IDENTIFYING BOTTLENECK ONSET IN A PRIVATE SOLANA TESTBED

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High-throughput blockchain platforms may abruptly leave their efficient operating region as transaction load rises, whereas practical diagnostics are often limited to end-to-end observables. The present study summarises the behaviour of a private Solana testbed under synthetic load and shows that effective bottleneck onset can be identified without exact visibility into the internals of validators. The analysis is grounded in commanded load, achieved throughput, a selected latency summary and the saturation ratio between sustained output and offered input [1-3].

The proposed grey-box interpretation distinguishes four empirical regimes: low, mid, knee and high load. In the low-regime, throughput remains nearly proportional to the commanded rate. The mid regime still demonstrates stable operation, yet the first signs of reduced scaling efficiency become visible. The knee regime marks the transition at which throughput ceases to track input ideally, and latency-related indicators deteriorate, while the high regime reflects persistent degradation and saturation-dominated behaviour [1, 2].

For the selected canonical runs, the low-load point at 1200 tx/s achieves about 1194 tx/s, and the mid-load point at 1820 tx/s sustains about 1795 tx/s. The knee point at 2800 tx/s still delivers roughly 2768 tx/s, but already departs from the near-linear baseline; at 3550 tx/s, the system falls to about 3368 tx/s, and the saturation ratio declines to approximately 0.949. Hence, bottleneck onset can be operationally treated as the first persistent loss of proportional scaling under increasing load [3, 4].

The practical value of this approach lies in transparent benchmarking and capacity planning for private blockchain deployments. A queueing-inspired grey-box model provides interpretable evidence of when a Solana-based platform leaves its efficient operating region and offers a reproducible basis for further performance assessment under partial observability.

References

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