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Business size: Small Disadvantaged Business, under NAICS 518210

Reference Solicitation: 2023-01556, ***Request for Information on Scope of Civil Space Situational Awareness Services***

Dear Mr. John Dyer,

Lyteworx Automation Systems, LLC, in partnership with DigitalArsenal.io, Inc. is pleased to provide this response to RFI 2023-01556, Request for Information on Scope of Civil Space Situational Awareness Services. The term “Team Lyteworx” refers to both companies for the remainder of the document.

It is critical to develop a practical, comprehensive and standards-based approach to ensuring the safety of government owned and commercial space systems, assets and data; as well as the safety of the ecosystems they operate within. Team Lyteworx views the Scope of Civil Space Situational Awareness Services RFI as an important first step in that process. Team Lyteworx is comprised of two qualified Civil Space Situational Awareness Services firms, currently providing professional services and products to defense, intelligence and commercial clients. We currently provide engineering services developing and implementing artificial intelligence (AI) and machine learning (ML); systems engineering and software development; and, cybersecurity and compliance. We currently support the Office of Space Commerce (OSC), as well as multiple clients with missions that are similar to OSC. In addition, Team Lyteworx brings intellectual property that is germane to the OSC mission, and the concepts discussed in this RFI. These include:

- Spacedatastandards.org – A standards-based framework for developing webservices that are compliant with CCSDS communications & data systems standards for spaceflight.
- Space Data Server (SDS) – An open-source software package that helps integrators to establish a "waypoint" for ingestion & data services from any source (ex., Celestrak OMM).
- Spaceaware.io – A webservice that ingests space data catalog comprised of public and private ephemeris data elements into a novel 3D graphical user interface.

We appreciate the opportunity to respond to this RFI, and look forward to continued dialogue relative to this matter.

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The following are Team Lyteworx's responses to the questions listed in RFI 2023-01556, Request for Information on Scope of Civil Space Situational Awareness Services. Each question from the document is listed, followed by the Team Lyteworx response.

## 1. A. Scope of Proposed Basic SSA Safety Services

### • **Does the proposed basic safety SSA service provide sufficient data to allow ongoing operations of orbital assets at a level equal to or beyond that currently provided by the DoD?**

Yes. The proposed basic safety SSA services provide sufficient data to allow ongoing operations of orbital assets at a level equal to that currently provided by the DoD. The primary public framework provided by the DoD, Space-Track.org, was created by Team Lyteworx team member Anthony Koury. Our conclusion is based upon Mr. Koury's assessment and extensive knowledge of the Space-Track.org system.

Team Lyteworx is currently developing two products that will expand on progress made by the Space-Track.org system. They are:

- Spacedatastandards.org – A standards-based framework for developing webservice that are compliant with CCSDS communications & data systems standards for spaceflight.
- Space Data Server (SDS) – An open-source software package that helps integrators to establish a "waypoint" for ingestion & data services from any source (ex., Celestrak OMM).

Each are built on a modern microservices platform, are open source and can be integrated into big data, AI/ML systems. The service can also directly power visualizations available on the Spaceaware.io platform. Spaceaware.io is a webservice that ingests space data catalog comprised of public and private ephemeris data elements into a novel 3D graphical user interface.

### • **What proposed basic safety SSA services are essential to your ongoing operations? If the U.S. Government were to prioritize the delivery of individual services as part of TraCSS, which ones should be provided soonest?**

The following basic safety SSA services are essential to Team Lyteworx's ongoing operations.

- Satellite Catalog (SATCAT) information
- Orbital Mean Element Messages (OMM)
- Conjunction Data Messages (CDM)

### • **What, if any, additional capabilities beyond those currently provided by the DoD should be included in the TraCSS?**

The TraCSS system can improve its efficiency in data transmission and reduce the overhead on the processing and computation of data by providing an efficient serialization format, such as those supported by the current effort at SpaceDataStandards.Org, maintained by the Lyteworx Team. This can be particularly important for space-related operations, where large amounts of

data need to be processed and analyzed in real-time. By optimizing data transmission and reducing processing overheads, the TraCSS system can help improve the reliability and safety of space operations while also enabling the development of more sophisticated and efficient applications.

The TraCSS system should also provide data visualization tools to enhance situational awareness and aid decision-making. One such tool is DigitalArsenal's OrbPro, which is a more robust version of the aforementioned Spaceaware.io.

- **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?**

As the use of space assets and the amount of data they generate continue to grow, it becomes increasingly important to have a reliable and secure system for managing and authenticating that data. One approach to this challenge is to implement a trustless distributed Public Key Infrastructure (PKI) system, which ensures the authenticity and integrity of space data without relying on a centralized authority. This approach is made more secure by integrating blockchain technology (e.g., Ethereum), which provides additional transparency in the management of digital assets.

- **Where applicable, at what level or how often should the service be performed? For example, comments may address how often routine collision assessments should be conducted as part of the basic SSA safety service. DoD currently provides these assessments three times a day. How often should OSC's basic safety SSA service provide these assessments?**

The proposed basic safety SSA service will provide both on-demand and pub-sub services to users. On-demand services will allow users to request specific data or analyses as needed, while pub-sub services will provide continuous monitoring and alerting for events of interest. The frequency of pub-sub updates will be configurable by the user based on their specific needs and preferences. These services will be built on top of a modern microservices platform with the ability to handle large volumes of data and requests in real-time. The pub-sub service can utilize modern messaging protocols such as WebSockets, MQTT and Apache Kafka to provide scalable and reliable event-based communication between different components of the system.

## 2. B. Impacts of Proposed Basic SSA Safety Services on Commercial SSA Providers

- **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?**

The current U.S. SSA industry provides some basic SSA safety services, but their availability and affordability vary. Some services like conjunction assessments and debris analysis are available, but they can be expensive and may not be accessible to all spacecraft owners and operators. On the other hand, some services like tracking data and object cataloging are readily available and relatively affordable. However, it's important to note that the U.S. SSA industry is

mostly geared towards serving government agencies and large commercial entities, leaving smaller organizations with limited options for SSA services. Therefore, there is a need for affordable and accessible basic SSA safety services that can serve a broader range of spacecraft owners and operators.

It should be noted that some of the existing services may not have open source code and may not conform to any standard, which could result in interoperability issues with other systems.

- **For commercial SSA service providers, does the current SSA capability offered by the DoD have any impacts on your current or future product offerings?**

A potential concern is the lack of transparency for US government propagation algorithms, which may hinder the development of comparable services. Additionally, the lack of open source code and standards in the current SSA industry can create barriers to entry for new companies, limiting competition and innovation.

- **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?**

N/A

- **For O/Os, are any of the basic SSA safety services identified for inclusion in TraCSS duplicative of what O/Os of spacecraft are already responsible for obtaining or providing?**

N/A

- **Are there unique advantages to the government purchasing and redistributing certain commercial services rather than leaving these to the commercial marketplace?**

There are unique advantages to this approach. Specifically, the government can often negotiate better prices than individual consumers. Additionally, by having the government purchase and redistribute these services, a level of regulation and subsequent quality control is introduced that may not exist within the purely commercial marketplace. One concern about this approach is government overreach and potential censorship. These concerns are mitigated by the aforementioned robust decentralized PKI system for digital signatures and end-to-end encryption.

### 3. C. Tenets of Participation and Receipt of Basic SSA Safety Services

- **Which basic SSA safety services identified for inclusion in TraCSS should be made publicly available?**

Inclusion of data specified and currently shared under USC Title 10, Sec. 2274, to include the satellite catalog and associated metadata, conjunction assessment data, launch notices, and reentry data. In addition, TraCSS should include an opt-in directory system with the ability for users to manage public keys through a distributed, decentralized PKI system.

**• What, if any, information should owners and operators of spacecraft be required to provide to OSC to participate in TraCSS?**

In addition to currently required FCC / ITU filings, owner/operators should be required to file:

- O/O unique numbering scheme for satellite constellation and mapping to International Designator. Examples: [Spire](#), [Planet](#)
- Standardized API endpoints for data provision

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

As part of participating in TraCSS, owners and operators of space objects may need to agree to certain actions, such as providing accurate identification and tracking information for their objects, participating in information sharing and coordination efforts with other participants, and adhering to established guidelines and standards for safe and responsible space operations.

**• What should happen when owners or operators fail to provide the relevant information to OSC or fail to take actions consistent with the tenets of participation?**

It is critical for owners and operators to comply with TraCSS requirements and take all necessary actions to ensure safe and responsible behavior in space. A formal system of record must be established to monitor data flows from owner/operators. Furthermore, parameters must be defined relative to identifying and substantiating non-compliance. Once properly identified and substantiated, non-compliance must be presented to the offending owner/operator. A process of escalation from warning to more material consequences must be introduced; however, it should be done without jeopardizing participation. In the event that an owner or operator fails to comply in a persistent manner, it should result in OSC referring the matter to relevant authorities for further action, and/or the imposition of fines or other penalties.