PostRR – PostgreSQL Round Robin Extension

Using PostgreSQL for storing time-series data

Sebastian 'tokkee' Harl <sh@tokkee.org>

teamix GmbH / **collect**d core team

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SOLIDE IT-INFRASTRUKTUR

Disclaimer

WARNING:
This talk presents work that is to be considered pre-alpha and / or random-thoughts.

Flaming, bashing, or other forms of constructive feedback are highly appreciated! :-)

Solid IT-Infrastructure
Location: Nuremberg, Munich, Frankfurt
`http://teamix.net/`

Open-Source	Monitoring	Network
N-IX	NetApp	Juniper
Riverbed	VMWare	Trainings

Background: RRDtool

RRDtool Overview

- RRDtool is the de-facto standard for time-series storage and graphing
- powerful graphing features
- easy to setup up
- fixed storage size
- $\Rightarrow$ also optimized for graphing

RRDtool Problems

- very inflexible backend storage (modifications of existing RRD files are a PITA)
- I/O-problems in large setups ($\rightarrow$ RRDCacheD; but missing clustering, replication, etc.)
- missing (limited) networking support
- limited querying support (abuse of `rrdgraph`)

$\Rightarrow$ an RDBMS might help solve some of these issues
$\Rightarrow$ needs further features to cover base features

Writing Data to PostgreSQL

Problems when Writing Data to PostgreSQL

Things to consider . . .

- database layout (data identifier, timestamps, values)
- identifiers might be hierarchical
- data partitioning
- graphing

Letting collectd Write Data to PostgreSQL

Current proposal for **collect**d:

- generic approach
- user-specified query to store one data-set
- ⇒ flexible database layout
- ⇒ may be used for experimenting
- problem: no bulk updates (e.g. `COPY`) possible
- idea: possibly build specialized plugin later

Example Configuration

collectd.conf:

```
<Plugin postgresql>
    <Writer sqlstore>
        Statement "SELECT collectd_insert($1, $2, \
            $3, $4, $5, $6, $7, $8, $9);"
    </Writer>
    <Database sh>
        Writer sqlstore
        CommitInterval 10
    </Database>
</Plugin>
```

Arguments: timestamp, hostname, plugin name, plugin instance, type name, type instance, array of data-source types, array of values.

Example Database Setup (1)

```
sh=> \d identifiers
                                  Table "public.identifiers"
   Column    |          Type          |                          Modifiers
-------------+------------------------+-------------------------------------------------
 id          | integer                | not null default nextval(...)
 host        | character varying(64)  | not null
 plugin      | character varying(64)  | not null
 plugin_inst | character varying(64)  | default NULL::character varying
 type        | character varying(64)  | not null
 type_inst   | character varying(64)  | default NULL::character varying
Indexes:
    "identifiers_pkey" PRIMARY KEY, btree (id)
    "identifiers_host_plugin_plugin_inst_type_type_inst_key"
        UNIQUE CONSTRAINT, btree (host, plugin, plugin_inst, type, type_inst)
    "identifiers_host" btree (host)
    "identifiers_plugin" btree (plugin)
    "identifiers_plugin_inst" btree (plugin_inst)
    "identifiers_type" btree (type)
    "identifiers_type_inst" btree (type_inst)
```

Example Database Setup (2)

```
sh=> \d+ values
                            Table "public.values"
 Column |            Type             | Modifiers | Storage  | Description
--------+-----------------------------+-----------+----------+-------------
 id     | integer                     | not null  | plain    |
 tstamp | timestamp without time zone | not null  | plain    |
 name   | character varying(64)       | not null  | extended |
 value  | double precision            | not null  | plain    |
Triggers:
    insert_values_trigger BEFORE INSERT ON "values"
        FOR EACH ROW EXECUTE PROCEDURE values_insert_trigger()
Child tables: "values$2012-10-24",
              "values$2012-10-25",
              "values$2012-10-26",
              "values$2012-10-27"
```

collectd_insert() (1)

```
SELECT id INTO ds_id
        FROM identifiers
        WHERE host = p_host
            AND plugin = p_plugin
            AND COALESCE(plugin_inst, '')
                = COALESCE(p_plugin_instance, '')
            AND type = p_type
            AND COALESCE(type_inst, '')
                = COALESCE(p_type_instance, '');
    IF NOT FOUND THEN
        INSERT INTO identifiers (host, plugin,
                plugin_inst, type, type_inst)
            VALUES (p_host, p_plugin, p_plugin_instance,
                p_type, p_type_instance)
            RETURNING id INTO ds_id;
    END IF;
```

```
i := 1;
LOOP
    EXIT WHEN i > array_upper(p_value_names, 1);
    INSERT INTO values (id, tstamp, name, value)
        VALUES (ds_id, p_time,
            p_value_names[i], p_values[i]);
    i := i + 1;
END LOOP;
```

Performance Considerations

- constant flow of data
- rather small amounts of data (MB - GB range)
- lots of single queries

ideas:

- commit interval (or insert count per transaction)
- use `COPY` → harder to implement in a generic way
- use temporary tables and sync to regulary
- use multi-threading / multiple connections?
- note: benchmarking should be done in an application specific manner (e.g. traffic generator `collectd-tg`)

COPY based implementation

- limit generic approach (a bit)
- use function to lookup (database) id for collectd identifier
- $\rightarrow$ more generic: generic lookup functions to define arbitrary columns
- cache id in collectd (limit overhead to startup)
- let user specify data format specification

The PostgreSQL Round-Robin Extension (PostRR)

The PostgreSQL Round-Robin Extension

- `https://github.com/tokkee/postrr`
- BSD license
- adds new data-types and helper functions to PostgreSQL
- similar to the general storage idea implemented in RRDtool
- may be used in addition to storing the actual values
- early pre-alpha state for now ;-)

Why?

- because I can (or rather couldn't)
- flexible queries
- link to other (meta-)data (e.g. spacial data)
- after having RRDCacheD available the next logical step was to extend that to behave similar to a database system
- . . . now the next step after (for) that is to extend an existing database system

`RRTimeslice` type

- Round-Robin Timeslice
- based on `timestamp`
- uses ‘length’ settings to define a time-slice
- uses ‘count’ settings to build a round-robin storage
- $\rightarrow$ stored in a “private” table
- splits the time-line into non-overlapping slices with unique id (sequence number; less than ‘count’)
- index on sequence number (TODO: and timestamp)
- casts to and from `timestamp`
- Usage: `RRTimeslice(<len>, <count>)`

CData type

- Consolidated Data
- based on `double precision`
- uses a built-in consolidation function (AVG, MIN, MAX)
- stores multiple consolidated data points (+ meta information like number of values and number of undefined values)
- casts from and to numeric types
- Usage: `CData(<AVG>|<MIN>|<MAX>)`
- `CData_update(cdata, cdata)` to merge two values

Round Robin Archives

- assigns a name / identifier to multiple “archives” storing values with different resolution, consolidation functions and value counts (using `RRTimeslice` and `CData` colums)
- “multiplexer” to insert a value into multiple tables and / or columns
- `PostRR_update(<rra_name>, <timestamp>, <value>)` used to insert a new value into an archive
- overwrites values based on their sequence number

Round Robin Archives: Internals

```
sh=# \d postrr.rrarchives
 Table "postrr.rrarchives"
 Column   | Type | Modifiers
----------+------+-----------
 rraname | text | not null
 tbl      | name | not null
 tscol    | name | not null
 vcol     | name | not null
```

Inserting Data

```
sh=# select postrr_update('name', 'now', 10);
 postrr_update
---------------
 10 (AVG U:0/1)
 10 (MIN U:0/1)
 10 (MAX U:0/1)

sh=# select postrr_update('name', 'now', 100);
...
sh=# select postrr_update('name', 'now', 1);
  postrr_update
-----------------
 37 (AVG U:0/3)
 1 (MIN U:0/3)
 100 (MAX U:0/3)
```

Graphing

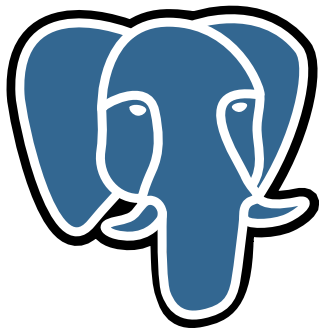
Graphing

Now, we're missing some way to actually create graphs of the data.

- `rrdgraph_libdbi` might be extended to be able to run more complex queries
- PostgreSQL CSV output could be used with Gnuplot; would need some wrapper scripts (benefit: lots of backends available)
- Graphite DB backend?
- ...

Thanks for your attention!

Any questions, thoughts, comments?



Contact:
Sebastian “tokkee” Harl
teamix GmbH, Nürnberg
<sh@tokkee.org>

<collectd@verplant.org> — irc.freenode.net/#collectd — http://identi.ca/collectd

https://github.com/tokkee/postrr