SCALE COMPUTING

Hyperconverged Infrastructure: A Brief Introduction

Maximizing the benefits of a modern IT infrastructure

Technical White Paper

From the Experts at Scale Computing

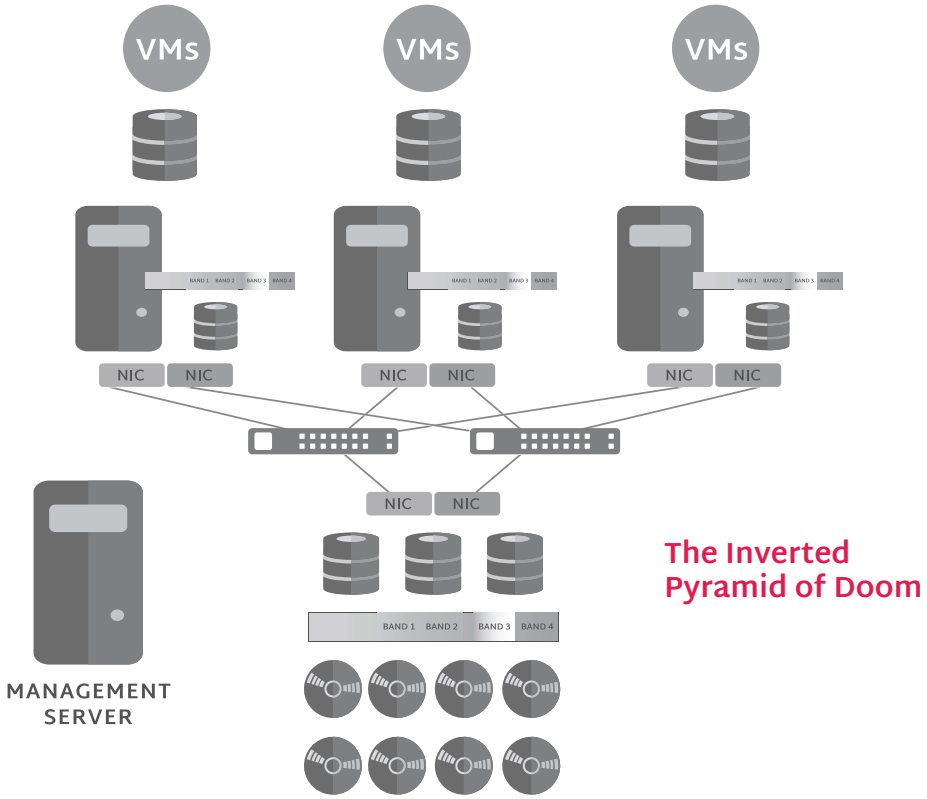
Table of Contents

Introduction

The term hyperconverged infrastructure (HCI) has become an industry buzzword applied to a number of different computing technologies. The misuse of the term has caused confusion for many IT professionals looking at HCI as an infrastructure solution. This document 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).



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.

This 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 requires its own training and certifications, and many IT departments found themselves hiring 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 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 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 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 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 third-party hypervisors like VMware or Hyper-V could be installed with relative ease. These converged infrastructure appliance solutions still exist 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 file 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. This is an important distinction because it has specific implications for the architecture design 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 of their customers fleeing their high licensing prices.

Saving money is only one of the hyperconverged infrastructure benefits. By utilizing a native hypervisor, the storage can be architected and embedded directly with the hypervisor, eliminating inefficient storage protocols, file 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, increasing management efficiency. A vendor that provides the operating system, software, servers, storage, and hypervisor in one overall solution makes it much easier to support, update, patch, and manage without the traditional compatibility issues and vendor finger-pointing. Ease of management represents 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 is implemented into IT infrastructure in various ways. Most organizations use a combination of on-premises 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 and integrated with cloud computing. For example, with nested virtualization in cloud platforms, an HCI solution can be extended into the cloud for a unified management experience.

Not only does HCI work alongside and integrated with cloud computing, but it also 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, true hyperconverged solutions offer additional benefits. A combined solution of software and hardware can be more thoroughly tested to avoid instability, while single-vendor support provides seamless coverage.

An HCI appliance can include OS, server compute resources, storage, preferably the hypervisor, and often disaster recovery and backup features. HCI is sometimes referred to as a "data center in a box" because, after the initial cabling and minimal networking configuration, it has all the features and functionality of the traditional 3-2-1 virtualization architecture.

By consolidating applications and infrastructure on a single, unified platform, like Scale Computing, administrators can simultaneously run legacy and modern applications on the same infrastructure, eliminating the need to manage the complexity of separate hardware and software components to support individual point solutions.

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 Platform) 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 third-party hypervisors, which typically end up using two 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 third-party hypervisor to install and VSAs to configure, but with a native hypervisor pre-loaded (as with SC//Platform), an entire cluster of appliances can be up and running in under an hour. This process is avoided with zero-touch provisioning (ZTP), which allows IT teams to quickly and easily stage clusters for installation with the fastest path to application deployment.

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 SC//Platform.

Backup and Disaster Recovery

Backup and disaster recovery are included at no extra cost in some HCI solutions. This includes everything from full VM-level backup and restore capabilities either locally on the cluster from immutable snapshots or at a remote site when paired with replication. Many even include advanced file-level restore functionality as well. This native functionality can either replace or augment other third-party backup products that specialize in more advanced protection by utilizing API-driven agentless backup (similar to Acronis' integration with SC//HyperCore) or with agents embedded within the operating system.

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. Our customers say that simplifying an IT environment with HCI can save over 50% in the total cost of ownership over 3-2-1 solutions.

Security

Some hyperconverged solutions leave hooks to plug in your own hypervisor and related management tools. This can be a complex and dangerous combination, especially concerning security management.

SC//Platform avoids opening the system to outside parties. First, the hypervisor and management tools are included in SC//HyperCore and locked behind the software and a built-in firewall. Second, and more critical, the entire virtualization layer is completely embedded into the system itself. There is no “controller” VM or VSA needed to access or manage clusters.

Simply put, Scale Computing has created a true hyperconverged solution. SC//HyperCore does not rely on third-party software, high resource overhead, a running VM to “serve” storage, or an easily accessible (and exploitable) file system to store and manage the system and data. This all has the added benefit of closing security threats from additional products, management tools, and protocols.

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 businesses (SMB), distributed enterprises with many remote offices or branch offices (ROBO), and managed service providers (MSPs) typically have on-premises staffing issues that make HCI an ideal choice.

In an SMB, the entire IT staff may be 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 contrast, allows it to be managed easily by a junior administrator or allows a more senior administrator to simply spend less time managing the infrastructure and more time delivering better applications and services for the business.

In a distributed enterprise, remote or branch offices and stores rarely have dedicated IT staff. MSPs face this same issue with their clients. 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.

HCI and Edge Computing

Traditional systems are overkill for edge deployments, being too complex and costly. HCI allows technology to operate within a smaller hardware design, while edge computing is the processing of data outside the traditional data center, typically on the edge of a network. When combined with HCI and edge computing, emerging use cases such as AI/ML, Computer Vision, and IoT benefit from drastically reduced latency, as edge computing enables the data and processing to reside on the edge of the device's network, and allows for new data to be stored, processed and later uploaded to the cloud.

HCI can reduce the complexity associated with edge computing beyond its deployment advantages by providing provisioning, monitoring, management, and on-demand scaling capabilities. Management and monitoring tools, like Scale Computing Fleet Manager, are available to easily extend the benefits of hyperconverged infrastructure out to thousands of sites while enjoying cloud-like infrastructure levels of convenience."

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 as well as legacy and modern applications?
- 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 logical step in on-premises 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 an HCI solution.

Like to know more about how SC//Platform can work for you? Take a self-guided product tour and then contact us with any questions.

Corporate Headquarters
525 S. Meridian Street - 3E
Indianapolis, IN 46225
P. +1 317-856-9959
scalecomputing.com

EMEA B.V.
Europalaan 28-D
5232BC Den Bosch
The Netherlands
+1 877-722-5359

SCALE COMPUTING