Compellent – Harnessing SSD's Potential

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Abstract: Rather than just physically adding solid state disk to its hardware offerings, Compellent has integrated SSD *into* its existing block-level tiered storage management system, overcoming the major challenge of solid state adoption: ensuring easy and optimum usage of the premium IO capabilities of SSD.

The Potential Benefits—and Challenges—of Solid State

In the IT world, you'd have to be living under a rock to avoid the onslaught of solid state storage news and announcements occurring over the last 12-18 months. It seems that every vendor has seen the potential and is queuing up to add solid state to its offerings. And, certainly, the operational and economic attractions of the technologies are significant. But, like most things in life and data centers, just because something shares a generic name and some attributes—a country, a haircut, a car—it does not mean that all versions or implementations of that thing are the same. This Brief focuses mainly on how Compellent is bringing SSD to its storage systems and will therefore include no more than a quick summary of why solid state is so compelling.[1]

ESG regularly surveys IT end-users regarding their views on technology and the market. In ESG's latest annual Enterprise Storage Survey, users were specifically asked why they would consider flash based SSDs. Figure 1 shows that the main reason, as one might expect, is performance, followed by reliability and improved power and cooling attributes. SSDs offer speed and huge IO capabilities—that much is very clear. However, users are also aware that SSDs come with a hefty price tag to match. Although the price differential between SSD and spinning disk has already declined considerably (and is expected to do so more, and faster) there remains a premium to pay for premium performance. Now, certainly, there are issues to consider around how real price is calculated; for example, if a user is short-stroking existing disks (a.k.a., wasting capacity) in order to squeeze out every last drop of performance, then the *relative* price advantage of the spinning disk per GB is certainly diminished. But a price differential still exists; this is, of course, nothing new in the world of storage—the whole storage hierarchy is predicated on economics and ensuring that each piece of data or application is served at the optimum level that budgets permit. If money were no object, everything could be in main memory. Conversely, if the lowest price per GB were the only criteria, then everything would be on tape. IT managers are used to having options—SSD is no different from anything else in the storage hierarchy inasmuch as the keys to a successful implementation (both operationally and financially) are to ensure that:

a) it is applied only where appropriate, and
b) it is utilized as fully as possible.

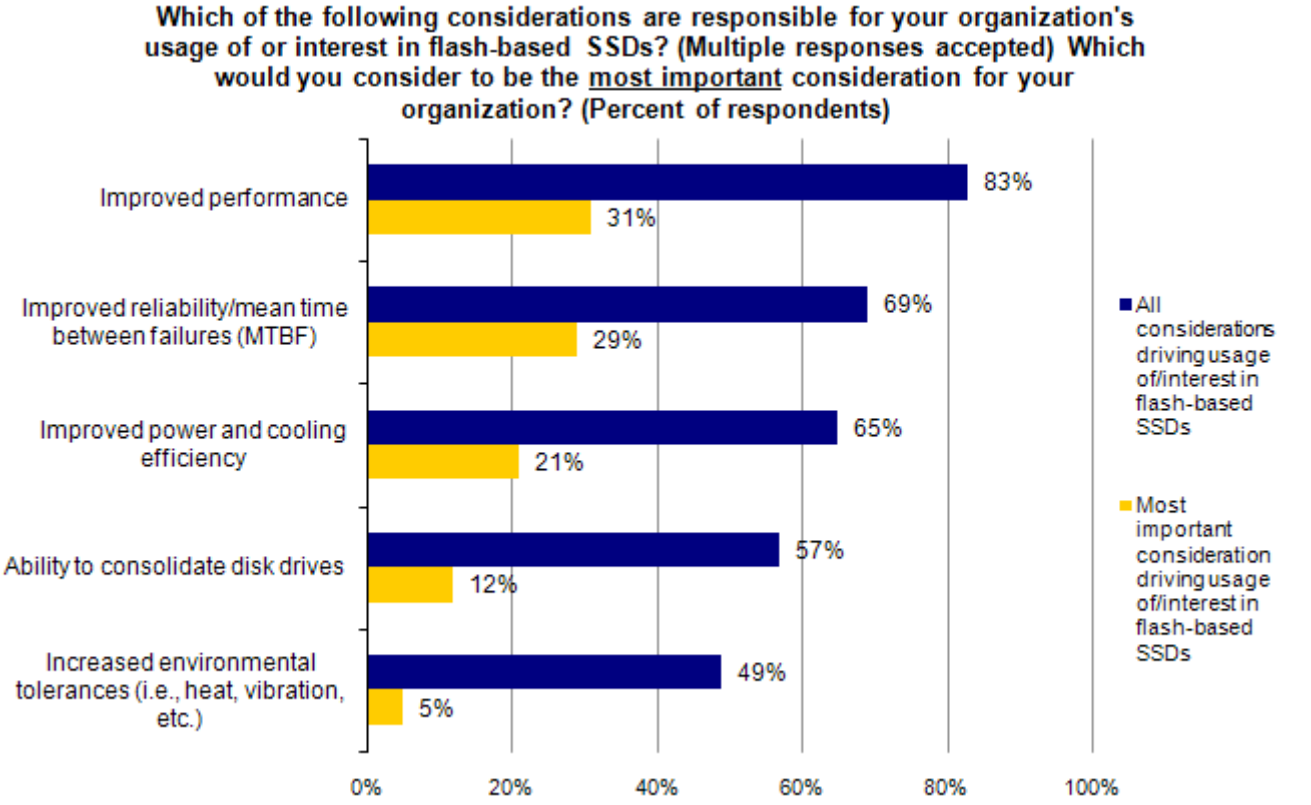
So, the attractions are obvious: great IO rates and stellar speed, low data center impact (in terms of space, power and cooling), and the ability to both "turbo-charge" applications and "clean up" and add efficiencies to less desirable approaches created out of necessity (such as short-stroking, over provisioning, etc.).

It all sounds great, but this is a premium performance storage product. The same survey asked why users might *not* be interested right now and the number one reason, by a significant margin, was the price of SSD relative to hard disk drives. Even those users that understand the value of SSDs (either in terms of their absolute business requirements and/or in terms of the relative price per IO) are, in most cases, only going to be able to justify a limited amount of solid state. Therefore, one of the main obstacles to wider and more rapid adoption is the lack of

[1] For an extensive general overview of the technologies, advantages and opportunities represented within the solid state market, see the ESG Report, *The State of Solid State,* April 2009, which is available from Compellent.

a deployment method that ensures both effective and efficient usage. In a nutshell, SSD is invariably easy to install, but often harder to use well. And this is where the Compellent approach comes into sharp focus.

FIGURE 1. CONSIDERATIONS FOR USER INTEREST IN FLASH-BASED SOLID STATE DISKS



Source: Enterprise Strategy Group, 2009

Compellent's Solid State Offering

Compellent is introducing its initial SSD offering through a partnership with one of the current leading vendors, STEC. The Zeus IOPS will be available in a 146 GB package with a 4 GB FC interface. The STEC device uses SLC (Single Level Cell) technology, which is currently the most preferred and proven choice for enterprise implementations. It offers 100k writes per cell as well as wear-leveling and many other features that are becoming standard to safeguard the longevity and availability of corporate data. There is, however, nothing stopping Compellent from using an alternative source or technology (such as MLC) as well as or instead of this initial offering if the company decides that such a move benefits its overall offering.

So far, you could be forgiven for thinking that this all sounds fairly 'me too-ish.' However, Compellent brings some key differentiators in its approach, which we'll categorize as financial and operational:

- **Financial:** Although STEC does not provide cheap 'no name' SSDs, Compellent is able to claim a low cost entry point. This is because Compellent runs a RAID 10 implementation, which means the minimum SSD configuration (allowing for sparing) is 3 drives, compared to the minimum 6 in a RAID 5 system. Keeping the price of entry down is obviously goodness. The financial impact of SSD in a Compellent system is also minimized because the non-disruptive addition of the new drives requires no new racks or infrastructure changes and no new training. The biggest financial gain of all, however, is delivered because of the way *existing* Compellent storage systems operate.

- **Operational:** Stated succinctly, Compellent is different with SSD, and offers great value as a result, *because of what stays the same*. Operationally, almost nothing changes when a user adds SSD to their Compellent installation. And that is great, because it means that the SSD component becomes a part of

the dynamic, automatic, and block-level managed storage pool that is the essence of Compellent. All the valuable functions that make Compellent storage easy-to-manage and efficient apply to the SSDs as much as to the (various tiers of) HDDs that are already there. This includes Dynamic Block Architecture (DBA), Data Progression (also known as Automated Tiered Storage), and thin provisioning (which Compellent refers to as Dynamic Capacity). These functions go to the heart of the challenge mentioned in the introduction, making SSD both easily used and optimally utilized.

In summary, then, Compellent has chosen to combine proven elements (its own existing systems, including the Storage Center management suite, together with the STEC SSDs) and to do what it has always done: apply management ease and operational efficiency in order to drive up the capabilities and value users get from their storage while driving down the required capacity and hence, the effective cost. Ironically, it is the lack of change that makes the addition of SSDs so valuable in a Compellent storage system.

Compellent Harnesses the Full Potential of SSDs

Data Progression and DBA are really the keys to Compellent SSD's value as it is what allows limited, premium solid state storage to be used effectively and optimally.

Data Progression: Compellent uses an innovative approach to store, manage, and migrate data among tiers of storage. Unlike traditional architectures that manage at the volume or file level, Compellent manages pools of storage inside the volume at the block level. To use an analogy, if storage were an encyclopedia, other vendors typically manage entire volumes and chapters, whereas Compellent manages individual words and pages within the chapters. Attributes including time written, time accessed, frequency of access, and RAID level are tracked at the block level. This metadata, or data about data, is used *to automatically migrate blocks to the optimum tier of storage based on user-defined policies.* Data Progression is used to define policies at the application volume level so that frequently accessed data is retained on high-performance media while infrequently accessed data is stored on lower-cost media. In other words, Compellent has the ability to not only move data *between* tiers; it can move data *within* a tier, placing only an appropriate portion of a volume onto SSD (or any other applicable storage). DBA and Data Progression are all about the optimized, effective use of available storage resources.

A single user interface in Storage Center is all that is needed to enable automated block-level migration; the management software keeps track of usage and automatically migrates frequently accessed data to the optimum storage tier. This existing capability is now enhanced by the ability to add SSDs as another high performance tier within the overall storage pool.

Harnessing SSD potential: As mentioned, gaining the optimum value of whatever amount of SSD that is added to a Compellent storage system is a result of what has not changed. Some vendors implement SSD as a specific and fenced new tier; others look to use the SSD as a cache. For Compellent, storage *management* has always been more important than the storage *media* itself. Any available and user-chosen range of storage—from high capacity SATA drives, through FC, and now to SSD—is within a single and dynamically managed pool. Automation is based on user-defined policies to enhance the value further, and thin provisioning (which allows for volume expansion as data grows) also applies across SSD just as it would any other part of the Compellent storage infrastructure. A recent ESG Lab report[2] used a descriptive analogy for the Compellent approach, which is reprinted here—the essence has not changed, only the addition of SSD.

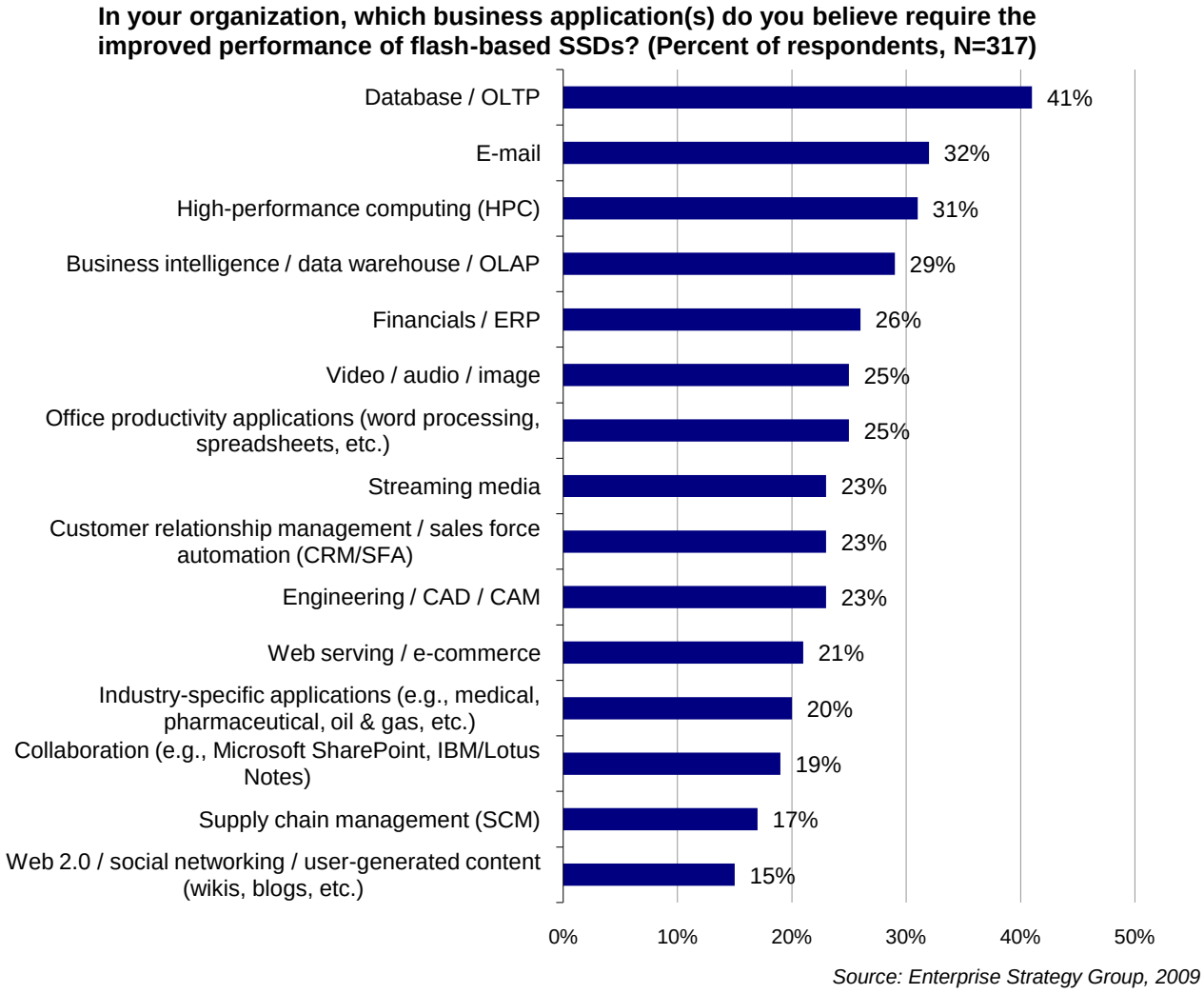
> *Let's compare the evolution of storage infrastructure within an organization to the haphazard evolution of the housing market within a community in New England. To meet the varying needs of the community, the storage infrastructure has evolved to contain a mix of houses, apartments and dorms. High-end mission critical applications like e-mail and databases live in gated communities and mansions (expensive enterprise-class disk arrays with the fastest Fibre Channel drives), second-tier applications like file sharing live in apartments (mid-tier arrays with a mix of FC and SATA drives) and near-line applications live in dormitories (DAS, JBOD and bulk SATA arrays).In contrast, the Compellent approach looks more like a well-planned community built around a state-of–the-art condominium complex. Sharing a common pool of infrastructure built from affordable commodity components, Storage Center reduces the cost of acquisition, maintenance, power, cooling and space.*

[2] Adapted from the ESG Lab Report, *Compellent Storage Center v4.0,* February 2008.

Residents are free to choose their own upgrades and control their own utility bills. The end result is a well-planned storage community built around a highly virtualized storage complex, with a rich set of system and data management features on a reliable high performance platform that enables IT managers to cost effectively provide best-in-class storage services to the business community.

Applying SSD in general: While not forgetting that the Compellent 'condominium manager' will take care of the optimum organization, users are also going to want to know that they have applications and data that will benefit from the addition of some SSD in the first place. After all, solid state is not pixie-dust! In terms of where to use SSD—where it is likely to add value—users should typically have some low latency applications. In the previously mentioned ESG survey, users were asked which applications they felt would require the improved performance of flash based SSDs; the results are shown in Figure 2.

FIGURE 2. APPLICATIONS USERS BELIEVE REQUIRE SOLID STATE DISK PERFORMANCE



Source: Enterprise Strategy Group, 2009

What is very apparent from the research results is that the list is not headed by arcane or specialist applications for the IT 'propeller head' organizations. Instead, users believe that the value of SSD applies across a wide spectrum of very standard and common business applications. Compellent offers a service to work with users to refine their precise needs accurately, but the takeaway is that any user running standard applications can probably benefit from solid state to some degree. And the beauty of the Compellent system is that once you have it, use and optimization are automatic.

The Bottom Line

SSDs make good sense on paper—even at today's prices, their value can be demonstrated. The trick is to transfer that paper value to the data center. Compellent is one of just a handful of companies that are really focused on that change. For Compellent, the 'change' is that it doesn't really have to change anything! The management system simply morphs, like mercury, to absorb the new component. One might say that some vendors are, literally, just slotting SSDs in (into racks), whereas for Compellent, the SSD slots into a fully fledged management system that optimizes the use of different tiers in order to extract the maximum value from a users storage investment. In a world where just about everyone in IT is watching their budgets carefully, 'efficiency' and 'optimization' are watchwords. In ESG's previously mentioned annual Enterprise Storage survey, users said that the number one business initiative significantly impacting their storage spending is pressure to reduce their overall cost of doing business. As such, a well implemented and properly utilized SSD component goes to the heart of what IT departments are trying to do.

Compellent's addition of SSDs takes a good thing and makes it better. Ironically, however, the degree of improvement may not be as dramatic as that produced by SSD on some less sophisticated systems. This is because Compellent was already managing for efficiency and performance with functions such as its DBA, Data Progression, and Fast Track (which optimizes the placement of appropriate blocks to the higher performing outer tracks of spinning disks). When you already tier and manage efficiently, the marginal improvements are more granular, but nonetheless welcome—and, of course, made far easier to attain thanks to the ease of implementation and integration into the Data Progression function that is just part and parcel of the Compellent approach. That said, because of all this and because of the positive potential for a low-entry point, it would be good if Compellent had a tool available to help with SSD candidacy and sizing decisions. Any other downsides of the Compellent approach are, frankly, hard to spot. The choice of STEC's proven SLC device is ultra-safe for now, which most users will no doubt prefer. As new entrants and technologies gain traction, the company can 'morph' those in as appropriate. Indeed, a range of solid state tiers is entirely conceivable and sensible in the Compellent model.

The 'modus operandi' at Compellent, from its inception, has always been the best use of the minimum resources to effectively get the job done. The addition of SSD is—and this is good—no great shake-up for the company and its products: it's just one more step along the path. Other vendors might highlight SSD as something special in-and-of itself; for Compellent, it's almost anticlimactic as it seamlessly fits into both its architecture and its business model. Solid state (the technology) meets solid state (the Compellent platform)!