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Google Loons : Balloon Powered Internet Access via Stratosphere

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ABSTRACT

The service of Internet Service Providers (ISP) connect us to the global network via Internet services but is reachable to only one out of three in the world's population. The rest of the Population 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. As we area aware of that the developing nation cannot afford such a huge sum of money to lay fiber cables, this will not result to a productful solution. Google proposed the project Loon being developed for providing internet access to remote and rural areas. This project is a network of balloons floating in the stratosphere at an altitude of about 20-30 km to create an aerial wireless network with up to 3G-like speeds. In the Loon network, balloons travel around the earth bringing access points to the users. While energy on the balloons cannot be supplied by stable power source or by replacing batteries frequently, the balloons can harvest energy from natural energy sources, e.g. solar energy, or from radio frequency energy by equipping with appropriate circuits. This paper covers the working and designing of Loon balloons, the Loon's Technology, and its advantages in various fields.

Keywords: Stratosphere, user antenna, solar panel, Google Loon Project, wind data, etc.

I. INTRODUCTION

After more than 40 years of development Internet has created a revolution in communication for humans because it allows people to access and exchange information efficiently. Although Internet is highly accessible, approximately60-70%of people worldwide do not have the Internet reported by International Telecommunications Union in June2013.This stems from a fact that many areas such as Africa, Asia, and Pacific, cannot offer Internet connections due to geographical and infrastructure issues. Therefore, the idea of providing Internet connections via wireless networks has become more and more popular.

In wireless Internet, mobile users can connect to the Internet service provider (ISP) through base stations or access points. However, deployment of base stations for every location on the Earth seems to be impossible, e.g., oceans and mountains. Therefore, the idea of providing Internet from the sky was introduced. The early version is based on the satellites, which suffers from high cost and long transmission delay. As a result, the cheaper and faster alternative, i.e. Google Loon project, was proposed. In Loon project access points will be placed on balloons flying at an altitude of about 20km which is safe from bad weather and flights. The balloons will travel around the Earth and form a network of access points for Internet users in remote places. When receiving data from the user, the balloon will find the shortest route to transfer data to the nearest base station on the ground, which will be forwarded to an ISP.

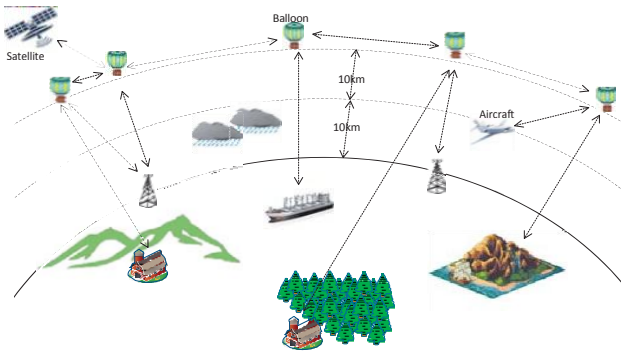

Figure 1. The model of wireless network in the sky

Since the balloons cannot acquire the energy from any stable supplied by stable power source or by replacing batteries frequently, the balloons can harvest energy from natural energy sources, e.g. solar energy, or from radio frequency energy by equipping with appropriate circuits. This seminar will cover the working and designing of Loon balloons, the Loon's Technology, and its advantages in various fields.

Google has taken an initiative and developed Project Loon which is a research and development project having the goal of providing Internet access to rural and remote areas. Google asserts that the stratosphere layer seems advantageous because of its relatively low wind speeds (likewise: wind speeds between 5 and 20 mph / 10 to 30 kmph) and minimum turbulence.

In this paper, we will cover working and designing of Loon balloons, the Loon's technology, its advantages and future scope of Google Loons.

II. THE TECHNOLOGY

In the stratosphere, there are many layers of wind, and each layer of wind varies in direction and speed. Loon balloons go where they're needed by rising or descending into a layer of wind blowing in the desired direction of travel.

Figure 2. Receiver antenna

By collaborating with Telecommunications companies to share cellular spectrum, Google has provided the facility which allow the people to connect to the balloon network directly from their cell phones and other LTE-enabled devices. The signal is then passes through the balloon network and back down to the global Internet on Earth.

Figure 3. Loons moving with wind

Project Loon balloons travel approximately 20 km above the Earth's surface in the stratosphere. Winds in the stratosphere are stratified, and each layer of wind varies in speed and direction. Project Loon uses certain software algorithms to decide where the balloons go and then moves each one into a layer of wind blowing in the required direction. By the process of moving along with the wind, the balloons can be arranged to form one large communications network.

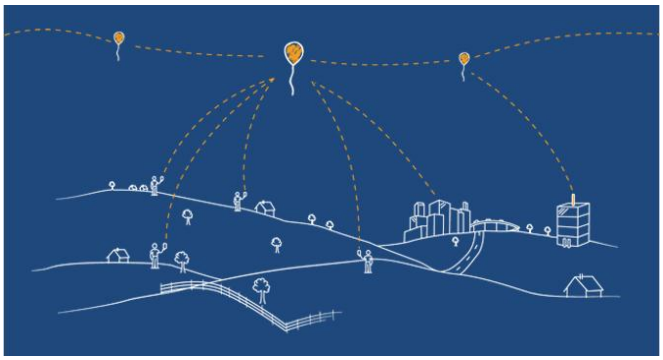

Figure 4. Communication network

III. Components Of Loon

ENVELOPE: The inflatable part of the balloon is called a balloon envelope. Loon's balloon envelopes are made from sheets of polyethylene plastic, and they measure fifteen meters wide by twelve meters tall when fully inflated. When a balloon is established well to be blown out of service, gas is released from the envelope to inflate the balloon down to Earth in a controlled manner. In case forbidden, the balloon drops too quickly. a parachute attached to the top of the envelope is deployed.

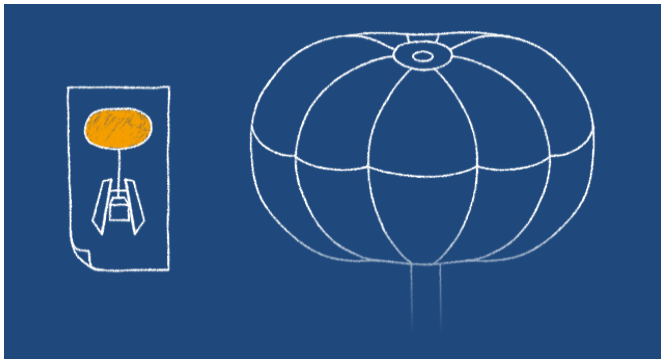

Figure 5. Envelope

SOLAR PANELS: Each balloon's electronics are powered by an array of solar panels. The solar array is mounted at a steep angle to effectively capture sunlight on short winter days at higher latitudes. The array is divided into two parts facing opposite directions to each other which allow us to capture energy in any orientation as the balloons spin slowly in the wind. The panels produce approximately 100 Watts of power in full sunrise, which is sufficient enough to keep Loon's electronics running along with this it also help in charging of the battery for effective use in the night hours. By moving along with the direction of the wind and getting charged in the sun, Project Loon is able to power itself using entirely renewable energy sources.

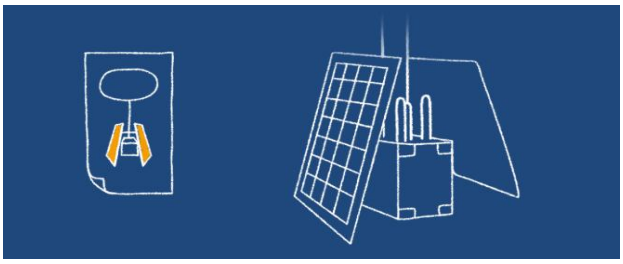

Figure 6. Solar Panels

ELECTRONICS: A small box containing the balloon's electronics hangs underneath the inflated envelope, like the basket carried by a hot air balloon. This box holds circuit boards that control the system, radio antennas to establish communication with other balloons and with Internet antennas on the ground, and lithium ion batteries to store solar power so the balloons can operate throughout the night.

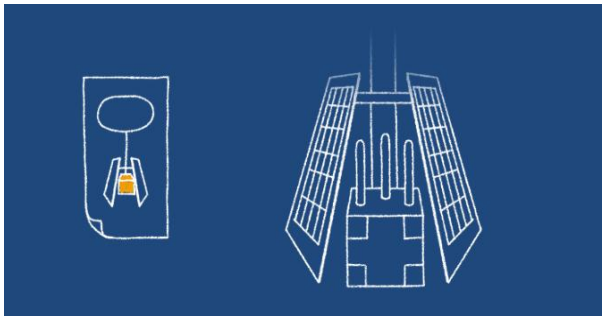

Figure 7. Electronics

IV. ADVANTAGES

Availability of Information: Assuming all the mechanisms of the project are functioning as planned, every single person who has access to some device that has Wi-Fi access would be able to search for almost any form of media online. Farmers in remote corners of third world countries would be able to research and analyze multiple techniques that could increase their yield, a father would be able to stay in touch with his daughter no matter which township either one of them lived in, villagers across an country would be able to transparently examine the country's political scenario and vote appropriately.

Education: With millions of uneducated children all across the world, this program might be able to successfully provide schooling through online classes on topics ranging anywhere from disaster management to literary analysis.

Health and Medicine: With globally available data on disease outbreaks and medical breakthrough, the entire population will be able to adjust to epidemics or adopt new drugs or medications.

Use of Renewable Energy: This will greatly influence and inspire future projects as well. Creating interplay between solar energy to keep proper functioning of the balloon while using wind energy to define its motor controls will help reduce the burden on coal, petroleum and other non-renewable energy sources.

Collaboration: Collaboration between people across the globe will become much easier with the constant connectivity to the each other through the internet, allowing newer more complicated projects to arise.

V. SUMMARY

After the detailed study on the topic, we can conclude that Google Loon's can be used for providing Internet access to remote and rural areas all over the world with up to 3G-like speeds. Given the relatively low winds and minimal turbulence, Google Loons can greatly increase the Internet usage in developing countries.

The planned deployment of Project Loon in Sri Lanka this year is a major step, following a successful trial in New Zealand launched in 2013. It's said that just three of the country's 20 million citizens have any sort of internet access, so even at 3G speeds Google's balloons will make a big difference. If Sri Lanka is a success, then Google's mission to deliver 'internet to everyone' has really just begun.

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