

**CONTENTS**

<u>Section</u>	<u>Page</u>
<b>1 INTRODUCTION.....</b>	<b>1-1</b>
1.1 PURPOSE AND SCOPE.....	1-1
1.2 APPLICABILITY.....	1-2
1.3 RATIONALE.....	1-2
1.4 DOCUMENT STRUCTURE.....	1-2
1.5 CONVENTIONS AND DEFINITIONS.....	1-3
1.6 REFERENCES.....	1-5
<b>2 OVERVIEW.....</b>	<b>2-1</b>
2.1 ORBIT PARAMETER MESSAGE.....	2-1
2.2 ORBIT MEAN-ELEMENTS MESSAGE.....	2-1
2.3 ORBIT EPHEMERIS MESSAGE.....	2-2
2.4 ORBIT COMPREHENSIVE MESSAGE.....	2-2
2.5 EXCHANGE OF MULTIPLE MESSAGES.....	2-3
2.6 DEFINITIONS.....	2-3
<b>3 ORBIT PARAMETER MESSAGE.....</b>	<b>3-1</b>
3.1 GENERAL.....	3-1
3.2 OPM CONTENT/STRUCTURE.....	3-2
<b>4 ORBIT MEAN-ELEMENTS MESSAGE.....</b>	<b>4-1</b>
4.1 GENERAL.....	4-1
4.2 OMM CONTENT/STRUCTURE.....	4-2
<b>5 ORBIT EPHEMERIS MESSAGE.....</b>	<b>5-1</b>
5.1 GENERAL.....	5-1
5.2 OEM CONTENT/STRUCTURE.....	5-1
<b>6 ORBIT COMPREHENSIVE MESSAGE.....</b>	<b>6-1</b>
6.1 GENERAL.....	6-1
6.2 OCM STRUCTURE AND OVERARCHING REQUIREMENTS.....	6-2
<b>7 ORBIT DATA MESSAGE SYNTAX.....</b>	<b>7-1</b>
7.1 OVERVIEW.....	7-1
7.2 GENERAL.....	7-1

## CONTENTS (continued)

<u>Section</u>	<u>Page</u>
7.3 ODM LINES .....	7-1
7.4 ORBIT DATA MESSAGES IN ‘KEYWORD = VALUE NOTATION’ (I.E., NON-XML) AND ORDER OF ASSIGNMENT STATEMENTS .....	7-2
7.5 VALUES .....	7-3
7.6 OCM VECTOR DATA TYPE.....	7-4
7.7 UNITS IN THE ORBIT DATA MESSAGES .....	7-5
7.8 COMMENTS IN THE ORBIT DATA MESSAGES .....	7-6
7.9 ORBIT DATA MESSAGE KEYWORDS .....	7-8
7.10 VALIDATION AND INGEST OF KVN CONTENT VIA REGULAR EXPRESSIONS (OR ‘REGEX’) .....	7-9
<b>8 CONSTRUCTING AN ODM/XML INSTANCE.....</b>	<b>8-1</b>
8.1 OVERVIEW .....	8-1
8.2 XML VERSION.....	8-2
8.3 BEGINNING THE INSTANTIATION: ROOT ELEMENT TAG .....	8-2
8.4 THE STANDARD ODM/XML HEADER SECTION.....	8-3
8.5 THE ODM/XML BODY SECTION .....	8-4
8.6 THE ODM/XML METADATA SECTION .....	8-4
8.7 THE ODM/XML DATA SECTION.....	8-4
8.8 CREATING AN OPM INSTANTIATION .....	8-5
8.9 CREATING AN OMM INSTANTIATION.....	8-6
8.10 CREATING AN OEM INSTANTIATION .....	8-8
8.11 CREATING AN OCM INSTANTIATION.....	8-10
8.12 CREATING A COMBINED INSTANTIATION .....	8-13
8.13 SPECIAL SYNTAX RULES FOR ODM/XML.....	8-16
<b>ANNEX A IMPLEMENTATION CONFORMANCE STATEMENT PROFORMA (NORMATIVE) .....</b>	<b>A-1</b>
<b>ANNEX B VALUES FOR SELECTED KEYWORDS (NORMATIVE) .....</b>	<b>B-1</b>
<b>ANNEX C SECURITY, SANA, AND PATENT CONSIDERATIONS (INFORMATIVE).....</b>	<b>C-1</b>
<b>ANNEX D ABBREVIATIONS AND ACRONYMS (INFORMATIVE) .....</b>	<b>D-1</b>
<b>ANNEX E RATIONALE FOR THIS STANDARD (INFORMATIVE) .....</b>	<b>E-1</b>
<b>ANNEX F TECHNICAL MATERIAL AND CONVENTIONS FOR ODM DATA (INFORMATIVE).....</b>	<b>F-1</b>
<b>ANNEX G ODM EXAMPLES (INFORMATIVE).....</b>	<b>G-1</b>
<b>ANNEX H INFORMATIVE REFERENCES (INFORMATIVE).....</b>	<b>H-1</b>
<b>ANNEX I ITEMS FOR AN INTERFACE CONTROL DOCUMENT (INFORMATIVE).....</b>	<b>I-1</b>
<b>ANNEX J CHANGES VERSUS PREVIOUS VERSION (INFORMATIVE) .....</b>	<b>J-1</b>

## CONTENTS (continued)

<u>Figure</u>	<u>Page</u>
6-1 LTM Covariance Element Ordering following Time Tag .....	6-28
6-2 UTM Covariance Element Ordering following Time Tag.....	6-28
6-3 Full Covariance Element Ordering following Time Tag .....	6-28
6-4 LTM Covariance/Correlation Element Ordering following Time Tag.....	6-29
6-5 UTM Covariance/Correlation Element Ordering following Time Tag .....	6-29
8-1 ODM/XML Basic Structure .....	8-1
8-2 Comparison of Single Message OPM with NDM Combined Instantiation .....	8-14
8-3 NDM Combined Instantiation Showing Mix of ODMs and Use of Attributes .....	8-15
F-1 Depiction of Optimally Enclosing Box and Definitions of MAX, INT, and MIN Orientation Vectors Relative to OEB Parent Frame.....	F-2
F-2 Depiction of Optical Viewing CATS Angle Geometry .....	F-6
F-3 Diagram of Time-based Duty Cycle (DC_TYPE = 'TIME') .....	F-7
F-4 Diagram of a Rotating Spacecraft Body's Progression through an Inertial Clock Angle-based Duty Cycle (DC_TYPE = 'TIME_AND_ANGLE').....	F-7
F-5 Regex Pattern for CCSDS Timecode .....	F-10
F-6 Regex Pattern Matching Sequence for CCSDS Timecode .....	F-11
F-7 Regex for a Non-Decimal String.....	F-12
F-8 Regex for Free-Text String .....	F-12
F-9 Regex for String Containing Numerical Value with Optional Units .....	F-12
F-10 Regex for String Containing Numerical Value with Optional Units .....	F-13
G-1 Simple OPM File Example .....	G-1
G-2 OPM File Example with Optional Keplerian Elements and Two Maneuvers .....	G-2
G-3 File Example with Covariance Matrix .....	G-3
G-4 OPM File Example with Optional Keplerian Elements, Covariance Matrix, and a User-defined Parameter .....	G-4
G-5 OPM File Example in XML Format .....	G-5
G-6 Example Two Line Element Set .....	G-6
G-7 OMM File Example without Covariance Matrix .....	G-6
G-8 OMM File Example with Covariance Matrix .....	G-7
G-9 OMM with Units and a User-defined Parameter .....	G-8
G-10 OMM File Example in XML Format.....	G-9
G-11 OEM Example with No Acceleration, No Covariance .....	G-10
G-12 OEM Example with Optional Accelerations.....	G-11
G-13 OEM Example with Optional Covariance Matrices .....	G-12
G-14 OEM File Example in XML Format .....	G-14
G-15 Simple/Succinct OCM Example with Only Cartesian PVA Ephemeris .....	G-15
G-16 OCM Example with Space Object Characteristics and Perturbations .....	G-17
G-17 OCM Example with Deployed Objects and Low-level Thrusting Maneuver during Deployment to Make 'String-of-Pearls' Deployment .....	G-17
G-18 OCM Example with Multiple Orbit Time Histories, a Maneuver, OD, Cartesian, and Keplerian Ephemeris .....	G-19
G-19 OCM Example with Covariance Matrix Time Histories in Two Element Set Types .....	G-20

## CONTENTS (continued)

<u>Figure</u>	<u>Page</u>
G-20 OCM Example in XML Format .....	G-21
G-21 Aggregating Multiple ODMs into a Single NDM File .....	G-22
G-22 Aggregating OPM, OMM, OEM, and OCM in a Single Navigation Data Message XML .....	G-25

### Table

3-1 OPM Header .....	3-3
3-2 OPM Metadata .....	3-4
3-3 OPM Data .....	3-6
4-1 OMM Header .....	4-3
4-2 OMM Metadata .....	4-4
4-3 OMM Data .....	4-5
5-1 OEM File Layout Specifications .....	5-2
5-2 OEM Header .....	5-3
5-3 OEM Metadata .....	5-4
5-4 OEM Covariance Keywords .....	5-8
6-1 OCM File Layout and Ordering Specification .....	6-3
6-2 OCM Header .....	6-5
6-3 OCM Metadata .....	6-6
6-4 OCM Data: Trajectory State Time History .....	6-14
6-5 OCM Data: Space Object Physical Characteristics .....	6-21
6-6 OCM Data: Covariance Time History .....	6-31
6-7 OCM Data: Maneuver Specification .....	6-37
6-8 OCM Data: Selectable Propulsive (i.e., Non-Deployment) Maneuver Fields in the Maneuver Time History Data .....	6-45
6-9 OCM Data: Selectable Deployment Fields in the Maneuver Time History Data .....	6-46
6-10 OCM Data: Perturbations Specification .....	6-48
6-11 OCM Data: Orbit Determination Data .....	6-53
6-12 OCM Data: User-Defined Parameters .....	6-56
8-1 ODM/XML Root Element Tags .....	8-2
8-2 Examples of Units in OPM/XML .....	8-5
8-3 OPM/XML Tag Delimiters .....	8-6
8-4 Examples of Units in OMM/XML .....	8-7
8-5 OMM/XML Tag Delimiters .....	8-8
8-6 Examples of Units in OEM/XML .....	8-9
8-7 OEM/XML Tag Delimiters .....	8-10
8-8 Examples of Units in OCM/XML .....	8-11
8-9 OCM/XML Tag Delimiters .....	8-12
E-1 Services Available with Orbit Data Messages .....	E-5
F-1 Space Surveillance Observation Product Description .....	F-16