Conjunction Assessment Performance and Operational Comparisons between the USSF Mission Delta 2 Conjunction Analysis System and the Traffic Coordination System for Space (TraCSS)

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ABSTRACT

On September 30, 2024, the Traffic Coordination System for Space (TraCSS), developed by the Office of Space Commerce (OSC), began providing provisional space flight safety services to a select group of beta users from a spectrum of satellite owner / operators. The purpose of TraCSS is to provide space situational awareness and space traffic coordination services to the space community and thus migrate the services currently being provided by the US Space Force (USSF) to OSC. This paper will examine the current capabilities and products being delivered by the USSF to the space community, provide the status of the migration of those services to TraCSS, and examine capabilities OSC plans to enhance safety for the space flight community. This paper will only cover features anticipated to be included in the first operational release of the TraCSS system and will not cover any anticipated features for future releases. The goal is to provide information that owner / operators will need to gain confidence in the usefulness and accuracy of the TraCSS system along with providing an overview of how to interact with TraCSS.

In preparation for the migration of satellite owner / operators from space-track.org to tracss.gov, the TraCSS user portal, OSC has conducted numerous side-by-side comparison tests with the existing system operated by USSF's Mission Delta 2 (MD2) to verify the quality of the conjunction analysis results produced by TraCSS. The tests show that TraCSS has been found to be operationally equivalent to the MD2 system. The paper will explain differences in the Concept of Operations (CONOPS) between the two systems and discuss how those differences result in slight variations in system outputs. The paper will also illustrate why those differences have no negative impact to the safety mission. Instead, the increased screening capabilities of TraCSS should provide substantial benefit to spaceflight safety.

The comparison tests examined Conjunction Data Messages (CDMs) produced by both systems to compare metrics of interest including probability of collision, time of closest approach, miss distance, and number of CDMs in each orbit regime. The paper will show how varying orbit regime, screening time, recency of atmospheric model updates, and other factors will affect the comparison of these metrics for both systems.

Finally, the paper will discuss the differences in usage between TraCSS and the existing MD2 system to provide satellite owner operators with expectations for migration to the TraCSS system. Discussion topics include the TraCSS specifications of CDMs and the Orbit Comprehensive Message (OCM), how users will be able to interact with TraCSS, and new capabilities, such as increased screening frequency, and on-demand screening

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requests. We will examine each of the additional new capabilities and provide recommended usage for each of them.

With the new features and capabilities provided by TraCSS, OSC anticipates improving spaceflight safety for the community as a whole and reducing workload for satellite owner / operators as TraCSS continues to receive upgrades and on-board new services. These new features and capabilities are especially vital in a space environment with increasing numbers of highly maneuverable and non-cooperative satellites.

1. INTRODUCTION

In early 2024, the Office of Space Commerce (OSC) began development of the Traffic Coordination System for Space (TraCSS) in response to Space Policy Directive-3. The TraCSS mission is to promote space-flight safety by promoting transparency, transferring operations from a military agency to a civilian agency, and by advancing space situational awareness (SSA) capabilities. By September 30, 2024, TraCSS was delivering provisional spaceflight safety services to a select group of beta users representing a range of satellite owner / operators (O/Os). Throughout the latter half of 2024, and 2025, development continued on the TraCSS program, and the most critical data products of the TraCSS system went through a thorough independent testing process.

Mission Delta 2 (MD2) has enabled two decades of trusted, global access to SSA products. TraCSS builds on and enhances that transparency by providing spaceflight-safety services under a civilian mandate, while preserving technical continuity through shared algorithms and data standards. Transparency is key to spaceflight safety, and the results of the TraCSS testing are useful to the satellite O/O community so the community can understand that TraCSS provides space flight safety services equivalent to the services currently provided by the MD2 through space-track.org. Using matched input states and atmospheres across 72,356 paired CDMs (8-min TCA window), TraCSS reproduced MD2 outputs exactly. During normal operations, differences between the two systems are within expected bounds considering the freshness and update cadence of the input data.

As the MD2 system is optimized across different mission objectives, the MD2 operational cadences are not ideal for providing space flight safety services for commercial O/Os. In addition to describing the test results of the TraCSS system, this paper informs the community of these aspects of the MD2 that they may not be aware of, which of those aspects the TraCSS system is inheriting, and how the TraCSS program will move forward to improve its services after the program goes live with the initial TraCSS release in January 2026.

Commercial organizations who operate satellites, or make use of space-track.org services can use this paper to help them understand how they should prepare for migration to the TraCSS system.

2. HISTORY OF SPACE TRAFFIC COORDINATION (STC) AND CA IN US GOVERNMENT

The practice of conjunction assessment (CA)—predicting and mitigating close approaches between resident space objects—emerged from the Space Defense Operations Center (SPADOC) Weapon System at Cheyenne Mountain Air Force Station. Fielded in the 1980s to replace the aging 427M system, SPADOC gave the Department of Defense (DoD) their first operationally reliable catalog maintenance capability. SPADOC was primarily designed for missile warning support and satellite tracking, but as the space environment grew more congested, the need for a conjunction assessment function was identified. SPADOC proved inadequate to protect high-value DoD assets and NASA's human spaceflight missions. Recognizing this shortfall, NASA assisted in the development of the High Accuracy Catalog (HAC) and the Astrodynamics Support Workstation (ASW), which enabled special perturbations–based orbit determination and higher-precision conjunction analysis. This capability, tailored specifically to safeguard DoD satellites and NASA missions, represented a major leap in accuracy and scalability over the earlier SPADOC-based CA process, which had been operational but constrained in fidelity and scope as it wasn't designed for that purpose. The catalog maintenance mission

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was assigned to the 1st Space Control Squadron at Cheyenne Mountain Operations Center (CMOC), who was also responsible for and Space Surveillance Network (SSN) tasking.

The 1st Space Control Squadron migrated from Cheyenne Mountain to Vandenberg AFB in 2007, bringing HAC/ASW operations with it,. By the mid-2000s, CA operations began consolidating at Vandenberg AFB as part of the establishment of the Joint Space Operations Center (JSpOC), later redesignated the Combined Space Operations Center (CSpOC). This centralization was intended to streamline SSA and CA activities under a joint structure capable of supporting both national security priorities and civil mission assurance, including NASA's Space Shuttle, the ISS, and NASA's non-human-spaceflight scientific fleet.

As the space environment became more congested, particularly following high-profile events such as the 2007 Chinese ASAT test and the 2009 Iridium–Cosmos collision, the operational burden on Vandenberg increased dramatically. The 18th Space Control Squadron (18 SPCS, later redesignated the 18th Space Defense Squadron, 18 SDS - the new entity that had evolved from 1SPCS) found itself balancing catalog maintenance, conjunction assessment screenings for thousands of satellites, and growing priority support for Protect and Defend activities at the National Space Defense Center (NSDC). To manage the workload, the DoD activated the 19th Space Defense Squadron (SDS) in Dahlgren, VA, in 2022 to assume dedicated responsibility for conjunction assessment. This organizational split allowed 18 SDS to remain focused on catalog fidelity, SSN tasking, and global SSA sharing, while 19 SDS specialized in continuous CA screening, close approach notifications, and maneuver coordination for USG, commercial and international operators.

Parallel to these organizational changes, the products used for CA matured significantly. Originally, close approach data was issued in the form of Orbital Conjunction Messages—compact reports that typically provided a state vector and covariance at time of closest approach. Following the Iridium-COSMOS collision, JSpOC recognized the value of increasing data sharing beyond USG operators and identified the need for a data standard that was machine readable and met the needs of commercial and international operators.

Therefore, JSpOC introduced Conjunction Summary Messages (CSMs), which added more context and metadata, as an interim solution while they engaged with the Consultative Committee for Space Data Systems (CCSDS) to revolutionize the message by creating the Conjunction Data Message (CDM) standard. CDMs provided machine-readable formats (KVN/XML), richer covariance information, and additional standardized data fields such as probability of collision, miss distance, and screening volumes. This standardization enabled consistent risk assessments across multiple agencies and operators, supported automation of screening pipelines, and improved maneuver decision-making. The expanded covariance matrices and higher-fidelity propagation inputs embedded in CDMs give operators in 2025 a level of detail that simply was not possible with Orbital Conjunction Messages—making CDMs the backbone of modern STC data sharing.

Alongside DoD efforts, NASA formalized its own CA office—Conjunction Assessment Risk Analysis (CARA)—in 2004 to provide independent support for non-human-spaceflight missions. CARA became the focal point for protecting NASA science and exploration satellites by screening against the DoD catalog and conducting risk analyses tailored to each mission profile. CARA built on the "screening volume" approaches used for human spaceflight, where ellipsoids are flown along a spacecraft's predicted trajectory to identify objects at risk of close approach, and expanded the Agency's processes for a broader range of orbits.

CARA also played a middle-man role in coordination: it provided a single interface for NASA mission teams with DoD operators, refined best practices for maneuver thresholds, and advanced transparency by publishing technical reports that influenced global CA standards. Its work proved especially impactful during the rise of large constellations, where CARA's tailored screenings helped operators manage risk without unnecessary maneuvers. Today, CARA remains central not only to NASA missions but also as a thought leader in the international CA and Space Traffic Coordination (STC) community.

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A key enabler of CA has been Space-Track.org, which began as a DoD pilot initiative in 2004 to provide broader access to satellite catalog data. Initially limited in scope, Space-Track has grown into the primary distribution portal for SSA products, managed by 18 SDS with CA notifications coordinated alongside 19 SDS. Over the years, its services expanded significantly: registered users worldwide gained access to two-line element sets (TLEs), orbital events, breakup reports, and eventually CDMs for high-interest conjunctions. This growth reflected both technical modernization and policy shifts toward transparency. For example, after the 2009 Iridium–Cosmos collision, demand for timely, public-facing SSA products surged, and Space-Track became the central mechanism for sharing them. It continued to expand through the 2010s, with APIs enabling automated operator workflows and broader datasets supporting collision avoidance across government, commercial, and international stakeholders.

The growth of Space-Track represented a major step forward in transparency and global participation, however the MD2 system was never designed to execute the full spectrum of STC functions. Transfer of STC responsibilities from the DoD to the Office of Space Commerce is designed to enable even further transparency and data sharing. The transfer to OSC will enable growth that is more responsive to the needs of the spacecraft community, as fostering growth is one of OSCs primary functions.

By 2025, Space-Track stands as both a success story and a constraint: a globally trusted clearinghouse that dramatically improved transparency and access to SSA, while simultaneously underscoring the structural need for civil authorities to take the lead in STC. Its legacy is undeniable—it normalized catalog sharing and CA notifications worldwide—but its limitations also illuminate the next steps required to manage an increasingly congested orbital environment.

3. KEY COMPARISONS BETWEEN TRACSS AND MISSION DELTA 2

When beginning development of TraCSS, the Office of Space Commerce intentionally made the decision to base its software on the existing ASW software in use by MD2. There were two main reasons for this decision. First, the ASW provides a high level of accuracy in its orbit propagation due to the incorporation of the High Accuracy Satellite Drag Model (HASDM). Secondly, using the same software as MD2 would provide a level of interoperability with MD2 data, allowing TraCSS to readily demonstrate delivery of the same quality of space flight safety products as MD2. The construction of an astrodynamics toolkit from the ground up would have required a testing program that would have focused on objective measures of accuracy and precision, and this approach was not taken by the TraCSS program due to schedule and budget constraints along with the need to readily demonstrate equivalence with the existing MD2 data. Instead, the TraCSS test program has been focused on comparisons to the CA screening process of MD2 in support of the initial production release of TraCSS.

Many aspects of TraCSS were chosen to temporarily mimic the MD2 system to support this testing philosophy, even when some of these choices may not be optimal to support spaceflight safety in the long term. Understanding several key similarities between the systems is necessary in order to understand when TraCSS behavior should be the exact same as products coming from MD2. Even more important to discuss are the CA screening processes that the TraCSS program did intentionally alter from its precursor. Understanding of these differences will serve as explanation for why testing results do not demonstrate an exact match of data outputs between the two systems. Additionally, these explanations aid satellite O/Os in understanding why they will see minor differences in the products they receive from TraCSS, and how these changes offer equally accurate, and timelier, SSA data.

4. ALGORITHMIC SIMILARITIES

TraCSS uses the same underlying code base as the MD2 system. This code base utilizes the Astrodynamics Support Workstation (ASW) developed by Omitron in 1998. While ASW is capable of several astrodynamics

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tasks and processing, TraCSS makes use of the ASP and SuperCOMBO algorithms. These two algorithms are based on the Air Force Space Command Astrodynamics Standards programs SP (Special Perturbations) and COMBO (Computation of Miss Distance Between Orbits) algorithms.

The ASP algorithm uses numerical integration to generate ephemerides for satellites in Earth-centered orbits. The MD2 system uses ASP to propagate satellite states and generate an ephemeris file for each satellite. These ephemerides are then used in the conjunction assessment process. Likewise, TraCSS receives satellite states from MD2 that are produced by the ASW suite of products. TraCSS then propagates these states using ASP to generate ephemerides for conjunction screening. [2]

The SuperCOMBO algorithm is used by MD2 for conjunction screening. This algorithm computes close approaches between satellites using the ephemeris generated by ASP. In the same manner, TraCSS uses SuperCOMBO to compute close approaches between satellites and generate CDMs for the TraCSS user base. [2]

The SuperCOMBO algorithm computes two different metrics at the time of closest approach (TCA) between two objects – miss distance and probability of collision (Pc). The miss distance computation is simply a matter of interpolation between ephemeris points to find the location of each object at the TCA time. To do this, SuperCOMBO uses 5-point Lagrange interpolation of the points in the ephemeris file. [2]

The second metric (Pc) is a more complex calculation. Pc uses the positions of both objects as well as the covariance matrix, a measure of the error resent in the state, of each object to calculate the probability that the primary object will intersect with the secondary object. In the standard Pc calculation, the dynamic 3D problem is collapsed down to a static 2D problem. This is done by projecting the covariance of each object onto the conjunction plane (the 2D plane perpendicular to the relative velocity vector between both objects. This projection gives two ellipses in the conjunction plane, each containing a Gaussian probability density function of where the satellite could be. Pc is then the double integration over these Gaussian probability density functions. [3]

$$P_C = \frac{1}{2\pi|Det(C)|^{1/2}} \iint_{x^2+y^2\leq d^2} \exp\left(-\frac{1}{2}\left(r - r_{S/P}\right)^T C^{-1}\left(r - r_{S/P}\right)\right) dxdy$$

- C is the 2x2 projection of the combined 3x3 covariance at TCA
- d is the sum of the two object sizes
- r is any point in the collision plane such that $x^2+y^2 \leq d^2$
- $r_{S/P}$ is the position of the secondary relative to the primary

5. SIMILARITIES IN SYSTEMS AND CONCEPT OF OPERATIONS (CONOPS)

The Mission Delta 2 organization contains both the 18th and 19th Space Defense Squadrons. This paper references MD2 for consistency, but this term also includes the 18 SDS and 19 SDS as well as Space-Track.org. As part of its mission, the 18 SDS stationed at Vandenberg Space Force Base (VSFB) in California ingests observation data coming from the Space Surveillance Network (SSN), and performs orbit determination process on those observations to generate high accuracy state vectors. Since 2022, 18 SDS has sent those state vectors approximately every 8 hours, along with several other sets of input parameters like atmospheric data files, to 19 SDS. The 19th takes these state vectors and propagates them into ephemeris files on which its CA screening runs are performed. The CDMs generated from these CA screening runs are posted to Space-Track.org for O/Os to access.

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At the most basic level, TraCSS follows the exact same process as 19 SDS. TraCSS receives input data including state vectors from 18 SDS, propagates the state vectors into ephemerides, and performs CA screening calculations (comparing the positions of the protected asset against the stats of all other objects in the catalog). Four additional similarities that the TraCSS CA process shares with the DoD CA process are the screening windows, screening volumes, objects screened, and object sizes.

The "screening window" refers to the duration of predictions in a CA screening. TraCSS and the MD2 system both share the same logic to determine screening window based on a particular object's orbit regime as defined by the 19th Space Flight Safety (SFS) Handbook and on the source of the ephemeris data. As shown in Table 1, both TraCSS and the MD2 system will screen objects for 5 days for Low Earth Orbit (LEO) objects if the ephemeris is based on High Accuracy Catalog (HAC) data. TraCSS and the MD2 system will screen LEO objects for 7 days if the data is based on submitted O/O ephemeris. In what TraCSS and MD2 call "Deep Space", meaning orbits having a period of longer than 255 seconds such as geosynchronous orbits, the systems will predict conjunctions for 10 days regardless of the data source.

Table 1. TraCSS Orbit Regimes and Screening Windows

TraCSS Orbit Regimes	Orbit Regime Definition	Propagation Time
Deep Space - HAC	Period: between 1300 and 1800 min Eccentricity > 0.25 & Inclination < 35 deg	10 days
Deep Space - OCMs	Period > 225 min	10 days
LEO 4 - HAC	Perigee: between 1200 and 2000 km & Eccentricity < 0.25	5 days
LEO 3 - HAC	Perigee: between 750 and 1200 km & Eccentricity < 0.25	5 days
LEO 2 - HAC	Perigee: between 500 and 750 km & Eccentricity < 0.25	5 days
LEO 1 - HAC	Perigee < 5000 km & Eccentricity < 0.25	5 days
Near Earth - OCMs	Period < 225 min	7 days

* Perigees are Height above Oblate Earth

As with the screening windows, TraCSS and the MD2 system (mostly) share screening volumes based on orbit regimes and data sources. A "screening volume" refers to the tolerance around the predicted location of a satellite that will define a conjunction that generates a CDM. In both systems, a satellite O/O will receive a CDM for their satellite when another space object enters the screening volume of the first satellite.

In LEO, a screening volume is essentially a rectangular prism that flies through the simulated space environment centered on the satellites center of mass, with primary axes in the radial, in-track, and cross-track directions. Fig. 1 illustrates an example of a screening volume in the LEO 2 orbit regime and Table 2 defines screening volume sizes used for each orbit regime and data source.

Table 2. TraCSS Orbit Regimes and Screening Volumes

TraCSS Orbit Regimes	Orbit Regime Definition	Radial	In-Track	Cross-Track
Deep Space - HAC	Period: between 1300 and 1800 min Eccentricity > 0.25 & Inclination < 35 deg	10 km	10 km	10 km
Deep Space - OCMs	Period > 225 min	20 km	20 km	20 km
LEO 4 - HAC	Perigee: between 1200 and 2000 km & Eccentricity < 0.25	0.4 km	2 km	2 km
LEO 3 - HAC	Perigee: between 750 and 1200 km & Eccentricity < 0.25	0.4 km	12 km	12 km
LEO 2 - HAC	Perigee: between 500 and 750 km & Eccentricity < 0.25	0.4 km	25 km	25 km
LEO 1 - HAC	Perigee < 5000 km & Eccentricity < 0.25	0.4 km	44 km	51 km
Near Earth - OCMs	Period < 225 min	2 km	25 km	25 km

* Perigees are Height above Oblate Earth

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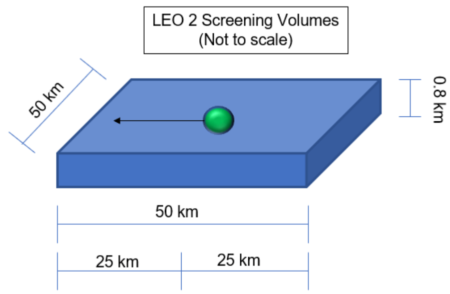

Fig. 1. Example LEO 2 Screening Volume

One important note regarding the 19th SFS Handbook is the 19th will describe their screening volumes as "covariance" shaped. This description is based on intricacies related to the ASW software; however, the end result is that the screening volumes are in reality shaped like rectangular prisms.

There is a minor difference in the systems in the screening volumes in "Deep Space". MD2 uses an Ellipsoidal screening volume in their Deep Space screenings. Due to intricacies of the underlying ASW software, use of ellipsoidal screening volumes actually prevents their system from generating a probability of collision for these conjunctions. The TraCSS program chose to continue using a rectangular prism screening volume shape for its Deep Space screenings. This allows TraCSS to provide a probability of collision for "Deep Space" conjunctions. This difference in computation method does result in a minor difference in output data. Since the rectangular prism is simply implemented as a circumscribing box around the dimensions of the ellipsoid, TraCSS will always be providing slightly more conjunctions than MD2. In reality, the differences are small enough to be rarely noticed.

The TraCSS system receives state vectors based on SSN data for nearly all tracked objects including analyst objects (objects with NORAD IDs in the 80,000s), and Space Fence objects (objects with NORAD IDs in the 270,000s). For every CDM that any given operator would see on Space-Track, TraCSS will also screen and produce CDMs for that pair of objects. Only DoD objects whose states are considered to be classified are not actively screened by the TraCSS system. Because CDMs have never been posted to Space-Track for these classified objects, operators will experience no difference in data received by migrating to the TraCSS system.

The last similarity to note is object sizes. The probability of collision is calculated by both systems using the FOSTER-1992 method. The probability of collision varies with the square of both objects' radii summed, assuming the objects to be perfect spheres. As such, the calculated probability of collision is sensitive to accurate object size information. MD2 generally assigns one of three object size values to be used in Pc calculations: 1 m for debris objects, 3 m for rocket bodies, and 5 m for all payloads. CDMs on Space-Track will list the size used in the Pc calculation in the "Exclusion Volume Radius" field.. Contrary to the description given in the CCSDS CDM Blue Book, the "Area_PC" field is not used in the Pc calculation performed by MD2 and TraCSS. In adherence to the philosophy to minimize changes between systems as users migrate, the TraCSS program has chosen to initially inherit this object size convention.

6. DIFFERENCES IN CONCEPT OF OPERATIONS

Operators will see similar conjunction information between TraCSS CDMs and CDMs received from MD2, but not exactly the same data. The two systems produce CDMs at slightly different times, and the 18th is continually generating new state vectors as observations come in, which means that a small difference in run start time may cause a difference in calculated CDM parameters. These differences will sometimes be substantial if an object that receives less frequent tracking gets an update between the two screenings. Overall,

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parameters generated by the two systems, such as time of closest approach (TCA), miss distance, and probability of collision, will generally mirror each other closely.

Even if screening times and the corresponding state vectors aligned exactly, differences would still exist in CDM parameters due to the timing in which each system updates the underlying atmospheric model. TraCSS receives new atmospheric data inputs roughly every 4 hours, immediately prior to its CA screening runs. The 19th system receives atmospheric data inputs roughly every 8 hours, and since their runs are performed by their operators along with other mission objectives, there can be substantially different times when the screening runs are executed at the 19th. This variation in timing often results in MD2 screenings happening just prior to atmospheric model updates. While the differences in updated atmospheric models used by the two systems does not appear to have large impacts on overall space flight safety, it does mean there are differences between TraCSS and MD2 CDMs, even when using the same set of state vectors. Users will only see exact matches in CDMs generated by the two systems (i.e. TCA, miss distance, and Pc exactly match) when the two systems are operating with the same set of most recent observations. Unfortunately, TraCSS is not permitted to provide the TIME_LASTOB_END information, which would inform a user if the two systems are using the exact same set of input data.

MD2 performs four types of screenings: LEO screenings with HAC ephemeris data, “Deep Space” screenings with HAC ephemeris data, “Operational” screenings of O/O submitted ephemeris, and “Special” screenings of candidate O/O submitted ephemeris. Candidate ephemerides are discussed below along with TraCSS “on-demand” screenings.

During the course of a day, MD2 performs a single “all vs all” LEO screening for which results are not posted to Space-Track. In this all vs all screening, MD2 creates a list of all of the objects involved in conjunctions having Pc > 1*10^-7. Objects on this “concern list” are added to the primary lists for the three LEO HAC screenings performed for the rest of the day. This method does accept some risk of new data not being screened if a conjunction rises in Pc from below 1*10^-7 to more concerning levels throughout the day. The 19th chose this method due to limitations in computational power at the time the system was developed. Since TraCSS is currently deployed on the AWS cloud with a Kubernetes engine, computational power is less of a concern. As such, the TraCSS program chose not to inherit this screening paradigm from the 19th in order to provide a greater level of service to the community.

Instead, TraCSS implements two main types of screenings, not counting “on-demand” screenings which are discussed later. Four times a day, TraCSS conducts a “payload vs all” screening, meaning that all objects classified as a payload within TraCSS are added to a primary list and screened against a secondary list of all known objects. As a reminder, in both the MD2 and TraCSS system, a CDM is generated when the predicted location for a secondary object enters the screening volume of a primary object. Also, twice a day, TraCSS conducts an all vs all screening in which all known objects are added to the primary list and all known objects to the secondary list. This results in TraCSS posting CDMs for conjunctions between two debris objects. These debris-versus-debris conjunctions are only of marginal operational value because debris is unable to mitigate a collision. TraCSS provides this vs all screening data for research purposes and to inform the satellite operations community when a particularly high-risk conjunction is happening between debris objects. Table 3 below shows an overview of the TraCSS screening schedule.

Table 3. TraCSS Screening Schedule

TraCSS Daily Screening Schedule					
0130Z	0530z	0930Z	1330Z	1730Z	2130Z
All v All	Payload v All	Payload v All	All v All	Payload v All	Payload v All

* On-demand screenings can happen any time

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Compared to the MD2 system, TraCSS produces more CDMs and is more likely to produce CDMs for concerning conjunctions due to both the increase in screening cadence and the more expansive primary list of objects supported by TraCSS. For satellite operators who wish to see fewer CDMs rather than more, TraCSS is incorporating ways to filter data through the APIs.

The last significant difference between the systems is screening of O/O ephemerides and the on-demand screening functionality of the TraCSS system. When TraCSS users submit O/O ephemeris to the TraCSS system for screening, they have two options. If the ephemeris represents the most up-to-date panned payload trajectory, the TRAJ_BASIS field in the submitted OCM is marked as OPERATIONAL. If the ephemeris instead represents a possible trajectory, such as a trajectory that includes a potential maneuver that is being screened to see the difference between this trajectory and the nominal, the TRAJ_BASIS field is marked as CANDIDATE. The system can only hold one OPERATIONAL OCM for each satellite at a time, with the priority going to the OCM with the most recent creation date. An OPERATIONAL OCM continues to be screened at each routine screening until a new OCM is submitted for that satellite, or until it runs out of usable ephemeris. A CANDIDATE OCM is only screened a single time.

The second option for users is to have the ephemeris screened within a few minutes or as part of the next regular screening cadence. In order to have CDM screening results returned within a few minutes, OCMs are submitted to the on-demand screening endpoint of the TraCSS API. This begins a CA screening that screens all of the submitted ephemeris files against the HAC and O/O ephemeris for all known objects. For single digit numbers of submitted ephemerides, this screening generally returns CDMs within minutes. For users with hundreds or thousands of satellites they wish to submit ephemeris for, on-demand screenings will take longer. This function works for either OPERATIONAL or CANDIDATE OCMs. If OPERATIONAL OCMs are submitted, the system screens them once on demand, before including them as part of its regular routine screenings.

O/O OCMs are uploaded to the database of ephemerides as soon as they are submitted, meaning that users are able to screen against the most up to date O/O data. The HAC data continues to be updated approximately every 4 hours, so users have to wait for updated information if their satellites have a predicted conjunction with satellites that don't supply O/O ephemerides, such as non-active satellites, and debris.

Table 4 provides a summary of the main similarities and differences between TraCSS and MD2 that pertain to the conjunction analysis process.

Table 4: TraCSS and MD2 comparison

	MD2	TraCSS
Routine CA Screening Cadence	Every 8 hours	Every 4 hours
CA Screening Primary Objects	Concern List Obejcts	All payloads 4x a day All objects 2x a day
O/O Ephemeris Screening Cadence	Several times a day	On-demand and 6x a day
Data Formats	CCSDS and others	CCSDS
Atmospheric Model Update Cadence	3 times a day, but irregular	Updated with every routine screening
LEO Screening Volumes	Based on 19th SFS Handbook	Based on 19th SFS Handbook
Deep Space Screening Volumes	Based on 19th SFS Handbook	19th Handbook but box instead of ellispoid
API	REST API	REST API

7. TESTING RESULTS

TraCSS testing was designed to assess if the system is performing the on-orbit Conjunction Assessment mission to an equal or greater level as MD2. This paper details the testing performed to assess whether the CDMs

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generated by the TraCSS system meet or exceed the technical bar set by MD2 CDMs. This paper focuses mainly on the LEO regime. Similar testing has been performed in the Deep Space orbit regime; the results are undergoing final validation and will be shared at a future time.

To validate whether TraCSS can meet this bar, the TraCSS system was examined against the following questions:

1. **When using the same set of input data, does TraCSS produce equivalent outputs to MD2?**

And then when not controlling the input data:

2. **Does TraCSS screen the same satellites as MD2?**
3. **Will TraCSS generate CDMs for the same (or more) conjunctions as MD2?**
4. **Are the TraCSS CDMs of the same accuracy as the MD2 CDMs?**
5. **Will TraCSS perform screenings with less latency than MD2?**

For the TraCSS CA process to unequivocally meet the MD2 bar, TraCSS must meet or exceed MD2 in all of these categories.

1. When using the same set of input data, does TraCSS produce equivalent outputs to MD2?

The answer to this question is yes. TraCSS obtained a set of input files and output files used in a conjunction screening by MD2. Then TraCSS ran a CA screening using those input files and the resulting CDMs were compared to the provided output files. Table 5 summarizes the results.

Table 5: CDM Generation Results

# of CDMs generated by both systems	72,356
# of CDMs generated by only one system	0
Max Difference in Miss Distance	0
Max Difference in TCA	0
Max Difference in Pc	2E-11 (7^{th} significant digit)

As shown in Table 5, the results showed as close to an exact match as can be reasonably expected. Of the 72,356 CDMs, only 5 had any differences at all, and those differences were small enough that the TraCSS team considered the test results an exact match. This result is expected due to TraCSS using the same conjunction analysis software as MD2. Still, this result was useful for determining the level of precision that could be expected when inputs exactly matched.

2. Does TraCSS screen the same satellites as MD2?

For all of the remaining questions, the exact inputs were not the same between TraCSS and MD2. Each system was operating at its expected operational cadence, with the operational data flows feeding the systems. For this reason, the comparisons are not straightforward and require an understanding of the CONOP differences between the systems.

Checking to see if TraCSS was screening the same satellites as MD2 was one of the simpler checks performed in the testing process. A week's worth of CDMs were downloaded from the TraCSS and Space-Track databases and compared. CDMs generated from O/O ephemeris data, and CDMs generated from NASA CARA satellites were excluded. TraCSS did not have access to the same O/O ephemeris data for screening, and Space-Track

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occasionally contains CDMs generated from NASA CARA in addition to MD2, so filtering these out made the process simpler. These filters apply to the remaining applicable tests in the testing process.

A list of all of the satellites involved in a conjunction on the MD2 side during a week was compiled and compared to a similar list on the TraCSS side. Of the 22,859 satellites involved in a conjunction on the MD2 side, it was found that 737 were not involved in a conjunction on the TraCSS side. This result was not unexpected because of the differences in the inputs between the systems like screening times and atmospheric data updates. To verify that these satellites were in fact being screened on the TraCSS side, the satellites data profiles were examined to ensure they did have screening data. This data was found for all expected satellites, so the TraCSS team concluded that TraCSS was screening all of the satellites screened by MD2. TraCSS also has the same primary list of objects as MD2 for all actively operated objects.

3. Will TraCSS generate CDMs for the same (or more) conjunctions as MD2?

A significant amount of effort has been put into comparing the CDM results of a sample TraCSS CA run to a sample MD2 run performed at a similar time. While it is straightforward to match up the data, analyzing the results requires a nuanced understanding of the operation of both systems.

The figures below show histograms of CDMs generated by the TraCSS and MD2 systems. The x-axis shows the miss distance of the CDM in either the radial, normal (cross-track), or transverse (in-track) direction. The y-axis shows the number of CDMs generated by a system with that miss distance. When both systems found a CDM pair, the data is shown as blue. This is defined as the two systems finding the same object1, object2, and the same TCA with a tolerance of 8 minutes. When only TraCSS finds a conjunction, the data shows as green, and when only MD2 finds a conjunction, the data shows as orange. The red-lines show the screening volumes as defined by the TraCSS system and the 19th SFS handbook for each orbit regime.

Fig. 2 below shows a pair of runs between the systems that happened within minutes of one another. However, even though both systems performed screenings at nearly the same time, the TraCSS system had received its inputs 3 hours and 27 minutes later, meaning it was working with newer state vectors. To control the known differences, the CDMs with TCAs before the run start of the TraCSS system (which started second) and the CDMs with TCAs after the screening period of the MD2 system have been removed. O/O ephemeris CDMs, NASA CARA CDMs and SpaceX CDMs were also removed. MD2 has a different screening process for large constellations so SpaceX CDMs could not be compared in the same way.

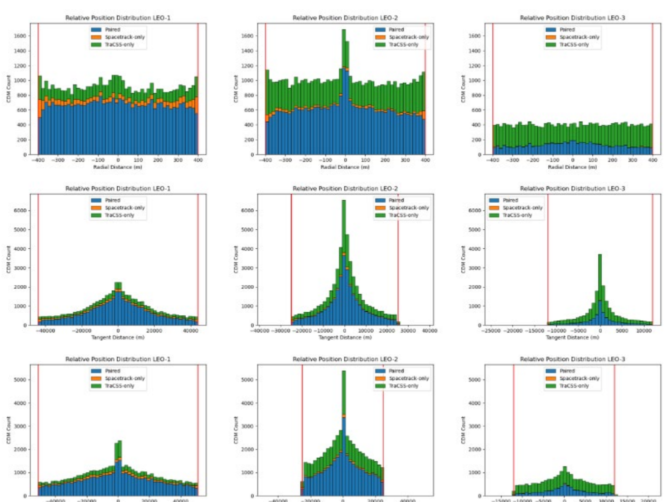

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Fig. 2. TraCSS and MD2 miss distances across orbit regimes

The figures show that both systems find the majority of CDMs in each of the examined orbit regimes. There is also a large amount of CDMs only found by the TraCSS system, which is explained by TraCSS performing all vs all runs rather than "Concern List" runs. There is a small quantity of CDMs only generated by the MD2 system. These are likely due to the difference in state vectors used by each system at the time of their screenings. After 3.5 hours, the SSN will have accumulated a number of new observations of satellites that will change their predicted trajectories. In some cases, these will push the predicted location of a satellite all the way outside of the screening volume meaning only one of the systems will generate a CDM for it. This theory is supported by the increased proportion of MD2-only CDMs at lower altitudes. In the orbit regimes more susceptible to drag, new observations on a satellite are more likely to have a significant change in its predicted location. Therefore, the expected number of CDMs generated by the MD2 system and not by TraCSS is higher at lower altitudes where differences in drag models have a larger impact.

The figures above also show a higher proportion of TraCSS-only CDMs with increasing altitude. This is likely due to the CONOPs difference between TraCSS using an all v all screening and MD2 utilizing a Concern List screening approach. Concern List screenings generate their primary lists by identifying the satellites involved in a conjunction with a Pc above $1*10^{\wedge-7}$. In orbit regimes with less density, satellites are less likely to be involved with a conjunction above this Pc. Therefore, fewer satellites get screened as primaries resulting in a higher proportion of TraCSS-only CDMs.

The numerical differences described by these histograms are shown in Table 6 below. These numbers may seem high for data only 3 hours and 27 minutes apart, but these screenings were also determined to have been performed with a different set of atmospheric data files. A study performed by Aerospace Corporation in support of the TraCSS program found that using atmospheric data files 3 hours old can account for a difference in the number of CDMs of roughly 5%. Given that difference in atmospheric data files and the difference in state vectors, the TraCSS team concluded that an unpaired MD2 percentage of ~10% is within the expected range.

Table 6: TraCSS and MD2 Unpaired CDMs

Orbital Regime	TraCSS Count in Regime	MD2 Count in Regime	TraCSS Unpaired Count	MD2 Unpaired Count	TraCSS Unpaired Proportion	MD2 Unpaired Proportion
LEO-1	42019	37468	8338	3787	19.84%	10.11%
LEO-2	49192	32522	18246	1576	37.09%	4.85%
LEO-3	20018	6402	13787	171	68.87%	2.67%
LEO-4	254	66	196	8	77.17%	12.12%
All	111483	77532	40567	6616	36.39%	8.53%

4. Are the TraCSS CDMs of the same accuracy as the MD2 CDMs?

The output of numerous runs between MD2 and TraCSS were compared during this testing process, and it was found that a TraCSS run and a MD2 run occurring at similar times do not actually produce the closest results. The closest results are found when comparing a TraCSS run to the MD2 run initiated roughly 4 hours after the TraCSS run. Comparing in this way usually results in the state vector input data being closer between the systems. It also usually means that MD2 will have updated their atmospheric data files to use the atmospheric models that TraCSS had been using at the previous screening.

When one of these closer screenings is identified, it is possible to identify a subset of CDMs between the two systems that are using the same state vector and atmospheric data.

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There is a field in MD2 and TraCSS CDMs called TIME_LASTOB_END which describes the time since the last SSN observation of the satellite in question. For security reasons, the exact values of these fields are obfuscated for users, but the TraCSS team has access to the un-obfuscated values. When the true values for these fields are the same in a CDM on both the TraCSS and MD2 side, it is a good indication that the state vectors used to generate those CDMs are the same. And when comparing a MD2 run 4 hours after a TraCSS run, the atmospheric data is usually the same. Fig. 3 below shows the differences in three main metrics: TCA, Miss Distance, and Pc when the state vector and atmospheric data is expected to be the same.

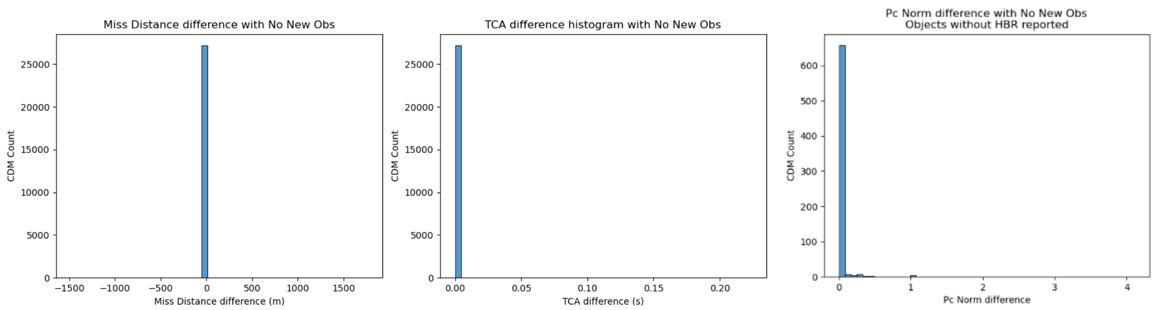

Fig. 3. TraCSS and MD2 Operational System Metrics with similar inputs

The figure shows that there are minimal differences between CDMs when the TIME_LASTOB_END fields are equal between CDMs and atmospheric data is the same. This is an indication that TraCSS is performing equivalently to MD2.

However, the results are not identical due to slight nuances in how the two systems operate. For this particular run, of the roughly 27000 CDMs with no new observations between runs, it was found that about 400 CDMs still had minor differences. The cause of this discrepancy is attributed to slight differences in the state vector data between the systems. Even though the data indicated the state vectors were generated with the same set of observations, it is still possible for other differences in the orbit determination to exist on occasion resulting in these minor differences. The result is these differences are also within the expected results.

MD2 allows for O/Os to submit their object's hard body radius (HBR) for use in the Pc calculation, and this had to be taken into consideration when comparing Pc between the two systems. If these HBR values are not present, MD2 uses the same default values for Pc calculation as TraCSS. TraCSS does have a similar functionality planned to allow for O/Os to submit their HBR, but currently TraCSS utilizes the same default values as MD2 for Pc calculation. When controlled for conjunctions utilizing the same HBR between the two systems, the comparison shows nearly exact matches.

In addition to large-scale comparisons between the two systems, the evolution of numerous conjunctions was examined between the two systems. Fig. 5 below shows the probability of collision and miss distance plotted for a conjunction over time.

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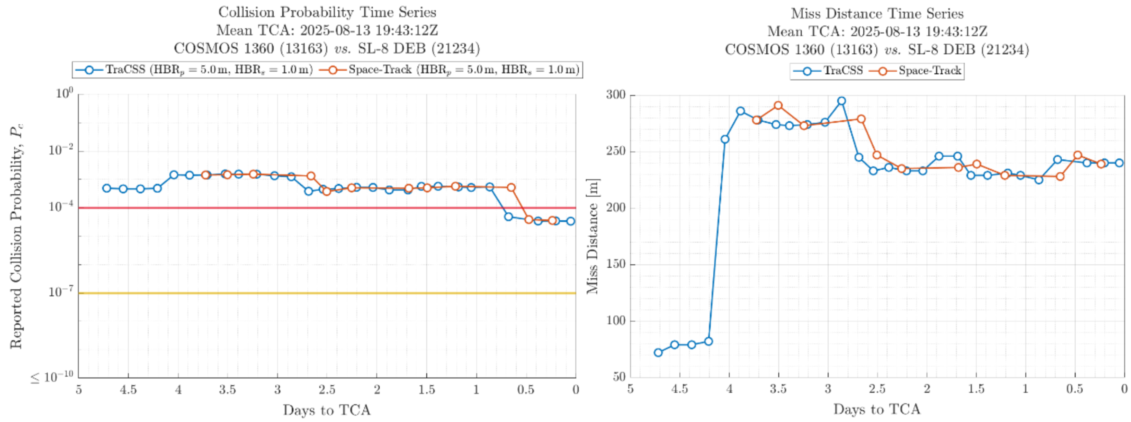

Fig. 4. Metric evolution - High Altitude

The figures show that the metrics from the two systems closely track each other over time. The variations of these state vectors over time cause slight disagreement in the Pc and miss distance values, but they are close enough that an operator would choose to make similar decisions based on the data.

These satellites were two relatively well tracked, non-maneuvering objects at higher altitudes, and therefore do not show significant variations in predicted trajectory over time. When any of those factors are not true, there are larger differences in CDM metrics. For example, Fig. 6 shows another example of Pc and Miss Distance over time in the LEO2 orbit regime. In these plots, the two predictions are tracking each other, but the variation in miss distance at comparable times is much larger. This plot also shows that TraCSS data tends to lead MD2 data. Any major changes in the metrics are usually present in the TraCSS system before the MD2 system. Sometimes TraCSS predicts a significant change in data before MD2 by up to 12 hours, though more commonly around 4-8 hours of lead time.

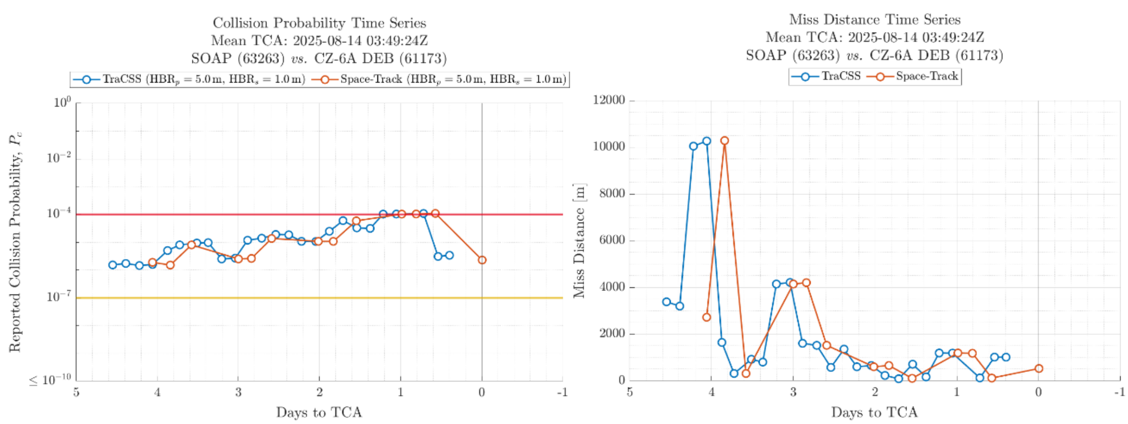

Fig. 5. Metric Evolution - Medium Altitude

The last set of Pc and miss distance plots (Fig. 7) shows a maneuverable satellite in the LEO1 regime. These figures show even greater disagreement due to the aforementioned reasons, but the trends still follow one another.

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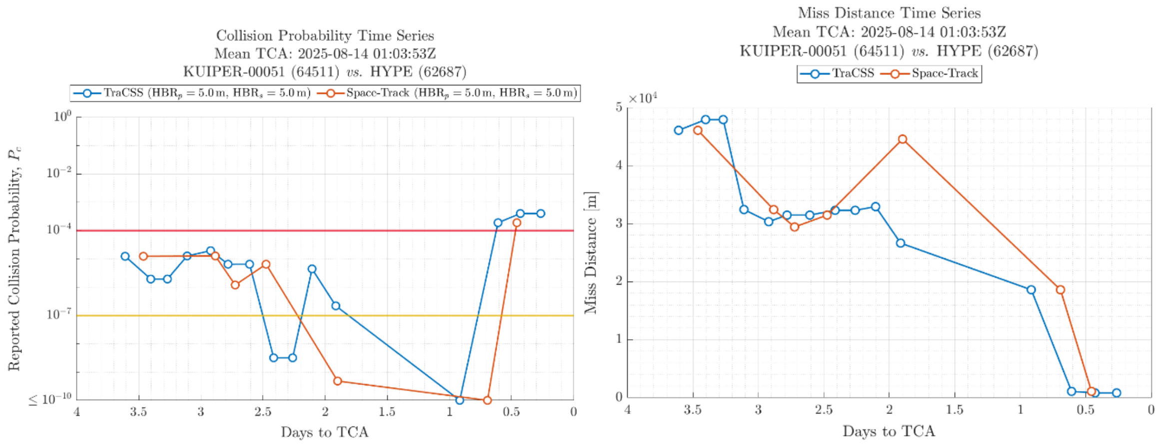

Fig. 6. Metric Evolution - Low Altitude

The TraCSS team is confident the TraCSS is producing CDMs of equal quality to the MD2 system given the tests show TraCSS exactly matching results when the inputs are the same, and the presence of similar results even when inputs are not guaranteed to be the same.

5. Will TraCSS perform screenings with equal or less latency than MD2?

The last metric examined is the freshness of the data used within the systems. Data freshness has been previously mentioned several times. It was first mentioned when CDMs on both TraCSS and MD2 had similar creation times; the state vector data was 3.5 hours fresher on the TraCSS side. In that case, the Pc and miss distance plots showed the TraCSS data leading the MD2 data by 4-12 hours. While those points already indicate TraCSS is using fresher data, one more direct comparison of data freshness was conducted.

Fig. 8 and Table 7 below show the difference in state vector epoch times for a pair of runs with similar creation times. In this case, the MD2 creation time is 1 minute after the TraCSS first creation time. This plot shows that even though the creation times are similar, the newest state vectors in the TraCSS data are 3.5 hours fresher than the newest state vectors in the MD2 system, and sometimes the difference in epoch ages is larger. This means that TraCSS is almost always operating with more up-to-date information than MD2.

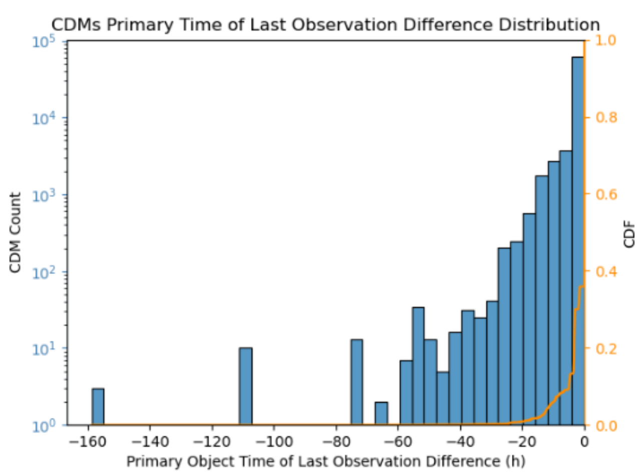

Fig. 7. Epoch age of MD2 State vectors compared to TraCSS state vectors

Table 7: Data Freshness Timestamp Example

	TraCSS	MD2
CDM Creation Time	14:22:58Z	14:23:19Z
Most Recent State Vector Time	13:32:29Z	10:04:41Z

Additionally, TraCSS performs more CA screenings than MD2. TraCSS performs CA runs every 4 hours, while MD2 performs CA runs approximately every 8 hours. While the previous plot showed that TraCSS was using data 3.5 hours newer at a comparable run time, TraCSS had also performed a run 4 hours before that without a comparable MD2 run at a similar time. This means that TraCSS is sometimes providing data 7.5 hours before MD2 is providing the same information. This indicates that even when there are differences between the systems, it is often the TraCSS system which is providing predictions based on the best data available.

All of these factors together indicate that TraCSS is performing its conjunction assessment mission with improvements over the MD2 system, as TraCSS is able to optimize its implementation to support the SSA mission.

8. TRACSS FUTURE CAPABILITIES

This paper has described the capabilities that will exist in TraCSS by January 2026. The Office of Space Commerce is making investments to increase the amount of space situational awareness that TraCSS will provide with its data products. The following sections describe a few of the capabilities the TraCSS program plans to explore in the future beyond the initial release in January 2026.

a. Streaming capabilities

While TraCSS is significantly increasing the data rates and freshness with its increased screening cadence, on-demand screenings, and O/O ephemeris database, spacecraft operators still have to wait up to 4 hours for TraCSS to refresh its debris catalog. Improvements to the data transfer process between the 18th SDS and TraCSS may enable TraCSS to receive new state vectors from the 18th minutes after new observations are taken.

This capability would enable several different conjunction analysis paradigms that spacecraft operators could benefit from. For example, TraCSS could screen these new state vectors as they come in, and eliminate the need for large CA runs every 4 hours. Since this would be a significant change to the way CA is performed today, TraCSS would get buy-in from the user community before getting rid of the large CA runs.

The section on testing results showed that TraCSS is currently providing data between 3.5 and 7.5 hours earlier than MD2. With streaming capabilities, TraCSS could add another 4+ hours to that difference and provide the operator community with data roughly 12 hours sooner than they are currently receiving it.

b. Incorporation of additional data sources

TraCSS plans to incorporate several different sources of input data into its CA screening service. The commercial SSA industry has made significant investments in the last few years to understand how to best use commercial observations of space objects. TraCSS plants to start incorporating this data as well as several other sources. Star-trackers attached to satellites have also shown to be able to produce huge quantities of space-based satellite observations. TraCSS is planning to acquire orbit determination and catalog management capabilities so it can effectively utilize these new sources of data.

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c. Incorporation of maneuver plans into propagation

Each of the two primary data sources for the TraCSS system has a weakness with regard to active payloads. Ephemerides propagated from HAC state vectors have traditionally not included O/O maneuver plans, and therefore are only accurate up to the maneuver point. Additionally, while the SSN sensors can produce very good ephemerides, O/O Global Navigation Satellite System (GNSS) data can generally outperform radar and optical measurements.

On the other hand, O/O ephemerides are produced in a non-standardized way and have varying levels of accuracy. Some O/Os provide MD2 with lower levels of predicted ephemeris accuracy and covariance realism. Even the more experienced O/Os generally cannot produce predicted ephemeris with the same level of accuracy as TraCSS or MD2 because they do not have access to the HASDM developed by the DoD.

There are several potential solutions that TraCSS is exploring to mitigate the weaknesses of both of these data sources. OCMs allow for O/Os to submit maneuver plans along with their ephemeris. The TraCSS system plans to explore options to include these in the propagation of its HAC ephemeris to ensure the HAC solutions retain accuracy for longer.

TraCSS is also considering accepting GNSS data and maneuver plans instead of ephemeris files. This would allow TraCSS to combine GNSS observation data with SSN and commercial observation data into an orbit determination process. TraCSS could then propagate these highly accurate state vectors along with O/O maneuver plans. Working at an observation level would mean that TraCSS could produce fewer and higher quality CDMs.

d. Launch screenings

Launch Collision Avoidance is a service that MD2 provides, which will not be available at the initial release of the TraCSS system. TraCSS is investigating ways that it can acquire capabilities that will enable it to reduce DoD workload and improve the efficacy of launch screenings.

e. Reentry predictions

On release, TraCSS will rehost reentry predictions calculated by MD2, but will not produce them itself. TraCSS is investigating how it can acquire capabilities in this area.

9. MIGRATION TO THE TRACSS SYSTEM

The TraCSS system will open up access to the broader operator community in January of 2026. Following that release, the Office of Space Commerce and the Department of Defense will encourage operators to create TraCSS accounts and begin using the TraCSS system. For a period of time, both TraCSS and MD2 will provide CDMs and other data products to commercial operators.

Upon registering in TraCSS, O/Os should begin submitting ephemerides in the OCM format to the TraCSS system. TraCSS and MD2 will share ephemerides for a limited amount of time during the migration period, but users should migrate quickly so that their ephemerides can still be screened once MD2 stops accepting ephemeris files. MD2, along with all users of TraCSS, has access to all ephemerides submitted to TraCSS and will continue to use these ephemerides as part of their internal screening process.

a. Account creation

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Starting in January 2026, TraCSS will open up access for all spacecraft operators worldwide to create a TraCSS account. Each operator organization will designate one of their members to request an organization account with the TraCSS system. This person will serve as the first account administrator. This administrator will submit a file containing basic information about the satellites owned by the organization which they desire to claim in the TraCSS system. Operators on the TraCSS side will verify the request. Following verification, the administrator is able to manage the account to meet the needs of the organization. The administrator can create invitations and approve profile creation for other members of their organization. They can also create subgroups for their organization or invite outside organizations to have access to organization data (primarily used for SSA provider groups).

Members of the public who do not operate spacecraft will not need to create an account. TraCSS will make a number of data products available to the public without authentication. This will include products that were only available to a select group on Space-Track.org such as the SP ephemerides.

b. OCMs and CDMs

TraCSS is utilizing the CCSDS recommended standards for CDMs and OCMs to ease information exchange. Detailed specifications for the formats of the CDM, and expected formats of the OCM are available on the Office of Space Commerce website [5] [6].

The OCM offers capabilities beyond what is capable with the various ephemeris formats currently accepted by MD2. Data about the physical characteristics of a satellite, and the orbit determination process can be included which can then be transferred over to any resulting CDMs. Additionally, O/Os can share information about planned maneuvers. TraCSS selected a single ephemeris format to encourage ephemeris sharing between its users.

c. APIs

Users of the space-track APIs for downloading MD2 data products will find a similar approach to accessing CDMs from the TraCSS system. All TraCSS data products are available through REST APIs along with being available through the presentation layer. Several custom parameters have been built that allow users to query for data easily and limit the number of returned CDMs they receive. Some organizations would like to receive CDMs representing the most recent data sources and only for active conjunctions that represent a real risk. The TraCSS APIs will make this straightforward. At the time of release, TraCSS will provide a handbook explaining how to use the system APIs to access data.

d. TraCSS Data Products

Most of the data products available on Space-Track have an equivalent data product on TraCSS. The notable exceptions are data products related to launch and re-entry, which are on the research and development roadmap for the TraCSS program.

The TraCSS Cat is like the SatCat available on Space-Track. TraCSS Cat is a table containing information about each object in the TraCSS system. There are additional fields in this table for informational purposes and as a source of data for the TraCSS CA screening process. For example, O/O's may submit their Hard Body Radius to the TraCSS system for TraCSS to incorporate into probability of collision calculations at a future date.

TraCSS Conjunction Notifications (TCNs) are CDMs, which are made publicly available. For the objects at the highest risk levels, TraCSS will make the CDMs publicly available as a TCN so the community can be aware of risks in the space environment. In order to not publicly display CDMs for already mitigated conjunctions,

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TraCSS implements a priority logic that will treat O/O ephemerides as a more trusted source than SP. TraCSS will only provide the CDMs from SP ephemeris if it is the only available data source.

SP ephemerides are trajectory predictions for all of the objects that TraCSS performs CA analysis for. Once a day, new ephemerides will be available with the covariances removed. Unlike on Space-Track, the public will have access to these files with no SSA sharing agreements needed. The SP ephemeris without covariance will be in the OCM format and be individually searchable with API queries.

TraCSS makes submitted O/O ephemerides publicly available per the TraCSS data policy [4]. The public will have access to the most recently submitted OPERATIONAL OCMs as soon as they are ingested into the TraCSS system. Custom query parameters will help users find only the newest OCMs for each spacecraft.

The final public data product in the TraCSS system are Two Line Elements (TLEs). Contrary to their name, TraCSS is making this data product available in the CCSDS Orbit Mean-Elements Message (OMM) format, similar to the GP class on Space-Track. This format breaks apart the traditional Two-Line Element format into individual fields that can be easily parsed. Also, like Space-Track, TraCSS places the actual Two-Line Element as the last two lines of the data message. For objects with NORAD IDs above 100,000 but below 340,000, TraCSS supports the Alpha-5 designations for these messages. Any objects that receive IDs above 340,000 still have all of the same OMM data fields available, but the Two-Line Element portion will not function. Two-Line Elements can be used for radar pointing and research purposes, but are of lower accuracy and should not be used for collision avoidance.

There are also data products that TraCSS keeps restricted to certain organizations. CDMs are a non-public data product because they will only be made available to the organizations operating the satellites involved in each conjunction.

The TraCSS O/O directory is a list of operational contacts per satellite. It will be available to all registered users (i.e. satellite operators), but is not available to the public.

As mentioned before, CANDIDATE OCMs are trajectories that organizations are considering for their satellites. To prevent confusion, these files will only be available to the organization that submitted them.

Table 8: TraCSS Data Products

	TraCSS Data Products
Public Data	TraCSS Catalog (TraCSSCat)
	TraCSS Conjunction Notifications (TCNs)
	SP Ephems w/o Covariance
	OCMs (operational ephemeris)
	TLEs (in OMM format)
	Re-entry Predictions
Non-Public Data	Conjunction Data Messages (CDMs)
	TraCSS O/O Directory
	OCMs (Candidate Ephemeris)
	Anomaly Reports

10. CONCLUSION

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This paper has shown that the TraCSS system is currently performing conjunction analysis equivalent to or at a higher service level than currently provided by MD2. The systems perform conjunction analysis with the same degree of accuracy, but TraCSS provides data to the community in a quicker manner due to the difference in operations.

Operators should prepare themselves to migrate from MD2 to TraCSS when TraCSS launches its production release in January 2026. Operators can familiarize themselves with the services that TraCSS provides, and with the data message specification used by TraCSS by reading this paper and the TraCSS specification documents [5] [6]. With the migration of CA services from MD2 to TraCSS quickly approaching, this paper should help operators to engage with TraCSS as soon as possible following the official release.

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