

21st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)  
Space Systems and Architectures Featuring Cross-Platform Compatibility (7A)

Author: Mr. Shreyas Kulkarni  
College of Engineering Pune, India

Mr. Nikhil Sambhus  
College of Engineering Pune, India

Mr. Vaibhav Rekhate  
College of Engineering Pune, India

Mr. Abhishek Joshi  
College of Engineering Pune, India

Mr. Pritesh Chhajed  
College of Engineering Pune, India

Mr. Lokeshsingh Bais  
College of Engineering Pune, India

Mr. Ameya Marathe  
College of Engineering Pune, India

Mr. Gaurav Mahajan  
College of Engineering Pune, India

Mr. Pushkar Chaudhari  
College of Engineering Pune, India

Mr. Sendhilkumar A  
College of Engineering Pune, India

Mr. Rahul Kulkarni  
College of Engineering Pune, India

COEPSAT PROTOCOL: A MODULAR LINK AND NETWORK LAYER PROTOCOL FOR SMALL  
SATELLITES

**Abstract**

Small satellites with experimental payloads help universities in conducting space experiments using established spacecraft templates. Satellites operating amateur radio transponders implement communication protocols modified and designed specifically for the concerned mission. ‘Swayam’, a 1-U pico-satellite with a Passive Attitude Control System (ACS) payload hosts a half-duplex communication system, providing short messaging services to the HAM community. Passively stabilized satellites have a limited pointing accuracy and can undergo frequent disruptions in the link. This paper describes the communication protocol specifically designed for the connectionless link establishment between the satellite and the Ground Stations, exploited to ensure minimum handshaking, within the pointing accuracy provided by the passive ACS. The protocol can be implemented on a microcontroller running a simple foreground-background system with no scheduling requirements, thus reducing system complexity to a great extent. COEPSAT protocol adopts the user configurable ‘service fields’ to implement the satellite’s mission specific commands and requests, including telemetry data and payload services. The flexible commands followed by associated data have a linear time complexity for decoding thus remitting strict computational requirements from the On Board Computer (OC). The protocol encompasses a Berlekamp-Massey

iterative Reed Solomon Forward Error Correction scheme to eliminate the bit flips introduced due to the channel. For network authorization and security, authentication strings have been added along with special service codes in order to prevent misuse of data. Authentication failures and incorrect usage of the protocols generate automated request rejects. Besides requesting a single packet, services requesting large chunks of data in a burst fashion have also been incorporated. COEPSAT Protocol thus encapsulates multiple functions for command and data handling and can be adopted as a supple communication protocol for the amateur radio community while operating small satellites.