

KAGUYA (SELENE)

Product Format Description

- Relay SATellite (RSAT)/

VLBI RADio source (VRAD) -

Version 1.0

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1. Introduction

1.1 Purpose

This document describes the format*2 used for the catalog and product files for the Relay SATellite^{□1} (RSAT) and the VLBI RADio source *1 (VRAD) that was board KAGUYA(SELENE). These files provided by Japan Aerospace Exploration Agency (JAXA).

*1 :Refer to the following “Project Homepage of KAGUYA” and “Image Gallery of KAGUYA” used for the RSAT/VRAD mission.

- ✓ Project Homepage for KAGUYA
http://www.kaguya.jaxa.jp/en/equipment/rsat_e.htm
- ✓ Image Gallery for KAGUYA
RSAT
http://wms.selene.darts.isas.jaxa.jp/selene_viewer/en/observation_mission/rsat/
- VRAD
http://wms.selene.darts.isas.jaxa.jp/selene_viewer/en/observation_mission/vrad/

*2 : The data format used for SELENE was based on the PDS (Planetary Data System) by NASA. However, the data format was not fully compliant with the PDS format.

1.2 The composition of this format description

Table 1-1 shows the composition of this format description

Table 1-1 the composition of this format description

No .	INDEX	Title	Description content
1	Section 1.3	Table 1-2 RV Products List	The name of the product, the object form, and the composition of the product are described as a product list illustrated by this description.
		Table 1-3 Product Description	Concerning each product shown in the No1 product list, the content included in data and the description of the observation method are illustrated.
2	Chapter X	“ Product Name”	Concerning the product shown in the No1 product list, rules used for file naming, label format, data object format and catalog information file format are described.
3	Section X.1	Rules used for File naming	Concerning the product shown in No2, the rules of file nomenclature is described.
4	Section X.2	Label Format	Concerning the product shown in No2, the label format is described.
5	Section X.3	Data Object Format	Concerning the product shown in No2, the data format of the data object is described. (The extension of the data file is unique in each product. Therefore, refer to the file nomenclature in No3.)
6	Section X.4	Catalog Information File Format	Concerning the product shown in No2, the format of the catalog information file (extension: .ctg) of the product is described.
7	Chapter X+1		
		Same as above	

1.3 Data Set

The Data Set refers to a set consisting of: Product, Catalog Information, and Thumbnail Image (JPEG format), which are tar-archived. This set is referred to as the “L2 Data Set”. The file extension is “SL2”. However, the thumbnail image may be omitted at the by composer’s judgment.

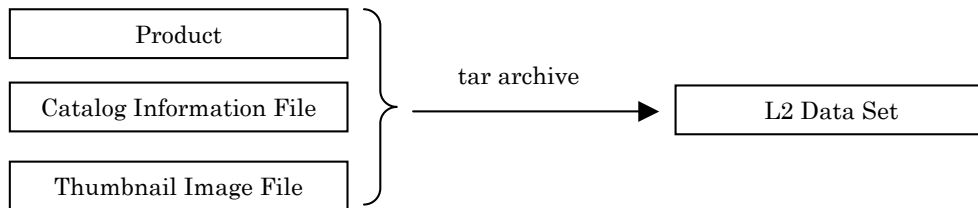


Figure 1-1 composition of the L2 Data Set

1.3.1 Product

For product composition, two possible options are available. Product Composition – Attached consists of label information and data information in a single data file. Product Composition – detached consists of separate files for the label file and data file.

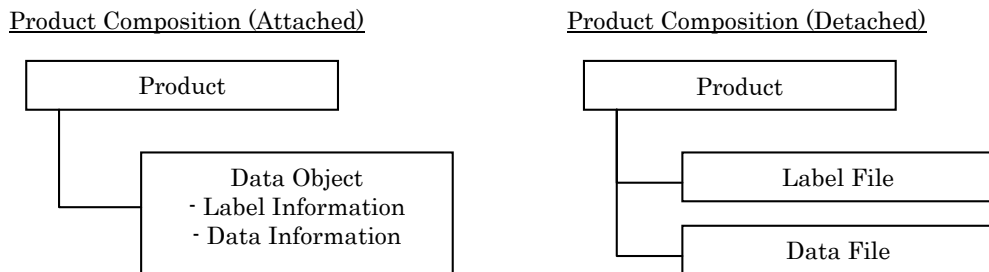


Figure 1-2 Product Composition : Attached and Detached

- (1) Label File (Data Object (Label Information))
The Label File (Label Information) is storing as text format the information that identifies the Data File (Data Information).

- (2) Data File (Data Object (Data Information))
The data File (Data Object (Data Information)) of the product are classified into the following four data types.

- a) **IMAGE** : image data
An **IMAGE** is a two-dimensional array of values, all of the same type, each of which is referred to as a sample. **IMAGE** are normally processed with special display tools to produce a visual representation of the samples by assigning brightness levels or display colors to the values. An **IMAGE** consists of a series of lines, each containing the same number of samples.
*Refer to the PDS Standard Reference V3.8 Appendix A.20 "IMAGE".

- b) **TABLE** : tabular form data
TABLEs are a natural storage format for collections of data from many instruments. The **TABLE** is a uniform collection of rows containing ASCII or binary values stored in columns.
*Refer to the PDS Standard Reference V3.8 Appendix A.29 "TABLE".

- c) **SERIES** : time series data
The **SERIES** is a sub-class of the **TABLE**. It is used for storing a sequence of measurements organized in a specific way. The sampling parameter keywords in the **SERIES** represent the variation between the **ROWS** of data.
*Refer to the PDS Standard Reference V3.8 Appendix A.24 "SERIES"

- d) **TEXT** : text data
The **TEXT** describes a file which contains plain text.
*Refer to the PDS Standard Reference V3.8 Appendix A.30 "TEXT".

1.3.2 Catalog Information File

Catalog Information File is the information file attached to explain the general of the product and is used to search for the product from L2DB subsystem.

1.3.3 Thumbnail Image File

Thumbnail Image File is the reduced image of the data object, and is the JPEG format image. However, the thumbnail image may be omitted at the by composer's judgment.

1.4 RSAT/VRAD Products

The list of RSAT/VRAD products, which this document describes, is shown in Table 1-2. In addition, the description for each product is shown in Table 1-3.

Table 1-2 RSAT/VRAD Product List

Level*1	Product Name	Product ID	Object Type	Product Format*2	
RSAT	Higher Level	Spherical Harmonic Coefficients of Lunar Gravity Model 1 - 11	RISE_GRAVcoef_1-11	TABLE	D
	Higher Level	Covariance Matrix of Lunar Gravity Model 1 - 11	RISE_GRAVcov_1-11	TABLE	D
	Higher Level	Gravity Field Map 1 - 11	RISE_GRAVmap_1-11	IMAGE	A
	Higher Level	Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model 1 - 11	RISE_GRAVpower_1-11	TEXT	D
	Higher Level	Main Orbiter Trajectory 1 - 11	RISE_TRAJ_MAIN_1-11	SERIES	D
	Higher Level	Rstar Trajectory 1 - 11	RISE_TRAJ_RSTAR_1-11	SERIES	D
VRAD	Higher Level	Doubly differenced 1-way range by differential VLBI	RISE_VRADd	SERIES	D
	Higher Level	Vstar Trajectory 1 - 11	RISE_TRAJ_VSTAR_1-11	SERIES	D

□ : Map product

*1 :Data obtained by equipments is not clear as it is, therefore various processings and correction treatment are necessary by the ground system. According to the difference in the process of processing and correction treatment, they can be classified to the standard processing and higher-level processing. The higher-level processing refers to the standard processing data to which various processing and correction treatment are conducted according to the research purpose et cetra.

*2 Product Format : A - Attached, D - Detached

Table 1-3 Product Description

Product Name	Descriptions	
RSAT	Spherical Harmonic Coefficients of Lunar Gravity Model 1 - 11	Spherical Harmonic Coefficients of the estimated lunar gravity model 1 - 11 (Maximum degrees and orders : 100)
	Covariance Matrix of Lunar Gravity Model 1 - 11	Covariance matrix of the estimated lunar gravity model 1-11
	Gravity Field Map 1 - 11	the estimated lunar gravity field map of the estimated lunar gravity model 1 - 11
	Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model 1 - 11	Power Spectrum of Spherical Harmonic Coefficients of the estimated lunar Gravity Model 1 - 11
	Main Orbiter Trajectory 1 - 11	Trajectory of Main Orbiter using the estimated lunar gravity model 1 - 11
	Rstar Trajectory 1 - 11	Trajectory of the Relay Satellite (Rstar) using the estimated lunar gravity model 1 - 11
VRAD	Doubly differenced 1-way range by differential VLBI	Doubly differenced 1-way range by differential VLBI. Time intervals of same-beam and switching observations are 60 sec and 120 sec, respectively.
	Vstar Trajectory 1 - 11	Trajectory of the VRAD Satellite (Vstar) using the estimated lunar gravity model 1 - 11

□ : Map product

2. Doubly differenced 1-way range by differential VLBI

2.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

SRV_XX_YYMMDDhhmm_MMDDhhmm.ext

- XX : Tracking data identifier(measurement type of GEODYN II)
 - ✓ 87 : Doubly differenced 1-way range
- YYMMDDhhmm : Date and Time of Start of data (UT)
- MMDDhhmm : Date and Time of End of data (UT)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ bin : Data Object File (binary file)
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

2.2 Label Format

The Label format for the SERIES object used for the Differential VLBI Delay is shown in Table 2-1. The Label includes Standard Item.

In Table 2-1, the numerical Values and character strings that correspond to the type of product, etc. is set, with exception of the Value shown as “STATIC”.

Table 2-1 Label Format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	FIXED_LENGTH [STATIC]
3	Byte count of the file records	RECORD_BYTES = %d	Int	XX
4	Count of the file records	FILE_RECORD = %d	Int	XXXX
5	Data format	DATA_FORMAT = %s	Char	PDS [STATIC]
6	File name	FILE_NAME = %s	Char	See Section5.1 “Rules used for File naming”.
7	Object pointer	^TABLE = %s	Char	Included with the file name.
8	Product ID	PRODUCT_NAME=%s	Char	See Table 1-2 “Product ID”.
9	Process Level	PROCESS_VERSION_ID=%s	Char	L2A: Standard, L2B: Higher
10	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
11	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
12	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	RSAT : SELENE-R, VRAD :SELENE-V
13	Data set name	DATA_SET_ID = %s	Char	The Model type (1-11) is removed from the Product ID.
14	Name of the instrument	INSTRUMENT_NAME = %s	Char	RSAT : RSAT, VRAD : VRAD
15	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
16	Start time	START_TIME = %s	Char	yyyy-mm-ddThh:mm:ss.ssssssZ
17	Stop time	END_TIME = %s	Char	yyyy-mm-ddThh:mm:ss.ssssssZ
18	Comment	DESCRIPTION = "%s"	Char	
19	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
END statement				

	END		
--	-----	--	--

<Example of label >

```

PDS_VERSION_ID = "PDS3"
RECORD_TYPE = "FIXED_LENGTH"
RECORD_BYTES = 208
FILE_RECORD = 282
DATA_FORMAT = "PDS"
FILE_NAME = "SRV_87_0801070345_01070444.bin"
^TABLE = "SRV_87_0801070345_01070444.bin"
PRODUCT_NAME = "RISE_VRADd"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-V"
DATA_SET_ID = "RISE_VRADd"
INSTRUMENT_NAME = "VRAD"
TARGET_NAME = "MOON"
START_TIME = "2008-01-07T03:45:00.000000Z"
END_TIME = "2008-01-07T04:44:02.000000Z"
DESCRIPTION = "Doubly differenced 1-way range by differential VLBI between Rstar and Vstar in METRIC
format"
PRODUCER_ID = "RISE"

```

2.3 Data Object Format

The Data Format for the Differential VLBI Delay is defined as “GEODYN II Metric Tracking Data Format”. (See Appendix-1) The data is described METRIC binary format.

2.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 2-2.

Table 2-2 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA....AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 5.1 “Rules used for File naming”)
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA....AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the instrument	InstrumentName	AAAA....AAAA (Up to 16 digits)	character strings	RSAT : RSAT VRAD : VRAD
Processing level	ProcessingLevel	AAAA....AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA....AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 “Product_ID”)
Version number of the product	ProductVersion	AAAA....AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	the value of 0-4	N/A
Start time of the data	StartDateTime	yyyy-mm-ddThh:mm:ss.sssssZ	Date and Time	dependent on the product
Stop time of the data	EndDateTime	yyyy-mm-ddThh:mm:ss.sssssZ	Date and Time	dependent on the product

(*1) “DataFileName” is the stored file name of the product. For the detached format, this is the stored file name.

<Example of Catalog Information: Differential VLBI Delay >

DataFileName = SRV_87_0801070345_01070444.bin
DataFileSize = 58656
DataFileFormat = PDS
InstrumentName = VRAD
ProcessingLevel = L2B
ProductID = RISE_VRADd
ProductVersion = 1.0
AccessLevel = 3
StartDateTime = 2008-01-07T03:45:00.000000Z
EndDateTime = 2008-01-07T04:44:02.000000Z

3. Spherical Harmonic Coefficients of Lunar Gravity Model

3.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

GRAV_COEF_##.ext

- ## :Version Number (Leading zero suppressed; 1, 2, 3, ..., 9, 10, 11, ...)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ txt : Data Object File (text file)
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

3.2 Label Format

The Label format for the TABLE object used for the Spherical Harmonic Coefficients of Lunar Gravity Model is shown in Table 3-1. The Label of TABLE object includes Standard Item.

In Table 3-1, the numerical values and the character strings that correspond to the type of the product, etc. is set, with the exception of those values shown as “STATIC”.

Table 3-1 Label Format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	FIXED_LENGTH [STATIC]
3	Byte count of the file records	RECORD_BYTES = %d	Int	XX
4	Count of the file records	FILE_RECORD = %d	Int	XXXX
5	Data format	DATA_FORMAT = %s	Char	PDS [STATIC]
6	File name	FILE_NAME = %s	Char	See Section 11.1 “Rules used for File naming”.
7	Object pointer	^TABLE = %s	Char	Included with the file name
8	Product ID	PRODUCT_NAME=%s	Char	See Table 1-2 “Product_ID”.
9	Process Level	PROCESS_VERSION_ID=%s	Char	L2A : Standard. L2B : Higher
10	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
11	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
12	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	SELENE-R[STATIC]
13	Data set name	DATA_SET_ID = %s	Char	The Model type (1-11) is removed from the Product ID.
14	Name of the instrument	INSTRUMENT_NAME = %s	Char	RSAT [STATIC]
15	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
16	Comment	DESCRIPTION = "%s"	Char	
17	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
END statement				
		END		

<Example of label : Spherical Harmonic Coefficients of Lunar Gravity Model>

PDS_VERSION_ID = "PDS3"

```

RECORD_TYPE = "FIXED_LENGTH"
RECORD_BYTES = 60
FILE_RECORD = 10199
DATA_FORMAT = "PDS"
FILE_NAME = "GRAV_COEF_1.txt"
^TABLE = "GRAV_COEF_1.txt"
PRODUCT_NAME = "RISE_GRAVcoef_1"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-R"
DATA_SET_ID = "RISE_GRAVcoef"
INSTRUMENT_NAME = "RSAT"
TARGET_NAME = "MOON"
DESCRIPTION = "Spherical Harmonic Coefficients of the estimated lunar gravity (Maximum degrees and
orders : 100)"
PRODUCER_ID = "RISE"

```

3.3 Data Object Format

The Data Format for the Spherical Harmonic Coefficients of Lunar Gravity Model Product is defined as “Default Gravity Model File Format”. (See Appendix -2) The data is described GEODYN format.

3.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 3-2.

Table 3-2 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA...AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 11.1 “Rules used for File naming”)
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA...AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the instrument	InstrumentName	AAAA...AAAA (Up to 16 digits)	character strings	RSAT : RSAT VRAD : VRAD
Processing level	ProcessingLevel	AAAA...AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA...AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 “Product_ID”)
Version number of the product	ProductVersion	AAAA...AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	the value of 0-4	N/A

(*1) “DataFileName” is the stored file name of the product. For the detached format, this is the stored file name.

<Example of Catalog Information: Spherical Harmonic Coefficients of Lunar Gravity Model >

```

DataFileName = GRAV_COEF_1.txt
DataFileSize = 611903
DataFileFormat = PDS
InstrumentName = RSAT
ProcessingLevel = L2B
ProductID = RISE_GRAVcoef_1
ProductVersion = 1.0

```

AccessLevel = 3

4. Covariance Matrix of Lunar Gravity Model

4.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

GRAV_COV_##.ext

- ## :Version Number (Leading zero suppressed; 1, 2, 3, ..., 9, 10, 11, ...)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ bin : Data Object File (binary file)
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

4.2 Label Format

The Label format for the TABLE object used for the Covariance Matrix of Lunar Gravity Model is shown in Table 4-1. The Label of TABLE object includes Standard Item.

In Table 4-1, the numerical values and the character strings that correspond to the type of the product, etc. is set, with the exception of those values shown as "STATIC".

Table 4-1 Label Format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	FIXED_LENGTH [STATIC]
3	Byte count of the file records	RECORD_BYTES = %d	Int	XX
4	Count of the file records	FILE_RECORD = %d	Int	XXXX
5	Data format	DATA_FORMAT = %s	Char	PDS [STATIC]
6	File name	FILE_NAME = %s	Char	See Section 12.1 "Rules used for File naming".
7	Object pointer	^TABLE = %s	Char	Included with the file name
8	Product ID	PRODUCT_NAME=%s	Char	See Table 1-2 "Product_ID".
9	Process Level	PROCESS_VERSION_ID=%s	Char	L2A : Standard. L2B : Higher
10	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
11	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
12	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	SELENE-R[STATIC]
13	Data set name	DATA_SET_ID = %s	Char	The Model type (1-11) is removed from the Product ID.
14	Name of the instrument	INSTRUMENT_NAME = %s	Char	RSAT [STATIC]
15	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
16	Comment	DESCRIPTION = "%s"	Char	
17	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
END statement				
		END		

<Example of label : Covariance Matrix of Lunar Gravity Model >

```
PDS_VERSION_ID = "PDS3"
RECORD_TYPE = "FIXED_LENGTH"
```

```

RECORD_BYTES = 8
FILE_RECORD = 52055710
DATA_FORMAT = "PDS"
FILE_NAME = "GRAV_COV_1.bin"
^TABLE = "GRAV_COV_1.bin"
PRODUCT_NAME = "RISE_GRAVcov_1"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-R"
DATA_SET_ID = "RISE_GRAVcov"
INSTRUMENT_NAME = "RSAT"
TARGET_NAME = "MOON"
DESCRIPTION = "Covariance matrix of the estimated lunar gravity"
PRODUCER_ID = "RISE"

```

4.3 Data Object Format

The Data Format for the Covariance Matrix of Lunar Gravity Model Product is defined as “Covariance Matrix File Format”. (See Appendix -3) The data is described GEODYN format.

4.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 4-2.

Table 4-2 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA....AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 12.1“Rules used for File naming”)
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA....AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the instrument	InstrumentName	AAAA....AAAA (Up to 16 digits)	character strings	RSAT : RSAT VRAD : VRAD
Processing level	ProcessingLevel	AAAA....AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA....AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 “Product ID”)
Version number of the product	ProductVersion	AAAA....AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	the value of 0-4	N/A

(*1) “DataFileName” is the stored file name of the product. For the detached format, this is the stored file name.

<Example of Catalog Information: Covariance Matrix of Lunar Gravity Model >

```

DataFileName = GRAV_COV_1.bin
DataFileSize = 416445680
DataFileFormat = PDS
InstrumentName = RSAT
ProcessingLevel = L2B
ProductID = RISE_GRAVcov_1
ProductVersion = 1.0
AccessLevel = 3

```


5. Gravity Field Map

5.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

GRAV_MAP_##.ext

- ## :Version Number (Leading zero suppressed; 1, 2, 3, ..., 9, 10, 11, ...)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ bin : Data Object File (binary file)
 - ✓ jpg : Thumbnail JPEG Image File
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

5.2 Label format

The Label format for the IMAGE object used for the Gravity Field Map is shown in Table 5-1. The Label for the IMAGE object includes: Standard Item, Image Data Object Format Description Part and IMAGE_MAP_PROJECTION Object Description Part.

In Table 5-1 with the exception of the Values expressed as “STATIC”, the numerical values and the character strings corresponding to the type of the product etc., are set.

Table 5-1 Label format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	UNDEFINED [STATIC]
3	Data File Format	DATA_FORMAT = %s	Char	PDS [STATIC]
4	File name	FILE_NAME = %s	Char	See Section 14.1 “Rules used for File naming”.
5	Starting position of the image object	^IMAGE = %d <BYTES>	Int	XXXX <BYTES>
6	Product ID	PRODUCT_NAME=%s	Char	See Table 1-2 “Product_ID”.
7	Process Level	PROCESS_VERSION_ID=%s	Char	L2A : Standard, L2B : Higher
8	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
9	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
10	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	SELENE-R[STATIC]
11	ID of the data set	DATA_SET_ID = %s	Char	See Table 1-2 “Product_ID”.
12	Name of the instrument (Full name)	INSTRUMENT_NAME = %s	Char	RSAT [STATIC]
13	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
14	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
15	Comment	DESCRIPTION = "%s"	Char	
Image Data Object Format Description Part>(* IMAGE *)				

		OBJECT = IMAGE		
16	Band storage type	BAND_STORAGE_TYPE = %s	Char	BAND_SEQUENTIAL [STATIC] *Refer to the PDS Standard Reference V3.5 Appendix A.19 "IMAGE".
17	Number of bands	BANDS = %d	small int	1[STATIC]
18	Compression class and encoding type	ENCODING_TYPE = %s	Char	N/A [STATIC]
19	Horizontal pixel count of image	LINE_SAMPLES = %d	Int	XXX
20	Vertical pixel count of image	LINES = %d	Int	XXX
21	Pixel bit length	SAMPLE_BITS = %d	Int	16[STATIC]
22	Pixel type	SAMPLE_TYPE = %s	Char	MSB_UNSIGNED_INTEGER [STATIC] *Refer to the PDS Standard Reference V3.5 Appendix C.2 for further information about "MSB_UNSIGNED_INTEGER".
23	Stretched Flag	STRETCHED_FLAG = %s	Char	FALSE [STATIC]
		END_OBJECT = IMAGE		
IMAGE_MAP_PROJECTION Object Description Part(* IMAGE_MAP_PROJECTION *)				
		OBJECT = IMAGE_MAP_PROJECTION		
24	Map projection type	MAP_PROJECTION_TYPE = "%s"	Char	SIMPLE_CYLINDRICAL [STATIC]
25	Resolution	MAP_RESOLUTION = %f<PIXEL/DEGREE>	Float	X.X
26	Easternmost longitude	EASTERNMOST_LONGITUDE = %f	Float	XXX.XXXXXX
27	Maximum latitude	MAXIMUM_LATITUDE = %f	Float	XXX.XXXXXX
28	Minimum latitude	MINIMUM_LATITUDE = %f	Float	XXX.XXXXXX
29	Westernmost longitude	WESTERNMOST_LONGITUDE = %f	Float	XXX.XXXXXX
		END_OBJECT = IMAGE_MAP_PROJECTION		
END statement				
		END		

<Example of Label : Gravity Field Map>

```

PDS_VERSION_ID = "PDS3"
RECORD_TYPE = "UNDEFINED"
DATA_FORMAT = "PDS"
FILE_NAME = "GRAV_MAP_1.bin"
^IMAGE = 971
PRODUCT_NAME = "RISE_GRAVmap_1"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-R"
DATA_SET_ID = "RISE_GRAVmap"
INSTRUMENT_NAME = "RSAT"
TARGET_NAME = "MOON"
PRODUCER_ID = "RISE"
DESCRIPTION = "the estimated lunar gravity field map of the estimated lunar gravity"
OBJECT = IMAGE
  BAND_STORAGE_TYPE = "BAND_SEQUENTIAL"
  BANDS = 1
  ENCODING_TYPE = "N/A"
  LINE_SAMPLES = 1440
  LINES = 721
  SAMPLE_BITS = 16
  SAMPLE_TYPE = "MSB_UNSIGNED_INTEGER"
  STRETCHED_FLAG = "FALSE"
END_OBJECT = IMAGE
OBJECT = IMAGE_MAP_PROJECTION
  MAP_PROJECTION_TYPE = "SIMPLE CYLINDRICAL"

```

```

MAP_RESOLUTION = 4.0
EASTERNMOST_LONGITUDE = 359.750000
MAXIMUM_LATITUDE = 90.000000
MINIMUM_LATITUDE = -90.000000
WESTERNMOST_LONGITUDE = 0.000000
END_OBJECT = IMAGE_MAP_PROJECTION
END

```

5.3 Data Object Format

The Gravity Field Map product is image data and is specified in either GIF, TIFF or JPEG format.

5.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 5-2.

Table 5-2 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA....AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 14.1 "Rules used for File naming")
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA....AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the thumbnail file	ThumbnailFileName	AAAA....AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 14.1 "Rules used for File naming")
Size of the thumbnail file	ThumbnailFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	depend on a product
File format of the thumbnail file	ThumbnailFileFormat	AAAA (Up to 4 digits)	JPEG	JPEG [STATIC]
Name of the instrument	InstrumentName	AAAA....AAAA (Up to 16 digits)	character strings	RSAT [STATIC]
Processing level	ProcessingLevel	AAAA....AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA....AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 "Product ID")
Version number of the product	ProductVersion	AAAA....AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	values of 0-4	N/A

(*1) "DataFileName" is the stored file name of the product. For the detached format, this is the stored file name.

< Example of Catalog Information: RSAT/ Gravity Field Map >

```

DataFileName = GRAV_MAP_1.bin
DataFileSize = 2077450
DataFileFormat = PDS
ThumbnailFileName = GRAV_MAP_1.jpg
ThumbnailFileSize = 45531
ThumbnailFileFormat = JPEG
InstrumentName = RSAT
ProcessingLevel = L2B

```

ProductID = RISE_GRAVmap_1
ProductVersion = 1.0
AccessLevel = 3

6. Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model

6.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

GRAV_POWER_##.ext

- ## :Version Number (Leading zero suppressed; 1, 2, 3, ..., 9, 10, 11, ...)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ ps : Postscript File
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

6.2 Label Format

The label format for the TEXT object used for the Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model is shown in Table 6-1. The Label includes: Standard Item and Object Format Description Part.

In Table 6-1, the numerical Values and character strings that correspond to the type of product, etc. is set, with exception of the Value shown as "STATIC".

Table 6-1 Label Format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	UNDEFINED [STATIC]
3	Data format	DATA_FORMAT = %s	Char	PDS [STATIC]
4	File name	FILE_NAME = %s	Char	See Section15.1 "Rules used for File naming".
5	Object pointer	^TABLE = %s	Char	Included with the file name.
6	Product ID	PRODUCT_NAME=%s	Char	See Table1-2 "Product_ID".
7	Process Level	PROCESS_VERSION_ID=%s	Char	L2A: Standard, L2B: Higher
8	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
9	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
10	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	Main orbiter : SELENE-M RSAT : SELENE-R
11	Data set name	DATA_SET_ID = %s	Char	The Model type (1-11) is removed from the Product ID.
12	Name of the instrument	INSTRUMENT_NAME = %s	Char	RSAT [STATIC]
13	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
14	Comment	DESCRIPTION = "%s"	Char	
15	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
Object Format Description Part				
		OBJECT = "TEXT"		
16	Creation Date	PUBLICATION_DATE = %s	Char	yyyy-mm-ddThh:mm:ss.sssssZ
17	Comment	DESCRIPTION = %s	Char	
		END_OBJECT		
END Statements				
		END		

<Example of label : Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model >

```

PDS_VERSION_ID = "PDS3"
RECORD_TYPE = "UNDEFINED"
DATA_FORMAT = "PDS"
FILE_NAME = "GRAV_POWER_1.ps"
^TABLE = "GRAV_POWER_1.ps"
PRODUCT_NAME = "RISE_GRAVpower_1"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-R"
DATA_SET_ID = "RISE_GRAVpower"
INSTRUMENT_NAME = "RSAT"
TARGET_NAME = "MOON"
PRODUCER_ID = "RISE"
OBJECT = "TEXT"
    PUBLICATION_DATE = "2009-04-10T00:00:00.000000Z"
    DESCRIPTION = "Power Spectrum of Spherical Harmonic Coefficients of the estimated lunar Gravity"
END_OBJECT
END

```

6.3 Data Object Format

The Power Spectrum of Spherical Harmonic Coefficients of Lunar Gravity Model product is a postscript file.

6.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 6-2.

Table 6-2 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA...AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 15.1 "Rules used for File naming")
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA...AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the instrument	InstrumentName	AAAA...AAAA (Up to 16 digits)	character strings	RSAT : RSAT VRAD : VRAD
Processing level	ProcessingLevel	AAAA...AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA...AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 "Product ID")
Version number of the product	ProductVersion	AAAA...AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	the value of 0-4	N/A

(*1) "DataFileName" is the stored file name of the product. For the detached format, this is the stored file name.

<Example of Catalog Information >

DataFileName = GRAV_POWER_1.ps

DataFileSize = 626154
DataFileFormat = PDS
InstrumentName = RSAT
ProcessingLevel = L2B
ProductID = RISE_GRAVpower_1
ProductVersion = 1.0
AccessLevel = 3

7. Main Orbiter Trajectory 1 - 11, Rstar Trajectory 1 - 11, Vstar Trajectory 1 - 11

7.1 Rules used for File naming

The nomenclature used for Label, Data Object and Catalog Information File the product files are described below. In addition, the file name is case-independent.

TR_X_##_YYMMDDhhmm_MMDDhhmm.ext

- X : Product
 - ✓ M : Main Orbiter Trajectory
 - ✓ R : Rstar Trajectory
 - ✓ V : Vstar Trajectory
- ## :Version Number (Leading zero suppressed; 1, 2, 3, ..., 9, 10, 11,)
- YYMMDDhhmm : Date and Time of Start of data (UT)
- MMDDhhmm : Date and Time of End of data (UT)
- ext : Extension
 - ✓ lbl : Label File
 - ✓ txt : Data Object File (text file)
 - ✓ ctg : Catalog File
 - ✓ sl2 : L2 Data Set (tar archive)

7.2 Label Format

The Label format for the SERIES object used for the Main Orbiter Trajectory 1 - 11 and Rstar Trajectory 1 - 11, Vstar Trajectory 1 - 11 are shown in Table 7-1. The Label for the SERIES object includes Standard Item.

In Table 7-1, the numerical Values and character strings that correspond to the type of product, etc. is set, with exception of the Value shown as “STATIC”.

Table 7-1 Label Format

No	Items	Elements	Types	Values
Standard Item				
1	PDS version number	PDS_VERSION_ID = %s	Char	PDS3 [STATIC]
2	Record format of the file	RECORD_TYPE = %s	Char	FIXED_LENGTH [STATIC]
3	Byte count of the file records	RECORD_BYTES = %d	Int	XX
4	Count of the file records	FILE_RECORD = %d	Int	XXXX
5	Data format	DATA_FORMAT = %s	Char	PDS [STATIC]
6	File name	FILE_NAME = %s	Char	See Section16.1 “Rules used for File naming”.
7	Object pointer	^TABLE = %s	Char	Included with the file name.
8	Product ID	PRODUCT_NAME=%s	Char	See Table 1-2 “Product_ID”.
9	Process Level	PROCESS_VERSION_ID=%s	Char	L2A: Standard, L2B: Higher
10	Product Version	PRODUCT_VERSION_TYPE = %s	Char	X.X
11	Name of the mission	MISSION_NAME = %s	Char	SELENE [STATIC]
12	Name of the spacecraft	SPACECRAFT_NAME = %s	Char	RSAT : SELENE-R, VRAD :SELENE-V
13	Data set name	DATA_SET_ID = %s	Char	The Model type (1-11) is removed from the Product ID.
14	Name of the instrument	INSTRUMENT_NAME = %s	Char	RSAT : RSAT, VRAD : VRAD

15	Target name	TARGET_NAME = %s	Char	MOON [STATIC]
16	Start time	START_TIME = %s	Char	yyyy-mm-ddThh:mm:ss.ssssssZ
17	Stop time	END_TIME = %s	Char	yyyy-mm-ddThh:mm:ss.ssssssZ
18	Comment	DESCRIPTION = "%s"	Char	
19	Producer ID	PRODUCER_ID = %s	Char	RISE : RISE group
END statement				
		END		

<Example of label : Main Orbiter Trajectory >

```

PDS_VERSION_ID = "PDS3"
RECORD_TYPE = "FIXED_LENGTH"
RECORD_BYTES = 133
FILE_RECORD = 482099
DATA_FORMAT = "PDS"
FILE_NAME = "TR_M_1_0710192351_12251528.txt"
^TABLE = "TR_M_1_0710192351_12251528.txt"
PRODUCT_NAME = "RISE_TRAJ_MAIN_1"
PROCESS_VERSION_ID = "L2B"
PRODUCT_VERSION_TYPE = "1.0"
MISSION_NAME = "SELENE"
SPACECRAFT_NAME = "SELENE-R"
DATA_SET_ID = "RISE_TRAJ_MAIN"
INSTRUMENT_NAME = "RSAT"
TARGET_NAME = "MOON"
START_TIME = "2007-10-19T21:51:00.000000Z"
END_TIME = "2008-12-25T15:28:00.000000Z"
DESCRIPTION = "Trajectory of Main Orbiter using the estimated lunar gravity"
PRODUCER_ID = "RISE"

```

7.3 Data Object Format

The trajectories for Rstar, Vstar and the main orbiter product are described in a SERIES format. The trajectories configures the time series data as 12 items per line. The data object format for the trajectories of Rstar, Vstar and the main orbiter product are shown in Table 7-2.

Table 7-2 Trajectory Product data object format

Column	Start Byte	Byte count	Item	Format	Unit	Example	Substance
	1	1	(blank)	N/A	N/A	N/A	Delimiter
1	2	6	Date	YYMMDD	-	050812	Date
	8	1	(blank)	N/A	N/A	N/A	Delimiter
2	9	4	Greenwich Time	hhmm	-	0	hour and minute (UT)
	13	2	(blank)	N/A	N/A	N/A	Delimiter
3	15	8	Greenwich Time	s.ssssss	Seconds	0.000000	Second (UT)
4	23	13	Inertial Cartesian Coordinates	F13.2	m	64460.01	x-coordinate
5	36	13		F13.2	m	-128240.30	y-coordinate
6	49	13		F13.2	m	2116719.09	z-coordinate
7	62	12	Inertial Cartesian Velocity	F12.5	m/s	830.25629	X-component of the inertial velocity (V _x)
8	74	12		F12.5	m/s	-1427.41638	Y-component of the inertial velocity (V _y)
9	86	12		F12.5	m/s	-512.93067	Z-component of the inertial velocity (V _z)
10	98	11	Geodetic North Latitude	F11.6	deg	86.120858	Latitude
11	109	11	Geodetic East Longitude	F11.6	deg	252.289487	Longitude
12	120	13	Spheroidal height	F13.2	m	383579.97	height
	133	1	<LF>statement	N/A	N/A	N/A	<0x0A>

The DE421 ephemeris was used for the orbit determination. The Cartesian coordinate system is in J2000 with the origin chosen to be the center of mass. The Latitude, Longitude and Height are described in the mean Earth/mean rotation axis frame for DE421 and with respect to the reference sphere with a radius of 1738 km.

<Example of Data Object : Trajectory Product>

```

50812 0 0.000000 64460.01 -128240.30 2116719.09 830.25629 -1427.41638 -512.93067 86.120858 252.289487 383579.97
50812 1 0.000000 114199.60 -213738.39 2083975.63 827.45975 -1422.04886 -578.71481 83.367189 253.709367 360018.41
50812 2 0.000000 163720.88 -298827.07 2047251.68 822.96291 -1413.74117 -645.58171 80.550505 254.302185 337413.87
50812 3 0.000000 212918.92 -383325.01 2006488.38 816.67035 -1402.33115 -713.32291 77.672646 254.625764 315842.57
50812 4 0.000000 261683.30 -467041.49 1961640.26 808.49325 -1387.66804 -781.70055 74.735016 254.828425 295381.30
50812 5 0.000000 309898.47 -549777.17 1912677.01 798.35171 -1369.61653 -850.44760 71.739266 254.966471 276106.85
50812 6 0.000000 357444.47 -631325.17 1859585.17 786.17716 -1348.06100 -919.26857 68.687447 255.065961 258095.20
50812 7 0.000000 404197.59 -711472.39 1802369.86 771.91507 -1322.91015 -987.84128 65.582068 255.140617 241420.80
50812 8 0.000000 450031.35 -790001.05 1741056.24 755.52741 -1294.10134 -1055.82009 62.426125 255.198351 226155.69
50812 9 0.000000 494817.56 -866690.63 1675690.79 736.99527 -1261.60459 -1122.83983 59.223113 255.244046 212368.56

```

7.4 Catalog Information File Format

The Catalog Information File Format is shown in Table 7-3.

Table 7-3 Catalog Information File Format

Item Name	Elements	Format of Value	Range of Value	Values
Name of the data file (*1)	DataFileName	AAAA....AAAA (Up to 31 digits)	alphanumeric characters	dependent on the product (See Section 16.1 "Rules used for File naming")
Size of the data file	DataFileSize	NNNNNNNNNNNN (Up to 12 digits)	unit:<byte>	dependent on the product
File format of the data file	DataFileFormat	AAAA....AAAA (Up to 16 digits)	character strings	PDS[STATIC]
Name of the instrument	InstrumentName	AAAA....AAAA (Up to 16 digits)	character strings	RSAT : RSAT VRAD : VRAD
Processing level	ProcessingLevel	AAAA....AAAA (Up to 16 digits)	character strings	L2A : Standard L2B : Higher
Product ID	ProductID	AAAA....AAAA (Up to 30 digits)	character strings	dependent on the product (See Table 1-2 "Product ID")
Version number of the product	ProductVersion	AAAA....AAAA (Up to 16 digits)	character strings	dependent on the product
Access level	AccessLevel	N	the value of 0-4	N/A
Start time of the data	StartDateTime	yyyy-mm-ddThh:mm:ss.ssssssZ	Date and Time	dependent on the product
Stop time of the data	EndDateTime	yyyy-mm-ddThh:mm:ss.ssssssZ	Date and Time	dependent on the product

(*1) "DataFileName" is the stored file name of the product. For the detached format, this is the stored file name.

<Example of Catalog Information: Main Orbiter Trajectory >

```

DataFileName = TR_M_1_0710192351_12251528.txt
DataFileSize = 64119167
DataFileFormat = PDS
InstrumentName = RSAT
ProcessingLevel = L2B
ProductID = RISE_TRAJ_MAIN_1
ProductVersion = 1.0
AccessLevel = 3
StartDateTime = 2007-10-19T21:51:00.000000Z
EndDateTime = 2008-12-25T15:28:00.000000Z

```

Appendix-1

GEODYN II Metric Tracking Data Format

The Satellite ID and Station ID used for SELENE are shown below.

Satellite ID	
Main Satellite(KAGUYA)	:7100000
Rstar(OKINA)	:7200000
Vstar(OUNA)	:7300000

Station ID	
UDSC 64m	: 800
USC 34m	: 801
Okinawa 10m	: 810
Okinawa 18m	: 811
Katsuura 10m	: 812
Katsuura 13m	: 813
Masuda 10m	: 814
Santiago	: 815
Perth	: 816
Maspalomas	: 817
VERA Mizusawa	: 820
VERA Ogasawara	: 821
VERA Iriki	: 822
VERA Ishigaki-jima	: 823
Mizusawa 10m	: 824
HOBART	: 830
URUMUQI	: 831
SHANGHAI	: 832
WETTZELL	: 836

Appendix -2
Default Gravity Model File Format

Appendix -3
Covariance Matrix File Format