Erlang for a New Era of Embedded Computing

Ulf Wiger, CTO Erlang Solutions Ltd
New Era of Embedded

- Embedded devices are becoming ubiquitous
- Devices are increasingly “always connected”
  - “In 2020, every device that can benefit from being connected, will be connected”

“50 billion connections 2020”
(Hans Vestberg, CEO, Ericsson AB)
What is Driving the Change?

• Ever-shrinking hardware footprint
• The Web and Mobile Internet
• Demand for more and more complex features
  - not least on Mobile Devices
• Battery life expectancy
  - exploit parallelism and specialised cores
Towards the “always connected” scene

• [...] the gap between large systems and embedded components will need to be bridged.

• Significant developments will be required in technology for
  - low power and high performance computing,
  - networked operating systems, programming environments,
  - energy management, networking and security.

(MARLOW Consortium 2002-2007)

A Major Shift

• “The convergence of low power computing with ubiquitous networking is leading to a major shift. Information and communication technology is embedded in an increasing range of products and processes, raising productivity and enabling new services and applications.”

• “Nomadic Environments allow people and moving objects to interact, dynamically and wirelessly, with services, resources and local and remote sources of information.”

• Nokia’s CTO gave a decidedly somber assessment of the technology challenges facing cellular handset makers: more features naturally consume more power, but battery technology can't keep up with the increasing power demand.”

• “It is clear that this will not be reached by conventional approaches only. So a significant effort on low power research is needed.”

(MARLOW Consortium)
What Matters for Embedded?

- Remote management
- Disk is optional
- Graphics display optional
- Often: no human operator nearby
Programming Challenges

• Good idle characteristics (low power)
• Remote handling
  - configuration
  - debugging
  - upgrades
• Support for heterogeneous-multicore programming
• Autonomous error recovery
Wearing the hair shirt

Getting hairier...

- Multicore is now the norm
- System-on-a-chip designs
- Need a strategy for handling parallelism and hardware accelerators
  - Single-thread abstraction?
  - Concurrency-oriented?

Message-passing is the way to go — but how?

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Erlang - A language for Embedded
A conflict resolved

• “The main challenge is to combine flexibility and power-efficiency, as these requirements are traditionally considered to be contradictory.” (MARLOW)

• In essence, parallelism is the preferred way to reduce power in hardware

• But parallelism is difficult for programmers, esp. in Java (shared objects) and C++ (no concept of concurrency)

• Erlang is based on share-nothing concurrency, which fits parallel architectures very well.
Erlang to the Metal

- HW abstractions via NIFs/Drivers
- Supervision: built-in fault-tolerance
- Abstract any device as an Erlang process
- “Black box” thinking similar to EE design
ESL and Embedded Erlang

- Idea: Opportunistic development
- Raise awareness
- Paid consultancy
- Partnerships
- Thesis projects

Second release of Erlang-embedded

By ErlangEmbedded, February 21, 2011 9:35 am

Today we release the second version of Erlang-embedded, dubbed "Harbor seal".

Changes:

- More optimized kernel
- Updated the core Linux distribution
- Updated Erlang to R14B01

As usual get it here, try it out, and tell us what you think!

Phoca vitulina, also known as the Common Seal or Harbor Seal, is found along temperate and Arctic marine coastlines of the Northern hemisphere. They are brown, tan, or gray, with distinctive V-shaped nostrils. An adult can attain a length of 1.85 meters and a mass of 132 kilograms. Females outlive males (30–35 years versus 20–25 years). Females are
Thesis: Erlang-Embedded

- Erlang running on Beagleboard & Gumstix
- Various related projects
- Presented at Erlang Factory London 2010

F. Bergström
H. Nord
G. Simonsson
N. Axelsson
C. Ferm
F. Andersson
erlang-embedded.com

- Downloads and links for Erlang on embedded devices
Thesis: Embedded Erlang Simulators

• Record events using real hardware
  - Or simulate hardware events

• Faithful playback in simulator

• Key message: Easy to create custom component simulators in Erlang
New EU-Funded Research (I)

Paraphrase
(http://www.paraphrase-ict.eu/)

Academic Partners:
1. UNIVERSITY OF ST ANDREWS, UNITED KINGDOM (Coordinator)
2. ROBERT GORDON UNIVERSITY, UNITED KINGDOM
3. UNIVERSITAET STUTTGART, GERMANY
4. UNIVERSITA DEGLI STUDI DI TORINO, ITALY
5. UNIVERSITA DI PISA, ITALY
6. QUEENS UNIVERSITY BELFAST, UNITED KINGDOM

Industrial Partners:
1. MELLANOX TECHNOLOGIES, ISRAEL
2. ERLANG SOLUTIONS, UNITED KINGDOM
3. SOFTWARE COMPETENCE CENTER HAGENBERG, AUSTRIA

Thursday, 3 November 2011
New EU-funded Research (2)

• **RELEASE** ([http://release-project.eu/](http://release-project.eu/))
  
  - Massively scaled processing ($10^5$ cores)
  - Optimizing the Erlang VM for > 100 cores
  - Continuous Integration of large-scale systems
  - Ad-hoc, capability-based cloud provisioning
Knowledge Transfer Partnership

- UK Govt funded, 2 years, 1 person full-time
  - Erlang Solutions
  - University of Kent
- Erlang on embedded ARM devices
- Build relations with device HW manufacturers
- Try to make Erlang one of the standard environments on new hardware

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Erlang Embedded Pioneers

corelatus

SEAZONE
Control your power

travelping

interoud
innovation

Couchbase
Emerging Markets – Example

• Electric car batteries age differently
  - ...and are very expensive!

• Continuous data collection can help determine 2\(^{nd}\) hand value

• Greenfield market, rapidly evolving applications
  - Remote upgrade essential
New Venture

• Magnus Feuer
• Tony Rogvall
• Ulf Wiger
• Motivo Engineering
• Erlang Solutions
Feuerlabs mission

- End-to-end solutions for connected devices
- An Erlang platform for connected device apps
  - Dual-license offering
- Hosted device management
- Secured initial funding
- Favourable market outlook
- Some pretty intense hacking ahead
Conclusion

- Explosive growth of connected embedded devices
  - A major paradigm shift
- Erlang has enormous potential in the embedded space
- Early adopters
- Exciting research projects
- Lots of fun ahead!
Thank you