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Improving Space Operations Workshop – Abstract

Mission Control Operations: Employing a New High Performance Design for Communications Links Supporting Exploration Programs

The planetary exploration programs demand a totally new examination of data multiplexing, digital communications protocols and data transmission principles for both ground and spacecraft operations. Highly adaptive communications devices on-board and on the ground must provide the greatest possible transmitted data density between deployed crew personnel, spacecraft and ground control teams. Regarding these requirements, this proposal borrows from research into quantum mechanical computing by applying the concept of a qubit, a single bit that represents 16 states, to radio frequency (RF) communications link design for exploration programs. This concept of placing multiple character values into a single data bit can easily make the evolutionary steps needed to meet exploration mission demands. To move the qubit from the quantum mechanical research laboratory into long distance RF data transmission, this proposal utilizes polarization modulation of the RF carrier signal to represent numbers from zero to fifteen. It introduces the concept of a binary-to-hexadecimal converter that quickly chops any data stream into 16-bit words and connects variously polarized feedhorns to a single-frequency radio transmitter. Further, the concept relies on development of a receiver that uses low-noise amplifiers and an antenna array to quickly assess carrier polarity and perform hexadecimal to binary conversion. Early testbed experiments using the International Space Station (ISS) as an operations laboratory can be implemented to provide the most cost-effective return for research investment. The improvement in signal-to-noise ratio while supporting greater baseband data rates that could be achieved through this concept justifies its consideration for long-distance exploration programs.