

**BUSINESS PLAN : USE OF PICOSATELLITE AS
MEANS FOR SECURE PRIVATE COMMUNICATION**

SPACE VENTURE COMPETITION : SEDSIC '07

AUTHORS :

**Shruti Vyas
M. Abhimitra
Himanshu Misra**

INTRODUCTION

Security of information and data has long been a major and cumbersome hurdle in every field of communication, whether it be the military, the government, social or business. Security is a major concern for everyone and requires constant enhancement, as the various methods for breaching security too develop. Reliability on a security system depends on various factors, beginning from track record to the back up technologies. In this complex web of technology based solutions, we offer a sound, reliable and cheap method of highly secure data transfer. **The proposal is the use of Pico-satellites known as CUBESAT for data transmission from anywhere to anywhere on earth.** Detailed discussion about the Pico satellite follows.

ROLE OF CUBESAT FOR INFORMATION SECURITY

CUBESAT is a very small satellite of the size 10cmx10cmx10cm weighing no more than 1 kg. Generally depicting a cube, it uses very small power (not more than 5w) for all its operations. The concept of CUBESAT has been around for 10 years, in which, it has been numerously used to carry a variety of payloads, ranging from cameras for earth imagery to remote sensing. One of the most important and studied payload for standard cubesats have been communication antennae and transponders. **Communication cubesats have been fairly successful even though they have been carried out at university research labs without the help of sophisticated equipments or large investments.** Amongst the various communication cubesats launched till now, one of the successful ones was the AAU CubeSat which was used for receiving and transmitting images and has remained in orbit for a span of 2 years.

THE PROPOSED SERVICES

The final proposal is the use of a cubesat to provide secure communications. As any other Pico satellite in space, it will be orbiting in low-earth-orbit at an altitude of 750 kms. The time period of one rotation is 99 min 54 sec, travelling at a velocity of 7.5 km/sec. The data transfer specifications are as mentioned below:

- **Proposed transceiver: Alinco DJ-C5 transceiver, with mission-specific modifications**
- **Transmission Frequency Range: 144-146 MHz and 430-440 MHz range**
- **Rate of Transmission: 100 kbps (in other cubesats it usually varies from 80-350 kbps depending on transceiver and modem used)**
- **Time slot: 12 min 11 sec for every 99 min 54 sec within India**

The time slot calculation has been done keeping in mind that the cubesat will be flown in a polar orbit over the length of India, and will be able to communicate between any two points within the country. To summarize, a single cubesat will be able to provide communication of approximately 3

hrs per day, in 10 time slots, each ranging 12 min 11 sec. In each slot, 10.5 MB worth data may be sent, allowing the transfer of total of **105 MB of data per day**. This permits the transfer of large amount text data that is kept highly secure using protective encryption and coding methods.

It is proposed that with the success of the first mission, we may use a swarm of cubesats in future in order to get a continuous data link. With the use of 11 cubesats, global services may also be provided. The future investments are expected to be reduced tremendously as the technology develops and we have tested methods of control and a sound track record.

WHY A PICOSATELLITE FOR DATA SECURITY?

The main intentions behind using a cubesat as secure means for communication are:

1. Reliable security due to no third party involvement: By any other means of communication, whether it is e-mail, mobile communication or optical fiber communication, there is always an involvement of a third party, which carries the data from the source to the destination. This makes the information highly vulnerable to tapping. Today, there are various security software's available to encrypt and code the information to the highest extent, yet it is impossible to stop the encrypted data from reaching a third party. The disadvantages in using encryption software are:

- Good encryption software's and algorithms don't come cheap
- Even though the data is encrypted, it DOES reach the 3rd party.

A cubesat provides solution to these problems. In cubesat communication, the signal goes from the source ground station to the cubesat and then to the destination ground station. There are no transmission lines used, hence tapping is impossible. The cost factor is discussed ahead.

2. Problems present in wireless network communication are absent: in wireless communications, the risk of crackers keeps the data highly insecure. Though there are no transmission lines, the signals are transmitted over a wide area, allowing a person just outside the transmission room to access the signals very easily. The cubesat abolishes this problem as it sends the signal directly to the satellite thus avoiding any signal interference.

3. Cost factor: Any communication cubesat yet manufactured has not cost more than 30 lakh Indian Rupees, considering the pre-launch cost requirements. The ground station basically consists of single antenna, a transceiver and a network analyzer, not costing more than 2 lakh Indian Rupees. In an over all, the manufacture costs do not exceed Rs 35 lakh. The design and testing will require some amount of initial investment, which is discussed ahead.

TECHNICAL DETAILS OF A CUBESAT

Communication cubesats use space antennae and a modem to accept signals from the ground station. The signal is amplified and re-transmitted using the transmitter. Till now, all communication in cubesats has been done using amateur radio frequencies, sent and received using transceivers. With government permission a more secure frequency and greater bandwidth may possibly be used.

A cubesat consists of various parts and uses many sub-systems to remain alive and operate efficiently. Among these are :

1. **Power Supply System:** We propose to use triple junction Ga-As solar cells which have an efficiency of upto 26%. The efficiency of the cells is increased using quantum dot technology. Li-ion batteries are used to store the power. Under full charge condition, the batteries operate for 2 hours. The proposed satellite remains in sun cover for 60 min per revolution and the remaining 30 minutes, uses the battery.
2. **Attitude Determination and Control System:** magnetometers are used for the attitude determination and magnatorquers are used for passive attitude control. Micro pulsed plasma thrusters are to be used to get active orientation control.
3. **Data Handling and Control:** This cubesat makes use of a microcontroller (preferably PIC16 or PIC18) for the priority power distribution, calculations for the ADC system and the computing required for communication purposes.
4. **Thermal Control System:** The temperature control is done by passive means using Freon filled cooling pipes so as to maintain the temperature gradient within the cubesat. No moving pumps and fans are used in order to avoid increased weight.
5. **Structure Design:** The external structure is made of Aluminium 6061-T6, which is a cubesat standard, tested and used successfully in the past.

The authors have been working on a cubesat mission for the last 8 months. The team has had gone through 2 phases of competition each time coming up with more sophisticated yet realistic design. We are presently working on a communication cubesat as proposed here that may be presented in the form of a near-working model within 2 months. The authors have sound technical backing with regard to the design. The testing of the design remains.

INVESTMENT AND RETURNS

The design and fabrication of the cubesat requires very less money, as demonstrated by various projects taken up on similar lines. Though none of them have been for used for a commercial purpose yet, the opportunity truly shines ahead for a business with great benefits in future. **The need**

for secure means of communication is undoubtedly very high, and cubesat provides a simple solution for the problem.

The necessary initial investment is required for the design, manufacture and testing of the cubesat. Considering past projects, **it may be estimated that the investment needed will be a sum of 35 lakh Indian Rupees, over a period of one year, in which we will finish the fabrication and testing to give the final ready-for-launch product.** Since the lifespan of a cubesat is approximately 2 years, we may expect the return within this stipulated time period. With the future plans covering the idea of cubesat swarms for greater area coverage, the business may be expected to take rapid growth with more companies pouring in for the services.

Though the technology is profitable, it requires certain initial investment, along with commercial guidance. The plan being a student made one, will require funding by a private company or by a business incubator. We promise returns in a short period of time, as may be seen by the innovative idea itself.

FUTURE – As we see it ...

Our tag line is “POTENTIAL TO PROGRESS”. We will improvise our technologies so as to match the dynamic market. The initial launch consists of a single cubesat. It will be followed by a series of launches consisting of 5 cube Sat for second stage and 11 for third phase , which eventually aims to veil the whole earth and at the same time provide continuous secure data handling.

In short, we have a commitment for growth.

The designs and proposed ideas presented in this work attempt to provide a realistic and fundamentally sound approach to solving the problem of security of data. In order to ensure the highest level of standard as a leader among the Cubesat community, a continual effort must be exerted to constantly analyze, redesigned, and test the existing satellite.

The proposed business plan is ready-to-implement and also sure-to-bring-profits.