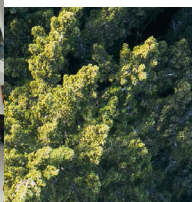


BRIEF

Consolidate
Mixed Workloads to
Deliver Predictable
Performance While
Controlling Costs





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IT Modernization and Consolidation Have Become Imperative

A typical enterprise utilizes hundreds or thousands of applications. It's the job of IT to operate all of these applications as efficiently and economically as possible. Unfortunately, 70-80% of the IT budget typically goes to day-to-day operations, leaving little budget to invest in technology innovations to move the business forward. As enterprises accelerate the pace of digital transformation, it's becoming imperative that IT teams re-think their approach to the infrastructure that supports all applications—from the most critical to the most mundane.

The dedicated silos of infrastructure used to support specialized applications add significantly to IT complexity and expense, but many IT teams are hesitant to mix critical workloads such as databases—and the ERP, CRM, and other business applications that rely on them—on infrastructure shared with other applications. As a result, silos persist, and expenses remain high.

A recent [survey of 650 IT decision makers across the globe](#) found that increasing IT operational efficiency was the number one digital transformation goal, and modernizing legacy infrastructure was cited as the most important initiative to achieve that goal. A new platform is needed to simplify operations and facilitate workload consolidation. This platform must:

- **Enable consolidation of mixed workloads**, including critical enterprise applications and databases
- **Drive down capital and operating costs**, freeing up budget for innovation

The key decision that IT teams are faced with is how to satisfy these goals while addressing the needs of different stakeholders. CIOs are interested in driving digital transformation and adopting new consumption models to control cost. Application teams want a solution that helps them meet new business demands, ensures performance, and protects availability. Storage teams must respond to growing data demands, even while budgets and staff are flat or shrinking. (See Figure 1.)

Enterprise IT teams are increasingly turning to hyper converged infrastructure (HCI) as a means to modernize legacy infrastructure, address the needs of diverse stakeholders, and enable mixed-workload consolidation. But, not every HCI architecture is the same. Only NetApp® HCI delivers the predictable performance and availability necessary to enable a high level of mixed workload consolidation, combined with the low total cost of ownership to make investment in NetApp HCI easy on your budget.

NetApp HCI Simplifies Mixed Workloads at Scale

Eliminate barriers and consolidate workloads with different needs

One of the main factors affecting your ability to support mixed workloads is the ability to deliver predictable performance and availability. When you consolidate diverse workloads on the same infrastructure, activity generated from one application can affect the performance of another. These “noisy neighbors” can slow down important workloads, leading to dissatisfied users or even loss of revenue. Quality of service (QoS), the ability to allocate and deliver a specified performance level to each workload, is absolutely essential to enable mixed workloads. Because failures have the potential to affect a large number of workloads in a mixed workload environment, infrastructure must also deliver superior availability.

Total cost of ownership is a second critical factor. If capital costs and ongoing operating expenses are too high, and you don't achieve the budget savings you were hoping for, the whole effort of modernizing and consolidating will have been beside the point. A complete cost analysis needs to factor in considerations such as management costs, service, and software licensing costs including virtualization and database licensing.

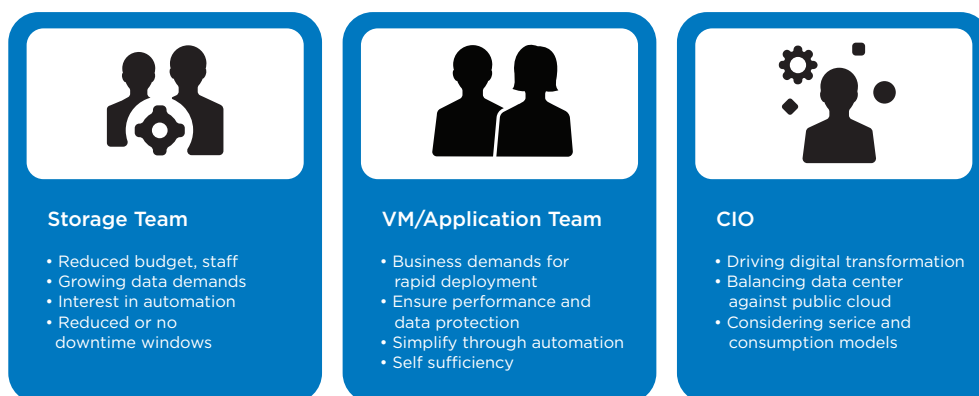


Figure 1) Different stakeholders within your IT organization all have requirements that your infrastructure must satisfy.

In addition to these factors, there are a few other things that can hamper the success of your mixed workload consolidation efforts.

- **Difficulty scaling.** Traditional infrastructure solutions can be difficult and time consuming to scale in the face of dynamic business demands, while many HCI solutions scale inefficiently and have narrow effective scaling limits.
- **Lack of cloud connectivity.** You may be looking for opportunities to move some applications to a public cloud or a service provider, as part of your consolidation efforts. Your data centers may now be a part of a larger hybrid cloud environment. Success depends on being able to interconnect on-premises and cloud activities, but usable tools to make this a reality are still in short supply.
- **Complex or unfamiliar operating environment.** It seems as if there are stories in the news every week about companies leaving data exposed in the cloud. This likely occurs not because of incompetence, but because the cloud environment is new and unfamiliar. To succeed with workload consolidation, your team needs to continue to use familiar interfaces and tools to the greatest extent possible.

NetApp HCI is an enterprise-scale hyper converged infrastructure solution designed to address these challenges and enable a far greater degree of workload consolidation than you've been able to achieve until now, including the ability to consolidate multiple demanding database environments with other applications on a single infrastructure platform. NetApp HCI (See Figure 2) integrates flexible compute options and proven all-flash storage in a turnkey scale-out solution. Independent compute and storage nodes deliver predictable performance and low TCO with flexible scaling and simple operations. Full integration with the NetApp Data Fabric facilitates cloud connectivity.

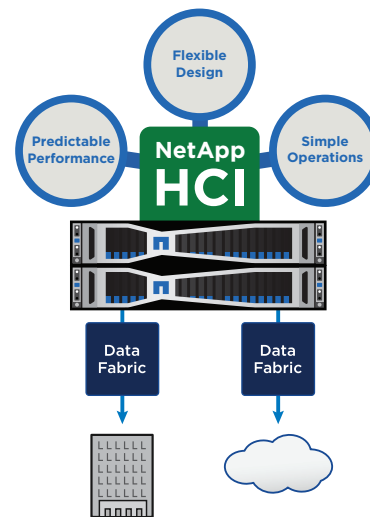


Figure 2) NetApp HCI combines a flexible, scalable design with predictable performance, automated operations, and superior cloud integration.

Predictable Performance and Availability

Guarantee the performance of every workload and protect availability with self-healing

With traditional approaches to storage infrastructure and previous approaches to HCI, mixing workloads led to inevitable slowdowns and user complaints. When you mix multiple workloads on the same infrastructure, it can be difficult to predict spikes in activity and manage performance successfully. Virtualization allows you to dedicate the necessary compute and memory resources to each workload, but I/O performance remains an issue. The only option is often to over-provision resources, moving back in the direction of the inefficient, siloed environment you were trying to escape. The consequences of hardware and software failures in these environments can result in important applications slowing down or going offline—and painful fire drills as you rush to make repairs and return everything to normal operation.

NetApp HCI Guarantees Performance

NetApp HCI eliminates these challenges. All applications see predictable I/O performance, even in the face of big unanticipated spikes in activity, increasing productivity and eliminating complaints. The unique architecture of NetApp HCI prevents noisy neighbors and runaway processes from interfering with other workloads running on the same cluster. NetApp HCI manages performance automatically, allows you to guarantee a minimum level of performance to each workload, and gives you the tools to address any performance issues instantaneously.



Figure 3) With NetApp HCI you can mix diverse workloads. Databases, traditional enterprise applications, containers and more can share the same infrastructure without interfering with one another.

With NetApp HCI you can:

- **Guarantee storage performance for each application.** With traditional storage infrastructure, the penalty for getting capacity and performance allocations wrong is complicated and time-consuming data migration or even re-architecting. NetApp HCI is ideal for mixed workloads because you can allocate capacity and performance independently for every workload and application and easily adjust allocations if needs change.
- **Automate data distribution and load balancing.** To guarantee performance, NetApp HCI balances pools of performance and capacity across the HCI cluster. Resources are provisioned to meet the needs of each volume or virtual disk with performance defined in terms of minimum, maximum, and burst characteristics. Changes to these performance and capacity policies take effect immediately without the need to move data to different storage.
- **Confidently mix workloads.** A single HCI cluster can support a mix of workloads including databases, virtual desktops, and cloud-native apps. Every application gets the performance it needs with no impact to other applications.
- **Provision storage the same way you provision virtual compute resources.** Storage resources are allocated to each individual volume, virtual volume, or virtual disk from available capacity and IOPS with no storage expertise required.
- **Address performance problems instantly.** NetApp HCI eliminates the penalty for underestimating performance requirements. You simply modify quality-of-service policies to change the settings for minimum, maximum, and burst, and the new settings take effect immediately. No storage vMotion or physical data movement is needed to change performance levels.

These capabilities are essential for a mixed workload environment operating at scale.

It's worth considering how these capabilities can be applied. Suppose you need to support one critical database, two databases of medium importance, 10 VDI superusers, 20 VDI office workers, and 5 business applications of low importance. Based on profiling your existing environment, the initial allocations might be similar to what is shown in Figure 4.

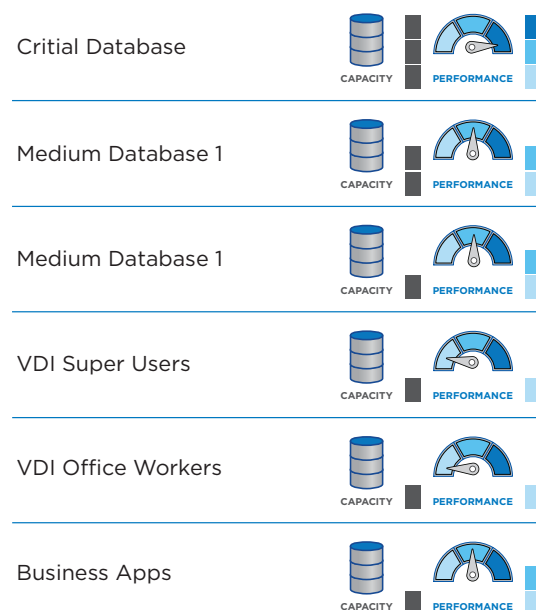


Figure 4) With NetApp HCI you can allocate capacity and performance separately and adjust those allocations instantaneously as your needs change.

Notice that capacity and performance are independent. You can have workloads with low capacity and high performance or vice versa. For a critical database, you might assign both a high minimum performance and a high burst to ensure the workload is never constrained. Less critical workloads can have tight constraints to make sure rogue applications or users never interfere with more critical work. If databases need more capacity and performance in order to run critical reports, you simply adjust the capacity and performance allocations and they take effect immediately.

NetApp HCI Protects Operations with Self-Healing

Availability is critical in mixed workload environments. NetApp HCI can absorb multiple concurrent faults without affecting application performance. Recovering from a drive or node failure takes only minutes and is fully automatic, requiring no operator intervention and eliminating the fire drills that usually occur when a component fails. NetApp HCI goes beyond conventional approaches to availability, providing self-healing from hardware and software failures.

NetApp HCI keeps two copies of every data block. Each copy is on a different storage node, providing resiliency and enabling a cluster to sustain application performance if a failure occurs. The system self-heals quickly, reducing the risk that a second failure will occur before redundancy is restored. Because nodes can go offline without disrupting operations, this also facilitates non-disruptive hardware and software upgrades.

All resources in the system are always active; there's no need to have spare drives or spare nodes sitting idle in case of failure. If a drive fails, the system automatically restores full redundancy using available free space. There's no degraded mode operation and no performance penalty during the process, which typically completes in 5 minutes or less.

All data remains accessible, even if a storage node fails, and connections are automatically redirected to other storage nodes. No matter the failure—drive, storage node, compute node, network failure, or software failure—the recovery process is quick and efficient, and no single node (or application workload) sees diminished performance.

Lower Overall TCO

Save your budget to address new priorities

Reducing day-to-day operating costs is critical to success in the digital era. To truly be successful supporting mixed workloads you need to significantly reduce costs. NetApp HCI delivers a lower cost of ownership versus competing HCI solutions.

A [recent study by the Evaluator Group](#) details how NetApp HCI delivers lower TCO versus two leading HCI competitors. The study evaluated the total cost of all three HCI systems including:

- **Acquisition cost** including per node cost at list price, VMware licensing costs, any added management software costs, cabling, and deployment.
- **Support** based on hardware and software maintenance costs for one year.
- **Overhead costs** including administration, power, and space consumption.

For cluster configurations designed to support 800, 1500, and 2500 VMs based on the [IOmark-VM workload](#), NetApp HCI demonstrates significantly lower costs versus competitors as shown in Figure 5.

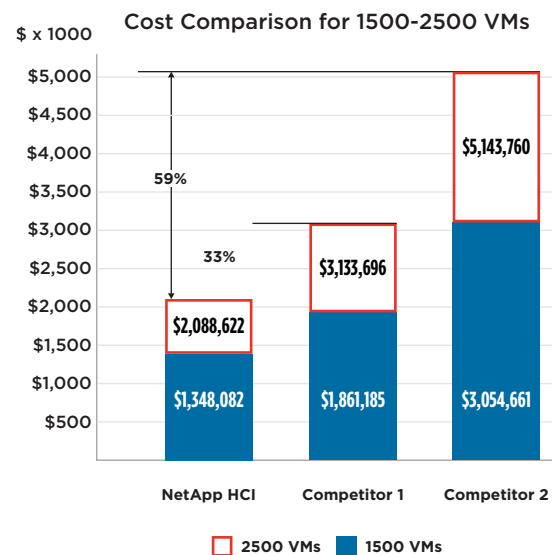
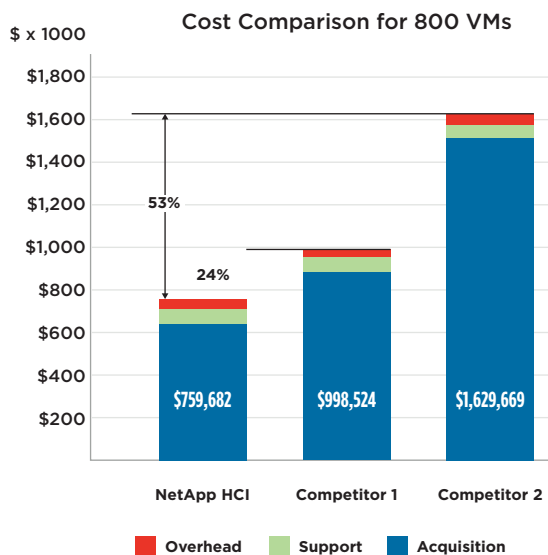


Figure 5) NetApp HCI delivers significantly lower total cost versus two leading HCI competitors.

Not only does NetApp HCI demonstrate a significant cost advantage, that cost advantage increases as VMs are added and the solution scales out. Evaluator Group identified two contributing factors:

- **Better storage performance** means the NetApp HCI cluster requires fewer storage nodes to support a given number of VMs. This, in turn, drives lower costs of acquisition and support.
- **Separate storage and compute nodes** allow NetApp HCI to take advantage of superior storage performance without stranding resources. As a result, resources are used more efficiently and fewer nodes are needed.

Several additional factors contribute to the superior TCO of NetApp HCI in real-world environments.

Reduce hypervisor and database licensing costs

Not only does separating storage from compute nodes lower costs by allowing you to use resources more efficiently, it also provides significant cost benefits when it comes to software licensing. When you have an HCI architecture that runs storage in a VM or as part of the hypervisor, part of your hypervisor licensing cost goes to pay for cores running the storage workload. If each storage VM consumes 20% of the resources on each node, you'll end up needing more nodes to meet your compute needs and pay higher hypervisor licensing costs as a result.

This licensing penalty becomes even more significant when you consider other software licenses such as databases. Popular databases such as Oracle and Microsoft SQL Server are typically licensed on a per-processor basis. With other HCI architectures, you again end up paying for licensing on cores that are running storage, not database functions. With NetApp HCI, you don't pay licensing fees on the processors that are running storage functions since they are on completely separate nodes. As a result, you license fewer processors to satisfy your database needs and achieve a substantial cost reduction.

Reduce storage needs with global inline efficiencies

NetApp HCI delivers a further efficiency advantage by delivering global inline efficiencies that are always active. All storage across an entire HCI cluster is both deduplicated and compressed for maximum data reduction. This means your NetApp HCI cluster delivers higher effective capacity than competitors and therefore you need less total storage. Less storage means less cost and less overhead.

For competing HCI solutions, deduplication and compression are not able to operate globally and, because compute and storage are on the same nodes, these efficiency technologies compete for resources with VMs. In the Evaluator Group study described above, the competitors actually had both these functions turned off. Enabling them would likely have resulted in an even greater difference in cost, since each solution would then have been able to support fewer total VMs per node.

Flexible Design

Take the pain out of scaling your mixed workload infrastructure

Because your business needs are constantly evolving, you can't expect to scale both compute and storage in lockstep. Each application has different resource requirements. NetApp HCI simplifies mixed workload deployments with an agile, scale-out architecture that future-proofs your investments. Start small and grow as needed without disruption to operations or users. NetApp HCI eliminates painful migrations and forklift upgrades. You can integrate newer node technology with your existing cluster, so you never have to wait three years for an upgrade.

With independent scaling of compute and storage, NetApp HCI allows you to dynamically scale on demand, while avoiding costly and inefficient over-provisioning and simplifying capacity and performance planning. As you learned in the previous section, by scaling compute and storage independently, NetApp HCI avoids the inefficiencies that come with tightly coupled compute and storage. If compute is the limiting factor, with NetApp HCI you can simply add more compute nodes. If you need more storage capacity or I/O performance, simply add storage nodes. New storage nodes integrate seamlessly, so there's never any need to rip and replace the infrastructure that's already in place to scale your environment. You're never forced to add compute resources when you need storage or vice versa.

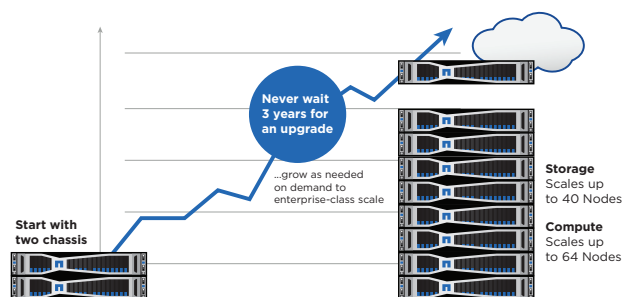


Figure 6) NetApp HCI scales compute and storage independently allowing you to grow resources to match needs without over-provisioning or purchasing resources you don't need.

An elastic design allows you to dynamically scale resources up or down independently for cloud-like agility. Each new node delivers a precise amount of compute performance—or storage performance and capacity—for predictable resource scaling. Application placement is automatically load-balanced in the background.

A unique open and flexible architecture enables you to preserve existing infrastructure investments, lowering total cost of ownership. Leverage existing virtualization infrastructure, licenses, and compute in conjunction with NetApp HCI to lower initial acquisition costs while integrating operations.

Data Fabric Integration

Connect with everything in your IT environment including cloud

The applications and services running in your mixed workload environment need to integrate easily with other parts of IT operations, both on premises and in the cloud. You must be able to manage and protect data globally and integrate with other important applications and services in your data centers and beyond.

NetApp HCI increases the agility of your business by delivering predictable performance and simplified operations on a highly flexible and efficient architecture. Because NetApp HCI is Data Fabric ready out of the box, you can easily gain access to all your data across your operations including public, private, or hybrid clouds. Because data is accessible everywhere, the Data Fabric enables you to respond and innovate more quickly.

Integration with the Data Fabric allows NetApp HCI to provide a variety of advanced data services as part of your mixed workload environment, including file services using ONTAP® Select, object services using StorageGRID®, replication services using SnapMirror®, data visibility using OnCommand® Insight, and backup and recovery services using AltaVault™. (See Figure 7.) These services increase the power and flexibility of your mixed workload infrastructure and enable you to support a wider variety of applications and services from traditional enterprise applications to next-generation apps.

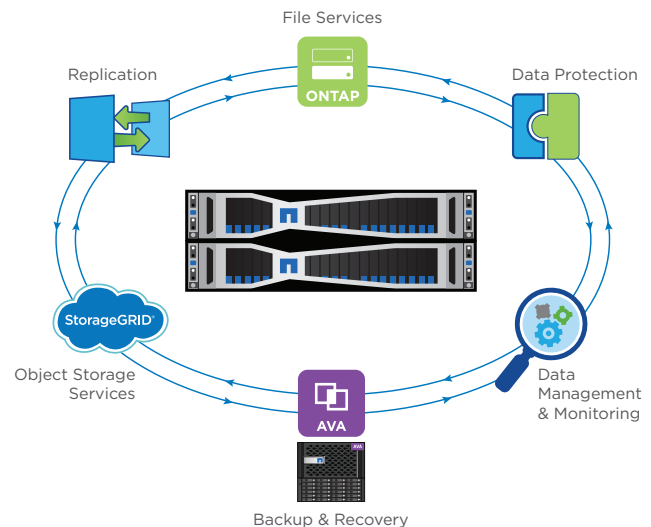


Figure 7) NetApp HCI provides full Data Fabric integration, providing advanced data services and full connectivity to other data center and cloud environments.

Through Data Fabric integration, your mixed workload environment also has direct access to a range of NetApp Cloud Data Services, enabling data protection and other important workflows.

Simple Operations

Reduce operating complexity and cost

Complex infrastructure solutions that require ongoing management and special tools can drive up your operational costs. NetApp HCI offers a simple operating model that eliminates management challenges while taking advantage of familiar interfaces.

With most infrastructure solutions, your team spends a lot of time adjusting I/O performance and storage capacity to meet changing application needs. This often involves time consuming data migrations between different tiers of storage. NetApp HCI allows you to tune I/O performance and capacity as easily as vCPUs and memory allocations, eliminating these cumbersome operations.

To further simplify management, the entire NetApp HCI cluster can be managed directly from the installed VMware vSphere web client, including monitoring and changing quality of service (QoS) settings. After initial configuration, there's no need to touch the NetApp HCI user interface to control storage. Your IT team can manage everything through the familiar VMware interface without having to learn new tools.

HCI at Enterprise Scale

A smarter approach to HCI, a better infrastructure solution to support mixed workloads

NetApp HCI delivers benefits for workload consolidation that traditional infrastructure solutions and other HCI solutions can't match, enabling you to confidently consolidate mixed workloads—including end-user computing, demanding databases, and cloud-native applications—on the same shared infrastructure. Predictable performance and availability means you can consolidate more workloads—including the most demanding mission-critical databases—without negative performance impacts. Applications benefit immediately from the all-flash performance of NetApp HCI.

By scaling compute and storage independently, NetApp HCI significantly lowers overall TCO, reducing hardware and licensing costs. Database environments experience even greater savings through significant reductions in per-processor database licenses.

NetApp HCI is an enterprise-scale hyper converged infrastructure solution that delivers predictable performance on a highly flexible, efficient architecture that is simple to deploy and manage. NetApp HCI allows you to meet rapidly changing IT needs so that you can focus on what matters most: growing your business.

Learn More

If you're ready to build infrastructure capable of consolidating mixed workloads at scale, NetApp is ready to help you. To learn more about NetApp HCI, visit:

- [NetApp HCI 360° Demo](#)
- [A Hyper Converged Future for Digital Transformation](#)
- [Gartner Report: Competitive Landscape for Hyperconverged Integrated Systems](#)

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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