Multimission Software Interface Specification (SIS)

SPICE
Digital Shape Kernel

DSK

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PURPOSE: This SIS outlines the content of a SPICE Digital Shape Kernel and it provides information about how to use a DSK.

CHANGE LOG

Version	Date	Page Nos.	Reason
1.0	29 May 2012	All	First draft
1.1	25 June 2013	3	Section 1.3

List of Acronyms

API	Application Program Interface (as in module or subroutine)
ASCII	American Standard Code for Information Interchange
DAS	Direct Access, Segregated
DEM	Digital Elevation Model
DLA	DAS Linked Array
DSK	Digital Shape Kernel
JPL	Caltech/Jet Propulsion Laboratory
NAIF	Navigation and Ancillary Information Facility
PCK	Planetary Constants Kernel
SIS	Software Interface Specification
SPICE	S-, P-, I-, C- and E-kernels; the principal logical data components of a particular NASA ancillary information system

Section 1
General Description

1.1 Purpose of Document

This Software Interface Specification (SIS) outlines the contents and structure of a SPICE Digital Shape Kernel (DSK) file, and summarizes SPICE Toolkit software provided to work with DSKs.

1.2 Scope

This is a multimission SIS, applicable for all flight projects.

1.3 Reference Documents

No.	NAIF Document ID	Title
1.	414	Digital Shape Kernel Required Reading
2.	286	DAS Required Reading
3.	318	Kernel Reqired Reading
4.	415	MAKDSK User's Guide

These reference documents are included in each delivery of the SPICE Toolkit and are also available under the Documents link of the NAIF website: http://naif.jpl.nasa.gov.

Also available is a SPICE tutorial, named shape_model_preview, available from the NAIF server:
http://naif.jpl.nasa.gov/pub/naif/toolkit_docs/Tutorials/pdf/individual_docs/

1.4 Functional Description

A digital shape kernel contains any of a variety of types of data used to constuct one of two kinds of three-dimensional shape models: a tessellated plate model or a digital elevation model. These two kinds of models are in addition to the tri-axial shape model, provided as part of a SPICE Planetary Constants Kernel (PCK). DSKs provide SPICE users with higher fidelity (more realistic) models of target bodies as compared to tri-axial models.

A tessellated plate model consists of a collection of triangular plates joined along their edges. It is useful in modelling small, irregularly shaped objects such as asteroids, comet nucleuses and some very small irregularly shaped satellites such as Phobos and Deimos.

A digital elevation model (DEM) is used to model bodies that are more spherically shaped but with some amount of measured surface topography; earth, the moon and mars are examples.

1.4.1 Data Source, Destination and Transfer Method

Data used to make a DSK typically come from a scientist or engineer who has used remote sensing data to determine a shape for a body. The source shape data are input to NAIF's MAKDSK utility program to produce a DSK file. The DSK file might be placed on a flight project's data server for wide use. Any common means for transfering a large, binary file without changing the file may be used: unix FTP is one such example.

1.4.2 Labeling and Identification

Within the SPICE context there are no requirements for labeling (file naming) for a DSK. However it is recommended that a DSK have ".bds" as its file name extesnion.

A DSK contains a "comment area" into which descriptive textual meta-data may be inserted by the file's creator. This area may also contain some information automatically inserted by the MAKDSK utility program. Any "comments" placed in the comment area of a DSK may be viewed using the *commnt* utility program available in SPICE Toolkits and from the NAIF webpages.

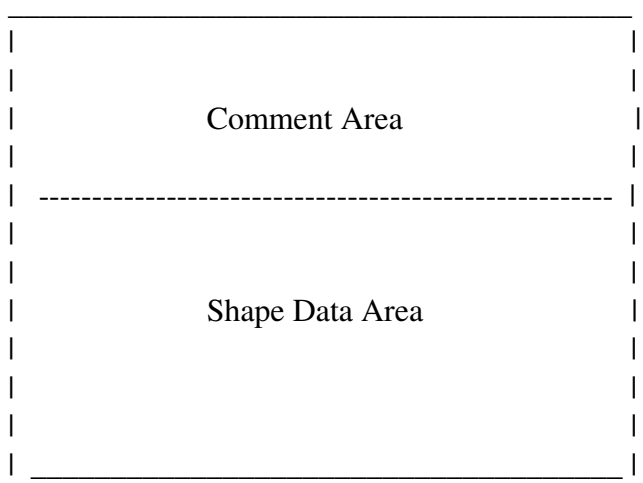
Section 2
Data Object Definition

2.1 Structure and Organization

A DSK is a binary file, based on a NAIF struture called "DAS Linked Array" (DLA). A DLA is itself built upon a more primitive NAIF structure known as "Direct Access Segregated" (DAS).

2.2 Data Description

A very simple view of a DSK file, based on SPICE DLA architecture, is shown in the drawing below.



Detailed descriptions and specifications for DSK and the underlying DLA and DAS architectures are provided in the first three reference documents; these specifications are not repeated in this SIS. General specifications for all SPICE kernel files are provided in the fourth reference docment.

Section 3
Using a Digital Shape Kernel

3.1 Loading a Digital Shape Kernel Into a Program

As for any SPICE file (usually called a kernel), a DSK must first be loaded into the user's application program using the *furnsh* API. Examples of doing this are provided below for all four languages supported by SPICE: Fortran 77, C, IDL and MATLAB.

```
CALL FURNSH ('<dsk file name>')
furnsh_c ('<dsk file name>')
cspice_furnsh, '<dsk file name>'
cspice_furnsh ('<dsk file name>')
```

However, it is much better practice to create a "furnsh kernel"–a kernel file in which the names of many or all of the SPICE files to be used are listed. Then the user's application program need load only that furnsh kernel in order to accomplish the loading of all the kernels it references.

Multiple DSKs may be loaded and used together.

Reference document number 4 more fully describes the use of the "*furnsh*" API.

3.2 Accessing and Using DSK Data

The user need not understand details about the format and record or byte-level contents of a DSK because the SPICE Toolkit contains the software, mostly in the form of APIs, needed to access a DSK, returning shape-related data and observation geometry quantities derived therefrom. As for all SPICE Toolkit code the details about how to use each of the DSK-related APIs provided in SPICE Toolkits are provided in the source code headers of those APIs. This documentation includes detailed descriptions of inputs, outputs and restrictions as well as one or more working examples of using the API.

A detailed description of the DSK subsystem, including the DSK-related APIs and utility programs, is provided in the "Digital Shape Kernel Required Reading" document, which is reference document No.1.