

INTERACTIVE JAVA GRAPHICS OF NETWORK-DISTRIBUTED *IN SITU* DATA SETS IN A COLLABORATIVE TOOL ENVIRONMENT

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I. Introduction

The collaboration of scientists that are not located at the same site poses many difficulties. The old paradigm of mailing, faxing, or ftp-ing documents and graphics is unwieldy and cumbersome. The process of analyzing and interpreting data often involves significant discussion between collaborating scientists. Presently these discussions must take place in person to effectively exchange information regarding graphical representations of data and analysis products. These communications are much less effective when they take place via mail (electronic and/or postal) or phone. The loss of communicative effectiveness is primarily due to the difficulty and imprecision of a strictly verbal exchange regarding graphical information, e.g. indicating a specific minimum in temperature from a CTD cast.

Removing the major barriers to effective collaboration between scientists not located at the same site, will improve the discussions that scientists can conduct about data and analyses. Scientists working on problems related to describing, monitoring and predicting changes in the Earth's environment are located across the country. Improvements in communication will translate into improved science.

II. Design Goals

The collaborative application will need the following capabilities to create an effective collaboration tool with *in situ* data sets.

- Provide an interactive and collaborative environment for *in situ* data exploration.
- Allow co-plotting of data from multiple, geographically distributed archives.
- Allow data from local files (netCDF) to be read.
- Enable scientists to interactively annotate data.
 - Highlight individual profiles
 - add text, arrows, lines, etc.
- Enable scientists to interact with the data.
 - Query values
 - Query metadata (geographic location, etc.)

III. Approach

The development of OceanShare, the collaborative tool, leverages from the collaborative tools and framework developed at NCSA under the Habanero project and the development of integrated graphics of data sets from multiple archives at different locations under the NOAA Server project (Daddio et al., 1999; Soreide and Daddio, 1998).

A. NCSA Habanero

Habanero is a framework for sharing Java objects with colleagues distributed around the Internet. Included, or planned, are all the networking facilities, routing, arbitration and synchronization mechanisms necessary to accomplish the sharing of state data and key events between collaborator's copies of OceanShare. Authentication and privacy features are also available. There is no inherent limit in the number of tools per session, nor is there a limit on the type of tools that may be shared. NCSA Habanero tools which may be utilized include a whiteboard, a collaborative text editor, and various chat utilities. Habanero is available at "<http://www.ncsa.uiuc.edu/SDG/Software/Habanero>".

B. NOAA Server

The NOAA Server project has developed a mechanism to locate, subset, and transfer data sets distributed over many servers (Denbo et al., 1998). This mechanism uses an object oriented data model and CORBA/IIOP implementation for data access. OceanShare uses the CORBA servers and client software developed by NOAA Server for distributed data access.

The Scientific Graphics Toolkit (sgt, described in more detail in another article in these proceedings), was also developed within the NOAA Server project (Denbo, 1999). Sgt provides the graphics engine for OceanShare. Sgt is available at "<http://www.epic.noaa.gov/NOAA Server/sgt>".

IV. OceanShare Architecture

OceanShare has three primary architectural components, data access, Habanero events, and graphics.

A. Data Access

The basic data access architecture is presented in Fig. 1. Observational data can be loaded into Ocean-

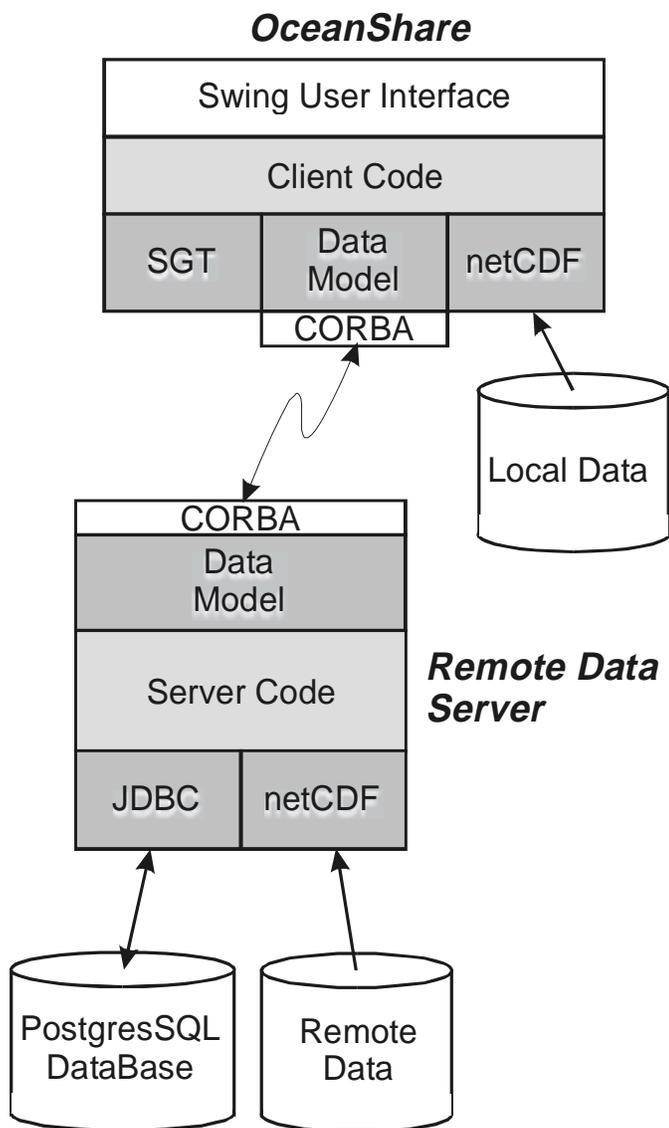


Fig. 1: OceanShare data access architecture.

Share either from local netCDF data files or from remote data servers that support the NOAA Server remote data model. The module responsible for data access takes either the local or remote data and packages it into objects that can be directly used by sgt then hands these data objects back to OceanShare. The details of data origin are hidden from both the graphic and collaborative aspects of OceanShare.

The separation of data access from display and collaboration will allow us to easily extend OceanShare to modify existing data access (e.g. CORBA to RMI) or add new data access capabilities (e.g. read local ascii files).

B. Collaboration

The Habanero framework is responsible for the collaborative aspects of OceanShare. OceanShare is responsible for posting the events to Habanero in response to a users actions. We have chosen not to post low-level events to Habanero, thus reducing the amount of communications. For example, when loading data, OceanShare takes the user through a series of dialogs to identify the data subset to load. Only after a subset has been loaded and packaged into objects are the other clients notified with an **ADD_PROFILE** event that contains the data objects.

Habanero event handling is demonstrated in Fig. 2. In

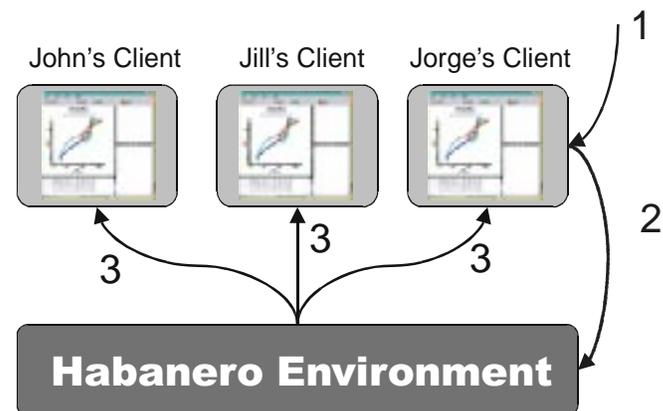


Fig. 2: Event flow in the Habanero framework.

this scenario 1) Jorge selects a profile to be highlighted, 2) OceanShare posts the event to Habanero, then 3) Habanero sends the event to John's, Jill's, and Jorge's client. (Note: Habanero also sends the event to the originator!) OceanShare is responsible for identifying what event was sent by Habanero and then taking the appropriate action. In this example, highlighting a profile.

C. Graphics

OceanShare uses the Scientific Graphics Toolkit (sgt) to provide data visualization capabilities. Sgt is described in detail in "The Scientific Graphics Toolkit" by D.W. Denbo elsewhere in these proceedings.

V. OceanShare Example

The design and architecture described above has been implemented in a collaborative application called *OceanShare*. (More information about obtaining and installing OceanShare can be found at "<http://www.epic.noaa.gov/collab>".) The following screen dumps demonstrate some of the capabilities of OceanShare.

A. Network Data Load

When loading data from a distributed data set the remote data selection wizard (Fig. 3) is displayed. The

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Denbo, D.W., 1999. Using Java graphics to display ocean observations in NOAA Server. In *15th International Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology*, AMS, Dallas, TX, 10-15 January 1999, 442-444.

Denbo, D.W., S. Hankin, J. Sirott, and W.H. Zhu, 1998. A unified browse environment for NOAA's data using distributed objects. In *Marine Technology Society/Ocean Community Conference '98*, Baltimore, Maryland, 16-19 November 1998.

Soreide, N.N., and E. Daddio, 1998. NOAA Server: Unified access to distributed NOAA environmental data. In *Marine Technology Society/Ocean Community Conference '98*, Baltimore, MD, 16-19 November 1998.