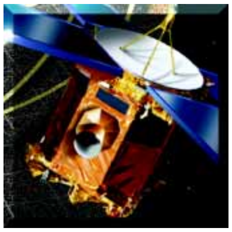

# The NEAR Science Data Center

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The Near Earth Asteroid Rendezvous (NEAR) Science Data Center serves as the central site for common data processing activities needed by the NEAR science teams and the scientific community. The Center provides instrument and spacecraft data to the science teams from around the world and redistributes science products produced by those teams, allowing the teams to focus on analysis. These data and the accompanying documentation are available at http://sd-www.jhuapl.edu/NEAR/. In addition, the Science Data Center is responsible for archiving spacecraft, instrument, and science data to the Planetary Data System.
(Keywords: Data archive, Data distribution, Spacecraft telemetry.)

## INTRODUCTION

The Science Data Center (SDC) established for the Near Earth Asteroid Rendezvous (NEAR) mission is the central site for the mission's data processing activities. This article describes the design, rationale, and implementation of the SDC, as well as the tasks performed and services provided.

The software components of SDC processing are telemetry server processing (TSP), science archive processing (SAP), and product server processing (PSP). These are discussed in terms of the sequence of data flow (Fig. 1). The TSP handles the raw telemetry data and produces the telemetry archive. The SAP uses the telemetry archive and ancillary information to produce the science archive and a catalog of indices to science archive data. The PSP uses the science archive and the catalog to produce products for the science teams and to archive data to the Planetary Data System (PDS).

Because the SDC is being developed during the NEAR cruise period (i.e., between launch and encounter), parts of the SDC are at varying stages of development. The development and function of these phases are discussed, in addition to a physical description of the SDC, including computer, display, and networking facilities.

### Mission and Technology Aspects

Unique mission design concepts and considerations have driven the NEAR program. The SDC design takes advantage of this uniqueness and of technological advances to produce a data center that is smaller and less expensive than similar facilities.[1]

Foremost, the amount of data that will be telemetered each day from the spacecraft is small in comparison with recent Earth-orbiting missions. NEAR will have approximately 95 megabytes of telemetered data per day during the rendezvous. For comparison, the Midcourse Space Experiment spacecraft downlinks between 2 and 7 gigabytes per day. The total

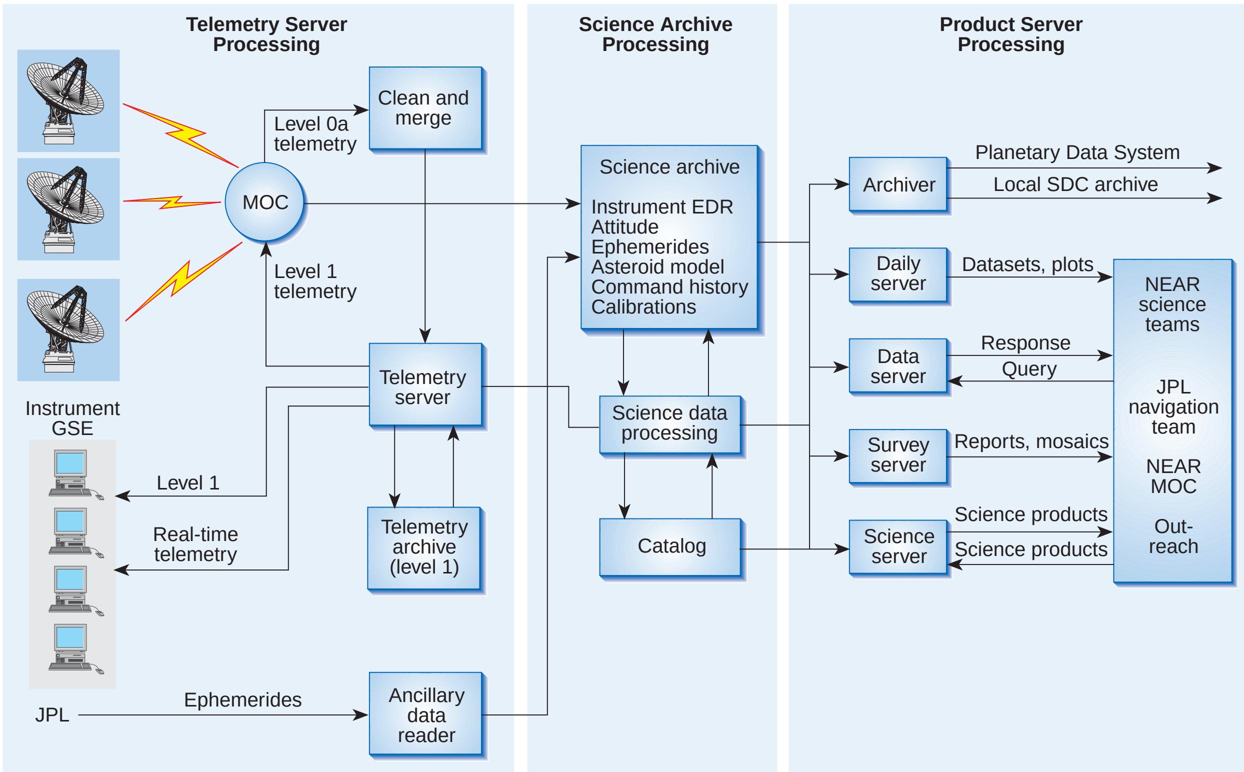


**Figure 1.** Data flows through the three major processing components of the NEAR Science Data Center. Telemetry data received from the Mission Operations Center is cleaned and merged into the telemetry archive. An archive of instrument science data is created, cataloged, and made available as science data products. (MOC = Mission Operations Center, GSE = ground support equipment, JPL = Jet Propulsion Laboratory, EDR = experimental data record, SDC = Science Data Center.)

amount of science data that will be collected is small: 30 gigabytes of telemetered data during rendezvous (this size estimate uses conservative estimates of antenna coverage and could increase if the project receives more coverage). The NEAR telemetry stream is simple. It consists of fixed-length Consultative Committee for Space Data Systems transfer frames assembled by the onboard command and data handling system. These transfer frames are primarily composed of fixed-length instrument packets formed by the instrument data processing units. A second simplification for the SDC is that the packaging of the telemetry stream necessary to transmit the data to Earth has been removed by the Mission Operations Center (MOC). Thus, the data appear to the SDC as they were formed by the command and data handling system.

The instruments package their science records into packets for collection by the command and data handling system. The instrument science records were designed to contain all of the instrument state information necessary to interpret the instrument data. This makes it easy to correlate measurements with state information. An exception to this is the Magnetometer, which will need currents from throughout the spacecraft to correctly interpret the data.

The project has a long cruise period (approximately 3 years from launch to rendezvous with Eros) during which no scheduled science activities will occur. As a result, the SDC will not need to be fully operational until just prior to rendezvous. In the meantime, the science teams are encouraged to use the instrument ground support equipment (GSE) software for quick-look analysis and calibration during the cruise.

Advances in technology are an element of the design. Because of the growth in on-line storage capacity, commonly available magnetic media, currently with a capacity of 9 gigabytes per drive, are expected to contain approximately 50 gigabytes by the time of rendezvous. This means that it will be easier to store all mission-related data on-line, and thus the design of all processing and analysis software will be simplified. Also, the staff required during rendezvous operations will be reduced because off-line media will not need to be archived and restored, and software will not have to be developed for this activity. The available on-line storage makes access more immediate and helps with correlative studies.

The phenomenal increase in the computing power of desktop systems, both in PCs and in workstations, allows us to defer some of the data processing to data access. Preprocessing of data is therefore reduced, and data can be stored in a very raw format. Most, if not all, analyses can be deferred to the scientist's desktop.

The SDC assumes that all members of the NEAR science teams have access to the global Internet. With universal networking and low data rate, we will deliver products through the Internet to the science teams in electronic form.

### SDC Design Considerations

The SDC design is based on the previously described mission aspects and technological advances leading to the following top-level design considerations. The SDC performs the common data processing tasks and makes spacecraft and navigation data available to the science teams and its members. Data are archived and retrieved in a format developed by the SDC and science teams. Through the SDC, a science team will have access to the data of the other science teams. Correction and calibration algorithms developed by the science teams will be incorporated into SDC processing and make preliminary validated science data generally available. The science teams are responsible for supplying final calibration algorithms for archiving to the PDS at the end of the mission.

The SDC will make extensive use of the Internet. All outputs from the SDC are delivered over the network, and in most cases, only over the network. Since the SDC is delivering data to the desktops of scientists, not software or applications, data will be delivered in common formats such as the Flexible Image Transport System (FITS) and Hierarchical Data Format (HDF). Data in these formats can be easily read by commercial and public domain software. Analysis software development by the science teams will also be aided by the availability of file access software libraries.

### Data Sources and Recipients

The major sources of data for the SDC are telemetry downlink, commands executed on the spacecraft, navigation data, and validated scientific data. The first two are delivered to the SDC by the MOC at APL. The Jet Propulsion Laboratory navigation team provides navigation data, and the science teams provide validated science data. The SDC distributes the data to the science teams, the general scientific community, and the PDS.

## TELEMETRY SERVER PROCESSING

Telemetry data received from the MOC needs to be prepared before further processing can be done. The TSP removes and logs errors in the telemetry stream, sorts the data according to time, breaks the telemetry stream into packets, and removes duplicate packets. The result is a cleaned and merged telemetry archive that becomes the basis for science archive processing. The TSP is also responsible for nearly real-time production of minimally cleaned and sorted files for use by GSE quick-look displays.

### Telemetry Archive

The telemetry data are delivered to the SDC in three virtual channels:[2] VC0 (recorder), VC3 (real-time), and VC2 (image), composed of Consultative Committee for Space Data Systems transfer frames (Fig. 2). The transfer frames all contain header information to support error detection and data interpretation. The MOC system (EPOCH) header contains ground processing data, including ground receipt time, data source station, and data quality values based on cyclic redundancy check (CRC) and Reed Solomon error detection. The primary and secondary transfer frame headers include the transfer frame virtual channel identifier, Mission Elapsed Time (MET), transfer frame sequence counters, and status information associated with the transfer frame.

The data portions of the VC0 and VC3 transfer frames are composed of three fixed-size packets (Fig. 3) that consist of primary and secondary headers followed by a fixed-size data portion. The packet headers include the packet type and MET. Table 1 summarizes the data portion of the science data packets for the Multispectral Imager (MSI), X-Ray/Gamma-Ray Spectrometer (XGRS), Near-Infrared Spectrometer/Magnetometer (NIS/MAG), and NEAR Laser Rangefinder (NLR). A more detailed discussion of the layout is found in Refs. 3 through 7.

The telemetry archive is organized by Universal Time (UT) year and UT day within UT year. Table 2 shows this directory organization with the subdirectories indicated by indentation and gives the packet header application identifiers. The UT time is the time that the transfer frame was formed on the spacecraft. These data are made available to the science teams, engineering teams, and MOC. The data are available locally using Network File System (NFS), AppleShare, and Microsoft Networking. The data are also available remotely via the World Wide Web (WWW) or File Transfer Protocol (FTP).

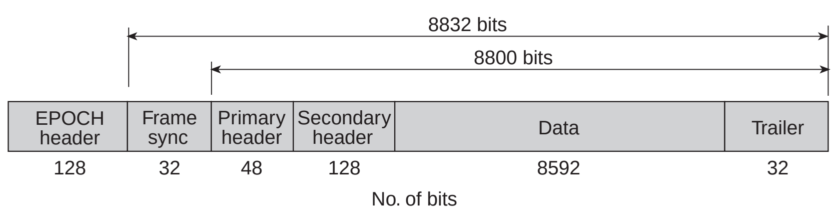


**Figure 2.** Consultative Committee for Space Data Systems transfer frame.

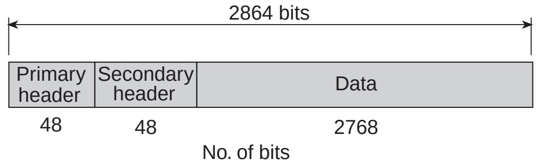


**Figure 3.** Consultative Committee for Space Data Systems packet.

## Clean and Merge

The process of adding the data to the telemetry archive is called "clean and merge," which starts with the transfer of the data from the MOC. The MOC performs the real-time capture of the telemetry downlink, and the data are written to a series of files used

Table 1. Summary of the instrument telemetry science data values. The instruments have multiple operation modes, each with a separate packet type.

| Instrument | Packet type (file name) | Science data description |
|---|---|---|
| MSI | Full image (imager.pkt, vc2.xfr) | Full image contains 244 lines of 537 pixels with header and housekeeping. A full image requires up to 183 VC2 transfer frames or 569 VC0/VC3 packets, depending on compression and 8- or 12-bit pixel size. The header contains filter position, exposure time, and compression mode. |
| | Summary image (imager.pkt) | Each packet contains a summary image consisting of 22 lines of 26-bit superpixels with header and housekeeping. |
| XGRS | Gamma-ray (xg-spec.pkt) | A gamma-ray science record requires 31 packets. A science record contains housekeeping and the following spectra. For each spectrum, the event that is counted and the number of 16-bit bins are shown in parentheses.<br>NaI integral (any NaI event) (1024)<br>BGO integral (any BGO event) (1024)<br>NaI anti-coincidence (NaI event, no coincidence) (1024)<br>NaI single escape shifted (coincidence, BGO in single escape window) (1024)<br>BGO single escape peak (coincidence, BGO in single escape window) (42)<br>NaI double escape shifted (coincidence, BGO in double escape window) (1024)<br>BGO double escape peak (coincidence, BGO in double escape window) (42) |
| | X-ray (xg-spec.pkt) | An X-ray science record requires seven packets. A science record contains housekeeping and four types of spectra: unfiltered, Mg, Al, and active solar X-ray. Each spectrum has 256 bins, with 16 bits per bin, of valid events. |
| | X-ray, gamma-ray summary (xg-spec.pkt) | One packet with housekeeping and spectra for unfiltered X-ray, Mg-filtered X-ray, Al-filtered X-ray, active solar monitor, integral NaI, and integral BGO. All spectra have 16 bins with compressed 8-bit values. |
| NIS | Streamed science records (nis-mag.pkt) | Each packet can contain approximately 2.3 NIS science records. Science records immediately follow the previous record. Each science record contains housekeeping, a Ge spectrum (0.8–1.5 $\mu$m) and an InGaAs spectrum (1.3–2.6 $\mu$m), both with $32 \times 16$ bit bins. The housekeeping values contain gain state and slit position. |
| MAG | Science record (nis-mag.pkt) | Each packet contains a single science record with housekeeping and 44 16-bit samples of $x$, $y$, and $z$ components of the DC field and 1 AC sample. |
| NLR | Normal rate (lidar.pkt) | Each packet contains a 60-bit status section and $56 \times 48$ bit data sets. A data set includes the Mission Elapsed Time, threshold setting, calibration range value, data quality flags, and a 21-bit range value. |
| | High rate (lidar.pkt) | Each packet contains a 60-bit status section and $112 \times 24$ bit data sets. A data set includes data quality flags and a 21-bit range value. |

Table 2. Telemetry archive file organization.

| Directory structure | | | | | Purpose |
|---|---|---|---|---|---|
| Telemetry(dir) | | | | | Contains all of the telemetry files |
| | data(dir) | | | | Contains telemetry archive |
| | | yyyy(dir) | | | Year of transfer frame formation |
| | | ddd(dir) | | | Day of transfer frame formation |
| | | | vc2.xfr | | Contains VC2 transfer frames with EPOCH headers |
| | | | vc2.idx | | Index file for use by instrument GSE |
| | | | vc0(dir) | | |
| | | | | vc0.xfr | Contains VC3 transfer frames with EPOCH headers |
| | | | | aiu1.pkt | Contains AIU packets with APID 2 |
| | | | | aiu2.pkt | Contains AIU packets with APID 3 |
| | | | | ctp1.pkt | Contains CTP packets with APID 0 |
| | | | | ctp2.pkt | Contains CTP packets with APID 1 |
| | | | | fc1.pkt | Contains flight computer packets with APID 10 |
| | | | | fc2.pkt | Contains flight computer packets with APID 11 |
| | | | | imager.pkt | Contains MSI packets with APID 4 |
| | | | | lidar.pkt | Contains NLR packets with APID 7 |
| | | | | nis-mag.pkt | Contains NIS/MAG packets with APID 6 |
| | | | | xg-spec.pkt | Contains XGRS packets with APID 5 |
| | | | | *xxx*.idx | Index files for each of the packet files, for use by GSE |
| | | | vc3(dir) | | |
| | | | | *save as vc0* | |
| | | tar(dir) | | | Gnu zip compressed tar files for older files |
| | error-cm(dir) | | | | Contains transfer frames that were found in error |
| | | yyyy(dir) | | | Year of transfer frame formation |
| | | ddd(dir) | | | Day of transfer frame formation |
| | | | yyddd.err | | |
| | | | yyddd.log | | |

Note: AIU = attitude interface unit, APID = application identifier, CTP = command and telemetry processing.

as input by the SDC. These files are read by a process running on the MOC front-end machine and passed, via a Transmission Control Protocol/Internet Protocol socket, to a process running on a machine in the SDC. This design means the processing in the SDC can be asynchronous with processes running in the MOC. There is no need for elaborate control and signal passing between the MOC and SDC. The SDC can incur downtime without affecting critical functions in the MOC. If the SDC loses contact with the MOC, no data are lost. The TSP resumes processing when contact is reestablished.

The MOC files that TSP reads are approximately 1 MB in size. When this size is reached or if approximately 1 h has elapsed, TSP starts a merge, and the data from the file are added to the full-day telemetry archive file. To do this, the telemetry reading process is momentarily halted. The transfer frames files that were being written are moved from the contact directory to the process directory, and the telemetry reading process continues. The data are cleaned by sorting, duplicate removal, and removal of data with flagged errors. The cleaned data are merged into the telemetry archive, creating the instrument data files described in Table 1, as well as the command and telemetry processor, attitude interface unit, and flight computer files.

### Real-Time Processing for Ground Support Equipment Quick Look

The NEAR GSE consists of PCs with software to provide a quick look at the NEAR science telemetry data. The equipment was developed for ground instrument checkout, but was also designed to be reused for rapid science data display for in-flight instrument checkout and monitoring. TSP real-time processing does a brief sort and clean and creates the real-time files for the GSE. The files are fixed-length circular queues of instrument data that are paired with index files reflecting the current position being written. The TSP provides data to all GSE, local and remote, through NFS or FTP. The GSE displays are being augmented by Visual Basic programs to display real-time command and telemetry processor, attitude interface unit, and flight computer packets.

## SCIENCE ARCHIVE PROCESSING

The science archive is the source data for all products provided to science teams and the data archived to the PDS. Science archive data created from telemetry data include instrument science data, housekeeping, and guidance and control system data. The science archive also contains command history, navigation, and instrument calibration data. It is created by processing telemetry archive packets into science experimental data records (EDRs). Each instrument has defined an EDR as a single complete unit of data, defined by the instrument requirements documents.[4–7] For example, for the MSI, an EDR is a single image. New EDR data are added to the science archive at 4-h intervals. This interval is set to allow time for all science archive update processing to be completed, but it can be shortened if processing load allows.

### Science Archive Files

Science archive data are stored in HDF, which was developed by the National Center for Supercomputer Applications for use in storing scientific data. It was selected for the science archive because the format and the associated libraries are platform independent. HDF is a self-documenting scientific data format with data type, names, and dimensionality built into the file. This provides the basis for automated access by the SDC and the science teams.

The HDF files are organized by instrument and then year, and then day of year. Internally, the data are organized into EDRs with the fields broken out into machine-recognized objects (e.g., byte or integer) to simplify access. All science data from the telemetry packet files are preserved in the transfer to the HDF files. The data are not stored in engineering units but are converted upon access. The layout of the data in the HDF file corresponds closely to the EDR definition. All EDR types for an instrument are stored together in a single file along with a descriptive file header. A complete list of variables will be on-line at our WWW site (http://sd-www.jhuapl.edu/NEAR/). The XGRS and MAG teams are directly using the HDF files, and other teams will use files created from the data in the HDF files.

### Command History

A history of commands, as executed on the spacecraft, is formed by the MOC. The purpose of these data is to provide the science teams with the capability to verify how their instrument was commanded and to correlate the information to observed measurements. The exact format and delivery method for command histories will be developed during the cruise portion of the mission.

### Navigation Data

The navigation and pointing information for the mission will be distributed to the science teams via SPICE kernels. SPICE (spacecraft, planet, instrument, C-matrix, events) is an information facility, created by the Navigation Ancillary Information Facility at the Jet Propulsion Laboratory, for providing ancillary observation geometry data. The SPICE kernels are composed of spacecraft and asteroid ephemerides produced by the Jet Propulsion Laboratory navigation team, clock kernels produced by mission operations, attitude kernels produced from the flight computer data by the SDC, and binary planet kernels produced by the Navigation Ancillary Information Facility. The binary planet kernel is an extension to SPICE, which will encapsulate the dynamics of the asteroid. A second extension to SPICE, built explicitly for NEAR, will allow the use of a plate model of the asteroid. The SDC maintains an on-line archive of SPICE files organized by mission phase and data source (predictive or determined).

### Catalog

The purpose of the catalog is to enhance access to the science archive, allowing the science teams to rapidly carry out complex queries of the database, to determine what measurements satisfy the criteria and to produce products based on those criteria. The NEAR SDC catalog makes use of an Oracle relational database to store state, position, pointing, and ancillary data information in a form that will make the queries easier and faster. The catalog will not directly contain the science data in the science archive, but it will contain indices to that data. The science archive is entirely on-line and can be scanned to retrieve data referenced by the catalog or to resolve a query not covered by the catalog.

The database will include asteroid locations, spacecraft locations, mission phases, instrument phases, instrument conditions, and pointing. Table 3 is a preliminary list of the tables that will be present in the database, and Table 4 provides a sample detailed look at the IMAGER table. Since the database is a query tool, not an analysis tool, the absolute fidelity of the database is not necessary. Information based on spacecraft and asteroid ephemerides will not be updated every time a new ephemeris is derived. Users of the information are cautioned to access a range of information and use the science archive with the most recent SPICE kernels to validate the information to obtain the best possible values. We can, during the course of the mission, add items to the catalog that would make subsequent analysis easier. Oracle database tools will be available to provide interactive and software developer access to the catalog from the SDC. In addition, limited WWW access to the catalog will be provided by the product server interface.

## PRODUCT SERVER PROCESSING

Previous sections have described data that go into the SDC and how data are internally stored in the SDC; the PSP provides these data to the science teams. The SDC is making spacecraft and ancillary data available to the science teams in formats developed in cooperation with them. When the science teams have specified a product for the SDC to provide, a PSP module is created to make this product from the data in the SDC telemetry and science archives. After SDC and science team testing, an automated production schedule is established, and the science team is given the file system location of the product files. For example, the MSI/NIS team, along with the SDC and

Table 3. Science data catalog tables.

| Table | Description |
|---|---|
| IMAGER | Contains search data for MSI data |
| IMAGERlrp | Contains a list of all of the low-resolution plates associated with each image |
| IMAGERhrp | Contains a list of all of the high-resolution plates associated with each image |
| IMAGERtoi | Contains times of interest to the MSI science team |
| NIS | Contains search data for the NIS |
| NISlrp | Contains a list of all of the low-resolution plates associated with each spectrograph |
| NIShrp | Contains a list of all of the high-resolution plates associated with each spectrograph |
| NIStoi | Contains times of interest to the NIS science team |
| XR | Contains search data for the X-Ray Spectrometer |
| XRtoi | Contains times of interest to the X-Ray Spectrometer science team |
| GR | Contains search data for the Gamma-Ray Spectrometer |
| GRtoi | Contains times of interest to the Gamma-Ray Spectrometer science team |
| MAGtoi | Contains times of interest to the Magnetometer team |
| LIDARtoi | Contains search data for the NLR |
| Position | Contains the position of the spacecraft in the asteroid body fixed-coordinate system |
| Mission phase | Contains the start and stop times for different mission phases |
| Science sequence | Contains times of interest when science sequences occurred |
| Science sequence codes | Contains the science sequence codes |
| LRP | Contains the low-resolution plate model |
| HRP | Contains the high-resolution plate model |
| Asteroid spectral properties | Contains pointers to asteroid spectral properties datasets |
| DPID | Contains pointers to science data |

Note: lrp = low-resolution plates, hrp = high-resolution plates, toi = times of interest, DPID = data product identifier.

Table 4. Example of catalog table contents (IMAGER table, item 1 in Table 3).

| Item | Description |
|---|---|
| Image ID | A unique number per image |
| DPID | A data product identifier |
| DQI | An indicator of the data quality |
| SSID | A pointer to a science sequence |
| Image no. | Image number within a day, used to label image products |
| UTC | Universal Time Coordinate when the image was taken |
| MINpos | The minimum $x$, $y$, and $z$ position values in the image based on the current plate model |
| MAXpos | The maximum $x$, $y$, and $z$ position values in the image based on the current plate model |
| Filter no. | Filter number for this image |
| Exposure time | Exposure time in milliseconds |
| TemperatureCCD | Temperature of the charge-coupled device in degrees Celsius |
| TemperatureTele | Temperature of the telescope body in degrees Celsius |
| Incidence angle | The angle between the surface normal and the Sun in degrees |
| Emission angle | The angle between the surface normal and the imager pointing vector in degrees |
| Range | Range from spacecraft to asteroid surface in kilometers using ephemeris data |
| Phase angle | The angle between the Sun and the imager pointing vector as measured from the surface in degrees |

navigation team, decided to use the imager data in the form of a FITS file. This file is a flat binary file with an ASCII header containing ancillary information of interest to both the MSI/NIS team and navigation team. These files are currently produced every 4 h when the science archive is updated.

The SDC was designed to generate products for science teams that reflect the data obtained that day and to update summary products based on the most recent data. The daily products will remain on-line for a short period of time (7 days), allowing the science teams to download them. The SDC will also provide an interface that will allow the science teams to create products based on criteria in the database. In the simplest case, a science team could ask for all of the images taken during a specific period. Some science teams have requested that the data products created by the SDC be restricted to them for a fixed period. Currently, that time is 7 days, after which the data will be available to the general public.

The SDC has the responsibility to make preliminary calibrated data available to nonprimary science team members and the general scientific community. The project has two competing goals: (1) to ensure that the science data are available to the larger community as quickly as possible, and (2) to make sure that the data are correct. The following compromises have been made: The science teams will deliver algorithms to the SDC that will allow it to correct the results for known gross errors based on bench and flight calibrations. The SDC will implement these algorithms so that it can produce the corrected data. These data are intended for the use of the nonprimary science team and the general science team. At the end of the mission, the science teams must deliver best and final algorithms for the calibration of their data to the PDS so that the algorithms can be archived with the data. The format of the delivery has not yet been specified.

The NEAR SDC is unique because it will be using the facilities of the Internet to distribute the data, stored on a server system within APL, to the science teams. The current prototype user interface for this design is using WWW–type access (http://sd-www.jhuapl.edu/NEAR/) and anonymous FTP and system-user FTP for science team members (ftp nearsdc-ftp.jhuapl.edu). Full development will include a database WWW access and will be available by encounter. The current home page is based on the Netscape 2.0 browser for access and will continue to follow browser and server development until final configuration prior to encounter. The prototype user interface provides complete access to the SDC for the science teams and allows restricted access for the general public.

The science teams are developing science result products that will be archived to the PDS. At the end of the mission, the science teams will be responsible for converting their results to PDS format. The SDC will convert the spacecraft data and produce a PDS archive.

## HARDWARE CONFIGURATION

The hardware configuration for the NEAR SDC is being purchased in two phases (see the boxed insert). The first phase is complete, and the second phase will occur six months before encounter.

The main processing will be done on UNIX workstations from Hewlett Packard. The main user interface and display systems are on IBM PC clones from Gateway 2000 and X Window System terminals from Network Computing Devices. The NEAR SDC hardware configuration supports the concept of data reduction on UNIX workstations and data displays on IBM PC clones, taking advantage of the current strengths of both architectures. Prior to rendezvous, APL will be purchasing additional hardware to support the rest of the mission.

The science teams are able to use the SDC equipment remotely or while they are resident at APL. The Laboratory is making an instrument GSE and an X-terminal available to each team (MSI/NIS, XGRS, and NLR/MAG) for use in the team's office while the members are resident at APL.

### SDC Hardware Configuration Listing

Original Purchase

Processors

1. loring: HP 9000/J200 dual processor, 384 MB
   24-bit color, 21-in. display
   4 × 9 GB disk arrays (4), 4 × 4 GB disk array (1)
   2-GB system disks (2), CD-ROM drive (1)
   DAT drive (1), DLT 4000 stacker (1)
2. morgan: HP 9000/715-64, 96 MB
   8-bit color, 17-in. display
   4 × 9 GB disk arrays (4), 4-GB disks (2)
   1-GB system disk (1), DAT drive (1)
3. nearsdc-ntas 1: Gateway 2000 P5-120, 32 MB
   17-in. display
   2-GB system drive (1), DAT drive (1)
4. nearsdc-gse 1: Gateway 2000 P5-75, 16 MB
   17-in. display
   1-GB system disk (1)

Secondary Purchase

Processors

1. Data distribution processor
   Distribute data to the science community
   Binary compatible with science data processor
   Serve as backup to the science data processor
2. Image processor
   Provide specialized image processing for project scientists

Peripherals

1. Additional disk capacity
2. CD-ROM writer for Planetary Data System archival

Note: MB = megabyte, GB = gigabyte, DAT = digital audio tape, DLT = digital linear tape.

## DEVELOPMENT AND OPERATIONS PLAN

Because the NEAR mission was planned with a long cruise phase, with no science activities, the SDC development was scheduled to occur between launch and encounter. Early funding allowed development of the TSP, which was ready at launch. This prototype system will be the working SDC software system for the early cruise period. The Build 1 SDC system was scheduled to be available by the encounter with the asteroid Mathilde in June 1997. The Build 1 development will have the basic capabilities of all elements of the final system including TSP, SAP, and PSP. After completion of the Build 1 system, changes and new products requested by the science teams will be incorporated in the design for the Build 2 system. Build 2 will be completed and tested before the encounter with Eros.

The SDC will need minimal operations staff during the encounter. A software development staff will be available to make limited revisions, as well as to create new products, as experience with the data is gained by the science teams. The software staff will also support incorporation of science team analysis products into the science archive.

During the encounter period, the SDC will prepare sample sets of science archive data in PDS format for science team review. Operation of the SDC is planned for a year after the end of the encounter. At that time, the science archive will be prepared for transfer to the PDS.

## SUMMARY

The SDC concentrates on the delivery of spacecraft and ancillary data to the science teams and general scientific community. It efficiently provides the common data preparation and access facilities required by all NEAR data users, minimizing duplication of data processing development efforts. In addition, the SDC provides centralized services for the archiving of documentation, mailing lists, and tools to diagnose and display telemetry data. It also provides the computing facilities and meeting and office space to promote collaborative science team activities. The latest information regarding the NEAR mission and the SDC can be found at http://sd-www.jhuapl.edu/NEAR/.

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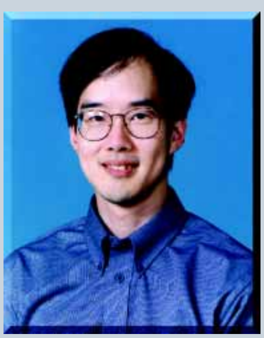

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