# Review on Project Loon

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**The Internet is one of the most transformative technologies in human beings life. But for 2 out of every 3 people on the earth, a fast, an affordable Internet connection is still out of reach. And this is very far from being a solved problem. There are many terrestrial challenges to the Internet connectivity—jungles, archipelagos, mountains etc. There are cost challenges also. Solving these problems is not simply a question: it requires looking at the problem of access from the new angles. "PROJECT LOON" is one such initiative taken up by the Google to solve the above mentioned problems. Team Loon believes that it might actually be possible to build the ring of multiple balloons, flying around the globe on the stratospheric winds, that provides the Internet access to anybody. They built a system that uses the balloons, carried by wind at altitudes twice as high as the commercial air planes, to beam Internet access to the ground at speeds similar to today's 3G networks or faster. As a result, they hope balloons could become an option for connecting the rural and remote areas. And they hope it would help in communications after the natural disaster. The idea may sound a bit crazy—and that is part of the reason we are calling it Project Loon, but there is solid science behind it. The balloons are maneuvered by adjusting their altitude to float to a wind layer after identifying the wind layer with desired speed and direction using the wind data from the (NOAA). People connect with the balloon network with the help of a special Internet antenna attached to their buildings. The signal moves through the balloon network from balloon to balloon, then to a ground-based station connected to an Internet Service Provider (ISP), then onto the global Internet. The system aims to bring the Internet service to remote and rural areas badly served by existing provisions, and to refine the communication during natural disasters to affected regions. Key people involved in the project was Rich DeVaul, chief technical architect, who is also an expert on wearable technology; Mike Cassidy, a project leader; and Cyrus Behroozi, a networking and telecommunication lead.**

**Keywords**— ***Include at least 5 keywords or phrases***

## I. INTRODUCTION

Project Loon is a network of balloons traveling on the edge of space, designed to connect the people in rural and remote areashelping to fill the coverage gaps, and bringing people back online after the natural disasters.In 2008, Google had considered contracting with or acquiring Space Data Corp., a company that sends the balloons carrying small base stations about 20 miles up in the air for providing connectivity to truckers and the oil companies in the southern U.S, but didn't do so Unofficial development on the project began in 2011 in Google X Lab with a series of trial runs in California's Valley. This project was officially announced as a Google project on 14 June 2013.

Project Loon balloons travel around 20 km above Earth's surface in the stratosphere. Winds in the stratosphere are generally steady and slow-moving between 5 and 20 mph, and each layer of the wind varies in direction and magnitude. Project Loon uses the software algorithms to determine where its balloons need to go. By moving with the wind, the balloons can be arranged to form one large communications network between 10 km and 60 km altitude on the edge of space.

## II. WHAT IS PROJECT LOON?

It is research and development project being developed by GOOGLE with the mission to provide Internet all over the world via a ring of balloons floating in the sky, about 20 kilometres above the ground.The basic idea behind this project was that they will fill up multiple High-altitude balloons that will go above the clouds without human i.e. around 20Km above the ground level in Stratosphere.

The technology designed in the project could allow countries to avoid using expensive fiber cable that would have to be installed underground to allow users to connect to the Internet. Google feels this will greatly increase Internet usage in developing countries in regions such as Africa and Southeast Asia that can'tafford to lay underground fiber cable.

The high-altitude polyethylene balloons fly around the world on the prevailing winds (mostly in a direction parallel with lines of latitude, i.e. east or west). Solar panels supplied by Power Film, Inc about the

size of a card table that are just below the free-flying balloons generate enough electricity in four hours to power the transmitter for a day and beam down the Internet signal to ground stations. These ground stations are spaced about 100 km (62 mi) apart, or two balloon hops, and bounce the signal to other relay balloons that send the signal back down.

This makes Internet access available to anyone in the world who has a receiver and is within range of a Balloon. It is incalculable how technologies that rely on short communications times (low latency pings), such as Voice Over Internet Protocol(VoIP), might need to be modified to work in an environment similar to mobile phones where the signal may have to relay through multiple balloons before reaching the wide Internet.

## III. PURPOSE OF PROJECT LOON

Many of us think that the internet as the global community But 2/3 of the world 's population does not yet have the internet facility. In Project Loon, balloons float in the stratosphere as twice as high as airplanes .People connect to the balloon network using a special internet antenna attached to their building.The signal bounces from balloons to balloons then to the global internet back on earth. Each balloon is equipped with a Global Positioning System (GPS) for tracking its location. Entire earth can communicate using Internet provided by GOOGLE BALLOON.

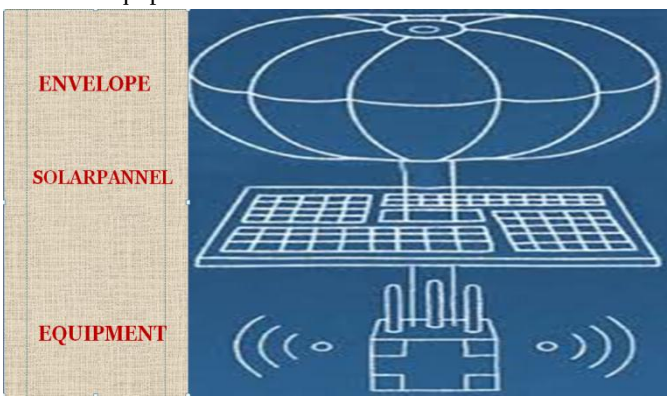
- It can improve communication during any disaster to affected regions.
- It will be available at all places, even in Sahara Desert.
- It can improve Internet usage in developing countries in region such as Africa and Southeast Asia that can't afford underground fiber cable for providing internet connectivity.
- It is fast, efficient and more reliable than wired broadband connection

Project Loon now a days uses ISM bands that are available for anyone to use.The industrial, scientific and medical (ISM) radio bands .Radio bands reserved internationally for the use of radio frequency (RF) energy for industrial, scientific and medical purposes other than communications. By moving with the wind, the balloons can be arranged to form one large communications network.

## IV.ARCHITECTURE OF PROJECT LOON

The Project loon relies on three parts:

1. An Envelope,
2. Solar panels,
3. Equipment.




(Fig. 4.1) Architecture of Project Loon

### (A) PROJECT LOON'S BALLOON

The balloon envelope is the name for the inflatable part of the balloon.

(Fig. 4.2) Envelope

Envelopes are made from the sheets of polyethylene plastic and stand 15 meters wide by 12 meters tall when fully inflated. The balloon powers itself by two renewable energies, sunlight and wind.

Its envelope is made from sheets of Mylar which is a brand for a thin strong polyester film about 0.076 mm thick. It is built to resist higher pressures than a normal weather balloon which reaches at an altitude of 40 km(approx.). Inside the envelope, there is another chamber, called Bladder. To make the balloon fall downwards, a fan powered by the solar energy fills the bladder with the air to make it heavier. Likewise, the fan vents air in the bladder, which causes it to rise. The balloon can move up or down a 1.7 km (1 mi) range through the bladder system. This system can help to choose suitable wind currents in stratosphere.It also releases some air inside out of the envelope to relieve pressure. When being out of the service, it releases gas from the envelope and descends slowly to the ground. It rarely happens, but when the balloon drops quickly, it uses the parachute on the top of the envelope.

### (B) SOLAR PANNELS

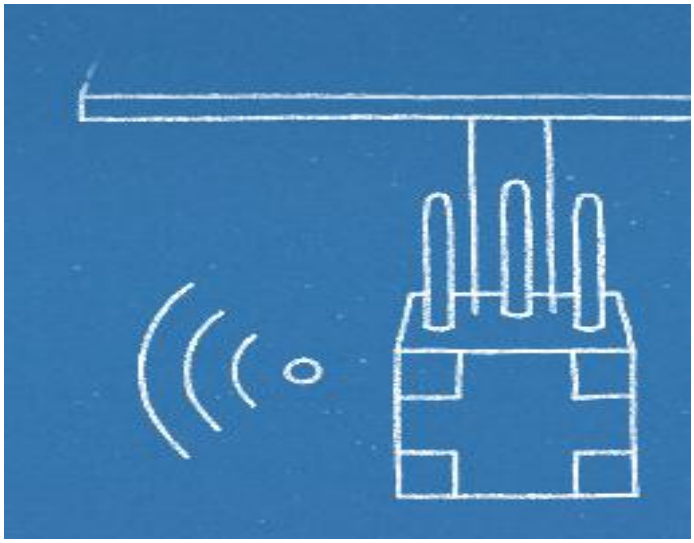
(Fig. 4.3) Solar Panel

Each balloon's electronics are powered by an array of solar panels. The solar array is a plastic laminate supported by light-weight aluminium frame. It uses high efficiency monocrystalline solar cells.

The panels produce approximately 100 Watts of power in full sun, which is enough to keep Loon's running while also charging a battery for use at night. By moving with the wind and charging in the sun, Project Loon is able to power itself using entirely renewable energy sources.By moving with the wind and charging in the sun, Project Loon is able to power itself using only renewable energy sources. Lithium ion batteries to store solar power so the balloons can operate throughout the night.

### (C) EQUIPMENT:

A small box containing the balloon's electronic equipment hangs underneath the inflated envelope, like the basket that is carried by a hot air balloon.



(Fig. 4.4) EQUIPMENT

Inside each box thereis a mini-command center: radio sensors, satellite receivers, and Wi-Fi electronics along with a stack of custom Google X circuit-boards.

These computers measure the acceleration, take temperature measurements, run communications between the satellite and the Wi-Fi networks, and who knows what else. This is how Google Mission Control talks to each Loon and tells it what to do.It also contain the batteries to store solar power so the balloons can operate during the night.

The loon antenna shaped in circular manner marking the symbolism of balloon. They are attached to the households or workplaces wherever the internet connectivity needs to be established.

(Fig. 4.5) ANTENNA

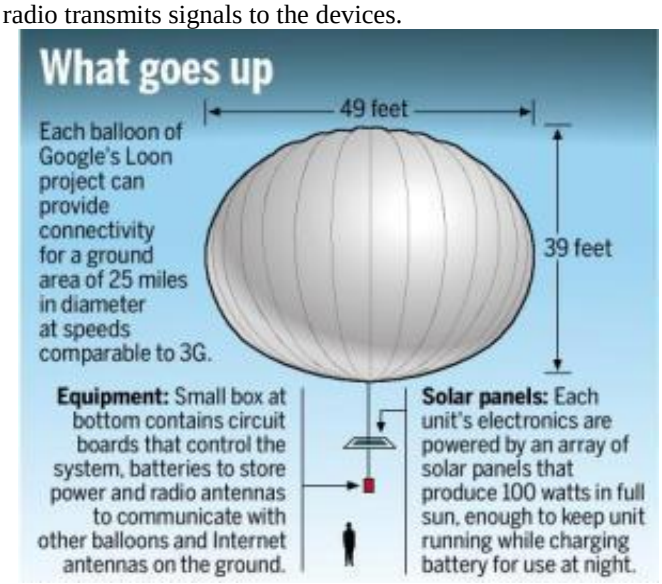
The Loon Antenna comprises of the following parts:-

a)Patch Antenna

b)Reflector

c)Radio

The top part of the interior of the shell is made up of a reflector disc, a pair of parallel patch antenna (radiating elements) perched a few inches above the disc, and a pair of cables leading down to radio, which lives in the bottom half of the bulb.The patch antenna receive the reflected radio waves from the reflector disc as well as the direct waves.The radio transmits signals to the devices.




(Fig. 4.6) Work of Project Loon Parts

## V. TYPES OF RADIO TRANSCEIVERS

There are three types of Radio Transceivers used in Project Loon:

1. Balloon-to-Balloon Communications.
2. Balloon-to-Ground Communication.
3. Third for Backup.

## VI. PROCESS OF PROJECT LOON

Project Loon balloons travel approximately 20 km above the Earth's surface in the stratosphere. Project Loon uses software algorithms to determine where its balloons need to go, then moves each one into a layer of wind blowing in the right direction. By moving with the wind, the balloons can be arranged to form one large communications network. The Loon team can access the web-based control system from any computer or tablet.Project Loon is able to take advantage of the stratosphere's steady winds and remain well above weather events, wildlife and airplanes.The high-altitude polyethylene balloons fly around the world on the prevailing winds (mostly in a direction parallel with lines of latitude, i.e. east or west). Solar panels supplied by Power Film, Inc about the size of a card table that are just below the free-flying balloons generate enough electricity in four hours to power the transmitter for a day and beam down the Internet signal to ground stations. This makes Internet access available to anyone in the world who has a receiver and is within range of a balloon. Currently, the balloons communicate using unlicensed 2.4 and 5.8 GHz ISM bands, and Google claims that the setup allows it to deliver "speeds comparable to 3G" to users Powering it all is a 600-watt battery, charged by solar panels on a carbon fiber frame atop the box. These large, extra-light photovoltaic cells -- amorphous silicon crystals on

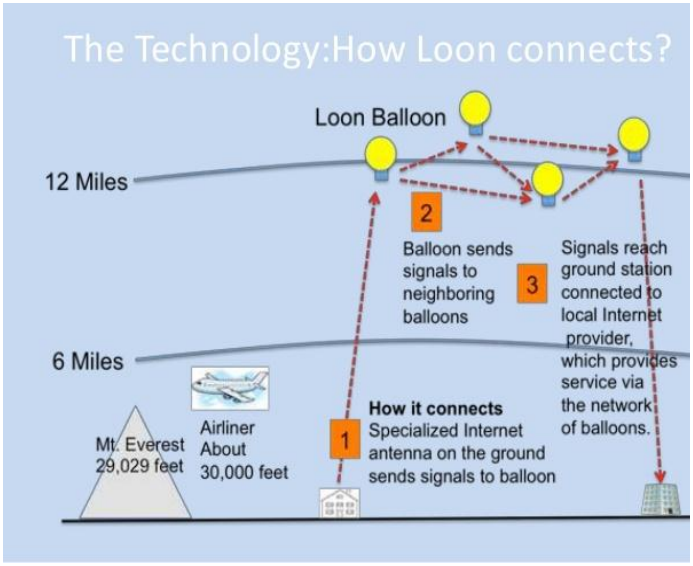
a fabric substrate - keep the weight of the balloon low so that the Loons can run for long missions without landing.

Each Loon balloon has three radio frequency antennas (on 2.4 Ghz and 5.8 Ghz bands) and a ground-pointing WiFi antenna, which beams an Internet signal to Earth in a 12-mile radius.

In addition to Mission Control, Google's Loon balloons can talk to each other, and control themselves.We use a distributed mesh network, so each balloon is pretty autonomous and has pretty much the same hardware in it," SameeraPonda, a lead aerospace engineer at the Dos Palos site that day, said on the video stream. "As one balloon floats over a certain area that balloon is talking to the ground antennas, and as that balloon floats away, another balloon comes in and takes its place, so it's a pretty seamless operation."

Each balloon can provide connectivity to a ground area about 40 km in diameter using a wireless communications technology called LTE. To use LTE, the Project Loon partners with the TELECOM companies to share cellular spectrum so that the people will be able to access the Internet from anywhere directly from their mobile phones and other LTE-enabled devices.

Balloons relay wireless traffic from cell phones and other devices back to the global Internet using high-speed links.




(Fig. 6.1) Loon Connectivity

Project Loon balloons travel around 65,000 feet above the Earth's surface in the stratosphere. Winds in the stratosphere are generally steady and slow-moving at between 5 and 20 mph, and each layer of wind varies in direction and magnitude. Due to the wind properties, balloons can travel along latitude line with a ± 5° latitude range.


(Fig. 6.2) Loon Floating

Google began a pilot test on 16 June 2013, when thirty balloons were launched from New Zealand's South Island and beamed Internet to a small group of pilot testers.

About 50 local users in and around Christchurch and the Canterbury Region tested connections to aerial network using the special antennas.


(Fig. 6.3) The Pilot Test

(Fig. 6.4) Loon Movement

The Antenna receives a clear signal as Polarization is used and the Polarization means direction of electromagnetic waves are oscillating with the wind.
To avoid this cross-polorization issue,2 antenna are placed to receive signals driving in any direction and making their bandwith double.
Google claims that the loon can deliver speed of 2.0MBps to 7.5MBps.

*ENGINEERING CHALLENGES:*
Moving of balloons in the stratosphere possess many challenges:

- Air pressure is 1% of that at Sea Level.
- Temperatures hover around -50°C.
- A thinner atmosphere offers less protection from the UV radiation and temperature swings caused by the Sun's rays.

## VII. PROS OF PROJECT LOON

- This project will offer worldwide access to everyone those who are as per now beyond the geographic reach of the internet.
- It providesthe connectivity at speeds comparable to 3G for about area of 40 km in the diameter.
- Wireless connection to the Web available for free to every person in the world.
- It would offer a humanitarian communication system,during emergencies in places where communications link has broken up during the natural disasters.

## VIII. CASE STUDY

On 16 June 2013, Google began a pilot experiment in the New Zealand where about 30 balloons were launchedin coordination with the Civil Aviation Authority from the Tekapo area in the South Island.
After this initial trial, Google plans to send 300 balloons around the world atthe 40th parallel south that would provide coverage to New Zealand, Australia, Chile, and Argentina.
Google hopes to eventually have the thousands of balloons flying in the stratosphere.
The first person to get Google Balloon Internet access this week was Charles Nimmo, a farmer andentrepreneur in the small town of Leeston. He found the experience a little bemusing after he was one of50 locals who signed up to be a tester for a project that was so secret, no one would explain to them whatwas happening. Technicians came to the volunteers' homes and attached to the outside walls bright redreceivers the size of basketballs and resembling the giant Google map pins.
In May 2014 Astro Teller announced that rather than negotiate a section of bandwidth that was free forthem worldwide they would instead become a temporary base station that could be leased by the
mobile operators of the country it was crossing over.
In May-June 2014 Google tested its balloon-powered internet access venture in Piauí, Brazil, marking its First LTE experiments and launch near the equator. In 2014 Google partnered with France's Centre nationaldetudesspatiales (CNES) on the project.
Each balloon would provide Internet service for an area twice the size of New York City, about 1,250square kilometres, and terrain is not a challenge. They could stream Internet into Afghanistan's steep
and winding Khyber Pass or Yaounde, the capital of Cameroon, a country where the World Bank estimatesfour out of every 100 people are online. Google engineers studied balloon science from NASA, theDefense Department and the Jet Propulsion Lab to design their own airships.

## IX. FUTURE SCOPE

MDIF plans to formally request NASA to use the Inter National Space Station to test their technology in September 2014.
Manufacturing and launching of satellite would begin in early 2015, and Outer net is planned to begin broadcasting in 2015.
Indian company Specify Inc. Is the private non-profit company which is working with outer net to provide global free WI-FI access.
FORGET THE INTERNET- SOON THERE WILL BE OUTERNET.

## X. CONCLUSION

Google's vision for Project Loon procures schooling for those currently without education, brings doctors for people who cannot travel to see one, and provides important weather data to assist farmers, whose harvests are affected by droughts and floods.Illiteracy, Disease and Famine could be dealt a swift and telling blow with a little Wi-Fi and according to Team Loon, balloons stationed so high above the earth they can only be seen with a telescope, is the most affordable and best way to achieve this.

"The materials are pretty inexpensive," says Project Loon's Richard DeVaul. "The plastic of the balloons is similar to that in shopping bags and the electronics aren't that different from consumer electronics. This is a very cost-effective way to connect the world."There is near about 75% comment is in the favor of project loons. As per the experts there would be great

Success for this Project in Future. And we hope balloons could become an option for connecting rural, remote, and underserved areas, and for helping with communications after natural disasters.Long distance tracking experiment of loon on 40th parallel south.There are many rules regarding airspace and who controls it, and also disagreements as to how far (up) such control extends. Floating in the stratosphere means that almost certainly, Google will always be required to seek permission from any government whose airspace the balloons float into. In addition, while this project uses unlicensed spectrum, there's no guarantee that will always be the case. Luckily for Google, approximately 70,000 weather balloons are launched every year, which may mitigate some, though not all, of the legal and regulatory issues.

## XI. ACKNOWLEDGEMENT

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