SatNav News

FAA Navigation Programs AJM-32
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Sunny Skies for SkyWest in Sun Valley

WAAS equipage and a new approach bring benefits to SkyWest

Photo: Alec Seybold, Flight Tech Engineering

Approach to Friedman Memorial Airport

SkyWest Airlines, the nation's largest regional airline recently partnered with Flight Tech Engineering (an FAA Navigation Service Provider) at Friedman Memorial Airport (SUN) to implement an innovative special instrument approach solution for their newly WAAS equipped ERJ175 aircraft. With no existing ground based navigational aids and only basic non-precision GPS approaches, SUN was previously hampered with numerous weather related diversions. I asked Brent Wilson, the company's Manager of Aircraft Operations to fill us in on some of the details of the new WAAS equipage and resulting benefits from the airline's perspective.

***SNN:** Can you describe the SkyWest Operation, Fleet Mix, and primary regions of operation?*

SkyWest: SkyWest Airlines operates through partnerships with United Airlines, Delta Air Lines, American Airlines and Alaska Airlines. Our fleet of nearly 450 aircraft connect passengers to 227 cities across the United States, Canada and Mexico. The fleet mix consists of CRJ200s (134), CRJ700s (86), CRJ900s (39) and ERJ175s (189).

***SNN:** How many aircraft are WAAS LPV equipped and are there plans for more?*

SkyWest: SkyWest has 55 ERJ175 aircraft that are WAAS LPV equipped, and is currently working with avionics vendors for a solution to equip the existing CRJ fleet.

***SNN:** What's required to use LPV in a Regional Jet?*

SkyWest: WAAS LPV is only used in the ERJ175 fleet. This fleet is equipped with Honeywell EPIC LOAD 27.3 (a software option we purchased), which is loaded with LPV software. Once this software is loaded on the aircraft its ready to use. There are no other equipage replacements required or Ops Specs approvals required.

For the CRJ, we are working with avionics vendors to determine the tech insert, or required equipage, that will be needed to effectively utilize LPV.

***SNN:** What are the crew training requirements to use LPV approaches? Has that taken long to update/qualify the crews?*

SkyWest: Training for LPV is something that has been part of our Standard Operating Procedures Manual (SOPM) for some time. This includes descriptions about what an LPV is, how to load an LPV approach (verifying correct WAAS channel and FAS Data block), and any scratch pad messages that may indicate an LPV is not available. With LPV now available on some of our aircraft and being implemented at airports, our pilots are able to review the information available in our SOPM prior to using it. From a time to train and difficulty perspective it is minimal and effective.

SNN: *What are the benefits of using WAAS LPV over RNP-AR (specifically RNP below 0.30)?*

SkyWest: It It has been our experience that LPV provides somewhat lower minima than an RNP Instrument Approach Procedure (IAP) to 0.30. Basically similar to flying an ILS to CAT I minima but doing it as a non-precision approach. SkyWest does not currently conduct RNP AR approaches to minima below 0.30

***SNN:** How does the new SUN RNAV (GPS) N RWY 31 (i.e. 'LPV') approach differ from the previous approach SkyWest used? Crew Feedback?*

SkyWest: The new approach, RNAV (GPS) N (IAP) takes advantage of the full capabilities of the ERJ175 by using an RNP Radius to Fix (RF) leg to join the WAAS (augmented) LPV final approach. Minimums improved from RNAV (GPS) X, 1631' at 3 nm to RNAV (GPS) N, 343' at 1 nm.

The RNAV (GPS) X has minimums of 1631' at .5 nm from the runway threshold after flying a 3.5-degree Vertical Path Angle (VPA). From a practical perspective this made it difficult

Photo: Tim Burke, FMAA Operations Manager

E175 Landing in IMC Conditions at SUN

Photo: Tim Burke, FMAA Operations Manager

SkyWest E175 emerging from the clouds in IMC Conditions

to conduct a safe descent, using normal maneuvers, to a landing in the touchdown zone. To accomplish a safe descent using normal maneuvers, a Visual Descent Point (VDP) had to be established almost 5.0 nm from the end of the runway. Reliability was impacted due to the need to execute a missed approach so far from the runway. The new RNAV (GPS) N IAP delivers the aircraft from a constant 3.50-degree Vertical Path Angle (VPA) to 343' DA .85NM from the runway threshold.

> “Safety was significantly enhanced with vertical guidance from coupled LPV extending to the runway at a constant 3.50 degrees”

Crew feedback on the new approach has been entirely positive. They love the increased accuracy and consistency of the LPV procedure. It delivers them right to the runway in a configuration and at an altitude where they can just transition to a landing, and they enjoy how easy the LPV are to fly. In the ERJ 175 they are set up and flown exactly like a normal RNAV procedure. The crew simply loads the approach in the FMS, sets their final segment altitude and arms the approach on the Guidance Panel.

***SNN:** Has the SUN RNAV (GPS) N RWY 31 (i.e. 'LPV') approach resulted in any tangible benefits to the SkyWest operation?*

SkyWest: Safety was significantly enhanced with vertical guidance from coupled LPV extending to the runway at a constant 3.50 degrees. At the point the aircraft breaks out of the clouds, (Decision Altitude is only 0.85NM from the landing threshold), the aircraft is setup on a stabilized approach ready for landing. The procedure provides a consistent repeatable safe track and outcome every time.

Reliability is also improved from 65 – 99% resulting in substantial busing and ground handling cost savings and improved passenger experience.

***SNN:** Do you plan to expand the use of LPV capabilities at other locations?*

SkyWest: SkyWest crews currently use LPV IAPs where ever they are available. The FAA continues to add new LPV approaches to the NAS, so it is our hope that as they do this, more LPV approaches will become available at more airports, including to runways that may not have had an instrument approach available in the past.

We want to thank SkyWest for sharing how equipping with WAAS LPV is making a difference with the carrier.

- Amy Trevisan, FAA AJM-32/NAVTAC

Upate:DFMC SBAS standards

The SBAS community continues to make strides in the development and provisioning of a dual-frequency multiple constellation SBAS service. The ICAO Navigation Systems Panel participants in the two-week long virtual Navigation Systems Panel 6 (NSP6) meeting in November approved the amendment package with the updated core constellation and the Dual Frequency Multiple Constellation (DFMC) Standards and Recommended Practices (SARPs). The core constellation packages include the GPS L5 update and introduce GLONASS Code Division Multiple Access, Galileo, and BeiDou signals. This represents a big step towards getting the additional frequencies and constellations and associated SBAS standards into the SARPs. The ICAO Secretariat now has the responsibility to finalize the amendment and send it for approval through the Air Navigation Commission and the formal State letter approval process. While the State letter approval process is normally two years, the current projection is for the amendment to be effective in either 2022 or 2023, with the extended timeline to account for difficulties in processing this large package during this pandemic situation.

This effective date for the SARPs amendment will line up well with Minimum Operational Performance Specification (MOPS) work being completed by a joint RTCA and EUROCAE working group. In late October, the working group reassessed the work remaining to develop the MOPS. While work continues during the pandemic, the pace has slowed with participants either working from home or on furlough for periods of time. RTCA and EUROCAE now project completion of the first DFMC SBAS MOPS in March 2022.

- Joseph Dennis, FAA AJM-32/NAVTAC

GPS Constellation update

November 5, 2020

Lift off of GPS III SV04

The U.S. Space Force, Space and Missile Systems Center (SMC) along with their mission partners successfully launched the fourth Global Positioning System (GPS) III satellite on November 5 from Space Launch Complex 40 at Cape Canaveral Air Force Station, Florida. A Falcon 9 launch vehicle carried the satellite into orbit.

December 1, 2020

Operational Acceptance

December 1st marked a significant milestone for the GPS III SV04 when it received Operational Acceptance approval. This is the fourth GPS III satellite delivered into the operational constellation in the past 12 months and the second in the past 3 months.

EGNOS Success Stories

Finnair's A350 transcontinental roundtrip using SBAS LPV (WAAS & EGNOS) at both origin and destination airports

Reprint from EGNOS BULLETIN Issue 34, Autumn'20 Edition

Landing at HEL airport

Credits: Finnair

Finnair's strategic vision of the future includes fundamental fleet management decisions that have borne fruit years later. As a launch customer of the Airbus A350 XWB, Finnair received its first A350-900 in October 2015. Five years later, Captain Marko Valtonen, Finnair's Fleet Chief Pilot for the A330/350, has performed the first known transcontinental roundtrip between Europe and the USA using SBAS LPV approaches at both origin and destination airports with the A350 (tail OH-LWI).

This singular flight used the latest SBAS technology to approach both airports using the United States SBAS (WAAS) at John F. Kennedy International Airport (JFK) in New York and the European SBAS (EGNOS) at Vantaa Airport (HEL) in Helsinki.

This journey started many years before when Finnair not only opted for the Airbus A350's clean-sheet latest generation design but also for its revolutionary SBAS-LPV capability: the so-called "SLS function" in Airbus aircraft. A customer option that allowed following GNSS-based approaches down to LPV minima using satellite-based augmentation with no need for ground navaids support at the airports.

Moreover, they also confirmed the ADS-B out option, which is now an almost-basic requirement to comply with EASA's implementing rule and FAA one. Both decisions made Finnair's A350 future-proof from the manufacturing line.

Operational approval

Apart from airworthiness, the flight operation elements that allowed Finnair to perform those RNP APCH down to LPV minima comprised two main activities: the training of pilots and the modification of the operational manual described generically in the PBN Manual (ICAO Doc 9613, Vol I, 3.4.3 and

> "Establishing approval procedures that are efficient and minimise overhead for both operators and regulators are important considerations."

attachment C), and translated to FAA and EASA regulations (See guidance material). Quoting ICAO: "Establishing approval procedures that are efficient and minimise overhead for both operators and regulators are important considerations." In Europe, EASA updated its AirOPS in 2016 to ease the process and remove all non-complex PBN from Part-SPA, meaning RNP APCH LPV no longer needs a "specific approval."

Finnair and Liikenteen Turvallisuusvirasto, its National Supervisory Authority –NSA-, were involved in the process. The training of pilots included the modification of the Type Rating Syllabus, CTR & CCQ (Common Type Rating Course & Cross-Crew-Qualification), and practical training in Finnair's Flight Simulation Training Devices. Finnair's A350 Operations Manual required checks from all staff before its submittal to the NSA. Eventually, Finnair received approval for both the training and the Flight Crew Operating Manual/ Aircraft Operations Manual modifications in the second quarter of 2020.

When asked, Captain Valtonen recalls that the process was worthwhile but required effort and resources, and he believes it will be much easier to implement LPV capability in future Finnair planes. Each stakeholder, Finnair, and its NSA were intertwined and had their learning curve. With its own EU-based NSA operational approval, Finnair then started the process directly with the FAA, which eventually recognised and approved Finnair's performance of LPV operations in US airspace as well. Captain Valtonen stated their experience with the FAA process was smooth and quick.

> "This (SBAS) service would be especially helpful for airlines that, under poor weather conditions, wished to land in certain airports that could not afford ground navaids."

Benefits of interoperability

As there are more than 700 EGNOS-based procedures publications (AIRAC #2010) in Europe, 20 in Finland (12 being APV-I and 8 additional SBAS-based APV-Baro), Finnair now counts with many more options accessing many airports in poor weather conditions, and, when conventional ground navaids are not available, they fail or are out of service due to maintenance or substitution.

Crossing the Atlantic has increased Finnair accessibility to North American airports, accomplished thanks to the A350's long range ability, as well as to 581 LPVs procedures in Canada and 4,064 LPVs in the USA, both served by WAAS. All of this is possible due to the interoperability between different SBAS services, a core design feature developed by international standards, and (E) TSO-145/146 equipment design and certification that ensure users will be able to operate seamlessly in areas worldwide that are covered by an SBAS. Finnair's particular case is an example of such interoperability between WAAS and EGNOS.

Pilot's corner

We asked Captain Valtonen for his opinion on the differences between WAAS or EGNOS-based procedures and flight operations from a pilot's perspective. He responded there are no differences at all

Landing at JFK

Credits: Finnair

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 in terms of SBAS services providers, nor in terms of the actual approach followed. From pre-departure flight planning, flight management, and display conception and symbology "it is essentially the same as you have always done before." He also added that the Airbus A350's cockpit design and advanced avionics made it even easier and transparent for the pilot. On September 12, 2020, while parked at the gate in Helsinki airport, Finnair's flight crew AY5 HEL-JFK set the flight plan to New York and chose the RNP APCH at JFK down to LPV minima on RWY04R. During the flight, they received confirmation on RWY04R according to SOP and proceeded as planned. The approach and landing were uneventful and were carried out under optimal visual conditions and without much traffic: a "joy" [sic].

On September 13, after a 24-hour layover at N.Y., and using the same plane, they performed a pre-planning for cargo flight AY6 JFK-HEL choosing the RNP Approach down to LPV minima for RWY15 at HEL. Landing took place on September 14, after receiving confirmation for RWY15 and completing the roundtrip.

Credits: Finnair

A more interesting feedback

When asked about his insight on the A350 LPVs roundtrip and the trip as a whole, Marko said "it is very easy to select LPV approaches at both ends, as there is no need to mess with low level details such as WAAS or EGNOS selection. Just enter your destination and the type of approach, and all the information is there. Confirm the SBAS channel and other info you need and go." [sic]

Marko encourages all pilots to get acquainted with, try out, and use RNP SBAS LPV approaches because even though it is a new feature that pilots have to face: "you essentially just do the same you would do with ILS or other approaches." [sic]. Marko also said that when you are flying conventional or with PBN-based navigation, "you always have to know what you are doing." [sic].

In terms of the future, which may bring SBAS LPV capability to relevant planes including the Airbus A320/A330 and Boeing B737MAX/B777X families, Captain Valtonen shared the thought that SBAS LPV "is now a reality, for sure a part of the future of air navigation"[sic]. He also highlighted this service would be especially helpful for airlines that, under poor weather conditions, wished to land in certain airports that could not afford ground navaids.

Talking with Captain Valtonen about Finnair's success story with the Airbus A350, its SLS and ADS-B out capabilities, and its transcontinental roundtrip between Europe and USA using EGNOS and WAAS for SBAS LPV approaches, brings to mind the tagline of one of the most influential advertisements ever: "Isn't it nice when things just work?"[sic].

SBAS Progress in Africa

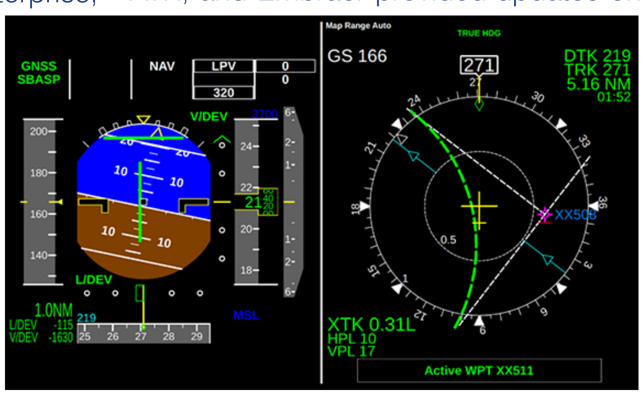
Recent events demonstrate the continued progress of deploying a Satellite-Based Augmentation System (SBAS) in Africa. The Agency for Air Navigation Safety in Africa and Madagascar (ASECNA), in coordination with Nigerian Communications Ltd (NIGCOMSAT) and Thales Alenia Space, conducted five SBAS demonstration flights at Lome International Airport in Togo on January 27, 2021. ASECNA used their ATR 42-300 with demonstration capability. The SBAS demonstration flight used the pre-operational service from the ASECNA SBAS that commenced test-signal broadcast in September 2020. ASECNA currently plans to certify a safety-of-life SBAS service by 2024.

> “Airlines indicated a readiness to equip with SBAS equipment and welcome the provisioning of SBAS.”

Flight crew for demonstration flights of ASECNA ATR 42-300

On January 28 and 29, ASECNA hosted an SBAS in Africa outreach event. The webinar-based event brought together over 440 participants from all over the world and included participation from multiple stakeholders in the SBAS enterprise, including SBAS providers, Air Navigation Service Providers (ANSPs), airline operators, and aircraft and avionics manufacturers. Three airlines, ASKY, Air France, and Tamara Niger Aviation, briefed on their aircraft operations, plans, and the perceived benefits from SBAS-based operations in Africa. They indicated a readiness to equip with SBAS equipment and welcome the provisioning of SBAS. They expressed concern with the availability of equipage for some aircraft models and the ability to use all potential SBAS signals.

Briefings from aircraft manufacturers and equipment manufacturers provided more insight into the ability to equip various aircraft types with SBAS equipment. Many manufacturers highlighted the need to address specific aircraft since there are nuances in the SBAS equipage. There are differences in different models of SBAS receiver and flight management systems. Some implementations only support a basic SBAS positioning while other options also support the precision approach capability. AIRBUS, Boeing, ATR, and Embraer provided updates on



Attitude indicator display (ATT) and Navigational display (NAV) for the ATR 42-300

ASECNA ATR 42-300

SBAS capability for their products. Easterline CMC and Collins provided receiver manufacturers' viewpoints, including providing information about current and future retrofit opportunities under Supplemental Type Certificate approval.

The event included briefings from SBAS providers and ANSPs. Greg Thompson (United Stated Federal Aviation Administration - FAA) presented an SBAS Global Status brief on behalf of the SBAS Interoperability Working Group. Benoit Roturier (French Civil Aviation Agency – DSNA) reviewed French efforts to implement Performance Based Navigation (PBN) with an emphasis on the use of SBAS to provide PBN capability. Pieter de Smet provided European Commission plans for the extension of EGNOS capability to provide SBAS service in Northern Africa. He also highlighted the need to conclude an international agreement with the European Union to use EGNOS for safety-of-life operations. Hicham Bennani (Arab Civil Aviation Organization – ACAO (see acao.org.ma/en)) reviewed the ACAO strategy and plans to support member-states adoption of GNSS in accordance with International Civil Aviation Organization resolutions. The strategy supports the use of EGNOS in the near term with an eventual transition to an African SBAS system. Louis Bakienon provided an update on the 'A-SBAS (SBAS for Africa and Indian Ocean) activities, including showing a video clip highlighting the flight demonstrations the previous day.

- Joseph Dennis, FAA AJM-32/NAVTAC

Click to see video of ASECNA SBAS Flight Demonstrations

ASECNA, NIGCOMSAT and Thales Alenia Space to accelerate SBAS for aviation in Africa

Reprint from African Aerospace News Service, published February 1, 2021

The Agency for Air Navigation Safety in Africa and Madagascar, ASECNA, the Nigerian Communications Satellite Ltd, NIGCOMSAT and Thales Alenia Space - a joint venture between Thales (67 %) and Leonardo (33 %) - have announced the completion of five flight demos at Lomé International Airport, set to accelerate SBAS (Satellite-Based Augmentation System) development for aviation in Africa.

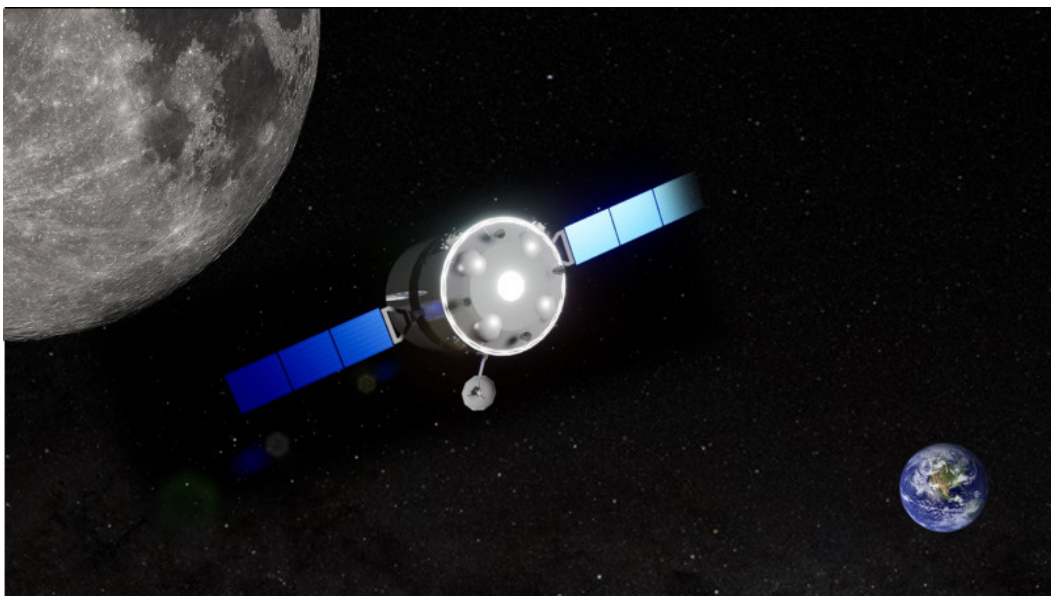


Image courtesy Thales Alenia Space

Following the broadcast of a SBAS signal over Africa & Indian Ocean (AFI) region since September 2020, providing the first SBAS open service in this part of the world via NIGCOMSAT-1R Satellite, the three partners have successfully conducted on 27 January 2021 a series of five flight demos at Lomé International Airport.

The goal was to show in real configuration the efficiency of the technology developed in the frame of the early open service as part of the ‘SBAS for Africa & Indian Ocean’ programme which pursues the autonomous provision over the continent of SBAS services, to augment the performances of the satellite navigation constellations GPS and Galileo.

These tests were carried out by means of the ASECNA calibration aircraft (ATR42-300), which has been equipped for the occasion by Pildo Labs with specific sensors and embarked VIPs and pilots in five rotations over Lome airport. The aim of the experiment was to demonstrate the ability of the system to allow landings on the two ends of the runway without deployment of local ground infrastructure and with a performance level close to the use of Instrument Landing Systems (ILS). It demonstrates the benefits of the future operational safety-of-life SBAS services, expected from 2024, in terms of flight safety, efficiency and of environmental protection.

> "We are proud to support the SBAS for Africa & Indian Ocean open service . . "

"We are proud to support the SBAS for Africa & Indian Ocean open service . . "

The outcomes of the demonstrations, as a crucial step forward the provision and use of satellite navigation services in the Africa and Indian Ocean region, were debriefed on 28 and 29 January during an international outreach event on SBAS in aviation in Africa, gathering airlines, aircraft manufacturers and other aviation stakeholders from all over the world.

"We are proud to support the SBAS for Africa & Indian Ocean open service and to have contributed to the success of these inflight demos using our geostationary communication satellite NIGCOMSAT-1R navigation payload", declared Dr. Abimbola Alale, MD/CEO of NIGCOMSAT Ltd. "The SBAS demonstration flight feat is in line with policy direction of the Honorable Minister of Communications and Digital Economy of Federal Republic of Nigeria; Dr. Isa Ali Ibrahim (Pantami) FNCS, FBCS, FIIM for value addition and propensity not only in the Telecommunications Sector but Aviation, Maritime, Rail Transport, Precision Agriculture, Survey, Oil & Gas and Mass-Market Applications for sustainable development beyond Nigerian shores".

"Our longstanding expertise acquired with the development of EGNOS SBAS in Europe and KASS SBAS in Korea combined with our new leading-edge satellite positioning technologies makes Thales Alenia Space the ideal partner to best support countries to implement their own SBAS efficiently. We hope these series of demos will help to accelerate SBAS adoption in aviation in Africa", declared Benoit Broudy, Vice President Navigation business at Thales Alenia Space.

"I'm proud to have demonstrated the utility and efficiency of the SBAS services in the continent. This event will bolster the deployment of the 'SBAS for Africa & Indian Ocean' system, the navigation solution for Africa by Africa, which will enhance air navigation safety and efficiency for the benefit of the whole continent, in line with my vision for the unification of the African Sky", stated Mohamed Moussa, Director General of ASECNA.

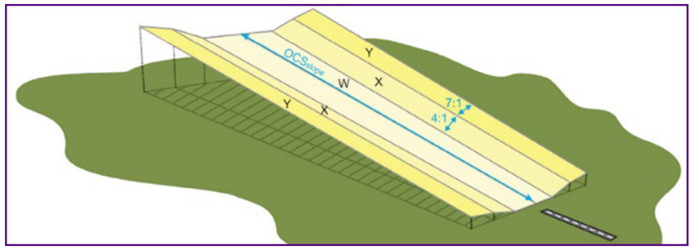
ASECNA ATR 42-300

Did You Know . . .

Why not LPV every time?

We received an inquiry about LPV versus LP and since and LPV gives useful vertical guidance, why not implement LPVs at every location? What is up with the LPs? I reached out to Alec Seybold of Flight Tech Engineering – an FAA authorized Navigation Service Provider to help explain why in some cases it's just not possible. Flight Tech specializes in approach procedures for a wide range of operators in challenging locations throughout the U.S.

***SNN** – Alec, you have experience building and implementing WAAS approach procedures/ lines of minima. What is the main reason for not putting in an LPV?*



An LPV line of minima provides numerous benefits over traditional procedure design methods. The 'W' shaped Obstacle Clearance Surface (OCS), which is similar to an ILS provides a narrow obstacle detection area which usually delivers improved procedure minima. Furthermore, the LPV portion of the procedure is based on geometric beam placement that is not affected by temperature fluctuations normally experienced when using LNAV/VNAV and RNP-AR minima types. However, these benefits require stringent conditions to be met on the ground and in the air. Here are a few of the reasons why LPV sometimes can't be implemented at a location:

Lack of Vertically Guided Approach Survey.
In order to provide a vertically guided LPV procedure to the runway, we have to know what obstacles are surrounding the airport in addition to precise runway coordinates.

Penetrations to the Obstacle Clearance Surface (OCS) or Vertically Guided Surface (VGS).
Design Requirements state that the LPV Glidepath must not exceed the limits for each approach speed category (ex. 4.20° for CAT B, 3.77° for CAT C, 3.50° for CAT D). If obstacles can't be mitigated through various design techniques, this would limit the implementation of the LPV minima.

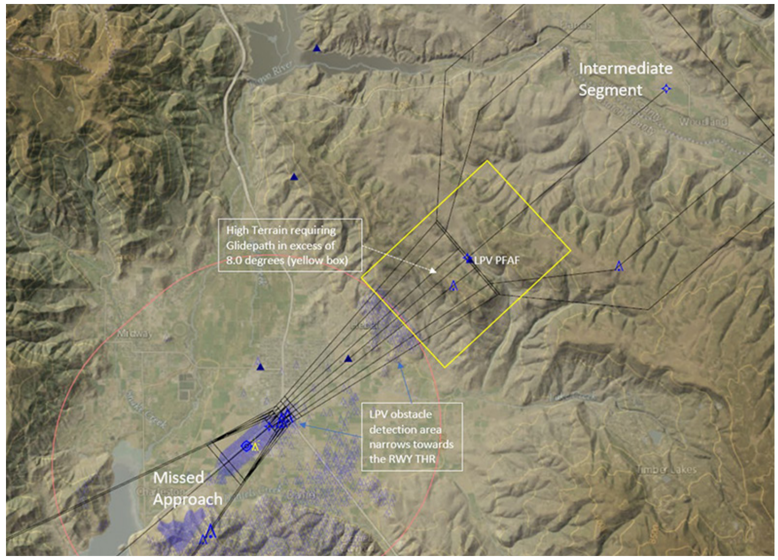
Inability to connect the flat surface intermediate segment to the sloping LPV final segment.
Prior to a Final Approach Fix (FAF), TERPS/RNAV rules allow for aircraft to fly a flat profile. This is to account for traditional step-downs and level-offs along the route to the next fix/waypoint. When an airport is surrounded by high terrain or man-made obstacles, it sometimes becomes impossible to connect the intermediate segment to the LPV final due to the higher terrain and lateral clearance requirements of traditional intermediate segments.

LPV final approach course exceeds 3 degrees left or right of the runway extended centerline.
Current rules only allow the LPV final segment to be offset 3 degrees which can prevent implementation when nearby terrain/obstacles require additional offset.

***SNN** – in your experience, is it difficult to work around, or work with most obstructions once they are identified?*
I like to equate this process as somewhat similar to completing a complex puzzle board. You have to find the right puzzle piece that works for the various surrounding components. Luckily there are

numerous tools in the shed that we can use to work around certain terrain and obstacle conditions.

These mitigations could include raising the Glidepath Angle (GPA) or Threshold Crossing Height (TCH), shortening the LPV final segment and/or building a curved intermediate path utilizing Track-to-Fix or Radius-to-Fix (RF) segments. In some scenarios the LPV final segment can be extended to take advantage of the tighter obstacle clearance surfaces that would have been an issue when using flat segment types. However, once the obstacle conditions start exceeding the design limits, we have to start considering other procedure methods (LP, circling approaches, RNP-AR, etc).



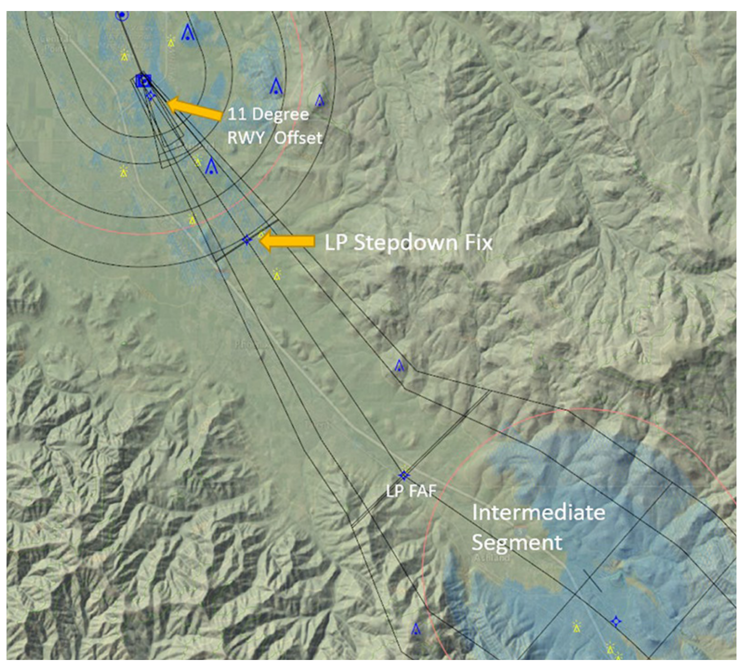
LPV Design Surfaces and impacts of terrain to the procedure surfaces.

***SNN** – have you had much experience with starting out thinking you could only develop an LP and found a way to implement the LPV?*

Usually, it's the other way around due to FAA requirements that prevent the publication of LP minima when an LPV is possible. We always like to start with LPV and then work our way down to less restrictive minima (from a design perspective) to ensure we're not leaving any stone unturned. This is especially important because some avionics providers have restrictions that prevent the use of an LP procedures in certain aircraft platforms. This tends to occur mostly in certain types of business jet and airline platforms. However, if the design is primarily for General Aviation customers than an LP can still provide a significant improvement in access and weather minima.

***SNN** – in the final evaluation, if all you can implement is an LP what are the advantages the LP brings?*

A Localizer Performance (LP) line of minima gets its name from the similarities it shares with conventional localizer-only procedures. Instead of relying on a ground based navigational aid installation, it uses WAAS Satellite based guidance for the lateral portion of the final segment. LP approaches have much more design flexibility due to the lack of vertical glidepath (not be confused with advisory guidance some GPS navigators provide). For example, LP approaches allow for higher degrees of offset from the runway end and allow for the use of stepdown fixes in the final segment which can be useful for stepping over high terrain.

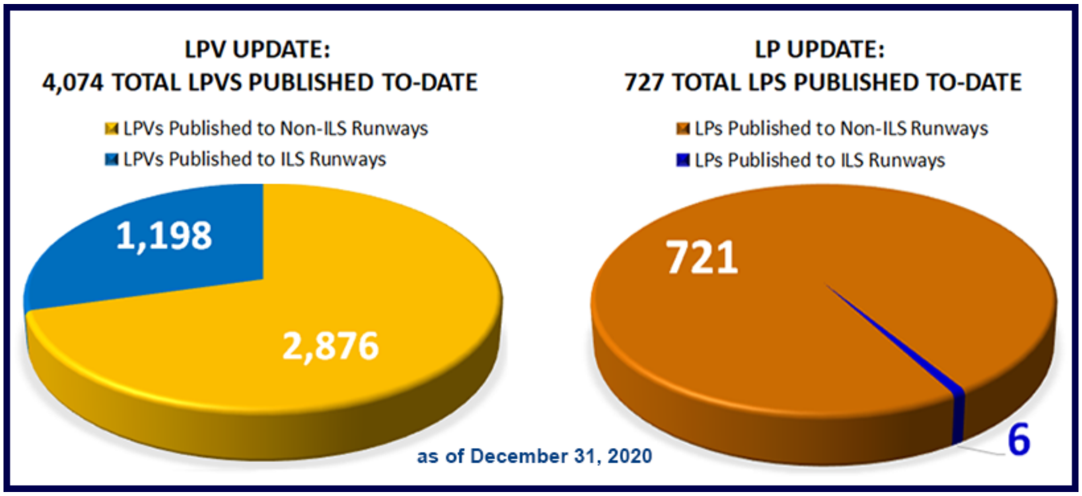


Example of an LP approach to increase access to a runway requiring an offset alignment due to terrain.

Satellite Navigation Approach Procedures

WAAS

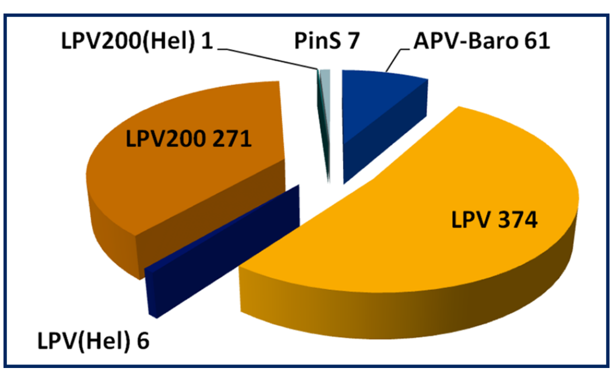
The charts below reflect the continuing growth of satellite-based approach procedures. For more detailed information about satellite-based instrument approach procedures, please visit our GPS/WAAS Approach Procedures web page.
http://www.faa.gov/about/office_org/ headquarters_offices/ato/service_units/techops/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



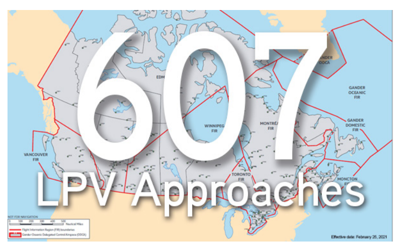
EGNOS

The number of LPVs in Europe is also growing. The chart below shows LPV procedures in Europe as of October 8, 2020, as included in the EGNOS Bulletin Autumn'20 (Source: EGNOS Bulletin, Issue 34, Autumn'20 Edition)

Follow this link to the most recent EGNOS Bulletin Issue 34, Autumn'20 Edition:
http://egnos-user-support.essp-sas.eu/new_egnos_ ops/content/quarterly-bulletin



Canada



Numbers provided by NAV CANADA
as of February 25, 2021
(click for map)