628-306

ULYSSES

SOFTWARE INTERFACE SPECIFICATION

SUPPLEMENTARY EXPERIMENT DATA RECORDS to ULYSSES PRINCIPAL INVESTIGATORS

SIS 2sc

July 13, 1984
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ABSTRACT: This SIS describes the format and contents of the ULS SEDR and the medium and access methods for the SEDR. The SEDR contains information on the ULS Spacecraft orientation and trajectory and solar system geometries.

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SEDR SOFTWARE INTERFACE SPECIFICATION

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SECTION 1

1 GENERAL DESCRIPTION

1.1 Overview

This Software Interface Specification (SIS) describes the contents and format of the Supplementary Experiment Data Record (SEDR) and the formats of the tapes for transferring SEDR data to the ULS Principal Investigators (PIs).

1.2 Scope

Record and tape formats and data types will be covered in this document. There is only one SEDR format for the entire ULS mission. A separate tape format is created for each PI host computer.

1.3 Applicable Documents

ULS-MOS-3-700	ULS Mission Operations System Functional Requirements Document - Data Records System Functional Requirements
ULS-SDD-ANNEX1	ULS Flight Dynamics System Design and Specification Document
ICD ULS 3sbb	DPTRAJ SEDR Parameters (SIS)
ICD ULS 2sf	SCLK/SCET Coefficient File (SIS)
ULS-SRD-DRS-3	ULS SEDRGEN Software Requirements Document
ICD ULS 2tg	Generation and Delivery of SEDR Tapes

1.4 System Site

1.4.1 Subsystem Medium and Location

SEDR and SEDR tapes are generated on the UNISYS computer at the Information Processing Center (IPC) of the Jet Propulsion Laboratory (JPL).

1.4.2 Data Sources, Destinations, and Transfer Method

Data for the SEDR are derived from two sources: navigational parameters from the Navigational System DPTRAJ program and spacecraft spin axis orientation information from the ESOC Attitude History file. SEDR will be provided to PIs with an ongoing experiment aboard the ULS spacecraft. The transfer method for the SEDR will be by magnetic tapes.

ULS PIs may request a printout of all SEDR parameters for their own use at JPL during critical mission periods.

1.4.3 Generation Method and Frequency

The ULS Data Management Team (DMT) is responsible for the generation of SEDR. DMT will generate an SEDR file once a month containing data for the previous one-month period.

DMT will generate a set of Predict SEDR (PSEDR) that covers the entire ULS mission from launch to end-of-mission. DMT may generate additional predict SEDR on request from PIs. These may cover shorter periods than the nominal PSEDR, or may be generated using a more accurate trajectory, or both.

1.4.4 Labeling and Identification (Internal/External)

No internal magnetic tape labels exist on SEDR tapes. The SEDR records will have three SFDU headers which contain such information as project identifier, file identifier, and date and time of file generation.

An external tape number will be placed on the SEDR tape reel and strap. This tape number is comprised of the three letter designation of the experiment and the six digit SEDR identification code. The following coding scheme will be used:

1. XXX - three letter experiment designator.

2. 00 - two digit experiment number.

3. 0 - one digit mission phase code.

4. 0 - one digit SEDR type code.

5. 00 - two digit individual tape sequence number. This number increments from 01 to 99 for each experiment in each mission phase and for each SEDR type except remakes.

The following tables provide a detailed description of the breakdown of the SEDR tape number:

Table 1-1: Experiment Designator versus Number

Exp	Num	Comment
BAM	00	copy to JPL
GLG	01	copy to College Park
GRU	02	copy to Heidelberg
HED	03	copies to London and JPL
HUS	04	copies to Munich and Berkely
KEP	05	copies to Katlenburg-Lindow and El Segundo
LAN	06	copy to APL
SIM	07	copy to Chicago
STO	08	copies to Toulouse and GSFC
SCE	09	copy to Bonn
GWE	10	copy to Pavia
GLG	11	copy to Bern
SIM	17	copy to Kiel
DRS	20	(Data Records tape for file transfer - for JPL use only)

Table 1-2: Mission Phase Code

Code	Mission Phase
0	Pre-launch test data.
1	Injection to second TCM cruise.
2	Second TCM to third TCM cruise.
3	Third TCM to Jupiter cruise.
4	Jupiter encounter.
5	Post Jupiter phase.
6	High solar latitude phase. (High Southern solar lat.)
7	Post high latitude phase. (High Northern solar lat., Post mime mission phase)

Table 1-3: SEDR Type Code

Code	SEDR Type
0	Predict SEDR
1	Final SEDR (original)
2	Final SEDR remake #1
3	Final SEDR remake #2
4	Final SEDR remake #3
5	Final SEDR remake #4
6	Final SEDR remake #5
7	Final SEDR remake #6
8	Final SEDR remake #7
9	Final SEDR specially requested by a PI

The following is an example of a SEDR tape number:

Example: SIM 072103

Breakdown of the tape number "SIM 072103" is given as follows: This SEDR tape is designated for the Simpson experimenters (SIM) in Chicago (07). The SEDR data on the tape covers a portion

of the cruise period between the second and third trajectory correction maneuvers or TCMs (2). The SEDR is the original "final" not a remake (1). Finally, this is the third in the series of SEDR tapes for the indicated mission phase (03).

1.5 Assumptions and constraints

1.5.1 Usage Constraints

The SEDR will be distributed in accordance with SIS 2tg on the generation and delivery os SEDR tapes.

1.5.2 Data Accuracy and Conventions

Data accuracy is defined in the ULS Mission Operations System Functional Requirements Document, Data Records System Functional Requirements (ULS-MOS-3-700).

Double precision (72 bits on the UNISYS) computation is used, but output to the SEDR is single precision (32 bits).

Fill data will be indicated by the value "1000". Note that the only possible fill data are the spin axis orientation data and the sun aspect angle during periods when the spacecraft is performing a maneuver.

DMT will inform PIs of any changes to the astronomical constants or conventions used on the SEDR. Viz., this SIS will continue to be maintained.

1.5.3 Time Tags

Each SEDR record is tagged with the time of the epoch for which the SEDR data are in effect. Both UTC and spacecraft clock count will be used in the time tagging. Time in UTC is equivalent to the spacecraft event time of the EDR. Spacecraft clock count will be computed from the spacecraft event time and will be consistent with the EDR.

The accuracy of the computed spacecraft clock count will be kept within $\pm$ 100 milliseconds of actual correlated relationships between spacecraft clock count and spacecraft event time. The smallest unit of computed spacecraft clock count is one one-thousandth of a count (2 milliseconds).

This requirement to maintain the required accuracy of the computed relationship between spacecraft event time and spacecraft clock count will account for the drift in spacecraft clock rate and any resets or rollovers of the spacecraft clock counter.

The SEDR does not provide any indication of spacecraft clock resets or rollovers. Such events will be noted in the logs and summaries which will accompany each shipment of SEDR.

SECTION 2

2 INTERFACE CHARACTERISTICS

2.1 Hardware Characteristics and Limitations

2.1.1 Special Equipment and Device Interfaces

None identified. SEDR tapes for the PIs will be in IBM compatible format.

2.1.2 Special Setup Requirements

None identified.

2.2 Volume and Size

The size of the SEDR file on tape will be less than 3000 tracks. A track contains 1792 32-bit words for the UNISYS computer. This is only an operational restriction set by DMT to ensure that an SEDR file will not require more than one reel of tape to write. Under the current plan of generating one SEDR file per month, the SEDR file should be less than 100 tracks per tape. DMT can adjust the size of the SEDR file by changing the processing time interval of the processing run.

2.3 Interface Medium Characteristics

SEDR records are comprised of 32-bit words. These words contain integer or floating point SEDR quantities depending upon the format requested. The SEDR file is written to a nine-track unlabelled tape at a density of 1600 bpi.

Logs and printed summaries on the start and stop times of the SEDR file and the number of records per tape are included in each SEDR shipment.

2.4 Failure Protection, Detection, and Recovery Procedures

2.4.1 File Backup Requirements

DMT will retain backup copies of the SEDR master files until end of mission plus three years, or until transfer of said data to a permanent archive center, whichever occurs earlier.

2.4.2 Security/Integrity Measures

DMT will restrict the release of SEDR to the ULS PIs. No other security measures are planned.

For data traceability, each SEDRGEN run will output an audit trail which identifies the source and version of the input data.

SECTION 3

3 ACCESS

3.1 Programs Using the Interface Data

PI software is not identified in this document. It will be the sole responsibility of the PI to produce software which accepts properly made SEDRs as its input.

3.2 Synchronization Considerations

3.2.1 Timing and Sequencing Characteristics

The records in the SEDR files will be in increasing Spacecraft Event Time (SCET) order (UTC).

3.2.2 Effective Duration

If the SEDR data are considered "final", the data will be within project science accuracy requirements for the time (UTC) indicated in each record.

SECTION 4

4 DETAILED INTERFACE SPECIFICATION

4.1 Overview of Structure and Organization

There will be only one file of SEDRs on each tape written for dissemination to the ULS PIs. (As a matter of consistency and predictability in operations, the DMT will limit the size of the SEDR file to that which will fit on a single reel of magnetic tape.) The SEDR file on tape shall terminate with two end-of-file tape markers. The layout of the SEDR file on tape is presented in Figure 4-1. There will be no internal tape labels on the SEDR tapes.

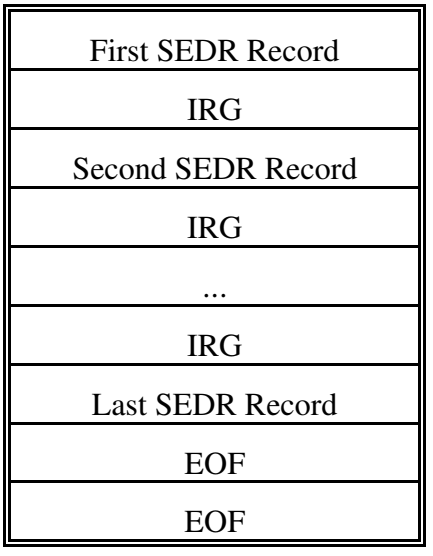


Figure 4-1: SEDR Tape Layout

There will be two SEDR formats, integer or floating-point. Tertiary-SFDU-header word 24 of the first SEDR in the file shall identify which of the two formats shall be used for the remainder of the file. Details of this scheme are found in Sections 4.2.3 and 4.2.4 of this document.

4.2 Substructure Definition and Format

The SEDR shall consist of three SFDU headers followed by a block of the supplementary experiment data (Figure 4-2). Each word in an SEDR shall be 32-bits in length. The first word in the SEDR shall be the first 32 bits of the primary SFDU header. All words in each SEDR shall be counted consecutively from this first word. Thus, since the three SFDU headers take up the first through the 25th word in the SEDR, the actual supplementary experiment data will appear in the 26th through the 288th words in the SEDR.

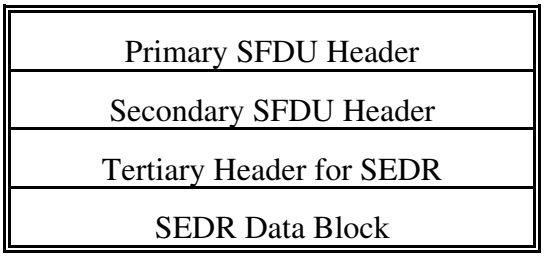


Figure 4-2: Data Block

In the case of an integer format SEDR, an additional record, the scale factor block (Figure 4-3) will appear as the first record on the SEDR.

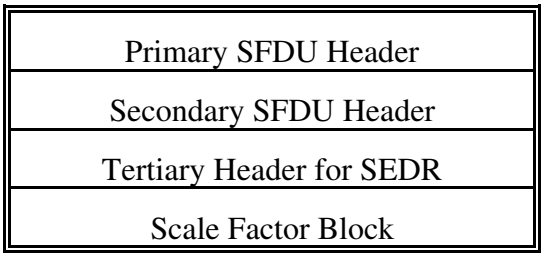


Figure 4-3: Scale Factor Block

4.2.1 SFDU Headers

The format of the primary and secondary SFDU headers for the SEDR is presented in Figure 4-4 and is specified in detail in Table 4-1. The format of the tertiary SFDU header for the SEDR is presented in Figure 4-5 and is specified in Table 4-2.

4.2.2 SEDR Contents

The contents of the SEDR (i.e. what word represents which parameter) are presented in Table 4-3.

4.2.3 Details of the Integer-Format SEDR

If word 24 of the tertiary-SFDU-header of the *first* SEDR in the file is set to "1", all the *remaining* SEDRs in that file (and on that tape) will be in the *integer format.* In this case, the data words found in the first SEDR will contain the scale factors (powers of ten) by which the integer values found in the remaining SEDRs in the file will be multiplied to obtain their actual values. Word 24 of the tertiary-SFDU-header of the second, and all remaining integer-format SEDRs in the file will be set to "2" to indicate that the values found in each word of those SEDRs are integer values.

Although the scale factors mentioned above are found in the first record of every integer-format SEDR file, for the sake of completeness, they are listed below:

Parameter TypeScale Factors

Ranges, positions, counts	10^{0}	=	1
Degrees (LAT, LONG)	10^{-4}	=	1/10000
Velocities (except body-fixed ΔV)	10^{-6}	=	1/1000000
Body-fixed ΔV and Solar-rotation numbers	10^{-4}	=	1/10000

A negative value in integer-format SEDR shall be represented by its twos complement.

The integer-format shall be used for SEDRs produced for the following ULS Experiment Teams:

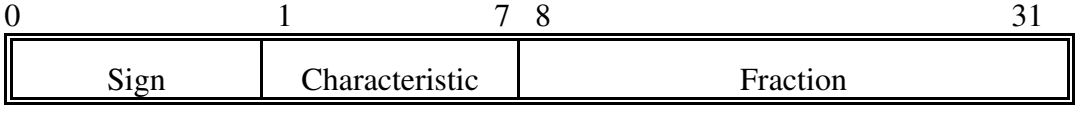
BAM, GLG (Bern), HED, and SIM (Germany)

4.2.4 Details of the Floating-Point-Format SEDR

If word 24 of the tertiary-SFDU-header of the *first* SEDR in the file is set to "0", *all* the SEDRs in that file (and on that tape), including the first SEDR, will be in the floating-point format. Furthermore, in this case, word 24 of the tertiary-SFDU-header of all the remaining SEDRs in the file will be set to "0".

The floating-point-words will appear as follows:

Bit Positions-



where,

Sign — will indicate the sign of the quantity represented by the floating-point word. If SIGN = 0, the quantity will be evaluated as positive; if SIGN = 1, the quantity will be evaluated as negative.

Characteristic — allows the calculation of the value of the characteristic (or exponent) (base 16) of the floating-point word. The characteristic will be evaluated as ($CHAR_{16}$ - 40_{16})

Fraction — consists of the most significant digits of the mantissa of the floating-point quantity, which will be a hexadecimal fraction, the value of which will always lie between 0 and ($0.FFFFFFFFFFFFFFFFFFFFFFF_{16}$).

Either of the following equations may be used to evaluate quantities in the floating-point format:

$Value_{16} = (1 - 2*Sign_{16}) * (Fraction_{16}) * (10_{16})^{(CHAR_{16} - 40_{16})}$

$Value_{10} = (1 - 2*Sign_{10}) * (Fraction_{10}) * (16_{10})^{(CHAR_{10} - 64_{10})}$

The following algorithm may be used to evaluate floating-point SEDR quantities:

1. Break-out the separate "raw" values of SIGN, CHAR, and FRACTION from the word.

2. Assume that the hexadecimal point of the number represented by FRACTION lies between bits 7 and 8 as FRACTION appears in the SEDR word.

3. Evaluate $N = CHAR_{16} - 40_{16}$

   a. If N = 0, the value of FRACTION as assumed in Step 2, above, is correct.

   b. If N < 0, shift the hexadecimal point in the assumed value of FRACTION to the left by N places, inserting N zeroes.

   c. If N > 0, shift the hexadecimal point in the assumed value of FRACTION to the right by N places, inserting N zeroes.

4. Finally, if SIGN = 0, the quantity is positive. If SIGN = 1, the quantity is negative.

The floating-point-format will be used for SEDRs produced for the following ULS Experiment Teams: GLG (U of Md), GRU, HUS, KEP, LAN, STO, SIM (Chicago), SCE, and GWE.

The SEDR made for archive by the DMT will be in floating point format.

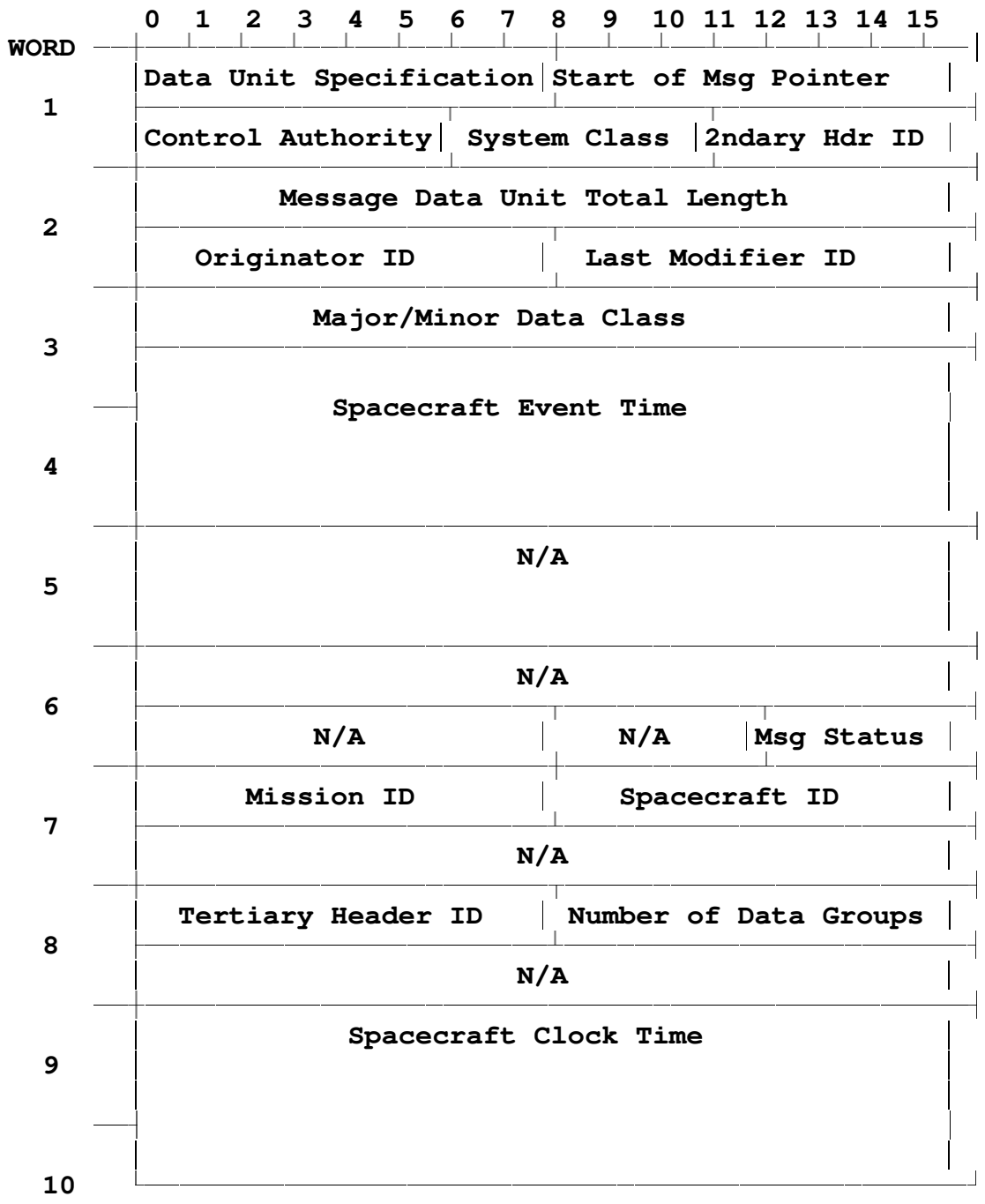


Figure 4-4: ULS SEDR Primary and Secondary SFDU Headers

Table 4-1: ULS SEDR Primary and Secondary SFDU Header Definition

WORD	BITS	Description
1	0-3	Label Version Number - indicates the version of standard formatted data unit (SFDU) 0001 - Base Version Code (constant for ULS)
1	4-5	Character Set - indicates the character representation used within this record. 00 = binary type (constant for ULS)
1	6-7	Unit Structure Type - globally defines the gross structural characteristics of the data unit. 00 - (constant for ULS)
1	8-15	Start of Message Pointer - Number of bytes to beginning of message.
1	16-21	Control Authority - Institution controlling the contents of the remainder of the data unit. 000101 = NASA JPL (constant for ULS)
1	22-26	System Classification - Local system responsible for creating the secondary header. 00010 = Data Records System (DRS)
1	27-31	Secondary Header Identifier - Identifies the secondary header type. 00010 = ULS (constant for ULS)
2	0-15	Message Unit Classification - Total length of this record in bytes
2	16-23	Originator ID Data Records System = 43_{16}
2	24-31	Last Modifier ID Data Records System = 43_{16}
3	0-15	Major/Minor Data Class Predict SEDR = 60_{16}, Final SEDR = 61_{16}, Special SEDR = 62_{16}
3 4	16-31 0-15	Spacecraft Event Time (SCET) - Time of validity of the SEDR record, elapsed seconds since Jan 1, 1950 (UTC).
4	16-31	Fraction of a second of SCET, binary point assumed to the left of bit 16. (Decimal Integer / 2^{16} format)
5	0-31	Unused (zero fill)
6	0-27	Unused (zero fill)
6	28	Data Quality Flag - Indicates if the data portion of this record is valid or not. 0 = data valid 1 = data suspect, incomplete or invalid

Table 4-1 (cont'd)

WORD	BITS	Description
6	29	Spacecraft Clock Flag - Indicates if the spacecraft clock is valid or not. 0 = SCLK is valid 1 = SCLK is missing, incomplete or invalid
6	30	Spacecraft Event Time Flag - Indicates if the SCET value is valid or not. 0 = SCET is valid 1 = SCET is missing, incomplete or invalid
6	31	Earth Received Time Flag - Indicates if the ERT value is valid or not. 0 = ERT is valid 1 = ERT is bad or missing
7	0-7	Mission ID 03_{16} = Ulysses
7	8-15	ULS Spacecraft ID = 37_{16} (55_{10})
7	16-31	Unused (zero fill)
8	0-7	Tertiary Header ID - indicates the type of tertiary header that follows the secondary header - 03_{16} = Data Records System header
8	8-15	Number of Data Groups = 01_{16}
8	16-31	Unused (zero fill)
9	0-31	Spacecraft Clock Count (whole number counts with an implied binary point at the right) - computed from SCET. (Decimal Integer format)
10	0-15	Spacecraft Clock Count (fractional part of count with an implied binary point at the left). (Decimal Integer / 2^{16} format)

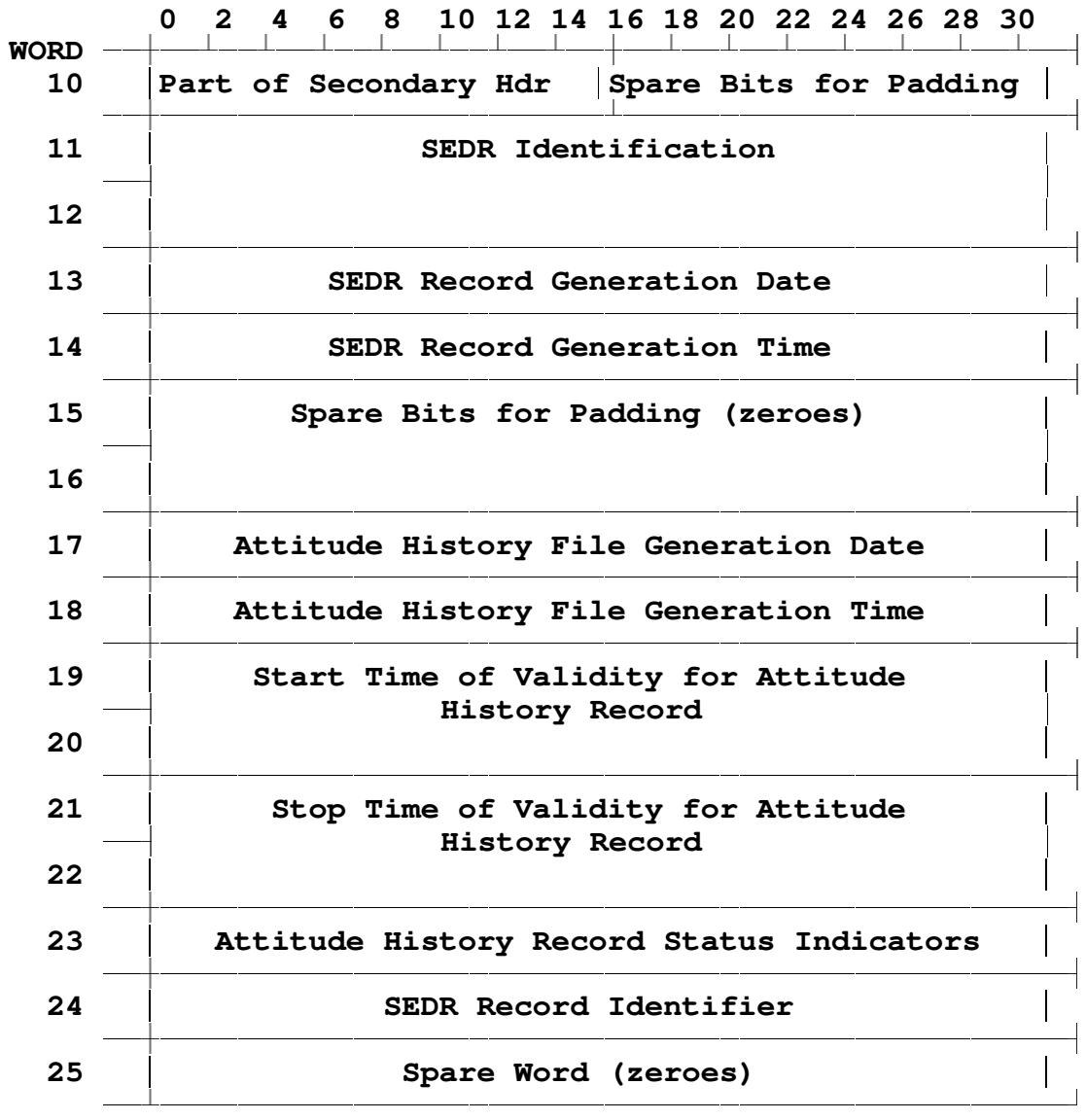


Figure 4-5: ULS SEDR Tertiary SFDU Header

Table 4-2: ULS SEDR Tertiary SFDU Header Definition

Word	Bits	Description
10	16-31	Spare bits for padding (zeroes)
11	0-31	Spare word (zeroes)
12	0-31	Last four digits of the SEDR Identification Number, integer format: MSTT where- M is the mission phase code S is the SEDR type code T identifies the tape sequence number (see section 1.4.4)
13	0-31	SEDR Record Generation Date, integer format: YYDDD (year, DOY) (e.g. 91300_{10})
14	0-31	SEDR Record Generation Time, integer format: HHMMSS (e.g. 210756_{10})
15 16	0-31	Spare words (zeroes)
17	0-31	Attitude History File Generation Date, integer format: YYDDD
18	0-31	Attitude History File Generation Time, integer format: HHMMSS
19	0-31	Start Date of Validity of Attitude Record, integer format: YYDDD
20	0-31	Start Time of Validity of Attitude Record, integer format: HHMMSS
21	0-31	Stop Date of Validity of Attitude Record, integer format: YYDDD
22	0-31	Stop Time of Validity of Attitude Record, integer format: HHMMSS

Table 4-2 (cont'd)

Word	Bits	Description
23	0-31	Attitude Record Status Indicators from Attitude History File, 3 digit decimal integer format XYZ, where X = 0 Actual Attitude History Data X = 1 Predict Attitude History Data Y = 0 delta-v accurate Y = 1 delta-v inaccurate Z = 0 delta-v provided Z = 1 delta-v not provided
24	0-31	SEDR Record Identifier, integer where 0 - floating point record 1 - scale factor record 2 - integer record (see sections 4.2.3 and 4.2.4)
25	0-31	Spare Word (zeroes)

Table 4-3: ULS SEDR Data Format

SEDR Word	Description	Units
26-27	Right Ascension and Declination of S/C Spin Axis, S/C Centered, Earth Mean Equator and Equinox of 1950.0	deg
28-29	Celestial Latitude and Longitude of S/C Spin Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0	deg
30	Spare Word (zeroes)	
31-36	Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
37-42	Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
43-48	Cartesian State of S/C, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
49-54	Cartesian State of S/C, Io Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
55-60	Cartesian State of S/C, Europa Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
61-66	Cartesian State of S/C, Ganymede Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
67-72	Cartesian State of S/C, Callisto Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
73-78	Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
79-84	Cartesian State of Jupiter, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
85-90	Cartesian State of Earth, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
91-96	Cartesian State of Io, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
97-102	Cartesian State of Europa, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
103-108	Cartesian State of Ganymede, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
109-114	Cartesian State of Callisto, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec

Table 4-3 (cont'd)

SEDR Word	Description	Units
115-120	Cartesian State of S/C, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
121-126	Cartesian State of Io, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
127-132	Cartesian State of Europa, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
133-138	Cartesian State of Ganymede, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
139-144	Cartesian State of Callisto, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
145-150	Cartesian State of S/C, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km km/sec
151-153	Cartesian Position of Io, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
154-156	Cartesian Position of Europa, Jupiter Centered, Jupiter System True Prime Meridian and Equator of Date	km
157-159	Cartesian Position of Ganymede, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
160-162	Cartesian Position of Callisto, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
163-168	Cartesian State of S/C, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km km/sec
169-171	Cartesian Position of Io, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
172-174	Cartesian Position of Europa, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date	km
175-177	Cartesian Position of Ganymede, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
178-180	Cartesian Position of Callisto, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
181-183	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of S/C	deg
184-186	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Io	deg

Table 4-3 (cont'd)

SEDR Word	Description	Units
187-189	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Europa	deg
190-192	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Ganymede	deg
193-195	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Callisto	deg
196	Range Earth - S/C	km
197	Range Sun - S/C	km
198	Range Sun - Earth	km
199	Range Sun - Jupiter	km
200	Range Jupiter - S/C	km
201	Range Jupiter - Io	km
202	Range Jupiter - Europa	km
203	Range Jupiter - Ganymede	km
204	Range Jupiter - Callisto	km
205	Angle Earth - Sun - S/C	deg
206	Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)	deg
207	Angle Sun - Earth -S/C	deg
208	Angle Jupiter - Sun - S/C	deg
209	Angle Sun - S/C - Jupiter (Celestial Cone Angle of Jupiter)	deg
210	Angle Sun - Jupiter - S/C	deg
211	Angle Earth - S/C - Jupiter	deg
212	Angle Sun Aspect (Angle Between Spacecraft Spin Axis and Direction to Sun)	deg
213-214	Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg
215-216	Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg
217-218	Right Ascension and Declination of Jupiter, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg

Table 4-3 (cont'd)

SEDR Word	Description	Units
219-220	Right Ascension and Declination of S/C, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
221-222	Right Ascension and Declination of Sun, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
223-224	Right Ascension and Declination of Io, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
225-226	Right Ascension and Declination of Europa, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
227-228	Right Ascension and Declination of Ganymede, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
229-230	Right Ascension and Declination of Callisto, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
231-232	Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
233-234	Celestial Latitude and Longitude of Earth, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
235-236	Celestial Latitude and Longitude of Jupiter, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
237-238	Right Ascension and Declination of S/C, Sun Centered, Sun True Equinox and Equator of Date	deg
239-240	Right Ascension and Declination of Earth, Sun Centered, Sun True Equinox and Equator of Date	deg
241-242	Right Ascension and Declination of Jupiter, Sun Centered, Sun True Equinox and Equator of Date	deg
243-244	Heliographic Latitude and Longitude of S/C	deg
245-246	Heliographic Latitude and Longitude of Earth	deg
247-248	Heliographic Latitude and Longitude of Jupiter	deg
249-254	Cartesian State of S/C, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	km km/sec
255-260	Cartesian State of Io, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	km km/sec
261	Range Jupiter Magnetic Dipole - S/C	km

Table 4-3 (cont'd)

SEDR Word	Description	Units
262-263	Latitude and Longitude of S/C, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	deg
264-265	Latitude and Longitude of Io, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	deg
266	Solar Rotation Number Relative to Earth	rotations
267	Solar Rotation Number Relative to Spacecraft	rotations
268-273	Cartesian State of Saturn, Sun centered, Earth Mean Ecliptic and Equinox of 1950	km km/sec
274-288	Spare Words (zeroes)	

APPENDIX A Glossary

Cartesian State	Cartesian position and velocity components in the following order: x-position, y-position, z-position, x-velocity, y-velocity, and z-velocity.
Equinox	Vernal equinox. For the planets, the vernal equinox is defined as the axis from the center of the planet to the ascending node of the planet's orbit through the planet's equatorial plane.
Jupiter System I	This prime meridian system is identified with the Prime Meridian rotation of the visible features in the Jovian equatorial zone. The exact definition of this system can be found in the Explanatory Supplement to the Astronomical Ephemeris and The American Ephemeris and Nautical Almanac (Explanatory Supplement to the Ephemeris). JPL Technical Report (TR) 32-12508, dated January 15, 1971.
Jupiter System III	This prime meridian system is identified with the Prime Meridian rotation of radio emissions from Jupiter. This rotation probably corresponds to the rotation of the Jovian inner core which is associated with the planet's magnetic field. The SEDR uses Jupiter System III (1965.0).
Longitude	The longitude convention will conform to the IAU standards which specify positive west longitudes for Jupiter.

APPENDIX B List of Acronyms and Abbreviations

BPI	Bits per inch
CDFGEN	Common Data File Generation (program)
deg	Degrees
DEC	Declination
DMT	Data Management Team
DOY	Day of Year
DPTRAJ	Double Precision Trajectory program
DRS	Data Records System
DUT	Difference between ET and UTC times (55.2 for 1 July 1985)
E	Floating Point Quantity
ECL50	Earth Mean Ecliptic and Equinox of 1950.0
EME50	Earth Mean Equator and Equinox of 1950.0
ERT	Earth Received Time
ESOC	European Space Operations Centre
ET	Ephemeris Time
HHMMSS	Hours-Minutes-Seconds
HEX	Hexadecimal Number
I	Integer Quantity
IAU	International Astronomical Union

ID	Identification
IPC	Information Processing Center
IRG	Inter-record Gap
JPL	Jet Propulsion Laboratory
km	Kilometers
km/sec	Kilometers Per Second
N/A	Not Applicable or Not Available
NAV	Navigation System or Team
P-FILE	Probe Ephemeris File
PI	Principal Investigator
RA	Right Ascension
S/C	Spacecraft
SCET	Spacecraft Event Time
SCLK	Spacecraft Clock (count)
SEDR	Supplementary Experiment Data Records
SEDRGEN	Supplementary Experiment Data Records Generation (program)
SFDU	Standard Formatted Data Unit (headers)
SIS	Software Interface Specification
SRD	Software Requirements Document
TBD	To Be Determined
TBS	To Be Supplied

TCM	Trajectory Correction Maneuver
UTC	coordinated Universal Time
YYDDD	Year (last two digits) - day of year