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Starlink is a Big Deal

11-13 minutes

Today, I watched a SpaceX Falcon 9 rocket leave Cape Canaveral and deliver 60 small Starlink satellites to Low Earth Orbit (LEO) on the Starlink L3 mission.

For those not with us last week, SpaceX has a subsidiary, known as Starlink, which is presently endeavoring to blanket the majority of the inhabited latitudes of Earth with orbiting satellites to provide wireless internet access and private-line communications services. This is a Big Deal, the consequences of which I will explain momentarily. But first, some background.

According to the physical rules of this universe, orbiting satellites have a velocity approximately inverse to their altitude to maintain same: that is to say, the higher a satellite's orbit, the slower it can maintain its orbit, and vice versa. Most communications satellites today are what are known as geosynchronous or geostationary, which is to say that they orbit the same axis around which the Earth rotates daily, and they are situated at an altitude that permits their orbital period to be equal to the time it takes for Earth to perform a full rotation, as it does each 86,164 seconds. This has the neat side effect of the satellite appearing perfectly motionless, simply hanging at a single point in the sky when viewed from the surface of the Earth, which is quite convenient for aiming antennas at them. This is how it's been done forever, since the esteemed Clarke first suggested it in 1945 (before we put up any satellites as all). (Please don't email me about Iridium/Inmarsat/Thuraya.)

The astute of you may have noticed that the inviolate physical laws and existing Earth rotational velocity, neither of which we can alter with current technology, conspire to fix the remaining variable in the equation: altitude. These geostationary satellites are about 35,786 kilometers above sea level at the equator. (For reference, the diameter of the Earth is about 13,000 kilometers.)

As fast as the speed of light is, traveling over 35,000 km to and from these geostationary satellites means that these are too far away to provide decent internet access.

Starlink satellites are the solution, at only a 550 kilometer altitude. Going much faster due to the lower orbit, they're not going to stay put, viewed from the ground: you're not going to be aiming a dish at them. There are also going to be a *lot* of them, which is why this project wasn't feasible until the previous milestone of "cheap access to orbit" was checked off. Thanks to the hard work of SpaceX to make cheap, reusable rockets an everyday reality, now a project of this scale and ambition is finally realistic.

Having started with a launch of 60 satellites on 24th May of last year, they're outlining a $10B USD project comprising of approximately 1,600 satellites for the first phase. Their announced plans speak of eventually 12,000, or even over 40,000 within 5-10 years. Today's launch brings them up to 242, if I am summing correctly.

Connectivity will be the great equalizer in the future. With high-quality, uncensored, reliable access to the global network, intelligent and resourceful people located virtually anywhere can operate on substantially similar footing to anyone else so equipped. Billions of people, blocked from accessing the Internet due to lack of infrastructure or local greed or fraud related to same, are presently kept from participating in the global knowledge economy. Starlink will remedy this, to some extent. Save for the wide deployment of the Internet itself, Starlink and its spiritual siblings launched by others may be one of the crowning technological achievements of our generation.

Of course, it wouldn't be possible at all without cheap access to orbit, the praise for which can really go to none other than SpaceX in the first place. Their long-term visions have certainly illustrated to me the intense power of a cohesive and simple narrative in motivating large groups to collective action. A business, their own large corporate infrastructure, staff, and R&D, need a steady stream of cash to continue to prosecute their vision. What an irony, that, once their initial milestone of "cheap access to orbit" is attained, their very first low-hanging fruit, "easy money" project amongst the huge list of potential profit centers enabled by cheap orbital access happens to be the one that will, in addition to generating monumental amounts of cash flow (via financial companies seeking lower latency long distance communication links between market centers) will also happen to connect approximately half of the

living humans to each other at, compared to existing terrestrial options, Ludicrously Extreme High Speed.

Preliminary tests with fewer than 100 satellites up showed approximately 600Mbps available as tested on an aircraft in flight to Starlink. For reference, my last flat in Berlin (the capital of the largest economy in the EU), on the ground on a main street in the city center, was serviced with approximately 14Mbps ADSL, and this was the fastest offering available from any vendor.

This is not just a game changer for people like you and I, living in relatively populated places struggling against greedy last-mile monopolists: remember that *half of the human beings are not online yet*.

The most meaningful impact to humanity will be that SpaceX generates revenue and doesn't go out of business, and continues to exist as a concern so that they can pursue technology to establish a permanent settlement on Mars, so that future pandemics, wars, changes in climate, or stray asteroids affecting Earth do not permanently end the human story before it really even got started properly.

The biggest impact to our present lifetimes will be bringing those online who presently have zero connectivity. Whatever four billion people can do, presumably eight billion people can do *at least* twice as well—but hopefully better, as the network effects of anyone being able to call or write or read anyone else should absolutely be superlinear (authoritarian governments' attempts at censorship and information control notwithstanding).

The biggest likely circumstantial impact to you and I: places previously unsuitable for long-term habitation or business development by businesspeople due to poor connectivity will be suddenly be rendered green on the map. Presently, to run a successful business, a minimum of 20+ Mbps, low latency, reliable connectivity is required, for such things as client calls, team collaboration, video training, software downloads, realtime chat, et c, in addition to the usual standards for a life relatively free of strife: electricity, clean water, reliable food, access to medicine, and reasonable lack of sustained violence. This limits one to cities, or remote places where terrestrial wireless capabilities can deliver best-in-class service, which is another way of saying that this limits one to cities.

Starlink means that you can go live in the woods in Siberia if you like, with relatively little impact to your team (presuming you already work with your team via an internet connection). The only barrier remaining is timezones/travel distances, another side project that SpaceX is actively pursuing. Cruise ships, undeveloped countries, remote forests, desert wandering: all become practically viable when you can receive 100+ Mbps anywhere outside of the (An/)Arctic circle you can see the sky.

Hundreds of cities and dozens of countries, fine for living but previously entirely unsuitable for a place of business, will blink from red to green on the map once Starlink goes live.

This is, of course, a selfish tangent for rich businesspeople, but a non-insignificant one nonetheless. Truly, I am most happy and excited to see the collected works of the *half* of humanity that is presently rendered entirely mute in the global consciousness. With any luck, not too many of those people so connected will be murdered by their local governments for piercing the historic local control on information dissemination by daring to speak to the stars. (I do fear the number will be nonzero, however.)

- Duh: HFT firms will be the first customers, seeking a few-millisecond reduction in the transmission of realtime data between markets. Starlink has already said as much, and I think they rely on this as their first and primary source of revenue. To me, there is a sort of lovely irony in the fact that the world's richest will be inadvertently subsidizing the world's most (presently) disadvantaged.

- Several nations will soon summarily ban any use of the system, as it will very effectively bypass longstanding local monopolies on last-mile profit and censorship.

- SpaceX will be pressured by the governments in the jurisdictions where their staff reside (where their physical threats of enforcement can be carried out) to selectively censor/blackout or otherwise wiretap use of the system, ostensibly for military purposes, in another tragic case of stupid, outdated nationalistic thinking trying to force its way into outer space and cyberspace. They will comply, silently and without fanfare, as all of the other telecommunications carriers have, excepting with great recognition the brave Joseph Nacchio, because they don't want to suffer the same fate he did. (I sometimes wonder how Elon Musk feels about living in a warmongering, nationalistic society essentially congruent to those ridiculed so eloquently in Banks' Culture novels, from which the names of some of the SpaceX vessels are taken.)

- Multinationals with multiple locations will purchase private WAN systems from Starlink as emergency backups for their existing IP WAN/VPN networks, for example when multiple fibers are cut (accidentally or otherwise), even if in small (<10Mbps) capacities (so that they can phone staff at remote locations or ssh into routers, et c). It's the backup WAN to beat all backup WANs.

- The ground-based antenna system will be too large to be handheld (it's described as "pizza-box" or "briefcase" sized), so some automakers will likely build them into the roofs of cars or trucks, which will then provide normal Wi-Fi signals to the occupants. This will be especially useful for undeveloped countries or truly remote places. Not many realize that due to long-haul truckers (who appear to be about as phone-addicted as any teenager, near as I can tell, being far from friends and family most of the time) among other reasons, there is already tremendously good terrestrial wireless data coverage on nearly 100% of major interstates in the US.

- Airplanes. You can't bring your own antenna, so the airline will simply use Starlink for backhaul and continue to charge you 10x for a tenth of the speed available.

- Cruise Ships. Same deal.

- Alternately: this potentially makes full-time, international waters seasteading practically viable.

- Wireless service providers will be able to use Starlink to provide backhaul for new GSM/LTE/5G towers, enabling mobile phone usage in places previously impractical. This may perhaps be the benefit to the largest number of people.