PowerEdge Product Group

Direct from Development

Advantages of PowerEdge Servers Configured with Intel® Optane™ DC Persistent Memory Module

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SUMMARY

Dell EMC PowerEdge integrates the Intel® Optane™ DC Persistent Memory Module to bridge functionality between traditional memory and storage.

The advancement of memory capability is critical to accommodate growing customer needs. Data center utilization is not possible if memory bandwidth or capacity is bottlenecking system performance.

With Intel® Optane™ DC Persistent Memory Module, we explore the benefits gained from non-volatility and large memory.

Server architecture defines the boundaries and limitations assigned to every configuration. Growing datacenter needs frequently push traditional hardware to its limits, forcing innovation to redefine component utilization. In the case of traditional memory, massive workloads plague latency and throughput. A typical DRAM card capacity is between 16GB-64GB; a fraction of standard storage devices. Non-volatility is also absent from typical DRAM. This means that once volatile memory capacity is exhausted data must travel a farther distance on a slower bus to SSD and HDD locations. Intel® Optane™ DC persistent memory aims to resolve this type of degradation.

Introduction to the Technology

Intel® Optane™ DC Persistent Memory Module, sometimes referred to as DCPMM, confronts DRAM limitations head on. There are two primary distinctions that make DCPMM a disparate solution.

1. The first differentiator is its massive memory capacity, entering the market at 128GB, 256GB and 512GB. This range is substantially greater than typical DRAM and allows for more data to pass through the memory bus lanes.
2. The second differentiator is its persistent memory technology, allowing assigned applications to retain data upon power cycles.

More importantly, both modules share the same form factor making them interchangeable components. This uniformity allows for strategic memory card placement when allocating drives to the high-speed memory bus lanes. With increased storage leveraging memory bus speeds, DCPMM will further utilize the fixed CPU channels.

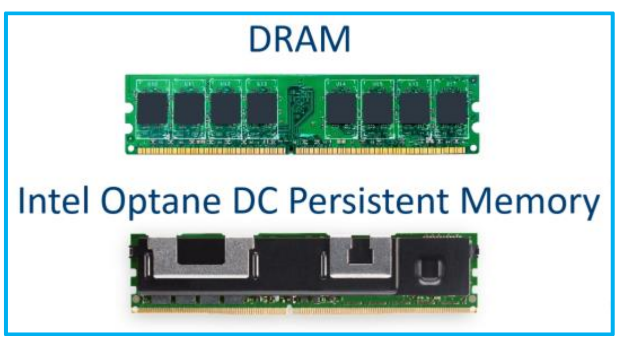

Figure 1: Scaled visual comparing DCPMM and traditional memory form factors

DCPMM leverages various technical concepts in its design to implement these performance advancements. Persistence capabilities currently exist on other memory solutions, but it was redesigned without the required additional chips and batteries that drive higher price points. Memory capacities have approached larger volumes like SSDs. Interface speeds are as swift as DRAM with only a slight performance reduction. DCPMM positions itself as a unique intermediate layer between DRAM and NVMe on the performance pyramid.

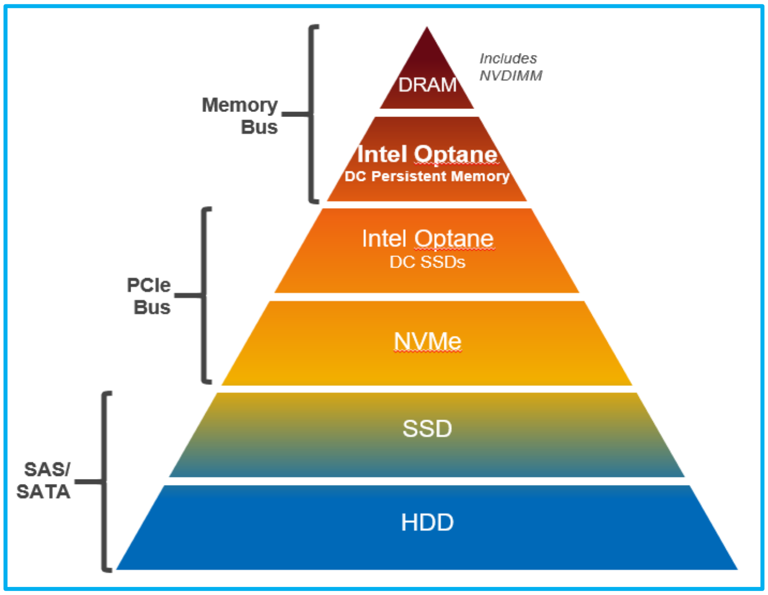

Figure 2: Performance pyramid showing where DCPMM sits between NVMe and DRAM.

Different Modes with Unique Advantages

There are currently two operating modes for Intel® Optane™ DC persistent memory technology: Memory mode and Application Direct (Persistent) mode. Each of these modes create unique advantages for specific use cases:

1. **Memory Mode** – This mode strongly emphasizes building large storage capacity environments around the memory space. The OS recognizes DCPMMs as traditional DRAM and does not identify any persistent properties. Having superior memory capacity to be used on memory bus lanes is the primary benefit of memory mode. Additionally, no set up is required as non-volatility is absent so ease of use is exceptional. If traditional DRAM is mixed in with DCPMM, it is hidden from the OS and serves as a caching layer. Recommended use cases would be to expand VM's for greater infrastructure scaling.
2. **Application Direct Mode** – This mode strongly emphasizes the latency reduction advantage received with persistence present and bandwidth speeds up to 2.7x faster than NVMe. The OS and applications must support Application Direct mode to gain non-volatile properties. In-memory data survives power cycles allowing for minimal latency among large memory environments. All outstanding DCPMM memory is automatically assigned to the memory bus for faster, temporary memory access. Any traditional DRAM mixed in with DCPMM operates as standard DRAM for applications. Recommended use cases would be for large in-memory databases such as Microsoft SQL Server 2019.

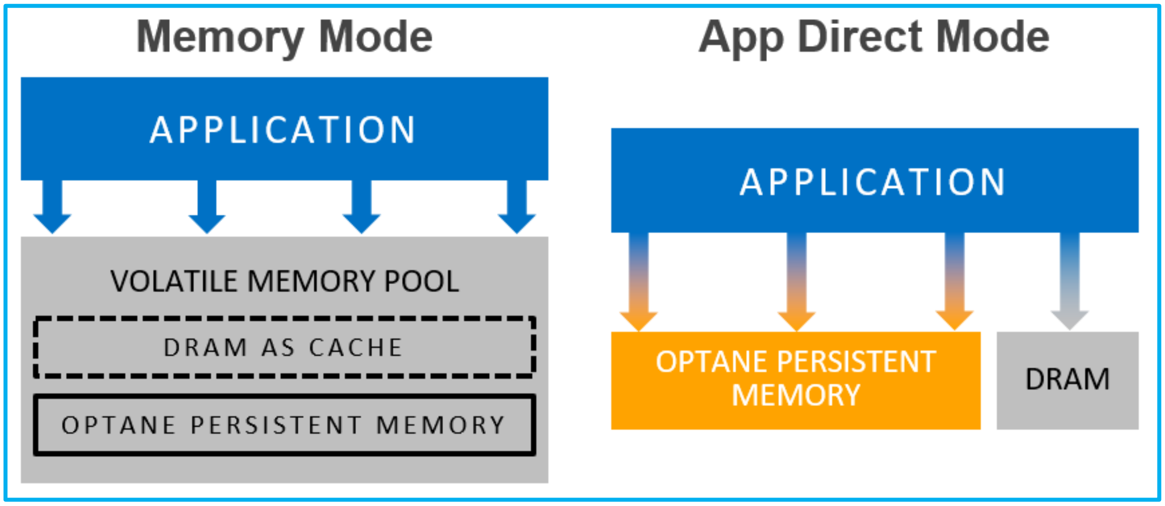

Figure 3: High level depiction of how OS recognizes DPCMM within each mode

Systems Management

Once DCPMM has been successfully installed it must be configured and administered. Dell EMC management tools make this experience fluid and simple. Memory settings can be accessed through BIOS upon startup, or preferably from the Dell EMC iDRAC management platform for a streamlined experience. The module will initially be read with memory mode properties but can be easily toggled to application direct mode. If persistence is active the OS will make persistent memory available for applications to request and use. Once server configuration is complete, its profile can be pushed to other servers through OpenManage Enterprise (OME). iDRAC will then manage and sustain the DCPMM going forwards. From in/out of band updates to end of life warnings, iDRAC will push notifications when any action is required.

Conclusion

Dell EMC PowerEdge servers configured with Intel® Optane™ DC Persistent Memory Modules focus on enabling the future of data center technology. Latency reduction is achieved by enabling core application data to be stored as non-volatile information; providing bandwidth support for large in-memory databases such as Microsoft SQL Server 2019. Furthermore, the substantial increase in memory capacity provides more resources to be used in large storage capacity environments such as VM scaling.