What NOT to do with Erlang

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(Presented at CodeMesh 2015)

About me

- Worked in the telecoms domain from 1995-2014
- Worked with Erlang since 1999
- Currently with bet365

About bet365

- Founded in 2000
- Located in Stoke-on-Trent, UK
- The largest online sports betting company
- Over 19 million customers
- One of the largest private companies in the UK
- Employs more than 2,000 people
- 2014-2015: Over £34 billion was staked
- Very technology focused company

Message passing

Selective receive

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```
receive
  Pattern_1 -> Expr_1;
  Pattern_2 -> Expr_2;
     …
  Pattern_n -> Expr_n
end.
```

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   Pattern_1 -> Expr_1;
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```

If incoming msg rate > speed of execution of each msg, queues build up

Do not allow large message queues to build up for any process

Problems with large message queues

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- Scanning messages in a mailbox can become time consuming

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- Scanning messages in a mailbox can become time consuming
- Processes sending messages incur a reduction count penalty

Suppress unnecessary messages

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```
msg_handler() ->
    receive
        {in, From, Msg} ->
            spawn_link(?MODULE,
                       worker,
                      [self(), Msg]),
            msg_handler();
        {result, Result} ->
            send_result(From, Result);
        {'EXIT', Pid, normal} ->
            ok;
        {'EXIT', Pid, Err} ->
            error_handler(Err);
    end.

worker(Parent, Msg) ->
    Res = do_something(Msg),
    Parent ! Res.
```

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```
msg_handler() ->
    receive
        {in, From, Msg} ->
            spawn(?MODULE, worker,
                  [From, Msg]),
            msg_handler()
    end.

worker(From, Msg) ->
    case catch do_something(Msg) of
        {'EXIT', Err} ->
            error_handler(Err);
        Result ->
            send_result(From, Result)
    end.
```

Beware of proc_lib:spawn

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- Crashed processes produce crash reports
- Crash reports are sent to the error_logger
- error_logger is REALLY bad at handling high volume of error reports

Use ETS as a message queue

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Producer

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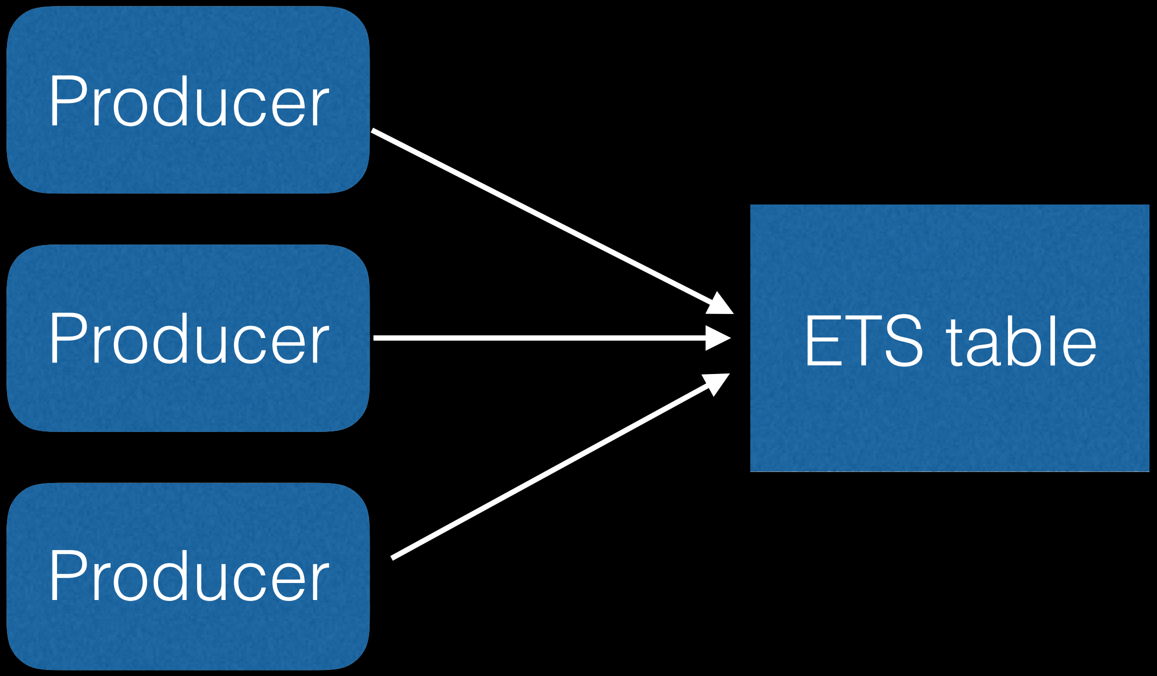
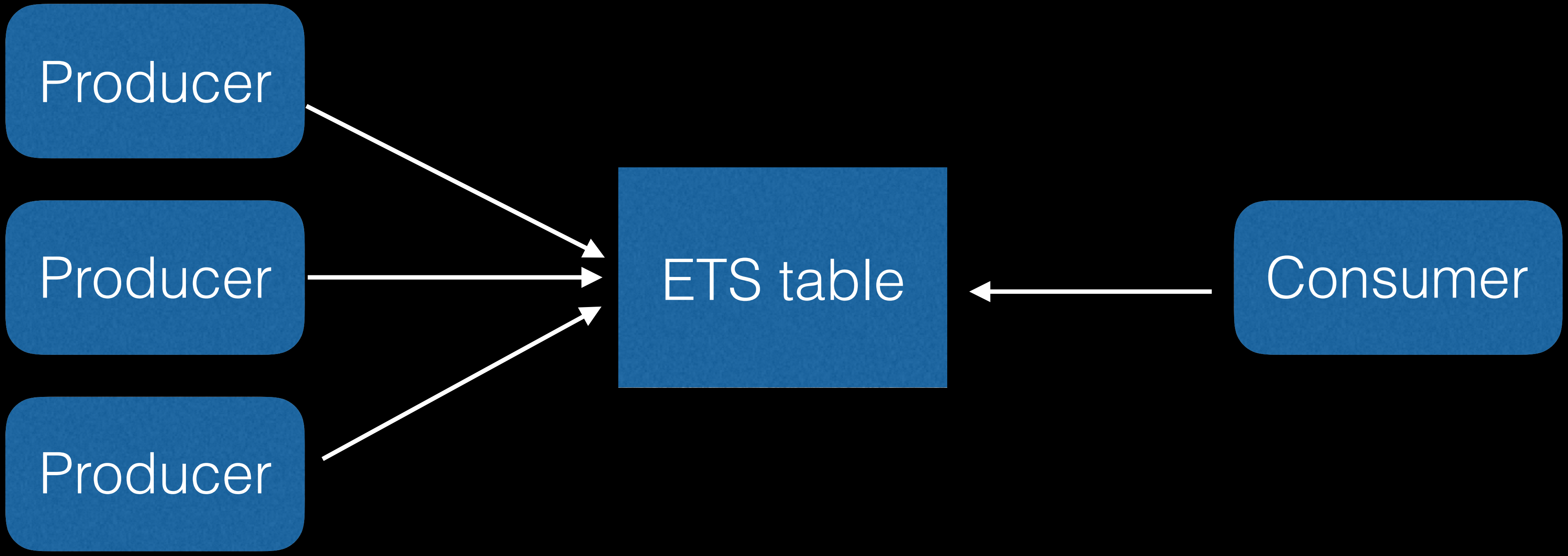
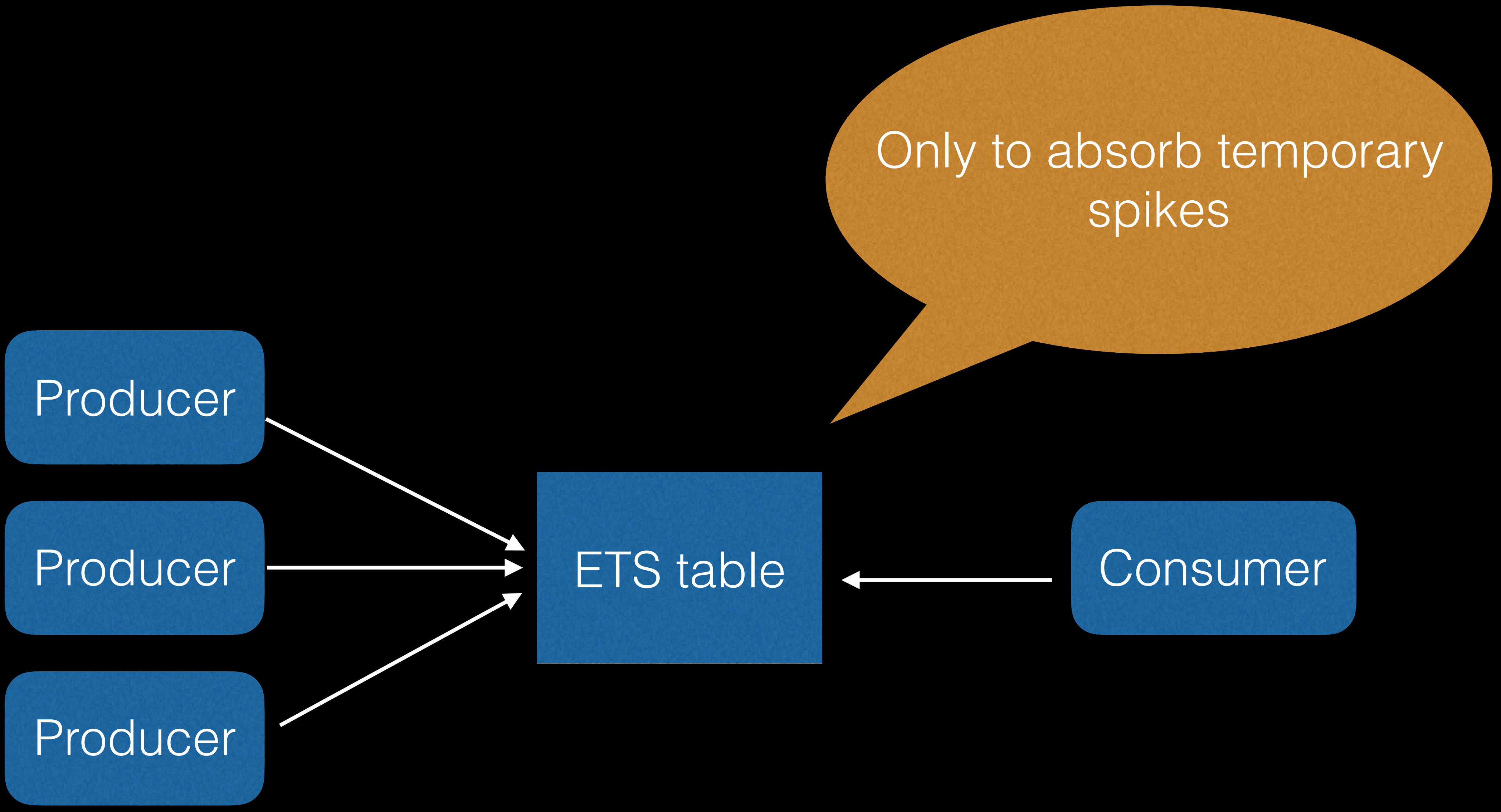


Use ETS as a message queue



Use ETS as a message queue



Overload control

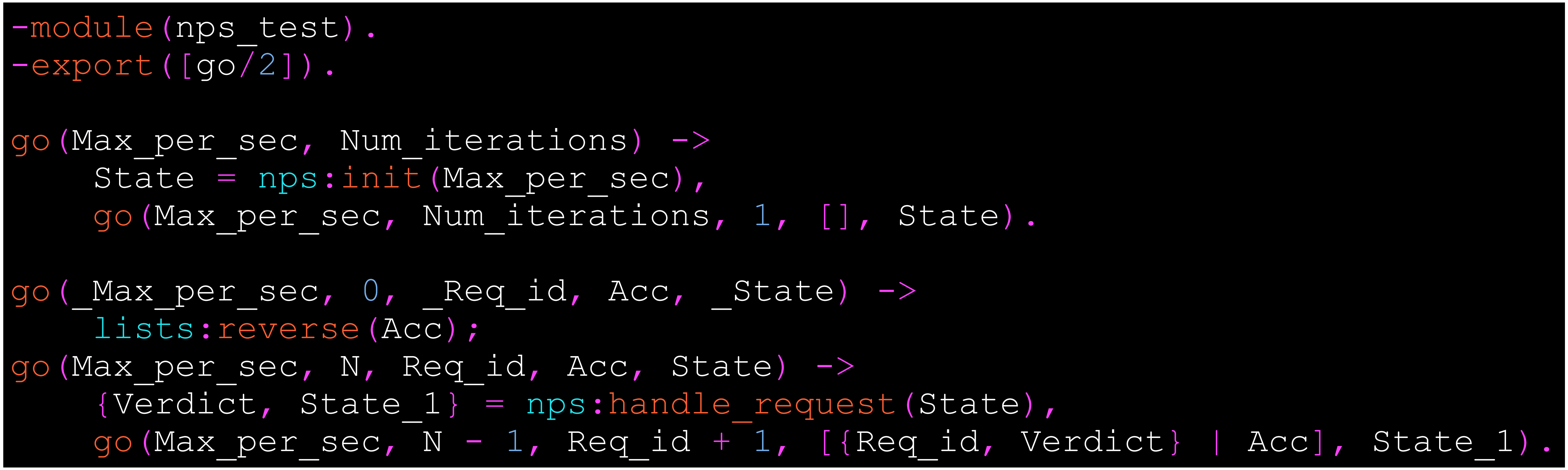
Built-in overload control

- See http://www.erlang.org/doc/man/overload.html
- Problematic because its a gen_server implementation
- Extra message passing
- Caters for ‘global load’ only - not interface specific load

Overload control - example

```erlang
-module(nps).
-export([init/1, handle_request/1]).

-record(nps_state, {max_per_sec, timestamp, cur_vol = 0}).

init(Max_per_sec) ->
    #nps_state{max_per_sec = Max_per_sec,
               timestamp   = timestamp()}.

timestamp() ->
    erlang:monotonic_time(seconds).

handle_request(
  #nps_state{cur_vol       = C,
             timestamp     = Prev_time,
             max_per_sec   = Max_per_sec} = State) ->
    Cur_time = timestamp(),
    case Prev_time < Cur_time of
        true ->
            {allow, State#nps_state{cur_vol = 1, timestamp = Cur_time}};
        false when C >= Max_per_sec ->
            {deny, State};
        false ->
            {allow, State#nps_state{cur_vol = C + 1}}
    end.
```

Overload control - test

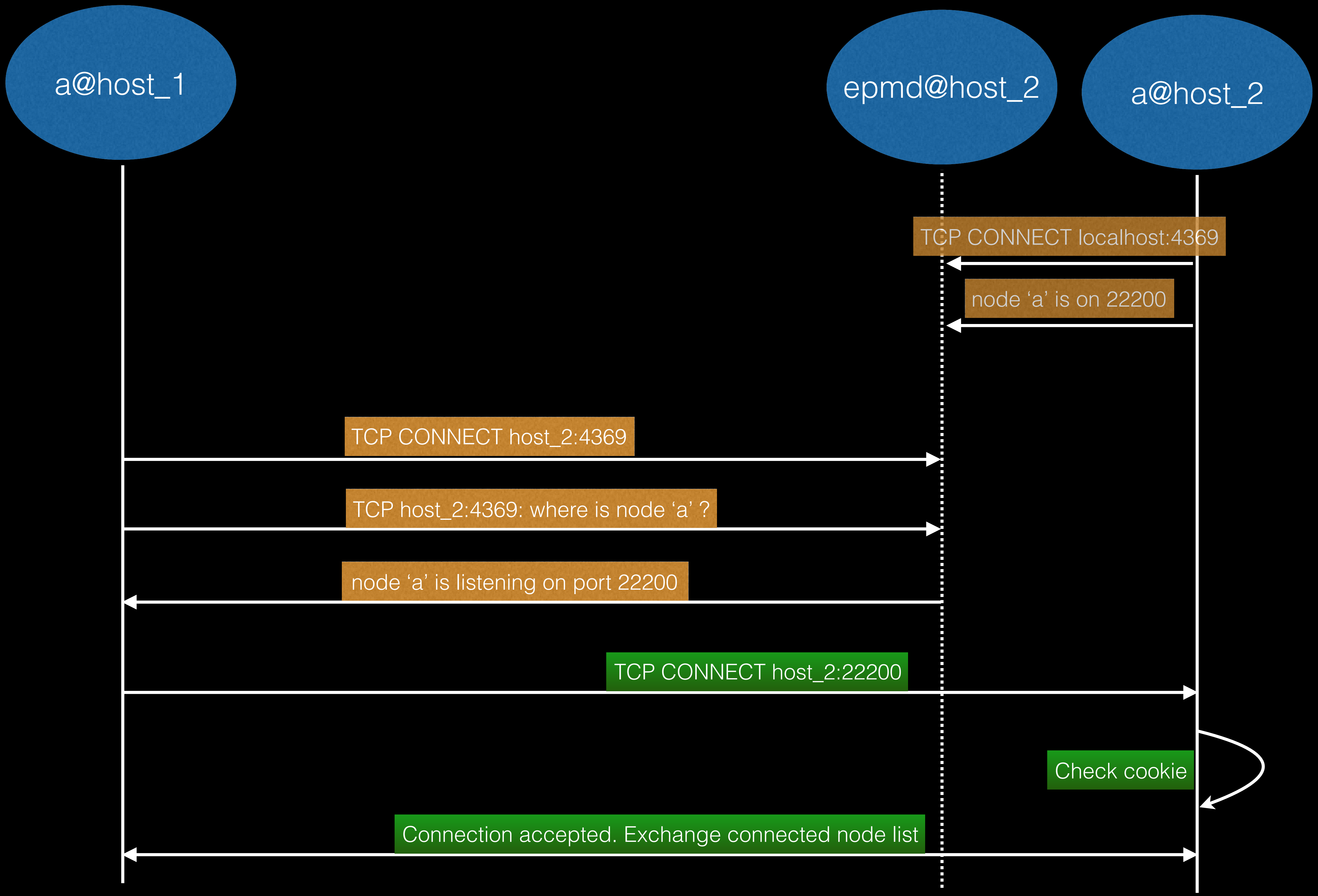


```erlang
-module(nps_test).
-export([go/2]).

go(Max_per_sec, Num_iterations) ->
    State = nps:init(Max_per_sec),
    go(Max_per_sec, Num_iterations, 1, [], State).

go(_Max_per_sec, 0, _Req_id, Acc, _State) ->
    lists:reverse(Acc);
go(Max_per_sec, N, Req_id, Acc, State) ->
    {Verdict, State_1} = nps:handle_request(State),
    go(Max_per_sec, N - 1, Req_id + 1, [{Req_id, Verdict} | Acc], State_1).
```

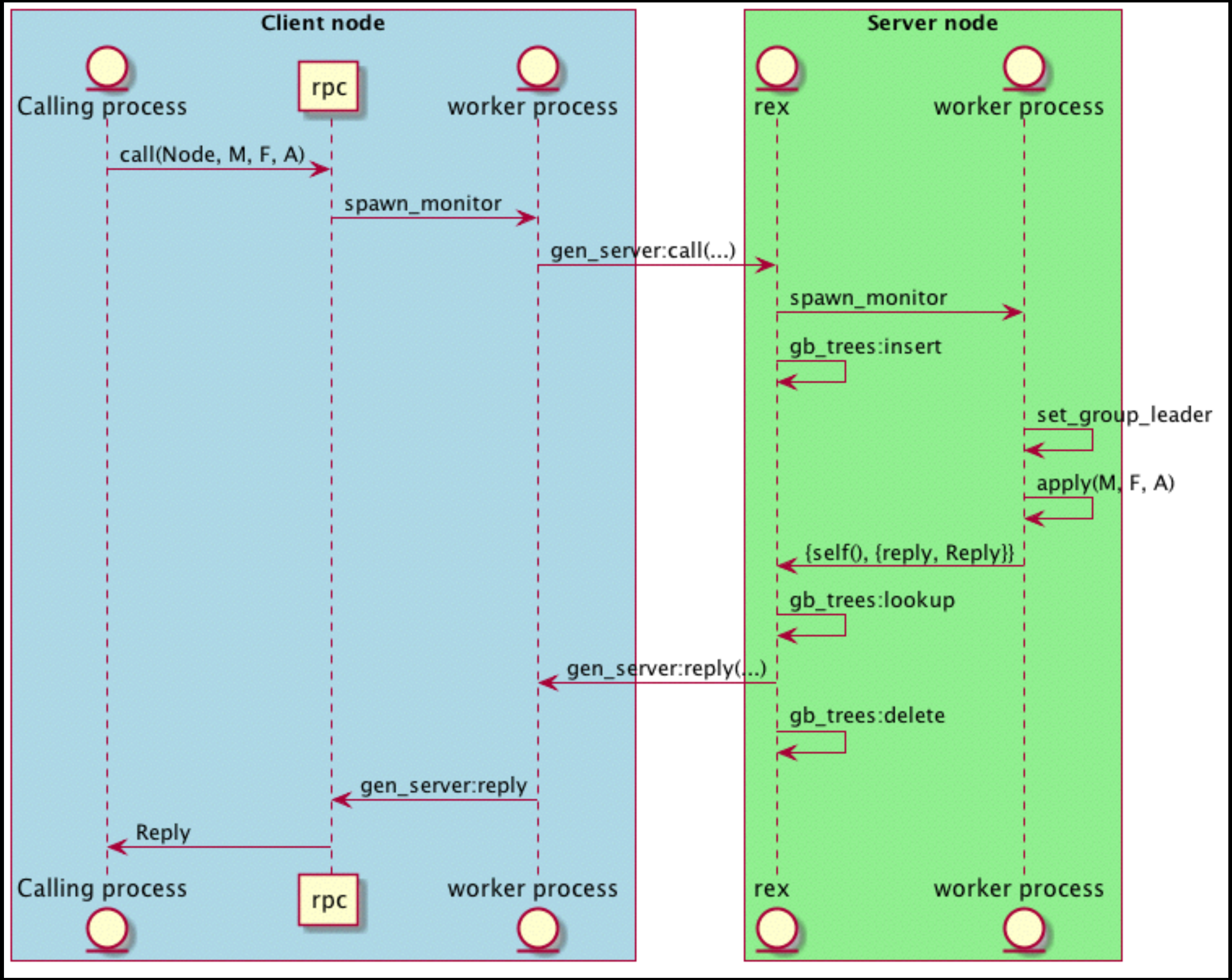
```
6> nps_test:go(10, 15).
[{1,allow}, {2,allow},
 {3,allow}, {4,allow},
 {5,allow}, {6,allow},
 {7,allow}, {8,allow},
 {9,allow}, {10,allow},
 {11,deny}, {12,deny},
 {13,deny}, {14,deny},
 {15,deny}]
```

Native RPC

Naming and Discovery


a@host_1
epmd@host_2
a@host_2
TCP CONNECT localhost:4369
node ‘a’ is on 22200
TCP CONNECT host_2:4369
TCP host_2:4369: where is node ‘a’ ?
node ‘a’ is listening on port 22200
TCP CONNECT host_2:22200
Check cookie
Connection accepted. Exchange connected node list

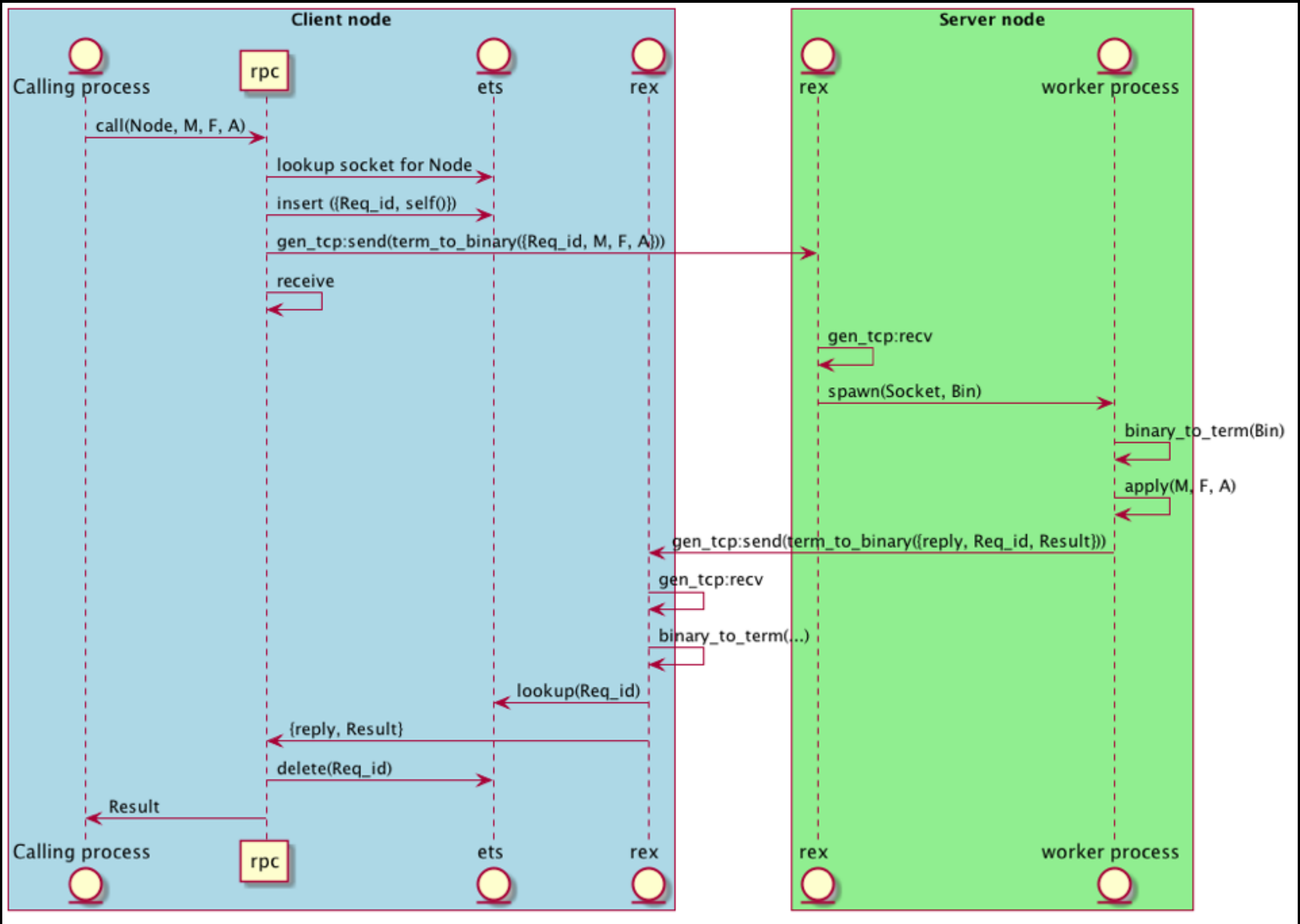
Native RPC - internals



Limitations of native RPC

- No overload control on the server side
- ‘rex’ is a message queue hotspot
- Inefficient implementation
- Head-of-line blocking problem, potentially delaying net_kernel heartbeats

A more efficient RPC



Advantages of proposed mechanism

- Possible to introduce overload control
- Can use a different transport protocol (e.g. SCTP)
- Clean load balancing and failure handling
- Use multiple connections
- Workaround head-of-line blocking problem

Long-lived stateful processes

- Harder to implement correctly
- Garbage collection issues
- More effort required to get correct supervision strategy

Mnesia

Mnesia

- Built-in KV store
- Supports ACID transactions
- Supports real-time replication of tables

Mnesia - table types

- 3 types of tables
  - ram_copies
  - disc_copies
  - disc_only_copies

Mnesia - table management

- Data in a table is stored in a <Table>.DCD file
- All modifications to persistent tables are written to LATEST.log
- ‘Occasionally’, contents of LATEST.log are written to <Table>.DCL files
- ‘Occasionally’, contents of <Table>.DCL are dumped to <Table>.DCD

Mnesia - problems

- Table management on disk leads to Mnesia overload for write-heavy applications
- Net-splits are resolved by restarting nodes (data loss)

Mnesia - where it worked

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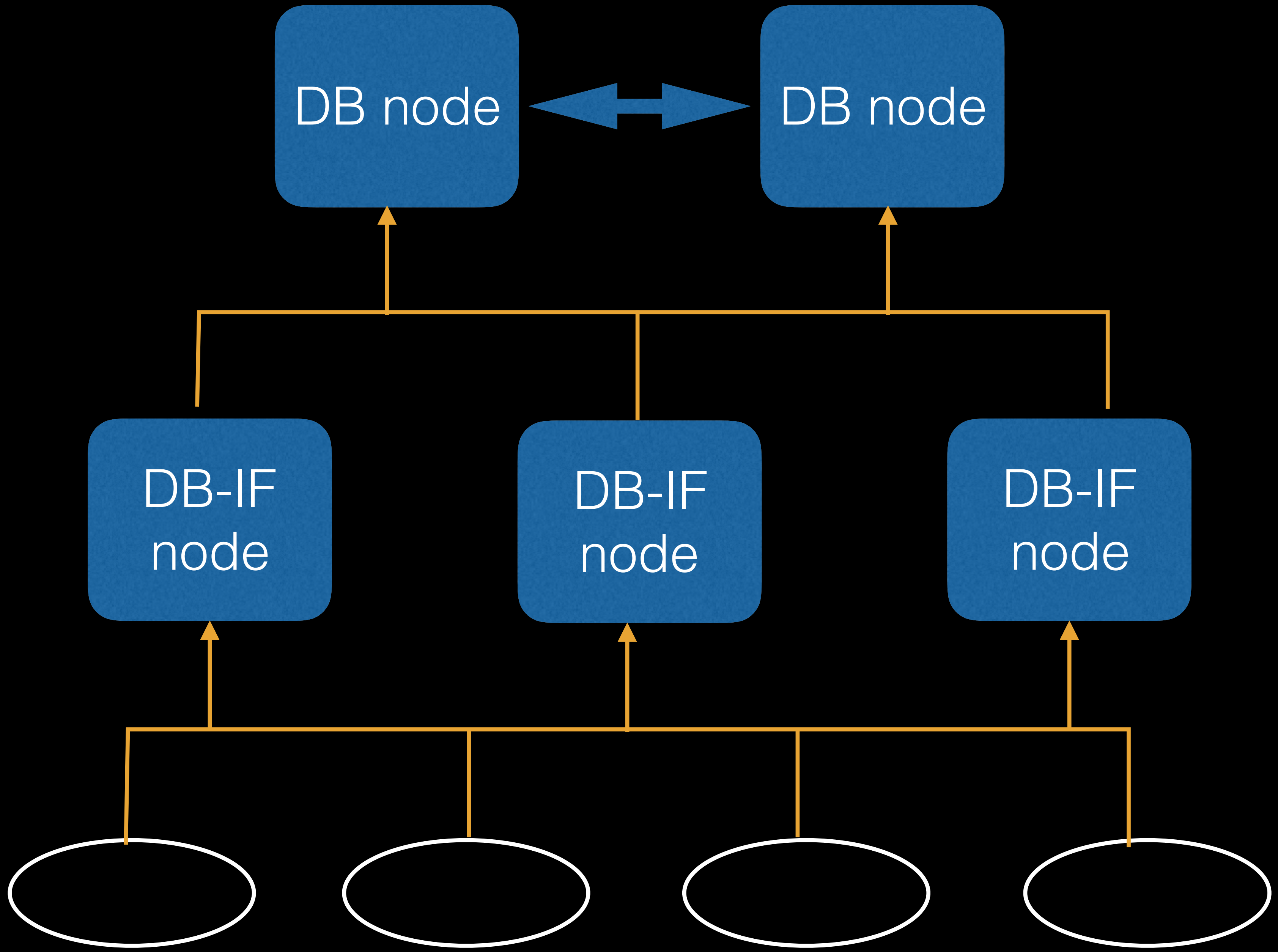

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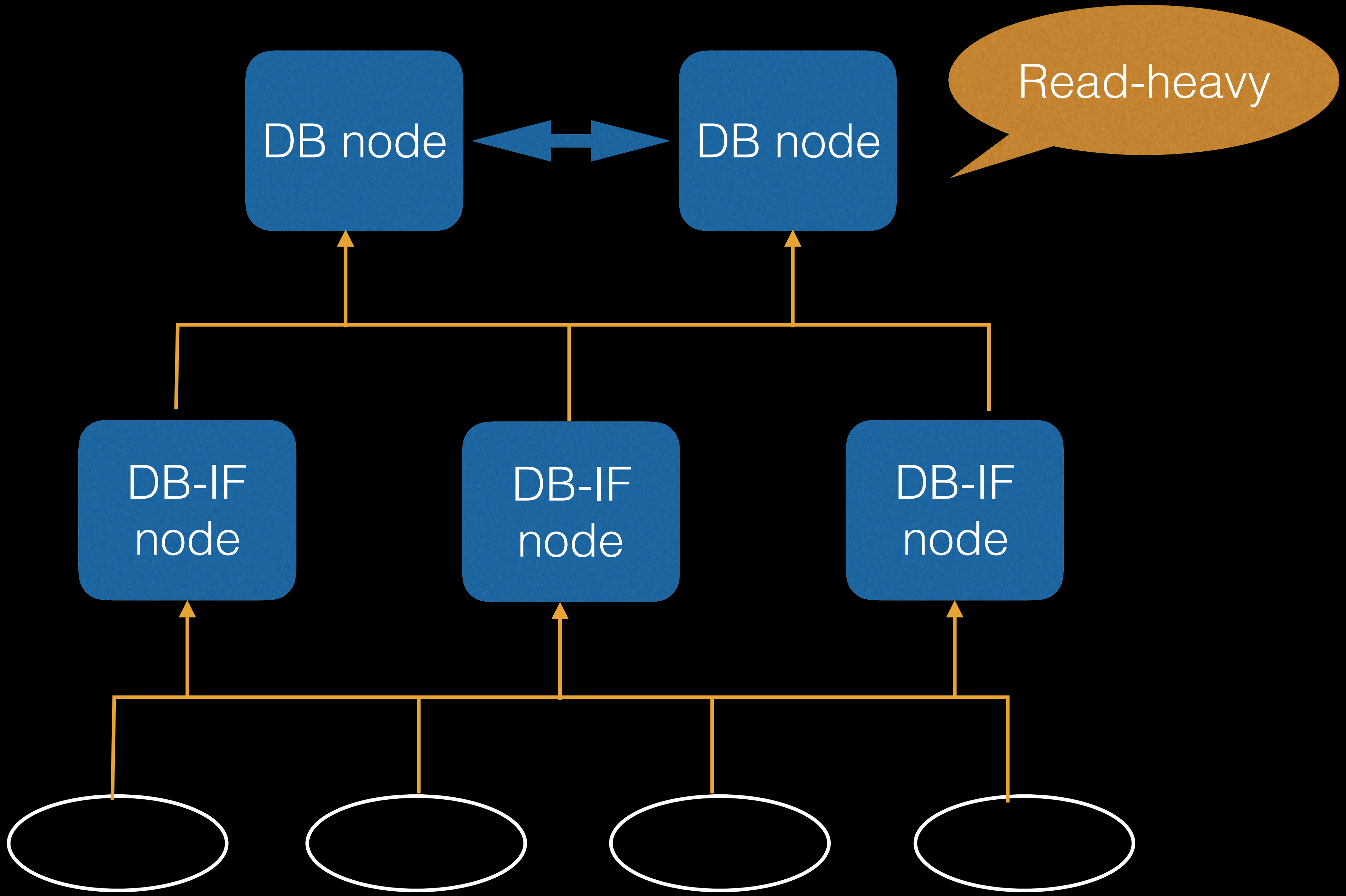

Mnesia - where it didn’t work

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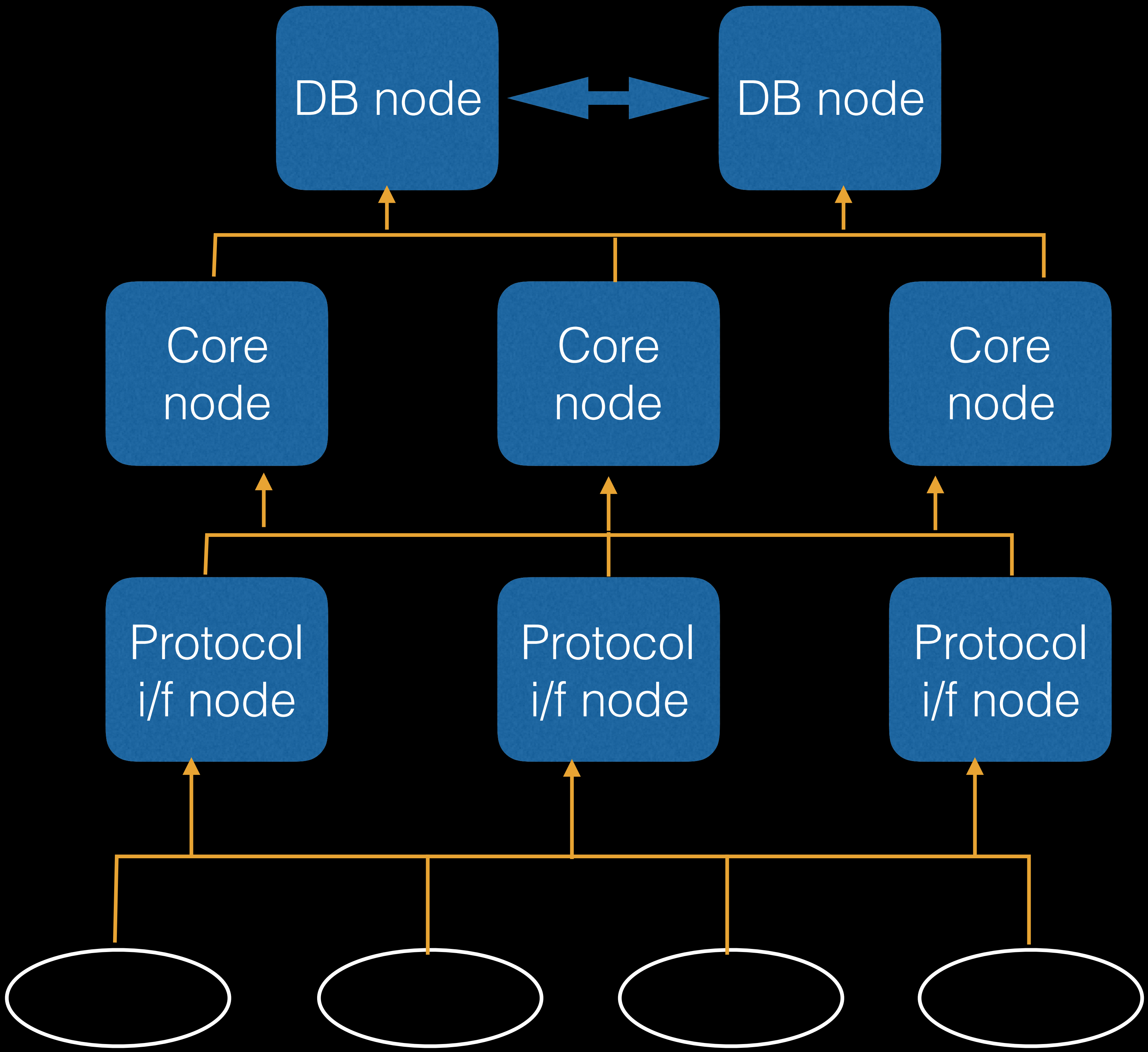

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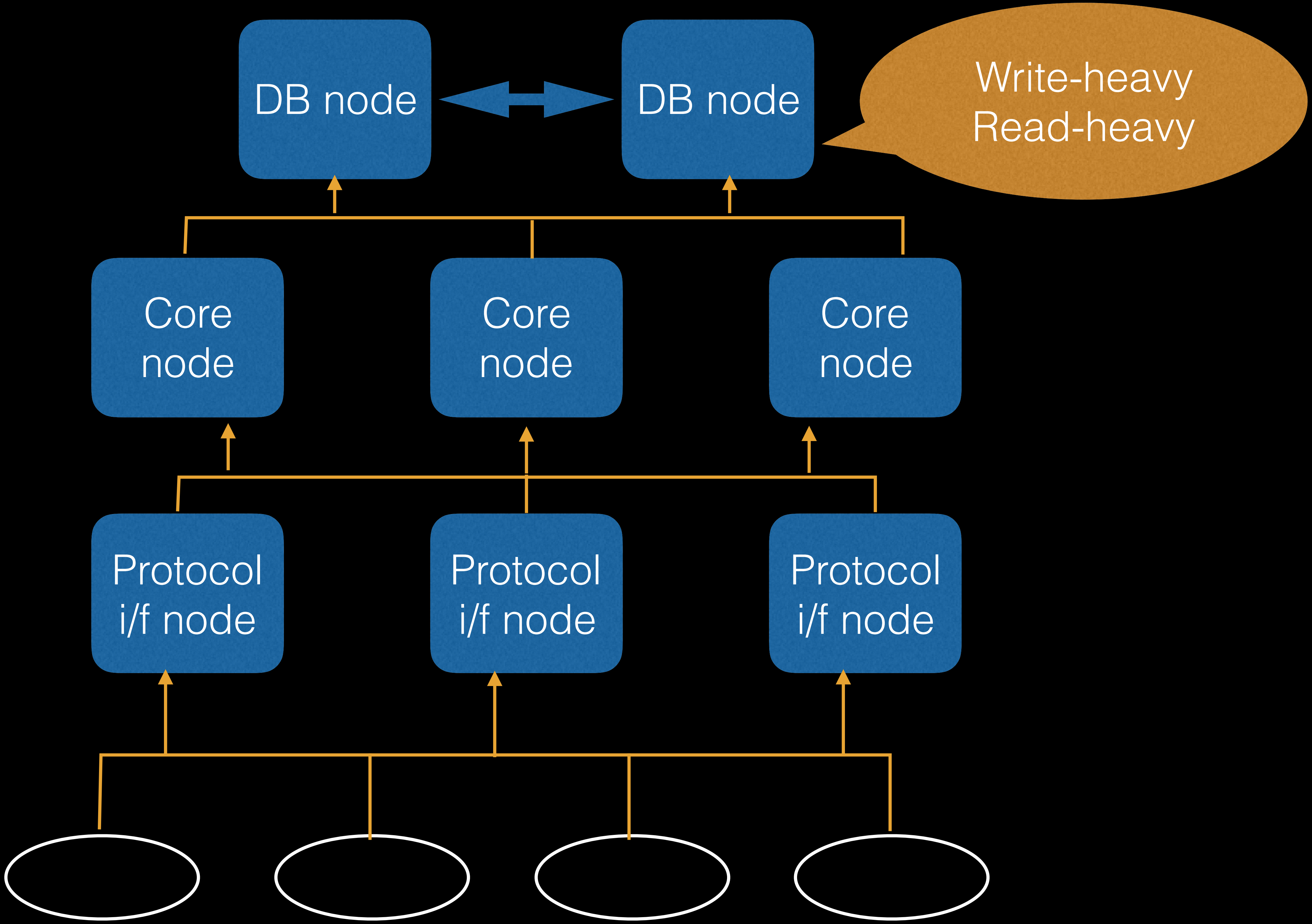

Don’t use Mnesia in a replicated write-heavy use case

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Replicated read-heavy is OK

Standalone write-heavy is OK

Hot code loading

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- Process state management
- Installation & Rollback
- Traceability

Don’t use hot code loading to patch your systems unless you have automated installation and rollback scripts

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- {active, N} seems to yield the highest performance

Overall system design

Design guidelines

- Make each Erlang node as independent as possible
- Each node should be a independent unit of computation

Bad design - example

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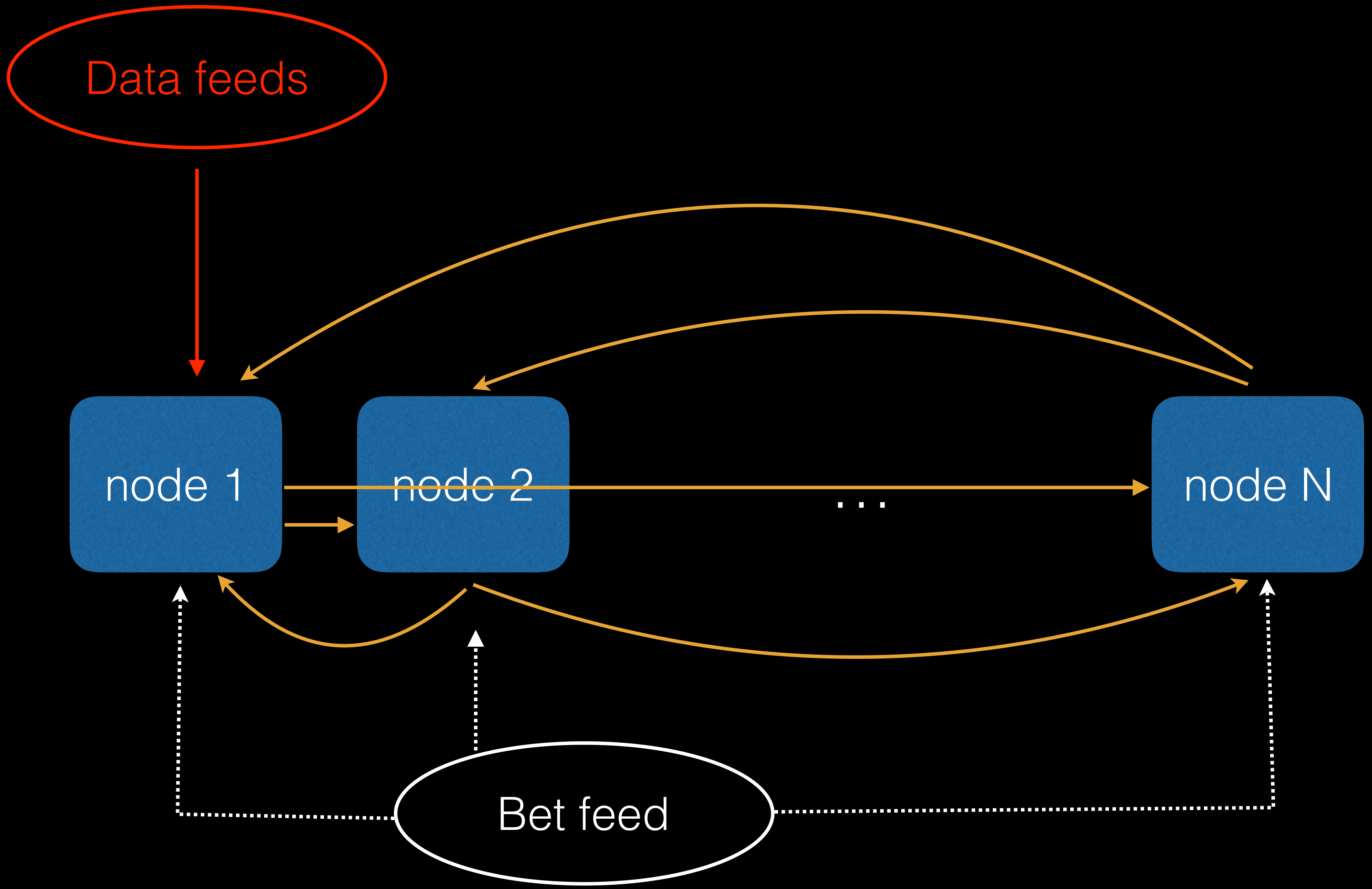
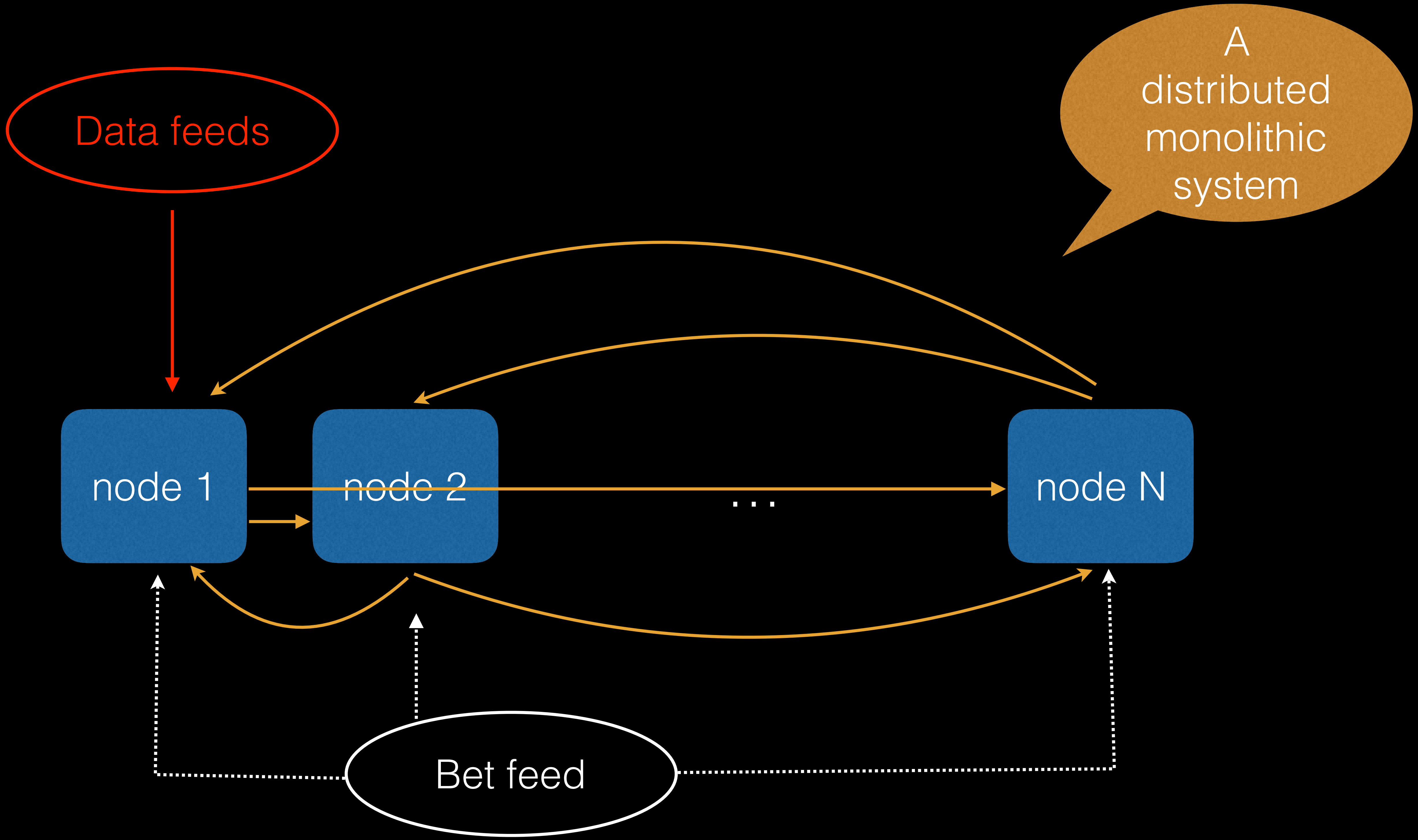
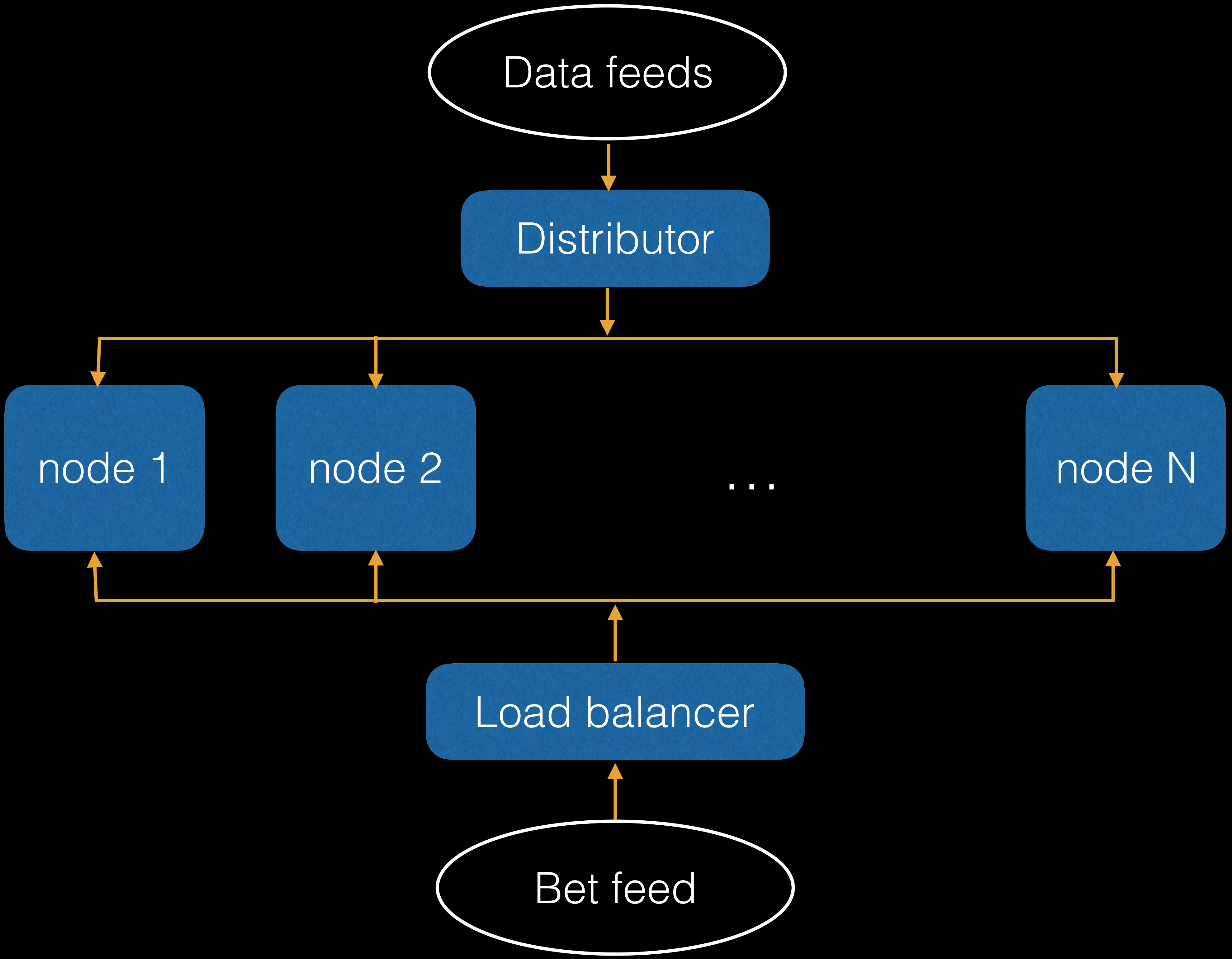


Bad design - example



A better way


Data feeds
Distributor
node 1
node 2
. . .
node N
Load balancer
Bet feed

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- Beware of message queue build up
- Beware of native RPC limitations
- Mnesia is awesome (for certain use cases)
- {active, N} works best for TCP sockets
- Overload control is not optional

Recap

- Prefer lots of short lived stateless processes over a few long lived ones
- Beware of message queue build up
- Beware of native RPC limitations
- Mnesia is awesome (for certain use cases)
- {active, N} works best for TCP sockets
- Overload control is not optional
- Pay attention to overall system design

Open source at bet365

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- Better ODBC support

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- A proper SOAP implementation in Erlang

Open source at bet365

- Better ODBC support
- A proper SOAP implementation in Erlang
- Assisting Ericsson to develop a package manager for Erlang

Acknowledgements

Source code highlighting: ‘Highlight’ courtesy of Andre Simon
http://www.andre-simon.de/dokuwiki/doku.php