Programming Systems consisting of Processors and FPGA technology

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Xilinx
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The Stack

Driving Applications

- Specification Exploration
- Verification
- Programming Models; Compute Models

Languages

Compilers

Intermediate Format

Run time / OS adaptation

API / Platform Abstraction Layer

Middleware/Overlay Architectures

Computation Hardware
- CPU, GPU, FPGA, Other mixtures

Parallelization and Scalability
- Programmability: (multi-tasking) plugins; replace & extend modules

Adapting to Process Technology
- Libraries
### Processors and Pipelines

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<tbody>
<tr>
<td>clock:sample</td>
<td>1000:1</td>
<td>100:1</td>
<td>10:1</td>
<td>1:1</td>
<td>1:10</td>
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<tr>
<td>Data Rate (200MHz clock)</td>
<td>200Ks/s</td>
<td>2Ms/s</td>
<td>20Ms/s</td>
<td>200Ms/s</td>
<td>2 Gs/s</td>
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<tr>
<td>Applications</td>
<td>control → audio → mobile video → HDTV → comms → networking</td>
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High-Level Synthesis Tools for FPGA

- **Code Restructuring**
  - Macro-architecture description
  - Parameterization
  - FPGA Optimizations

- **Directives (pragmas)**
  - Specify performance
  - Mapping resources

- **C/C++ level verification**
  - Use traditional tools (C/C++ compiler, Matlab)
  - Re-use C/C++ testbench
Certified results for the BDTI Optical Flow Workload, Programming for performance with HLS easier than for DSP

Very good results compared to a DSP
Typical steps in programming with HLS
Next step: Integration of processor system + programming environment

SW application programming using only C/C++
System level programming

- GCC/Visual Studio
- Customer C code
- Sim libraries (*.c, *.h)
- Targeted Design Platform

- Design Templates
- Customer C code
- Design Libraries (*.c, *.h)

- Algorithmic C-to-FPGA
- C Libraries
- Xilinx ISE/XPS
- Xilinx IP Cores

- Xilinx FPGA

- C to gates tool
- Xilinx ISE/EDK synthesis, place, route, bitgen
example today

- All programming in C/C++
- Video Platform abstraction, board support package for C/C++ programmer, includes processor (microblaze) + AutoESL
- Atlys, Xilinx University Program board, supports 720p
- Video Functions: scaling, picture in picture, your application
Targeted Reference Design Targets Video, Wireless
- Demonstrates use of HD Video in applications like Object Detection, Motion Estimation
- Demonstrates use of wireless algorithms
- Uses Key Features of processor subsystem
- Interface with FPGA Fabric Using standard APIs
Exciting times

Market:
- Everybody needs video, wireless and networks

Technology:
- Moore’s Law for Semiconductors
- Novel processor + FPGA architectures
- New applications in the video domain: 3D, glassless 3D, 4kx2k,
- New applications in the wireless algorithms
- New programming methods for FPGA
- Novel processor + FPGA programming frameworks