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Exploiting program phases in an FPGA-based Hybrid Transactional Memory system

Philipp Kirchhofer[1], Martin Schindewolf[1], Wolfgang Karl[1], Nehir Sonmez[2]

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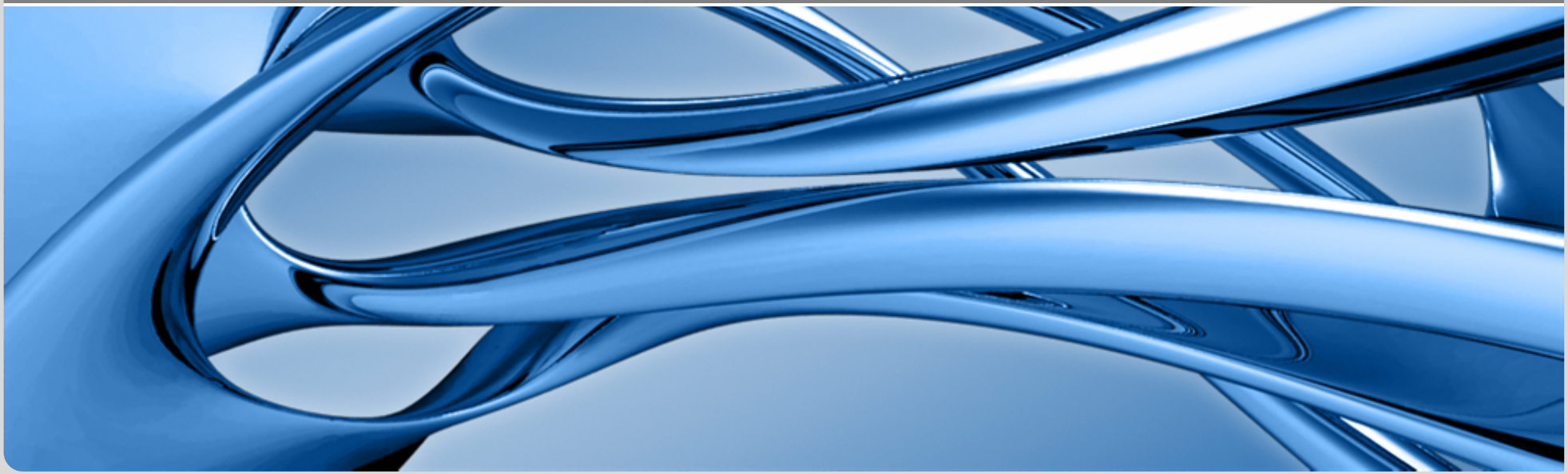
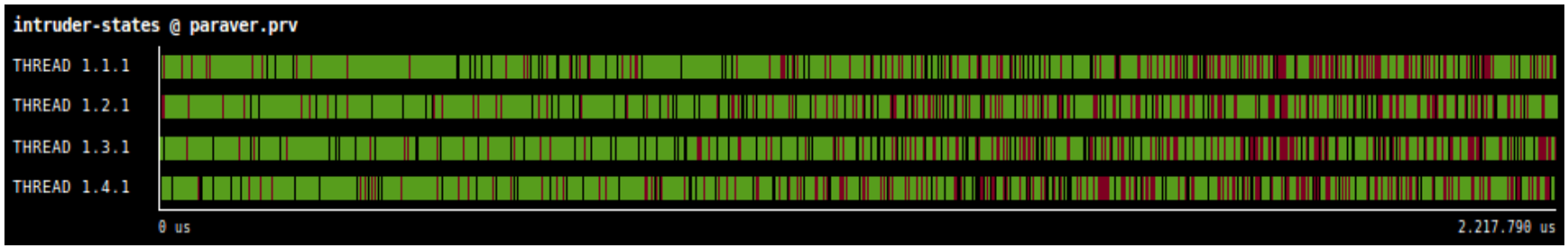
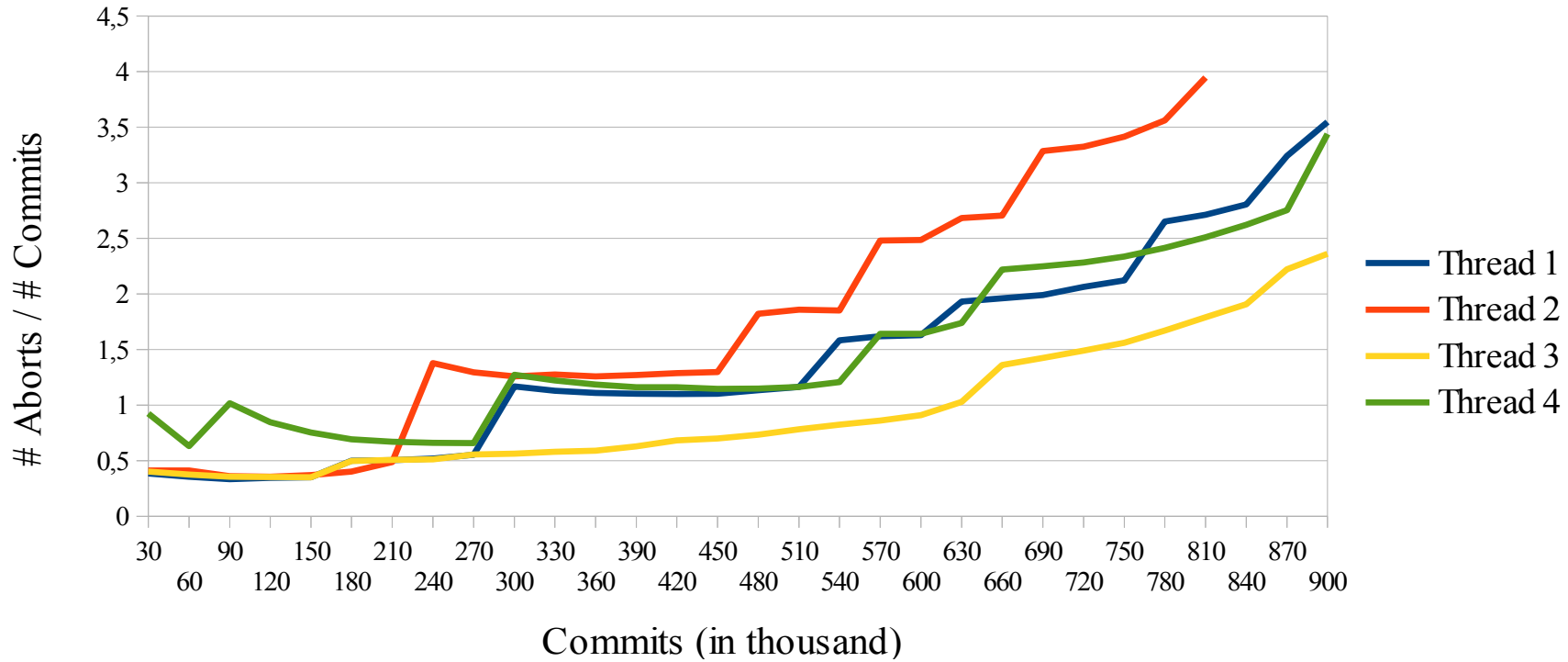


Motivation

Example: Application contention phases (STAMP Intruder)





Motivation

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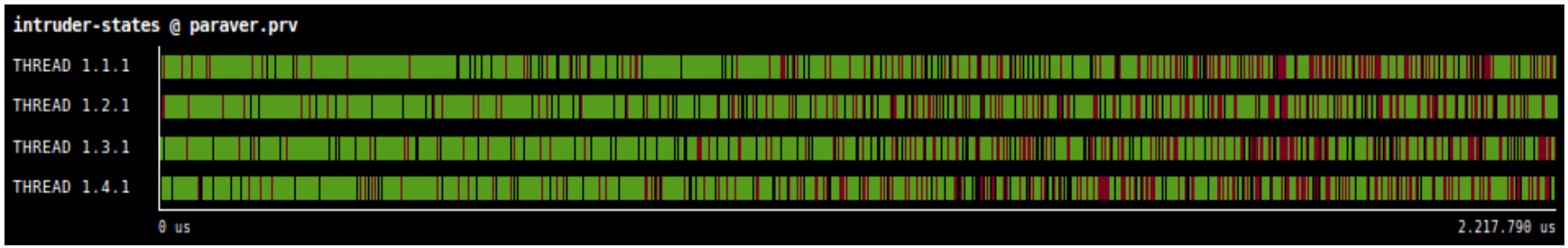
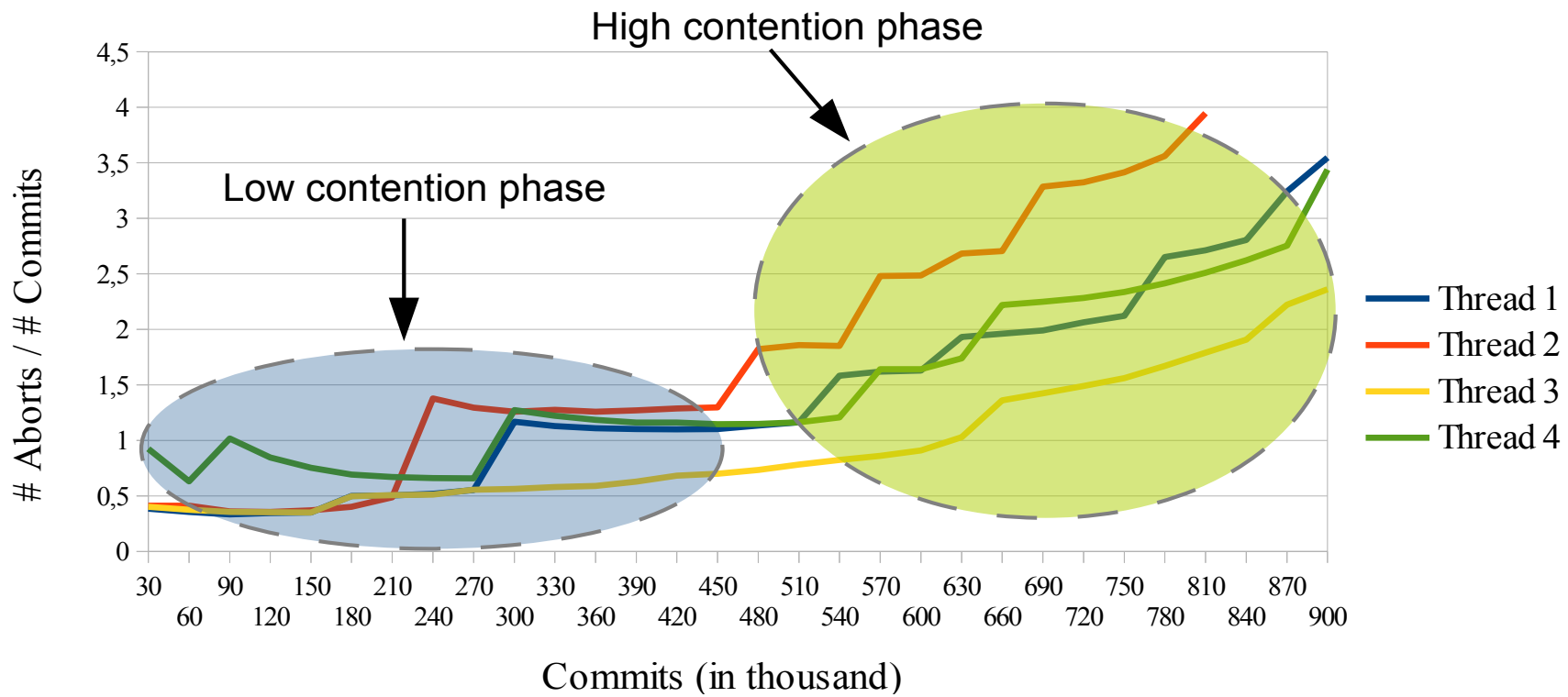
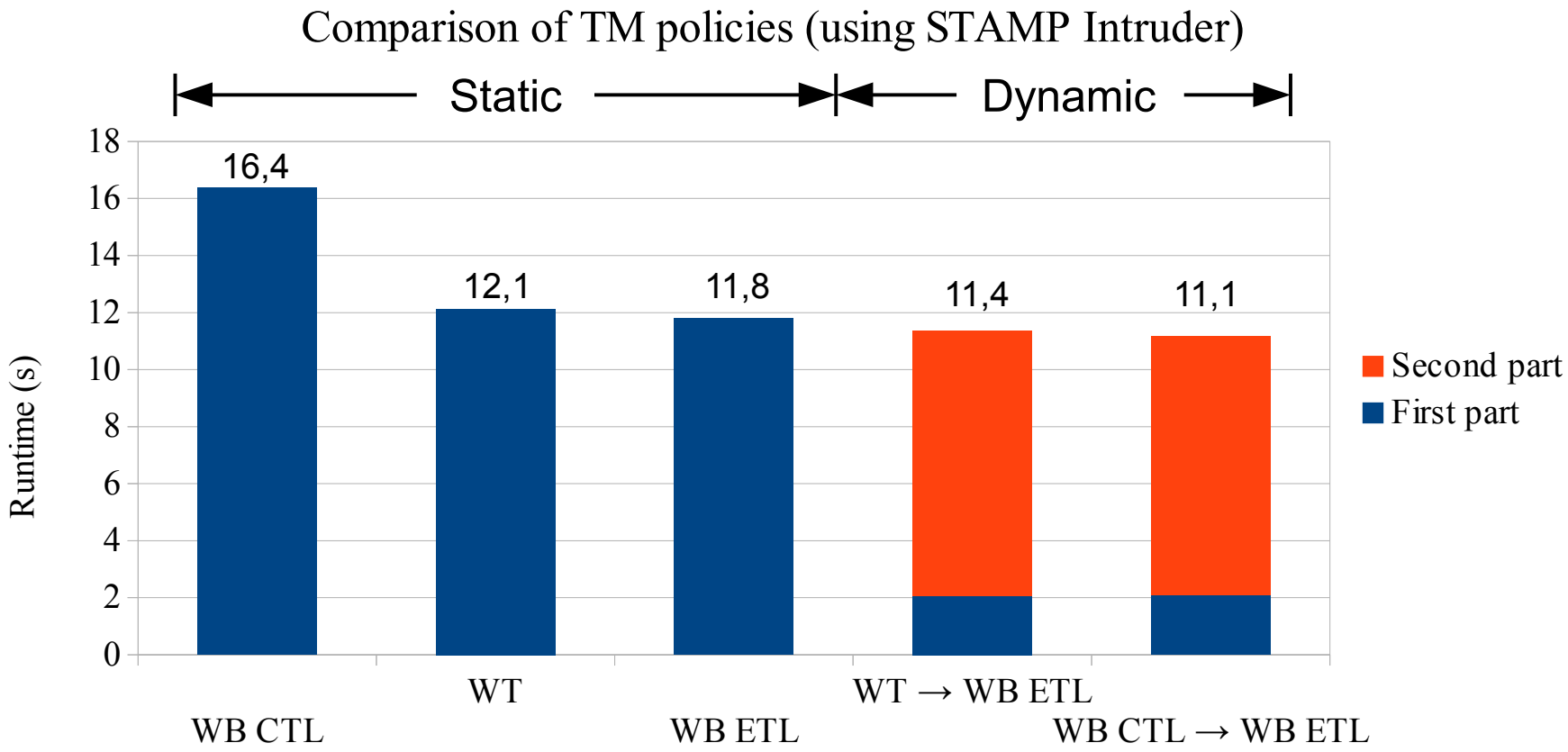




Motivation

Impact of different STM policies on application runtime



Advantage: Relative improvement of about 5 % using simple adaptive policy when compared to best static policy.

Design

Outline

Project goal

Exploit program phases in HybridTM applications

Previous project

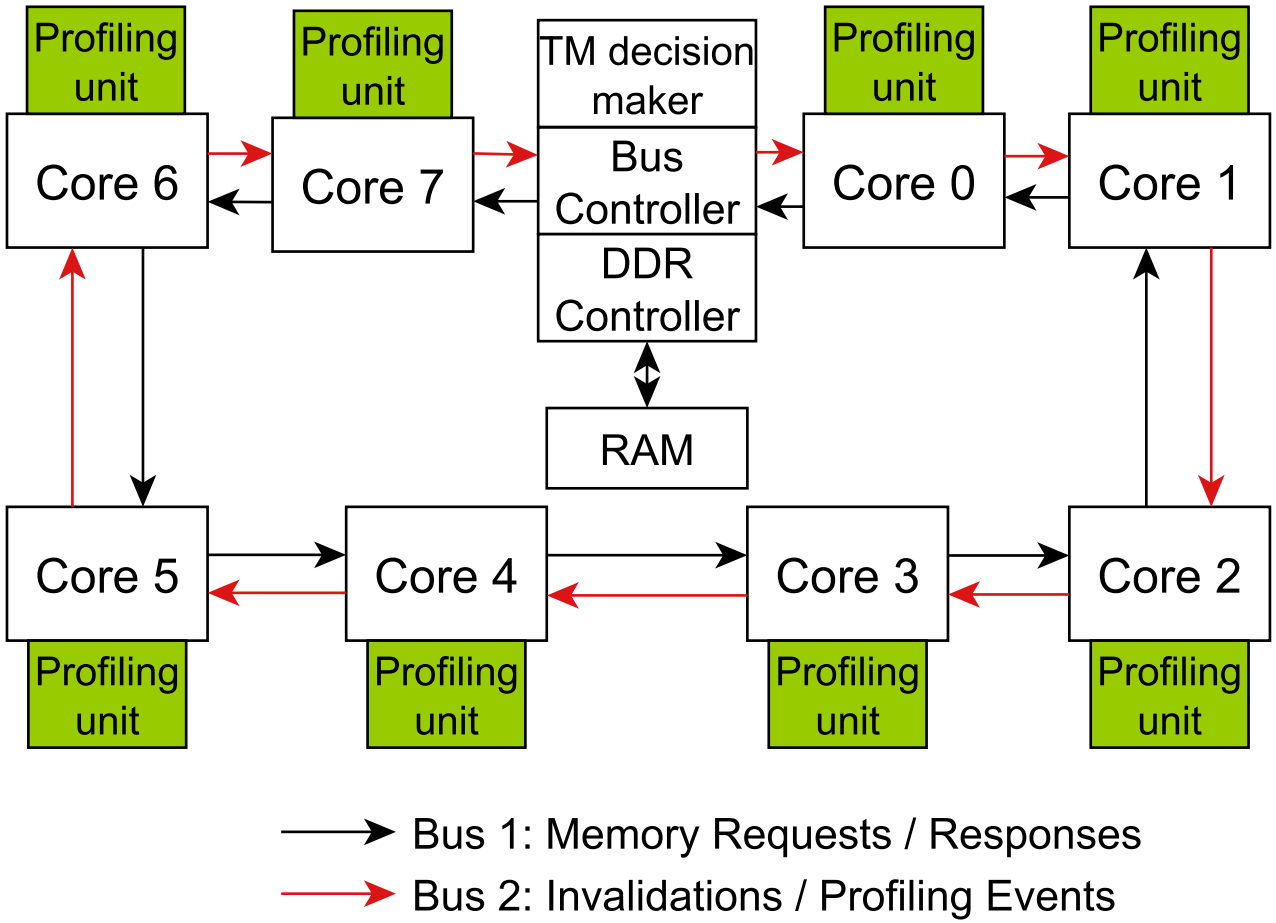
Low overhead event based profiling framework for existing HybridTM system (TMbox)

- HTM event: Zero overhead
- STM event: 1 instruction overhead

Design

Details - Step 1

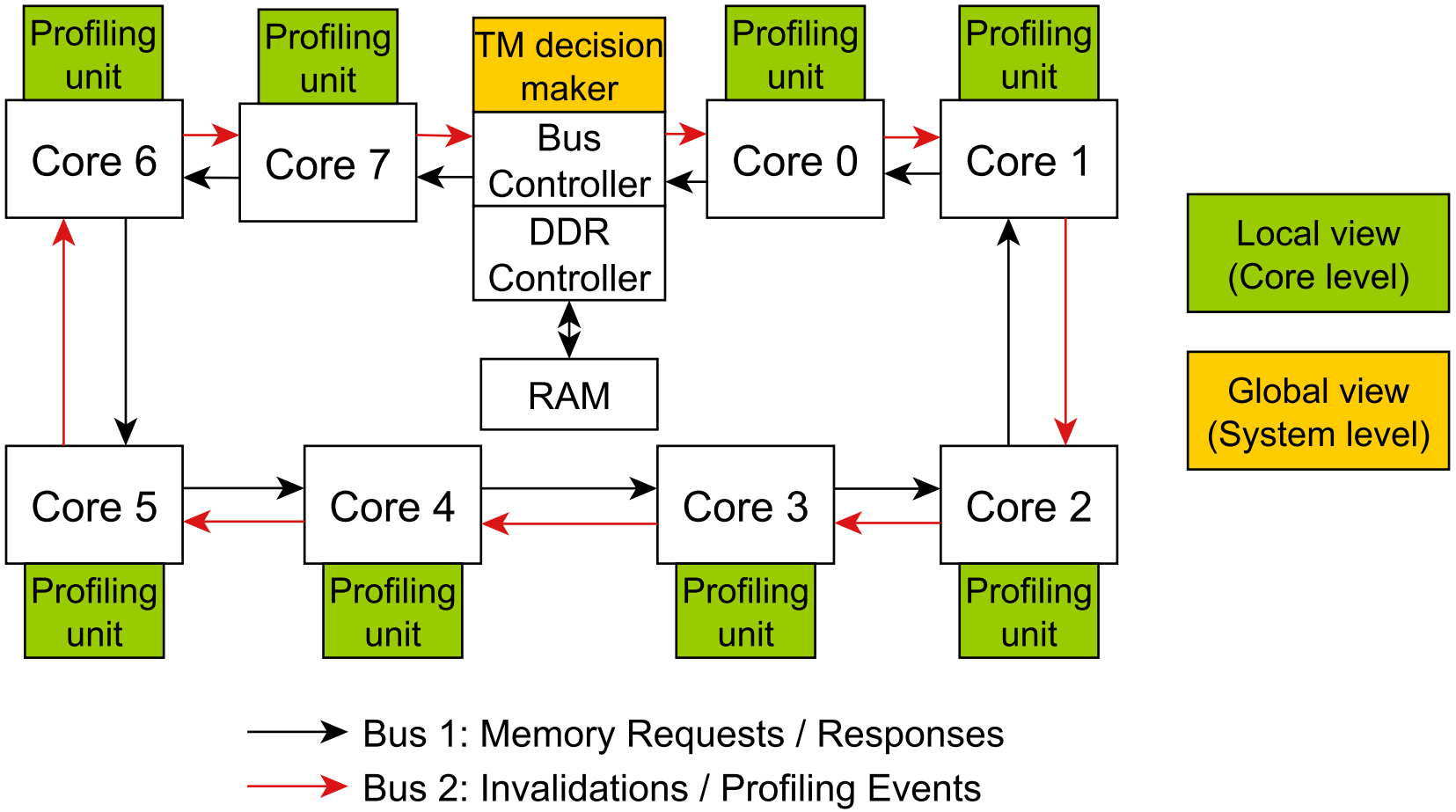
- Aggregate profiling data and send summarized data to decision maker.



Design

Details - Step 2

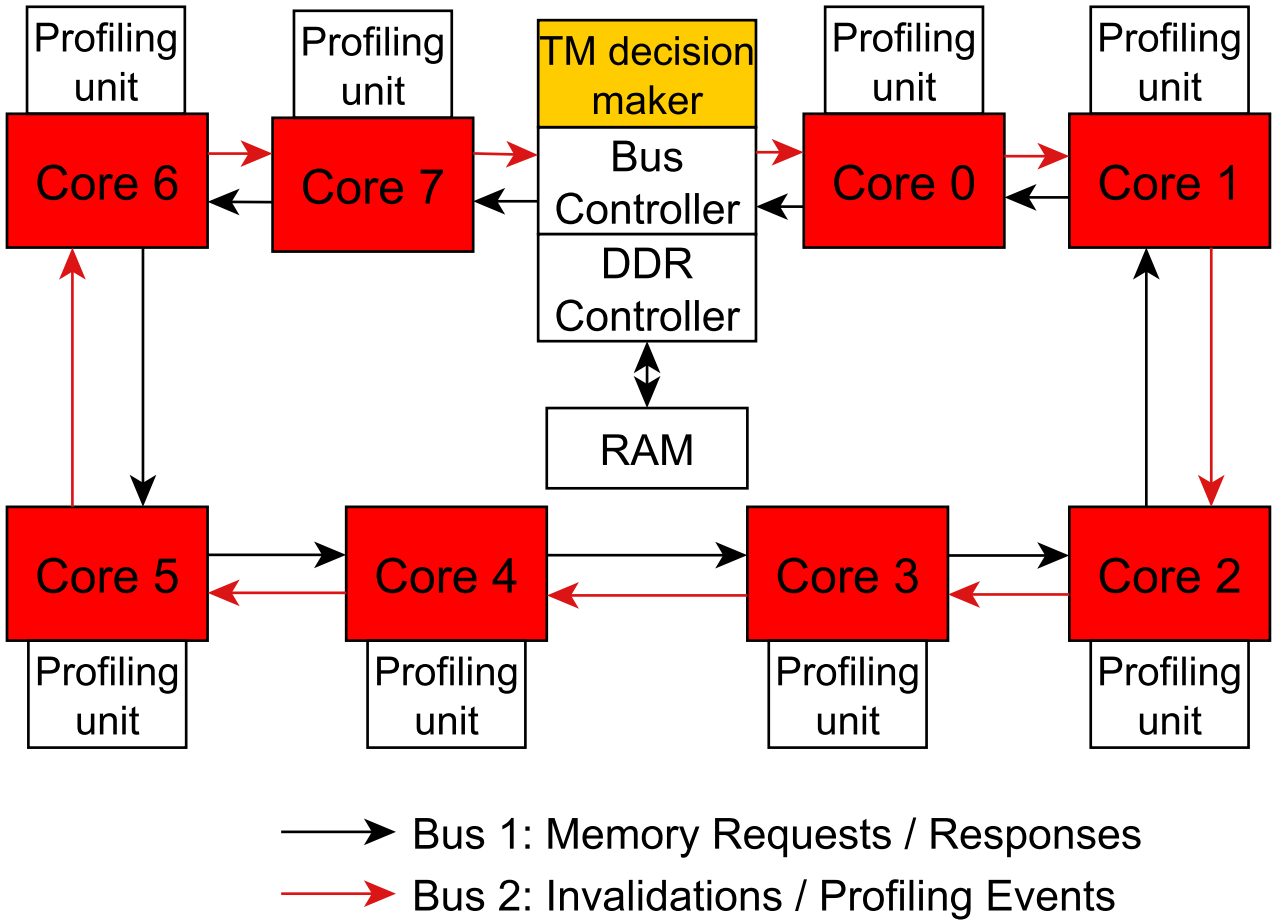
- Evaluate local and global view and make a switching decision.



Design

Details - Step 3

- Switch parameters simultaneously on all cores.



Design

Design space I

On which profiling data is the decision based?

- Contention $\left(\frac{\#\text{Aborts}}{\#\text{Commits}}\right)$
- Transaction length (Time)
- Transaction size (Read-/Write-Set)
- Hardware TM usage
- Switching Overhead

Decision making

- Majority decision
- Consensus decision

Map local (core) to global (system) view

Design

Design space II

Select TM strategy

1. HW/SW partitioning
   - Hybrid TM mode
     Fall back to STM only mode if HTM constraints reached
   - STM only mode
2. Data versioning
   - Write-Through
   - Write-Back
3. Conflict detection
   - Commit Time Locking
   - Encounter Time Locking

Design

Design space III

Select contention manager

- HTM: Suicide
- STM: Suicide, Delay, Backoff

When to back off to pure software transaction?

- Contention: Maximum number of retries reached
- Retry as irrevocable transaction
- HTM capacity exceeded

Design

Overhead

Low overhead crucial for performance gain:

- Existing profiling system overhead is low

Overhead of TM policy switching determined by

- Phase detection algorithm
- Switching frequency
- Switching delay time

$\Rightarrow$ Use hardware components

Ongoing work

Implementation and evaluation of a HW based prototype:

- Find suited phase detection algorithm
- Implement decision maker
- Determine influence of TM parameters on HybridTM

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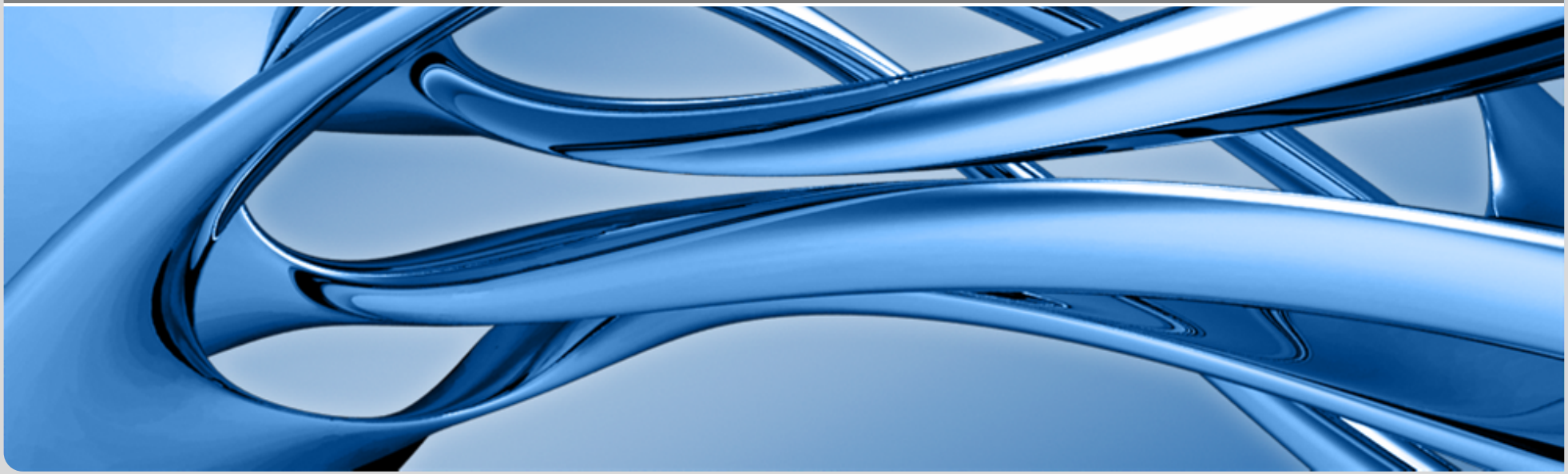

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Additional slides

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Switching algorithm