COMSPOC

February 27, 2023

COMSPOC Corporation is please to present the following response to **Request for Information on Scope of Civil Space Situational Awareness Services.**

II. Description of Basic Safety SSA Services

OSC will provide basic SSA safety services through TraCSS to meet the core U.S. Government interest to further safety, stability, and sustainability in space and increase U.S. commercial leadership in space. Provision of these services is vital for the commercial growth of the American economy and to promote national security. These services can help reconcile the growing use of orbital space with the effective management of this domain.

(1) **Satellite Attributes, Capabilities, Status, and Point of Contact** (Included). To maintain a database of primary (protected) assets, which contains basic satellite attributes (approximate dimensions, mass), indicates satellite trajectory change capabilities and current status, and includes 24/7/365 contact information to coordinate mitigation actions for conjunctions between active satellites.

> The proposed satellite attributes are insufficient. For this service as well as exchange of any other space data, we recommend adopting and incorporating internationally standardized CCSDS orbit and maneuver data exchange messages to ensure that a standardized terminology, timing systems, reference frames, and formats are used. The new Orbit Comprehensive Message (due to be published by ~ April 2023) could be a suitable mechanism/format for the sharing of such data, including managerial and technical points of contact, wet and dry mass, satellite "Optimally Enclosing Box" (size/dimensions) as well as Quaternion describing basic attitude rule, and maneuvers. However, even with standardized message formats, each owner/operator could still have significant errors that require independent validation. Additionally, TraCSS needs to be able to service satellite operators who are unable to provide data in the required frame and/or standardized format; this is a non-trivial point as COMSPOC currently has over 40 "translators" of space data to accommodate operator system limitations.

(2) **Receipt and Sharing of Predictions O/Os Ephemerides** (Included). To receive predicted ephemerides from O/Os, store them in a manner that makes them available for download by other interested O/Os, and use them as the representation of the primary object for collision assessments (CA) screenings, risk assessment, and (when appropriate) mitigation planning.

> TraCSS should be able to accept O/O predicted ephemerides, but we disagree that this should be used as the primary object representation for CA (unless no other source is available). We believe that O/O predicted ephemerides are of limited value, given that (a) they will not typically include covariance information (either at an epoch or as a time history) which is a fundamental requirement for collision probability assessment; and (b) some operators are not able to generate actionable ephemerides.
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> Instead, TraCSS should ingest all available observations and maneuvers (commercial and SSN SSA observations and maneuver plans) for primaries and secondaries (i.e., all unclassified cataloged RSOs) and use a modern sequential filter OD system to holistically provide, to the greatest practical extent, accurate and timely positional knowledge suitable for generating actionable flight safety products for all space objects. This will require the gathering of best-available knowledge from spacecraft operators, government, and commercial SSA, agnostic of a space object's size footprint, orbital regime, maneuverability, or whether or not the object's owner or legal authority is a participant in DOC's services or cooperates with DOC by sharing their data.

(3) **Routine Collision Assessment (CA) Screening and Conjunction Data Message (CDM) Production** (Included). To screen primary objects against a robust satellite catalog, both routinely and on demand; and to generate CDMs for objects that violate the particular physical volumes used for the screening activity.

> This is the essential service for flight safety. We believe public authorities such as DOC are best suited to provide the fee-free Basic Services to ensure all responsible space operators benefit and that certain additional, specialized services may be provided commercially on the open market. However, the proposed basic services are insufficient; knowledgeable operators will discount the alerts knowing they are not credible and the remaining operators may make faulty decisions on inaccurate USG messages resulting in increased risk to mission and increased damage to the space environment.

The DOC's robust catalog should be constructed as a part of DOC's basic services and fully leverage commercial SSA data and analytics. DOC should obtain necessary metric observational data to maintain accurate solutions for all objects (spacecraft, launch systems, debris), both cooperative and non-cooperative, in all orbital regimes, sourced from spacecraft operators, commercial SSA systems, and government tracking network(s).

In addition, the resulting set of orbit solutions TraCSS generates or obtains should be provided to the space community as a basic service, allowing spacecraft operators, commercial SSA analytics providers, and the research and academic communities to further refine conjunction alerts, associated methodologies, and to develop risk mitigation strategies. DOC should incentivize the commercial SSA market in a fashion similar to EU SST with 80% of their budget allocated to US commercial companies. The only way money is going to go to US commercial SSA companies is from the US government to them. Whenever there is any free service available, from the United States or EUSST or the Chinese or the Russians, commercial satellite companies will not pay for the service.

(4) **Special CA Screening and CDM Production** (Included). To perform an on-demand screening against a robust satellite catalog for a particular submitted ephemeris or set of ephemerides (usually for a confirmatory or speculative screening as part of maneuver planning).

Yes, we agree this is an important service. We note that the Space Data Association (SDA) and its Space Data Center (SDC) have provided this capability since its inception in 2010.

(5) **Data Quality Evaluation** (Included). To perform a first-order evaluation of the orbit determination and propagation of the (usually secondary but in principle both) objects' state estimates and covariances in order to determine whether these inputs are of sufficient quality to serve as a basis for a durable risk assessment calculation.

We agree that continued monitoring of both the precision (repeatability) and accuracy (as compared to reference, reconstructed, or "truth" orbits) positional knowledge is essential to achieve an effective flight safety system. The SDA's SDC performs such quality assessments today through comparative SSA assessments. With 12+ years of experience processing hundreds of commercial and government satellites we can tell you that while the O/Os can produce orbits good enough to operate their spacecraft they typically do not produce orbits with sufficient accuracy to be used with other O/O's orbits to do Conjunction Assessment at the thresholds necessary to produce actionable STM

(6) **Launch Collision Avoidance (COLA) Screenings** (Included). To perform timely screenings of a set of launch nominals against a robust satellite catalog in order to identify specific launch times during a launch window that would create unacceptably high collision risk and therefore should not be used.

Yes, we agree. We note that commercial SSA offerings provide much more actionable LCOLA screening and products that serve to accurately maximize launch window availability. COMSPOC has a close partnership with the only commercial LCOLA company nearing completion of its FAA Safety Certification.

(7) **O/O Ephemeris Generation and Curation with Covariance** (Included). To use O/O telemetry and on-board global positioning system state information, as well as potentially other commercial tracking information, to generate a reliable predicted O/O ephemeris that includes covariance at each ephemeris point and incorporates planned maneuvers (and maneuver execution error).

We agree and amplify that operator sharing of its own metric observations (including transponder ranging, GPS NavSol, optical, and passive RF) accompanied by the operator's set of planned spacecraft maneuvers is critical in establishing accurate trajectories for actively moving spacecraft. Combining such O/O observational data with both government and commercial SSA data using sequential filter OD processes (as the SDA did in the DOC Pilot) yields the most actionable SSA and flight safety analysis products.

Active non-cooperative spacecraft are a direct space traffic management problem to commercial and international players. The threat to responsible space actors from non-cooperative, highly-maneuverable spacecraft cannot be ignored or minimized by any STM system. Active RSOs, cooperative or non-cooperative are the most significant tracking, processing, and alerting challenge on orbit. TraCSS must fuse all available observations to obtain and maintain accurate positional knowledge, including the ability to rapidly recover accurate positional knowledge when faced with non-cooperative maneuvers.

(8) **Re-entry Management and Assessment** (Included). To perform reentry forecasting and event pacing assistance for primary objects undergoing either natural decays or managed deorbits in order to assist the DoD in orchestrating the overall decay and de-cataloguing process.

> We agree that this service can be useful. Certainly, more effort needs to be made in accurate forecasting of reentry locations to inform consequence management.

(9) **Precision Probability of Collision Calculation** (Included). To include in each generated CDM a Probability of Collision (PC) calculation that uses more advanced approaches for determining the appropriate hard-body radius (HBR) and employs a calculation technique appropriate to the particular dynamics of the encounter.

> An accurate, filter-based covariance is essential for a realistic Pc. Existing government systems such as ASW, using weighted batch least squares algorithms, do not produce decision-quality Pc calculations nor can they maintain custody with long-duration electric thrust maneuvers. DOC should provide and improve on today's situation, not perpetuate out-dated DOD processes designed for a cooperative space environment of the 1980s and 1990s. We recognize that several things render today's collision probability assessments questionable if not useless:
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> a) Space objects are not "spherical" in shape, and the rudimentary algorithms currently used in legacy Pc estimates assume a sphere.
> b) The dimension(s) used by the Pc estimation are often not based on authoritative shape, dimension, and attitude. Where this information is freely shared and/or available (e.g., DISCOS database from ESA), TraCSS should utilize that to improve upon such faulty assumptions.
> c) The so-called "linear relative motion" assumption used in the rudimentary Pc algorithm works in most cases, but in the important case of non-linear relative motion such as occurs for two coplanar GEO objects, an improved algorithm is needed.

(10) **Collision Consequence and Debris Production Potentials** (Included). To calculate, using an appropriate model, an estimate of the number of trackable debris fragments that would be generated if a particular conjunction were to result in a collision.

> Yes, such a predictive collision consequence assessment/metric will be useful in the avoidance maneuver decision-making process.

(11) **Conjunction Object Solution Improvements with Additional Tracking** (Included). To obtain additional tracking on the satellites involved in conjunctions of interest (typically the secondary objects), improve these objects' predicted states at the conjunction time of closest approach (TCA), and calculate higher-fidelity risk assessment metrics with this improved information.

> The concept of additional tracking on secondaries and updating orbit solutions in batch processing is the wrong approach to today's dynamic space environment. There are countless examples in other industries of dynamic tracking using filter-based approaches. With filter processing, orbit states are updated with each new observation and the resultant object interactions are recomputed one-versus-all for the most accurate forecasting of future encounters. This should not be listed as a separate service; it should go without saying that the continual flow of normal updated multi-source observations augmented by any explicit commercial sensor tasking should lead to CDM refinement. As well, a means to provide some level of transparency concerning this additional tasking process to service recipients would be welcome and inform the operator's decision-making process.

(12) **Expected Tracking Determination** (Included). To generate a pass schedule and probabilities of detection for obtaining additional commercial tracking for conjunction-related objects, so that O/Os can infer the potential benefit of additional tracking and be able to schedule mitigation action decision points appropriately.

> We agree that this might be beneficial, but the selected OD system must be a sequential filter that can responsively update and yield timely, accurate orbit solutions that are responsive to maneuvers.

(13) **Risk Assessment Time History Plots** (Included). To produce time history plots of conjunction risk assessment parameters of interest to allow assessment of conjunction event phasing and stability.

We agree that collision threat trending and assessment of the decision quality of results could be useful but suggest caution in their usage since a trend of increasing miss distance may not correspond to decreasing risk, and a trend of decreasing probability may reflect poor orbit solutions rather than decreasing risk. Using something like the Pc Topology to represent the multiple dimensions of such trending would help clarify the situation.

(14) **Space Weather Sensitivity** (Included). To provide warnings about space weather perturbative events and to assess the effects the perturbation induced atmospheric density uncertainty will have on conjunction risk assessment parameters.

We agree but believe that this is too narrowly focused on drag effects and low LEO spacecraft. We recommend DOC focus more broadly on the sensitivity of collision threat estimates to any/all effect. Space weather sensitivity is important, but so is sensitivity of Pc to attitude, dimensions, scale factors, etc. Recommend that they all be addressed/included and not limit consideration to orbital regions where atmospheric drag is the dominant force.

(15) **Fusion of CA Products** (Not Included). To combine CA products, such as CDMs or predicted ephemerides, from multiple providers into a single, higher-fidelity product that can then be used to enable CA risk assessment.

We agree that the fusion of conjunction assessment analysis products (i.e., so-called "ensemble modeling" such as is often done with weather predictions) is not required as a Basic Service. For now, we recommend that the DOC strive to provide a single best CA product for operators by, for example, fusing the observational data from multiple providers to yield the most accurate positional knowledge possible.

(16) **PC Variability** (Not Included). By considering bounding scale factors for the ''true'' size of the primary and secondary objects' covariances, to generate a matrix of possible PC values to allow risk assessors to assign a more conservative ''high-water mark'' PC value.

DOC should provide such variability in the Basic Services. Even if TraCSS were to obtain or provide robust realistic covariance information that doesn't require scaling, the variability associated with space object dimensions and attitude alone warrants providing operators with the range of collision probabilities they face for a given encounter.

(17) **Additional Concierge Services** (Not Included). To provide on-call, personalized telephone support at all times by CA subject matter experts to assist O/Os with the interpretation of conjunction screening and risk assessment products.

We disagree with the DOC's determination not to include this service, noting that operators need a touch point to help coordinate flight safety services whenever the need arises. Such real-time support does not need to be via telephone, but can leverage other communications technologies (chat, messaging, e-mail, etc.). We note that the EU SST does today for all operators.

(18) **Anomaly Resolution** (Not Included). To arrange for the obtaining and interpretation of anomaly resolution SSA products, such as point signatures (radar cross-section and/or photometry), time-series satellite signatures, and radar and optical imaging.

Partially agree. We would expect that an emergency anomaly resolution service be provided by TraCSS, but that ongoing support be arranged by the affected O/Os through alternate channels.

(19) **Design-time Assistance for Improved CA** (Not Included). During the satellite construction and mission design phase, to assist O/Os in the prudent selection of mission orbits, satellite construction decisions to produce favorable light pollution properties, and the proper build-out of effective O/O ephemeris construction and CA software and procedures.

This service should not be included as part of the Basic Services provided by the DOC.

(20) **Maneuver Trade Space** (Not Included). To assemble a visual aid that identifies particular maneuver times and intensities (and, for some maneuver types, durations) to achieve the desired level of conjunction risk reduction (for both the main conjunction and any other conjunctions that the particular maneuver might introduce).

This service should not be included as part of the Basic Services provided by the DOC.

(21) **Optimized Maneuver Recommendations** (Not Included). In addition to the parameters in service (20) above, to include satellite contact restrictions, spacecraft maneuverability limitations, and O/O optimality preferences to construct a recommended maneuver plan to mitigate the main conjunction and ensure against the creation of any serious derivative conjunctions.

This service should not be included as part of the Basic Services provided by the DOC.

(22) **Breakup Detection, Tracking, and Cataloguing** (Not Included). To commission routine surveillance tracking to detect satellite break-ups; and upon the detection of a break-up, to increase supplementary surveillance tracking to collect break-up uncorrelated tracks (UCT), perform UCT processing, obtain dedicated tracking on new candidate objects, and suggest/perform cataloging actions for stable candidates for which the country of origin can be established.

DOC *should* include assessments of this and are aware that EU SST does include this as a basic service. While DoD eventually catalogs debris fragments (Russian ASAT debris fragment cataloging and publication of orbital states took four months), to the best of our knowledge, the DoD does little to alert commercial operators of breakup events and likely satellites put at risk by such a fragmentation. This is something that is readily achievable and helps address the spacecraft operator's safety concern.

(23) **Maneuver Detection and Processing** (Not Included). To commission heightened surveillance tracking on maneuverable objects; execute maneuver detection algorithms against the tracking obtained from such heightened surveillance; and for objects for which maneuvers are detected, perform appropriate maneuver processing to create a durable post maneuver state estimate.

We disagree and believe that TraCSS should not only include the ability to refine planned maneuvers of cooperative participating spacecraft BUT ALSO non-cooperatively detect, characterize, and recover from unknown maneuvers. This is critical to achieving accurate CA and must be incorporated as a foundation of basic DOC orbit maintenance. The DOD's current CA screening products have had limited usefulness for maneuvering spacecraft because they fail to incorporate operator maneuver plans and data, recover quickly from non-cooperative maneuvers, incorporate maneuver uncertainties to achieve covariance realism, solve orbits in the presence of maneuvers, and predict through future (planned) maneuvers.

III. Questions To Inform Development of Basic SSA Safety Services

OSC seeks responses to three categories of questions, and invites any member of the public to provide input:

- 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?

  The service provided by the DOD, using batch least squares processing, is insufficient for today's dynamic space environment. It's discouraging that DOC would simply want to replicate STM processes that are well-known to be of insufficient quality for knowledgeable space operators to consider to be credible. The service of prioritizing and achieving accurate space object positional knowledge – historical and predicted. To support both the DOC's routine CA as well as a product for spacecraft operators who conduct their own CA screening (either on ground or autonomously on the spacecraft), high-accuracy timely positional information is necessary for every RSO. This will require capabilities to perform real-time maneuver detection, characterization, processing, and recovery, especially for all non-cooperative maneuverable spacecraft.

- 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?

  We defer the direct answer to this question to the spacecraft operator community, the Space Data Association, and its member operators. However, we will share our knowledge that the majority of commercial satellite owner operators have told us that they will make do with whatever free government capability is available to them. The capability and data offered by EU SST serves their purpose.

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

As mentioned above, it is imperative that DOC have as its foundational goal the achievement of accurate positional knowledge, suitable for flight safety and predictive/forward-looking/proactive collision avoidance combining best-available knowledge from spacecraft operators, government tracking data, and commercial SSA data.

TraCSS should include the ability to combine multi-source observational data, non-cooperatively detect, characterize, and recover from maneuvers, and improved collision probability estimates.

Beyond that, we note that the EU SST has a number of additional capabilities and offerings beyond what DOC is considering, as shown in Table 1.

Table 1: DOC and EU SST services; ●=Included, ◒=partial inclusion, ○=Not Included

	DoC RFI services	DOC Basic Service	EU SST	Comment
1	Satellite Attributes, Capabilities, Status, and Point of Contact	●	◒	EU SST uses ESA DISCOS DB and Space-Track SATCAT
2	Receipt and Sharing of O/O-predicted Ephemerides	●	◒	Ephemeris sharing not included
3	Routine Collision Assessment (CA) Screening and Conjunction Data Message (CDM) Production	●	●	
4	Special CA Screening and CDM Production	●	●	
5	Data Quality Evaluation	●	●	
6	Launch Collision Avoidance (COLA) Screenings	●	●	
7	O/O Ephemeris Generation and Curation with Covariance	●	○	
8	Re-entry Management and Assessment	●	●	
9	Precision Probability of Collision Calculation	●	●	
10	Collision Consequence and Debris Production Potentials	●	○	
11	Conjunction Object Solution Improvements with Additional Tracking	●	●	
12	Expected Tracking Determination	●	○	
13	Risk Assessment Time History Plots	●	●	
14	Space Weather Sensitivity	●	○	
15	Fusion of CA Products	○	○	
16	PC Variability	○	●	
17	Additional Concierge Services	○	●	
18	Anomaly Resolution	○	○	
19	Design-time assistance for improved CA	○	○	
20	Maneuver Trade Space	○	●	
21	Optimized Maneuver Recommendations	○	○	
22	Breakup Detection, Tracking, and Cataloguing	○	●	
23	Maneuver Detection and Processing	○	(Unknown)	

- 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?

  DOC should incentivize the commercial SSA market in a fashion similar to EU SST with 80% of their budget allocated to US commercial companies. The only way money is going to go to US commercial SSA companies is from the US government to them.

- 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?

  We believe a "Y times per day" mindset to be an outdated model today, considering that electric propulsion, autonomously operating spacecraft, drag effects, frequent maneuvers, and gaps in coverage suggest a modern approach that is observation or event driven, providing updates (as our COMSPOC system does) when relevant space object orbits and predictions are obtained. As a practical matter, updates on the order of an hour or two, rather than eight hours, would be more useful and relevant.

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

OSC's provision of basic SSA safety services through TraCSS is intended to advance safety, stability, and sustainability in space and help the domestic commercial SSA industry grow. OSC is evaluating the potential impacts that the basic SSA safety services provided through TraCSS may have on the commercial SSA industry. OSC is seeking public input on whether there are any concerns with respect to commercial SSA providers with their own services or other value-added providers that may rely on governmental SSA basic safety services. Furthermore, OSC invites comment on the following questions:

- 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?

  Yes, most if not all of these basic services are available commercially. The DOC plan, as communicated to industry to date, will most definitely further exacerbate the negative cash flow to the US domestic SSA industry.

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

  Yes, the USG will likely be the only customer of US SSA companies and EU will be the only customer for European SSA companies. If the USG is unwilling to pay US commercial companies and would, rather, offer services for free, then satellite operators will likely turn to the more capable EU offering. The current DoD offerings have been a highly disruptive and limiting service allowing the DoD to compete with current commercial SSA data, information, and analytical services. A commercial SSA market cannot exist as long as any government offers any SSA service that is over the bare minimum threshold required for O/Os to backstop that with insurance coverage.

- 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?

  The DOC plan to layer on commercial SSA tools on top of an insufficient USG catalog derived from ASW Astro standards will drive the entire commercial marketplace to the EU. If tru.e, the DOC will have failed at the intent of SPD3 as well as what Congress intended for the $70M allocated to DOC in the GFY 2023 budget

- 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?

Yes, definitely. Our experience, since 2010, is with 25 of the largest commercial space owner/operators who have told us in writing that they will terminate our services as quickly as another credible source of their STM services are available (e.g., EU SST). Operators don't want to pay for conjunction alerts, whether basic or advanced. They would rather accept faulty alerts from a credible source (USG) and mitigate their mission risk via insurance policies.

USG-purchased commercial STM services has several advantages:

1. There can be no significant commercial market for SSA services as long as any single credible government is giving away any SSA service that crosses a minimal threshold. The US set the market price for SSA services at $0 when it began giving away that service years ago. Further, the EU SST is going to take the lead, giving even more advanced SSA service to the market for free. In addition, Russia and China have already announced their intentions to give away advanced SSA data and services. If the US government wants US commercial SSA companies to exist, it must be the primary, if not sole, customer of those companies.

2. Having the USG as a predictable customer with on-going demand can help promote and protect our domestic commercial SSA market, given that EU SST has already entered in "competition" with US commercial SSA providers and other countries have also mentioned plans [e.g., China and Russia] to offer services.

3. USG can provide independent, third-party quality assessment of commercial SSA products to ensure that operators have high confidence in their quality, timeliness, and completeness.

4. We have concluded that spacecraft operators typically will use freely available SSA products rather than paying for advanced services if/when they see the need. Providing a set of "basic services" as a minimally acceptable capability is fundamentally flawed if the "minimally-acceptable" service is not of decision quality for the operators. Operators will chose a free, decision quality solution elsewhere before paying for an advance commercial multi-source data fusion and high-accurate solutions such as ours.

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

OSC is seeking public input regarding what should be required to receive "free of fee" basic SSA safety services through TraCSS. OSC recognizes that certain basic SSA safety services should be made publicly available. For example, space objects from a current DoD catalog that are not sensitive to national security are currently made accessible to the public through the Space-Track.org website. OSC also recognizes that other basic SSA safety services should be available to all owners and operators. In response to previous RFIs, some comments suggested that OSC require owners and operators to provide operational information or act in good faith in response to the basic SSA safety services in order to participate in TraCSS. OSC also invites comment on the following questions:

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

We believe it should all be publicly available, subject to site registration requirements.

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

Operators should be required to provide (and TraCSS should be able to accommodate) the following:

1. POC information
2. Identity of authorizing administration(s)/registry
3. Spacecraft characteristics

a. Dimensions
b. Attitude flight rules
c. Wet mass
d. Propulsion type
e. Operational status
    i. Operational
    ii. Nonoperational
    iii. Degraded operations
    iv. Backup storage standby
    v. Extended mission
    vi. Reentry mode
    vii. Decayed
    viii. Unknown
f. Planned maneuvers.

4. Provision of either or both:
    a. Ten-day predictive ephemerides incorporating planned maneuvers and containing covariance information.
    b. Astrometric observations, observation type/description, and observing station locations.

Optionally, provision of maneuver capabilities, remaining propellant, time required to implement an avoidance maneuver, and dry mass.

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

  Statement of Best Effort data production (Duty of Care).

- 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?

  Removal from service with notification by DOC to their Authorizing Admin.

D. General Feedback

OSC welcomes feedback about any other related topics. For example, are there any matters not discussed above that OSC should or must consider before it provides basic SSA safety services through TraCSS?

Please direct any questions to the undersigned.

Mike Wasson

Mike Wasson
General Manager