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A M E R I C A

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Year in review

Space transportation

This was a year of transition. NASA retired its iconic and first-of-its-kind space shuttle fleet, leaving the U.S. without a home-grown means to transport astronauts and their cargo to space. But while worldwide launch systems continue to operate with remarkable success, a new generation of U.S. private and public launch systems is on the horizon, with their sights set on both sub-orbital and orbital space, including providing cargo and crew transportation services to NASA.

As of this writing, there were nine U.S. launches this year. United Launch Alliance Delta IV rockets delivered the WGS 4 satellite for the Air Force and two NRO satellites. ULA Atlas V rockets launched five payloads—AEHF 2, MUOS 1, the RBSP, and two NRO satellites. A Pegasus XL deployed NASA's NuSTAR spacecraft, in its first launch since 2008.

Microsoft cofounder Paul Allen teamed up with pioneer aerospace engineer Burt Rutan on a venture called Stratolaunch Systems. The company plans to launch rockets into space from a carrier plane that would be the biggest aircraft in history, with a wingspan of 385 ft (117 m).



Internationally, Sea Launch carried out two launches for Intelsat, while India and Iran each had one launch.

As of the end of October, there were five Ariane 5 launches; two more are scheduled before year's end. The third ATV carried supplies to the ISS. Vega's maiden flight lofted a LARES payload. Two Soyuz launches are on the manifest in 2012, one carrying two Galileo navigation satellites.

Japan launched its third HTV cargo carrier to the space station and a pair of satellites using its H2A. Russia had eight Soyuz launches; seven Proton launches, of which five were for ILS; and one Rocket launch. Soyuz launches included three Progress cargo deliveries to the ISS and two with ISS crewmembers.

China completed an ambitious schedule this year, with 11 Long March launches. One delivered the Shenzhou 9 spacecraft, a crewed capsule that docked with the orbit-

ing Tiangong 1 laboratory module. Crew and capsule were successfully recovered.

NASA made significant progress in its development of a heavy-lift Space Launch System, completing development and risk reduction tests for Orion Exploration Flight Test 1 and awarding advanced booster demonstration and risk reduction efforts.

The emerging commercial transportation market achieved several milestones toward providing suborbital and orbital services. Under the NASA Commercial Orbital Transportation Services (COTS) program, SpaceX successfully launched its Dragon capsule on a demonstration mission to the ISS. It exchanged cargo, reentered, and was recovered successfully—the first time for a private company. It followed up this success by conducting CRS-1, the first commercial resupply mission to the ISS, using the Falcon 9 and Dragon systems, the first of at least 12 such missions. Orbital Sciences completed development of its Antares launch vehicle and initial Cygnus cargo vehicle, with plans to complete its COTS demonstration mission early in 2013.

NASA awarded Space Act Agreements (SAA) for further development to SpaceX for its Falcon 9/Dragon, Boeing for its CST-100 capsule, and Sierra Nevada for the Dream Chaser lifting body under the Commercial Crew Integrated Capability program. Both CST-100 and Dream Chaser will launch from ULA Atlas rockets. ATK also made progress on its Liberty launch system under an unfunded SAA.

Virgin Galactic hopes to begin rocket-powered testing of SpaceShipTwo by year's end and commercial flights of space tourists in 2013. XCOR announced plans for a Florida operations base. Blue Origin has continued development of New Shepard, conducting successful pad escape and recovery tests of its crew capsule.

Under the NASA Flight Opportunities program, Armadillo, Masten Space, Near Space, UP Aerospace, Virgin Galactic, Wittinghill, and X-COR offer payload opportunities for suborbital missions.

DARPA's Airborne Launch Assist Space Access program awarded launch system development concept contracts to Lockheed Martin, Boeing, and Virgin Galactic for systems capable of delivering 100 lb to LEO for less than \$1 million. Microsoft cofounder Paul Allen teamed up with pioneer aerospace engineer Burt Rutan on a venture called Stratolaunch Systems for air-launch of much larger payloads. ♠

by **Carl Ehrlich, Doug Zimpfer**, and the **AIAA Space Transportation Technical Committee**