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Google Project Loon

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***Abstract:-*Project Loon is a network of balloons traveling on the edge of space, designed to connect people in rural and remote areas, help fill coverage gaps, and bring people back online after disasters. 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 controlled 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.**

Keywords: **Stratosphere, Envelope, Equipment, Solar Plates.**

I. INTRODUCTION

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. Because of the project's seemingly outlandish mission goals, Google dubbed it "Project Loon". The balloons are manoeuvred 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 Devalue, chief technical architect, who is also an expert on wearable technology; Mike Cassidy, a project leader; and Cyrus Behroozi, a networking and telecommunication lead.

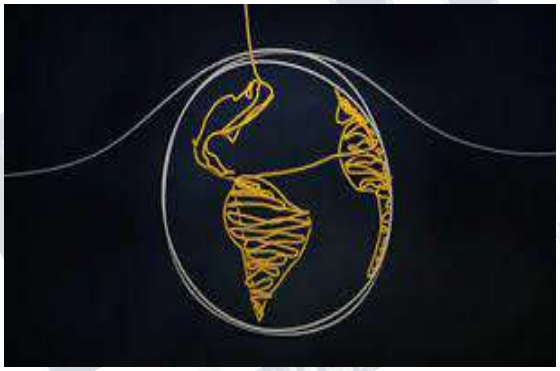

Fig 1: Introduction to The Loon

The Internet is one of the most transformative technologies of our lifetimes. But for 2 out of every 3 people on earth, a fast, affordable Internet connection is still out of reach. And this is far from being a solved problem. There are many terrestrial challenges to Internet connectivity jungles, archipelagos, mountains. There are also major cost challenges. Right now, for example, in most of the countries in the southern hemisphere, the cost of an Internet connection is more than a month's income. Solving these problems isn't simply a question of time: it requires looking at the problem of access from new angles. So today we're unveiling our latest moon shot from Google[x]: balloon-powered Internet access.

II. TECHNOLOGY

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't afford 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 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 Project workers are allowed 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. 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 (485 sq mi).

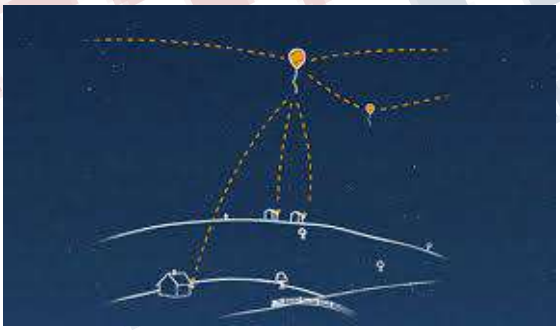

Fig 2 : Technology Behind Loon

III. HOW LOON WORKS

Project Loon works on open Radio Frequency Bands (unlicensed spectrum) and powered by Solar energy and Wind energy. Google X engineers studied balloon Science from NASA. To connect to the Google Balloon network, the client require a special internet antenna at ground. A Google Balloon can cover an area of 100s of square kilometres.

3.1 Navigation with the wind

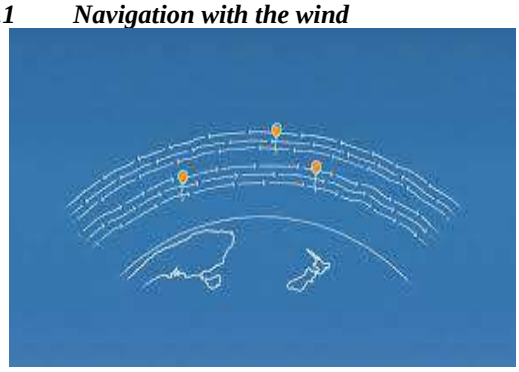

Fig 3 : Navigation With The Wind

Project Loon balloons travel around 20km above the Earth's surface in the stratosphere. Winds in the stratosphere are generally steady and slow-moving at between 5 and 20mph,and each layer of wind varies in direction and magnitude. 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 communication network.

3.2 Stratosphere

Stratosphere 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 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 weather events, wildlife and airplanes.

Fig 4 : Stratosphere

3.2.1 Equipment

The balloon envelopes used in the project are made by Raven Aerostar, 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. A small box weighing 10 kg (22 lb) containing each balloon's electronic equipment hangs underneath the inflated envelope. This box contains circuit boards that control the system, radio antennae and a Ubiquiti Networks Rocket 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.

IV. HOW LOON IS DESIGNED

4.1 Envelope

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.

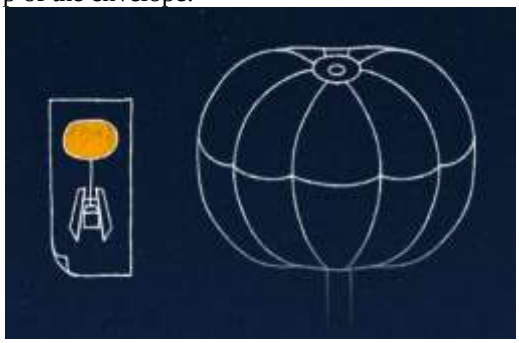

Fig 5 : Envelope

4.2 Solar Panels

Each unit's electronics are powered by an array of solar panels that sits between the envelope and the hardware. In full sun, these panels produce 100 Watts of power - enough to keep the unit 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 only renewable energy sources.

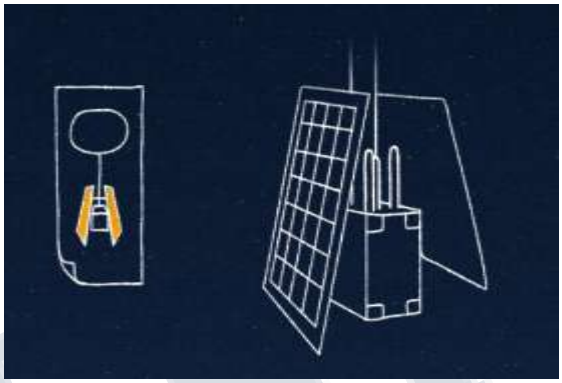

Fig 6 : Solar Panels

4.3 Electronics

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

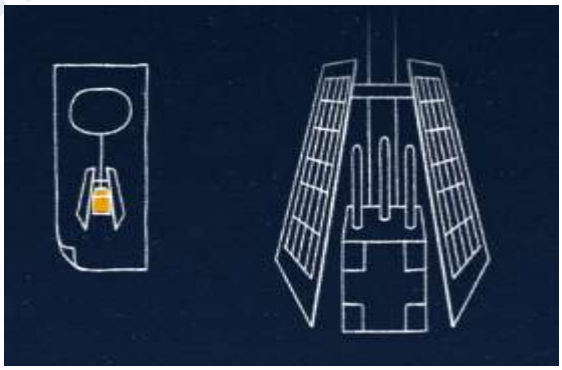

Fig 7 : Electronics

V. HOW LOON CONNECTS

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.

Fig 8 : How Loon Connects

VI. WHERE LOON IS GOING

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. The pilot test has since expanded to include a greater number of people over a wider area.Looking ahead,project loon will continue to expand the pilot,with a goal of establishing a ring of uninterrupted connectivity at latitudes in the southern hemisphere,so that pilot testers in this latitude can receive continuous service via balloon-powered internet.

Fig 9 : Where Loon Is Going

VII. HOW TO RECEIVE INTERNET SERVICE FROM THE BALLOONS

Signals are transmitted directly to the LTE enabled devices. Web traffic that travels through the balloon network is ultimately relayed to our local telecommunication partner's ground station, where it connects to pre-existing internet infrastructure. 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). The system aims to improve communication during natural disasters to affected regions.

VIII. HOW HIGH DO THE BALLOONS FLY

Balloons will fly in the stratosphere well above commercial air traffic and weather events ,at around 18-27 KM or 60,000 to 90,000 feet.

Fig 10 : Receiver that receives signal from the Balloon

IX. HOW THE BALLOONS ARE CONTROLLED

Balloons are controlled by lowering and raising them to an altitude with winds blowing in the desired direction of travel. They are planned to take balloons down over preselected, safe recovery zones so they can easily collect them to reuse and recycle their parts. In the event of an unexpected landing, every loon balloon is equipped with a parachute to slow its decent.

X. 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 broad band 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 sounds 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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