Abstract
This poster describes the development of a new open source sensor platform for the interplanetary Cubesat missions. All the existing earth orbiting Cubesat missions employ a beacon to transmit the housekeeping parameters of the satellite, the limitation being they can transmit only on VHF/UHF or S band. The new sensor platform being developed will be capable of detecting the level of radiation observed at any particular time and will have the capability to transmit this information along with the housekeeping parameters of the satellite using a software defined radio. This system would thus help us in identifying places like the South Atlantic anomaly region, which might exist in different locations in our solar system. This poster’s focus is mainly on the engineering aspects involved in the development of such a platform for the interplanetary Cubesat missions.

Introduction
Until now, Planetary exploration missions are preformed only by various space agencies around the world who have the capability to afford multi-hundred million dollar budgets for these kind of missions. Interplanetary Cubesats offer the opportunity to conduct several other science investigations by reducing the cost budget of the missions by an order of 10. All the earth orbiting & interplanetary satellite missions usually employ a VHF/UHF communication link, which is used to perform payload operations in few missions or to send the health parameters of the satellite by means of a beacon in most of the missions.

There is no standard beacon platform/subsystem in these planetary missions, as these are complex missions and are not usually based on any standard satellite bus like the 3U or 6U Cubesat. There might be many locations in our solar system, which are similar to the South Atlantic anomaly region, hence using an instrument which can record the radiation levels observed during the entire mission phase is vital. A user reconfigurable subsystem that can offer the flexibility to record various health parameters of the satellite along with the radiation levels observed at any point during the mission and transmit this information on a user configurable radio channel would be advantageous.

Platform Architecture

Platform Description
The above figure illustrates the simplified architecture of the proposed beacon platform. The health parameters from the satellite subsystems such as the Attitude Determination and Control subsystem, Power sub-system, Payload and Telecommand radio, different Payload subsystems are relayed to the Beacon platform in the standard PC 104 interface protocol. Additionally the Beacon platform is also equipped with a Radiation Measurement Unit. The measured Radiation data is coupled to the Microprocessing Unit.

The Microprocessing unit packets the data into a predefined standard Beacon format and relay it to Software Defined Radio. The Microprocessing Unit is also responsible for the Command and Control of the Software Defined Radio. The frequency of transmission/reception, modulation, demodulation of data, source coding etc can be changed according to need by the commands of the MCU to the Software Defined Radio.

Radiation Detection
A radiation detector onboard the satellite will provide the information on the level of radiation observed at any particular point during the mission. The radiation detector, which we propose to use in this platform, is a Geiger counter. A Geiger counter is an instrument that detects the presence and the intensity of radiation. The advantage of using this platform to measure the radiation is that, it can be used to provide information about the radiation level irrespective of weather a particle measurement unit is used in the mission or not and will be very useful if multiple Cubesat missions are planned, as various samples of data could be obtained from each one of them. In case, a particle measurement unit is already being used as one of the payloads in a mission, then the Geiger counter can be used as a auxiliary payload to provide data.

Software Defined Radio
A software defined radio is one in which majority of the signal processing is done by using Digital Signal Processing (DSP). The DSP algorithms are implemented using an Field Programmable Gate Array (FPGA). The purpose of using an FPGA is to provide flexibility to run DSP algorithms onboard. It is possible to change various signal-processing variables such as the modulation format, baseband frequency, source coding etc by simply changing the algorithm programmed on the FPGA i.e by calling various files stored in the onboard memory.

The baseband data from/to the FPGA is sent/received to a wideband analog RF front end. The wideband analog front end can be programmed to operate a.k.a send/receive in a range of carrier frequencies. Further the SDR can also be used for Radiometric Tracking of the spacecraft. The spacecraft range is determined by measuring the round trip transit time of an uplinked ranging signal generated by Ground Station on Earth. The Beacon platform locks on and tracks the Ranging signal from Earth.

Hardware compatibility with other Systems
The platform planned is a dual stacked architecture, where the Radiation measurement unit will be partially stacked over the MCU and communication interface. PC-104 standard will be used to interface with the various other subsystems. The hardware design will be compatible with the Cubesat standard, the dimensions being well within 90 X 90 X 30 mm. The subsystem is capable of operating in two modes. One mode(B) in which the MCU and SDR is always sending the beacon every few minutes, which is user definable and other mode(R) in which SDR, MCU and Radiation measurement unit would all function together. The power consumption of the module will depend on the mode in which the subsystem is being operated. The expected power consumption in mode (R) is about 3.75 W. The platform design will adhere to the Cubesat standards and all the component selections and PCB design methodologies will be based on the ESA-ECSS and NASA-GSFC standards. The weight of the platform is expected to be around 650gms.

Conclusion
This project is an idea envisioned by the authors, who are currently graduate students of the Erasmus Mundus SpaceMaster program (www.spacemaster.eu). Sanjay Nekkanti specializes in Space Instrumentation, Vinay Ravindra specializes in Space Robotics and this project is being done under the guidance of Mr. Loganathan Muthuswamy, a retired ISRO scientist. We are writing proposals on this concept and are looking for collaborators and funding agencies to realize this platform for interplanetary missions. We would be glad to accept any suggestions in improving our design.