



FLASH

Oracle Enters the High-Growth All-Flash Array Market with an Oracle-Optimized Solution

Eric Burgener

IN THIS FLASH

This IDC Flash summarizes Oracle's August 27, 2015, announcement of the new All Flash FS, heralding Oracle's entry into the rapidly growing all-flash array (AFA) market that IDC thinks will dominate primary storage solutions by 2019 and discusses the importance of the announcement for both Oracle and non-Oracle customers.

SITUATION OVERVIEW

The AFA market is on fire, and IDC expects that it will grow at a compound annual growth rate (CAGR) of 22.5% through 2019 to reach \$5.056 billion. A number of different AFA options are available in the market today, with entries from well-established enterprise storage vendors such as EMC, HP, and IBM as well as start-ups such as Kaminario, SolidFire, and Violin Memory. All of the established enterprise storage vendors, including Dell, EMC, HDS, HP, IBM, NetApp, and Oracle, have offered flash-optimized hybrid flash arrays (HFAs) for several years. A number of start-ups, including Nimble Storage, Tegile, and Tintri, also had very flash-optimized HFAs available in the market. Oracle's entry in this space was the original FS1 that shipped in 2014. Over the past year, all of these established vendors have also shipped all-flash configurations of HFAs (HFA/A), a market segment IDC tracks under the HFA/A moniker. Oracle announced its entry in this space, an all-flash populated version of the FS1 HFA, in September 2014.

In general, HFAs can deliver flash performance most of the time at a blended dollar-per-gigabyte (\$/GB) acquisition cost lower than that of all-flash systems, but HFAs can be unpredictably subject to the "long-tailed I/O" problem. In HFAs, data placement algorithms keep more active data on flash and less active data on hard disk drives (HDDs), striving to service as much real-time I/O as possible from flash. Occasionally though, reads have to be serviced directly by HDDs, and this drops the latency for any transaction that must touch HDDs to HDD latencies. Certain application environments significantly benefit from more predictable latencies for all reads and writes, traditionally a strong point of AFAs. Customers' desire for more predictable performance led many of the HFA vendors to introduce volume pinning (so that flash performance could be delivered all the time for selected applications) and then ultimately all-flash configurations of their HFAs. All-flash configurations of HFAs deliver better and more consistent performance than mixed-media HFAs, but they still do not deliver the same consistently low latencies under load as true AFAs. As flash prices continue to come down, we are now seeing traditional HFA vendors introduce true AFAs. Tegile and Tintri both introduced true AFAs in the past several months, and now Oracle has introduced one as well.

Oracle is somewhat unique among enterprise storage vendors in that it has done extensive optimizations specifically for Oracle environments with its "Engineered Systems" storage offerings.

Oracle's Exadata Database Machine is intended for use only in dedicated Oracle environments, but the Oracle file system (FS) platforms (both the AFAs and HFAs) can be used in general-purpose environments as well. Oracle owns roughly 45% of the enterprise relational database market and also has entries in the nonrelational database and in-memory database markets. Since the All Flash FS can support any open systems-based Oracle environments, these combined Oracle-related markets represent close to a \$14 billion total available market (TAM) for that platform in 2015. And because the All Flash FS can also be used with general-purpose workloads (subject to the limitations discussed in the sections that follow), that increases that TAM even more.

Oracle's All Flash FS builds on the company's HFA hardware (which represents the evolution of the Axiom intellectual property Oracle obtained in the 2011 acquisition of Pillar Data) but includes hardware and software optimizations that are specific to flash media. The All Flash FS has more powerful controllers with more cache than the HFA platforms, and the operating environment includes "FastPath" I/O optimizations that are specific to flash media. Customer interest in consolidating multitenant, Oracle-dominated online transaction processing (OLTP) workloads on a single shared storage array while maintaining predictably consistent flash latencies is what drove Oracle to engineer and release the All Flash FS. Note that while the Exadata Database Machine is specifically targeted at Oracle-only workloads running on the integrated Oracle servers (the Exadata Database Machine meets IDC's definition of an integrated system that includes servers, storage, and networking in a single SKU), the All Flash FS is a shared storage array targeted at use in Fibre Channel (FC) SANs to support multitenant OLTP.

The All Flash FS includes a number of Oracle-specific optimizations, many of which have been borrowed from Oracle's experience with Exadata Database Machine customers. It supports Oracle Automatic Storage Management (ASM), which includes flash profiles prebuilt, pretuned, and pretested for Oracle ASM, a cluster file system and volume manager that is integrated with Oracle to improve I/O efficiencies, and wide striping that eliminates hotspots and helps maximize flash endurance. It also supports Oracle Enterprise Manager, which allows database administrators (DBAs) to easily, safely, and directly manage their own Oracle storage. It supports Oracle's Advanced Compression Option (ACO), which can compress Oracle data encrypted with Oracle's Transparent Data Encryption (TDE) option, as well as Oracle's Hybrid Columnar Compression (HCC). HCC can also be used with TDE-encrypted data and, in common use, delivers data reduction ratios in the range of 6:1 to 10:1 – much higher than traditional Lempel-Ziv based-approaches – and sometimes as much as 50:1, but it can only be used with Oracle storage solutions (i.e., Exadata, FS, and ZS systems). The All Flash FS also takes advantage of certain Oracle "hints" not accessible on competitive storage arrays to make common database operations faster and more efficient. Oracle-specific optimizations such as these make Oracle's claim to be the best all-flash platform in the industry for Oracle very credible.

As a platform for Oracle databases, the All Flash FS offers an extremely competitive platform. A single dual controller system can deliver between 350,000 and 700,000 IOPS in normal usage (depending on workload profile), delivers consistent submillisecond latencies in the 200-800 microsecond range (depending on block size), scales from a 2.8TB entry capacity to 912TB maximum (raw), and includes a full set of data services for quality of service (through I/O prioritization), systems management, space optimization (thin provisioning and space-efficient snapshots), data protection (RAID and application-consistent recovery), and disaster recovery (synchronous and asynchronous replication). Write coalescing and wide striping promote highly efficient space management operations and improve flash media endurance. Security features include support for up to 64 all-flash storage domains (containers that can be used to provide effective isolation in multitenant environments), Oracle-aware data at rest encryption (TDE), and end-to-end integrity checking for the prevention of silent data corruption using

T10-PI. And over 100 different "one click" application provisioning profiles help make storage provisioning operations simple and well matched to various application I/O requirements.

The All Flash FS does not, however, support general-purpose, inline, array-based compression and deduplication like most other AFAs. When an AFA is purchased for dedicated application deployment (like with a single database), enterprises often use data services such as data reduction, encryption, and replication that are application based. When enterprises are looking to use an AFA for storage consolidation, array-based data services tend to become more important. Today's mixed virtual workloads are highly reducible data sets, and flash performance enables the use of inline data reduction while still delivering very good performance. IDC survey data suggests that enterprises can easily achieve data reduction ratios in the range of 4:1 to 6:1 for mixed virtual workloads (lower for databases and higher for clone-intensive environments such as VDI and test/dev). Data reduction significantly lowers the effective dollar-per-gigabyte cost of flash deployment, and since cost is still the single biggest obstacle to broader flash deployment, array-based, inline data reduction capabilities that can be used across all workloads have become a baseline requirement in AFAs for most enterprises. Inline data reduction does impose a performance impact, but most AFAs are able to still deliver consistent submillisecond latencies even with it enabled, and that level of performance is very attractive to enterprises moving away from HDD-based systems.

FUTURE OUTLOOK

In dedicated application environments where an AFA is purchased for a single application that demands the highest levels of performance regardless of cost, Oracle's All Flash FS is a formidable competitor. But the market is already shifting more toward the use of AFAs as platforms for mixed workload consolidation, which includes Oracle as well as other databases and applications, and the All Flash FS' lack of general-purpose, array-based, inline compression and deduplication may put Oracle at a disadvantage here. IDC expects that over time, the use of AFAs for general-purpose mixed workload consolidation will become the norm as denser consolidation accentuates the secondary economic benefits of flash deployment (fewer devices, lower energy and floor space requirements, fewer servers required to drive storage performance, and lower software licensing costs due to need for fewer servers) to drive lower total cost of ownership (TCO). IDC assumes that the widespread use of this deployment model (dense mixed workload consolidation) is what will ultimately lead to AFAs dominating the primary storage markets.

For customers looking specifically for an Oracle solution, the All Flash FS offers compelling value that translates directly into higher performance and management advantages (secure storage domains, data services enablement at the application level, access to HCC and the ability to compress encrypted data, application provisioning profiles, etc.). The platform is well architected to deliver submillisecond performance consistently in dense multitenant OLTP environments. General-purpose, array-based, inline data reduction that can be enabled at the application level is on Oracle's All Flash FS road map, and competitors should begin to see this platform compete very aggressively outside of Oracle-only environments in that time frame.

The relational database management system (RDBMS) market is undergoing substantial transformations along three key lines: in-memory, cloud, and agility. All the leading RDBMS vendors have various forms of in-memory database technology and database-as-a-service (DBaaS) offerings. Oracle has a strong cloud-based offering and is leveraging the All Flash FS as part of this infrastructure to cost effectively enable multitenant OLTP environments for its customers. The

inclusion of All Flash FS in Oracle's cloud infrastructure enables Oracle to offer premium service levels with guaranteed consistency, a feature important to an increasing set of enterprise customers looking to migrate at least some database operations to the cloud for improved agility and lowered cost. Overall, the ability of RDBMS vendors to adapt to evolving market conditions such as cloud will be a key factor in their continuing success, and the All Flash FS boosts Oracle's competitiveness not only with storage appliance sales to enterprises but also with customers looking to the cloud for high-performance DBaaS offerings.

The entry of Oracle, a well-established HFA vendor and enterprise player, into the AFA market is indicative of the overall evolution of enterprise storage more in the direction of not just flash but highly flash-optimized storage solutions that are designed specifically around the use of flash, not spinning disk, media. There is clearly a need for enterprise storage solutions that can deliver flash performance at scale all the time for applications – regardless of whether they are on-premise or hosted – and customers are demanding this option from their trusted vendors. This announcement makes Oracle more competitive relative to other AFA vendors that are heavily touting their performance in Oracle environments, and it has a compelling argument that the All Flash FS is the best storage platform in the industry for Oracle deployment.

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Global Headquarters

5 Speen Street
Framingham, MA 01701
USA
508.872.8200
Twitter: @IDC
idc-insights-community.com
www.idc.com

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