With Purpose-built Flash Architecture Oracle FS1 Series Brings Heavy Artillery to the Flash Market

Enhanced QoS, Automated Tiering, Storage Domains, Enterprise-grade availability, Robust set of data services, co-engineering with Oracle Database and Applications provide clear differentiation

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When the Oracle FS1 Flash Storage System was introduced at Oracle OpenWorld 2014, CTO Larry Ellison referred to it as a ‘great product’ and said that it would challenge other flash vendors at half the price. What’s the FS1 and why does Oracle think it will succeed in the all-flash and hybrid array market? The FS1 was architected from the onset as an all-flash array and can be sold as such (there will be a dedicated all flash model). For customers looking to tier beyond two tiers of flash (eMLC and SLC), the ability to incorporate performance HDDs and capacity HDDs was a secondary design consideration of the product.

Customers are looking for higher, low-latency performance that traditional arrays are not delivering. Flash provides that performance. However, many all-flash and hybrid arrays solve only one or two applications’ performance issues and do not often provide enterprise-class experience and capabilities or robust, proven, industry-hardened data services.

Oracle believes that the FS1 provides a complete package—flash performance plus data services plus enterprise-class capabilities that can meet the needs of the most demanding enterprise customers, especially in the Oracle Database and Oracle Applications installed base, and establish a strong presence in the flash storage market. What sets FS1 apart from the rest of the flash storage products out there?

Purpose-built flash design in a scale-out architecture

Oracle leveraged five generations of flash hardware and software innovations in designing the Oracle FS1 to take advantage of flash from the onset. FS1 systems begin with a high-availability pair of nodes that can support up to 912TB of flash, at least twice the capacity of available all-flash arrays, and it scales out to 16 nodes and 7PB of flash, while vendors, such as EMC XtremIO, top out at 6 nodes and 120TB. The FS1 can operate at a steep two million IOPs with throughput of up to 80GBps in a 16-node configuration, according to Oracle’s claims. These capacities are then multiplied by Oracle Database compression capabilities, which can reduce data by up to 50X.

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Flash and disk media are configurable in four storage tiers within each system: single-level cell (SLC) NAND Flash, the fastest and resilient persistent memory technology; multi-level cell NAND Flash, which costs about one-half of SLC on a capacity basis, but is also slower and wears out sooner; high-performance SAS hard drives; and, capacity hard drives with upwards of 6TB per drive. This combination of flash and disk provides operational efficiencies and produces a significant reduction in cost of ownership while delivering increased performance and scalability.

**QoS Plus and Auto-tiering**

Oracle’s patented QoS Plus combines with Auto-tiering to move data across four tiers of flash and disk media based not just on frequency of access but also on an application’s performance, cost and business priority. It monitors workloads, adaptively learns from usage patterns and prioritizes I/O processing based on customized business priorities and access patterns, not first in-first out (FIFO) order as has been done since the IBM RAMAC in 1956, helping accelerate critical applications. For various vendors, QoS means throttling, or slowing down, all applications much like the phone company does to smart phone users; in contrast FS1’s QoS Plus delivers an application’s performance as set by its specific business priority. FS1 moves data in fine-grained 640KB blocks, 400x greater efficiency than the competition. This means that when keeping data in flash, it is hot data and not a mixture of hot and warm or cold. And, when data is moved to disk, it is cold data. For customers this translates into substantial savings of valuable resources (See Figure 1) as data blocks are stored in their appropriate flash or disk tier.

**QoS Plus and Storage Domains in a Multi-tenant Environment**
Storage Domains

Oracle's Storage Domains software enables multiple, virtual storage systems to be created within a single Oracle FS1, isolating data from other storage domains and providing independence and security in multi-tenancy environments. Each domain is assigned a pool of resources (any combination of flash and/or disk) according to its QoS Plus settings. For example, some applications, such as high-volume OLTP, can be placed entirely on a flash-only domain, other applications can share a mix of flash and disk tiers, while “cold” archive data will be placed on a capacity disk domain. With FS1 Storage Domains, applications with much different workloads can use FS1 resources simultaneously without affecting each other's performance (See Figure 2). When compared to other all-flash vendors, with its all-flash model, the FS1 is the only system to support storage domains for user, data, and application security and isolation in an all flash environment---with up to 64 secure domains per system, and two tiers of flash per domain.

Figure 2. Example Applications and Storage Domains

Application Profiles

A set of pre-tuned and pre-tested Application Profiles are included with each FS1 system. Application Profiles provide one-click provisioning for fast, streamlined deployment of Oracle Database and Applications with a minimum of administration. Oracle Database and Applications -- such as JD Edwards, Siebel, Fusion Middleware, E-Business Suite and Peoplesoft -- as well as Microsoft SharePoint and Exchange, span a wide range, all having different storage characteristics. These begin with the relative business priority of the application, access patterns and I/O bias, RAID level and thin provisioning, cache behavior and read-ahead characteristics. Application Profiles can be customized for a particular application and then exported to other FS1 systems to ensure standardized storage provisioning across geos. Application Profiles encompass the expertise that takes years to develop and learn in regards to application and database provisioning skills and it’s all incorporated right into the FS1. Instead of spending more time on application and database administration, Oracle has put all the smarts enterprises need in the FS1. Application Profiles are a result of Oracle
hardware and software co-engineering and further expand Oracle's Application Engineered Storage capabilities, now encompassing both the database layer and the app layer.

Enterprise Grade SAN Storage

The Oracle FS1 storage system is designed with enterprise-grade features to provide maximum uptime and data availability, which are generally not offered by various other all-flash or hybrid storage systems. These include rapid failover, warm start for upgrades and no single point of failure (SPOF) with additional protection from pre-emptive copy. To protect against silent data corruption, the FS1 uses T10 Protection Information (T10-PI) for data integrity checking from the application to the storage devices. In addition, the optional Oracle MaxRep Replication Engine supports both high-performance synchronous and asynchronous replication to local and remote locations for business continuity and disaster recovery.

Robust Data Services

The FS1 includes robust, proven data services ranging from thin provisioning to copy services (read/write clones and snapshots) QoS Plus and auto-tiering, Application Profiles, Storage Domains and Hybrid Columnar Compression support. And, unlike some competitive offerings, which are not as extensive or robust, nearly all in-box software is included in the system base price—no extra cost, no incremental license or maintenance fees.

Co-engineered with Oracle Database and Applications

As with all Oracle storage systems, FS1 is co-engineered with Oracle Database and Applications to provide unique features not available to any other vendor. For example, by supporting Oracle Database Hybrid Columnar Compression, data can be compressed by 10-50x, reducing database storage requirements by up to 40% and speeding queries by up to 5x. The FS1 system takes Oracle's Application Engineered Storage to a new level by providing out-of-the-box tuned storage provisioning profiles for Oracle Database and key applications, as covered above. These co-engineered capabilities give the FS1 an unbeatable advantage vs. other vendor’s flash arrays in Oracle environments.

Operating system and hypervisor support

The Oracle FS1 Series provides broad operating system and hypervisor support, including support for Oracle Linux, Oracle Solaris, Oracle VM, IBM AIX, HP-UX, Microsoft Windows and VMware. Unified file and block access is supported and Fibre Channel or Ethernet connectivity can be used.

Our take

Oracle has raised the bar for flash and hybrid arrays with the FS1. The system scales to a larger number of nodes (16 compared to 6 to 8 for competitors) and delivers extreme performance. It has configuration flexibility and comprehensive management functionality included in the system and contributes to a surprisingly low cost profile. The FS1 has unique QoS controls that combined with auto-tiering moves data based on business priorities and policies and what it learns from data access patterns. With these capabilities, Oracle FS1 has clear advantages over other flash and hybrid arrays. Oracle brings the FS1 to the flash storage market with a bang, clearly intending to take on both established and emerging vendors. CIOs, DBAs and application owners should take a close look at FS1 and understand the business value it can deliver to their respective IT environments.
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