



## Flash Storage on the Memory Bus

Databases inevitably grow over time, boosting the need for additional memory and capacity to maintain an expected level of performance and response times. As this data grows, storage performance and data movement can slow, generating noticeable delays in database response and associated business workload performance. Storage bottlenecks in a server's I/O subsystem make this situation worse.

With Big Data and Analytics, larger amounts of data are being transferred into, and out of, the central processor via the I/O controller—a process that is becoming increasingly bottlenecked by the limits of hard-disk-drive (HDD) storage.

Now, there's a new way to address this problem: The ULLtraDIMM SSD, a solid state storage device (SSD) from SanDisk in which flash storage is placed on a memory module form-factor. The ULLtraDIMM storage modules plug directly into the industry-standard DIMM memory slots in a server. The benefit of this deployment is ultra-low latency and predictable access from storage to the processor—accelerating application performance beyond what is possible with other storage solutions and providing consistent response times.

*By connecting flash to the memory bus, data center managers can avoid the arbitration and data contention on the I/O controller hub. By plugging in multiple ULLtraDIMM SSDs across 8, 12 or more DIMM slots, many terabytes (TB) can be supported close-in to the processor.*

### A New Approach to Accelerate System Performance

Using ULLtraDIMM, multiple terabytes (TB) of storage can be located directly on the server's memory bus. This is a new approach to bringing storage—and capacity—closer to the system's processor. This new form of storage avoids the system's big hardware/software I/O stack that can contribute to overall system latency, slowing database performance.

SanDisk's ULLtraDIMM technology provides a new way to accelerate database performance. By placing flash storage directly into a server system's DIMM slots, which are directly connected to the systems memory bus, the storage is much closer to the processor. This dramatically speeds up database performance. ULLtraDIMM SSDs provide 200GB or 400GB<sup>1</sup> of storage capacity in each drive.

The high-performance memory bus can now deliver data directly to the DIMM-slot-installed flash drives, reducing the data-path for data flowing into the server—and heading quickly to the main CPU for processing. By connecting flash to the memory bus, data center managers can avoid the arbitration and data contention on the I/O controller hub. By plugging in multiple ULLtraDIMM SSDs across 8, 12 or more DIMM slots, many terabytes (TB) can be supported close-in to the processor.

The ULLtraDIMM also leverages SanDisk's Guardian Technology™ Platform to achieve up to 10 complete drive writes per day (DWPD) over the five-year warranty period. This allows it to meet the endurance requirements write-intensive enterprise applications, while improving the total cost of ownership (TCO).

### The ULLtraDIMM Solution for Workloads

The ULLtraDIMM is designed to support use cases that require extremely fast storage, such as Transaction Processing, Big Data/Analytics, VDI (Virtualized Desktop Infrastructure) and Cloud Computing. The ULLtraDIMM SSD is designed to expand the reach of flash storage throughout the data center. It is designed to scale

to meet the requirements of any enterprise application—no matter how bandwidth-intensive or capacity-intensive the workload.



The ULLtraDIMM solution for workloads

*By placing flash storage on the memory bus, and installing it directly in the DIMM slots of servers, overall processing time is dramatically reduced.*

Importantly, ULLtraDIMM delivers latency in microseconds—with response times as low as 5 microseconds—dramatically faster than traditional HDD storage solutions, which have many milliseconds of latency<sup>2</sup>. With faster performance, greater data-density, lower power and cooling costs and the ability to replace the high numbers of HDDs required to do the same tasks, the value proposition for flash storage is becoming clear: It's all about capability, and total cost of ownership (TCO), over the 3-5 years of ownership.

Let's take a look at the ways in which ULLtraDIMM will impact key workloads for the enterprise data center:

- **Database/OLTP:** Capacity and speed are vital to fast and efficient database processing. By leveraging ULLtraDIMM in servers, database and OLTP (transactional) workloads will directly benefit by the dramatic improvement in response time, as data is quickly transferred via the memory bus.
- **Big Data/Analytics:** Analytics applications allow enterprises to find the “patterns in the data” that is stored within large, scalable databases. Database acceleration allows businesses to get better time-to-results, producing actionable data for the business more quickly than before.
- **VDI:** The speed and flexibility of flash technology increases the VM density on physical servers, enabling the support of many more VMs per server compared to traditional storage technologies. This leads to greater IT efficiency—and to Operational Expense (OpEx) savings related to reduced requirements for data center space, power and cooling.

#### Contact Information

ESS.channelsales@sandisk.com  
ESS.OEMsales@sandisk.com  
businesspartners@sandisk.com

#### SanDisk Americas

951 SanDisk Drive  
Milpitas, CA 95035-7933, USA  
T: 1-866-744-2165

#### SanDisk Europe, Middle East, Africa

Unit 100, Airside Business Park  
Swords, County Dublin, Ireland  
T: 1-866-744-2165

#### SanDisk Asia Pacific

Suite C,D,E, 23/F, No. 918 Middle  
Huahai Road, Jiu Shi Renaissance Building  
Shanghai, 20031, P.R. China  
T: 1-866-744-2165

For more information, please visit:

[www.sandisk.com/enterprise](http://www.sandisk.com/enterprise)

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## OEM Support for ULLtraDIMM

ULLtraDIMM technology is being adopted by OEM system providers, including IBM, Supermicro and Huawei. For more details, see the SanDisk website:

[www.sandisk.com/enterprise/ulltradimm-ssd](http://www.sandisk.com/enterprise/ulltradimm-ssd).

## Conclusions

SSDs allow customers to apply solid-state technology, rather than mechanical technology, to the very real, everyday business challenge of supplying data to applications and databases quickly and reliably, throughout an enterprise or organization. SanDisk's ULLtraDIMM takes that approach to storage one step further: By placing flash storage on the memory bus, and installing it directly in the DIMM slots of servers, overall processing time is dramatically reduced. Now, with ULLtraDIMM on the server memory bus, the time to results, leading to actionable data for the business, is much closer than before.

<sup>1</sup> GB = 1,000,000,000 bytes. Actual user capacity less.

<sup>2</sup> This latency level, in the microseconds range, was referenced in the IDC report: Improving Enterprise Performance with Flash on the Memory Bus, IDC # 249905, July, 2014.

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