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A Lightweight Log-based Deferred Update for Linux Kernel Scalability

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Abstract

A Lightweight Log-based Deferred Update for Linux Kernel Scalability

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In highly parallel computing systems with many-cores, a few critical factors cause performance bottlenecks severely limiting scalability. The kernel data structures with high update rate naturally cause performance bottlenecks due to very frequent locking of the data structures. There have been research on log-based synchronizations with time-stamps that have achieved significant level of performance and scalability improvements. However, sequential merging operations of the logs with time-stamps pose another sources of scalability degradation.

To overcome the scalability degradation problem, we introduce a lightweight log-based deferred update method, combining the log-based concepts in the distributed systems and the minimal hardware-based synchronization in the shared memory systems. The main contributions of the proposed method are:(1) we propose a lightweight log-based deferred update method, which can eliminate synchronized time-stamp counters that limits the performance scalability;and (2) we

implemented the proposed method in the Linux 4.5-rc6 kernel for two representative data structures (anonymous reverse mapping and file mapping) and evaluated the performance improvement due to our proposed novel light weight update method. Our evaluation study showed that application of our method could achieve from 1.5x through 2.7x performance improvements in 120 core systems.