Request for Information on Scope of Civil Space Situational Awareness

Response from Katalyst Space Technologies

Rev

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1.   Overview

This document outlines RFI response from Katalyst Space Technologies. Katalyst exists to advance innovations with in-space robotics, assembly, and manufacturing while seeking to solve existing problems like congestion and traffic management in space. Katalyst emphasizes leveraging modular technology to provide customers with responsiveness, mission flexibility, and sustainability. The Katalyst mission is to bridge the gap between traditional space mission architectures and the infrastructure needed for second-generation space robotics. Katalyst wants to shake up how the space industry works, breaking long cycle times, rigid architectures, and inflexibility in mission planning that dominates the space industry.

With respect to this RFI, Katalyst offers responses based off experience building hardware and software SDA products for DoD customers. Our products add value to current SDA and STM paradigms, offering additional insights to bolster safety, stability, and sustainability of the space environment. The responses outlined below are provided as recommendations, accompanied by solutions currently in our portfolio. Katalyst has flexibility to operate as a data provider to the TraCSS system or provide commercial data through marketplaces offered by BlueStaq and Privateer. Katalyst has also partnered with LUMI Space to provide an opportunity for more proliferated solutions, mirroring steps taken by FAA to ensure robust knowledge of the observable domains.

2.   Response

Below are more specific responses to the questions outlined in the RFI:

2.1.   Scope of Proposed Basic SSA Safety Services;

Q. Are there any additional capabilities not listed that should be included in the basic SSA safety service to provide a baseline level of safety for owners and operators?

   a. While basic services provided by TraCSS are essential to safety of flight such as collision assessments (CA), Ephemeris Generation and Curation with Covariance, Precision Probability of Collision Calculation, and Risk Assessment, these services are enhanced by a sophisticated understanding of space object characteristics. Better understanding object type/materials, area-to-mass ratio, and attitude stability improves the precision of high-fidelity orbital propagators that incorporate perturbations such as solar radiation pressure, gravitational gradients, and atmospheric drag. While usually trivial for known objects, uncorrelated tracks (UCTs) and foreign objects usually have unknown characteristic information that hinders the ability to produce these high-fidelity predictions of state over long time periods. Providing additional tools to derive object characteristics for unknown objects using astrometric and photometric data sources would reduce the covariance in collision and risk assessments and allow O/Os to make more informed decisions that improve safety of flight.
   b. Additionally, services not "included" such as Anomaly Resolution, Breakup Detection, and Maneuver Detection all require adequate fingerprinting techniques to establish a pattern of life from which deviations can be detected and classified. While traditionally done using purely astrometric data, fusing additional data such as object light curves from photometry will be essential for reducing "time-to-fingerprint" of unknown objects and lead to more timely delivery of anomaly detections, thereby reducing response times of O/Os. Katalyst Space is working

this type of effort on an active contract with USAF customer. Further expansion of this capability would provide timely detection of these types of events.
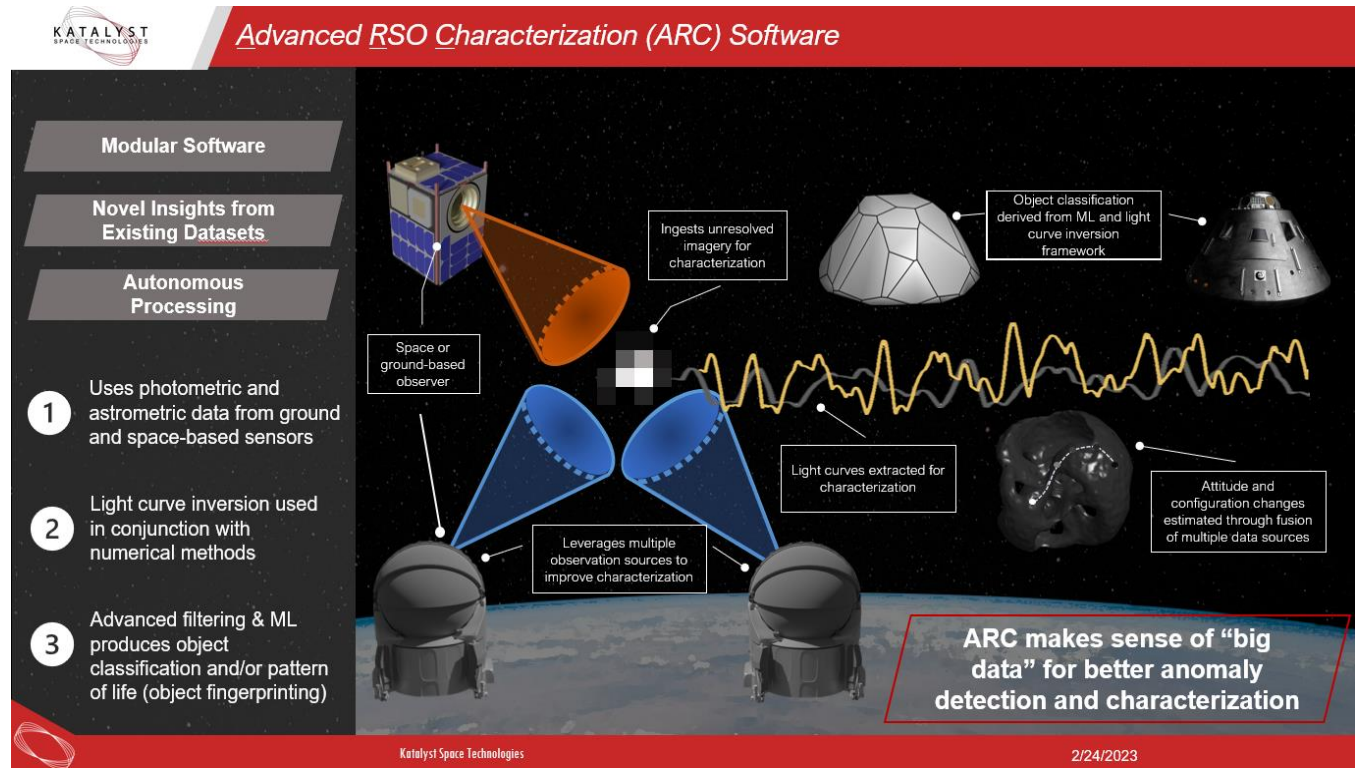
c. The DoD is currently onboarding a limited number of international companies to provide services in SDA/STM. Only including US Commercial companies could limit the input from international O/O's. Without the proper data from foreign owned vehicles, gaps exist in illustrating the full picture for safety of flight. The DoD has recognized this challenge; Joint Space Task Force – Space Defense has begun hosting Sprint Advanced Concept Training (SACT) sessions where allies and international partners participate in creating a full offering for data availability. TraCCS should consider a similar paradigm, expanding the envelope of providers to US companies who are pairing with international companies, as well as international providers capable of significantly supplementing the basic service offering.

2.2. Impacts of Proposed Basic SSA Safety Services on Commercial SSA Providers;

Q. *Are any of the basic SSA safety services readily available from the current U.S. SSA industry? If so, is the service affordable to owners and operators of spacecraft?*

a. Katalyst is currently developing the Advanced RSO Characterization (ARC) software to address the above needs and believe it would enhance the TraCSS offering. ARC ingests photometric and astrometric observations of space objects

to derive object characteristic information such as area-to-mass ratio, object type classification (rocket body, active/inactive satellite, debris object), object stability, and perform object fingerprinting to establish a pattern of life from which anomalies and maneuvers can be readily detected. The software is highly automated which reduces the need for analyst and operator involvement, allowing O/Os to focus on critical tasks such as course of action determination. This software is being developed for a USAF customer, participating in ongoing SACT events, and will be available to commercial consumers in the 4th quarter 2023.

Q. *For commercial SSA service providers, do any of the basic SSA safety services identified for inclusion in TraCSS have any impacts or implications on your current or future product offerings? If so, which services proposed to be part of TraCSS would have an impact on your offerings and why?*

a. In addition to the ARC software previously discussed, Katalyst is developing in-space hardware upgrades for existing spacecraft. The first of these upgrades, LIMPET, is an attachable sensor for SSA. LIMPET will provide relevant space based SSA data that may be delivered to the TraCSS "Open Architecture Data Repository." As TraCSS is rolled out it will be essential to consider how space-based observations are stored and delivered to commercial O/O's and identify what hurdles still exist for space imagery. Katalyst intends to expand its offering of hardware upgrades in the future, leveraging its proprietary attachment system and intends to work with Lumi Space to install SSA hardware upgrades such as the retroreflectors. Lumi is currently developing these retroreflectors to deliver more precise state and ephemeris data on existing space objects. This future offering will have direct impact on the fidelity of data delivered through TraCSS to commercial operators.

2.3. Tenets of Participation and Receipt of Basic SSA Safety Services

Q. *What, if any, actions should owners and operators agree to take to participate in TraCSS as part of the tenets of participation?*

a. DoC should strongly consider implementation of retroreflectors as a mandatory fixture for new spacecraft. Retroreflectors would enable precise ephemeris data to be obtained from any vehicle on orbit, using extremely accurate laser ranging. These retroreflectors are passive, low cost, and low mass. Further, this would reduce overall dependency on GPS, and avoid scenarios where dead vehicles are incapable of providing real-time ranging updates. This is a similar model to the Federal Aviation Administration's implementation of ADS-B capability to provide higher fidelity information regarding US airspace. The use of these passive capabilities is vital to the long-term sustainability of the space environment.