



## Ground Based Augmentation System (GBAS)

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The Ground Based Augmentation System is a satellite-based precision landing aid system for aircraft. It is significantly more flexible than the currently used Instrument Landing System (ILS) and can replace it in the future.

GBAS works by analyzing the relatively inaccurate signals received from GPS satellites and then sending correction messages to the aircraft. This enables the aircraft to calculate its own position with great precision. In addition, pre-defined approach paths can be sent. With both of these components, inbound traffic can use the GBAS station as an approach aid.

The network of GBAS ground stations around the world is still under development. In this first expansion phase, ground stations are being used in such a way that the avionics of a suitably equipped aircraft work as they do during an ILS approach. Thus, the ground stations broadcast flight paths similar to those with ILS.



Approach and landing using GBAS

The Institute of Flight Guidance operates its own GBAS station at Braunschweig-Wolfsburg airport. The ground station is used for flight trials to develop operational procedures based on GBAS. The Institute is analyzing the best way to avoid noise and optimize flight paths while taking advantage of the increased flexibility over ILS in providing nominal approach paths. Approach paths can be flexibly defined with GBAS based on transmitted coordinates. Work is currently under way around the world to further develop and certify this landing system for adverse visibility conditions (CAT II/III operations).

## Research areas

In December 2008, the GBAS ground station (DGRU 610) of the company THALES Air Systems was installed and became operational at Braunschweig-Wolfsburg airport. Since then, it has been used for numerous flight trials and evaluations.



Ground station at Braunschweig-Wolfsburg airport

The ground station is ready for certification, but it is being used for experiments in order to flexibly make changes in operations. The German Aerospace Centre (DLR) has full access to the parameters of the station and the data transmitted.

The station is under permanent development in cooperation with the manufacturer. New developments in May 2012 have rendered the ground station capable of transmitting terminal area paths (TAP). This allows curved reference approach paths to be developed in order to provide guidance for precision landings. As a result, inbound traffic can, for example, fly around noise-sensitive areas or obstacles.

The Institute of Flight Guidance regularly performs comprehensive approaches with the GBAS ground station using its own research aircraft and in cooperation with different GBAS users, such as the Technical University of Braunschweig and airberlin. The Institute focuses on developing operational procedures, noise avoidance and reducing fuel consumption.

## Technical background

The GBAS ground station comprises different components, one of which is the positioning component. This means three GPS reference receivers with antennas at accurately surveyed positions. Correction messages for the GPS satellites can be calculated based on the GPS data received and the exact position of the receivers. These correction messages are monitored by the integrity monitors that are directly integrated into the ground station.

Another component is the VHF data broadcast transmitter. This transmitter is connected to a three-bay turnstile antenna that transmits the correction messages and reference flight paths. Up to 49 approach paths can be transmitted depending on the station.

The station itself has a VHF receiver for checking the data that it transmits. In this way, the station can compare the transmitted and received data and check them for consistency.

The software of the system offers many ways to check, analyze and change the GBAS data. This allows all outputs from the sub-systems to be displayed and recorded. Moreover, the software can be used to change all parameters for test purposes and to integrate new reference approach paths.

A multi-mode receiver fitted in the aircraft receives the transmitted correction messages and the reference approach paths and uses this data to guide the aircraft.



Integrity monitors and equipment at the ground station

# Air Traffic Validation Center

Simulators, sensor systems and flight testing equipment together form the Air Traffic Validation Center of the DLR Institute of Flight Guidance. The entire center offers researchers the right tools for testing and evaluating new ideas, concepts and technologies for all areas of air traffic management. It allows each development step to be continuously reviewed, from the initial idea down to the testing of prototypes and their implementation under realistic conditions.

The Institute of Flight Guidance performs long-term engineering research preceding industrial developments in the field of flight control and air traffic management. Its main areas of research are operational procedures, technology development and human-centered automation. The goal is to ensure a safe, efficient, environmentally friendly and reliable air transport system.

## DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 20 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Bremerhaven, Dresden, Goettingen, Hamburg, Jena, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Oldenburg, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

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