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Industry Brief

Space 3.0. Turning the corner in 2021?

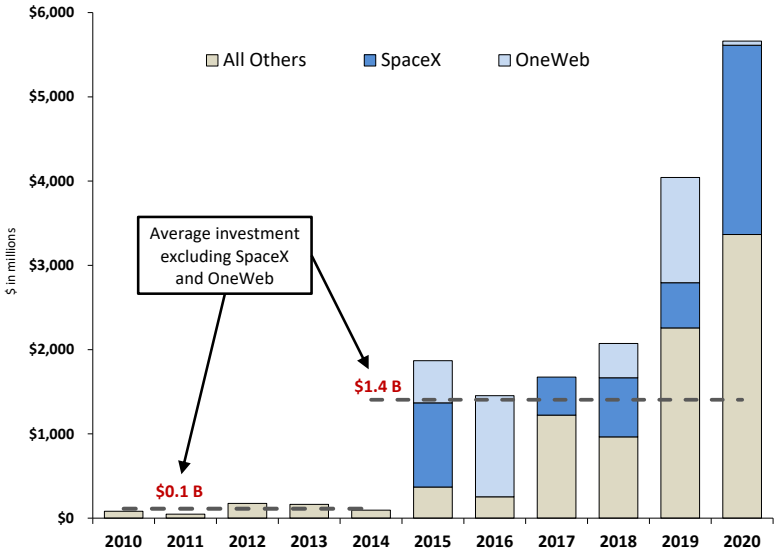
WHAT IS SPACE 3.0?

By our count, the space industry is currently immersed in the third great wave of innovation and investment, an era we refer to as Space 3.0. The first wave of investment (Space 1.0) peaked in the mid-1960s and was driven almost entirely by geopolitically motivated government spending on crewed spaceflight. By contrast, the second wave (Space 2.0) crested circa 2000 and was predominantly supported by satcom-oriented corporate investments by the likes of **Alcatel**, **Boeing**, **Motorola**, and **Teleglobe**.

Unlike these earlier cycles, Space 3.0 started as a chaotic affair, lacking a singular motivating force or even a coherent direction. But evidence of a new investment cycle is undeniable. Since 2015, more than 500 venture-backed space startups have been formed, compared to ~200 startups in the decade prior. Likewise, since 2015, the industry has attracted nearly $17 billion of investment, up 20-fold over the less than $1 billion invested cumulatively over the prior decade.

Where is all of this money going, and will investors be able to generate attractive returns?

Equity Investments in Space Ventures



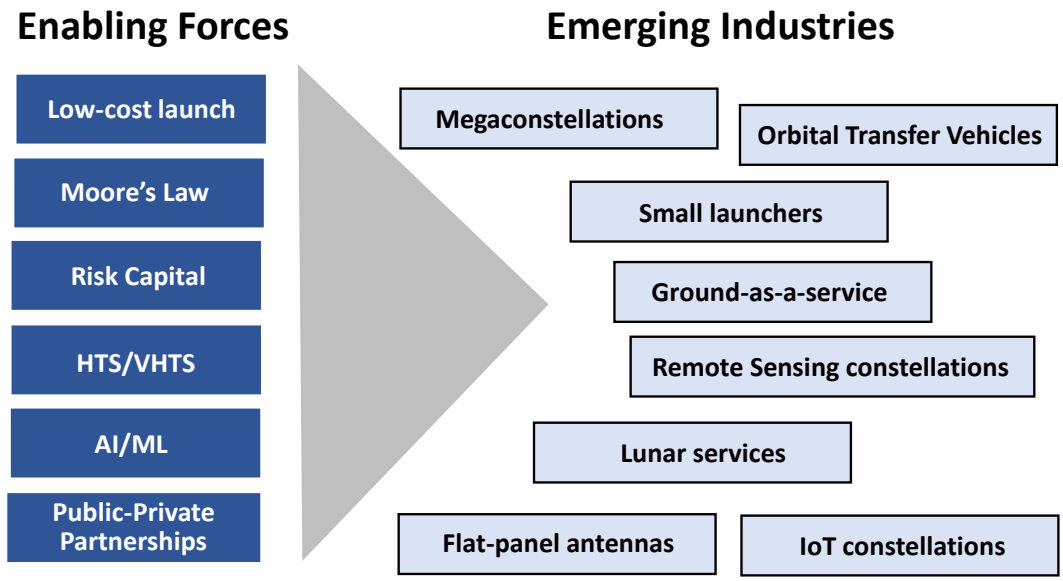
Source: Bryce Start-up Space Report Series, Quilty Analytics.

HOW WE GOT HERE

The current era of Space 3.0 lacks an obvious starting point (some would suggest the 2002 founding of **SpaceX**) or a central organizing principle. That said, Space 3.0 began as a commercial affair and one that has been largely propelled by a "NewSpace" ethos. Although sometimes used as a pejorative nowadays, the NewSpace movement gained critical mass around 2010, led by a handful of Venture Capital (VC)-backed West Coast startups, most notably **Skybox Imaging**, **Planet Labs**, and **NanoSatisfi** (now **Spire Global**). These companies, and others that would follow, abandoned many traditional space/aerospace design and manufacturing models in favor of what can best be characterized as an agile software approach – go fast, fail if necessary, and advance through rapid, iterative improvement.

While an important contributor to Space 3.0, the NewSpace philosophy was by no means sufficient to single-handedly bend the arc of the ~$400 billion space industry. Instead, like all great movements, Space 3.0 came

about through a confluence of factors, many technological, but also financial (e.g., VC funding, billionaire support, government funding, and most recently, private equity firms and Special Purpose Acquisition Companies, or SPACs), regulatory (export control, commercial remote sensing and RF spectrum licensing rules), and structural (like the formation of the U.S. Space Force, and NASA's innovations in commercial cargo/crew). The graphic below highlights a handful of these enabling forces, along with a sampling of the downstream business ventures spawned by the Space 3.0 revolution.



Source: Quilty Analytics.

AREAS TO WATCH

Traditionally viewed as a hidebound industry dominated by government interests and incremental engineering advances, the space industry has experienced an explosion of new companies, new technologies, and new investors seeking to transform the sector into a modern, dynamic, and rapidly growing commercial ecosystem. Some key areas of investment (and the companies pursuing these markets) include:

- **Command and Control (C2) ground systems.** When Planet and Spire began deploying large constellations of cubesats in the mid-2010s, they had little choice but to also deploy sprawling, proprietary ground station networks across the Earth to retrieve their data from space. Now, several companies offer "ground-as-a-service" to smallsat operators, providing a means to outsource ground communications. As satellites collect larger quantities of data, their need for ground communications only increases. The space industry's adoption of cloud data storage has accelerated the outsourcing of ground communications services since satellite data can be downlinked directly to the cloud.

Select Ground System Companies

- **Flat-panel antennas.** Traditionally used for niche, high-end military applications, Flat Panel Antennas (FPAs) are expected to become a mainstream satcom technology over the next several years thanks to the efforts of more than two dozen companies developing commercial/consumer-grade antennas. FPAs offer a range of benefits over traditional dish antennas, including instantaneous beam-switching, no moving parts, and simultaneous multi-satellite tracking. FPAs have traditionally been too expensive for commercial adoption, but their necessity for the success of broadband constellations has fueled a surge in investment activity. The antennas will also have application for geostationary satellites, particularly with defense and aviation customers.

Select Antenna Companies

- **GEO satellites.** Traditionally the lifeblood of the satellite manufacturing industry, GEO satellites have fallen out of favor in recent years as new entrants and even traditional satellite operators focus their efforts on building LEO constellations. That said, GEO satellites have undergone a quiet revolution over the past 15 years that have radically reshaped their performance and economics. Core to this change is the advent of high-throughput satellites (HTS) that employ narrow beams and frequency reuse to boost their system-level data throughput from less than five Gbps to hundreds of Gbps. The latest iteration of these satellites, referred to as Very High Throughput Satellites (VHTS), are expected to deliver 3,000 to 5,000 Gbps per satellite by the end of the decade. In addition to raw throughput, GEO satellites have gained flexibility through the use of digital payloads and software-defined architectures while also packing more punch-for-the-pound thanks to electric propulsion.

Select GEO Satellite Companies

- **Lunar exploitation.** Historically NASA and other space agencies led endeavors beyond the planet, while commercial space activities remained in Earth orbits. Over the past five years, however, advances in rocketry, space tugs, and other technologies have made commercial lunar activities viable. Seeking to support and stimulate these efforts, NASA in 2018 selected nine companies to compete for the 10-year, $2.6 billion Commercial Lunar Payload Services (CLPS) program, which will pay qualified bidders a fixed-price to deliver payloads to the moon on private vehicles and landers. The agency has since expanded the number of participants to 14 companies. Participants are using NASA's CLPS program to foster demand for additional lunar activities from other governments and institutions.

Select Lunar Companies

- **On-Orbit Servicing.** Traditionally, all space hardware (i.e., rockets and satellites) was designed to be expendable, but economic and environmental considerations, plus advances in robotics and automation, are prompting a rethink. A growing number of companies are developing orbital spacecraft capable of active debris removal, orbital transfer services, cubesat deployments, satellite refueling, and life extension services. In addition to these "space tug" applications, other orbital services include robotic assembly and (eventually) commercial manufacturing of certain industrial and medical products such as ZBLAN optical fiber and pharmaceuticals that benefit from microgravity environments.

Select OTV/IOS Companies

- **Propulsion technologies.** Historically dominated by chemical propulsion and aerospace giants, the spacecraft propulsion market has blossomed in recent years as new entrants seek to capitalize on new electric propulsion technologies capable of supporting the thousands of smallsats projected to launch over the next decade. Other growth drivers include the On-Orbit Servicing (OSS) market, lunar and planetary propulsion systems, expanding need for agile spacecraft in the defense realm, and the possibility of new regulations mandating spacecraft propulsion for deorbiting. Improved propulsion efficiency has facilitated the development of new product classes such as "small GEO" satellites, while also enabling VHTS satellites to carry a higher payload-to-mass ratio.

Select Propulsion Companies

- **Small launch**. More than 100 small launch vehicles are currently in development seeking to capitalize on the industry's macro shift from large GEO satellites to proliferated smallsat constellations. These new launch vehicles promise to deliver payloads ranging from 25 to 2,000 kilograms to LEO, often with a specific customer/market focus (e.g., cubesats, govt. responsive launch, constellation replacement, etc.). Small launch startups like **ABL Space Systems**, **Astra**, **Isar Aerospace**, and **Relativity Space** have raised some of the space industry's largest investment rounds in recent years, but only two new entrants (**Rocket Lab** and **Virgin Orbit**) have successfully reached orbit to date. Launch demand is expected to grow over the next decade, though we expect no more than a half-dozen to a dozen of these small launch companies to survive, especially as traditional launch providers increasingly cater to rideshare customers. Only a few will thrive.

Select Small Launch Companies

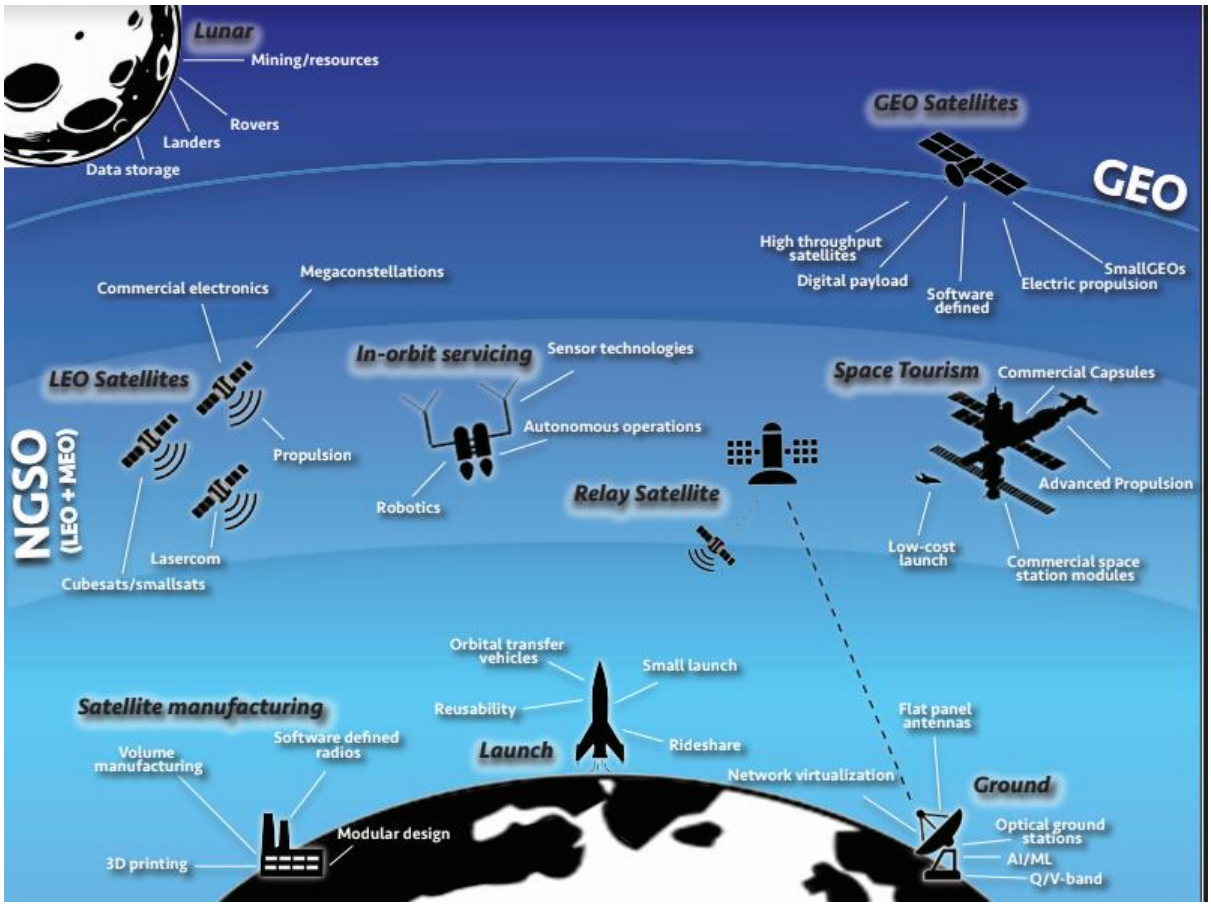
- **Smallsat manufacturing.** Historically relegated to technology demonstrations and academic research, smallsats have become a mainstream platform to perform conventional space missions, including broadband access, Internet-of-Things (IoT) connectivity, Earth observation, weather monitoring, and more. Factors contributing to the growth of smallsats include improved access to space (rideshares, low-cost launch), improved propulsion technologies, less dependence on dedicated high-reliability components, electronics miniaturization, and high volume, modular manufacturing techniques. Improved smallsat capabilities have led to opportunities and investor interest for new market entrants while accelerating the rate of technology adoption – now 3-7 years compared to the typical 15-year or more lifecycle of a traditional GEO satellite.

Select Smallsat Companies

While not explicitly addressed in the tables above, the needs of global defense and intelligence customers are also expanding dramatically within the space domain. For example, the U.S. Department of Defense is investing aggressively in proliferated smallsats constellations used for hypersonic detection and missile defense, low-latency intelligence gathering, global data transport, and C5ISR capabilities. In part, this is driven by the rise of the capabilities of near-peer adversaries – for example, a rising state- and non-state threat environment, the development of difficult-to-address hypersonic threats, and the emergence of anti-satellite weapons against a backdrop where the U.S. and other nations depend on a small number of large GEOs – "sitting ducks" for such weapons.

We expect the U.S. government to launch hundreds if not thousands of small LEO spacecraft over the coming decade. Other governments worldwide have similar ambitions. Not surprisingly, these long-term, defense-driven secular demand drivers have caught the attention of both private equity consolidators and large defense contractors, each of whom is looking to gain market share and assemble key space-related enabling technologies.

Notably, many of the technology developments discussed above have the potential to impact multiple commercial endeavors. For example, lower-cost launch services (coupled with rideshares) have played a key role in the growth of smallsats and could eventually support the creation of a space tourism market. Likewise, advances in propulsion technologies stand to benefit LEO and GEO satellites, the on-orbit servicing market, and even lunar exploitation (see graphic below).



TURNING THE CORNER IN 2021?

Following years of rapid growth, investment, and startup activity, the "NewSpace" industry faced a potentially existential threat at the start of 2020 with the onset of the COVID-19 pandemic. Structural industry changes had weakened the foundations of some legacy players, particularly among mobility-dependent satcom players, three of which (**Intelsat**, **Global Eagle**, and **Speedcast**) filed for Chapter 11 bankruptcy protection in early 2020. The pandemic environment emerged as a feared threat to the ~450 startups funded since 2015 that hadn't yet generated free cash flows and yet had large, ongoing capital investment needs.

Many VCs and other space investors temporarily put new investments on hold to begin sorting their portfolio companies into survivors vs. sacrificial lambs in preparation for a dark winter. But this effort proved unnecessary as most space companies (even startups) were awarded "essential service" designations. The ensuing V-shaped economic recovery prompted VCs to rapidly shift from survival to growth mode. In fact, 2020 proved to be another banner year for space investments, up 40% y/y to $5.7 billion. At the same time, three new trends emerged that began to radically reshape the space startup ecosystem.

- **Large financing rounds** began enabling companies to chart fully funded pathways to market, be it a first rocket launch or a product release. Examples include $100+ million rounds by launch startups ABL Space Systems and Relativity Space, synthetic aperture radar startup **Iceye's** $87 million Series C, and antenna-builder **Kymeta's** $85 million round.

- **Private equity** firms, which had largely ignored the space industry for much of the past decade, suddenly renewed their interest, focusing primarily on roll-up strategies. From March 2020 to March 2021, **AMERGINT**, **RedWire**, and **Voyager Space Holdings** collectively acquired more than a dozen small-to-midsize companies ranging from startups to long-established industry players. In 2021, a range of other private equity investors have also entered the sector, further accelerating consolidation.
- **The SPAC phenomenon**, already making waves in electric cars and other industries, hit the space sector head-on, providing another means for promising space companies to raise equity capital (and providing a path to future liquidity for their sponsors). Seven space companies announced SPAC deals over the past six months, nearly double the amount in the past 12 years. Notably, the expansion of the public company universe, both through SPACs and traditional IPOs (e.g., **MDA** in Canada), will significantly strengthen the capital base of the space industry and provide investors with new opportunities to explore and new risks to understand that are quite specific to the space ecosystem.

While encouraging, these trends are not necessarily a panacea for the industry's sizeable and ongoing capital needs. The table below outlines a range of possible outcomes that could unfold over the next 12-24 months as the industry seeks to cross the bridge from aspirational to sustainable business models.

	Optimistic	Middling	Pessimistic
Mega-round recipients	Companies with significant funding use their capital to deploy constellations, debut rockets, and otherwise create a bedrock for future business. Tech demos turn into products, and backlogs provide growing long-term revenue.	Companies meet critical milestones (launch debuts, fleet deployments), but scaling takes additional time, potentially resulting in additional financing events or, in some cases, early exits before the business is fully proven out.	Companies fail to execute on their plans despite raising large rounds, resulting in years of wasted technology development and possible liquidation, bankruptcy, or a fire sale of the company or its IP.
Private equity roll-up firms	SMEs stitched together by M&A become greater than the sum of their parts, delivering robust solutions to customers that would have otherwise been too demanding for individual firms.	Acquired companies benefit from professionalization, better-capitalized and more-focused growth strategies, and centralized infrastructure as key synergies.	Scale fails to help as disparate business lines struggle to support each other, resulting in unwieldy groupings of companies no better (or even worse) off than before.
SPAC IPOs	Armed with hundreds of millions of dollars in fresh capital, publicly listed space companies catapult past their competition. Freed from ongoing capital constraints, these public companies focus on honing products and aggressively grow market share, and/or establishing altogether new markets.	Fresh funding propels companies to new heights, but not fully to the levels projected in investor decks, whether due to timing delays or from slower-to-develop markets/products. A smaller subset of companies succeeds handily, and the remainder grows modestly (including through M&A), though missing early expectations.	Most (though not all) of the companies fail to achieve product-market fit or to fully develop their solutions, at best limping along with relatively limited organic revenues while attempting to use their cash reserves to pivot to other market opportunities.

CONCLUSION

All investment cycles must eventually come to an end, but the space industry is still arguably in the early stages of what has the potential to become a multi-year or multi-decade expansion phase. The industry has never had a shortage of grand visions, just fundable, executable business models – and access to the needed capital to execute on such plans. Undoubtedly, more duds are on the horizon, but the favorable confluence of technological, structural, regulatory, and financial forces now supporting the industry would suggest that there will be a number of high-profile winners whose capabilities could dramatically change and improve life on Earth.

We have long expressed our concern that the industry's insatiable demand for capital (e.g., 100+ launch vehicles and dozens of satellite constellations) puts many participants/stakeholders at an elevated risk of failure in the event of a sustained economic downturn. Those risks remain, but if the industry emerges from 2021 with more than a half dozen new public companies and billions of dollars in new investment, the space sector will be on a steadier path to achieving one or more grand vision. Occupy Mars, anyone?

For readers interested in further analysis of the space sector and key companies within the ecosystem, Quilty Analytics' senior professionals can offer expert research and insights based on more than two decades at the forefront of the space and technology industries. The Quilty Analytics team is dedicated solely to matters relating to the Satellite & Space industry, and it welcomes the opportunity to share its perspectives with interested institutions and corporate stakeholders.

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