Microservices and Erlang/OTP

Christoph Iserlohn

About me

Senior Consultant @ innoQ

MacPorts Team member

Agenda

- Microservices
- Erlang / OTP
- How they fit together

Microservices

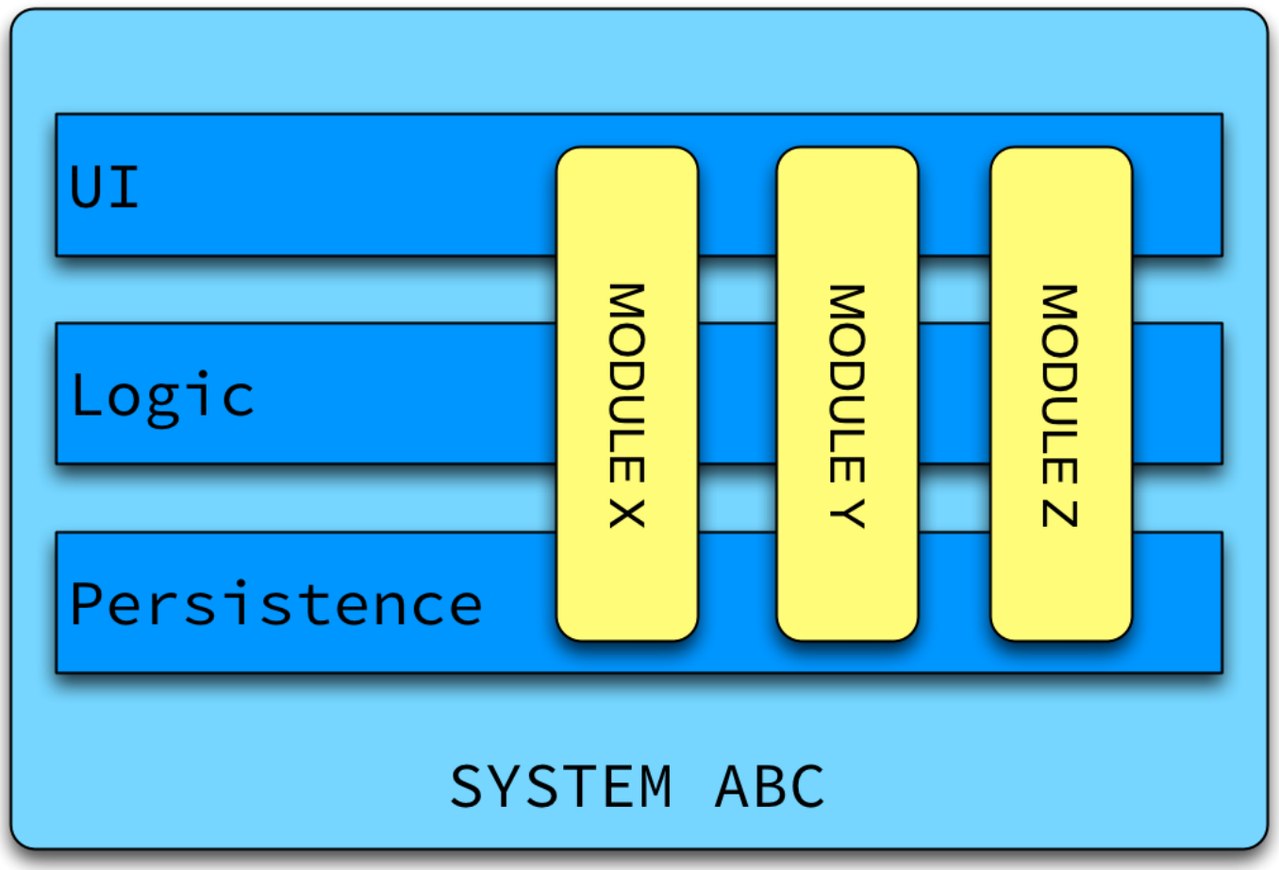
Attempt of definition

- A system consisting of small, self-contained services. All running isolated from each other, communicating only over the network.

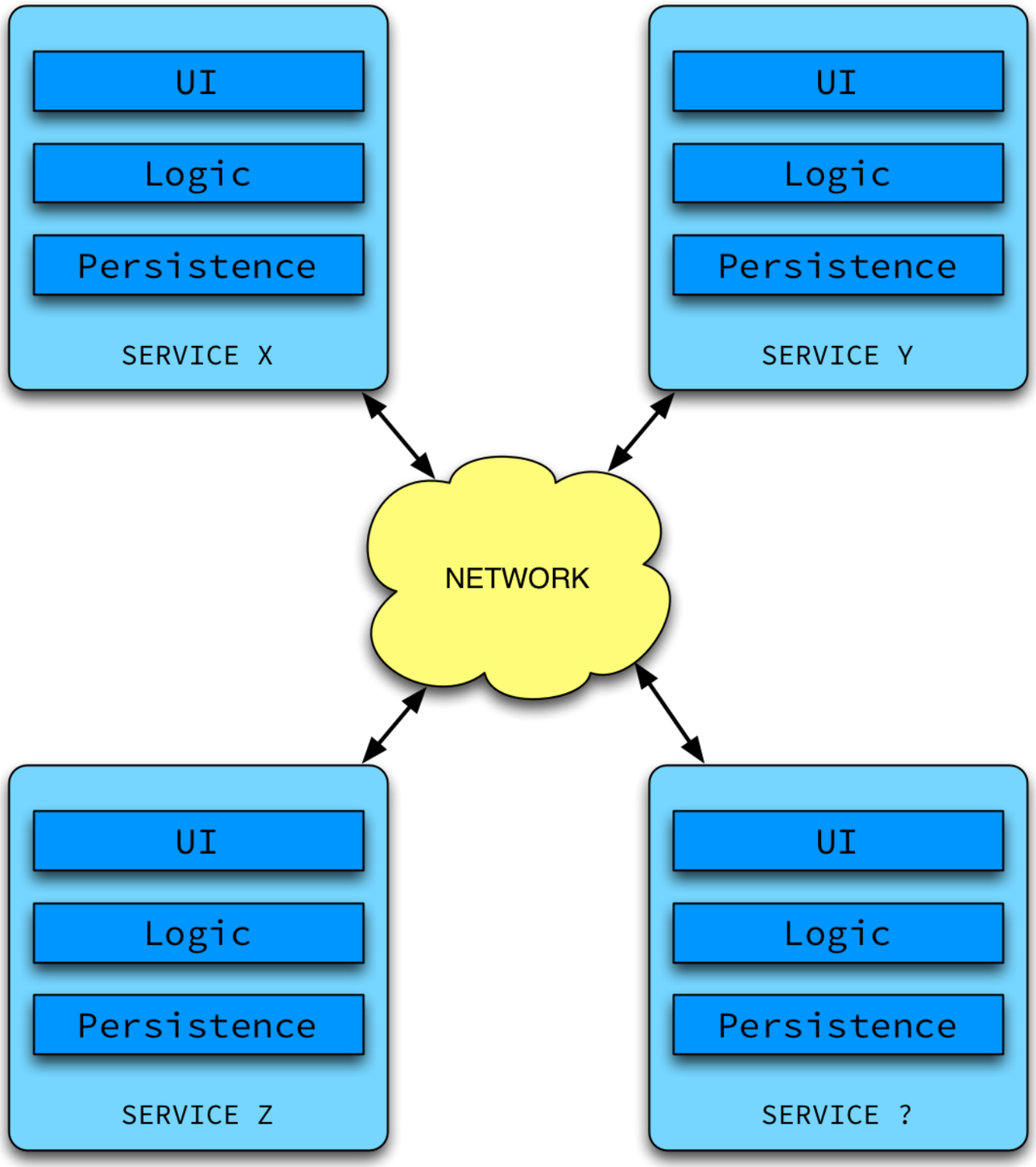
Monoliths

Microservices

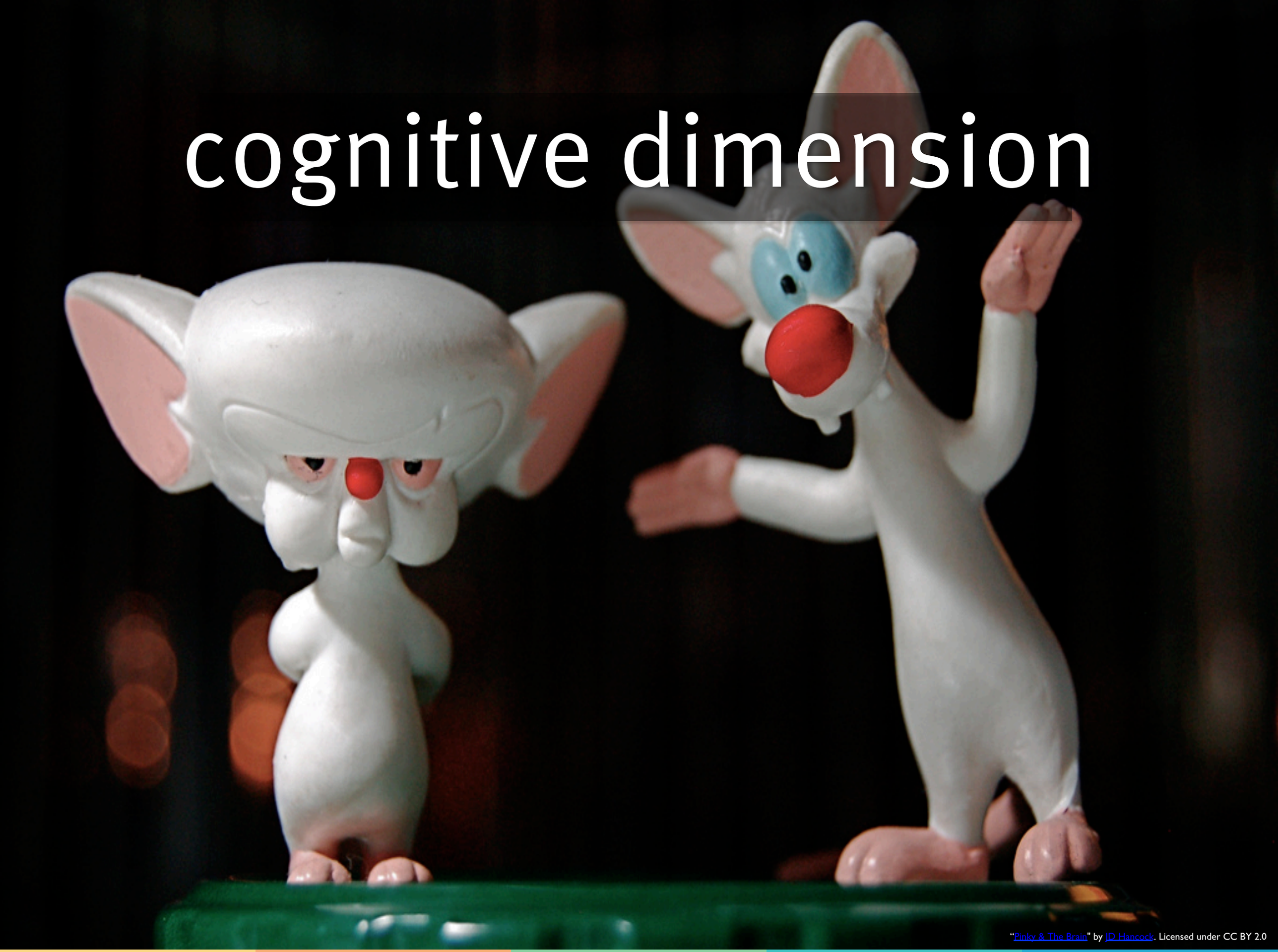
the new hotness


UI
Logic
Persistence
MODULE X
MODULE Y
MODULE Z
SYSTEM ABC

vs.


UI
Logic
Persistence
SERVICE X
UI
Logic
Persistence
SERVICE Y
NETWORK
UI
Logic
Persistence
SERVICE Z
UI
Logic
Persistence
SERVICE ?

cognitive dimension



on the service level:

more comprehensible

on the system level:
unable to see the
big picture

organisational dimension

organized around business capabilities

cross-functional teams

„you build it, you run it“

technological dimension

fault tolerance
resilience

asynchronous communication

coarse-grained interfaces

sophisticated monitoring

"Mission control center" by NASAOriginal uploader was Cjosefy at en.wikipediaLater version(s) were uploaded by TheDJ at en.wikipedia. - http://spaceflight.nasa.gov/gallery/images/shuttle/sts-114/html/jsc2005e09159.htmlTransferred from en.wikipedia. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Mission_control_center.jpg#mediaviewer/File:Mission_control_center.jpg

infrastructure automation

Advantages

- fast development cycle
- it‘s easy to scale
- flexibility of implementation
- easy to get started for new developers
- parts of the system can be replaced

Prerequisites

- monitoring the whole system
- central logging
- tracing across service boundaries
- automatic deployment
- automatic provisioning

Challenges

- service boundaries
- contracts and governance
- testing and refactoring
- fallacies of distributed systems
- support for a dozen technology stacks

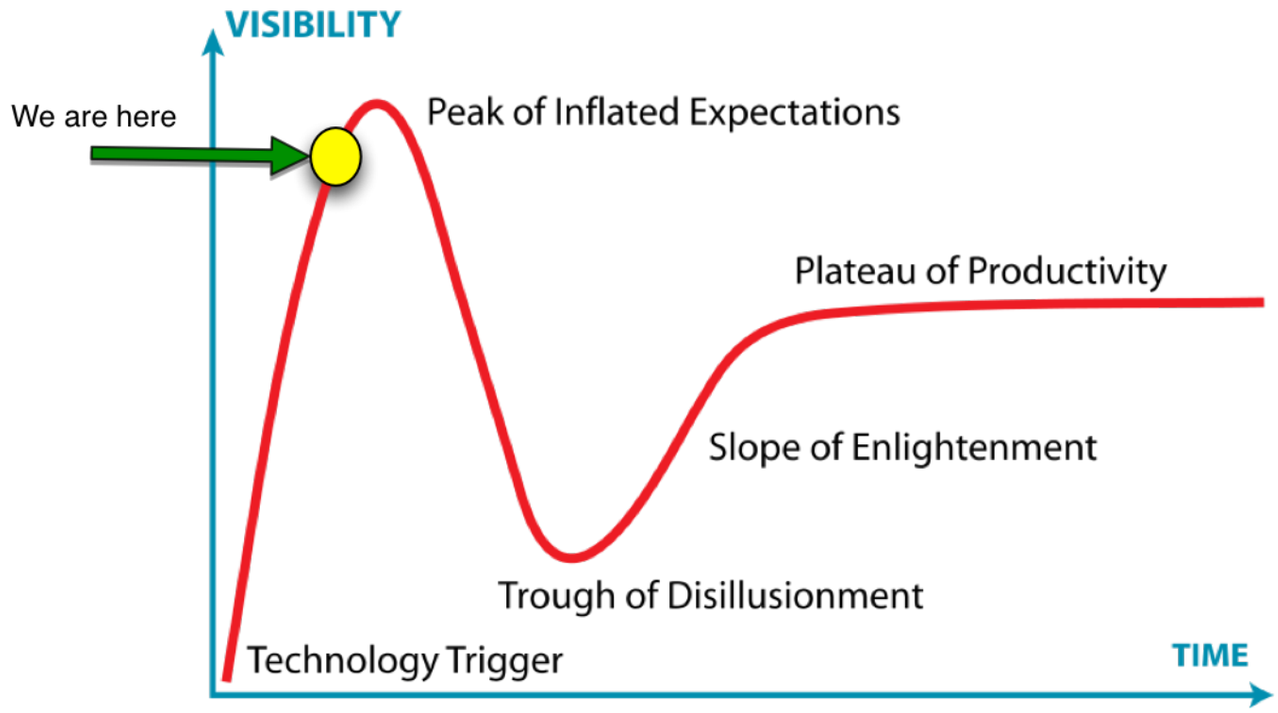
Open questions

- how big?
- isn‘t this just SOA?

Summary

- it‘s a promising approach,
- but don‘t start with it mindlessly

Where are we now?



Erlang / OTP

What is Erlang / OTP?

- a general purpose programming language
- runtime environment and VM
- Open Telecom Platform: libraries, tools and design patterns for building highly concurrent, distributed, fault tolerant systems


PROBLEM
PROBLEM SOLVING

:(

Your PC ran into a problem and needs to restart. We're just collecting some error info, and then we'll restart for you. (0% complete)

If you'd like to know more, you can search online later for this error: HAL_INITIALIZATION_FAILED

fault tolerant to software and hardware errors

distributed systems

non-stop running - continous operation over years

Principles

- lightweight concurrency
- asynchronous communication
- isolation
- error handling
- simple high-level language
- tools not solutions or products

Erlang – the language

- high-level functional language
- prolog inspired syntax
- dynamically typed / safe
- pattern matching everywhere
- recursion
- immutable data and variables

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

factorial(N) when N >= 0 -> factorial(N,1).

factorial(0,Acc) -> Acc;
factorial(N,Acc) -> factorial(N-1,N*Acc).
```

Concurrency

- millions of processes on one machine
- processes are isolated
- processes are used for everything:
  - concurrency
  - managing state
  - parallelism
- no global data

Message passing

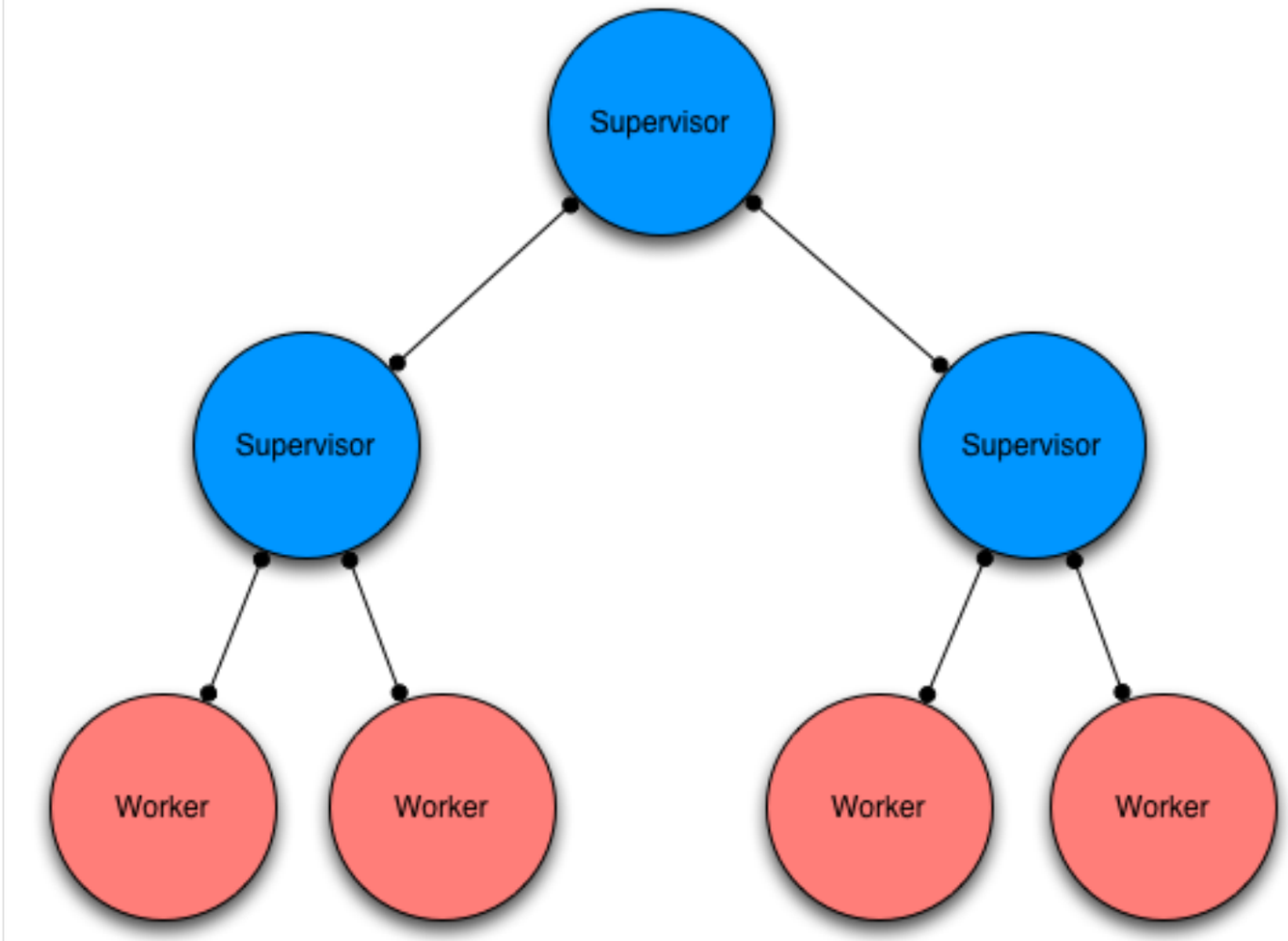
- asynchronous
- primitives:
  - fire & forget send
  - selective receive
- more complex interactions can be built on top of these primitives

```erlang
-module(pingpong).
-export([start/1]).

start(N) when N > 0 ->
    Pong = spawn(fun pong/0),
    ping(N, Pong).

ping(0,Pong) ->
    Pong ! exit,
    ok;
ping(N, Pong) ->
    Pong ! {self(), ping},
    receive
        pong ->
            io:format("Pid ~p: got pong. ~p pings left~n", [self(), N-1])
    end,
    ping(N - 1, Pong).

pong() ->
    receive
        {From, ping} ->
            io:format("Pid ~p: got ping from ~p~n", [self(), From]),
            From ! pong,
            pong();
        exit ->
            ok
    end.
```

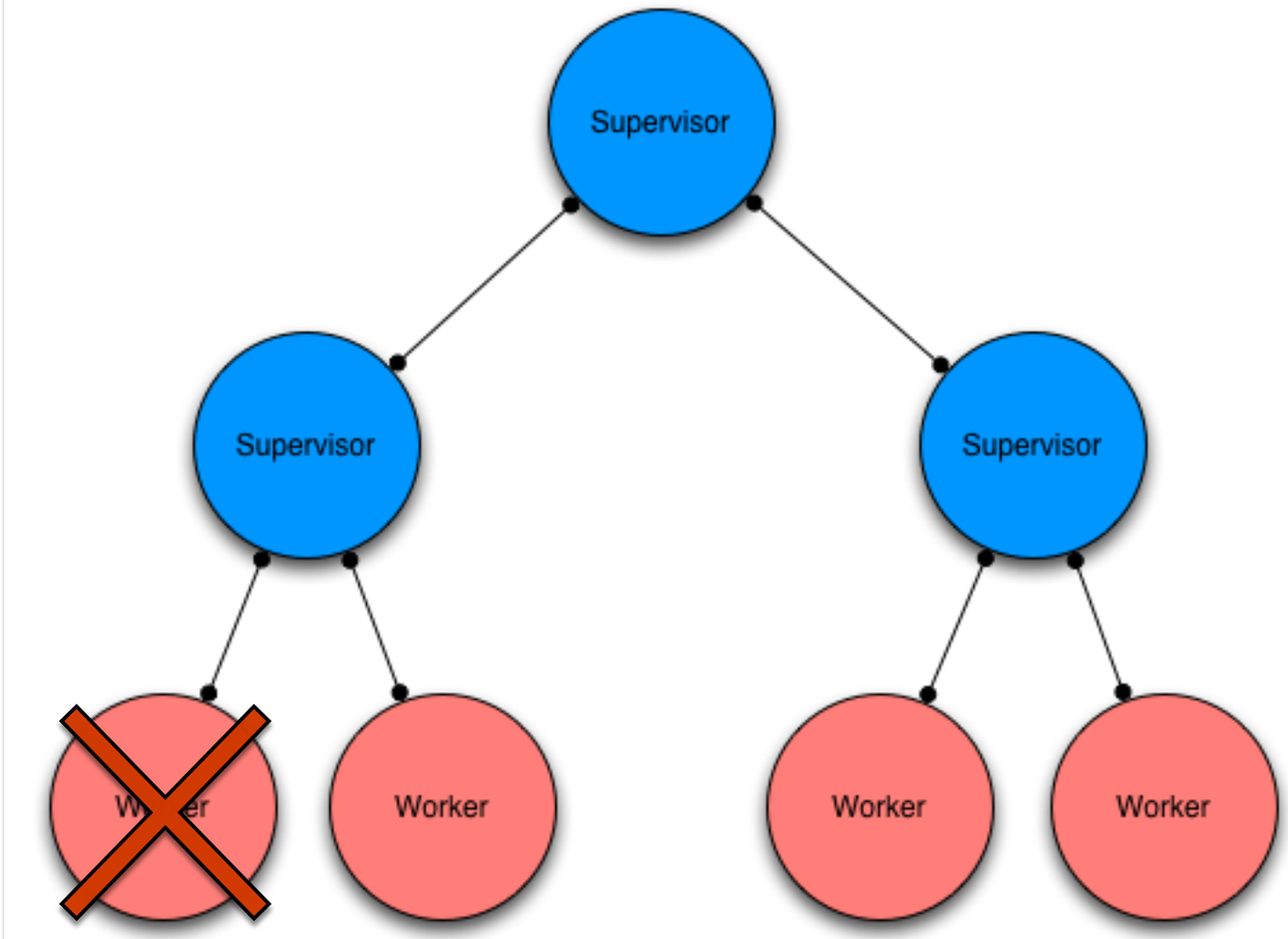
Error handling

- avoid error checking code everywhere
- let it crash
- process based:
  - link - bidirectional
  - monitor - unidirectional
- supervision trees

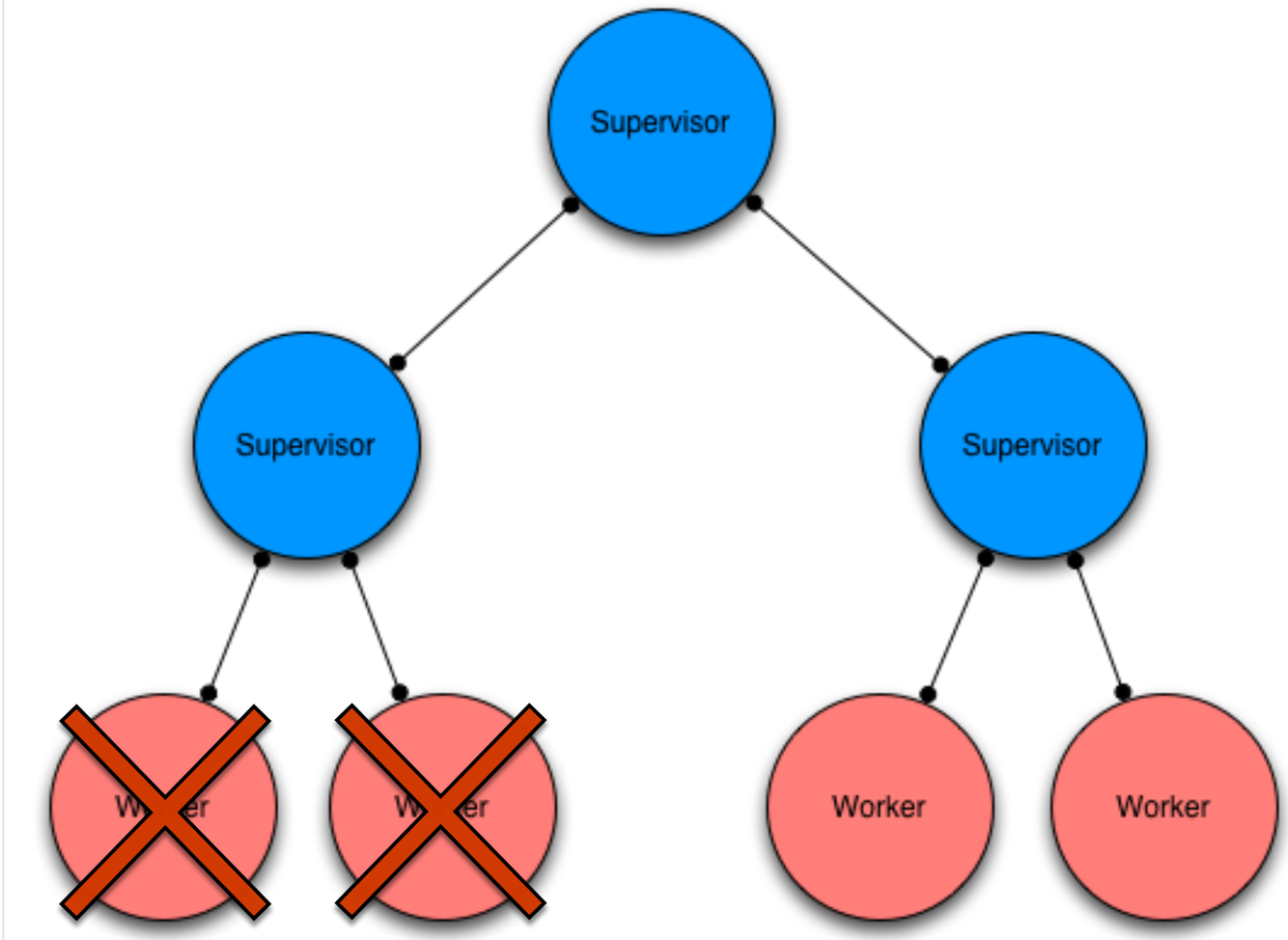
Supervision trees



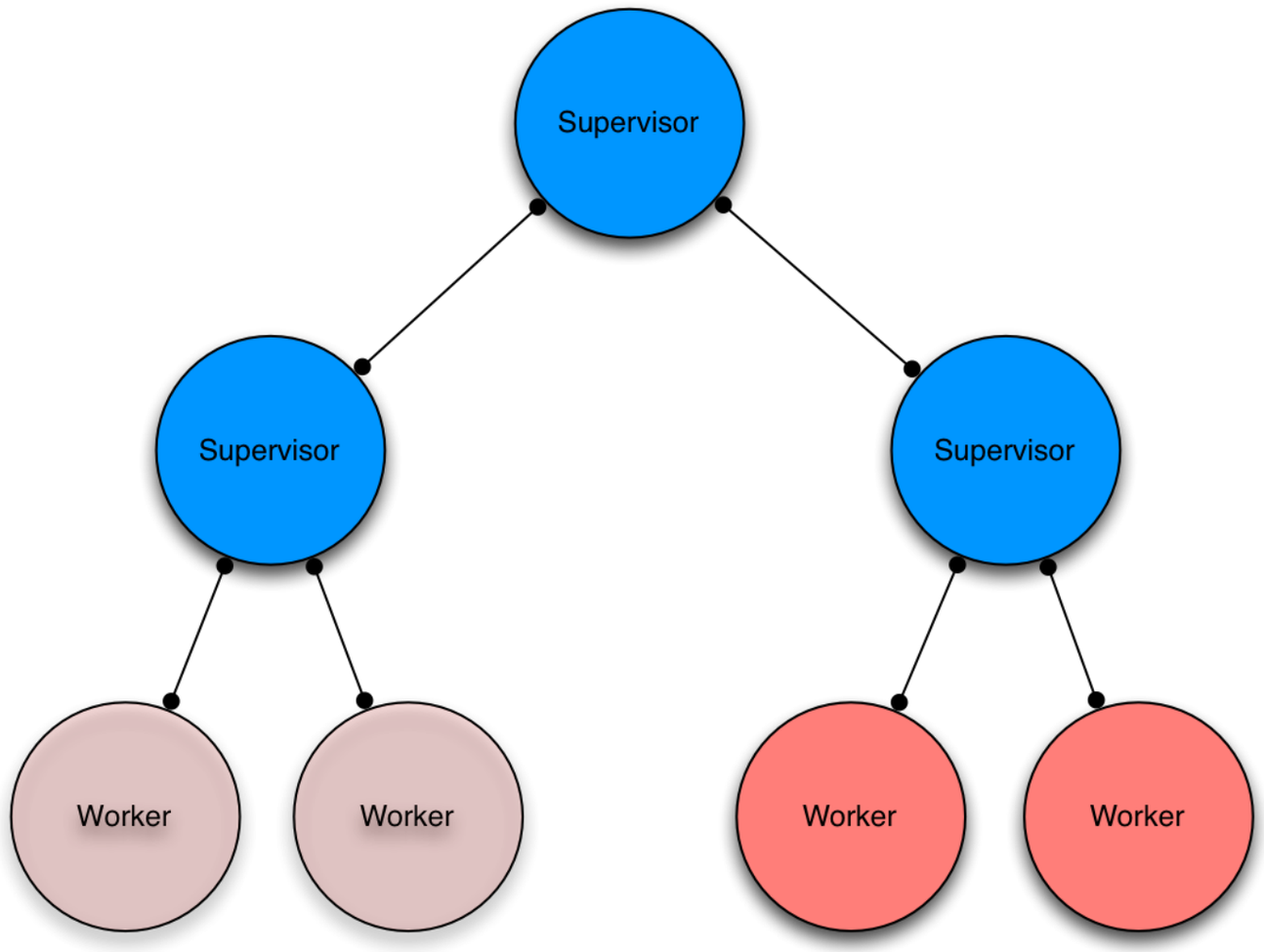
Supervision trees



Supervision trees



Supervision trees



Distribution

- loosely coupled nodes
- mostly transparent
- TCP/IP based

OTP

- helps creating:
  - servers
  - finites state machines
  - event handler
  - supervisors
  - releases and upgrades

Hot code loading

- module is unit of code handling
- exists in two variants: old and current
- controlled take over

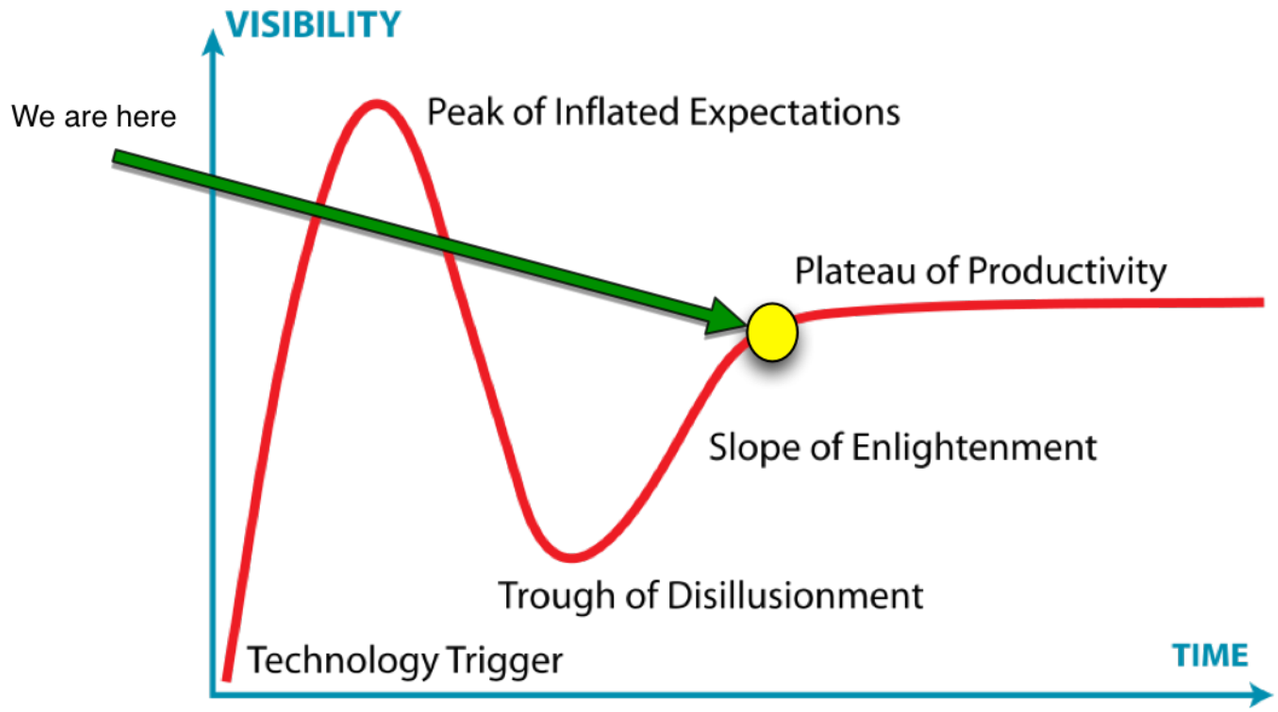
Instrumentation

- can trace almost everything:
  process events, send & receive
  messages, function calls
- process introspection:
  memory, mailbox, links, cur. function...
- interactive shell
- SNMP based OAM

Summary

- everything you need for building highly concurrent, distributed, robust systems
- but not well suited for number crunching or maximum perfomance requirements

Where are we now?



Microservices & Erlang/OTP: how they fit together

How they fit together

> Erlang / OTP has everything you need to build production-ready Microservices

How they fit together

- fault tolerance / resilience
- async communication is the default
- amazing monitoring capabilites
- tools for upgrading / downgrading running systems

Erlang / OTP
&
Microservices
=
Insanely great!

Thank you!

- Questions ?
- Comments ?

Christoph Iserlohn

christoph.iserlohn@innoq.com