



Open ISAs, Hardware

and the Numerous Innovation Opportunities

OpenPOWER ISA

OpenPOWER ISA



- IBM 801 was one of the first RISC computers
- RISC System/6000 (1990) introduced POWER ISA
- IBM + Apple + Motorola (AIM Alliance) worked on PowerPC
- Renamed as POWER ISA in 2006
- OpenPOWER Foundation started in 2013
- Latest Spec Version - 3.1

RISC-V

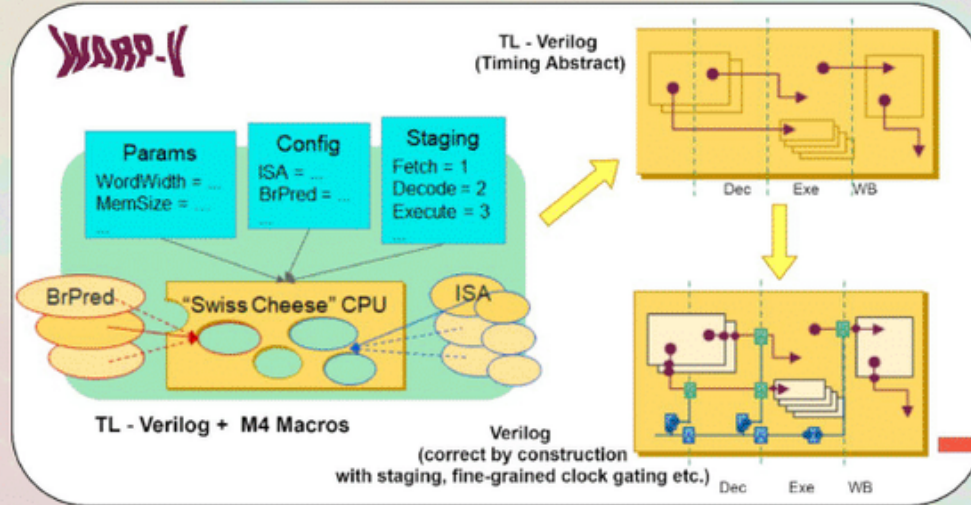


- 5th RISC ISA from Berkeley (2010)
- Open right from the beginning
- Maintained and promoted by RISC-V International
- Adopted by SiFive, WD, Nvidia, Microchip, Alibaba, CDAC, IIT Madras

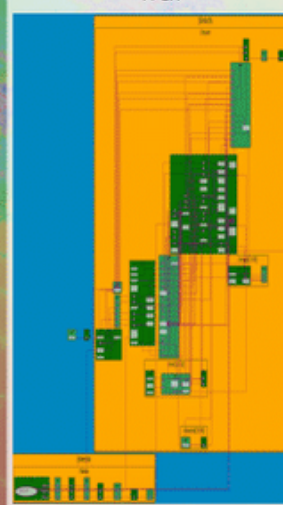
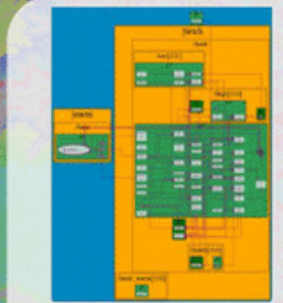
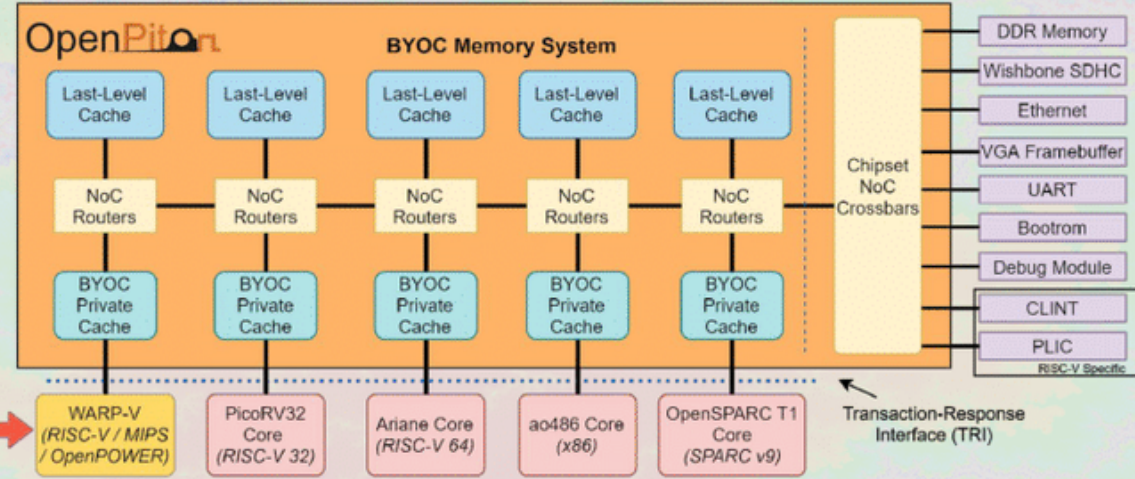


DAC Experience

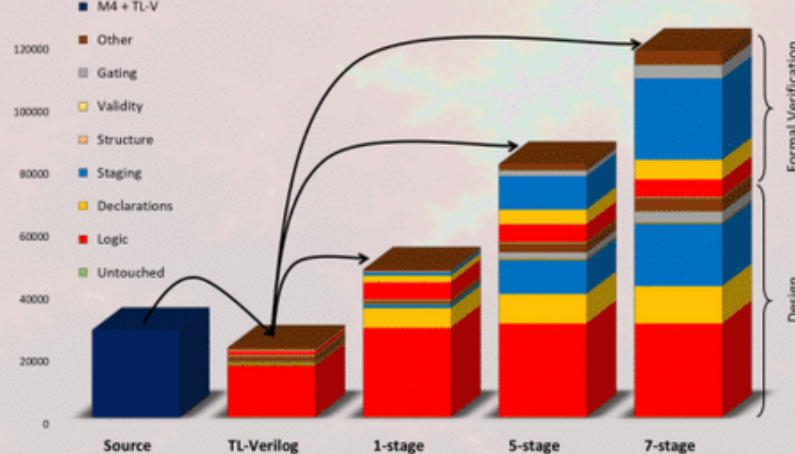
Flexible and Configurable CPU Microarchitecture



Flexible and Scalable Uncore



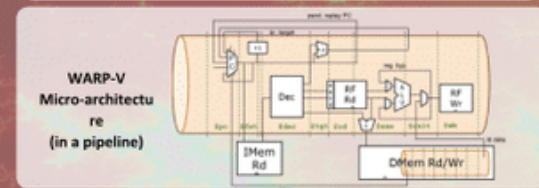
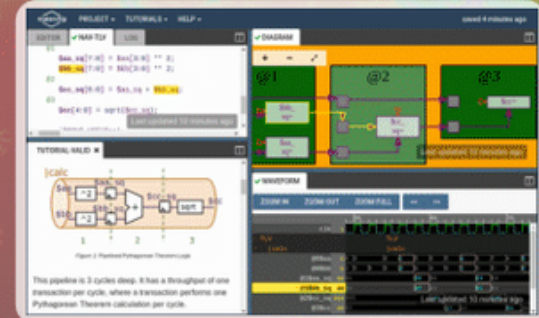
Huge Code Reduction and Flexibility, but full RTL Control !



Key Takeaways :

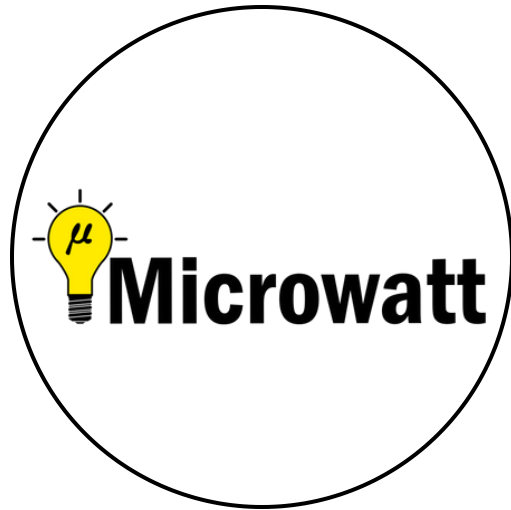
- Demonstrates large-scale design in new Verilog-compatible transaction-level design and formal verification methodology
- Hardware *Design*, not HLS
- Pipeline staging, clock gating, hierarchy etc. *implied*

This research is sponsored by Google under Google Summer of Code 2020



Project Opportunities with OpenPOWER

Open Source POWER Cores



Microwatt

VHDL 2008

GHDL Simulator

Xilinx FPGAs (A7)



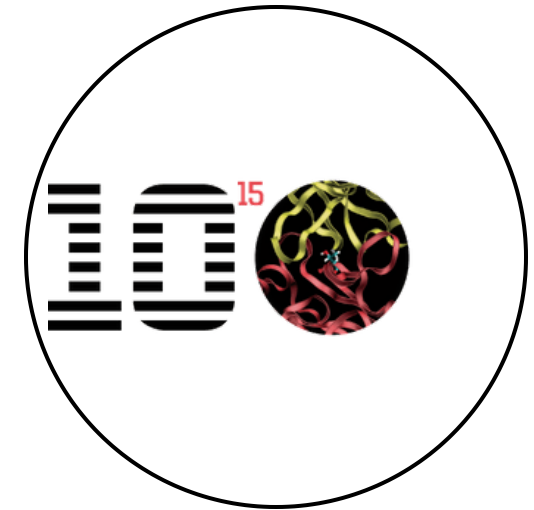
Chiselwatt

Chisel

Verilator Simulator

Yosys/nextpnr support for ECP5 based FPGAs

(ULX3S / Orangecrab etc.)



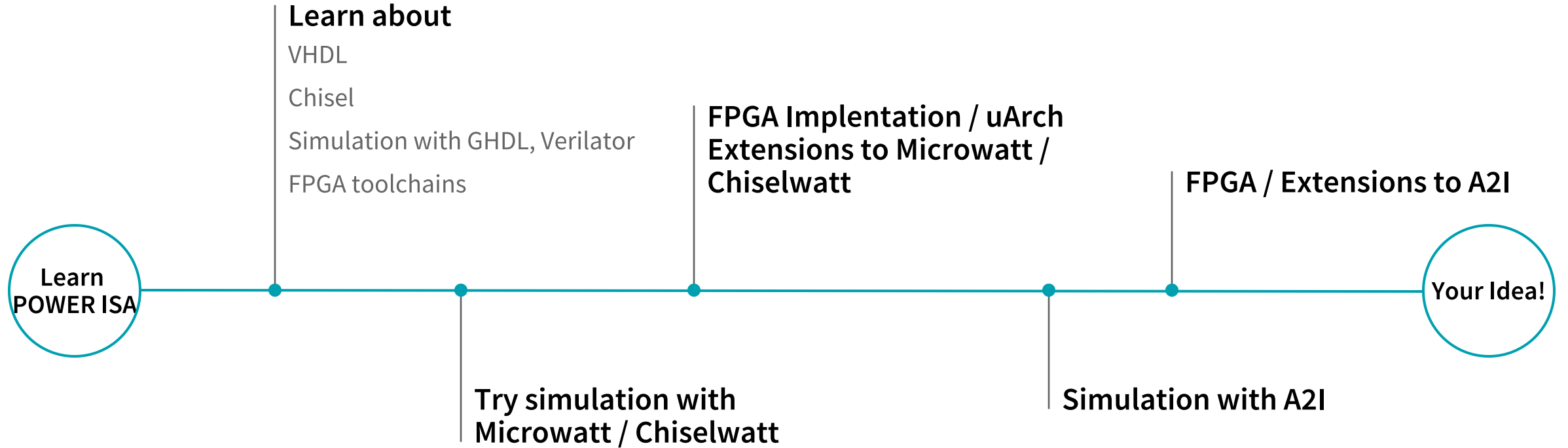
A2I

Most powerful open source POWER core at the moment

Used in BlueGene/Q (in many supercomputers even today)

VHDL source

Potential Roadmap



Resources

- All 3 cores are available on GitHub
- VHDL/ Verilog - books and YouTube videos by Brock J Lamares (Free)
- Coursera - HDLs for FPGA Design - UC Boulder
- Computer Organization and Design - Patterson and Hennessy
- POWER ISA Manuals
- Verilator, GHDL, Yosys documentation

Open hardware in future

- SoCs
- Heterogeneous systems
- Completely open source RTL to GDS Flow - OpenLane
- Adoption of open standards - industry direction
- Worldwide collaboration
- Make in India

Thank You!

Efforts for OpenPOWER Community being led by -



Mr Ganesan Narayanasamy

Senior Technical Computing Solution and
Client Care Manager, IBM



Abhishek Jadhav

BE (EnTC) Senior, FCRIT, Mumbai



Shivam Potdar

BTech (EEE) Senior, NITK Surathkal