National Oceanic & Atmospheric Administration (NOAA)
Office of Space Commerce (OSC)

Traffic Coordination System for Space (TraCSS)

Orbit Comprehensive Message (OCM) Specification for Traffic Coordination System for Space (TraCSS)

TraCSS-Spec-002

Release: 2.0 **Date: June 5, 2025**

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1. Purpose

This document describes the format and content required to create an Orbit Comprehensive Message (OCM) that is compliant with the Consultative Committee for Space Data Systems (CCSDS) and is suited for data exchange with the Traffic Coordination System for Space (TraCSS). This document is intended to be a further restriction on the CCSDS OCM Blue Book. 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 Blue Book 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 ODM Blue Book.

The main body of this document organizes both mandatory and optional keywords for which TraCSS has a direct use. Appendix A of this document contains optional keywords that the TraCSS system will not use beyond data sharing between owner/operators.

2. CCSDS OCM Structure and Overarching Requirements

The following requirements apply to all OCM sections and content:

1. The order of occurrence of OCM keywords shall be fixed as listed in the keyword value tables in the OCM section descriptions.
2. All time tags may be specified by either:
    a. a (signed) double precision relative time (e.g., 20157.26) measured in SI seconds with respect to the specified epoch time (EPOCH_TZERO).
    b. an absolute time of the form YYYY-MM-DDThh:mm:ss.sss in UTC or YYYY-DDDThh:mm:ss.sss in UTC.
3. There is no required number of fractional second digits for time tags
4. Duplicate time tags shall not be used in any given OCM data block
5. 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.
6. Time tags of information within ordered sequences of OCM sections may be separated by uniform or non-uniform step size(s).
7. Time tags of one OCM section may or may not match those of another OCM section.

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.

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	

3. Header

Table 2 shows the order and relevant information for header section keywords.

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'

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.

Keyword	M/O/C	Restriction	Additional Information
META_START	M		
OBJECT_NAME	O		
INTERNATIONAL_DESIGNATOR	M		Use UNKNOWN where an international designator is not known or available.
OBJECT_DESIGNATOR	M	DoD Satellite Catalog Number	TraCSS is reviewing approaches to assign object designators for objects that are lacking a DoD Satellite Catalog Number
ORIGINATOR_POC	O		
ORIGINATOR_POSITION	O		
ORIGINATOR_PHONE	M		Field will be converted into equivalent “operator” fields in any CDMs generated by this OCM
ORIGINATOR_EMAIL	M		Field will be converted into equivalent “operator” fields in any CDMs generated by this OCM
ORIGINATOR_ADDRESS	M		
PREVIOUS_MESSAGE_ID	O		
NEXT_MESSAGE_ID	O		
CDM_MSG_LINK	O		
OPERATOR	M	Enumerated Value	Based on organizations registered with TraCSS. UNKNOWN and N/A are also valid values.
OWNER	M	Enumerated Value	Based on owners registered with TraCSS. UNKNOWN and N/A are also valid values
COUNTRY	M	Enumerated Value	ISO3166, https://www.iso.org/iso-3166-country-codes.htm l or UNKNOWN Full text or abbreviation may be used.
CONSTELLATION	O	Enumerated Value	Constellation as recognized by individual owner/operators. UNKNOWN and N/A are also valid values

OBJECT_TYPE	O	Enumerated Value	https://sanaregistry.org/r/object_types/
TIME_SYSTEM	M	UTC	
EPOCH_TZERO	M		Default epoch to which all relative times are referenced in all OCM data blocks. If absolute times are used in the OCM, this matches the first timestamp recorded in the state time history data of the Orbit Data Section.
OPS_STATUS	O	Enumerated Value	Values from the SANA Operational Status registry (https://sanaregistry.org/r/operational_status/) and the following additional values: IN_TRANSIT: A spacecraft which is in the process of moving between orbital locations ON_STATION : A spacecraft located in an operational orbit location DISPOSAL - A spacecraft located in a disposal or graveyard orbit This may be a comma separated list of values, for example: OPERATIONAL_MANEUVERABLE, DEGRADED_OPERATIONS
ORBIT_CATEGORY	O	Enumerated Value	Values from the Orbit Categories SANA Registry: https://sanaregistry.org/r/orbit_categories/
OCM_DATA_ELEMENTS	M	Comma-delimited list	Possible section values: ORB: Orbit Data PHYS: Physical Properties COV: Covariance Data MAN: Maneuver Data PERT: Perturbation Parameters OD: Orbit Determination It is possible to have multiple ORB, COV, and MAN sections listed to represent the number of each present in the OCM.
START_TIME	M		This should correspond to the earliest USEABLE_START_TIME value in the Orbit data blocks

STOP_TIME	M		This should correspond to the latest USEABLE_STOP_TIME value in the Orbit data blocks
META_STOP	M		

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

An example trajectory state time history with Cartesian representations of position and velocity (CARTPV) is provided:

2019-12-18T12:00:00.331 2789.6 -280.0 -1746.8 4.73 -2.50 -1.04
2019-12-18T12:01:00.331 2783.4 -308.1 -1877.1 5.19 -2.42 -2.00
2019-12-18T12:02:00.331 2776.0 -336.9 -2008.7 5.64 -2.34 -1.95

< intervening data records omitted here >

2019-12-28T21:28:00.331 -3881.0 564.0 -682.8 -3.29 -3.67 1.64

An example trajectory state time history with Cartesian representations of position, velocity, and acceleration (CARTPVA) is provided:

2019-12-18T12:00:00.331 2789.6 -280.0 -1746.8 4.73 -2.50 -1.04 0.003 -0.004 -0.007
2019-12-18T12:01:00.331 2783.4 -308.1 -1877.1 5.19 -2.42 -2.00 0.005 -0.002 0.008
2019-12-18T12:02:00.331 2776.0 -336.9 -2008.7 5.64 -2.34 -1.95 -0.009 0.003 0.006

< intervening data records omitted here >

2019-12-28T21:28:00.331 -3881.0 564.0 -682.8 -3.29 -3.67 1.64 -0.008 0.002 0.002

Table 4 shows the order and relevant information for orbit data section keywords. See Appendix B for an example of an OCM with multiple orbit data blocks to represent an impulsive maneuver.

Table 4. The orbit data keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
TRAJ_START	M		
TRAJ_ID	M	Orbit Data sections shall be numbered consecutively starting with 1	
TRAJ_BASIS	M	Enumerated Value	OPERATIONAL: The trajectory expected to be flown, including maneuvers and other considerations. If TRAJ_BASIS is OPERATIONAL, other ephemeris will be screened against this OCM CANDIDATE: A candidate trajectory for the purpose of maneuver screening. If TRAJ_BASIS is CANDIDATE, the OCM will be screened once against all current ephemeris in TraCSS, but no other users will receive CDMs based on this OCM.
PROPAGATOR	O		
CENTER_NAME	M	EARTH	
TRAJ_REF_FRAME	M	EME2000	https://sanaregistry.org/r/celestial_body_reference_frames/
USEABLE_START_TIME	M		The trajectory state time history section shall contain at least 5 records prior to the USEABLE_START_TIME value to ensure accurate interpolation within the “usable” time span of the data
USEABLE_STOP_TIME	M		The trajectory state time history section shall

			contain at least 5 records following the USEABLE_STOP_TIME value to ensure accurate interpolation within the “usable” time span of the data
TRAJ_TYPE	M	CARTPV, CARTPVA	https://sanaregistry.org/r/orbital_elements/
TRAJ_UNITS	M	[km,km,km,km/s,km/s,km/s], [km,km,km,km/s,km/s,km/s, km/s**2,km/s**2,km/s**2]	
<trajectory state time history>	M		This section shall contain at least 5 records prior to the USEABLE_START_TIME value and 5 records after the USEABLE_STOP_TIME value to ensure accurate interpolation within the “usable” time span of the data
TRAJ_STOP	M		

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		

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. 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).

$$\begin{bmatrix} \sigma_x^2 & \sigma_x\sigma_y & \sigma_x\sigma_z \\ \sigma_x\sigma_y & \sigma_y^2 & \sigma_y\sigma_z \\ \sigma_x\sigma_z & \sigma_y\sigma_z & \sigma_z^2 \end{bmatrix} \rightarrow \begin{bmatrix} \sigma_x^2 & & \\ \sigma_x\sigma_y & \sigma_y^2 & \\ \sigma_x\sigma_z & \sigma_y\sigma_z & \sigma_z^2 \end{bmatrix}$$

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.

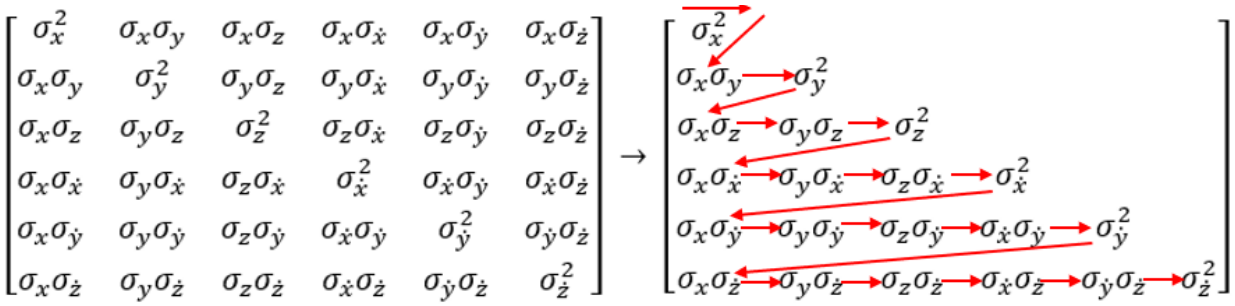

Figure 2. Conversion of a CARTPV covariance matrix into LTM format with the pattern to add elements to a corresponding covariance data line for the covariance time history.

An example covariance time history with Cartesian representations of position (CARTP) is provided below; the ellipses indicate that the data would altogether make up one line of the covariance time history:

2019-12-18T12:00:00.331 3.3313494e-04 4.6189273e-04 6.7824216e-04 …
-3.0700078e-04 -4.2212341e-04 3.2319319e-04

An example covariance time history with Cartesian representations of position and velocity (CARTPV) is provided below:

2019-12-18T12:00:00.331 3.3313494e-04 4.6189273e-04 6.7824216e-04 …
-3.0700078e-04 -4.2212341e-04 3.2319319e-04 -3.3493650e-07 -4.6860842e-07 …
2.4849495e-07 4.2960228e-10 -2.2118325e-07 -2.8641868e-07 1.7980986e-07…
2.6088992e-10 1.7675147e-10 -3.0413460e-07 -4.9894969e-07 3.5403109e-07 …
1.8692631e-10 1.0088625e-10 6.2244443e-10

Table 6 shows the order and relevant information for covariance section keywords.

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_fra mes/
COV_TYPE	M	CARTP, CARTPV	https://sanaregistry.org/r/orbital_covariance_matrix_t ypes/
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,km**2/s**2,km**2/s**2, km**2/s**2]	
<covariance time history data>	M		
COV_STOP	M		

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 explicit use for this section at this time; however, it may be beneficial to provide other owner/operators with information about maneuvers.

The purpose of the maneuver data section is to:

1. Indicate the presence of maneuver(s) within the time span of the file.
2. Indicate the start time and duration(s) of maneuver(s) within the file.

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.

Table 7. The maneuver data keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
MAN_START	M		
MAN_ID	M	Maneuver data sections must be numbered consecutively starting with 1	
DC_TYPE	M	CONTINUOUS TIME TIME_AND_ANGLE	Duty cycle type to use for this maneuver time history section: CONTINUOUS denotes full/continuous thrust <default>; TIME denotes a time-based duty cycle driven by time past a reference time and the duty cycle ON and OFF durations; TIME_AND_ANGLE denotes a duty cycle driven by the phasing/clocking of a space object body frame ‘trigger’ direction past a reference direction.
MAN_COMPOSITION	M	Comma-delimited list	Each maneuver data line must contain the fields

			TIME_ABSOLUTE or TIME_RELATIVE and MAN_DURA as the first two fields
MAN_UNITS	M	Comma-delimited list of SI unit designations	
<maneuver data lines>	M		Maneuver time history data Impulsive maneuvers shall have a duration of 0 seconds
MAN_STOP	M		Mandatory if Maneuver Section is present.

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.

Table 8. The perturbation parameters keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
PERT_START	M		
ATMOSPHERIC_MODEL	O		The name of a specific atmospheric model. Any corresponding CDMs generated from this OCM will display the name of the atmospheric model used. Not including this field in the OCM, or leaving a blank space will result in the corresponding CDM field being left blank in any CDMs generated by this OCM NO, or N/A will indicate that no atmospheric model was used and the corresponding CDM fields will display NO in any CDMs generated by this OCM.
GRAVITY_MODEL	O		The name of a specific gravity model. Any corresponding CDMs generated from this OCM will display the name of the gravity model used. Not including this field in the OCM, or leaving a blank space will result in the corresponding CDM field being left blank in any CDMs generated by this OCM. NO, or N/A will indicate that no gravity model was used and the corresponding CDM fields will display NO in any CDMs generated by this OCM.
N_BODY_PERTURBATIONS	O	Single value or comma-delimited list	The gravitational perturbation models used in a comma separated format.

			E.g. MOON, SUN Not including this field in the OCM, or leaving a blank space will result in the corresponding CDM field being left blank in any CDMs generated by this OCM.
OCEAN_TIDES_MODEL	O	YES/NO	If this field has the value YES and SOLID_TIDES_MODEL is included with the value YES, any CDMs generated from this OCM will display YES for EARTH_TIDES. If both OCEAN_TIDES_MODEL and SOLID_TIDES_MODEL are NO, the corresponding CDM will display NO. If either OCEAN_TIDES_MODEL or SOLID_TIDES_MODEL is left blank or not included, the EARTH_TIDES field in any CDMs generated from this OCM will be left blank
SOLID_TIDES_ MODEL	O	YES/NO	If this field has the value YES and OCEAN_TIDES_MODEL is included with the value YES, any CDMs generated from this OCM will display YES for EARTH_TIDES. If both OCEAN_TIDES_MODEL and SOLID_TIDES_MODEL are NO, the corresponding CDM will display NO. If either OCEAN_TIDES_MODEL or SOLID_TIDES_MODEL is left blank or not included, the EARTH_TIDES field in any CDMs generated from this OCM will be left blank
SRP_MODEL	O		Providing the name of a specific solar radiation pressure model or YES as a value indicates its use. The corresponding field in an associated CDM will display YES as the value. Not including this field in the OCM, or leaving a blank space will result in the corresponding CDM field being left blank in any CDMs generated by this OCM.

			NO and N/A are recognized values for indicating that a solar radiation pressure model was not used and in the corresponding CDM field showing NO in any CDMs generated by this OCM.
PERT_STOP	M		

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.

Table 9. The orbit determination keywords are specified.

Keyword	M/O/C	Restriction	Additional Information
OD_START	M		
OD_EPOCH	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
DAYS_SINCE_FIRST_OBS	O		
DAYS_SINCE_LAST_OBS	O		
RECOMMENDED_OD_SPAN	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
ACTUAL_OD_SPAN	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
OBS_AVAILABLE	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM.

			If this field is left blank, or is not included, the corresponding CDM field will be left blank.
OBS_USED	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
TRACKS_AVAILABLE	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
TRACKS_USED	O		Data included in this field will be carried over to the corresponding CDM field in any CDMs generated by this OCM. If this field is left blank, or is not included, the corresponding CDM field will be left blank.
SEDR	O		
WEIGHTED_RMS	O		
OD_STOP	M		

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		

Appendix A - Additional Optional Keywords

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.

Keyword
CLASSIFICATION

Table 12. Optional keywords for the metadata section.

Keyword
CATALOG_NAME
ALTERNATE_NAMES
TECH_ORG
TECH_POC
TECH_POSITION
TECH_PHONE
TECH_EMAIL
TECH_ADDRESS
ADM_MSG_LINK
PRM_MSG_LINK
RDM_MSG_LINK
TDM_MSG_LINK
SCLK_OFFSET_AT_EPOCH
SCLK_SEC_PER_SI_SEC
PREVIOUS_MESSAGE_EPOCH
NEXT_MESSAGE_EPOCH
TIME_SPAN
TAIMUTC_AT_TZERO
NEXT_LEAP_EPOCH
NEXT_LEAP_TAIMUTC
UT1MUTC_AT_ TZERO
EOP_SOURCE
INTERP_METHOD_EOP
CELESTIAL_SOURCE

Table 13. Optional keywords for the orbit data section.

Keyword

TRAJ_PREV_ID
TRAJ_NEXT_ID
TRAJ_BASIS_ID
INTERPOLATION
INTERPOLATION_DEGREE
PROPAGATOR
TRAJ_FRAME_ EPOCH
ORB_REVNUM
ORB_REVNUM_BASIS
ORB_AVERAGING

Table 14. Optional keywords for the physical properties section.

Keyword
MANUFACTURER
BUS_MODEL
DOCKED_WITH
DRAG_CONST_ AREA
DRAG_COEFF_ NOM
DRAG_UNCERTAINTY
INITIAL_WET_ MASS
DRY_MASS
OEB_PARENT_ FRAME
OEB_PARENT_ FRAME_EPOCH
OEB_Q1
OEB_Q2
OEB_Q3
OEB_QC
OEB_MAX
OEB_INT
OEB_MIN
AREA_ALONG_OEB_MAX
AREA_ALONG_OEB_INT
AREA_ALONG_OEB_MIN
AREA_MIN_FOR_PC
AREA_MAX_FOR_PC
AREA_TYP_FOR_PC
RCS

RCS_MIN
RCS_MAX
SRP_CONST_AREA
SOLAR_RAD_COEFF
SOLAR_RAD_UNCERTAINTY
VM_ABSOLUTE
VM_APPARENT_MIN
VM_APPARENT
VM_APPARENT_MAX
REFLECTANCE
ATT_CONTROL_MODE
ATT_ACTUATOR_TYPE
ATT_KNOWLEDGE
ATT_CONTROL
ATT_POINTING
AVG_MANEUVER_FREQ
MAX_THRUST
DV_BOL
DV_REMAINING
IXX
IYY
IZZ
IXY
IXZ
IYZ

Table 15. Optional keywords for the covariance data section.

Keyword
COV_PREV_ID
COV_NEXT_ID
COV_BASIS
COV_BASIS_ID
COV_FRAME_EPOCH
COV_SCALE_MIN
COV_SCALE_MAX
COV_CONFIDENCE

Table 16. Optional keywords for the maneuver data section.

Keyword
MAN_PREV_ID
MAN_NEXT_ID
MAN_BASIS
MAN_BASIS_ID
MAN_DEVICE_ID
MAN_PREV_EPOCH
MAN_NEXT_EPOCH
MAN_PURPOSE
MAN_PRED_SOURCE
MAN_REF_FRAME
MAN_FRAME_EPOCH
GRAV_ASSIST_NAME
DC_WIN_OPEN
DC_WIN_CLOSE
DC_MIN_CYCLES
DC_MAX_CYCLES
DC_EXEC_START
DC_EXEC_STOP
DC_REF_TIME
DC_TIME_PULSE_DURATION
DC_TIME_PULSE_PERIOD
DC_REF_DIR
DC_BODY_FRAME
DC_BODY_TRIGGER
DC_PA_START_ANGLE
DC_PA_STOP_ ANGLE

Table 17. Optional keywords for the perturbation parameters section.

Keyword
EQUATORIAL_RADIUS
GM
CENTRAL_BODY_ROTATION
OBLATE_FLATTENING
REDUCTION_THEORY
ALBEDO_MODEL

ALBEDO_GRID_SIZE
SHADOW_MODEL
SHADOW_BODIES
SW_DATA_SOURCE
SW_DATA_EPOCH
SW_INTERP_METHOD
FIXED_GEOMAG_KP
FIXED_GEOMAG_AP
FIXED_GEOMAG_DST
FIXED_F10P7
FIXED_F10P7_MEAN
FIXED_M10P7
FIXED_M10P7_MEAN
FIXED_S10P7
FIXED_S10P7_MEAN
FIXED_Y10P7
FIXED_Y10P7_MEAN

Table 18. Optional keywords for the orbit determination section.

Keyword
OD_ID
OD_PREV_ID
OD_METHOD
MAXIMUM_OBS_GAP
OD_EPOCH_EIGMAJ
OD_EPOCH_EIGINT
OD_EPOCH_EIGMIN
OD_MAX_PRED_EIGMAJ
OD_MIN_PRED_EIGMIN
OD_CONFIDENCE
GDOP
SOLVE_N
SOLVE_STATES
CONSIDER_N
CONSIDER_PARAMS
SENSORS_N
SENSORS

DATA_TYPES

Appendix B – Example OCM with Multiple Orbit Data Blocks

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

```
CCSDS_OCM_VERS   = 3.0
CREATION_DATE    = 2019-12-15T17:22:31
ORIGINATOR       = NASA/JPL
MESSAGE_ID       = OCM 203413719185

META_START
INTERNATIONAL_DESIGNATOR      = 1996-062A
OBJECT_DESIGNATOR             = 24648
ORIGINATOR_PHONE              = +1-818-354-4321
ORIGINATOR_EMAIL              = nasa.employee@nasajpl.gov
ORIGINATOR_ADDRESS            = 4800 Oak Grove Drive, La Cañada Flintridge, CA 91011
OPERATOR                      = JPL
OWNER                         = NASA
COUNTRY                       = USA
TIME_SYSTEM                   = UTC
EPOCH_TZERO                   = 2019-12-18T12:00:00.331
OCM_DATA_ELEMENTS             = ORB, ORB
START_TIME                    = 2019-12-18T12:00:00.331
STOP_TIME                     = 2020-01-07T23:48:00.331
META_STOP

TRAJ_START
TRAJ_ID                 = 1
TRAJ_BASIS              = OPERATIONAL
CENTER NAME             = EARTH
TRAJ_REF_FRAME          = EME2000
USEABLE_START_TIME      = 2019-12-18T12:10:00.331
USEABLE_STOP_TIME       = 2019-12-28T21:23:00.331
TRAJ_TYPE               = CARTPV
TRAJ_UNITS              = [km,km,km,km/s,km/s,km/s]

2019-12-18T12:00:00.331 2789.6 -280.0 -1746.8 4.73 -2.50 -1.04
2019-12-18T12:01:00.331 2783.4 -308.1 -1877.1 5.19 -2.42 -2.00
2019-12-18T12:02:00.331 2776.0 -336.9 -2008.7 5.64 -2.34 -1.95

< intervening data records omitted here >

2019-12-28T21:28:00.331 -3881.0 564.0 -682.8 -3.29 -3.67 1.64

TRAJ_STOP

TRAJ_START
TRAJ_ID                 = 2
TRAJ_BASIS              = OPERATIONAL
CENTER NAME             = EARTH
TRAJ_REF_FRAME          = EME2000
USEABLE_START_TIME      = 2019-12-28T21:23:00.331
USEABLE_STOP_TIME       = 2020-01-07T23:43:00.331
TRAJ_TYPE               = CARTPV
```

```
TRAJ_UNITS                  = [km,km,km,km/s,km/s,km/s]

2019-12-28T21:23:00.331 -3701.3 456.7 -589.8 -3.25 -3.43 1.48
2019-12-28T21:24:00.331 -3724.4 483.1 -623.5 -3.56 -3.16 1.34
2019-12-28T21:25:00.331 -3765.1 501.3 -662.3 -3.17 -3.54 1.55

< intervening data records omitted here >

2020-01-07T23:48:00.331 -3881.0 564.0 -682.8 -3.29 -3.67 1.64

TRAJ_STOP
```