HIRDLS

SW-HIR-2000

Originator: Charles Cavanaugh

Date: 10 Dec. 2012

Subject/Title: **The Requirements of the HIRDLS Level 0 – Level 1 Processor**

Description/Summary/Contents:

The purpose of this document is to capture the requirements of the High Resolution Dynamics Limb Sounder (HIRDLS) Level 0 to Level 1 Processing System, and correctly and comprehensively catalog those requirements in an unambiguous form.

The goal of this document is to detail those requirements at a level that allows system architectural analysis to create a blueprint for construction.

Keywords:

Purpose of this Document:

Oxford University
Atmospheric, Oceanic &
Planetary Physics
Parks Road
OXFORD OXI 3PU
United Kingdom

University of Colorado, Boulder Center
for Limb Atmospheric Sounding
3450 Mitchell Lane, Bldg. FL-0
Boulder, CO 80301

EOS

The Requirements of the HIRDLS Level 0 – Level 1 Processor

Charles Cavanaugh

Table of Contents

Table of Contents i
List of Figures and Tables. ii

Section 1 Document Purpose and Goal 1
Section 2 Functionality of the System 1
Section 3 External Interfaces 1
Section 4 Constraints 1
Section 5 Interaction 1
Section 6 Overview 1
Section 7 Input 2
Section 8 Output 2
Section 9 Algorithms 2

List of Figures and Tables

Figure 1 L1 Processor Overview 2

Table 1 HIRDLS1 File Structure and Contents 3
Table 2 Flags Field Description 5

1 Document Purpose and Goal

The purpose of this document is to capture the requirements of the High Resolution Dynamics Limb Sounder (HIRDLS) Level 0 to Level 1 Processing System, and correctly and comprehensively catalog those requirements in an unambiguous form. The goal of this document is to detail those requirements at a level that allows system architectural analysis to create a blueprint for construction.

2 Functionality of the System

The HIRDLS Level 0 (L0) to Level 1 (L1) Processing System, hereby known as the L1 Processor, is to ingest HIRDLS L0 Production Data Set (PDS) binary files (known as HIR0SCI files), geo-locate and calibrate the data within those files, and create a HIRDLS L1 Hierarchical Data Format (HDF) file that contains the geo-located and calibrated data, as well as other ancillary data needed in subsequent processors. Those subsequent processors, when combined with the L1 Processor and any preceding processor(s), form a Product Generation Executive (PGE) that creates the required HIRDLS standard data products. The L1 Processor creates a standard data product known as the HIRDLS1 file, and the details of that file will be enumerated later in this document.

3 External Interfaces

The L1 Processor is to interact with the EOSDIS Core System (ECS) Project Science Data Production (SDP) Toolkit to perform certain required tasks, including time conversion, L0 file access and data geo-location. The SDP Toolkit is a suite of functions, written in the C language, with C language primitives and Toolkit-specific data types as arguments in their contracts. The Toolkit is provided as a dynamic-link UNIX-specific library. For further information on the Toolkit, please see the ECS document 333-CD-004-001, Release B.0 SCF Toolkit Users Guide for the ECS Project.

The L1 Processor is also to interact with the HIRDLS Science Investigator-Led Processing System (SIPS). The SIPS creates the environment for the L1 Processor to run, invokes the L1 Processor, and also post-processes the L1 Processor output. The SIPS was created to be a mini-EDOS (EOS Data and Operations System), and because of that, certain conventions must be followed, including using a Process Control File (PCF) to envelope all processor systems run in SIPS, including the L1 Processor. Other interactions with SIPS are negotiable with the SIPS team, including ancillary data ingestion by processors, post-processing status handling, and hardware requirements.

4 Constraints

Certain constraints (HDF file generation, interacting with a C-written library) have already been introduced, but beyond those, the only constraint is hardware-oriented, which are ever-changing, as CPUs get faster (and more plentiful) and memory gets cheaper, and therefore those constraints are to be negotiated with the SIPS team and the HIRDLS Project Manager.

5 Interaction

There need be no graphical interface to the L1 Processor, nor does there need to be interaction during the execution of the L1 Processor. The system is considered to be a stand-alone, non-embedded scientific application, capable of running in the environment and on the platform chosen via negotiation with the HIRDLS Program Manager.

6 Overview

Given the information in the preceding sections, a visual overview of the system is as follows in Figure 1. SIPS and SDP Toolkit have been introduced in Section 3, and any further discussion of these is beyond the scope of this document. The input HIR0SCI File(s) and the output HIRDLS1 File, while introduced in Section 2, will be discussed in further sections.

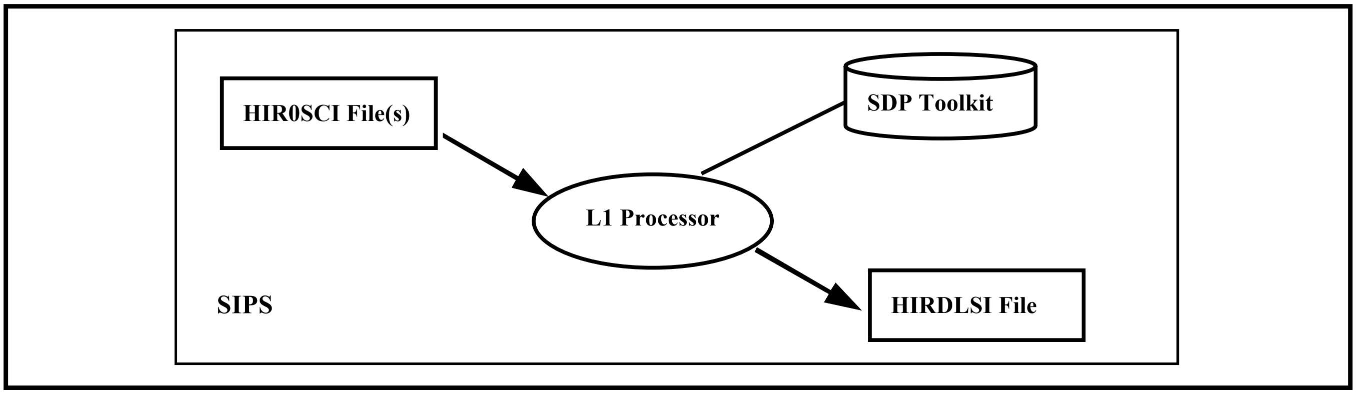

Figure 1 L1 Processor Overview

7 Input

As first noted in Section 2, the L1 Processor takes one or more HIR0SCI files as input. The exact structure of these binary input files is beyond the scope of this document, and can be found in HIRDLS document SW-LOC-113B, Section 4.5. Though the structure of the HIR0SCI file might change, the content will not. Each packet of HIRDLS data represents a Minor Frame of data (or 96 milliseconds of data, or 8x Science Rate, depending on your view). The entire Minor Frame of data should be saved, in whatever data format is appropriate. These Minor Frames are stacked serially, and represent a time series of HIRDLS (and appropriate spacecraft) data, and therefore the L1 Processor must retain the data in its original series, or at least the knowledge of its original series, and the output HIRDLS1 HDF file must store the data in its original series.

Also input to the L1 Processor is various files that contain information to: 1) decode the housekeeping block data; 2) characterize the radiance out-of-field effect; and 3) describe the metadata content necessary for delivery to EDOS. These files are considered part of the L1 Processor, and are to be included in its deliveries. The format and content of these files is negotiable with the HIRDLS hardware team (in the case of 1 and 2), and with the HIRDLS Program Manager and EDOS Liaison (in the case of 3). As the L1 Processor progresses through development, this list of system input files could grow or shrink.

8 Output

As first noted in Section 2, the L1 Processor generates one HIRDLS1 file as output. This file's content and structure are enumerated in Table 1. The format of the file is to be HDF & HDF-EOS (Earth Observing System). The data in the file ancillary to the HIRDLS data (and required by EDOS) is to be determined by HIRDLS' EDOS Data System Working Group representative. The extent of the data in the HIRDLS1 file is to span not more than one day's worth of HIRDLS data.

9 Algorithms

The form of the output HIRDLS1 file is different than that of the input HIR0SCI file(s), and therefore much of the data from the input file(s) will undergo at least one transformation as it passes through the system. Also, some input data will be combined to derive new output data. Any enumeration of these algorithms is beyond the scope of this document, but will be introduced in the HIRDLS L1 Processor Architecture document.

Field Name	*Rate*	*Form*	*Mbytes*	*Units*	*Description*
Altitude	Rev	I 32	28.800	Meters	Altitude of the reference point for the boresight
Altitude ChXX Offset *<XX denotes values 01 to 21, inclusive>*	Rev	I 16	14.400 * 21	Meters	Channel center vertical offset from Altitude
Azimuth Housing Temperature	Maf	F 32	.450	K	(AZ_HSG_TMP_1 + AZ_HSG_TMP_2) / 2
Azimuth LOS Angle	Rev	I 16	14.400	.00005 Radians	Line-of-sight azimuth angle of the boresight
Azimuth Shaft Angle	Rev	F 32	28.800	Degrees	Shaft azimuth angle of the boresight
Cal Mirror 01 Temperature	Maf	F 32	.450	K	CALMIR_TMP1
Cal Mirror 03 Temperature	Maf	F 32	.450	K	CALMIR_TMP3
Chopper Housing Temperature	Maf	F 32	.450	K	CHOP_HSG_TMP3
Chopper Period	Maf	I 16	.225	Micro-seconds	10^6 / CHOP_FREQ
Elevation LOS Angle	Rev	I 32	28.800	Nano-radians	Line-of-sight elevation angle of the boresight
Elevation Shaft Angle	Rev	F 32	28.800	Degrees	Shaft elevation angle of the boresight
Field Rotation	Rev	I 16	14.400	.0001 Degrees	Detector array rotation about the boresight
Flags	Rev	I 32	28.800	n/a	*< see Table 2 >*
Focal Plane A Temperature	Maf	F 32	.450	K	FPA_TMP_A
Focal Plane B Temperature	Maf	F 32	.450	K	FPA_TMP_B
Frame Counter	Maf	I 16	.225	n/a	Minor frame (Mif) counter
IFC Front Plate Temperature	Maf	F 32	.450	K	IFCBB_FRPL_TMP
Latitude	Rev	F 32	28.800	Degrees N	Latitude of the reference point
Lens Housing Temperature	Maf	F 32	.450	K	(LNSASSY_TMP1 + LNSASSY_TMP2) / 2
Lens2 Temperature	Maf	F 32	.450	K	LNS2_TMP3
Local Solar Time	Rev	F 32	28.800	Seconds	Local solar time at the reference point
Longitude	Rev	F 32	28.800	Degrees E	Longitude of the reference point
Mirror1 Temperature	Maf	F 32	.450	K	M1_TMP3
Mirror2 Temperature	Maf	F 32	.450	K	M2_TMP2
Nearest ECI Ray Point	Rev {3}	I 32	86.400	Meters	Ray point ECI coordinates closest to surface
Nearest ECI Surface Point	Rev {3}	I 32	86.400	Meters	Surface point ECI coordinates closest to ray
Optical Bench 02 Temperature	Maf	F 32	.450	K	OBA_TMP_02
Optical Bench 06 Temperature	Maf	F 32	.450	K	OBA_TMP_06
Optical Bench 07 Temperature	Maf	F 32	.450	K	OBA_TMP_07
Optical Bench Plate Temperature	Maf	F 32	.450	K	OBA_PLT_TMP
Orbit Number	Mif	I 32	3.600	n/a	Aura orbit number
Orbit Position	Maf	I 16	.225	Mafs	SAIL_SHM_256
Radiance Scale Factors	Day {21}	F 32	.000	n/a	Scale factor for radiance and radiance error fields
Radiance Scale Offsets	Day {21}	F 32	.000	$W/m^2/sr$	Scale offset for radiance fields

Table 1 HIRDLS1 File Structure and Contents

Field Name	*Rate*	*Form*	*Mbytes*	*Units*	*Description*
Radiometric Gain	Day {21}	F 32	.000	$W/m^2/sr/$ counts	Radiometric gain used to calibrate radiances
Radiometric Offset	Maf {21}	F 32	9.450	Counts	Radiometric offset used to calibrate radiances
Scaled ChXX Radiance *<XX denotes values 01 to 21, inclusive>*	Rev	I 16	14.400 * 21	$W/m^2/sr$	Calibrated radiances, scaled
Scaled ChXX Radiance Error *<XX denotes values 01 to 21, inclusive>*	Mif	I 16	1.800 * 21	$W/m^2/sr$	Error in calibrated radiances, scaled
Scan Mirror Index	Maf	I 16	.225	n/a	TSW_CTL_INDEX
Scan Mirror Temperature	Maf	F 32	.450	K	SM_TMP3
Scan Mode Identifier	Maf	I 32	.450	n/a	SAIL_SHM_264
Scan Number	Rev	I 16	14.400	n/a	Scan since beginning of day
Scan Table	Maf	I 16	.225	n/a	Scan table number
SMA Mount Ring Temperature	Maf	F 32	.450	K	SMA_MTRING_TMP
Solar Azimuth Angle	Maf	I 16	.225	.01 Degrees	Solar azimuth angle at reference point
Solar Beta Angle	Day	F 32	.000	Degrees	Solar beta angle
Solar Zenith Angle	Maf	I 16	.225	.01 Degrees	Solar zenith angle at reference point
Space Mirror Temperature	Maf	F 32	.450	K	SPVUMIR_TMP3
Spacecraft Altitude	Rev	I 32	28.800	Meters	Altitude of the spacecraft
Spacecraft ECI Position	Rev {3}	I 32	86.400	Meters	Spacecraft position, in ECI coordinates
Spacecraft ECR Position	Maf {3}	I 32	1.350	Meters	Spacecraft position, in ECR coordinates
Spacecraft Latitude	Rev	F 32	28.800	Degrees N	Latitude of the sub-satellite point
Spacecraft Longitude	Rev	F 32	28.800	Degrees E	Longitude of the sub-satellite point
Spacecraft Solar Elevation Angle	Rev	F 32	28.800	Degrees	Solar elevation angle at spacecraft
Sun Sensor 1 Temperature	Maf	F 32	.450	K	SUNSEN1_TMP
Sun Sensor 2 Temperature	Maf	F 32	.450	K	SUNSEN2_TMP
Sun Sensor 3 Temperature	Maf	F 32	.450	K	SUNSEN3_TMP
Sunshield +Z Surface Temperature	Maf	F 32	.450	K	SSH_PZSURF_TMP
Sunshield –Z Surface Temperature	Maf	F 32	.450	K	SSH_NZSURF_TMP
Sunshield Aperture Plate Temperature	Maf	F 32	.450	K	SSH_APL_TMP
Sunshield Door Angle	Maf	F 32	.450	Degrees	DOOR_POT
Sunshield Door Motor Temperature	Maf	F 32	.450	K	SSH_DORMOT_TMP
Sunshield Door Temperature	Maf	F 32	.450	K	SSH_DOOR_TMP
Sunshield Hot-Wax Actuator Temperature	Maf	F 32	.450	K	SSH_HWA_TMP
Time	Rev	F 64	57.600	Seconds	TAI93 time stamp
View Direction	Maf	I 16	.225	.01 Degrees	Boresight bearing at reference point

Table 1 HIRDLS1 File Structure and Contents (cont.)

Notes on Table 1:

The Rate field describes the data rate of the field. "Rev" means the data is stored at the chopper rev rate, which is one data point every 12 milliseconds (or at 83.3 Hz). "Mif" means the data is stored at the minor frame rate, which is one data point every 96 milliseconds (or every 8 chopper revs, or at 10.4 Hz). "Maf" means the data is stored at the major frame rate, which is one data point every 768 milliseconds (or every 8 minor frames, or every 64 chopper revs, or at 1.3 Hz).

The Form field describes the IEEE format of the data. "F" means floating point, and "I" means integer (or fixed point). The number after either of these letters is the bit width.

Bit	*Description*	*Values*
0	Not Part of Nominal Atmospheric Scan	0 – No; 1 - Yes
1	Channel 1 Radiances Unusable	0 – No; 1 - Yes
2	Channel 2 Radiances Unusable	0 – No; 1 - Yes
3	Channel 3 Radiances Unusable	0 – No; 1 - Yes
4	Channel 4 Radiances Unusable	0 – No; 1 - Yes
5	Channel 5 Radiances Unusable	0 – No; 1 - Yes
6	Channel 6 Radiances Unusable	0 – No; 1 - Yes
7	Channel 7 Radiances Unusable	0 – No; 1 - Yes
8	Channel 8 Radiances Unusable	0 – No; 1 - Yes
9	Channel 9 Radiances Unusable	0 – No; 1 - Yes
10	Channel 10 Radiances Unusable	0 – No; 1 - Yes
11	Channel 11 Radiances Unusable	0 – No; 1 - Yes
12	Channel 12 Radiances Unusable	0 – No; 1 - Yes
13	Channel 13 Radiances Unusable	0 – No; 1 - Yes
14	Channel 14 Radiances Unusable	0 – No; 1 - Yes
15	Channel 15 Radiances Unusable	0 – No; 1 - Yes
16	Channel 16 Radiances Unusable	0 – No; 1 - Yes
17	Channel 17 Radiances Unusable	0 – No; 1 - Yes
18	Channel 18 Radiances Unusable	0 – No; 1 - Yes
19	Channel 19 Radiances Unusable	0 – No; 1 - Yes
20	Channel 20 Radiances Unusable	0 – No; 1 - Yes
21	Channel 21 Radiances Unusable	0 – No; 1 - Yes
22	Spacecraft in Earth's Shadow	0 – No; 1 - Yes
23	Celestial Body in FOV	0 – No; 1 - Yes
24	Nominal Science Scan Mode	0 – No; 1 - Yes
25	Part of Kapton Scan	0 – No; 1 - Yes
26	*< not used>*	0 – No; 1 - Yes
27	*< not used >*	0 – No; 1 - Yes
28	Scanning Left (Decreasing Azimuth Angle)	0 – No; 1 - Yes
29	Scanning Right (Increasing Azimuth Angle)	0 – No; 1 - Yes
30	Scanning Up (Decreasing Elevation Angle)	0 – No; 1 - Yes
31	Scanning Down (Increasing Elevation Angle)	0 – No; 1 - Yes

Table 2 Flags Field Description