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EFFECTS OF MICROWAVES Robust Computer Architectures

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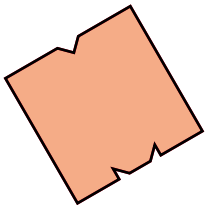

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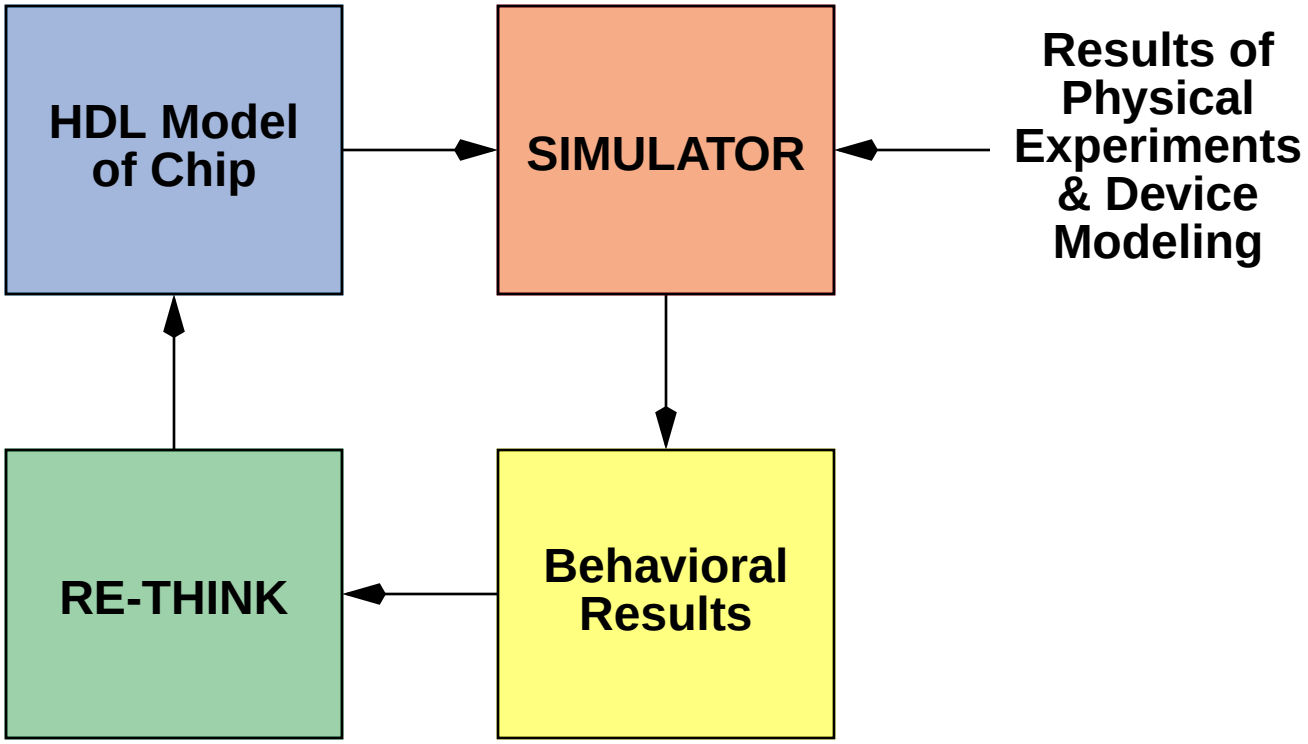
System Modeling



WHEN systems fail, HOW do they fail?

**We use this information
to develop & test reliable architectures**

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Tasks (Talk Outline)

ACCOMPLISHED

- Verilog models of two bootable microprocessors (simple/advanced)
- Initial work on robust architectures (reliability studies, draft floorplan)

IN PROGRESS

- Verilog model of microprocessor with hardware checkpoint/repair

FUTURE WORK

- Fabricate and test physical designs
- Enhanced Verilog and SPICE software

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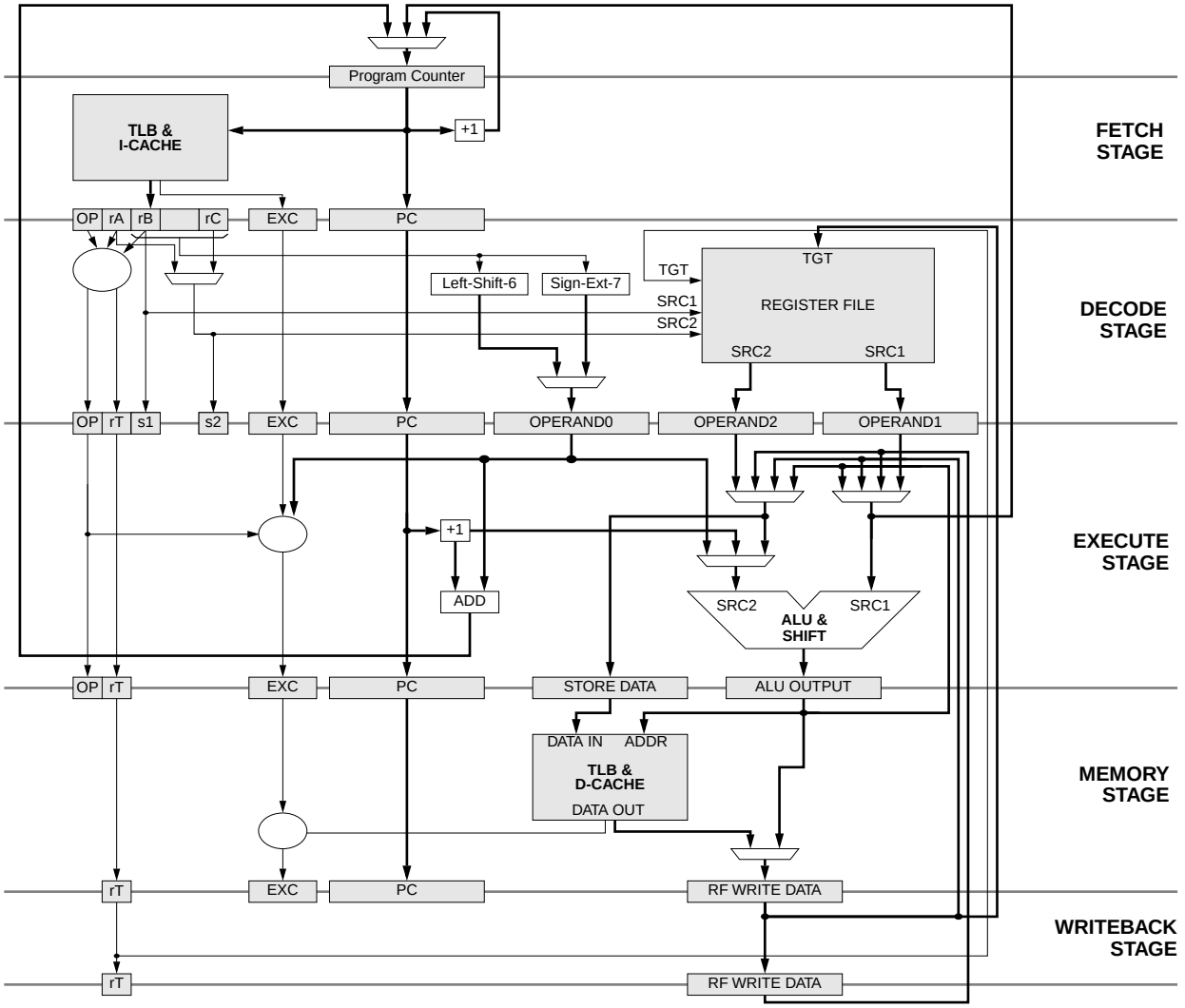
Processor Model: simple

Single-Issue, In-Order, Five-Stage Pipeline



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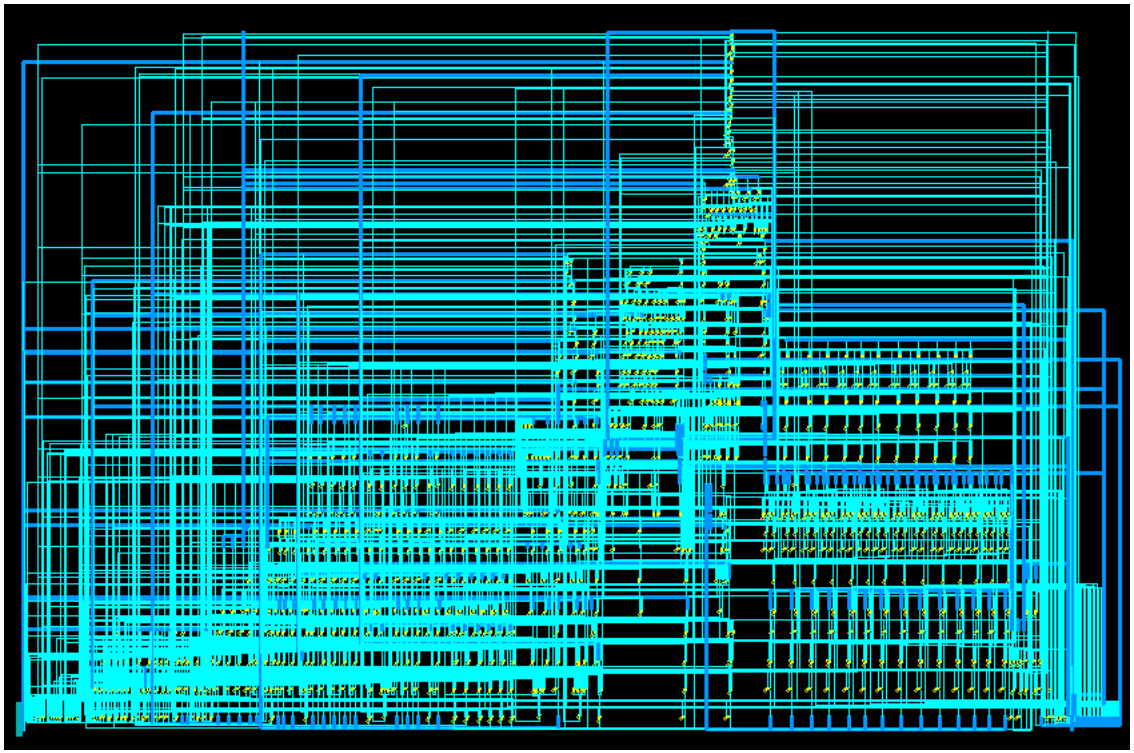
Processor Model: simple

Single-Issue, In-Order, Five-Stage Pipeline



16-bit processor core

Handles interrupts precisely

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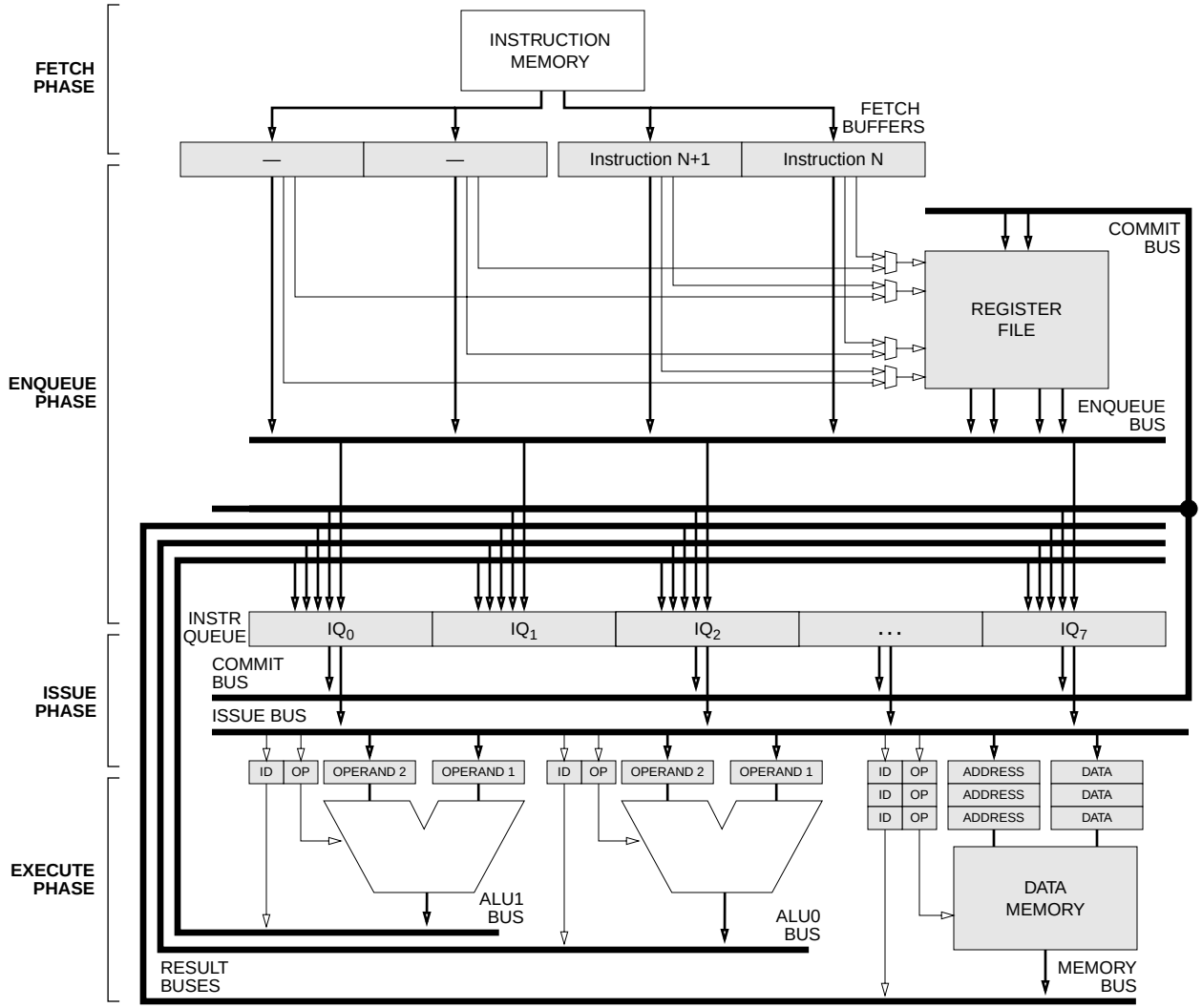
Processor Model: advanced

High-Performance Out-of-Order Core



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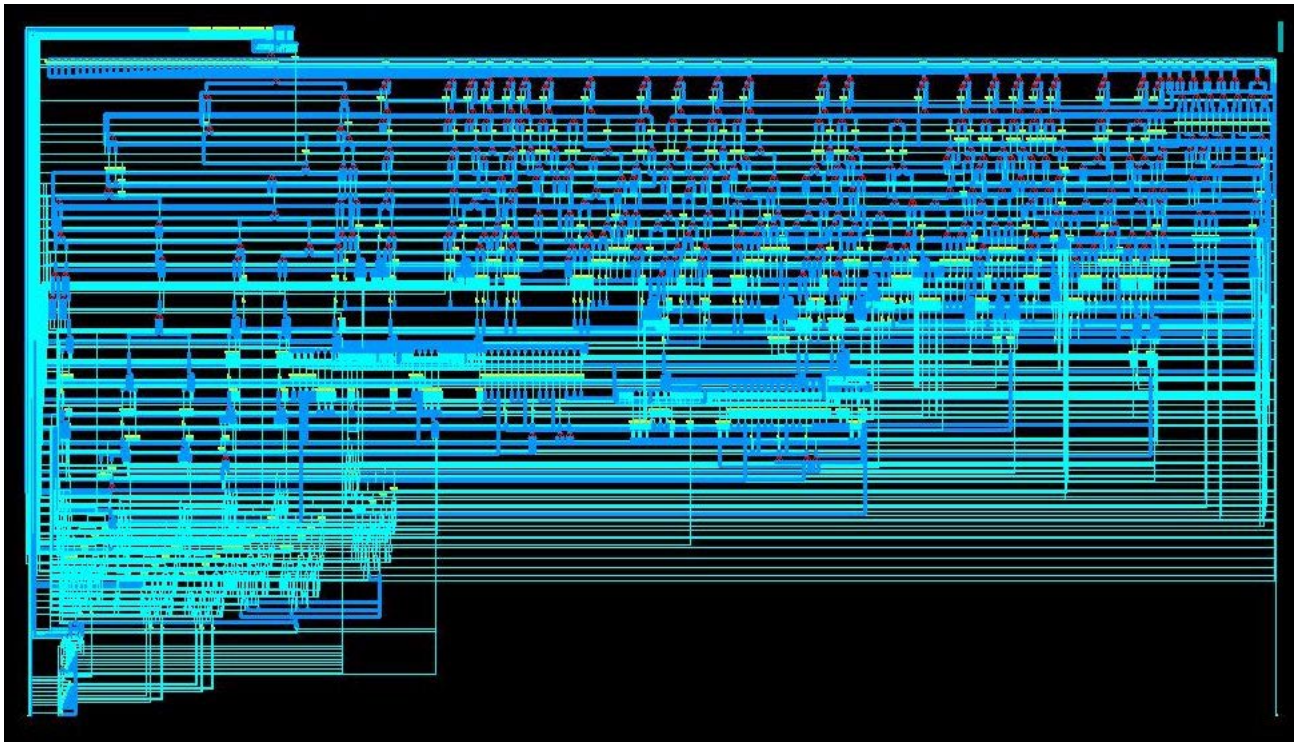
Processor Model: advanced

PowerPC ISA with AltiVec SIMD Unit



Design & layout of core in progress (AltiVec multiplier above)

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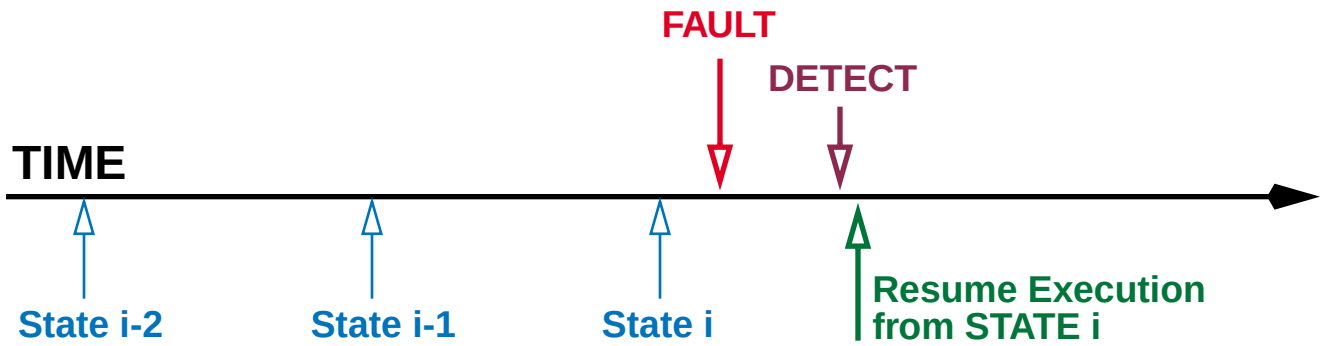
INITIAL STUDY: Assume the Worst Case

Checkpoint/Repair ...



CHECKPOINT:

Periodically save KNOWN-GOOD STATE

In case of FAULT, REPAIR to last saved state

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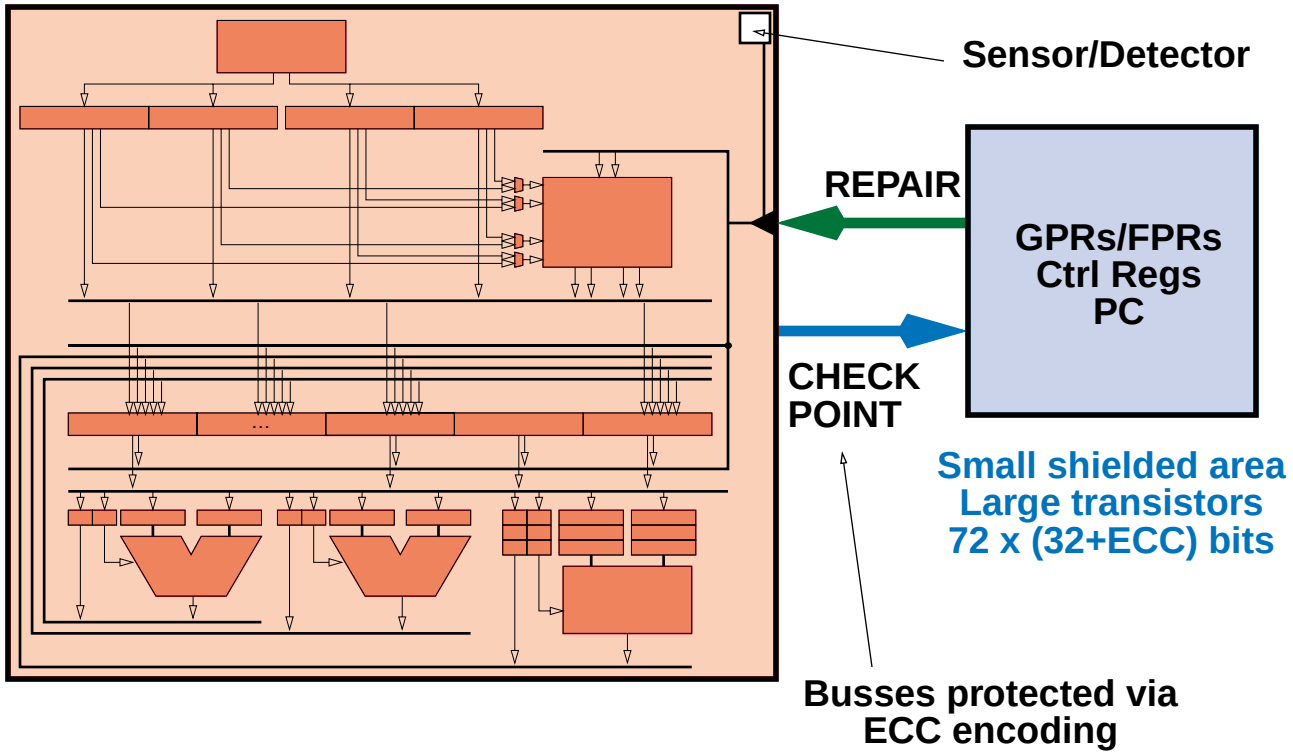
INITIAL STUDY: Assume the Worst Case



Implementation can be single- or multi-chip

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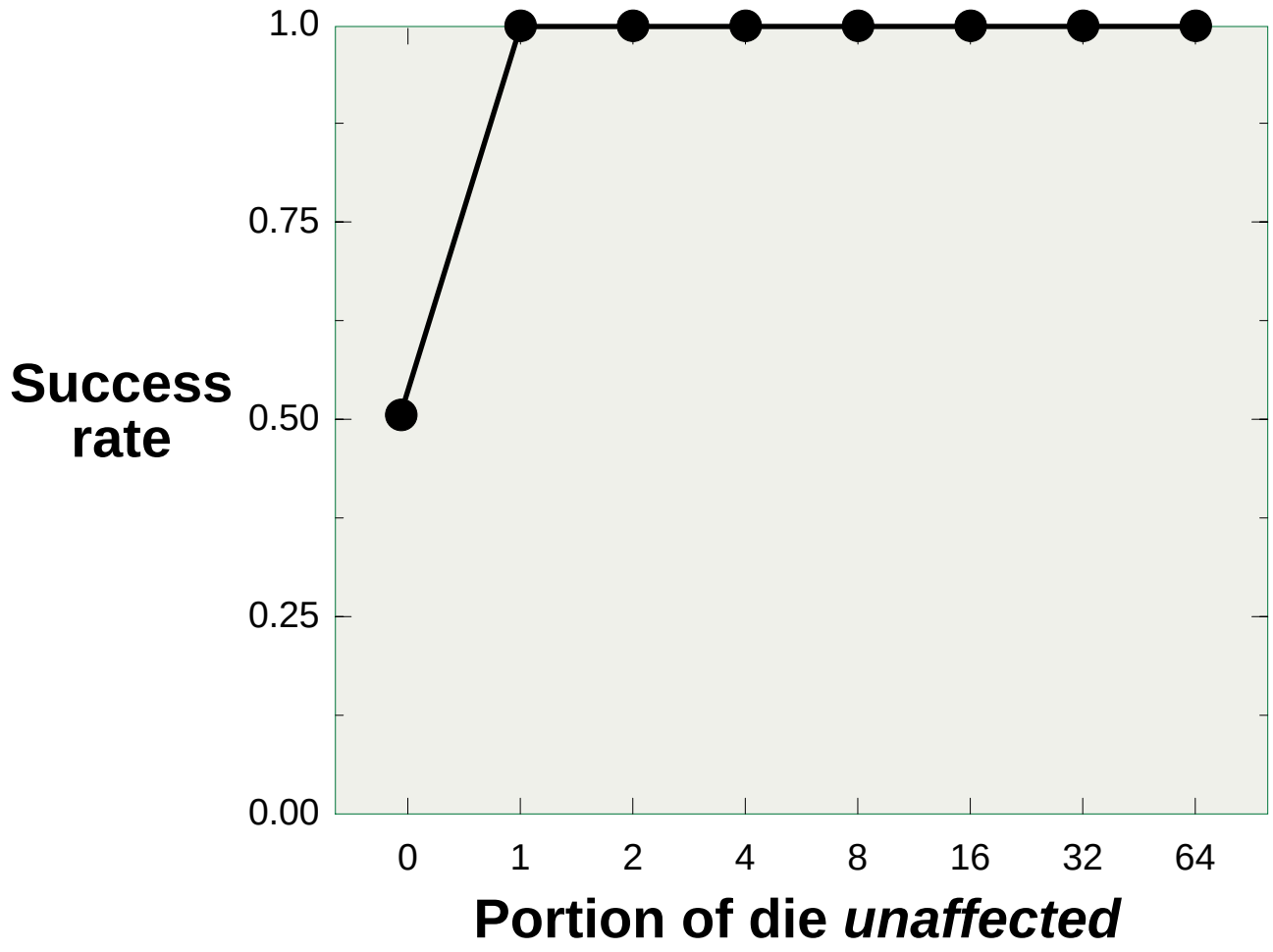

RELIABLE COMPUTER ARCHITECTURES

MURI Review
June 8, 2002

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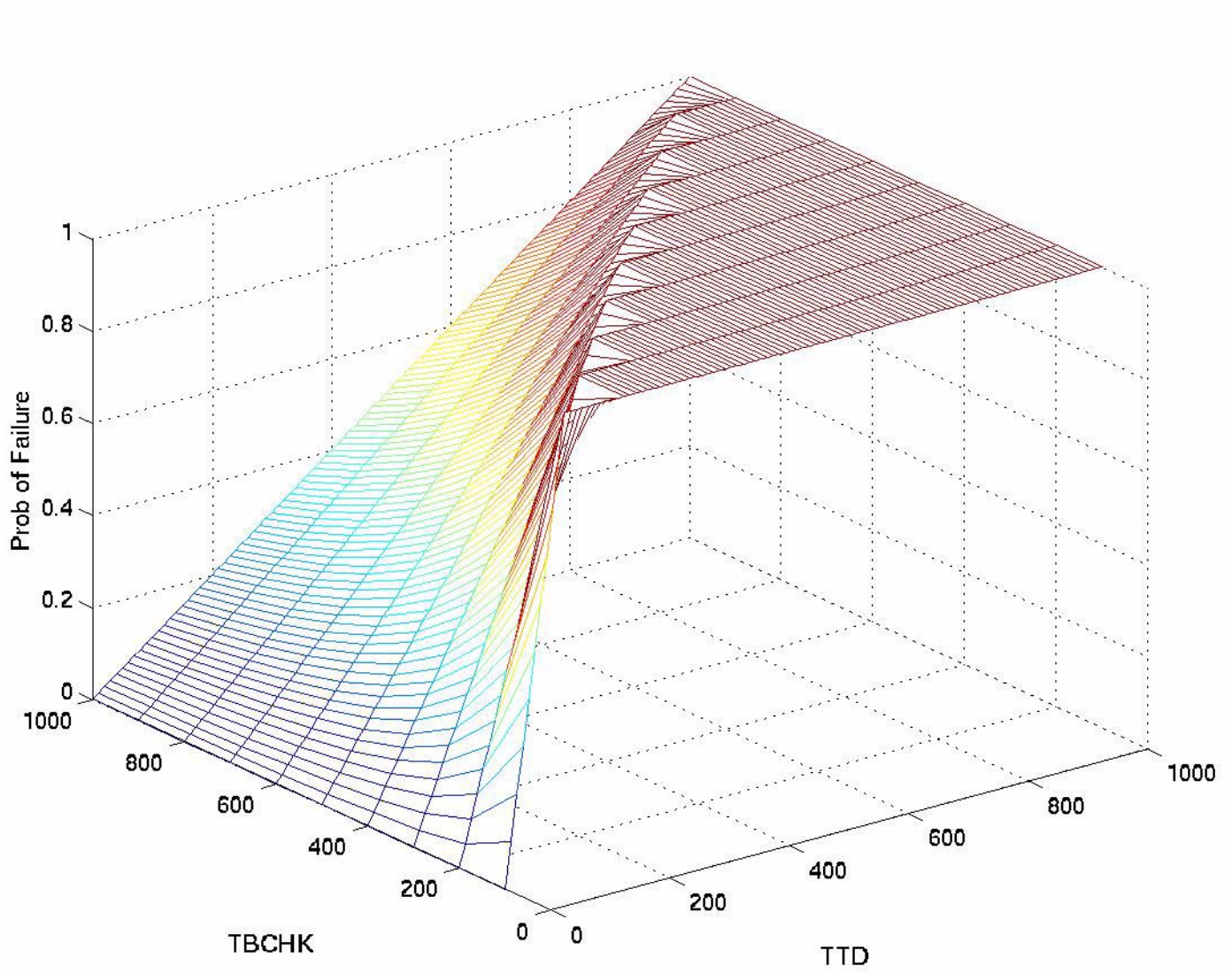

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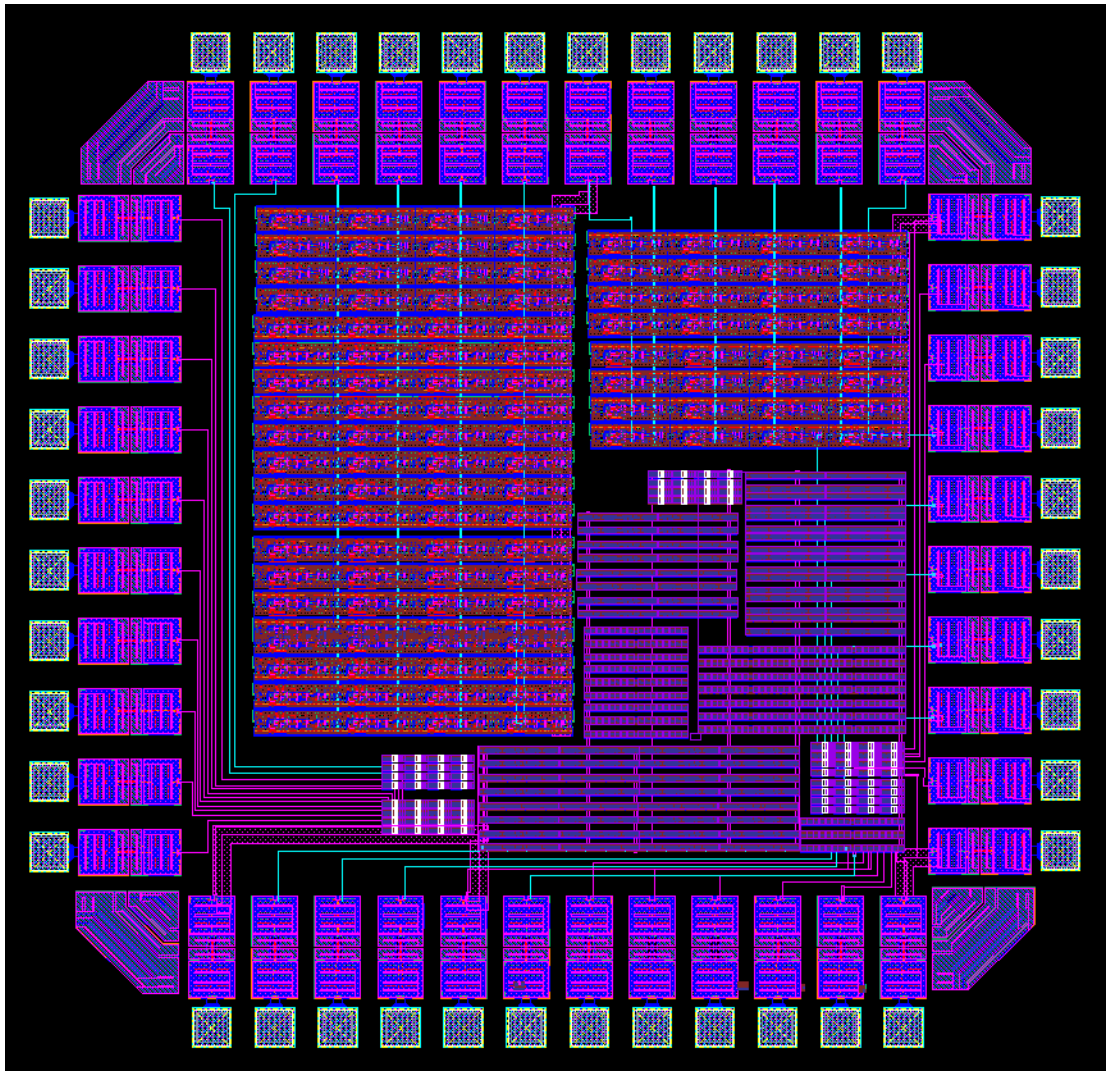
Initial Floorplan (simple CPU + safestore)



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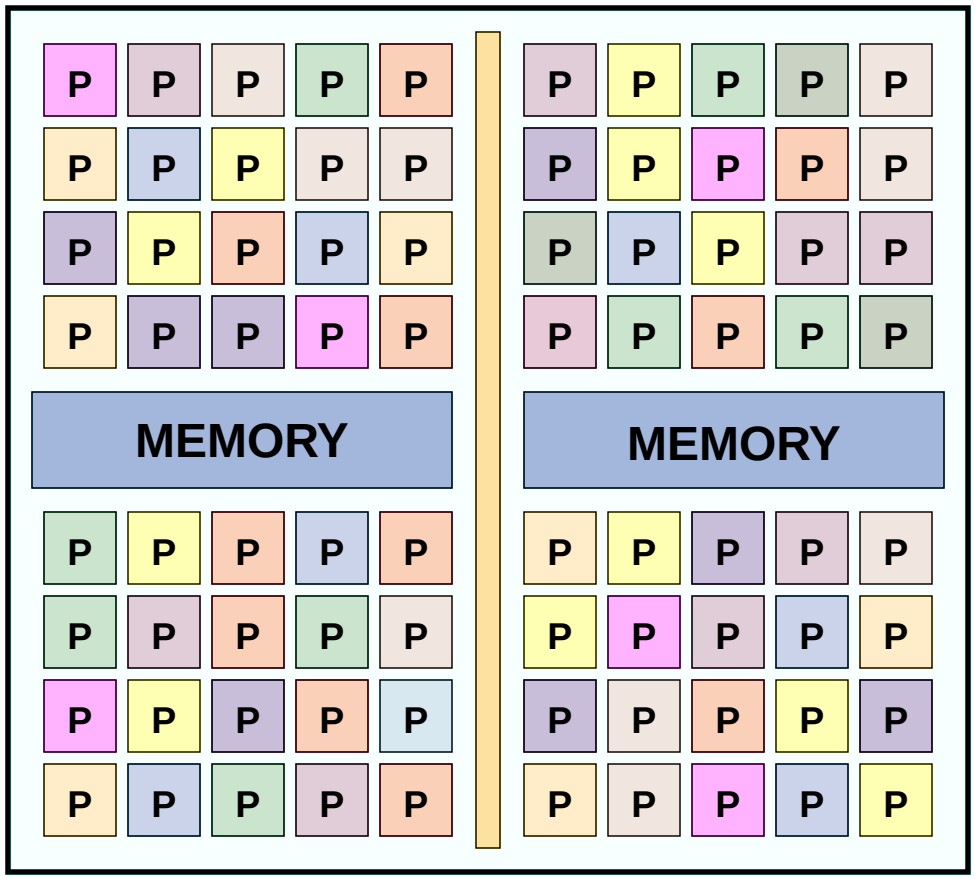
Globally Asynchronous

ASSUMPTION: Clock Net is Weak Point



Processing elements generate local clocks
Synchronize at inter-node communication

Future Work

Synthesize, Fabricate, Test Canonical Forms

- **Clock trees**
- **Busses (w/ and w/o ECC)**
- **Memories (w/ and w/o ECC)**
- **Arithmetic/Logic Units**

Incorporate Drift-Diffusion into CAD tools (more accurate SPICE/Verilog modeling)

Participants

Profs. Bruce Jacob & Neil Goldsman, UMCP

A host of grad students:

- **Azadeh Davoodi, Cagdas Dirik, Amol Gole, Samuel Rodriguez, Ohm Tuaycharoen (Architecture)**
- **Akin Akturk, Zeynep Dilli, Tejas Chitnis (Microelectronics)**