European R&D in Embedded Systems

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The European Union today

Democratic countries, committed to working together for peace and prosperity

EU-15
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Luxembourg, Portugal, Spain, Sweden, UK

citizens: 370 million
GDP: € 9,180 bn

EU-25
Cyprus, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia, Slovakia

(since 1 May 2004)
citizens: 445 million
GDP: € 9,626 bn

EU’s historical roots lie in WW2:
« Such killing & destruction should not happen again in Europe »
- Robert Schuman, French Foreign Minister on 9 May 1950

Joining after 2006
Bulgaria, Romania

EU-15

EU-25

EU-15

EU-25

EU-25

Key European Institutions & Bodies

- **European Parliament**
  Elected by the peoples of the 25 Member States

- **Council of the European Union**
  Representing the governments of the Member States

- **European Commission**
  Driving force and executive body

- **Court of Justice**
  Ensuring compliance with the law

- **Court of Auditors**
  Controlling sound and lawful management of the EU budget

- **European Economic & Social Committee**
  Expresses opinions of organised civil society on economic & social issues

- **Committee of the Regions**
  Expresses opinions of regional and local authorities

- **European Central Bank**
  Responsible for monetary policy & managing the Euro

- **European Ombudsman**
  Deals with citizens’ complaints about maladministration by any EU institution or body

- **European Investment Bank**
  Helps achieve EU objectives by financing investment projects
Key Policies to Achieve Lisbon Goals

Lisbon 2000

"EU: Largest knowledge-based economy by 2010"

... towards a ‘single market for research’

R&D Policy

European Research Area, Eureka, COST, nat’l R&D programmes

Deployment & promotion

eEurope

Broadband access, e-business, e-government, security, e-health, ...

Legal & Reg. Policy

Entrepreneurship, benchmarking (innovation scoreboard), R&D investment 3% of GDP by 2010, industrial policy, ...

... towards ‘online Europe’
R&D Investment (2001)

In brackets: 
average annual growth rate (%) 
between 1997-2001

GERD (% GDP)

EU average still lags behind investments of Japan & US
- But EU figures are growing, slowly though
- A large variety across EU Member States
- Significant catch-up race of some laggards

Source: DG Research
Data: OECD, Eurostat
New PhDs in Science & Engineering (2001)

per 1000 population aged 25-34

In brackets:
ave. annual growth rate (%) between 1998-2001
Share of World Publications Evolution

Source: DG Research
Data: ISI, CWTS (treatments), DG Research (calculations)
More than 20 Years of EU Framework Program for Research

EU activities require:

- **Collaboration & cross-disciplinarity**

- **Consensus & partnership**
  (funding levels: 50% of industrial, 100% of academic participation)

FP evolution in last 20 years:


- Growing, but only 4% of public R&D spending in Europe
6th Framework Program for Research

• Focusing & Integrating Community Research
  - Life sciences, genomics, biotech
  - Information Society Technologies
  - Nanotechnologies, knowledge-based materials, new processes
  - Aeronautics and space
  - Food quality & safety
  - Sustainable development, ...
  - Citizens & governance
  - S&T needs, SMEs, Int’l Co-operation
  - JRC non-nuclear research
  € mn
  2,255
  3,625
  1,300
  1,075
  685
  2,120
  225
  1,300
  760

• Structuring the European Research Area
  - Research & innovation
  - Human resources
  - Research infrastructures (Géant/GRID, ...)
  - Science & society
  € mn
  290
  1,580
  655
  80

• Strengthening the foundations of the European Research Area
  - Support to co-ordination
  - Support to policy development
  € mn
  270
  50

• Nuclear research (mainly fusion)
  € mn
  1,230

(2003-2006)
€ 17.6 bn
Information Society Technologies in FP6

- Anywhere anytime natural and enjoyable access to IST services for ALL
- Pervasive, mobile, wireless, trustful infrastructures
- Miniaturised, low cost - low power components & μsystems
- Natural interactions with ‘knowledge’
- Communication & networking
- Embedded systems & software
- μ, nano, opto electronics
- μ & nano systems
- Knowledge technologies
- Interfaces

Applied IST for major societal and economic challenges

Trust & Confidence
IST for societal challenges
IST for economic challenges
Demanding applications

~ 1 billion € / year
Who is involved in IST

- Attractive R&D
  - High subscription - success rate 1:6
- Industrial focus
- Multi-stakeholder collaboration
  - Pan-European
  - Large + small companies + academic research
IST: From FP5 to FP6

After two calls:
- 2500 proposals received
- 400 projects supported with ~6500 participations

Increased size of projects
- average budget 3 times larger (1.6->4.3 M€)
- 3 times more partners per projects on average (10->24)

![Average project funding](chart1)
![Average number of participants](chart2)

Funding per instrument, Calls 1 & 2
International Cooperation

• Globalisation
  - Increasing competition at a global scale
  - Outsourcing and de-localisation
  - Also for research, including from emerging economies
  - Brain drain

• Global challenges
  - Security
  - Ageing
  - Environment
  - ...

int’l co-operation as a positive sum game
Embedded intelligence everywhere

- Embedded Systems underpin Europe’s industrial strongholds
  - Automotive, avionics, consumer electronics, telecommunications, plant automation, medical,…
- Enormous potential for the future
  - Key enabler for competitiveness and innovation
  - Creation of new markets and societal-scale applications
- Major challenges
  - In science, technology, education, infrastructures

Embedded systems provide the added value of European products
Embedded systems facts and figures

- Most of top 25 EU companies - by R&D investment - rely on embedded systems
  - Overall R&D spending of top 25: 61 billion annually
- Embedded Systems feature strong growth
  - Number of embedded components expected to grow to 16 billion worldwide by 2010
  - Electronics will account for up to 40% of a vehicle’s value by 2010
  - A smart phone can contain millions of lines of code
  - Annual growth rate 10.3%
- Embedded systems - a European strength

Exponential growth of embedded systems

Embedded software vs. Embedded electronics

Source: Philips Research
Trends and obstacles in embedded systems

- open
- networked
- physical
- intelligent

Complexity  Software architecture today  Interoperability
R&D support for Embedded Systems in EU

Strategic Priority Embedded Systems within IST/FP6
– 58 M€ in Call 2 and 75 M€ in Call 5; also ES elsewhere in IST

ICT cluster projects within EUREKA
– MEDEA+ (2001-2008): systems on silicon; 4.0 B€ costs

National/regional programmes
– e.g. in NL: PROGRESS, ESI

EU Competitiveness Council and EUREKA Ministers call for closer cooperation and more synergy between FP and EUREKA
– Instrumental role for ETPs, JTIs
Two main priorities

- **System Design**
  - Concepts, methods and tools for model-based system design and reconfigurable architectures

- **Networked Embedded Systems**
  - Middleware and platforms for building secure, swarming and fault-tolerant systems of “cooperating objects”
Master complexity

- Model-based system design, validation and testing
  - Interoperability at the semantic level of model and tools
- Design methods, programming models and compilation tools for reconfigurable architectures
  - Mastering of heterogeneity and predictability

Key issues

- component-based and modular design; heterogeneity

International co-operation

- Specifically invited for the US
- Common research directions, joint projects

Call deadline: 21 September!
European Technology Platforms
Technological or Sectoral

Providing the means to foster effective public-private partnerships
- between the research community, industry, financial institutions, users & policy-makers
- to mobilise the research and innovation effort and facilitate the emergence of “lead markets” in Europe

"Investing in Research. An Action Plan for Europe"
The Artemis Technology Platform

*Advanced research and technology in embedded intelligence and systems*

**Aim and scope**

- Develop and drive joint European vision and strategy on Embedded Systems
  - R&D and educational challenges
  - structural challenges: IPR, open source software, standards, research infrastructure,...
- Align fragmented R&D efforts in ERA along common strategic agenda at Community, intergovernmental and national levels

ARTEMIS Steering Board includes 9 of the top-25 EU companies in terms of global R&D
Cooperation in EmS

- IST - NSF: a long history of cooperation
- Bottom-up vs. top-down
- Setting joint research agendas
  - Topics and objectives?
- Two workshops
  - Design
  - Security and Control of LSI