SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Systems (6)

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SPACEWIRE MISSIONS AND ARCHITECTURES

Abstract

SpaceWire is an onboard data-handling network for spacecraft which connects together instruments, mass-memory, processors and telemetry sub-systems. It offers high-speed, low power, simplicity, low cost, and architectural flexibility making it ideal for many space missions. The availability of many radiation tolerant components, extensive test and development equipment, and spacecraft design engineers familiar with SpaceWire, make it increasingly attractive for future space missions. Since the SpaceWire standard was published in January 2003, it has been adopted by ESA, NASA, JAXA and RosCosmos for many missions and is being widely used for commercial and other spacecraft.

SpaceWire provides high-speed (2 Mbits/s to 200 Mbits/s), bi-directional, full-duplex, data links which connect together the SpaceWire enabled equipment. Networks can be built to suit particular applications using point-to-point data links and routing switches. Application information is sent across SpaceWire links and networks in discrete packets, each containing a logical address of the destination or a description of the route to follow through the network, and the user data (cargo) being carried. Control and time information is also be sent over SpaceWire links. The Remote Memory Access Protocol (RMAP) which operates over SpaceWire provides a common mechanism for reading and writing to registers and memory in a remote device over a SpaceWire network. It can be used to configure devices and read housekeeping information, to read data from an instrument or mass-memory, and to write data from an instrument to a mass-memory. Together RMAP and SpaceWire provide a powerful combination for spacecraft instrument data-handling.

High-profile missions using SpaceWire include: Bepi-Colombo Mercury Magnetospheric Orbiter (MMO) and Mercury Planetary Orbiter (MPO), James Webb Space Telescope, Mars Express, Gaia, EarthCare, GOES-RT, Lunar Reconnaissance Orbiter, MMS, Swift, PnPSat, TacSat.

Bepi Colombo MMO uses RMAP running over SpaceWire to interface to all its instruments. A central payload processing computer is able to configure the instruments using RMAP. When data is available it can be read from the instrument using an RMAP read command. A uniform memory space is provided for each instrument with pages for instrument data, configuration registers and housekeeping status registers.

The full paper will introduce several missions using SpaceWire and explain how SpaceWire is being used to support those missions. In each case the specific onboard data-handling architecture used to fulfil the mission requirements will be analysed. This paper, aimed at project managers and system engineers, will show how SpaceWire has been used on past missions, is being used on current ones, and how the heritage, available technology and capability of SpaceWire make it an ideal data-handling network for many future missions. Mission requirements that SpaceWire cannot fulfil will also be highlighted.