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June 2, 2016

Changes in the U.S. Commercial Space Industry

The Space Economy

Rockets, satellites, and the services they provide, once the domain of governments, are increasingly launched and managed by privately owned companies as well. Commercial activities accounted for 76% of the $330 billion spent on global space activities in 2014, according to the Space Foundation. Governments and companies in more than two dozen countries have built and launched an orbital payload, but the Federal Aviation Administration (FAA) estimates that the United States was responsible for about 38% of total global space spending in 2014.

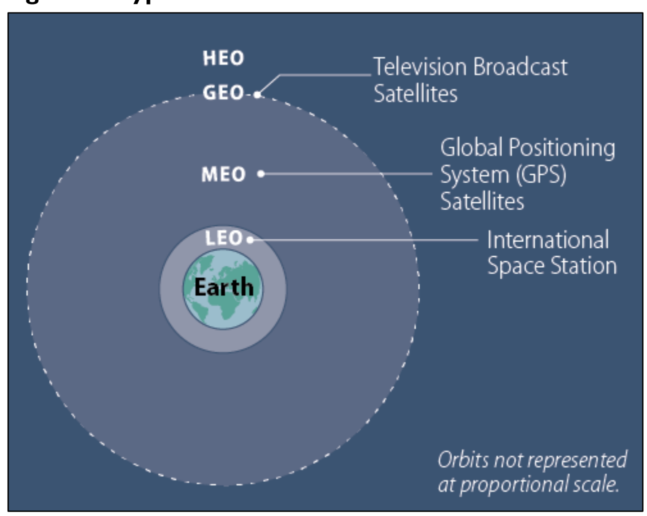
The space economy is made up of both commercial and government components. Commercial products and services are generated by companies providing launch services, manufacturing satellites and ground equipment, and operating satellites; government investments in space make up the rest of space economy spending. Typically, commercial launch providers are also manufacturers, designing and assembling the rockets they use. Service providers (such as television broadcasters) may design and build their own satellites, or may purchase them from third-party manufacturers.

The U.S. space industry supply chain has changed in recent years as new forms of competition have arisen. Launch vehicle manufacturers produced vehicles only under contract to the National Aeronautics and Space Administration (NASA) or the Department of Defense (DOD) until 1982. Until then, the U.S. government launched all civil and commercial payloads into orbit. Now commercial payloads are increasingly launched by private providers, including long-standing aerospace contractors such as Boeing and Lockheed Martin, and new entrants such as Space Exploration Technologies (SpaceX), Blue Origin, and Virgin Galactic. Commercial space technology services include

- **communications systems** utilizing satellites to transmit television signals (satellite television alone accounts for almost a third of all space-related commercial activity), in-flight calls from airplane passengers, and some smartphone data;
- **environmental monitoring** of oceans, forests, deserts, wildlife habitats, and natural disasters;
- **weather applications** monitoring hurricanes and El Niño on a global scale, as well as measuring soil water content to assist in prediction of droughts and floods;
- **transportation uses** providing geolocation services to delivery trucks and ride-sharing services and their passengers; and
- **enhancements of safety** by providing data to first responders at oil spills and forest fires and preventing train collisions with geolocation services.

Satellites are placed into different types of Earth orbits depending on their planned use: low Earth orbit (LEO), medium Earth orbit (MEO), geosynchronous Earth orbit (GEO), and high Earth orbit (HEO) (**Figure 1**). The altitude of the orbit determines the spacecraft's speed around Earth, with those closer moving more quickly. Some types of space activities require closer proximity to Earth for supply and maintenance and to provide higher-resolution images of Earth. Others operate further in space to more effectively deploy their services. The International Space Station (ISS), in LEO, for example, takes just 90 minutes for a full orbit, while a television or weather satellite in GEO will take a full day. A satellite in geosynchronous orbit matches Earth's rotational speed, so unlike other types of satellites, it will remain in the same place above Earth. GEO enables a satellite to monitor the same locations for changes in weather or to facilitate telecommunications.

Figure 1. Types of Earth Orbits



Source: CRS.

Developments in the Industry

Three developments are changing the shape of the commercial space industry: a **shift in government space activities** toward the use of commercial services, **new entrants** with new launch products, and an increase in the launch of **small satellites**.

During the final years of the space shuttle program, NASA encouraged and funded commercial providers to develop systems that could transport crew and cargo to the ISS. The first of these were the SpaceX Dragon capsule and Falcon 9 rocket, which have ferried supplies to the ISS since 2012. Last year, four ISS cargo launches were conducted by

Orbital ATK and three more by SpaceX. (Boeing and SpaceX are each developing ISS crew transportation capabilities for first use in 2017 or 2018.)

New entrants are changing the economics of launches by reuse of rocket boosters. SpaceX's entry into the launch market provides NASA and DOD with new options, and it is also cutting into the international launch market formerly dominated by foreign providers. SpaceX has had several successful launches and relandings (e.g., placing a Japanese telecommunications satellite into GEO from a Cape Canaveral launch site). Blue Origin has to date launched several prototypical rockets that have returned to their launch pads.

The newer entrants are taking advantage of venture capital, which is increasingly being invested in space-related industries. According to the Tauri Group, a space industry research organization, this trend has accelerated over the past five years: 2015 saw a record level of space-related venture capital investment ($2.3 billion). The biggest growth stems from investments in commercial space industry infrastructure such as launch facilities, ground stations, and satellite manufacturing. Of 86 global launches in 2015, 22 were commercial (26%), while 40% of U.S. launches were commercial, according to FAA.

An increased interest in the launch of small satellites—often called CubeSats—is also bringing into the industry new entrants, new technologies, and new private investors. Smaller satellites for Earth imaging and establishing space-based Internet networks from LEO are now possible because satellite components have been miniaturized and standardized. Groups of small satellites are referred to as constellations; Planet Labs, for example, has a constellation of 36 small satellites in orbit, with customers paying for the images it can capture from closer to Earth than traditional, large satellites in more distant orbits. Some observers argue that demand for data may be driving the market for small satellites, as much as the new technologies.

Issues in Commercial Space Policy

The legal basis for commercial space launch policy was established in the Commercial Space Launch Act of 1984 (as amended), which authorized FAA to regulate nongovernmental launches and reentry sites, while also encouraging the development of private-sector commercial space activities. Congress has amended that statute from time to time, most recently enacting the SPACE Act of 2015, which extends indemnification and financial responsibility requirements for space flight participants through 2025, reaffirms federal policies to promote commercial space launches and reentries, and revises the Commerce Department's role in promoting geospatial technologies and the technological advancement of the domestic commercial space industry. (In addition to FAA and the Department of Commerce, the National Oceanic and Atmospheric Administration, the Federal Communications Commission, and the Department of State also have regulatory responsibilities for commercial space activities.)

The White House National Space Transportation Policy provides guidance to federal agencies about commercial and governmental space transportation. The policy calls for use of commercial products and services to help fulfill the federal government's space needs, and encourages partnerships with industry to increase scientific knowledge and reduce government space expenses through use of hosted payloads. (Hosted payloads utilize capacity on commercial satellites to accommodate federal government instruments and other space-bound items.)

Selected issues of congressional interest that may affect the U.S. commercial space launch industry include the following:

Debate over ICBMs

The Commercial Space Act of 1998 permits the conversion of excess intercontinental ballistic missiles (ICBMs) for use by the federal government as space launch vehicles. Some see this use as an efficient way to dispose of the nearly 400 missiles no longer needed for military purposes and less expensive than destroying them. It has been proposed that these ICBMs could be sold for commercial launch vehicles. However, large-scale conversions of ICBMs into space transportation vehicles could undermine the commercial production of space launch vehicles, stall the development of more efficient spacecraft, and diminish private investment in the sector.

Using Indian Launch Services

U.S. nuclear nonproliferation policy has historically not supported the development of space transportation systems in countries that are not members of the Missile Technology Control Regime (MTCR), such as India. However, U.S. companies may receive a license to export satellites to such countries for launch if the federal government waives the MTCR prohibition. Some U.S. satellite manufacturers are urging increased access to Indian services because of a perceived shortage of other launch capacity, especially for smaller satellites. Several U.S.-made satellites have been launched on Indian vehicles. The Office of the U.S. Trade Representative announced last year that it is reviewing the current policy as the demand for commercial launch services increases.

Servicing the ISS

When NASA's space shuttles were retired in 2011, Russian spacecraft became the only means to ferry U.S. crew and cargo to the ISS. U.S. commercial providers now provide cargo transportation, and NASA is funding Boeing and SpaceX to develop commercial crew transport to and from the ISS and potentially other destinations in LEO. Some argue that commercial providers will reduce NASA's costs and encourage development of the domestic commercial space industry. Others contend that there will be few non-NASA customers, question whether there is enough business for more than one provider, and express concerns about astronaut safety.

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