

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Space Communications and Navigation Systems (1)

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INTEGRATED SPACE BASED AUGMENTATION SYSTEM (SBAS) FOR NAVIC/IRNSS

Abstract

NavIC (Navigation with Indian Constellation), the operational name of the Indian Regional Navigation Satellite System (IRNSS), provides Positioning, Navigation Timing (PNT) services to the users in the region covering India and an area extending up to 1500 km from its geo-political boundary. The NavIC, a stand-alone system similar to other GNSS systems like GPS, Galileo, Glonass, Beidou etc, has the inherent limitations of any GNSS system. Limitations in meeting the stringent requirements of applications like civil aviation in terms of accuracy, integrity, continuity and availability etc for the various phases of flight. The time-to-alarm in a stand-alone navigation system varies from minutes to hours and there is not quality-of-service indication. The accuracy limitations in NavIC are mainly due to the various sources of errors like Ionospheric error, tropospheric errors, clock and ephemeris errors etc. The inherent limitations call for special system for augmenting the stand-alone systems. Various types of Augmentation, which included Land-based, Air-based and Space-based augmentation systems have been deployed, of which space-based augmentation systems (SBAS) being the most widely used.

The operational SBAS systems include WAAS, EGNOS, MSAS and GAGAN, all of which augment the GPS. The augmentation systems are carried out with a network of ground stations and multiple satellites in Geo-synchronous orbits. This paper proposes a method for Space based augmentation for the NavIC system. The augmentation system shall improve the limitations of NavIC in terms of position accuracy by reducing the ionospheric, tropospheric, ephemeris and clock errors; integrity of service; availability; and continuity. The augmentation system architecture shall consist of the space segment and a vast network of ground segment elements. The space segment shall be a uniquely designed integrated space platform that shall simultaneously serve for the stand-alone NavIC system and the augmentation system. The integration of the augmentation payload into the GEO- GSO constellation of NavIC primarily avoids the necessity of additional GEO spacecrafts for the purpose of augmentation, as is done in the case of other SBAS. This paper envisages an integrated constellation that shall, in parallel, transmit the signal-in-space of NavIC (presently the SPS and RS signals) along with the signals for the Augmentation system. The paper also analyzes a signal structure for the augmentation system of NavIC that ensures compatibility with the existing SBAS to support seamless inter-operability between the various systems.