

Transactifying Apache's Cache Module

H. Eran O. Lutzky Z. Guz I. Keidar

Department of Electrical Engineering
Technion – Israel Institute of Technology



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Outline

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- 2 Transactification Process
- 3 Results
- 4 Summary



Transactifying Apache's Cache Module



The shift to multicore machines challenges software developers to exploit parallelism. Transactional Memory is one approach to make this easier.

Our Goals:

- Transactifying a large-scale legacy application.
- Creating a performance evaluation method for STM systems.



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Why Apache?

- Large-scale
- Popular
- Already parallel



And why Apache's Cache module?

- One of the points of interaction between Apache's worker threads.
- Well encapsulated.
- Currently implemented using one big lock.



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Previous work

- Concurrent data structures
(e.g. red-black trees and skip lists.)
- STMBench7 – Measures operations on a more complex yet still artificial object graph.
- STAMP – Stanford Transactional Applications for Multi-Processing:
A collection of transactified scientific algorithms.



Which STM to use?

- Library-based or compiler-based.
- TANGER
 - Open source
 - LLVM compiler extension
 - Supports tinySTM and other STM systems.
- Intel STM Compiler
 - Experimental version of Intel's ICC
 - Proprietary STM system.
 - Has published ABI for other STM systems.



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What to transactify

- 1 Convert mutex critical sections into transactions.
- 2 Wrapping atomic instructions inside transactions.
- 3 Decorate functions with Intel's `tm_callable` attribute.



Defining Atomic Blocks

Sometimes just converting a critical section in not optimal:

Get an object from the cache

- ❶ **Mutex lock**
- ❷ $\text{obj} \leftarrow \text{find key in cache}$
- ❸ if obj found
 - ❶ increment reference count on obj
 - ❷ register obj for reference count decrementation when done.
- ❹ **Mutex unlock**



Defining Atomic Blocks

Sometimes just converting a critical section in not optimal:

Get an object from the cache

- ① **Begin transaction**
- ② $\text{obj} \leftarrow \text{find key in cache}$
- ③ if obj found
 - ① increment reference count on obj
 - ② register obj for reference count decrementation when done.
- ④ **End transaction**



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- ④ End transaction



Defining Atomic Blocks

Suppose we know cleanup won't happen too soon.

Get an object from the cache

- ① Begin transaction
- ② $\text{obj} \leftarrow \text{find key in cache}$
- ③ if obj found
 - ① increment reference count on obj
- ④ End transaction
- ⑤ if obj found
 - ① register obj for reference count decrementation when done.



Commit Handlers

- Pieces of code to be run on commit.
- Together with abort handlers allow for more efficient transactions.
- Can also be used in the shown scenario to clean up the code.



Handler Closures

- Intel's commit handler syntax is:

```
_ITM_addUserCommitAction(transaction,  
commitFunction, resumingTransactionId,  
userArgument)
```

- Probably like any such construct in C.
- In languages that support closures, the use of commit handlers for our purpose would be much cleaner.



Statistics and Profiling

[TODO - a single line somewhere - not an entire slide.]



Evaluation

Client The *Siege* HTTP load testing tool.

Workload The set of unix man-pages, served using the *man2html* CGI program. The program uncompressed the man-pages and rendered them to HTML.

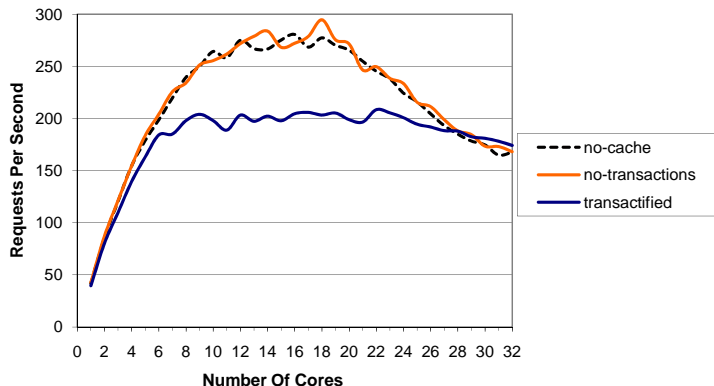
Distribution Request files by Zipf distribution, whose *s* parameter determines the level of locality in the requests.

Setup Two machines connected by Gigabit ethernet, each an 8-processors SMP with quad core 2.3GHz AMD Opteron processors and 126GB of RAM.



Results – Requests per Second

$s = 0.1$

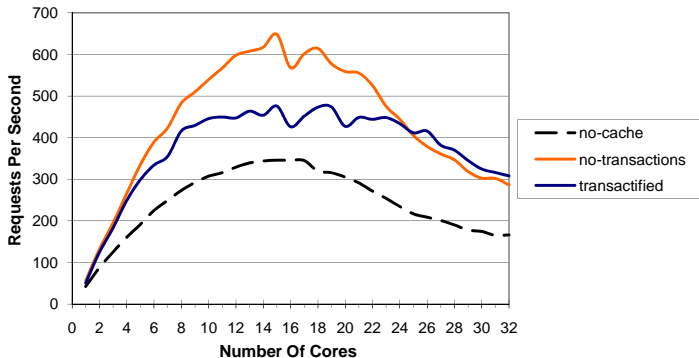


Very **low** locality. Cache not effective. STM penalty high.



Results – Requests per Second

$s = 1$

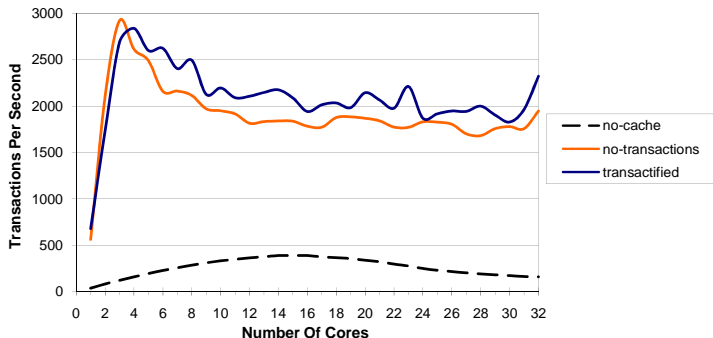


Medium locality. Cache is an improvement. STM incurs penalty.



Results – Requests per Second

$s = 2$



High locality. Cache is vital. STM version works best.



Conclusion

- Encapsulation is important.
- Commit handlers might be useful not only for open transactions.
- Real-world applications are challenging and important to work on.



Questions?

