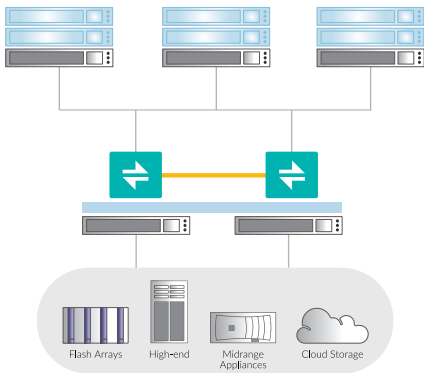


Windows Server®

The Ideal Platform for DataCore™ Storage Virtualization Software



DataCore SANsymphony™

Why Windows?

Curious why we didn't choose some open source kernel or Linux-derivative to host our storage hypervisor?

Learn the technical and commercial reasons that drove DataCore to select Windows as the underlying operating system for its SANsymphony™ product line.

It's all explained here.

Validated by Commercial Success

The resiliency, performance and cost-effectiveness of applications are governed in large part by the platform on which they are deployed. That holds particularly true for large-scale storage virtualization software – arguably one of the most mission critical systems under IT's purview.

The design team at DataCore deliberated numerous tradeoffs when selecting the operating system (OS) platform for the SANsymphony product line. They ultimately chose to use Windows Servers on standard x86 machines as their foundation. This white paper examines the rationale behind that calculated decision and validates the choice with undeniable evidence of commercial success over the past decade.

Firmware Ruled Out

Designers of custom storage and networking devices have historically written proprietary firmware to control all aspects of the underlying hardware. Whether monolithic or distributed, these firmware implementations are prone to a type of undetectable programming error known as stray pointers. Without the supervision of an operating system, these designs have no way to prevent one firmware program from unintentionally overwriting memory addresses that affect other modules.

Stray pointers account for many unpublished data corruption incidents encountered in high-end hardware appliances. The likelihood of many such errors occurring somewhere in millions of lines of firmware code is shockingly high. What's worse, no amount of testing can ensure they've been discovered. Usually the culprit is never found even after much irreparable damage has been done to a customer's data.

Windows' Memory Management Catches Hidden Programming Errors

DataCore, on the other hand, takes advantage of built-in memory segmentation in Windows to prevent programming errors from addressing space outside their range. Any such errors are immediately detected and stopped by the operating system. The origin can be traced and corrected to prevent it from causing any damage. This is a key benefit of having a robust commercial OS acting as an untiring traffic cop.

In addition, DataCore engineers can take advantage of modern development tools and high-level languages available for Windows to substantially reduce the lines of code written. Such tools dramatically reduce the incidence and consequences of programming errors. As a result, SANsymphony software can be statistically proven to be more reliable than the firmware that other vendors implicitly trust.

Other Operating Systems Lack Critical Control over Real-Time Behavior

Some are curious why DataCore picked Microsoft Windows over one of the many UNIX or Linux variants. Given that all of these commercial operating systems offer similar memory management features and development tools, using a Linux offshoot, for example, would potentially provide a cheaper platform.

On the face of it, UNIX and Linux were the natural first choices for DataCore. The principal architect, one of the company's founders, is referenced in the literature as an authority on UNIX multi-threading. Other members of the design team include UNIX kernel developers. Many earned their stripes writing proprietary operating systems for high-fidelity military flight simulators and nuclear power plant controllers.

However, the team's first-hand experiences in trying to adapt multi-processing UNIX and its derivatives to closely-coupled storage subsystems had earlier revealed a key shortcoming: Commercial UNIX and Linux operating systems lack deterministic interrupt processing.

In other words, standard distributions of UNIX and Linux cannot ensure that a given code sequence will complete in a predictable and consistent time window on the order of a few microseconds. While this is not an issue for time-sharing applications and system management products whose response time is measured in minutes and seconds, DataCore recognized it as a critical limitation for real-time processes necessary in enterprise-class storage virtualization.

The lack of determinism explains why storage appliances running on off-the-shelf UNIX or Linux kernels suffer from poor and erratic performance. Despite their reliance on considerably more expensive hardware, these UNIX/Linux products are unable to achieve the extraordinary response and throughput provided by DataCore products.

Proprietary Real-Time OS Adaptations Violate 3rd Party Qualifications

The vendor must accept responsibility for maintaining and supporting its proprietary UNIX or Linux variant – which eliminates any benefits from standardization.

Though suppliers might claim to use a particular base OS, their custom modifications invalidate all software and hardware qualifications against the original OS version.

These suppliers find themselves weighed down with the monumental task of re-qualifying hardware and software additions. Which in turn forces them to devote a large number of people and numerous person-years to retesting. Invariably, the added burden delays their time to market, increases their R&D costs and prevents them from incorporating bug fixes and security patches available from the latest commercial updates. Their proprietary OS version rapidly becomes obsolete, as does their choice of compatible hardware.

Windows Offers Determinism & Compatibility

Windows on the other hand, provides deterministic interrupt processing in its micro-kernel. This unique property allows DataCore to plug in its low-latency, feature-rich, I/O stack without modifying the base operating system.

By prioritizing the execution of the storage virtualization stack ahead of background services, DataCore can poll I/O channels for inputs, and use on-board RAM as inexpensive high-speed cache to eliminate unpredictable I/O processing delays.

These traits enable DataCore to achieve ten times more throughput than other products running on similarly-equipped servers.

As importantly, the clean Windows application programming interfaces (APIs) make it practical to develop storage virtualization modules that maintain hardware and software compatibility with the complete spectrum of qualified devices and applications from 3rd parties. Strictly adhering to the Windows conventions ensures that DataCore software stays current with new technology without any extra effort, fully leveraging the development and qualifications of other best-of-breed hardware and software suppliers.

Precautions Ensure a Tightly Controlled Robust Environment

While no one can guarantee that operating systems won't fail, DataCore and its customers employ several measures to minimize the occurrence of such incidents.

Some actions are controlled by DataCore software, while others fall under the realm of IT best practices. All take the perspective that SANsymphony executes in dedicated nodes or virtual machines, specially configured for storage virtualization, without exposure to potentially misbehaved applications.

For example, SANsymphony creates a controlled and compartmented environment by executing as a well-behaved I/O stack layered on top of the Windows micro-kernel. The core software reserves processor, memory and I/O resources for the exclusive purpose of providing dependable target disk emulation and value-added block I/O storage virtualization services. Essentially, the same loop of code runs repetitively much like a virtual machine inside the OS shell. Windows merely serves as a convenient host for the administrative GUI, as well as the conduit for standard IP networking services between collaborating SANsymphony nodes.

Standard operating procedures dictate that no user applications or unqualified third-party device drivers are permitted on the SANsymphony address space. Avoiding unknown interactions between variables eliminates the root cause behind most OS panics. This precaution alone sidesteps numerous instability issues seen in the general-purpose use of popular operating systems.

Security and Virus Protection

DataCore customers also employ prudent, security-conscious best practices to physically isolate their Windows-based nodes from virus assaults and other security threats.

Just like any mission critical resource, customers take practical steps to keep their SANsymphony nodes away from untrusted Internet or e-mail services.*

Of course, DataCore storage virtualization nodes may be serving disk blocks over Fibre Channel or iSCSI to web servers and e-mail servers subject to virus attacks. In these cases, the pooled disk drives could potentially house a virus or worm. To shield against contamination and other potential security concerns, SANsymphony prevents the underlying OS from accessing the disk drives or any executable programs stored there.

* Contact DataCore's service and support organization for more explicit security recommendations.

Network Design: More Resilient Than Its Parts

While throughout this paper we've focused on the rationale for selecting Windows, DataCore's end-to-end design criteria goes much further:

No single component of the storage infrastructure can possibly be trusted to be bulletproof. Failure to acknowledge this simple fact would be foolish.

Storage networks are made up of many parts constantly in flux: some failing, new ones being added, still others being decommissioned. Turmoil is the norm, not the exception. With this in mind, SANsymphony configurations account for equipment that goes down unexpectedly or intentionally for periodic software updates, hardware upgrades, maintenance and facility outages.

The software architecture is designed to insulate applications from this chaos, removing all single points of failure and disruptions while continually providing access to data despite planned and unplanned outages.

Grid of Loosely Coupled Redundant Nodes

DataCore solutions make use of path, platform and block level replication to eliminate all single points of failure.

They employ a loosely coupled asynchronous grid. The network design is borrowed from the telecommunications industry, where it has been successfully applied to large-scale, highly distributed voice and data networks for many years. Redundant paths from applications through the infrastructure (FC or iSCSI) ensure that critical data is accessible over alternate routes should the primary connection be disrupted for any reason.

Redundant Windows-based storage virtualization nodes take over for each other in the event of an outage. Yet the nodes do not incur the synchronization overhead or the scalability constraints necessary to keep server clusters in lock step.

Nevertheless, SANsymphony provides its comprehensive set of enhanced storage services to servers and applications in clustered configurations. Our loosely coupled approach is by definition more highly available, less complex, and much more economical than trying to bolster the reliability of any one device or attempting to closely tie a pair of them together.

Nodal independence and loose inter-node cooperation form the foundation for SANsymphony software. This approach brings high-availability, unmatched performance and optimum scalability at the lowest cost.

A long list of satisfied customers using DataCore solutions over the past 15 years can attest to these benefits. They range from very large Enterprises responsible for multiple petabytes of storage to more modest SMB environments with just a few terabytes of capacity.

Other Distinguishing Attributes

Like many successful Independent Software Vendors (ISVs), DataCore finds the Windows platform attractive on several other fronts. Many of the operating system's characteristics translate into a fabulous value proposition for both our end-users and our integration / OEM partners.

As a proven commercial environment that ships in huge volumes, the Windows platform provides rapid time-to-market and numerous price point advantages. Its familiar look-and-feel makes it easy for storage administrators to quickly be effective with very little training.

Perhaps most significantly, the benefits of the Windows platform are enduring:

- It's not locked into a proprietary hardware platform. DataCore customers get to choose from a wide range of physical and virtual server configurations available from numerous trusted suppliers.
- Windows is first to market with support for all the latest, best-of-breed and relatively inexpensive hardware.

- The large installed Windows Server base persuades hardware manufacturers to qualify their storage subsystems, host-bus adapters, switches and network interface cards on Windows first, freeing DataCore from such cost and responsibility while allowing us to concentrate on innovating within our core competencies.
- There is a wealth of 3rd party software to further enhance manageability.
- Windows-based servers consistently offer the best price-performance, while the massive consumer market ensures that they sustain that lead.

Even if DataCore ceased development today, SANsymphony customers would enjoy faster storage virtualization performance just by non-disruptively migrating their software to next year's more powerful and more cost-effective Windows-based servers. These are all lasting benefits that purpose-built appliances can never offer.

From an IT operations and business perspective, SANsymphony software leverages Windows Server for competitive advantage by offering:

- Freedom to choose from a variety of hardware suppliers during acquisition and upgrades (no hardware lock-in)
- Successive generations of higher speed, lower cost equipment from which to virtualize, consolidate and automate their storage infrastructure
- Reduced Total Cost of Ownership (TCO) arising from the use of standard off-the-shelf servers as storage virtualization nodes.

Applications Benefit from Performance Boost

It may surprise a few of you to find that as early as 2004, DataCore achieved well over 400,000 I/Os per second (IOPS) and more than 2 GB/sec throughput on just two inexpensive dual-processor nodes.

The performance figures continue to climb as the software taps the power of increasingly faster servers arriving regularly on the market.

With DataCore's N+1 redundant, grid architecture, throughput and IOPS scale out linearly as SANsymphony-nodes are added to expand the storage infrastructure for ever growing workloads.

Peace of Mind

At the end of the day, personal experiences and those of trusted colleagues often provide the most comfortable basis for decision-making. Simply consider the broad spectrum of enterprise organizations using DataCore software. They operate continuously around the clock on redundant networks of Windows-based nodes to virtualize, consolidate and control very large heterogeneous storage pools.

Applications in their data centers don't have to be taken down for storage infrastructure maintenance or unplanned facility repairs.

These customers span all the major vertical sectors including healthcare, financial services, government, manufacturing and telecommunications. They host mission-critical line of business applications in conjunction with popular packages like Oracle, SAP, Microsoft SQL Server, Exchange and SharePoint. Their environments often include mixtures of UNIX, Linux, MacOS, and Windows servers; some physical, many virtual, using VMware, Citrix and Microsoft Hyper-V.

Rationale Reaffirmed

You now know the technical and commercial reasons why DataCore chose Windows Server 2012 as the O.S. platform for our SANsymphony software. You can also better appreciate why other open source and Linux-alternatives were ruled out.

The operational and financial value of these careful and purposeful design choices continue to be reaffirmed by the thousands of new customer implementations rolled out every year. The combination of Microsoft OS, DataCore software and interchangeable hardware has proven to yield the highest availability, superior performance, and optimal utilization of storage resources for modern data centers, whether on-premises or in the Cloud.

For additional information, please visit datacore.com or email info@datacore.com

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