National Oceanic & Atmospheric Administration (NOAA)

Office of Space Commerce (OSC)

Traffic Coordination System for Space (TraCSS)

Conjunction Data Message (CDM) Specification for Traffic Coordination System for Space (TraCSS)

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Conjunction Data Message (CDM) Specification for Traffic Coordination System for Space (TraCSS):

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1. Purpose

This specification provides the space situational awareness (SSA) community with the specifications on conjunction data messages (CDM) fields in the CDM product that the Department of Commerce (DOC) Traffic Coordination System for Space (TraCSS) will deliver for on-orbit conjunction assessment (CA).

The TraCSS specifications rely on a format based on the Consultative Committee for Space Data Systems (CCSDS) CDM Recommended Standard 508.0-B-1[1] and Draft Recommended Standard 508.0-P-1.1[2], with modifications based on the needs of the TraCSS architecture and its users. These modifications have been formulated using input from beta users participating in TraCSS from Phase 1.0 (September 30, 2024) to increment Phase 1.1 (March 2025) and are described in this specification.

[1] Conjunction Data Message. Issue 1. Recommendation for Space Data System Standards (Blue Book), CCSDS 508.0-B-1. Washington, D.C.: CCSDS, June 2013 (This current issue includes all updates through Technical Corrigendum 2, dated October 2021. Available at: https://public.ccsds.org/Pubs/508x0b1e2c2.pdf (Accessed April 17, 2025)

[2] Conjunction Data Message. Draft Recommended Standard. Draft Recommendation for Space Data Standards (Pink Book) CCSDS 508.0-P1.1, Washington D.C.: CCSDS March 2024. Available at: https://ccsds.org/wp-content/uploads/gravity_forms/9-6f599803174a64f5da08b9814720b5c4/2025/02/508x0p11.pdf (Accessed April 17, 2025)

2. Background

2.1. Consultative Committee for Space Data Systems

The Consultative Committee for Space Data Systems (CCSDS)[3] is a multi-national organization of international space agencies that develops open communications and data standards for space systems. CCSDS has multiple working groups developing and publishing standards. The Navigation Working Group family of space data messages are most applicable for use by space launch operators, spacecraft operators, SSA service data providers, analysts, and message exchange partners and are freely accessible at the CCSDS website.

2.2. CCSDS Conjunction Data Message

As detailed by the CCSDS in its March 2023 report, the currently available CCSDS Conjunction Data Message (CDM) 508.0-B-1 specifies a standard message format for exchanging spacecraft conjunction information between providers of CA results and spacecraft owners and operators. The CA results provide information associated with the closest point of approach or local minimum in the difference between the position components of two space object trajectories at their time of closest approach (TCA).

The CDM is the final product of CA results and is intended to provide spacecraft owner/operators with sufficient information to assess the risk of collision and design collision avoidance maneuvers, if necessary.

3. CDM Fields for TraCSS

3.1. CDMs in the TraCSS System

As noted above, the CDM will be the primary product that TraCSS will deliver for on-orbit CA. This TraCSS CDM specification was designed to leverage the format present in the CCSDS CDM Recommended Standard 508.0-B-1 and Draft Recommended Standard 508.0-P-1.1 to the max extent possible. Additions to the specifications were made only when changes were necessary to provide additional SSA, or increase the effectiveness of the TraCSS system. Instances of such modifications are noted where present in Table 1 below.

TraCSS CDMs will be made available in multiple formats: Keyword = Value Notation (KVN), Extensible Markup Language (XML), and JavaScript Object Notation (JSON). A CDM will contain identical information regardless of the file format in which it is presented.

If a CDM meets certain alertable emergency criteria, information about the conjunction will be posted as a TraCSS Conjunction Notification (TCN). Posted TCNs will contain a

[3] Visit https://ccsds.org/ for more information on the CCSDS. (Accessed April 17, 2025)

limited subset of the information in a typical CDM but will be publicly available for the SSA community. In addition to viewing public TCNs, spacecraft owners/operators will be able to access the full CDM information as normal.

3.2. Specifications for the TraCSS CDM

The CDM consists of the following fields. Where applicable, CDM values will also display units. In the KVN format, units will be displayed per the example below:

```
MISS_DISTANCE        = 22        [m]
```

Table 1: TraCSS CDM Specification

Keyword	Description	Example
CCSDS_CDM_VERS	CDM format version in the form of X.Y.	2.0
CLASSIFICATION	Description of dissemination controls	UNCLASSIFIED. "Operator-proprietary data; secondary distribution not permitted", UNCLASSIFIED. "Public TraCSS Conjunction Notification
MEETS_ALERTABLE_CRITERIA	A comment placed here to indicate if this CDM meets TraCSS alertable criteria defined in the TraCSS user handbook.	YES NO
CREATION_DATE	File creation date/time in UTC in month-day format	2015-07-04T12:00:00.000000
ORIGINATOR	Creating agency or operator	TraCSS
MESSAGE_FOR	Spacecraft name(s) for which the CDM is provided	STARLINK-61, <secondary satellite name>
MESSAGE_ID	ID that uniquely identifies the CDM message.	000049304_conj_000005614_2024287050914
RUN_ID	The unique ID of the conjunction analysis run that produced this CDM, for traceability.	258526987
CORRELATION_ID	The unique ID correlates the CDM to the package of SP	258526987

Keyword	Description	Example
	Vectors used by TraCSS. May be used by operators to get insight on SP Vector updates	
TCA	The Date and Time of the conjunction in UTC ISO8601 format	2015-07-04T12:00:00.000000
MISS_DISTANCE	The overall separation distance of both objects at TCA in meters	437
MAHALANOBIS_DISTANCE	The length of the relative position vector, normalized to one-sigma dispersions of the combined error covariance in the direction of the relative position vector	12
RELATIVE_SPEED	The magnitude of the relative velocity vector in meters/sec. The speed at which both objects are moving relative to each other at TCA in meters/second	15031
COLLISION_PROBABILITY	The probability of collision (Pc) calculated from values of 0.0 to 1.0	0.000003656957
COLLISION_PROBABILITY_METHOD	The method utilized to calculate probability of collision	FOSTER-1992
COLLISION_MAX_PROBABILITY	The maximum collision probability that Object1 and Object2 will collide	0.001243656957
COLLISION_MAX_PC_METHOD	Method used to calculate COLLISION_MAX_PROBABILITY	FRISBEE
DILUTION_STATUS	Flag indicating whether conjunction is in the dilution region or robust region.	ROBUST DILUTED
DILUTION_SIGNIFICANCE	Value indicating difference between Pc and Max Pc. This relates how severely diluted a conjunction is or how safely robust it is.	

Keyword	Description	Example
SCREEN_PC_THRESHOLD	The collision probability screening threshold used to identify this conjunction.	0
ENVIRONMENTAL_IMPACT_ FRAGMENTATION	Value indicating number of predicted fragments if this collision were to occur	2438
FRAGMENTATION_MODEL	Free text field containing the name of the space environment fragmentation model used	
START_SCREEN_PERIOD	The start time in UTC of the screening period for the conjunction assessment	2015-07-04T12:00:00.000000
STOP_SCREEN_PERIOD	The stop time in UTC of the screening period for the conjunction assessment	2015-07-09T12:00:00.000000
FIELDS BELOW REPEATED FOR OBJECT 1 AND 2 Each field will have SAT1_ or SAT2_ Prepended to the key		
OBJECT	The object for which the metadata applies	OBJECT 1 OBJECT 2
OBJECT_DESIGNATOR	The SCC or NORAD CAT ID for the object	25544
CATALOG_NAME	The satellite catalog used for the object	DOD Catalog TraCSS OCM Catalog TraCSS Commercial Data Catalog
OBJECT_NAME	The common name for the object	STARLINK-61 COSMOS 1408 DEB
INTERNATIONAL_DESIGNAT OR	The International Designator for the object in a YYYY-NNNP{PP}, where: YYYY = Year of launch. NNN = Three-digit serial number of launch in year YYYY (with leading zeros). P{PP} = At least one capital letter for the identification of	1998-06

Keyword	Description	Example
	the part brought into space by the launch.	
SCREENING_DATA_SOURCE	The data used to generate the CDM	DoD HAC State Vector O/O Operational Ephemeris O/O Candidate Ephemeris Commercial SSA Provider
EPHEMERIS_NAME	The MESSAGE_ID of the ephemeris utilized if the data source is an OCM	NONE d49d5103-1124-4909-952a-a391d92dc372
OBJECT_TYPE	Category of type of object	PAYLOAD ROCKET BODY DEBRIS UNKNOWN OTHER
OPS_STATUS	Specification of the operational status of the space object. Information will be pulled from corresponding OCM if available.	OPERATIONAL_MANEUVERABLE NONOPERATIONAL Full list can be found on the SANA Registry at https://sanaregistry.org/r/operational_status/
MANEUVERABLE	The maneuvering capability of the object for collision avoidance. This field will be populated with information from corresponding OCM, or TraCSS database of satellite information if available	YES NO UNKNOWN
OPERATOR_ORGANIZATION	The organization of the owner/operator of the object	SpaceX
OPERATOR_PHONE	The phone number of the owner/operator of the object. Space-Track will place a URL for a query that will lead to this information	284-135-4239
OPERATOR_EMAIL	The e-mail of the owner/operator of the object. Space-Track will place	First.last@email.org

Keyword	Description	Example
	a URL for a query that will lead to this information	
COVARIANCE_METHOD	The method of which covariance is calculated. When covariance cannot be calculated, default values may be used. Caution should be used when using default values when calculating Pc	CALCULATED DEFAULT
ORBIT_CENTER	The central body about which Object1 and Object2 orbit. If not specified, the center is assumed to be Earth.	EARTH SUN
GRAVITY_MODEL	The name of the gravity model used for propagation. Information will be pulled from corresponding OCM if available.	EGM-96: 36D 360
ATMOSPHERIC_MODEL	The name of the atmospheric model used for propagation. Information will be pulled from corresponding OCM if available.	JBH09
N_BODY_PERTURBATIONS	The gravitational perturbation models used in a comma separated format. Information will be pulled from corresponding OCM if available.	MOON, SUN
SOLAR_RAD_PRESSURE	Indicates whether solar radiation pressure was used during the Orbit Determination (OD) of the object. Information will be pulled from corresponding OCM if available.	YES NO
EARTH_TIDES	Indicates whether solid Earth and ocean tides were used in the OD of object. Information will be pulled from	YES NO

Keyword	Description	Example
	corresponding OCM if available. Will be YES if both OCEAN_TIDES_MODEL and SOLID_TIDES_MODEL are YES	
INTRACK_THRUST	Indicates whether in-track thrust modeling was used for the OD and propagation of the object.	YES NO
TIME_LASTOB_START	The binned time in UTC of the start of the timespan that contains observations used in the OD. If last observation time < 24 hours from CDM creation, TIME_LASTOB_START = CREATION_DATE - 1 day If 24 < last observation time < 48, TIME_LASTOB_START = CREATION_DATE – 2 days If last observation time < 48 hours, TIME_LASTOB_START = CREATION_DATE – 180 days	2015-07-04T12:00:00.000000
TIME_LASTOB_END	The binned time in UTC of the end of the timespan that contains observations used in the OD. If last observation time < 24 hours from CDM creation, TIME_LASTOB_END = CREATION_DATE If 24 < last observation time < 48, TIME_LASTOB_END = CREATION_DATE – 1 day If last observation time < 48 hours, TIME_LASTOB_END = CREATION_DATE – 2 days	2015-07-04T12:00:00.000000
RECOMMENDED_OD_SPAN	The recommended time span for the OD of the object in days. Information will be	2.76

Keyword	Description	Example
	pulled from corresponding OCM if available.	
ACTUAL_OD_SPAN	The actual time span used in the OD of the object in days. Information will be pulled from corresponding OCM if available.	2.76
OBS_AVAILABLE	Total amount of observations available for the OD of the object. Information will be pulled from corresponding OCM if available.	57
OBS_USED	Actual number of observations used in the OD of the object. Information will be pulled from corresponding OCM if available.	57
TRACKS_AVAILABLE	The number of sensor tracks available for the OD of the object. Information will be pulled from corresponding OCM if available.	7
TRACKS_USED	The number of sensor tracks accepted for the OD of the object. Information will be pulled from corresponding OCM if available.	7
RESIDUALS_ACCEPTED	The percentage of residuals accepted in the OD of the object	99.3
WEIGHTED_RMS	The weighted Root Mean Square (RMS) of the residuals from a batch least squares	1.4
APOAPSIS_ALTITUDE	The apogee of the object in km above oblate earth surface	460

Keyword	Description	Example
PERIAPSIS_ALTITUDE	The perigee of the object in km above oblate earth surface	437
INCLINATION	The inclination of the object in deg	60.7
HBR	The Hard Body Radius in m used by the TraCSS system to calculate probability of collision	3.00
AREA_PC	The cross-sectional area of the object in m2. This value is NOT used to calculate Pc	3.12
CD_AREA_OVER_MASS	The object's CD•A/m used in the propagation of the vector and covariance to TCA in m2/kg	0.161615504658
CR_AREA_OVER_MASS	The object's CR•A/m used in the propagation of the vector and covariance to TCA in m2/kg	0
THRUST_ACCELERATION	The object's acceleration in the In-track or Transverse (T) direction (RTN) used for propagating the state vector and covariance until TCA in m/s2	0 0.634
SEDR	The Specific Energy Dissipation Rate, which is the amount of energy being removed from the object's orbit by the non-conservative forces. This value is an average calculated during the OD	0.020492
MASS	The mass of the object in kg	10.1
RELATIVE_POSITION_R	If in Object 1's section: The radial (R) component of Object 2's position relative to Object 1 in Object 1's RTN coordinate frame in meters	-57

Keyword	Description	Example
	 If in Object 2’s section: Vice versa the above	
RELATIVE_POSITION_T	If in Object 1’s section: The transverse (T) component of Object 2’s position relative to Object 1 in Object 1’s RTN coordinate frame in meters If in Object 2’s section: Vice versa the above	-264
RELATIVE_POSITION_N	If in Object 1’s section: The normal (N) component of Object 2’s position relative to Object 1 in Object 1’s RTN coordinate frame in meters If in Object 2’s section: Vice versa the above	260
RELATIVE_VELOCITY_R	If in Object 1’s section: The radial (R) component of Object 2’s velocity relative to Object 1’s velocity in Object 1’s RTN coordinate frame in meters/second If in Object 2’s section: Vice versa the above	1.5
RELATIVE_VELOCITY_T	If in Object 1’s section: The transverse (T) component of Object 2’s velocity relative to Object 1’s velocity in Object 1’s RTN coordinate frame in meters/second If in Object 2’s section: Vice versa the above	-14072.6
RELATIVE_VELOCITY_N	If in Object 1’s section:	-2511.5

Keyword	Description	Example
	The normal (N) component of Object 2's velocity relative to Object 1's velocity in Object 1's RTN coordinate frame in meter/second If in Object 2's section: Vice versa the above	
APPROACH_ANGLE	If in Object 1's section: The angle between the inertial velocity vector of Object1 and the inertial velocity vector of Object2 with respect to Object1. 0 degrees reflects "overtaking" and 180 degrees reflects "head-on" condition. If in Object 2's section: Vice versa the above	30
SCREEN_VOLUME_SHAPE	Shape of the screening volume: ELLIPSOID or BOX.	ELLIPSOID BOX
SCREEN_VOLUME_FRAME	Name of the Object 1 or Object 2 centered reference frame in which the screening volume data are given.	RTN
SCREEN_VOLUME_X	The R component size of the screening volume in the SCREEN_VOLUME_FRAME in km	0.4
SCREEN_VOLUME_Y	The T component size of the screening volume in the SCREEN_VOLUME_FRAME in km	25
SCREEN_VOLUME_Z	The N component size of the screening volume in the SCREEN_VOLUME_FRAME in km	25

Keyword	Description	Example
REF_FRAME	Name of the reference frame for the provided state vectors	EME2000 for position and velocity
X	Object position vector X component in km	1670.352554
Y	Object position vector Y component in km	-6834.579872
Z	Object position vector Z component in km	-1430.950837
X_DOT	Object velocity vector X component in km/s	2.780391335
Y_DOT	Object velocity vector Y component in km/s	2.808606433
Z_DOT	Object velocity vector Z component in km/s	-5.751722603
CR_R	Object covariance matrix [1,1] in m2 in Object 1's RTN coordinate frame	2.762478951638903E+01
CT_R	Object covariance matrix [2,1] in m2 in Object 1's RTN coordinate frame	-6.541950061667144E+00
CT_T	Object covariance matrix [2,2] in m2 in Object 1's RTN coordinate frame	1.090607087502915E+03
CN_R	Object covariance matrix [3,1] in m2 in Object 1's RTN coordinate frame	-1.587445746741558E+00
CN_T	Object covariance matrix [3,2] in m2 in Object 1's RTN coordinate frame	-5.317841526701392E+01
CN_N	Object covariance matrix [3,3] in m2 in Object 1's RTN coordinate frame	8.797136762538368E+01
CRDOT_R	Object covariance matrix [4,1] in m2/s in Object 1's RTN coordinate frame	-6.857932575721321E-03
CRDOT_T	Object covariance matrix [4,2] in m2/s in Object 1's RTN coordinate frame	-1.093942116989287E+00
CRDOT_N	Object covariance matrix [4,3] in m2/s in Object 1's RTN coordinate frame	5.141264772990662E-02

Keyword	Description	Example
CRDOT_RDOT	Object covariance matrix [4,4] in m2/s2 in Object 1's RTN coordinate frame	1.122438786460208E-03
CTDOT_R	Object covariance matrix [5,1] in m2/s in Object 1's RTN coordinate frame	-2.853074300735485E-02
CTDOT_T	Object covariance matrix [5,2] in m2/s in Object 1's RTN coordinate frame	5.986579249990964E-03
CTDOT_N	Object covariance matrix [5,3] in m2/s in Object 1's RTN coordinate frame	1.478514422166540E-03
CTDOT_RDOT	Object covariance matrix [5,4] in m2/s2 in Object 1's RTN coordinate frame	7.996126426440161E-06
CTDOT_TDOT	Object covariance matrix [5,5] in m2/s2 in Object 1's RTN coordinate frame	2.947267656834074E-05
CNDOT_R	Object covariance matrix [6,1] in m2/s in Object 1's RTN coordinate frame	-6.272024074839294E-03
CNDOT_T	Object covariance matrix [6,2] in m2/s in Object 1's RTN coordinate frame	-5.847356784490015E-02
CNDOT_N	Object covariance matrix [6,3] in m2/s in Object 1's RTN coordinate frame	2.510808305542750E-02
CNDOT_RDOT	Object covariance matrix [6,4] in m2/s2 in Object 1's RTN coordinate frame	5.918716392405004E-05
CNDOT_TDOT	Object covariance matrix [6,5] in m2/s2 in Object 1's RTN coordinate frame	6.412943205733823E-06
CNDOT_NDOT	Object covariance matrix [6,6] in m2/s2 in Object 1's RTN coordinate frame	3.037280667193719E-05
DENSITY_FORECAST_UNCERTAINTY	The dynamic considers parameter (DCP) 1-sigma uncertainty of the relative atmospheric density for the specified object (given as a	2.143370310000000E-0

Keyword	Description	Example
	simple ratio). This is the uncertainty of the average atmospheric density exerting drag on the object, relative to the nominal (measured) atmospheric density	
DCP_SENSITIVITY_POSITION_R	The DCP position sensitivity in the radial (R) direction expressed in the object's radial-transverse-normal (RTN) reference frame in meters. This sensitivity vector relates changes in the object's TCA position vector to variations in relative atmospheric density and is in meters	-7.345809012167026E+02
DCP_SENSITIVITY_POSITION_T	The DCP position in the transverse (T) direction in m	3.865957136169006E+05
DCP_SENSITIVITY_POSITION_N	The DCP position in the Normal (N) direction in m	-1.456925086066596E+02
DCP_SENSITIVITY_VELOCITY_R	The DCP velocity in the radial (R) direction that relates changes in the object's TCA inertial velocity vector to variations in relative atmospheric density and is in m/s	-2.195009966872100E+02
DCP_SENSITIVITY_VELOCITY_T	The DCP velocity in the transverse (T) direction in m/s	2.630946954519584E-01
DCP_SENSITIVITY_VELOCITY_N	The DCP velocity in the normal (N) direction in m/s	3.265607422364180E-01

Appendix 1: Engineering Justification for Draft TraCSS-Spec-001

This appendix supports the “Draft Conjunction Data Message (CDM) Specification for Traffic Coordination System for Space (TraCSS) TraCSS-Spec-001” dated April 17, 2025, as it is released for public feedback.

As decisions were made regarding the TraCSS CDM specification, it became apparent that choices were made that not all TraCSS users would agree with and that would potentially impact the parsing tools used by satellite operators. The TraCSS Standards working group faced a number of competing priorities that balanced the continued use of existing message formats against facilitating the growth of TraCSS space situational awareness (SSA) capabilities and preventing the need to make future specification changes to allow for those capabilities.

TraCSS highly values the international standards community and based the TraCSS CDM specification on the CCSDS Conjunction Data Message recommended standard. While it is recognized the CCSDS CDM Pink Book standard will soon be published, and much of TraCSS-Spec-001 was in alignment with what is forthcoming, the message format in its pure form was somewhat restrictive, and made the parsing of information contained in the messages overly burdensome.

To overcome these limits, the draft TraCSS-Spec-001-2.0 moves away from these limitations and are presents them for public feedback. Many of the updates in the draft follow the draft CCSDS CDM Pink Book standard, but several do not.

This appendix offers insight into cases where there are exceedances of the CCSDS standard and explain why the TraCSS standards team believes they are worthwhile in pursuit of improvement to spaceflight safety communications.

1. The first category are fields added to the TraCSS CDM spec that enable greater Space Situational Awareness (SSA). By adding the following additional fields, it provides satellite operators have more insight into upcoming conjunctions. These fields are:
    - **MAHALANOBIS_DISTANCE**
    - **COLLISION_MAX_PROBABILITY**
    - **COLLISION_MAX_PROBABILITY_METHOD**
    - **DILUTION_STATUS**
    - **DILUTION_SIGNIFICANCE**
    - **ENVIRONMENTAL_IMPACT_FRAGMENTATION**
    - **FRAGMENTATION_MODEL**
    - **APPROACH_ANGLE**

    Of these fields, most satellite operators heavily involved in the SSA community are likely familiar with all except “Environmental_Impact_Fragmentation”. As TraCSS has the goal to reduce the risk of spaceflight operations, the team thought it was prudent to include this metric to give insight into the possible environmental impact of a collision on the space environment, and other spacecraft. This field also offers support for the United Nations Committee on the Peaceful Use of Outer Space goals to achieve greater sustainability of the outer space environment through greater awareness of the potential to generate space debris.

2. The second category pertains to fields that come from the current CDMs offered on space-track.org. The commercial space community is expected to migrate from using existing SSA services offered by the 18th and 19th Space Defense Squadrons and space-track.org to the TraCSS system by January 2026. To assist with this transition. TraCSS will not eliminate the provision of any data that space-track.org users are familiar with or use on a regular basis.   Rather, several additional new fields to those in paragraph 1 above are incorporated that are not included in the published CCSDS CDM standard or provided by space.track.org:
    - **APOAPSIS_ALTITUDE** (renamed to match the draft CCSDS pink book standard)
    - **PERIAPSIS_ALTITUDE** (renamed to match the draft CCSDS pink book standard)
    - **INCLINATION** (renamed to match the draft CCSDS pink book standard)
    - **DCP_SENSITIVITY_POSITION_R** (broken into components to match the way vectors are handled elsewhere in the specification)
    - **DCP_SENSITIVITY_POSITION_T**
    - **DCP_SENSITIVITY_POSITION_N**
    - **DCP_SENSITIVITY _VELOCITY_R** (broken into components to match the way vectors are handled elsewhere in the specification)
    - **DCP_SENSITIVITY_VELOCITY_T**
    - **DCP_SENSITIVITY_VELOCITY_N**

3. The third category are fields added to add transparency to the TraCSS system. Some of these are unique to give insight into TraCSS system processes. Others are new to the TraCSS system due to the utilization of the Orbit Comprehensive Messages (OCMs) as input data rather than plain ephemeris files. TraCSS CDMs will include much more information about users' ephemeris than in the existing processes with space-track.org. Many of these fields will simply make it easier to use the TraCSS system and search for information that users are looking for, again offering additions to grow capabilities within TraCSS to make it more useful. These transparency fields are:
    - **OPS_STATUS**
    - **SCREENING_DATA_SOURCE**
    - **RUN_ID**

- **CORRELATION_ID**
- **MEETS_ALERTABLE_CRITERIA**

4. The fourth category goes beyond new fields. Specifically, there are slight adjustments to the way that the KVN standard is formatted. The first being the prepended SAT1_ and SAT2_ markers. Key – Value notation is intended to have a single key paired to a single value. In the existing KVN format, the section repeated for each object has the same key repeated, causing challenges in building parsers for the message. The TraCSS system will prepend SAT1_ and SAT2_ to these fields so each value will have a unique key. This is intended to make it easier for users new to the community to interact with TraCSS. Additionally, TraCSS is providing CDM messages in a variety of data formats including JSON, XML, and csv with the same goal of providing flexibility for satellite operators.

5. The fifth category pertains to the comment fields. The comment fields in the existing space-track.org CDMs are another example of breaking KVN format. This key is repeated, and then does not follow the same ‘key’ = ‘value’ format of the other fields. The TraCSS CDM spec does not include any comment fields because the team believes they make parsing the message for the desired data overly complex.

6. The sixth category pertains to reference frames. TraCSS is choosing to output state vectors in the EME2000 frame rather than the ITRF frame output by the current space-track.org CDMs. This frame is more relevant to satellite operators and will make CDM analysis more accessible to newer users.

7. Lastly, and probably most importantly, is the change to the prevailing concept that a CDM is intended for object1 (often called the primary object) and that additional calculations must be performed to generate a CDM representing the same conjunction from object2’s (often called the secondary object) perspective. Instead, TraCSS will generate a single message and distribute it to both users. In this paradigm object1 and object2 are simply descriptors for the two space objects involved in a conjunction and are not intended to convey that object1 is a protected primary object and object2 is a secondary object.

   The specification changes to make this happen are relatively simple. The following fields will be moved into the object specific sections:

   - **RELATIVE_POSITION_R**
   - **RELATIVE_POSITION_T**
   - **RELATIVE_POSITION_N**
   - **RELATIVE_VELOCITY_R**

- **RELATIVE_VELOCITY_T**
- **RELATIVE_VELOCITY_N**
- **APPROACH_ANGLE**
- **SCREEN_VOLUME_SHAPE**
- **SCREEN_VOLUME_FRAME**
- **SCREEN_VOLUME_X**
- **SCREEN_VOLUME_Y**
- **SCREEN_VOLUME_Z**

This will cause CDMs generated by the TraCSS system to be “symmetrical”. This means that the message is equally relevant to the object1 operators and to the object2 operators.

This change has advantages and disadvantages that are listed below.

Advantages:

- TraCSS can generate a single CDM for the single conjunction instead of two. This will speed up processing, and reduce data storage costs
- Discussing a conjunction with other satellite operators, or TraCSS operators will be easier because everyone will be discussing the same document that can be identified by things like message_id rather than discussing two similar documents.
- The TraCSS team sees a potential future where routine screenings become less common, and TraCSS is constantly performing one v all screenings as new data is streamed into the system. Having symmetrical CDMs that can be distributed to the operators of both objects greatly simplifies the screening process in this case.
- Related to the previous point, if TraCSS ever does change the screening process to be more streaming focused, this change to the specification may be required. Making the spec change now, before users are using the system helps ensure we won’t have to ask users to change to accommodate TraCSS process changes after the TraCSS system is operational.
- Perhaps most importantly, this change would actually result in satellite operators receiving CDMs that they otherwise would not receive. While uncommon, there are ephemeris and covariance geometries that result in object2 being in the screening volume of object1, but not the other way around. There is potential that object2 is an active payload, but object1 is debris. In this case, even though there could be a relatively high Pc, no one will receive the generated CDM, because the debris object has no owner. The change to send the CDM to both users will mitigate this edge case.

Disadvantages:

- Satellite operators will not be guaranteed to be object1 on any given CDM. For the operators that auto-ingest CDMs, to perform analysis, they will have to account for this in their code.
- For operators who receive CDMs from sources other than space-track, they will have to make sure their parsers can handle TraCSS CDMs as well as CDMs from other sources.

In the interest of TraCSS users, and advancing the system for better SSA capabilities and future needs, the disadvantages are not seen as barriers to users. The community is encouraged to provide feedback on this specification and start discussion on ways to improve this specification to enable satellite operators to more easily retrieve SSA information.