

AC/DSim: Full System Energy Estimation with Modular Simulation



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1. Evaluating HW-Accelerated Systems

- Many system and hardware design choices
- Manufacturing hardware is too costly and slow
- FPGAs are only an emulation for custom chips
 - Slower, higher energy consumption

How to evaluate system design choices?

- How much faster is the accelerated system?
- Is the accelerated system more energy efficient?

3. Challenge: Measuring Energy Use

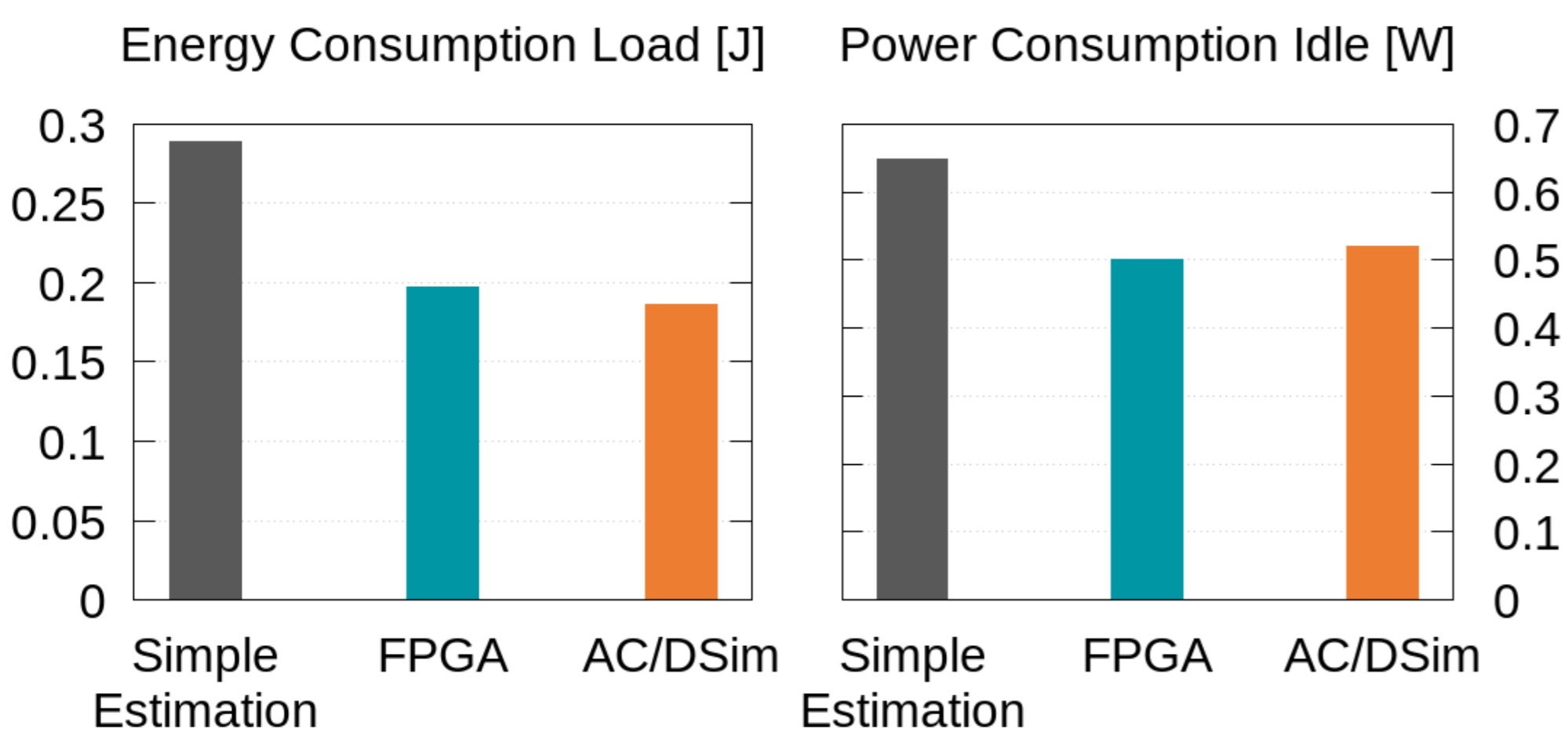
- Energy consumption is spread across components
- Depends heavily on dynamic runtime workload

How to measure system energy use w/ custom HW?

- Hardware tools offer RTL power estimation
- Must supply signal activities for accurate results
- Currently: model HW workload with RTL testbench
 - Correctly change circuit inputs at every clock cycle
- **This is laborious and inaccurate**
- Also need energy use for rest of the system

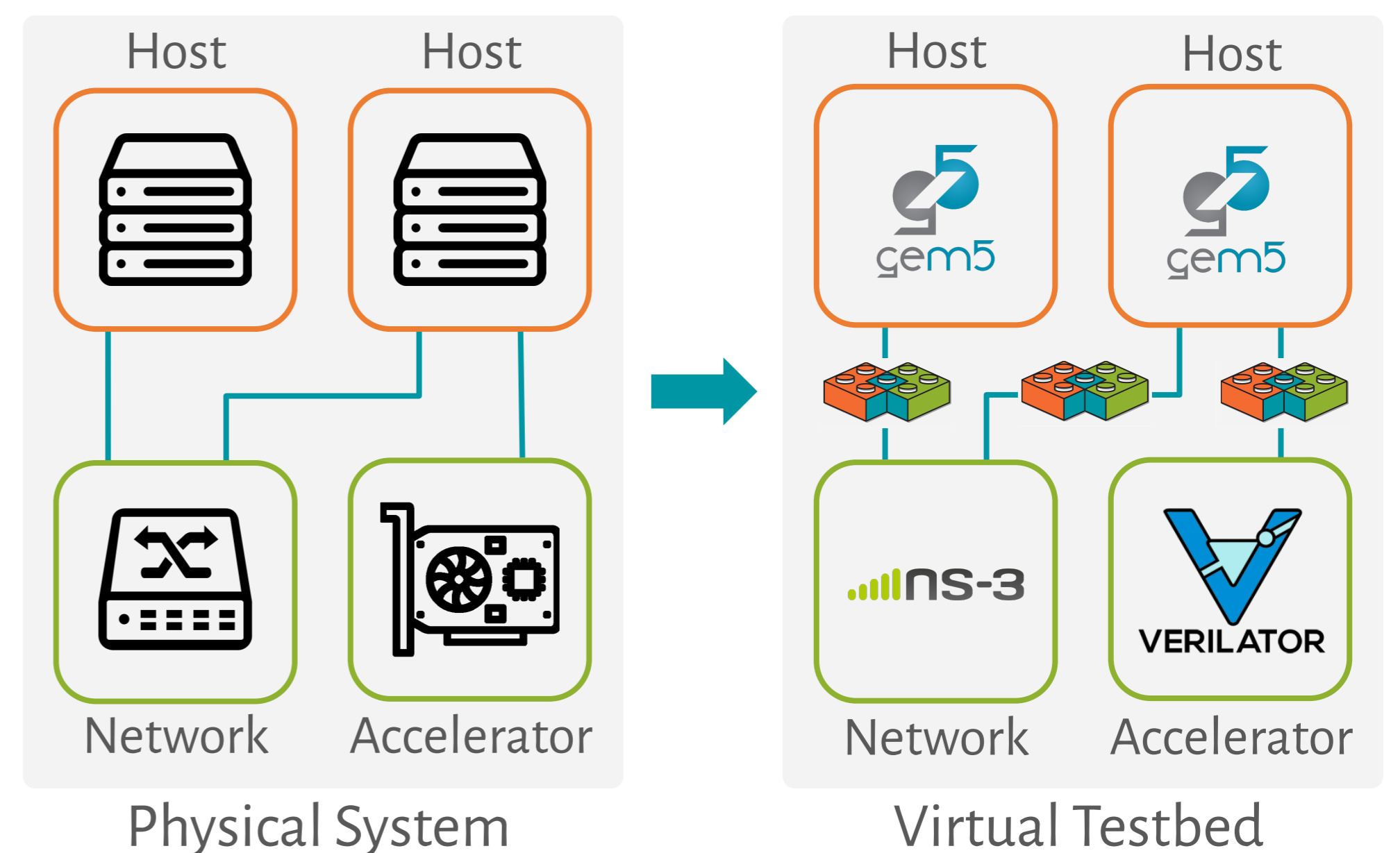
5. Preliminary Results

- Setup: SoC FPGA board, JPEG decoder accelerator
- FPGA allows us to validate against physical system
- Compare to simple estimation without workload



2. Evaluating Performance in Simulation

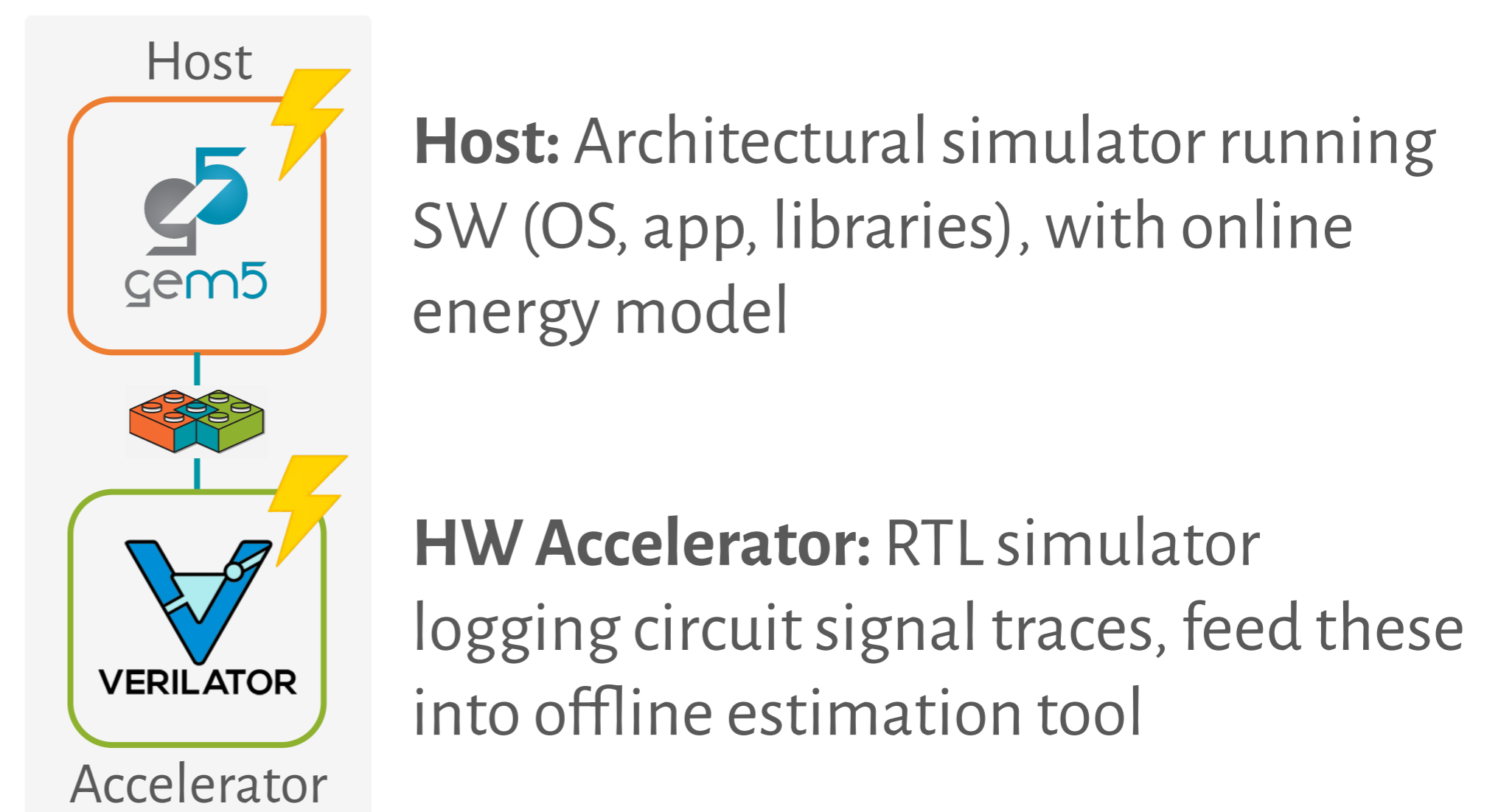
- We can simulate hardware before manufacturing
- Challenge: Need full-system performance
- **SimBricks** : Connect existing simulators into a full virtual testbed
- Run and measure complete system
 - **Actual workload** with **unmodified SW** (App, OS)
 - Captures complex interactions between components



4. AC/DSim: Modular Energy Estimation

Combine existing component energy models with full system simulation for accurate workload inputs

1. Use SimBricks to simulate actual app workload
2. Collect necessary component workload metrics
3. Run separate per-component energy models
4. Combine (sum up) component energy use



6. Next Steps

Improving accuracy, reducing trace size:

- Currently: average signal activities over whole execution -> large, inaccurate?
- Proposal: sample workload characteristics over smaller time intervals

Full network system estimation:

- Include models for currently missing components, e.g., NICs and network switches



<https://simbricks.github.io>