

# HeatMap Analyzer

V0.1

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## About

I am a Storage, Virtualization and Data Protection engineer working on midrange storage devices. This is an extension and extensive rework of the previous HeatMap script.

HeatMap Analyser is an analytical tool that can be used to analyse performance data from EMC VNX / CLARiiON NAR files (this requires the array to be licensed for Analyzer) and Data Domain devices. It can download and process NAR files automatically, or can manually process NAR files and then produce performance data from them. It does this with the navisecli tool provided by EMC, so presumably you will need a login to their support site. The script can also collect performance data from Data Domain devices, although the amount and granularity of the performance data from a Data Domain is somewhat limited.

One of the benefits of this tool is that you can load multiple sets of data into the database, which allows for more detailed analysis over a greater time period.

While I have only done a small amount of testing with this (implementation of the Data Domain collector), the scripts are fairly open, and should allow for other datasets to be imported and analysed with limited changes to scripts.

The script has been tested reasonably extensively under the Chrome browser, and has had some testing under FireFox and Internet Explorer, earlier versions of IE or if IE is running in compatibility mode may produce some unexpected results.

I would be happy to work with anyone who would be interested in extending the functionality of this out to a wider range of devices.

Please feel free to contact me either by posting to the relevant blog article found here <http://www.penguinpunk.net/blog/> or by e-mailing me directly at matharvest@gmail.com for any suggestions, bug notifications (and I'm sure there are plenty of them in there) or any potential extensions.

## Install & Configure VM

Here are the instructions to get the guest ready for the script... (The OVF file below is 250MB).

This has all been developed on a Turnkey Linux VM shell – if you want to use your own you'll need to have apache / PERL and SQLite installed (I guess there is no reason that it couldn't be run under windows – but some changes may be required). The instructions below assume you are using one of the Turnkey appliances.

### VM Shell

Download Turnkey Core + LAMP Stack OVF from

<http://www.turnkeylinux.org/download?file=turnkey-lamp-13.0-wheezy-amd64-ovf.zip>

Import (drag and drop) into VMware Workstation

Possibly look at increasing CPU (1 vCPU) and RAM (256MB) set by default

Change VM settings -> Options -> General -> Guest OS -> Linux/Debian

If you want to use shared folders configure them now VM->Settings -> Options -> Shared Folders ...

Power on

Setup

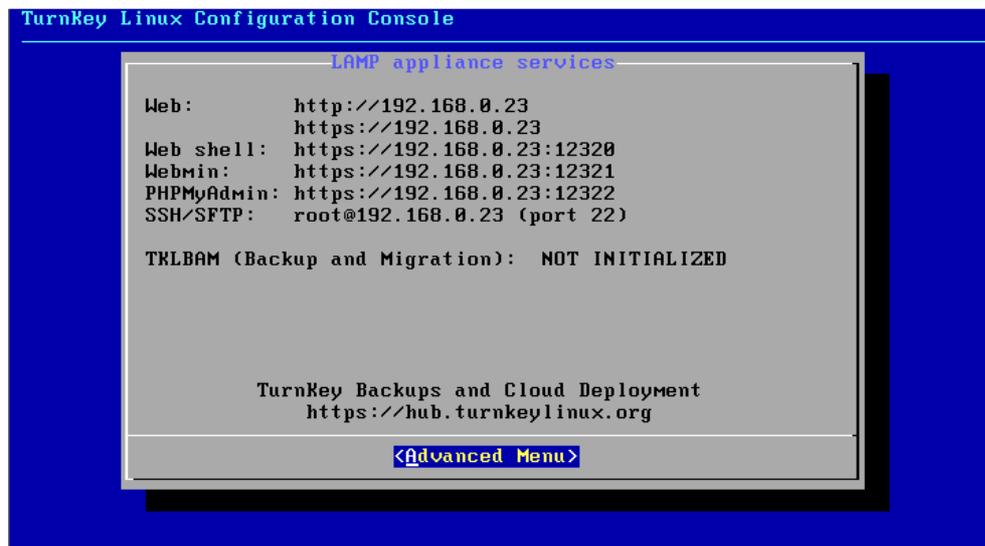
Password for Root account – password (or whatever you want)

Password for root MySQL account - password (or whatever you want)

Backup/migration & domain mgmt - skip

Install Security updates

Base install complete



```
TurnKey Linux Configuration Console
LAMP appliance services
Web:          http://192.168.0.23
              https://192.168.0.23
Web shell:    https://192.168.0.23:12320
Webmin:       https://192.168.0.23:12321
PHPMyAdmin:  https://192.168.0.23:12322
SSH/SFTP:    root@192.168.0.23 (port 22)

TRLBAM (Backup and Migration): NOT INITIALIZED

TurnKey Backups and Cloud Deployment
https://hub.turnkeylinux.org

<Advanced Menu>
```

At this point you can go into the Advanced Menu and setup networking if you want to, or leave it as a DHCP obtained IP address.

You can either use putty to ssh to the command line, or run the following from the console.

### Web access via a proxy

If your machine is sitting behind a proxy server you may need to set the various proxy variables, so that apt-get and cpan can download updates from the internet (if the proxy server requires authentication add

domain\\user:password@ options, otherwise leave them out). If you reboot the guest then you may need to re-set these after each reboot.

```
export http_proxy=http://domain\\user:password@your.proxy.server:port_number
export ftp_proxy=$http_proxy
export FTP_PROXY=$http_proxy
export HTTP_PROXY=$http_proxy
```

## Latest Updates

Install distribution upgrades

```
apt-get update
apt-get dist-upgrade
```

Use the default options if any required

Install Build Essentials - needed to run alien to convert RPM packages

```
apt-get install build-essential
```

## CPAN

Before cpan can be used it needs to be configured, generally the auto-configuration option works pretty well, if you are behind web proxies you may need to have the HTTP/FTP proxy system variables set (see above).

Running cpan without any options the first time will go through the configuration process, you have the option to set it up manually or automatically and whether to let it choose the mirror sites. This generally works well, however in some cases you may need or want to configure it yourself manually. Bear in mind again that if you require authenticated proxy access you may need to have the proxy variables set.

## SQLite

Currently the script utilizes SQLite, so we need to install it, run the following commands to installed SQLite andit associated PERL modules.

```
apt-get install sqlite3
cpan DBD::SQLite
```

## Sudo

Install and Configure sudo

```
apt-get install sudo
```

The setup script will attempt to modify the sudo configuration file, but it assumes that the user that the web server runs as is www-data and that the installation path of naviseccli is /opt/Navisphere/bin, if any of this differs then the configuration file may need to be changed.

Edit /etc/sudoers add line

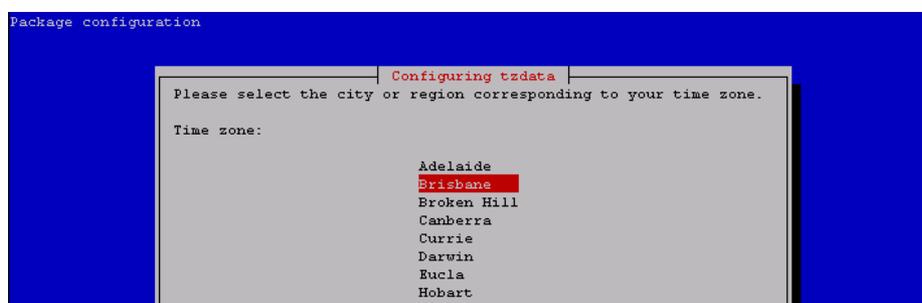
```
www-data ALL = (root) NOPASSWD: /opt/Navisphere/bin/naviseccli
```

Where www-data (this is the default user in the turnkey appliance – if you are using an existing machine, or configuring apache yourself you might have picked a different user) is the user that you browser runs as and /opt/Navisphere/bin/naviseccli is where navisphere CLI will be installed by default – if you change the install location you will have to change this path.

## Timezone

You can use the “gui” to set the correct timezone or use the command lines detailed below

```
dpkg-reconfigure tzdata
```



```
Current default time zone: 'Australia/Brisbane'  
Local time is now:      Sun Mar 30 13:25:18 EST 2014.  
Universal Time is now: Sun Mar 30 03:25:18 UTC 2014.
```

Or (changing the country/city to your relevant location)

```
echo "Australia/Brisbane" | sudo tee /etc/timezone  
sudo dpkg-reconfigure --frontend noninteractive tzdata
```

## VMware Tools

If you are using a vm hosed by ESX/vm workstation you should install / upgrade the vm tools

```
mount /dev/cdrom /mnt  
cp /mnt/VMwareTools-8.8.6-1035889.tar.gz /tmp  
cd /tmp  
gunzip VMwareTools-8.8.6-1035889.tar.gz  
tar xvf VMwareTools-8.8.6-1035889.tar  
cd vmware-tools-distrib/  
./vmware-install.pl
```

## Shared Folder (VMWare Workstation)

Mount shared folder. If you want to use the shared folder option provided by VMware then configure the client.

```
mount -t vmhgfs .host:/ /mnt
```

## NavisecCLI

NavisecCLI is generally pretty good at reading older NAR files, however if you are trying to open a NAR file generated from an array running a newer version of Flare/MCx than the version of naviseccli it will sometimes be reported as being corrupted, so you need to make sure that you keep the version at least at the same level as code running on your arrays.

## Install navisecli

Download the Linux RPM of NaviCLI (I used the 64-x86 binary)

Convert the RPM to a DEB file (convert the package to something Debian can understand – if you are not using Debian then you may not need this step). There is a package called alien that can be used to perform this conversion for you.

```
apt-get install alien
```

Copy the NaviCLI package to your machine (when using a workstation guest I copy it to the shared folder, and then copy it to the local /tmp directory).

```
cd /tmp
cp /mnt/SharedFolder/NaviCLI-Linux-64-x86-en_US-7.30.15.0.44-1.x86_64.rpm /tmp
alien --scripts NaviCLI-Linux-64-x86-en_US-7.30.15.0.44-1.x86_64.rpm
```

Install Debian package

```
dpkg -i navicli-linux-64-x86-en-us_7.30.15.0.44-2_amd64.deb
```

The package is installed to /opt/Navisphere/bin/navisecli.

**NOTE: During the installation you may be asked to get the certificate verify level. Make sure you set his to low, otherwise you will need to manually accept and store the certificate for each array that you want to connect to.**

Newer versions of the package may ask you to run a script after installation; this will allow you to set the verification level:

```
/opt/Navisphere/bin/setlevel_cli.sh
```

## Installing Net::SSH::Perl

This is currently only required if you want to gather performance data from Data Domain devices.

```
apt-get install libgmp-dev
cpan Net::SSH::Perl
```

You should select the default options when prompted during the installation of this package.

```
[3] Both SSH1 and SSH2
[1] IDEA
Install Crypt::RSA
Install GP/PARI
```

```
mkdir /var/www/.ssh
chown www-data /var/www/.ssh/
chgrp www-data /var/www/.ssh/
chmod 700 /var/www/.ssh/
```

## Installing Scripts

If this is the initial installation of the scripts you will have to download both tar balls

1. heatmap-analyzer\_3rd\_party – This contains all the 3<sup>rd</sup> party JavaScript packages (D3, Dimple, JQuery and JQuery UI).
2. heatmap-analyzer – This is the HeatMap Analyzer application.

Unzip and extract the each of the TAR ball into the /var/www directory (root of the apache web server)

Copy the tar ball to the /var/www directory

```
cd /var/www
gunzip heatmap-analyzer_v0.1.tar.gz
tar xf heatmap-analyzer_v0.1.tar
gunzip heatmap-analyzer_3rd_party_v0.1.tar.gz
tar xf heatmap-analyzer_3rd_party_v0.1.tar
```

This should create the following directories

<code>/var/www/cgi-bin</code>	the location of perl scripts
<code>/var/www/d3</code>	d3 module – used for offline graphing – required by dimple
<code>/var/www/dimple</code>	dimple module for offline graphing
<code>/var/www/jquery</code>	jquery – used for floating windows – required by jqueryUI
<code>/var/www/jquery-ui-1.10.4</code>	jqueryUI – creates floating windows

## Required PERL Modules

You may need to install extra PERL modules in addition to the ones that are packaged with PERL already. If you are behind a web/FTP proxy then ensure you have the variables set.

Running the `/var/www/cgi-bin/setup.pl check_perl_modules` script (see below) it will give you a list of the required perl modules, and also an indication of which ones are already available (you will have to install the remainder of the modules using CPAN eg. `cpan Text::CSV`)

Running the setup command with the `check_perl_modules` option will return something like this

```
root@lamp www/cgi-bin# ./setup.pl check_perl_modules
----- checking perl modules -----
getting perl modules used in scripts.
/var/www/cgi-bin/archive.pl, /var/www/cgi-bin/cache_cred.pl, /var/www/cgi-bin/css.pl, /var/www/cgi-bin/db_maintenance.pl, /var/www/cgi-bin/getData.pl, /var/www/cgi-bin/processArrays.pl, /var/www/cgi-bin/processDD.pl, /var/www/cgi-bin/processNAR.pl, /var/www/cgi-bin/purge.pl, /var/www/cgi-bin/query.pl, /var/www/cgi-bin/setup.pl, /var/www/cgi-bin/upload.pl
Module CGI loaded
Module Capture::Tiny not loaded
Module DBI loaded
Module Data::Google::Visualization::DataTable not loaded
Module Data::Validate::IP not loaded
Module File::Basename loaded
Module File::Which loaded
Module Getopt::Long loaded
Module JSON not loaded
Module Net::SSH::Perl loaded
Module Storable loaded
Module Term::ANSIColor loaded
Module Text::CSV not loaded
Module Time::Local loaded
Module Time::Piece loaded
Module common loaded
Module lib loaded
```

Use `cpan` to install the missing modules (if you have used the Turnkey + LAMP stack VM / ISO the above should be all you need to load manually).

```
cpan Capture::Tiny
cpan Data::Google::Visualization::DataTable
cpan Data::Validate::IP
cpan JSON
cpan Text::CSV
```

## Setup and Configuration checking script

Run the `/var/www/cgi-bin/setup.pl` script (this script should be located under `/var/www` – or wherever you unpacked the tar ball. This script should create the required directory structures, populate the configuration database with some basic details, and check that the relevant PERL modules are loaded.

Running the script without any options will check / configure all options. Running it with an option of `'?'` or `help` will display the various options

```
root@lamp /var/www# cgi-bin/setup.pl ?
Valid Command Line Options:
  set_dir_perms - set directory permissions
  make_dirs     - make directory structure
```

```
set_config_db      - setup the configuration DB
create_log_flags   - create log flag files
check_perl_modules - check PERL modules are installed
check_3rd_party    - check 3rd party apps and modules are installed
set_cron           - setup basic cron entries
```

running the script without a command line option will run all options

**Green** means an operation was successful

**Yellow** means the operation produced a warning (the directory already exists, etc.)

**Red** means the operation failed

## Reboot / Restart Cron service

It appears that there the service that runs cron won't automatically update its time over a time zone setting. Restarting the cron service should fix the problem running the command

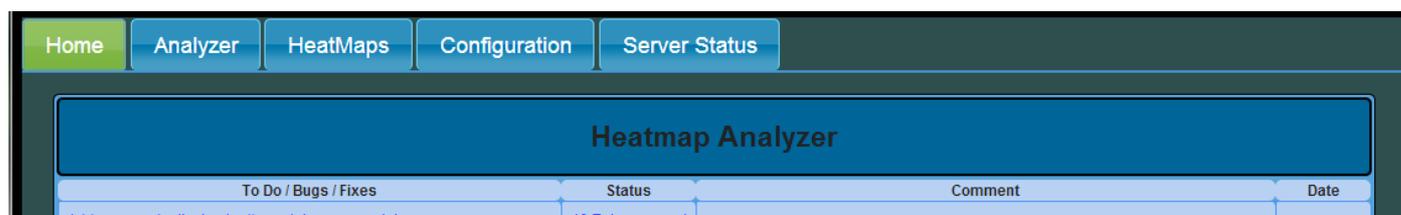
```
service cron restart
```

Or you can restart the server

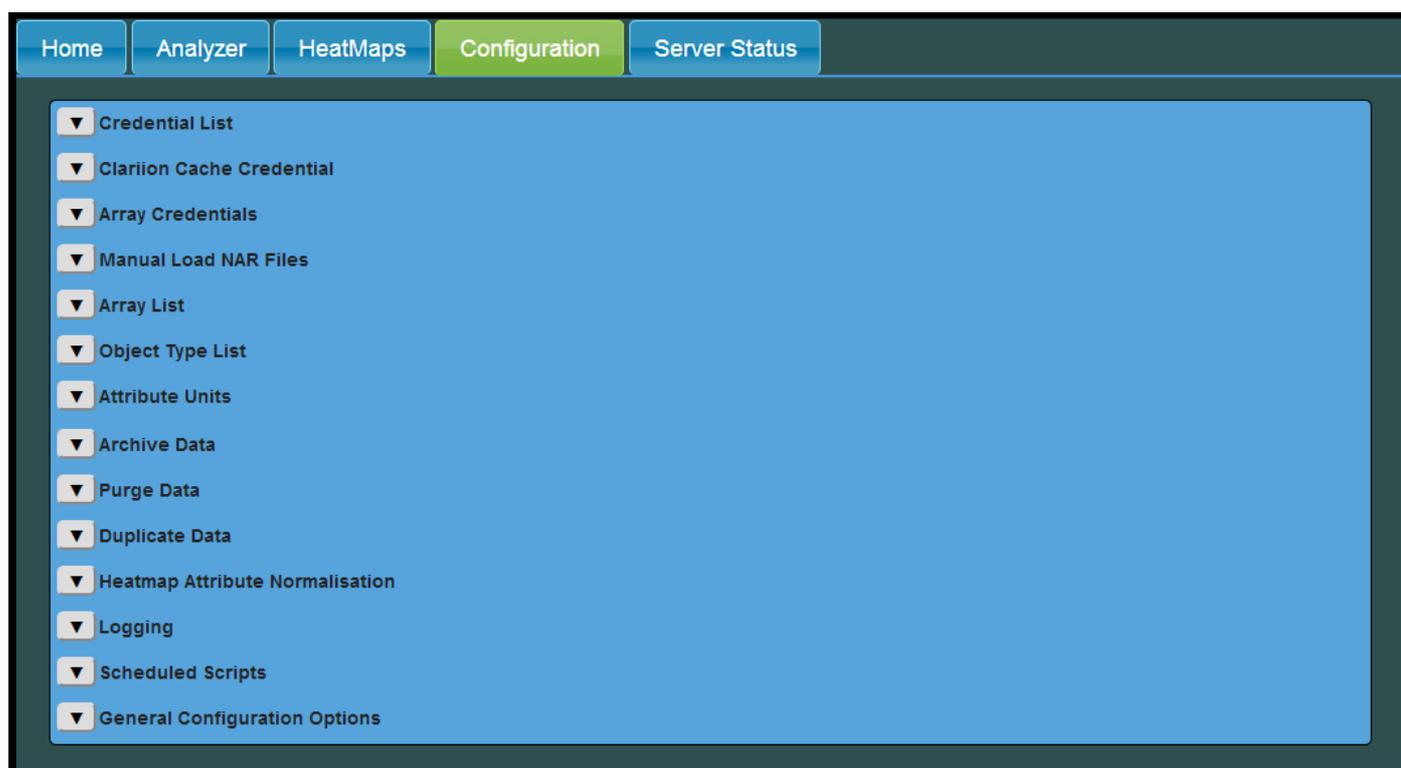
```
shutdown -h now
```

## Configuration

Point your browser at the guest (if the IP address of the VM is 1.1.1.1) <http://1.1.1.1/HMA.html>



Go to the configuration tab, this is broken into several sections, clicking on the down arrow should display the configuration options for that section.



## Credential List

The screenshot shows the Credential List form. At the top, there is a header "▲ Credential List". Below this, there are four input fields: "Credential Name", "User Name", "Password", and "Scope". The "Scope" field has a dropdown menu set to "0 - Global". To the right of these fields is a "Add Credential" button. Below the input fields is a table with three columns: "Credential Name", "User Name", and "Scope". The table contains two rows of data:

Credential Name	User Name	Scope	
dd_admin	administrator	0	Delete
testuser	Test_user	0	Delete

The Credential List is a list of credentials that can be used to connect to devices. To use the cached credential functionality of navisecli you also need to create a temporary credential, and then use this in the CLARiiON Cache Credential section. After the credential has been cached, it can be removed from the credential list.

## CLARiiON Cache Credential

▲ Clariion Cache Credential

Cache Credential

Use this section to cache a credential that will be used to connect to the CLARiiON array(s). If that is all you are using the credential for it can then be removed from the Credential List.

## Array Credentials

▲ Array Credentials

IP Address  Cached Credentials  Credential  Device Type

Array IP	Uses Cached Credentials	Stored Credential	Model	Serial Number	Device Type	
1.1.1.1	<input type="checkbox"/>	dd_admin	null	null	datadomain	<input type="button" value="Delete"/>

In this section you can define arrays (currently CLARiiON CX/VNX & VNX2 and Data Domains are supported), and specify the IP Address (the script currently doesn't support DNS Names for arrays)

**NOTE: with Data Domain support, it has been tested against DDOS 5.4. It seems that DD engineers like to change the format of the performance data on a fairly regular basis, and as far as I am aware there isn't an easy way to get a well-defined CSV out of a DD. If you are running a different version of DDOS then it might be worthwhile getting in contact to check if the performance data format is correct, and making changes to the code to make it work.**

## Manual Load NAR Files

▲ Manual Load NAR Files

Files  No file chosen

**NOTE: Processing of files can take up to 10 minutes each**

If you are manually loading NAR files into HeatMap Analyzer select the file(s) and then click upload. NOTE that it can take a considerable amount of time to process each NAR file, and it is possible in the script's current state that the connection between the front end client and backend may timeout. If this occurs processing will continue on the backend, and it can be monitored from the Server Status tab, monitoring the running processes (you should see the processNAR.pl script running) or by viewing the log file for the processNAR.pl script.

NAR files from different arrays can be selected and processed at the same time, the script should identify that these NAR files are from different arrays and process them accordingly.

**NOTE: currently the script uses SQLite which locks the database while updates are being performed, it is recommended that you do not query the database while you are processing NAR files**

## Array List

▲ Array List

Serial Number	DB Filename	Schedule Archive	Schedule Purge	
CX4-111	/heatmap_analyzer/db/CX4-111_NAR.db	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="Delete"/>

A list of arrays that have been processed by the HMA. You can use this to enable data archiving / purging for each array, or to remove the array and its performance data from the system.

## Object Type List

**Object Type List**

Object Name:  Object Code:  Object Type:  Standard  Device Type:

Object Name	Object Code	Device Type	
All LUNs	al	clarion	Delete
Asynchronous Mirror	am	clarion	Delete
CPU	pcu	clarion	Delete
DataDomain	dd	datadomain	Delete
Disk	d	clarion	Delete
Port	p	clarion	Delete
RAID Group	rg,prg	clarion	Delete
Snap Session	ss	clarion	Delete
Storage Processors	s	clarion	Delete
Thin Pool	tp	clarion	Delete

List of objects to collect performance data for.

Can be either single objects or a comma separated list, eg to group Traditional RAID Groups and Private RAID Groups specify rg,prg. Objects that are grouped can graphed together - be aware that the order of the object list affects the table names.

Object types required for connectivity diagram of array **al** - All LUNs, **s** - Storage Processors, **d** - Disks, **rg,prg** - RAID groups / Private RAID Groups, **p** - Ports, **tp** - Pools

- al All LUNs
- am Asynchronous Mirrors
- l LUNs
- mic Meta LUN Components
- ml Meta LUNs
- d Disks
- plu Pool LUNs
- hl Host LUNs?
- pool Pools
- p Ports
- pcu CPU
- pl Private LUNs
- ppl Private Pool LUNs
- prgl Private RAID Group LUNs
- rgl RAID Group LUNs
- rg RAID Groups
- s Storage Processors
- ss Snap Sessions
- tl Thin LUNs
- tp Thin Pools

A list of objects that the script collects data for. You shouldn't need to change this and certain parts of the script require the objects that are configured to work correctly. However if you wanted to have a collection of just RAID Group LUNs you could create a new Object with the object code of "rgl", the object of this can be done with filtering also, which is probably better.

## Attribute List

**Attribute Units**

Unit Type:  Aggregatable:

Unit Name	Aggrigatable	
%		Delete
GB	✓	Delete
IO/s	✓	Delete
KB	✓	Delete
MB	✓	Delete
MB/s	✓	Delete
count		Delete
flag		Delete
min		Delete
ms		Delete
ratio		Delete

This is a list of attribute types (units) and whether they are "aggregatable". Attributes that are aggregatable can be graphed using stacked line charts and pie charts.

## Archive Data

▲ Archive Data

Archive greater than  days old convert to  seconds data interval. [Add Archive Rule](#)

Days	Interval	
5	1800	<a href="#">Delete</a>
7	1800	<a href="#">Delete</a>
10	3600	<a href="#">Delete</a>
20	7200	<a href="#">Delete</a>
21	3600	<a href="#">Delete</a>
43	1800	<a href="#">Delete</a>
45	3600	<a href="#">Delete</a>

Allows you to define policies that based on the age change the average interval of the dataset i.e. depending on how you have the CLARiON configured you may have it collecting performance data in 5 minute intervals (300 seconds). You can define a policy that after 5 days the data will be re-averaged over 30 minute (1800 seconds) intervals and then after 10 days 1 hour intervals (3600 seconds).

Depending on the size of the array (number of disks, LUNs, etc. defined) you may find that the script response begins to degrade over time. Our CX4-960 configured with 960 drives and approximately 500 host LUNs (3200 objects in each NAR file) can gather a little over a week's worth of data before it starts to slow. Enabling archiving means that we are able to store over a month's worth of data.

Placing the VM / Database on faster disk and increasing the amount of RAM presented may increase your performance dramatically.

Also note that you can define any number of archive levels.

## Purge Data

▲ Purge Data

Delete records greater than  days old. [Update Purge Rule](#)

Defines the age of data before it gets deleted from the system.

## Duplicate Data

▲ Duplicate Data

[Get Stats](#) [Remove Duplicates](#)

[Assess DB's to get duplicate stats](#)

Searches the performance databases and removes any duplicate data.

## HeatMap Attribute Normalisation

**▲ Heatmap Attribute Normalisation**

Attribute	al			d			rg			s			dd			tp			p		
	Min	Max	Skew	Min	Max	Ske															
Average_Busy_Queue_Length	0	24	1	1	10	1	1	10	1	2	12	1									
Average_Busy_Queue_Length_Nonoptimal	0	30	1																		
Average_Busy_Queue_Length_Optimal	0	17	1																		

Defines Minimum / Maximum and skew for each attribute. A skew of 1 will provide an even, linear distribution. A skew of 0 will decrease the size of the lower brackets and increase the size of the upper brackets and a skew of 2 will increase the size of the lower brackets and decrease the size of the upper brackets.

## Logging

**▲ Logging**

Enabled	Script	Description
<input checked="" type="checkbox"/>	archive.pl	Archiving Script
<input checked="" type="checkbox"/>	cache_cred.pl	Credential Caching Script
<input checked="" type="checkbox"/>	db_maintenance.pl	Database Maintenance Script
<input checked="" type="checkbox"/>	getData.pl	Return Performance Data
<input checked="" type="checkbox"/>	processArrays.pl	Retrieve NAR files for listed Arrays
<input checked="" type="checkbox"/>	processNAR.pl	Process NAR Files
<input checked="" type="checkbox"/>	purge.pl	Purge Data Script
<input checked="" type="checkbox"/>	query.pl	Queries Script
<input checked="" type="checkbox"/>	upload.pl	Upload NAR Files
Extended		
<input type="checkbox"/>		SQL Commands
<input type="checkbox"/>		SQL Data
<input type="checkbox"/>		NaviSecCLI Commands
<input type="checkbox"/>		NaviSecCLI Data
<input type="checkbox"/>		JSON Data
<input type="checkbox"/>		CGI Parameters

Enable / disable logging for particular backend scripts, and extended logging for information types. Enabling CGI Parameter logging will enable it for each enabled script log.

## Scheduled Scripts

Enabled	Minute	Hour	Day of Week	Script Name	Description
<input checked="" type="checkbox"/>	0	6,18	*	processArrays.pl	retrieve NAR files defined arrays
<input checked="" type="checkbox"/>	2	7	2	archive.pl	Archives data, averaging into greater intervals
<input checked="" type="checkbox"/>	3	7	3	purge.pl	Deletes old data
<input checked="" type="checkbox"/>	30	19	*	db_maintenance.pl	Optimize Databases

Enable / disable and set start times for scheduled script, basically modifies the crontab file for the www-data user. The timing modifiers work the same as cron configurations, can be individual numbers, comma separated lists (6, 18) or ranges (0-4).

Minute	0 thru 59
Hour	0 thru 23
Day of Week	0 thru 6 (where 0 = Sunday)

## General Configuration Options

General Configuration Options	
<input type="button" value="Update"/>	
<b>Clariion Collections</b>	
Maximum number of NAR files to download	<input type="text" value="7"/>
Keep NAR Files	<input checked="" type="checkbox"/>
NAR File storage Location	<input type="text" value="/mnt/SharedFolder/"/>
<b>Data Domain Collections</b>	
Hours of DataDomain Performance Data to Collect	<input type="text" value="25"/>
DataDomain Performance Data interval (minutes)	<input type="text" value="1"/>
<b>Charting</b>	
Google Graphing	<input checked="" type="checkbox"/>

## CLARiiON Collections

Configuration options for CLARiiON data collection

**Maximum Number of NAR files:** This is the maximum number of the most recent NAR files that the script will attempt to download, if the NAR file has already been downloaded then the script won't attempt to download or process the file again. **NOTE: The more NAR files processed the longer the initial processing will take.**

**Keep NAR Files:** whether the NAR files should be kept after processing or discarded.

**NAR File Storage Location:** The location where NAR file will be moved after they have been processed, if Keep NAR Files is enabled.

## Data Domain Collection

Configuration options for Data Domain data collection.

Hours of Data Domain Performance Data to Collect: The number of hours of data to collect.

Data Domain Performance Data Interval: The interval between each dataset.

## Charting

**Google Graphing:** Enable / disable Google charting. By default the scripts will use Google Charts to render performance graphs. These APIs are hosted on Google servers, if the server / guest do not have access to the internet then this functionality will not work. Currently the script should fall back to using some locally hosted charting scripts. This is currently implemented with DimpleJS and currently only allows to chart in Line and Area charts.

## Charting

Draw performance / analytical charts for array objects

The screenshot displays the 'Analyzer' tab of a storage management interface. The main configuration area includes:

- Array:** CX4-111 - CX4-111
- Array Type:** clarion
- Object Type:** All LUNs
- Start:** 06 October 2009
- End:** 13 October 2009
- Filter:** Enable ; top 8 objects by avg Utilization; Object Type:  Private RaidGroup LUN,  Public RaidGroup LUN; Include Text: ; Exclude Text: ; Filter button.
- Object:** 62 (selected), 90, 200, 202, 203, 300, 301, 302
- Attribute:** Utilization
- Avg Interval:** 0
- Graph:**  Line,  Line by Day,  Stacked,  Pie,  Distribution,  Table,  Connectivity; Graph button.

On the right side, there are two detail panels:

**Closest NAR File Details**

Array Serial Number	CX4-111
Array Name	CX4-111
Array Model	CX4-480
Flare Code	4.28.504
FAST Cache State	Not Available (Enabler is not installed)
FAST Cache Size (GB)	0
FAST Cache Mode	N/A
Cache High watermark	80
Cache Low watermark	60
Write Cache Enabled	Yes
Write Cache Mirrored	Yes
SP Total Memory (MB)	8160
SP User Memory (MB)	4498
SP Write Cache (MB)	4298
SP Read Cache (MB)	200
Stats Logging	Yes

**LUN ID 62**

LUN ID	62
LUN Type	Public RaidGroup LUN
LUN Name	
RAID Type	RAID5
RAID Group ID	3
Pool ID	
Container Name	Raid Group 3
Current Owner	SP A
Default Owner	
Allocated Owner	
Write Cache	ENABLED
Read Cache	ENABLED
Fast Cache State	N/A
Capacity (MB)	409600.00
Consumed (MB)	0.00
LUN Type	undefined
Hosts	

1. Select the Array.
2. Select the object type.
3. Modify the Start / End Dates to chart.
4. Filter / Order objects if required.
5. Select the objects. If the object doesn't have any values for a particular attribute then the attribute won't be available for selection.
6. Select the Attribute, this will depending on the Attribute Units defined on the configuration page will alter the graph types available. Attributes that are aggregatable will be able to be graphed in a stacked or pie chart.

7. Select the Chart Type.

Chart Type	Chart Description	Modifier	Modifier Description
Line	Basic line chart, multiple objects can be selected and charted.	Average Interval	The amount of seconds between graphed data points
Line by Day	Line chart where the object is broken into individual series, one for each day and stacked. Multiple objects can be selected however it clutters the graph.		
Stacked	Stacked Line chart. Only available for certain attribute types	Average Interval	The amount of seconds between graphed data points
Pie	Pie Chart. Only available for certain attribute types	Max Slices	The Maximum number of slices displayed in the pie chart, remaining objects will be grouped under "other"
Distribution	Bar chart that maps the distribution of data across a range	Minimum	Minimum value for distribution chart
		Maximum	Maximum value for distribution chart
		Intervals	Number of intervals in distribution chart
Table	Text table of the data	Average Interval	The amount of seconds between graphed data points, the data is selectable and can be copied to a spreadsheet, etc.
Connectivity	A Sankey connectivity chart, currently only works for CLARiiON arrays		

8. Enter Chart Modifiers.

9. Click on the Graph button.

## Filtering

The screenshot shows a filtering panel with the following elements:

- Filter** (header with an upward arrow)
- Enable**  **top**  **objects by**  **Utilization** (dropdown)
- Object Type**
  - Private RaidGroup LUN
  - Public RaidGroup LUN
- Include Text**
- Exclude Text**
- Filter** (button)

Using the filtering tools you can order and restrict the number of objects lists

[top|bottom] [number] objects by [avg|min|max] [attribute] – this section can be used to order and filter the number of objects displayed.

Object Type – Filter the objects displayed by the object types.

Include / Exclude Text – Filter the objects by searching the extended data for each object, multiple objects can be specified using a comma separated list.

## Chart Types

### Line

Line chart of SP A & SP B's Utilization

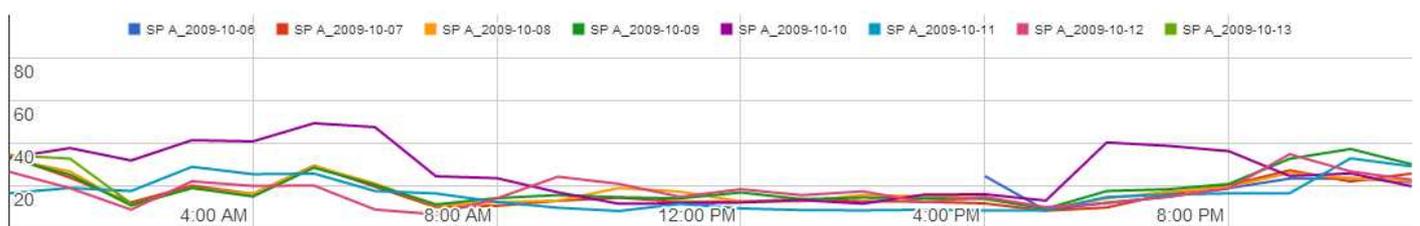
CX4-111 s Utilization



### Line by day

Line chart by day of SP A & SP B's Utilization

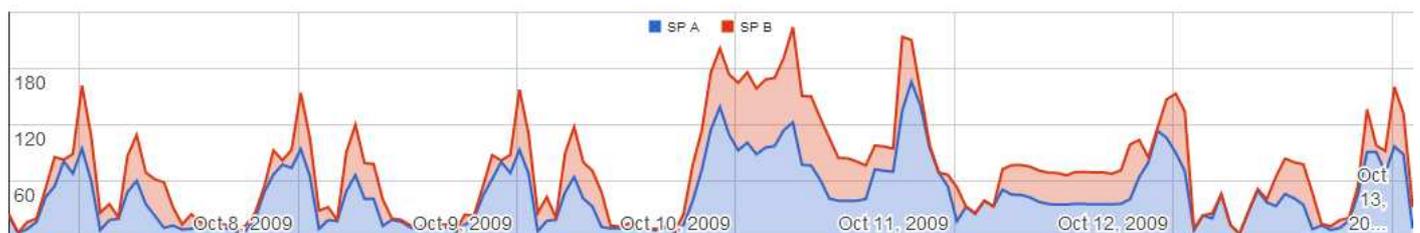
CX4-111 s Utilization



### Stacked

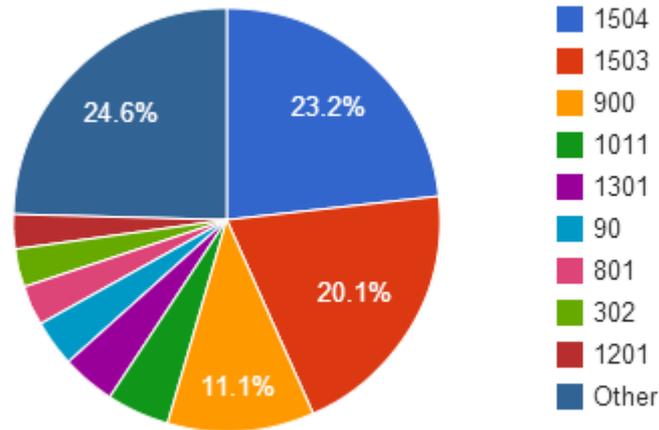
Stacked Line chart of SP A & SP B's total bandwidth

CX4-111 s Total\_Bandwidth\_MB\_s



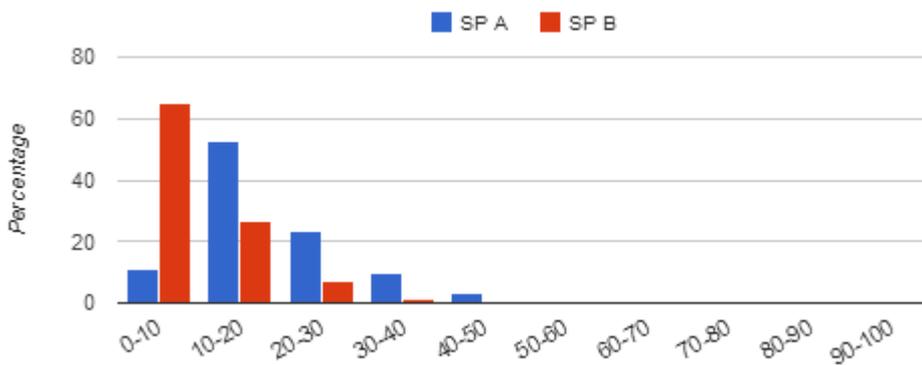
## Pie

Pie chart of LUNs Total Bandwidth displaying a maximum of 10 slices



## Distribution

Distribution chart of SP A & SP B's utilization



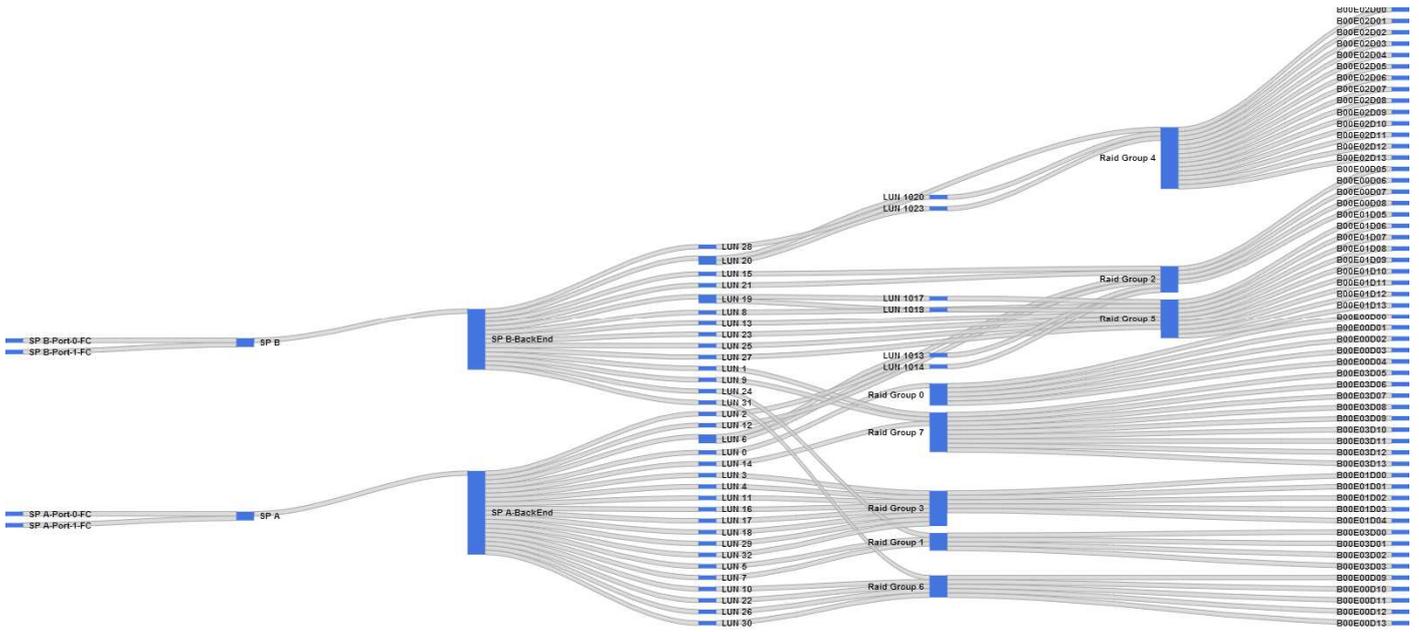
## Table

Table of SP A & SP B's utilization normalized to 3600 second (1 hour) interval

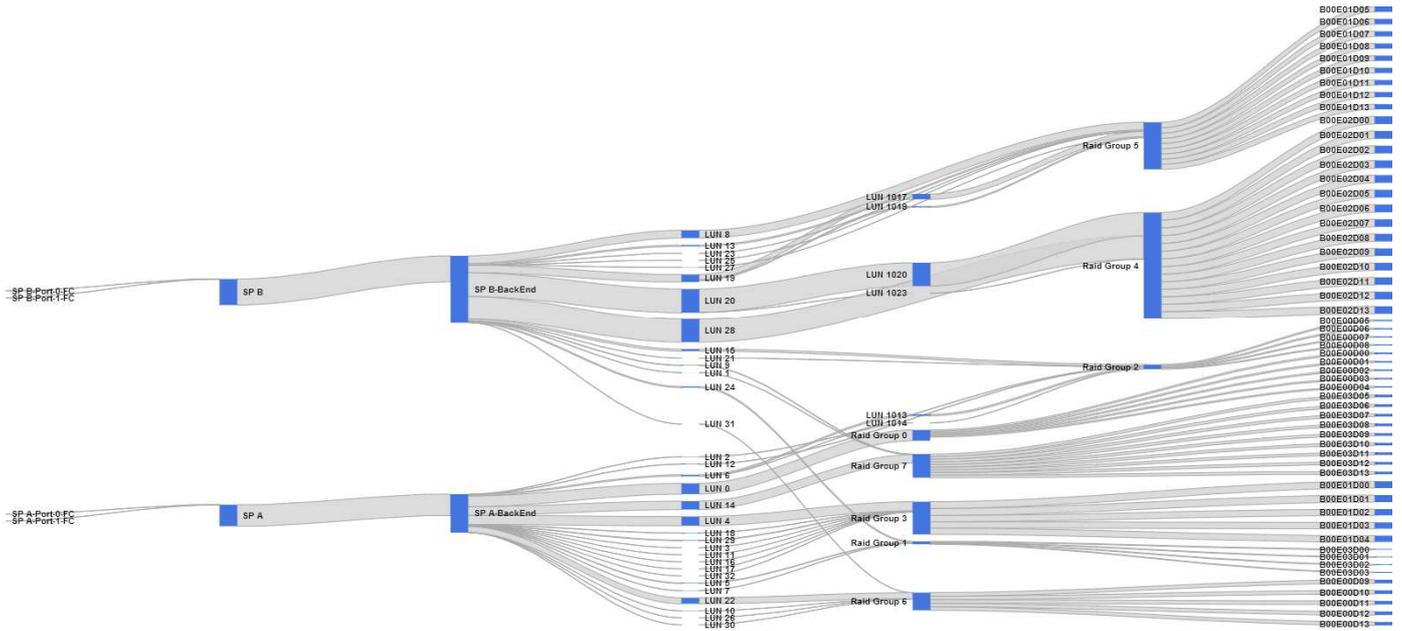
CX4-111-s-(SP A,SP B)-Utilization		
Poll Time	SP A	SP B
Oct 6, 2009, 4:00:00 PM	24.63	7.97
Oct 6, 2009, 5:00:00 PM	8.55	3.86
Oct 6, 2009, 6:00:00 PM	12.12	7.18
Oct 6, 2009, 7:00:00 PM	14.84	6.65
Oct 6, 2009, 8:00:00 PM	18.97	7.99
Oct 6, 2009, 9:00:00 PM	23.43	14.51

## Connectivity

Connectivity chart of the array – the links are weighted evenly



Connectivity chart of the array – the links are weighted by utilization (where the object exposes utilization)



## HeatMaps

Draw HeatMaps over time for array object types

Home Analyzer **HeatMaps** Configuration Server Status

Array

Array Type

Start

End

Avg Interval

All LUNs

Storage Processors

Disk

RAID Group

Port

CPU

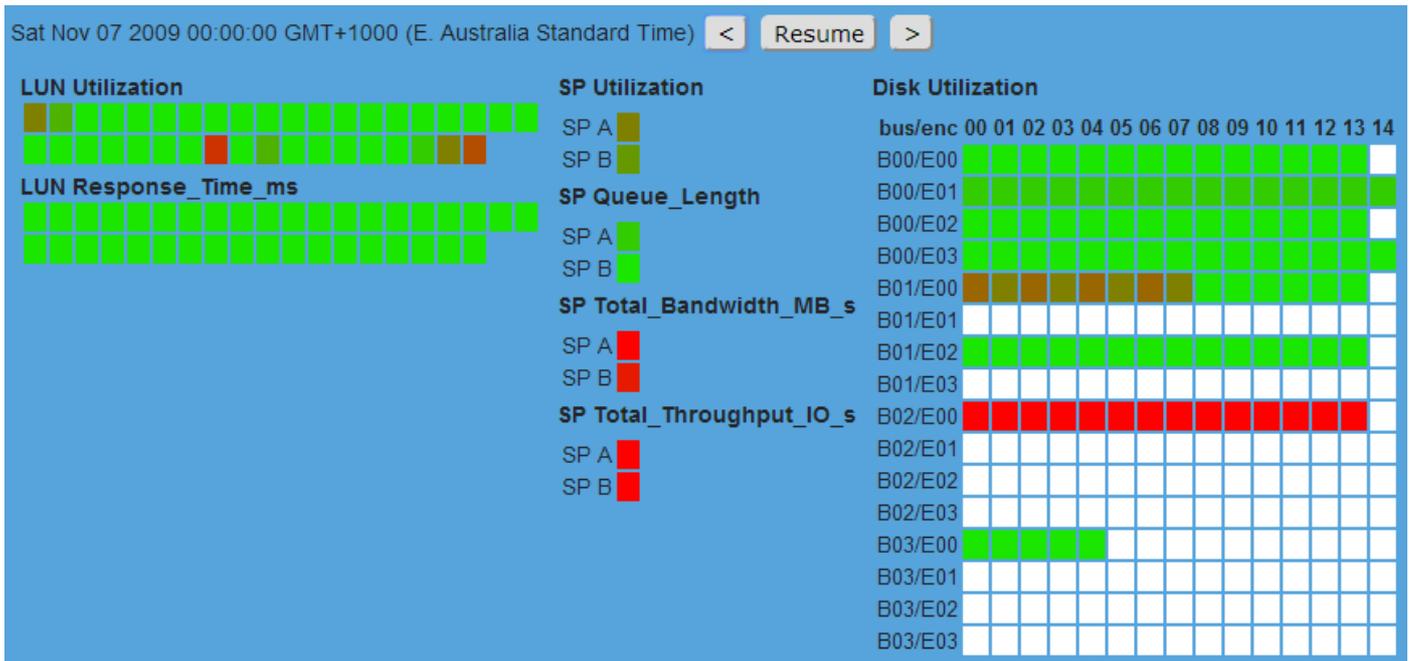
**Selected HeatMap Attributes**

1. Select the Array
2. Modify the Start / End Dates to chart.
3. Modify the Average Interval
4. Select the various attributes from the different object types
  - a. As you select each attribute you should see an entry appear under the “Selected HeatMap Attributes” section

**Selected HeatMap Attributes**

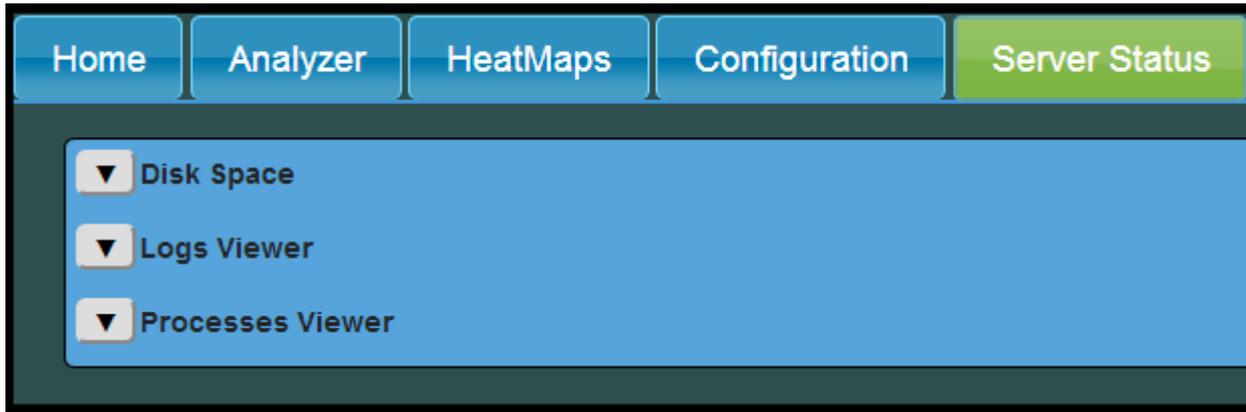
Type:al Attribute:Utilization	<input type="button" value="Remove"/>
Type:al Attribute:Response_Time_ms	<input type="button" value="Remove"/>
Type:s Attribute:Utilization	<input type="button" value="Remove"/>
Type:s Attribute:Queue_Length	<input type="button" value="Remove"/>
Type:s Attribute:Total_Bandwidth_MB_s	<input type="button" value="Remove"/>
Type:s Attribute:Total_Throughput_IO_s	<input type="button" value="Remove"/>
Type:d Attribute:Utilization	<input type="button" value="Remove"/>

## 5. Select Draw Heatmap



There can be one HeatMap drawn at a time. The HeatMap will normalize the selected attributes for their respective object relative to the Maximum, Minimum and Skew figures, where Green = Minimum and Red = Maximum.

## Server Status



This allows you a limited amount of monitoring of the server

## Disk Space

The screenshot shows the 'Disk Space' monitoring interface. It features an 'Auto Update' checkbox which is currently unchecked. Below this, there are two sections of disk utilization data presented in a terminal-like format.

**Server Disk Utilization**

Filesystem	Size	Used	Avail	Use%	Mounted on
rootfs	17G	4.5G	12G	28%	/
udev	10M	0	10M	0%	/dev
tmpfs	397M	168K	397M	1%	/run
/dev/mapper/turnkey-root	17G	4.5G	12G	28%	/
tmpfs	5.0M	0	5.0M	0%	/run/lock
tmpfs	794M	0	794M	0%	/run/shm
/dev/sda1	415M	19M	375M	5%	/boot
.host:/	932G	925G	7.4G	100%	/mnt

**HeatMap Analyzer Disk Utilization**

188M	/heatmap_analyzer/archive
164K	/heatmap_analyzer/config
132K	/heatmap_analyzer/config.tar
2.6G	/heatmap_analyzer/db
736K	/heatmap_analyzer/log
4.0K	/heatmap_analyzer/nar
145M	/heatmap_analyzer/packages
4.0M	/heatmap_analyzer/rel
316K	/heatmap_analyzer/rel.old
328K	/heatmap_analyzer/rel.old2
8.0K	/heatmap_analyzer/tmp

## Log Viewer

▲ Logs Viewer

Log File  Auto Update  Auto Scroll

```
Sat Jul 5 15:41:08 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:41:08 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:41:08 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:41:08 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:41:08 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:41:13 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:27 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:27 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:28 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:28 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:28 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Finished GetData
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Setting log level: 3
Sat Jul 5 15:48:29 2014 /var/www/cgi-bin/getData.pl: Connecting to /heatmap_analyzer/db/CX4-111_NAR.db performance database.
Sat Jul 5 15:48:34 2014 /var/www/cgi-bin/getData.pl: Finished GetData
```

Select the log file to view, the last 200 lines will be displayed, selecting auto update will get new lines every 2 seconds, and Auto Scroll will automatically scroll to the bottom, showing any new data.

## Process Viewer

▲ Processes Viewer

Auto Update  Script Processes Only

```
top - 16:09:57 up 1 day, 4:12, 2 users, load average: 0.00, 0.01, 0.05
Tasks: 107 total, 1 running, 106 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.7 us, 0.1 sy, 0.0 ni, 99.1 id, 0.1 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem: 4063332 total, 1838072 used, 2225260 free, 59076 buffers
KiB Swap: 524284 total, 0 used, 524284 free, 1595728 cached

PID USER PR NI VIRT RES SHR S %CPU %MEM TIME+ COMMAND
1 root 20 0 10648 868 732 S 0.0 0.0 0:02.42 init [2]
2 root 20 0 0 0 0 S 0.0 0.0 0:00.00 [kthreadd]
3 root 20 0 0 0 0 S 0.0 0.0 0:00.07 [ksoftirqd/0]
5 root 20 0 0 0 0 S 0.0 0.0 0:00.00 [kworker/u:0]
6 root rt 0 0 0 0 0 S 0.0 0.0 0:00.10 [migration/0]
7 root rt 0 0 0 0 0 S 0.0 0.0 0:00.36 [watchdog/0]
8 root rt 0 0 0 0 0 S 0.0 0.0 0:00.08 [migration/1]
10 root 20 0 0 0 0 S 0.0 0.0 0:00.09 [ksoftirqd/1]
11 root 20 0 0 0 0 S 0.0 0.0 0:00.67 [kworker/0:1]
12 root rt 0 0 0 0 0 S 0.0 0.0 0:00.32 [watchdog/1]
13 root rt 0 0 0 0 0 S 0.0 0.0 0:00.06 [migration/2]
15 root 20 0 0 0 0 S 0.0 0.0 0:00.06 [ksoftirqd/2]
16 root rt 0 0 0 0 0 S 0.0 0.0 0:00.30 [watchdog/2]
17 root rt 0 0 0 0 0 S 0.0 0.0 0:00.08 [migration/3]
19 root 20 0 0 0 0 S 0.0 0.0 0:00.09 [ksoftirqd/3]
20 root rt 0 0 0 0 0 S 0.0 0.0 0:00.32 [watchdog/3]
21 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 [cpuset]
22 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 [khelper]
23 root 20 0 0 0 0 S 0.0 0.0 0:00.00 [kdevtmpfs]
24 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 [netns]
```

View the currently running processes, ordered by CPU utilization, Auto Update will update top output every 2 seconds, and selecting Script Processes Only will restrict the processes show to only those related to the script.

## Notes, Limitation and Known Issues

- Offline graphing only supports line and area charts, resizing chart functionality is limited.
- HeatMap functionality is basic.
- Analysis / alerting engine not yet implemented.
- Chart saving / export functionality is basic:
  - client side;
  - uses Google scripts;
  - Can't export Heat Maps; and
  - Can't create reports.
- Charting under "early" versions of IE is flaky.

## 3<sup>rd</sup> Party Scripts

The 3<sup>rd</sup> party scripts that this script depends on are bundled with the script so don't need to be downloaded again, some of the bundles provide backward compatibility by either supplying older versions of the scripts, or provide a common API.

Using newer versions of these may produce unexpected results.

### Dimple

DIMPLE – offline graphing <http://dimplejs.org>

Download the tar ball

<https://github.com/PMSI-AlignAlytics/dimple/tarball/master>

```
cd /tmp
wget https://github.com/PMSI-AlignAlytics/dimple/tarball/master
                                     or
cp /mnt/SharedFolder/PMSI-AlignAlytics-dimple-1.1.5-38-g61965f6.tar.gz /tmp

gunzip PMSI-AlignAlytics-dimple-1.1.5-38-g61965f6.tar.gz
tar xvf PMSI-AlignAlytics-dimple-1.1.5-38-g61965f6.tar
cd PMSI-AlignAlytics-dimple-61965f6/
mv dist/ /var/www
```

### D3

Dimple requires D3.js <http://d3js.org/>

```
wget https://github.com/mbostock/d3/releases/download/v3.4.6/d3.zip
unzip d3.zip
mkdir /var/www/d3
mv LICENSE /var/www/d3/
mv *.js /var/www/d3/
ls -la /var/www/d3/
```

### jQuery

Download jquery

```
mkdir /var/www/jquery
cd /var/www/jquery
wget http://code.jquery.com/jquery-2.1.0.min.js
```

### jQuery UI

Download jqueryUI

```
cd /var/www/
wget http://jqueryui.com/resources/download/jquery-ui-1.10.4.zip
unzip jquery-ui-1.10.4.zip
```