Erlang Solutions Ltd.

Erlang for a New Era of Embedded Computing

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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)





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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



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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)

http://web.archive.org/web/20070727095046/http://www.lowpower.org/



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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)



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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



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Wearing the hair shirt





http://matthsu-abacus.blogspot.com/2011/03/alternative-use-of-openmoko-debug-board.html

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

ebY	.uk Welcome! Sign	in or register		
CATEGORIES -	ELECTRONICS	FASHION	DAILY DEALS	

Computers > Networking > Hubs





Item condition:	Used				
	AU \$6,000.00 Approximately £3,8	Buy it now B76.44 Wish list Add to Watch list			
Postage:	Read item description or contact seller for details. Se Item location: Marrickville, New South Wales, Australia Post to: Worldwide				
Delivery:	Varies				
Payments:	PayPal [®] , Postal order or banker's draft See payment inf Returns accepted Read details				
D					

A conflict resolved

- "The main challenge is to combine flexibility and powerefficiency, 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 sharenothing 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



News	Features	Getting started	Contact	Downloads	Supported hardware						
Second release of Erlang-embedded											
By Erl	angEmbedde	d, February 21, 2011	9:35 am		🖓 Comments (1)						

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

Changes:

- More optimized kernel
- Updated the core Linux distrubtion
- 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

Erlang have been tested on the following devices



Samsung Galaxy Tab(Thanks to Robin T)



HTC Desire

HTC Supersonic (Evo)(Thanks to Garret S)



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Motorola Droid(Thanks to Chris J)



Samsung Galaxy I9000(Thanks to neurofen)

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HTC Desire HD(Thanks to Mikkel M)



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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





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New EU-Funded Research (1)



New EU-funded Research (2)

- **RELEASE** (<u>http://release-project.eu/</u>)
 - Massively scaled processing (10⁵ cores)
 - Optimizing the Erlang VM for > 100 cores
 - Continuous Integration of large-scale systems
 - Ad-hoc, capability-based cloud provisioning





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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





Erlang Embedded Pioneers



Emerging Markets – Example

- Electric car batteries age differently
 - ...and are very expensive!
- Continuous data collection can help determine 2nd hand value



- Greenfield market, rapidly evolving applications
 - Remote upgrade essential



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New Venture

- Magnus Feuer
- Tony Rogvall
- Ulf Wiger
- Motivo Engineering

A A DITIVO

• 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



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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



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