Overheads of Virtualizing Memory

We show that the increase in translation lookaside buffer (TLB) miss-handling costs due to hard-ware-assisted memory management unit (MMU) is the largest contributor to the performance gap between native and virtual servers.

Two-level Translation

Base Virtualized

Support for Virtualizing Memory

Shadow Page Table
Software only solution

2D Hardware Page Table
Hardware Support Required

Translation Hardware

Page Table Walk

Support for Virtualizing Memory

Up to Mem accesses

5 + 5 + 5 + 5 + 4 = 24
Overheads of virtual memory can be high.

Overheads of virtualizing virtual memory are even higher.

Large Pages at VMM are not sufficient to achieve native performance.

Large Pages are not sufficient to achieve negligible overheads.