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A critical year for small satellites

Small satellites are everywhere these days; in the commercial segment, government and military, scientific exploration, and even among academic institutions such as schools. With the miniaturisation of satellite technology, access to space has never been more achievable.

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As an industry with less than 100 years of history, the satellite sector continues to innovate. Moving on from massive, multi-million-dollar communications satellites, each one carefully crafted over years of planning, construction, and testing, we're now entering an era where smaller, assembly-line satellites are all the rage.

Mini (100kg-500kg), micro (10kg-100kg), nano (1kg-10kg), pico (0.1kg-1kg) and femto (<100g) satellites are attracting consumers from all walks of life, with benefits including cost effective payloads and launches, rapid production and launch cycles, lower latencies as a result of lower orbits, and a much lower overall barrier to entry.

The potential marketplace for space and satellite technology is wide open for anyone bold enough to make a move.

Technology is good, but demand is better

It's all well and good having this incredible new technology in place, but technology for the sake of technology, without demand and solid well-thought out applications is doomed to failure (remember the 3D TVs of the noughties, anyone?). Fortunately, that's not the case where small satellites are concerned, with market research companies across the globe – as well as a simple Google search which divulges success stories aplenty – all in fervent agreement on the booming future for small satellites.

ResearchAndMarket.com's *'Small Satellite Market – Growth, Trends, and Forecast (2019-2024)'* report expects a small satellite market CAGR of more than 17 percent in 2019-2024, with massive investments by venture companies, growing demand for low-cost satellites and Earth observation applications all propelling the growth of the sector. The company highlights power-related limitations and launch regulations as potential barriers for the market growth during the forecast period. However, technological advancements, particularly the miniaturization of electronic components, 3D printing, advanced material technology, artificial intelligence and machine learning are expected to help manufacturers overcome some of the barriers and develop advanced small systems capable of performing multiple missions. On a similar note, Mart Research expects the US3.53 billion small satellite segment of 2018 to grow at a CAGR of 20.83 percent in 2019-2026, citing that small satellites are 'more useful than their larger counterparts in purposes like gathering scientific data and radio relay.' Vastly reduced mission costs are also highlighted as a key demand driver.

Notably, ResearchAndMarkets.com reports that the military held the largest share of the end user of small satellites in 2018, utilising the satellites to augment communications capabilities. The draw of small satellites reportedly stems from the risk to large communications

satellites from newly developed anti-satellite weaponry. However, the commercial segment is expected to experience the highest CAGR during 2019-2024, with heavy investments and many start-ups being launched.

ResearchAndMarkets.com and Mart Research, among others, both reported that North America held the largest market share in the small satellite segment in 2018, mainly due to the number of small satellite launches by the USA for both commercial companies and NASA. However, the Asia Pacific region is expected to grow at the largest CAGR during 2019-2024, with China, Japan and South Korea actively developing and launching their own small satellites.

Interestingly, while much of the space sector is currently undergoing market consolidation, the small satellite segment is in fact becoming quite fragmented due to the aforementioned start-up companies as well as existing satellite manufacturing companies branching out into small satellites. Additionally, due to the simpler designs, quite a number of schools and universities are also producing their own small satellites for launch.

Small satellites = Big business

The applications of small satellites are so varied that educations and research institutions, small businesses, militaries, governments, and commercial entities alike want in on the action. Naturally, it's the big-name constellations which are drawing the most attention, as the race to stay ahead of the curve is well and truly underway.

O3b Networks has continued to build out its O3b network of MEO satellites, completing its first-generation small satellite constellation in April 2019, bringing the total to 20 satellites. Now the company is working on its O3b mPOWER constellation in cooperation with Isotropic Systems, ALCAN and Viasat. The new constellation will be based around seven 'super-powered' MEO satellites, with more than 30,000 dynamic, electronically generated fully-shapeable and steerable beams that can be shifted and switched in real time. Delivering multiple Terabits of throughput globally, the Boeing-built fleet is scheduled for launch next year via SpaceX and is scalable to multiple terabits of throughput globally, providing coverage to an area of nearly 400 million square kilometres. A total of 22 O3b mPOWER satellites have been approved.

SpaceX, which launched its first demonstration satellites Tintin A and Tintin B back in 2018, is making huge strides towards its Starlink constellation, which will ultimately feature 12,000 small satellites utilizing inter-satellite links and operating in Ka and Ku-bands. The company kicked off 2020 with the January launch of another 60 Starlink satellites, and combined with subsequent launches this year, has brought the current Starlink constellation total to 360 (or 362 including the demonstrator satellites) at the time of writing. This latest launch makes SpaceX the owner of the largest commercial fleet in orbit; indeed, one of the significant benefits of operating your own launch company seems to be a much speedier than usual constellation build-out. As many as 18 more missions are planned for this year.

Another constellation contender, OneWeb Satellites, has been in the news for all the wrong reasons this year. Things were moving along quite nicely, with the first major launch of 34 of its LEO satellites successfully launched in February. Prior to this, an initial six satellites were launched back in February 2019, and provided examples of impressive capabilities in the following months. However, in March the company announced it had filed for Chapter 11 after several investors pulled out due to the pandemic. However, it is not all bad news as on July 3rd it was announced that a consortium of the UK Government and Bharti Global Limited

SpaceX, which launched its first demonstration satellites Tintin A and Tintin B back in 2018, is making huge strides towards its Starlink constellation. Photo courtesy of SpaceX

had committed to provide more than US$1 billion to acquire OneWeb and fund the full restart of its business operations.

Canada's Telesat is also gearing up for a not too distant small satellite constellation launch. The LEO constellation has 300 planned satellites, although may ultimately grow to 500, and will be launched on board Blue Origin's New Glenn rocket, which has its maiden flight planned for next year. Following highly successful prototype satellite tests in orbit and a lucrative partnership with the Government of Canada – expected to generate CAD$1.2 billion for Telesat over 10 years, and an additional CAD$85 million contribution through the Government's Strategic Innovation Fund - the future is looking bright indeed.

July 2018 saw the announcement that Facebook is planning its own constellation of LEO satellites. Indeed, the planned Athena constellation is designed to provide broadband Internet connectivity, particularly to rural regions. The FCC has approved the Facebook subsidiary PointView's constellation plans; however, more details are few and far between.

In more recent news, Amazon has decided to get in on the action, with a planned 3,236 strong constellation of small satellites in LEO for broadband Internet connectivity. Kuiper Systems will call for three layers of satellites, 784 at 590km, 1,156 at 630km and 1,296 at 610km. The news makes sense given that Amazon owner Jeff Bezos also owns launch company Blue Origin, making the operational ideals more and more similar to SpaceX's Elon Musk.

Elsewhere, LeoSat Enterprises had planned a unique constellation of 78 small satellites featuring inter-satellite links, comprising 13 satellites (12 functioning and one spare) in six polar orbits. However, in November 2019 it was announced that operations had been suspended and all employees laid off after Hispasat and SKY Perfect JSAT failed to complete LeoSat's US$50 million Series A investments as pledged.

2020: A big year for small launchers

The influx of small satellite projects has created fantastic opportunities for launch providers. Existing providers have developed new launch vehicles with a much greater emphasis on rideshare capabilities, while more than a handful of start-ups have been created solely dedicated to small satellite launch technologies. Indeed, Frost & Sullivan expects a total of 20,425 satellites to be launched in 2019-2033, with high demand taking the small satellite launch market beyond US$28 billion by 2030.

"Serial production and rapid manufacturing will play a pivotal role in meeting market demands. To ensure the success of the industry, it's imperative that launch frequency, inventory and manufacturing capability are optimized," said Prachi Kawade, Research Analyst, Space, Frost & Sullivan.

Small satellite launch provider Rocket Lab closed out 2019 with the official opening of its new US launch site, Launch Complex 2, at the Mid-Atlantic Regional Spaceport. Rocket Lab's Launch Complex 1 on the Mahia Peninsula of New Zealand had achieved 10 flights of the Electron launcher by this time, including six in 2019. Launch Complex 2 is expected to open up new markets, including government customers and national security applications, with up to 12 missions per year. The first mission will deliver the US Air Force's Space Test Program 27RM, which will deliver the Monolith microsatellite into orbit, in the spring of this year. This is the latest in a long line of impressive 2019 news for Rocket Lab, which also announced its new Photon spacecraft for missions to the Moon and beyond and began testing its Electron rocket boosters for reusability.

Looking ahead, 2020 is expected to be huge for small satellite launch specialists.

One of my personal favourite small satellite launchers Virgin Orbit launched an orbital rocket for the first time in May. LauncherOne was carried into high altitude onboard the Cosmic Girl aircraft prior to successful in-air separation; however, while details remain murky, LauncherOne failed to continue to its target orbit. Virgin Orbit is also looking for new launch sites and destinations this year, with the UK Space Agency having recently awarded the company £7.35 million to enable LauncherOne missions from Spaceport Cornwall, with the first launch expected not before 2022. Virgin Orbit is also collaborating with SatRevolution and Polish universities for up to three launches delivering small spacecraft to Mars, with the first launch due no earlier than 2022.

Meanwhile, newcomer FireFly Aerospace is preparing for the inaugural launch of its Alpha rocket in the first quarter of the year from Vandenberg Air Force Base in California. FireFly has partnered with Aerojet Rocketdyne to gain expertise on 3D printing for its Reaver engine production (each Alpha launcher contains four Reaver engines), as well as collaborating on its upcoming Orbital Transfer Vehicle and a larger Beta launch vehicle. FireFly has also partnered with Israel Aerospace Industries to cooperate on lunar landing technology, Genesis, which will be used for mission contracts under NASA's Commercial Lunar Payload Services program; the first flight is expected at the end of 2021.

Beyond the US, Taiwan Innovative Space Inc. (TiSPACE) is looking forward to achieving its first small satellite launch on board its Hapith launcher at the end of the year. The company spent 2019 increasing the efficiency of its hybrid rocket engines to meet NASA's Class-I rocket propulsion status while also keeping costs lower than competitors. TiSPACE is presently negotiating leasing launch facilities in other countries, plans to create a California office to access US commercial space, and ultimately build a satellite technology industrial park. ■

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