ETHERNET FOR SPACE APPLICATIONS:

TTETHERNET

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Long Paper

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ABSTRACT

On-board spacecraft computer networks have to be robust against harsh environments including high-level radiation, which can cause transient upsets, like bit-flips, in a computer chip. As a result, one of the driving requirements in hardware deployment for spacecrafts lies in small memory sizes and footprints, which typically leads to specific space products.

Standard Ethernet networks, on the other side, are primarily developed with a focus on consumer electronics and office requirements and do not impose said limits on memory and footprint. On the contrary, with increasing wire-speed, the requirements on message buffer memory in Ethernet switches and routers become excessive in order to avoid message drops.

TTEthernet closes the gap between restricting hardware requirements from space applications and excessive hardware requirements from modern Ethernet networks. The key is the introduction of a time-triggered paradigm on top of Ethernet that allows a coordinated and pre-determined usage of the memory resources present in the network. As a result TTEthernet is scalable for cross-domain usage, which gives a vast economic benefit and significantly accelerates the maturity process of the TTEthernet technology.

This paper gives an introduction to the TTEthernet concepts and arising benefits from TTEthernet deployment in mixed criticality systems. Furthermore, we present a network-architecture using TTEthernet as deterministic high-speed backbone that interconnects individual SpaceWire networks. In particular, we discuss data-flow and the flow of synchronization in such a hybrid network, where data-flow is considered in both directions, while the flow of synchronization is considered from TTEthernet to SpaceWire, if required at all.