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PERFORMANCE EVALUATION ON TIME SENSITIVE NETWORK FOR SPACE APPLICATION

Abstract

The main purpose to use Ethernet in spacecraft is to take advantage of its flexibility to reduce the cost and complexity, and it rapidly replaces legacy networks as the core high-speed network in avionics and mission systems. However, real-time communication with Quality-of-Service (QoS) guarantees is essential for some aerospace embedded systems, and Ethernet does not provide deterministic, real-time transmission. In fact, Ethernet is the universal solution in commercial networks because of its high bandwidth, lower cost, openness, maintainability and flexibility. Therefore, in order to apply Ethernet technology to the aerospace field, Ethernet extensions with predictable timing were developed, such as EtherCAT, PROFINET, Ethernet/IP, AFDX and TTE. Time-sensitive network (TSN) stands out against the foregoing alternatives as it consists of a number of enhancements over regular Ethernet networks brought forward by the IEEE standardization committees. IEEE 802 and SAE Avionics Networks AS-1 A2 are currently working together to define a TSN profile for aerospace onboard Ethernet communications., which is a project named as IEEE P802.1DP / SAE AS 6675. As a result, it can be predicted that in the near future, TSN will become the optimal choice for the next-generation bus network of aerospace applications. This paper firstly generalizes and discusses the characteristics of communication network for distributed avionic system by analyzing the design method of the next generation spacecraft. And further, a prototype TSN-based communication architecture, including self-developed endpoint controller and switch, for spacecraft applications is presented. Then we analyze this architecture and discuss technical details from perspective of high precision clock synchronization, redundancy fault-tolerant, deterministic scheduling, network management and upper layer software. Finally, a test environment is built to evaluate the system performance. The results represent that our TSN solution are able to satisfy the requirement of current distributed avionic system and TSN should be considered as the next generation of communication network for critical aerospace applications.