AS-COMA: An Adaptive Hybrid Shared Memory Architecture *

Chen-Chi Kuo, John B. Carter, Ravindra Kuramkote, Mark Swanson

{chenchi, retrac, kuramkot, swanson}@cs.utah.edu
WWW: http://www.cs.utah.edu/projects/avalanche

UUCS-98-010

Department of Computer Science
University of Utah, Salt Lake City, UT 84112

March 23, 1998

Abstract

Scalable shared memory multiprocessors traditionally use either a *cache coherent non-uniform memory access* (CC-NUMA) or *simple cache-only memory architecture* (S-COMA) memory architecture. Recently, hybrid architectures that combine aspects of both CC-NUMA and S-COMA have emerged. In this paper, we present two improvements over other hybrid architectures. The first improvement is a page allocation algorithm that prefers S-COMA pages at low memory pressures. Once the local free page pool is drained, additional pages are mapped in CC-NUMA mode until they suffer sufficient remote misses to warrant upgrading to S-COMA mode. The second improvement is a page replacement algorithm that dynamically backs off the rate of page remappings from CC-NUMA to S-COMA mode at high memory pressure. This design dramatically reduces the amount of kernel overhead and the number of induced cold misses caused by needless thrashing of the page cache. The resulting hybrid architecture is called *adaptive S-COMA* (AS-COMA). AS-COMA exploits the best of S-COMA and CC-NUMA, performing like an S-COMA machine at low memory pressure and like a CC-NUMA machine at high memory pressure. AS-COMA outperforms CC-NUMA under almost all conditions, and outperforms other hybrid architectures by up to 17% at low memory pressure and up to 90% at high memory pressure.

Keywords: Distributed shared memory, multiprocessor computer architecture, memory architecture, CC-NUMA, S-COMA, hybrid.

Technical Areas: Architecture.

*This work was supported by the Space and Naval Warfare Systems Command (SPAWAR) and Advanced Research Projects Agency (ARPA), Communication and Memory Architectures for Scalable Parallel Computing, ARPA order #B990 under SPAWAR contract #N00039-95-C-0018