Efficient Indexing for Google Zanzibar Based Authorization Systems Using Graph Dynamic-Transitive Closures

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***Abstract*— Efficient indexing in Google Zanzibar-like graph authorization systems is critical for achieving scalability and low-latency query performance. These systems play a central role in managing access control, ensuring secure and accurate permissions across users, roles, and resources. However, the current reliance on graph traversal-based approaches, such as Breadth-First Search (BFS), limits scalability in deeply nested permission hierarchies. As authorization checks are in the critical path of user interactions, even slight delays can degrade the overall user experience and system responsiveness. To overcome this limitation, we have proposed an indexing framework that employs dynamic transitive closures using support vertices, allowing for efficient permission checks. Our approach involves maintaining forward and reverse reachability graphs for these vertices to optimize query handling, and using a blue-green write queue for parallelizing writes and updates. This work provides a practical solution for optimizing large-scale graph authorization systems, offering faster permission checks and improved system performance.**

***Keyword*— Authorization, Authorization requests, Google Zanzibar, Graph Dynamic-Transitive Closures, Indexing, SpiceDB**

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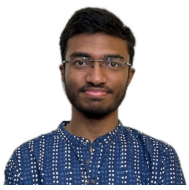

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