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Richard DalBello  
Director, Office of Space Commerce  
National Oceanic and Atmospheric Administration  
Silver Spring, MD

Forwarded via email to [space.commerce@noaa.gov](mailto:space.commerce@noaa.gov)

### **Privateer Input to DOC RFI on Scope of Civil Space Situational Awareness Services**

Privateer welcomes the opportunity to comment on NOAA's Request for Information (RFI) on Scope of Civil Space Situational Awareness Services. Per the RFI guidance, no Privateer proprietary, copyrighted, or personally identifiable information is included in this response.

Privateer recognizes the multiple policy objectives driven in Space Policy Directive-3 (June, 2018) and the subsequent United States Space Priorities Framework (December 2021) that require delineation between the U.S. government's provision of space situational awareness (SSA) products and services and those provided by the private sector. It is essential for the U.S. government to leverage state-of-the art technologies in order to keep up with the speed of change expected in the space environment. Leveraging private sector activities is the best opportunity to make rapid progress in mitigating the space debris and space congestion problems.

Privateer provides the following comments in response to the specific questions raised within NOAA's RFI:

#### ***A: "Scope of Proposed Basic SSA services"***

Privateer welcomes the delineation of services that the Office of Space Commerce (OSC) intends to provide per the RFI, and accepts the characterisation of basic and advanced services, with some qualifications. Privateer agrees that these and many other services will be necessary to improve spaceflight safety and thereby enable advances in space exploration and space commerce. Furthermore, Privateer holds that some of the services would be better developed and delivered by the government to reduce ambiguity for owner operators (O/O) who may otherwise be forced to navigate

multiple directives while also interpreting the operating picture for a counterparty in maneuver operations. This challenge exists even when trying to retrieve basic SSA data, where a user needs to navigate multiple systems, data lakes and programming environments each with their own complexities. With the OSC developing and providing these basic services, extending what they have offered in the OADR prototype<sup>1</sup> would be desirable in Privateer’s opinion.

Given the rapid growth in the number of anthropogenic space objects (ASOs) expected in the coming decade, improving spaceflight safety is the most important task the OSC should focus on. Space operators need data that are much more accurate, precise, and timely than what is available today, as well as improved information about how various ASOs behave. To most effectively provide such data, OSC must approach the task through robust collaboration with the private sector across a wide range of technologies and capabilities. Many of these technologies already benefit from large-scale private investment and we welcome any OSC Request for Proposal on this matter.

Privateer provides services that enable the monitoring, assessment and verification of ASO behavior through a publicly accessible web platform that can support government, commercial, and international space actors. Privateer provides some services for free – such as very near-term SSA data (e.g., within 24 hours) SSA – while offering longer-term coverage to space operators as a commercial service. We believe extended situational awareness and conjunction assessment information (for specific spacecraft during specific intervals, for example) to be a premium service that should not have to compete with publicly-available SSA services. In other words, OSC should provide basic services (such as the refinement and aggregation of SSA data and information for space-safety purposes) but then refrain from providing additional, more detailed services as they should be reserved for commercial providers.

Responses to specific questions from the RFI Section A:

For the first service, Satellite Attributes, Capabilities, Status and Point of Contact (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the*

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<sup>1</sup> Existing OADR prototype presentation: <https://www.youtube.com/watch?v=XAJE7VpOelo>

*future”*

Privateer believes that this service should be included as a basic service, and should be developed by the OSC immediately.

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

Yes, the proposed first service would be an improvement from the Space-Track.org service currently provided by the DoD in several ways. Space-Track.org does not include the basic ASO physical trait attributes (e.g. mass, size, shape, orientation) or complete contact information for all providers which are necessary for astrodynamics calculations and deconfliction communication respectively. We are supportive of this effort because Privateer’s software for orbit determination and prediction has the capability to ingest material properties of ASOs but we don’t have them for the vast majority of objects. This approach will reduce uncertainty by improving the accuracy and precision of physics based models which will reduce uncertainty. The uncertainty reduction will result in a lower amount of currently high Type I errors (false positives) on collision risks leading to more collision avoidance maneuvers that in likelihood are not necessary and may actually increase actual risk. By bringing these data into the public domain, the US Government will improve space safety.

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

The first service is crucial for maintaining track custody and collision mitigation strategies and is the database of record on which further space safety services can be built. Privateer believes that there are a number of additional features to this source that, if added, will promote this goal.

Reducing the time that it takes objects to be registered by the US Government into the catalog is critical. In some cases, this may take more than a week for US launched objects, especially small satellites, and for satellites launched from foreign areas, this information may not be available for several years<sup>2</sup>. Without associating all relevant Launching States to each object, we have no way, legally,

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<sup>2</sup> Astrianet \* [http://astriaservices.tacc.utexas.edu/compliance/query5/tabular\\_results](http://astriaservices.tacc.utexas.edu/compliance/query5/tabular_results)

to infer liability for any damages from these space objects. This is a critical and missing piece to achieving “basic” space safety, and will enable providers to build compliance assessment monitoring tools which promote transparency, predictability and accountability in space.

This service can also be enhanced by requiring the O/O to provide 3D CAD models for their satellites to aid in physics based astrodynamics modeling. We recognize that this information can be seen as sensitive, but size, shape and material properties are critical data to reduce uncertainty on position.

Furthermore, for large constellations flying in low earth orbit, we feel that operators should have to provide material reflectivity information, such as a bi-directional reflectivity distribution function for use in astronomy deconfliction. The satellite provider should provide these reflectivity measurements for any swatches of material with variable brightness on their spacecraft. This information has utility beyond brightness models used for astronomy, and has been used in anomaly detection to determine the rotation of non-responsive space objects and recover those assets.

For all objects, it would be helpful to have up to date satellite attitude profiles, both for improved track and custody and conjunction analysis and mitigation. And for objects which have propulsion, qualifying operational status by amount of fuel planned and available would be useful inputs for planning maneuvers and avoiding collisions. These data should be contained within the first service and dynamically updated by O/O.

Privateer believes that the US government should make explicit use of the Space Sustainability Rating<sup>3</sup> “SSR” as a requirement for licensing space operators and launchers. The SSR captures some number of these traits and characteristics of ASOs in the computation of the SSR with more information about the ASO leading to a higher SSR score.

*“Where applicable, at what level or how often should the service be performed?”*

Privateer holds that it is crucial for space safety that this information be accurate,

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<sup>3</sup> <https://spacesustainabilityrating.org/>

complete and well maintained for it to be effective. The data provided by the U.S. Government should have associated so-called Dimensions of Data Quality, a formalism that provides details on the accuracy, timeliness, uniqueness, completeness, validity, etc. of each source of data and information. This will lead to improved confidence by the community and allow users to know how best to use and trust the data and information for their decision-making needs.

For the second service, Receipt and Sharing of Predictions O/Os Ephemerides (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and should be developed by the OSC immediately alongside the 7th proposed service, O/O Ephemeris Generation and Curation with Covariance. Access to O/O predicted ephemerides is fragmented across multiple sites with differing access mechanisms and limits. For example, Planet publishes 10-day predicted ephemerides on their own site. It would be helpful to have a unified interface to access these data products.

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

Yes, this proposed service would be an improvement upon what is offered today.

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

Effective download and visualization of O/O provided ephemerides, especially in conjunction with other space safety services is critical. We suggest that the scope of this service be extended to supervision of all space activities of both state and non-state actors. We feel this is consistent with Article 6 of the Outer Space Treaty.

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*“Where applicable, at what level or how often should the service be performed?”*

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<sup>4</sup> <https://aerospaceamerica.aiaa.org/departments/industry-must-help-the-u-s-government-meet-its-responsibility-for-orbital-safety/>

Critically, space-track.org has stringent download and API access limits. These volume limits severely curtail the data made available by O/Os. We feel strongly that the actual framework must do away with artificial download limits and be more robust against network failures to be useful in its aim. Further refinements to the service levels should be dictated by the needs of analysis.

For the third service, Routine Collision Assessment (CA) Screening and Conjunction Data Message (CDM) Production (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

The DoD currently provides these assessments three times a day, but Privateer believes that this should vary by orbital regime and by class of object. Privateer suggests that the government work with the research and commercial community to develop a classification and taxonomy of ASOs to determine service levels in different orbital regimes.

As a practical matter the system produces an overabundance of alerts, which has the effect of desensitizing the space operator community. Alerts representing False Positives (Type I Error with the null hypothesis that there is no collision risk) can lead operators to disregard CDMs. Excessive Type I Errors render CDMs inactionable. By increasing the accuracy and precision of data, the government can produce a regime where catastrophic False Negative (Type II errors) are avoided, and Type I errors are curtailed.

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

This must be an API based system without limits on usage and robust against failures, as described earlier in this response.

*“Where applicable, at what level or how often should the service be performed?”*

We propose that the assessments are offered every 90 minutes in LEO and 3 times a day for other regimes unless analysis dictates otherwise.

We direct the OSC to consider implementing the CARA<sup>5</sup> Tools which have been validated by NASA, as the default community standard used by the US government.

For the fourth service, Special CA Screening and CDM Production (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

The DoD currently does not provide any special CA screening but it is needed and OSC should use the NASA CARA tool suite by default.

*“Where applicable, at what level or how often should the service be performed?”*

This service should be performed at a level consistent with NASA’s CARA tools.

For the fifth service, Data Quality Evaluation (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

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<sup>5</sup> <https://www.nasa.gov/cara/cara-services>

Privateer believes that this service should be included as a basic service, and that it should be delivered in the future.

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

Yes this goes beyond what is offered by the US government since no similar service is offered to the community at present.

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

The US government should have the capability to readily seek and ingest all sorts of independent heterogeneous data and information to achieve its orbital safety and sustainability goals.

*“Where applicable, at what level or how often should the service be performed?”*

This fifth service should be performed continuously to keep with the goals of the OSC. Furthermore, many O/Os today provide predicted ephemerides but it would be helpful to obtain reconstructed ephemerides based on tracking data and/or precise solutions from GPS. This will assist in assessing the quality of state predictions, covariance realism and conjunction predictions so that algorithms and tools are constantly being improved in a feedback cycle.

For the sixth service, Launch Collision and Avoidance (COLA) Screenings (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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



Today, the launch provider provides a set of launch trajectories (as well as trajectories for deorbit) along with deployment times, size of payloads and position/covariance data for the deployed satellites. This is provided (or sent to an intermediary to provide) to the 18th Space Wing (or now SLD 18/19) which receives the data and performs the screening against the satellite catalog.

As part of the launch notification to the FAA, the launch operator provides a window, and the interval with which screenings should occur. Launchers desire more flexibility, represented as more launch windows, which translates to more screenings which have to be calculated. A launch provider obtains available opportunities with acceptable collision probabilities from which the launcher can choose to launch in.

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

For different missions, such as those involving maneuverable spacecraft, human spaceflight or missions to the ISS, NASA is also involved with calculating screenings at higher fidelity (i.e. PCs less than  $1e^{-6}$ ). An issue for many launch providers today is that they get informed 5-10 days out, at which time the in-situ environment may change.

It would be preferable if launch providers were provided access to a better catalog which included planned and real launches, and maneuvers, especially if these launches may be shared between countries, so that they could run these analyses internally and update their mission plans accordingly.

The main challenge is that there is a “COLA gap” in between the time that the DoD acquires and tracks in spacetrak.org and when ASOs are actually in orbit. It is critical to close this gap.

For the seventh service, O/O Ephemeris Generation and Curation with Covariance  
(Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

The US Government does not provide the capability to generate predicted O/O ephemeris that include covariance at each ephemeris point and incorporates planned maneuvers (and maneuver execution error) using O/O telemetry and on-board GPS state information or other commercial tracking information.

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

This should be API based and also should provide sources (or types) of information that were used to derive the OEMs

*“Where applicable, at what level or how often should the service be performed?”*

Our discussions with commercial space operators indicate an increased willingness to share ephemeris data and other mission planning data as long as it can be protected from a proprietary perspective as well as a cybersecurity perspective. Space operators, in our experience, also see data sharing concepts as a preferred way to improve space safety and sustainability measures than other regulatory mechanisms. Such a requirement will help the U.S. achieve its space safety, security, and sustainability objectives while developing best practices in its private sector.

For the eighth service, Re-entry Management and Assessment (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, in light of the “5 Year Rule,” increased use of reusable rockets, and in contemplation of the potential for commercial growth for space tourism, as well as manufacturing in

space. Privateer believes this service should be part of the initial offering.

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

Yes, because this forecasting and event pacing assistance for primary objects undergoing either natural decays or managed deorbits is not currently offered by the DoD.

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

Calculations of probability of expected casualties should be a service that is provided by the government. It should also be API based and enable operators to run as many calculations as mission safety would dictate. As a rule, the US Government should incentivize controlled rather than uncontrolled re-entries.

*“Where applicable, at what level or how often should the service be performed?”*

Privateer believes that this should be a continuous service. NOAA Weather Radars can be used as serendipitous sensors that can bear on assessment of re-entries. Privateer have an initial capability (RASR) along these lines. Also, given a description of the mission life each anthropogenic space object should be given a clear window to deorbit that enables them to meet or exceed that limit set by the FCC

Furthermore, as often and as quickly as possible, priority clearance should be provided within the bounds of safety for missions which have astronauts, followed by manufactured goods and rocket bodies under propulsion.

For the ninth service, Precision Probability of Collision Calculation (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

If provided in an accessible and reliable API based system, this capability would be beyond what is currently provided.

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

We direct the OSC to consider implementing the CARA Tools which have been validated by NASA.

*“Where applicable, at what level or how often should the service be performed?”*

These collision assessments should be performed as frequently as NASA CARA provides. CARA takes as an argument an initial condition and the frequency can modulate as the situation requires.

For the tenth service, Collision Consequence and Debris Production Potentials (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should NOT be included as a basic service and that the OSC should focus its attention on other features first.

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

Yes, this service would go beyond what is offered today.

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

The NASA CARA tools which were referenced earlier in the RFI obtain a notional sense of collision risk and consequence.

*“Where applicable, at what level or how often should the service be performed?”*

The NASA CARA tools obtain their consequence calculation by making assumptions without taking in the material properties of the satellite based on state vectors. Should these material properties be widely available, as in the case of an enhanced first service, this consequence calculation could be made with less uncertainty.

For the eleventh service, Conjunction Object Solution Improvements with Additional Tracking (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and delivered immediately.

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

If staffed, resourced and executed correctly, the US Government has demonstrated some of these capabilities within an existing OADR prototype<sup>6</sup>. To date, Privateer’s feeling is that progress on this prototype has not credibly shown that it is capable of performing at the level of real system demands.

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

The government should quantify the benefit to any given data/information source added to the fusion by measuring the reduction in epistemic uncertainty in a mathematical formalism (e.g. using information theory)

*“Where applicable, at what level or how often should the service be performed?”*

As often as needed to incentivize required maneuvers, minimizing Type I errors

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<sup>6</sup> <https://www.youtube.com/watch?v=XAJE7VpOelo>

For the twelfth service, Expected Tracking Determination (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

Yes because the government does not currently provide this service.

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

In order for this to be useful, the US government would need the details of the sensors for which the tracking would be based upon and then have the ability to propagate/predict the ASO trajectories and compute, *inter alia*, the Fisher Information that said sensor(s) assuming their nominal performance would yield. The DoD’s SNOW Tables is inadequate because this doesn’t capture the Fisher Information which is required. The other aspect of this that would be required is some notion of ASO probability of detection which depends on three things 1) an ASO dependence on its size, shape, orientation, and material properties 2) a sensor dependence on its resolution, biases, noises, etc. and 3) everything between the sensor and the object (i.e. telescopes won't detect ASOs through clouds). Privateer believes that the US government should contract industry expertise to execute on this task.

*“Where applicable, at what level or how often should the service be performed?”*

As often as required to maintain custody of all trackable ASOs, in other words, this needs to be data-driven/informed.

For the thirteenth service, Risk Assessment Time History Plots (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

Yes because this isn't offered by the DoD today.

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

This tool should be configurable by the user, to provide these visualizations and others that are of interest to mission success and space safety.

*“Where applicable, at what level or how often should the service be performed?”*

As often as needed to minimize collision avoidance maneuvers that would be unnecessary, with special consideration given to the ease of access and reliability of network connections for this critical data.

For the fourteenth service, Space Weather Sensitivity (Included)

*“OSC is seeking public input about whether the services should be included in TraCSS, and if so, whether it should be part of the initial offering or added in the future”*

Privateer believes that this service should be included as a basic service, and that it should be delivered immediately.

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

Yes, because this service is not currently provided by the US government.

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

Physics based models such as NOAA's WAM have been proposed to complement empirical models such as MSISE to characterize atmospheric drag density. Further work needs to be done to compare the performance of physics based models to empirical models during both nominal periods and those of heightened solar activity and flares.

*“Where applicable, at what level or how often should the service be performed?”*

This service should be performed continuously. The challenge of this task is more than just running space weather data with ASO data information concurrently. Instead, these data and others need to be linked to find the Correlation Pleiades within the aggregated data to draw insights and casual relationships that would measurably aid in spacecraft operations and space traffic management. This science is an avenue for further investigation, but not known to the US Government at this time.

*“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?”*

Privateer intends to become an O/O late in 2024, so our input to this question is withheld.

***B: “Impacts of Proposed Basic SSA Safety Services on Commercial SSA Providers***

Privateer understands that to make OSC’s services useful to enhancing spaceflight safety, OSC intends to combine U.S. government and commercial data sources to create the various services referenced in the RFI. On the U.S. government side, this would include, for example, the data currently provided to the public by the 18th Space Defense Squadron via Space-Track.org and NOAA’s space weather data.

Privateer believes this is a great opportunity for OSC to create public-private partnerships and leverage the diverse and growing capabilities of the private sector, especially considering the efforts to date in developing these capabilities within the government (previously OADR) have taken longer to accomplish and have so far not



yielded a production ready environment for space operators. However, in improving their public service, OSC must remain mindful to avoid creating non-competitive pressures within the emerging market for SSA products and services. We recommend that the government instead partner with commercial entities, like Privateer, to develop the services they propose.

Leveraging commercial capabilities to improve the public service creates the challenging position of buying data and services that are then given away for free, placing the U.S. government in the position of paying non-market prices for those capabilities (often at substantially higher prices to the taxpayer) and then potentially limiting the company's ability to further commercialize their data. There are many cases in the satellite imagery and commercial weather markets exemplifying these challenges both in the short and long-term.

For OSC to effectively engage with commercial partners, it must respect and protect the proprietary information of the commercial entities it interacts with and handle all commercial information with an appropriate amount of sensitivity. OSC should develop and promote clear guidelines for dealing with the data and services provided by commercial SSA partners. OSC should also work with private sector partners to develop standards and best practices for a wide range of space safety measures.

Responses to specific questions from the RFI Section B:

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

Yes most, if not all of the basic SSA services are readily available from the current U.S. SSA industry. In the current market, they are not affordable to all operators which poses a challenge to space safety. We understand that it is the OSC's goal to close the affordability gap to improve space safety and we support this effort.

*“Does the current SSA capability offered by the DOD have any impact on your current or future product offerings”*

Yes, for instance, Privateer relies on ASO data from Space-Track.org and the 18th Air Squadron, and if we were given more accurate information from the catalog these could

improve our offerings to customers. SSA providers like Privateer will have access to validated, fused data with which to focus on use case generation for advanced O/O support and more bespoke missions. Furthermore, some of the data collection efforts that the government proposes unlock Privateer's advanced capabilities as they relate to data fusion and are strongly situated within our technical capabilities. We would suggest that the OSC enlist the help of the private sector in developing and providing these services to O/O.

*“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 and why?”*

Privateer plans to earn future revenue by offering advanced services. We believe that the basic services that are proposed are for the benefit of all O/O and business models that are dedicated primarily to SSA will need to adapt. Privateer intends to help the government achieve its development goals and to earn revenue from more downstream advanced offerings such as bespoke services and capabilities.

With regards to providing advanced services derived from purchased data, The OSC should consider adopting the approach taken by the 18th Space Defense Squadron. The 18th SDS places limitations on the resale and distribution of data directly from their services, but not on the sale and distribution of derived products. Any product derived, or created, from the data provided by OSC may then be sold commercially.

Privateer notes in its responses in this section that the emergence of a robust commercial SSA ecosystem will not only provide improved space safety, but form the basis of additional services to increase the sustainability of space for future use. One adjacent industry that will benefit from a robust commercial SSA sector is the space insurance industry. Commercially available SSA data will have the completeness and transparency to provide space insurers the basis for improving risk models related to various on-orbit activities. A wider range of space insurance products and services could complement or play a key role in effective new regulatory mechanisms designed to improve space safety, security, and sustainability. Privateer imagines that in time SSA providers may become natural insurance - technology providers, interpreting SSA data for financial risk providers.

*“Are there unique advantages to the government purchasing and redistributing certain*

*services rather than leaving them to the commercial marketplace?”*

Privateer believes that any U.S. government research and development designed to improve better tracking algorithms is helpful and should be provided for public use. At issue is whether the government should purchase, redistribute or reprovision commercial services.

There are some unique advantages to the government purchasing the services from the market. These include the improvement to space safety if all O/O are given a common operating picture fused with diverse and timely data, which can reduce ambiguity. Anecdotaly, we know that even if O/O purchases SSA services from multiple commercial providers to augment what is provided for free, in conflict, they tend to act only upon the government's service.

The government's provision of these services is also a matter of responsibility. All countries fundamentally represent any and all national activities and persons in space, as codified by Article VI of the Outer Space Treaty.<sup>7</sup> Therefore, despite the enormous role and influence of the private sector in space operations today, each launching state continues to assume legal responsibility for the commercial and non-governmental space activities licensed and regulated by its government.

In the event of an on-orbit collision between two U.S. spacecraft operators, the overarching liability framework is derived from international space law, namely the Liability Convention, which asserts that countries are liable for the damages incurred by satellites operated by their persons and launched under their auspices.<sup>2</sup> However, international standards have given little specific consideration to events in which the two parties involved are both represented by the same government (in this case, the United States). Therefore, a novel system for determining the liability of a collision between two U.S. spacecraft operators must be considered. This system must take into account the growing role of SSA information and services, whether offered by the U.S. government through OSC and commercial providers. To avoid an issue where there is no definitive SSA information source or where operators fail to communicate effectively, it is in the best interest of the US government to provide this authoritative service free of use.

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<sup>7</sup> UNGA. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty). Jan. 27, 1967. 18 U.S.T. 2410; 610 U.N.T.S. 8843.

Furthermore, OSC is obligated to do so to ensure the integrity of the information and actions driven by the data. Privateer expects OSC will share the ways in which they plan to effectively protect commercial data from cybersecurity threats, and if OSC fails to adequately follow standard data protection and security practices, commercial partners like Privateer retain the right to recommend or request improved practices.

Last, as has been seen helpful in other areas of space commercialization, it is important that OSC, in partnership with other U.S. government agencies, is able to validate the technical capabilities of commercial SSA and other providers in this area. Any U.S. government assessment must be done on an expedient basis. Privateer believes that if the U.S. government validates or certifies these capabilities, OSC's use of these capabilities within the public service should include indemnification of the participating commercial entity.

### ***C: “Tenets of Participation and Receipt of Basic SSA Services”***

The tenets of participation in Space-Track.org are not sufficient moving forward. We suggest that further responsibilities be placed upon the commercial sector beyond signing an SSA Sharing Agreement with USSPACECOM.

Responses to Specific Questions in Section C:

*“Which of the basic SSA safety services identified in TraCSS should be made publicly available?”*

We believe that all of the basic services described in the RFI should be made publicly available. For information in the catalog that may be sensitive, such as space object material, size and shape, there could be a heightened review process to limit competitive issues.

*“What, if any, information should owner operators be required to provide to the OCS in order to participate in TraCSS”*

Privateer's cofounder, Dr. Jah has written widely on this topic.<sup>8</sup> Right now, the free and globally accessible U.S. government data is imprecise. The U.S. government ultimately

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<sup>8</sup> <https://aerospaceamerica.aiaa.org/departments/industry-must-help-the-u-s-government-meet-its-responsibility-for-orbital-safety/>

wants to accurately and precisely predict the behavior of anthropogenic space objects, ASOs, for orbital safety purposes. This ability to predict must come from the statistical inference made from observations of the ASO population. The U.S. government has its own radars and classified sensors, but these are not ubiquitous and, as with all sensors, suffer from biases and performance shortcomings. The ability to confirm or refute a hypothesis confidently is generally strengthened by drawing conclusions from data generated by independent sources of observations. The inconsistency in accuracy and precision in what the U.S. government currently provides to the community could be greatly increased by acquiring observations beyond its own sensors. This includes the demonstrated sensing capabilities found among international allies and partners and the global private industry.

The space community benefits from this improved accuracy, and Privateer holds that O/O should have to submit accurate and timely information about the satellite attributes, capabilities, status and point of contact (basic service 1). Additionally, O/O should have to submit predicted ephemerides that can be shared with other interested O/O, or for use as the representation for CA screenings, risk assessments, and mitigation planning (basic service 2). Furthermore, the OSC should mandate receipt of O/O provided telemetry and on-board GPS state information, as well as any other useful commercial tracking information such as laser ranging, to generate a reliable predicted O/O ephemeris that includes covariance at each ephemeris point and incorporates planned maneuvers (basic service 7). This information is embedded in the telemetry, tracking and command data, or TT&C, that's sent to the ground. However, owners and operators are not required by law to install GPS receivers or health software, or to share that information if they do have those things onboard. They should be required to do so if they expect their national governments to authorize them to operate in space. The planned maneuver receipt is especially important, as it can be used to trigger special CA screening (basic service 4).

*“What, if any, actions should owner operators agree to take to participate in TraCSS as part of the tenets of participation”*

The OSC's TraCSS is an ambitious undertaking and the overarching goal of increasing safety, stability and sustainability in space is one that will require cooperation from many parties. Privateer wonders why the OSC has delayed the introduction of certain space traffic management functions, like maneuver planning and CA fusion services, which

would be the basis for actions that O/O would verifiably take. Complying with prescribed maneuvers and operating in a sustainable manner is of the utmost importance but the basic services suggested do not yet necessitate these actions.

In lieu of these requirements, Privateer suggests that O/O be required to provide timely and accurate data to inform OSCs services, agree to hold the government harmless for the use of those services, and agree to arbitration for collisions involving two spacecraft launched from the US.

Furthermore, private sector initiatives like the Space Sustainability Rating (EPFL/MIT) and industry collaborations like CONFERS will provide important, practical input to “rules of the road” for space operations that should inform international diplomatic discussions on the topic. OSC should work with the private sector and academia to expand focus on these standards and best practices.

*“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?”*

Depending on the severity of infraction, operators should be fined and for serious offenses, coordination with the FAA or FCC could result in having their launch or spectrum license revoked.

***D: “General feedback”***

Privateer appreciates the opportunity to provide input to OSC and the Department on the scope of civil space situational awareness service issues and looks forward to future dialogue with the U.S. government on these important matters.