

Part 1 - SLE Services

Introduction

CCSDS Space Link Extension (SLE) defines a standardized set of services that allow ground antenna sites and control centers to send spacecraft data back and forth. This spacecraft data includes the data channels in the return link (spacecraft to ground) and the forward link (ground to spacecraft).

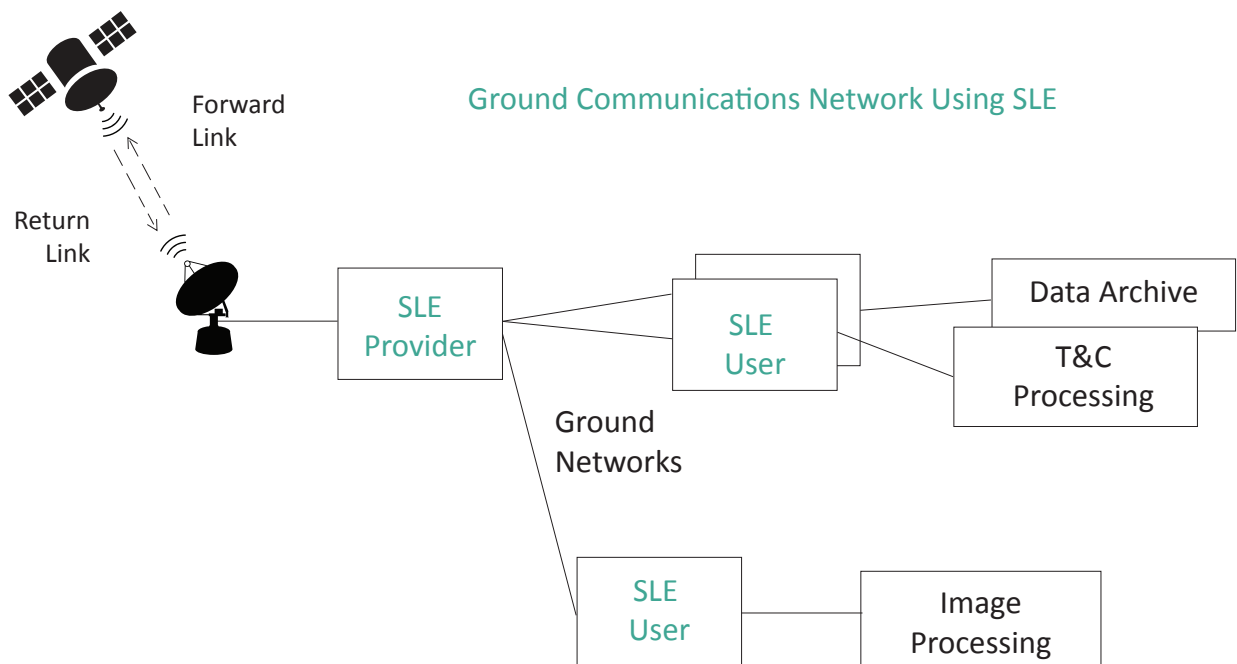
SLE Services

SLE is a CCSDS standard. Whereas many of the CCSDS standards define the data content, format, and protocol of the forward and return links, the SLE standards define a set of services for the transfer of the data between the nodes of a ground network. The SLE standards also define a set of management services that are used to make and manage the connections between nodes.

These “services” are implemented in software that runs on the computer systems that are part of the ground communications network. The SLE standards help ensure software written by different organizations can interoperate over the ground network.

SLE uses lots of terms and acronyms so that the standard is generic and not specific to any implementation. This App Note tries to describe SLE in more general terms, but there’s no avoiding having to relay some of the SLE terminology.

SLE differentiates the two sides of the ground network as the SLE Provider and the SLE User.



Part 2 - SLE Providers / SLE Users

SLE Providers and SLE Users

Typically, the SLE Provider is the ground antenna side and the SLE User is the control center side. The SLE User requests a service, like “give me the data from my instrument on the spacecraft,” and the SLE Provider does its best to comply with the request.

Data channels in the return link flow from the SLE Provider to one or more SLE Users. Multiple SLE Users can connect to the same SLE Provider and receive some or all of the return link data. The SLE Provider acts as the distribution point on the ground for the spacecraft data.

Forward link data flows in the other direction, from the SLE User to the SLE Provider. Since this is the data that is subsequently modulated and transmitted to the spacecraft, there are usually fewer ground nodes producing the forward link data and the nodes must coordinate who has authorization to be transmitting.

Multiple SLE Users can connect to a SLE Provider and a SLE User can have forward links being sent to more than one SLE Provider.

Making the Connection

There are SLE Management Services to establish the connection and validate that connection. These connections are known as Service Instances. A SLE User requests an SLE Bind operation when It wants to establish a connection with an SLE Provider. There’s authentication with user names, passwords, and credentials being exchanged. If all is good, the connection is made and the SLE User can Start the flow of data. A Stop and Unbind operation requests shutdown of this particular connection between SLE User and SLE Provider.

Part 3 - Forward and Return Links

SLE Return Link Services

CCSDS allows for multiple data sources on the spacecraft to be combined into a single downlink. These data sources might be data from multiple instruments on the spacecraft, state-of-health data, image data, even voice data if it's a manned mission. Each data source builds its own CCSDS frames with a unique channel ID. The downlink multiplexes these channels together transmitting them one after another based on which channels have frames to send, while accounting for their assigned priority. All channels come down the RF link together, but likely need to end up in different places for processing.

RCF: The Return Channel Frames (RCF) service lets the SLE User get a single channel that's of interest (or that they are allowed to have access to). For example, a research organization that has an instrument on-board might use the RCF service to get the data from their instrument and not any of the others. A separate connection is required to request each separate channel.

RAF: The SLE User who requests the Return All Frames (RAF) service gets all the frames. A good example might be a ground system that is recording the return link and wants to get every channel.

RSP: The Return Space Packets (RSP) service delivers a set of Space Packet channels. A Space Packet is a channel of variable sized data packets within the frame.

There are another half-dozen or more Return Link services within the SLE standard, but these are the three most commonly used.

SLE Forward Link Services

CCSDS systems commonly use a Communications Link Transmission Unit (CLTU) for the forward link data. A CLTU is a formatted block of data that gets put into one or more CCSDS Transfer Frames. This is the data stream that is sent to the SLE Provider location and then modulated and transmitted to the spacecraft or satellite. At the spacecraft, each CLTU has a specific destination where it is processed.

FCLTU: The Forward CLTU service enables the user of the service to send an asynchronous stream of CLTUs. The service allows the SLE User to specify a window of time for sending the data out the antenna.

EFCLTU: A newer service is the Enhanced Forward CLTU service. EFCLTU adds the ability to send a synchronous stream of CLTUs.

Can we help? AMERGINT's expertise is available to assist in your systems engineering and design

Randy Culver
randy@amergint.com
719-522-2802