# INTRODUCTION

# Overview

# ORBIT PARAMETER MESSAGE (OPM)

# ORBIT MEAN ELEMENTS MESSAGE (OMM)

# ORBIT EPHEMERIS MESSAGE (OEM)

# ORBIT COMPREHENSIVE MESSAGE (OCM)

# ORBIT DATA MESSAGE SYNTAX

## Overview

## GENERAL

## ODM Lines

## keyword = value notation and order of assignment statements

## Values

## Units IN THE ORBIT DATA MESSAGES

## COMMENTS IN THE ORBIT DATA MESSAGES

## ORBIT DATA MESSAGE KEYWORDS

# constructing an ODM/XML instance

## Overview

This section provides detailed instructions for the user on how to create an XML message based on one of the ASCII-text KVN-formatted messages described in Section 3, Section 4, Section 5, and Section 6.

## XML VERSION

The first line of each instantiation shall specify the XML version, exactly as follows:

<?xml version="1.0" encoding="UTF-8"?>

## BEGINNING THE INSTANTIATION: ROOT ELEMENT TAG

* + 1. Each instantiation shall have a ‘root element tag’ that identifies the message type and other information such as where to find the applicable schema, required attributes, etc.
    2. The root element tag in an ODM/XML instantiation shall be one of those listed in Table 8‑1.

Table 8‑ : ODM/XML Root Element Tags

|  |  |
| --- | --- |
| **Root Element Tag** | **Message Type** |
| <opm></opm> | Orbit Parameter Message |
| <omm></omm> | Orbit Mean Elements Message |
| <oem></oem> | Orbit Ephemeris Message |
| <ocm></ocm> | Orbit Comprehensive Message |

* + 1. The XML Schema Instance namespace attribute must appear in the root element tag of all ODM/XML instantiations, exactly as shown:

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

If it is desired to validate an instantiation against the CCSDS Web-based schema, the xsi:noNamespaceSchemaLocation attribute must be coded as a single string of non-blank characters, with no line breaks exactly as shown:

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

NOTE – The value associated with the xsi:noNamespaceSchemaLocation attribute shown in this document is too long to appear on a single line.

* + 1. For use in a local operations environment, the schema set may be downloaded from the CCSDS Web site to a local server that meets local requirements for operations robustness.
    2. If a local version is used, the value associated with the xsi:noNamespaceSchemaLocation attribute must be changed to a URL that is accessible to the local server.
    3. Two attributes shall appear in the root element tag of an ODM/XML single message instantiation, specifically, the CCSDS\_xxx\_VERS keyword that is also part of the standard KVN header, and the Blue Book version number.
    4. The CCSDS\_xxx\_VERS keyword shall be supplied via the ‘id’ attribute of the root element tag (xxx = OPM, OMM, OEM, OCM).
    5. The version number of the Blue Book to which the schema applies shall be supplied via the ‘version’ attribute.

NOTE – The following example root element tag for an OPM instantiation combines all the directions in the preceding several subsections:

<?xml version="1.0" encoding="UTF-8"?>

<opm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

id="CCSDS\_OPM\_VERS" version="3.0">

## The STANDARD ODM/XML Header SECTION

* + 1. The ODMs shall share a standard header format, with tags <header> and </header>.
    2. Immediately following the <header> tag the message may have any number of <COMMENT></COMMENT> tag pairs.
    3. The standard ODM header shall contain the <CREATION\_DATE> and the <ORIGINATOR> tags.

NOTE – An example <header> section is shown immediately below.

<header>

<COMMENT>This is the common ODM/XML header</COMMENT>

<COMMENT>I can put as many comments here as I want,</COMMENT>

<COMMENT>including none.</COMMENT>

<CREATION\_DATE>2004-281T17:26:06</CREATION\_DATE>

<ORIGINATOR>AGENCY-X</ORIGINATOR>

</header>

## The ODM BODY section

* + 1. After coding the <header>, the instantiation must include a <body></body> tag pair.
    2. Inside the <body></body> tag pair must appear at least one <segment></segment> tag pair.
    3. Each segment must be made up of one or more <metadata></metadata> and <data></data> tag pairs.

## The ODM metadata section

* + 1. All ODMs must have a metadata section.
    2. The metadata section shall be set off by the <metadata></metadata> tag combination.
    3. Between the <metadata> and </metadata> tags, the keywords shall be the same as those in the metadata sections in Section 3, Section 4, Section 5, and Section 6, with exceptions as noted in the subsections that discuss creating instantiations of the specific messages.

## The ODM data section

* + 1. All ODMs must have a data section.
    2. The data section shall follow the metadata section and shall be set off the by the <data></data> tag combination.
    3. Between the <data> and </data> tags, the keywords shall be the same as those in the data sections in Section 3, Section 4, Section 5, and Section 6, with exceptions as noted in the subsections that discuss creating instantiations of the specific messages.

## CREATING AN OPM INSTANTIATION

* + 1. An OPM instantiation shall be delimited with the <opm></opm> root element tags using the standard attributes documented in **8.3**.
    2. The final attributes of the <opm> tag shall be ‘id’ and ‘version’.
    3. The ‘id’ attribute shall be ‘id="CCSDS\_OPM\_VERS"’.
    4. The ‘version’ attribute shall be ‘version="3.0"’.
    5. The standard NDM header shall follow the <opm> tag (see **8.4**).
    6. The OPM <body> shall consist of a single <segment>.
    7. The <segment> shall consist of a <metadata> section and a <data> section.
    8. The keywords in the <metadata> and <data> sections shall be those specified in Section 3. The rules for including any of the keyword tags in the OPM/XML are the same as those specified for the OPM/KVN.
    9. Tags for keywords specified in Section 3 shall be all uppercase.
    10. Several of the OPM/XML keywords may have a unit attribute, if desired by the OPM producer.
    11. In all cases, the units shall match those defined in Section 3.
    12. The following table lists the keyword tags for which units may be specified.

| **Keyword** | **Units** | **Example** |
| --- | --- | --- |
| X | km | <X units="km">numeric-value</X> |
| Y | km | <Y units="km">numeric-value</Y> |
| Z | km | <Z units="km">numeric-value</Z> |
| X\_DOT | km/s | <X\_DOT units="km/s">numeric-value</X\_DOT> |
| Y\_DOT | km/s | <Y\_DOT units="km/s">numeric-value</Y\_DOT> |
| Z\_DOT | km/s | <Z\_DOT units="km/s">numeric-value</Z\_DOT> |
| SEMI\_MAJOR\_AXIS | km | <SEMI\_MAJOR\_AXIS units="km">numeric-value</SEMI\_MAJOR\_AXIS> |
| INCLINATION | deg | <INCLINATION units="deg">numeric-value</INCLINATION> |
| RA\_OF\_ASC\_NODE | deg | <RA\_OF\_ASC\_NODE units="deg">numeric-value</RA\_OF\_ASC\_NODE> |
| ARG\_OF\_PERICENTER | deg | <ARG\_OF\_PERICENTER units="deg">numeric-value</ARG\_OF\_PERICENTER> |
| TRUE\_ANOMALY | deg | <TRUE\_ANOMALY units="deg">numeric-value</TRUE\_ANOMALY> |
| MEAN\_ANOMALY | deg | <MEAN\_ANOMALY units="deg">numeric-value</MEAN\_ANOMALY> |
| GM | km\*\*3/s\*\*2 | <GM units="km\*\*3/s\*\*2">numeric-value</GM> |
| MASS | kg | <MASS units="kg">numeric-value</MASS> |
| SOLAR\_RAD\_AREA | m\*\*2 | <SOLAR\_RAD\_AREA units="m\*\*2">numeric-value</SOLAR\_RAD\_AREA> |
| DRAG\_AREA | m\*\*2 | <DRAG\_AREA units="m\*\*2">numeric-value</DRAG\_AREA> |
| CX\_X, CY\_X, CY\_Y, CZ\_X, CZ\_Y, CZ\_Z | km\*\*2 | <CX\_X units="km\*\*2">numeric-value</CX\_X> |
| CX\_DOT\_X, CX\_DOT\_Y, CX\_DOT\_Z, CY\_DOT\_X, CY\_DOT\_Y, CY\_DOT\_Z, CZ\_DOT\_X, CZ\_DOT\_Y,CZ\_DOT\_Z | km\*\*2/s | <CX\_DOT\_X units="km\*\*2/s">numeric-value</CX\_DOT\_X> |
| CX\_DOT\_X\_DOT, CY\_DOT\_X\_DOT, CY\_DOT\_Y\_DOT, CZ\_DOT\_X\_DOT, CZ\_DOT\_Y\_DOT, CZ\_DOT\_Z\_DOT, | km\*\*2/s\*\*2 | <CX\_DOT\_X\_DOT units="km\*\*2/s\*\*2">numeric-value</CX\_DOT\_X\_DOT> |
| MAN\_DURATION | s | <MAN\_DURATION units="s">numeric-value</MAN\_DURATION> |
| MAN\_DELTA\_MASS | kg | <MAN\_DELTA\_MASS units="kg">numeric-value</MAN\_DELTA\_MASS> |
| MAN\_DV\_1 | km/s | <MAN\_DV\_1 units="km/s">numeric-value</MAN\_DV\_1> |
| MAN\_DV\_2 | km/s | <MAN\_DV\_2 units="km/s">numeric-value</MAN\_DV\_2> |
| MAN\_DV\_3 | km/s | <MAN\_DV\_3 units="km/s">numeric-value</MAN\_DV\_3> |

* + 1. In addition to the OPM keywords specified in Section 3, there are several special tags associated with the OPM body as described in the next few subsections. The information content in the OPM is separated into ‘logical blocks’. Special tags in the OPM are used to encapsulate the information in the logical blocks of the OPM.
    2. The ODM/XML tags used to delimit the logical blocks of the OPM shall be drawn from the following table:

|  |  |
| --- | --- |
| **OPM Logical Block** | **Associated ODM/XML OPM Tag** |
| State Vector | <stateVector> |
| Keplerian Elements | <keplerianElements> |
| Spacecraft Parameters | <spacecraftParameters> |
| Covariance Matrix | <covarianceMatrix> |
| Maneuver Parameters | <maneuverParameters> |
| User Defined Parameters | <userDefinedParameters> |

* + 1. Between the begin tag and end tag (e.g., between <spacecraftParameters> and </spacecraftParameters>), the user shall place the keywords required by the specific logical block as specified in Section 3.
    2. A sample OPM/XML follows:

<?xml version="1.0" encoding="UTF-8"?>

<opm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

id="CCSDS\_OPM\_VERS" version="3.0">

<header>

<COMMENT>THIS EXAMPLE CONFORMS TO FIGURE 3-1 IN 502.0-B-2</COMMENT>

<CREATION\_DATE>2001-11-06T09:23:57</CREATION\_DATE>

<ORIGINATOR>JAXA</ORIGINATOR>

</header>

<body>

<segment>

<metadata>

<COMMENT>GEOCENTRIC, CARTESIAN, EARTH FIXED</COMMENT>

<OBJECT\_NAME>GODZILLA 5</OBJECT\_NAME>

<OBJECT\_ID>1998-057A</OBJECT\_ID>

<CENTER\_NAME>EARTH</CENTER\_NAME>

<REF\_FRAME>ITRF-97</REF\_FRAME>

<TIME\_SYSTEM>UTC</TIME\_SYSTEM>

</metadata>

<data>

<COMMENT>OBJECT\_ID: 1998-057A</COMMENT>

<stateVector>

<EPOCH>1996-12-18T14:28:15.1172</EPOCH>

<X>6503.514000</X>

<Y>1239.647000</Y>

<Z>-717.490000</Z>

<X\_DOT>-0.873160</X\_DOT>

<Y\_DOT>8.740420</Y\_DOT>

<Z\_DOT>-4.191076</Z\_DOT>

</stateVector>

<spacecraftParameters>

<MASS>3000.000000</MASS>

<SOLAR\_RAD\_AREA>18.770000</SOLAR\_RAD\_AREA>

<SOLAR\_RAD\_COEFF>1.000000</SOLAR\_RAD\_COEFF>

<DRAG\_AREA>18.770000</DRAG\_AREA>

<DRAG\_COEFF>2.500000</DRAG\_COEFF>

</spacecraftParameters>

<covarianceMatrix>

<COV\_REF\_FRAME>ITRF-97</COV\_REF\_FRAME>

<CX\_X>0.316</CX\_X>

<CY\_X>0.722</CY\_X>

<CY\_Y>0.518</CY\_Y>

<CZ\_X>0.202</CZ\_X>

<CZ\_Y>0.715</CZ\_Y>

<CZ\_Z>0.002</CZ\_Z>

<CX\_DOT\_X>0.912</CX\_DOT\_X>

<CX\_DOT\_Y>0.306</CX\_DOT\_Y>

<CX\_DOT\_Z>0.276</CX\_DOT\_Z>

<CX\_DOT\_X\_DOT>0.797</CX\_DOT\_X\_DOT>

<CY\_DOT\_X>0.562</CY\_DOT\_X>

<CY\_DOT\_Y>0.899</CY\_DOT\_Y>

<CY\_DOT\_Z>0.022</CY\_DOT\_Z>

<CY\_DOT\_X\_DOT>0.079</CY\_DOT\_X\_DOT>

<CY\_DOT\_Y\_DOT>0.415</CY\_DOT\_Y\_DOT>

<CZ\_DOT\_X>0.245</CZ\_DOT\_X>

<CZ\_DOT\_Y>0.965</CZ\_DOT\_Y>

<CZ\_DOT\_Z>0.950</CZ\_DOT\_Z>

<CZ\_DOT\_X\_DOT>0.435</CZ\_DOT\_X\_DOT>

<CZ\_DOT\_Y\_DOT>0.621</CZ\_DOT\_Y\_DOT>

<CZ\_DOT\_Z\_DOT>0.991</CZ\_DOT\_Z\_DOT>

</covarianceMatrix>

</data>

</segment>

</body>

</opm>

## CREATING AN OMM INSTANTIATION

* + 1. An OMM instantiation shall be delimited with the <omm></omm> root element tags using the standard attributes documented in **8.3**.
    2. The final attributes of the <omm> tag shall be ‘id’ and ‘version’.
    3. The ‘id’ attribute shall be ‘id="CCSDS\_OMM\_VERS"’.
    4. The ‘version’ attribute for the version of the OMM described in Section 4 shall be ‘version="3.0"’.
    5. The standard NDM header shall follow the <omm> tag (see **8.4**).
    6. The OMM <body> shall consist of a single <segment>.
    7. The <segment> shall consist of a <metadata> section and a <data> section.
    8. The keywords in the <metadata> and <data> sections shall be those specified in Section 4. The rules for including any of the keyword tags in the OMM/XML are the same as those specified for the OMM/KVN in Section 4.
    9. Tags for keywords specified in Section 4 shall be all uppercase.
    10. Several of the OMM/XML keywords may have a unit attribute, if desired by the OMM producer.
    11. In all cases, the units shall match those defined in Section 4.
    12. The following table lists the keyword tags for which units may be specified.

| **Keyword** | **Units** | **Example** |
| --- | --- | --- |
| SEMI\_MAJOR\_AXIS | km | <SEMI\_MAJOR\_AXIS units="km">numeric-value</SEMI\_MAJOR\_AXIS> |
| MEAN\_MOTION | rev/day | <MEAN\_MOTION units="rev/day">numeric-value</MEAN\_MOTION> |
| INCLINATION | deg | <INCLINATION units="deg">numeric-value</INCLINATION> |
| RA\_OF\_ASC\_NODE | deg | <RA\_OF\_ASC\_NODE units="deg">numeric-value</RA\_OF\_ASC\_NODE> |
| ARG\_OF\_PERICENTER | deg | <ARG\_OF\_PERICENTER units="deg">numeric-value</ARG\_OF\_PERICENTER> |
| MEAN\_ANOMALY | deg | <MEAN\_ANOMALY units="deg">numeric-value</MEAN\_ANOMALY> |
| GM | km\*\*3/s\*\*2 | <GM units="km\*\*3/s\*\*2">numeric-value</GM> |
| MASS | kg | <MASS units="kg">numeric-value</MASS> |
| SOLAR\_RAD\_AREA | m\*\*2 | <SOLAR\_RAD\_AREA units="m\*\*2">numeric-value</SOLAR\_RAD\_AREA> |
| DRAG\_AREA | m\*\*2 | <DRAG\_AREA units="m\*\*2">numeric-value</DRAG\_AREA> |
| BSTAR | 1/ER | <BSTAR units="1/ER">numeric-value</BSTAR> |
| MEAN\_MOTION\_DOT | rev/day\*\*2 | <MEAN\_MOTION\_DOT units="rev/day\*\*2">numeric-value</MEAN\_MOTION\_DOT> |
| MEAN\_MOTION\_DDOT | rev/day\*\*3 | <MEAN\_MOTION\_DDOT units="rev/day\*\*3">numeric-value</MEAN\_MOTION\_DDOT> |
| CX\_X, CY\_X, CY\_Y, CZ\_X, CZ\_Y, CZ\_Z | km\*\*2 | <CX\_X units="km\*\*2">numeric-value</CX\_X> |
| CX\_DOT\_X, CX\_DOT\_Y, CX\_DOT\_Z, CY\_DOT\_X, CY\_DOT\_Y, CY\_DOT\_Z, CZ\_DOT\_X, CZ\_DOT\_Y, CZ\_DOT\_Z | km\*\*2/s | <CX\_DOT\_X units="km\*\*2/s">numeric-value</CX\_DOT\_X> |
| CX\_DOT\_X\_DOT, CY\_DOT\_X\_DOT, CY\_DOT\_Y\_DOT, CZ\_DOT\_X\_DOT, CZ\_DOT\_Y\_DOT, CZ\_DOT\_Z\_DOT | km\*\*2/s\*\*2 | <CX\_DOT\_X\_DOT units="km\*\*2/s\*\*2">numeric-value</CX\_DOT\_X\_DOT> |

* + 1. In addition to the OMM keywords specified in Section 4, there are several special tags associated with the OMM body as described in the next few subsections. The information content in the OMM is separated into constructs described in Section 4 as ‘logical blocks’. Special tags in the OMM are used to encapsulate the information in the logical blocks of the OMM.
    2. The ODM/XML tags used to delimit the logical blocks of the OMM shall be drawn from the following table:

|  |  |
| --- | --- |
| **OMM Logical Block** | **Associated ODM/XML OMM Tag** |
| Mean Keplerian Elements | <meanElements> |
| Spacecraft Parameters | <spacecraftParameters> |
| TLE Parameters | <tleParameters> |
| Covariance Matrix | <covarianceMatrix> |
| User Defined Parameters | <userDefinedParameters> |

* + 1. Between the begin tag and end tag (e.g., between <spacecraftParameters> and </spacecraftParameters>), the user must place the keywords required by the specific logical block as specified in Section 4.
    2. A sample OMM/XML follows:

<?xml version="1.0" encoding="UTF-8"?>

<omm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

id="CCSDS\_OMM\_VERS" version="3.0">

<header>

<COMMENT>THIS EXAMPLE CONFORMS TO FIGURE 4-3 IN 502.0-B-2</COMMENT>

<CREATION\_DATE>2007-065T16:00:00</CREATION\_DATE>

<ORIGINATOR>NOAA/USA</ORIGINATOR>

</header>

<body>

<segment>

<metadata>

<OBJECT\_NAME>GOES-9</OBJECT\_NAME>

<OBJECT\_ID>1995-025A</OBJECT\_ID>

<CENTER\_NAME>EARTH</CENTER\_NAME>

<REF\_FRAME>TEME</REF\_FRAME>

<TIME\_SYSTEM>UTC</TIME\_SYSTEM>

<MEAN\_ELEMENT\_THEORY>TLE</MEAN\_ELEMENT\_THEORY>

</metadata>

<data>

<meanElements>

<EPOCH>2007-064T10:34:41.4264</EPOCH>

<MEAN\_MOTION>1.00273272</MEAN\_MOTION>

<ECCENTRICITY>0.0005013</ECCENTRICITY>

<INCLINATION>3.0539</INCLINATION>

<RA\_OF\_ASC\_NODE>81.7939</RA\_OF\_ASC\_NODE>

<ARG\_OF\_PERICENTER>249.2363</ARG\_OF\_PERICENTER>

<MEAN\_ANOMALY>150.1602</MEAN\_ANOMALY>

<GM>398600.8</GM>

</meanElements>

<tleParameters>

<NORAD\_CAT\_ID>23581</NORAD\_CAT\_ID>

<ELEMENT\_SET\_NO>0925</ELEMENT\_SET\_NO>

<REV\_AT\_EPOCH>4316</REV\_AT\_EPOCH>

<BSTAR>0.0001</BSTAR>

<MEAN\_MOTION\_DOT>-0.00000113</MEAN\_MOTION\_DOT>

<MEAN\_MOTION\_DDOT>0.0</MEAN\_MOTION\_DDOT>

</tleParameters>

<covarianceMatrix>

<COV\_REF\_FRAME>TEME</COV\_REF\_FRAME>

<CX\_X>0.316</CX\_X>

<CY\_X>0.722</CY\_X>

<CY\_Y>0.518</CY\_Y>

<CZ\_X>0.202</CZ\_X>

<CZ\_Y>0.715</CZ\_Y>

<CZ\_Z>0.002</CZ\_Z>

<CX\_DOT\_X>0.912</CX\_DOT\_X>

<CX\_DOT\_Y>0.306</CX\_DOT\_Y>

<CX\_DOT\_Z>0.276</CX\_DOT\_Z>

<CX\_DOT\_X\_DOT>0.797</CX\_DOT\_X\_DOT>

<CY\_DOT\_X>0.562</CY\_DOT\_X>

<CY\_DOT\_Y>0.899</CY\_DOT\_Y>

<CY\_DOT\_Z>0.022</CY\_DOT\_Z>

<CY\_DOT\_X\_DOT>0.079</CY\_DOT\_X\_DOT>

<CY\_DOT\_Y\_DOT>0.415</CY\_DOT\_Y\_DOT>

<CZ\_DOT\_X>0.245</CZ\_DOT\_X>

<CZ\_DOT\_Y>0.965</CZ\_DOT\_Y>

<CZ\_DOT\_Z>0.950</CZ\_DOT\_Z>

<CZ\_DOT\_X\_DOT>0.435</CZ\_DOT\_X\_DOT>

<CZ\_DOT\_Y\_DOT>0.621</CZ\_DOT\_Y\_DOT>

<CZ\_DOT\_Z\_DOT>0.991</CZ\_DOT\_Z\_DOT>

</covarianceMatrix>

</data>

</segment>

</body>

</omm>

## CREATING AN OEM INSTANTIATION

* + 1. An OEM instantiation shall be delimited with the <oem></oem> root element tags using the standard attributes documented in 8.3.
    2. The final attributes of the <oem> tag shall be ‘id’ and ‘version’.
    3. The ‘id’ attribute shall be ‘id="CCSDS\_OEM\_VERS"’.
    4. The ‘version’ attribute for the version of the OEM described in Section 5 shall be ‘version="3.0"’.
    5. The standard NDM header shall follow the <oem> tag (see 1.4).
    6. The OEM <body> shall consist of one or more <segment> constructs.
    7. Each <segment> shall consist of a <metadata> section and a <data> section.
    8. The keywords in the <metadata> and <data> sections shall be those specified in Section 5. The rules for including any of the keyword tags in the OEM/XML are the same as those specified for the OEM in Section 5.
    9. Tags for keywords specified in Section 5 shall be all uppercase.
    10. In addition to the OEM keywords specified in Section 5, there are some special tags associated with the OEM body as described in the next subsections.
    11. The <stateVector> tag shall encapsulate the keywords associated with one of the ephemeris data lines in the OEM.
    12. In the XML representation of the OEM, the components of the <stateVector> ephemeris data line must be represented with keywords (i.e., a tag).
    13. The <stateVector> keywords shall be the same as those defined for the same construct in the OPM.
    14. The ODM/XML tags used within the <stateVector> structure shall be drawn from the following table:

|  |  |  |
| --- | --- | --- |
| **OEM Tag** | **Represents** | **Example** |
| <EPOCH> | time tag of the state | <EPOCH>2007-09-20T17:41:00</EPOCH> |
| <X> | x component of position | <X units="km">6678.0</X> |
| <Y> | y component of position | <Y units="km">0.0</Y> |
| <Z> | z component of position | <Z units="km">0.0</Z> |
| <X\_DOT> | x component of velocity | <X\_DOT units="km/s">0</X\_DOT> |
| <Y\_DOT> | y component of velocity | <Y\_DOT units="km/s">7.73</Y\_DOT> |
| <Z\_DOT> | z component of velocity | <Z\_DOT units="km/s">0.0</Z\_DOT> |
| <X\_DDOT> | x component of acceleration | <X\_DDOT units="km/s\*\*2">0.0</X\_DDOT> |
| <Y\_DDOT> | y component of acceleration | <Y\_DDOT units="km/s\*\*2">0.50</Y\_DDOT> |
| <Z\_DDOT> | z component of acceleration | <Z\_DDOT units="km/s\*\*2">0.0</Z\_DDOT> |

* + 1. Between the begin tag and end tag (i.e., between <stateVector> and </stateVector>), the user shall place the values required by the ephemeris data line as specified in Section 5.
    2. Since the state vector structure is shared by the OPM schema and OEM schema, units may optionally appear in the XML version of the OEM ephemeris data line.
    3. The <covarianceMatrix> tag shall encapsulate the keywords associated with the covariance matrix lines in the OEM.
    4. In the XML representation of the OEM, the covariance data line must be represented with keywords (i.e., a tag).
    5. The OEM <covarianceMatrix> keywords shall be the same as those defined for the same construct in the OPM and OMM.

NOTE – In the KVN representations of the OEM covariance matrix data lines, keywords are not used. Rather, the components of the covariance matrix data line appear in an order defined in Section 5. Similarly, units are not used in the KVN version of the OEM covariance matrix; however, they are optional in the OPM and OMM.

* + 1. Since the covariance matrix structure is shared by the OPM, OMM and OEM, units may optionally appear in the XML version of the OEM covariance matrix line.
    2. The OEM/XML tags used within the <covarianceMatrix> structure shall be drawn from the following table:

| **Keyword** | **Units** | **Example** |
| --- | --- | --- |
| CX\_X, CY\_X, CY\_Y, CZ\_X, CZ\_Y, CZ\_Z | km\*\*2 | <CX\_X units="km\*\*2">numeric-value</CX\_X> |
| CX\_DOT\_X, CX\_DOT\_Y, CX\_DOT\_Z, CY\_DOT\_X, CY\_DOT\_Y, CY\_DOT\_Z, CZ\_DOT\_X, CZ\_DOT\_Y, CZ\_DOT\_Z | km\*\*2/s | <CX\_DOT\_X units="km\*\*2/s">numeric-value</CX\_DOT\_X> |
| CX\_DOT\_X\_DOT, CY\_DOT\_X\_DOT, CY\_DOT\_Y\_DOT, CZ\_DOT\_X\_DOT, CZ\_DOT\_Y\_DOT, CZ\_DOT\_Z\_DOT | km\*\*2/s\*\*2 | <CX\_DOT\_X\_DOT units="km\*\*2/s\*\*2">numeric-value</CX\_DOT\_X\_DOT> |

* + 1. Between the begin tag and end tag (i.e., between <covarianceMatrix> and </covarianceMatrix>), the user shall place the values required by the covariance matrix line type as specified in Section 5.
    2. A sample OEM/XML follows:

<?xml version="1.0" encoding="UTF-8"?>

<oem xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

id="CCSDS\_OEM\_VERS" version="3.0">

<header>

<COMMENT>THIS EXAMPLE CONFORMS TO FIGURE 5-2 IN 502.0-B-2</COMMENT>

<COMMENT>OEM WITH OPTIONAL ACCELERATIONS CAN ONLY BE OEM VERSION 2.0</COMMENT>

<CREATION\_DATE>1996-11-04T17:22:31</CREATION\_DATE>

<ORIGINATOR>NASA/JPL</ORIGINATOR>

</header>

<body>

<segment>

<metadata>

<OBJECT\_NAME>MARS GLOBAL SURVEYOR</OBJECT\_NAME>

<OBJECT\_ID>1996-062A</OBJECT\_ID>

<CENTER\_NAME>MARS BARYCENTER</CENTER\_NAME>

<REF\_FRAME>EME2000</REF\_FRAME>

<TIME\_SYSTEM>UTC</TIME\_SYSTEM>

<START\_TIME>1996-12-18T12:00:00.331</START\_TIME>

<USEABLE\_START\_TIME>1996-12-18T12:10:00.331</USEABLE\_START\_TIME>

<USEABLE\_STOP\_TIME>1996-12-28T21:23:00.331</USEABLE\_STOP\_TIME>

<STOP\_TIME>1996-12-28T21:28:00.331</STOP\_TIME>

<INTERPOLATION>HERMITE</INTERPOLATION>

<INTERPOLATION\_DEGREE>7</INTERPOLATION\_DEGREE>

</metadata>

<data>

<COMMENT>Produced by M.R. Sombedody, MSOO NAV/JPL, 1996 OCT 11. It is</COMMENT>

<COMMENT>to be used for DSN scheduling purposes only.</COMMENT>

<stateVector>

<EPOCH>1996-12-18T12:00:00.331</EPOCH>

<X>2789.6</X>

<Y>-280.0</Y>

<Z>-1746.8</Z>

<X\_DOT>4.73</X\_DOT>

<Y\_DOT>-2.50</Y\_DOT>

<Z\_DOT>-1.04</Z\_DOT>

<X\_DDOT>0.008</X\_DDOT>

<Y\_DDOT>0.001</Y\_DDOT>

<Z\_DDOT>-0.159</Z\_DDOT>

</stateVector>

<stateVector>

<EPOCH>1996-12-18T12:01:00.331</EPOCH>

<X>2783.4</X>

<Y>-308.1</Y>

<Z>-1877.1</Z>

<X\_DOT>5.19</X\_DOT>

<Y\_DOT>-2.42</Y\_DOT>

<Z\_DOT>-2.00</Z\_DOT>

<X\_DDOT>0.008</X\_DDOT>

<Y\_DDOT>0.001</Y\_DDOT>

<Z\_DDOT>0.001</Z\_DDOT>

</stateVector>

<stateVector>

<EPOCH>1996-12-18T12:02:00.331</EPOCH>

<X>2776.0</X>

<Y>-336.9</Y>

<Z>-2008.7</Z>

<X\_DOT>5.64</X\_DOT>

<Y\_DOT>-2.34</Y\_DOT>

<Z\_DOT>-1.95</Z\_DOT>

<X\_DDOT>0.008</X\_DDOT>

<Y\_DDOT>0.001</Y\_DDOT>

<Z\_DDOT>0.159</Z\_DDOT>

</stateVector>

<stateVector>

<EPOCH>1996-12-28T21:28:00.331</EPOCH>

<X>-3881.0</X>

<Y>564.0</Y>

<Z>-682.8</Z>

<X\_DOT>-3.29</X\_DOT>

<Y\_DOT>-3.67</Y\_DOT>

<Z\_DOT>1.64</Z\_DOT>

<X\_DDOT>-0.003</X\_DDOT>

<Y\_DDOT>0.000</Y\_DDOT>

<Z\_DDOT>0.000</Z\_DDOT>

</stateVector>

<covarianceMatrix>

<EPOCH></EPOCH>

<COV\_REF\_FRAME>ITRF-97</COV\_REF\_FRAME>

<CX\_X>0.316</CX\_X>

<CY\_X>0.722</CY\_X>

<CY\_Y>0.518</CY\_Y>

<CZ\_X>0.202</CZ\_X>

<CZ\_Y>0.715</CZ\_Y>

<CZ\_Z>0.002</CZ\_Z>

<CX\_DOT\_X>0.912</CX\_DOT\_X>

<CX\_DOT\_Y>0.306</CX\_DOT\_Y>

<CX\_DOT\_Z>0.276</CX\_DOT\_Z>

<CX\_DOT\_X\_DOT>0.797</CX\_DOT\_X\_DOT>

<CY\_DOT\_X>0.562</CY\_DOT\_X>

<CY\_DOT\_Y>0.899</CY\_DOT\_Y>

<CY\_DOT\_Z>0.022</CY\_DOT\_Z>

<CY\_DOT\_X\_DOT>0.079</CY\_DOT\_X\_DOT>

<CY\_DOT\_Y\_DOT>0.415</CY\_DOT\_Y\_DOT>

<CZ\_DOT\_X>0.245</CZ\_DOT\_X>

<CZ\_DOT\_Y>0.965</CZ\_DOT\_Y>

<CZ\_DOT\_Z>0.950</CZ\_DOT\_Z>

<CZ\_DOT\_X\_DOT>0.435</CZ\_DOT\_X\_DOT>

<CZ\_DOT\_Y\_DOT>0.621</CZ\_DOT\_Y\_DOT>

<CZ\_DOT\_Z\_DOT>0.991</CZ\_DOT\_Z\_DOT>

</covarianceMatrix>

</data>

</segment>

</body>

</oem>

## CREATING AN OCM INSTANTIATION

* + 1. An OCM instantiation shall be delimited with the <ocm></ocm> root element tags using the standard attributes documented in 8.3.
    2. The final attributes of the <ocm> tag shall be ‘id’ and ‘version’.
    3. The ‘id’ attribute shall be ‘id="CCSDS\_OCM\_VERS"’.
    4. The ‘version’ attribute for the version of the OCM described in Section 6 shall be ‘version="3.0"’.
    5. The standard NDM header shall follow the <ocm> tag (see 8.4).
    6. The OCM <body> shall consist of a single <segment> construct.
    7. The <segment> shall consist of a <metadata> section and a <data> section.
    8. The keywords in the <metadata> and <data> sections shall be those specified in Section 6. The rules for including any of the keyword tags in the OCM/XML are the same as those specified for the OCM in Section 6.
    9. Tags for keywords specified in Section 6 shall be all uppercase.
    10. In addition to the OCM keywords specified in Section 6, there are some special tags associated with the OCM body as described in the next subsections.
    11. TBD
    12. TBD
    13. TBD
    14. The OCM/XML tags used within the <tbd> structure shall be drawn from the following table:

|  |  |  |
| --- | --- | --- |
| **OCM Tag** | **Represents** | **Example** |
| <tbd> | tbd | <tbd units="tbd">tbd</tbd> |

* + 1. Between the begin tag and end tag (e.g., between <tbd> and </tbd>), the user shall place the values required by the TBD data line as specified in Section 6.
    2. In the XML representation of the OCM, the tbd data line must be represented with keywords (i.e., a tag).
    3. A sample OCM/XML follows:

<?xml version="1.0" encoding="UTF-8"?>

<ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd"

id="CCSDS\_OEM\_VERS" version="3.0">

<header>

<COMMENT>THIS EXAMPLE IS TBD</COMMENT>

<CREATION\_DATE>2017-11-04T17:22:31</CREATION\_DATE>

<ORIGINATOR>NASA</ORIGINATOR>

</header>

<body>

<segment>

<metadata>

</metadata>

<data>

</data>

</segment>

</body>

</ocm>