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Year in review

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Space colonization

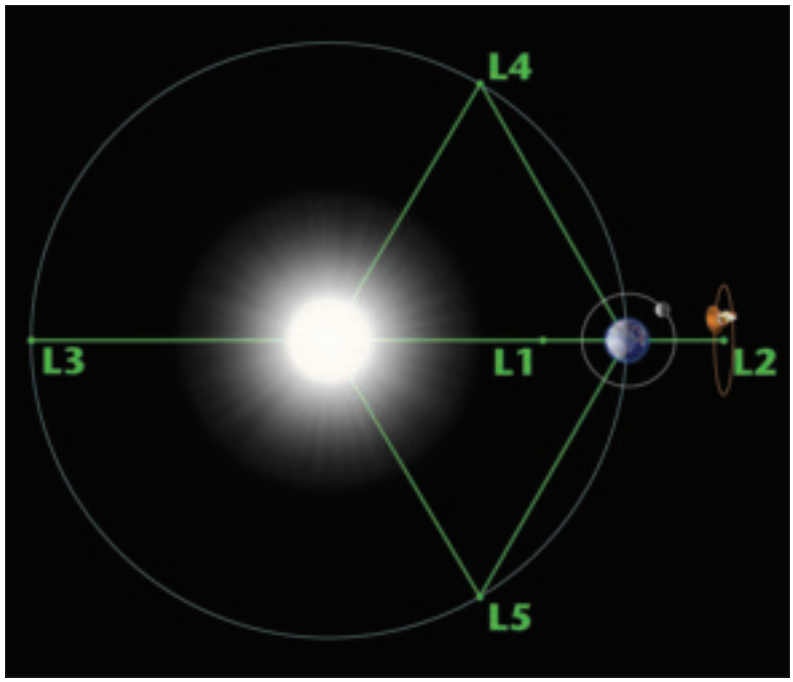
Throughout the history of human interest in space settlements, one constant has been the struggle to justify the huge expenditures required to move and maintain thousands of people in space. Early assumptions that construction of solar power satellites for a power-hungry world would pay for large orbital communities were invalidated by energy conservation and development of new energy supplies. Subsequent triggering events—whether for economic, political, or survival imperatives—failed to materialize.

This year, however, saw the first indications of a new economic direction that may provide a path toward large-scale human habitation in space: At an AIAA conference in January, several industry and government leaders described ideas for infrastructure enabling on-orbit repair and upgrades of GEO and other satellites, retaining heavy satellite structures and realizing cost savings through launch only of components for replacement or upgrade. This is a trend that bears watching.

The concept of space infrastructure received attention this year with discussions showing how space station elements can be repurposed to provide orbital services throughout cis-lunar space, including for operations on the lunar surface. Studies of orbital options are revealing loiter or parking orbit possibilities involving Earth-Moon libration points L1 and L2, including orbits around L2 that stray sufficiently from the discrete point to enable direct communication with Earth, and complicated patterns that oscillate between L1 and L2. Solar power satellites also remain in the infrastructure picture, with a $100,000 grant created for further research.

Commercial space was in the news, most notably with the successful berthing of a SpaceX Dragon cargo vehicle with the ISS. Development of commercial crew delivery to the space station continues, with the announcement of 'two and a half' contracts for the third phase of NASA Commercial Crew Development vehicles: Boeing and SpaceX received approximately equal contracts for their capsule-based concepts; Sierra Nevada received approximately half funding for winged vehicle development.

CCDev contractors are intending flexible uses of their vehicles; NASA mission requirements presume that some crew seats may be replaced by cargo installations.



When one large body is in orbit around another, there are five points in orbits around the larger body where gravitational forces balance out to enable satellites to be placed where they could not stay if the smaller of the large bodies were not present. These are called libration or Lagrangian points.

Downweight options from the ISS are being recognized as a priority, as the agency is encouraging the development of commercial products in the ISS environments.

A commercial enterprise not connected with NASA was established by Planetary Resources, which announced plans to mine asteroid resources.

Simultaneously, work continues on traditional NASA contracts for development of the Orion crew vehicle, capable of enduring more severe environments associated with return from higher than LEO orbits, and the Space Launch System (SLS), intended to launch Orion. Contractors for Orion and SLS are creatively investigating how their vehicles can be used for multiple types of missions, especially missions to asteroids, Mars, and the Moon. Mars captured public interest with the landing and early operations of the Curiosity rover, which pioneered an innovative Sky Crane technique for landing large, heavy cargo in the slight Martian atmosphere.

Potentially the greatest penetration of space settlement concepts into the public consciousness occurred with publication of a special edition of *U.S. News & World Report* on "Mysteries of Space," including an article titled "Home on the Final Frontier." Statements included "living on Mars or the Moon is not such a far-fetched idea" and "the first pilot settlements could begin construction in little more than a decade."

Previously established space settlement programs also continued this year.

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