YOUNG PROFESSIONALS VIRTUAL FORUMS (YPVF)
Space Communications and Navigation (SCAN) (1)

Author: Dr. Tong Yang
China Academy of Space Technology (CAST), China

A GEO-ISL BASED TC&R PLAN FOR LEO COMMUNICATION CONSTELLATION SYSTEM

Abstract

The LEO mobile communication constellation system has been applied since late of 1990's. The constellation system, such as the Iridium system, is normally featured with a wider global coverage, lower communication delay, as well as higher transmission reliability. Since a LEO constellation might be consist of tens of satellites, like the 66 satellites in the Iridium system. The issue of implementing a Telemetry, Control and Ranging(TCR) plan with lower cost and higher security and reliability is becoming increasingly important.

In the Iridium system, totally 11 ground facilities(station/gateway) were distributed all over the world for its TCR mission, which may bring a more convenient network connection. However, this scheme might result in a higher construction cost and a more complex design in signal routing, besides, the whole TCR network might be interrupted provided that several ground nodes failed. Hence, a novel TCR plan is proposed in this paper, which makes use of the GEO Inter-Satellite Links(GEO-ISL) to perform TCR mission to LEO constellation satellites, since GEO satellite is provided with a broader view field at synchronized orbit, one or two GEO satellites could buildup a quasi-complete orbit coverage to LEO constellation satellites, and it is simple and feasible to transmit the telemetry(TM) and telecontrol(TC) signals from and to the LEO satellites through GEO satellites. As the ISL is deployed, signal routing would be more simplified and convenient rather than that transmitting only among those complex cross-linked ground nodes. Moreover, GEO satellite would represent a better robust performance in case of encountering natural disasters, such as earthquake that always causes ground facilities destroyed.

This paper would study and discuss several questions relating to satellite/terrestrial TCR network, inter-satellite signal routing, multi-access antenna capability, beam coverage, as well as link optimization and reconfiguration. The estimation performance is analyzed at the end of this paper, which gives the simulation result to prove that this novel GEO-ISL based TCR plan is fundamentally feasible, the beam coverage percentage will be improved almost 8 times(24h) rather than performing TCR merely via few ground nodes, considering a CDMA signaling and multi-access antenna techniques, the link transmitting capability/margin will be elevated to approx. 10dB, supposing that a maximum of 14 satellites can be simultaneously covered by one GEO satellite multi-access antenna beam. Moreover, total link transmitting rate will be increased to 1.023Mbps by applying a CDMA signaling, which presents a higher utility comparing with most terrestrial network based TCR plan.