Exploring Real-world Workload Conditions

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This document is the supplementary material to the paper "Improving UI Responsiveness of Mobile Operating Systems by Restructured Rendering," submitted to DAC 2025.

To accurately simulate light and heavy workload scenarios in our custom Android application to evaluate our proposed Solution 1 and Solution 2, we conducted a detailed analysis of the typical performance characteristics observed in real-world Android apps. Our goal was to understand the range of time delays experienced by the UI thread during both standard and intensive rendering tasks. This involved observing a variety of commonly used applications under typical usage conditions, such as scrolling through different types of content for approximately 20 seconds each session.

We employed specific Android APIs to quantify these workloads to monitor and log rendering delays on the UI thread. The results of our measurements are depicted in Figure 1-6, where the horizontal axis represents time and the vertical axis indicates the delay incurred to produce a new frame. Our experimental findings highlighted significant performance variability across different applications. For example, applications like BigoLive and YouTube consistently generated heavy workloads, whereas applications such as Instagram and Twitter triggered such conditions less frequently.

Under light workload conditions, normal rendering jobs typically resulted in rendering delays ranging from $2ms$ to $5ms$ (e.g., Instagram). Conversely, heavy rendering tasks exhibited delays between $50ms$ and $70ms$ (e.g., TikTok) during these conditions. In scenarios of heavy workloads, delays for normal rendering jobs may reach up to $40ms$, while those for heavy jobs are up to about $140ms$.

Figure 1: BigoLive (vlog)

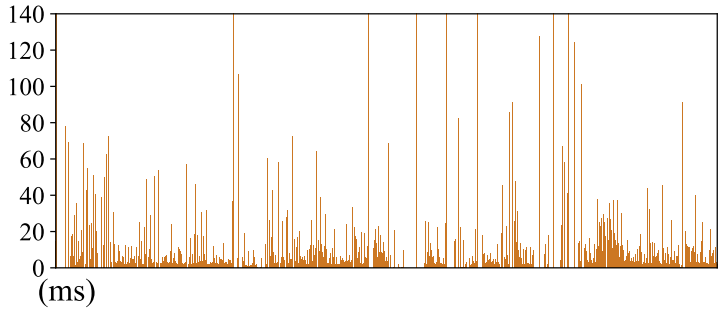

Figure 2: CNN (news)

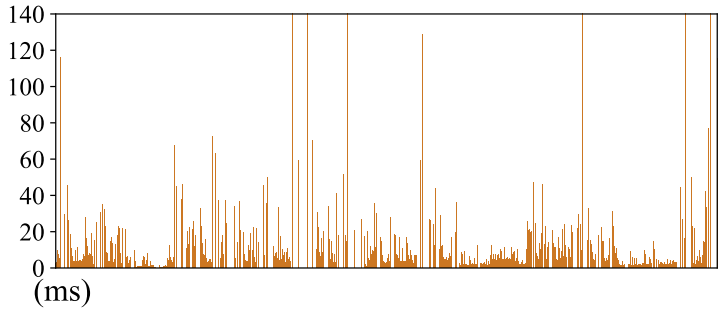

Figure 3: Instagram (blog + instant messaging)

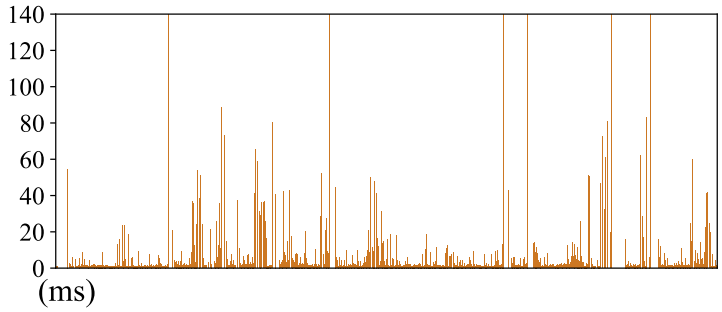

Figure 4: TikTok (vlog)

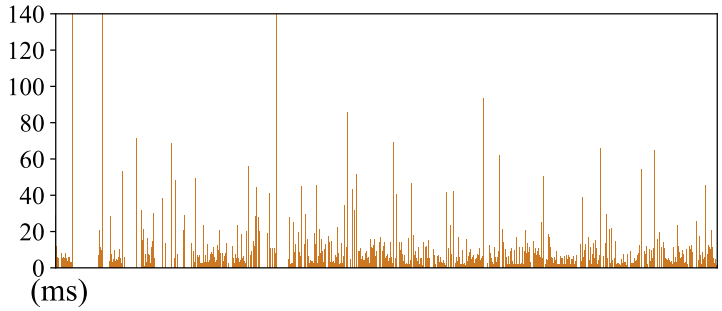

Figure 5: Twitter (blog + instant messaging)

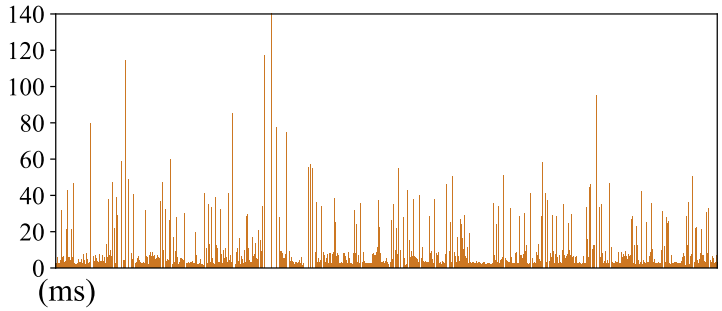

Figure 6: YouTube (video app)