PmaControl Internal Architecture: Aspirateur, Listener, Dot3 and 162 Tables

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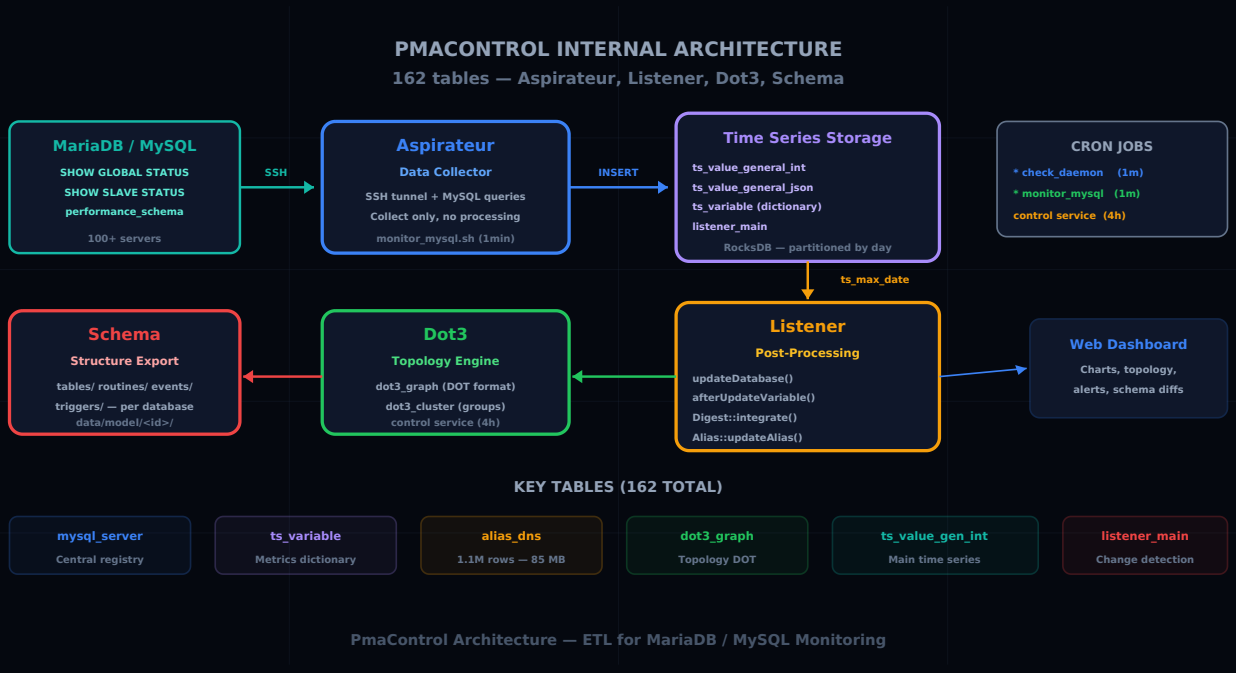
PMACONTROL ARCHITECTURE AGENTS CRON MONITORING



162 Tables, Not One Too Many

PmaControl is not a simple dashboard. It is a distributed system that collects, stores, transforms, and exposes metrics from hundreds of MariaDB / MySQL servers in real time. The internal database contains **162 tables** — each with a precise role in the data pipeline.

This article details the internal architecture: the four main components (Aspirateur, Listener, Dot3, Schema), the end-to-end data flow, the cron jobs that orchestrate everything, and the key tables you need to know for debugging or extending the system.

The Four Pillars

Aspirateur: The Data Collector

The Aspirateur is the component that fetches metrics from each monitored server. Its operation is simple but effective:

1. It connects to the server via **SSH** (tunnel) then opens a local **MySQL** connection
2. It executes a series of queries: `SHOW GLOBAL STATUS`, `SHOW GLOBAL VARIABLES`, `SHOW SLAVE STATUS`, `SHOW PROCESSLIST`, `performance_schema` queries, etc.
3. It writes the results to the `ts_value_*` (time series) tables in the PmaControl database

The `ts_` prefix is ubiquitous: it stands for **time series**. Each metric is timestamped and stored with the source server identifier.

```
Aspirateur → SSH tunnel → local MySQL
           → SHOW GLOBAL STATUS
           → SHOW SLAVE STATUS
           → performance_schema queries
           → INSERT INTO ts_value_general_int (...)
           → INSERT INTO ts_value_general_json (...)
```

The Aspirateur does **no processing**. It collects and writes. This is a fundamental design principle: separate collection from processing so they can be scaled independently.

Listener: The Post-Processing Engine

The Listener is PmaControl's brain. It monitors time series tables and triggers actions when new data arrives. Its mechanism relies on a pivot table: `listener_main`.

The `listener_main` table contains:

Column	Role
`ts_file`	The data source file
`ts_max_date`	The last processed timestamp
`ts_date_by_server`	The last timestamp per server

The Listener runs in a continuous loop. On each iteration, it compares the recorded `ts_max_date` with the most recent timestamp in the `ts_value_*` tables. If a difference is detected, it means the Aspirateur has written new data — the Listener then triggers the post-processing chain:

```
Listener loop:
  1. Check ts_max_date vs actual max(timestamp)
  2. If changed → trigger pipeline:
     a. updateDatabase()      — updates server metadata
     b. afterUpdateVariable() — triggers conditional rules
     c. Digest::integrate()   — aggregates performance_schema metrics
     d. Alias::updateAlias()  — refreshes DNS aliases
```

updateDatabase() synchronizes basic information: server version, replication status, database sizes, active connection count.

afterUpdateVariable() is the rule engine. It compares new values against configured thresholds and generates alerts if necessary. For example, if `Seconds_Behind_Master` exceeds 60, a Warning alert is created.

Digest::integrate() processes `performance_schema` data. It aggregates query statistics (execution time, rows examined, frequency) and stores them in PmaControl's digest tables. This feeds the performance dashboards.

Alias::updateAlias() maintains the `alias_dns` table, which maps friendly names to actual IP addresses. This table is one of the largest: **1.1 million rows, 85 MB of data**. Aliases are used throughout the interface to display readable names instead of IP addresses.

Dot3: Real-Time Topology

Dot3 is the topology mapping component. It analyzes replication relationships between servers and generates a directed graph in DOT format (Graphviz).

The process:

1. Dot3 reads each server's replication metadata (master/slave, GTID, channel)
2. It builds a dependency graph: who is master of whom, who is slave of whom
3. It generates a visual representation with clusters (groups of related servers)

The tables involved:

- **`dot3_graph`** : the complete DOT graph, ready to be rendered
- **`dot3_cluster`** : server clusters (a cluster = a replication group)

Dot3 is particularly useful for detecting broken topologies: a slave pointing to a nonexistent server, an unexpected circular replication loop, or an isolated server that should be part of a cluster.

Schema: Structure Export

The Schema component exports the complete structure of each monitored database. For each server, it creates a file tree:

```
data/model/<server_id>/databases/<db_name>/
├── schema/
│   └── tables/
│       ├── users.sql
│       ├── orders.sql
│       └── ...
├── routines/
│   ├── calculate_total.sql
│   └── ...
├── events/
│   ├── daily_cleanup.sql
│   └── ...
└── triggers/
    ├── before_insert_users.sql
    └── ...
```

Each file contains the corresponding `CREATE TABLE`, `CREATE PROCEDURE`, `CREATE EVENT` or `CREATE TRIGGER`. This enables:

- Versioning the structure in Git (diff between two exports)
- Comparing structure between production and staging
- Detecting schema drift (an index manually added in production, a column modified without a migration)

The Glial CLI

PmaControl is built on the Glial framework, which provides a standardized command-line interface:

```
./glial <controller> <action> [params]
```

Concrete examples:

```
# Check daemon status
./glial agent check_daemon

# Force a collection cycle
./glial control service

# Export a server's schema
./glial schema export 42

# Regenerate topology
./glial dot3 generate
```

The CLI is used both manually (debugging, maintenance) and by cron jobs for automatic orchestration.

Cron Jobs: The Orchestration

Three essential cron jobs keep PmaControl running:

1. `./glial agent check_daemon` — Every Minute

This is the most frequent cron job. It checks that all agent processes are alive and restarts them if needed. A dead agent means a gap in data — this cron ensures collection continuity.

```
* * * * * cd /srv/www/pmacontrol && ./glial agent check_daemon >> /tmp/pmacontrol_agent.log 2>&1
```

If an agent does not respond after 3 attempts, a Telegram alert is sent.

2. `./glial control service` — Every 4 Hours

This cron performs heavy maintenance tasks:

- Recalculation of daily aggregations
- Cleanup of expired data (configurable retention)
- Regeneration of Dot3 topology
- Server metadata synchronization
- Consistency checks between tables

Four hours is a good tradeoff between freshness and load: these operations are expensive and do not need to be real-time.

```
0 */4 * * * cd /srv/www/pmacontrol && ./glial control service >> /tmp/pmacontrol_control.log 2>&1
```

3. `./monitor_mysql.sh` — Every Minute

This script is the Aspirateur's entry point. It triggers a complete collection cycle:

```
* * * * * cd /srv/www/pmacontrol && ./monitor_mysql.sh >> /tmp/pmacontrol_monitor.log 2>&1
```

The script handles parallelization: if you are monitoring 200 servers, it does not contact them sequentially. It distributes work in parallel batches, with a configurable number of workers.

Key Tables

Here are the most important tables to know for understanding or debugging PmaControl:

`mysql_server`

The central table. Each row represents **a monitored instance** — not just MariaDB / MySQL servers, but also:

- **MariaDB / MySQL servers** (the primary use case)
- **Proxies**: MaxScale, ProxySQL, HAProxy
- **VIPs** (Virtual IPs)

The `is_proxy` and `is_vip` columns distinguish the types:

is_proxy	is_vip	Type
0	0	Regular MariaDB / MySQL server
1	0	Proxy (MaxScale, ProxySQL, HAProxy)
0	1	VIP (Virtual IP)

```
-- MariaDB/MySQL servers only
SELECT id, ip, port, name, display_name, id_environment
FROM mysql_server
```

```
WHERE is_deleted = 0 AND is_proxy = 0 AND is_vip = 0;

-- Proxies (MaxScale, ProxySQL, HAProxy)
SELECT id, ip, port, name, display_name
FROM mysql_server
WHERE is_deleted = 0 AND is_proxy = 1;

-- VIPs
SELECT id, ip, port, name, display_name
FROM mysql_server
WHERE is_deleted = 0 AND is_vip = 1;
```

Proxies and VIPs are stored in the same table as MySQL servers to simplify joins and topology. Dot3 uses them to draw connections between network layers (VIP → Proxy → Master → Slave). The `timeout` column is dynamically computed: 11 seconds for proxies (which respond more slowly to checks), 1 second for regular servers.

Dedicated tables complement proxy-specific details:

- **`maxscale_server`** / **`maxscale_server__mysql_server`** — MaxScale configuration and its backends
- **`proxysql_server`** — ProxySQL configuration
- **`haproxy_main`** / **`haproxy_main_input`** / **`haproxy_main_output`** / **`link__haproxy_main_output__mysql_server`** — HAProxy configuration (listeners, frontends, backends)
- **`vip_server`** — VIP details

`ts_variable`

The metrics dictionary. Each collected variable (for example `Threads_connected`, `Innodb_buffer_pool_pages_data`) has an entry in this table with its numeric identifier.

```
SELECT id, name, source
FROM ts_variable
WHERE name LIKE 'Innodb%';
```

`ts_value_general_int`

The main storage for numeric metrics. This is the largest table — it receives thousands of inserts per second, and can reach several billion rows per day on the largest PmaControl installations.

```
SELECT server_id, variable_id, value, timestamp
FROM ts_value_general_int
WHERE server_id = 42
  AND variable_id = 107  -- Threads_connected
  AND timestamp > NOW() - INTERVAL 1 HOUR;
```

This table is partitioned by day to allow fast cleanup of old data (`ALTER TABLE ... DROP PARTITION`).

`ts_value_general_json`

For complex metrics that do not fit in an integer: `SHOW PROCESSLIST` results, `performance_schema` tables (query digests, locks, table I/O), `SHOW ENGINE INNODB STATUS` , etc. The JSON format allows storing arbitrary structures. Replication metrics (`SHOW SLAVE STATUS`) have their own dedicated tables (`ts_value_slave_*`).

`alias_dns`

The DNS alias table — 1.1 million rows, 85 MB. It maps IP addresses to readable names and is used throughout the interface.

```
SELECT ip, alias, source, updated_at
FROM alias_dns
WHERE ip = '10.0.1.42';
```

`dot3_graph` and `dot3_cluster`

The topology tables. `dot3_graph` contains the complete DOT graph, `dot3_cluster` the logical server groups.

The Complete Data Flow

Let us recap the journey of a metric, from source to screen:

Step	Component	Action
1	**CRON** `monitor_mysql.sh` (every minute)	Launches Aspirateur
2	**ASPIRATEUR**	SSH tunnel → MySQL → `SHOW GLOBAL STATUS`

Step	Component	Action
		Writes to `ts_value_general_int` / `ts_value_general_json`
3	**LISTENER** (detects `ts_max_date` changed)	`updateDatabase()` — updates server metadata
		`afterUpdateVariable()` — alerts if thresholds exceeded
		`Digest::integrate()` — aggregates `performance_schema`
		`Alias::updateAlias()` — refreshes `alias_dns`
4	**DOT3** (loops every ~3s)	Regenerates replication topology in real time
5	**CRON** `control service` (every 4h)	Daily cleanup and aggregation
6	**WEB INTERFACE**	Reads aggregated tables → dashboards, charts, topology

Sizing

For a typical deployment of 100 MariaDB / MySQL servers:

- **PmaControl database**: approximately 15 GB of data (dominated by `ts_value_*` tables)
- **CPU**: 2-4 cores are sufficient (the Listener is the most demanding)
- **RAM**: 4 GB minimum, 8 GB recommended (for the buffer pool of the PmaControl database itself)
- **Disk**: SSD mandatory — time series tables generate heavy random I/O

The recommended storage engine for `ts_value_*` tables is **RocksDB** (via MyRocks): better compression, better sequential write performance, and native partitioning by day.

Debugging

When something is not working, here is the checklist:

1. **Are agents running?** `./glial agent check_daemon` — if an agent is dead, data is no longer being collected for the servers it manages
2. **Is the Listener running?** Check `ts_max_date` in `listener_main` — if it is no longer progressing, the Listener is stuck
3. **Are cron jobs executing?** Check `/tmp/pmacontrol_*.log` for errors
4. **Is SSH connectivity OK?** Manually test `ssh -p <port> <user>@<host>` with the configured key
5. **Is the PmaControl database healthy?** Check disk space, locks, slow queries on the PmaControl database itself

Conclusion

PmaControl's architecture follows a classic ETL (Extract-Transform-Load) model adapted for monitoring:

- **Extract**: the Aspirateur collects without transforming
- **Transform**: the Listener applies rules and aggregates
- **Load**: dashboards read the transformed data

The 162 tables are not an accident of complexity — they reflect the richness of data collected on each MariaDB / MySQL server. Understanding this architecture is essential for anyone who wants to debug a collection problem, extend PmaControl with a new metric type, or optimize the performance of the monitoring system itself.