When Girls Design CPUs!

An overview on one of the world’s most famous CPU cores: ARM
Once Upon a Time…

• There was a company in UK
  • Acorn
• This company was the competitor to
  • IBM
  • Apple
• They were creating personal computers and selling them
• BBC company signed a contract with Acorn
  • To create a computer for BBC
BBC Micro

- Used a processor
  - MOS Technology 6502
- BBC advertised for BBC Micro widely
- All of the schools in UK used BBC Micro for education
- Also some universities
- And research laboratories
- Acorn was thinking about the next product
  - They needed a better CPU
  - CPU should be owned by themselves
Acorn’s own CPU!

- Acorn decided to have its own CPU
- But how?
  - It required a great background
  - Acorn has nothing as the background to perform this task
- At same time at Berkley
  - A team of graduate students
  - Designed a new purely RISC cpu
  - They published some papers
  - CPU was competitive to CPUs on the market that time
- Acorn found the papers!
- It was a great starting point!
The journey to the west!

- Acorn decided to send some of its engineers to learn required info about creating CPUs
- Selected engineers
  - Sophie Wilson
  - Steve Furber
- They travelled to Western Design Center
- They learned
  - Creating a new CPU is not that much difficult!
Designing the CPU

• Sophie Wilson
  • Began to develop the *instruction set* for the new CPU
  • She also developed the basic new CPU structure
• She talked to Acorn CEO
  • Convinced them the new design is good
• A team of engineers
  • Helped Wilson to create CPU circuits
• VLSI technology was selected to build the CPU
The CPU by Wilson

• The new CPU
  • Had a very simple architecture
• No cache memory!
• No DMA controller!
• No Memory protection mechanism!
• No multiple register banks!
• No delayed branches!
• No Single cycle execution of all instructions!
• ...
• Nothing!!!!
Acorn’s first CPU

• Designers omitted every risky part of CPU
• Just kept simplest sections
• Result: a very simple CPU
  • And so: its power consumption was very small
  • And this was the revolution!
Acorn RISC Machines

• Acorn had now a better name
  • Acorn RISC Machines
• April 1985
  • Acorn RISC Machine introduced their first CPU
  • ARM1
• Using ARM1 machine Wilson developed “BBC Basic”
  • BBC Basic was developed for ARM1
  • Used to create CAD software required for development of ARM2
• 1986
  • ARM2 was in the market!
ARM2 Processor

- 32Bits data bus
- 26Bits address space
- 16 Registers 32Bits
- ARM2 was simplest 32Bits processor of the world
- Transistor count: 30,000
- Intel 80286 transistor count was: 134,000
- ARM2’s performance was better than 80286
- ARM2’s power consumption was much lower
- Transistor count growth for arm
  - Very slow
  - ARM6 was 35,000 transistors
In 1990, Apple, Acorn and VLSI Technologies joined forces to further enhance the ARM architecture. A new company was created, a spin-off from Acorn that became Advanced RISC Machines. This company then began its existence.
ARM6

- 1992
  - ARM6: The result of effort by ARM and Apple
  - ARM610 CPU used by Apple in PDAs
- DEC company licensed ARM6 core
  - It enhanced ARM6 architecture and created StrongARM
- StrongARM was then given to Intel
  - Intel implemented a high performance implementation of StrongARM
  - Intel called it: Xscale
  - Intel sold Xscale to Marvell
What is a core?

- A core is a ready to use design
  - Hardware
    - A piece of ready to use silicon (transistors and wires)
    - A circuit consisting gates and their connections
      - Should be converted into Silicon
  - Software
    - Source code of the core in a hardware description language
- You purchase the core
  - You put the ready-to-use core into your design directly
ARM Cores

• ARM company
  • Does not sell chips
  • Sells CPU cores
• ARM licenses CPU cores to other companies
• They use the core to build their own chip
  • Microprocessor
  • Microcontroller
• They add their own peripherals to the chip
• They sell their chips
  • One part of obtained money : will go back to ARM company
ARM Financial Status

• In 2005
  • ARM sold 1.6 billion cores
• In 2006
  • 2.45 billion cores were sold
  • Income:
    • Royalties: $164.1 million
    • Licensing revenues: $119.5 million (65 Licenses signed)
• In 2011
  • Predication: ARM will sell 5 billion ARM cores
• In 2007
  • 98% of mobiles phones contained some sort of ARM core
• In 2009
  • 90% of 32Bits embedded systems were based on ARM
## ARM core Families & Architectures

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