Eureka

Why Elon Musk will win the race for space-based internet

SpaceX is planning to launch over four thousand satellites to bring high-speed internet to the world, doubling Earth's count of currently functioning satellites. David W. Smith looks into Elon Musk's ambitions within the context of the emerging satellite internet sector – and why he is going to beat his competitors.

April 24, 2018 by **David W. Smith**

Even by Elon Musk's standards, his plan to send 4,425 low-earth orbit (LEO) satellites into space to provide high-speed internet to the whole planet, is audacious and financially risky. The SpaceX constellation would more than double the world's current number of functioning satellites and Musk is already planning to send up another 7,518 satellites for Phase 2 of the Starlink project after 2023. Not for the first time, the scale of his ambition is unprecedented, yet several companies have already lost billions of dollars on similar satellite ventures, notably Teledesic back in the 1990s. So why should Elon Musk succeed where they all failed?

There are two reasons to believe Musk has a better chance of making it work. The first is his track record of proving doubters wrong, despite the frequent delays. The second reason is that the economics of the satellite market have changed fundamentally, partly because of SpaceX's interventions, which have helped to lower launch costs dramatically. By 2025, Musk plans to recoup US$5 billion in revenue from launches and a colossal US$30 billion from satellite internet. "I would never bet against Elon Musk," says Greg Autry, a professor of Clinical Entrepreneurship at UCS Marshall. "He achieves what everyone else says is impossible. He always runs his companies right to the edge of a cash-flow crisis, as people are seeing with Tesla right now, but eventually he delivers, even if it's not always on time. I'm cautiously optimistic SpaceX will succeed."

The target market for SpaceX will be both the developing world and the high-end niche markets of ships, airlines and private businesses in search of an encrypted service.

Autry says there is a widespread belief that SpaceX is profitable, although as a privately held company it doesn't have to release financial data. There have been major investors, including US$1 billion from Google and Fidelity. "The fact that Musk has maintained financial control of SpaceX gives him far more room to manoeuvre. Everything he does is in line with his ultimate vision of colonising Mars, which may not have aligned with the short-term goals of a board of directors, or distributed shareholders," says Autry. The biggest challenge will be keeping to the tight launch schedule. SpaceX's Falcon 9 rocket launched the first two Starlink satellites in February, but Musk has only five years to send up another 2,000 satellites in order to meet the stipulations of the Federal Communications Commission (FCC). "He wants to make all the launches in-house, but ultimately he may need to partner with other launch companies," says Autry.

If he succeeds, **the target market for SpaceX will be both the developing world and the high-end niche markets** of ships, airlines and private businesses in search of an encrypted service. "Musk is aiming for frequent travellers who want a strong, consistent signal. Anyone who has travelled on a cruise ship will know how horrible the internet is. At the other end of the curve, around four billion people have no coverage, including large parts of the rural US. Most of the public won't need it as cell phones work great in the city and they have solid connections at home, although some die-hard tech fanatics will be interested," says Autry.

One of the closest observers of the SpaceX story is Larry Press, a professor of Information Systems at California State University. For economic reasons, Dr Press believes low-orbit satellites have a far greater chance of being viable today than when Teledesic pulled out of the market in the 1990s after similar projects from Iridium and Globalstar ended in bankruptcy. Teledesic's collapse

1990s after similar projects from Iridium and Globalstar ended in bankruptcy. Teledesic's collapse was well-publicised because it had high-profile backers like Bill Gates, the cellular pioneer Craig McCaw and Saudi Prince Alwaleed bin Talal. After that, the low-orbit satellite market went quiet for a while, but several competitors are now clamouring to make a mark.

SpaceX's project is the most ambitious, but the **Richard-Branson backed OneWeb is proposing a constellation of 882 satellites and plans to bring internet to users as early as next year**. Meanwhile the Canadian company Telesat wants to achieve global coverage rapidly and at low cost by deploying a small, hybrid constellation with both polar and inclined-orbit satellites. Telesat plans to launch just 117 LEO satellites but they claim their patented hybrid polar-inclined constellation requires far fewer satellites to achieve global coverage. "We've seen a flood of companies enter this arena because satellites have become cheaper, smaller and lighter and launch costs have also gotten much cheaper," says Dr Press.

SpaceX, he says, has made landing a 549,054kg rocket on a small drone barge at sea almost routine. They have had 18 successful soft landings and their next-generation rocket, the BFR, is designed for reusability. Musk says it will be able to launch several satellites per flight. OneWeb, and their manufacturing partner Airbus, say automation will enable them to manufacture three satellites per day at less than US$1 million apiece. The launch cost per satellite will be low because they are small and light. The consumer ground stations required to collect the signals will also be small, cheap and easy to install, according to Dr Press. "They will be like pizza boxes and end users will be able to install them. Unlike TV and Internet dishes, they won't have to be aimed precisely at a single, geostationary satellite," he adds.

Another positive development in favour of the satellite market is that communication technology has improved dramatically. Today's 'smart' radios can rapidly change power, frequency and modulation scheme. They allow spectrum sharing in a way that was simply not possible when Teledesic failed to break through. Meanwhile, the terrestrial fiber network has grown exponentially since the 1990s, making internet 'gateways' attractive targets for satellite companies. Musk claims that SpaceX satellites will communicate optically among themselves, forming a low-latency, highly interconnected mesh that will carry the majority of our long-distance traffic.

There are several issues that need resolving, however. One of the regulators' biggest concerns is falling debris and SpaceX is in discussions with the FCC about the likelihood of human injury. Musk has suggested SpaceX may be able to use the BFR rocket to recapture spent satellites. Fortunately, a spirit of cooperation has developed between the satellite providers as they have realised their projects could rise or fall together. OneWeb is working on a grappling mechanism for retrieving spent satellites and hopes to 'open source' the design. All the providers are in favour of sharing spectrum among themselves and with terrestrial service providers. Dr Press says they agree that dividing frequencies could cause interference.

One unknown factor is how more repressive political regimes will react to the advent of satellite internet. In China, for example, the state government controls what material can be accessed on the web. "There are a lot of fascinating questions – such as would nations like China or North Korea allow citizens to install home ground stations and connect to the internet? Would Saudi Arabia tolerate access to pornography? Cuba would also need to shift politically to allow citizens to connect

to fast, cheap internet satellites, but they would be a prime candidate if the government allows it," he says.

The satellite internet providers are not just competing with each other in the battle for control of the skies. Facebook founder **Mark Zuckerberg plans to use solar-powered drones to provide internet access to billions of people in the dark**. Last year a Facebook 'Aquila' drone flew for an hour and 46 minutes at Yuma Proving Ground, in Arizona. The drones have longer wingspans than Boeing 747s, but they are lightweight (455kg). The challenge for Facebook is making them stay in the air for months at a time as they use about 5000W of power at cruising altitude of 60,000 feet. Zuckerberg admits no one has ever built an unmanned airplane that can fly for that long and the Aquila team will need to make the crafts lighter, reduce power consumption and improve in-flight dynamics. Meanwhile, Google owner Alphabet has also seen the potential in the telecommunications market. Project Loon aims to supply internet access from high-altitude balloons placed about 18 km up in the stratosphere.

The Californian company Airborne Wireless Network (AWN) claims to have found a more efficient method of providing high-speed internet using commercial airplanes, known as the "Infinitus Super Highway". AWN wants to install broadband transceivers on a critical mass of aircraft and use them as signal repeaters capable of providing wireless signals globally. The company says this is similar to how communications satellites provide connectivity to ground-based users, but with superior higher bandwidth, better data communications performance and lower costs.

"A lot of these different solutions have similar goals of offering global coverage, especially to the developing world," says Professor Autry. "But the drones have issues with the batteries and the balloons can be affected by the weather. Satellites providers don't have to worry about either of those problems. In the developing world, however, there could be a lot of niche uses for the drones and balloons, such as at an American football game when so many cell phones interfere with normal service. To be able to throw up a balloon up and connect it to all the cell phones would be awesome."

Autry is most excited about Elon Musk's space solution, however. "Personally, I am a fan of space. Anything that increases our use of space and the launch rate into space promotes the really important thing that Elon Musk and Richard Branson are trying to do, which is to get human beings off the planet. In the long run that's good for the economy and good for the environment. As Elon Musk says it will eventually save the human race..."

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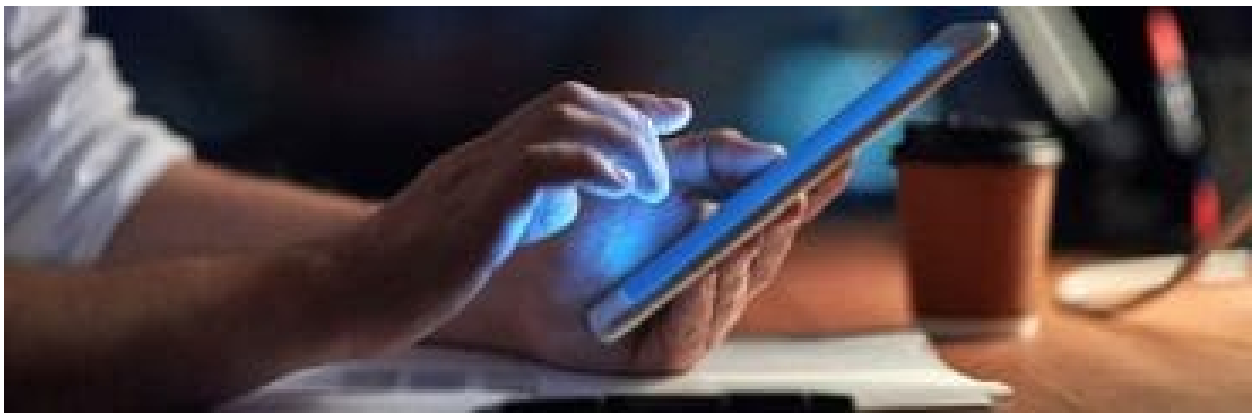
The game-changing charger for electric vehicles

Electric vehicles are catching on fast. Every car manufacturer is now working on one or has already released one. Several countries have committed to getting rid of petrol and diesel cars completely, some like the Netherlands and Norway as early as 2025, others like Germany and India in 2030. Even the largest car market in the world, China, has promised to end the production of traditional energy vehicles in the near future.

5 firms using biometrics to change the way we pay

The average Briton has to remember a total of 19 passwords to access all of their logins for online accounts. 35% of them choose to use unsafe passwords simply because it's difficult to remember them all. It's clear the days of the password are numbered, but what will replace them? The growing field of biometrics may have the answer.



Going beyond the Internet of Things sales hype

Every Internet of Things (IoT) salesman is hyping their products. Businesses have to be clear about their goals before they decide what to install and how. But if they get it right, it can be transformative. Supply chain 'Ninja' Patrick Strauss always asks the same question when he comes into a business as an Internet of Things (IoT) supply chain consultant. The simple question is 'why do you need this IoT technology?'

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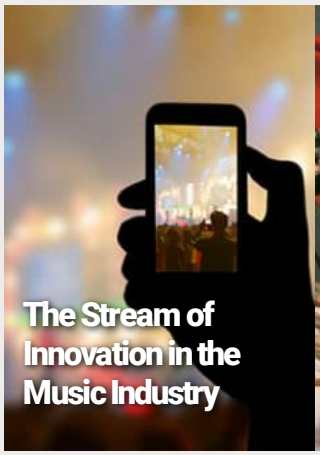

ABOUT EUREKA

Eureka means "I found it!" and was the phrase that exclaimed Archimedes after discovering that the volume of water that ascends is equal to the volume of the submerged body. It is about problem solving, learning, and discovery. So that is precisely the purpose of this website: to understand, to learn. A tribute to our ancient history. From Europe to the world.