



# Internet Balloon

## (Connecting remote areas through Google balloon Powered internet facility)

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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 provide this service. This is reachable only to 1/3 of the world's population. The remaining 2/3 are not able to get internet access. In order to provide internet connection to everyone around the globe especially, it is not possible to lay the telecommunication lines all around. 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 access to rural and remote areas, we need a high altitude platform. Google has introduced the new idea of balloon powered internet access. The 'Project loon' is a network of balloons travelling in the stratosphere, which acts as a wireless station, providing internet to the rural and unreachable areas, 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 have internet access at all. It is found that, for every two among 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, usage of fibre cable would not be the optimal solution, since the developing countries cannot afford such a huge sum of money to lay the cable all over the country. Google searched for the solution somewhere around like the skies, which brought out the idea of balloon powered internet access to all. The quest resulted in 'Project Loon'. Through this they are able to provide internet access to all the remote areas at an affordable price. The project Loon is a network of balloons floating around in

the edge of sky to connect rural and remote areas. The balloon travel in the stratosphere, at an altitude of about 20 km (kilo metres) above the earth surface and they provide an aerial wireless network with up to 4G speeds. With 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 signals. These signals travel through the network of balloons before reaching the ground station, which is in turn connected to ISP (Internet Service Provider) and joins the global network.

### II.THE LOON'S TECHNOLOGY

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

#### A. ENVELOPE



Fig.1: Fully inflated balloon envelope

The inflatable part of balloon made of sheets of polyethylene plastics, which is of about 3 mil or 0.076 mm thickness. It forms the balloon envelope. These balloons are filled with Helium and stands 15m (49ft) wide and 12m (39ft) tall when fully inflated for a height. They are long-lasting than normal weather balloons and withstand the high pressure from the air inside as the balloon when it reaches the high float altitude. These are super pressure balloons and have a maximum life of 55 days. When a balloon is to be taken out of service, gas is released in a periodic manner for controlled descent. This is implemented with the help of a custom air pump system, which used to pump in or release air from the balloon. Unfortunately, if a balloon drops quickly or when it is to be taken out of service safely, we deploy a parachute attached to the top of the envelope.

#### B. SOLAR PANNELS



Fig.2: Renewable power source - Solar panels

The electronics of each unit are powered by an array of solar panels conveniently placed between the envelope and the hardware. In full sun these panels produce a power of **100W** (Watt) that is sufficient to keep the unit running and also for charging the battery for use at night.

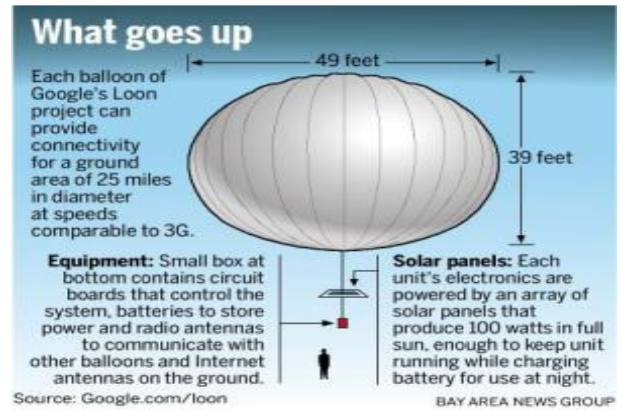


Fig.3: Balloon architecture

#### C. CONTROL BOX

A small box weighing 10kg hangs underneath the inflated envelope which contains all Wi-Fi circuits, batteries, circuit boards to control the unit and a Linux based computer, **GPS** (Geographical positioning System) devices, sensors to record air temperature, altitude and the speed of balloon movement. Google has not yet conformed the material to be used for the envelope. The Loon developers suggested that the balloon equipment can be reused and recycled.

### III.NAVIGATION OF LOON

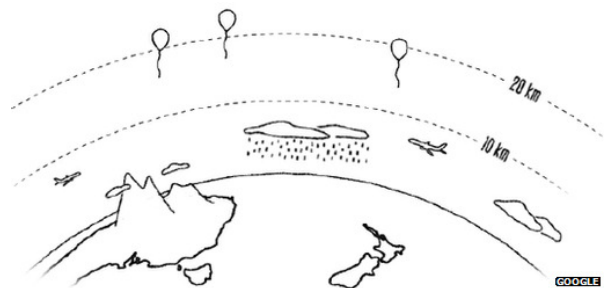


Fig.4: Balloon in stratosphere

The project loon balloon moves by navigating the wind in the stratosphere. At stratospheric altitudes (twice as high as aircrafts fly), 20km above the earth surface winds tend to move in specific directions where there are different wind layers. Each layer varies in direction and magnitude. With the help of wind data obtained from NOAA and by the use of many complex software algorithms, they determine where the balloon must move. The custom built solar powered pump is used to inflate or deflate the balloon

remotely from the ground. As a result each balloon rises or falls to the desired height and move in the required direction at required speed. Actual life time of balloons is 100 days but, Google replaces it constantly once in 55 days for checking which avoids unexpected failures. By doing so the company aims to keep the balloon updated. Within this time period it travels approximately 3 times around the globe. The extreme altitude presents many challenges to the loon like air pressure, very low temperature, thinner atmosphere, less protection from **UV** (Ultra Violet) rays, temperature swings. Yet the balloon is able to overcome all these hurdles and withstand these conditions only by the perfect designing of balloon envelope. Thus 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 that can deliver Internet access over a broad area of about 1250 square kilometres at speeds comparable to 4G. For communication between balloon to balloon and 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.5: User antenna to communicate with balloon each balloon unit has three transceivers for different purposes. One is for balloon to balloon communication and one more for balloon to ground communication and the other one is the backup utility. There are two main components inside the shell (Control box) the radio in the bottom and the antenna towards the top, separated by a reflector plate are used to establish the network. The top is made up of two green parts that together are called a "patch antenna". These receive reflected waves that bounce off the reflector and go up into the patch along with direct waves. Users are able to connect to the network (balloon) with the help of a basketball sized antenna attached to our building. It resembles a big bright red party balloon and is convenient to

place anywhere in our building. The signals are sending and received with the help of this antenna.

#### V. CONNECTING PEOPLE



Fig.6: Transmission of signals

Once the trifecta of balloon, antenna and local **ISP** is complete, each balloon is theoretically capable of bringing internet connectivity for everyone in a 12 mile radius. The radios and antennas are designed such that it can send and receive signals from project loon only. The users send signals by the stationary antenna attached to 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. Simultaneously, it also receives direct waves. These two waves interfere constructively only for the correct wavelength that are to be received. The received signals bounce from balloon to balloon and finally reaches the ground station which are spaced about 100 km (62 mi) apart and joins the global network with pre-existing internet infrastructure, like our local telecommunications partners. This is cost effective compared to satellite communication, where the service cost exceeds the monthly income of a common man. The developing country that cannot afford to lay fibre cables is greatly benefited.

#### VI. PILOT TESTS CONDUCTED

Project loon is a research and development project. Several pilot tests are done to improve its performance. One among them was conducted in New Zealand on June 2013 at Christchurch.





Fig.7: Pilot test in New Zealand

They offered 18 minutes of balloon based internet for 60 lucky volunteers on 40th parallel south. Initially 40 balloons were launched. 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 broad cast an Omni-directional internet signal from 31 miles away. Google is trying to test all manners of materials subjecting them to durability, temperature resistance etc., Small private tests were conducted in California also. These tests are conducted with a motive to add more sophisticated technologies and to increase the balloons performance.

## VII.CONCLUSION

Internet has become one of the basic needs in day to day life. One part of the world is getting improved in a tremendous speed with the help of internet, while 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 broad band problem. Project loon, one of the biggest ideas of Google, acts as a wireless station for an area of about 25miles in diameter. The vision to bring mobile internet connectivity to billions using balloon. The balloon powered network may sounds crazy but it might work. Google states that "It is highly experimental technology we have long way to go". It is an early and inspiring attempt made by the Google to provide connection to rural and remote areas that deserve internet connection. The launch of this project made balloons also an option to provide internet access to rural and remote areas that too in a cost effective manner.

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