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Study on SQL vs. NoSQL vs. NewSQL

Dr. Alshafie Gafaar Mhmoud Mohmmed
Computer Science department,
Emirates Collage of Science & Technology,
Sudan
dr_shaf@yahoo.com

Prof. Saife Eldin Fatoh Osman
Dean of Emirates Collage of Science & Technology
Computer Science department,
Collage of Science & Technology, Sudan
saifefatoh@hotmail.com

***Abstract*— NoSQL provided great promises to be a perfect database system for Big Data applications; it however falls short because of some major drawbacks like NoSQL does not guarantee ACID properties (Atomicity, Consistency, Isolation and Durability) of SQL systems. It is also not compatible with earlier versions of database. This is where NewSQL comes into picture. NewSQL is a latest development in the world of database systems. NewSQL is a Relational Database with the scalability properties of NoSQL. NewSQL is a different type of relational database management systems that is provide the same scalable performance of NoSQL (Not Only SQL) systems for OLTP (Online Transaction Processing) workloads as well as still maintaining the ACID (Atomicity, Consistency, Isolation, Durability) guarantees of a traditional single node database system.**

***Keywords*— NoSQL, NewSQL, Big Data, ACID**

1. INTRODUCTION

NewSQL is a category of SQL database products that address the performance and scalability issues posed by traditional online transaction processing (OLTP) relational database management systems (RDBMS).
NewSQL is purportedly best for those enterprises interested in migrating existing applications to Big Data platforms, developing new applications on highly scalable online transaction processing systems, and wishing to use their existing knowledge of online transaction processing.
NoSQL data stores offer flexible schemas or are sometimes completely schema-free and are designed to handle a wide variety of data structures.
The category of NewSQL data stores, on the other hand, is being used to classify a set of solutions aimed at bringing to the relational model the benefits of horizontal scalability and fault tolerance provided by NoSQL solutions.

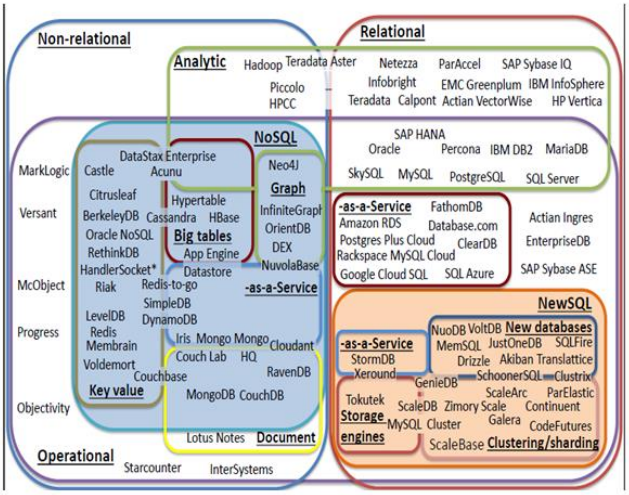

Fig 1: The database landscape

2- Background

SQL

SQL is a computer language used in databases for managing data in Relational Database Managing System (RDBMS).
These data stores may not require fixed table schemas, usually avoid join operations and typically scale horizontally; where data is stored in a distributed way, but accessed and analysed from applications.

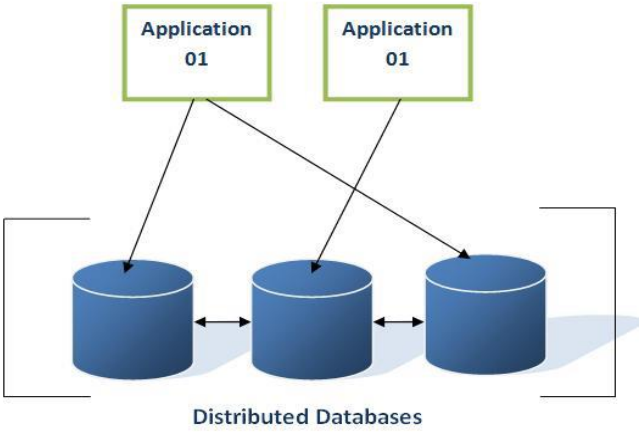

Figure 2: Distributed Databases

NoSQL

NoSQL stands for “not only SQL” . In broader sense, it includes all non-relational DBMS (which may or may not use a querying language).

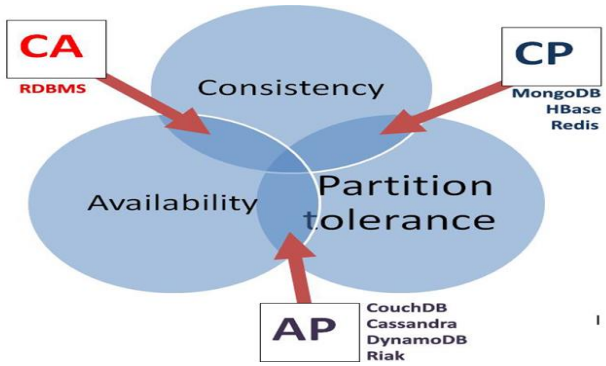

Figure 3: CAP theorem with supported NoSQL Databases

NoSQL systems are distributed, non-relational databases designed for large-scale data storage and for massively-parallel data processing across a large number of commodity servers.

NewSQL

NewSQL is next-Generation Scalable relational database management systems (RDBMS) for Online Transaction Processing (OLTP) that provide scalable performance ofNoSQL systems for read-write workloads, as well as maintaining the ACID (Atomicity, Consistency, Isolation, Durability) guarantees of a traditional database system.

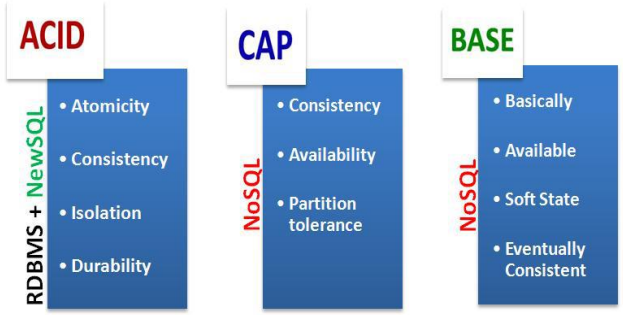

Figure 4: ACID, CAP, and BASE properties and supported DMS

3- NewSQL DBMSs deliver ACID transactions. ACID is an acronym for atomicity, consistency, isolation, and durability.

Each of these four qualities is necessary for a transaction to be able to ensure the integrity of data:

- **Atomicity** means that a transaction must exhibit “all or nothing” behavior. Either all of the instructions within the transaction happen, or none of them happen. Atomicity preserves the completeness” of the business process.
- **Consistency** refers to the state of the data both before and after the transaction is executed. A transaction maintains the consistency of the state of the data. In other words, after a transaction is run, all data in the database is “correct.”
- **Isolation** means that transactions can run at the same time. Any transactions running in parallel have the illusion that there is no concurrency. In other words, it appears that the system is running only a single transaction at a time. No other concurrent transaction has visibility to the uncommitted database modifications made by any other transactions. To achieve isolation, a locking mechanism is required.
- **Durability** refers to the impact of an outage or failure on a running transaction. A durable transaction will not impact the state of data if the transaction ends abnormally. The data will survive any failures.

NewSQL is a relational database. It supports ACID properties. Its schema is a combination of SQL and NoSQL. It provides horizontal scalability. It has cloud support and can also be used for OLTP. It supports SQL but query complexity is very high. NewSQL gives high performance by keeping all data in RAM. Scalability is provided by employing partitioning and replication in such a way queries generally do not have to communicate between multiple machines. They get the required information from a single host. This is why NewSQL is the best option for those who want to develop highly scalable and efficient OLTP systems.

Table 1: Comparison of SQL, NoSQL and NewSQL

Distinguishing Feature	OldSQL	NoSQL	NewSQL
Relational	Yes	No	Yes
ACID	Yes	No(Provides CAP)	Yes
SQL	Yes	No	Yes
OLTP	Not fully	Supported	Fully

4- CHARACTERISTICS OF NEWSQL SOLUTION

1- NewSQL provides feature SQL as the primary mechanism for application interaction.
2- NewSQL support ACID properties for transactions.
3- NewSQL controls a non-locking concurrency control mechanism which is helpful for the real-time reads will not conflict with writes.
4- NewSQL (dbShards) architecture providing much higher per-node performance than available from traditional RDBMS solutions.
5- NewSQL support a scale-out, parallel, sharednothing architecture, capable of running on a large number of nodes without suffering bottlenecks.
6- NewSQL systems are approximately 50 times faster than traditional OLTP RDBMS.

Table2: Comparative Characteristic of RDBMS, NoSQL, and NewSQL Databases

Characteristic	RDBMS	NoSQL	NewSQL
ACID compliance (Data, Transaction integrity)	Yes	No	Yes
OLAP/OLTP	Yes	No	Yes
Data analysis (aggregate, transform, etc.)	Yes	No	Yes
Schema rigidity (Strict mapping of model)	Yes	No	Maybe
Data format flexibility	No	Yes	Maybe
Distributed computing	Yes	Yes	Yes
Scale up (vertical)/Scale out (horizontal)	Yes	Yes	Yes
Performance with growing data	Fast	Fast	Very Fast
Performance overhead	Huge	Moderate	Minimal
Popularity/community Support	Huge	Growing	Slowly

5- Conclusions

- In recent years, cloud computing has emerged as a computational paradigm that can be used to meet the continuously growing storage and processing requirements of today's applications. This study has focused on the storage aspect of cloud computing systems, in particular, NoSQL and NewSQL data stores. These solutions have presented themselves as alternatives to traditional relational databases, capable of handling huge volumes of data by exploiting the cloud environment.
- Data consistency, high availability, and partition tolerance are the three primary concerns that determine which data management system is suitable for a given application Scalability in NoSQL systems comes at the cost of transactional guarantees, application maintained relationships, and simpler data models.
- As DBAs, we need to understand and embrace NewSQL to help our organizations and clients utilize the technology where and when it makes sense.

- NoSQL and NewSQL pose a long-term threat to MySQL's position as the default database for Web applications, given their use for new development projects.
- NewSQL technologies are, at this stage, largely being adopted to improve the performance and scalability of existing databases, particularly MySQL.

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