

An Adaptive Page Management in Hybrid DRAM and PRAM Main Memory of Manycore Systems for Energy Efficiency

Dong-Jae Shin, Sung Kyu Park and Kyu Ho Park^{*} Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, Daejon, KOREA

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The recent manycore systems face the challenges to reduce energy consumption of the main memory consisted of DRAM, which consumes about 30% of total energy in data centers. In an attempt to mitigate the energy and memory problems, we propose MN-MATE(Manycore and NVRAM – MATE), with manycores and large size of off-chip DRAM and non-volatile memory(NVRAM). In MN-MATE, the hypervisor places consolidated VMs and balances memory among them. A guest OS reduces energy consumption with small performance loss based on the NVRAM-aware data placement policy. One of the non-volatile memories, Phase-change RAM (PRAM) is a candidate for replacing DRAM. However, it has some disadvantages which are its low performance, high write power, and write endurance limitation compared to DRAM. To overcome these weak points of PRAM, the research related to the hybrid model combining PRAM with DRAM has been studied.

In this paper, we propose an Adaptive Page Grouping (APG) algorithm, which manages the hybrid PRAM-DRAM main memory to reduce the energy consumption. We suggest the method to store the access information of pages without using additional space. We allocate pages effectively and reduce the migration among them through the grouping of pages that have the similar access properties. All these schemes are implemented in Linux OS without additional hardware. We have decreased average energy consumption by 36% compared to a DRAM only system while access time increases less than 8% even with the high latency of PRAM.