The Erlang Rationale

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A Rationale

Rationale – n. 1. Fundamental reasons; the basis. 2. An exposition of principles or reasons.

Why would we want one?

- Help users understand how/why to use various features
- Help language designers
- Help implementors
- Help people wishing to extend language

First Principles

- Lightweight concurrency

  Must handle a large number of processes; process creation, context switching and inter-process communication must be cheap and fast.

- Asynchronous communication
- Process isolation

  What happens in one process must not affect any other process.

- Error handling

  The system must be able to detect and handle errors.

- Continuous evolution of the system

  We want to upgrade the system while running and with no loss of service.

First Principles

Also

- High level language to get real benefits.
- The language should be simple

  Simple in the sense that there should be a small number of basic principles, if these are right then the language will be powerful but easy to comprehend and use. Small is good.

  The language should be simple to understand and program.

- Provide tools for building systems, not solutions

  We would provide the basic operations needed for building communication protocols and error handling.

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Trivial Code Example

```
ringing_a_side(Addr, B_Pid, B_Addr) ->
    receive
        on_hook ->
            B_Pid ! cleared,
            tele_os:stop_tone(Addr),
            idle(Addr);
        answered ->
            tele_os:stop_tone(Addr),
            tele_os:connect(Addr, B_Addr),
            speech(Addr, B_Pid, B_Addr);
        {seize,Pid} ->
            Pid ! rejected,
            ringing_a_side(Addr, B_Pid, B_Addr);
        _ ->
            ringing_a_side(Addr, B_Pid, B_Addr)
    end.
```

Trivial Code Example

```
ringing_b_side(Addr, A_Pid) ->
    receive
        cleared ->
            tele_os:stop_ring(Addr),
            idle(Addr);
        off_hook ->
            tele_os:stop_ring(Addr),
            A_Pid ! answered,
            speech(Addr, A_Pid, not_used);
        {seize,Pid} ->
            Pid ! rejected,
            ringing_b_side(Addr, A_Pid);
        _ ->
            ringing_b_side(Addr, A_Pid)
    end.
```

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Erlang “things”

Only two basic types of things in Erlang

- Immutable data structures

  Normal Erlang terms
- Processes

  Everything with internal state

Yes, the process dictionary is a mutable data structure (sort of), but we never really liked it!

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Processes

A process is something which obeys *process semantics*:

- Parallel independent execution
- Communicates through asynchronous message passing
- Links/monitors for error detection/handling
- Obey/transmit exit signals

N.B. Implementation and internal details irrelevant!

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Processes

- Everything is run within a process
- All processes are equal – no special or system processes
- No process hierarchy – flat process space

Process communication

All process communication by messages

All process communication asynchronous

Process BIFs asynchronous

- Only check arguments
- One exception then: sending to registered name!

Works the same with distribution!

Ports

”Processes” for communicating with the outside world

Obey process semantics

- Message based interface
- Obeys links and exit signals
- Fits in with rest of erlang

Ports talk to hardware

Ports need connected process to communicate with.

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Error handling

Errors will ALWAYS occur!

Error handling

- Robust systems must always be aware of errors
- Want to avoid writing error checking code everywhere
- Want to be able to handle process crashes among cooperating processes
- System must detect, contain and handle errors
- Interact well with process communication

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Error handling

We just want to

Let it crash!

Error handling

- →Process based
- →If one process crashes then all should crash

  Cooperating processes are *linked* together
  Process crashes propagate along links

- →”System” processes can monitor them and restart them when necessary
- →But sometimes we do need to handle errors locally

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Modules, code and code loading

- Only compiled code
- Module is both the unit of compilation and of all code handling
  - Relatively efficient compilation
  - More consistent system when loading code
- Multiple versions of a module

→No inter-module dependencies

Modules, code and code loading

- All functions belong to a module
- All modules are equal – no system or special
- No module hierarchy – flat module space

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Things missing in early Erlang

- Code handling
- Binaries
- ETS
- Funs
- OTP

- NIFs

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Distribution

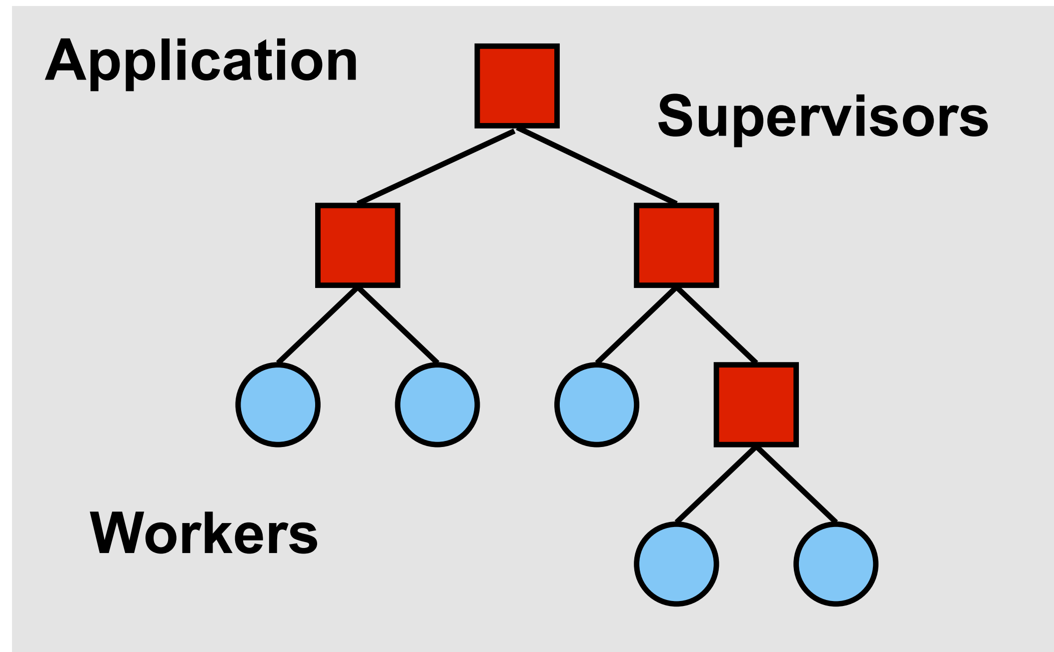
- Based on loosely coupled nodes – like processes
- Completely transparent if desired (almost true)
- Easier with asynchronous communication, so keep communication and error handling asynchronous

OTP
(Open Telecoms Platform)

Erlang just a language, for building large scale applications you need:

- A large set of standard libraries
- A set of rules and design patterns for building robust systems
- Generic behaviours
  - And patterns for building new behaviours
- Tools

OTP (Open Telecoms Platform)



An application, its supervision tree and its workers

- Supervisors ensure robust system by restarting workers

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