Motivation

- **Temporal indexing** maintains both current and historical data
- Historical data serves many useful systems purposes
  - Backup, restore, auditing, and transaction time support
- **Transaction time support** enables access to historical data to perform as of queries and time travel to observe data changes
- **Modern hardware** targeted by this work
  - Multi-core machines
  - Coordinating access using locks limits performance
  - Large main memories
  - Available space to tolerate redundant data
  - Flash storage
  - Good at random reads and sequential reads/writes

- **BW-Tree** [1,2] is an existing B-Tree index structure which targets modern hardware
  - Latch (Lock) free techniques allow better performance
  - No updates in-place to reduce cache invalidations
  - Log-structured storage on flash

This work: An index structure, Time-split BW-Tree (TSBW-Tree), which extends the BW-Tree to support temporal indexing. The goal is to retain high performance on modern hardware.

Index structure

- TSBW-Tree is based on the B-Tree data structure
- Each node in the tree can be in one of three states
  - **In memory**: A copy of the node is in main-memory
  - **On disk**: The node is not in memory and need to be fetched from disk to be processed
  - **In archive**: This is a historical node that is in an archival medium. It need to be fetched from the archive to be read
- Logical Page IDs (PIDs) are used to identify pages
  - A mapping table is used to translate from a PID to a physical address of a page
  - The physical address encodes the state of the page
  - PIDs are important for latch-free behaviour
  - PIDs isolate updates to a single page

TSBW-Tree: A B-tree for new hardware platforms.”” In ICDE 2013.

Experiments

- Intel Xeon W3550 – 4 cores – 8 hyperthreads - 24 GB RAM
- Synthetic workload: 10% inserts, 10% updates, 80% reads

<table>
<thead>
<tr>
<th>Overhead of multi-versioning</th>
<th>Overhead of archiving</th>
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<tbody>
<tr>
<td>BW-Tree</td>
<td>TSBW-Tree</td>
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<td>2.2 Mops/s</td>
<td>1.1 Mops/s</td>
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References