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LOON-A WIRELESS NETWORK COMMUNICATION FOR PROVIDING FAST INTERNET ACCESS

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ABSTRACT

This project that aims to bring internet access to everyone by creating an internet network of balloons through the stratosphere and providing internet service access for an area about 1250 sq kms. This project uses high altitude balloons which is made up of Polyethylene plastic and placed in stratosphere at an altitude of 32 kilometer to create an aerial wireless network with the speed of 3G network. A small box weighing 10 kg containing each balloon's electronic equipment hangs underneath the inflated envelope. This box contains circuit boards, radio antennae, GPS system, transponder, a Ubiquiti Networks Rocket (UNR) M2, batteries and antennae to connect to the internet via ground station on the earth, they can then transmit the internet via their antennae within a 40 kilometer diameter and to receive data from the user side it uses a special antenna for the users which will connect to the internet of any balloon flying overhead. If successful the technology might allow countries to leapfrog the expense of laying fibre cable, which is to be installed underground to allow the users to connect internet and dramatically increasing Internet usage in various countries.

I. INTRODUCTION

Today only 2.7 billion people – a little more than one third of the world's population—have Internet access. This fact can be attributed to many reasons, but the most important factor is the scarcity of intensive capital necessary for Internet infrastructure implementation in many developing areas. The rapid development in wireless telecommunication industry has boosted another revolution in data services. Even though there are more than 1 billion smartphone subscribers in the world, the majority of them still don't have data access due to the costly data plan in many countries.

On the other hand, the vast majority of the prices people pay for data plans go directly towards covering the tens of billions of dollars spent each year building the infrastructure to deliver the connections. Unless the infrastructure expansion becomes more efficient, the industry cannot sustainably serve everyone. Bring majority of the global population into Internet community is one of the greatest challenges of our generation, and now we see hope from the Google Project Loon – a network of balloons traveling on the edge of space, designed to provide ubiquitous Internet connectivity free of terrestrial constrains and with an affordable rate worldwide. Now the time is 2015, and the Google Project Loon finally matured in technology. The novel system is ready to enter the market to provide Broadband Internet connectivity.

However, this industry is highly competitive and prospers with various Broadband technologies. You and your team are hired by Mr. Mike Cassidy, the Project Leader of Project Loon in Google[X] to develop strategies for a successful launch of the Loon based WiFi network. After intensive study, now you are going to present a promising solution to Mr. Cassidy. Before the day of the presentation,

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you need to write a business letter (no more than 300 hundred words) to briefly summarize your deliverables in a professional tone. To ensure a successful presentation.

II. HISTORY OF LOON

In 2008, Google had considered contracting with or acquiring Space Data Corp., a company that sends balloons carrying small base stations about 20 miles (32 km) up in the air for providing connectivity to truckers and oil companies in the southern United States, but didn't do so. Unofficial development on the project began in 2011 under incubation in Google X with a series of trial runs in California's Central Valley. The project was officially announced as a Google project on 14 June 2013.

On 16 June 2013, Google began a pilot experiment in New Zealand where about 30 balloons were launched in coordination with the Civil Aviation Authority from the Tekapo area in the South Island. About 50 local users in and around Christchurch and the Canterbury Region tested connections to the aerial network using special antennas.[1] After this initial trial, Google plans on sending up 300 balloons around the world at the 40th parallel south that would provide coverage to New Zealand, Australia, Chile, and Argentina. Google hopes to eventually have thousands of balloons flying in the stratosphere.[1][2]

III. CONCEPT OF LOON

Project Loon is a research and development project being developed by Google with the mission of providing Internet access to rural and remote areas. The project uses high-altitude balloons placed in the stratosphere at an altitude of about 20 mi (32 km) to create an aerial wireless network with up to 3G-like speeds.[1][2][3][4] Because of the project's seemingly outlandish mission goals, Google dubbed it "Project Loon".

The balloons are maneuvered by adjusting their altitude to float to a wind layer after identifying the wind layer with the desired speed and direction using wind data from the National Oceanic and Atmospheric Administration (NOAA). Users of the service connect to the balloon network using a special Internet antenna attached to their building. The signal travels 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 Internet access to remote and rural areas poorly served by existing provisions, and to improve communication during natural disasters to affected regions. Key people involved in the project include 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.

While the concept is new, people have used balloons for communication, transportation and entertainment for centuries. In recent years, the military and aeronautical researchers have used tethered balloons to beam Internet signals back to bases on earth.

Google's balloons fly free and out of eyesight, scavenging power from card table-sized solar panels that dangle below and gather enough charge in four hours to power them for a day as the balloons sail around the globe on the prevailing winds. Far below, ground stations with Internet capabilities about 100 kilometers apart bounce signals up to the balloons.

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The signals would hop forward, from one balloon to the next, along a backbone of up to five balloons.
Each balloon would provide Internet service for an area twice the size of New York City, about 1,250 square kilometers, 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 estimates four out of every 100 people are online.

There are plenty of catches, including a requirement that anyone using Google Balloon Internet would need a receiver plugged into their computer in order to receive the signal. Google is not talking costs at this point, although they're striving to make both the balloons and receivers as inexpensive as possible, dramatically less than laying cables.

The signals travel in the unlicensed spectrum, which means Google doesn't have to go through the onerous regulatory processes required for Internet providers using wireless communications networks or satellites. In New Zealand, the company worked with the Civil Aviation Authority on the trial. Google New Zealand in part because of its remoteness. Cassidy said in the next phase of the trial they hope to get up to 300 balloons forming a ring on the 40th parallel south from New Zealand through Australia, Chile, Uruguay, Paraguay and Argentina.

IV. TECHNOLOGY

The technology designed in the project could allow countries to avoid using expensive fibre 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't afford to lay underground fibre 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 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. 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. It is unclear how technologies that rely on short communications times (low latency pings), such as 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 wider Internet.

The first person to connect to the "Google Balloon Internet" after the initial test balloons were launched into the stratosphere was a farmer in the town of Leeston, New Zealand, who was one of 50 people in the area around Christchurch who agreed to be a pilot tester for Project Loon. The New Zealand farmer lived in a rural location that couldn't get broadband access to the Internet, and had used a satellite Internet service in 2009, but found that he sometimes had to pay over $1000 per month for the service. The locals knew nothing about the secret project other than its ability to deliver Internet connectivity; but allowed project workers to attach a basketball-sized receiver resembling a giant bright-red party balloon to an outside wall of their property in order to connect to the network.

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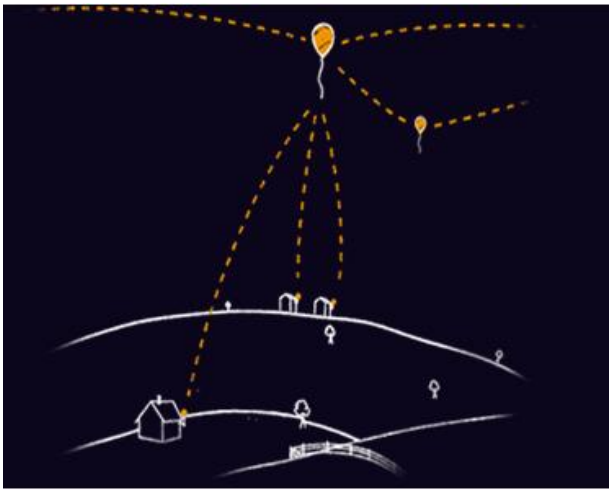

Fig 1.: Loon Balloons in stratosphere

The high-altitude balloons fly twice as high as airplanes, but below the range of satellites. Each balloon provides Internet service in a 20 km (12 mi) radius covering an area of about 1,256 km^2(485 sq mi).

The technology differs from that of a geostationary satellite dish because the balloons are not at a uniform distance from the antenna at all times.
"As most satellite rotate around the earth at the same rate that it revolves, and stay in the same spot overhead, the satellite dishes on the side of your house can be aimed in a particular direction and hit that satellite.
"With the balloons, because they are drifting overhead a fixed pointing dish will not work. They'll be further away when they aren't directly overhead and as they glide overhead they'll be closer then further away again, so the antenna has to have more sensitivity off to an angle than it does straight up, resulting in a uniform signal strength no matter where the balloon is overhead."
Project Loon balloons float in the stratosphere, twice as high as airplanes and the weather. They are carried around the Earth by winds and they can be steered by rising or descending to an altitude with winds moving in the desired direction. People connect to the balloon network using a special Internet antenna attached to their building. The signal bounces from balloon to balloon, then to the global Internet back on Earth.

V. EQUIPMENTS

The balloon envelopes used in the project are made by Raven Aero star and are composed of polyethylene plastic about 3 mil or 0.076 mm (0.0030 in) thick. The balloons are super pressure balloons filled with helium, stand 15 m (49 ft) across and 12 m (39 ft) tall when fully inflated, and carry a custom air pump system dubbed the "Croce" that pumps in or releases air to ballast the balloon and control its elevation.[1] A small box weighing 10 kg (22 lb) containing each balloon's electronic equipment hangs underneath the

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inflated envelope. This box contains circuit boards that control the system, radio antennae and a UNR M2 to communicate with other balloons and with Internet antennae on the ground, and batteries to store solar power so the balloons can operate during the night.

Each balloon's electronics are powered by an array of solar panels that sit between the envelope and the hardware. In full sun, the panels produce 100 watts of power, which is sufficient to keep the unit running while also charging a battery for use at night. A parachute attached to the top of the envelope allows for a controlled descent and landing when a balloon is ready to be taken out of service. In the case of an unexpected failure, the parachute deploys automatically. The balloons typically have a maximum life of about 55 days, although Google claims that its tweaked design can enable them to stay aloft for more than 100 days.

The prototype ground stations use a Ubiquiti Network Rocket M5 radio and a custom patch antenna to connect to the balloons beaming down the Internet when the balloons are in a 20 km (12 mi) radius. Some reports have called Google's project the Google Balloon Internet.

VI. BACKGROUND

Project loon is a research and development project being developed by Google. It is a network of balloons traveling on the edge of space, designed to provide ubiquitous Internet connectivity. The balloons float in the stratosphere, twice as high as airplanes and the weather. They are carried around the Earth by winds and they can be steered by rising or descending to an altitude with winds moving in the desired direction. People connect to the balloon network using a special Internet antenna attached to their building. The signal bounces from balloon to balloon. Then to the global Internet back on the Earth.

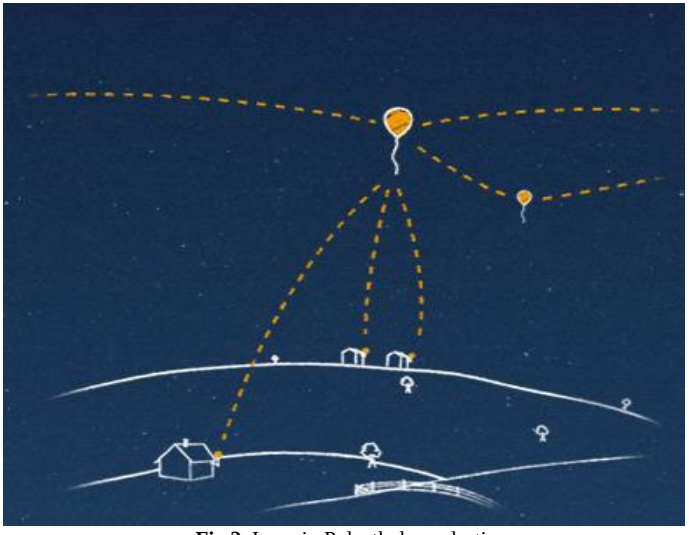

Fig 2. Loon in Polyethylene plastic

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VII. DESIGNING A LOON

The loon is comprised of three parts: an envelope, solar panels and equipment. Project Loon's balloon envelopes, inflatable part of the balloon, are made from sheets of polyethylene. They are specially constructed for use in Super pressure balloons, which are resistant to UV radiation, and is capable to function at temperature as low as -58 °F, and at pressure as low as 1/100 atm. Balloons filled with Helium and air mixture are launched, recycled and re-launched at a designated collecting point.

After 100 days from the launching, the balloon is ready to be taken out of service and the gas is released from the envelope to bring down the balloon in a controlled descent to the ground. Each balloon includes a parachute to ensure a more controlled landing. The balloons and equipment on board can be re-used and each loon has an approximately 2-years life time.

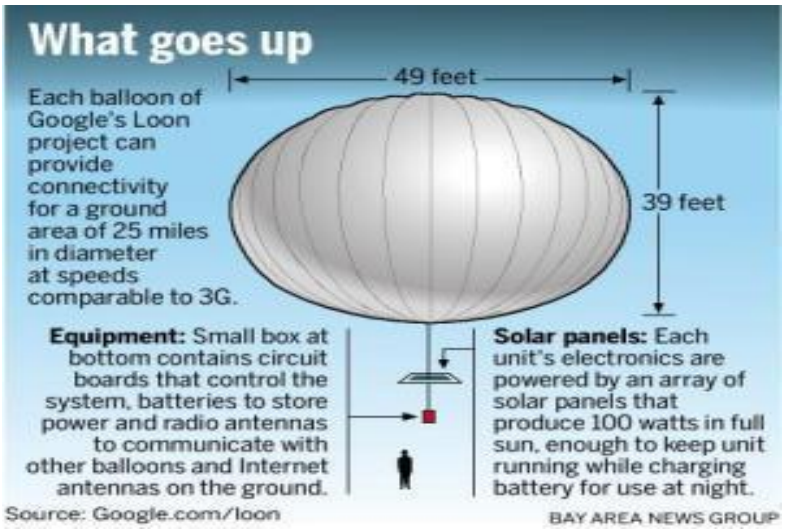

Fig:3 Structure of Loon

Solar panels power each unit's electronics. In full sun, these panels produce 100 watts to keep the unit running while also charging a battery for use at night. By moving with the wind and charging in the sun, the Loon is able to power itself using only renewable energy sources.

A small box containing the balloon's electronic equipment hangs underneath the inflated envelope, which contains circuit boards that control the system, radio antennas to communicate with other balloons and with Internet antennas on the ground, batteries to store solar power so the balloons can operate during the night, and weather instruments to monitor the weather and the conditions around them.

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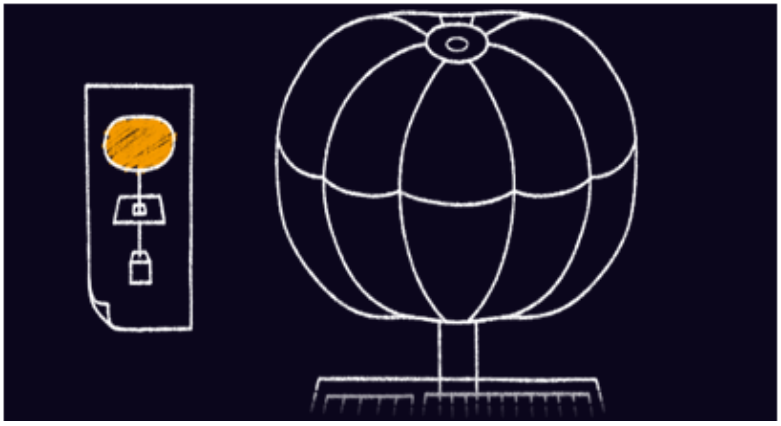
Fig:4 Movements by Loon

The balloon envelope is the name for the inflatable part of the balloon. Project Loon's balloon envelopes are made from sheets of polyethylene plastic and stand fifteen meters wide by twelve meters tall when fully inflated. They are specially constructed for use in super pressure balloons, which are longer-lasting than weather balloons because they can withstand higher pressure from the air inside when the balloons reach float altitude. When a balloon is ready to be taken out of service, gas is released from the envelope to bring the balloon down in a controlled descent. In the unlikely event a balloon drops too quickly, we deploy the parachute attached to the top of the envelope.



Situated between 10 km and 60 km altitude on the edge of space, the stratosphere is named after the different strata, or layers, of wind within it. But the extreme altitude also presents unique engineering challenges: air pressure is 1% of that at sea level, temperatures

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hover around -50°C, and a thinner atmosphere offers less protection from the UV radiation and temperature swings caused by the sun's rays. By carefully designing the balloon envelope to withstand these conditions, Project Loon is able to take advantage of the steady stratospheric winds, and remain well above.

VIII. LOON CONNECTIONS

Far below the loons, ground stations providing connectivity to backbone Internet can transmit signals to the balloons up to 65 miles far. The signals would hop forward, from one balloon to the next, along a chain of up to 5 balloons. Each balloon is networked to one another within 30 miles with a radio transceiver as in a mesh, designed to ensure signal reliability. A second transceiver keeps the balloon in contact hundreds of antennas on ground area about 25 miles in diameter at speeds comparable to 3G. The specialized antennas can be placed on homes, much like a very small satellite TV receiver. Project Loon currently uses ISM bands (specifically 2.4 and 5.8 GHz bands) that are available for anyone to use. There is also a back-up transceiver and a GPS on each balloon, so Google can monitor each balloon's location.

Each balloon can provide connectivity to a ground area about 40 km in diameter at speeds comparable to 3G. For balloon-to-balloon and balloon-to-ground communications, the balloons use antennas equipped with specialized radio frequency technology. Project Loon currently uses ISM bands (specifically 2.4 and 5.8 GHz bands) that are available for anyone to use.

IX. FEATURES

A recently awarded patent for dynamically addressing bandwidth demand using internet access points attached to helium-filled balloons, may shed new light on how Google either intends to deploy (and monetise) innovations developed from Project Loon. As one might suspect, its use cases extend beyond humanitarian applications.

COST (estimated according to current market prices)

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1. Balloon Polyethylene plastic envelops manufactured by Raven Aerostar: $4,000 Helium gas per loon per flight: $2,000 100W solar panels (5ft × 5ft): $500 Navigation control system: $1000 Equipment box (circuit boards, radio antennae, GPS, weather instruments and batteries): $12,000 Re-launch fee for a used balloon: $3,000
2. Ground station connected to backbone Internet Station construction and equipment installation: $1.2 million Maintenance: equipment cost is $30,000/year and land cost depends on local market. Need dedicated personnel to conduct regular maintenance and troubleshooting. Labor cost varies at different location.
3. Balloon launching and collecting point All the installation, maintenance costs depend on local land cost and human resource cost. Due to properties of wind in the stratosphere, balloon moves along latitude line with a ± 5 latitude range, so please be aware of coverage limitation of balloons from one balloon station.
4. Antenna for users Antenna: $500 Assume it could be installed easily so no extra labor fee.

X. ADVANTAGES OF PROVIDING INTERNET

The advantages of providing Internet to each and every human being on this planet are of gigantic proportions:
Information would never have been available at this ease in the history of this planet, everything just a couple of clicks away, from any corner of the world you are in.
Education: There are millions of poor children all over the world who haven't even heard the word 'school.' Loon has the potential to become a school on the air for the under privileged.
Medicine: Health and hygiene information can be made easily available to the people who haven't even heard of the word doctor.
Collaboration: Connecting with the remote countries and inaccessible terrains will no longer be impossible. It'll eliminate the need to lay down cables in those areas, and live weather forecast reports in such areas would be of a great help to the locals there.
Costs: This technology has the potential to drastically bring down the cost of using Internet, and to increase the quality at the same time.
Google will steal the 'connecting the world' crown from Facebook by the end of this decade!
Internet Giant Google has revealed some additional details regarding the technology behind its Project Loon that aims to bring WiFi connectivity to everyone on the planet.

a. Current Progress

The Project Loon pilot test began in June 2013 on the 40th parallel south. Thirty balloons, launched from New Zealand's South Island, beamed Internet to a small group of pilot testers. The experience of these pilot testers is now being used to refine the technology and shape the next phase of Project Loon.

b. Pilot test project in New Zealand.

Long distance tracking experiment of loon on 40th parallel south In this document, we only briefly introduce Project Loon. We strongly recommend visit Project Loon official

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.

Google has a truly sky-high idea for connecting billions of people to the internet - 19 kilometers in the air to be exact - through giant helium balloons circling the globe that are equipped to beam Wi-Fi signals .

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Google has revealed that it has 30 balloons floating over New Zealand to provide free internet access to disaster-stricken, rural or poor areas. Eventually, as the balloons move across the stratosphere, consumers in participating countries along the 40th parallel in the Southern Hemisphere could tap into the service. The technology will be trialed in Australia next year, possibly in Tasmania.

XI. CONCLUSION

For a developing country like India with connectivity as major setback, this is the one very essential element towards a digital era. After all, India stands third highest in terms of internet users in the world after China and US. At the very least, we, the people of India, can finally hope to get internet access at all places where there is not one now. This will support the nation during disasters when all means of communication are destroyed. Google is in the early stages of developing balloon-powered Internet connectivity that it hopes will expand the reach of the Web to connect the "two out of every three people" that lack access.
In future , Google decide to increase the lifetime of Loon from few weeks to 100 days then to 1000 days, Hence this Technology will made a great tremendous achievement in future enhancement.

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