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Identifying Future Mission Drivers on the Deep Space Network

This paper discusses the methodology used to identify mission drivers on the future architecture for the Deep Space Network (DSN). Three approximate time epochs were treated: 2010, 2020, and 2030. Downlink drivers were treated first, then uplink.

Treatment of the 2010 epoch relied largely on the analysis of DSN mission set demographics and, from that, identification of the more robust, enduring trends. Four distinct trends emerged that indicated the need for increased future downlink capability. Inherent mission model uncertainties were addressed by applying a quasi-Monte Carlo technique to the analysis of the data.

Because mission and spacecraft designers do not have a reliable means for knowing the capabilities that may exist in 2020 and 2030, mission concepts for such time frames are generally biased toward today's capabilities. To avoid this bias, treatment of the 2020 and 2030 epochs involved less reliance on mission demographics and more on using Earth-based science capability trends as predictors of deep space science capability needs. In particular, the downlink analysis benchmarked current DSN capabilities against the future deep-space data rate requirements implied by current Earth remote sensing capabilities. This analysis revealed the need for potential orders-of-magnitude growth in current DSN downlink capabilities.

In a similar manner, mission set demographic analyses for the uplink identified a need for increased X-band emergency uplink capability in the 2010 time frame, as well as a possible science-driven need for increased routine uplink capability. For the 2020 and 2030 epochs, the uplink requirements for *in situ* robotic mobility elements were derived from examination of the uplink required for operating current, autonomous, Earth-robotic mobility elements. This examination revealed a change in the nature of how the uplink is used – with diminished need for low-level commanding and increased need for responding to *in situ* requests for science instrument calibration data, navigation-related information, and occasional re-configurable system software uploads. A key capacity-related question still outstanding is what the frequency of these upload requests might be.