

Micron Elevates the Cloud: Why the Right Flash Solutions Matter



Introduction

The concept of cloud computing has been around for a while now. As the concept of centralized compute, storage and/or applications offered as a service has become more acceptable in the IT community, more and more companies have adopted the cloud as part of their overall IT strategy. A myriad of cloud providers offers everything from simple email application services to comprehensive infrastructures as a service (IaaS), consisting of compute and storage services, along with all of the “glue” that is required to connect to, manage, and fully utilize that infrastructure, such as networking, domain management, backup-and-recovery, etc. These services free up businesses from having to size, justify, procure, and deploy IT hardware; rent/purchase and build out complex data centers to host this hardware; and hire potentially expensive IT staff to manage it. Cloud service providers can perform some or all of these services for a simple monthly service fee.

Even so, some businesses may not be able to take full advantage of a holistic off-premises cloud for a variety of reasons. Fortunately, alternatives exist to the traditional off-premises cloud paradigm: on-premises clouds and hybrid clouds. Both of these paradigms include an on-premises, internally managed infrastructure component while, at the same time, the operations of each infrastructure mirror the cloud service provider model, offering and billing IT services (applications, storage capacity, compute functions, etc.) on an “as-consumed” basis rather than building out dedicated infrastructures for specific departments or functions.

As the names imply, on-premises clouds typically mirror what the big cloud providers offer but are hosted in, and managed by, internal resources; and hybrid clouds are simply a combination of both an on-premises and off-premises set of services. The former is great for larger companies that have a major investment in data center space and human resources expertise for the applications that they use. The latter is great for smaller companies or those companies whose IT infrastructure (typically a small part) has regulatory restrictions that preclude them from using a public cloud, but whose non-regulated or non-mission-critical data can still take advantage of the potential cost savings of leveraging external services.

Micron, as a leading memory and storage solution provider, offers extraordinary value to today's cloud computing infrastructures. Our storage and memory solutions enable faster, scalable, cost-efficient IT for public (off-premises), private (on-premises) and hybrid cloud models, accelerating and redefining the workload experience of multi-tenant environments.

In support of this, Micron is invested in helping customers understand the storage and memory technologies used within the cloud and their potential impact on cloud solutions. As a major technology supplier for many of the largest cloud service providers, we're delivering the robust product features that industry-leaders require. At the same time, we also want customers who have on-premises or hybrid cloud infrastructures to understand how our storage and memory technologies can affect their internal cloud solutions. Whether customers are experiencing the benefits of our products through their cloud service provider or directly from their own on-premises or hybrid cloud infrastructures, the value-add is significant. This paper focuses specifically on Micron products used within the latter two environments.

Top Three Challenges of the Cloud

Integration

One of the primary challenges that customers face when they decide to implement a cloud strategy is how to tie their existing application and server infrastructure with the cloud. Moving incrementally is the typical strategy for upgrading to a cloud-based infrastructure.

First, virtualize existing application servers while still using legacy supporting services for storage and networking. Then create a private, on-premises cloud infrastructure that provides a complete "infrastructure as a service" implementation model using a more comprehensive hyper-converged infrastructure (HCI) solution such as VMWare® vSAN, Microsoft® Hyper-V, or open source Linux-based KVM®, with an integrated software-defined storage implementation to host all of the data and provide virtual networking services. Once the on-premises infrastructure is virtualized, it is much easier to integrate with external cloud service providers using cloud gateway tools (typically provided by the cloud provider) to connect the on-premises infrastructure to the off-premises cloud provider's services. This allows customers to selectively move virtual servers between local and remote infrastructures as desired (Figure 1).

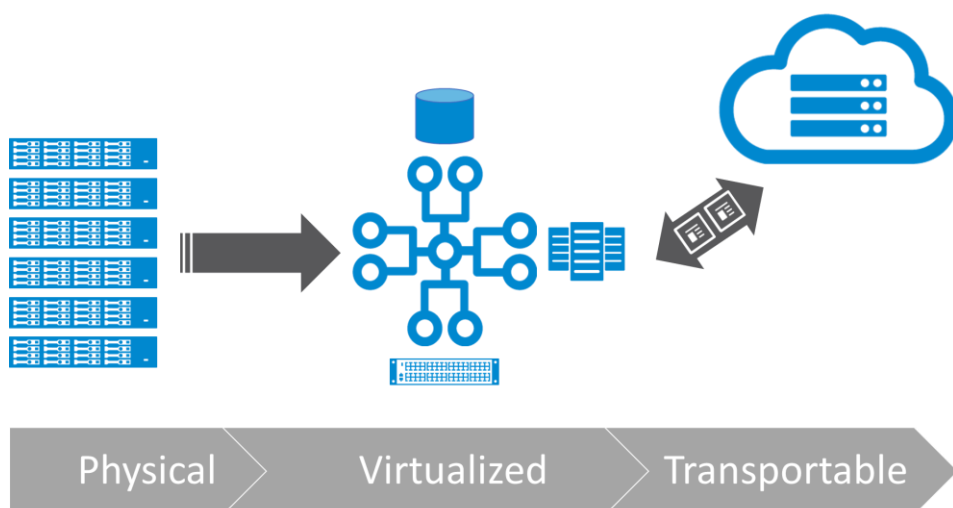


Figure 1: Overview of Migration to Cloud

Micron Suggests: When considering a virtualized infrastructure strategy, the components you select for your deployment have a direct impact on your success. High-performance servers, storage and memory are key to creating a scalable infrastructure that grows with your on-premises needs. Micron's extensive work investigating virtualized infrastructure environments has given us a wealth of information that can help you design and build out a high-performing, converged, virtual infrastructure. Working closely with virtualization software providers in the ecosystem such as VMWare, Microsoft and Redhat, we created a series of reference architectures (RAs) that demonstrate the value of our memory and storage components. Each Micron RA provides instructions for building and optimizing the solution, along with test results from our labs showing you what to expect when you deploy similar solutions on your hardware. Flexible "x86"-based reference architectures do not commit you to any one server vendor; rather, the focus is on the value of the components — processor, memory and storage — to the solution.

For instance, Micron's VMware vSAN accelerated solutions using vSAN 6.7 target a configuration based on VMware's AF-6 (All Flash) specification. (See VMware's [website](#)¹ for details on vSAN Ready Nodes.) Results show that a 4-node cluster based on this server design can produce over 50,000 I/Os per second (IOPS) per node using an all-SATA SSD storage configuration while cutting total cost of ownership by 50% versus a physical server solution through consolidation. The results of our 4-node cluster testing showed a typical 70% read workload resulted in over 300,000 IOPS. Learn more in our [Micron Accelerated All-Flash SATA vSAN™ Reference Architecture](#),² which details the complete configuration, platform and disk group configuration, software tuning, performance measurements and deployment.

Likewise, our accelerated solutions for Microsoft Hyper-V and Storage Spaces Direct are powered by fast Micron NVMe™ and SATA enterprise SSDs and Micron DRAM memory. Our reference architecture provides specific configuration and optimization recommendations for deploying NVMe cache to maximize performance, along with SATA read-intensive SSDs for capacity. The result: small block random I/O performance of up to 1.5 million IOPS for read-intensive virtualized solutions and a 62% decrease in storage latency (Figure 2) for 99.99% of all read/write transactions relative to a similar solution without NVMe cache.³ Learn more in our [Hyper-V with Storage Spaces Direct Reference Architecture](#),⁴ which details the complete configuration, platform and disk group configuration, software tuning, performance measurements and deployment. (See Figure 3.)

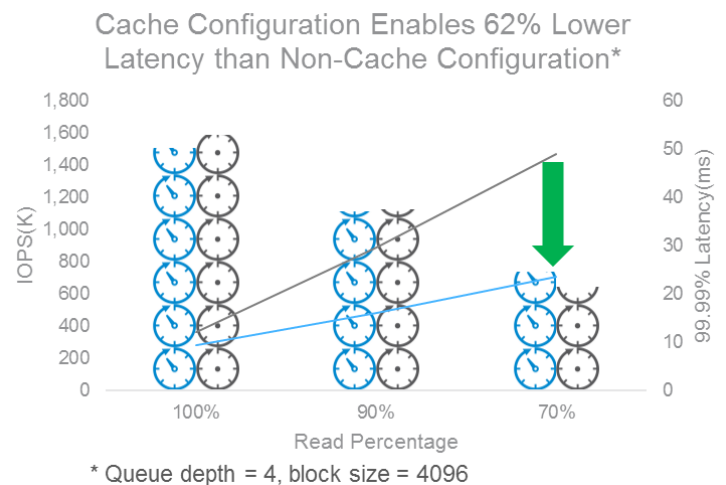


Figure 2: Hyper-V + Storage Spaces Direct Benefits from NVMe Cache

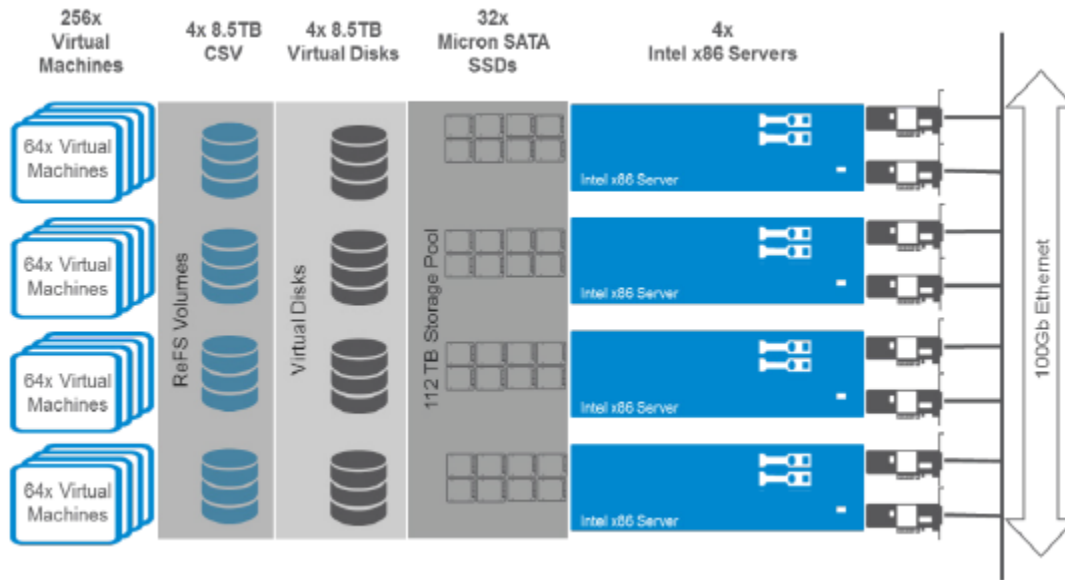


Figure 3: Micron's Hyperconverged Infrastructure (HCI) Reference Architecture With Microsoft's Hyper-V and Storage Spaces Direct

The net result of both of these reference architectures is an ultra-fast infrastructure designed specifically for hosting virtualized solutions that are typically used for on-premises cloud implementations. For hybrid computing environments, major cloud providers offer integrated tools that automate management of workloads — applications and virtual servers — between local on-premises and off-premises infrastructures. This can support on-demand scaling of applications during peak workload periods, enabling you to manage a smaller on-premises infrastructure.

Performance

More efficient utilization of your on-premises resources is one of the primary benefits of a cloud-based infrastructure, but this raises many concerns about overall performance as you start sharing these resources. Moving less critical services to off-premises clouds can alleviate some of this, but, depending on your business needs, you may have several mission-critical services that must remain on-premises. This will be especially true if you must stay in compliance for regulated data and applications that access that data. A high-performance on-premises virtual infrastructure, along with a high-performance storage solution, are critical.

Having access to test results and benchmarking helps mitigate these concerns. Micron's extensive investigation into technologies that enable the cloud, such as software-defined storage and HCI solutions, and our deep understanding of memory and flash technology ensure that we can help you create optimized solutions based on these foundational cloud technologies.



Persistent memory is a new offering that combines ultra-low latency and high bandwidth. Placing nonvolatile, fast memory closer to the processor bridges the gap between DRAM and storage. Using Micron NVDIMMs provides performance and data security for a wide range of enterprise-class server and storage applications often found in on- and off-premises cloud implementations. Even virtualized servers with VMware vSphere can now use persistent memory (“PMEM”). If you’re deploying big data analytics, online transaction processing or in-memory databases on a cloud infrastructure, be sure to find out about the benefits and TCO of our [persistent memory](#).⁵

Micron Suggests: Software-defined storage (SDS) is the new “storage area network” that replaces the custom-designed and custom-built, monolithic, centralized storage array model with a cloud-ready, scale-out storage solution that is built on common, off-the-shelf server technology. This scale-out model has proven its value in highly flexible solutions such as cloud, real-time analytics and traditional application services like database, messaging, and file storage and archival solutions. Our [Redhat® CEPH-Based SDS Reference Architecture](#)⁶ demonstrates that open source solutions can be performant and easily managed and scaled. A 4-node reference cluster easily generates over 2.1 million IOPS with QoS latency of only 250ms using our 9200 NVMe family of SSDs and Micron advanced DRAM.⁷

Micron has also built SDS reference architectures based on other, closed-source solutions as well:

- [Microsoft Storage Spaces Direct](#)⁷ is a native software-defined storage solution that can be used as either a disaggregated storage area network solution or as a distributed compute/storage infrastructure, along with Microsoft Hyper-V with Microsoft Azure® cloud services.
- [VMware vSAN](#)⁸ is primarily used to support VMware’s ESX as a hyperconverged infrastructure solution.
- [Excelero NVMesh](#)⁹ provides scale-out storage services for Linux application servers using the new NVMe over Fabric storage protocol to support the connection and sharing of NVMe SSDs across a networking infrastructure such as Ethernet or Fibre Channel.

Each of these reference architectures demonstrates that SSDs provide a high-performance storage solution with results reaching hundreds of thousands to millions of IOPS.

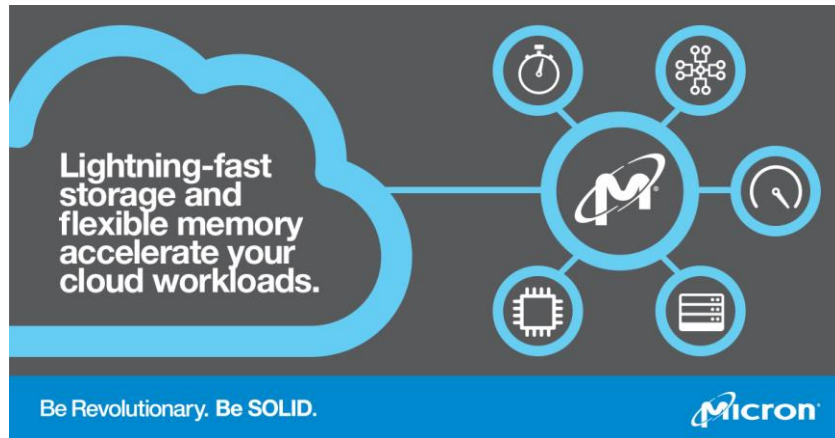
Security

Security is another major concern, some say the top concern, for businesses looking to implement a cloud strategy. Whether you’re moving internal data and applications to an external cloud or ensuring that your on-premises cloud is secure from outside inspection, the storage solution needs to ensure that your data is safe. Today’s advanced server technology supports a variety of physical security options, such as secure boot, software- and hardware-based data-at-rest encryption and root certificate in chain of trust that can use physically stored and immutable keys to determine whether devices of all types, including HDDs or SSDs, have been tampered with and even whether the server’s BIOS has been altered.

Micron’s [Authenta™ technology](#)¹⁰ (available soon) combines a unique device-specific identity that only a hardware root of trust can provide and the measurement capability necessary for in-memory authentication of critical code and data. It will also enable device- or firmware-specific identities necessary for silicon-to-cloud service enablements — whether in the cloud, at the edge or on the device. Authenta technology’s cryptographic identity capability, combined with Microsoft’s Azure Device Positioning Service (DPS) (as one example) will help ensure that only trusted devices gain access to the Azure IoT cloud platform.

Micron Suggests: In addition to the upcoming flash memory products enabled with Authenta Technology, the technology industry is working to support multiple types of security features to add defense in depth to all solutions. Micron’s enterprise-class SSDs support industry standards-based Trusted Computing Group-Enterprise (TCG-E).¹¹ In addition, SSDs provide an on-device function to securely erase SSDs in support of reprovisioning drives for new purposes. This leaves no stray data behind and ensures your data is safe once the SSD has reached its end of life. Taken together, these features protect your data when it is read and when you are ready to replace the SSD.

See [Micron’s website](#)¹² for more information about our data security features.



Conclusion

Cloud and cloud service providers have created a major shift in IT strategy for companies of all sizes. Small businesses can run their entire infrastructure in the cloud via various service providers such as Amazon, Google, and Microsoft, among others. From email and customer relationship management, to simple file storage and archive, external cloud providers enable companies of all sizes to be more agile and take advantage of the latest technologies.

Larger business, with their many users, multiple complex applications, and stricter security concerns, may not be able to move to an external cloud provider for all of their IT needs. They must consider a hybrid strategy that encompasses both an on-premises and off-premises infrastructure and migrate from their existing IT management model to one that supports a cloud-like strategy focused on services. A good first step, if it's not already in place, is to migrate from an IT infrastructure that is managed and deployed using the monolithic server and application paradigm to one based on virtual servers and application services. Once this happens, it becomes much easier to move these software-defined entities to off-premises cloud service provider infrastructures when and how you deem suitable.

Micron provides several, state-of-the-art software/hardware reference architectures that support this on-premises cloud model with virtualized, converged infrastructures that combine virtualized compute, storage, and networking resources, as well as dedicated scale-out software-defined storage solutions for all types of application data needs. When combined with Micron's native SSD features, such as secure-boot and data-at-rest encryption, you can be sure that you will have the tools you need to create a secure, scalable internal cloud infrastructure.

For more information about these and all of Micron's products, be sure to visit micron.com or contact your Micron sales representative or channel representative.

¹ www.vmware.com/resources/compatibility/vsan_profile.html

² www.micron.com/resource-details/9bf40f56-3104-4204-ab02-39cd75474216

³ Performance is based on configuration documented in the Micron Hyper-Converged Infrastructure Using Microsoft® Hyper-V® and Storage Spaces Direct with Micron® Enterprise NVMe and SATA SSDs Reference Architecture referenced and linked in this white paper. Your workload and solution configuration may result in different performance than that documented in this brief.

⁴ www.micron.com/products/storage-platforms/micron-accelerated-solutions/micron-accelerated-solutions-for-microsoft-hyper-v-and-storage-spaces-direct

⁵ www.micron.com/resource-details/a6e983e6-bf6e-4665-8207-acee63ea6f7e

⁶ www.micron.com/products/storage-platforms/micron-accelerated-solutions/micron-accelerated-solutions-forceph-storage

⁷ Performance is based on configuration documented in the Micron RedHat® CEPH Reference Architecture referenced and linked in this white paper. Your workload and solution configuration may result in different performance than that documented in this brief.

⁸ www.micron.com/products/storage-platforms/micron-accelerated-solutions/micron-accelerated-vmware-vsan-ready-nodes

⁹ www.micron.com/products/storage-platforms/micron-accelerated-solutions/micron-accelerated-solutions-for-excelero-nvmesh

¹⁰ www.micron.com/products/advanced-solutions/authenta

¹¹ TCG-E is not available in all countries.

¹² www.micron.com/solutions/storage-data-security

micron.com

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