Software for Evolving Critical Systems
An Introduction to Lero

Prof. Vinny Cahill
Trinity College Dublin
vinny.cahill@scss.tcd.ie
Contents

• Lero mission & structure
• Lero expertise
• Research focus for the next five years
  – Sub themes & project opportunities
Mission

• Lero is delivering world-leading research in software engineering with a special emphasis on Evolving Critical Systems.

• Lero will enhance the quality and competitiveness of the Irish software industry through shared projects, knowledge transfer and education.
The Lero CSET was founded in 2005 with funding from SFI and other sources covering the period 2006-2010.

A second 5-year CSET proposal is in preparation for submission to SFI in July 2010 covering the period 2011-2015.
Lero Researchers

- **UL**
  - Prof Mike Hinchey
  - Prof Bashar Nuseibeh
  - Prof Kevin Ryan
  - Dr Ita Richardson
  - Dr Jim Buckley
  - Dr Chris Exton
  - Dr Michael English
  - Dr Goetz Botterweck

- **TCD**
  - Prof Vinny Cahill
  - Dr Siobhan Clarke
  - Dr David Gregg
  - Dr Andrew Butterfield

- **UCD**
  - Dr John Murphy
  - Dr Liam Murphy

- **DCU**
  - Dr David Sinclair
  - Dr Geoff Hamilton

- **NUIG**
  - Dr Kieran Conboy

- **DkIT**
  - Dr Fergal McCaffery
• Autonomic computing – self-managing systems, e.g., sensor-networks, data centres, smart power grids, smart cities.

• Middleware for mobile and embedded service-oriented architectures.

• Requirements engineering for adaptive systems.

• Formal methods, verification – reliable software systems, e.g., banking, aerospace, life-critical.

• Agile software development methodologies.

• Strategies and practice in global software development.

• Lean methodologies for software development.

• Software product lines.
Evolving Critical Systems (ECS)
Evolving Systems

- Evolving systems are software systems that exhibit change over time.

- Many software systems in use today have evolved from legacy code and legacy systems, or evolve as a result of a focused and intentional change in organization and architecture to exploit newer techniques believed to be beneficial.

- Others require that the system adapt and evolve at run-time in order to react to changes in the environment or to meet necessary constraints on the system that were not previously satisfied and possibly not previously known.
Critical Systems

- Critical systems are systems where failure or malfunction will lead to significant negative consequences.
- These systems may have strict requirements for security and safety, to protect the user or others.
- These systems may be critical to the organization’s mission, product base, profitability or competitive advantage.
Lero’s research agenda addresses the following themes within ECS:

- Development methodologies for ECS
- The evolution of software from a single processor to a multi-core environment or from sequential to parallel processing
- Evolving embedded systems
- Run-time dynamic adaptation
Development Methodologies

• Themes
  – Customising software development methodologies from agile/planned/open source approaches
  – Developing process roadmaps for software development in the specific industry segments
  – Improving software development efficiency using lean methodologies

• Potential Industrial Involvement
  – Large multinational and indigenous medical device, financial, and pure software companies
Evolving Embedded Systems

• Themes
  – Porting software to parallel supercomputing architectures
  – Porting software to multi-core architectures
  – Evolving software for medical devices
  – Software evolution planning for embedded systems

• Potential Industrial Involvement
  – Software and hardware companies (SME and large multinational), medical device companies
Evolution to Multicore

• Themes
  – Development of methods and tools to automate porting of applications from single to multicore environments
  – Development of software design principles for multicore environments
  – Porting software to parallel supercomputing architectures

• Potential Industrial Involvement:
  – Processor, computer and operating system companies
  – Software companies with heavy computational needs, e.g., modelling of complex financial phenomena
Run-time Dynamic Adaptation

• Themes
  – Software for large-scale critical infrastructure
  – Modelling and analysis of large data centres to reduce the need for manual intervention
  – Model-driven engineering for service evolution

• Potential Industrial Involvement
  – Large utility providers, data centre managers
Conclusions

• Software must evolve.

• There is a tension between reliability, predictability and cost and this need for evolution.

• There is a need for an Evolving Critical Systems research effort.

• Lero is leading that effort.
Contacts

Brendan O’Malley
Industry Liaison Manager
brendan.omalley@lero.ie

Jack Downey
Industry Liaison Officer
jack.downey@lero.ie

http://www.lero.ie/
LGSSE

- Lero Graduate School in Software Engineering
- Four Lero Partner Universities involved in PRTLI proposal
- Structured PhD programme starting with 4 sites
- Benefits from combined research strengths
- Open to Industry and to all Irish HEIs
- Part-time industry-based PhDs and Masters students