WiSat Project

Traditionally, wired-data handling systems are used for the data distribution in satellites. These systems are based on extended standard buses such as the Mil-1553b, CAN, SPI, I2C… or point-to-point connections such as RS422, SpaceWire, etc. Furthermore, the majority of these communication standards are based on redundant cables to increase the reliability increasing the complexity and mass of the satellite harness. These elements (harnessing) have a clear impact on the spacecraft dry mass and the spacecraft assembly and testing. Statistics shows that the increment of the dry mass of spacecraft due to harnessing is in the order of a 10%. Furthermore the wired data-handling systems have other associated problems such as:

- Requiring complex assembly (communication paths), integration and testing as spacecraft complexity increase.
- Signal leakage and isolation for avoiding electromagnetic compatibility issues (EMC)
- Restriction in physical dimensions
- High cost of late design changes
- Possible failures of wires and connectors, risk of system malfunctioning due to EMI and risk of total failure due to any short circuit
- In case of failure it is very difficult to isolate the faulty system
- Overhead for tasks associated to wires allocation and assembly, shields, connectors, brackets, fasteners, supported structure, etc.
- In this context, the use of wireless communication on-board satellites for replacing, complementing or extending standard data communication systems can potentially solve the majority of the above problems, reducing the overall dry mass and the effort for assembly and testing tasks and enhancing the design flexibility and late redesign tasks.

Use of wireless communication buses leads to a significant reduction of mass, cost and AIV effort. Wireless communications should be based on wireless micro-sensors combining low power micro controller, transceiver and power supply with one or more attached equipment (e.g. sensor or actuators). For the space industry, the wireless communication buses will benefit the final performance of the on-board data handling system and will offer a number of specific advantages on the development, assembly, integration and testing activities:

- It simplifies development phases, reducing the development costs.
- It allows modular development independently of the final harness necessities.
- It allows cost reductions exploiting the flexibility offered by the wireless systems, e.g. inclusion of late design modifications, more flexible placement of the equipment…
- It simplifies the EGSE facilities, since data monitoring can be also based on wireless systems (it is not needed to physically attach the monitoring equipment to the on-board avionic).

The objective of the project was to investigate the feasibility of a robust spacecraft communication bus system with reduced or no harness and improving the intra-spacecraft interfacing flexibility without impact in power consumption and minimizing the overall mass. In order to achieve this objective, the project investigated the fulfillment of detailed requirements by a breadboard system composed of 4 wireless nodes running a custom implementation of the ISA100 Wireless protocol which is based on a 802.15.4 PHY layer. The project investigated the feasibility of porting the ISA100 Wireless protocol onto a faster PHY layer than 802.15.4 (802.15.4 UWB) and executed the design and implementation of 4 Wireless Nodes and one Wireless Gateway. The end result of the project is an implementation of ISA100 Wireless onto a UWB PHY layer that was tested in laboratory conditions (TRL 4).