# Introduction

[10] *XML Specification for Navigation Data Messages*. Recommendation for Space Data System Standards, CCSDS 505.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, December 2010.

# Overview

# Re-entry Data Message structure & content (KVN)

# Re-entry Data Message structure & content (XML)

## GENERAL—THE RDM/XML SCHEMA

This section applies only to the XML version only.

The RDM/XML schema is available on the SANA Web site. SANA is the registrar for the protocol registries created under CCSDS.

The RDM XML schema explicitly defines the permitted data elements and values acceptable for the XML version of the RDM message. The location of the RDM/XML schema is:

[http://sanaregistry.org/r/ndmxml/ndmxml-1.0-rdm-1.0.xsd](http://sanaregistry.org/r/cdmxml/cdmxml-1.0-nhm-1.0.xsd)

Where possible this schema uses simple types and complex types used by the constituent schemas that make up Navigation Data Messages (see Reference [10]).

## RDM/XML BASIC STRUCTURE

Each RDM shall consist of a <header> and a <body>.

The RDM <body> shall consist of a single <segment> construct.

The RDM <segment> shall consist of a <metadata>/<data> pair, as shown in Figure 4‑1.

|  |
| --- |
| <header>  </header>  <body>  <segment>  <metadata>  </metadata>  <data>  </data>  </segment>  </body> |

Figure 4‑ : RDM XML Basic Structure

## RDM/XML TAGS

An RDM XML tag shall be all uppercase if it corresponds directly to a KVN keyword from the Header, Metadata, or Data sections.

There is an exception where there is not a strict correspondence between keywords in the KVN and tags in the XML implementations, specifically, the ‘CCSDS\_RDM\_VERS’ keyword from the RDM Header. The 'CCSDS\_RDM\_VERS' keyword and its value shall appear as XML attributes rather than as an XML element.

RDM XML tags related to the XML message structure (i.e., that do not correspond directly to a KVN keyword) shall be in ‘lowerCamelCase’ (e.g., <header>, <segment>, <metadata>, etc.).

## CONSTRUCTING AN RDM/XML INSTANCE

### OVERVIEW

This subsection provides more detailed instructions for the user on how to create an XML message based on the ASCII-text KVN-formatted message described in 0 through 0. [Note to Alexandru: "0 through 0" should be cross references to "3.2 through 3.4"]

### XML VERSION

The first line in the instantiation shall specify the XML version:

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

This line must appear on the first line of each instantiation, exactly as shown.

### BEGINNING THE INSTANTIATION: root Data element

An RDM instantiation shall be delimited with the <rdm></rdm> root element tags using the standard attributes documented in Reference [10].

The XML Schema Instance namespace attribute must appear in the root element tag of all RDM/XML instantiations, exactly as shown:

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

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

xsi:noNamespaceSchemaLocation="[http://SANAregistry.org/r/ndmxml/ndmxml-1.0-master.xsd](http://sanaregistry.org/r/cdmxml/cdmxml-1.0-master.xsd)"

NOTE – The length of the value associated with the xsi:noNamespaceSchemaLocation attribute can cause the string to wrap to a new line; however, the string itself contains no breaks.

The final attributes of the <rdm> tag shall be ‘id’ and ‘version’.

The ‘id’ attribute shall be ‘id="CCSDS\_RDM\_VERS"’. The ‘version’ attribute shall be ‘version="1.0"’.

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

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

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

"<http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd>" id="CCSDS\_RDM\_VERS" version="1.0">

### THE RDM/XML HEADER SECTION

The RDM header shall have a standard header format, with tags <header> and </header>.

Immediately following the <header> tag the message may have any number of <COMMENT></COMMENT> tag pairs.

The standard RDM header shall contain the following element tags:

1. <CREATION\_DATE>
2. <ORIGINATOR>
3. <MESSAGE\_ID>

NOTE – The rules for these keywords are specified in Table 3-1. The header would look like this:

<header>

<COMMENT>Some comment string.</COMMENT>

<CREATION\_DATE>2010-03-12T22:31:12.000</CREATION\_DATE>

<ORIGINATOR>AGENCYX</ORIGINATOR>

<MESSAGE\_ID>AGENCYX-1234</MESSAGE\_ID>

</header>

### THE RDM/XML BODY SECTION

After coding the <header>, the instantiation must include a <body></body> tag pair.

Inside the <body></body> tag pair must appear one <segment></segment> tag pair.

NOTE – In essence, the segment tag in the RDM XML implementation is not strictly necessary, however, it is necessary for structural symmetry with the overall NDM/XML paradigm (see Reference [10]).

The <segment> must be made up of one <metadata></metadata> tag pair and one <data></data> tag pair.

### THE RDM/XML METADATA SECTION

The Metadata Section shall be set off by the <metadata></metadata> tag combination.

Between the <metadata> and </metadata> tags, the keywords shall be those specified in table 3-2 with the exception of the META\_START and META\_STOP keywords. [NOTE to Alexandru: The KVN RDM currently doesn't have delimiters for metadata (META\_START/META\_STOP) and data (DATA\_START/DATA\_STOP)... something you may wish to consider given conventions in other Nav WG standards.]

Immediately following the <metadata> tag, the message may have any number of <COMMENT></COMMENT> tag pairs.

### THE RDM DATA SECTION

The Data Section shall follow the Metadata Section and shall be set off by the <data></data> tag combination.

Between the <data> and </data> tags, the keywords shall be those specified in table 3-3 with the exception of the DATA\_START and DATA\_STOP keywords. [See note above.]

Immediately following the <data> tag, the message may have any number of <COMMENT></COMMENT> tag pairs.

### SPECIAL RDM/XML TAGS

Special tags shall be used to encapsulate the information in the XML implementation of the RDM that are not necessary in the KVN implementation. The special tags indicating logical block divisions shall be those defined in table 4‑1.

Table 4‑ : Special RDM/XML Tags

|  |  |
| --- | --- |
| **Special Tag** | **Definition** |
| <atmosphericReentryParameters> | Delineates the logical block for atmospheric re-entry parameters. |
| <groundImpactParameters> | Delineates the logical block for ground impact and burn-up data parameters, if they are used. |
| <stateVector> | Delineates the state vector components in the coordinate system specified in the metadata, if it is used. |
| <covarianceMatrix> | Delineates the 6x6 position/velocity covariance matrix, if it is used. |
| <spacecraftParameters> | Delineates the logical block containing spacecraft parameters, if they are used. |
| <odParameters> | Delineates the logical block containing orbit determination parameters, if they are used. |
| <userDefinedParameters> | Delineates the logical block containing user defined parameters, if they are used.  NOTE – The use of <userDefinedParameters> is defined in Reference [10] |

### UNITS IN THE RDM/XML

The units in the RDM/XML shall be the same units used in the KVN-formatted RDM described in 3.3 and 3.4. XML attributes shall be used to explicitly define the units or other important information associated with the given data element (see Annex C for examples).

## Local Operations

### For use in a local operations environment, the NDM/XML schema set (which includes the RDM schema) may be downloaded from the SANA web site to a local server that meets local requirements for operations robustness. See Reference [10].

### If a local version is used, the value associated with the xsi:noNamespaceSchemaLocation attribute must be changed to a URL that is accessible to the local server.

# RE-ENTRY DATA Message KVN syntax

# RE-ENTRY DATA Message XML syntax

## OVERVIEW

XML instantiations of an RDM shall observe the syntax described in this chapter.

## RDM LINES IN XML

Each RDM file shall consist of a set of RDM lines. Each RDM line shall be one of the following:

* XML version line;
* an XML-formatted line; or
* a blank line.

Each RDM line must not exceed 254 ASCII characters and spaces (excluding line termination character[s]).

Only printable ASCII characters and blanks shall be used. Control characters (such as TAB, etc.) shall not be used, with the exception of the line termination characters specified below.

Blank lines may be used at any position within the file. Blank lines shall have no assignable meaning, and may be ignored.

All lines shall be terminated by a single Carriage Return or a single Line Feed, or a Carriage Return/Line Feed pair or a Line Feed/Carriage Return pair.

## RDM VALUES IN XML

Each obligatory XML tag must be present and contain a valid value.

Integer values shall follow the conventions of the integer data type per Reference [reference here to XML datatypes document, ref [4] in WB4]. Additional restrictions on the allowable range of values permitted for any integer data element may also be defined in the RDM XML Schema.

NOTE – Examples of such restrictions may include a defined range (e.g., 0 - 100, 1 - 10, etc.), a set of enumerated values (e.g., 0,1,2,4,8), a pre-defined specific variation such as positiveInteger, or a user-defined data type variation.

Non-integer numeric values may be expressed in either fixed-point or floating-point notation. Numeric values shall follow the conventions of the double data type per Reference [reference here to XML datatypes document, ref [4] in WB4]. Additional restrictions on the allowable range of values permitted for any numeric data element may also be defined in the RDM XML Schema.

NOTE – Examples of such restrictions may include a defined range (e.g., 0.0-100.0, etc.), or a user-defined data type variation.

Text value data shall follow the conventions of the string data type per Reference [reference here to XML datatypes document, ref [4] in WB4]. Additional restrictions on the allowable range or values permitted for any data element may also be defined in the RDM XML Schema.

NOTE – Examples of such restrictions may include a set of enumerated values (e.g., ‘YES’/‘NO’) or other user-defined data type variation.

Text values in RDM/XML instantiations (i.e., the values between the opening and closing tags), shall consist of either all uppercase or all lowercase characters; an exception is made for values between the <COMMENT> and </COMMENT> tags, which may be in any case desired by the user. Otherwise, mixing of uppercase and lowercase characters is prohibited.

### In value fields that represent a time tag, values shall follow the conventions of the ndm: epochType data type used in all CCSDS NDM/XML schemas.

## RDM COMMENTS IN XML

Comments are optional and must be displayed as values between the <COMMENT> and </COMMENT> tags. Comments may be in any case desired by the user.

3. RDM EXAMPLE IN XML FORMAT  
     
   (INFORMATIVE)

The following is a sample of an RDM in XML format. Note that some of the lines wrap in this representation, but would not wrap in an actual RDM file given the 254 character line length.

|  |
| --- |
| <?xml version="1.0" encoding="UTF-8"?>  <rdm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="http://sanaregistry.org/r/ndmxml/ndmxml-1.0-master.xsd" id="CCSDS\_RDM\_VERS" version="1.0">  <header>  <COMMENT>This is RDM Annex C KVN Fig C-1 expressed in XML</COMMENT>  <CREATION\_DATE>2018-04-22T09:31:34</CREATION\_DATE>  <ORIGINATOR>ESA</ORIGINATOR>  <MESSAGE\_ID>ESA/20180422-001</MESSAGE\_ID>  </header>  <body>  <segment>  <metadata>  <OBJECT\_NAME>SPACEOBJECT</OBJECT\_NAME>  <INTERNATIONAL\_DESIGNATOR>2018-099B</INTERNATIONAL\_DESIGNATOR>  <OBJECT\_TYPE>ROCKET BODY</OBJECT\_TYPE>  <CONTROLLED\_REENTRY>NO</CONTROLLED\_REENTRY>  <CENTER\_NAME>EARTH</CENTER\_NAME>  <TIME\_SYSTEM>UTC</TIME\_SYSTEM>  <EPOCH\_TZERO>2018-04-22T00:00:00.00</EPOCH\_TZERO>  </metadata>  <data>  <atmosphericReentryParameters>  <ORBIT\_LIFETIME units="d">23.0</ORBIT\_LIFETIME>  <REENTRY\_ALTITUDE units="km">150.0</REENTRY\_ALTITUDE>  </atmosphericReentryParameters>  </data>  </segment>  </body>  </rdm> |

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

<rdm xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="file:///Z:/Desktop/ccsds-ndmxml/schemas-TESTunqual//ndmxml-1.0-master.xsd" id="CCSDS\_RDM\_VERS" version="1.0">

<header>

<COMMENT>This is RDM Annex C KVN Fig C-2 expressed in XML</COMMENT>

<CREATION\_DATE>2018-04-22T09:31:34</CREATION\_DATE>

<ORIGINATOR>ESA</ORIGINATOR>

<MESSAGE\_ID>ESA/20180422-001</MESSAGE\_ID>

</header>

<body>

<segment>

<metadata>

<OBJECT\_NAME>SPACEOBJECT</OBJECT\_NAME>

<INTERNATIONAL\_DESIGNATOR>2018-099B</INTERNATIONAL\_DESIGNATOR>

<CATALOG\_NAME>SATCAT</CATALOG\_NAME>

<OBJECT\_DESIGNATOR>81594</OBJECT\_DESIGNATOR>

<OBJECT\_TYPE>ROCKET BODY</OBJECT\_TYPE>

<OBJECT\_OWNER>ESA</OBJECT\_OWNER>

<CONTROLLED\_REENTRY>NO</CONTROLLED\_REENTRY>

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

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

<EPOCH\_TZERO>2018-04-22T00:00:00.00</EPOCH\_TZERO>

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

<GRAVITY\_MODEL>EGM-96: 36D 36O</GRAVITY\_MODEL>

<ATMOSPHERIC\_MODEL>NRLMSISE-00</ATMOSPHERIC\_MODEL>

<N\_BODY\_PERTURBATIONS>MOON</N\_BODY\_PERTURBATIONS>

<SOLAR\_RAD\_PRESSURE>NO</SOLAR\_RAD\_PRESSURE>

<EARTH\_TIDES>ESR</EARTH\_TIDES>

<INTRACK\_THRUST>NO</INTRACK\_THRUST>

<REENTRY\_DISINTEGRATION>MASS-LOSS + BREAK-UP</REENTRY\_DISINTEGRATION>

<PREVIOUS\_MESSAGE\_ID>ESTEC/20150421-007</PREVIOUS\_MESSAGE\_ID>

<PREVIOUS\_MESSAGE\_EPOCH>2015-04-23T09:00:00</PREVIOUS\_MESSAGE\_EPOCH>

</metadata>

<data>

<atmosphericReentryParameters>

<ORBIT\_LIFETIME units="d">5</ORBIT\_LIFETIME>

<REENTRY\_ALTITUDE units="km">80.0</REENTRY\_ALTITUDE>

<REENTRY\_WINDOW\_START>2018-04-27T11:45:33</REENTRY\_WINDOW\_START>

<REENTRY\_WINDOW\_END>2018-04-27T22:12:56</REENTRY\_WINDOW\_END>

</atmosphericReentryParameters>

<groundImpactParameters>

<COMMENT>Short term re-entry prediction results</COMMENT>

<PROBABILITY\_OF\_IMPACT>0.0</PROBABILITY\_OF\_IMPACT>

<PROBABILITY\_OF\_BURN\_UP>1.0</PROBABILITY\_OF\_BURN\_UP>

</groundImpactParameters>

<stateVector>

<COMMENT>State vector at the last OD epoch</COMMENT>

<EPOCH>2018-04-22T09:30:12</EPOCH>

<X units="km">4000.000000</X>

<Y units="km">4000.000000</Y>

<Z units="km">4000.000000</Z>

<X\_DOT units="km/s">7.000000</X\_DOT>

<Y\_DOT units="km/s">7.000000</Y\_DOT>

<Z\_DOT units="km/s">7.000000</Z\_DOT>

</stateVector>

<covarianceMatrix>

<COMMENT>Position/velocity covariance matrix at last OD epoch</COMMENT>

<COV\_REF\_FRAME>RTN</COV\_REF\_FRAME>

<CX\_X units="km\*\*2">0.10000</CX\_X>

<CY\_X units="km\*\*2">0.10000</CY\_X>

<CY\_Y units="km\*\*2">0.10000</CY\_Y>

<CZ\_X> units="km\*\*2"0.10000</CZ\_X>

<CZ\_Y> units="km\*\*2"0.10000</CZ\_Y>

<CZ\_Z units="km\*\*2">0.10000</CZ\_Z>

<CX\_DOT\_X units="km\*\*2/s">0.20000</CX\_DOT\_X>

<CX\_DOT\_Y units="km\*\*2/s">0.20000</CX\_DOT\_Y>

<CX\_DOT\_Z units="km\*\*2/s">0.20000</CX\_DOT\_Z>

<CX\_DOT\_X\_DOT units="km\*\*2/s\*\*2">0.00500</CX\_DOT\_X\_DOT>

<CY\_DOT\_X units="km\*\*2/s">0.20000</CY\_DOT\_X>

<CY\_DOT\_Y units="km\*\*2/s">0.20000</CY\_DOT\_Y>

<CY\_DOT\_Z units="km\*\*2/s">0.20000</CY\_DOT\_Z>

<CY\_DOT\_X\_DOT units="km\*\*2/s\*\*2">0.00600</CY\_DOT\_X\_DOT>

<CY\_DOT\_Y\_DOT units="km\*\*2/s\*\*2">0.00600</CY\_DOT\_Y\_DOT>

<CZ\_DOT\_X units="km\*\*2/s">0.00200</CZ\_DOT\_X>

<CZ\_DOT\_Y units="km\*\*2/s">0.00200</CZ\_DOT\_Y>

<CZ\_DOT\_Z units="km\*\*2/s">0.00200</CZ\_DOT\_Z>

<CZ\_DOT\_X\_DOT units="km\*\*2/s\*\*2">0.00400</CZ\_DOT\_X\_DOT>

<CZ\_DOT\_Y\_DOT units="km\*\*2/s\*\*2">0.00400</CZ\_DOT\_Y\_DOT>

<CZ\_DOT\_Z\_DOT units="km\*\*2/s\*\*2">0.00400</CZ\_DOT\_Z\_DOT>

</covarianceMatrix>

<spacecraftParameters>

<COMMENT>Spacecraft parameters used in OD and re-entry prediction</COMMENT>

<MASS>3582</MASS>

<DRAG\_AREA>23.3565</DRAG\_AREA>

<DRAG\_COEFF>2.2634</DRAG\_COEFF>

</spacecraftParameters>

<odParameters>

<COMMENT>Object1 OD Parameters</COMMENT>

<ACTUAL\_OD\_SPAN units="d">3.4554</ACTUAL\_OD\_SPAN>

<OBS\_AVAILABLE>137</OBS\_AVAILABLE>

<OBS\_USED>129</OBS\_USED>

<TRACKS\_AVAILABLE>18</TRACKS\_AVAILABLE>

<TRACKS\_USED>17</TRACKS\_USED>

</odParameters>

</data>

</segment>

</body>

</rdm>