 Paper ID: 14173
student

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Systems (3)

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DESIGN & DEVELOPMENT OF TELECOMMUNICATION PROTOCOL FOR ARAMIS NANOSATELLITES

Abstract

Research in the field of Nanosatellite design for LEO orbit has continuously grown in recent years. AraMis (acronym for Modular Architecture for Satellites in Italian), is a true modular architecture which consist of a number of modules, called tiles, pre-assembled and pre-tested that have the characteristic of reusability depending on the needs of a specific mission. The telecommunication tile has to perform efficiently and reliably even in the harsh conditions, keeping under consideration the short communication timeframe, typical for LEO orbits, and limited available onboard power. Initially this paper describes communication typology supported by AraMis with particular focus on Remote Command and Telemetry. (i) The Basic Housekeeping Telemetry, that contains the value of each on-board sensor acquired just before transmission, (ii) Extended Housekeeping Telemetry, which contains some information about basic telemetry (iii) Payload Telemetry, which has mission specific contents.

The major constrain for LEO orbit is limited visible communication period from a specific ground station (maximum 20 minutes). AraMis protocol overcomes this limitation and is designed to ensure compatibility with GENSO (a European Space Agency Project) that supports worldwide network of amateur ground stations. Thus, extending communication up to 24 hours a day by tunneling traffic over Internet. The AraMis communication subsystem uses two different narrowband channels, completely independent and redundant: UHF at 435 MHz and S-Band at 2440 MHz. FSK modulation scheme is used for both bands and in particular AX.25 protocol with 9600 bps data rate is used specifically on the 435 MHz channel for compliance with ham-radio operators. Remote Command and Telemetry for non GENSO communication are handled by proprietary protocol classified as ad-hoc ARQ protocol, where acknowledgements and timeouts are used to achieve reliable data transmission over an unreliable service. Such ad-hoc protocol allows us to design packets without needless overhead information and to optimize parameters to maximize efficiency and reliability.

The main driving requirements for hardware design are to use only COTS components, to minimize cost, space and power budget. Basically the system includes a micro-controller performing protocol functions, two transceivers along with RF front-end and antennas. MSP430 is selected as it provides low cost, low power and easy to operate solutions. The transceivers are CC1020 for 435MHz band and CC2510 for 2440MHz that are narrowband, power efficient, easily configurable and only need few external passive components. In the end full set of test results and analyses are performed on the completed telecommunication tile.