

Evaluation of NoSQL in the Energy Marketplace with GraphQL Optimization

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Abstract : The growing popularity of electric vehicles in the United States requires an ever-expanding infrastructure of commercial DC fast charging stations. The U.S. Department of Energy estimates 33,355 publicly available DC fast charging stations as of September 2023. In 2017, 115,370 gasoline stations were operating in the United States, much more ubiquitous than DC fast chargers. Range anxiety is an important impediment to the adoption of electric vehicles and is even more relevant in underserved regions in the country. The peer-to-peer energy marketplace helps fill the demand by allowing private home and small business owners to rent their 240 Volt, level-2 charging facilities. The existing, publicly accessible outlets are wrapped with a Cloud-connected microcontroller managing security and charging sessions. These microcontrollers act as Edge devices communicating with a Cloud message broker, while both buyer and seller users interact with the framework via a web-based user interface. The database storage used by the marketplace framework is a key component in both the cost of development and the performance that contributes to the user experience. A traditional storage solution is the SQL database. The architecture and query language have been in existence since the 1970s and are well understood and documented. The Structured Query Language supported by the query engine provides fine granularity with user query conditions. However, difficulty in scaling across multiple nodes and cost of its server-based compute have resulted in a trend in the last 20 years towards other NoSQL, serverless approaches. In this study, we evaluate the NoSQL vs. SQL solutions through a comparison of Google Cloud Firestore and Cloud SQL MySQL offerings. The comparison pits Google's serverless, document-model, non-relational, NoSQL against the server-base, table-model, relational, SQL service. The evaluation is based on query latency, flexibility/scalability, and cost criteria. Through benchmarking and analysis of the architecture, we determine whether Firestore can support the energy marketplace storage needs and if the introduction of a GraphQL middleware layer can overcome its deficiencies.

Keywords : non-relational, relational, MySQL, mitigate, Firestore, SQL, NoSQL, serverless, database, GraphQL

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