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DEVELOPMENT OF A PROCESS TO CHARACTERIZE HARDWARE FOR HIGH FIDELITY END-TO-END COMMUNICATIONS EMULATION

Abstract

As the complexity of the space infrastructure increases, more sophisticated communications networks must be developed to support it and enable full utilization of available assets by future missions. However, testing in realistic conditions the reliability and capabilities of these communication networks, particularly concerning fault detection and recovery, can be both difficult and expensive using existing space communication links. To mitigate the cost and complexity, and enhance the development of new communication systems, emulation of the hardware and software used in the networks can be conducted. Hardware emulation requires that these hardware components are run in real-time and do not realize that they are communicating with network emulation software nor are affected by it. For end-to-end emulation, every piece of hardware used in the transmitter and receiver is modeled, and the Systems Tool Kit (AGI-STK) is used to model the channel. The hardware is controlled, in real-time, by the STK simulation scenario. This leverages the capabilities of STK simulation with the available hardware and provides a high-fidelity result. To accurately model the characteristics of the space communications channel, the delays and losses associated with the particular hardware being used must be precisely measured to ensure a high-fidelity emulation. The goal of this project is to develop a standardized process for characterizing hardware used in end-to-end emulation of a wireless channel, particularly a space link. Once the process has been determined, the capabilities of the emulation environment can be scaled up, enabling emulation of multiple generic communications links. In this way, complex space networks which cannot be directly tested, such as TDRSS to TDRSS links, can be emulated with high confidence. The emulation testbed to develop this process is a dual channel sim model bidirectional link to a single satellite. This environment was chosen because it uses components readily available to the emulation lab. Both active and passive components will be characterized. Parameters being measured include the S-parameters, bandwidth, saturation levels, compression points (if applicable), gains, processing delays, and phase shifts. The process developed will be turned into a procedure that can be given to an RF technician to perform on a Device Under Test (DUT) which is being added to an emulated network.