Advances in web-based visualization of the state-of-health of Earthscope's Transportable Array: webdlmon

Newman, R.L. <rlnewman@ucsd.edu>[1], Lindquist, K.G.[2], Vernon, F.L.[1], Davis, G.A.[1], Eakins, J.[1] and Astiz, L.[1]

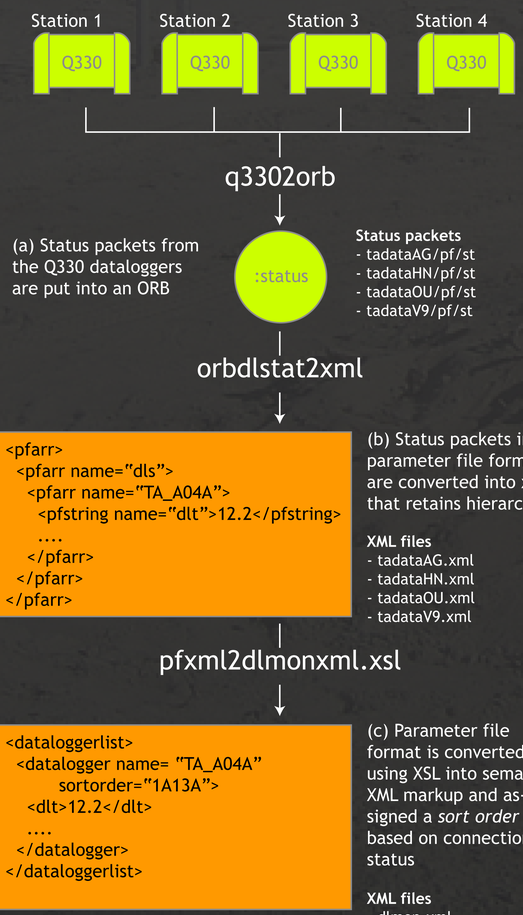
1. Array Network Facility, Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA 92093-0225
2. Lindquist Consulting Inc., 59 College Rd. Suite #7, Fairbanks, AK 99701

1. Abstract

The Earthscope Transportable Array has increased in size over the last three years to over 250 broadband seismic stations. Critical real-time assessment of datalogger state-of-health information and data transfer meta-data is fundamental to maintaining a healthy network. Providing this information to analysts, station engineers, administrative staff, researchers and the public is the responsibility of the Array Network Facility (ANF). Various interconnected software packages (including the Antelope Environmental Monitoring System, Round Robin Database Tool, Generic Mapping Tools, MATLAB) and web services (including Nagios and Flickr) build data products in near real-time that are organized and integrated into the ANF website using XML, Javascript, and PHP. These metadata and data products are readily accessible via the world-wide-web at http://anf.ucsd.edu. This poster will highlight recent advances in web-based tool development, including an XML-based Datalogger Monitor (webdlmon) that is integrated with real-time graphing capabilities.

2. Schematic workflow

Status packets in an ORB have to be converted to a format that can be easily parsed by XML libraries on the PHP back-end and Javascript front-end. This is achieved with orbdlstat2xml (Perl) and pfxml2dlmon.xsl (XSL) which generate a parameter file structure of the packets and then a more "web-centric" semantic markup of the XML respectively.



3. Application and add-ons

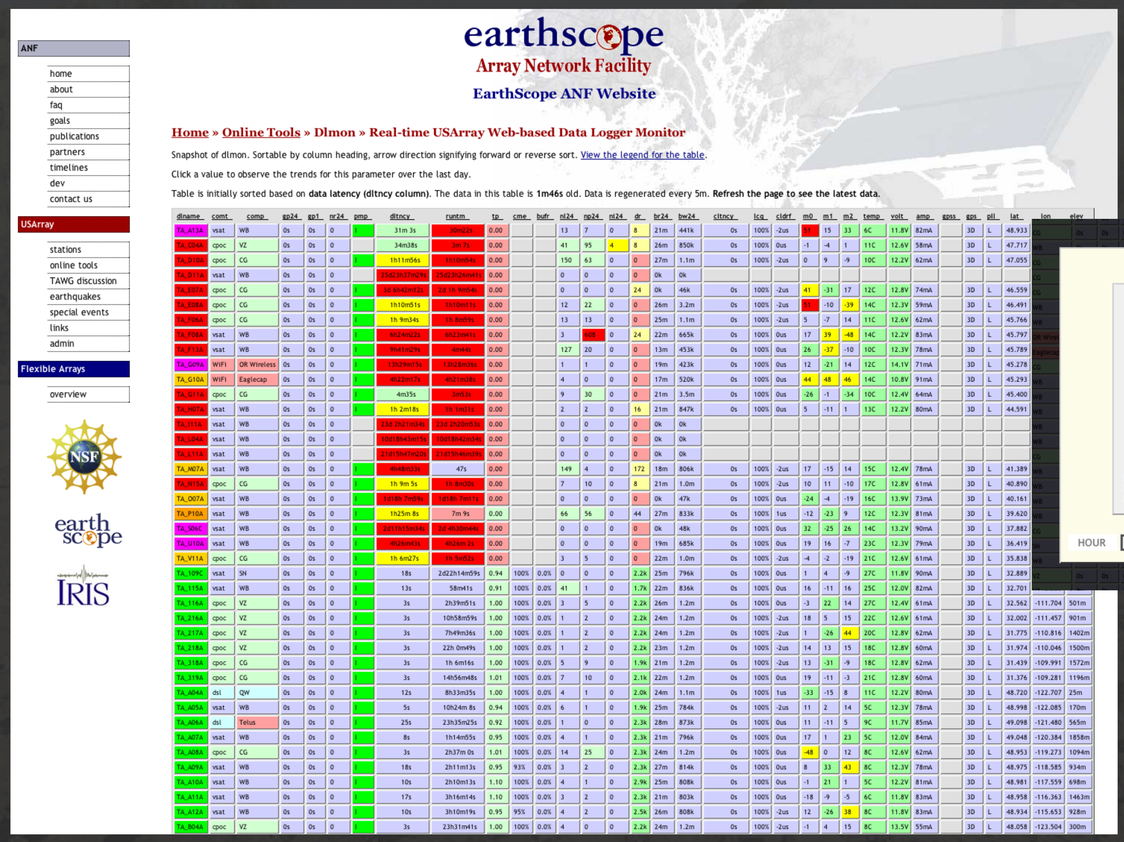
Webdlmon is written in PHP 5 (http://www.php.net) and uses PHP's built-in Document Object Model (DOM) Document class. This object-oriented class follows the DOM Level 3 standard as closely as possible. It allows application developers to easily load external XML files and traverse the document tree using methods to access the Element interface (e.g. *getElementsByTagName()* and *getElementById()*). Webdlmon loads the external XML file *dlmon.xml*.

A variety of channel-centric PHP functions are dynamically assigned and applied to the different XML elements in *dlmon.xml* that correspond to channels of state-of-health data. These functions mirror the core Antelope Tcl/Tk *dlmon* application by displaying simplified formats of the data and assigning a color-code based on a warning hierarchy; see (a) below.

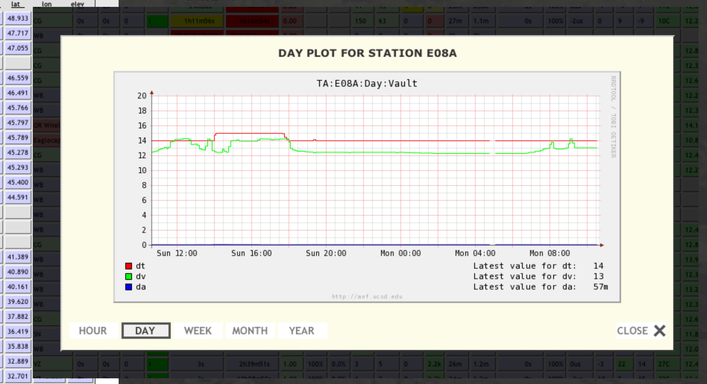
Channel titles located at the top of each column are clickable and allow the user to forward- or reverse-sort the table entries dynamically on a particular channel's values for all stations. By default stations are sorted based on their *sortorder* attribute value defined in the converted XML (see Section 2).

The application ties in with the state-of-health Round Robin Tool archives, which are individual station-channel databases used to dynamically create graphs. These graphs plot values for hourly, daily, weekly, monthly and yearly views of each respective channel. To view the graphs for a station, users click a station channel value; see (b) below.

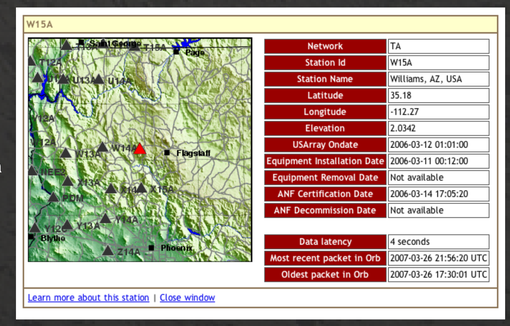
Clicking the datalogger name (*dlname* column) creates a pop-up window that displays a station location map and meta-data for the selected station. Meta-data includes station name, latitude and longitude, equipment installation dates, on- and off-dates, and data-latency for the datalogger in the data-transfer ORB; see (c) below.



(a) **Datalogger color legend:** The default view (based on the *sortorder* attribute value in the source XML, *dlmon.xml*) defines the order of stations in the table. This is typically based on connection status. All other channels are colored according to Antelope's *dlmon* application to allow ease-of-use for station engineers and analysts familiar with the Antelope desktop application.



(b) **RRDTool real-time plot:** Built-in integration with RRDTool's archives of station-channel state-of-health databases allows station engineers and analysts to quickly and easily build graphs of the latest real time data. The multiple time views allow users to discern trends in the data over hourly, daily, weekly, monthly and yearly periods. Data are typically plotted with related channels (example above plots vault time, voltage and current).



(c) **Pop-up station summaries:** Clicking a stations datalogger name (dlname column) creates a new browser window displaying a station map (with surrounding stations plotted in gray) and meta-data from the station.

4. Future directions

This application points to what is possible in web-based real-time monitoring with maturing internet technologies. Command line and desktop applications that run in a real-time environment are being replicated to perform through the state-less web. Standards driven browsers are now the norm instead of the exception. Websites are becoming full-blown applications and webdlmon is typical of a Web2.0 model as found in the commercial environment, such as Google Maps, GMail and Flickr: Applications that produce data products (i.e. web services) in XML which can be transformed with XSL and then interacted with in a meaningful way using server-side scripting languages such as PHP and client-side scripting languages such as Javascript. This standardization allows web-application developers free-reign in building application driven software that can be easily customized to fit a projects particular needs.