Designing for Scale

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About this talk

2 developers and erlang
vs.
1 million daily users

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Social Games

Flash client (game)

HTTP API

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Social Games

Flash client

- Game actions need to be persisted and validated
- 1 API call every 2 secs

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Social Games

HTTP API

- @ 1 000 000 daily users
- 5000 HTTP reqs/sec
- more than 90% writes

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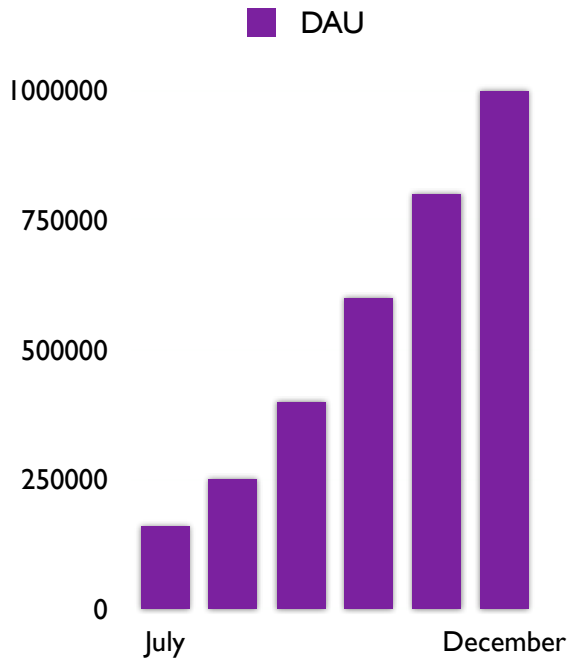
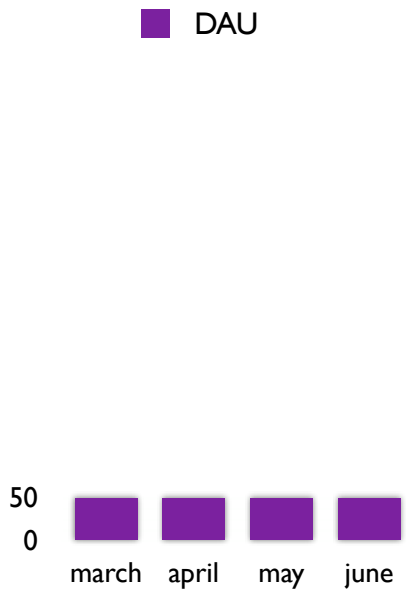
Users we expect

"Monster World"
daily users
july - december 2010



Users we have

New game
daily users
march - june 2011



What to do?

1 Simulate users

Simulating users

- Must not be too synthetic (like apachebench)
- Must look like a meaningful game session
- Users must come online at a given rate and play

Tsung

- Multi protocol (HTTP, XMPP) benchmarking tool
- Able to test non trivial call sequences
- Can actually simulate a scripted gaming session

http://tsung.erlang-projects.org/

Tsung - configuration

Fixed content Dynamic parameter

```
<request subst="true">
<http url="http://server.wooga.com/users/%
%ts_user_server:get_unique_id%%/resources/column/5/
row/14?%%_routing_key%%"
method="POST" contents='{"parameter1":"value1"}'>
</http>
</request>
```

http://tsung.erlang-projects.org/

Tsung - configuration

- Not something you fancy writing
- We're in development, calls change and we constantly add new calls
- A session might contain hundreds of requests
- All the calls must refer to a consistent game state

http://tsung.erlang-projects.org/

Tsung - configuration

- From our ruby test code

```
user.resources(:column => 5, :row => 14)
```

- Same as

```
<request subst="true">
<http url="http://server.wooga.com/users/%
%ts_user_server:get_unique_id%%/resources/column/5/
row/14?%%_routing_key%%"
method="POST" contents='{"parameter1":"value1"}'>
</http>
</request>
```

http://tsung.erlang-projects.org/

Tsung - configuration

- Session
  - requests
- Arrival phase
  - duration
  - arrival rate

A session is a group of requests

Sessions arrive in phases with a specific arrival rate

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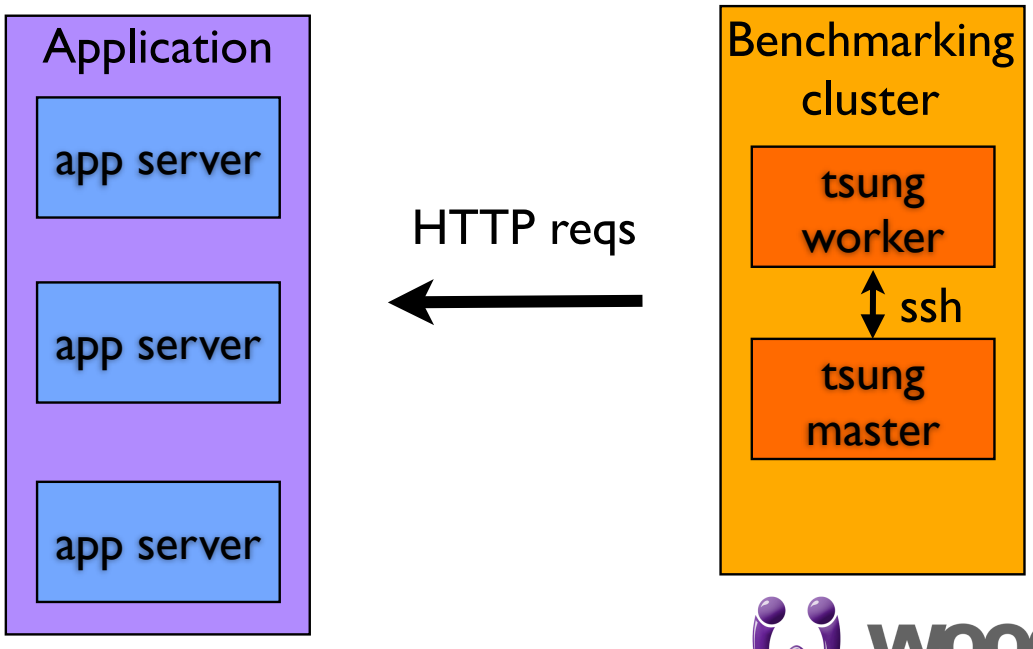
Tsung - setup



http://tsung.erlang-projects.org/

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Tsung

- Generates ~ 2500 reqs/sec on AWS m1.large
- Flexible but hard to extend
- Code base rather obscure

http://tsung.erlang-projects.org/

What to do?

2 Collect metrics

Tsung-metrics

- Tsung collects measures and provides reports
- But these measure include tsung network/ cpu congestion itself
- Tsung machines aren't a good point of view

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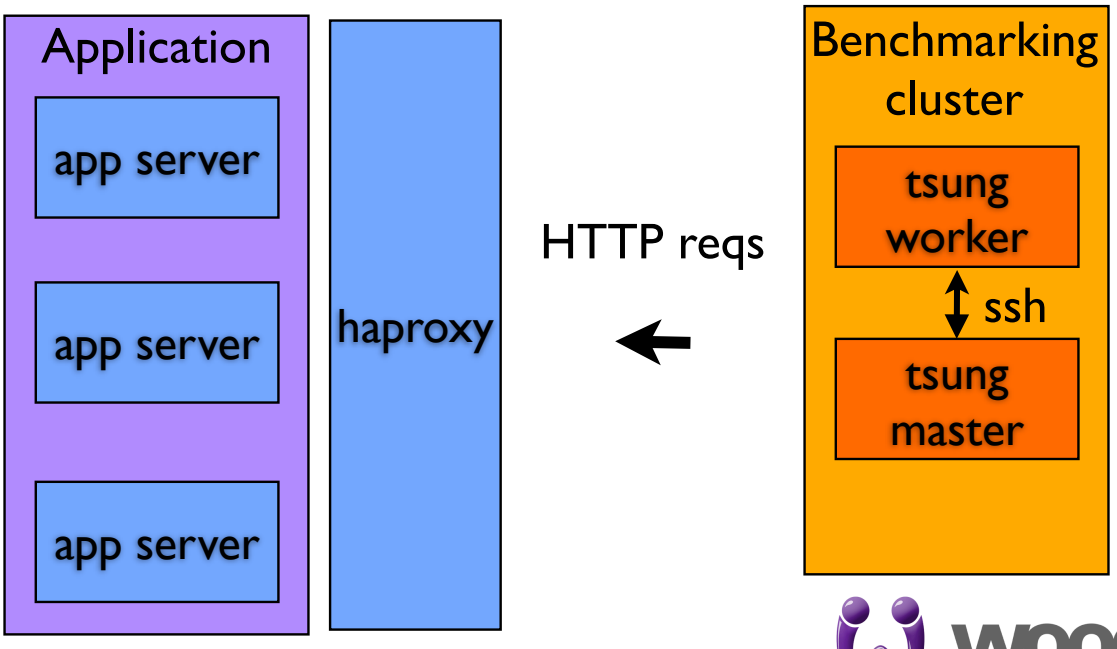
HAproxy



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HAproxy

"The Reliable, High Performance TCP/ HTTP Load Balancer"

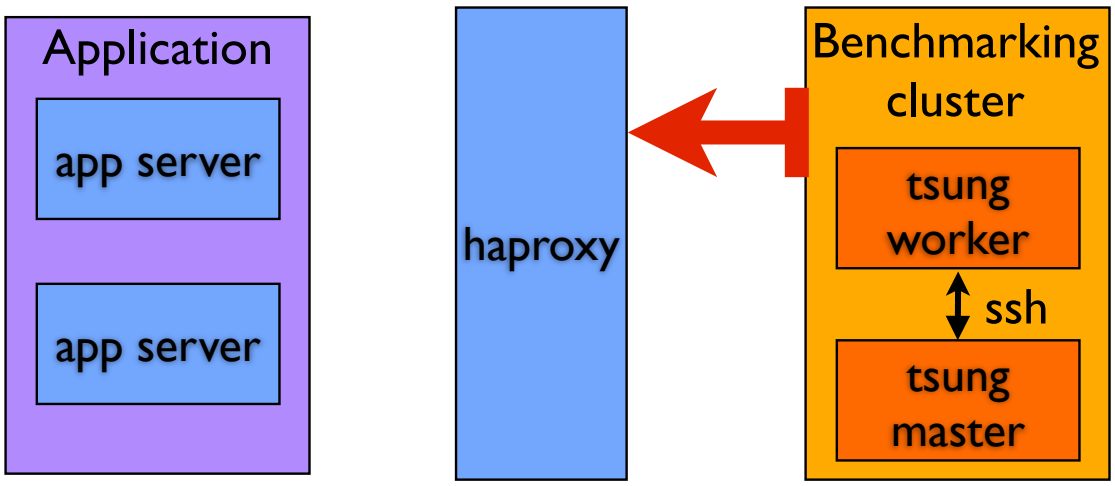
- Placed in front of http servers
- Load balancing
- Fail over

HAproxy - syslog

- Easy to setup
- Efficient (UDP)
- Provides 5 timings per each request

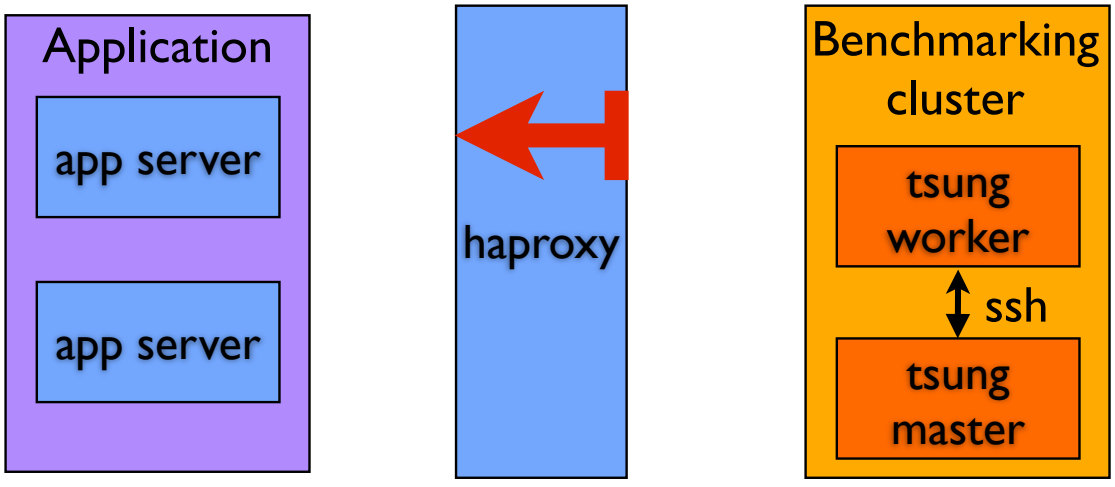
HAproxy

- Time to receive request from client



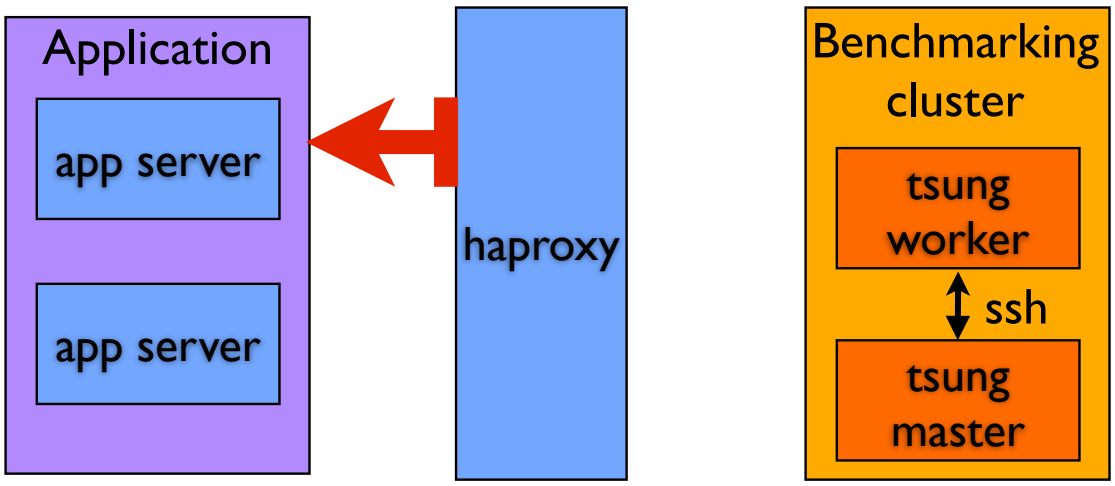
HAproxy

- Time spent in HAproxy queue



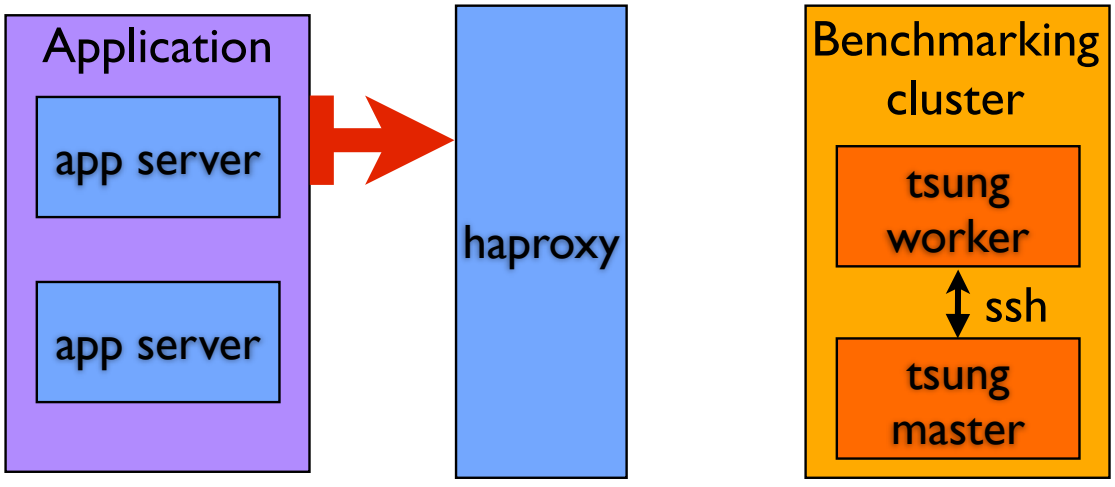
HAproxy

- Time to connect to the server



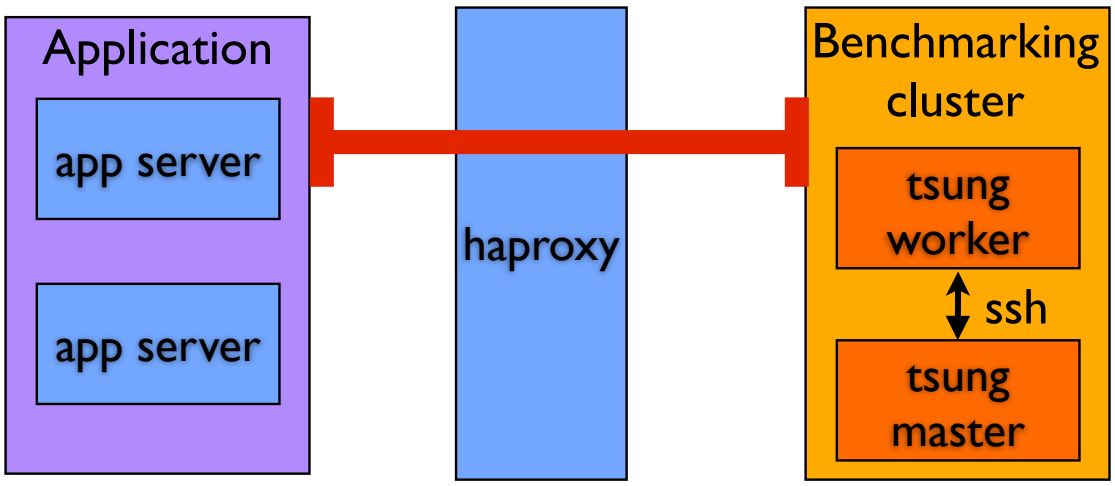
HAproxy

- Time to receive response headers from server



HAproxy

- Total session duration time



HAproxy - syslog

- Application urls identify directly server call
- Application urls are easy to parse
- Processing haproxy syslog gives per call metric

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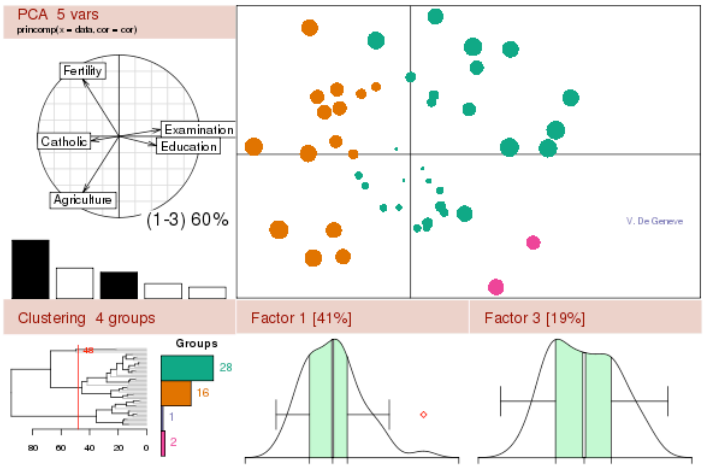
What to do?

3 Understand metrics

Reading/aggregating metrics

- Python to parse/normalize syslog
- R language to analyze/visualize data
- R language console to interactively explore benchmarking results

R is a free software environment for statistical computing and graphics.



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What you get

- Aggregate performance levels (throughput, latency)
- Detailed performance per call type
- Statistical analysis (outliers, trends, regression, correlation, frequency, standard deviation)

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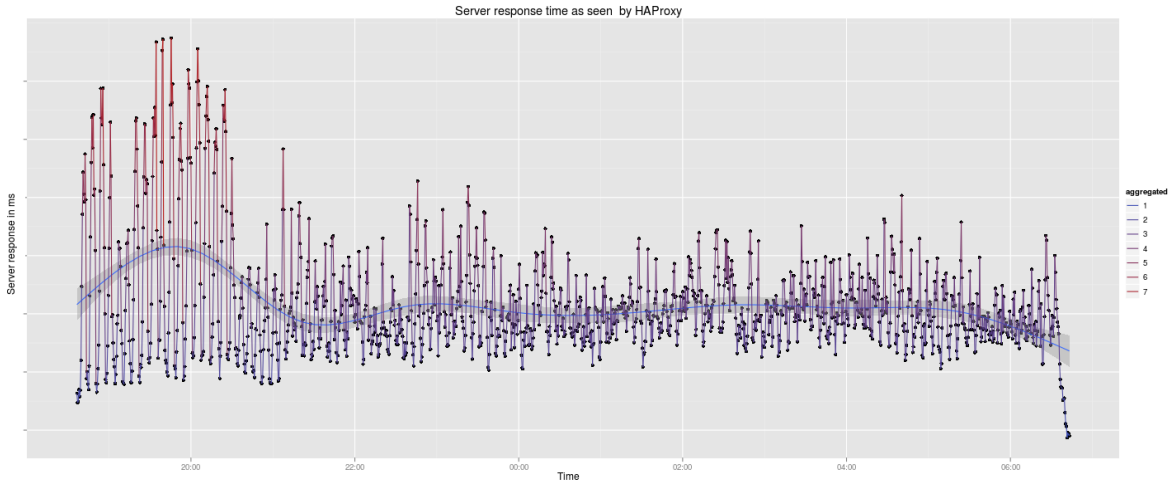
What you get



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What to do?

4 go deeper

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Digging into the data

- From HAproxy log analisys one call emerged as exceptionally slow
- Using eprof we were able to determine that most of the time was spent in a redis query fetching many keys (MGET)

Tracing erldis query

- More than 60% of runtime is spent manipulating the socket
- gen_tcp:recv/2 is the culprit
- But why is it called so many times?

```
prim_inet:enc_opt/1                    1000   2.14   502  [      0.50]
prim_inet:type_value/3                 1000   2.47   578  [      0.58]
inet:setopts/2                         1501   2.75   643  [      0.43]
prim_inet:encode_opt_val/1             1501   2.86   670  [      0.45]
erldis_client:trim2/1                  2002   3.62   848  [      0.42]
prim_inet:ctl_cmd/3                    2001   4.03   944  [      0.47]
prim_inet:enc_opt_val/2                3002   4.51  1056  [      0.35]
erlang:setelement/3                    2018   5.75  1347  [      0.67]
prim_inet:enum_val/2                  11000  12.09  2830  [      0.26]
erlang:port_control/3                  2001  16.20  3794  [      1.90]
```

Understanding the redis protocol

C: LRANGE mylist 0 2

s: *2

s: $5

s: Hello

s: $5

s: World

```
<<"*2\r\n
   $5\r\n
   Hello\r\n
   $5\r\n
   World\r\n">>
```

Understanding erldis

- recv_value/2 is used in the protocol parser to get the next data to parse

```
recv_value(Socket, NBytes) ->
    inet:setopts(Socket, [{packet, 0}]),

    %% Read raw bytes from the socket
    case gen_tcp:recv(Socket, NBytes+2) of
        {ok, Packet} ->
            inet:setopts(Socket, [{packet, line}]),
            trim2(Packet);
        ...
    end.
```

A different approach

- Two ways to use gen_tcp: active or passive
- In passive, use gen_tcp:recv to explicitly ask for data, blocking
- In active, gen_tcp will send the controlling process a message when there is data
- Hybrid: active once

A different approach

- Is active sockets faster?
- Proof-of-concept proved active socket faster
- Change erldis or write a new driver?

A different approach

- Radical change => new driver
- Keep Erldis queuing approach
- Think about error handling from the start
- Use active sockets

A different approach

- Active socket, parse partial replies

```
handle_info({tcp, _, Data}, State) ->
    case eredis_parser:parse(State#state.parserstate, Data) of
        %% Got complete response, return value to client
        {ReturnCode, Value, NewParserState} ->
            reply({ReturnCode Value}, Client)
            ...
            State#state{parser_state = NewParserState};
        %% Parser needs more data, the parser state now contains the
        %% continuation data and we will continue where it stopped
        %% when we receiver more data
        {continue, NewParserState} ->
            State#state{parser_state = NewParserState}
    end.
```

Circuit breaker

- eredis has a simple circuit breaker for when Redis is down/unreachable
- eredis returns immediately to clients if connection is down
- Reconnecting is done outside request/response handling
- Robust handling of errors

Benchmarking eredis

- Redis driver critical for our application
- Must perform well
- Must be stable
- How do we test this?

Basho bench

- Basho produces the Riak KV store
- Basho build a tool to test KV servers
- Basho bench
- We used Basho bench to test eredis

Basho bench

- Create callback module

```
run(get, KeyGen, _ValueGen, Client) ->
    case eredis:q(Client, ["GET", KeyGen()]) of
        {ok, _Value} ->
            {ok, Client};
        ...
    end;

run(put, KeyGen, ValueGen, Client) ->
    case eredis:q(Client, ["SET", KeyGen(), ValueGen()]) of
        {ok, <<"OK">>} ->
            {ok, Client};
        ...
    end.
```

Basho bench

- Configuration term-file

```
{mode, max}.
{duration, 15}.
{concurrent, 30}.
{driver, basho_bench_driver_eredis}.
{code_paths, ["/home/knutin/git/eredis/ebin/"]}.
{operations, [{get,1}, {put,4}]}.
{key_generator, {uniform_int, 10000}}.
{value_generator, {function, basho_bench_driver_eredis, value_gen, []}}.
```

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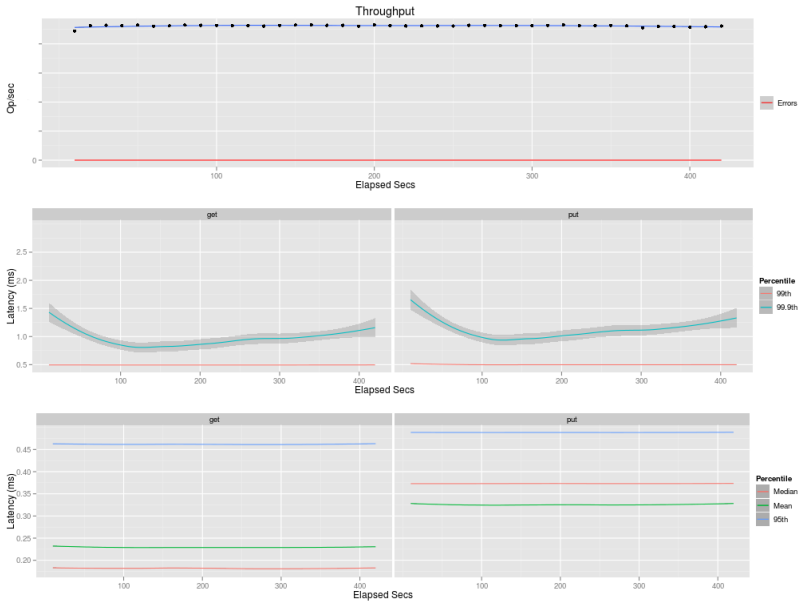
Basho bench output



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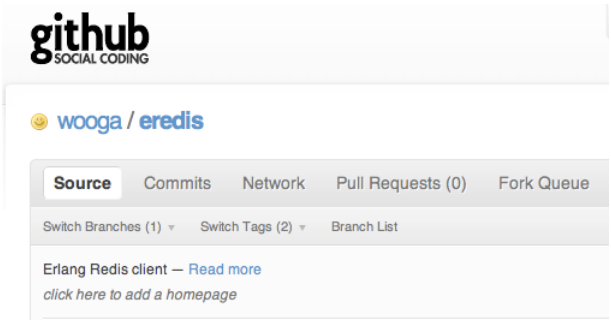
eredis is open source



https://github.com/wooga/eredis

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What to do?

5 measure internals

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Measure internals

HAproxy point of view is valid but how to measure internals of our application, while we are live, without the overhead of tracing?

Think Basho bench

- Basho bench can benchmark a redis driver
- Redis is very fast, 100K ops/sec
- Basho bench overhead is acceptable
- The code is very simple

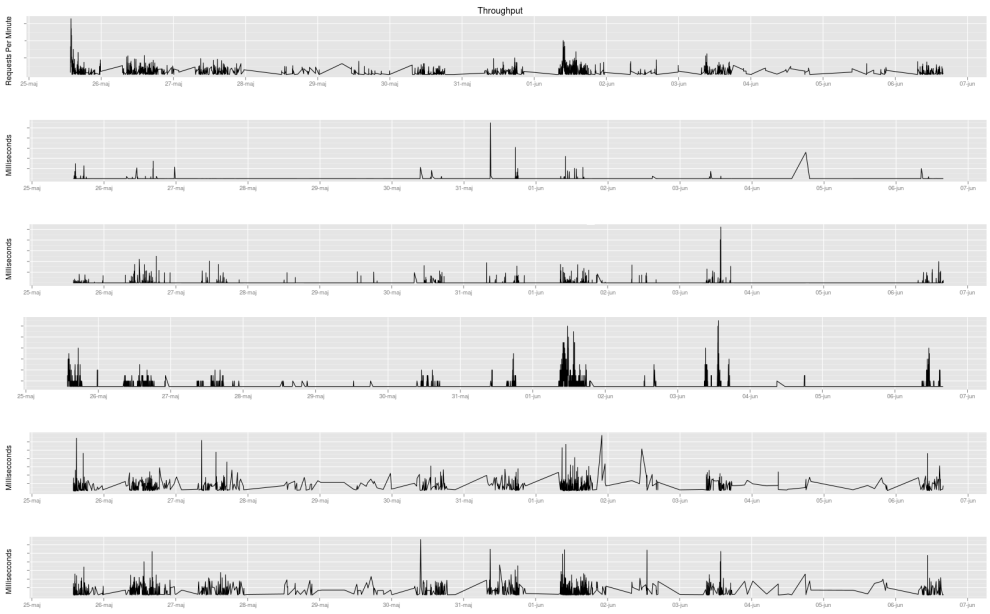
Cherry pick ideas from Basho Bench

- Creates a histogram of timings on the fly, reducing the number of data points
- Dumps to disk every N seconds
- Allows statistical tools to work on already aggregated data
- Near real-time, from event to stats in N+5 seconds

Homegrown stats

- Measures latency from the edges of our system (excludes HTTP handling)
- And at interesting points inside the system
- Statistical analysis using R
- Correlate with HAproxy data
- Produces graphs and data specific to our application

Homegrown stats



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Recap

Measure:

- From an external point of view (HAproxy)
- At the edge of the system (excluding HTTP handling)
- Internals in the single process (eprof)

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Recap

Analyze:

- Aggregated measures
- Statistical properties of measures
  - standard deviation
  - distribution
  - trends

Thanks!

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