 400’ MDA typical.

**LNAV/VNAV** abbr. Lateral Navigation / Vertical Navigation. Non-precision RNAV (GPS) approach procedure; uses lateral guidance from GPS and/or WAAS and vertical guidance from WAAS; 350’ MDA typical.

**LPV** abbr. Localizer Performance with Vertical guidance. Non-precision RNAV (GPS) approach procedure; uses WAAS for lateral and vertical navigation; often referred to as the satellite navigation equivalent of ILS procedures; 200-250’ MDA typical; requires Class 3 avionics certified to TSO-C145 or TSO-C146.

**LP** abbr. Localizer Performance. Future non-precision RNAV (GPS) approach procedure; uses WAAS for lateral guidance and barometric altimeter for vertical guidance; published for runways where obstacles or other infrastructure limitations prohibit a vertically guided approach (LPV or LNAV/VNAV); 300’ MDA expected.
Universal Avionics answers the most commonly asked questions about WAAS.

What is an LPV Approach?
What is commonly referred to as an “LPV approach” or perhaps “WAAS approach” is actually an RNAV (GPS) approach procedure.

How do I tell a WAAS procedure from a GPS procedure?
RNAV (GPS) approach procedures utilizing WAAS signal data contain a WAAS Channel ID on the approach chart (upper right corner). When a given procedure contains a WAAS Channel ID, it means that a Final Approach Segment Data Block (FAS DB) is included as part of the approach record. On these plates, multiple approach descent minimums may be published, referred to as LPV, LNAV / VNAV and LNAV levels of service (LOS).

Note that not all approaches provide all three levels of service; some are LPV only, some LPV and LNAV/VNAV only and some LPV and LNAV only. These levels of service require the FMS to provide annunciations to the flight crew to tell them what integrity level the FMS is providing and subsequently what minimums the aircraft is authorized to descend to before runway visual contact is made.

When flying a RNAV (GPS) procedure, how do I know if I’m using WAAS?
The WAAS/SBAS-FMS uses WAAS lateral navigation for all flight phases when within the WAAS SBAS coverage area. In the approach environment, the FMS can use either WAAS or barometric altitude reference information to provide vertical guidance.

If an LPV or LNAV/VNAV level of service is annunciated, the FMS is using WAAS to provide vertical guidance. This applies to WAAS procedures as well as many other RNAV approaches. In this scenario, changes to the barometric setting will not affect FMS vertical path or steering.

If the VNAV only or no level of service annunciation is provided, the WAAS/SBAS-FMS vertical guidance (if provided) is referenced from barometric altitude (not WAAS). This is true for any approach type (WAAS approach or not). Subsequently, any temperature restrictions on the approach chart will apply and changes to the baro setting will change the FMS vertical path and steering.

Differing levels of integrity are required for the each of the levels of service as defined by the procedure’s FAS DB. When guidance is being provided for LPV level of service, the approach integrity is monitored by the off-side FMS or LP/LPV Monitor to ensure the integrity meets requirements. This is why dual FMSs (or single WAAS/SBAS-FMS with LP/LPV Monitor) are required for LPV operations.

The Federal Aviation Administration WAAS Program Office has engaged Northern Air Cargo, Horizon Airlines, CareFlite, NetJets and Associated Aircraft Group in data collection efforts to provide economic and operational benefits gained from operating with WAAS. These activities also support STC approval for airframes such as the Boeing 737, Bombardier Q-400, Sikorsky S76, and Augusta 109.

The benefits of the Wide Area Augmentation System (WAAS) are far-reaching. WAAS serves Canada and Mexico and is interoperable with other satellite-based augmentation systems (SBAS) being implemented worldwide.

Since its inception, the WAAS has enabled 1,688 Localizer Performance with Vertical (LPV) approach procedures — already exceeding the number of ILS approaches in the National Airspace System by more than 300. There are LPVs at nearly 1,000 airports and the FAA is planning to implement an LPV at every qualified runway throughout the U.S. by 2018.

Next year, users will begin seeing WAAS lateral precision (LP) procedures. LPs will be used at locations that won’t support LPV, but will provide lateral guidance to as low as 300 feet AGL.

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FAA: More LPVs and LPs on the Horizon

By Mary Ann Davis,
Federal Aviation Administration GPS/TAC WAAS Program Office AJW43

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Is WAAS Right for You?

Welcome to Universal’s special WAAS edition of The Universal Flyer. I hope you find the articles informative and insightful about the many facets of the Wide Area Augmentation System (WAAS) and other Satellite-Based Augmentation Systems (SBAS) becoming available worldwide.

There are many benefits of WAAS navigation, but every operator has a unique set of flight requirements that makes switching to WAAS more advantageous for some operators over others.

As you browse the WAAS section, you may want to take a minute to evaluate your flight operations to determine if WAAS is right for you.

- Would access to more airports benefit my operation?
- Do we have a need to land at airports not served by an ILS?
- Do I regularly utilize smaller airports?

As the FAA and other certifying agencies continue to transition from ground-based to satellite-based equipment, WAAS and other SBAS will be the preferred navigation system of the future.

As a leading supplier of WAAS-capable FMSs, Universal is available to answer your questions about this new technology. Our goal is to provide you the best navigation solutions for your flight operations and with that, present the information you need to make important decisions regarding the avionics in your aircraft.

The Universal Flyer WAAS edition is just the beginning. We’re aiming to publish more educational pieces like this one soon (hint: www.waas.aero). Have a question? Email me at mjames@uasc.com.

Michelle A. James, Managing Editor