OneWeb RFI Response

RTID 0648–XV190 – Scope of a Basic Safety Service for Civil Space Situational Awareness Services

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1. Introduction

WorldVu Development LLC, referred to as "OneWeb", is pleased to submit this response to the Request for Information (RFI) on Scope of a Basic Safety Service for Civil Space Situational Awareness Services.

1.1. Purpose

OneWeb is providing its response to the questions posted by the Department of Commerce in this RFI to address the scope of the basic safety services that the Traffic Management System for Space (TraCSS) system plans to provide to space operators and the public. Being the world's second largest satellite constellation operator, OneWeb recognizes its responsibility in ensuring space safety and sustainability, and the importance of sharing constructive feedback to ensure that the basic SSA services, to be provided by the TraCSS service, are sufficient to meet any space operator's needs.

1.2. Company Overview

OneWeb currently operates a constellation of 542 Low Earth Orbit (LEO) communications satellites that provide services to customers above 50 degrees North. The final constellation configuration will include nearly 650 satellites and over 40 Satellite Network Portal (SNP) gateways to provide Global telecommunication services to the more than 3 billion people without Internet access.

1.3. OneWeb Fleet Management Segment Overview

The OneWeb Fleet Management Segment (FMS) was formed in mid-2015, nearly one year after the company was founded. The FMS team is responsible for the design, development, test, integration, and delivery of all operations products necessary to fly the 600+ OneWeb satellite constellation. The FMS team currently operates the OneWeb constellation from two Satellite Operations Centers (SOC) in the US and UK. The FMS SOC software is made of several Commercial Off-The-Shelf (COTS) software packages to perform many basic satellite operations functions. This software is supplemented with OneWeb-developed microservices which provide the functionality and scalability required for a large constellation. The SOC software is hosted in a modern containerized infrastructure on commodity compute and storage hardware.

1.4. OneWeb SSA Operations

OneWeb is committed to preserve and promote on-orbit operational safety as a responsible and cooperative operator in the space community. OneWeb uses Space Situational Awareness (SSA) data to promote safe spaceflight operations. As a responsible space operator, OneWeb publishes

spacecraft state and covariance data for its operational fleet, shares maneuver plans with other owner/operators, and processes Conjunction Data Messages (CDMs) provided by public and private SSA sources to assess and mitigate collision risk on-orbit. Most importantly, OneWeb is in constant, active conjunction coordination with government and other commercial space operators.

OneWeb SSA operations are highly automated due to the large number of satellites OneWeb operates. The SSA automation is continuously evaluated and improved as our constellation grows. As an added precaution, OneWeb operators also review high risk conjunctions, assess conjunction trends, and react to conjunction events, as necessary. When conjuncting with other operational, maneuverable spacecraft, OneWeb operators always coordinate with the secondary party to clarify maneuver responsibility. As an example, OneWeb works very closely another large constellation operator to follow a dedicated Collision Avoidance (COLA) Concept of Operations (ConOps) which ensures both parties understand each other's maneuver responsibilities. This coordination is especially critical given the other operator's onboard satellite COLA automation. OneWeb operations relies heavily on openly shared data within the space community. Frequent and accurate ephemeris data from other Owner Operators (O/O) and tracking data of orbital debris are critical to maintain a safe space environment. The more data that is available, the more confidence spacecraft operators can have in COLA maneuver planning and assessment.

2. Answers to RFI Questions

2.1. Scope of Proposed Basic SSA Safety Services

1. ***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 current SSA service that the Department of Defense (DoD) is providing can be considered as the most basic of SSA service required for the current space dynamics and environment. As the space environment changes in the next years, the proposed SSA services included in the "free of fee" service through the TraCSS program could address some of the immediate and foreseen growing concerns based on current observations. OneWeb believes the proposed services that are being considered for inclusion in the "free of fee" service via the TraCSS service should be the minimum new standard of SSA service going forward. From OneWeb's perspective, the proposed included services (1 through 14) are at a level equal to and beyond what DoD is currently supporting.

2. ***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 basic safety SSA services that OneWeb sees as most essential in its ongoing operations are listed as (1) through (9), except (7). OneWeb's satellite constellation utilizes low thrust propulsion system, and it has been observed that ground observations of these maneuvering vehicles are in general of relatively poor quality. Therefore, the delivery of SSA services for these vehicles and improvement to the thrust modeling should be prioritized to increase operators' awareness and confidence in navigating the satellite constellation. For any collaborative O/Os, accurate knowledge of thrust modeling is essential and OneWeb believes that TraCSS could potentially create a so-called "*trusted*" O/O service where their products should be the primary source of decision making for SSA for maneuvering vehicles. Understanding that the space object population will soon be dominated by large constellations with relatively high resources, TraCSS could establish closer collaboration with the large constellation O/Os to increase SSA product quality for maneuvering vehicles.

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

One feature that could increase interaction/collaboration between operators is to include COLA deconfliction notice board on the platform. Currently, for any two O/Os involved in a high risk conjunction event, it is the responsibility of either O/O to coordinate with the other to clarify maneuver responsibility. This coordination is currently not visible to the public even when the maneuver responsibility has been clarified between the two parties involved. Having the visibility of which O/O is taking the COLA responsibility of its active spacecraft could be very beneficial and a way to acknowledge receipt of the conjunction event message by both O/Os.

On (4), the current special CA screening requests utilize HAC observations which is less accurate than O/O based ephemeris. In order to increase the quality of the SSA product from the special CA screening, OneWeb would highly recommend using O/O based ephemeris instead if this is made available by the O/O to TraCSS. TraCSS could potentially offer this option to any O/Os who favor this basic SSA services. In addition to improving the SSA product quality, OneWeb strongly recommends OSC to improve on the turn-around time for special CA screening to better accommodate a rapidly changing space environment. In OneWeb's point of view, the concept of special CA screening is meant to facilitate emergency conjunction events, having a turn-around time in minutes instead of hours would enable operators to make better COLA decisions and reduce collision risk.

While the focus of this RFI is on SSA services pertaining mostly to spacecrafts already in orbit, it may be worth including, as part of the basic SSA services, the capability to address and adapt launch vehicle injection uncertainties in the launch COLA screening volume. This would enable launch COLA screening to be much more reliable for an extended period of time.

4. ***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?***

In general, OneWeb believes the current collision assessment cadence of three times a day is sufficient, excluding on-demand special CA screenings. However, the cadence should be adjusted when a concerning conjunction is observed based on either newly acquired tracking data of a given space object or an updated operator ephemeris.

A re-assessment of this object could be performed if its re-calculated trajectory has changed by a defined threshold relative to its previous computed trajectory. Any concerning conjunctions that arise from this re-calculation should be delivered to the affect O/Os as soon as possible and not delay until the next default delivery cadence.

In view of this type of event, OneWeb recommends that this be included as part of the essential basic SSA service. This service is currently provided by LeoLabs but OneWeb sees this as a basic part of a functional SSA service to be included as "free of fee" service in the TraCSS.

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

1. ***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 leading U.S. SSA commercial provider is Leolabs. A number of companies are emerging and aim to provide additional or attractive SSA services beyond what Leolabs is currently offering. In regards to the essential SSA products/services that Leolabs are providing, In the past year, Leolabs has been continuously improving the quality and reliability of their SSA products for a handsome fee for O/Os to experiment with. On the question of affordability, O/O has to strike a balance between fleet safety and cost. The advantage of subscribing to a paid commercial service is in hope of a more reliable, in terms of timely delivery, quality improvement, tracking cadence, etc., SSA products and a fall back option in the event that the DoD is unable to meet the growing demand and requirements. If the TraCSS service is able to meet the most essential and reliable SSA services requirement, it could reduce O/O's financial burden on getting the most basic SSA services from commercial SSA providers. O/Os could, instead, focus on subscribing to value-added services that could further enhance the safety and provide redundancy to the O/Os satellites fleet management.

2. ***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?***
   Currently, OneWeb has in place the risk assessment time history plots as specified in (13) where OneWeb sees this as an essential capability for any O/Os. As for all concerning conjunctions, OneWeb re-assess the conjunctions using 2nd order quality metrics, such as probability of collision, miss distances and other complex metrics and trend analysis to help with better COLA decision making. OneWeb does not claim that the duplication is an indication of services not needed in the basic SSA safety services. They are redundant capabilities to facilitate OneWeb's internal needs. All the SSA safety services that are planned to be included in the TraCSS should be offered to all (big or small constellation) satellite operators regardless.

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

   If those commercial service strengthens the reliability and quality of the basic SSA services, OneWeb encourages the government to purchase and integrate those services into its system to generate an improved SSA product. Redistribution of those services could potentially benefit the O/O but this will heavily depend on the type of services purchased and that the redistribution policy does not violate the O/O proprietary information framework.

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

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

   OneWeb's approach to SSA data sharing concept aligns with what is currently offered on Spacetrack and managed by the DoD. Basic SSA data such as mentioned under (1), (8) and (14) are a few that should be made publicly available. OneWeb understands that the definition of "*publicly*" available refers to data accessible by anyone in the world even if they are not O/O or registered users on the platform. As mentioned in the previous RFI, any SSA data that contains proprietary information of the O/O should be respected (not made public) and can only be shared with other O/O who are contributing and adhering to the tenets of participation to the TraCSS service.

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

   The most basic information that any participating O/O of spacecraft should provide is mentioned under (1) and (2). In principle, O/O should be encouraged to share as much as possible but any additional information, not mentioned in (1) and (2), should not be made mandatory for participation. The O/O should be given the option to select what data they want to share publicly and with other operators under what circumstances. This would encourage O/Os of spacecraft, who wish to protect their business interest and sensitive information, to engage and participate in TraCSS service. Upload of realistic covariance data associated to the ephemeris of the spacecraft should be encouraged.

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

Besides contributing the basic information, all participating O/Os should be pro-active in coordinating and remediating conjunction events, ensure contact information on TraCSS platform is always up-to-date and that they are reachable 24/7.

4. ***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?***

   This is a complex problem to solve if O/Os fail to abide to the tenets of participation. OneWeb believes that OSC should trust all participants to act in good faith to keep space sustainable. OSC could strive to introduce a trust-based system. A trusted O/O can be defined as an operator who continuously abides to the agreed actions as part of the tenets of participation. OSC could introduce a feedback mechanism, in the trust-based system, to gather information on the collaborative effort of O/Os of spacecraft in handling/coordinating maneuver responsibility. OSC could then use this feedback as a method to identify a trusted O/O. A trusted O/O could be given some incentives as opposed to those who are not.

   For example, if the government were to purchase certain commercial services (Section 2.2 Question #3), a trusted O/O could potentially be offered to receive those additional services as part of the government redistribution policy.

2.4. General Feedback

OneWeb appreciates that the OSC is working towards providing free and enhanced basic SSA safety services and preparing to potentially include additional services in the future via the TraCSS service. As the space environment gets contested in the coming years, OneWeb must stress that it is also vital to start establishing clear space traffic rules for all active spacecrafts. The combination of these traffic rules and availability of free basic SSA safety services will unquestionably boost space sustainability and stability as the number of active space objects increase over the coming years.

3. Summary

OneWeb has addressed most of the questions in the three categories put forth by the OSC in the RFI on the Scope of the Civil Space Situational Awareness Services. OneWeb believes the response provided clarifies OneWeb's support of OSC's effort in delivering the 14 free basic SSA safety services to all space operators in its initial operating capability. OneWeb hopes that the feedback/suggestions provided in this RFI will further assist OSC in improving the proposed basic SSA services which could strengthen commercial and non-commercial space actors' engagement and participation in the TraCSS service.