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Current Development at the Southern California Earthquake Data Center (SCEDC)

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Station Information System (SIS) Development at the SCEDC

The SCEDC has developed an improved Station Information System (SIS) for the California Integrated Seismic Network (CISN) Southern California Management Center (SCMC). The single most important determinant of any project's success is the identification of a clear and well-defined goal. The goal of this project was:

"Build a simplified database-driven Station Information System that will provide station metadata that is as complete as possible and allow easy viewing and modification of data that is contained in the database"

Problem Statement: The current methods of keeping track of all station information at the SCMC are not providing the functionality required to meet the needs of all of the users who need complete, accurate station information from a single source.

Scope: The scope of the system is to develop and implement a simplified metadata information system with the following capabilities:

1. Provide accurate station/channel information for active stations to the SCSN real-time processing system.
2. Provide accurate station/channel information for active and historic stations that have parametric data at the SCEDC e.g., for users retrieving data via STP from the SCEDC.
3. Provide all necessary information to generate dataless SEED volumes for active and historic stations that have data at the SCEDC.
4. Provide all necessary information to generate COSMOS V0 metadata information.
5. Be updated through a graphical interface that is designed to minimize editing mistakes.
6. Allow stations to be added to the system with a minimum, but incomplete set of information using predefined defaults that can be easily updated as more information becomes available. This aspect of the system becomes increasingly important with historic data when some aspects of the meta-data are simply not known.
7. Facilitate statewide metadata exchange for both real-time processing and provide a common approach to CISN historic station metadata.

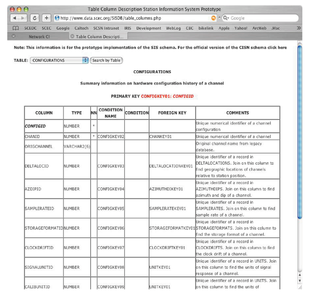
The system that will be developed has two fundamental design requirements:

1. A well-designed database that is the single source of information, i.e., the authoritative information is what is contained in the database, not in flat-files or any other databases.
2. Applications that interact with the data will interact directly with the database, i.e., they will not check information out of the database, manipulate it in another environment, and repopulate the database with the modified information.

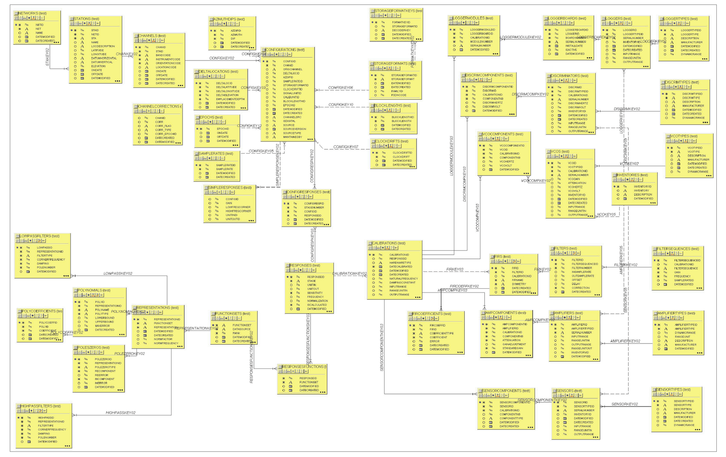
More information on this project is available at: http://www.data.scec.org/stations/SIS/

SIS Data Model

The SIS data model is the product of the database design process where we identified and organized the required data logically and physically. A database model identifies what information is to be contained in a database, how the information will be used, and how the items in the database will be related to each other.



The SCEDC invested significant time and effort on the data model which has had a positive impact on the end product. The SIS's highly normalized logical data model (schema pictured below) is implicitly designed for performance. If a database is not well modeled, it becomes clear to the applications and the users. The SIS's well-designed data model reduces the need for programming changes and increases application maintainability.

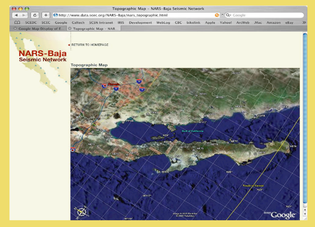


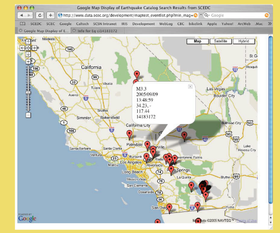
A searchable database schema (top) is available at:
http://www.data.scec.org/SISDB/table_columns.php

and a pdf of the SIS Entity Relationship Diagram (ERD) (above) is available at:
http://www.data.scec.org/stations/SIS/

Google Mapping Tool Development

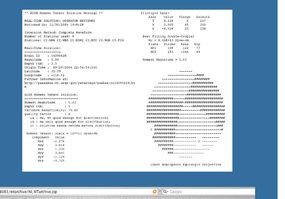
The SCEDC has developed new methods of displaying event data and station information using Google's mapping Tools: Google Maps and Google Earth. We are providing KML files to display current earthquakes and historic catalogs of earthquakes in Google Earth (Windows only). The image on the lower right is the output of a catalog search that displays the results directly on a Google map. Development is underway to develop a catalog search for an n-sided polygon.

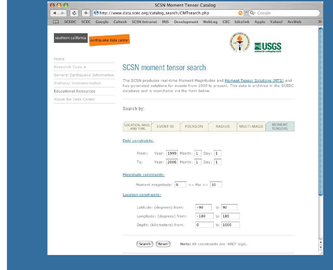




Moment Magnitude and Moment Tensor Solutions in the SCEDC

The SCEDC is currently archiving and delivering Moment Magnitudes and Moment Tensor Solutions (MTS) produced by the SCSN in real-time and has post-processed solutions for events spanning back to 1999.





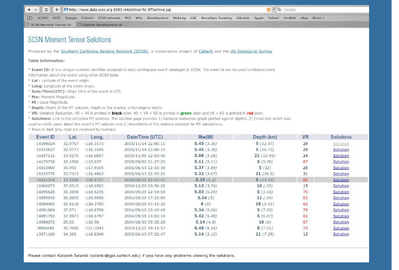
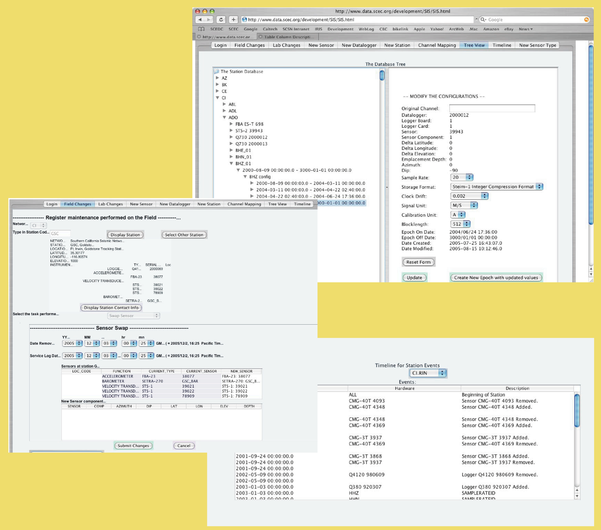


Figure 1 (top right): email summary solution message from the SCSN
Figure 2 (top left): Moment Tensor catalog search page
Figure 3 (top right): Result output

SIS Grapical User Interface

The SIS interface is a Java program that directly accesses and updates the SIS database. The users requested that the design provided drop-down lists, radio buttons, and drill-down (nested tree) capabilities. For instance, a user can type in a minimum set of parameters and then assemble a station from drop-down lists of components in inventory (i.e., components that are not installed at other stations.). When a technician enters a new instrument into inventory, s/he can accept the nominal values for an instrument of that type, or can modify the values if desired. Field staff make their changes directly in the SIS interface and trigger a pre-compiled email to the operators' mailing list when the changes are submitted.

Top right: Tree View of station/channel configurations.
Middle left: Sensor swap on the Field Change panel.
Bottom right: Timeline view, which shows what changed to require an epoch change at the station

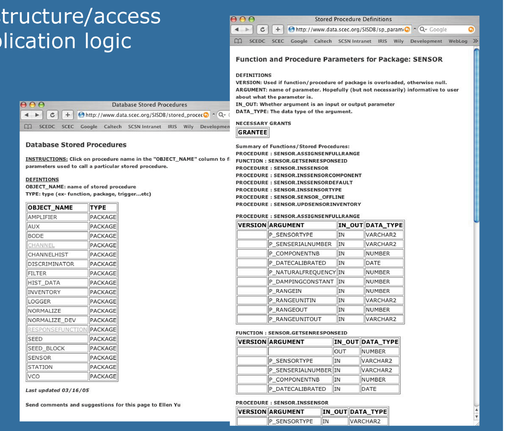


Database Packages, Procedures and Functions

With this project, the SCEDC requested that embedded SQL statements NOT be allowed in applications. All SQL that is routinely executed was written as stored procedures and functions, contained in database packages.

What are the benefits?

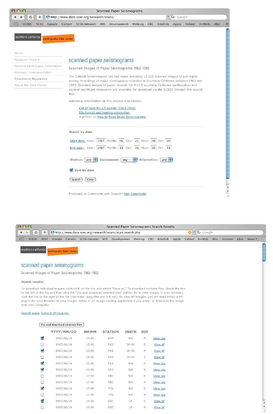
1. Programmers do not need worry about the database structure. which is beneficial because most programmers don't like working with databases that are as well-designed [read: no natural-keys] as the SISDB).
2. Changes in the database structure/access paths do not influence application logic
3. Tuning of SQL is done independently of how many times (or places) this access path is in use
4. Stored procedures outperform any programmer's SQL - our DBA can write the statements to utilize indexes and performance-improving hints that programmers typically aren't aware of.

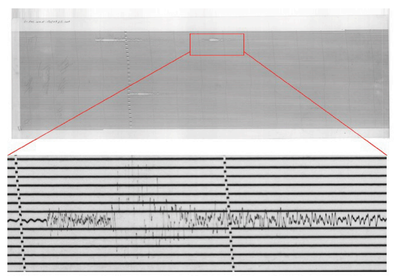


Searchable Scanned Waveforms Site

The Caltech Seismological Lab has made available 12,223 scanned images of pre-digital analog recordings of major earthquakes recorded in Southern California between 1962 and 1992 at http://www.data.scec.org/research/scans/.

The SCEDC has developed a searchable web interface that allows users to search the available files, select multiple files for download and then retrieve a zipped file containing the results. Scanned images of paper records for M>3.5 southern California earthquakes and several significant teleseisms are available for download via the SCEDC through this search tool.





Scanned image of a Wood-Anderson recording at the Pasadena station, PAS for September 25, 1965 (above). Enlarged image of the recording for a M 5.2 event at 34.42.21, -116 25.10 (below).

Figure 1 (above left): Serchable scanned seismogram interface.
Figure 2 (lower left): Download page of result set from above query. Users can download individual images or multiple files by checking the box to the left of the files and then clicking the "Zip and download selected files" button.

Acknowledgements

The SCEDC is supported by the Southern California Earthquake Center (SCEC) and the USGS/ANSS.

The Station Information System project was financed with joint special funding to the Data Center from the USGS/ANSS and IRIS. This project has been a tremendous success, which we could not have achieved without this financial sponsorship. Thank you, from The SIS Gang.