Multi Core Design Needs A System Level View

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Agenda

■ **The Business Case for Multicore**

■ **The Need for ESL tools**

■ **The Embedded Software Challenge**

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Key Issues

- SoC => **System** on Chip

- The continued success of an SoC platform lies in the strength of the software

- Multicore systems are the new generation of SoCs

- How will ESL tools and methodologies help solve SoC design and implementation problems?

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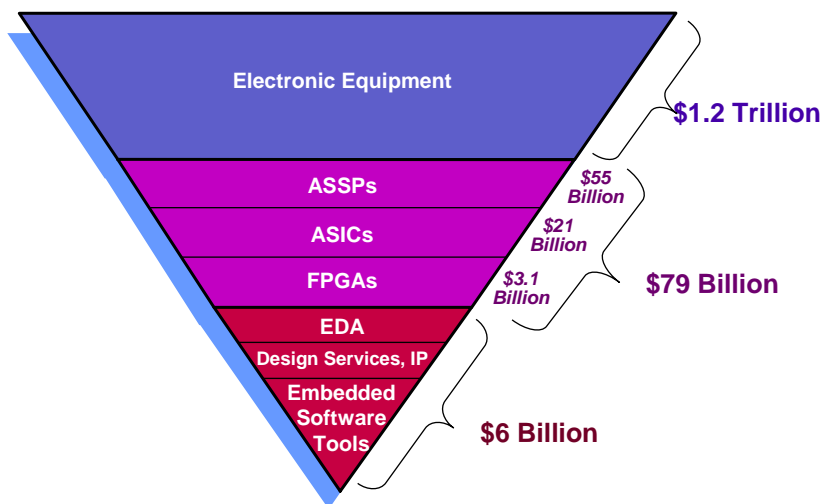
SoC: Its more than a chip

- It's a HW & SW & System Level Design Challenge

- It's multi-feature convergence on one platform!

- It's a design-time race against the Clock

- It's a big market opportunity

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The Business Case for MultiCore
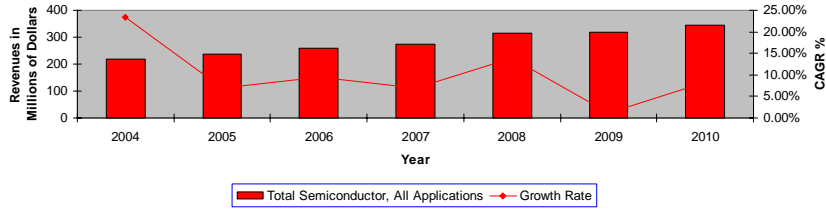

The Electronic Supply Chain in 2005

Electronic Equipment

$1.2 Trillion

ASSPs — *$55 Billion*

ASICs — *$21 Billion*

FPGAs — *$3.1 Billion*

$79 Billion

EDA

Design Services, IP

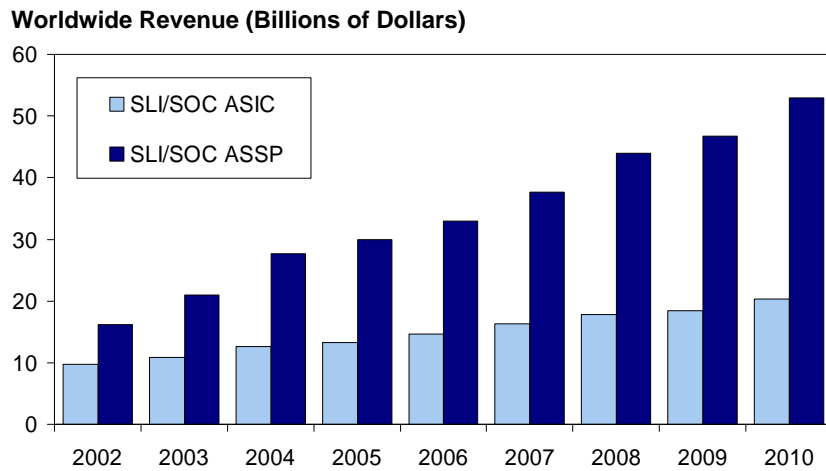Embedded Software

Tools

$6 Billion

Semiconductor Market Update, 1Q06:
Top Line Forecast

- **2005**: **Market conditions gradually improving**

- **2006: Continued market growth expected**

- **2007: Commodity memory downturn hampers top line growth**

- **2008: Cyclical market peak**

- **2009: Oversupply driven down cycle**

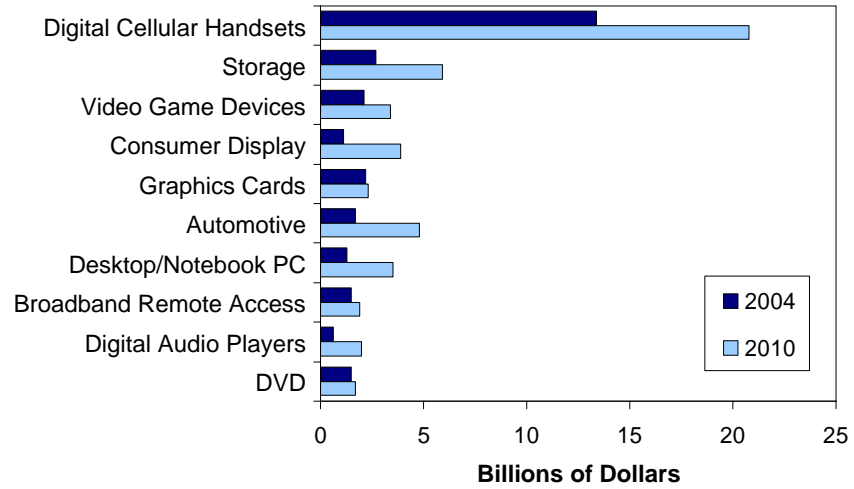- **2010: Market recovery as the next cycle begins**

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SLI/SOC Market Has Great Potential

Worldwide Revenue (Billions of Dollars)

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Top SLI/SOC Markets

Market	Billions of Dollars
Digital Cellular Handsets	2004: ~13.5, 2010: ~21
Storage	2004: ~2.5, 2010: ~6
Video Game Devices	2004: ~2, 2010: ~3.5
Consumer Display	2004: ~1.5, 2010: ~4
Graphics Cards	2004: ~2, 2010: ~2.5
Automotive	2004: ~1.5, 2010: ~5
Desktop/Notebook PC	2004: ~1.5, 2010: ~3.5
Broadband Remote Access	2004: ~1.5, 2010: ~2
Digital Audio Players	2004: ~0.5, 2010: ~2
DVD	2004: ~1.5, 2010: ~2

Billions of Dollars

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Its A Design Challenge!

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SoC is a System

- SoCs require <u>both</u> software and hardware

App #1 **App #2** **App #3** **App #4** **App #5**

Embedded Middleware

RTOS

HW/SW binding layer/HAL

HW=DSP+ CPU + Memory+Control Logic +

EDA Tools

Programming API

Embedded SW tools and RTOS

Firmware (drivers, low level architecture controllers) arch specific

ESL tools
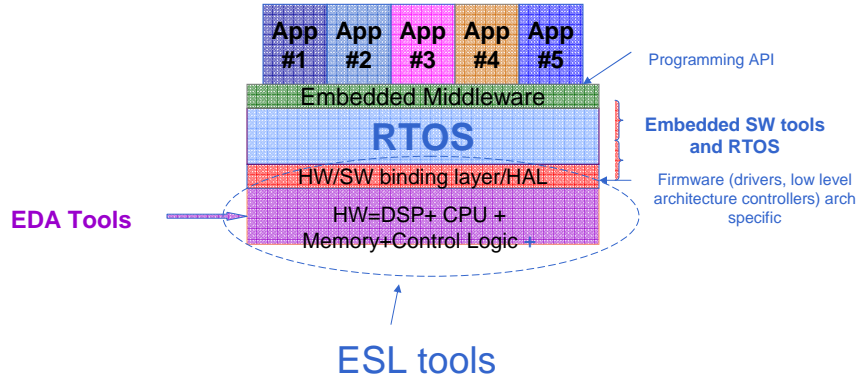
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Software Engineer View

- RTOS, Applications

SW engr view of ESL Tools

Apps Apps **Apps** **Apps** **Apps**

Embedded Middleware

RTOS

HW/SW binding layer/HAL

EDA Tools

Programming API

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Software engineer view of platform
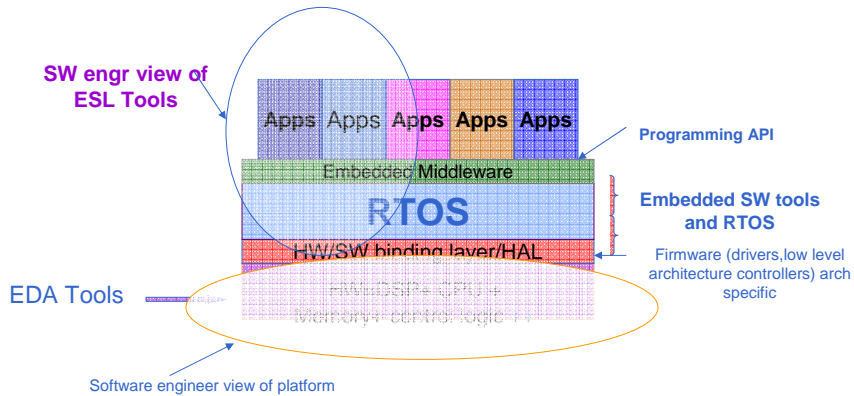
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Hardware Engineer View

■ Applications=algorithms in hardware

Hardware engineer
view of platform

Apps | Apps | Apps | Apps | Apps

Embedded Middleware

RTOS

HW/SW binding layer/HAL

HW=DSP+ CPU + Memory
control logic++

Programming API

**Embedded SW tools
and RTOS**

Firmware (drivers,low level
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EDA Tools

HW engr view of ESL Tools
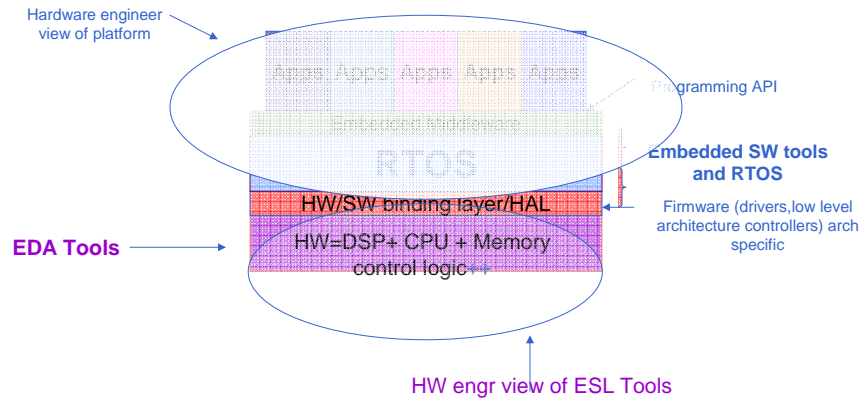
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ITRS 2005 High Level Challenges

■ Productivity
■ Power
■ Manufacturability
■ Interference
■ Reliability

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SoCs Need a System Level View

- For early exploration of the design, verification and validation

  - Design: partitioning decisions
  - Verification: does the product do what it is supposed to
  - Validation: does it match the specification
  - Manufacturing: can it be manufactured

- The cost of failure is high

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Key Issues for Product Development

- Design times are down sharply from where they were 10 years ago
  - Under 12 months for consumer and 3 years for automotive
  - Commoditization of hardware is forcing semi and systems vendors to look for the differentiation and competitive edge in software

- Applications are driving the hardware markets
  - Hardware selection is being made based on the goodness of fit of the SoC for the particular application. Platforms tend to be applications specific.
  - Protocol/standards support

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Key Issues for Product Development(2)

- Feature explosion in many vertical markets
  - Support for multiple applications on a single device
  - Manage IP from multiple sources

- Driving the need for multi processor SoC cores, application specific processors

- Which drives the need for even more software
  - **Intra-processor communication**
  - **OS services**
  - **Middleware layers**

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The ESL Vision

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The ESL Vision

- The goal is concurrent design of hardware and software driven from a single high level model.

- The model should describe the system architect's vision AND should have an automated implementation path to the virtual prototype which can be tested and verified against the specification
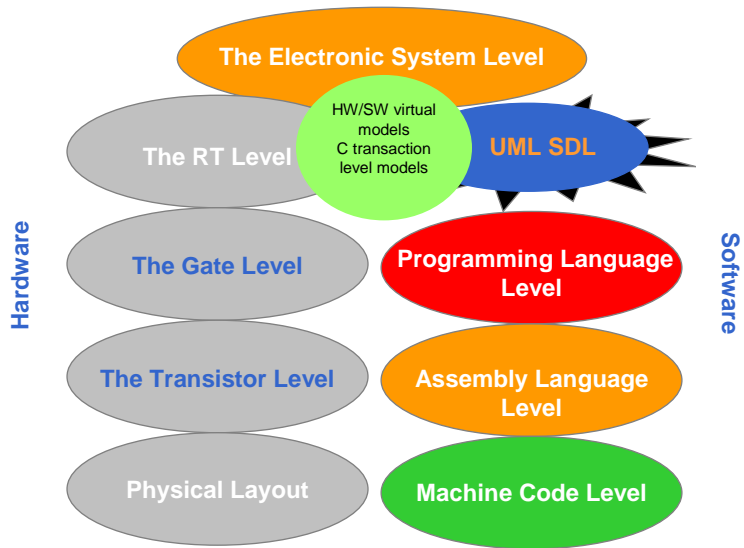
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The New ESL Landscape 2006

Algorithmic Methodology	Processor/Memory Methodology	Control Logic Methodology
Behavioral Level	Behavioral Level	Behavioral Level
Hardware-Software Partitioning		
Architectural Level	Architectural Level	Architectural Level
1. Architectural Design	1. Architectural Design	1. Architectural Design
2. Platform-Based Design	2. Platform-Based Design	2. Platform-Based Design
ESL Verification		
Other ESL Tools		

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The Automation of Design: 1999–2005

The Electronic System Level

HW/SW virtual models
C transaction level models

UML SDL

The RT Level

The Gate Level

Programming Language Level

The Transistor Level

Assembly Language Level
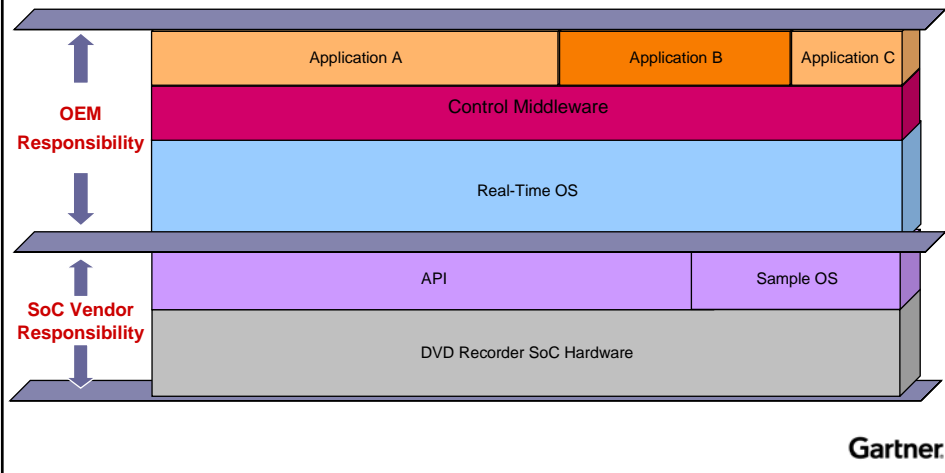
Physical Layout

Machine Code Level

Hardware

Software

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The Embedded Software Challenge

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SoC Embedded Software — 2000

SoC Vendor With Limited Responsibilities

OEM Responsibility

SoC Vendor Responsibility

Application A | Application B | Application C
Control Middleware
Real-Time OS
API | Sample OS
DVD Recorder SoC Hardware

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SoC Embedded Software — 2005

SoC Vendor With a Greater Role

OEM Responsibility

SoC Vendor Responsibility

Application A | Application B | Application C
Control Middleware
Real-Time OS
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DVD Recorder SoC Hardware

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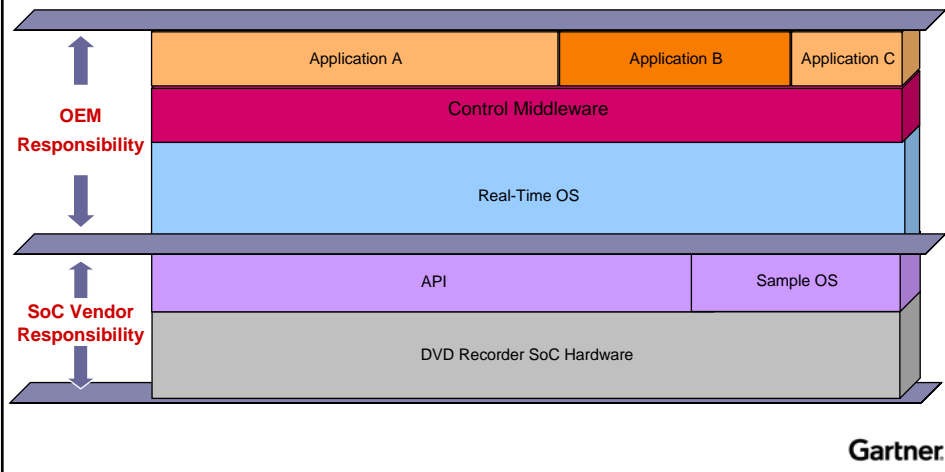
Software Challenges

- Power and reliability are especially important for consumer devices

- Software consumes more power than an implementation in hardware

- 2G SoC devices require different software programming techniques than currently practised

- Are we ready for 2G SoC?

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