# SIMPLIFYING OPERATIONS WITH AN UPLINK/DOWNLINK INTEGRATION TOOLKIT

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The Operations Engineering Lab (OEL) at JPL has developed a simple, generic toolkit to integrate the uplink/downlink processes, (often called *closing the loop,), in* JPL's Multimission Ground Data System. This toolkit provides capabilities for integrating telemetry verification points with predicted spacecraft commands and ground events in the Mission Sequence Of Events (SOE) document. In the JPL data system, the uplink processing functions and the downlink processing functions are separate subsystems that are not well integrated. Our new closed-loop monitoring tool allows an analyst or mission controller to view and save uplink commands and ground events with their corresponding downlinked telemetry values, without requiring real-time intervention by the user.

An SOE document is a tin~c-ordered list of all the planned ground and spacecraft event.s, including all commands, sequence loads, ground events, significant mission activities, spacecraft status, and resource allocations. The SOE document is generated by expansion and integration of spacecraft sequence files, ground station allocations, navigation files, and other ground event files. 'l'his SOE generation process has been automated within the OEL and includes a graphical, object-c)ricntcd SOE editor and real-time viewing tool running under X/Motif. The SOE toolkit was used as the framework for the integrated implementation.

The SOE is used by flight engineers to coordinate their operations tasks, serving as a predict data set in ground operations and mission control, The closed-loop SOE toolkit allows simple, automated integration of predicted uplink events with indicated telemetry points in a single SOE document for on-screen viewing and archiving. It automatically interfaces with existing real-time sources of information, to display actual values from the telemetry data stream.

'l'his toolkit was designed to greatly simplify the user's ability to access and view telemetry data, and also provide a means to view this data in the context of the commands and ground events that are used to interpret it. A closed-loop system can prove especially useful in small missions with limited resources requiring automated monitoring tools. "l'his paper will discuss the toolkit implementation, including design trade-offs and future plans for enhancing the automated capabilities.