

# In-Memory OLTP



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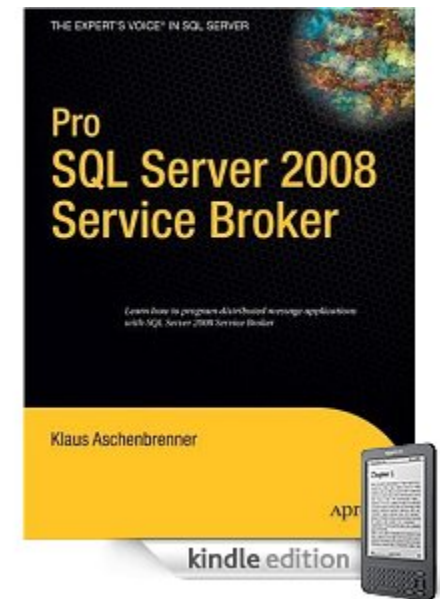
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# About me

- CEO & Founder SQLpassion
- International Speaker, Blogger, Author
- SQL Server 2008 MCM
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  - <http://www.SQLpassion.at/academy>
  - Free Newsletter, Training Videos



# Agenda

- Challenges
- In-Memory OLTP
- Limitations

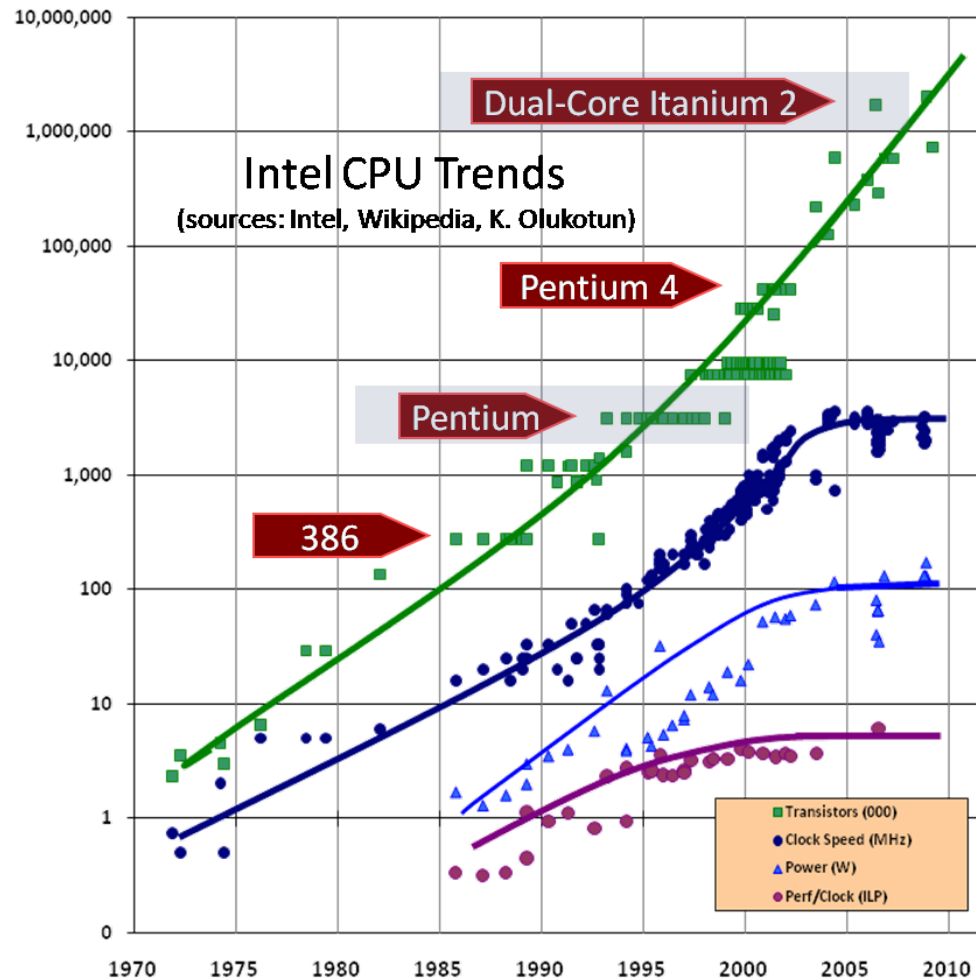
# Agenda

- Challenges
- In-Memory OLTP
- Limitations

# Challenges

- Slow rotational Storage
- Expensive SSD Storage
- CPU Clock Speeds aren't scaling
- RDBMS Systems can't scale linearly
  - Locking, Blocking, Latching

# Hardware Trends



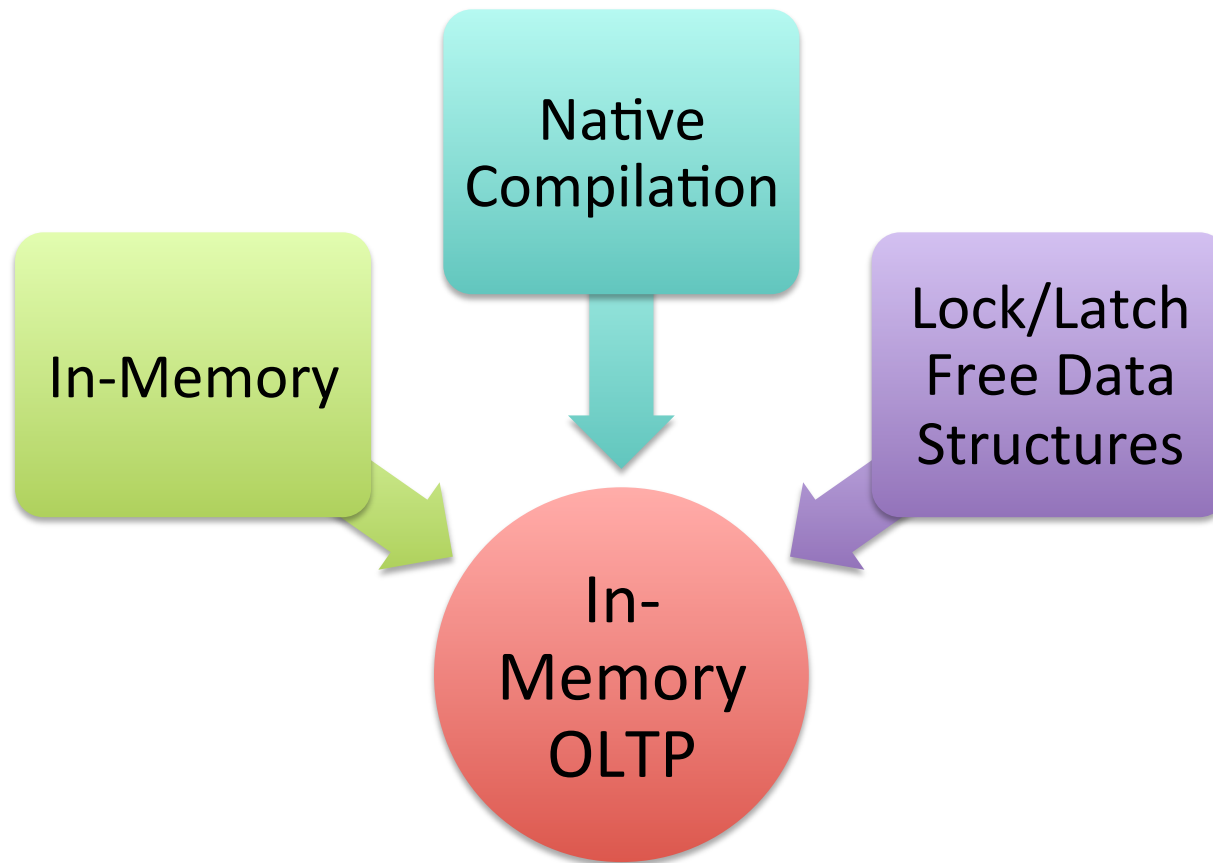
Source: <http://gotw.ca/publications/concurrency-ddj.htm>



# We need a Technology that...

- Uses RAM to store data
  - No SSD Storage needed
- Executes queries with the least amount of Clock Cycles
  - Cost effective use of CPUs
- Avoid Locking/Blocking/Latching completely
  - Can scale linearly

# The Solution





# Agenda

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# Main Pillars

- Memory Optimized Tables
- Native Compiled Stored Procedures
- Lock/Latch Free Data Structures

# Memory Optimized Tables

- Data Storage
  - Completely In-Memory
  - Hash Indexes
  - Range Indexes
  - Stored in a FILESTREAM File Group
- Durability
  - Schema & Data
  - Schema Only

# Memory Optimized Tables

- Compiled to Native Code
  - Compiled to a C DLL
  - sys.dm\_os\_loaded\_modules
- Integration into SQL Server
  - Query Interop
  - Backup/Restore
  - HA/DR Integration

# Demo

## Memory Optimized Tables

# Native Compiled Stored Procedures

- Traditional Stored Procedures
  - Interpreted during Runtime
  - Additional CPU Instructions
  - C++ Virtual Function Calls
- Native Compiled SPs
  - Compiled to a C DLL
  - Contains your logic in Native Code
  - Can only query Memory-Optimized Tables...

# Demo

## Native Compiled Stored Procedures



# Lock/Latch Free Data Structures

- Pessimistic Concurrency
  - Reading: Shared Locks
  - Writing: Exclusive Locks
- Optimistic Concurrency (RCSI, SI)
  - Reading: Version Store
  - Writing: Exclusive Locks
- Latching
  - Synchronized In-Memory Access
  - Reading/Writing is always Single-Threaded

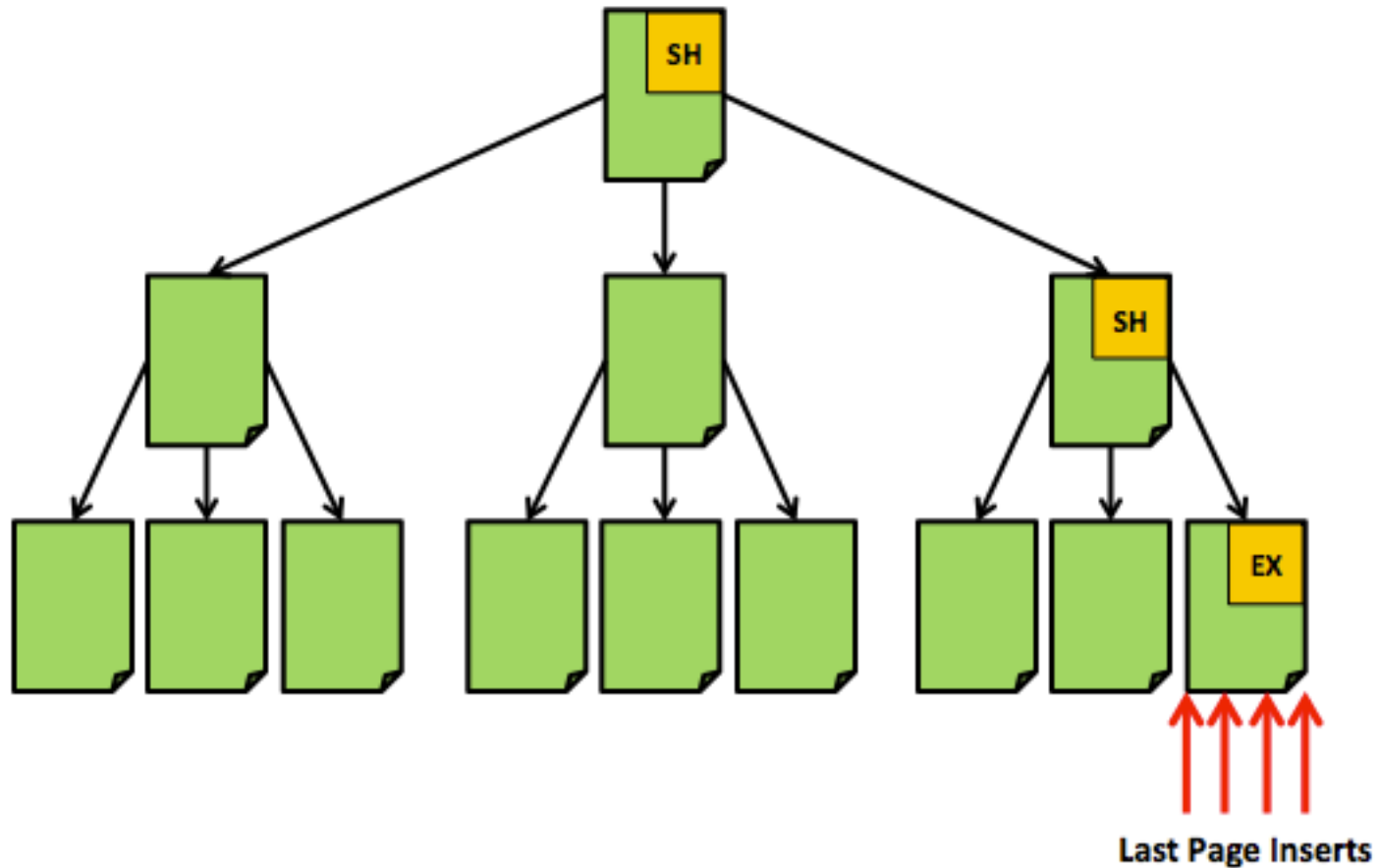
# Lock/Latch Free Data Structures

- Hash Indexes
  - No Locks, no Latches anymore!
  - Based on MVCC
  - Data is stored internally in a Hash Table
- Your new (old) Performance Bottleneck
  - The Transaction Log!
- Side Effects
  - Writer-Writer Conflict
  - Retry Logic is needed

# Scalability

- It scales tremendously, if you have the *\*right\** problems
  - Bad Hardware Configuration? No!
  - Bad Indexing Strategy? No!
  - Bad performing Transaction Log? No!
- What are *\*right\** problems?
  - Transient Data (Session State)
  - Last Page Insert Latch Contention
  - CPU intensive Business Logic in Stored Procedures!?

# Last Page Insert Latch Contention



# Current Solutions

- Random Clustered Keys
  - UNIQUEIDENTIFIER
  - Distributes the INSERTs across the Leaf Level
  - Larger Lookup Values in Non-Clustered Indexes...
- Hash Partitioning
  - Distribute INSERTs across different partitions
  - Every CPU core has its own partition
  - You can't additionally partition your table...
  - Partition Elimination is almost not possible...

# Demo

## Last Page Insert Latch Contention

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# Limitations

In-Memory OLTP is integrated into SQL Server

**BUT...**

# Limitations - Tables

- No Constraints
  - FOREIGN KEY
  - CHECK
- IDENTITY Columns
  - SEED and INCREMENT of 1
- No other DDL statements are allowed
  - CREATE INDEX
  - DROP INDEX
  - ALTER INDEX

# Limitations – Stored Procedures

- Access to Memory Optimized Tables only
- No Parameter Sniffing
  - All input values are treated as UNKNOWN
- No Recompilations
- No Parallel Plans
- No Statistics Update

# Summary

- Challenges
- In-Memory OLTP
- Limitations

# SQL Server Performance Tuning Workshop

- June 1 – 5 in London
- Content
  - Database Internals
  - Execution Plans
  - Indexing
  - Statistics
  - Locking, Blocking, Deadlocking
  - Performance Troubleshooting
- More Information
  - <http://www.SQLpassion.at/academy/perftuning>
  - 10% Discount!

