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TTETHERNET NETWORK PLATFORM FOR ADVANCED SPACE EXPLORATION AVIONICS ARCHITECTURES

Abstract

TTEthernet is a networking technology that uses time scheduling to deliver deterministic real-time communication via Ethernet, which allows to transmit safety critical and regular traffic on a single physical network layer. TTEthernet has been selected to be used on launchers (e.g. Ariane 6) and is also applied in human space transportation applications such as the Orion MPCV and on its European Service Module. TTEthernet combines standard Ethernet (IEEE802.3), rate constrained traffic (ARINC 664 p7) and a time-triggered traffic (SAE AS6802) class and was identified by NASA for future manned space missions due to its synchronization, fault-containment and Quality of Services features [2]. TTEthernet was also specified as network interoperability standard on the Lunar GATEWAY and ARTEMIS Program, placing it at the core of future international avionics developments. TTEthernet relies as regular Ethernet on a switched architecture consisting of Switches that connect/manage several links, and "End System" nodes that are connected to host computers in the network allow transmission of data via the network. The synchronization protocol that supports a precise time synchronization [4] of all network nodes enables tight control-loops and allows synchronous and latency bound data transfer between applications running on various computers on the GATEWAY.

To improve re-use and manage complexity of flight software applications, NASA's Goddard Space Flight Center has developed the core Flight System (cFS), a software framework that standardizes avionics software interfaces and can be tightly integrated with TTEthernet to fully leverage on the synchronization and fault tolerance features of the underlying network. The framework enables developments of different software elements in parallel, while ensuring interoperability when things come together.

In order to deploy TTEthernet in multiple mission elements of the GATEWAY and ARTEMIS program, a modular equipment platform is being developed by TTTech and RUAG. In alignment with NASA and ESA, the platform is based on compact PCI (cPCI) and ANSI VITA industry standards, allowing to assemble spacecraft data-handling subsystems with only limited backplane customization on unit level. The products are developed and qualified for an enveloping set of requirements that cover needs of the GATEWAY and ARTEMIS mission profile.

The platform described in this paper is designed for scalability and upgradability for future missions and use cases and enables such TTEthernet based high integrity computing solutions for a large range of

space applications, after having shown to perform in the GATEWAY and ARTEMIS program.