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NEVER MIND THE QUALITY, FEEL THE BANDWIDTH: QUALITY OF SERVICE DRIVERS FOR FUTURE ONBOARD COMMUNICATION NETWORKS

Abstract

Several future space-based instruments, for example synthetic aperture radar (SAR) and hyperspectral imagers, will be capable of producing data at data rates of several Gbits/s. New downlink telemetry techniques (laser and Ka-band communications) will be able to provide much higher downlink capacity than previously possible. High speed memory technologies will be able to serve multiple high data rate instruments and stream data to ground on demand. To support the growing demand for onboard communications network bandwidth, technologies able to support multi-Gbits/s data transfer have been and are being developed (e.g. Channel Link, Wizard Link, SpaceFibre). Emphasis has been on providing the raw bandwidth across point-to-point links with various proprietary or mission specific protocols being developed to carry the data across the links. Support for different qualities of service (QoS) has not been essential. The move towards standardisation of multi-Gbits/s network technology has begun with initial work on SpaceFibre. To cover as broad a range of applications as possible, and to support technology reuse, QoS has to be considered at the outset. This paper examines the quality of service drivers for future onboard communications networks.

QoS requirements may be separated into two classes: those concerned with reliability and those concerned with timeliness of delivery. Reliability requirements aim to fulfil the fault detection, isolation and recovery (FDIR) mandate of space missions. The network has to detect temporary, intermittent and permanent faults. It has to isolate any faulty component so that the fault cannot propagate to other health devices and so that the faulty component cannot interfere with communication on the network (babbling idiot problem). It then has to recover from the fault, resending any important data that has been corrupted or gone missing and providing an alternative route through the network to overcome permanent faults.

Timeliness requirements aim to ensure that critical data is delivered within specified time margins. Priority is one approach that is often promoted, however, onboard a spacecraft it is determinism that is more often the driver for real-time applications including spacecraft control systems. Determinism can be met using a scheduled approach to data transfer over the network.

The full paper will detail the QoS requirements and explore techniques for their efficient and effective implementation. The aim is to provide a multi-Gbits/s network technology suitable for space flight applications, which can meet the needs of a diverse set of missions.