

# GNSS TECHNOLOGY ADVANCES IN A MULTI-CONSTELLATION FRAMEWORK

## ABSTRACT

The coming years will witness a major surge in the number of satellite constellations, along with an increase in their interoperability, that are dedicated to satellite navigation. In addition to an upgraded GPS and the evolution of the GLONASS Russian system, which will have a signal wholly compatible with that of GPS, the European and Chinese systems, respectively Galileo and Beidou, will provide by 2020 an increase of performance at a global level. The significant increase of visible satellites will lead to a major improvement in the availability of the service, also in contexts previously considered critical (e.g., navigation in metropolitan areas). The availability of multiple frequencies will also allow for an improvement of precision positioning algorithms, as well as offer innovative services.

The evolution of these systems is crucial to the development of applications aimed at satisfying the ever increasing outdoor-to-indoor service continuity requirements (from the outside of buildings, where satellites are visible, to the inside, where direct satellite signals cannot be received). Currently, although GNSS delivers optimum performance outdoors, the development of applications indoors (such as in the Internet of Things) requires its integration with systems that are not dedicated to navigation (Wi-Fi or Bluetooth inside the buildings) in order to provide 2D or 3D positioning. These applications may be related to premise emergency services, asset tracking, positioning of goods in warehouses or supermarkets, etc...

These issues will therefore necessarily be dealt with through the integration of navigation and communications systems, developing positioning services on mobile platforms (smartphones and tablets) in which the navigation component will increasingly become a commodity delivered within the framework of multiple other functionalities.

The evolution of satellite signal detection instruments will necessarily proceed along with the need to develop adequate security systems capable of protecting positioning data and counteract any fraudulent attack. The availability of jammer and spoofer applications at relatively cheap prices makes it ever easier to generate interferences or intentional manumissions of the received GNSS signal, jeopardising the dependability of satellite positioning. This security debate will probably follow the same evolution that has characterised the development of viruses and related anti-viruses in the ICT world.

The development of dependable anti-jamming e anti-spoofing algorithms and technologies will therefore be an essential requirement for the use of GNSS services in both the commercial and governmental/institutional spheres. No less important will be the dependable delivery of services for critical applications, as in life-risk and government contexts (for instance, the tracking of dangerous substances). In this area, SBAS (Satellite Based Augmentation Systems), possibly integrated into local systems, have and will have an ever increasingly important role to play in safeguarding the use of untampered signals on the part of the final user.

SECOND WORKSHOP

# GNSS TECHNOLOGY ADVANCES IN A MULTI-CONSTELLATION FRAMEWORK

The Workshop, which is in its second edition, aims to explore, in the light of current scientific knowledge, the future prospects of GNSS technology. The two days of proceedings, divided into various sessions, will be attended by important international representatives of academia, the industrial sector and public institutions.

The first day will be dedicated to the analysis of multi-constellation systems, the theoretical foundations of GNSS signal integrity and some innovative satellite navigation applications. The session will be opened by Prof. Pratap Misra (Tufts University), who will touch upon the interoperability challenges to application development, followed by Prof. Per Enge (Stanford University), who will detail the state of the art of GNSS signal integrity determination systems. Application development will be explored by Francesco Rispoli (Ansaldo - STS) and Alessandro Neri (Università Roma Tre), in the area of high-integrity rail traffic control system development, as well as by Juan Ramon Martin Piedelobo (GMV) and Oscar Pozzobon (Qascom), respectively on Galileo services advanced precision positioning technologies and the evolution of anti-jamming and anti-spoofing systems.

The second day of the Workshop will be characterised by the presentation of the points of view of some of the major national and international stakeholders on the development of the GNSS system, the presentation of a number of Italian research and development activities in the use of satellite navigation by Public Authorities and an in-depth analysis of the future prospects of GNSS utilization. The session will be introduced by Carlo des Dorides (Executive Director of the European GNSS Agency - GSA), who will describe the current development status of the Galileo and EGNOS systems, as well as some related organisational and institutional issues. He will be followed by Marco Lisi (Special Advisor to the European Commission) and Mario Caporale (Agenzia Spaziale Italiana - ASI), who will analyse the engineering and architectural features of the delivery of Galileo services, expand on integrity issues and illustrate the role played by the Italian Space Agency in the international sphere. The session will continue with Alessandro del Ninno, who will describe the legal aspects related to the delivery of GNSS services, and Roberto Capua (Sogei), with a presentation on Sogei's research and development activities in the areas of high-precision GNSS positioning and the development of SDR software receivers for institutional applications. The closing remarks by Prof. Pratap Misra and Prof. Per Enge will deal respectively with the use of innovative security systems based on the analysis of receiver clock errors and the role of GNSS applications on behalf of sustainable development.

The Workshop will end with a round table discussion that will allow participants to share and compare their respective points of view of the future prospects of GNSS research, applications and technologies