VLSI DESIGN CONFERENCE 1998 TUTORIAL

Embedded System Design and Validation: Building Systems from IC cores to Chips

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Welcome!

- The Evolving Flow in System Design
- A New Opportunity and Its Challenges
- Tutorial Goals and Outline

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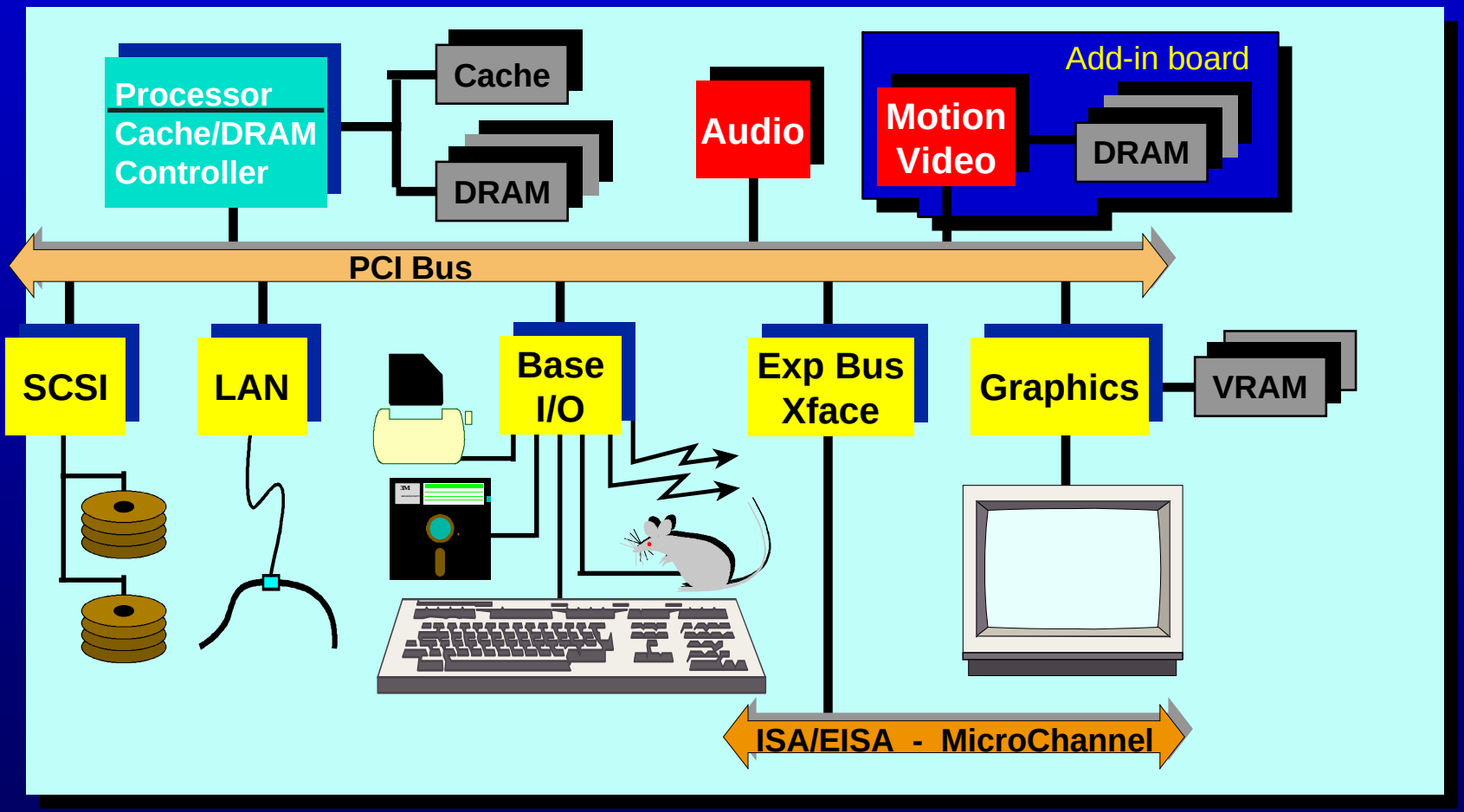
Anatomy Of A Personal Computer



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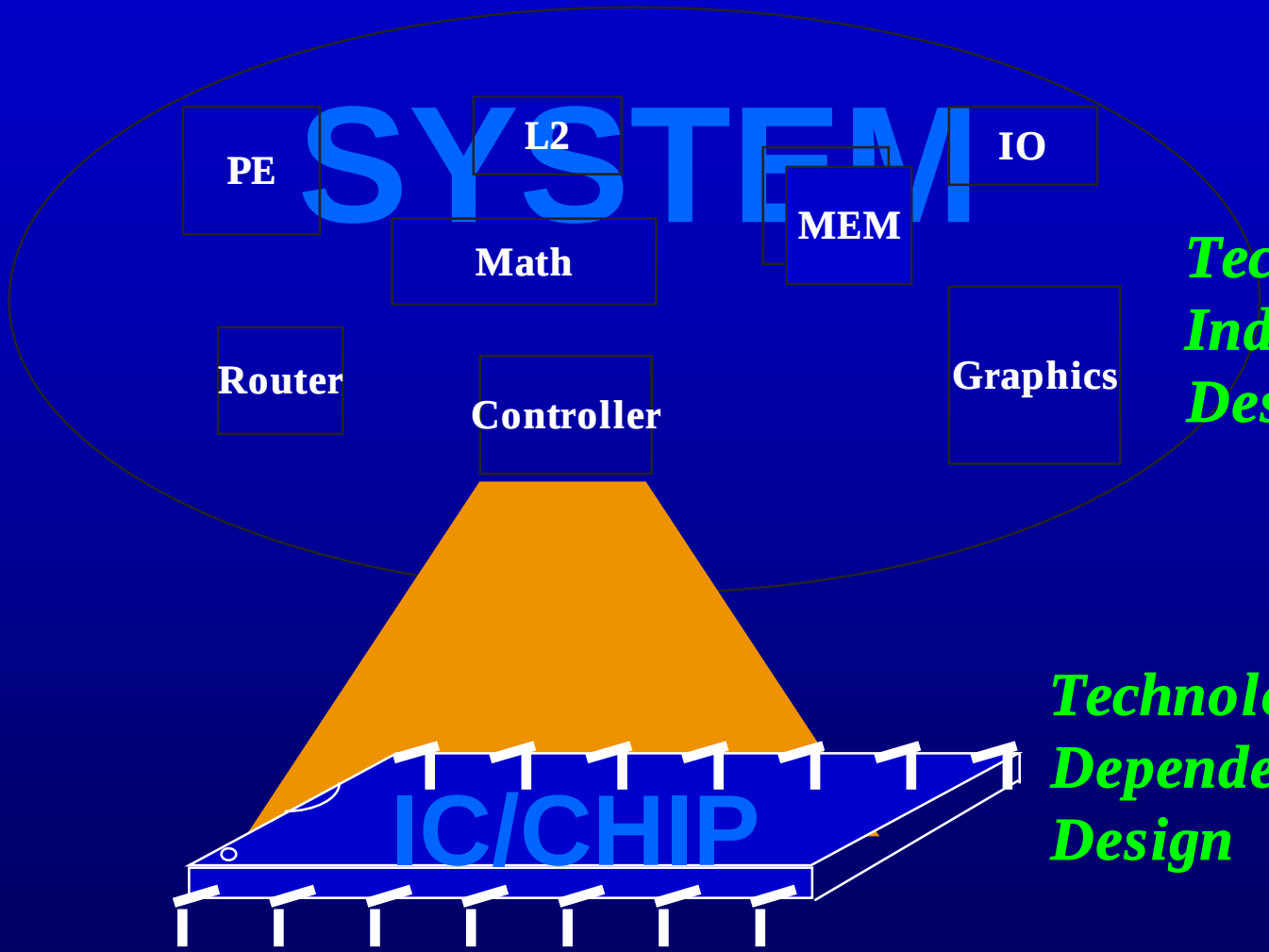
Bridge Architecture

System Design Circa 1980



Technology Independent Design

Technology Dependent Design

1987 CAVE Prediction

"ICs will be designed by system designers."

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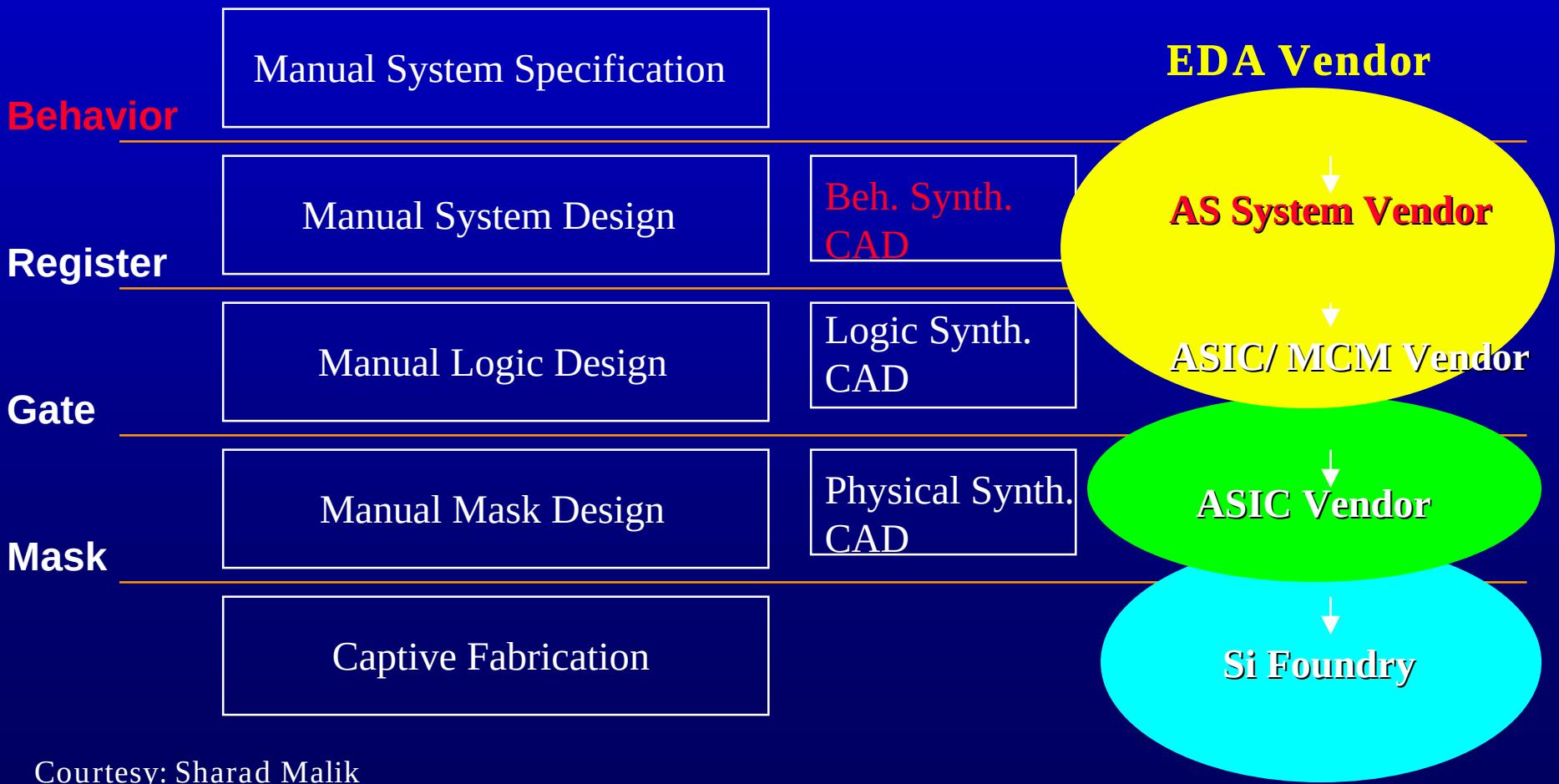
The Evolving Design Flow in IC Design



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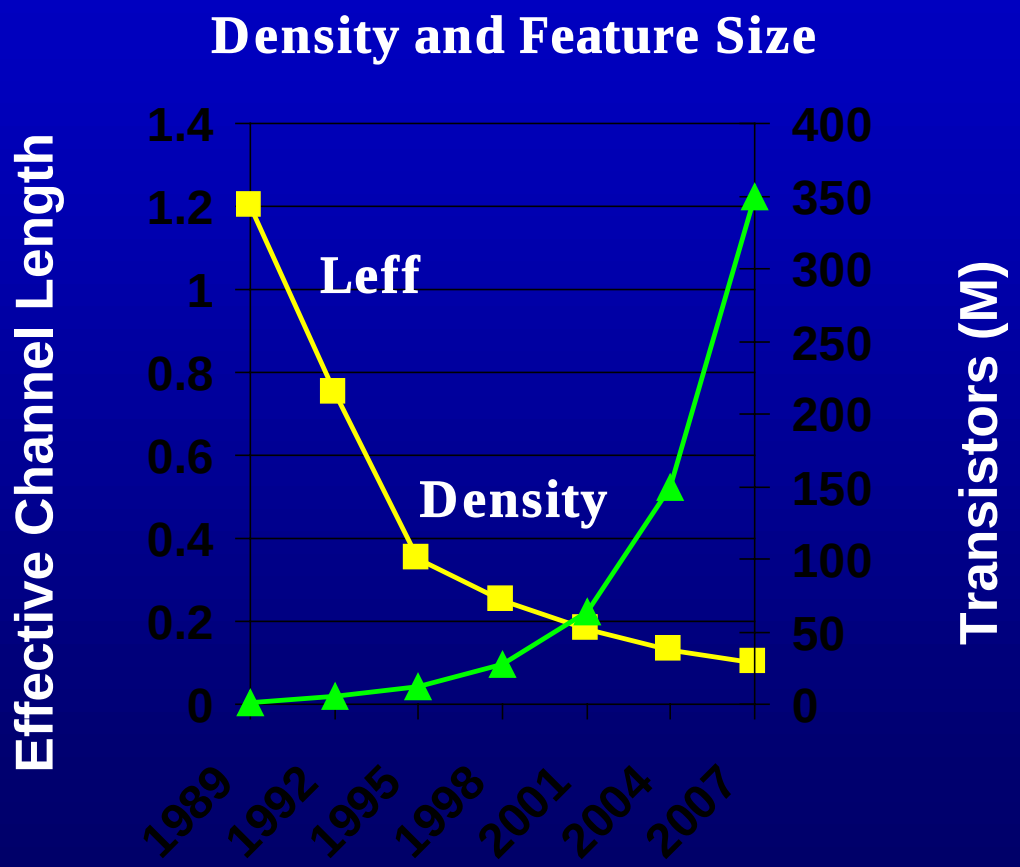
Technology Trends



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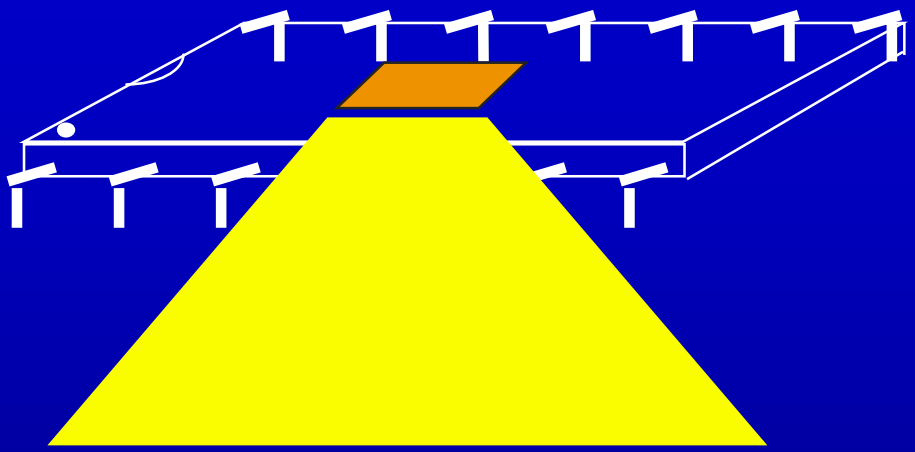
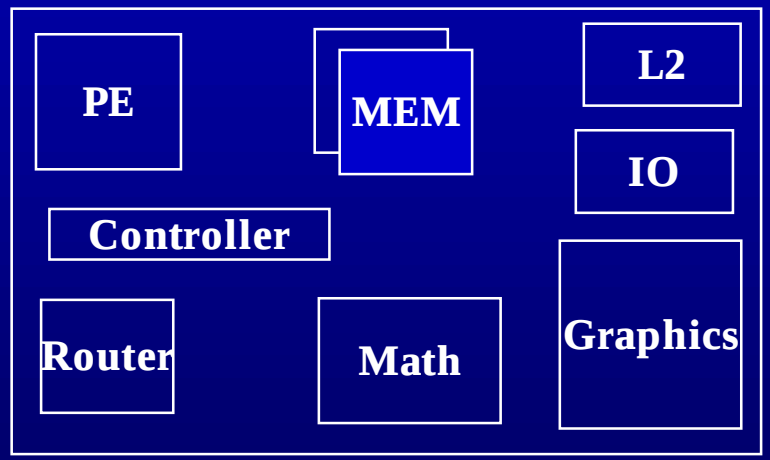
System Design Circa 2000





SYSTEM-ON-A-CHIP

"Systems will be designed by IC designers."

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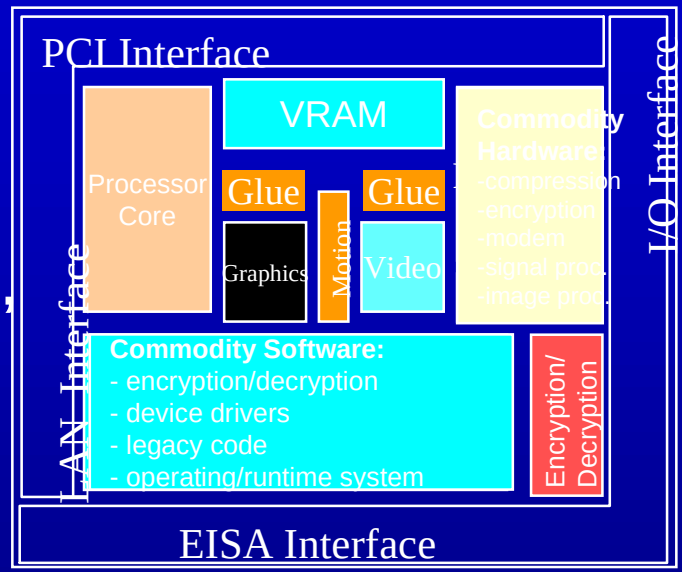
"Commodity" Components

- **Hardware**
  - microprocessor and DSP "cores"
  - network interfaces (PCI bridges)
  - video, audio engines: compression, decompression
  - data encryption engines
  - modems
- **Software**
  - encryption procedures
  - device drivers, I/O procedures
  - signal and image processing
  - operating and runtime system



Hub Architecture

These components represent significant "Intellectual Property", i.e., products of technology, software, know-how that is subject to patents, copyrights.

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A New Opportunity

ICs on a PC board → *Cells on an IC (Chip)*

- Rich cell libraries of predesigned, preverified components
- Technology import, technology leverage
- Highly integrated, compact, portable end products
- Reuse design blocks across systems/chips
- Quickly differentiate/personalize systems
- Significantly reduce time-to-market

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Creating A New Market

"Third Party IP Providers"

- Combine traditional roles of "EDA", "ASIC" and "Foundry" services.
- Provide design specifications
- Synthesizable cores, design documentation
- Implementation guidance
- Examples:
  - Virtual Chip Group of Phoenix Technologies
  - Mentor's 3Soft, DSP Group, Zoran, VLSI Cores
  - Sand Microelectronics, ASIC Intl., Eureka Technologies, VAutomation Inc, Western Design Center, Symbios, LogicVision, Palmchip, ...

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Tutorial Goals

- Describe technologies important to embedded systems
  - what is involved in system design
  - what are the steps, and where are the bottlenecks
- Describe the state of the art
  - existing concepts and established tools
  - research ideas and where are we heading in system design?

These lectures will not:

- describe detailed algorithms
- describe detailed designs using cores.

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Tutorial Outline

I. Embedded Systems and Co-Design
- Characteristics, applications
- Co-design tasks
- Core-based design

II. Validation Issues in Embedded System Design
- System modeling and validation components
- Emulation technologies
- Compliance test environments
- ISA simulation, co-simulation
- Formal verification

- III. Software Issues in Embedded Systems
  - software compilation and optimization techniques
  - runtime and operating system support
  - software analysis

IV. The Future and Open Discussion