Research on Embedded Systems in IST: current status and future prospects

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Outline

- Introduction
- Embedded Systems in the IST FP6
- ARTEMIS platform
- Joint Technology Initiatives
- Prospects for FP7
- Outlook
Knowledge is key to the Lisbon agenda

EU: Largest knowledge-based economy by 2010?

7th R&D Framework Programme:
- Collaborative R&D
- Person-driven research
- Technology Platforms
- Mobility

Education & Training:
- Lifelong learning
- Modernising universities
- Bologna process
- Entrepreneurship

More than 20 years of Framework Programs

Budget (in bn €)


FP1 FP2 FP3 FP4 FP5 FP6

3.75 5.39 6.6 13.22 14.96 17.6

EU activities require:
- Collaboration & cross-disciplinarity
- Consensus & partnership

FP evolution in last 20 years:
growing, but only 5% of public R&D spending in Europe
ICT in FP7: Building on Europe’s strengths

- Industrial & technological leadership in key ICT fields
  - Telecoms, embedded IT, nanoelectronics, microsystems, rich optoelectronics, audio-visual content etc.
- Expertise in handling complexity
  - Transform “complex technologies” into reliable products
  - Infrastructures: energy, telecoms, transport
  - Complex devices: mobile, home
- Strengths in many markets
  - Automotive, aerospace, machinery, pharmaceuticals, automation, …
- Experience in partnering & collaboration
  - Pan-European partnerships & consensus-building

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EmS in IST-FP6 (2002-2006)

Advanced Control
- hybrid systems
- fault adaptive control
- networked autonomous controls

Systems Design
- Holistic approach, hw+sw
- Hard and soft real-time
- Dependability & robustness
- Model-driven architecture
- Reconfigurability

EmSEmS

Networked Embedded
Middleware & platforms for wireless objects
- scalable & self-organising platforms
- services for adhoc networking

2 main Calls
40 projects
140 m € funding

Portfolio in Systems Design 2003

Level of abstraction
Modelling
Components
Tools
Compilers
Architecture

HARD REAL-TIME
+ARTIST2

SOFT REAL-TIME
Portfolio in Systems Design 2005

Portfolio in Networked EmS
Examples of topics

- Service-Oriented Computing in industrial and home automation
- Middleware platforms for heterogeneous devices
- Automotive middleware
- Platforms for embedded peer-to-peer systems
- Coordination of unmanned aerial and underwater vehicles
- End-to-end system architecture for wireless sensor networks
- Self-organising platforms for wireless sensor networks
  - civil security, healthcare and other applications
**Portfolio in Control 2003**

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The Artemis Technology Platform

**Aim and scope**
- Develop and drive joint European vision on Embedded Systems
  - R&D and educational challenges
  - Structural challenges: IPR, open source, standards, infrastructure,…
- Align fragmented R&D efforts along common strategic agenda at Community, intergovernmental and national levels

**ARTEMIS Steering Board includes 19 of the top-25 EU companies in terms of global R&D.**

**ARTEMIS Objective**
- World leadership in intelligent electronic systems
  - Embedded everywhere

**ARTEMIS Vision:** "... An ongoing, major evolution of our society in which all systems, machines and objects will become digital, communicating and self-managed"
Focus research on technologies with high re-usability

- **Identified four, strategically significant “Application Contexts”:**
  - **Industrial systems**
    - Automotive: “Frugal, safe car”
    - Aerospace: “Customisable, efficient, safe air transport”
    - Manufacturing & process Industries: “Efficient, flexible manufacturing”
  - **Private spaces:** “Efficiency, safety and pleasure in the home”
    - Includes Medical sector
  - **Nomadic Environments:** “Walk, Talk, Hear, See”
  - **Public Infrastructure:** “Secure and dependable environment”

**ARTEMIS SRA Structure**

- ARTEMIS approach cuts barriers between application sectors, stimulating creativity and yielding multi-domain, re-usable results

- **Common objectives:**
  - Sustainability
  - Design Efficiency
  - Ease of Use
  - High added value
  - Time to market
  - Modularity
  - Safety / Security
  - Robustness
  - Competitiveness
  - Innovation
  - Cost reduction
  - Interoperability

- **http://www.artemis-office.org**
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JTIs – motivation and benefits

- Bringing together fragmented efforts, building critical mass (ERA)
  - Combine, for the first time, national, EC and private funding in a single R&D programme that focuses on joint objectives (SRA)

- Combining the strengths of trans-national (EUREKA) and European programmes – while overcoming their weaknesses
  - No budget uncertainty (e.g. compared to Eureka)
  - No duplication of evaluation/monitoring procedures (as in Eureka)
  - Shorter time-to-contract
  - No additional red tape for participants

This could pioneer new ways for running industrial R&D programmes in Europe!
Proposed Joint Technology Initiatives in IST

To implement parts of the Strategic Research Agendas of ENIAC and ARTEMIS, aligning fragmented R&D efforts at European level in the fields:

Nanoelectronics:
- addressing the needs of silicon-based technologies & beyond
  - shrinking of CMOS logic & memory devices
  - development of value-added functions for System-on-Chip or System-in-Package solutions
  - equipment & materials
  - design automation

Embedded Computing Systems:
- ubiquitous, interoperable & cost-effective embedded systems
  - reference designs and architectures
  - middleware for interoperability and seamless connectivity
  - integrated design software tools for rapid development & prototyping

Synergetic approach for executing SRA

ETP
Industry-driven long-term vision
Common pan-European SRA
Overall coordination and policy alignment in ERA
Joint project monitoring and programme assessment

ARTEMIS

FP7
Upstream
IST collab. R&D
ERC, Mare Curie
Research infrastructure

JTI
Downstream
Unified processes
National contracts
EC top-up

EUREKA
Downstream
ITEA2, MEDEA+
National contracts
No EC top-up

National Programmes
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FP7 Specific Programmes
Preliminary budget agreement, Graz, May 2006

<table>
<thead>
<tr>
<th>Programme</th>
<th>Budget 2007-2013</th>
<th>% of Total</th>
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<tbody>
<tr>
<td>&quot;Cooperation&quot;</td>
<td>€ 32.315 bn</td>
<td>65 %</td>
</tr>
<tr>
<td>Collaborative R&amp;D, pre-defined themes, JTIs</td>
<td></td>
<td></td>
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<tr>
<td>&quot;Ideas&quot;</td>
<td>€ 7.46 bn</td>
<td>15 %</td>
</tr>
<tr>
<td>Frontier research, individual grants</td>
<td></td>
<td></td>
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<tr>
<td>&quot;People&quot;</td>
<td>€ 4.723 bn</td>
<td>9 %</td>
</tr>
<tr>
<td>Human potential, mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Capacities&quot;</td>
<td>€ 4.287 bn</td>
<td>8 %</td>
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<tr>
<td>Infrastructure, SMEs, science and society</td>
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<td></td>
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<tr>
<td>Joint Research Centre (non-nuclear)</td>
<td>€ 1.751 bn</td>
<td>3 %</td>
</tr>
<tr>
<td>EURATOM Programme</td>
<td>€ 2.751 bn</td>
<td>5 %</td>
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</table>

Total € 54.582 bn

2007-2013
**FP7 (2007-2013)**
Structure & Budget

**Total FP7 Budget: 50521 B€**

- **Cooperation**: 32315 M€ (64%)
- **Ideas**: 7460 M€ (15%)
- **People**: 4728 M€ (9%)
- **Capacities**: 4267 M€ (8.5%)
- **JRC**: 1751 M€ (3.5%)

**Implementation of ICT in the “Cooperation” part**

- **Continuity of instruments**
  - Collaborative projects;
  - Networks of Excellence;
  - Coordination/support actions

- **+ New schemes**
  - Joint Technology Initiatives
  - Coordination (ERA-NET; ERA-NET+; Article 169)

- **Simplification, a high priority**
ICT: Main Themes

- **ICT Technology Pillars**
  - pushing the limits of performance, usability, dependability, cost-efficiency

- **Integration of Technologies**
  - integrating multi-technology sets that underlie new functionalities, services and applications

- **Applications Research**
  - providing the knowledge and the means to develop a wide range of ICT-based services and applications

**ROADMAP:**
- WP publication in October 2006
- Launch of first Call in November 2006

ICT in FP7 (2007-2013)

- **FET**
  - Nano-electronics, photonics and micro/nano-systems
  - Communication Networks
  - Embedded systems, Computing and control

- **Technology pillars**
  - Software, grids, security and dependability
  - Knowledge, cognitive and learning systems
  - Simulation, visualisation, interaction and mixed Realities
  - New perspectives in ICT, drawing on other science and technology disciplines

- **Integration Environments**
  - **Personal environments**
  - **Home environments**
  - **Robotic systems**
  - **Intelligent infrastructures**

- **Applications research**
  - Trust and confidence
  - Societal challenges
  - Content, creativity and personal development
  - Business and industry
ICT in FP7 (2007-2013): Challenge Areas

Technology-driven Challenge Areas
1. Pervasive and trusted infrastructures
3. Components, subsystems & embedded systems

Socio-economy-driven Challenge Areas
1. Content & Knowledge
2. ICT for Health
3. Transport - energy efficiency
4. Inclusive society, governance & independent living

Additional Areas
- Critical Infrastructure Protection
- ICT for the Enterprise
- International Collaboration

EmS in FP7: Likely challenges (from SRA and consultations)

- Design of modular, composable, predictable systems
  - Obtain orders of magnitude increase in productivity
  - Resource and context-aware systems
- Cooperating Objects: Spontaneous, scalable, robust and secure
  - From node-centric to data-centric
  - Open middleware platforms, SW-HW, wireless sensor networks and middleware for seamless interconnectivity
- Novel versatile computing architectures
  - Extreme flexible architectures: power, performance, lifecycles
  - Heterogeneous, communication-centric, reconfigurable, programmable, resource-aware, secure platforms
- Next-generation control of large-scale distributed infrastructures
  - From SCADA to NEC (networked embedded control)
  - Efficiency, robustness and security
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Embedded Systems in FP7

Strategy
- Combination of top-down (ARTEMIS) and bottom-up innovation-driven
- Part of broader research and innovation environment

Selected S&T Domains
- Feeding into the ICT application poles

Means of intervention
- "Traditional" EC projects
- JTI and Synergy with Eureka
- Coordination with national programmes
- SMEs
- Centres of excellence and research infrastructure
- Education and training
- International cooperation
JTI vs. FP

- **Upstream vs. downstream**
  - Industrial vs. foundational R&D
    - Inquiry-driven, targeted proactive and targeted reactive foundational research
  - Industrial vs. academic participation
  - Funding rates (50-75% in FP)

- **Who would participate**
  - FP: all MAS; JTI: mainly countries committing budget

ICT-FP7: State of Play

**Annual Work programmes under FP7**
- Orientations, objectives and structure
- Budgets and mechanisms within each priority research topic
- Drafting first Work Programme texts
- Consolidation & improvement
- Opinion by IST-C and adoption by the Commission
- First Calls for proposals

- End JUL
- End OCT
- DEC or JAN
ICT 2006 in Helsinki

Conference
Exhibition
Networking & workshops


Thank you

European research on the web:
http://ec.europa.eu/fp7
http://ec.europa.eu/information_society/istevent/2006/
FP7 Specific programme:
http://ec.europa.eu/comm/research/future/

Embedded Systems:
http://cordis.europa.eu/ist/embedded

ARTEMIS Technology Platform:
http://www.artemis-office.org

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