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Evaluation of HTTP/2 and HTTP/3 Performance on Mobile Applications Across Varied Network Conditions

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HTTP/3 made an appearance as the latest version of HTTP with the objective of improving web communication. Unlike the previous version of HTTP, HTTP/3 does not introduce new features instead it has the same set of features that HTTP/2 has with more performance and security improvements. HTTP/3 was first called 'HTTP-over-QUIC' because its main goal is to make the HTTP syntax and all the existing HTTP/2 functionality compatible with the QUIC transport protocol. Although some research has examined the potential advantages offered by HTTP/3 in web environments, its impact on mobile applications remains a relatively under-investigated area. This research aims to bridge this knowledge gap by conducting a comprehensive evaluation of HTTP/2 and HTTP/3 performance within the context of mobile applications. The primary objective is to assess how these protocols compare across diverse mobile network conditions (e.g., 2G, 3G, 4G, WiFi) with varying bandwidth limitations, signal strengths, and latency levels. The focus will be on key performance metrics like latency, throughput, and bandwidth utilization. An experimental approach will be employed to achieve this. A native Android mobile application was developed with HTTP/2 and HTTP/3 clients, executing the same set of HTTP requests of varying sizes, resulting in different latency levels. Network conditions will be meticulously controlled and manually manipulated using mobile network settings to simulate real-world scenarios. During application execution in these environments, performance metrics like latency (round-trip time), throughput (data transfer rate), and bandwidth utilization will be recorded and analyzed. Rigorous statistical analysis techniques will be employed to compare the performance of HTTP/2 and HTTP/3 across different network conditions. The analysis conducted in this research reveals several key findings regarding the performance of HTTP/2 and HTTP/3 in mobile applications across varied network conditions. Firstly, HTTP/2 consistently demonstrates lower latency compared to HTTP/3 across all different network types. This means that HTTP/2 requests generally experience shorter response times, indicating better responsiveness for users. Secondly, in terms of throughput, HTTP/2 consistently outperforms HTTP/3 across all network conditions. Throughput refers to the rate of data transfer between the client and the server, and HTTP/2 achieves higher data transfer speeds compared to HTTP/3. Moreover, HTTP/2 appears to utilize available bandwidth more efficiently than HTTP/3, particularly in scenarios with limited or fluctuating bandwidth. These findings provide valuable insights for Android mobile app developers that integrating HTTP/3 for client-server communication may not yield significant benefits over HTTP/2 in terms of network performance. Additionally, since HTTP/3 is still in the experimental stage, further enhancements may be necessary to optimize its performance in the Android mobile platform. Future research could explore several avenues to expand upon this study. Similar experiments could be conducted on other platforms to verify the results and generalize the findings. While this research primarily focused on network performance, future studies could investigate mobile device resource utilization for each protocol, including CPU and memory usage. These studies would provide a broader understanding of how HTTP/2 and HTTP/3 impact overall mobile application performance.

Keywords: HTTP/3, Internet Protocols, Mobile Applications, Network Performance, QUIC