RISC-V Tapeout Flow & SoC Integration - Overview

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Topic: RISC-V Tapeout Process & System-on-Chip (SoC) Integration

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1. Chip Design & RTL Process

O1: Specification (C Model)

- The system architecture is initially described using C language.
- Testbenches are also developed in C for validating the design.

O2: RTL Architecture (Verilog Hardware Model)

- The design is translated into RTL (Register Transfer Level) using Verilog.
- The processor, along with peripherals and various intellectual properties (IPs), is described at this stage.

O3: SoC Integration

- Integration of the processor, peripherals, and both analog and digital IPs.
- Synthesis generates a gate-level netlist.
- Analog IPs and custom macros are then "hardened" into hard macros (HM).

ASIC Design Flow → Synthesis → RTL to GDS

- This phase includes steps like synthesis, floorplanning, placement, clock tree synthesis (CTS), and routing.
- The final outcome is a GDSII file, which undergoes Design Rule Checks (DRC) and Layout Versus Schematic (LVS) checks for verification.

2. Final SoC & Practical Applications

O4: Final Chip Realization

- The final SoC operates at real-world clock frequencies (100–130 MHz).
- The same C testbench used during the specification phase is re-employed for final validation, ensuring consistency throughout the design flow.
- Ensuring that the specifications in O1, O2, and O3 match O4 ensures the correctness of the final chip.

Applications in Real-World Products

- Wearables like iWatch.
- Development platforms like Arduino boards.
- Consumer electronics such as TV panels.
- Embedded controllers in air conditioning (AC) systems.

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3. Key Insights

- A unified C-based testbench provides consistency and ensures correctness throughout the design process.
- The SoC design flow progresses through these key stages: C-based specification → RTL in Verilog → SoC design → GDSII generation.
- Verification at each design phase is critical to guarantee the accuracy and functionality of the final chip.
- RISC-V-based SoCs have diverse real-world applications in both consumer and industrial sectors.