Dynamic Adaptability in Support of Extreme Scale Systems

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"Computers are not intelligent, they only think they are." – Anonymous
"No matter how many resources you have, it is never enough" – Murphy's Law

Modern operating systems (OS) are compiled with a fixed set of policies, parameters, and algorithms for the management of resources such as CPUs, memory, I/O (disk), that serve executing applications. This kind of setup provides a generalized execution environment for all the applications in which some applications perform their best, while others suffer. Modern operating systems represent a performance bottleneck when application resource usage behavior conflicts with the policies, parameters, and algorithms used by the OS. This problem is particularly non-trivial in high-performance systems, where multiple sophisticated scientific applications, with different resource needs, execute simultaneously.

A promising solution for this problem is dynamic adaptability of operating systems. Adopting this solution, operating systems characterize application resource usage behavior at run-time and automatically adapt OS parameters, policies, and algorithms in an effort to best suit the needs of the executing applications and the system state and provide a performance-rich environment for the applications. This solution will extend the state-of-the-art in this field, making operating systems truly "intelligent". Our research (in collaboration with IBM-Austin and University of Wisconsin) will develop breakthrough techniques for building a general-purpose methodology for incorporating this solution into commodity operating systems.

Our techniques will be implemented on the Linux OS running on an IBM-p690 system hosted by UTEP. Currently we are implementing the methodology for dynamic adaptation (coarse-grained switching) of I/O schedulers. Recent work also involves investigation of adaptation issues in the area of memory management and fine-grained adaptation of I/O schedulers and process schedulers.

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