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| Orbit Data Messages V3.0 Test Plan/Report |

CCSDS Record

CCSDS 502.0-Y-3

Yellow Book

March 2023

FOREWORD

This document records the plans for prototype testing and results of that testing for the Orbit Data Messages Version 2 Blue Book. As a record of prototype testing, it is expected that expansion, deletion, or modification of this document will **not** occur. This document is subject to CCSDS document management and change control procedures, which are defined in the *Procedures Manual for the Consultative Committee for Space Data Systems*. Current versions of CCSDS documents are maintained at the CCSDS Web site:

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# Introduction

## PURPOSE

The purpose of this document is to describe the prototype testing conducted on the CCSDS Orbit Comprehensive Message (OCM), CCSDS 502.0-P-3.0 [3].

## SCOPE

The scope of this document is testing of the Orbit Comprehensive Message. The OCM is part of the Orbit Data Message (ODM) suite of messages included in the technical program of the CCSDS Navigation Working Group. Document CCSDS 502.0-P-3.0 is an update to the existing CCSDS/ISO Standard Orbit Data Messages CCSDS 502.0-B-2 [3] and 502.0-B-1/ISO 26900 originally published in September 2009 (reference [2]). ODM document 502.0-P-2.0 completed a joint CCSDS Agency Review and ISO TC20/SC14/WG3 review in September 2017; the process is described in reference [1].

## APPLICABILITY

The ODM describes standard formats for the interagency exchange of data required for spacecraft tracking and navigation (specifically, orbit parameters and orbit ephemeris). There are three distinct message types that historically have comprised the Orbit Data Message family. These are:

* Orbit Parameter Message (OPM)
* Orbit Mean Elements Message (OMM)
* Orbit Ephemeris Message (OEM)

In its new revision, the ODM now includes an additional message type, the Orbit Comprehensive Message or OCM. Since this revision of document 502.0-B-2 facilitates the addition of this new OCM without altering the definition of the OMM, OPM and OEM, no repeat testing of the OMM, OPM and OEM are undertaken.

This document applies to the prototype testing of the OCM, required to advance the ODM revision document from Red Book to Blue Book status.

## RATIONALE

The CCSDS Procedures Manual states that for a Recommendation to become a Blue Book, the standard must be tested in an operational manner. The following requirements for an implementation exercise were excerpted from reference [1]:

“At least two independent and interoperable prototypes or implementations must have been developed and demonstrated in an operationally relevant environment, either real or simulated.”

This document outlines the Navigation Working Group’s approach to meeting this requirement for the ODM 502.0-P-3.0.

## DOCUMENT STRUCTURE

The first sections of this document describe the Test Plan for the prototyping activity; the last sections of the document provide a Test Report of the realized plan. Acronyms are provided in Annex A.

## References

The following documents are referenced in this document. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS documents.

[1] *Procedures Manual for the Consultative Committee for Space Data Systems*. CCSDS A00.0-Y-9. Yellow Book. Issue 9. Washington, D.C.: CCSDS, November 2003.

[2] *Orbit Data Messages*. Recommendation for Space Data System Standards, CCSDS 502.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2004.

[3] Orbit Data Messages. Recommendation for Space Data System Standards, CCSDS 502.0-P-1.1. Pink Book. Issue 1.1. Washington, D.C.: CCSDS, July 2008.

[4] Orbit Data Messages. Draft Recommendation for Space Data System Standards, CCSDS 502.0-P-2.1. Pink Book. Issue 2.0. Washington, D.C.: CCSDS, February 2023.

# Summary Conclusion/Recommendation

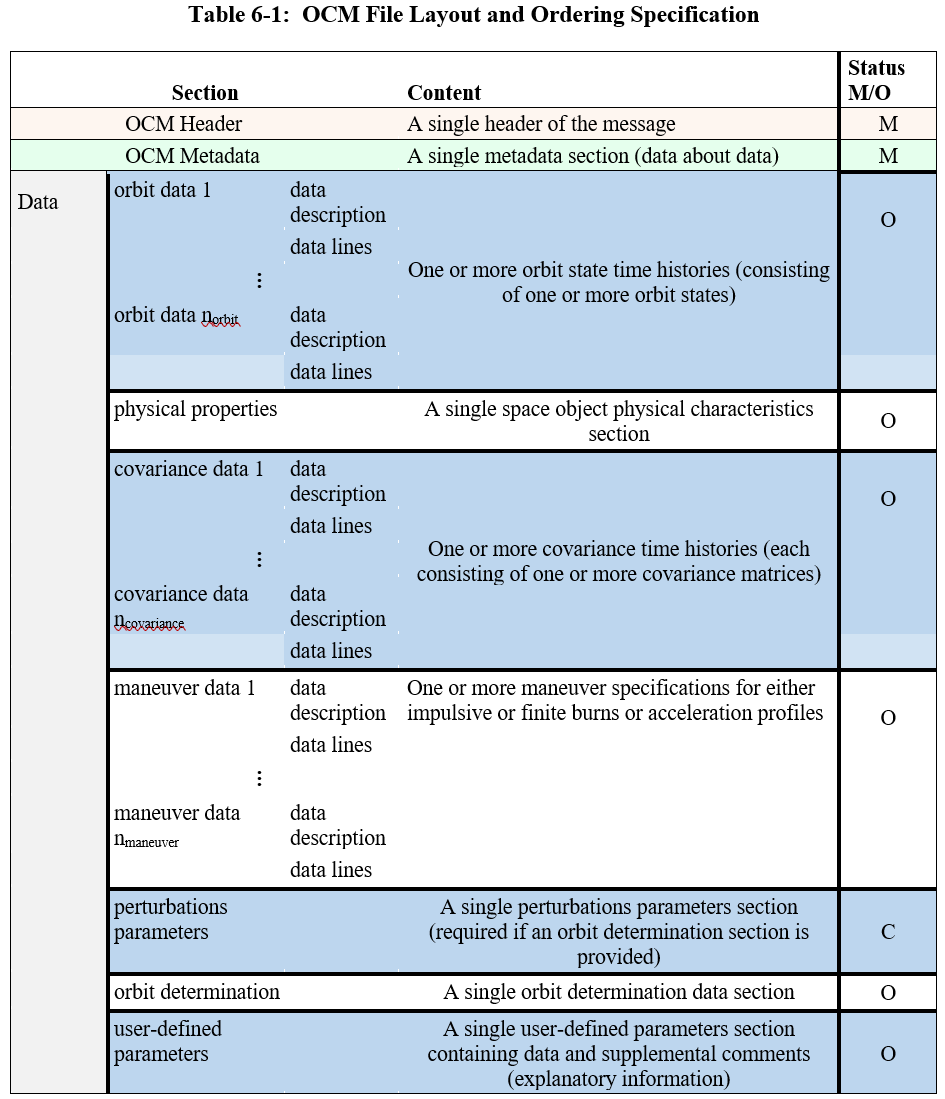
The test plan and test reports documented herein substantiate that the organizations participating in the CCSDS Navigation Working Group have successfully conducted prototype testing of the Orbit Comprehensive Message as described in the Orbit Data Messages (ODM) 502.0-P-3.0 document. During the testing, OCMs of various types were produced, and the ability to read/process the messages was demonstrated in 2 independent organizations. Based on the demonstrated ability to read/write the OCMs and the positive test results, the Navigation Working Group recommends that the revised ODM 502.0-P-3.0 document be promoted to a Blue Book CCSDS Recommended Standard.

# Orbit Data Messages (ODM) Testing Goals

Testing of the OCM is described in Section 5 and Section 6 of this plan. This testing will be conducted to meet the CCSDS requirements described in Section 2. In Section 7 and Section 8, the results of the testing are presented.

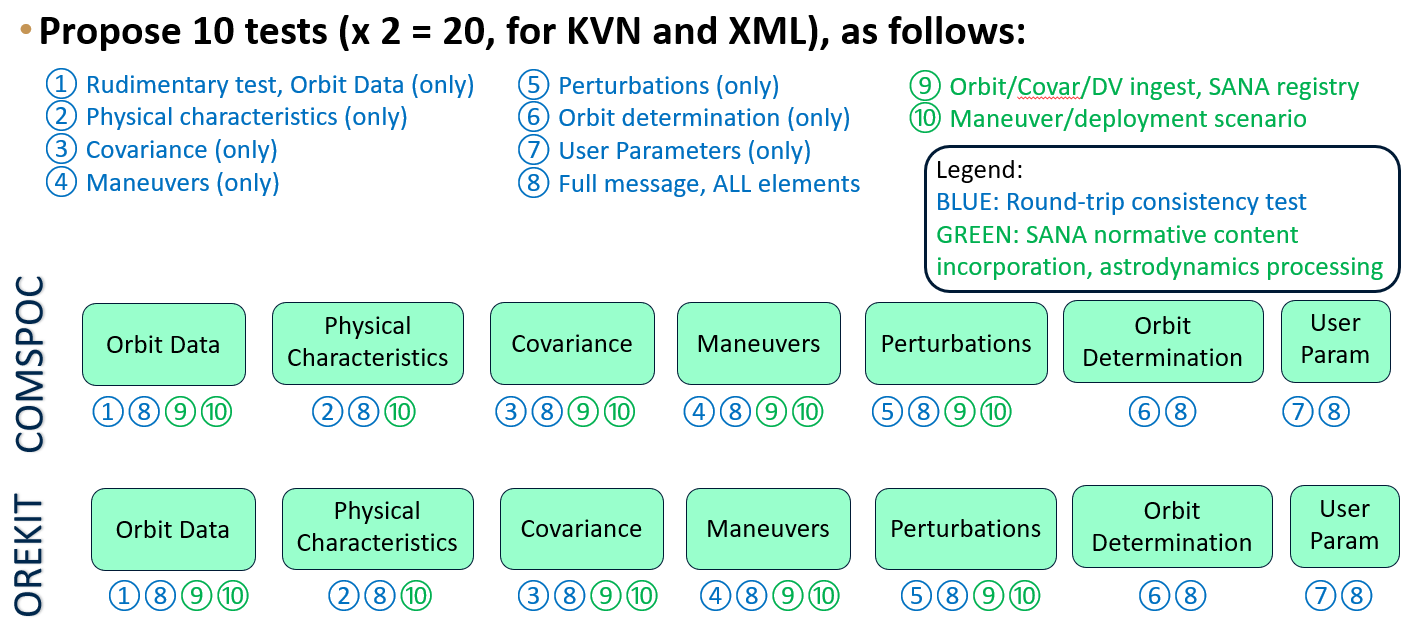
## OCM Overview

The OCM is an ASCII file in either a hybrid “keyword=value” format (header and metadata are keyword=value, data lines and covariance lines have a positional field layout) or in XML format. The OCM is comprehensive, in allowing users to exchange orbit, uncertainty, maneuver, and many other space object-relevant parameters. The file is organized into nine distinct sections, as shown in the table below (excerpted from Table 6-1 of the draft standard: the Header section, Metadata section, and the Data section with its seven subsections as listed. The Header Section contains identification information (version, creation date, originator). The Metadata section contains information regarding the object to which the orbit applies, applicable reference frame, time system, interpolation parameters, and data start/stop times. The Data Section contains orbit, covariance, and maneuver time histories, as well as detailed specificity of physical properties, perturbations modeled, orbit determination settings and user parameters.



# Test Plan Overview

Prototyping of the OCM will be performed as summarized in the following figure.



**Figure 4‑1: Schematic of ten test cases**

The following table depicts the order of message creation, transmission, and comparison to be conducted by the two prototyping entities performing the tests (COMSPOC and OREKIT), in support of their sponsoring member agencies of the Navigation Working Group (JPL and CNES). The direction of message transfer and brief description of message content are also provided, consistent with the summary figure shown above.

|  |  |  |
| --- | --- | --- |
| **Test #** | **Message description** | **Organizations, Direction** |
| 1 | Orbit using relative time | COMSPOC => OREKIT => COMSPOC |
| 2 | Physical Characteristics | COMSPOC => OREKIT => COMSPOC |
| 3 | Covariance using relative and absolute time | COMSPOC => OREKIT => COMSPOC |
| 4 | Maneuvers (both deployments and finite burn) using relative and absolute time | COMSPOC => OREKIT => COMSPOC |
| 5 | Perturbations | COMSPOC => OREKIT => COMSPOC |
| 6 | Orbit Determination | COMSPOC => OREKIT => COMSPOC |
| 7 | User Parameters | COMSPOC => OREKIT => COMSPOC |
| 8 | All data blocks | COMSPOC => OREKIT => COMSPOC |
| 9 | Orbit in Keplerian elements, covariance, and finite burn maneuver | COMSPOC => OREKIT => COMSPOC |
| 10 | Orbit in Keplerian elements and deployed object “maneuver” scenario | COMSPOC => OREKIT => COMSPOC |

# Test Plan Details

## Test Case #1: OCM orbit data unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing a sequence of spacecraft orbit states as a function of relative time to OREKIT. In this simple case, a Cartesian ephemeris will be shared. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the orbit state time history and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #2: OCM PHysical characteristics unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing space object physical characteristics to OREKIT. In this simple case, an inertia matrix, Optimally-Enclosing Box (OEB), drag characteristics and space weather proxies will be shared. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the space object physical characteristics and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #3: OCM Covariance unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing a sequence of spacecraft orbit covariances as a function of absolute time to OREKIT. In this simple case, two covariance blocks will be included: (1) a Cartesian 6x6 covariance; and (2) a SIG3EIGVEC3 set. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the sequence of spacecraft orbit covariances as a function of absolute time and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #4: OCM Maneuver UNIT test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing space object maneuvers to OREKIT. In this simple case, a single finite burn will be shared. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the space object maneuvers and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #5: OCM Perturbations unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing perturbations modeling specifics to OREKIT. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the perturbations data and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #6: OCM Orbit determination unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing orbit determination characteristics and settings to COMSPOC Corporation. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the orbit determination configuration settings and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #7: OCM User parameters unit test

### Test Description

For this test, COMSPOC Corporation will send an OCM describing user-defined parameters to OREKIT. In this simple case, a Cartesian ephemeris will be shared. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the user-defined parameters and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #8: OCM Full message

### Test Description

For this test, COMSPOC Corporation will send an OCM containing the merged data blocks of all the previous unit test content to OREKIT. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the merged data blocks and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #9: OCM message requiring sana registry interpretation and enforcement, and astrodynamics conversions

### Test Description

For this test, COMSPOC Corporation will send an OCM containing orbit, covariance, and maneuver details in a diverse set of orbit element sets, reference frames, absolute and relative time, and maneuver data to OREKIT. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the orbit, covariance, and maneuver details and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

## Test Case #10: OCM Maneuver and deployment scenario

### Test Description

For this test, COMSPOC Corporation will send an OCM describing space object deployment time histories to OREKIT. The OREKIT organization will ingest the message, write it back out and transmit the message back to COMSPOC for comparison and verification.

### Expected Results

It is anticipated that COMSPOC and OREKIT will successfully write and read the deployment time history and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

# Test Report Overview

Engineers at COMSPOC and OREKIT will prepare test data sheets as applicable, and send them to the Navigation Working Group via email.

The Test Report Details will be consolidated in Section 8 of this document. A summarization of the test process and the recommendation of the Navigation Working Group may be found in Section 3 of the report. The report will be submitted to the CCSDS Engineering Steering Group (CESG) and CCSDS Management Council (CMC), along with results of the Agency Reviews. At that time, a formal request will be submitted to the CMC for progression of the ODM version 2.0 to CCSDS Blue Book status.

The next page contains a format for the test data sheets that will be used to report the results of individual tests. The form includes sections for the producer of the message and the consumer of the message (producing agency, producing test engineer, consuming agency, and consuming test engineer).

**SAMPLE**



**Orbit Comprehensive Message Prototype Test Data Sheet**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: |  |
| 2 | Program Under Test: | Orbit Comprehensive Message (OCM) Prototype |
| 3 | Test Case Number: |  |
| 4 | Agencies Participating in this Test Case: |  |
| 5 | Agency Responsible for Producing Test Message |  |
| 6 | Producing Test Engineer: |  |
| 7 | Agency Responsible for Consuming Test Message |  |
| 8 | Consuming Test Engineer: |  |
| 9 | Spacecraft: |  |
| 10 | Results (Pass, Partial Pass, Fail): |  |
| 11 | Variances from Expected Result: |  |
| 12 | Comments: |  |

# Test Report Details

## Test Case #1: Simple OCM with orbit state time history data

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| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 1 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | NONE |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the TRAJECTORY data block  CLASSIFICATION = U  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  COMMENT This is a comment in MIXED case  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  CATALOG\_NAME = COMSPOC  OBJECT\_DESIGNATOR = 18SPCS 18571  ALTERNATE\_NAMES = SV08, IN8  ORIGINATOR\_POC = Mr. Rodgers  ORIGINATOR\_POSITION = Mission Design Lead  ORIGINATOR\_PHONE = +12345678901  ORIGINATOR\_EMAIL = JOHN.DOE@ SOMEWHERE.ORG  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345  TECH\_ORG = NASA  TECH\_POC = Maxwell Smart  TECH\_POSITION = Flight Dynamics  TECH\_PHONE = +49615130312  TECH\_EMAIL = JOHN.DOE@ SOMEWHERE.ORG  TECH\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345  PREVIOUS\_MESSAGE\_ID = PrvMsg00  NEXT\_MESSAGE\_ID = NxtMsg02  ADM\_MSG\_LINK = ADM\_MSG\_35132.txt  CDM\_MSG\_LINK = CDM\_MSG\_35132.txt  PRM\_MSG\_LINK = PRM\_MSG\_35132.txt  RDM\_MSG\_LINK = RDM\_MSG\_35132.txt  TDM\_MSG\_LINK = TDM\_MSG\_37.txt  OPERATOR = INTELSAT  OWNER = SIRIUS  COUNTRY = US  CONSTELLATION = SPIRE  OBJECT\_TYPE = PAYLOAD  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  OPS\_STATUS = OPERATIONAL  ORBIT\_CATEGORY = GEO  OCM\_DATA\_ELEMENTS = ORB, PHYS, COV, MAN, MAN, PERT, OD, USER  SCLK\_OFFSET\_AT\_EPOCH = -5000.0  SCLK\_SEC\_PER\_SI\_SEC = 2.5  PREVIOUS\_MESSAGE\_EPOCH = 2001-11-06T11:17:33  NEXT\_MESSAGE\_EPOCH = 2001-11-07T11:17:33  START\_TIME = 0.0  STOP\_TIME = 86400.0  TIME\_SPAN = 1.0 [d]  TAIMUTC\_AT\_TZERO = 37  NEXT\_LEAP\_EPOCH = 2024-12-31T23:59:60  NEXT\_LEAP\_TAIMUTC = 38  UT1MUTC\_AT\_TZERO = -0.0404  EOP\_SOURCE = CELESTRAK\_20201028  INTERP\_METHOD\_EOP = LINEAR  CELESTIAL\_SOURCE = JPL\_DE\_FILES  META\_STOP  TRAJ\_START  TRAJ\_BASIS = SIMULATED  TRAJ\_REF\_FRAME = TOD\_EARTH  TRAJ\_FRAME\_EPOCH = 2022-12-18T14:28:15.1172  USEABLE\_START\_TIME=2022-12-18T14:32:15.1172  USEABLE\_STOP\_TIME= 2022-12-19T14:26:15.1172  TRAJ\_TYPE = CARTPVA  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s,km/s\*\*2,km/s\*\*2,km/s\*\*2]  0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52 0.0037 -0.0038 -0.0070  120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29 0.0072 0.0006 -0.0051  240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16 0.0054 -0.0022 -0.0066  TRAJ\_STOP  TRAJ\_START  TRAJ\_BASIS = DETERMINED  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = OSCULATING  TRAJ\_UNITS = [km, n/a, deg, deg, deg, deg]  0.000000 6600.0 .03 28.5 50.0 30.0 10.0  10.000000 6600.0 .03 28.5 50.0 30.0 10.1  20.000000 6600.0 .03 28.5 50.0 30.0 10.2  TRAJ\_STOP  TRAJ\_START  COMMENT This is comment 01  COMMENT This is comment 02  TRAJ\_ID = TRAJ\_20160402\_XYZ  TRAJ\_PREV\_ID = ORB20160305A  TRAJ\_NEXT\_ID = ORB20160305C  TRAJ\_BASIS = PREDICTED  TRAJ\_BASIS\_ID = OD\_5910  INTERPOLATION = HERMITE  INTERPOLATION\_DEGREE = 5  PROPAGATOR = HPOP  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  USEABLE\_START\_TIME = 1996-12-18T14:28:15.1172  USEABLE\_STOP\_TIME = 1996-354T14:28:15.1172  ORB\_REVNUM = 1500  ORB\_REVNUM\_BASIS = 0  TRAJ\_TYPE = CARTPV  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s]  0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52  120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29  240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16  TRAJ\_STOP |

Figure ‑: Input KVN OCM for Test Case 1

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the TRAJECTORY data block</COMMENT>  <CLASSIFICATION>U</CLASSIFICATION>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <COMMENT>This is a comment in MIXED case</COMMENT>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <CATALOG\_NAME>COMSPOC</CATALOG\_NAME>  <OBJECT\_DESIGNATOR>18SPCS 18571</OBJECT\_DESIGNATOR>  <ALTERNATE\_NAMES>SV08, IN8</ALTERNATE\_NAMES>  <ORIGINATOR\_POC>Mr. Rodgers</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>+12345678901</ORIGINATOR\_PHONE>  <ORIGINATOR\_EMAIL>JOHN.DOE@ SOMEWHERE.ORG</ORIGINATOR\_EMAIL>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345</ORIGINATOR\_ADDRESS>  <TECH\_ORG>NASA</TECH\_ORG>  <TECH\_POC>Maxwell Smart</TECH\_POC>  <TECH\_POSITION>Flight Dynamics</TECH\_POSITION>  <TECH\_PHONE>+49615130312</TECH\_PHONE>  <TECH\_EMAIL>JOHN.DOE@ SOMEWHERE.ORG</TECH\_EMAIL>  <TECH\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345</TECH\_ADDRESS>  <PREVIOUS\_MESSAGE\_ID>PrvMsg00</PREVIOUS\_MESSAGE\_ID>  <NEXT\_MESSAGE\_ID>NxtMsg02</NEXT\_MESSAGE\_ID>  <ADM\_MSG\_LINK>ADM\_MSG\_35132.txt</ADM\_MSG\_LINK>  <CDM\_MSG\_LINK>CDM\_MSG\_35132.txt</CDM\_MSG\_LINK>  <PRM\_MSG\_LINK>PRM\_MSG\_35132.txt</PRM\_MSG\_LINK>  <RDM\_MSG\_LINK>RDM\_MSG\_35132.txt</RDM\_MSG\_LINK>  <TDM\_MSG\_LINK>TDM\_MSG\_37.txt</TDM\_MSG\_LINK>  <OPERATOR>INTELSAT</OPERATOR>  <OWNER>SIRIUS</OWNER>  <COUNTRY>US</COUNTRY>  <CONSTELLATION>SPIRE</CONSTELLATION>  <OBJECT\_TYPE>PAYLOAD</OBJECT\_TYPE>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  <OPS\_STATUS>OPERATIONAL</OPS\_STATUS>  <ORBIT\_CATEGORY>GEO</ORBIT\_CATEGORY>  <OCM\_DATA\_ELEMENTS>ORB, PHYS, COV, MAN, MAN, PERT, OD, USER</OCM\_DATA\_ELEMENTS>  <SCLK\_OFFSET\_AT\_EPOCH>-5000.0</SCLK\_OFFSET\_AT\_EPOCH>  <SCLK\_SEC\_PER\_SI\_SEC>2.5</SCLK\_SEC\_PER\_SI\_SEC>  <PREVIOUS\_MESSAGE\_EPOCH>2001-11-06T11:17:33</PREVIOUS\_MESSAGE\_EPOCH>  <NEXT\_MESSAGE\_EPOCH>2001-11-07T11:17:33</NEXT\_MESSAGE\_EPOCH>  <START\_TIME>0.0</START\_TIME>  <STOP\_TIME>86400.0</STOP\_TIME>  <TIME\_SPAN units="d">1.0</TIME\_SPAN>  <TAIMUTC\_AT\_TZERO units="s">37</TAIMUTC\_AT\_TZERO>  <NEXT\_LEAP\_EPOCH>2024-12-31T23:59:60</NEXT\_LEAP\_EPOCH>  <NEXT\_LEAP\_TAIMUTC units="s">38</NEXT\_LEAP\_TAIMUTC>  <UT1MUTC\_AT\_TZERO units="s">-0.0404</UT1MUTC\_AT\_TZERO>  <EOP\_SOURCE>CELESTRAK\_20201028</EOP\_SOURCE>  <INTERP\_METHOD\_EOP>LINEAR </INTERP\_METHOD\_EOP>  <CELESTIAL\_SOURCE>JPL\_DE\_FILES</CELESTIAL\_SOURCE>  </metadata>  <data>  <traj>  <TRAJ\_BASIS>SIMULATED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>TOD\_EARTH</TRAJ\_REF\_FRAME>  <TRAJ\_FRAME\_EPOCH>2022-12-18T14:28:15.1172</TRAJ\_FRAME\_EPOCH>  <USEABLE\_START\_TIME>2022-12-18T14:32:15.1172</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>2022-12-19T14:26:15.1172</USEABLE\_STOP\_TIME>  <TRAJ\_TYPE>CARTPVA</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s,km/s\*\*2,km/s\*\*2,km/s\*\*2]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52 0.0037 -0.0038 -0.0070</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29 0.0072 0.0006 -0.0051</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16 0.0054 -0.0022 -0.0066</trajLine>  </traj>  <traj>  <TRAJ\_BASIS>DETERMINED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>OSCULATING</ORB\_AVERAGING>  <TRAJ\_UNITS>[km, n/a, deg, deg, deg, deg]</TRAJ\_UNITS>  <trajLine>0.000000 6600.0 .03 28.5 50.0 30.0 10.0</trajLine>  <trajLine>10.000000 6600.0 .03 28.5 50.0 30.0 10.1</trajLine>  <trajLine>20.000000 6600.0 .03 28.5 50.0 30.0 10.2</trajLine>  </traj>  <traj>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <TRAJ\_ID>TRAJ\_20160402\_XYZ</TRAJ\_ID>  <TRAJ\_PREV\_ID>ORB20160305A</TRAJ\_PREV\_ID>  <TRAJ\_NEXT\_ID>ORB20160305C</TRAJ\_NEXT\_ID>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <TRAJ\_BASIS\_ID>OD\_5910</TRAJ\_BASIS\_ID>  <INTERPOLATION>HERMITE</INTERPOLATION>  <INTERPOLATION\_DEGREE>5</INTERPOLATION\_DEGREE>  <PROPAGATOR>HPOP</PROPAGATOR>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <USEABLE\_START\_TIME>1996-12-18T14:28:15.1172</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>1996-354T14:28:15.1172</USEABLE\_STOP\_TIME>  <ORB\_REVNUM>1500</ORB\_REVNUM>  <ORB\_REVNUM\_BASIS>0</ORB\_REVNUM\_BASIS>  <TRAJ\_TYPE>CARTPV</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16</trajLine>  </traj>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 1

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the TRAJECTORY data block  CLASSIFICATION = U  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  COMMENT This is a comment in MIXED case  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  CATALOG\_NAME = COMSPOC  OBJECT\_DESIGNATOR = 18SPCS 18571  ALTERNATE\_NAMES = SV08,IN8  ORIGINATOR\_POC = Mr. Rodgers  ORIGINATOR\_POSITION = Mission Design Lead  ORIGINATOR\_PHONE = +12345678901  ORIGINATOR\_EMAIL = JOHN.DOE@ SOMEWHERE.ORG  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345  TECH\_ORG = NASA  TECH\_POC = Maxwell Smart  TECH\_POSITION = Flight Dynamics  TECH\_PHONE = +49615130312  TECH\_EMAIL = JOHN.DOE@ SOMEWHERE.ORG  TECH\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345  PREVIOUS\_MESSAGE\_ID = PrvMsg00  NEXT\_MESSAGE\_ID = NxtMsg02  ADM\_MSG\_LINK = ADM\_MSG\_35132.txt  CDM\_MSG\_LINK = CDM\_MSG\_35132.txt  PRM\_MSG\_LINK = PRM\_MSG\_35132.txt  RDM\_MSG\_LINK = RDM\_MSG\_35132.txt  TDM\_MSG\_LINK = TDM\_MSG\_37.txt  OPERATOR = INTELSAT  OWNER = SIRIUS  COUNTRY = US  CONSTELLATION = SPIRE  OBJECT\_TYPE = PAYLOAD  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  OPS\_STATUS = OPERATIONAL  ORBIT\_CATEGORY = GEO  OCM\_DATA\_ELEMENTS = ORB,PHYS,COV,MAN,MAN,PERT,OD,USER  SCLK\_OFFSET\_AT\_EPOCH = -5000.0 [s]  SCLK\_SEC\_PER\_SI\_SEC = 2.5 [s]  PREVIOUS\_MESSAGE\_EPOCH = 2001-11-06T11:17:33.0  NEXT\_MESSAGE\_EPOCH = 2001-11-07T11:17:33.0  START\_TIME = 0.0  STOP\_TIME = 2022-12-19T14:28:15.1172  TIME\_SPAN = 1.0 [d]  TAIMUTC\_AT\_TZERO = 37.0 [s]  NEXT\_LEAP\_EPOCH = 2024-12-31T23:59:60.0  NEXT\_LEAP\_TAIMUTC = 38.0 [s]  UT1MUTC\_AT\_TZERO = -0.0404 [s]  EOP\_SOURCE = CELESTRAK\_20201028  INTERP\_METHOD\_EOP = LINEAR  CELESTIAL\_SOURCE = JPL\_DE\_FILES  META\_STOP  TRAJ\_START  TRAJ\_BASIS = SIMULATED  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = TOD\_EARTH  USEABLE\_START\_TIME = 240.0  USEABLE\_STOP\_TIME = 2022-12-19T14:26:15.1172  TRAJ\_TYPE = CARTPVA  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s,km/s\*\*2,km/s\*\*2,km/s\*\*2]  0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52 0.0037 -0.0038 -0.007  120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29 0.0072 6.0E-4 -0.0051  240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16 0.0054 -0.0022 -0.0066  TRAJ\_STOP  TRAJ\_START  TRAJ\_BASIS = DETERMINED  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = OSCULATING  TRAJ\_UNITS = [km,n/a,deg,deg,deg,deg]  0.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.0  10.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.1  20.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.2  TRAJ\_STOP  TRAJ\_START  COMMENT This is comment 01  COMMENT This is comment 02  TRAJ\_ID = TRAJ\_20160402\_XYZ  TRAJ\_PREV\_ID = ORB20160305A  TRAJ\_NEXT\_ID = ORB20160305C  TRAJ\_BASIS = PREDICTED  TRAJ\_BASIS\_ID = OD\_5910  INTERPOLATION = HERMITE  INTERPOLATION\_DEGREE = 5  PROPAGATOR = HPOP  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  USEABLE\_START\_TIME = 1996-12-18T14:28:15.1172  USEABLE\_STOP\_TIME = 1996-12-19T14:28:15.1172  ORB\_REVNUM = 1500  ORB\_REVNUM\_BASIS = 0  TRAJ\_TYPE = CARTPV  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s]  0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52  120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29  240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16  TRAJ\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 1

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the TRAJECTORY data block</COMMENT>  <CLASSIFICATION>U</CLASSIFICATION>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <COMMENT>This is a comment in MIXED case</COMMENT>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <CATALOG\_NAME>COMSPOC</CATALOG\_NAME>  <OBJECT\_DESIGNATOR>18SPCS 18571</OBJECT\_DESIGNATOR>  <ALTERNATE\_NAMES>SV08,IN8</ALTERNATE\_NAMES>  <ORIGINATOR\_POC>Mr. Rodgers</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>+12345678901</ORIGINATOR\_PHONE>  <ORIGINATOR\_EMAIL>JOHN.DOE@ SOMEWHERE.ORG</ORIGINATOR\_EMAIL>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345</ORIGINATOR\_ADDRESS>  <TECH\_ORG>NASA</TECH\_ORG>  <TECH\_POC>Maxwell Smart</TECH\_POC>  <TECH\_POSITION>Flight Dynamics</TECH\_POSITION>  <TECH\_PHONE>+49615130312</TECH\_PHONE>  <TECH\_EMAIL>JOHN.DOE@ SOMEWHERE.ORG</TECH\_EMAIL>  <TECH\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach, FL, USA, 12345</TECH\_ADDRESS>  <PREVIOUS\_MESSAGE\_ID>PrvMsg00</PREVIOUS\_MESSAGE\_ID>  <NEXT\_MESSAGE\_ID>NxtMsg02</NEXT\_MESSAGE\_ID>  <ADM\_MSG\_LINK>ADM\_MSG\_35132.txt</ADM\_MSG\_LINK>  <CDM\_MSG\_LINK>CDM\_MSG\_35132.txt</CDM\_MSG\_LINK>  <PRM\_MSG\_LINK>PRM\_MSG\_35132.txt</PRM\_MSG\_LINK>  <RDM\_MSG\_LINK>RDM\_MSG\_35132.txt</RDM\_MSG\_LINK>  <TDM\_MSG\_LINK>TDM\_MSG\_37.txt</TDM\_MSG\_LINK>  <OPERATOR>INTELSAT</OPERATOR>  <OWNER>SIRIUS</OWNER>  <COUNTRY>US</COUNTRY>  <CONSTELLATION>SPIRE</CONSTELLATION>  <OBJECT\_TYPE>PAYLOAD</OBJECT\_TYPE>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  <OPS\_STATUS>OPERATIONAL</OPS\_STATUS>  <ORBIT\_CATEGORY>GEO</ORBIT\_CATEGORY>  <OCM\_DATA\_ELEMENTS>ORB,PHYS,COV,MAN,MAN,PERT,OD,USER</OCM\_DATA\_ELEMENTS>  <SCLK\_OFFSET\_AT\_EPOCH units="s">-5000.0</SCLK\_OFFSET\_AT\_EPOCH>  <SCLK\_SEC\_PER\_SI\_SEC units="s">2.5</SCLK\_SEC\_PER\_SI\_SEC>  <PREVIOUS\_MESSAGE\_EPOCH>2001-11-06T11:17:33.0</PREVIOUS\_MESSAGE\_EPOCH>  <NEXT\_MESSAGE\_EPOCH>2001-11-07T11:17:33.0</NEXT\_MESSAGE\_EPOCH>  <START\_TIME>0.0</START\_TIME>  <STOP\_TIME>2022-12-19T14:28:15.1172</STOP\_TIME>  <TIME\_SPAN units="d">1.0</TIME\_SPAN>  <TAIMUTC\_AT\_TZERO units="s">37.0</TAIMUTC\_AT\_TZERO>  <NEXT\_LEAP\_EPOCH>2024-12-31T23:59:60.0</NEXT\_LEAP\_EPOCH>  <NEXT\_LEAP\_TAIMUTC units="s">38.0</NEXT\_LEAP\_TAIMUTC>  <UT1MUTC\_AT\_TZERO units="s">-0.0404</UT1MUTC\_AT\_TZERO>  <EOP\_SOURCE>CELESTRAK\_20201028</EOP\_SOURCE>  <INTERP\_METHOD\_EOP>LINEAR</INTERP\_METHOD\_EOP>  <CELESTIAL\_SOURCE>JPL\_DE\_FILES</CELESTIAL\_SOURCE>  </metadata>  <data>  <traj>  <TRAJ\_BASIS>SIMULATED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>TOD\_EARTH</TRAJ\_REF\_FRAME>  <USEABLE\_START\_TIME>240.0</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>2022-12-19T14:26:15.1172</USEABLE\_STOP\_TIME>  <TRAJ\_TYPE>CARTPVA</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s,km/s\*\*2,km/s\*\*2,km/s\*\*2]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52 0.0037 -0.0038 -0.007</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29 0.0072 6.0E-4 -0.0051</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16 0.0054 -0.0022 -0.0066</trajLine>  </traj>  <traj>  <TRAJ\_BASIS>DETERMINED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>OSCULATING</ORB\_AVERAGING>  <TRAJ\_UNITS>[km,n/a,deg,deg,deg,deg]</TRAJ\_UNITS>  <trajLine>0.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.0</trajLine>  <trajLine>10.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.1</trajLine>  <trajLine>20.0 6600.0 0.03 28.5 50.0 29.999999999999996 10.2</trajLine>  </traj>  <traj>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <TRAJ\_ID>TRAJ\_20160402\_XYZ</TRAJ\_ID>  <TRAJ\_PREV\_ID>ORB20160305A</TRAJ\_PREV\_ID>  <TRAJ\_NEXT\_ID>ORB20160305C</TRAJ\_NEXT\_ID>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <TRAJ\_BASIS\_ID>OD\_5910</TRAJ\_BASIS\_ID>  <INTERPOLATION>HERMITE</INTERPOLATION>  <INTERPOLATION\_DEGREE>5</INTERPOLATION\_DEGREE>  <PROPAGATOR>HPOP</PROPAGATOR>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <USEABLE\_START\_TIME>1996-12-18T14:28:15.1172</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>1996-12-19T14:28:15.1172</USEABLE\_STOP\_TIME>  <ORB\_REVNUM>1500</ORB\_REVNUM>  <ORB\_REVNUM\_BASIS>0</ORB\_REVNUM\_BASIS>  <TRAJ\_TYPE>CARTPV</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16</trajLine>  </traj>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 1

## Test Case #2: Simple OCM with physical characteristics data

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 2 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | NONE |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the  COMMENT PHYSICAL CHARACTERISTICS data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  ORIGINATOR\_POC = R. Rabbit  ORIGINATOR\_POSITION = Flight Dynamics Mission Design Lead  ORIGINATOR\_PHONE = (719)555-1234  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach FL USA 12345  TECH\_POC = Mr. Rodgers  TECH\_PHONE = (719)555-1234  TECH\_EMAIL = email@email.XXX  TIME\_SYSTEM = UT1  EPOCH\_TZERO = 2022-12-18T00:00:00.0000  TAIMUTC\_AT\_TZERO = 36 [s]  UT1MUTC\_AT\_TZERO = .357 [s]  META\_STOP  PHYS\_START  COMMENT This is comment 01  COMMENT This is comment 02  MANUFACTURER = BOEING  BUS\_MODEL = 702  DOCKED\_WITH = ISS  DRAG\_CONST\_AREA = 2.5 [m\*\*2]  DRAG\_COEFF\_NOM = 2.2  DRAG\_UNCERTAINTY = 10.0  INITIAL\_WET\_MASS = 500 [kg]  WET\_MASS = 472.3 [kg]  DRY\_MASS = 300 [kg]  OEB\_PARENT\_FRAME = ITRF1997  OEB\_PARENT\_FRAME\_EPOCH = 2001-11-06T11:17:33  OEB\_Q1 = -0.575131822  OEB\_Q2 = -0.280510532  OEB\_Q3 = -0.195634856  OEB\_QC = 0.743144825  OEB\_MAX = 1  OEB\_INT = 0.5  OEB\_MIN = 0.3  AREA\_ALONG\_OEB\_MAX = 0.15  AREA\_ALONG\_OEB\_INT = 0.3  AREA\_ALONG\_OEB\_MIN = 0.5  AREA\_MIN\_FOR\_PC = 1.0  AREA\_MAX\_FOR\_PC = 1.0  AREA\_TYP\_FOR\_PC = 1.0  RCS = 1.25  RCS\_MIN = 1.1  RCS\_MAX = 2.5  SRP\_CONST\_AREA = 1.0 [m\*\*2]  SOLAR\_RAD\_COEFF = 1.7  SOLAR\_RAD\_UNCERTAINTY = 1.0  VM\_ABSOLUTE = 15.0  VM\_APPARENT\_MIN = 19.0  VM\_APPARENT = 15.0  VM\_APPARENT\_MAX = 16.0  REFLECTANCE = 0.7  ATT\_CONTROL\_MODE = SPIN  ATT\_ACTUATOR\_TYPE = ATT\_THRUSTERS  ATT\_KNOWLEDGE = 0.3  ATT\_CONTROL = 2.0  ATT\_POINTING = 2.3  AVG\_MANEUVER\_FREQ = 20.0  MAX\_THRUST = 1.0  DV\_BOL = 1.0  DV\_REMAINING = 0.2  IXX = 1000.0  IYY = 800.0  IZZ = 400.0  IXY = 20.0  IXZ = 40.0  IYZ = 60.0  PHYS\_STOP |

Figure ‑: Input KVN OCM for Test Case 2

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the </COMMENT>  <COMMENT>PHYSICAL CHARACTERISTICS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <ORIGINATOR\_POC>R. Rabbit</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Flight Dynamics Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>(719)555-1234</ORIGINATOR\_PHONE>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach FL USA 12345</ORIGINATOR\_ADDRESS>  <TECH\_POC>Mr. Rodgers</TECH\_POC>  <TECH\_PHONE>(719)555-1234</TECH\_PHONE>  <TECH\_EMAIL>email@email.XXX</TECH\_EMAIL>  <TIME\_SYSTEM>UT1</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T00:00:00.0000</EPOCH\_TZERO>  <TAIMUTC\_AT\_TZERO units="s">36</TAIMUTC\_AT\_TZERO>  <UT1MUTC\_AT\_TZERO units="s">.357</UT1MUTC\_AT\_TZERO>  </metadata>  <data>  <phys>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <MANUFACTURER>BOEING</MANUFACTURER>  <BUS\_MODEL>702</BUS\_MODEL>  <DOCKED\_WITH>ISS</DOCKED\_WITH>  <DRAG\_CONST\_AREA units="m\*\*2">2.5</DRAG\_CONST\_AREA>  <DRAG\_COEFF\_NOM>2.2</DRAG\_COEFF\_NOM>  <DRAG\_UNCERTAINTY units="%">10.0</DRAG\_UNCERTAINTY>  <INITIAL\_WET\_MASS units="kg">500</INITIAL\_WET\_MASS>  <WET\_MASS units="kg">472.3</WET\_MASS>  <DRY\_MASS units="kg">300</DRY\_MASS>  <OEB\_PARENT\_FRAME>ITRF1997</OEB\_PARENT\_FRAME>  <OEB\_PARENT\_FRAME\_EPOCH>2001-11-06T11:17:33</OEB\_PARENT\_FRAME\_EPOCH>  <OEB\_Q1>-0.575131822</OEB\_Q1>  <OEB\_Q2>-0.280510532</OEB\_Q2>  <OEB\_Q3>-0.195634856</OEB\_Q3>  <OEB\_QC>0.743144825</OEB\_QC>  <OEB\_MAX units="m">1</OEB\_MAX>  <OEB\_INT units="m">0.5</OEB\_INT>  <OEB\_MIN units="m">0.3</OEB\_MIN>  <AREA\_ALONG\_OEB\_MAX units="m\*\*2">0.15</AREA\_ALONG\_OEB\_MAX>  <AREA\_ALONG\_OEB\_INT units="m\*\*2">0.3</AREA\_ALONG\_OEB\_INT>  <AREA\_ALONG\_OEB\_MIN units="m\*\*2">0.5</AREA\_ALONG\_OEB\_MIN>  <AREA\_MIN\_FOR\_PC units="m\*\*2">1.0</AREA\_MIN\_FOR\_PC>  <AREA\_MAX\_FOR\_PC units="m\*\*2">1.0</AREA\_MAX\_FOR\_PC>  <AREA\_TYP\_FOR\_PC units="m\*\*2">1.0</AREA\_TYP\_FOR\_PC>  <RCS units="m\*\*2">1.25</RCS>  <RCS\_MIN units="m\*\*2">1.1</RCS\_MIN>  <RCS\_MAX units="m\*\*2">2.5</RCS\_MAX>  <SRP\_CONST\_AREA units="m\*\*2">1.0</SRP\_CONST\_AREA>  <SOLAR\_RAD\_COEFF>1.7</SOLAR\_RAD\_COEFF>  <SOLAR\_RAD\_UNCERTAINTY units="%">1.0 </SOLAR\_RAD\_UNCERTAINTY>  <VM\_ABSOLUTE>15.0</VM\_ABSOLUTE>  <VM\_APPARENT\_MIN>19.0</VM\_APPARENT\_MIN>  <VM\_APPARENT>15.0</VM\_APPARENT>  <VM\_APPARENT\_MAX>16.0</VM\_APPARENT\_MAX>  <REFLECTANCE>0.7</REFLECTANCE>  <ATT\_CONTROL\_MODE>SPIN</ATT\_CONTROL\_MODE>  <ATT\_ACTUATOR\_TYPE>ATT\_THRUSTERS</ATT\_ACTUATOR\_TYPE>  <ATT\_KNOWLEDGE units="deg">0.3</ATT\_KNOWLEDGE>  <ATT\_CONTROL units="deg">2.0</ATT\_CONTROL>  <ATT\_POINTING units="deg">2.3</ATT\_POINTING>  <AVG\_MANEUVER\_FREQ units="#/yr">20.0</AVG\_MANEUVER\_FREQ>  <MAX\_THRUST units="N">1.0</MAX\_THRUST>  <DV\_BOL units="km/s">1.0</DV\_BOL>  <DV\_REMAINING units="km/s">0.2</DV\_REMAINING>  <IXX units="kg\*m\*\*2">1000.0</IXX>  <IYY units="kg\*m\*\*2">800.0</IYY>  <IZZ units="kg\*m\*\*2">400.0</IZZ>  <IXY units="kg\*m\*\*2">20.0</IXY>  <IXZ units="kg\*m\*\*2">40.0</IXZ>  <IYZ units="kg\*m\*\*2">60.0</IYZ>  </phys>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 2

|  |
| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the  COMMENT PHYSICAL CHARACTERISTICS data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  ORIGINATOR\_POC = R. Rabbit  ORIGINATOR\_POSITION = Flight Dynamics Mission Design Lead  ORIGINATOR\_PHONE = (719)555-1234  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach FL USA 12345  TECH\_POC = Mr. Rodgers  TECH\_PHONE = (719)555-1234  TECH\_EMAIL = email@email.XXX  TIME\_SYSTEM = UT1  EPOCH\_TZERO = 2022-12-18T00:00:00.0  TAIMUTC\_AT\_TZERO = 36.0 [s]  UT1MUTC\_AT\_TZERO = 0.357 [s]  META\_STOP  PHYS\_START  COMMENT This is comment 01  COMMENT This is comment 02  MANUFACTURER = BOEING  BUS\_MODEL = 702  DOCKED\_WITH = ISS  DRAG\_CONST\_AREA = 2.5 [m\*\*2]  DRAG\_COEFF\_NOM = 2.2  DRAG\_UNCERTAINTY = 10.0 [%]  INITIAL\_WET\_MASS = 500.0 [kg]  WET\_MASS = 472.3 [kg]  DRY\_MASS = 300.0 [kg]  OEB\_PARENT\_FRAME = ITRF1997  OEB\_PARENT\_FRAME\_EPOCH = 2001-11-06T11:17:33.0  OEB\_Q1 = -0.575131822  OEB\_Q2 = -0.280510532  OEB\_Q3 = -0.195634856  OEB\_QC = 0.743144825  OEB\_MAX = 1.0 [m]  OEB\_INT = 0.5 [m]  OEB\_MIN = 0.3 [m]  AREA\_ALONG\_OEB\_MAX = 0.15 [m\*\*2]  AREA\_ALONG\_OEB\_INT = 0.3 [m\*\*2]  AREA\_ALONG\_OEB\_MIN = 0.5 [m\*\*2]  AREA\_MIN\_FOR\_PC = 1.0 [m\*\*2]  AREA\_MAX\_FOR\_PC = 1.0 [m\*\*2]  AREA\_TYP\_FOR\_PC = 1.0 [m\*\*2]  RCS = 1.25 [m\*\*2]  RCS\_MIN = 1.1 [m\*\*2]  RCS\_MAX = 2.5 [m\*\*2]  SRP\_CONST\_AREA = 1.0 [m\*\*2]  SOLAR\_RAD\_COEFF = 1.7  SOLAR\_RAD\_UNCERTAINTY = 1.0 [%]  VM\_ABSOLUTE = 15.0  VM\_APPARENT\_MIN = 19.0  VM\_APPARENT = 15.0  VM\_APPARENT\_MAX = 16.0  REFLECTANCE = 0.7  ATT\_CONTROL\_MODE = SPIN  ATT\_ACTUATOR\_TYPE = ATT\_THRUSTERS  ATT\_KNOWLEDGE = 0.3 [deg]  ATT\_CONTROL = 2.0 [deg]  ATT\_POINTING = 2.3 [deg]  AVG\_MANEUVER\_FREQ = 20.0 [#/yr]  MAX\_THRUST = 1.0 [N]  DV\_BOL = 1.0 [km/s]  DV\_REMAINING = 0.2 [km/s]  IXX = 1000.0 [kg\*m\*\*2]  IYY = 800.0 [kg\*m\*\*2]  IZZ = 400.0 [kg\*m\*\*2]  IXY = 20.0 [kg\*m\*\*2]  IXZ = 40.0 [kg\*m\*\*2]  IYZ = 60.0 [kg\*m\*\*2]  PHYS\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 2

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the</COMMENT>  <COMMENT>PHYSICAL CHARACTERISTICS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <ORIGINATOR\_POC>R. Rabbit</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Flight Dynamics Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>(719)555-1234</ORIGINATOR\_PHONE>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach FL USA 12345</ORIGINATOR\_ADDRESS>  <TECH\_POC>Mr. Rodgers</TECH\_POC>  <TECH\_PHONE>(719)555-1234</TECH\_PHONE>  <TECH\_EMAIL>email@email.XXX</TECH\_EMAIL>  <TIME\_SYSTEM>UT1</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T00:00:00.0</EPOCH\_TZERO>  <TAIMUTC\_AT\_TZERO units="s">36.0</TAIMUTC\_AT\_TZERO>  <UT1MUTC\_AT\_TZERO units="s">0.357</UT1MUTC\_AT\_TZERO>  </metadata>  <data>  <phys>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <MANUFACTURER>BOEING</MANUFACTURER>  <BUS\_MODEL>702</BUS\_MODEL>  <DOCKED\_WITH>ISS</DOCKED\_WITH>  <DRAG\_CONST\_AREA units="m\*\*2">2.5</DRAG\_CONST\_AREA>  <DRAG\_COEFF\_NOM>2.2</DRAG\_COEFF\_NOM>  <DRAG\_UNCERTAINTY units="%">10.0</DRAG\_UNCERTAINTY>  <INITIAL\_WET\_MASS units="kg">500.0</INITIAL\_WET\_MASS>  <WET\_MASS units="kg">472.3</WET\_MASS>  <DRY\_MASS units="kg">300.0</DRY\_MASS>  <OEB\_PARENT\_FRAME>ITRF1997</OEB\_PARENT\_FRAME>  <OEB\_PARENT\_FRAME\_EPOCH>2001-11-06T11:17:33.0</OEB\_PARENT\_FRAME\_EPOCH>  <OEB\_Q1>-0.575131822</OEB\_Q1>  <OEB\_Q2>-0.280510532</OEB\_Q2>  <OEB\_Q3>-0.195634856</OEB\_Q3>  <OEB\_QC>0.743144825</OEB\_QC>  <OEB\_MAX units="m">1.0</OEB\_MAX>  <OEB\_INT units="m">0.5</OEB\_INT>  <OEB\_MIN units="m">0.3</OEB\_MIN>  <AREA\_ALONG\_OEB\_MAX units="m\*\*2">0.15</AREA\_ALONG\_OEB\_MAX>  <AREA\_ALONG\_OEB\_INT units="m\*\*2">0.3</AREA\_ALONG\_OEB\_INT>  <AREA\_ALONG\_OEB\_MIN units="m\*\*2">0.5</AREA\_ALONG\_OEB\_MIN>  <AREA\_MIN\_FOR\_PC units="m\*\*2">1.0</AREA\_MIN\_FOR\_PC>  <AREA\_MAX\_FOR\_PC units="m\*\*2">1.0</AREA\_MAX\_FOR\_PC>  <AREA\_TYP\_FOR\_PC units="m\*\*2">1.0</AREA\_TYP\_FOR\_PC>  <RCS units="m\*\*2">1.25</RCS>  <RCS\_MIN units="m\*\*2">1.1</RCS\_MIN>  <RCS\_MAX units="m\*\*2">2.5</RCS\_MAX>  <SRP\_CONST\_AREA units="m\*\*2">1.0</SRP\_CONST\_AREA>  <SOLAR\_RAD\_COEFF>1.7</SOLAR\_RAD\_COEFF>  <SOLAR\_RAD\_UNCERTAINTY units="%">1.0</SOLAR\_RAD\_UNCERTAINTY>  <VM\_ABSOLUTE>15.0</VM\_ABSOLUTE>  <VM\_APPARENT\_MIN>19.0</VM\_APPARENT\_MIN>  <VM\_APPARENT>15.0</VM\_APPARENT>  <VM\_APPARENT\_MAX>16.0</VM\_APPARENT\_MAX>  <REFLECTANCE>0.7</REFLECTANCE>  <ATT\_CONTROL\_MODE>SPIN</ATT\_CONTROL\_MODE>  <ATT\_ACTUATOR\_TYPE>ATT\_THRUSTERS</ATT\_ACTUATOR\_TYPE>  <ATT\_KNOWLEDGE units="deg">0.3</ATT\_KNOWLEDGE>  <ATT\_CONTROL units="deg">2.0</ATT\_CONTROL>  <ATT\_POINTING units="deg">2.3</ATT\_POINTING>  <AVG\_MANEUVER\_FREQ units="#/yr">20.0</AVG\_MANEUVER\_FREQ>  <MAX\_THRUST units="N">1.0</MAX\_THRUST>  <DV\_BOL units="km/s">1.0</DV\_BOL>  <DV\_REMAINING units="km/s">0.2</DV\_REMAINING>  <IXX units="kg\*m\*\*2">1000.0</IXX>  <IYY units="kg\*m\*\*2">800.0</IYY>  <IZZ units="kg\*m\*\*2">400.0</IZZ>  <IXY units="kg\*m\*\*2">20.0</IXY>  <IXZ units="kg\*m\*\*2">40.0</IXZ>  <IYZ units="kg\*m\*\*2">60.0</IYZ>  </phys>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 2

## Test Case #3: Simple OCM with covariance time history data

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 3 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | NONE |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the COVARIANCE data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  ORIGINATOR\_POC = R. Rabbit  ORIGINATOR\_POSITION = Flight Dynamics Mission Design Lead  ORIGINATOR\_PHONE = (719)555-1234  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach FL USA 12345  TECH\_POC = Mr. Rodgers  TECH\_PHONE = (719)555-1234  TECH\_EMAIL = email@email.XXX  TIME\_SYSTEM = UT1  EPOCH\_TZERO = 2022-12-18T00:00:00.0000  TAIMUTC\_AT\_TZERO = 36 [s]  UT1MUTC\_AT\_TZERO = .357 [s]  META\_STOP  COV\_START  COV\_BASIS = PREDICTED  COV\_REF\_FRAME = J2000  COV\_TYPE = ADBARV  COV\_ORDERING = LTM  COV\_UNITS = [deg, deg, deg, deg, km, km/s]  10.00 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04 -3.349365e-07 -4.686084e-07 2.484949e-07 4.296022e-10 -2.211832e-07 -2.864186e-07 1.798098e-07 2.608899e-10 1.767514e-10 -3.041346e-07 -4.989496e-07 3.540310e-07 1.869263e-10 1.008862e-10 6.224444e-10  20.0 3.442450e-04 4.507816e-04 6.893532e-04 -3.060006e-04 -4.110123e-04 3.342042e-04 -3.238254e-07 -4.575073e-07 2.373838e-07 4.307133e-10 -2.100721e-07 -2.753075e-07 1.687087e-07 2.507788e-10 1.878625e-10 -3.030235e-07 -4.878385e-07 3.430200e-07 1.758152e-10 1.007751e-10 6.224444e-10  COV\_STOP  COV\_START  COMMENT This is a comment  COV\_ID = COV\_20160402\_XYZ  COV\_PREV\_ID = COV\_20160305a  COV\_NEXT\_ID = COV\_20160305C  COV\_BASIS = PREDICTED  COV\_BASIS\_ID = OD\_5910  COV\_REF\_FRAME = FIXED\_EARTH  COV\_FRAME\_EPOCH = 2001-11-06T11:17:33  COV\_SCALE\_MIN = 0.5  COV\_SCALE\_MAX = 5.0  COV\_CONFIDENCE = 50  COV\_TYPE = CARTP  COV\_ORDERING = LTM  COV\_UNITS = [km, km, km]  2022-12-18T14:31:35.1172 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04  COV\_STOP |

Figure ‑: Input KVN OCM for Test Case 3

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the COVARIANCE data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <ORIGINATOR\_POC>R. Rabbit</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Flight Dynamics Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>(719)555-1234</ORIGINATOR\_PHONE>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach FL USA 12345</ORIGINATOR\_ADDRESS>  <TECH\_POC>Mr. Rodgers</TECH\_POC>  <TECH\_PHONE>(719)555-1234</TECH\_PHONE>  <TECH\_EMAIL>email@email.XXX</TECH\_EMAIL>  <TIME\_SYSTEM>UT1</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T00:00:00.0000</EPOCH\_TZERO>  <TAIMUTC\_AT\_TZERO units="s">36</TAIMUTC\_AT\_TZERO>  <UT1MUTC\_AT\_TZERO units="s">.357</UT1MUTC\_AT\_TZERO>  </metadata>  <data>  <cov>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_REF\_FRAME>J2000</COV\_REF\_FRAME>  <COV\_TYPE>ADBARV</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[deg, deg, deg, deg, km, km/s]</COV\_UNITS>  <covLine>10.00 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04 -3.349365e-07 -4.686084e-07 2.484949e-07 4.296022e-10 -2.211832e-07 -2.864186e-07 1.798098e-07 2.608899e-10 1.767514e-10 -3.041346e-07 -4.989496e-07 3.540310e-07 1.869263e-10 1.008862e-10 6.224444e-10</covLine>  <covLine>20.0 3.442450e-04 4.507816e-04 6.893532e-04 -3.060006e-04 -4.110123e-04 3.342042e-04 -3.238254e-07 -4.575073e-07 2.373838e-07 4.307133e-10 -2.100721e-07 -2.753075e-07 1.687087e-07 2.507788e-10 1.878625e-10 -3.030235e-07 -4.878385e-07 3.430200e-07 1.758152e-10 1.007751e-10 6.224444e-10</covLine>  </cov>  <cov>  <COMMENT> This is a comment</COMMENT>  <COV\_ID>COV\_20160402\_XYZ</COV\_ID>  <COV\_PREV\_ID>COV\_20160305a</COV\_PREV\_ID>  <COV\_NEXT\_ID>COV\_20160305C</COV\_NEXT\_ID>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_BASIS\_ID>OD\_5910</COV\_BASIS\_ID>  <COV\_REF\_FRAME>FIXED\_EARTH</COV\_REF\_FRAME>  <COV\_FRAME\_EPOCH>2001-11-06T11:17:33</COV\_FRAME\_EPOCH>  <COV\_SCALE\_MIN>0.5</COV\_SCALE\_MIN>  <COV\_SCALE\_MAX>5.0</COV\_SCALE\_MAX>  <COV\_CONFIDENCE units="%">50</COV\_CONFIDENCE>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[km, km, km]</COV\_UNITS>  <covLine>2022-12-18T14:31:35.1172 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04</covLine>  </cov>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 3

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the COVARIANCE data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  OBJECT\_NAME = OSPREY 5  INTERNATIONAL\_DESIGNATOR = 2022-999A  ORIGINATOR\_POC = R. Rabbit  ORIGINATOR\_POSITION = Flight Dynamics Mission Design Lead  ORIGINATOR\_PHONE = (719)555-1234  ORIGINATOR\_ADDRESS = 5040 Spaceflight Ave., Cocoa Beach FL USA 12345  TECH\_POC = Mr. Rodgers  TECH\_PHONE = (719)555-1234  TECH\_EMAIL = email@email.XXX  TIME\_SYSTEM = UT1  EPOCH\_TZERO = 2022-12-18T00:00:00.0  TAIMUTC\_AT\_TZERO = 36.0 [s]  UT1MUTC\_AT\_TZERO = 0.357 [s]  META\_STOP  COV\_START  COV\_BASIS = PREDICTED  COV\_REF\_FRAME = J2000  COV\_TYPE = ADBARV  COV\_ORDERING = LTM  COV\_UNITS = [deg,deg,deg,deg,km,km/s]  10.0 3.331349E-4 4.6189270000000006E-4 6.782421E-4 -3.070007E-4 -4.221234000000001E-4 3.231931E-4 -3.349365E-7 -4.686084E-7 2.484949E-7 4.296022E-10 -2.211832E-7 -2.8641859999999994E-7 1.7980979999999998E-7 2.608899E-10 1.767514E-10 -3.041346000000001E-7 -4.989495999999999E-7 3.54031E-7 1.8692630000000003E-10 1.008862E-10 6.224444E-10  20.0 3.44245E-4 4.5078159999999997E-4 6.893532E-4 -3.060006E-4 -4.110123E-4 3.342042E-4 -3.238254E-7 -4.575073E-7 2.373838E-7 4.307133E-10 -2.100721E-7 -2.7530750000000003E-7 1.687087E-7 2.5077880000000007E-10 1.878625E-10 -3.030235E-7 -4.878385E-7 3.4302E-7 1.758152E-10 1.007751E-10 6.224444E-10  COV\_STOP  COV\_START  COMMENT This is a comment  COV\_ID = COV\_20160402\_XYZ  COV\_PREV\_ID = COV\_20160305a  COV\_NEXT\_ID = COV\_20160305C  COV\_BASIS = PREDICTED  COV\_BASIS\_ID = OD\_5910  COV\_REF\_FRAME = FIXED\_EARTH  COV\_FRAME\_EPOCH = 2001-11-06T11:17:33.0  COV\_SCALE\_MIN = 0.5  COV\_SCALE\_MAX = 5.0  COV\_CONFIDENCE = 50.0 [%]  COV\_TYPE = CARTP  COV\_ORDERING = LTM  COV\_UNITS = [km,km,km]  2022-12-18T14:31:35.1172 3.331349E-4 4.618927E-4 6.782421E-4 -3.070007E-4 -4.221234E-4 3.231931E-4  COV\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 3

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the COVARIANCE data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <OBJECT\_NAME>OSPREY 5</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2022-999A</INTERNATIONAL\_DESIGNATOR>  <ORIGINATOR\_POC>R. Rabbit</ORIGINATOR\_POC>  <ORIGINATOR\_POSITION>Flight Dynamics Mission Design Lead</ORIGINATOR\_POSITION>  <ORIGINATOR\_PHONE>(719)555-1234</ORIGINATOR\_PHONE>  <ORIGINATOR\_ADDRESS>5040 Spaceflight Ave., Cocoa Beach FL USA 12345</ORIGINATOR\_ADDRESS>  <TECH\_POC>Mr. Rodgers</TECH\_POC>  <TECH\_PHONE>(719)555-1234</TECH\_PHONE>  <TECH\_EMAIL>email@email.XXX</TECH\_EMAIL>  <TIME\_SYSTEM>UT1</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T00:00:00.0</EPOCH\_TZERO>  <TAIMUTC\_AT\_TZERO units="s">36.0</TAIMUTC\_AT\_TZERO>  <UT1MUTC\_AT\_TZERO units="s">0.357</UT1MUTC\_AT\_TZERO>  </metadata>  <data>  <cov>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_REF\_FRAME>J2000</COV\_REF\_FRAME>  <COV\_TYPE>ADBARV</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[deg,deg,deg,deg,km,km/s]</COV\_UNITS>  <covLine>10.0 3.331349E-4 4.6189270000000006E-4 6.782421E-4 -3.070007E-4 -4.221234000000001E-4 3.231931E-4 -3.349365E-7 -4.686084E-7 2.484949E-7 4.296022E-10 -2.211832E-7 -2.8641859999999994E-7 1.7980979999999998E-7 2.608899E-10 1.767514E-10 -3.041346000000001E-7 -4.989495999999999E-7 3.54031E-7 1.8692630000000003E-10 1.008862E-10 6.224444E-10</covLine>  <covLine>20.0 3.44245E-4 4.5078159999999997E-4 6.893532E-4 -3.060006E-4 -4.110123E-4 3.342042E-4 -3.238254E-7 -4.575073E-7 2.373838E-7 4.307133E-10 -2.100721E-7 -2.7530750000000003E-7 1.687087E-7 2.5077880000000007E-10 1.878625E-10 -3.030235E-7 -4.878385E-7 3.4302E-7 1.758152E-10 1.007751E-10 6.224444E-10</covLine>  </cov>  <cov>  <COMMENT>This is a comment</COMMENT>  <COV\_ID>COV\_20160402\_XYZ</COV\_ID>  <COV\_PREV\_ID>COV\_20160305a</COV\_PREV\_ID>  <COV\_NEXT\_ID>COV\_20160305C</COV\_NEXT\_ID>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_BASIS\_ID>OD\_5910</COV\_BASIS\_ID>  <COV\_REF\_FRAME>FIXED\_EARTH</COV\_REF\_FRAME>  <COV\_FRAME\_EPOCH>2001-11-06T11:17:33.0</COV\_FRAME\_EPOCH>  <COV\_SCALE\_MIN>0.5</COV\_SCALE\_MIN>  <COV\_SCALE\_MAX>5.0</COV\_SCALE\_MAX>  <COV\_CONFIDENCE units="%">50.0</COV\_CONFIDENCE>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[km,km,km]</COV\_UNITS>  <covLine>2022-12-18T14:31:35.1172 3.331349E-4 4.618927E-4 6.782421E-4 -3.070007E-4 -4.221234E-4 3.231931E-4</covLine>  </cov>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 3

## Test Case #4: Simple OCM with maneuver time history data

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| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 4 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | Test cases #4, #8, and #9 contained a spurious entry in the maneuver specification where both TIME\_ABSOLUTE and TIME\_RELATIVE were not specified, yet both were provided as numerical entries.  One entry has been changed manually before feeding Orekit with the files: the second maneuver DC\_TYPE was changed from TIME to TIME\_AND\_ANGLE. This was done in order to properly check the entries DC\_REF\_DIR, DC\_BODY\_FRAME, DC\_BODY\_TRIGGER, DC\_PA\_START\_ANGLE, and DC\_PA\_STOP\_ANGLE that would otherwise be irrelevant for a time-only duty cycle |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the MANEUVER(S) data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  MAN\_COMPOSITION = TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_PREV\_ID = E\_W\_20160305A  MAN\_NEXT\_ID = E\_W\_20160305C  MAN\_BASIS = CANDIDATE  MAN\_BASIS\_ID = OD\_20181122A  MAN\_DEVICE\_ID = ALL  MAN\_PREV\_EPOCH = 2001-11-06T11:17:33  MAN\_NEXT\_EPOCH = 2001-11-06T11:18:33  MAN\_PURPOSE = ORBIT  MAN\_PRED\_SOURCE = OD\_5  MAN\_REF\_FRAME = RSW\_ROTATING  MAN\_FRAME\_EPOCH = 2001-11-06T11:17:33  GRAV\_ASSIST\_NAME = EARTH  DC\_TYPE = TIME\_AND\_ANGLE  DC\_WIN\_OPEN = 50.0  DC\_WIN\_CLOSE = 100.0  DC\_MIN\_CYCLES = 5  DC\_MAX\_CYCLES = 200  DC\_EXEC\_START = 50.0  DC\_EXEC\_STOP = 100.0  DC\_REF\_TIME = 8000.0  DC\_TIME\_PULSE\_DURATION = 10.0  DC\_TIME\_PULSE\_PERIOD = 200.0  DC\_REF\_DIR = 1.0 0.0 0.0  DC\_BODY\_FRAME = SC\_BODY\_1  DC\_BODY\_TRIGGER = 0.707 0.0 0.707  DC\_PA\_START\_ANGLE = 25.0  DC\_PA\_STOP\_ANGLE = 35.0  MAN\_COMPOSITION = TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC  MAN\_UNITS = [s, N, N, N, %, n/a, s, n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP |

Figure ‑: Input KVN OCM for Test Case 4

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the MANEUVER(S) data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <man>  <COMMENT> Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT> 20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  <man>  <COMMENT> 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT> NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT> deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_PREV\_ID>E\_W\_20160305A</MAN\_PREV\_ID>  <MAN\_NEXT\_ID>E\_W\_20160305C</MAN\_NEXT\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_BASIS\_ID>OD\_20181122A</MAN\_BASIS\_ID>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_PREV\_EPOCH>2001-11-06T11:17:33</MAN\_PREV\_EPOCH>  <MAN\_NEXT\_EPOCH>2001-11-06T11:18:33</MAN\_NEXT\_EPOCH>  <MAN\_PURPOSE>ORBIT</MAN\_PURPOSE>  <MAN\_PRED\_SOURCE>OD\_5</MAN\_PRED\_SOURCE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <MAN\_FRAME\_EPOCH>2001-11-06T11:17:33</MAN\_FRAME\_EPOCH>  <GRAV\_ASSIST\_NAME>EARTH</GRAV\_ASSIST\_NAME>  <DC\_TYPE>TIME\_AND\_ANGLE</DC\_TYPE>  <DC\_WIN\_OPEN>50.0</DC\_WIN\_OPEN>  <DC\_WIN\_CLOSE>100.0</DC\_WIN\_CLOSE>  <DC\_MIN\_CYCLES>5</DC\_MIN\_CYCLES>  <DC\_MAX\_CYCLES>200</DC\_MAX\_CYCLES>  <DC\_EXEC\_START>50.0</DC\_EXEC\_START>  <DC\_EXEC\_STOP>100.0</DC\_EXEC\_STOP>  <DC\_REF\_TIME>8000.0</DC\_REF\_TIME>  <DC\_TIME\_PULSE\_DURATION units="s">10.0</DC\_TIME\_PULSE\_DURATION>  <DC\_TIME\_PULSE\_PERIOD units="s">200.0</DC\_TIME\_PULSE\_PERIOD>  <DC\_REF\_DIR>1.0 0.0 0.0</DC\_REF\_DIR>  <DC\_BODY\_FRAME>SC\_BODY\_1</DC\_BODY\_FRAME>  <DC\_BODY\_TRIGGER>0.707 0.0 0.707</DC\_BODY\_TRIGGER>  <DC\_PA\_START\_ANGLE units="deg">25.0</DC\_PA\_START\_ANGLE>  <DC\_PA\_STOP\_ANGLE units="deg">35.0</DC\_PA\_STOP\_ANGLE>  <MAN\_COMPOSITION>TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s, N, N, N, %, n/a, s, n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 4

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the MANEUVER(S) data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  DC\_TYPE = CONTINUOUS  MAN\_COMPOSITION = TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_PREV\_ID = E\_W\_20160305A  MAN\_NEXT\_ID = E\_W\_20160305C  MAN\_BASIS = CANDIDATE  MAN\_BASIS\_ID = OD\_20181122A  MAN\_DEVICE\_ID = ALL  MAN\_PREV\_EPOCH = 2001-11-06T11:17:33.0  MAN\_NEXT\_EPOCH = 2001-11-06T11:18:33.0  MAN\_PURPOSE = ORBIT  MAN\_PRED\_SOURCE = OD\_5  MAN\_REF\_FRAME = RSW\_ROTATING  GRAV\_ASSIST\_NAME = EARTH  DC\_TYPE = TIME\_AND\_ANGLE  DC\_WIN\_OPEN = 50.0  DC\_WIN\_CLOSE = 100.0  DC\_MIN\_CYCLES = 5  DC\_MAX\_CYCLES = 200  DC\_EXEC\_START = 50.0  DC\_EXEC\_STOP = 100.0  DC\_REF\_TIME = 8000.0  DC\_TIME\_PULSE\_DURATION = 10.0 [s]  DC\_TIME\_PULSE\_PERIOD = 200.0 [s]  DC\_REF\_DIR = 1.0 0.0 0.0  DC\_BODY\_FRAME = SC\_BODY\_1  DC\_BODY\_TRIGGER = 0.707 0.0 0.707  DC\_PA\_START\_ANGLE = 25.0 [deg]  DC\_PA\_STOP\_ANGLE = 35.0 [deg]  MAN\_COMPOSITION = TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC  MAN\_UNITS = [s,N,N,N,%,n/a,s,n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 4

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the MANEUVER(S) data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <man>  <COMMENT>Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT>20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  <man>  <COMMENT>100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT>NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT>deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_PREV\_ID>E\_W\_20160305A</MAN\_PREV\_ID>  <MAN\_NEXT\_ID>E\_W\_20160305C</MAN\_NEXT\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_BASIS\_ID>OD\_20181122A</MAN\_BASIS\_ID>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_PREV\_EPOCH>2001-11-06T11:17:33.0</MAN\_PREV\_EPOCH>  <MAN\_NEXT\_EPOCH>2001-11-06T11:18:33.0</MAN\_NEXT\_EPOCH>  <MAN\_PURPOSE>ORBIT</MAN\_PURPOSE>  <MAN\_PRED\_SOURCE>OD\_5</MAN\_PRED\_SOURCE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <GRAV\_ASSIST\_NAME>EARTH</GRAV\_ASSIST\_NAME>  <DC\_TYPE>TIME\_AND\_ANGLE</DC\_TYPE>  <DC\_WIN\_OPEN>50.0</DC\_WIN\_OPEN>  <DC\_WIN\_CLOSE>100.0</DC\_WIN\_CLOSE>  <DC\_MIN\_CYCLES>5</DC\_MIN\_CYCLES>  <DC\_MAX\_CYCLES>200</DC\_MAX\_CYCLES>  <DC\_EXEC\_START>50.0</DC\_EXEC\_START>  <DC\_EXEC\_STOP>100.0</DC\_EXEC\_STOP>  <DC\_REF\_TIME>8000.0</DC\_REF\_TIME>  <DC\_TIME\_PULSE\_DURATION units="s">10.0</DC\_TIME\_PULSE\_DURATION>  <DC\_TIME\_PULSE\_PERIOD units="s">200.0</DC\_TIME\_PULSE\_PERIOD>  <DC\_REF\_DIR>1.0 0.0 0.0</DC\_REF\_DIR>  <DC\_BODY\_FRAME>SC\_BODY\_1</DC\_BODY\_FRAME>  <DC\_BODY\_TRIGGER>0.707 0.0 0.707</DC\_BODY\_TRIGGER>  <DC\_PA\_START\_ANGLE units="deg">25.0</DC\_PA\_START\_ANGLE>  <DC\_PA\_STOP\_ANGLE units="deg">35.0</DC\_PA\_STOP\_ANGLE>  <MAN\_COMPOSITION>TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s,N,N,N,%,n/a,s,n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure‑: Output (Round Trip) XML OCM for Test Case 4

## Test Case #5: Simple OCM with perturbation data

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| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 5 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | This message had originally used “DUAL CONE” as the keyword value for SHADOW\_MODEL, but the OREKIT software inserted an underscore between the two words. It was then realized that the intent had been for that keyword value to have an underscore separating the two words anyway, so one was inserted into the OCM standard. This variance is accepted. |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the PERTURBATIONS data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON, SUN, JUPITER  CENTRAL\_BODY\_ROTATION = 4.17807421629e-3  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL\_CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2  FIXED\_GEOMAG\_AP = 21  FIXED\_GEOMAG\_DST = -20  FIXED\_F10P7 = 120.0  FIXED\_F10P7\_MEAN = 132.0  FIXED\_M10P7 = 120.0  FIXED\_M10P7\_MEAN = 120.0  FIXED\_S10P7 = 120.0  FIXED\_S10P7\_MEAN = 120.0  FIXED\_Y10P7 = 120.0  FIXED\_Y10P7\_MEAN = 120.0  PERT\_STOP |

Figure ‑: Input KVN OCM for Test Case 5

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the PERTURBATIONS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <pert>  <COMMENT> Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON, SUN, JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">4.17807421629e-3</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL\_CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 5

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| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the PERTURBATIONS data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137 [km]  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON,SUN,JUPITER  CENTRAL\_BODY\_ROTATION = 0.00417807421629 [deg/s]  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL\_CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00.0  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2 [nT]  FIXED\_GEOMAG\_AP = 21.0 [nT]  FIXED\_GEOMAG\_DST = -20.0 [nT]  FIXED\_F10P7 = 120.0 [SFU]  FIXED\_F10P7\_MEAN = 132.0 [SFU]  FIXED\_M10P7 = 120.0 [SFU]  FIXED\_M10P7\_MEAN = 120.0 [SFU]  FIXED\_S10P7 = 120.0 [SFU]  FIXED\_S10P7\_MEAN = 120.0 [SFU]  FIXED\_Y10P7 = 120.0 [SFU]  FIXED\_Y10P7\_MEAN = 120.0 [SFU]  PERT\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 5

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the PERTURBATIONS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <pert>  <COMMENT>Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON,SUN,JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">0.00417807421629</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL\_CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00.0</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21.0</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20.0</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 5

## Test Case #6: Simple OCM with orbit determination data

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 6 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | NONE |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

|  |
| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the OD data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON, SUN, JUPITER  CENTRAL\_BODY\_ROTATION = 4.17807421629e-3  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2  FIXED\_GEOMAG\_AP = 21  FIXED\_GEOMAG\_DST = -20  FIXED\_F10P7 = 120.0  FIXED\_F10P7\_MEAN = 132.0  FIXED\_M10P7 = 120.0  FIXED\_M10P7\_MEAN = 120.0  FIXED\_S10P7 = 120.0  FIXED\_S10P7\_MEAN = 120.0  FIXED\_Y10P7 = 120.0  FIXED\_Y10P7\_MEAN = 120.0  PERT\_STOP  OD\_START  COMMENT Orbit Determination information  OD\_ID = OD\_20160402  OD\_PREV\_ID = OD\_20160401  OD\_METHOD = SF: ODTK  OD\_EPOCH = 27854.239  DAYS\_SINCE\_FIRST\_OBS = 3.5  DAYS\_SINCE\_LAST\_OBS = 1.2  RECOMMENDED\_OD\_SPAN = 5.2  ACTUAL\_OD\_SPAN = 2.3  OBS\_AVAILABLE = 100  OBS\_USED = 90  TRACKS\_AVAILABLE = 33  TRACKS\_USED = 30  MAXIMUM\_OBS\_GAP = 1.0  OD\_EPOCH\_EIGMAJ = 58.73  OD\_EPOCH\_EIGINT = 35.7  OD\_EPOCH\_EIGMIN = 21.5  OD\_MAX\_PRED\_EIGMAJ = 21.5  OD\_MIN\_PRED\_EIGMIN = 21.5  OD\_CONFIDENCE = 95.3  GDOP = .857  SOLVE\_N = 6  SOLVE\_STATES = POS[3], VEL[3]  CONSIDER\_N = 2  CONSIDER\_PARAMS = DRAG, SRP  SEDR = 4.54570E-05  SENSORS\_N = 3  SENSORS = EGLIN, FYLINGDALES  WEIGHTED\_RMS = 1.3  DATA\_TYPES = ANGLE\_1, ANGLE\_2  OD\_STOP |

Figure ‑: Input KVN OCM for Test Case 6

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the OD data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <pert>  <COMMENT> Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON, SUN, JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">4.17807421629e-3</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  <od>  <COMMENT> Orbit Determination information</COMMENT>  <OD\_ID>OD\_20160402</OD\_ID>  <OD\_PREV\_ID>OD\_20160401</OD\_PREV\_ID>  <OD\_METHOD>SF: ODTK</OD\_METHOD>  <OD\_EPOCH>27854.239</OD\_EPOCH>  <DAYS\_SINCE\_FIRST\_OBS units="d">3.5</DAYS\_SINCE\_FIRST\_OBS>  <DAYS\_SINCE\_LAST\_OBS units="d">1.2</DAYS\_SINCE\_LAST\_OBS>  <RECOMMENDED\_OD\_SPAN units="d">5.2</RECOMMENDED\_OD\_SPAN>  <ACTUAL\_OD\_SPAN units="d">2.3</ACTUAL\_OD\_SPAN>  <OBS\_AVAILABLE>100</OBS\_AVAILABLE>  <OBS\_USED>90</OBS\_USED>  <TRACKS\_AVAILABLE>33</TRACKS\_AVAILABLE>  <TRACKS\_USED>30</TRACKS\_USED>  <MAXIMUM\_OBS\_GAP units="d">1.0</MAXIMUM\_OBS\_GAP>  <OD\_EPOCH\_EIGMAJ units="m">58.73</OD\_EPOCH\_EIGMAJ>  <OD\_EPOCH\_EIGINT units="m">35.7</OD\_EPOCH\_EIGINT>  <OD\_EPOCH\_EIGMIN units="m">21.5</OD\_EPOCH\_EIGMIN>  <OD\_MAX\_PRED\_EIGMAJ units="m">21.5</OD\_MAX\_PRED\_EIGMAJ>  <OD\_MIN\_PRED\_EIGMIN units="m">21.5</OD\_MIN\_PRED\_EIGMIN>  <OD\_CONFIDENCE units="%">95.3</OD\_CONFIDENCE>  <GDOP>.857</GDOP>  <SOLVE\_N>6</SOLVE\_N>  <SOLVE\_STATES>POS[3], VEL[3]</SOLVE\_STATES>  <CONSIDER\_N>2</CONSIDER\_N>  <CONSIDER\_PARAMS>DRAG, SRP</CONSIDER\_PARAMS>  <SEDR units="W/kg">4.54570E-05</SEDR>  <SENSORS\_N>3</SENSORS\_N>  <SENSORS>EGLIN, FYLINGDALES</SENSORS>  <WEIGHTED\_RMS>1.3</WEIGHTED\_RMS>  <DATA\_TYPES>ANGLE\_1, ANGLE\_2</DATA\_TYPES>  </od>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 6

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| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the OD data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137 [km]  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON,SUN,JUPITER  CENTRAL\_BODY\_ROTATION = 0.00417807421629 [deg/s]  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL\_CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00.0  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2 [nT]  FIXED\_GEOMAG\_AP = 21.0 [nT]  FIXED\_GEOMAG\_DST = -20.0 [nT]  FIXED\_F10P7 = 120.0 [SFU]  FIXED\_F10P7\_MEAN = 132.0 [SFU]  FIXED\_M10P7 = 120.0 [SFU]  FIXED\_M10P7\_MEAN = 120.0 [SFU]  FIXED\_S10P7 = 120.0 [SFU]  FIXED\_S10P7\_MEAN = 120.0 [SFU]  FIXED\_Y10P7 = 120.0 [SFU]  FIXED\_Y10P7\_MEAN = 120.0 [SFU]  PERT\_STOP  OD\_START  COMMENT Orbit Determination information  OD\_ID = OD\_20160402  OD\_PREV\_ID = OD\_20160401  OD\_METHOD = SF:ODTK  OD\_EPOCH = 27854.239  DAYS\_SINCE\_FIRST\_OBS = 3.5 [d]  DAYS\_SINCE\_LAST\_OBS = 1.2 [d]  RECOMMENDED\_OD\_SPAN = 5.2 [d]  ACTUAL\_OD\_SPAN = 2.3 [d]  OBS\_AVAILABLE = 100  OBS\_USED = 90  TRACKS\_AVAILABLE = 33  TRACKS\_USED = 30  MAXIMUM\_OBS\_GAP = 1.0 [d]  OD\_EPOCH\_EIGMAJ = 58.73 [m]  OD\_EPOCH\_EIGINT = 35.7 [m]  OD\_EPOCH\_EIGMIN = 21.5 [m]  OD\_MAX\_PRED\_EIGMAJ = 21.5 [m]  OD\_MIN\_PRED\_EIGMIN = 21.5 [m]  OD\_CONFIDENCE = 95.3 [%]  GDOP = 0.857  SOLVE\_N = 6  SOLVE\_STATES = POS[3],VEL[3]  CONSIDER\_N = 2  CONSIDER\_PARAMS = DRAG,SRP  SEDR = 4.5457E-5 [W/kg]  SENSORS\_N = 3  SENSORS = EGLIN,FYLINGDALES  WEIGHTED\_RMS = 1.3  DATA\_TYPES = ANGLE\_1,ANGLE\_2  OD\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 6

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| --- |
| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the OD data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <pert>  <COMMENT>Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON,SUN,JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">0.00417807421629</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL\_CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00.0</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21.0</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20.0</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  <od>  <COMMENT>Orbit Determination information</COMMENT>  <OD\_ID>OD\_20160402</OD\_ID>  <OD\_PREV\_ID>OD\_20160401</OD\_PREV\_ID>  <OD\_METHOD>SF:ODTK</OD\_METHOD>  <OD\_EPOCH>27854.239</OD\_EPOCH>  <DAYS\_SINCE\_FIRST\_OBS units="d">3.5</DAYS\_SINCE\_FIRST\_OBS>  <DAYS\_SINCE\_LAST\_OBS units="d">1.2</DAYS\_SINCE\_LAST\_OBS>  <RECOMMENDED\_OD\_SPAN units="d">5.2</RECOMMENDED\_OD\_SPAN>  <ACTUAL\_OD\_SPAN units="d">2.3</ACTUAL\_OD\_SPAN>  <OBS\_AVAILABLE>100</OBS\_AVAILABLE>  <OBS\_USED>90</OBS\_USED>  <TRACKS\_AVAILABLE>33</TRACKS\_AVAILABLE>  <TRACKS\_USED>30</TRACKS\_USED>  <MAXIMUM\_OBS\_GAP units="d">1.0</MAXIMUM\_OBS\_GAP>  <OD\_EPOCH\_EIGMAJ units="m">58.73</OD\_EPOCH\_EIGMAJ>  <OD\_EPOCH\_EIGINT units="m">35.7</OD\_EPOCH\_EIGINT>  <OD\_EPOCH\_EIGMIN units="m">21.5</OD\_EPOCH\_EIGMIN>  <OD\_MAX\_PRED\_EIGMAJ units="m">21.5</OD\_MAX\_PRED\_EIGMAJ>  <OD\_MIN\_PRED\_EIGMIN units="m">21.5</OD\_MIN\_PRED\_EIGMIN>  <OD\_CONFIDENCE units="%">95.3</OD\_CONFIDENCE>  <GDOP>0.857</GDOP>  <SOLVE\_N>6</SOLVE\_N>  <SOLVE\_STATES>POS[3],VEL[3]</SOLVE\_STATES>  <CONSIDER\_N>2</CONSIDER\_N>  <CONSIDER\_PARAMS>DRAG,SRP</CONSIDER\_PARAMS>  <SEDR units="W/kg">4.5457E-5</SEDR>  <SENSORS\_N>3</SENSORS\_N>  <SENSORS>EGLIN,FYLINGDALES</SENSORS>  <WEIGHTED\_RMS>1.3</WEIGHTED\_RMS>  <DATA\_TYPES>ANGLE\_1,ANGLE\_2</DATA\_TYPES>  </od>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 6

## Test Case #7: Simple OCM with user parameters data

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 7 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | It was realized during testing that XML tag “userDef” was modified to “user” and “covar” was modified to “cov”, both of which had do be updated in order to validate properly. |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

|  |
| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the USER DEFINED PARAMETERS data block  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  USER\_START  USER\_DEFINED\_CONSOLE\_POC = MAXWELL RAFERTY  USER\_DEFINED\_EARTH\_MODEL = WGS-84  USER\_STOP |

Figure ‑: Input KVN OCM for Test Case 7

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the USER DEFINED PARAMETERS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <user>  <USER\_DEFINED parameter="CONSOLE\_POC">MAXWELL RAFERTY</USER\_DEFINED>  <USER\_DEFINED parameter="EARTH\_MODEL">WGS-84</USER\_DEFINED>  </user>  </data>  </segment>  </body>  </ocm> |

Figure‑: Input XML OCM for Test Case 7

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of the USER DEFINED PARAMETERS data block  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  USER\_START  USER\_DEFINED\_CONSOLE\_POC = MAXWELL RAFERTY  USER\_DEFINED\_EARTH\_MODEL = WGS-84  USER\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 7

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of the USER DEFINED PARAMETERS data block</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <user>  <USER\_DEFINED parameter="CONSOLE\_POC">MAXWELL RAFERTY</USER\_DEFINED>  <USER\_DEFINED parameter="EARTH\_MODEL">WGS-84</USER\_DEFINED>  </user>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 7

## Test Case #8: Full-featured OCM with all data blocks

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| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 8 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | Test cases #4, #8, and #9 contained a spurious entry in the maneuver specification where both TIME\_ABSOLUTE and TIME\_RELATIVE were not specified, yet both were provided as numerical entries. Also, it was realized during testing that XML tag “userDef” was modified to “user” and “covar” was modified to “cov”, both of which had do be updated to validate properly. |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result.  As in Test #4, the fact that DC\_TYPE was set to “TIME” meant that many of the duty cycle related functions were unnecessary and not used. The Orekit OCM processor correctly identified this and only retained the “TIME” relevant keywords and their values. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of ALL data blocks in aggregate  CREATION\_DATE = 2022-11-06T09:23:57  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  TRAJ\_START  COMMENT This is comment 01  COMMENT This is comment 02  TRAJ\_ID = TRAJ\_20160402\_XYZ  TRAJ\_PREV\_ID = ORB20160305A  TRAJ\_NEXT\_ID = ORB20160305C  TRAJ\_BASIS = PREDICTED  TRAJ\_BASIS\_ID = OD\_5910  INTERPOLATION = HERMITE  INTERPOLATION\_DEGREE = 5  PROPAGATOR = HPOP  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  USEABLE\_START\_TIME = 1996-12-18T14:28:15.1172  USEABLE\_STOP\_TIME = 1996-354T14:28:15.1172  ORB\_REVNUM = 1500  ORB\_REVNUM\_BASIS = 0  TRAJ\_TYPE = CARTPV  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s]  0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52  120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29  240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16  TRAJ\_STOP  PHYS\_START  COMMENT This is comment 01  COMMENT This is comment 02  MANUFACTURER = BOEING  BUS\_MODEL = 702  DOCKED\_WITH = ISS  DRAG\_CONST\_AREA = 2.5 [m\*\*2]  DRAG\_COEFF\_NOM = 2.2  DRAG\_UNCERTAINTY = 10.0  INITIAL\_WET\_MASS = 500 [kg]  WET\_MASS = 472.3 [kg]  DRY\_MASS = 300 [kg]  OEB\_PARENT\_FRAME = ITRF1997  OEB\_PARENT\_FRAME\_EPOCH = 2001-11-06T11:17:33  OEB\_Q1 = -0.575131822  OEB\_Q2 = -0.280510532  OEB\_Q3 = -0.195634856  OEB\_QC = 0.743144825  OEB\_MAX = 1  OEB\_INT = 0.5  OEB\_MIN = 0.3  AREA\_ALONG\_OEB\_MAX = 0.15  AREA\_ALONG\_OEB\_INT = 0.3  AREA\_ALONG\_OEB\_MIN = 0.5  AREA\_MIN\_FOR\_PC = 1.0  AREA\_MAX\_FOR\_PC = 1.0  AREA\_TYP\_FOR\_PC = 1.0  RCS = 1.25  RCS\_MIN = 1.1  RCS\_MAX = 2.5  SRP\_CONST\_AREA = 1.0 [m\*\*2]  SOLAR\_RAD\_COEFF = 1.7  SOLAR\_RAD\_UNCERTAINTY = 1.0  VM\_ABSOLUTE = 15.0  VM\_APPARENT\_MIN = 19.0  VM\_APPARENT = 15.0  VM\_APPARENT\_MAX = 16.0  REFLECTANCE = 0.7  ATT\_CONTROL\_MODE = SPIN  ATT\_ACTUATOR\_TYPE = ATT\_THRUSTERS  ATT\_KNOWLEDGE = 0.3  ATT\_CONTROL = 2.0  ATT\_POINTING = 2.3  AVG\_MANEUVER\_FREQ = 20.0  MAX\_THRUST = 1.0  DV\_BOL = 1.0  DV\_REMAINING = 0.2  IXX = 1000.0  IYY = 800.0  IZZ = 400.0  IXY = 20.0  IXZ = 40.0  IYZ = 60.0  PHYS\_STOP  COV\_START  COMMENT This is a comment  COV\_ID = COV\_20160402\_XYZ  COV\_PREV\_ID = COV\_20160305a  COV\_NEXT\_ID = COV\_20160305C  COV\_BASIS = PREDICTED  COV\_BASIS\_ID = OD\_5910  COV\_REF\_FRAME = FIXED\_EARTH  COV\_FRAME\_EPOCH = 2001-11-06T11:17:33  COV\_SCALE\_MIN = 0.5  COV\_SCALE\_MAX = 5.0  COV\_CONFIDENCE = 50  COV\_TYPE = CARTP  COV\_ORDERING = LTM  COV\_UNITS = [km, km, km]  2022-12-18T14:31:35.1172 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04  COV\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  MAN\_COMPOSITION = TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_PREV\_ID = E\_W\_20160305A  MAN\_NEXT\_ID = E\_W\_20160305C  MAN\_BASIS = CANDIDATE  MAN\_BASIS\_ID = OD\_20181122A  MAN\_DEVICE\_ID = ALL  MAN\_PREV\_EPOCH = 2001-11-06T11:17:33  MAN\_NEXT\_EPOCH = 2001-11-06T11:18:33  MAN\_PURPOSE = ORBIT  MAN\_PRED\_SOURCE = OD\_5  MAN\_REF\_FRAME = RSW\_ROTATING  MAN\_FRAME\_EPOCH = 2001-11-06T11:17:33  GRAV\_ASSIST\_NAME = EARTH  DC\_TYPE = TIME  DC\_WIN\_OPEN = 50.0  DC\_WIN\_CLOSE = 100.0  DC\_MIN\_CYCLES = 5  DC\_MAX\_CYCLES = 200  DC\_EXEC\_START = 50.0  DC\_EXEC\_STOP = 100.0  DC\_REF\_TIME = 8000.0  DC\_TIME\_PULSE\_DURATION = 10.0  DC\_TIME\_PULSE\_PERIOD = 200.0  DC\_REF\_DIR = 1.0 0.0 0.0  DC\_BODY\_FRAME = SC\_BODY\_1  DC\_BODY\_TRIGGER = 0.707 0.0 0.707  DC\_PA\_START\_ANGLE = 25.0  DC\_PA\_STOP\_ANGLE = 35.0  MAN\_COMPOSITION = TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC  MAN\_UNITS = [s, N, N, N, %, n/a, s, n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON, SUN, JUPITER  CENTRAL\_BODY\_ROTATION = 4.17807421629e-3  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2  FIXED\_GEOMAG\_AP = 21  FIXED\_GEOMAG\_DST = -20  FIXED\_F10P7 = 120.0  FIXED\_F10P7\_MEAN = 132.0  FIXED\_M10P7 = 120.0  FIXED\_M10P7\_MEAN = 120.0  FIXED\_S10P7 = 120.0  FIXED\_S10P7\_MEAN = 120.0  FIXED\_Y10P7 = 120.0  FIXED\_Y10P7\_MEAN = 120.0  PERT\_STOP  OD\_START  COMMENT Orbit Determination information  OD\_ID = OD\_20160402  OD\_PREV\_ID = OD\_20160401  OD\_METHOD = SF: ODTK  OD\_EPOCH = 27854.239  DAYS\_SINCE\_FIRST\_OBS = 3.5  DAYS\_SINCE\_LAST\_OBS = 1.2  RECOMMENDED\_OD\_SPAN = 5.2  ACTUAL\_OD\_SPAN = 2.3  OBS\_AVAILABLE = 100  OBS\_USED = 90  TRACKS\_AVAILABLE = 33  TRACKS\_USED = 30  MAXIMUM\_OBS\_GAP = 1.0  OD\_EPOCH\_EIGMAJ = 58.73  OD\_EPOCH\_EIGINT = 35.7  OD\_EPOCH\_EIGMIN = 21.5  OD\_MAX\_PRED\_EIGMAJ = 21.5  OD\_MIN\_PRED\_EIGMIN = 21.5  OD\_CONFIDENCE = 95.3  GDOP = .857  SOLVE\_N = 6  SOLVE\_STATES = POS[3], VEL[3]  CONSIDER\_N = 2  CONSIDER\_PARAMS = DRAG, SRP  SEDR = 4.54570E-05  SENSORS\_N = 3  SENSORS = EGLIN, FYLINGDALES  WEIGHTED\_RMS = 1.3  DATA\_TYPES = ANGLE\_1, ANGLE\_2  OD\_STOP  USER\_START  USER\_DEFINED\_CONSOLE\_POC = MAXWELL RAFERTY  USER\_DEFINED\_EARTH\_MODEL = WGS-84  USER\_STOP |

Figure ‑: Input KVN OCM for Test Case 8

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of ALL data blocks in aggregate</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <TRAJ\_ID>TRAJ\_20160402\_XYZ</TRAJ\_ID>  <TRAJ\_PREV\_ID>ORB20160305A</TRAJ\_PREV\_ID>  <TRAJ\_NEXT\_ID>ORB20160305C</TRAJ\_NEXT\_ID>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <TRAJ\_BASIS\_ID>OD\_5910</TRAJ\_BASIS\_ID>  <INTERPOLATION>HERMITE</INTERPOLATION>  <INTERPOLATION\_DEGREE>5</INTERPOLATION\_DEGREE>  <PROPAGATOR>HPOP</PROPAGATOR>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <USEABLE\_START\_TIME>1996-12-18T14:28:15.1172</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>1996-354T14:28:15.1172</USEABLE\_STOP\_TIME>  <ORB\_REVNUM>1500</ORB\_REVNUM>  <ORB\_REVNUM\_BASIS>0</ORB\_REVNUM\_BASIS>  <TRAJ\_TYPE>CARTPV</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.90 4.86 0.52</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.50 5.87 4.29</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.80 5.58 2.16</trajLine>  </traj>  <phys>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <MANUFACTURER>BOEING</MANUFACTURER>  <BUS\_MODEL>702</BUS\_MODEL>  <DOCKED\_WITH>ISS</DOCKED\_WITH>  <DRAG\_CONST\_AREA units="m\*\*2">2.5</DRAG\_CONST\_AREA>  <DRAG\_COEFF\_NOM>2.2</DRAG\_COEFF\_NOM>  <DRAG\_UNCERTAINTY units="%">10.0</DRAG\_UNCERTAINTY>  <INITIAL\_WET\_MASS units="kg">500</INITIAL\_WET\_MASS>  <WET\_MASS units="kg">472.3</WET\_MASS>  <DRY\_MASS units="kg">300</DRY\_MASS>  <OEB\_PARENT\_FRAME>ITRF1997</OEB\_PARENT\_FRAME>  <OEB\_PARENT\_FRAME\_EPOCH>2001-11-06T11:17:33</OEB\_PARENT\_FRAME\_EPOCH>  <OEB\_Q1>-0.575131822</OEB\_Q1>  <OEB\_Q2>-0.280510532</OEB\_Q2>  <OEB\_Q3>-0.195634856</OEB\_Q3>  <OEB\_QC>0.743144825</OEB\_QC>  <OEB\_MAX units="m">1</OEB\_MAX>  <OEB\_INT units="m">0.5</OEB\_INT>  <OEB\_MIN units="m">0.3</OEB\_MIN>  <AREA\_ALONG\_OEB\_MAX units="m\*\*2">0.15</AREA\_ALONG\_OEB\_MAX>  <AREA\_ALONG\_OEB\_INT units="m\*\*2">0.3</AREA\_ALONG\_OEB\_INT>  <AREA\_ALONG\_OEB\_MIN units="m\*\*2">0.5</AREA\_ALONG\_OEB\_MIN>  <AREA\_MIN\_FOR\_PC units="m\*\*2">1.0</AREA\_MIN\_FOR\_PC>  <AREA\_MAX\_FOR\_PC units="m\*\*2">1.0</AREA\_MAX\_FOR\_PC>  <AREA\_TYP\_FOR\_PC units="m\*\*2">1.0</AREA\_TYP\_FOR\_PC>  <RCS units="m\*\*2">1.25</RCS>  <RCS\_MIN units="m\*\*2">1.1</RCS\_MIN>  <RCS\_MAX units="m\*\*2">2.5</RCS\_MAX>  <SRP\_CONST\_AREA units="m\*\*2">1.0</SRP\_CONST\_AREA>  <SOLAR\_RAD\_COEFF>1.7</SOLAR\_RAD\_COEFF>  <SOLAR\_RAD\_UNCERTAINTY units="%">1.0 </SOLAR\_RAD\_UNCERTAINTY>  <VM\_ABSOLUTE>15.0</VM\_ABSOLUTE>  <VM\_APPARENT\_MIN>19.0</VM\_APPARENT\_MIN>  <VM\_APPARENT>15.0</VM\_APPARENT>  <VM\_APPARENT\_MAX>16.0</VM\_APPARENT\_MAX>  <REFLECTANCE>0.7</REFLECTANCE>  <ATT\_CONTROL\_MODE>SPIN</ATT\_CONTROL\_MODE>  <ATT\_ACTUATOR\_TYPE>ATT\_THRUSTERS</ATT\_ACTUATOR\_TYPE>  <ATT\_KNOWLEDGE units="deg">0.3</ATT\_KNOWLEDGE>  <ATT\_CONTROL units="deg">2.0</ATT\_CONTROL>  <ATT\_POINTING units="deg">2.3</ATT\_POINTING>  <AVG\_MANEUVER\_FREQ units="#/yr">20.0</AVG\_MANEUVER\_FREQ>  <MAX\_THRUST units="N">1.0</MAX\_THRUST>  <DV\_BOL units="km/s">1.0</DV\_BOL>  <DV\_REMAINING units="km/s">0.2</DV\_REMAINING>  <IXX units="kg\*m\*\*2">1000.0</IXX>  <IYY units="kg\*m\*\*2">800.0</IYY>  <IZZ units="kg\*m\*\*2">400.0</IZZ>  <IXY units="kg\*m\*\*2">20.0</IXY>  <IXZ units="kg\*m\*\*2">40.0</IXZ>  <IYZ units="kg\*m\*\*2">60.0</IYZ>  </phys>  <cov>  <COMMENT> This is a comment</COMMENT>  <COV\_ID>COV\_20160402\_XYZ</COV\_ID>  <COV\_PREV\_ID>COV\_20160305a</COV\_PREV\_ID>  <COV\_NEXT\_ID>COV\_20160305C</COV\_NEXT\_ID>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_BASIS\_ID>OD\_5910</COV\_BASIS\_ID>  <COV\_REF\_FRAME>FIXED\_EARTH</COV\_REF\_FRAME>  <COV\_FRAME\_EPOCH>2001-11-06T11:17:33</COV\_FRAME\_EPOCH>  <COV\_SCALE\_MIN>0.5</COV\_SCALE\_MIN>  <COV\_SCALE\_MAX>5.0</COV\_SCALE\_MAX>  <COV\_CONFIDENCE units="%">50</COV\_CONFIDENCE>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[km, km, km]</COV\_UNITS>  <covLine>2022-12-18T14:31:35.1172 3.331349e-04 4.618927e-04 6.782421e-04 -3.070007e-04 -4.221234e-04 3.231931e-04</covLine>  </cov>  <man>  <COMMENT> Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT> 20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  <man>  <COMMENT> 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT> NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT> deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_PREV\_ID>E\_W\_20160305A</MAN\_PREV\_ID>  <MAN\_NEXT\_ID>E\_W\_20160305C</MAN\_NEXT\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_BASIS\_ID>OD\_20181122A</MAN\_BASIS\_ID>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_PREV\_EPOCH>2001-11-06T11:17:33</MAN\_PREV\_EPOCH>  <MAN\_NEXT\_EPOCH>2001-11-06T11:18:33</MAN\_NEXT\_EPOCH>  <MAN\_PURPOSE>ORBIT</MAN\_PURPOSE>  <MAN\_PRED\_SOURCE>OD\_5</MAN\_PRED\_SOURCE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <MAN\_FRAME\_EPOCH>2001-11-06T11:17:33</MAN\_FRAME\_EPOCH>  <GRAV\_ASSIST\_NAME>EARTH</GRAV\_ASSIST\_NAME>  <DC\_TYPE>TIME</DC\_TYPE>  <DC\_WIN\_OPEN>50.0</DC\_WIN\_OPEN>  <DC\_WIN\_CLOSE>100.0</DC\_WIN\_CLOSE>  <DC\_MIN\_CYCLES>5</DC\_MIN\_CYCLES>  <DC\_MAX\_CYCLES>200</DC\_MAX\_CYCLES>  <DC\_EXEC\_START>50.0</DC\_EXEC\_START>  <DC\_EXEC\_STOP>100.0</DC\_EXEC\_STOP>  <DC\_REF\_TIME>8000.0</DC\_REF\_TIME>  <DC\_TIME\_PULSE\_DURATION units="s">10.0</DC\_TIME\_PULSE\_DURATION>  <DC\_TIME\_PULSE\_PERIOD units="s">200.0</DC\_TIME\_PULSE\_PERIOD>  <DC\_REF\_DIR>1.0 0.0 0.0</DC\_REF\_DIR>  <DC\_BODY\_FRAME>SC\_BODY\_1</DC\_BODY\_FRAME>  <DC\_BODY\_TRIGGER>0.707 0.0 0.707</DC\_BODY\_TRIGGER>  <DC\_PA\_START\_ANGLE units="deg">25.0</DC\_PA\_START\_ANGLE>  <DC\_PA\_STOP\_ANGLE units="deg">35.0</DC\_PA\_STOP\_ANGLE>  <MAN\_COMPOSITION>TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s, N, N, N, %, n/a, s, n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  <pert>  <COMMENT> Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON, SUN, JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">4.17807421629e-3</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  <od>  <COMMENT> Orbit Determination information</COMMENT>  <OD\_ID>OD\_20160402</OD\_ID>  <OD\_PREV\_ID>OD\_20160401</OD\_PREV\_ID>  <OD\_METHOD>SF: ODTK</OD\_METHOD>  <OD\_EPOCH>27854.239</OD\_EPOCH>  <DAYS\_SINCE\_FIRST\_OBS units="d">3.5</DAYS\_SINCE\_FIRST\_OBS>  <DAYS\_SINCE\_LAST\_OBS units="d">1.2</DAYS\_SINCE\_LAST\_OBS>  <RECOMMENDED\_OD\_SPAN units="d">5.2</RECOMMENDED\_OD\_SPAN>  <ACTUAL\_OD\_SPAN units="d">2.3</ACTUAL\_OD\_SPAN>  <OBS\_AVAILABLE>100</OBS\_AVAILABLE>  <OBS\_USED>90</OBS\_USED>  <TRACKS\_AVAILABLE>33</TRACKS\_AVAILABLE>  <TRACKS\_USED>30</TRACKS\_USED>  <MAXIMUM\_OBS\_GAP units="d">1.0</MAXIMUM\_OBS\_GAP>  <OD\_EPOCH\_EIGMAJ units="m">58.73</OD\_EPOCH\_EIGMAJ>  <OD\_EPOCH\_EIGINT units="m">35.7</OD\_EPOCH\_EIGINT>  <OD\_EPOCH\_EIGMIN units="m">21.5</OD\_EPOCH\_EIGMIN>  <OD\_MAX\_PRED\_EIGMAJ units="m">21.5</OD\_MAX\_PRED\_EIGMAJ>  <OD\_MIN\_PRED\_EIGMIN units="m">21.5</OD\_MIN\_PRED\_EIGMIN>  <OD\_CONFIDENCE units="%">95.3</OD\_CONFIDENCE>  <GDOP>.857</GDOP>  <SOLVE\_N>6</SOLVE\_N>  <SOLVE\_STATES>POS[3], VEL[3]</SOLVE\_STATES>  <CONSIDER\_N>2</CONSIDER\_N>  <CONSIDER\_PARAMS>DRAG, SRP</CONSIDER\_PARAMS>  <SEDR units="W/kg">4.54570E-05</SEDR>  <SENSORS\_N>3</SENSORS\_N>  <SENSORS>EGLIN, FYLINGDALES</SENSORS>  <WEIGHTED\_RMS>1.3</WEIGHTED\_RMS>  <DATA\_TYPES>ANGLE\_1, ANGLE\_2</DATA\_TYPES>  </od>  <user>  <USER\_DEFINED parameter="CONSOLE\_POC">MAXWELL RAFERTY</USER\_DEFINED>  <USER\_DEFINED parameter="EARTH\_MODEL">WGS-84</USER\_DEFINED>  </user>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 8

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of ALL data blocks in aggregate  CREATION\_DATE = 2022-11-06T09:23:57.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-12-18T14:28:15.1172  META\_STOP  TRAJ\_START  COMMENT This is comment 01  COMMENT This is comment 02  TRAJ\_ID = TRAJ\_20160402\_XYZ  TRAJ\_PREV\_ID = ORB20160305A  TRAJ\_NEXT\_ID = ORB20160305C  TRAJ\_BASIS = PREDICTED  TRAJ\_BASIS\_ID = OD\_5910  INTERPOLATION = HERMITE  INTERPOLATION\_DEGREE = 5  PROPAGATOR = HPOP  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  USEABLE\_START\_TIME = 1996-12-18T14:28:15.1172  USEABLE\_STOP\_TIME = 1996-12-19T14:28:15.1172  ORB\_REVNUM = 1500  ORB\_REVNUM\_BASIS = 0  TRAJ\_TYPE = CARTPV  TRAJ\_UNITS = [km,km,km,km/s,km/s,km/s]  0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52  120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29  240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16  TRAJ\_STOP  PHYS\_START  COMMENT This is comment 01  COMMENT This is comment 02  MANUFACTURER = BOEING  BUS\_MODEL = 702  DOCKED\_WITH = ISS  DRAG\_CONST\_AREA = 2.5 [m\*\*2]  DRAG\_COEFF\_NOM = 2.2  DRAG\_UNCERTAINTY = 10.0 [%]  INITIAL\_WET\_MASS = 500.0 [kg]  WET\_MASS = 472.3 [kg]  DRY\_MASS = 300.0 [kg]  OEB\_PARENT\_FRAME = ITRF1997  OEB\_PARENT\_FRAME\_EPOCH = 2001-11-06T11:17:33.0  OEB\_Q1 = -0.575131822  OEB\_Q2 = -0.280510532  OEB\_Q3 = -0.195634856  OEB\_QC = 0.743144825  OEB\_MAX = 1.0 [m]  OEB\_INT = 0.5 [m]  OEB\_MIN = 0.3 [m]  AREA\_ALONG\_OEB\_MAX = 0.15 [m\*\*2]  AREA\_ALONG\_OEB\_INT = 0.3 [m\*\*2]  AREA\_ALONG\_OEB\_MIN = 0.5 [m\*\*2]  AREA\_MIN\_FOR\_PC = 1.0 [m\*\*2]  AREA\_MAX\_FOR\_PC = 1.0 [m\*\*2]  AREA\_TYP\_FOR\_PC = 1.0 [m\*\*2]  RCS = 1.25 [m\*\*2]  RCS\_MIN = 1.1 [m\*\*2]  RCS\_MAX = 2.5 [m\*\*2]  SRP\_CONST\_AREA = 1.0 [m\*\*2]  SOLAR\_RAD\_COEFF = 1.7  SOLAR\_RAD\_UNCERTAINTY = 1.0 [%]  VM\_ABSOLUTE = 15.0  VM\_APPARENT\_MIN = 19.0  VM\_APPARENT = 15.0  VM\_APPARENT\_MAX = 16.0  REFLECTANCE = 0.7  ATT\_CONTROL\_MODE = SPIN  ATT\_ACTUATOR\_TYPE = ATT\_THRUSTERS  ATT\_KNOWLEDGE = 0.3 [deg]  ATT\_CONTROL = 2.0 [deg]  ATT\_POINTING = 2.3 [deg]  AVG\_MANEUVER\_FREQ = 20.0 [#/yr]  MAX\_THRUST = 1.0 [N]  DV\_BOL = 1.0 [km/s]  DV\_REMAINING = 0.2 [km/s]  IXX = 1000.0 [kg\*m\*\*2]  IYY = 800.0 [kg\*m\*\*2]  IZZ = 400.0 [kg\*m\*\*2]  IXY = 20.0 [kg\*m\*\*2]  IXZ = 40.0 [kg\*m\*\*2]  IYZ = 60.0 [kg\*m\*\*2]  PHYS\_STOP  COV\_START  COMMENT This is a comment  COV\_ID = COV\_20160402\_XYZ  COV\_PREV\_ID = COV\_20160305a  COV\_NEXT\_ID = COV\_20160305C  COV\_BASIS = PREDICTED  COV\_BASIS\_ID = OD\_5910  COV\_REF\_FRAME = FIXED\_EARTH  COV\_FRAME\_EPOCH = 2001-11-06T11:17:33.0  COV\_SCALE\_MIN = 0.5  COV\_SCALE\_MAX = 5.0  COV\_CONFIDENCE = 50.0 [%]  COV\_TYPE = CARTP  COV\_ORDERING = LTM  COV\_UNITS = [km,km,km]  200.0 3.331349E-4 4.618927E-4 6.782421E-4 -3.070007E-4 -4.221234E-4 3.231931E-4  COV\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  DC\_TYPE = CONTINUOUS  MAN\_COMPOSITION = TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_PREV\_ID = E\_W\_20160305A  MAN\_NEXT\_ID = E\_W\_20160305C  MAN\_BASIS = CANDIDATE  MAN\_BASIS\_ID = OD\_20181122A  MAN\_DEVICE\_ID = ALL  MAN\_PREV\_EPOCH = 2001-11-06T11:17:33.0  MAN\_NEXT\_EPOCH = 2001-11-06T11:18:33.0  MAN\_PURPOSE = ORBIT  MAN\_PRED\_SOURCE = OD\_5  MAN\_REF\_FRAME = RSW\_ROTATING  GRAV\_ASSIST\_NAME = EARTH  DC\_TYPE = TIME  DC\_WIN\_OPEN = 50.0  DC\_WIN\_CLOSE = 100.0  DC\_MIN\_CYCLES = 5  DC\_MAX\_CYCLES = 200  DC\_EXEC\_START = 50.0  DC\_EXEC\_STOP = 100.0  DC\_REF\_TIME = 8000.0  DC\_TIME\_PULSE\_DURATION = 10.0 [s]  DC\_TIME\_PULSE\_PERIOD = 200.0 [s]  MAN\_COMPOSITION = TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC  MAN\_UNITS = [s,N,N,N,%,n/a,s,n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP  PERT\_START  COMMENT Perturbations specification  ATMOSPHERIC\_MODEL = MSISE90  GRAVITY\_MODEL = EGM-96: 36D 36O  EQUATORIAL\_RADIUS = 6378.137 [km]  GM = 398600.4415 [km\*\*3/s\*\*2]  N\_BODY\_PERTURBATIONS = MOON,SUN,JUPITER  CENTRAL\_BODY\_ROTATION = 0.00417807421629 [deg/s]  OBLATE\_FLATTENING = 0.00335281066475  OCEAN\_TIDES\_MODEL = DIURNAL  SOLID\_TIDES\_MODEL = DIURNAL  REDUCTION\_THEORY = IAU2010  ALBEDO\_MODEL = STK  ALBEDO\_GRID\_SIZE = 100  SHADOW\_MODEL = DUAL\_CONE  SHADOW\_BODIES = EARTH  SRP\_MODEL = BOX\_WING  SW\_DATA\_SOURCE = CELESTRAK  SW\_DATA\_EPOCH = 2001-11-08T00:00:00.0  SW\_INTERP\_METHOD = LINEAR  FIXED\_GEOMAG\_KP = 3.2 [nT]  FIXED\_GEOMAG\_AP = 21.0 [nT]  FIXED\_GEOMAG\_DST = -20.0 [nT]  FIXED\_F10P7 = 120.0 [SFU]  FIXED\_F10P7\_MEAN = 132.0 [SFU]  FIXED\_M10P7 = 120.0 [SFU]  FIXED\_M10P7\_MEAN = 120.0 [SFU]  FIXED\_S10P7 = 120.0 [SFU]  FIXED\_S10P7\_MEAN = 120.0 [SFU]  FIXED\_Y10P7 = 120.0 [SFU]  FIXED\_Y10P7\_MEAN = 120.0 [SFU]  PERT\_STOP  OD\_START  COMMENT Orbit Determination information  OD\_ID = OD\_20160402  OD\_PREV\_ID = OD\_20160401  OD\_METHOD = SF:ODTK  OD\_EPOCH = 27854.239  DAYS\_SINCE\_FIRST\_OBS = 3.5 [d]  DAYS\_SINCE\_LAST\_OBS = 1.2 [d]  RECOMMENDED\_OD\_SPAN = 5.2 [d]  ACTUAL\_OD\_SPAN = 2.3 [d]  OBS\_AVAILABLE = 100  OBS\_USED = 90  TRACKS\_AVAILABLE = 33  TRACKS\_USED = 30  MAXIMUM\_OBS\_GAP = 1.0 [d]  OD\_EPOCH\_EIGMAJ = 58.73 [m]  OD\_EPOCH\_EIGINT = 35.7 [m]  OD\_EPOCH\_EIGMIN = 21.5 [m]  OD\_MAX\_PRED\_EIGMAJ = 21.5 [m]  OD\_MIN\_PRED\_EIGMIN = 21.5 [m]  OD\_CONFIDENCE = 95.3 [%]  GDOP = 0.857  SOLVE\_N = 6  SOLVE\_STATES = POS[3],VEL[3]  CONSIDER\_N = 2  CONSIDER\_PARAMS = DRAG,SRP  SEDR = 4.5457E-5 [W/kg]  SENSORS\_N = 3  SENSORS = EGLIN,FYLINGDALES  WEIGHTED\_RMS = 1.3  DATA\_TYPES = ANGLE\_1,ANGLE\_2  OD\_STOP  USER\_START  USER\_DEFINED\_CONSOLE\_POC = MAXWELL RAFERTY  USER\_DEFINED\_EARTH\_MODEL = WGS-84  USER\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 8

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of ALL data blocks in aggregate</COMMENT>  <CREATION\_DATE>2022-11-06T09:23:57.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-12-18T14:28:15.1172</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <TRAJ\_ID>TRAJ\_20160402\_XYZ</TRAJ\_ID>  <TRAJ\_PREV\_ID>ORB20160305A</TRAJ\_PREV\_ID>  <TRAJ\_NEXT\_ID>ORB20160305C</TRAJ\_NEXT\_ID>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <TRAJ\_BASIS\_ID>OD\_5910</TRAJ\_BASIS\_ID>  <INTERPOLATION>HERMITE</INTERPOLATION>  <INTERPOLATION\_DEGREE>5</INTERPOLATION\_DEGREE>  <PROPAGATOR>HPOP</PROPAGATOR>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <USEABLE\_START\_TIME>1996-12-18T14:28:15.1172</USEABLE\_START\_TIME>  <USEABLE\_STOP\_TIME>1996-12-19T14:28:15.1172</USEABLE\_STOP\_TIME>  <ORB\_REVNUM>1500</ORB\_REVNUM>  <ORB\_REVNUM\_BASIS>0</ORB\_REVNUM\_BASIS>  <TRAJ\_TYPE>CARTPV</TRAJ\_TYPE>  <TRAJ\_UNITS>[km,km,km,km/s,km/s,km/s]</TRAJ\_UNITS>  <trajLine>0.0 2854.5 -2916.2 -5360.7 5.9 4.86 0.52</trajLine>  <trajLine>120.0 5478.6 434.3 -3862.5 2.5 5.87 4.29</trajLine>  <trajLine>240.0 4146.0 -1655.8 -5038.3 4.8 5.58 2.16</trajLine>  </traj>  <phys>  <COMMENT>This is comment 01</COMMENT>  <COMMENT>This is comment 02</COMMENT>  <MANUFACTURER>BOEING</MANUFACTURER>  <BUS\_MODEL>702</BUS\_MODEL>  <DOCKED\_WITH>ISS</DOCKED\_WITH>  <DRAG\_CONST\_AREA units="m\*\*2">2.5</DRAG\_CONST\_AREA>  <DRAG\_COEFF\_NOM>2.2</DRAG\_COEFF\_NOM>  <DRAG\_UNCERTAINTY units="%">10.0</DRAG\_UNCERTAINTY>  <INITIAL\_WET\_MASS units="kg">500.0</INITIAL\_WET\_MASS>  <WET\_MASS units="kg">472.3</WET\_MASS>  <DRY\_MASS units="kg">300.0</DRY\_MASS>  <OEB\_PARENT\_FRAME>ITRF1997</OEB\_PARENT\_FRAME>  <OEB\_PARENT\_FRAME\_EPOCH>2001-11-06T11:17:33.0</OEB\_PARENT\_FRAME\_EPOCH>  <OEB\_Q1>-0.575131822</OEB\_Q1>  <OEB\_Q2>-0.280510532</OEB\_Q2>  <OEB\_Q3>-0.195634856</OEB\_Q3>  <OEB\_QC>0.743144825</OEB\_QC>  <OEB\_MAX units="m">1.0</OEB\_MAX>  <OEB\_INT units="m">0.5</OEB\_INT>  <OEB\_MIN units="m">0.3</OEB\_MIN>  <AREA\_ALONG\_OEB\_MAX units="m\*\*2">0.15</AREA\_ALONG\_OEB\_MAX>  <AREA\_ALONG\_OEB\_INT units="m\*\*2">0.3</AREA\_ALONG\_OEB\_INT>  <AREA\_ALONG\_OEB\_MIN units="m\*\*2">0.5</AREA\_ALONG\_OEB\_MIN>  <AREA\_MIN\_FOR\_PC units="m\*\*2">1.0</AREA\_MIN\_FOR\_PC>  <AREA\_MAX\_FOR\_PC units="m\*\*2">1.0</AREA\_MAX\_FOR\_PC>  <AREA\_TYP\_FOR\_PC units="m\*\*2">1.0</AREA\_TYP\_FOR\_PC>  <RCS units="m\*\*2">1.25</RCS>  <RCS\_MIN units="m\*\*2">1.1</RCS\_MIN>  <RCS\_MAX units="m\*\*2">2.5</RCS\_MAX>  <SRP\_CONST\_AREA units="m\*\*2">1.0</SRP\_CONST\_AREA>  <SOLAR\_RAD\_COEFF>1.7</SOLAR\_RAD\_COEFF>  <SOLAR\_RAD\_UNCERTAINTY units="%">1.0</SOLAR\_RAD\_UNCERTAINTY>  <VM\_ABSOLUTE>15.0</VM\_ABSOLUTE>  <VM\_APPARENT\_MIN>19.0</VM\_APPARENT\_MIN>  <VM\_APPARENT>15.0</VM\_APPARENT>  <VM\_APPARENT\_MAX>16.0</VM\_APPARENT\_MAX>  <REFLECTANCE>0.7</REFLECTANCE>  <ATT\_CONTROL\_MODE>SPIN</ATT\_CONTROL\_MODE>  <ATT\_ACTUATOR\_TYPE>ATT\_THRUSTERS</ATT\_ACTUATOR\_TYPE>  <ATT\_KNOWLEDGE units="deg">0.3</ATT\_KNOWLEDGE>  <ATT\_CONTROL units="deg">2.0</ATT\_CONTROL>  <ATT\_POINTING units="deg">2.3</ATT\_POINTING>  <AVG\_MANEUVER\_FREQ units="#/yr">20.0</AVG\_MANEUVER\_FREQ>  <MAX\_THRUST units="N">1.0</MAX\_THRUST>  <DV\_BOL units="km/s">1.0</DV\_BOL>  <DV\_REMAINING units="km/s">0.2</DV\_REMAINING>  <IXX units="kg\*m\*\*2">1000.0</IXX>  <IYY units="kg\*m\*\*2">800.0</IYY>  <IZZ units="kg\*m\*\*2">400.0</IZZ>  <IXY units="kg\*m\*\*2">20.0</IXY>  <IXZ units="kg\*m\*\*2">40.0</IXZ>  <IYZ units="kg\*m\*\*2">60.0</IYZ>  </phys>  <cov>  <COMMENT>This is a comment</COMMENT>  <COV\_ID>COV\_20160402\_XYZ</COV\_ID>  <COV\_PREV\_ID>COV\_20160305a</COV\_PREV\_ID>  <COV\_NEXT\_ID>COV\_20160305C</COV\_NEXT\_ID>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_BASIS\_ID>OD\_5910</COV\_BASIS\_ID>  <COV\_REF\_FRAME>FIXED\_EARTH</COV\_REF\_FRAME>  <COV\_FRAME\_EPOCH>2001-11-06T11:17:33.0</COV\_FRAME\_EPOCH>  <COV\_SCALE\_MIN>0.5</COV\_SCALE\_MIN>  <COV\_SCALE\_MAX>5.0</COV\_SCALE\_MAX>  <COV\_CONFIDENCE units="%">50.0</COV\_CONFIDENCE>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <COV\_UNITS>[km,km,km]</COV\_UNITS>  <covLine>200.0 3.331349E-4 4.618927E-4 6.782421E-4 -3.070007E-4 -4.221234E-4 3.231931E-4</covLine>  </cov>  <man>  <COMMENT>Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT>20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  <man>  <COMMENT>100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT>NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT>deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_PREV\_ID>E\_W\_20160305A</MAN\_PREV\_ID>  <MAN\_NEXT\_ID>E\_W\_20160305C</MAN\_NEXT\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_BASIS\_ID>OD\_20181122A</MAN\_BASIS\_ID>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_PREV\_EPOCH>2001-11-06T11:17:33.0</MAN\_PREV\_EPOCH>  <MAN\_NEXT\_EPOCH>2001-11-06T11:18:33.0</MAN\_NEXT\_EPOCH>  <MAN\_PURPOSE>ORBIT</MAN\_PURPOSE>  <MAN\_PRED\_SOURCE>OD\_5</MAN\_PRED\_SOURCE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <GRAV\_ASSIST\_NAME>EARTH</GRAV\_ASSIST\_NAME>  <DC\_TYPE>TIME</DC\_TYPE>  <DC\_WIN\_OPEN>50.0</DC\_WIN\_OPEN>  <DC\_WIN\_CLOSE>100.0</DC\_WIN\_CLOSE>  <DC\_MIN\_CYCLES>5</DC\_MIN\_CYCLES>  <DC\_MAX\_CYCLES>200</DC\_MAX\_CYCLES>  <DC\_EXEC\_START>50.0</DC\_EXEC\_START>  <DC\_EXEC\_STOP>100.0</DC\_EXEC\_STOP>  <DC\_REF\_TIME>8000.0</DC\_REF\_TIME>  <DC\_TIME\_PULSE\_DURATION units="s">10.0</DC\_TIME\_PULSE\_DURATION>  <DC\_TIME\_PULSE\_PERIOD units="s">200.0</DC\_TIME\_PULSE\_PERIOD>  <MAN\_COMPOSITION>TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s,N,N,N,%,n/a,s,n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  <pert>  <COMMENT>Perturbations specification</COMMENT>  <ATMOSPHERIC\_MODEL>MSISE90</ATMOSPHERIC\_MODEL>  <GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>  <EQUATORIAL\_RADIUS units="km">6378.137</EQUATORIAL\_RADIUS>  <GM units="km\*\*3/s\*\*2">398600.4415</GM>  <N\_BODY\_PERTURBATIONS>MOON,SUN,JUPITER</N\_BODY\_PERTURBATIONS>  <CENTRAL\_BODY\_ROTATION units="deg/s">0.00417807421629</CENTRAL\_BODY\_ROTATION>  <OBLATE\_FLATTENING>0.00335281066475</OBLATE\_FLATTENING>  <OCEAN\_TIDES\_MODEL>DIURNAL</OCEAN\_TIDES\_MODEL>  <SOLID\_TIDES\_MODEL>DIURNAL</SOLID\_TIDES\_MODEL>  <REDUCTION\_THEORY>IAU2010</REDUCTION\_THEORY>  <ALBEDO\_MODEL>STK</ALBEDO\_MODEL>  <ALBEDO\_GRID\_SIZE>100</ALBEDO\_GRID\_SIZE>  <SHADOW\_MODEL>DUAL\_CONE</SHADOW\_MODEL>  <SHADOW\_BODIES>EARTH</SHADOW\_BODIES>  <SRP\_MODEL>BOX\_WING</SRP\_MODEL>  <SW\_DATA\_SOURCE>CELESTRAK</SW\_DATA\_SOURCE>  <SW\_DATA\_EPOCH>2001-11-08T00:00:00.0</SW\_DATA\_EPOCH>  <SW\_INTERP\_METHOD>LINEAR</SW\_INTERP\_METHOD>  <FIXED\_GEOMAG\_KP units="nT">3.2</FIXED\_GEOMAG\_KP>  <FIXED\_GEOMAG\_AP units="nT">21.0</FIXED\_GEOMAG\_AP>  <FIXED\_GEOMAG\_DST units="nT">-20.0</FIXED\_GEOMAG\_DST>  <FIXED\_F10P7 units="SFU">120.0</FIXED\_F10P7>  <FIXED\_F10P7\_MEAN units="SFU">132.0</FIXED\_F10P7\_MEAN>  <FIXED\_M10P7 units="SFU">120.0</FIXED\_M10P7>  <FIXED\_M10P7\_MEAN units="SFU">120.0</FIXED\_M10P7\_MEAN>  <FIXED\_S10P7 units="SFU">120.0</FIXED\_S10P7>  <FIXED\_S10P7\_MEAN units="SFU">120.0</FIXED\_S10P7\_MEAN>  <FIXED\_Y10P7 units="SFU">120.0</FIXED\_Y10P7>  <FIXED\_Y10P7\_MEAN units="SFU">120.0</FIXED\_Y10P7\_MEAN>  </pert>  <od>  <COMMENT>Orbit Determination information</COMMENT>  <OD\_ID>OD\_20160402</OD\_ID>  <OD\_PREV\_ID>OD\_20160401</OD\_PREV\_ID>  <OD\_METHOD>SF:ODTK</OD\_METHOD>  <OD\_EPOCH>27854.239</OD\_EPOCH>  <DAYS\_SINCE\_FIRST\_OBS units="d">3.5</DAYS\_SINCE\_FIRST\_OBS>  <DAYS\_SINCE\_LAST\_OBS units="d">1.2</DAYS\_SINCE\_LAST\_OBS>  <RECOMMENDED\_OD\_SPAN units="d">5.2</RECOMMENDED\_OD\_SPAN>  <ACTUAL\_OD\_SPAN units="d">2.3</ACTUAL\_OD\_SPAN>  <OBS\_AVAILABLE>100</OBS\_AVAILABLE>  <OBS\_USED>90</OBS\_USED>  <TRACKS\_AVAILABLE>33</TRACKS\_AVAILABLE>  <TRACKS\_USED>30</TRACKS\_USED>  <MAXIMUM\_OBS\_GAP units="d">1.0</MAXIMUM\_OBS\_GAP>  <OD\_EPOCH\_EIGMAJ units="m">58.73</OD\_EPOCH\_EIGMAJ>  <OD\_EPOCH\_EIGINT units="m">35.7</OD\_EPOCH\_EIGINT>  <OD\_EPOCH\_EIGMIN units="m">21.5</OD\_EPOCH\_EIGMIN>  <OD\_MAX\_PRED\_EIGMAJ units="m">21.5</OD\_MAX\_PRED\_EIGMAJ>  <OD\_MIN\_PRED\_EIGMIN units="m">21.5</OD\_MIN\_PRED\_EIGMIN>  <OD\_CONFIDENCE units="%">95.3</OD\_CONFIDENCE>  <GDOP>0.857</GDOP>  <SOLVE\_N>6</SOLVE\_N>  <SOLVE\_STATES>POS[3],VEL[3]</SOLVE\_STATES>  <CONSIDER\_N>2</CONSIDER\_N>  <CONSIDER\_PARAMS>DRAG,SRP</CONSIDER\_PARAMS>  <SEDR units="W/kg">4.5457E-5</SEDR>  <SENSORS\_N>3</SENSORS\_N>  <SENSORS>EGLIN,FYLINGDALES</SENSORS>  <WEIGHTED\_RMS>1.3</WEIGHTED\_RMS>  <DATA\_TYPES>ANGLE\_1,ANGLE\_2</DATA\_TYPES>  </od>  <user>  <USER\_DEFINED parameter="CONSOLE\_POC">MAXWELL RAFERTY</USER\_DEFINED>  <USER\_DEFINED parameter="EARTH\_MODEL">WGS-84</USER\_DEFINED>  </user>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 8

## Test Case #9: SANA, Orbit, covariance, maneuver data and processing

|  |  |  |
| --- | --- | --- |
| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 9 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | Test cases #4, #8, and #9 contained a spurious entry in the maneuver specification where both TIME\_ABSOLUTE and TIME\_RELATIVE were not specified, yet both were provided as numerical entries. |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| --- |
| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of ALL data blocks in aggregate  CREATION\_DATE = 2022-10-13T18:00:00.000  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-10-14T18:00:00.000  META\_STOP  TRAJ\_START  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = OSCULATING  TRAJ\_UNITS = [km,n/a,deg, deg, deg, deg]  2022-10-14T18:00:00.000 6678.137000 0.0 44.998 359.837 0.0 89.823  2022-10-14T18:15:00.000 6678.137000 0.0 44.998 359.837 0.0 149.478  2022-10-14T18:30:00.000 6678.137000 0.0 44.998 359.837 0.0 209.134  2022-10-14T18:45:00.000 6678.137000 0.0 44.998 359.837 0.0 268.789  2022-10-14T19:00:00.000 6678.137000 0.0 44.998 359.837 0.0 328.445  2022-10-14T19:15:00.000 6678.137000 0.0 44.998 359.837 0.0 28.101  2022-10-14T19:30:00.000 6678.137000 0.0 44.998 359.837 0.0 87.756  2022-10-14T19:45:00.000 6678.137000 0.0 44.998 359.837 0.0 147.412  2022-10-14T20:00:00.000 6678.137000 0.0 44.998 359.837 0.0 207.067  TRAJ\_STOP  COV\_START  COV\_REF\_FRAME = LVLH\_ROTATING  COV\_TYPE = CARTP  COV\_ORDERING = LTM  2022-10-14T18:00:00.000 10000.000000000009 0.000000048376 40000.000000000036 0.000000 -0.000000000003 4000.000000000003  2022-10-14T18:15:00.000 52209.674239994412 -20533.690690490912 19620.524072277567 86.300502 -32.351259220281 1077.435963465894  2022-10-14T18:30:00.000 93256.040742805810 -182029.809213432018 360411.251167382405 161.746756 -324.470830948616 1015.581471585544  2022-10-14T18:45:00.000 91616.867740726637 -286023.352704605612 1238630.902879786445 -56.968256 182.919891158875 4002.179886970403  2022-10-14T19:00:00.000 93783.912463504952 -294012.112974442076 2209594.528031021357 -243.285865 1904.353216813331 1148.628921075619  2022-10-14T19:15:00.000 55127.908092809790 -269301.361555538548 3064877.791415952146 -157.957561 2366.642983445933 950.692035149922  2022-10-14T19:30:00.000 10403.629862217660 -193655.678902380372 3632952.470601547509 -3.223979 -122.502905758709 3994.014904406626  2022-10-14T19:45:00.000 49743.292059866930 -296110.065320241149 4137231.055016793776 314.501148 -3730.935319543780 1214.265142509268  2022-10-14T20:00:00.000 93096.019936268640 -647661.414134236635 5617644.555827878416 570.004009 -4867.193048637446 894.627485308091  COV\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_DEVICE\_ID = ALL  MAN\_REF\_FRAME = RSW\_ROTATING  DC\_TYPE = CONTINUOUS  MAN\_COMPOSITION = TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC  MAN\_UNITS = [s, N, N, N, %, n/a, s, n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP |

Figure ‑: Input KVN OCM for Test Case 9

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of ALL data blocks in aggregate</COMMENT>  <CREATION\_DATE>2022-10-13T18:00:00.000</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-10-14T18:00:00.000</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>OSCULATING</ORB\_AVERAGING>  <TRAJ\_UNITS>[km,n/a,deg, deg, deg, deg]</TRAJ\_UNITS>  <trajLine>2022-10-14T18:00:00.000 6678.137000 0.0 44.998 359.837 0.0 89.823</trajLine>  <trajLine>2022-10-14T18:15:00.000 6678.137000 0.0 44.998 359.837 0.0 149.478</trajLine>  <trajLine>2022-10-14T18:30:00.000 6678.137000 0.0 44.998 359.837 0.0 209.134</trajLine>  <trajLine>2022-10-14T18:45:00.000 6678.137000 0.0 44.998 359.837 0.0 268.789</trajLine>  <trajLine>2022-10-14T19:00:00.000 6678.137000 0.0 44.998 359.837 0.0 328.445</trajLine>  <trajLine>2022-10-14T19:15:00.000 6678.137000 0.0 44.998 359.837 0.0 28.101</trajLine>  <trajLine>2022-10-14T19:30:00.000 6678.137000 0.0 44.998 359.837 0.0 87.756</trajLine>  <trajLine>2022-10-14T19:45:00.000 6678.137000 0.0 44.998 359.837 0.0 147.412</trajLine>  <trajLine>2022-10-14T20:00:00.000 6678.137000 0.0 44.998 359.837 0.0 207.067</trajLine>  </traj>  <cov>  <COV\_REF\_FRAME>LVLH\_ROTATING</COV\_REF\_FRAME>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <covLine>2022-10-14T18:00:00.000 10000.000000000009 0.000000048376 40000.000000000036 0.000000 -0.000000000003 4000.000000000003</covLine>  <covLine>2022-10-14T18:15:00.000 52209.674239994412 -20533.690690490912 19620.524072277567 86.300502 -32.351259220281 1077.435963465894</covLine>  <covLine>2022-10-14T18:30:00.000 93256.040742805810 -182029.809213432018 360411.251167382405 161.746756 -324.470830948616 1015.581471585544</covLine>  <covLine>2022-10-14T18:45:00.000 91616.867740726637 -286023.352704605612 1238630.902879786445 -56.968256 182.919891158875 4002.179886970403</covLine>  <covLine>2022-10-14T19:00:00.000 93783.912463504952 -294012.112974442076 2209594.528031021357 -243.285865 1904.353216813331 1148.628921075619</covLine>  <covLine>2022-10-14T19:15:00.000 55127.908092809790 -269301.361555538548 3064877.791415952146 -157.957561 2366.642983445933 950.692035149922</covLine>  <covLine>2022-10-14T19:30:00.000 10403.629862217660 -193655.678902380372 3632952.470601547509 -3.223979 -122.502905758709 3994.014904406626</covLine>  <covLine>2022-10-14T19:45:00.000 49743.292059866930 -296110.065320241149 4137231.055016793776 314.501148 -3730.935319543780 1214.265142509268</covLine>  <covLine>2022-10-14T20:00:00.000 93096.019936268640 -647661.414134236635 5617644.555827878416 570.004009 -4867.193048637446 894.627485308091</covLine>  </cov>  <man>  <COMMENT> 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT> NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT> deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_ABSOLUTE, MAN\_DURA, THR\_X, THR\_Y, THR\_Z, THR\_MAG\_SIGMA, THR\_INTERP, THR\_ISP, THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s, N, N, N, %, n/a, s, n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 9

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of ALL data blocks in aggregate  CREATION\_DATE = 2022-10-13T18:00:00.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-10-14T18:00:00.0  META\_STOP  TRAJ\_START  TRAJ\_BASIS = PREDICTED  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = OSCULATING  TRAJ\_UNITS = [km,n/a,deg,deg,deg,deg]  0.0 6678.137 0.0 44.998 359.837 0.0 89.823  900.0 6678.137 0.0 44.998 359.837 0.0 149.478  1800.0 6678.137 0.0 44.998 359.837 0.0 209.134  2700.0 6678.137 0.0 44.998 359.837 0.0 268.789  3600.0 6678.137 0.0 44.998 359.837 0.0 328.445  4500.0 6678.137 0.0 44.998 359.837 0.0 28.101  5400.0 6678.137 0.0 44.998 359.837 0.0 87.756  6300.0 6678.137 0.0 44.998 359.837 0.0 147.412  7200.0 6678.137 0.0 44.998 359.837 0.0 207.067  TRAJ\_STOP  COV\_START  COV\_BASIS = PREDICTED  COV\_REF\_FRAME = LVLH\_ROTATING  COV\_TYPE = CARTP  COV\_ORDERING = LTM  0.0 10000.00000000001 4.8375999999999996E-8 40000.00000000004 0.0 -3.0E-12 4000.000000000003  900.0 52209.67423999441 -20533.690690490912 19620.524072277567 86.300502 -32.351259220281 1077.435963465894  1800.0 93256.04074280581 -182029.80921343202 360411.2511673824 161.746756 -324.470830948616 1015.581471585544  2700.0 91616.86774072664 -286023.3527046056 1238630.9028797864 -56.968256 182.919891158875 4002.179886970403  3600.0 93783.91246350495 -294012.1129744421 2209594.528031021 -243.285865 1904.353216813331 1148.628921075619  4500.0 55127.90809280979 -269301.36155553855 3064877.791415952 -157.957561 2366.642983445933 950.692035149922  5400.0 10403.629862217658 -193655.67890238037 3632952.4706015475 -3.223979 -122.502905758709 3994.014904406626  6300.0 49743.29205986693 -296110.06532024115 4137231.055016794 314.501148 -3730.93531954378 1214.265142509268  7200.0 93096.01993626864 -647661.4141342368 5617644.555827878 570.004009 -4867.193048637446 894.627485308091  COV\_STOP  MAN\_START  COMMENT 100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error  COMMENT NOTE that this OCM specifies a future compound maneuver, with  COMMENT deployment during low-level host platform thrusting.  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = PLANNED  MAN\_DEVICE\_ID = ALL  MAN\_REF\_FRAME = RSW\_ROTATING  DC\_TYPE = CONTINUOUS  MAN\_COMPOSITION = TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC  MAN\_UNITS = [s,N,N,N,%,n/a,s,n/a]  2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95  MAN\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 9

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of ALL data blocks in aggregate</COMMENT>  <CREATION\_DATE>2022-10-13T18:00:00.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-10-14T18:00:00.0</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>OSCULATING</ORB\_AVERAGING>  <TRAJ\_UNITS>[km,n/a,deg,deg,deg,deg]</TRAJ\_UNITS>  <trajLine>0.0 6678.137 0.0 44.998 359.837 0.0 89.823</trajLine>  <trajLine>900.0 6678.137 0.0 44.998 359.837 0.0 149.478</trajLine>  <trajLine>1800.0 6678.137 0.0 44.998 359.837 0.0 209.134</trajLine>  <trajLine>2700.0 6678.137 0.0 44.998 359.837 0.0 268.789</trajLine>  <trajLine>3600.0 6678.137 0.0 44.998 359.837 0.0 328.445</trajLine>  <trajLine>4500.0 6678.137 0.0 44.998 359.837 0.0 28.101</trajLine>  <trajLine>5400.0 6678.137 0.0 44.998 359.837 0.0 87.756</trajLine>  <trajLine>6300.0 6678.137 0.0 44.998 359.837 0.0 147.412</trajLine>  <trajLine>7200.0 6678.137 0.0 44.998 359.837 0.0 207.067</trajLine>  </traj>  <cov>  <COV\_BASIS>PREDICTED</COV\_BASIS>  <COV\_REF\_FRAME>LVLH\_ROTATING</COV\_REF\_FRAME>  <COV\_TYPE>CARTP</COV\_TYPE>  <COV\_ORDERING>LTM</COV\_ORDERING>  <covLine>0.0 10000.00000000001 4.8375999999999996E-8 40000.00000000004 0.0 -3.0E-12 4000.000000000003</covLine>  <covLine>900.0 52209.67423999441 -20533.690690490912 19620.524072277567 86.300502 -32.351259220281 1077.435963465894</covLine>  <covLine>1800.0 93256.04074280581 -182029.80921343202 360411.2511673824 161.746756 -324.470830948616 1015.581471585544</covLine>  <covLine>2700.0 91616.86774072664 -286023.3527046056 1238630.9028797864 -56.968256 182.919891158875 4002.179886970403</covLine>  <covLine>3600.0 93783.91246350495 -294012.1129744421 2209594.528031021 -243.285865 1904.353216813331 1148.628921075619</covLine>  <covLine>4500.0 55127.90809280979 -269301.36155553855 3064877.791415952 -157.957561 2366.642983445933 950.692035149922</covLine>  <covLine>5400.0 10403.629862217658 -193655.67890238037 3632952.4706015475 -3.223979 -122.502905758709 3994.014904406626</covLine>  <covLine>6300.0 49743.29205986693 -296110.06532024115 4137231.055016794 314.501148 -3730.93531954378 1214.265142509268</covLine>  <covLine>7200.0 93096.01993626864 -647661.4141342368 5617644.555827878 570.004009 -4867.193048637446 894.627485308091</covLine>  </cov>  <man>  <COMMENT>100 s of 0.5N +in-track thr w/?=0.95, Isp=300s, 5% 1-sigma error</COMMENT>  <COMMENT>NOTE that this OCM specifies a future compound maneuver, with</COMMENT>  <COMMENT>deployment during low-level host platform thrusting.</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>PLANNED</MAN\_BASIS>  <MAN\_DEVICE\_ID>ALL</MAN\_DEVICE\_ID>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_ABSOLUTE,MAN\_DURA,THR\_X,THR\_Y,THR\_Z,THR\_MAG\_SIGMA,THR\_INTERP,THR\_ISP,THR\_EFFIC</MAN\_COMPOSITION>  <MAN\_UNITS>[s,N,N,N,%,n/a,s,n/a]</MAN\_UNITS>  <manLine>2022-12-18T14:36:35.1172 100.0 0.0 0.5 0.0 5.0 ON 300.0 0.95</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 9

## Test Case #10: Maneuvers and deployment scenario

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| 1 | Report Date: | 14 Feb 2023 |
| 2 | Program Under Test: | Orbit Data Messages P3.0 (OCM) Prototype |
| 3 | Test Case Number: | 10 |
| 4 | Agencies Participating in this Test Case: | NASA/JPL (COMSPOC Corp) and CNES (OREKIT) |
| 5 | Agency Responsible for Producing Test Message | COMSPOC Corporation, sending to OREKIT, and back (round trip) |
| 6 | Producing Test Engineer: | Dan Oltrogge of COMSPOC, then produced by Luc Maisonobe of OREKIT |
| 7 | Agency Responsible for Consuming Test Message | OREKIT, receiving and ingest for transmission by COMSPOC (round trip) |
| 8 | Consuming Test Engineer: | Luc Maisonobe of OREKIT, then sending back to be received by Dan Oltrogge (round trip) |
| 10 | Results (Pass, Partial Pass, Fail): | PASS |
| 11 | Variances from Expected Result: | NONE |
| 12 | Comments: | Noted that optional elements (e.g., UNITS, or keywords having DEFAULT values, may be introduced and/or removed during message production. This is normal and the expected result. |

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of deployment while conducting low-level thrusting  CREATION\_DATE = 2022-10-13T18:00:00.000  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-10-14T18:00:00.000  META\_STOP  TRAJ\_START  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = MA\_DA\_VZ  TRAJ\_UNITS = [km,n/a,deg, deg, deg, deg]  2022-10-14T18:00:00.000 6678.137000 0.0 44.998 359.837 0.0 89.823  2022-10-14T18:15:00.000 6678.137000 0.0 44.998 359.837 0.0 149.478  2022-10-14T18:30:00.000 6678.137000 0.0 44.998 359.837 0.0 209.134  2022-10-14T18:45:00.000 6678.137000 0.0 44.998 359.837 0.0 268.789  2022-10-14T19:00:00.000 6678.137000 0.0 44.998 359.837 0.0 328.445  2022-10-14T19:15:00.000 6678.137000 0.0 44.998 359.837 0.0 28.101  2022-10-14T19:30:00.000 6678.137000 0.0 44.998 359.837 0.0 87.756  2022-10-14T19:45:00.000 6678.137000 0.0 44.998 359.837 0.0 147.412  2022-10-14T20:00:00.000 6678.137000 0.0 44.998 359.837 0.0 207.067  TRAJ\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  MAN\_COMPOSITION = TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP |

Figure ‑: Input KVN OCM for Test Case 10

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| <?xml version="1.0" encoding="utf-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of deployment while conducting low-level thrusting</COMMENT>  <CREATION\_DATE>2022-10-13T18:00:00.000</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-10-14T18:00:00.000</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>MA\_DA\_VZ</ORB\_AVERAGING>  <TRAJ\_UNITS>[km,n/a,deg, deg, deg, deg]</TRAJ\_UNITS>  <trajLine>2022-10-14T18:00:00.000 6678.137000 0.0 44.998 359.837 0.0 89.823</trajLine>  <trajLine>2022-10-14T18:15:00.000 6678.137000 0.0 44.998 359.837 0.0 149.478</trajLine>  <trajLine>2022-10-14T18:30:00.000 6678.137000 0.0 44.998 359.837 0.0 209.134</trajLine>  <trajLine>2022-10-14T18:45:00.000 6678.137000 0.0 44.998 359.837 0.0 268.789</trajLine>  <trajLine>2022-10-14T19:00:00.000 6678.137000 0.0 44.998 359.837 0.0 328.445</trajLine>  <trajLine>2022-10-14T19:15:00.000 6678.137000 0.0 44.998 359.837 0.0 28.101</trajLine>  <trajLine>2022-10-14T19:30:00.000 6678.137000 0.0 44.998 359.837 0.0 87.756</trajLine>  <trajLine>2022-10-14T19:45:00.000 6678.137000 0.0 44.998 359.837 0.0 147.412</trajLine>  <trajLine>2022-10-14T20:00:00.000 6678.137000 0.0 44.998 359.837 0.0 207.067</trajLine>  </traj>  <man>  <COMMENT> Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT> 20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE, DEPLOY\_ID, DEPLOY\_DV\_X, DEPLOY\_DV\_Y, DEPLOY\_DV\_Z, DEPLOY\_MASS, DEPLOY\_DV\_SIGMA, DEPLOY\_DV\_RATIO, DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a, km/s, km/s, km/s, kg, %, n/a, m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.3969E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.3969E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.8670E-5 -9.3969E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.3969E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.3969E-4 9.6360E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.3969E-4 -9.6360E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.3969E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.8670E-5 -9.3969E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.3969E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.3969E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Input XML OCM for Test Case 10

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| CCSDS\_OCM\_VERS = 3.0  COMMENT This OCM KVN message is a unit test of deployment while conducting low-level thrusting  CREATION\_DATE = 2022-10-13T18:00:00.0  ORIGINATOR = JAPAN AEROSPACE EXPLORATION AGENCY  META\_START  TIME\_SYSTEM = UTC  EPOCH\_TZERO = 2022-10-14T18:00:00.0  META\_STOP  TRAJ\_START  TRAJ\_BASIS = PREDICTED  CENTER\_NAME = EARTH  TRAJ\_REF\_FRAME = J2000  TRAJ\_TYPE = KEPLERIAN  ORB\_AVERAGING = MA\_DA\_VZ  TRAJ\_UNITS = [km,n/a,deg,deg,deg,deg]  0.0 6678.137 0.0 44.998 359.837 0.0 89.823  900.0 6678.137 0.0 44.998 359.837 0.0 149.478  1800.0 6678.137 0.0 44.998 359.837 0.0 209.134  2700.0 6678.137 0.0 44.998 359.837 0.0 268.789  3600.0 6678.137 0.0 44.998 359.837 0.0 328.445  4500.0 6678.137 0.0 44.998 359.837 0.0 28.101  5400.0 6678.137 0.0 44.998 359.837 0.0 87.756  6300.0 6678.137 0.0 44.998 359.837 0.0 147.412  7200.0 6678.137 0.0 44.998 359.837 0.0 207.067  TRAJ\_STOP  MAN\_START  COMMENT Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time  COMMENT 20 deg off of back-track direction  MAN\_ID = E\_W\_20160305B  MAN\_BASIS = CANDIDATE  MAN\_DEVICE\_ID = DEPLOY  MAN\_PURPOSE = DEPLOY  MAN\_REF\_FRAME = RSW\_ROTATING  DC\_TYPE = CONTINUOUS  MAN\_COMPOSITION = TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA  MAN\_UNITS = [n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]  500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033  510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033  520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033  530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033  540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033  550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033  560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033  570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033  580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033  590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033  MAN\_STOP |

Figure ‑: Output (Round Trip) KVN OCM for Test Case 10

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| <?xml version="1.0" encoding="UTF-8"?>  <ocm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://beta.sanaregistry.org/r/ndmxml\_unqualified/ndmxml-3.0.0-master-3.0.xsd" id="CCSDS\_OCM\_VERS" version="3.0">  <header>  <COMMENT>This OCM KVN message is a unit test of deployment while conducting low-level thrusting</COMMENT>  <CREATION\_DATE>2022-10-13T18:00:00.0</CREATION\_DATE>  <ORIGINATOR>JAPAN AEROSPACE EXPLORATION AGENCY</ORIGINATOR>  </header>  <body>  <segment>  <metadata>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2022-10-14T18:00:00.0</EPOCH\_TZERO>  </metadata>  <data>  <traj>  <TRAJ\_BASIS>PREDICTED</TRAJ\_BASIS>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TRAJ\_REF\_FRAME>J2000</TRAJ\_REF\_FRAME>  <TRAJ\_TYPE>KEPLERIAN</TRAJ\_TYPE>  <ORB\_AVERAGING>MA\_DA\_VZ</ORB\_AVERAGING>  <TRAJ\_UNITS>[km,n/a,deg,deg,deg,deg]</TRAJ\_UNITS>  <trajLine>0.0 6678.137 0.0 44.998 359.837 0.0 89.823</trajLine>  <trajLine>900.0 6678.137 0.0 44.998 359.837 0.0 149.478</trajLine>  <trajLine>1800.0 6678.137 0.0 44.998 359.837 0.0 209.134</trajLine>  <trajLine>2700.0 6678.137 0.0 44.998 359.837 0.0 268.789</trajLine>  <trajLine>3600.0 6678.137 0.0 44.998 359.837 0.0 328.445</trajLine>  <trajLine>4500.0 6678.137 0.0 44.998 359.837 0.0 28.101</trajLine>  <trajLine>5400.0 6678.137 0.0 44.998 359.837 0.0 87.756</trajLine>  <trajLine>6300.0 6678.137 0.0 44.998 359.837 0.0 147.412</trajLine>  <trajLine>7200.0 6678.137 0.0 44.998 359.837 0.0 207.067</trajLine>  </traj>  <man>  <COMMENT>Ten 1kg objects deployed at 1 m/s from 190kg host over 90 s time</COMMENT>  <COMMENT>20 deg off of back-track direction</COMMENT>  <MAN\_ID>E\_W\_20160305B</MAN\_ID>  <MAN\_BASIS>CANDIDATE</MAN\_BASIS>  <MAN\_DEVICE\_ID>DEPLOY</MAN\_DEVICE\_ID>  <MAN\_PURPOSE>DEPLOY</MAN\_PURPOSE>  <MAN\_REF\_FRAME>RSW\_ROTATING</MAN\_REF\_FRAME>  <DC\_TYPE>CONTINUOUS</DC\_TYPE>  <MAN\_COMPOSITION>TIME\_RELATIVE,DEPLOY\_ID,DEPLOY\_DV\_X,DEPLOY\_DV\_Y,DEPLOY\_DV\_Z,DEPLOY\_MASS,DEPLOY\_DV\_SIGMA,DEPLOY\_DV\_RATIO,DEPLOY\_DV\_CDA</MAN\_COMPOSITION>  <MAN\_UNITS>[n/a,km/s,km/s,km/s,kg,%,n/a,m\*\*2]</MAN\_UNITS>  <manLine>500.0 CUBESAT\_10 2.8773E-4 -9.396899999999999E-4 1.8491E-4 -1.0 5.0 -0.005025 0.033</manLine>  <manLine>510.0 CUBESAT\_11 1.4208E-4 -9.396899999999999E-4 3.1111E-4 -1.0 5.0 -0.005051 0.033</manLine>  <manLine>520.0 CUBESAT\_12 -4.867E-5 -9.396899999999999E-4 3.3854E-4 -1.0 5.0 -0.005076 0.033</manLine>  <manLine>530.0 CUBESAT\_13 -2.2398E-4 -9.396899999999999E-4 2.5848E-4 -1.0 5.0 -0.005102 0.033</manLine>  <manLine>540.0 CUBESAT\_14 -3.2817E-4 -9.396899999999999E-4 9.636E-5 -1.0 5.0 -0.005128 0.033</manLine>  <manLine>550.0 CUBESAT\_15 -3.2817E-4 -9.396899999999999E-4 -9.636E-5 -1.0 5.0 -0.005154 0.033</manLine>  <manLine>560.0 CUBESAT\_16 -2.2398E-4 -9.396899999999999E-4 -2.5848E-4 -1.0 5.0 -0.005181 0.033</manLine>  <manLine>570.0 CUBESAT\_17 -4.867E-5 -9.396899999999999E-4 -3.3854E-4 -1.0 5.0 -0.005208 0.033</manLine>  <manLine>580.0 CUBESAT\_18 1.4208E-4 -9.396899999999999E-4 -3.1111E-4 -1.0 5.0 -0.005236 0.033</manLine>  <manLine>590.0 CUBESAT\_19 2.8773E-4 -9.396899999999999E-4 -1.8491E-4 -1.0 5.0 -0.005263 0.033</manLine>  </man>  </data>  </segment>  </body>  </ocm> |

Figure ‑: Output (Round Trip) XML OCM for Test Case 10

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1. ACRONYMS

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| CCSDS | Consultative Committee for Space Data Systems |
| CESG | CCSDS Engineering Steering Group |
| CMC | CCSDS Management Council |
| CNES | Centre National d’Études Spatiales |
| CSSI | Center for Space Standards and Innovation |
| CWE | Common Working Environment |
| DSN | Deep Space Network |
| ESA | European Space Agency |
| ESOC | European Space Operations Center |
| GSFC | Goddard Space Flight Center |
| JAXA | Japan Aerospace Exploration Agency |
| JPL | Jet Propulsion Laboratory |
| NASA | National Aeronautics and Space Administration |
| ODM | Orbit Data Messages |
| RID | Review Item Discrepancy |