DATA TECHNOLOGIES AND SERVICES

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(send email beforehand)

NewSQL

Where to? To take the third way ...

New SQL

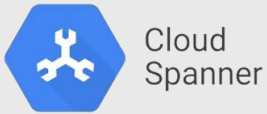
Property	RDB	NoSQL	NewSQL
Relational data model	YES	NO	YES
SQL query language	YES	NO	YES
ACID support/guarantee	YES	NO	YES
Horizontal scalability	NO	YES	YES
Schema flexibility	NO	YES	NO
Efficiency of processing large amounts of data	Moderate	Fast	Very fast
Public (web) support	Very large	Large	Small
Support for unstructured data	NO	YES	To some extent

NewSQL

- Modern RDB management system
  - 2011; H-Store
- Same scalability as NoSQL for OLTP processing
- Retains all ACID guarantees
- Supports HTAP
  - Hybrid transaction/analytical processing
- General:
  - RDB reliability
  - NoSQL speed and performance

NewSQL

- Product examples

#1	#2	#3	#4	#5
VoltDB	NuoDB	ClustrixDB	Google Spanner	SAP HANA
				

NewSQL

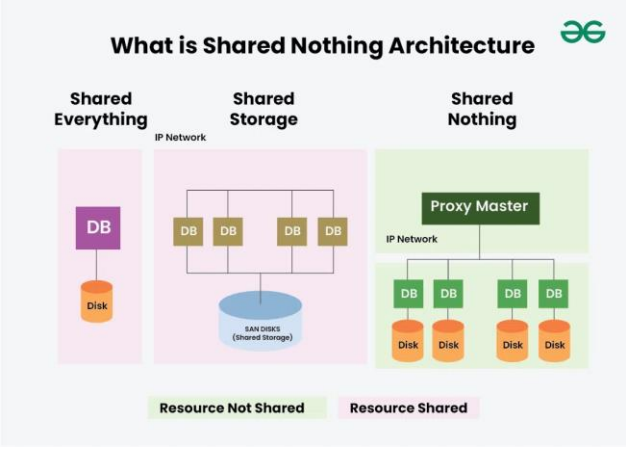
- Architecture
  - Storage **in-memory** (SSD)
  - Taking snapshots of the disk and copying to persistent storage (hard disk)
  - Transaction logging -> strict serializability

NewSQL

- Architecture
  - Minimising table locks
    - Optimistic control over concurrent transaction execution (Google Spanner)
    - Multi-version control on concurrent transaction execution (NuoDB)

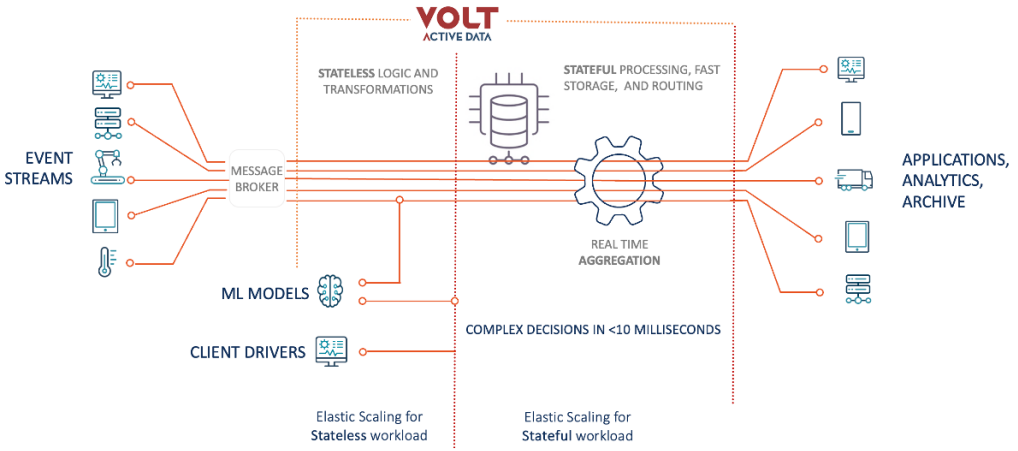
VoltDB (Volt Active Data)

- A horizontally scalable, ACID-enabled relational database running in-memory, built on C++
- Designed by Michael Stonebraker (Ingres, PostgreSQL)
- Based on shared-nothing architecture (SN) or sharding
  - SN architecture is a distributed computing architecture where each update request is fulfilled by a single node (processor/memory/memory unit)
- Community and commercial versions
- Based on H-Store



VoltDB

- Operations are performed in-memory
  - Reduce the need for buffering (buffer management)
  - Avg. latency of 1-2 ms
  - “Always process, sometimes store.” (only data for immediate decisions)

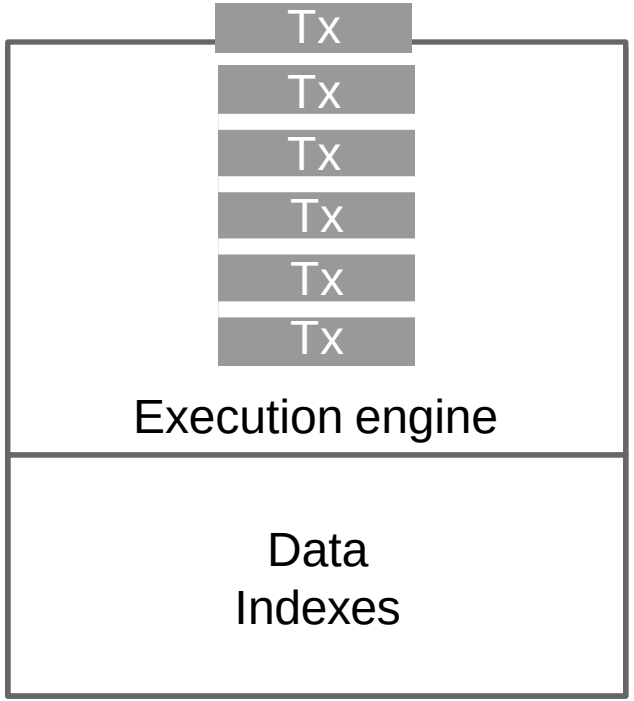


VoltDB

- Two types of tables
  - Partitioned
    - One parameter (column) serves as a key for partitioning (horizontal parsing)
    - Rows are spread across all VoltDB partitions
  - Replicated
    - All rows are stored on all partitions
      - Referenced data -> small read-only tables (e.g. product codes)

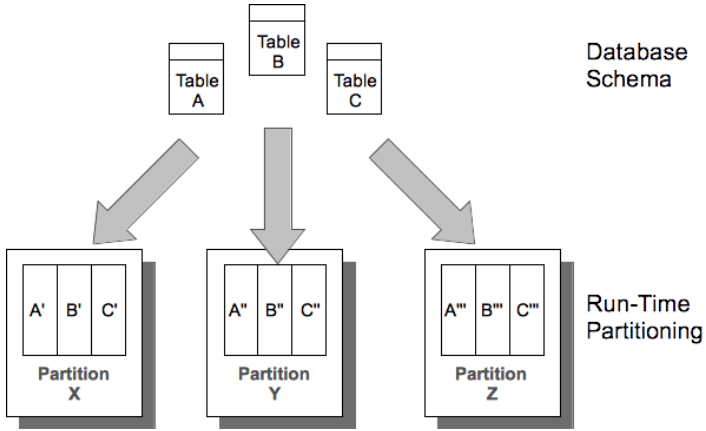
VoltDB

- Partition
  - Each partition stores data and an execution engine
    - Stores the transaction queue
    - Transactions are single-threaded

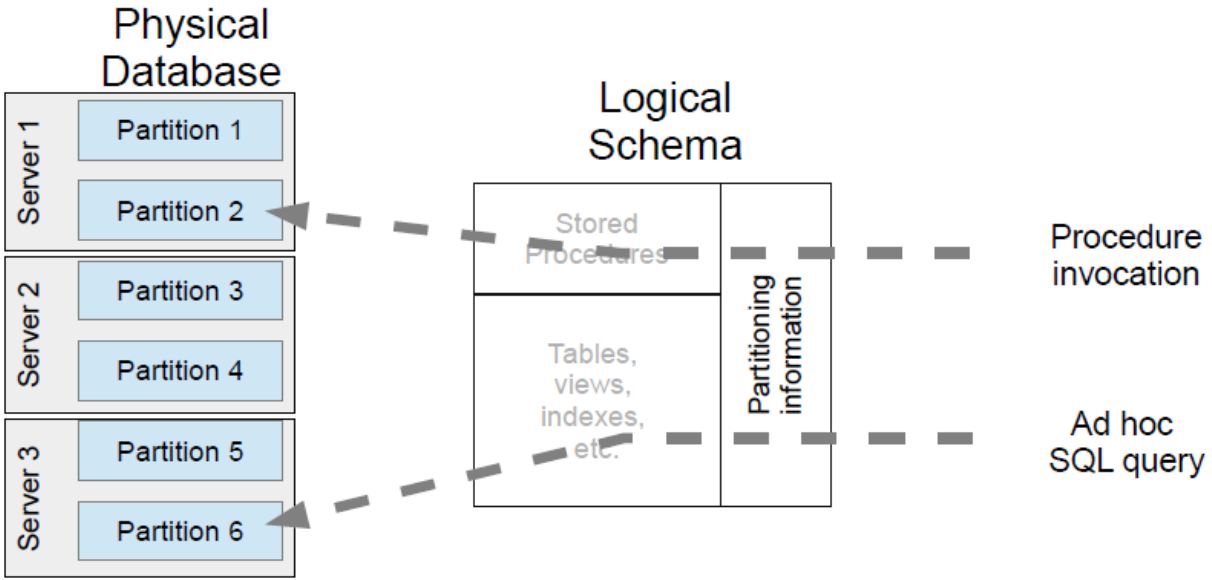


VoltDB

- Structure
  - Tables are defined using DDL
- Table and stored procedure (transaction) partitioning to create a distributed DB -> multiple queries run in parallel
- Data analysis and pre-compiling takes place in stored procedures
- Command logic is implemented using stored procedures (Java)
  - Optimisation for server-side process execution
- For each project, we define users, groups, etc.



VoltDB


Physical Database
Server 1
Partition 1
Partition 2
Server 2
Partition 3
Partition 4
Server 3
Partition 5
Partition 6
Logical Schema
Stored Procedures
Tables, views, indexes, etc.
Partitioning information
Procedure invocation
Ad hoc SQL query

VoltDB use cases

- Real-time analytics on large volumes of data (millions of entries on a daily basis) -> focus on **FAST** data
- High performance applications (financial trade, telco record streams, sensor-based systems…)
- NOT optimal for large historical datasets in data warehouses

NewSQL

What's Really New with NewSQL?

		Year Released	Main Memory Storage	Partitioning	Concurrency Control	Replication	Summary
NEW ARCHITECTURES	**Clustrix** [6]	2006	No	Yes	MVCC+2PL	Strong+Passive	MySQL-compatible DBMS that supports shared-nothing, distributed execution.
	CockroachDB [7]	2014	No	Yes	MVCC	Strong+Passive	Built on top of distributed key/value store. Uses software hybrid clocks for WAN replication.
	Google Spanner [24]	2012	No	Yes	MVCC+2PL	Strong+Passive	WAN-replicated, shared-nothing DBMS that uses special hardware for timestamp generation.
	H-Store [8]	2007	Yes	Yes	TO	Strong+Active	Single-threaded execution engines per partition. Optimized for stored procedures.
	HyPer [9]	2010	Yes	Yes	MVCC	Strong+Passive	HTAP DBMS that uses query compilation and memory efficient indexes.
	MemSQL [11]	2012	Yes	Yes	MVCC	Strong+Passive	Distributed, shared-nothing DBMS using compiled queries. Supports MySQL wire protocol.
	NuoDB [14]	2013	Yes	Yes	MVCC	Strong+Passive	Split architecture with multiple in-memory executor nodes and a single shared storage node.
	SAP HANA [55]	2010	Yes	Yes	MVCC	Strong+Passive	Hybrid storage (rows + cols). Amalgamation of previous TREX, P*TIME, and MaxDB systems.
	VoltDB [17]	2008	Yes	Yes	TO	Strong+Active	Single-threaded execution engines per partition. Supports streaming operators.
MIDDLEWARE	**AgilData** [1]	2007	No	Yes	MVCC+2PL	Strong+Passive	Shared-nothing database sharding over single-node MySQL instances.
	MariaDB MaxScale [10]	2015	No	Yes	MVCC+2PL	Strong+Passive	Query router that supports custom SQL rewriting. Relies on MySQL Cluster for coordination.
	ScaleArc [15]	2009	No	Yes	Mixed	Strong+Passive	Rule-based query router for MySQL, SQL Server, and Oracle.
DBAAS	**Amazon Aurora** [3]	2014	No	No	MVCC	Strong+Passive	Custom log-structured MySQL engine for RDS.
	ClearDB [5]	2010	No	No	MVCC+2PL	Strong+Active	Centralized router that mirrors a single-node MySQL instance in multiple data centers.