



CONTENT-AWARE VM I/O OPTIMIZATION FOR THE CLOUD

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ABSTRACT: Modern data centers each contains thousands of servers, each hosting dozens of virtual machines. Therefore, both local disks and remote storage servers are exposed to heavy storage and I/O workloads. To mitigate this issue, we propose to leverage the content similarity among VMs and trim I/O requests before storage devices. First we studied the degree and pattern of similarity among VM images from a production cloud, indicating a compression ratio of $\sim 70\%$ [Middleware-Industrial 2011]. Based on the observations, we developed multiple I/O optimization technologies. To reduce the I/O traffic between compute nodes and storage servers, we developed VDN [INFOCOM 2012], a peer-to-peer content distribution network (CDN) which leverages similar image data blocks on nearby neighbor nodes. Furthermore, to avoid duplicate memory usage of a VM guest and its physical host to cache identical blocks, we developed a functionally partitioned method, where the host only caches data in base images and a VM guest only caches its own “private data” [HotCloud 2012]. Finally, to reduce duplicate memory cache usage among VMs on a compute/hypervisor node, we developed VMAR [Middleware 2013], which creates a block translation map at VM image creation time and uses it to redirect accesses for identical blocks to the same filesystem address before they reach the OS.

BIOGRAPHY: Zhe Zhang is a Research Staff Member at the Cloud Innovation Technologies Department of the IBM T. J. Watson Research Center, where his current research interests span virtualization, distributed computing, and software-defined storage. Before joining IBM in 2010 Zhe worked at the Oak Ridge National Laboratory on Peta-scale storage technologies in support of the Jaguar supercomputer. Zhe received his Ph.D. from North Carolina State University in 2009 and B.E. from USTC in 2003. Zhe has served (or is serving) on the TPC of CCGrid 2014, ICPADS 2013, IPDPS 2012, and SBAC-PAD 2012~13; he's also serving as Finance Chair of IC2E 2014. Zhe's work at IBM has been recognized with a Research Accomplishment award in 2013 and a Services Research Publication Achievement Award in 2012. Currently Zhe is co-chair of IBM's Professional Interest Community (PIC) in Storage Systems.