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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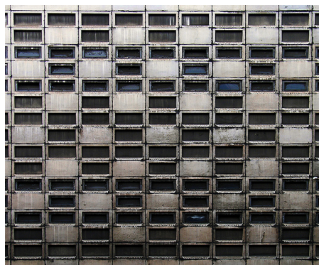

The shift to multicore machines challenges software developers to exploit parallelism. Transactional Memory is one approach to make this easier.

Our Goals:

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

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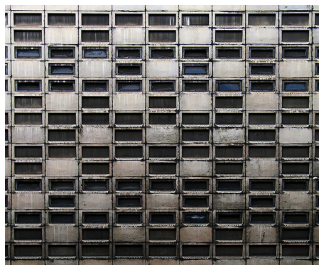

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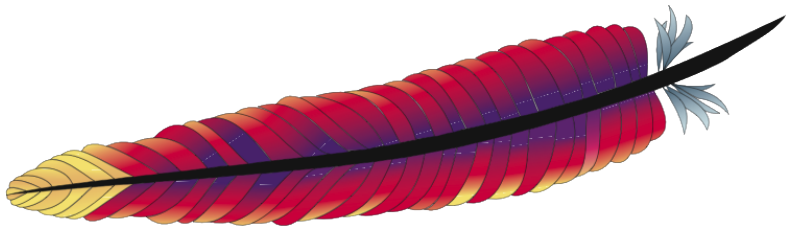
Why Apache?

- 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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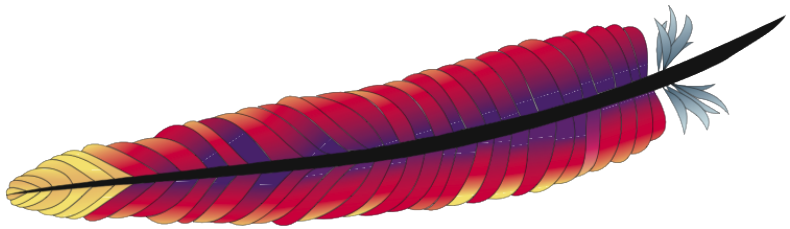

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Previous work

- Concurrent data structures
  (e.g. red-black trees and skip lists.)
- STMBench7 – Measures operations on a more complex yet still artificial object graph.
- STAMP – Standford 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

1. Mutex lock
2. `obj` ← find key in cache
3. if `obj` found
   1. increment reference count on `obj`
   2. register `obj` for reference count decrementation when done.
4. Mutex unlock

Defining Atomic Blocks

Sometimes just converting a critical section in not optimal:

Get an object from the cache

1. Begin transaction
2. `obj` ← find key in cache
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4. End transaction

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Defining Atomic Blocks

Suppose we know cleanup won't happen too soon.

Get an object from the cache

1. Begin transaction
2. `obj` ← 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 Closurs

- 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.

Evaluation

Client The *Siege* HTTP load testing tool.

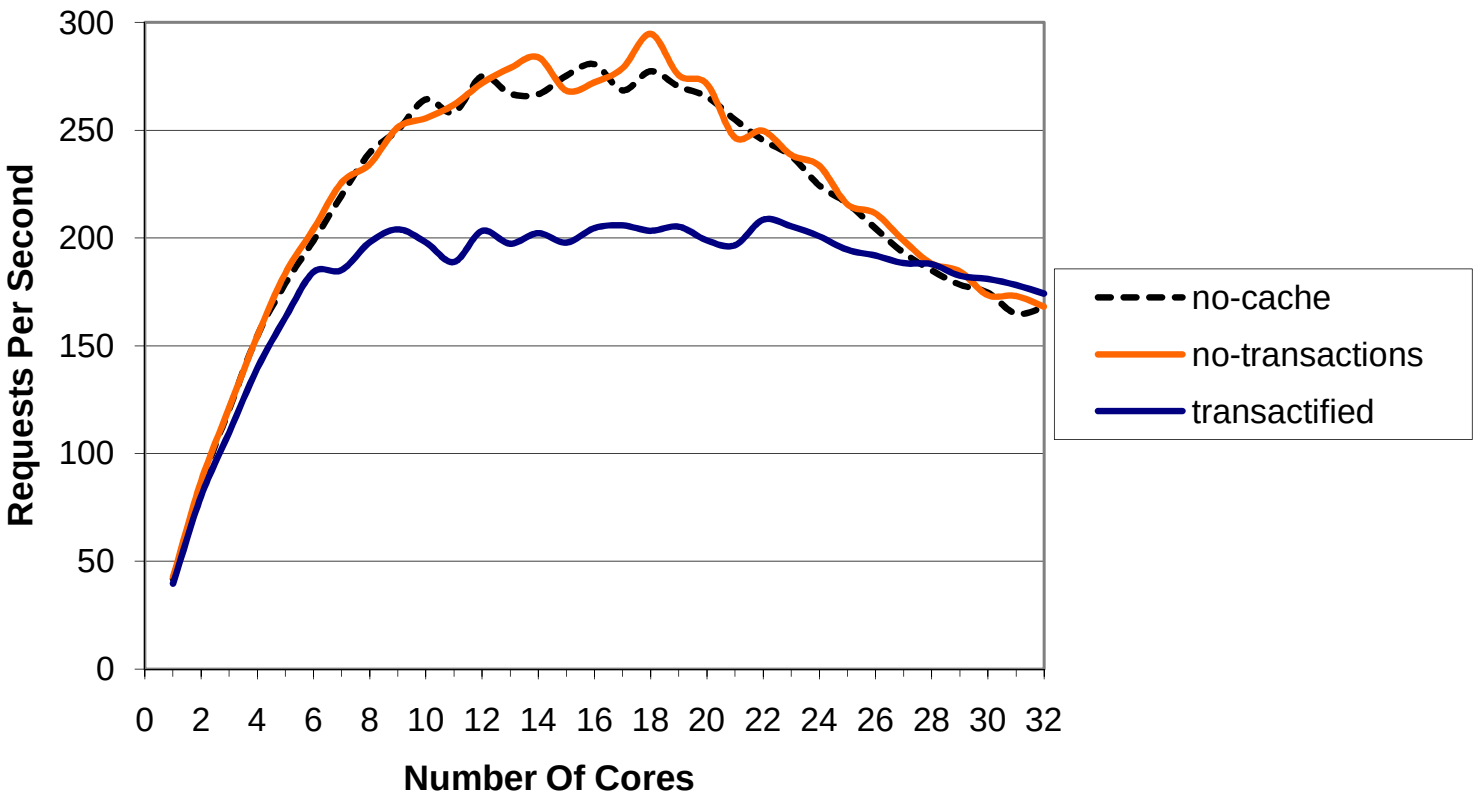
Workload The set of unix man-pages, served using the *man2html* CGI program. The program uncompressed the man-pages and rendered them to HTML.

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

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

Results – Requests per Second

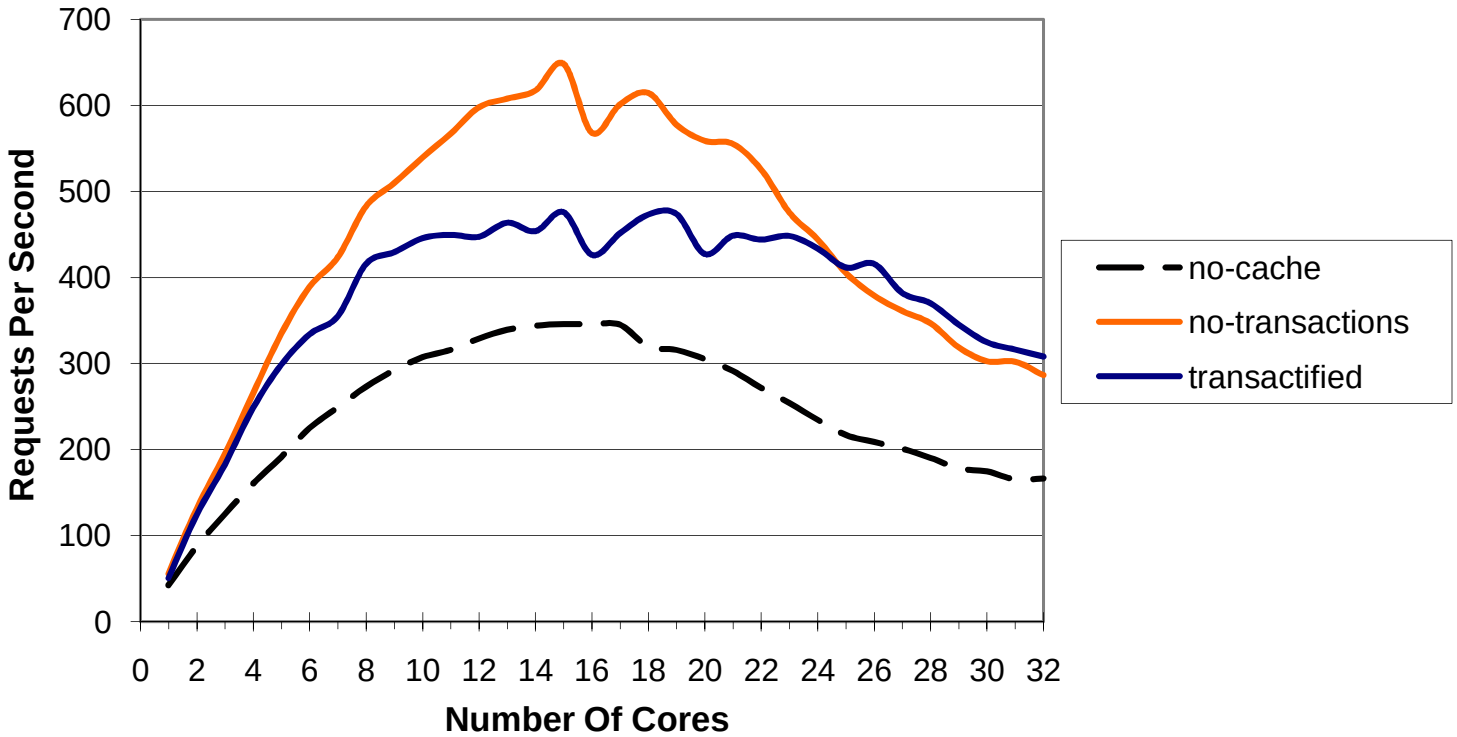
$s = 0.1$



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

Results – Requests per Second

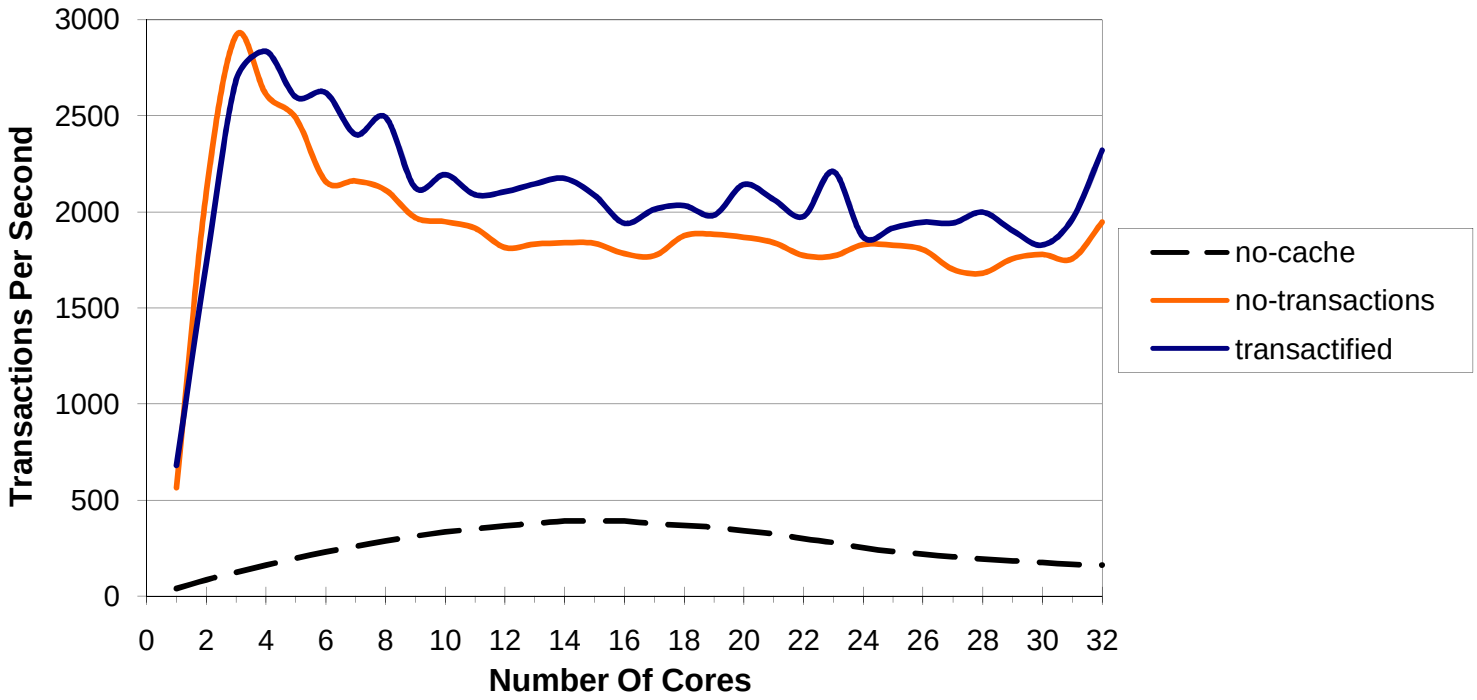
$s = 1$



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?