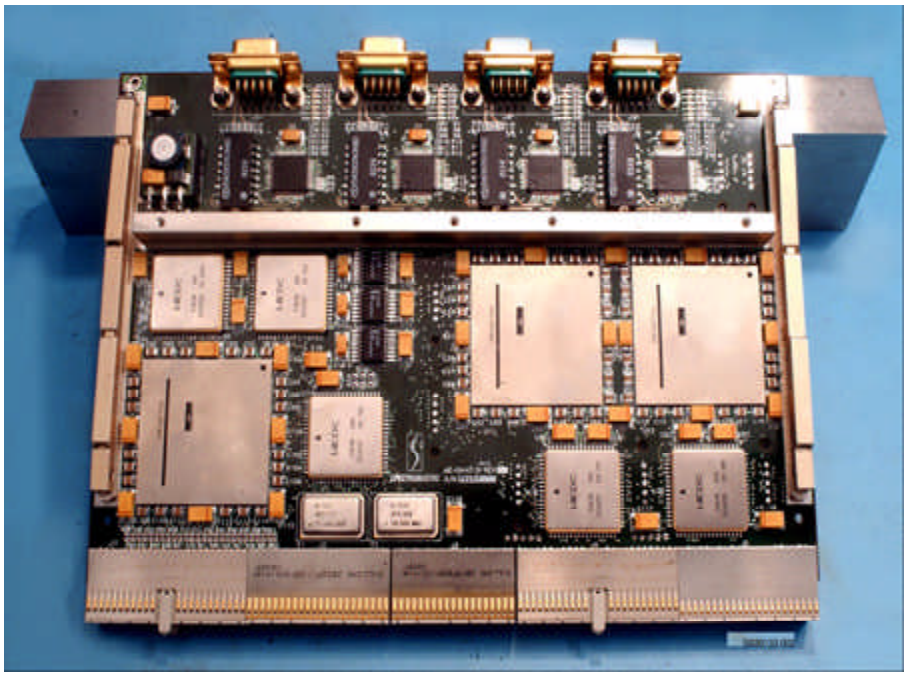
Space Network Devices Developed

The NASA Glenn Research Center through a contract with Spectrum Astro, Inc., has been developing space network hardware as an enabling technology using open systems interconnect (OSI) standards for space-based communications applications. The OSI standard is a well-recognized layered reference model that specifies how data should be sent node to node in a communications network. Because of this research and technology development, a space-qualifiable Ethernet-based network interface card (similar to the type found in a networked personal computer) and the associated four-port hub were designed and developed to flight specifications. During this research and development, there also have been many lessons learned for determining approaches for migrating existing spacecraft architectures to an OSI-network-based platform. Industry has recognized the benefits of targeting hardware developed around OSI standards such as Transmission Control Protocol/Internet Protocol (TCP/IP) or similar protocols for use in future generations of space communication systems. Some of these tangible benefits include overall reductions in mission schedule and cost and in system complexity. This development also brings us a step closer to the realization of a principal investigator on a terrestrial Internet site being able to interact with space platform assets in near real time.

To develop this hardware, Spectrum Astro first conducted a technology analysis of alternatives study. For this analysis, they looked at the features of three protocol specifications: Ethernet (IEEE 802.3), Firewire (IEEE 1394), and Spacewire (IEEE 1355). A thorough analysis was performed on the basis of criteria such as current protocol performance and suitability for future space applications. Spectrum Astro also projected future influences such as cost, hardware and software availability, throughput performance, and integration procedures for current and transitive space architectures. After a thorough analysis, Ethernet was chosen because it was seen as the best longer term fit because of the prevalent commercial market; the current and projected availability of hardware, software, and development tools; and the ease of architecture integration.



Ethernet multipurpose board.

Long description. This Ethernet multipurpose board was used as a base for the Spectrum Astro, Inc., network interface card and four-port hub development.

On the basis of the results of this study, Spectrum Astro designed and developed the Ethernet network interface and four-port hub around the IEEE 802.3-2000 specification for supporting 10BASE-T/100BASE-T (10 Mbps and 100 Mbps) data rates, which are prevalent in industry today. Spectrum Astro used an Ethernet multipurpose board (see the photograph), peripheral component interconnect, and compact peripheral component interconnect interfaces as development bases for the hardware. The design was made scaleable to accommodate future projected 1-Gbps rates and can be migrated to the 3U form factor board, which already exists in versions of space-qualified products. Military and space components were specified and included in the design where possible. Design techniques were targeted to flight specifications such as random access memory (RAM) scrubbing and cyclic redundancy error check of packets. This minimized the effects of radiation, such as latchup and single-event upset, and augmented overall radiation-hardened qualities. Total ionizing dose testing was performed on the chips used in the design as part of the verification, and the final hardware and software functionality was verified using accepted industry standard benchmarks.

This development is an enabling technology that will be useful in a variety of space communications applications including point-to-point links, onboard instrument control, and command and data handling. In addition, valuable lessons were learned during this development about migrating existing spacecraft architectures to future configurations using OSI network products.

Find out more about this research: http://ctd.grc.nasa.gov/5650/5650.html

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