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Internet Penetration And Google Loon As A Last Mile Solution

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ABSTRACT

Two-thirds of the world's population does not yet have Internet access. Some locations around the globe are too poor and sparsely populated for wireless carriers to invest in Internet infrastructure there. Internet access is very far from universal [9]. As of 2013 nearly 4.4 billion people around the world were not connected to internet and of these 4.4 billion people nearly 3.4 billion (75% of not connected to internet) people live in just 20 countries [8]. Between 1.1 billion and 2.8 billion individuals cannot get online via the mobile network because they do not live within sufficient mobile network coverage [8]. The worldwide Internet user population was around 2.7 billion people in 2013 [8] while the world population in 2013 was close to around 7.1 billion [12] and that means more than 60% "offline population" in 2013. Estimates from multiple sources suggest that 500 million to 900 million people will join the online ranks by 2017, expanding the online population to 3.2 billion to 3.6 billion users. By these projections, between 3.8 billion and 4.2 billion people more than half of the forecasted global population will remain offline in 2017 [8]. As of 2016 the world population is 7.4 billion (midyear) [13] and the number of internet users are around 3.5 billion [14], still more than half the population without internet, confirming the estimates. Projects like Google Loon may help in overcoming this lack of internet access and removing this digital divide.

Keywords

Internet, Loon.

1. WHY INTERNET ACCESS MATTERS

Just why should we worry about connecting people to internet at all? Well, the Internet has a great deal of room to sustain economic growth in developing countries, and robust Internet ecosystems could unlock much more value. Research by the World Bank in 2009 found that for every 10 percentage-point increase in high speed Internet connections in developing countries, there is an increase of 1.3 percentage points in economic growth. From 2004 to 2009, for example, MGI (McKinsey Global Institute) estimates that the Internet contributed 10 percent or more to the total GDP growth in China, India, and Brazil and this contribution is increasing [8].There have been studies that show if we connected a billion more people to the Internet, 100 million more jobs would be created, and more than that would be lifted out of poverty [10]. Some benefits from several different uses of internet are presented below.

1.1 Social connection

The use of internet for social connection is on the top in several developing countries. Generally people with the internet connection at least have a Facebook account. Internet helps to connect people to their friends and family both home and abroad.

1.2 Education

The internet is a high quality source of educational material. All the latest in any field and historical data are available on internet. The online videos, online courses including distance learning programs can be very helpful for education purpose. One can just sit at home and can study the courses offered by some distant University. Analysts forecast that global revenues from online learning will reach USD 51 billion by 2016, with developing nations such as China, India, Malaysia, and Vietnam all boasting annual growth rates of more than 30 percent [8]

1.3 E-services

With internet access people can access the E-government services, it may include applying for driving license to filing of income tax returns online. The global retailers like Amazon, e-bay, offers various items online ranging from electronics items to grocery. Online banking is also very useful service.

1.4 Cost and time saving

Due to the transparency provided by search tools, online prices are, on average, around 10 percent lower than offline prices, generating tens of billions of dollars of consumer surplus in the nations with the widest Internet use [8]. Scheduling trips to arranging for the delivery of goods, consumers can carry out a wide array of tasks without leaving the comfort of their homes or offices. And as it is said "Time is Money".

1.5 Greater awareness and engagement

We live in an age when any event or news can be shared instantaneously.. The online population also plays a huge role in political movements, with social media becoming a potent tool to reach voters. In 2014, for example, political parties in India used Twitter and Facebook to shore up support and solicit donations. The Internet has also been used to mobilize aid for people affected by natural disasters and can be used to raise money for relief operations.

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1.6 Internet contribution to GDP (iGDP)

The McKinsey Global Institute (MGI) estimates that in 2010, the Internet accounted for USD 1,672 billion of the global economy, or an average 2.9 percent of total GDP. That year, the total contribution of the Internet to GDP in all aspiring countries was USD 366 billion. Of this Fig., Brazil, Russia, India, and China were responsible for USD 243 billion—almost two-thirds of the total. The contribution from developed countries is greater. The economic value generated annually by the Internet in aspiring countries is USD 119 per capita compared with USD 1,488 per capita in developed countries [8].

2. WHO ARE "OFFLINE PEOPLE"

According to McKinsey & Company report on the digital divide, the offline population is disproportionately rural, poor, illiterate, elderly, and female. To characterize the offline population, the McKinsey used data from 20 countries, chosen by the size of offline population. These 20 countries account for nearly 75% of the total offline population. Out of 4.9 billion people in these 20 countries only 1.7 billion people are online. The online population is nearly 100% literate and no one has low income (Low income defined as incomes below the average between the national poverty line and the median). 28% of the offline population is illiterate and about 50% have low incomes. More than half of the offline population is female. Many factors cultural, religious, and economic have been found to contribute to this discrepancy. Women may not have the enough income for phones or data plans. Illiteracy is also more prevalent in women in developing countries; across all developing countries around the globe, approximately 14 percent of men and 25 percent of women are illiterate.

3. BAREERS TO INTERNET ADOPTION

McKinsey have found four main causes that hinder the global internet access: incentives, Low income and affordability, user capability and infrastructure.

3.1 Incentives

It refers to the fact that much of the offline population is not as eager to connect to the internet as one might expect. It can be because they lack awareness of the internet and its benefits or it is not socially accepted. In many countries, women have been largely excluded from Internet adoption due to several cultural factors.

3.2 Low income and affordability

In some countries the price of an average smartphone is more than 20% of the GNI(Gross National Income). In addition to the purchase price of the device, there are ongoing costs associated with ownership, including maintenance, repairs, and charging. The electrical connectivity of the area is also very important parameter for internet connectivity. If regular electrical supply is not available, there is hardly any use for smartphones or devices to connect to the internet. In Africa where more than 80% of the population lives without grid electricity, it can cost more to charge a phone than a data plan.

3.3 User capability

A lack of familiarity with or inability to use digital technologies (for example, use a device to navigate a website) and a basic inability to read and write in any language comes under this cause. That is, the digital literacy and linguistic literacy are very important to utilize the benefits of internet. People who do not know how to use a device to surf the internet or who are illiterate do not have any meaningful use of internet. Language can have a direct impact on consumer adoption of Internet-enabled mobile devices. In many countries, mobile devices have not been designed and manufactured to accommodate the official language, let alone dialects or unofficial languages. More intuitive mobile applications, services with simple graphical interfaces, and stronger local language support could significantly reduce the language and digital literacy barriers to Internet adoption in countries with these issues.

3.4 Infrastructure

As said earlier between 1.1 billion to 2.8 billion people cannot connect to the internet via the mobile network because they do not live with sufficient mobile network coverage, the necessary infrastructure is absent. All the households are not connected to the electricity grid and roads are not made in remote areas. All these issues create obstacles in setting up the required internet infrastructure in these areas and also to maintain it.

4. LAST MILE SOLUTIONS

Till now we have talked about the factors that are responsible for the internet penetration. Now we will talk about how the internet connection is provided to the users. The last mile solutions are responsible for providing the internet access to the locality or the end users by connecting to the local internet service provider. The telephone line dial up connection and fibre optic cables are one method for doing this, but they are very expensive to set up in the first place especially in sparsely populated areas where there are not many users. So rather than spending billions of dollars in setting up this type of infrastructure, it is better to use High altitude platforms or HAPS. High-Altitude Platforms (HAPS) offer a middle path. They broadcast wireless Internet not from the ground, not from the satellites, but instead from aeronautical vehicles [9].

A HAP can be a manned or unmanned airplane, a balloon, or an airship, at a specified, nominal, fixed point relative to the Earth [15]. The Scaled Composites Proteus, a piloted aircraft, shown in Fig. 2 was developed for high altitude communication relay. Since HAPS operate at much lower altitudes than satellites (20km-50km), it is possible to cover a small region much more effectively. Lower altitude also means much lower telecommunications link budget (hence lower power consumption) and smaller round trip delay compared to satellites. Furthermore, deploying a satellite requires significant time and monetary resources, in terms of development and launch. HAPS, on the other hand, are comparatively less expensive and are rapidly deployable. Another major difference is that a satellite, once launched, cannot be landed for maintenance, while HAPS can [15].

If the above definition of HAPS is considered, Project Loon does not fall neatly within the definition. It is a balloon network but not stationary or at a fixed point relative to earth. The balloons in the network keeps on moving with the wind in the stratosphere but the movement is arranged in such a way that there is at least one balloon overhead a place where the Internet is to be provided. Before project loon the HAP projects always centered on fixing the HAP in one particular location so it could provide Internet access to a fixed area. The description of what Loon is and how it is designed is given below.

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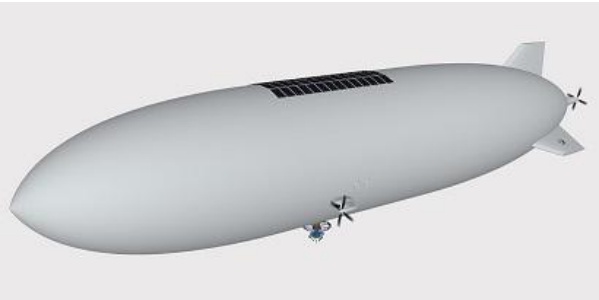

Fig. 1: Geostationary airship satellite, Source: 15

Fig. 2: Scaled Composites Model 281 Proteus

5. INTRODUCTION TO LOON

Project Loon is a network of balloons traveling on the edge of space (stratosphere), designed to connect people in rural and remote areas, help fill coverage gaps, and bring people back online after disasters. Project Loon balloons travel 20km above the earth's surface in the stratosphere Winds in the stratosphere area stratified, and each layer of wind varies in speed and direction. 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. Loon uses patch antennas to transmit signals to ground stations or LTE users. To use LTE, Project loon partners with telecommunications companies to share cellular spectrum so that the people will be able to access the Internet everywhere directly from their phones and other LTE enabled devices .Each balloon can handle upto 1000 connections at a time and has a coverage area of 5000 square kilometers [4]. The traffic or the request from the ground are picked up by the balloons and passed to the internet service provider (ISP) in the nearby city or any base station which then connect to Internet. To deploy the electronics in the stratosphere high-altitude balloon network operating in the stratosphere, at altitudes between 18 km and 25 km are used. This particular layer of the stratosphere is advantageous because of its relatively low wind speeds and minimal turbulence. The wind patterns in the stratosphere can be modeled with reasonable accuracy. Given a reasonably accurate model of wind speeds within the 18–25 km band, the position of high-altitude balloons can be controlled by adjusting only the balloon's altitude [5], which can be done by adjusting the volume and density of the gas.

6. HOW LOON IS DESIGNED

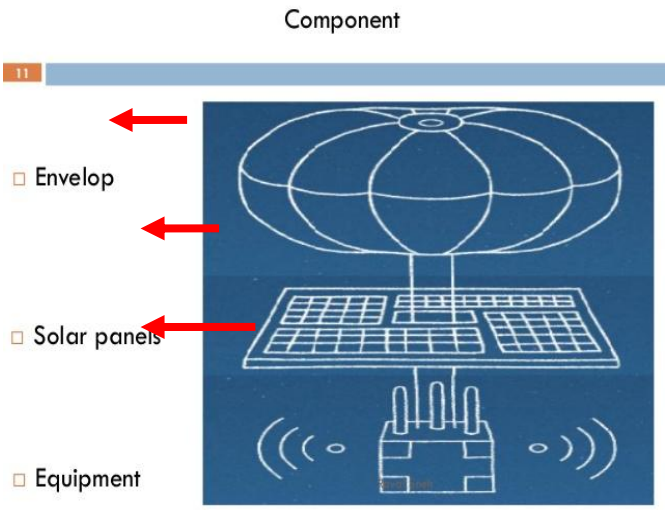

Fig. 3

6.1 Envelope

The inflatable part of the balloon is called a balloon envelope. A well- made balloon envelope is critical for allowing a balloon to last around 100 days in the stratosphere [4]. Loon's balloon envelopes are made from sheets of polyethylelne plastic, and they measure 15m wide and 12m tall and have an area of about 500m2.When a balloon is ready to be taken out of service, gas is released from the envelope to bring the balloon down to earth in a controlled descent. As the project leader of Loon, Michael Cassidy says "We basically have the ability to bring the balloon down where and when we want and at this point we can bring it down within half a kilometer of a spot we want to land it" [11]. In the unlikely event that a balloon drops too quickly a parachute attached to the top of the envelope is deployed automatically. Croche mechanism is used to control the quantity of air inside the balloon [1]. The disk which contain openings to let air in and out is attached to a pump. When it is required to lower the altitude of the balloon, air is pumped inside through central three openings and when it is required to raise the altitude, air is moved out using the other two openings located opposite to each other. The signals are sent from the ground to raise or lower the altitude of the balloons [1]. Raven Aerostar is manufacturing the envelopes for Loon [3].

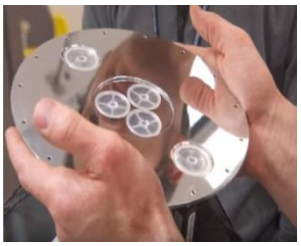

Fig. 4: "Croche" mechanism

Fig. 5: Envelope

6.2 Solar Panels

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

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steep angle to effectively capture sunlight on short winter days at higher latitudes. The array is divided into two sections facing in opposite directions, allowing us to capture sunlight in any orientation as the balloon spin slowly in the wind.

6.3 Electronics

A small box of electronics hangs underneath the inflated envelope in a Styrofoam box. The box weighs around 15 kg [3].This box contains circuit boards that control the system, radio antennas to communicate with other balloons and with Internet antennas on the ground, and lithium ion batteries to store solar power so the balloons can operate through the night. The temperature in the region of the stratosphere in which balloons are deployed can get as low as -600C, so the electronics compartment is insulated to protect the battery and other electronics from the extreme temperatures.

7. LOON CONNECTIONS AND WORKS

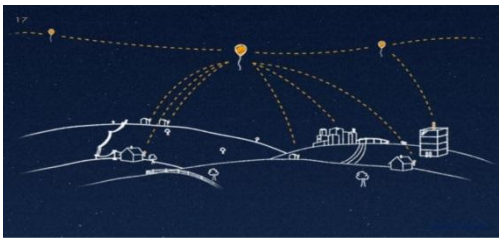

Fig. 6

- Each balloon can provide the connectivity to a ground area about 80 km in diameter.
- Each balloon is equipped with a GPS for tracking its location.
- Three radio transceivers are used for balloon too balloon communication, balloon to ground communication and for backup.
- It uses a wireless communication technology called LTE (Long-Term Evolution).
- There is a special ground antenna that is installed on the home or workplace to access the internet from balloon. The balloons are moving overhead so a fixed pointing dish will not work, so the antenna has to have more sensitivity off to an angle than it does straight up [2].
- Project loon partners with telecommunications companies to share cellular spectrum so that people will be able to access internet everywhere directly with their phones and other LTE enabled devices.

Fig. 7: Ground antenna

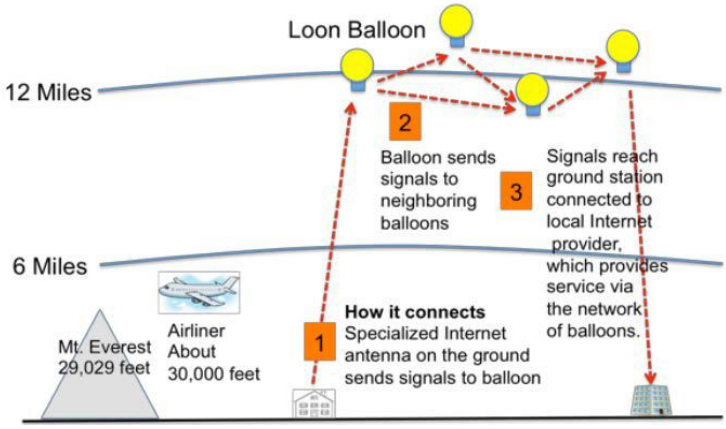

Fig. 8

As shown in Fig. 8, primarily, a user with the help of ground antenna installed in the house or workplace sends signals to a balloon close to him/her. The balloon sends the signals to neighboring balloons. Eventually, the signals reach the balloon which is connected to the local Internet. The wireless mesh network is constantly adjusting as balloons move. Any balloon is able to connect the Internet to a base station which has Internet connectivity and then receives Internet data and forwards them via balloons in the sky to the destination. Finally, the balloon close to the request user broadcasts the data to the ground. The antenna installed outside of home receives data and decrypt the data.

8. ADVANTAGES

- People with no connection to the outer world before can now have access to the any form of media online.
- Education can be boosted in remote areas. With access to internet a lot can be gained with vast amount of material available on internet
- People can stay updated. They will get to know what activities are happening around the world, what's new in any field they are interested in.
- In case of a natural disasters in which network infrastructure such as cell towers and Internet cables as well as power cables are affected so that people in the area cannot communicate with outside world and even within the same area, the balloon network can provide connectivity.

9. DISADVANTAGES

- The life of balloon is not more than100 days.
- If for any reason the control of balloon is lost from ground, the balloon can cause damage if landed in an urban area and can even cause delay in flights.
- Getting permissions from the countries to let the balloons fly over their airspace is not easy.
- Last mile solutions are not the only reason for low internet penetration.

10. CONCLUSION

Internet connectivity has become one of the basic needs in modern life. The projects like Google Loon cannot alone increase the "online population" but as we have seen there as several other parameters that are responsible for increasing the "online population". People need to be literate not only linguistically but digitally too. The infrastructure should be

developed. More and more people should be connected with roads and through electrical grid. Awareness should be developed among the people of the possible benefits they will get through internet. The devices should be available at affordable prices and the data plans should also be within reach of everyone. Going forward, sustained, inclusive Internet user growth will require a multipronged strategy, one that will depend on close collaboration among players across the ecosystem, including governments, policymakers, non-governmental organizations, network operators, device manufacturers, content and service providers, and brands. These all things need to be done first in order to get the benefits of projects like Google Loon.

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