

628-306

ULYSSES

SOFTWARE INTERFACE SPECIFICATION

COMMON DATA FILE

SIS 2sd

September 22, 1994

ABSTRACT: This SIS describes the detailed format, contents, and transmission medium of the Ulysses Common Data File. The CDF tape is produced by the Data Records Subsystem program CDFGEN under the auspices of the Data Management Team and contains science experiment data that have been reduced through algorithms developed by the Ulysses Principal Investigators. This version is a revision of the document.



Jet Propulsion Laboratory
California Institute of Technology

Acknowledgement

The original version of this document was prepared by H. Woo and R. Hungerford. Much of the revision to this document done in 1986 is the work of J. Springer, who was at the time, the Ulysses Project CDF Cognizant Engineer and Data Records System Engineer. Therefore, the bulk of this document is their work. The update done in 1990 was the work of R. D. Shaffer, who was the Ulysses Data Management Team Leader.

Approved:

J. A. Johnson, Leader Ulysses Project Data Management Team	Date

Concurred:

M. A. Orr, Supervisor Division 37 Project Data Management Group	Date

P. Mullen, Manager Ulysses Project Software	Date

DISTRIBUTION:

W. Armstrong
T.P. Armstrong
A. Balogh
S.J. Bame
A. Barnes
P. Beech
E. Beyer
M.K. Bird
M. Boykins
J.C. Brandt
A.B. Galvin
J. Geiss
G. Gloeckler
R. Gold
B.E. Goldstein
E. Gruen
E. Herrington

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K. Hurley
J.A. Johnson
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J. Lemaire
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S. Mazuk
R. J. McDowall
C. Meetre
W. Meeks
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B. Monsignori-Fossi

R. Mueller-Mellin
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J.A. Simpson
E.J. Smith
M. Sommer
C.P. Sonett
J. Springer
R.G. Stone
N. Toy
H. Volland
P. Wenzel
M. Witte
H. Woo

CDF SOFTWARE INTERFACE SPECIFICATION

PRINCIPAL INVESTIGATOR CONCURRENCES:

BAME EXPERIMENT

S. J. BAME

GLOECKLER-GEISS EXPERIMENT

G. GLOECKLER

J. GEISS

HEDGECOCK EXPERIMENT

A. BALOGH

KEPPLER EXPERIMENT

E. KEPPLER

LANZEROTTI EXPERIMENT

L. J. LANZEROTTI

SIMPSON EXPERIMENT

J. A. SIMPSON

STONE EXPERIMENT

R. G. STONE

DOCUMENT CHANGE LOG

Change	Date	Affected Portions
Changes to SFDU header contents	Jul 90	Section 4
Change to 5-1 on float vs int., mod HED algorithm, add STO algorithm	Jul 90	Section 5
Changes to SIM, HED formats	Oct 91	Section 5
Add info on tape block size, HED file description	June 92	Section 1,2,5
Change Distribution, signature page	Aug 92	Preface
Record sizes, various data block format changes	Apr 93	Section 2,4,5
Change KEP units	May 93	Section 5
Add CD-ROM information	Feb 94	All
Change DSS and minor data class numbers in table 4-1	Sept 94	Section 4

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SECTION 1

1 GENERAL DESCRIPTION

1.1 Overview

This Software Interface Specification (SIS) provides the contents and format of each individual instrument Common Data Record in the Common Data File (CDF) required by the Ulysses Principal Investigators.

1.2 Scope

This specification covers the detailed format of the Ulysses CDF for all phases of the mission from ground data system testing through the end of mission.

1.3 Applicable Documents

- | | | |
|-----|----------------|--|
| (1) | ISPM-MOS-3-700 | Data Records System Functional Requirements |
| (2) | ISPM-MOS-4-300 | Data Management Team Plan |
| (3) | ISPM-MOS-3-800 | Telemetry System Functional Requirements |
| (4) | ISPM-SRD-DRS-4 | Common Data File Software Requirements Document |
| (5) | JPL 628-55(B) | Ulysses Science Data Management Plan |
| (6) | JPL Document | Software Interface Specification - Compact Disk Read Only Memory |

1.4 Subsystem Site

1.4.1 Interface Location and Medium

Common Data File (CDF) tapes are generated on computers located at the JPL Information Processing Center (IPC). The Hedgecock file is prepared on a VAX computer and provided to the Ulysses DMT for inclusion on the tape or CD-ROM.

1.4.2 Data Sources, Destinations, and Transfer Methods

CDF tapes are created from spacecraft telemetry data using Experiment Data Records (EDR) as the source. The CDF is written to magnetic tape or CD-ROM and shipped to each Principal Investigator or Interdisciplinary Scientist as designated by the Project.

1.4.3 Generation Method and Frequency

The Ulysses Data Management Team (DMT) shall operate the Data Records System CDF generation software on a routine basis to generate CDFs covering a one calendar month period.

1.4.4 Pertinent Relationships with Other Interfaces

None identified.

1.4.5 Labeling and Identification (Internal/External)

All CDF tapes shall have IBM magnetic tape labels; CD-ROM shall conform to ISO Standard 9660 (see Applicable Document 6). All media shall be labeled with an external label describing its contents. In addition, each record within the CDF shall contain Standard Formatted Data Unit (SFDU) headers which contain such information as project identifier, file identifier, data type indicators, earth received time, etc.

1.5 Assumptions and Constraints

1.5.1 Usage Constraints

Only Ulysses designated Principal Investigators, Radio Scientists, Interdisciplinary Scientists, and Project Scientists shall receive CDFs. The CDF distribution is defined in Applicable Document 5.

1.5.2 Priority Phasing Constraints

None identified.

1.5.3 Explicit and Derived Constraints

None identified.

SECTION 2

2 INTERFACE CHARACTERISTICS

2.1 Hardware Characteristics and Limitations

2.1.1 Special Equipment and Device Interfaces

None identified.

2.1.2 Special Setup Requirements

None identified.

2.2 Volume and Size

Each CDF consists of two tape files consisting of records containing processed experiment data. Each file consists of n fixed length records. The maximum size of any file is 10000 bytes. The first file contains CDF data from the BAM, GLG, KEP, LAN, SIM, and STO experiments. The record size varies from 48 bytes to 100 bytes depending upon the experiment algorithm. One experiment may have more than one algorithm and hence more than one type of output record. The frequency of output records is dependent upon instrument cycle times as described individually in Section 5.

The second file contains data from the HED experiment. The record size is 47 bytes blocked to 9964 bytes.

2.3 Failure Protection, Detection, and Recovery Procedures

2.3.1 File Backup Requirements

None identified.

2.3.2 Security/Integrity Measures

Common Data File data are provided to all experimenters and their staffs for the purposes of correlating measurements between different experiments at an early stage in the analysis process. This is intended to aid in the interpretation of scientific results. The uses of these correlative

data, including publication, are subject to constraints imposed by the Science Working Team (SWT). The intent of these constraints is to protect the proprietary right of the experimenter while promoting timely inter-experiment correlation.

2.4 End-of-file Conventions

The Common Data Record file on the tape shall be terminated by the standard IBM end-of-file and end-of-volume labels. End file conditions on CD-ROM shall conform to ISO Standard 9660.

SECTION 3

3 ACCESS

3.1 Programs Using the Interface Data

Principal Investigator software is not defined here.

3.2 Synchronization Considerations

3.2.1 Timing and Sequencing Considerations

The records in the CDF files are in Spacecraft Event Time (SCET) order. If no SCET is available, then data shall be placed in Earth Received Time (ERT) as deemed appropriate by the Data Management Team.

3.2.2 Effective Duration

CDF files will be generated on a monthly basis. Each file will contain the data for the previous calendar month. The input source to the CDF processor, the Master Data Record (the complete set of all EDR and Monitor data from the mission), is archived until the end of the mission.

3.2.3 Priority Interrupts

None identified.

3.3 Input/Output Protocols, Calling Sequences

None identified.

SECTION 4

4 Detailed Interface Specifications

4.1 Structure and Organization Overview

The CDF shall consist of two files of data records.

4.2 Substructure Definition and Format

The first data file, the CDF file, is written in binary format and consists of a set of records, each beginning with an SFDU header and followed by the experiment data block. The physical blocks vary in size but are a maximum of 10000 bytes. The format and description may be found in Section 5.

The second data file, the HED CDR Average File, is written in ASCII with a block size of 10000 bytes and a record size of 47 bytes blocked at 9964 bytes. The format and description may be found in Section 5.4.

4.2.1 SFDU Headers

The Ulysses CDF utilizes the Standard Formatted Data Unit (SFDU) system of headers. Described in detail on the following pages are the multi-mission primary and secondary headers (Figure 4-1, Table 4-1) and the tertiary header (Figure 4-2, Table 4-2) which is unique to the ULS Common Data Record.

Figure 4-1: ULS SFDU Primary and Secondary Header Format

	<u>Bits</u>			
Word	0	7	8	15
	16	23	24	31
1	Data Unit Specification		Start of Msg Pointer	
	Control Authority		System Class	2ndary Hdr ID
2	Message Data Unit Total Length			
	Originator ID		Last Modifier ID	
3	Major/Minor Data Class			
	Spacecraft Event Time			
4	(con't)			
	(con't)			
5	Earth Received Time			
	(con't)			
6	(con't)			
	User Dependent Type		Msn Mode	Qual Status
7	Mission ID		Spacecraft ID	
	Source ID		Format	
8	Tertiary Header ID		Number of Data Groups	
	Unused (0 fill)			
9	Spacecraft Clock			
	(con't)			
10	(con't)			

Table 4-1: ULS SFDU Primary and Secondary Header Description

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. 00011 = 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 = 42 ₁₆
2	24-31	Last Modifier ID Data Records System = 43 ₁₆

WORD	BITS	Description
3	0-15	Major/Minor Data Class <u>Major</u> <u>Minor</u> 5 - Experiment Data Record (EDR) 0 Spare 1 Gloeckler-Geiss Experiment (GLG) 2 Gruen Experiment (GRU) 3 Hedgecock Experiment (HED) 4 Hurley-Sommer Experiment (HUS) 5 Keppler Experiment (KEP) 6 Lanzerotti Experiment (LAN) 7 Simpson Experiment (SIM) 8 Stone Experiment (STO) 9 Engineering Data (enge) A Bame Ion Experiment B Bame Electron Experiment C Engineering Data (engs) 6 - Supplementary EDR (SEDR) 0 Predict 1 Final 2 Special 7 - Common Data File 0 Solar Wind Plasma (BAM) 1 Solar Wind Ion Composition (GLG) 2 Magnetic Field (HED) 3 Solar X-rays/Cosmic Gamma-ray Bursts (HUS) 4 Energetic Particles (KEP) 5 Low-energy Ions and Electrons (LAN) 6 Cosmic Ray and Solar Particles (SIM-LET) 7 Cosmic Ray and Solar Particles (SIM-HET) 8 Cosmic Ray and Solar Particles (SIM-KET) 9 Unified Radio/Plasma Wave (STO-VLF) A Unified Radio/Plasma Wave (STO-ELF) B Unified Radio/Plasma Wave (STO-FES) D 0 Ground Monitor 5-9 Records
3	16-31	Spacecraft Event Time (SCET) - Time of the first minor frame from which this record's prime data was extracted, elapsed seconds since Jan 1, 1950 (UTC).
4	0-15	

WORD	BITS	Description
4	16-31	Fraction of a second of SCET, binary point assumed to the left of bit 16.
5	0-31	Earth Received Time (ERT) - Time of Earth receipt of the first minor frame from which this record's prime data was extracted, elapsed seconds since Jan 1, 1950 (UTC).
6	0-15	Fraction of a second of ERT, binary point assumed to the left of bit 0.
6	16-23	User Dependent Type (UDT) code: 0B = DTM 1, Channel 1 07 = DTM 1, Channel 2 73 = DTM 2, Channel 1 08 = DTM 2, Channel 2 0C = DTM 3, Channel 1 09 = DTM 3, Channel 2 0D = DTM 4, Channel 1 0A = DTM 4, Channel 2 01 = DTM 5, Channel 1 02 = DTM 5, Channel 2 26 = DTM 6, Channel 1 27 = DTM 6, Channel 2
		<u>Mission Mode Flags</u> - Indicators for how data was generated for this record.
6	24	Spacecraft Realtime/Playback Data Flag - Indicates whether data was downlinked by the spacecraft in realtime or as a result of a tape recorder playback. 0 = Realtime data or not applicable 1 = Playback data
6	25	Real/Simulated Data Flag - Indicates whether data is real or stimulated. 0 = Real data 1 = Simulated data
6	26	System Test/MOS Flag - Indicates whether data is test or flight generated. 0 = Test complex generated 1 = Flight (MOS) generated

WORD	BITS	Description
6	27	Replay Flag - Indicates if record contains replay data. 0 = Initial acquisition or not applicable 1 = Replay data
		<u>Message Contents Quality Status</u> - Indicates gross quality of the data in the secondary and tertiary headers and/or in the data block.
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
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) (Flight Spacecraft) 41 ₁₆ (65 ₁₀) (Simulation/Test)

WORD	BITS	Description																																																												
7	16-23	<p>DSN Source Station - Indicates the DSN source station. (Controlled by document 820-13, module OPS-6-21).</p> <p>Permitted Value Interpretation</p> <table> <thead> <tr> <th><u>Hex</u></th> <th><u>Dec</u></th> <th></th> </tr> </thead> <tbody> <tr><td>55</td><td>85</td><td>DSS 05 (34-m STD, CTA-21)</td></tr> <tr><td>5B</td><td>91</td><td>DSS 06 (70-m, CTA-21)</td></tr> <tr><td>5F</td><td>95</td><td>DSS 07 (34-m HEF, CTA-21)</td></tr> <tr><td>BD</td><td>189</td><td>DSS 09 (34-m BWG, JPL Test Facility)</td></tr> <tr><td>81</td><td>129</td><td>DSS 12 (34-m STD, Goldstone)</td></tr> <tr><td>82</td><td>130</td><td>DSS 14 (70-m, Goldstone)</td></tr> <tr><td>83</td><td>131</td><td>DSS 15 (34-m HEF, Goldstone)</td></tr> <tr><td>C9</td><td>201</td><td>DSS 24 (34-m BWG, Goldstone, Subnet 1)</td></tr> <tr><td>CA</td><td>202</td><td>DSS 25 (34-m BWG, Goldstone, Subnet 2)</td></tr> <tr><td>CB</td><td>203</td><td>DSS 26 (34-m BWG, Goldstone, Subnet 3)</td></tr> <tr><td>E6</td><td>230</td><td>DSS 27 (34-m BWG, Goldstone, Subnet 1)</td></tr> <tr><td>E7</td><td>231</td><td>DSS 28 (34-m BWG, Goldstone, Subnet 2)</td></tr> <tr><td>9A</td><td>154</td><td>DSS 34 (34-m BWG, Tidbinbilla)</td></tr> <tr><td>92</td><td>146</td><td>DSS 42 (34-m STD, Tidbinbilla)</td></tr> <tr><td>93</td><td>147</td><td>DSS 43 (70-m, Tidbinbilla)</td></tr> <tr><td>94</td><td>148</td><td>DSS 45 (34-m HEF, Tidbinbilla)</td></tr> <tr><td>F3</td><td>243</td><td>DSS 61 (34-m STC, Robledo)</td></tr> <tr><td>F4</td><td>244</td><td>DSS 63 (70-m, Robledo)</td></tr> <tr><td>FD</td><td>253</td><td>DSS 65 (34-m HEF, Robledo)</td></tr> </tbody> </table>	<u>Hex</u>	<u>Dec</u>		55	85	DSS 05 (34-m STD, CTA-21)	5B	91	DSS 06 (70-m, CTA-21)	5F	95	DSS 07 (34-m HEF, CTA-21)	BD	189	DSS 09 (34-m BWG, JPL Test Facility)	81	129	DSS 12 (34-m STD, Goldstone)	82	130	DSS 14 (70-m, Goldstone)	83	131	DSS 15 (34-m HEF, Goldstone)	C9	201	DSS 24 (34-m BWG, Goldstone, Subnet 1)	CA	202	DSS 25 (34-m BWG, Goldstone, Subnet 2)	CB	203	DSS 26 (34-m BWG, Goldstone, Subnet 3)	E6	230	DSS 27 (34-m BWG, Goldstone, Subnet 1)	E7	231	DSS 28 (34-m BWG, Goldstone, Subnet 2)	9A	154	DSS 34 (34-m BWG, Tidbinbilla)	92	146	DSS 42 (34-m STD, Tidbinbilla)	93	147	DSS 43 (70-m, Tidbinbilla)	94	148	DSS 45 (34-m HEF, Tidbinbilla)	F3	243	DSS 61 (34-m STC, Robledo)	F4	244	DSS 63 (70-m, Robledo)	FD	253	DSS 65 (34-m HEF, Robledo)
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2	1:1 ratio																																																													
3	3:1 ratio																																																													
4	7:1 ratio																																																													
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 = 1																																																												
8	16-31	Unused (0 fill)																																																												
9	0-31	Spacecraft Clock Count (whole number counts with an implied binary point at the right).																																																												

WORD	BITS	Description
10	0-15	Spacecraft Clock Count (fractional part of count with an implied binary point at the left).

Figure 4-2: ULS SFDU Tertiary Header Format

Word	<u>Bits</u>	
	0	15 16 31
10		Spares
11	Instrument Data Quality Flags	Spares

Table 4-2: ULS SFDU Tertiary Header Description

Word	Bits	Description
10	16-31	Spares
11	0	Valid Record Flag - Indicates that the record contains valid data and the record will be output to the Common Data File. Binary 1 = good data.

Word	Bits	Description
11	1-7	<p>Bad Data Flags - Instrument specific single bit flags indicating anomalies in the data or no data. Categorized alphabetically by experiment, bits 1-7 flag the following conditions:</p> <p>BAM - bit 7 = 1 indicates calculated density = 0.</p> <p>GLG - bit 7 = 1 indicates calculated value = 0; refer to bits 13, 14, 15.</p> <p>KEP - bit 3 = 1 indicates no synch word. bit 4 = 1 indicates early synch word. bit 5 = 1 indicates ambiguous synch word. bit 6 = 1 indicates no valid sample. bit 7 = 1 indicates no spin data.</p> <p>LAN - bit 7 = 1 indicates that at least one field in the record received no data. Which field(s) are affected is defined by bits 10 - 15.</p> <p>SIM - HET: bit 7 = 1 indicates that the product of the parameters SPNS and Spin Period = 0. Parameters H2, H5 and H8 are therefore invalid due to /0 condition. KET: bit 7 = 1 indicates that at least one of bits 11-15 is set to 1. Refer to bits 11-15 for details. LET: Bit 7 = 1 indicates that one or more of bits 13, 14, or 15 is set to 1. Refer to bits 13, 14, or 15 for specifics.</p> <p>STO - FES: bit 1 = 1 indicates that there is no valid Fast Envelope Sampler (FES) status word. bit 2 = 1 indicates that a status discontinuity exists for FES. ELF bit 3 = 1 indicates values D, E, or F = 0, no ELF calculated. bit 4 thru 7 = 1 indicates that STO Extremely Low Frequency (ELF) fields 1 - 4, respectively, received no data. bit 8 not used. VLF bit 9 = 1 indicates fixed tune mode on.</p>

Word	Bits	Description
11	10-15	<p>Instrument Specific Data Anomaly Flags - defined as follows:</p> <p>GLG - bit 13 = 1 indicates that the alpha density = 0; /0 condition exists. bit 14 = 1 indicates velocity problem - value = 0. bit 15 = 1 indicates that the heavy ion flux = 0; /0 condition exists.</p> <p>LAN - bit 10 - 15 = 1 indicates that no data were received for the corresponding element in the field; viz. P2, P5, E2, E4, W3, and W5 respectively.</p> <p>SIM - KET: bit 11 = 1 indicates that Period reported by CPU1 = 0; used ONLY when rate = 128 bps. bit 12 = 1 indicates that Period reported by CPU2 = 0; used ONLY when rate = 128 bps. bit 13 = 1 indicates that Period = 0; E4 and E12 are invalid. bit 14 = 1 indicates that SR Buffer = 0; MEANSR and PERIOD are invalid. bit 15 = 1 indicates that Spin Count = 0; SRBUFF is invalid.</p> <p>LET: bit 13 = 1 indicates that the L3/L12 field is invalid. bit 14 = 1 indicates that the L24/L25 field is invalid. bit 15 = 1 indicates that the L28 field is invalid.</p> <p>STO - VLF: (Very Low Frequency) bits 10 AND 11 both = 1 indicates that R1 = 0. bits 12 AND 13 both = 1 indicates that R2 = 0. bits 14 AND 15 both = 1 indicates that R3 = 0.</p>
11	16-31	Spares

SECTION 5

5 CDF DATA RECORD FORMAT SPECIFICATIONS

5.1 Data Overview

The CDF generation software (CDFGEN) accepts experiment data in the form of EDR type records from the MDR file. Experiment data are processed through algorithms developed by Principal Investigators and output as individual science records. No synchronization between experiments is possible because of the wide variation in timing between the individual instruments; however, all records will be in SCET order within each CDF file.

Filler and spare bits in the CDF formats shall be binary zeroes unless otherwise noted.

The following subsections define CDF processing, record build-up, and the CDF data block formats for each instrument.

5.2 CDF Processing

CDFGEN shall provide processing of control parameters that govern the production of Common Data File records such as start/stop time, algorithms to be used, and data types to be included. CDFGEN shall then retrieve the appropriate records from the MDR file and present them one at a time to the individual CDF algorithms. When an algorithm has an output result from its processing, CDFGEN shall take the result and produce a record as defined in the following subsections. A copy of the summary information for a given period shall be provided to each Investigator along with the CDF tape.

5.2.1 Spacecraft Clocks and Counters

The on-board spacecraft clock (SCLK) is a 32-bit counter that increments once every two seconds. However, the SCLK is output in the telemetry only once ever 32 minor frames (1 major frame). Thus the relationship between data rate, number of minor frames (MF), time, and SCLK increment is as follows:

<u>Data Rate</u>	<u>#MF</u>	<u>#Seconds (N)</u>	<u>SCLK Incr</u>
1024 bps	32	32	16
512	32	64	32
256	32	128	64
128	32	256	128

In addition, word 63 in each minor frame contains an 8-bit counter that counts from 0-31 and is used to synchronize ground decommutation. Word 127 of each minor frame contains a 5-bit auxiliary MF counter counting from 0 to 31 and is used to identify major frame boundaries in real time as well as playback. These values are used by the Data Records System to insert a SCLK for each minor frame, if possible.

5.2.2 Extraction Procedure

Real time and playback data for each experiment are already merged in spacecraft event time order prior to their introduction to the CDF processors. Only one sampling rate has been defined for each experiment algorithm, independent of telemetry downlink rates. All processing shall be based upon spacecraft event time. CDFGEN shall be responsible for interpreting data presence indicators in the EDR records in order to detect missing frames of data.

5.3 File 1

The first CDF file contains data from the BAM, GLG, KEP, LAN, SIM, and STO experiments.

Each CDF File 1 record shall contain standard SFDU primary and secondary headers and an instrument unique science data block reflecting the instrument record structure as illustrated in Figure 5-1. A block of 16 filler bits is included at the end of the tertiary header in order to align the data along full 32-bit word boundaries.



Figure 5-1: Ulysses CDF File 1 Format

5.3.1 Bame (BAM) Experiment

The BAM CDF science record is designed to produce one set of parameters every 4.266 minutes at any telemetry bit rate. The logical structure is shown in Figure 5-2.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: BAM CDF record buildup will proceed following extraction of the appropriate BAM bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure. Although the Bame instrument produces two types of EDR records, only the BAM-I ion instrument EDRs are used in the generation of BAM common data records.

Record Header: The BAM record shall receive a standard SFDU header as described in Section 4.

Data Block: The BAM data block contains BAM parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-2.

Word	Bits	Description	Units	Rep
1	0-31	V(x) = Plasma velocity in x-direction	Km/sec	Float
2	0-31	V(y) = Plasma velocity in y-direction	Km/sec	Float
3	0-31	V(z) = Plasma velocity in z-direction	Km/sec	Float
4	0-31	N(sw) = Solar wind plasma density	cm ⁻³	Float
5	0-31	T = Plasma temperature	deg _K	Float

Figure 5-2: BAM CDF Data Block Format

5.3.2 Gloeckler-Geiss (GLG) Experiment

The GLG CDF science record is designed to produce one set of parameters every cycle. The time in minutes, to complete a cycle at a telemetry bit rate, is given in the following table.

Rate	Cycle Time
128 bits/second	52 minutes
256	26
512	13
1024	13

The logical structure is shown in Figure 5-3.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: GLG CDF record buildup will proceed following extraction of the appropriate GLG bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The GLG record shall receive a standard SFDU header as described in Section 4.

Data Block: The GLG data block contains GLG parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-3.

Word	Bits	Description	Units	Rep
1	0-31	$N(\alpha)$ = Alpha particle density	cm^{-3}	Float
2	0-31	$V(\alpha)$ = Alpha particle velocity	km/sec	Float
3	0-31	$J(Z)$ = Heavy ion flux, $Z > 2$	$\text{cm}^{-2}\text{sec}^{-1}$	Float

Figure 5-3: GLG CDF Data Block Format

5.3.3 Keppler (KEP) Experiment

The KEP CDF science record is designed to produce one set of parameters every 17.066 minutes at any telemetry bit rate. The logical structure is shown in Figure 5-4.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: KEP CDF record buildup will proceed following extraction of the appropriate KEP bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The KEP record shall receive a standard SFDU header as described in Section 4.

Data Block: The KEP data block contains KEP parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-4.

Word	Bits	Description	Units	Rep
1	0-31	OP Flux = Counts over 2 spin periods	$\frac{\text{Particles}}{\text{cm}^2 \text{ sec ster}}$	Float

Figure 5-4: KEP CDF Data Block Format

5.3.4 Lanzerotti (LAN) Experiment

The LAN CDF science record is designed to produce one set of parameters every 8.533 minutes at any telemetry bit rate. The logical structure is shown in Figure 5-5.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: LAN CDF record buildup will proceed following extraction of the appropriate LAN bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The LAN record shall receive a standard SFDU header as described in Section 4.

Data Block: The LAN data block contains LAN parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-5.

Word	Bits	Description	Units	Rep
1	0-31	P2' = Ion flux (0.077-0.127 MeV)	Flux	Float
2	0-31	P5' = Ion flux (0.366-0.601 MeV)	Flux	Float
3	0-31	DE2 = Electron flux (0.053-0.103 MeV)	Flux	Float
4	0-31	DE4 = Electron flux (0.175-0.315 MeV)	Flux	Float
5	0-31	W3 = Heavy ions (0.389-1.278 MeV/nuc)	Flux/nuc	Float
6	0-31	W5 = Heavy ions (0.465-1.709 MeV/nuc)	Flux/nuc	Float

(Flux = $1/(\text{cm}^2 \text{ sec ster MeV})$)

Figure 5-5: LAN CDF Data Block Format

5.3.5 Simpson (SIM) Experiment

The SIM CDF science record is designed to produce three sets of parameters every 17.066 minutes at any telemetry bit rate. The logical structure is shown in Figure 5-6.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: SIM CDF record buildup will proceed following extraction of the appropriate SIM bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The SIM record shall receive a standard SFDU header as described in Section 4. The SIM record shall also receive a tertiary header as shown in Figure 5-9.

Data Block: The SIM data block contains SIM parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-6.

LET

Word	Bits	Description	Units	Rep
1	0-31	L3+L12 = Proton rate (1.8-8 MeV)	counts/sec	Float
2	0-31	L24+L25 = Alpha rate (4.0-19 MeV/n)	counts/sec	Float
3	0-31	L28 = CNO rate (2.6-7.1 MeV/n)	counts/sec	Float

HET

Word	Bits	Description	Units	Rep
1	0-31	H2 = Proton flux (12-18 MeV)	counts/sec	Float
2	0-31	H5 = Proton flux (68-92 MeV)	counts/sec	Float
3	0-31	H8 = Electron flux (3-5 MeV)	counts/sec	Float

KET

Word	Bits	Description	Units	Rep
1	0-31	E4 = Electron flux (4-12 MeV)	counts/sec	Float
2	0-31	E12 = Electron flux (12-399 MeV)	counts/sec	Float
3	0-31	SCLK = Spacecraft Clock Counts	counts	Int

Word	Bits	Description	Units	Rep
4	0-15	Fractional SCLK Count	counts	Int
4	16-31	Fill	fill	Int
5	0-11	KET status word	flags	Int
5	12-15	Fill	fill	Int
5	16-23	QFLAG = Questionable Data Flag	flags	Int
5	24-31	SFLAG = Varying Status Flag	flags	Int

Figure 5-6: SIM CDF Data Block Format

5.3.6 Stone (STO) Experiment

The STO CDF science record is designed to produce one set of parameters every 4 minutes 16 seconds at any telemetry bit rate. The logical structure is shown in Figure 5-7.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: STO CDF record buildup will proceed following extraction of the appropriate STO bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The STO record shall receive a standard SFDU header as described in Section 4.

Data Block: The STO data block contains STO parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-7.

Word	Bits	Description	Units	Rep
1	0-31	Start time of the data window	Julian second	Float
2	0-31	ELF Average Power (10-100 Hz)	V ² M ⁻²	Float
3	0-31	ELF Peak Power (10-100 Hz)	V ² M ⁻²	Float
4	0-31	ELF Average Power (100-500 Hz)	V ² M ⁻²	Float
5	0-31	ELF Peak Power (100-500 Hz)	V ² M ⁻²	Float
6	0-31	VLF Average Power (0.5-2 kHz)	V ² M ⁻²	Float
7	0-31	VLF Peak Power (0.5-2 kHz)	V ² M ⁻²	Float
8	0-31	VLF Average Power (2-8 kHz)	V ² M ⁻²	Float
9	0-31	VLF Peak Power (2-8 kHz)	V ² M ⁻²	Float
10	0-31	VLF Average Power (8-32 kHz)	V ² M ⁻²	Float
11	0-31	VLF Peak Power (8-32 kHz)	V ² M ⁻²	Float
12	0-31	FES Upper Band	db	Int
13	0-31	FES Lower Band	db	Int
14	0-7	FES Status	flags	Int
14	8-31	Spare	fill	Int

Figure 5-7: STO CDF Data Block Format

5.4 File 2

The second file contains data from the HED experiment.

Each CDF File 2 record shall contain a header and a series of instrument data records as depicted in the instrument record structure as illustrated in Figure 5-8. This file is an ASCII tape with a maximum block size of 10000 bytes and a record size of 47 bytes.

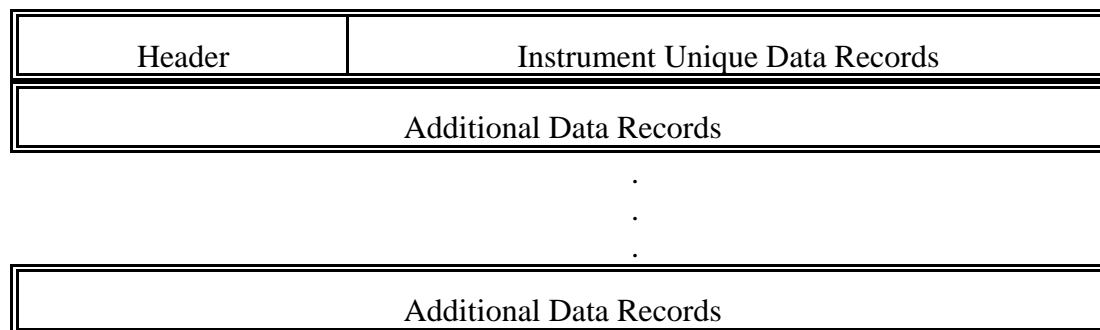


Figure 5-8: Ulysses CDF File 2 Format

5.4.1 Hedgecock (HED) Experiment

The HED CDF science record is designed to produce one set of parameters every 4.266 minutes at any telemetry bit rate. The logical structure is shown in Figure 5-8.

Processing Start/Stop: Refer to Section 5.2.

Record Buildup: HED CDF record buildup will proceed following extraction of the appropriate HED bits and processing through the PI-provided algorithms. Section 5.2 defines the basic data extraction procedure.

Record Header: The header contains the initial time, final time, and the number of 47-byte time/vector entities in the file.

Bytes	Description	Units	Rep
0-15	Time of first record in file	sec p50	ASCII
16	Blank separator		ASCII

Bytes	Description	Units	Rep
17-32 0	Time of last record in file	sec p50	ASCII
33	Blank separator		ASCII
34-38	Count of time/vector entities in file	count	ASCII
39-46	Blank fill		ASCII

Figure 5-9: HED Header Format

Data Block: The HED data block contains HED parameters calculated from the raw telemetry data. The order of word locations is given in Figure 5-10.

Bytes	Description	Units	Rep
0-15	Time of this record	sec p50	ASCII
16	Blank separator		ASCII
17-25	X component	nT	ASCII
26	Blank separator		ASCII
27-35	Y component	nT	ASCII
36	Blank separator		ASCII
37-45	Z component	nT	ASCII
46	Blank fill		ASCII

Figure 5-10: HED CDF Data Record Format

- Notes:
1. Time, in real seconds from 1 January 1950 is expressed as xxxxxxxxxxxxxx.xxx
 2. X, Y, and Z vector components are expressed as ±xxx.xxx
 3. Counts are expressed as xxxxx

5.5 Non-participants

The GRU, HUS, GWE, and SCE experiments currently do not generate CDF records.

APPENDIX A List of Acronyms and Abbreviations

ATP	Acceptance Test Plan
BPI	Bits per inch
CE	Cognizant Engineer
CDF	Common Data File
CP	Cognizant Programmer
DEC	Declination
deg	Degrees
DMT	Data Management Team
DOY	Day of Year
DPTRAJ	Double Precision Trajectory program
DRS	Data Records System
DSI	Data System Integration
E	Floating Point Quantity
EDR	Experiment Data Records
ELF	Extremely Low Frequency
EME50	Earth Mean Equator and Equinox of 1950.0
ERT	Earth Received Time
ESOC	European Space Operations Centre
ET	Ephemeris Time
FES	Fast Envelope Sampler

HET	High Energy Telescope
HEX	Hexadecimal Number
HHMMSS	Hours-Minutes-Seconds
I	Integer Quantity
ID	Identification
IPC	Information Processing Center, JPL
IRG	Inter-record Gap
ISPM	International Solar Polar Mission (former project name)
JPL	Jet Propulsion Laboratory
KET	Kiel Electron Telescope
km	Kilometers
km/sec	Kilometers Per Second
LET	Low Energy Telescope
MOS	Mission Operations System
N/A	Not Applicable
NAV	Navigation System or Team
P-FILE	Probe Ephemeris File
PI	Principal Investigator
RA	Right Ascension
RJE	IPC Remote Job Entry (site)
S/C	Spacecraft
SCET	Spacecraft Event Time

SCLK	Spacecraft Clock (count)
SECP50	Seconds past January 1, 1950
SFDU	Standard Formatted Data Unit (headers)
SIS	Software Interface Specification
SRD	Software Requirements Document
TBD	To Be Determined
TBS	To Be Supplied
UG	User's Guide
ULS	Ulysses (new project name)
UTC	Universal Time, coordinated