Reshaping Internet Access

The internet from its very basic stages to what it is today has been around for more than 35 years now. Its potent is all around us. From interactive education to speech enabled AI, most of the resources we use rely on the internet. One might think with such a huge dependence on connectivity, most people must have access to the internet. At a price, perhaps costly in some cases, nevertheless access. Yet, it is not so. More than half of the population worldwide remains offline. This has several contributing factors. From scarce population density in an area, its geological conditions, to its economy, many places in India and worldwide are not accustomed to or familiar with the internet.

Making a connection

The internet, in essence, is a network of connected computers. Data is sent in parts of certain sizes along with other information in the form of packets. This network contains some specialized computers known as routers. Their task is to move packets through the network to reach from the source to the destination. We pay the ISPs to be connected with this network. We pay for the bandwidth and indirectly for the material that goes into maintaining the network.

The fastest method available today for connecting to the internet is fiber-optic cables. The transmission of data in these cables is in the form of pulses of light. These signals tend to be stronger than electrical signals that can be sent via metallic wires. The speed that fiber-optics provide is more than enough for purposes such as browsing and streaming. They fall short only when long distances are concerned. Users experience a considerable lag between distant locations. Also, laying these cables over long distances is no small feat. There is a comparatively cheaper method from which isolated places could especially benefit - satellite-based internet. The location must have a dish installed to transmit signals to the satellites orbiting the earth. The speed that they offer comes close to that of metallic cable but is lesser than fiber-optic cables. Satellite communication would emerge victorious as far as distances are involved.

As we see, there seems to be a demand for a cost-effective, more reliable and pervasive mode of connection.

Internet connectivity is a market of possibilities and revenue. Urged to capture this market even in places of isolation, many potential companies have set forth to deploy constellations consisting of thousands of satellites. SpaceX's Starlink is the the first to begin launching their satellite models.

Starlink

The project was announced by SpaceX's CEO, Elon Musk, back in 2015. He quoted that there was significant unmet demand for low-cost global broadband capabilities. The company aims to create a dense satellite constellation orbiting the earth at a lower altitude to provide satellite internet access. Their goal is to provide high-quality broadband internet to the most isolated places on the planet and to improve latency in already connected cities. On May 24, 2019, the first 60 satellites were successfully launched. The target is to send more than 12000 satellites by the end of this decade. Initially, satellites would be launched into an orbit of 280 km, and afterwards, each os them would raise its altitude to about 350 km using ion engines. Functioning satellites will then continue moving up to an altitude of 550 km.

Let's see how the proposed network would work.

These satellites have been designed meticulously. Equipped with laser beams, each Starlink satellite will link to four others. These lasers will use light pulses to transmit data. This will be achieved using phased antenna (computer-controlled, electronically steered), which can change the direction of the signal without moving their parts. Each satellite has a 81 degree range of view and can cover a circular area with a radius of 500 km. The decreased altitude does decrease the area the satellite can cover but it also decreases its latency. Owing to the area a single satellite can cover, many satellites would need to be launched to create even a minor network. Within the first phase, the network will have 24 orbital planes with 66 satellites per plane. Satellites in the same orbital plane would be relatively stationary to each other and thus communication within them would be easier. But two physical sites might not be connected by a single orbital plane. Satellites belonging to different orbital planes will come in and out of view of each other. and therefore the source satellite would need to find the best path to relay data accurately. This would incur a lag. Since the transmission is taking place at the speed of light, it might still be significantly fast once the network size is notable.

A comparison

Starlink would be a huge upgrade to what we have with fiber-optics. In these cables, light travels at a speed of about 180,000 to 200,000 km/s, This speed depends on the refractive index of the medium which in this case depends on the kind of glass used. The speed in vacuum is around 300,000 km/s. Thus, the speed of transmission in vacuum is at least 65% faster than the speed of light in glass. In rural areas, even a limited Starlink network could present competition to the internet speed in well-networked cities. SpaceX claims to provide a terminal of the size of a pizza-box in the future that would cost around $200. This amount is still out of reach for many people but it is a start.

Data transmission beamed over current satellites is slow to respond. The transmission depends on the open downlink process - the transfer of information to/ from the earth. It takes around 240 ms for geostationary satellites orbiting at around 30,000 km to achieve this. Starlink could bring this down to 3.6 ms.

Moreover, you could be in a forest or a city and enjoy the same level of service.

Concerns and conclusion

The project, albeit ambitious, has come into a lot of controversies, especially from the community of astronomers. They've raised the concern that their observations of space will be affected by the bright streaks of light caused by the reflective surface of the satellites. On 6 January 2020, the 60 satellites that were launched were coated in an "experimental darkening treatment". This has still left some experts in a lot of scepticism. Giorgio Savini, director of the University College London Observatory called out the move saying no one would deliberately paint satellites dark as this could disturb its heat regulation capabilities.

Another issue has been raised by David Clements, an astronomer at Imperial College London. He says that the satellites could mimic the phenomenon of occultation. Astronomers search for exoplanets by monitoring the light of stars. When a planet passes in front of a star, a flicker is detected. Therefore, even if SpaceX manages to launch completely dark satellites, these could mimic occultation and astronomers might not be able to tell the difference.

SpaceX has deployed 180 satellites so far and plans to send more than 1500 by the end of 2020. It is possible that looking at the sky with a telescope in a few years would show perhaps more satellites than stars. The future seems interesting for this project. Worldwide internet access could become a boon for avenues of education and research. Timely communication between large distances could save lives and resources during a calamity. Starlink does not aim to be selfless. If successfully implemented, revenue generation could be billions of dollars yearly. Despite the advantages and incentives, the people responsible need to seriously take into consideration the concerns raised by the astronomical society as well as make them a part of conversations in the planning of future satellites. SpaceX aims to bring about significant transformation to internet connectivity through Starlink. Many risks and responsibilities are involved but one can hope that the results might make up for the fair amount of mistakes they might make during the journey.