

The

Global

Network.

Why we need to get the world online and how to go about it.

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The Internet is a necessity in the modern world. It opens a plethora of opportunities for anyone who uses it. Unfortunately, even today more than 50% of the world remains without internet. This will result in increased digital divide in an already divided world. In an age where information is power and data is the new oil, almost half the worlds population will not have access to timely information, online education, telemedicine, entertainment, and other opportunities delivered by the internet.

## How Internet works.

Right now, there are two ways to access the internet. One is through long underground fiber-optic cables that cross continents and literally connect the entire world. These cables are made of glass and carry requests from a user to the server and then back again with the internet service provider acting as a middleman and directing requests. Data is transferred in the form of light. But the speed of light is not constant in all mediums and its speed in glass is 47% of that in a vacuum. Also, internet is available only places where these cables are present. The other method uses satellites. Requests from the user are sent up to satellites which relay them to the service provider, which in turn relays them to the server. The problem with this method is that these satellites are in very high geosynchronous orbits which greatly increases transmission time. These satellites have a very large range because of their altitude, but the long transmission times make them impractical for day to day purposes.

## Why so many people don’t have internet.

The main reason is availability of infrastructure, or the lack of it. Most people use data on mobile phones to access the internet. Unfortunately, this is also expensive and not accessible to everyone.

The second problem is price. The cost per Megabyte of data right now is just too high right now for it to be practical for most people.

The third big problem is the lack of awareness regarding the internet. Many people don’t realize its necessity and choose not to use it.

## How Covid is worsening the situation.

The Covid-19 pandemic has widened the gap between these people more than ever. In places with Internet, education has continued online while students in places without internet have been left behind. Even exams have now moved online making it even more difficult for students to study. The problems are not limited to education, however. Covid-19 is a virus that spreads very easily. Even going to hospitals is unsafe, because it takes only one person with the virus to spread it to a thousand of others. As a result, telemedicine has been thrust into the spotlight as a means for doctors and patients to communicate without putting anyone at risk. In places that do not have internet, this is not an option. Moreover, many of these regions are under-developed, and people may not be aware of the necessary precautions, facilitating the spread of the virus.

## How low orbit satellites can bridge the divide.

Wires are the main means of data transfer today in cities. In remote places, the only way to access the internet is through satellites. Both require relatively sophisticated equipment which may not be available to everyone.

## What SpaceX is doing.

SpaceX plans to create an intricate web of satellites in Low Earth Orbit (~550km) around Earth. These satellites take the best of both above methods. Requests will be sent up to the satellites. Because of their low orbits, data transfer will be very fast. Once the request reaches the satellite, it will use lasers to connect to the other satellites. The vacuum at that altitude will allow light to travel at twice the speed it does in glass. However, due to their low altitude, the range they can serve will be limited. Which is why there will be 30000 satellites at different orbital inclinations providing high speed internet to every single place on Earth. Except Antarctica. And the Arctic. Anyone will be able to access the internet with nothing but a small pizza-box sized device. With a production rate of 120 satellites a month, this web could be reality sooner than anyone expected.



## Problems caused by the idea and how they are being fixed.

A dense network of satellites around the Earth comes with a few problems. Luckily, through years of testing, we have been able to recognize and fix them.

**Space debris** is a growing problem and puts both, the lives of astronauts as well as millions of dollars’ worth of equipment at risk. This presents two challenges to the SpaceX team. The satellites must be able to automatically avoid debris because monitoring so many satellites constantly is impossible. Secondly, the satellite must deorbit itself at the end of its life to make sure it doesn’t end up as space debris itself. Another problem is the satellites’ low altitude. At their altitude, they would still be skimming the upper atmosphere, thus creating drag, resulting in a decaying orbit. This is a phenomenon encountered by most satellites including the ISS. On the ISS, chemical engines are used to ‘boost’ the orbit when it gets too low. However, this is not possible on a small satellite like starlink which is designed to be light and modular for launch. SpaceX has therefore used Hall-Effect thrusters to solve all three problems. I, personally, am fascinated by this technology, so I will explain what these thrusters are and how they work.

Iron Man’s arc reactor? No, it is a Hall Effect Thruster.



Hall Effect thrusters, in essence, make use of Newton’s Third Law (Action-reaction) at the atomic level. Using an electric field, these thrusters throw out a small number of atoms of a heavy element to produce thrust in the opposite direction. Usually Xenon is used, because of its high mass and the fact that more atoms of xenon can be packed into a smaller volume (SpaceX has gone with Krypton because it is more economical).

As a result, these thrusters can provide thrust using this single propellant and electricity (provided by solar cells), while chemical engines need heavy liquid fuel and oxidizer. The actual thrust provided by this method is very small, but enough to avoid any debris a satellite may encounter, and to deorbit a satellite at the end of its life. Even in case of complete failure, these satellites will deorbit themselves within a few years due to atmospheric drag.

With a web of satellites as dense as this, **astronomy** will become considerably harder. Images showing the first batch of satellites in the sky through a telescope went viral after astronomers’ complaints SpaceX responded by saying that the satellites could be moved as needed for astronomical purposes. SpaceX is also experimenting with a satellite cover that reduces albedo (the whiteness of an object).



They may look like something out of an alien conspiracy theorist’s dream but are Starlink satellites.

### How can we collaborate to bridge the digital divide?

Historically, the technology transfer to the developing world has been painstakingly slow. UN agencies can collaborate with companies like SpaceX to accelerate adoption on the ground. For example, the UNAIDS Health Innovation exchange aims to bring the different players like national governments, space agencies, innovators to work together on pilot a program to get everyone in the world online.

The goal of these collaborations is to make internet available to people as soon as possible. Every day without pervasive internet results in loss of lives that could have easily been saved by doctors through telemedicine or medicines that could have been ordered on Amazon. We do not have the luxury of time anymore.

We will most likely put humans on Mars by the end of the decade. And it will be a spectacle to watch.

Let’s make sure that when it happens, ***everyone*** will be able to watch it.