TraCSS

TraCSS Updated CDM & OCM Specifications

Stakeholder Listening Session

August 1, 2025 | 12:00 – 1:00 PM (EDT)

Listening Session “Ground Rules”

General Guidelines:

- **Stay on schedule** – Respect everyone’s time.
- **Be respectful & professional** – Maintain a courteous tone.
- **Keep questions brief & relevant** – Submit via Q&A panel.
- **No marketing pitches** – This is for feedback, not promotion.

Confidentiality & Conduct:

- This session is **recorded** and subject to **FOIA**.
- Do **not** share proprietary or sensitive info.
- Disruptions may result in removal.

Participation Protocol:

- **You will be muted** when not speaking.
- **Videos are turned off.**
- Use chat responsibly.

Q&A Process:

- Submit questions in the **Q&A Panel**.
- Pre-submitted questions will be addressed live.
- Speakers will be called on **by order of hands raised**

TRACSS

Background/Introduction

Dr. Dianne Poster - Office of Space Commerce

TraCSS & CDM & OCM Specifications

- DOC has developed proposals for conjunction data messages (CDM) and orbit comprehensive message (OCM) data formats.
- Today's updates are relative to the presentations of these message formats taking into consideration previous listening sessions on the formats.
  - CDM specification was reviewed on 04/30/2025
  - OCM specification was reviewed on 05/02/2024
  - Updates take into consideration feedback from the current beta users participating in TraCSS
- The CDM specification fields and the product that TraCSS will deliver for on-orbit conjunction assessment (CA) will be discussed in the first 25 minutes, with a short overview followed by time for feedback on the CDM.
- The OCM specification fields will be discussed in the second 25 minutes, with a short overview followed by time for feedback on the OCM.
- A ten-minute wrap up time will be provided, with feedback welcome on either topic.

TraCSS & CDM & OCM Specifications

- The TraCSS CDM and OCM are based on the Consultative Committee for Space Data Systems (CCSDS) recommended standards.
- CDM recommended standard 508.0-B-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)
- Orbit Data Messages, Recommended Standard (Blue Book), CCSDS 502.0-B-3. Washington, D.C. CCSDS, April 2023. Available at: https://public.ccsds.org/Pubs/502x0b3e1.pdf

TraCSS

CDM & OCM Overview

Robert Wolff, Flight Dynamics Engineer,TraCSS

TraCSS & Conjunction Data Messages

- Fields proposed are based on CCSDS 508.0-B-1 and work of the CCSDS Navigation Working Group on its revision to the maximum extent possible.
- Proposed fields are those based on input from beta users participating in TraCSS from Phase 1.0 (September 30, 2024) to increment Phase 1.2 (began May 2025).
- The CDM will be the primary product that TraCSS will deliver for on-orbit CA.
- TraCSS CDMs will be made available in five formats: Keyword = Value Notation (KVN), Extensible Markup Language (XML), a JavaScript Object Notation (JSON) format like the JSON format currently on space-track, a TraCSS unique JSON, and a Comma Separated Value (CSV).
- These formats are necessary to best support the needs of the many TraCSS users who have drafted their processes around these formats.
- The KVN, and XML versions are an implementation of the CCSDS recommended standards.
- The JSON and CSV formats are largely in agreement with the CCSDS recommended standards, but not in perfect adherence (see Table 1 in specification and next slide)

TraCSS & Conjunction Data Messages

Format	Origin	Additional Information
KVN - Section 3.2	CCSDS CDM Version 2.0	• Keywords repeated for object1 and object2 sections • CCSDS standard • ITRF frame state vectors • Most human readable
XML - Section 3.3	CCSDS CDM Version 2.0	• Keywords repeated for object1 and object2 sections • CCSDS standard • ITRF frame state vectors
JSON-ST - Section 3.4	space-track JSON format	• Unique keywords • Widely used ST format • ITRF frame state vectors
CSV	space-track CSV format	• Identical to JSON-ST except in CSV • Unique keywords • ITRF frame state vectors
JSON-TraCSS - Section 3.5	TraCSS Unique	• Unique keywords • Identical to JSON-St except reference frames • EME2000 frame state vectors

Table 1 provides:

- a summary of the five CDM formats that TraCSS will provide to its users, and
- additional information to help users decide which format or formats are best for their use

TraCSS & Conjunction Data Messages

- The specification document provides a listing of the fields applicable to TraCSS CDMs in Section 3.2.
- Table 2 provides the specifications in KVN format, includes descriptions of the fields.
- In the In the KVN format, units will be displayed per the example:

  MISS_DISTANCE = 22 [m]

- Section 3.3 provided a CDM specification example in XML
- Section 3.4 provides a CDM specification example in JSON-ST; notice that compared to the KVN version of the standard, this version has SAT1_ and SAT2_ prefixes added to the object1 and object2 sections to match what TraCSS users may be used to from using space-track.org
- Section 3.5 provides an example of a TraCSS unique CDM; notice that compared to the KVN version of the standard, this version has SAT1_ and SAT2_ prefixes added to the object1 and object2 sections to match what TraCSS users may be used to from using space-track. The only difference between this format and JSON-ST is that this format uses EME2000 state vectors

TraCSS CDM Spec – New SSA Fields

- MAHALANOBIS_DISTANCE
- COLLISION_MAX_PROBABILITY
- COLLISION_MAX_PROBABILITY_METHOD
- DILUTION_STATUS
- DILUTION_SIGNIFICANCE
- ENVIRONMENTAL_IMPACT_FRAGMENTATION
- FRAGMENTATION_MODEL
- APPROACH_ANGLE

Existing DoD Fields

- APOAPSIS_ALTITUDE
- PERIAPSIS_ALTITUDE
- INCLINATION

TraCSS Transparency Fields

- OPS_STATUS
- SCREENING_DATA_SOURCE
- RUN_ID
- CORRELATION_ID
- CONJUNCTION_ID
- MEETS_ALERTABLE_CRITERIA

IRALSS

Feedback Session on CDM

TraCSS & Orbit Comprehensive Messages

- As a subset of the keywords and options allowed by the full recommended standard published by the CCSDS in its Orbit Data Messages Blue Book of April 2023 (CCSDS 502.0-B-3), this TraCSS specification remains fully compliant with the CCSDS OCM.
- Not all information contained within the Blue Book is repeated in this document. The CSDS Blue Book 502.0-B-3 may be used as a resource to provide further clarification when necessary.
- OCMs are comprehensive messages containing and augmenting information from the Orbit Parameter Message (OPM), the Orbit Mean-Elements Message (OMM), and the Orbit Ephemeris Message (OEM).
- The OCM allows the user to embed high-fidelity orbit propagation into an ephemeris time history, akin to the OEM ephemeris, in a single message/file.
- The OCM has many optional fields, allowing for the creation of concise or detailed spacecraft data messages.
- OCMs can be used to exchange information for spacecraft identification, owner/operator contacts, physical properties, ephemeris, covariance, maneuvers, perturbations, and orbit determination.
- For further information on OCM background, format, content, and uses, see the CSDS Blue Book 502.0-B-3.

TraCSS & Orbit Comprehensive Messages

- The main body of this document organizes both mandatory and optional keywords for which TraCSS has a direct use and Appendix A of this document contains optional keywords that the TraCSS system will not use beyond data sharing between owner/operators.
- **Section 2 provides the CCSDS OCM Structure and overarching requirements**, the following requirements apply to all OCM sections and content:
  - The order of occurrence of OCM keywords shall be fixed as listed in the keyword value tables in the OCM section descriptions.
  - All time tags may be specified by either:
  - a (signed) double precision relative time (e.g., 20157.26) measured in SI seconds with respect to the specified epoch time (EPOCH_TZERO).
  - an absolute time of the form YYYY-MM-DDThh:mm:ss.sss in UTC or YYYY-DDDThh:mm:ss.sss in UTC.
  - There is no required number of fractional second digits for time tags
  - Duplicate time tags shall not be used in any given OCM data block
  - Within an OCM data block, all time-tags must adhere to either relative time or absolute time for the entirety of that data block. Relative and absolute time shall not be used within the same data block.
  - Time tags of information within ordered sequences of OCM sections may be separated by uniform or non-uniform step size(s).
  - Time tags of one OCM section may or may not match those of another OCM section..

TraCSS & Orbit Comprehensive Messages

- OCM data sections and keywords are categorized as either Mandatory (denoted by an ‘M’), Optional (denoted by an ‘O’), or Conditional (denoted by a ‘C’).
- Mandatory data sections must be included and Optional data sections may be included. Mandatory keywords must be included if the associated data section is included (i.e., all mandatory keywords of mandatory data sections must be included while mandatory keywords of optional data sections must be included whenever the optional data section is included).
- Optional keywords may be included whenever the associated data section is included. No data sections are conditional.
- Conditional keywords must be included if the associated data section is included, and certain conditions are met as specified in the keyword description.
- An OCM meets compliance when it provides keywords in the correct order and provides values for the mandatory fields of each mandatory data section.
- Note that if mandatory fields are not provided for an OCM, TraCSS may return an error upon submission. Table 1 outlines the order and requirement status of each OCM data section.
- The TraCSS OCM specification allows for comment fields in each data section, but TraCSS will not make active use of information within any included comments.

TraCSS & Orbit Comprehensive Messages

Table 1. OCM layout with requirement classifications for the data sections.

Data Section	M/O/C	Additional Information
Header	M	
Metadata	M	
Orbit Data	M	Each file shall contain a single Orbit Data section, unless multiple sections are used to represent pre-maneuver and post-maneuver trajectories in the representation of impulsive maneuvers.
Physical Properties	O	
Covariance Data	O	If Covariance Data sections are included, it must be equal to the number of Orbit Data sections, and each shall cover the same time span.
Maneuver Data	O	
Perturbation Parameters	C	This section must be included if an Orbit Determination section is included, but can be provided without an Orbit Determination section
Orbit Determination	O	
User-defined Parameters	O	

TraCSS & Orbit Comprehensive Messages

Section 3 Header

Table 2. The header keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
CCSDS_OCM_VERS	M	3.X	Currently 3.0. The “X” in the Restriction denotes a sub-version number.
CREATION_DATE	M	UTC date/time	
ORIGINATOR	M		Creating organization name that matches account name within TraCSS system. TraCSS encourages organizations to register under the same name with the SANA Registry: https://sanaregistry.org/r/organizations/
MESSAGE_ID	M	Unique identifier	TraCSS recommends jointly using object designator and creation time with sufficient significant digits, i.e. 'OBJECT_DESIGNATOR' + '_' + 'CREATION_DATE'

TraCSS & Orbit Comprehensive Messages

Section 4 Metadata

- The metadata section must begin with keyword META_START and end with keyword META_STOP.
- At most, only one metadata section shall appear in the entire scope of an OCM. Table 3 shows the order and relevant information for metadata section keywords
- Table 3. The metadata keywords are specified – See document

TraCSS & Orbit Comprehensive Messages

- **Section 5 Orbit Data**: the following statements apply to orbit data sections:
- The trajectory state time history portion of the orbit data section shall contain at least 5 records prior to the USEABLE_START_TIME value and at least 5 records after the USEABLE_STOP_TIME value to ensure accurate interpolation within the “useable” time span of the data
- Multiple orbit data sections should be used to represent position and/or velocity discontinuities such as pre-maneuver and post-maneuver trajectories in impulsive maneuver situations
- Multiple orbit data sections must be consecutive in time such that the USEABLE_START_TIME of a successive section must equal the USEABLE_STOP_TIME of the preceding orbit data section
- Multiple trajectory state time histories must be delimited by TRAJ_START and TRAJ_END keywords
- At least one space character must be used to separate the items in each orbit ephemeris data line
- Each trajectory state time history line shall contain an epoch followed sequentially by position, velocity, and acceleration where applicable
- Table 4. The orbit data keywords are specified – See document

TraCSS & Orbit Comprehensive Messages

Section 6 Physical characteristics

- Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided. Table 5 shows the order and relevant information for the physical characteristics section keywords.

Table 5. The physical characteristics keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
PHYS_START	M		
WET_MASS	O		
PHYS_STOP	M		

TraCSS & Orbit Comprehensive Messages

Section 7 Covariance Data

- TraCSS recommends providing this data section because probability of collision data cannot be provided and the quality of ephemeris data cannot be adequately assessed without it.
- The following statements apply to covariance data sections:
  - Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided
  - Each orbit data section has an associated covariance data section; there is a one-to-one correspondence between orbit data time history lines and covariance data time history lines within each pair of sections
  - Each pair of time history lines shall have identical epochs
  - Discontinuous covariance time segments shall be represented by separate covariance time history data blocks.
- Lower Triangular Matrix (LTM) ordering for covariance data is the only kind permitted for TraCSS purposes.
- As such, owner/operators will convert their covariance matrices to LTM and then create a single covariance data line for the OCM from the matrix elements to represent the covariance at a particular epoch.
- Figures 1 and 2 (next slide)

TraCSS & Orbit Comprehensive Messages

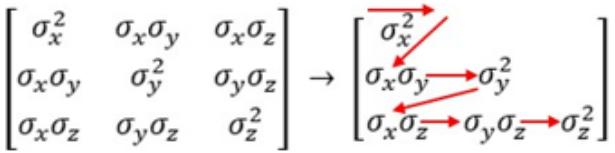

Figure 1. Conversion of a CARTP covariance matrix into LTM format with the pattern to add elements to a corresponding covariance data line for the covariance time history.

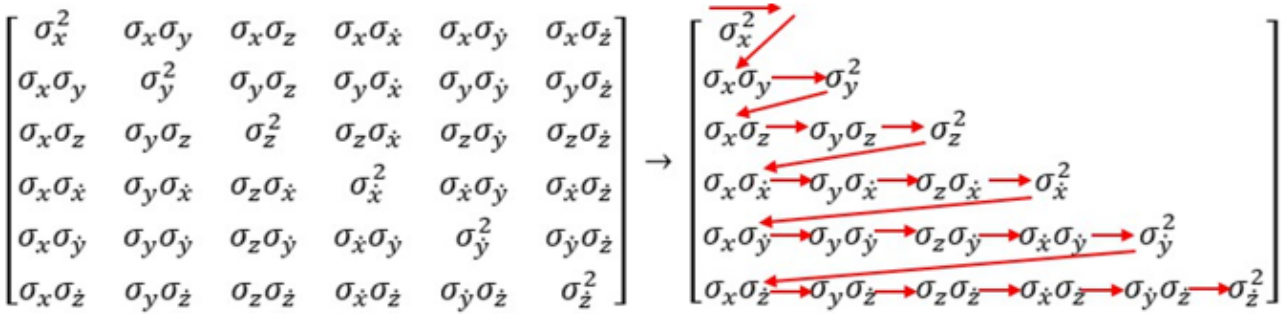

Figure 2. Conversion of a CARTPV covariance matrix into LTM format with the pattern to add elements to a corresponding covariance data line for the covariance time history.

- To create the covariance data line, add elements from the matrix in LTM form in this order:
- start at the top left corner of the covariance matrix and then procedurally add elements while proceeding rightward and downward in the pattern shown in the covariance matrix at the right side of Figure 1 for the case of Cartesian position (CARTP) and
- the right side of Figure 2 for Cartesian position and velocity (CARTPV).

TraCSS & Orbit Comprehensive Messages

Table 6. The covariance data keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
COV_START	M		
COV_ID	M	Covariance Data sections must be numbered consecutively starting with 1.	
COV_REF_FRAME	M	TNW_INERTIAL, RSW_INERTIAL	https://sanaregistry.org/r/orbit_relative_reference_frames/
COV_TYPE	M	CARTP, CARTPV	https://sanaregistry.org/r/orbital_covariance_matrix_types/
COV_ORDERING	M	LTM	
COV_UNITS	M	[km**2,km**2,km**2,km**2,km**2,km**2],	
		[km**2,km**2,km**2,km**2,km**2,km**2,km**2/s,km**2/s,km**2/s,km**2/s**2,km**2/s,km**2/s,km**2/s,km**2/s**2,km**2/s**2,km**2/s,km**2/s,km**2/s**2,km**2/s**2,km**2/s**2]	
<covariance time history data>	M		
COV_STOP	M		

TraCSS & Orbit Comprehensive Messages

Section 8 Maneuver Data

- Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided.
- TraCSS does not have an functional use for this section at this time; however, it may be beneficial to provide other owner/operators with information about maneuvers, and allow for new TraCSS features based on maneuver plans
- The expected trajectory during and after any maneuvers shall be represented in the orbit data section(s). Impulsive maneuvers shall be represented by consecutive orbit data sections where the USEABLE_STOP_TIME of the pre-maneuver orbit data section and the USEABLE_START_TIME of the post-maneuver orbit data section are both equal to the maneuver epoch.
- Table 7 shows the order and relevant information for the maneuver data section keywords.

TraCSS & Orbit Comprehensive Messages

Section 9 Perturbation Parameters

- Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided.
- Note that if optional fields in the Perturbation Parameters section are provided, they will be included in the associated CDM.
- Table 8 shows the order and relevant information for the perturbation parameters section keywords.

Section 10 Orbit Determination

- Feel free to provide this data section and any of the associated information as it helps us assess TraCSS data quality. In particular, OD_EPOCH, DAYS_SINCE_FIRST_OBS, and DAYS_SINCE_LAST_OBS are useful for covariance realism assessments.
- Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided.
- Note that if optional fields in the Orbit Determination Section are provided, they will be included in the associated CDM.
- Table 9 shows the order and relevant information for the orbit determination section keywords.

TraCSS & Orbit Comprehensive Messages

Section 11 User-Defined Parameters

- Since this data section is optional, the associated keywords that are marked mandatory are only required if the data section is provided.
- TraCSS highly encourages inclusion of a spacecraft's Hard Body Radius (HBR) with the USER_DEFINED_HBR keyword so that it can be used in probability of collision calculations.

Table 10. The user-defined parameters keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
USER_DEFINED_START	M		
USER_DEFINED_HBR	O		
USER_DEFINED_STOP	M		

TraCSS & Orbit Comprehensive Messages

Appendix A - Additional Optional Keywords – See document

- This appendix section contains a list of CCSDS OCM keywords that TraCSS does not currently have an explicit use for. These may be optionally included in an OCM if an owner/operator wishes.
- Table 11. Optional keyword for the header section.
- Table 12. Optional keywords for the metadata section.
- Table 13. Optional keywords for the orbit data section.
- Table 14. Optional keywords for the physical properties section.
- Table 15. Optional keywords for the covariance data section.
- Table 16. Optional keywords for the maneuver data section.
- Table 17. Optional keywords for the perturbation parameters section.
- Table 18. Optional keywords for the orbit determination section.

Appendix B – Example OCM with Multiple Orbit Data Blocks – See document

- This appendix section contains an example of an OCM with multiple orbit data blocks to represent an impulsive maneuver

Feedback Session on OCM

Connect with OSC

https://www.space.commerce.gov/

Website

TraCSS

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