

ECHO

GNSS Monitoring and Interference Detection Solution



ECHO is a solution for GNSS monitoring and RF interference detection, allowing the continuous observation and logging of GNSS signals. With 3 main components, the **Monitoring Station (MS)**, the **Monitoring Center (MC)** and the **User Application**, ECHO provides periodical GNSS performance reports and real-time alerting of GNSS degradations and interference events.

With algorithms based on international aviation standards and GNSS performance specifications, ECHO is the GNSS monitoring solution for supporting **Performance Based Navigation** operations at airports. The interference monitoring module is designed to alert the users when an interference event is detected, allowing them to take the necessary mitigation measures. A network of high-density low-cost monitoring stations can be deployed for increased airport safety.

KEY FEATURES

- ▶ Monitoring of all GNSS bands and constellations
- ▶ Jamming and spoofing detection and characterization
- ▶ Interference source direction finding
- ▶ Intuitive web based user interface aggregating data from the network
- ▶ Automated generation of alerts and reports
- ▶ Continuous 24/7 operation and remote access
- ▶ Compliance to ICAO SARPs and EUROCAE MOPS interference and GNSS monitoring requirements

System performance

- ▶ Monitoring of all GNSS signals:
 - GPS: L1C/A, L1PY, L2C, L2P, L5
 - GLONASS: L1CA, L2CA, L2P, L3 CDMA
 - Beidou: B1I, B1C, B2a, B2I, B3
 - Galileo: E1, E5a, E5b, E5 AltBoc
 - QZSS: L1C/A, L2C, L5
 - Navic: L5
 - SBAS: EGNOS, WAAS, GAGAN, MSAS, SDCM (L1, L5)
- ▶ User configurable update rate of GNSS measurements and interference detection parameters between 1 Hz - 10 Hz
- ▶ 5 independent, synchronized, receiving modules with 3 RF Front-Ends each
- ▶ 60 MHz bandwidth per signal band
- ▶ 16 bit baseband ADC resolution
- ▶ Less than 20 seconds warm start
- ▶ Less than 45 seconds cold start
- ▶ Internal logging capabilities
- ▶ Continuous data storage of GNSS measurements and signal snapshots for at least 30 days

Communication

- ▶ Gigabit Ethernet 1000BaseTX interface (8P8C)
- ▶ TCP/IP communication protocol
- ▶ Wide array of interfaces, including an Ethernet over USB for rapid configuration and data handling

Jamming and spoofing detection

- ▶ Advanced jamming and spoofing detection and characterization technology
- ▶ Detection of interference signals using configurable or predefined (ICAO) thresholds
- ▶ Source direction finding with single station direction finding accuracy of 10 degrees
- ▶ Maximum 5 seconds latency between interference detection and user notification

GNSS Signal-in-Space performance monitoring

- ▶ Automated reporting of ICAO recommended monitoring parameters
- ▶ 14 days periodical reports based on data collected by the stations
- ▶ Continuous updates in line with GNSS evolutions and ICAO recommendations

Environmental and physical characteristics

- ▶ Low-cost modular and compact design for easy installation and upgrades
- ▶ Antenna module with mounting and cables, designed for outdoor operation
- ▶ Compact hardware box for GNSS signal tracking and data preprocessing
- ▶ Optional IP 65 housing for outdoor installation
- ▶ Operating temperature: -40 to +65 degrees C
- ▶ Storage temperature: -40 to +85 degrees C

User interface

- ▶ Overview of the location and real-time status of the stations
- ▶ Real-time GNSS and interference status, indicating the presence of a degradation event and the bearing of the detected interference
- ▶ Detailed GNSS spectrum analysis, including spectrum views for multiple GNSS frequency bands
- ▶ Periodic report visualization with integrated date selection, including the ICAO recommended GNSS performance KPIs
- ▶ Alerting via the user application and email
- ▶ Coherent design, which can be customized with additional features according to the user needs

Operational characteristics

- ▶ Platform as a Service (PaaS) using OS-level virtualization for fast software deployment
- ▶ Automatic detection of RF interference sources
- ▶ Comprehensive and configurable GNSS performance and signal quality reports
- ▶ Configurable outputs: raw samples in standard GNSS output formats, interference detection results, signal snapshots, alerts, reports
- ▶ Increased threat monitoring coverage and improved source localization accuracy through a network of monitoring stations
- ▶ Continuous updates in line with GNSS evolutions and ICAO recommendations

BENEFITS

Real-time GNSS status and interference detection

The MS provides streams of data that enable the monitoring of GNSS signals in real-time and the detection of interference. An alarm is triggered if an event is detected. The user can request a customized event report generated by the MC.

Aggregated GNSS integrity monitoring

A synthetic view of the GNSS signal status at all locations with ECHO stations is permanently available to provide the user with signal reliability information and to support rapid mitigation decisions.

Scalability and easy maintenance

ECHO is designed to be scalable and easy to maintain at remote locations by minimum training. Scalability supports staged deployment and an increase in the number of station based on user needs. Each station is also modular and installation is straight-forward.

Pilot network at Romanian airports

A demonstrative implementation of the ECHO solution has become operational in July 2022 with deployment at 7 major international airports in Romania. An additional ECHO station has been installed at Graz airport in March 2025.

ARCHITECTURE

ECHO Monitoring Station

The Monitoring Station features professional equipment for tracking of all visible GNSS signals. It supports the real-time detection and localization of RF interference, while also logging data for the periodical performance reports. Data preprocessing is performed at station level to facilitate a smoother transfer to the monitoring center. Having a compact and modular design, its installation is straightforward, reducing the maintenance requirements and the needed human interactions. Increased performance and accuracy are provided by adding multiple stations.

ECHO Monitoring Center

The Monitoring Center stores all the recorded data, for post processing and generation of performance reports. It can be provided as a local server at the airport or as a cloud-based service.

ECHO User Interface

The User Interface has an intuitive design providing the user with a complete overview of the system, including both essential real-time information alerts and detailed periodical performance reports and statistics. Its role-based access control ensures the integrity of the displayed information and protects the system from unauthorized access.

Contact us to learn more about the ECHO GNSS and Interference Monitoring solution!

