**CS595 - Assignment 8**

***Reading Assignment:***

1. Read and provide a half page summary and analysis of this article available on the blackboard in the ‘Articles’ section: Dynamo: Amazon’s Highly Available Key-value Store.

**Answer:** Following is the summary of “Dynamo: Amazon’s Highly Available Key-value Store” article:

* The article introduces design and implementation of Dynamo, a highly available and scalable distributed data (key-value) storage system built for Amazon’s platform that some of Amazon’s core services use to provide an “always-on” experience.
* Dynamo is used to manage the state of services that have very high reliability requirements and need tight control over the tradeoffs between availability, consistency, cost-effectiveness and performance.
* Dynamo provides a simple primary-key only interface to meet the requirements of applications that only need primary-key access to a data store such as those that provide best seller lists, shopping carts, customer preferences, session management, sales rank, and product catalog etc.
* Dynamo uses well known techniques to achieve:
  + **Scalability and Availability**: Data is partitioned and replicated using consistent hashing, and
  + **Consistency:** Consistency is facilitated by object versioning. The consistency among replicas during updates is maintained by a quorum-like technique and a decentralized replica synchronization protocol.
* Dynamo is a completely decentralized system with minimal need for manual administration. Storage nodes can be added and removed from Dynamo without requiring any manual partitioning or redistribution.

**Business case for Dynamo:**

* Most of the services on Amazon only store and retrieve data by primary key and do not require the complex querying and management functionality offered by an RDBMS. This excess functionality requires expensive hardware and highly skilled personnel for its operation, making it a very inefficient solution. In addition, the available replication technologies are limited and typically choose consistency over availability.
* **The Approach:** Evaluation of how different techniques can be combined to provide a single highly-available system. It also provides insight into the tuning of these techniques to meet the requirements of demanding production applications/systems with very strict performance demands using an eventually-consistent storage system. It involved leveraging of some of the existing techniques such as Peer to Peer Systems, Distributed File Systems and Databases etc.
* Dynamo has a simple key/value interface, is highly available with a clearly defined consistency window, is efficient in its resource usage, and has a simple scale out scheme to address growth in data set size or request rates.
* The article then further discusses key design considerations, system architecture, detection and handling of failures, adding/removing storage nodes, important lessons learned, and performance and load balancing techniques implemented within the Dynamo system.

**Conclusion:**

* Dynamo is a highly available and scalable data store, used for storing state of a number of core services of Amazon.com’s e-commerce platform. It provides the desired levels of availability and performance and has been successful in handling server failures, data center failures and network partitions.
* Dynamo is incrementally scalable and allows service owners to scale up and down based on their current request load. It also allows the service owners to customize their storage system to meet their desired performance, durability and consistency SLAs by allowing them to tune the parameters N (durability of each object), R and W (object availability, durability and consistency) respectively.

1. Read and provide a half page summary and analysis of this article available on the blackboard in the ‘Articles’ section: Data management in cloud environments: NoSQL and NewSQL data stores.

**Answer:** Following is the summary of “Data management in cloud environments: NoSQL and NewSQL data stores”

article:

* 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 such as Web technologies, mobile devices, sensory data, IoT etc.
* The article focuses on the storage aspect of cloud computing, specifically on data management in cloud environments.
* The article reviews NoSQL and NewSQL data store solutions with the objective of:
  + To provide a perspective on the domain by summarizing, organizing, and categorizing NoSQL and NewSQL solutions.
  + To compare the characteristics of the leading solutions to provide guidance to practitioners and researchers to choose the appropriate data store for specific applications.
  + To identify research challenges and opportunities in the field of large-scale distributed data management.
* Specifically, the most prominent solutions are compared focusing on a number of dimensions, including Data Models (Key-Value stores, Column-family stores, Document stores, Graph Databases, New SQL), querying capabilities, scaling, and security attributes related capabilities.
* Features driving the ability to scale read requests and write requests, or scaling data storage are investigated, in particular partitioning, replication, consistency, and concurrency control.
* Furthermore, use cases and scenarios in which NoSQL and NewSQL data stores have been used were discussed and the suitability of various solutions for different sets of applications was examined. The discussion of the use cases, together with the comparison of data stores, will assist practitioners in choosing the best storage solution for their needs.
* This study has also led to identification of challenges in the field, including the immense diversity and inconsistency of terminologies, limited documentation, sparse comparison and benchmarking criteria, occasional immaturity of solutions and lack of support and nonexistence of standardized query languages.

**Objective of the Article/Paper:**

* Traditional relational databases were designed in a different hardware and software era and are facing challenges in meeting the performance and scale requirements of Big Data.
* NoSQL and NewSQL data stores present themselves as alternatives to traditional relational databases, capable of handling huge volumes of data by exploiting the cloud environment.
* Because of the large number and diversity of existing NoSQL and NewSQL solutions, it is difficult to comprehend the domain and even more challenging to choose an appropriate solution for a specific task.

**Conclusion:**

* The article focuses on the storage aspect of cloud computing, specifically on data management in cloud environments.
* The paper reviewed NoSQL and NewSQL data stores with the objectives objective of: (1) providing a perspective in the field, (2) providing guidance to practitioners and researchers to choose the appropriate data store, and (3) identifying challenges and opportunities in the field.
* The discussion of the use cases of implementation of NoSQL and NewSQL data stores, together with the comparison of data stores on several dimensions such as Data Models, Querying, Scaling, and Security, helps assist practitioners in choosing the best storage solution for their needs.
* In addition, it has identified challenges in the domain, including terminology diversity and inconsistency, limited documentation, sparse comparison and benchmarking criteria, occasional immaturity of solutions and lack of support, and non-existence of a standard query language.