

Advancing Space Safety in the 21st Century: Recommendations for Space Situational Awareness

Commercial Space Federation (CSF) member companies today operate spacecraft and satellite constellations that connect the world through satellite-based internet and communications, provide global navigation, and monitor weather and environmental changes on Earth, among other uses. Soon, multiple spacecraft in low-Earth orbit will be available for crewed and uncrewed research and in-space manufacturing. Orbital data centers providing compute power and satellites that harness the sun's energy to provide power on Earth are on the horizon. With more than 15,000 active satellites currently in orbit, a number expected to grow significantly over the next decade, maintaining a safe and predictable operating environment is a collective imperative for the global space community. CSF offers the following recommendations for spacecraft operators and policymakers to strengthen spaceflight safety through enhanced transparency, improved space situational awareness, and continued international coordination.

Transparency and Communications

Each day, spacecraft operators may receive numerous Conjunction Data Messages (CDMs), which provide notifications of potential close approaches between objects in space. Upon receiving a CDM, operators must assess the potential risk to the spacecraft involved and determine whether a maneuver or other action is necessary to mitigate the risk of collision. Because CDMs may be issued only days before a predicted close approach, and actions to mitigate the risk of collision may inadvertently create new risks, timely communication and coordination among operators is essential.

Recommendation 1: Spacecraft operators should be required to provide and maintain current points of contact, including contacts available 24/7 for time-critical events, and to share their contact information with other spacecraft owner/operators. Direct operator-to-operator communication is generally the most effective means of coordinating a response to a potential high-risk close approaches; however, national governments could also designate points of contact that are available at all times to facilitate coordination when direct operator communication is not possible. Spacecraft operators should also be required to share relevant operational information, including ephemeris and covariance data, spacecraft maneuverability status, and planned maneuvers. In addition to sharing operator contact information and relevant spacecraft information to other operators, such data should be provided to national space situational awareness/space traffic coordination (SSA/STC) centers and points of conduct should be provided to the United Nations Office for Outer Space Affairs (UNOOSA) to facilitate timely communication and coordination.

Improving Space Situational Awareness

The United States, Europe, other nations, and private-sector entities operate or are developing SSA/STC systems that provide data and services to government and commercial spacecraft operators in support of spaceflight safety. The continued development of these capabilities is an encouraging step toward improving space safety. Multiple sensor networks can provide

independent observations of space objects, potentially improving the accuracy, reliability, and timeliness of conjunction warnings. At the same time, different SSA systems may produce differing assessments of collision probability or other aspects of a conjunction event. In such circumstances, timely operator-to-operator communication remains essential to reconciling divergent assessments and coordinating an appropriate response. The points of contact described in Recommendation 1 can help facilitate this coordination.

Recommendation 2: National governments should encourage spacecraft operators under their jurisdiction to participate in the U.S. Traffic Coordination System for Space (TraCSS) or comparable national, regional, or commercial SSA/STC systems that support spaceflight safety and operator coordination.

Recommendation 3: National, regional, or commercial entities operating SSA/STC systems that support spaceflight safety and operator coordination should establish communication mechanisms and protocols to facilitate the timely sharing of conjunction assessment information and coordination of potential responses.

Continued International Dialogue

International coordination on SSA and STC is necessary even as individual countries develop and maintain their own national capabilities. A collision, debris-generating event, or misunderstood maneuver involving one nation's spacecraft can have consequences for operators around the world. Continued international dialogue can help establish common standards and practices, improve communication and coordination, and reduce the risk of misunderstandings associated with unusual or potentially hazardous behavior in orbit.

Recommendation 4: Building on the work initiated by the Space Situational Awareness Expert Group, nation-states should establish an ongoing technical forum for international SSA and STC coordination. Such a forum should support the development of common international standards and practices, promote voluntary coordination directly among operators and governments, and establish mechanisms for communication regarding potential conjunctions and other potentially hazardous activities in space. Private sector spacecraft operators and other relevant technical experts should be meaningfully represented in this forum to ensure that its work reflects operational realities and practical spaceflight safety considerations.