Got GPS+?

A Qantas 737-800 lands at Queenstown, New Zealand, using Required Navigation Performance operations, which represent a new, comprehensive instrument-navigation plan. Adding the RNP-complementary Ground-Based Augmentation System landing system would provide precision approach capability and unprecedented improvements to safety and efficiency.

PHOTO COURTESY OF ALEX PASSERINI/QANTAS

Boeing unveiling a next-generation satellite-based airport landing system

By Walter Polt

Boeing has a bold vision: replace the aging Instrument Landing System (ILS) with one that uses the Global Positioning System.

After a decade-long program with the U.S. Federal Aviation Administration (FAA) and RTCA Inc. to develop internationally harmonized standards and address any system safety issues, Boeing and the aviation industry now have a new capability—known by the acronym GLS. This technology, which is one part of Boeing's overall air traffic management strategy, can enhance safety, reduce airplane noise, fuel consumption and emissions, and increase airport arrival and departure capacity, especially in bad weather. GLS is in use with the Next-Generation 737 and is set to be a basic feature on the upcoming 787 Dreamliner and 747-8; it's also an option on the Airbus A380.

ILS is a WWII-era flashlight-like radio beacon. Its signals can be affected by nearby objects such as terrain, vehicles and airplanes, and keeping ILS protected from these disturbances is cumbersome. ILS also is expensive to purchase and maintain. Most notably, the ILS beam offers little of the flexibility needed for future air traffic management operations. GLS, on the other hand, provides pilots variable approach paths and adjustable glide slopes and runway touchdown points. GLS procedures readily integrate with Required Navigation Performance (RNP) instrument procedures in the process of being adopted. Together, these capabilities are some of the tools available for high-capacity, high-efficiency operations.

Unlike current technology, which relies solely on information from ground stations, GLS integrates data from the GPS satellite system, ground stations and a multimode receiver on the airplane to provide pinpoint accuracy of the airplane's position relative to the runway and surrounding terrain.

Boeing's GLS system is digital. It augments GPS signals, making limited-visibility landings precise to within 6 feet (about 2 meters), exceeding ILS accuracy. To support such accuracy requires two components. One is a Ground-Based Augmentation System (GBAS): a land-based computer-and-antenna system developed by Honeywell, among others, that rebroadcasts satellite-generated GPS navigation data corrected for local signal conditions. The other is an onboard multimode receiver capable of correctly receiving and processing the signals from the satellites as well as from the GBAS ground station. Together these elements support an airplane-level function called a GBAS landing system—which is where the acronym GLS comes from. It has all the functionality of the previous instrument landing system and much more.

"The GBAS essentially tells the incoming airplane, 'Here's where you really are,'" said Steve Duenkel, program manager for Performance Based Navigation in the Navigation Services business unit within Commercial Aviation Services. It also broadcasts precision digital approaches that guide the autopilot to a landing.

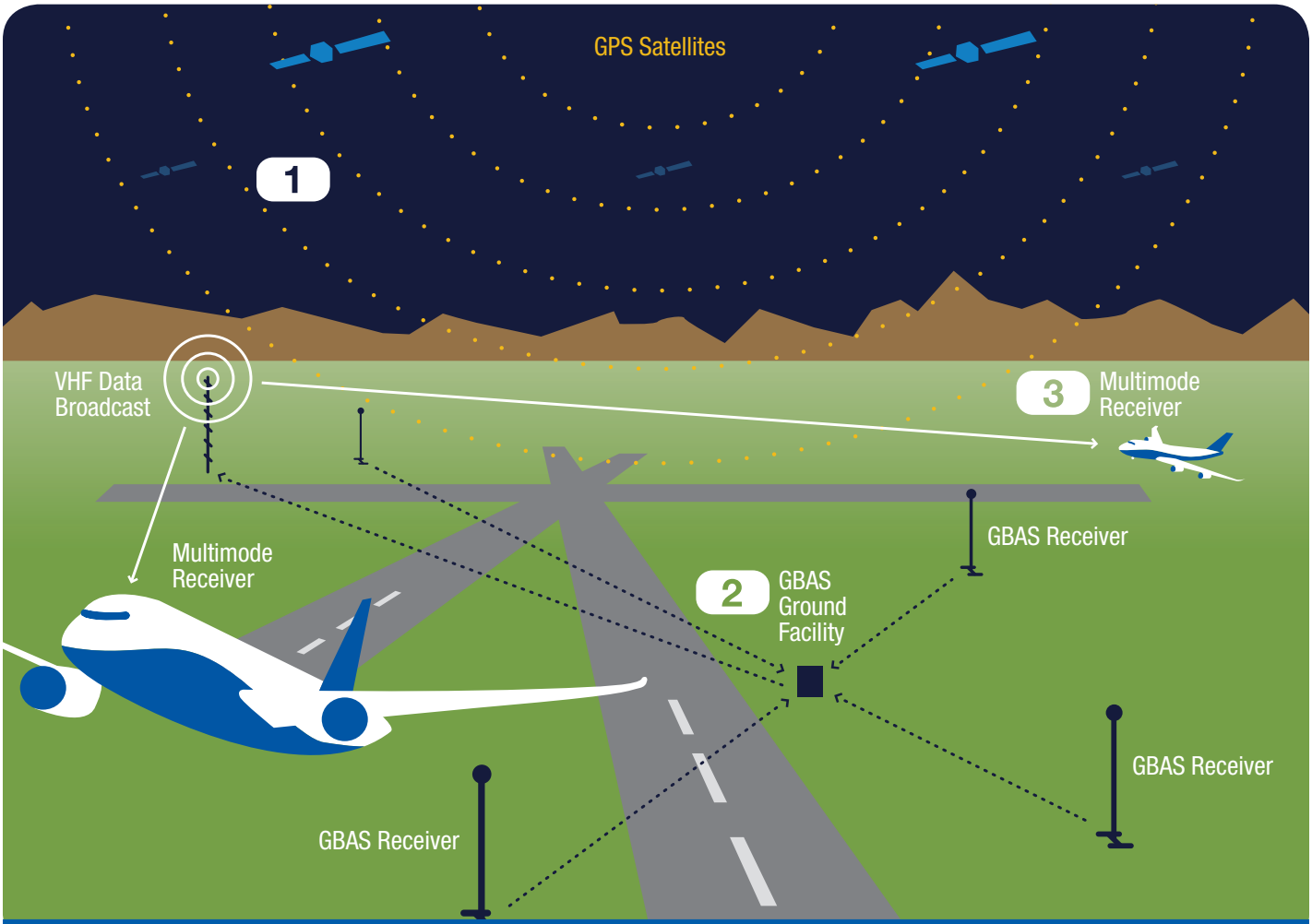
GLS offers many benefits to the whole industry, including Boeing's customers. For example, a single GBAS station can serve multiple runways—perhaps even at multiple nearby airports. That can eliminate the intricate installation, calibration and maintenance of million-dollar ILS devices at both ends of every runway. Simply put, GLS is a much more flexible way to get ILS-type approaches without the expense of the ILS installation.

In addition, any airport anywhere can install GBAS. That gives fast-growing aviation sectors such as those in Australia, the Middle East and the Asia-Pacific region the opportunity for more-affordable precision-guidance access to runways. In turn, this likely will give flights over expansive areas with few airports the availability of additional, closer alternate airports during flights, in case of contingencies such as medical emergencies. That may allow lighter fuel loads, which can help the environment by reducing fuel burn and emissions, while increasing passenger and freight revenues.

Another benefit: Airlines' pilot-training expenses are minimal, because Boeing carefully kept instrument displays and crew procedures essentially the same as those used for ILS operations. As pilots already rated in Boeing airplanes are familiar with ILS procedures, no simulator practice is needed to learn GLS.

OVERCOMING EARLY DISTRUST

Despite these potential benefits, the industry wasn't completely sold on this system.



Boeing's new landing system: (1) Signals from in-view Global Positioning System satellites reach multimode receivers (in airplanes) and Ground Based Augmentation System (GBAS) receivers (on the ground). (2) The GBAS ground facility detects any errors in GPS signals and sends corrections (and digital approach information) to airplanes via VHF broadcast. (3) On board the airplane, the GBAS landing system uses the satellite signals and GBAS corrections to establish and track the airplane's true position—and gives the autopilot precision landing instructions. DAVID DANNER GRAPHIC

"Even with these incentives," said Tim Murphy, Technical Fellow in Electronic Systems and author of several GBAS-related patents, "in the early days the technology was distrusted and unappreciated."

The prevailing opinion internationally was that to achieve adequate performance for low-visibility landings known as Category IIIb

operations, GLS would require new signals in addition to GPS—from systems such as the coming European Galileo satellites.

Boeing has countered that opposition by tackling it from both the technical and operational fronts.

On the technical front, Duenkel said, "Murphy has worked closely with the FAA in recent years to promote GLS as a mature technology. For several years it has been ready for use in Category I operations." That's a category of landing conditions in which visibility is good at least to 200 feet (60 meters) height with a runway visual range of not less than 1,800 feet (550 meters). Boeing also showed that GLS exceeds Category I functioning using today's GPS only—and doesn't need to wait for the input of possible future systems such as Galileo.

The result? Growing international support. Murphy said the International Civil Aviation Organization is working on standards to allow a GPS-only, single-frequency system to support Category IIIb approach and landing operations—for conditions more adverse than Category I. He described that stance as "a major turnaround."

On the operational front, Duenkel said Boeing has teamed worldwide with airline customers, air-navigation service providers, governmental aviation authorities, avionics manufacturers and GBAS manufacturers for opportunities to introduce the technology with early-adopter airlines. "We've been getting airlines equipped to fly GLS operations in the real world" on revenue-generating flights, he said.

These airlines operate with onboard GLS equipment certified in 2005 by the FAA for all versions of the Next-Generation 737; and on the ground are Honeywell GBAS stations provisionally approved by the appropriate authorities. Work is under way through the FAA Local Area Augmentation System Program with Honeywell at Memphis, Tenn., to gain full approval for the ground stations' use in U.S. Category I operations.

Airlines making GLS history so far:

- Qantas Airways began operational trials in Sydney in 2006. Alex Passerini, Qantas technical pilot, Boeing 737, said Qantas has 14 737-800s doing 10 to 12 GLS approaches every day; is nearing its 1,000th approach; and has purchased retrofit kits to equip 24 more airplanes. GLS, he said, is "much more accurate, more stable, cheaper [than ILS]: Pilots like it. Everybody likes it."
- TUIfly introduced GLS "for reasons of cost and capabilities" and has been flying GLS in Bremen, Germany, since last September, said Gabriele Zaki of German air-navigation service provider DFS and the GBAS project manager for DFS.
- Continental Airlines in February received FAA approval for GLS operations on nine 737s at Guam, said Chris Baur, Continental's manager of Flight Technical Programs. This is a first in the U.S. national airspace system. Continental has requested provisions for GLS on all new 737s in anticipation of expanded use at other airports.

NEXT STOP, NEWARK?

A new project team that includes Continental Airlines, the FAA Local Area Augmentation System Program Office, The Port Authority of New York & New Jersey, Honeywell, and Boeing is seeking to implement GLS-GBAS operations at Newark Liberty International Airport later this year, said Duenkel, a team participant.

"This effort is intended to build on Continental's success at Guam" and the anticipated FAA approval of GBAS use in Category I operations, Duenkel said. The technology would help protect or maintain airport capacity at Newark when winds change or weather deteriorates, Duenkel added, plus serve as a potential operational environment to implement Category III capability in all its subcategories once it is available.

And GLS isn't just for commercial use. In a U.S. Department of Defense program called the Joint Precision Approach and Landing System, a variation of GLS is under consideration for both fixed-wing and rotorcraft approaches on ships and land. Boeing, along with Sierra Nevada Corporation and QinetiQ, is a member of the Honeywell team competing for the JPALS System Development and Demonstration Program. ■

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Tim Murphy (left) and Steve Duenkel sit in the flight deck of a Boeing jetliner—in which new landing-system equipment can be installed. JIM ANDERSON PHOTO