Embedded Systems Requirement: Hardware/Configware and Software as Alternatives

Algorithm

partitioning

Hardware, Configware
Software

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fine grain and coarse grain Morphware

• Microelectronics History
• fine grain and coarse grain Morphware
• Anti Matter of Computing
• Anti Machine and its Resources
• Problems to be solved

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Top 4 FPGA Manufacturers 2000

You do not need specific silicon!

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Configware and EDA as the Key Enabler

• Growing no. of independent configware houses (soft IP core vendors) and design services provide libraries of "pre-fabricated" re-usable IP cores
• Synplicity 57%,
  • Mentor 37%,
  • Synopsys 7%
• Emerging separate EDA software market - FPGA synthesis [2001: Dataquest]:
  • Synplicity 57%,
  • Mentor 37%,
  • Synopsys 7%

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Throughput vs. Efficiency

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Commercial rDPAs

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**Antimatter of Computing is available**

- Using FPGAs (fine grain morphware) has been just ‘Logic Synthesis’ on a strange platform
- **Coarse Grain rDPAs (Reconfigurable Computing):**
  - a fundamental Paradigm Shift
  - up several abstraction levels
- Data-stream-based Computing

**Anti Matter of Computing**

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**The anti universe**

- Paul Dirac predicted a complete anti universe consisting of antimatter
- “There are regions in the universe, which consist of antimatter…”
- “...But there are asymmetries”
- when a particle hits its antiparticle, both are converted into energy: Annihilation
- We are not aware, that there is a new area in computing sciences, which consists of antimatter of computing
- Reconfigurable Computing is made from this antimatter: data-stream-based computing

**Anti particles**

- 1928: Paul Dirac: “there should be an anti electron having positive charge” (Nobel prize 1933)
- 1932: Carl David Anderson detected this “positron” in cosmic radiation (Nobel prize 1936)
- 1935: Owen Chamberlain et al. create anti proton on Bevatron
- 1954: new accelerators: cyclotron, like Berkeley’s Bevatron
- 1965: creation of a deuterium anti nucleus at CERN
- 1995: hydrogen anti atom created at CERN – by forcing positron and anti proton to merge by very low energy.

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Matter & Antimatter: Atom and Anti Atom

The World of Matter - machine paradigm: the Atom
- Electron spinning
- Positron spinning

Anti Matter - machine paradigm: Anti Atom

Matter & Antimatter of Informatics: Machine and Anti Machine

CPU
- Instruction stream spinning
- Machine paradigm: "von Neumann"
- Novel compilation techniques

DPU
- Data stream spinning
- All ingredients available

Matter vs. antimatter: CPU vs. DPU
- There are asymmetries

Parallelism by Concurrency
- Independent instruction streams difficult...

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Dichotomy of machine paradigms

Terminology: DPU versus CPU ...

Terminology: Digital System Platforms clearly distinguished

Configware / Flowware Compilation

... for a Stream-based Soft Machine

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Enabling Technology for Reconfigurable Computing; Seminar Prof.
José Camargo da Costa, 22 Nov 2002, ENE UnB, Brasilia, DF, Brasil

GAG Slider Operation Demo Example

GAG Complex Sequencer Implementation

Generic Sequence Examples

Storage scheme optimization: scanline unrolling
MoM anti machine architecture

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http://kressarray.de
Problems to be solved

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What is the trend?

- VN is needed for embedded systems, OS, compilers, Superknot software, non-performance-critical applications, others...
- VN is obsolete for massive parallelism, except some special application areas
- Anti machine is the way to go for massive parallelism, also data-intensive applications
- Morphware is the way for high performance with short product life cycles, unstable standards
- Data-stream-based Computing is heading for mainstream

Problems to be solved

- Lack of qualified users and implementers
- Each programmer should have qualified awareness on dichotomy and morphware
- Curricular innovations are urgently needed

Conclusion: all knowledge needed is available

- Machine paradigm
- Languages
- HW/SW partitioning methodology
- Compilation techniques
- Anti architectural resources
- Sequencing methodology: hw & sw
- Parallel memory IP core and module generator vendors
- Anything else needed

Annihilation?

Avoidable by careful methodology
... is based on the Submarine Model
This model disables ...

Hardware invisible: under the surface
Software visible: at the surface

Brain usage: procedural-only

Algorithm

Software

procedural high level Programming Language

Assembly Language

Hardware

procedural

structural

Algorithm

Hardware, Configware

Software

partitioning

Hardw/Configw only

Software only

Software & Hardw/Configw

procedural

structural

Brain usage: both Hemispheres

Hardware, Configware

Software

partitioning

Hardw/Configw only

Software only

Software & Hardw/Configw

procedural

structural

The Dominance of the Submarine Model ...

(procedural) structurally disabled

... indicates, that our CS education system produces zillions of mentally disabled Persons

... completely disabled to cope with solutions other than software only

It’s time to attack the software faculty dictatorship. Get involved!

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Antimatter Search ?

in EE & CS we do not need to search

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