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RRLP (LPP and LPPe) Based Open Source Mobile Multi-GNSS Assisted GNSS Assistance Model

Architecture Proposal and Test results of OSGRSv3 on LTE LBS Framework

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ABSTRACT

Radio resource location protocol (RRLP) was proposed by Third Generation Partnership Project (3GPP) primarily to provide efficient data transfer and network capability for applications such as Location Based Services (LBS). This is achieved by exploiting third Generation (3G) or the next generation Long Term Evolution (LTE) mobile network's capability. 3GPP LTE positioning protocol (LPP) provides the basic infrastructure roadmap for high accuracy positioning assistance model through control-plane bandwidth channels in mobile access and core communication networks. Despite its inherent capacity constraints, LPP can perform well in conjunction with Open Mobile Alliance (OMA) Secure User Plane release 3 (SUPLr3) based extension (LPPe). Combining the constrained control-plane with unconstrained user-plane bandwidth alleviates such network limitations by exploiting priority based traffic deviation. Where Secure User Plane (SUPLr1&r2) provided the positioning functionality through conventional mobile communication systems, SUPLr3 comprehensively extended the positioning parameter portfolio laying the baseline for LPPe. This paper presents the integrated architecture of LPP and LPPe based LTE mobile network with third generation Open Source GNSS Reference Server (OSGRSv3). Interconnection of two networks is provided through IP data control gateways for information exchange according to user preferences. This expands the current Assistance Model Portfolio of Multi-GNSS OSGRSv3 and establishes its interworking criteria with several mobile communication systems involved. Current LPPe protocol, Core Network and Transmission technology evolution status are discussed with future outlook to outline reasonable design strategies for such bandwidth hungry and higher data rate applications. A real network scenario has been implemented in a controlled laboratory of a carrier environment exploiting LTE RAN, Transmission, Core and GNSS elements to test the pre-commercial launch potential of such system. Interface parameters with performance graphs are presented. RRLP based system demonstrated improvements in lowering TTFF and improving availability and accuracy over its predecessor MGNSS (OSGRSv2) with LPPe enhancements by concatenating the functionality of HSGNSS, RINEX, RTCM and NTRIP. However system design is complicated and real-world operational support may further be implicated due to unforeseen parameter change in broad-baseline architecture. Logical complications could arise in multi system integration, protocol translation, network latency and traffic priorities. Nevertheless with future proof hardware architecture, OSGRSv3 could be a cost effective Multi-GNSS LBS solution for both research and industrial applications in weak signal environments such as unclear sky or indoors.

KEYWORDS: OSGRSv3, Multi-GNSS, RRLP, 3GPP-LPP, OMA-LPPe, SUPLr3, LTE