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ABSTRACTING CUBESAT OPERATIONS: A PATH TO REAL CUBESAT INTEROPERABILITY

Abstract

Introduction of the CubeSat form factor brought a paradigm shift in the industry. With the size becoming a standard, cost and development time were able to be reduced significantly. However, the industry has not yet fully realized the potential of this new paradigm of space missions. Whilst mechanical form factor has some standardization now, and board-level interfacing largely follows the PC-104 header design mechanically, there are still many other simplifications or standardization that could be made, whilst still meeting CubeSat mission requirements. This includes component hardware and software compatibility, engineering design simplifications such as engineering budget standardization or auto generation, and some regulatory standardization such as CubeSat mission spectrum licensing, etc. A number of these benefits relate to design elements, which would require new standards development and a number of CubeSat component developers or re-sellers to follow such new guidelines. One area that can be addressed without significant change in the CubeSat ecosystem is mission operations. Many operations activities for CubeSat busses are common, or the differences between missions are close enough to benefit from common streamlining. This paper introduces a common abstraction for CubeSat operations that addresses the majority of bus activities, and illustrates this abstraction through a generic software tool. The abstracted operations sequence can then also be used with any operating tool for spacecraft operations. Simplification of operations activities do not only affect development of operations tasks and testing. Satellite operator training is able to become much more intuitive across missions, and routine and anomaly handling standardization can reduce errors in operations. Common ways for real-time review of telemetry and command actions will allow operators to deal with in-flight issues faster and more efficiently. Each operation sequence and ground pass can be refined and optimized, benefitting from a much larger pool of lessons learned. This paper will highlight the abstracted operations sequences selected for CubeSat operation. These will be demonstrated by applying them to an upcoming CubeSat mission being developed in York University, to be launched in 2019 – the DESCENT (Deorbiting spacecraft using electrodynamic tethers) mission. The paper concludes by highlighting the simplifications that can be made as a result of this abstraction, to serve the majority of CubeSat missions in the near-term. It will thereby also point to some of the other improvements that could be made longer-term for CubeSat mission designers and operators through further industry standardization.