Functional Programming In Real Life

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Creative Payment Solutions

Introduction

- I will talk about KREDITOR, a company that bet it's future on Erlang, a functional programming language
- I will tell you what KREDITOR does, how we do it, why we do it this way, and whether it worked out or not...
  at least, so far.
- I will also tell you about Erlang, and **why** and **why not** to use it.

Kreditor Europe AB

- The business model:
  - Bring trust to Internet shopping.
  - Bring old style billing into the new IT-economy.
- Brief background:
  - Founded in **February 2005**.
  - With < $100,000 in venture capital.
  - Live system in **March 2005**.

- The company vision:
  - “Be the coolest company in Sweden.”

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The Problem

- Internet shopping is a question of **trust**.
  - The shop has to **trust** the customer to get paid.
  - The customer has to **trust** the shop to send the right stuff.
- Many customers are **uncomfortable** using credit card over the Internet.
- Many banks are actually **worried about the security** of Internet shops handling credit card information.

The Solution

- Bring in *a trusted party*, i.e., KREDITOR.
- Send an invoice with the goods to the customer.
- The customer pays after receiving the goods and takes no risk. The customer does **not** have to trust anyone.
- The shop is guaranteed (by contract) to get money from KREDITOR. The shop only have to trust KREDITOR with whom they have a written contract.

The Implementation

A customer

surfs

A webshop

xmlrpc

identity
kredit check

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Credit information

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The Implementation

A customer

surfs

A webshop

xmlrpc

KREDITOR

stores

DB

Credit information

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The Implementation

A customer

surfs

A webshop

Ok, invno=42

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DB

Credit information

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The Implementation

A customer

Pack goods, print invoice, ship.

Buy ok

A webshop

Credit information

KREDITOR

DB

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The Implementation

A customer

A webshop

Pay

KREDITOR

DB

Credit information

Pay

Pay

Bank

KREDITOR

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The Implementation

A customer

A webshop

Credit information

Print&mail

Reminder

KREDITOR

DB

Bank

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Some details

- The system is built from scratch using LYME (Linux, Yaws, Mnesia, and Erlang).
- So far we operate in Sweden and Finland, and we sell to Norway and Denmark.
- We have a distributed system with multiple servers to provide a fault tolerant, high availability solution.
- We aim for less than 5 minutes down-time per year, in a setting where we introduce new features in the system every week.
- The problem fits Erlang really well.

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Why not use Erlang?

- The main reasons that I have heard of are:
  1. Politics – Erlang is not C/Java, company policy.
  2. One provider – Concern that Ericsson will stop supporting Erlang.
  3. Lack of programmers – Erlang is still not mainstream how can we ensure we get qualified staff?
- When starting a new company, 1 is (usually) not a problem.
- I can't see 2 happening, and Erlang is open source anyway.
- When setting up in Stockholm, 3 is not a problem.

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Erlang - Background

- Developed by the Computer Science Lab at Ericsson.
- Problem domain - ~~Telephone exchanges~~ Modern financial applications
  - High Availability
  - Highly concurrent
  - Real time
  - Distributed
  - Continuos operation
  - In service upgrades

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Erlang Design Goals*

- How can we build software systems that are as reliable as hardware systems.
- How can we make programming almost as easy as assembling hardware.

* This is my own reconstructed view of what the goal might have been, I was not in any way involved in the design of Erlang.

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Erlang - Insight

To make a fault-tolerant system you need at least **two** computers.

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Real - Insight

Actually,
to make a fault-tolerant system you really need at least
three
computers*.

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* This is an insight about consensus algorithms shown by Leslie Lamport in “The Byzantine Generals Problem” (1982) and in more detail in “Lower Bounds for Asynchronous Consensus” (2004).

Erlang - Background

- The Erlang designers realised “To do fault tolerant computing we need at least two isolated computers.”
- This lead to concurrent programming with pure message passing and no shared state.
  - Large number of (isolated) processes
  - Communication through message passing
  - No mutable state in processes
  - Pure functional programming

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Erlang - OTP

- A huge part of the success of Erlang comes from the standard library OTP (Open Telecom Platform).
- OTP extends the fault tolerance in Erlang by providing standard patterns (or behaviours in Erlang lingo) for building telco-grade systems.
  - Supervisors, with restart polices
  - Generic servers
  - Generic state machines
  - Logging

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The Erlang Advantage

- Easy to build fault-tolerant systems.
- Rapid development.
- Low-maintenance and easy upgrade.
- Ability to leverage multicore technology.
- Network programming is easy.
- Good way to get great programmers.

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Easy to Build Fault-tolerant Systems

- Erlang was designed from the ground up with the purpose of making it easy to develop fault-tolerant systems.
- Erlang was developed by Ericsson with the telecom market in mind.
- Erlang supports processes, distributed systems, advanced exception handling, and signals.
- Erlang comes with OTP-libraries (Open Telecom Platform), e.g. *supervisors* and *generic servers*.

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Rapid Development

- Erlang has a number of features to support rapid prototyping and fast development:
  - Automatic memory management.
  - Symbolic constants (atoms).
  - An interactive shell.
  - Dynamic typing.
  - Simple but powerful data types.
  - Higher order functions and list comprehensions.
  - Built in (distributed) database.

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Fast Development

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  - Automatic memory management.
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  - An interactive shell.
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  - Simple but powerful data types.
  - Higher order functions and list comprehensions.
  - Built in (distributed) database.

Low-maintenance and Easy Upgrade

- Erlang has a number of features that makes it easy to maintain and upgrade:
  - –Hot code loading.
  - –Distribution.
  - –Interactive shell.
  - –Simple module system.
  - –No shared state.
  - –Virtual machine.

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Ability to Leverage Multi Core

- The concept of processes is an integral part of Erlang.
- The Erlang Virtual machine (BEAM) has support for *symmetric multiprocessing*.
- No shared memory -- easier to program.
- As Joe Armstrong is found of saying:

"Each year your sequential programs will go slower.
Each year your concurrent programs will go faster."

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Network Programming is Easy

- Distributed Erlang solves many network programming needs.
- Setting up a simple socket protocol is a breeze.
- The binary- (and now bit-) syntax makes parsing binary protocols easy.
- There are simple but powerful libraries for HTTP, XML, XML-RPC and SOAP.

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Good Way to Get Great Programmers

- **Nice paradox**:
  The lack of Erlang programmers makes it easier for us to find great programmers.
- There are many great C and Java programmers, I'm sure, but they are hidden by hordes of mediocre programmers.
- Programmers who know a functional programming language are often **passionate** about programming.
- Passionate programmers makes Great Programmers™.

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Building a Scalable Fault-tolerant 24/7 System

- You need at least three of everything
- Start simple
- Only optimise when and where necessary
- Scale by adding nodes, make each node the same as all other nodes
- Monitor everything

Erlang Downsides

- It is not mainstream*
  - There are not many third party libraries yet
  - Even if we can find great programmers it is hard to find enough programmers who know Erlang or who even want to use Erlang.

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* A big advantage according to Paul Graham in “**Beating the Averages**”.

Making Erlang More Mainstream

- I have a cunning plan.
- We set up an independent language ranking firm, paid by the Erlang community of course.
- They rank Erlang as an AAA language.
- Every manager faced with a language decision can then make the non-decision of choosing the tripel AAA language Erlang.

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Erlang is Gaining Popularity

- "Erlang for Concurrent Programming", by Jim Larson, **Google**: "Designed for concurrency from the ground up, the Erlang language can be a valuable tool to help solve concurrent problems."
  (http://www.acmqueue.com/modules.php?name=Content&pa=showpage&pid=556)

- New **Facebook** Chat Feature Scales to 70 Million Users Using Erlang
  (http://highscalability.com/new-facebook-chat-feature-scales-70-million-users-using-erlang)

- **Dr.Dobb's** 3/12: "It's Time to Get Good at Functional Programming"
  "Erlang: A No-Compromises Approach"
  (http://www.ddj.com/development-tools/212201710;jsessionid=AGLEX11IQPUNQQSNDLRSKHSCJUNN2JVN?pgno=2)

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When not to Use Erlang

- Don’t try to build a stand-alone GUI.
- Don’t expect to do fancy text handling out of the box.
- A fancy web-GUI is not easy to do yet.
- Fast file crunching is not Erlangs forte.

  - But Erlang can easily interface with other languages and applications, so use Erlang as the glue to write the robust server core, and plug in the missing parts.

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Did it work?

- Erlang has been a great help in providing rapid development with maintained high availability.
- KREDITOR has introduced new services several times per year.
- The system has never been down. Not even while upgrading the system hardware or moving the hosting to a new site.

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Some Customers

We have signed with over 2700 internet shops.

(Dustin, Ginza, Discshop, SIBA, Webhallen, Gymgrossisten)

svt

MÖTESPLATSEN
Bästa sättet att träffas

nelly.se

WEBHALLEN

Jam
www.jam.se

PIXmania.com

CYBERPHOTO

MISCO

Scandinavian Photo

GYMGROSSISTEN.com
For Athletes, By Athletes

eleven

Handla Trygg!
SVENSKA GUMMI HUSET
www.gummihuset.se

www.Inreda.com

designonline.se

TBH.se

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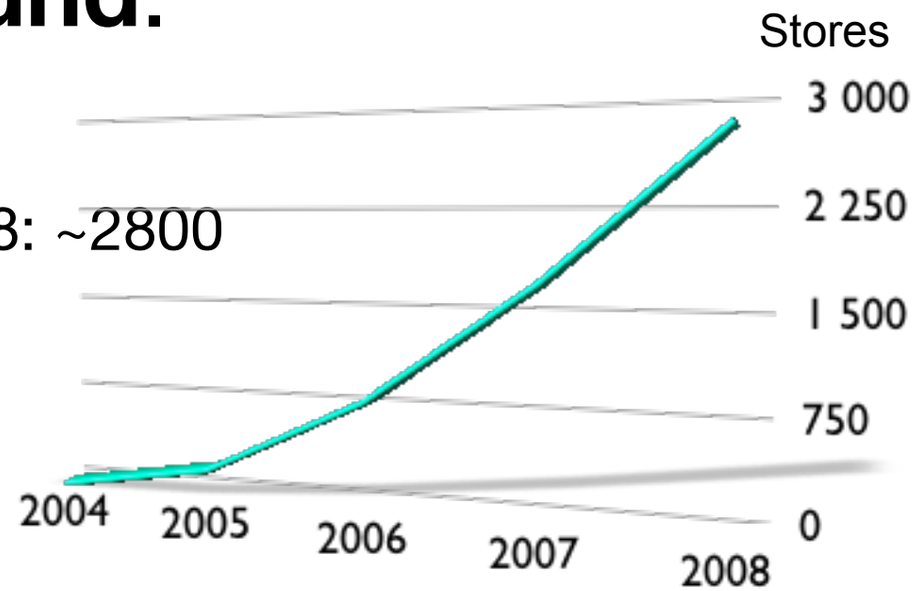
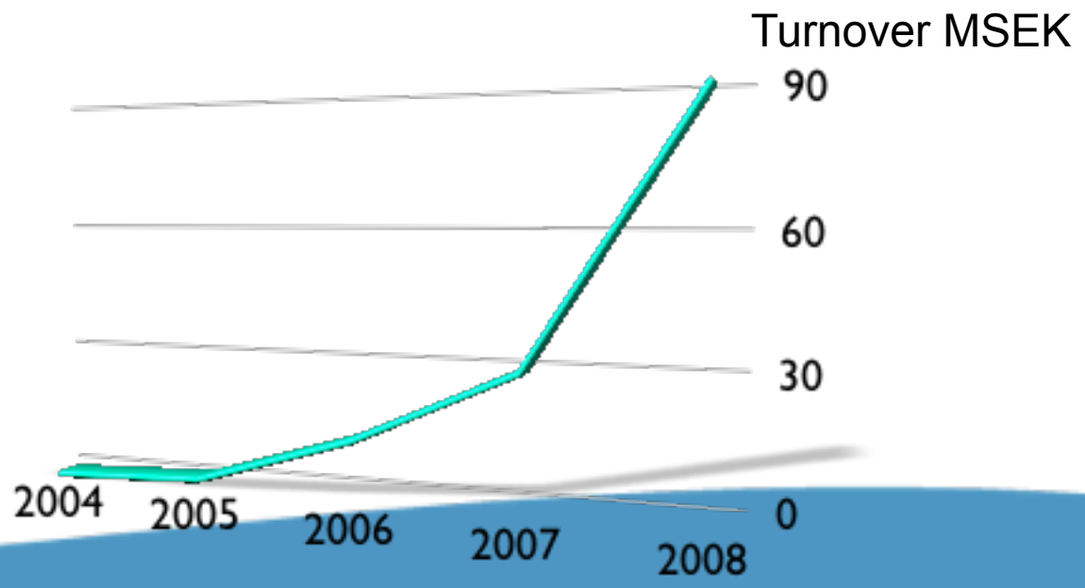
Did it work?

- The business model **has been sound**.
- Number of connected stores:
  2004: 0, 2005: ~200, 2006: ~800, 2007: ~1700, 2008: ~2800
- Number of employees ~100.
- Turnover:
  - 2004: ~0 SEK
  - 2005: 1.5 million SEK
  - 2006: 13.5 million SEK
  - 2007: 35 million SEK
  - *2008: 90 million SEK*





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Conclusion

KREDITOR took a bet on Erlang,
and we are winning.

Questions?

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Added benefits

- The customer gets credit.
- The customer can pay using familiar methods.
- Returning goods is easy.
- Better fraud detection.
- Advanced credit assessments.
- Easy to add similar features like *pre-pay*, *subscriptions* and *instalment plans*.