"OUTERNET" (A Review)

Swapnil Jain[1] Sonil Sharma[2]
[1,2]Department of Electronics & Communication Engineering

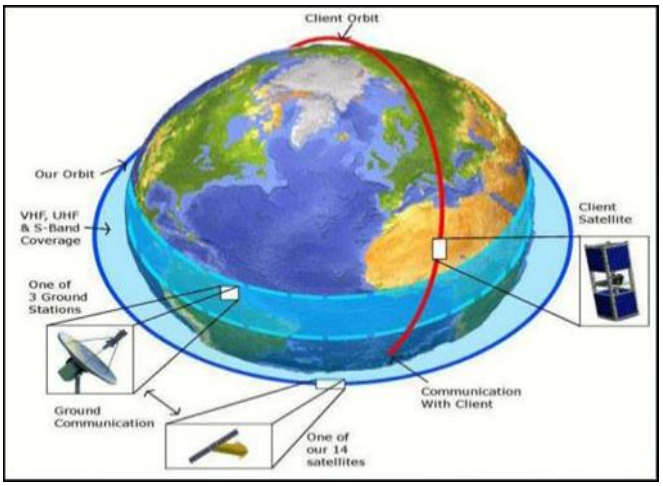
Abstract— When everyone is talking about changing the world, let us do this by bringing new technology to our daily life with the help of "INTERNET OF THINGS" that provides us with products that can understand us, so basic need of IOT is internet accessibility but the question arises that "Do everyone have basic internet access?". A fact says only one third of the total population have accessibility to the internet. It is becoming the backbone of our life, without it we can't imagine a single day especially in case of disaster or natural calamity our connectivity of data, communication system all becomes a waste. But, since every problem comes with a solution, here we have OUTERNET. It is like a light in this dark world so this review paper aims to clear the term Outernet, how it can rectify the problems, and how it works.
Key words: Outernet, Cubesats, Lantern, Data casting, User Datagram Protocol, VHF, UHF, S-Band, Clyde space

I. INTRODUCTION

Outernet is a global network of cube satellites (cubesats) broadcasting internet data to all over the world. Its goal is to provide free access to internet data through wifi, made available effectively to the all across the globe. Project would involve data casting & user diagram protocol through hundreds of cubesats measuring 10cm (3.9 inch) each. Wifi enabled devices would communicate with the satellite in their region which would communicate with other satellites & ground based networks, thus forming the global network. It is a modern version of short wave radio or bit torrent from space and provides a basic level of information and education to the world for free. "The Primary Objective of the Outernet is to Bridge the Global Information Divide". The Outernet will connect the entire world with the information on various subjects, and this connectivity will be achieved with the help of the satellites. Keeping all these problems in mind, a non-profit organization, named Media Development Investment Fund (MDIF), initiated a project called OUTERNET.

The project was been initiated in the year 2013, and is accelerating at a great speed. The countries like America, Europe, Middle East, and North Africa have started getting Outernet access. Soon, the access will become worldwide.

II. OUTERNET CONCEPTUAL ILLUSTRATION



The Outernet includes a Client Orbit where the Client Satellite is placed and an Outernet Orbit where the 14 Cubesats constellation is made. A complete coverage of Very-High Frequency (VHF), Ultra-High Frequency (UHF) and S-band occupies the area between Outernet orbit and earth's surface. The VHF and UHF are the radio frequency electromagnetic waves or simply radio waves. The difference between VHF and UHF is their frequency range. The VHF frequency range is between 30MHz to 300MHz while that of the UHF is between 300MHz to 3GHz. The S-band comes on under electromagnetic spectrum. It is a part of spectrum's microwave band. The frequency range between 2GHz to 4GHz is a part of S-band.

This Outernet orbit interacts with the ground segment to create a communication pathway for the data signals. Likewise, the ground segment also interacts with the space segment.

In this way, the Outernet concept is followed for providing a global information network to everyone alike.

III. COMPONENTS OF OUTER NET

The main areas of its components include:

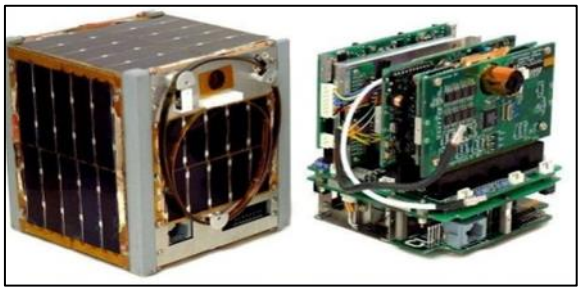
- Cube Satellites
- Segments
- Receiver

A. Cube Satellites:-

A cubesats is a type of miniaturized satellite for space research that is made up of multiples of 10 * 10 * 10 cm cubic units. This configuration can be doubled and tripled, and accordingly its dimensions become 20 * 10 * 10 cm and 30 * 10 * 10 cm respectively. Cubesats have a mass of no more than 1.33 kilograms per units and often use commercial off-the-shelf (COTS) components for their electronics and structure. . Cubesats are launched and deployed using a mechanism called Poly-Pico satellite Orbit Deployer (P-POD).

P-PODs are mounted to a launch vehicle and carry Cubesats into orbit, then deploy them after proper signal is received from the launch vehicle.

1) External & Internal Structure



B. Segment:-

The Outernet is divided into three segments.

1) Space Segment

Space Segment consists of satellites evenly spaced in circular equatorial orbit.

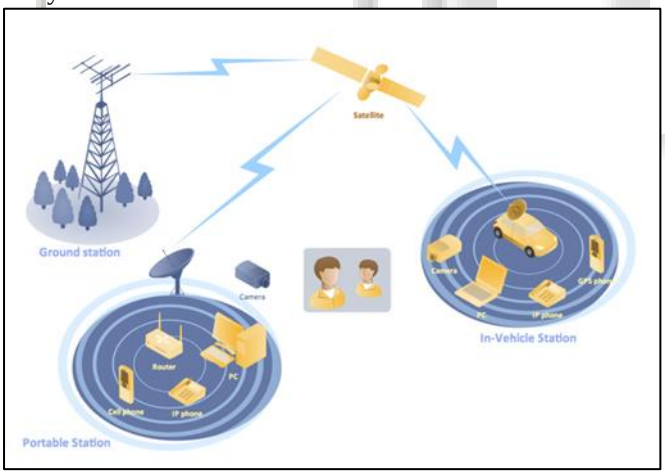
2) User segment

The user segment consists of clients who wish to use the Outernet Service via their mobiles or tablets.

3) Ground segment

This segment consists of several ground stations spread around the equator of earth. The three main ground stations are- Guiana Space Center (South America), Broglie Space Center (Kenya), and Pusat Remote Sensing (Malaysia).

Due to the constellation's equatorial orbit, each of the satellites will pass every ground station during every orbit.



C. Receiver:-

Currently, reception of the Outernet is possible from the following three devices:

- Lighthouse, which is a small receiver that looks like a set-top box
- Lantern, which is currently under development in the Outernet with Indiegogo campaign
- Build-your-own receiver using USB satellite tuner and Raspberry Pi

1) Lighthouse:-

This is a small receiver that looks like set-top box. It receives one-way data multicast from the Outernet network of six geostationary satellites. It requires a satellite dish for signal reception. Lighthouse is perfect for places where there is no Internet access, is too expensive, unreliable, very slow and limited. It costs approximately US$ 99 plus shipping charges.

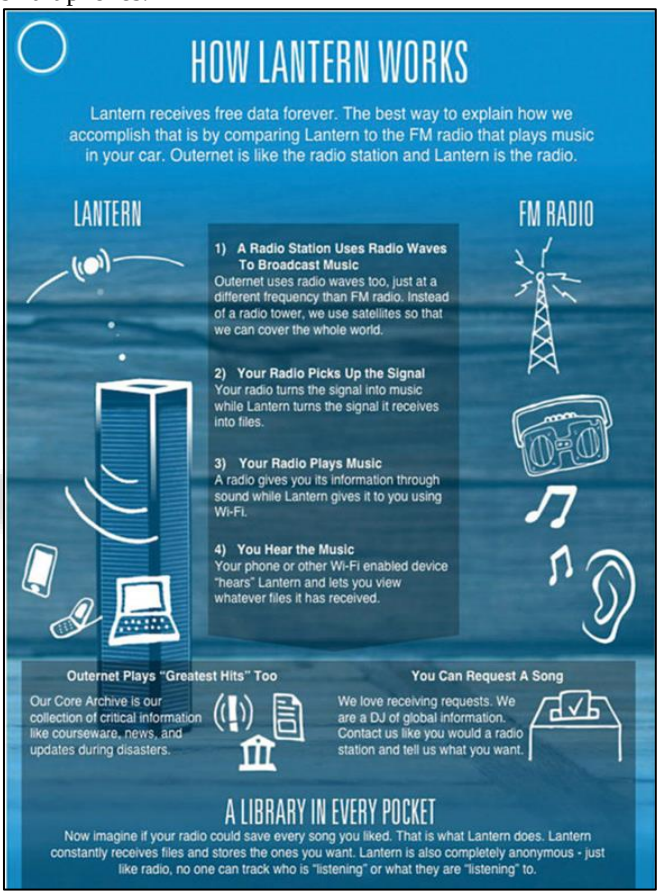
2) Lantern:-

This is a small and portable device that can receive data from satellite networks directly without any satellite dish antenna. It has complete global reception capability. It is Wi-Fi-enabled and allows content to be accessed on other devices wirelessly. There is no limit to the amount of data that can be downloaded.

Lantern can be charged via a power adaptor and/or using solar power.

Lantern receives data in small sizes of, say, 2MB per day (in future it could go up to 100MB to 200MB per day).

Lantern can also receive data using a dish antenna at high speed. Its battery works for 12 hours for data reception. It can even be used to charge devices such as smart phones.



3) Build-your-own receiver:-

Another way to access transmissions sent by the Outernet is to build a receiver that requires components like Raspberry Pi, satellite dish antenna, LNB and USB TV tuner card. After completion of the setup, the satellite dish receives transmissions sent by the Outernet, which are then sent to the USB TV tuner card and then to Raspberry Pi. Data received is stored on Raspberry Pi and can be accessed when a Wi-Fi dongle is connected to the Raspberry Pi and setup is done correctly.

IV. WORKING OF OUTERNET

As written before, there are three segments – Space segment, Ground segment, and User segment. The Outernet works with the connectivity among all these three segments.

Satellites are the fastest and cheapest way to reach every person on Earth. Outer net's Wi-Fi solution works by using hundreds of tiny 10cm cube shaped satellites called "Cubesats". The plan is to launch hundreds of low-cost miniature satellites, known as Cubesats, into low Earth orbit (LEO). Each satellite receives data streams from a network of ground stations and transmits that data in a continuous loop until new content is received. In order to serve the widest possible audience the entire constellation utilizes globally accepted standards based protocols, such as DVB, digital radio mandible and UDP based wifi multicasting.

The Outernet downloads files from various sources like Khan Academy, Wikipedia, MIT open courseware and the like, and sends it to its servers. The satellite dish sends this data to the satellites. The satellite broadcasts information back to Earth all over the world. Ku/C-band dish antenna receives the information and sends it to the receiver, which decodes and saves it to its memory. The receiver then shares this information with other devices using Wi-Fi. Wi-Fi-enabled devices like laptops and Smartphone's connect to the receiver access point and open any browser. Information is then displayed on the screen.

Initially, the Outernet holds one-way communication system like an FM radio. The users will be able to get information on the subjects that are already saved for the users. The user has to filter his/her search, and accordingly, the results will be displayed. This process takes place as follows:

- Firstly, the ground station sends the signals to the cube satellites about the data request. The ground station can be any among the three stations located in South America, Kenya, and Malaysia.
- The cube satellite, then, processes the request, and sends the signals to the Outernet servers of the ground segment. These cube satellites are in the Outernet space on the equatorial orbit, existing in a constellation of 14 cube satellites.
- The Outernet servers get connected to the lanterns, and send them all the data in the form of the radio wave signals.
- The lantern, passively receives all the data in the form of radio waves, and then stores them as digital files. The digital files can be music, videos, eBooks, webpage's, application, and many other information source formats.
- The information stored in the lantern is accessed by the user using a WiFi enabled device. The user has
- To simply turn on the WiFi of his/her device, and connect to the lantern. And according to the needs, the user can get access to all the available data in the lantern.

The Outernet will be further extended as a two-way communication but only after successful implementation of one-way communication, and reaching enough funds for the same.

In two-way communication system, the user will be able to request information that is not available in lantern. The users will get access to that information by sending signals for the request, and in return, the requested information will be sent to the user.

NOTE: - To make it simple, let's consider the Outernet to work like an FM radio. It is just like FM radio, Outernet works in a similar way, the difference lies between radio tower and satellites, and FM radio receiver and lantern. And hence, the communication is also one-way.

V. INTERESTING FEATURES

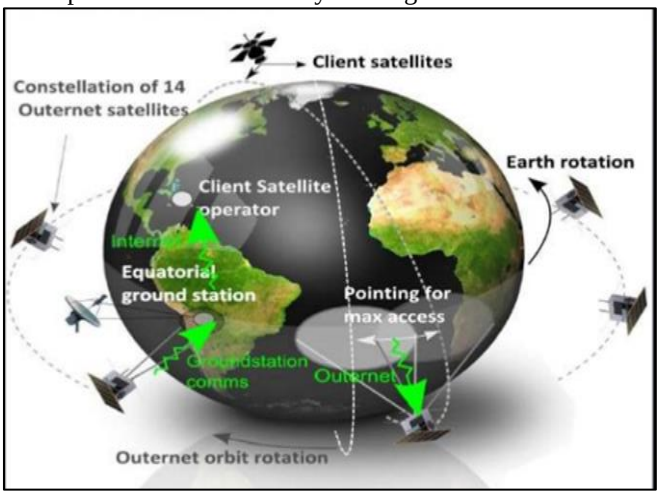
Given below are some interesting features of the Outernet:

- Global coverage
- Unlimited data broadcasting (currently 1GB/day)
- No subscription/no registration
- Totally anonymous (because receive-only service)
- High-speed data download (tested up to 25Mbps)
- Anyone can request content to be multicast on the Outernet

VI. TIMELINE OF OUTER NET PROJECT

The Outernet was founded by Syed karim on 1 February 2014 in New York, USA. The project is being carried by MDIF. The company is working on it since 2013. The detailed timeline of the project is given below:

- December 2013 – Phase I Technical Assessment
- June 2014 – Prototype satellites were developed, and long range WiFi multicasting was tested.
- September 2014 – Testing of transmission in flight-like environment took place.
- January 2015 – Constellation operations were launched and tested.
- April 2015 – Hundreds of satellites processed for manufacturing.
- June 2015 – Outernet deployment according to launch permit.
- December2015- public editing of Outernet.
- January2016- Outernet launches its first community call.
- February 2016-Outernet and GWA Chicago began a service learning project called Project Empathy.
- Aprail2017:- Successfully running



"Librarian" - Outernet's Content Application Librarian is what a user would have installed on their device that would receive Outernet content and act as their browser. Librarian decrypts the broadcast content that has been downloaded to the device. The current version does not provide any search capability. That feature is planned for future releases.

Librarian Implementation details are:-

1) Multi-language support:-
Librarian has been built with multi- language support.
2) Content signature:-
Each piece of content (HTML page and/or images) is sent in encrypted format using GnuPG and 2048- bit encryption key.
3) Storage conservation:-
In order to conserve bandwidth and storage, all content is broadcast as zip files.

VII. OUTER NET BENEFITS

The Outernet will provide access to:
a) News and Information
b) Applications and Content
c) Educational Courseware
d) Emergency Communications

In the age of the Outernet the physical world functions like a website. Every object can be clicked on like a hyperlink in order to access information, services and communication. The Outernet promotes individuality by providing us with individually tailored information. This enables us to act more efficiently and make more informed decisions. A virtual personal assistant supports us in our everyday lives by taking our preferences (context layer) and our frame of mind (mood layer) into consideration. The Outernet will even be manageable for young children and the elderly. This is particularly relevant in view of the ageing structure of society: concepts such as ambient-assisted living or home monitoring make it possible for even the very elderly to lead an anxiety-free and self-determined life outside overburdened nursing homes.

VIII. SIMILAR PROJECTS TO OUTER NET

There are three more projects that are being processed in same direction. These projects have a different operational and conceptual structure but they aim to solve the same problem, the problem of people unable to access information. These two projects are listed and explained in detail below:

A. Google Loon

The Project Loon is initiated by Google. The project was started in June 2013 in New Zealand to test the Loon technology. Presently, the project is growing there to help people to reach higher in technology and connectivity. The goal of this project is to connect the people to the internet who live in an area where the internet access is next to impossible. The aim is to be achieved by using Balloons in the geographical regions where there is no internet facility. These balloons will be placed in the Stratosphere, much higher than the sphere where airplanes fly or weather conditions interfere.

B. Internet.org

Where Google is opting for balloons, however, Facebook is taking a slightly different direction to connect the world from the sky with drones. Facebook's work is a part of larger initiative called Internet.org. Specifically, Facebook hopes to use solar-powered drones by Ascenta to beam down Internet connections from different altitudes and platforms depending on population density.

C. Nets kuku

Developed in 2005 by an Italian company, FreakNet Media, Netsukuku is a distributed network that provides an anonymous, uncensored and completely independent network. The network is without any server, ISP or central authority. With a capacity to handle 2128 nodes, Netsukuku uses minimum resources and that too without any server or central system.

IX. CONCLUSION

Outernet is an ambitious project that seeks to create a global WI-FI. Under the name "Outernet" a technological development is approaching which will profoundly Change our relationships with each other and with the objects around us in the world. The Internet is leaving the previously detached realm of cyberspace and placing itself over our environment like a second skin. The Outernet will change our lives even more dramatically than the Internet. This will not take place from one day to the next, but in a constant, evolutionary process. Outernet is not only providing Global connect, but also uncensored and anonymous connection worldwide.

REFERENCES

[1] NASA. (2010, September) Tracking and Data Relay Satellites (TDRS). [Online]. http://nssdc.gsfc.nasa.gov/multi/tdrs.html
[2] Stephan Horan, "The potential for using LEO telecommunications constellations," International Journal of Satellite Communications, vol. 20, no. 5, pp. 347-361, July 2002.
[3] Swartwout, M. A., "A Brief History of Rideshares (and Attack of The Cubesats)," Aerospace Conference 2011 IEEE, 1-15 (2011).
[4] https://www.clyde.space/what-we-do/platforms/1u-platform
[5] https://en.m.wikipedia.org/wiki/Outernet
[6] https://www.indiegogo.com/#/picks_for_you
[7] http://www.bqlive.co.uk/innovation/2017/02/01/news/bringing-internet-access-to-the-world-8622/
[8] https://www.outernet.is/
[9] https://www.fastcompany.com/3027663/all-about-google-loons-low-cost-space-based-competitor-outernet

