Callas

High-performance ACID via Modular Concurrency Control

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TRANSACTIONS:
SIMPLE AND POWERFUL
TRANSACTIONS: SIMPLE AND POWERFUL

Atomicity
Consistency
Isolation
Durability

ACID txn

\[
\begin{align*}
z &= x + y \\
y &= y + 1 \\
x &= 0
\end{align*}
\]
TRANSACTIONS:
SIMPLE AND POWERFUL

Atomicity
Consistency
Isolation
Durability

ACID txn

\[ z = x + y \]
\[ y++ \]
\[ x = 0 \]
TRANSACTIONS: SLOW

ACID Paradigm
TRANSACTIONS: SLOW

ACID Paradigm

Slow
TRANSACTIONS: SLOW

ACID Paradigm

Non-transactional

Slow

Fast
TRANSACTIONS: SLOW

ACID Paradigm  Middle Ground  Non-transactional

Slow  Fast  Fast
WE LOVE ACID
WE LOVE ACID
Uniformity

Ease of Programming
Uniform Abstraction  
Ease of Programming  

Uniform Implementation  
Conservative Mechanism  

The Price of Uniformity
THE PRICE OF UNIFORMITY

ACID Abstraction

Implementation
THE PRICE OF UNIFORMITY

ACID Abstraction

Implementation
THE PRICE OF UNIFORMITY

ACID Abstraction

Conservative Implementation
MODULAR CONCURRENCY CONTROL

ACID Abstraction

Implementation
MODULAR CONCURRENCY CONTROL

ACID Abstraction

Insight 1: Decouple Abstraction and Implementation
MODULAR CONCURRENCY CONTROL

ACID Abstraction

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MODULAR CONCURRENCY CONTROL

ACID Abstraction

Cross-Group CC

Specialized in-group CC

Implementation
Insight 2: Separation of Concerns
MODULAR CONCURRENCY CONTROL

ACID Abstraction

Implementation

Insight 2: Separation of Concerns
MODULAR CONCURRENCY CONTROL

ACID Abstraction

Insight 2: Separation of Concerns

Limited Scope

Aggressive Optimizations

Implementation

Specialized in-group CC
PERFORMANCE OF CALLAS

Throughput (transactions/sec)

<table>
<thead>
<tr>
<th></th>
<th>MySQL Cluster</th>
<th>Callas</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPC-C</td>
<td>0</td>
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</tr>
<tr>
<td>Fusion Ticket</td>
<td>0</td>
<td>16000</td>
</tr>
</tbody>
</table>
A MORE PERFECT UNION

ACID Abstraction

Cross-Group CC

Implementation
A MORE PERFECT UNION

ACID Abstraction

Cross-Group CC

Implementation

single version & lock-based
ACID Abstraction

Cross-Group CC

Implementation

single version & lock-based

only work in single version databases
How to apply MCC in a multi-version DB?
NEXT STEP : MULTI-VERSION

ACID Abstraction

Cross-Group CC

Implementation
NEXT STEP: MULTI-VERSION

ACID Abstraction

Multi-version Cross-Group CC

Implementation
NEXT STEP: MULTI-VERSION

ACID Abstraction

Multi-version Cross-Group CC

Single Version API

Multi-version API

Single Version API

Implementation

temporary single-version “bubbles”
NEXT STEP: MULTI-VERSION

ACID Abstraction

Multi-version Cross-Group CC

Single Version API

Multi-version API

Single Version API

Implementation

temporary single-version “bubbles”

single version CC within a multi-version database
NEXT STEP: MULTI-VERSION

ACID Abstraction

Multi-version Cross-Group CC

Single Version API

Multi-version API

Single Version API

Implementation

temporary single-version “bubbles”

relieved r-w conflict

single version CC within a multi-version database
NEXT STEP: MULTI-VERSION

ACID Abstraction

Multi-version Cross-Group CC

- temporary single-version “bubbles”
- single version CC within a multi-version database
- relieved r-w conflict
- relieved w-w conflict and write skew