Deploy Fast and Persistent NoSQL and SQL Databases

Data management is key to organizations of all sizes. Persistence has always been a key requirement for SQL databases, but was initially waived for NoSQL databases. As big data usage expands and matures, there is a growing demand for persistence. This is challenging because persistent storage is traditionally several orders of magnitude slower than the volatile memory used by NoSQL databases to achieve performance.

Recently, leading x86 server vendors have added support for persistent memory — specifically, nonvolatile DIMM modules (NVDIMM). NVDIMM modules are similar to DRAM modules in speed, byte-addressability and reliability, but their data is made persistent by the NAND flash memory included on the NVDIMM. NVDIMM in this implementation resembles storage. NVDIMM modules open great opportunities and are currently available in 8GB and 16GB capacities, with 32GB capacity coming in late 2016.

This brief demonstrates how databases can run efficiently by leveraging Plexistor's Software Defined Memory (SDM), combined with Micron's NVDIMM and flash NVMe devices, as a unified storage solution.

Micron
Leader in memory technologies. Its enterprise-grade DRAM, NVDIMM modules, Flash SSDs and NVMe devices are used by all major server and storage suppliers. For more information, refer to micron.com.

Plexistor
Leader in system software designed from the ground up for persistent memory. Its SDM combines the speed of memory with the capacity and cost structure of Flash. SDM is available for free download at plexistor.com/download.

Methodology
The analysis and benchmark employs a standard configuration server from Supermicro and a Linux operating system. This is a configuration commonly used by Micron customers.

The database server was a single-socket E5-2670v3 from Supermicro, installed with Ubuntu 16.04. The benchmarked solution includes four 8GB DDR4 Micron NVDIMM modules, alongside a Micron 9100 NVMe card.

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Results

Applications running on top of the proposed SDM solution will experience standard file-level data access, but at speeds that are two orders of magnitude faster than other file systems. SDM serves reads and synchronous writes at under 3μs even when serving millions of operations per second per server.

Running a NoSQL or SQL database on top of SDM accelerates both throughput and latency. In the example below, MongoDB and PostgreSQL were measured achieving 4X the number of transactions per second (TPS), while reducing the latency (transaction response time) by a factor of 4 or 5, respectively.

Software-Defined Memory

	Operations per second			Latency in μs		
	Flash PCIe (XFS)	NVMe + NVDIMM-N (SDM)		Flash PCIe (XFS)	NVMe + NVDIMM-N (SDM)	
MongoDB NoSQL v3.2 *Durable. Mixed (50% update)*	21,163	78,808	x4	904	187	x5
PostgreSQL v9.5 *DBT2 warehouse workload*	1164	4146	x4	193,127	54,090	x4

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