

Providing Internet Connectivity Using Ring of Balloons Flying Around the Globe

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ABSTRACT

Internet is without any doubt one of the most important revolutions in the past decades. It has now become an integral part of almost everyone's life. Internet access is very far from universal. In one way or another, overcoming this lack of Internet access is the focus of many initiatives, whether they aim to increase Internet access directly or simply compensate for its absence. But there is always a problem when it comes to accessing the internet. The most challenging problems are those posed by the terrain. To overcome these problems, a continuously moving ring of balloons are used to provide us a high altitude platform for establishing internet connectivity to the earth below. These balloons are continuously monitored and maneuvered such that they provide un-interrupted internet connectivity to remote and rural areas in a cost-effective manner. However making Internet available to all is no solution for global poverty, but there are various things that the 4.5 Billion people disconnected from the web will gain from the Internet.

Keywords

Balloon, Solar Panel, Payload, Navigation.

1. INTRODUCTION

In recent times, access to the Web has become increasingly inevitable for all the people of different economic, educational and social strata. It has become very important when it comes to various goods and services, working of the government and more. Some of the sectors in the developed and developing countries have become so dependent on the internet that they cannot function without the internet. Internet is thus the backbone of most of the modern and efficient organizations. As of 2016, 3.4 billion people, that is around 40% of the world's population is not connected to the internet. The numbers of people are joining the internet every year but the rate at which they are joining is slowly decreasing. If this type of a trend continues and the rate doesn't pick up then even by the end of 2017 around 50% of the population will be offline.

Many noted personalities have repeatedly called this type of a global divide as one of the pronounced problems of the modern generation. Overcoming this lack of internet access is the ultimate aim of many initiatives. Some of them try to increase the internet access by just providing free internet to the people, like governments setting up free Wi-Fi at the railway stations in India. But this type of an approach will not serve the purpose. The solution must have wider reach, must be scalable, economic and must bring a maximum number of people to the internet.

Internet Users by Country (2016)

See also: 2015 Estimate and 2014 Finalized

#	Country	Internet Users (2016)	Penetration (% of Pop)	Population (2016)	Non-Users (Internetless)	Users 1 Year Change (%)	Internet Users 1 Year Change	Population 1 Y Change
1	China	721,434,547	52.2 %	1,382,323,332	660,888,785	2.2 %	15,520,515	0.46 %
2	India	462,124,989	34.8 %	1,326,801,576	864,676,587	30.5 %	1,08,010,242	1.2 %
3	U.S.	286,042,362	88.5 %	324,118,787	37,176,425	1.1 %	3,329,095	0.73 %
4	Brazil	139,111,185	66.4 %	209,567,920	70,456,735	5.1 %	6,753,879	0.83 %
5	Japan	115,111,599	91.1 %	126,322,715	11,212,120	0.1 %	117,385	-0.2 %
6	Russia	102,320,250	71.3 %	143,439,832	41,119,576	0.3 %	339,007	-0.01 %
7	Nigeria	86,219,965	46.1 %	186,987,643	100,767,678	5 %	4,124,947	2.63 %
8	Germany	71,016,605	88 %	80,682,351	9,665,746	0.6 %	447,557	-0.01 %
9	U.K.	60,222,305	92.6 %	65,111,143	4,887,758	0.3 %	554,411	0.61 %
10	Mexico	58,016,997	45.1 %	128,832,004	70,615,007	2.1 %	1,182,988	1.27 %

Figure 1. Internet Users by country in 2016

1.1. CURRENT TECHNOLOGIES

Ethernet is the most generally utilized LAN today. A LAN or the Local Area Network is a system of PCs that traverse over a little zone like a classroom, an office, a building or a ground. It is the inverse of WAN or the Wide Area Network which ranges for bigger zones. Ethernet is only a system convention that controls how the information is transmitted over Local Area Network. In fact it is alluded to as the IEEE 802.3 convention. The convention has developed and enhanced after some time and can now convey at the speed of a gigabit for every second that is around one million kbps. Many individuals have for their entire lives been utilizing Ethernet without really knowing it. It is the wired system in workplaces, at the bank and even at home. Moreover, most desktop and PCs with coordinated an Ethernet card inside so it is prepared to be associated with an Ethernet LAN. Wi-Fi is the mainstream remote systems administration innovation that utilizes radio waves to give remote fast Internet and system associations. A typical misguided judgment is that the term Wi-Fi is short for remote constancy, however it is not valid. Wi-Fi is essentially a trademarked expression that implies IEEE 802.11x. Wi-Fi systems have no physical wired association amongst sender and recipient by utilizing radio frequency (RF) innovation a

recurrence inside the electromagnetic range related with radio wave engendering. At the point when a RF current is provided to a reception apparatus, an electromagnetic field is made that then can engender through space. The foundation of any remote system is an Access Point (AP). The essential occupation of a get to indicate is communicating a remote flag that PCs can distinguish and tune into. So as to associate with a get to point and join a remote system, PCs and gadgets must be equipped with remote system connectors

Fiber optics is one of the quickest know methods for transmitting information. Fiber optics transmit information as light particles or photons that heartbeat through a fiber optic link. The glass fiber center and the cladding each have an alternate refractive record that curves approaching light at a specific point. At the point when light flags are sent through the fiber optic link, they reflect off the center and cladding in a progression of crisscross skips, holding fast to a procedure called add up to inside reflection. The light flags don't go at the speed of light in view of the denser glass layers, rather going around 30% slower than the speed of light. To re-establish, or help, the flag all through its excursion, fiber optics transmission at times requires repeaters at far off interims to recover the optical flag by changing over it to an electrical flag, preparing that electrical flag and retransmitting the optical flag. Light Fidelity or Li-Fi is a Visible Light Communications (VLC) framework running remote correspondences going at high speeds. Li-Fi utilizes basic family unit LED (light producing diodes) lights to empower information exchange, gloating paces of up to 224 gigabits for each second.

The term Li-Fi was authored by University of Edinburgh Professor Harald Haas amid a TED Talk in 2011. Haas imagined lights that could go about as remote switches. Li-Fi and Wi-Fi are very comparative as both transmit information electromagnetically. Be that as it may, Wi-Fi utilizes radio waves while Li-Fi keeps running on obvious light. We now know, Li-Fi is a Visible Light Communications (VLC) framework. This implies it obliges a photograph finder to get light flags and a flag handling component to change over the information into 'stream-capable' substance. A LED light is a semi-transmitter light source implying that the steady current of power provided to a LED light can be plunged and darkened, here and there at amazingly high speeds, without being unmistakable to the human eye. For instance, information is sustained into a LED light (with flag handling innovation), it then sends information (implanted in its shaft) at quick speeds to the photograph finder (photodiode). The little changes in the fast darkening of LED knobs is then changed over by the "recipient" into electrical flag. The signal is then changed over once again into a parallel information stream that we would perceive as web, video and sound applications that keep running on web empowers gadgets. While some may surmise that Li-Fi with its 224 gigabits for each second leaves Wi-Fi in the tidy, Li-Fi's elite utilization of noticeable light could stop a mass take-up. Li-Fi signals can't go through dividers, so keeping in mind the end goal to appreciate full availability, able LED knobs should be set all through the home. Also, Li-Fi requires the light is on at all circumstances to give availability, implying that the lights should be on amid the day.

1.2. CURRENT CHALLENGES

Internet gets to is not generally available in created nations, nor all around out of reach in creating ones. A large portion of the disconnected populace are not as excited for Internet access as

one may expect, either on the grounds that they are ignorant of it, in light of the fact that the Internet needs assets pertinent to them, or in light of the fact that the Internet is not exceedingly respected in their region. One little case, in India, individuals in urban areas like Bangalore have motivation to utilize the Internet which is to get to the wide cluster of products on Amazon. In numerous towns in India, where Amazon doesn't convey and utilizing a MasterCard online is viewed as a hazard, the Internet gives unmistakably less incentive in that circle. The second hindrance to Internet appropriation, low incomes and reasonableness, is maybe a more significant one. While the soliciting cost from Internet get to has dropped essentially over the most recent few years, regardless it stays distant for a tremendous number of individuals. Also, as focuses out, paying for the web is by all account not the only cost of going on the web.

Cell phones are still exceptionally costly in many places in India; in towns and residential areas, for instance, they cost over 20Third obstruction to Internet get to is client fitness, which incorporates advanced proficiency additionally, and all the more fundamentally, dialect education. It is found that the Digital learning of the disconnected clients is around 72The last hindrance to Internet get to is framework. One competent that has prompted quick establishment of broadband associations in creating nations, other than high per-capital salary, obviously, is the high rate of modernization. In less urbanized creating nations and even in rustic parts of created nations, wired association are extremely costly to introduce. Not just Internet framework itself additionally different sorts of contiguous foundation are fundamental for Internet network like dependable power, cleared streets, et cetera. Just 24% of sub-Saharan Africans have entry to power. In India, just 55% of rustic family units have power. Control foundation is consequently a fundamental concern blocking the development of existing portable systems. In created situations PC systems administration is a typical fiber optics utilize case, because of optical fiber's capacity to transmit information and give high transfer speed. So also, fiber optics is much of the time utilized as a part of broadcasting and gadgets to give better associations and execution.

1.3. OBJECTIVES

An idea of this magnitude and a huge impact will have a lot of factors that must be kept in mind. It is firstly important to define the goals or objectives and move towards it. The main objectives of this idea are as follows: To device a system that provides internet connectivity all over the world irrespective of location or terrain. To come up with an indigenous infrastructure that provides a platform for the flourishing of indisputable internet connectivity. Provide ease in which the user is able to learn, operate, prepare inputs and interpret outputs through interaction with a system. To do all the above within a certain feasible economic limits as the end user will be normal people of all classes.

2. INTERNET CONNECTIVITY THROUGH BALLOONS

There are various new technologies in providing internet to people on a small scale. The idea is to provide internet to a larger scale of people with minimum risk and investment. In this chapter we discuss how this can be achieved.

2.1. OUTLINE

In 2011, Google entered the High Altitude Platforms area by propelling Project Loon, innovatively named both for the inflatable at the center of the venture. Extend Loon is housed in Google X, a similar lab that created Google Glass and Google's self-driving auto; other than those more feasible endeavors, in any case, Google X is known for seeking after thoughts that verge on sci-fi. Less fruitful activities incorporate a space lift and teleportation, which were closed down for being infeasible and physically unimaginable, individually. Before Project Loon, High Altitude Platform extends constantly based on keeping a flying machine, swell or other aircraft as stationary as would be prudent, with the goal that it could give Internet access to a settled topographical territory. This included either tying the vehicle or utilizing huge vitality to neutralize stratospheric winds. Google's Richard DeVaul thought about whether, rather than paying the high expenses of attempting to keep a high-height transport stationery, it is conceivable to give Internet scope through an entire armada of flying machine that float overhead, however which are sufficiently various that there's constantly one inside range more like GPS satellites. In this manner, Project Loon was conceived. Extend Loon, Google's push to pillar broadband Internet access down to remote or provincial districts of the globe from a system of stratosphere-meandering inflatables. Nut case was begun inside the organization's Google X lab in 2011 and has went with other high-flying endeavors, for example, one to fly sun oriented fueled automatons transmitting remote Internet signals

2.2. BALLOON DESIGN

The Balloon consists of majorly 3 items:

1. The Envelope
2. The Solar Panels.
3. The Equipment.

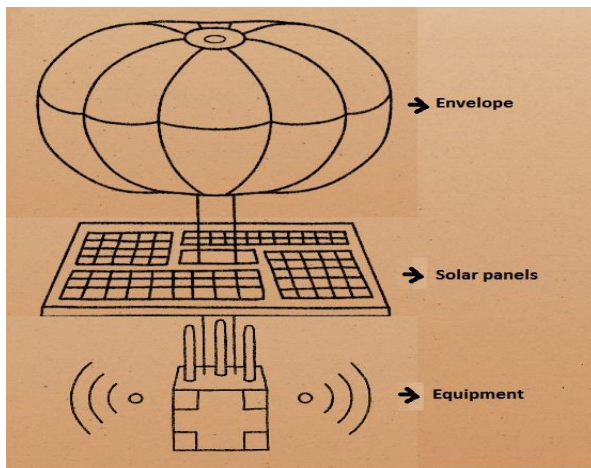


Figure 2. Components of the Balloon.

2.2.1. The Envelope:

Each Project Loon stage is lifted by a 14m width helium expand. The inflatable's envelope is made of polyethylene plastic, taking into account "super weight" the specialized term for an inflatable that is loaded with sufficiently high weight gas that it

doesn't empty when the temperature drops. The exact determinations of this inflatable are still being worked on. Extend Loon utilizes a solitary inflatable, and that gas is discharged from the envelope to slip, while Cassidy says every helium expand has an air-filled inflatable inside, which can be swelled and emptied to change height. In any case, the inflatables are equipped for rising or falling inside the stratosphere. Since winds in various levels of the stratosphere blow in various headings, changing height enables the gadget to be controlled in the coveted course. Along these lines, Project Loon doesn't fall conveniently into any of the three classifications of High Altitude Platforms, it's neither a carrier nor a flying machine, and it doesn't endeavor to remain in one area after some time.

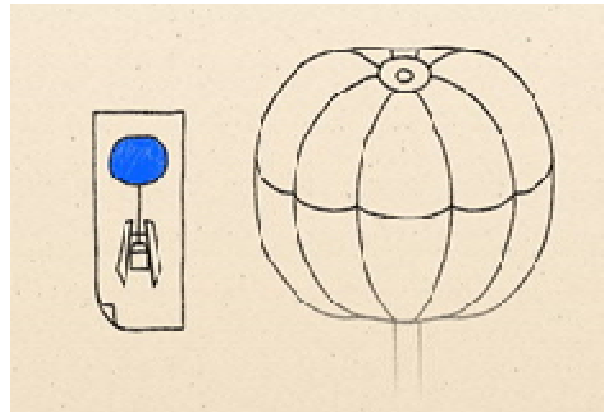


Figure 3. The Envelope

2.2.2. The Solar Panels:

The crate is either encompassed or topped by a variety of sun based boards fit for creating 100 Watts in full daylight. This powers the hardware and fan, and charges the batteries for overnight use. Touted as a promising option vitality hotspot for quite a long time, sunlight based boards crown housetops and roadside signs, and help keep rocket fueled. A sun based board works by permitting photons, or particles of light, to thump electrons free from iotas, creating a stream of power. Sunlight based boards really contain numerous, littler units called photovoltaic cells. Photovoltaic basically implies they change over daylight into power. Numerous cells connected together make up a sunlight based board. To work, photovoltaic cells need to set up an electric field. Much like an attractive field, which happens due to inverse posts, an electric field happens when inverse charges are isolated. To get this field, producers "dope" silicon with different materials, giving each cut of the sandwich a positive or negative electrical charge. In particular, they seed phosphorous into the top layer of silicon, which includes additional electrons, with a negative charge, to that layer. In the meantime, the base layer gets a dosage of boron, which brings about less electrons, or a positive charge. This all signifies an electric field at the intersection between the silicon layers. At that point, when a photon of daylight thumps an electron free, the electric field will drive that electron out of the silicon intersection. There are different sorts of sun based power innovation including sun based warm and focused sun based power that work in an alternate design than photovoltaic sun based boards, yet all outfit

the energy of daylight to either make power or to warm water or air. The sunlight based boards on the Balloons in some ways add weight to the Balloon. This is another issue that we should remember and ensure that these sun powered boards are not that overwhelming. The sunlight based boards need to create least vitality only for the working of the electrical gear like the transmitter or handsets. The sun based boards ought not be too overwhelming that they negate their exceptionally reason. The expanded weight will affect the route of the Balloons. Since the inflatable will explore totally in light of the characteristic assets we should consider this issue important and must fare thee well while planning the sun powered boards. The situating of the sun based boards may likewise affect the execution of the boards. Legitimate situating must be done to such an extent that they produce most extreme power for utilization by the inflatable in the night too. The most ideal approach to position sun based boards according to research is taking after Fibonacci geometry. However, since the area of situating is little this is impossible. Elective methods for proficient situating must be done before going live.

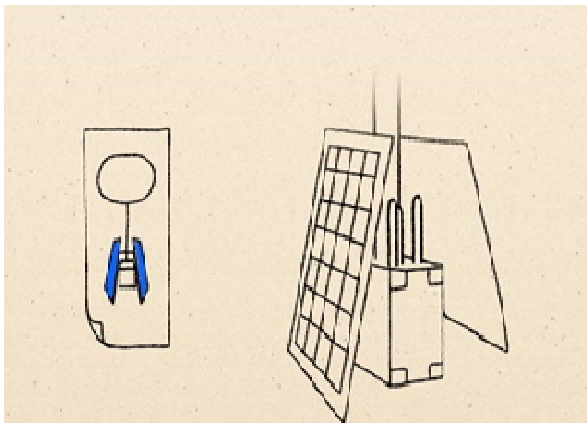


Figure 4. The Solar Panels

2.2.3. The Payload :

The Payload The inflatable's payload comprises of a Styrofoam box about the extent of a brew cooler. The payload may contain different electrical parts. Some of these might be exceptionally delicate and henceforth should be taken at most care of. The parts should be sheltered, that is they should be protected from the dampness and the overheat that they might be presented to. The payload might be inclined to climate challenges like excessively solid winds. It should likewise contain a move down power supply which might be overwhelming and henceforth enhancing the power supply source will likewise affect the execution. Radio wires to speak with base stations, different inflatables, and gadgets looking for web, up to a scope of around 40 km. The handling energy to run the inflatable and speak with Google. Lithium particle batteries to store control for night utilize, and A fan (at any rate on account of the two-envelope setup) to blow up and collapse the inward inflatable. The Equipment comprises of the thermometers, gadgets to figure the velocities. They additionally contain the handset which will help them in sending messages. Radio waves are electromagnetic unsettling influences that emanate out every which way. At the point when a present goes along a wire, it creates an attractive

field around that wire. Wi-Fi transmitters abuse this element to beat a current out onto the copper wire inside a radio wire.

The wire is grounded toward one side and unattached at the flip side. The establishing implies each flag scatters very quickly, however the nearness of the charge on the wire immediately makes a constrain field that produces a radio wave. Metal is a transmitter of both power and attraction. As the radio wave flag shafts out from the transmitter, it will "stick" to any metal protest it experiences. It then occupies and keeps running along the length of that metal protest. That is the reason expansive metal articles, similar to ice chests, square Wi-Fi flag and make no man's lands. The flag goes through the plastic packaging of the accepting radio wire and strikes the copper wire inside. It then goes along the length of that wire, which prompts a remote system connector. The system connector deciphers the electronic heartbeat into information and passes it to the PC or switch that it serves.

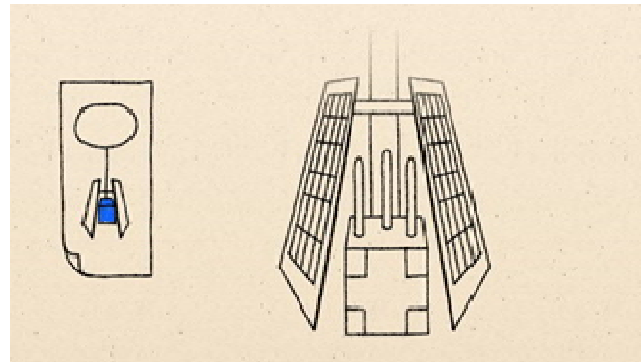


Figure 5. The Equipment

3. FUNCTIONING OF BALLOON

The idea of having a HAP sounds very simple and easy to implement, but the difficulties involved in it are really huge. The most important among them is how the Balloon will actually work as planned.

3.1. Balloon Navigation

The inflatable's envelope is made of polyethylene plastic, taking into account "super weight" the specialized term for an inflatable that is loaded with sufficiently high weight gas that it doesn't flatten when the temperature drops. The exact particulars of this inflatable are still a work in progress; the venture site says Project Loon utilizes a solitary inflatable, and that gas is discharged from the envelope to drop, while Cassidy says every helium swell has an air-filled inflatable inside, which can be expanded and flattened to change height. In any case, the inflatables are equipped for rising or falling inside the stratosphere. Since winds in various levels of the stratosphere blow in various bearings, changing height enables the gadget to be controlled in the coveted course.

Hence, Project Loon doesn't fall conveniently into any of the three classes of HAP; it's neither a carrier nor an air ship, and it doesn't endeavor to remain in one area after some time. As of late, machine learning has rethought picture and discourse acknowledgment, dialect interpretation and advertisement focusing on. It has broken the antiquated session of Go. In any case, these are recently the most punctual advancements in what

specialists see as an immense development toward an extensive variety of frameworks that can figure out how to perform brings keeping pace with or far better than we people. Until further notice, the greater part of what machine realizing can fulfill happens in the simply advanced domain. Be that as it may, as the Project Loon test appears, these frameworks can possibly assume a part online as well as in the physical world, as well. Furthermore, not simply with driverless autos. Beforehand, X coded the Loon route framework by hand, which gave the lab just such a great amount of control over its inflatable, on account of the gigantically unusual climate up in the stratosphere. The ultra-light inflatable have just constrained capacity to alter course all alone: Like hot air inflatable, they can just climb or down. To remain in a specific range, they have to figure out how to peruse the stratosphere and rise and tumble to get the streams that will keep them in one place. By breaking down past flight information, the inflatable can make sensibly precise expectations about what will occur amid flights to come. Be that as it may, they likewise investigate information amid the flight itself and modify their forecasts as needs be. This self-revision inclines toward another AI method, fortification taking in, an approach that supported Alpha Go, the Go- playing machine worked by Google's DeepMind lab that beat a grandmaster the previous spring. It's a piece of a venture that could have an undeniable effect. At this moment, the energy of machine learning is for the most part noticeable on the web. In any case, it's exploring this present reality, as well, with the possibility to bring numerous more individuals online all the while.



Figure 6. The Balloon Positioning

3.2. BALOON CONNECT

The essential structure of the Project Loon system is that Internet network streams from a base station to any inflatable inside 40 km away. This inflatable can then "shaft" its association with whatever other inflatables inside 40 km sweep.

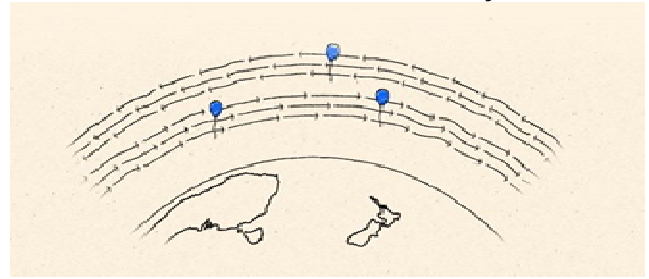


Figure 7. The Balloon Navigation

The association can as of now make "jumps" between five inflatables. This implies base stations are required roughly every 200 km, rather than each couple of km as on account of cell towers. Google guarantees this ought to increment to around 1000 km inside the following couple of years. Each inflatable then communicates Internet to empowered gadgets inside its range, which is asserted to be a hover with a 40 km distance across in and with a 40 km sweep. In early tests, this communicate was done utilizing ISM radio groups (at 2.4 and 5.8 GHz), which required gadgets interfacing with Loon's administrations to have extraordinary reception apparatuses. All the more as of late, they appear to have changed to LTE conventions, which are available through unmodified phones and through settled radio wires.

The rates offered by Project Loon have likewise developed after some time; in mid-2014, Cassidy called Loon's Internet "single-digit megabits every second," equivalent to 3G. Before the finish of 2014, the venture asserted "5 megabits for every second to cell phones, or a zippy 22 Mbps to settled radio wires", and by March 2015 the claim had heightened to "around 10Mbps downloads". Transfer speeds have not been revealed. At the point when the 2G computerized systems were being actualized the condition of radio correspondences was no place close as cutting edge as it is today. The framework utilized relied on upon a blend of conventional remote interchanges and PC systems. A piece of frequencies is sufficiently assigned to give around 800 one-way flag channels and for two-way or full duplex correspondence you require two channels for every telephone conveying this down to 400 associations. This unmistakably isn't sufficient to offer correspondences channels to a vast populace and the way to making things work is "recurrence reuse". There is one thing that no measure of tinkering can change around 2G administrations. They all make use of FDMA and TDMA, both of which are known not to be the most ideal approach to share a square of frequencies. The insurgency in many remote advances, for example, Wi-Fi has been the utilization of spread-range strategies. Rather than transmitting on a solitary recurrence, spread-range makes utilization of the greater part of the accessible frequencies either by recurrence jumping or the much more productive approach of spreading the flag at low power over the accessible transmission capacity.

The European 3G standard Universal Mobile Telecommunications System UMTS which is utilized as a part of 3GSM, makes utilization of Wideband CDMA. For this situation the channel utilized is 5MHz which is four times more extensive than the first CDMA. WiMAX is being accustomed to convey the Internet to remote areas or to areas that don't have great ADSL speeds it is probably not going to be the victor in the 4G stakes. Different organizations have delivered WiMAX telephones and

more are en route to showcase yet LTE equipment appears to be a great deal more progressed. Each inflatable then communicates Internet to empowered gadgets inside its range, which is guaranteed to be a hover with a 40 km measurement in and with a 40 km sweep. In early tests, this communicate was done utilizing ISM radio groups (at 2.4 and 5.8 GHz), which required gadgets interfacing with Loon's administrations to have exceptional reception apparatuses. All the more as of late, they appear to have changed to LTE conventions, which are open through unmodified PDAs and (for non-cell phones) through settled radio wires.

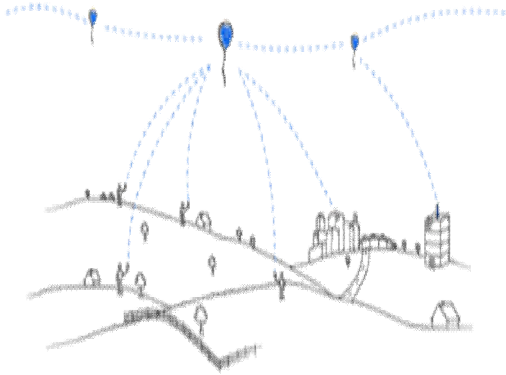


Figure. 8. Balloon Connection

4. CONCLUSION

In this paper Project Loon is not cure-all even adding a very huge number of Balloons will not solve the problem of no Internet access completely. But, realizing a large-scale High-Altitude Platform in rural, developing, remote and underdeveloped areas will surely bring a lot of the people who are not having access to internet. Educating people with about Digital Literacy will also help people move towards internet to all. Proper Infrastructure and improvements in the schooling in various under developed areas of the world will bring the world closer to internet for all. Internet to all will also imply that there will be more number of opportunities open to the people. This will also create a enormous number of employment opportunities. None of such High Altitude Platform ideas have come to reality till date. But realizing these will one day open up an entirely new world for the people and the endless possibilities achievable.

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