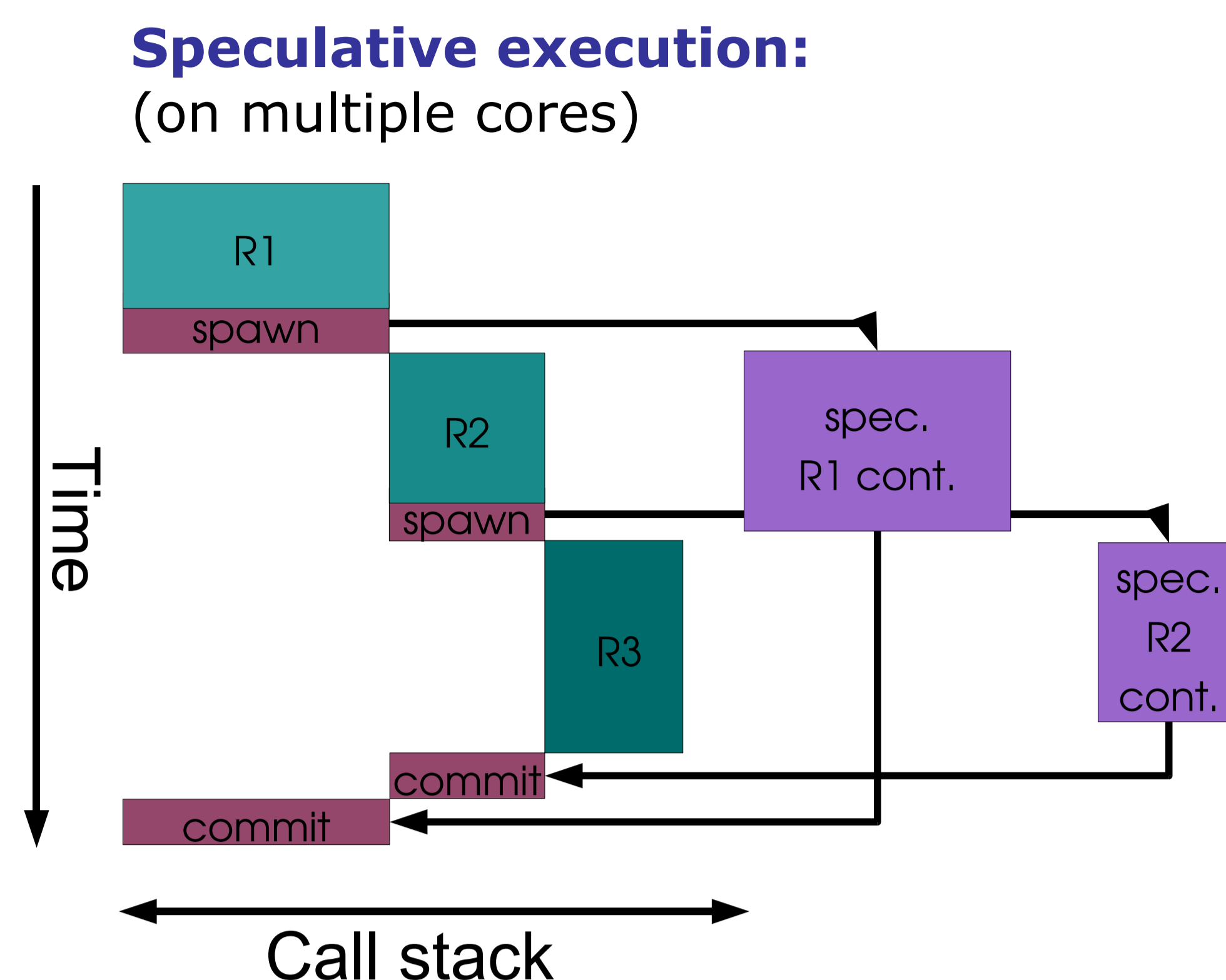
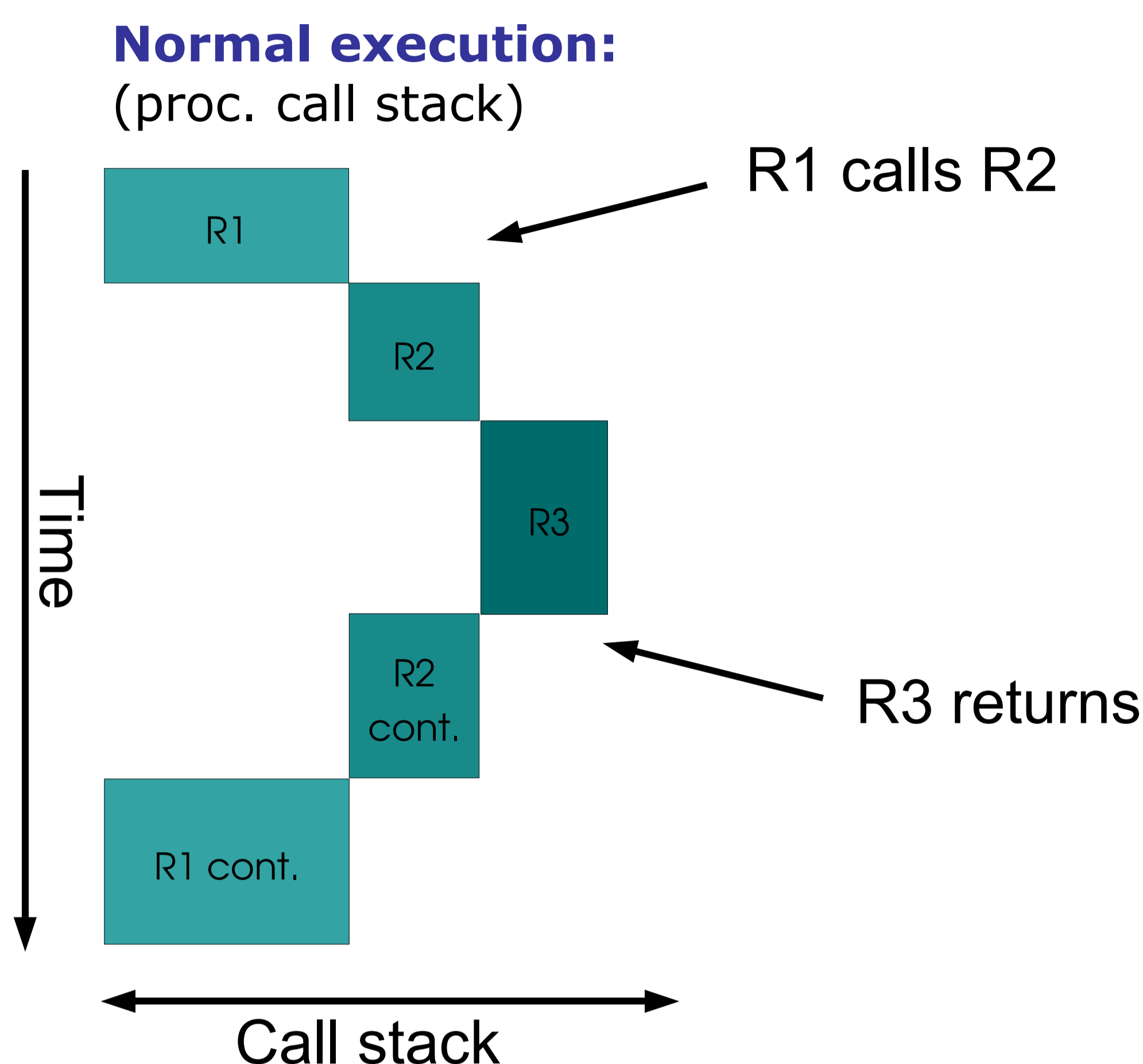


Virtualization Support for the Execution of Speculative Threads

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Motivation

- Not all available resources are used (SMP, CMP, SMT)
- Limits of Instruction Level Parallelism and automatic (non-speculative) parallelization reached
- Call for new, speculative optimization techniques

Introduction

- Parts of code executed speculatively
- Code runs separated from normal control flow
 - Abort speculation on exceptions and synchronization
- State-changes must be validated for hazards
 - (non spec.) Writer after (spec) Read
 - Write after Write
- Increases Thread Level Parallelism

Speculative method calls

- Promising method calls replaced by spec. spawning points
 - normal thread runs the method call
 - speculative thread runs speculatively from return point on
- Return value prediction in the spec. section
- Spec. thread stops as normal thread returns from method

Possible problems / challenges

- Low overhead for non-speculative thread
 - Move as much work as possible to speculative thread
 - Keep synchronization (notify) overhead low
- Memory allocation (low overhead needed)
 - Speculation should not increase memory pressure
- Integration into Opt-Compiler and collaboration with MMTk

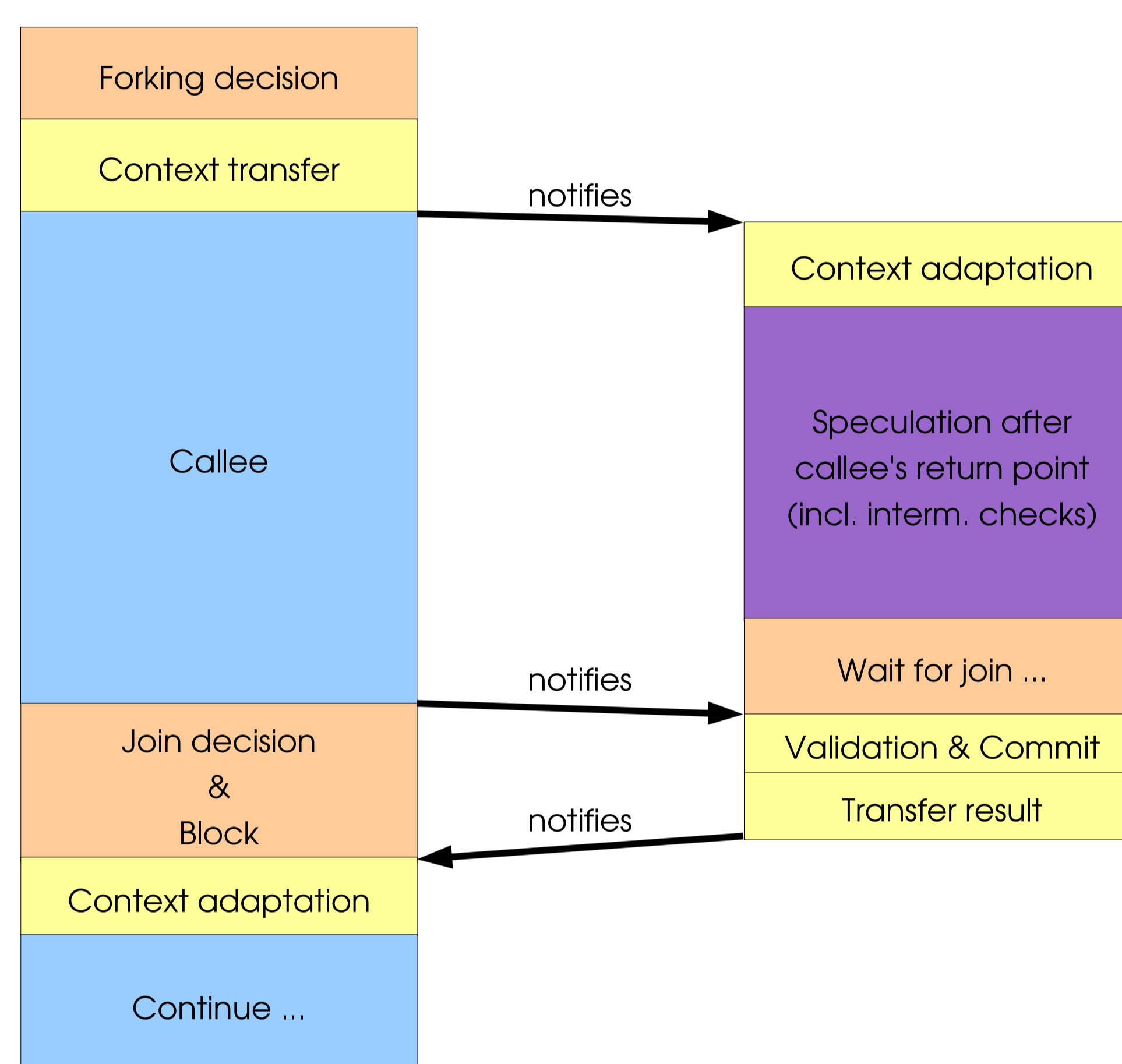
Implementation

- Prototype in Jikes RVM
 - Opt-Compiler extended to generate speculative code
 - Simple buffer structure for speculative objects
- Analysis using ASM bytecode modification toolkit and Spec Benchmarks
- Target architecture: IA32 (Core 2 Duo)

Related work

- JavaSpMt uses src-src transformations for loop speculation, does not change JVM
- SableSpMt is a speculation systems for interpreting JVMs, uses method level speculation

Speculative control transfer and coordination



First results: Low overhead thread synchronization

- Thread library (pthread)
 - High level abstraction (barriers)
 - High overhead (1810 cycles, $\sigma=436$ cycles)
- Custom tailored
 - Based on CAS
 - Overhead
 - 115 cycles ($\sigma=4$ cycles) on success
 - 440 cycles ($\sigma=87$ cycles) on conflict

Hazard frequency for speculations

	compress	raytrace	javac	mpeg
RAW	0.33530%	4.36%	11.81%	32.42%
WAR	0.33548%	8.50%	22.00%	67.38%
WAW	0.33529%	2.86%	11.26%	31.58%

Upper bound for spec. success rate

Aborts	0.22350%	1.21%	7.52%	25.19%
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Quality of prediction and end to end overhead not yet evaluated.

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