CMDB Driven by Perl

Road to a Perl "driven" Configuration Management Database

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Niederrhein Perl Mongers

The Perl Conference in Amsterdam

Overview

Part I

Introduction

Motivation

Progress

Progress isn't made by early risers. It's made by lazy men trying to find easier ways to do something.

*(*Robert A. Heinlein*)*

Motivation

Efficiency

Business success is because of Perl. It enables us to deliver right solutions in days instead of months.

*(*Elizabeth Mattijsen*)*

Goal

Automation

Full flavoured systems management

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- Installation without Administrator interaction

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- Installation without Administrator interaction
- Control sensors and alarming
- Ensured system state by actual-theoretical comparison
- Faster reaction in emergency cases by organized component moving
- Have an up-to-date "Operation Handbook" as well as archiving them

Overview

Part II

Challenge

Begin with reporting

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In the beginning was the (Installation-)Report

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- Technical Sales defined an XML Document for Change Requests and Status Reports

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$\Rightarrow$ Appears to be a dead end

From reporting to ...

Mind the goal

Alice: Would you tell me, please, which way I ought to go from here?

The Cheshire Cat: That depends a good deal on where you want to get to.

(Lewis Carroll)

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- Changes shall be deployed from the same report format as installations are reported.

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- This solution did not maintain an abstraction layer for gathered data - every time when the report needs an extension, an end-to-end (snapshot to XML-Tag) enhancement had to be created.
- Changes shall be deployed from the same report format as installations are reported.
- We have to be able to say at any moment what is operated on the platform.

Baby Steps

Improve knowledge

Based on identified issues the first goal had to be to identify all entities and their relations together

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Surrounded

Problem: The entire platform was completely unstructured

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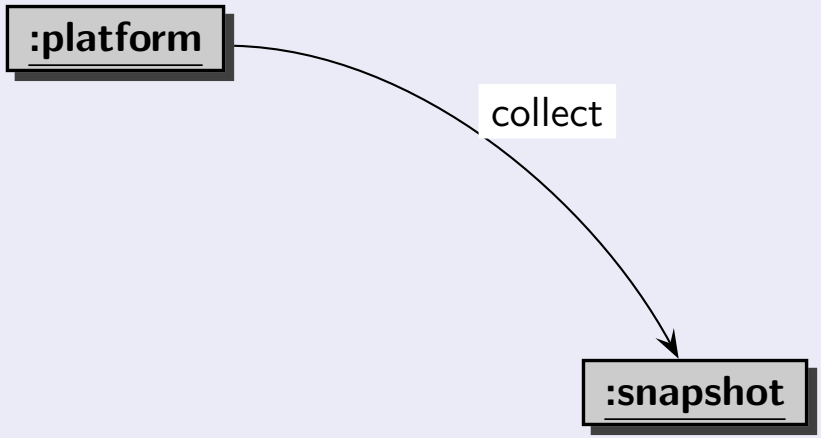
  Hiera is Puppet's built-in key/value data lookup system. By default, it uses simple YAML or JSON files, although one can extend it to work with almost any data source.

Part III

Sweat

Circle in the Sand

Circle in the Sand



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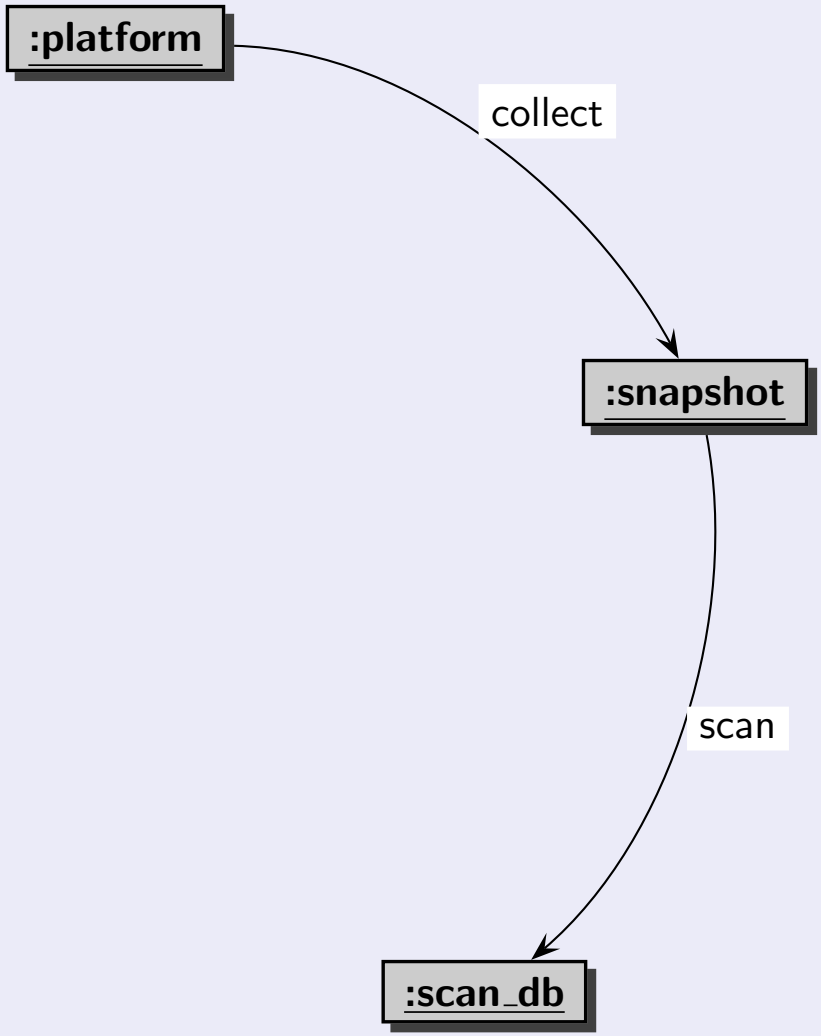

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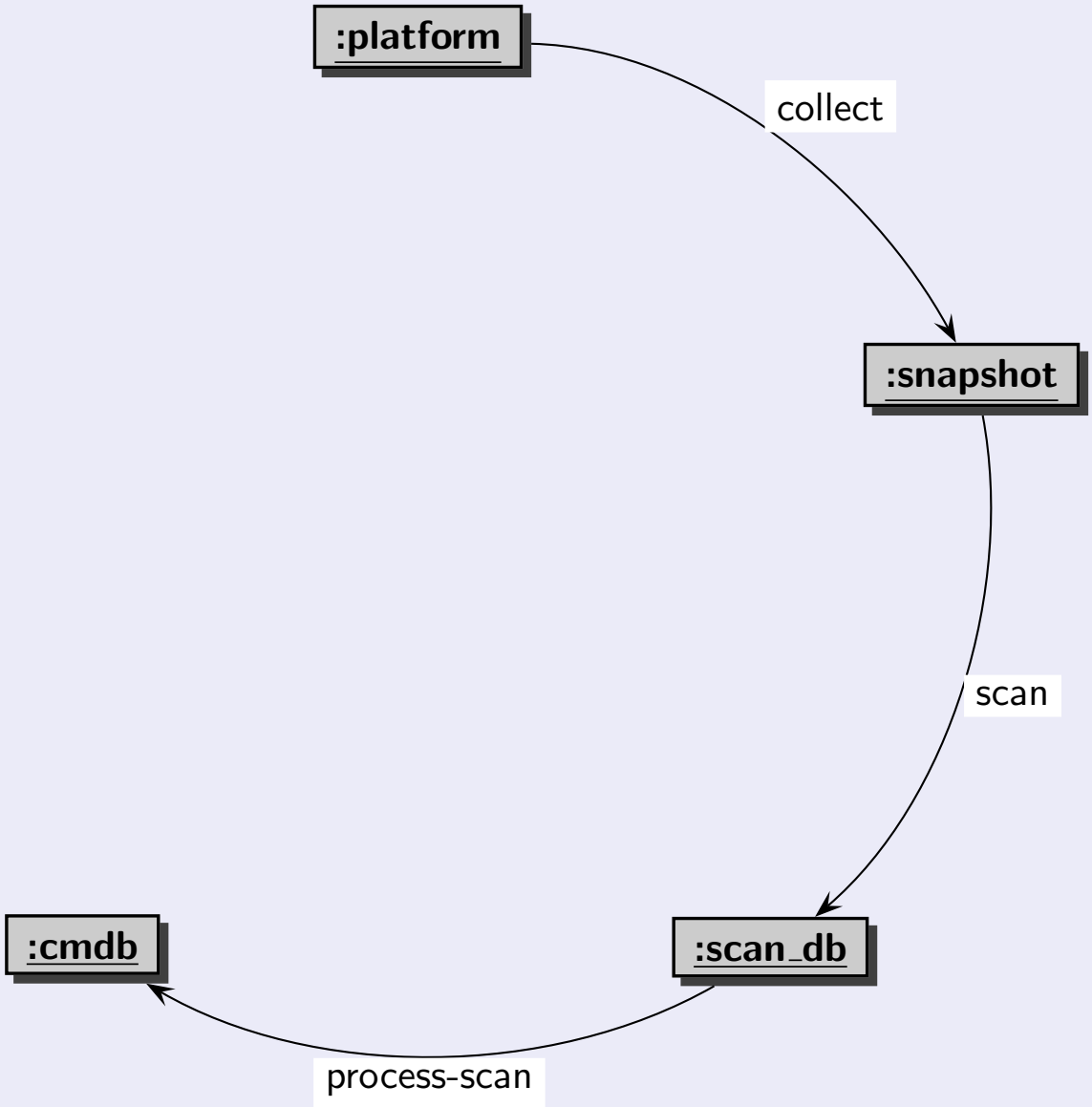

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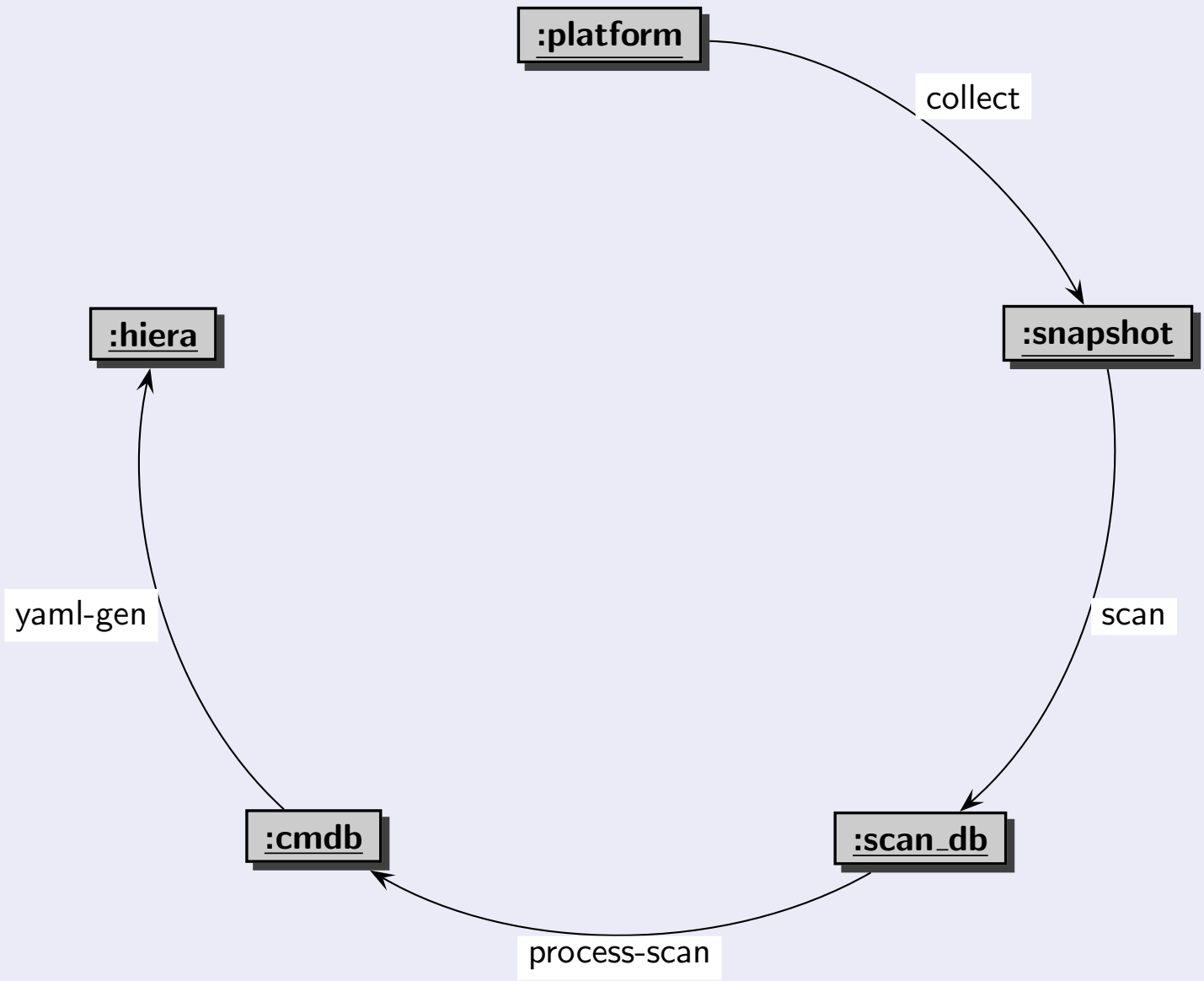

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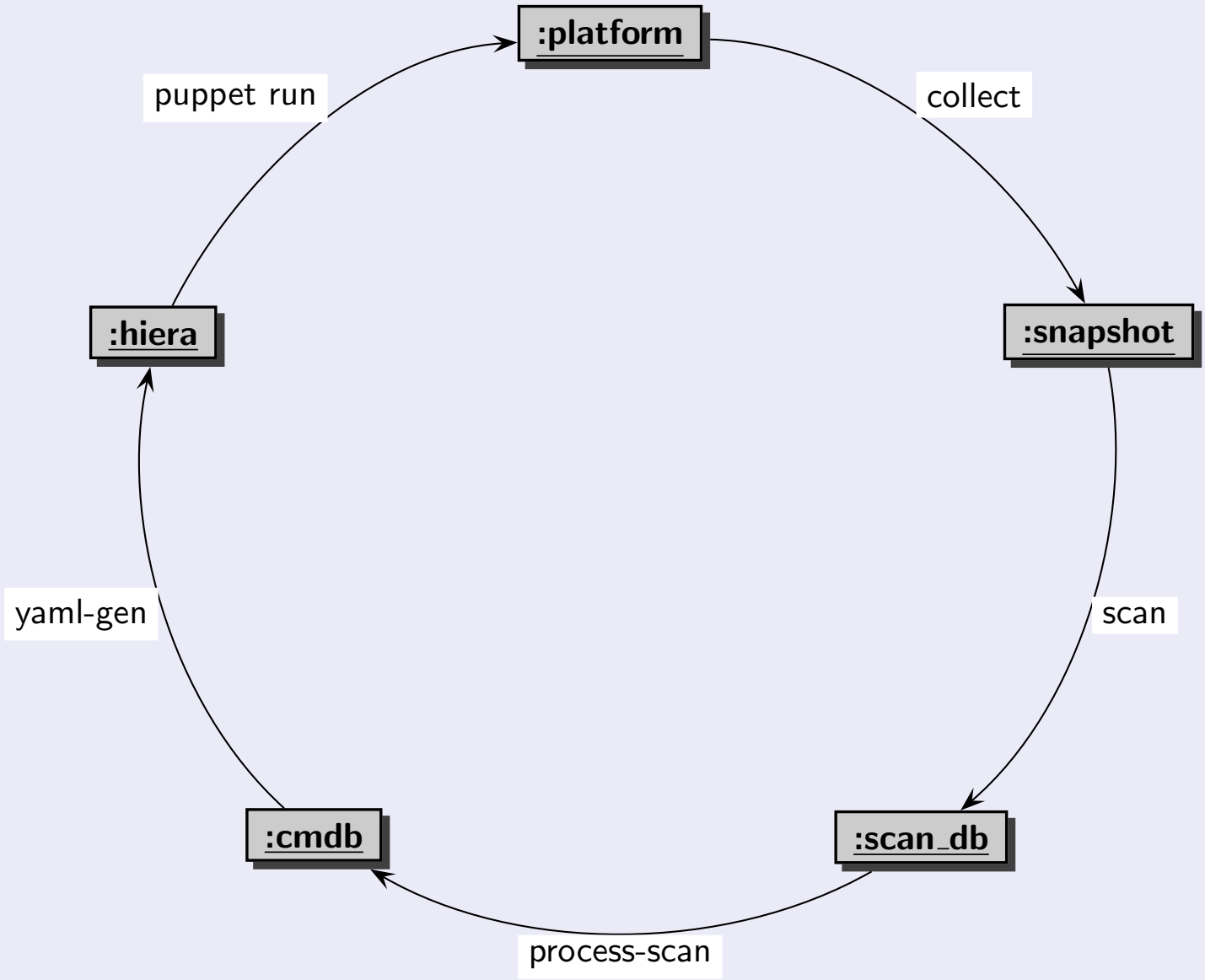

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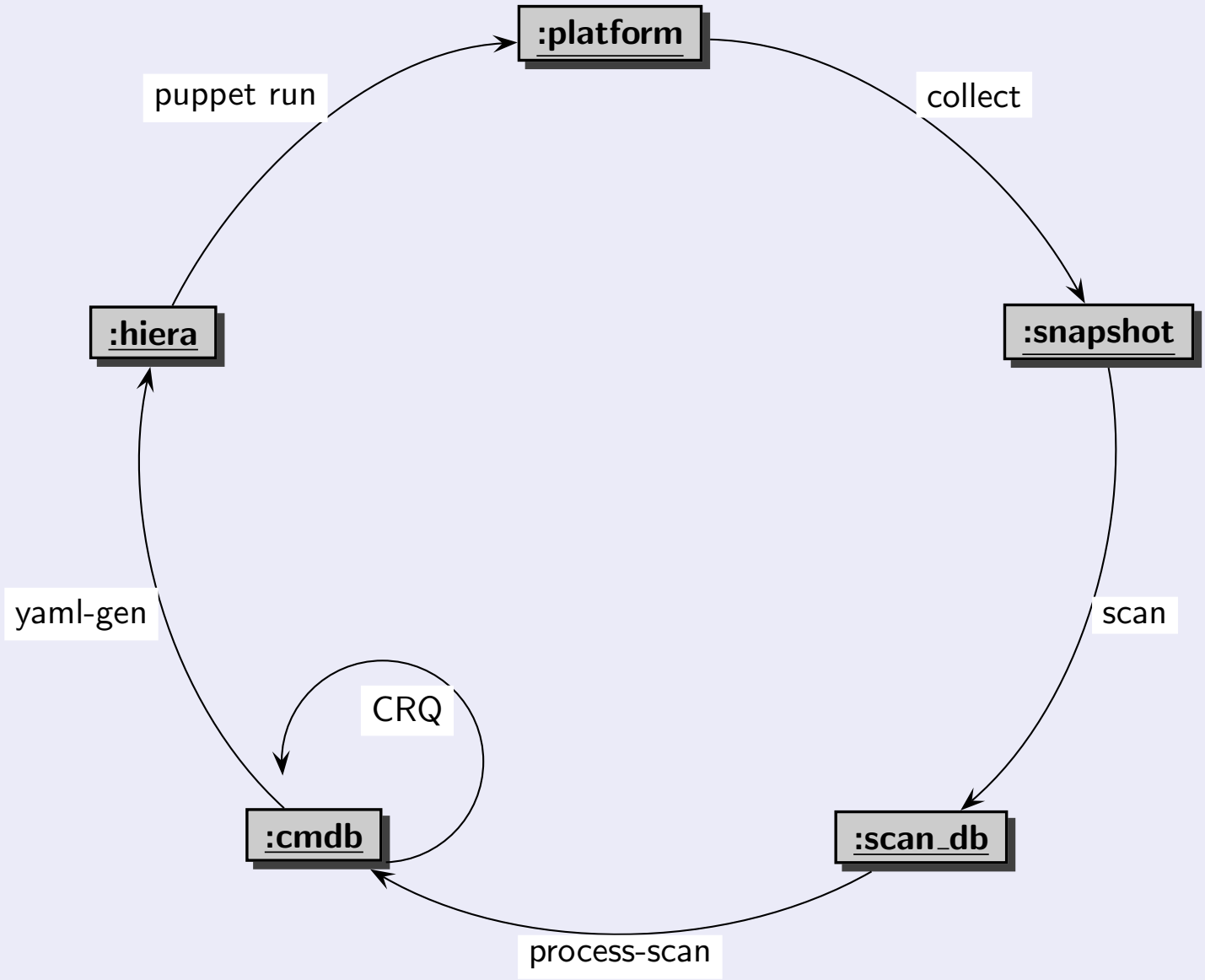

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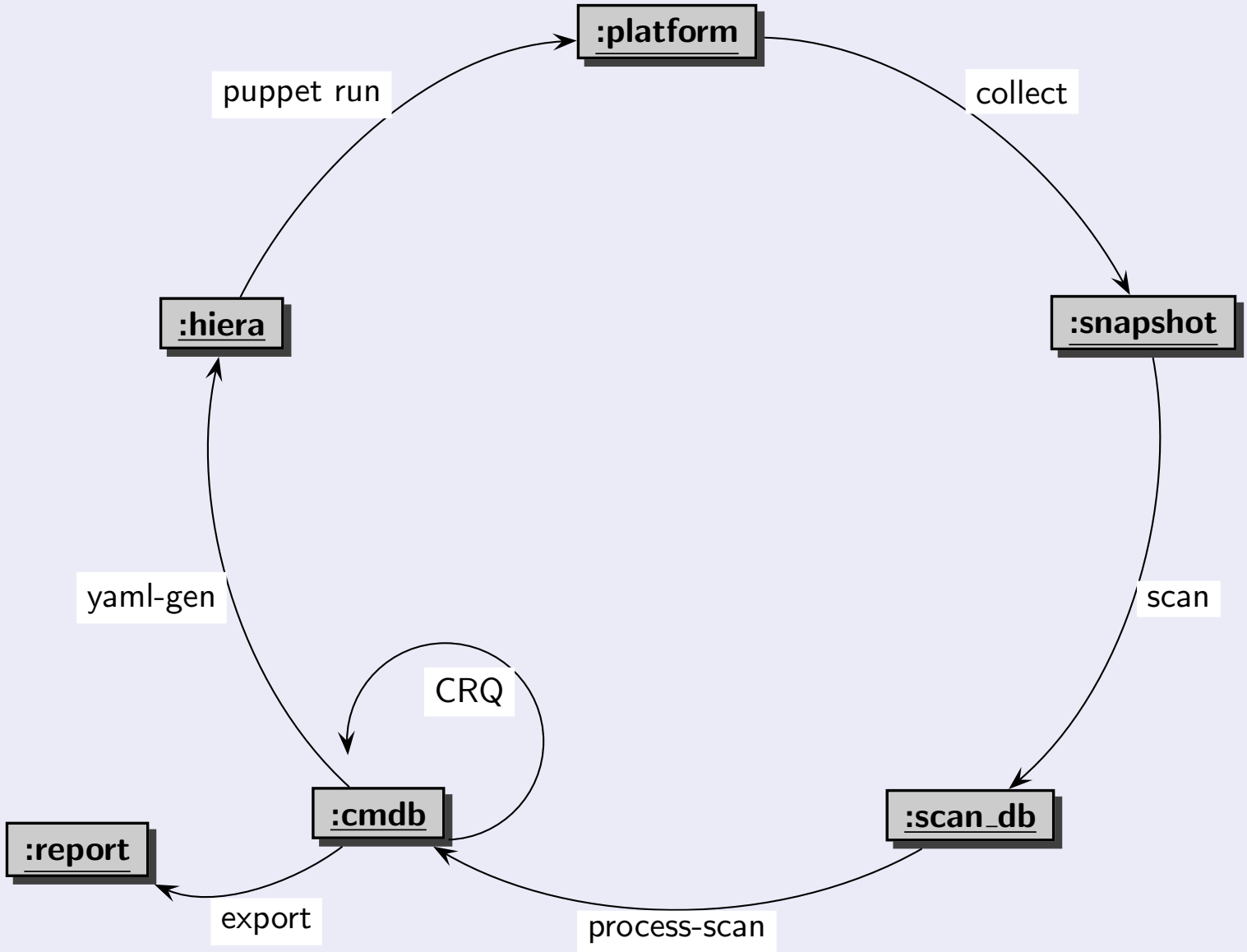

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- Limits of our `CI`'s
- Data ownership of `CI`'s
- Methods to persist `CI`'s
- Methods to access `CI`'s
- Permission management

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Impossible Things

Impossible Things

Alice laughed. "There's no use trying," she said: "one can't believe impossible things."

"I daresay you haven't had much practice," said the Queen. "When I was your age, I always did it for half-an-hour a day. Why, sometimes I've believed as many as six impossible things before breakfast." (Lewis Carroll)

The Fool with a Tool

Try again

So we closed our eyes, took a deep breath (multiple times) and looked around for tools to store serialized data and read in structured way . . .

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AnyData2 gotcha - allows reading most confusing stuff and could be queried in structured way

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The entire ER model remains a moving target

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- Depth first search over all component configuration files
- Identify relationships (remember: there is no operation model at all)
- Clean up configuration when no reasonable relationships can be resolved or relationships are conflicting

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`MooX::Cmd`	helps separating concerns
`MooX::ConfigFromFile`	helps contribute "divine wisdom"
`MooX::Options`	allow overriding "divine wisdom" by "individual wisdom"
`MooX::Log::Any`	feeds `DBIx::LogAny`

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- Manage database connections based on concerns
- Manage `CI` structures based on relations
- Manage Web-API integration

Craziness

Crazy

I'm not crazy. My reality is just different than yours.

The Cheshire Cat

(Lewis Carroll)

Harmonization

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- Practically any administrator had a different background regarding to the platform components thus a different picture of their relationships
- EPIC battles leads to common craziness
- ER model analysis sessions uncovered holes in picture

Civilized

March Hare: Have some wine.
(Alice looked all round the table, but there was nothing on it but tea.)
Alice: I don't see any wine.

March Hare: There isn't any.
Alice: Then it wasn't very civil of you to offer it.
March Hare: It wasn't very civil of you to sit down without being invited.

(Lewis Carroll)

Adding a Goal

CentOS 5 ends its maintenance

- Many of existing tools need to be upgraded

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- Same problem like the report format:
  - neither the ER model of platform components nor issues of platform where known
  - nor cared about

Self Protection

Delegation

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$\Rightarrow$ ER model of `CMDB` is presented via *RESTful API*

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- There is no future, nor past
- Time for *CMDB* to enter the stage

Customers . . .

```
CREATE TABLE customer_t
(
      customer_id INTEGER PRIMARY KEY
    -- entity stuff
    , customer_name VARCHAR(80) UNIQUE NOT NULL
    -- cmdb stuff
    , valid_from DATETIME NOT NULL
    , valid_to DATETIME
    , modified_at DATETIME NOT NULL
    , modified_by VARCHAR(32) NOT NULL
);
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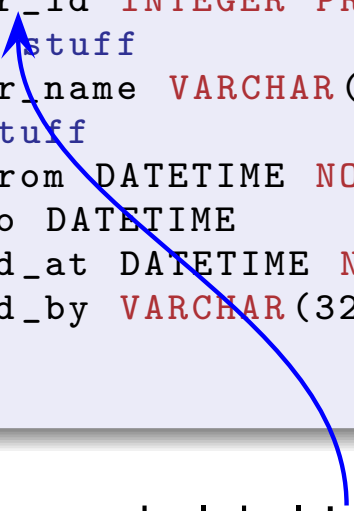

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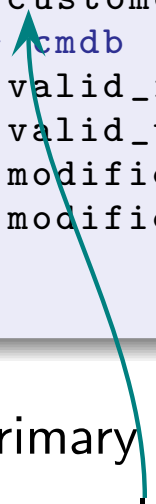

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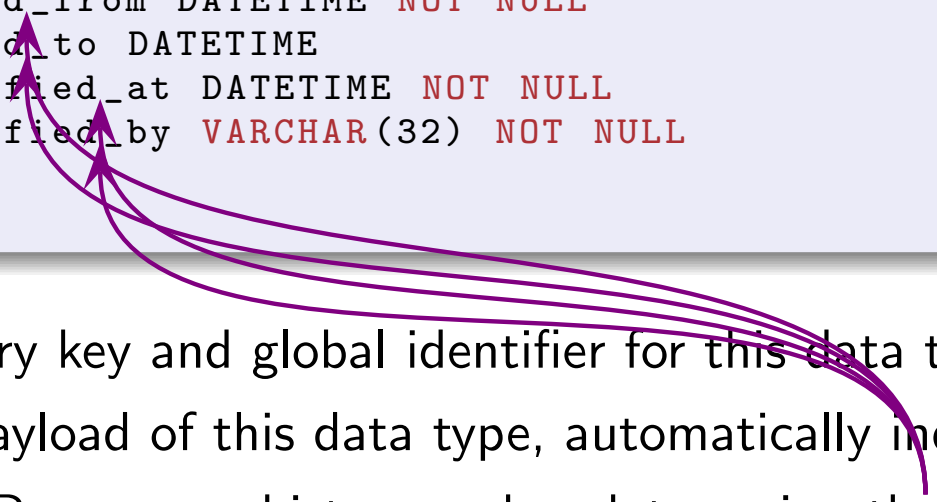

- primary key and global identifier for this data type
- the payload of this data type, automatically indexed
- CMDB manages history and updates using these columns

VPN links to customers . . .

```
CREATE TABLE vpn_link_t
(
      vpn_link_id INTEGER PRIMARY KEY
    -- entity stuff
    , customer_id INTEGER NOT NULL
    , vpn_link_type VARCHAR(12)
    , customer_net VARCHAR(64) UNIQUE NOT NULL
    , services_net VARCHAR(64) UNIQUE NOT NULL
    -- cmdb stuff
    , valid_from DATETIME NOT NULL
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    , modified_at DATETIME NOT NULL
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    , FOREIGN KEY (customer_id) REFERENCES customer_t(customer_id)
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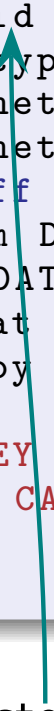

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- refer the customer
- support Cisco, Juniper, Paolo Alto, . . .
- networks must be unique or network admins kill you

Moo Interception

```
package Foo::Role::Database::CMDB;
use Moo::Role;
requires "log";

has cmdb => (
    is       => "ro",
    required => 1,
    handles  => "Foo::Role::Database",
    isa      => sub {
        _INSTANCE_OF($_[0], "Foo::Helper::CMDB") and $_[0]->DOES("Foo::Role::Dat
          and return;
        die "Insufficient initialisation parameter for cmdb";
    },
    coerce => sub {
        _HASH($_[0]) and return Foo::Helper::CMDB->new(%{$_[0]});
        $_[0];
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- role can be consumed by any class needing access to CMDB
- transform hash initializer into object

Hard work

```
package Foo::Helper::CMDB;
use Moo; extends "Foo::Helper::DatabaseClass";
has config_tables => (is => "lazy", ...);
has history_tables => (is => "lazy", ...);
around deploy => sub { ...
my @tables = @{$self->config_tables};
foreach my $tbl (@tables) {
  my @hist_coldefs =
    map { my $default = defined $_->[4] ? " DEFAULT $_->[4]" : "";
      $pure_cols{$_->[1]} ? ("$_->[1] $_->[2]$default")
        : ("old_$_->[1] $_->[2]$default", "new_$_->[1] $_->[2]$default")
    } @table_info;
}
unshift @hist_coldefs, "${base_name}_hist_id INTEGER PRIMARY KEY";
my $hist_defs = join("\n    , ", @hist_coldefs);
my $hist_tbl = <<EOCHT;
CREATE TABLE ${base_name}_hist (
      ${hist_defs}
);
EOCHT
```

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has config_tables => (is => "lazy", ...);
has history_tables => (is => "lazy", ...);
around deploy => sub { ...
my @tables = @{$self->config_tables};
foreach my $tbl (@tables) {
  my @hist_coldefs =
    map { my $default = defined $_->[4] ? " DEFAULT $_->[4]" : "";
      $pure_cols{$_->[1]} ? ("$_->[1] $_->[2]$default")
        : ("old_$_->[1] $_->[2]$default", "new_$_->[1] $_->[2]$default")
    } @table_info;
}
unshift @hist_coldefs, "${base_name}_hist_id INTEGER PRIMARY KEY";
my $hist_defs = join("\n    , ", @hist_coldefs);
my $hist_tbl = <<EOCHT;
CREATE TABLE ${base_name}_hist (
      ${hist_defs}
);
EOCHT
```

- that are all tables with trailing _t in their names

Hard work

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```

- that are all tables with trailing _t in their names
- create history table for each config table
- memoizing old and new values on updating payload

Hard work (continued) - INSERT

```
my $new_cols = join(", ", map { $pure_cols{$_} ? $_ : "new_$_" }
                grep { !$skipped{$_} } @table_cols);
my $new_vals = join(", ", map {"NEW.$_"} grep { !$skipped{$_} } @table_cols);

my $new_trgr = <<EONT;
CREATE TRIGGER new_${base_name}_row AFTER INSERT ON ${base_name}_t
BEGIN
  INSERT INTO ${base_name}_hist ($new_cols)
  VALUES ($new_vals);
END;
EONT
```

Hard work (continued) - INSERT

```
my $new_cols = join(", ", map { $pure_cols{$_} ? $_ : "new_$_" }
                grep { !$skipped{$_} } @table_cols);
my $new_vals = join(", ", map {"NEW.$_"} grep { !$skipped{$_} } @table_cols);

my $new_trgr = <<EONT;
CREATE TRIGGER new_${base_name}_row AFTER INSERT ON ${base_name}_t
BEGIN
  INSERT INTO ${base_name}_hist ($new_cols)
  VALUES ($new_vals);
END;
EONT
```

⇒ ON INSERT fill history rows without filling "OLD_" columns

Hard work (continued) - UPDATE

```
my (@updt_cols, @rfrs_cond, @updt_vals);
foreach my $colnm (grep { !$skipped{$_} } @table_cols) {
  my @lcd = $pure_cols{$colnm} ? $colnm : ("old_${colnm}", "new_${colnm}");
  push @updt_cols, @lcd;
  push @rfrs_cond, $pure_cols{$colnm}
    ? _cmp_if_nullable("existing.${colnm}", "NEW.${colnm}")
    : (_cmp_if_nullable("existing.old_${colnm}", "OLD.${colnm}"),
       _cmp_if_nullable("existing.new_${colnm}", "NEW.${colnm}"));
  push @updt_vals, $pure_cols{$colnm}?("NEW.$colnm"):("OLD.$colnm","NEW.$colnm")
}
my $updt_cols = join(", ", @updt_cols);
my $updt_refreshed_cols = join(", ", map { "refreshed.$_" } @updt_cols);
my $updt_vals = join(", ", @updt_vals);
```

Hard work (continued) - UPDATE

```
my (@updt_cols, @rfrs_cond, @updt_vals);
foreach my $colnm (grep { !$skipped{$_} } @table_cols) {
  my @lcd = $pure_cols{$colnm} ? $colnm : ("old_${colnm}", "new_${colnm}");
  push @updt_cols, @lcd;
  push @rfrs_cond, $pure_cols{$colnm}
    ? _cmp_if_nullable("existing.${colnm}", "NEW.${colnm}")
    : (_cmp_if_nullable("existing.old_${colnm}", "OLD.${colnm}"),
       _cmp_if_nullable("existing.new_${colnm}", "NEW.${colnm}"));
  push @updt_vals, $pure_cols{$colnm}?("NEW.$colnm"):("OLD.$colnm","NEW.$colnm")
}
my $updt_cols = join(", ", @updt_cols);
my $updt_refreshed_cols = join(", ", map { "refreshed.$_" } @updt_cols);
my $updt_vals = join(", ", @updt_vals);
```

⇒ Prepare for a bit complexer trigger

Hard work (continued) - UPDATE

```
my (@updt_cols, @rfrs_cond, @updt_vals);
foreach my $colnm (grep { !$skipped{$_} } @table_cols) {
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  push @updt_cols, @lcd;
  push @rfrs_cond, $pure_cols{$colnm}
    ? _cmp_if_nullable("existing.${colnm}", "NEW.${colnm}")
    : (_cmp_if_nullable("existing.old_${colnm}", "OLD.${colnm}"),
       _cmp_if_nullable("existing.new_${colnm}", "NEW.${colnm}"));
  push @updt_vals, $pure_cols{$colnm}?("NEW.$colnm"):("OLD.$colnm","NEW.$colnm")
}
my $updt_cols = join(", ", @updt_cols);
my $updt_refreshed_cols = join(", ", map { "refreshed.$_" } @updt_cols);
my $updt_vals = join(", ", @updt_vals);
```

⇒ Prepare for a bit complexer trigger

⇒ Distinguish between real updates and just "touches"

Hard work (continued) - UPDATE

```
my $updt_trgr = <<EONT;
CREATE TRIGGER updt_${base_name}_row AFTER UPDATE ON ${base_name}_t
BEGIN
  INSERT OR REPLACE INTO ${base_name}_hist (${base_name}_hist_id, $updt_cols)
  VALUES (
    (SELECT MAX(existing.${base_name}_hist_id) ${base_name}_hist_id
     FROM ${base_name}_hist existing WHERE $updt_refreshed_cond),
    $updt_vals);
END;
EONT
```

Hard work (continued) - UPDATE

```
my $updt_trgr = <<EONT;
CREATE TRIGGER updt_${base_name}_row AFTER UPDATE ON ${base_name}_t
BEGIN
  INSERT OR REPLACE INTO ${base_name}_hist (${base_name}_hist_id, $updt_cols)
  VALUES (
    (SELECT MAX(existing.${base_name}_hist_id) ${base_name}_hist_id
     FROM ${base_name}_hist existing WHERE $updt_refreshed_cond),
    $updt_vals);
END;
EONT
```

⇒ ON UPDATE create history (INSERT) rows with "OLD_" and "NEW_" columns

Hard work (continued) - UPDATE

```
my $updt_trgr = <<EONT;
CREATE TRIGGER updt_${base_name}_row AFTER UPDATE ON ${base_name}_t
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  VALUES (
    (SELECT MAX(existing.${base_name}_hist_id) ${base_name}_hist_id
     FROM ${base_name}_hist existing WHERE $updt_refreshed_cond),
    $updt_vals);
END;
EONT
```

⇒ ON UPDATE create history (`INSERT`) rows with "OLD_" and "NEW_" columns
except nothing changes (`REPLACE`)

"UPSERT"

```
MERGE INTO tablename USING table_reference ON (condition)
  WHEN MATCHED THEN
  UPDATE SET column1 = value1 [, column2 = value2 ...]
  WHEN NOT MATCHED THEN
  INSERT (column1 [, column2 ...]) VALUES (value1 [, value2 ...]);
```

"UPSERT"

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MERGE INTO tablename USING table_reference ON (condition)
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SQLite

- Unsupported by SQLite

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SQLite

- Unsupported by SQLite
- `INSERT OR` REPLACE deletes before insert

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```

SQLite

- Unsupported by SQLite
- `INSERT OR REPLACE` deletes before insert

→ Kills `UPDATE` Trigger

Perl helps out

```
$self->cmdb->upsert( customer_t => {
  customer_name => "Foo Enterprises", });
$self->cmdb->upsert( vpn_link_t => {
  customer_name => "Foo Enterprises",
  vpn_link_type => "Juniper",
  customer_net  => "10.116.47.8/29",
  services_net  => "10.126.47.8/29" } );
```

SQL created ...

```
INSERT OR IGNORE INTO vpn_link_t (
  customer_id, vpn_link_type, customer_net, services_net, modified_by
) VALUES (
  (SELECT customer_id FROM customer_t WHERE customer_name=?),
  ?, ?, ?, ?);
UPDATE vpn_link_t SET vpn_link_type=?, customer_net=?, services_net=?,
  modified_by=?, touched_at=CURRENT_TIMESTAMP
WHERE changes()=0 AND customer_id=(
  SELECT customer_id FROM customer_t WHERE customer_name=?);
```

Known limitations

- Restricted to CMDB

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- Refuse updates of identifying columns (UNIQUE constraints)

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- Restricted to CMDB
- Refuse updates of identifying columns (UNIQUE constraints)
- WHERE clause derived from UNIQUE constraints

CMDB to Hiera

YAML Generator

- Development team read via *RESTful API* the theoretical configuration set

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- *Hiera* `YAML` files are written

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- Additional exports are managed via *Hiera*

CMDB to Hiera

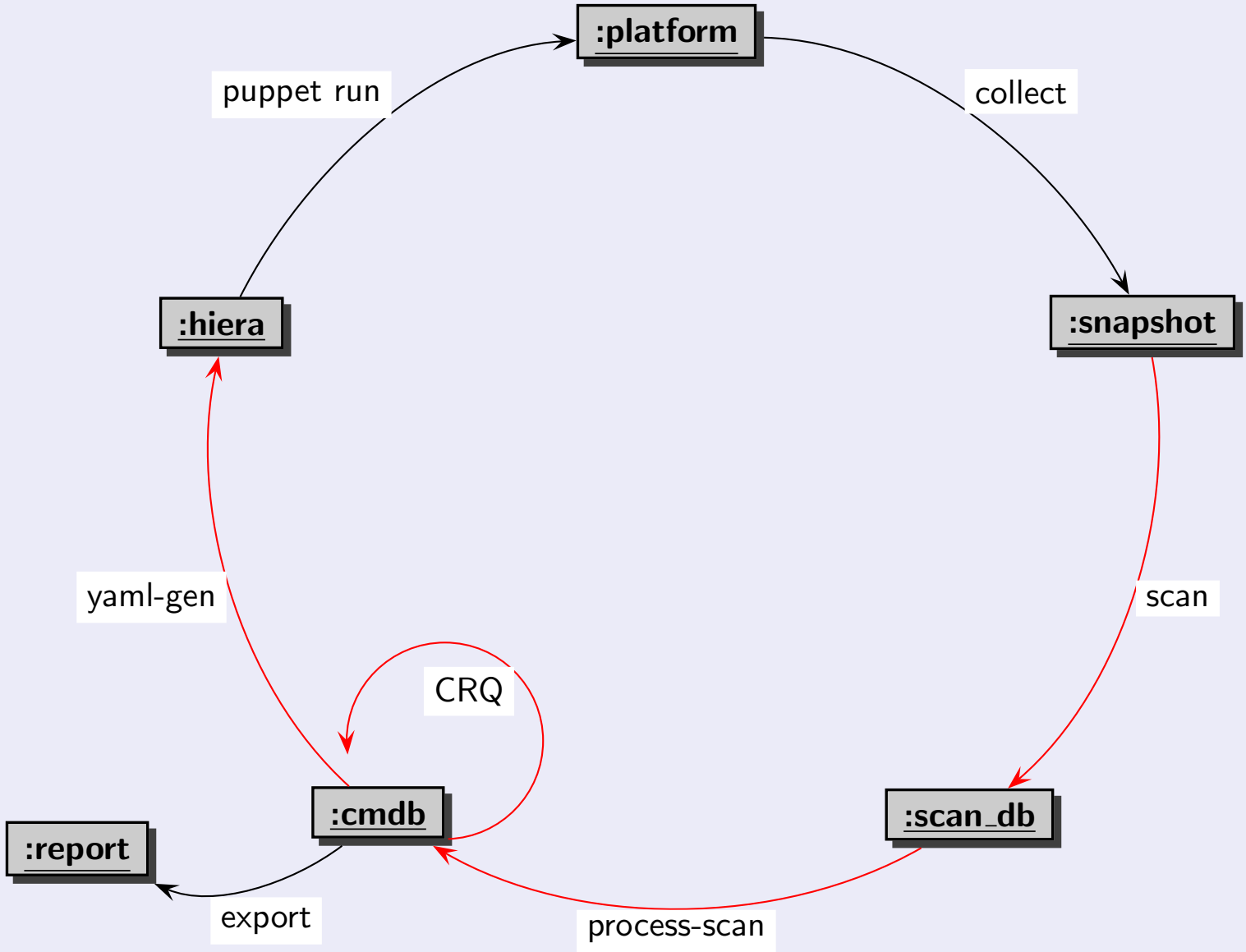
YAML Generator

- Development team read via *RESTful API* the theoretical configuration set
- *Hiera* `YAML` files are written
- Additional exports are managed via *Hiera*
- Puppet classes are rewritten to understand new ER model

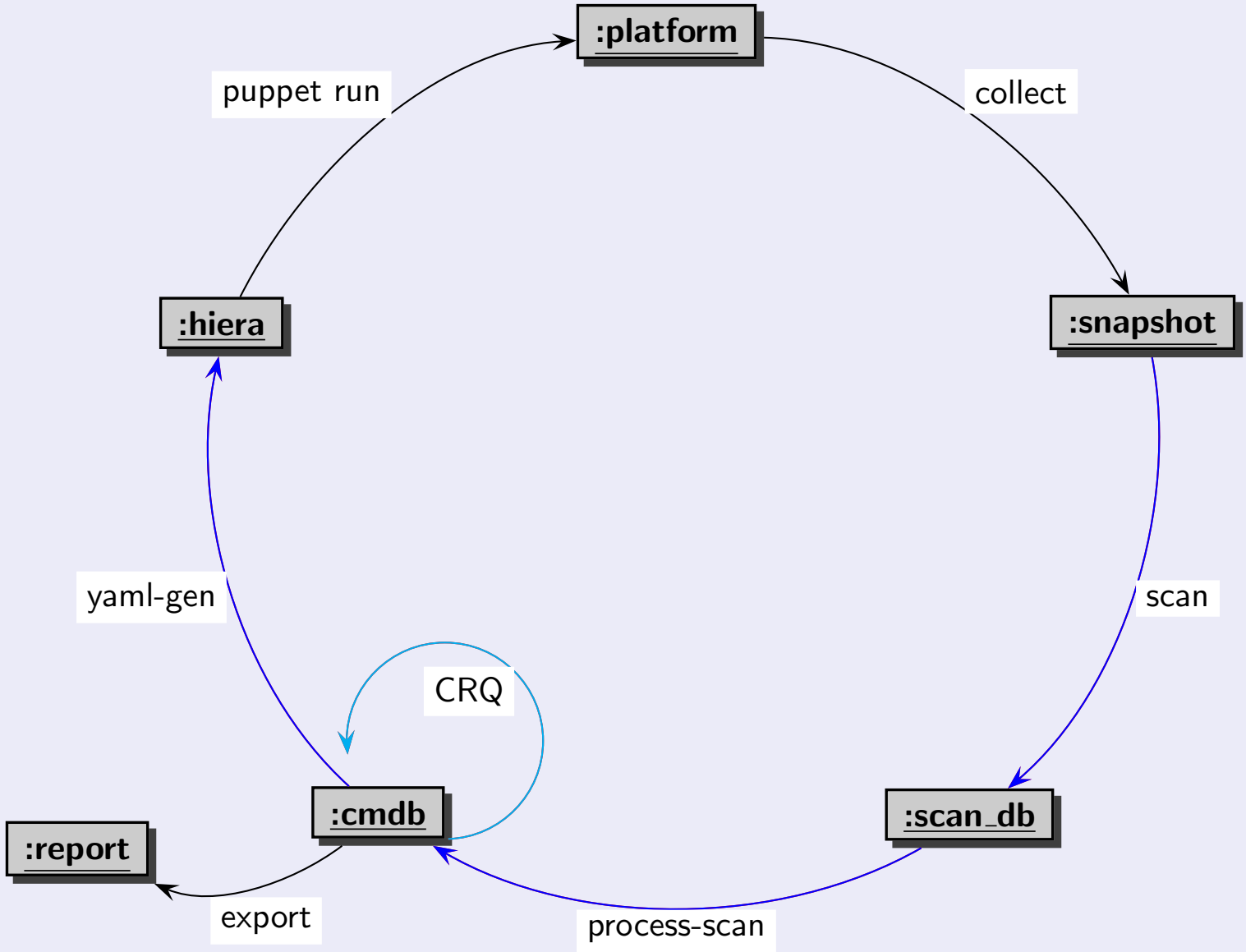
Part IV

Finish

Circle closed



Circle closed



Goals reached

→ Actual-theoretical comparison done via processing scan database

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- → Actual-theoretical comparison done via processing scan database
- → Unmaintainted installation via cronjob possible
- → Reaction in emergency cases by organized component moving done multiple times
- → Monitoring, sensors, alarming open

Conclusion

Can a programming language save a life

- Yes, it can - but here it saves our business

Thank You For Listening

Questions?

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