DECEMBER 2021

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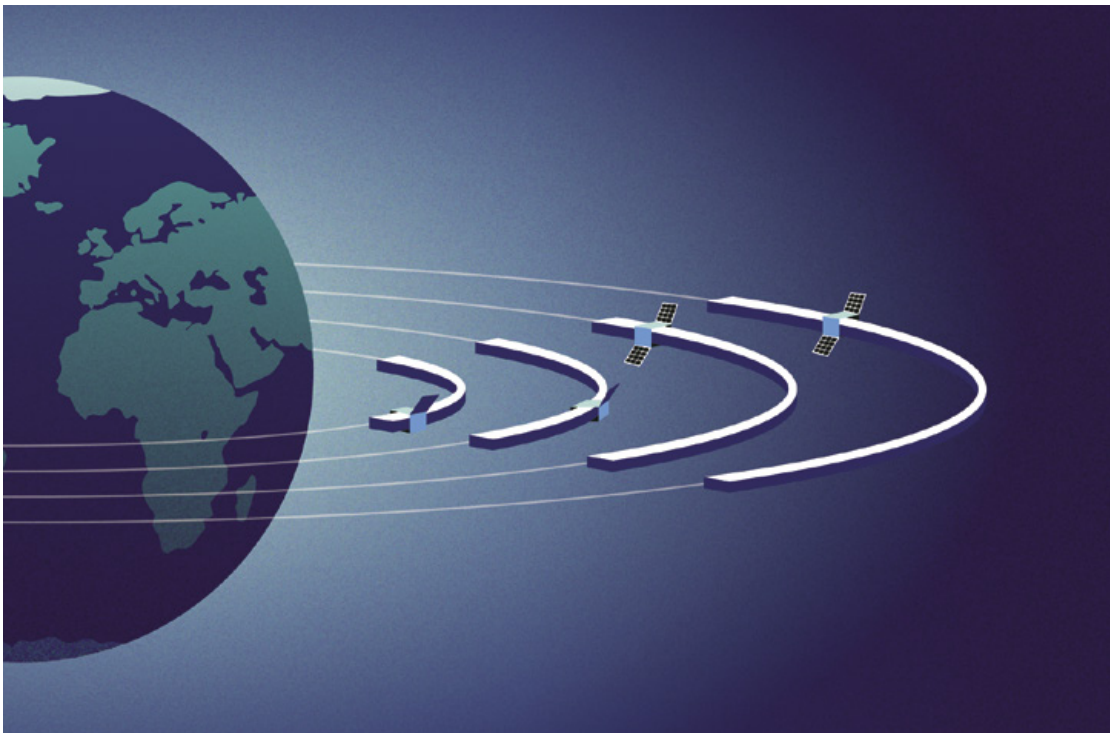

ENGINEERING AND COMPUTING

# SPACE CONNECTS THE GLOBE

## The Internet of Things goes into orbit

*By Rajalakshmi Nandakumar*

**Today at least 10 billion** active devices make up the Internet of Things (IoT), a number that is expected to more than double in the next 10 years. Maximizing the IoT's benefits in communication and automation requires devices to be spread across the globe, collecting zettabytes of data. The data are assimilated in cloud data centers, using artificial intelligence to identify patterns and anomalies, such as weather patterns and natural disasters. There is a big problem, though: cellular networks span less than half the globe, leaving enormous gaps in connectivity.

A space-based IoT system could patch those gaps, using a network of low-cost, low-weight (less than 10 kilograms) nanosatellites that orbit a few hundred kilometers from Earth. The first nanosatellite launched in 1998; today roughly 2,000 CubeSats serve as orbiting monitors. Companies such as SpaceX Starlink, OneWeb, Amazon and Telesat have used nanosatellites for the goal of providing global Internet coverage.

Soon it will be possible to communicate with these orbiting nanosatellites from small battery-powered IoT devices here on Earth. Data from a device—say, a location reading from a tracking sensor—would be sent to a satellite using low-power, low-cost communication protocols similar to long-range communication and Sigfox, which can decode even weak signals. It would then be transferred to ground stations where the data would be analyzed.

This technology is enabling various data-driven applications in previously unreachable or difficult-to-connect locations. Communications company Iridium, for instance, has a network of 66 low-Earth-orbit satellites that can connect ships to aircraft flying anywhere in the world. Battery-powered sensors from Lacuna Space in the U.K. can connect to their low-Earth-orbiting satellites to track assets such as packages in ships, as well as monitor farm data to enable agriculture that uses water, fertilizer and herbicide more efficiently. Myriota in Adelaide, Australia, uses space-based IoT to track endangered species such as rhinos. And to move data from a satellite to centralized servers in data centers, Microsoft partnered with SpaceX Starlink to launch a space-based cloud computing platform.

Space IoT still faces a multitude of challenges before becoming truly global. For instance, nanosatellites have a relatively short lifetime of about two years and must be supported by expensive ground station infrastructure. To confront the growing problem of orbiting space junk, plans are underway by NASA and others to either automatically deorbit satellites at the end of their functional life or collect them using other spacecraft.

It also will be important to provide secure, reliable, high-bandwidth communication links from satellites to maintain connectivity in different weather conditions and terrains. To do so, companies are working on a different frequency spectrum and developing coding schemes to improve the bandwidth and robustness of the communication systems.