White Paper

Why the Correct Information Infrastructure Is a Crucial Consideration for SQL Server 2012 Implementations

How EMC’s Offerings Can Fit the Bill

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SQL Server 2012: Application Database and Storage Needs

Introduction

So many things in life are dependent on something else, and intuitively adjusted by varying needs: Maybe you put different amounts of sugar in your coffee depending on the size of the mug. Perhaps you have different floor coverings for different parts of your house depending on the use and wear characteristics.

On a more technical level, DBAs will always think about response times and user profiles, while storage managers will definitely think about capacity and backup needs. But is storage always considered—really considered—when key applications such as SQL Server are being implemented and grown? All too often, it can be an afterthought. Yet not only is storage a crucial foundational infrastructure that supports mission-critical applications such as SQL Server, but it also can be something that actually affects the achieved business value of the application: Good storage, well implemented, can enhance and optimize the application. The arrival of the new version of SQL Server (SQL Server 2012, or “Denali” as it was called during development) is an excellent time to revisit the need to consider this crucial dependency.

The intent of this paper is neither to explain SQL Server 2012 in full nor to be a buying guide for all EMC storage products. It is simply to highlight enough information on each, so that IT managers (if they are not already doing so) can focus on the database system and storage hardware relationship. Dependencies do exist. Also, there is optimized value to be enjoyed. Quite simply, storage must be actively considered in concert with SQL Server; if not, it is almost certain that costs will rise and quality of service will decline. Certainly, neither will be optimized.

Application Servers and Enterprise RDBMS Systems—a Reminder

Almost all modern applications require persistent storage. Many of those applications process transactions and retrieve historical information about users, purchases, assets, or money. These functions are at the core of modern computing, and most serious applications rely on a database—particularly a relational database management system (RDBMS)—to provide these functions. All major RDBMS systems use a version of SQL (the “Structured Query Language”), and the use of RDBMS servers has exploded over recent years. It is not conceivable to think of running a significant enterprise or consumer application—whether cloud-based, web-based, client-server or N-tier—without a significant database engine for storage, transaction processing, reporting, and data mining.

Naturally, all of that data and those transactions need to live somewhere, so storage concerns and abilities go hand-in-hand with the RDBMS discussion. And the same criteria (responsiveness, availability, scalability) apply to the storage subsystems as well. If a database must be highly responsive, highly available, or fault-tolerant and able to scale quickly, then so must the underlying storage.

Microsoft SQL Server

Microsoft’s RDBMS is Microsoft SQL Server, or simply “SQL Server,” which has been built over approximately a dozen releases since 1989. It has grown to be one of Microsoft’s flagship enterprise products, with multiple billions of dollars of licensing revenue. According to Microsoft, the new SQL Server 2012 is “a significant product release that helps customers continue to build and support mission-critical environments, now with more confidence and efficiency out of the box. New tools and enhancements enable breakthrough insight across all levels of the organization, while cloud-ready technologies for application symmetry across server, private, and public clouds help customers stay agile for the future.”¹ The company promotes three main “pillars” of advancement in the new version:

- Mission Critical Confidence
- Breakthrough Insight
- Cloud On Your Own Terms

We will start by reviewing each pillar briefly, together with its implication for storage environments.

- **Mission Critical Confidence:** Here, Microsoft is focusing on high availability, or what it refers to as “Always On,”² promoting the five- or six-nines (99.9999%) uptime³ that can be achieved using SQL Server 2012. Through a host of specific feature additions, Microsoft has designed SQL Server 2012 to be able to meet the most stringent service level agreements (SLAs) yet remain cost effective. In addition, Microsoft has made huge improvements in performance (such as a columnstore index to deliver performance gains in data warehousing scenarios) versus SQL Server 2008.

  **Storage Implications:** There’s little point to having a high-availability database without an equally resilient storage infrastructure. The same holds true for multi-site clustering. The increased performance demands of SQL Server 2012 in turn require increased storage performance capabilities, in order to avoid the storage subsystem becoming a bottleneck to overall application performance.

- **Breakthrough Insight:** Having the data is one thing. Having information is another. Being able to act on information that is understood is yet another. Bringing users from data, through information, into action or understanding is the second cornerstone of the SQL Server 2012 release. From better reporting services to more self-service, and from enhanced abilities to aggregate data from disparate sources to collaboration with tools such as Excel and SharePoint, Microsoft is encouraging the design and use of “self-service BI” (business intelligence) solutions. Advanced semantic search abilities allow unstructured data to be managed alongside a more traditionally rigid database.

  **Storage Implications:** All of these advances will apply stress to a storage system, both from a capacity perspective (thereby demanding scalability) and from a more intensive performance perspective. “More access to more data more dynamically” is easy to say and to write, but harder to design and deliver.

- **Cloud On Your Own Terms:** Microsoft is positioning SQL Server 2012 to be the data engine of choice for any and all of the cloud designs being used by its customers. It is doing so by streamlining process, supporting more data types, and so on. For the purposes of this paper, perhaps the most obvious single hallmark of a “cloud”—whatever sort of cloud it may be—is the ability to quickly and easily “spin up” new instances of (or capabilities for) workloads, reconfiguring them almost instantly, usually using stored server templates or snapshots. A key enabling technology here is the use of server virtualization that divides physical database servers into logical instances, and thus allows seamless movement of workloads as well as a higher utilization level of hardware.

  **Storage Implications:** Flexibility (regarding performance, capacity, point of management, or interoperability) and scalability are the keys to ensuring that storage can be rapidly (re)provisioned as virtual servers are added and removed, and that it can scale with the changing performance demands as SQL Server environments grow, in both physical and virtual models.

### Why Storage Choices for Application Databases Matter

Getting effective results for any application—but especially an application driven by data—depends on the careful selection and marriage of software and hardware. No hardware component is more important than the storage system chosen. While there are bound to be many application-focused IT professionals who believe that Microsoft is hitting the ball out of the park with the release of SQL Server 2012, some of those same people may be very disappointed if they provision this best-of-breed RDBMS system with sub-optimal or limited storage systems.

A key concern is the economic efficiency of storage. In the real world, there are precious few instances where ultimate performance must be achieved regardless of cost; in the vast majority of cases, performance must be balanced with cost. Of course quality of service also matters, and this forms the other leg of the stool: Storage matters for application databases because it can determine, and hopefully enhance, the business results, efficiency,
and cost-effectiveness achieved by the application. However quality of service is measured—be it response, availability, data integrity, carbon footprint, lack of downtime, cost per query, or whatever—the strength of the overall database experience is only as strong as its weakest link. Having detailed conversations about the needs, expectations, and planned growth of the underlying storage system supporting a SQL Server 2012 environment is crucial to preclude it being a weak link.

Moreover, there are few if any users who run SQL Server and nothing else. In other words whatever storage a user chooses should “play well in the overall IT sandbox,” especially as workloads are increasingly virtualized and thus required to share server and storage resources. Both for the specific needs of SQL Server and for the general needs of a data center, when it comes to storage, users should be looking for choice, flexibility, and advanced features.

**How EMC Storage Helps Optimize SQL Server 2012**

The succinct answer to the implicit question in this section’s title is that EMC not only has a range of products thoroughly tested to operate with SQL Server, but also that these products can complement the features of SQL Server 2012 and thereby optimize the investments made by IT users in the latest version of the Microsoft database. Just as crucial as the joint technologies is the cumulative, long-term investment in consulting services and integrated support made by both EMC and Microsoft.

Without having this brief paper become a lengthy diatribe on every EMC feature and capability, here is a selection of some relevant EMC offerings that can specifically address SQL Server needs:

- **VNX:** The EMC VNX Series consists of “high-performing unified storage with unsurpassed simplicity and efficiency, optimized for virtual applications.” VNX can help meet the requirements to reduce cost and complexity while providing the power and flexibility to meet the demands of virtualization, especially when combined with FAST Cache—which extends the system memory with flash drives for real-time performance improvements—and FAST VP (see below for more explanation of both these tools). SQL Server workloads can be set up quickly—in up to 80% less time—by using the automatic tuning and configuration available with the VNX platform. Compared with some other storage solutions, VNX can run a SQL Server workload three times faster. And when using an all-flash-drive option (which may be particularly well suited to a heavily loaded OLTP workload), users can obtain ten times the performance for only one-eighth the cost per TPM (transactions per minute) of an equivalent system with all HDD drives. For workloads centered on data warehousing, EMC has created specific configurations ideal for SQL Server. EMC has tested SQL Server extensively on VNX systems, and as a result, it is included in Microsoft’s SQL Server Fast Track Data Warehouse Reference Architectures.

- **Symmetrix VMAXe:** VMAXe provides “cost-effective multi-controller scale-out architecture, proven VMAX innovation, and market-leading efficiency.” VMAXe was only introduced in 2011, yet it has a great pedigree, being built on 20 years of Symmetrix technology. Symmetrix VMAXe provides very high levels of reliability and scalability with its modular architecture (providing seamless growth for SQL Server infrastructures) and 100% uptime availability guarantees (even when upgrading a controller), which maximizes the quality of service. VMAXe is designed so that initial installation and provisioning of the first terabytes of usable storage can be accomplished in less than four hours, not days or weeks. After the initial setup, VMAXe uses virtual provisioning, which allows another TB of data to be provisioned in only about four minutes. Data is automatically moved to the right level of storage (flash, SATA, FC drives), using FAST VP (see below), which according to EMC’s figures can yield up to 40% performance improvement with 40% lower cost (while the precise statistical interpretation of these numbers can vary, the point is that significant efficiency gains are to be expected). This is the product for large, complex, mission-critical SQL Server environments. And it is a perfect complementary product as users migrate their SQL Server environments to tier-1 data centers.

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5 [http://www.emc.com/storage/symmetrix/symmetrix.htm](http://www.emc.com/storage/symmetrix/symmetrix.htm)
- **FAST VP, FAST Cache, VFCache**: Helping improve SQL Server 2012 performance and reduce costs, three innovative technologies from EMC leverage flash technology to improve TPM, IOPS, and response time, while minimizing the performance-tuning efforts required of SQL Server DBAs:
  - Fully Automated Storage Tiering for Virtual Pools (FAST VP) is automation software that puts the right data on the right storage at the right time. In terms of applicability to SQL Server, this is what drives and balances performance with economic efficiency. The software is based on accurately understanding user environments—an effort that involved more than 30 PhDs, hundreds of customers, more than 4,000 applications’ access to information, almost one million volumes of information, more than 2 PB of customer statistics, and more than 54 billion I/O transactions. The result of all this engineering and analysis is FAST VP, a software tool that makes the storage platform stand up and dance, maximizing performance while keeping costs in check. FAST VP is deployed with both EMC VNX and Symmetrix VMAXe. FAST VP allows various types of data to be automatically placed on the most appropriate type of storage, ensuring that the “hot” data in the SQL Server database is kept on flash storage, while data that is not used frequently is stored on lower-cost media.
  - FAST Cache is a storage performance optimization feature that provides immediate access to frequently accessed data. FAST Cache complements FAST VP by automatically absorbing unpredicted spikes in application workloads. FAST Cache uses enterprise flash drives to extend existing cache capacities up to 2 TB. FAST Cache monitors incoming I/O for access frequency and automatically copies the most frequently accessed data from the backend spinning disk drives to the cache. It is simple to configure, easy to monitor, and able to deliver a significant performance increase for all SQL Server read and write workloads.
  - EMC’s new VFCache is a server flash caching solution. It uses intelligent caching software and PCIe flash technology to reduce latency and increase throughput to dramatically improve SQL Server performance. The caching optimization within VFCache automatically adapts to changing SQL Server workloads by determining what data is most frequently referenced and promoting it to the server flash cache. The result is that the “hottest” data automatically resides on the PCIe card in the server, providing significantly faster response time to the request from the SQL Server database.

- **Backup and Deduplication**: Many customers are moving away from traditional tape-based backup toward backup to disks. EMC offers a wide range of backup tools to accommodate various approaches. It is also a market leader in deduplication, which can—depending on various factors including retention time—reduce the amount of data storage required by 10X to 30X on average, reduce the replication bandwidth required by up to 99%, reduce volume of data moved by up to 95%, and reduce the CPU load by up to 80%. As SQL Server 2012 environments are deployed, IT organizations should evaluate their backup frequency, SLAs, and data-change rates to determine if deduplication could positively affect their backup and recovery times as well as long-term storage costs. From the perspective of a SQL Server DBA, deduplication seamlessly integrates into the existing backup methodologies that they are already familiar with today.
  - EMC backup and recovery solutions include EMC’s Data Domain deduplication storage systems, which scale from less than 40 TB to more than 28 PB of logical capacity. Data Domain systems can integrate directly with SQL Server as a disk backup target or through backup software, including EMC Avamar or EMC NetWorker. EMC Avamar is a deduplication backup software and system optimized to backup virtual machines, remote offices, NAS systems, and laptops. Avamar integrates into SQL Server by using an Avamar agent on the SQL Server, which ensures application-consistent backups and recoveries. EMC NetWorker is EMC’s unified backup and recovery software that leverages Microsoft’s Volume Shadow Copy Service (VSS) framework to provide protection for all Microsoft applications, including SQL Server. NetWorker is tightly integrated with Avamar and Data Domain, while it also supports long-term retention requirements with backup to tape.
**From Faster Recovery to Active-Active Availability:** With SQL Server becoming pervasive, ensuring fast recovery is a key requirement for most IT organizations. EMC offers advanced recovery solutions that permit cross-database application consistency as well as active-active availability.

- **EMC RecoverPoint:** Integrates with SQL Server for industrial-strength application protection in both physical and virtual deployments. It provides intelligent, dynamic synchronous and asynchronous replication for maximum availability and has advanced bandwidth-reduction technology—and integrated WAN deduplication—to make the most of the available bandwidth. RecoverPoint provides “DVR-like” recovery of replicated data to any point in time—and automated recovery of SQL Server to any event in time. It supports federated applications for cloud deployments and is available with a cluster enabler option for use with Microsoft clusters.

- **VPLEX:** Many SQL Server 2012 users are global in nature. Optimizing the utilization of IT resources is crucial, yet traditional options—such as migrating applications—are labor intensive and fraught with the risk of lost productivity, data, or even revenue. VPLEX is a high-end storage federation tool that enables HA and continuous availability across distance and across heterogeneous storage platforms. Neither data center walls nor vendor choices need to be limitations to providing seamless uptime and transactional integrity as SQL Server instances move or are accessed across infrastructure, time zones, or data centers.

**EMC Consulting:** Something of a hidden gem, EMC Consulting helps organizations manage their complex issues of information management by providing not only business insights and guidance, but also custom code development when needed, data warehousing advice and services, and analytics. EMC Consulting can also provide assistance to customers migrating to SQL Server 2012 from Oracle, DB2, Sybase, or previous versions of Microsoft SQL Server. Naturally, EMC Consulting can also recommend optimum uses for EMC’s wide range of capabilities. Perhaps this could mean taking advantage of Accelerated Microsoft Data Protection (EMC offers tools for advanced non-disruptive business continuity and disaster recovery across virtual machines, be they VMware or Hyper-V environments). Or it might be implementing the use of snapshots optimally to produce clones of SQL Server workloads and enable easy, fast copies of real-world data that DBAs can use in a variety of ways, such as testing and development.

**EMC and Microsoft:** The extent and depth of inter-company relationships (especially with industry giants like Microsoft and EMC) can sometimes be taken for granted. But it should not be overlooked. While everyone claims to be a BFF (“best friend forever”) with popular partners such as Microsoft, the facts and numbers do the talking better than mere assertions. EMC is a Global Alliance Partner of Microsoft. It has more than 19 Microsoft Gold and Silver Certified Partner Competencies. And it has been recognized as Microsoft “Partner of the Year” an impressive 21 times. Naturally, many EMC consultants are certified as Microsoft MVPs, MCPs, and Certified Architects. Of more importance to SQL Server users, EMC Consulting has completed hundreds of SQL Server engagements, including award-winning user experience designs. The two vendors have been jointly engineering and testing their products for years (including interoperability, management links, and certifications of EMC hardware, software, and support services for SQL Server 2012).

The bottom line is that SQL Server is an aggressive application when it comes to the demands it can place upon storage. EMC’s abilities—and its suitability—for the SQL Server world are centered in its breadth (both in terms of scalable products and varied, advanced features) and its depth (in terms of support and consulting capabilities, and the corporate relationship with Microsoft).

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6 RecoverPoint also works with Microsoft Exchange and other applications. This paper’s focus is SQL Server only.
ESG Lab Experience with an EMC/SQL Server Combination

The Microsoft adCenter business intelligence infrastructure is a great example of the combined value of Microsoft SQL Server and EMC storage. EMC Symmetrix and Microsoft SQL Server 2008 have been used to create the massively scalable foundation for the Microsoft adCenter Business Intelligence (BI) platform. The adCenter platform, which in 2009 delivered $1.9 billion in online advertising revenue\(^7\) from Microsoft and partner properties (e.g., Bing and MSN), was upgraded to accommodate a massive wave of new growth as Yahoo search and online advertising began moving to the platform in 2010.

ESG Lab visited with the adCenter BI team in Bellevue, Washington. Interviews with Microsoft and EMC employees were used to assess the extreme scalability of the adCenter BI infrastructure. In an in-depth audit,\(^8\) ESG Lab confirmed that the combination of Microsoft SQL Server and EMC Symmetrix can handle this massive project, its enormous growth, and its stringent service-level requirements on a moment-to-moment basis. Wrapping SQL Server and EMC Symmetrix technology in tier-1 processes and procedures, the Microsoft adCenter team has created a BI infrastructure with tier-1 uptime and performance. They enabled the platform to take on Yahoo’s advertising, continued to support 30% annual growth, and managed to reduce the total cost of the storage infrastructure by 69% over five years.

ESG Lab Vice President Brian Garrett, who audited the adCenter BI infrastructure, said he is “confident that the adCenter BI infrastructure will be even faster and more reliable with SQL Server 2012.”

\(^7\) Source: Microsoft 10K, July 2010.
\(^8\) Source: ESG Lab Report, Microsoft adCenter Business Intelligence Infrastructure: Powered by EMC Symmetrix VMAX and Microsoft SQL Server 2008, November 2010.
The Bigger Truth

A long conclusion here would do a disservice to three very simple points.

First, the new and growing abilities of SQL Server 2012 will drive value for users as long as the storage infrastructure has the flexibility and advanced functions to adequately support the dynamic needs of this application.

Second, this means that it is absolutely crucial for IT organizations to consider storage when planning and implementing SQL Server 2012, not to leave it as an afterthought or assumption.

Third, EMC offers market-leading technologies, products, services, consulting, and support that not only can support SQL Server 2012, but also can help it deliver enhanced value in terms of quality of service and economic efficiency.