SOLUTION BRIEF
Memory and Storage
Intel® Memory Drive Technology

Leveraging Intel® Memory Drive Technology for In-Memory Data Store & Caching

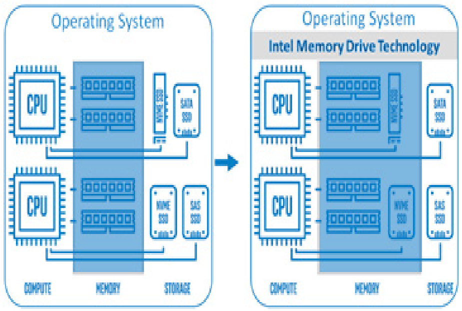
Intel® Memory Drive Technology – enabling affordable data center solutions.

Memory Use and the Need for More Memory per Server

In-Memory data-stores and caching engines, such as Redis* and Memcached*, are widely used in a variety of application domains, such as ad-tech, financial services, gaming, healthcare and IoT. It is widely accepted that in-memory data-stores can improve application performance, as well as reduce costs at scale.

In-memory engines improve application performance by storing frequently accessed data items in the main memory, for later retrieval without additional access to the persistent data store.

To achieve the highest performance, the entire dataset is stored in-memory. If the data being handled is larger than the available memory in a single server, these engines allow for scale-out to multiple nodes (using sharding, according to the maximum amount of memory available per node).



The Scalability Challenge for In-Memory Deployments

In-memory computing deployments can be limited by the amount of memory available on a single server, as well as prohibitive DRAM pricing. The maximum amount of memory per node is capped due to modern server architecture, which limits the number of DIMMs per socket to 12, and in many cases, with high-density servers, to as low as 6-8 DIMMs per socket. The above, combined with the fact that the per GB cost of DRAM increases exponentially with size for DIMMs larger than 64GB, leads to a practical limit of 768GB to 1.5TB per dual socket node.

The number of nodes required for a large-scale solution (of a single tenant and/or multi-tenants on the same infrastructure), is determined by the amount of memory in each node, rather than by the compute capacity of the node. This is evident in typical deployments where, most commonly, CPU utilization in a cluster is in the range of 10%-20%.

To hold larger data in memory, organizations are forced to use expensive high-density DIMMs, or to increase the number of nodes for a large-scale solution, resulting in much higher costs for the infrastructure per application, as well as a larger data-center footprint.

Intel® Memory Drive Technology Benefits and Capabilities

The ability to increase the total memory per node, or to reduce the cost per GB of memory, can significantly improve the cost structure of such in-memory engines, as well as their adoption to additional use cases.

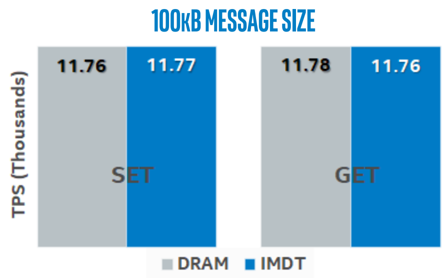
Intel® Memory Drive Technology is a revolutionary software-defined memory (SDM), which transparently integrates an Intel® Optane™ SSD into the memory subsystem and makes it appear like DRAM to the OS and applications.

Intel® Memory Drive Technology increases memory capacity without DRAM limitations and is significantly more cost effective. It also delivers DRAM-like performance in a completely transparent manner to the operating system and application, and requires no changes to the OS or applications.

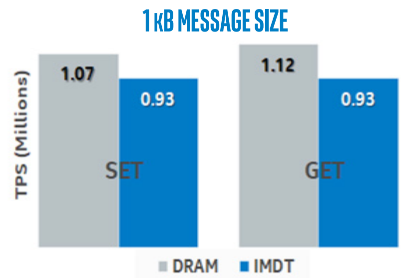
Intel® Memory Drive Technology Performance

The Redis* benchmark is using high concurrency SET/GET operations of small (1kB) and large (100kB) messages (reflecting small values and large objects), where the Redis server and client/load system are connected over 10GbE.

Since it is impossible to benchmark against a 6TB DRAM-only server, an apples-to-apples comparison was performed using a DRAM-only server (768GB DDR4) versus a server with 192GB DDR4, augmented with Intel® Memory Drive Technology for a total of 768GB.[1] The amount of memory consumed by Redis was ~700GB.



99 percentile latency: <17ms



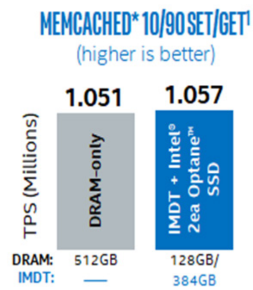
99 percentile latency: <300µs

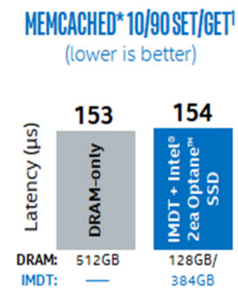
Deliver 83-100% of DRAM-only performance for a dataset 4x larger than DRAM

The Memcached* benchmark is using high concurrency SET/GET operations of small messages (1kB) with a set/get ratio of 10%/90%.

Comparing a DRAM-only server (512GB DDR4) versus a server with 128GB DDR4 plus Intel® Memory Drive Technology for a total of 512GB.[2]

Equivalent performance for a dataset 4x larger than DRAM with reduced memory investment





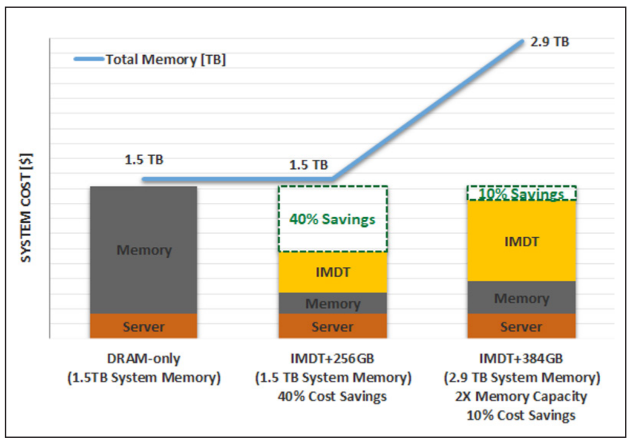
Cost Efficiency and Overall Savings

Intel® Memory Drive Technology allows you to obtain the same memory configuration for a significantly lower cost (vs. DRAM), or alternatively, obtain larger amounts of memory – much higher than the practical limitations of a given server – for a similar cost.

The cost chart (right)[3] compares the cost structure of:

- DRAM-only server with 1.5TB of memory
- A server configuration with 256GB RAM + Intel® Memory Drive Technology to reach the same overall amount of memory (1.5TB), with 40% lower cost than DRAM-only.
- A server configuration with 384GB RAM + Intel® Memory Drive Technology to reach almost double the total amount of memory (2.9TB total) for a similar cost.

Additional cost savings are achieved as the solution requires a smaller data center footprint, energy savings, and reduced maintenance costs.



Summary

Leveraging Intel® Optane™ SSDs with Intel® Memory Drive Technology provides a cost-effective way to support nodes with up to 8x more memory than the server's specifications' limits, and thereby enabling a cost-effective infrastructure for in-memory data stores and caching engines, with minimal impact on performance.

1 2x Intel® Xeon® Processor Gold 6154 @ 3.0GHz, 2x Intel® Optane™ SSD DC P4800X
2 2x Intel® Xeon® Processor E5-2680 v3 @ 2.5GHz, 2x Intel® Optane™ SSD DC P4800X
3 Source – Intel: MSRP for Intel® Memory Drive Technology license with Intel® Optane™ SSD (April 2018). Trendforce* - Server DRAM Price Report Sep 2017 (Market Price)