Erlang Solutions Ltd

An Introduction to Erlang

From behind the trenches…

Erlang Factory Lite
Zurich, April 23rd 2012

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So Here I Am….

Erlang

Telecom Applications: Issues

Complex

No down time

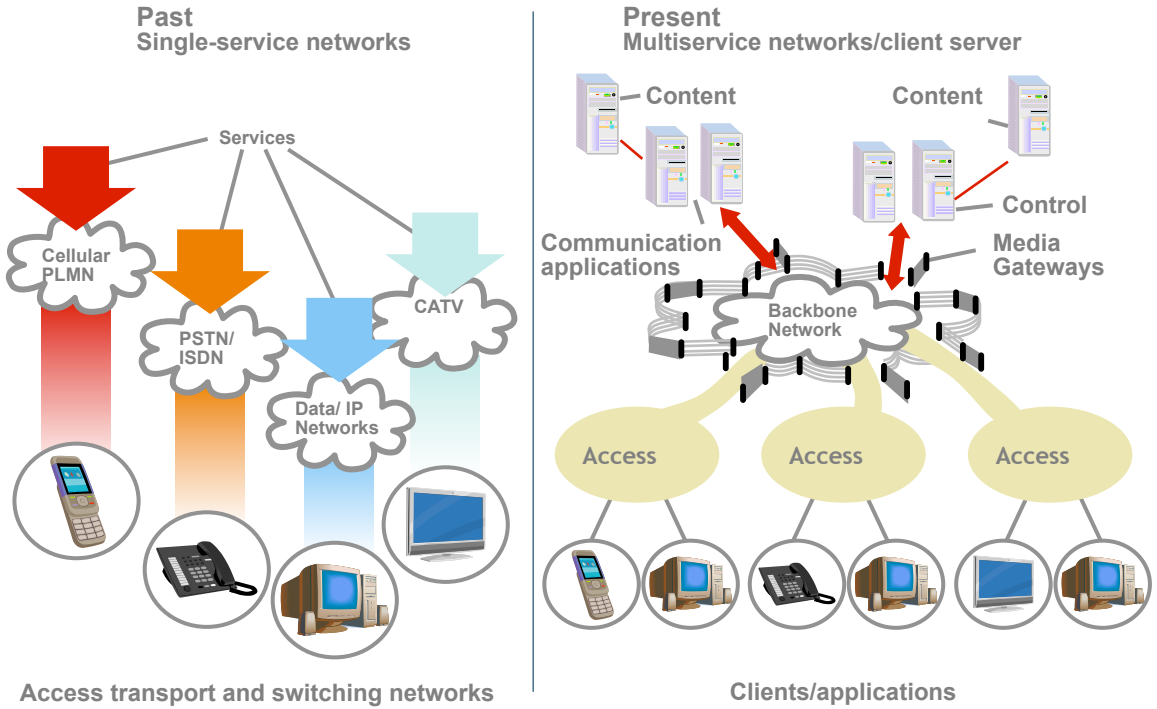
Scalable

Maintainable

Distributed

vs

Time to Market



Erlang

The Ancestors

Languages like SmallTalk, Ada, Modula or Chill

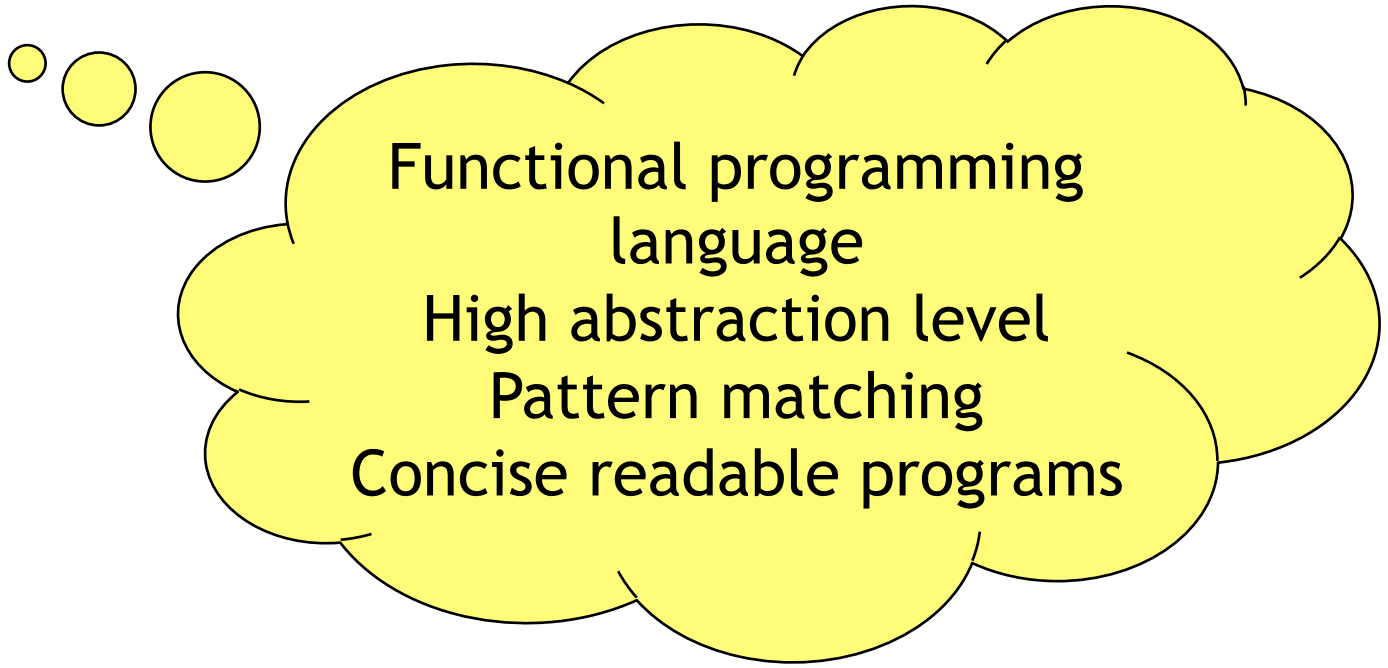
Functional languages like ML or Miranda

Logical languages like Prolog

Erlang

Erlang Highlights

- Declarative
- Concurrent
- Robust
- Distributed
- Hot code loading
- Multicore Support
- OTP



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Erlang Highlights: Factorial

Factorial using Recursion

Definition

$$n! = \begin{cases} 1 & n = 0 \\ n*(n-1)! & n \geq 1 \end{cases}$$

Implementation

```
-module(ex1).
-export([factorial/1]).

factorial(0) ->
   1;
factorial(N) when N >= 1 ->
   N * factorial(N-1).
```

```
Eshell V5.0.1  (abort with ^G)
1> c(ex1).
{ok,ex1}
2> ex1:factorial(6).
720
```


Erlang

Erlang Highlights: High-level Constructs

QuickSort using List Comprehensions

```
-module(ex2).
-export([qsort/1]).

qsort([Head|Tail]) ->
   First = qsort([X || X <- Tail, X =< Head]),
   Last  = qsort([Y || Y <- Tail, Y > Head]),
   First ++ [Head] ++ Last;
qsort([]) ->
   [].
```

```
Eshell V5.0.1  (abort with ^G)
1> c(ex2).
{ok,ex2}
2> ex2:qsort([7,5,3,8,1]).
[1,3,5,7,8]
```

"all objects Y taken from the list Tail, where Y > Head"

Erlang

Erlang Highlights: High-level Constructs

Parsing a TCP packet using the Bit Syntax

```
<< SourcePort:16, DestinationPort:16, SequenceNumber:32,
   AckNumber:32, DataOffset:4, _Reserved:4, Flags:8,
   WindowSize:16, Checksum:16, UrgentPointer:16,
   Payload/binary>> = Segment,

OptSize = (DataOffset - 5)*32,
<< Options:OptSize, Message/binary >> = Payload,
<< CWR:1, ECE:1, URG:1, ACK:1, PSH:1,
   RST:1, SYN:1, FIN:1>> = <<Flags:8>>,

%% Can now process the Message according to the
%% Options (if any) and the flags CWR, ..., FIN
```

etc…

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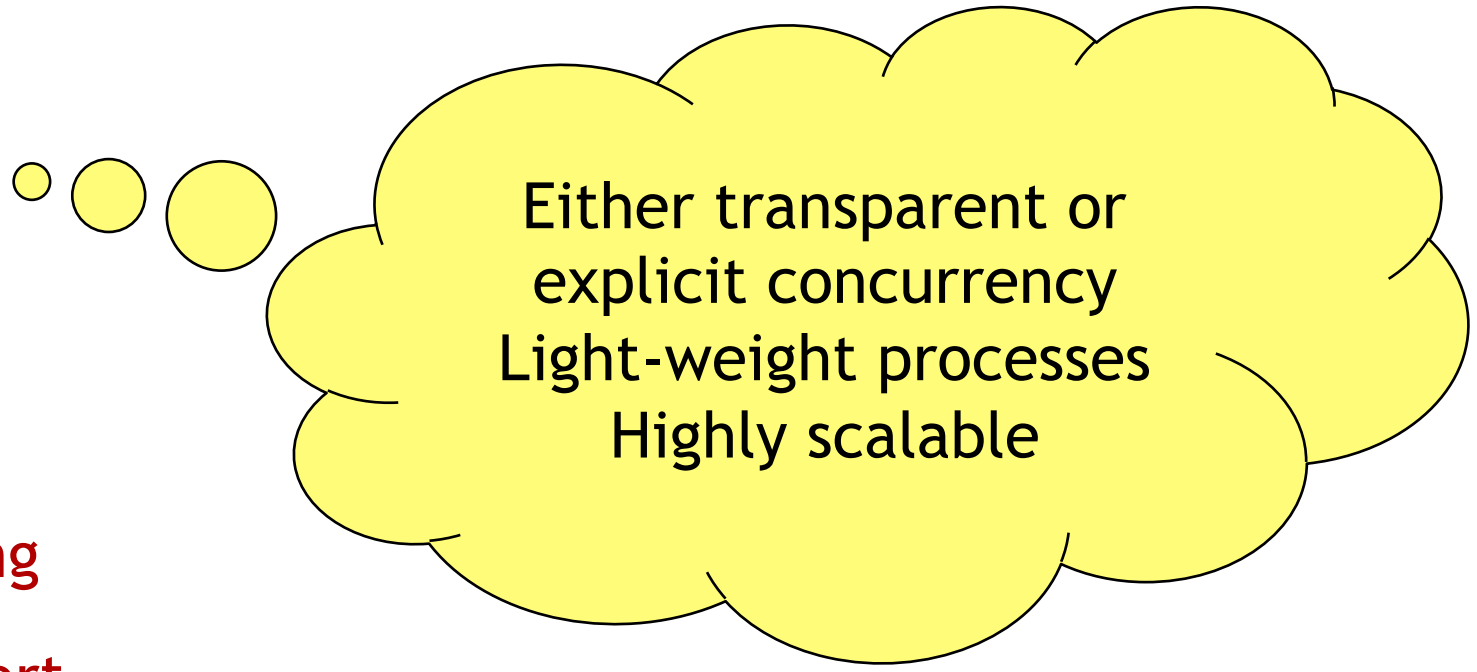
OTP



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Erlang Highlights: Concurrency

Creating a new process using spawn

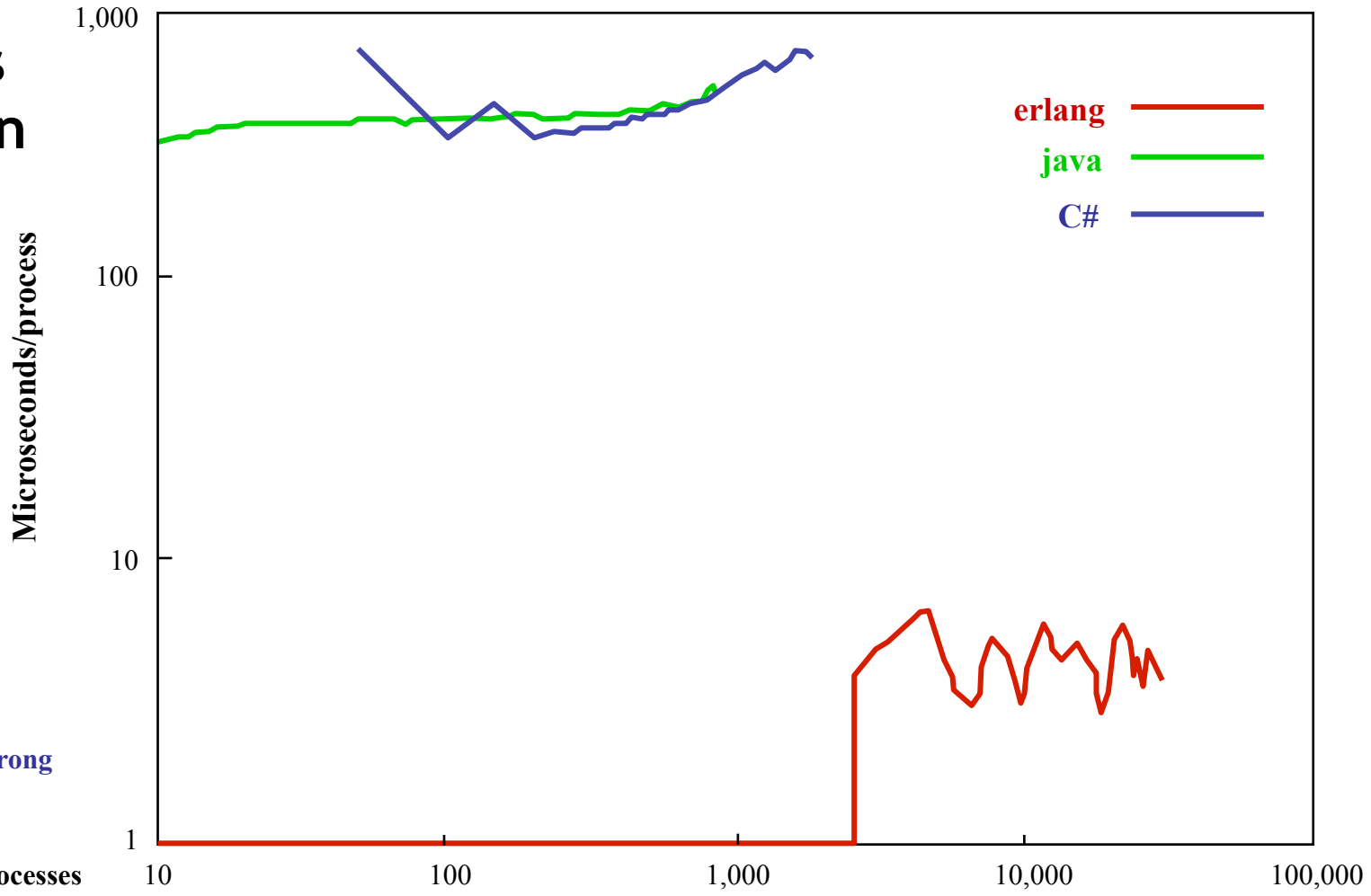
```
-module(ex3).
-export([activity/3]).

activity(Name,Pos,Size) ->
    ..........
```


```
Pid = spawn(ex3,activity,[Joe,75,1024])
```

Erlang Highlights: Concurrency

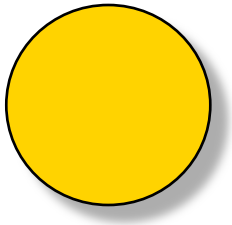
Process creation time

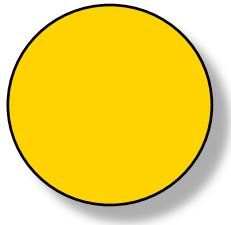


Source:
Joe Armstrong
SICS

Erlang Highlights: Concurrency

Processes communicate by asynchronous message passing





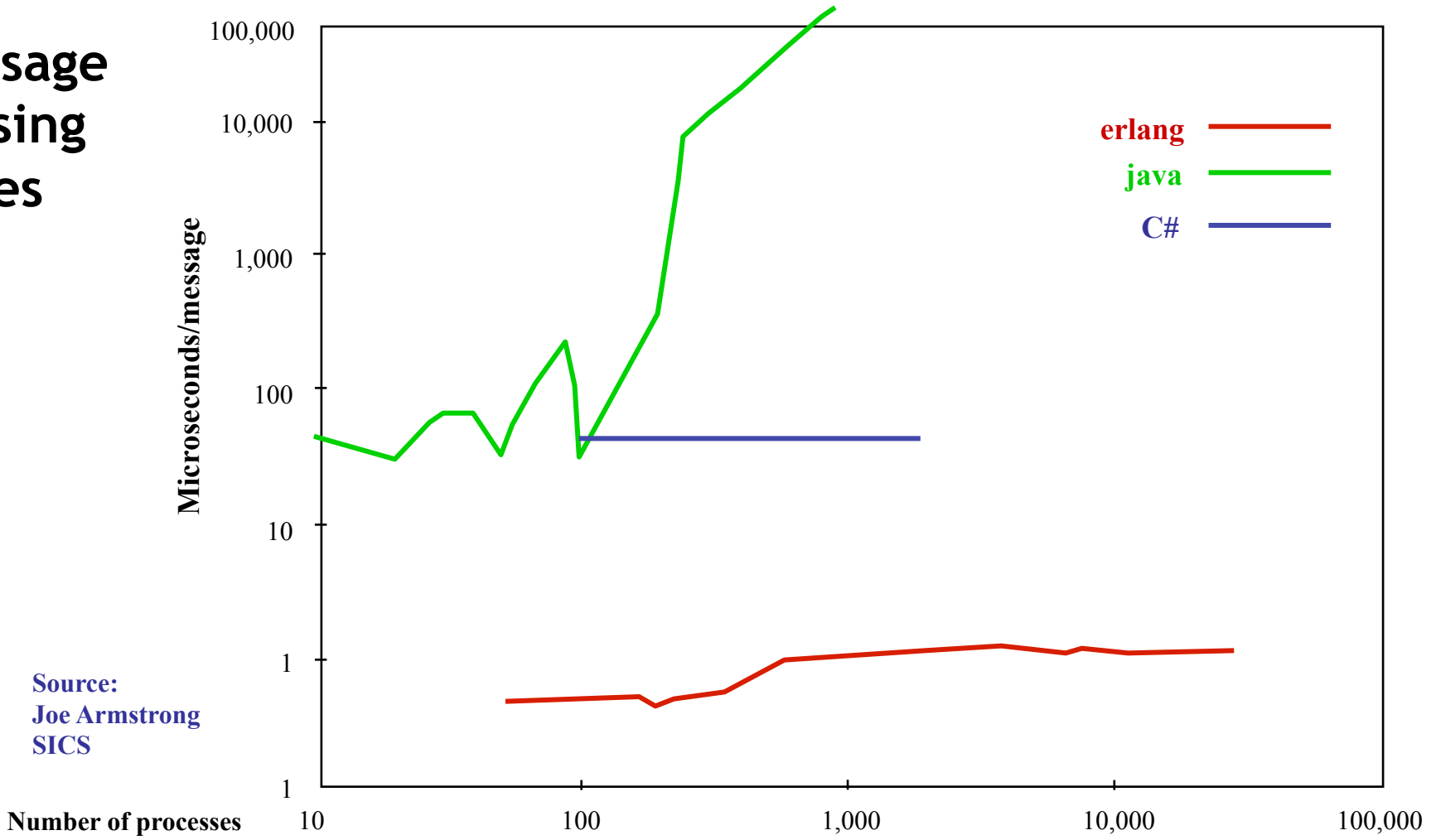
```
Pid ! {data,12,13}
```

```
receive
     {start} -> ……
     {stop} -> ……
     {data,X,Y} -> ……
end
```


Erlang

Erlang Highlights: Concurrency

Message passing times



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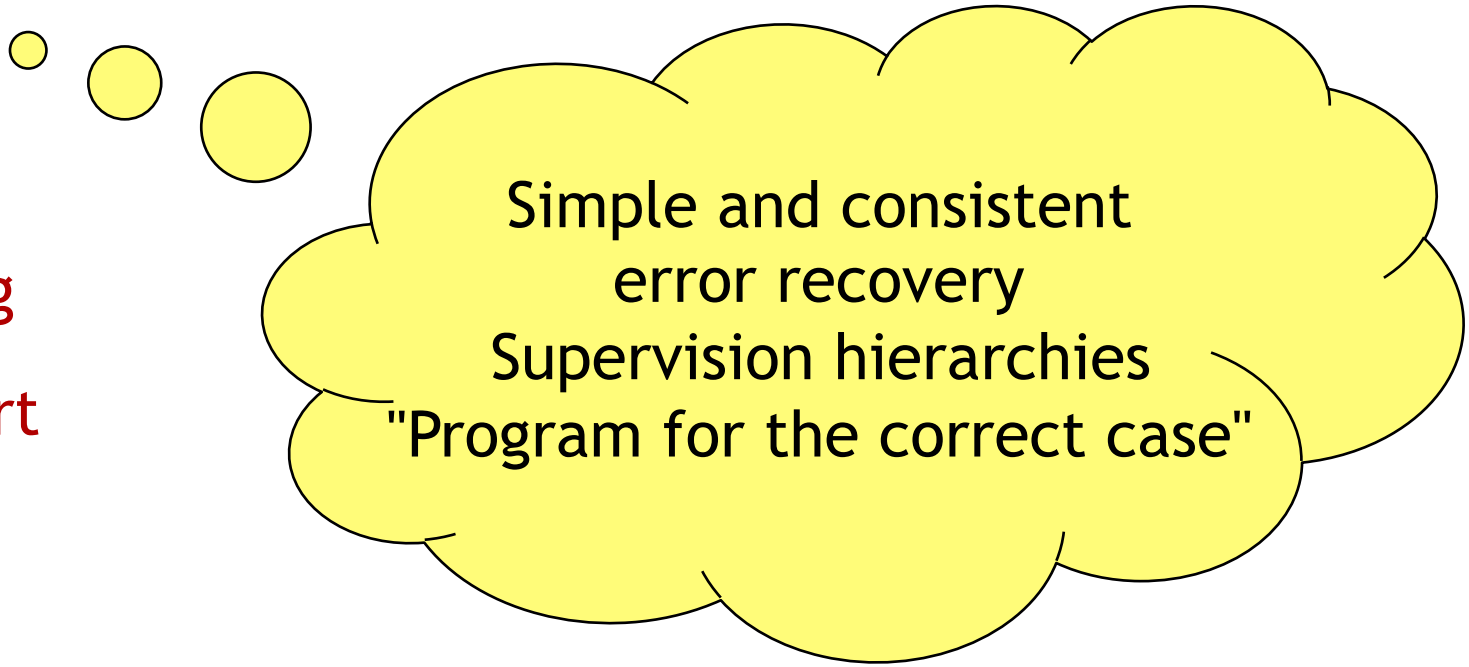

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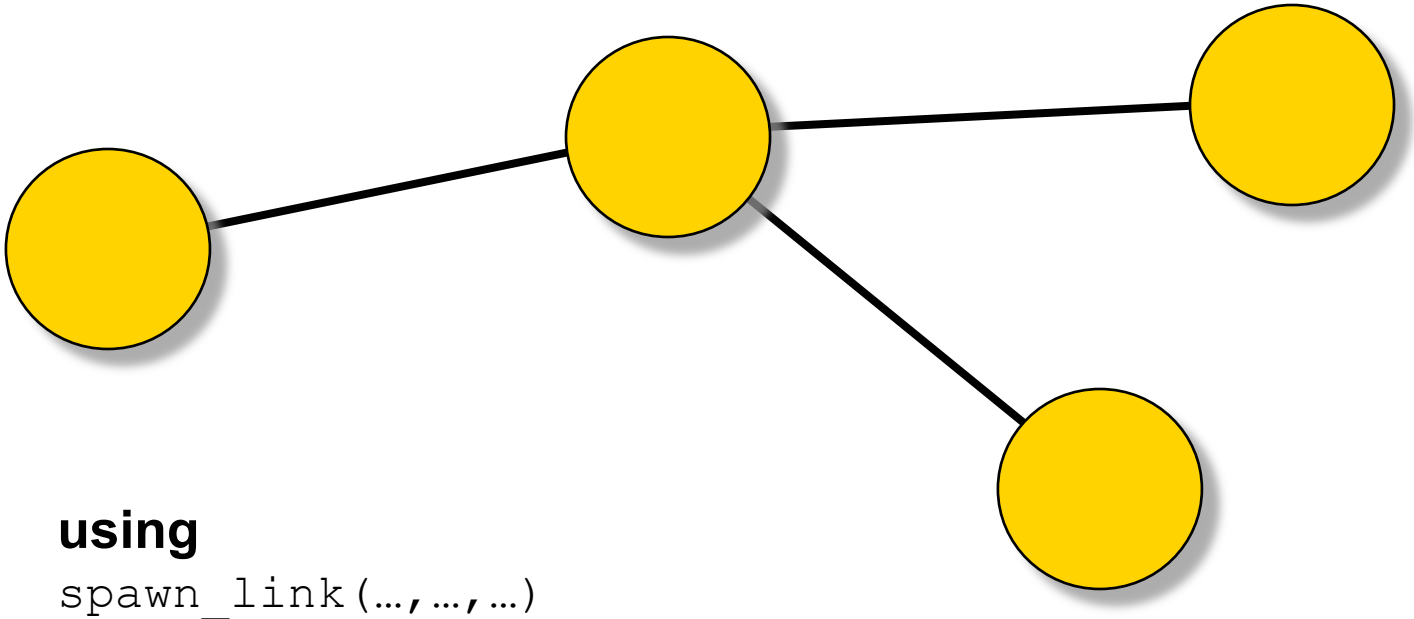
Erlang Highlights: Robustness

Cooperating processes may be linked together



using

```
spawn_link(…,…,…)
```

or

```
link(Pid)
```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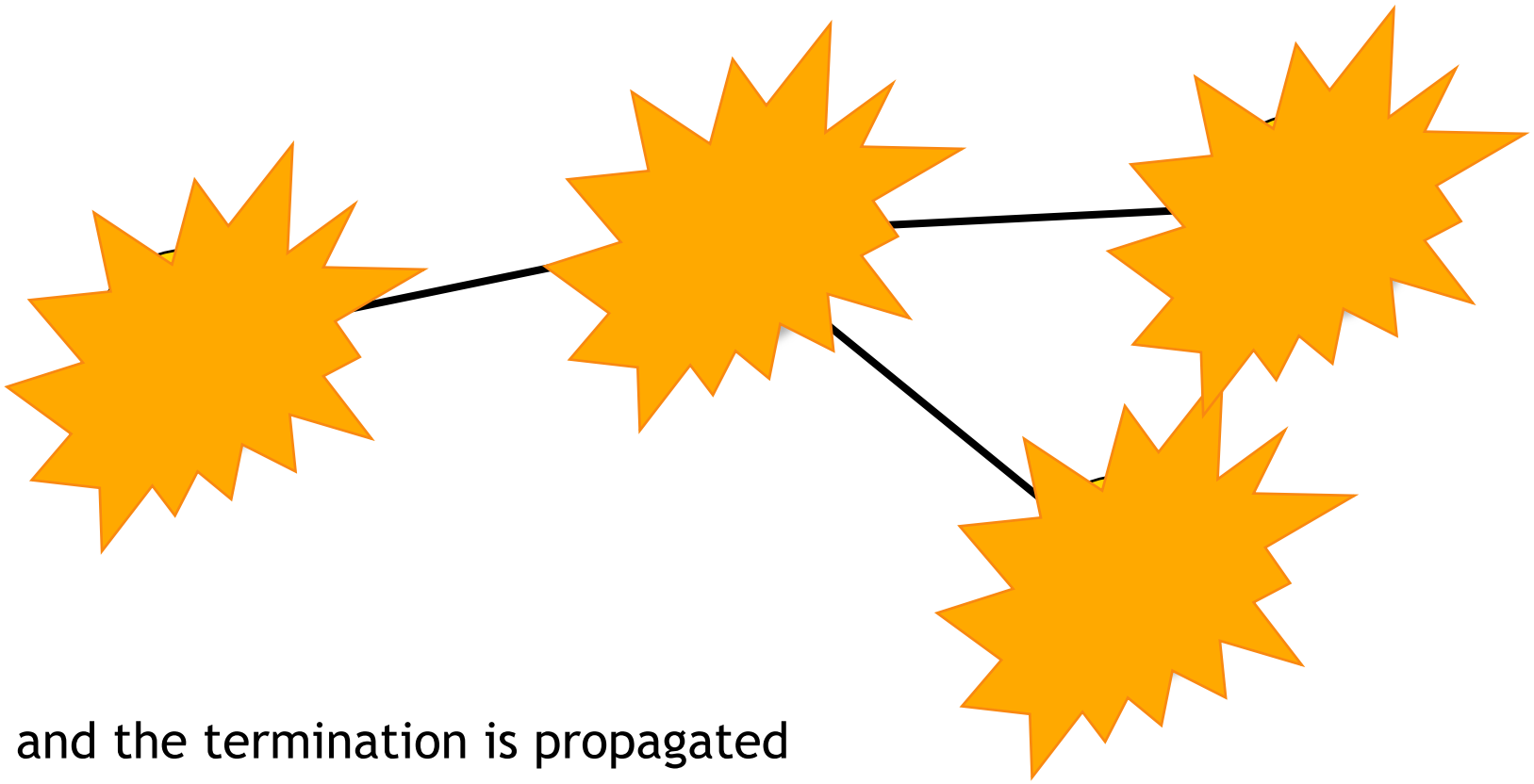
Erlang Highlights: Robustness

When a process terminates, an exit signal is sent to all linked processes



… and the termination is propagated

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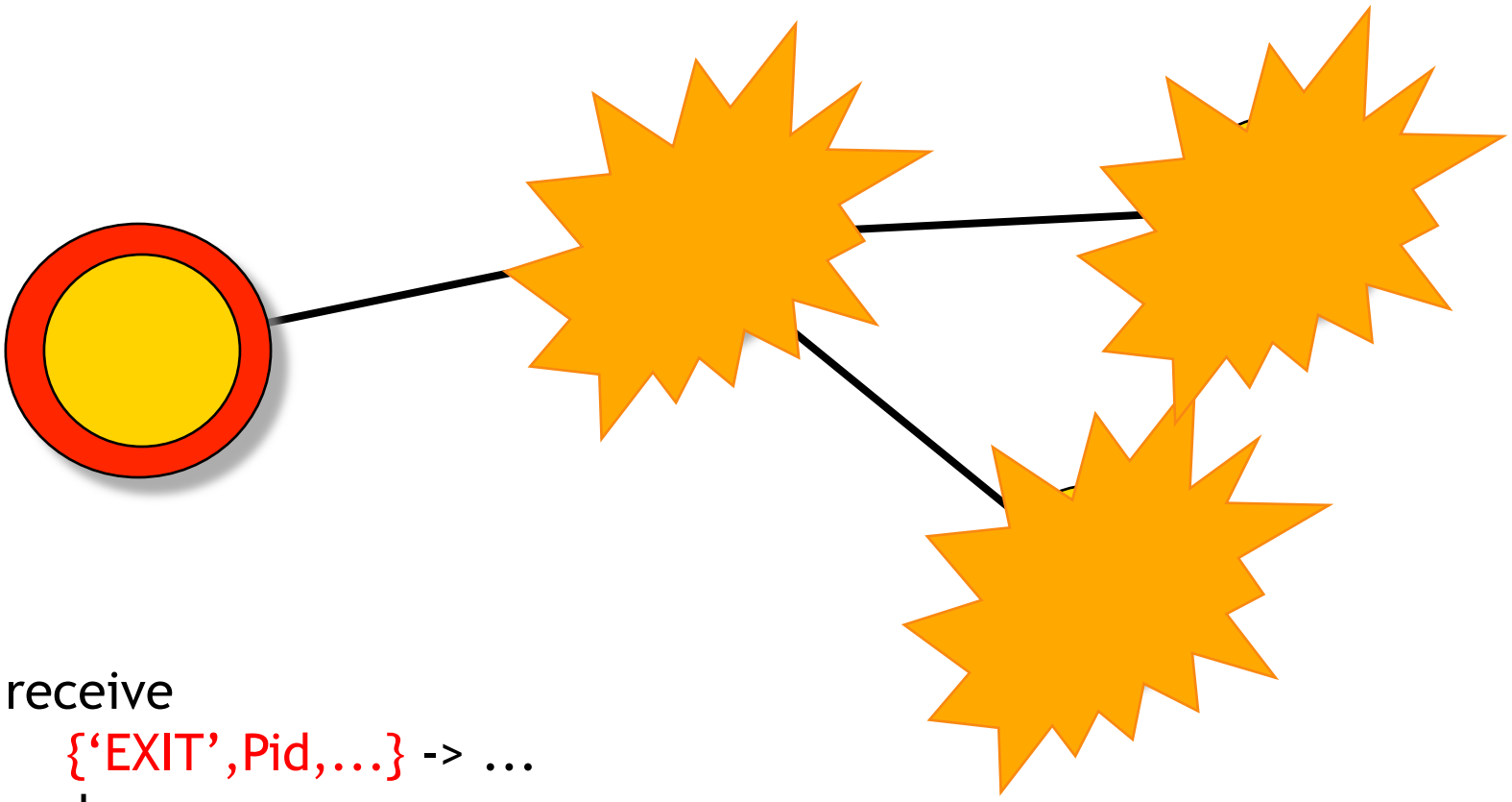
Erlang Highlights: Robustness

Exit signals can be trapped and received as messages



```
receive
   {‘EXIT’,Pid,...} -> ...
end
```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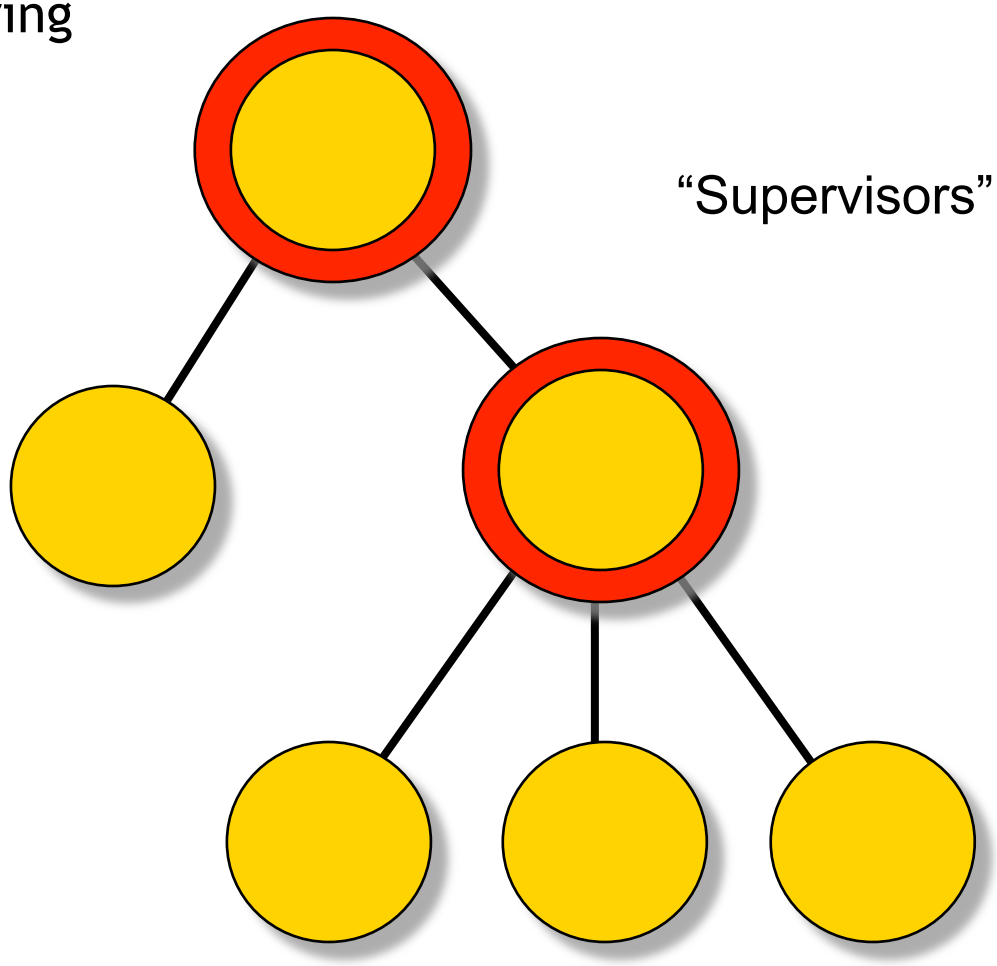
Erlang Highlights: Robustness

Robust systems can be built by layering



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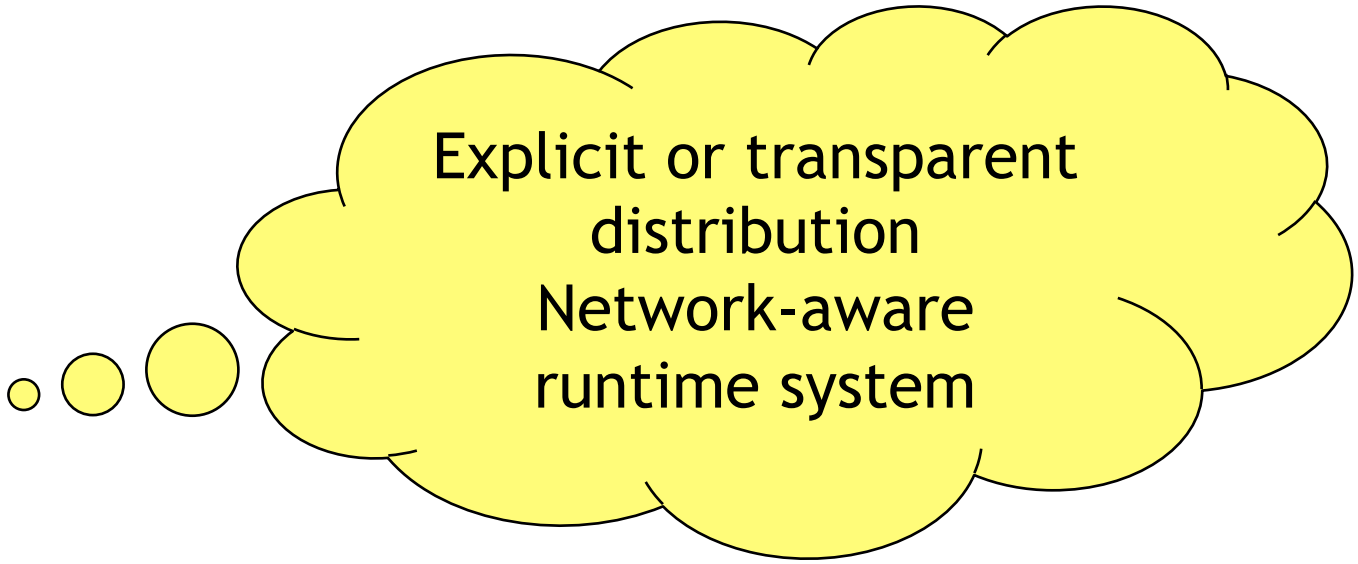

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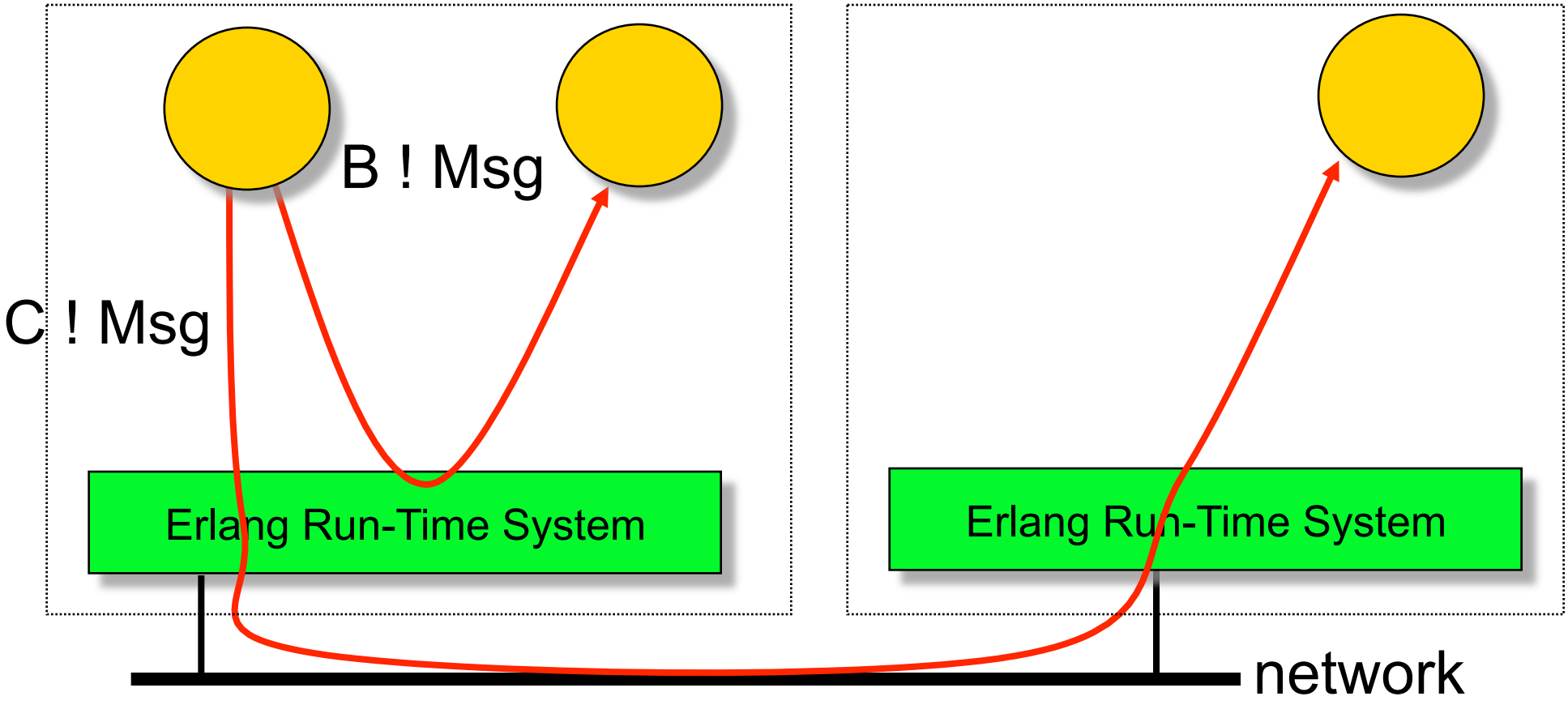
Erlang Highlights: Distribution



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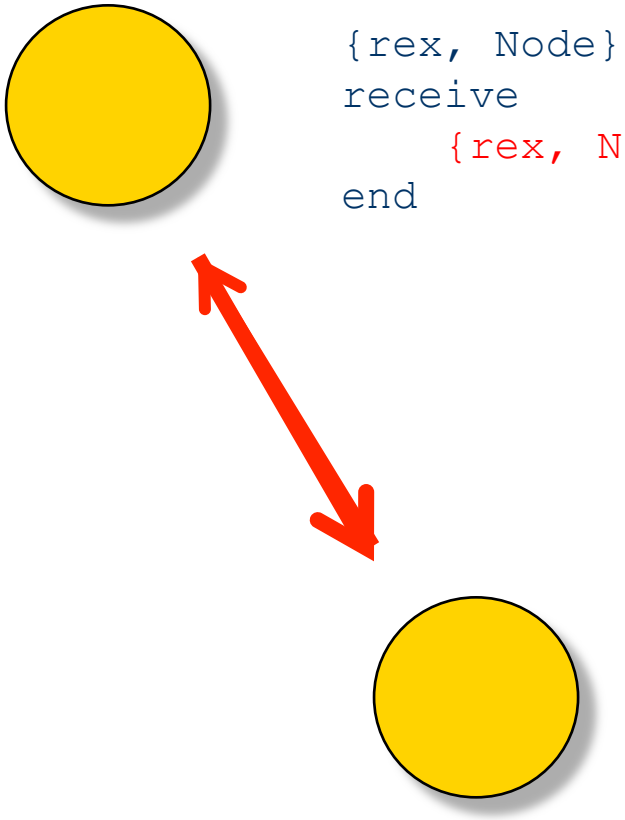
Erlang Highlights: Distribution

Simple Remote Procedure Call



```
{rex, Node} ! {self(), {apply, M, F, A}},
receive
    {rex, Node, What} -> What
end
```

```
loop() ->
    receive
        {From, {apply, M, F, A}} ->
            Answer = apply(M, F, A),
            From ! {rex, node(), Answer}
            loop();
        _Other -> loop()
    end.
```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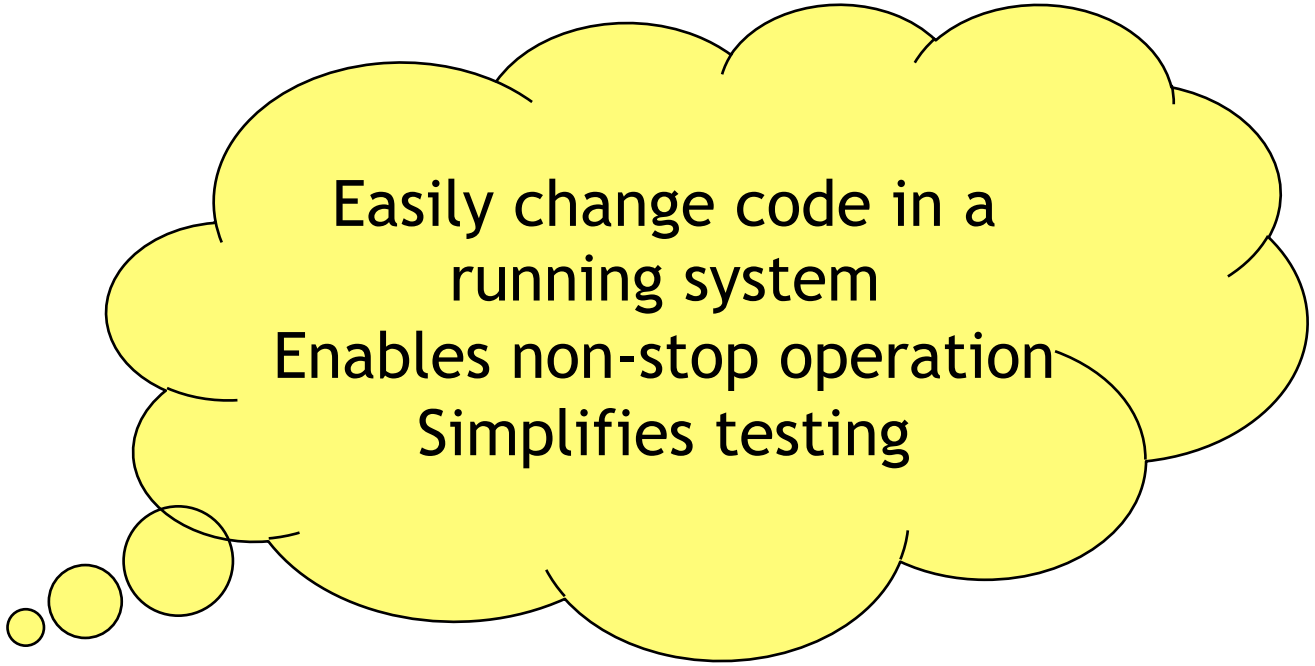

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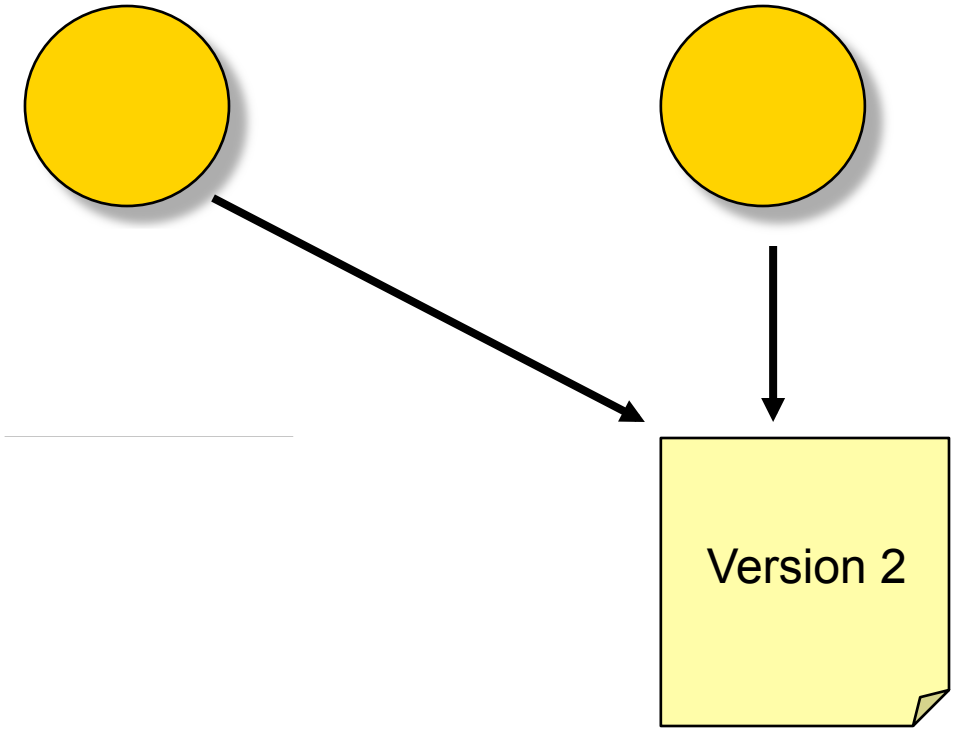
Erlang Highlights: Hot Code Swap



Erlang

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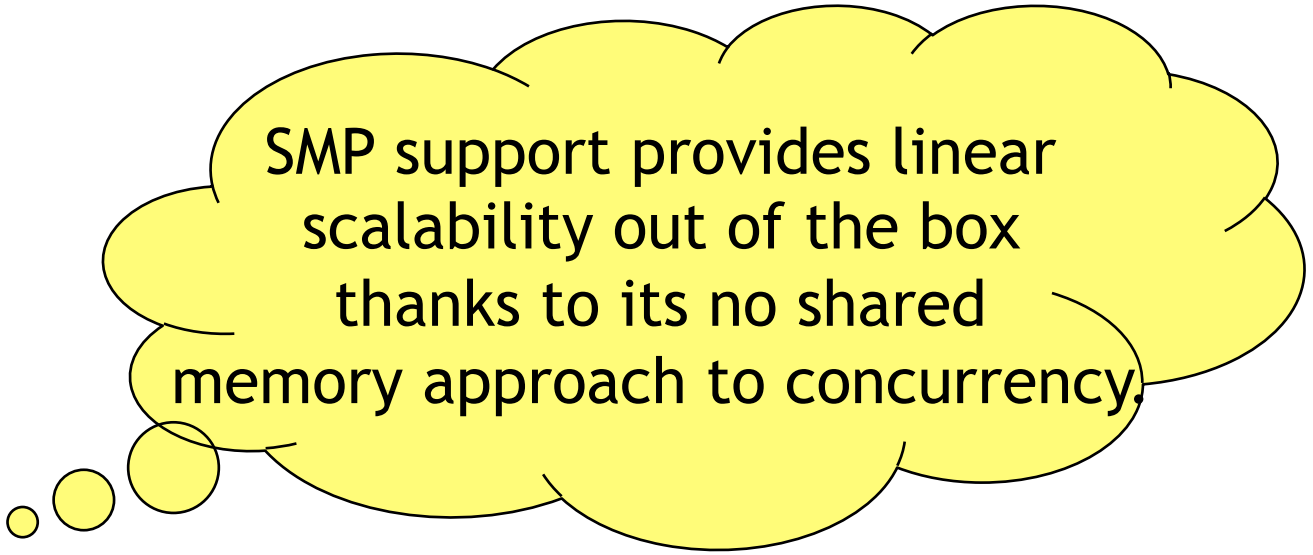


Erlang

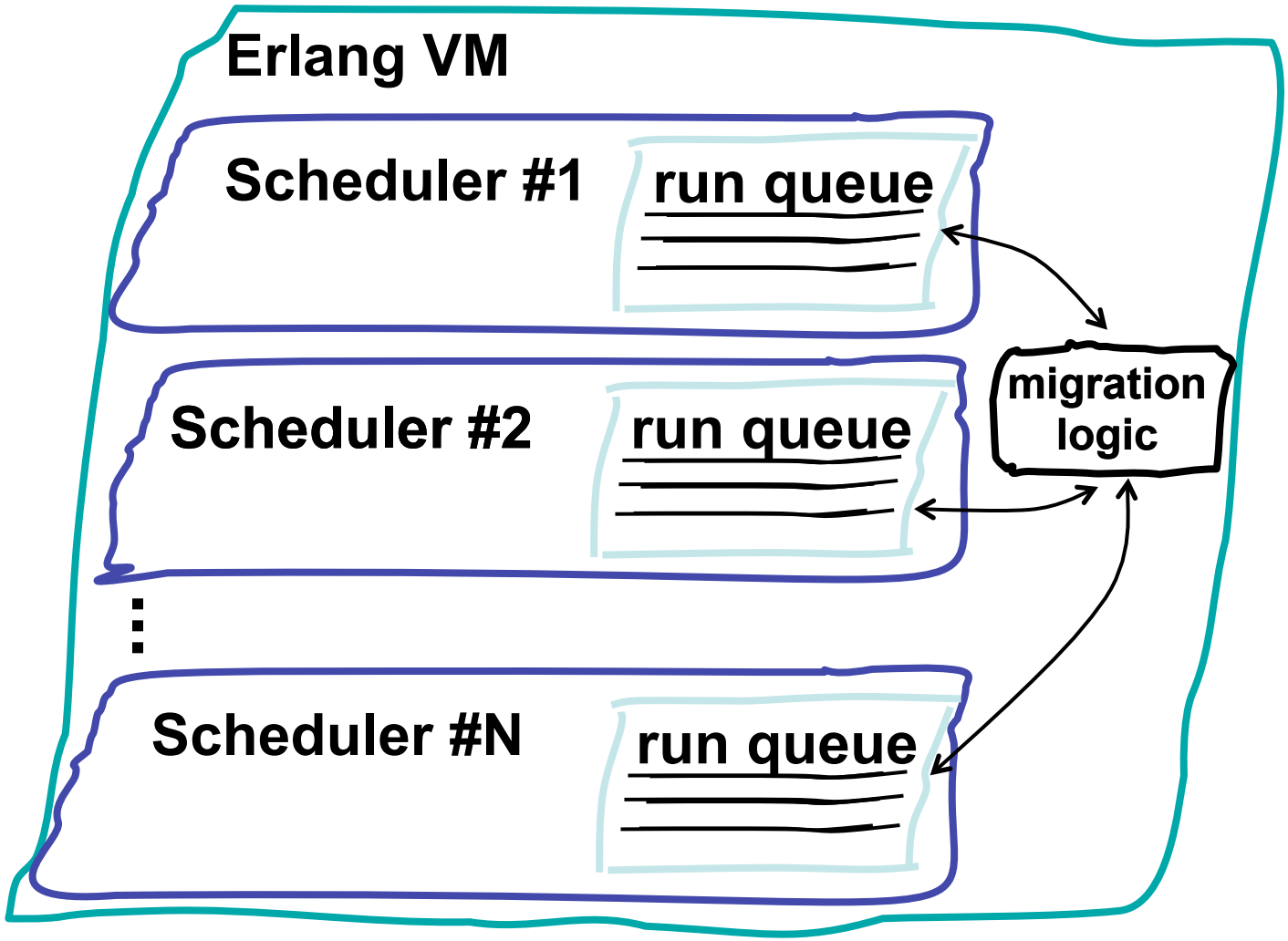
Ericsson's strategy with SMP

Hide the problems and awareness of SMP from the programmer

Programmed in the normal style using processes for encapsulation and parallelisation

Erlang

Multicore Erlang



Telephony Gateway Controller

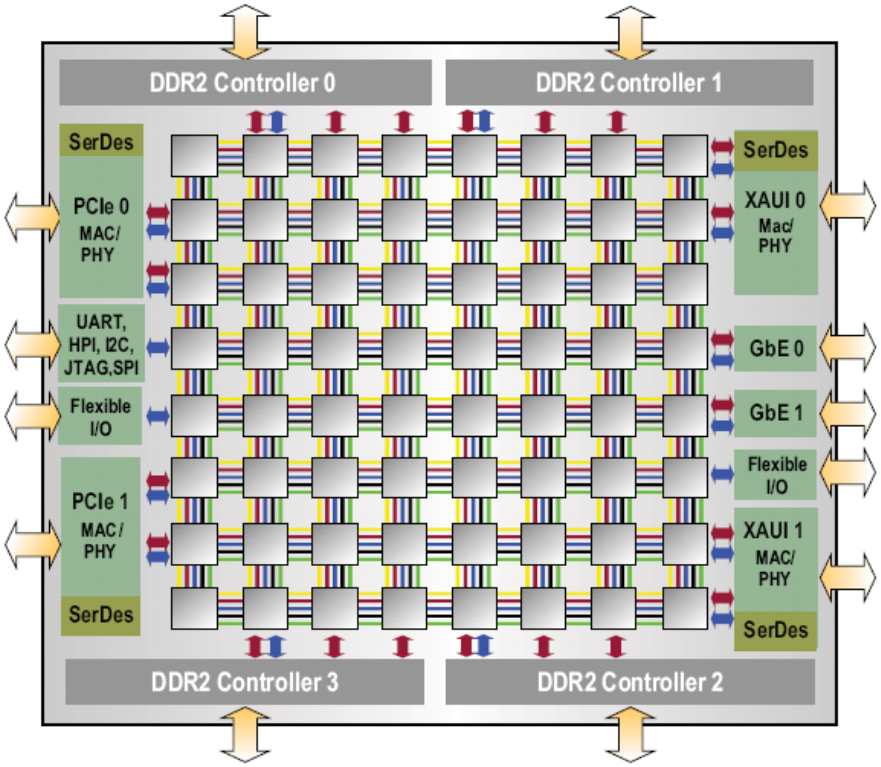
Traffic scenario	IS/GCP 1slot/board	IS/GEP Dual core One core running 2slots/board	IS/GEP Dual core Two cores running 2slots/board	AXD CPB5	AXD CPB6
POTS-POTS / AGW	X call/sec	2.3X call/sec One core used	4.3X call/sec OTP R11_3 beta +patches	0.4X call/sec	2.1X call/sec
ISUP-ISUP /Inter MGW	3.6X call/sec	7.7X call/sec One core used	13X call/sec OTP R11_3 beta +patches	.55X call/sec	7.6X call/sec
ISUP-ISUP /Intra MGW	5.5X call/sec		26X call/sec	3.17X call/sec	14X call/sec

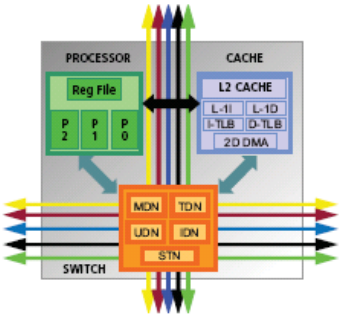
Tilera “Tile64”

Chatty

500 processes created

Each process randomly sends messages and receives a response from all other processes





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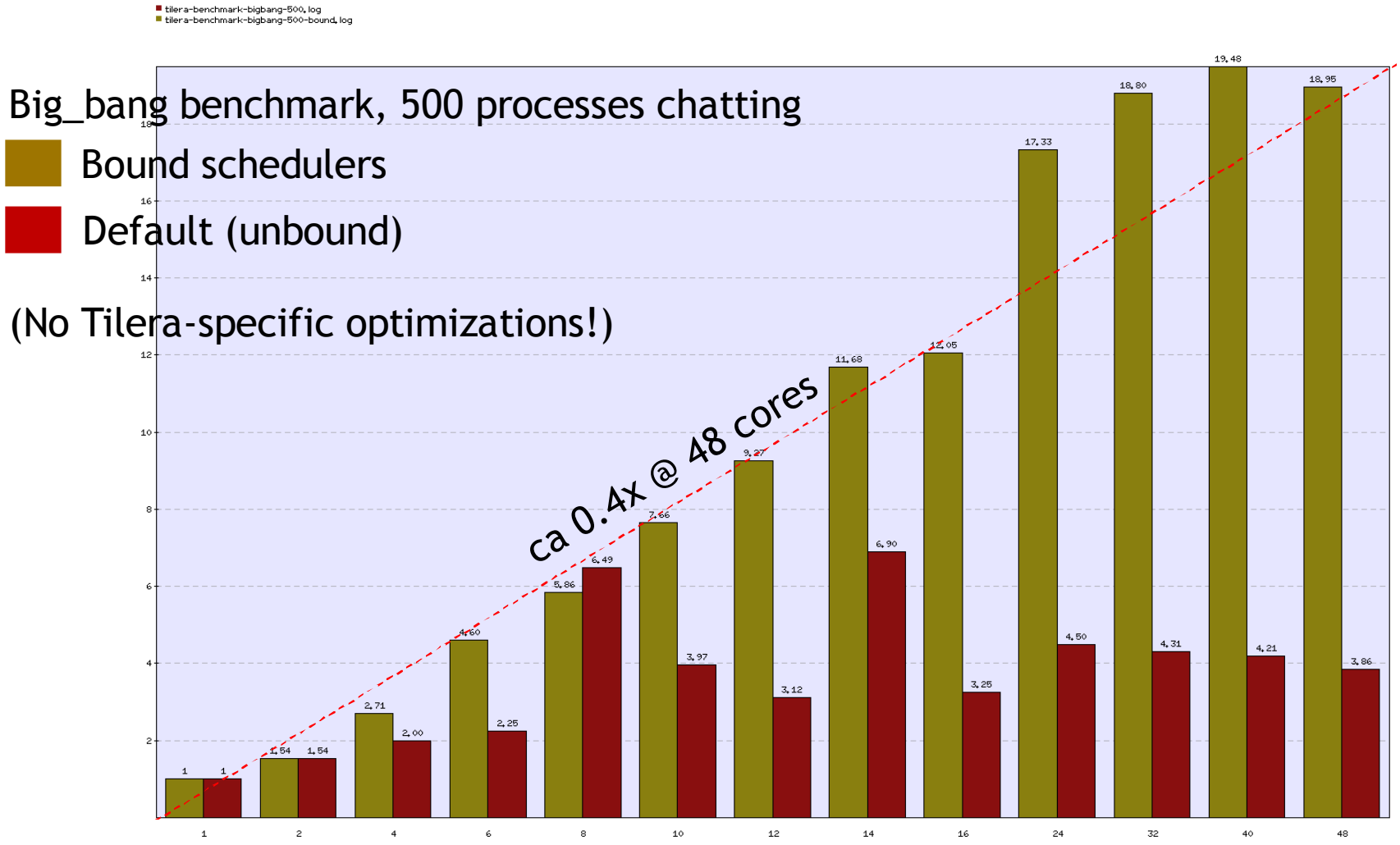
Multicore Benchmark – Big Bang



Erlang/OTP R13B on Tilera Pro 64-core

Erlang Highlights

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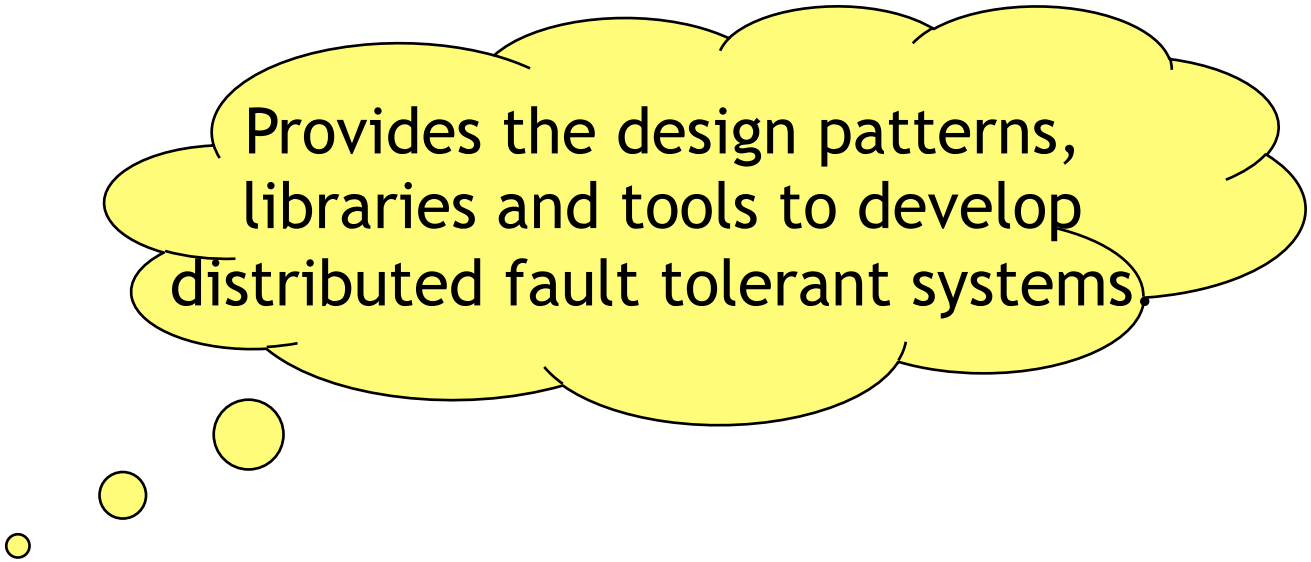

Erlang

OTP Middleware

Applications &
Libraries

System Design
Principles

Erlang

T

O

P

Erlang

OTP: System Design Principles

A set of abstract principles and design rules.

- They describe the software architecture of an Erlang System
- Needed so existing tools will be compatible with them
- Facilitate understanding of the system among teams

A set of generic behaviours.

- Each behaviour is a formalisation of a design pattern
- Contains frameworks with generic code
- Solve a common problem
- Have built in support for debugging and software upgrade
- Facilitate understanding of the sub blocks in the system

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Erlang Highlights

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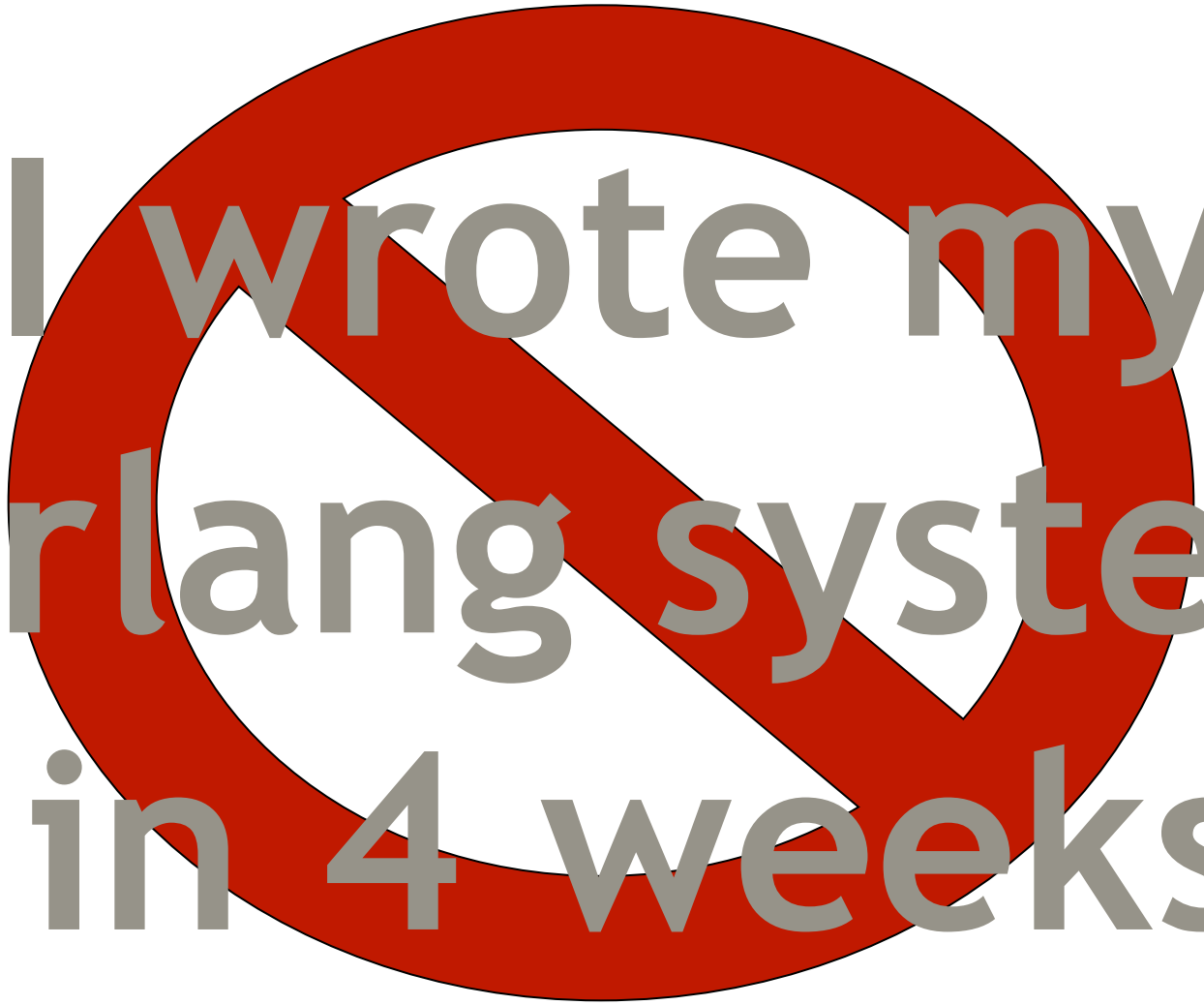

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The Myths of Erlang….

Is it Documented?

Is the developer supporting it?

What visibility does support staff have into what is going on?

- SNMP
- Live Tracing
- Audit Trails
- Statistics
- CLI / HTTP Interface

How much new code was actually written?

Erlang

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The Myths of Erlang….

Yes, it is easy for

- Simple patches
- Adding functionality without changing the state

Non backwards compatible changes need time time

- Database schema changes
- State changes in your processes
- Upgrades in distributed environments

Test, Test, Test

- A great feature when you have the manpower!

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The Myths of Erlang….

"As a matter of fact, the network performance has been so reliable that **there is almost a risk that our field engineers do not learn maintenance skills**"

Bert Nilsson, Director NGS-Programs Ericsson

Ericsson Contact, Issue 19 2002

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The Myths of Erlang….

99,999 (Five Nines) is a more like it!

- Achieved at a fraction of the effort of Java & C++

Upgrades are risky!

Non Software related issues

- Power Outages
- Network Failures, Firewall Configurations
- Hardware Faults

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Who is using Erlang?

Erlang: It's Happening!

CouchDB
Distributed Robust document database

Riak
Distributed, partition tolerant and scalable database

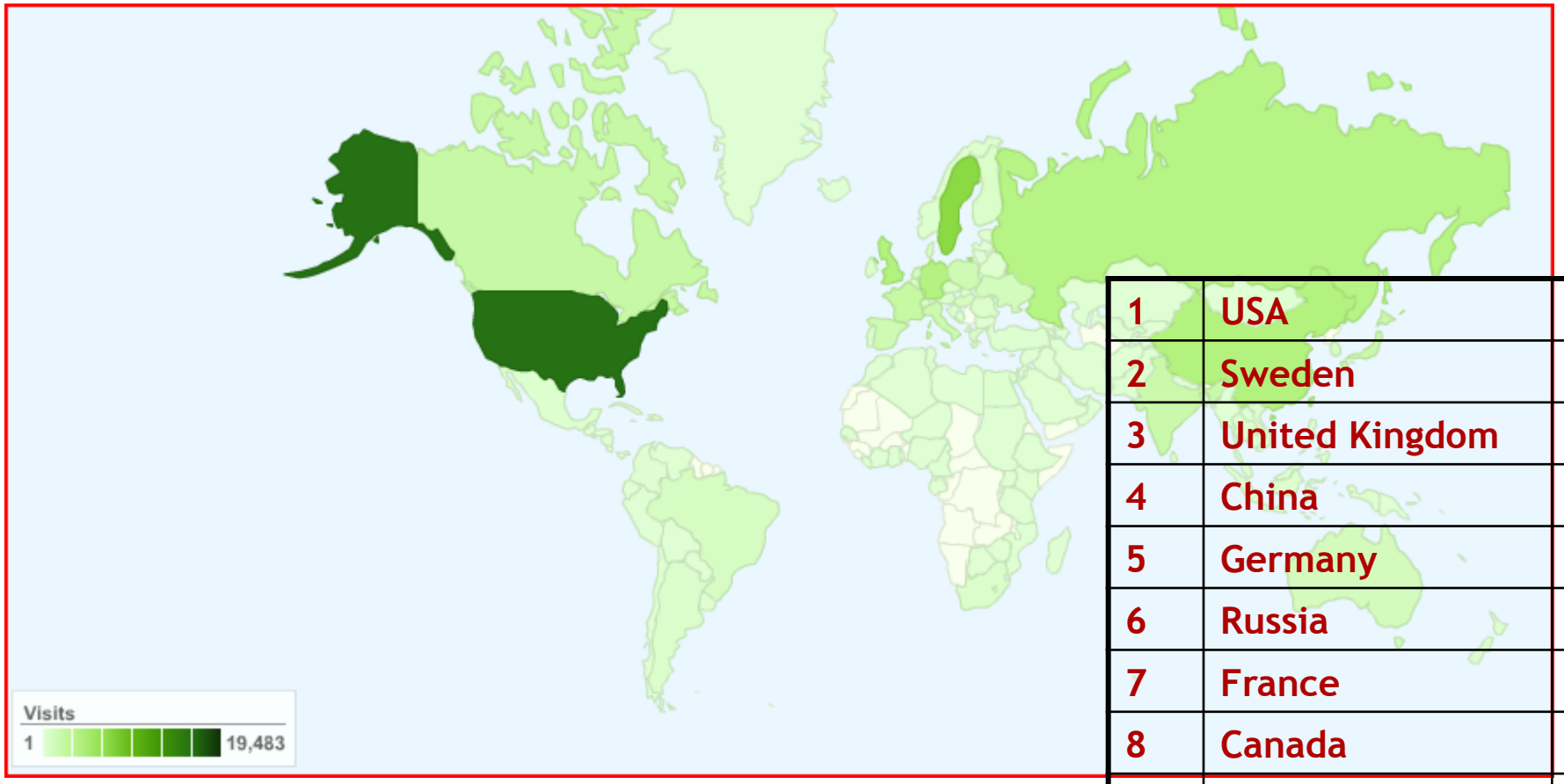
YAWS
Yet Another Web Server

RabbitMQ
High performance enterprise messaging

Ejabberd
XMPP instant messaging server

Erlang

erlang.org site usage (Unique visits, 30 days)



1	USA	19,483
2	Sweden	8,465
3	United Kingdom	4,984
4	China	4,897
5	Germany	4,745
6	Russia	4,465
7	France	2,722
8	Canada	2,647
9	India	2,299
10	Japan	2,261

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Books

Erlang

More Information

Programming Erlang

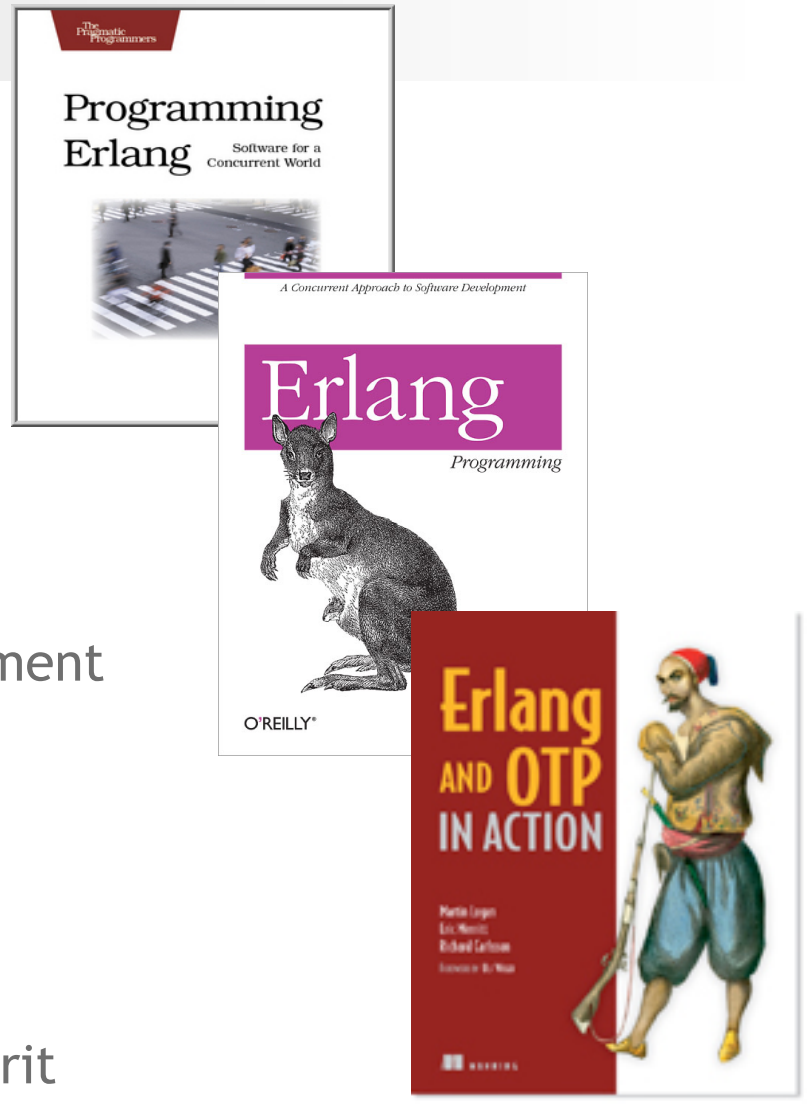
- Software for a Concurrent World
- by Joe Armstrong

Erlang Programming

- A Concurrent Approach to Software Development
- by Francesco Cesarini & Simon Thompson

Erlang and OTP in Action

- Large-scale software design with OTP
- by Richard Carlsson, Martin Logan & Eric Merrit



Erlang

2012 Erlang User Conference

Erlang User Conference

Stockholm 2012

Conference: May 28 - 29
Tutorials: May 30
University: May 30 - June 1

ERLANG

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Erlang User Conference 2012

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Organisers

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ERICSSON

Overview

Erlang User Conference 2012

28 May - 01 Jun 2012

35 days left

Dates for Your Diary

The Erlang User Conference is returning again but this year, in the Swedish sunshine. The 2012 Erlang User Conference will take place 28-30 May 2012 with two days of fantastic talks and a day of enlightening tutorials.

Come along and rub shoulders with all 3 of the Erlang Inventors, **Robert Virding**, **Joe Armstrong** and **Mike Williams** as well as other great names.

With a brand new venue last year the conference was the most successful to date. We will be returning once again to the exciting, spacious building of the **Münchenbryggeriet.**

The Erlang User Conference brings together the best minds and names in Erlang programming from language inventors, implementers and maintainers to open-source committers, community leaders and Erlang authors.

Everyone who is anyone will be at the Erlang User Conference 2012!

Register

Offers

Registration now open for the Erlang User Conference 2012

Registration has opened for the Erlang User Conference tobe held in Stockholm at the end of May.

Book early to get the Very Early-Bird price!

Register

News

A-list and sell out! Thats the Erlang Factory SF Bay Area 2012!

This year's Erlang Factory SF Bay Area 2012 had an A-list sell-out line-up of speakers which included Erlang Inventors **Mike Williams** and **Robert Virding** discussing software approaches used in the industry and the unique features of the Erlang VM and a Keynote talk from **Jim Zemlin**, Executive Director of The Linux Foundation.

More News...

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Questions

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Thank You!

@FrancescoC on Twitter or
francesco@erlang-solutions.com

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