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ARAMIS PROTOCOL PERFORMANCE ANALYSES AND OPTIMIZATION USING S-BAND DOWNLINK COMMUNICATION WITH FRAGMENTED DATA

Abstract

The major constraint for LEO orbit satellites is its limitation interms of visible period for radio communication from a specific ground station (maximum 20 minutes for each orbit). The telecommunication protocol developed for AraMiS (acronym for Modular Architecture for Satellites in Italian), has been designed to overcome this constraint, by making it compatible with GENSO, a project of the European Space Agency (ESA).GENSO supports a worldwide network of radio amateur ground stations that can provide an extended communication timeframe of upto 24 hours a day. It is made possible by tunneling traffic between the satellite client and the ground station over the internet. This designed protocol is in compliance with frequency bands, modulation schemes and protocols used by GENSO member ground stations The AraMiS telecommunication protocol and subsystem uses two different narrowband channels that are completely independent and redundant: UHF at 435 MHz and S-band at 2440 MHz (radio amateur satellite bands).FSK modulation scheme is used for both bands and in particular AX.25 protocol with datarate of 9600 bps, specifically on the 435 MHz channel to be compliant with ham-radio operators.For non GENSO communications, this telecommunication subsystem handles Remote Command and Telemetry by means of a proprietary protocol. It can be classified as ad-hoc ARQ protocol,where acknowledgements and timeouts are used to achieve reliable data transmission over an unreliable service. Development of such ad-hoc protocol allows us to design packets without needless overhead information, as a legacy from the AX.25 and to optimize parameters in order to maximize the efficiency and reliability, considering the harsh conditions mentioned of LEO orbit. The initial development of AraMiS protocol was performed considering particularly the UHF band that can provide a bitrate of 9600bps.From basic telemetry perspective, the provided datarate is acceptable but for extended payload communication it seems insufficient. The GENSO can also support S-band communication in downlink for selected number of ground stations at bitrate of 500kbps. This can help in improving the developed protocol to achieve higher thruput. This paper provides a performance analysis of our designed protocol by considering different scenarios. It also presents a detailed comparison of s-band communication (in downlink) for variation of bitrates from 10-500kbps. Another method that can improve thruput is using fragmented data communication in downlink. Its observed that by opting for such an approach we can attain quite remarkable performance interms of thruput and efficiency.