Project Strategy Summary

Tendai Mbwanda

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1 Background

Commonly known as Global Navigation Satellite Systems (GNSS), systems of satellites orbiting the earth to enable positioning on, above or below its surface have become widely adopted in everyday life. Cadastral Surveying is an example of a GNSS application area which additionally requires high accuracy positioning achieved through augmentation. Real Time Kinematic (RTK) and Precise Point Positioning (PPP) are two standardised techniques to attain high accuracy which according to the European Global Navigation Satellite Systems Agency (2019) ranges between centimetre and decimetre levels. Nevertheless, until the introduction of Europe's own GNSS, Galileo, the GPS and GLONASS constellations largely provided a basis for augmentation. As the number of Galileo satellites increased between 2016 and 2019, Huisman *et. al* (2020) illustrate the associated improvement in availability of the Galileo GNSS service. This improved availability then served as a foundation for the Galileo High Accuracy Service (HAS) which will provide free of charge high accuracy Precise Point Positioning (PPP) corrections for Galileo and GPS through the E6-B signal, as well as creation of markets to enable and encourage innovative use of these services.

2 Problem Statement

Although the HAS is said to have an accuracy of ¡2dm, the built environment presents multipath and line of sight errors which challenge the achievement of high accuracy positioning. Considering that this service will be delivered at no cost, it provides a lucrative alternative to RTK and Network RTK (NRTK) operated using high-value equipment which require maintenance and use of an extra (virtual) GNSS receiver for augmentation during a field measurement campaign. The benefit of possibly providing Cadastral Surveying services with the same accuracy but at a somewhat lower expense is evident. For these reasons, the Galileo High Accuracy Service has attracted attention at regional and national scales. The European Global Navigation Satellite Systems Agency (GSA) has embarked on the Galileo Improved Services for Cadastral Augmentation Development of On-field Validation (GISCAD-OV) project to design, develop and

validate an innovative and cost-effective High Accuracy Service for Cadastral Surveying (CS) applications, based on GPS and Galileo High Accuracy Services (HAS) and Precise Point Positioning-Ambiguity Resolution quick convergence (PPP-AR) advanced techniques. At national level, the Dutch Land Registry known as Kadaster is a key stakeholder in the GNSS value chain as it provides CS services and maintains the Land Registry Database and Topography Basic Registration. Because other players in the value chain make use of these services in numerous markets, the importance of high accuracy positioning cannot be over-emphasized. Currently, Kadaster achieve high accuracy positioning through NRTK positioning. With the the introduction of Galileo HAS edging closer, there however is no immediate indication of its accuracy for CS in the built environment in comparison to the current techniques, although Huisman *et. al* (2020) demonstrate the possibility of a reconstructing a parcel boundary using Galileo only RTK. On this backdrop, performance of Galileo HAS in urban areas for CS applications can be questioned and explored.

3 Methodology

To compare the possible accuracy of reconstructing a parcel boundary in an urban environment using Galileo HAS for augmentation against the well-known RTK accuracy enhancement technique is one approach to validate the performance of the High Accuracy Service. It would involve predicting availability of Galileo satellites at given locations and times, conducting 3D observations on parcel boundaries using Galileo HAS enabled equipment, computing deviation of these new measurements from the well-known parcel boundary positions recorded in the Land Registry and visualising the reconstructed parcels. Alternatively, a control-and-experimental observation group approach can be followed. An ongoing validation phase in the GISCAD-OV project involves conducting field measurement campaigns in different European Union Member States. One of them will be in Germany from 19 to 22 September 2022, and could be treated as a control exercise. Measurements acquired under nominal operational conditions in Germany, characterised by absence of ionospheric storms, clear sky above 10° and absence of electromagnetic interference (GSA, 2020), can serve as a baseline for comparison with observations acquired on another field survey of parcel boundaries in the Netherlands. Visualisation would also be a last step to understanding the conclusions arising from the differences in observed accuracy from the two sets of measurements.

4 References

Huisman *et. al.* (2020). Galileo-Only Cadastral Survey

European Global Navigation Satellite Systems Agency. (2020).Galileo Improved

Services for Cadastral Augmentation Development On-field Validation Deliverable D2.1

European Global Navigation Satellite Systems Agency. (2019). PPP-RTK Market and Technology Report