Hedgehog User Guide 2.2.0

Overview of Hedgehog

Hedgehog is a visualisation tool for DNS statistics that consumes data acquired with the DSC collector.

Hedgehog was initially developed for ICANN by Sinodun IT and is now released open source under the Apache License, version 2.0. For more information on the development and support of Hedgehog see the http://www.dns-stats.org website.

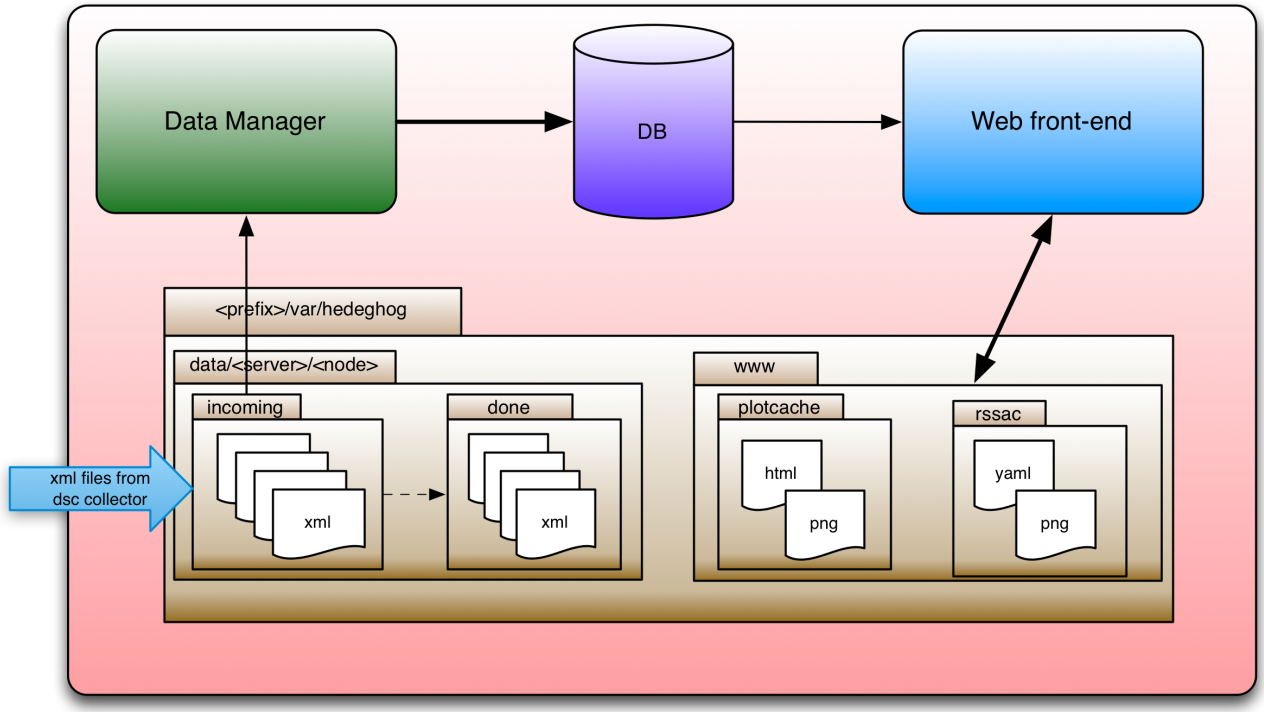
Components

Hedgehog comprises 3 components which can be run on the same or different machines:

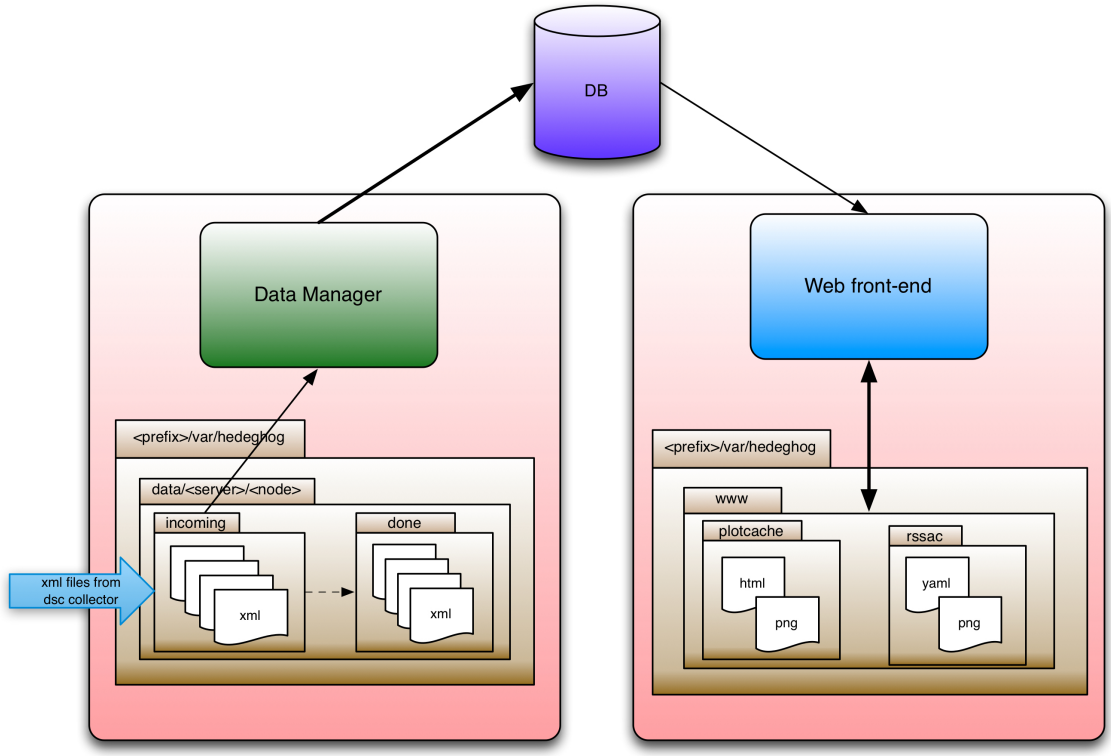
- A Postgres Database
- Data Manager
    - Scripts for database creation and management
    - XML/DAT processing
- Web GUI front-end

Installation options

Hedgehog can be installed to run on a single server with all the components local to that server.



Alternatively the DB may be on a remote server and the Data Manager and Web front-end may be on different servers as shown below.



Install from Packages (Ubuntu)

In 2.2 packages for Ubuntu are provided for Hedgehog. It is recommended to use this method for new installs and that existing installs migrate to this method in 2.1 (see the Installation and Upgrade Guides for details).

Install from Source Code

2.2 can also be installed directly from source code if desired - note: this is not a supported method.

Datasets

> Hedgehog is currently tested against the output of the original DSC collector. It has not been tested against the recently released DSC 2.0.

An example dsc.conf file for the data sets that Hedgehog supports is given below:

```
# Basic data sets
dataset qtype dns All:null Qtype:qtype queries-only;
dataset rcode dns All:null Rcode:rcode replies-only;
dataset opcode dns All:null Opcode:opcode queries-only;
dataset rcode_vs_replylen dns Rcode:rcode ReplyLen:msglen replies-only;
dataset client_subnet dns All:null ClientSubnet:cip4_net queries-only max-cells=200;
dataset qtype_vs_qnamelen dns Qtype:qtype QnameLen:qnamelen queries-only;
dataset qtype_vs_tld dns Qtype:qtype TLD:tld queries-only,popular-qtypes max-cells=200;
dataset certain_qnames_vs_qtype dns CertainQnames:certain_qnames Qtype:qtype queries-only;
dataset client_subnet2 dns Class:query_classification ClientSubnet:cip4_net queries-only
max-cells=200;
dataset client_addr_vs_rcode dns Rcode:rcode ClientAddr:client replies-only max-cells=50;
dataset chaos_types_and_names dns Qtype:qtype Qname:qname chaos-class,queries-only;
dataset idn_qname dns All:null IDNQname:idn_qname queries-only;
dataset edns_version dns All:null EDNSVersion:edns_version queries-only;
dataset do_bit dns All:null D0:do_bit queries-only;
dataset rd_bit dns All:null RD:rd_bit queries-only;
dataset ipv6_rsn_abusers dns All:null ClientAddr:client
queries-only,aaaa-or-a6-only,root-servers-net-only max-cells=50;
dataset transport_vs_qtype dns Transport:transport Qtype:qtype queries-only;
dataset direction_vs_ipproto ip Direction:ip_direction IPProto:ip_proto any;
dataset dns_ip_version_vs_qtype dns IPVersion:dns_ip_version Qtype:qtype queries-only;
```

```
# Additional data sets for RSSAC
dataset unique_sources dns IPVersion:dns_ip_version ClientAddr:client queries-only;
dataset traffic_volume_queries dns Transport:transport IPVersion:dns_ip_version queries-only;
dataset traffic_volume_responses dns Transport:transport IPVersion:dns_ip_version replies-only;
dataset traffic_sizes_queries dns Transport:transport MsgLen:msglen queries-only;
dataset traffic_sizes_responses dns Transport:transport MsgLen:msglen replies-only;
```

```
# New in 2.1
dataset server_addr dns All:null ServerAddr:server queries-only;
# New in 2.2.0
dataset qtype_vs_client_subnet dns Qtype:qtype ClientSubnet:cip4_net queries-only max-cells=200;
```

> Data collection for the server_addr dataset is not yet supported in the official release of DSC, but is available using the latest code from the DSC github repo. Also, note this dataset will contain the source addresses of all responses (QR = 1) seen on the collection node even if they do not originate from the local_address specified in the dsc.conf (i.e. if another server sends a response to the collection node for some reason).

Plots

The relationship between the Hedgehog plots and those produced by the DSC Presenter are listed here for convenience.

Hedgehog plot category	Hedgehog plot display name	DSC plot id	DSC display name
Node Statistics			
	By node	by_node	By node
Query Attributes			

	CHAOS queries	chaos_types_and_names	CHAOS
	DO bit	do_bit	Query Attributes > DO bit
	EDNS version	edns_version	Query Attributes > EDNS version
	IDN qnames	idn_qname	Query Attributes > IDN Qnames
	OPCODE	opcode	Opcodes
	RD bit	rd_bit	Query Attributes > RD bit
QTYPE			
	DNS queries by QTYPE	qtype	Qtypes
	DNSSEC queries by QTYPE	dnssec_qtype	DNSSEC Qtypes
	Popular query names by QTYPE	certain_qnames_vs_qtype	Popular Names
	QTYPE for most popular TLDs	qtype_vs_tld	TLDs
	Query Name Lengths by QTYPE	qtype_vs_qnamlen	Qname Lengths
RCODE			
	Replies by RCODE	rcode	Rcodes
	Reply lengths by RCODE	rcode_vs_replylen	Reply Lengths
IP Protocol			
	IP version	dns_ip_version	IP version
	Queries by IP version, QTYPE	dns_ip_version_vs_qtype	IP version > Query types
	Received packets by IP protocol	direction_vs_ipproto	IP protocols
	Transports carrying DNS queries	transport_vs_qtype	DNS transport
PCAP statistics			
	PCAP statistics		
Client Subnet Statistics			
	Busiest client subnets	client_subnet_accum	Client Geography
	RCODE by client subnet	client_addr_vs_rcode_accum	Rcodes by Client Address
	Root abusers	ipv6_rsn_abusers_accum	IPv6 root abusers
Classification			
	Query classification by client subnet (accum)	client_subnet2_accum	Classification
	Query classification by client subnet (count)	client_subnet2_count	Classification > count
	Query classifications	client_subnet2_trace	Classification > trace

In addition Hedgehog is capable of displaying plots based on datasets defined in the RSSAC 002 document (see later for more details):

Hedgehog plot category	Hedgehog plot display name
RSSAC	
	RCODE volume
	Traffic sizes
	Traffic volume
	Traffic volume differences
	Unique sources
	Zone size
	Zone propagation time

The following plots are new in 2.1

Hedgehog plot category	Hedgehog plot display name
Node Statistics	
	By instance

	By server IP address
	By city
	By country
QTYPE vs TLS	
	QTYPE for most popular Undelegated TLDs
	QTYPE for most popular ccTLDs
	QTYPE for most popular Legacy TLDs
	QTYPE for most popular New TLDs
Client Subnet Statistics	
	Busiest client ASNs
	Busiest client BGP prefix
	RCODE by client ASNs
	RCODE by clients by BGP prefix
Classification	
	Query classification by clients by BGP prefix
	Query classification by client ASNs
RSSAC	
	Zone size
	Zone propagation time
GEO	
	Busiest client locations by country
	Busiest client locations by city

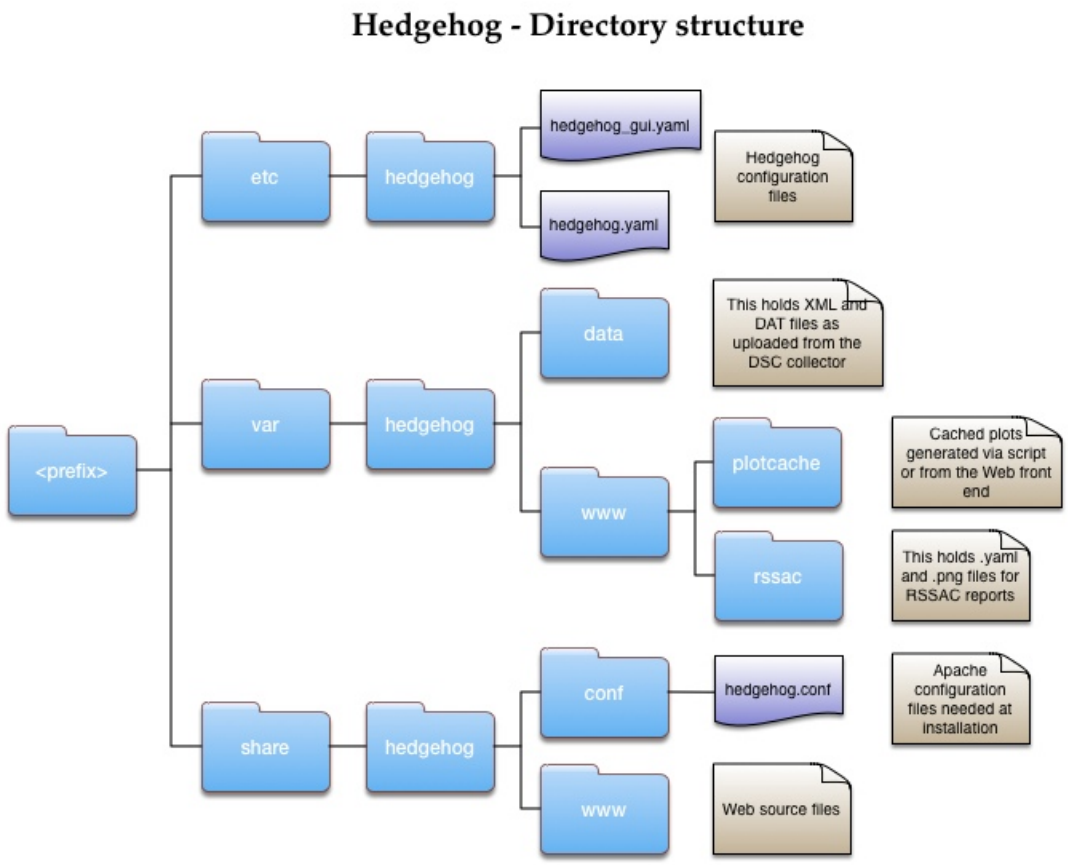
The following plots are new in 2.2

Hedgehog plot category	Hedgehog plot display name
Client Subnet Statistics	
	DNSKEY Queries by ASN

- **RSSAC: Zone size and Zone propagation time graphs.** In order for data to be available for these graphs, an instance of the *rssacd* demon must be run to collect the data (it is not provided by the DSC collector).
- **GEO: Busiest client location by country.** Both client locations and collection node locations can be displayed on this graph. For node locations to be displayed the nodes must have a city specified via the nodes.csv file.

Directory Structure

If installed from source code Hedgehog uses the following directory structure under the install <prefix> directory (/usr/local/ by default)



When installing from a Ubuntu package the structure is different:

Location (install from source)	Location (install from package)	Contents
<prefix>/etc/hedgehog/	/etc/hedgehog/	Hedgehog configuration files (yaml and nodes)
<prefix>/etc/hedgehog/*.sample	/usr/share/doc/hedgehog/examples/*.sample	Sample Hedgehog configuration files
<prefix>/var/hedgehog/	/var/lib/hedgehog/	'data' directory containing XML data 'www' directory containing cached plots and rssac reports
<prefix>/bin/hedgehogctl	/usr/bin/hedgehogctl	Wrapper script for Hedgehog tools
<prefix>/bin/refile_and_grok	/usr/bin/refile_and_grok	refile_and_grok script
<prefix>/libexec/hedgehog/	/usr/lib/hedgehog/	Hedgehog tools scripts and DDL updates

In the rest of this document only the relative path under the install location is given so the instructions are applicable to both methods of install.

Tools

Hedgehog provides a set of Data Manager scripts to support the database and data file management, and Web scripts to generate cached plots and the RSSAC reports. They are documented separately in the Hedgehog Tools PDF.

Data Manager

Upload of Data

It is assumed that the user has already deployed an upload mechanism used with the DSC collector and presenter. A common practice is to use ssh for the upload.

Hedgehog also supports the use of WebDAV for uploads, validated with certificates. This is particularly useful for deployments with many nodes as it scales better than ssh. It can be configured with the hedgehog-webdav-upload package.

Import of data

Hedgehog provides a refile_and_grok script for this purpose. See the Installation guide for more details of how to configure this.

Monitoring data import

The import process produces two different logs for the user to track the progress of the data import:

- The *refile_and_grok* script writes output about which nodes it is processing to a *refile_and_grok.out* file in the Hedgehog */var/hedgehog/data* directory. This gives a high level view of the processing.
- The import also generates a log file per node in the */var/hedgehog/data/<server>/<node>* directory called *dsc-extractor.out*. This lists more details on the processing of each XML file for a specific node.
- A utility script is also provided: */bin/hedgehogctl datafiles_create_summary* which can be run to get an summary of the current state of processing.

Adding or updating servers and nodes

If new servers or nodes need to be added to the system then the user should:

- update the */etc/hedgehog/nodes.csv* files as required to include the new servers/nodes
- run the */bin/hedgehogctl database_update_nodes* script which will update the data in the database and create any required directory structures

> In the event of adding new servers the user **must** also then run the */bin/hedgehogctl database_manage_partition* scripts to create the required database tables so that data can be imported for the new server.

Web front-end

Plot caching

Hedgehog caches plot image files as they are generated by the user. The plot files are cached in the directory listed in the */etc/hedgehog/hedgehog.yaml* file in the directories section for 'plotcache' (this path is auto-generated in 2.0 and should not be changed by the user).

- The reuse of cached plots can be enabled/disabled by changing the *use_plot_caching* option in the */share/www/conf/hedgehog_gui.yaml* configuration file
- The *caching_delay_in_hours* option in the same file controls the delay applied to caching the most recently uploaded data. For example the default for this is 1 i.e. only plots for which the end time is more than one hour ago will be cached. This avoids caching plots where the data may still be being imported for some nodes if there were a delay in upload or processing for some reason.
- If desired, a cron job can be created that will create cached plots for specific time periods, for example it may be useful to have a cron job to create daily plots for the previous day (see the section on Maintenance). This will make loading of the homepage faster.
- If needed the cached files for selected or all plots may be deleted by running the */bin/hedgehogctl plotcache_rm_cached_plots* script .

RSSAC reports

Data collection

If the required datasets are collected via the DSC collector (see Datasets above), Hedgehog can produce RRSAC reports as described in the " RSSAC Recommendation on Measurements of the Root Server System - RSSAC 002 " document for the following metrics:

- traffic-volume
- traffic-size
- rcode-volume
- unique-sources

- zone-size
- load-time

RSSACD

In order to collect the zone-size and load-time statistics a dedicated *rssacd* demon must be run on the Hedgehog Data Manager to collect the information directly from the nodes. It requires that the IP addresses of the nodes have been populated via the nodes.csv file. More details are given in the Installation/Upgrade Guides.

Generating the reports

- To produce the RSSAC reports 2 scripts must be run (see the Hedgehog Tools guide for more information):
    1. the *<prefix>/bin/hedgehogctl database_process_rssac_data* script via the Database tools component
    2. the *<prefix>/bin/hedgehogctl rssac_generate_reports* script on the Web front-end component that will store and display the results
- The resulting yaml files (along with matching plot files) are stored in the directory listed in the *<prefix>/etc/hedgehog/hedgehog.yaml* file in the directories section for '*rssac*' (this path is auto-generated in 2.0 and should not be changed by the user).
- The generated files are served by the Hedgehog front end and can be found by clicking on the "RSSAC reports" link at the bottom left of the Hedgehog webpage.

> Note that RSSAC reports can be run for any server, however the name of the server affects the value in the service field of the generated yaml:
>
> If the server name is of the pattern "*-root" where * is a letter, then the service will be "*.root-servers.org". For all other server names the service will simply be the server name.

The script can either be run manually, or via a cron job as described in the Maintenance section of the installation guide.

Notes

Some notes on the RSSAC data:

- The DSC collector cannot collect extended RCODES and therefore Hedgehog cannot include this information in the rcode_volume report
- As a result of the DSC collector mechanism (i.e collecting data in 1 minute windows) the total quantity of data collected in the 'unique_sources' dataset can be significant and can result in exceptionally large database tables for this dataset. However, this 'raw' data must be uploaded to the Hedgehog database so that it can be accumulated over the 24 hour report period.
    - Once the raw data for the entire 24 hours is uploaded, the RSSAC report can be generated to create the summary figures required in the report and the 'raw' data may be discarded to save disk space (see the Maintanance section of the Installation guide for details of the script to do this).
    - The 'Unique sources' plot in the Hedgehog GUI is generated from the summary data, not from the raw data and therefore the plot cannot be viewed until after the relevant RSSAC report has been generated via the *rssac_generate_reports* script.

Limitations/Known issues

Users should be aware of several limitations in the current version of Hedgehog as listed below. It is hoped they will be addressed in future versions

- The full list of possible plots are displayed via the drop down menu in the GUI, regardless of whether there is data in the database for the plot.
- There is a known issue with the SVG line plots where long legends are not wrapped properly: https://code.google.com/p/google-visualization-api-issues/issues/detail?id=1536 . This affects, for example, the 'by node' plot if there are many nodes. A configuration option is available (*default_interactive_plot_type* in *hedgehog_gui*.yaml) which can specify the system to produce non-SVG line plots that do not have this issue - however these plots require Flash.
- No static plots are provided for the GEO plot category. Plotting of the GEO "Busiest client locations by country' plot is dynamic and may be slow if there are many countries to be plotted.
- Server, node and group and instance names may only contain alphanumeric characters, full stops (.) and hyphens (-). Country and city names can only contain alphanumeric characters, spaces and hyphens (-)
- The Unique Sources plot is not available until after the RSSAC report has been generated for the date in question.