FRANCESCO CESARINI

presents

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Jvfshj xht Gj xfvsn
Erlang Solutions

@FrancescoC
francesco@erlang-solutions.com
www.erlang-solutions.com

Erlang SOLUTIONS

What Is Scalability?

What Is (massive) Concurrency?

NOKIA

What Is High Availability?

What Is Fault Tolerance?

В65
64

What Is Distribution Transparency?

Do you need a **distributed** system? Do you need a **scalable** system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do you need a **massively concurrent** system? Do you need a **distributed** system? Do you need a **scalable**

YES, PLEASE!!!

system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do **distributed** system? Do you need a **scalable** system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do you need a **massively**

ERLANG

TO THE RESCUE

WHAT IS ERLANG

- Open source
- Concurrency-oriented
- Lightweight processes
- Asynchronous message passing
- Share-nothing model
- Process linking / monitoring
- Supervision trees and recovery strategies
- Transparent distribution model
- Soft-real time
- Let-it-fail philosophy
- Hot-code upgrades

WELL, IN FACT YOU NEED MORE.

ERLANG IS JUST
A PROGRAMMING LANGUAGE.

YOU NEED ARCHITECTURE PATTERNS.

YOU NEED MIDDLEWARE.

YOU NEED LIBRARIES.

YOU NEED TOOLS.

You need OTP.

What is Middleware?

Design Patterns

Fault Tolerance

Distribution

Upgrades

Packaging

What are Libraries?

Storage

O&M

Interfaces

Communication

What Tools?

Development

Test Frameworks

Release & Deployment

Debugging & Monitoring

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OPEN SOURCE

OTP IS

PART OF THE ERLANG DISTRIBUTION

OTP

Less Code
Less Bugs
More Solid Code
More Tested Code
More Free Time

Servers
Finite State Machines
Event Handlers
Supervisors
Applications

Master

Let It Fail

```
convert(Day) ->
  case Day of
      monday    -> 1;
      tuesday   -> 2;
      wednesday -> 3;
      thursday  -> 4;
      friday    -> 5;
      saturday  -> 6;
      sunday    -> 7;
      Other ->
         {error, unknown_day}
  end.
```

Let It Fail

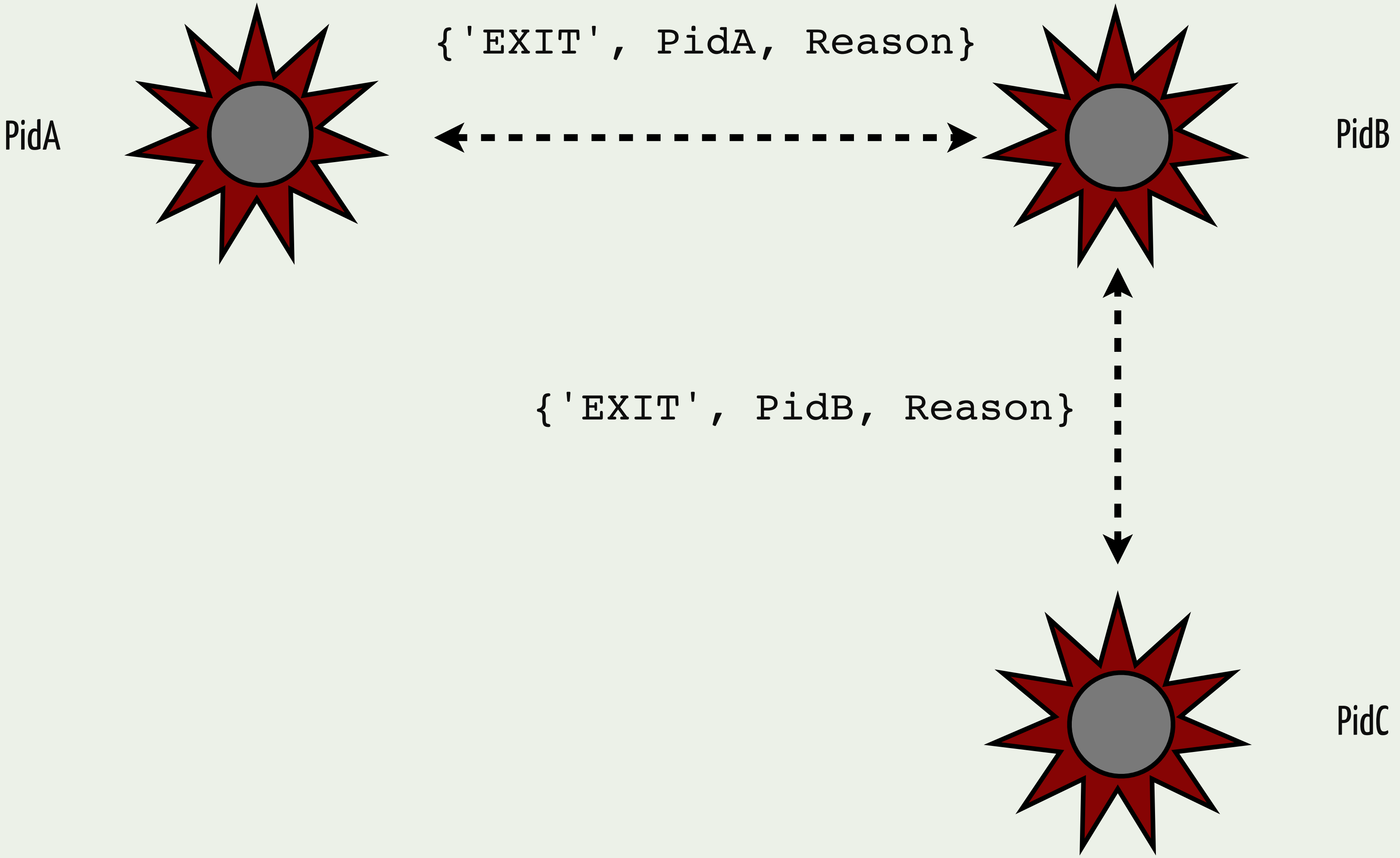
```
convert(Day) ->
  case Day of
      monday    -> 1;
      tuesday   -> 2;
      wednesday -> 3;
      thursday  -> 4;
      friday    -> 5;
      saturday  -> 6;
      sunday    -> 7;


  end.
```

Isolate The Error!

Exit Signals

Propagating Exit Signals



PidA

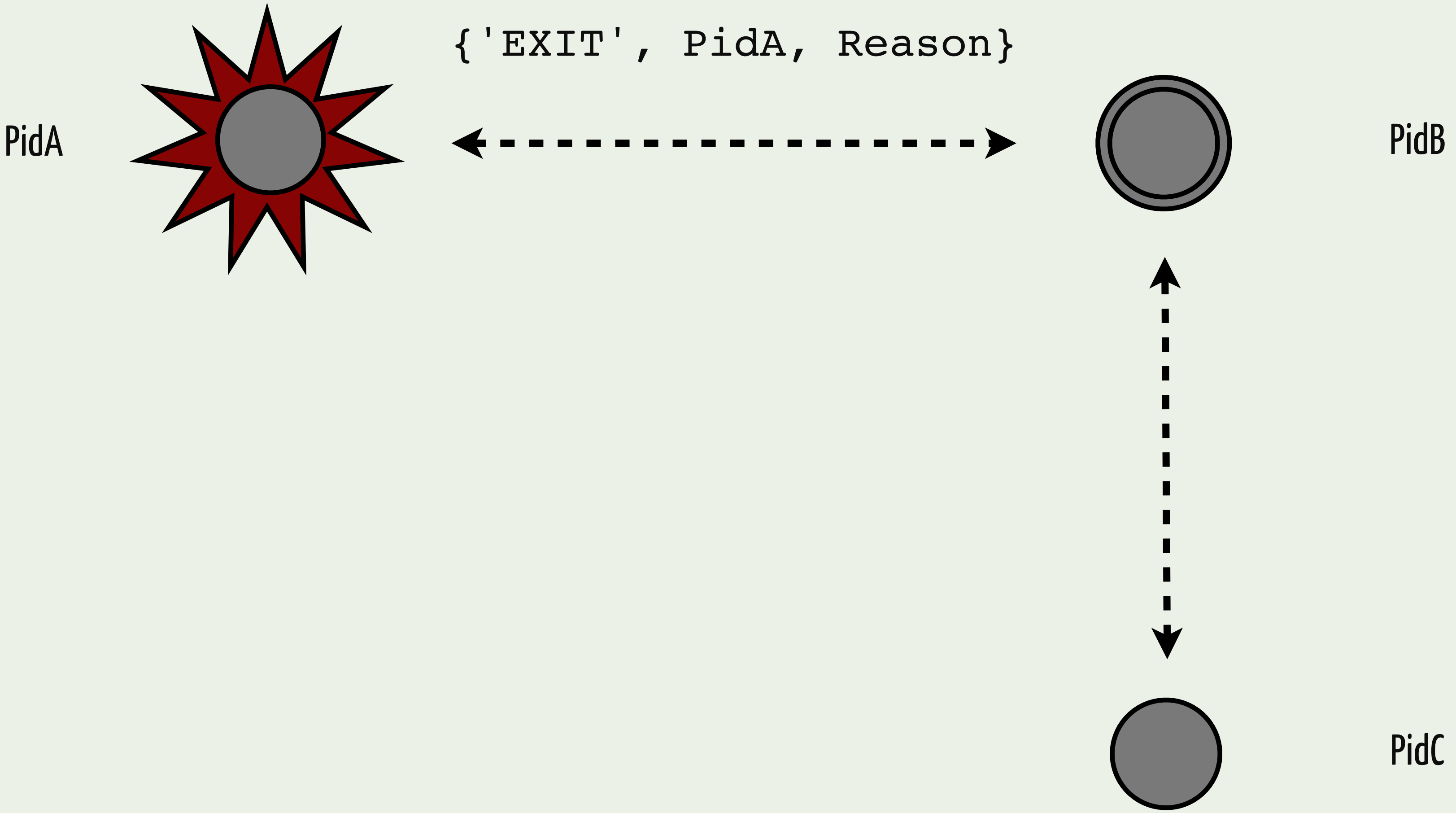
{'EXIT', PidA, Reason}

PidB

{'EXIT', PidB, Reason}

PidC

Trapping an Exit Signal



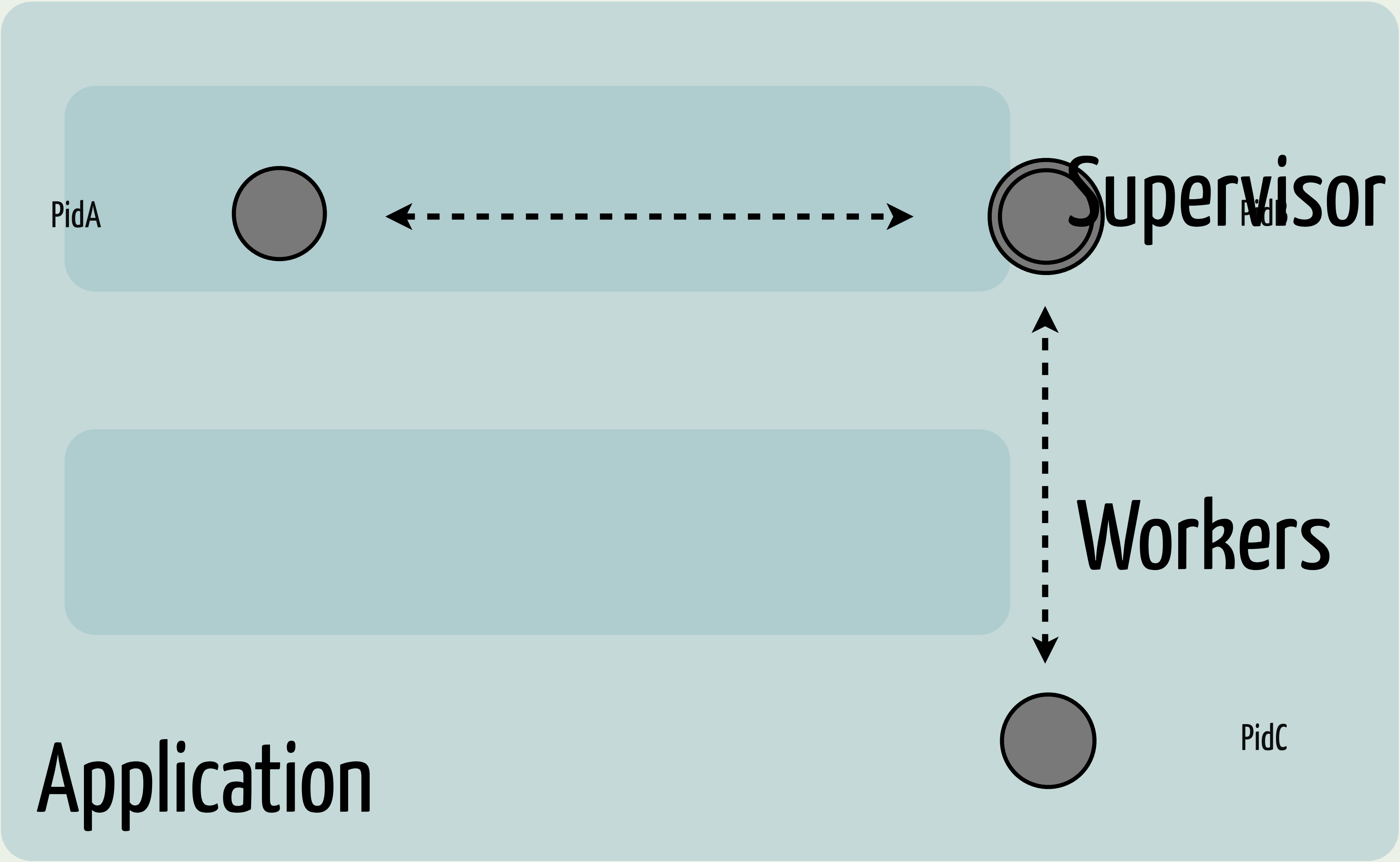
{'EXIT', PidA, Reason}

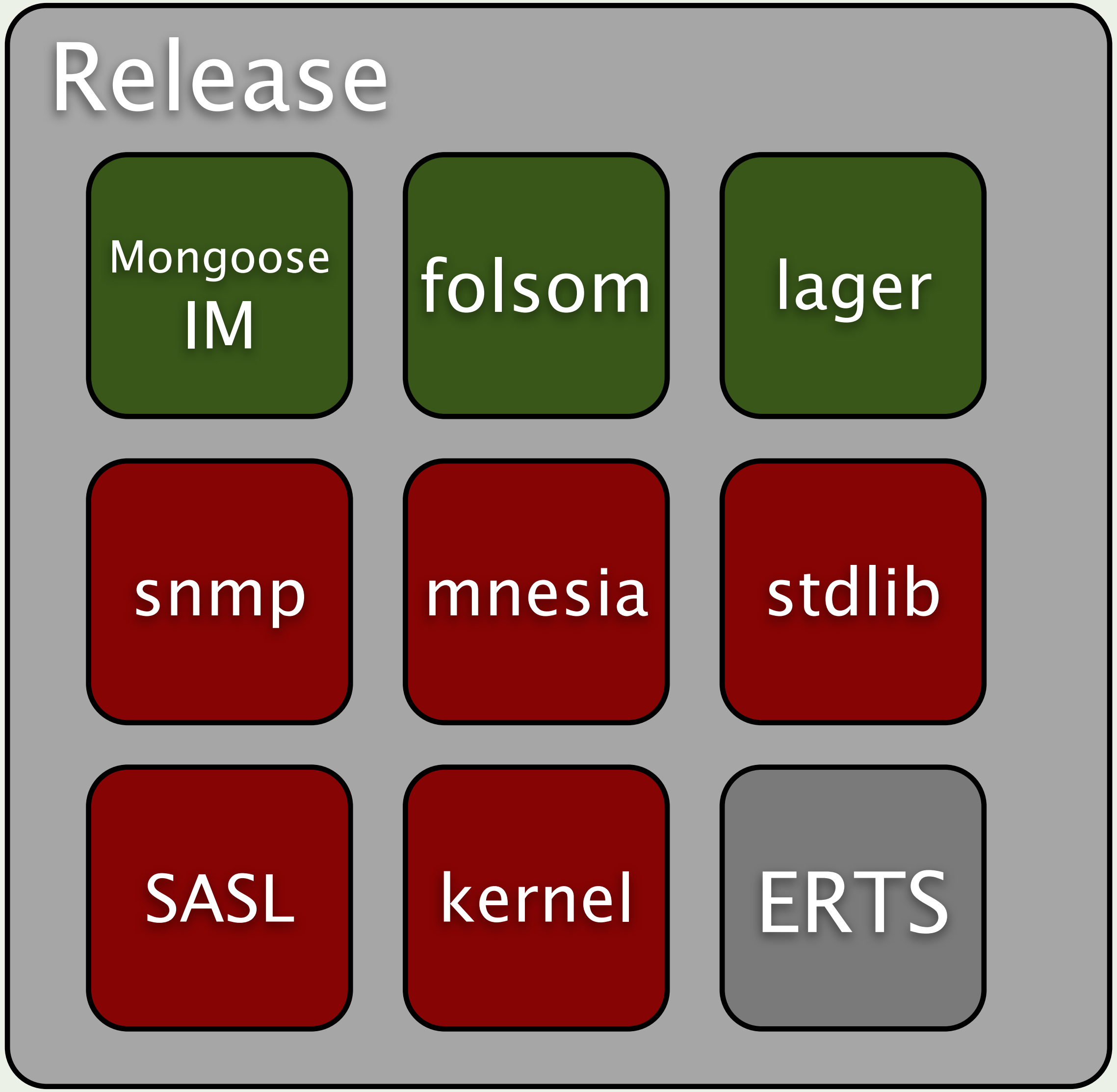
PidA

PidB

PidC

Supervisors





Release

Mongoose IM

folsom

lager

snmp

mnesia

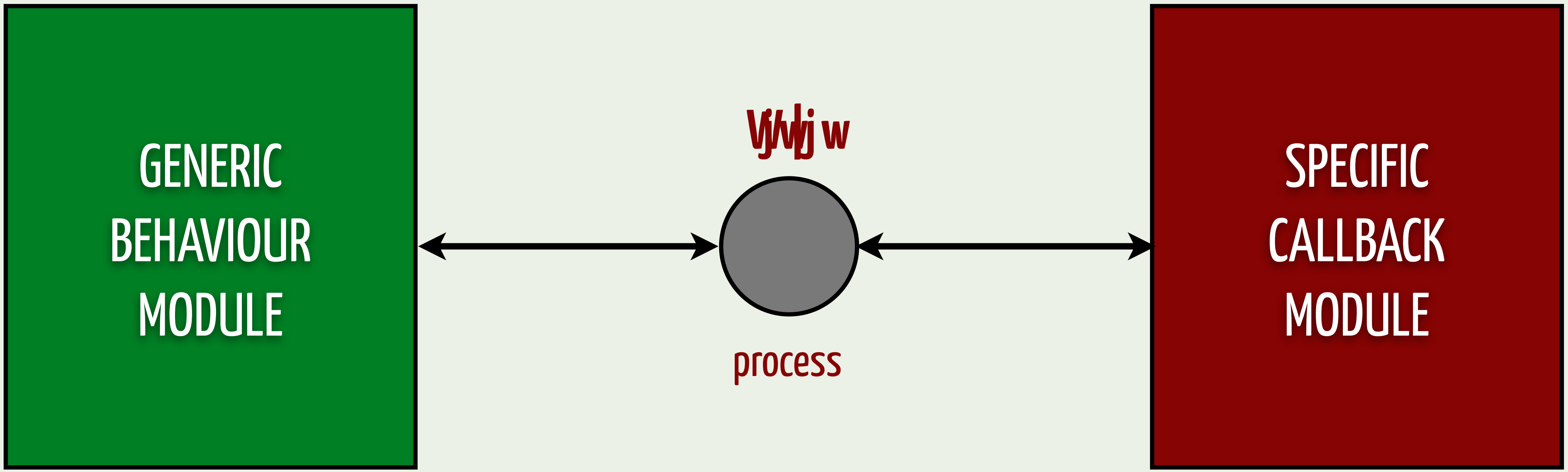
stdlib

SASL

kernel

ERTS

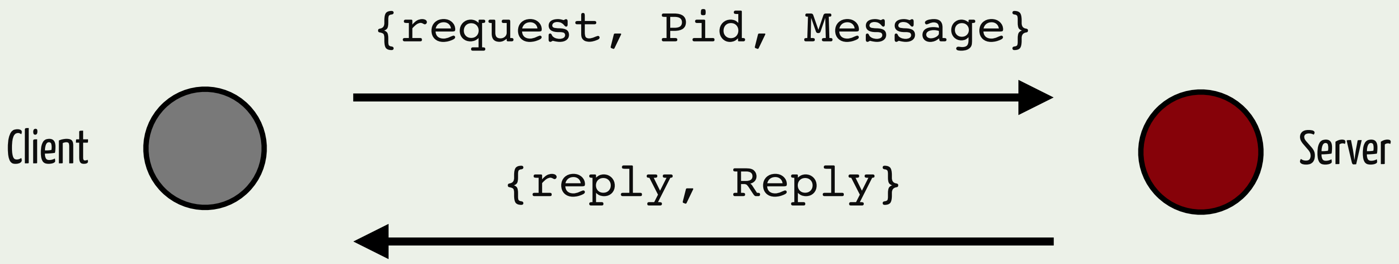
Behaviours

GENERIC BEHAVIOUR MODULE
Vjfwlj w
process
SPECIFIC CALLBACK MODULE

OTP

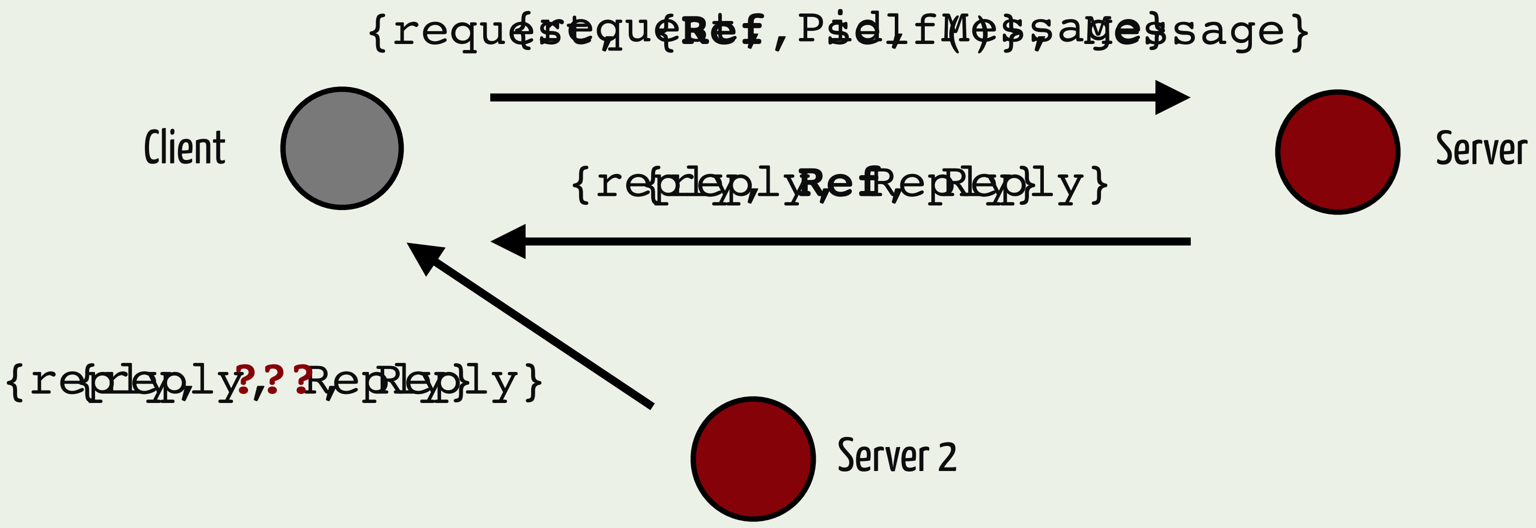
Less Code
Less Bugs
More Solid Code
More Tested Code
More Free Time

Servers
Finite State Machines
Event Handlers
Supervisors
Applications



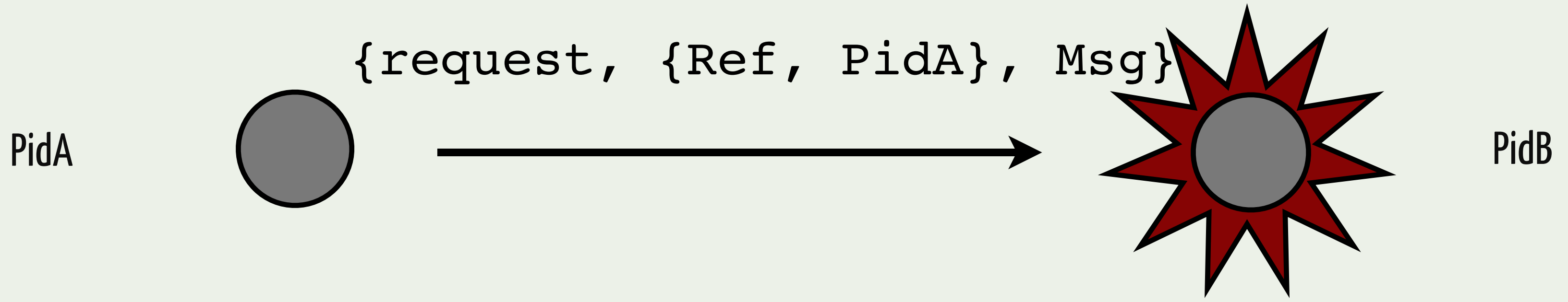
```
call(Name, Message) ->
    Name ! {request, self(), Message},
    receive
        {reply, Reply} -> Reply
    end.
```

```
reply(Pid, Reply) ->
    Pid ! {reply, Reply}.
```

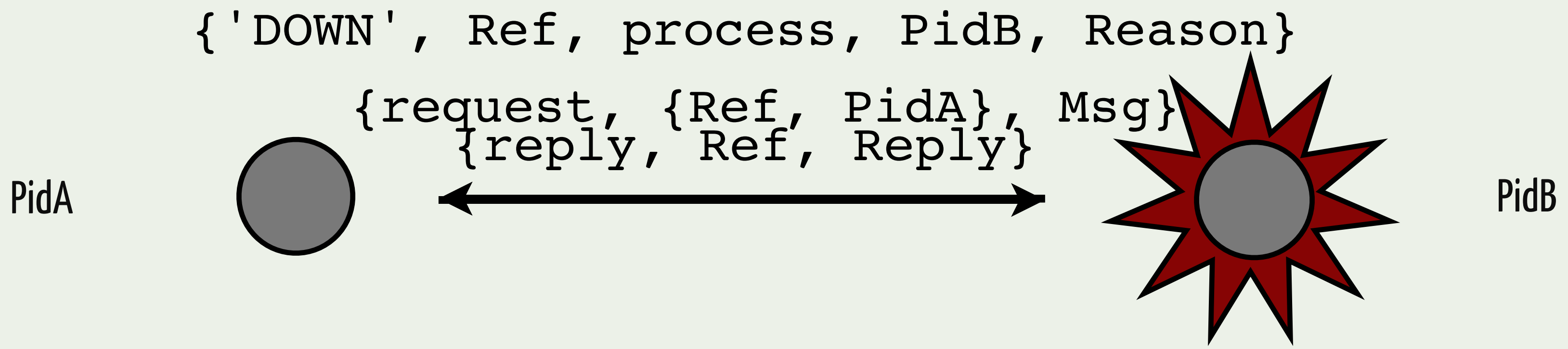


```
call(Name, Msg) ->
    Ref = make_ref(),
    Name ! {request, {Ref, self()}, Msg},
    receive {reply, Ref, Reply} -> Reply end.

reply({Ref, Pid}, Reply) ->
    Pid ! {reply, Ref, Reply}.
```



```
call(Name, Msg) ->
    Ref = erlang:monitor(process, Name),
    Name ! {request, {Ref, self()}, Msg},
    receive
      {reply, Ref, Reply} ->
        erlang:demonitor(Ref),
        Reply;
      {'DOWN', Ref, process, _Name, _Reason} ->
        {error, no_proc}
    end.
```



{'DOWN', Ref, process, PidB, Reason}

{request, {Ref, PidA}, Msg}

{reply, Ref, Reply}

PidA

PidB

```
call(Name, Msg) ->
    Ref = erlang:monitor(process, Name),
    Name ! {request, {Ref, self()}, Msg},
    receive
      {reply, Ref, Reply} ->
        erlang:demonitor(Ref, [flush]),
        Reply;
      {'DOWN', Ref, process, _Name, _Reason} ->
        {error, no_proc}
    end.
```

Timeouts

Deadlocks

tracing

Monitoring

Distribution

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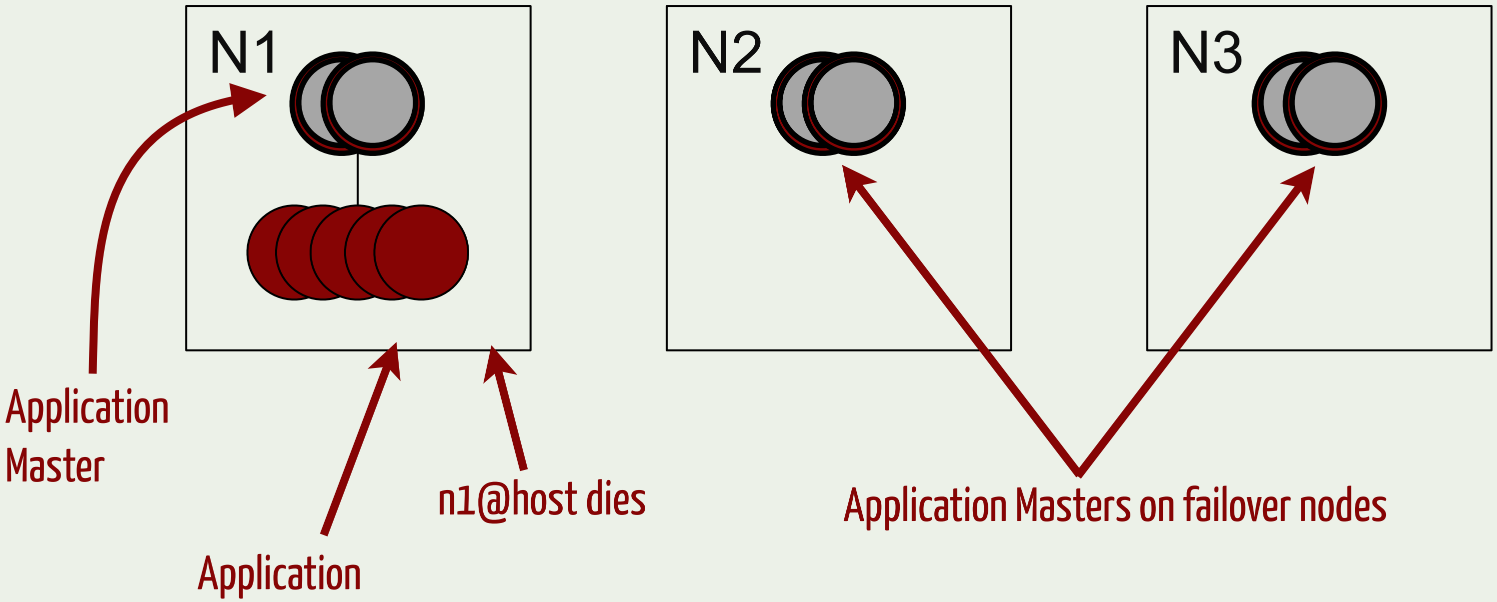
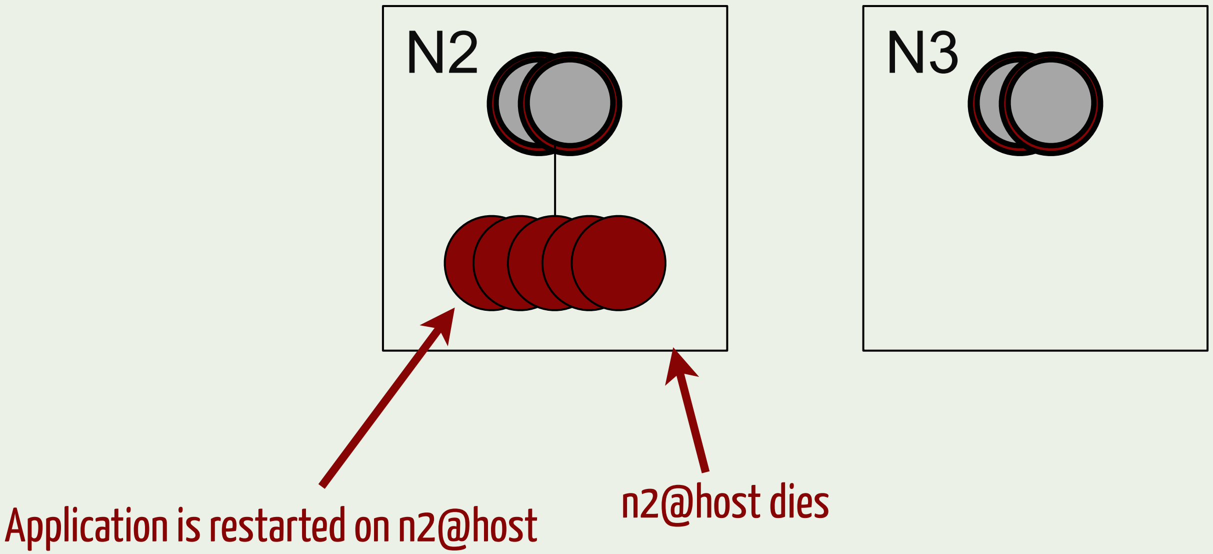
Automatic Takeover and Failover

```
{myApp, 2000, {n1@host, {n2@host, n3@host}]}
```



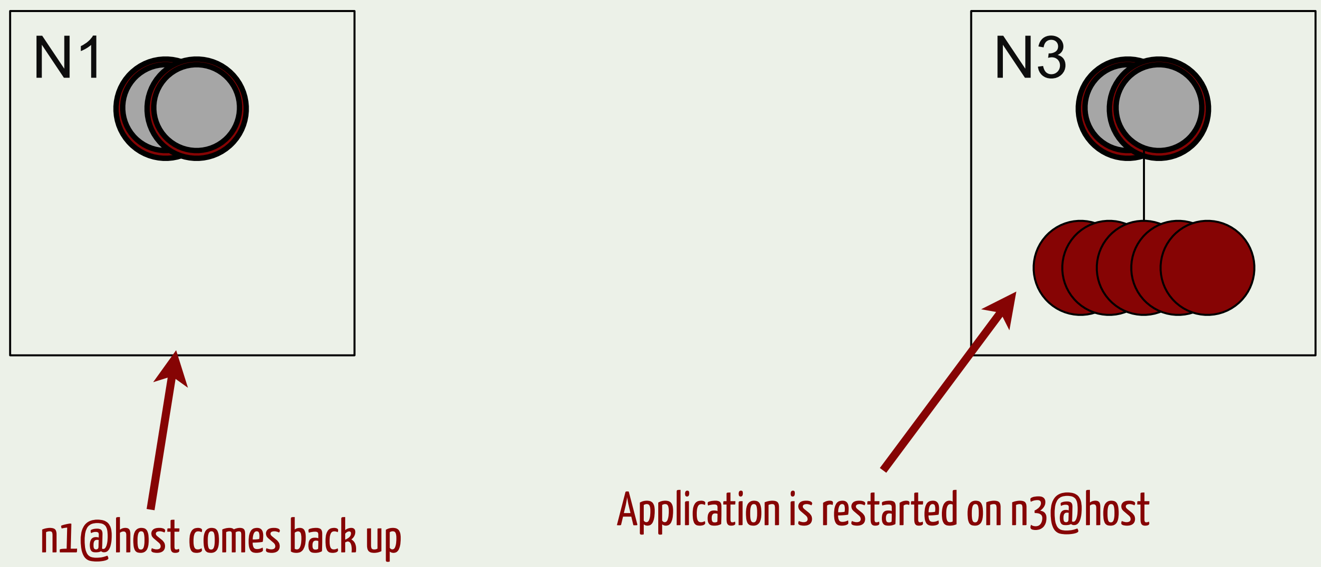
```
{myApp, 2000, {n1@host, {n2@host, n3@host}]}
```



Application is restarted on n2@host

n2@host dies

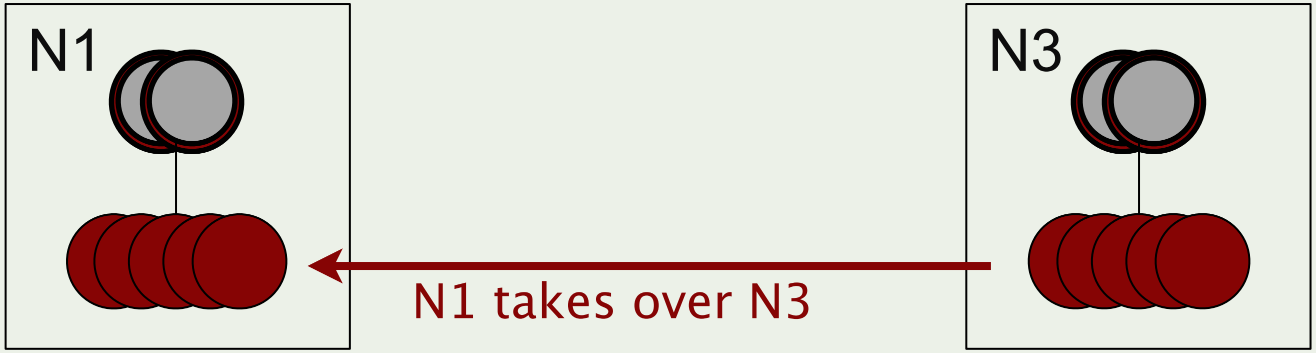
```
{myApp, 2000, {n1@host, {n2@host, n3@host}]}
```



n1@host comes back up

Application is restarted on n3@host

```
{myApp, 2000, {n1@host, {n2@host, n3@host}]}
```

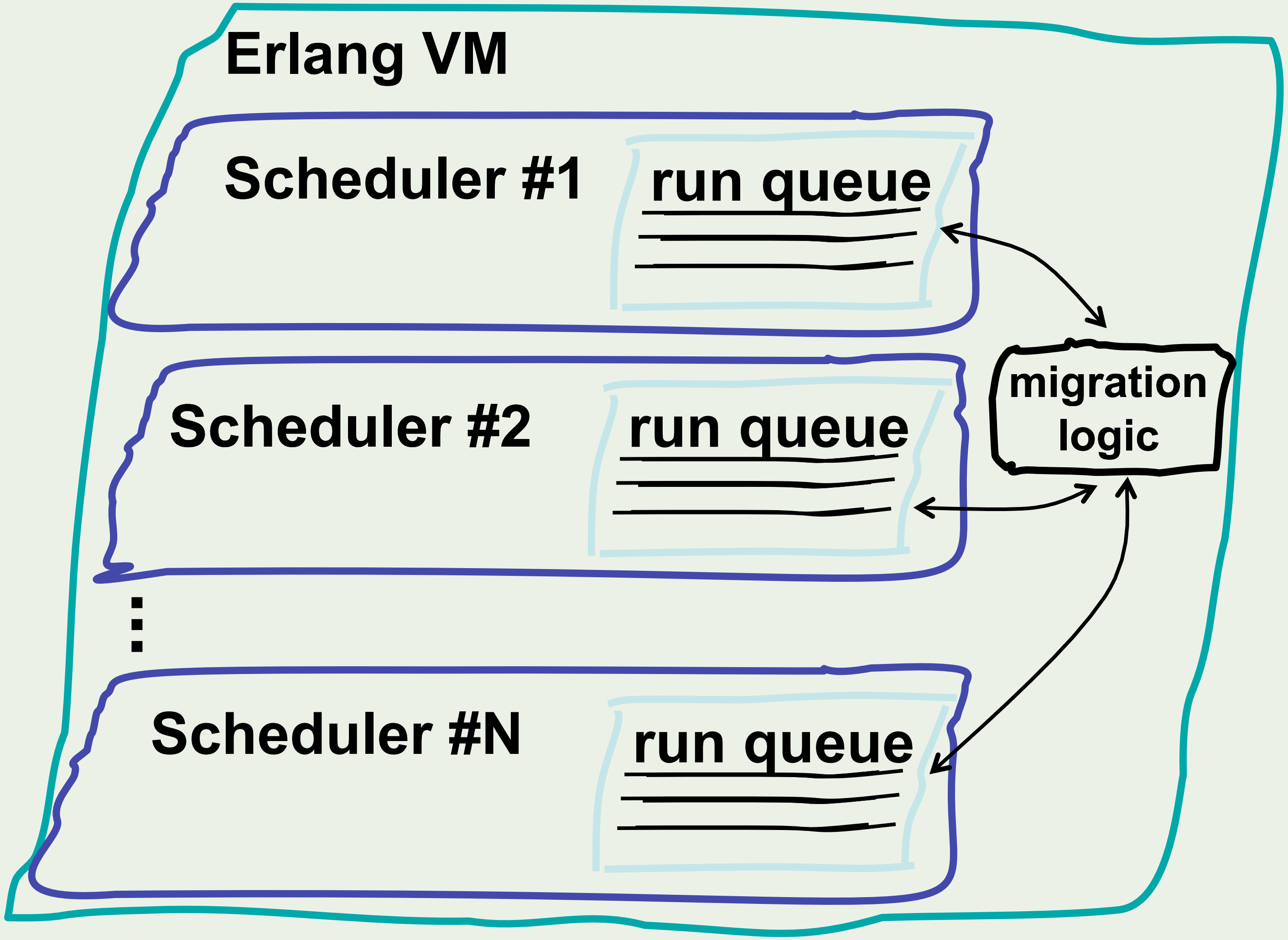


N1 takes over N3

RELEASE STATEMENT OF AIMS

“To scale the radical concurrency-oriented programming paradigm to build reliable general-purpose software, such as server-based systems, on massively parallel machines (10^5 cores).”

The Runtime Queues



Erlang VM

Scheduler #1

run queue

Scheduler #2

run queue

⋮

Scheduler #N

run queue

migration logic

eDF

ERICSSON

Erlang
SOLUTIONS

HERIOT
WATT
UNIVERSITY

UPPSALA
UNIVERSITET

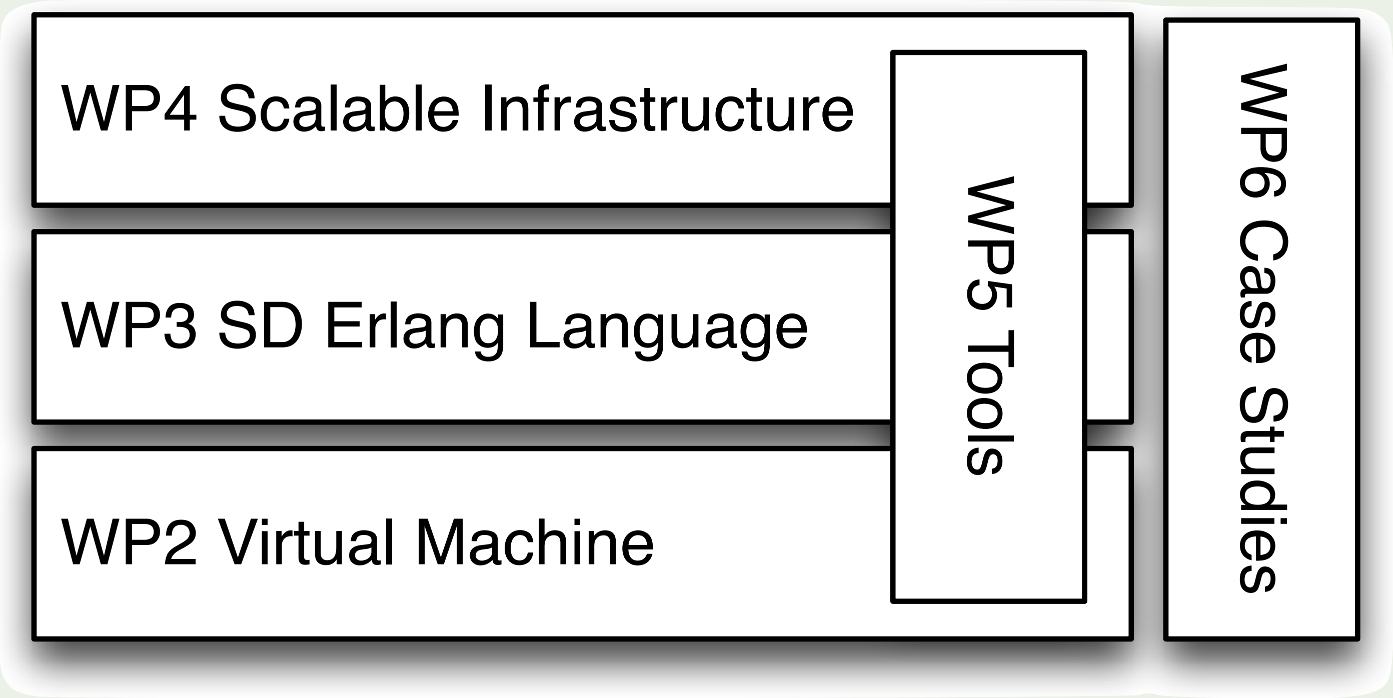
University of
Kent

ΕΠΙΣΕΥ
ICCS

SEVENTH FRAMEWORK
PROGRAMME

RELEASE

LIMITATIONS ARE PRESENT AT THREE LEVELS



WP4 Scalable Infrastructure

WP3 SD Erlang Language

WP2 Virtual Machine

WP5 Tools

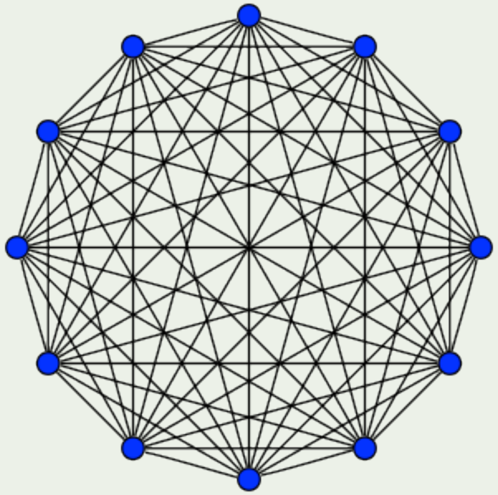
WP6 Case Studies

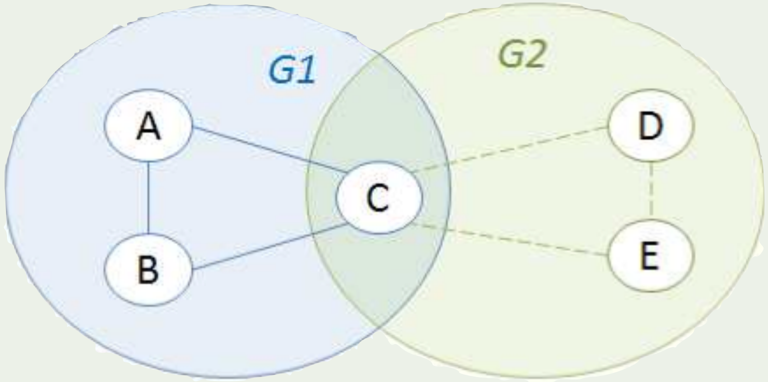
VM | LANGUAGE | INFRASTRUCTURE

- Push the responsibility for scalability from the programmer to the VM
- Analyze performance and scalability
- Identify bottlenecks and prioritize changes and extensions
- Tackle well-known scalability issues
  - Ets tables (shared global data structure)
  - Message passing, copying and frequently communicating processes

VM | LANGUAGE | INFRASTRUCTURE

- Two major issues
  - Fully connected clusters
  - Explicit process placement
- Scalable Distributed (SD) Erlang
  - Nodes grouping
  - Non-transitive connections
  - Implicit process placement
  - Part of the standard Erlang/OTP package
- New concepts introduced
  - Locality, Affinity and Distance





VM | LANGUAGE | INFRASTRUCTURE

CCL /sɪˈsɪlɪ/

- Middleware layer
- Set of Erlang Applications
- Create and manage clusters of (heterogeneous) erlang nodes
- API to monitor and control erlang distributed systems
- Existing tracing/logging/debugging tools pluggable
- Broker layer between users and cloud providers
- Auto-scaling

... And Much More

Conclusions

Do you need a **distributed** system? Do you need a **scalable** system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do you need a **massively concurrent** system? Do you need a **distributed** system? Do you need a **scalable**

USE ERLANG

system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do **distributed** system? Do you need a **scalable** system? Do you need a **reliable** system? Do you need a **fault-tolerant** system? Do you need a **massively**

Do you need a distributed system? Do you need a scalable system? Do you need a reliable system? Do you need a fault-tolerant system? Do you need a massively concurrent system? Do you need a distributed system? Do you need a scalable

USE ERLANG/OTP

system? Do you need a reliable system? Do you need a fault-tolerant system? Do distributed system? Do you need a scalable system? Do you need a reliable system? Do you need a fault-tolerant system? Do you need a massively

Questions?

@francescoC