

The CCSDS Link Layer Protocol Suite

The purpose of this paper is three-fold. First, to provide a general overview of the four CCSDS link layer protocols: Telecommand (TC), Packet Telemetry (TM), Advanced Orbiting Systems (AOS) and Proximity-1. Second, to describe the environments in which these protocols operate. Third, to provide example application profiles demonstrating how these 4 link layer protocols are configured to work in those environments for the next generation of space missions.

The overview describes the principle functions i.e., data transfer and services provided by these link layer protocols. The capabilities of source identification, spacecraft addressing, link configuration control, stream multiplexing/demultiplexing, and ARQ are discussed. Furthermore, key considerations in choosing a link layer protocol are examined such as: provision for the underlying physical link characteristics, hardware complexity at the source and destination, allowable data error rate, as well as decision making capabilities at the termini of the links. The link layer as the carrier of network layer packets and point to point messages used for remote control directives will be described in detail. These CCSDS link layer protocols enable the following capabilities: 1) the transfer of CCSDS source packets (which provide a means to publish and subscribe to packets), the capability of transmitting Ipv4 packets (which provide Internet connectivity via gateways to space mission data), SCPS NP packets, and the CCSDS Encapsulation Packet, which support the CFDP, IPV6 and other protocols.

The paper will describe the environments in which each of the four CCSDS link layer protocols operate. For each protocol, the key characteristics that define the environment will be examined. These are: round trip light time, the protocol controlling entity, SNR characteristics, technology available at the termini of the links, data rates, and the characteristics of the physical layer. Then the key characteristics of each protocol will be described. These characteristics are: QoS, PDU definition, accounting features, error detection, protocol services, security, and APIs to other protocol layers. Finally a comparison between these environmental and protocol characteristics will be made, to show which protocols work well in which environments.

In conclusion, examples of link layer protocol configurations, called application profiles will be examined for the following 4 space mission cases: a) telecommand, b) low rate (< 500 Kbps) telemetry, c. high rate telemetry, d. proximity (in-situ) bi-directional links.