

Using Small Satellites as an Interplanetary Data Highway

Rahul Ravikumar ¹, Abhay Egoor ², Krishna Teja Penamakuru ³
Sanjay Srikanth Nekkanti ⁴, Vishal Latha Balakumar ⁵

1,2,3,4,5 Dhruva Space Private Limited

Overview: The P30 platform is a 300 x 300 x 300 mm structure which has a modular internal configuration that was tested successfully and allows for between 9U and 12U volume within an optimized, modular structure. The proposed structure will include the P30 external structure as the 'Parent' spacecraft and multiple 1U CubeSats or 'children' deployed from the P30 to act as an interplanetary communication relay or information highway, for efficient data transmission using small satellites.

Payload: The capability to provide a customizable internal configuration for the Payload and additional space than generally available on a similar CubeSat platform is unique to the P30 structure and can be utilized for a wide range of applications. The P30 platform can accommodate upto 3 CubeSats of 1U form factor that can be deposited at various orbital planes with magnetometers, enabling high harmonics characterization. The network of small satellites will be placed in lunar orbit and will communicate with surface landers and rovers and relay data to the P30 'parent' satellite. The system will include an integrated communication system, based on a Disruption Tolerant Network (DTN), as well as an on-board propulsion system to enable orbit insertion. This design will greatly enhance data assimilation capabilities in interplanetary missions and reduce the latency time for downlinking of data.

Mission Design: The platform will be designed to have a nominal mission lifetime of 3 years. The structure will include 3-axis attitude stabilization using reaction wheels and star trackers. The inter-satellite link using the DTN system will be developed to enable autonomous data transmission between the 'children' and 'parent' spacecraft, to be downlinked to the ground station with minimal latency. The various subsystems such as the EPS (Electrical Power Supply) and the OBC (On-board Computing) will be designed in-house according to the requirements of the payload/s.

Development Status: The P30 structure has been already proven to be flight-capable and current development will be focused on minor updates of the design of the external structure and the necessary interface components to meet interplanetary flight requirements. Additionally, the 1U CubeSats will be developed based on the communication requirements and integrated within the P30 platform. The 'parent' structure will be updated to include a deployment system for orbit insertion of the 1U CubeSats. Further research will be conducted into control of the internal thermal environment and communication capabilities with respect to interplanetary missions.