

SOLAR POWERED SATELLITE INTERNET FOR RURAL AREAS IN SRI LANKA

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Abstract

This article proposes a high-speed communication system. Past few years ago, all people witnessed the internet, networking, and communication system as one of the most valuable parts of our life. So people will be able to use high-speed satellite internet. In the modern world, people must consider how much data and internet speed are needed. When more people use internet service at the same time will be required more data and internet speed. Satellite-internet covered hard-to-reach rural areas where Digital Subscriber Line (DSL), a cable, may not exist yet. In the rural areas of Sri Lanka, one of the main problems is, supplying electrical power. In this paper, how to power up satellite connections by using solar energy will be discussed. Primarily, rural village areas of Sri-Lanka where there are no terrestrial internet services available can provide significant achievements for improving the villager's life standards of poor village people of Sri-Lanka. Here discusses how to get many opportunities such as e-learning, e-commerce, e-health, e-entertainment, e-banking and other internet opportunities.

Keywords: satellite-internet, solar, power, economy, Srilanka

1. INTRODUCTION

Sri Lanka is democratic, socialist an independent nation. Sri Lanka is an island located in the Indian ocean with approximately 21.9 million citizens, a total land area of about 65,610, with 2,905 of water area and 62,705 of the land area [1]. The nation is split into nine provinces and subdivided into twenty-five districts for administrative purposes. Sri Lanka rich is in natural resources. After thirty-year violence struggles between the Sinhala and Tamil communities, the country's economy increased by an average of 6.4 percent between 2010 and 2018. This country has been one of the fastest increasing economics in South Asia. The island has a tropical climate. The monthly temperature average is between 22 °C-33 °C in the lowlands and between 7 °C – 21 °C in the highlands [02]. Sri Lanka's majority of people are poor, live in rural village areas. Many rural village areas in Sri Lanka have no access to the internet.

The COVID-19 pandemic situation has continued around Sri Lanka, By mid-April 2020. The pandemic situation daunting challenge for more people from rural village areas. Sri Lanka-wide school closures, the impact of the covid-19. This situation most impacts

students from rural village areas in Sri Lanka. More schools, some education institutes, and some universities have adopted an online learning system. However, students from rural villages still face more challenges with internet networks and data speed. Because many rural villages in Sri Lanka have no internet network system. This pandemic situation influences the health and economy of rural village areas in Sri Lanka [2-5].

This article has been discussed how to access provide internet services for rural village areas in Sri Lanka. Modern-day internet services have one of the greatest important parts of human life because it provides a lot of opportunities. Especially the main purpose how this internet services can be provided for rural village areas. So using satellite communication, these internet services are provided for rural village area users like in Sri Lanka because these methods are more simple, reliable, and affordable. Satellite internet is provided to make peoples life very easy and comfortable, like education services, health services, bank services and a lot of social works [06]. As the people live in rural village areas, they cannot move to urban areas due to long distances. So they can use their services by using satellite internet communication system. The impact of satellite internet communication services in the rural village areas will create more opportunities, and standard living life will also increase. In the last twenty years, the annual electricity growth rate between 5-6% in Sri Lanka. Now present-day more rural villages have not distributed electricity in Sri Lanka. When the Norochcholai power plant breaks down in Sri Lanka, Daily electricity power cuts have been arranged across the country. So the solar power system in rural village areas can be introduced. According to the Starlink project, there are a planned approximately 11943 satellite constellations in low orbit. The goal is to provide satellite internet and deliver the beta services coverage of people everywhere in the world. They consider it about near the future all over the people can use the internet service any time and anywhere. Satellite internet services will be established that faster (50 Mb/s to 150 Mb/s), low latency (20ms to 40 ms), and reliable internet service should be provided to rural village area's users at more possible very low cost. So how internet service through satellite can be provided and what future advancements opportunities can be arranged for improving the lives of rural village areas in Sri Lanka will be discussed. The major mission is to provide reliable, high-speed internet service using satellites in rural village areas in Sri Lanka.

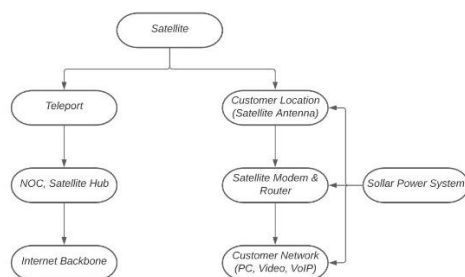


Figure 1 - Satellite internet network overview

2. CHARACTERISTICS OF SATELLITE INTERNET

Sri Lanka is surrounded by the sea. Present-day, this region has internet network access using a dial-up connection, which impacts Sri Lanka's development. Modern-day satellite internet network services are used in more developed countries in the world. Satellite internet can be set up faster than terrestrial networks because

- The infrastructure can be grown independently of geography features because satellite internet networks do not have to depend on location. Any location people live, they can be connected internet through satellite communication.
- They can be developed freely, establishing terrestrial infrastructure because satellite internet technical equipment can be taken around and located anywhere.
- The major part is that satellite internet service can at once publish an individual copy of data to more destinations.

The development of satellite internet service is changing as internet technology, and the satellite continues to evolve.

3. OPPORTUNITIES FOR RURAL VILLAGE AREAS

The satellite internet technology can allow the following opportunities for the people of the rural village areas in Sri Lanka. This technology improves more business opportunities and a standard lifestyle in rural village areas [8-10].

- E-learning system.

Satellite internet network service can provide more content of E-learning system for rural village areas peoples. It makes it easy to balance their work with family work. An online lesson can be given to people. They will become educated. They can take part in the progress of their motherland.

- Internet banking and Online marketing.

E-banking service allows people of various financial instructions and more features. So people from rural village areas do not need to move long distances for going to cities for banking and shopping. People from rural village areas can online order more of their things from the internet and collectively ship for them.

- Telephone access.

The people from rural areas do not migrate to urban areas. They can work from their houses for many companies. They can create small offices in their houses and can access connectivity with the main branch across the internet network service supplied across the satellite.

- E-entertainment.

By supplying internet network services across satellite will give various new more entertainment services for people of rural village areas in Sri Lanka, like internet radio, Internet Protocol television (IP TV), and high definition (HD) videos.

- Telehealth technology

By supplying internet network services across satellite can be available expert doctors for them from cities. Patients can be checked, and their problems can be solved by using telehealth technology.

4. INTRODUCING SATELLITE INTERNET CONNECTION FOR RURAL VILLAGE AREAS

Sri Lanka faces various technological problems developed in rural village areas in Sri Lanka. With an estimated 10.9 million internet users online, but more than 49.2% of the people without access to the internet in January 2021. The number of internet users in Sri Lanka grew +7.9% (800 000) between 2020 and 2021 [20]. In developed countries no more difference between rural and urban areas because they have widespread internet service. Sri Lanka is a developing country. The majority of people are poor and live in the rural village area. People from rural village areas have very low living standards, education, health, medical care, and transportation infrastructure. Sri Lanka has more different geographical areas like a mountain, terrains, small islands, forests providing internet services across wired connectivity (like fibre optical, wire, and so on). It becomes an extremely challenging situation. So the satellite internet system is the most suitable platform for rural village areas in Sri Lanka [11].

The last few years saw an increase in more satellite industry. In Sri Lanka, the most suitable platform using by low earth orbit (LEO) satellite for satellite-based internet systems. The billionaire Elon Musk is CEO of Tesla Motors and chief designer of the SpaceX project. This Project is planning to establish Starlink Satellite internet sooner and provide internet service all over the world through satellite. So then, this paper will propose to collaborate with the Starlink project of Elon Musk. Low Earth Orbit (LEO) satellites are located around 160-2000 km above the earth's surface [12].

SpaceX's Starlink has installed over 1553 LEO satellites since May 2021. They are planning to constellate 11943 LEO satellites for Global coverage internet service because their footprints are much smaller, but Low Earth Orbit satellites are closer to earth. So transmission power level and necessary antenna size are much smaller. These Low Earth Orbit satellites move at high speed because they are relative to the earth's surface. They are planning to provide an internet network speed as very high as 1 Gigabit per second through Low Earth Orbit Satellites because these satellite's roundtrip delay is 20-27 ms. The Low Earth Orbit satellites are established near the earth's surface. So the data latencies are better than fibre optical. The Low Earth Orbit satellite internet has high speed, quality, reliable services, and long-distance communication. Because Low Earth Orbit Satellite

performance better than traditional satellite internet. SpaceX's Starlink Low Earth Orbit satellites can deliver high-quality internet service to the location where connection has been unavailable or unreliable. This method for the most suitable platform for rural village areas in Sri Lanka to access the internet.

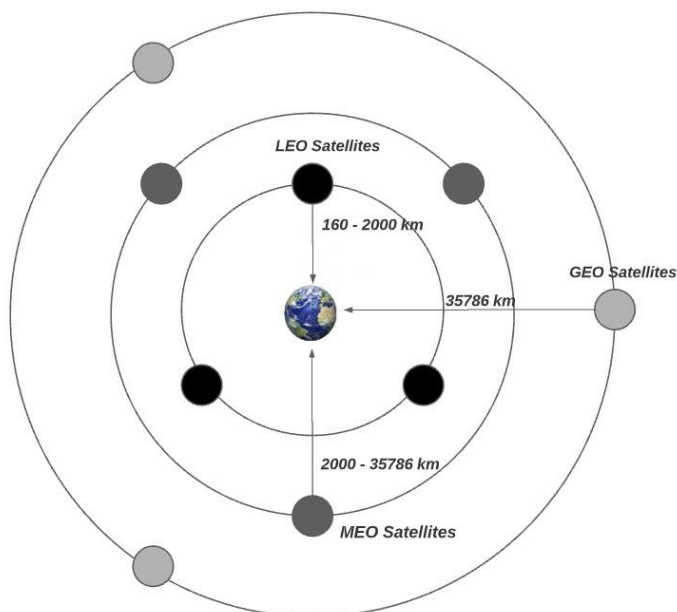


Figure 2 - Comparison of Satellite; GEO, MEO, LEO

<u>Satellite Type</u>	<u>Distance (km)</u>	<u>Orbital Period</u>	<u>Latency (ms)</u>	<u>Necessary to Number of Satellites</u>	<u>Cost per Satellite (Approximately \$)</u>	<u>Effective Years of Satellite</u>
<u>Low Earth Orbit</u>	<u>160-2000</u>	<u>88-127 min</u>	<u>20-27</u>	<u>100-1000</u> <u>(depend on distance)</u>	<u>0.5-45 million</u>	<u>5-10</u>
<u>Medium Earth Orbit</u>	<u>2000-35786</u>	<u>127 min-24h</u>	<u>27-477</u>	<u>5-30</u> <u>(depend on distance)</u>	<u>80-100 million</u>	<u>10-15</u>
<u>Geostationary Earth Orbit</u>	<u>35786</u>	<u>24 h</u>	<u>477</u>	<u>3</u>	<u>100-400 million</u>	<u>15-20</u>

Table 1 - Comparison of Satellite Internet; GEO, MEO, LEO

According to the table, LEO Satellite system is one of the greatest opportunities for internet services. SpaceX's Starlink project pricing offered during the internet is 99\$, speed between 50-150 Mbps per month, and data latency between 20-40 ms. Another advancement of this service, it's easy to set up. The one-time equipment set price is 499\$, including a Wi-Fi router, power supply, mounting tripod, and cables [13-18].

5. INTRODUCING SOLAR POWER SYSTEM FOR ELECTRICITY GENERATION

Sri Lanka's power demand was supplied by thermal generation and hydrogeneration. Annual Sri Lanka's electricity consumption and demand percentage are an increasingly more in the last few years. Sri Lanka's more population live in rural areas, but Sri Lanka's Electricity Board can't supply the necessary electricity demand consistently and reliable more rural village areas in Sri Lanka. Some rural village area's geographical infrastructure was very complicated. So Ceylon Electricity Board can't reach to provide electricity demand for some rural areas. Sri Lanka is situated near the equator. So Sri Lanka receives solar radiation over the year. Solar power is a renewable energy system and can provide the necessary Electricity usage in rural village areas. The solar power system is the most suitable medium for generating electricity for rural village areas in Sri Lanka because solar power is free natural resources, low-cost value-generating electricity, and the most eco-friendly renewable energy resources [19] [20].

	Equipment	Watts	Using Hours	Watt hours (W h)
For Telecommunication Devices	Computers	150	12	1800
	Smart Phones	25	3	75
	Router	10	24	240
Domestic Usages	Bulbs	500	12	6000
	42inch LCD TV	120	6	720
	Refrigerator	150	24	3600
	Oven	2200	0.5	1100
	Toaster	1500	0.5	750
	Kettle	3000	1	3000
	Iron	1100	0.25	275
	Rice Cooker	700	1.5	1050
	Fan	70	4	280
	Washing Machine	2000	1	2000
Total				20890

Table 2 - Electricity usage per day in house

According to the table, approximately electricity usage in the house per day 21 kWh nearly around. So,

Annual, monthly electricity usage = 21 kWh * 30 = 630 kWh

systems were installed throughout the country.

6. CONCLUSIONS

Sri Lanka is a small island and developing country. More people are poor and live in rural village areas and People from rural village areas life standard very low. It is a very big problem for face to Sri Lanka Government. So this paper aims for using solar power to generate electricity and provide internet services through satellites in rural village regions. The benefits of this project can be stated very easy to arrange, service sustained and established wherever because it generates electricity using by solar-powered.

Currently, Sri Lanka Telecom is mainly an internet provider in Sri Lanka. They can't provide internet service in more rural village areas. But satellite internet services can provide internet anywhere. Satellite internet services are better than typical Sri Lanka telecom internet services. Because satellite internet services access anywhere, have High Data speed, and low latency, people can achieve more opportunities through internet services, like mainly improving the majority of people living standards of rural areas. It makes their life very easy and comfortable. There are several options for establishing satellite internet services in Sri Lanka. Currently, the best choice is Sri Lanka to collaborate with SPACEX'S STARLINK PROJECT and build an LEO satellite internet system as soon as possible.

Sri Lanka's electricity demands more increase in near future. Ceylon Electricity Board can't supply electricity all over the country consistent and reliable. Sri Lanka's more power plants are present-day using diesel, natural gas, and furnace oil. Using these fuels expands the very harmful effect on the environment. So modern-day more countries are introducing solar power systems. This is the best option for Sri Lanka. Because solar power is free energy resources and environment friendly. So then Sri Lanka's people from rural areas achieve high living standards, a beautiful and happy future as soon as possible.

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