Recent Developments and Future Directions in CCSDS Flight Dynamics Standards

David S. Berry,[1*]
[1]California Institute of Technology, Jet Propulsion Laboratory
david.s.berry@jpl.nasa.gov

Keyword : International Standards, CCSDS, Operations

Starting in 2004, the progress of the Consultative Committee for Space Data Standards (CCSDS) Navigation Working Group (CNWG) in developing international standards for use in flight dynamics operations has been regularly presented at the ISSFD [1], [2], [3]. Since the most recent status update in 2012, there have been a number of developments and some interesting future directions that will be discussed in the proposed presentation.

Recent developments include changes in the status of several works in progress relative to previous reports. One standard has been published and is now in wide usage (the Conjunction Data Message, CDM). One standard is in the final prototyping phase prior to publication (the Pointing Request Message, PRM). Development of one standard has recently been discontinued (the Spacecraft Maneuver Message, SMM). Another standard has been the subject of significant effort, but has reached a decisive point in its development and may be subject to cancellation (the Navigation Hardware Message, NHM). A new standard has been started (the Re-Entry Data Message, RDM), and another is about to start (tentatively named the "Events Message", EVM). Several other standards are in the process of revision, per standard CCSDS operating procedures; these documents are those in "the first generation" of CNWG products (the Orbit Data Messages, ODM; Attitude Data Messages, ADM; and Tracking Data Message, TDM).

Future directions focus on a few topics that have arisen in many CNWG discussions as the number and specificity of standards has increased, specifically, the closely related topics of inheritance, duplication, and consistency. These discussions have mostly arisen in the context of a number of ancillary "second generation" standards that supplement the first generation ODM, TDM, and ADM. The need to duplicate common data structures (e.g., an orbit state) commonly arises. For example, the CDM and ODM share several data structures, and much of the information in the RDM is inherited from the CDM. There's a famous quote attributed to Emerson that "a foolish consistency is the hobgoblin of little minds...", however, the operative word here is "foolish", and in the process of developing international standards consistency between related standards is not foolish! Two of the most important objectives of CCSDS standards are the enablement of "interoperability" and "cross-support". In the achievement of these two high level objectives, consistency is essential. CNWG members have agreed that avoidance of duplication of material wherever possible is desirable, but where data structures must be duplicated they should be consistent unless there is a very good reason to diverge. Still, the effort to maintain consistency from one standard to another is a constant struggle. These related concepts and pressures have led to the notion of a "universal, modular message" that emerged in late 2014 and has increasingly arisen in subsequent meetings; one might characterize this notion as related to "The Lego Principle". The concept of this modular "Frankenstein" message is still in its early formative stages, and the CNWG is not in a position to be able to act on this idea immediately, but recent work suggests that it is the way forward. Another future idea relates to message integrity, which the CNWG has not to date addressed; applicable mechanisms are under consideration.

References

[1] Martin-Mur, Tomas, et al., "Exchange of Standardized Flight Dynamics Data", Proceedings of the 18th International Symposium on Space Flight Dynamics, Munich, Germany, 2004.
[2] Van Eepoel, John, et al., "Standardizing Navigation Data: A Status Update", Proceedings of the 20th International Symposium on Space Flight Dynamics, Annapolis, Maryland, USA, 2007.
[3] Berry, David S., et al., "Progress in Standardizing Flight Dynamics Data Exchange", Proceedings of the 23rd International Symposium on Space Flight Dynamics, Pasadena, California, USA, 2012.