Electromagnetic Spectrum Use Supports a Vibrant Commercial U.S. Space Economy

Reliable and interference-free access to electromagnetic spectrum has enabled a robust array of American commercial space activities for more than fifty years. Today, American commercial space activities are valued at nearly $90 billion and support more than 200,000 direct private sector jobs in the satellite services, satellite manufacturing, launch services and ground equipment segments. Every day, American consumers and enterprises rely on services enabled by access to spectrum:

- to watch real-time news, sports and entertainment events.
- to provide internet, phone and video to users in both remote and urban locations.
- to support a variety of safety, remote sensing and other services that are critical but invisible to most of their beneficiaries.

Looking to the future, American companies are harnessing next-generation technologies to develop new products with the potential to unlock whole new classes of business over the coming years. With more and more users making demands upon the scarce spectrum resource, we must have policies that promote sound and predictable spectrum for commercial space activities if we are to achieve and sustain the societal and economic benefits offered by these technologies.

How American Commercial Space Activities Use Spectrum

Satellites rely on spectrum to establish communications links with Americans nationwide, whether to satellite dishes on the ground, mobile satellite terminals on airplanes, or home broadband systems. They also provide critical backhaul for the mobile wireless industry, as well as emergency and public safety response capabilities in the face of floods, hurricanes or forest fires.

Satellites operate in specified bands of spectrum, which are typically globally harmonized to reflect their inherent international service capability. Satellites have a long history of successful co-existence in the same spectrum bands as fixed wireless or various other types of satellite systems. They are able to co-exist based on their respective operating conditions, which ensure they will not interfere with each other and leave room for growth and innovation.

Spectrum Access

Spectrum bands are allocated to specific kinds of use by the International Telecommunication Union (ITU), a specialized agency of the United Nations. Each Member State retains the authority to grant spectrum licenses to specific users within its sovereign territory. Thus, while a sovereign nation does not have to follow the ITU allocation table, it must ensure that the uses it authorizes do not cause harmful interference to other nations’ uses that are consistent with the ITU allocation table. Nations discuss and solve spectrum related issues at the World Radiocommunication Conference (WRC) every three to four years.

Because of the global nature of satellite spectrum use from orbit, satellite systems’ use of spectrum is coordinated through a treaty-based process directly at the international level through the ITU Radiocommunication Sector. The United States has succeeded in coordinating its commercial, civil and military satellites through this process, and has been able to address satellite-to-satellite interference issues.
Examples of Spectrum-Enabled Commercial Space Services

Telecommunications – Satellites provide voice, video and data options to users across the United States, in both urban and rural environments. These satellite services provide healthy competition to local cable operators, and in some cases provide the only option for consumers to obtain telecommunications services.

Aviation – Satellites use spectrum to provide location information, voice, video and data services to aviation users all over the globe, ensuring aviation safety and allowing passengers and airlines to be more productive than ever before. Remote sensing weather satellites also provide instantaneous weather information to aviation users as well as users on the ground.

Defense – The Department of Defense regularly uses commercial communications and remote sensing capabilities to support the U.S. warfighter and intelligence community with access to global coverage reaching remote areas. These systems work in conjunction with government-exclusive systems providing increased capacity to meet increasing ad-hoc demand.

Mobile telecommunications – Commercial satellites are used to provide mobile communications to users in remote areas, routing traffic around congested points and as backhaul for mobile telecommunications.

Banking – Satellites enable rural users not connected to the terrestrial grid to access secure financial transactions, and provide redundancy and load-balancing for purchases all across the globe. Last year, Bank Rakyat Indonesia became the first bank to launch a satellite specifically to service its need to communicate secure financial data with thousands of branches across Indonesia.

Agriculture – Many farmers rely on multispectral images of their fields to identify problems, improve yields and optimize fertilizer and pesticide use, saving money and reducing runoff.

Next Generation Spectrum-Dependent Space Innovations

• Earth Remote Sensing - Improved technology is allowing for increasingly powerful Earth-based observation to occur from small and inexpensive satellites (CubeSats) operating in low Earth orbit, enabling increased imaging frequency. The startup Planet is building a global constellation of such satellites to soon image every spot on the Earth once per day.

• Commercial Satellite Servicing – Technology to rendezvous with on-orbit satellites and either perform repairs, augment propulsion and attitude control systems, or replenish consumable supplies has the potential to extend lifespans of existing satellites and reduce risk from on-orbit failures. For example, Orbital ATK has announced it will launch a mission in 2018 to provide additional propulsion and orientation control for an active Intelsat satellite.

• Beyond Radio Line-of-Sight Capability for Unmanned Aircraft Systems – Commercial use of unmanned aircraft systems (UAS) continues to expand. As the industry matures, satellite control will be crucial to enabling the use of UAS for long distance operations.

• Non-Geostationary Broadband – Broadband services operating from low Earth orbit have the potential to vastly increase the bandwidth of space-based internet connectivity and reduce latency. As one of several new systems being announced globally, the Boeing Company has proposed a constellation of 1,500 low-orbiting satellites to provide broadband coverage of the world. O3b Networks is operating and expanding a medium Earth orbit constellation to provide affordable broadband to users in remote or underdeveloped areas of the world.

• Global Aeronautical Distress Safety System – In response to recommendations from the International Civil Aviation Organization, companies are developing satellite-based flight tracking solutions for aviation users that would monitor in-flight aircraft locations in real time using standardized broadcasts.

Recommended Strategies to Preserve and Promote Commercial Space Spectrum Use

• The United States should maintain and expand internationally harmonized space-related spectrum allocations to ensure economies of scale supporting space innovations both for the developers of these technologies and systems and to produce social and economic benefits for consumers here and abroad.

• The significant investments of U.S.-licensed companies in developing and launching commercial satellites, based on specific spectrum interference environments and regulations, must be protected from harmful interference from new entrants or terrestrial uses that would constrain or limit their ability to operate their satellite systems.

• Spectrum sharing regimes should ensure that new entrants rather than incumbent users shoulder the burden of proving technical compatibility, or co-existence, by preventing increases in interference. If harmful interference occurs, there must be clear and effective mechanisms to expeditiously resolve conflicts.
Additional Background: Critical Space Spectrum Bands Are Under Threat

As the United States government works to make spectrum available to a variety of users, several bands critical to current or next generation space systems are threatened by allocation plans that limit their viability for existing and emerging space concepts. The aerospace industry welcomes equitable spectrum sharing policies, but such sharing should adhere to the principles we have articulated here.

- **3400-4200 Megahertz (MHz):** This band contains important high availability satellite services and is used in parts of the world (including Alaska) for satellite communications in support of aviation. Most significantly, the 3700-4200 MHz band is economically valuable to satellite services. This band was considered under the WRC-15 mobile broadband agenda item and the FCC 3.5 gigahertz (GHz) proceeding. Parts of the band (predominantly 3400-3600 MHz and in certain countries 3600-3700 MHz) now have planned mobile broadband use as a result of WRC-07 and WRC-15. This band is also to be studied under the draft MOBILE NOW Act.

- **27.5-28.35 GHz:** This band supports feeder links for satellite broadband services. New rules will limit extensive use of the band for satellite service. Impacts on protecting satellite services will continue to be evaluated in a further Federal Communications Commission (FCC) docket. The FCC adopted 5G for this band in July 2016. Japan, South Korea, Sweden and possibly Canada may also adopt 5G for this band.

- **37.5-42.5 GHz and 47.2-50.2 GHz:** These paired bands are satellite expansion bands and will be included in Boeing’s non-geostationary satellite orbit pending FCC application. The FCC adopted 5G for parts of this band (37.5-40 GHz) in July 2016. The FCC also issued a further notice of proposed rulemaking to consider 42-42.5 GHz and 47.2-50.2 GHz for 5G. The ITU is considering 37.5-42.5 and 47.2-50.2 GHz for mobile broadband at WRC-19. These traditional space bands should be managed to ensure both commercial space access and sharing of spectrum with a wide range of potentially compatible services, from fixed broadband to satellite, airborne platforms or other services not yet conceived.

- **Numerous other bands, including 6 GHz, 10-14 GHz and 18-20/28-30 GHz are critical to space users, but are not being actively considered for other purposes at this time.**