Our Own Satellite Network

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Abstract- *Satellite can be defined as a heavy object which goes around object in space due to the effect of mutual gravitational forces, used for broadband communication. In our project, we are making our own satellite network for limited area of campus. We are going to use our satellite for live video streaming, weather monitoring, text communication using satellite etc.*

Keywords- nRF24L01, FPVcam, Transmitting and receiving antennas , Arduino.

I. INTRODUCTION

Wireless communication is undergoing explosive growth, and satellite-based delivery is a major player. With the introduction of satellite personal communication services in the near future, an important step will be made towards the implementation of a global communication infrastructure. Satellite communications were first deployed in the 1960s and have their roots in military applications. Since the 1965 launch of the Early Bird satellite (the first commercial communication satellite) by the U.S. National Aeronautics and Space Administration (NASA) proved the effectiveness of satellite communications, satellites have played an important role in both domestic and international communication networks. They have brought voice, video, and data communications to areas of the world that are not accessible with terrestrial lines. By extending communications to the remotest parts of the world, satellites have helped to allow virtually everyone to be part of the global economy.

Communication by satellite is not a replacement for the existing terrestrial systems but rather an extension of wireless systems. In our project, we are making our own satellite network for limited area of campus.We are going to use our satellite for live video streaming, weather monitoring, text communication using satellite etc.

II. LITERATURE REVIEW

Every satellite communication involves the transmission of information from a ground station to the satellite (the uplink), followed by a retransmission of the information from the satellite back to the earth(the downlink). Hence, the satellite must typically have a receiver antenna, a receiver,[1] a transmitter antenna, a transmitter, some mechanism for connecting the uplink with the downlink, and a power source to run the electronic system. These components are illustrated in Fig. 1 and explained as follows:

• *Transmitters:*

The amount of power that a satellite transmitter is required to send out dependson whether it is GEO or LEO satellite. The GEO satellite is about 100 times farther away than the LEO satellite. Thus, a GEO satellite would need 10,000 times as much power as a LEO satellite. Fortunately, other parameters can be adjusted to reduce this amount of power.

• *Antennas:*

The antennas dominate the appearance of a communication satellite[1]. The antenna design is one of the more difficult and challenging parts of a communication satellite project. The antenna geometry is constrained physic ally by the design and the satellite topology. A major difference between GEO and LEO satellites is their antennas. Since all the receivers are located in the coverage area, which is relatively small, a properly designed antenna can focus most of the transmitter power within that area. The easiest way to achieve this is simply to make the antenna larger. This is one of the ways the GEO satellite makes up for the apparently larger transmitter power it requires.

Power generation:

The satellite must generate all of its own power. The power is often generated by large solar cells, which convert sunlight into electricity. Since there is a limit to how large the solar panel can be, there is also a practical limit to the amount of power that can be generated.

Satellites must also be prepared for periods of eclipse, when the earth is between the sun and the satellite. This necessitates having batteries on board that can supply power during eclipse period and recharge later.

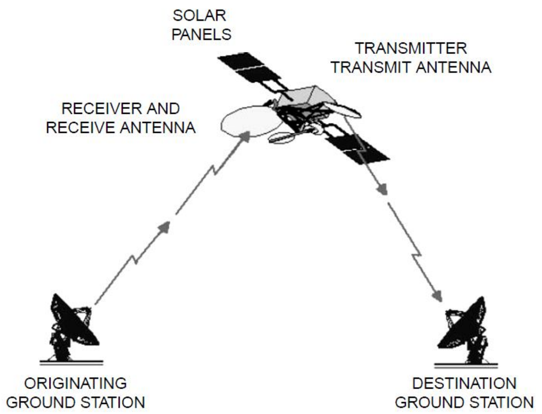

Fig. 1 Basic components o f a communication satellite link.

III. nRF24L01

The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced Shock Burst), designed for ultra low power wireless applications[4]. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 -2.4835GHz. An MCU (microcontroller) and very few external passive components are needed to design a radio system with the nRF24L01. The nRF24L01 is configured and operated through a Serial Peripheral Interface (SPI.) Through this interface the register map is available[2]. The register map contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip. The embedded baseband protocol engine (Enhanced Shock Burst) is based on packet communication and supports various modes from manual operation to advanced autonomous protocol operation. Internal FIFOs ensure a smooth data flow between the radio front end and the system's MCU. Enhanced Shock- Burst™ reduces system cost by handling all the highspeed link layer operations. The radio front end uses GFSK modulation. It has user configurable parameters like frequency channel, output power and air data rate. The air data rate supported by the nRF24L01 is [4]configurable to 2Mbps. The high air data rates combined with two power saving modes makes the nRF24L01 very suitable for ultra low power designs. Internal voltage regulators ensure a high Power Supply Rejection Ratio (PSRR) and a wide power supply.The Satellite is a 26 cm cube, hence it has six sides[3]. The names of the sides are as follows:

Nadir Side: This is the bottom plane of the satellite. The Launch Vehicle Interface (LVI) is attached to the lower surface of this side.

Zenith Side: This is the top plane of the satellite. It is opposite the Nadir Side.

Sun Side: Since the satellite will be in a Polar Sun-synchronous orbit, this side will always face the sun. Sun Side

Antisun Side: This side never faces the sun. It is opposite the Sun Side.

Leading Side: The normal to this side, pointing away from the center of the satellite, points along the direction of the velocity vector of the satellite in orbit.

Lagging Side: The normal to this side, pointing away from the center of the satellite, points opposite to the direction of the velocity vector of the satellite in orbit. It is opposite to the Leading Side.

The power is often generated by large solar cells, which convert sunlight into electricity. Since there is a limit to how large the solar panel can be, there is also a practical limit to the amount of power that can be generated. Satellites must also be prepared for periods of eclipse, when the earth is between the sun and the satellite. This necessitates having batteries on board that can supply power during eclipse periods and recharge later[1].The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced Shock Burst), designed for ultra low power wireless applications. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 -2.4835GHz. An MCU (microcontroller) and very few external passive components are needed to design a radio system with the nRF24L01[2]. The nRF24L01 is configured and operated through a Serial Peripheral Interface (SPI.) Through this interface the register map is available. The register map contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip. The air data rate supported by the nRF24L01 is configurable to 2Mbps. The high air data rates combined with two power saving modes makes the nRF24L01 very suitable for ultra low power designs[2]. The primary goal of the Communication and Ground Station subsystem is to establish a communication link between the Pratham satellite and the ground station at IIT Bombay and measure the plane of polarization of the signals[3]. Onboard the satellite, all the components of the Communication Sub-system is placed on the Antisun Side; with the exception of the uplink circuit which is placed on the Lagging Side. There are 3 pre-deployed monopole antennas, 2 of which are used for transmitting linearly polarized signals with a polarization purity of greater than 99.9% (30dB). The monopoles are mounted away from the Nadir Side to obtain the desired radiation pattern. There is a low bit rate Beacon at 145.98 MHz frequency transmitting throughout the world in OOK modulation[3]. There is also a high bit rate (1.2kbps) 437.455 MHz CC1020 circuit for downlink of data only above

India. Power System efficiently provides power to all sub-systems at the required voltage levels. The power system comprises of one circuit board with the microcontroller, battery protection circuit, voltage regulators, current distribution switches, etc. which interfaces with all the onboard systems. The power circuit board with dimensions of 12.8 x 12.8 cm is mounted on the Sun Side. For power generation, there are solar panels on 4 sides of the satellite (Zenith, Leading, Lagging and Sun Sides). The battery and the battery box are mounted on the Nadir Side[3].Our project is to monitor weather conditions including atmospheric humidity & atmospheric temperature with help of GSM modem. Local weather measurements are extremely important to a wider range of professions, from horticulturists to fire fighters[4]. It provides around the clock monitoring of various types of applications. For example, it can be used in greenhouse to manage climate control and help to promote favorable growing conditions. On green roofs, it can help researchers understand performance by tracking soil moisture and air temperature[4].The wireless weather monitoring in varied areas ranging from agricultural growth and development to industrial development[5]. The weather conditions of a field can be monitored from a distant place by farmers and won't require them to be physically present there in order to know the climatic behavior at the location by using wireless communication. It will be of great use in the war affected regions as it would be risky for farmers to visit their farm regularly, instead now they could monitor their farm from their home[5]. Satellite technology is a solution for some of the most complicated access problems, connecting cities across a large landmass, where copper or fiber would be cost-prohibitive, bringing broadband to the last mile‖ of residences and businesses[6].Satellite communications feature superior Reliability. When terrestrial outages occur from man- made and natural events, satellite connections remain operational. Satellite is unmatched for broadcast applications like television. For two-way IP networks, the speed, uniformity and end-to-end control of today's advanced satellite solutions are resulting in greater use of satellite by corporations, governments and consumers[6]. The wireless arduino weather station has a capability of working on low power. Hence it is not much dependent on power source. The device is also made of low cost items and around ±1 unit error accuracy[7]. As an application, a normal person can place this device at various places like in his backyard garden for soil moisture and rain water readings, indoor swimming pool for the maintenance of water temperature and humidity in air. This weather has an external feature of a website access all around the world. It attempts to show live feed of readings from that environment where the result is required[7].

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