Case Studies on Transport Policy 3 (2015) 238–242

Contents lists available at ScienceDirect

Case Studies on Transport Policy

journal homepage: www.elsevier.com/locate/cstp

Is access to general aviation airports with precision approach and no instrument landing systems a club good? A study of six airports☆

Tony Diana *

Federal Aviation Administration, Office of NextGen and Outreach, 800 Independence Avenue SW, Washington, DC 20591, United States

ARTICLE INFO

Article history:
Received 30 June 2013
Accepted 26 April 2015
Available online 8 May 2015

Keywords:
NextGen
Satellite navigation
Access to airports
Club goods

ABSTRACT

Access to general aviation (GA) airports can generally be viewed as non-excludable and non-rivalrous. However, access to GA airports using lateral vertical guidance (LPV/LP) and no instrument landing systems (ILS) will exclude aircraft operators not equipped to take advantage of satellite navigation, thus transforming access into a club good. Extending access to GA airports through satellite navigation is an important aviation issue at a time when air traffic service providers are transitioning from a radar- to a satellite-based air traffic managed system. The provision of access to GA airports with precision approach and no ILS as a club good may require a change in the level of service that emphasizes service priority to the aircraft capable of taking advantage of satellite navigation as opposed to a first-come, first-served queue management.

Published by Elsevier Ltd on behalf of World Conference on Transport Research Society.

1. Introduction

This article focuses on general aviation (GA) airports that enable precision approaches using Localizer Performance with Vertical Guidance (LPV) and without Vertical Guidance (LP) when there is no Instrument Landing System (ILS). For convenience, we will refer to this type of airport as GA airport with precision approach. As of April 2013, there were 3100 new Wide Area Augmentation System (WAAS) LPV and 414 LP approach procedures, according to the Federal Aviation Administration (FAA).[1]

Before outlining the attributes of the LPV and LP approaches, it is important to define ‘general aviation’ and ‘general aviation airports’. General aviation flights are usually operated under 14 CFR (Code of Federal Regulations) 91 Subpart K (on-demand fractional ownership flights) and Part 135 (commuter and air taxi operations[2]). In this study, a GA airport refers to a facility where itinerant and local GA aircraft represent at least 50% of the total operations (takeoffs and landings) based on FAA’s OPSNET data.

GA airports play a significant role in the National Airspace System (NAS) and in the U.S. economic activities. They, not only provide critical access to smaller communities, but also support commercial activities necessary for manufacturing and distribution, emergency preparedness and response, as well as training for pilots, among many other benefits. According to the FAA’s Economic Impact of Civil Aviation in the U.S. Economy (2011:22), “general aviation operations contributed $38.8 billion to total output. Factoring in manufacturing and visitor expenditures, GA accounted for a significant contribution of $76.5 billion.”

Lately, there has been much discussion on how to encourage operators to acquire equipment that enables precision approaches. However, less attention has been paid to the characteristics of access to GA airports with precision approach. This is of importance to the aviation community since GA airports with precision approach amounted to 159 facilities in fiscal year 2012 (October 2011 to September 2012), up 15% from the previous fiscal year.[3] Some of these airports provide service to remote local communities that would not otherwise be connected to larger metropolitan areas.

This article will refer to six cases (three airports with LPV and three with LP approach capabilities only) in order to evaluate the features of the aircraft operators and any difference of access among the sampled airports. Access to airports may be considered

☆ *Note*: This paper does not reflect the official opinion of the Federal Aviation Administration.

* Tel.: +1 410 564 0286.
E-mail address: tonydiana1@verizon.net

[1] The information is available at the following FAA site: http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/.

[2] Part 135 covers operations by any aircraft with a payload of less than 6000 lbs. and a seating capacity of less than 20 seats.

[3] Information retrieved from the FAA’s NextGen Performance Snapshots website at http://www.faa.gov/nextgen/snapshots/nas/.

http://dx.doi.org/10.1016/j.cstp.2015.04.007
2213-624X/Published by Elsevier Ltd on behalf of World Conference on Transport Research Society.

as a public good (it is not rivalrous and non-excludable). However, while access to GA airports with precision approach may be non-rivalrous, it may be excluded from aircraft that do not have equipment to utilize satellite navigation in the absence of ILS. This may have some implications on aircraft operators' decision to purchase satellite navigation systems, the utilization of the GA airports with precision approach and, as a whole, the best possible provision of such airports in the National Airspace System (NAS).

To understand how access to GA airports with precision approach may be excludable, it is important to specify the type of equipment required for satellite navigation and the benefits it provides to aircraft operators as opposed to ILS.

2. The features and benefits of LPV and LP approaches

The FAA Advisor Circular (AC) 90–107 provides directives to pilots on the type of equipment and procedure required to fly LPV/LP precision approaches. LPV/LP is designed to improve access to GA airports in reduced visibility with approach aligned to the runway (the operational equivalent to Category 1 for Instrument Landing Systems).[4] LPV is an area navigation (RNAV) procedure[5] requiring Wide Area Augmentation System (WAAS). WAAS enhances the strength of the Global Positioning System (GPS) signals in order to improve their accuracy and integrity for LPV/LP precision approaches. LP is designed to use the high precision of LPV for lateral guidance and barometric altimeter for vertical positioning. WAAS navigation relies on three main components: (1) wide-area reference stations and wide-area master stations on the ground, (2) geosynchronous communication satellites in space, and (3) aircraft's GPS and WAAS receivers. LPV/LP operations provide pilots with several benefits:

- It minimizes their need to use step-down (referred to as "dive and drive") approaches, hence improving safety and passenger comfort.
- The glide path does not rely on ground and barometric equipment. With WAAS LPV, pilots do not have to deal with incorrect altimeter settings and lack of local altimeter source.
- It provides the lowest minima with GPS equipment with a decision height of 200–250 feet above touchdown and minimum visibility of half a mile.
- GPS is the primary means of navigation which minimizes pilots' reliance on transponder-based distance measuring equipment (DME) and Very High Frequency (VHF) omnidirectional radio range navigation system (VOR).
- Pilots do not have to continuously check the reliability of their GPS system along the flight and terminal area (GPS integrity monitoring to meet navigation requirements).
- Pilots have more flexibility to fly more direct routes and utilize GPS approaches to selected or alternate airports in case of bad weather conditions with ILS Category 1 precision.
- Pilots can land at small airports at night when they have no altimeter setting.

For an aircraft to fly LPV/LP procedures, it must be equipped with a dual WAAS-capable GPS that must be certified under TSO 145 and 146 as standalone receivers. A specific antenna is also required and existing equipment such autopilot has to be upgraded. From an infrastructure standpoint, the airport or the Federal Aviation Administration (FAA) does not need to install expensive equipment. The implementation of the LPV/LP approaches requires the FAA to design and implement procedures. According to AOPA, the cost of publishing a runway's WAAS procedure was about $50,000 in 2006.[6]

An ILS system requires markings, runway lights, and terrain clearance on the glide path. While providing the advantages of ILS Category 1, WAAS does not require expensive ground infrastructures. A WAAS approach system costs about $80,000 whereas the cost of an ILS can exceed $1.5 million per runway end (at the time of this writing). It is also important to stress that an ILS only covers the runway end where radio transmitters have been installed. AOPA also maintains that "while the annual ILS maintenance cost can be as high as $85,000, the cost to maintain a WAAS approach is less than $3000 every two years."[7] Local communities may find it hard to get federal government's Airport Improvement Program funds if they cannot justify traffic volume. Finally, the efficiency of an ILS system depends on terrain, obstructions and frequency pollution that affect the ILS signal.

In the next section, we will focus on the attributes of access to GA airports with precision approach in light of the theory of public and club goods.

3. Access to GA airports with LPV and LP access and no ILS as a club good

While Samuelson (1954) was instrumental in developing the theory of public goods, both Buchanan (1965) with club goods and Hardin (1968) with common resources goods felt that there was a spectrum of goods between purely private and purely public goods. Over the last fifty years, much has been written on the subject of club goods and interested readers are referred to Berglas (1976), Cornes and Sandler (1986), Sandler and Tschirhart (1997) and McNutt (1999, 2002) for a review of the theory of club goods. In principle, when a public good such as access to GA airports is excludable, it then becomes a club good. Although GA operators may have a different mission (i.e., commercial versus leisure flight), they will share the same utility for access to GA airports with precision approach.

3.1. A utility model for access to GA airports with LPV/LP approaches and no ILS

As mentioned earlier, not all the aircraft have the capabilities of utilizing WAAS to fly precision approaches to GA airports without ILS. Although no specific pilot certification is required to fly an LPV/LP approach, aircraft must have certified equipment that meets the requirements of TSO 145 and 146 as well as upgraded avionics to carry out the procedure. In specify the pilots' utility for access to GA airports with precision approach, we assume that there is no difference among the aircraft operators, whether the flights are commercial or not.

Given E_i as the required WAAS-compliant equipment (a private good) necessary for an aircraft to fly LPV/LP procedures, L as access to a GA airport with LPV/LP procedures and no ILS (club good) and Ops, the number of operations (takeoffs and landings), the utility function for i users can be characterized as follows:

$$U_i = U_i(E_i, L, \text{Ops}) \quad (1)$$

[4] See Appendix A of the FAA's 2012 NextGen Implementation Plan available at http://www.faa.gov/nextgen/implementation/media/NextGen_Implementation_Plan_2012.pdf.

[5] Area Navigation (RNAV) is one element of Performance-Based Navigation (PBN) with Required Navigation Performance (RNP). The key difference between the two types of PBN is the requirement of on-board performance monitoring and alerting for RNP.

[6] Aircraft Owners and Pilots Association, AOPA welcomes improved WAAS minimums. March 7, 2006. http://www.aopa.org/whatsnew/newsitems/2006/060307waas.html.

[7] Aircraft Owners and Pilots Association, Air Traffic Services Brief: Wide Area Augmentation System (WAAS) retrieved at http://www.aopa.org/whatsnew/air_traffic/waas.html.