IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Navigation Systems, Services, and Applications (7)

Author: Dr. Manfred Sust
RUAG Space GmbH, Austria, manfred.sust@ruag.com

Mr. Thomas Lindgren
RUAG Space AB, Sweden, thomas.lindgren@ruag.com
Mr. Franz Zangerl
Beyond Gravity, Austria, franz.zangerl@beyondgravity.com
Mr. Roland Kaufmann
RUAG Space GmbH, Austria, roland.kaufmann@beyondgravity.com
Mr. Hannes Schwammschneider
RUAG Space GmbH, Austria, hannes.schwammschneider@ruag.com
Dr. Heinz Reichinger
Beyond Gravity, Austria, heinz.reichinger@beyondgravity.com
Mr. Andreas Dielacher
RUAG Space GmbH, Austria, andreas.dielacher@ruag.com
Mr. Michael MOSER-MORITSCH
RUAG Space GmbH, Austria, m.g.moritsch@protonmail.com
Dr. Anders Carlström
beyondgravity, Sweden, anders.carlstrom@ruag.com

A PLATFORM APPROACH TO COMPLEMENTARY POSITIONING, NAVIGATION AND TIMING SYSTEM SATELLITE PAYLOADS

Abstract

Apart from mobile high bandwidth processing and communication capabilities, accurate and ubiquitous knowledge of position and time is a pre-requisite for a manifold of smart applications which can be foreseen to be the pillars of future economy and living conditions. While the outstanding requirements with respect to availability and reliability are obvious for fully autonomous driving in rural or urban areas and for safe and secure autonomous transport at land, sea or in the air, the remarkable dependence of critical infra-structure - in particular communication and all services building upon it as well as the distribution of power - is less recognized. Today's Positioning, Navigation and Timing (PNT) demand is primarily furnished by Global Navigation Satellite Systems (GNSS) such as GPS, GALILEO, GLONASS or BEIDOU. Building upon expensive infra-structure in the ground- and space segment, they offer excellent service, but leave future applications with considerable coverage limitations and are susceptible with respect to local denial by means of jamming and spoofing. For mitigation of the latter, GNSS systems provide encrypted services like the GALILEO Public Regulated Service or the GPS Precise Positioning Service, which are, however, associated with barriers far too high to be considered as backbones for commercial services.

RUAG Space is developing a software defined product and technology platform for satellite payloads for complementary and/or alternative PNT systems. Closely following the GNSS principles but intended to be used in multi-layered satellite constellations between LEO and GEO and even suitable as building block of a lunar satellite navigation system, the concept requires only a minimal ground segment and avoids the need for expensive on-board clocks by leveraging GNSS performance. For superior resilience,

information gained from ground and space-based signals of opportunity, inter-satellite links and inertial navigation sensors can be fused to establish an autonomous time and position reference frame. Transmission power, frequency, bandwidth and structure of the navigation signals can be adapted to signal propagation conditions, e.g. indoor, presence of foliage, power-flux density requirements, and to combat local interference.

The present paper outlines the system concept, assesses user performance for different scenarios, presents the different platform components and exemplifies their use for several practical implementations, viz. CubeSat, hosted payload to be embarked on satellite constellations dedicated to other services as well as a solution integrated into a regenerative communication payload. Performance as well as Size, Weight and Power (SWAP) are presented along with experimental results for critical components.