EECS 222C: System-on-Chip Software Synthesis Lecture 9

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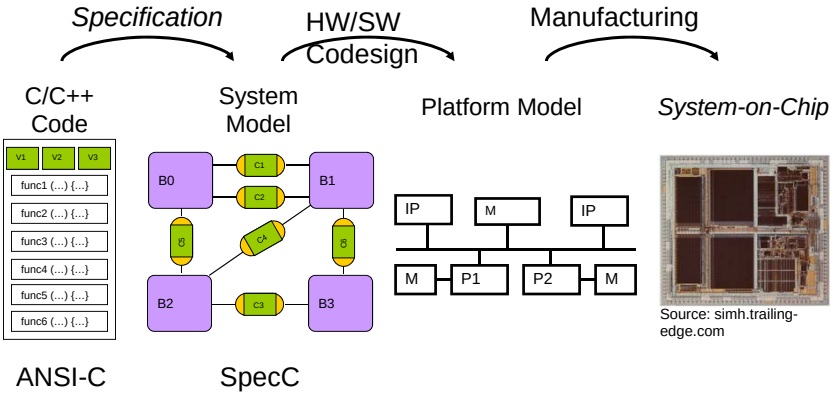
Lecture 9: Overview

- SoC Design Flow
  - Project status, completion
- Assignment 7
  - Discussion
- Embedded Software
  - Scheduling algorithms
    - Periodic scheduling
      - RMS, EDF
    - Priority inversion
      - Mars Pathfinder Example

System-on-Chip Design Flow

- MP3 Decoder Project Status, Completion:
  - Given: Reference source code (**`mad_C.tar.gz`**)
  - Analyzed: Specification Model (**`mad_SpecC.tar.gz`**)
  - Final: Platform Model with integrated ISS



Source: simh.trailing-edge.com

Assignment 7

1. SW Synthesis and ISS Integration of the MP3 Decoder in SCE
   - Continue from “TLM” and “PAM” models of previous assignment
   - Perform C code generation
     - Software Synthesis Refinement, C code generation
   - Perform Instruction Set Simulation
     - Software Synthesis Refinement, ISS integration
   - Reference instructions:
     - **`/home/doemer/EECS222C/Assignment7.txt`**
   - Deliverable:
     - Text file “**`SWgen.txt`**” with
       - short (!) description of “your story”
       - execution time of your ISS model
   - Due:
     - by Friday, Nov 19, 2010, at noon
     - by email to **doemer@uci.edu**, with subject “EECS222C HW7”

Assignment 7: Problem Solving…

1. Communication models are very slow
   - Symptom:
     - Simulation shows that delay per frame increases drastically in TLM and PAM models
   - Analysis:
     - Communication time is not taken into account before
     - TLM and PAM include accurate communication delay
     - Communication can be a bottleneck for certain architectures
       - Congestion due to single communication bus
       - Indirect communication from slave to slave via master
   - Potential Solutions:
     - Analyze bus traffic by viewing connectivity in Network model
     - Introduce a separate bus between hardware components
       - See **`Lecture7-ASPDAC07-AG-MP3.pdf`**
     - Increase bus frequency

Assignment 7: Problem Solving…

2. Error message when simulating ISS model
   - Symptom:
     - Simulation of ISS model reports errors such as **`Core: Shifter distance more than 31, i.e. 226`**
   - Analysis:
     - Error message originates from ISS implementation
     - The same (or similar) message shows for other successful examples
   - Solution:
     - Probably a shift-instruction with argument out of range without serious other effects
     - Simply ignore the message!

Assignment 7: Problem Solving…

3. Priority conflicts in ISS model
   - Symptom:
     - Simulation of ISS model reports errors such as **`TaskCreate Failed prio 2 already exists!`**
   - Analysis:
     - We have been selecting Round-robin scheduling (all priorities 1) or Priority scheduling (with non-exclusive priorities)
     - The ISS model uses micro-C-OS-2 as RTOS which requires fixed non-exclusive priorities
   - Attempted Solutions:
     - Isolate all parallel behaviors so that unique priorities can be assigned
     - Select Priority-based scheduling with different priorities
     - ➢ Error messages persist…
     - ➢ Suspect a bug in the RTOS port that prevents clean task deletion…

Assignment 7: Problem Solving…

4. Persistent priority conflicts in ISS model
   - Symptom:
     - Simulation of ISS model reports errors such as **`TaskCreate Failed prio 2 already exists!`**
   - Analysis:
     - We have been selecting Round-robin scheduling (all priorities 1) or Priority scheduling (with non-exclusive priorities)
     - The ISS model uses micro-C-OS-2 as RTOS which requires fixed non-exclusive priorities
   - Successful Solution:
     - Revert to static scheduling!
     - In Scheduling refinement, select static scheduling and serialize the entire tree of behaviors mapped to the CPU
     - ➢ Error messages are gone!

Assignment 7: Problem Solving…

5. Large frame delay in ISS model
   - Symptom:
     - Simulation of TLM/PAM models estimated frame delays such as **`Decode time per frame = 20.010 ms`**
     - Simulation of ISS model reports frame delays such as **`Decode time per frame = 65.979 ms`**
   - Analysis:
     - TLM/PAM computation time is only estimated (by SCE profiler)
     - Profiling produces only fidelity (not absolute accuracy!)
     - Profiler for ARM7 is based on overly optimistic operation cycles
       - Assumes zero cache-misses, pipeline stalls, etc.
   - Possible Solutions:
     - Trust the ISS, not the profiler!
     - ➢ Increase CPU frequency, and/or improve system architecture!
     - ➢ Consider a different CPU, e.g. LEON3

Assignment 7: Problem Solving…

6. Incorrect output file in ISS model
   - Symptom:
     - Decoded stream by ISS model fails comparison with reference stream
       `Binary files reference/spot1_3K.pcm and spot1_3K.pcm differ`
   - Analysis:
     - Linux **`diff`** reports file difference
     - Linux **`ls -l`** shows difference in number of bytes
     - Linux **`vi -d`** shows that only the end of the file differs
   - Solution:
     - Decoding by ISS model was correct, it just didn't finish!
     - ➢ Extend simulation time before stimulus behavior exits, or
     - ➢ Find a faster architecture, then decoded file will be complete!

Embedded Software

- Chapter 4, part 3, of
  "Embedded System Design"
  by P. Marwedel (Univ. of Dortmund, Germany),
  Kluwer Academic Publishers, 2003.

  – Scheduling Algorithms
    - Periodic scheduling
      – RMS, EDF
    - Priority inversion
      – Mars Pathfinder Example

  – **`Lecture9-es-marw-4c-periodic.ppt`**