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Content-Addressable Network for Distributed Simulations

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for my grandparents

献给我的姥爷、姥姥

Abstract

The development of distributed systems, parallel computation technology, and Peer-to-Peer systems facilitates the realization of a distributed interactive world model. Thereby, we can implement a worldwide distributed simulation and virtual community, e.g., city traffic simulation and Massively Multiuser Virtual Environments (MMVE).

In this thesis, we present Content-Addressable Network for Simulations (CANS), which is based on CAN. Thus, it incorporates all the advantages of CAN, such as self-organization, scalability, and fault-tolerance. The peers in CANS carry out the simulation for the zone assigned to them, and the zones are allocated in such a way that there is as little communication between the peers as possible. We propose two approaches for reorganizing zone-assignments after peers churn. These approaches are based on the distributed tree structure and prefix code. In comparison to existing approaches, our proposed approaches are more efficient and reliable.

Since CANS is used to simulate "city traffic" and MMVE, it requires a low-dimensional key space, i.e., a two-dimensional or three-dimensional key space. Thus, we propose CAN tree routing and zone code routing, both of which adopt long links. CAN tree routing has a hierarchical design that is based on the CAN tree. Each peer equips two long links on average. Zone code routing is based on B*-tree. Each peer equips $\log_2 n$ long links and shares the load evenly. Both of these routing solutions achieve $O(\log n)$ routing hops on average.

Consequently, the existing CAN can be optimized to perform simulations efficiently and reliably.

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Zhongtao Li

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