

CASSINI PROJECT

IMAGING SCIENCE SUBSYSTEM (ISS)

Mosaicked Image Data Record (MIDR) Archive Volumes

SOFTWARE INTERFACE SPECIFICATION (SIS)

IO-AR-XXXXX

JPL D-35335

Version 1.0

July 1, 2006

SIGNATURE PAGE

Custodian: Leslie Pieri Haley, ISS Archive Lead

Approved:

---

Carolyn Porco, ISS Team Lead

---

Susan LaVoie, PDS Imaging Node Manager

---

Ed Grayzeck, PDS Project Manager

## TABLE OF CONTENTS

1. Introduction
  - 1.1. Purpose and Scope
  - 1.2. Content Overview
  - 1.3. Applicable Documents and Constraints
  - 1.4. Relationships with Other Documents
  
2. Archive Volume Contents
  - 2.1. ROOT Directory Contents
  - 2.2. DATA Directory Contents and Naming
  - 2.3. INDEX Directory Contents
  - 2.4. DOCUMENT Directory Contents
  - 2.5. CATALOG Directory Contents
  
3. Archive Volume Format
  - 3.1. ASCII Text Files (.txt)
  - 3.2. PDF Files (.pdf)
  - 3.3. VICAR Files (.img)
  - 3.4. Index Files (.tab)
  - 3.5. Catalog Files (.cat)
  
4. Archive Cartographic Product Volume Generation
  - 4.1. Data Transfer Methods and Archive Volume Creation
  - 4.2. Validation Methods
  - 4.3. Data Product Sizes and Delivery Rates
  - 4.4. Archive Media Characteristics
  - 4.5. Backup and Duplicates
  - 4.6. Labeling and Identification
  
5. Support Staff and Cognizant Persons
  
6. Appendices

## ACRONYMS AND ABBREVIATIONS

ASCII American Standard Code for Information Interchange  
CICLOPS Cassini Imaging Central Laboratory for Operations  
CISSCAL Cassini Imaging Science Subsystem Calibration Software  
CODMAC Committee On Data Management And Computation  
DVD Digital Video Disc  
EDR Experiment Data Record  
GIF Graphics Interchange Format  
HTML HyperText Markup Language  
IDL Interactive Data Language  
IMG Image  
IO Instrument Operations (Team)  
ISO International Standards Organization  
ISS Imaging Science Subsystem  
JPEG Joint Photographic Experts Group  
JPL Jet Propulsion Laboratory  
MIDR Mosaicked Image Data Record  
MIPS Multimission Image Processing Subsystem  
NAC Narrow Angle Camera  
NASA National Aeronautics and Space Administration  
NSSDC National Space Science Data Center  
PDF Adobe? Portable Document Format  
PDS Planetary Data System  
SIS Software Interface Specification  
SOI Saturn Orbit Insertion  
TBD To Be Determined  
TDS Telemetry Data System  
WAC Wide Angle Camera

## DOCUMENT CHANGE LOG

Date	Change
------	--------

---

July 1, 2006	Initial Document Release
--------------	--------------------------

## 1. Introduction

### 1.1. Purpose and Scope

This Software Interface Specification (SIS) is intended to be used by those who wish to understand the contents and formats for the Cassini Project Imaging Science Subsystem (ISS) cartographic map volumes known as Mosaicked Image Data Records (MIDRs). Typically, these individuals would be planetary scientists, software engineers or data analysts using the ISS archive.

This SIS complements the EDR and Archive Volume SISs that describe the collection of raw Experiment Data Record (EDR) and calibration volumes produced by the Cassini Imaging Central Laboratory for Operations (CICLOPS) archive team.

### 1.2. Content Overview

This SIS describes the format, content and generation details of the cartographic map products. Section 1 provides an introduction to the volumes. Section 2 (Archive Volume Contents) describes the structure of the volumes and briefly describes the contents of each file; Section 3 (Archive Volume Format) describes the file types found on these volumes; Section 4 (Archive Volume Generation) describes the volume assembly and generation process and the transfer process to PDS. Section 5 (Support Staff and Cognizant Persons) lists the individuals associated with the production of these volumes.

### 1.3. Applicable Documents and Constraints

This MIDR volume SIS is intended to be consistent with the following documents:

1. Cassini Program Data Management Plan (PDMP), JPL D-12560, PD 699-061, Rev. B, April 1999.
2. Cassini / Huygens Program Archive Plan for Science Data, JPL D-159576, PD 699-068, Version 3, March 2004.
3. Cassini Imaging Science Subsystem (ISS) Tour VICAR Image Data File and Detached Planetary Data System (PDS) Label Software Interface Specification (SIS), Tour Version 1.2, JPL D-24724, DOIS-002, March 10, 2006, and the Cruise Version of this document (not numbered).
4. Planetary Data System Data Preparation Workbook, February 17, 1995, Version 3.1, JPL D-7669, Part 1.
5. Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL D-7669, Part 2.
6. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.
7. Universal Disk Format? Specification, Revision 1.02, August 30, 1996,

Optical Storage Technology Association (OSTA).

8. Planetary Data Dictionary Document, August 28, 2002, JPL D-7116, Rev E.

The two references below provide a comprehensive description of the team's science objectives, details on the ISS camera instrument, a discussion on the instrument calibration, details on the cartographic map products and other valuable dataset information. These publications serve as excellent resources and complement the ISS archive volumes. They should be referred to prior to any extensive use of the ISS data (note: a pre-print of reference #10 is included on these MIDR volumes within the document directory).

9. Cassini Imaging Science: Instrument Capabilities and Anticipated Scientific Investigations at Saturn. Space Science Reviews 115, 363-497.2004.

10. Mapping of the icy Saturnian satellites: First results from Cassini-ISS  
Th. Roatsch, M. Wahlisch, F. Scholten, A. Hoffmeister, K.-D. Matz, T. Denk, G. Neukum, P. Thomas, P. Helfenstein, and C. Porco, Planetary and Space Sciences, submitted 2006.

## 2. Archive Volume Contents

Files found on all ISS archive DVDs are organized into a series of subdirectories below the top-level directory. Each subdirectory has an information file that fully explains the contents and conventions for the directory.

FILE	CONTENTS
-----	
[ROOT] (Top level directory)	
- aareadme.txt	The file you are now reading.
- errata.txt	Known anomalies and errors.
- voldesc.cat	Contents description of this DVD volume.
- [catalog]	Directory with PDS catalog information about the Cassini ISS datasets.
- catinfo.txt	Description of files in the catalog directory.
- cartods.cat	Cartographic map dataset description.
- dsmap.cat	Description of map projections used.
- issna_inst.cat	Cassini ISS narrow angle camera description.
- isswa_inst.cat	Cassini ISS wide angle camera description.
- insthost.cat	Cassini Orbiter description catalog object.
- mission.cat	Mission description catalog objects.
- person.cat	Cassini Imaging personnel objects.
- projref.cat	Cassini project reference objects.
- cartoref.cat	Cassini project reference objects.
- [data]	Contains the EDR image data files and labels.
- datainfo.txt	Description of files in the data directory.
- [maps]	Directory containing map sheets
- [images]	Directory containing tile images and global mosaic.
- [document]	Directory containing document files.
- docinfo.txt	Description of files in document directory.
- mapping_iss.pdf	Mapping publication released by ISS Team (PDF).
- mapping_iss.html	Mapping publication released by ISS Team (HTML).
- mapping_iss.lbl	PDS detached label for mapping_iss document.
- cartosis.lbl	PDS detached label for the mapping SIS.
- cartosis.pdf	PDF version of the mapping SIS.
- cartosis.txt	TXT version of the mapping SIS
- [mapping_iss_images]	Directory containing images for mapping_iss.html.
- [index]	Directory containing index files.
- indxinfo.txt	Description of files in the index directory.
- img_cumindex.tab	Cumulative index for /data/images/ PDS image files.
- img_cumindex.lbl	PDS label for the img_cumindex.tab.
- img_index.tab	Volume index for /data/images/ PDS image files.
- img_index.lbl	PDS label for the img_index.tab.
- map_cumindex.tab	Cumulative index for /data/maps/ PDF maps.
- map_cumindex.lbl	PDS label for the map_cumindex.tab
- map_index.tab	Volume index for /data/maps/ PDF maps.

| |- map\_index.lbl    PDS label for the map\_index.tab.  
|  
|- [label]            Directory containing labels and include files.  
| |- labinfo.txt      Description of label directory files.  
| |- vicar2.txt        Description of VICAR Label.

### 3. Archive Volume Formats

This section describes the file formats used for the types of files found on these cartographic map volumes:

#### 3.1 ASCII Text Files (.txt)

A flat, human-readable ASCII text version of each document must be included on the volume. Also, adhering to PDS recommendations, plain text files have line lengths restricted to 78 characters or fewer in order to accommodate printing and display on standard devices. Each line is terminated by the two-character carriage-return/linefeed sequence, <CR><LF> (ASCII decimal character codes 13 and 10, respectively), for a maximum total line length of 80 characters. Document .txt files are flat ASCII text files which may have embedded PDS labels (see PDS Label Formats below).

#### 3.2 PDF Files (.pdf)

The full cartographic mapping product for a particular target body consists of one or more cartographic map sheets. A map sheet will contain one or more images of different projections of the body. Also included on the map sheet is text information describing the index of original images used to make the map, image processing used, a summary of the map projections, references, and contact information.

These map sheets are stored as PDF (Portable Document Format) files. Portable Document Format (PDF) is a proprietary format of Adobe Systems Incorporated that is frequently used for distributing documents. Adobe offers a free downloadable reader, Acrobat Reader, from their website at <http://www.adobe.com>. Be sure to download the latest version of Acrobat Reader to view the PDF files on the this volume.

#### 3.3 VICAR Files (.IMG)

All tile images and the global mosaic image in the /data/images/ directory are in JPL/MIPS VICAR (Video Image Communication And Retrieval) image format. (See 'Software' section below for more information.)

Each VICAR image file is accompanied by a detached ASCII PDS label file. The label consists of ASCII 'keyword=value' pairs describing the important characteristics of the image.

### 3.4 Index Files (.tab)

The index table files contain keyword information about each data product (images and maps) on the volume.

This file consists of fixed-length records in ASCII character format. Each line is a record containing all the keywords for a particular data product on the volume. Fields in a record are delimited by commas. Non-numeric fields are enclosed in quotes and left-justified, whereas numeric fields are not enclosed by any characters and are right-justified. Multi-valued fields are enclosed in brackets and each item in that field is separated by a comma.

The corresponding label files for each index file details the keyword name, data type, start byte, number of bytes, and format so that keywords can be easily referenced and the file can be properly read into a database.

### 3.5 Catalog Files (.cat)

Catalog files (suffix .cat) exist in the catalog directory. They are text files formatted in an object-oriented structure consisting of sets of 'keyword=value' declarations. Each line is terminated by the two-character carriage-return/linefeed sequence, <CR><LF> (ASCII decimal character codes 13 and 10, respectively). PDS recommends catalog files have line length restricted to 72 characters or fewer, including the <CR><LF>, to accommodate PDS data ingestion requirements set forth by their internal catalogs and databases.

## 4. Archive Volume Generation

### 4.1 MIDR Volume Creation

The Map Sheets and Tile Images used in generating these volumes were compiled by members of the ISS team at the Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany and the Remote Sensing of the Earth and Planets, Freie Universitat Berlin, Germany and provided via electronic transfer (ftp) to the archive group within CICLOPS. Additional informational and PDS-required files were generated within CICLOPS.

Both Cassini ISS and Voyager images were used in the processing of the map sheets and tile images. Briefly, to generate these cartographic map products, an image conversion from PDS format to VICAR for the Voyager images was done followed by performing radiometric and geometric calibrations using standard VICAR programs to both the Voyager and Cassini images. The next step converted the images to digital maps. The final step of the image processing is the combination of all map projected images to a homogeneous mosaic.

One (1) DVD copy of the MIDR volume is sent to the PDS Imaging Node, at JPL and one (1) is retained within CICLOPS. The PDS Imaging Node creates two



additional DVD copies for dissemination, validation and retention by the PDS Central Node and the National Space Science Data Center (NSSDC). Archive volume submissions are recorded and tracked through the use of the Cassini Archive Tracking System (CATS).

#### 4.2 Validation Methods

Validation is the method by which data sets and volumes are verified to be in accordance with the standards identified in the Planetary Data System Standards Reference document [Applicable Document #5]. Validation is considered to have 2 aspects: 1) quality scientific usability and 2) technical compliance to PDS standards.

In order to ensure PDS-compliant products, the archive volumes are validated by a collaborative effort between the ISS/CICLOPS team, the Imaging and Central Nodes of the PDS, and non-Cassini imaging scientists. The ISS/CICLOPS team is responsible for producing PDS-compliant archive volumes, while the PDS personnel are responsible for ensuring that the archive volume(s) meet PDS standards.

Scientific usability is assessed through the ISS science team's normal and routine use of the mission imaging data sets in their science analysis. Additionally imaging scientists not associated with the Cassini project participate in the archive volume peer review process where they verify the "science" content of the data set, the completeness of the documentation, and the scientific validity (i.e., the integrity and usability) of the data.

For these cartographic maps volumes a peer review of sample volumes is conducted by PDS to serve as a method to validate the volume for proper structure, format, completeness and science usability. Any deficiencies found during the review are addressed and resolved such that PDS is in agreement with the resolution. Non-correctable errors (e.g., an error in the downlink data file) is described in the ever-evolving errata file, errata.txt, included on each archive volume in the ROOT Directory

#### 4.3 Data Product Sizes and Delivery Rates

The size of each cartographic map volume will not be known until generated. However, each volume will contain products for a single satellite for a total of 7 volumes that includes the satellites Mimas, Enceladus, Tethys, Dione, Rhea, Iapetus, and Phoebe. The delivery schedule is also not known at this time. First versions for each satellite will most likely be delivered before EOM. Subsequent versions for any particular satellite may be delivered as more images are taken during future planned flybys and extended mission flybys, or as improvements or corrections to a particular volume are made at any time in the future.

#### 4.4 Archive Media Characteristics

All ISS standard product archive volumes have a Digital Versatile Disk (DVD-ROM or DVD-R) format that is produced in UDF-Bridge format (Universal

Disc Format) with ISO 9660 level 2.

#### 4.5 Backup and Duplicates

Following transfer of the assembled physical archive DVD volumes from the ISS/CICLOPS to the PDS Imaging Node, the virtual volumes are stored on magnetic media by the ISS/CICLOPS at least through the generation of the archive media.

#### 4.6 Labeling and Identification

The filenaming convention for the cartographic map sheets reveals their contents and is defined as follows:

[satellite abbr]\_[scale]\_[center lat]\_[center lon]\_SMN.PDF

where:

[satellite abbr] = 2-letter abbreviation for the target body  
[scale] = image scale given in thousands (K) or millions (M) of meters  
[center lat] = latitude at the center point of the image  
[center lon] = longitude at the center point of the image

examples:

SE\_500K\_44N\_225W\_SMN.PDF (Saturn/Enceladus map sheet centered at 44 degrees North latitude and 225 degrees West longitude, taken at 500 kilometers resolution)

SP\_1M\_0\_0\_SMN.PDF (Saturn/Phoebe map sheet centered at the equator and 0 degrees West longitude taken at 1 million meters resolution)

The filenaming convention for the tile images reveals their contents and is defined as follows:

[satellite abbr]\_[scale]\_[center lat]\_[center lon]\_[type].IMG

where:

[satellite abbr] = 2-letter abbreviation for the target body  
[scale] = image scale given in thousands (K) or millions (M) of meters  
[center lat] = latitude at the center point of the image  
[center lon] = longitude at the center point of the image  
[type] = projection type (MERCATOR, LAMBERT, or STEREO)

examples:

SE\_500K\_43N\_135W\_LAMBERT.IMG (Saturn/Enceladus tile using Lambert

projection centered at 43 degrees North latitude and 135 degrees West longitude, taken at 500 kilometers resolution)

SP\_1M\_90N\_0\_STEREO.IMG (Saturn/Phoebe tile using Stereo-graphic projection centered at the north pole taken at 1 million meters resolution)

Further, the following labeling conventions are found on these mapping volumes:

DATA\_SET\_ID = "CO-S-ISSNA/ISSWA-5-MIDR-V1.0"  
DATA\_SET\_NAME = "CASSINI ORBITER SATURN ISSNA/ISSWA 5 MIDR  
VERSION 1.0"  
VOLUME\_SERIES\_NAME = "MISSION TO SATURN"  
VOLUME\_SET\_NAME = "CASSINI ISS CARTOGRAPHIC MAP VOLUMES"  
VOLUME\_SET\_ID = USA\_NASA\_PDS\_COISS\_3XXX (where 3 = map and xxx =  
sequential numbering of the volumes)  
VOLUMES = 7  
VOLUME\_FORMAT = "UDF\_ISO-9660\_BRIDGE"  
MEDIUM\_TYPE = "DVD-R"  
MISSION\_NAME = "CASSINI-HUYGENS"  
SPACECRAFT\_NAME = "CASSINI ORBITER"  
STANDARD\_DATA\_PRODUCT\_ID = ISS\_MIDR