

MITRE Response to Notice 11630: Seeking Private Sector Written Input on Implementation of the 21 Guidelines for the Long-Term Sustainability of Outer Space Activities - SOLICITATION FOR FEDERAL REGISTER, JULY 8, 2022:

MITRE is grateful for the opportunity to contribute to the U.S. State Department's request for industry input regarding the United Nations Long Term Sustainability Guidelines. Space activities are a critical component of the national and international space enterprise that MITRE designs, builds, and secures—making our world safer and more prosperous. As space transitions from a government-led, specialized infrastructure to a multi-player, commodity-based system of systems, MITRE places the Long-term Sustainability of Outer Space Activities at the center of our thinking.

MITRE knows tomorrow's space environment will be more complex and crowded than ever. Vehicles will increasingly become commodities, configured and deployed quickly. Many will be highly autonomous, with off-the-shelf vulnerabilities leaving them open to cyber-attack and other vulnerabilities.

Combining decades of knowledge and highly skilled staff, MITRE serves as an impartial and objective advisor. (free of commercial conflicts of interest) MITRE is an R&D innovation partner to the U.S. and international organizations, focusing on all aspects of space infrastructure design, spanning policy framework formulation, spaceflight safety operations, and capacity building. This breadth of scope allows MITRE to function as a go-between, fostering and cementing technology-related relationships and discussions across many levels of government, commerce, and academia.

What concrete actions your organization has taken to improve the long-term sustainability of outer space and what specific LTS guidelines correspond to those actions?

Specifically, the following MITRE efforts directly align with LTS guidelines as indicated below:

1. Sensor Network Autonomous Resilient Extensible (SNARE) - SNARE is a MITRE architectural and operational concept (in prototype) that uses permissioned blockchain for a space-based sensor network that is sensor agnostic and extensible. It enables traditional and non-traditional sensor data to achieve greater observational capacity and information gain. SNARE uses permissioned blockchain to record orbital element sets from space sensors. SNARE enables a new collection approach that provides a candidate replacement for the legacy centralized daily collection regimen with a new regimen that continually collects data from sets of decentralized, shared, or distributed sensor sources. Each sensor schedules its collection, coordinating with other sensors by recording collects on a shared blockchain network. A MITRE test against 1,000 randomly chosen orbiting objects, SNARE demonstrated that its use could provide an average improvement of the accuracy of space cataloged objects by 0.8 kilometers, and "over 10 percent of the catalog had accuracy improved by more than 3.0 kilometers." In addition, and just as important, SNARE decreased by six hours the average time it takes to re-find an object after it maneuvers. It also significantly reduced the gap time in coverage of objects. SNARE can provide three key revolutionary capabilities for space situational awareness: "autonomous sensor management, change detection, and dynamic tipping and queuing" of other sensors when an object of particular interest is seen. Blockchain technology provides resiliency to attacks and accidents for tamper-evident and highly available records. In essence, SNARE provides immutable transparency of resident space objects contributing to trust and confidence-building measures and a scalable collective picture for space domain awareness. Validity for false narratives is reduced, and automated discovery of anomalous normative behaviors enhances decision making and makes treaties violations or irresponsible use of orbital space apparent to all.

Related LTS Guidelines: A3, A5, B1, B2, B3, B4, C1, C3, C4

2. Collaboration with Space Information Sharing and Analysis Center (ISAC) and Critical Infrastructure thought leadership – MITRE is a founding member and significant contributor to the space ISAC. Sector-based Information Sharing and Analysis Centers collaborate via the National Council of ISACs. Formed in 2003, the NCI today comprises 27 organizations. It is a coordinating body designed to maximize information flow across the private sector critical infrastructures and with the government. Information Sharing and Analysis Centers help critical infrastructure owners and operators protect their facilities, personnel, and customers from

cyber and physical security threats and other hazards. ISACs collect, analyze, and disseminate actionable threat information to their members and provide members with tools to mitigate risks and enhance resiliency. ISACs reach deep into their sectors, communicating critical information far and wide and maintaining sector-wide situational awareness. The Space ISAC provides the industry's principal channel for collecting, analyzing, and disseminating information regarding potential and actual threats to space systems. The Space ISAC's membership represents many leading space industry participants. The ISAC maintains active liaison relationships with the U.S. Department of State, the Department of Homeland Security, U.S. Space Command, and other U.S. Government components. A new 24/7Watch Center, scheduled to open in Q4, 2022, will facilitate real-time information validation and analysis regarding space system threats and overall situational awareness. Other information-sharing initiatives can serve to validate threat and situational awareness data. For example, the Space ISAC is establishing information sharing mechanisms with Japan's Aerospace Exploration Agency (JAXA) and the European Space Agency (ESA) and is working to adopt an ATT&CK¹ model to improve its characterization of cyber threats. This work subsequently helps space system manufacturers and operations fine-tune their cyber defenses for systems and supply chains. MITRE frequently conducts Tabletop Exercises (TTX) with the space ISAC and members to address cyber issues and analyze results, then share findings with members. Overall, this collaborative approach to information sharing can lead to more substantial peer review and better validation contributing to conditions of stability conducive to global space-related economic prosperity and capacity building.

Related LTS Guidelines: A3, B1, B3, C2, C3, C4,

3. Space Information Sharing Ecosystems (SISE). - MITRE has been at the forefront of fundamental, applied, and formative research and development for Space Information Sharing Ecosystems (SISE) design concepts that enhance innovations in space activities capacity development. This work contributes to its responsible use and influences positive behavioral norms. SISE includes emerging and future technology innovations such as artificial intelligence, shared vocabularies, capacity innovations, Blockchain immutability, consensus algorithms, Transparency and Confidence Building Measures (TCBM), and the benefits of polycentric information sharing designs. These innovations complement or enhance necessary bilateral arrangements with stronger collective mutual understanding, thereby mitigating misinterpretations of intent. Similar programs to SISE, such as an International Space Reference Architecture (ISRA), Blockchain Enabled Space Traffic Awareness (BESTA), and SNARE, contribute to creating a full-scope picture, transparency, and trust by leveraging technologies and systems engineering to achieve normative socio-economic transformative, impactful outcomes. Put succinctly altogether, they are socio-technological transformative mechanisms that provide an agnostic framework to serve space-related inter-discourse across national boundaries and allow the reconciliation of differences across cultural divides. Like Defense mission objectives, socio-economic and environmental impactful outcomes can also be architected with the help of technologies and systems thinking that is the hallmark of MITRE know-how. - *Related LTS Guidelines: A1, A2, A5, B1, B2, B3, B9, C1, C2, C3, C4*
4. MITRE's International Space Strategy and the engagement activities therein are designed with three pillars that span and balance efforts across defense, preservation and sustainability, and organizational and policy components of space use. This strategy's goals are:
 - a. Contributing to fostering a coalition of global space partners to achieve a common understanding of the challenges and collaboration on proposed solutions
 - b. Provide an environment to work seams between international partners and the U.S.
 - c. Cooperatively Contribute to a global space-domain awareness enterprise architecture

MITRE is equipped and ready to act in the public interest to assist the civil and international communities in addressing the national and international voids in space strategy, policy, and domain awareness. This unique position is derived from our impartiality and our space and international programs experience and presence in the Department of Commerce, Federal Aviation Administration, National Aeronautics and Space Administration, Department of Homeland Security, Justice Department, Department of State, the Department of Defense (DoD), as well as considerable academic outreach. MITRE serves as a public-interest and impartial

¹ MITRE ATT&CK® is a globally accessible knowledge base of adversary tactics and techniques based on real-world observations. The ATT&CK knowledge base is used as a foundation for the development of specific threat models and methodologies in the private sector, in government, and in the cybersecurity product and service community; bringing communities together to develop more effective cybersecurity. ATT&CK is open and available to any person or organization for use at no charge.

entity to help the civil and international communities address the national and international voids in space strategy, policy, and domain awareness.

Further, MITRE empowers an inclusive international community of innovators, learners, knowledge leaders, and risk-takers. Engagements convene participants and sponsors that span national security, economic and technical growth, and the public and international safety domains. This multidisciplinary and holistic capstone is fundamental to the overall MITRE space strategy. To redress the growing competition for space and to increase resilience in space, the U.S needs to meaningfully contribute to international partnerships and cooperation to ensure that a good, normative behavioral landscape continues to evolve. The international space community, in turn, will need to effectively execute a strategic vision to create new structures and policies to pioneer a better future in space. As a pioneer and convener for international technology innovation, MITRE meaningfully contributes to this goal of creating new bridges of constructive discourse for international space-related RDT&E. - *Related LTS Guidelines: A1, A2, A5, B1, B2, B3, B9, C1, C2, C3, C4*

What might be missing from the current set of 21 LTS guidelines, and what are potential new and emerging challenges that could benefit from being discussed?

The word "cyber" does not appear in the LTS 1.0 guidelines, nor does the word "threat," despite the concrete efforts of competitors and adversaries to build capabilities that can hold at risk space systems. We believe that space, in many ways, is a domain of information operations and that good cyber hygiene is as essential to the sustainability of the environment as debris mitigation because responsible use implies sound, secure cyber security practices. Together MITRE and our partnership with the space ISAC can significantly inform ongoing workgroup activities in support of the UN LTS 2.0 working group. We would welcome an opportunity to contribute or become an observer toward the purpose of redressing space operations and cybersecurity practices within the LTS construct.

MITRE has a rich history of working with international partners and organizations to make the world safer. MITRE applies strategic systems-of-systems thinking and a "total package" enterprise approach to our international work to achieve the following outcomes:

- Develop concepts of operations/employment early in the process to define the art of the possible for advanced concept employment
- Identify opportunities for international integration and interoperability
- Inform partner interoperability gaps, requirements, and opportunities

MITRE's Technology Transfer Office (TTO) ensures that innovations reach the most extensive possible user base by licensing select technologies to commercial organizations, foreign governments, and others. Our TTO brings products and services incorporating MITRE intellectual property to market or use to support their needs. Licensing is the most viable mechanism to bring MITRE intellectual property to bear, enhancing foreign partner capacities, addressing risks, and helping to build more resilient and prosperous space economies. MITRE also works with many sovereign nations, including Japan, Australia, the United Kingdom, and other countries, on enhancing sovereign capabilities. In March 2022, MITRE established its first international center in South Australia as a home for the first-of-its-kind Applied Research Center for Space, Defense, and Cyber security.

A trusted partner with decades of experience, MITRE brings both defense and security and a holistic, impartial, and rigorous approach to space systems engineering, and regulatory policies designed to mitigate risks ensuring the long-term sustainability of outer space activities.