Erlang Solutions Ltd.

JOBS – Generic Load Regulation

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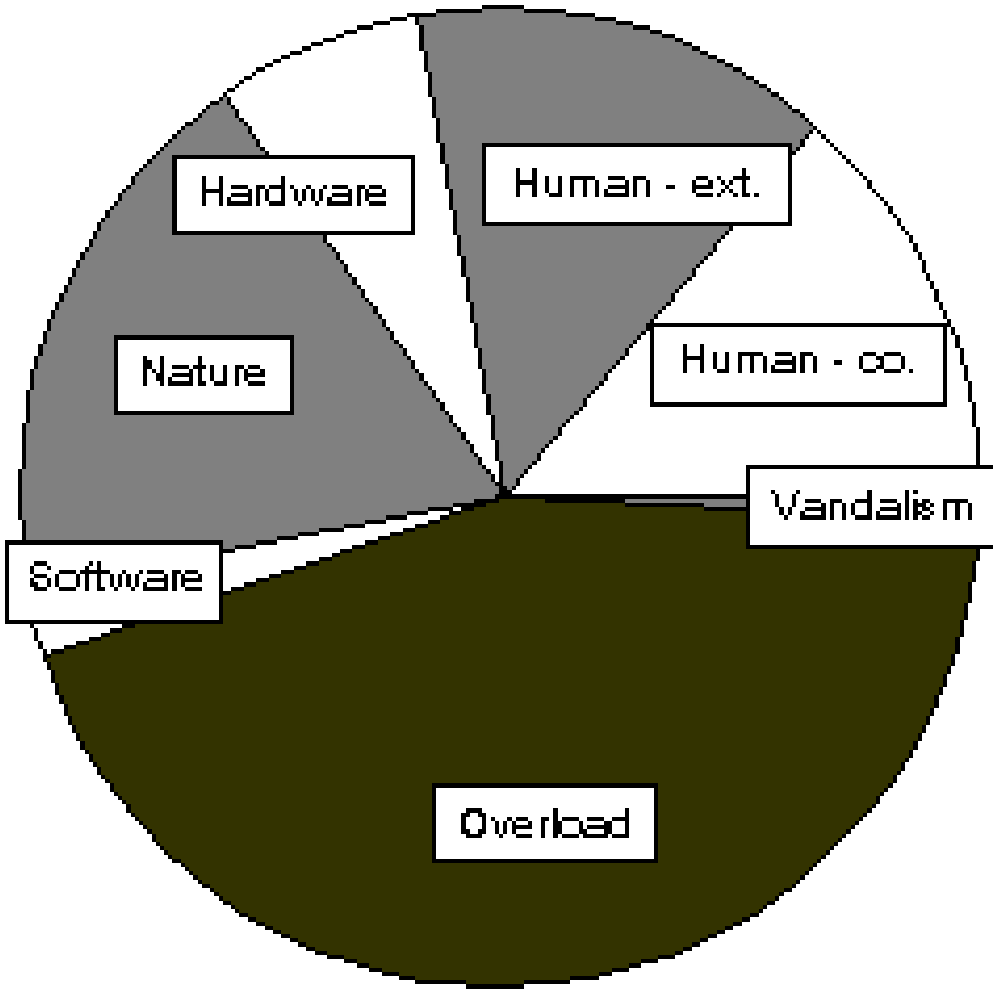
Overload a Big Contributor to downtime

- In Telecoms, nearly half of registered downtime is due to overload (source: FCC)



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Erlang/OTP has no load regulation lib

- 'overload' is an old and very primitive solution
- Estimates request frequency
- Denies request if $f > Limit$
- No queueing
- All requests are equal

- Few know it exists – even fewer actually use it

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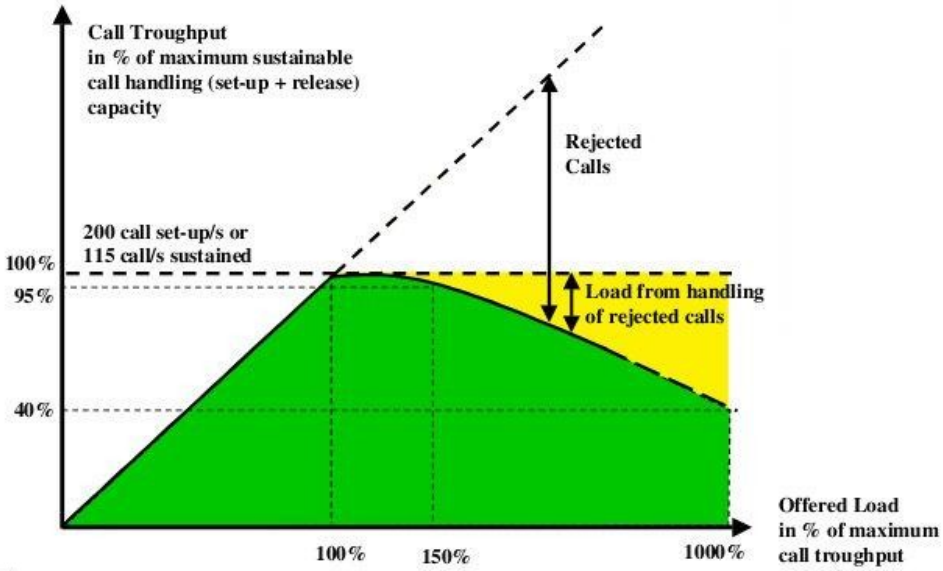
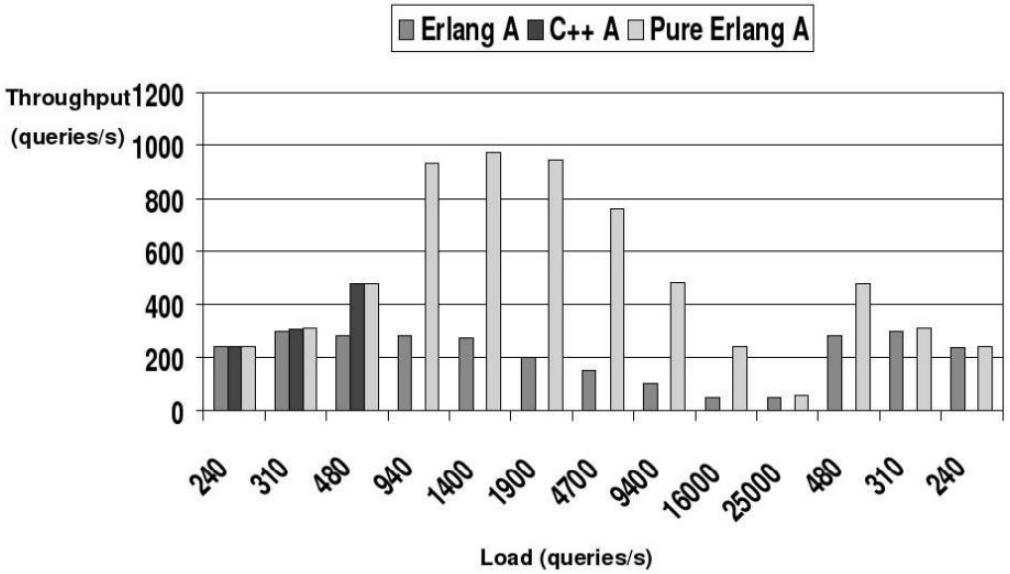
Erlang apps have done well in the past...

U. Wiger (2001)





J. H. Nyström, P. W. Trinder, and D. J. King (2008)

Multicore brings new exciting problems

- Emergent patterns result from non-determinism
- Risk of oscillation or memory bursts ("rouge wave" problem)
- Likely to surface during final stress tests
- Throttling (smoothing) seems to help

Photo: http://www.randyjaybraun.com

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The JOBS Paper

- Common overload reasons in Erlang
- Examples of mitigation strategies
- Overview of the JOBS framework
- https://github.com/esl/jobs/raw/dev/doc/erlang07g-wiger.pdf

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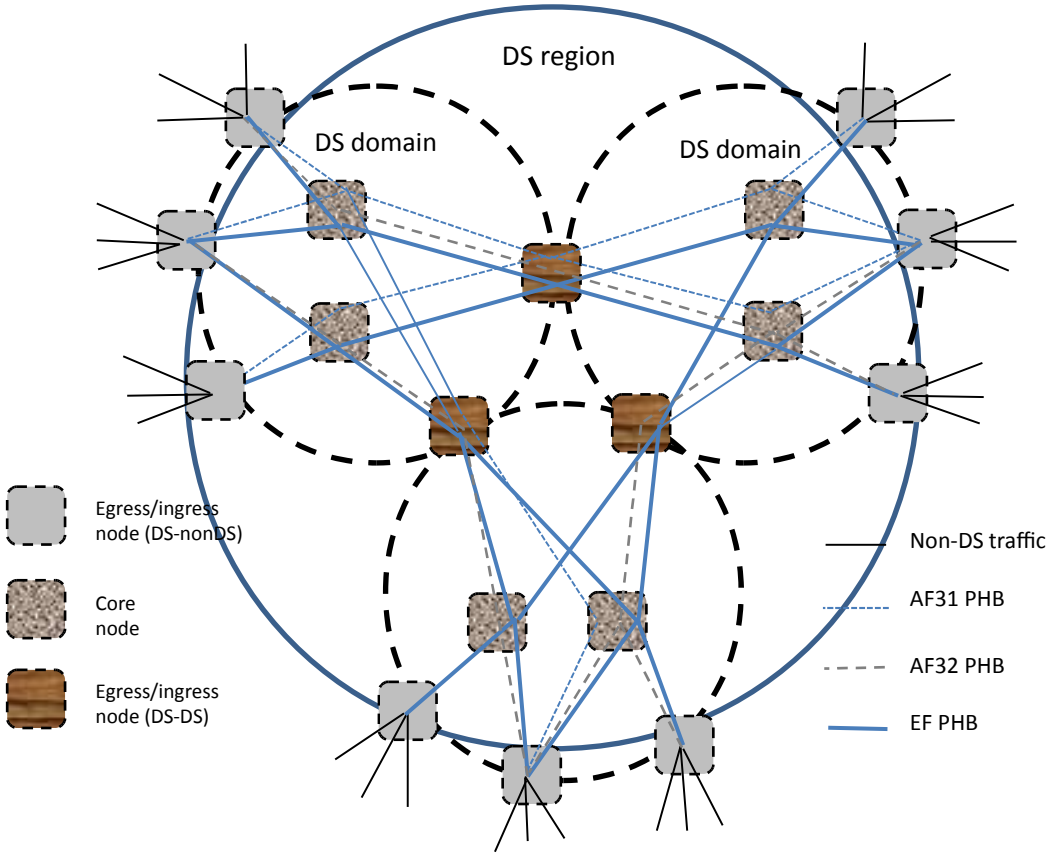
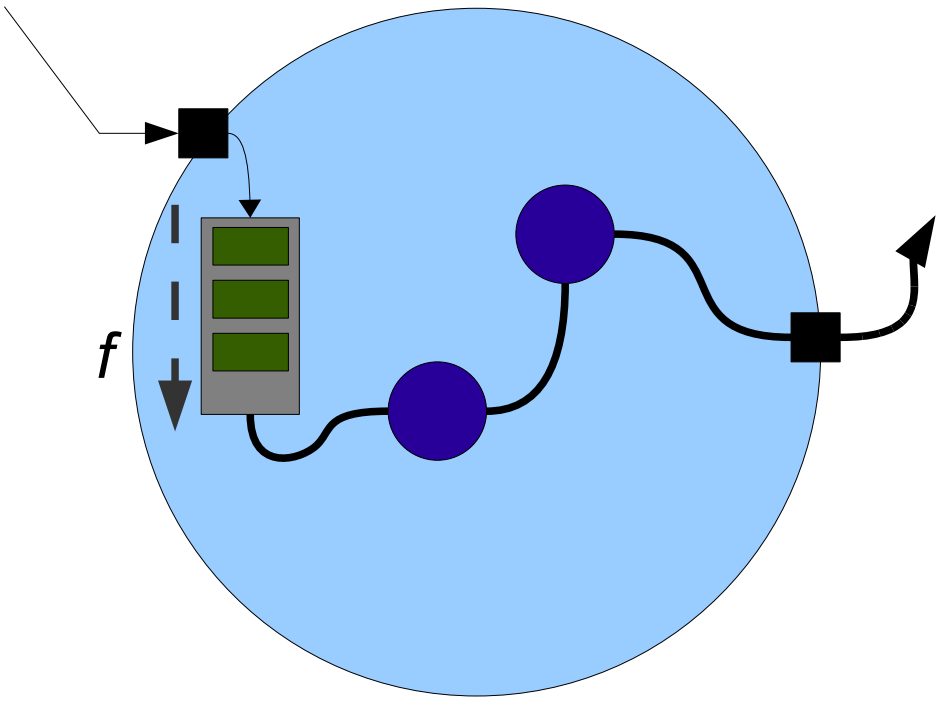
The DiffServ model from Datacom

- Stateless core
- Regulate at the edges
- Much more successful than the more complex IntServ regulation model
- Claim: This model fits well for Erlang software



Regulate at the edges

- Job input queue
  - Configurable
    - Throughput
    - Maximum wait
    - (etc...)
- “Stateless” core components



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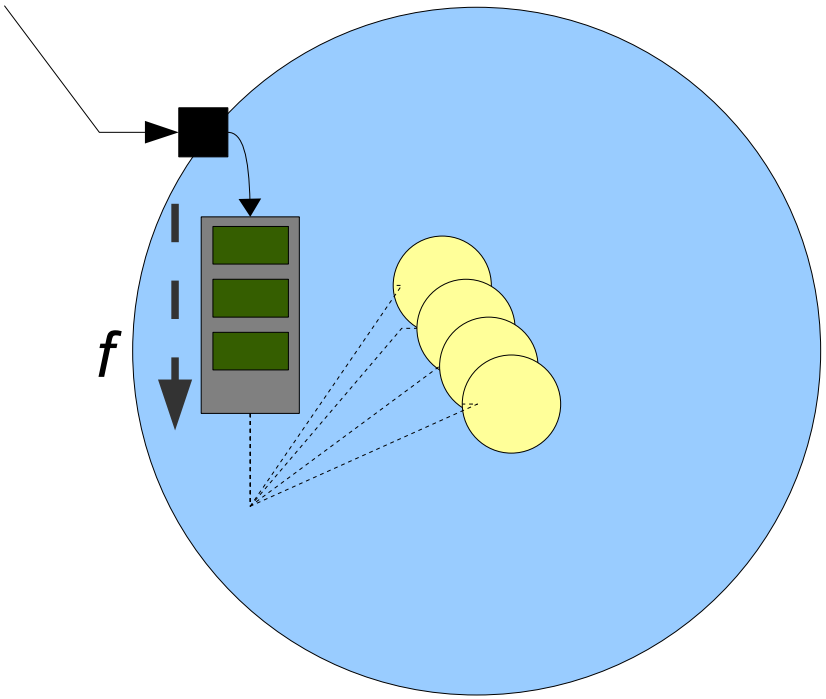
Process pools

- Pool: allow N concurrent workers
  - Can actually raise throughput by lowering contention
- Credit system: check out a value from a credit pool
- 'Counter-based' regulation in JOBS combines the two
  - ~~(gproc aggregated counters)~~



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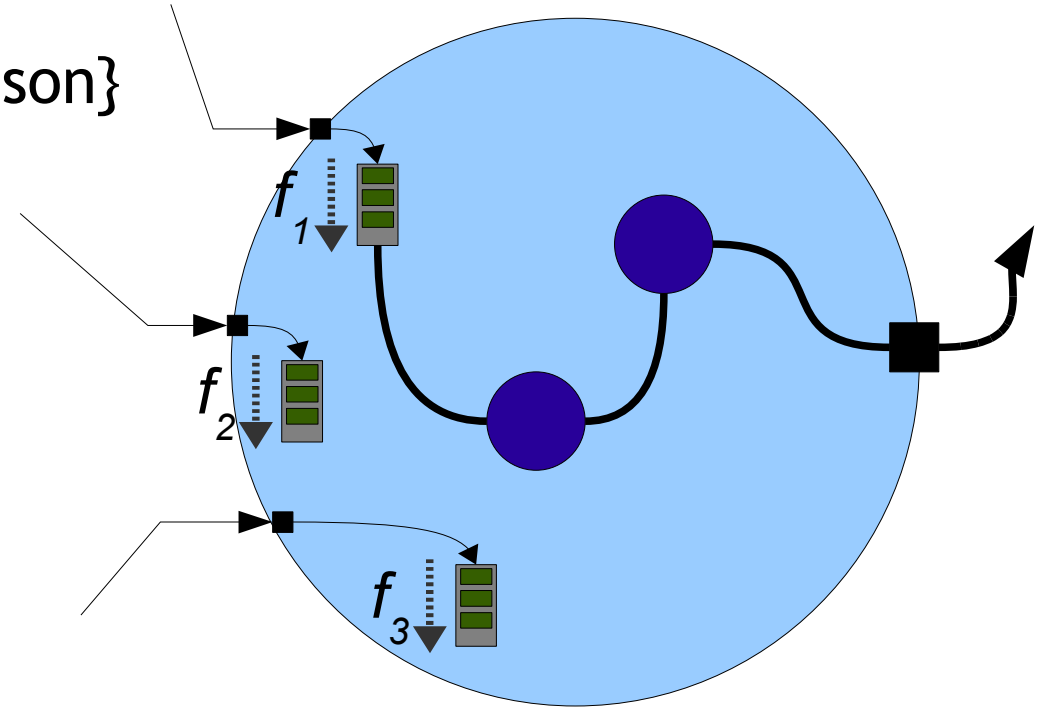
Differentiating inputs

- ask(JobType) ⟶
  {ok, Opaque} | {error, Reason}
- Set rate/lifetime per queue
- Non-rejectable jobs:
  - Infinite wait time



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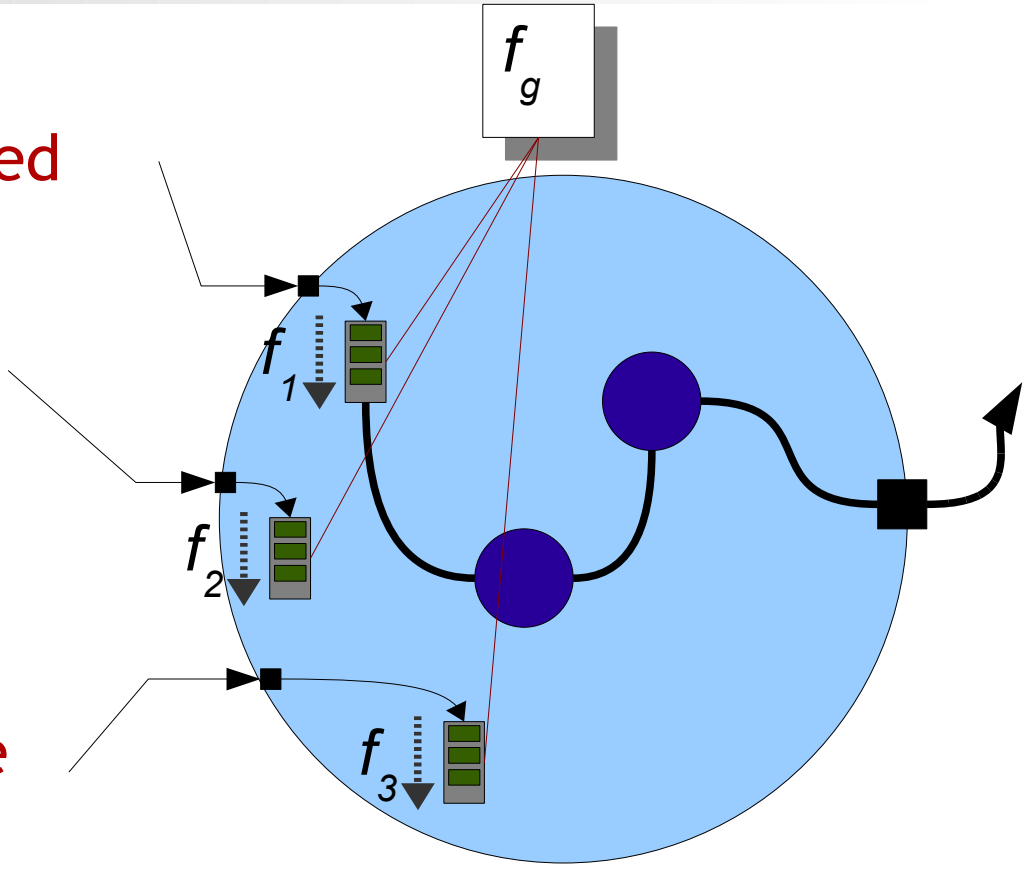
Group rate regulation

- Total rate of jobs from grouped queues cannot exceed f_g
- Useful e.g. when serving multiple similar clients

  (or e.g. setup/release jobs)
- Counter regulators can also be shared, by giving them the same name



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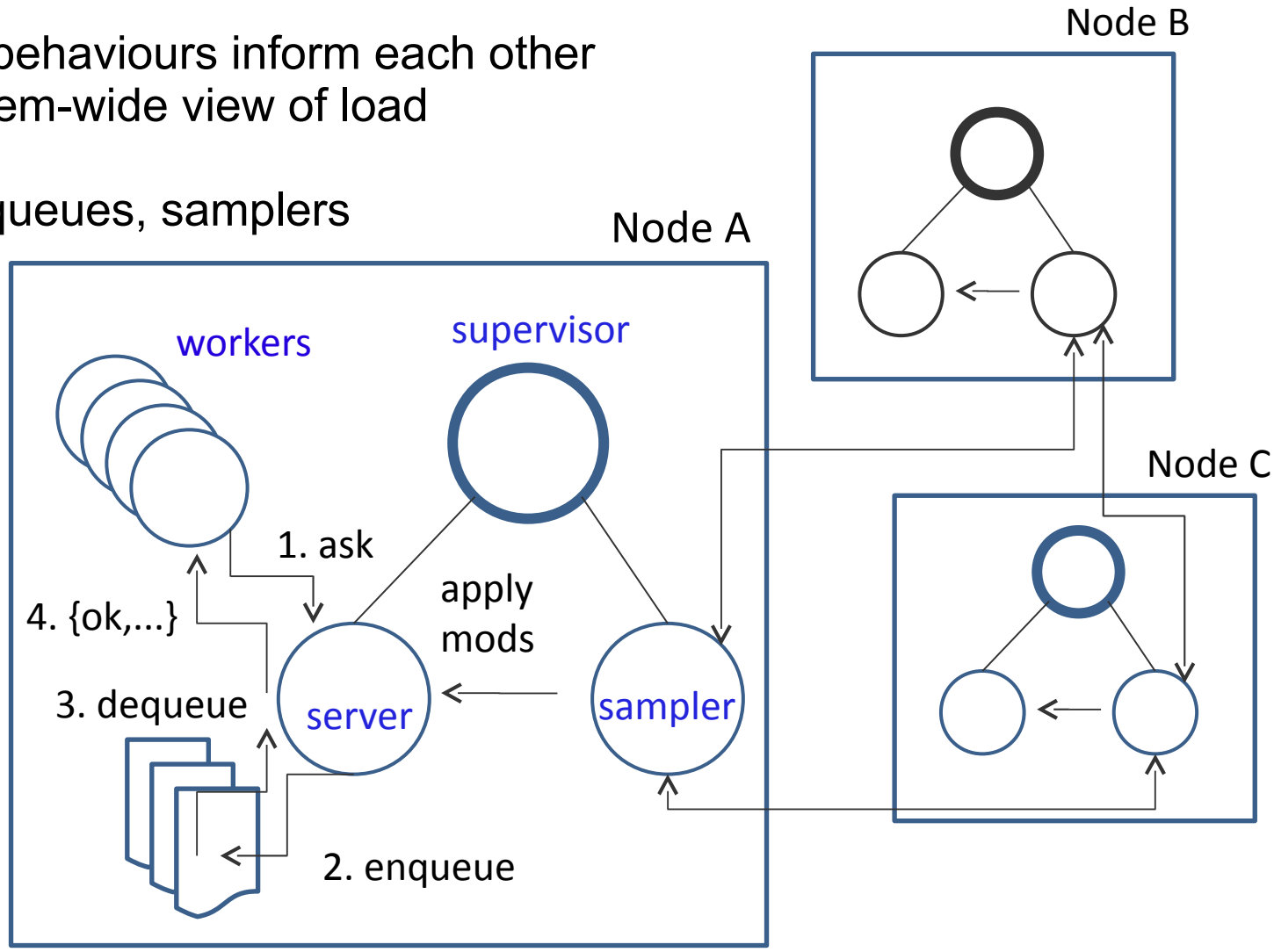
The JOBS Architecture

Sampler behaviours inform each other for a system-wide view of load

Plugins: queues, samplers



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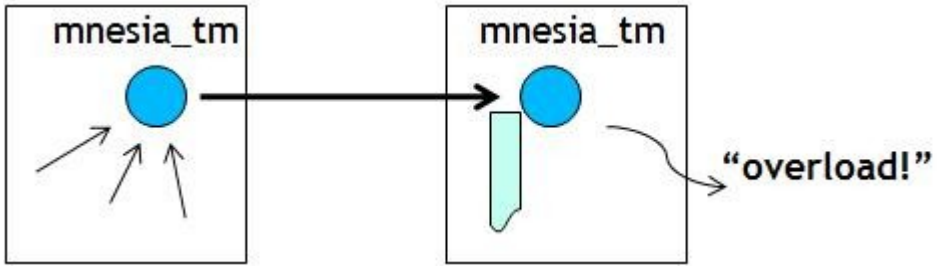
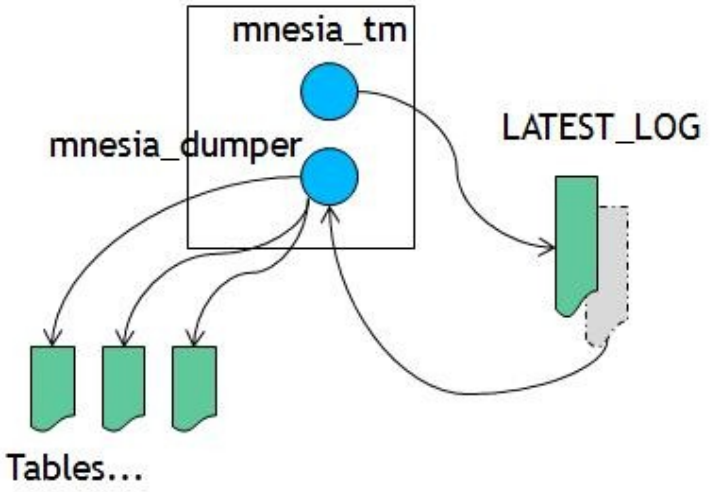
Example: Mnesia overload

- Mnesia sends 'overload' events only on the node where overload was detected
- The cause of the overload may well be on other nodes
- Feedback modifiers in JOBS lower the rate of relevant job queues

Message queue overload



Log dump overload



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Admission request function (simplified)

```
-spec ask(job_class()) → {ok, reg_obj()} | {error, rejected | timeout}.
%%
ask(Type) →
    call(?SERVER, {ask, Type, timestamp()}, infinity).


-spec done(reg_obj()) -> ok.
%%
done(Opaque) ->
    gen_server:cast(?MODULE, {done, Opaque})..
```


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Alternative request function

```
-spec run(job_class(), fun(() -> X)) -> X.
%%
run(Type, Fun) when is_function(Fun, 0) ->
    case ask(Type) of
        {ok, Opaque} ->
            try Fun()
                after
                    done(Opaque)
                end;
        {error, Reason} ->
            erlang:error(Reason)
    end.
```


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Mnesia sampler behaviour (extract)

```
init(Opts) ->
    mnesia:subscribe(system),
    Levels = proplists:get_value(levels, Opts, default_levels()),
    {ok, #st{levels = Levels}}.

default_levels() ->
    {seconds, [{0,1}, {30,2}, {45,3}, {60,4}]}.

handle_msg({mnesia_system_event, {mnesia,{dump_log,_}}}, _T, S) ->
    {log, true, S};
handle_msg({mnesia_system_event, {mnesia_tm, message_queue_len, _}}, _T, S) ->
    {log, true, S};
handle_msg(_, _T, S) ->
    {ignore, S}.

sample(_T, S) ->
    {is_overload(), S}.

calc(History, #st{levels = Levels} = S) ->
    {jobs_sampler:calc(time, Levels, History), S}.
```


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CPU sampler behaviour (extract)

```
init(Opts) ->
    cpu_sup:util([per_cpu]),  % first return value is rubbish, per the docs
    Levels = proplists:get_value(levels, Opts, default_levels()),
    {ok, #st{levels = Levels}}.

default_levels() -> [{80,1},{90,2},{100,3}].

sample(_Timestamp, #st{} = S) ->
    Result = case cpu_sup:util([per_cpu]) of
                 ...
             end,
    {Result, S}.

calc(History, #st{levels = Levels} = St) ->
    L = jobs_sampler:calc(value, Levels, History),
    {L, St}.
```


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Queue (list) behaviour (extract)

```
new(Options, Q) ->
    case proplists:get_value(type, Options, lifo) of
        lifo -> Q#q{st = []}
    end.

delete(#q{}) -> true.

in(TS, Job, #q{st = []} = Q) ->
    Q#q{st = [{TS, Job}], oldest_job = TS};
in(TS, Job, #q{st = L} = Q) ->
    Q#q{st = [{TS, Job} | L]}.

out(N, #q{st = L, oldest_job = OJ} = Q) when N >= 0 ->
    {Out, Rest} = split(N, L),
    OJ1 = case Rest of
              [] -> undefined;
              _  -> OJ
          end,
    {Out, Q#q{st = Rest, oldest_job = OJ1}}.
```


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JOBS Status

- http://github.com/esl/jobs
- Not yet fielded in real applications (coming soon...)
- More documentation, testing and debugging needed
- Feedback most welcome

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