

The ESA SPICE Service (ESS) leads the SPICE operations for ESA missions. Its main activities:

1. The group is responsible for the generation, development, maintenance and archive of the **SPICE Kernel Datasets for the ESA Planetary Missions** (and Solar Orbiter)
2. It develops and operates software to convert orbit, attitude, telemetry and spacecraft clock correlation data into the corresponding SPICE formats.
3. Provides consultancy and support to the Science Ground Segments and the Science Community of the planetary missions for SPICE and ancillary data management.

ESS also provides an instance of **WebGeocalc** and **Cosmographia**

- WebGeocalc is a web-based interface to some SPICE Functions, extremely powerful for quick-look data
- Cosmographia is a Visualization Tool for a full SPICE Scenario.

Available, SPICE Kernel Datasets:
Releases and support to the community is provided



SPICE Kernel Dataset



The main purpose of the ESS for the Planetary Science Community is to provide a complete, consistent, high-quality, validated and up-to-date SPICE Kernel Dataset (SKD) for the given mission in order to be able to use SPICE with it. A SKD consists on a complete set of SPICE Kernels that cover the whole mission lifespan including long term predicted trajectory and orientation. Kernels in a SKD can be classified in two main types:

- (1) **Setup kernels (STK)** [FK, IK, PCK, LSK] are developed by ESS and are reviewed and iterated with the SGS and with the Instrument Teams when need be during the whole duration of the mission.
- (2) **Time-varying kernels (TVK)** [SPK, CK, SCLK, MK] are generated with the Auxiliary Data Conversion System (ADCSng) and the source data is provided by the Flight Dynamics in terms of OEMs, AEMs and Housekeeping TM data.

Depending on the mission phase SKDs can be in different states:

- (1) **Studies (pre-operational)** These kernel datasets are characterized for being highly dynamic with changes in Instrument and S/C frames definitions. Usually different study cases for different consolidated trajectories provided by Mission Analysis and with default and or study S/C Orientations are generated by the ESS.
- (2) **Operational:** Mars Express, ExoMars 2016. These kernel datasets are updated with kernels generated from the periodical trajectory and orientation updates and from the relevant information obtained from housekeeping telemetry. Some updates on Instrument and S/C models might occur responding to operational demands.
- (3) **Legacy (post-operations):** Rosetta, Venus Express: These are final peer-reviewed and consolidated datasets. This process is currently on-going for both missions.

SKDs are released on a regular basis when **STKs** are updated. For missions in operational phase updates will include the periodic release of **TVKs**.

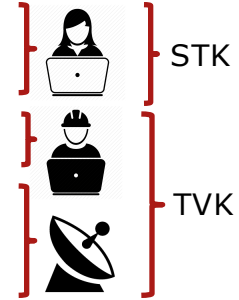
It is also important to distinguish in between **SKDs published in the ESA FTP** (Study and Operational) and the peer-reviewed and **PSA-PDS compliant Archived SKDs** (following the PDS3 and PDS4 standards from the Planetary Data System and IPDA).



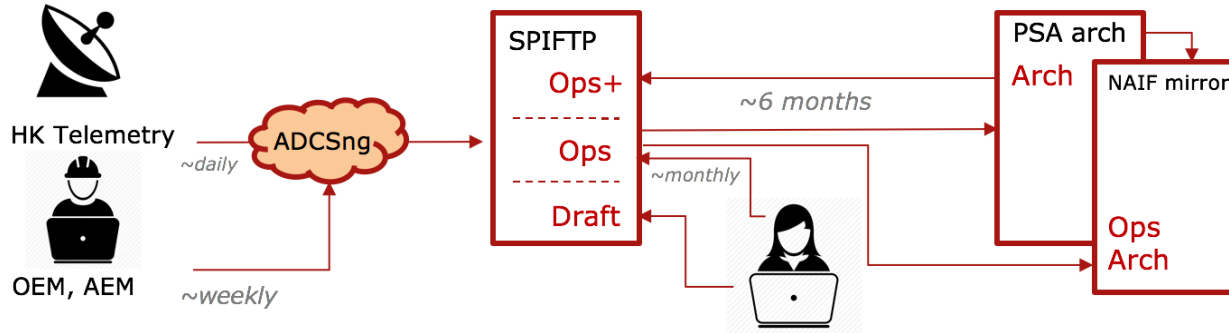
SKD Generation at ESAC

Operational kernels contain the following information:

1. Set of Reference Frames of interest for geometry computations
2. FoV and boresight modeling for remote and in situ sensors (at least)
3. Predicted trajectory and as-planned or default orientation for S/C
4. Reconstructed trajectory and orientation and on-board measured orientation for S/C
5. OBT to UTC/CAL time conversion
6. Orientation of Solar Arrays and HGA (if applicable)
7. Position of scans or turn-tables or articulations of payload



The **Auxiliary Data Conversion System next-generation (ADCSng)** generates the **time-varying kernels** when the mission is in operations and provides up-to-date trajectory, attitude and orientation information to science operations engineers and scientists.



VIA FTP

- So far the SKD has been distributed via FTP in a dedicated server accessible from here <ftp://spiftp.esac.esa.int/data/SPICE/ExoMars2016/kernels/>
- The FTP contains all the kernels that have been generated for EM16 and contains the operational meta-kernel that specifies which are the latest applicable kernels. This might not be the best solution.

PERMANENT LINK

- There is a permanent link to the latest SKD, containing only the kernels present in the latest operational meta-kernel. The link is available in the ESA SPICE page or directly here: <ftp://spiftp.esac.esa.int/data/SPICE/ExoMars2016/misc/skd/ExoMars2016.zip>
- This solution works if a user needs to make quick usage of the latest SKD.

GIT/BITBUCKET REPOSITORY

- Distribution of SPICE Kernel Dataset via Git is available in BitBucket and the latest version of the list of kernels for a given meta-kernel will be available via a Git Pull.
- The Bitbucket page is available here: https://repos.cosmos.esa.int/socci/projects/SPICE_KERNELS/repos/exomars2016/browse
- Large files (SPKs and CKs mainly) are available without overloading the repository with GIT-lfs (GIT large file system. Basically stores a reference to the file, not the file).
- This is the best solution to work with the EM16 SKD.