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## THE MULTI-GNSS SPACE SERVICE VOLUME

**Abstract**

Global Navigation Satellite Systems (GNSS) were originally designed to provide position, velocity and time services for users on the surface of the Earth (land and sea), and for aviation. These signals could also be used by space users in Low Earth Orbits (LEO), but no specific requirements or specifications originally existed for this user community. In the last decade, usage of GNSS in LEO has become routine. And it has expanded to other orbit regimes like Geostationary Orbits (GEO) and High Eccentric Orbits (HEO) where GNSS signal availability has historically been very limited. With the recent development of multiple GNSS constellations and current upgrades to existing constellations, GNSS signal availability will improve significantly. As a result, this expanded multi-GNSS signal capability will enable improved on-orbit navigation performance and new mission concepts. High altitude space users will especially benefit from this evolution, which will provide GNSS signals to challenging regimes well beyond Low Earth Orbit. These benefits will only be obtained, however, if the additional signals are designed to be interoperable and are clearly documented and supported. Therefore, in order to enhance the overall GNSS performance for spacecraft in regimes from LEO to HEO and beyond, all Satellite Navigation constellation providers and regional augmentation system providers are working together through the United Nations International Committee on GNSS (ICG) forum to establish an interoperable GNSS Space Service Volume (SSV) for the benefit of all GNSS space users.

The paper/presentation will provide an overview of the coordinated Interoperable GNSS SSV concept, activities, achievements, and the latest status of the ICG Working Group. In order to demonstrate the potential benefits of the interoperable GNSS SSV for space users, results of extensive simulations conducted in a joint effort by Space Agencies and supported by all GNSS providers for multiple orbit regimes (GEO, HEO, and lunar) will be presented and discussed. Finally, an outlook will be provided for upcoming coordinated international initiatives.