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

# 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 metadata 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 "webcentric" 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 getEle*mentById()* ). 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.

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#### Array Network Facility EarthScope ANF Website

Home » Online Tools » Dlmon » Real-time USArray Web-based Data Logger Monitor arrow direction signifying forward or reverse sort. View the legend for the table.

Click a value to observe the trends for this parameter over the last day. Table is initially sorted based on data latency (ditney column). The data in this table is 1m46s old. Data is regenerated every 5m. Refresh the page to see the latest

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TA A13A	vsat	WB	05	05	0	1	31m 3s	30m22s	0.00	<u></u>	<u></u>	13	7	0	8	21m	441k	05	100%	-2us	51	15	33	6C	11.8V	82mA	<u> </u>	3D	<u></u>	48,933			
TA CO4A	CDOC	vz	05	0s	0		34m38s	3m 7s	0.00			41	95	4	8	26m	850k	05	100%	Ous	-1	-4	1	110	12.6V	58mA		3D	L	47.717			
TA D104	срос	CG	0s	0s	0		1h11m56s	1h10m54s (	0.00			150	63	0	0	27m	1.1m	0s	100%	-2us	0	9	-9	100	12.2V	62mA		3D	L	47.055			
TA_D114	vsat	WB	0s	0s	0		25d23h37m29s	25d23h26m41s	0.00			0	0	0	0	0k	Ok		1														
TA_E07A	срос	CG	0s	0s	0	1	3d 6h42m12s	2d 1h 9m54s (	0.00			0	0	0	24	0k	46k	0s	100%	-2us	41	-31	17	12C	12.8V	74mA		3D	L	46.559			
TA_E08A	срос	CG	0s	0s	0	1	1h10m51s	1h10m11s	0.00			12	22	0	0	26m	3.2m	0s	100%	-2us	51	-10	-39	14C	12.3V	59mA		3D	L	46.491		20 +	
TA_F06A	срос	CG	0s	0s	0	1	1h 9m34s	1h 8m59s	0.00			13	13	0	0	25m	1.1m	Os	100%	-2us	5	-7	14	11C	12.6V	62mA		3D	L	45.766 WP		18	
TA_F08A	vsat	WB	0s	0s	0	1	6h24m22s	6h23m41s (	0.00		í	3	608	0	24	22m	665k	0s	100%	Ous	17	39	-48	14C	12.2V	83mA		3D	L	45.797 OR	Wirel	16	
TA_F13A	vsat	WB	0s	0s	0	1	9h41m29s	4m44s (	0.00		i	127	20	0	0	13m	453k	0s	100%	Ous	26	-37	-10	10C	12.3V	78mA		3D	L	45.789 Eas	lecap	14	
TA_G09/	WiFi	OR Wireless	0s	0s	0	1	13h29m15s	13h28m36s (	0.00			1	1	0	0	19m	423k	0s	100%	Ous	12	-21	14	12C	14.1V	71mA		3D	L	45.278 CG		12	
TA_G10A	WiFi	Eaglecap	0s	0s	0	1	4h22m17s	4h21m38s (	0.00			4	0	0	0	17m	520k	0s	100%	Ous	44	48	46	14C	10.8V	91mA		3D	L	45.293 WB		10	
TA_G114	срос	CG	0s	0s	0	1	4m35s	3m53s (	0.00			9	30	0	0	21m	3.5m	Os	100%	Ous	-26	-1	-34	10C	12.4V	64mA		3D	L	45.400 WB		8	
TA_H07/	vsat	WB	0s	0s	0	1	1h 2m18s	th tm31s	0.00			2	2	0	16	21m	847k	0s	100%	Ous	5	-11	1	13C	12.2V	80mA		3D	L	44.591 WB		6	
TA_111A	vsat	WB	0s	0s	0		23d 2h21m34s	23d 2h20m53s	0.00			0	0	0	0	0k	0k													WB		4	
TA_L04A	vsat	WB	0s	0s	0		10d18h43m15s	10d18h42m34s	0.00			0	0	0	0	0k	0k													WB		2	
TA_L11A	vsat	WB	0s	0s	0		21d15h47m20s	21d15h46m39s	0.00			0	0	0	0	0k	0k													CG		0	
TA_M07A	vsat	WB	0s	0s	0	I.	4h48m33s	47s (	0.00			149	4	0	172	18m	806k	0s	100%	-2us	17	-15	14	15C	12.4V	78mA		3D	L	41.389 WB		Sur	12:00 Sun
TA_N15/	срос	CG	0s	0s	0	1	1h 9m 5s	1h 8m30s (	0.00			7	10	0	8	21m	1.0m	0s	100%	-2us	10	11	-10	17C	12.8V	61mA		3D	L	40.890 WB			
TA_0074	vsat	WB	0s	0s	0	1	1d18h 7m59s	1d18h 7m11s (	0.00			0	0	0	0	0k	47k	0s	100%	Ous	-24	-4	-19	16C	13.9V	73mA		3D	L	40.161 WB		🗖 da	
TA_P10A	vsat	WB	0s	0s	0	I.	1h25m 8s	7m 9s	0.00			66	56	0	44	27m	833k	0s	100%	1us	-12	-23	9	12C	12.3V	81mA		3D	L	39.620 WB			
TA_S06C	vsat	WB	0s	0s	0	I.	2d11h15m34s	2d 4h30m44s	0.00			0	0	0	0	0k	48k	0s	100%	Ous	32	-25	26	14C	13.2V	90mA		3D	L	37.882 CG			
TA_U10A	vsat	WB	0s	0s	0	I	4h26m43s	4h26m 2s	0.00			0	0	0	0	19m	685k	0s	100%	Ous	19	16	-7	23C	12.3V	79mA		3D	L	36.419 SN	HOUR	DAY	WEEK MO
TA_V11A	cpoc	CG	0s	0s	0	1	1h 6m27s	1h 5m52s (	0.00			3	5	0	0	22m	1.0m	0s	100%	-2us	-4	-2	-19	21C	12.6V	61mA		3D	L	35.838 WB			
TA_1090	vsat	SN	0s	0s	0	I.	18s	2d22h14m59s	0.94	100%	0.0%	0	0	0	2.2	k 25m	796k	Os	100%	Ous	1	4	-9	27C	11.8V	90mA		3D	L	32.889 VZ	0s 0	s O I	3s 2h)
TA_115A	vsat	WB	0s	0s	0	1	13s	58m41s	0.91	100%	0.0%	41	1	0	1.7	k 22m	836k	Os	100%	Ous	16	-11	16	25C	12.0V	82mA		3D	L	32.701		dina trans	
TA_116A	cpoc	vz	0s	0s	0	1	35	2h39m51s	1.00	100%	0.0%	3	5	0	2.2	k 26m	1.2m	0s	100%	Ous	-3	22	14	27C	12.4V	61mA		3D	L	32.562 -1	1.704 501m	(h)	RRDTool r
TA_216A	cpoc	VZ	0s	0s	0	1	35	10h58m59s	1.00	100%	0.0%	1	2	0	2.2	k 24m	1.2m	0s	100%	-2us	18	5	15	22C	12.6V	61mA		3D	L	32.002 -1	1.457 901m		
TA_217A	cpoc	VZ	0s	0s	0	1	35	7h49m36s	1.00	100%	0.0%	1	2	0	2.2	k 24m	1.2m	0s	100%	-2us	1	-26	44	20C	12.8V	62mA		3D	L	31.775 -1	0.816 1402m	OT S	tation-cha
TA_218A	cpoc	VZ	0s	0s	0	1	35	22h 0m49s	1.00	100%	0.0%	1	2	0	2.2	k 23m	1.2m	0s	100%	-2us	14	13	15	18C	12.8V	60mA		3D	L	31.974 -1	0.046 1500m	ana	lvsts to au
TA_318A	cpoc	CG	0s	0s	0	1	35	1h 6m16s	1.00	100%	0.0%	5	9	0	1.9	k 21m	1.2m	0s	100%	-2us	13	-31	-9	18C	12.8V	62mA		3D	L	31.439 -10	9.991 1572m	The	multipla
TA_319A	cpoc	CG	0s	0s	0	1	35	14h56m48s	1.01	100%	0.0%	7	10	0	2.1	k 22m	1.2m	Os	100%	Ous	19	-11	-3	21C	12.8V	60mA		3D	L	31.376 -10	9.281 1196m	Ine	multiple
TA_A04A	dsl	QW	0s	0s	0	1	12s	8h33m35s	1.00	100%	0.0%	4	1	0	2.0	k 24m	1.1m	Os	100%	1us	-33	-15	8	110	12.2V	80mA		3D	L	48.720 -12	2.707 25m	hou	rly, daily, <sup>,</sup>
TA_A05A	vsat	WB	Os	0s	0	1	55	10h24m 8s	0.94	100%	0.0%	6	1	0	1.9	k 25m	784k	05	100%	-Zus	11	2	14	5C	12.30	78mA		3D	L	48.998 -12	2.085 170m	ted	with relat
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TA_A07A	vsat	WB	Os	0s	0		85	1h14m55s	0.95	100%	0.0%	4	1	0	2.3	Z1m	796k	0s	100%	Ous	17	1	23	SC	12.00	84mA		3D	L	49.048 -12	0.384 1858m	Curi	rent).
	cpoc	20	US	OS	0		35	2h37m 0s	1.01	100%	0.0%	14	25	0	Z.3	x 24m	1.2m	05	100%	ous	-48	0	12	80	12.6V	62mA		3D	L	48.953 -1	9.273 1094m	Sec. 14.	
TA_A09A	vsat	WB	OS .	0s	0		185	2h11m13s	0.95	93%	0.0%	3	2	0	2.3	27m	814k	05	100%	Ous	8	33	43	80	12.30	78mA		30	L	48.975 -1	8.585 934m		
	vsat	WB	US	OS OF	0		105	2h10m13s	1.10	100%	0.0%	4		0	2.9	25m	808K	05	100%	ous	-1	21	1	50	12.20	81mA		30	L	48.981 -1	6 363 1463m		
	vsat	WB	05	US	0		1/5	3h10m14s	0.05	0.5%	0.0%	3	2	0	2.3	21m	803K	05	100%	Jus	-18	-7	-7	0C	11.87	03ITA		30	L	48.934 -1	5.452 038m		
	vsat	WB V7	US Cr	05	0		105	22b21m119	1.00	1000	0.0%	4	2	0	2.5	26m	508K	05	100%	-205	12	-26	38	80	12.64	55mA		30	L	48.934 -1	2.504 200m		
A DU4A	CLERK	V C	1 1/2	1 1/3	L V		22	43113111415	1.00	100.5	U.U.h		1.11	1 1/	1 1.1	5 I Z4ID	1 1.700	105	111115	/ 115			1.1.2	01	1 1 2 2 2 4			1 21/		-10.1/10 -1	1. 104 1. 100/11		



(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-ofuse for station engineers and analysts familiar with the Antelope desktop application.

### 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.

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(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.

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)



eal-time plot: Built-in integration with RRDTool's archives annel state-of-health databases allows station engineers and lickly and easily build graphs of the latest real time data. ime views allow users to discern trends in the data over weekly, monthly and yearly periods. Data are typically ploted channels (example above plots vault time, voltage and







