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NEPAL'S MUNAL HIGH SCHOOL 1U CUBESAT: SATELLITE SYSTEM-ON-CHIP PAYLOAD  
DEMONSTRATION FOR STORE AND FORWARD MISSION

**Abstract**

The CubeSat platform has allowed easy access to space for technology demonstration missions at a lower cost and shorter development period. The Store and Forward (S&F) Mission in small satellites have become a convenient method for remote sensor data acquisition. The use of LoRa technology in Ground Sensor Terminal (GST) for CubeSat S&F constellation is highly in demand for low cost disaster resilience. Especially countries like Nepal with complex geography, there is a need for frequent monitoring of its geographic state. To enable surveillance in remote areas using satellites, a low cost GST and S&F payload can be a solution. This paper presents a detailed design of the S&F mission with Satellite System-on-Chip (SoC) payload demonstration in 1U Munal High School Satellite. The main objective of the mission is to demonstrate the use of a STM32WL LoRa SoC as an On-board Computer and LoRa Communication system for S&F satellites. The payload is designed with M4 and M0+ dual core ARM processor with LoRa integrated System-on-Chip transceiver. The LoRa communication payload beacons LoRa packets with house keeping data and receives the sensor data from GST. The GST is designed with a modular system which allows it to interface any type of sensor and be able to uplink LoRa beacon to satellite. The SoC LoRa transceiver has transmitting power of up to 0.15W. 1 Gigabit Flash memory is used for storing housekeeping data and sensor data received from the remote GST. In case of a single event upset, a supervisory circuit is used to reset the system. 400MHz licensed frequency band is allocated for transmission and reception in LoRa Modulation. The payload shall be placed in 550km low earth orbit by August 2023. By the calculation of link budget, LoRa technology is able to transmit up to 2000 km with 6dBm link margin. The length of the LoRa packet is set to be 32 bytes with a data rate of 152 bps and 2.17 second time on air. If the on-orbit demonstration is successful with uplink and downlink from the system, a low cost computer and LoRa Communication system within a single ARM chip can be used

for S&F CubeSats.