

# Too congested before we're connected? Broadband satellites will need to navigate a crowded sky

LEO satellites could bring high-speed internet to every corner of the world—if they can stay out of each other's way. Fortunately, adjacent industries are gearing up to help.

David Jarvis, Duncan Stewart, Kevin Westcott, and Ariane Bucaille

IN *TMT PREDICTIONS 2020*, we said that low Earth orbit (LEO) satellite broadband constellations would be either a revolution or just a bunch of space junk.<sup>1</sup> Three years later, it still isn't entirely clear which it is—but a lot of companies are betting on the former. Deloitte Global predicts that more than 5,000 broadband satellites will be in LEO by the end of 2023, making up two working constellations providing high-speed internet to nearly a million subscribers on all parts of the planet, no matter how remote. Looking further out, if every organization currently planning to build a LEO constellation succeeds, seven to 10 competing networks could be operational by 2030, with a total

of 40,000 to 50,000 satellites serving more than 10 million end users.

## Doing choreography ... in space

The anticipated surge in satellite broadband deployments spells good news for users. It is likely that new applications will emerge, prices will decline, coverage and reliability will improve, and latency will fall. But several complications could slow the industry down. A much more crowded orbital environment significantly raises the risk of

collisions, requiring higher levels of cooperation and coordination. At the same time, the various national, regional, and global players will likely continue to fight over spectrum, orbital slots, launch capacity, and access to terrestrial markets. Among the major competitors:

**SpaceX's Starlink:** More than 2,600 working Starlink satellites serving almost half a million subscribers are currently in orbit.<sup>2</sup> Beyond typical consumer use, Starlink has demonstrated its utility for emergency services in a number of recent natural disasters.<sup>3</sup> Multiple airlines have begun exploring and testing the system for high-speed in-flight internet access.<sup>4</sup> SpaceX also received FCC approval to provide mobile connectivity for boats, planes, and other vehicles, fulfilling one of the company's early promises.<sup>5</sup>

**Amazon's (Project) Kuiper:** Although none of its planned 3,236 satellites are currently in orbit, Amazon announced a multibillion-dollar agreement with three providers in April 2022 to launch most of these satellites over five years.<sup>6</sup> But Amazon will need to hurry: It must have half of its satellites in place by 2026 and the entire constellation in orbit by 2029, or it will lose its FCC authorization.

**OneWeb:** More than two-thirds of UK-based OneWeb's planned 648 satellites are currently in orbit, and the company is aiming to start global operations by the end of 2023.<sup>7</sup> OneWeb also recently combined with France-based Eutelsat in a US\$3.5 billion deal.<sup>8</sup> The combined company intends to focus on enterprise and government connectivity by integrating Eutelsat's geostationary satellites with OneWeb's LEO network.<sup>9</sup>

Additional players include Canada's Telesat, which plans to start launching its 188-satellite Lightspeed network in 2025.<sup>10</sup> Another is Telco-backed AST SpaceMobile, which is planning a constellation of 243 satellites that will allow mobile devices to connect directly to its LEO network.<sup>11</sup> And China,

as part of a national plan, launched six test satellites in March 2022 for the private firm Galaxy Space. China's network may eventually contain up to 13,000 satellites.<sup>12</sup>

The big challenge for these companies? Keeping their satellites out of harm's way. Space surveillance networks currently track more than 31,000 orbiting objects, including more than 6,000 operating satellites.<sup>13</sup> On top of that are an estimated hundreds of thousands of untracked debris fragments, ranging from pieces of destroyed satellites to paint flecks. To keep satellites from colliding with each other and from being struck by debris, it's necessary to know where all those objects are in real time, and with great precision, a discipline known as space situational awareness (SSA). Also essential is effective space traffic management (STM)—that is, robust technical and regulatory standards around launching, operating, and returning satellites to Earth.<sup>14</sup>

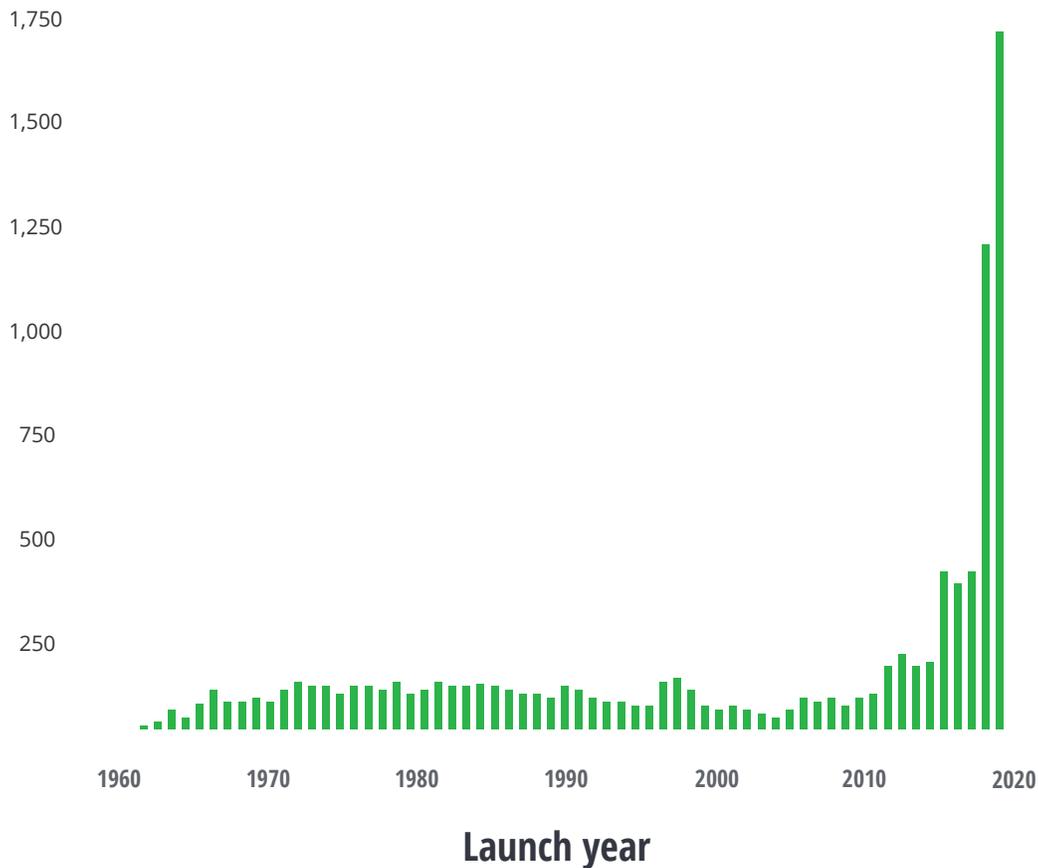
Currently, governments generally provide data for SSA, but there are challenges.<sup>15</sup> Dramatically increasing the number of satellites to track could overload the current system from both a technical and operational standpoint. The number of near-collisions—satellites passing within 1 kilometer of each other—has already risen significantly since LEO broadband constellations have started going up.<sup>16</sup>

This challenge is driving the creation and growth of new markets. Prime among these is commercial SSA, which, while niche today, could grow to US\$1.4 billion by 2032.<sup>17</sup> SSA providers are building a combination of ground- and space-based sensors along with powerful computer models to track objects in space and predict their orbital paths.<sup>18</sup> A well-developed commercial SSA capability could augment government data and feed a trusted common operating picture. This market can be helped by the funding of the US Office of Space Commerce, which will work to take over civil space traffic management responsibilities as early as 2024.<sup>19</sup>

FIGURE 1

## The number of objects launched into low Earth orbit has dramatically increased, driven by commercial satellite constellations

■ Number of objects



Source: European Space Agency, *ESA's space environment report 2022*, April 22, 2022.

In-orbit satellite servicing and space-debris removal could also receive a boost from LEO satellite constellations. In space-debris removal, a specialized satellite rendezvouses with a dead satellite or object, captures it, and pushes it into a different orbit or the atmosphere to safely burn up. Several proof-of-concept space debris-removal missions have already occurred,<sup>20</sup> and many more are planned in the coming years.<sup>21</sup> In-orbit satellite

servicing aims to prolong satellite life: A servicing vehicle could refuel a satellite to extend its usefulness or, if a malfunction occurs, swap out a part to avoid having to scrap the whole thing. The industry-led Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) is currently working to develop standards for this emerging industry.<sup>22</sup>

### **THE BOTTOM LINE**

If the industry continues on its current trajectory, the LEO broadband market will not only grow but also drive the expansion of supporting markets, creating a new and dynamic ecosystem. However, for this ecosystem to be viable in the long term, all involved should focus their attention and resources on protecting the commons of space. Critical uncertainties include:

- How much global cooperation will there be in space traffic management? To what extent will all the players be able to establish and follow formal “rules of the road”?
- Will better-quality SSA data become widely available and used before satellite operators become overwhelmed with managing potential collisions?
- How effectively will improvements in spaceborne computing and processing power, such as those enabled by advanced radiation-hardened chips,<sup>23</sup> facilitate real-time avoidance of debris or other satellites?
- How many more debris-creation events can LEO absorb before things get unsustainable? How will the market respond if things get worse?

So back to the original question: Are LEO satellite constellations a revolution or a bunch of space junk? As we said at the start, the jury’s still out. With lots of players in the game and lots of launches to come, the potential for both outcomes still exists—perhaps simultaneously.

## Endnotes

1. David Jarvis, Mark Casey, and Craig Wigginton, *High-speed from low orbit: A broadband revolution or a bunch of space junk?*, Deloitte Insights, December 9, 2019.
2. Stephen Clark, "SpaceX deploys 53 more Starlink satellites on record-tying 31st launch of the year," *Spaceflight Now*, July 17, 2022; Michael Sheetz, "SpaceX's Starlink satellite internet surpasses 400,000 subscribers globally," *CNBC*, May 25, 2022.
3. Mihir Tripathy, "How is Starlink changing connectivity?," *Smithsonian Magazine*, September 13, 2022.
4. Micah Maidenberg and Alison Sider, "Delta Air Lines tested SpaceX's Starlink internet for planes, Delta CEO Says," *Wall Street Journal*, April 18, 2022; Michael Sheetz and Leslie Josephs, "SpaceX's Starlink to provide Wi-Fi on Hawaiian Airlines flights with free service for passengers," *CNBC*, April 25, 2022.
5. Micah Maidenberg and Drew FitzGerald, "SpaceX wins permission to connect planes, boats, and other vehicles to Starlink internet service," *Wall Street Journal*, June 30, 2022.
6. Jeff Foust, "Amazon signs multibillion-dollar Project Kuiper launch contracts," *Space News*, April 5, 2022.
7. Jason Rainbow, "Eutelsat and OneWeb agree multi-orbit merger plan," *Space News*, July 25, 2022.
8. Sara Reuberg, "Deal struck to create European satellite rival to Elon Musk's Starlink," *Wall Street Journal*, July 26, 2022.
9. Low Earth orbit (LEO): An orbit between 160 and 2,000 kilometers above the Earth. Low Earth orbits have a short orbital period (approximately 90 to 120 minutes) and are commonly used for remote sensing, human space flight, and data communication. Satellites in this orbit can only communicate with a small portion of the Earth's surface at any given moment, which is why a larger number of satellites is needed for global coverage. Geosynchronous orbit (GEO): An orbit at 35,786 kilometers above the Earth's surface. Satellites in this orbit move at the same speed as the Earth rotating, so they stay in roughly the same place over the Earth's surface. With a much wider view of the Earth, this orbit is good for imagery, communications, and weather satellites, because only a few satellites can provide global coverage.
10. Jason Rainbow, "Telesat to order 100 fewer satellites for LEO constellation," *Space News*, May 6, 2022.
11. Martyn Warwick, "New 243-strong satellite system will bring 4G and 5G to equatorial regions," *Telecom TV*, December 18, 2020.
12. Andrew Jones, "China launches test satellites for broadband constellation," *Space News*, March 7, 2022.
13. Space Debris Users Portal, *Environment report*, accessed October 26, 2022.
14. United Nations Office for Outer Space Affairs, "Space traffic management and small satellites: new topics to be included in United Nations international space law discussions," press release, April 25, 2015.
15. US Department of Commerce, "Department of Commerce and Department of Defense sign Memorandum of Agreement to advance coordination in space," press release, accessed October 26, 2022; National Space Council, *Recommendations on trust and interoperability in space situational awareness data*, accessed October 26, 2022.
16. Tereza Pultarova, "SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says," *Space.com*, August 18, 2021; Ramish Zafar, "Starlink moved its satellites 1,700 times to evade Russian missile debris," *WCCF Tech*, July 16, 2022.
17. Jason Rainbow, "Getting SSA off the ground," *Space News*, June 17, 2022.

18. SCOUT Space, "A new vision for spaceflight," accessed October 26, 2022; Privateer, "Home," accessed October 26, 2022.
19. Sandra Erwin, "Office of Space Commerce to start developing architecture for traffic management," *Space News*, July 13, 2022.
20. *Astroscale*, "Astroscale's ELSA-d mission successfully completes complex rendezvous operation," press release, May 4, 2022; Jackie Wattles, "Satellite captures space junk for the first time," *CNN Business*, September 20, 2018.
21. Tereza Pultarova, "Commercial space clean-up service could be ready in 2024," *Space.com*, May 26, 2021; Sandra Erwin, "Space Force selects 125 industry proposals for on-orbit servicing technologies," *Space News*, May 2, 2022.
22. CONFERS, "Home," October 26, 2022; Mandy Mayfield, "Industry offering on-orbit satellite servicing," *National Defense*, January 29, 2021.
23. Duncan Stewart et al., *That's just rad! Radiation-hardened chips take space tech and nuclear energy to new heights*, Deloitte Insights, November 30, 2022.

## About the authors

**David Jarvis** | [davjarvis@deloitte.com](mailto:davjarvis@deloitte.com)

David Jarvis is a senior research manager with Deloitte's Center for Technology, Media & Telecommunications, Deloitte Services LP. He has more than 15 years of experience in the technology industry and is a passionate expert and educator focused on the future of our digital society.

**Duncan Stewart** | [dunstewart@deloitte.ca](mailto:dunstewart@deloitte.ca)

Duncan Stewart is the director of TMT Research for Deloitte Canada and is a globally recognized specialist on the forecasting of consumer and enterprise technology, media & telecommunications trends. He presents regularly at conferences and to companies on marketing, technology, consumer trends, and the longer-term TMT outlook.

**Kevin Westcott** | [kewestcott@deloitte.com](mailto:kewestcott@deloitte.com)

Kevin Westcott, vice chairman, is the leader of Deloitte's US Technology, Media & Telecommunications (TMT) practice and the global Telecommunications, Media & Entertainment (TME) practice. His industry experience spans film, television, home entertainment, broadcasting, over-the top, publishing, licensing, and games.

**Ariane Bucaille** | [abucaille@deloitte.fr](mailto:abucaille@deloitte.fr)

Ariane Bucaille is Deloitte's global TMT industry leader and also leads the TMT practice and the TMT Audit practice in France. She has more than 20 years of experience and is a chartered and certified public accountant.

## Acknowledgments

The authors would like to thank **Adam Routh** and **Aijaz Hussain** for contributing with their insights and expertise to this chapter.

Deloitte's Technology, Media & Telecommunications (TMT) industry group brings together one of the world's largest pools of industry experts—respected for helping companies of all shapes and sizes thrive in a digital world. Deloitte's TMT specialists can help companies take advantage of the ever-changing industry through a broad array of services designed to meet companies wherever they are, across the value chain and around the globe. Contact the authors for more information or read more on [www.deloitte.com](http://www.deloitte.com).

# Deloitte.

## Insights

Sign up for Deloitte Insights updates at [www.deloitte.com/insights](http://www.deloitte.com/insights).



Follow @DeloitteInsight

### Deloitte Insights contributors

**Editorial:** Junko Kaji, Andy Bayiates, Aditi Gupta, Aishwarya Iyer, Dilip Poddar, Arpan Kumar Saha, Aparna Prusty, Blythe Hurley, Shambhavi Shah, and Preetha Devan

**Creative:** Sylvia Chang, Jaime Austin, Sofia Sergi, Govindh Raj, Sanaa Saifi, Rishwa Amarnath, Ayushi Mishra, Pooja N, and Gautham Dutt (TMT center)

**Audience development:** Pooja Boopathy

**Cover artwork:** Sylvia Chang, Jaime Austin, and Sofia Sergi

### About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited (“DTTL”), its global network of member firms, and their related entities (collectively, the “Deloitte organization”). DTTL (also referred to as “Deloitte Global”) and each of its member firms and related entities are legally separate and independent entities, which cannot obligate or bind each other in respect of third parties. DTTL and each DTTL member firm and related entity is liable only for its own acts and omissions, and not those of each other. DTTL does not provide services to clients. Please see [www.deloitte.com/about](http://www.deloitte.com/about) to learn more.

### About this publication

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited (“DTTL”), its global network of member firms or their related entities (collectively, the “Deloitte organization”) is, by means of this communication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser. No representations, warranties or undertakings (express or implied) are given as to the accuracy or completeness of the information in this communication, and none of DTTL, its member firms, related entities, employees or agents shall be liable or responsible for any loss or damage whatsoever arising directly or indirectly in connection with any person relying on this communication. DTTL and each of its member firms, and their related entities, are legally separate and independent entities.