

GALILEO for TIMING and SYNCHRONISATION APPLICATIONS



High Accuracy, High Reliability, High Resilience



European
Global Navigation
Satellite Systems
Agency



European GNSS to power the next-generation of high-precision Timing & Synchronisation applications in the telecommunications, energy and finance sectors.

Precise Time and Synchronisation (T&S) is crucial for a range of strategic activities. This is especially the case for Critical Infrastructure (CI), a system or asset that is essential to support vital societal functions such as health, safety and security, and to ensure the socio-economic well-being of the population.

GNSS T&S applications include but are not limited to telecommunications and computer networks, energy generation and distribution, and finance. All these applications use Critical Infrastructures (CI) with different accuracy requirements: these start from low in finance transactions (order of milliseconds), to medium for energy and most telecom applications (order of microseconds) and high (order of nanoseconds) for Satcom services.

GNSS timing services are accessible globally, giving users access to global standards for time with nanosecond-level accuracy. However, despite its long experience in GNSS, the T&S community is currently facing a number of challenges linked to an increased need for reliability and security: cyber-attacks on Critical Infrastructure are an increasing issue and GNSS is also subject to cybersecurity threats – particularly through jamming and spoofing.

Telecommunications

The telecommunications sector requires T&S solutions that are more accurate and resilient.

- **Mobile communication:** Digital cellular networks, operated by mobile network operators, provide voice and data services to users. The majority of today's networks employ GNSS as a primary or secondary synchronisation source. T&S requirements are rapidly becoming more stringent as fifth generation mobile networks and backhaul technologies will emerge by 2020. Timing requirements for

5G will require tight accuracies at base stations to allow for efficient use of spectrum and bandwidth, and smooth handover between stations.

- **Fixed-line networks:** Modern digital fixed-line networks rely on a hybrid architecture of atomic clocks and GNSS as primary time and frequency reference sources. GNSS receivers ensure traceability to UTC in all network elements that require it.
- **Professional mobile radio (PMR):** PMRs are field radio communications systems used primarily by government services, e.g. police. GNSS is used at base stations to synchronise data timeslots and facilitate smooth handovers between base stations.
- **Satellite communication:** GNSS receivers are typically used in Satellite Control Stations and Telecommunications Gateways to synchronise local high quality oscillators.

With growing demands for network synchronisation and increasing threats of tampering or interference, network operators are seeking better resilience and integrity from GNSS signals.

Finance

New competitive demands and regulatory requirements are driving financial firms around the world to use highly precise timestamps on incoming information and transactions. The European regulatory framework (MIFID II), which is entering into force in 2018, mandates that financial operators should prove UTC traceability with microsecond timestamp resolution. Similar US regulations are expected to follow.

This trend is likely to accelerate the adoption of global time sources such as GNSS. Many financial organisations have



already upgraded their banking and trading platforms and timing infrastructure to support the new timing requirements.

Nevertheless, the high economic impact of interference with the timing source in national market systems means that there is a need for a high level of confidence in the resilience of GNSS-based timing. Galileo-based multi-GNSS, dual-signal receivers and message authentication will help combat this risk.

Smart energy grids

Smart grid development is under way all over the world. Precision timing is a key enabling technology for the protection, metering, and control of substation functions. In the future, grid systems will require sub-microsecond level accuracy at power substations to implement automatic network management and protection relay functions, and to support fault detection and performance measurements. The widespread adoption of smart grids has the potential to make grid systems more efficient and safe.

Today grid systems rely on GNSS clocks as time reference sources and atomic clocks as a backup in case of outages. GNSS receivers are low-cost, reliable, high-precision timing sources that can be implemented in a large number of intelligent grid sensors (i.e. Phasor Measurement Units), to enable real-time automatic control of the grid. The rapid detection of intentional and unintentional time anomalies was identified by several utilities as a key near-term requirement.

Due to the criticality of the power system and the likelihood of future smart grid reliance on high-precision timing, resilience of the GNSS signals to interference, and increasingly to jamming and spoofing, is crucial.

Why Galileo?

Galileo will benefit users of GNSS-based timing in many ways.

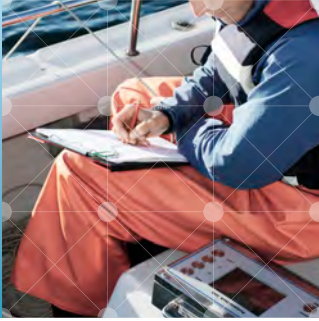
The freely available **Galileo Open Service** will offer:

- **Improved availability through multi-GNSS:** Augmenting existing systems like GPS with Galileo will increase GNSS timing availability, especially in high-interference environments;
- **Excellent performance:** The advent of Galileo allows T&S users to draw on accurate and even more robust timing signals;
- **Further resilience:** When available, the Open Service Navigation Message Authentication will add a layer of protection to the navigation message, making spoofing and jamming significantly more difficult.

Beyond Open Service, **Commercial Service Authentication** will offer an additional layer of protection to commercial users by providing fully encrypted GNSS signals. These signals will minimise the risk of spoofing-attacks, providing users with confidence that they are utilising signals and data from actual satellites and not from any other source.

The **Public Regulated Service (PRS)** will offer an encrypted and robust timing and synchronisation service specifically for authorised government users.

Galileo implements key features aimed at ensuring GNSS is a reliable timing source. With the implementation of Initial Services, Galileo is being adopted more and more by telecommunications, finance and energy users.



Galileo Initial Services

With the declaration of Initial Services in December 2016, Galileo – the European Global Satellite Navigation System (GNSS) – has moved from testing to the provision of live services. Users around the world can now be guided using the positioning, navigation and timing information provided by Galileo's global satellite constellation.

By working together with GPS, Galileo satellites provide **better positioning and navigation** for users, particularly in cities, where satellite signals can often be blocked by buildings. Plus, Galileo's excellent **timing accuracy** helps make the synchronisation of banking and financial transactions and telecommunication and energy distribution networks more resilient, allowing them to operate more efficiently.

Galileo's **Search and Rescue** service reduces the time it takes to detect emergency distress beacon signals from up to three hours to just ten minutes, potentially saving many more lives. The additional resiliency provided by Galileo is expected to help drive **economic growth** in Europe and beyond by enabling a range of new applications and services.

useGALILEO.eu

Mass-market devices containing a Galileo-enabled chipset, such as smartphones or vehicle navigation devices, can use Galileo signals for positioning, navigation and timing. The **useGALILEO.eu** tool helps you keep track of all the devices, services and service-providers already using Galileo.

GSA: linking space to user needs

The GSA's core mission is to achieve the highest return on European GNSS investment in terms of economic growth and benefits to users, ensuring that European citizens get the most out of Europe's satellite navigation programmes. As Europe's link between space technology and user needs, the GSA is committed to keeping the end-user at the centre of Galileo and EGNOS.

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