Hyperconverged Infrastructure: A Brief Introduction

From the Experts at Scale Computing

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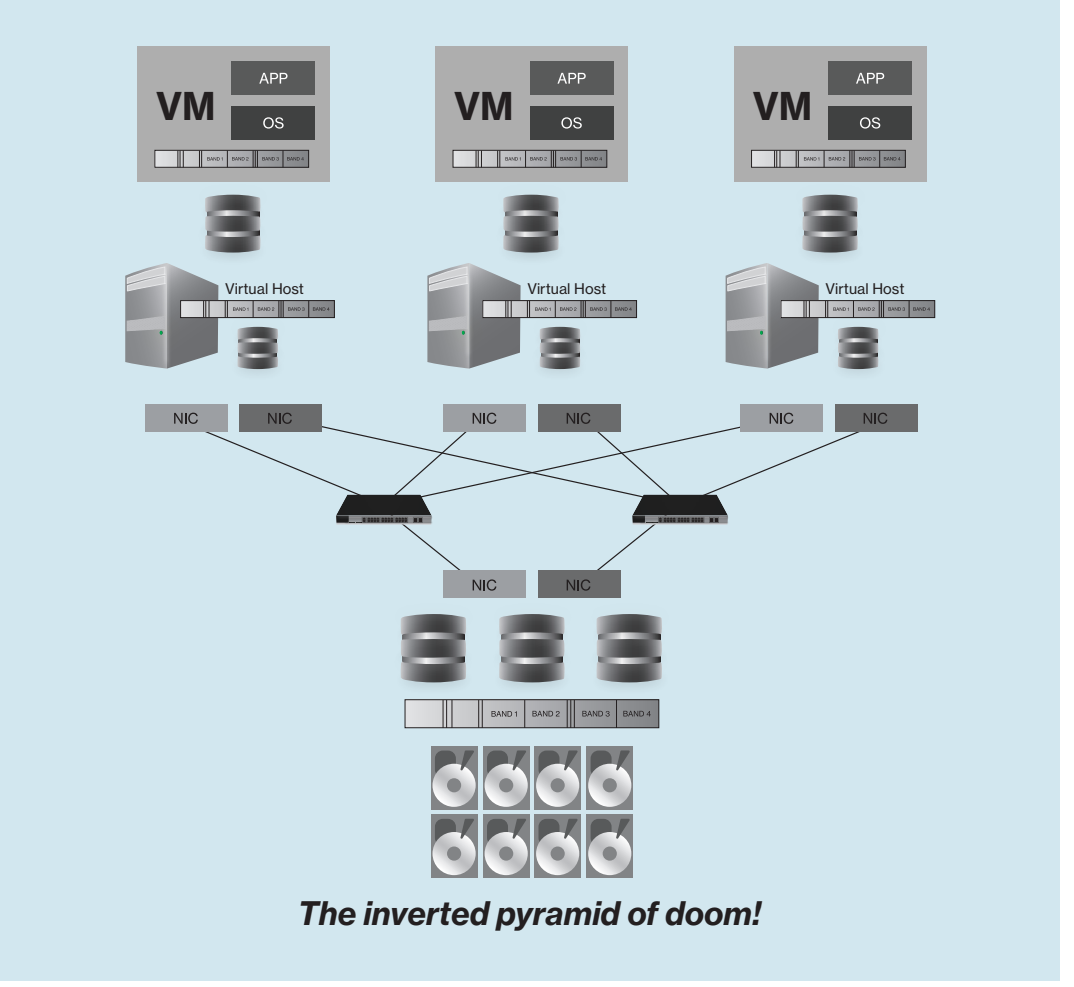
Introduction

The term hyperconverged infrastructure (HCI) has become an industry buzzword that has been applied to a number of different new computing technologies. The misuse of the term has caused confusion for many IT professionals looking at HCI as an infrastructure solution. In this document we will shed some light on what HCI really means and why it might be the right IT solution for you.

The Inverted Pyramid of Doom

Before HCI and converged infrastructure, virtualized infrastructure was organized into what we now call a 3-2-1 architecture (or the inverted pyramid of doom). This 3-2-1 architecture consists of VMs running on 3 or more clustered host servers connected by 2 network switches and backed by 1 or more shared storage appliances (SAN/NAS).



The inverted pyramid of doom!

When virtualization first arrived in the market, the physical server model was dominating IT infrastructure. As a software solution, virtualization required the existing physical servers as well as shared storage technologies like SAN and NAS to survive and thrive.

The 3-2-1 architecture was the result of combining these existing hardware components into clusters. Unfortunately, these hardware components were never designed for virtualization and were typically from different vendors.

The 3-2-1 architecture has led to a number of challenges, the most obvious being the complexity. Not only do these various layers each have their own management systems, but they each have their own individual support services. Each vendor component solution seemed to require its own training and certifications, and many IT departments have found themselves needing to hire multiple specialized experts either internally or as external consultants to cover these varying components. Dealing with compatibility issues between different vendor solutions such as ensuring vendor X solution's update level is compatible with vendor Y solution's update level can be challenging for even the highest priced experts.

Another issue in the 3-2-1 architecture is expandability, both in terms of capacity and performance. Shared storage appliances tend to be monolithic and only be designed to scale up by filling empty drive bays. When the system requires bigger or faster storage in a 3-2-1 architecture, that often means having to swap out with a bigger, faster, and more costly storage appliance. The same idea applies when better or faster hardware is needed in the physical server (RAM, CPU, etc): costly upgrades, expensive downtime, and a hefty administrative workload to complete the project.

The final, and the potentially fatal, flaw for the IT department utilizing 3-2-1 architecture is the storage. Being the "1" in the 3-2-1, storage represents a single point of failure for the entire architecture (leading to the "Inverted Pyramid of Doom" moniker). While many storage devices can be implemented redundantly, redundancy usually means more than double the cost of the storage, already an expensive component. Instead, many organizations rely on backups and prayers to protect against the catastrophic failure of the storage layer.

Despite all of its flaws, the 3-2-1 architecture did get the job done in terms of delivering features like high availability, VM live migration (aka vMotion), and cluster-wide shared storage. It was also the only viable way to effectively implement virtualization for many years. Luckily, there are now other alternatives to this architecture profile.

Converged Infrastructure

Before HCI, there was converged infrastructure. To tackle the complexity of the 3-2-1 architecture, the idea of converged infrastructure was to combine some of the different component layers into a single "system" and SKU, most often combining servers and storage. Sold as a single system, the hardware and software components were pre-tested together to avoid incompatibility issues and speed up deployment time. However, these "converged" solutions were generally the same separate components, just pre-installed, pre-wired and delivered in a rack.

The next stage in converged infrastructure was combining and integrating the different components into a single appliance. It wasn't difficult to add more compute resources to a storage appliance in order to run virtual machines, and that's what some vendor solutions offered. Clustering would make the storage appliances highly available.

Generally, converged infrastructure solutions were meant to be hardware platforms onto which 3rd party hypervisors like VMware or Hyper-V could be installed with relative ease. These converged infrastructure appliance solutions are primarily what exists in the market today; most have adopted the term hyperconverged infrastructure due to the buzz factor.

The problem with converged infrastructure solutions is that they generally mimic the same storage architectures as the 3-2-1. These clustered, converged storage and compute solutions relied on virtual storage appliances (VSAs) running as VMs to manage storage in a similar way that shared SAN and NAS controllers functioned. VSAs are the best example of this problem as they effectively virtualize all the inefficiencies of the SAN architecture from the 3-2-1. VSAs consume large amounts of CPU and RAM from the appliance, keeping it from being used by other virtual machines.

Because the hypervisor and storage are still from two different vendors in these converged solutions, the VMs must consume the storage through a number of protocols and files system layers (and VSAs) that reduce storage efficiency. Each of these layers, including VSA, adds hops to the data I/O path. Only the emergence of flash storage has enabled these converged infrastructure solutions to provide efficient storage for virtualization.

The Real Meaning of 'Hyperconverged'

When the term 'hyperconverged' was coined, it meant a converged infrastructure solution that natively included the hypervisor for virtualization. The "hyper" wasn't just hype as it is today. This is an important distinction because it has specific implications for how the architecture can be designed for greater storage efficiency and simplicity.

Who can provide a native hypervisor? Anyone can, really. Hypervisors have become a market commodity with very little feature difference between them. With free, open source hypervisors like KVM, anyone can build on KVM to create a hypervisor unique and specialized to the hardware they provide in their hyperconverged appliances. Many vendors still choose to stay with converged infrastructure models, perhaps banking on the market dominance of VMware—even with many consumers fleeing the high prices of VMware licensing.

Saving money is only one of the benefits of HCI. By utilizing a native hypervisor, the storage can be architected and embedded directly with the hypervisor, eliminating inefficient storage protocols, files systems, and VSAs. The most efficient data paths allow direct access between the VM and the storage; this has only been achieved when the hypervisor vendor is the same as the storage vendor. When the vendor owns the components, it can design the hypervisor and storage to directly interact, resulting in a huge increase in efficiency and performance.

In addition to storage efficiency, having the hypervisor included natively in the solution eliminates another vendor which increases management efficiency. A single vendor that provides the servers, storage, and hypervisor makes the overall solution much easier to support, update, patch, and manage without the traditional compatibility issues and vendor finger-pointing. Ease of management represents a significant savings in both time and training from the IT budget.

What about the Cloud?

Cloud computing has been around even longer than HCI and many have already begun implementing the cloud into their IT infrastructure in various ways. Most market indicators are pointed toward organizations using a combination of on-prem infrastructure with cloud-based infrastructure or services in what may be called hybrid cloud architectures.

As a fully functional virtualization platform, HCI can nearly always be implemented alongside other infrastructure solutions as well as integrated with cloud computing. For example, with nested virtualization in cloud platforms, an HCI solution like HC3 Cloud UnityTM from Scale Computing can be extended into the cloud for a unified management experience.

Not only does HCI work alongside and integrated with cloud computing but it offers many of the benefits of cloud computing in terms of simplicity and ease-of-management on premises. In fact, for most organizations, HCI may be the private cloud solution that is best suited to their environment. Like cloud computing, HCI is so simple to manage that it lets IT administrators focus on apps and workloads rather than managing infrastructure all day as is common in 3-2-1. HCI is not only fast and easy to implement, but it can be scaled out quickly when needed. HCI should definitely be considered along with cloud computing for data center modernization.

What does Hyperconverged Infrastructure Include?

Although there are some software-only solutions that call themselves HCI, appliance-based HCI hardware solutions offer additional benefits. Not only can a combined solution of hardware and software in an appliance be more thoroughly tested to avoid instability, but single-vendor support provided for a HCI appliance can cover both hardware and software seamlessly. An HCI appliance can include server compute resources, the storage, preferably the hypervisor, and often disaster recovery and backup features. HCI is sometimes referred to as a "datacenter in a box" because, after the initial cabling and minimal networking configuration, it has all of the features and functionality of the traditional 3-2-1 virtualization architecture.

Clustering

Although HCI can sometimes be deployed as a single appliance for selected use cases, it is usually deployed as a cluster of appliances for high availability. This way, not only can an appliance absorb the loss of a disk drive, but the cluster can absorb the loss of an entire appliance. Clustering also allows the HCI system to scale seamlessly by adding more appliances to the cluster. Some HCI solutions require clustering appliances of the same model and configuration while others (like Scale Computing's HC3 system) allow clustering of dissimilar appliances.

Management

HCI solutions can generally be managed from a single management interface, eliminating the multiple management consoles and interfaces found in 3-2-1 architectures. This is not necessarily the case for HCI solutions using 3rd party hypervisors which typically end up using 2 interfaces. For HCI with a native hypervisor included, this single interface approach significantly reduces management time and effort and simplifies management tasks for the administrator.

Rapid Deployment

HCI systems can be deployed more rapidly than other virtualization solutions because of the appliance-based architecture. Racking and networking are often the most time consuming factors in implementation. Deployment times vary by vendor, especially if there is a 3rd party hypervisor to install and VSAs to configure but with a native hypervisor pre-loaded (as with Scale Computing's HC3 system), an entire cluster of appliances can be up and running in under an hour.

Software and Hardware Updates

Doing regular system software and firmware updates can be a dreaded task but HCI tends to make this process easy. By owning the entire virtualization/server/storage stack and operating in a highly available cluster, updates can be performed automatically across the entire cluster. All software layers (hardware firmware, hypervisor, storage, and management) can be upgraded in unison as a single, fully tested system to eliminate component compatibility concerns. VMs can be automatically moved from appliance to appliance in the cluster as updates are made to keep all systems operational. HCI can eliminate downtime and headaches when performing updates, as seen in the Scale Computing HC3 system.

Backup and Disaster Recovery

Backup and disaster recovery are included at no extra cost in some HCI solutions to help eliminate yet another vendor from your IT environment. And truly, backup, failover, failback, and recovery should be a part of every IT environment. In that line of thought, it makes perfect sense to include these features natively in HCI solutions. Unlike 3rd party solutions, native solutions are typically embedded in the storage layer and allow innate awareness of block changes for cleaner backup, replication, and recovery options.

Lower Cost of Ownership

HCI may not always be the lowest cost solution in terms of the initial Capex investment—although it often is because the ease of scalability allows organizations to purchase only the needed appliances and does not require excessive over-provisioning in the initial investment. Buying only what you need when you need it can lead to significant savings. In addition to Capex savings, HCI provides considerable Opex savings over time by greatly reducing the costs of management and maintenance. Simplifying an IT environment with HCI can save over 50% in the total cost of ownership over 3-2-1 solutions.

Who Should Use Hyperconverged Infrastructure?

Hyperconverged Infrastructure is designed as a replacement for 3-2-1 architecture to eliminate excess cost and complexity. Therefore, it can benefit any size organization that requires a robust virtualization environment. However, the extreme simplicity of HCI makes it most beneficial in use cases where IT staff is limited. Small and medium business (SMB) and distributed enterprises with many remote offices or branch offices (ROBO) typically have staffing issues that make HCI an ideal choice.

In SMB, the entire IT staff may be as small as only one full-time or even part-time IT administrator. The complexity of a 3-2-1 architecture can be extremely challenging. It can require levels of training and certification that make managing administrators either under-trained or too expensive to afford. The simplicity of HCI, in turn, can allow it to be managed easily by a junior administrator or allow a more senior administrator to simply spend less time managing the infrastructure and more time delivering better applications and services and improving the business.

In a distributed enterprise, remote offices and branch offices rarely have dedicated IT staff. These remote locations often require frequent visits from IT staff which can result in high travel costs and lower productivity. The simplicity of HCI includes multiple redundancies for high availability, failure handling, and self healing. A failed drive at a remote site does not cause an outage and does not require immediate replacement, cutting down on IT staff visits. Greater uptime and accessible remote monitoring and management lead to lower travel costs of IT staff to these locations and significantly lower operating costs—not to mention the increase in productivity.

Summary

Hyperconverged infrastructure is not only a buzzword. It is a revolutionary way of thinking about IT infrastructure that reduces IT investments in terms of both money and manpower. Although it may be difficult to determine whether a solution is truly hyperconverged, just converged, or some other pretender, it is worth investigating HCI solutions to make sure your organization can gain the maximum benefit of modern IT infrastructure.

Ask HCI vendors some of the following questions when you're exploring HCI solutions:

- Does the solution provide a native hypervisor or does it require an additional purchase of hypervisor licensing and support?
- Does the solution offer hypervisor-embedded storage or does it use virtual storage appliances (VSAs)?
- Can the solution combine and scale with dissimilar appliance models and configurations?
- Does the solution offer native backup and disaster recovery capabilities?
- Does the solution integrate with cloud computing?

As the IT industry continues to evolve, HCI is the next logical step in on-prem and cloud-integrated virtualization infrastructure. Standing still with more traditional virtualization solutions like the 3-2-1 architecture may end up costing organizations far more in capital, manpower, and training than switching over to the simplicity and savings of a HCI solution.

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