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Improving Fault Tolerance and Load Balancing in Heterogeneous Grid Computing Using Fractal Transform

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Abstract : The popularity of the Internet and the availability of powerful computers and high-speed networks as low-cost commodity components are changing the way we use computers today. These technical opportunities have led to the possibility of using geographically distributed and multi-owner resources to solve large-scale problems in science, engineering, and commerce. Recent research on these topics has led to the emergence of a new paradigm known as Grid computing. To achieve the promising potentials of tremendous distributed resources, effective and efficient load balancing algorithms are fundamentally important. Unfortunately, load balancing algorithms in traditional parallel and distributed systems, which usually run on homogeneous and dedicated resources, cannot work well in the new circumstances. In this paper, the concept of a fast fractal transform in heterogeneous grid computing based on R-tree and the domain-range entropy is proposed to improve fault tolerance and load balancing algorithm by improve connectivity, communication delay, network bandwidth, resource availability, and resource unpredictability. A novel two-dimension figure of merit is suggested to describe the network effects on load balance and fault tolerance estimation. Fault tolerance is enhanced by adaptively decrease replication time and message cost while load balance is enhanced by adaptively decrease mean job response time. Experimental results show that the proposed method yields superior performance over other methods.

Keywords : Grid computing, load balancing, fault tolerance, R-tree, heterogeneous systems
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