

On the Bright Future of Hardware Acceleration

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Talk Overview

- FPGAs at Microsoft
- Vision
- Obstacles

Microsoft Research

- Founded in 1991
- Staff of 750+ in over 55 areas
- Small part of the overall R&D ~\$6 Billion
- Research locations:
 - Redmond, Washington, USA
 - Silicon Valley, California, USA
 - New England, Massachusetts, USA
 - Cambridge, United Kingdom
 - Beijing, People's Republic of China
 - Bangalore, India

MSR Mission Statement

- Advance the state of the art in our chosen areas of computer science
 - Making computers easier to use
 - Reducing the cost of computing
 - Making software developers more productive
- Transfer technology to Microsoft businesses

Some of those 55 areas are..

- Platform Elements
 - Networking, Distributed systems, Operating systems
 - Embedded Systems
 - Security, Protection against Malware
- Reinventing Software Development
 - Languages, tools, compilers
- Data and Documents
 - Data Solutions for a Terabyte World
 - Search
 - Fighting SPAM
- UI and Collaboration
 - New UI – Speech, Ink, Gesture, Natural Language
 - Meetings and Collaboration
 - Modeling of People and Groups
- Media
 - Graphics and Multimedia
 - Digital Photography and Video
- Science
 - AIDS Vaccine, Quantum Computing, Astronomy
 - Algorithms, Cryptography

FPGA activities in MSR

- SVC: Computer Architecture, Applications
- Redmond: Processors, OS, Tools, Applications
- Cambridge: Programming Languages
- Beijing: System building
- Bangalore: nothing 😞

SVC (Mountain View)

- Chuck Thacker: BEE3, Beehive



- John Davis: SSD, SAT solvers, BLAS



Redmond

- Ray Bittner: CAM machine, Zippy
- Ken Eguro: security, SPAM, Bioinfo, SIRC
- Alessandro Forin: eMIPS, OS, Tools
- Andrew Putnam: new processor
- Turner Whitted: graphics (VX)



Beijing

- Feng-Hsiung Hsu (CB): building boards for use in..
 - higher-level education
 - search



Cambridge (UK)

- Satnam Singh: Accelerator, C, C#, functional languages, ..



FPGA activities in Prod. Div.

- Prototyping in hw devdiv (kbd/mice/cameras)
- Some testing in Windows
- Windows Automotive shipped once

Vision for an FPGA program?

Total Domination

- Soft-FABs will eliminate VLSI entirely
- There are no better alternatives!
- ..but we need to rewire all the developers

Lessons from the GPU experience

- Follow the money!
 - games, GUI, and.. ahem.. pornography??
- Direct-X made it happen
 - Stable&flexible API, industry commitment
- Portability
 - shader language, compiled on the fly
- Hard to use is ok.. if trivial to design for
 - “graphics is just one big matrix”

Low-hanging fruits?

- Data centers
- Portables
 - Leverage the lower-power advantage!

How low do they really hang??

- Data center:
 - PCI-X boards are *all* non-standard
 - RESETs across reprogramming (PR can help!)
 - excess power
 - design trade-offs (FPGA chips/board?)
 - price!
- Portables:
 - only the Pico guys have tried so far??
 - power
 - price!

One word: Usability!!

- Why is it that even GPUs are “easier to use” ?
- ..after 20+ years!!!!
- Matlab and.. nothing else?? Still.. doesn't fly.
- Stop saying that it does not fit!
 - You got slop now, use it.
- Performance is nothing without users.

Other Serious Obstacles

- Software developers must learn parallel programming (in school?)
- Area scales, but there's no modularity
- PR: promising but even harder to use
- Where are the APIs?? to write free tools, to make bitfiles portable, to build the new “virtuous cycle”..

Reversing direction

- User comes first
 - Other than network switches.. what?
- ..then the tools / programming language
 - Verilog is way overdue for a refresher
 - Domain-specific is small and beautiful, but.
 - Where are the DLLs?
- ..then the compilation tools
 - .. And force your students to use actual chips
 - “debugging” anyone?
- ..then the architecture
 - “portability” anyone?
- ..then Altera and Xilinx.