Western Digital.

SOLUTION BRIEF

Scale Memcached for Larger Caching

Ultrastar DC ME200 Memory Extension Drive, NVMe U.2 and AIC HH-HL form factors

TCO Highlights

- Better management of in-memory data stores through reduced server count
- Improve memory density
- Overcome limitations of DIMM slots per server for larger caching and scalable data stores
- Reduce overall data center footprint and power consumption
- Expand Memcached server effective RAM up to 8 times physical DRAM

Product Features

- Up to 24TiB[1] software-defined memory per 2U server (U.2)
- Works transparently with existing Linux® distrubutions and applicatipn stacks

Ultrastar® DC ME200 Memory Extension Drive with Memcached enables scalable in-memory caching for a better TCO

Mobile and web applications succeed or fail by their responsiveness. A shopping website whose product pages take half a second to generate is in danger of losing impatient customers to a quicker site. A mobile gaming world whose state updates take too long will suffer from "lag" and may be dropped by gamers seeking a more immersive and responsive gameplay experience.

Memcached has been used to speed up these kinds of uses for over 15 years. It provides a simple, high performance means of updating and storing transient user state or caching results of heavyweight database processes. This has the double benefit of reducing latency for the end user while also minimizing the load on the backend database.

Memcached Server Sprawl

Memcached is a cache whose size can grow to the size of a system's memory. The larger the cache, the higher its hit rate and effectiveness. Because the amount of DRAM that can economically be added to conventional servers is limited, large arrays of servers are often used to increase the total usable cache for an application. This poses two problems for data center architects: First, while it is really only the extra memory that Memcached needs, each additional server has significant non-memory costs such as the processors, power supplies, and motherboards. Second, the space, power, and cooling required by these additional servers and their DRAM can become a significant operational expense over time.

Avoiding Memcached Sprawl

By increasing the economically reasonable amount of effective RAM available per-server up to eight times, the Ultrastar DC ME200 Memory Extension Drive can help data center architects keep Memcached server sprawl to a minimum. This memory extension not only reduces the number of servers required, it also helps make better use of the remaining servers, by allowing the CPUs and other overhead components in any one server to be amortized over a larger amount of Memcached cache space.

[1] Memory capacity is indicated by GiB and TiB and based on binary values such that one gibibyte (GiB) is equal to 2^{30} bytes and one tebibyte (TiB) is equal to 1024 GiB (2^{40}) bytes. Suggested expansion of 8x DRAM based on internal performance testing across a variety of industry standard benchmarks.

Ultrastar DC ME200 Memory Extension Drive Overview

The Ultrastar DC ME200 combines one or more custom NVMe™ drives, tuned for low latency and high performance, with a software layer that expands system RAM onto them. Unmodified Linux operating systems using this technology can address system memory up to eight times the capacity of the DRAM installed in a server with near DRAM speeds. Memory-intensive, highly parallel applications such as Memcached can take advantage of this extra system RAM without any changes. For example, a 1U server with 256 GiB of DRAM installed can be extended to make use of up to 2 TiB of Memory Extension RAM.

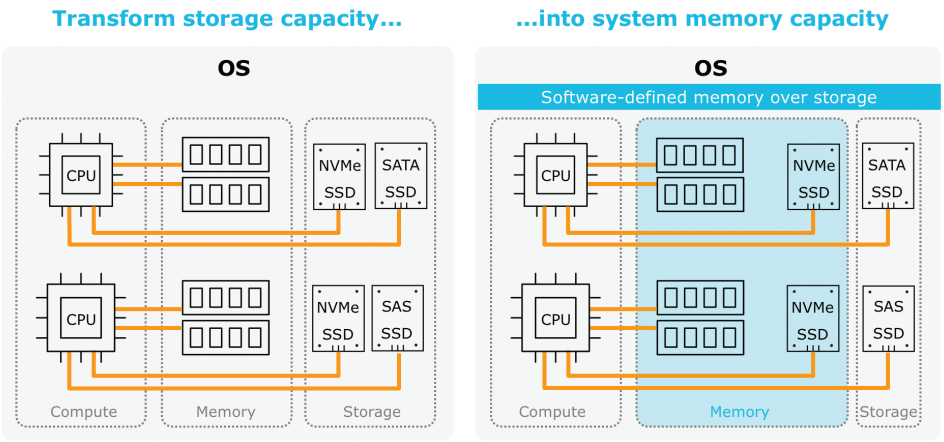
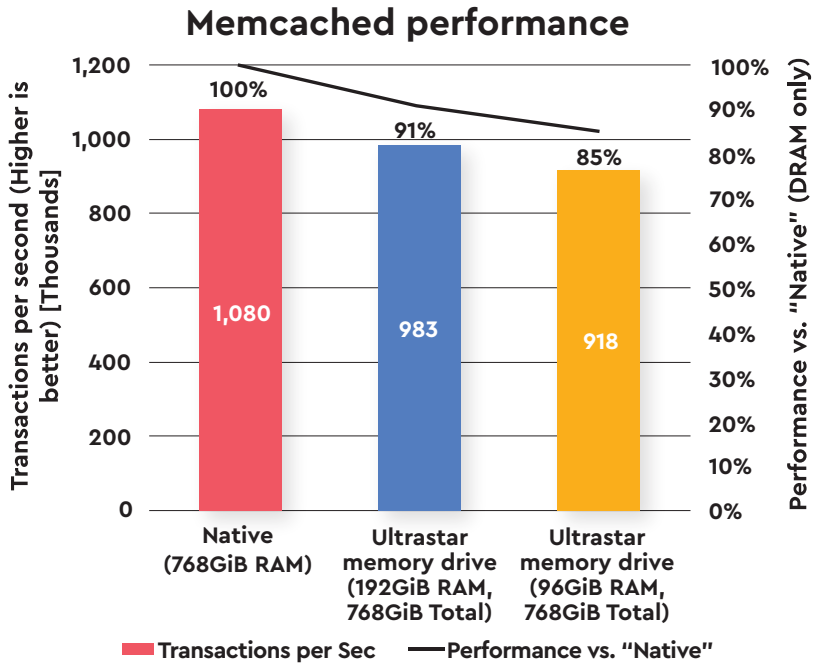


Figure – The left diagram depicts the traditional compute-memory-storage architecture, The right digram depicts how Memcached configurations can take advantage of Ultrastar memory drives to augment server DRAM to create a virtualized memory pool to enable greater memory expansion.



Replacing DRAM with Ultrastar DC ME200 Memory Extension Drive

Western Digital has benchmarked the Memcached performance of Ultrastar memory in order to validate that it provides near-DRAM performance while expanding RAM capacity four or eight times at significant cost savings. Mirroring a typical Memcached use case, the testing consisted of high concurrency, small requests (1KB) with a 10:90 SET to GET ratio from several testing clients to the Memcached server.

The Memcached server was configured as a baseline using only physical DRAM to provide 768 GiB of system RAM. This baseline system then had its DRAM reduced by three-quarters, to only 192 GiB, while using Ultrastar memory to provide a combined total of 768 GiB of effective system RAM. Finally, the server had its physical memory reduced to a mere 96 GiB of DRAM while using Ultrastar memory to provide the remainder of the total 768 GiB of system RAM, a reduction in DRAM usage by 87.5%.

As shown in the graph below, the Ultrastar memory enabled system was able to provide 85% of the performance of a full 768 GiB DRAM solution while only requiring 96 GiB of DRAM backed by the Ultrastar memory devices.[2] Enabling Memcached servers with such capacities and such economical DRAM costs can minimize the number of Memcached servers required in a cluster.

[2] Performance comparison based on internal testing. Results may vary based on system configuration, load, and other factors.

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