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DESIGNING THE NEXT GENERATION OF GNSS: HOW TO BEST SERVE THE DIVERSE INTERESTS OF MILITARY, CIVILIAN AND PUBCLIC USERS

Abstract

Everyone travelling in the air, on water or on the road is aware of the importance of precise positioning, navigation and timing information. While humanity has been forced for centuries to rely on the use of regional landmarks, light houses and special radio beacons, the 20th century has enabled true global navigation by making use of dedicated satellite systems.

The US GPS was the first GNSS to be started, with the premiere launch of a GPS I series satellite taking place in 1978. The second GPS generation ("block 2") is the current one, with launches taking place since 1989. Finally, as of 2016, GPS III is to be deployed. While the US are working on the third GPS generation, both Russia, China and Europe are modernising or deploying their own systems.

Although GPS, GLONASS and BeiDou are military systems, serving primarily the interests of their country's armed forces, the inherent structure of all GNSS – and especially of the civilian Galileo – allow(ed) for the development of civilian applications, effectively transforming GPS & Co from pure military into dual-use systems. This transformation was so successful that the GPS market has become the second largest space market (after satellite communications). The rapidly growing GNSS market, including equipment and applications, reached US$6.2 billion in 2000 and is forecasted to reach US$137 billion in 2022.

While these numbers are indeed impressive, the question remains whether the current broadcast-based GNSS concepts, which employ a one-way ranging strategy, can satisfy the complex emerging needs of a user community among which are pilots, ship captains, locomotive and truck drivers, all requiring a system with the highest levels of accuracy and integrity. While the one-way ranging methodology enables the user to remain invisible, which is of major interest for soldiers, armoured vehicles, ships, etc., the very same concept has its drawbacks when an aircraft relies on GNSS to perform a final approach and a consequent landing. Jamming as well as spoofing become immanent issues under such circumstances and consequently the question emerges, whether GPS, Galileo, et al, should not employ a two-way ranging structure, effectively mitigating these issues at the expense of giving up the invisibility of the GNSS user.

This paper examines the different options of one-way and two-way ranging and how a potential next generation GNSS may combine the advantages of both concepts to satisfy the diverse needs of military, civilian and public users.