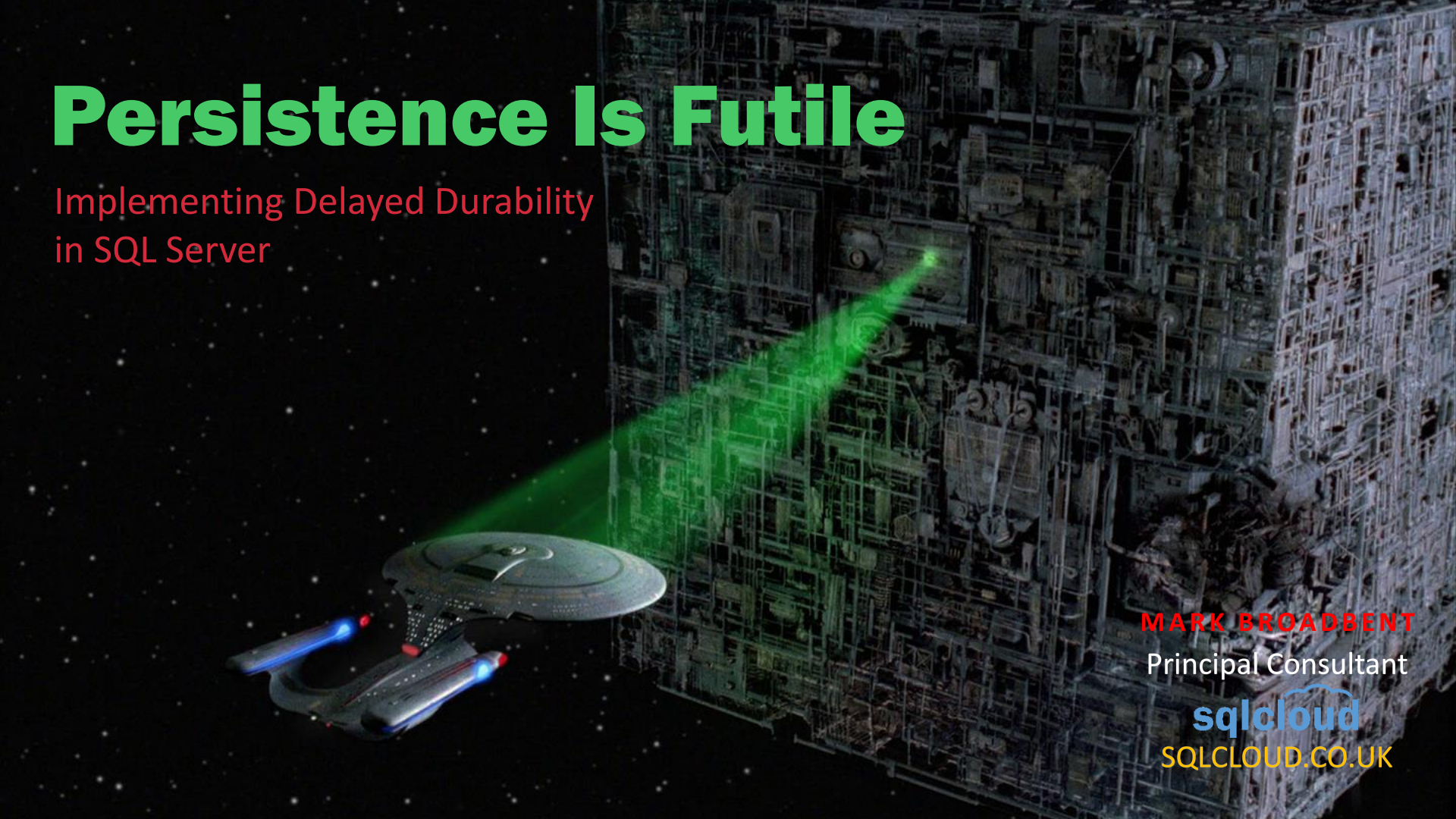
Persistence Is Futile

Implementing Delayed Durability in SQL Server



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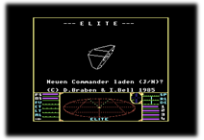
Guilty pleasures…

SERVERLESS

Likes…



Badges…

Microsoft CERTIFIED
Master: SQL Server

MVP Microsoft® Most Valuable Professional

Microsoft Community Contributor AWARD

Microsoft CERTIFIED Solutions Expert Data Platform

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PASS

Community…

PASS HYBRID VIRTUAL CHAPTER

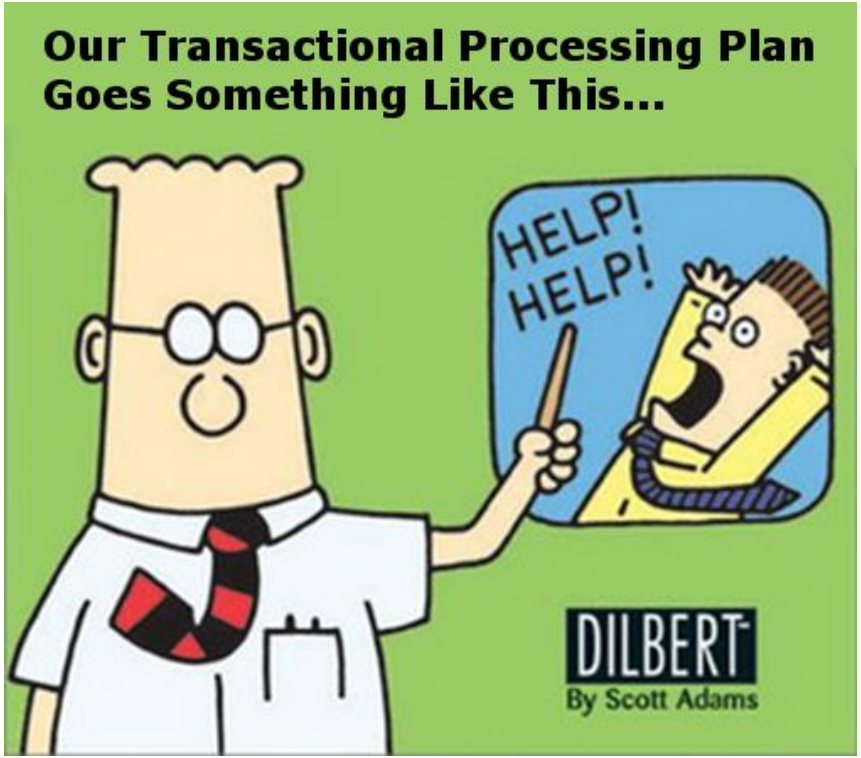
SQLEA

SQL SATURDAY CAMBRIDGE

SHAREPOINT SATURDAY CAMBRIDGE

SQL Nexus

Agenda



1 Transactions & Breaking ACID Properties

We'll also need to explain In-Memory OLTP in this context!

2 Log Architecture

3 Delayed Durability Implementation On-disk/ IMOLTP

4 Limitations

5 The best part of the presentation… Gin O'Clock

Requirements

- From SQL 2014 and upward
- On all editions (including Express)
- For SQL on Windows OR SQL on Linux
- In any database recovery mode
  - FULL/ BULK_LOGGED/ SIMPLE

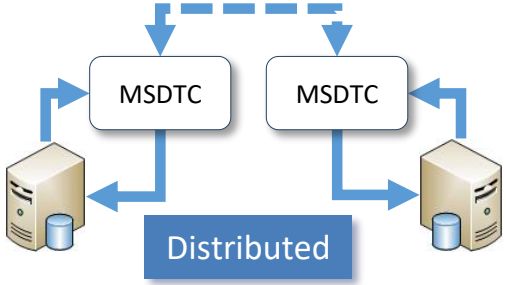
A C I D

Transactions can be…

Explicit

```
BEGIN TRAN
…
COMMIT TRAN
```

```
BEGIN DISTRIBUTED TRAN
…
COMMIT TRAN
```



Batch Scope (MARS)

```
UPDATE …
INSERT …
DELETE …
GO
```

(there is also…)

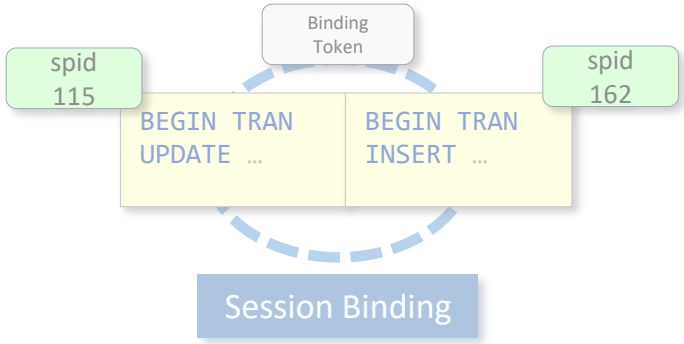
Auto-Commit

```
INSERT …
DELETE …
```

Implicit (evil muthas!)

```
INSERT …
DELETE …
COMMIT TRAN
```

"BEGIN TRAN"



Transactions

```
BEGIN TRAN transaction_1 WITH MARK 'restorepoint'
    BEGIN TRAN
       --do something
    COMMIT TRAN
    SAVE TRAN savepoint
    BEGIN TRAN
       --do something else
    COMMIT
    IF {something_wrong} THEN ROLLBACK TRAN savepoint
COMMIT
```

"Nested Transaction" *1

Savepoint

Outer Transaction

*1 Not to be confused with Atomic Blocks (we'll discuss these later!)

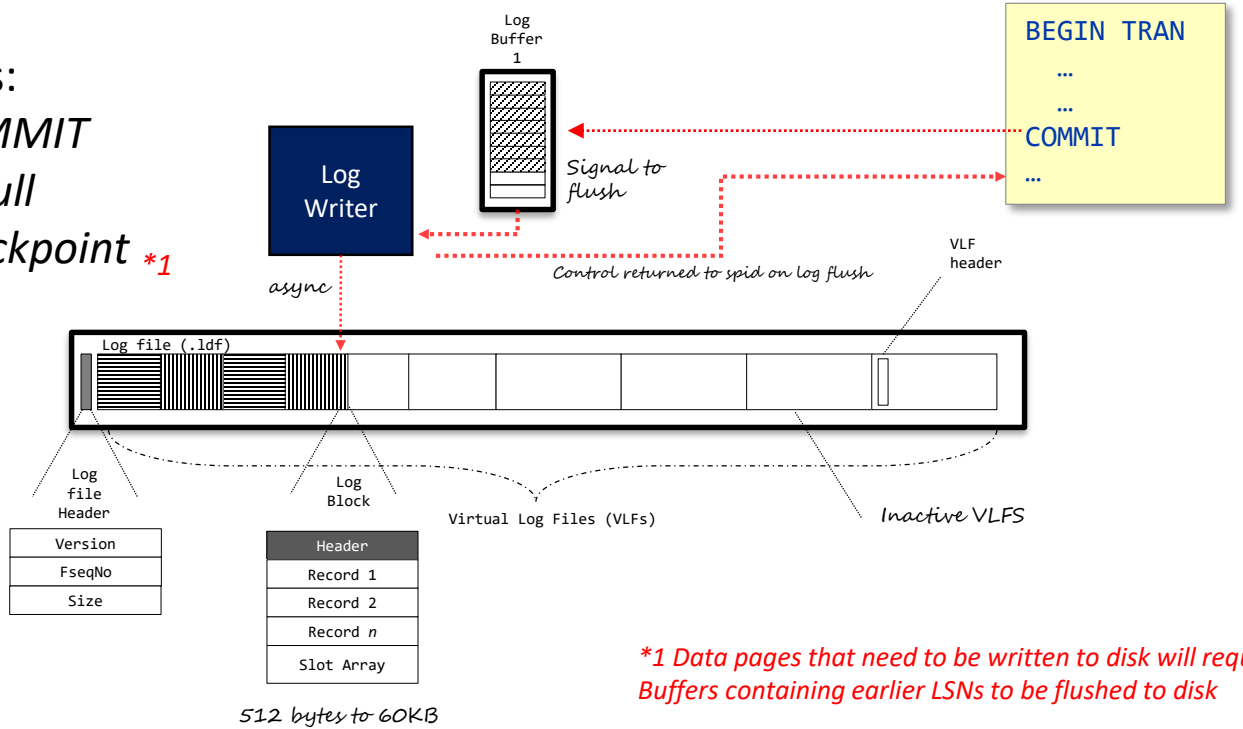
Demo

Transactions and broken ACID properties…

Durable Transactions

Log flushes:

- *On COMMIT*
- *When full*
- *On Checkpoint* *1

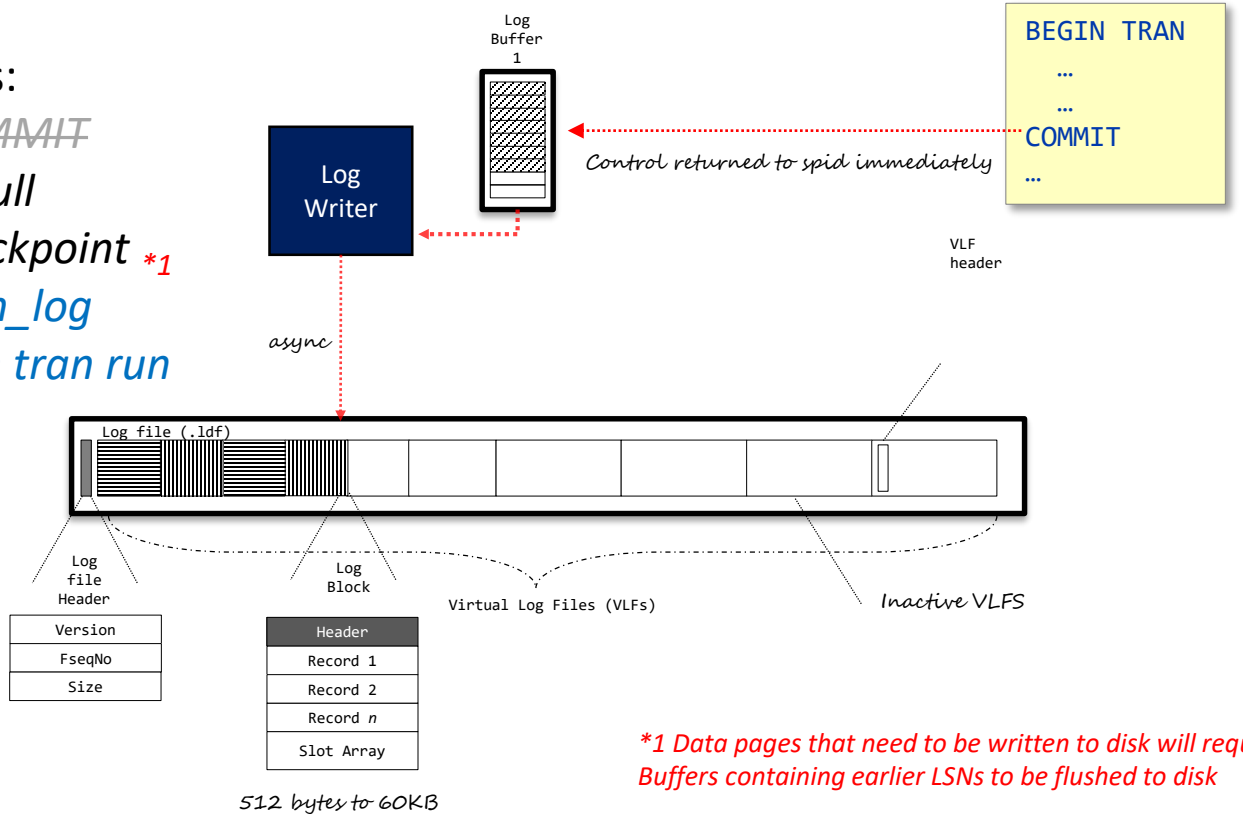


*1 Data pages that need to be written to disk will require Buffers containing earlier LSNs to be flushed to disk

Delayed Durable Transactions

Log flushes:

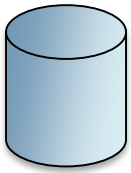
- ~~On COMMIT~~
- *When full*
- *On Checkpoint* *1
- *sp_flush_log*
- *Durable tran run*



*1 Data pages that need to be written to disk will require Buffers containing earlier LSNs to be flushed to disk

Delayed Durability Hierachy

DATABASE

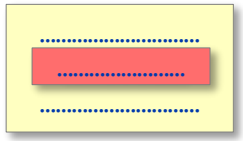


- DISABLED
- ALLOWED
- FORCED

TRANSACTION
(On-disk or IM tables)

- OFF
- ON

ATOMIC BLOCK (IM tables via
Native Compiled Stored Procs)



- OFF
- ON

Except

- If CDC is enabled
- Is a cross database transaction
- Is a distributed transaction

…BUT delayed durability is not guaranteed regardless!

Demo

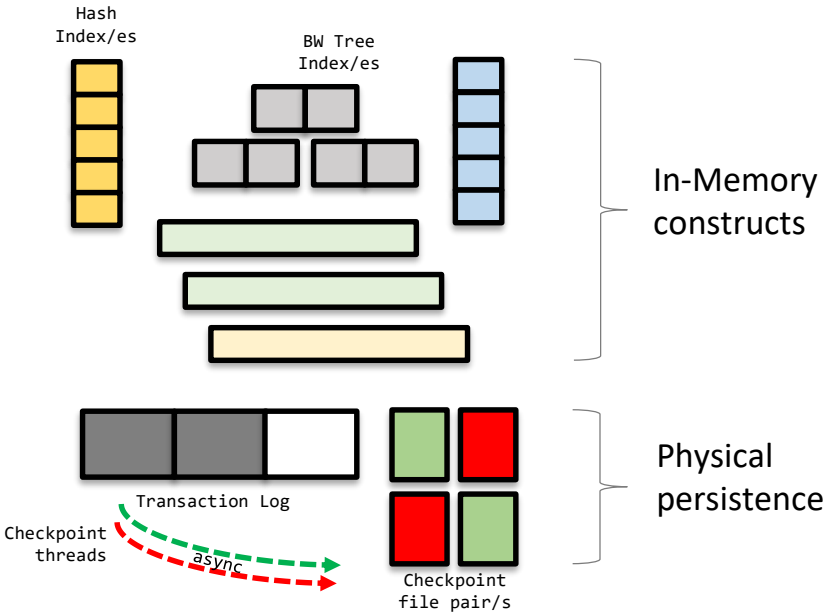
On disk delayed durability

In-Memory OLTP Overview and Log Improvements

- New concurrency model (as of SQL Server 2014)
- All row and index data in memory, all versioning In-Memory
- Lockless and latchless operation
- Physical persistence when SCHEMA_AND_DATA)
  - Thru Checkpoint file pairs + Log

<u>Log Improvements</u>

- SCHEMA_ONLY has no log overhead
- Log block “compression” (less log writes)
- No undo record generation
- Indexes not persisted, rebuilt on start-up
  - …so NO index maintenance logging.



Demo

In-Memory delayed durability

Log Waits and Log Performance Monitoring

- LOGBUFFER wait – time taken to create log record in log buffer
- WRITELOG wait – time taken for log buffer to be flushed to logfile
- Use sys.dm_io_virtual_file_stats to look at file IO, sizes and stalls
- Performance Monitors e.g.
  - Log flushes per second counter of Databases counter set
  - Transactions per second counter of Databases counter set
  - Transactions created per second counter of SQL Server <YYYY> XTP Transactions/ <DB> (instance of object).

Limitations and Special Cases

- Ignored when
  - CDC enabled tables
  - Cross-database or distributed transactions
- Not supported in Transaction Replication
- Reporting and Failover scenarios *1
  - Sync Read-only replicas
  - High Safety Database Mirrors
  - Failover Clustered Instances
  - Log backups and Log shipping targets
  - Hyper-V Quick Migration.

Warning!
Data loss is very possible in these scenarios!

*1 In a nutshell, crash recovery can (and possibly *will*) result in data loss!

Summary

- Delayed Durability attempts to make log flushes to disk more efficient
- Is a compromise of performance over durability
- Force on all trans per DB, a specific trans or on atomic block via Natively Compiled SP
- IMOLTP can remove many bottlenecks
  - But IMOLTP already provides some great logging improvements
  - However Delayed Durability *could* still remove log buffer waits
- It can result in lost data, even under highly available environments.

Thank you for listening!

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Slideshare: http://www.slideshare.net/retracement

Demo: https://github.com/retracement/Persistence_is_Futile