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Commercial Space: Federal Regulation, Oversight, and Utilization

-name redacted-
Specialist in Science and Technology Policy

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SUMMARY

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Commercial Space: Federal Regulation, Oversight, and Utilization

U.S. companies have always been involved in spaceflight as contractors to government agencies. Increasingly, though, space is becoming commercial. A majority of U.S. satellites are now commercially owned, providing commercial services, and launched by commercial launch providers. Congressional and public interest in space is also becoming more focused on commercial activities, such as companies developing reusable rockets or collecting business data with fleets of small Earth-imaging satellites. This report addresses two distinct but closely related topics: how the federal government regulates, oversees, and promotes the commercial space sector; and how the federal government itself uses (or might in the future use) commercial space capabilities.

Multiple federal agencies regulate the commercial space industry, based on statutory authorities that were enacted separately and have evolved over time. The Federal Aviation Administration (FAA) licenses commercial launch and reentry vehicles (i.e., rockets and spaceplanes) as well as commercial spaceports. The National Oceanic and Atmospheric Administration (NOAA) licenses commercial Earth remote sensing satellites. The Federal Communications Commission (FCC) licenses commercial satellite communications. The Departments of Commerce and State license exports of space technology. In response to industry concerns about the complexity of this regulatory framework, the Administration and Congress have made several reform proposals, including Space Policy Directive–2, *Streamlining Regulations on Commercial Use of Space*; the American Space Commerce Free Enterprise Act (H.R. 2809); and the Space Frontier Act of 2018 (S. 3277).

How the federal government makes use of commercial space capabilities is also evolving. The National Aeronautics and Space Administration (NASA) used to own and operate the space shuttles that contractors built for it, but since 2012 it has contracted with commercial service providers to deliver cargo to the International Space Station using their own spacecraft. The Department of Defense (DOD) has its own satellite communications capabilities, but it also procures communications bandwidth from commercial satellite companies. Agencies are considering a host of new opportunities, including acquisition of weather data from commercial satellites, acquisition of science data from commercial lunar landers, and expanded commercial utilization of the International Space Station.

As Congress considers these topics, some of the questions that may arise include:

- Should the federal regulatory framework for commercial space activities be consolidated? Reorganization proposals include transferring the FAA's licensing responsibilities to the Office of the Secretary of Transportation, consolidating NOAA's licensing responsibilities and other Department of Commerce functions in the Office of the Secretary of Commerce, and creating a new civil authority for space situational awareness in either the FAA or the Department of Commerce.
- How can the commercial space licensing process be made simpler, more timely, and more transparent? One focus of this discussion has been the process for interagency consultation on license applications for commercial remote sensing satellites. The challenge for that process is balancing industry's need for timeliness and transparency with the government's need to meet national security and foreign policy objectives.
- How should federal regulatory policies be adjusted as the commercial space industry develops new capabilities and applications? For example, there is currently no clear mechanism for new space applications, not already subject to FAA, NOAA, or FCC regulation, to be authorized and supervised as mandated by the Outer Space Treaty. Current law restricts the FAA's authority to regulate the safety of commercial spacecraft with human occupants.
- What government space activities can or should be conducted by commercial entities? How can government and industry best work together? As the commercial space industry's capabilities expand, there may be new opportunities for agencies to execute programs via commercial contracts, but stakeholders may not always agree on which programs are suitable for a commercial approach.

Contents

Figures

Tables

Appendixes

Contacts

Introduction

U.S. industry has always been involved in spaceflight. Contractors for the National Aeronautics and Space Administration (NASA) built the spacecraft that took astronauts to the Moon. Contractors build reconnaissance satellites for the Department of Defense (DOD) and weather satellites for the National Oceanic and Atmospheric Administration (NOAA). Increasingly, though, space is becoming commercial. A majority of U.S. satellites are now commercially owned, providing commercial services, and launched by commercial launch providers. Congressional and public interest in space is also becoming more focused on commercial activities, such as companies developing reusable rockets or collecting business data with fleets of small Earth-imaging satellites.[1]

Multiple federal agencies regulate the commercial space industry, based on statutory authorities that were enacted separately and have evolved over time. The Federal Aviation Administration (FAA) licenses commercial launch and reentry vehicles (i.e., rockets and spaceplanes) as well as commercial spaceports. NOAA licenses commercial Earth remote sensing satellites. The Federal Communications Commission (FCC) licenses commercial satellite communications. The Departments of Commerce and State license exports of space technology. In response to industry concerns about the complexity of this regulatory framework, the Administration and Congress have made several reform proposals, including Space Policy Directive–2, *Streamlining Regulations on Commercial Use of Space* (SPD-2, issued in May 2018);[2] the American Space Commerce Free Enterprise Act (H.R. 2809, passed by the House in April 2018); and the Space Frontier Act of 2018 (S. 3277, ordered to be reported by the Senate Committee on Commerce, Science, and Transportation in August 2018).

How the federal government makes use of commercial space capabilities is also evolving. NASA used to own and operate the space shuttles that contractors built for it, but since 2012 it has contracted with commercial service providers to deliver cargo into orbit using their own spacecraft. DOD has its own satellite communications capabilities, but it also procures communications bandwidth from commercial satellite companies. Agencies are considering a host of new opportunities, including acquisition of weather data from commercial satellites, acquisition of science data from commercial lunar landers, and expanded commercial utilization of the International Space Station. At present, Congress is addressing these developments primarily through oversight of agency programs and decisions on agency budgets, rather than through authorizing legislation.

This report addresses these two distinct but closely related topics: how the federal government regulates, oversees, and promotes the commercial space sector; and how the federal government itself uses (or might in the future use) commercial space capabilities. As Congress considers these topics, some of the questions that may arise include:

- Should the federal regulatory framework for commercial space activities be consolidated?
- How can the commercial space licensing process be made simpler, more timely, and more transparent?

[1] For more information from CRS on commercial space issues, see CRS Report R44708, *Commercial Space Industry Launches a New Phase*, by (name redacted), and CRS Video WVB00187, *Commercial Spaceflight: New Technologies and Applications*, by (name redacted).

[2] President Donald J. Trump, *Streamlining Regulations on Commercial Use of Space*, Space Policy Directive–2, May 24, 2018, https://www.whitehouse.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/.

- How should federal regulatory policies be adjusted as the commercial space industry develops new capabilities and applications?
- What government space activities can or should be conducted by commercial entities? How can government and industry best work together?

Federal Regulation, Oversight, and Promotion

Key federal agencies involved in the regulation, oversight, and promotion of commercial space activities include the Federal Aviation Administration, for regulation of launch and reentry; the Department of Commerce, for regulation of Earth remote sensing from space, promotion of the U.S. space industry, and export controls on space technology; and the Federal Communications Commission, for regulation of satellite communications. Some functions, such as mitigation of orbital debris, are shared among agencies. Agency roles are not yet fully settled for certain other functions, such as space situational awareness.

Federal Aviation Administration

Until the 1980s, there was no commercial space launch industry. Private companies and most foreign governments (other than the former Soviet Union) contracted with NASA to launch their satellites. The space shuttle, which became operational in 1982, was intended to replace expendable rockets for the launch of both government and commercial payloads. The shuttle's flight schedule, however, could not meet all the demand for satellite launch, and launch vehicle manufacturers soon became interested in offering launch services commercially.

In February 1984, President Reagan designated the Department of Transportation (DOT) as the lead agency for encouraging, facilitating, and licensing commercial expendable launch vehicle activities.[3] DOT established the Office of Commercial Space Transportation (AST) to carry out these duties. AST subsequently became part of the Federal Aviation Administration (FAA).[4]

In October 1984, Congress affirmed the establishment of AST and set out statutory requirements for commercial space launch regulation and licensing in the Commercial Space Launch Act (P.L. 98-575).[5] Among other provisions, the act requires that "no person shall launch a launch vehicle or operate a launch site within the United States, unless authorized by a license issued or transferred under this Act."[6] The Commercial Space Transportation Advisory Committee (COMSTAC), also established in 1984, provides information, advice, and recommendations to AST.[7]

Licensing Launch and Reentry

AST licenses commercial launch and reentry vehicles, such as rockets and spaceplanes, in two different ways:

[3] Executive Order 12465, "Commercial Expendable Launch Vehicle Activities," https://www.archives.gov/federal-register/codification/executive-order/12465.html.

[4] The AST website is https://www.faa.gov/about/office_org/headquarters_offices/ast/.

[5] The Commercial Space Launch Act, as amended, is codified at 51 U.S.C. Chapter 509. Associated regulations are at 14 C.F.R. Chapter III.

[6] Section 6(a)(1), now codified, with amendments to provide for reentry as well as launch, at 51 U.S.C. §50904(a)(1). Note that for the purpose of this requirement, the federal government is not a "person."

[7] For more information about COMSTAC, including its charter and membership and minutes of its meetings, see https://www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/.

- A *specific* license authorizes one or more individually identified launches or reentries, all at the same site and using the same type of vehicle. For example, license LLS 17-096 (rev. 1) authorizes Space Exploration Technologies (SpaceX) to launch eight flights of the Falcon 9 rocket, all from a specified launch site at Vandenberg Air Force Base in California, carrying a total of 75 specified commercial communications satellites and two specified NASA science satellites.
- An *operator* license authorizes an unspecified number of launches or reentries, using a family of similar but not necessarily identical vehicles, over a period of years. For example, license LLO 18-113 authorizes United Launch Alliance to launch any number of flights of six different versions of the Atlas V rocket, all from Cape Canaveral Air Force Station in Florida, at any time during the five years following the grant of the license.

The first licensed launch took place in 1989. Since then there have been a total of 299 licensed launches, including 24 from January through September 2018 (see **Figure 1**).[8] As of September 2018, there were 24 active launch licenses, including 8 specific licenses and 16 operator licenses.[9]

The first licensed reentry was in 2010.[10] Since then there have been a total of 17 licensed reentries, including 3 so far in 2018 (see **Figure 1**).[11] All but one of these reentries have been by the Dragon spacecraft that SpaceX uses to deliver cargo to and from the International Space Station for NASA. The other was the first test flight of the Orion crew capsule being developed for NASA by Lockheed Martin. All reentry licenses issued to date have been specific licenses.

Under the Commercial Space Launch Amendments Act of 2004 (P.L. 108-492), AST can grant permits rather than full licenses for experimental reusable launch vehicles that are suborbital (in other words, that launch into space but not high enough or fast enough to orbit the Earth before returning).[12] To encourage the development of the industry, the permitting process has fewer requirements and a faster approval timeline than the licensing process. Launch permits are less common than launch licenses. The first permitted launch took place in 2006. There have been a total of 44 permitted launches; the most recent was in October 2016 (see **Figure 1**).[13] As of September 2018, there were no active launch permits.[14]

[8] For a list of licensed launches, see Federal Aviation Administration, Office of Commercial Space Transportation, "Launches," https://www.faa.gov/data_research/commercial_space_data/launches/?type=license.

[9] For a list of active launch licenses, see Federal Aviation Administration, Office of Commercial Space Transportation, "Active Licenses," https://www.faa.gov/data_research/commercial_space_data/licenses/.

[10] Reentry is the return of a spacecraft to Earth. The term refers, literally, to re-entering Earth's atmosphere.

[11] For a list of licensed reentries, see Federal Aviation Administration, Office of Commercial Space Transportation, "Reentries," https://www.faa.gov/data_research/commercial_space_data/reentries/.

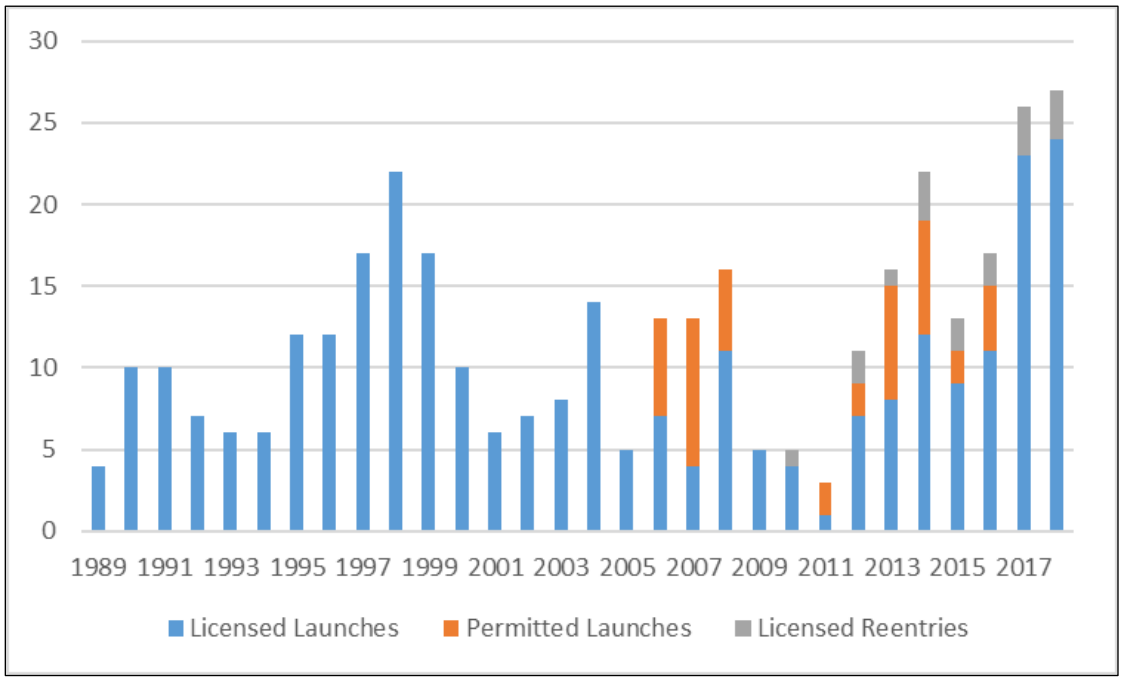
[12] 51 U.S.C. §50906.

[13] For a list of permitted launches, see Federal Aviation Administration, Office of Commercial Space Transportation, "Launches," https://www.faa.gov/data_research/commercial_space_data/launches/?type=Permitted.

[14] For a list of active experimental launch permits, see Federal Aviation Administration, Office of Commercial Space Transportation, "Active Permits," https://www.faa.gov/data_research/commercial_space_data/permits/.

Figure 1. Licensed and Permitted Launches and Reentries by Year, 1989-2018

(2018 data through September 20)



Source: CRS analysis of data from FAA/AST website: https://www.faa.gov/data_research/commercial_space_data/launches/?type=Licensed, https://www.faa.gov/data_research/commercial_space_data/launches/?type=Permitted, and https://www.faa.gov/data_research/commercial_space_data/reentries/.

Licensing Spaceports

Commercial launch and reentry sites, commonly known as spaceports, must also be licensed. Licensing procedures for commercial spaceports are set out in 14 C.F.R. Part 420 and are described in more detail on the AST website.[15] As of September 2018, 11 spaceports held active launch site operator licenses (see **Table 1**). Several additional applications are pending.

Some spaceports are located at government launch facilities. For example, Cape Canaveral Spaceport uses facilities leased from Cape Canaveral Air Force Station and NASA's Kennedy Space Center. Others, such as Midland International Air and Space Port, are located at commercial airports. Still others, such as Spaceport America, were purpose-built as commercial spaceports.

Most licensed launches currently use just three of the licensed sites: the Cape Canaveral Spaceport in Florida; the California Spaceport, located at Vandenberg Air Force Base in California; and the Midatlantic Regional Spaceport (MARS), located at NASA's Wallops Flight Facility in Virginia. The other eight sites are used infrequently or are not yet operational. For example, a suborbital test launch in August 2018 from Spaceport America was the first licensed launch from that location since 2013, and construction of the Houston Spaceport, licensed in 2015, has not yet broken ground.

[15] See links under the heading "Launch Site" at Federal Aviation Administration, Office of Commercial Space Transportation, "Licenses, Permits and Approvals," https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/.

Table 1. Commercial Spaceports with Active Licenses

Site	Operator	First Licensed	Comments
California Spaceport Vandenberg AFB, CA	Harris Corporation	1996	Located at an Air Force launch facility
Mid-Atlantic Regional Spaceport Wallops Island, VA	Virginia Commercial Space Flight Authority	1997	Located at a NASA launch facility
Pacific Spaceport Complex Alaska Kodiak Island, AK	Alaska Aerospace Corporation	1998	
Cape Canaveral Spaceport Cape Canaveral, FL	Space Florida	1999	Located at Air Force and NASA launch facilities
Mojave Air and Space Port Mojave, CA	Mojave Air & Space Port	2004	License limited to suborbital reusable launch vehicles
Oklahoma Air and Space Port Burns Flat, OK	Oklahoma Space Industry Development Authority	2006	License limited to suborbital reusable launch vehicles
Spaceport America Sierra County, NM	New Mexico Spaceflight Authority	2008	License limited to suborbital launches
Cecil Spaceport Jacksonville, FL	Jacksonville Aviation Authority	2010	License limited to suborbital reusable launch vehicles
Midland International Air and Space Port Midland, TX	Midland International Airport	2014	
Houston Spaceport Houston, TX	Houston Airport System	2015	
Colorado Air and Space Port Watkins, CO	Adams County, CO (Front Range Airport)	2018	

Source: Compiled by CRS based on data from https://www.faa.gov/data_research/commercial_space_data/licenses/ and Federal Aviation Administration, *The Annual Compendium of Commercial Space Transportation: 2016*, https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2016_Compendium.pdf.

Insurance Requirements

As part of its licensing process, AST requires launch providers to carry third-party liability insurance.[16] Its method for calculating the required insurance amount is based on estimating the maximum probable loss from a claim, up to a statutory cap of $500 million.[17] In the event of a loss greater than the required insurance amount, the federal government indemnifies licensees for up to an additional $3.1 billion.[18] AST's method for estimating the maximum probable loss has drawn congressional attention because of the potential cost to the federal government if a claim exceeded the insured amount (to date, none has). Section 102 of the U.S. Commercial Space Launch Competitiveness Act (CSLCA, P.L. 114-90) mandated an update to AST's methodology.[19]

[16] This is required by 51 U.S.C. §50914.

[17] 51 U.S.C. §50914(a).

[18] 51 U.S.C. §50915. The statute sets the maximum indemnification amount at $1.5 billion, adjusted for inflation since 1989. The Government Accountability Office (see footnote 19) estimates that this amount is $3.1 billion in 2017 dollars.

[19] For the FAA's response, see Federal Aviation Administration, *Report to Congress: FAA's Development of an*

Congress also periodically reconsiders the policy of indemnification. Initially enacted in 1988 for a five-year period,[20] the indemnification provision has been extended repeatedly, most recently through September 2025 by subsection 102(d) of the CSCLA.

Addressing Human Spaceflight Occupant Safety

To date, only a handful of commercial space launches, all of them suborbital, have had humans on board. Several companies are now actively developing crewed spacecraft, including two that are expected to start carrying astronauts to the International Space Station as soon as 2019, several that are intended to be suborbital, and at least one designed to be capable of flights beyond Earth orbit. This increased activity has drawn congressional attention to how commercial spacecraft are regulated for the safety of their human occupants.

AST has the authority to regulate the design and operation of commercial launch vehicles to protect the health and safety of humans on board.[21] That authority is not prospective, however. It is limited to addressing design features and operating practices that have previously resulted in a serious or fatal injury or that have contributed to an unplanned event posing a high risk of such an injury. This limitation, sometimes referred to as a moratorium or learning period, was initially enacted in 2004 for an eight-year period.[22] It has been extended several times and is currently in effect until October 2023.[23] The most recent extension was enacted in 2015 in the CSCLA.

The CSCLA also directed the Secretary of Transportation to facilitate the development of voluntary industry standards to improve the safety of commercial human spaceflight. In 2016, the industry standards organization ASTM International formed a Committee on Commercial Spaceflight.[24] The committee has established a consensus standard for commercial spaceflight safety terminology and has several additional draft standards in development.[25]

The CSCLA also directed the Secretary of Transportation to report to Congress on

- industry's progress in developing voluntary industry standards for commercial human spaceflight safety;
- metrics that might indicate readiness to transition to "a new safety framework that may include regulatory action"; and
- a proposed transition plan for such a framework.

An FAA report to Congress on the first two of these items identified three sets of indicators that might indicate readiness for a regulation-based safety framework:

Updated Maximum Probable Loss Method, https://www.faa.gov/about/plans_reports/congress/media/CSLCA_Section102_Report_to_Congress.pdf. For GAO's assessment of the FAA analysis, also mandated by Section 102 of CSLCA, see Government Accountability Office, *Commercial Space Launch Insurance: FAA Needs to Fully Address Mandated Requirements*, GAO-18-57, January 16, 2018.

[20] Commercial Space Launch Act Amendments of 1988 (P.L. 100-657).

[21] 51 U.S.C. §50905(c).

[22] Commercial Space Launch Amendments Act of 2004 (P.L. 108-492).

[23] 51 U.S.C. §50905(c)(9).

[24] For more information, see ASTM International, "Committee F47 on Commercial Spaceflight," https://www.astm.org/COMMITTEE/F47.htm.

[25] Jane Kinney, Director of Business Operations, Commercial Spaceflight Federation, and Recording Secretary, ASTM Committee F47, email to CRS, September 23, 2018. See also the list of subcommittees and standards of Committee F47, at https://www.astm.org/COMMIT/SUBCOMMIT/F47.htm.

- Indicators of industry's readiness: the purpose for which people fly in space, the size and complexity of the industry, the safety of the industry.
- Indicators of industry's progress in developing a safety framework: voluntary safety reporting, voluntary consensus standards, compliance.
- Indicators of the FAA's readiness: authority to make the transition, expertise in human spaceflight safety.[26]

As of September 2018, the congressionally mandated transition plan was still in development.[27]

Proposed Reforms and Organizational Changes

In Space Policy Directive–2, issued in May 2018, President Trump directed the Department of Transportation to review the regulations that govern licensing of commercial launch and reentry. By February 1, 2019, the department is to rescind or revise those regulations or publish a proposed rule rescinding or revising them. Among the changes that SPD-2 directs the department to consider are requiring a single license for all types of commercial launch and reentry vehicle operations and moving from a prescriptive approach to launch and reentry licensing to a performance-based approach.[28] Some industry stakeholders have criticized the fast pace of this effort and the perceived lack of industry engagement.[29]

Like SPD-2, the Space Frontier Act of 2018 (S. 3277) would direct the department to issue a notice of proposed rulemaking by February 1, 2019, to reform the commercial space launch regulatory regime. It would also elevate the head of AST to the rank of Assistant Secretary and express the sense of Congress that "in the absence of comprehensive regulatory reform, the Secretary of Transportation should make use of existing authorities … to protect the public, make more efficient use of resources, and reduce the regulatory burden."

Some industry stakeholders have suggested moving AST to the Office of the Secretary of Transportation (where it was from its establishment in 1984 until its move to the FAA in 1995). A 2017 GAO study of this proposal found that the Secretary could make this change administratively, without legislation;[30] that industry representatives were generally in favor, while FAA officials were generally opposed; and that there would be potential advantages and disadvantages in three areas:

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[26] Federal Aviation Administration, *Report to Congress: FAA Evaluation of Commercial Human Space Flight Safety Frameworks and Key Industry Indicators*, October 2017, https://www.faa.gov/about/plans_reports/congress/media/CSLCA_Sec111_Report_to_Congress.pdf.

[27] FAA/AST email to CRS, September 21, 2018.

[28] SPD-2 (see footnote 2), Section 2.

[29] See, for example, Jeff Foust, "Industry Concerned About Fast Pace of Commercial Launch Regulatory Reform," *Space News*, November 1, 2018, https://spacenews.com/industry-concerned-about-fast-pace-of-commercial-launch-regulatory-reform/.

[30] For more information on authorities for initiating and implementing agency reorganizations, see CRS Report R44909, *Executive Branch Reorganization*, by (name redacted). If the Secretary were to seek to make the proposed change through a reprogramming of appropriations, certain statutory restrictions might apply. The Consolidated Appropriations Act, 2018 (P.L. 115-141) states that "Except as otherwise provided in this Act, none of the funds provided in this Act … shall be available for obligation or expenditure through a reprogramming of funds that … creates, reorganizes, or restructures a branch, division, office, bureau, board, commission, agency, administration, or department … unless prior approval is received from the House and Senate Committees on Appropriations" (Division L, Title IV, Section 405). This provision for FY2018 presumably remains in effect under a continuing resolution for FY2019.

- Moving AST might help to give industry a unified point of contact for commercial space issues, but it might make coordination with other FAA offices more difficult.
- Moving AST might or might not help to accelerate the pace of commercial space regulatory reform. Stakeholders interviewed by GAO had differing views on this point.
- Moving AST might give it a higher profile and more resources, but this prospect is uncertain.

The GAO study also recommended identifying the goals, costs, and benefits of such a reorganization before undertaking it.[31]

Department of Commerce

The Department of Commerce has multiple roles with respect to commercial space. The Commercial Remote Sensing Regulatory Affairs Office regulates and licenses space-based commercial remote sensing. The Office of Space Commerce promotes the commercial space industry and facilitates the industry's interactions with the U.S. government and foreign countries. The Bureau of Industry and Security administers export controls for space technologies on the Commerce Control List.

Licensing Commercial Remote Sensing

Under Title II of the Land Remote Sensing Policy Act of 1992 (P.L. 102-555), as amended, operation of a "private remote sensing space system," such as a satellite that takes imagery of Earth from orbit, requires a license from the Department of Commerce.[32] This authority is executed by NOAA's Commercial Remote Sensing Regulatory Affairs Office (CRSRA).[33] The Advisory Committee on Commercial Remote Sensing (ACCRES), established in 2002, provides related information, advice, and recommendations.[34]

As of June 2018, CRSRA had issued 119 licenses to operate more than a thousand imaging satellites.[35] As required by 15 C.F.R. §960.5(b), public summaries of current commercial remote sensing licenses are posted on the CRSRA website.[36] Some of these licenses are for individual satellites. Others are for constellations of hundreds of satellites. Many of the licenses are for cubesats or other small satellites.[37] A majority of the licensees are corporations, but many are colleges and universities.

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[31] Government Accountability Office, *Federal Aviation Administration: Stakeholders' Perspectives on Potentially Moving the Office of Commercial Space Transportation*, GAO-18-96, October 2017, https://www.gao.gov/products/GAO-18-96.

[32] See 51 U.S.C. §60121 et seq. and associated regulations at 15 C.F.R. Part 960.

[33] The CRSRA website is https://www.nesdis.noaa.gov/CRSRA/.

[34] The ACCRES website is https://www.nesdis.noaa.gov/CRSRA/accresHome.html.

[35] Department of Commerce, National Oceanic and Atmospheric Administration, "Licensing Private Remote Sensing Systems," 83 *Federal Register* 30592, June 29, 2018, at p. 30593.

[36] See https://www.nesdis.noaa.gov/CRSRA/licenseHome.html, under the heading "NOAA Licensees."

[37] Cubesats are small satellites built in a standard format of one, two, three, or six cubical units, each unit being 10 centimeters on a side. See National Aeronautics and Space Administration, "CubeSats Overview," https://www.nasa.gov/mission_pages/cubesats/overview.

In issuing commercial remote sensing licenses, CRSRA is required by law to consult with "other appropriate United States Government agencies" to ensure that any national security or foreign policy concerns are addressed and to ensure compliance with international obligations.[38] Procedures for this consultation process are described in a February 2000 memorandum of understanding among the intelligence community and the Departments of Commerce, State, Defense, and the Interior.[39] Some in the commercial remote sensing industry have long-standing concerns that the process is time-consuming, burdensome, and nontransparent. In the 115th Congress, both the American Space Commerce Free Enterprise Act (H.R. 2809) and the Space Frontier Act of 2018 (S. 3277) include provisions to strengthen the authority of the Secretary of Commerce, provide more clarity to license applicants whose applications are not approved, and limit the duration of the consultation process.

SPD-2 mandated a Commerce Department review of the licensing regime for commercial remote sensing.[40] In June 2018, the department published an advance notice of proposed rulemaking seeking public comment on remote sensing regulatory reform.[41] The notice identified five topics for comment:

- the circumstances in which a commercial remote sensing license is required;
- the license application and review processes;
- processes for implementing and enforcing license conditions;
- compliance and enforcement; and
- integration with other commercial space licensing and regulatory regimes.

Office of Space Commerce

Under the authority of 51 U.S. §50702, the Commerce Department's Office of Space Commerce is the department's "principal unit for the coordination of space-related issues, programs, and initiatives."[42] Its functions are not regulatory. Rather, its director is charged with the following:

> (1) promoting commercial provider investment in space activities by collecting, analyzing, and disseminating information on space markets, and conducting workshops and seminars to increase awareness of commercial space opportunities;
>
> (2) assisting United States commercial providers in the efforts of those providers to conduct business with the United States Government;
>
> (3) acting as an industry advocate within the executive branch of the Federal Government to ensure that the Federal Government meets the space-related requirements of the Federal Government, to the fullest extent feasible, using commercially available space goods and services;

[38] 51 U.S.C. §60121(a)(1).

[39] See Executive Office of the President, Office of Science and Technology Policy and National Security Council, *Fact Sheet Regarding the Memorandum of Understanding Concerning the Licensing of Private Remote Sensing Satellite Systems*, February 2, 2000, reproduced as Appendix 2 to 15 C.F.R. Part 960.

[40] SPD-2 (see footnote 2), Section 3.

[41] Department of Commerce, National Oceanic and Atmospheric Administration, "Licensing Private Remote Sensing Systems," 83 *Federal Register* 30592, June 29, 2018.

[42] The Office of Space Commerce website is https://www.space.commerce.gov/.

> (4) ensuring that the United States Government does not compete with United States commercial providers in the provision of space hardware and services otherwise available from United States commercial providers;
>
> (5) promoting the export of space-related goods and services;
>
> (6) representing the Department of Commerce in the development of United States policies and in negotiations with foreign countries to ensure free and fair trade internationally in the area of space commerce; and
>
> (7) seeking the removal of legal, policy, and institutional impediments to space commerce.[43]

This statutory authority derives from the Technology Administration Act of 1998 (P.L. 105-309), but the office was established 10 years earlier under the department's administrative authorities. Since 2005, the Office of Space Commerce has been part of NOAA. From 1988 to 1996, it was in the Office of the Secretary. From 1996 to 2005, it was part of the department's Technology Administration.[44]

Export Controls[45]

The Commerce Department's Bureau of Industry and Security administers export licensing under the Export Control Reform Act of 2018 (P.L. 115-232, Title XVII, Subtitle B) via the Export Administration Regulations.[46] The list of items subject to these regulations is known as the Commerce Control List.[47] The Commerce Control List includes, among others, categories for Spacecraft and Related Commodities (9A515) as well as Commodities Related to Launch Vehicles, Missiles, and Rockets (9A604).

The Department of State administers a separate export licensing regime under the Arms Export Control Act of 1976 (P.L. 90-629), as amended, via the International Traffic in Arms Regulations (ITAR).[48] The list of items subject to ITAR is known as the U.S. Munitions List.[49] Commercial communications satellites were initially subject to ITAR. They were transferred to the Commerce Control List in 1996, then back to the U.S. Munitions List in 1999. Following industry complaints about licensing delays and lost sales,[50] they were returned to the Commerce Control List in 2017. While the vast majority of commercial spacecraft and components now fall under the Export Administration Regulations, some space technologies remain subject to ITAR (see, especially, Category XV, Spacecraft and Related Vehicles).

[43] 51 U.S.C. §50702(d).

[44] See Office of Space Commerce, "Legal and Departmental Authorities of the Office of Space Commerce, https://www.space.commerce.gov/law/office-of-space-commercialization/.

[45] For more information on the U.S. export control system, see CRS Report R41916, *The U.S. Export Control System and the Export Control Reform Initiative*, by (name redacted) and (name redacted)

[46] 15 C.F.R. Chapter VII, Subchapter C. The Export Control Reform Act of 2018 replaced previous authorities under the Export Administration Act of 1979 (P.L. 96-72), as amended.

[47] 15 C.F.R. Part 774.

[48] 22 C.F.R. Chapter I, Subchapter M.

[49] 22 C.F.R. §121.1.

[50] See, for example, Space Foundation, *ITAR and the U.S. Space Industry*, 2008, https://www.spacefoundation.org/sites/default/files/white-papers/SpaceFoundation_ITAR_0.pdf.

The Office of Space Commerce and the FAA AST jointly publish a plain-language guidebook, *Introduction to U.S. Export Controls for the Commercial Space Industry*.[51]

SPD-2 directed the National Space Council to review export licensing regulations affecting commercial space activity and present recommendations to the President.[52]

Proposed Reorganization

SPD-2 directed the Department of Commerce to consolidate its commercial space regulatory responsibilities within the Office of the Secretary.[53] In May 2018, the Secretary announced plans to establish a new office known as the Space Policy Advancing Commercial Enterprise (SPACE) Administration.[54] Under the proposal, some current offices, including CRSRA and the Office of Space Commerce, would relocate into the new SPACE Administration, while others, including the Bureau of Industry and Security, would liaise with it. The department asked Congress for permission to move CRSRA and the Office of Space Commerce from NOAA to the Office of the Secretary, with no changes in funding or scope, under the authority of a reprogramming of its FY2018 appropriations; this reprogramming request was not accepted.[55]

In October 2018, the department transmitted a legislative proposal to Congress that would change the name of the Office of Space Commerce to the Bureau of Space Commerce; elevate the director of the office to be the Assistant Secretary for Space Commerce; and direct the bureau to oversee the department's promotion, coordination, and regulation of commercial space activities. The proposal would not explicitly place the bureau in the Office of the Secretary rather than NOAA, but it specifies that the new Assistant Secretary would report directly to the Secretary of Commerce. Similarly, the proposal would not explicitly transfer CRSRA to the new bureau, but it would direct the Secretary to act through the bureau when issuing commercial remote sensing regulations.[56]

Federal Communications Commission

Commercial satellites that communicate using radio frequencies—which in practice means all of them—must obtain a license from the Federal Communications Commission (FCC). Unlike the FAA and NOAA licensing authorities discussed above, which are specific to commercial spaceflight, the FCC's statutory authority to license commercial satellite communications derives from its broad authority under the Communications Act of 1934, as amended, to license radio use

[51] Department of Commerce and Federal Aviation Administration, *Introduction to U.S. Export Controls for the Commercial Space Industry*, 2nd edition, November 2017, https://www.space.commerce.gov/wp-content/uploads/2017-export-controls-guidebook.pdf.

[52] SPD-2 (see footnote 2), Section 6. For more on the National Space Council, see below under "Other Agencies."

[53] SPD-2 (see footnote 2), Section 4.

[54] Department of Commerce, "Secretary Ross Praises President Trump's Signing of Space Policy Directive–2," press release, May 24, 2018, https://www.commerce.gov/news/press-releases/2018/05/secretary-ross-praises-president-trumps-signing-space-policy-directive-2.

[55] Email from the Office of Space Commerce to CRS, October 23, 2018. The Consolidated Appropriations Act, 2018 (P.L. 115-141) requires that "None of the funds provided under this Act … shall be available for obligation or expenditure through a reprogramming of funds that … reorganizes or renames offices, programs or activities … unless the House and Senate Committees on Appropriations are notified 15 days in advance of such reprogramming of funds." (Division B, Title V, Section 505)

[56] Legislative proposal by the Department of Commerce, October 15, 2018, provided to CRS by the Office of Space Commerce, October 23, 2018.

in general,[57] as well as to implement requirements of the International Telecommunications Union (ITU) Radio Regulations.[58] In effect, the FCC considers satellites to be radio stations in space.[59] It determines which radio frequencies they can use and whether particular frequency bands should be reserved for satellites or shared with other applications.[60]

Because the FCC's mandate is to issue licenses "if public convenience, interest, or necessity will be served thereby,"[61] FCC licensing procedures for satellites sometimes go beyond the direct regulation of radio frequency use. For example, it coordinates with the ITU when assigning orbital slots for geosynchronous satellites,[62] and it drew attention in early 2018 after denying a license for a commercial satellite on the grounds that the satellite was too small to be reliably tracked from the ground by the Department of Defense.[63] See also the section below on "Mitigating Orbital Debris" for the FCC's role in debris mitigation.

Most U.S. commercial satellites are licensed by the Satellite Division of the FCC International Bureau under the regulatory procedures of 47 C.F.R. Part 25.[64] As of September 2018, the FCC website listed 200 licenses granted under this authority.[65] The Satellite Division also grants permission for U.S. market access to commercial satellites licensed by other countries.[66] In some cases, a commercial satellite that is experimental or developmental in nature may instead be licensed by the FCC Office of Engineering and Technology under the regulatory procedures of 47 C.F.R. Part 5.[67]

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[57] See 47 U.S.C. §152(a), which states: "The provisions of this chapter shall apply to all interstate and foreign communication by wire or radio and all interstate and foreign transmission of energy by radio, which originates and/or is received within the United States, and to all persons engaged within the United States in such communication or such transmission of energy by radio, and to the licensing and regulating of all radio stations as hereinafter provided…."

[58] The ITU is an agency of the United Nations. Its Radio Regulations are binding under a 1992 treaty, the Constitution and Convention of the International Telecommunications Union. See 47 U.S.C. §303(r) for the FCC's authority to implement treaties and their annexed regulations.

[59] Indeed, it refers to them as "space stations," a term that in other contexts would usually mean a spacecraft intended for long-term human occupation, such as the International Space Station. The FCC's definition of *space station* in 47 C.F.R. §25.103 is "a [radio] station located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere."

[60] For example, a controversial FCC decision in July 2016 allowed shared use of the 28 GHz frequency band, previously reserved for satellites, for terrestrial mobile services. See Federal Communications Commission, *Report and Order and Further Notice of Proposed Rulemaking*, July 14, 2016, https://docs.fcc.gov/public/attachments/FCC-16-89A1.pdf.

[61] 47 U.S.C. §307(a).

[62] Geosynchronous or geostationary satellites orbit above the equator at an altitude of 22,236 miles. This means that they orbit at exactly the same rate as the Earth is rotating, so that they appear to remain fixed over a stationary point in the ground. After allowing enough spacing to prevent radio interference and other issues, there are a limited number of positions—known as slots—for satellites in these orbits.

[63] See, for example, Caleb Henry, "FCC Issues Warning in Wake of Swarm's Unauthorized Launch," *Space News*, April 13, 2018, https://spacenews.com/fcc-issues-warning-in-wake-of-swarms-unauthorized-launch/. For the FCC's denial of the license application, see Anthony Serafini, Chief, Experimental Licensing Branch, Federal Communications Commission, letter to Sara Spangelo, Swarm Technologies, Inc., December 12, 2017, https://apps.fcc.gov/els/GetAtt.html?id=203152&x=.

[64] The website of the Satellite Division is https://www.fcc.gov/general/international-bureau-satellite-division.

[65] See https://www.fcc.gov/approved-space-station-list. The number of licenses is not the same as the number of licensed satellites. Some licenses are for multiple similar satellites—in a few cases, hundreds of them. Some licenses are for satellites that have not yet been launched.

[66] See 47 C.F.R. §25.137.

[67] The website of the Office of Engineering and Technology is https://www.fcc.gov/engineering-%26-technology. For the scope of activities permitted under an experimental license, see 47 C.F.R. §5.3.

In May 2018, the FCC published a notice of proposed rulemaking that would streamline the licensing process for small satellites, which make up a growing share of all satellites launched.[68] The proposed rule would establish a new license application category. The stated intent is to reduce the burden on applicants submitting applications and the staff time required to process applications, commensurate with the short mission lifetime of many small satellites. Some school and college researchers have criticized the proposal, because it appears to place small educational satellites in the new category along with small commercial satellites (under an amended 47 C.F.R. Part 25). Small educational satellites are currently in the experimental category (under 47 C.F.R. Part 5). Moving between these categories could significantly increase the license fees that schools and colleges would have to pay.[69]

Space Policy Directive–2 directed the Secretary of Commerce and the Director of the Office of Science and Technology Policy, in consultation with the Chairman of the FCC and other officials, to provide a report to the President on "improving the global competitiveness of the United States space sector through radio frequency spectrum policies, regulation, and United States activities at the International Telecommunication Union and other multilateral forums."[70]

Department of State

Multiple offices in the Department of State have roles in commercial space policy. Each of them also has other responsibilities, not discussed here.

The Office of Space and Advanced Technology (SAT) in the Bureau of Oceans and International Environmental and Scientific Affairs (OES) is the primary State Department office for commercial space policy, including representing the United States in consultations with other countries and international organizations. OES/SAT also executes the department's responsibility under 51 U.S.C. §50918(b) to consult with FAA/AST on any aspects of commercial space launch and reentry licensing that affect foreign policy.[71]

The responsibilities of the Office of International Communications and Information Policy (CIP) in the Bureau of Economic and Business Affairs (EB) include policies relating to communications satellites. This office also advocates overseas for U.S. commercial business interests in the area of telecommunications, including communications satellites, although it does not advocate for specific companies.[72]

The Office of Commercial and Business Affairs (CBA) in the Bureau of Economic and Business Affairs advocates overseas for specific individual U.S. companies, including space-related companies.[73]

[68] Federal Communications Commission, "Streamlining Licensing Procedures for Small Satellites," 83 *Federal Register* 24064, May 24, 2018.

[69] See, for example, Jeremy Straub, "New Federal Policy Would Hike Student Spacecraft Costs, Threatening Technology Education," *The Conversation*, May 29, 2018, https://theconversation.com/new-federal-policy-would-hike-student-spacecraft-costs-threatening-technology-education-96388.

[70] SPD-2 (see footnote 2), Section 5.

[71] The OES/SAT website is https://www.state.gov/e/oes/sat/.

[72] The EB/CIP website is https://www.state.gov/e/eb/cip/.

[73] The EB/CBA website is https://www.state.gov/e/eb/cba/.

As noted above in the section on "Export Controls," the Department of State has a role in controlling the export of certain commercial space technologies. This function is executed by the Directorate of Defense Trade Controls (DDTC) in the Bureau of Political-Military Affairs (PM).[74]

The Office of Conventional Arms Threat Reduction (CATR) in the Bureau of International Security and Nonproliferation (ISN) leads State Department policy on commercial remote sensing. Its responsibilities include advising PM/DDTC on export license applications for commercial remote sensing satellites and executing the department's responsibility under 51 U.S.C. §60121(a)(1) to consult with the Department of Commerce on applications for commercial remote sensing licenses.[75]

Other Agencies

In addition to the agencies already discussed, numerous others also have roles in regulating, overseeing, and promoting the commercial space industry. Although NASA and DOD are not regulatory agencies, they lease facilities to several commercial spaceports and provide related services such as range safety. The U.S. Coast Guard notifies mariners of planned commercial launches and reentries over water so that they can stay safely clear. The National Telecommunications and Information Administration, which administers radio spectrum for federal use, works closely with the FCC on satellite radio frequency allocation. As already noted, the intelligence community, DOD, and the Department of the Interior consult with NOAA on commercial remote sensing licensing.

Commercial space companies are also subject to a host of regulatory requirements that are not space-specific. Some of these may be familiar, such as financial regulations for corporations or regulations for environmental protection or occupational health and safety. Others may be less apparent. For example, sonic booms during the return to Earth of SpaceX's reusable Falcon 9 rockets are regulated by the National Marine Fisheries Service, as they could potentially cause harassment of marine mammals.[76]

Because space policy involves so many agencies, the National Space Council was established in 1989 "to provide a coordinated process for developing a national space policy and strategy and for monitoring its implementation."[77] It is chaired by the Vice President and includes the Secretaries of State, Defense, Commerce, Transportation, and Homeland Security; the NASA Administrator; the Director of the Office of Management and Budget; the Director of the Office of Science and Technology Policy; and other senior officials. After a long period of inactivity, the council was reestablished in June 2017.[78] It met for the first time in nearly 25 years in October 2017.

[74] The PM/DDTC website is https://www.pmddtc.state.gov/.

[75] See the discussion of interagency consultation above under "Licensing Commercial Remote Sensing." The ISN/CATR website is https://www.state.gov/t/isn/offices/catr/index.htm.

[76] See, for example, Department of Commerce, National Oceanic and Atmospheric Administration, "Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Boost-Back and Landing of Falcon 9 Rockets," 82 *Federal Register* 60954, December 26, 2017.

[77] Executive Order 12675, *Establishing the National Space Council*, April 20, 1989, https://www.presidency.ucsb.edu/documents/executive-order-12675-establishing-the-national-space-council.

[78] Executive Order 13803, *Reviving the National Space Council*, June 30, 2017, https://www.presidency.ucsb.edu/documents/executive-order-13803-reviving-the-national-space-council.

Mitigating Orbital Debris[79]

Debris in Earth orbit poses a serious risk to both commercial and government spaceflight. Orbital debris includes defunct satellites, used rocket stages, fragments from broken or exploded satellites and rockets, and miscellaneous other man-made objects—even tools and other items that astronauts have dropped during spacewalks. The Space Surveillance Network (operated by DOD) routinely tracks orbital debris larger than about 10 centimeters in diameter. According to the NASA Orbital Debris Program Office, there are more than 21,000 orbital debris objects of that size and approximately 500,000 more that are smaller than 10 centimeters but larger than 1 centimeter.[80] Because the speed of objects in orbit is thousands of miles per hour, a collision with something as tiny as 0.2 millimeters can be a threat, and a collision with a larger object can be devastating.[81]

In 1997, an interagency working group developed the U.S. Government Orbital Debris Mitigation Standard Practices (USGODMSP).[82] The document establishes four principles, paraphrased by the Office of Science and Technology Policy as follows:[83]

1. Minimize or eliminate the debris released during normal operations.
2. Minimize accidental explosions.
3. Minimize opportunities for collisions.
4. Dispose of spacecraft and launch vehicle components at the end of mission life.

Federal agencies that acquire or operate spacecraft apply the USGODMSP principles directly. For the commercial space sector, the principles are implemented through the licensing practices of three agencies. NOAA licensing requirements for commercial remote sensing satellites include agency approval of plans and procedures for end-of-life disposal (principle 4).[84] FCC licensing requirements for commercial satellites that communicate—in effect, all satellites—include all four principles.[85] FAA licensing requirements for commercial launch operators include preventing accidental explosions of launch vehicles stages or components that reach orbit (principle 2).[86] The FAA has initiated a rulemaking that would incorporate the remaining USGODMSP principles into its regulatory requirements for launch vehicles; it anticipates publishing a formal notice of proposed rulemaking in May 2019.[87]

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[79] For more information on orbital debris mitigation, from the perspective of national security space rather than commercial space, see CRS Report R43353, *Threats to U.S. National Security Interests in Space: Orbital Debris Mitigation and Removal*, by (name redacted) and (name redacted) .

[80] National Aeronautics and Space Administration, Orbital Debris Program Office, "Frequently Asked Questions," https://www.orbitaldebris.jsc.nasa.gov/faq.html.

[81] Ted Wackler, Acting Director, Office of Science and Technology Policy, letter to Members of Congress in response to Section 839(b)(2) of the NASA Transition Authorization Act of 2017 (P.L. 115-10), August 14, 2017, https://www.whitehouse.gov/wp-content/uploads/2017/12/08-14-17-OSTP-Orbital-Debris-Report.pdf.

[82] U.S. Government Orbital Debris Mitigation Standard Practices, https://www.orbitaldebris.jsc.nasa.gov/library/USG_OD_Standard_Practices.pdf.

[83] See footnote 81.

[84] 15 C.F.R. §960.11(a)(12). See also 15 C.F.R. Part 960 Appendix 1 §V(C).

[85] 47 C.F.R. §5.64(b) and 47 C.F.R. §25.114(d)(14).

[86] 14 C.F.R. §417.129.

[87] Department of Transportation, *Report on DOT Significant Rulemakings*, September 2018, https://www.transportation.gov/sites/dot.gov/files/docs/regulations/322441/sept-2018-significant-rulemaking-report.doc, item 14.

In June 2018, the President issued Space Policy Directive–3 (SPD-3), which directs NASA, in coordination with other agencies, to update the USGODMSP. In addition, whereas the focus of past policy has been on preventing the release of new debris, SPD-3 states that the United States should also pursue active debris removal as a necessary long-term approach.[88]

Space Situational Awareness and Space Traffic Management

Closely related to orbital debris mitigation is the challenge of monitoring the orbits and characteristics of operational satellites and debris that already exist (known as space situational awareness, SSA) and potentially, based on SSA data and analysis, providing direction to satellite operators to avoid projected collisions (known as space traffic management, STM).

SSA data are currently collected and compiled by the DOD Joint Space Operations Center (JSpOC), a unit of U.S. Strategic Command (USSTRATCOM), which models orbits to project potential collisions or close approaches. Because collisions in orbit create large numbers of additional debris objects, DOD has an interest in preventing collisions even when they do not involve DOD or other U.S. government satellites. Under 10 U.S.C. §2274, DOD is authorized to provide SSA services and information to non-U.S. government entities, including U.S. and foreign commercial entities.

As commercial activities in space grow, some observers may find it inappropriate that DOD is the agency responsible for a safety service that is important for commercial satellite operations. Section 110 of the CSCLA laid out a new course: Congress directed the Secretary of Transportation to study the feasibility of taking on responsibility for processing and releasing safety-related SSA data. The resulting report, issued in April 2016, noted that about 70% of close approaches involving active satellites in orbit involve commercial systems, and that supporting commercial, civil, and foreign satellite operators is "not necessarily an inherently military mission."[89] It concluded:

> It is feasible for a civil agency, specifically the Department of Transportation (DOT) acting through the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, to release safety-related SSA data and information on tracked objects.…

In contrast, SPD-3 identifies the Department of Commerce, not the FAA, as the civil agency for public release of DOD SSA data. It directs the Departments of Commerce and Defense to develop a plan for providing basic SSA data and basic STM services (including notifications of projected close approaches, known as conjunctions) either directly or through a partnership with industry or academia. For STM more broadly—which some stakeholders envision as becoming a prescriptive function somewhat analogous to air traffic control—SPD-3 would limit the federal role to supporting the development of standards and best practices.[90]

Like SPD-3, the American Space Situational Awareness and Framework for Entity Management Act (American Space SAFE Management Act, H.R. 6226) identifies the Department of Commerce as the lead civil agency for SSA. It would direct the Secretary of Commerce to establish a civil program providing SSA services and information "as good as or better than" the current program operated by DOD under 10 U.S.C. §2274. It would also direct the Secretary to

[88] President Donald J. Trump, *National Space Traffic Management Policy*, Space Policy Directive–3, June 18, 2018, https://www.whitehouse.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

[89] Department of Transportation, *Report on Processing and Releasing Safety-Related Space Situational Awareness Data*, April 2016.

[90] President Donald J. Trump, *National Space Traffic Management Policy*, Space Policy Directive–3, June 18, 2018, https://www.whitehouse.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

promote the development of voluntary civil space traffic coordination guidelines, practices, and standards; use those guidelines, practices, and standards as the basic for a civil space traffic coordination pilot program; and report biennially on next steps for STM, including the state of both voluntary and legally binding developments domestically and internationally.

Section 1604 of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (P.L. 115-232, enacted in August 2018) amended DOD's SSA authority under 10 U.S.C. §2274. Starting in 2024, DOD will only be authorized to provide SSA data and services to commercial space companies and other non-U.S. government entities if the Secretary of Defense determines that doing so is necessary to meet U.S. national security interests. The act also directs the President to submit a plan to Congress for a federal department or agency other than DOD to provide SSA services and information to non-U.S. government entities.

Authorization and Supervision Under the Outer Space Treaty

Under Article VI of the Outer Space Treaty, which forms the basis of international space law, "the activities of non-governmental entities in outer space … shall require authorization and continuing supervision by the appropriate State Party to the Treaty."[91] FAA, NOAA, and FCC regulation of commercial launch and reentry, remote sensing, and satellite communications, as described above, is generally considered to meet this requirement for commercial space activities under the jurisdictions of those agencies. There is congressional interest, though, in how other commercial activities in space, not subject to current FAA, NOAA, and FCC regulation, should be authorized and supervised. Such activities might include commercial activities on the Moon or Mars, commercial services such as satellite repair or on-orbit refueling, or commercial extraction of in-space resources such as water or minerals.

In April 2016, as directed by the CSCLA, the Office of Science and Technology Policy proposed giving the FAA an additional responsibility of "mission authorization" for commercial space activities not already covered by FAA, NOAA, or FCC regulations.[92] Some Members of Congress and other stakeholders advocate a more hands-off approach. In March 2017, the House Committee on Science, Space, and Technology held a hearing at which some witnesses argued that compliance with the treaty provision does not require congressional action.[93]

The American Space Commerce Free Enterprise Act (H.R. 2809) would find that existing mechanisms "satisfy and are in conformity with" U.S. treaty obligations to authorize and supervise nongovernmental space activities, but that current mechanisms "could be improved to relieve administrative burdens." The bill would charge the Secretary of Commerce, acting through the Office of Space Commerce, with issuing "certifications for the operation of a space object"; such a certification would not be required, however, for entities already holding an FAA payload approval for launch or reentry.[94] The Space Frontier Act of 2018 (S. 3277) would allow

[91] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, ratified 1967, https://www.state.gov/t/isn/5181.htm, Article VI.

[92] John P. Holdren, Director, Office of Science and Technology Policy, letter to Members of Congress in response to Section 108 of the Commercial Space Launch Competitiveness Act (P.L. 114-90), April 4, 2016.

[93] House Committee on Science, Space, and Technology, Subcommittee on Space, *Regulating Space: Innovation, Liberty, and International* Obligations, hearing March 28, 2017, https://science.house.gov/legislation/hearings/space-subcommittee-hearing-regulating-space-innovation-liberty-and. For a summary of the discussion, see Marcia Smith, "Should Commercial Space Activities Be Permissionless?" *SpacePolicyOnline*, March 14, 2017, https://spacepolicyonline.com/news/should-commercial-space-activities-be-permissionless/.

[94] Although the FAA licenses launch and reentry, not payloads, it reviews payloads prior to launch as part of the launch licensing process. See 14 C.F.R. Part 415, Subpart D.

the FAA to use AST's current payload review process "to authorize nongovernmental space activities that are related to an application for a [launch or reentry] license or permit and are not subject to authorization under other Federal law." The Commerce Department's October 2018 legislative proposal would charge the new Assistant Secretary for Space Commerce with "developing procedures for authorizing and supervising, as appropriate, commercial space activities not already authorized and supervised through other Federal authorities."[95]

Federal Utilization

As well as regulating, overseeing, and promoting the commercial space industry, the federal government is a customer, acquiring commercial services. In taking this approach, agencies may hope to increase efficiency and reduce cost in their own programs, while helping to develop an industry that could contribute to broader national objectives. This section of the report discusses commercial resupply of the International Space Station, commercial launch of government satellites, commercial acquisition of satellite communications and data from space-based remote sensing, the potential government use of future in-space services such as satellite repair and refueling, and new commercial initiatives being proposed by NASA. The section ends with a discussion of factors that Congress and the Administration may consider when deciding whether agencies should conduct space activities themselves or acquire them commercially.

Commercial Resupply of the International Space Station

NASA used to rely on the space shuttle to carry U.S. cargo and crews to and from the International Space Station (ISS). The shuttle fleet was retired in July 2011. Since then, ISS cargo has been carried by Russian, European, and Japanese spacecraft and, starting in 2012, by two U.S. commercial providers—Space Exploration Technologies (SpaceX) and Northrop Grumman Innovation Systems (formerly Orbital ATK)—under NASA contracts. In 2016, NASA awarded a contract to Sierra Nevada Corporation as a third commercial provider for ISS cargo missions starting in 2020.

Since the end of the space shuttle program, crews have been transported to and from the ISS by Russian *Soyuz* spacecraft, at a cost of up to $82 million per seat. NASA has contracts with two U.S. companies—SpaceX and Boeing—to transport ISS astronauts. Both companies plan crewed demonstration flights in 2019. An analysis by GAO in July 2018 projected that operational crewed flights will start in late 2019 or 2020.[96]

Past congressional debates about these activities illustrate some issues that may arise for other agency programs seeking to use commercial space capabilities. First is the potential for competition. In the early debate over whether NASA should take a commercial approach to ISS resupply, advocates argued that competition between providers had the potential to reduce costs and drive innovation, while opponents expressed doubt that the demand would support enough providers to ensure effective competition. During the period when NASA was funding potential providers to help develop their capabilities, some in Congress saw funding multiple providers as necessary to enable future cost savings through competition, while others saw it as adding to NASA's costs in the near term.

[95] Legislative proposal by the Department of Commerce, October 15, 2018, provided to CRS by the Office of Space Commerce, October 23, 2018.

[96] Government Accountability Office, *NASA Commercial Crew Program: Plan Needed to Ensure Uninterrupted Access to the International Space Station*, GAO-18-476, July 11, 2018, https://www.gao.gov/products/GAO-18-476.

Second, taking a commercial approach may require agencies to use less familiar contracting models. The traditional model has been for an agency to pay a contractor to develop and supply a spacecraft, which the agency then owns and operates. Typically this model uses a cost-plus contract, that is, the agency reimburses the contractor's costs plus a performance-based fee. For the development phases of its commercial ISS cargo and crew programs, NASA initially used Space Act Agreements—a type of "other transaction"—with fixed payments for achieving certain milestones.[97] Other transactions can increase flexibility; can be funded partly, or in some cases entirely, by the company; and avoid accounting and other requirements that companies may see as expensive and cumbersome. On the other hand, they may limit an agency's ability to dictate specific system concepts or mandate compliance with agency requirements.[98] For procurement of actual ISS transportation services, NASA is using fixed-price contracts under the Federal Acquisition Regulation (FAR). While fixed-price contracts reduce an agency's financial risk (because the contractor takes on the risk of cost overruns) they may provide for less government insight into the contractor's management of the program.

Third, agencies using commercial space capabilities may face challenges in ensuring that their requirements will be met. NASA's processes for safety certification of ISS crew transportation providers illustrate these challenges. NASA's plans for certification have been a focus of attention for Congress, NASA's Aerospace Safety Advisory Panel, and other stakeholders. The July 2018 GAO analysis described a long list of key deliverables that contractors must provide to NASA to inform its certification review. The analysis noted "concerns about the program's ability to assess and evaluate all of the deliverables in a timely manner" and found that NASA's workload for certification was "an emerging schedule risk."[99]

Commercial Launch of Government Spacecraft

In February 1988, a presidential directive on national space policy required U.S. civil government agencies to "encourage, to the maximum extent feasible, a domestic commercial launch industry" by contracting with commercial launch providers to launch government satellites.[100] A similar statutory requirement was subsequently enacted by Section 201 of the Commercial Space Act of 1998 (P.L. 105-303):

> Except as otherwise provided … the Federal Government shall acquire space transportation services from United States commercial providers whenever such services are required in the course of its activities. To the maximum extent practicable, the Federal Government shall plan missions to accommodate the space transportation services capabilities of United States commercial providers.[101]

[97] Space Act Agreements are authorized by the National Aeronautics and Space Act of 1958 (51 U.S.C. 20113(e)). For more information, see CRS Report RL34760, *Other Transaction (OT) Authority*, by (name redacted) (out of print; available to congressional clients from the author of this report).

[98] See, for example, Paul Martin, Inspector General, National Aeronautics and Space Administration, *NASA's Commercial Crew Development Program*, testimony before the House Committee on Science, Space, and Technology, October 26, 2011, https://oig.nasa.gov/docs/IG_Statement_NASAs_CCDev_Program_10_26_2011.pdf.

[99] Government Accountability Office, *NASA Commercial Crew Program: Plan Needed to Ensure Uninterrupted Access to the International Space Station*, GAO-18-476, July 11, 2018, https://www.gao.gov/products/GAO-18-476, pp. 20-22.

[100] "Presidential Directive on National Space Policy," February 11, 1988, https://www.hq.nasa.gov/office/pao/History/policy88.html.

[101] 51 U.S.C. §50131(a).

NASA manages many commercial launches of NASA satellites and robotic interplanetary spacecraft, as well as NOAA weather satellites, through its Launch Services Program. The program uses a standardized contracting mechanism to provide access to space via multiple providers and types of rocket.[102]

The U.S. Air Force manages many commercial launches of national security satellites through its Evolved Expendable Launch Vehicle (EELV) program. From 2006 to 2015, the EELV program procured launches from a single provider, United Launch Alliance, via two families of rocket, the Atlas V and the Delta IV. SpaceX was certified as an additional provider in 2015. In October 2018, the Air Force announced other transaction awards to United Launch Alliance, Blue Origin, and Northrop Grumman Innovation Systems to support the development of new launch vehicles for future EELV program procurements.[103]

Although the Launch Services Program and the EELV program procure launch services from commercial providers, their launches are generally not licensed by the FAA as commercial launches. Typically, the agency procuring the launch is so substantially involved that it is considered to be effectively controlling and directing the launch, and launches "carried out by the United States Government on behalf of the United States Government" (14 C.F.R. §400.2) do not require a license. There are exceptions, however. For example, the launch of a satellite for the National Reconnaissance Office in May 2017, procured by the EELV program, was not considered to be controlled and directed by the government, so it was licensed as a commercial launch.[104]

Government Use of Data and Services from Commercial Satellites

To supplement their own capabilities, several agencies use—or are exploring opportunities to use—remote sensing data acquired by commercial satellites. The National Geospatial-Intelligence Agency acquires commercial imagery and other remote sensing data and analysis to supplement data provided by National Reconnaissance Office satellites.[105] The intelligence community, through its In-Q-Tel venture capital organization, has offered cash prizes for companies that develop automated methods to detect roads or other landmarks in high-resolution satellite imagery.[106] NASA has announced a pilot program to acquire Earth science data from constellations of small commercial satellites.[107] NOAA has a pilot program to acquire weather forecasting data from commercial satellites that measure the occultation of radio signals by Earth's atmosphere.[108]

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[102] For more information, see the Launch Services Program brochure, https://www.nasa.gov/centers/kennedy/pdf/678112main_LSP%20Brochure.pdf.

[103] U.S. Air Force, "Air Force Awards Three Launch Service Agreements," news release, October 10, 2018, https://www.af.mil/News/Article-Display/Article/1658765/air-force-awards-three-launch-service-agreements/.

[104] FAA/AST email to CRS, October 25, 2018.

[105] See National Geospatial-Intelligence Agency, *Commercial GEOINT Strategy, 2018 Update*, https://www.nga.mil/Partners/Pages/Commercial-GEOINT-Strategy.aspx. Both the National Geospatial-Intelligence Agency and the National Reconnaissance Office are DOD agencies.

[106] Debra Werner, "Artificial Intelligence Extends into Space," *Space News*, October 10, 2018, https://spacenews.com/artificial-intelligence-space-applications/. In-Q-Tel, established by the Central Intelligence Agency, invests strategically in startup companies to ensure that U.S. intelligence agencies have access to emerging technologies.

[107] National Aeronautics and Space Administration, *NASA Evaluates Commercial Small-Sat Earth Data for Science*, press release 18-086, October 4, 2018, https://www.nasa.gov/press-release/nasa-evaluates-commercial-small-sat-earth-data-for-science.

[108] Department of Commerce, Office of Space Commerce, "Commercial Weather Data Pilot,"

An issue that may arise for some agencies, particularly NASA and NOAA, is that when they acquire data using their own satellites, they may share it freely with the public, but if they acquire it commercially, the providers may want to limit its dissemination in order to allow subsequent sale to other customers.[109] This question was contentious, for example, when the Reagan Administration proposed to privatize NOAA's system of weather satellites. Under the Land Remote Sensing Policy Act of 1992 (P.L. 102-555), the commercialization of NOAA weather satellites is expressly prohibited.[110]

Agencies can also use services, such as communications, provided by commercial satellites. Most notably, DOD leases commercial satellite bandwidth. Historically it did this to augment its own capabilities, but it has become increasingly reliant on commercial satellite communications to support ongoing operations. A GAO study in 2015 found that in FY2011, DOD spent more than $1 billion leasing commercial bandwidth.[111] NASA, which has historically used its own systems to communicate with its satellites, recently announced plans to study the use of public-private partnerships for the next generation of space communications services.[112]

Government Use of Commercial In-Space Services

There may also be opportunities for commercial providers to offer in-space services to government agencies. At present, these services are nascent. They might include satellite servicing, such as repair or fuel replenishment;[113] on-orbit storage of propellant to supply satellite servicing ventures;[114] orbital debris removal;[115] or in-space extraction and supply of commodity products such as fuel, water, or oxygen. Section 502 of the NASA Authorization Act of 2018 (H.R. 5503, ordered to be reported by the House Committee on Science, Space, and Technology in April 2018) would direct NASA to acquire in-space services commercially "to the greatest extent practicable." Section 501 would similarly direct NASA to acquire and use "space products" to the greatest extent practicable.

Commercial Initiatives in NASA FY2019 Budget

NASA's FY2019 budget request, released in February 2018, proposed several new initiatives to increase NASA's use of commercial space capabilities. First, NASA proposed to end direct funding for the ISS by 2025 and rely on commercial partners for NASA's research and technology demonstration needs in low Earth orbit (LEO).[116] In March 2018, the agency

https://www.space.commerce.gov/business-with-noaa/commercial-weather-data-pilot-cwdp/.

[109] See, for example, Mariel Borowitz, "Op-Ed: Satellite Data and Cheeseburgers," *Space News*, August 8, 2018, https://spacenews.com/op-ed-satellite-data-and-cheeseburgers/.

[110] 51 U.S.C. §§60161-60162.

[111] Government Accountability Office, *Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements*, GAO-15-459, July 2015, https://www.gao.gov/assets/680/671484.pdf.

[112] Jeff Foust, "NASA to Study Use of Commercial Partnerships for Space Communications Services," *Space News*, August 22, 2018, https://spacenews.com/nasa-to-study-use-of-commercial-partnerships-for-space-communications-services/.

[113] See, for example, Kendall Russell, "Why the Market Is Ready for On-Orbit Satellite Servicing," *Via Satellite*, February 13, 2018, https://www.satellitetoday.com/innovation/2018/02/13/market-ready-orbit-satellite-servicing/.

[114] See, for example, Jeff Foust, "Startup Plans 'Gas Stations' for Satellite Servicing," *Space News*, August 28, 2018, https://spacenews.com/startup-plans-gas-stations-for-satellite-servicing/.

[115] See, for example, Jeff Foust, "Orbital Debris Removal Company Astroscale Raises $50 Million," *Space News*, October 31, 2018, https://spacenews.com/orbital-debris-removal-company-astroscale-raises-50-million/.

[116] See CRS In Focus IF10828, *The International Space Station (ISS) and the Administration's Proposal to End Direct*

published a plan for this transition, including more commercial planning and execution of ISS activities.[117] In the transition plan, NASA argued that its strategy would help to develop the commercial space industry and new commercial markets in space; reduce NASA's costs in LEO because resources would be shared with other commercial, government, and international users; and allow NASA to focus its resources on missions beyond LEO. The proposal drew a skeptical response from some Members of Congress and other stakeholders, however.[118] A July 2018 report by the NASA Inspector General concluded that NASA would have to consider other options:

> Based on our audit work, we question the viability of NASA's current plans, particularly with regard to the feasibility of fostering increased commercial activity in low Earth orbit on the timetable proposed. Specifically, we question whether a sufficient business case exists under which private companies will be able to develop a self-sustaining and profit-making business independent of significant Federal funding within the next 6 years.[119]

Nevertheless, in September 2018, NASA published a report on its National Space Exploration Campaign, in which it identified the transition to commercial operations in LEO as the campaign's first strategic goal:

> Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy.[120]

Second, NASA proposed a new Commercial LEO Development program to fund "commercial partner development of capabilities that the private sector and NASA can use," in part to support the agency's plans for the ISS transition. The proposed program's efforts would focus on "enabling, developing, and deploying commercial orbital platforms."[121]

Third, NASA proposed to fund a series of commercial lunar landers to conduct science and exploration on the Moon. In March 2018, it issued a request for information (RFI) seeking input from industry "to assess commercial interest in development of domestic lunar lander capabilities that would evolve … towards human-class landers."[122]

NASA Funding by 2025, by (name redacted)

[117] National Aeronautics and Space Administration, *International Space Station Transition Report*, March 30, 2018, https://www.nasa.gov/sites/default/files/atoms/files/iss_transition_report_180330.pdf.

[118] For example, on May 16, 2018, the Senate Committee on Commerce, Science, and Transportation, Subcommittee on Space, Science, and Competitiveness held a hearing on "Examining the Future of the International Space Station: Administration Perspectives." The opening statement of subcommittee chairman Sen. Ted Cruz stated: "Nowhere in federal statue is there a request from Congress seeking a hard deadline to end federal support for ISS, to cross our fingers and hope for the best." The opening statement of ranking member Sen. Bill Nelson stated: "It's pretty clear that the proposal to end funding for the ISS by 2025 was not a NASA decision—it was a political decision. As far as this committee is concerned, that proposal is dead on arrival."

[119] National Aeronautics and Space Administration, Office of Inspector General, *NASA's Management and Utilization of the International Space Station*, IG-18-021, July 30, 2018, https://oig.nasa.gov/docs/IG-18-021.pdf.

[120] National Aeronautics and Space Administration, *National Space Exploration Campaign Report*, September 2018, https://www.nasa.gov/sites/default/files/atoms/files/nationalspaceexplorationcampaign.pdf.

[121] National Aeronautics and Space Administration, FY2019 congressional budget justification, https://www.nasa.gov/sites/default/files/atoms/files/fy19_nasa_budget_estimates.pdf, p. LSO-76.

[122] National Aeronautics and Space Administration, *Lunar Surface Transportation Capability Request for Information*, solicitation NNH18-AES-LSTC-RFI, March 16, 2018, https://www.fbo.gov/index?id=c716b289ae9f6c82cea8b87d59966cd2.

Government Role or Commercial Role?

Not all agency space activities are equally appropriate for provision on a commercial basis. First, in federal procurement, there is the concept of *inherently governmental* functions.[123] The Federal Acquisition Regulation states that "contracts shall not be used for the performance of inherently governmental functions"; it provides numerous examples of functions that are or are not inherently governmental.[124] From time to time, Congress provides statutory guidance on this point. For example, the NASA Authorization Act of 2008 (P.L. 110-422) expressed the sense of Congress that:

> a healthy and robust commercial sector can make significant contributions to the successful conduct of NASA's space exploration program. While some activities are inherently governmental in nature, there are many other activities, such as routine supply of water, fuel, and other consumables to low Earth orbit or to destinations beyond low Earth orbit, and provision of power or communications services to lunar outposts, that potentially could be carried out effectively and efficiently by the commercial sector at some point in the future.[125]

In general, though, for activities that are not considered inherently governmental, agencies have considerable discretion in determining whether to conduct them in-house or procure them commercially. For space activities, some of the factors they might consider are:

- Is the activity operational or research-oriented?
- Does it require the application of existing, mature technology, or the development of new technology?
- How do the agency's in-house technical capabilities for a particular task compare to the technical capabilities of the private sector?
- If a company developed a new service or capability, would government demand be sufficient to make it profitable? Are there potential nongovernment customers?

For example, rather than developing new government-owned spacecraft to replace the space shuttle, NASA has chosen to use commercial launch services to carry cargo and crews to the ISS. This activity is operational, requires multiple launches per year, and employs launch vehicles that have numerous other customers. The technology is relatively mature, with commercial developments focused on reducing cost and improving reliability. Although launch to LEO remains technically challenging, NASA sometimes refers to it as "routine."[126]

In contrast, NASA has chosen to develop its own spacecraft for future human exploration beyond Earth orbit: the Orion Multipurpose Crew Vehicle and the Space Launch System (SLS). Each planned exploration mission will be unique. Humans have not travelled beyond Earth orbit since 1972. Launch beyond Earth orbit has, as yet, few identifiable commercial customers. NASA's

[123] For further information, see CRS Report R42325, *Definitions of "Inherently Governmental Function" in Federal Procurement Law and Guidance*, by (name redacted) (out of print; available to congressional clients from the author of this report).

[124] 48 C.F.R. §7.503.

[125] P.L. 110-422, Section 901.

[126] See, for example, National Aeronautics and Space Administration, *Human Exploration and Operations Exploration Objectives*, July 31, 2017, https://www.nasa.gov/sites/default/files/atoms/files/heomd-001-heomd-exploration-objectives-revision-a-cr-08032017.pdf, p. 16.

strategic plan states that using commercial transportation to LEO allows the agency to "expand its focus" on building Orion and the SLS for missions to deep space.[127]

Another example is the 1980s effort to commercialize the provision of medium-resolution satellite imagery under the Landsat program. Supporters argued that private-sector provision would eventually result in lower costs, but the commercial market for Landsat data turned out to be less robust than they had anticipated. Eventually, the argument that Landsat data were a public good prevailed, and the Landsat program continued under federal management. Since that time, however, the market for land remote sensing data has evolved, and some preliminary studies have revisited the willingness of users to pay for Landsat images.[128]

Concluding Observations

As Congress addresses the issues discussed in this report, there are several key policy questions to consider.

Should the federal regulatory framework for commercial space activities be consolidated? Stakeholders sometimes call for a "one-stop shop" for commercial space licensing and regulation. Congress and the Administration have made proposals to consolidate functions currently executed by multiple offices of the Commerce Department. Proposals for a new civil authority for space situational awareness would place it at an existing agency (either Commerce or the FAA) rather than create a new office. So far, however, Congress appears to have little appetite for transferring existing regulatory responsibilities between agencies.

How can the commercial space licensing process be made simpler, more timely, and more transparent? Congressional attention to this question has focused, in large part, on the process for interagency consultation on commercial remote sensing licenses. The challenge for that process is balancing industry's need for timeliness and transparency with the government's need to meet national security and foreign policy objectives. The rapidly advancing capabilities of foreign government and commercial satellites make identifying the appropriate balance more difficult, because if sensitive imagery can be obtained elsewhere, prohibiting U.S. companies from providing it may have few security benefits.

How should federal regulatory policies be adjusted as the commercial space industry develops new capabilities and applications? For commercial human spaceflight, the limitation on FAA safety regulation was instituted to avoid burdening a nascent industry. At some point, Congress may judge that the industry's development is ready for the limitation to be lifted or allowed to expire. For new applications, Congress and the Administration have proposed additional mechanisms for authorization and supervision under the Outer Space Treaty, but other issues may arise in particular cases. For example, because satellite servicing involves intentional close approaches between satellites, it may create novel issues for space situational awareness, which currently focuses on avoiding close approaches.[129]

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[127] National Aeronautics and Space Administration, *NASA 2018 Strategic Plan*, https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf, p. 35.

[128] See, for example, Holly M. Miller et al., U.S. Geological Survey, *The Users, Uses, and Value of Landsat and Other Moderate-Resolution Satellite Imagery in the United States–Executive Report*, Open-File Report 2011-1031, 2011, http://pubs.usgs.gov/of/2011/1031/pdf/OF11-1031.pdf.

[129] See, for example, Brian Weeden and Victoria Samson, Secure World Foundation, "Insight—Space Situational Awareness and Commercial Rendezvous and Proximity Operations," November 5, 2018, https://swfound.org/news/all-news/2018/11/insight-space-situational-awareness-and-commercial-rendezvous-and-proximity-operations.

What government space activities can or should be conducted by commercial entities? How can government and industry best work together? As the capabilities of the commercial space industry expand, there may be new opportunities for agencies to execute programs via commercial contracts. Changes in agency strategy or organization—such as the proposed creation of a Space Force within DOD—may also create opportunities. Stakeholders may not always agree on which programs are suitable for a commercial approach, either because they have different perspectives on the roles of government and industry, or because they have different expectations about criteria such as technical maturity or likely commercial demand. Part of the debate may be about how to structure the relationship between agencies and contractors, through various forms of public-private partnership or through choices about contracting approaches.

Appendix. List of Acronyms

ACCRES	Advisory Committee on Commercial Remote Sensing
AFB	Air Force Base
AST	Office of Commercial Space Transportation
COMSTAC	Commercial Space Transportation Advisory Committee
CRSRA	Commercial Remote Sensing Regulatory Affairs Office
CSCLA	Commercial Space Launch Competitiveness Act
DOD	Department of Defense
DOT	Department of Transportation
EB/CBA	Office of Commercial and Business Affairs
EB/CIP	Office of International Communications and Information Policy
EELV	Evolved Expendable Launch Vehicle
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FCC	Federal Communications Commission
GAO	Government Accountability Office
ISN/CATR	Office of Conventional Arms Threat Reduction
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunications Union
JSpOC	Joint Space Operations Command
LEO	Low Earth Orbit
MARS	Midatlantic Regional Spaceport
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OES/SAT	Office of Space and Advanced Technology
PM/DDTC	Directorate of Defense Trade Controls
RFI	Request for Information
SLS	Space Launch System
SPD	Space Policy Directive
SSA	Space Situational Awareness
STM	Space Traffic Management
USGODMSP	U.S. Government Orbital Debris Mitigation Standard Practices
USSTRATCOM	U.S. Strategic Command

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