STARDUST-NExT

Science Data Management and Archive Plan

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Change Log

DATE	CHANGE
03/08/2007	First draft
03/12/2007	Carcich & Klaasen: added acronyms; misc fixes
10/08/2007	Carcich: Extracted DMP section from JPL proposal
12/12/2007	Carcich: Inserted first cut at signature page, added TOC, reviewed text; made minor corrections
01/18/2008	Carcich: Change tracking turned on; removed signatories Anderson, Bredekamp, Dobinson, Jarrett, Kurtik, Parrish, Klaasen at recommendation of Duxbury; minor changes.
01/25/2008	Carcich: Incorporated comments from Acton, Klaasen & McLaughlin. Made data release policy consistent regarding delivery of data sets to PDS. Added Bingham in as signatory (TMOD does the safed data set).
01/29/2008	Carcich: Compressed all "archive volume" and "collection" references to "data set" or equivalent. Carcich: Re-wrote signatures page: added Grayzeck; fixed A'Hearn initials; added institutions. Carcich: added calibration data sets and references throughout per A'Hearn review Carcich: updated & corrected tables & figures. Carcich: many improvements per A'Hearn review
02/02/2008	Carcich: CIDA & DFMI calibrated data sets added; revised figures
02/08/2008	Carcich (mostly per McLaughlin 06.Feb review email): cleaned up inconsistencies in SDC/NAVCAM/CIDA/DFMI RDR responsibilities; added URLs in Table DMAP.7; fiddled with Figure DMAP.2; PDS-SBN is the interface to NSSDC; minor typos Carcich: CIDA & DFMI are responsible for generating RDR data sets for their respective instruments Carcich: added requirements for PDS to 1) support accelerate delivery schedule by being available during the mission to informally review preliminary data set components. 2) sponsor peer reviews consistent with the budget of the instrument teams
02/11/2008	Carcich: changed text in table dmap.4
2/13/2008	Carcich: updated TOC; dmap.3: calib DFMI data is vs. Mass
2/19/2008	Carcich: NAIF creates SPICE data sets, PDS/SBN node reviews and archives SPICE data sets; Added note in section 7.1 that NAV does SPKs (mentioned elsewhere); Fixed spelling of auspices; Added 19.Feb date to signature page; Changed to smaller font in this Change Log table.
5/14/2008	Carcich (mostly per A'Hearn email 03.May, 2008): 1.4 & Table DMAP.7: removed references to Data Prep. Workbook & printed Planetary Science Data Dictionary 3.0: Made it clear that global maps are an example, not an expected, product 5.6 Re-wrote & re-arranged first three sentences to be self-consistent 7.1 & Table DMAP.4: expanded ancillary data description 7.1: Rephrased sentences in last para; fixed typo 7.3: Modified PDS requirement re peer reviews. Table DMAP.3: Modified DFMI RDR product description Misc: removed leftover references to Archive Volume Misc: removed or modified references of Software as a data set deliverable
5/15/2008	Carcich (per Acton email 15.May, 2008) Table DMAP.6 & Misc: Shifted SPICE archive to NAIF; reworded NAIF safing
6/10/2008-	Carcich: Cover and title page only: final dates on cover; added signature info &

6/13/2008	dates; updated Bingham title

ACRONYMS

C&DH	Command and Data Handling
CCSDS	Consultative Committee on Space Data Systems
CD	Compact Disc
CIDA	Cometary and Interstellar Dust Analyzer
CODMAC	Committee On Data Management, Archiving, and Computing
Co-I	Co-Investigator
DFMI	Dust Flux Monitor Instrument
DSMS	Deep Space Mission System, provided by IPN
DSN	Deep Space Network
DVD	Digital Versatile Disc
EADR	Engineering Archive Data Record
EDR	Experiment Data Record (i.e. Raw data)
EOM	End Of Mission
GB	Gigabyte(s)
GDS	Ground Data System
GSE	Ground Support Equipment
IPN	Interplanetary Network Directorate (at JPL)
JPL	Jet Propulsion Laboratory
LMA	Lockheed Martin Company, Astronautics Division
MMO	Mission Management Office (part of DSMS)
MOPS	Mission Operations
NAIF	Navigation and Ancillary Information Facility (services provided under DSMS)
NASCOM	NASA Communications
NAV	Navigation and related services provided by DSMS
NSSDC	National Space Science Data Center
ODL	Object Description Language
PDS	Planetary Data System (of NASA)
PI	Principal Investigator
RDR	Reduced Data Record (i.e. Calibrated data)
RS	Radio Science
SBN	Small Bodies Node of the Planetary Data System
SDC	Science Data Center
SFDU	Standard Formatted Data Unit
SIS	Software Interface Specification
SPICE	Spacecraft, Planet, Instrument, C-matrix, Events
SSD	Solar System Dynamics Group (located at JPL)
TC&DM	Telemetry, Command and Data Management (services provided under DSMS)
TCM	Trajectory Correction Maneuver
TDS	Telemetry Data Server

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide a plan for the generation, validation, and transfer to the Planetary Data System (PDS) of the STARDUST-NExT archives and related algorithms and documentation. A second purpose is to delineate plans for the additional release of data through Press Conferences and the posting of a subset of data and documentation that shows interesting and timely results on the Internet.

1.2 Scope

The plan covers archiving of Experiment Data Records (EDRs), Reduced Data Records (RDRs) and related packet and engineering data to be acquired or derived during the STARDUST-NExT Mission. The plan is based on the successful Data Management Plan for the Stardust mission.

Specific activities addressed in this plan are:

1. Generation of high-level mission, space-craft and instrument description documentation, instrument calibration reports, algorithms, and documentation of software used to produce Experiment Data Records and Reduced Data Records.
2. Reduction of telemetered science packet data to EDRs and to RDRs, with associated documentation.
3. Generation of SPICE data sets for use with software from the Jet Propulsion Laboratory's Navigation and Ancillary Information Facility (NAIF).
4. Generation and validation of data sets containing STARDUST-NExT data, algorithms, documentation, and ancillary information.
5. Delivery to the PDS of validated STARDUST-NExT data sets.
6. Release of limited data to the public through news conferences and through the posting of data on the Internet.

1.3 Contents

This plan begins with an overview of the STARDUST-NExT Mission, the science goals, and the Ground Data System (GDS). This is followed by a description of the data release policies, data sets and functions, roles and responsibilities for organizations and personnel associated with the generation, validation, and archiving of STARDUST-NExT data. The document ends with specific plans for archiving and for posting of subsets of data for outreach and educational purposes. For reference, a glossary of archive terms used in this document is at the end of this appendix.

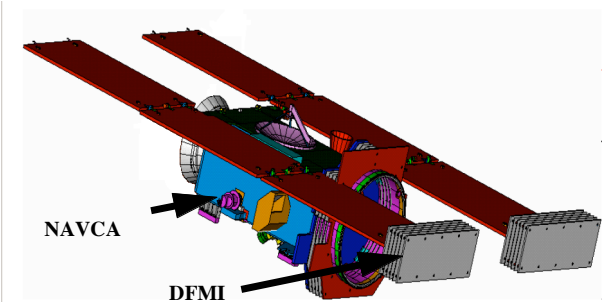

Figure DMAP.1. STARDUST-NExT Spacecraft

1.4 Applicable Documents and Constraints

The STARDUST-NExT Science Data Management and Archive Plan is responsive to the following NASA HQ and Project documents pertaining to the management and archive of project data:

Announcement of Opportunity, Discovery Program, AO NNH06ZDA001O, April 5, 2006

OSSA Program Directive, Science Data Management Policy, March 5, 1992.

The plan is consistent with the principles delineated in the following National Academy of Sciences reports:

Data Management and Computation, Volume 1, Issues and Recommendations, 1982, National Academy Press, 167 p.

Issues and Recommendations Associated

with Distributed Computation and Data Management Systems for the Space Sciences, 1986, National Academy Press, 111 p.

The plan is also consistent with the following PDS documents:

Planetary Data System - National Space Science Data Center Memorandum of Understanding, see Table DMAP.7 for URL reference, September 1, 1993.

Planetary Science Data Dictionary Online Database, see Table DMAP.7 for URL reference, Version 1r69, January 23, 2008,

Planetary Data System Data Standards Reference, JPL D-7669, Part-2, March 20, 2006, Version 3.7; see also Table DMAP.7.

Planetary Data System Archive Preparation Guide (APG), JPL D-31224, August 29, 2006, Version 1.1; see also Table DMAP.7.

2.0 OVERVIEW OF STARDUST-NExT MISSION

2.1 Mission Overview

STARDUST-NExT uses the Stardust (SDU) spacecraft to effect a flyby of comet 9P/Tempel 1 at 200 km on February 14, 2011 (39 days post perihelion) and obtain high-resolution images of the coma and nucleus, as well as measurements of the composition, size distribution and flux of dust emitted into the coma. We have developed a reliable plan to update knowledge of the rotational phase of the comet sufficiently well to have a high probability of viewing significant portions of the hemisphere studied by Deep Impact in 2005 and a good chance of imaging the crater excavated by the impactor.

STARDUST-NExT is a low-cost, low-risk mission that will complete and expand the investigation of comet Tempel 1 initiated by Deep Impact, and for the first time assess the changes in the surface of a comet between two successive perihelion passages. It will provide important new information on how Jupiter family comets (JFCs) evolve and how they were formed 4.6 billion years ago.

The investigation of comets addresses each of the three strategic objectives for solar system exploration enunciated in NASA's Space Science Enterprise Strategy (SSES) 2003:

- To learn how the solar system originated and evolved to its current state.
- To understand how life begins and determine the characteristics of the solar system that led to the origin of life.
- To catalog and understand the potential impact hazard to Earth from space.

STARDUST-NExT will contribute significantly to the first and last of these objectives. STARDUST-NExT will obtain essential new data, capitalize on the discoveries of earlier missions to determine how cometary nuclei were constructed at the birth of the solar system, and increase our understanding of how they have evolved since then.

2.2 Science Goals

The investigations on the STARDUST-NExT mission include:

Cometary coma and nucleus imaging
(Using the Navigation Camera)

Comet particle composition measurements
(CIDA instrument)

Dust flux measurements
(DFMI instrument)

The goals at the comet flyby will be satisfied by high-resolution imagery and include:

1. Document surface changes between two perihelion passages.
2. Extend geologic mapping to elucidate nature of layering and constrain models of interior structure.
3. Extend study of smooth flows to understand source and origin.
4. Image the Deep Impact crater to understand crater formation on comets and derive further information of the structure of the outer layers of the nucleus.

The STARDUST-NExT Mission also collects data during the Earth Gravity Assist (with lunar and Earth images, and possible dust

detection) as well as during camera calibrations at intervals during cruise.

Table DMAP.1 describes the STARDUST-NExT instruments and designates the Team Leads for each instrument.

2.3 Ground Data System

As was done for the prime SDU mission, a service provided by the JPL Navigation and Ancillary Information Facility (NAIF) will extract archival channelized and packetized telemetry, convert these data to instrument Health and Safety Monitor files and intermediate EDRs, and transfer a subset of these files to the Science Data Center (SDC).

A new feature of STARDUST-NExT is the Science Data Center (SDC; see Figure DMAP.2), which was developed at Cornell University to support the CONTOUR and Deep Impact missions. STARDUST-NExT SDC is based on the successful Deep Impact SDC. The SDC will receive the intermediate EDRs from the NAIF file server, convert them to science- and archive-oriented formats and presentations (Raw EDRs for all instruments and Calibrated RDRs for NAVCAM), and distribute them to science team members, to EPO entities, and to PDS-SBN. The SDC will also produce ancillary PDS information. (See Section 5.0, Data Sets) . Automated secure file transfers will be used to transfer data to the SDC by NAIF.

The Raw CIDA and DFMI Raw EDRs will be converted to Calibrated RDRs by their respective instrument teams. The archive data sets for CIDA and DFMI Calibrated RDRs will also be generated and delivered to PDS-SBN by their instrument teams. The SDC may be used to store and distribute these CIDA and DFMI RDR products, but will not be responsible for generating them.

The SDC will also provide copies of the intermediate EDR products from the NAIF file server to their respective team members.

Table DMAP.2 lists the expected volume of telemetered science data.

3.0 DATA RIGHTS AND RELEASE POLICY

As was the case for the Stardust mission, there are no proprietary data rights for the STARDUST-NExT mission. Science team members do have a limited amount of time – not to exceed three months for the Raw EDRs and six months for the Calibrated RDRs (see Section 5) –for validation of data prior to delivery to the PDS for the start of the peer review process.

The PI, SDC and Team Leads are responsible for coordinating all scientific investigations involving the use of calibrated data from their respective instruments and ensuring that all science data products are delivered in a timely fashion.

Because of the expected widespread scientific and public interest in science results from 9P/Tempel 1 and the strong commitment of STARDUST-NExT scientists to releasing data on a timely basis, it is important to establish a clear release policy.

A cornerstone of the policy is the need for a reasonable interval of time to generate and validate data products and data sets before release to the general community. Based on experiences from the Stardust mission, a six-month period after encounter was necessary to produce useful products. At the same time, it is important to release significant data and findings immediately. STARDUST-NExT scientists are encouraged to validate and release data products as soon as possible, with the six-month period being a maximum for this mission (although optional Special Data Products - see section 5.7 below - such as global maps may require more time to generate). Thus, the policy also defines a separate release of a significant subset of data, using modern technologies to reach a wide audience. The release policy is summarized as follows:

1. The generation/validation period for Standard Data Products is defined to be the period from receipt, at the SDC, of the last NAIF intermediate EDR (or equivalent) data in a data set until delivery of that data set to the PDS to

begin the peer review process. During the generation/validation period, Team Leads are expected to obtain EDRs or equivalent science data and validate the EDRs. Efforts involving all of the STARDUST-NExT investigators are expected to be underway during this period. The generation/validation period may be up to three months for Raw EDR data and up to six months for Calibrated RDR data. The anticipated start of this generation / validation period will be late February, 2011, after all 9P/Tempel 1 encounter data are downlinked to and processed by the Ground Data System and the SDC, so the delivery dates for peer review of Raw EDR and Calibrated RDR data sets will be 31.May, 2011 and 31.August, 2011, respectively.

2. To ensure rapid dissemination of new and significant information, Instrument Teams will also release a subset of data earlier as a form of public outreach and education. These releases will typically be available within a day or so of data receipt. Postings on the Internet (e.g., the STARDUST-NExT Instrument Team and Outreach World Wide Web Sites) will be used as a cost-effective way for widespread dissemination of these special products. The posted data will include images, spectra, dust counts and other forms of data that illustrate mission events and significant science results. Postings will include documentation.

3. By the end of the generation/validation period, the relevant data sets and posted products will have been transferred to the PDS, which will make them available to the general science community as products in peer review.

4.0 PUBLIC INFORMATION RELEASE POLICY

Public information release includes press conferences and written material concerning both mission operations and scientific analyses. Specific policy statements for Public Information Release for the STARDUST-NExT Mission are:

1. Information concerning spacecraft and instrument anomalies may only be released by the STARDUST-NExT Project Manager, in coordination with LMA, NASA Headquarters and the Principal Investigator.

2. Information concerning scientific results may be released during press conferences and press releases organized by the STARDUST-NExT Project and the Jet Propulsion Laboratory's Public Information Office, in coordination with NASA Headquarters and the Principal Investigator.

3. Information concerning scientific results from a given instrument may also be released by the Instrument Teams. For example, such releases may be organized by the home institution of the Principal Investigator, the CIDA Lead, the DFMI Lead, and the Imaging Lead.

The STARDUST-NExT Principal Investigator and NASA and JPL Public Information Offices will receive, in advance of the release, a copy of the release material (e.g., images, spectra, captions, summary of results), a schedule for the release, and a statement of the mechanisms for release. The intent is not to require concurrence for the release, but only to make sure that all parties are informed of the release before it happens.

5.0 DATA SETS

5.1 Overview

The PDS has developed archive standards (see PDS Data Standards Reference in Section 1.4 above).that are being applied to all planetary missions and have been used for data restorations going back to the early Mariner flights. These standards will be implemented by STARDUST-NExT for all but the safed packet and engineering data set.

Eight STARDUST-NExT data sets are defined as part of this Science Data Management and Archive Plan. Three of these correspond to the assemblage of Raw EDR data and associated information for each of the

instruments (NAVCAM, CIDA, and DFMI); three correspond to Calibrated RDR data for each of the instruments. The seventh data set corresponds to the SPICE data. For reference, Table DMAP.3 shows the Standard Data Products to be produced. The eighth data set comprises engineering products that need archiving, including science packet data; this last data set will be safed only and subject to neither peer-review nor PDS cataloging. Table DMAP.4 summarizes the components of the STARDUST-NExT data sets.

5.2 High-Level Catalog Objects

The PDS has developed a suite of objects used to provide high-level information about a mission, spacecraft, instruments, and data sets (Planetary Data System Standards Reference, see Section 1.4 above for reference). The objects provide a high-level view of a mission and its data sets and are also used to populate a high-level catalog maintained by the PDS. The objects will be generated under the auspices of STARDUST-NExT SDC.

5.3 Data Product Labels

STARDUST-NExT data products will have labels that utilize the PDS labeling scheme. Label structures will be described in data product documents.

5.4 Science Data Packets

Instrument science data comprise data packets of time-ordered sequences of observations obtained by a given instrument and engineering information defining the operational state of the instruments. Unchannelized science instrument packet data and channelized engineering telemetry will be accessed within the firewall on the Telemetry Data Server (TDS) by NAIF during intermediate EDR production. The exact contents of science and engineering packet data are instrument-dependent. The DSMS TC&DM service will produce safed data set(s), not subject to peer review or normal PDS cataloging, containing relevant packet and engineering data.

5.5 Standard Data Products

Standard Data Products are those data objects generated from science packets and SPICE files, or from other data products. Such Standard Data Products will be generated by the SDC and later validated by the Instrument Teams. Table DMAP.3 lists Standard Data Products for STARDUST-NExT.

5.6 Calibrations

The instrument teams are to provide calibration software (as documentation), data, procedures and examples as appropriate. The CIDA and DFMI instrument teams will also convert Raw CIDA and DFMI EDRs to Calibrated RDRs. The SDC will create an automated calibration pipeline to convert the Raw NAVCAM EDRs into calibrated RDRs. These calibrated data, along with the calibration information, will compose separate data sets for each instrument.

5.7 Special Data Products

Special Data Products are derived from EDR and RDR products produced during the course of scientific research. They are called Special Products as opposed to Standard Data Products, because they are difficult to predefine and schedule, since they will be dependent on the specific scientific content of STARDUST-NExT observations. Examples of potential higher-level derived products include 3-dimensional, topographic models of the nucleus, dust flux models, nucleus albedo maps, and controlled photomosaic map products. Each Special Data Product will be delivered directly to the PDS by the investigator who produces it.

5.8 Estimated Archive Data Volume

The total returned data volume (not including the safed packet and engineering data) is estimated at less than 5 GBits. Including calibration of the NAVCAM data, the total data volume to be delivered to PDS-SBN is estimated at about 50GBits (see Table DMAP.2).

6.0 OVERVIEW OF ARCHIVING FUNCTIONS

Standard Data Products form the core of the data sets to be delivered to the PDS for distribution to the science community. These products and associated SPICE ancillary information will be placed in data sets for

validation and transfer to the PDS. A logical grouping of data is termed a data set. Table DMAP.4 lists the key elements associated with data sets, and Table DMAP.5 lists suppliers of data and information for STARDUST-NExT data sets. There will be two data sets (Raw and Calibrated) for each instrument, one for SPICE files and one for packet and engineering data. This last will be treated as a safed data set, not subject to peer review or normal PDS cataloging. It will reside at the PDS NAIF node, consistent with treatment of engineering data from other missions.

6.1 Data Product Generation

Figure DMAP.3 shows the flow of components through the various stages of data set generation, validation, and transfer to the PDS, and distribution of products to the science community. Not shown are postings by the instrument teams of timely results on the Internet / www for education and outreach.

Generation of the safed packet and engineering data is the responsibility of TC&DM. Only those channelized telemetry and science packets needed for the production of science EDRs, SPICE Kernels and Small Forces Files need be included.

The SDC will work with the NAVCAM, CIDA and DFMI Instrument Teams and the PDS to develop the EDR and RDR (NAVCAM only) file formats and content definitions. SDC will produce all EDRs and RDRs (NAVCAM only). The Instrument Teams will be responsible for validating these products and producing the associated documentation, algorithms or software to generate higher-level products. After validation, product data sets will be generated for the Instrument Teams by SDC, with the exception of the CIDA and DFMI Calibrated RDR data sets, which will be generated by their respective instrument teams.

NAIF will, in most cases, produce and will assemble the SPICE Kernels, which include:

SPK - high precision, numerically integrated spacecraft trajectory, planetary and cometary ephemerides (source: NAIF; NAV team)
PcK - selected planetary and cometary physical and dynamical parameter values (source: NAIF, STARDUST-NExT Science team)
IK - science instrument field of view specifications (source: SDU Archive, SDC)
CK - spacecraft attitude, spacecraft body-fixed rates, and NAVCAM mirror position (source: SDC)
EK - **optional:** description of spacecraft conditions and events
LSK - leapseconds file (source: NAIF)
SCLK - spacecraft clock calibration parameters (source: Mission Operations (MOPS))

(The asteroid, comet and planet ephemeris SPKs are produced by JPL's Solar System Dynamics Group, and the STARDUST-NExT spacecraft trajectory SPKs are produced by the STARDUST-NExT NAV Team.)

The SDC and NAIF will transfer the instrument (EDRs, NAVCAM RDR) and SPICE data sets to the PDS/SBN node for peer review and data ingestion based on the release schedule given in Section 8 of this Plan. The CIDA and DFMI instrument teams will do the same for their respective RDR data sets; the SDC may be used for storage and distribution of these data sets if convenient.

6.2 Validation and Delivery

Validation of EDRs and RDRs will be an intrinsic part of Standard Data Product generation. Validation of Standard Data Products will be done in part during analysis of the data. However, a key additional requirement is the validation of data sets for integrity of scientific content, file structures, directory structures, compliance with PDS standards, and integrity of the physical media used to transfer the datasets. This validation will be overseen by the SDC and will rely on participation of the Instrument Teams.

Final validation and peer review will take place under PDS auspices as a check of data sets before the delivery of lien-resolved data to PDS. Any problems will be referred back to the STARDUST-NExT Project for correction.

7.0 ROLES AND RESPONSIBILITIES

This section summarizes the roles and responsibilities for personnel and organizations

involved in STARDUST-NExT data set generation, validation, transfer, and distribution.

7.1 STARDUST-NExT Project

The Project and Deputy Principal Investigators provide an oversight function for implementation of the Science Data Management and Archive Plan. The STARDUST-NExT SDC Group will advise the Project with regard to archiving. SDC will work in an advisory role with STARDUST-NExT and the PDS to ensure that detailed plans are in place for generation of PDS-compatible products and associated documentation, and that data sets are generated, validated, and transferred to the PDS.

TC&DM is responsible for producing and delivering to PDS/NAIF the safed Engineering Archive Data Record (EADR) data sets containing packets and engineering data (the eighth data set referred to in section 5.1 above). These data sets will not be peer reviewed–they will only be safed at the NAIF node of the PDS. In some cases a subset of these data may also be included with the Standard Data Products, e.g. instrument operation temperatures or decontamination bake-out history.

NAIF will provide the initial processing of the incoming packets and engineering files into intermediate EDR files, as they did for the STARDUST prime mission, and transfer a subset of those files to the Science Data Center. NAIF will also generate all SPICE files except SP-Kernels, which will be generated by NAV.

The Science Data Center (SDC) will perform the analysis and data set preparation of the raw science data. The SDC will accept and process intermediate EDRs from NAIF, command history files and navigation data, creating Raw EDRs. The SDC will also receive and organize NAVCAM calibration files, and will coordinate with JPL navigation to develop the comet kinematics model and shape model. SDC development will be carried out at Cornell University, but SDC operations may take place simultaneously at several locations, including JPL, via multiple SDC computers.

The NAVCAM, CIDA and DFMI instrument teams are responsible for developing and documenting calibration procedures and ancillary products (e.g. calibration files). See Table DMAP.1 for instrument team leads.

The SDC is responsible for generating and validating the NAVCAM calibrated science data files, the comet shape and kinematic models, and the source code and associated documentation of software used to generate these data products. The SDC will provide the source code and be responsible for its archiving; however, the SDC will not support the code after the end of the mission (EOM). The NAVCAM calibration procedures provided will be in the form of source code and calibration documentation; it is the responsibility of the SDC to integrate the NAVCAM calibration procedures into the data pipeline.

The calibration procedures, as documented by the software, are useful to include in the archived data sets so that a future user can redo the calibration without recourse to the science teams.

The SDC will produce raw PDS data sets containing EDRs for all three instruments (NAVCAM, CIDA and DFMI), calibrated data set(s) containing RDRs for NAVCAM.

NAIF will produce and archive the SPICE PDS archive data sets containing SPICE kernel files.

The SDC will participate in the PDS-sponsored peer review of the data sets it produces, and will resolve any liens against those data sets.

Table DMAP.5 lists the suppliers for each component of the data sets. Each Instrument Team will also be responsible for posting a subset of reduced data (and relevant documentation) on the STARDUST-NExT Outreach system accessible via the Internet for public access. Finally, the supplier of each data set is responsible for publishing a Software Interface Specification document that delineates the format and content of the respective data sets.

The STARDUST-NExT Project will distribute data sets for use by the STARDUST-NExT Project community. The PDS will distribute data sets for the NASA-supported science community once the data sets are released to and approved by the PDS.

7.2 Science Instrument Team Leads

Leads of each science instrument investigation are responsible for generation and delivery of any special data product(s) to the PDS SBN (Small Bodies Node).

The instrument team leads are responsible for providing documentation required by the PDS archive process, specifically PDS Catalog objects for the mission, mission design, spacecraft, instruments and calibration. If possible, instrument teams should negotiate copyrights on science publications that make the publications available for inclusion in PDS archive data sets.

Instrument team leads are responsible for reviewing and validating the data sets. PDS will help with this informal review of the initial archival products. The instrument team leads, or their representatives, will also participate in PDS-sponsored peer review of data sets from their respective instruments.

As noted in the previous section, the NAVCAM science team lead is responsible for providing calibration software and documentation to the SDC.

The CIDA and DFMI instrument team leads are responsible for implementing calibration procedures for their respective instruments, and for generating calibrated data products.

The CIDA and DFMI instrument team leads are responsible for PDS data sets containing RDRs for their respective instruments, for participating in the peer review of those data sets, and for resolving any liens against those data sets.

7.3 Planetary Data System

The PDS Small Bodies Node (PDS-SBN) is the designated point of contact for STARDUST-NExT on archival data set-related issues. The interfaces between the STARDUST-NExT teams and elements of the PDS-SBN are summarized in Table DMAP.6. The PDS-SBN is the interface between STARDUST-NExT and the NSSDC.

The PDS-SBN will work with the SDC and the instrument teams to ensure that the STARDUST-NExT data sets are compatible with PDS standards and formats. To facilitate the accelerated schedule of data set deliveries to PDS-SBN after the mission, the PDS-SBN will be available during the mission to advise the various data set producers and to perform informal reviews of preliminary PDS data set components (e.g. catalog files, index files, data labels, data set IDs).

The PDS will make its best effort to sponsor peer reviews of the non-safed data sets which are considerate of the STARDUST-NExT mission budgets of the instrument teams.

The PDS will maintain active data sets of released STARDUST-NExT products for access by the science community.

7.4 National Space Science Data Center

The National Space Science Data Center will maintain a "deep archive" of the data for long-term preservation and for filling large delivery orders to the science community. The PDS-SBN will serve as the interface between STARDUST-NExT and NSSDC (see PDS-NSSDC MOU).

8.0 Archive Generation, Validation, and Release Schedules

8.1 Postings for Outreach and Education

Instrument Team Leaders and the PI may develop World Wide Web sites providing access to data and documentation that illustrate results from their instrument's observations. These sites will have pointers to the STARDUST-NExT Project Web site and to the other STARDUST-NExT instrument sites.

8.2 Data Sets for Science Community Use

Standard Data Products will be generated after encounter. These products will be used for analyses, and some will be posted for education and outreach. Standard Data Products also provide the research community the best data for their analyses.

The Standard Data Products are the core data in data sets to be delivered to the PDS. All SPICE files used to help generate the Standard Data Products will be released to the PDS at the same time that the Standard Data Products are released.

Raw data products will be included in data sets for delivery to the PDS by the SDC to begin the peer review process within three months after receipt of the last data used in generating the Standard Data Products.

The calibrated products will be included in data sets for delivery to the PDS to begin the peer review process within six months after receipt of the last data used in generating the data sets.

The calibrated NAVCAM products and archive will be generated by the SDC per a calibration procedure to be developed by the NAVCAM instrument team. The calibrated NAVCAM archive will be delivered to the PDS SBN by the SDC.

The calibrated CIDA and DFMI products will be generated by the CIDA and DFMI instrument teams, respectively. The CIDA and DFMI instrument teams will be responsible for delivering the calibrated archives to PDS SBN; they may use the SDC as the vehicle (i.e. disk space) for these deliveries.

8.3 Data Management Contingency Plan

Few contingencies are possible during the management of STARDUST-NExT file and stream data. Routine operational practices and redundant hardware as well as redundant storage at key locations for limited periods within the GDS are planned. STARDUST-NExT project data will be backed up as part of routine daily operations and/or processed on remote redundant systems. If significant amounts of expected data are not present, a replay from the most convenient location within the GDS will occur. The following contingencies cannot be accommodated with routine operations:

1. Data recorded on the spacecraft but not received on Earth
2. Earth-received data that the GDS is not able to process

Data being recorded on the spacecraft but not received on Earth is a possibility. Should any STARDUST-NExT data fall into this category and be of such importance that it must be recovered, only a change in spacecraft data storage management and downlink strategy can recover the data. Once on the ground the data will be processed like any other telemetry data.

Earth-received data that cannot be processed by the GDS due to a GDS or spacecraft problem will require retention at the most convenient of the temporary locations where data are captured until the problem that was preventing processing has been corrected or a work-around has been implemented.

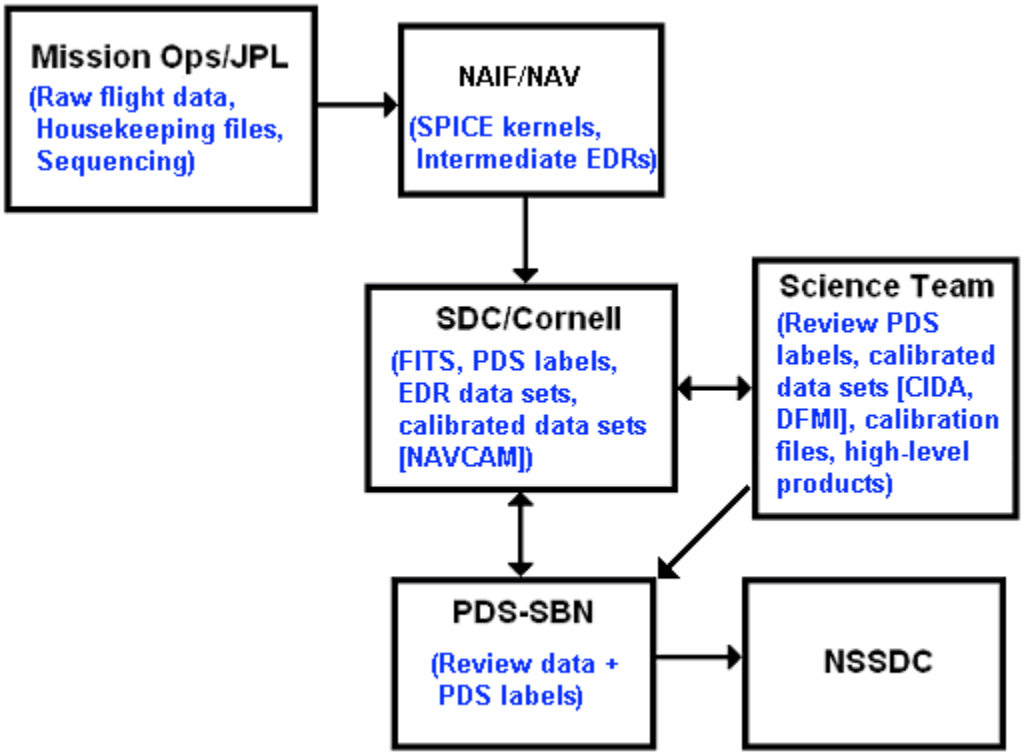

Figure DMAP.2. STARDUST-NExT Conceptual Data Flow Detail Around Science Data Center (SDC)

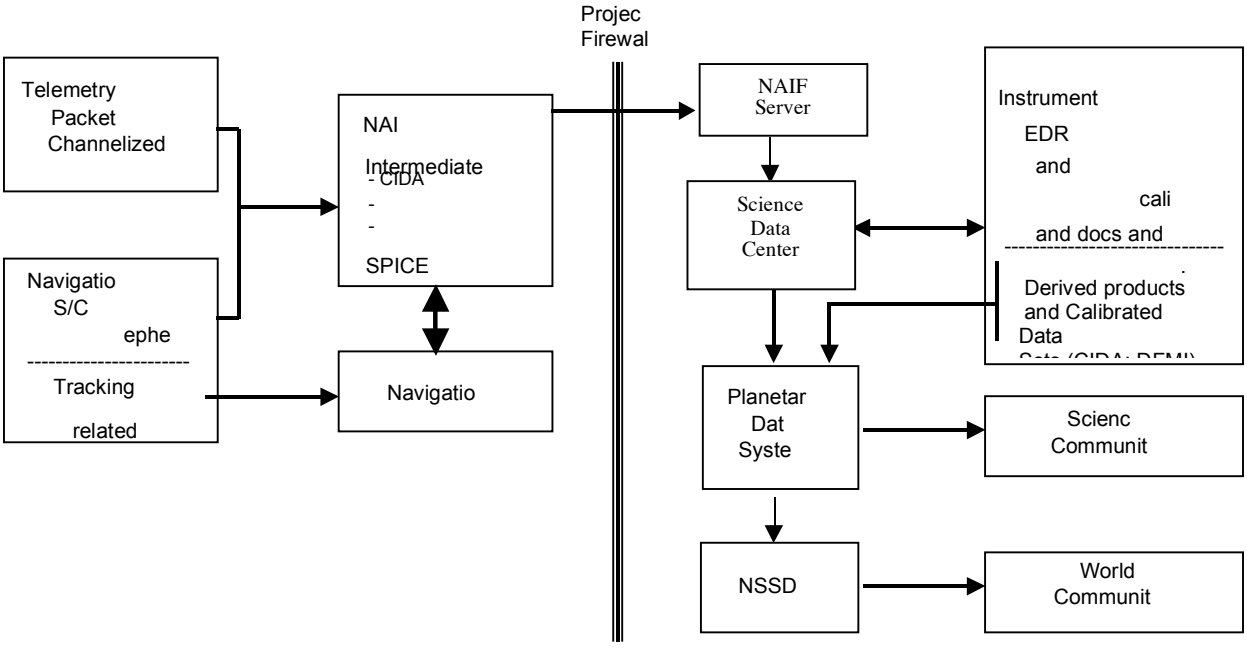

Figure DMAP.3. STARDUST-NExT Downlink Data Flow, Processing and Interfaces

TABLE DMAP.1. STARDUST-NExT Telemetered Flight Science Data

Investigation	Description	Team Lead
Navigation Imaging Camera (NAVCAM)	CCD-based camera having 1024 x 1024 active pixels with a 3.5 x 3.5 deg field of view and a mirror to change pointing over a 200 deg angle. Navigation is primary function; science is bonus.	Mr. Kenneth Klaasen, JPL & Dr. Joseph Veverka, Cornell
Dust Flux Monitor Instrument (DFMI)	Two acoustic and two PVD sensors counting dust impacts from $1.0*10^{-11}$ to $1.0*10^{-3}$ grams.	Dr. Thanasis Economou, University of Chicago
Cometary and Interstellar Dust Analyzer (CIDA)	Time of Flight Mass spectrometer	Dr. Teemu Mäkinen, FMI, Dr. Jochen Kissel, MPI Emeritus

TABLE DMAP.2. ESTIMATED INSTRUMENT DATA SET VOLUMES

	Data, Mbits	
Instrument/Purpose	**EDR**	**RDR**
CIDA	100	200
DFMI	20	40
NAVCAM *	3,600	36,000
NAIF/NAV/SPICE	1,000	-
Calibration files	-	8,000
Documentation **	700	700
Total	**5,420**	**44,940**

* Includes lightcurve data on approach
** Estimated at 100 MBits per data set

TABLE DMAP.3. STANDARD DATA PRODUCTS

	Standard Data Product	
Source	**EDR**	**RDR**
CIDA	Time-of-flight Records	Charge vs. AMU
DFMI	Time series of dust counts	Flux (or Fluence) at each Mass vs. Time
NAVCAM	Raw Full frame images	Calibrated Full frame images
NAIF/NAV	SPICE Kernels	N/A

TABLE DMAP.4. Components of STARDUST-NEXT Data Sets

Raw Science Data Sets (one for each of the 3 instruments)

- Catalog and index files per PDS requirements
- Software Interface Specification Documents or equivalent
- Processing Descriptions, Algorithms, and Software (as documentation)
- Instrument Calibration Reports and associated information needed to understand the data
  - E.g. engineering data such as operation temperatures, decontamination bake-outs
- EDRs for CIDA, DFMI and NAVCAM

Calibrated Science Data Sets (one for each of the 3 instruments)

- Catalog and index files per PDS requirements
- Software Interface Specification Documents or equivalent
- Processing Descriptions, Algorithms, and Software (as documentation)
- Instrument Calibration Reports and associated information needed to understand the data
- Calibration files (these may occupy a separate media volume of the calibrated data set)
- Calibrated RDRs

SPICE Data Set

- Catalog and index files per PDS requirements
- SPICE Kernels

Packet and Engineering Data Safed Data Set

- Data Set Software Interface Specification Document
- Science Packet Data Products
- Engineering File Data Products

TABLE DMAP.5. STARDUST-NEXT Data Set Component Suppliers

Science Data Center (SDC)

- Planetary Data System objects
- EDRs and NAVCAM RDRs
- Raw PDS data sets; calibrated NAVCAM data set
- Project documentation

Navigation Team (NAV) and NAIF

- SPK kernel files (NAV)
- Non-SPK SPICE kernel files (NAIF)
- SPK files (NAV)
- SPICE PDS archive
- Small Forces File

All Instrument Teams (NAVCAM, CIDA, DFMI)

- Instrument calibration reports and associated data and software (as documentation)
- PDS Data Set Catalog object documentation
- Copyright-free science publications (if possible)

CIDA and DFMI Instrument Teams

- CIDA and DFMI RDRs
- Calibrated CIDA and DFMI data sets

DSMS / TC&DM

- Packet and engineering data (for safing)

TABLE DMAP.6. PDS RESPONSIBILITIES FOR ARCHIVING STARDUST-NEXT DATA

Planetary Data System Organization	Responsibility
Small Bodies Node	Overall coordination with STARDUST-NExT Project, including joint planning efforts. Validate the compliance of CIDA, DFMI, and NAVCAM and SPICE data sets to PDS standards. Arrange peer review of CIDA, DFMI, NAVCAM and SPICE data sets. Archive CIDA, DFMI, and NAVCAM data sets.
NAIF Node	Archive SPICE data set. Safe packet and engineering data records.

TABLE DMAP.7. URLs FOR ONLINE REFERENCES IN SECTION 1.4

Title and Date	URL
Planetary Data System - National Space Science Data Center Memorandum of Understanding, September 1, 1993	http://nssdc.gsfc.nasa.gov/archive/mou/PDS_MOUo.txt
Planetary Science Data Dictionary Online Database, January 23, 2008	ftp://pds.jpl.nasa.gov/pub/toplevel/tools/bin/datadictionary_1r69.zip
Planetary Data System Data Standards Reference, JPL D-7669, Part-2, March 20, 2006, Version 3.7	http://pds.nasa.gov/documents/sr/index.html
Planetary Data System Archive Preparation Guide (APG), JPL D-31224, August 29, 2006, Version 1.1	http://pds.nasa.gov/documents/apg/index.html

Glossary of Selected Terms

CODMAC Level — For this document, the CODMAC data processing levels are as defined in Chapter 6, Section 6.3.2 of the Planetary Data System Standards Reference (JPL D-7669, Part 2, March 20, 2006, Version 3.7):

Level	Type	Data Processing Level Description
1	Raw Data	Telemetry data with data embedded
2	Edited Data	Corrected for telemetry errors and split or decommutated into a data set for a given instrument. Sometimes called Experimental Data Record. Data are also tagged with time and location of acquisition.
3	Calibrated Data	Edited data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so edited data can be reconstructed.

N.B. In this document, other than in the table above, Raw refers to CODMAC Level 2 data.

Data Product — A labeled grouping of data resulting from a scientific observation i.e. a PDS label and its corresponding data. A product label describes the structure of the data. Examples of data products are planetary images, spectrum tables, and time series tables.

Data Set — Data Sets are defined in terms of Data Products. A data set is an aggregation of data products with a common origin, history, or application. A data set includes primary (observational) data plus the ancillary data, and documentation needed to understand and use the observations.

Experiment Data Record — CODMAC Level 2 data product produced from instrument packet data with PDS labels.

High-level catalog — High-level descriptive information about mission, spacecraft, instrument, data sets, and related items. Catalog inputs derived from objects expressed in Object Description Language (ODL) which are suitable for loading into a catalog.

Reduced Data Record — CODMAC Level 3 data product.

Science packets — CODMAC Level 1 data for a given instrument in unchannelized telemetry packetized form.

Special Data Products — derived from CODMAC Level 2 or higher products by use of data analysis, data transformation in space, spectra and/or time. Examples include dust models, 3-dimensional topography models and map products.

Standard data product — data record generated in standard or predefined way using well-understood procedures. Processed in a software pipeline.