



Balloon Powered Internet Access in Remote and Rural Regions

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Abstract - At present we seek the service of Internet Service Providers to connect us to the global network. The telephone companies or the telecommunication operators provides this kind of service for us. This is reachable to only one out of three in the world's population . The remaining people are not able to get internet access. It is not an easy task to lay the telecommunication lines all around the world to provide internet connection everywhere . Since the developing countries cannot afford such a huge sum of money to lay fiber cables, this will not be the optimal solution. To provide internet facility in remote places and rural areas, we need a high altitude platform. Google came up with a innovative solution to use balloons to provide internet connection in remote regions. Balloons are used for numerous purposes but here it is used to provide internet connection in remote regions. This project is a network of balloons floating in the stratosphere. It acts as a wireless station and provides internet service to the rural areas and remote regions in a cost-effective manner.

Keywords: Envelope; user antenna; wind data; solar panel;

I. INTRODUCTION

Internet is a global system of interconnected network to serve billions of users. It is a network of networks. We are bouncing from **3G** (Third Generation) to **4G** (Fourth Generation) yet, there are still people who don't get internet access . It is found that, for every two in a group of three of world's population, internet is unreachable technology. The use of satellite internet communication is also very expensive and common people cannot afford it. In order to overcome this problem, we can use fibre cable connections, since the developing countries cannot afford such a huge sum of money to lay the cable all over the country it would not yield optimal solution. Google searched for the solution somewhere around like the skies, which popped up with an innovative concept of balloon powered internet access to all. The quest resulted in '**Project Loon**'. Through this they are able to bring internet access to all the remote areas at an affordable price. The project Loon is an aerial balloon network. It flies at an altitude of 20 km (kilo metres) above the earth surface in the stratosphere, and they provide wireless mobile network station in sky with up to 3G speeds. Utilizing the help of wind data obtained from the **NOAA** (National Oceanic and Atmospheric Administration) they govern the balloon movements. The balloons are equipped with transceivers to send and receive the signals which travel in the balloon network before reaching the ground station. In turn it joins the global network by establishing connection with **ISP** (Internet Service Provider) or using **LTE** (Long Term Evolution) technology we can directly connect to network using mobile phones.

II. THE LOON'S TECHNOLOGY

The technology implemented in this project avoids use of expensive fiber cables. Most of the equipments used in loon can be reused and recycled hence this loon is safe and environment scientific research.

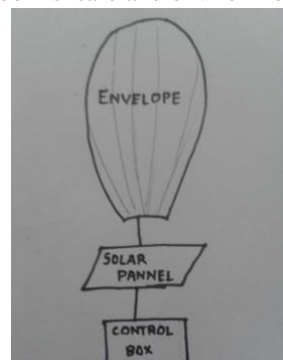


Fig. 1 Architecture of System

A. Envelope

The inflatable part of balloon is made of sheets of polyethylene plastics, which is about 3 mil or 0.076 mm thickness. It forms the balloon envelope. When filled with Helium, it stands 15m (49 ft) wide and 12m (39 ft) tall, on

full inflation. They are long-lasting than conventional weather balloons. These are super pressure balloons and have a maximum life time of 55 days. When a balloon is to be pulled out of service, first we have to release the gas in the balloon. This is achieved with the implementation of a custom air pump system, which is used to release air from or pump into the balloon in a periodic manner for controlled descent. Unfortunately, if the balloons drops quickly or when the balloon is to be picked out of network safely, we use a parachute which is fixed at the top of the envelope.

B. Solar Panels

The electronics of each unit are powered by solar panel array which is conveniently placed between the envelope and hardware part. These panels generate a power of **100 W** (Watt) in full sun that is sufficient enough to run the entire unit during day time and for charging the battery, to use at night.

C. Control Box

A small box weighing 10 kg hangs below the balloon's envelope which has all Wi-Fi circuits, batteries, a Linux-based computer, **GPS** (Geographical positioning System) devices and sensors to record the temperature of air, altitude of balloon and its speed and circuit boards to control the unit.

III. NAVIGATION OF LOON

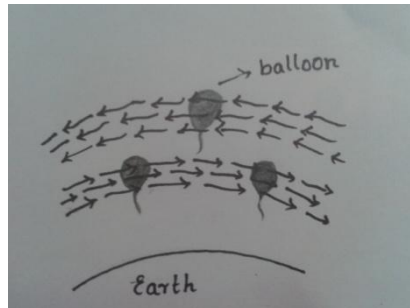


Fig. 2 Balloon movement in stratosphere

The balloons move by navigating the wind in the stratosphere. At stratosphere (twice the range of aircrafts travel altitude), 20km above the surface of earth, winds prefer to move in specific direction. There are different wind layers in stratosphere. Each layer varies in its direction and magnitude. We can determine the direction of wind from the wind data provided by NOAA and direct the balloons movement. The balloons are made to raise or fall to the desired altitude and move in desired direction at the specified speed by inflating or deflating the envelope using an air pump fixed in the setup. Actual life of balloons is estimated to be 100 days but, we can replace it constantly once in 55 days for checking which avoids unexpected failures. By doing so we could keep the balloon updated. Within this period it flies approximately 3 times around the globe. The extreme altitude presents many challenges to the loon like air pressure, extreme low temperature, less protection from UV(Ultra Violet) rays and the temperature swings. Yet it is able to overcome all these hurdles and withstand these conditions only by the perfect designing of balloon envelope. Hence, balloons are able to form a large communication network in the stratosphere.

IV. ESTABLISHING THE NETWORK

The balloons form a network of airborne hot spots. It can deliver internet access over a broad area of about 1250 square kilometres at speeds comparable to 3G. For communication between balloon to balloon and to communicate to ground stations it uses a specialized radio frequency technology. Presently, the project loon uses **ISM bands specifically 2.4-5.8 GHz** bands.

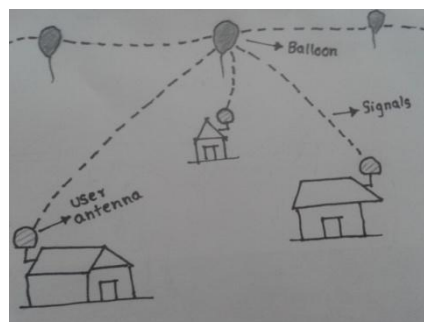


Fig. 3 Establishment of internet connection

Each balloon unit has three transceivers for different purposes. First one is for the balloon to balloon communication and the second one is for balloon to ground communication and the other is the backup utility. The reflector plate placed between the antenna on top and radio in bottom is equipped together in the control box. It is used to establish the network connection. The head is composed of two parts which are called as "patch antenna" together. They serve to receive the signals reflected from the plate and direct signals. These signals when coupled together forms

the signals to be transmitted. Users are able to achieve connection to the network (balloon) with the help of a basket ball sized antenna attached to their building. It resembles a big bright red party balloon and can be conveniently placed anywhere on their building. The signals are sent and received with the help of this antenna.

V. CONNECTING PEOPLE

Once the entire setup is assembled then the balloon will be able to provide internet coverage for an area of 40 km in its diameter. Initially we can send and receive signals using the radios and antennas within the balloon network system alone. But now using a special technology called LTE, people can connect to network using their mobiles and other LTE-enabled devices. The users send signals by the stationary antenna fixed on their building. The top of the balloon envelope consists of a reflector disc and a pair of patch antenna kept parallel. The signals from the user are reflected to the patch antenna and at the same time it also receives direct waves. These two waves interfere constructively only for the particular signal wavelength that are to be received by the balloon. The received signals bounce from balloon to balloon and finally reaches the ground station which are spaced about 100 km (62 mi) apart and there it joins the global network with pre-existing infrastructure for internet service like our local telecommunications partners. This is cost effective compared to the usage of satellite communication service, where the cost charged exceeds the monthly income of a common man. The developing countries that cannot afford to lay fibre cables is greatly benefited through this technology.

VI. PILOT TESTS CONDUCTED

This Project loon balloon network so called Google balloon is a research and development project by Google. Several pilot tests were conducted to improve its performance. One among them was conducted in New Zealand on June 2013 at Christchurch. Initially 40 balloons were launched. They offered 18 minutes of balloon based internet for 60 lucky volunteers on 40th parallel south. The results of these tests are being used in the refinement of technology and the feedback is also used for the betterment of next phase of testing. National Space Research Institute of Brazil (Inpe) ran a test in São Paulo state. It yielded a positive response. The balloon was able to broadcast an Omni-directional internet signal from 31 miles away. Google is trying to test all manners of materials subjecting them to temperature resistance, durability, etc., Small private tests were conducted in California also. These tests are conducted with an urge to add more sophisticated technologies and to increase the balloons performance.

VII. CONCLUSION

Internet is emerged as the basic need in day to day life. While one part of the world is getting improved in a tremendous speed with the help of internet connection, about 2/3 of population is not even able to access it. Google tried to fill this void by the 'Project Loon' and fix the broadband problem. Project loon is one of the biggest idea of Google. It acts as a wireless station for an area of about 25 miles in diameter. The technique to bring mobile internet connectivity to billions of people using balloons may sound crazy but it might work. Google states that "It is highly experimental technology we have long way to go". This innovative attempt made by the Google to provide connection to rural areas and remote regions that deserve internet connection is an inspiring effort. The launch of 'Project Loon' made balloons too an option to provide internet access everywhere that too in a cost effective manner.

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