Symmetric Multiprocessing Virtualization

Master's Thesis Defense
by
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Abstract

System virtualization and multiprocessing are two technologies that are altering the landscape of modern general-purpose computing architecture. System virtualization uses software to partition the resources of a single physical computer into multiple virtual machines (VMs). Multiprocessing combines the capabilities of multiple CPUs in a single computer system. For general-purpose computing, the most common form of multiprocessing is symmetric multiprocessing (SMP), where all processors are identical and can perform any task.

Most modern operating systems provide support for symmetric multiprocessing and manage the scheduling of processes on different logical processors. System virtualization introduces additional complexities for implementing SMP because VMs have different timing characteristics from physical computers. However, the guest operating system executing in a VM is usually unaware of these differences.

This thesis provides a quantitative analysis of two different approaches for SMP virtualization used by two leading virtualization platforms: VMware ESX server and Xen. It compares the advantages of each approach for different types of system workloads, and compares implemented optimizations to alternative proposals to improve SMP virtualization. It also explores ways to improve the performance of SMP VMs through dynamic virtual CPU allocation.