



*IST - NSF workshop  
Paris, 8 July 2005*

## European R&D in Embedded Systems

Kostas Glinos, Head of Unit Embedded Systems  
European Commission, Brussels



Information Society  
& Media



# *The European Union today*

Democratic countries, committed to  
working together for peace and prosperity

## **EU-15**

citizens: 370 million

GDP: € 9,180 bn

## **EU-25**

citizens: 445 million

GDP: € 9,626 bn



## **EU-15**

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

## **EU-25**

(since 1 May 2004)

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

**joining after 2006**

Bulgaria, Romania

**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



# *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**

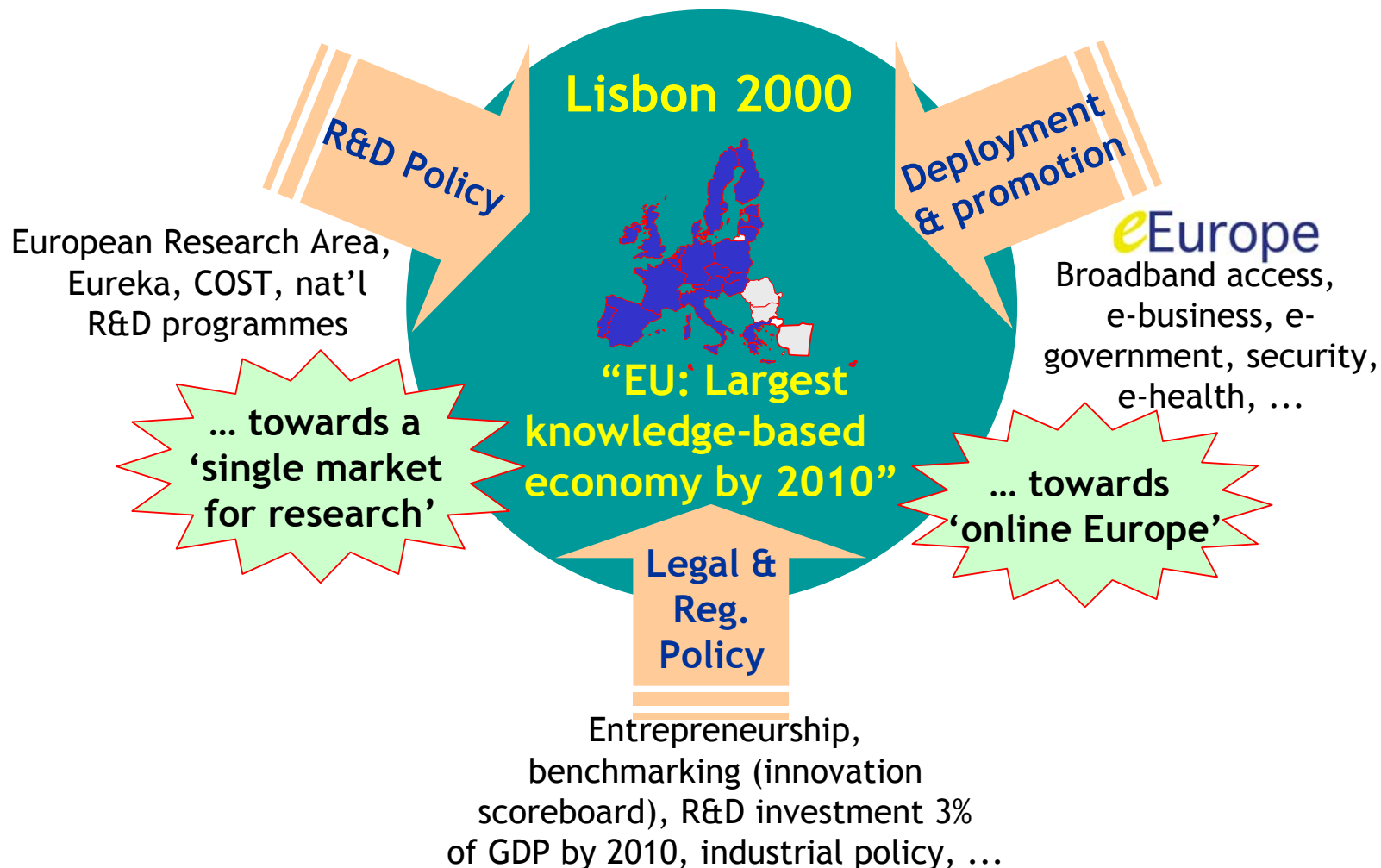
Deals with citizens' complaints about maladministration by any EU institution or body

- **European Investment Bank**

Helps achieve EU objectives by financing investment projects

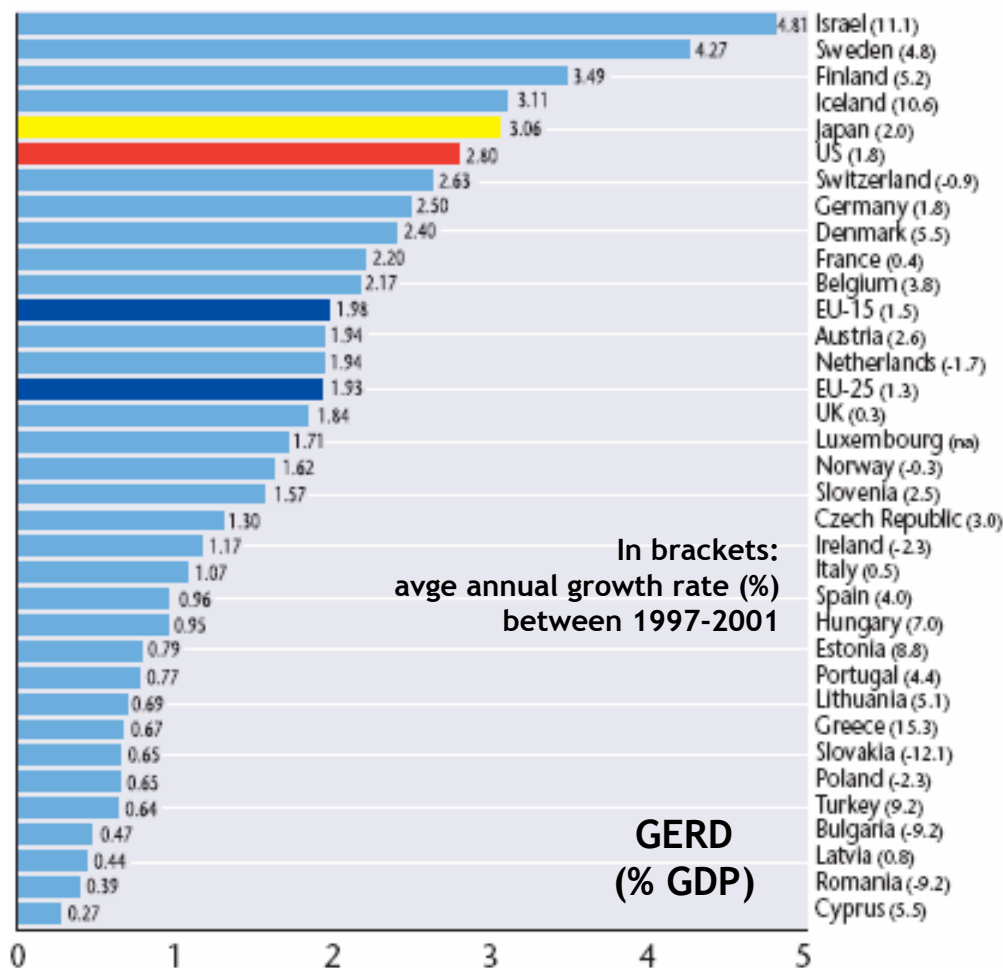


# Key Policies to Achieve Lisbon Goals





# R&D Investment (2001)



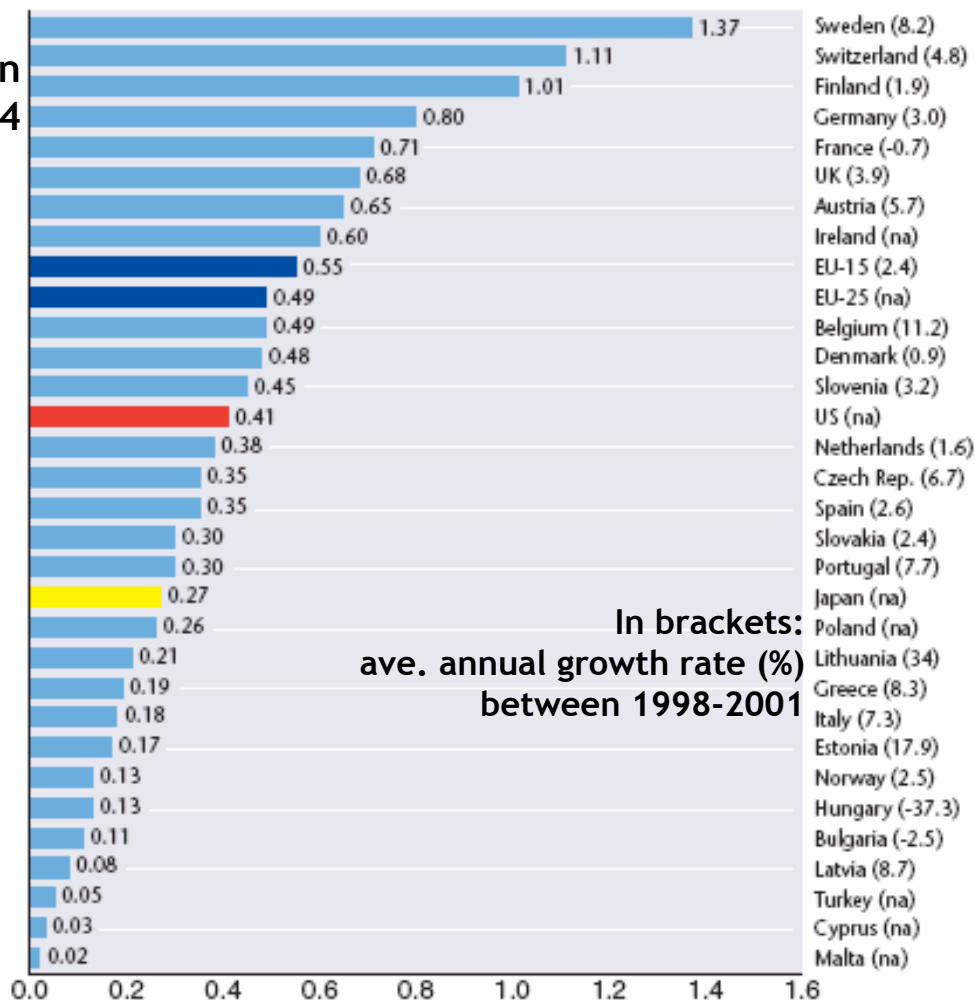
EU average still lags behind investments of Japan & US

- But EU figures are growing, slowly though
- A large variety across EU Member States
- Significant catch-up race of some laggards



# New PhDs in Science & Engineering (2001)

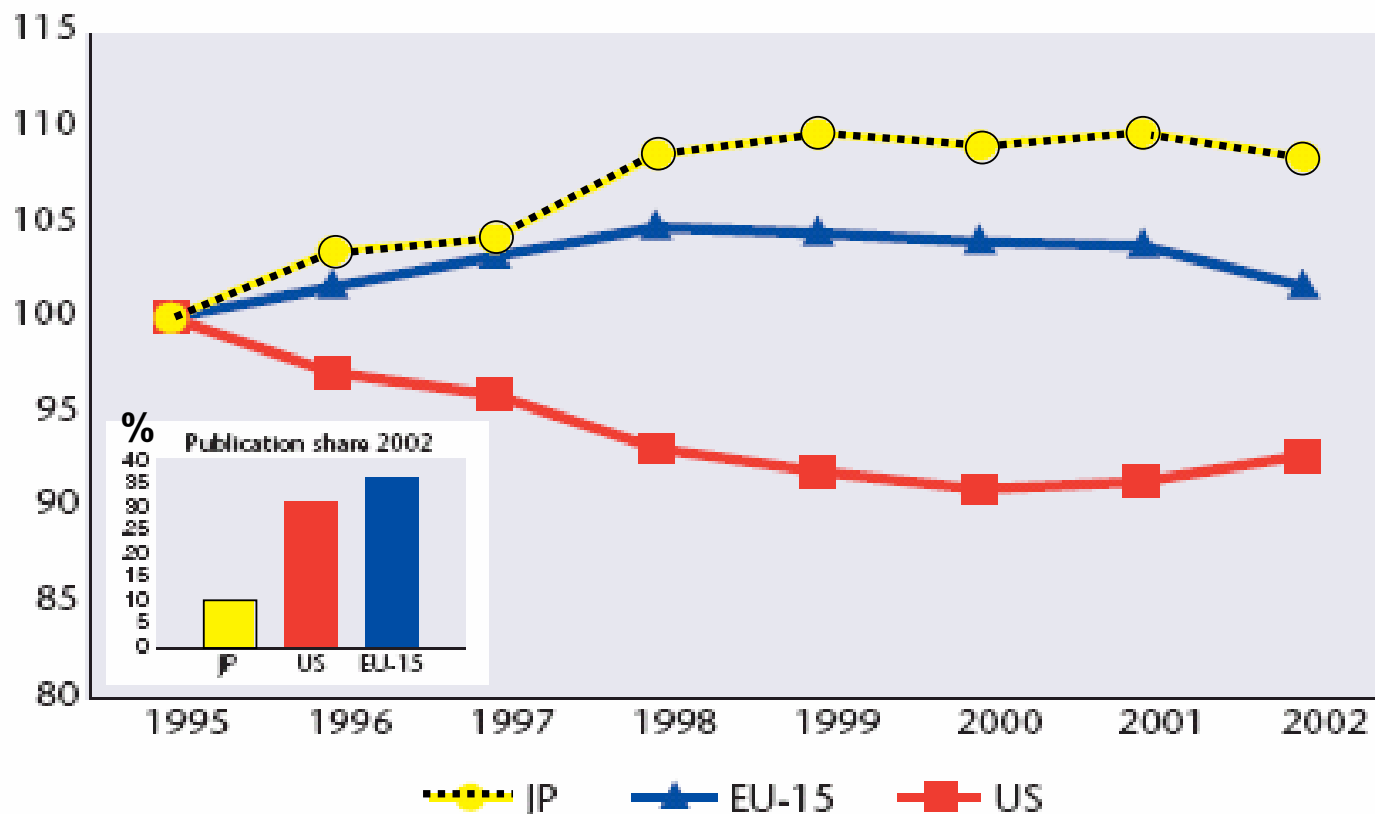
per 1000 population  
aged 25-34



In brackets:  
ave. annual growth rate (%)  
between 1998-2001



## Share of World Publications Evolution



Source: DG Research

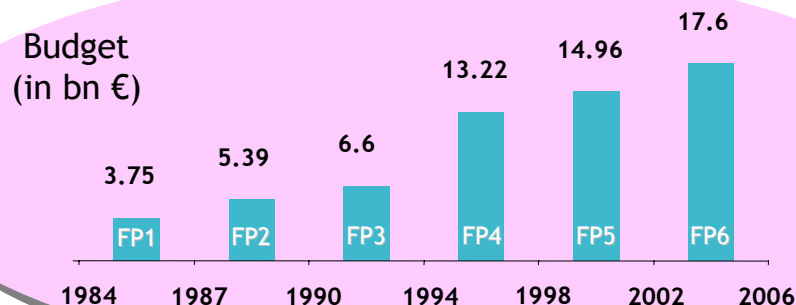
Data: ISI, CWTS (treatments), DG Research (calculations)

Key Figures 2003-2004



# More than 20 Years of EU Framework Program for Research

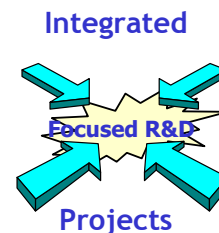
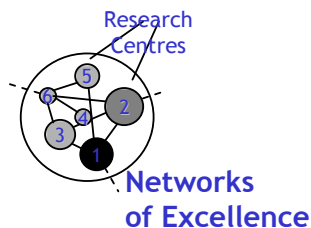
## FP evolution in last 20 years:



growing, but only  
4% of public R&D  
spending in Europe

## EU activities require:

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





# 6th Framework Program for Research

(2003-2006)  
€ 17.6 bn

	€ mn
• <b>Focusing &amp; Integrating Community Research</b>	
- Life sciences, genomics, biotech	2,255
- Information Society Technologies	3,625
- Nanotechnologies, knowledge-based materials, new processes	1,300
- Aeronautics and space	1,075
- Food quality & safety	685
- Sustainable development, ...	2,120
- Citizens & governance	225
- S&T needs, SMEs, Int'l Co-operation	1,300
- JRC non-nuclear research	760
• <b>Structuring the European Research Area</b>	
- Research & innovation	290
- Human resources	1,580
- Research infrastructures (Géant/GRID, ...)	655
- Science & society	80
• <b>Strengthening the foundations of the European Research Area</b>	
- Support to co-ordination	270
- Support to policy development	50
• <b>Nuclear research (mainly fusion)</b>	1,230



# Information Society Technologies in FP6

specific

Trust &  
Confidence

IST for societal  
challenges

IST for economic  
challenges

Demanding  
applications

Applied IST for major societal and economic challenges

Anywhere anytime natural and  
enjoyable access to IST services for ALL

Integration

generic

Pervasive, mobile,  
wireless, trustful  
infrastructures



Miniaturised, low  
cost - low power com-  
ponents &  $\mu$ systems



Natural interactions  
with 'knowledge'

communic.  
& networking

embedded  
systems  
& software

$\mu$ , nano, opto  
electronics

$\mu$  & nano  
systems

knowledge  
technologies

interfaces

Building blocks

~ 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





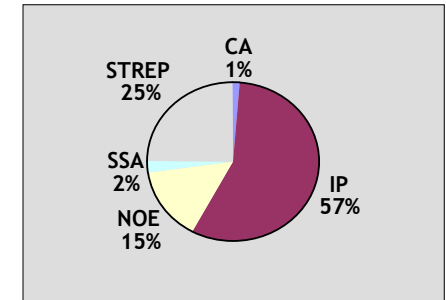
## IST: From FP5 to FP6

After two calls:

- 2500 proposals received
- 400 projects supported with ~6500 participations

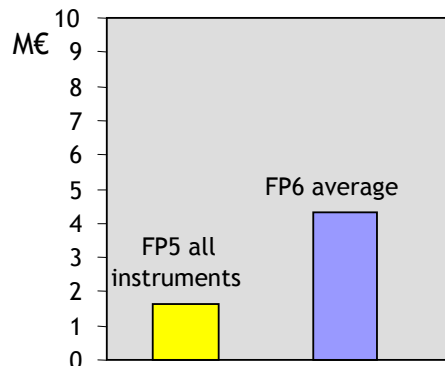
Increased size of projects

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

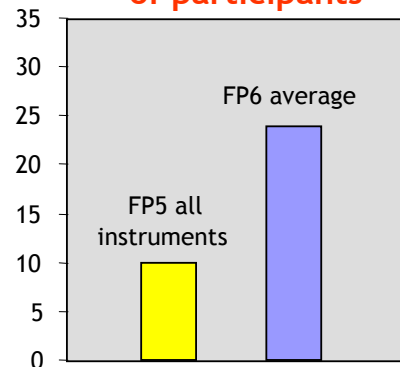


Funding per instrument,  
Calls 1 & 2

Average project funding



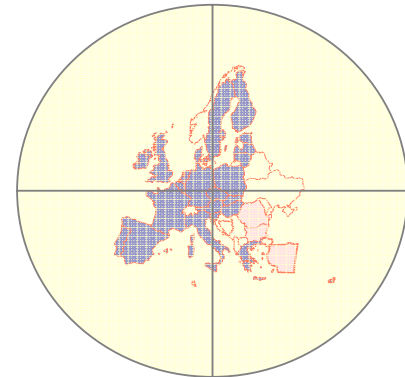
Average number  
of participants





# ***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**

# Embedding 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**

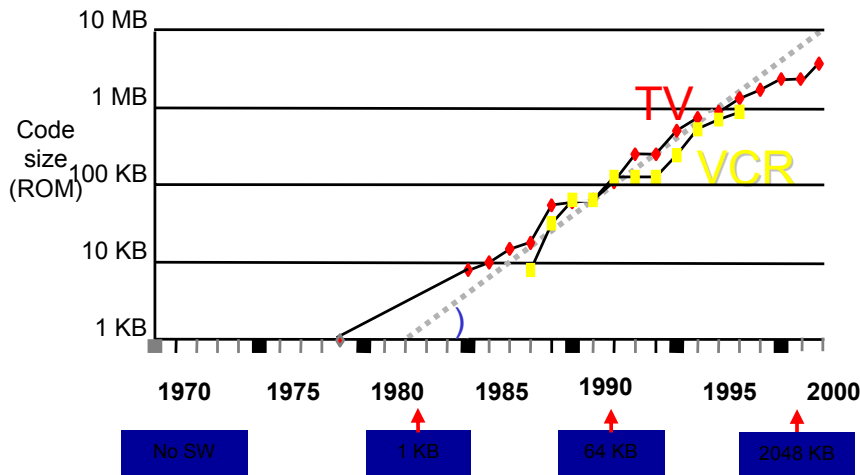


# Embedded systems facts and figures

- 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

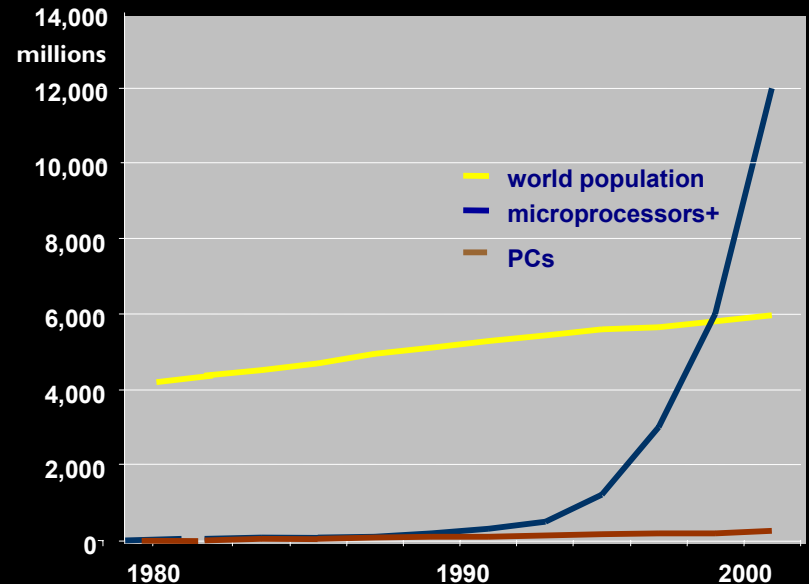
## Exponential growth of embedded systems

### embedded software



Source: Philips Research

### embedded electronics



# Trends and obstacles in embedded systems

**open**



**networked**



**physical**



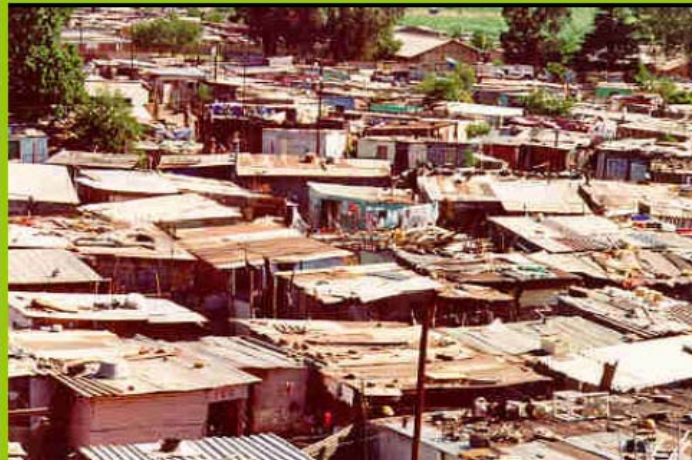
**intelligent**



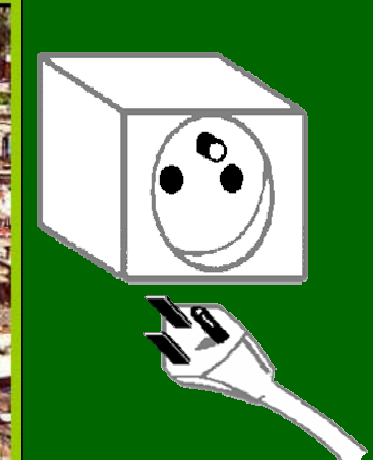
**Complexity**



**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



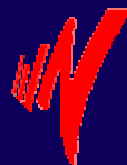
## ICT cluster projects within EUREKA

- ITEA (1999-2007): software-intensive systems; 3.2 B€ costs
- 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, JTI



## Embedded Systems in WP 2005-2006

“... next generation of technologies, methods and tools for modelling, design and implementation”

### 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”



# Embedded Systems 2005-06: System Design

## 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

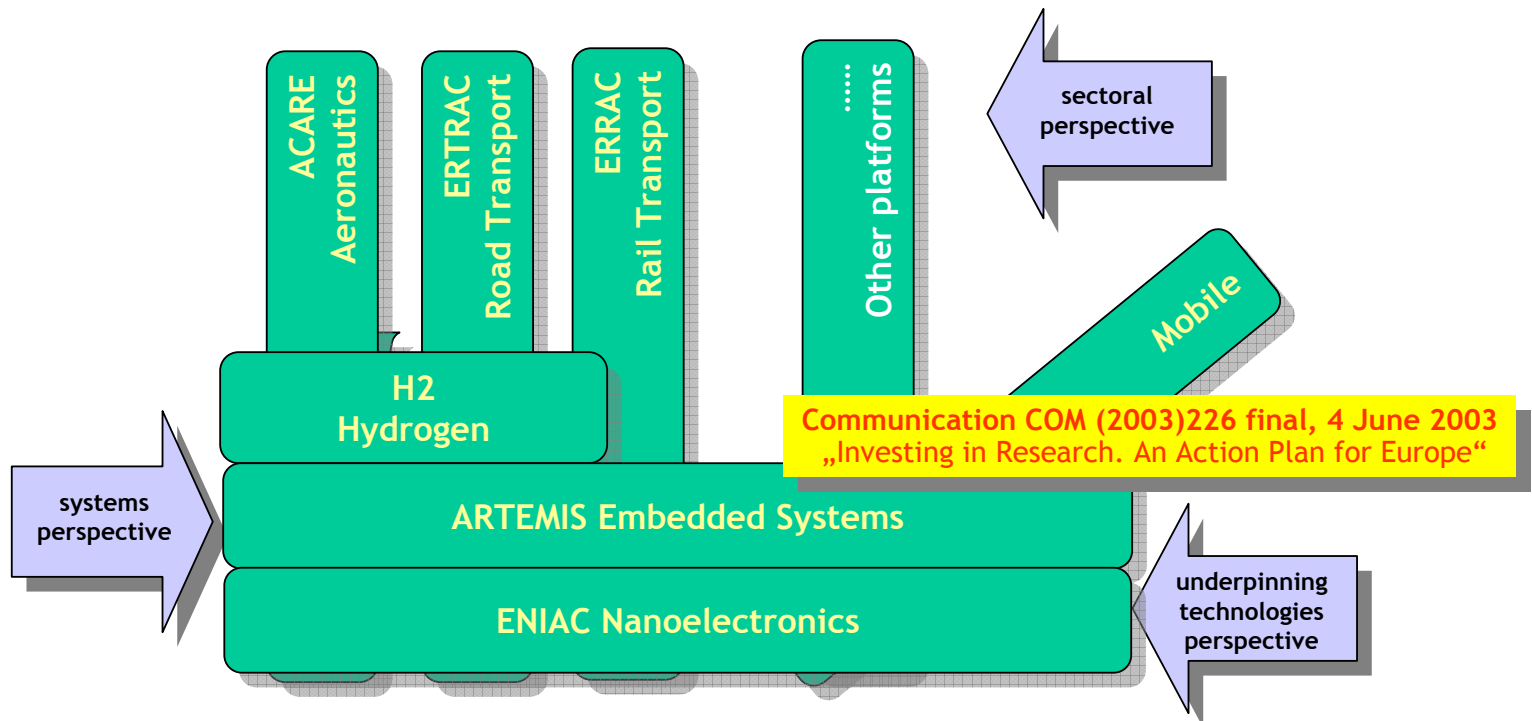
**Call deadline: 21 September!**



# 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



# 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